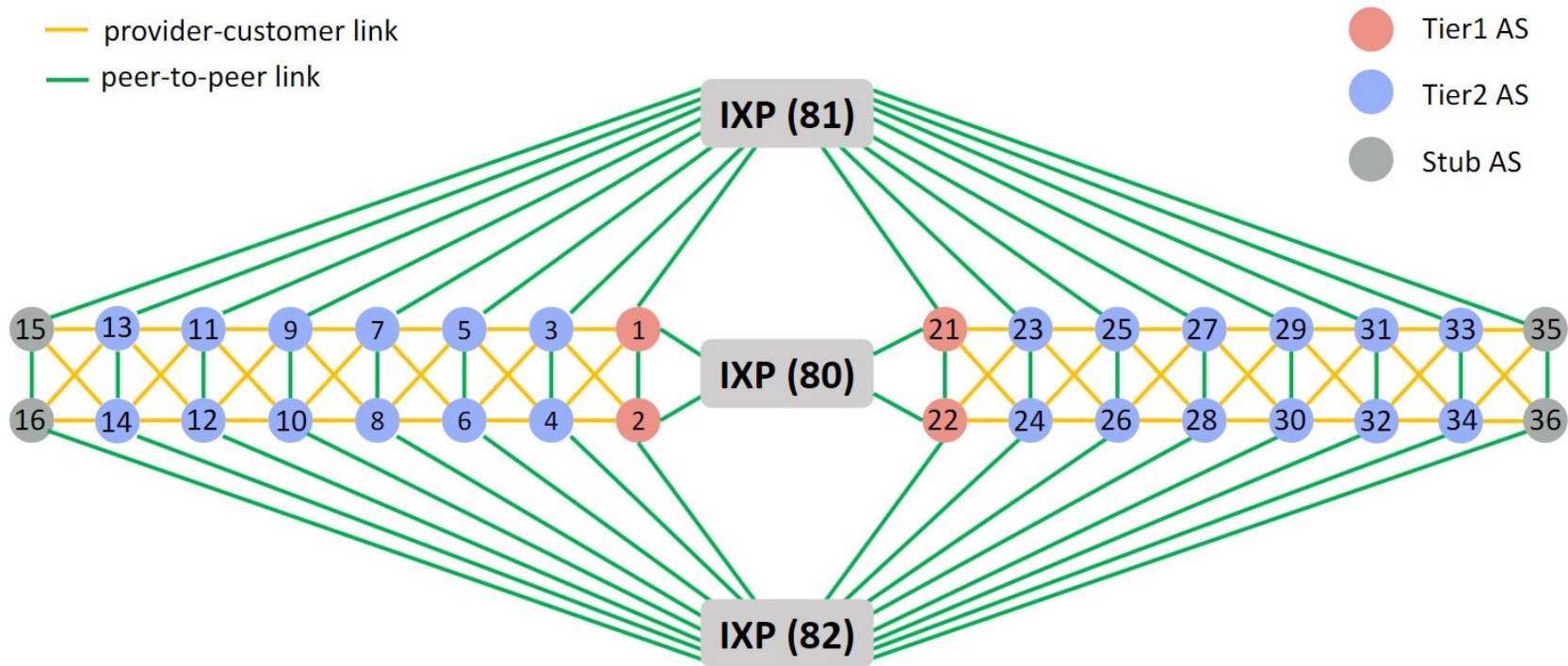# RN: The Mini-Internet

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Our Mini-Internet

Some technical details

Our project is based on work from ETH Zürich.
Thanks Laurent, Thomas, et al.!

The complete project runs on a powerful server (mobi8.inet.haw-hamburg.de).
64 cores, 128 threads, 512 GB RAM

Each student group owns multiple <u>docker</u> containers. A "jump container" allows access to all your containers, which serve network devices of your autonomous system.

Exercise 2: Configuring your AS

Autonomous System: A network (at least a collection of connected routers and public routing prefixes) administered by a single entity.

ASes present a common, clearly defined routing policy to the other ASes (the Internet). ASes exchange information via the Border Gateway Protocol (BGP).

ASes have a number assigned to them, their AS number (ASN). They should be globally unique. Within our environment we can assign them

We focus on the configuration of the local network in this exercise!

AS Numbers & Passwords

You should all have an email from me (philipp.meyer@haw-hamburg.de) with the subject **"RN, Informationen zur Aufgabe 2"** that includes your AS number (ASN) and password.

Login into your AS

You will work on a remote server, this means you will need `ssh`.
We use tcp port forwarding to forward your credentials to the correct container.

Each group will receive an ASN and password via email. You can login with:

```
ssh -p X root@internet.link-lab.net  # X = 2000 + ASN
```

You can enable key-based authentication, but do not change the passwords.

Simple Rules

The real Internet has security problems.

Our testbed has security problems.

Please don't abuse the resources for non lab-related tasks such as DDoS or other misuse.

How to backup your project state?

We all break things. There is an easy way to backup the current state of your AS and download it to your local machine. Then, just sync it with your git repository.

```
# → RUN THIS COMMAND ON YOUR JUMP CONTAINER
# creates: file configs_[date]_[time].zip and dir configs_[date]_[time]/
./save_configs.sh

# → RUN THIS COMMAND ON YOUR LOCAL MACHINE
# ASN Y copies from your container to current dir of local machine
# where X = 2000 + Y
scp -r -P X root@internet.link-lab.net:~/configs_[date]_[time] .
```

Make incremental changes!

Do not change everything at once -- even if you are frustrated.

Make incremental changes and test them step by step.

What is your IP prefix?

ASN.0.0.0/8

You will have to split this prefix into more-specific prefixes.

How to access specific devices in your AS?

You can access the devices of your AS using the `./goto.sh` script. If you want to access a host connected to the router HAM, just use the following command:

```
# hosts connected to a router
./goto.sh HAM host
```

```
# hosts in local LAN use special keyword
./goto.sh L2N S_HAW
```

When you use a non-existent location the script will show you some examples.

First host configuration
Details depend on your IP prefix

```
# interface towards router has the name <routerTag>router, double check:
ip address show

# add ip address and subnet information to host
# you must not add two ip addresses to a single interface!
ip address add 111.0.222.3/24 dev HAMrouter

# we also need a default route at the host for all the other prefixes
ip route add default via 111.0.222.1

# check table entries
netstat -rn
```
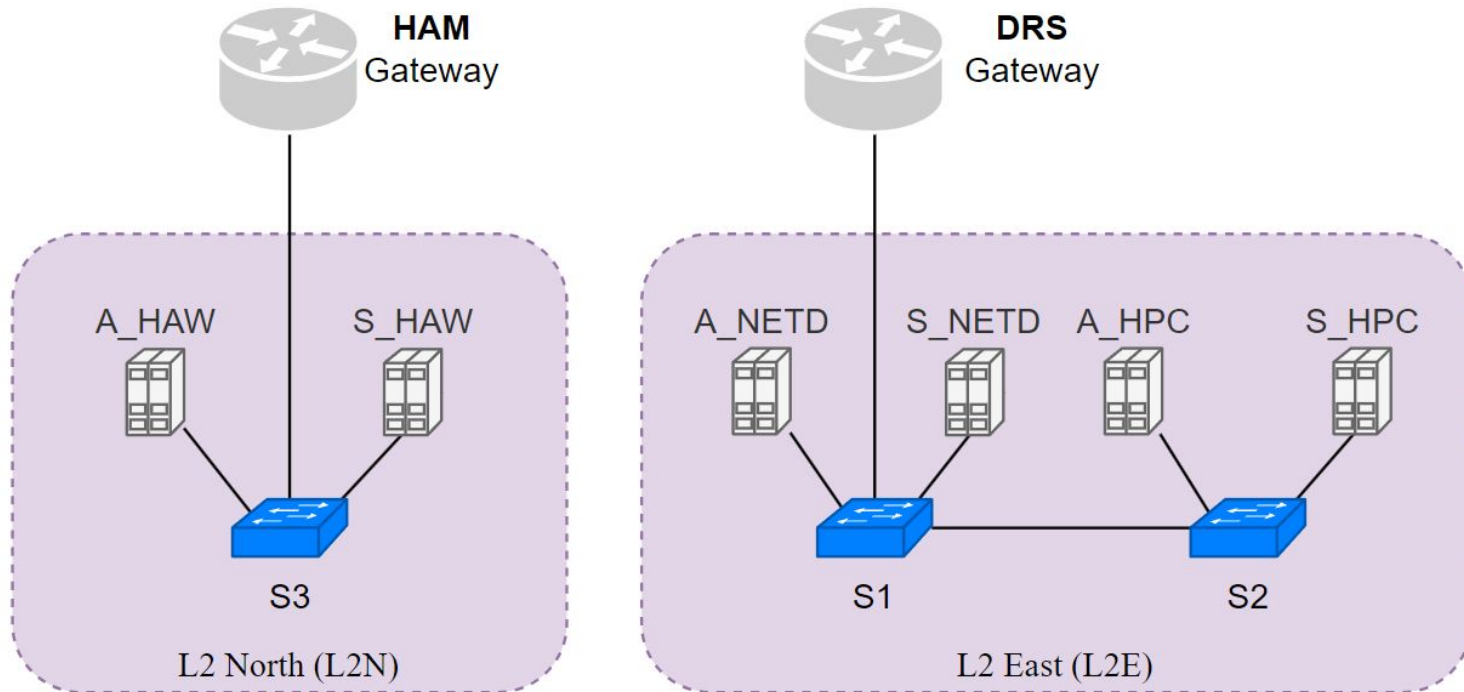
Intro: Switches and VLANs

Open vSwitch is a popular software switch, which e.g. connects virtual machines. You will start with two VLANs. A host can only be part of one VLAN.

```
# switch ports carrying one VLAN
ovs-vsctl set port PORT_NAME tag=10


# switch ports multiplexing two VLANs
ovs-vsctl set port PORT_NAME trunks=10,20
```

For switch status use `ovs-vsctl show` and for port status use `ovs-vsctl show br0`.

Switches in local LANs

HAM
Gateway

DRS
Gateway

A_HAW   S_HAW

A_NETD   S_NETD   A_HPC   S_HPC

S3

S1   S2

L2 North (L2N)

L2 East (L2E)

Hint: VLAN Specifics

Interfaces <u>without</u> a VLAN configuration <u>drop all frames with VLAN IDs</u>

A Hint for Exercise 3.1

It requires multiple tweaks. If you run into problems, double check:

- Interfaces
- STP
- VLAN (tag, trunks)
- ARP
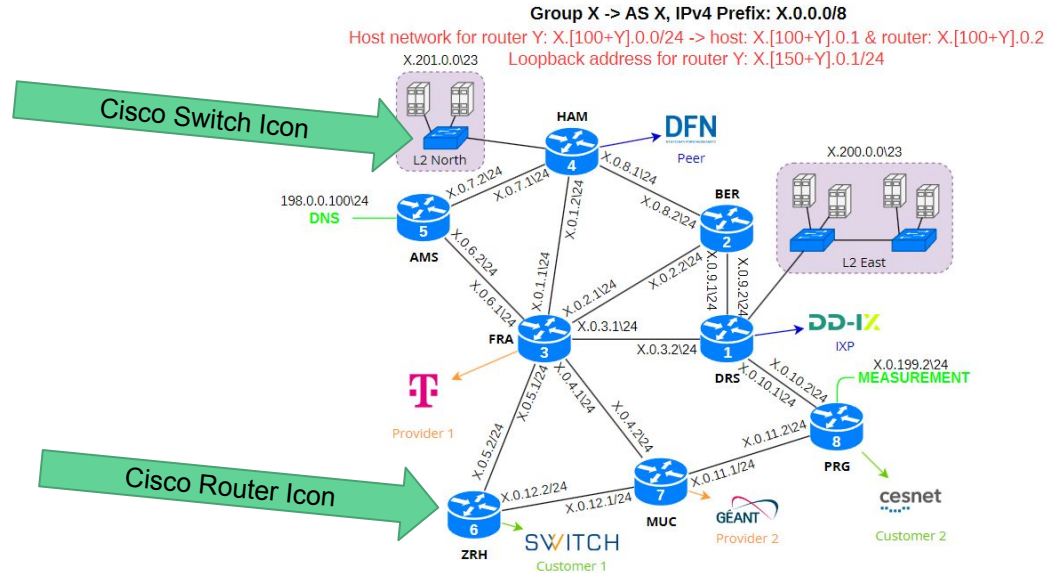- Subnets
- Forwarding / Routing
- Ping

How to test connectivity?

- Layer 2: ARP requests are broadcasts
- Layer 3: ping / traceroute
- Layer 4: iperf3

Note, that the **hosts** are *normal* linux environments. You can run all the bash commands. In contrast, the **routers** use a special CLI.

Use a network sniffer on the hosts and switches to check the one-way connectivity and to display VLAN tags! (`tcpdump -i $iface -vvnne "arp or icmp"`)

Router Links

Group X -> AS X, IPv4 Prefix: X.0.0.0/8
Host network for router Y: X.[100+Y].0.0/24 -> host: X.[100+Y].0.1 & router: X.[100+Y].0.2
Loopback address for router Y: X.[150+Y].0.1/24

Cisco Switch Icon

Cisco Router Icon

Hint: Wording (Prefix size)

Do not say *larger* prefix. From experience, this is confusing. Does a *larger* prefix have more network bits or host bits? E.g., for *prefix/16*:

- prefix/8: has smaller /n, but more hosts
- prefix/24: has larger /n, but less hosts

Just use **less-specific** (prefix/8) or **more-specific** (prefix/24) prefix.

Text Editor: VIM

Linux usually comes with VIM (Raphael's favorite text editor).

`$ vim FILENAME`

VIM has multiple modes: **command mode**, **insert mode**, etc.

- Command mode:
  - Navigation with h, j, k, l
  - Commands start with ':', e.g., :w (write/save), :q (quit), :wq (write and quit), :q! (quit, no write)
  - / to find, then n and N to jump between hits
  - yy copies the line, p inserts the line, dd deletes the line
- Switch to insert mode: i
  - Here, you can type & use arrows for navigation
  - ESC to return to command mode
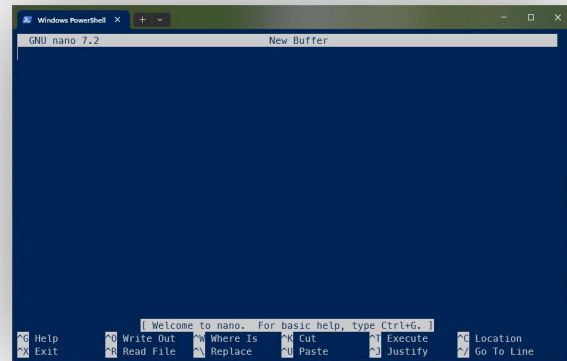
Text Editor: nano

Linux usually comes also with nano.

`$ nano FILENAME`

- On-Screen Instructions
- Less Steep Learning Curve
- No Modes

But ...

- Limited Features
- Less Efficient for Large Files
- Limited Plugin Ecosystem

FAQ: OSPF (1)

Do we need to work with static routes?

You need them *if* you want to force a link into the forwarding table.

What is the weight of static routes?

The weight you set them too.

What values should we use for weights?

Any value works, but try to keep it simple to avoid mistakes.

FAQ: OSPF (2)

How do we setup load-balancing?

By enforcing *redundant* links with the same weight.

Do OSPF changes take immediate effect?

No, but they propagate and converge very fast.

How do I classify my configuration with iperf?

iperf uses sockets, so explicitly start a server with `-s` at the other host.