

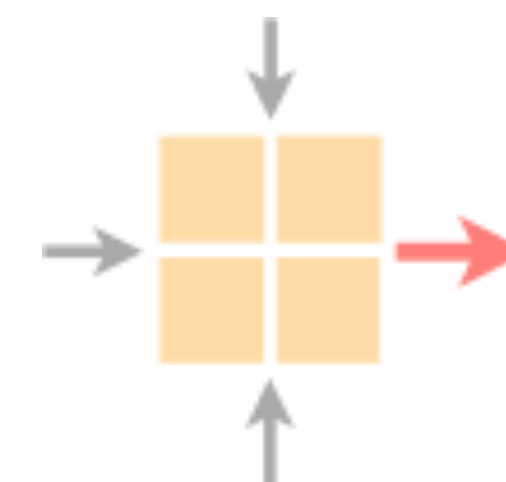
# Communication Networks

Spring 2022

Routing Project

Q/A session

March 31, 2022

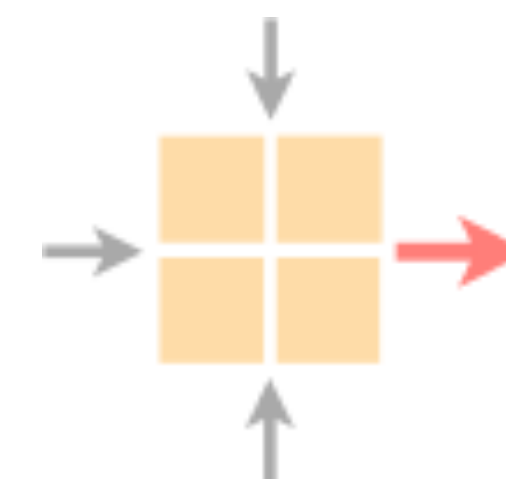


**Networked Systems**

ETH Zürich — seit 2015

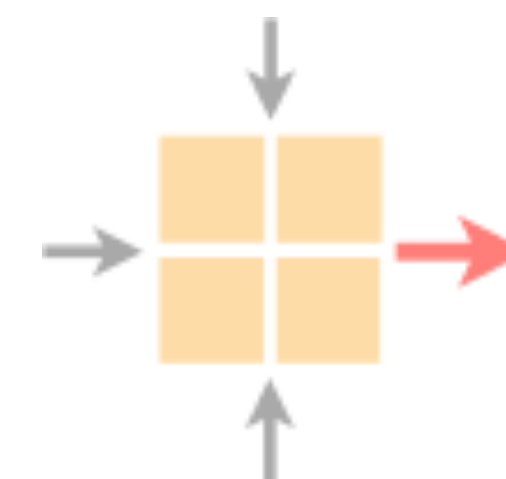
# Today's schedule

1. More detailed introduction on the routing project
2. Introduction to Git
3. How to minimize the size of a forwarding table (Exam question)



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The project counts for 20% of your final grade

- There is a total of 10 points (+ 2 bonus questions)

You can ask questions

- During the Q/A sessions
- On Slack, in the **#routing\_project** channel
- Maybe your question is in the FAQ already

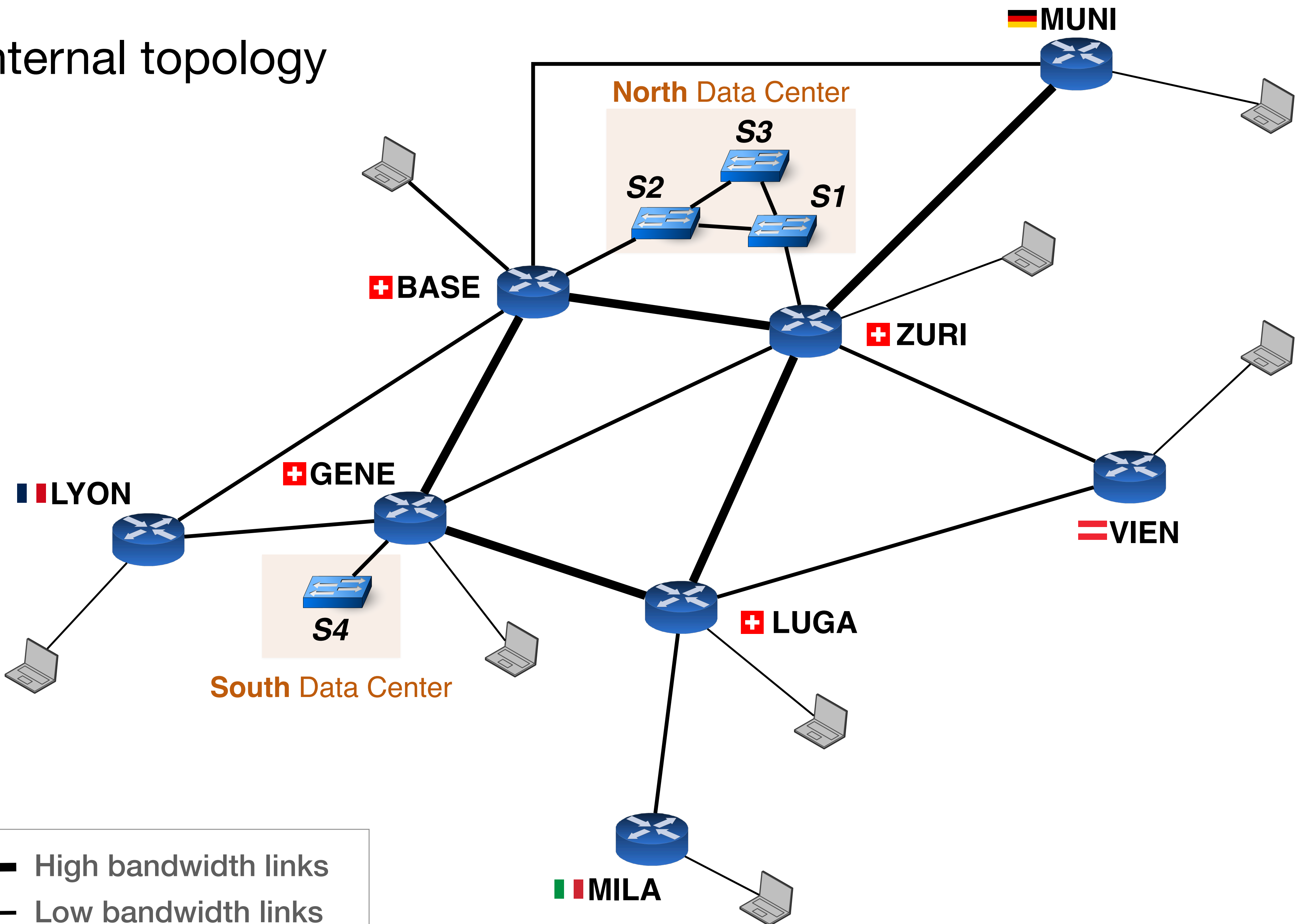
Use GitLab to submit your work

- Submit your routers and switches configuration
- Submit your report (max 10 pages!)
- Sign the declaration of originality and submit it

We wrote a tutorial where we give useful information

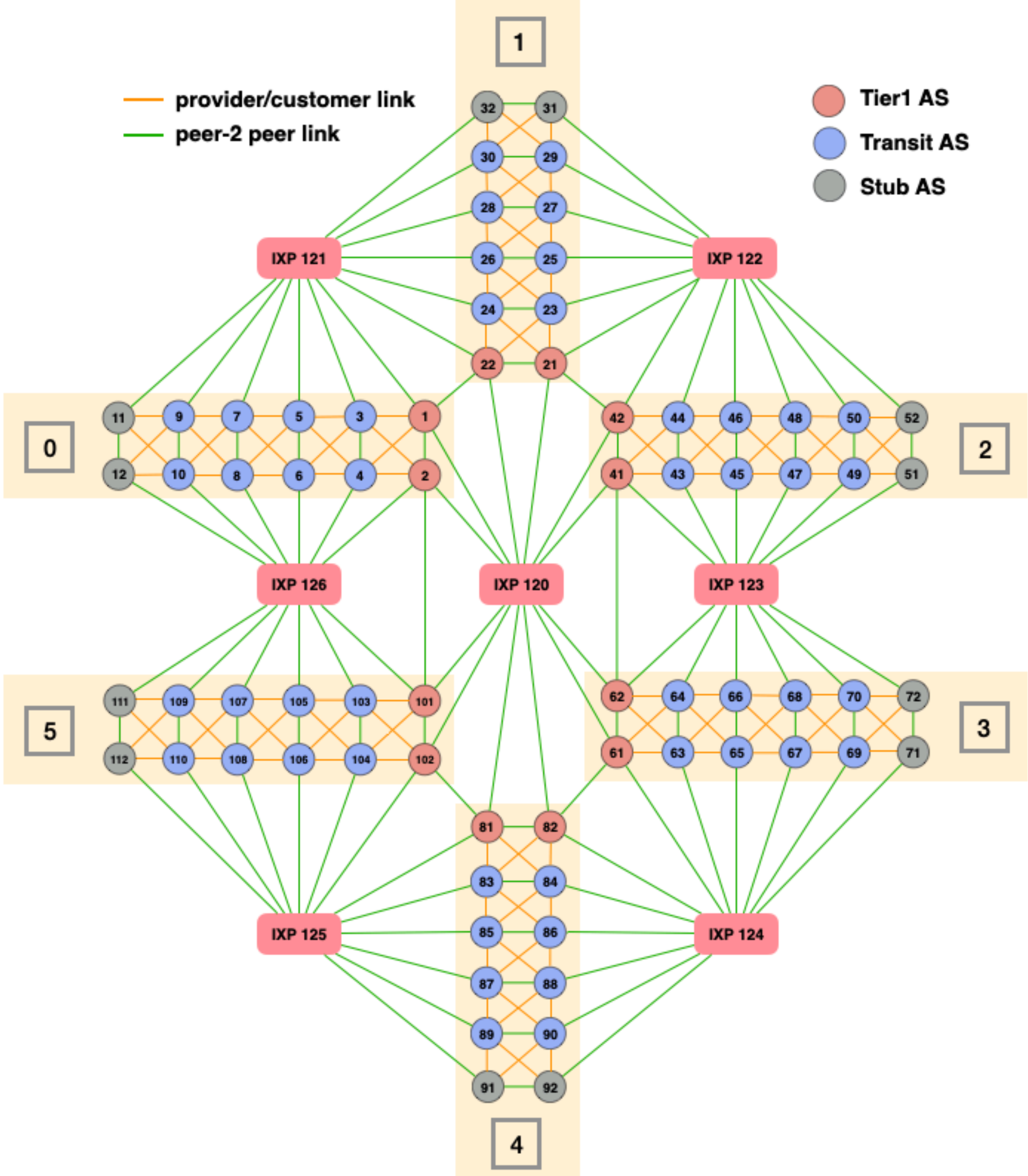
- Including how you can access

# Your internal topology

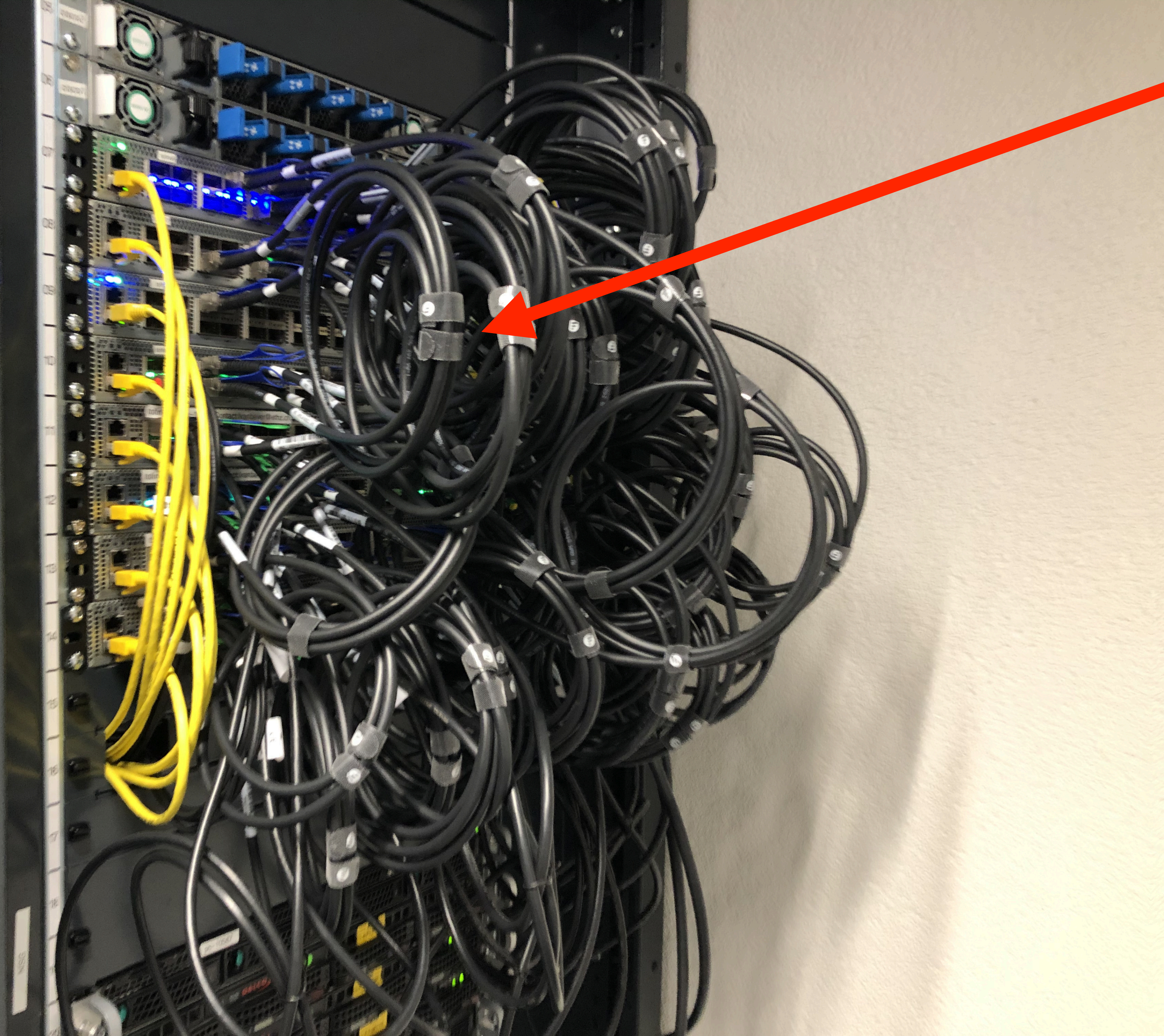


— High bandwidth links  
— Low bandwidth links

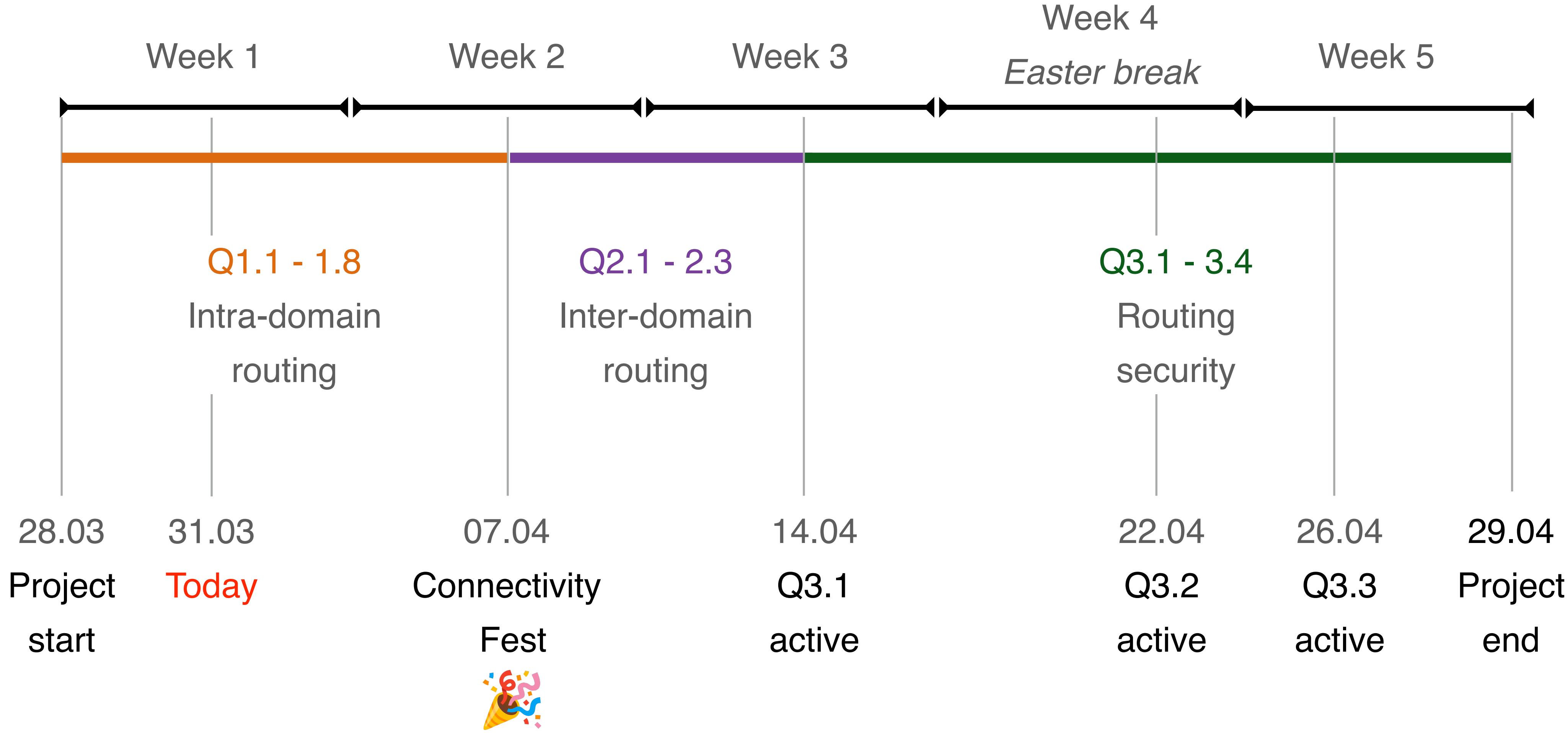
# Your AS-level topology



This is where your  
mini-Internet is running



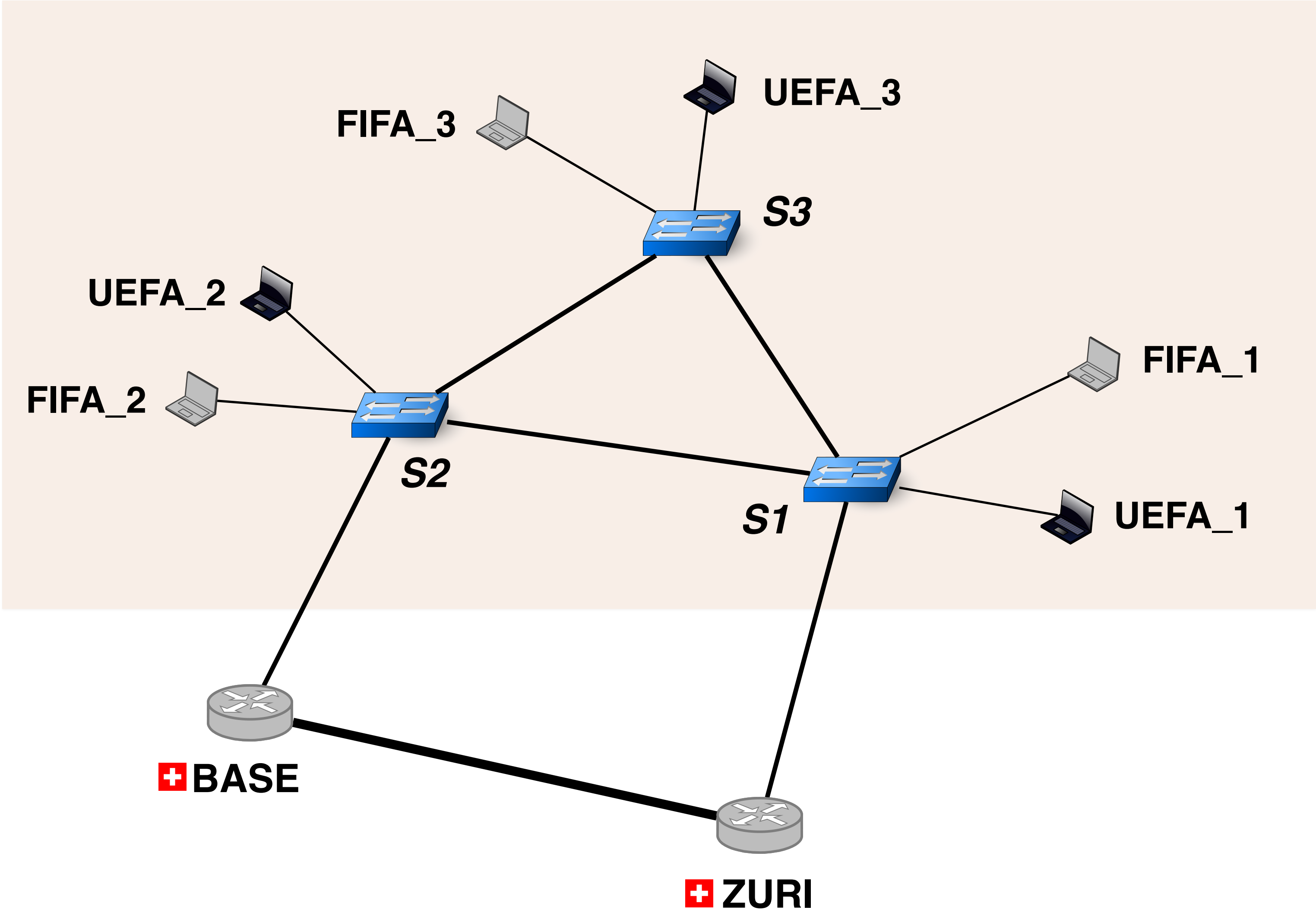
# Routing project timetable





# Question 1.1: Enabling connectivity in the North Data Center

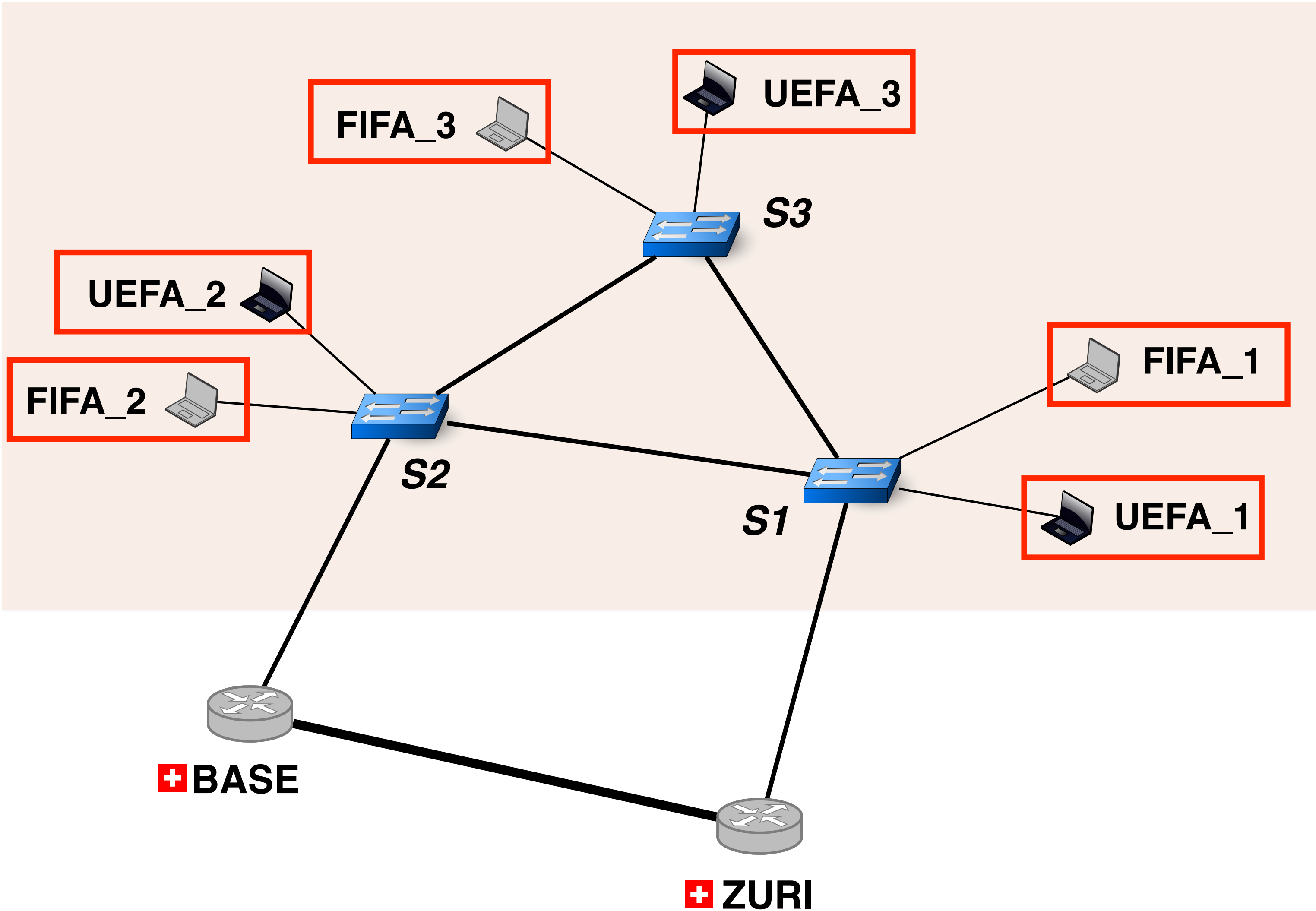
## North Data Center



# Question 1.1: Enabling connectivity in the North Data Center

Where to configure an IP address and a default gateway

## North Data Center

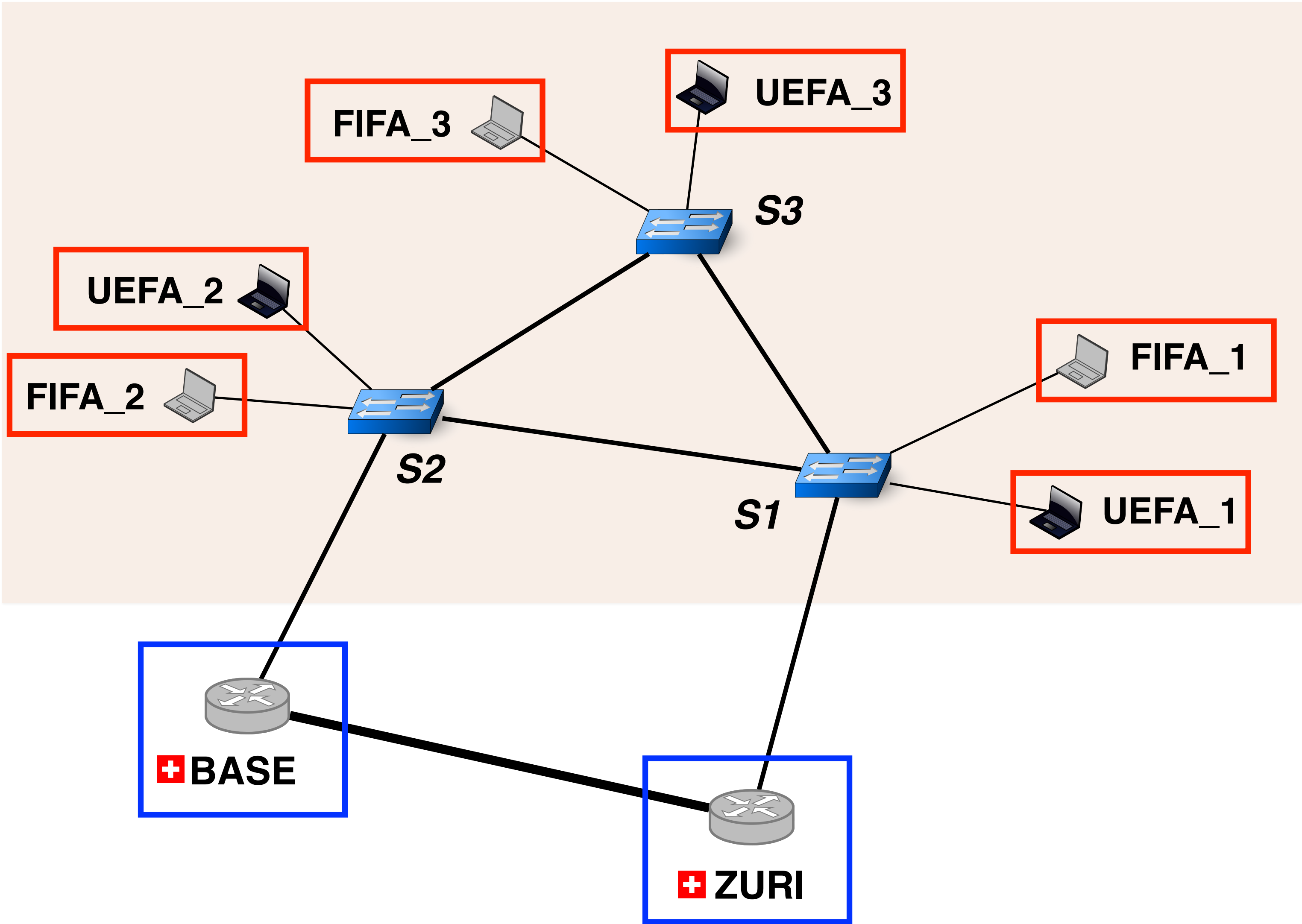


# Question 1.1: Enabling connectivity in the North Data Center

## North Data Center

Where to configure an IP address and a default gateway

Where to configure an IP address for each VLAN



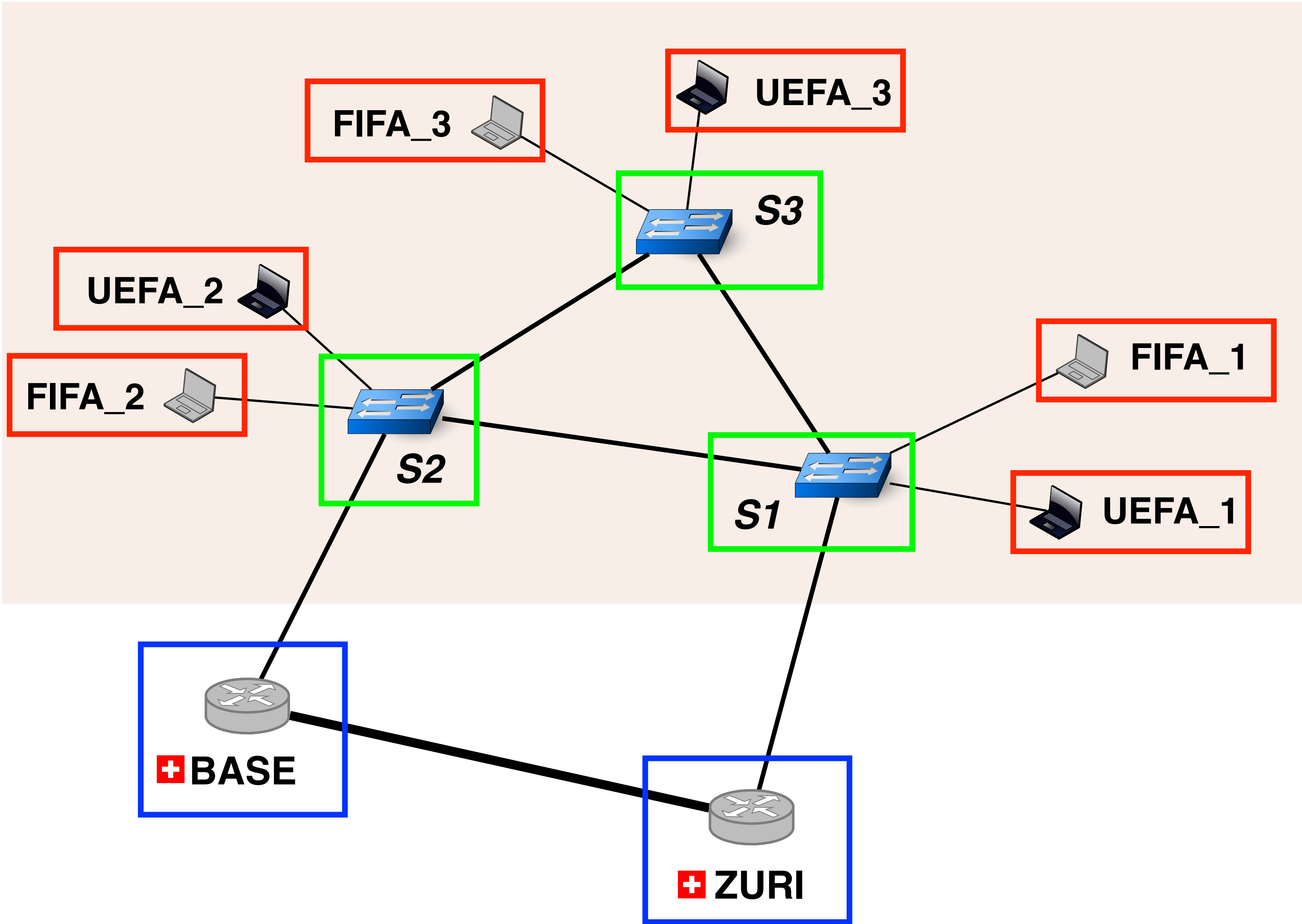
# Question 1.1: Enabling connectivity in the North Data Center

## North Data Center

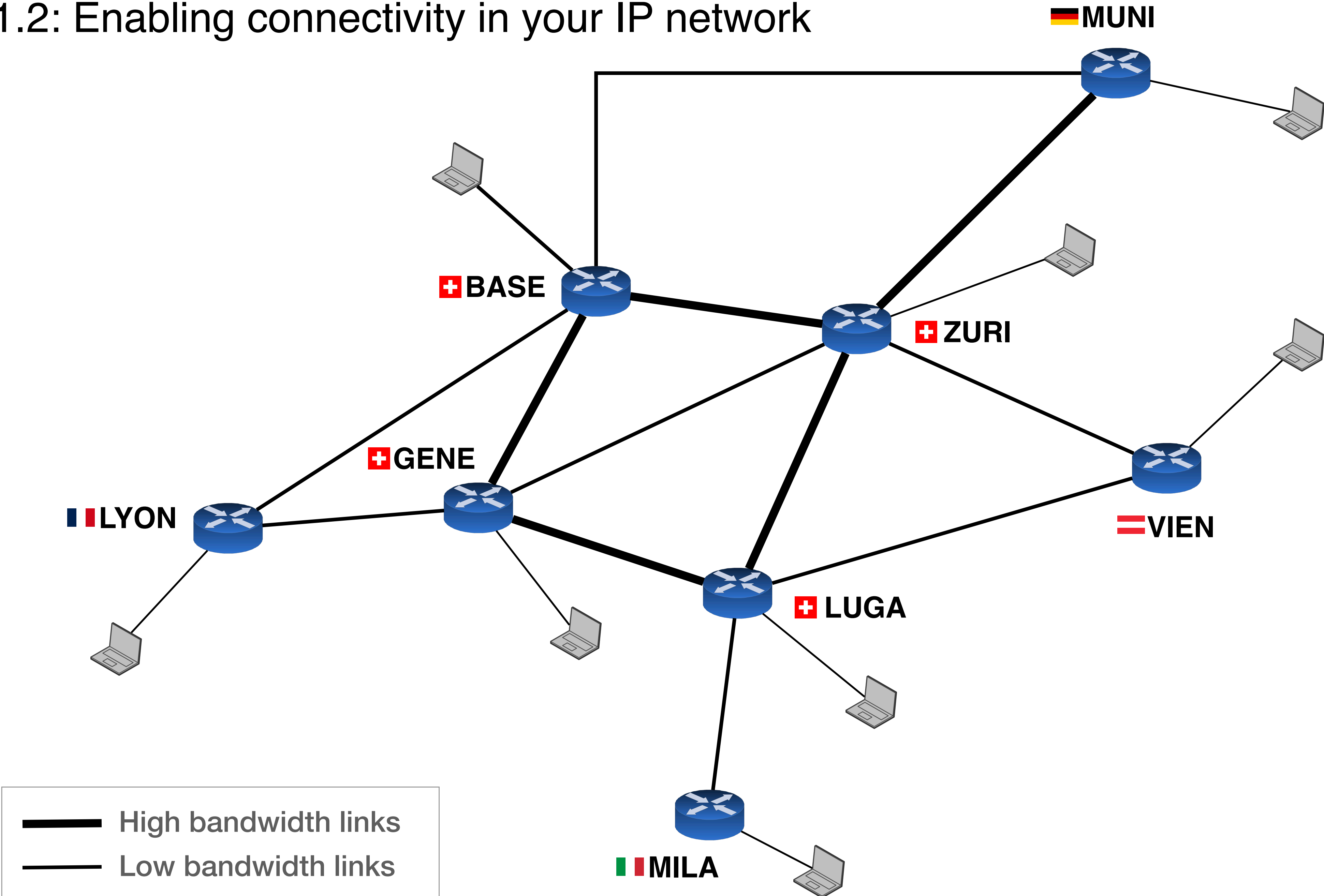
Where to configure an IP address and a default gateway

Where to configure an IP address for each VLAN

Where to configure the VLANs

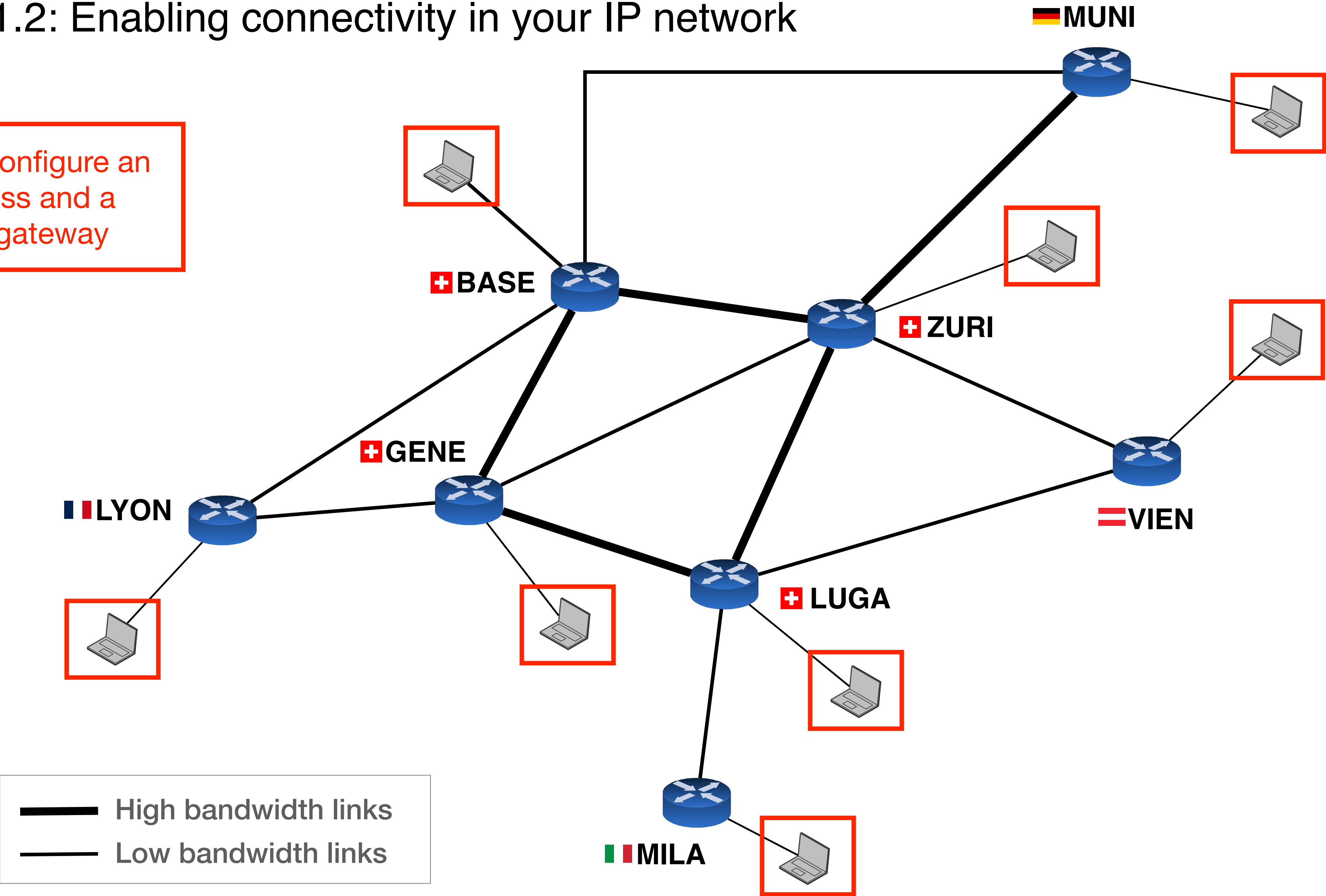


# Question 1.2: Enabling connectivity in your IP network



# Question 1.2: Enabling connectivity in your IP network

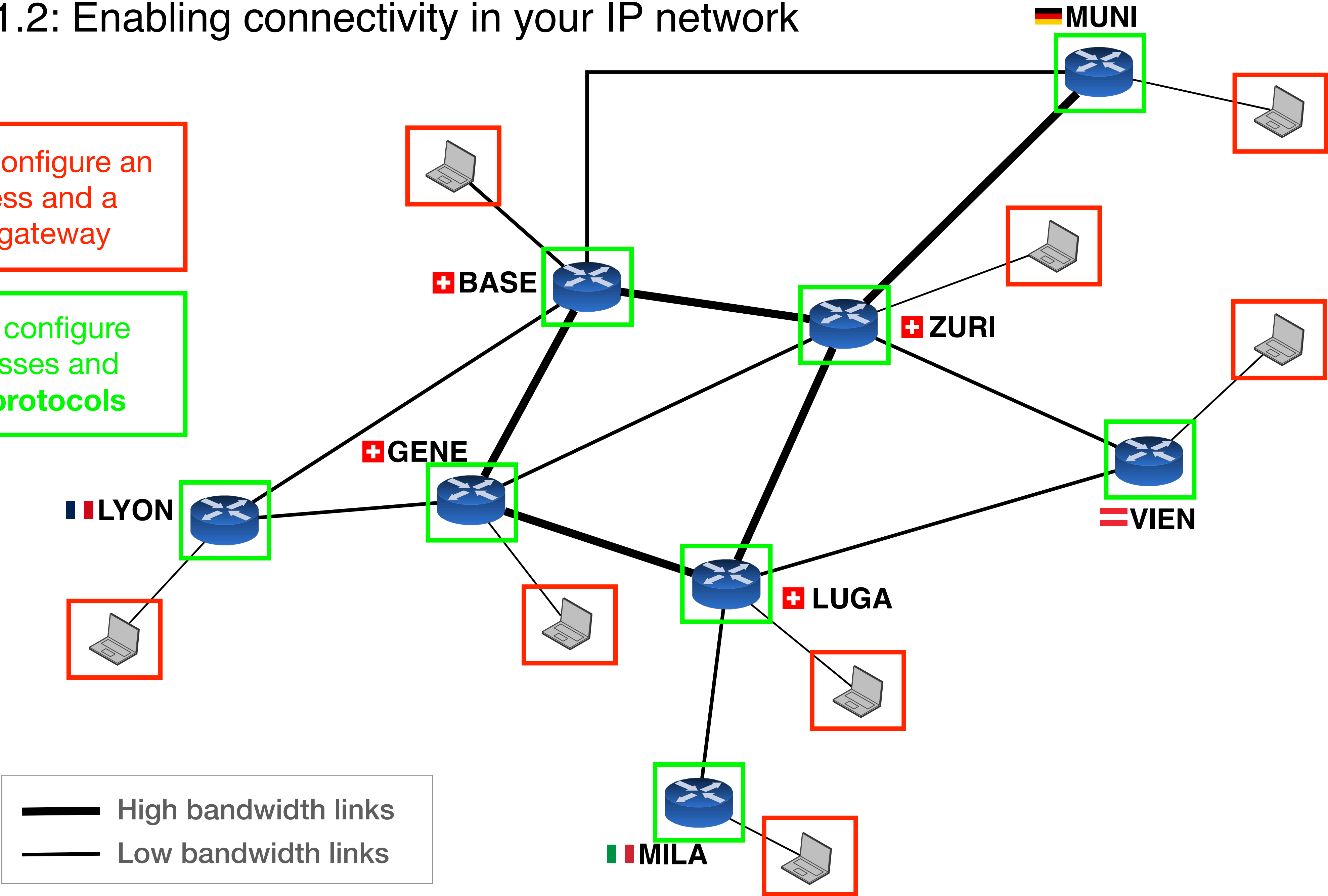
Where to configure an IP address and a default gateway



# Question 1.2: Enabling connectivity in your IP network

Where to configure an IP address and a default gateway

Where to configure IP addresses and routing protocols



## General advice: do not forget to use the debugging tools

### Linux networking tools

- Ping and traceroute to verify connectivity and IP paths
- Tcpdump to sniff packets on an interface

### Routers and switches debugging commands

- You can show the current config, the content of the routing table, etc
- You can see information about each protocol

### Monitoring tools we provide (and document in the Wiki)

- Connectivity matrix
- BGP looking glass
- BGP policy analyser
- Measurement container

→ <https://duvel.ethz.ch>



## General advice: do not forget to use the debugging tools

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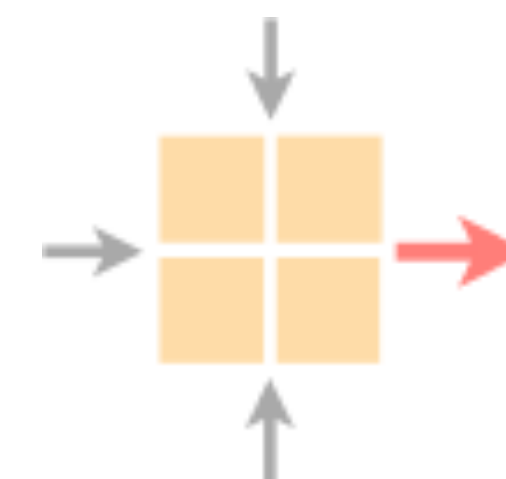
We are here to guide you through the project  
**do not hesitate to ask questions! :-)**

# Today's schedule

1. More detailed introduction on the routing project

2. Introduction to Git

3. How to minimize the size of a forwarding table (Exam question)



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- gsn routing project
- + nsg routing project

git organizes **code in repositories**, usually hosted online

A screenshot of the GitLab web interface. The top navigation bar is dark blue with the 'ETH zürich' logo and a search bar. Below it, a red banner contains a notification about scheduled maintenance. The main content area shows the 'Group 10' repository page, including project information, commit history, and a file list. The left sidebar contains a navigation menu with various project management options.

ETH zürich Menu Search GitLab

To receive notifications about scheduled maintenance, please subscribe to the mailing-list [gitlab-operations@sympa.ethz.ch](mailto:gitlab-operations@sympa.ethz.ch). You can subscribe to the mailing-list at <https://sympa.ethz.ch>

Group 10

Project information

Repository

Issues 0

Merge requests 0

CI/CD

Security & Compliance

Deployments

Monitor

Infrastructure

Packages & Registries

Analytics

Wiki

Snippets

Settings

Group 10  
Project ID: 32133

3 Commits 1 Branch 0 Tags 123 KB Files 123 KB Storage

master group-10 / +

History Find file Web IDE Clone

init  
CommNet Team authored 1 day ago

Upload File README Add LICENSE Add CHANGELOG Add CONTRIBUTING Add Kubernetes cluster Set up CI/CD Configure Integrations

Name	Last commit	Last update
configs	init	1 day ago
report	init	1 day ago
resources	init	1 day ago
README.md	init	1 day ago

setup: **use ssh keys for security and convenience**



1. Add your public key under **preferences > SSH keys**
2. Clone repositories using ssh (not https)  
the ssh urls look like **git@gitlab.ethz.ch:...**



every **set of changes** to the code is called a **commit**



 nsg >  > routing\_project > Group 10 > Commits

master



group-10

27 Mar, 2022 3 commits



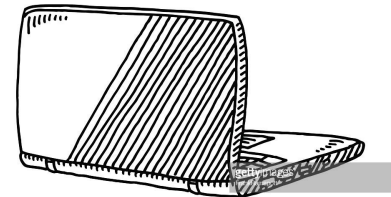
init

CommNet Team authored 1 day ago

to create commits, **clone the repository** to get a local copy



**git clone** <repository>  
*creates local copy*

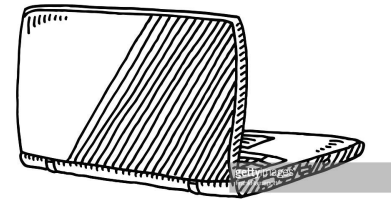




if you have cloned in the past, you **pull to get up-to-date**



**git pull**  
*updates local copy*



all code changes and **commits are created locally**

*codecodecodecode...*

**git status**

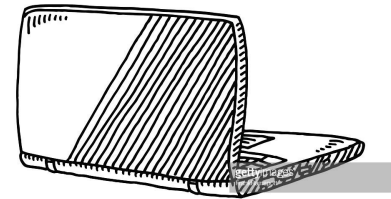
*shows all changed (and staged) files*

**git add <all relevant changes>**

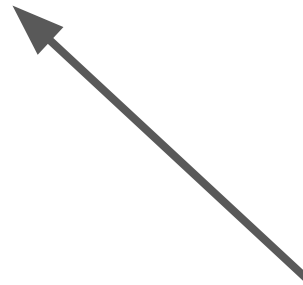
*stages files to be committed*

**git commit**

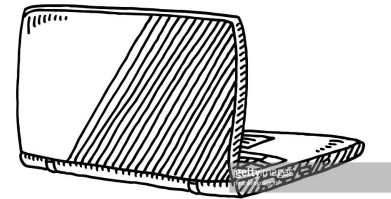
*creates a local commit with all added changes*



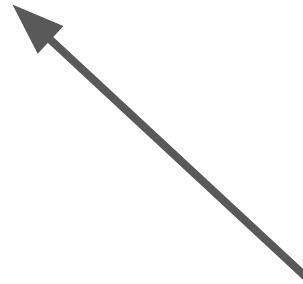
finished **commits** need to be pushed online



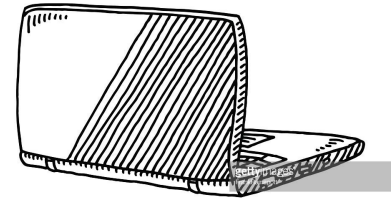
**git push**  
*uploads commits*



if someone else pushed before you, **git prevents pushing**



**git push**  
*fails if not up-to-date!*



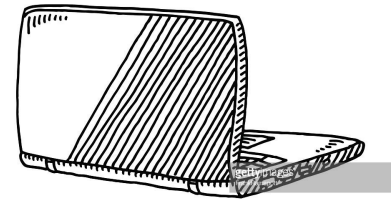
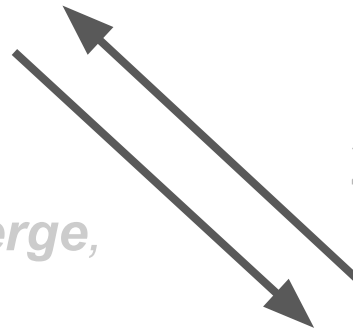
you first need to **solve conflicts locally**



1. **git pull**

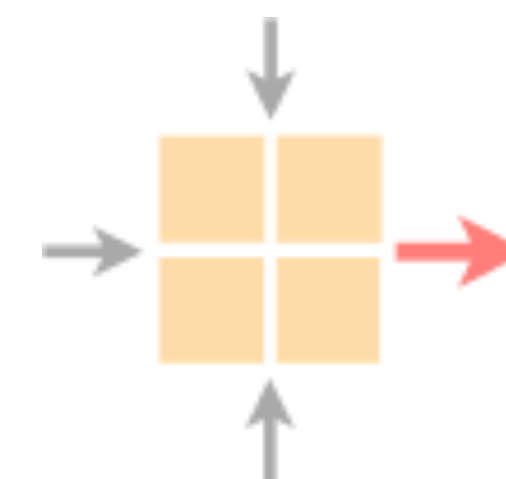
*gets updates. you need to merge,  
i.e. make sure all fits together*

2. **git push**



# Today's schedule

1. More detailed introduction on the routing project
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## Task 5.3: Summer Pruning (Exam Question 2018)

Goal:

- Simplify a forwarding table  
i.e., **least** number of entries
- Forwarding behaviour should be **equivalent** to initial table

prefix	next-hop
82.130.32.0/20	1
82.130.64.0/20	1
82.130.80.0/20	2
82.130.96.0/20	1
82.130.112.0/21	1
82.130.120.0/21	1
82.130.122.0/24	1
82.130.123.0/24	1
82.130.124.0/24	2

## Task 5.3: Summer Pruning (Exam Question 2018)

Goal:

- Simplify a forwarding table  
i.e., **least** number of entries
- Forwarding behaviour should be **equivalent** to initial table



A lot of students had trouble with this question

prefix	next-hop
82.130.32.0/20	1
82.130.64.0/20	1
82.130.80.0/20	2
82.130.96.0/20	1
82.130.112.0/21	1
82.130.120.0/21	1
82.130.122.0/24	1
82.130.123.0/24	1
82.130.124.0/24	2



## Task 5.3: Solution intuition

Two main **simplification approaches**:

- Replace multiple prefixes with a larger one
- Exploit longest prefix match behaviour

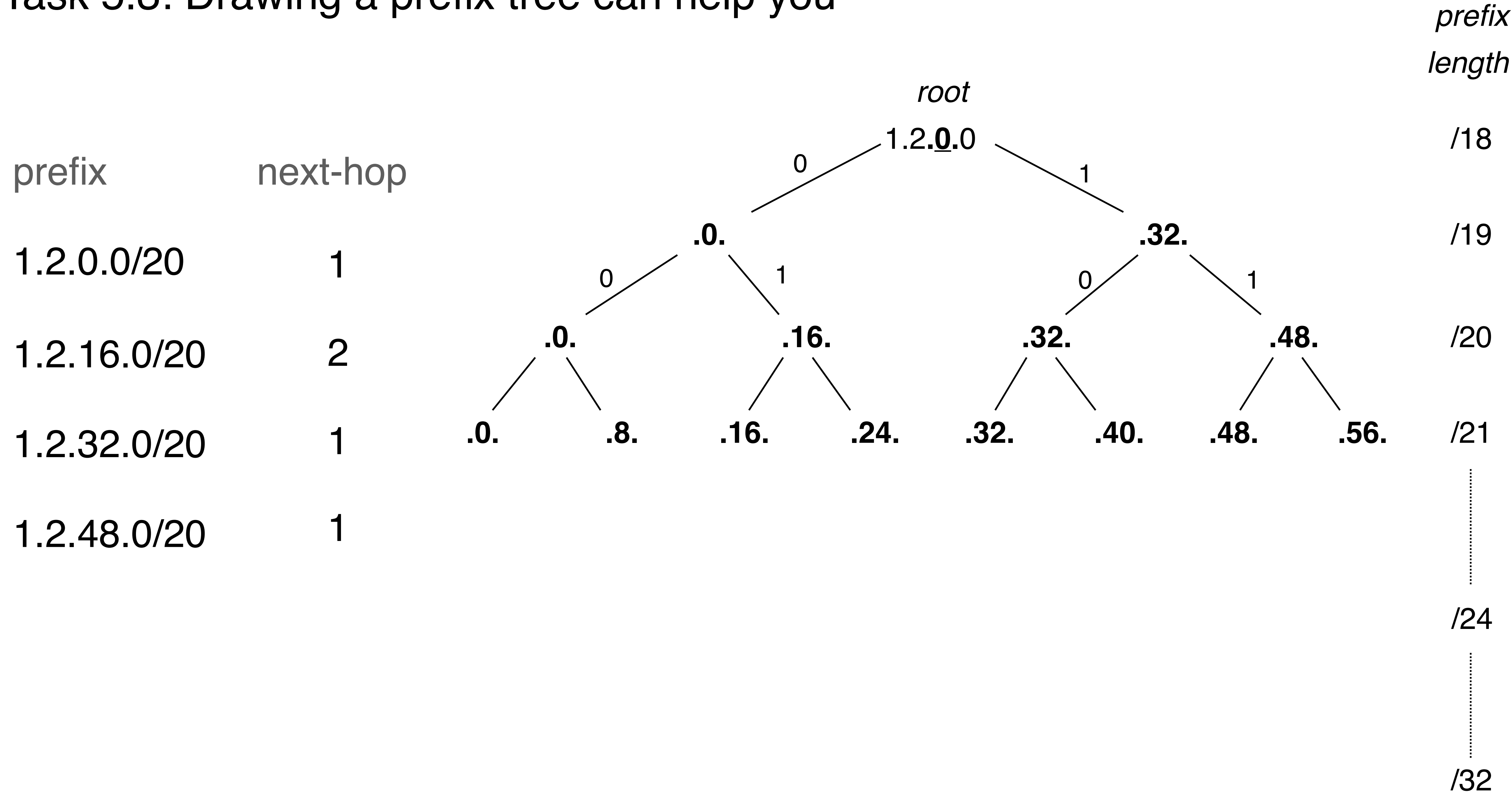
Possible **pitfalls**:

- Some IPs are forwarded to a different next-hop
- The new table covers more IPs than the old one

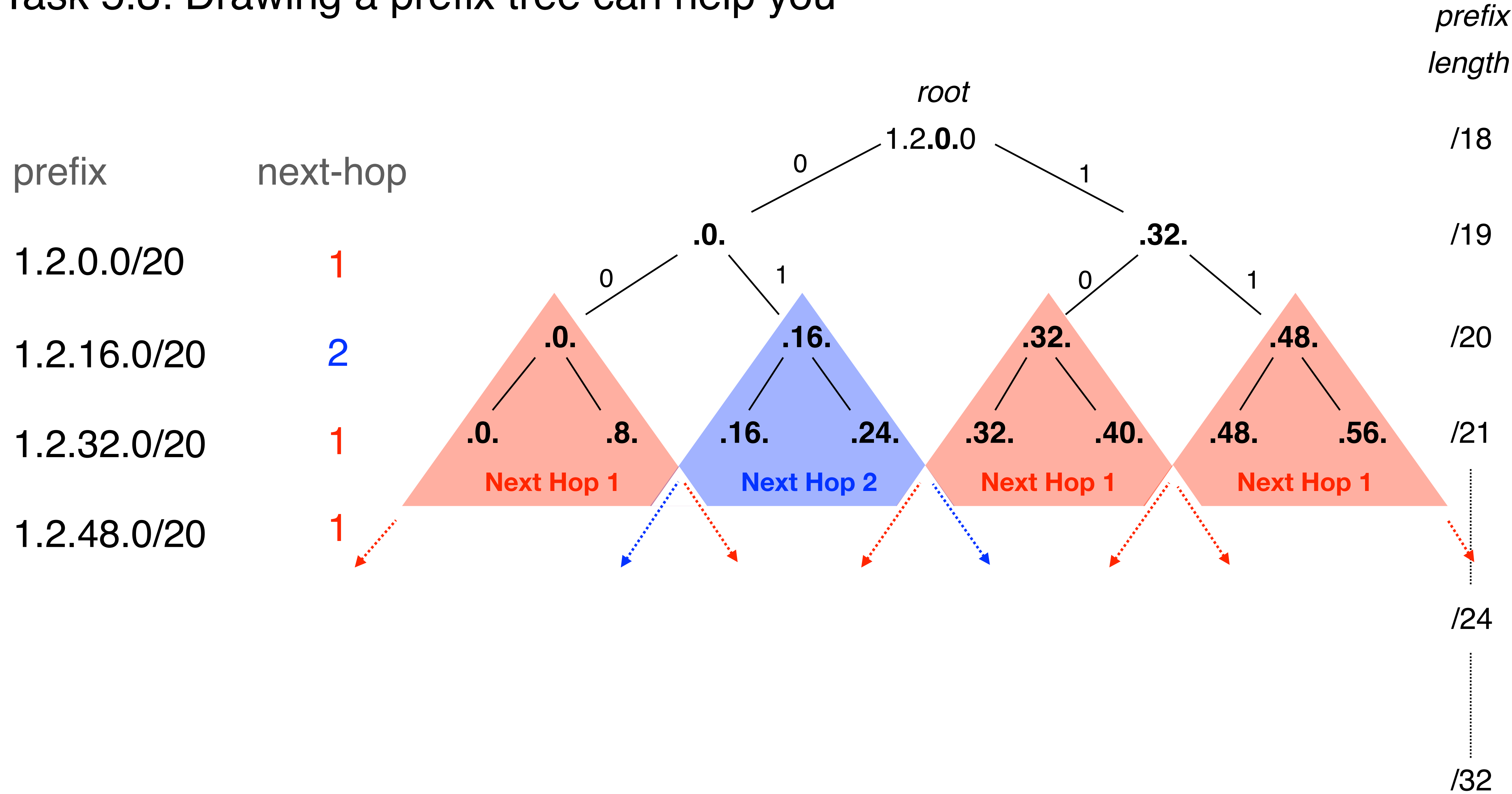
## Task 5.3: Drawing a prefix tree can help you

prefix	next-hop
1.2.0.0/20	1
1.2.16.0/20	2
1.2.32.0/20	1
1.2.48.0/20	1

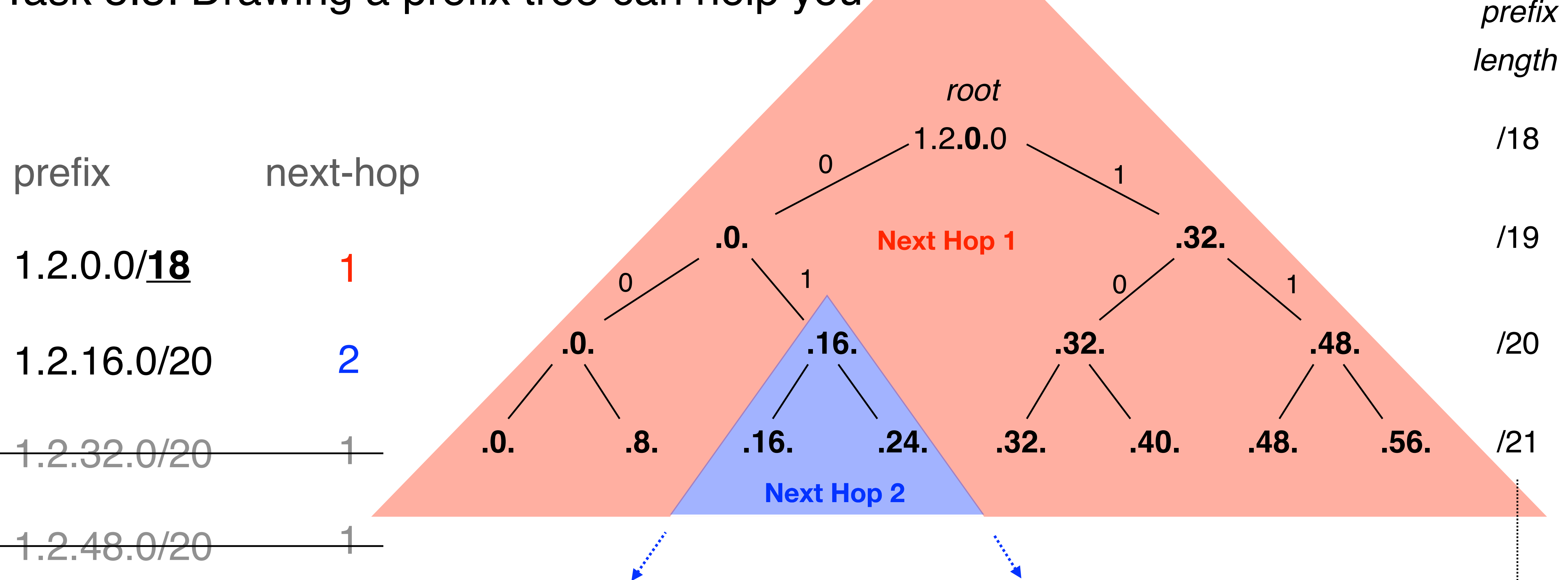
# Task 5.3: Drawing a prefix tree can help you



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It works because of the **longest prefix match!**

▲ has priority over ▲