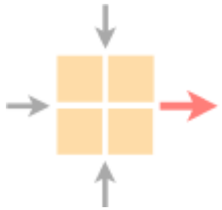
Communication Networks 2022
Project #1: Build your *own* mini-Internet

Introduction to the project



Networked Systems
ETH Zürich — seit 2015

Assignment available as a GitLab Wiki at:

https://gitlab.ethz.ch/nsg/lectures/lec_commnet/projects/2022/routing_project/assignment/-/wikis/home

Home

This wiki contains all information to the mini-Internet project, which is part of the Communication Networks Course at ETH taught by Prof. Laurent Vanbever from the Networked Systems Group.

Introduction to the project

In this project, you will build and operate your very own mini-Internet together with more than 100 of your fellow classmates. Your main goal? Enabling end-to-end connectivity across around 70 Autonomous Systems (ASes) composed of hundreds of network devices. In doing so, you will experiment with the most common switching and routing technologies used in the Internet today. You will also face the same challenges actual network operators experience every day.

To reach Internet-wide connectivity, you will first need to enable internal connectivity, **within** your own AS, before interconnecting your AS with other ASes, managed by other groups of students. To establish connectivity **within** your AS, you will configure IPv4 and IPv6 addresses and use Open Shortest Path First (OSPF). To establish connectivity **across** different ASes, you will use the only inter-domain routing protocol available today: the Border Gateway Protocol (BGP). Throughout the project, you will also have to ensure that traffic follows the **business relationships** and that routing is **secured**. At the end of the project, end-hosts should be able to communicate with each other, independently of the AS they are located in.

To help you, we have pre-built a base network topology on top of virtual layer-2 switches, running Open vSwitch and virtual routers, running the FRRouting software routing suite. You will configure the virtual switches and routers through a Command Line Interface (CLI). This interface is virtually identical to the one used by actual network operators.

Table of contents

This wiki consists of three main parts, an assignment, a tutorial and a FAQ section. The assignment section contains:

- General instructions about the project, including **submission instructions**.
- An overview of the mini-Internet and the network you will configure.
- The tasks you need to solve and what to include in your final report.
- The tools to help you testing and verifying your configuration.

The tutorial section explains how to:

- Access your devices such as routers, switches and hosts.
- Configure a host to e.g., give it an IP address.

0. Routing Project Overview

1. Assignment
   - 1.1 General Instructions
   - 1.2 Your mini Internet
   - 1.3 Questions
   - 1.4 Tools to help you

2. Tutorial
   - 2.1 Accessing your devices
   - 2.2 Configuring a host
   - 2.3 Configuring Open vSwitch
   - 2.4 Configuring 6in4 tunnels
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     - 2.5.1 The FRRouting CLI
     - 2.5.2 Router interfaces
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     - 2.5.4 OSPF
     - 2.5.5 BGP
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   - 2.6 VPN Configuration
   - 2.7 RPKI Configuration

Each group has its own GitLab repository

In which you can find the required information to access your virtual devices

—> gitlab.ethz.ch/nsg/lectures/lec_commnet/projects/2022/routing_project/group-X

Your group number

Routing Project - Group 12

This is your group repository it contains the credentials to access your network and the necessary information to setup the VPN from the bonus question. You will also use this repository to submit your work---both the configurations and the report---at the end of the project.

Accessing your network

To access your network, follow these instructions using the following credentials:

- **user:** `root`
- **port:** `2012`
- **password:** [redacted]

For example, you can use:

```
ssh -p 2012 root@duvel.ethz.ch
```

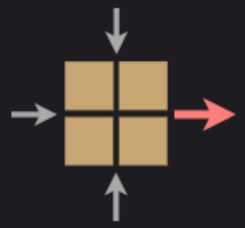
Accessing the measurement container

The password to access the measurement container is `6574ded005106c02`.

Bonus Question: Setting up your VPN

When trying to solve the bonus question, you will need the certificate files and ports at which the VPN servers are listening:

- **VPN server at S1:**
  Port: `10027` Certificate: vnp1_ca.crt



routing project

In this project, we give each group a network that it has to operate
Your goal: enable Internet-wide connectivity

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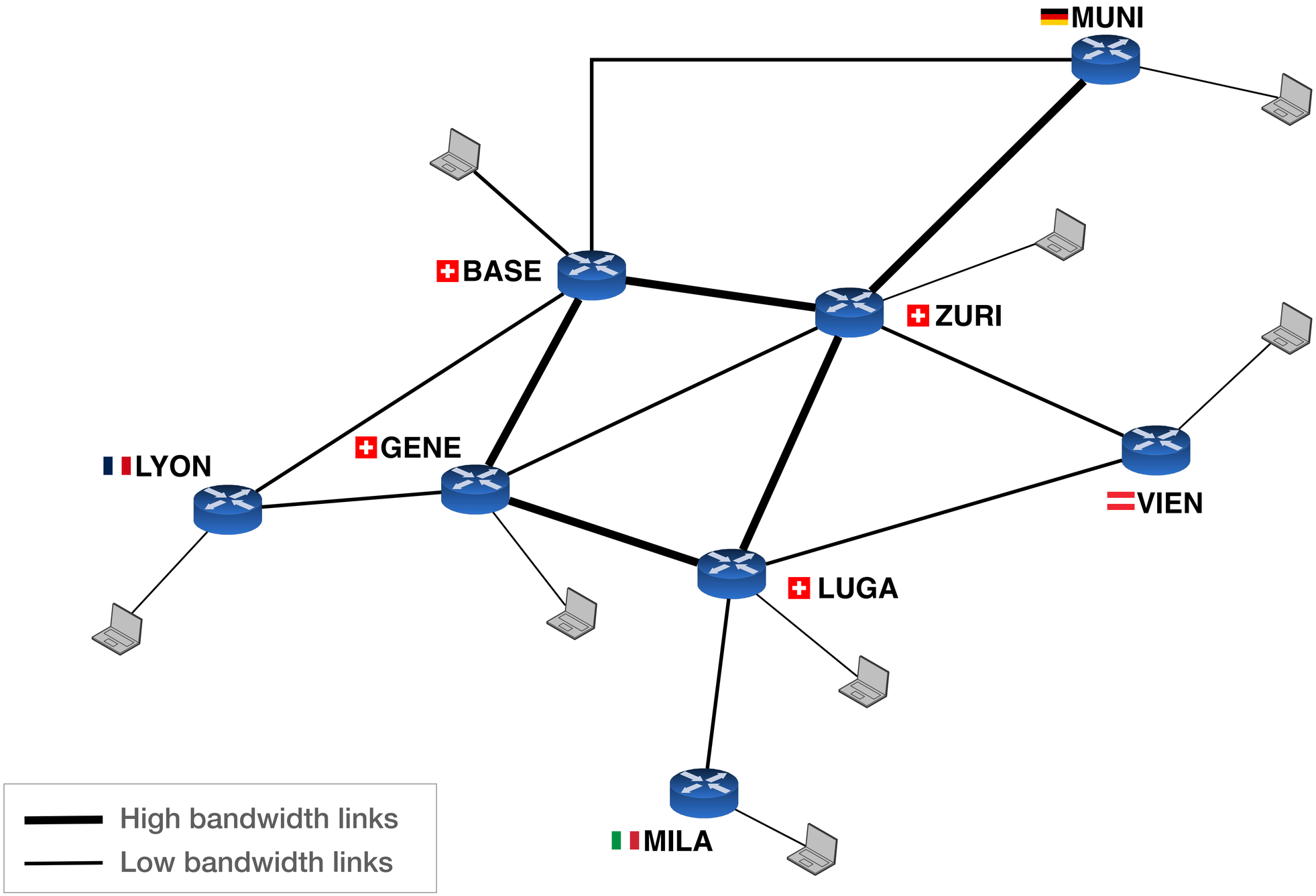
Your goal: enable Internet-wide connectivity

ETH students working
on the mini-Internet
(before the covid outbreak)

Intra-Domain Routing **Inter-Domain Routing** **Routing Security**

March 28 → April 7 → April 29

Connectivity Fäscht


MUNI
BASE
ZURI
GENE
LYON
VIEN
LUGA
MILA
High bandwidth links
Low bandwidth links

DEMO

Intra-Domain Routing

Inter-Domain Routing

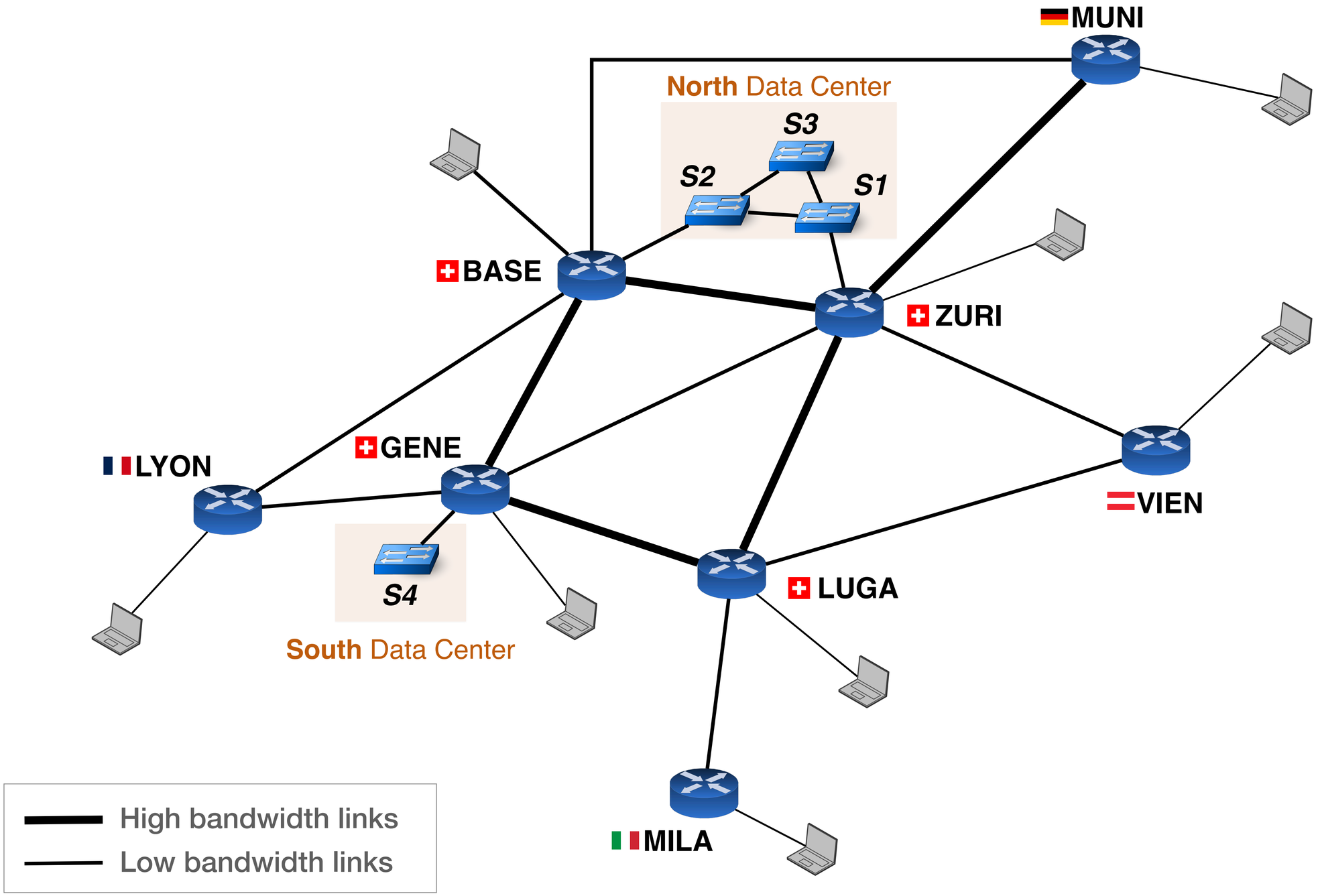
Routing Security

March 28 → April 7 → April 29

Configure your data centers

Configure routing within your network

Perform some traffic engineering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North Data Center
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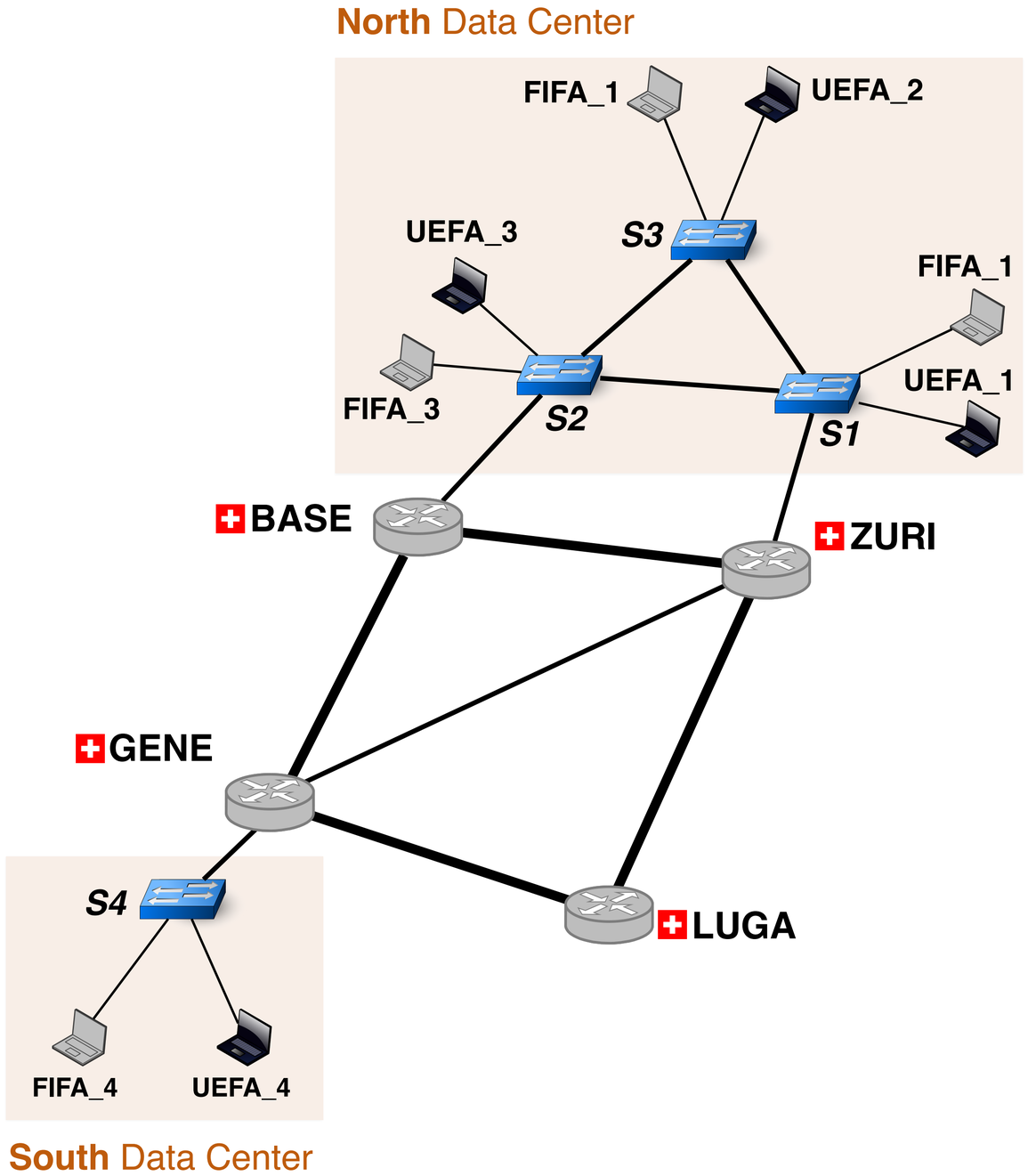
S4
South Data Center
LUGA
MILA
High bandwidth links
Low bandwidth links


North Data Center
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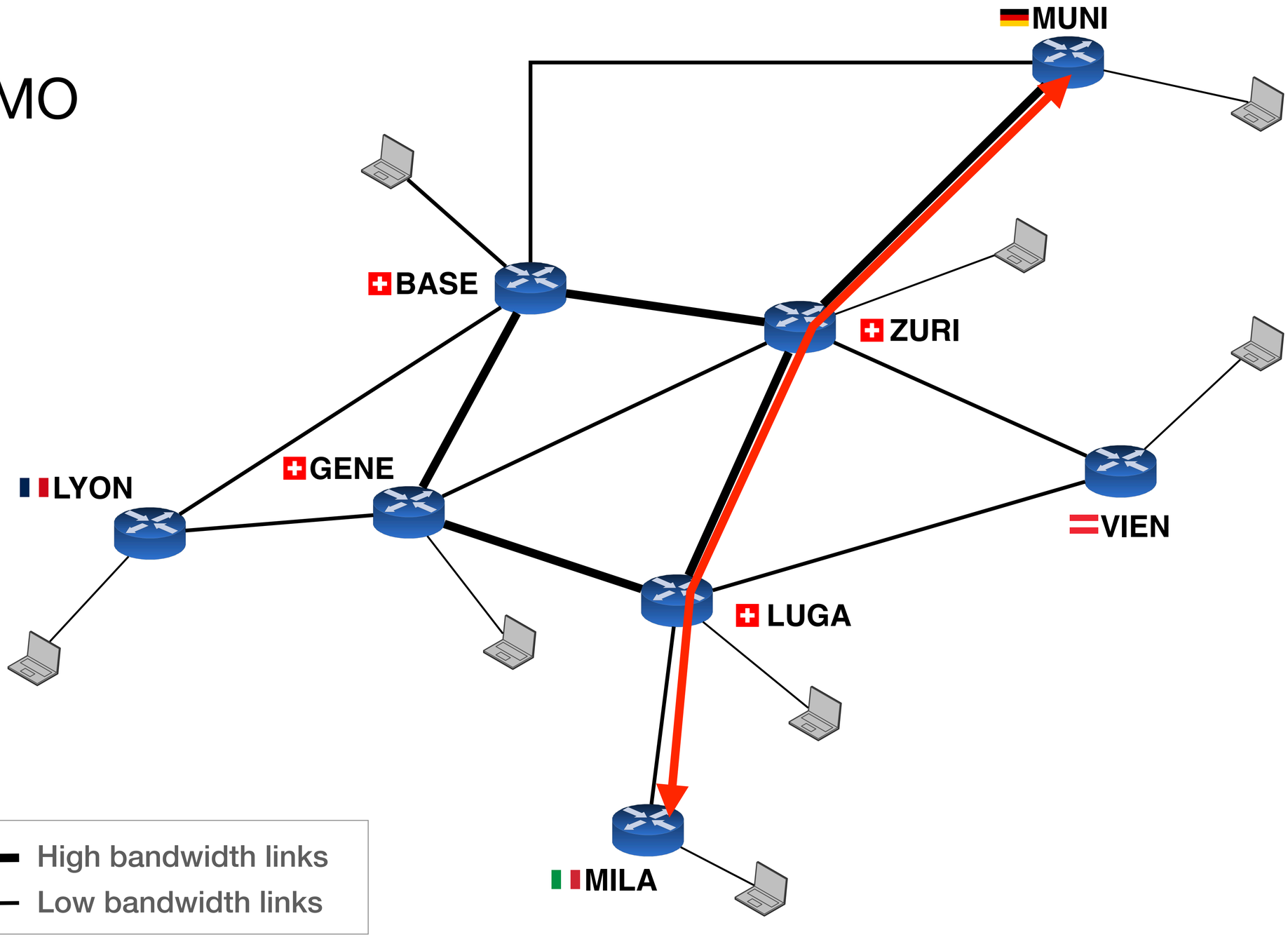
LUGA
FIFA_4
UEFA_4
South Data Center

DEMO


MUNI
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High bandwidth links
Low bandwidth links

Intra-Domain Routing

Inter-Domain Routing

Routing Security

March 28

Configure your
data centers

Configure routing
within your network

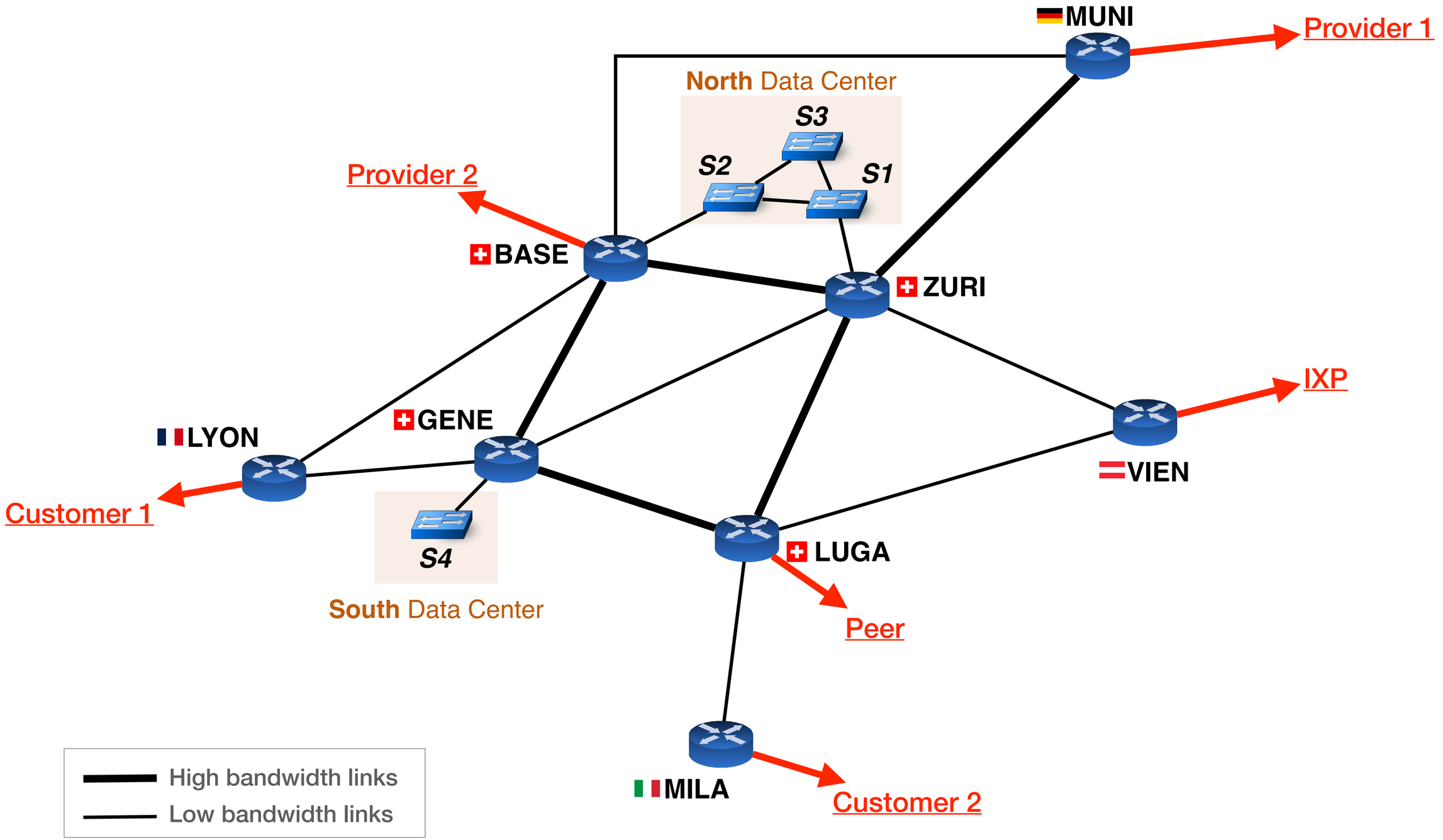
Perform some
traffic engineering

April 7

Connect with
your neighbours

Configure routing
policies

April 29


MUNI
Provider 1
North Data Center
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Provider 2
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Customer 1
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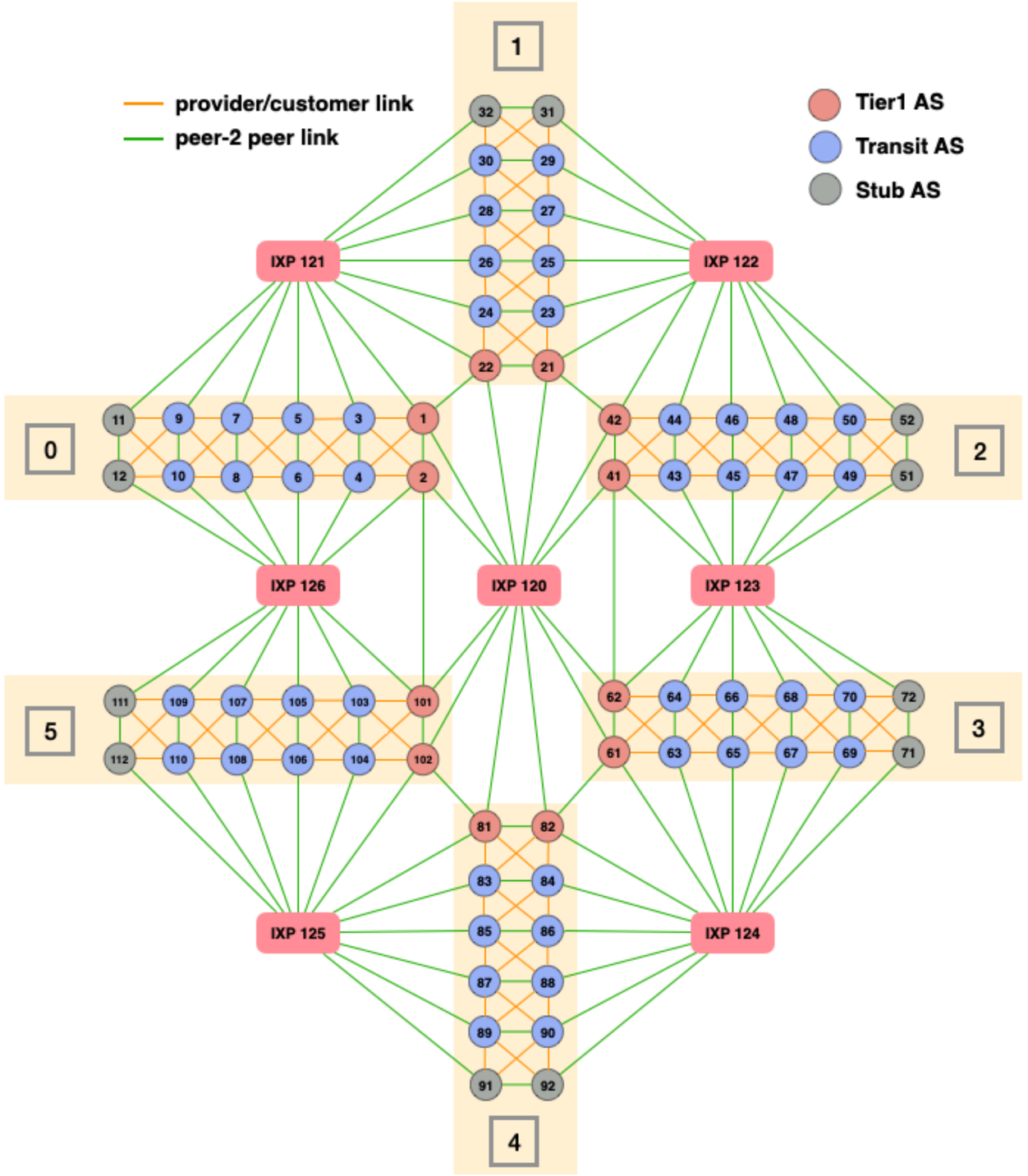
South Data Center
Peer
MILA
Customer 2
High bandwidth links
Low bandwidth links


provider/customer link
peer-2 peer link
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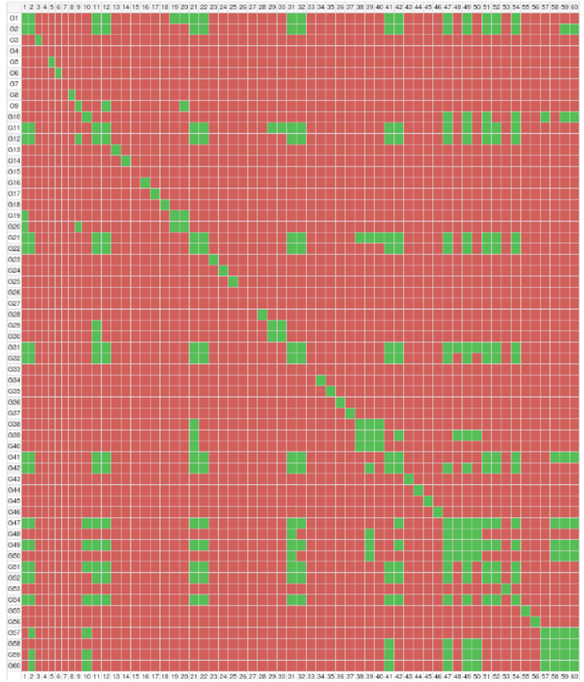
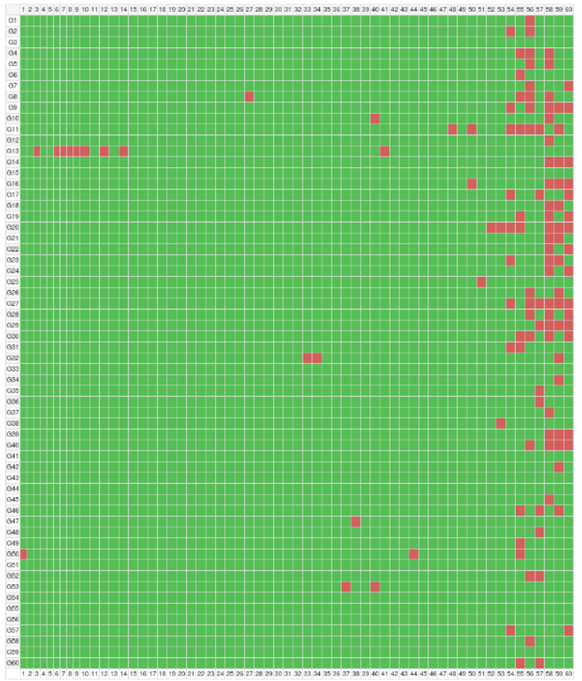
81 82 83 84 85 86 87 88 89 90 91 92

We periodically update a connectivity matrix
available at https://duvel.ethz.ch

Before configuring
eBGP sessions



After configuring
eBGP sessions



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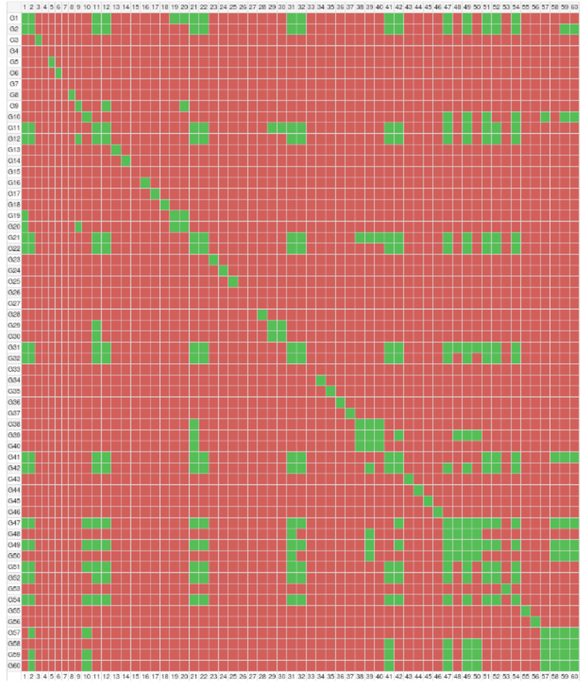
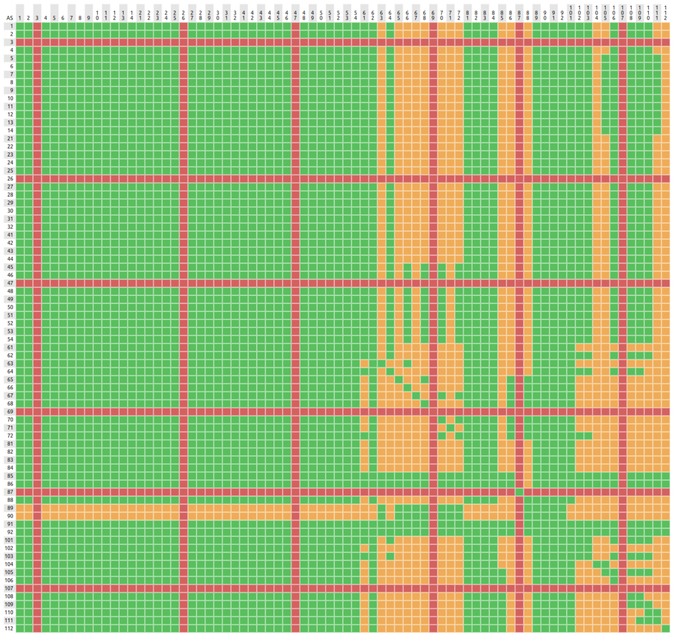


While configuring
eBGP sessions



After configuring
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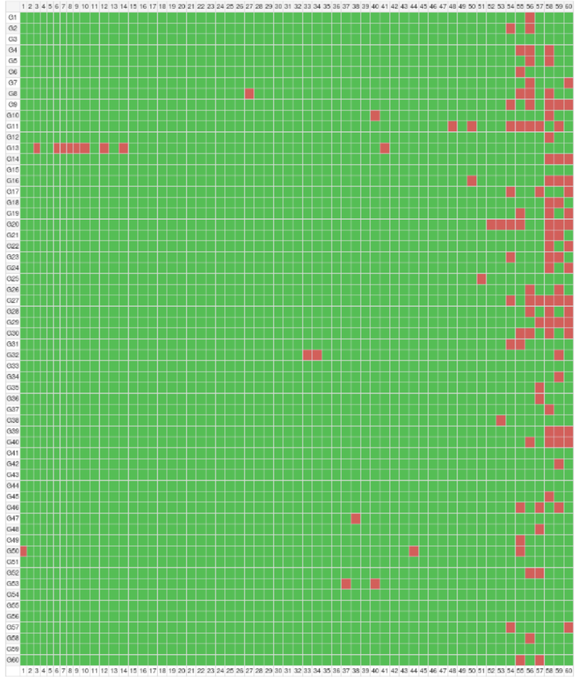

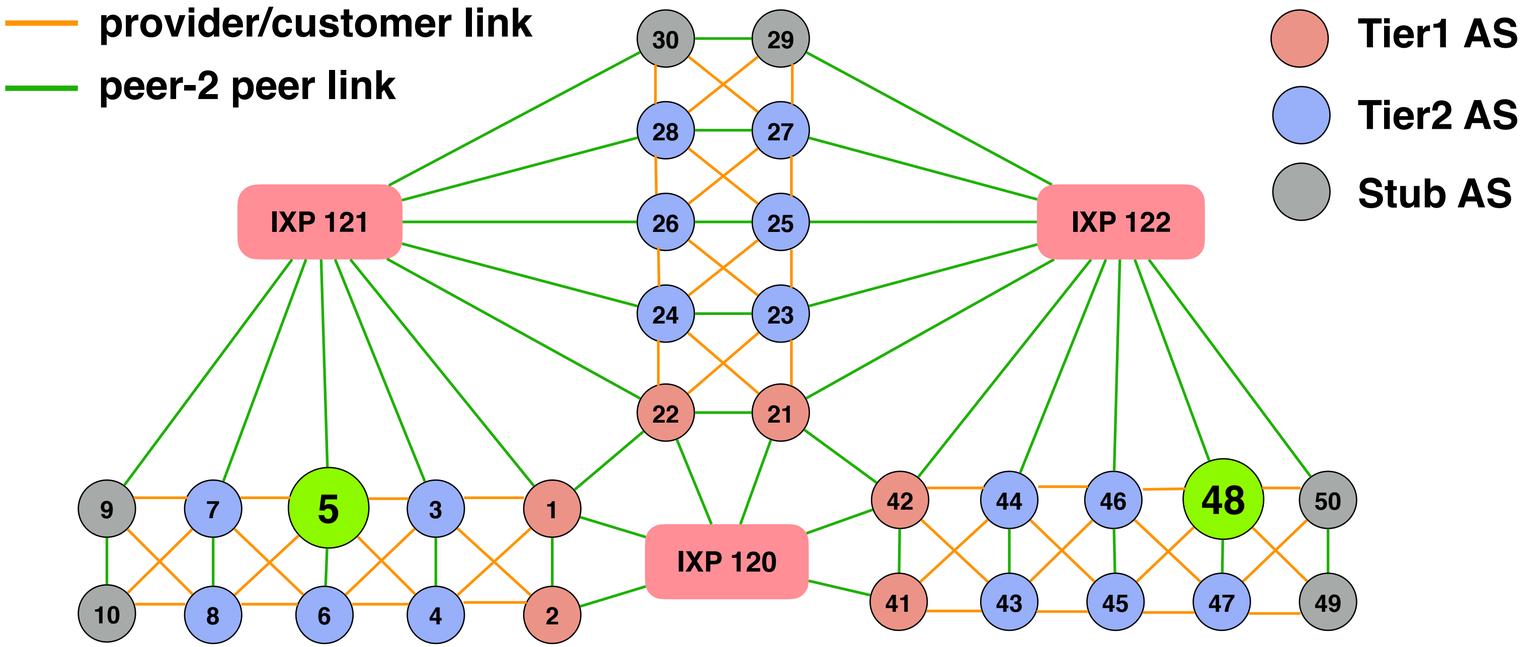
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Tier2 AS
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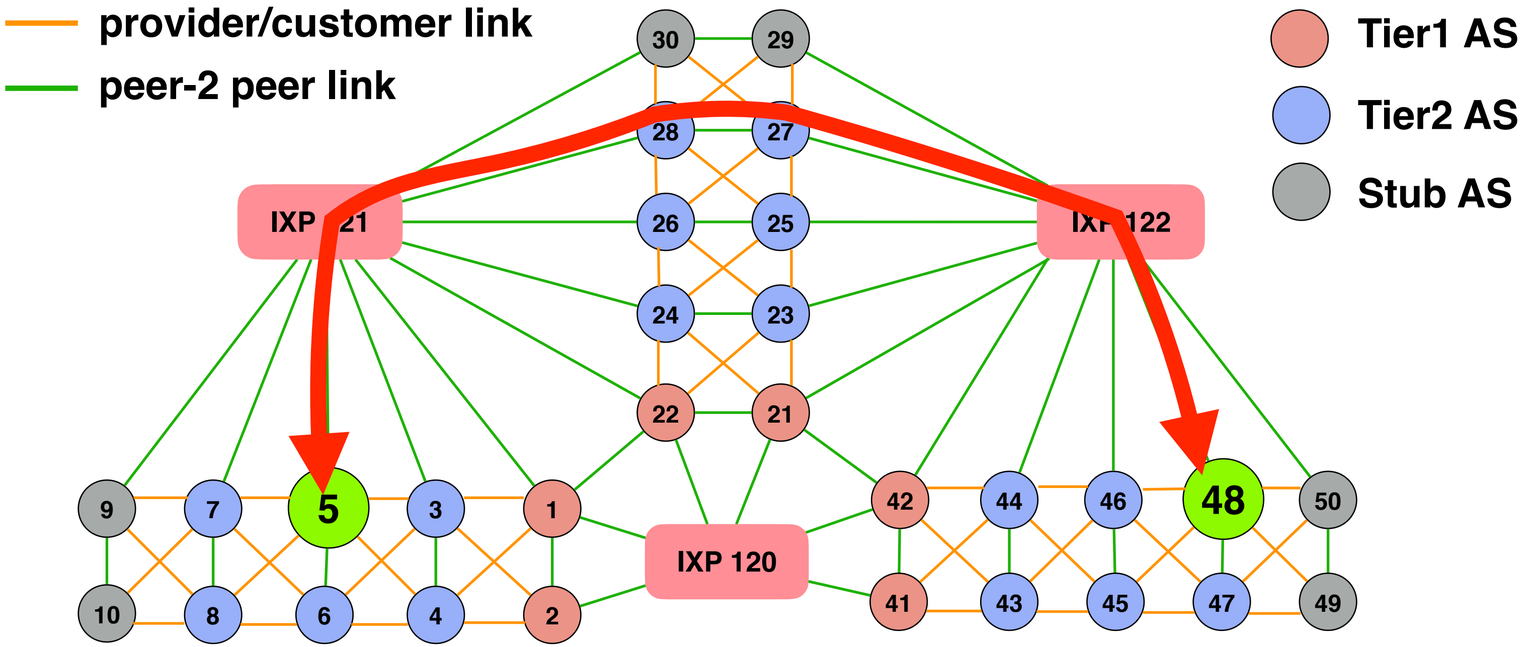
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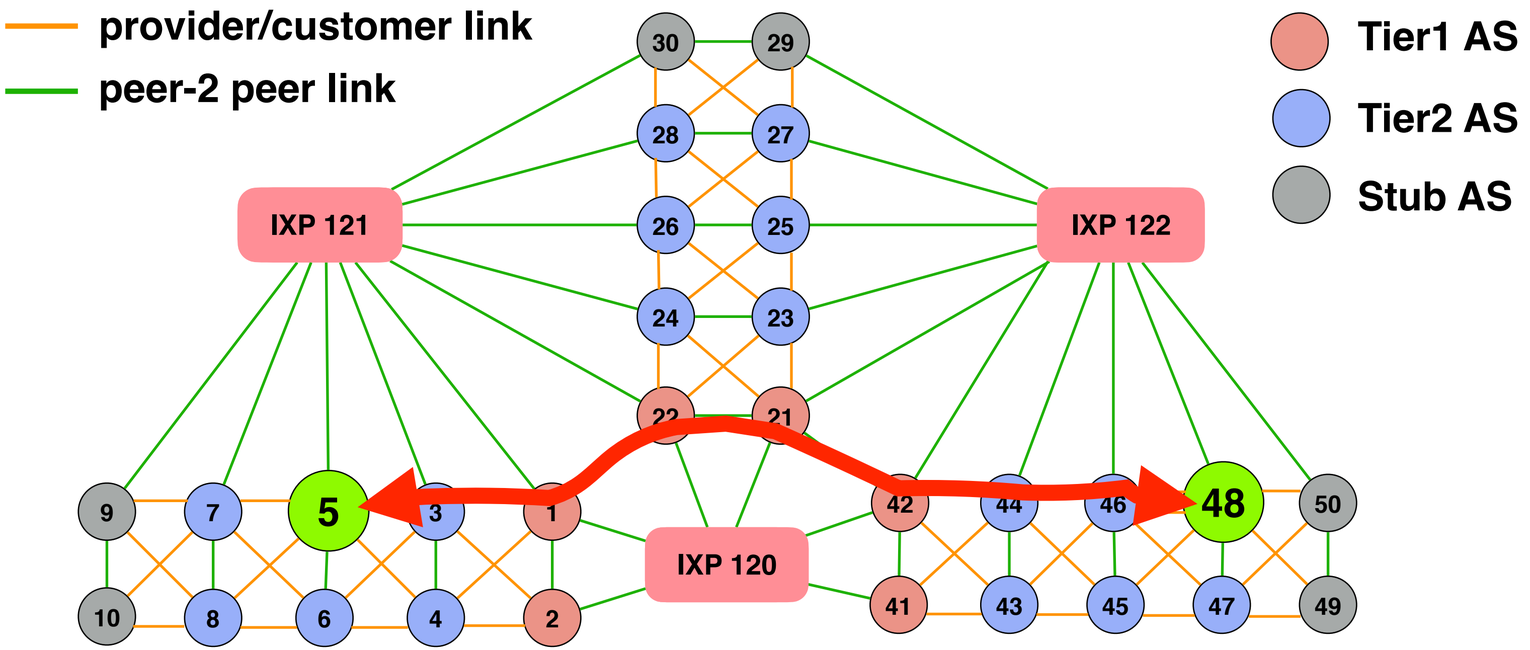
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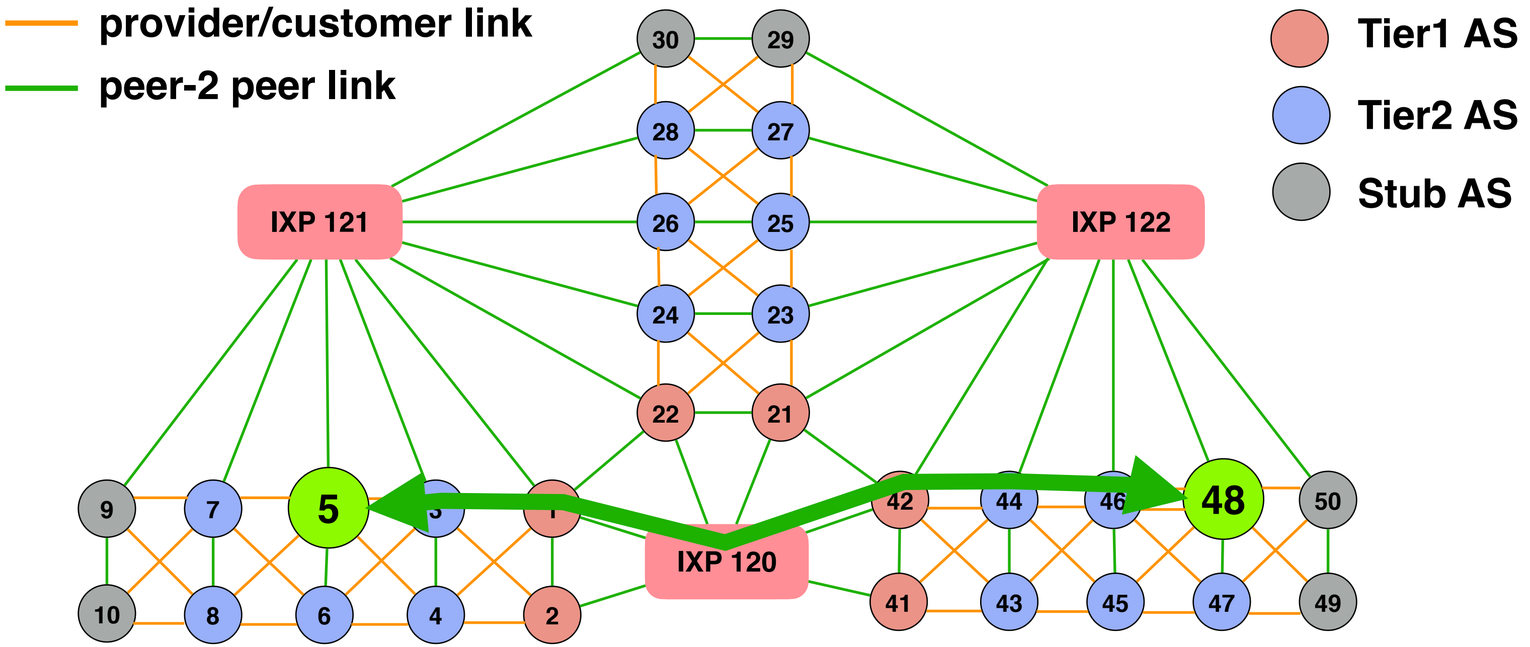
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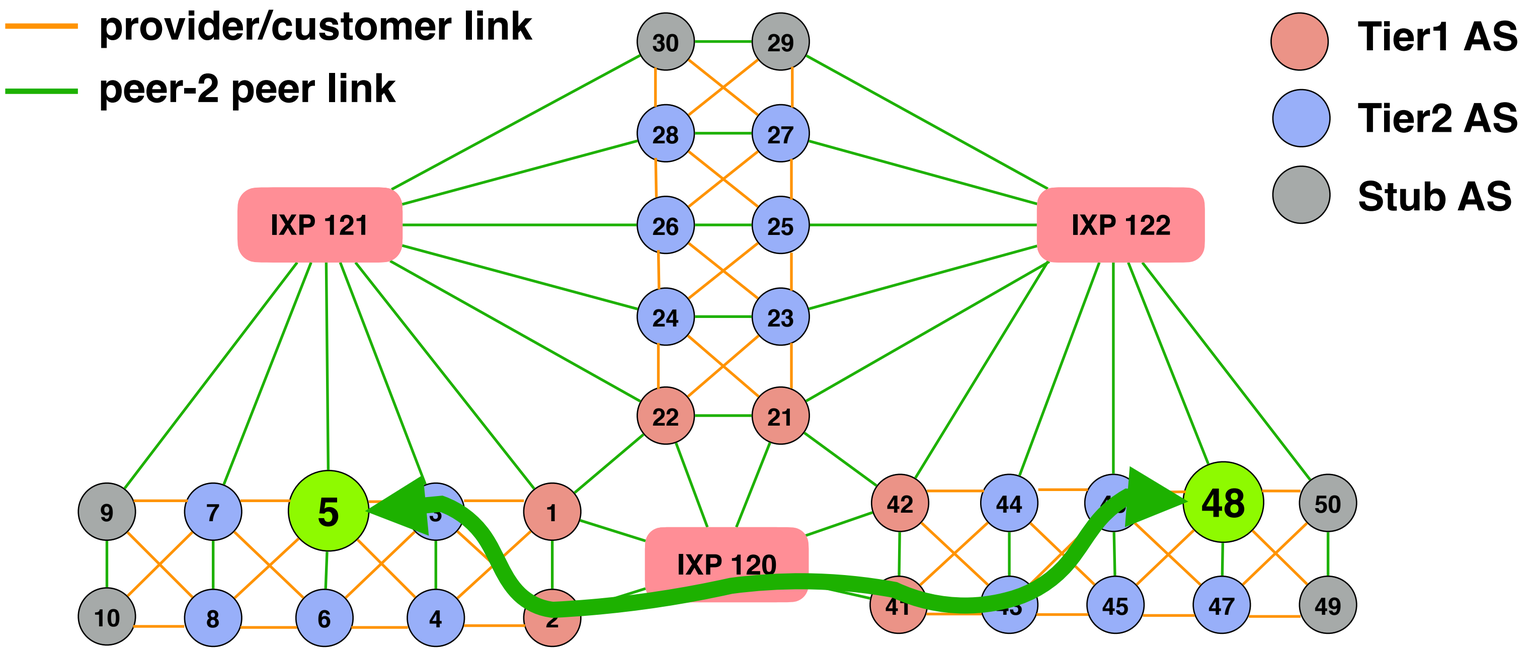
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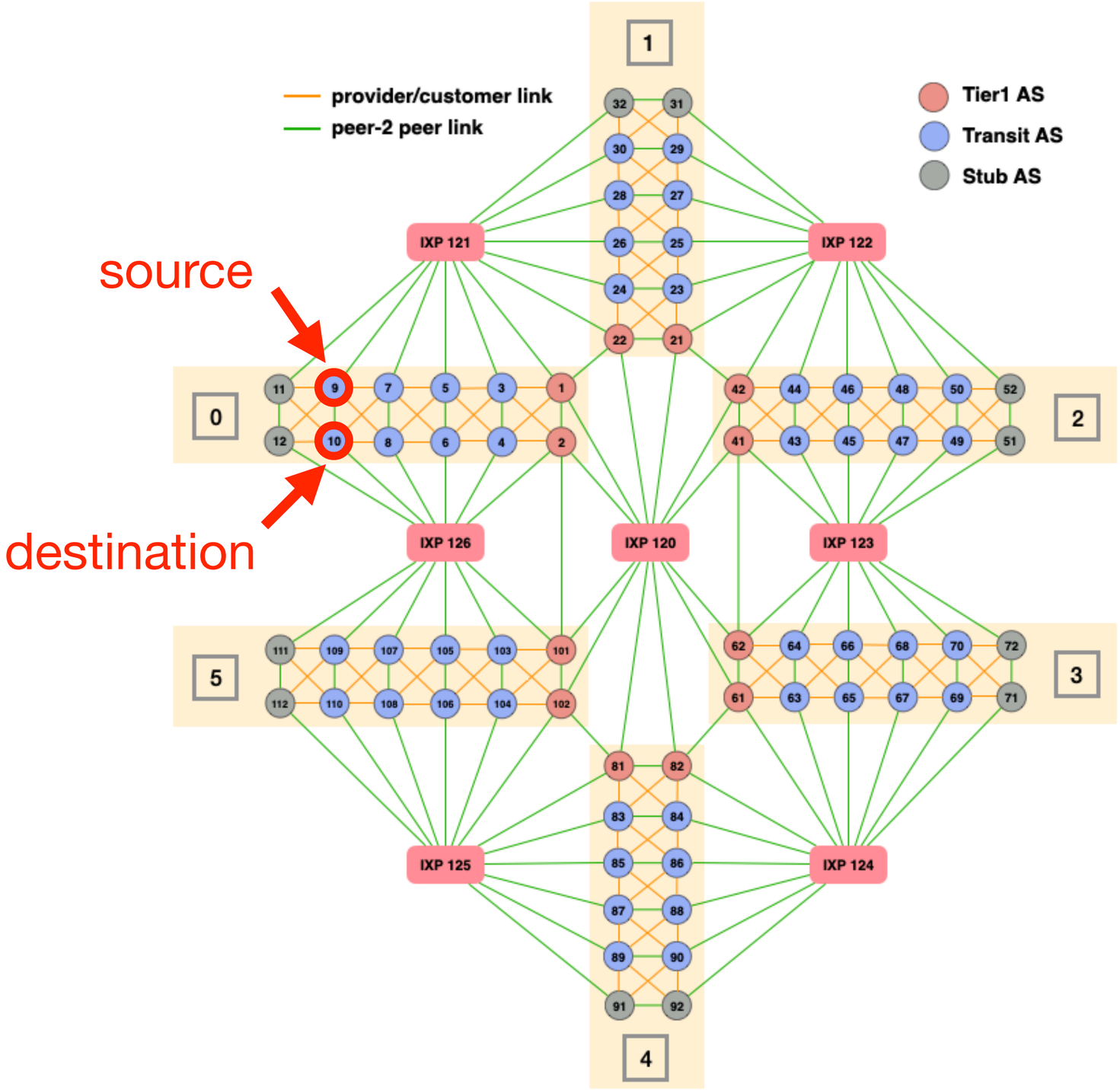
DEMO


provider/customer link
peer-2 peer link
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Intra-Domain Routing

March 28

Configure your data centers

Configure routing within your network

Perform some traffic engineering

Inter-Domain Routing

April 7

Connect with your neighbours

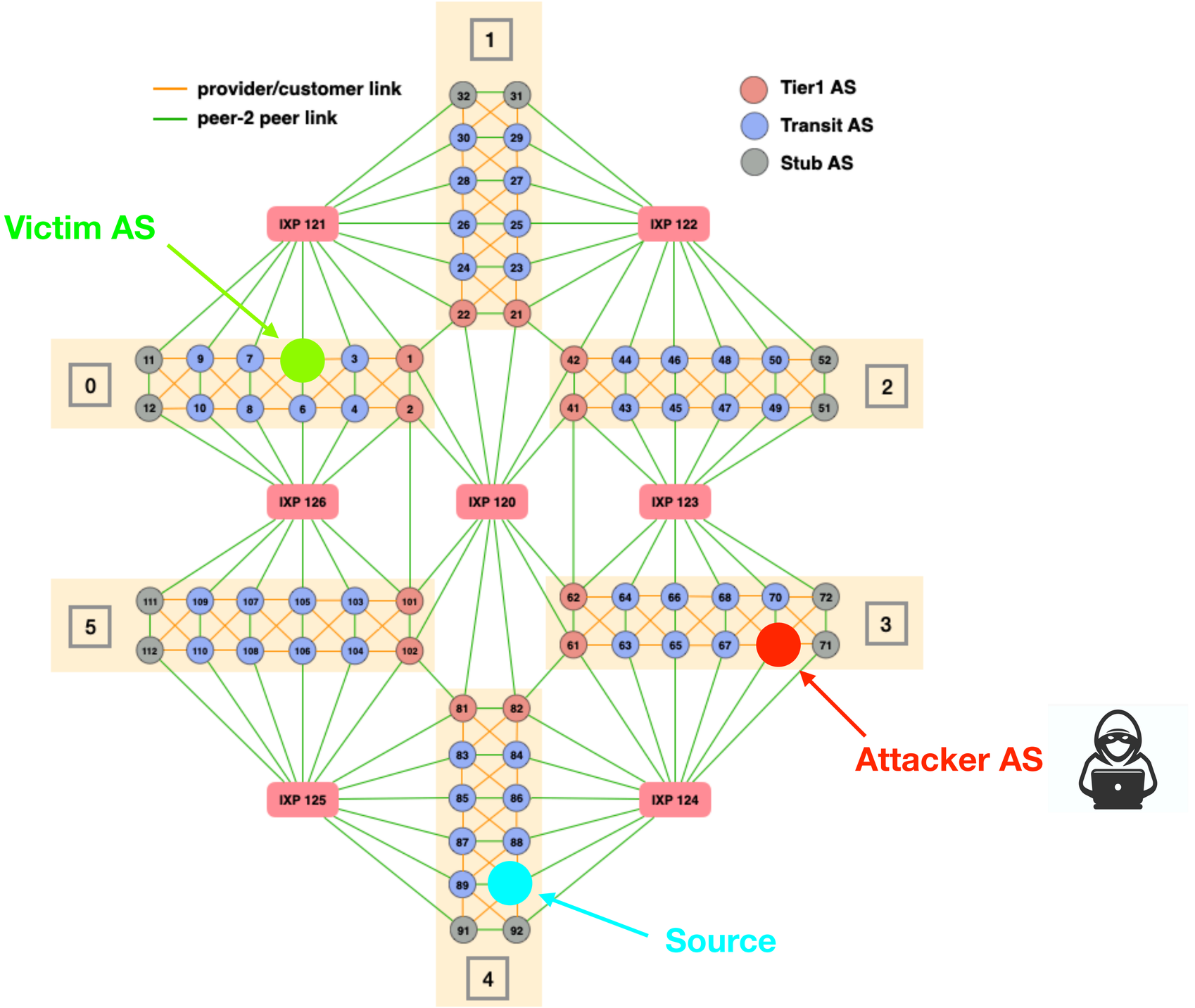
Configure routing policies

Routing Security

April 29

Protect your network against misconfigurations

Protect *(or not)* your network against routing attacks


provider/customer link
peer-2 peer link
Tier1 AS
Transit AS
Stub AS
Victim AS
Attacker AS
Source
IXP 120
IXP 121
IXP 122
IXP 123
IXP 124
IXP 125
IXP 126
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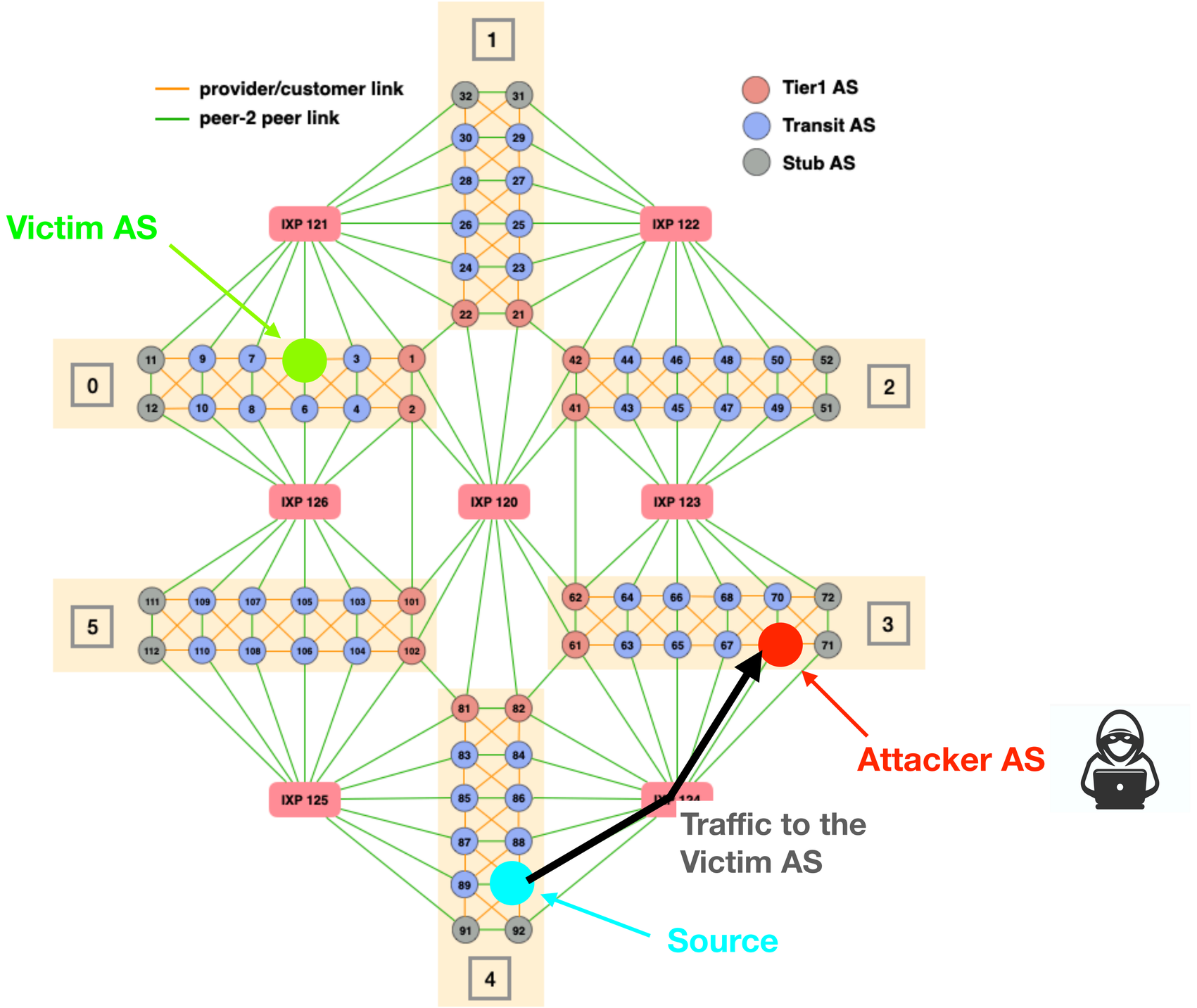
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Tier1 AS
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Stub AS
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IXP 122
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IXP 120
IXP 123
IXP 125
IXP 124
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5
Attacker AS
Traffic to the Victim AS
Source

Communication Networks 2022

Project #1: Build you *own* mini-Internet

Questions?

Slack channel: **@routing_project**