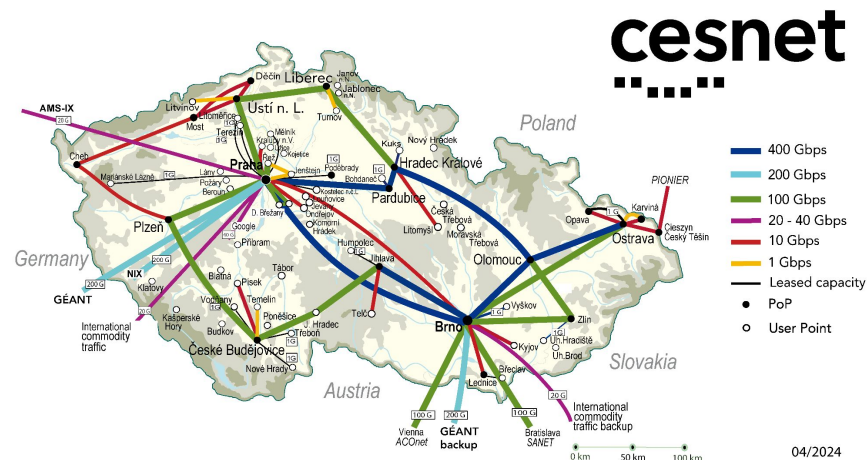


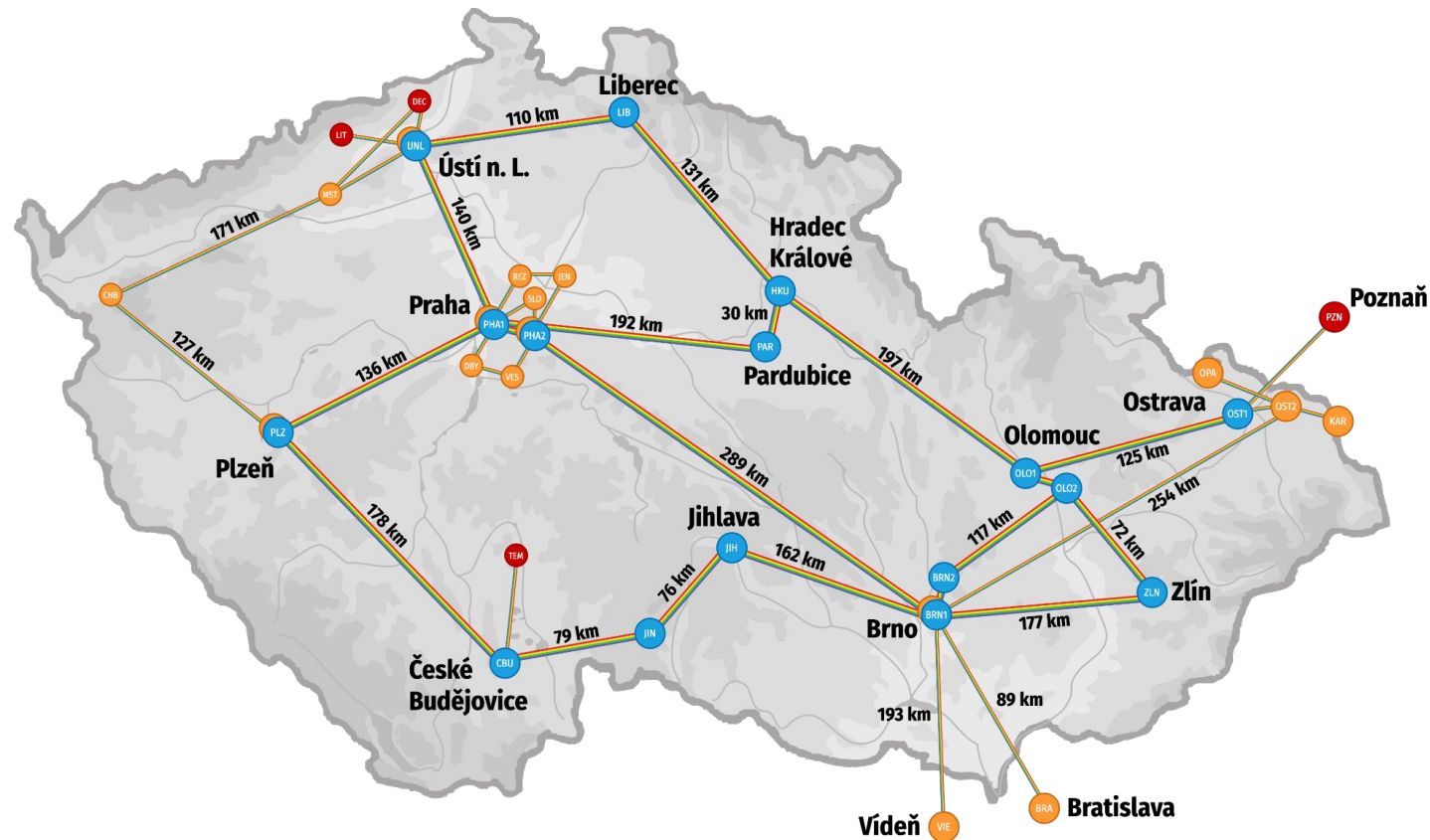
CESNET Developments

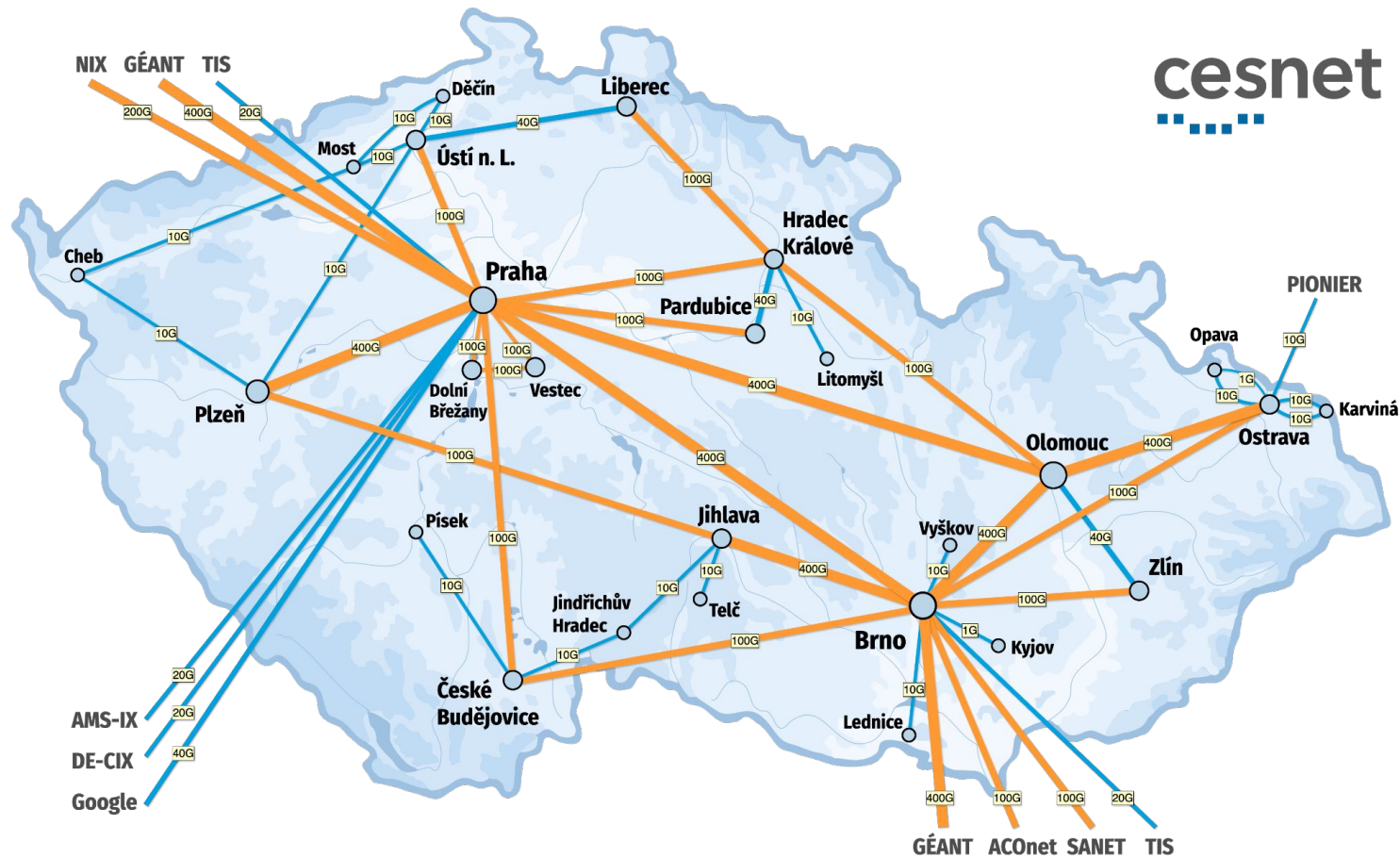
Miloš Liška
6GRP Workshop 09/16/25

- E-infrastructure service provider
- Czechia, EU
- Science, research & education
- Services
 - Network
 - Computing infrastructure
 - Storage facilities
 - Multimedia services
 - Security
 - Identity services

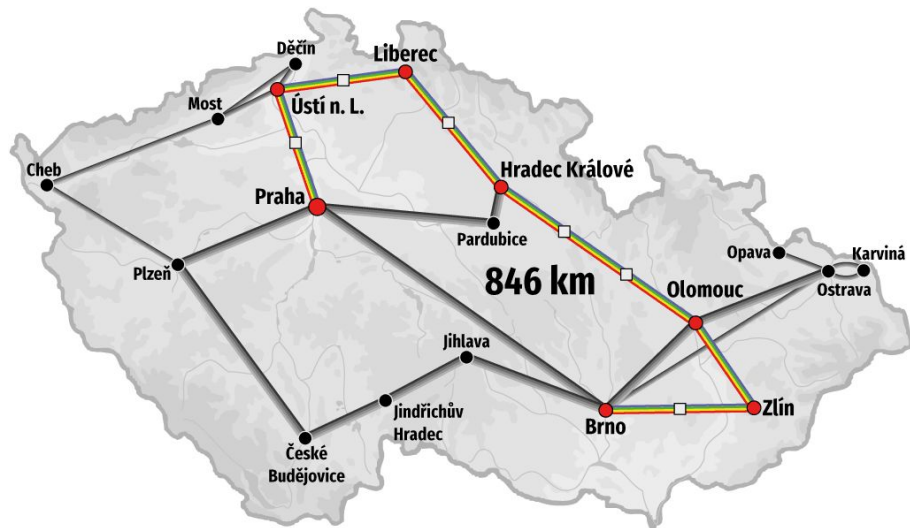


Network Precise Time Distribution Security



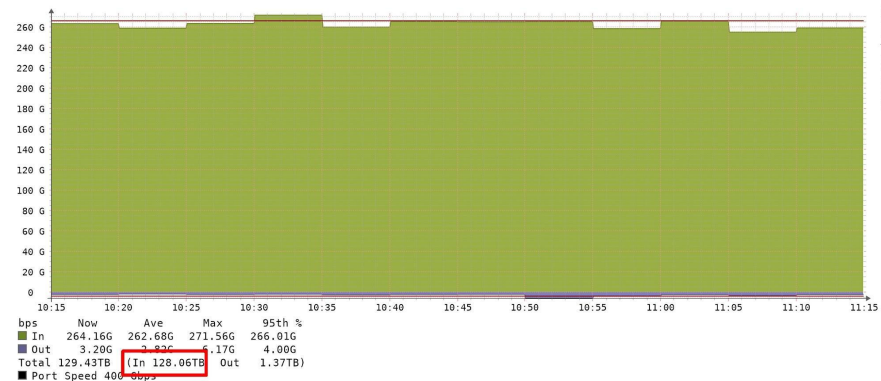


- 856 km 400G connection based on tunable coherent transceivers Cisco QSFP-DD Bright 400G ZR+



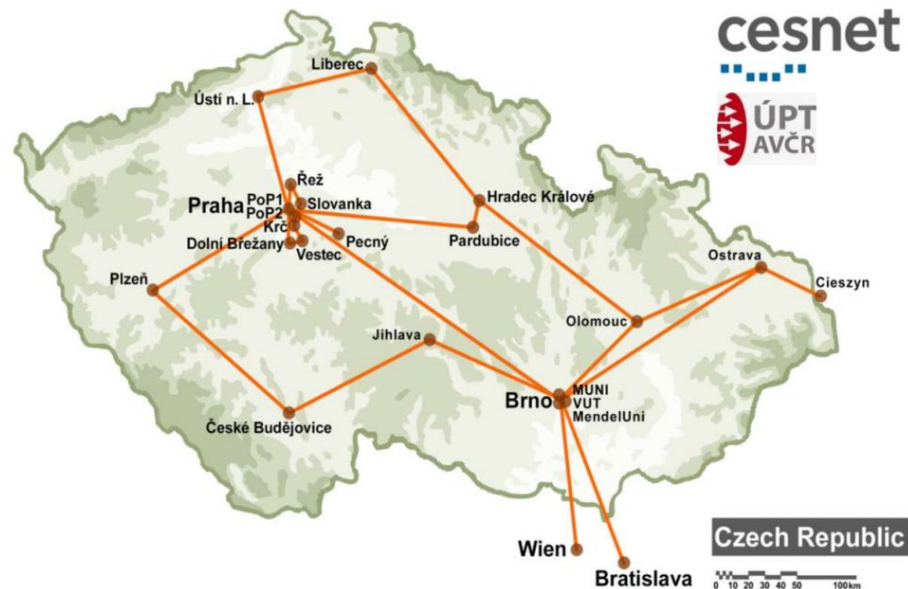
- Institute of Physics CAS upgraded to 400G

- FZU ← LHCONe ← CERN
- Also part of DUNE experiment
- 128TB/h transmissions (approx. 270Gbps)



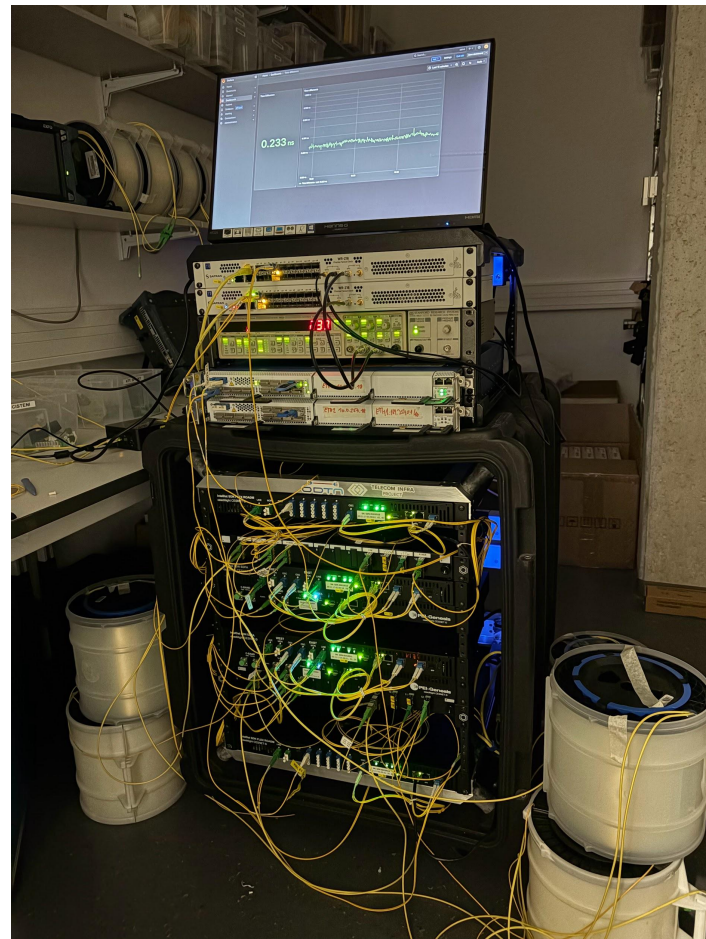
Network **Precise Time Distribution** Security

- Deployment of White Rabbit switches in 20 POPs
- Deployed on production fibres with regular traffic
 - Deployment along CISCO DWDM Ribbon over shared fibres
- 43 bidirectional optical amplifiers (CzechLight BiDi EDFAs) for inline amplification
- Over 2000 km of fibre footprint
- Deployment ready by the end of year 2026

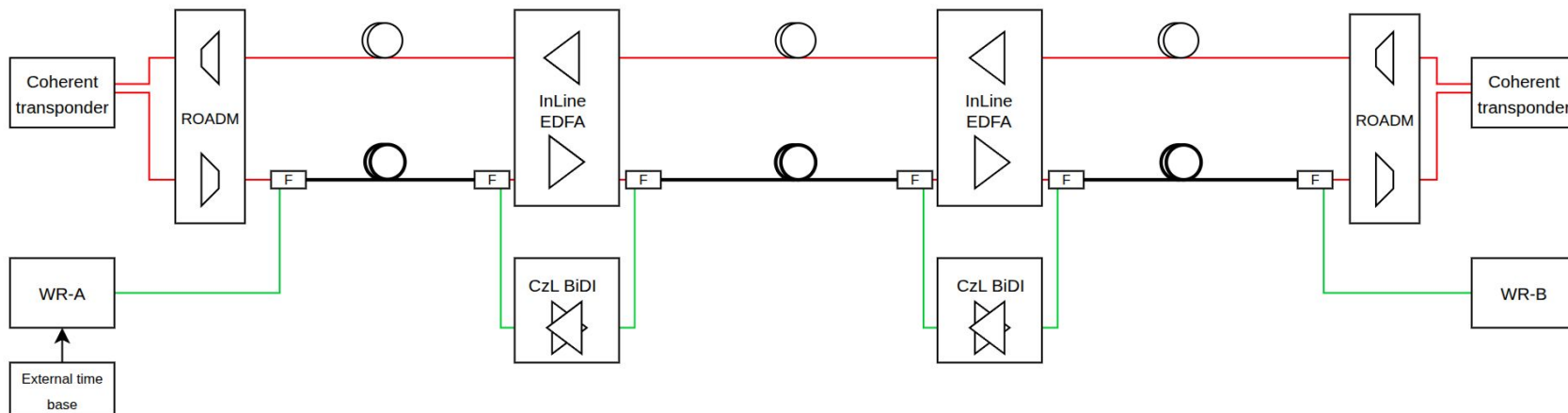


- Bidirectional transmission over existing fibre lines equipped by commodity transmission systems
 - Need to add/drop BiDi channels at each inline node for amplification
 - Filters have already been part of the CESNET3 design (future proof design work)
- Long Haul White Rabbit with L-Band DWDM SFPs
 - There are not many vendors supplying 1GE DWDM transceivers for L-band
 - Compatibility issues
- Integrating the management and monitoring of new equipment into the existing ecosystem
 - SDN driven solution using open source tools and CzechLight amplifiers

- Fiber line (3 spans)
- Coherent 400G signal via fiber pair
- Rubidium timebase and time interval counter for time comparison
- White Rabbit protocol for precise time transfer over one fiber of the pair
- CzechLight OLS
 - 2x ROADM
 - 2x InLine EDFA
 - 2x BiDi EDFA
 - 6x DWDM filters for BiDi channels



- 300 km fiber line in lab
- 1GE LR DWDM SFPs for L-Band
 - 2 channels 1570 nm and 1571 nm
 - Filters on Tx and Rx side
- 2 Bidirectional amplifiers for time transfer channels
- DWDM filters



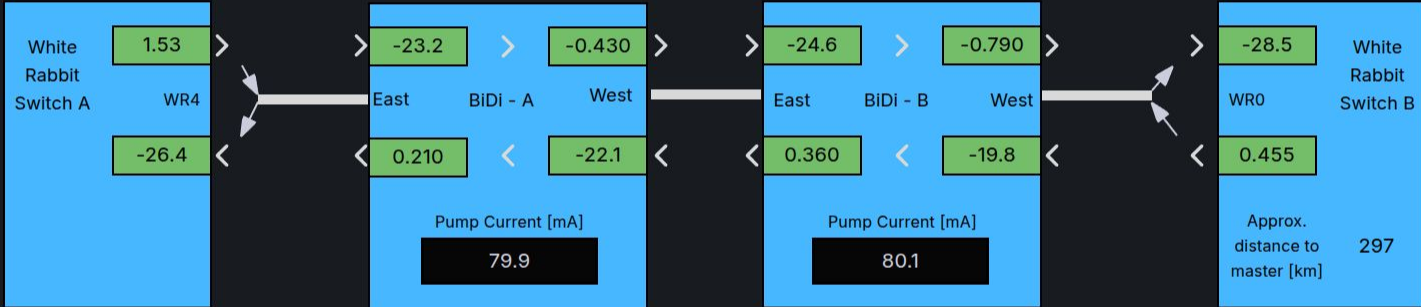
- Bidirectional optical amplifiers for precise time distribution in CESNET3
- Key features
 - Multiband: C-band and L-band
 - Dual power supply AC 230V/DC 48V
 - Hot swap fans
 - Open Source OS - images released by CESNET→full control over the device (security)
 - NETCONF, RESTCONF, local CLI
 - Streaming telemetry
- Devices already delivered by PEI-GENESIS



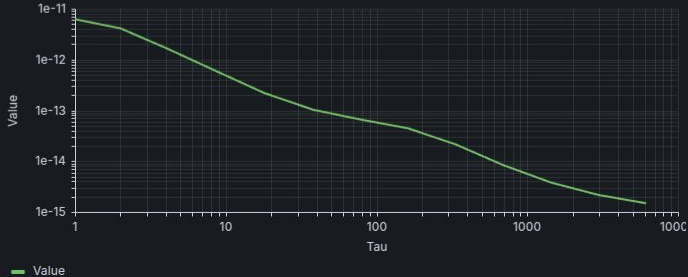
Time difference



Line view



Service Quality - MDEV for last 6h



Time difference



Network Precise Time Distribution **Security**

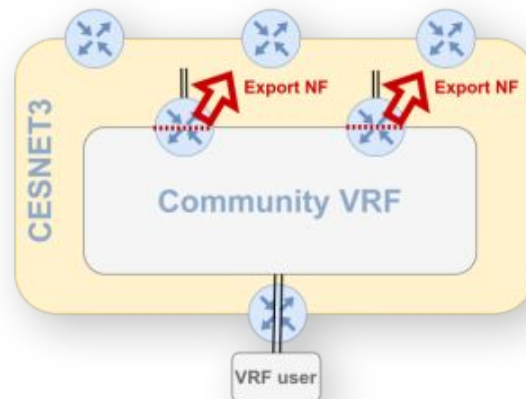
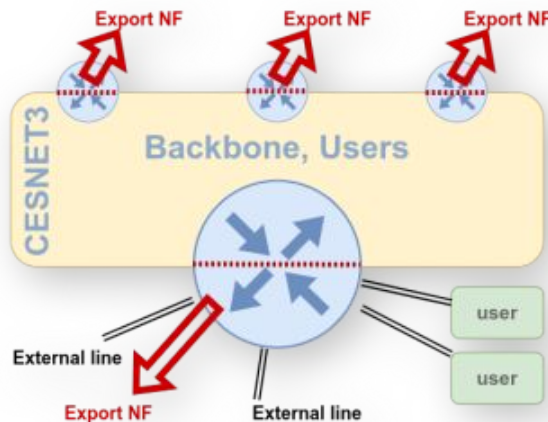
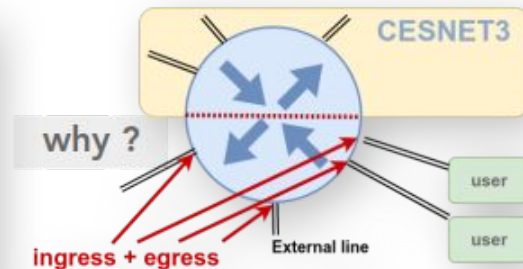
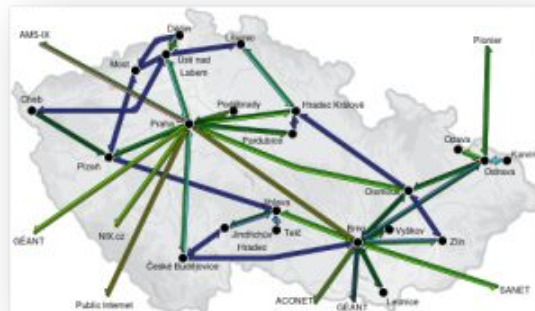
Flow-based monitoring setup in CESNET backbone

■ CESNET3 network

- multiple external paths
- GÉANT, cross-borders, IXs, private peering
- transit operator

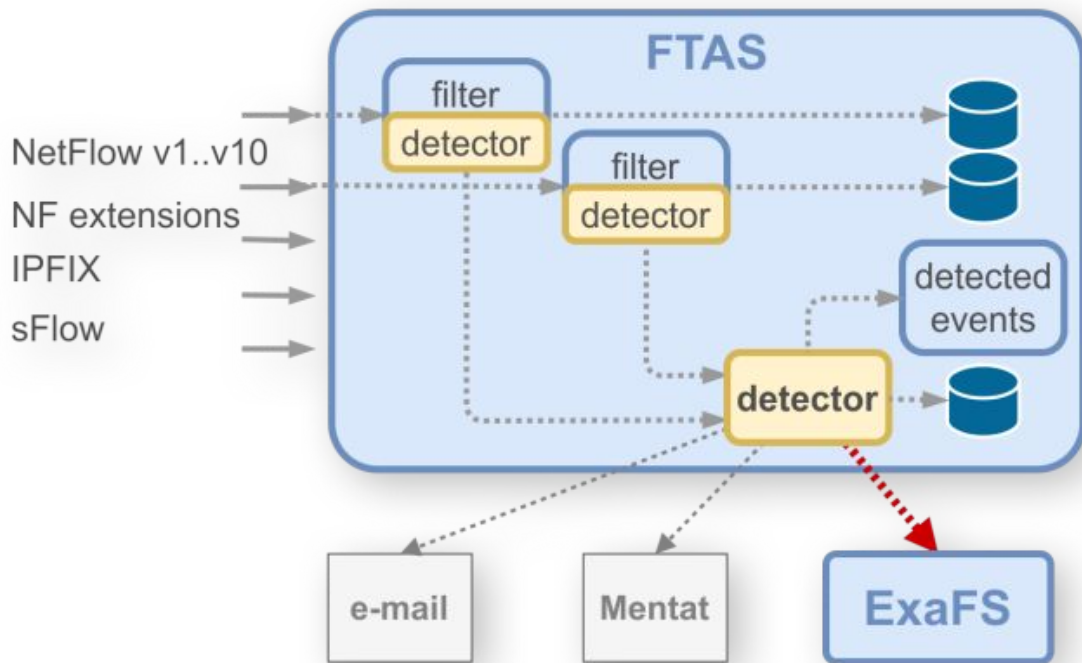
■ Flow information export

- routers - whole backbone border
- VRFs border
- *probes on external lines*



FTAS traffic anomaly detection

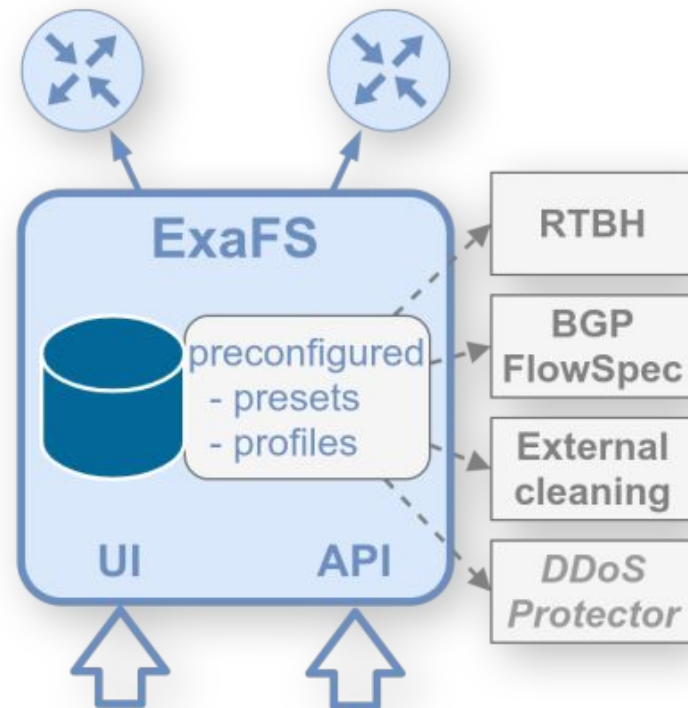
- functions to evaluate filtered traffic **sources** or **destinations** behavior according to configured limits and timing
- **single or two phase evaluation possible** (WAN, LAN, other)
- no hard-coded detectors
- direct **ExaFS** tool control



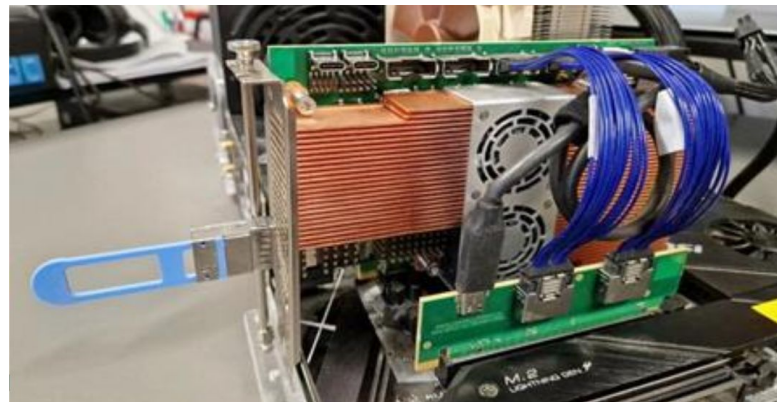
ExaFS – essential tool

- **network traffic control** (routing based)
- **BGP FlowSpec, RTBH, external cleaning, DDoS protector**
- **single point of knowledge** (everything what is currently configured within a network entity)
- **UI+API**
- pre-configured set of rules and traffic profiles for automated machine based control
- also as a service for connected networks ("prefix based" authorization)

<https://github.com/CESNET/exafs>



- Fine grained traffic filtering
- FPGA cards
 - Research & development of unique HW accelerated technology
 - Open source platform - Intel and AMD/Xilinx cards
 - First 400G monitoring card developed together with Reflex CES (Intel Agilex HW)
 - Development of 800G already started
- Also commodity NICs supporting Open Source Data Plane Development Kit
 - E.g. NVidia ConnectX-6 DX
- Guaranteed wirespeed processing and feature extraction including ML for DDOS protection



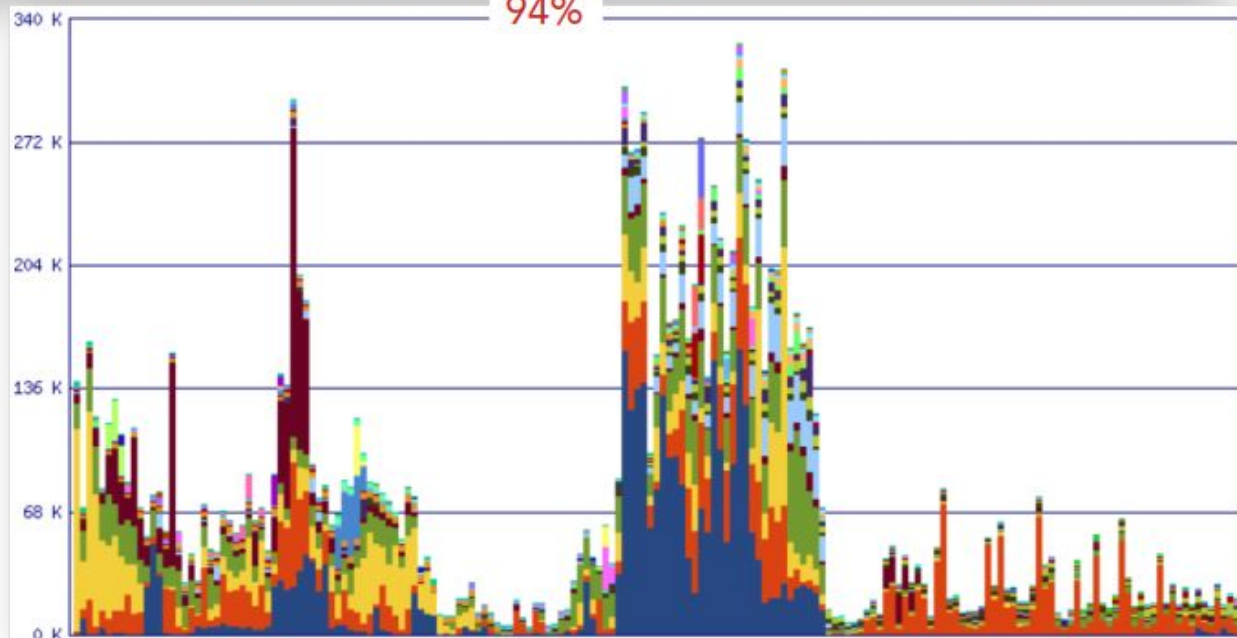
Detected-Event-Cnt: sums/time steps 23/09/24 12:24:28-24/09/24 12:24:28, value per 2 days, cumulative

Bytes-estimated	Pkts-estimated	Src-IP-Cnt	Flow-Cnt	Flow-Cnt-Drop	Detected-Event-Cnt	Detector-Type
40.037 TB	747.142 Gp	49834	14854903208	14033188644	14068158	Src-IP

94%

1. level – whole infrastructure & all users

- external sources of anomalies
- 1 day
- 1 event every 2.5 seconds in average



Questions?

milos.liska@cesnet.cz