SURF & NetherLight: Enabling Global Science through Next-Generation Infrastructure

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PM NetherLight, International Connectivity & Science Projects @ SURF

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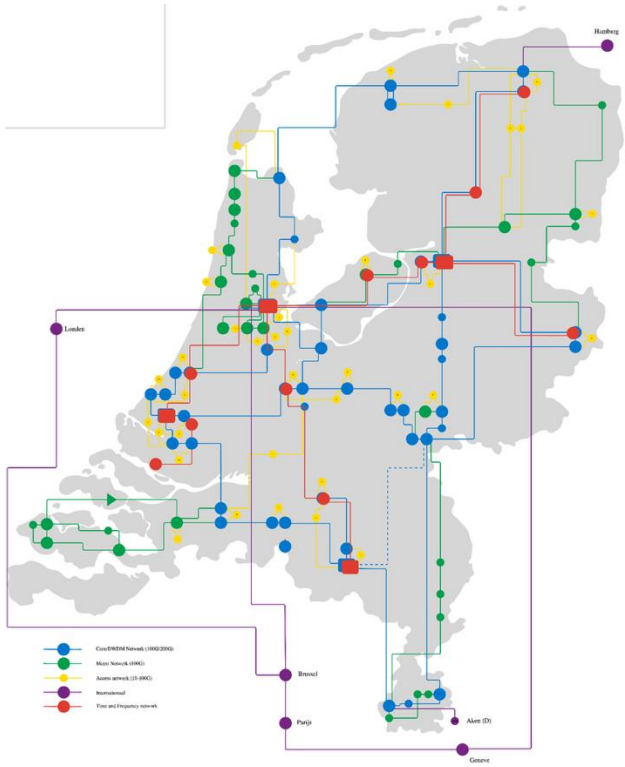
Raise your hand if you don’t know SURF

What is SURF?

- **Dutch NREN**: a member owned, non-for-profit ICT association of the Netherlands
- Our members are **125** Universities, Universities of Applied Sciences, Research Institutes, other Institutes of Higher Education, and University Hospitals
- Offering a **wide range of services** such as Networking, Data Management, Processing & Storage, HPC, Security, Trust & Identity & Access Management, and more (too many to mention)



Who am I?

- PM NetherLight, International Connectivity & Science Engagement at SURF
- Part of the Network Development Team

SURFnews

- Next Generation SURF Network: SURFnet Infinity
- NetherLight GXP
- ANA system upgrades: NetherLight-MOXY link
- International Connectivity & Collaboration (and include the vendors this time!)
  - From Snellius to LUMI: trial Amsterdam-Kajaani
  - Amsterdam-Geneva (CERN) Trials with CIENA, Nokia, Juniper, Ribbon.
- Advancing Research Networks and Technologies
  - LOFAR 2.0
  - The Quantum-Secure Future of Communication
  - Fiber Sensing
  - TFT

Next Generation SURF Network

- Supports **L2 & L3 services**, with integrated orchestration
- Standardized, secure, and **future-proof service delivery**
- **Integration** with campus services, data center, wireless, quantum, and cloud

Tailored performance for diverse needs of the diverse member base:

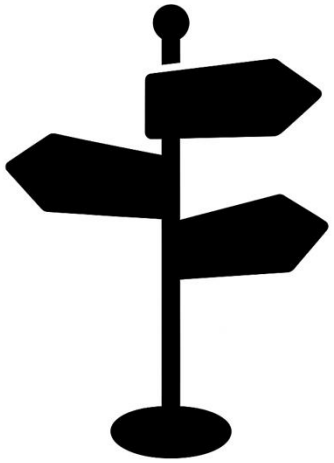
- Research groups → high bandwidth, ultra-low latency
- Institutions → high availability, strong security

To support a broad range of requirements, sometimes the only or best solution can be using hardware from different suppliers

New Procurement Model: Flexibility by Design

A broker-based approach to remain agile

- SURF must comply with the **European Procurement Act**
- Current contract ends **Q4 2025**
- Instead of a fixed hardware contract → **broker model**
- Enables:
  - **Mini-competitions** for new hardware
  - Faster reselection of suppliers
  - Flexibility to adopt best-in-class equipment when needed
- Result: agile, cost-efficient, **no lengthy procurement cycles**

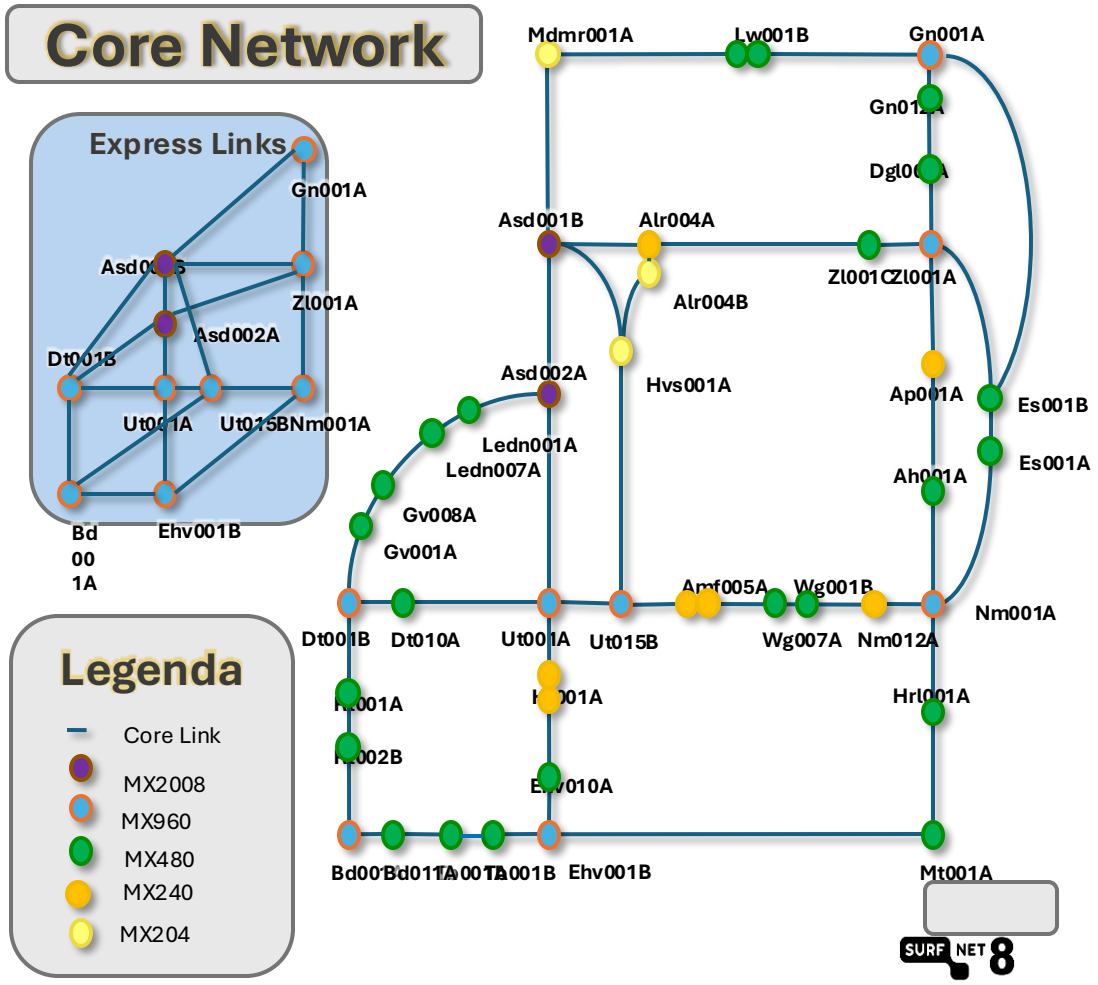


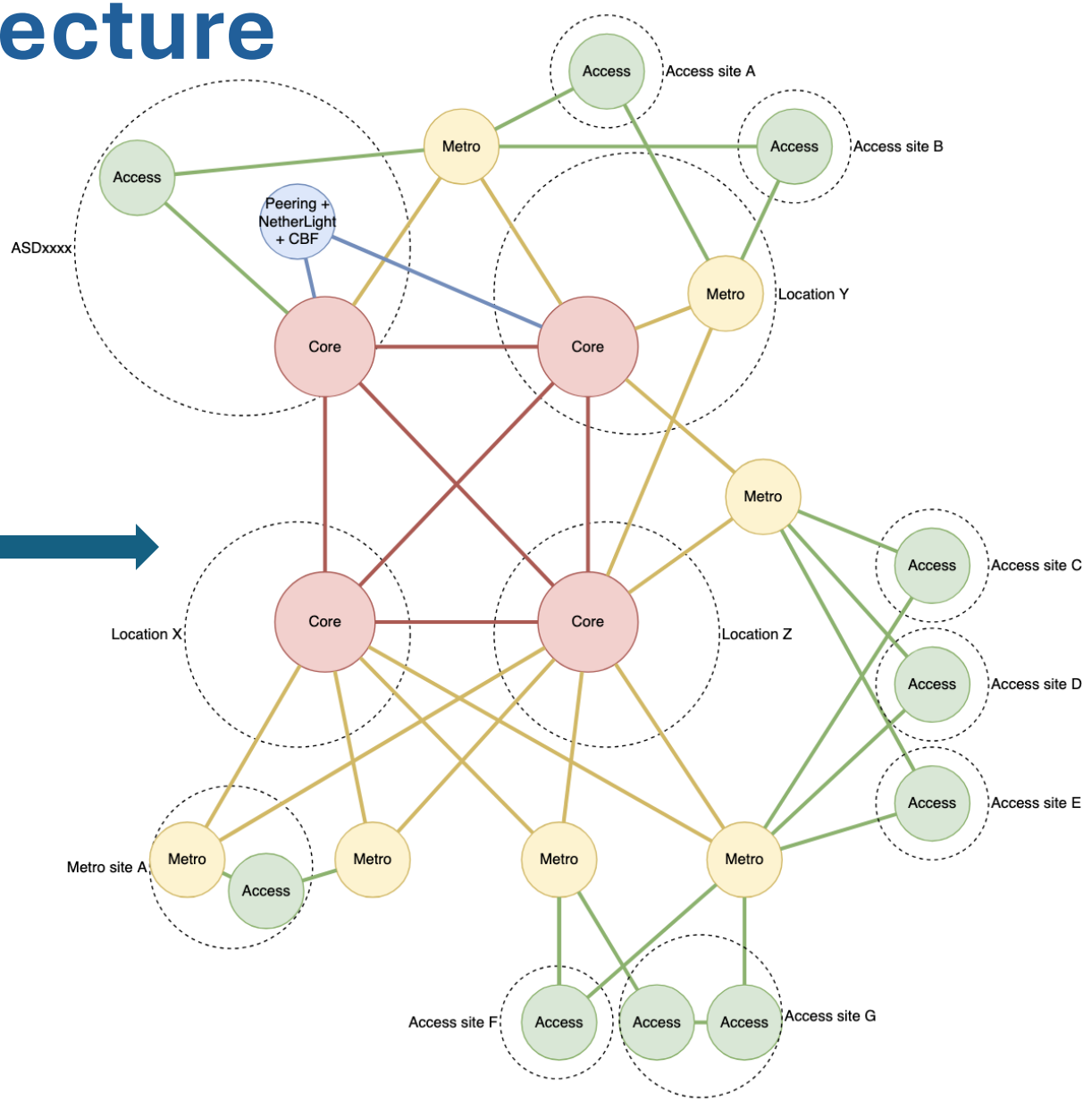
SURFnet Infinity

Requirements for SN∞

- **Separate functions and eliminate daisy-chaining** to limit the blast radius during outages and maintenance.
- **Fit-for-purpose hardware** per layer.
- **Multivendor-ready design** to support sovereignty.
- **Loosely coupled layers** so components are interchangeable and independently upgradable.
- **Predictable traffic flows** through clear core/metro/access roles.
- **100G-capable access rings.**
- **Easy capacity augments.**
- **External connectivity at more locations** (currently only in Amsterdam).

New Service layer architecture





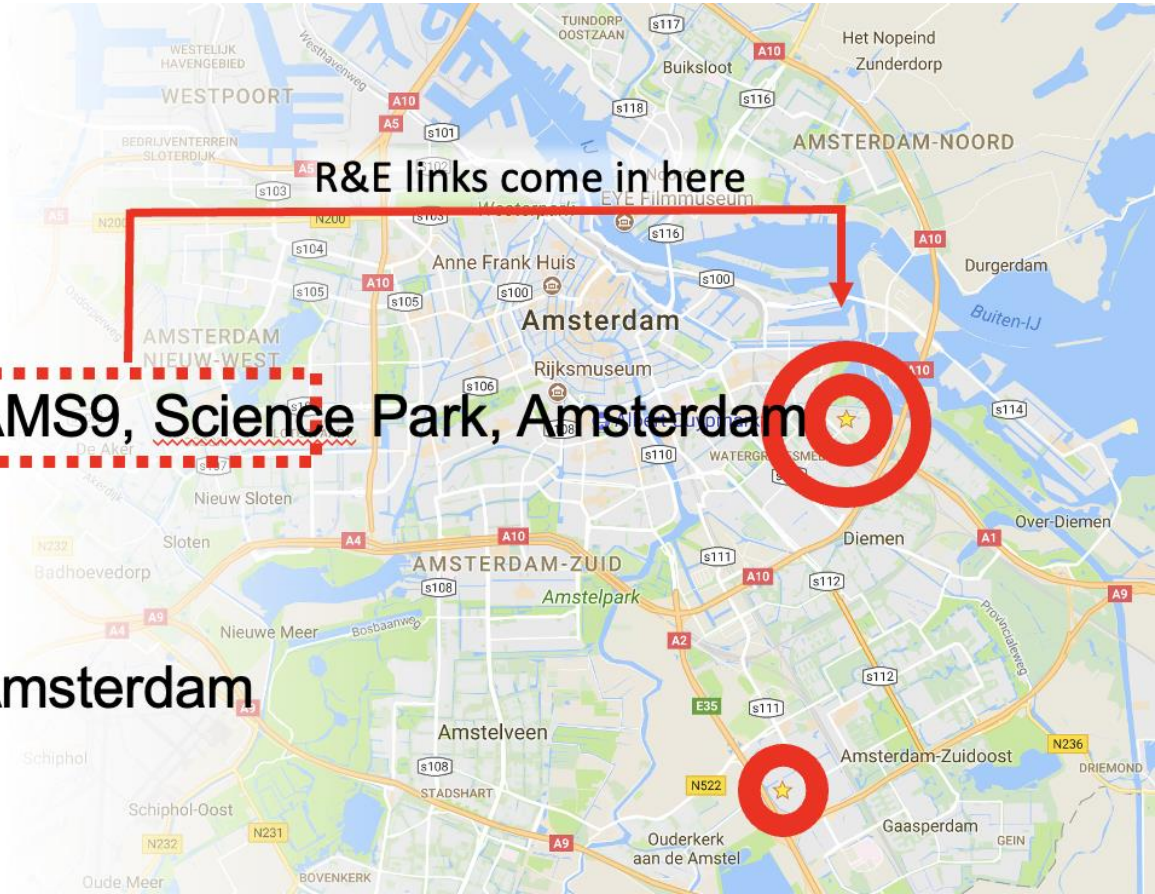
NetherLight GXP

What are GXP's?

Federated, neutral hubs where the R&E community connects on equal terms — keeping the fabric open, resilient, and trusted

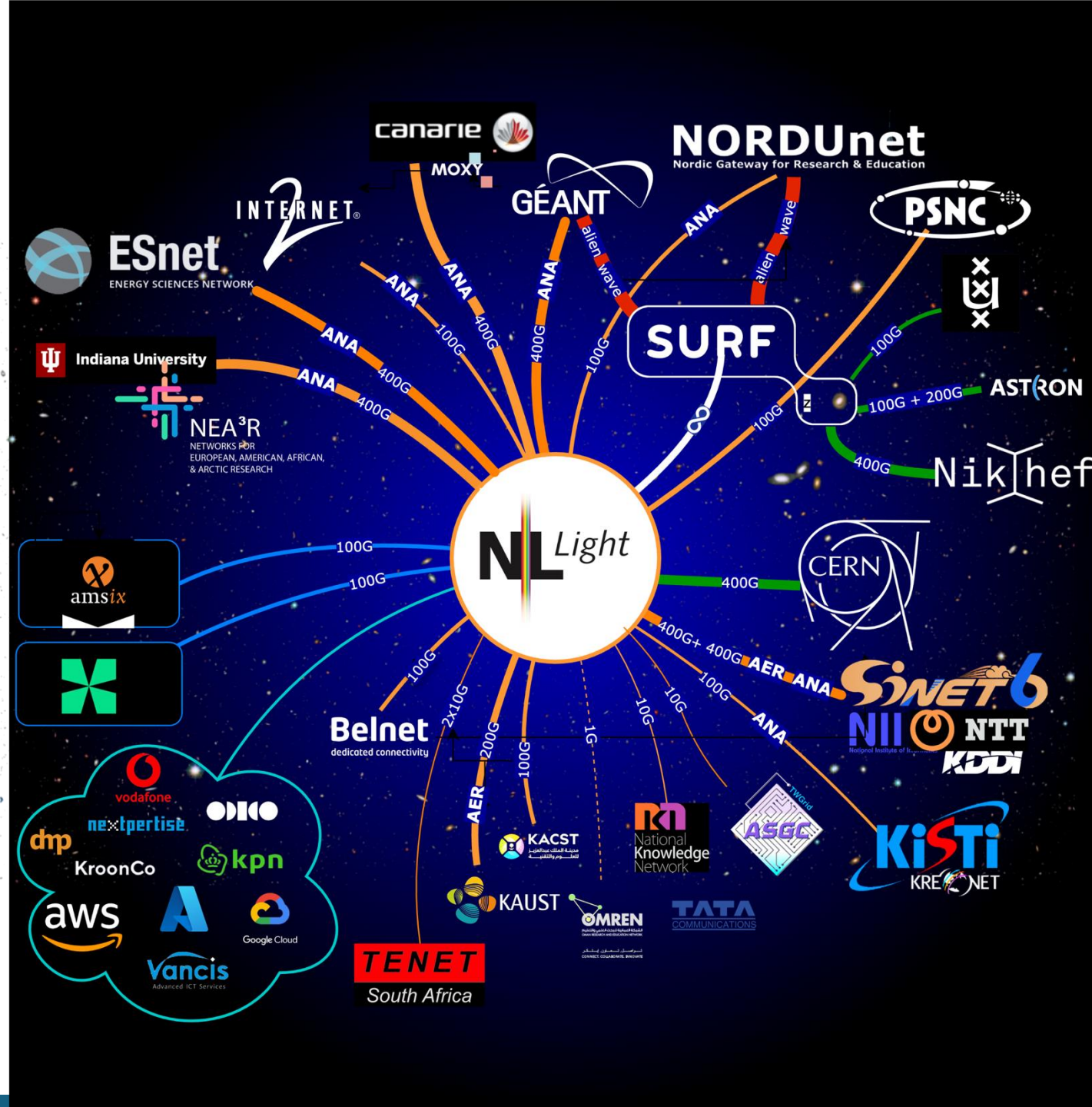
NetherLight GXP

- **Two locations in Amsterdam**
  - **ASD001B** (Digital Realty AMS9, Science Park – formerly known as InterXion AMS9)
    - Juniper MX10008
      - Up to 9.6T connectivity available (100G and 400G)
    - Juniper MX480
      - For < 100G connectors (1GE and 10GE)
      - Uplinks with n*100G to the MX10008
  - **ASD002A** (Equinix AM7)
    - Juniper MX480
      - Mainly for cloud connectors that would like to provide redundancy
      - Facilitates up to 100GE connections (1G, 10G, 100G)

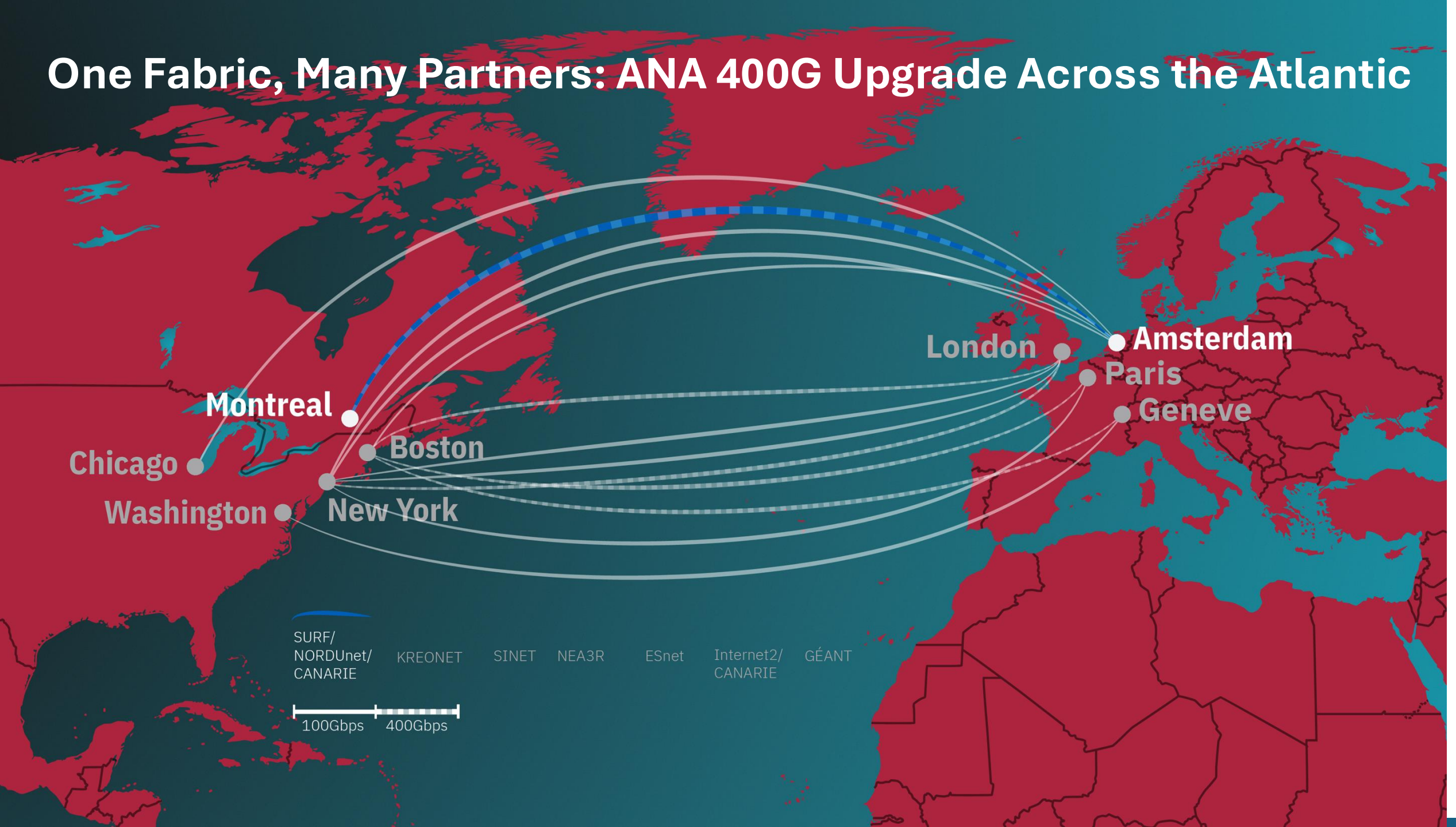


NetherLight GXP

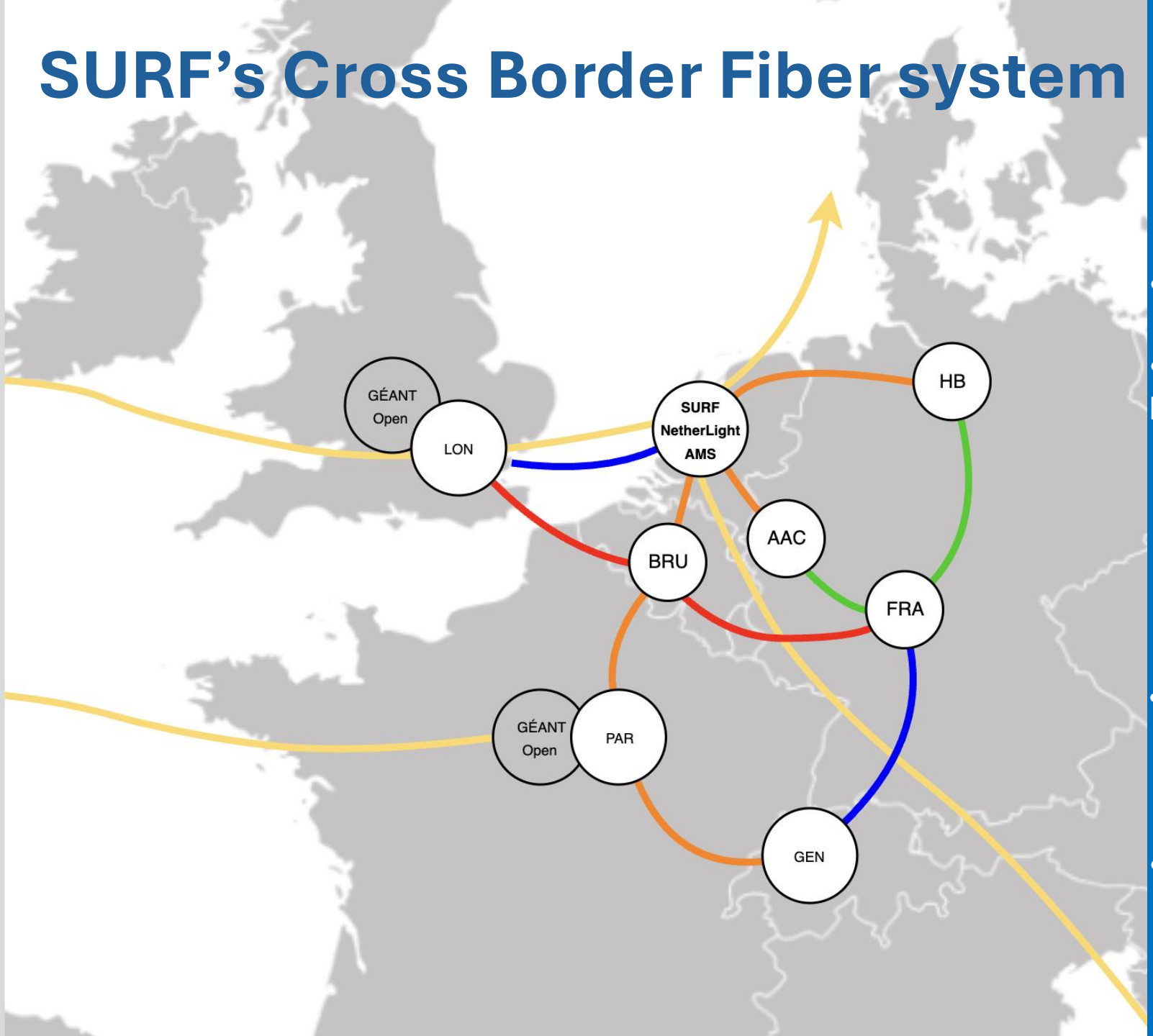
- Key GLOBAL EXCHANGE POINT focused on connecting educational and research networks internationally
- Facilitates high-speed connectivity for research purposes up to 400 Gbit/s per interface
- Offers interconnections via Ethernet VPN (multipoint and point-to-point)
- Access for our members to services from connected parties, such as NREN services worldwide, but also services from various cloud providers



One Fabric, Many Partners: ANA 400G Upgrade Across the Atlantic



SURF’s Cross Border Fiber system



Cross Border Fiber system (CBF)

- Production traffic from/to CERN
- Well-connected to the four Open Exchange Points in Europe
  - NetherLight @ Amsterdam
  - GÉANT Open @ Londen
  - GÉANT Open @ Parijs
  - CERNLight @ Genève
- Sharing capacity on the CBF with other partners that connect on the Open Exchange Points
- Perform cutting-edge trials (800G, 1+ Tbps)

Trials, Innovation & International Collaboration on SURF's CBF

Testing new technologies together with partners to strengthen the global R&E fabric.

PAST (2024 & 2025)	FUTURE
1.6 Tb Trial Amsterdam-Geneva (with Ciena)	QKD @NetherLight
1.2 Tb Optical Trial Amsterdam-Kajaani, from Snellius to LUMI	Fiber Sensing trial (with GÉANT, WMR, and others)
1.6 Trial AMS-GEN (with Nokia)	More to come…
800G Trial Amsterdam-Geneva (with Nokia, Nikhef and CERN)	
800G Trial Amsterdam-Geneva (with Ribbon, Nikhef and CERN)	
800G ZR Trial with Juniper, Astron, Nikhef	
SINET/NII/NICT 800GE Test SC24 (with 23 NREN & GXP partners)	
400G Trial ZR+ (with Nokia and Juniper)	

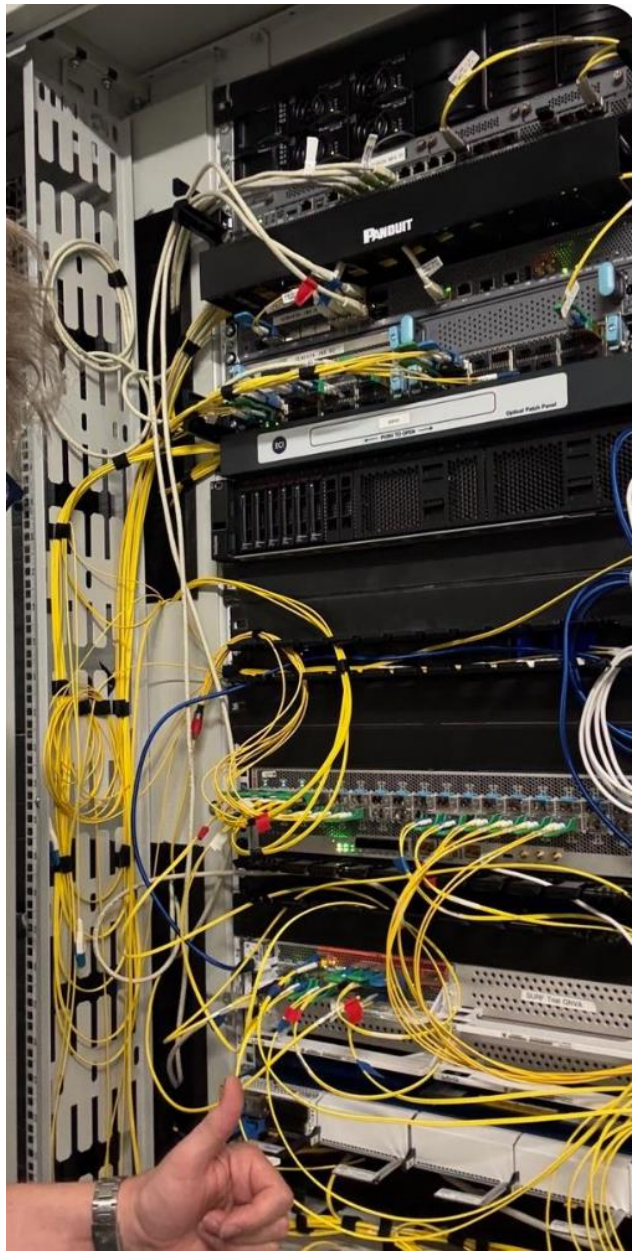
CIENA Terabit Trial: Amsterdam ↔ Geneva (CERN)

- Goal: 1 Tbit/s+ over brownfield fiber
- Route: AMS → CERN (Prévessin), 1,648 km
- Line characteristics: mostly G.655 (not ideal)
- Platform: Ciena Waveserver 5 + WaveLogic 6 Extreme

https://www.ciena.com/products/wavelogic/wavelogic-6

CIENA Terabit Trial: Amsterdam ↔ Geneva (CERN)

- Line system: Ribbon
- Endpoints & client gear (Amsterdam: Juniper QFX + Lenovo/NVIDIA; Geneva: Ciena 8190 + Lenovo/NVIDIA)
- Optics: 2 channels @ 200 GHz, 191.55 THz + 193.20 THz
- Configurable 800–1200 Gbit/s, client mapping 2×400G + 4×100G

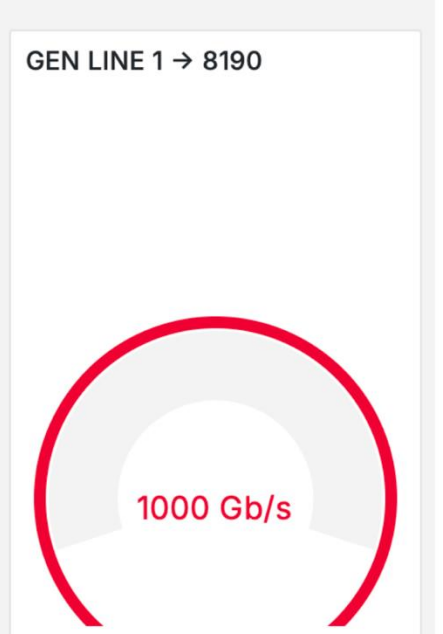


CIENA Terabit Trial: Amsterdam ↔ Geneva (CERN)

THE RESULTS

- **Sustained ~1 Tb/s** end-to-end during the trial window *(Grafana snapshot)*
- Terabit-class transmission over **1,648 km brownfield** route
- Confirms feasibility of **single-wavelength** high-rate services on the CBF path to CERN

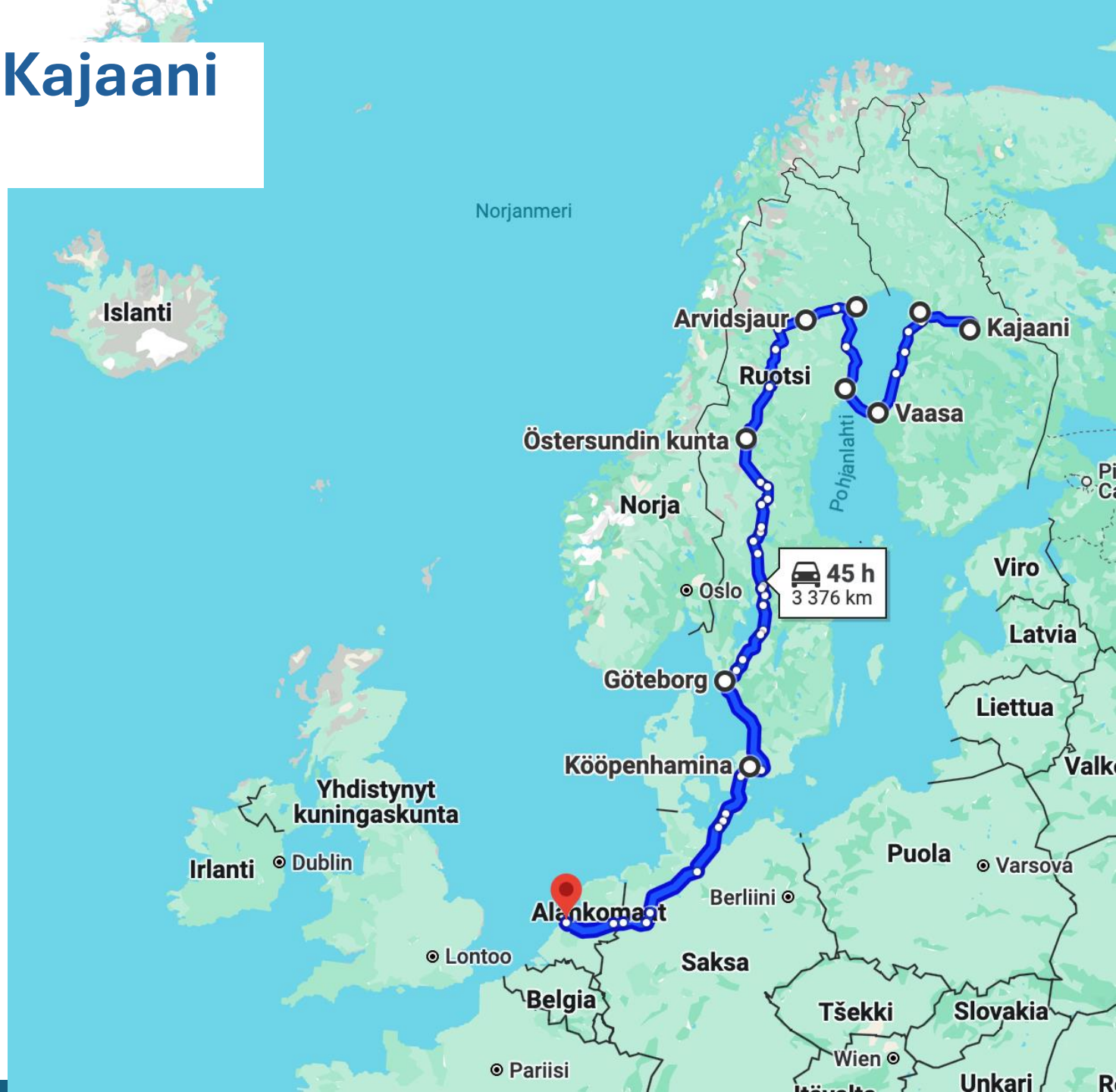
Results from Grafana



NOKIA Trial Amsterdam ↔ Kajaani

From Snellius to LUMI

- **Throughput: >1.2 Tbit/s** end-to-end, **disk-to-disk**
- **Distance:** data traversed **>3,500 km**; longest path **4,700 km via Norway** at **1 Tbit/s**
- **Networks:** ran across **five production R&E networks — SURF**, **NORDUnet**, **Sunet**, **SIKT**, **Funet**
- **Tech stack: Nokia IP/MPLS** + **quantum-safe optical**; **FlexE** used to accommodate “**elephant flows**”
- **Purpose:** prepare connectivity for **LUMI / LUMI-AI** and future **AI Factories**



NOKIA Trial Amsterdam ↔ Kajaani

What we validated & why it matters

- **Operational realism:** mix of **real research + synthetic** data, **disk-to-disk** transfers
- **Distance no obstacle:** long-haul **terabit-class** feasible over European R&E fabric
- **Future-ready:** supports **HPC/AI** workflows; insights for **data transport & storage** at scale
- **Collaboration model: SURF, CSC (Finland), Nokia**, with key **Nordic NRENs**—a federated approach

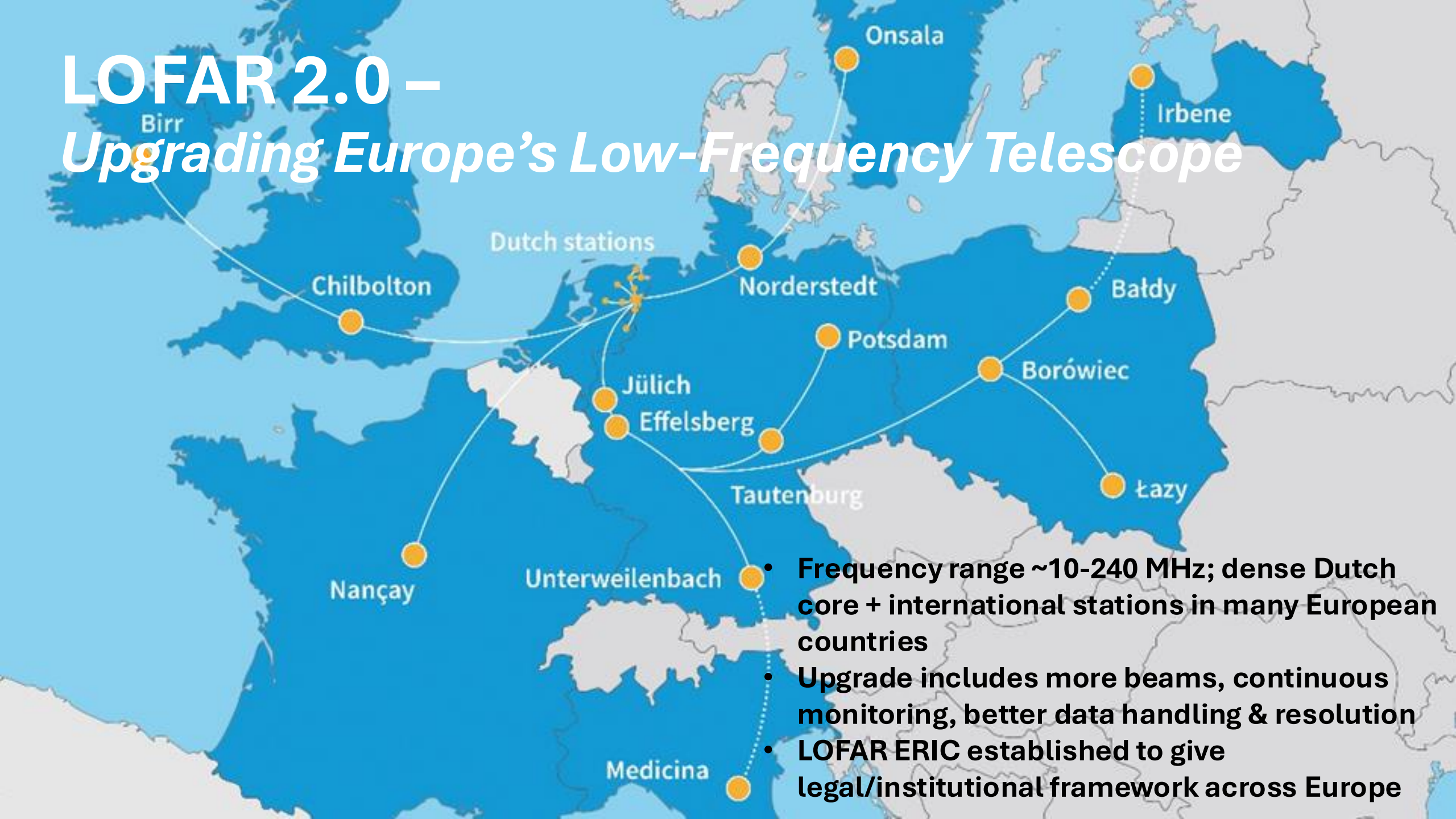
>1.2 Tbit/s over 3,500+ km
Longest route: 4,700 km at 1 Tbit/s

Advancing Research Networks and Technologies

- LOFAR 2.0
- The Quantum-Secure Future of Communication
- Fiber Sensing
- TFT (Time-Frequency Transfer)

LOFAR 2.0

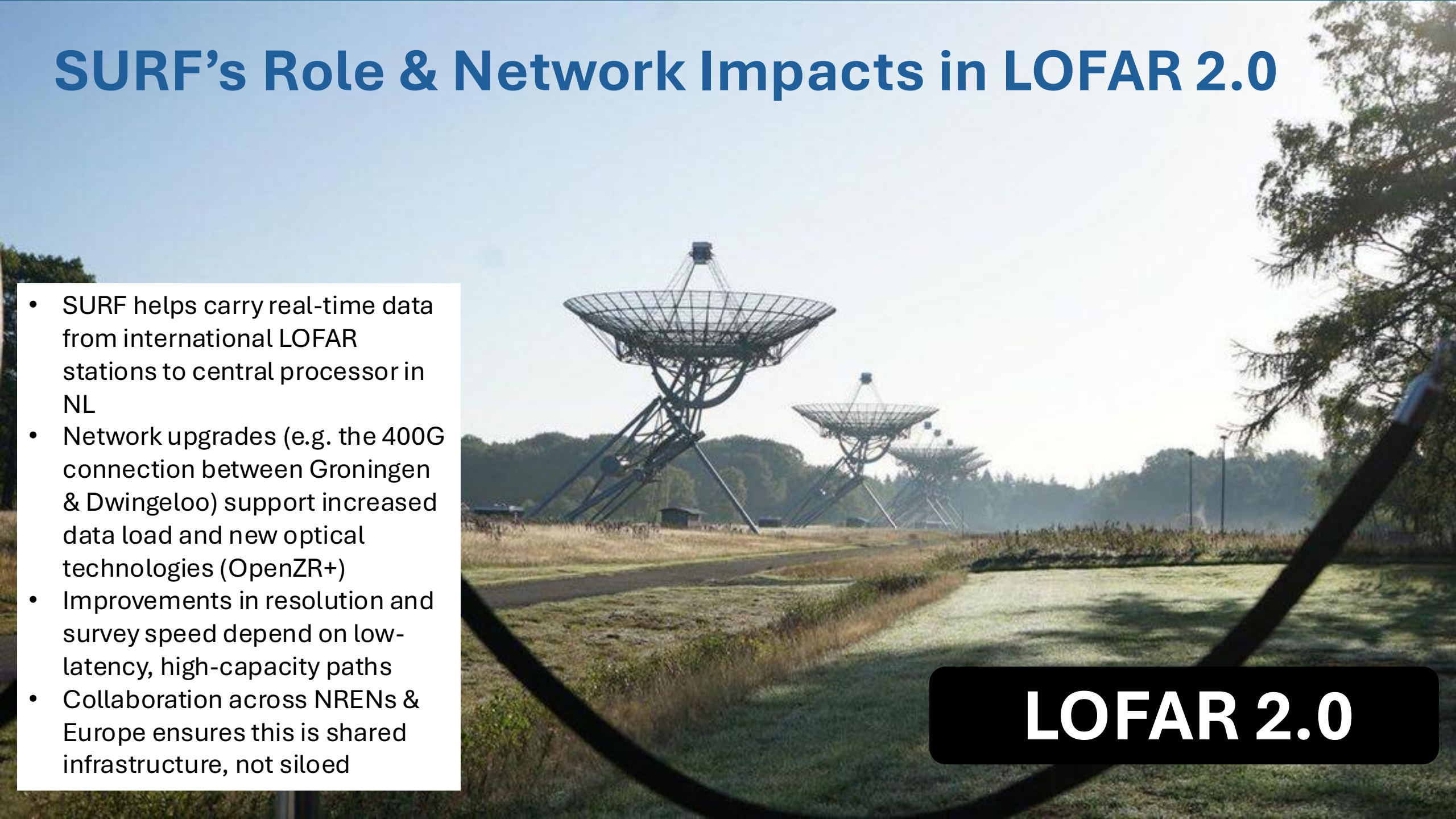
LOFAR 2.0 –
Upgrading Europe's Low-Frequency Telescope



- **Frequency range ~10-240 MHz; dense Dutch core + international stations in many European countries**
- **Upgrade includes more beams, continuous monitoring, better data handling & resolution**
- **LOFAR ERIC established to give legal/institutional framework across Europe**

SURF's Role & Network Impacts in LOFAR 2.0

- SURF helps carry real-time data from international LOFAR stations to central processor in NL
- Network upgrades (e.g. the 400G connection between Groningen & Dwingeloo) support increased data load and new optical technologies (OpenZR+)
- Improvements in resolution and survey speed depend on low-latency, high-capacity paths
- Collaboration across NRENs & Europe ensures this is shared infrastructure, not siloed



Quantum

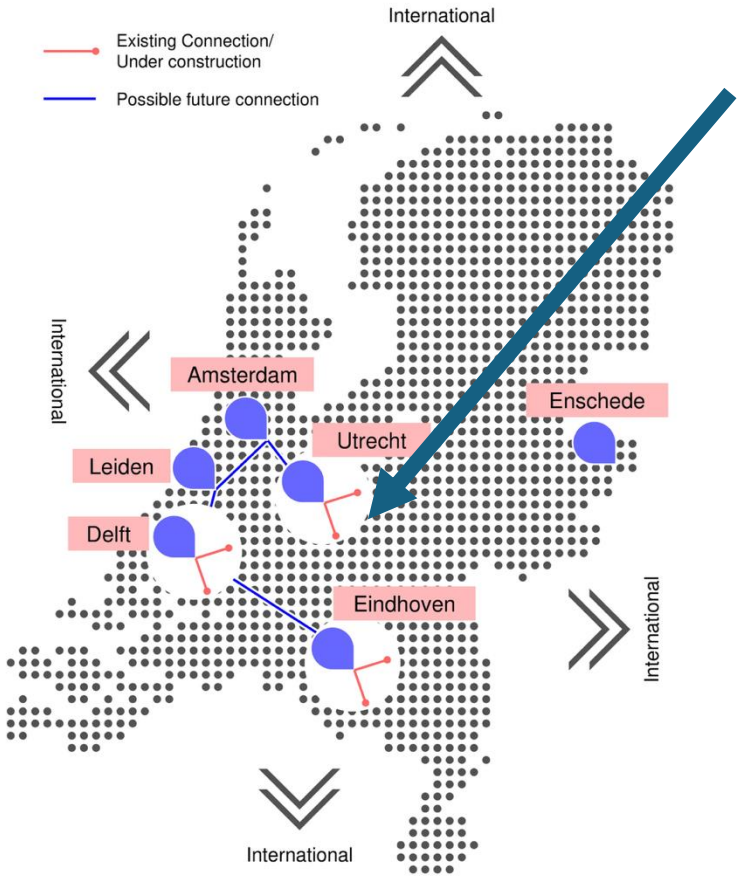
SURF & the Quantum-Secure Future of Communication

Quantum Internet Alliance

QUANTUM INTERNET ALLIANCE

- exploring use cases for the quantum internet together with researchers
- user engagement to find pain points that can be solved with quantum networks
- consolidation to identify requirements for adoption of quantum networks
- hackathons to engage with the community

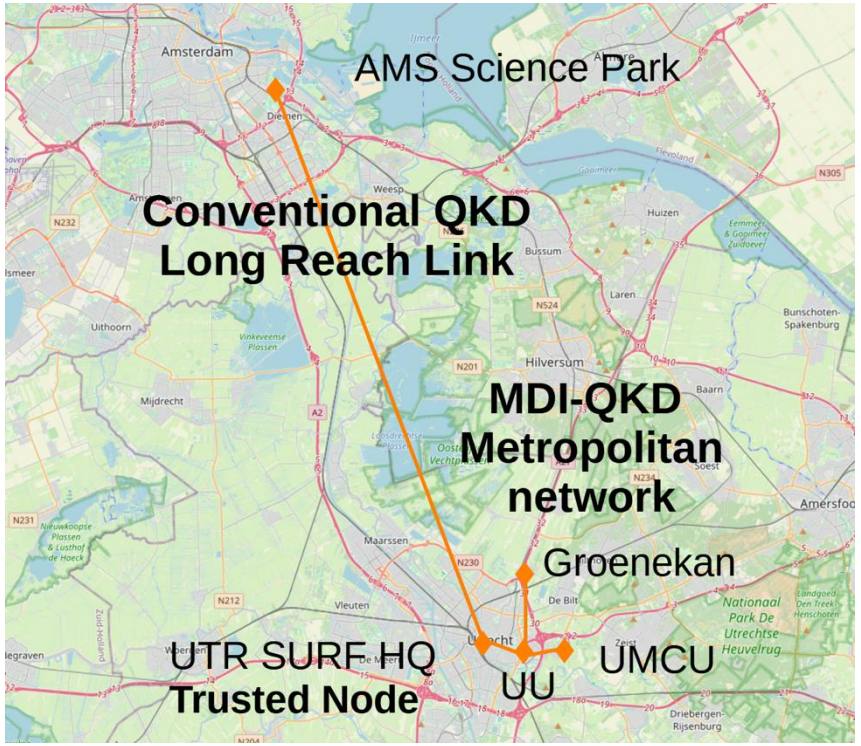
QCINed (Part of EuroQCI)

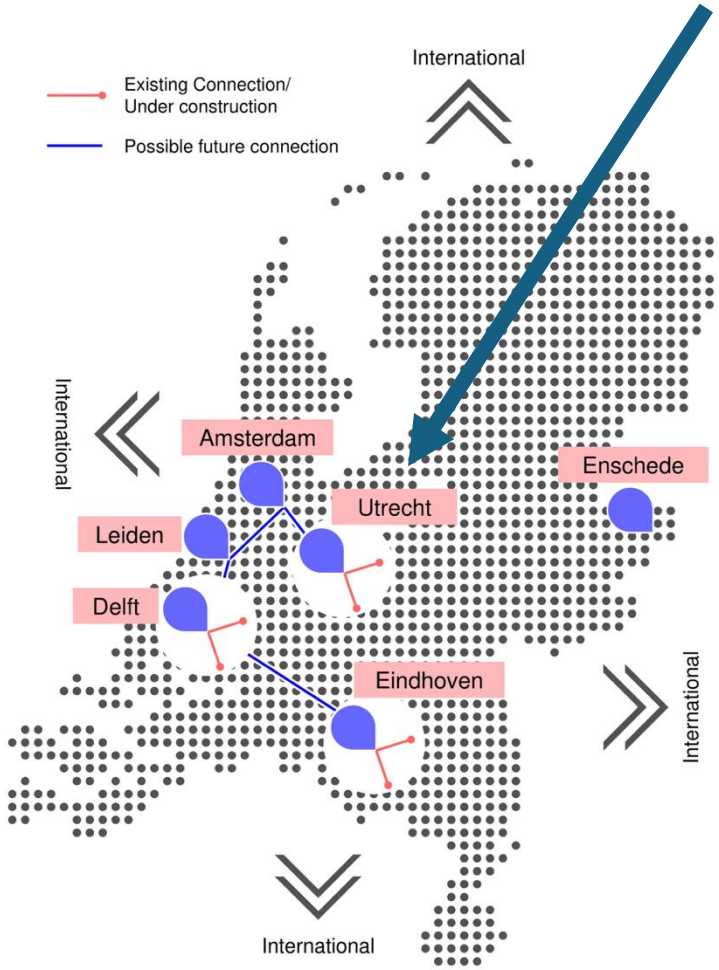


Quantum Delta NL

Funded by the European Union

QCINed





- deployed a development network in Utrecht
- defined what a QKD service could look like
- developed tools and workflows for integrating QKD into telecommunication networks
- engaged with vendors working on quantum networks
- started preparing infrastructure for the next-generation quantum internet

Funded by
the European Union

Quantum
Delta NL

Fiber Sensing

WMR/SURF/GÉANT Fiber Sensing

- **Partners:** GÉANT (North Sea fiber), WMR (science use case), SURF (infrastructure & innovation)
- **Goal:** explore fiber sensing for marine biology research (mammals, fish, environment)
- **Strategic fit:** part of SURF's mission to test and adopt innovative research networking methods
- **Approach:** start small — one fiber, one partner, one set of clear questions
- **Next step:** build experience, then open results and methods to wider science community

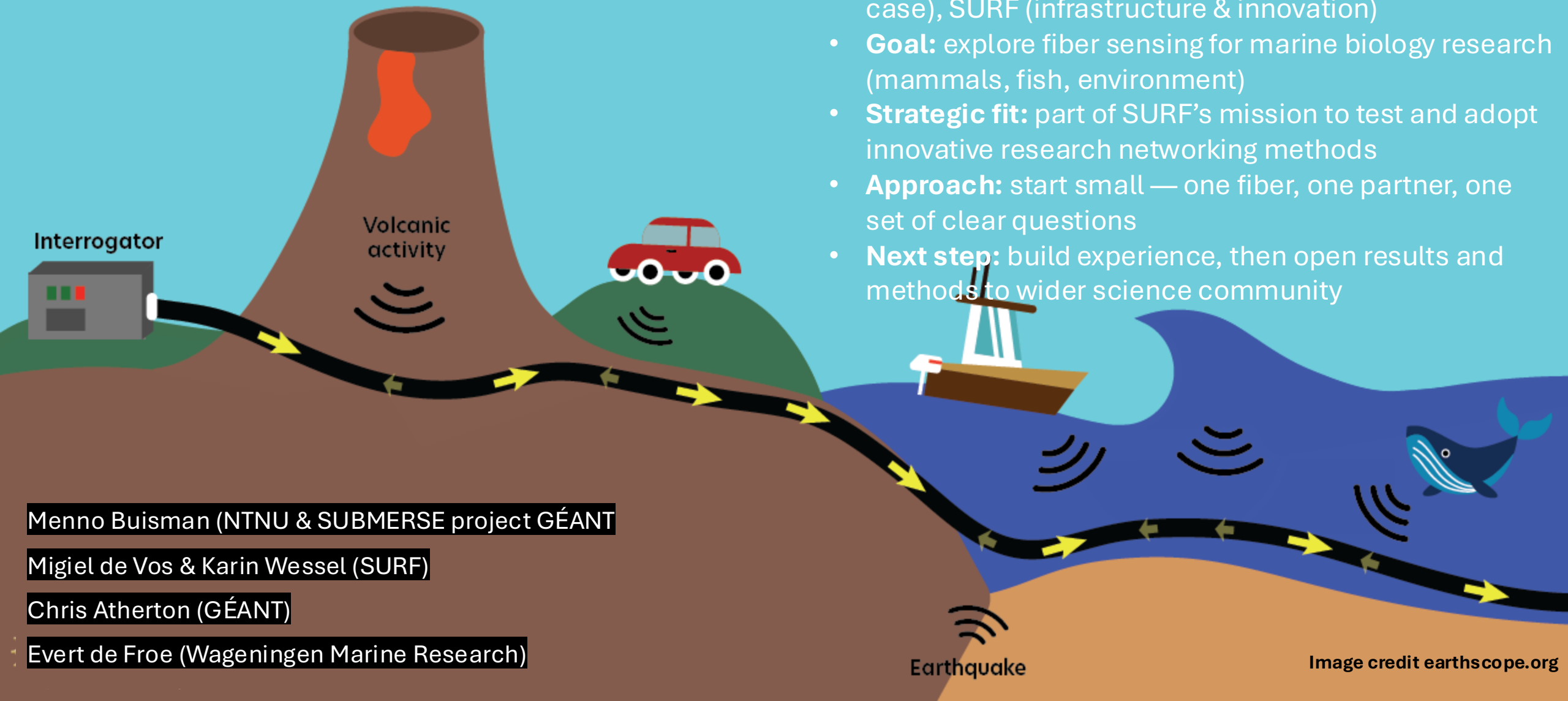
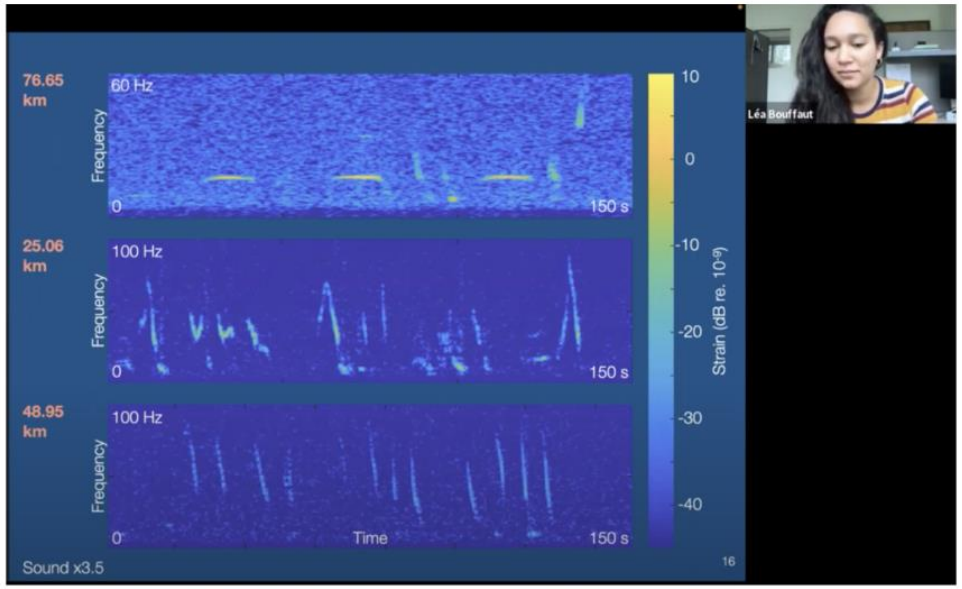


Image credit earthscope.org

Menno Buisman (NTNU & SUBMERSE project GÉANT
Migiel de Vos & Karin Wessel (SURF)
Chris Atherton (GÉANT)
Evert de Froe (Wageningen Marine Research)

Fiber Sensing

We can use DAS to listen to the cable and detect whales



https://youtu.be/4hw3NyUISdM?si=Ulg4f-uMoyZ-Wenz&t=2178

In this case, signals of baleen whales range between 1 Hz - 100 Hz

Porpoise signals are + 100 kHz.

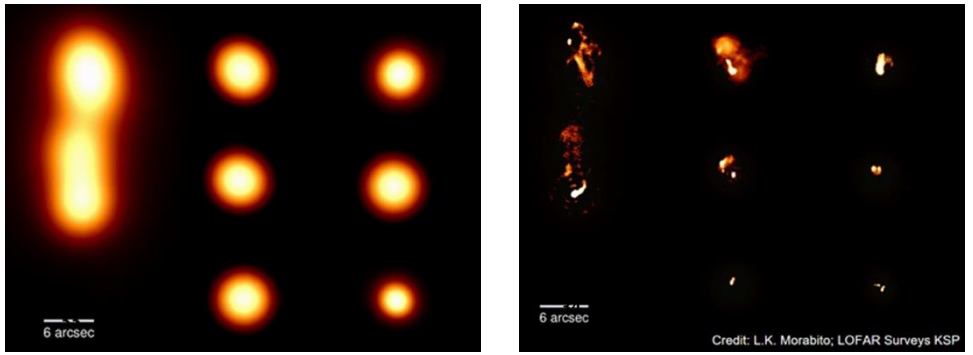
Time sampling DAS for 1 km fibre = max 100 kHz

Time & Frequency

SURF Time & Frequency feature

SURFtime&frequency provides institutions with a reliable and highly accurate time (under 1 nanosecond) and frequency signal over SURF's fiber optic network. It is a new application using the existing SURF network.

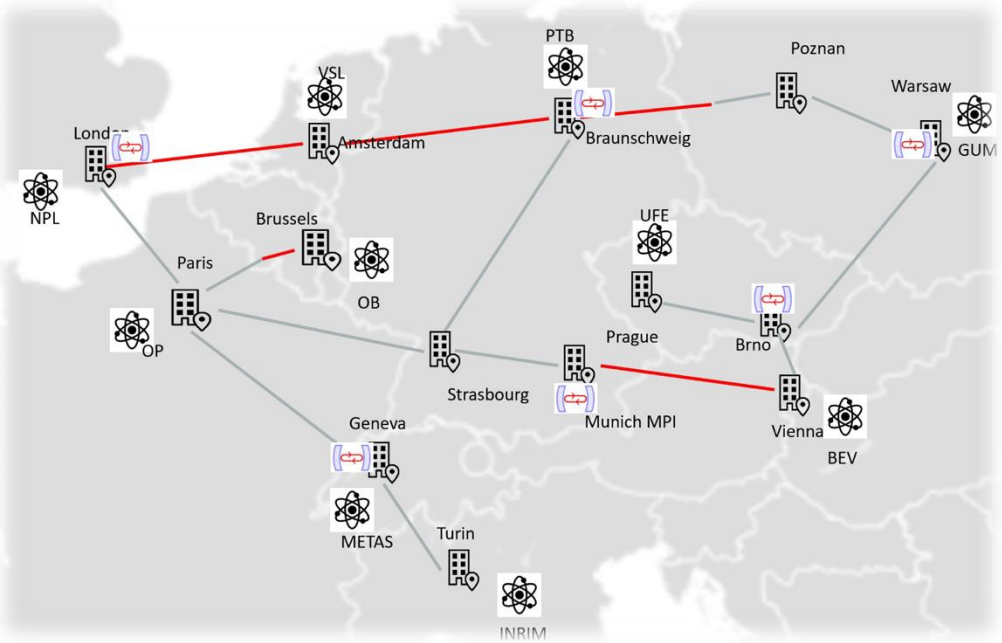
Institutions use this Time and Frequency (TFT) signal as a reference for fundamental scientific research, synchronizing (measurement) equipment, as an alternative to GPS, or as a traceable source of time.



Source: LOFAR : Improvement of images by radio telescope synchronization

Ambition

- Enabling the synchronization of geographically dispersed research instruments
- Systems and devices on the network perfectly synchronized independently of GPS
- As SURF, be a leader in European network innovation and TFT projects aligned with the broader European ambition."



Source: GEANT Time-Frequency Incubator Project 2024

Openness & Collaboration

Let's connect & discuss

THANK YOU FOR LISTENING!
ANY QUESTIONS?

- karin.wessel@surf.nl
- LinkedIn and #nren channel on Slack

SCAN ME