



GÉANT Project Services for Large-Scale Data-Intensive Science

The GN5-2 Network Development Work Package – WP6

Dr.sc. Ivana Golub, PCSS

6th Global Research Platform Workshop
15th September 2025, Chicago, IL, USA

Public (PU)



GÉANT Environment & Project Development & Services Q&A

GÉANT Project

The collaboration of
European National Research
and Education Networks
(NRENs) and European
Commission.

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The project's mission is to provide secure access to scientists, researchers and students to the world's most advanced connectivity and collaboration services, enabling effective and secure collaboration within virtual research communities around the world.

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The collaboration of European National Research and Education Networks (NRENs) and European Commission.

38 Partners
1 Associated partner
43 Countries
80 Mil EUR Budget
9 Projects - Work Packages

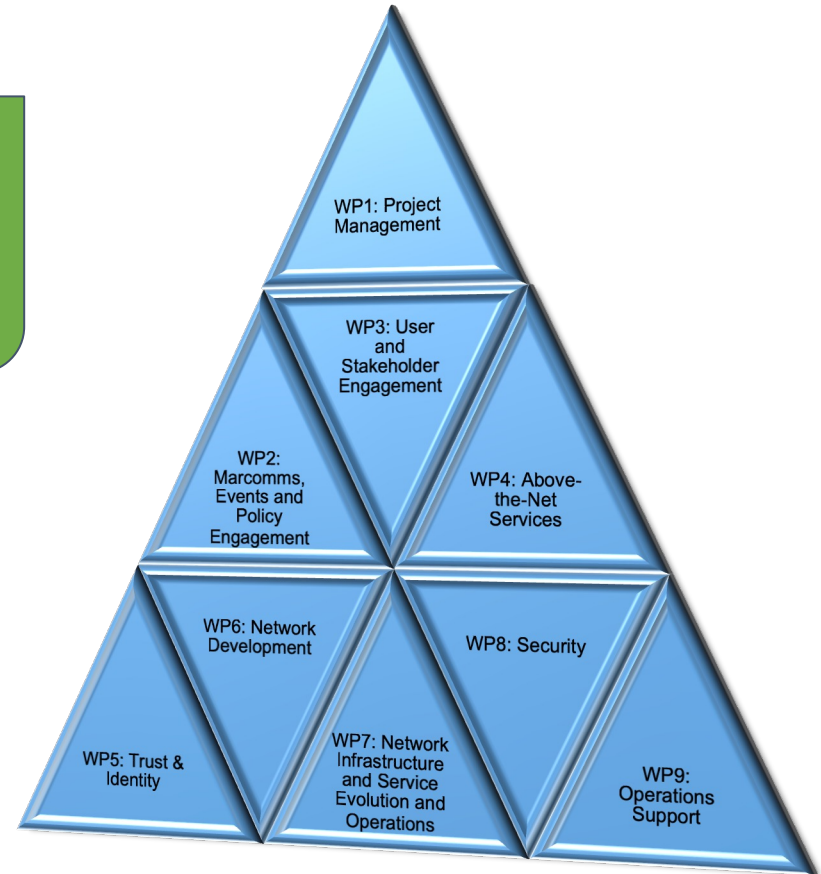
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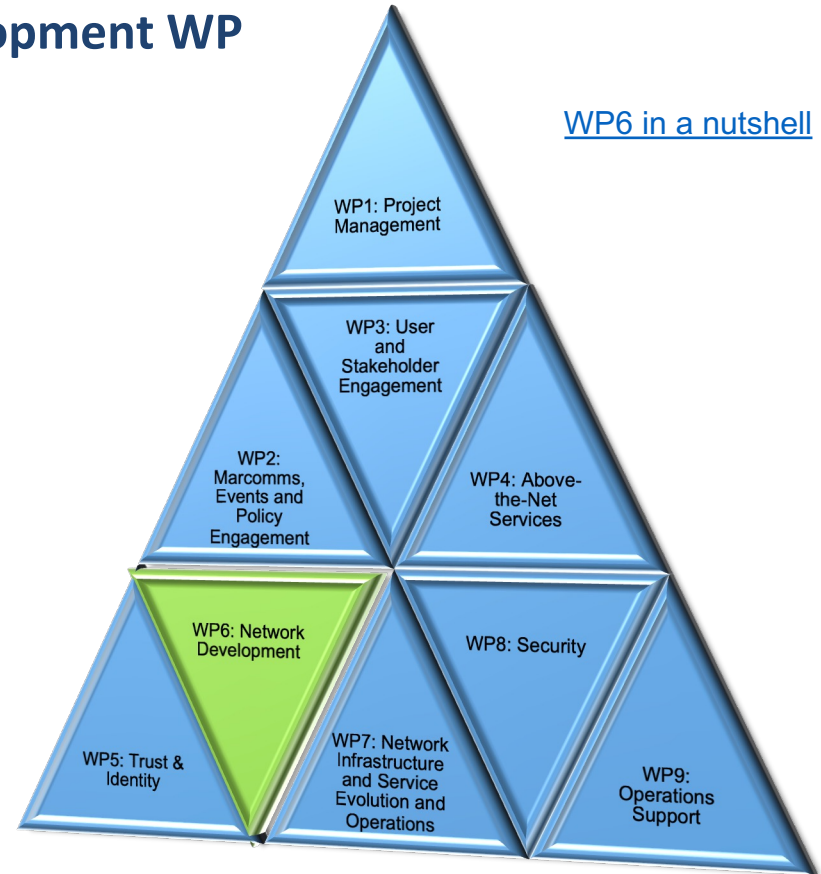
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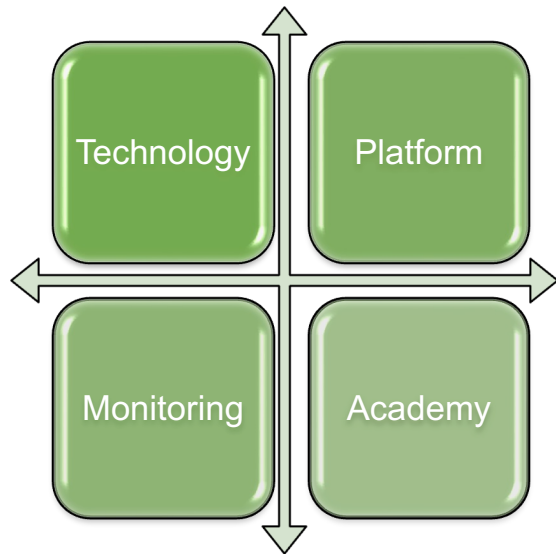


GÉANT Project Structure – Network Development WP

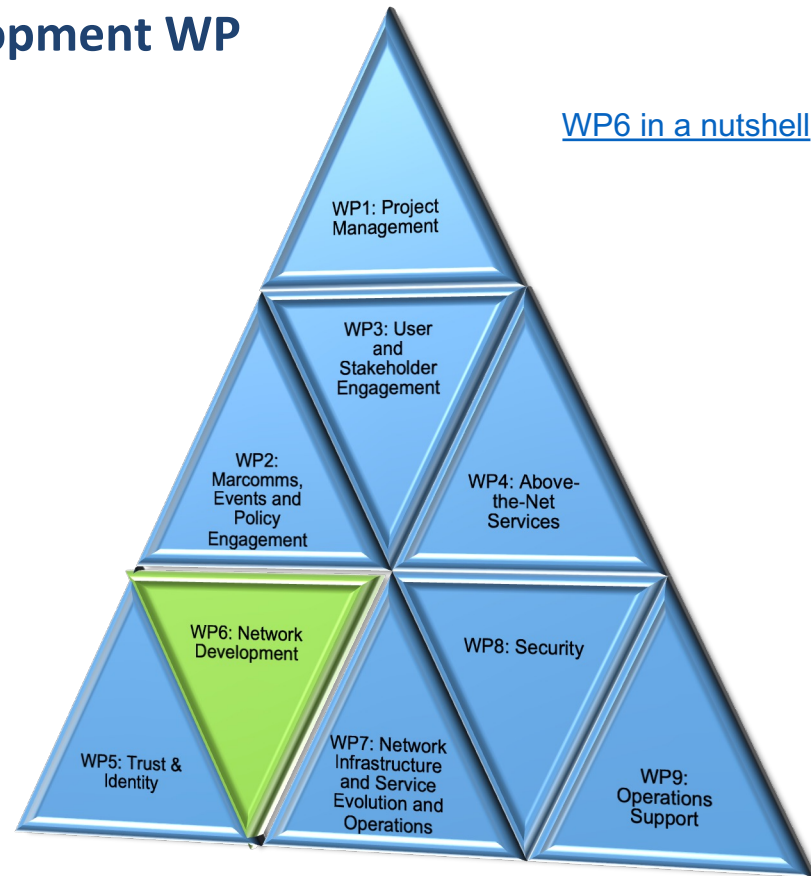
[WP6 in a nutshell](#)



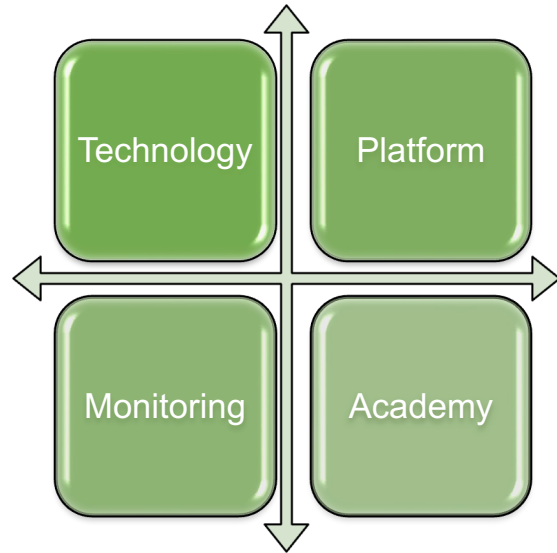
GÉANT Project Structure – Network Development WP



[WP6 in a nutshell](#)



GÉANT Project Structure – Network Development WP



25 organisations

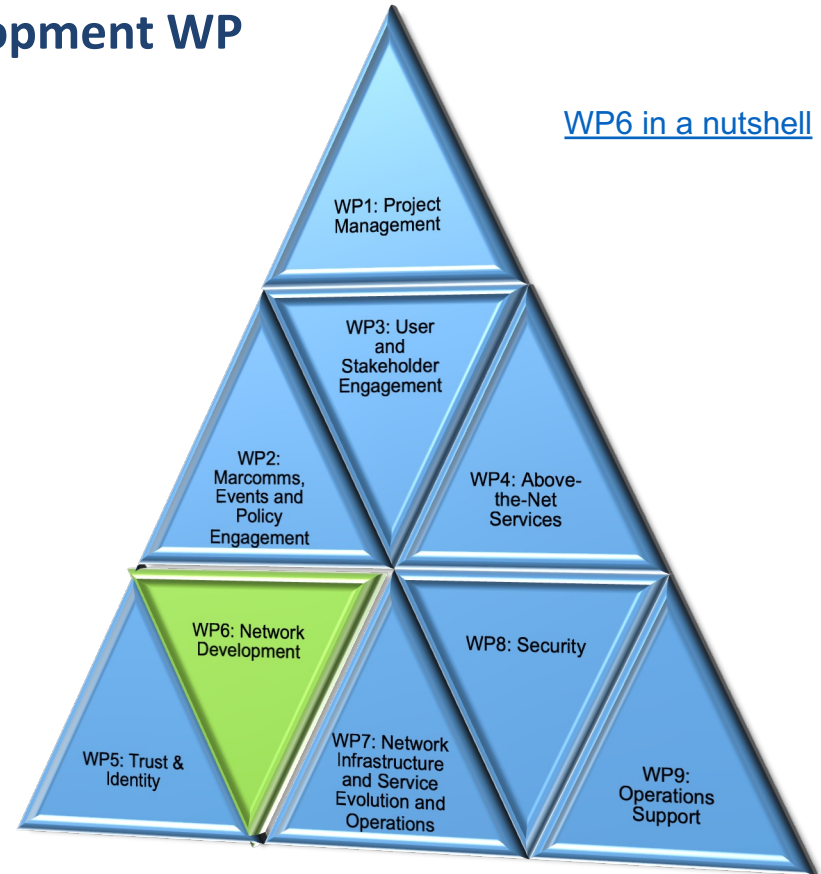
>100 persons

5,6 MEUR

28,1 FTE

>20 topics

WP6 in a nutshell



GÉANT Project Development and Services for Large Scale Data-Intensive Science

Infrastructure

Time and Frequency Network
Quantum Communication



Operations

Network Management
Data Sharing



Infrastructure

Time and Frequency Network
Quantum Communication

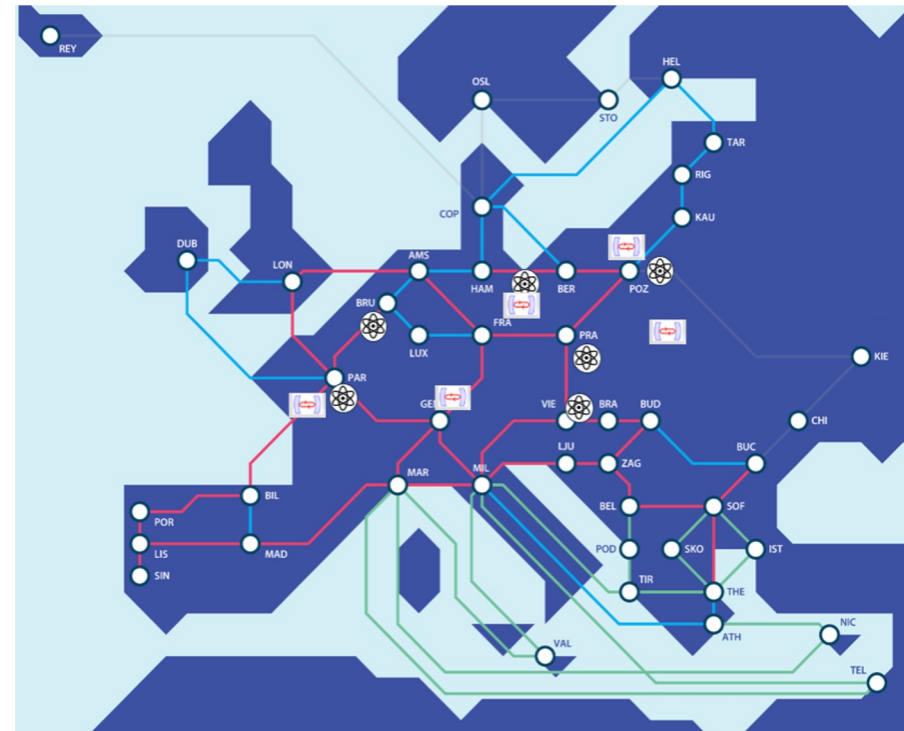
Infrastructure

Time and Frequency Network
Quantum Communication

Optical Time and Frequency Networks - OTFN

Europe-wide Core Time and Frequency Network (C-TFN):

- Independent new T&F Network in C-band



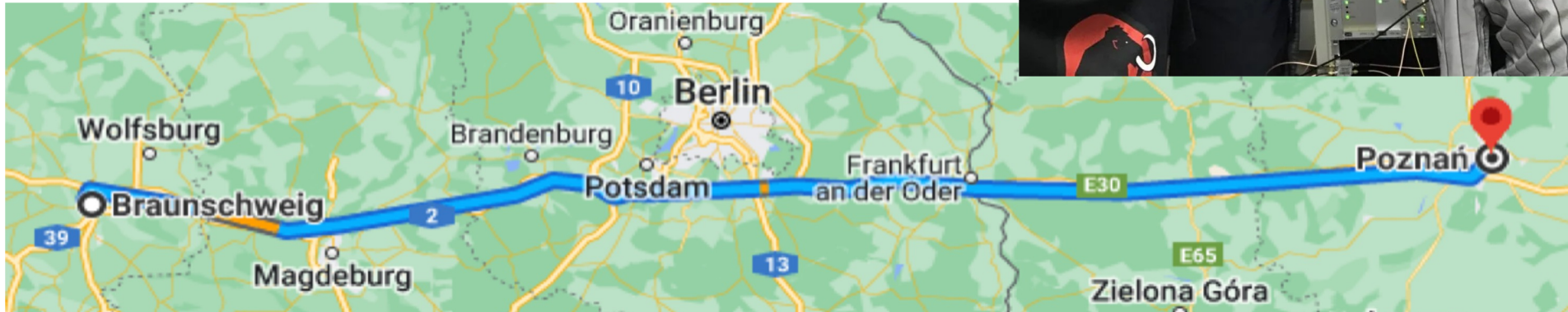
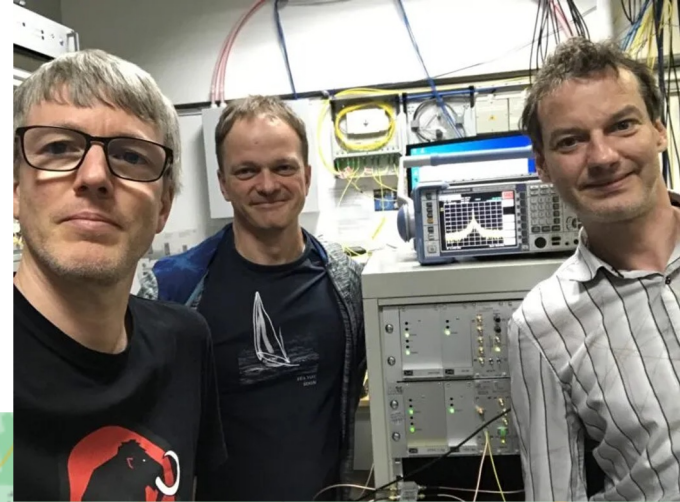
<https://wiki.geant.org/display/NETDEV/OTFN>

Core Time and Frequency Network (C-TFN)

The first C-TFN PathFinder Link

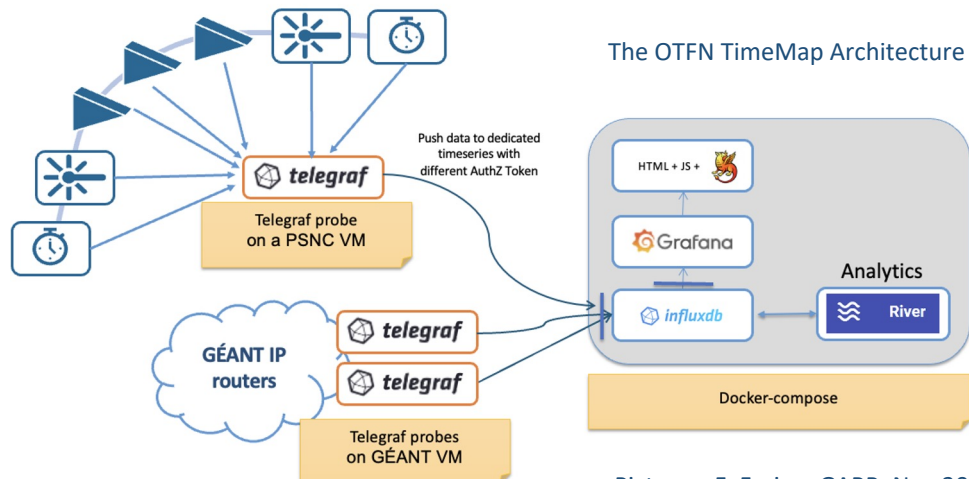
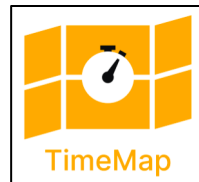
PSNC Poznan - PTB Braunschweig

Established: 23 September 2024



Monitoring the Core TF Network - C-TFN TimeMap

- Leverages TimeMap's modular design
- Deployed on a pilot link PCSS-PTB
- **TF and IP network monitoring data from multiple sources and domains (ELSTAB, K+K)**
- Extendable to provide per-user group view



Pictures: F. Farina, GARR, Nov 2024

[TimeMap](#)
[Code and documentation](#)
[TimeMap page](#)

OTFN fields

Field ↓

ULState

ULState

ULNoiseLF

ULNoiseHF

ULBeatPowCur

ULBeatPowCur

Interface sfp5(): Operational status

Interface sfp5(): Operational status

Interface sfp5(): Optical Rx Power

Interface sfp5(): Optical Rx Power

Interface sfp2(): Operational status

Interface sfp2(): Operational status

Interface sfp2(): Optical Rx Power

Interface sfp2(): Optical Rx Power

DL1State

DL1JittMax

DL1BeatPowCur

GÉANT fields

Field

dst_latitude

dst_longitude

egressAverage

egressMax

egressMin

egressStdDev

ingressAverage

ingressMax

ingressMin

ingressStdDev

negRttJitterAverage

negRttJitterMax

negRttJitterMin

negRttJitterStdDev

posRttJitterAverage

posRttJitterMax

posRttJitterMin

posRttJitterStdDev

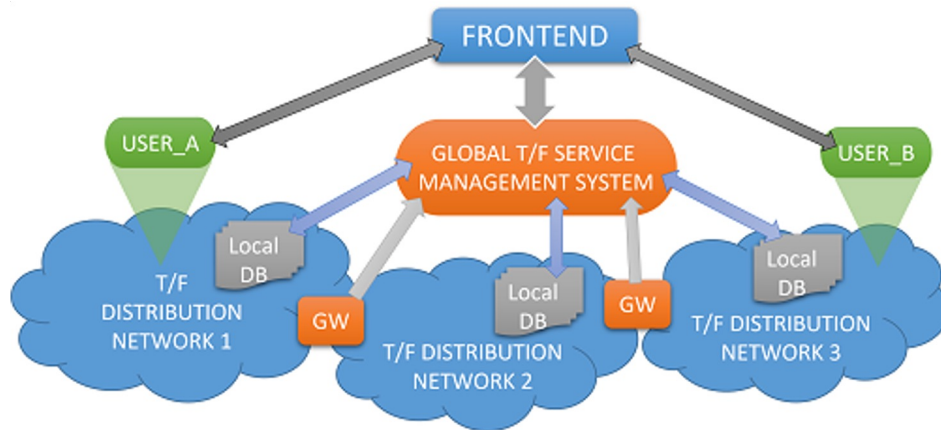
roundTripTimeAverage

Optical Time and Frequency Networks - OTFN

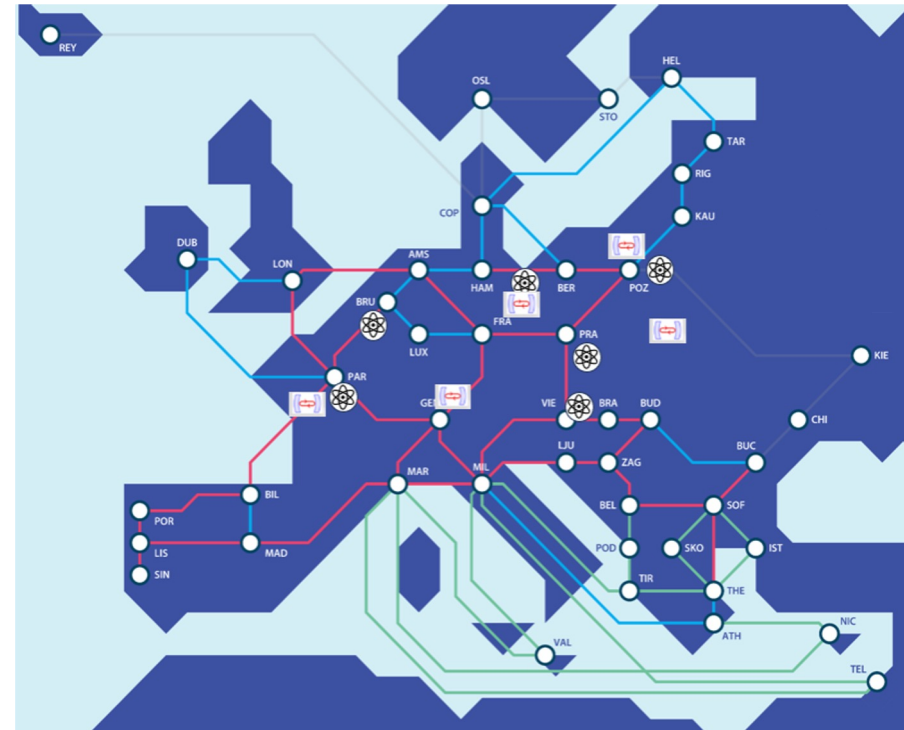
Europe-wide Core Time and Frequency Network (C-TFN):

- Independent new T&F Network in C-band

Cross-domain TFN monitoring



<https://wiki.geant.org/display/NETDEV/OTFN>

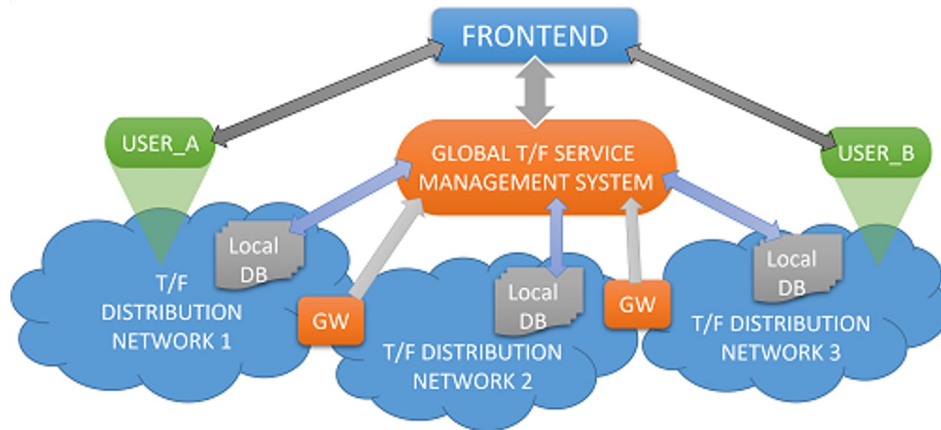


Optical Time and Frequency Networks - OTFN

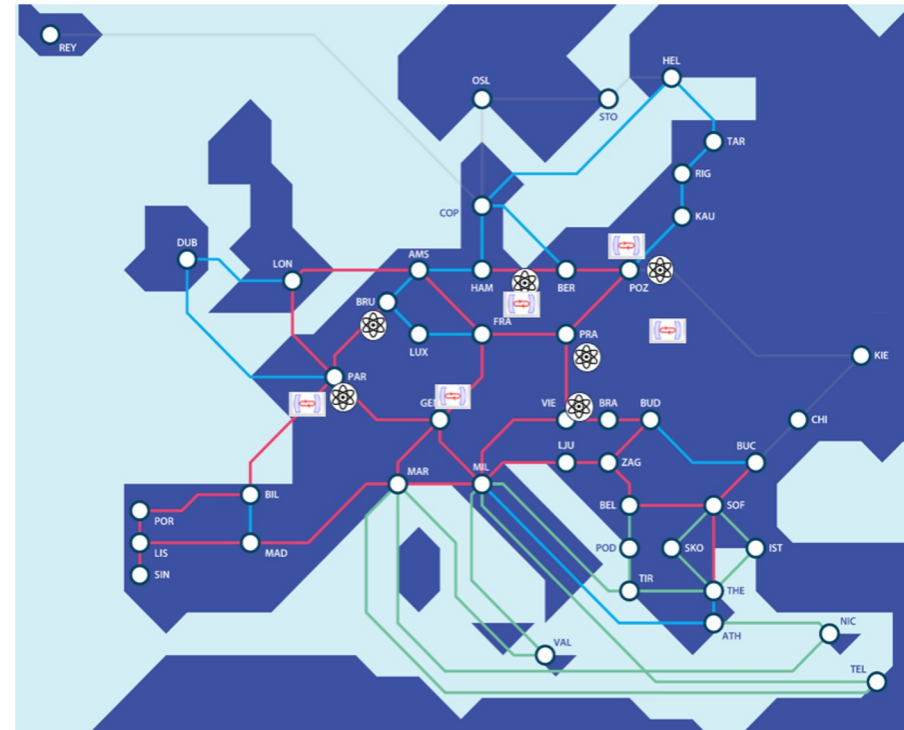
Europe-wide Core Time and Frequency Network (C-TFN):

- Independent new T&F Network in C-band
- Long-haul White Rabbit Time Distribution over the legacy DWDM/IP network

Cross-domain TFN monitoring



<https://wiki.geant.org/display/NETDEV/OTFN>



Long-haul White Rabbit Time Distribution

Project objectives:

- Explore possibility to provide **time distribution over legacy DWDM network**
- Carry out a review of existing research and deployments in the topic.
 - White Rabbit technology developed by CERN; L-band;
 - Use of IEEE 1588 Precision Time Protocol (PTP) and Synchronous Ethernet (SyncE)
- Lab test in CESNET:
 - 4x 100 km Test White Rabbit / Superchannel 400/800G–BiDi EDFA version + repeater version
- Field trial:
 - On the GÉANT network existing route Prague–Vienna
 - Existing DWDM Infinera equipment, L-band used for WR for ongoing operation

Goal:

- Recommend the best way of deploying WRS in long-haul systems for NRENs and GEANT

<https://wiki.geant.org/display/NETDEV/OTFN>

Collaboration: SIG-TFN

Special Interest Group for Time Frequency Networks (SIG-TFN) created to support collaboration around C-TFN

Two working groups within the SIG-TFN:

- T/F Sustainability
- C-TFN technical specification

More information:

- [SIG-TFN Connect article](#)
- [SIG-TFN Web page](#)

Join the mailing list sig-tfn@lists.geant.org

Explore other [GÉANT Community Special Interest Groups](#)



Infrastructure

Time and Frequency Network
Quantum Communication

Cross-border QCI Exploration

Architectural and operational design

Cross-border interconnection of national Quantum Communication Infrastructures (QCI)

One Service in scope:

- A dedicated Key Management System (KMS) for key exchange between different National QCI Infrastructures

Interoperability of Quantum Key Management Systems

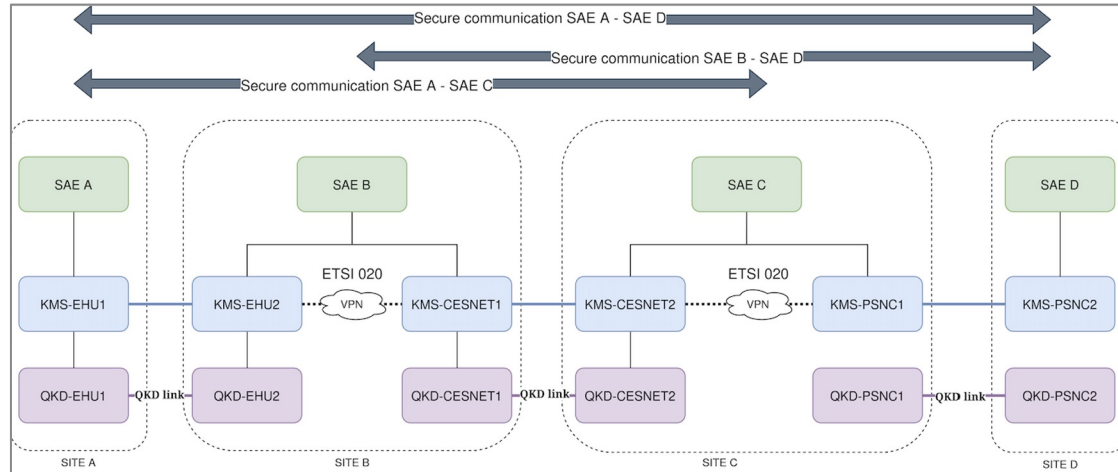
2 vendor KMSs provided by PSNC

3 open-source community developed software-based KMSs

- University of the Basque Country (UPV/EHU)
- Hochschule Darmstadt
- SURF

Want to join the test with your KMS?

Let us know: netdev@lists.geant.org



QKD Trusted Relay

An innovative network architecture for cross-domain end-to-end Key Management System (KMS)

- Per-domain KMS identification, relay path discovery using Software-Defined Networking (SDN) principles
- Creates a high-level virtual KMSs (vKMS) in each node and Quantum Security Controller (QuSeC).
- Scalable
- Proposes: architecture and operational processes

More to follow...

*Source: A. Sanz, A. Atutxa, D. Franco, J. Astorga, E. Jacob, D. Lopez
[Toward quantum-safe scalable networks: an open, standards-aware
key management framework](#)*

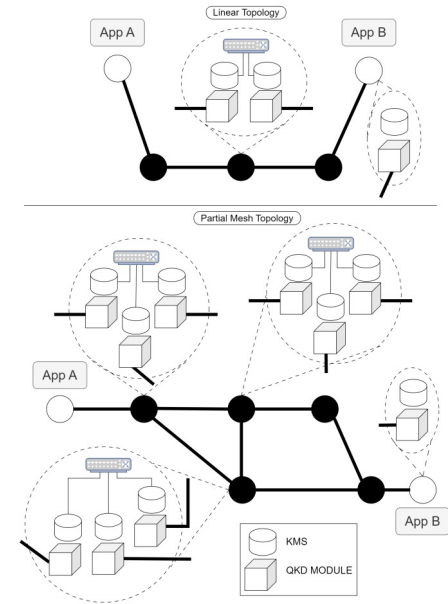


Fig. 1: A representation of linear (top) and partial mesh (down) topologies formed by QKD and trusted relay nodes.

Operations

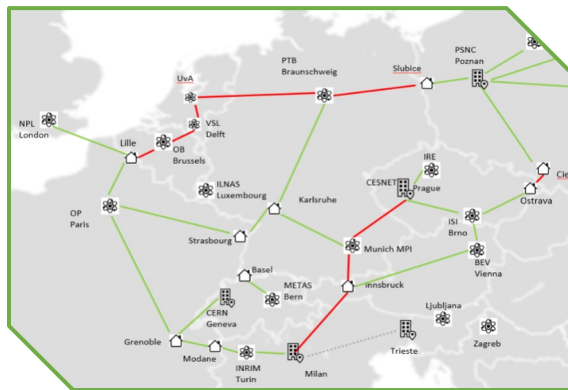
Network Management
Data Sharing

Operations

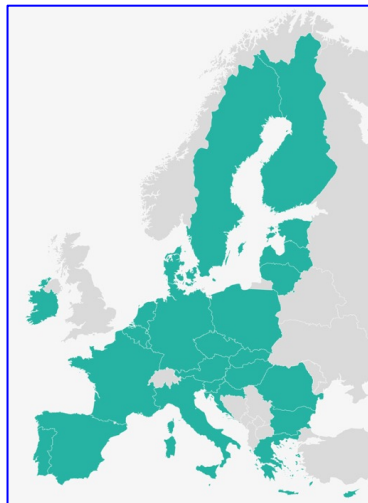
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Data Sharing

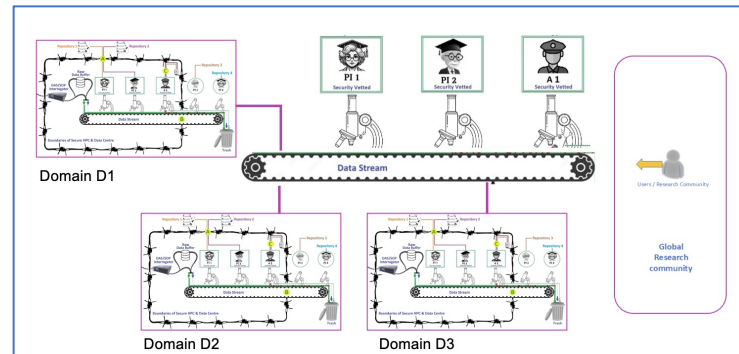
Recent Developments



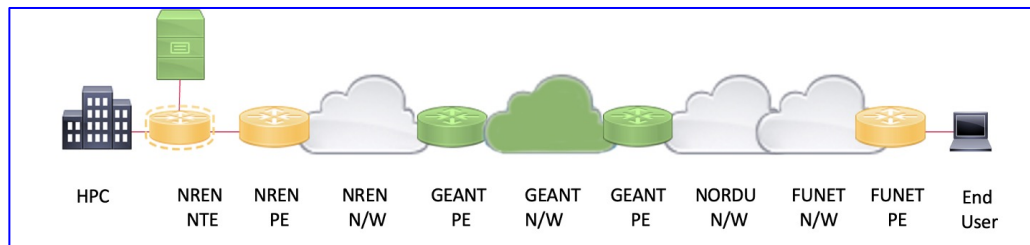
Time and Frequency Network



EuroQCI



Fibre Sensing



EuroHPC

What do they have in common?

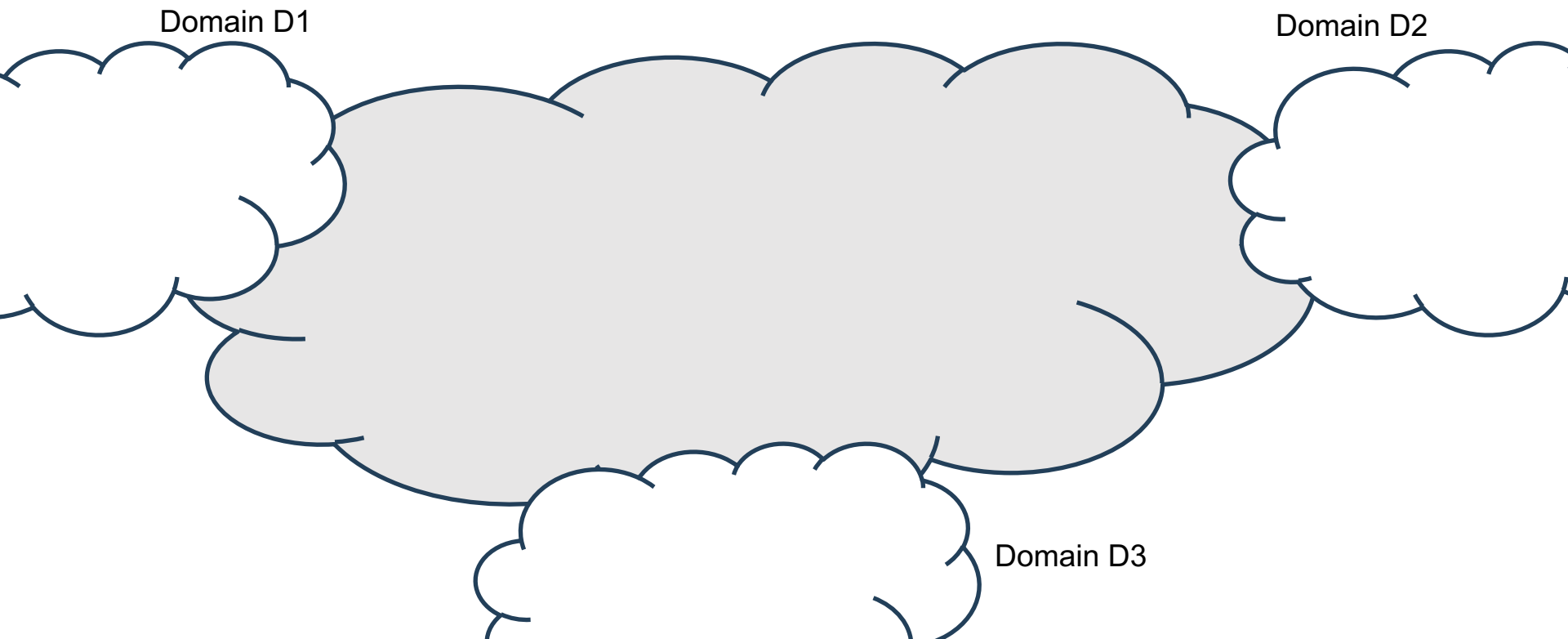
- Service sources in more than one domain/organisation
- Services provided within and cross-domains
- Service providers from more than one domain/organisation
- Users from different domains accessing service resources in more than one domain
- Domains are invisible to users (Users ignorant of domains)

As a result:

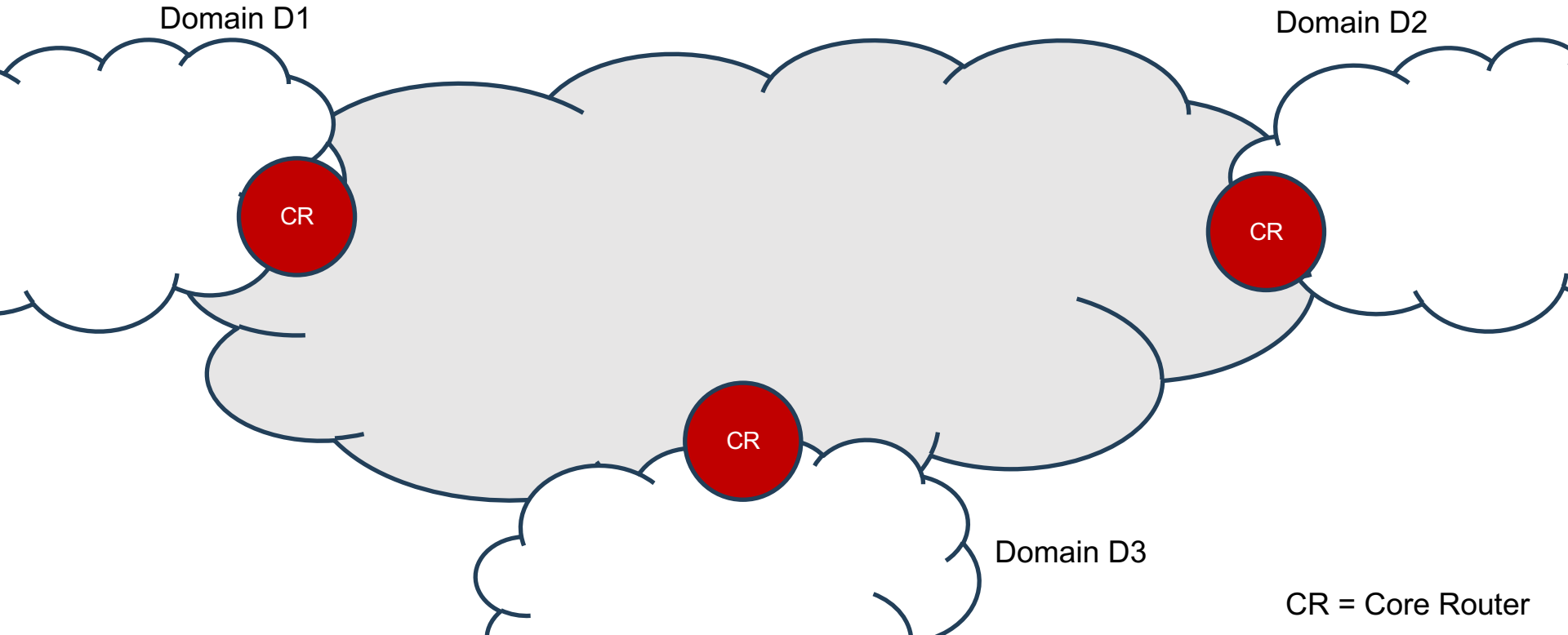
- Service delivery model crosses domains
- Successful service delivery depends on more than one domain
- End-to-end visibility is required
- Legal, technical and operational agreements required

How to manage such a heterogeneous multi-domain network/service?

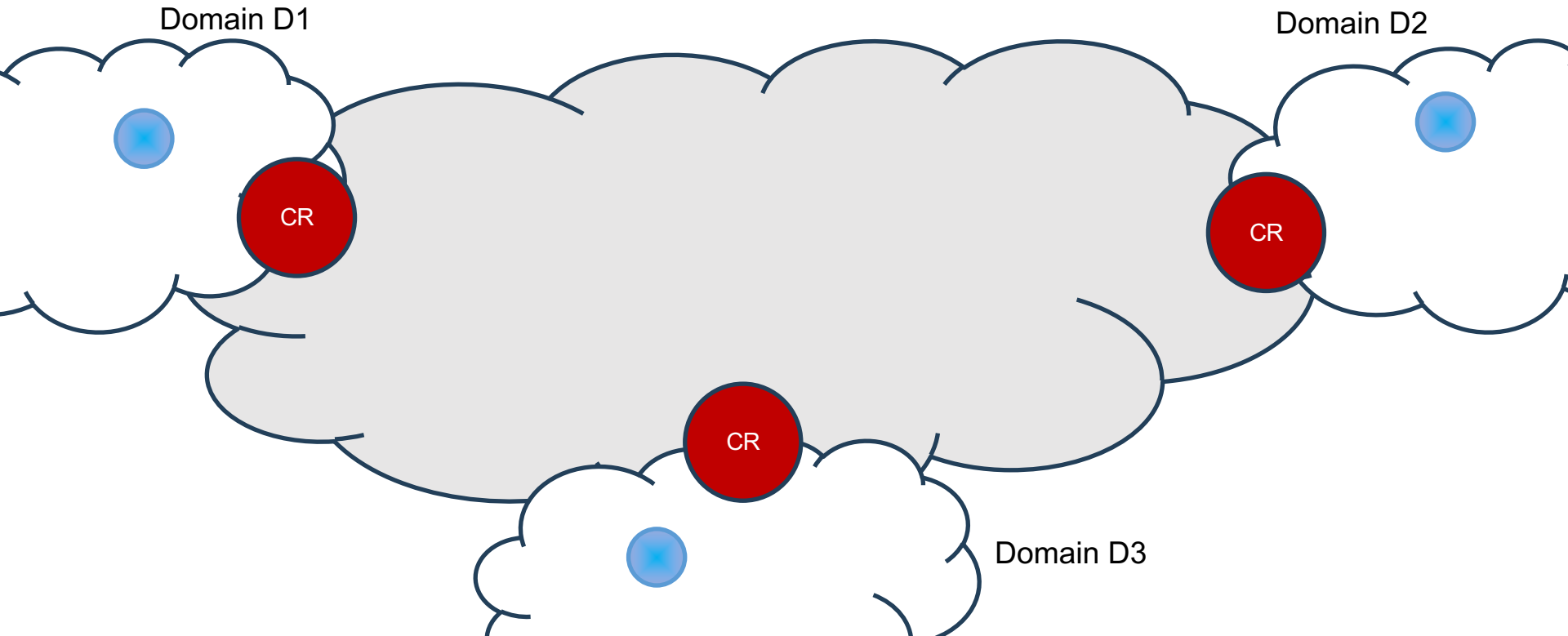
Cross– Multi-Domain Network Management Architecture



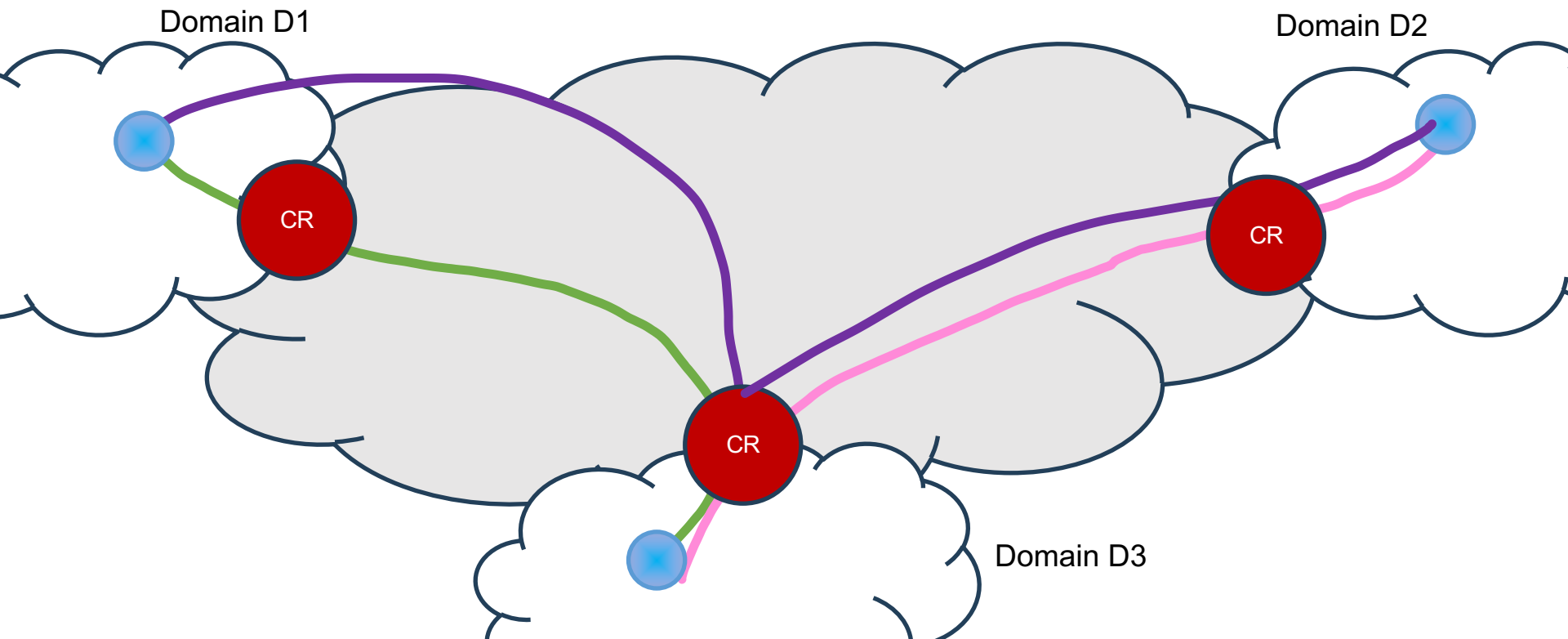
Cross– Multi-Domain Network Management Architecture



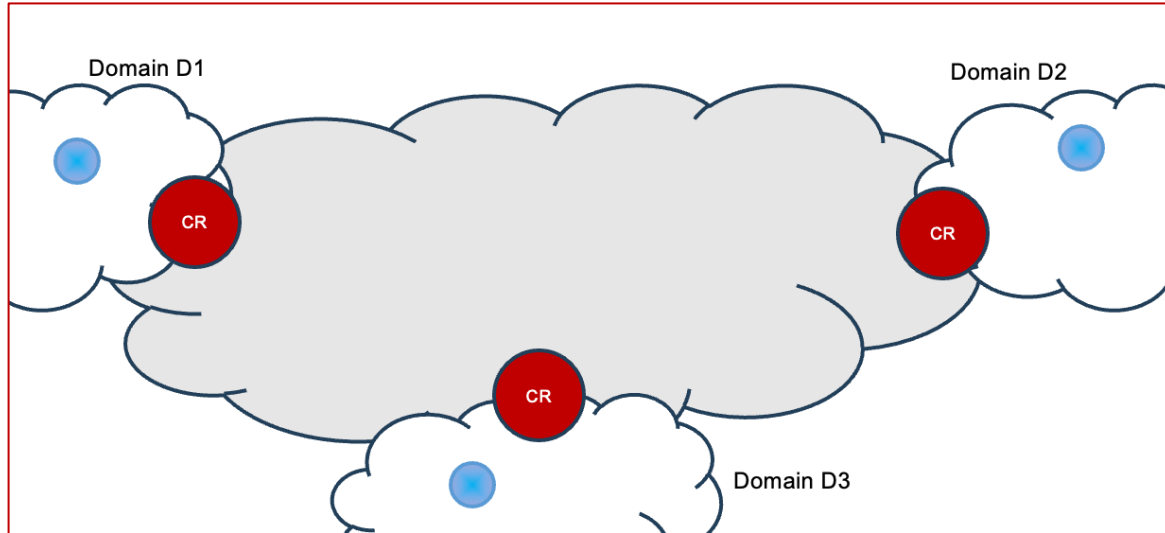
Cross-, Multi-Domain Network Management Architecture



Cross– Multi-Domain Services



Federated Monitoring Platform



Federated infrastructure – where to host the monitoring system all the parties can access?

nmaas 

 **VirtualNOC**
powered by **nmaas**

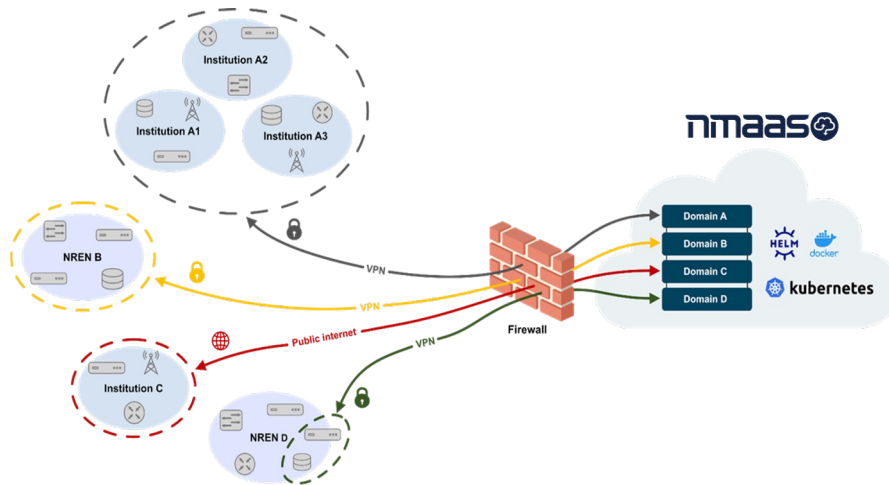
Network and service management
platform for NRENs and institutions

28 Network Management apps

<https://nmaas.eu/>



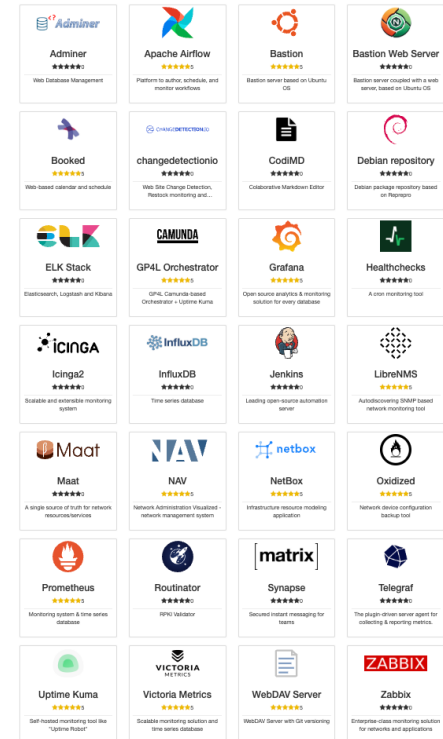
Effortless network management for small and medium size networks



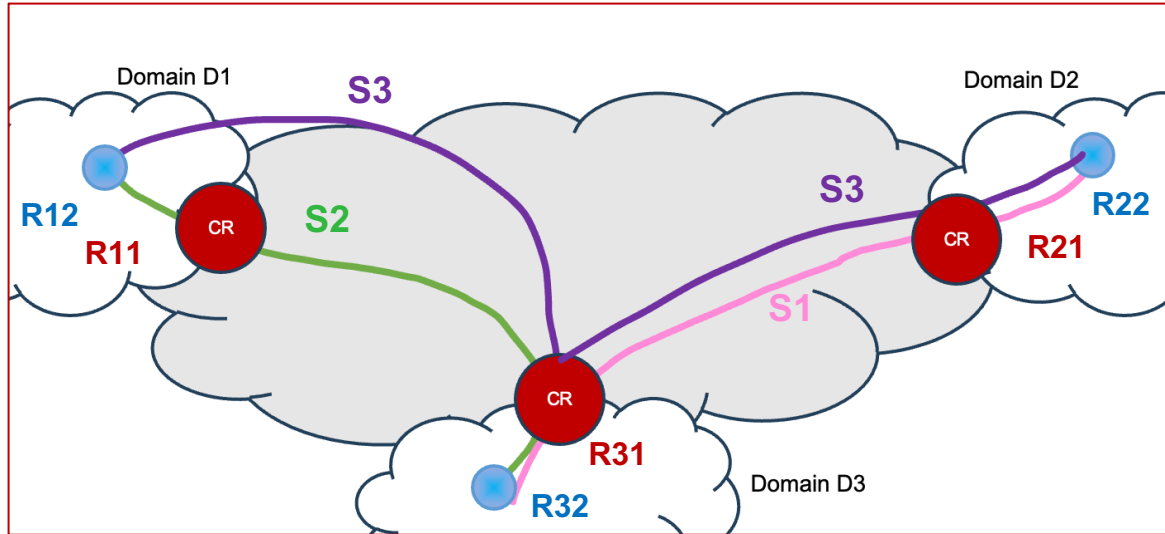
- A cloud platform and toolbox of network management applications for R&E community
- Stable, reliable and secure
- Tenants isolation by VPNs, firewall and network configuration
- Simple, efficient procedure for onboarding users
- Technical support of the nmaas team



<https://vnoc.nmaas.eu>



Resource and Service Management



Which Resources do I have?

Which Services do I provide?

Which Resources participate in which Service?

If one Resource is not available, which Service will be affected?



Network Source of Truth

Service and Resource
Inventory

Maat - Source of Truth



Vendor Agnostic

Maat offers a unified and federated view of network resources and services in a single source of truth that supports multi-vendor and multi-technology networks.

Open API

It enables automation of service and resource lifetime management via a flexible open API and notification manager.

Granular control

It provides strong authentication and defining custom granular authorization rules for fine grained access control.

Made to measure

Only by using an accurate and flexible single source of truth can you fast-track service delivery and solve problems proactively.

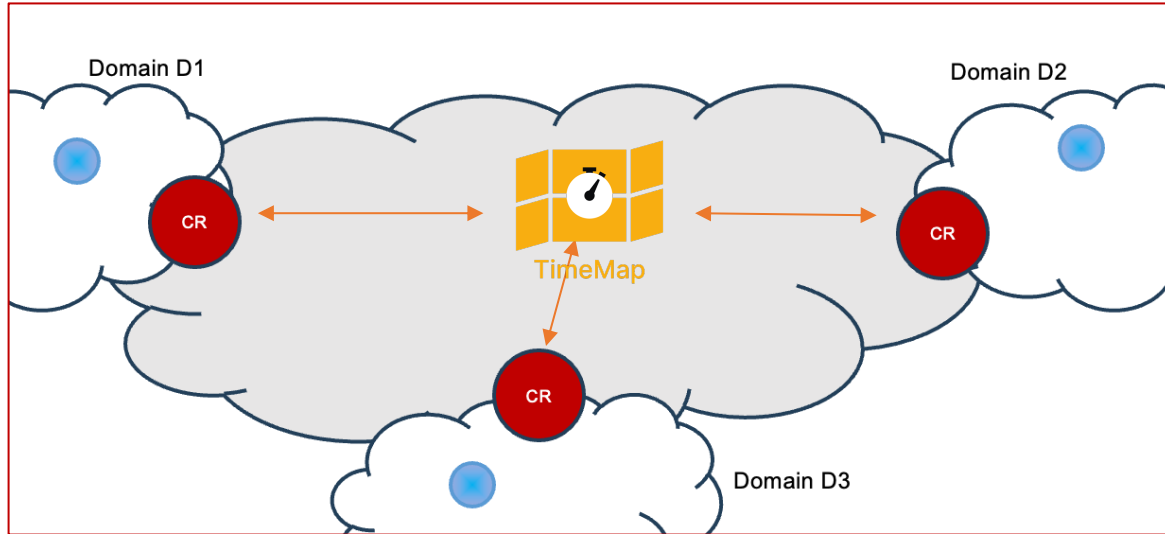
Optimized

The consolidated view of the network simplifies decision making, minimizes costs and improves resource management.

<https://geant-netdev.gitlab-pages.pcass.pl/MaatDocs/>

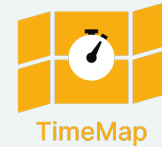


Performance Monitoring



No faults, but - how is my network behaving?

What are the performance parameter values
- in the network core?



Active Zero-footprint monitoring

TimeMap

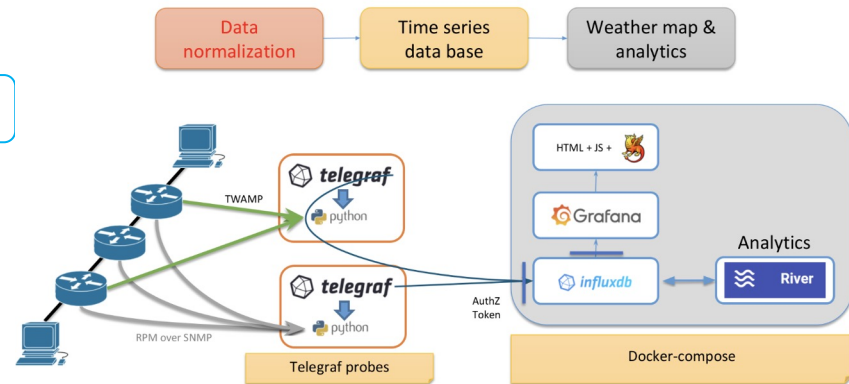
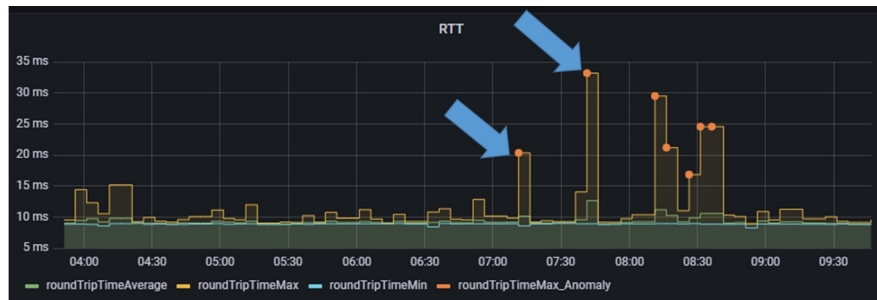
Zero-footprint per-segment latency and jitter monitoring tool

Based on TWAMP (RFC 5357)

Easy and quick modular installation

Deployed in the [GÉANT network](#), GÉANT, FCCN, GARR, CSUC
Maintenance and user support provided by the team
Initial AI-based anomaly detection implemented

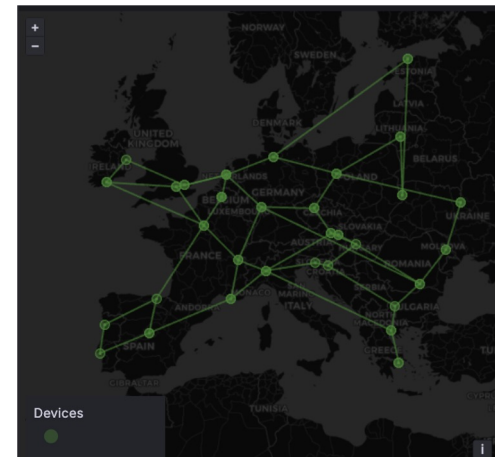
Architectural model for C-TFN TimeMap



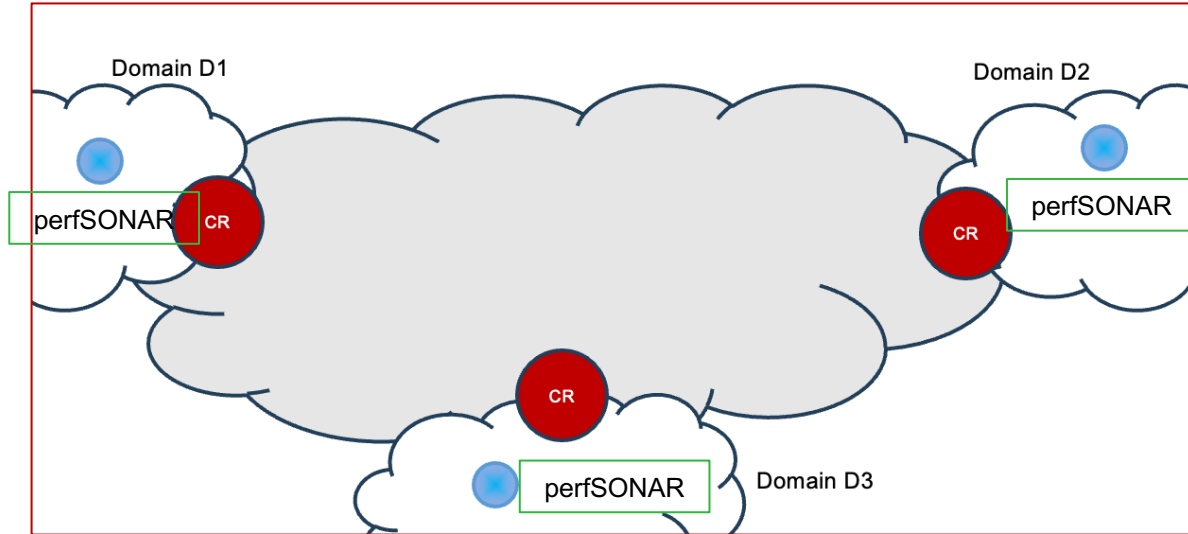
Pictures: F. Farina, GARR, Nov 2024



[TimeMap](#)
[Code and documentation](#)
[TimeMap page](#)



Performance Monitoring



What are the performance parameter values ...

At the Point of Interest?

End-to-end?

Cross-domain?

perf20NAR
years

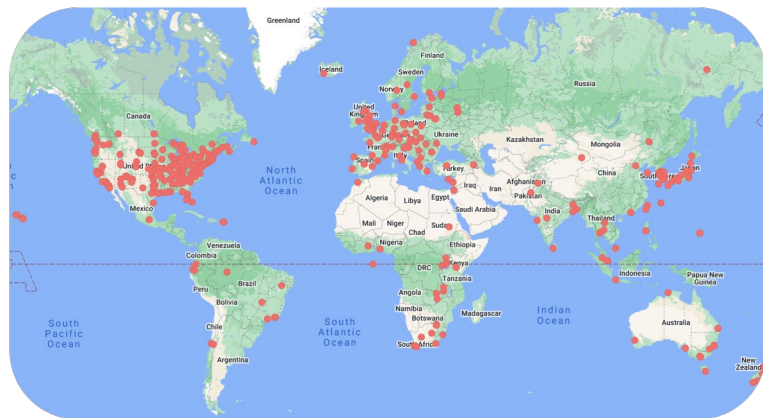
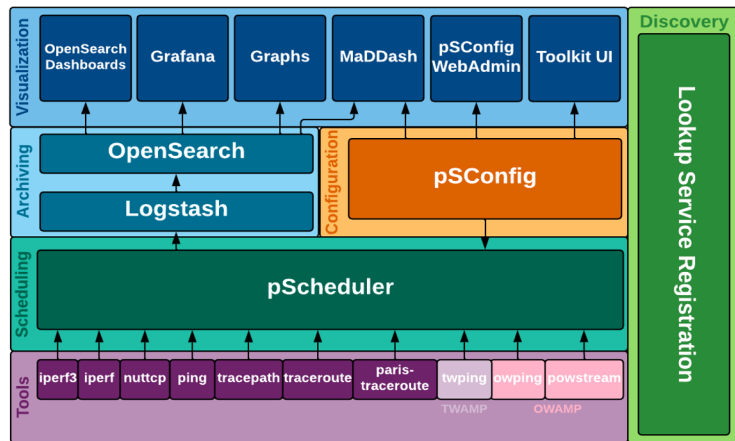
Active end-to-end
monitoring with
perfSONAR

perfSONAR

Open-source, modular, vendor-agnostic architecture for IPv4 and IPv6 active network measurement and monitoring

Some GÉANT's recent contributions:

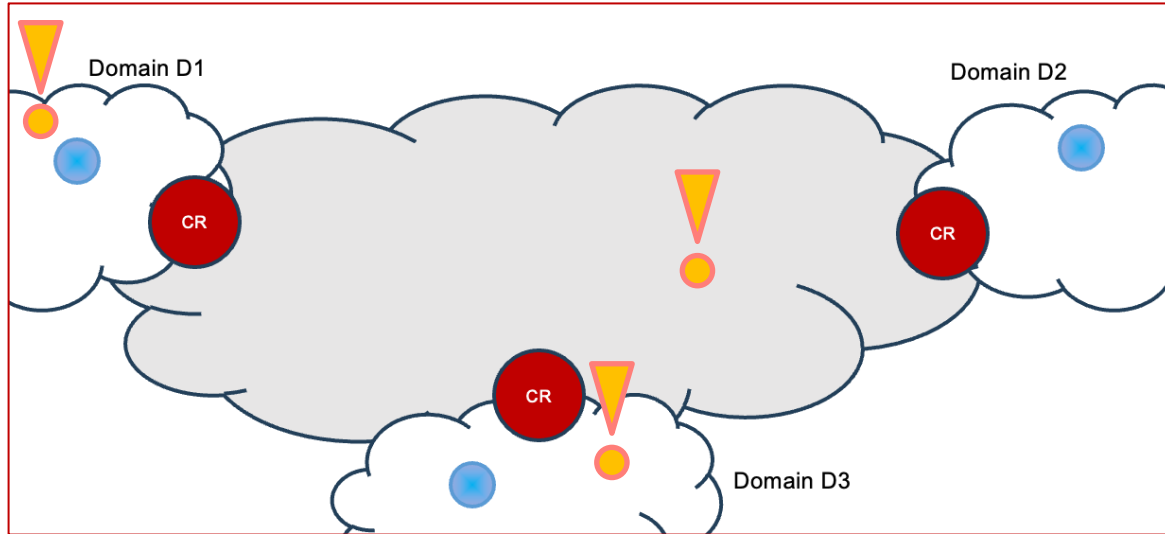
- Lookup Service dashboards
- Microdep integration with perfSONAR
- On-demand perfSONAR Graphical User Interface (psGUI)
- **400 Gbps testing**



Over 2000 registered hosts in more than 1000 organisations around the world



Fault Management



Alarms in different domains?

How do I know which are relevant for my service?

How do I gather alarms from different domains?



Aggregates alarms from different monitoring applications into a single, unified dashboard and notification system



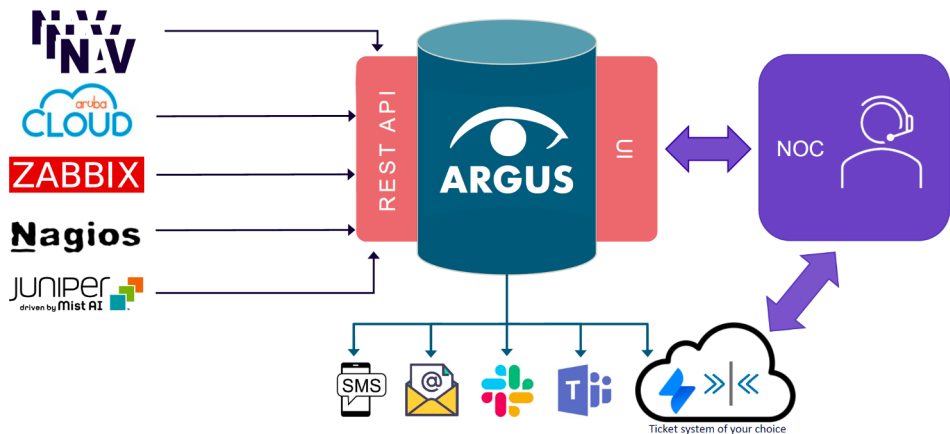
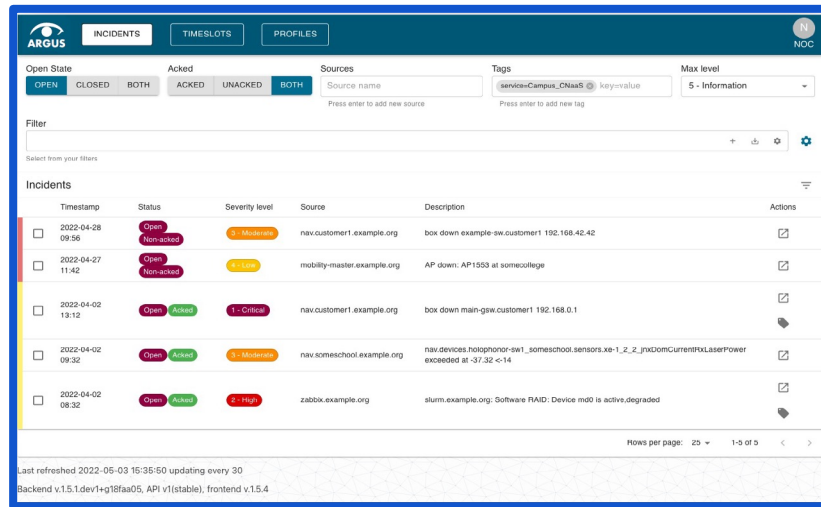


An alarm aggregation and correlation tool

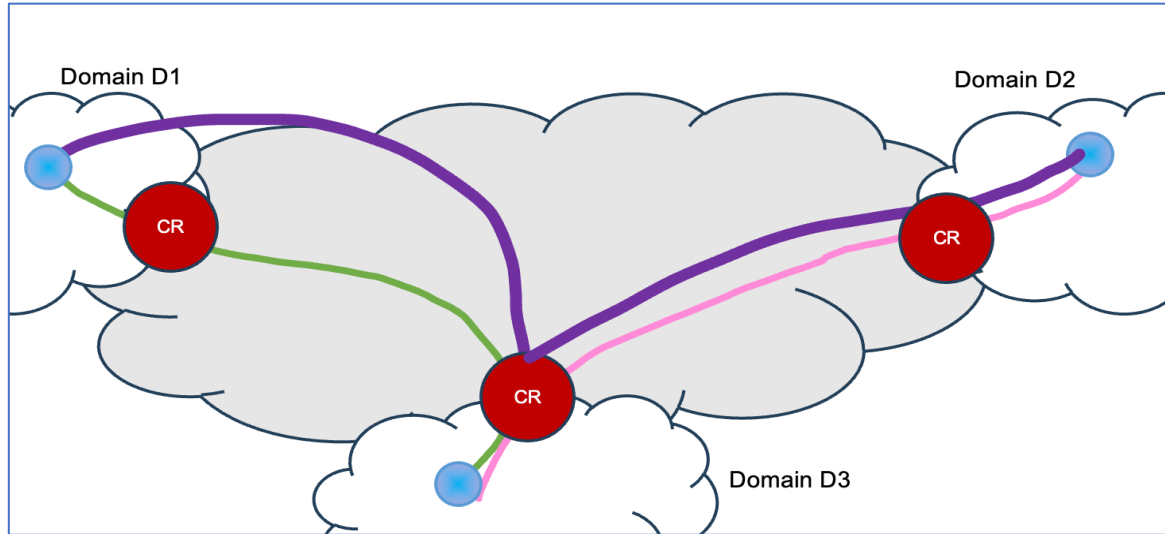
- A single unified dashboard and notification system for aggregated incidents from all monitoring applications
- Based on the CNaas use case
- A production service since Sept 2022
- In production in Sikt, SUNET and GÉANT

Software development and maintenance
User engagement and support

<https://wiki.geant.org/display/netdev/argus>



Open Source Community Built Tools for Multi-Domain Service Management



nimaas

Maat

TimeMap

perf20NAR
years

ARGUS

Operations

Network Management

Data Sharing

Operational Data Sharing

Required for joint management and operations of cross-domain infrastructure and services

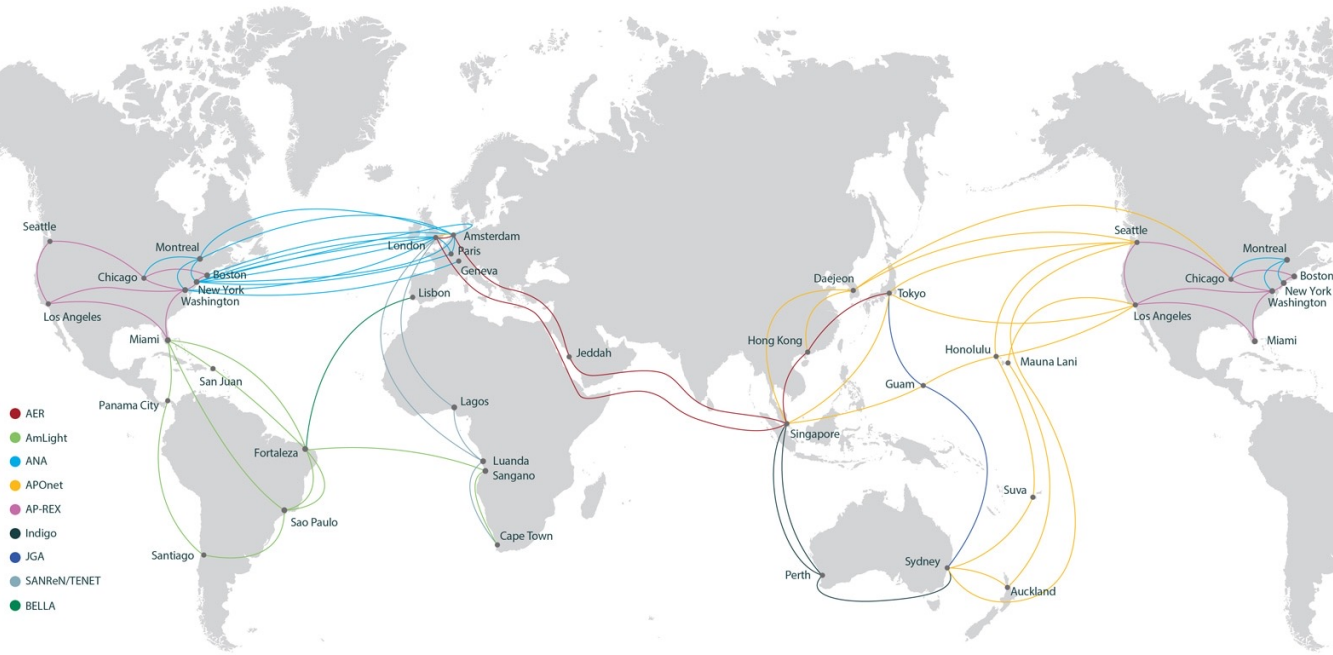
Technical, operational, policy aspects of data sharing

Examples:

- Network topology visualisation – GNA-G GREN Map WG
- Flow information sharing - MetrANOVA



GREN Map - GNA-G Working Group



<https://www.gna-g.net/join-working-group/gren-mapping/>

GREN Map - GNA-G Working Group

Led by RNP, Brazil

Objectives:

- Share network topology data to build GREN Map

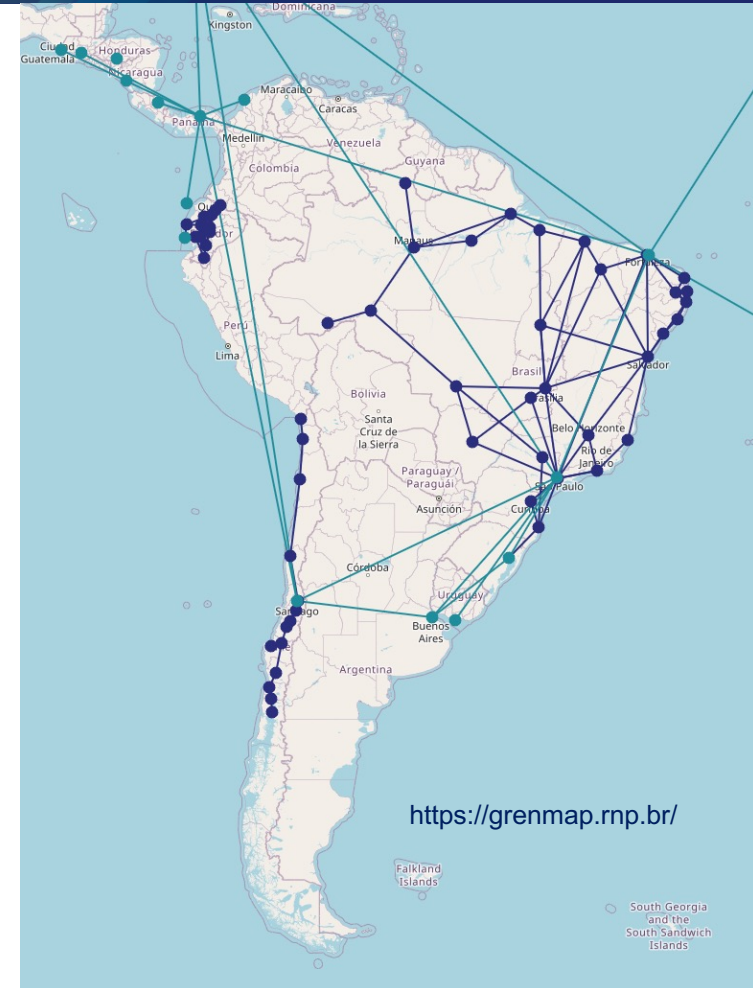
Used by the GREN Resilience GNA-G Working Group

Useful for single-domain topology representation

Challenges:

- Expand NREN Participation
- Manage data sharing for creating and updating the GREN Map

Want to join? gren-mapping-wg@lists.nordu.net



Technical and policy aspect of Data Sharing

Consortium to create a Measurement and Analysis Toolbox for Research and Education Networks Worldwide



- Technical: PoC on flow data sharing – Demo on SC25 Scinet network
- Policy: Environment for confident data sharing



MetrANOVA Policy Concepts

- Data Classification
 - Data Classification Model - Traffic Light Protocol ([TLP](#))
- Data Labeling
- Retention
- Identity and Group Provisioning
- Policy Enforcement
- ... TBC



Summary: GÉANT Project Network Services for Large-Scale Data Intensive Science

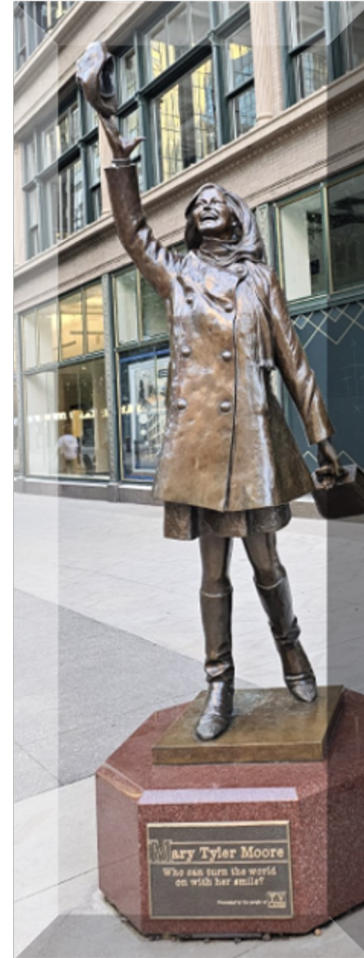
- **Cross-domain, multi-domain Infrastructure development**
 - Time and Frequency Distribution
 - Quantum Communication Infrastructure
- **GÉANT project tools for Network Management for Large Scale Data-Intensive Science**
 - nmaas, Maat, TimeMap, perfSONAR, Argus
- **Operational data sharing**
 - Technical and policy aspects



Events

9-10 October	<u>16th SIG-NGN meeting</u> , Karlsruhe, Germany
14-15 October	<u>23rd SIG-NOC meeting</u> , Barcelona, Spain
21 October	<u>GNA-G Q3 Community VC1 (6am UTC)</u>
22 October	<u>GNA-G Q3 Community VC2 (8pm UTC)</u>
19 November	<u>GNA-G @ SC25 (8-9 am US CT. Room 142)</u>
2 December	<u>GNA-G Q4 Community VC1 (6am UTC)</u>
3 December	<u>GNA-G Q4 Community VC2 (8pm UTC)</u>
3 December	<u>Infoshare: Community-Built Quantum Communication Tools (Virtual)</u>

More information about the events: <https://events.geant.org/>





Thank You!

www.geant.org



Co-funded by
the European Union

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<https://wiki.geant.org/display/NETDEV/>