



The GN5-2 Network Development Work package – WP6

Ivana Golub, PSNC

34th Service and Technology Forum
26th February 2025, Dublin Ireland

Public (PU)

GN5-2

Agenda

GN5-2 Project

Network Development - WP6

- Development
- Services
- NETDEV Incubator

Q&A



GÉANT Project

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

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.

38 Partners

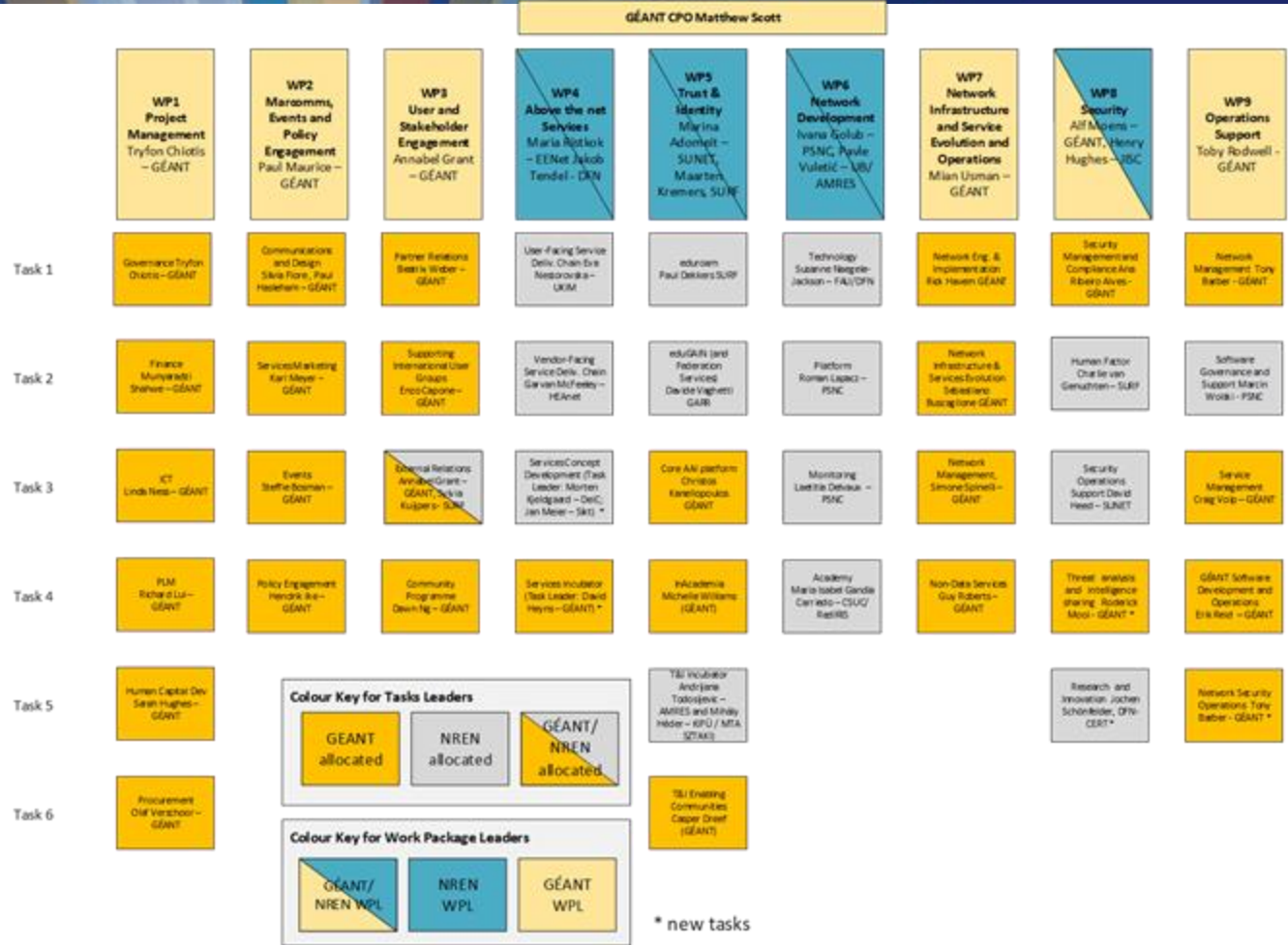
1 Associated partner

43 Countries

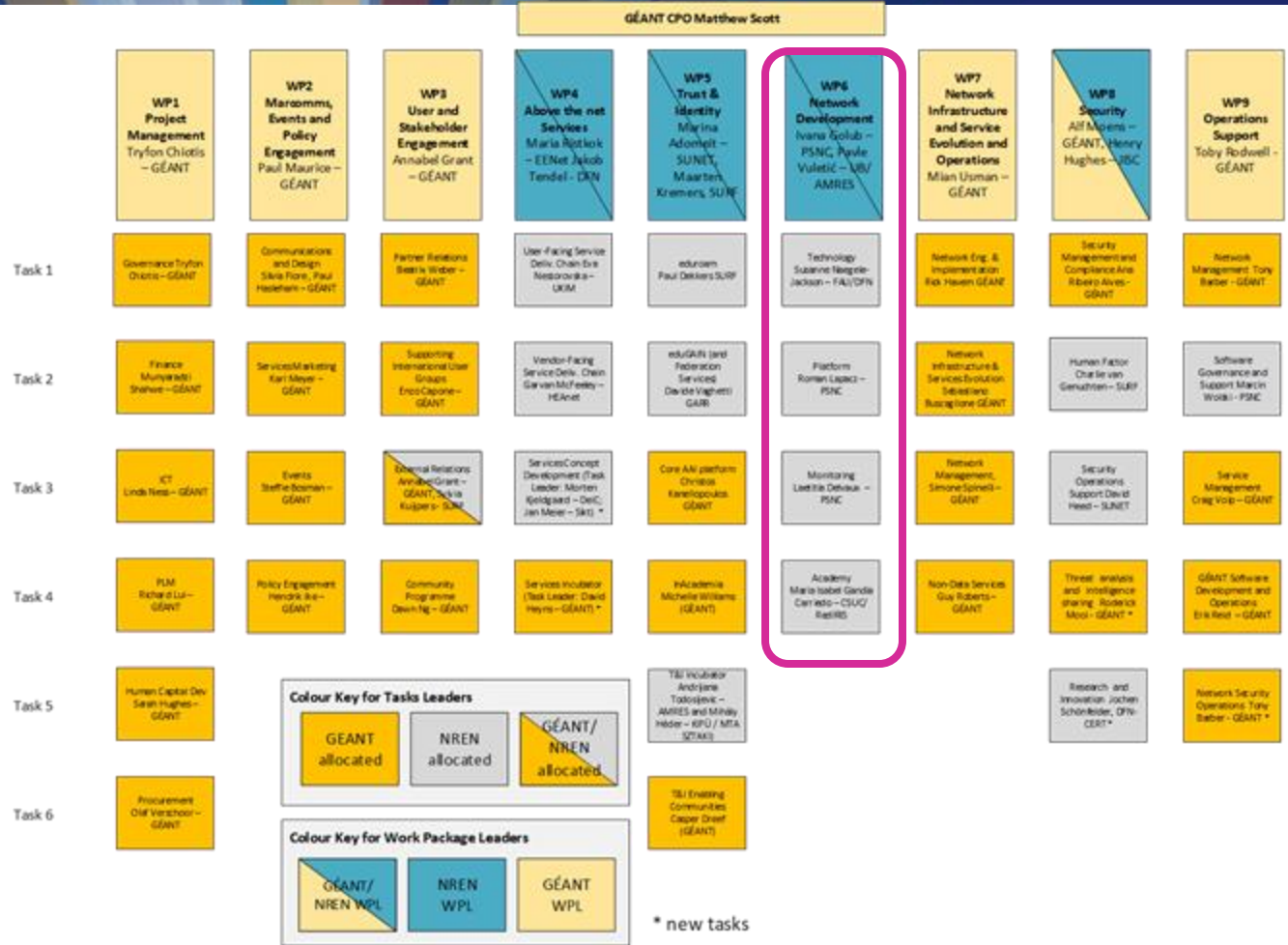
80 Mil EUR Budget

9 Projects - Work Packages

GN5-2 Project Structure



GN5-2 Project Structure



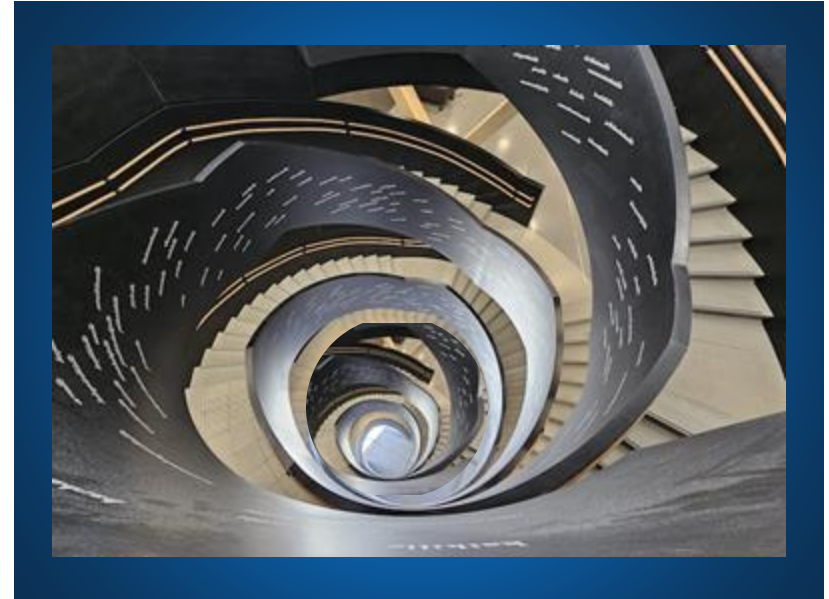
Network Development WP Objective

Undertaking **technology evaluation** and **testing, prototyping** and **development** to **support** evolution and enhancement of **NREN network infrastructures and services** in the areas of

- Network infrastructure and services
- Network monitoring and management

Exploring how emerging technologies can be applied for the GÉANT community

Enhancing GÉANT and NREN knowledge transfer through dissemination activities



NETDEV in a Nutshell

Why

Advancement of
GÉANT community network
infrastructure and services

25 organisations

How

Testing, piloting, product
and service development

Production services

Incubator

Partners' collaboration

>100 persons

5,6 MEUR

What

Technologies,
Platforms,
Monitoring,
eAcademy

20+ topics

28,1 FTE

The GN5-2
Network
Development
team in WP6
working with
GÉANT and
project partners

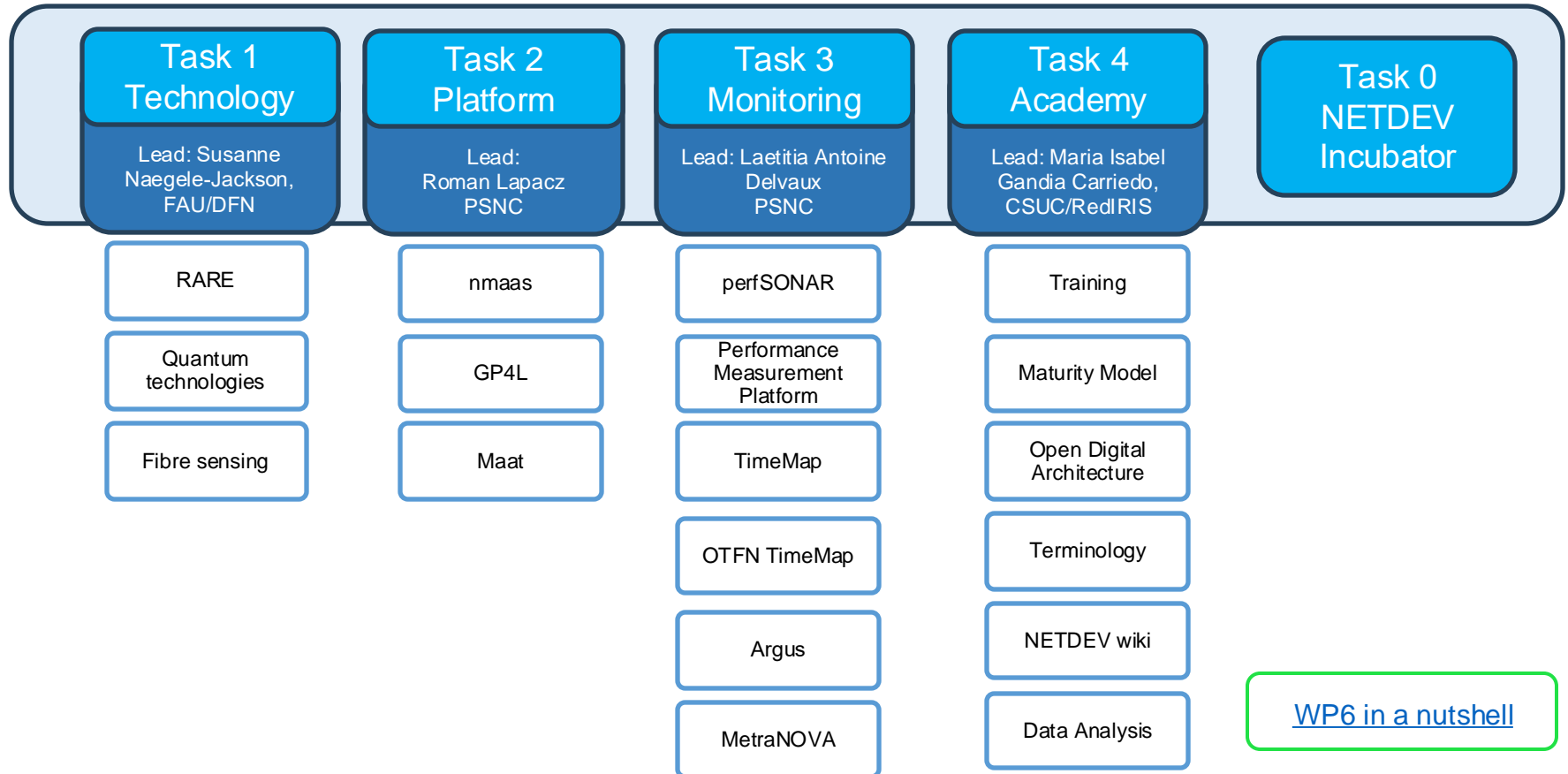
Advancing
GÉANT community network
infrastructure and services

Infrastructure and
Service
Development

Building
human capital
through
Network
eAcademy

Production services

WP6 Topics



Development

Network Technologies Development

RARE

Router for Academia, Research and Education

A software routing platform coupling an open source control plane with a P4/DPDK data plane, implementing a variety of R&E use cases.

<https://wiki.geant.org/display/RARE/Home> and rare@lists.geant.org

Fibre Sensing

Exploring technologies, solutions, processes and best practices on deploying fibre sensing in NRENs, focusing on R&E use cases and beyond.

<https://wiki.geant.org/display/NETDEV/Fibre+Sensing> and fibre-sensing@geant.lists.org

Quantum

Knowledge and expertise building through testing of R&E use cases, training, wiki-based knowledge hub and Open Quantum Group meetings.

<https://wiki.geant.org/display/NETDEV/QKD> and qkd-discuss@lists.geant.org

RARE - Router for Academia, Research and Education



Demonstrating network programmability via use cases leveraging RARE/FreeRtr software

Last year use cases

- NeMo
- 5G User Plane Function

RARE

rare-users@lists.geant.org

rare-dev@lists.geant.org

rare@lists.geant.org

Supporting GP4L expansion and maintenance

User engagement and support

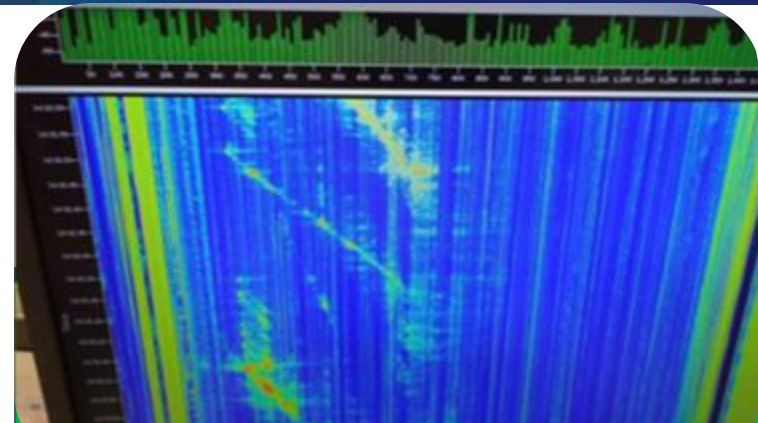
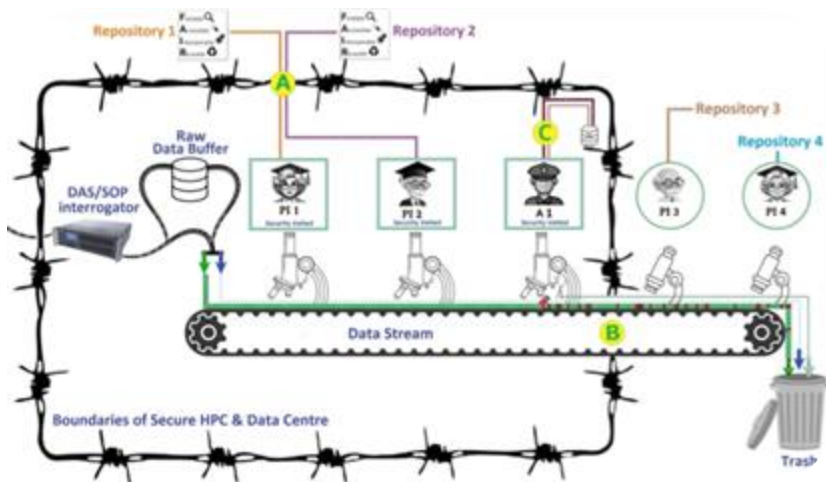
Network programmability state of the art document in progress

Knowledge sharing, documentation

Fibre Sensing

Objectives:

- Explore DAS, SOP, SOP OTDR, SOP OFDR technologies
- Define FS architecture and how it fits existing networks
- Ecosystem from data harvesting to R&E usage
- Best practices of deploying and managing FS networks



First implementations:

Car travelling along road outside University College Cork.
(Image source: D. Cunningham (HEANet) and Dr. A. Gautam of the Tyndall Institute, University College Cork)

Use cases:

Security & operations
Civil protection
Scientific Research

- Earth (seismic) activity
- Sea life (Wales)
- Sea transport (Ships) ...

Quantum Technologies

Technical
evaluation

Cross-Border QKD/QKE
Quantum-Safe Networks

Knowledge
hub

Network Quantum eAcademy
[QT @NETDEV wiki page](#)

Collaboration
and
Dissemination

Open Quantum Group Meetings
Infoshares



Cross-border QCI Exploration

Architectural and operational design

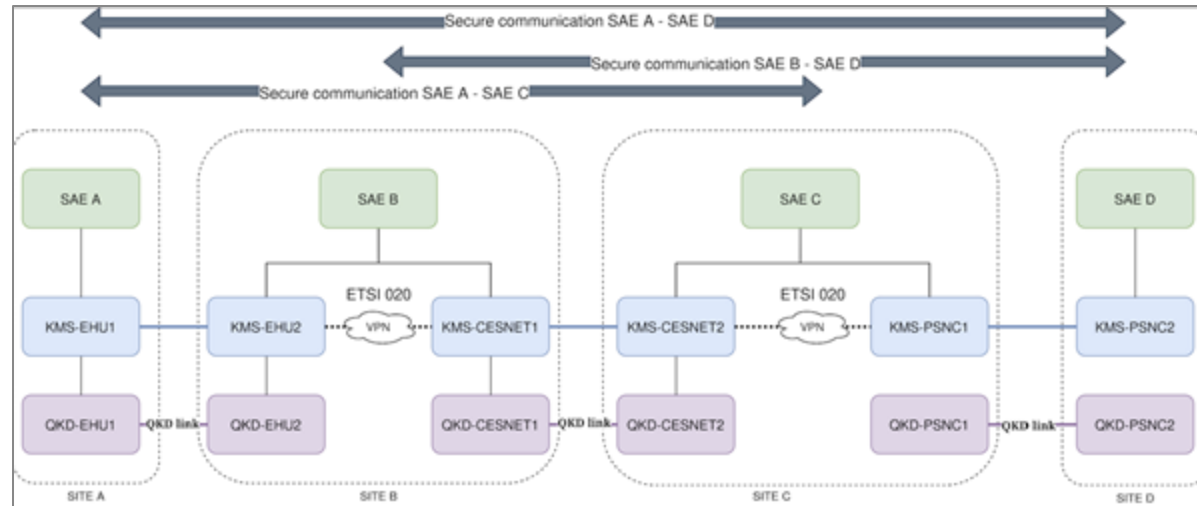
Cross-border interconnection of national QCI

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
- 1 open-source software KMS developed by University of the Basque Country (UPV/EHU)



Quantum-safe Networks

“Quantum-safe networks are designed to be secure and trusted even against attacks from the threats posed by Cryptographically Relevant Quantum Computers (CRQC). “

Implementing encryption mechanisms:

- Quantum Key Distribution (QKD)
- Post-quantum cryptography (PQC)

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- Post-quantum cryptography (PQC)



Join at menti.com | use code **6645 9163**

Network Operations Development

GP4L

A platform of programmable network devices with automated and orchestrated service management operations.

Used for evaluation of network technologies, tools, processes and services.

<https://geant-netdev.gitlab-pages.pcss.pl/gp4ldocs/>

Maat

The Source of Truth application that stores the current state of a network

Primarily intended for use in network service orchestration and automation systems.

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

OTFN TimeMap

Time and Frequency multi-domain monitoring tool, visualising OTFN and IP parameters

MetrANOVA

Technical and policy aspects of multi-domain monitoring data sharing

GP4L - GÉANT P4 Lab

P4 switch-based lab infrastructure over the GÉANT network

- 8 switches in Europe: AMS, POZ, FRA, BUD and GNV (4)

Validation of the RARE/FreeRtr OS routing stack software

World-wide testbed, with experimental dataplane programming facilities for geographically distributed network experiments:

- With the usage of RARE/FreeRtr NOS
- Using a clean slate environment (i.e without RARE/FreeRtr dataplane & control plane)

A platform for **advancing network operations**:

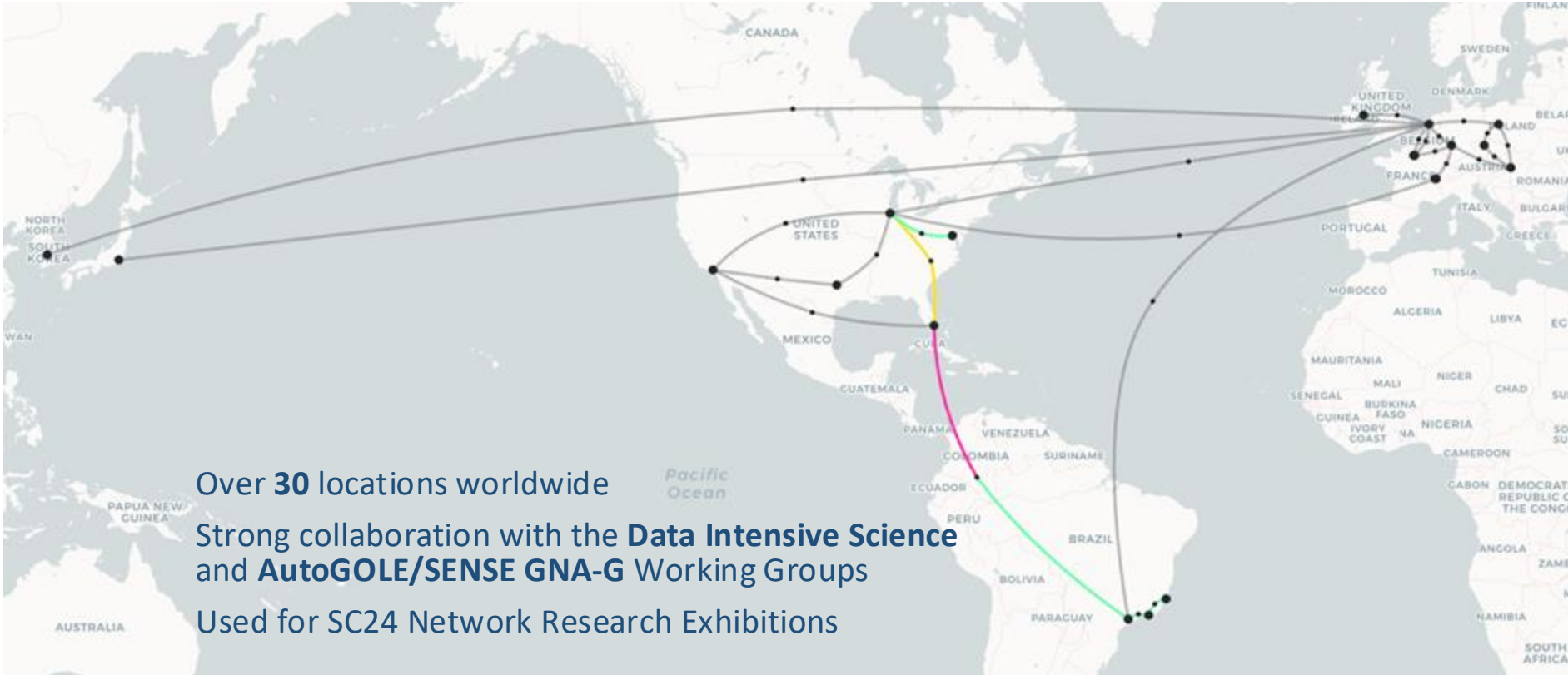
- New device management
- New experiment reservation
- Digital Twin
- Network automation

Managed and supported using nmaas as a platform

<https://wiki.geant.org/display/GP4L>



GP4L - Global P4 Lab



Over **30** locations worldwide

Strong collaboration with the **Data Intensive Science**
and **AutoGOLE/SENSE GNA-G** Working Groups

Used for SC24 Network Research Exhibitions

Maat



The Single Source of Truth for network automation

Resource Inventory and Service Inventory implemented as a stand-alone application

- Storing information about resource and service instances
- Use of NoSQL (MongoDB) database
- Data model can be easily updated/extended and validated
- In use in GP4L
- In **production** in PSNC/PIONIER
- Available on nmaas

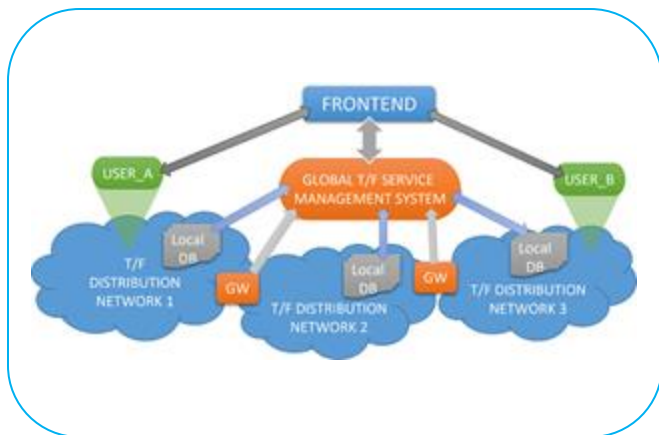


Optical Time and Frequency Networks - OTFN

Supporting Time and Frequency (T&F) Services in NREN Networks for the new definition of the SI unit of a second

Building upon already existing T&F knowledge, infrastructure and services

Started in GN5-1, now a part of GN5-2 WP7



Core Time and Frequency Network (C-TFN) Design

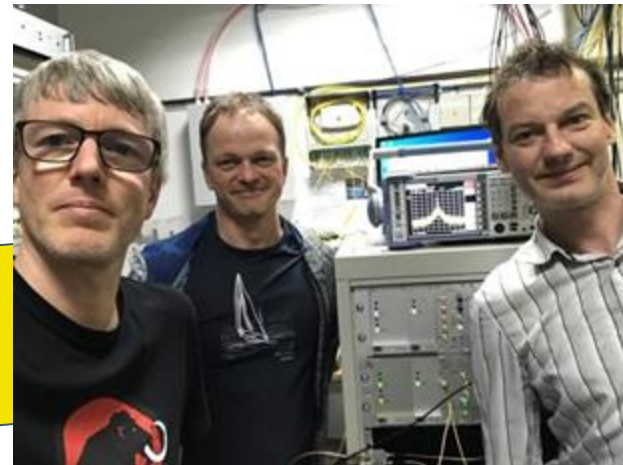
C-TFN Design run as and NETDEV Incubator project

More information: [GÉANT C-TFN Network Development Incubator Report](#)

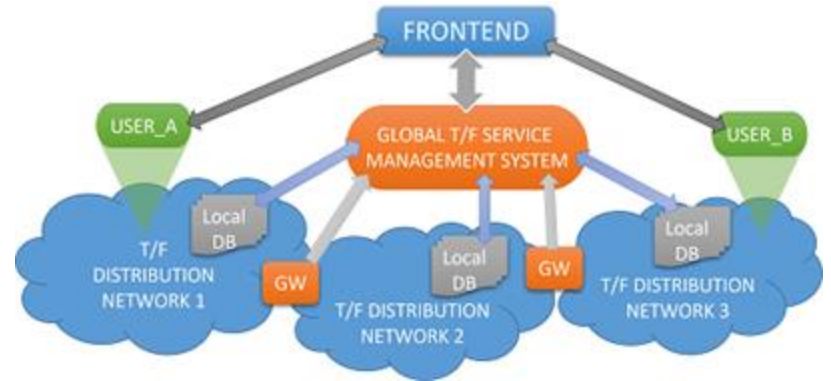
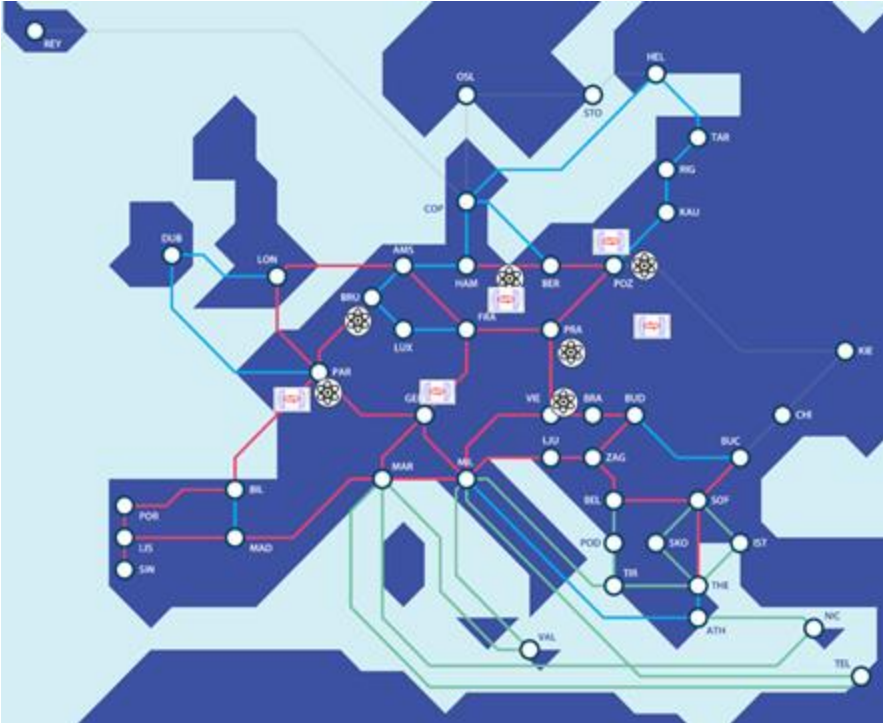
Establishment of the C-TFN PathFinder Link

PSNC Poznan - PTB Braunschweig

**C-TFN PathFinder Link
Established:
23. September 2024**



C-TFN Monitoring Considerations



TF and IP management and monitoring parameters

- Link state, delay, jitter / amplifiers / RLS state / comparators / flywheel performance

Multi-domain data sources with heterogeneous TF and IP equipment vendors

Different user groups with different requirements

- GÉANT, NRENS, NMIs, Other organisations, Researchers

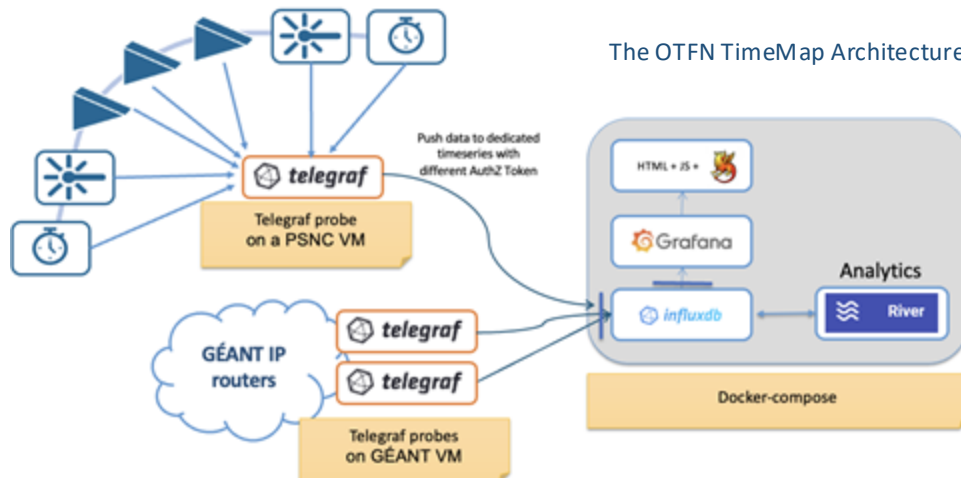
Monitoring the Core TF Network - C-TFN TimeMap

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

- Leverages TimeMap's modular design
- Deployed on a pilot link PSNC-PTB
- TF and IP network monitoring data from multiple sources and domains
- Extendable to provide per-user group view



The OTFN TimeMap Architecture



Pictures: F. Farina, GARR, Nov 2024

OTFN fields	GÉANT fields
Field ↓	Field
ULState	dst_latitude
ULState	dst_longitude
ULNoiseLF	egressAverage
ULNoiseHF	egressMax
ULBeatPowCur	egressMin
ULBeatPowCur	egressStdDev
Interface sfp5(): Operational status	ingressAverage
Interface sfp5(): Operational status	ingressMax
Interface sfp5(): Operational status	ingressMin
Interface sfp5(): Operational status	ingressStdDev
Interface sfp5(): Optical Rx Power	negRtt.JitterAverage
Interface sfp2(): Operational status	negRtt.JitterMax
Interface sfp2(): Operational status	negRtt.JitterMin
Interface sfp2(): Operational status	negRtt.JitterStdDev
Interface sfp2(): Optical Rx Power	posRtt.JitterAverage
Interface sfp2(): Optical Rx Power	posRtt.JitterMax
DL1State	posRtt.JitterMin
DL1JittMax	posRtt.JitterStdDev
DL1BeatPowCur	roundTripTimeAverage

Example - MetrANOVA

MetrANOVA

A Consortium for Advancing Network Observation, Visualization and Analysis



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

Two work streams:

- Technical: PoC on flow data sharing - live since Dec 2024
- Policy: Environment for confident data sharing



NETDEV Services

Production Services - Network Management and Monitoring

nmaas

A cloud-based orchestration platform for application deployment. Two use-cases:

- **vNOC** - secure virtual network management
- **vLAB** - virtual labs with hands-on exercises

<https://nmaas.eu>

perfSONAR

An open-source, modular and flexible toolkit for active performance monitoring

www.perfsonar.net and perfsonar@lists.geant.org

Performance Measurement Platform

The GÉANT backbone performance assessment as seen by its users. perfSONAR measurements towards GÉANT backbone nodes

<http://pmp-archive.geant.org/> and pmp-ot@lists.geant.org

TimeMap

Zero-footprint per-segment delay and jitter measurements of the GÉANT backbone

<https://timemap.geant.org/> and timemap@lists.geant.org

Argus

Alarm aggregation open-source unified dashboard and notification system.

<https://network.geant.org/argus/> argus@lists.geant.org



Effortless network management and teaching with orchestrated application deployment on a multi-tenant platform



Use cases



Managing of small and medium size networks

- 37 Net management applications available
- Stable, reliable and secure
- Tenants isolation by VPNs, firewall and network configuration
- Simple, efficient procedure for onboarding users
- Technical support of the NMaas team



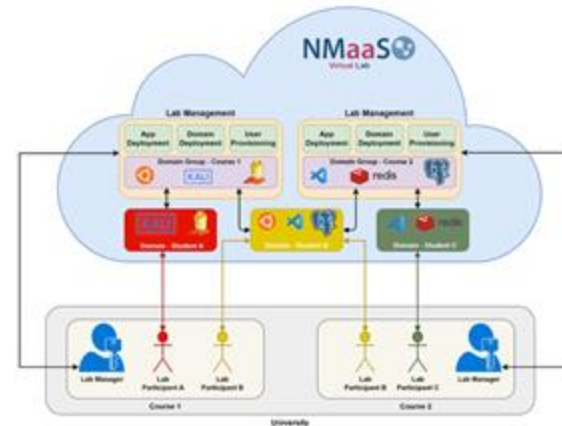
Managing and execution of university and hands-on exercises

- Application deployment in the cloud
- No application configuration overhead
- Simple access and management for Lab Managers and Participants

2 Pilot courses

- IT service management
- Network Security

@Ss. Cyril and Methodius
University in Skopje,
North Macedonia
@NTUA, Greece

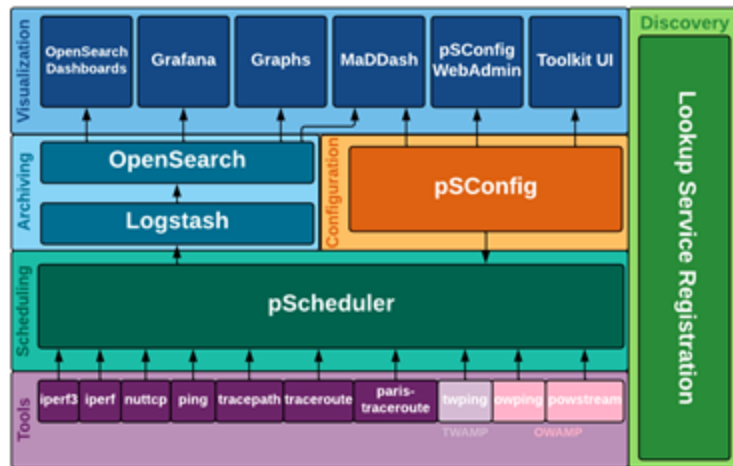


perfSONAR

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)



perfSONAR



<https://www.perfsonar.net/>



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

Performance Measurement Platform - PMP

Exploring the performance of the GÉANT backbone while experiencing perfSONAR on small nodes

- Low-cost hardware nodes with pre-installed perfSONAR software and deployed in GÉANT collaborating organisations in Europe and Africa.
- Central components including a central Measurement Archive (MA) and a Dashboard.
- Measurement points in the GÉANT backbone network
- PMP data analysis for new service report using AI/ML
- In green: Countries with the PMP service coverage in Europe

Dashboard: <https://pmp-archive.geant.org/grafana/>

Contact: perfsonar-smallnodes@lists.geant.org



TimeMap

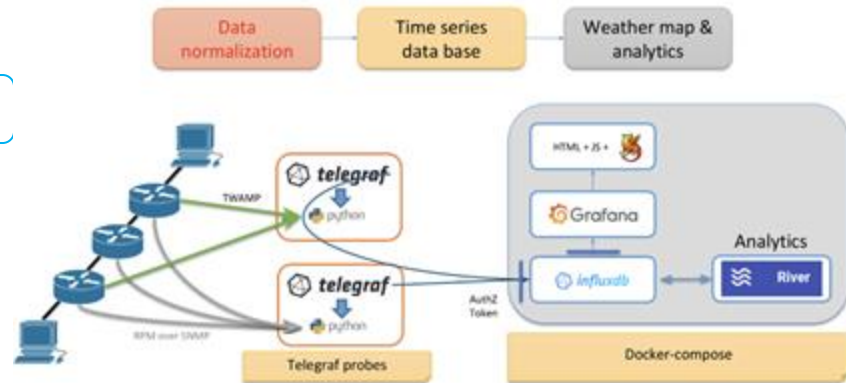
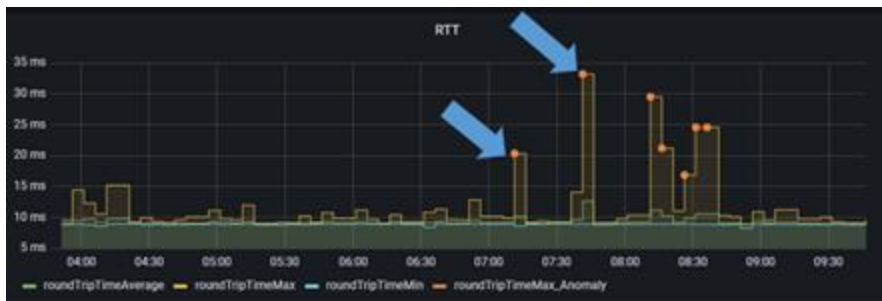
Zero-footprint per-segment latency and jitter monitoring tool

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

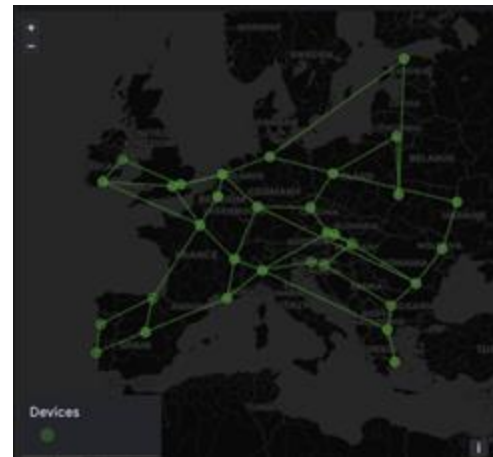
Architectural model for C-TFN TimeMap



Pictures: F. Farina, GARR, Nov 2024



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





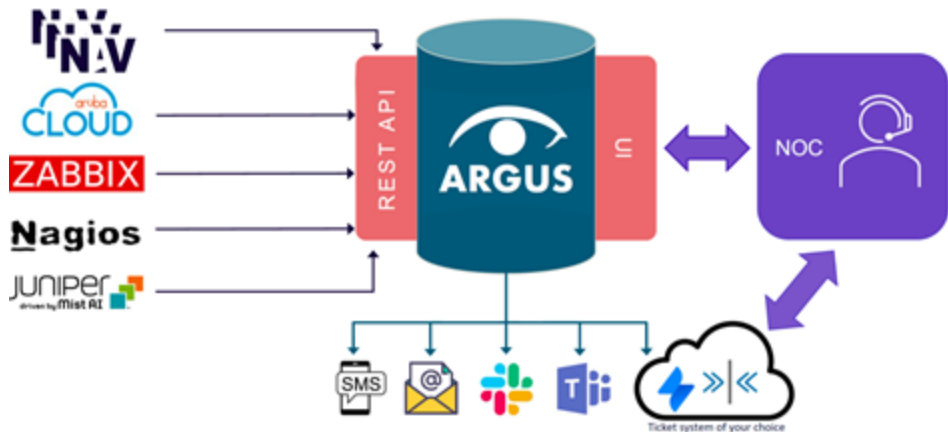
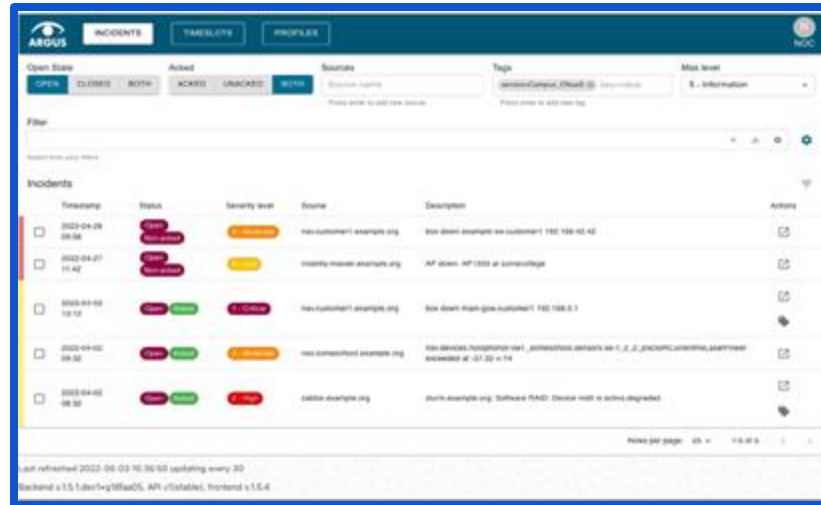
An alarm aggregation and correlation tool

- 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>



Production Services - Network eAcademy

Training

Orchestration, Automation, Virtualisation (OAV), Quantum Technologies, Time and Frequency Networks, Artificial Intelligence (AI) and more - courses available on Moodle
<https://e-academy.geant.org/moodle/>
<https://wiki.geant.org/display/NETDEV/Network+eAcademy>

Maturity Model

Online self-assessment tool for organisations to track their OAV journey
<https://wiki.geant.org/display/NETDEV/OAV+Maturity+Model>

Open Digital Architecture

Analysis of digital architectures through the lenses of TMF Open Digital Architecture blueprint <https://wiki.geant.org/display/NETDEV/OAV+Architectures>

Terminology

OAV and AI Terminology and Glossary document
<https://wiki.geant.org/display/NETDEV/OAV+Terminology>

NETDEV wiki

Network Development Work Package (WP6) public wiki space
<https://wiki.geant.org/display/NETDEV/>

Data Analysis

Analysis of data to extract conclusions, starting with the Moodle database for training

Network eAcademy Learning Tracks

**Orchestration,
Automation and
Virtualisation**

**Quantum
Technologies**

**Optical Time and
Frequency
Networks**



**Artificial
Intelligence**

**Network
Monitoring**

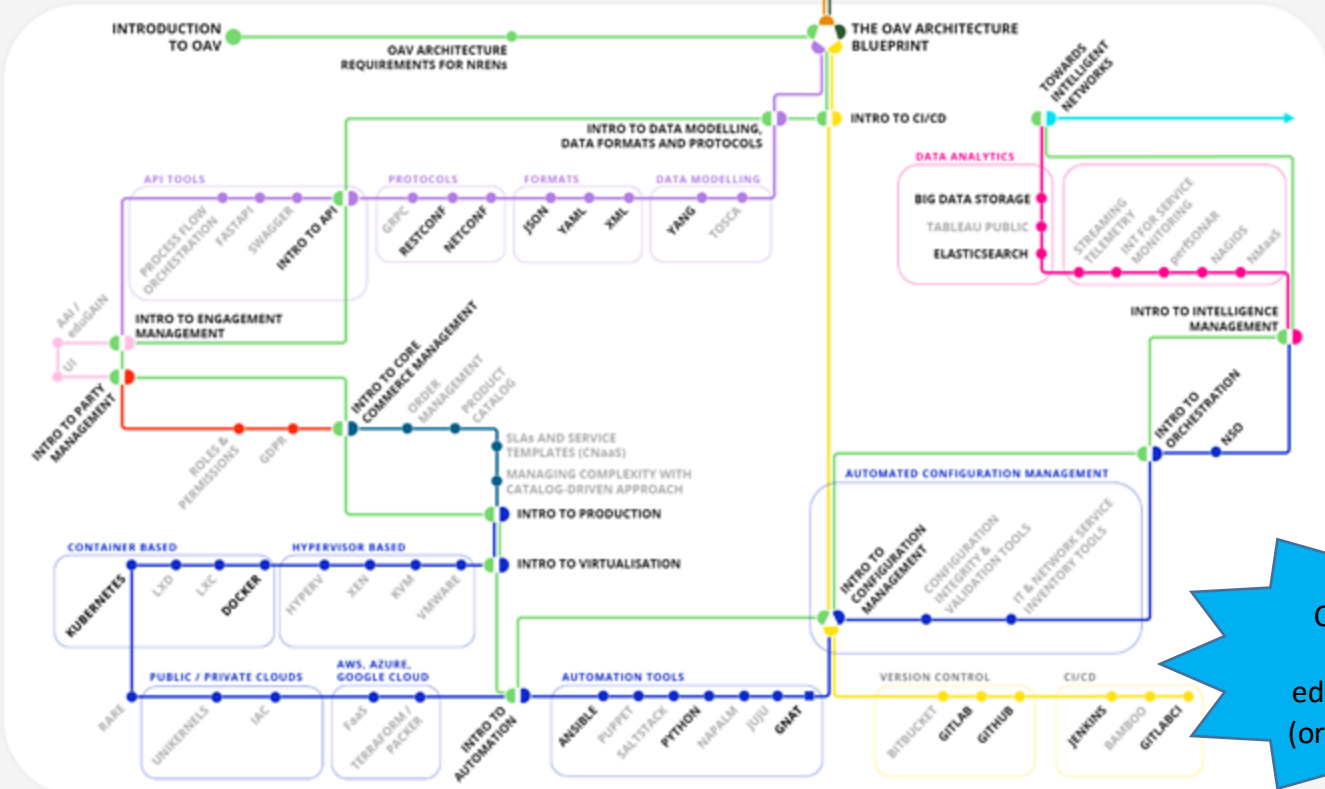
...to be continued

Network Automation eAcademy



- Legend**
- Unit / Document
 - Released / Not released
 - Exchange point
 - You can jump back and forth between this station and all exchange points at any time

- Tracks**
- GENERAL INTRODUCTION
 - AGILE, DevOps, CI/CD
 - DECOUPLING & INTEGRATION
 - PRODUCTION
 - ENGAGEMENT MANAGEMENT
 - PARTY MANAGEMENT
 - CORE COMMERCE MANAGEMENT
 - INTELLIGENCE MANAGEMENT
 - OAV REALISATION
 - USE CASES AND EXAMPLES
 - ARCHITECTURE

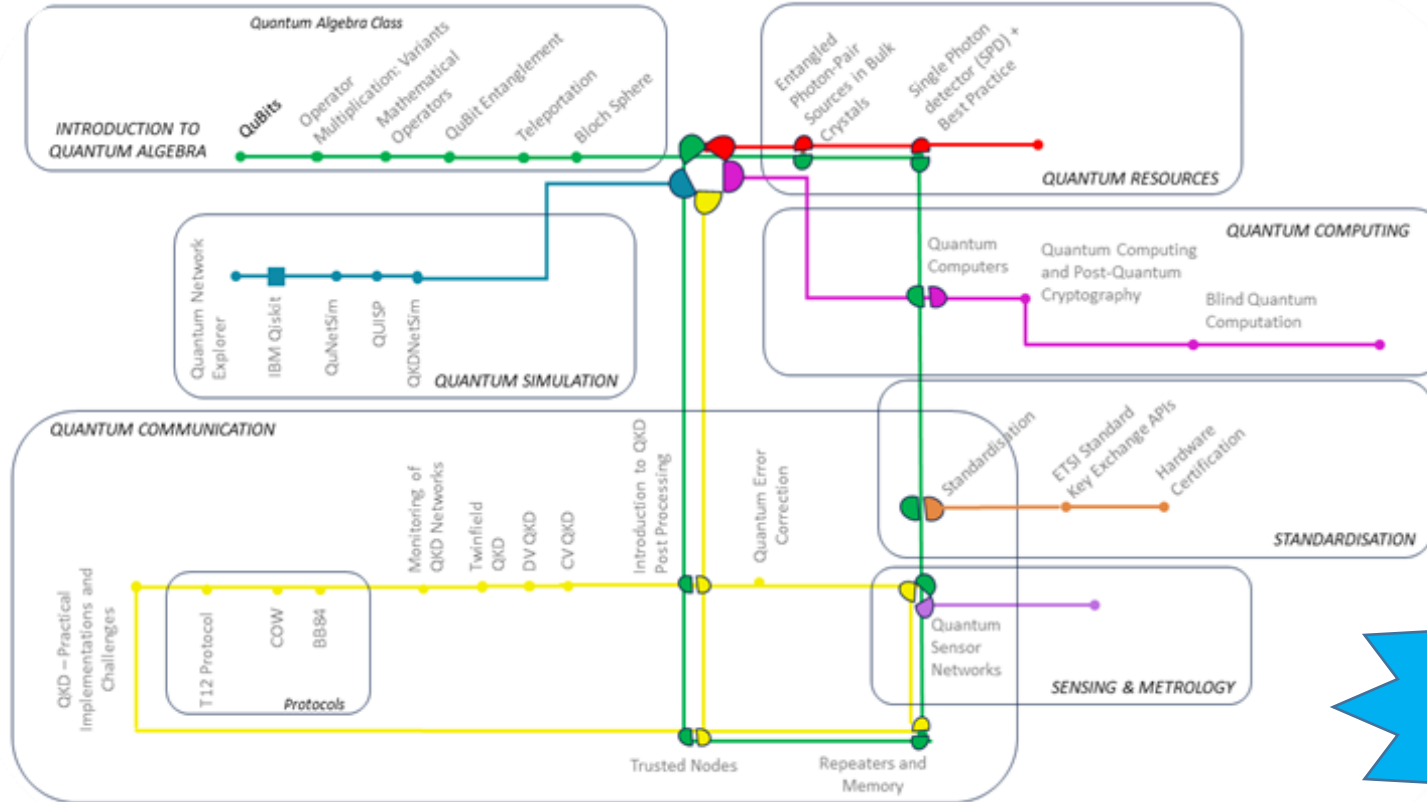


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eduGAIN access
(or social media)

<https://wiki.geant.org/display/NETDEV/OAV+Training+Portal>

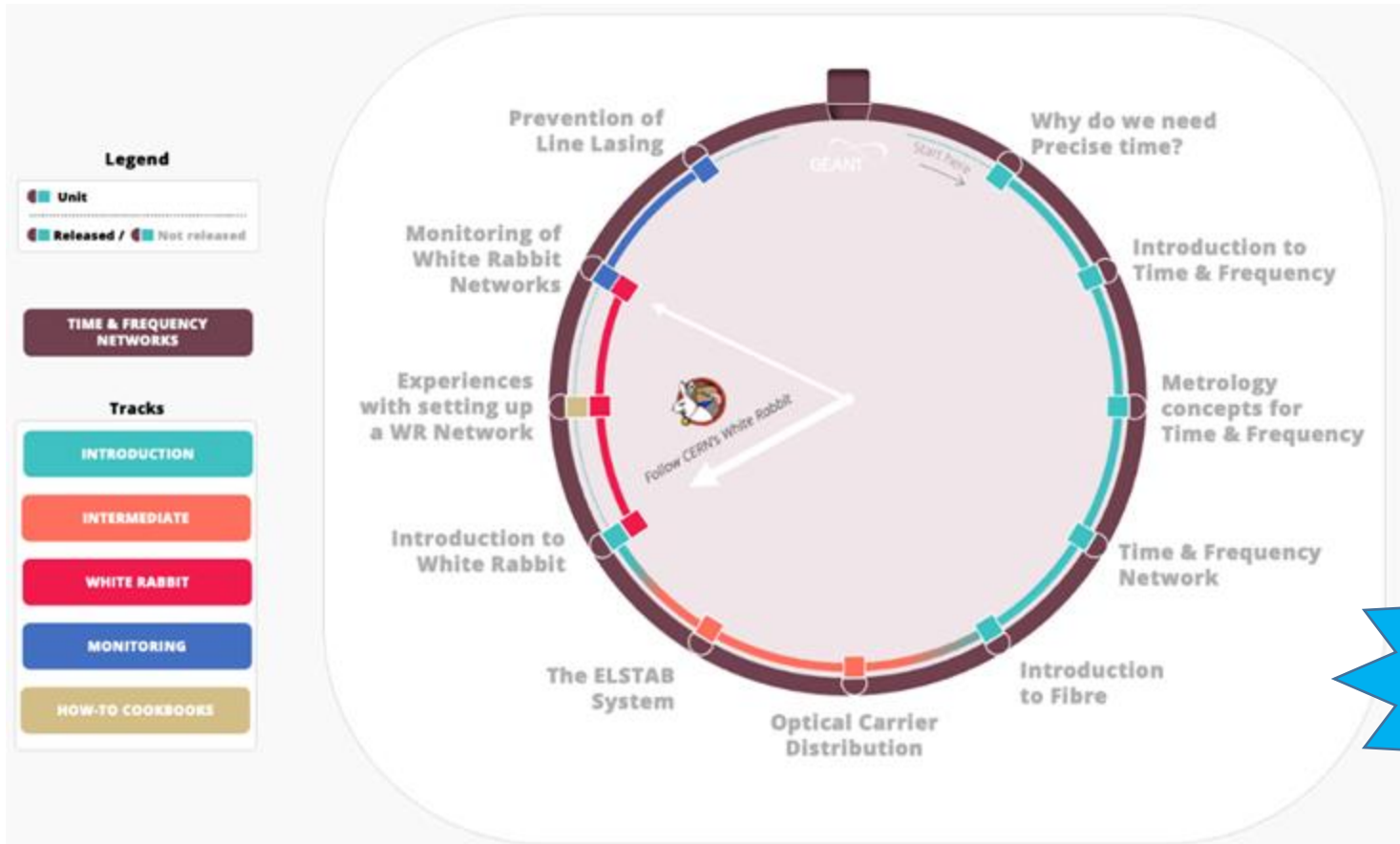
Functional Blocks in the TM Forum OPEN DIGITAL ARCHITECTURE (ODA)

Quantum eAcademy



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Optical Time and Frequency eAcademy



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Collaboration with the SoBigData Academy

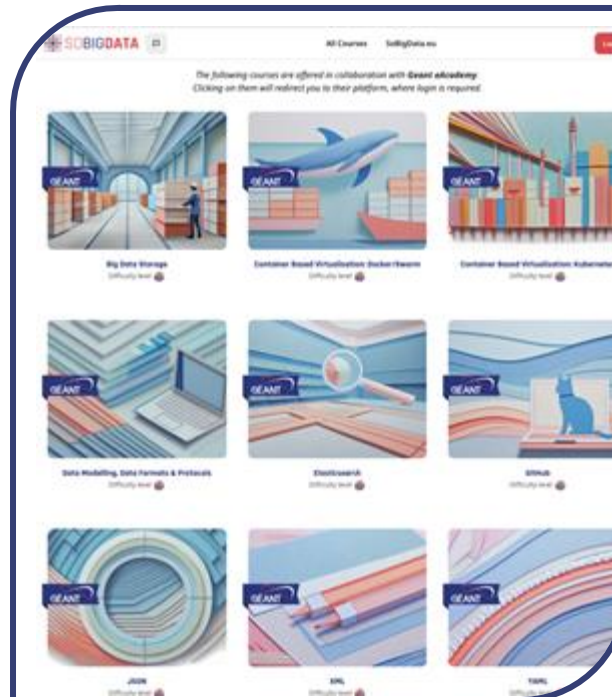
Synergies to Support Human Capital Development

SoBigData Academy

SoBigData promotes an open innovation culture in Big Data and AI, offering educational resources to support responsible data science. You'll find engaging and flexible MOOCs designed for a relaxed yet captivating learning experience.

Challenge yourself with interactive "play to learn" games, and earn certifications to build your professional portfolio.

<https://sobigdata.unipi.it/>



Network Automation Training



This Training Portal is offering courses focused on the research and education community, with external references that can be useful for us and examples that can be closer to our use cases. It is training by the community for the community. We will be publishing new classes regularly; all classes are online courses that you can follow and complete at your own pace.

External Collaborations

- Automation tools: GNAT (GNOC)
- Database (SoBigData Academy)
- Data Analysis (SoBigData Academy)
- Legal and Ethical aspects of Data Science (SoBigData Academy)
- Information Retrieval (SoBigData Academy)
- Data Mining & Machine Learning (SoBigData Academy)
- Data Analysis with Spark (SoBigData Academy)
- Data Theory and Society (SoBigData Academy)
- Complex Network Analysis (SoBigData Academy)

[Network eAcademy Training Portal](#)

OAV Terminology

Terminology and Glossary of terms related to:

- Orchestration, Automation and Virtualisation
- Maturity Model
- Artificial Intelligence

Motivation:

- To bridge the terminology gap in the community
- To systematically structure relevant OAV, AI and MM terminology

Published in collaboration with the GNA-G Automation Working Group

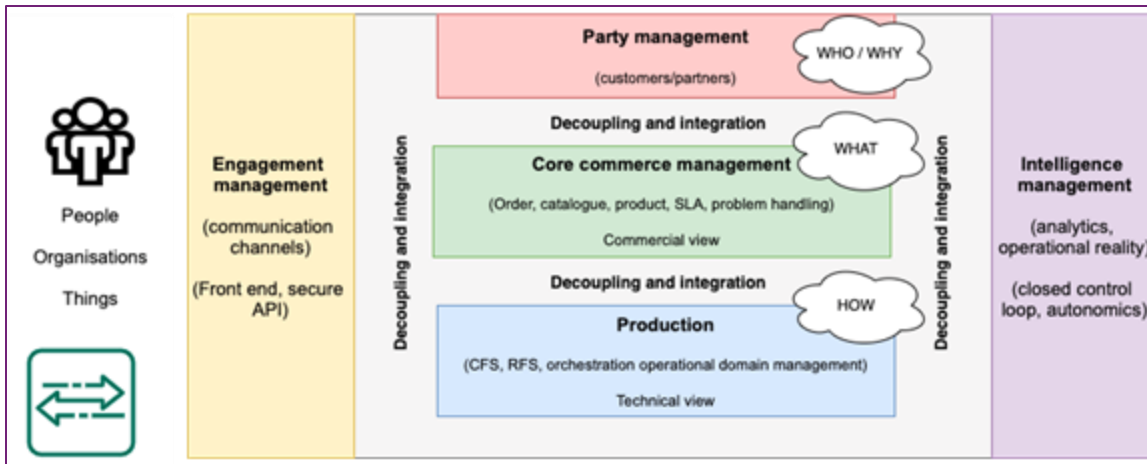


NEW:

[OAV Terminology Document Version 3.0](#)

Digital Architecture Analysis

Understanding different OSS/BSS architectures through the lenses of a standard blueprint architecture of TM Forum's ODA (Open Digital Architecture)



NETDEV Architectures

- [Argus](#)
- [NMaaS](#)
- [SPA](#)
- [PMP](#)

NREN Architectures

- [CARNET](#)
- [CYNET](#)
- [GÉANT](#)
- [GRNET](#)
- [HEAnet](#)
- [PIONIER](#)
- [SURF](#)

Other Use Cases

- [5G](#)
- [EOSC](#)
- [ETSI GANA](#)
- [ETSI OSM](#)
- [ETSI ZSM](#)
- [GVM](#)
- [MEF LSO](#)
- [Open Baton](#)
- [ONAP](#)
- [SENSE](#)
- [TALENT](#)

Maturity Model for Orchestration, Automation and Virtualisation

A self-assessment tool as a digital transformation progress indicator:

- 31 questions
- Data is used for analytical purposes only
- Report is sent to the person defined in survey
- Reports include guidelines to evolve
- Individual responses not published



<https://www.surveymonkey.com/r/SPYDQVB>

NETDEV Incubator

NETDEV Incubator

Why

Include new topics

Include new people
and organisations

How

Simple and easy
NETDEV Incubator
process

Call for proposals
always open

What

NREN-Supported
Network Development - WP6- Related Topic

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

What can be an Incubator Project ?

A new design

A new development

**An existing service
improvement**

**New life of an old
work**

A **specific** and **well-defined**,
WP6-related work chunk
that is **doable** in a **limited**
period of time with **limited**
resources.

**Design of a new
service**

A learning unit

A proof of concept

**An existing work
topic improvement**

A study

NETDEV Incubator Process



Prepare a proposal using NETDEV Template

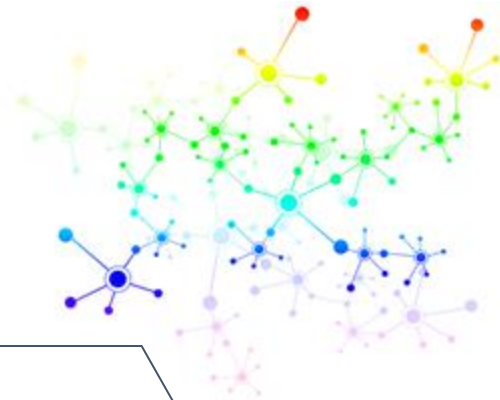
S **M** **A** **R** **T**

Specific, Measurable, Achievable, Resource- and Time-bound

Obtain
support
from 3
NRENs'

Submit a
proposal

netdev-
incubator
@
lists.geant.org



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

WP6 help and support

WP6 provides help and support in all incubator process phases:

- When filling in any of the Templates
- When searching for support
- In promoting the proposal in all its steps
 - Matching the user groups and communication channels
- In tasks during the project execution
- In coordinating and facilitating the work of the focus groups and project teams



Global Network Advancement Group – GNA-G



A community of network professionals from the R&E networking organisations worldwide

Working together to better align resources and make the continent-to-continent interconnections more efficient for global science collaborations and transnational education

Working groups

AutoGOLE/SENSE
autogole@lists.gna-g.net

GREN Engineering Advancement
gren-engineering-wg@lists.gna-g.net

Securing GREN
securing-the-gren-wg@lists.gna-g.net

GREN Resilience
gren-resilience-wg@lists.gna-g.net

Data Intensive Science
gna-dis-wg@lists.gna-g.net

Routing
routing-wg@lists.gna-g.net

Network Automation
network-automation@lists.gna-g.net

Global LEOSat
global-leosat-wg@lists.gna-g.net

Community Meetings

Online – 4 Qs VCs

- 8 & 10 April

In-person at events

- APAN59
- TNC25

Events

- 19 March [Network Technologies Workshop](#), online
- 1-2 April [Network Performance and Monitoring Workshop](#),
Prague, Czech Republic
- 2-3 April [22nd SIG-NOC](#), Prague, Czech Republic
- 8 April [GNA-G Community VC 1](#), online
- 10 April [Network Platforms Workshop](#), online
- 10 April [GNA-G Community VC 2](#), online
- 7 May [Network eAcademy Infoshare](#), online

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





Thank You!

www.geant.org



*netdev@lists.geant.org
netdev-incubator@lists.geant.org*

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