



The GN5-2

# Network Development Tools and Services

Work package – WP6

Ivana Golub, PCSS

10 April 2026, 24<sup>th</sup> SIG-NOC Meeting, Utrecht, Netherlands

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.

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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.

# GÉANT Project

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

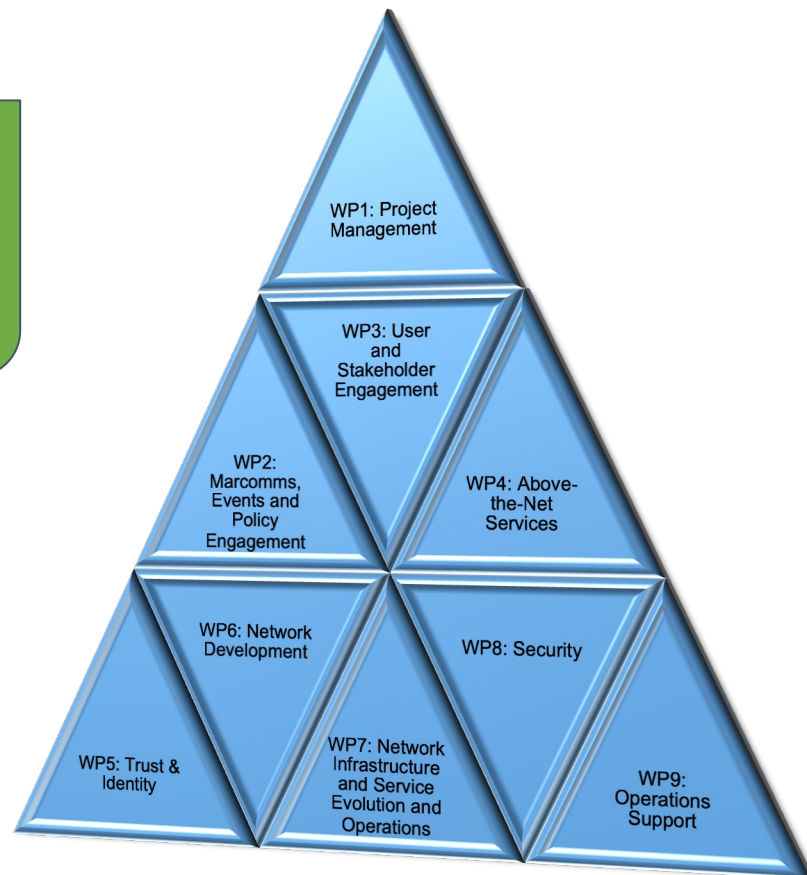
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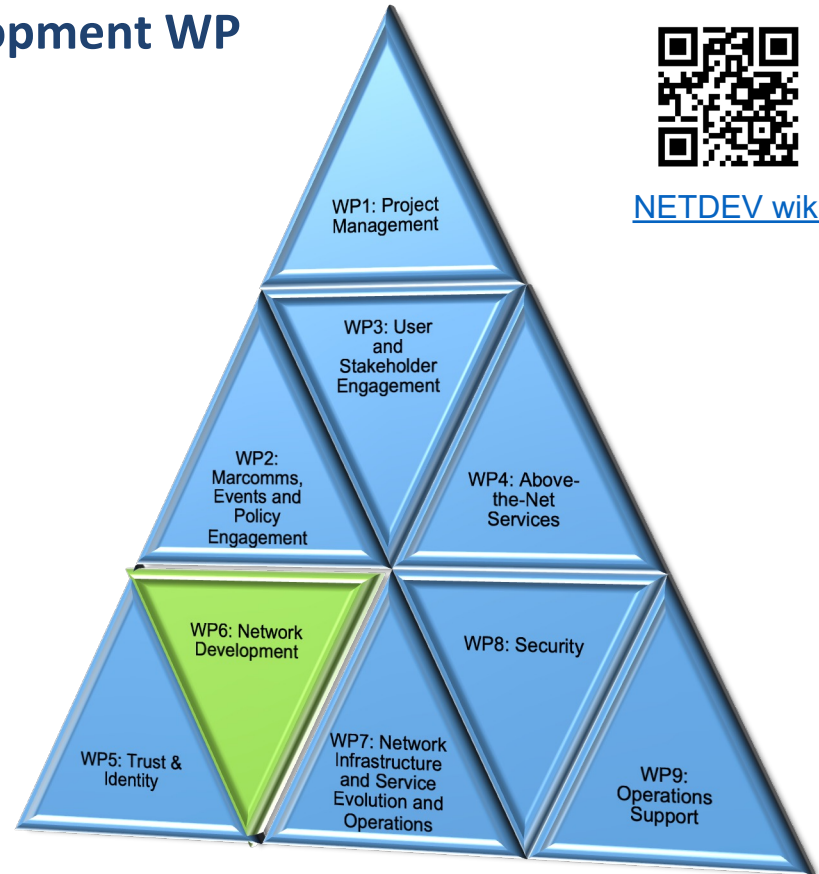
The project's mission is to provide secure access to scientists, researchers and students to the world's most advanced connectivity and collaboration services, enabling effective and secure collaboration within virtual research communities around the world.



# GÉANT Project Structure – Network Development WP



[NETDEV wiki](#)



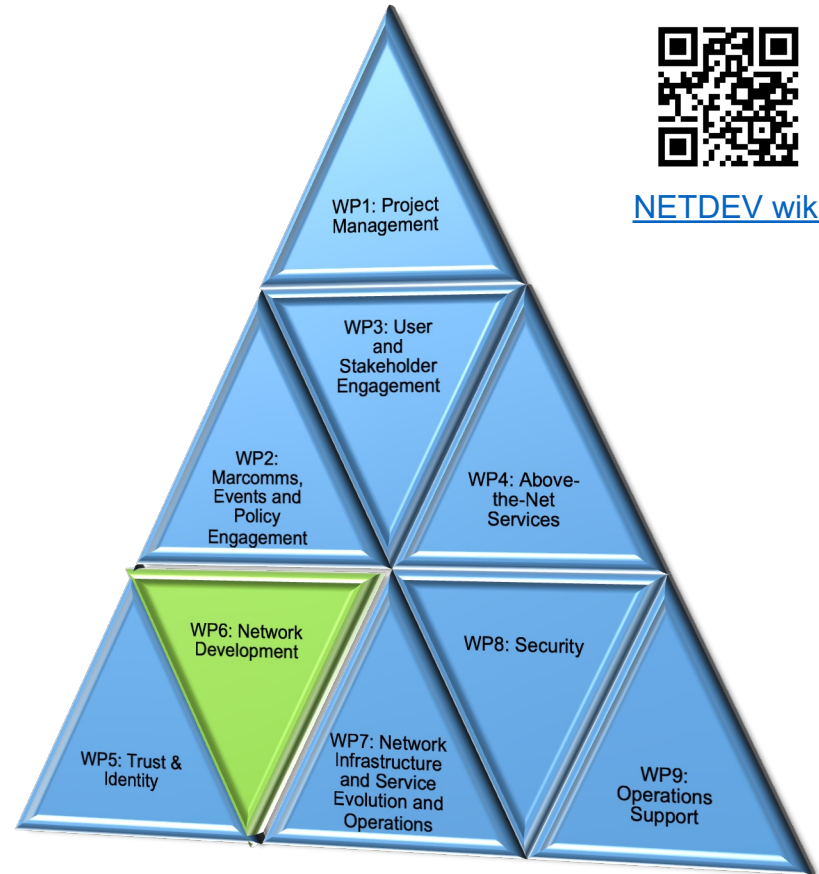
## Network Development WP Objective

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

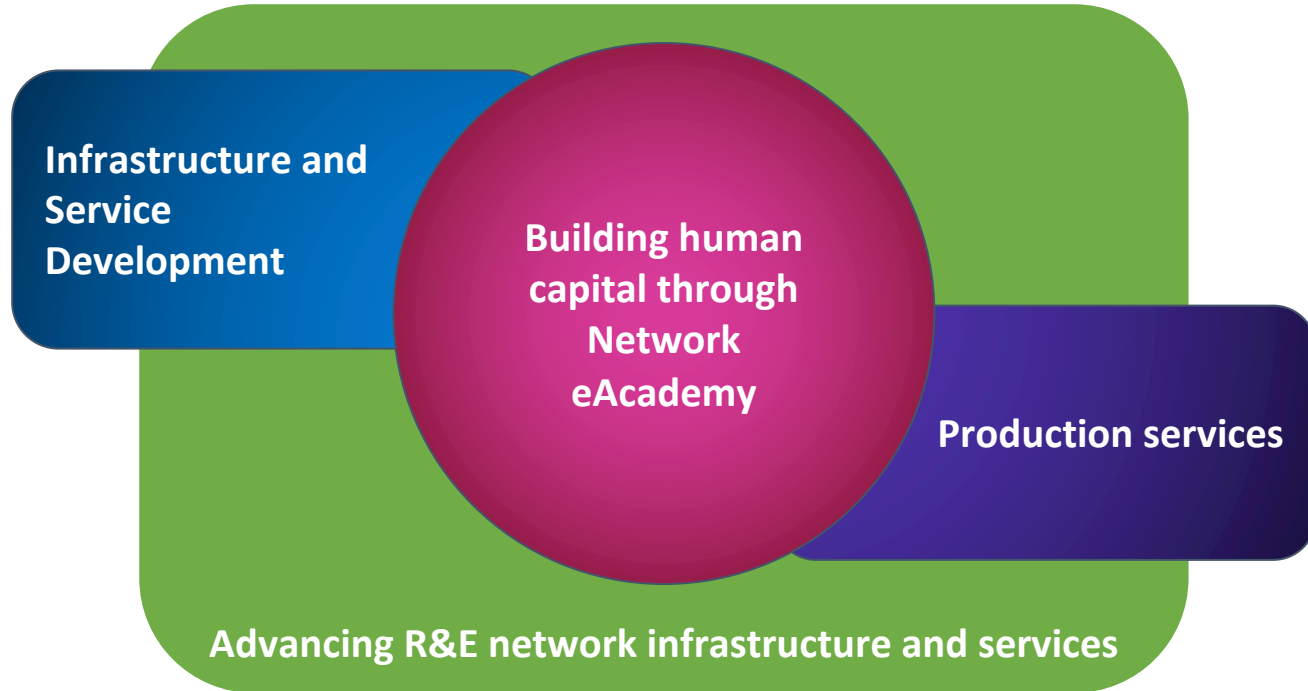
Exploring how emerging technologies can be applied for the GÉANT community

Enhancing GÉANT and NREN knowledge transfer through dissemination activities

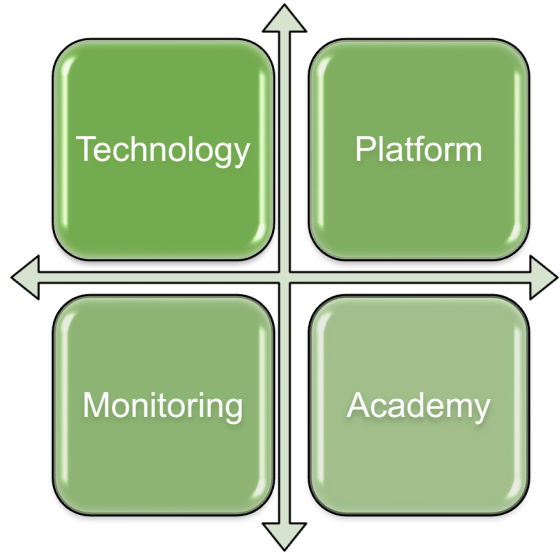


[NETDEV wiki](#)

## WP6 in collaboration with Project Partners and GÉANT



# GÉANT Project Structure – Network Development WP



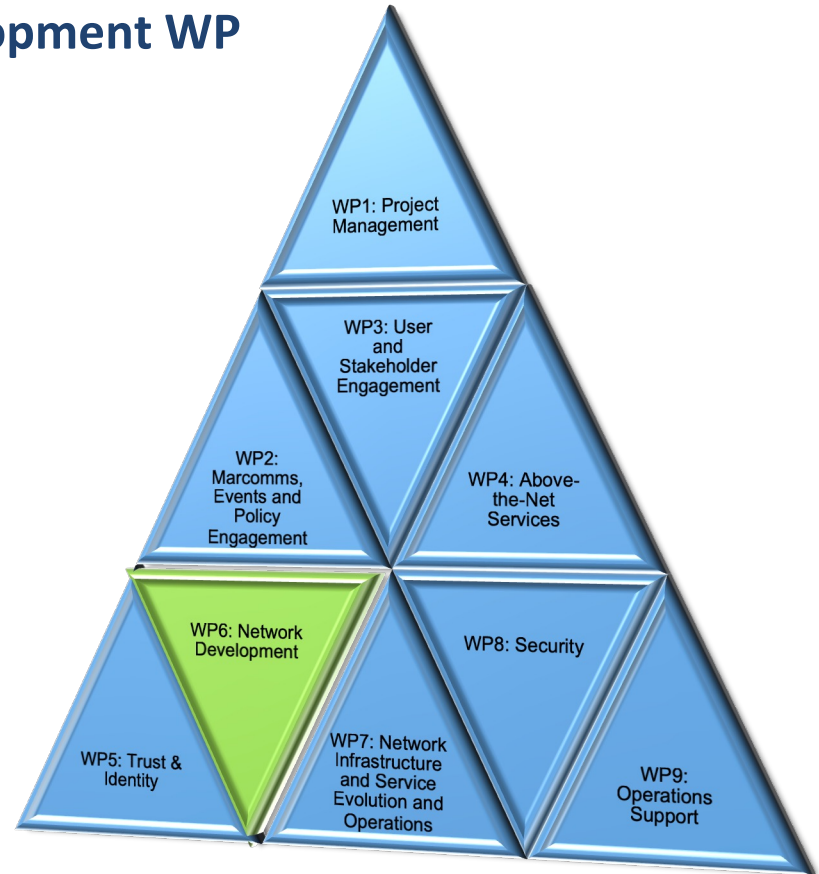
25 organisations

>100 persons

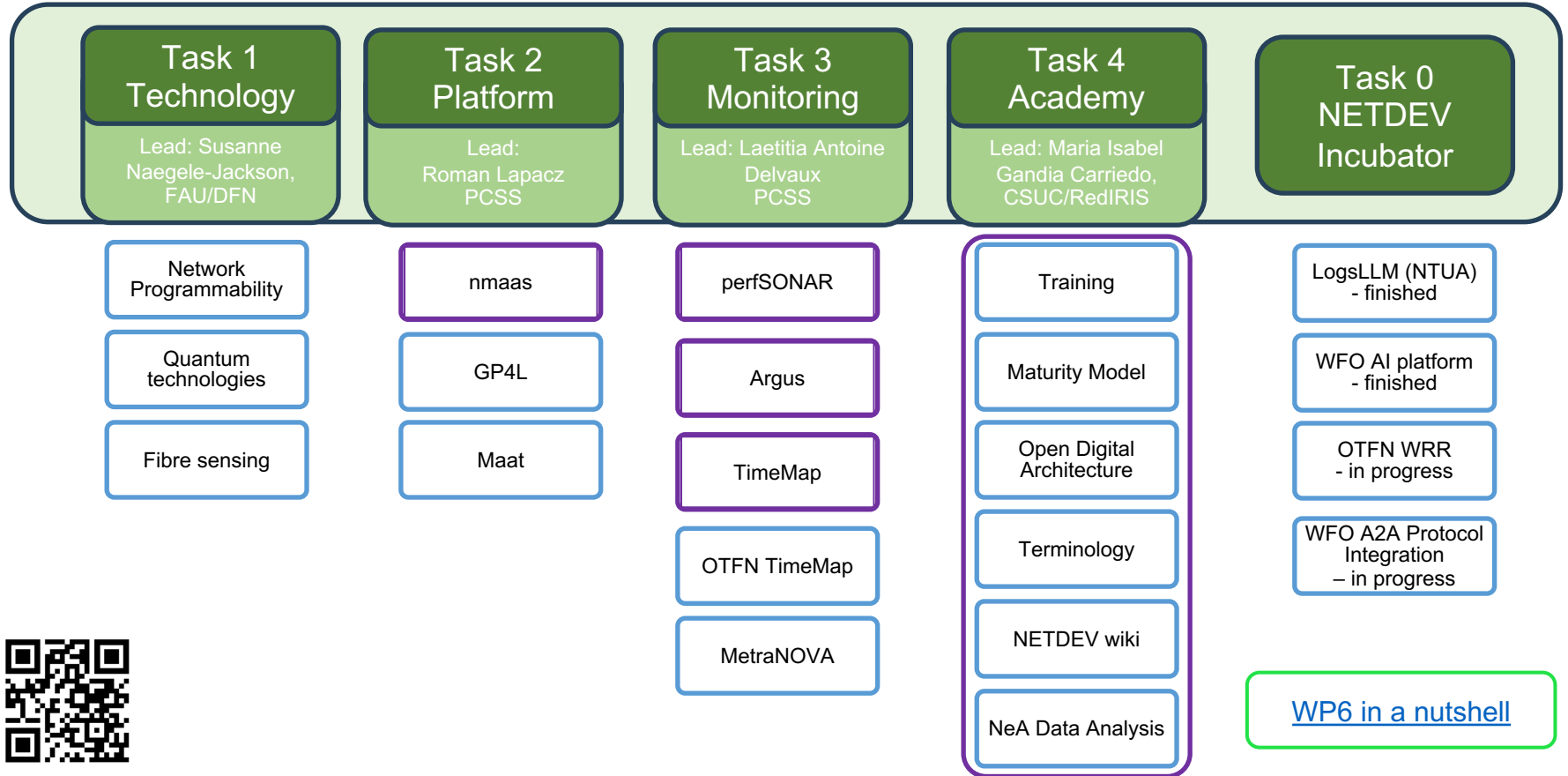
5,6 MEUR

28,1 FTE

>20 topics



# WP6 Development, Tools and Services



# Development

# Network Technologies Development

## Network Programmability using RARE

### Router for Academia, Research and Education - RARE

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](mailto:rare@lists.geant.org)



## Fibre Sensing

Exploring technologies, solutions, processes and best practices on deploying fibre sensing, focusing on R&E use cases and beyond.  
<https://wiki.geant.org/display/NETDEV/Fibre+Sensing> and [fibre-sensing@geant.lists.org](mailto:fibre-sensing@geant.lists.org)



## Quantum

Knowledge and expertise building through testing of R&E use cases, training and wiki-based knowledge hub.  
<https://wiki.geant.org/display/NETDEV/QKD> and [gkd-discuss@lists.geant.org](mailto:gkd-discuss@lists.geant.org)



# 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 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, based on TimeMap visualising OTFN and IP parameters, in design for the Core Time and Frequency Network C-TFN

## MetrANOVA

Technical and policy aspects of controlled data sharing  
<https://github.com/MetrANOVA>



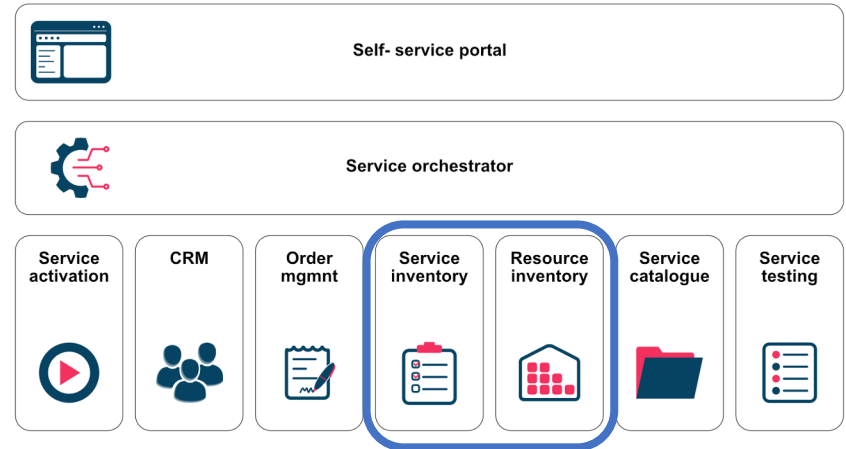
# Maat



## The Single Source of Truth for network automation

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

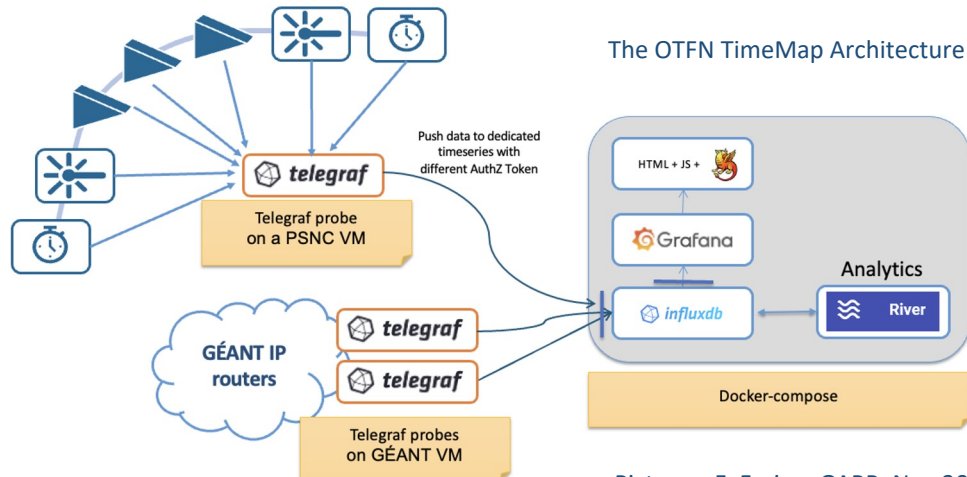
- Storing information about resource and service instances
- Use of NoSQL (MongoDB) database
- Data model can be easily updated/extended and validated
- In use in GP4L
- In **production** in PCSS/PIONIER and RENATER
- Available on nmaas



# Monitoring the Core TF Network - OTFN TimeMap

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

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



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

# MetrANOVA

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

Open-source software stack for  
collecting, storing and sharing  
operational network data

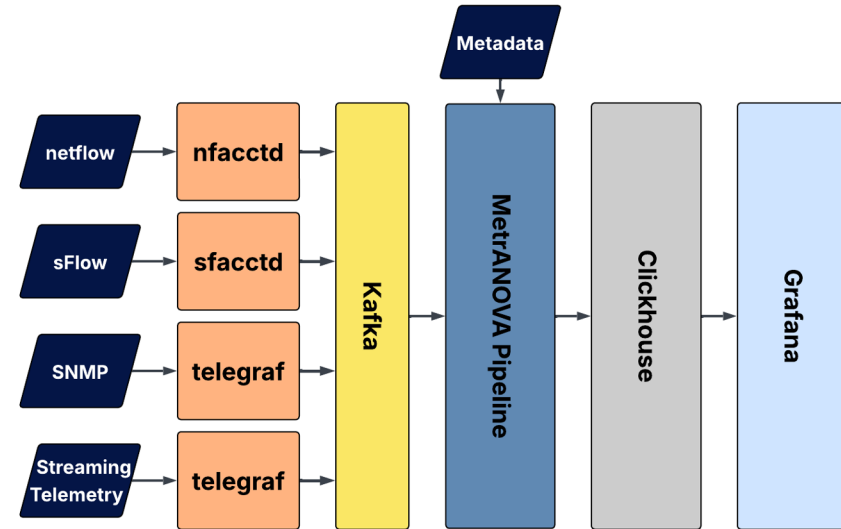
## Two work streams:

**Technical:** flow, SNMP and streaming telemetry data sharing

**Policy:** Defining and creating an environment for confident and controlled data sharing

# MetrANOVA

A Consortium for Advancing Network Observation, Visualization and Analysis



MetrANOVA stack

# NETDEV Services

# Production Services - Network Management and Monitoring

nmaas

A cloud-based orchestration platform for application deployment.

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

<https://nmaas.eu>



perfSONAR

Open-source, modular, flexible toolkit for active performance monitoring

[www.perfsonar.net](http://www.perfsonar.net) and [perfsonar@lists.geant.org](mailto:perfsonar@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](mailto:timemap@lists.geant.org)



Argus

Alarm aggregation open-source unified dashboard and notification system.

<https://network.geant.org/argus/> [argus@lists.geant.org](mailto:argus@lists.geant.org)





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

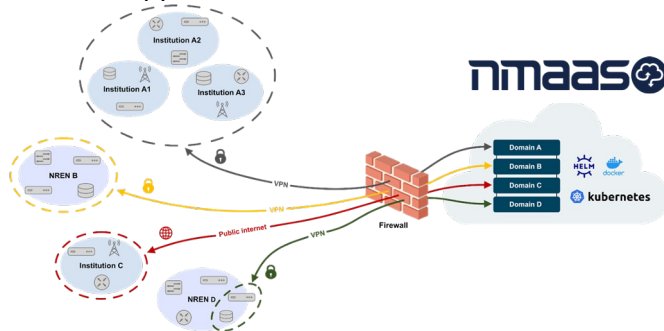


## Use cases



### Managing of small and medium size networks

- 37 network 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



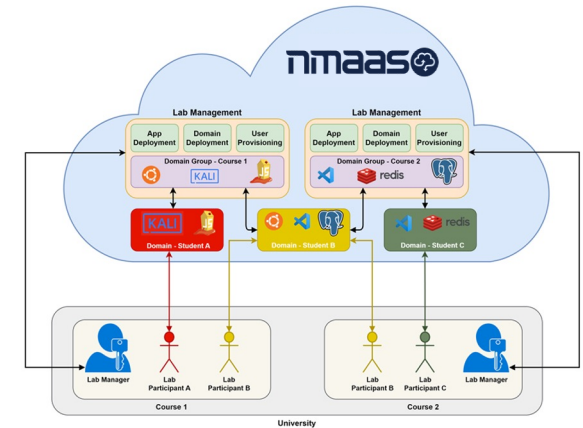
### Managing and execution of university and hands-on exercises

- 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



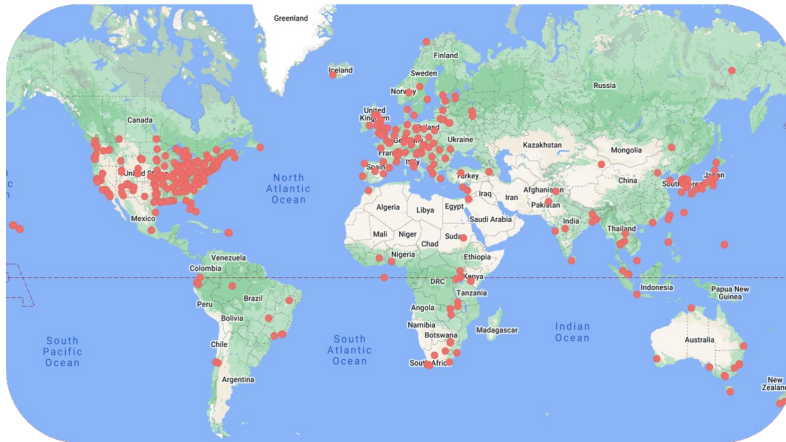
# perfSONAR

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

## Some GÉANT project team contributions:

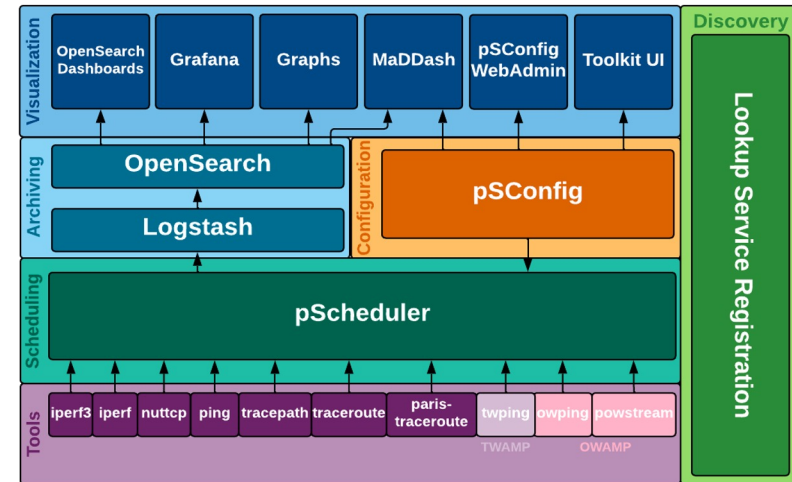
- Microdep integration with perfSONAR
- On-demand perfSONAR Graphical User Interface (psGUI)
- ML-based data analysis
- Support for GÉANT community & large-scale project (e.g. WLCG, EuroHPC, NPAW)

2500+  
registered  
hosts in  
1000+  
organisations  
worldwide



perfSONAR

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



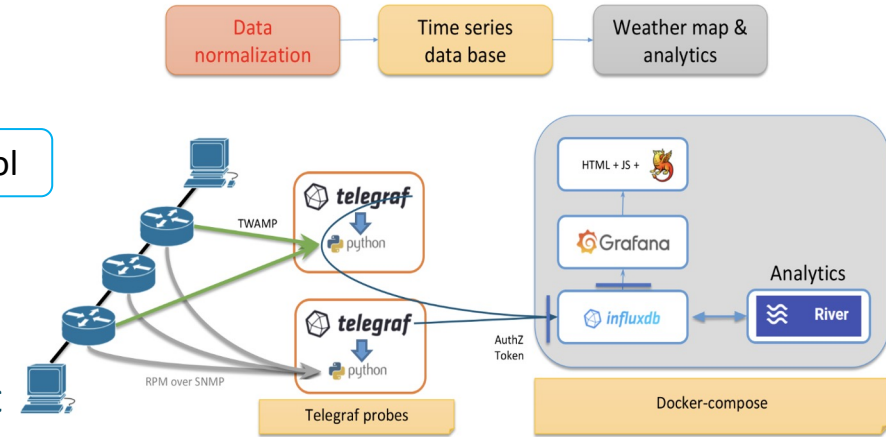
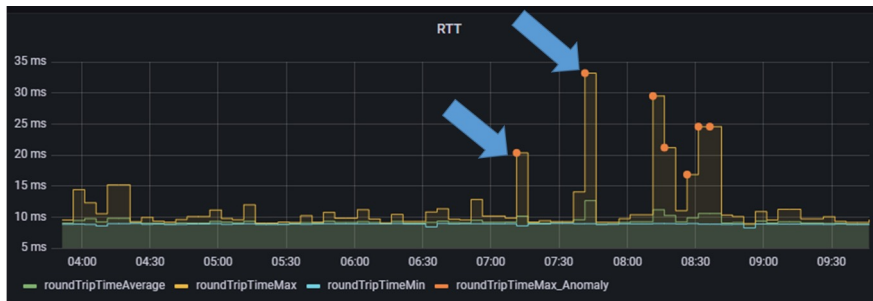
# TimeMap

Zero-footprint per-segment latency and jitter monitoring tool

Based on TWAMP (RFC 5357)  
Easy and quick installation

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

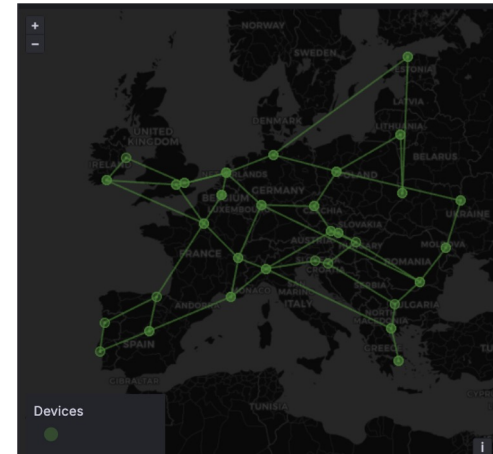
Architectural model for C-TFN TimeMap



Pictures: F. Farina, GARR, Nov 2024



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





## An alarm aggregation and correlation tool

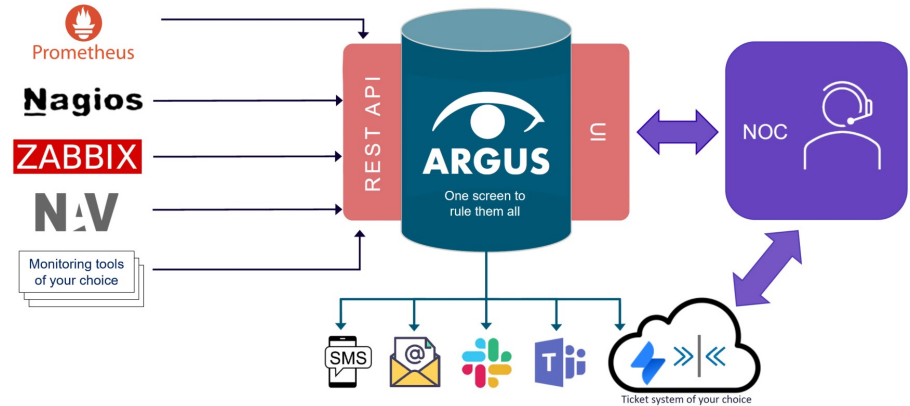
- A single unified dashboard and notification system for aggregated incidents from all monitoring applications
- Based on the CNaas use case
- A production service since Sept 2022
- In production in Sikt, SUNET, GÉANT, RHnet

Software development and maintenance

User engagement and support

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

ID	Timestamp	Status	Severity level	Source	Description	Ticket
52975	Fri, 25 Oct 2024 08:35:26 +0200	Open Acked	5 - Information	argus	fsdaf	
52966	Mon, 14 Oct 2024 13:48:28 +0200	Open Acked	4 - Low	cnaas-vk.c.uninett.no	box down mdir-osl-t1.uninett.no 158.38.181.80	
52965	Mon, 14 Oct 2024 13:48:28 +0200	Closed Acked	4 - Low	cnaas-vk.c.uninett.no	box down samiskvg-t1.uninett.no 158.38.181.81	
52974	Mon, 14 Oct 2024 13:48:28 +0200	Open Acked	4 - Low	cnaas-vk.c.uninett.no	box down mdir-trd-t1.uninett.no 158.38.181.76	
52973	Mon, 14 Oct 2024 13:48:27 +0200	Closed Acked	4 - Low	cnaas-vk.c.uninett.no	box down udir-tos-t1.uninett.no 158.38.181.54	
52972	Mon, 14 Oct 2024 13:48:27 +0200	Closed Acked	4 - Low	cnaas-vk.c.uninett.no	box down udir-osl-t1.uninett.no 158.38.181.49	
52971	Mon, 14 Oct 2024 13:48:27 +0200	Closed Acked	4 - Low	cnaas-vk.c.uninett.no	box down sikt-osl-t1.uninett.no 158.38.181.45	
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52969	Mon, 14 Oct 2024 13:48:27 +0200	Closed Unacked	4 - Low	cnaas-vk.c.uninett.no	box down norid-osl-t1.uninett.no 158.38.181.41	
52968	Mon, 14 Oct 2024 13:48:27 +0200	Closed Unacked	4 - Low	cnaas-vk.c.uninett.no	box down niwa-t1.uninett.no 158.38.181.26	



# 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**

**Fibre Sensing**

**...to be continued**

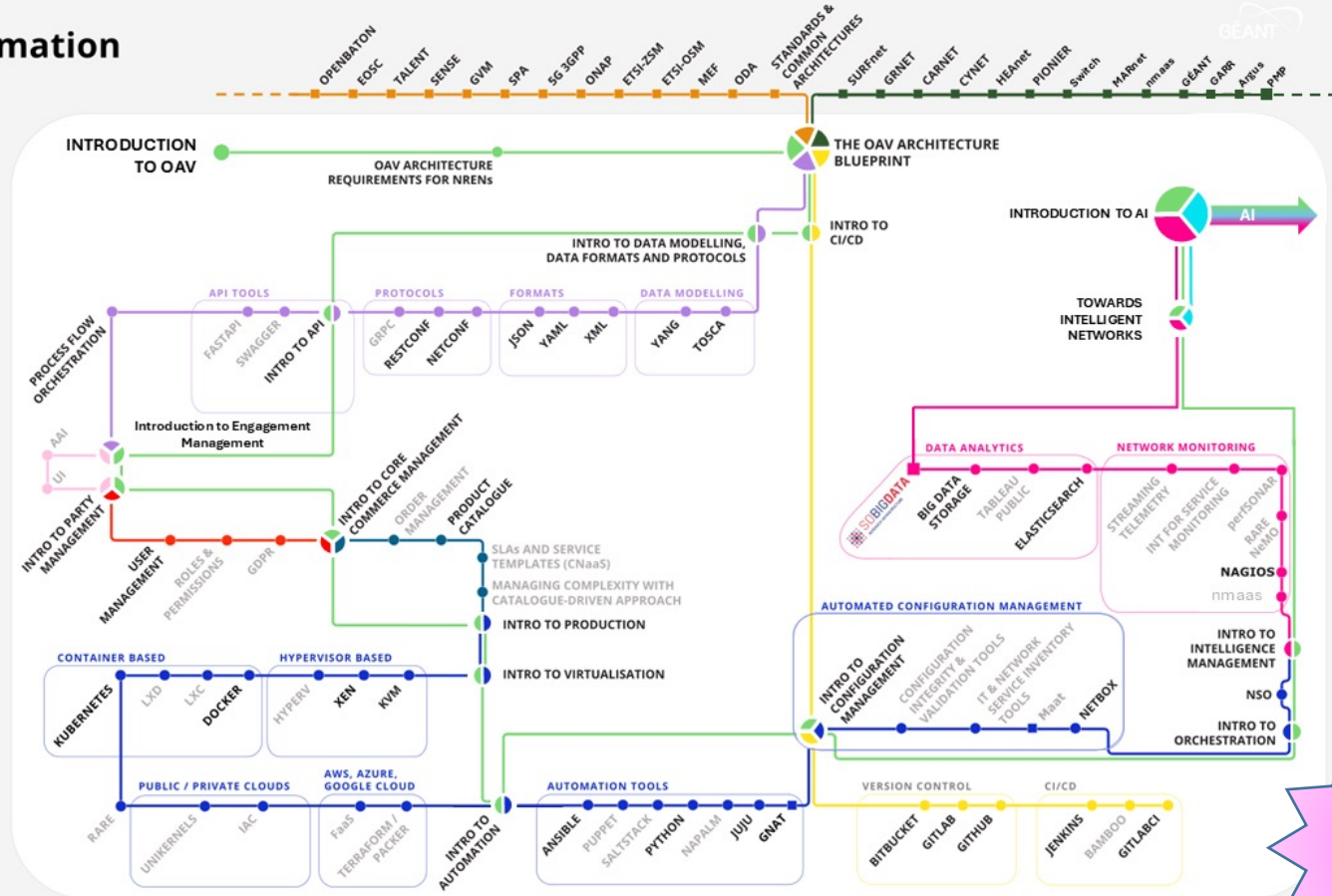
# Network Automation eAcademy

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

- Legend**
- Unit / ■ Document / ext. link
  - 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



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



# Quantum Tech eAcademy

## Legend

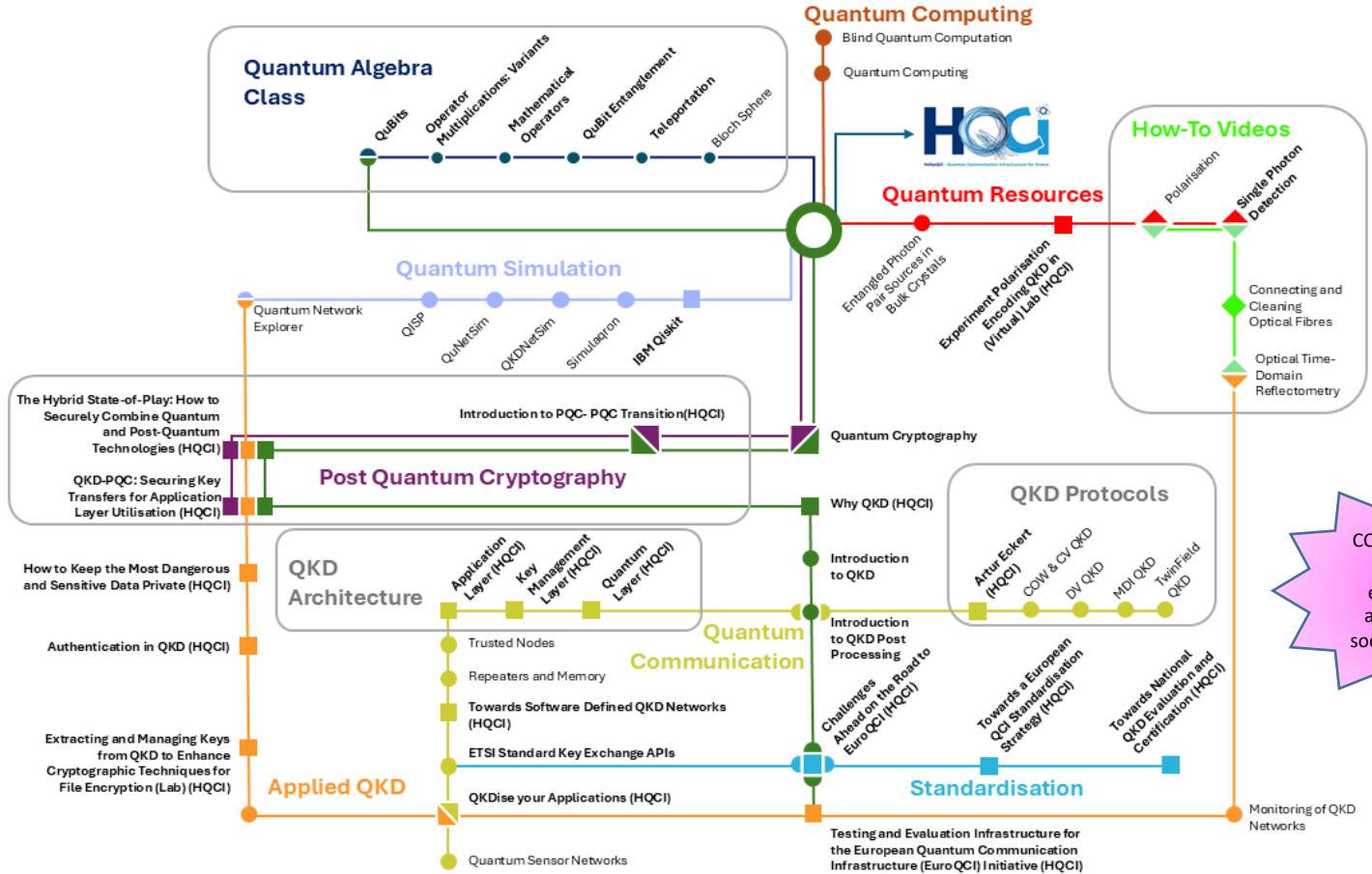
- Unit
- Document
- ◆ Video
- Released
- Not Released
- Exchange point

Start Here: the green line marks the introductory units

Exchange point: From this station onwards, you can continue the course in any direction

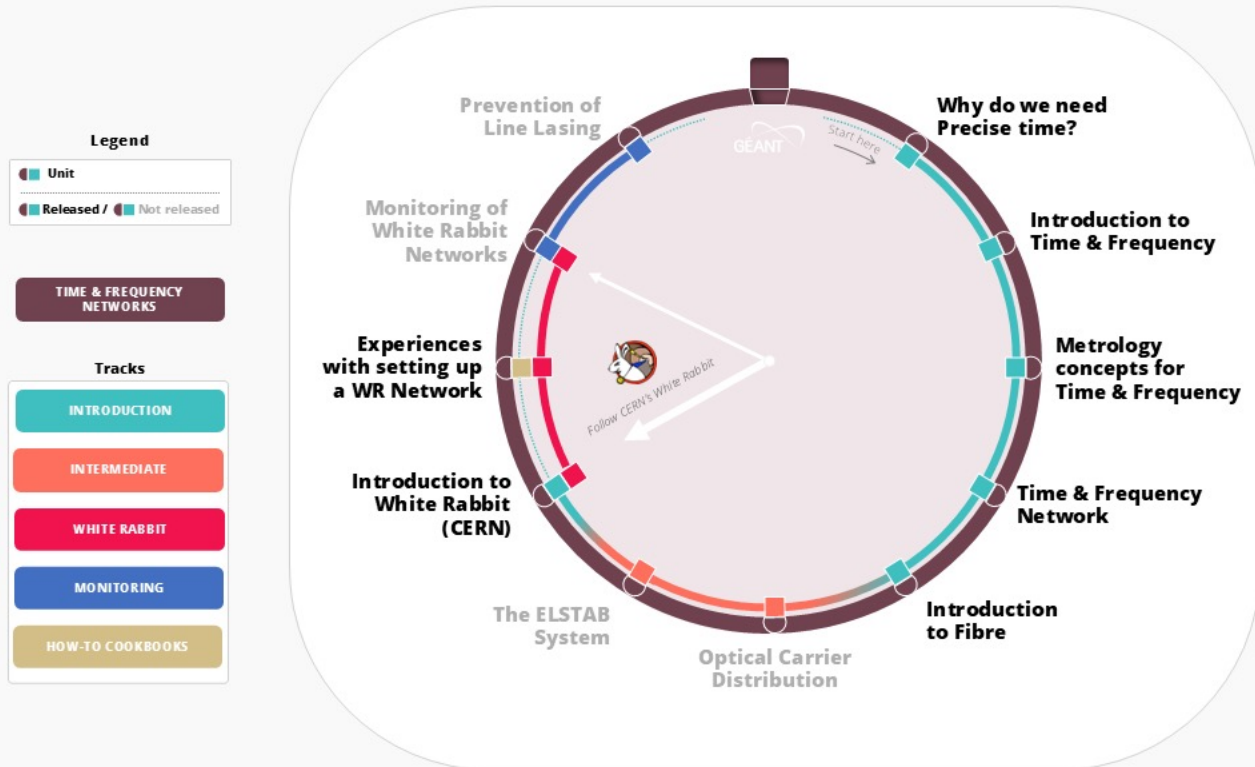
## Tracks

- GENERAL INTRODUCTION
- QUANTUM ALGEBRA
- QUANTUM COMMUNICATION
- QUANTUM SIMULATION
- QUANTUM COMPUTING
- POST QUANTUM CRYPTOGRAPHY
- APPLIED QKD
- STANDARDISATION
- QUANTUM RESOURCES
- HOW-TO VIDEOS



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eduGAIN access (or social media)

# Optical Time & Frequency Networks (OTFN) eAcademy



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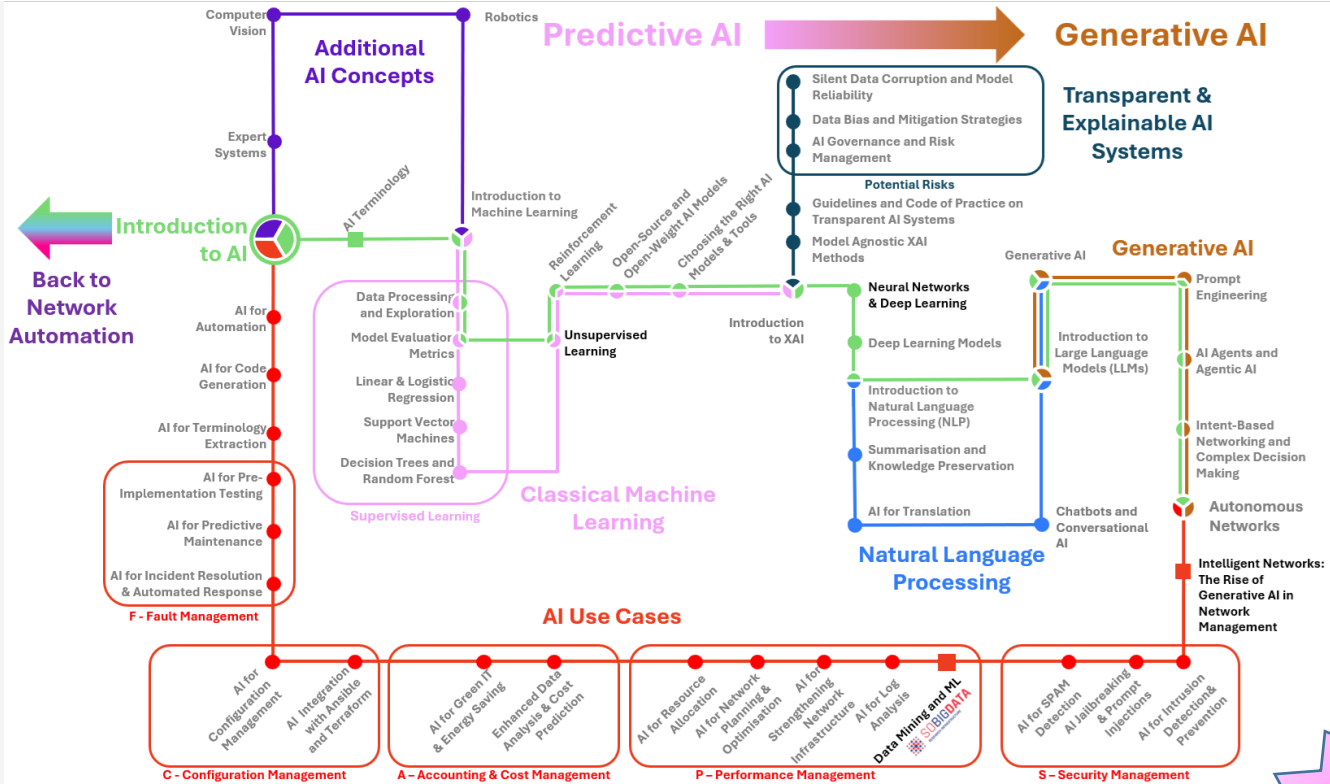
# Artificial Intelligence eAcademy

## Legend

- Unit
- Document/ External Link
- Released
- Not Released
- Exchange Point

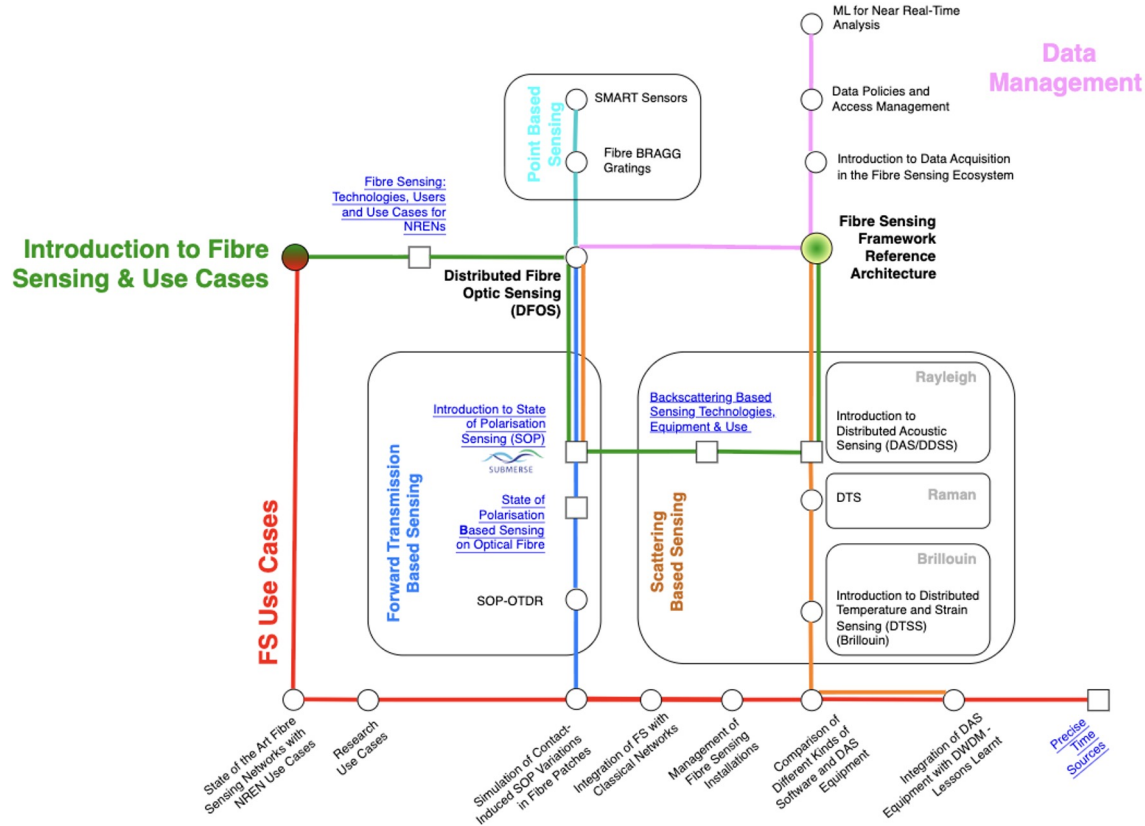
## Tracks

- Introduction to AI
- Classical Machine Learning
- AI Use Cases
- Natural Language Processing
- Additional AI Concepts
- Transparent & Explainable AI Systems
- Generative AI



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# Fibre Sensing eAcademy



# 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



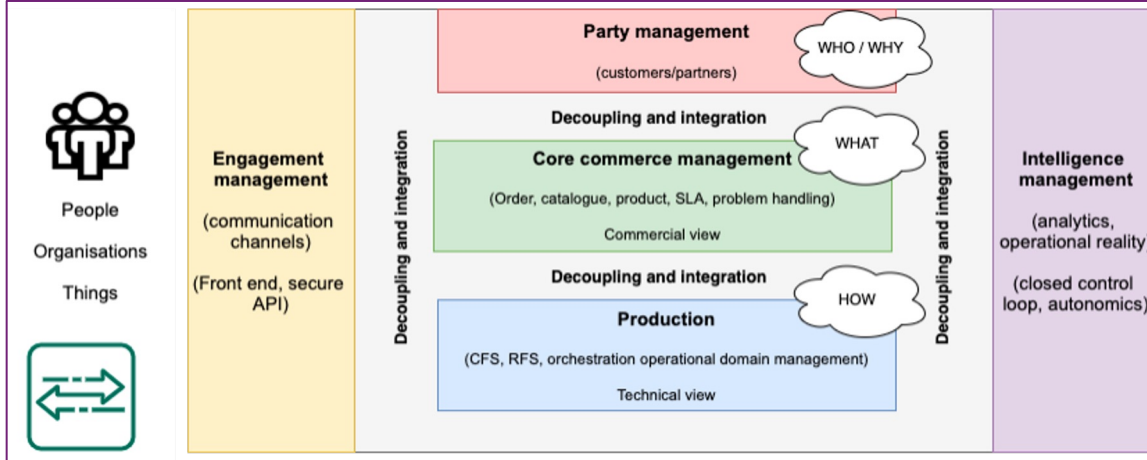
# Digital Architecture Analysis

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](#)
- [PMP](#)



## NREN Architectures

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

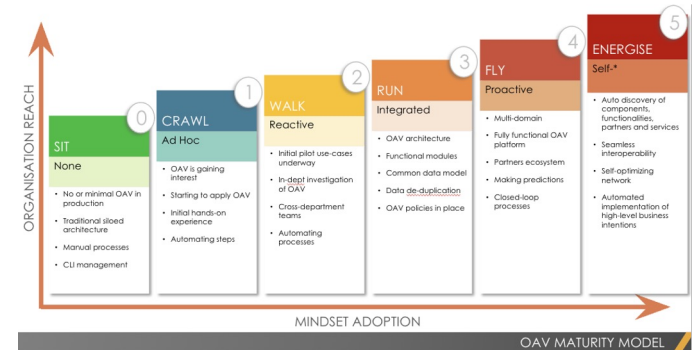
## Other Use Cases

- [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:

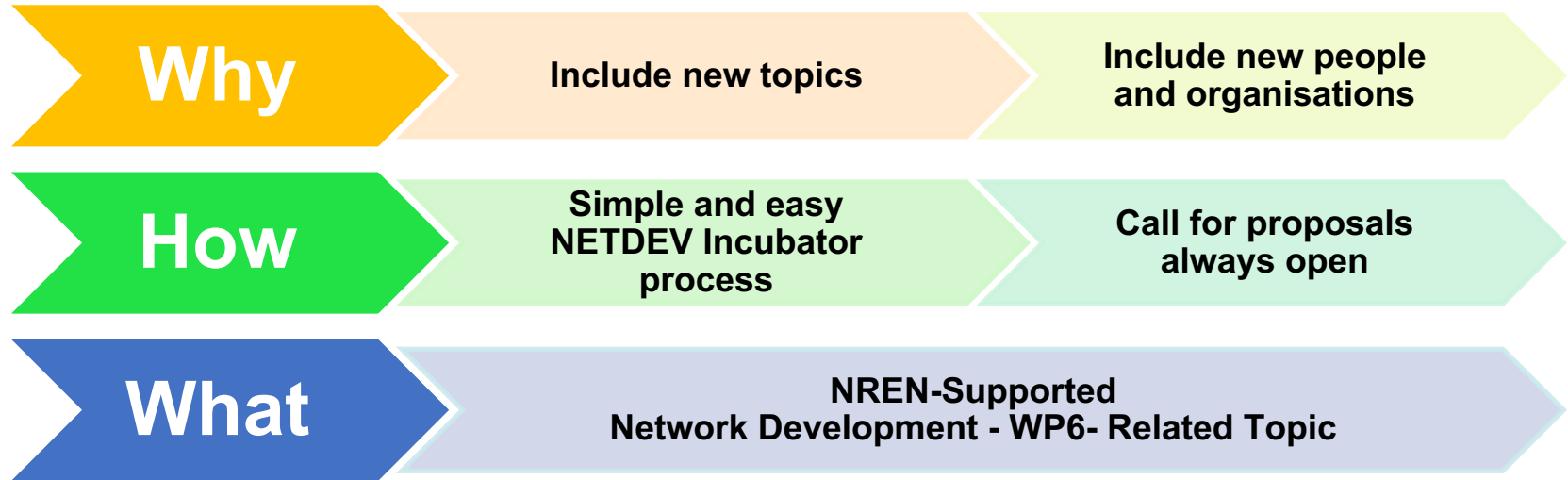
- 31 questions
- Data is used for analytical purposes only
- Report is sent to the person defined in survey
- Reports include guidelines to evolve
- Individual responses not published



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

# NETDEV Incubator

# NETDEV Incubator



<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>

## NETDEV Incubator Projects in GN5-2

NETDEV Incubator



### **LogsLLM: Automated Log Analysis and Management based on LLMs**

AI-supported log correlation and analysis

### **Incubator: Long-haul White Rabbit (WR) Time Distribution**

Technical feasibility & economic viability of distributing high-accuracy time services over existing NREN infrastructures

### **Workflow Orchestrator (WFO) RAG agent and LLM integration**

AI-supported data searching and filtering from the WFO database

### **Workflow Orchestrator (WFO) A2A Protocol Integration**

Multi-agent troubleshooting demonstrator of a microservice architecture for agents

## More information about WP6 work and results

NETDEV Wiki:

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

White papers, presentations and more:

<https://wiki.geant.org/spaces/NETDEV/pages/212303969/Dissemination>

NETDEV Incubator:

<https://wiki.geant.org/spaces/NETDEV/pages/613122207/NETDEV+Incubator>



# Thank You!



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[netdev-incubator@lists.geant.org](mailto:netdev-incubator@lists.geant.org)*

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