GÉANT NETDEV Services for Large-Scale Data-Intensive Science Facilities

Ivana Golub, PSNC

4th Global Research Platform

October 9-10, Limassol, Cyprus

30 years of Poznań Supercomputing and Networking Center

https://www.psnc.pl/

PSNC in numbers

507	16	30	16+	65	103
employees	laboratories	years of operation	fields of activity	current projects	projects in H2020, Horizon Europe, Digital Europe Programme

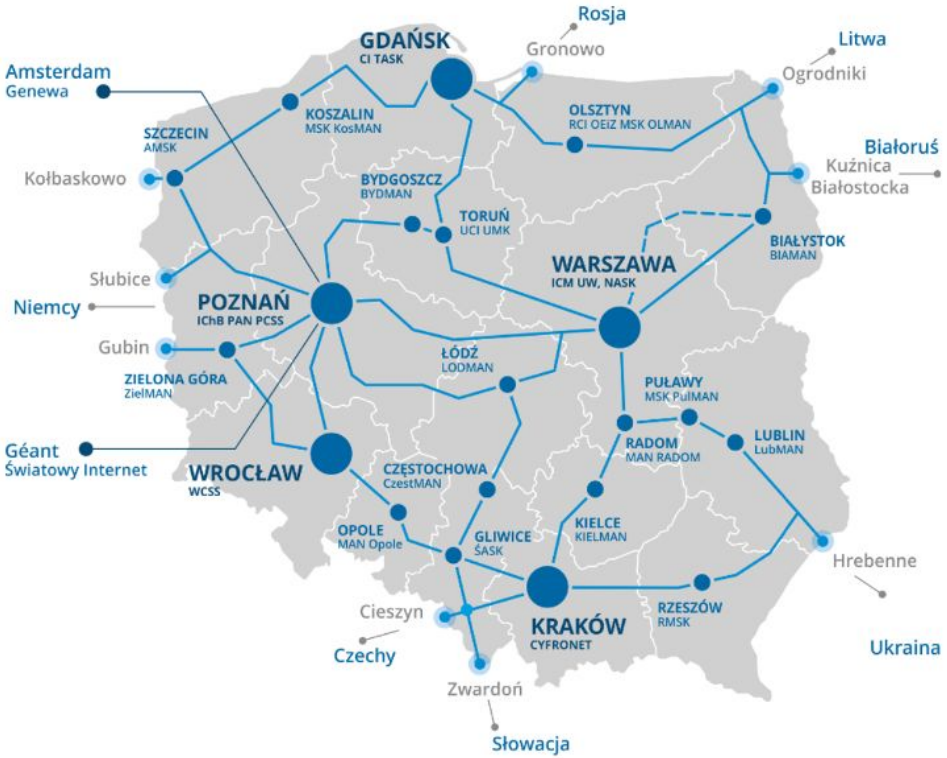
Center of e-Infrastructure

- National Research and Education Network PIONIER
- Research Metropolitan Area Network - POZMAN
- HPC Center
- Data repositories and Digital Libraries Federation

Center of Research & Development

- New Generation Networks
- HPC, Grids & Clouds
- Grand challenge applications
- New media and visualization technologies
- Knowledge Platforms
- Future Internet - Technology, Applications and Services for IS
- Cyber Security
- Quantum Communication and Computing – use cases and practical scenarios

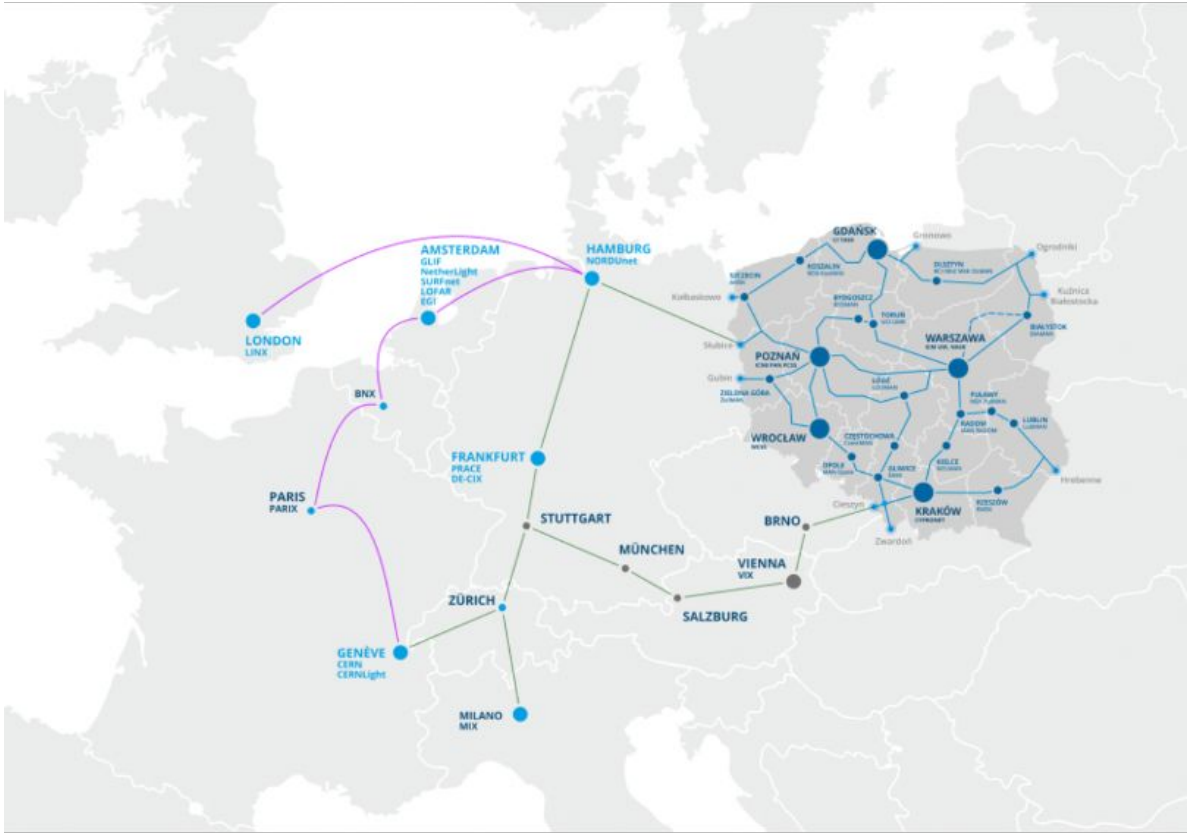
PSNC Network - PIONIER in Poland



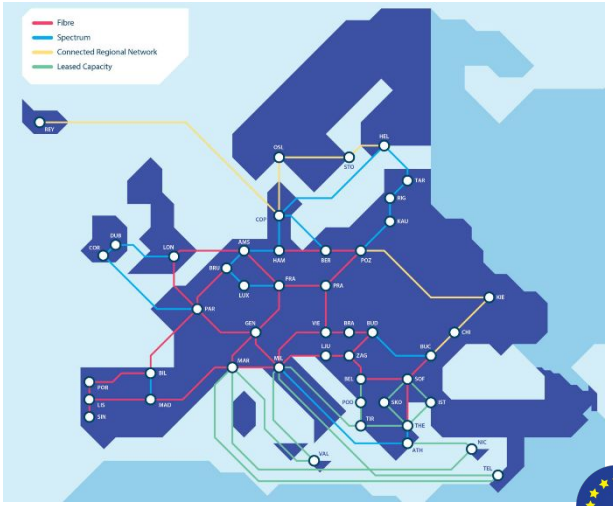
Type of connected unit	Number of units
Research institutions	221
Universities	196
Post-secondary schools	21
High schools, secondary schools, primary schools and vocational schools	234
Healthcare	59
Public safety	27
Goverment administration	27
Provincial administration	59
District, municipality and city administration	73
Other administration	9
Court and public prosecutor's office	26
Cultural institutions	104
Other educational	27

~10 000 km of fiber in total

PIONIER Connectivity in Europe



GÉANT – European Network Infrastructure, Services and Community



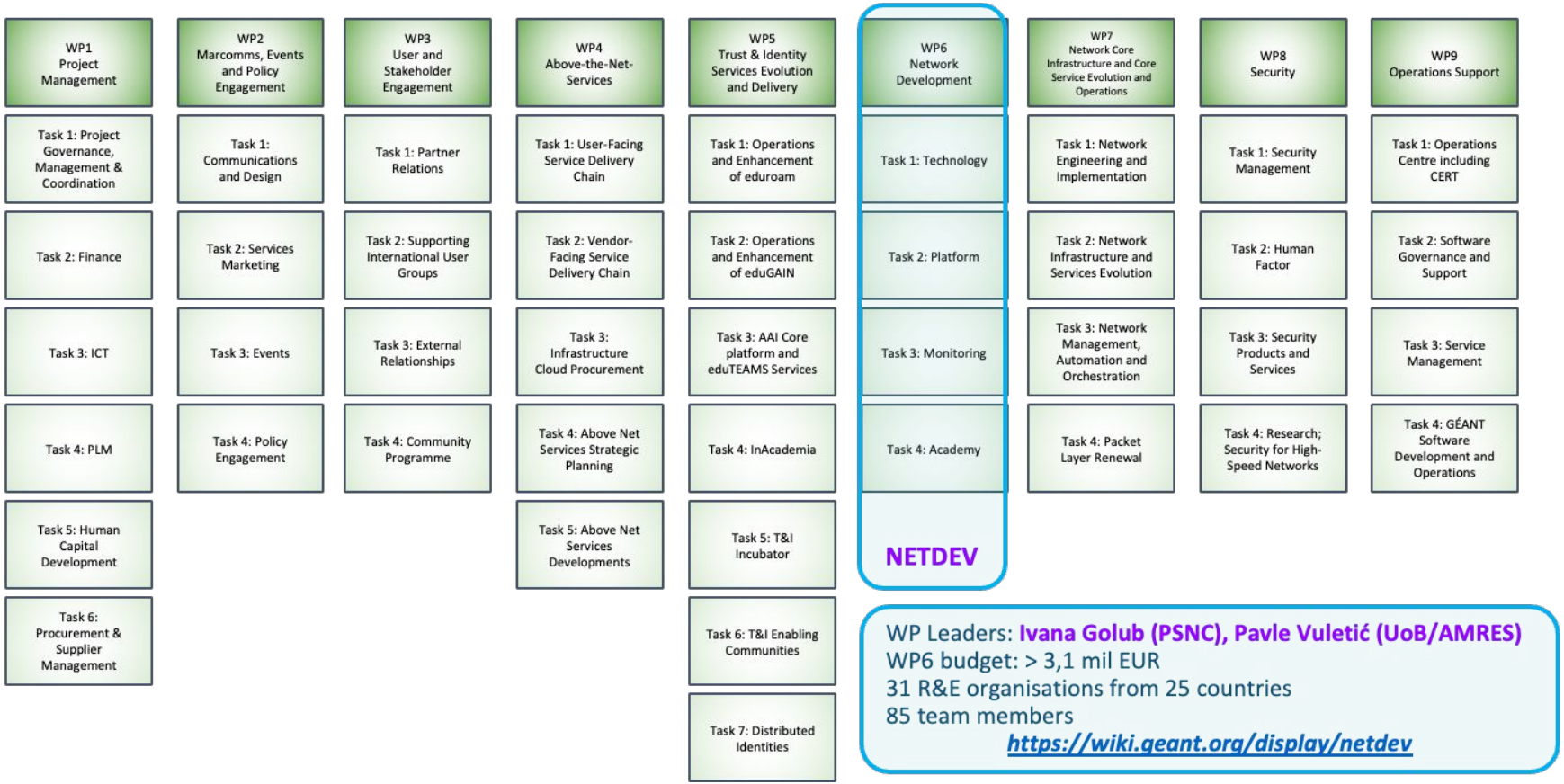
The GÉANT-5 project is under Horizon Europe Research and innovation funding programme until 2027

GÉANT
Networks • Services • People

- High bandwidth, high speed and highly resilient pan-European backbone
- Interconnecting European NRENs
- over 20 years of support for Europe's research and education communities

- 37 partners
- 500 contributors
- 50M users

The GÉANT 5-1 Project Structure



WP Leaders: **Ivana Golub (PSNC), Pavle Vuletić (UoB/AMRES)**
WP6 budget: > 3,1 mil EUR
31 R&E organisations from 25 countries
85 team members
https://wiki.geant.org/display/netdev

GÉANT NETDEV Services for Large-Scale Data-Intensive Science Facilities

Development
- Optical Time and Frequency Network
- Quantum Technologies
- RARE
- GP4L

Production services
- NMaaS
- Service Provider Architecture
- perfSONAR
- Performance Measurement Platform
- WiFiMon
- TimeMao
- Argus

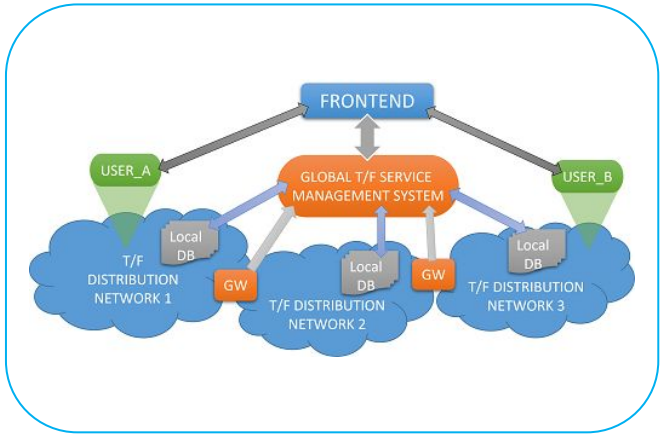
Network eAcademy
- Training
- Architecture Analysis and Mapping
- OAV Maturity Model

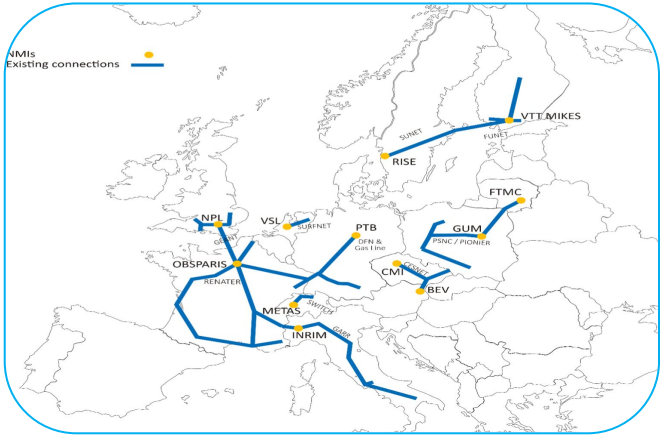
NETDEV Incubator

Optical Time and Frequency Networks - OTFN

Exploring approaches for Time and Frequency (T&F) Services in NREN Networks:

- Building upon already existing T&F infrastructure and services
- T&F Gateway - national signal sources and cross-border transfer
- Monitoring and calibration solutions





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

Quantum Technologies

Exploring Quantum Technologies (QT) for NREN Use cases

Supporting NRENs in their QT deployments and EuroQCI project

- QT training material in the Network eAcademy
- Open Quantum Group meetings and infoshares
- Knowledge hub on the QT wiki

https://wiki.geant.org/display/NETDEV/QT

RARE - Router for Academia, Research and Education

An open source router OS for R&E use cases

Supports six data planes:

- based on UNIX socket
- Libpcap
- DPDK
- BMv2 (P4)
- INTEL TOFINO ASIC (P4)
- XDP, eXpress Data Path

RARE features (not limited to):

- Interior Routing Protocol
- Dataplane forwarding
- External Routing Protocol
- Link local protocol
- Network management

RARE
rare-users@lists.geant.org
rare-dev@lists.geant.org
rare@lists.geant.org

Complete feature list

Type	Test #	Name			DPDK	XDP
acl	01	copp	✓	✓	✓	NA
acl	02	ingress access list	✓	✓	✓	NA
acl	03	egress access list	✓	✓	✓	NA
acl	04	nat	✓	✓	✓	NA
acl	05	vlan ingress access list	✓	✓	✓	NA
acl	06	vlan egress access list	✓	✓	✓	NA
acl	07	bundle ingress access list	✓	✓	✓	NA
acl	08	bundle egress access list	✓	✓	✓	NA
acl	09	bundle vlan ingress access list	✓	✓	✓	NA
acl	10	bundle vlan egress access list	✓	✓	✓	NA
acl	11	bridge ingress access list	✓	✓	✓	NA
acl	12	bridge egress access list	✓	✓	✓	NA
acl	13	vlan bridge ingress access list	✓	✓	✓	NA
acl	14	vlan bridge egress access list	✓	✓	✓	NA
acl	15	ingress pppoe access list	✓	✓	✓	NA
acl	16	egress pppoe access list	✓	✓	✓	NA
acl	17	ingress vlan pppoe access list	✓	✓	✓	NA
acl	18	egress vlan pppoe access list	✓	✓	✓	NA
acl	19	hairpin ingress access list	✓	✓	✓	NA
acl	20	hairpin egress access list	✓	✓	✓	NA
acl	21	hairpin vlan ingress access list	✓	✓	✓	NA
acl	22	hairpin vlan egress access list	✓	✓	✓	NA
acl	23	hairpin pppoe ingress access list	✓	✓	✓	NA
acl	24	hairpin pppoe egress access list	✓	✓	✓	NA
acl	25	hairpin vlan pppoe ingress access list	✓	✓	✓	NA
acl	26	hairpin vlan pppoe egress access list	✓	✓	✓	NA
acl	27	ingress gre access list	✓	✓	✓	NA
acl	28	egress gre access list	✓	✓	✓	NA
acl	29	ingress vlan gre access list	✓	✓	✓	NA

GP4L - GÉANT P4 Lab

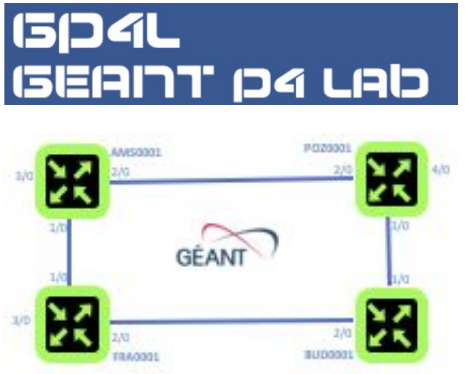
P4 switch-based lab infrastructure interconnected through the GÉANT network

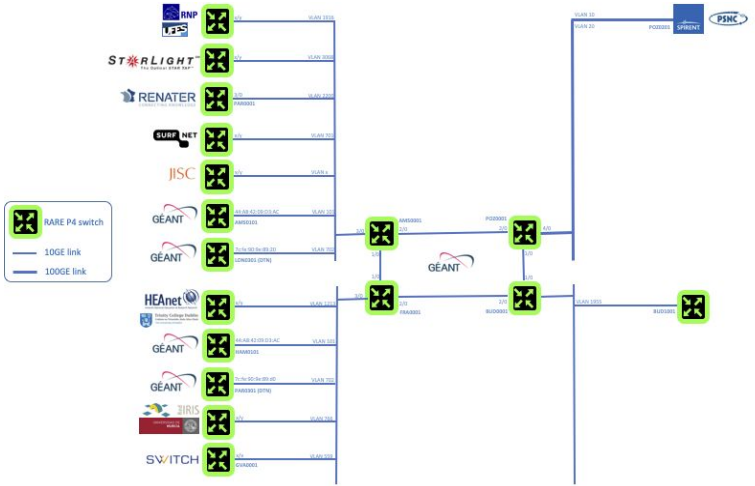
- 4 switches in Europe: AMS, POZ, FRA, BUD

Validation of the RARE/FreeRtr OS routing stack software

World-wide testbed, offering **experimental dataplane programming facilities to researchers** to perform geographically distributed network experiments:

- With the usage of RARE/FreeRtr NOS
- Using a clean slate environment
  (i.e use exclusively GP4L without RARE/FreeRtr dataplane & control plane)





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

Global P4 Lab (September 2023)

NMaaS - Network Management as a Service

A portfolio of network management applications run as dedicated, cloud-based per-user instance

28 applications available, easy to add new tools

Use cases:

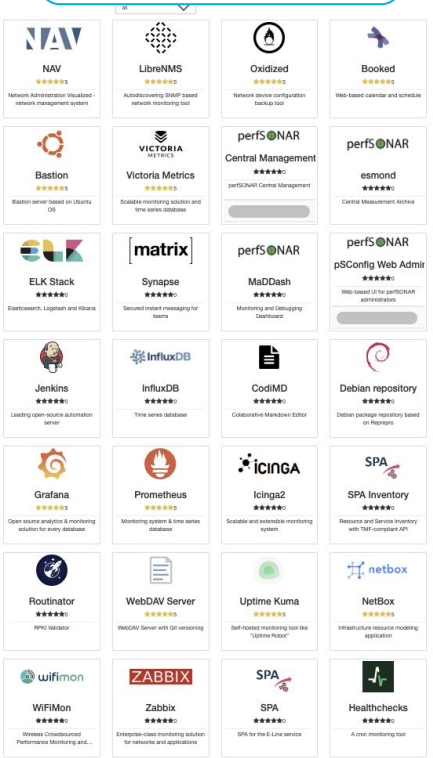
- Network/Equipment Management for Small/Medium size networks/ institutions
- Project-owned equipment
- NMaaS Virtual Lab - **NEW!**

How to use NMaaS?

- Managed service
  - Production NMaaS instance: https://nmaas.eu
  - Sandbox instance: https://nmaas.geant.org
- Self-hosted
  - On your own NMaaS instance: https://docs.nmaas.eu/install-guide
  - On a local machine: https://docs.nmaas.eu/local-vm

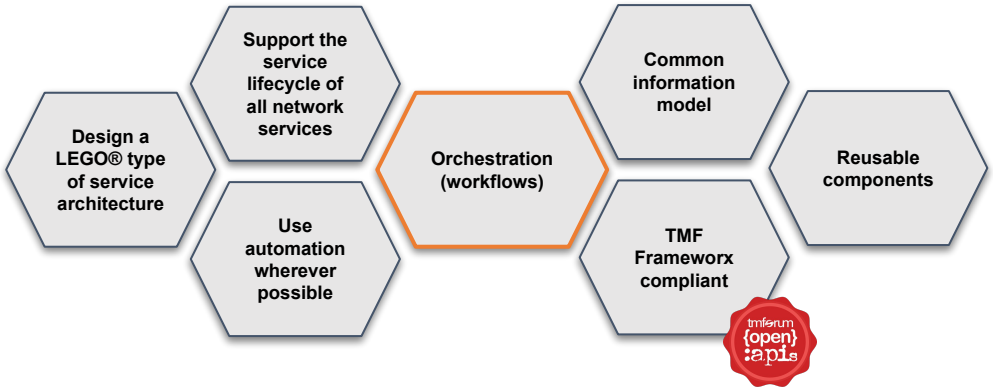
NMaaS

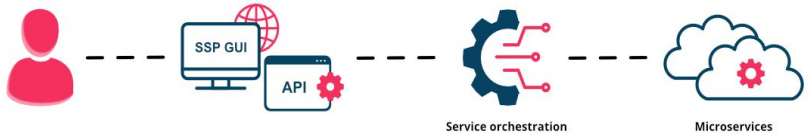
nmaas.eu
nmaas@lists.geant.org

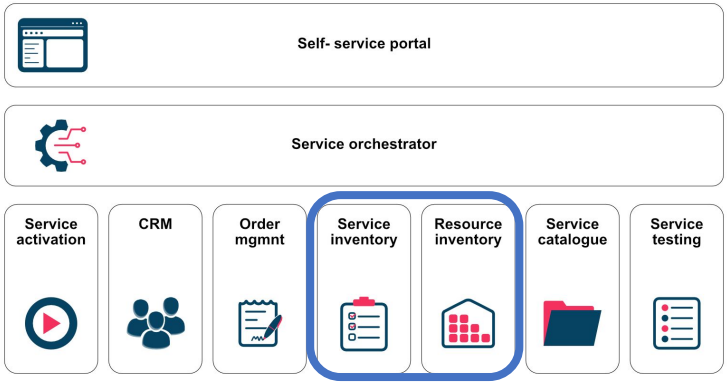


SPA Service Provider Architecture

SPA is a modular distributed platform to orchestrate and automate network services in the GÉANT and NREN network infrastructures.







- Process and service orchestration and automation in action
- Used for the GÉANT Connection Service (GCS)
- Test service instance available in NMaaS

spa@lists.geant.org
https://wiki.geant.org/display/NETDEV/SPA

perfSONAR

ESnet perfSONAR

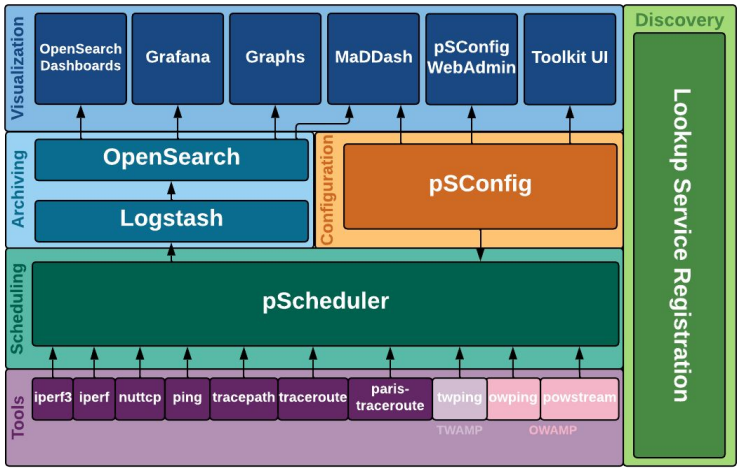
https://www.perfsonar.net/

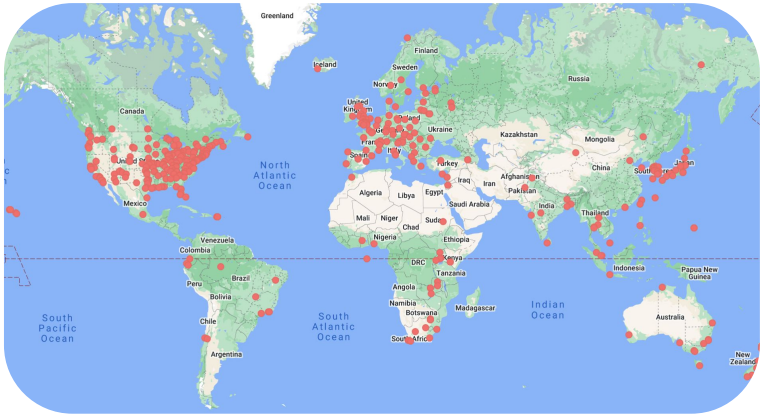
GÉANT INTERNET2 RNP

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

Some GÉANT's recents contributions:

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





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

Supported on **Ubuntu 20**
More OSs to follow in early summer
(EL8, EL9, Ubuntu 22, Debian 11)

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-central.geant.org/maddash-webui/
Contact: perfsonar-smallnodes@lists.geant.org

TimeMap

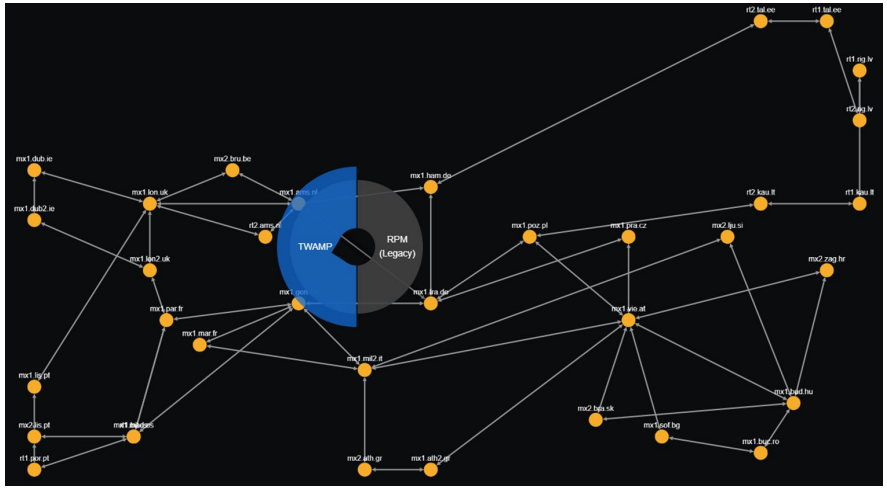
Per-segment latency and jitter monitoring tool

Based on TWAMP (RFC 5357)

Easy and quick modular installation

Initial AI-based anomaly detection implemented

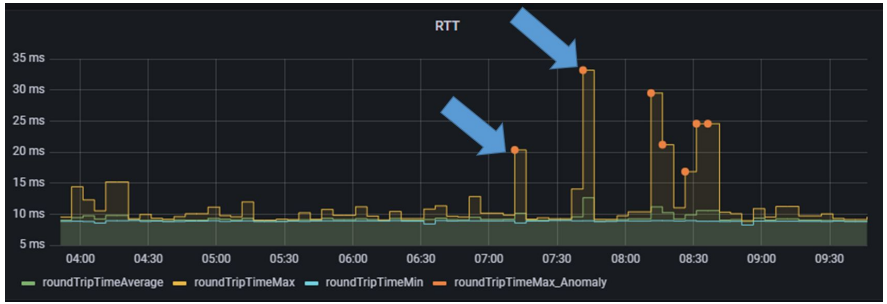
Deployed in the GÉANT backbone network



Documentation

- TimeMap
- Code and documentation
- TimeMap page

TimeMap



WiFiMon

A WiFi network monitoring and performance verification system

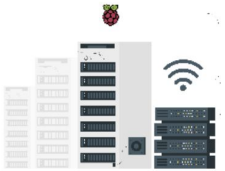
WiFiMon is a WiFi network monitoring and performance verification system. It is capable of detecting performance issues, visualising the achievable throughput of a wireless network for each user, and providing technical information about a WiFi network (e.g., signal strength, link quality, bit rate, etc.). **WiFiMon** leverages well-known performance verification tools (e.g., Akamai Boomerang and Speedtest) and in addition uses data from the WiFi physical layer in order to gather a comprehensive set of WiFi network performance metrics.

WiFiMon Operation Modes

***WiFiMon** can operate in two different modes which can be used either separately or together*

Software Crowdsourced Measurements

Hardware Probe Measurements



WiFiMon

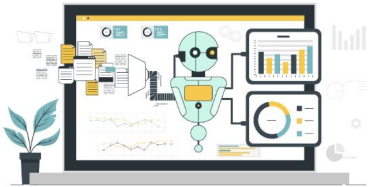
Technology and vendor agnostic

WiFiMon can be deployed on any WiFi network as it monitors the performance on the network layer. It can also provide additional benefits in 802.1x enabled networks including eduroam in which case users can make various performance analyses per access point, per user, etc.

Fine grained information on network performance

WiFiMon shows the end-user (mobile client) behaviour on a network, its perception about the responsiveness of the network and the speed of web resource downloads, correlation of the performance data with end-user data, and data analysis with an effective query builder.

Easy to deploy



WiFiMon is a software image (also available as a Docker Image) and can be easily deployed on an NREN/University network on hardware or software probes.

Active monitoring with low network overhead

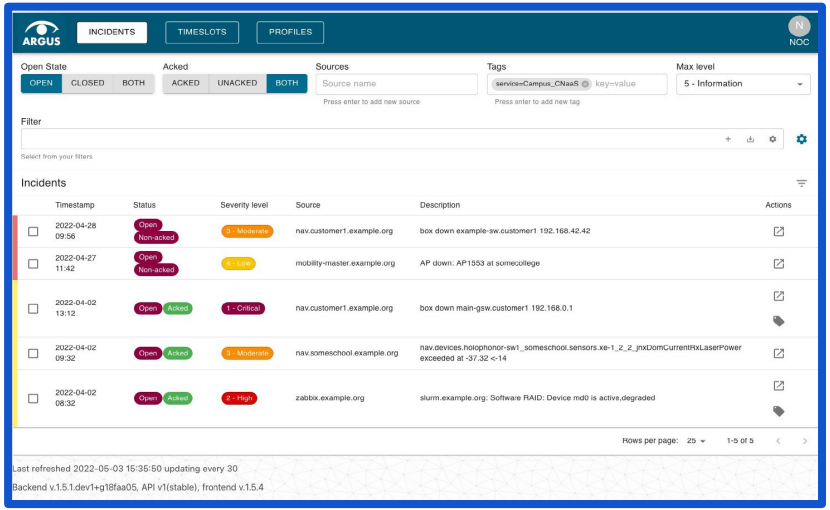
WiFiMon active measurements are not significantly invasive and do not use any significant bandwidth. One **WiFiMon** measurement is comparable to one average web-page download (load speed).

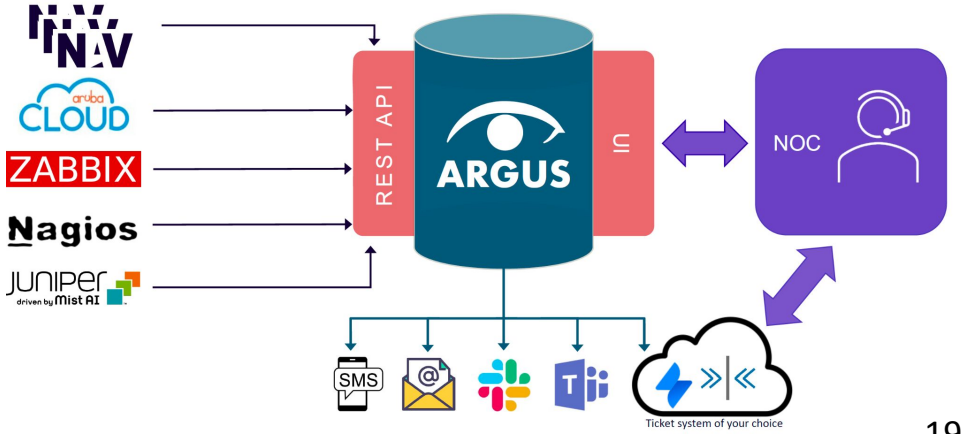
ARGUS

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
- In production in Sikt and SUNET
- A production service since Sept 2022

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



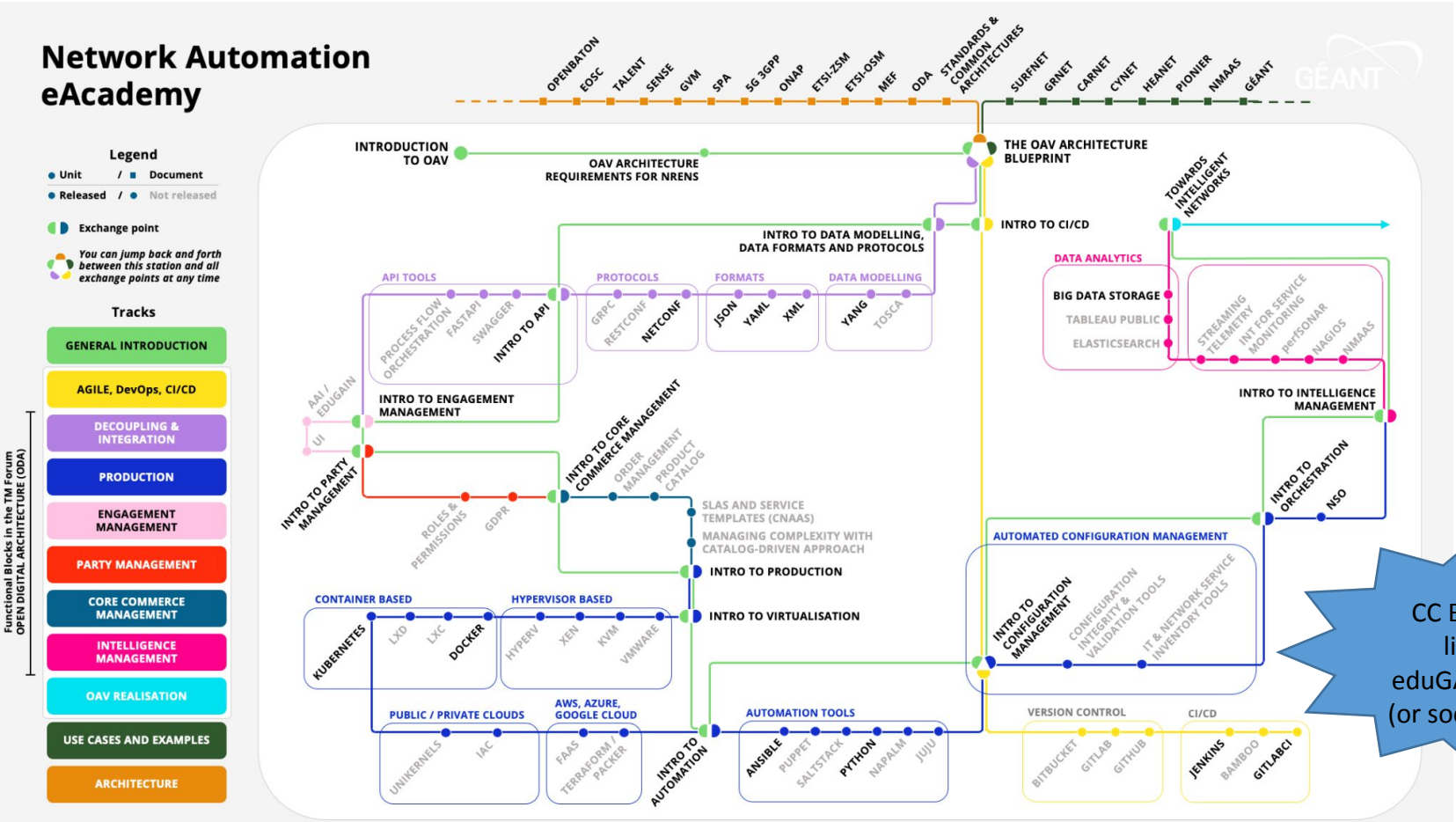


Network eAcademy

Network eAcademy

Powered by:

GLAD
GÉANT LEARNING & DEVELOPMENT



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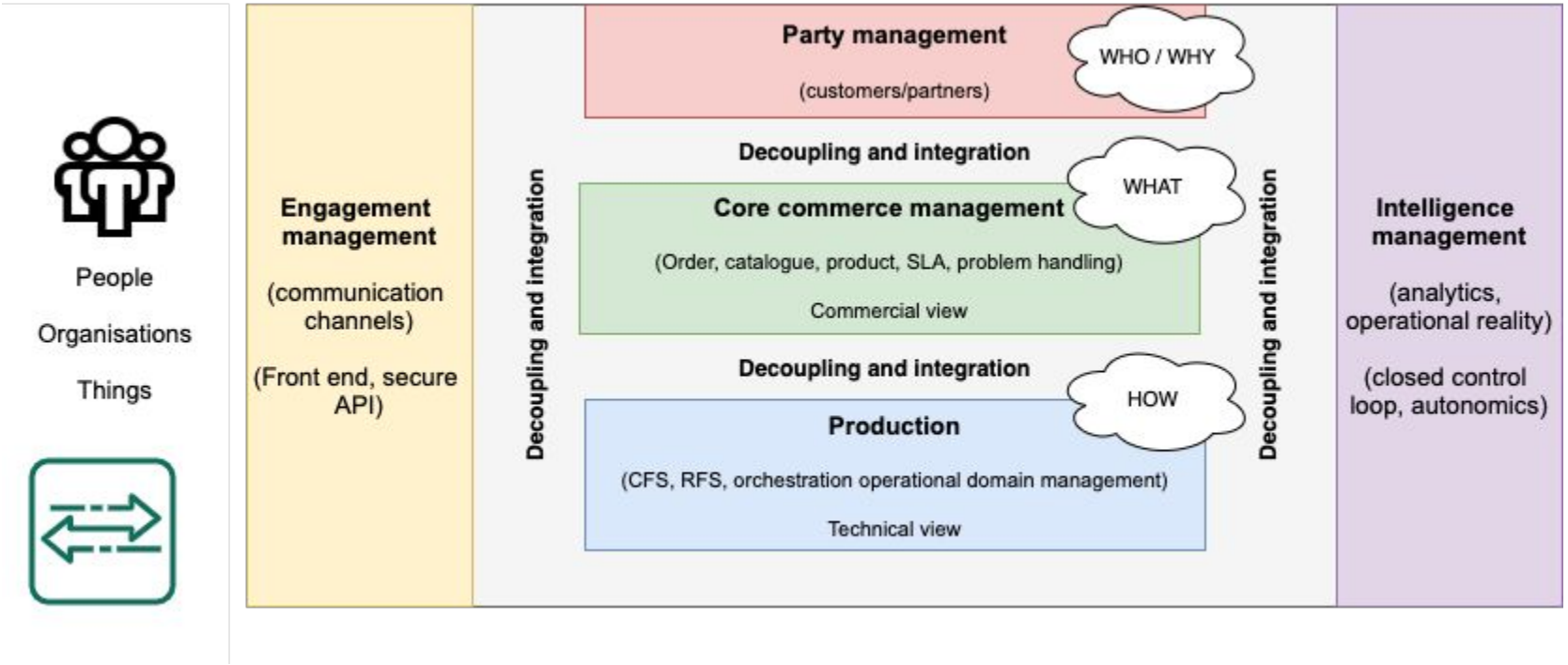
eduGAIN access
(or social media)

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

TMForum Open Digital Architecture as a Reference Architecture



Digital Architecture Analysis

Mapping NREN & use cases architectures to a common blueprint, the TM Forum Open Digital Architecture (functional architecture).

Align efforts → **Find similarities** → **Collaboration** → **Interoperability**

NREN Architectures

- CARNET
- CYNET
- GÉANT
- GRNET
- HEAnet
- PIONIER
- SURF

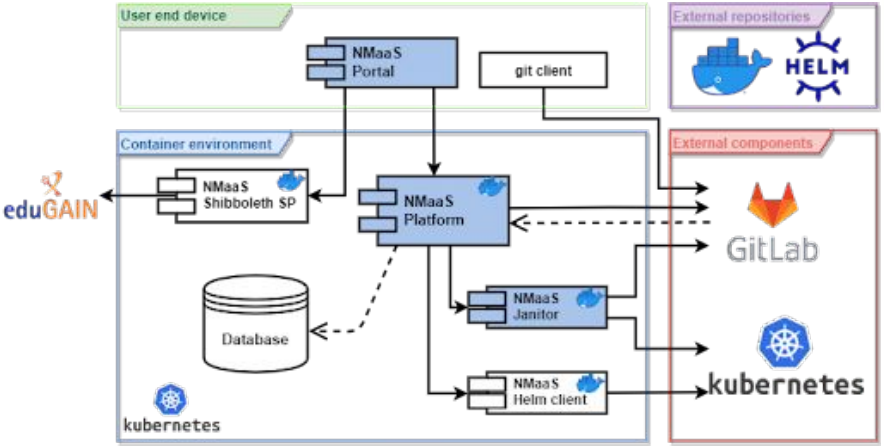
NETDEV Architectures

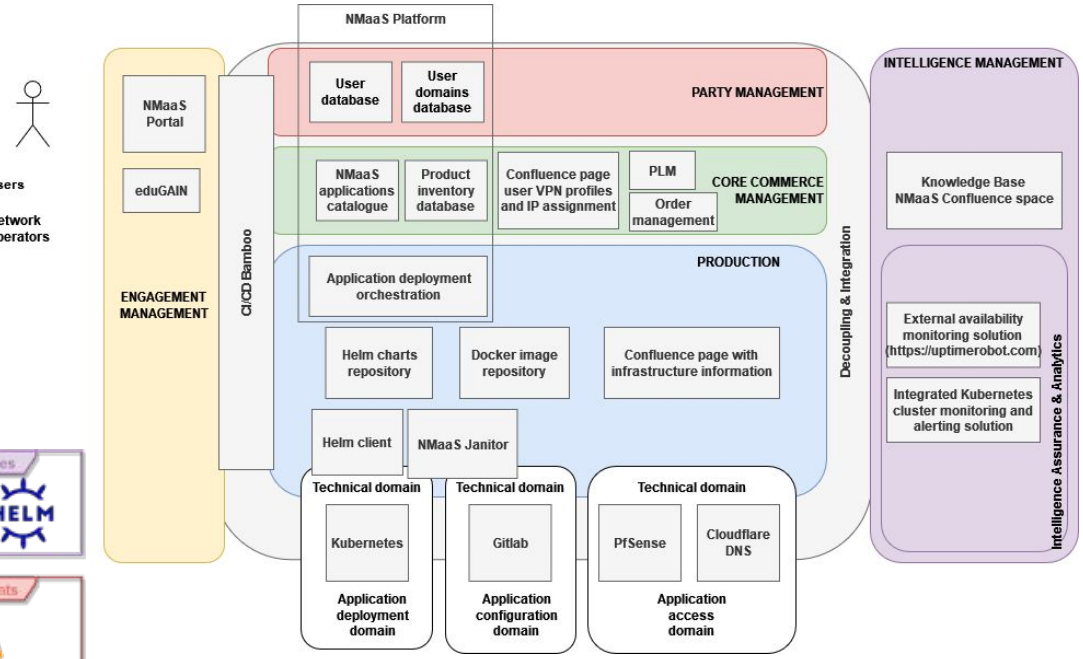
- Argus
- NMaaS
- SPA

Other Use Cases

- 5G
- EOSC
- ETSI GANA
- ETSI OSM
- ETSI ZSM
- GVM
- MEF LSO
- Open Baton
- ONAP
- SENSE
- TALENT

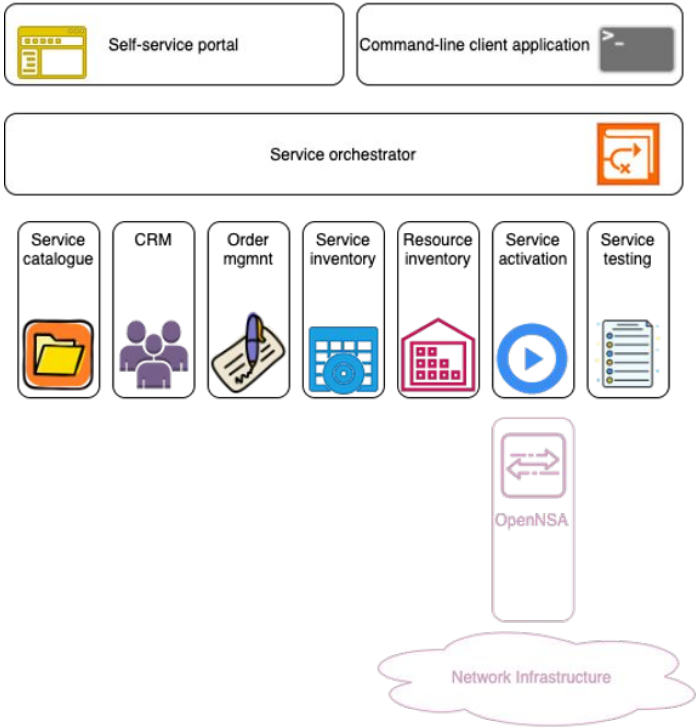
NMaaS Architecture

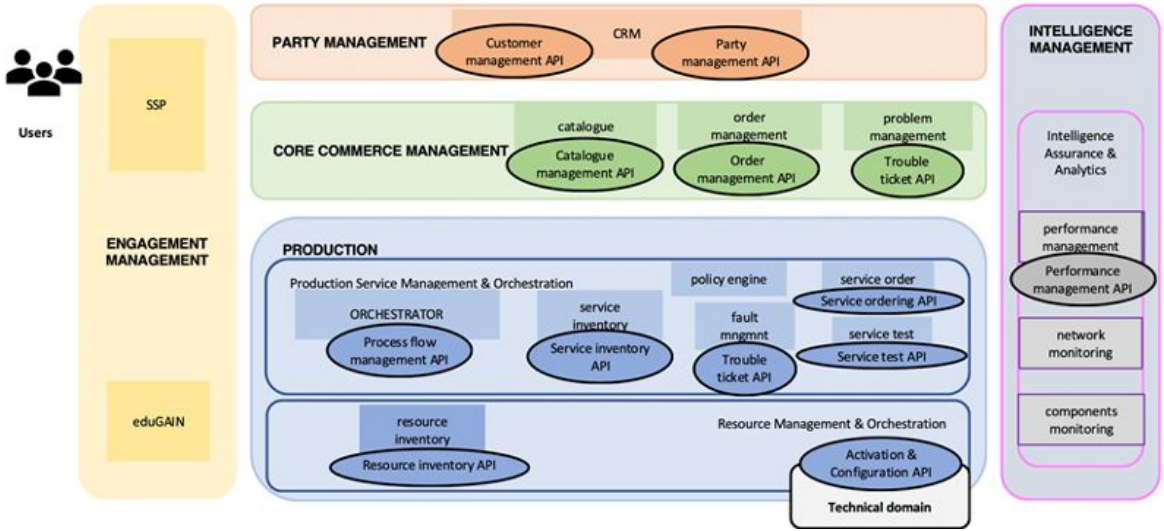




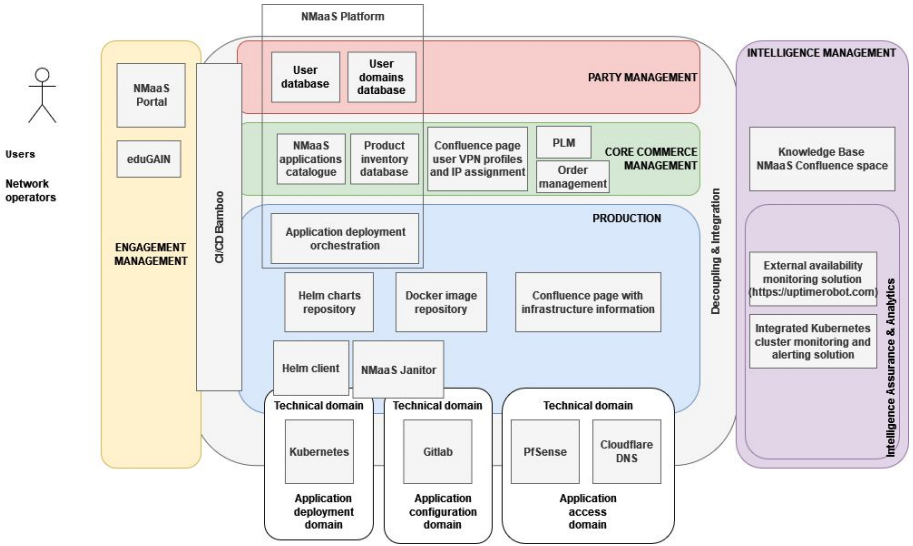
[NMaaS-OAV-Architecture-Analysis]

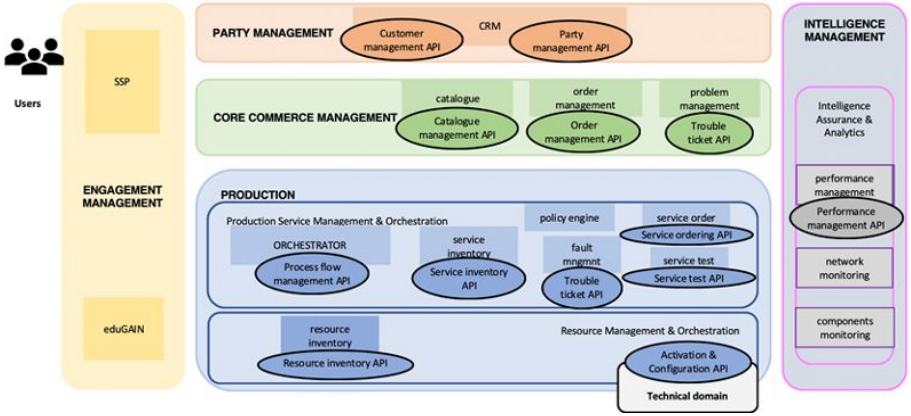
Service Provider Architecture





NMaaS and SPA Architectures





Maturity Model Goals

Measure	Measure the current OAV capabilities in a meaningful way
Identify	Enable clear identification of strengths and improvement points, be aware of threats and opportunities
Prioritise	Help prioritise what to do in order to advance and improve
Journey	Identify gaps between the current and future state and how to get there

OAV Maturity Model - Stages

Level 0

Sit

None

Created by Valerie Lamm

Level 1

Crawl

Ad Hoc

Level 2

Walk

Use Case / Project-based / Reactive

Level 3

Run

Integrated

Level 4

Fly

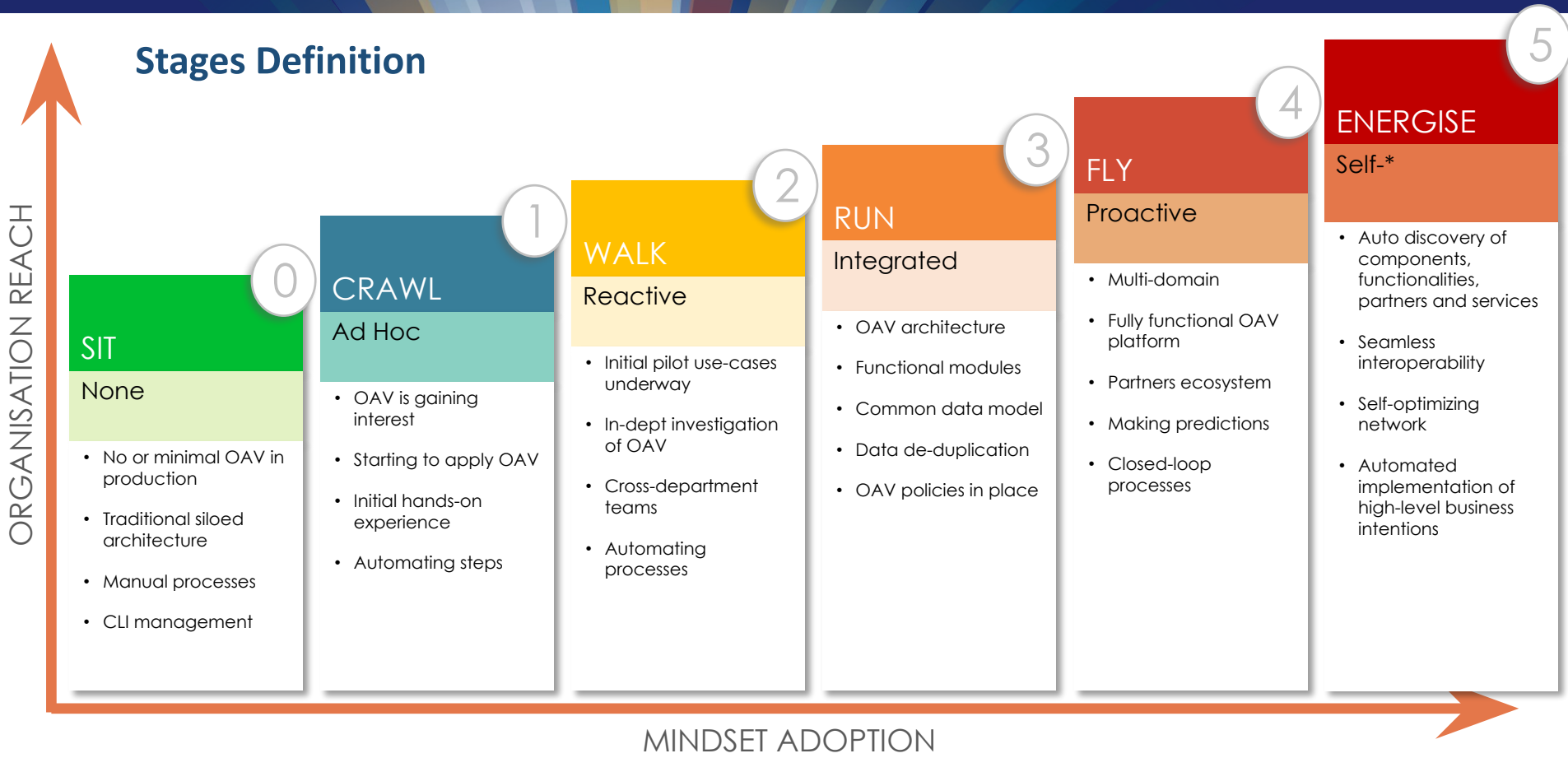
Proactive

Level 5

Energise

Self-*

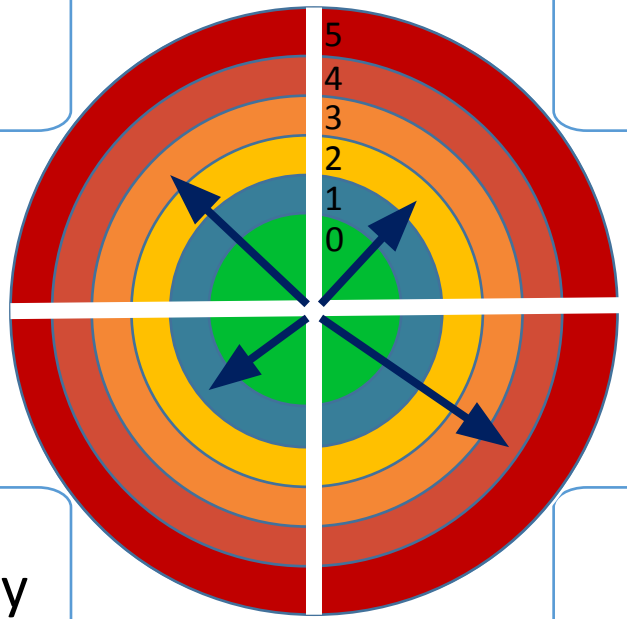
Stages Definition



OAV Maturity Model - Dimensions

Architecture & Technology

Processes & Services



Vision & Strategy

People & Organisation

Granular OAV Maturity Assessment

		Architecture & Technology			Processes & Services			Vision & Strategy		People & Organisation	
		Components	Virrtualisation	Data modeling	Service design	Monitoring and reporting	Security management	Policies development	Standardisation	Culture	Training
Level 5	Self-*										
Level 4	Proactive										
Level 3	Integrated										
Level 2	Reactive										
Level 1	Ad Hoc										
Level 0	None										

Conducting a Maturity Assessment

Three-phase approach

More information: https://wiki.geant.org/display/NETDEV/OAV+Maturity+Model

OAV Assessment

- https://www.surveymonkey.com/r/SPYDQVB
- 31 questions
- Data is used for analytical purposes only
  - we do not publish data for individual institutions
- Report is sent to the person defined in survey

NETDEV Incubator

A mechanism to include new work during the project

Simple proposal procedure following simple rules

A proposed project MUST be:

- Relevant to the NETDEV project (GN5-1 WP6)
- SMART: *Specific, Measurable, Achievable, Resource- and Time-bound*
- With evident interest for the results from the community

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

More Information

Contact details

- netdev@lists.geant.org
- https://wiki.geant.org/display/NETDEV/

NMaaS

Argus

TimeMap

WiFiMon

Service Provider Architecture

perfSONAR

Performance Measurement Platform

Inventory

GP4L

Optical Time and Frequency Networks

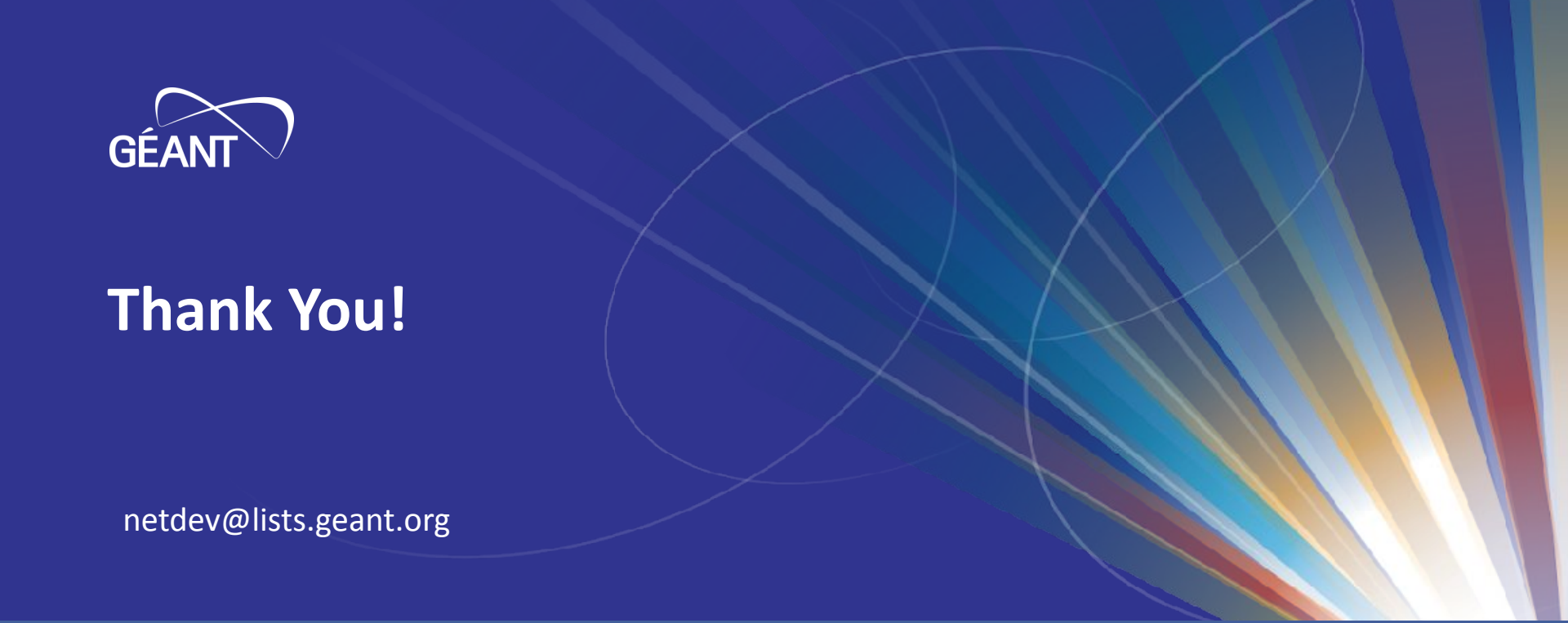
RARE

Network eAcademy

Quantum Technologies

TechLab

NETDEV Incubator



Thank You!

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