



Network Development in the GÉANT Project

Ivana Golub, PSNC

STF, 7 November 2023, Paphos, Cyprus

Public (PU)

Network Development Work Areas

Network Development

- Optical Time and Frequency Networks - OTFN
- Quantum Technologies - QT
- Router for Academia, Research and Education - RARE
- GÉANT P4 Lab - GP4L



Production Services

- Network Management as a Service - NMaaS
- Service Provider Architecture Platform - SPA
 - and (SPA) Inventory
- perSONAR
- Performance Management Platform - PMP
- WiFiMon
- TimeMap
- Argus
- Network eAcademy



NETDEV Incubator



Network Development

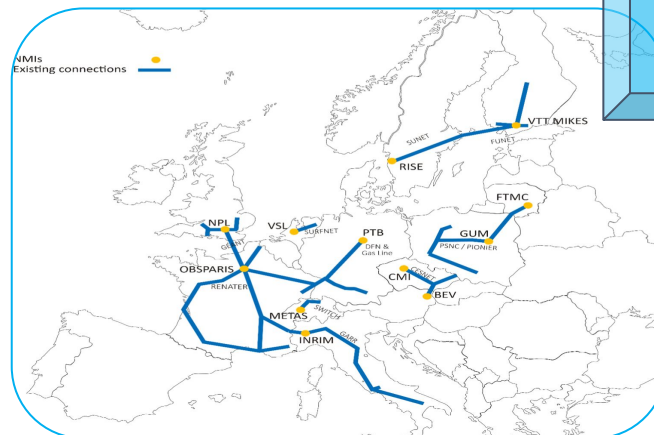
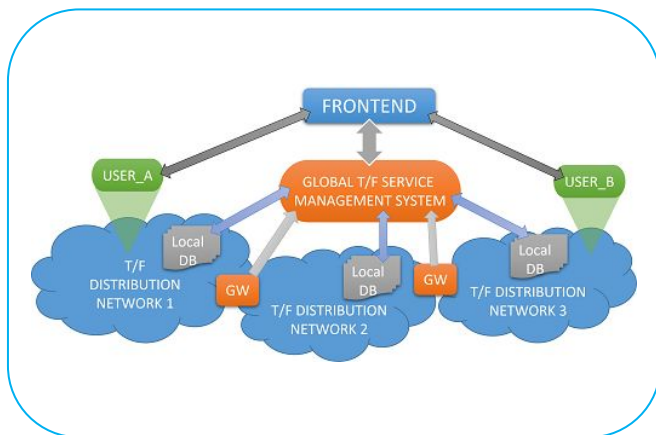
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Optical Time and Frequency Networks - OTFN

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

OTFN training material in the Network eAcademy



The OTFN
Incubator
Project

Quantum Technologies

Exploring Quantum Technologies (QT) for NREN Use cases

Supporting NRENs in their QT deployments and EuroQCI project

- Open Quantum Group meetings and infoshares
- Knowledge hub on the [QT wiki](#)

QT training material in the Network eAcademy



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

GP4L - GÉANT P4 Lab

P4 switch-based lab infrastructure interconnected through the GÉANT network

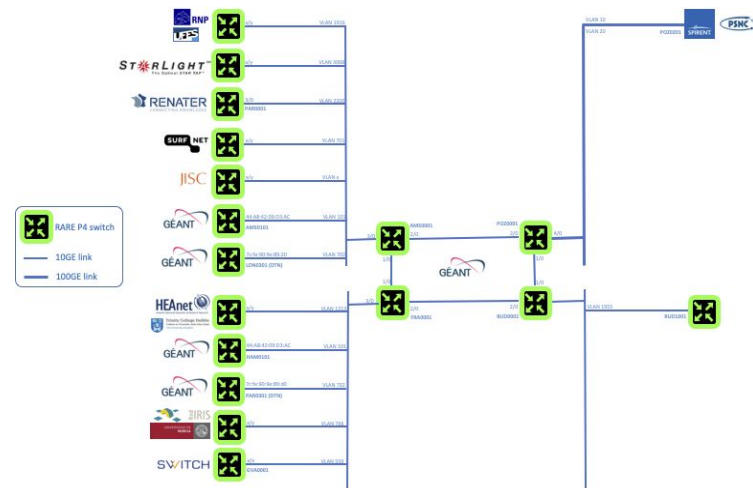
- 4 switches in Europe: AMS, POZ, FRA, BUD

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)

GP4L GÉANT P4 LAB



Global P4 Lab (September 2023)

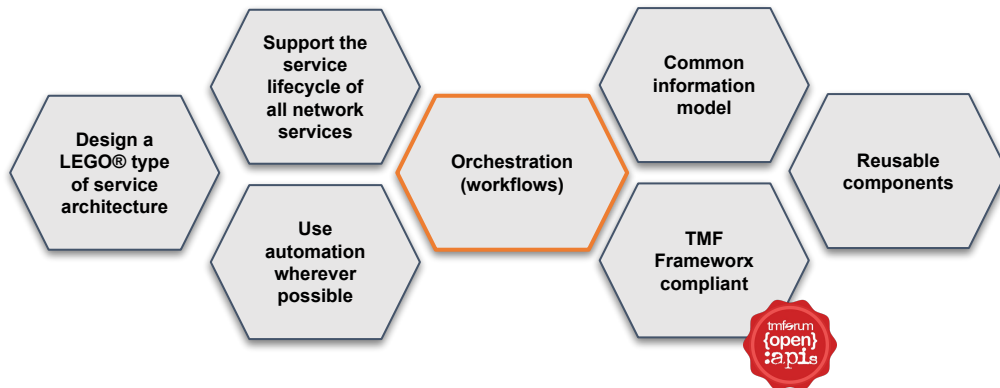


Production Services

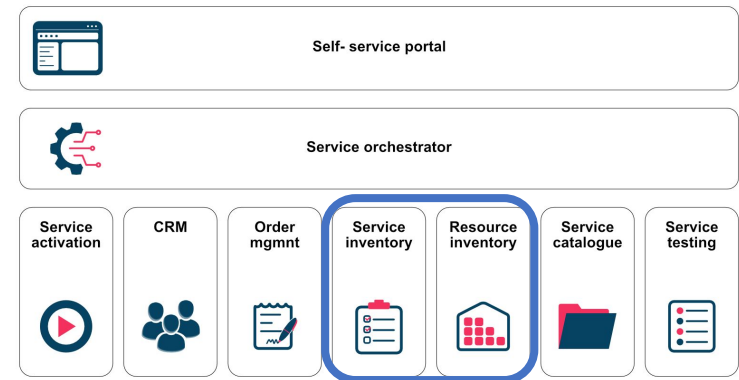
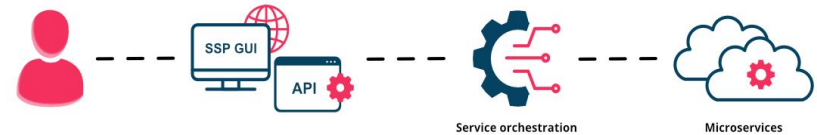
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SPA Service Provider Architecture

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>

Inventory



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

- Storage for the information about resources and service instances

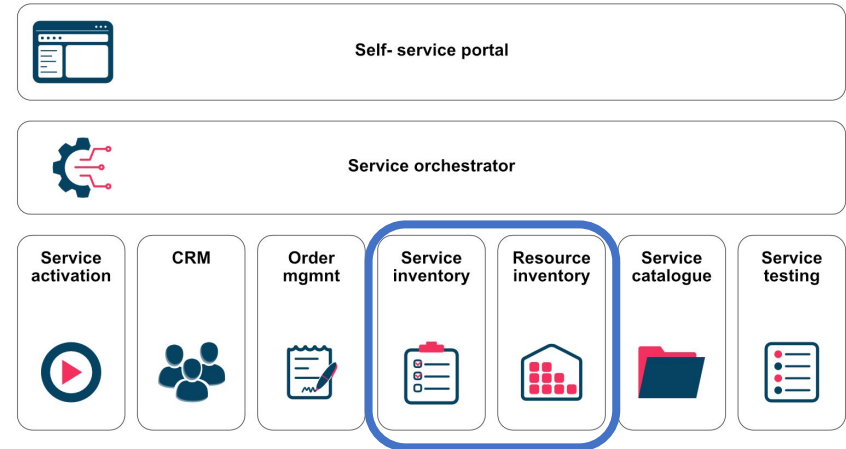


One of the key components of SPA

The Source of Truth for automation

Inventory version 3

- Use of NoSQL (MongoDB) database
- Data model can be easily updated/extended and validated
- In testing in PSNC/PIONIER



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:

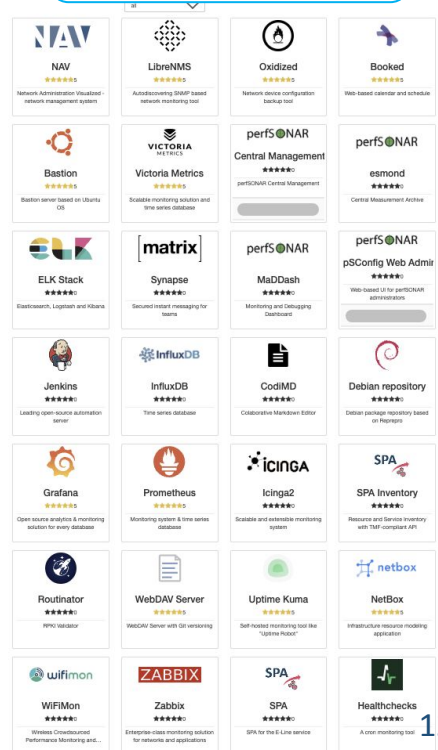
- Network/Equipment Management for Small/Medium size networks/institutions
- Project-owned equipment
- NMaaS Virtual Lab - **NEW!**

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.eu
nmaas@lists.geant.org

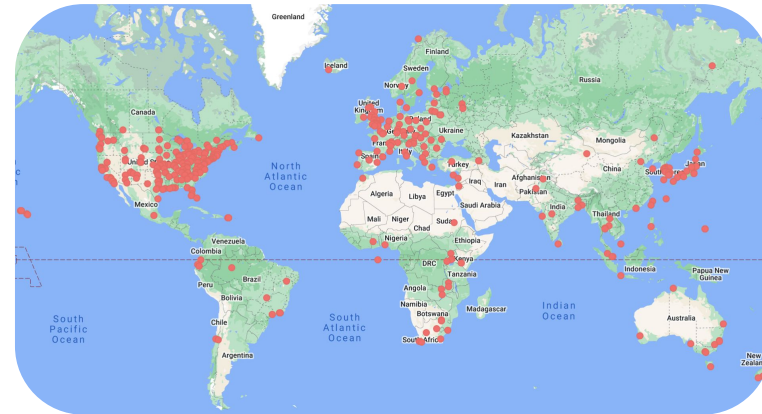
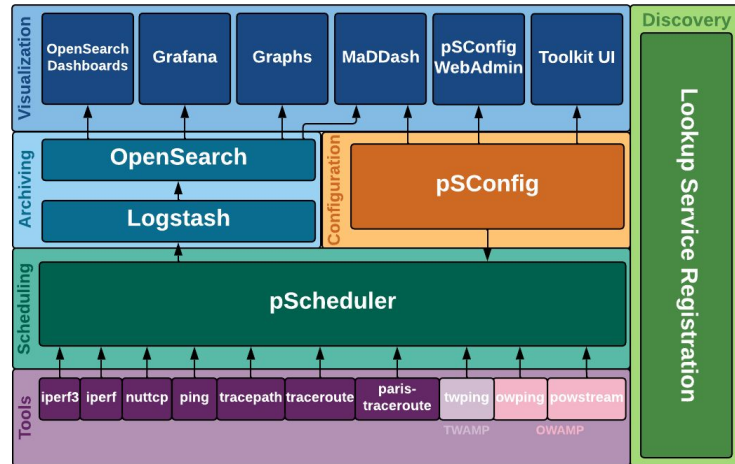


perfSONAR

Open-source, modular, flexible 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)



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





An alarm aggregation and correlation tool

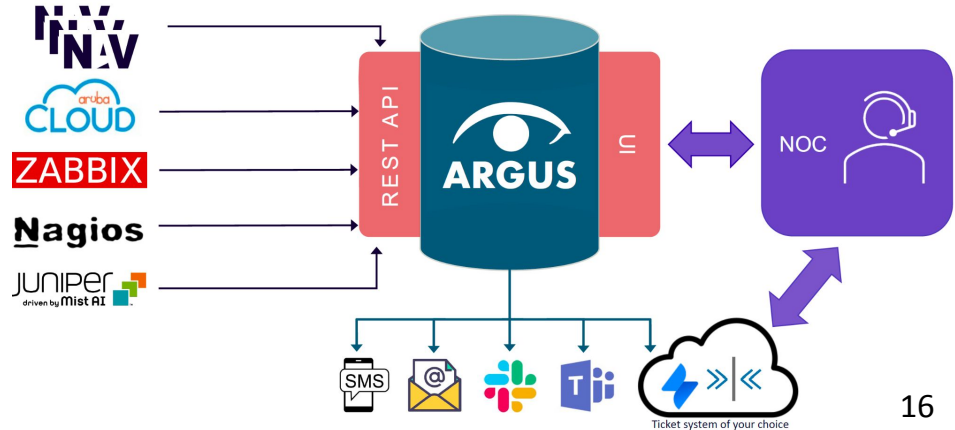
- A single unified dashboard and notification system for aggregated incidents from all monitoring applications
- Based on the CNaas use case
- In production in Sikt and SUNET
- A production service since Sept 2022

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

The screenshot shows the ARGUS web interface with the following details:

- Navigation:** INCIDENTS, TIMESLOTS, PROFILES
- Filters:** Open State (OPEN, CLOSED, BOTH), Acked (ACKED, UNACKED, BOTH), Sources (Service-Campus_CNaas, key=value), Tags (5 - Information), Max level (5 - Information)
- Incidents Table:**

Timestamp	Status	Severity level	Source	Description	Actions
2022-04-28 09:36	Open / Non-acked	3 - Moderate	nav.customer1.example.org	box down example-sw.customer1 192.168.42.42	[Icon]
2022-04-27 11:42	Open / Non-acked	3 - Edge	mobility-master.example.org	AP down: AP1533 at somescolleg	[Icon]
2022-04-02 13:12	Open / Acked	1 - Critical	nav.customer1.example.org	box down main-gsw.customer1 192.168.0.1	[Icon]
2022-04-02 09:32	Open / Acked	3 - Moderate	nav.someschool.example.org	nav.devices.hologonom-rs1_someschool.sensors.xe-1_2_2_jtuDomCurrentInxLaserPower exceeded at -37.32 <-14	[Icon]
2022-04-02 08:32	Open / Acked	2 - High	zabbix.example.org	slurm.example.org: Software RAID: Device md0 is active/degraded	[Icon]
- Footer:** Last refreshed 2022-05-03 15:35:50 updating every 30s. Backend v1.5.1.dev1+g18faa05, API v1(stable), frontend v1.5.4



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.

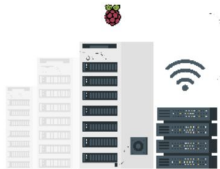
WiFiMon Operation Modes

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

Software Crowdsourced Measurements



Hardware Probe Measurements



WiFiMon



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.

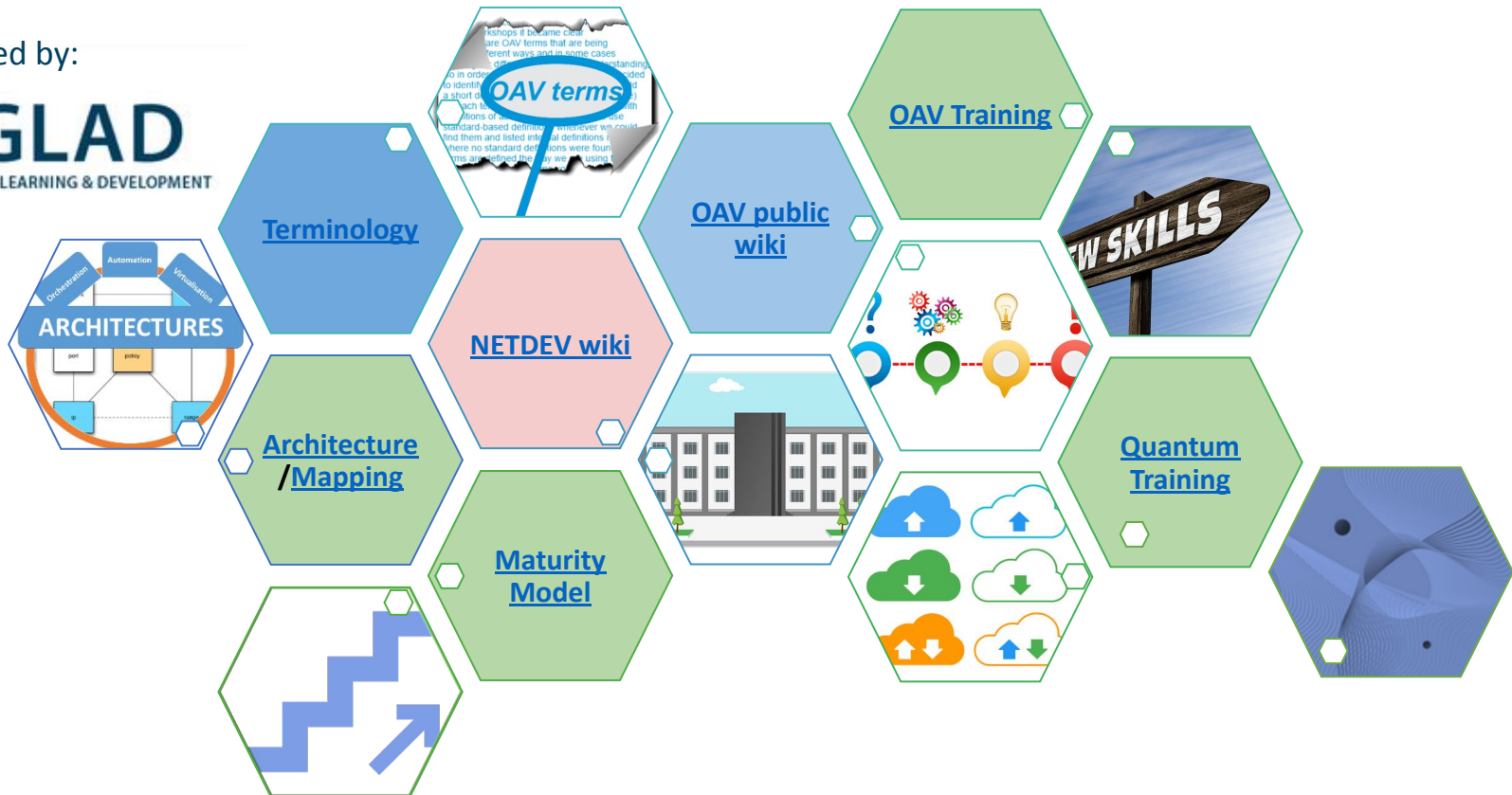
Active monitoring with low network overhead



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).

Network eAcademy

Powered by:

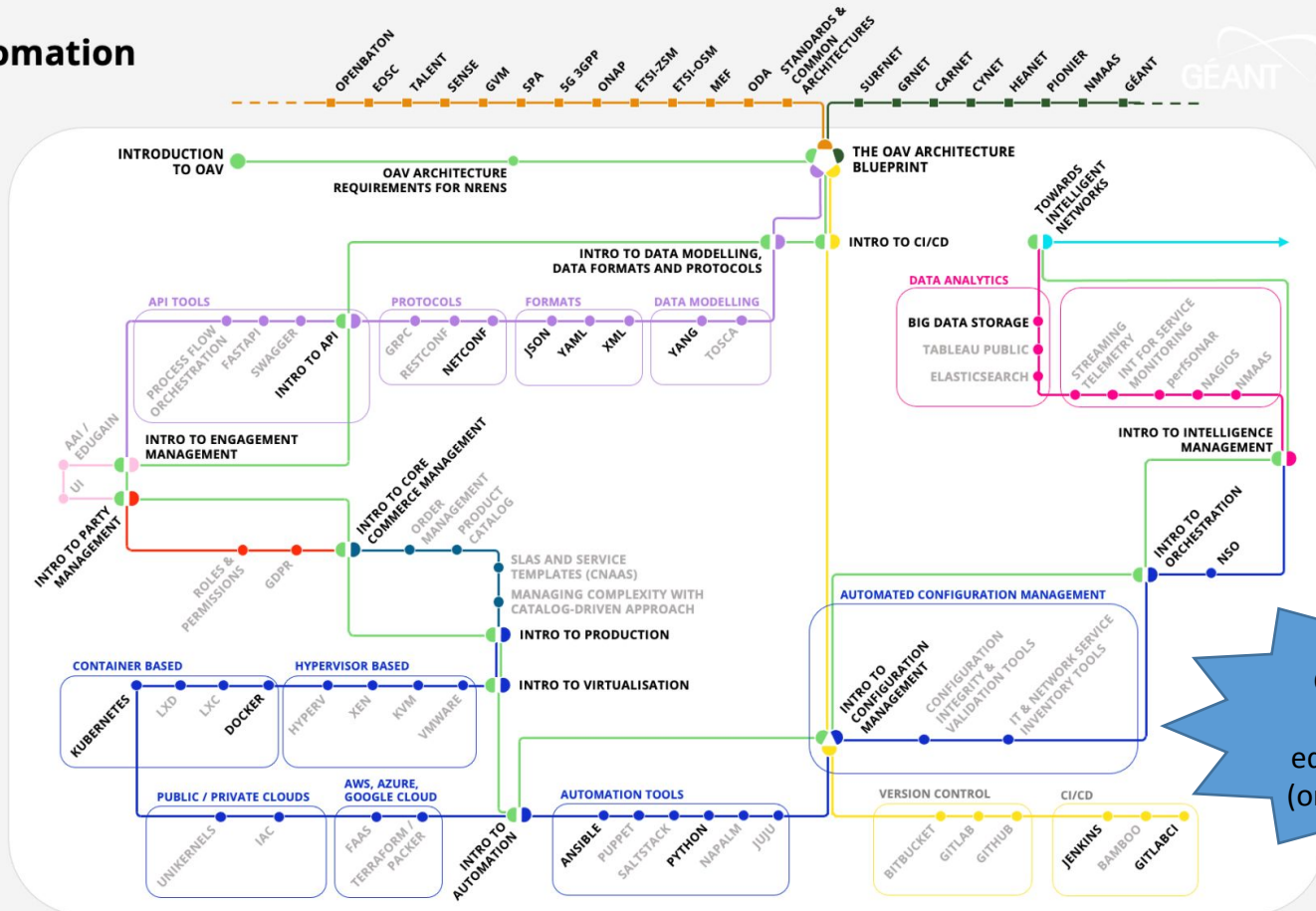


Network Automation eAcademy

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

- 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



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

Quantum Technologies eAcademy

Available courses



Quantum Algebra: QuBits

Category: **Quantum Technology**
Course creator: Peter Kaufmann



Quantum Algebra: Operator Multiplication: Variants

Category: **Quantum Technology**
Course creator: Peter Kaufmann



More learning units in preparation

<https://e-academy.geant.org/moodle/course/index.php?categoryid=54>

OAV Terminology

Terminology and Glossary of terms related to:

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

Motivation:

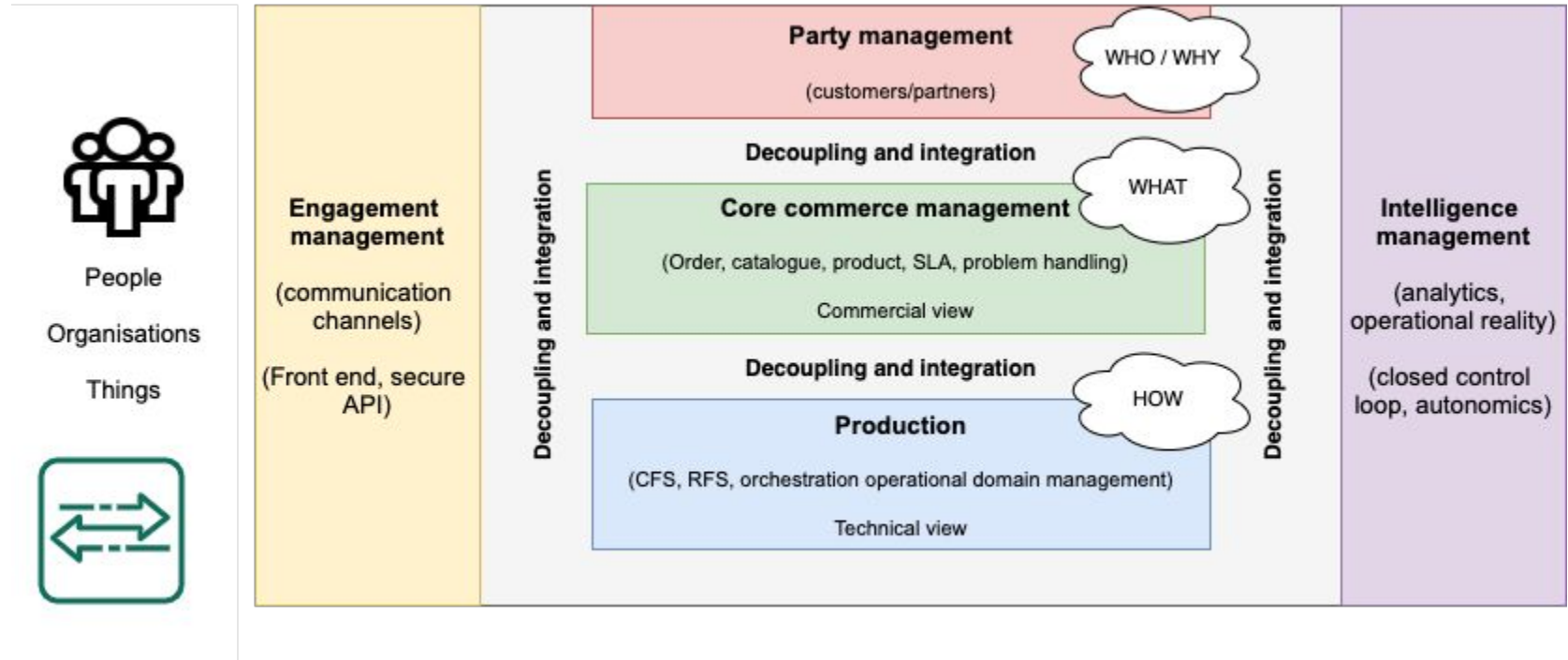
- To bridge the terminology gap in the community
- To systematically structure relevant OAV, AI and MM terminology

Published in collaboration with the GNA-G Automation Working Group

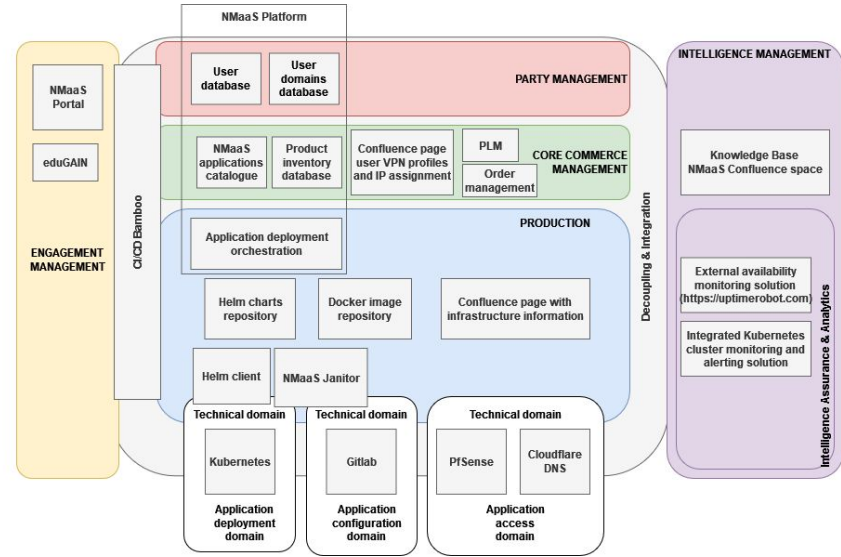
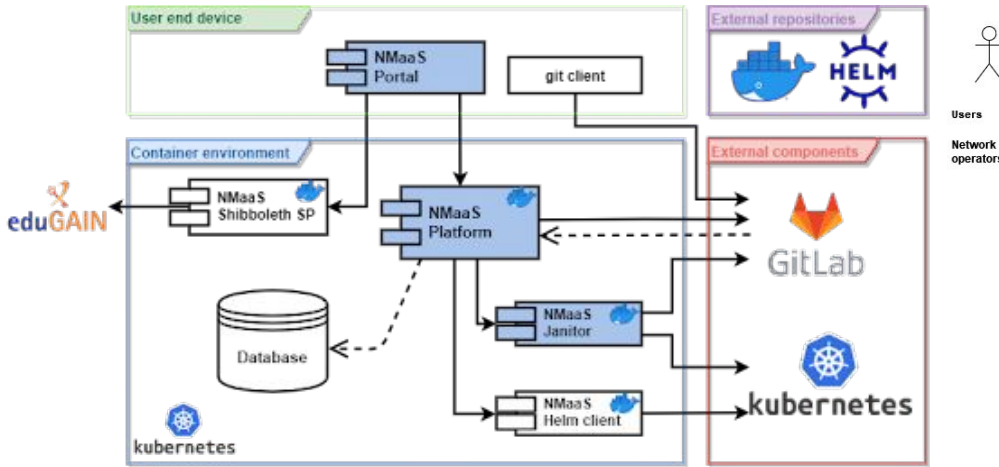


[OAV Terminology Document](#)

TMForum Open Digital Architecture as a Reference Architecture



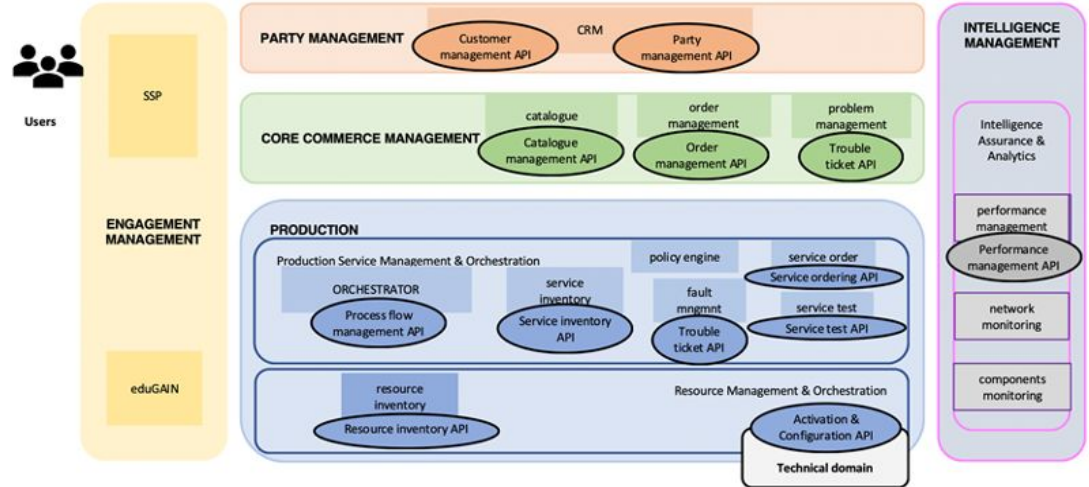
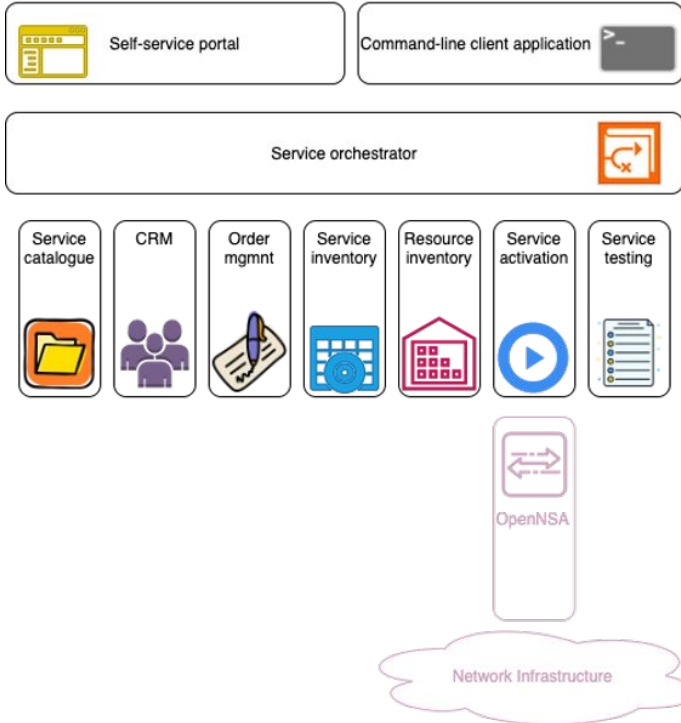
NMaaS Architecture



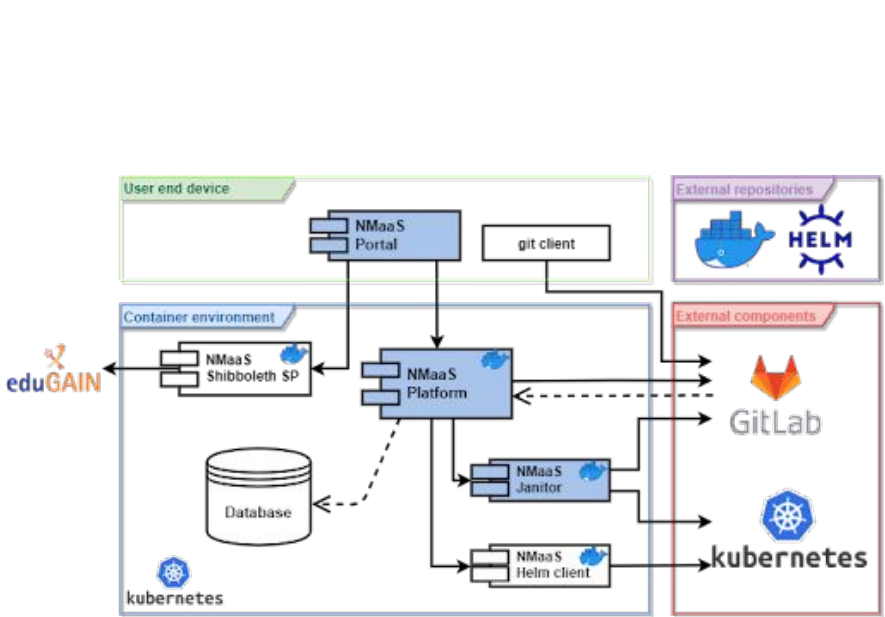
[NMaaS-OAV-Architecture-Analysis](#)



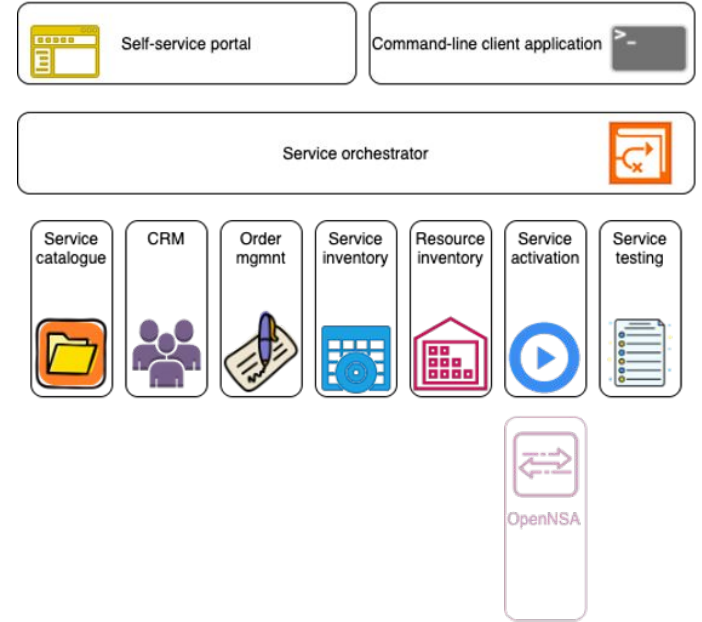
Service Provider Architecture



NMaaS and SPA Architectures

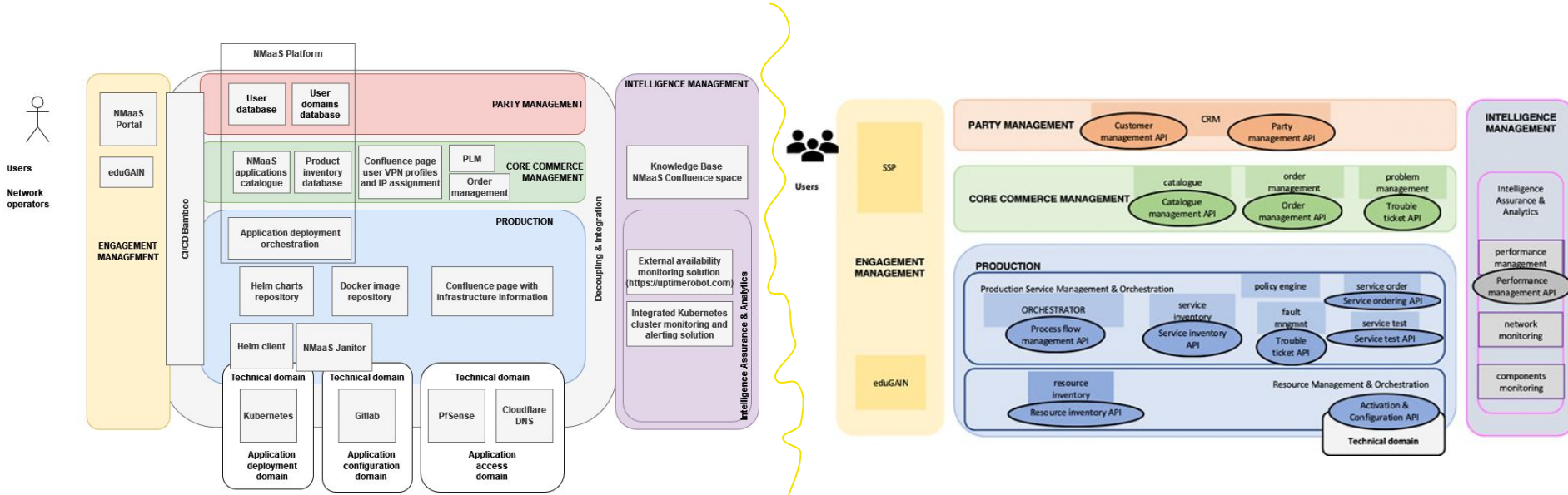


eduGAIN



CEANT

NMaaS and SPA Architectures



Digital Architecture Analysis

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



NREN Architectures

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

NETDEV Architectures

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

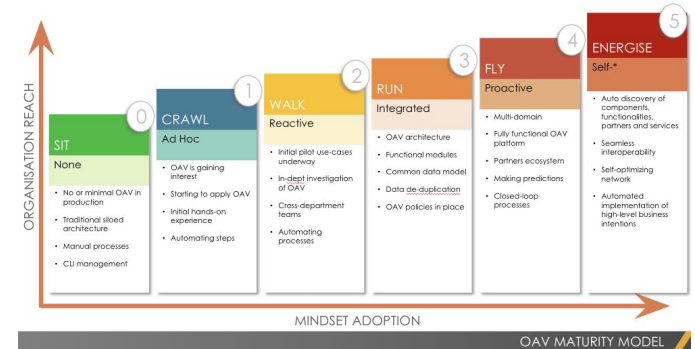
Other Use Cases

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

Maturity Model for Orchestration, Automation and Virtualisation (OAV)

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
- Individual responses not published



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

NETDEV Incubator

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>



Forthcoming Events

November

- 8 Nov, OAV Maturity Model Workshop, Paphos, Cyprus
- 14-15 Nov, SIG-NOC meeting, Dublin, Ireland
- 14 Nov, GNA-G Community Meeting at SC23, Denver, Colorado, USA
- 22-23 Nov, CTO Workshop - Network and Network Technologies, Amsterdam, NL
- 30 Nov, GÉANT Infoshare - NMaaS Virtual Labs for Education

December

- 8 Dec, GÉANT Infoshare - Relying on RARE for DDoS Attack Protection
- 12-14 Dec, GÉANT Project Symposium 2023



Thank You!

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