Orchestrating Service Automation

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2023 Internet2 Community Exchange

May 8-11, Atlanta, Ga, USA

Agenda

- Environment
- More than just a Theory: Network eAcademy
- Practice: Operational Services and TechLab
- Bringing it all together

The GÉANT Project

GÉANT's vision is to ensure equal network access for all scientists across Europe to the research infrastructures and the e-infrastructure resources

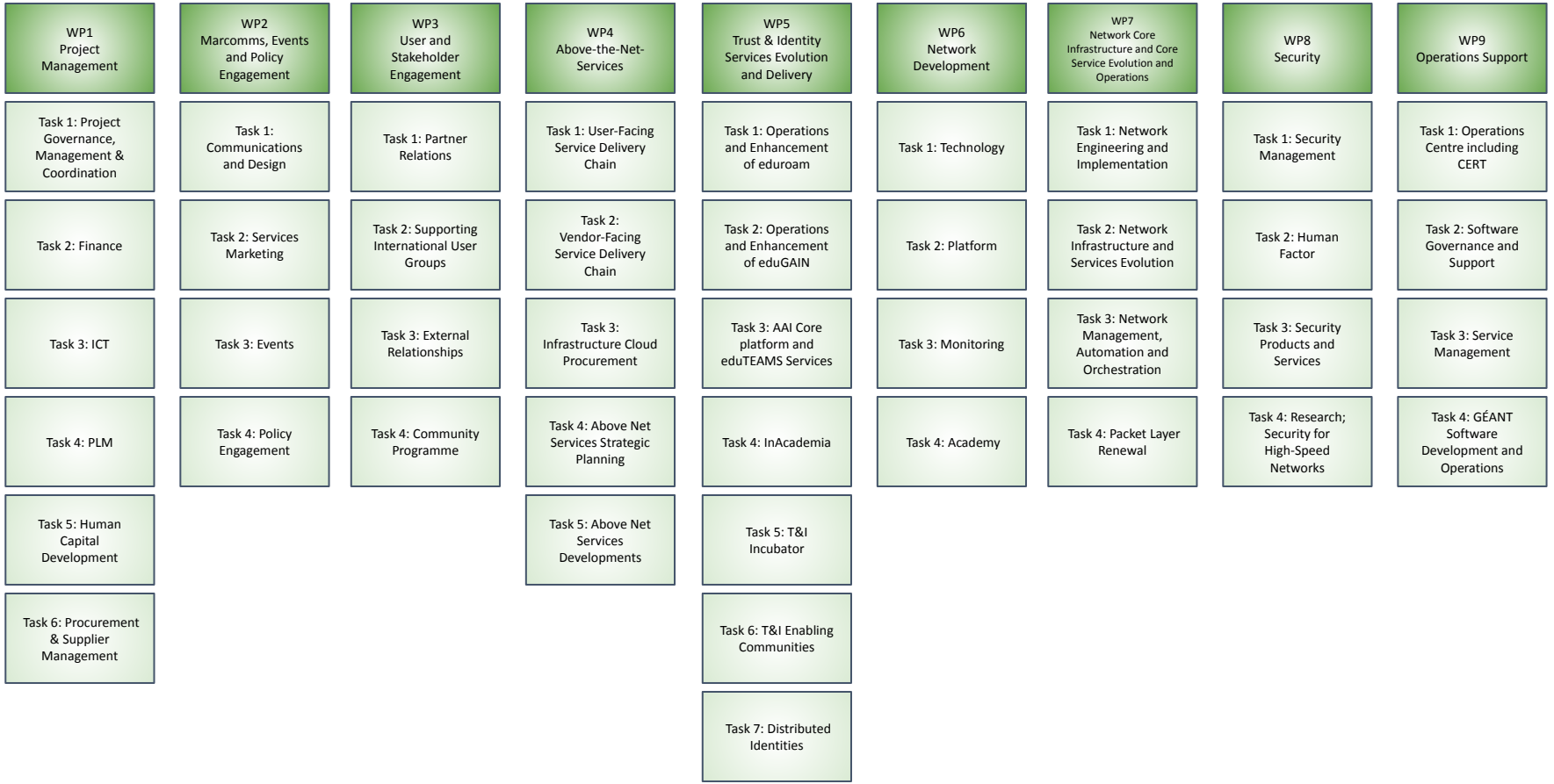
The GÉANT Project is a part of the European Union's Horizon Europe research and innovation programme under the seven-year Framework Partnership Agreement (FPA)

500 contributors from 37 partners - European R&E Institutions

50 M users

GÉANT 5-1 (GN5-1) Project duration: 1 Jan 2023 – 31 December 2024

The GÉANT 5-1 Project Structure



The GÉANT Project Structure

WP1 Project Management	WP2 Marcomms, Events and Policy Engagement	WP3 User and Stakeholder Engagement	WP4 Above-the-Net-Services	WP5 Trust & Identity Services Evolution and Delivery	WP6 Network Development	WP7 Network Core Infrastructure and Core Service Evolution and Operations	WP8 Security	WP9 Operations Support
Task 1: Project Governance, Management & Coordination	Task 1: Communications and Design	Task 1: Partner Relations	Task 1: User-Facing Service Delivery Chain	Task 1: Operations and Enhancement of eduroam	Task 1: Technology	Task 1: Network Engineering and Implementation	Task 1: Security Management	Task 1: Operations Centre including CERT
Task 2: Finance	Task 2: Services Marketing	Task 2: Supporting International User Groups	Task 2: Vendor-Facing Service Delivery Chain	Task 2: Operations and Enhancement of eduGAIN	Task 2: Platform	Task 2: Network Infrastructure and Services Evolution	Task 2: Human Factor	Task 2: Software Governance and Support
Task 3: ICT	Task 3: Events	Task 3: External Relationships	Task 3: Infrastructure Cloud Procurement	Task 3: AAI Core platform and eduTEAMS Services	Task 3: Monitoring	Task 3: Network Management, Automation and Orchestration	Task 3: Security Products and Services	Task 3: Service Management
Task 4: PLM	Task 4: Policy Engagement	Task 4: Community Programme	Task 4: Above Net Services Strategic Planning	Task 4: InAcademia	Task 4: Academy	Task 4: Packet Layer Renewal	Task 4: Research; Security for High-Speed Networks	Task 4: GÉANT Software Development and Operations
Task 5: Human Capital Development			Task 5: Above Net Services Developments	Task 5: T&I Incubator	NETDEV			
Task 6: Procurement & Supplier Management				Task 6: T&I Enabling Communities				
				Task 7: Distributed Identities				

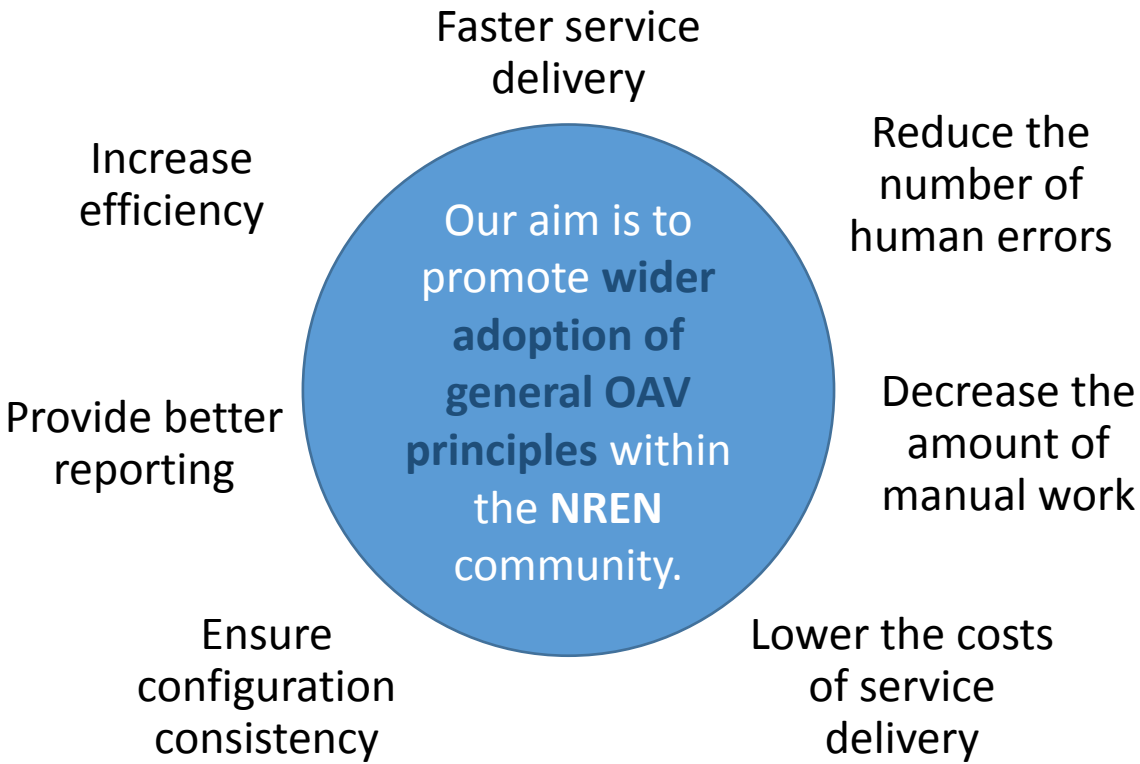
WP Leaders: **Ivana Golub (PSNC), Pavle Vuletić (UoB/AMRES)**
WP6 budget: > 3,1 mil EUR
31 R&E organisations from 25 countries
85 team members
https://wiki.geant.org/display/netdev

Network eAcademy

Agenda: Network eAcademy

- Introduction: Orchestration, Automation and Virtualisation
- Architecture/Mapping
- Training
- Terminology
- Maturity Model
- Promoting Orchestration, Automation and Virtualisation

OAV: Orchestration, Automation and Virtualisation



Why Architecture, Training, Terminology, Maturity Model...?

- OAV Survey to the NRENs (published in Sep 19):

  https://www.geant.org/Projects/GEANT_Project_GN4-3/GN43_deliverables/D6-2_Automation-and-Orchestration-of-Services-in-the-GEANT-Community.pdf

- Several discussions and workshops around the topic:
  - GN4-3 Future Service Strategy Workshop, May 19
  - BoF session at TNC, June 19
  - STF17, July 2019
  - Network Management and Monitoring Workshop (NEMMO), Oct 19

Collaborative approach to OAV in the GÉANT Community

Strong need for collaboration and exchange of knowledge and expertise

Knowledge as a gap

We speak different languages

A generally accepted architecture blueprint needed

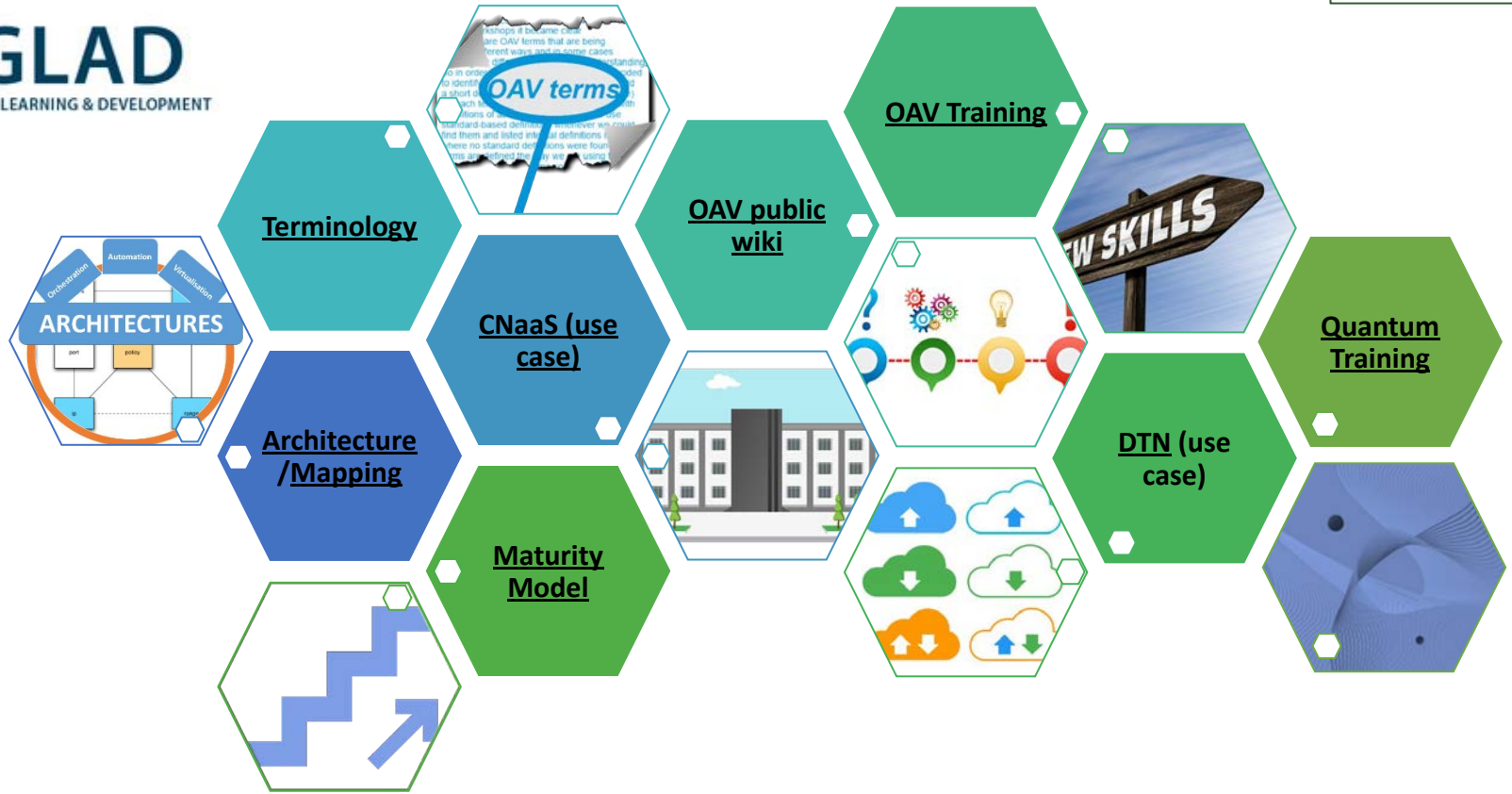
NRENs are willing to share experiences and learn from others

Network eAcademy

Network eAcademy

Powered by:

GLAD
GÉANT LEARNING & DEVELOPMENT

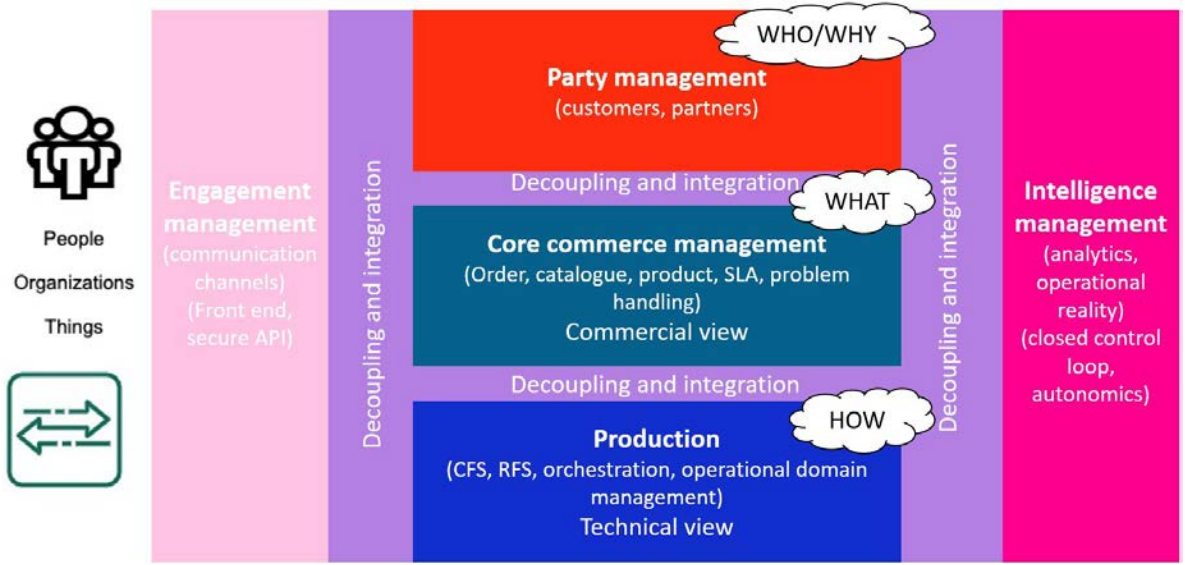


Architecture & Mappings

Architecture

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

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



NREN mappings to date:

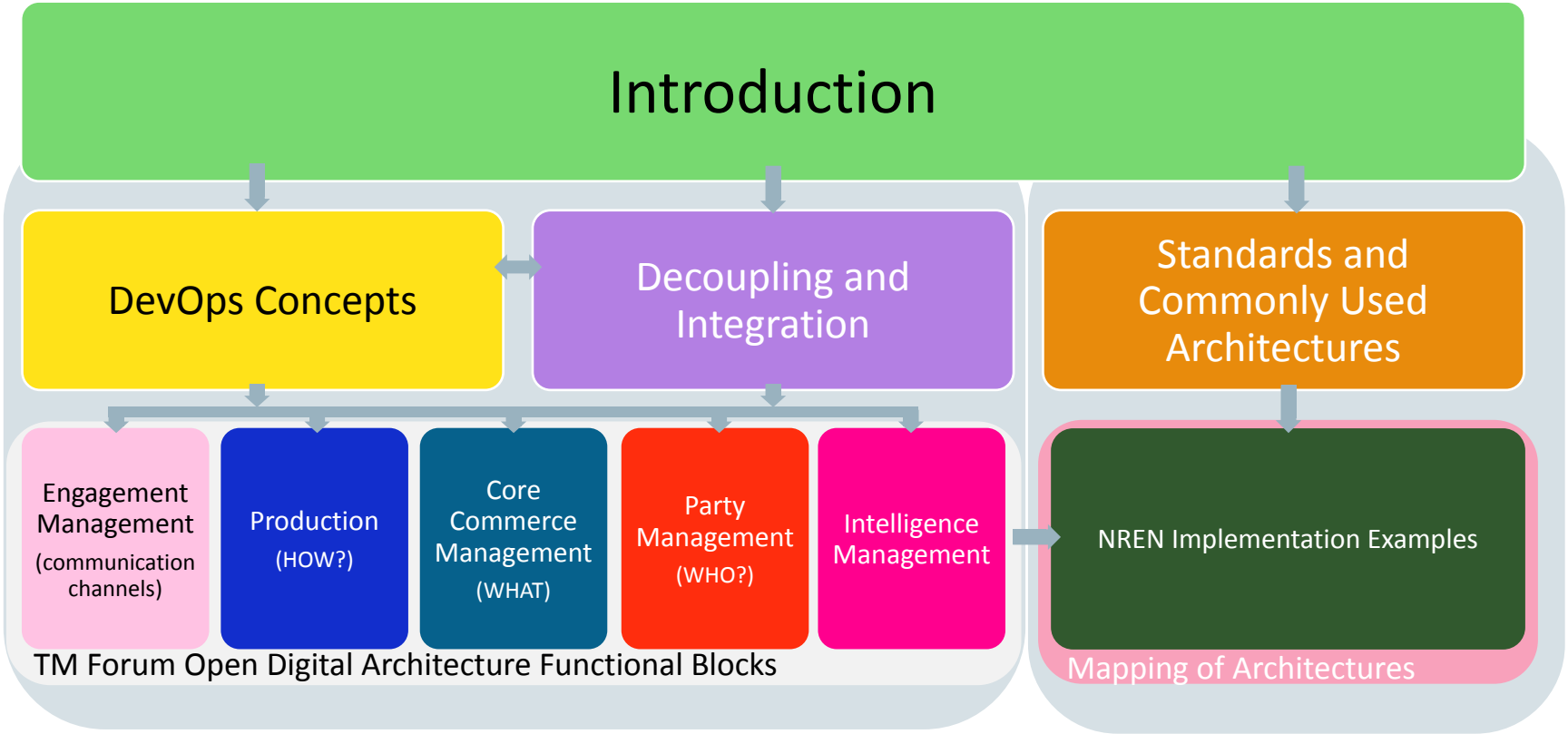
- CARNET
- CYNET
- GÉANT
- GRNET
- HEAnet
- PIONIER
- SURFNET

Platform mappings:

- NMaaS

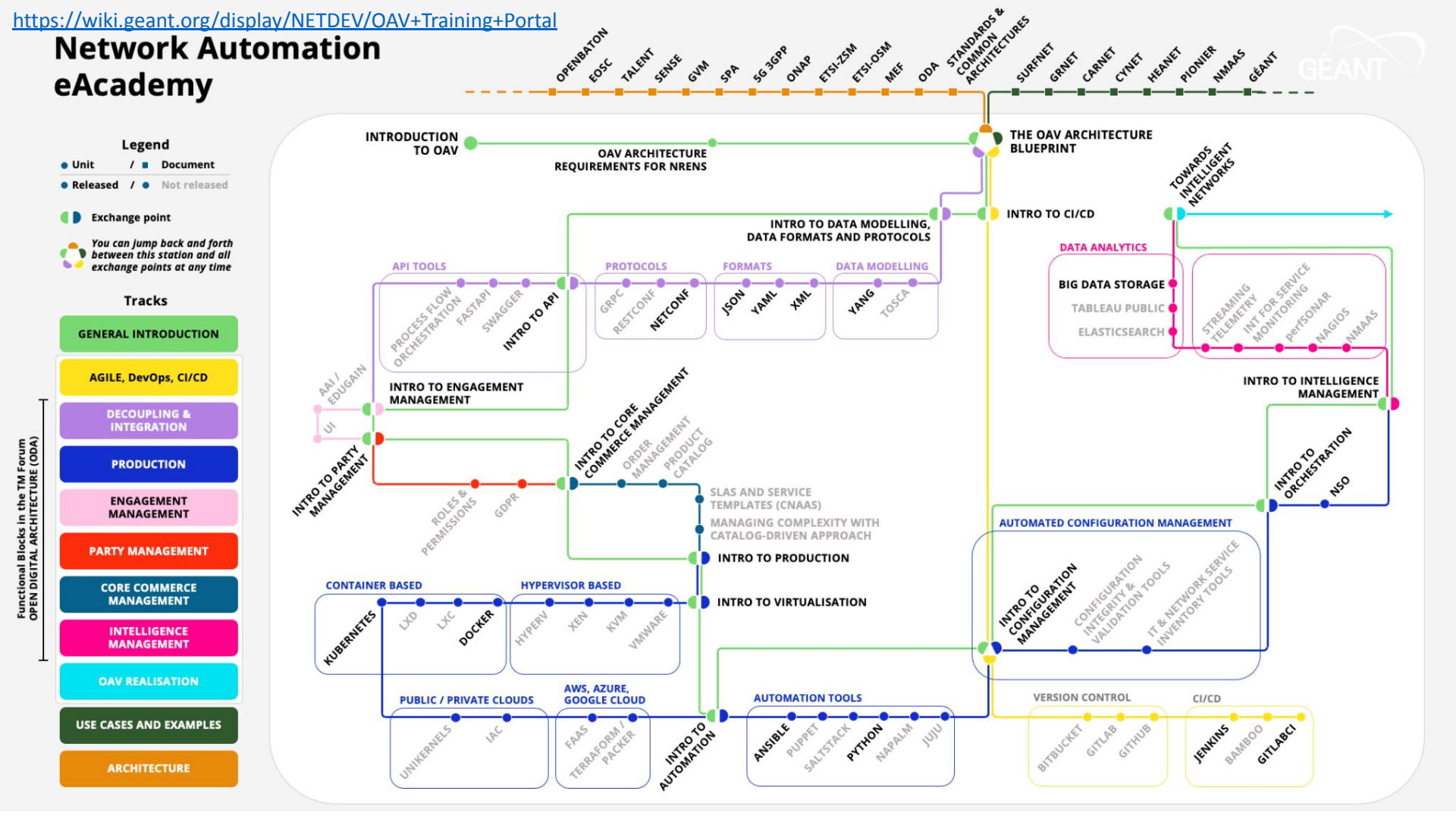
Knowledge Map for the Training

Training



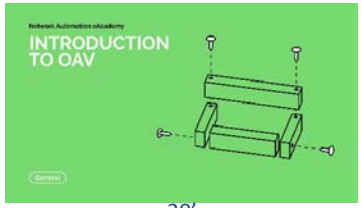
https://wiki.geant.org/display/NETDEV/OAV+Training+Portal

Network Automation eAcademy



General Introduction Line

Training



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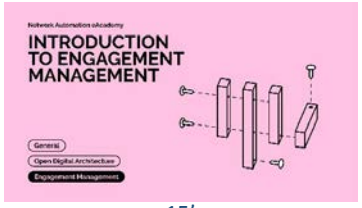
45’



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

Decoupling and Integration (Data Models, Formats, Protocols, APIs)

Training

30’

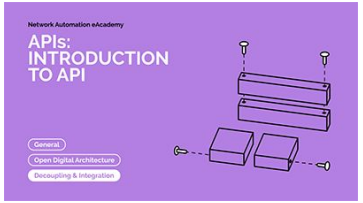
10’

60’

30’

45’

4h (including installation)



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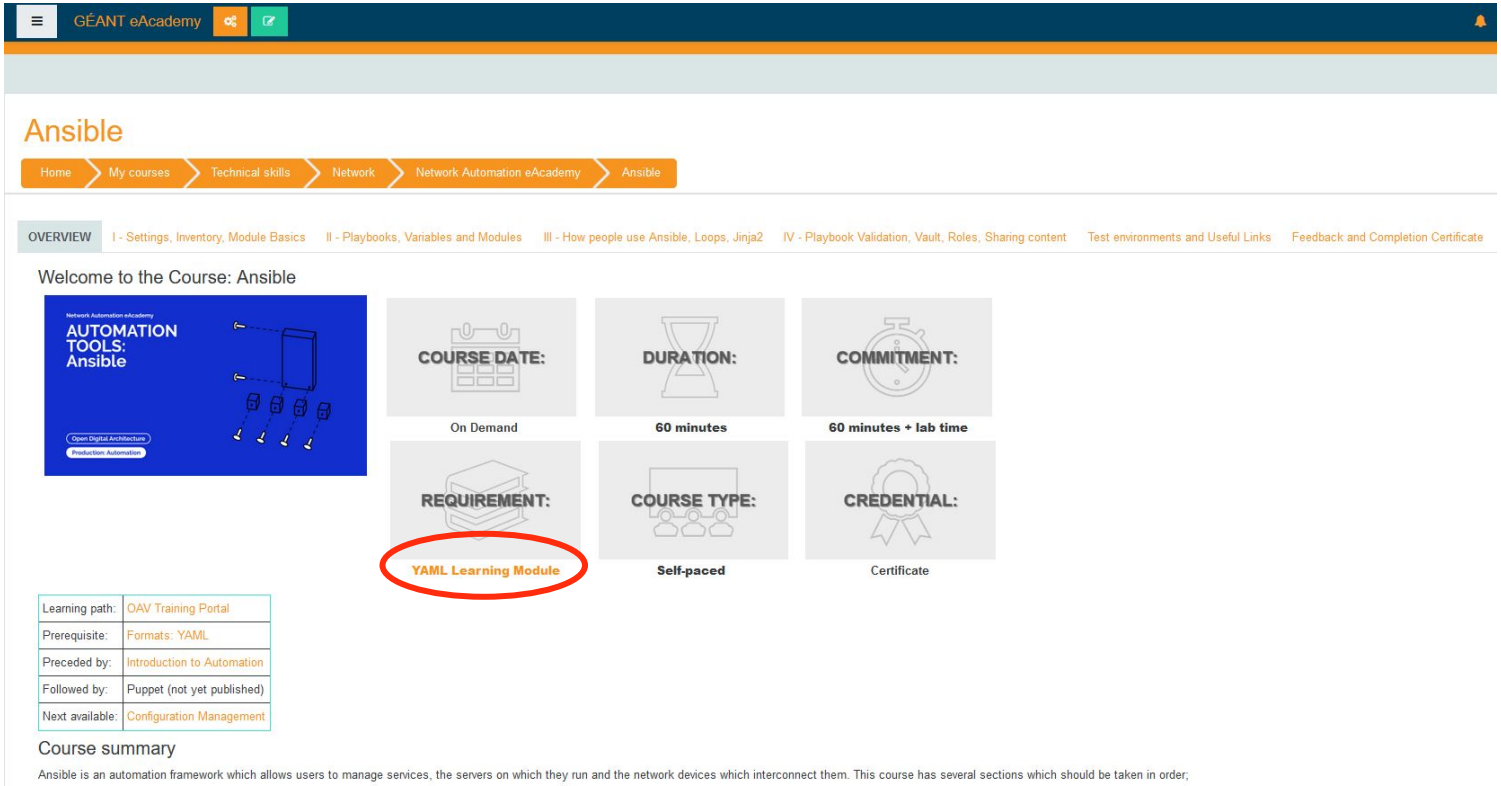
Ansible

Training



https://e-academy.geant.org/moodle/course/view.php?id=120

Ansible Requirement: YAML, YAML Requirement?

Training

GÉANT eAcademy

Formats: YAML

Home > My courses > Technical skills > Network > Network Automation eAcademy > Formats: YAML

OVERVIEW | Main Goals | Formats: YAML | Useful Links | Quiz | Feedback & Certificate

Welcome to the Course: Formats: YAML

COURSE DATE:	DURATION:	COMMITMENT:
From September 2021	20 min	30 min

REQUIREMENT:	COURSE TYPE:	CREDENTIAL:
Introduction to Data Models, Data Formats, and Protocols (recommended)	Selfpaced	Certificate of completion

Learning path:	OAV Training Portal
Preceded by:	Formats: XML
Followed by:	Formats: JSON

Course summary

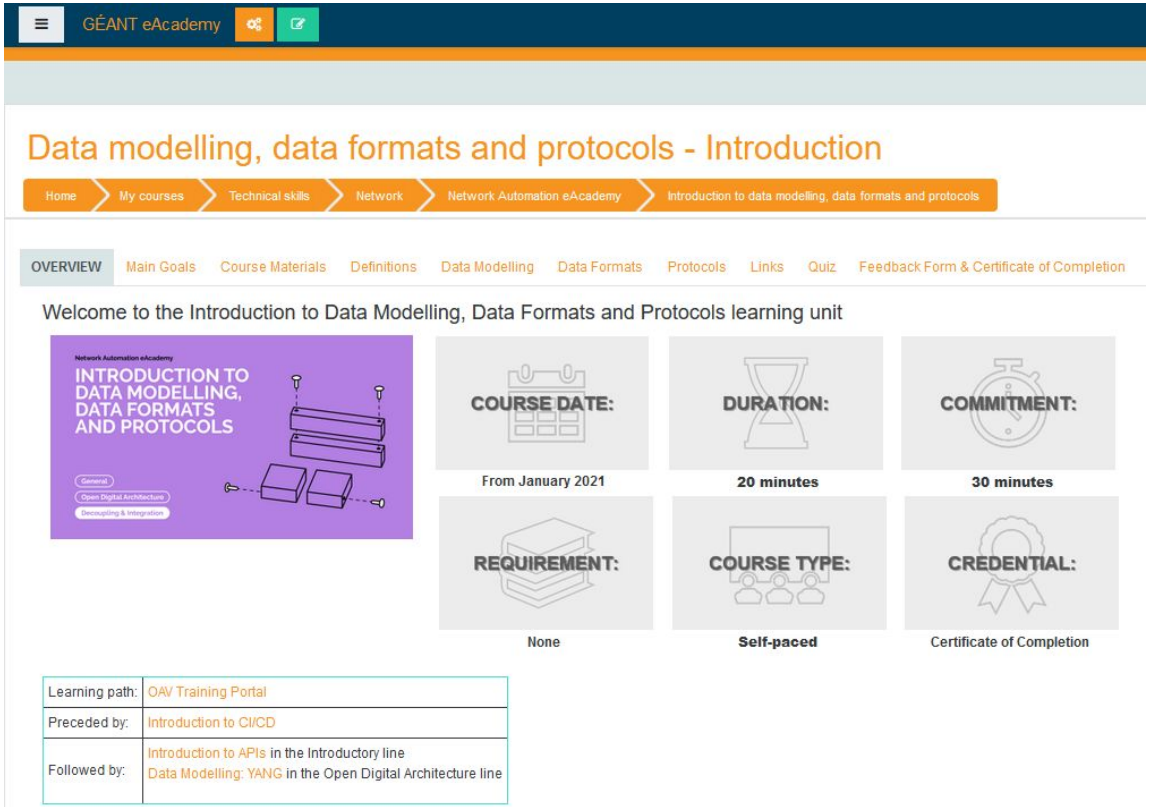
YAML is a human-friendly data serialisation standard broadly used in Orchestration, Automation and Virtualisation (OAV). This course offers a quick overview of the YAML syntax and some examples from the real world in a single video, with useful tips and references and a quiz.

In more detail, the learning unit discusses the following topics:

https://e-academy.geant.org/moodle/course/view.php?id=129

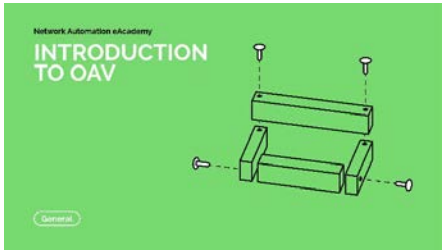
Ansible □ YAML □ Data models, Data Formats, and Protocols

Training



https://e-academy.geant.org/moodle/course/view.php?id=61

Ansible



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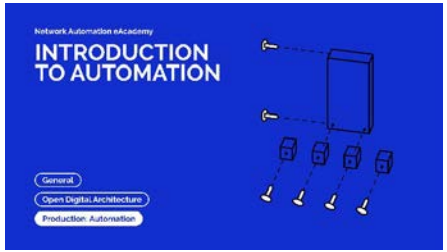


30’

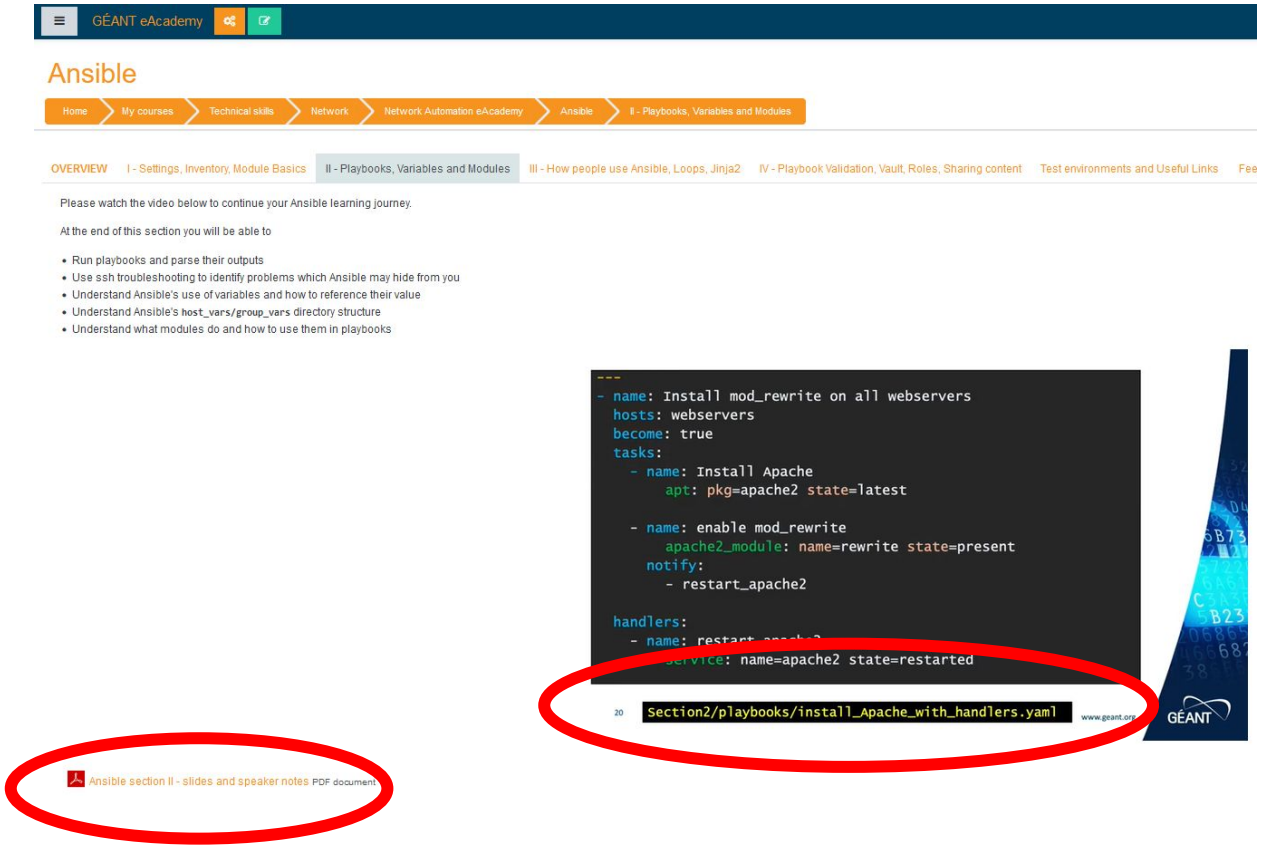
30’

60’ + lab time

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

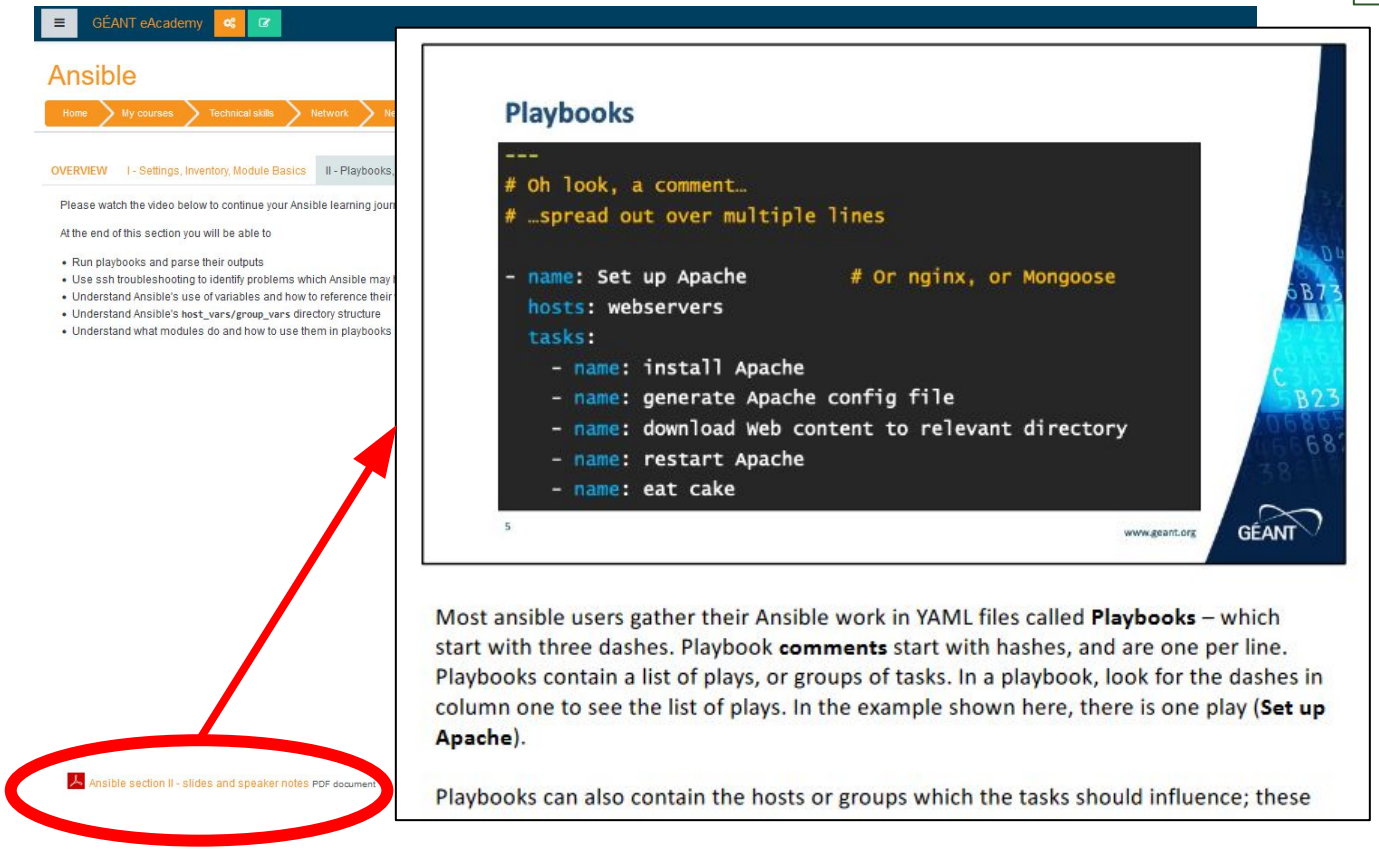
Ansible: Video with Subtitles

Training



Ansible: Slides with Speaker Notes

Training



Current Courses in the Network eAcademy – Automation

Training

Introduction

- **OAV - Introduction** (30')
- **OAV Architecture Requirements for NRENS** (10')
- **The OAV Architecture Blueprint** (30')

DevOps

- **Introduction to CI/CD** (15')
- **CI/CD: Jenkins** (5h)
- **CI/CD: GitlabCI** (40')

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(or social media)

TM Forum Open Digital Architecture

Decoupling & Integration
- **Introduction to Data Modelling, Data Formats, and Protocols** (30')
- **Data Modelling: YANG** (10')
- **Formats: XML** (60')
- **Formats: YAML** (30')
- **Formats: JSON** (45')
- **Protocols: NETCONF** (4 h - including installation)
- **Introduction to API** (45')

Engagement Management
- **Introduction to Engagement Management** (15')

Party Management
- **Introduction to Party Management** (15')

Core Commerce Management
- **Introduction to Core Commerce Management** (15')

Production
- **Introduction to Production** (30')
- **Introduction to Virtualisation** (30')
- **Container-Based Virtualisation: Docker / Swarm** (3h)
- **Container-Based Virtualisation: Kubernetes** (4h - including lab)
- **Introduction to Automation** (30')
- **Automation Tools: Ansible** (60'+lab time)
- **Automation Tools: Python** (90')
- **Introduction to Configuration Management** (20')
- **Introduction to Orchestration** (30')
- **Orchestration: NSO** (6h - including lab)

Intelligence Management
- **Introduction to Intelligence Management** (15')
- **Big Data Storage** (1.5h)

OAV Realisation

- **Towards Intelligent Networks** (30')

ADDITIONAL READING

Architecture Mappings

NREN use cases
- **CARNET**
- **CYNET**
- **GÉANT**
- **GRNET**
- **HEAnet**
- **PIONIER**
- **SURFNET**
- **GÉANT**

other use cases
- **NMaaS**

Architectures

- **Standards & Common Architectures**
- **TM Forum ODA**
- **SPA**
- **MEF**
- **ETSI-OSM**
- **ETSI-ZSM**
- **ONAP**
- **5G 3GPP**
- **GVM**
- **SENSE**
- **TALENT**
- **EOSC**
- **OpenBaton**

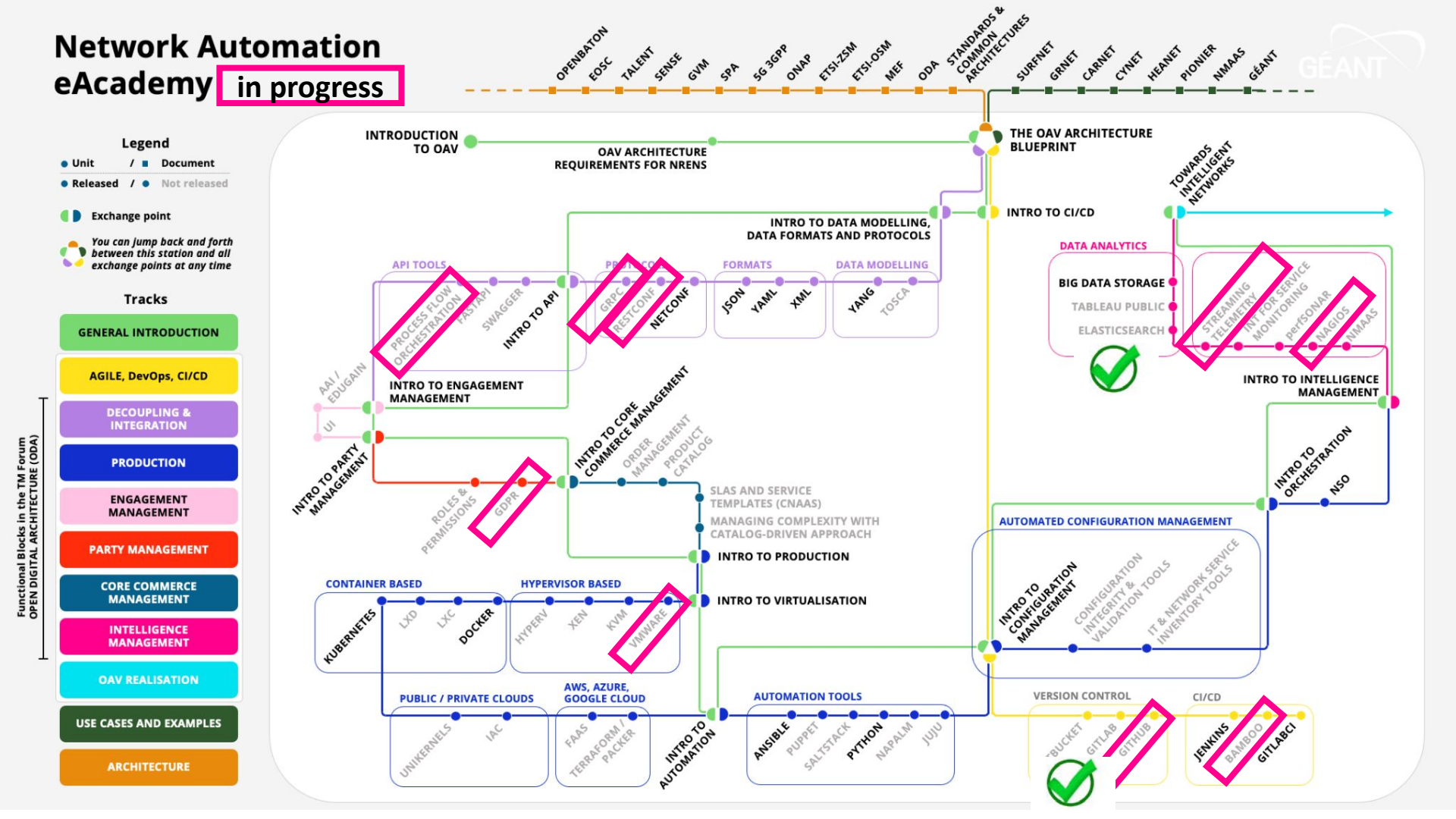
https://wiki.geant.org/display/NETDEV/OAV+Training+Portal

Practical Examples

Training

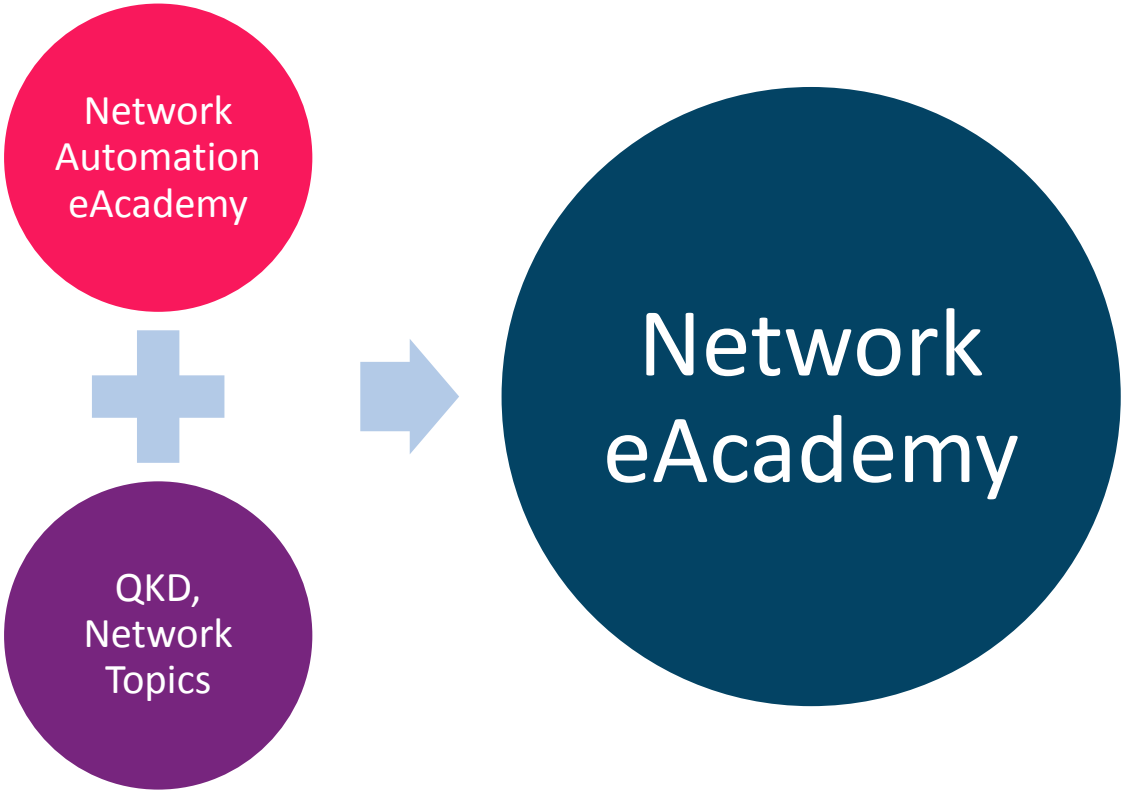
- Ansible:
  - Git repository with the examples in the unit.
  - Mini-Lab: Vagrant testing environment with a Unix server and a JunOS box.
- NETCONF:
  - Installation guide with a virtual environment in GNS3.
  - Adding a static route to a router, step-by-step.
- NSO:
  - Installation of free trial version.
  - Implementing a Radius server configuration over multiple devices.
  - Deploying an ACL on multiple devices, and/or interfaces on a device.

Network Automation eAcademy in progress



The Network eAcademy

Network eAcademy



Current Courses in the Network eAcademy – Quantum

Training

Quantum Algebra: Bloch Sphere

Course creator: Peter Kaufmann

Quantum Algebra: Entanglement Swapping

Course creator: Peter Kaufmann

Quantum Algebra: Mathematical Operators

Course creator: Peter Kaufmann

Quantum Algebra: Operator Multiplication: Variants

Course creator: Peter Kaufmann

Quantum Algebra: QuBit Entanglement

Course creator: Peter Kaufmann

Quantum Algebra: QuBits

Course creator: Peter Kaufmann

Quantum Algebra: Teleportation

Quantum Computers

Quantum Computing and Post-Quantum Cryptography

Currently working on – Quantum in progress

Training

Quantum Algebra: Bloch Sphere

Course creator: Peter Kaufmann

Quantum Algebra: Entanglement Swapping

Course creator: Peter Kaufmann

Quantum Algebra: Mathematical Operators

Course creator: Peter Kaufmann

Quantum Algebra: Operator Multiplication: Variants

Course creator: Peter Kaufmann

Quantum Algebra: QuBit Entanglement

Course creator: Peter Kaufmann

Quantum Algebra: QuBits

Course creator: Peter Kaufmann

Quantum Algebra: Teleportation

Quantum Computers

Quantum Computing and Post-Quantum Cryptography

Terminology and Glossary of OAV Terms

Terminology

- Need for an agreement on common terminology.
- The idea is to have a common ground of understanding.
- Published version 2.0 with additional terms about **AI** and **Maturity Model**
- Accepted by the GNA-G Automation Working Group

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Glossary

OAV Terms	Definition and reference
AIOps	***AIOps is (the usage of) Artificial Intelligence for IT Operations. It combines big data and machine learning to automate IT operations processes, including event correlation, anomaly detection and causality determination.*** • https://www.gartner.com/en/information-technology/glossary/aiops-artificial-intelligence-operations
AI-powered Virtual Agent (AIVA)	***An AI-powered Virtual Agent is an animated virtual character, more complex than a chatbot, that makes use of technologies like machine learning and natural language processing (NLP). This allows it to actively participate in a conversation, acting more like a human.*** • **Reference(s)**: based on https://www.ringcentral.com/virtual-agent.html and TM Forum AI Fundamentals course [TMF_AIF] and TM Forum "AI and its pivotal role in transforming operations" report and webinar [TMF_AI]
API (Application Programming Interface)	***An API is a set of commands, functions, protocols, and objects that programmers can use to create software or interact with an external system. Any data can be shared with an application program interface.***

https://wiki.geant.org/display/NETDEV/OAV+Terminology

OAV Maturity Model

Maturity Model

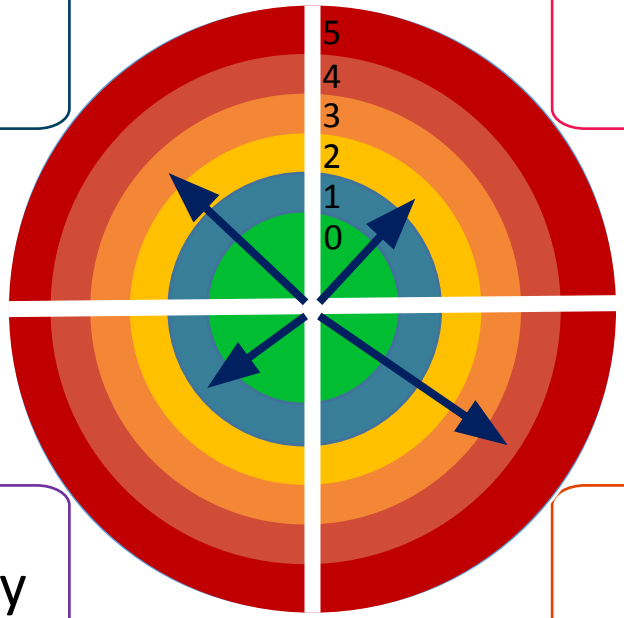
Measure	Measure the current OAV capabilities in a meaningful way
Identify	Enable clear identification of strengths and improvement points, be aware of threats and opportunities
Prioritise	Help prioritise what to do in order to advance and improve
Journey	Identify gaps between the current and future state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

OAV Maturity Model - Dimensions

Maturity Model

Architecture & Technology

Processes & Services



Vision & Strategy

People & Organisation

OAV Maturity Model - Stages

Maturity Model

Level 0

Sit

None

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-*

The Maturity Model

Maturity Model

Survey (31 questions)*:
https://www.surveymonkey.com/r/SPYDQVB

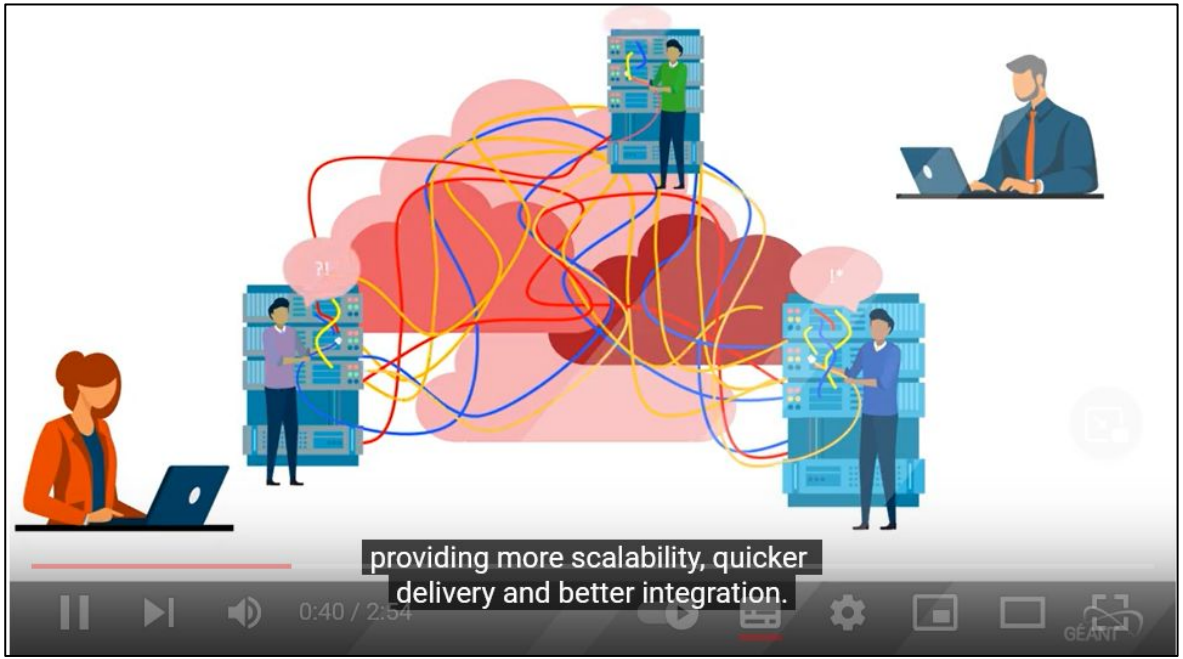
Information to help you check your progress through stages and dimensions:
https://wiki.geant.org/display/NETDEV/OAV+Maturity+Model

Presentations of the OAV MM Infoshare:
https://events.geant.org/e/OAV-MM

* Data is used for analytical purposes only (we don't publish data for individual institutions)
The report is sent to the person defined in the survey

Promoting Orchestration, Automation and Virtualisation (I)

Promotion

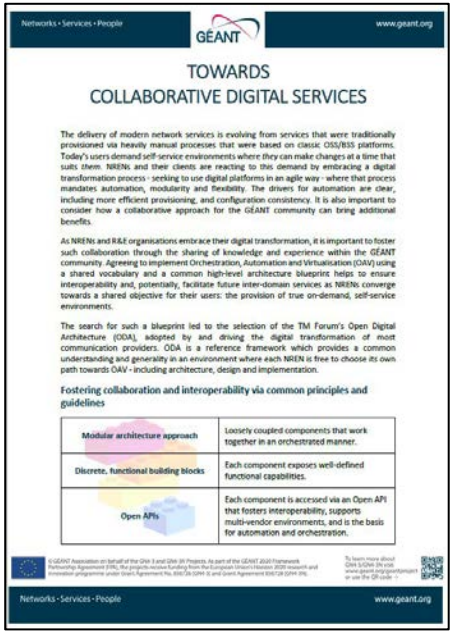


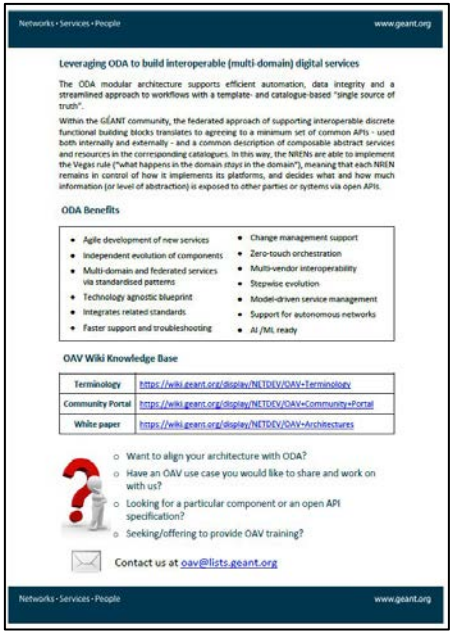
Towards Service Automation for Research and Education

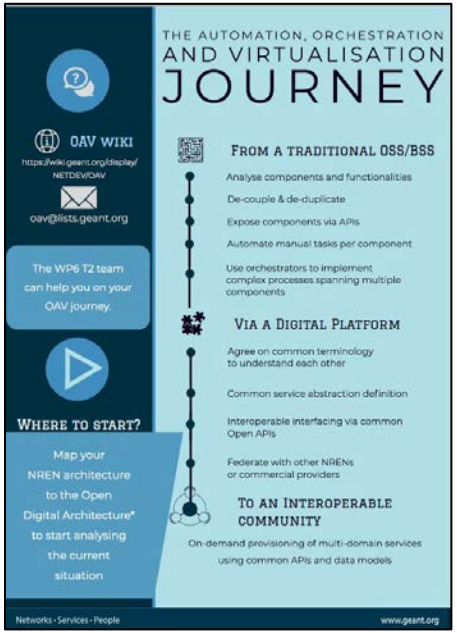
Video in the GÉANT TV channel:
https://youtu.be/Q5Wg1Qnqybg

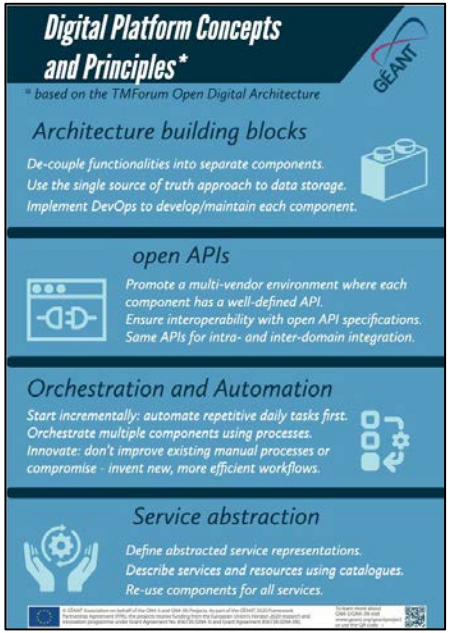
Promoting Orchestration, Automation and Virtualisation (II)

Promotion









Towards Collaborative Digital Services

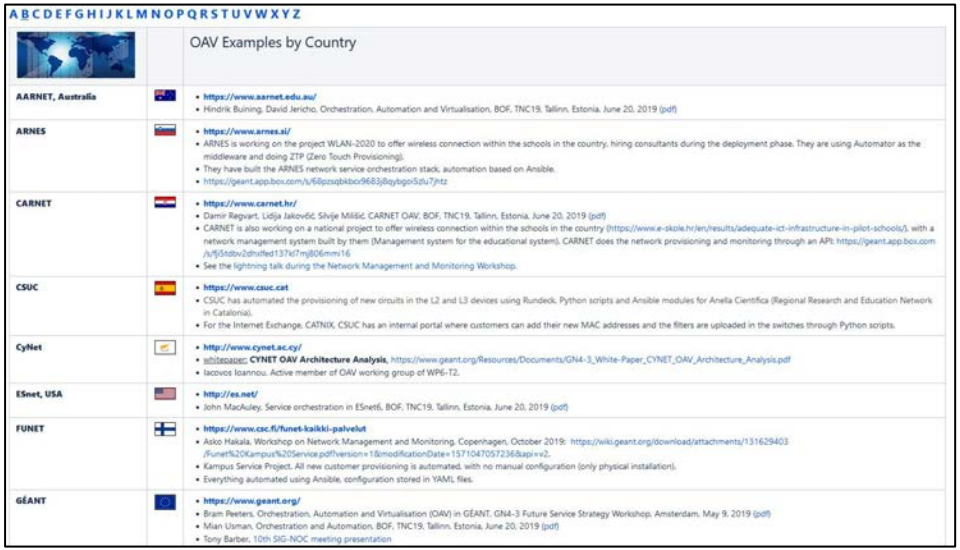
Pamphlet and Infographic:

https://www.geant.org/Resources/Documents/OAV_Arch_text_and_infographics_new_links.pdf

Wiki

Wiki

- Community Portal
- Sections for OAV:
  - Architecture
  - Training
  - Maturity Model
  - Terminology
  - Literature
  - Examples of usage: CNaaS, DTN
  - Dissemination: Deliverables, Infoshares, Presentations, Articles...



A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

OAV Examples by Country

AARNET, Australia	• https://www.aarnet.edu.au/ • Hindrik Buining, David Jericho, Orchestration, Automation and Virtualisation, BOF, TNC19, Tallinn, Estonia. June 20, 2019 (pdf)
ARNES	• https://www.arnes.si/ • ARNES is working on the project WLAN-2020 to offer wireless connection within the schools in the country, hiring consultants during the deployment phase. They are using Automator as the middleware and doing ZTP (Zero Touch Provisioning). • They have built the ARNES network service orchestration stack, automation based on Ansible. • https://geant.app.box.com/s/68pzxqbkbcn9683j8qybgoi5zlu7jhtz
CARNET	• https://www.carnet.hr/ • Damir Regvart, Lidija Jakovčić, Silvije Milišić, CARNET OAV, BOF, TNC19, Tallinn, Estonia, June 20, 2019 (pdf) • CARNET is also working on a national project to offer wireless connection within the schools in the country (https://www.e-skole.hr/en/results/adequate-ict-infrastructure-in-pilot-schools/), with a network management system built by them (Management system for the educational system). CARNET does the network provisioning and monitoring through an API: https://geant.app.box.com/s/fj5tdtv2dhxlfed137xl7mj806mm16 • See the lightning talk during the Network Management and Monitoring Workshop.
CSUC	• https://www.csuc.cat • CSUC has automated the provisioning of new circuits in the L2 and L3 devices using Rundeck, Python scripts and Ansible modules for Anella Científica (Regional Research and Education Network in Catalonia). • For the Internet Exchange, CATNIX, CSUC has an internal portal where customers can add their new MAC addresses and the filters are uploaded in the switches through Python scripts.
CyNet	• http://www.cynet.ac.cy/ • whitepaper: CYNET OAV Architecture Analysis, https://www.geant.org/Resources/Documents/GN4-3_White-Paper_CYNET_OAV_Architecture_Analysis.pdf • Iacovos Ioannou. Active member of OAV working group of WP6-T2.
ESnet, USA	• http://es.net/ • John MacAuley. Service orchestration in ESnet6. BOF, TNC19. Tallinn, Estonia. June 20, 2019 (pdf)
FUNET	• https://www.csc.fi/funet-kaikki-palvelut • Asko Hakala. Workshop on Network Management and Monitoring. Copenhagen, October 2019: https://wiki.geant.org/download/attachments/131629403/Funet%20Kampus%20Service.pdf?version=1&modificationDate=1571047057236&api=v2. • Kampus Service Project. All new customer provisioning is automated, with no manual configuration (only physical installation). • Everything automated using Ansible, configuration stored in YAML files.
GÉANT	• https://www.geant.org/ • Bram Peeters, Orchestration, Automation and Virtualisation (OAV) in GÉANT. GN4-3 Future Service Strategy Workshop. Amsterdam, May 9, 2019 (pdf) • Mian Usman, Orchestration and Automation, BOF, TNC19, Tallinn, Estonia, June 20, 2019 (pdf) • Tony Barber, 10th SIG-NOC meeting presentation

With Many Thanks to our Trainers!

Aristos Anastasiou (MARNET)	Iacovos Ioannou (CyNet)
Jasone Astorga (RedIRIS / UPV/EHU)	Hamzeh Khalili (RedIRIS / i2CAT)
Estela Carmona (RedIRIS / i2CAT)	Roman Łapacz (PSNC)
Dónal Cunningham (HEAnet)	Eldis Mujarić (CARNET)
Yuri Demchenko (SURFnet / UvA)	Anastas Mishev (MARNET / UKIM)
Aleksandra Dedinec (MARNET/UKIM)	Susanne Naegele-Jackson (DFN / FAU)
Sonja Filiposka (MARNET / UKIM)	Simone Spinelli (GÉANT)
Maria Isabel Gandia (RedIRIS / CSUC)	Kostas Stamos (GRNET / CTI)
Eduardo Jacob (RedIRIS / UPV/EHU)	Your name here?
Nicolai Iliuha (RENAM)	

Contact us at network-eacademy@lists.geant.org

For any questions, the R&E community can join us once a month.

And the WPL, the GLAD team and the Communications team at GÉANT!

Orchestrated Services in Practice

Operational Services and TechLab

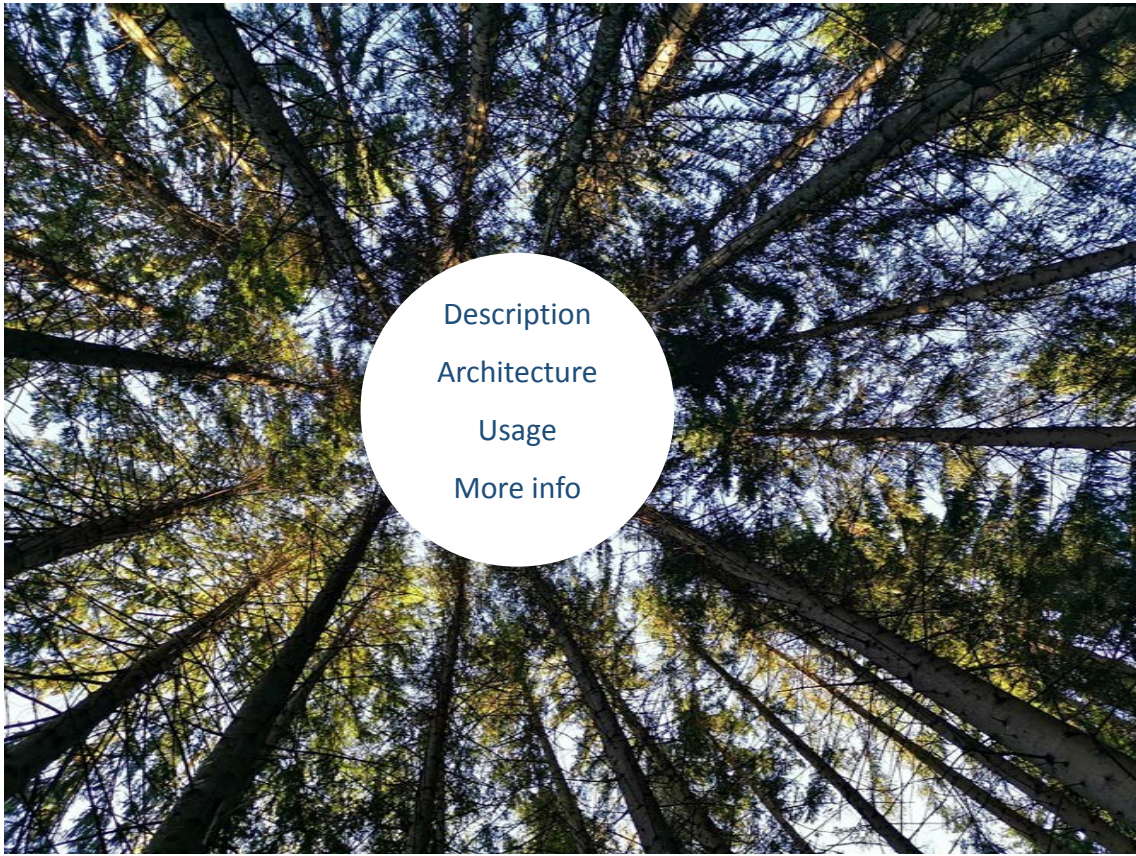
Agenda: Orchestrated Services in Practice

NMaaS

SPA Service Provider Architecture

GÉANT P4 LAB

TechLab



NMaaS

Network Management as a Service

NMaaS is an effective and efficient **network and service management platform:**

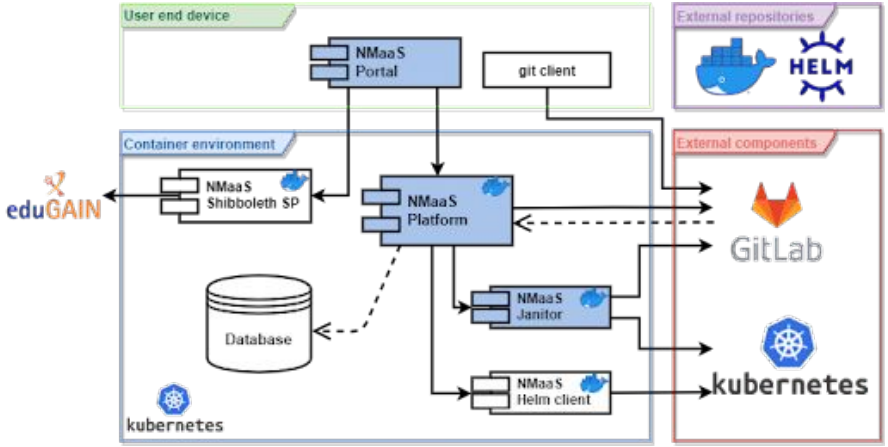
- Simplifies intra-domain network management by providing the **infrastructure and tools** via a **cloud-based** network management system.
- Enables **management and monitoring of client networks** through **on-demand deployment** of network management tools in the cloud infrastructure.
- Uses a **multi-tenant approach** - each organisation has private access to their network and services from a highly available cloud based platform.

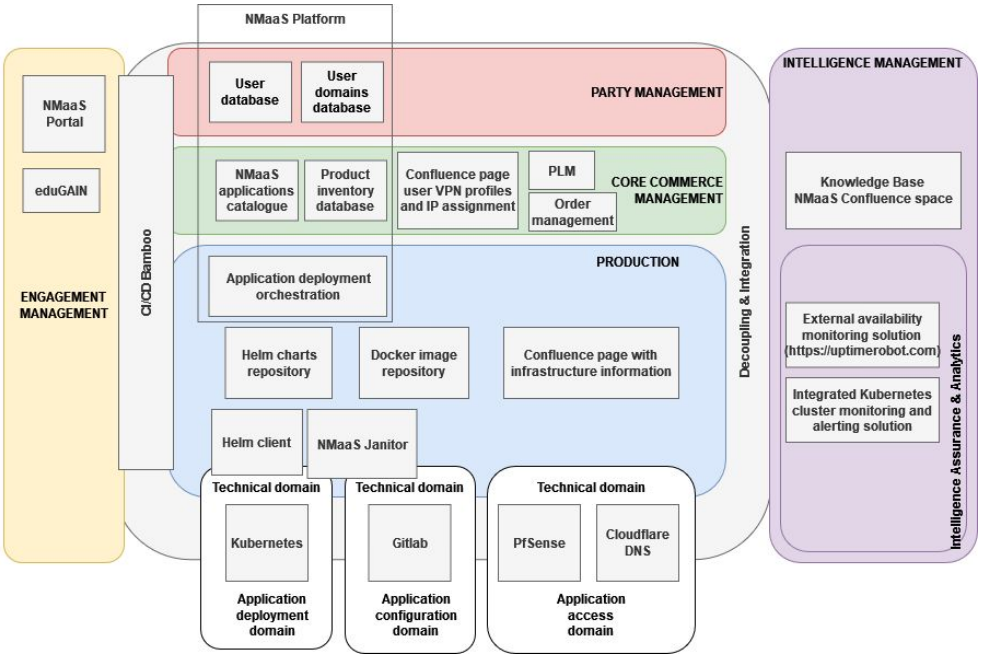
Network Management as a Service

Contact: nmaas@lists.geant.org

Portal: https://nmaas.eu

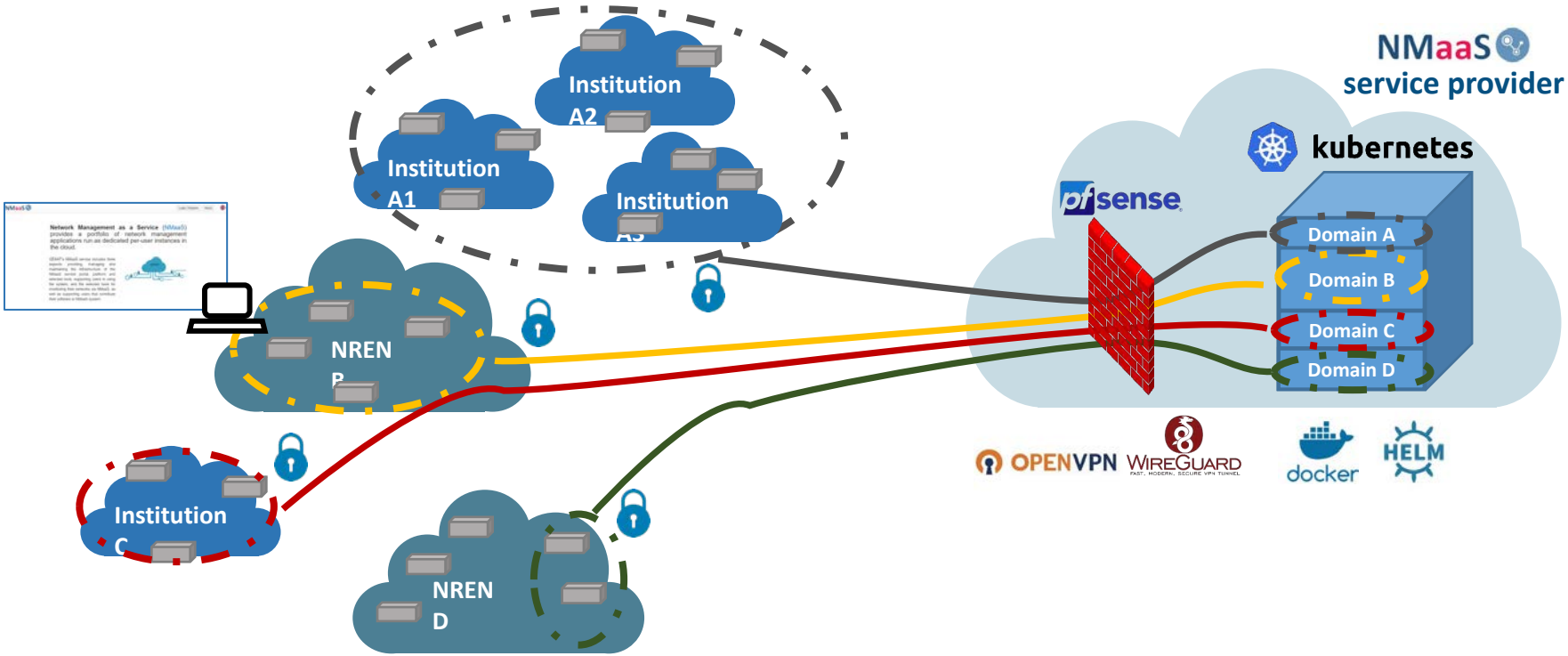
NMaaS Architecture





[NMaaS-OAV-Architecture-Analysis]

NMaaS service deployment



NMaaS tools

28 applications available in the portfolio

Oxidized	Icinga2	SPA & Inventory
NAV	CodiMD	perfSONAR Central Management
Prometheus	Synapse	WiFiMon
Grafana	InfluxDB	Uptime Kuma
Booked	ELK Stack	Victoria Metrics
Bastion	Jenkins	WebDAV Server
Debian repo	Zabbix	Healthchecks
Routinator	LibreNMS	
NetBox		

Adding new tools require:

- Docker image(s)
- Helm chart
- Metadata and info about the application

NMaaS Use Cases

Network / Equipment Management

- Small / medium size networks / institutions
- Project-owned equipment

NMaaS Virtual Lab

NEW

- Aimed for education
- Using on-demand application deployment in a learning context
- Creating personalised and portable development environments

Examples:

- Deploying black-box containers to study software vulnerabilities
- Shared domains between multiple users for where teamwork scenarios
- Personalised catalog of applications for each user through domain groups
- Bulk application deployment
- …

How to use NMaaS?

MANAGED SERVICE

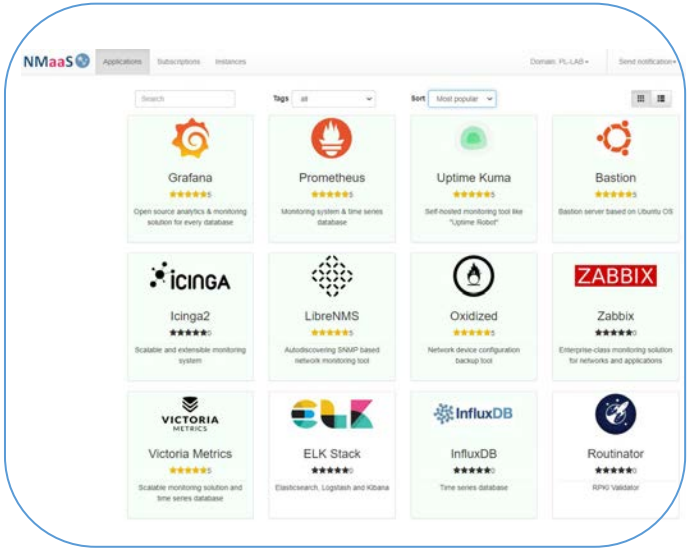
Production NMaaS instance for operational network management i maintenance *(secure, fully supported)*
https://nmaas.eu

A **sandbox NMaaS instance** to explore NMaaS features and offered applications *(no configuration overhead, demo apps already deployed)*
https://nmaas.geant.org

SELF-HOSTED

Run your own NMaaS instance (Kubernetes cluster required) visit NMaaS **Installation Guide**:
https://docs.nmaas.eu/install-guide

Run Kubernetes cluster and NMaaS on a local machine visit **local** NMaaS **Testing Environment** Installation Guide:
https://docs.nmaas.eu/local-vm



https://network.geant.org/nmaas/

nmaas@lists.geant.org

https://github.com/nmaas-platform

Service Provider Architecture Platform

Service Provider Architecture

Enables and supports transformation from traditional OSS/BSS environments towards the Digital Business Platform

SPA is a modular blueprint guide for designers and developers that want to build a next generation service management platform by integrating functionalities in a flexible and uniform way.

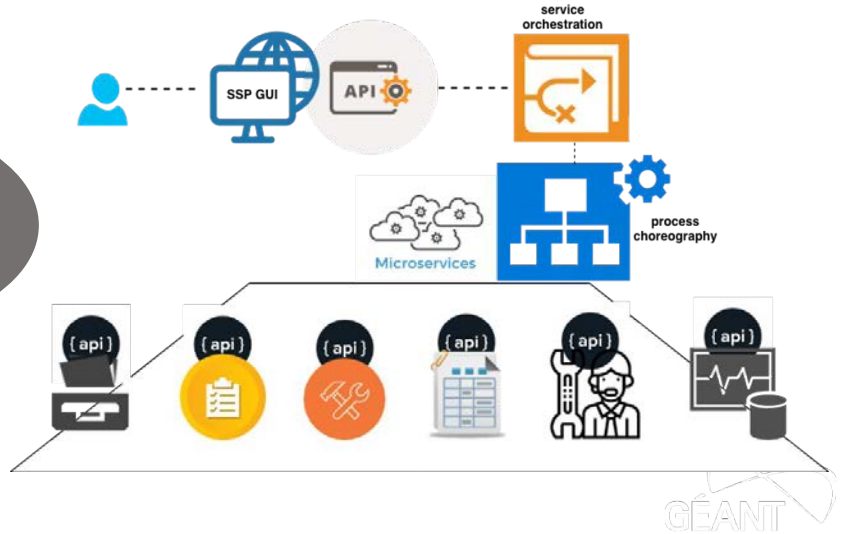
spa@lists.geant.org
gn4-3-wp6-t2-dev@lists.geant.org
https://wiki.geant.org/display/NETDEV/SPA

Service Provider Architecture Platform

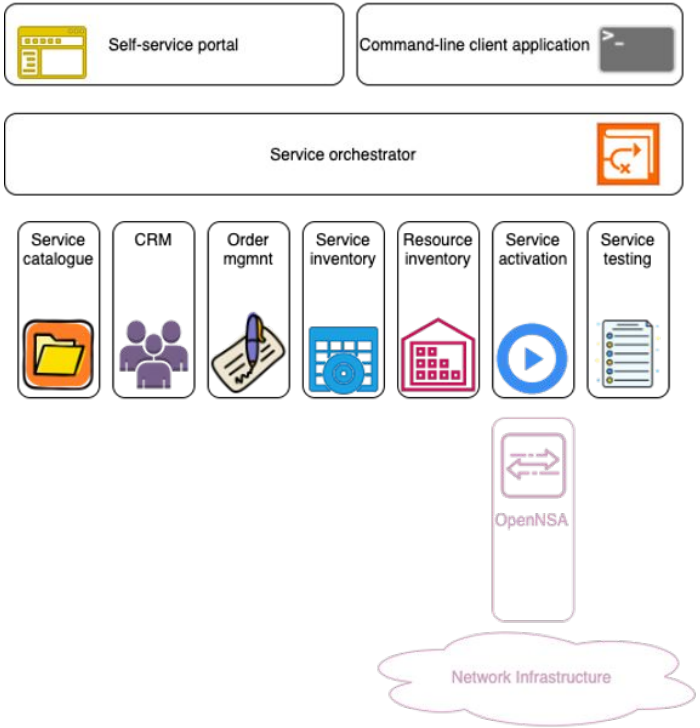
SPA Service Provider Architecture

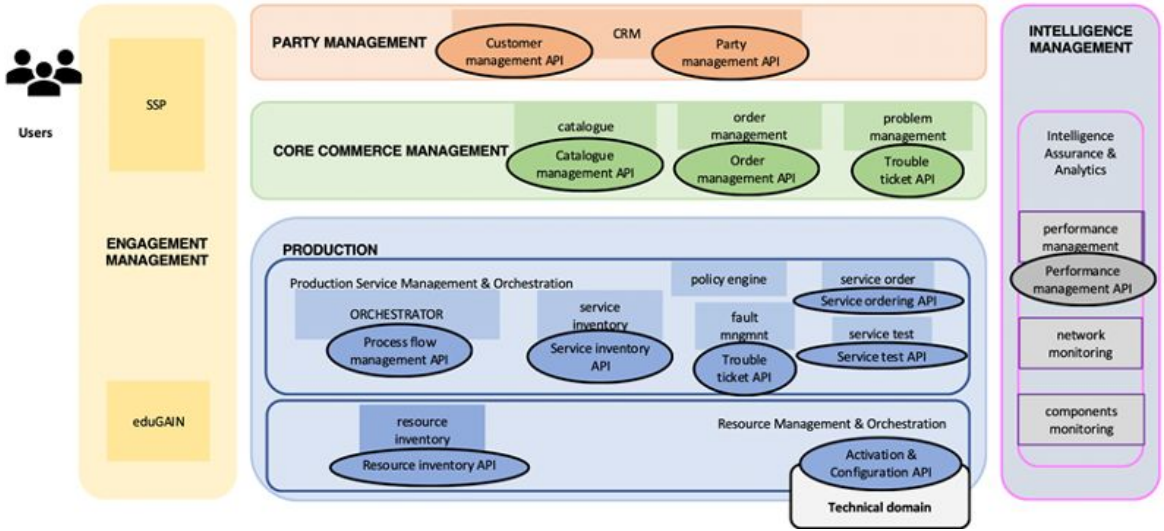
SPA platform is the implementation of the SPA to orchestrate and automate network services in the GÉANT and NREN network infrastructures.

- Design a LEGO® type of service architecture
- Support the service lifecycle of all network services
- Common information model
- TMF Frameworx compliant
- Orchestration for complex workflows
- Use automation wherever possible



Service Provider Architecture





Single Point of Truth for the orchestration and automation framework

- **Resource and Service Inventory** version 3 NEW
- OpenAPI 3.0 schema validation for the REST API
  - Any data model described by the schema can be supported
- REST API compliant with TMF OpenAPI specs (verified with the TMF test suites)
- Flexible for data model extensions and updates (NoSQL database)
- REST API OAuth 2.0 Authentication with Keycloak
- Upcoming: a series of tests in the PIONIER network
  - SPoT - one of the key components for the work on automation of resource and service configuration

Services based on SPA

GÉANT Connection Service

E-Line Service in NMaaS

GÉANT Connection Service (GCS)

SPA Service Provider Architecture

- Microsoft ExpressRoute point-to-point L2 circuits in the GÉANT infrastructure
- Production service for GÉANT OC
- OpenNSA as the activation component (topology abstraction, access to the infrastructure)
- Continuous improvements
  - New requirements from the GÉANT OC
  - UAT (User Acceptance Test) environment for pre-production tests

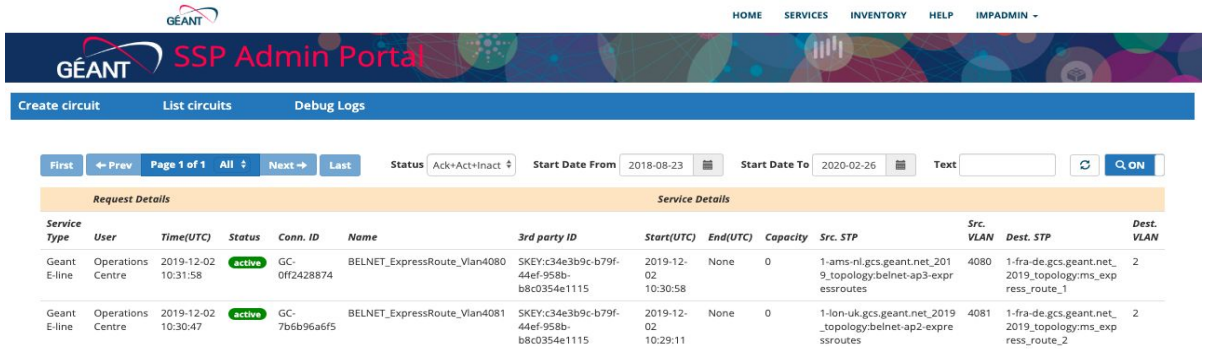
36 STPs

44 routers

24 active circuits

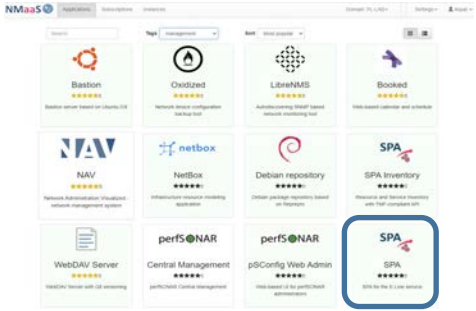
707 automated workflows

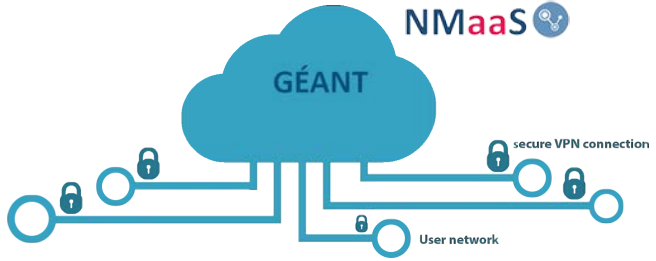
665 terminated circuits



E-Line Service in NMaaS

- Sandbox for testing L2 point-to-point connection service
  - All SPA components with default test settings
  - OpenNSA with simple emulated network topology
  - All service lifecycle actions
- No need to deploy the service on your own resources
  - Only an account in NMaaS is needed
  - User creates an instance of the service for testing
- SPA in NMaaS may help to familiarise with the OAV concept and the available SPA implementation (start of the orchestration and automation journey)





GP4L

GP4L - GÉANT P4Lab

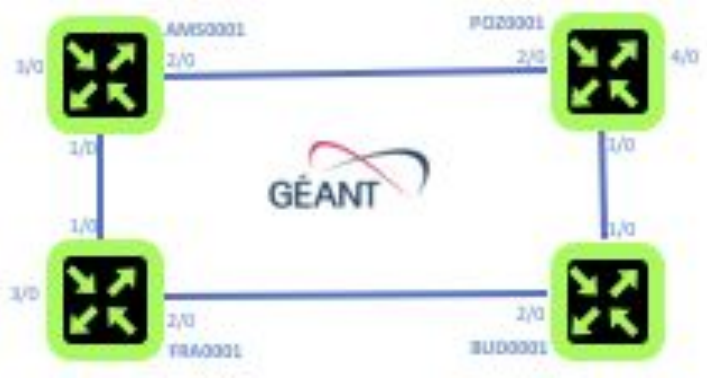
P4 switch-based lab infrastructure interconnected through the GÉANT network

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

Initially aimed **to validate the RARE/FreeRtr** open source routing stack software

With growing interest, 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

Router for Academia, Research and Education (RARE)

RARE is an open source routing platform, used to create a network operating system (NOS) on commodity hardware (a white box switch).

RARE uses FreeRtr as a control plane software and is thus often referred to as RARE/FreeRtr

FreeRtr

More information:
https://wiki.geant.org/display/rare

GÉANT

P4 Programmable Switches

EdgeCore Wedge100BF-32QS:

100GbE Data Center Switch

- Bare-Metal Hardware
- L2/L3 Switching
- 32xQSFP28 Ports

Data-Plane Programmability

- Intel Tofino Switch Silicon
- Barefoot Networks

Quad-Pipe Programmable Packet Processing Pipeline

- 6.4 Tbps Total Bandwidth

CPU: Intelx86 Xeon 2.0GHz

- 8-core/48GB/2TB SSD

RARE IPv4/IPv6 Features

Include, but not limited to:

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

Supported platforms:

- BMv2, TOFINO, DPDK, XDP

List updated regularly:

- https://wiki.geant.org/display/rare

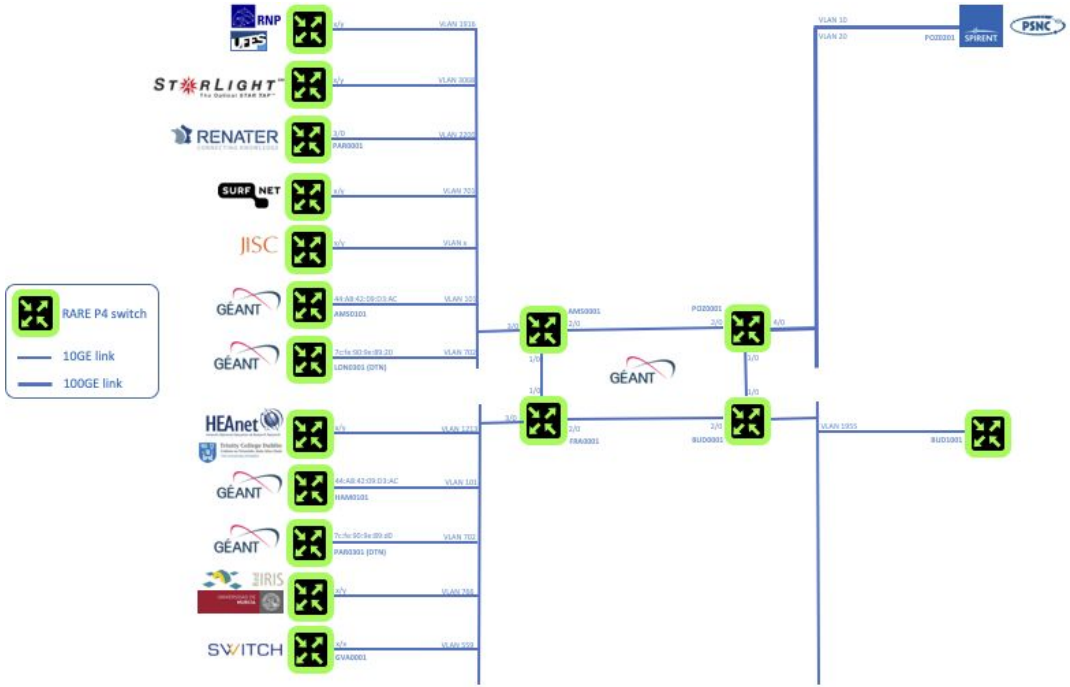
For more features or details, contact:

- rare-users@lists.geant.org

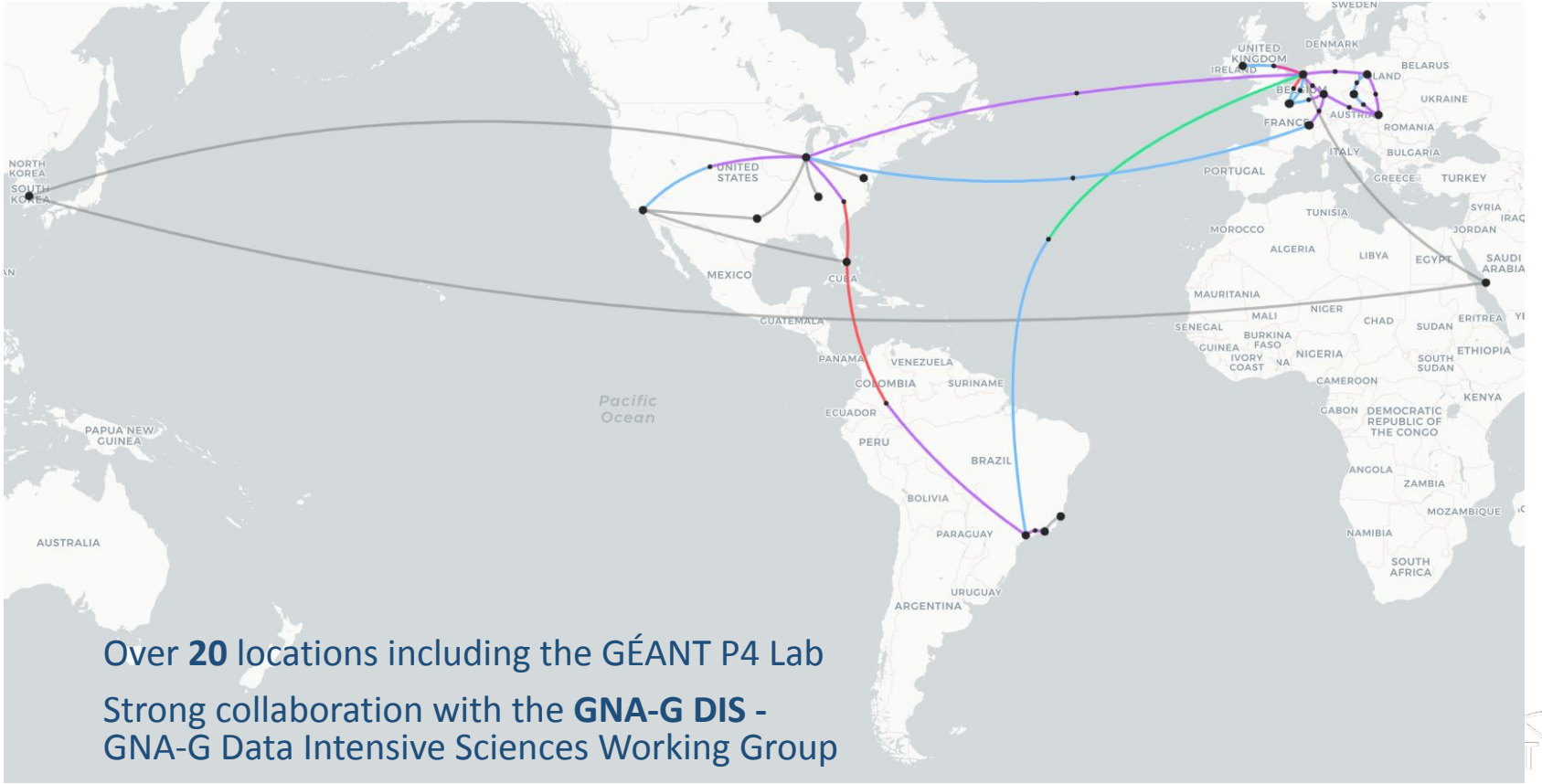
Complete feature list

Type	Test #	Name	P4	∞	DPDK	xdp
acl	01	copp	✓	✓	✓	n/a
acl	02	ingress access list	✓	✓	✓	n/a
acl	03	egress access list	✓	✓	✓	n/a
acl	04	nat	✓	✓	✓	n/a
acl	05	vlan ingress access list	✓	✓	✓	n/a
acl	06	vlan egress access list	✓	✓	✓	n/a
acl	07	bundle ingress access list	✓	✓	✓	n/a
acl	08	bundle egress access list	✓	✓	✓	n/a
acl	09	bundle vlan ingress access list	✓	✓	✓	n/a
acl	10	bundle vlan egress access list	✓	✓	✓	n/a
acl	11	bridge ingress access list	✓	✓	✓	n/a
acl	12	bridge egress access list	✓	✓	✓	n/a
acl	13	vlan bridge ingress access list	✓	✓	✓	n/a
acl	14	vlan bridge egress access list	✓	✓	✓	n/a
acl	15	ingress pppoe access list	✓	✓	✓	n/a
acl	16	egress pppoe access list	✓	✓	✓	n/a
acl	17	ingress vlan pppoe access list	✓	✓	✓	n/a
acl	18	egress vlan pppoe access list	✓	✓	✓	n/a
acl	19	hairpin ingress access list	✓	✓	✓	n/a
acl	20	hairpin egress access list	✓	✓	✓	n/a
acl	21	hairpin vlan ingress access list	✓	✓	✓	n/a
acl	22	hairpin vlan egress access list	✓	✓	✓	n/a
acl	23	hairpin pppoe ingress access list	✓	✓	✓	n/a
acl	24	hairpin pppoe egress access list	✓	✓	✓	n/a
acl	25	hairpin vlan pppoe ingress access list	✓	✓	✓	n/a
acl	26	hairpin vlan pppoe egress access list	✓	✓	✓	n/a
acl	27	ingress gre access list	✓	✓	✓	n/a
acl	28	egress gre access list	✓	✓	✓	n/a
acl	29	ingress vlan gre access list	✓	✓	✓	n/a

GP4L Going Global



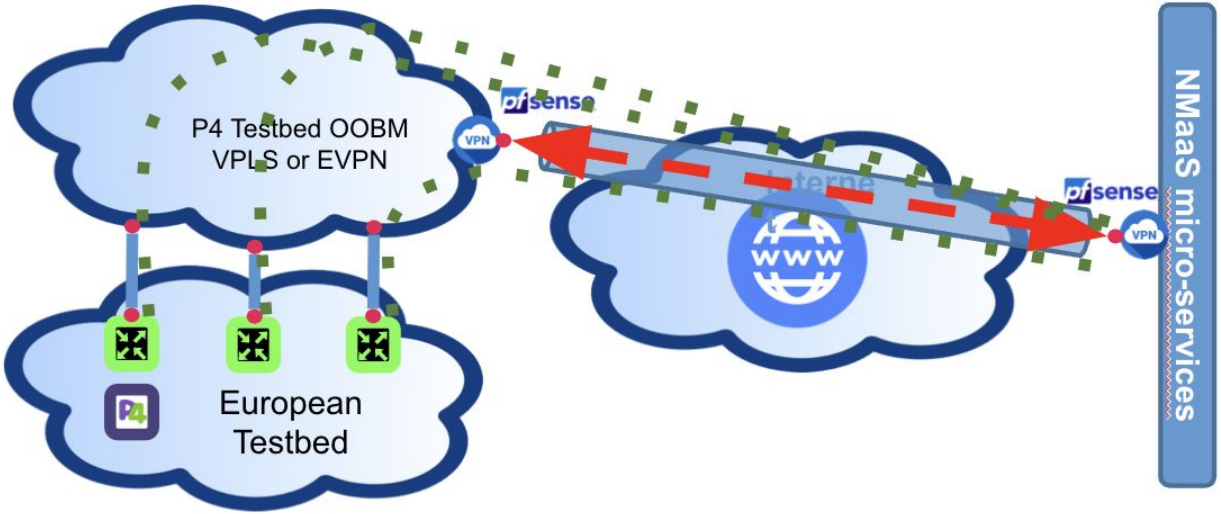
Global P4L October 2022



Over **20** locations including the GÉANT P4 Lab

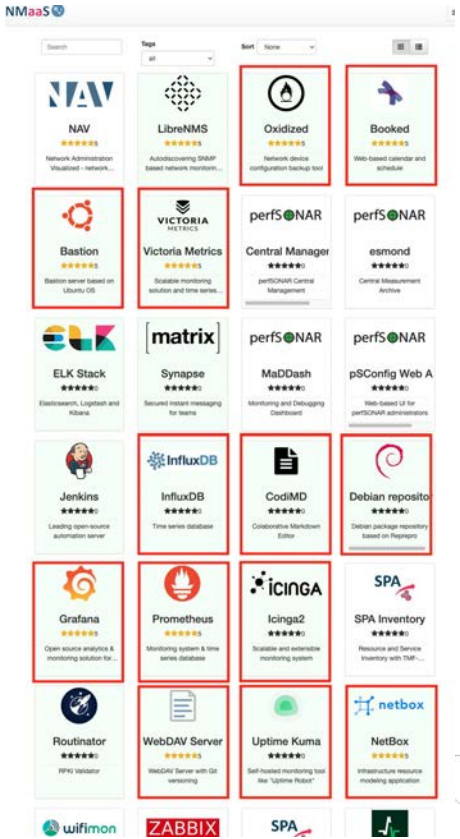
Strong collaboration with the **GNA-G DIS -**
GNA-G Data Intensive Sciences Working Group

NMaaS Tools Portfolio for GP4L Monitoring and Management



NMaaS

Network Management as a Service:
https://nmaas.eu
https://wiki.geant.org/display/NMaaS



GP4L Use cases

- Topology Monitoring with BGP-LS
- Next Generation Multicast with AMT relay/gateway and Unicast to Multicast translator, Juniper and Akamai
- Polka - an innovative source routing paradigm, IFES/UFES
- Packet Marking Specification: IPv6 Flow Label, CERN
- SuperComputing22 Demo, GNA-G DIS

More information about the use cases

Useful Links

Documentation:

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

RARE/FreeRtr: https://wiki.geant.org/display/RARE
https://blog.freertr.org
https://docs.freertr.org
https://blog.freertr.org

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

Contact:

Users: gp4l-users@lists.geant.org, rare-users@lists.geant.org

Developers: gp4l-dev@lists.geant.org, rare-dev@lists.geant.org

Project: gp4l@lists.geant.org, rare@lists.geant.org

TechLab

TechLab

TechLab is an **initiative** to **facilitate access to information** on **research network infrastructures and services** that can be made available to work on **modern and innovative solutions**.

Brings together specialists and researchers **to share knowledge and experience** and promote work results

Offers shared resources and services for advanced testing, piloting and research.

Promotes test infrastructures whose owners are open for collaboration

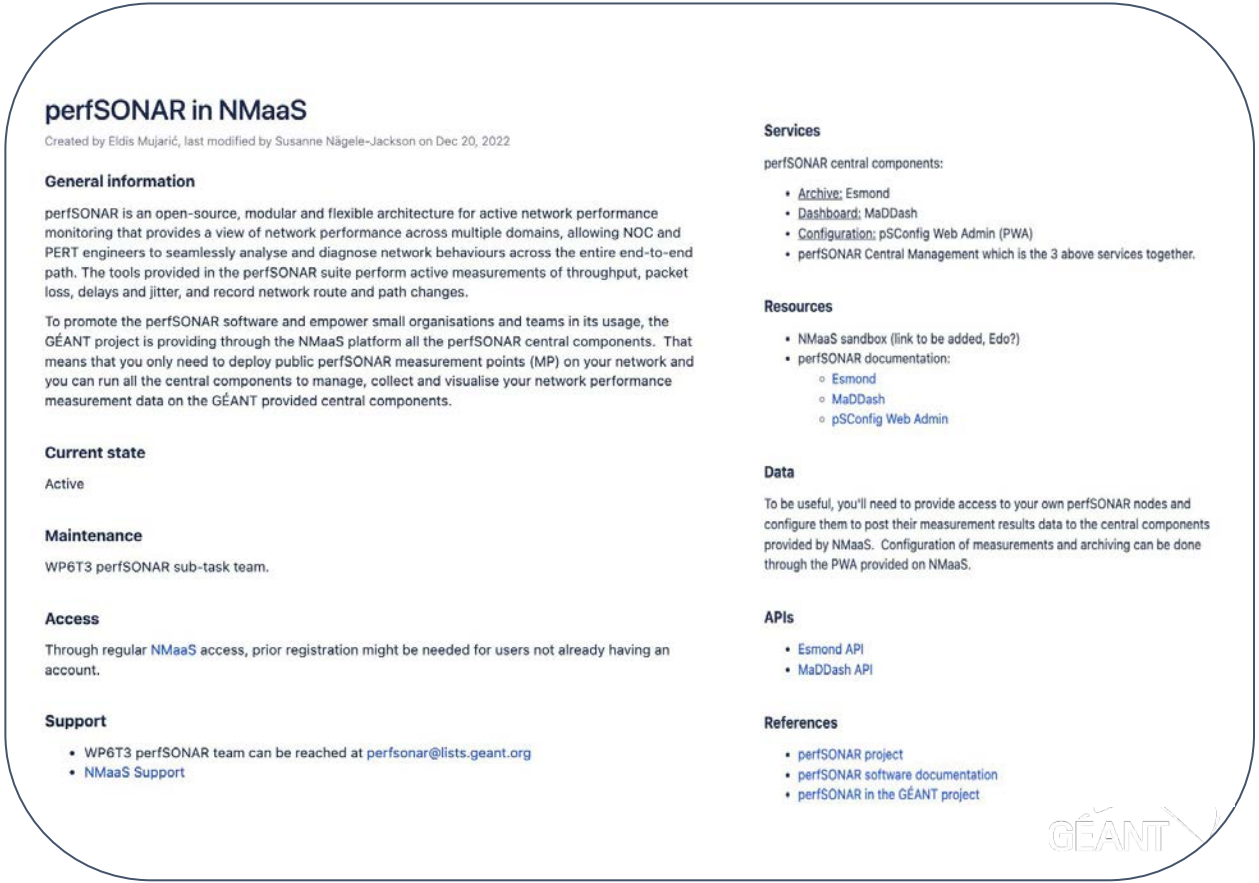
Increases the visibility of test infrastructures and there developed solutions

TechLab

TechLab - information sharing

Data provided:

- General information
- Current state
- Maintenance
- Access
- Support
- Services
- Resources
- Data
- APIs
- References



perfSONAR in NMaaS

Created by Eldis Mujarić, last modified by Susanne Nägele-Jackson on Dec 20, 2022

General information

perfSONAR is an open-source, modular and flexible architecture for active network performance monitoring that provides a view of network performance across multiple domains, allowing NOC and PERT engineers to seamlessly analyse and diagnose network behaviours across the entire end-to-end path. The tools provided in the perfSONAR suite perform active measurements of throughput, packet loss, delays and jitter, and record network route and path changes.

To promote the perfSONAR software and empower small organisations and teams in its usage, the GÉANT project is providing through the NMaaS platform all the perfSONAR central components. That means that you only need to deploy public perfSONAR measurement points (MP) on your network and you can run all the central components to manage, collect and visualise your network performance measurement data on the GÉANT provided central components.

Current state

Active

Maintenance

WP6T3 perfSONAR sub-task team.

Access

Through regular NMaaS access, prior registration might be needed for users not already having an account.

Support

- WP6T3 perfSONAR team can be reached at perfsonar@lists.geant.org
- NMaaS Support

Services

perfSONAR central components:

- Archive: Esmond
- Dashboard: MaDDash
- Configuration: pSConfig Web Admin (PWA)
- perfSONAR Central Management which is the 3 above services together.

Resources

- NMaaS sandbox (link to be added, Edo?)
- perfSONAR documentation:
  - Esmond
  - MaDDash
  - pSConfig Web Admin

Data

To be useful, you'll need to provide access to your own perfSONAR nodes and configure them to post their measurement results data to the central components provided by NMaaS. Configuration of measurements and archiving can be done through the PWA provided on NMaaS.

APIs

- Esmond API
- MaDDash API

References

- perfSONAR project
- perfSONAR software documentation
- perfSONAR in the GÉANT project

TechLab

Brand name for available shared testing facilities

Starting from NETDEV facilities, open for contributions

Available so far:

[GP4Lab]

[NMaaS]

[perfSONAR in NMaaS]

[SPA/E-Line in NMaaS]

[SPA Inventory2 in NMaaS]

[WiFiMon in NMaaS]

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

perfSONAR in NMaaS

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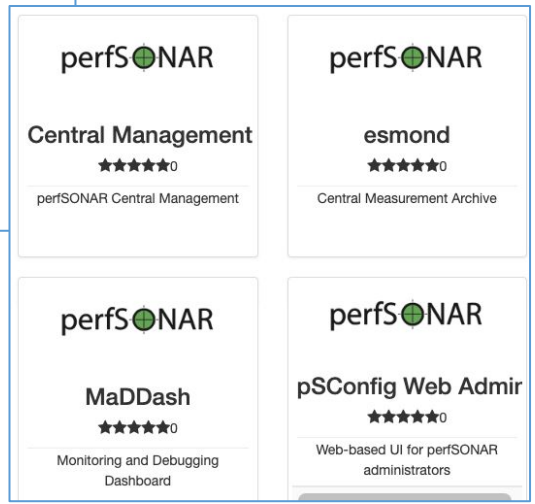

Services

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- Dashboard: MaDDash
- Configuration: pSConfig Web Admin (PWA)
- perfSONAR Central Management which is the 3 above services together.

WiFiMon in NMaaS

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.

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.

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.

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).

TechLab next steps

Collect information
about test infrastructures
from around the world,
built and managed by
projects and institutions
of all kinds.

Want to join?
Contact us at netdev@lists.geant.org

Collaboration - How can you get involved?

Providing examples for the community portal.

Creating learning units, sharing your knowledge!

Mapping your architecture to the blueprint.

Running the Maturity Model survey.

Using the materials and Techlab and providing feedback.

...

Contact us at network-eacademy@lists.geant.org

More from NETDEV: Production services

ARGUS

[Argus - Alarm Aggregation and Correlation Tool]

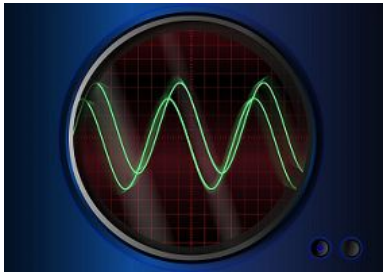
TimeMap

[TimeMap - Open-source Latency/Jitter Measurement Service]

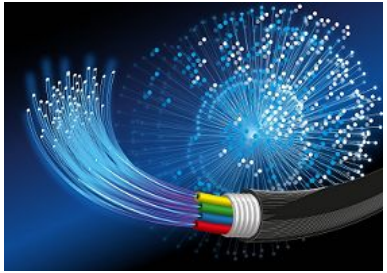
[Performance Measurement Platform (PMP)]

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

More from NETDEV: Network development



Optical Time and Frequency Networks (OTFN)



Quantum Technologies

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

Future Events

16-17 May, 18th SIG-NOC meeting, Stockholm Sweden including
Argus, perfSONAR

22-26 May, RIPE86, Rotterdam, the Netherlands including
WiFiMon and TimeMap

02 June, GNA-G automation WG meeting in Utrecht, the Netherlands

05-09 June, TNC23, Tirana, Albania including

Network Development in the GÉANT Project,
Network eAcademy and the OAV Maturity Model, Argus, WiFiMon,
Quantum Internet Activities in European NRENs

06 June, GNA-G side meeting at TNC23 Tirana, Albania

21 June, Quantum Solutions, online

Thank You!

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

www.geant.org

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