



GÉANT's Network eAcademy

Dr. sc. Ivana Golub, dipl.ing.

PSNC

RIPE Student's Infoshare, 14 November 2023, online

Public (PU)

Agenda

- GÉANT
- Network eAcademy
- ... and more



30 years of Poznań Supercomputing and Networking Center

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

<https://www.psnec.pl/>

PSNC in numbers



507

employees



16

laboratories



30

years of operation



16+

fields of activity



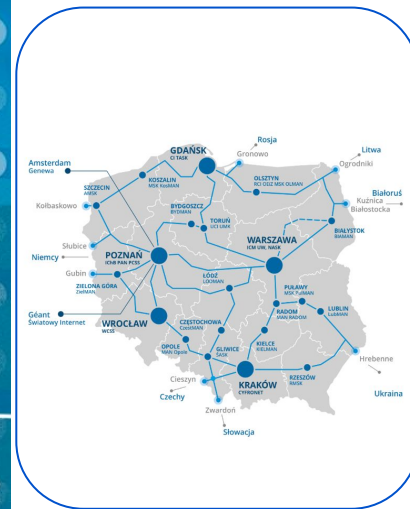
65

current projects

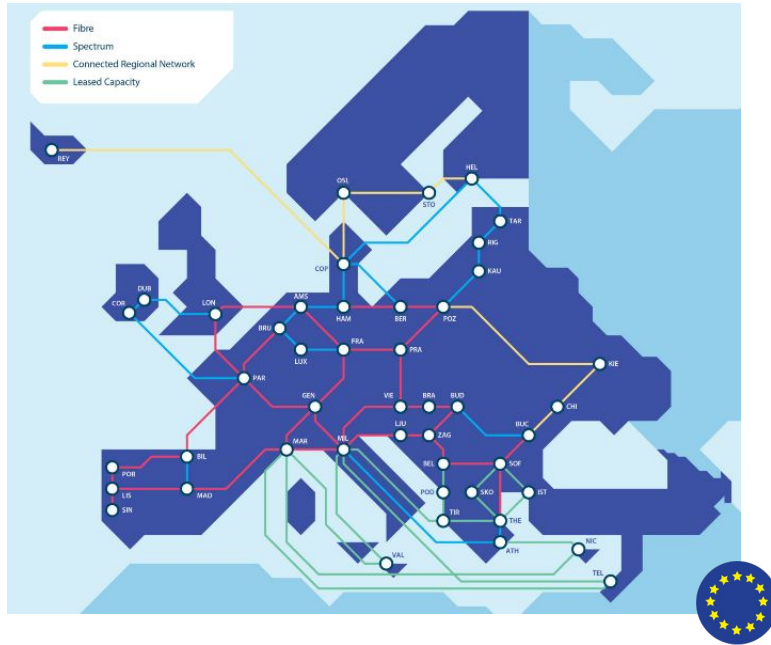


103

projects in H2020,
Horizon Europe,
Digital Europe
Programme



GÉANT – European Network Infrastructure, Services and Community



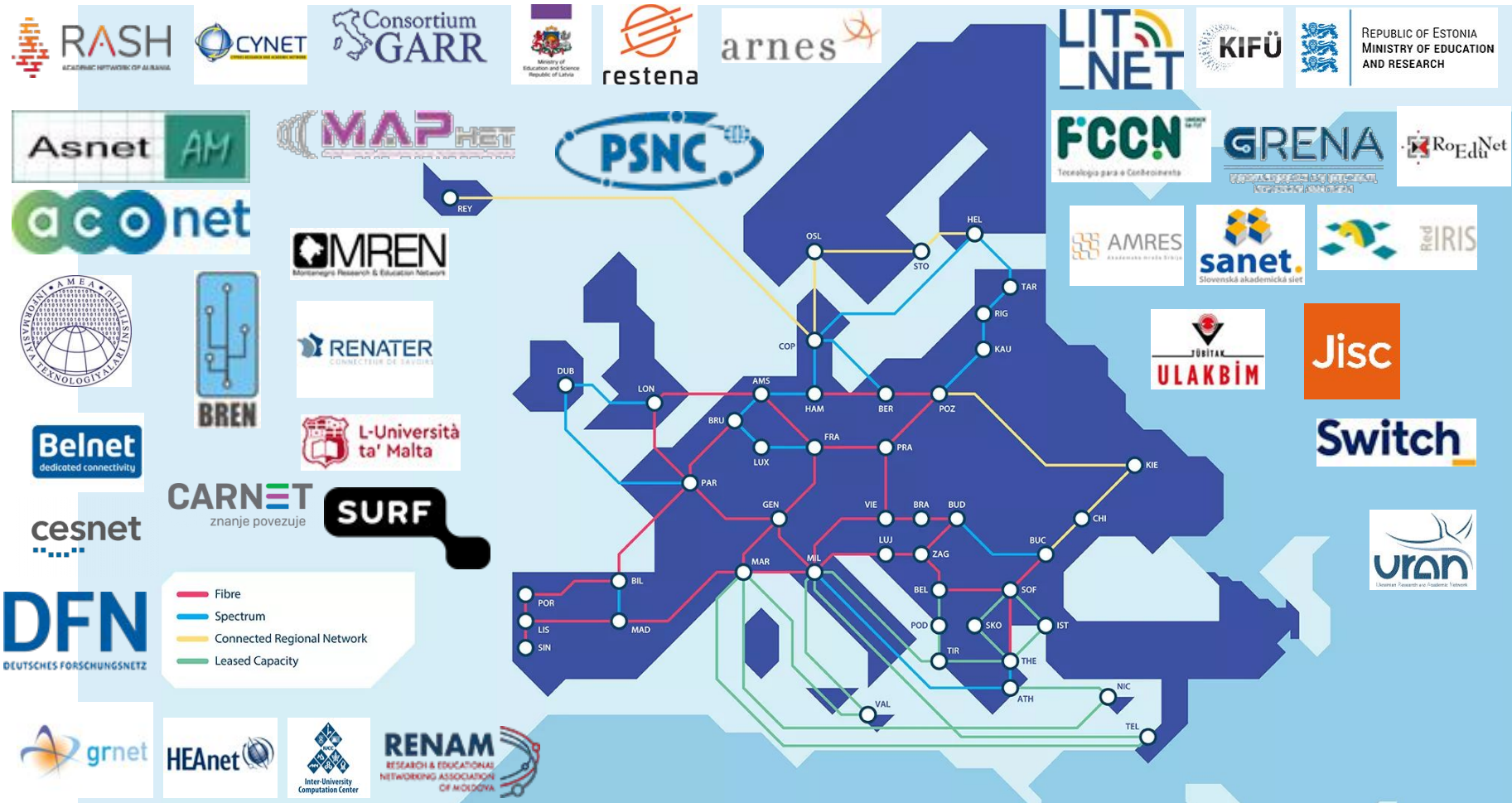
The GÉANT-5 project is under Horizon Europe Research and innovation funding programme until 2027



- 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

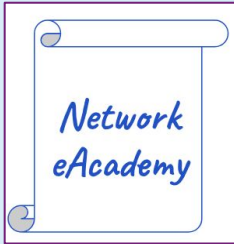
- 37 partners
- 500 contributors
- 50M users

GÉANT Network, GÉANT Community

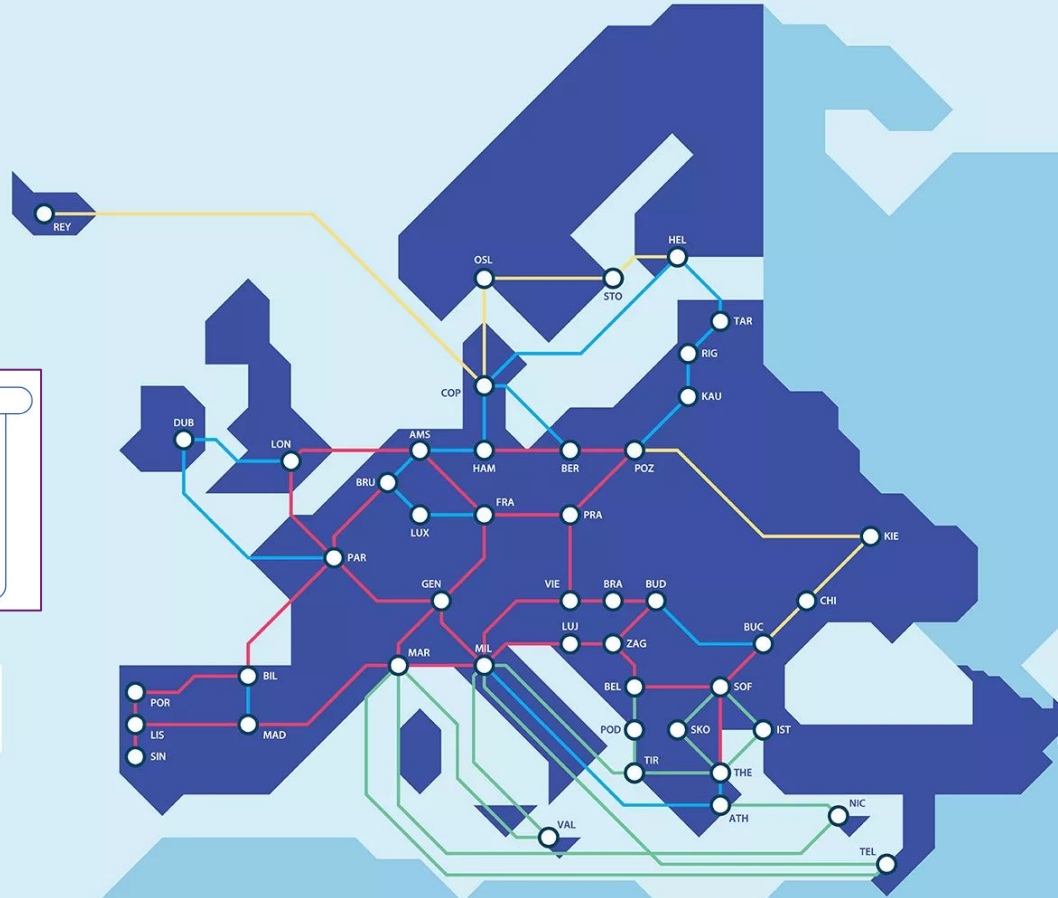




TimeMap



- Fibre
- Spectrum
- Connected Regional Network
- Leased Capacity

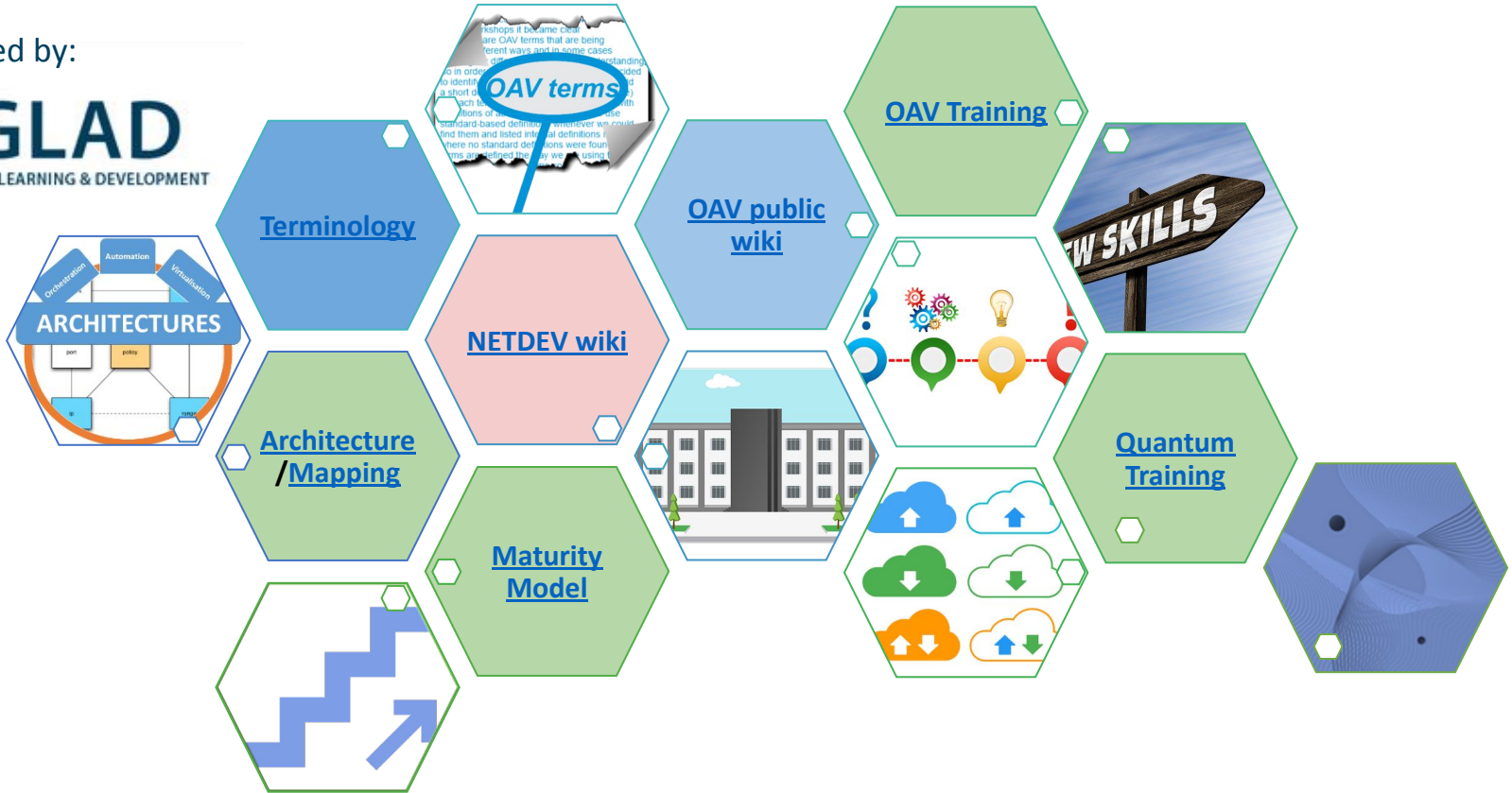


Network eAcademy



Network eAcademy

Powered by:



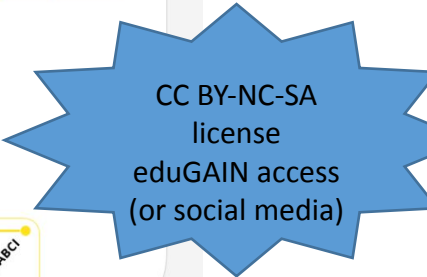
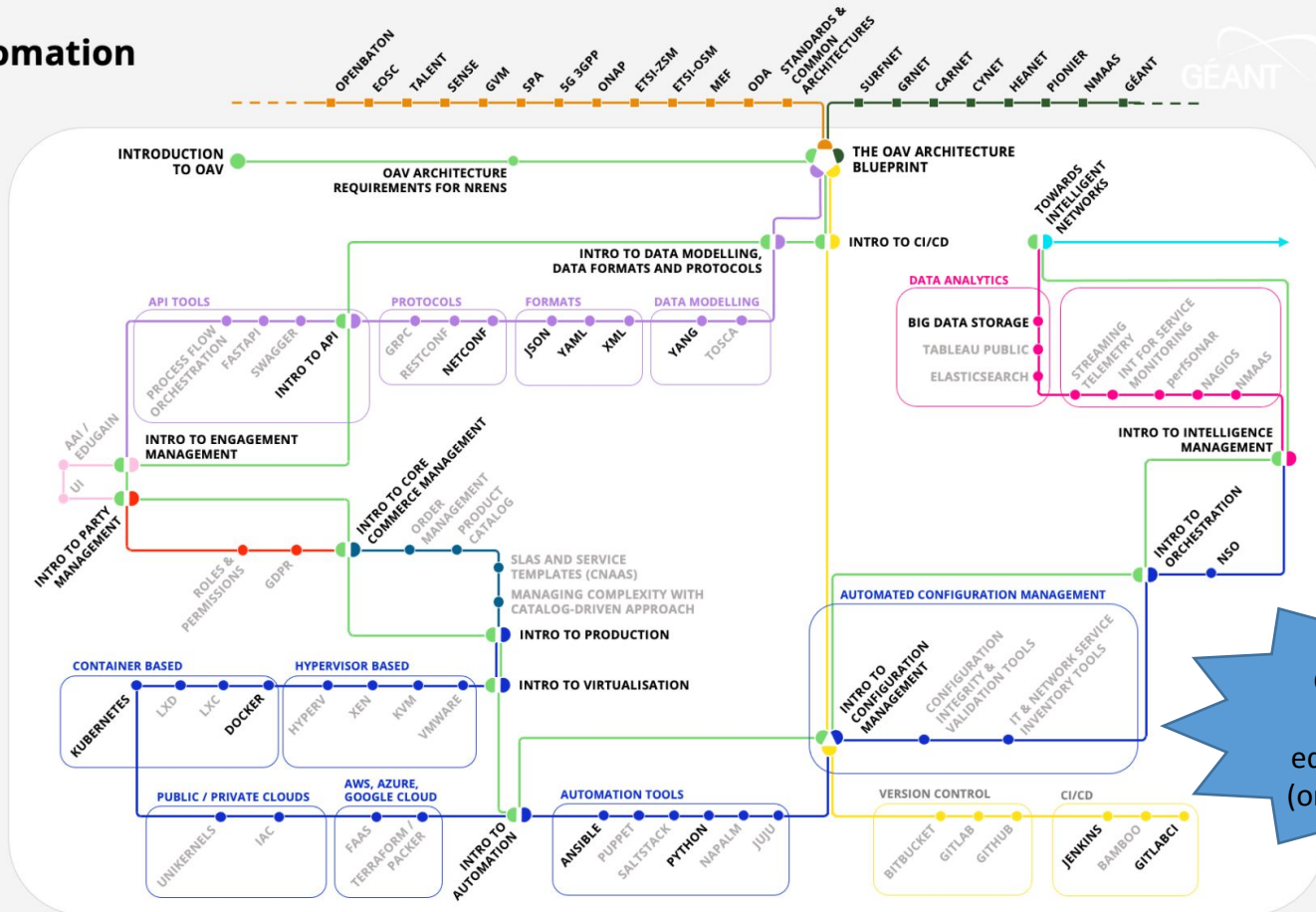
Network Automation eAcademy

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

Tracks

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

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





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credentials or social
media accounts**

<https://e-academy.geant.org/moodle/>

GÉANT eAcademy

<https://e-academy.geant.org/moodle/>

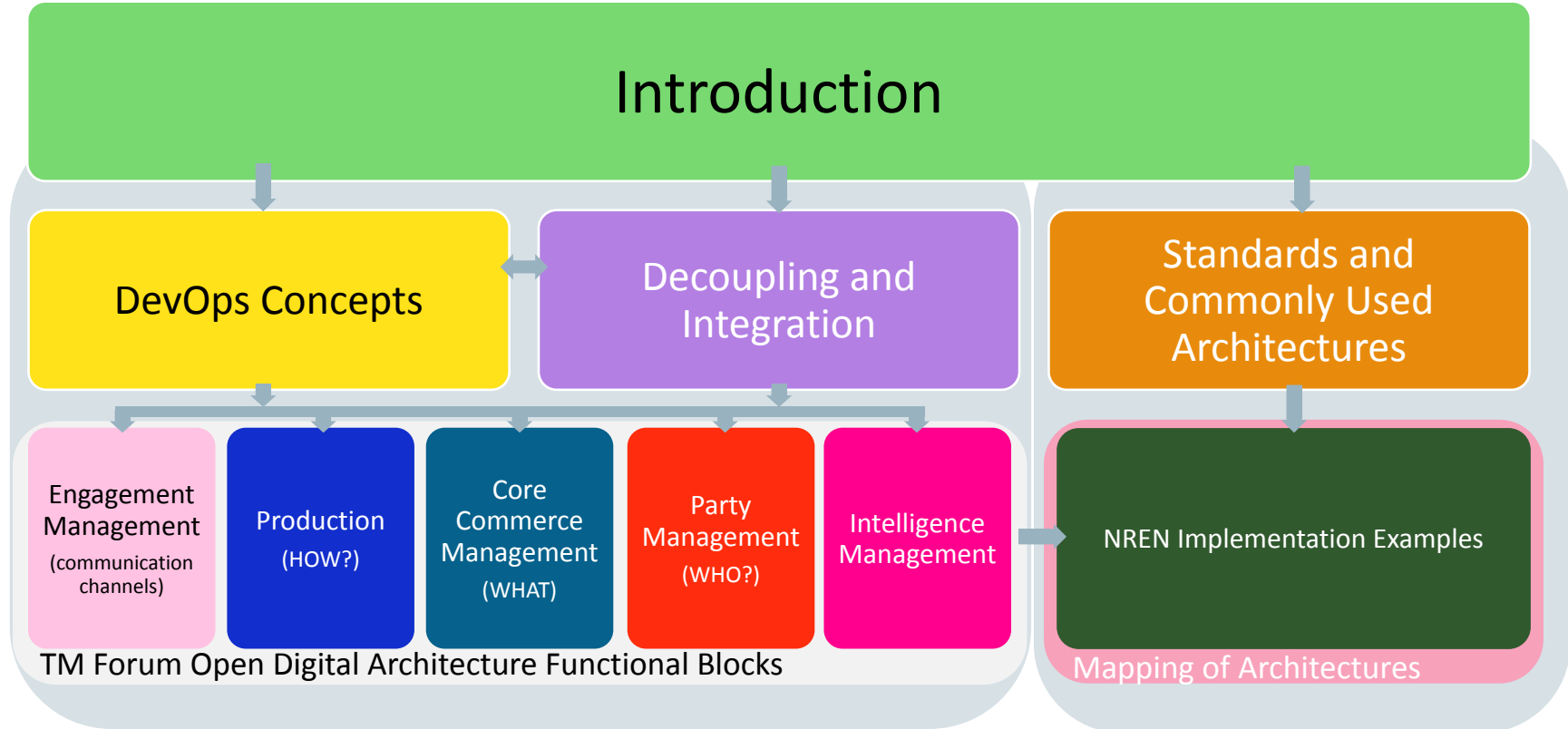
Available Courses

Network eAcademy

- ▶ Professional Competencies
- ▼ Technical skills
 - ▶ Trust and Identity
 - ▶ Network
 - ▶ Cyber Security
 - ▶ Cloud
 - ▶ Real Time Communication
 - ▶ Software Development

Knowledge Map for the Training

Training



Network Automation eAcademy

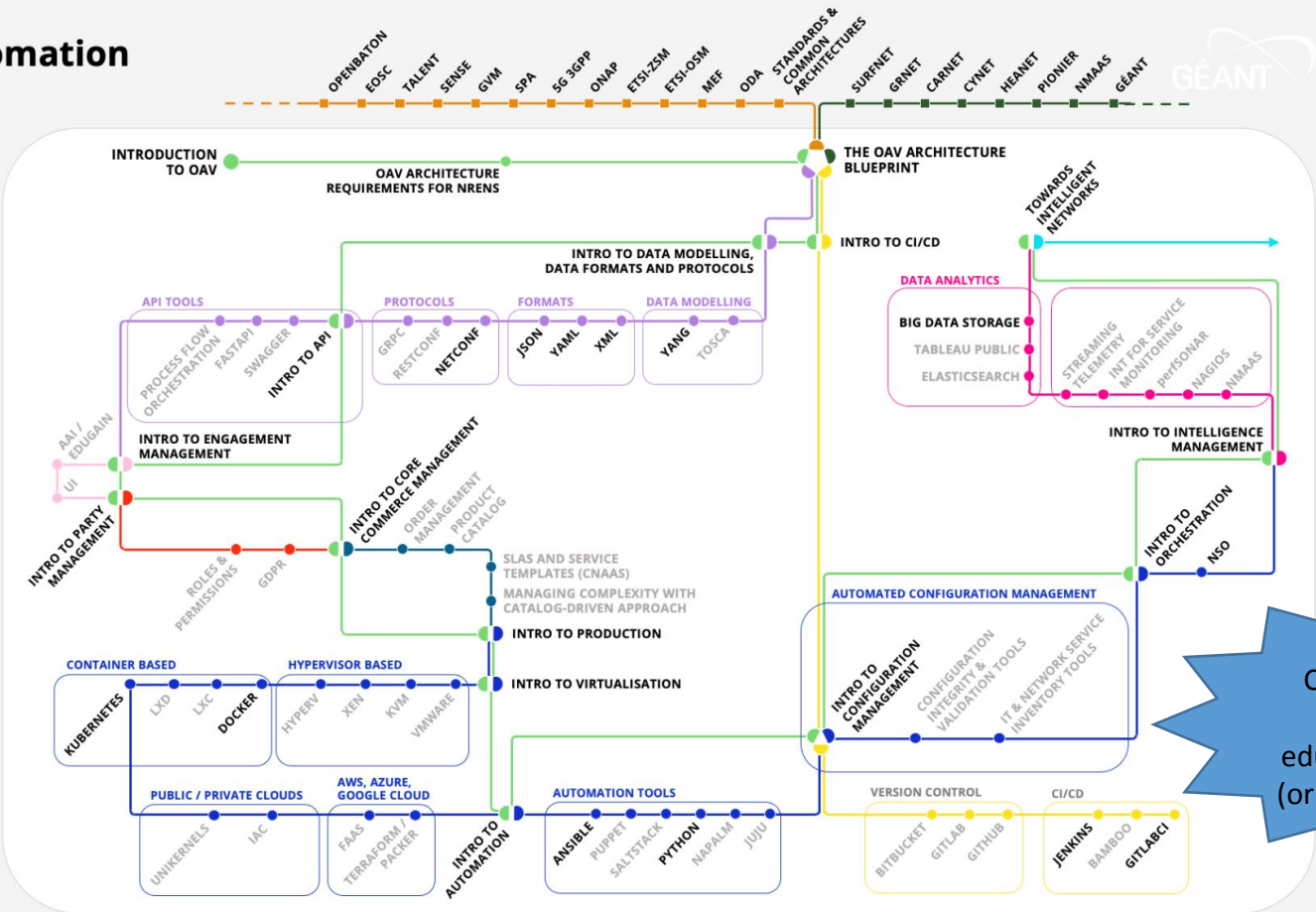
Legend

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Tracks

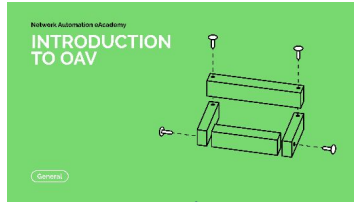
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Functional Blocks in the TM Forum OPEN DIGITAL ARCHITECTURE (ODA)

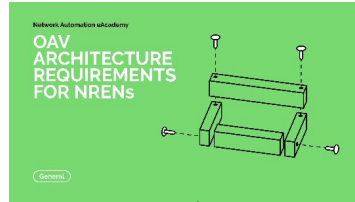


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license
eduGAIN access
(or social media)

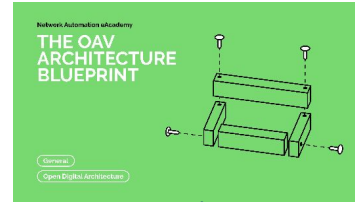
General Introduction Line



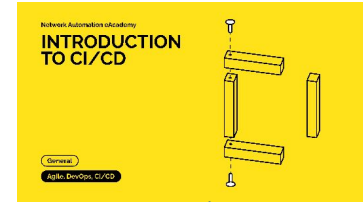
30'



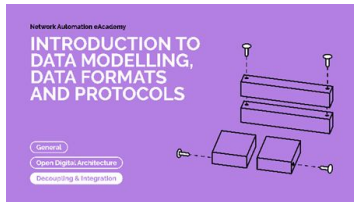
10'



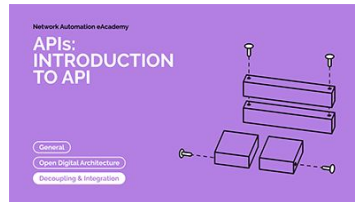
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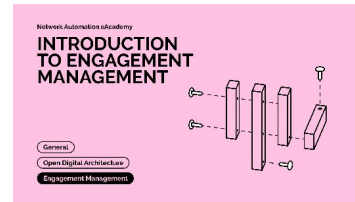
15'



30'



45'



15'



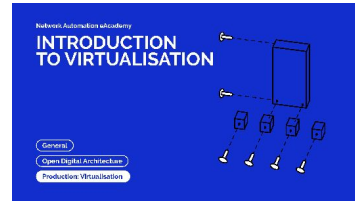
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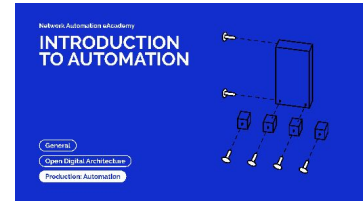
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30'



30'



30'



30'



30'



15'

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

+Training+Portal

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

Training

Network Automation Academy

INTRODUCTION TO DATA MODELLING, DATA FORMATS AND PROTOCOLS

General
Open Digital Architecture
Decoupling & Integration

30'

Network Automation Academy

DATA MODELLING: YANG

Open Digital Architecture
Decoupling & Integration

10'

Network Automation Academy

DATA FORMATS: XML

Open Digital Architecture
Decoupling & Integration

60'

Network Automation Academy

DATA FORMATS: YAML

Open Digital Architecture
Decoupling & Integration

30'

Network Automation Academy

DATA FORMATS: JSON

Open Digital Architecture
Decoupling & Integration

45'

Network Automation Academy

PROTOCOLS: NETCONF

Open Digital Architecture
Decoupling & Integration

4h (including installation)

Network Automation Academy

PROTOCOLS: RESTCONF

Open Digital Architecture
Decoupling & Integration

45'

Network Automation Academy

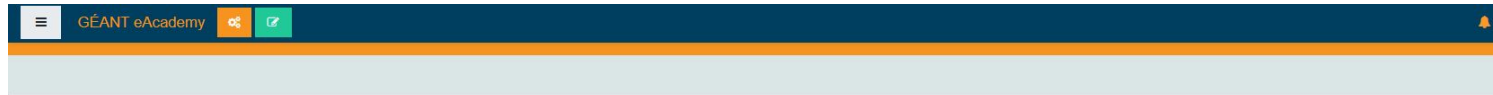
APIs: INTRODUCTION TO API

General
Open Digital Architecture
Decoupling & Integration

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

Ansible

Training



Ansible

Home > My courses > Technical skills > Network > Network Automation eAcademy > Ansible

OVERVIEW | I - Settings, Inventory, Module Basics | II - Playbooks, Variables and Modules | III - How people use Ansible, Loops, Jinja2 | IV - Playbook Validation, Vault, Roles, Sharing content | Test environments and Useful Links | Feedback and Completion Certificate

Welcome to the Course: Ansible



COURSE DATE: On Demand	DURATION: 60 minutes	COMMITMENT: 60 minutes + lab time
REQUIREMENT: YAML Learning Module	COURSE TYPE: Self-paced	CREDENTIAL: Certificate

Learning path:	OAV Training Portal
Prerequisite:	Formats: YAML
Preceded by:	Introduction to Automation
Followed by:	Puppet (not yet published)
Next available:	Configuration Management

Course summary

Ansible is an automation framework which allows users to manage services, the servers on which they run and the network devices which interconnect them. This course has several sections which should be taken in order,

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

Ansible Requirement: YAML, YAML Requirement?


GEANT 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

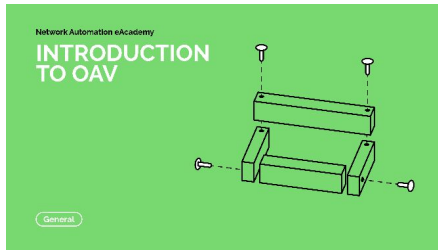
YAML is a human-friendly data serialisation standard broadly used in Orchestration, Automation and Virtualisation (OAV). This course offers a quick overview of the YAML syntax and some examples from the real world in a single video, with useful tips and references and a quiz.

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

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

Ansible

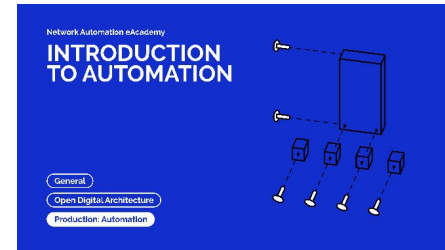
Training



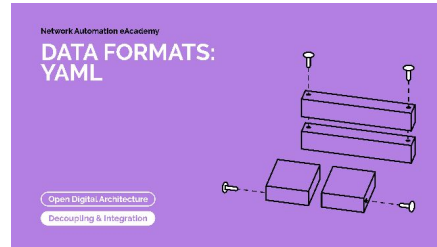
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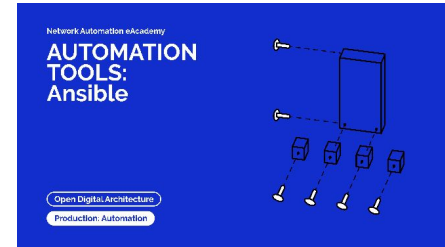
30'



30'



30'



60' + lab time

Ansible: Video with Subtitles

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Ansible

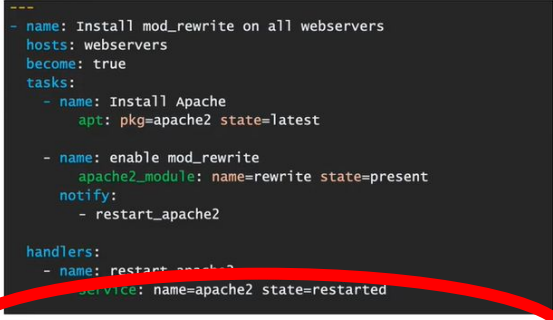
Home >
 My courses >
 Technical skills >
 Network >
 Network Automation eAcademy >
 Ansible >
 II - Playbooks, Variables and Modules

OVERVIEW |
 I - Settings, Inventory, Module Basics |
 II - Playbooks, Variables and Modules |
 III - How people use Ansible, Loops, Jinja2 |
 IV - Playbook Validation, Vault, Roles, Sharing content |
 Test environments and Useful Links |
 Fee

Please watch the video below to continue your Ansible learning journey.

At the end of this section you will be able to

- Run playbooks and parse their outputs
- Use ssh troubleshooting to identify problems which Ansible may hide from you
- Understand Ansible's use of variables and how to reference their value
- Understand Ansible's `host_vars/group_vars` directory structure
- Understand what modules do and how to use them in playbooks




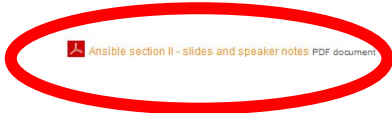
```

---
- name: Install mod_rewrite on all webservers
  hosts: webservers
  become: true
  tasks:
    - name: Install Apache
      apt: pkg=apache2 state=latest

    - name: enable mod_rewrite
      apache2_module: name=rewrite state=present
      notify:
        - restart_apache2

  handlers:
    - name: restart_apache2
      service: name=apache2 state=restarted
          
```

20 section2/playbooks/install_Apache_with_handlers.yaml www.geant.org 



Ansible: Slides with Speaker Notes

GEANT eAcademy

Ansible

Home > My courses > Technical skills > Network > Ansible

OVERVIEW I - Settings, Inventory, Module Basics II - Playbooks

Please watch the video below to continue your Ansible learning journey.

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- Understand Ansible's `host_vars/group_vars` directory structure
- Understand what modules do and how to use them in playbooks

Playbooks

```

---
# Oh look, a comment...
# ...spread out over multiple lines

- name: Set up Apache           # Or nginx, or Mongoose
  hosts: webservers
  tasks:
    - name: install Apache
    - name: generate Apache config file
    - name: download Web content to relevant directory
    - name: restart Apache
    - name: eat cake
  
```


5

www.geant.org



Most ansible users gather their Ansible work in YAML files called **Playbooks** – which start with three dashes. Playbook **comments** start with hashes, and are one per line. Playbooks contain a list of plays, or groups of tasks. In a playbook, look for the dashes in column one to see the list of plays. In the example shown here, there is one play (**Set up Apache**).

Playbooks can also contain the hosts or groups which the tasks should influence; these

 Ansible section II - slides and speaker notes PDF document

Current Courses in the Network eAcademy – Automation

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

Training

Practical Examples

- 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



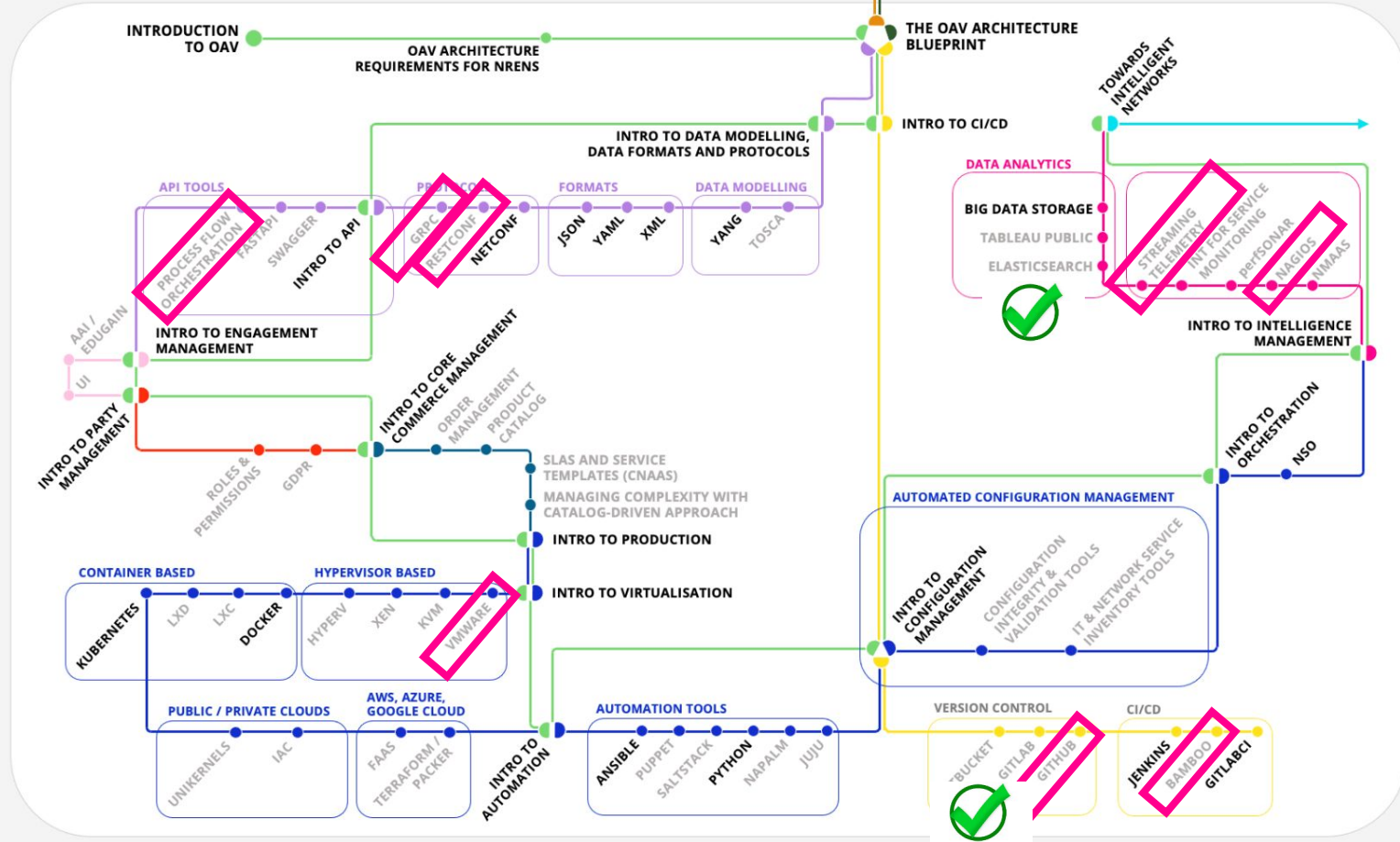
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- USE CASES AND EXAMPLES
- ARCHITECTURE

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



PROCESS FLOW ORCHESTRATION

RESTCONF

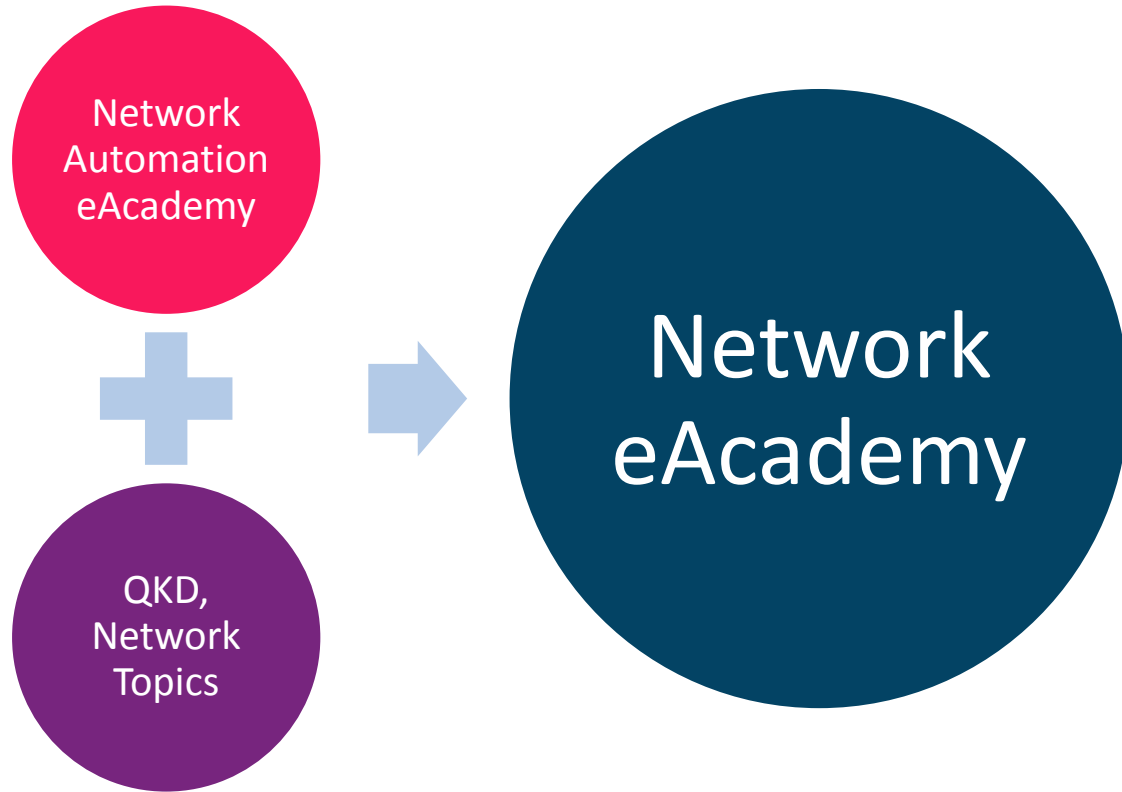
VMWARE

GITHUB

JENKINS



The Network eAcademy



Courses in the Network eAcademy – Quantum Technologies

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 Technologies **in progress**

Training



Quantum Algebra: Bloch Sphere

Course creator: Peter Kaufmann



Quantum Algebra: Entanglement Swapping

Course creator: Peter Kaufmann



Quantum Algebra: Mathematical Operators

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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

- 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

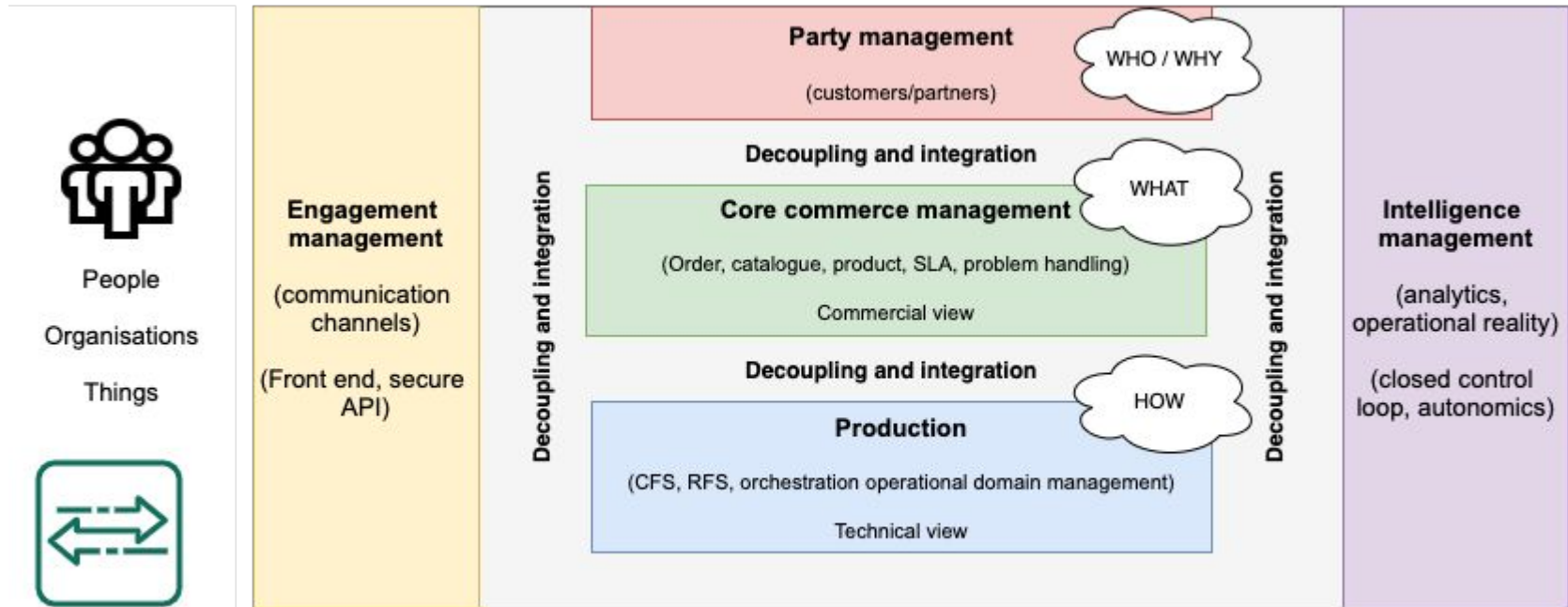
OAV Terms	Definition and reference
AIOps	<p>AIOps is (the usage of) Artificial Intelligence for IT Operations. It combines big data and machine learning to automate IT operations processes, including event correlation, anomaly detection and causality determination.</p> <ul style="list-style-type: none"> • https://www.gartner.com/en/information-technology/glossary/aiops-artificial-intelligence-operations
AI-powered Virtual Agent (AIVA)	<p>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.</p> <ul style="list-style-type: none"> • 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)	<p>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.</p>



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

TM Forum Open Digital Architecture as a Reference Architecture

Mapping NREN & use cases architectures to a common blueprint



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

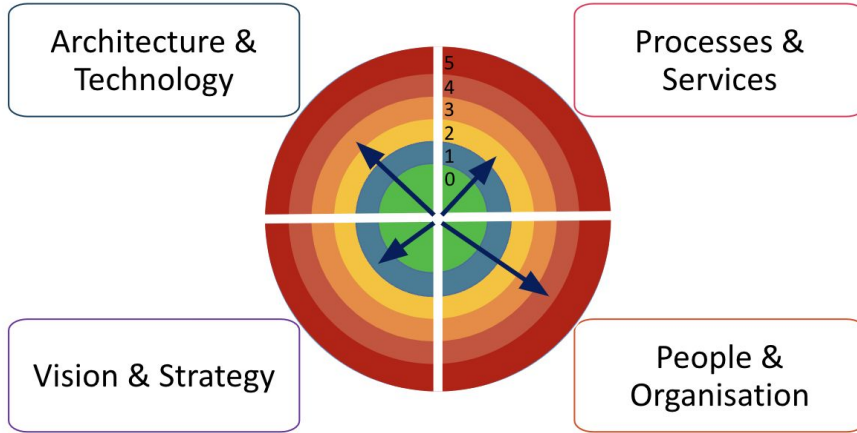
- [5G](#)
- [EOSC](#)
- [ETSI GANA](#)
- [ETSI OSM](#)
- [ETSI ZSM](#)
- [GVM](#)
- [MEF LSO](#)
- [Open Baton](#)
- [ONAP](#)
- [SENSE](#)
- [TALENT](#)

Maturity Model for Orchestration, Automation and Virtualisation (OAV)

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

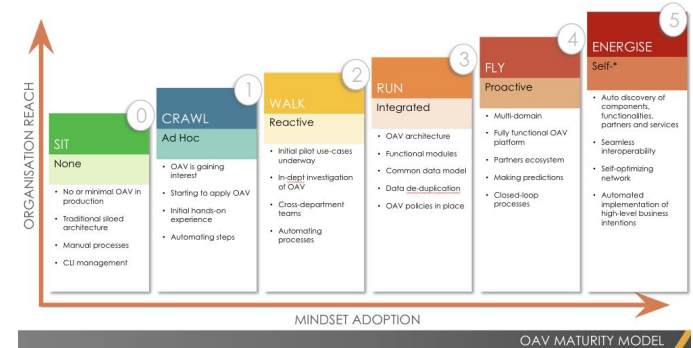
OAV Maturity Model - Dimensions and Stages



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>

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

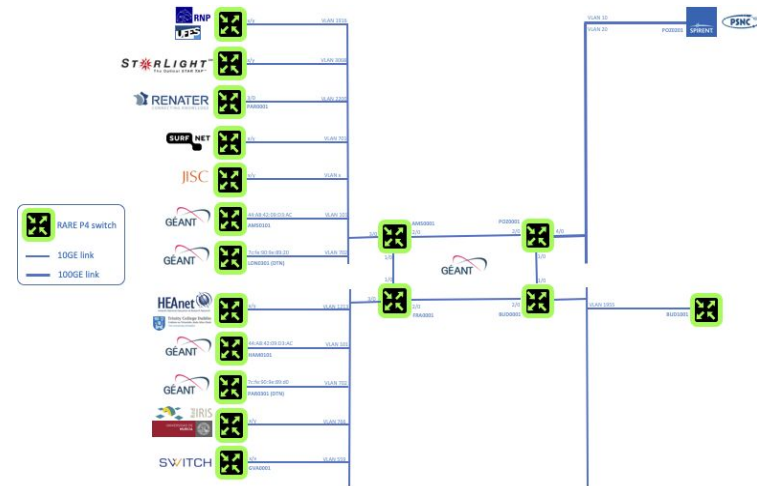
Validation of the RARE/FreeRtr OS routing stack software

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)

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

GP4L GÉANT P4 LAB



Global P4 Lab (September 2023)



Over **20** locations worldwide
Strong collaboration with the **DIS** and **AutoGOLE/SENSE GNA-G** Working Groups

More Information

Contact details

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

NMaaS

Argus

TimeMap

WiFiMon

Performance
Measurement
Platform

perfSONAR

Inventory

Optical Time and Frequency Networks

Service Provider Architecture

Quantum Technologies

RARE

GP4L Network eAcademy

TechLab

NETDEV Incubator



Thank You!

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