Network eAcademy

Eldis Mujarić, CARNET

Maria Isabel Gandia Carriedo, CSUC/RedIRIS

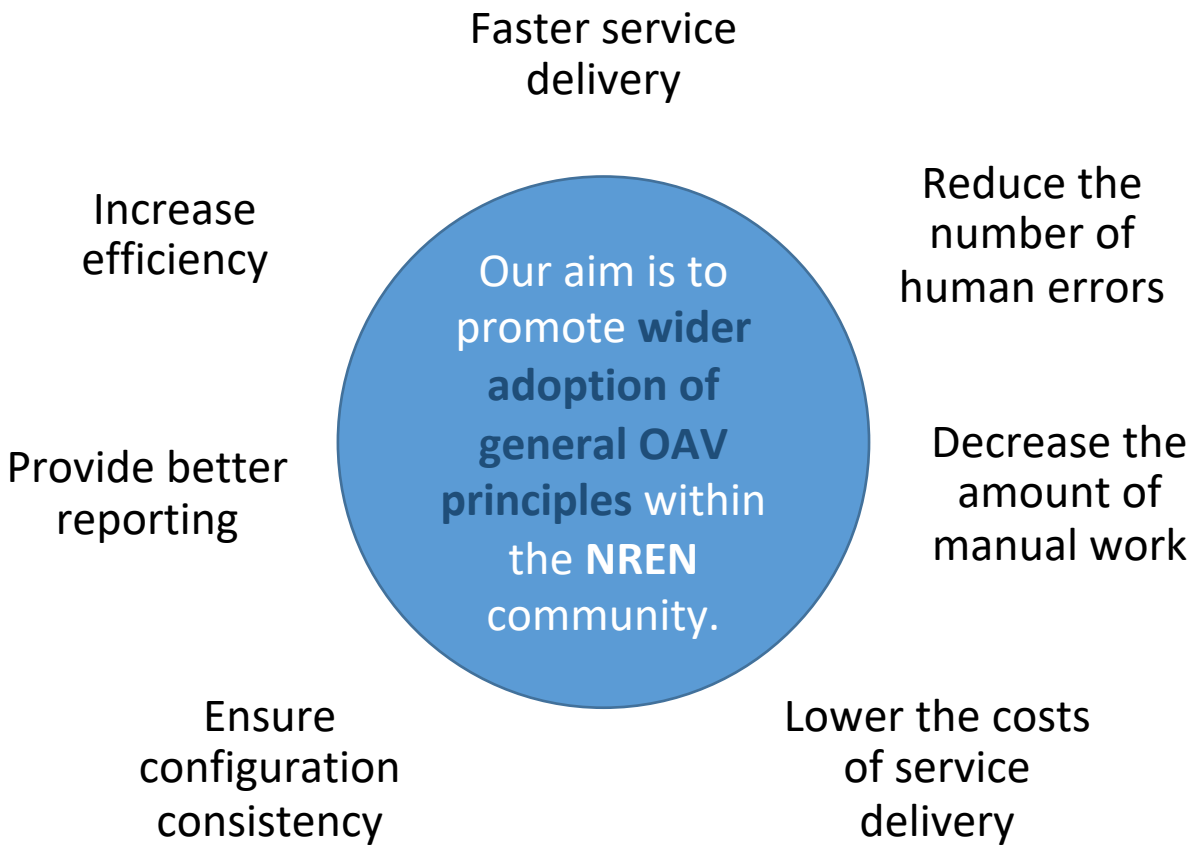
Ivana Golub, PSNC

RIPE SEE 11, Split Croatia

5 April 2023

Agenda: Network eAcademy

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


Faster service delivery
Reduce the number of human errors
Decrease the amount of manual work
Lower the costs of service delivery
Ensure configuration consistency
Provide better reporting
Increase efficiency
Our aim is to promote **wider adoption of general OAV principles** within the **NREN** community.

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

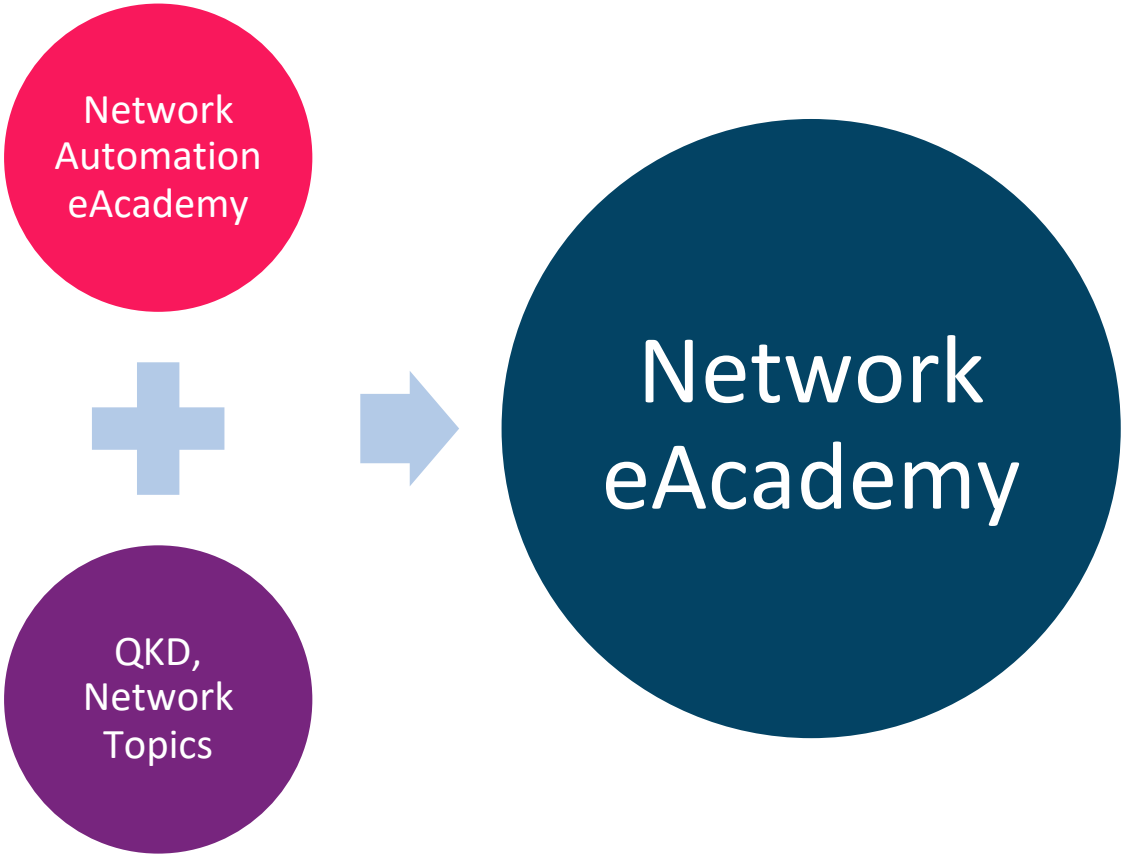
Knowledge as a gap

We speak different languages

A generally accepted architecture blueprint needed

NRENs are willing to share experiences and learn from others

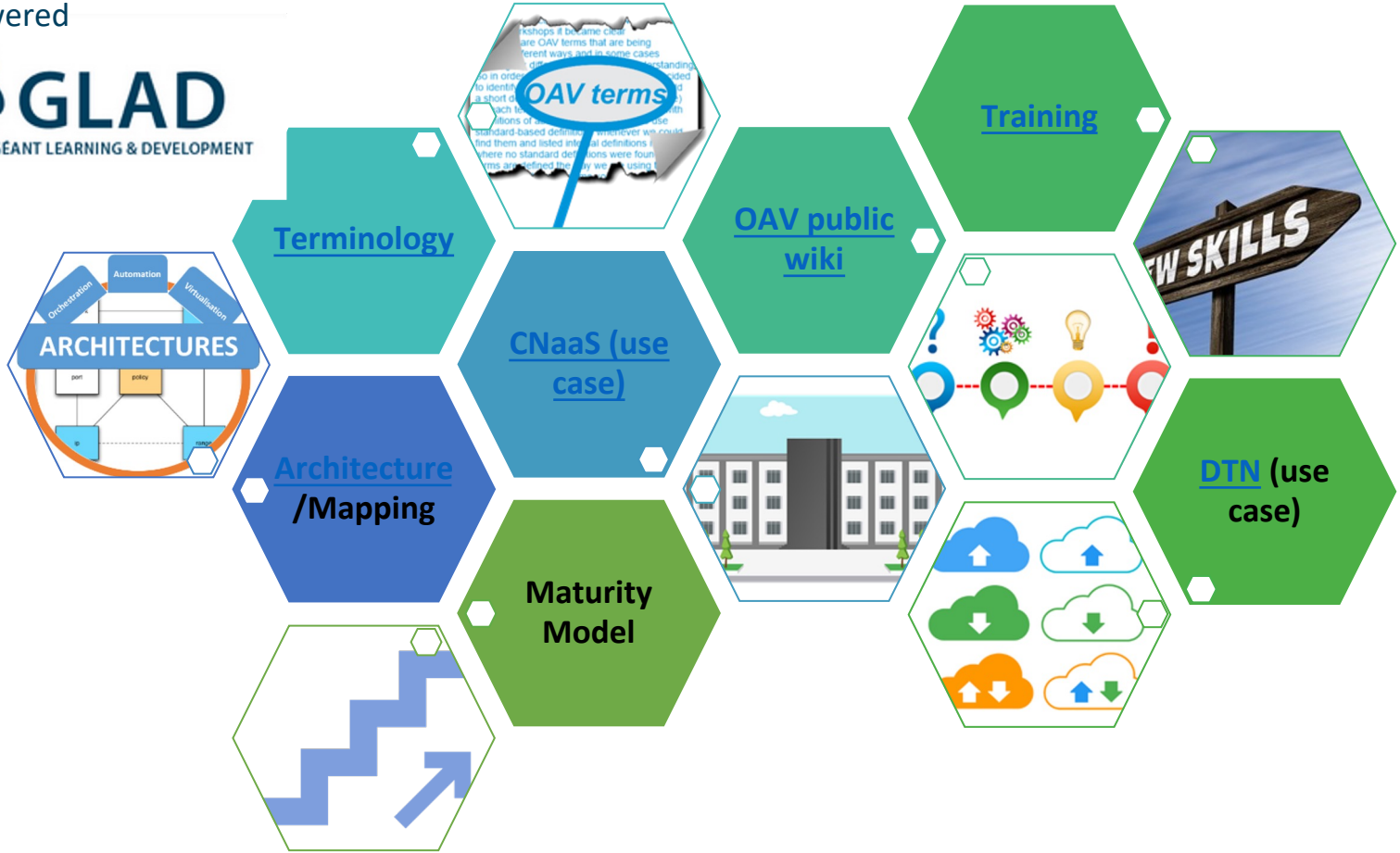
The Network eAcademy



Network eAcademy

Powered by:

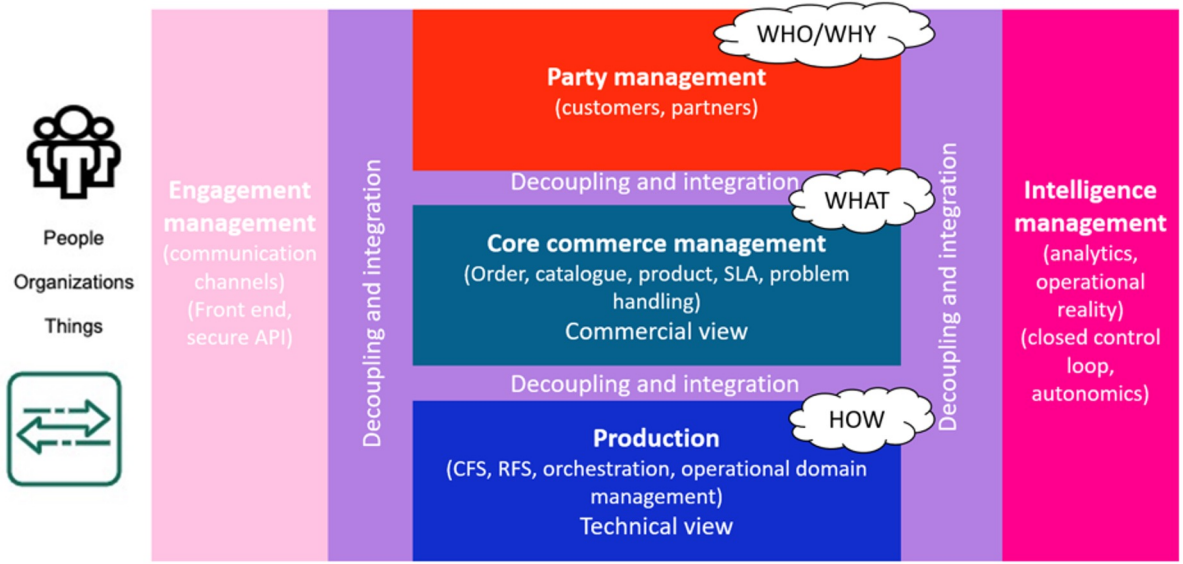
GLAD
GÉANT LEARNING & DEVELOPMENT



Architecture & Mappings

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

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

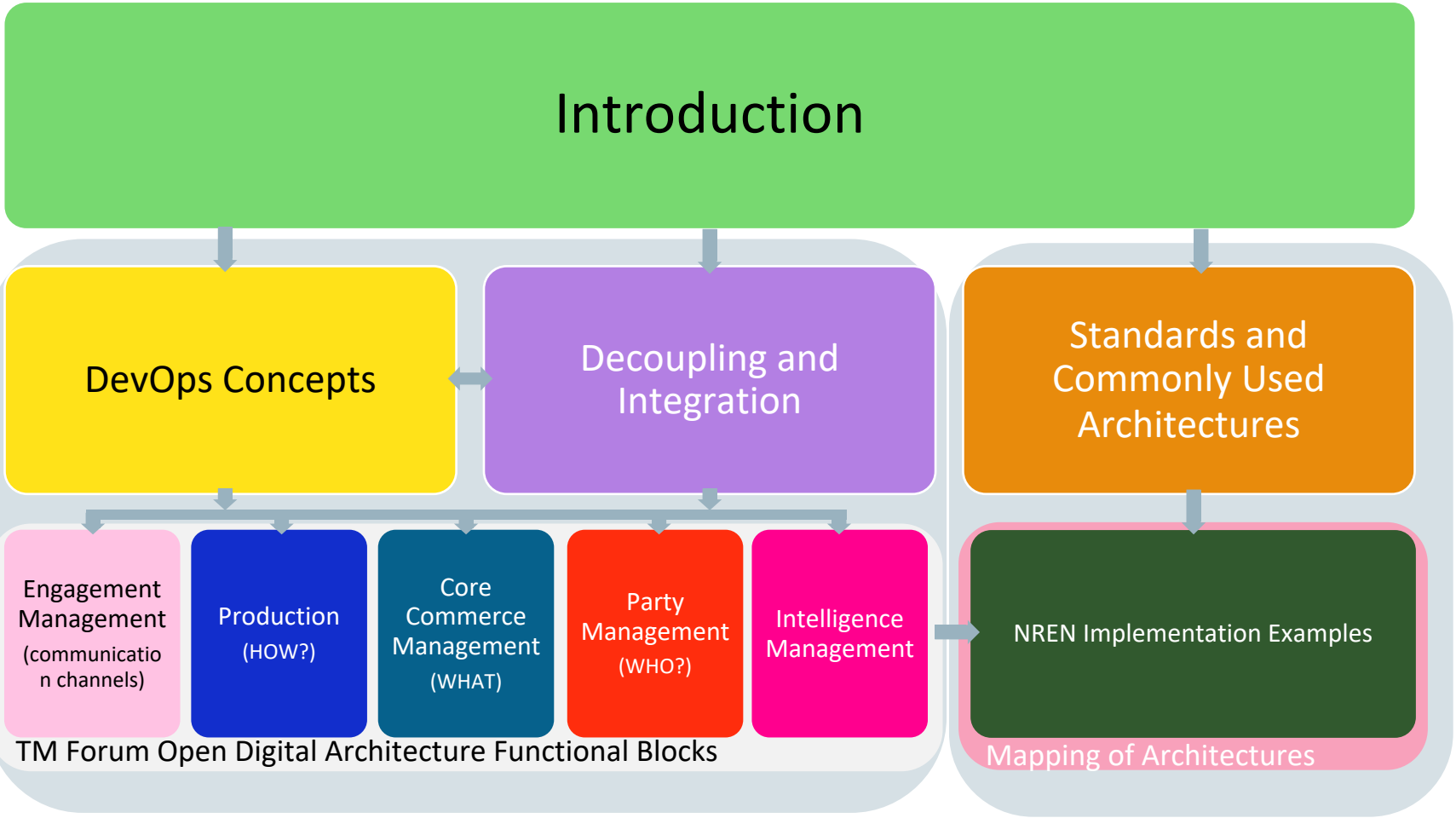


NREN mappings to date:

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

Platform mappings:

- NMaaS


Introduction
DevOps Concepts
Decoupling and Integration
Standards and Commonly Used Architectures
Engagement Management (communication channels)
Production (HOW?)
Core Commerce Management (WHAT)
Party Management (WHO?)
Intelligence Management
NREN Implementation Examples
TM Forum Open Digital Architecture Functional Blocks
Mapping of Architectures

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

Network Automation eAcademy

OPENBATON EOSC TALENT SENSE GVM SPA 5G 3GPP ONAP ETSI-ZSM ETSI-OSM MEF ODA STANDARDS & COMMON ARCHITECTURES SURFNET GRNET CARNET CYNET HEANET PIONIER NMAAS

GÉANT

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)

INTRODUCTION TO OAV

OAV ARCHITECTURE REQUIREMENTS FOR NRENS

THE OAV ARCHITECTURE BLUEPRINT

TOWARDS INTELLIGENT NETWORKS

INTRO TO CI/CD

INTRO TO DATA MODELLING, DATA FORMATS AND PROTOCOLS

API TOOLS: PROCESS FLOW ORCHESTRATION, FASTAPI, SWAGGER, INTRO TO API

PROTOCOLS: GRPC, RESTCONF, NETCONF

FORMATS: JSON, YAML, XML

DATA MODELLING: YANG, TOSCA

DATA ANALYTICS

BIG DATA STORAGE

TABLEAU PUBLIC

ELASTICSEARCH

STREAMING TELEMETRY, INT FOR SERVICE MONITORING, perfSONAR, NAGIOS, NMAAS

AAI / EDUGAIN

UI

INTRO TO ENGAGEMENT MANAGEMENT

INTRO TO PARTY MANAGEMENT

ROLES & PERMISSIONS

GDPR

INTRO TO CORE COMMERCE MANAGEMENT

ORDER MANAGEMENT

PRODUCT CATALOG

SLAS AND SERVICE TEMPLATES (CNAAS)

MANAGING COMPLEXITY WITH CATALOG-DRIVEN APPROACH

INTRO TO INTELLIGENCE MANAGEMENT

INTRO TO ORCHESTRATION

NSO

AUTOMATED CONFIGURATION MANAGEMENT

INTRO TO CONFIGURATION MANAGEMENT

CONFIGURATION INTEGRITY & VALIDATION TOOLS

IT & NETWORK SERVICE INVENTORY TOOLS

INTRO TO PRODUCTION

INTRO TO VIRTUALISATION

CONTAINER BASED: KUBERNETES, LXD, LXC, DOCKER

HYPERVISOR BASED: HYPERV, XEN, KVM, VMWARE

PUBLIC / PRIVATE CLOUDS: UNIKERNELS, IAC

AWS, AZURE, GOOGLE CLOUD: FAAS, TERRAFORM / PACKER

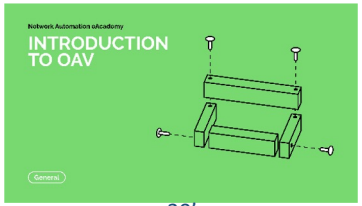
INTRO TO AUTOMATION

AUTOMATION TOOLS: ANSIBLE, PUPPET, SALTSTACK, PYTHON, NAPALM, JUJU

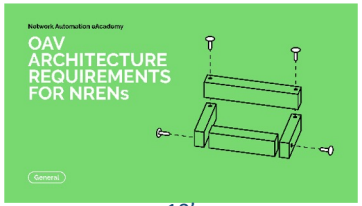
VERSION CONTROL: BITBUCKET, GITLAB, GITHUB

CI/CD: JENKINS, BAMBOO, GITLABCI

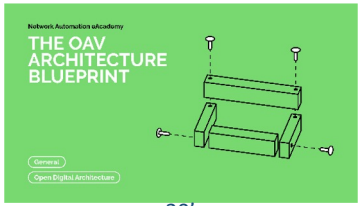
General Introduction Line



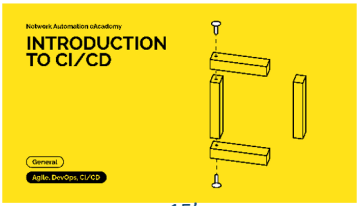
30’



10’



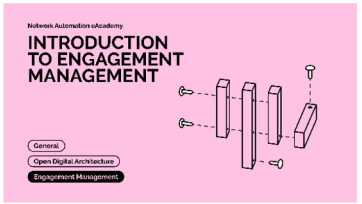
30’



15’

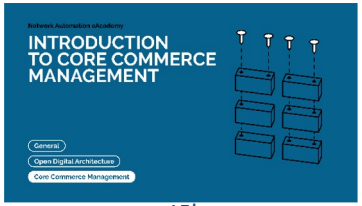
30’

45’



15’

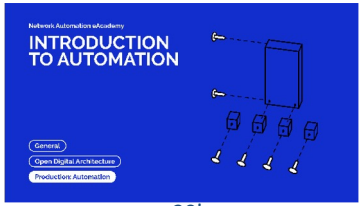
15’



15’

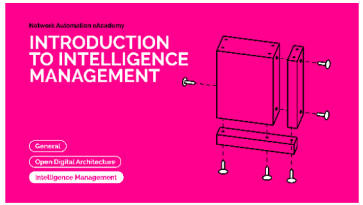
30’

30’



30’

30’

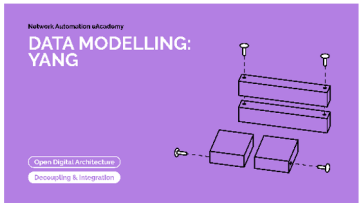


15’

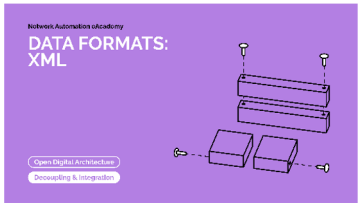
https://wiki.geant.org/display/NETDEV/OAV+Training+Portal

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

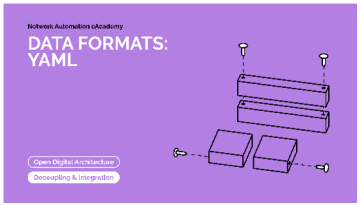
30’



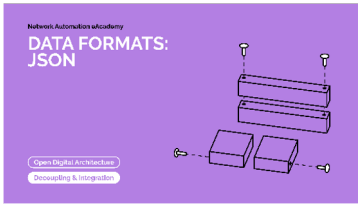
10’



60’



30’



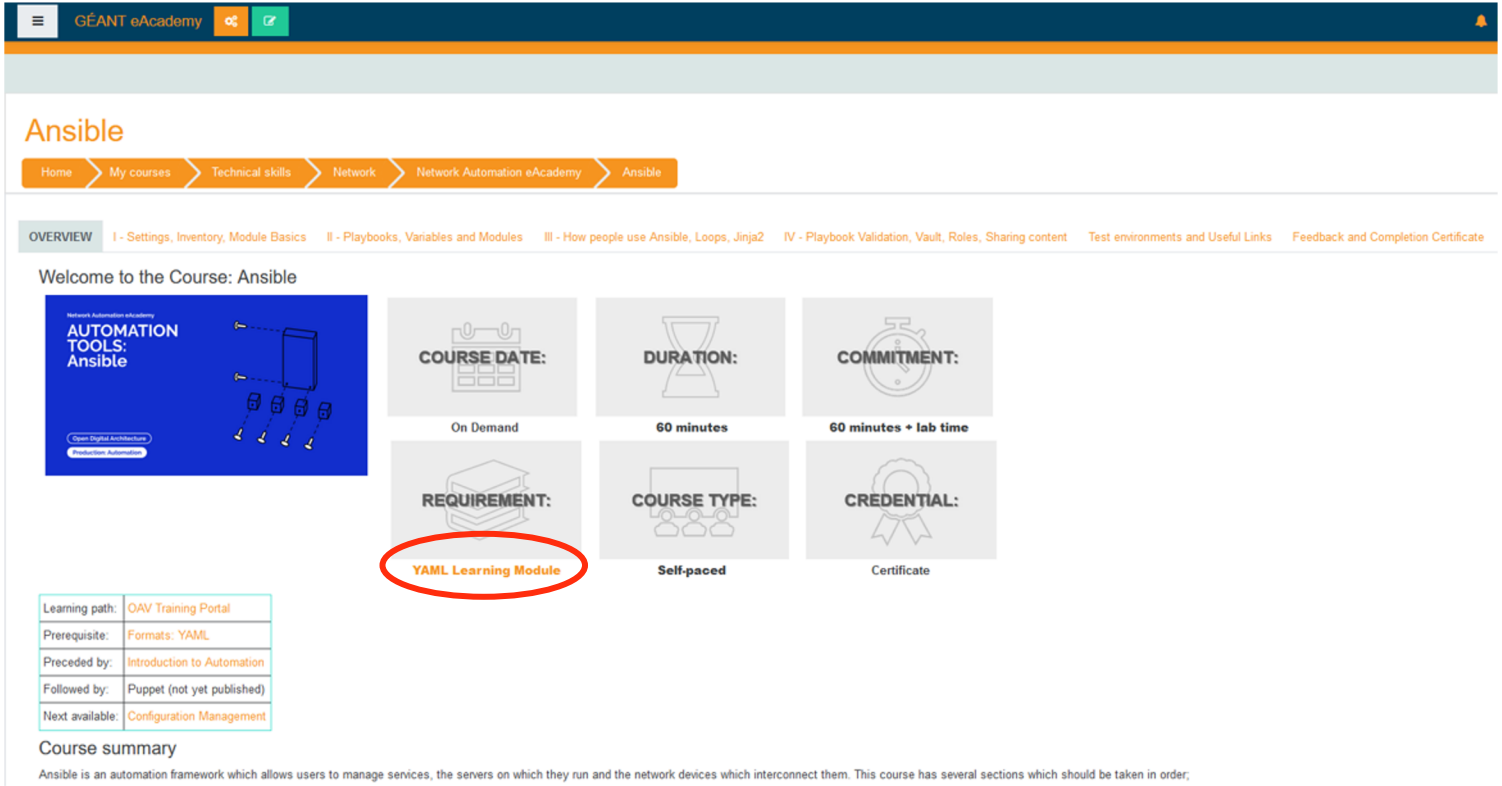
45’

4h (including installation)

45’

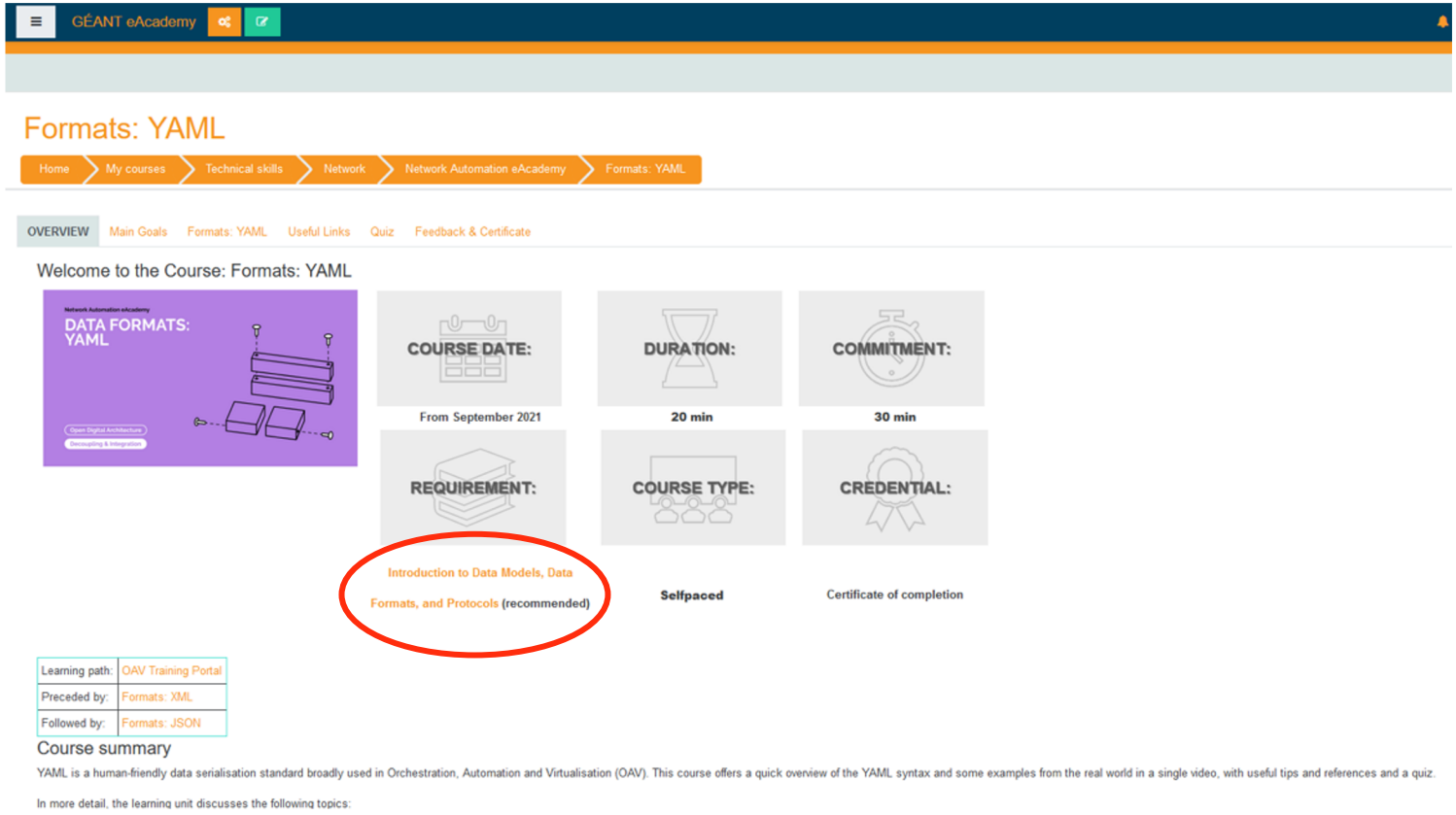
https://wiki.geant.org/display/NETDEV/OAV+Training+Portal

Ansible



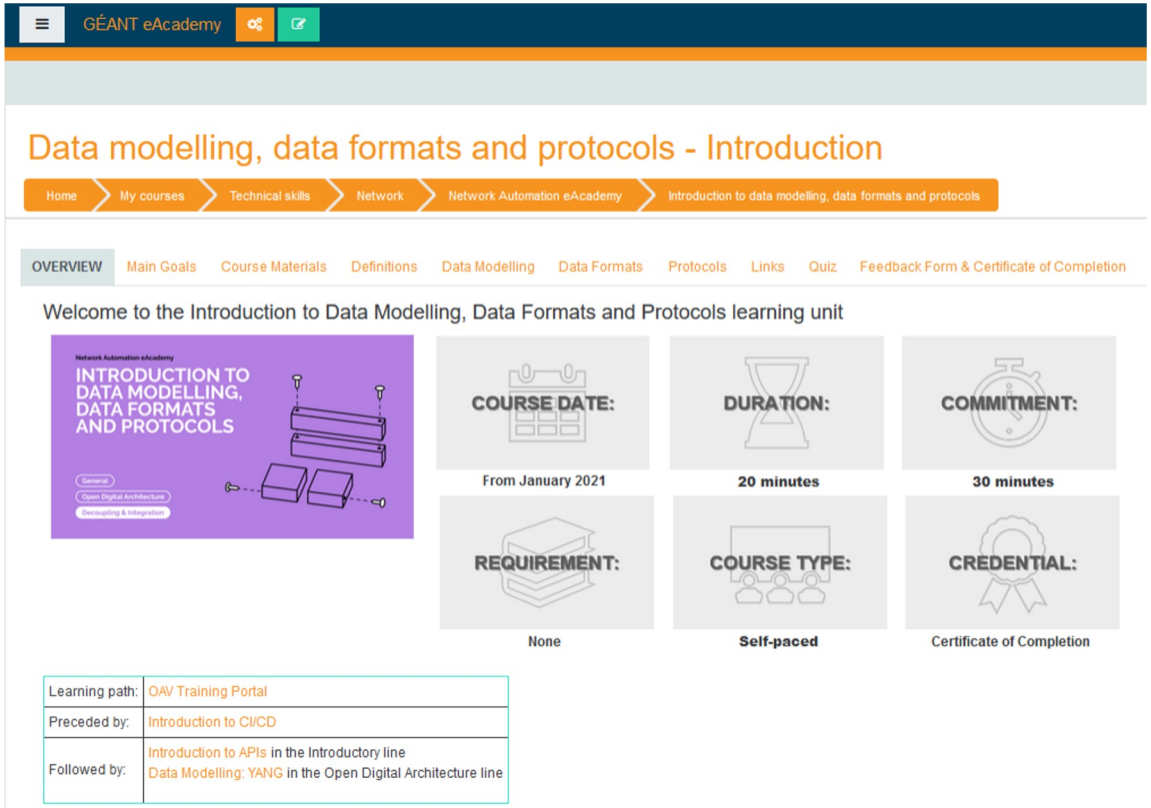
https://e-academy.geant.org/moodle/course/view.php?id=120

Ansible Requirement: YAML, YAML Requirement?



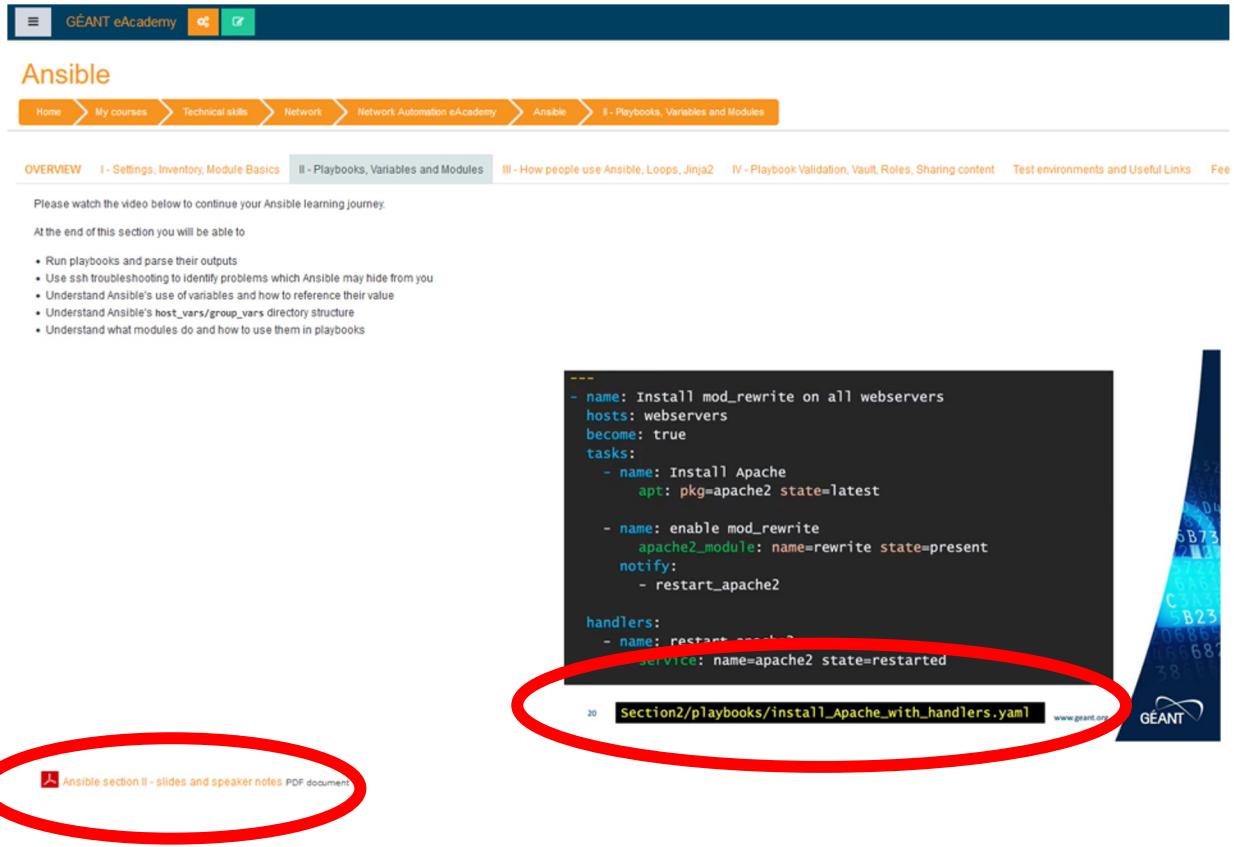
https://e-academy.geant.org/moodle/course/view.php?id=139

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

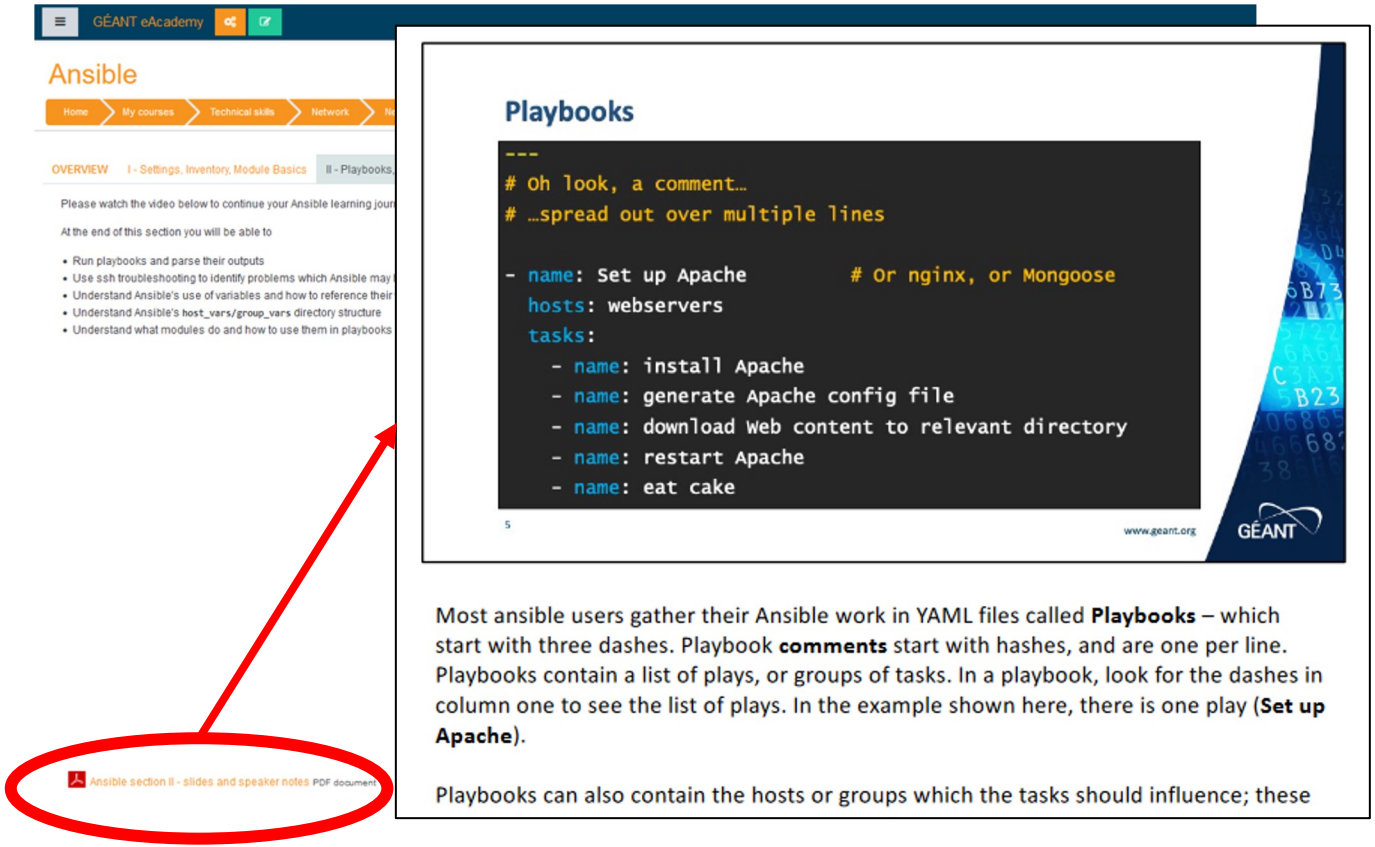


https://e-academy.geant.org/moodle/course/view.php?id=61

Ansible: Video with Subtitles



Ansible: Slides with Speaker Notes



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')

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 Processing** (15')

Production
- **Introduction to Production** (30')
- **Introduction to Virtualisation** (30')
- **Container-Based Virtualisation: Docker / Swarm** (3h)
- **Introduction to Automation** (30')
- **Automation Tools: Ansible** (60'+lab time)
- **Introduction to Configuration Management** (20')
- **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**

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

Current Courses in the Network eAcademy – Quantum

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

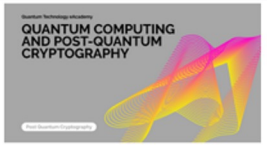
Course creator: Peter Kaufmann

Quantum Algebra: QuBits

Course creator: Peter Kaufmann

Quantum Algebra: Teleportation

Quantum Computers



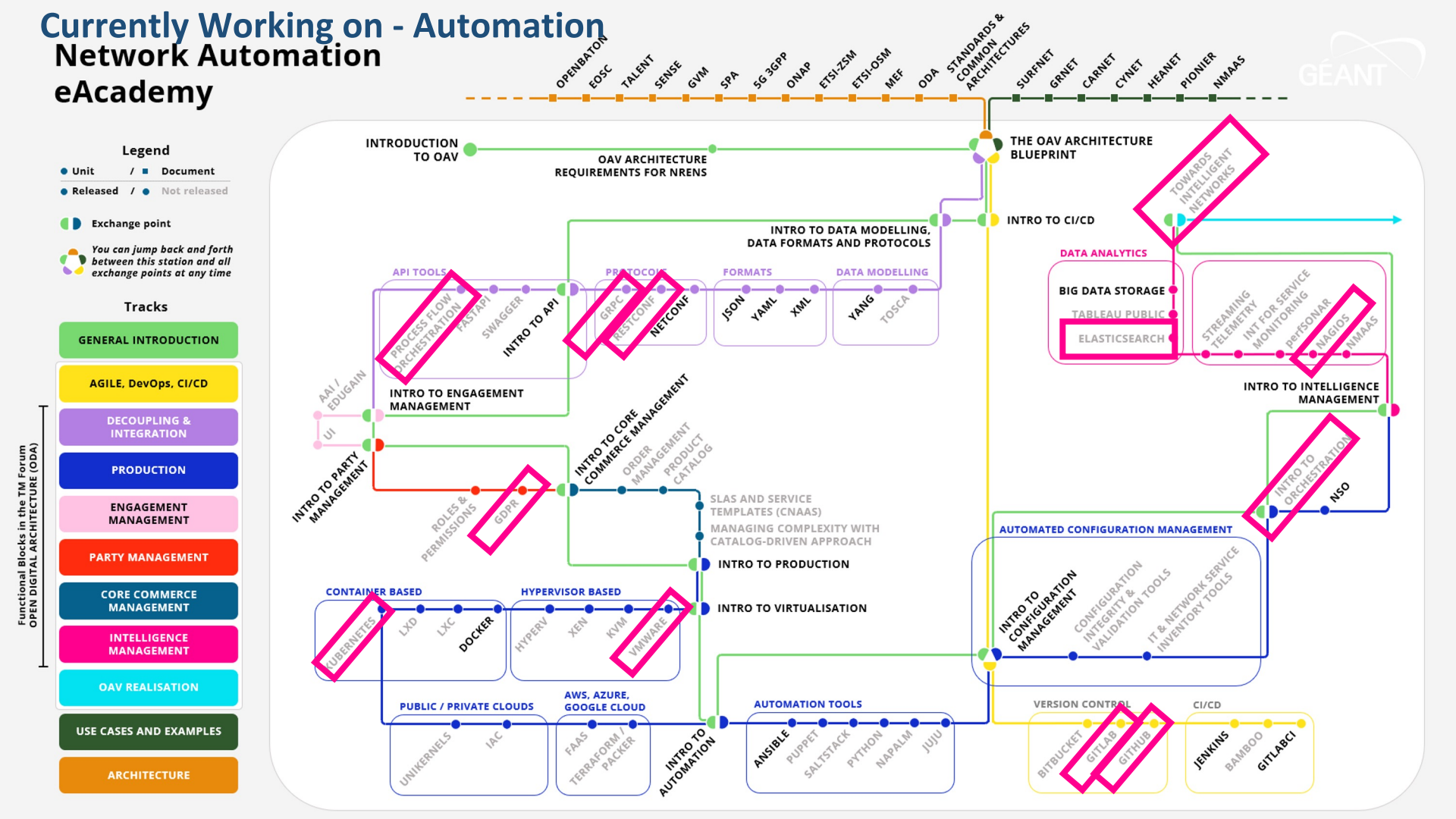
Quantum Computing and Post-Quantum Cryptography

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.

Currently Working on - Automation

Network Automation eAcademy



Currently working on – Quantum

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

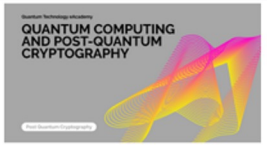
Course creator: Peter Kaufmann

Quantum Algebra: QuBits

Course creator: Peter Kaufmann

Quantum Algebra: Teleportation

Quantum Computers



Quantum Computing and Post-Quantum Cryptography

Terminology and Glossary of OAV Terms

- 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 technologies like machine learning and natural language processing (NLP). This allows it to actively participat 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

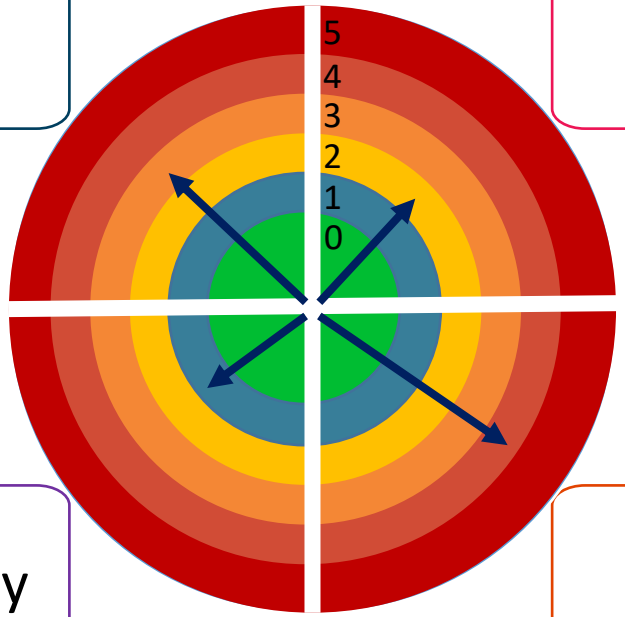
OAV Maturity Model

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

Architecture & Technology

Processes & Services



Vision & Strategy

People & Organisation

OAV Maturity Model - Stages

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

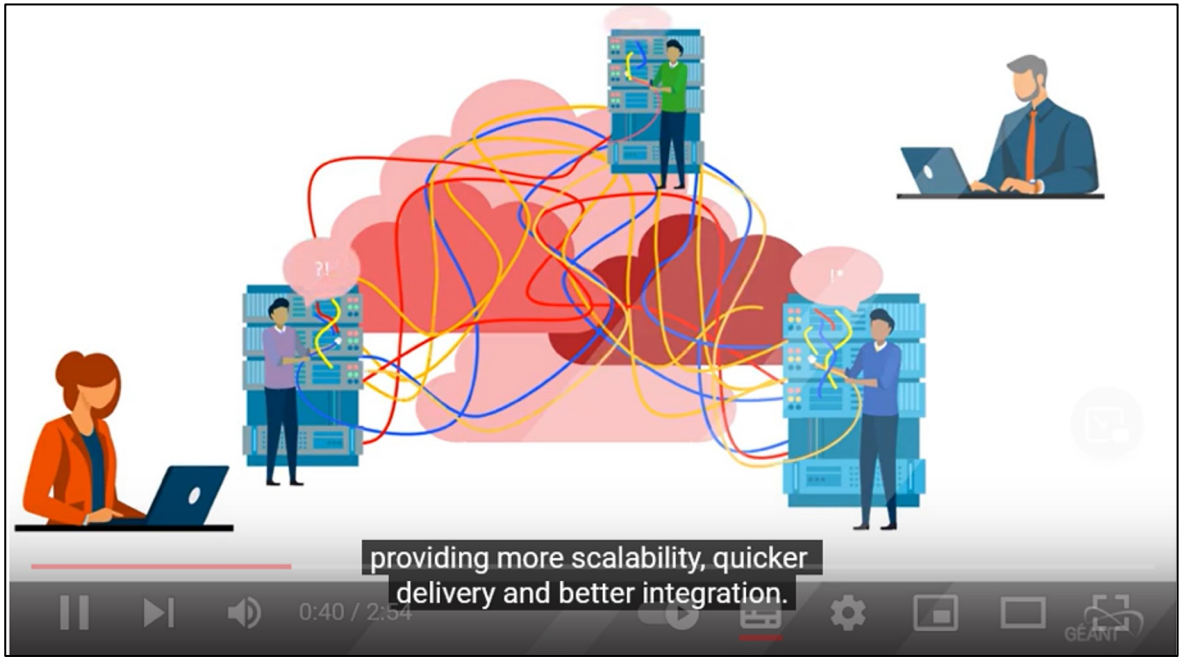
Survey (31 questions)*:
https://www.surveymonkey.com/r/SPYDQVB

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 will be used for analytical purposes only (we will not publish data for individual institutions)
The report will be sent to person defined in survey

Promoting Orchestration, Automation and Virtualisation (I)

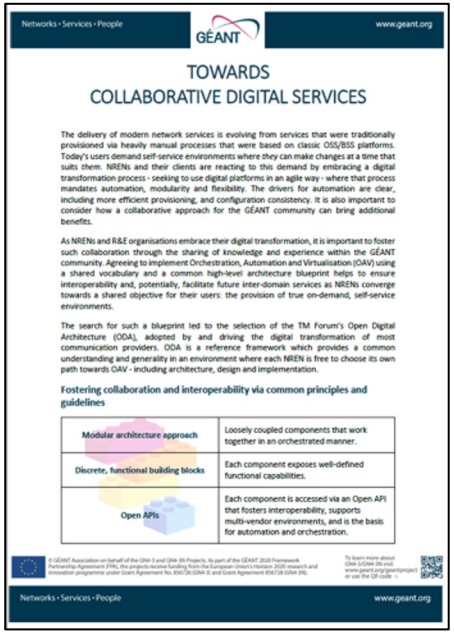


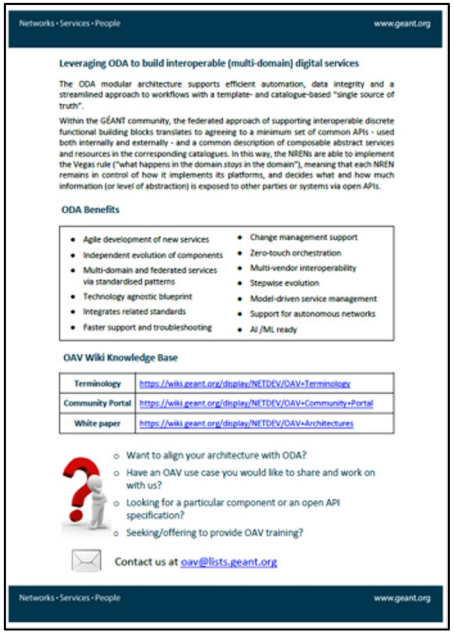
Towards Service Automation for Research and Education

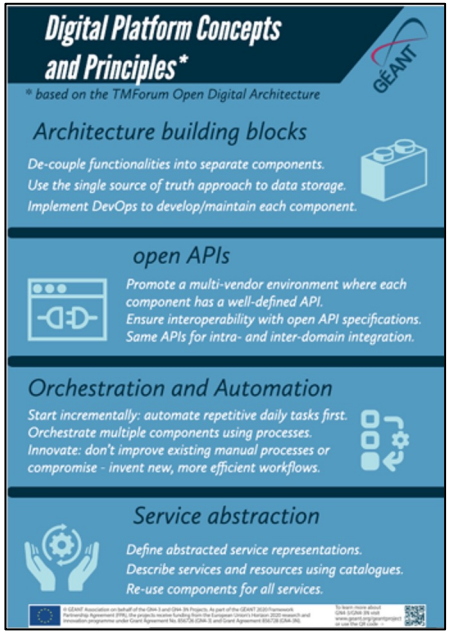
Video in the GÉANT TV channel:

https://youtu.be/Q5Wg1Qnqybg

Promoting Orchestration, Automation and Virtualisation (II)







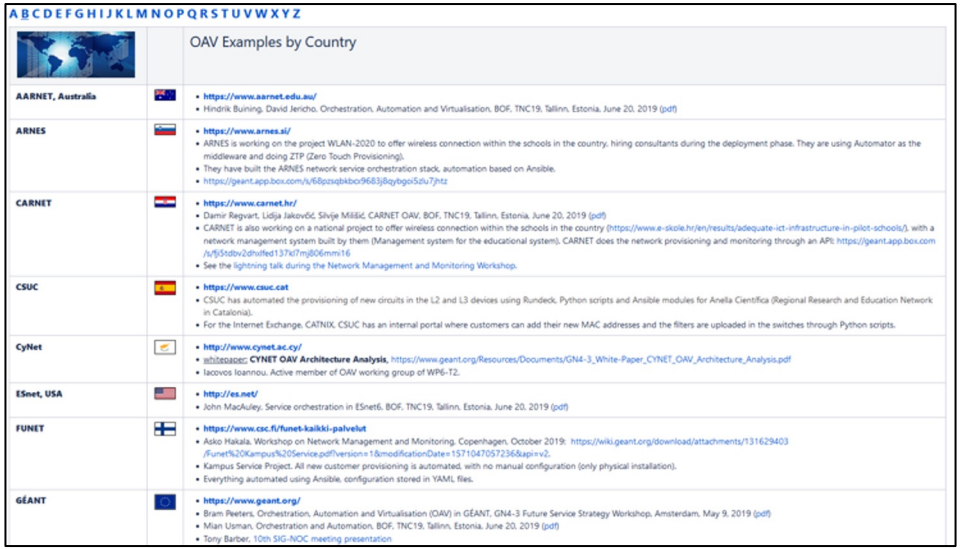
Towards Collaborative Digital Services

Pamphlet and Infographic:

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

Wiki

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



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)	

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

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

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

Thank You!

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

www.geant.org

Co-funded by
the European Union