



Network eAcademy

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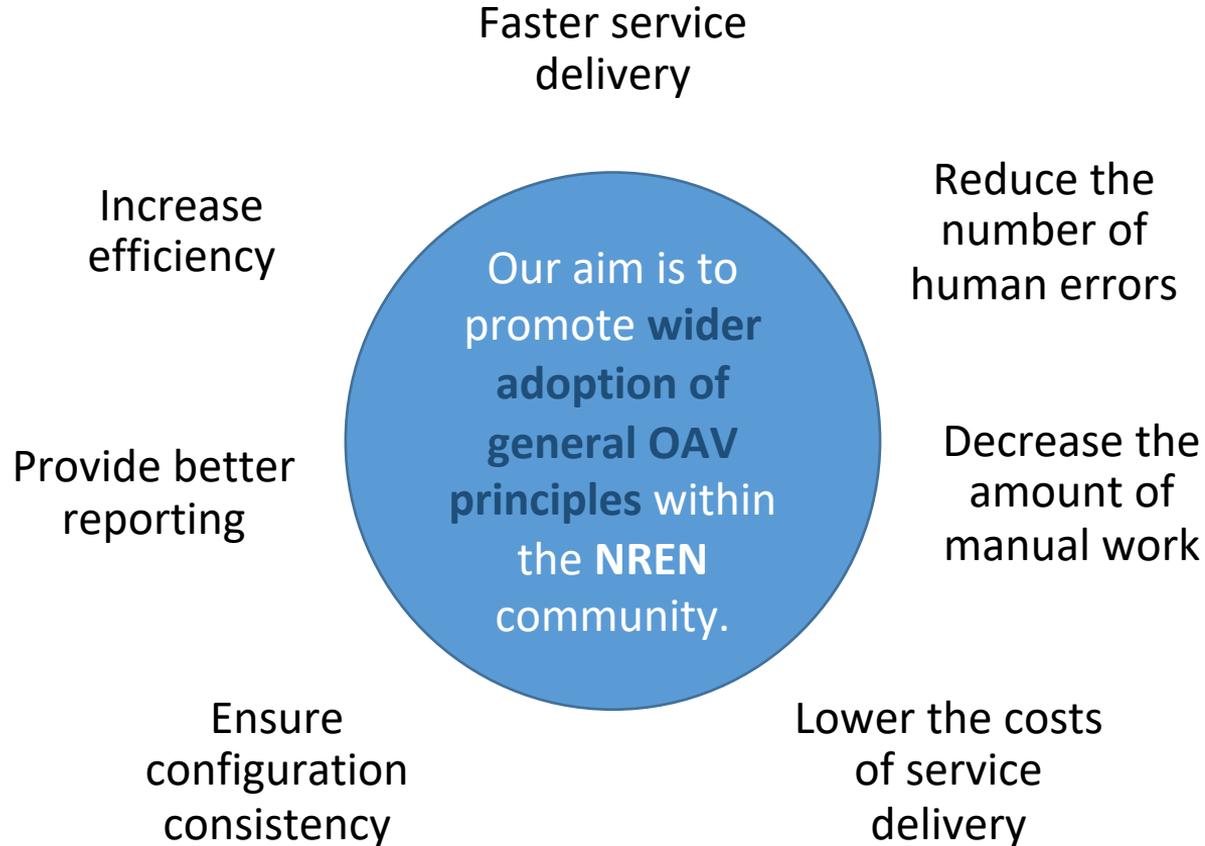
RIPE SEE 11, Split Croatia

5 April 2023

Public (PU)

Agenda: Network eAcademy

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

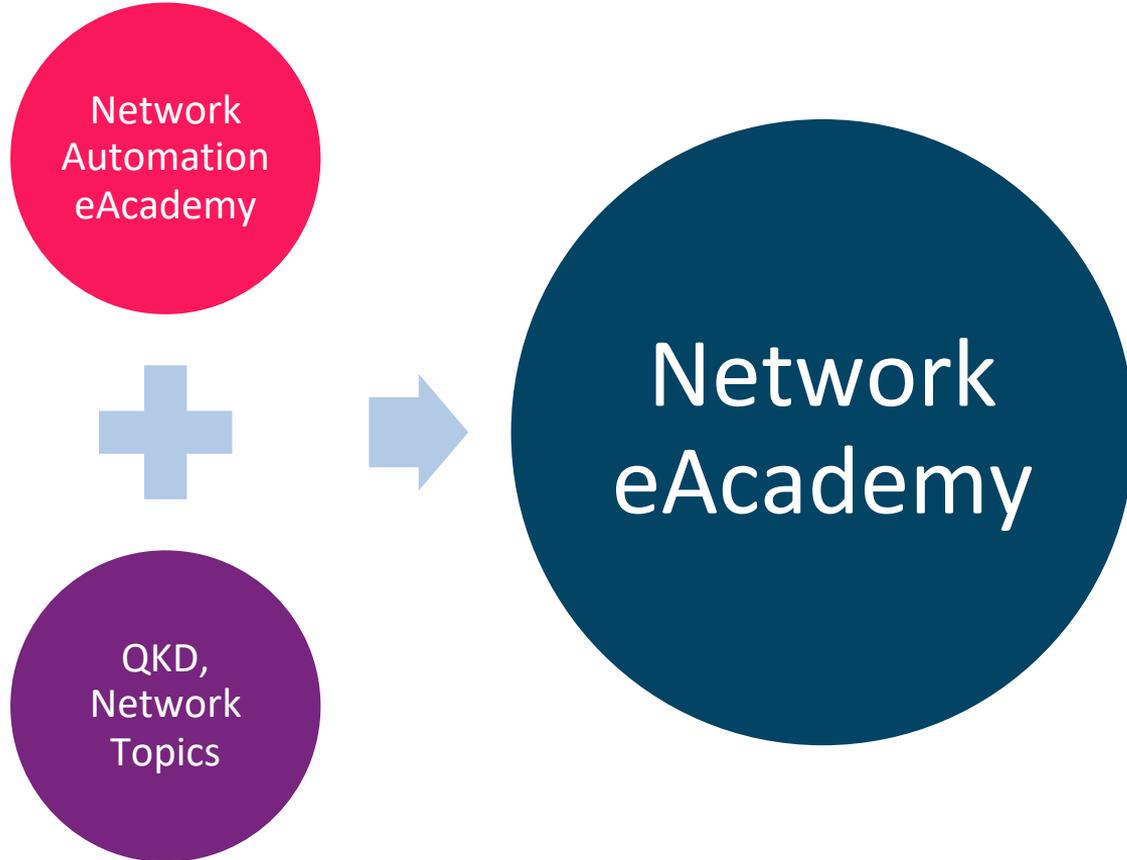


A generally accepted architecture blueprint needed



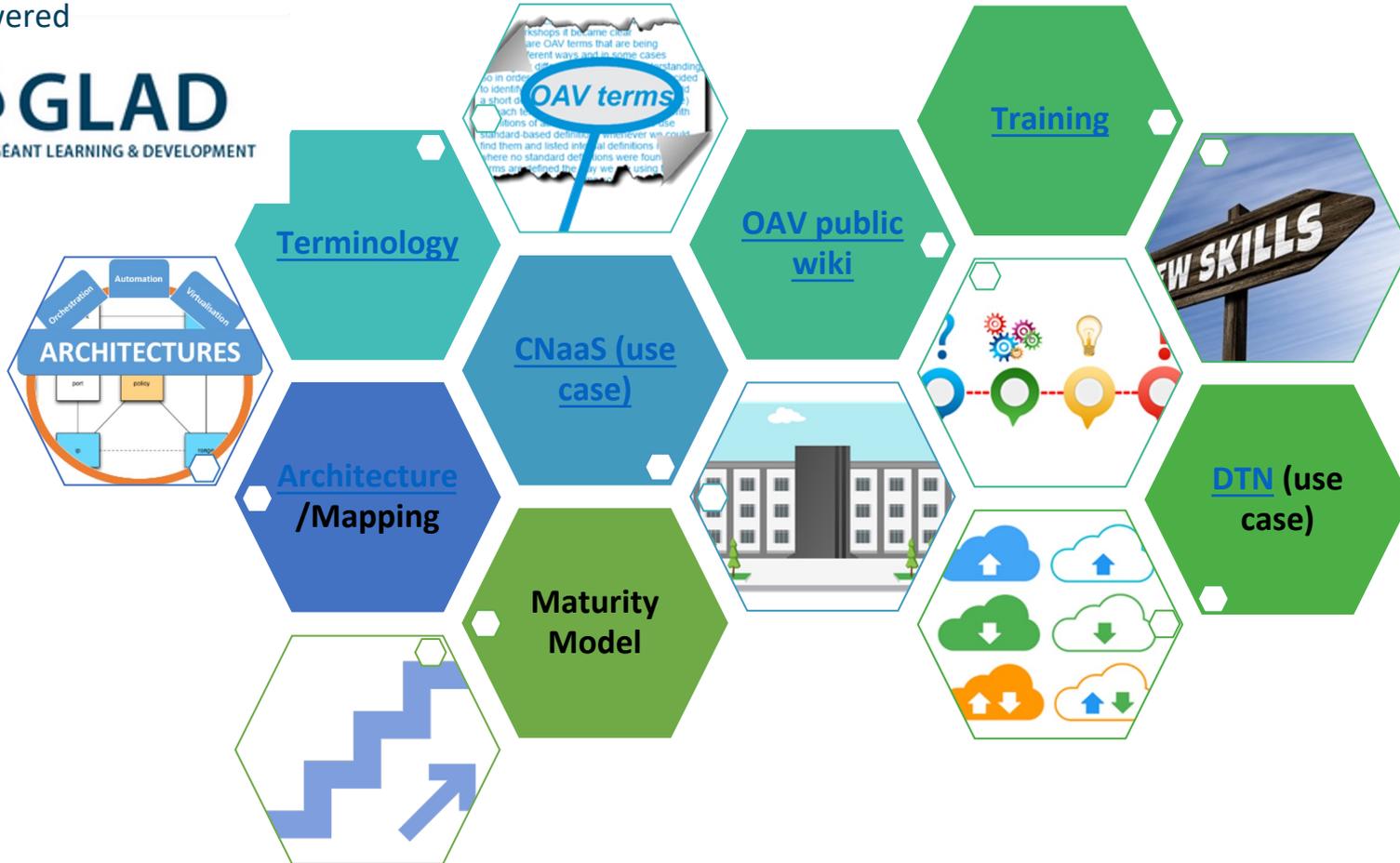
NRENs are willing to share experiences and learn from others

The Network eAcademy



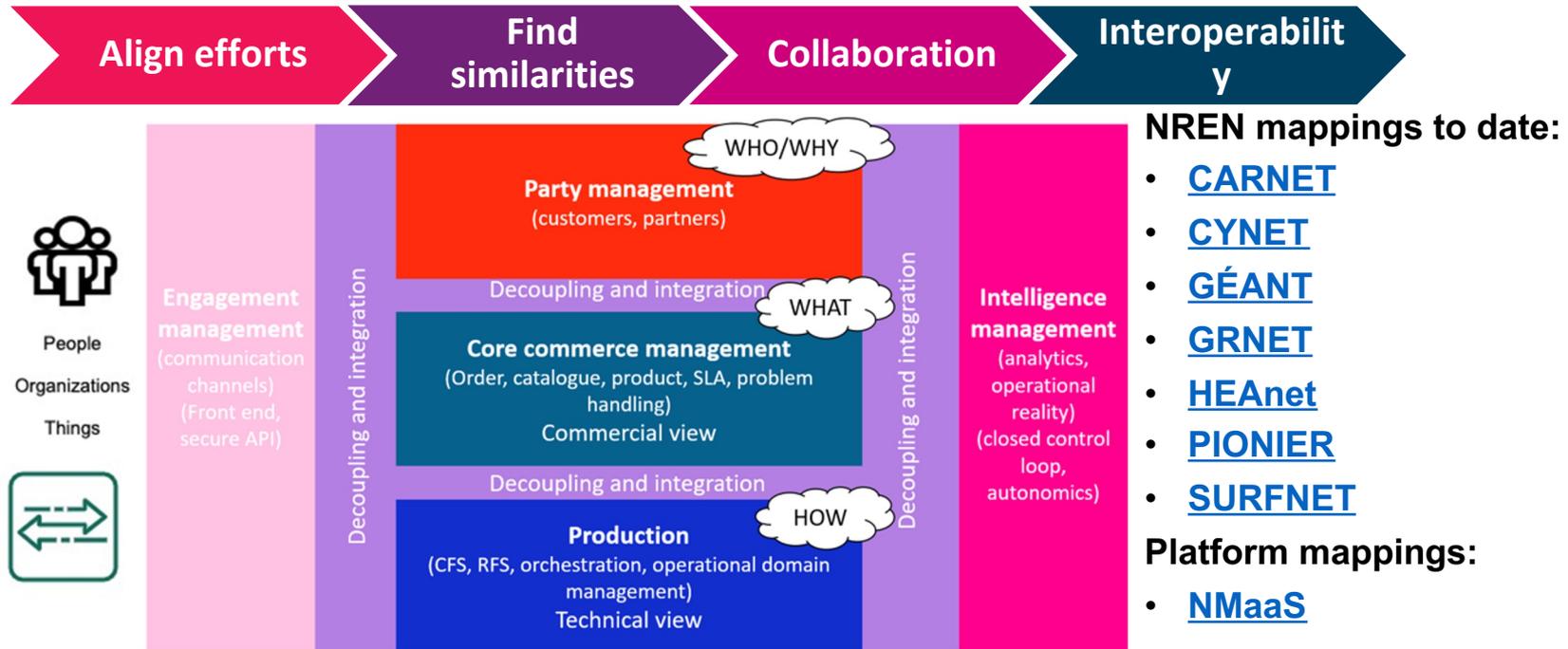
Network eAcademy

Powered



Architecture & Mappings

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



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

Network Automation eAcademy



- Legend**
- Unit / ■ Document
 - Released / ● Not released

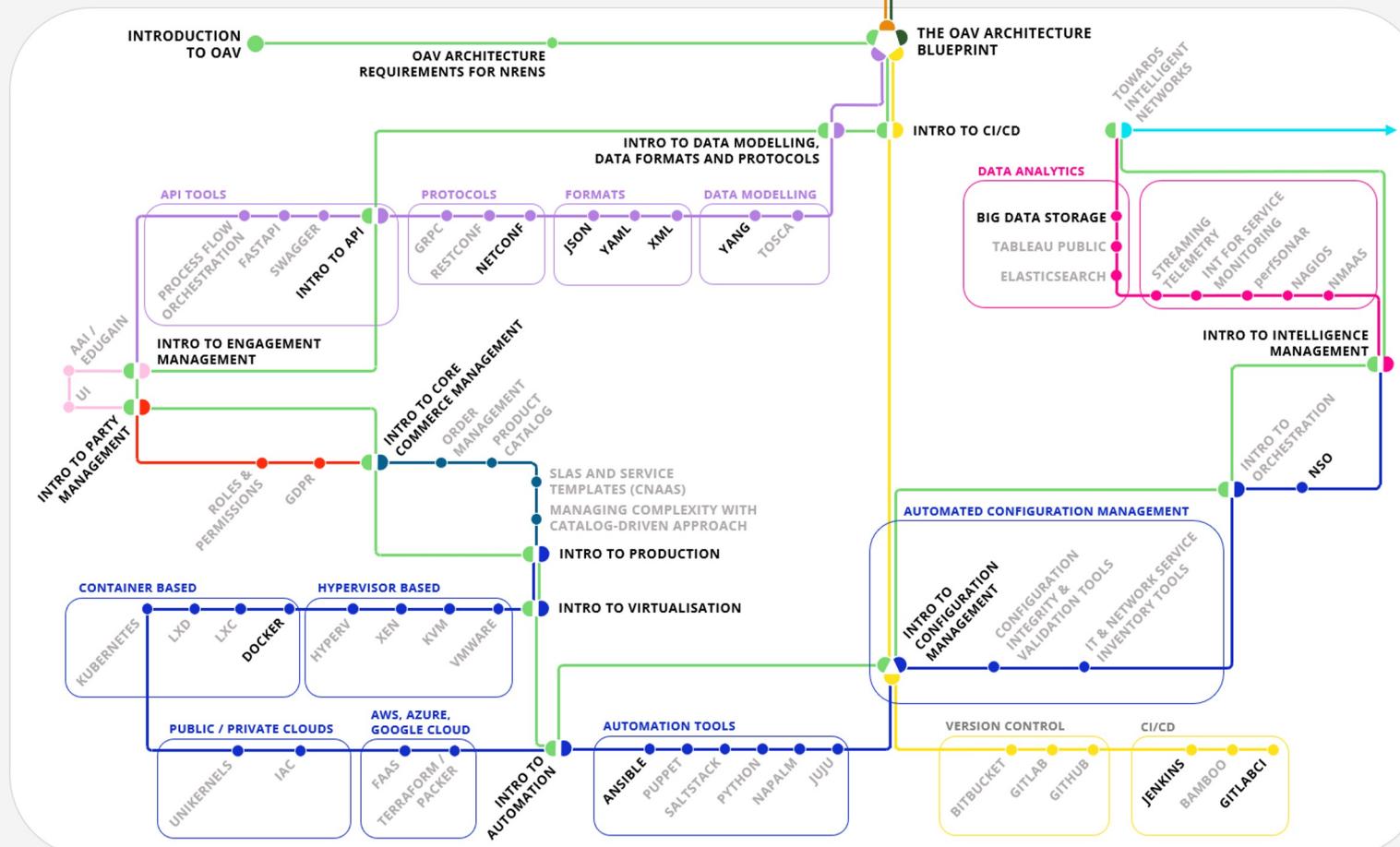
● Exchange point

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)



General Introduction Line

Network Automation academy
INTRODUCTION TO OAV

General

30'

Network Automation academy
OAV ARCHITECTURE REQUIREMENTS FOR NRENs

General

10'

Network Automation academy
THE OAV ARCHITECTURE BLUEPRINT

General
 Open Digital Architecture

30'

Network Automation academy
INTRODUCTION TO CI/CD

General
 Agile DevOps, CI/CD

15'

Network Automation academy
INTRODUCTION TO DATA MODELLING, DATA FORMATS AND PROTOCOLS

General
 Open Digital Architecture
 Interworking & Integration

30'

Network Automation academy
APIs: INTRODUCTION TO API

General
 Open Digital Architecture
 Interworking & Integration

45'

Network Automation academy
INTRODUCTION TO ENGAGEMENT MANAGEMENT

General
 Open Digital Architecture
 Engagement Management

15'

Network Automation academy
INTRODUCTION TO PARTY MANAGEMENT

General
 Open Digital Architecture
 Party Management

15'

Network Automation academy
INTRODUCTION TO CORE COMMERCE MANAGEMENT

General
 Open Digital Architecture
 Core Commerce Management

15'

Network Automation academy
INTRODUCTION TO PRODUCTION

General
 Open Digital Architecture
 Production

30'

Network Automation academy
INTRODUCTION TO VIRTUALISATION

General
 Open Digital Architecture
 Production Virtualisation

30'

Network Automation academy
INTRODUCTION TO AUTOMATION

General
 Open Digital Architecture
 Production Automation

30'

Network Automation academy
AUTOMATED CONFIGURATION MANAGEMENT: INTRODUCTION TO CONFIGURATION MANAGEMENT

General
 Open Digital Architecture
 Production Automation

30'

Network Automation academy
INTRODUCTION TO ORCHESTRATION

General
 Open Digital Architecture
 Production Orchestration

15'

Network Automation academy
INTRODUCTION TO INTELLIGENCE MANAGEMENT

General
 Open Digital Architecture
 Intelligence Management

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

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

Network Automation Academy

APIs: INTRODUCTION TO API

General
Open Digital Architecture
Decoupling & Integration

45'

Ansible



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?



Formats: YAML

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

OVERVIEW Main Goals Formats: YAML Useful Links Quiz Feedback & Certicate

Welcome to the Course: Formats: YAML



From September 2021



20 min



30 min



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=120>

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

The screenshot shows the GÉANT eAcademy interface. At the top, there's a navigation bar with 'GÉANT eAcademy' and icons for home, search, and user profile. Below this is a breadcrumb trail: Home > My courses > Technical skills > Network > Network Automation eAcademy > Introduction to data modelling, data formats and protocols. The main content area has a tabbed interface with 'OVERVIEW' selected. The overview section includes a course card for 'INTRODUCTION TO DATA MODELLING, DATA FORMATS AND PROTOCOLS' with details on course date, duration, commitment, requirement, course type, and credential. A table at the bottom provides the learning path, including 'OAV Training Portal', 'Introduction to CI/CD', and 'Introduction to APIs in the Introductory line' and 'Data Modelling: YANG in the Open Digital Architecture line'.

Home > My courses > Technical skills > Network > Network Automation eAcademy > Introduction to data modelling, data formats and protocols

OVERVIEW Main Goals Course Materials Definitions Data Modelling Data Formats Protocols Links Quiz Feedback Form & Certificate of Completion

Welcome to the Introduction to Data Modelling, Data Formats and Protocols learning unit

INTRODUCTION TO DATA MODELLING, DATA FORMATS AND PROTOCOLS

General
Open Digital Architecture
Decoupling & Integration

COURSE DATE:	DURATION:	COMMITMENT:
From January 2021	20 minutes	30 minutes
REQUIREMENT:	COURSE TYPE:	CREDENTIAL:
None	Self-paced	Certificate of Completion

Learning path:	OAV Training Portal
Preceded by:	Introduction to CI/CD
Followed by:	Introduction to APIs in the Introductory line Data Modelling: YANG in the Open Digital Architecture line

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

Ansible: Video with Subtitles

☰
GÉANT eAcademy

Ansible

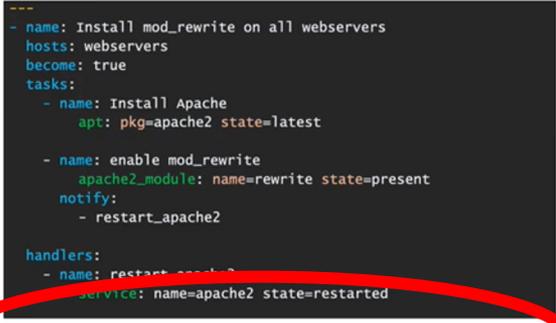
Home
My courses
Technical skills
Network
Network Automation eAcademy
Ansible
II - Playbooks, Variables and Modules

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
Fe

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



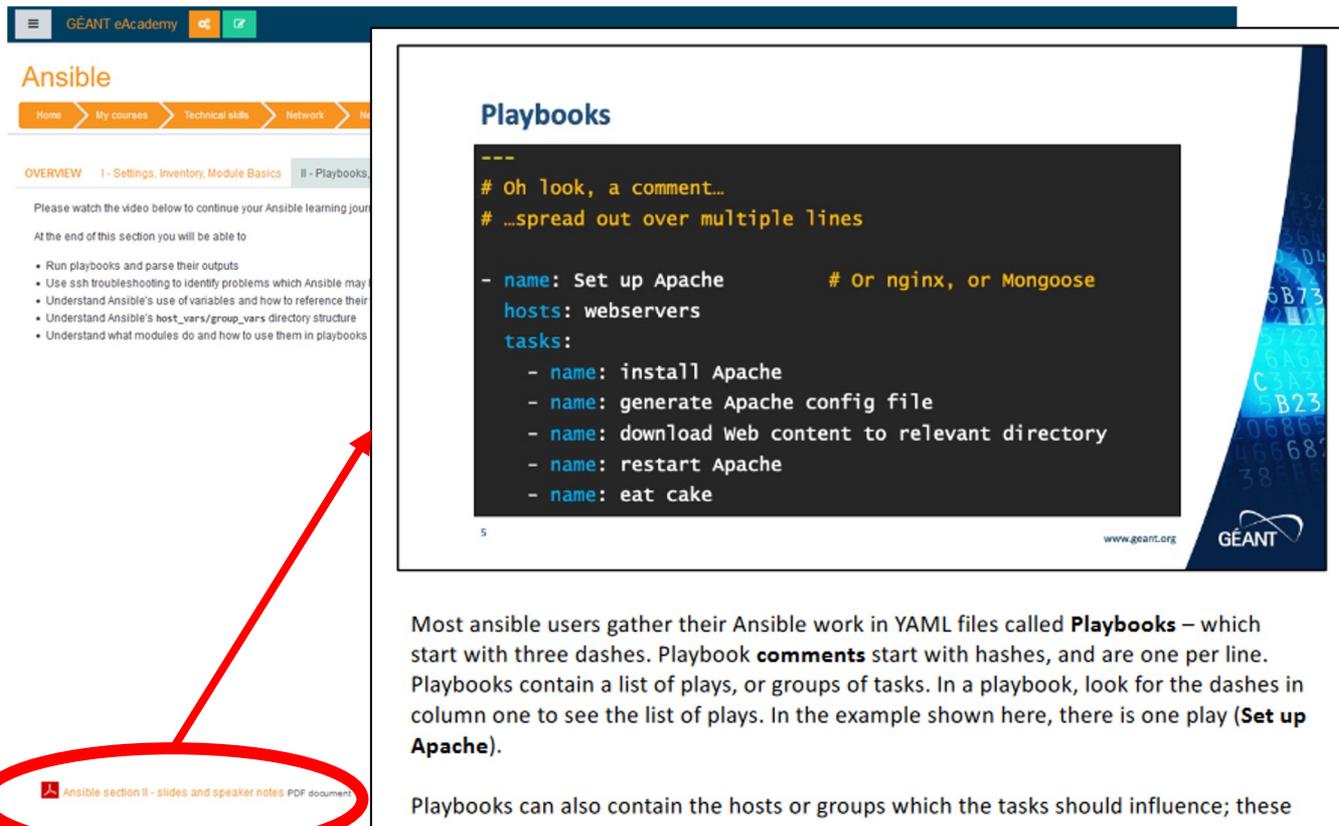
```

---
- 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.yam1 www.geant.org GÉANT


Ansible section II - slides and speaker notes PDF document

Ansible: Slides with Speaker Notes



The image shows a presentation slide titled "Playbooks" with a code example and speaker notes. The slide is part of a course on Ansible, as indicated by the navigation bar at the top. The code example shows a YAML snippet for a play named "Set up Apache". The speaker notes explain that Ansible users gather their work in YAML files called "Playbooks", which start with three dashes. Comments start with hashes. The notes also mention that playbooks contain a list of plays or groups of tasks, and that the first column of a play lists the tasks. The slide includes a red arrow pointing to a PDF document icon in the bottom left corner, which is circled in red.

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

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
- Understand Ansible's use of variables and how to reference their
- 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 GEANT

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

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**

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

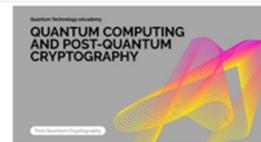
Course creator: Peter Kaufmann



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

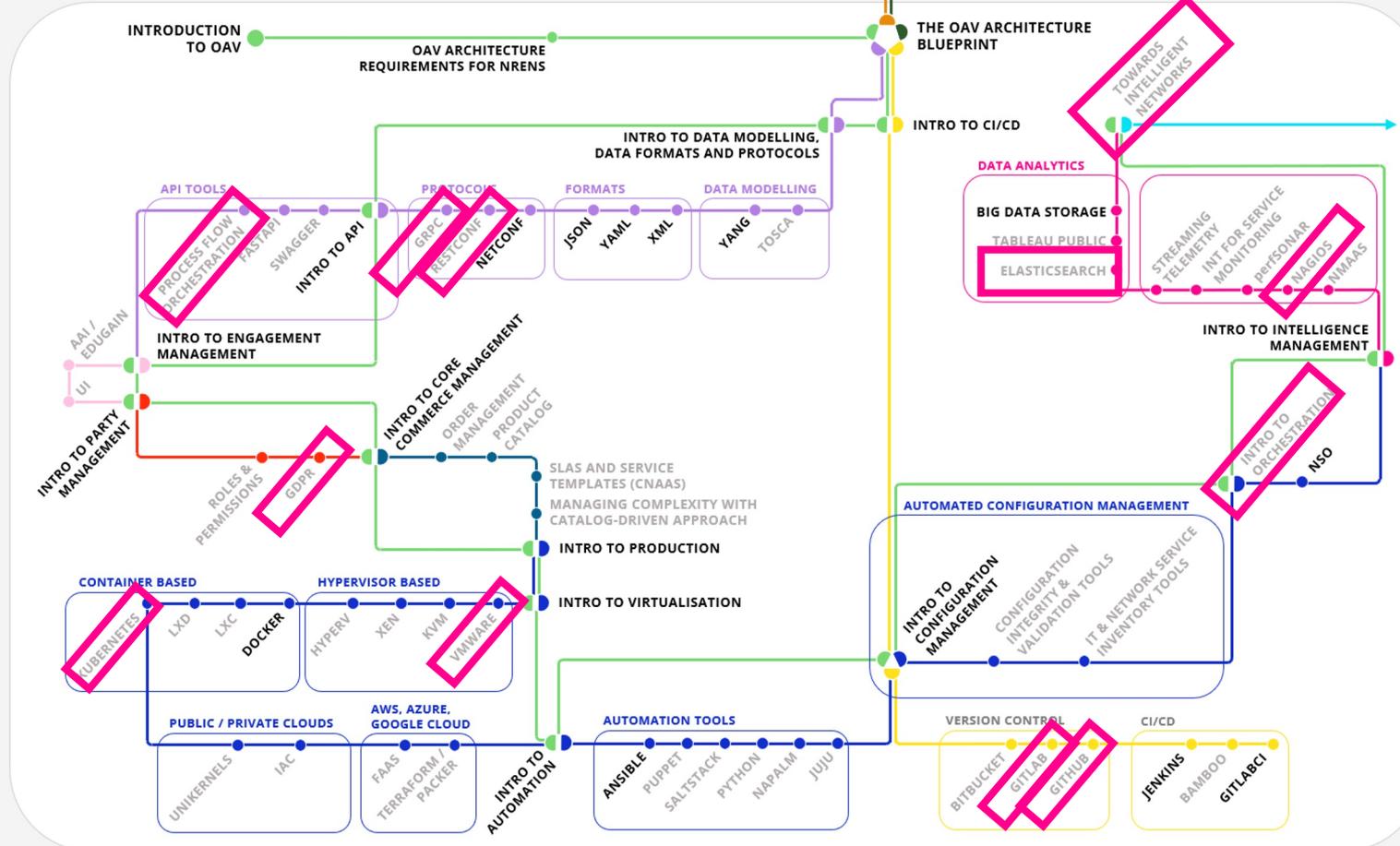


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Tracks

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- 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)



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

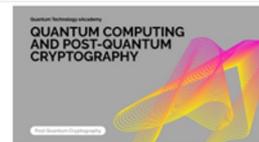
Course creator: Peter Kaufmann



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

Glossary

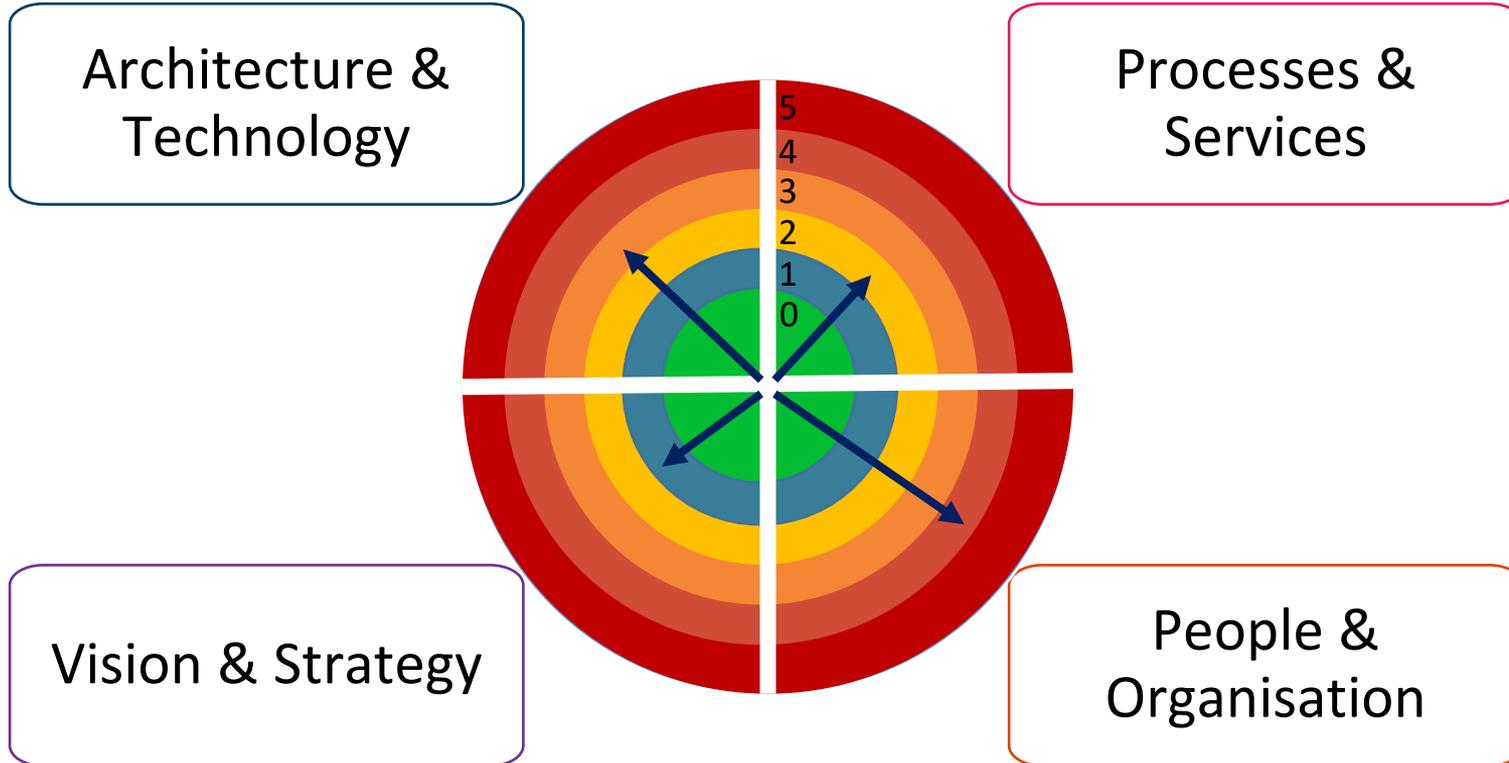
OAV Terms	Definition and reference
AIOps	<p>AIOps is (the usage of) Artificial Intelligence for IT Operations. It combines big data and machine learning to automate IT operations processes, including event correlation, anomaly detection and causality determination.</p> <ul style="list-style-type: none"> • 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 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>



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



OAV Maturity Model - Stages



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>

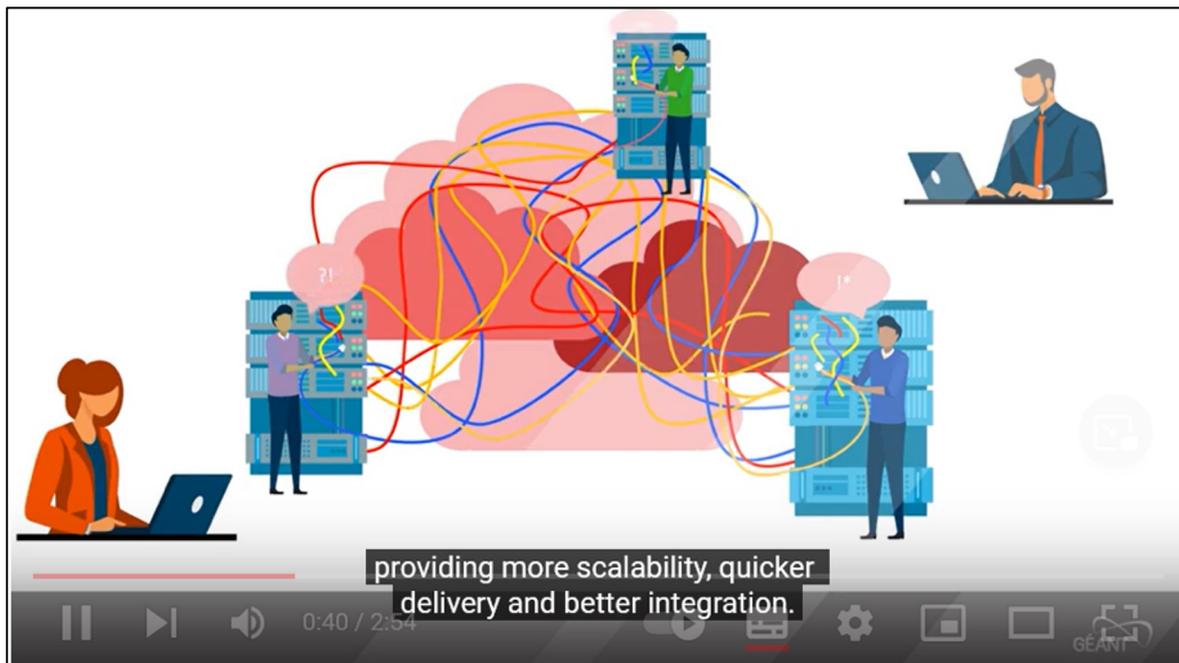
Presentations of the OAV MM Infoshare:

<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)

Networks - Services - People **GEANT** www.geant.org

TOWARDS COLLABORATIVE DIGITAL SERVICES

The delivery of modern network services is evolving from services that were traditionally provisioned via heavily manual processes that were based on classic OSS/BSS platforms. Today's users demand self-service environments where they can make changes at a time that suits them. NRENs and their clients are reacting to this demand by embracing a digital transformation process - seeking to use digital platforms in an agile way - where that process mandates automation, modularity and flexibility. The drivers for automation are clear, including more efficient provisioning, and configuration consistency. It is also important to consider how a collaborative approach for the GEANT community can bring additional benefits.

As NRENs and R&E organisations embrace their digital transformation, it is important to foster such collaboration through the sharing of knowledge and experience within the GEANT community. Agreeing to implement Orchestration, Automation and Virtualisation (OAV) using a shared vocabulary and a common high-level architecture blueprint helps to ensure interoperability and, potentially, facilitates future inter-domain services as NRENs converge towards a shared objective for their users: the provision of true on-demand, self-service environments.

The search for such a blueprint led to the selection of the TM Forum's Open Digital Architecture (ODA), adopted by and driving the digital transformation of most communication providers. ODA is a reference framework which provides a common understanding and generality in an environment where each NREN is free to choose its own path towards OAV - including architecture, design and implementation.

Fostering collaboration and interoperability via common principles and guidelines

Modular architecture approach	Loosely coupled components that work together in an orchestrated manner.
Discrete, functional building blocks	Each component engages well-defined functional capabilities.
Open APIs	Each component is accessed via an Open API that fosters interoperability, supports multi-vendor environments, and is the basis for automation and orchestration.

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Leveraging ODA to build interoperable (multi-domain) digital services

The ODA modular architecture supports efficient automation, data integrity and a streamlined approach to workflows with a template- and catalogue-based "single source of truth".

Within the GEANT community, the federated approach of supporting interoperable discrete functional building blocks translates to agreeing to a minimum set of common APIs - used both internally and externally - and a common description of composable abstract services and resources in the corresponding catalogues. In this way, the NRENs are able to implement the Virges rule ("what happens in the domain stays in the domain"), meaning that each NREN remains in control of how it implements its platforms, and decides what and how much information (or level of abstraction) is exposed to other parties or systems via open APIs.

ODA Benefits

- Agile development of new services
- Independent evolution of components
- Multi-domain and federated services via standardised patterns
- Technology agnostic blueprint
- Integrates related standards
- Faster support and troubleshooting
- Change management support
- Zero-touch orchestration
- Multi-vendor interoperability
- Stepwise evolution
- Model-driven service management
- Support for autonomous networks
- AI/ML ready

OAV Wiki Knowledge Base

Terminology	https://wiki.geant.org/display/NETDEV/OAV+Terminology
Community Portal	https://wiki.geant.org/display/NETDEV/OAV+Community+Portal
White paper	https://wiki.geant.org/display/NETDEV/OAV+Architectures

- Want to align your architecture with ODA?
- Have an OAV use case you would like to share and work on with us?
- Looking for a particular component or an open API specification?
- Seeking/offering to provide OAV training?

Contact us at oav@lists.geant.org

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THE AUTOMATION, ORCHESTRATION AND VIRTUALISATION JOURNEY

OAV WIKI
<https://wiki.geant.org/display/NETDEV/OAV>
oav@lists.geant.org

The WPG T2 team can help you on your OAV journey.

WHERE TO START?

Map your NREN architecture to the Open Digital Architecture* to start analysing the current situation

FROM A TRADITIONAL OSS/BSS

- Analyse components and functionalities
- De-couple & de-duplicate
- Expose components via APIs
- Automate manual tasks per component
- Use orchestrators to implement complex processes spanning multiple components

VIA A DIGITAL PLATFORM

- Agree on common terminology to understand each other
- Common service abstraction definition
- Interoperable interfacing via common Open APIs
- Federate with other NRENs or commercial providers

TO AN INTEROPERABLE COMMUNITY

On-demand provisioning of multi-domain services using common APIs and data models

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Digital Platform Concepts and Principles*

* based on the TMForum Open Digital Architecture

Architecture building blocks

De-couple functionalities into separate components. Use the single source of truth approach to data storage. Implement DevOps to develop/maintain each component.

open APIs

Promote a multi-vendor environment where each component has a well-defined API. Ensure interoperability with open API specifications. Same APIs for intra- and inter-domain integration.

Orchestration and Automation

Start incrementally: automate repetitive daily tasks first. Orchestrate multiple components using processes. Innovate: don't improve existing manual processes or compromise - invent new, more efficient workflows.

Service abstraction

Define abstracted service representations. Describe services and resources using catalogues. Re-use components for all services.

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Towards Collaborative Digital Services

Pamphlet and Infographic:

[https://www.geant.org/Resources/Documents/OAV Arch text and infographics new links.pdf](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...

OAV Examples by Country	
	
AARNET, Australia 	<ul style="list-style-type: none"> • https://www.aarnet.edu.au/ • Hindrik Buning, David Jericho, Orchestration, Automation and Virtualisation, BOF, TNC19, Tallinn, Estonia, June 20, 2019 (pdf)
ARNES 	<ul style="list-style-type: none"> • 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/v/682szqkbc096838y8qps05du7htz
CARNET 	<ul style="list-style-type: none"> • https://www.carnet.hr/ • Damir Ragnvat, Lidja Jakovč, Shije Mšić, 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-izola.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/5f55dov2dthfled13767m806mm16 • See the lightning talk during the Network Management and Monitoring Workshop.
CSUC 	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • http://es.net/ • John MacAuley. Service orchestration in ESnet6. BOF, TNC19, Tallinn, Estonia, June 20, 2019 (pdf)
FUNET 	<ul style="list-style-type: none"> • 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&app=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 	<ul style="list-style-type: none"> • https://www.geant.org/ • Bram Beelen, Orchestration, Automation and Virtualisation (OAV) in GÉANT, GN4-3 Future Service Strategy Workshop, Amsterdam, May 9, 2019 (pdf) • Milan Usman, Orchestration and Automation, BOF, TNC19, Tallinn, Estonia, June 20, 2019 (pdf) • Tony Barber, 10th SIG-NOC meeting presentation

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

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



Thank You!

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