



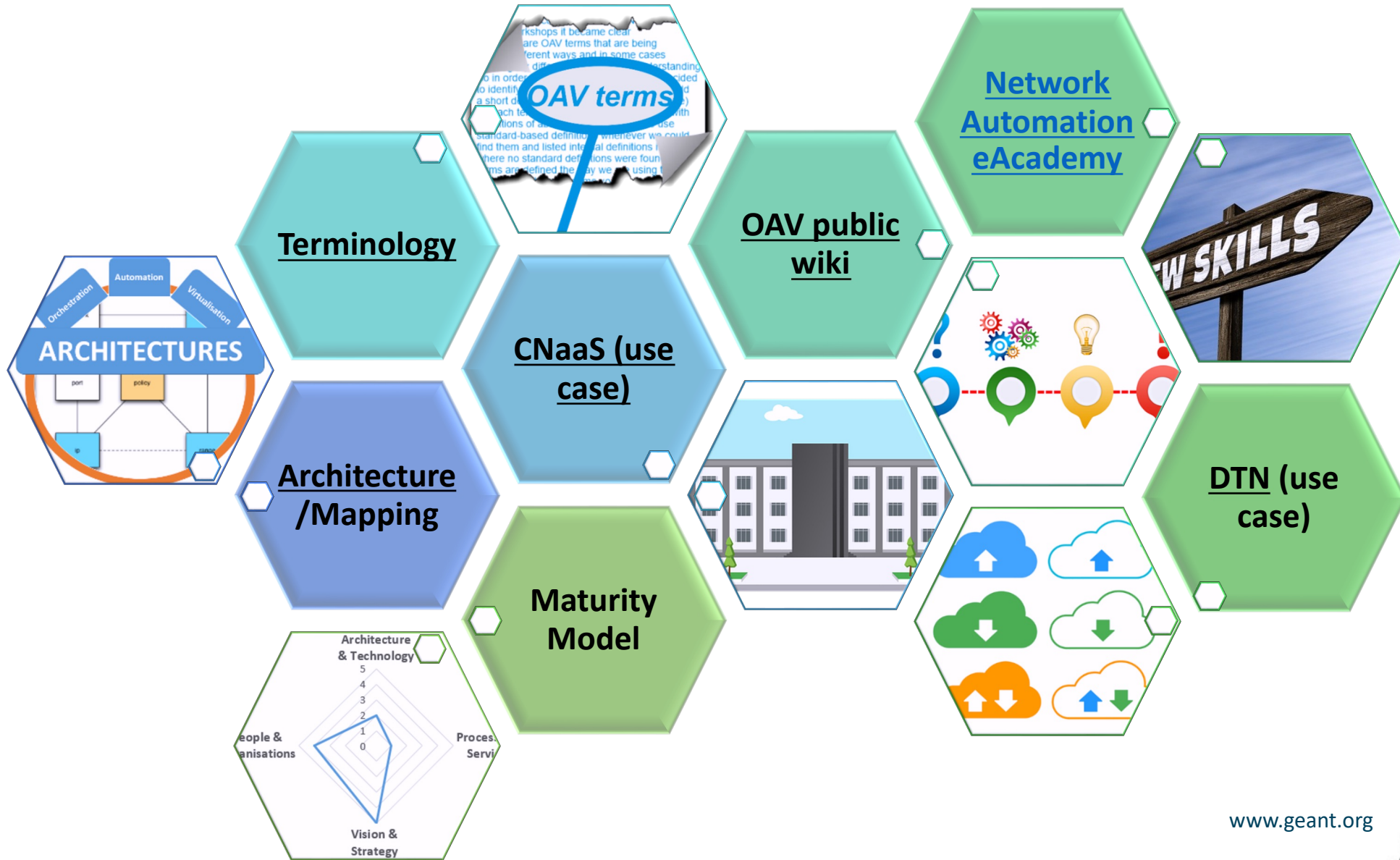
Network Automation eAcademy

Maria Isabel Gandia, CSUC/RedIRIS
WP6-T2

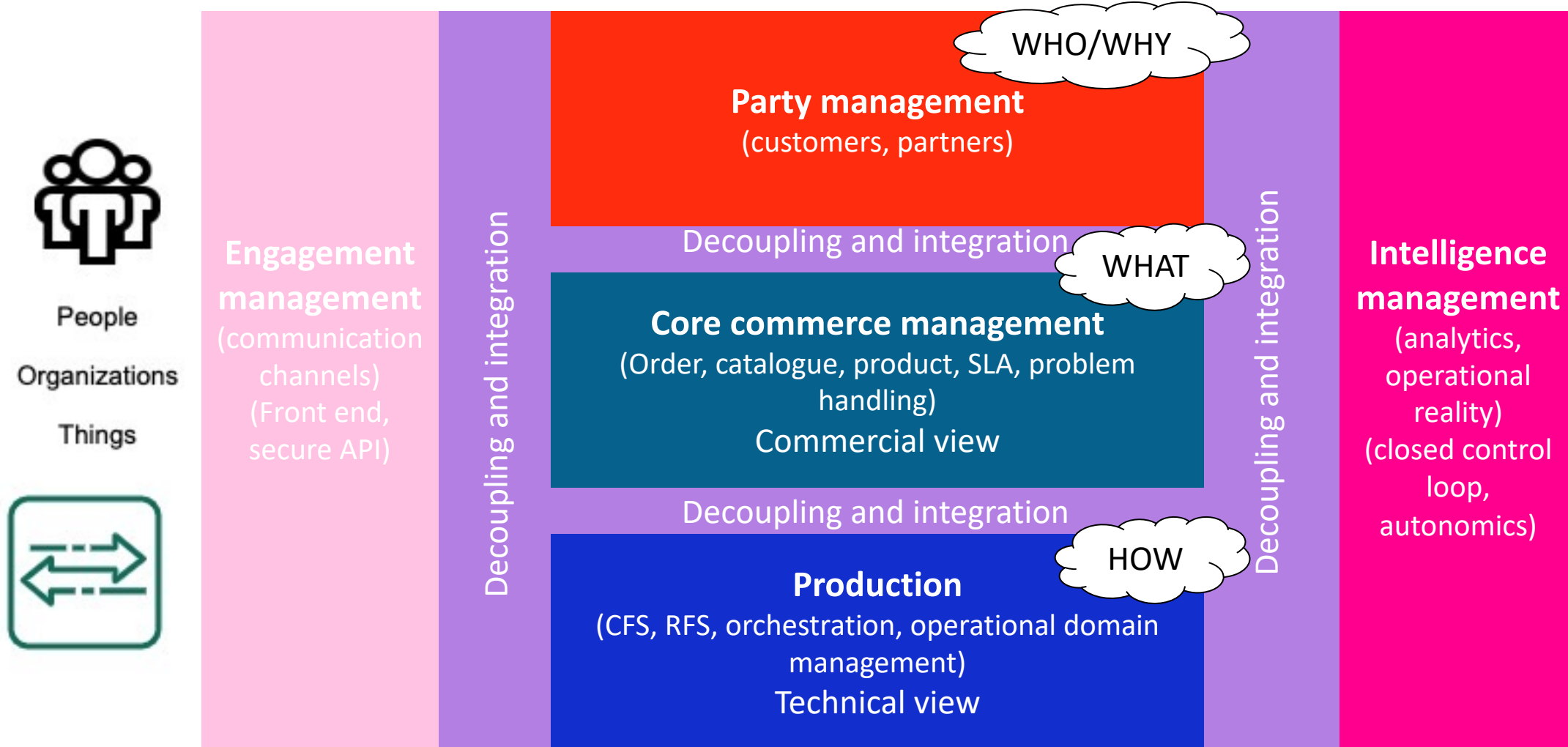
16th SIG-NOC Meeting
Cambridge

www.geant.org

Orchestration, Automation and Virtualisation



Architecture Blueprint: TM Forum Open Digital Architecture



Knowledge Map

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

TMForum Open Digital Architecture Functional Blocks

Mapping of Architectures

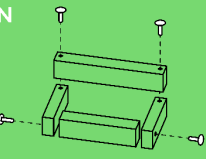
www.geant.org



Current Courses in the Network Automation eAcademy

Network Automation eAcademy

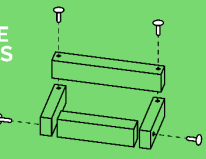
INTRODUCTION TO OAV



General

Network Automation eAcademy

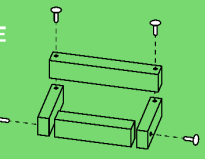
OAV ARCHITECTURE REQUIREMENTS FOR NRENs



General

Network Automation eAcademy

THE OAV ARCHITECTURE BLUEPRINT



General
Open Digital Architecture

Network Automation eAcademy

INTRODUCTION TO CI/CD



General
Agile, DevOps, CI/CD

Network Automation eAcademy

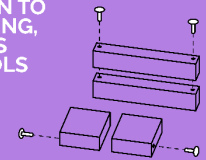
CI/CD: GitlabCI



Agile, DevOps, CI/CD

Network Automation eAcademy

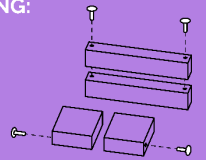
INTRODUCTION TO DATA MODELLING, DATA FORMATS AND PROTOCOLS



General
Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

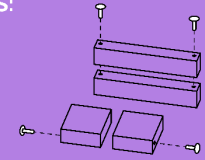
DATA MODELLING: YANG



Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

DATA FORMATS: XML



Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

DATA FORMATS: YAML



Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

DATA FORMATS: JSON



Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

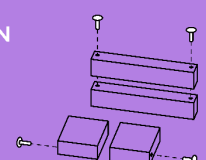
PROTOCOLS: NETCONF



Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

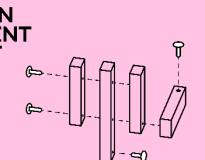
APIs: INTRODUCTION TO API



General
Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

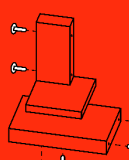
INTRODUCTION TO ENGAGEMENT MANAGEMENT



General
Open Digital Architecture
Engagement Management

Network Automation eAcademy

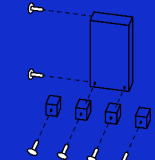
INTRODUCTION TO PARTY MANAGEMENT



General
Open Digital Architecture
Party Management

Network Automation eAcademy

INTRODUCTION TO PRODUCTION



General
Open Digital Architecture
Production

Network Automation eAcademy

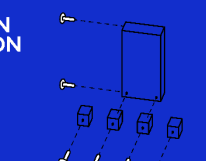
INTRODUCTION TO VIRTUALISATION



General
Open Digital Architecture
Production: Virtualisation

Network Automation eAcademy

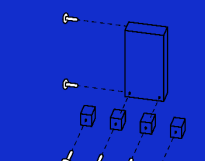
INTRODUCTION TO AUTOMATION



General
Open Digital Architecture
Production: Automation

Network Automation eAcademy

AUTOMATION TOOLS: Ansible



Open Digital Architecture
Production: Automation

Network Automation eAcademy

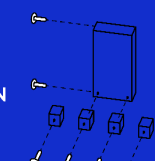
NSO: Cisco Network Services Orchestrator



Open Digital Architecture
Production: Orchestration

Network Automation eAcademy

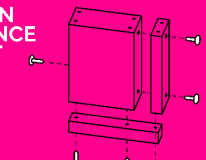
AUTOMATED CONFIGURATION MANAGEMENT: INTRODUCTION TO CONFIGURATION MANAGEMENT



General
Open Digital Architecture
Production: Automation

Network Automation eAcademy

INTRODUCTION TO INTELLIGENCE MANAGEMENT



General
Open Digital Architecture
Intelligence Management

<https://wiki.geant.org/display/NETDEV/OAV+Training+Portal>
<https://e-academy.geant.org/moodle/course/index.php?categoryid=20>

Network Automation eAcademy

INTRODUCTION TO CORE COMMERCE MANAGEMENT



General
Open Digital Architecture
Core Commerce Management

Training Packages

General Intro

The training packages are as follows:

- INTRODUCTION TO OAV** (General)
- OAV ARCHITECTURE REQUIREMENTS FOR NRENs** (General)
- THE OAV ARCHITECTURE BLUEPRINT** (General, Open Digital Architecture)
- INTRODUCTION TO CI/CD** (General, Agile, DevOps, CI/CD)
- CI/CD: GitlabCI** (Agile, DevOps, CI/CD)
- INTRODUCTION TO DATA MODELLING, DATA FORMATS AND PROTOCOLS** (General, Open Digital Architecture, Decoupling & Integration)
- DATA MODELLING: YANG** (Open Digital Architecture, Decoupling & Integration)
- DATA FORMATS: XML** (Open Digital Architecture, Decoupling & Integration)
- DATA FORMATS: YAML** (Open Digital Architecture, Decoupling & Integration)
- DATA FORMATS: JSON** (Open Digital Architecture, Decoupling & Integration)
- PROTOCOLS: NETCONF** (Open Digital Architecture, Decoupling & Integration)
- APIs: INTRODUCTION TO API** (General, Open Digital Architecture, Decoupling & Integration)
- INTRODUCTION TO ENGAGEMENT MANAGEMENT** (General, Open Digital Architecture, Engagement Management)
- INTRODUCTION TO PARTY MANAGEMENT** (General, Open Digital Architecture, Party Management)
- INTRODUCTION TO PRODUCTION** (General, Open Digital Architecture, Production)
- INTRODUCTION TO VIRTUALISATION** (General, Open Digital Architecture, Production: Virtualisation)
- INTRODUCTION TO AUTOMATION** (General, Open Digital Architecture, Production: Automation)
- AUTOMATION TOOLS: Ansible** (Open Digital Architecture, Production: Automation)
- NSO: Cisco Network Services Orchestrator** (Open Digital Architecture, Production: Orchestration)
- AUTOMATED CONFIGURATION MANAGEMENT: INTRODUCTION TO CONFIGURATION MANAGEMENT** (General, Open Digital Architecture, Production: Automation)
- INTRODUCTION TO INTELLIGENCE MANAGEMENT** (General, Open Digital Architecture, Intelligence Management)
- INTRODUCTION TO CORE COMMERCE MANAGEMENT** (General, Open Digital Architecture, Core Commerce Management)

Training Packages

Network Automation eAcademy

INTRODUCTION TO OAV

General

Network Automation eAcademy

OAV ARCHITECTURE REQUIREMENTS FOR NRENs

General

Network Automation eAcademy

THE OAV ARCHITECTURE BLUEPRINT

General

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INTRODUCTION TO CI/CD

General

Agile, DevOps, CI/CD

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CI/CD: GitlabCI

Agile, DevOps, CI/CD

Network Automation eAcademy

INTRODUCTION TO DATA MODELLING, DATA FORMATS AND PROTOCOLS

General

Open Digital Architecture

Decoupling & Integration

Network Automation eAcademy

DATA MODELLING: YANG

Open Digital Architecture

Decoupling & Integration

Network Automation eAcademy

DATA FORMATS: XML

Open Digital Architecture

Decoupling & Integration

Network Automation eAcademy

DATA FORMATS: YAML

Open Digital Architecture

Decoupling & Integration

Network Automation eAcademy

DATA FORMATS: JSON

Open Digital Architecture

Decoupling & Integration

Network Automation eAcademy

PROTOCOLS: NETCONF

Open Digital Architecture

Decoupling & Integration

Network Automation eAcademy

APIs: INTRODUCTION TO API

General

Open Digital Architecture

Decoupling & Integration

Network Automation eAcademy

INTRODUCTION TO ENGAGEMENT MANAGEMENT

General

Open Digital Architecture

Engagement Management

Network Automation eAcademy

INTRODUCTION TO PARTY MANAGEMENT

General

Open Digital Architecture

Party Management

Network Automation eAcademy

INTRODUCTION TO PRODUCTION

General

Open Digital Architecture

Production

Network Automation eAcademy

INTRODUCTION TO VIRTUALISATION

General

Open Digital Architecture

Production: Virtualisation

Network Automation eAcademy

INTRODUCTION TO AUTOMATION

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Open Digital Architecture

Production: Automation

Network Automation eAcademy

AUTOMATION TOOLS: Ansible

Open Digital Architecture

Production: Automation

Network Automation eAcademy

NSO: Cisco Network Services Orchestrator

Open Digital Architecture

Production: Orchestration

Network Automation eAcademy

AUTOMATED CONFIGURATION MANAGEMENT: INTRODUCTION TO CONFIGURATION MANAGEMENT

General

Open Digital Architecture

Production: Automation

Network Automation eAcademy

INTRODUCTION TO INTELLIGENCE MANAGEMENT

General

Open Digital Architecture

Intelligence Management

Network Automation eAcademy

INTRODUCTION TO CORE COMMERCE MANAGEMENT

General

Open Digital Architecture

Core Commerce Management

Training Packages

Network Automation eAcademy

INTRODUCTION TO OAV

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Network Automation eAcademy

OAV ARCHITECTURE REQUIREMENTS FOR NRENs

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THE OAV ARCHITECTURE BLUEPRINT

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Open Digital Architecture

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INTRODUCTION TO CI/CD

General

Agile, DevOps, CI/CD

Network Automation eAcademy

CI/CD: GitlabCI

Agile, DevOps, CI/CD

Network Automation eAcademy

INTRODUCTION TO DATA MODELLING, DATA FORMATS AND PROTOCOLS

General

Open Digital Architecture

Decoupling & Integration

Network Automation eAcademy

DATA MODELLING: YANG

Open Digital Architecture

Decoupling & Integration

Network Automation eAcademy

DATA FORMATS: XML

Open Digital Architecture

Decoupling & Integration

Network Automation eAcademy

DATA FORMATS: YAML

Open Digital Architecture

Decoupling & Integration

Network Automation eAcademy

DATA FORMATS: JSON

Open Digital Architecture

Decoupling & Integration

Network Automation eAcademy

PROTOCOLS: NETCONF

Open Digital Architecture

Decoupling & Integration

Network Automation eAcademy

APIs: INTRODUCTION TO API

General

Open Digital Architecture

Decoupling & Integration

Network Automation eAcademy

INTRODUCTION TO ENGAGEMENT MANAGEMENT

General

Open Digital Architecture

Engagement Management

Network Automation eAcademy

INTRODUCTION TO PARTY MANAGEMENT

General

Open Digital Architecture

Party Management

Network Automation eAcademy

INTRODUCTION TO PRODUCTION

General

Open Digital Architecture

Production

Network Automation eAcademy

INTRODUCTION TO VIRTUALISATION

General

Open Digital Architecture

Production: Virtualisation

Network Automation eAcademy

INTRODUCTION TO AUTOMATION

General

Open Digital Architecture

Production: Automation

Network Automation eAcademy

AUTOMATION TOOLS: Ansible

Open Digital Architecture

Production: Automation

Network Automation eAcademy

NSO: Cisco Network Services Orchestrator

Open Digital Architecture

Production: Orchestration

Network Automation eAcademy

AUTOMATED CONFIGURATION MANAGEMENT: INTRODUCTION TO CONFIGURATION MANAGEMENT

General

Open Digital Architecture

Production: Automation

Network Automation eAcademy

INTRODUCTION TO INTELLIGENCE MANAGEMENT

General

Open Digital Architecture

Intelligence Management

Network Automation eAcademy

INTRODUCTION TO CORE COMMERCE MANAGEMENT

General

Open Digital Architecture

Core Commerce Management

**Decoupling and Integration
Intro**

Training Packages

DevOps Intro

The image displays a grid of 20 training package cards from Network Automation eAcademy. Each card includes a title, a diagram, and category tags. The 'DevOps Intro' card is highlighted with a red border.

Card Title	Category/Tags
INTRODUCTION TO OAV	General
OAV ARCHITECTURE REQUIREMENTS FOR NRENs	General
THE OAV ARCHITECTURE BLUEPRINT	General, Open Digital Architecture
INTRODUCTION TO CI/CD (highlighted)	General, Agile, DevOps, CI/CD
CI/CD: GitlabCI	Agile, DevOps, CI/CD
INTRODUCTION TO DATA MODELLING, DATA FORMATS AND PROTOCOLS	General, Open Digital Architecture, Decoupling & Integration
DATA MODELLING: YANG	Open Digital Architecture, Decoupling & Integration
DATA FORMATS: XML	Open Digital Architecture, Decoupling & Integration
DATA FORMATS: YAML	Open Digital Architecture, Decoupling & Integration
DATA FORMATS: JSON	Open Digital Architecture, Decoupling & Integration
PROTOCOLS: NETCONF	Open Digital Architecture, Decoupling & Integration
APIs: INTRODUCTION TO API	General, Open Digital Architecture, Decoupling & Integration
INTRODUCTION TO ENGAGEMENT MANAGEMENT	General, Open Digital Architecture, Engagement Management
INTRODUCTION TO PARTY MANAGEMENT	General, Open Digital Architecture, Party Management
INTRODUCTION TO PRODUCTION	General, Open Digital Architecture, Production
INTRODUCTION TO VIRTUALISATION	General, Open Digital Architecture, Production: Virtualisation
INTRODUCTION TO AUTOMATION	General, Open Digital Architecture, Production: Automation
AUTOMATION TOOLS: Ansible	Open Digital Architecture, Production: Automation
NSO: Cisco Network Services Orchestrator	Open Digital Architecture, Production: Orchestration
AUTOMATED CONFIGURATION MANAGEMENT: INTRODUCTION TO CONFIGURATION MANAGEMENT	General, Open Digital Architecture, Production: Automation
INTRODUCTION TO INTELLIGENCE MANAGEMENT	General, Open Digital Architecture, Intelligence Management
INTRODUCTION TO CORE COMMERCE MANAGEMENT	General, Open Digital Architecture, Core Commerce Management

Training Packages

Broader Intro

<p>Network Automation eAcademy</p> <h3>INTRODUCTION TO OAV</h3> <p>General</p>	<p>Network Automation eAcademy</p> <h3>OAV ARCHITECTURE REQUIREMENTS FOR NRENs</h3> <p>General</p>	<p>Network Automation eAcademy</p> <h3>THE OAV ARCHITECTURE BLUEPRINT</h3> <p>General Open Digital Architecture</p>	<p>Network Automation eAcademy</p> <h3>INTRODUCTION TO CI/CD</h3> <p>General Agile, DevOps, CI/CD</p>	<p>Network Automation eAcademy</p> <h3>CI/CD: GitlabCI</h3> <p>Agile, DevOps, CI/CD</p>
<p>Network Automation eAcademy</p> <h3>INTRODUCTION TO DATA MODELLING, DATA FORMATS AND PROTOCOLS</h3> <p>General Open Digital Architecture Decoupling & Integration</p>	<p>Network Automation eAcademy</p> <h3>DATA MODELLING: YANG</h3> <p>Open Digital Architecture Decoupling & Integration</p>	<p>Network Automation eAcademy</p> <h3>DATA FORMATS: XML</h3> <p>Open Digital Architecture Decoupling & Integration</p>	<p>Network Automation eAcademy</p> <h3>DATA FORMATS: YAML</h3> <p>Open Digital Architecture Decoupling & Integration</p>	<p>Network Automation eAcademy</p> <h3>DATA FORMATS: JSON</h3> <p>Open Digital Architecture Decoupling & Integration</p>
<p>Network Automation eAcademy</p> <h3>PROTOCOLS: NETCONF</h3> <p>Open Digital Architecture Decoupling & Integration</p>	<p>Network Automation eAcademy</p> <h3>APIs: INTRODUCTION TO API</h3> <p>General Open Digital Architecture Decoupling & Integration</p>	<p>Network Automation eAcademy</p> <h3>INTRODUCTION TO ENGAGEMENT MANAGEMENT</h3> <p>General Open Digital Architecture Engagement Management</p>	<p>Network Automation eAcademy</p> <h3>INTRODUCTION TO PARTY MANAGEMENT</h3> <p>General Open Digital Architecture Party Management</p>	<p>Network Automation eAcademy</p> <h3>INTRODUCTION TO PRODUCTION</h3> <p>General Open Digital Architecture Production</p>
<p>Network Automation eAcademy</p> <h3>INTRODUCTION TO VIRTUALISATION</h3> <p>General Open Digital Architecture Production: Virtualisation</p>	<p>Network Automation eAcademy</p> <h3>INTRODUCTION TO AUTOMATION</h3> <p>General Open Digital Architecture Production: Automation</p>	<p>Network Automation eAcademy</p> <h3>AUTOMATION TOOLS: Ansible</h3> <p>Open Digital Architecture Production: Automation</p>	<p>Network Automation eAcademy</p> <h3>NSO: Cisco Network Services Orchestrator</h3> <p>Open Digital Architecture Production: Orchestration</p>	<p>Network Automation eAcademy</p> <h3>AUTOMATED CONFIGURATION MANAGEMENT: INTRODUCTION TO CONFIGURATION MANAGEMENT</h3> <p>General Open Digital Architecture Production: Automation</p>
<p>Network Automation eAcademy</p> <h3>INTRODUCTION TO INTELLIGENCE MANAGEMENT</h3> <p>General Open Digital Architecture Intelligence Management</p>	<p>Network Automation eAcademy</p> <h3>INTRODUCTION TO CORE COMMERCE MANAGEMENT</h3> <p>General Open Digital Architecture Core Commerce Management</p>			

Hands-on units

Network Automation eAcademy

INTRODUCTION TO OAV

General

Network Automation eAcademy

OAV ARCHITECTURE REQUIREMENTS FOR NRENs

General

Network Automation eAcademy

THE OAV ARCHITECTURE BLUEPRINT

General
Open Digital Architecture

Network Automation eAcademy

INTRODUCTION TO CI/CD

General
Agile, DevOps, CI/CD

Network Automation eAcademy

CI/CD: GitlabCI

Agile, DevOps, CI/CD

Network Automation eAcademy

INTRODUCTION TO DATA MODELLING, DATA FORMATS AND PROTOCOLS

General
Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

DATA MODELLING: YANG

Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

DATA FORMATS: XML

Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

DATA FORMATS: YAML

Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

DATA FORMATS: JSON

Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

PROTOCOLS: NETCONF

Open Digital Architecture
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APIs: INTRODUCTION TO API

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Network Automation eAcademy

INTRODUCTION TO ENGAGEMENT MANAGEMENT

General
Open Digital Architecture
Engagement Management

Network Automation eAcademy

INTRODUCTION TO PARTY MANAGEMENT

General
Open Digital Architecture
Party Management

Network Automation eAcademy

INTRODUCTION TO PRODUCTION

General
Open Digital Architecture
Production

Network Automation eAcademy

INTRODUCTION TO VIRTUALISATION

General
Open Digital Architecture
Production: Virtualisation

Network Automation eAcademy

INTRODUCTION TO AUTOMATION

General
Open Digital Architecture
Production: Automation

Network Automation eAcademy

AUTOMATION TOOLS: Ansible

Open Digital Architecture
Production: Automation

Network Automation eAcademy

NSO: Cisco Network Services Orchestrator

Open Digital Architecture
Production: Orchestration

Network Automation eAcademy

AUTOMATED CONFIGURATION MANAGEMENT: INTRODUCTION TO CONFIGURATION MANAGEMENT

General
Open Digital Architecture
Production: Automation

Network Automation eAcademy

INTRODUCTION TO INTELLIGENCE MANAGEMENT

General
Open Digital Architecture
Intelligence Management

Network Automation eAcademy

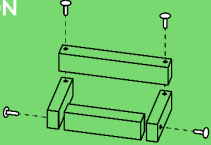
INTRODUCTION TO CORE COMMERCE MANAGEMENT

General
Open Digital Architecture
Core Commerce Management

Ansible

Network Automation eAcademy

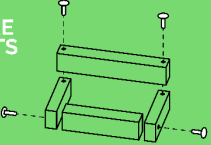
INTRODUCTION TO OAV



General

Network Automation eAcademy

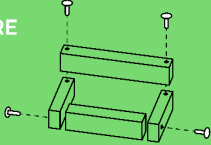
OAV ARCHITECTURE REQUIREMENTS FOR NRENs



General

Network Automation eAcademy

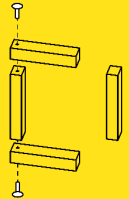
THE OAV ARCHITECTURE BLUEPRINT



General
Open Digital Architecture

Network Automation eAcademy

INTRODUCTION TO CI/CD



General
Agile, DevOps, CI/CD

Network Automation eAcademy

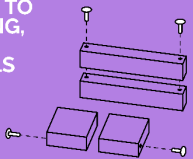
CI/CD: GitlabCI



Agile, DevOps, CI/CD

Network Automation eAcademy

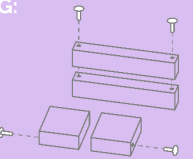
INTRODUCTION TO DATA MODELLING, DATA FORMATS AND PROTOCOLS



General
Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

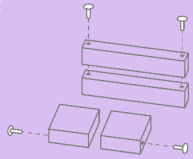
DATA MODELLING: YANG



Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

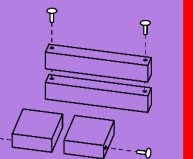
DATA FORMATS: XML



Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

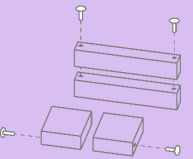
DATA FORMATS: YAML



Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

DATA FORMATS: JSON



Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

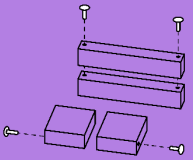
PROTOCOLS: NETCONF



Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

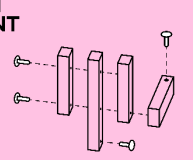
APIs: INTRODUCTION TO API



General
Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy

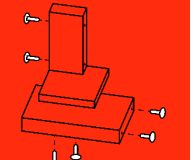
INTRODUCTION TO ENGAGEMENT MANAGEMENT



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Open Digital Architecture
Engagement Management

Network Automation eAcademy

INTRODUCTION TO PARTY MANAGEMENT



General
Open Digital Architecture
Party Management

Network Automation eAcademy

INTRODUCTION TO PRODUCTION



General
Open Digital Architecture
Production

Network Automation eAcademy

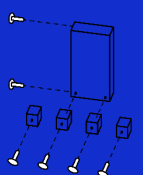
INTRODUCTION TO VIRTUALISATION



General
Open Digital Architecture
Production: Virtualisation

Network Automation eAcademy

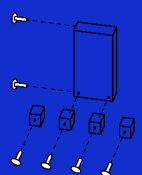
INTRODUCTION TO AUTOMATION



General
Open Digital Architecture
Production: Automation

Network Automation eAcademy

AUTOMATION TOOLS: Ansible



Open Digital Architecture
Production: Automation

Network Automation eAcademy

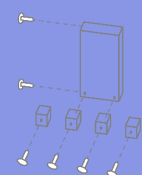
NSO: Cisco Network Services Orchestrator



Open Digital Architecture
Production: Orchestration

Network Automation eAcademy

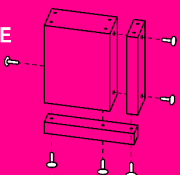
AUTOMATED CONFIGURATION MANAGEMENT: INTRODUCTION TO CONFIGURATION MANAGEMENT



General
Open Digital Architecture
Production: Automation

Network Automation eAcademy

INTRODUCTION TO INTELLIGENCE MANAGEMENT



General
Open Digital Architecture
Intelligence Management

Network Automation eAcademy

INTRODUCTION TO CORE COMMERCE MANAGEMENT



General
Open Digital Architecture
Core Commerce Management

Ansible

Ansible

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;

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



COURSE DATE:

From September 2021



DURATION:

20 min



COMMITMENT:

30 min



REQUIREMENT:

Introduction to Data Models, Data
Formats, and Protocols (recommended)



COURSE TYPE:

Selfpaced



CREDENTIAL:

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.

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

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

www.geant.org

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 a menu, a gear, and a document. Below this is a breadcrumb trail: Home > My courses > Technical skills > Network > Network Automation eAcademy > Introduction to data modelling, data formats and protocols. A secondary navigation bar includes 'OVERVIEW' (selected), Main Goals, Course Materials, Definitions, Data Modelling, Data Formats, Protocols, Links, Quiz, and Feedback Form & Certificate of Completion. The main content area starts with a welcome message: 'Welcome to the Introduction to Data Modelling, Data Formats and Protocols learning unit'. To the left is a purple course card with the title 'INTRODUCTION TO DATA MODELLING, DATA FORMATS AND PROTOCOLS' and sub-topics: General, Open Digital Architecture, and Decoupling & Integration. To the right are six information cards: COURSE DATE: From January 2021; DURATION: 20 minutes; COMMITMENT: 30 minutes; REQUIREMENT: None; COURSE TYPE: Self-paced; CREDENTIAL: Certificate of Completion. At the bottom left is a table with learning path and prerequisites.

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

Ansible: Contents

The screenshot shows the GÉANT eAcademy interface. At the top, there is a dark blue header with the GÉANT eAcademy logo and a notification bell. Below the header, the word 'Ansible' is displayed in orange. A breadcrumb trail shows the path: Home > My courses > Technical skills > Network > Network Automation eAcademy > Ansible. Below this, a horizontal menu lists the course topics: 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, and Feedback and Completion Certificate.

- What is Ansible?, How Ansible works, Installing Ansible, Settings, Inventories and Module basics
- Playbooks, Variables and Modules
- How to use Ansible, Loops and templating with Jinja2
- Playbook Validation, Ansible Vault, Roles and sharing/using Ansible content

Ansible: Video and Slides with Speaker Notes

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 Feedback

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 section II - slides and speaker notes PDF document

Ansible: Speaker Notes

GÉANT eAcademy

Ansible

Home > My courses > Technical skills > Network > Ne

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
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- Understand what modules do and how to use them in playbooks

[Ansible section II - slides and speaker notes PDF document](#)

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 GÉANT

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 Examples



GEANT-OAV > ansible-examples



A **ansible-examples**  ☆ Star 0
Project ID: 762 

12 Commits 1 Branch 0 Tags 195 KB Files 195 KB Storage


Example code for the GÉANT OAV Ansible learning unit - <https://e-academy.geant.org/moodle/course/view.php?id=120>

main ansible-examples
History Find file  Clone

 **Purging tabs from YAML files** 82d4e9b3 
Dónal Cunningham authored 4 months ago

 README  No license. All rights reserved

Name	Last commit	Last update
Section1	DC - reorganised the show version playbooks	4 months ago
Section2	Purging tabs from YAML files	4 months ago
Section4	DC - Initial commit	5 months ago
README.md	DC - reorganised the show version playbooks	4 months ago

 README.md

The GÉANT Ansible learning unit

This repo holds sample Ansible playbooks for the GÉANT OAV Ansible course.

Example code used in the unit



Ansible Mini-Lab

GEANT-OAV > ansible-minilab



ansible-minilab

Project ID: 763

Star 0

17 Commits 1 Branch 0 Tags 287 KB Files 287 KB Storage

master ansible-minilab

History Find file Clone



Update README.md

Simone Spinelli authored 4 months ago

50d8aaaf



README No license. All rights reserved

Name	Last commit	Last update
ansible-minilab	Initial commit	4 months ago
images	Initial commit	4 months ago
scripts	Initial commit	4 months ago
README.md	Update README.md	4 months ago
Vagrantfile	Initial commit	4 months ago

README.md

Network Automation Minilab

20

The mini-lab consists of:

- 1 Ubuntu VM (for the Ansible control node)
- 3 fully-interconnected Juniper vSRXs
- VM specifications:
 - The vSRXs each have 2 vCPUs and 4GB RAM
 - The Ansible control node has 2 vCPUs and 1GB RAM

NETCONF: Requirements, YANG & XML (and Data Models, Formats...)



Protocols: NETCONF



Welcome to the NETCONF learning unit



COURSE DATE: On demand	DURATION: About 2 hours	COMMITMENT: About 4-6 hours
REQUIREMENT: YANG & XML (recommended)	COURSE TYPE: Self-paced	CREDENTIAL: Certificate of Completion

Learning path:	OAV training portal
Preceded by:	Formats: JSON
Followed by:	Protocols: RESTCONF (coming soon)
Next available unit:	API Tools: Introduction to APIs

YANG: <https://e-academy.geant.org/moodle/course/view.php?id=63>

XML: <https://e-academy.geant.org/moodle/course/view.php?id=132>

<https://e-academy.geant.org/moodle/course/view.php?id=126>

NETCONF: Contents



Protocols: NETCONF

Home > My courses > Technical skills > Network > Network Automation eAcademy > Protocols: NETCONF

OVERVIEW Main Goals Introduction to NETCONF NETCONF Operations – Part I NETCONF Operations – Part II Complete Practical Example Additional Materials Quiz Feedback

- Introduction to NETCONF (fundamentals, protocol layers, secure transport, NETCONF session, message framing, Remote Procedure Call (RPC), XML and datastores).
- NETCONF operations (hello, get-config, get and edit-config, lock, unlock, close-session, get-schema, commit, ...).
- Practical example.

NETCONF: Installation guide

Protocols: NETCONF

Installation guide

Installation and preparation guidelines for experimenting with the NETCONF protocol

Useful options for practical experimentation with the NETCONF protocol are the following:

- `Netconf-console` package can be installed using `pip`, which is in fact NETCONF client CLI tool and includes an interactive console
 - `pip install netconf-console`
- `Pyang`, which we use to transform YANG modules into more convenient formats, is a very useful tool
 - `pip install pyang`
- You can also use a docker container, such as [this example](#), if you have NETCONF enabled device. This container includes NETCONF console and allows quick and easy interface to the device (`netconf-console`).
- If you don't have a NETCONF enabled device, you can create virtual environment in GNS3 and use one of the following options for NETCONF client
 - Pre-configured appliances in GNS3, which are easy to add, such as the network-automation by Julien Duponchelle (<https://www.gns3.com/marketplace/appliances/network-automation>), where `netconf-console` client can be installed, as well as `pyang`
 - Ubuntu network automation container for GNS3 by adosztal (<https://hub.docker.com/r/adosztal/network-automation>) where `netconf-console` client can be installed as well

Installation and prepara...

Example of virtual envir...

Collapse all

Back to top

Go to bottom

NETCONF: Practical Example

Home > My courses > Technical skills > Network > Network Automation eAcademy > Protocols: NETCONF

OVERVIEW Main Goals Introduction to NETCONF NETCONF Operations – Part I NETCONF Operations – Part II **Complete Practical Example** Additional Materials Quiz Feedback

Welcome to the NETCONF learning unit

PROTOCOLS: NETCONF

Open Digital Architecture
Decoupling & Integration

COURSE DATE:
On demand

DURATION:
About 2 hours

COMMITMENT:
About 4-6 hours

REQUIREMENT:
YANG & XML (recommended)

COURSE TYPE:
Self-paced

CREDENTIAL:
Certificate of Completion

Learning path:	OAV training portal
Preceded by:	Formats: JSON
Followed by:	Protocols: RESTCONF (coming soon)
Next available unit:	API Tools: Introduction to APIs

NETCONF: Practical Example

Adding a static route to a router, step-by-step and with the guidance of the trainer:

1. Choosing the right YANG module
2. Downloading and viewing the YANG module
3. Getting the current operational and configuration data from the router
4. Copying the running configuration to the candidate datastore
5. Creating an XML file for making the required configuration
6. Applying the changes to the router
7. Checking the configuration
8. Copying the running configuration to the startup datastore

NSO



NSO

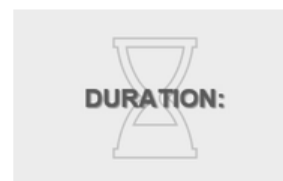


Welcome to the Course: NSO - Cisco Network Services Orchestrator



COURSE DATE:

On demand



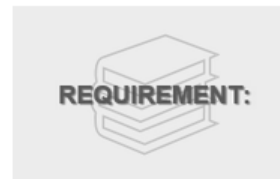
DURATION:

About 4 hours



COMMITMENT:

About 6 to 8 hours



REQUIREMENT:

Orchestration
YANG & XML



COURSE TYPE:

Self-paced



CREDENTIAL:

Certificate of Completion

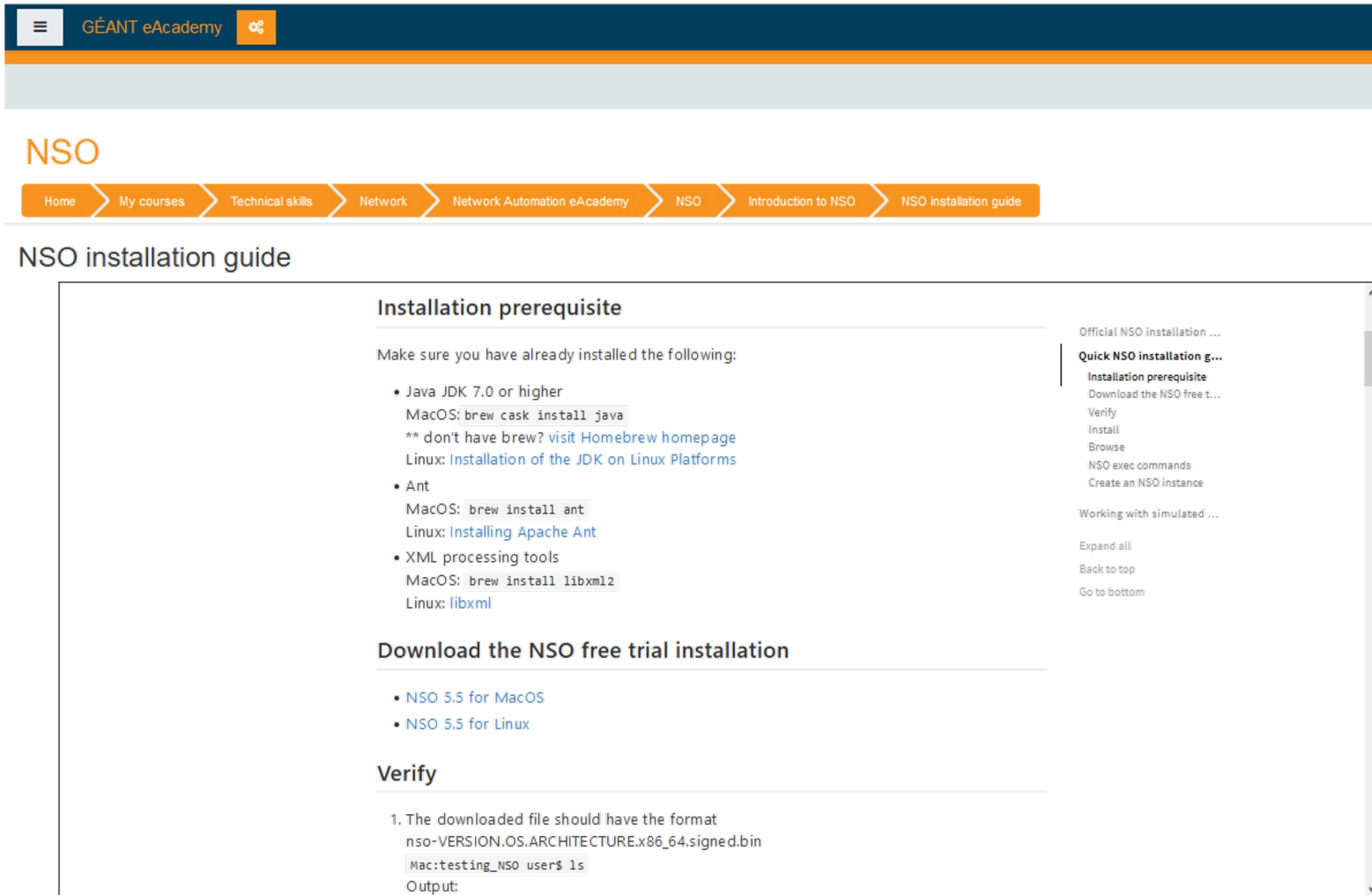
Learning path:	OAV training portal
Preceded by:	Introduction to Orchestration (coming soon)
Previous available learning unit:	Introduction to Configuration Management
Followed by:	Introduction to Intelligence Management

NSO: Contents

The screenshot shows the GÉANT eAcademy interface. At the top, there is a dark blue header with the GÉANT eAcademy logo and navigation icons. Below the header, the title 'NSO' is displayed in orange. A breadcrumb trail shows the path: Home > My courses > Technical skills > Network > Network Automation eAcademy > NSO. Below this, a horizontal menu lists the course content: OVERVIEW (highlighted), Main Goals, Introduction to NSO, Device Configuration, Service Management, Service Layering, Additional Materials, Quiz, and Feedback.

- Introduction to NSO and its use for automation and orchestration
- NSO functionalities
- NSO components
- Device configuration management using NSO
- Service management using NSO
- Layered Service Architecture
- How to install and use NSO
- Practical examples for device configuration and service management

NSO: Installation Guide



The screenshot shows the NSO installation guide page on the GEANT eAcademy website. The page has a dark blue header with the GEANT eAcademy logo and a navigation menu. The main content area is titled "NSO installation guide" and contains three sections: "Installation prerequisite", "Download the NSO free trial installation", and "Verify".

Installation prerequisite

Make sure you have already installed the following:

- Java JDK 7.0 or higher
MacOS: `brew cask install java`
** don't have brew? visit [Homebrew homepage](#)
Linux: [Installation of the JDK on Linux Platforms](#)
- Ant
MacOS: `brew install ant`
Linux: [Installing Apache Ant](#)
- XML processing tools
MacOS: `brew install libxml2`
Linux: `libxml`

Download the NSO free trial installation

- [NSO 5.5 for MacOS](#)
- [NSO 5.5 for Linux](#)

Verify

1. The downloaded file should have the format
`nso-VERSION.OS.ARCHITECTURE.x86_64.signed.bin`
Mac: `testing_nso user$ ls`
Output:

On the right side of the page, there is a table of contents with the following items:

- Official NSO installation ...
- Quick NSO installation g...**
- Installation prerequisite
- Download the NSO free t...
- Verify
- Install
- Browse
- NSO exec commands
- Create an NSO instance
- Working with simulated ...
- Expand all
- Back to top
- Go to bottom

Detailed guideline on how to install an NSO evaluation version and setup a simulated network environment using NETSIM.

NSO: Practical Device Configuration Management with NSO

Launch NSO CLI:

```
Mac:nso-test-instance user$ ncs_cli -u admin -c

admin connected from 127.0.0.1 using console on Mac.local
admin@ncs#
```

Enter configuration mode, load the exported file and then commit the changes:

```
admin@ncs# config
Entering configuration mode terminal
admin@ncs(config)# load merge devices.xml
Loading.
3.27 KiB parsed in 0.02 sec (128.56 KiB/sec)
admin@ncs(config)# commit
Commit complete.
admin@ncs(config)# exit
```

Verify you are good to go

Verify the devices are present using show devices list

```
admin@ncs# show devices list
NAME      ADDRESS  DESCRIPTION  NED ID      ADMIN STATE
-----
router0   127.0.0.1 -      cisco-ios-cli-3.8  unlocked
router1   127.0.0.1 -      cisco-ios-cli-3.8  unlocked
router2   127.0.0.1 -      cisco-ios-cli-3.8  unlocked
```

Now you are ready to start exploring NSO's functionalities in full.

Configuration management...
Add simulated devices
Create a simulated envir...
Import devices in NSO ru...
Verify you are good to go

Adding lab devices
Device Configuration Ma...
NSO Web UI
Expand all
Back to top
Go to bottom

Simple practical examples showcasing the power of transactions in NSO.

NSO: Two Practical Examples

Service Management with NSO

We are now going to work with an example service to showcase all of the steps of the service design and activation process.

Radius service

Our first example service is a service that implements RADIUS server configuration over multiple devices that reside in different campuses where each campus has a different server IP address. The service parameters for the service are:

1. the name of the campus - variable - service attribute
2. the server IP address - variable - service attribute
3. the authentication port number - fixed = 1812
4. the accounting port number - fixed = 1813
5. the list of devices to be configured - variable - needs to be provided during service configuration

1. Create a service package skeleton

The first step as outlined in the video is to create a new NSO service package. This should be done in the /packages directory, same as above.

```
Mac:packages user$ ncs-make-package --service-skeleton template radius --augment /ncs:service
Mac:packages user$ ls
cisco-ios-cl1-3.8  cisco-iosxr-cl1-3.5  radius
```

A new radius service package has been created where the service package YANG module augments the NSO services YANG module. All services in NSO should stem from the ncs:service

Simple practical examples showcasing the power of service orchestration in NSO.

1. Implementing a RADIUS server configuration over multiple devices in different campuses.
2. Deploying the same access list (ACL) to multiple devices, and/or multiple interfaces on one device.

Accessing the Network Automation eAcademy (Moodle)

Introduction

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

DevOps

- **Introduction to CI/CD** (15')
- **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** (15')

Production

- **Introduction to Production** (30')
- **Introduction to Virtualisation** (30')
- **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')



More on Architectures in the Network Automation eAcademy

Architectures

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

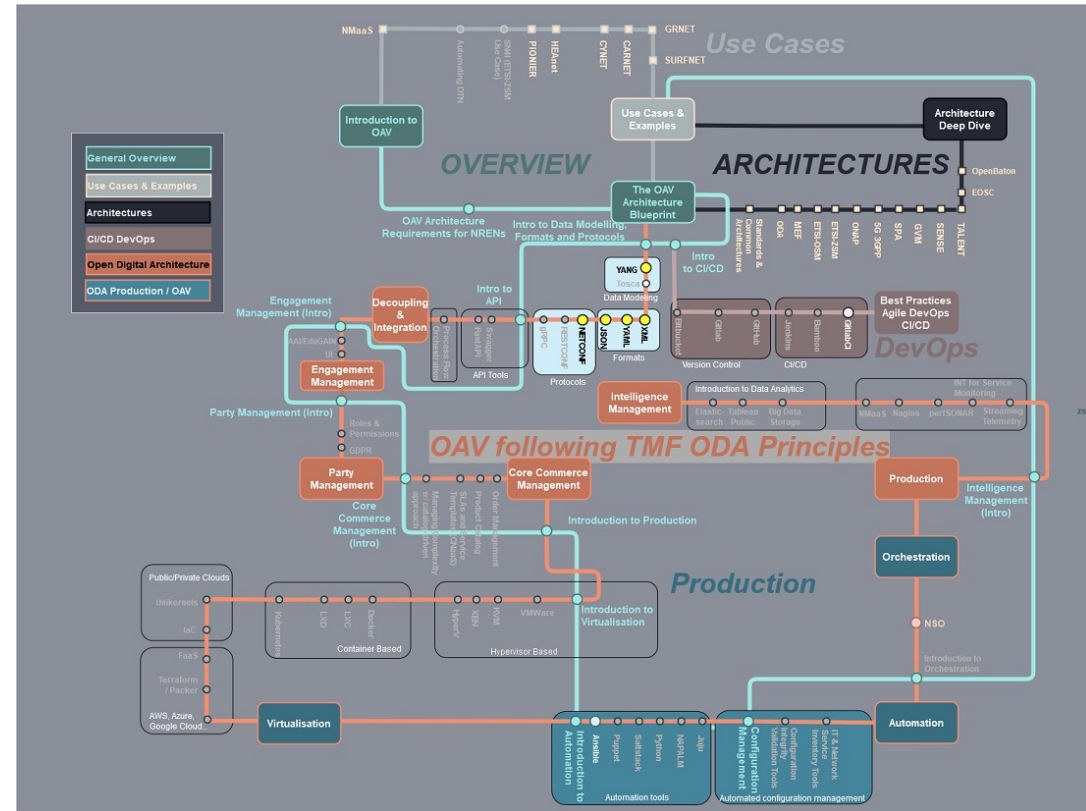
Architecture Mappings

NREN use cases

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

other use cases

- NMaaS



What Next? Currently Working on...

Network Automation eAcademy
VERSION CONTROL: Gitlab

Agile DevOps, CI/CD

Network Automation eAcademy
VERSION CONTROL: GitHub

Agile DevOps, CI/CD

Network Automation eAcademy
CI/CD: Jenkins

Agile DevOps, CI/CD

Network Automation eAcademy
DATA MODELLING: Tosca

Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy
PROTOCOLS: RESTCONF

Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy
PROTOCOLS: gRPC

Open Digital Architecture
Decoupling & Integration

Network Automation eAcademy
HYPERVISOR BASED: VMWare

Open Digital Architecture
Production: Virtualisation

Network Automation eAcademy
CONTAINER BASED: Docker / Swarm

Open Digital Architecture
Production: Virtualisation

Network Automation eAcademy
INTRODUCTION TO ORCHESTRATION

General
Open Digital Architecture
Production: Orchestration

Network Automation eAcademy
CONTAINER BASED: Kubernetes

Open Digital Architecture
Production: Virtualisation

Network Automation eAcademy
PROCESS FLOW ORCHESTRATION

Open Digital Architecture
Production: Orchestration

Network Automation eAcademy
AUTOMATION TOOLS: Python

Open Digital Architecture
Production: Automation

Network Automation eAcademy
Nagios

Open Digital Architecture
Intelligence Management

Network Automation eAcademy
BIG DATA STORAGE

Open Digital Architecture
Intelligence Management

Network Automation eAcademy
ElasticSearch

Open Digital Architecture
Intelligence Management

Network Automation eAcademy
GDPR

Open Digital Architecture
Party Management

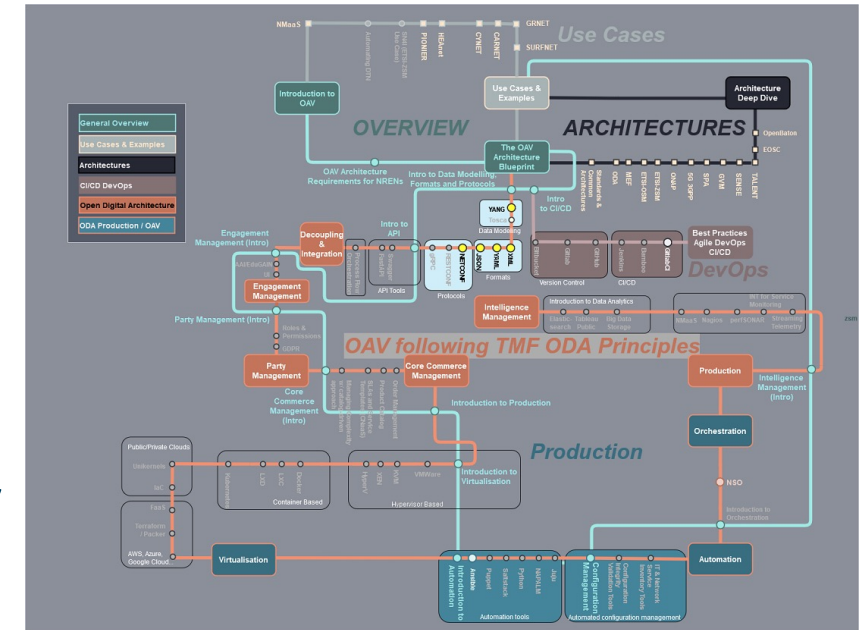
What Next?

- More units:

- CI/CD: Bamboo
- FastAPI
- User Management
- Product Catalog
- Order Management
- KVM
- XEN
- LXC
- Tableau Public
- Bitbucket
- SWAGGER
- UI
- HyperV
- LXD
- Terraform/Packer (AWS, Azure,

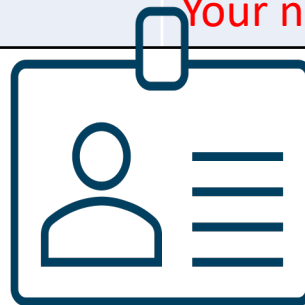
Google Cloud...)

- Juju
- Configuration integrity
- Validation tools
- AAI
- Roles&Permissions
- SLAs and Service Templates
- Unikernels (Public / Private clouds)
- Saltstack
- NAPALM
- Performance measurement with perfSONAR
- Streaming Telemetry



With Many Thanks to our Trainers!

Jasone Astorga (RedIRIS / UPV/EHU)	Xavier Jeannin (RENATER)
Estela Carmona (RedIRIS / i2CAT)	Hamzeh Khalili (RedIRIS/i2CAT)
Dónal Cunningham (HEAnet)	Roman Łapacz (PSNC)
Yuri Demchenko (SURFnet / UvA)	Anastas Mishev (UKIM/MARNET)
Aleksandra Dedinec (UKIM/MARNET)	Susanne Naegele-Jackson (DFN / FAU)
Sonja Filiposka (MARNET / USC)	Simone Spinelli (GÉANT)
Maria Isabel Gandia (RedIRIS/CSUC)	Kostas Stamos (GRNET / CTI)
Eduardo Jacob (RedIRIS / UPV/EHU)	Pavle Vuletić (AMRES)
Iacovos Ioannou (CyNet)	Your name here?



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

Contact us at oav@lists.geant.org

Do you want to know more?



... enjoy our training packages!



Thank you

Any questions?

Or email us:

oav@lists.geant.org

www.geant.org

