

¿Cómo estar al día en tecnologías de red?

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Jornadas Técnicas de RedIRIS

21 Mayo 2024, Academia de Infantería del Ejército de Tierra (Toledo)

Public (PU)

El proyecto GÉANT

Colaboración de las redes nacionales de investigación y educación (NRENs) y la Comisión Europea

La misión del proyecto es proveer acceso seguro a los científicos, investigadores y estudiantes a los servicios más avanzados de conectividad y colaboración del mundo, habilitando una colaboración efectiva y segura con comunidades virtuales de investigación de todo el mundo.

38 Miembros

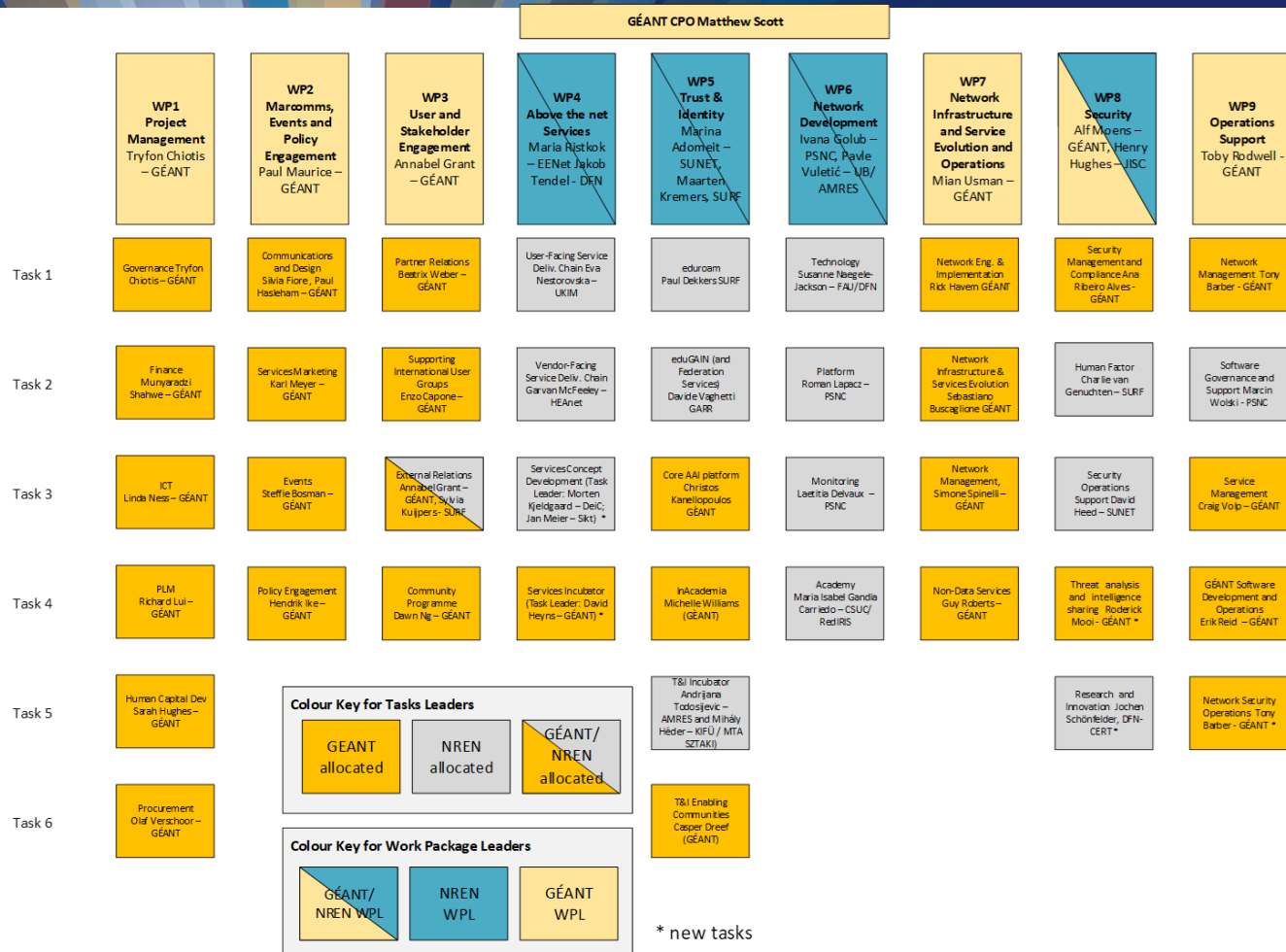
1 Miembro asociado

43 Países

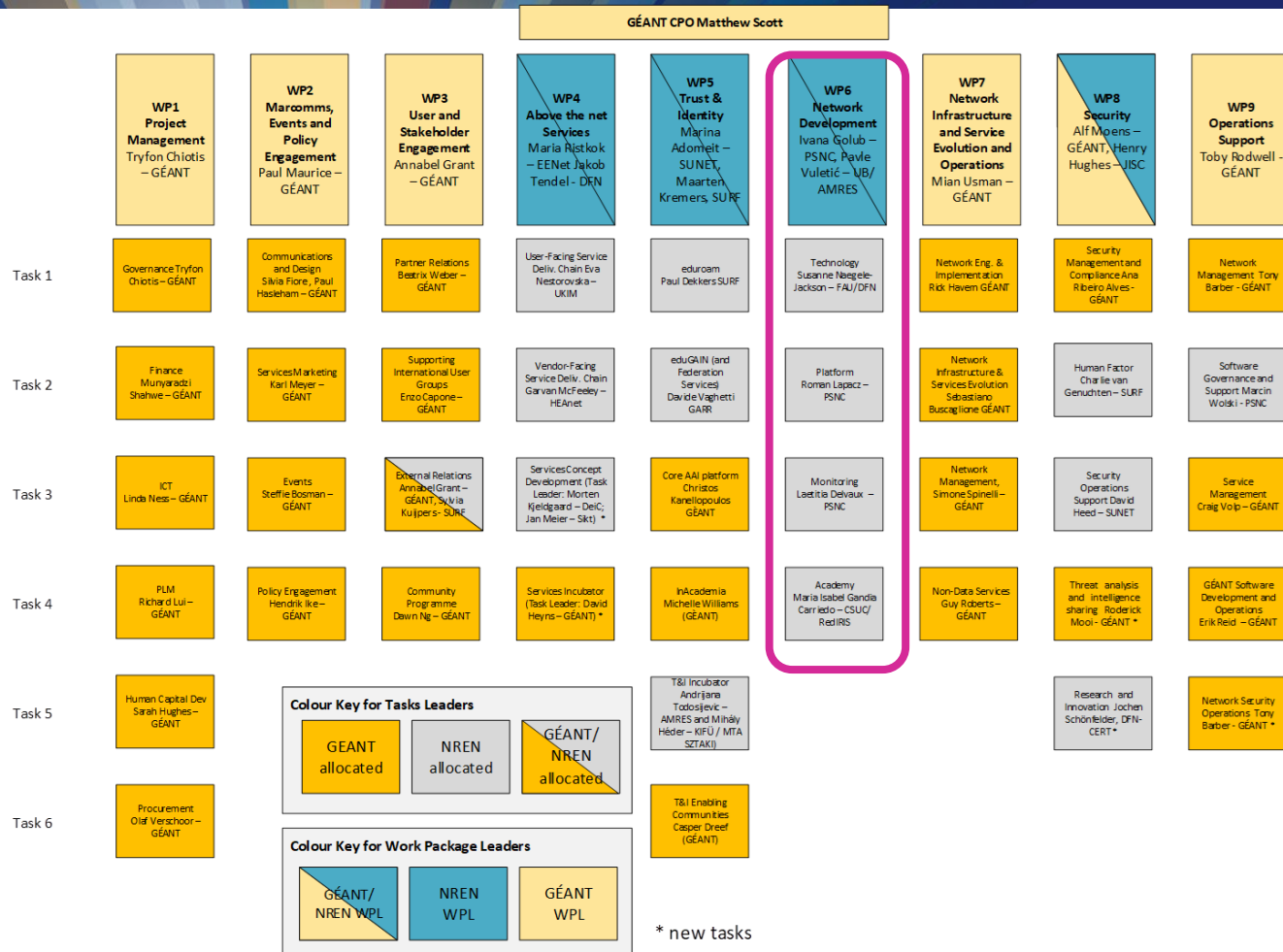
80 Mil EUR Presupuesto

9 Work Packages

Estructura del proyecto GN5-2



Estructura del proyecto GN5-2



NETDEV en tres pinceladas

¿Por qué?

Para hacer avanzar la
infraestructura de red y los
servicios de la comunidad
GÉANT

¿Cómo?

Testeo, pilotos, desarrollo
de productos y servicios

Servicios en producción

Incubadora

Colaboración con los
partners

¿Qué?

Tecnologías,
Plataformas,
Monitorización,
eAcademy

20+ temas

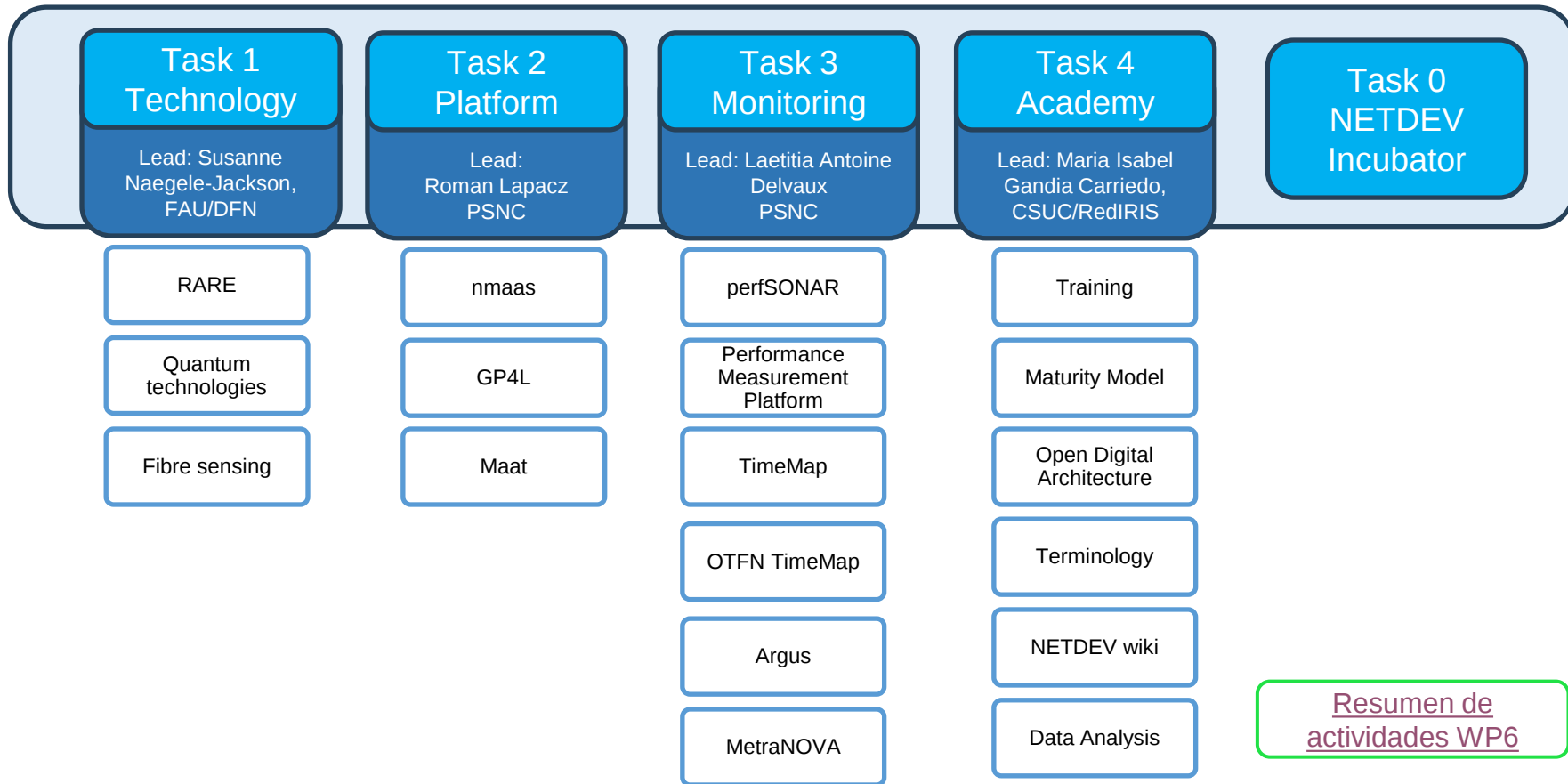
25 organizaciones

>100 personas

5,6 MEUR

28,1 FTE

WP6 en 3 pinceladas



Operaciones de red y gestión con IA. Hacia las redes autónomas.

SELF

- Self-service
- Self-fulfilling
- Self-assuring
- Self- planning
- Self-ordering
- Self-organising
- Self-governing
- Self-healing / Self-repairing
- Self-optimising

ZERO

- Zero-wait
- Zero-touch
- Zero-trouble
- Zero-downtime
- Zero-trust

Ejemplos de detección de anomalías *closed-loop* (Traffic Flow Optimization , Security violations, Performance Prediction, Alert Correlation, etc):
<https://www.tmforum.org/resources/introductory-guide/ig1219-ai-closed-loop-automation-anomaly-detection-and-resolution-v2-1-0/>



Automatización – Procesar tareas de forma repetible para dar **el mismo resultado** cada vez sin intervención humana.



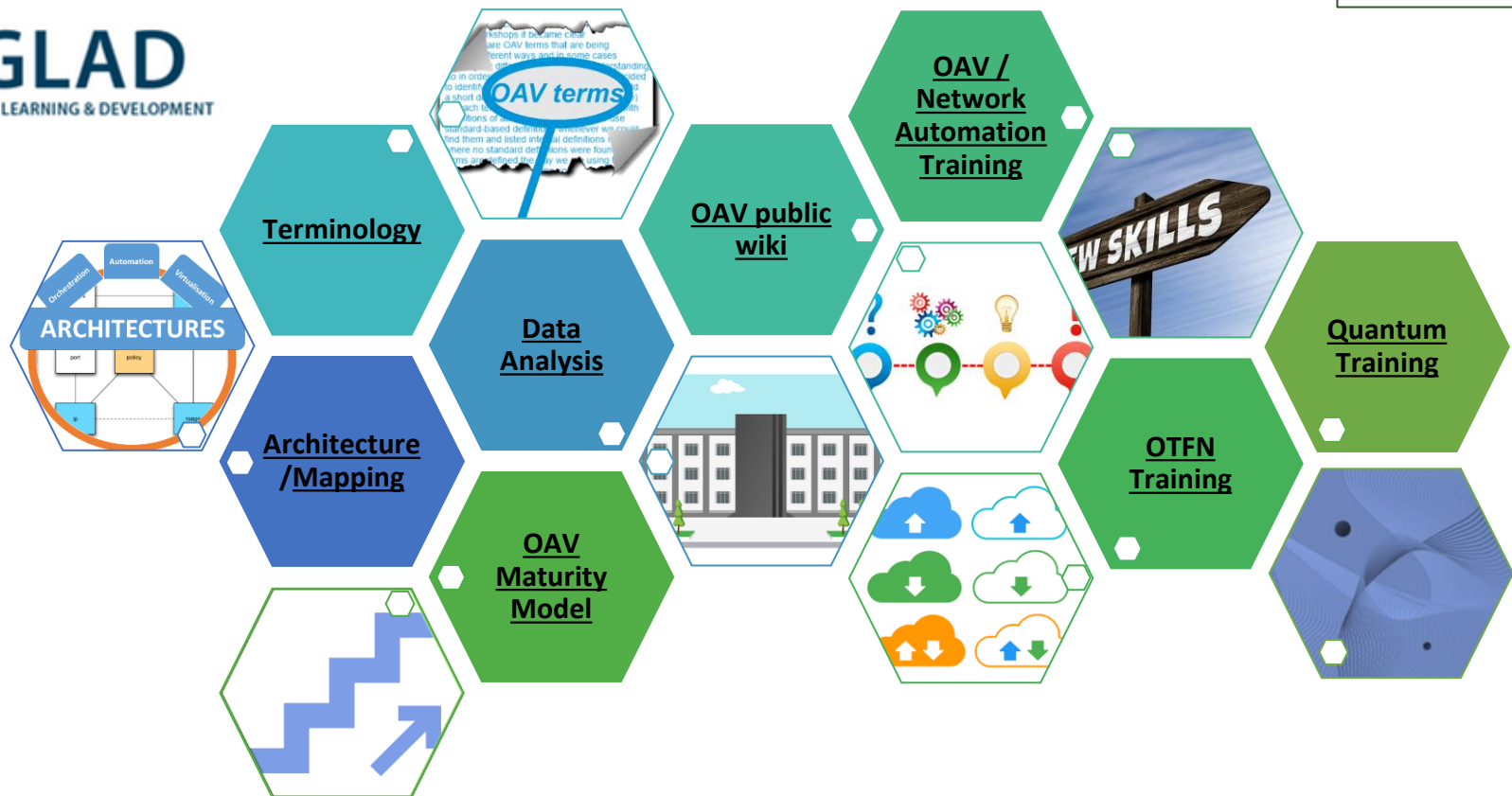
Redes Autónomas – Conjunto de plataformas de software y hardware que pueden **sentir su entorno y adaptarse** sin intervención humana

Network eAcademy

Powered by:



Network
eAcademy



Páginas

Blog

ÁRBOL DE PÁGINAS

- Argus
- Dissemination
- Fibre Sensing
- NETDEV Incubator
- Network eAcademy**
 - Highlights
 - Network eAcademy Training Portal
 - Network Automation Training
 - Quantum Technology Training
 - Time and Frequency Networks Training
 - OAV Architectures
 - Architecture Investigation
 - Introduction to Digital Platforms
 - Mapping Use Cases
 - ODA - Open Digital Architecture (TM Forum)
 - Requirements for an Automated Digital Framework
 - OAV Community Portal
 - OAV Maturity Model
 - Architecture and Technology
 - People and Organisation
 - Processes and Services
 - Vision and Strategy
 - OAV Terminology
- QT
- TimeMap
- WP6 Archive
- WP6 Events

Panel / NETDEV Home

Network eAcademy

Creado por Susanne Nägele-Jackson, modificado por última vez en abr 22, 2025

The Network eAcademy (NeA) offers knowledge sharing and exchange between GÉANT, NRENs, and organisations and is intended to serve as a platform to discuss strategies, common use cases and ideas related to a variety of topics. One of our main focus areas are network and service orchestration, automation and virtualisation (OAV) in our GÉANT community (including an OAV maturity model, information on OAV terminology and OAV architectures). Applied OAV can be found as part of our OAV community portal and with the example of the SPA Service Provider Architecture. Another major focus area of NeA is the Network eAcademy Training Portal with on-demand training courses ranging from Network Automation to Quantum Technology.



Network eAcademy Training Portal

Network Automation



Quantum Technology

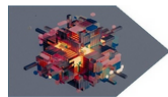


Time & Frequency Networks



OAV Maturity Model

Our model defines four main dimensions that describe different aspects of OAV, each further specified using subdimensions that highlight the important OAV areas of each dimension. The short and long descriptions of stages for each subdimensions help quickly identify the current status in the organisation and the main tasks that need to be accomplished in order to advance to the next level. [Read more...](#)



OAV Architectures

A high-level architectural blueprint (the TM Forum Open Digital Architecture, or ODA), provides R&E institutions with an easy way to understand and compare the architectures of their Network Management (NMS), Operations and Business Support Systems (OSS/BSS) and helps guide community efforts towards the creation of interoperable systems and operations. [Read more...](#)



OAV Terminology

During our discussions with NRENs it became clear that there are OAV terms that are being used in different ways and in some cases with slightly different meaning and understanding. In order to have a common basis we decided to identify a list of relevant OAV terms and add a short definition with a reference link (source) for each term as well as an acronym table. [Read more...](#)



OAV Community Portal

Applied OAV examples by country. Follow our community portal to see what NRENs are implementing in their own environments. [Read more...](#)



GNA-G Network eAcademy WG

Research and Education Networks and institutions around the globe are facing the same challenges as in the GÉANT community. As Artificial Intelligence strikes in all areas, new tools arise, others disappear or stop being used, and with the daily operations of the network, an up-to-date training programme with inputs from actors in all the regions of the world is a must. Therefore a new GNA-G Network eAcademy Working Group was formed with the objective to make the current contents and tools of the Network eAcademy available to the entire research and education community. [Read more...](#)



Infoshares ++ Events

- all events
- NEW** GNA-G Network eAcademy Working Group
- NEW** Infoshare: How to create learning units for the Network eAcademy and beyond, May 12, 2025
- NEW** Infoshare: Network eAcademy, May 7, 2025
- RARE/FreeRTR Use Case: Open-Source Implementation of 5G User Plane Function (UPF), Dec 19, 2024
- AI Chatbot for the GÉANT eAcademy, Dec 18, 2024
- What's New in the Network eAcademy?, Dec 17, 2024
- NREN Fibre Infrastructure for Sensing, Dec 5, 2024
- Telemetry Module for the Workflow Orchestrator, Nov. 5, 2024
- 4th European perSONAR User Workshop, May 14-16, 2024
- OAV Architecture Workshop, April 18, 2024
- GÉANT Infoshare - NETDEV Incubator, March 29, 2023
- GÉANT Infoshare: Maturity Model for Orchestration, Automation and Virtualisation, March 29, 2023
- GÉANT Infoshare: Tools for Campus Network Management as a Service (CNaaS), April 28, 2021
- Orchestration, Automation and Virtualisation in the NRENs. Ready, Steady, Go!, December 16, 2020
- Highlights
- Standardisation Bodies



Network eAcademy Expands, Connect Magazine, Issue 47, 2024, p. 22



Network Automation eAcademy, Connect Magazine, Issue 38, 2021, p. 19

<https://wiki.geant.org/display/NETDEV/Network+eAcademy>



NETDEV



Network eAcademy Training Portal

Created by Susanne Nägele-Jackson, last modified on Dec 17, 2024

Pages

Blog

Calendars

Analytics

PAGE TREE

Argus

Dissemination

Fibre Sensing

NETDEV Incubator

Network eAcademy

Highlights

Network eAcademy Training Portal

Network Automation Training

Quantum Technology Training

Time and Frequency Networks Training

OAV Architectures

OAV Community Portal

OAV Maturity Model

OAV Terminology

QT

TimeMap

WP6 Archive

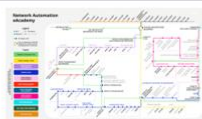
WP6 Events



Network Training

This Training Portal is offering courses focused on the research and education community, with external references that can be useful for us and examples that can be closer to our use cases. It is training by the community for the community. We will be publishing new classes regularly; all classes are online courses that you can follow and complete at your own pace.

Network Automation



Take network automation classes to learn about orchestration, automation and virtualisation of networks. Get started with network architecture, data modeling, data formats and protocols and CI/CD and then move on towards intelligent networks using data analytics and AI.

[Learn more about Network Automation....](#)

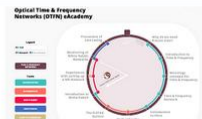
Quantum Technology



Follow our Quantum technology track to learn about basics such as Qubits, Qubit Entanglement and Teleportation. Find out about Quantum Key Distribution and quantum simulation. Or learn the latest on standards and APIs.

[Learn more about Quantum Technology....](#)

Time and Frequency Networks



Follow our track for Time and Frequency Networks to learn about the basic metrology concepts of time and frequency, or find out about working with White Rabbit in networks. Other learning units will offer an insight into Optical Carrier Distribution, or the ELSTAB system, which is used for Time and Frequency dissemination via optical fibers.

[Learn more about Time and Frequency Networks....](#)

Info | Infosharing ++ Events

- all upcoming and past events
- New in Network Automation:** Process Flow Orchestration, Hypervisor-based Virtualisation: KVM, Nagios



Meet us on the first Tuesday of every month
One hour for questions & answers
Just drop us an email at
network-eacademy@lists.geant.org
and we will send you the link.

[Watch our video:](#)

Towards Service Automation for Research and Education



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

Estructura general de las unidades

• Descripción general (overview)

- Fecha desde la que está disponible / bajo demanda.
- Indicadores de duración y compromiso
- Prerequisitos (si los hay)
- Certificado de finalización

Introduction to Artificial Intelligence

Course Settings Participants Grades Reports More ▾

Overview Main Goals Part 1: Basic concepts of Artificial Intell... Part 2: Artificial Intelligence in Everyda... Useful Links Quiz

Feedback Form & Completion Certific...

Welcome to the Introduction to Artificial Intelligence learning unit



 COURSE DATE: From December 2024	 DURATION: 50 minutes	 COMMITMENT: 75 minutes
 REQUIREMENT: None	 COURSE TYPE: Self-paced	 CREDENTIAL: Certificate of Completion

Learning path:	Network Automation eAcademy Training Portal
Prerequisite:	None
Preceded by:	Big data storage
Followed by:	Data processing and exploration
Next available unit:	Towards Intelligent Networks

Estructura general de las unidades

- Main Goals
- Video (s) + pdf
- Enlaces útiles
- Quiz
- Feedback & Certificado de asistencia
- What's Next?
- En caso de dudas, contactad con **network-eacademy@lists.geant.org**

Overview | Main Goals | Part 1: Basic concepts of Artificial Intell... | Part 2: Artificial Intelligence in Everyda... | Useful Links | Quiz

Feedback Form & Completion Certific...

Main Goals



This video contains the introduction to Single Photon Avalanche Diode (SPAD) Technology, mainly explaining the distinction between macroscopic and single-photon level intensities and providing information about the importance of avoiding detector saturation to maintain measurement accuracy.

It will also explain how the single photon avalanche diode works together with data acquisition and an interface where the operation parameters can be set by the user.



ters. If you want to turn on the subtitles in the video, press

Short quiz on mathematical operators

Quiz

Settings

Questions

Results

Question bank

More

Back

Question 1

Not yet answered

Marked out of 1.00

Flag question

Edit question

I, H, X, Y, Z are operators.

Select one:

☐ True

☐ False

Next page

GÉANT

ETSI Standard

004 Specification Functions and Parameters

Ane Sanz (UPV/EHU)

Quantum Training Developer

Quantum training by the GÉANT project

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

training@lists.geant.org

on YouTube

What's Next?

You have now completed this learning unit. We hope it has sparked further interest and that you will explore other learning units. If you have any questions about this learning unit or any other learning units, please feel free to contact us at training@lists.geant.org. We would love to hear from you!



Photo by Tim Moscholder on Unsplash

For more Quantum Algebra learning units, continue with:

- ✓ Qubits
- ✓ Operator Multiplication: Variants
- ✓ Mathematical Operators
- ✗ Qubit Entanglement
- ✗ Teleportation
- ✗ Bloch Sphere

For more learning units in our series, go back to [Quantum Technology](#).

Course | Settings | Participants | Grades | Reports | More

INTRODUCTION | Quantum Algebra Class | Identity Operator | Hadamard Operator | Exercise 1 | Pauli Operator X | Pauli Operator Z

Pauli Operator Y | Operator Applications | Exercise 2 | Useful Links | Quiz | Feedback & Certificate | What's Next? | Results

Need some exercises?

Let's have a look at the **Identity Operator I** again:

$$I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$I \cdot |0\rangle = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \cdot \begin{bmatrix} 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

Now let's try this for the **Hadamard Operator H**:

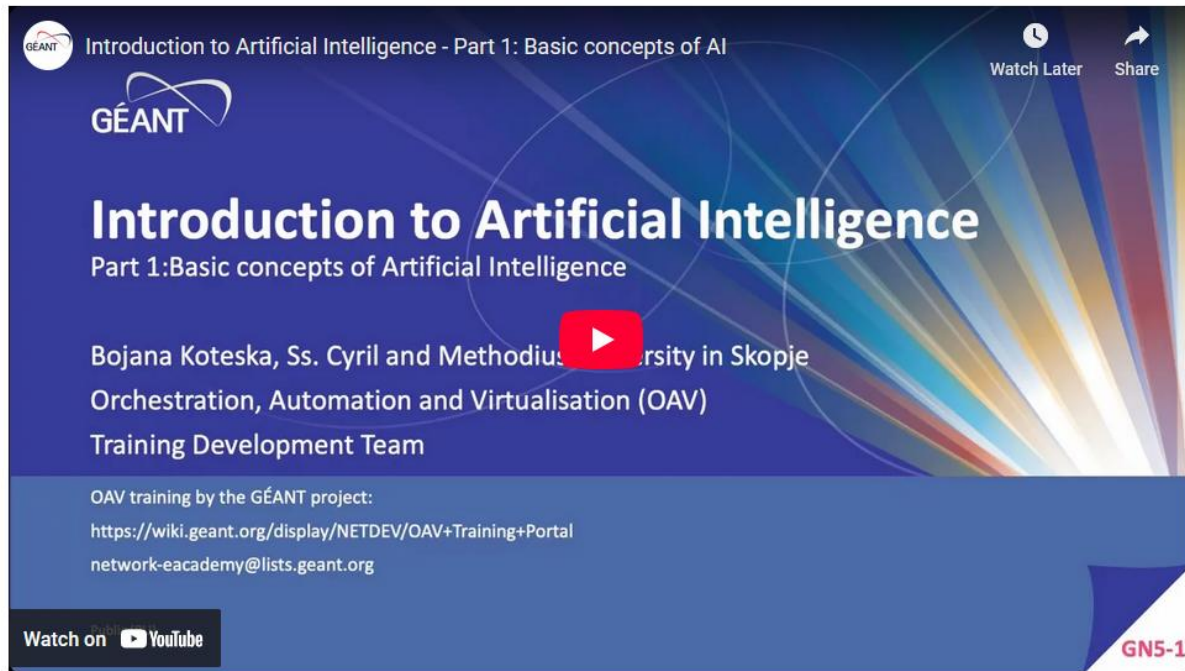
$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \cdot \begin{bmatrix} 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

How did we get this result?

$$1 \cdot 1 + 0 \cdot 0 = 1 \quad (\text{upper value})$$

$$0 \cdot 1 + 1 \cdot 0 = 0 \quad (\text{lower value})$$

Estructura general de las unidades: contenido



Vídeo con subtítulos
(en inglés, pero se
pueden traducir)



Part 1: Basic concepts of Artificial Intelligence PDF document



PDF con script

Network Automation Training

Created by Susanne Nägele-Jackson, last modified by Leonardo Marino on May 16, 2025

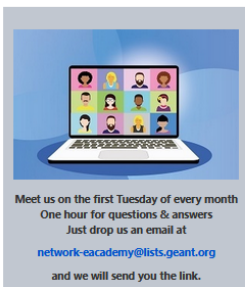


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[See more training...](#)

① Info | Infosharing ++ Events

- all upcoming and past events
- **New in Network Automation:** Automated Configuration Management: NetBox, Neural Networks & Deep Learning, Introduction to AI
- Infoshare: Network eAcademy, May. 7, 2025



Meet us on the first Tuesday of every month
One hour for questions & answers
Just drop us an email at
network-eacademy@lists.geant.org
and we will send you the link.

Introduction

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

DevOps

- **Introduction to CI/CD** (15)
- **New:** Version control: **Bitbucket** (40)
- Version control: **GitLab** (40)
- Version control: **GitHub** (2h)
- **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)
- **Protocols: RESTCONF** (2h)
- **Process Flow Orchestration** (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)
- **Hypervisor-based Virtualisation: KVM** (50)
- **Hypervisor-based Virtualisation: XEN** (90)
- **Container-Based Virtualisation: Docker / Swarm** (3h)
- **Container-Based Virtualisation: Kubernetes** (4h - including lab)
- **Introduction to Automation** (30)
- **Automation Tools: Ansible** (60+lab time)
- **Automation Tools: Python** (90)
- **Introduction to Configuration Management** (20)
- **New:** **Automated Configuration Management: NetBox** (25)
- **Introduction to Orchestration** (30)
- **Orchestration: NSO** (6h - including lab)

Intelligence Management

- **Introduction to Intelligence Management** (15)
- **Introduction to Automated Monitoring: Nagios** (2h)
- **Big Data Storage** (1.5h)
- **Elasticsearch** (30)
- **New:** **Introduction to AI** (50)

ADDITIONAL READING

Architecture Mappings

NREN use cases

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

other use cases

- Argus
- NMaas
- PMP
- SPA

Architectures

Standards & Common Architectures

- TM Forum ODA
- MEF
- ETSI-OSM
- ETSI-ZSM
- ONAP
- OpenBaton
- 5G 3GPP
- GVM
- SENSE
- TALENT
- EOSC

External Collaborations

- **Automation tools: GNAT** (GNOG)
- **Database** (SoBigData Academy)
- **Data Analysis** (SoBigData Academy)
- **Legal and Ethical aspects of Data Science** (SoBigData Academy)
- **Information Retrieval** (SoBigData Academy)
- **Data Mining & Machine Learning** (SoBigData Academy)

Legend

● Unit / ■ Document / ext. link

● Released / ● Not released

 ***You can jump back and forth between this station and all exchange points at any time***

GENERAL INTRODUCTION

AGILE, DevOps, CI/CD

DECOUPLING &

PRODUCTION

ENGAGEMENT MANAGEMENT

PARTY MANAGEMENT

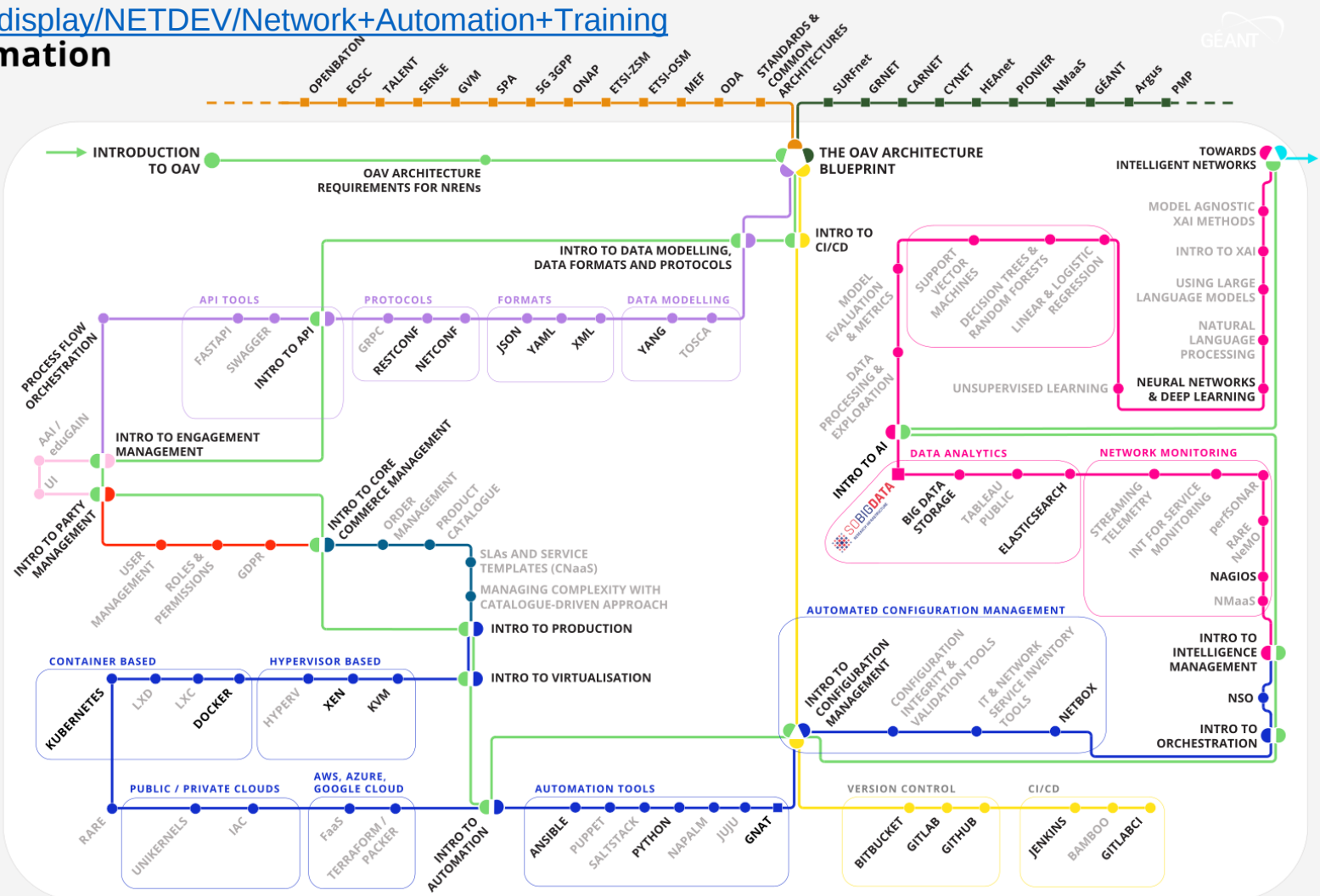
CORE COMMERCE

INTELLIGENCE

OAV REALISATION

USE CASES AND EXAMPLES

ARCHITECTURE



Formación en automatización: Acceso vía GLAD

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

- **All courses**
 - **Technical Skills**
 - **Network**
 - **Network Automation eAcademy**

OAV - Introduction



OAV architecture requirements for NRENs



The OAV Architecture Blueprint



CI/CD - Introduction



Data modelling, data formats and protocols - Introduction



NetBox



YANG - Data modelling



Formats: XML



Formats: YAML



Formats: JSON



Protocols: NETCONF



Protocols: RESTCONF



Process Flow Orchestration



Engagement Management - Introduction



Party Management - Introduction



Managing complexity with a catalogue-driven approach



Production - Introduction

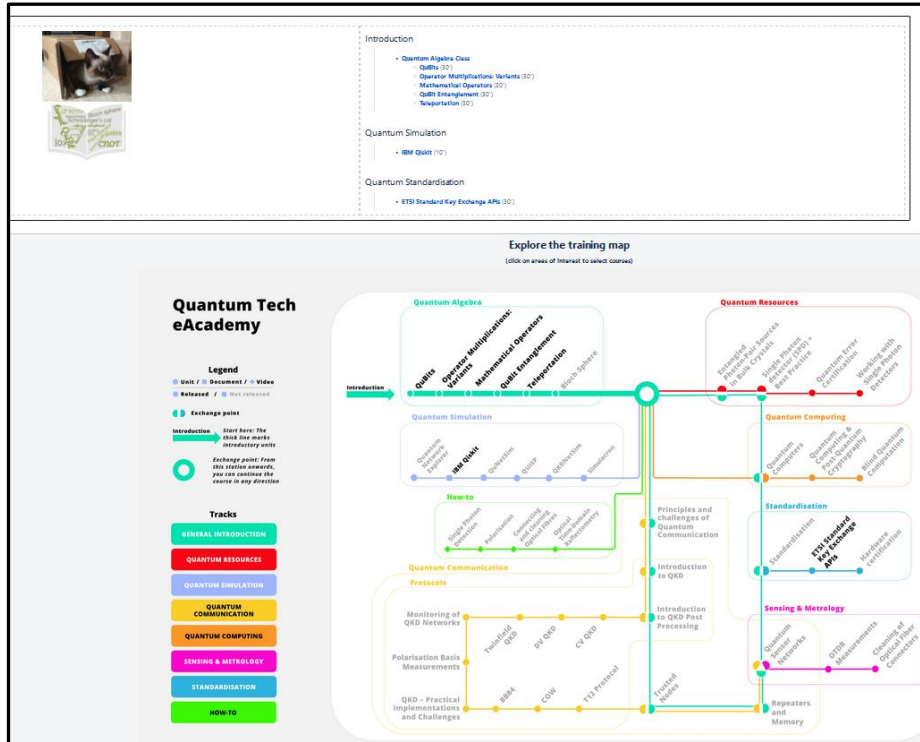


Virtualisation - Introduction



Formación en tecnologías cuánticas

- <https://wiki.geant.org/display/NETDEV/Quantum+Technology+Training>



Enlaces texto

Mapa de metro

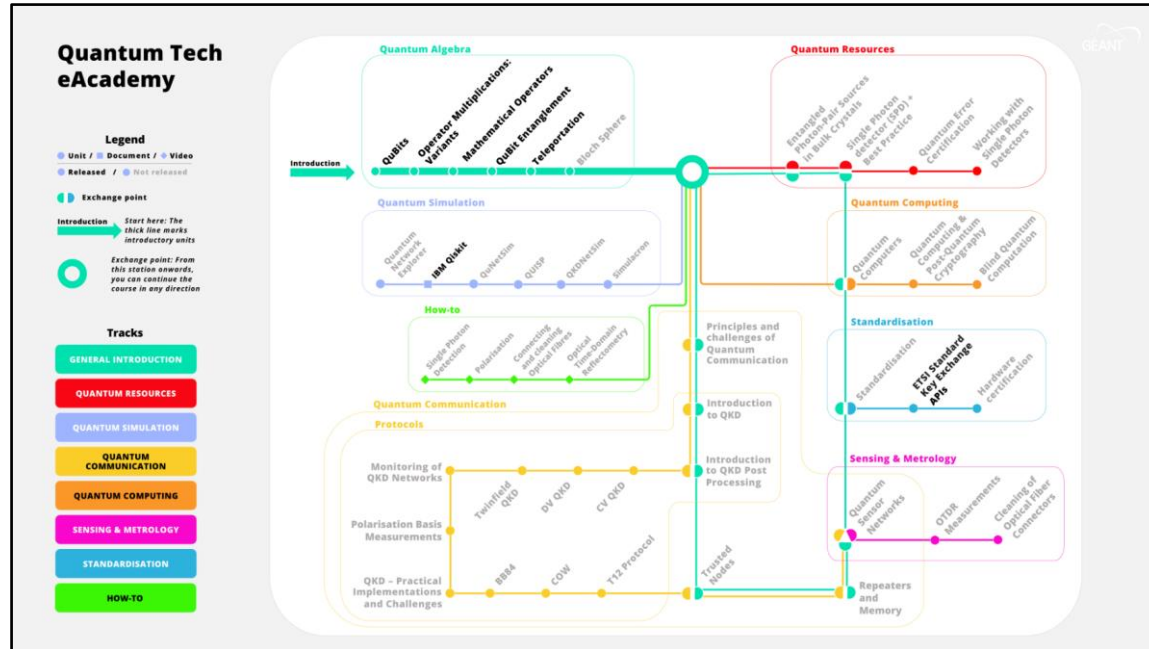
Formación en tecnologías cuánticas: Mapa

- <https://wiki.geant.org/display/NETDEV/Quantum+Technology+Training>

- Estaciones:
 - Negro → unidades publicadas
 - Gris → unidades previstas
 - Círculos: unidad en Moodle
 - Cuadrados: documentos y enlaces externos



- Líneas:
 - Verde: cursos introductorios.
 - Verde: How-to videos
 - Rojo: Quantum Resources
 - Azul liloso: Simulacron
 - Amarillo: Quantum Communication
 - Naranja: Quantum Computing
 - Fúcsia: Sensing & Metrology
 - Azul verdoso: Estandarización



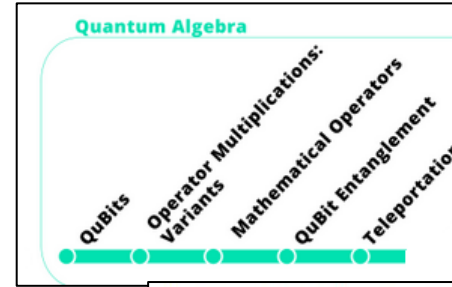
Formación en tecnologías cuánticas

- Clase de álgebra cuántica**

5 unidades para entender cómo funcionan el entrelazamiento y el teletransporte (*entanglement and teleportation*)

- En breve:**

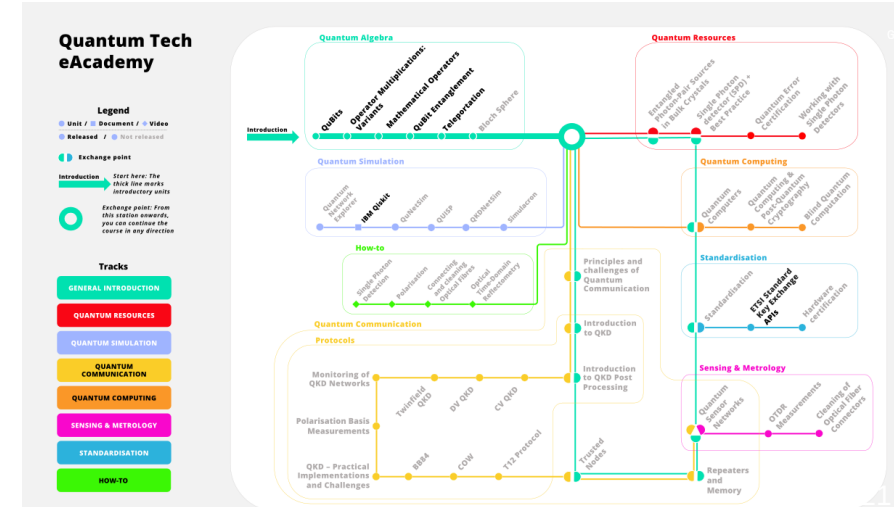
- Introduction to QKD
- Simulacron
- Entangled-Photon-Pair Sources in Bulk Crystals
- Introduction to QKD Post Processing
- **Nuevo:** Cuatro How-to-videos:
 - Connecting and Cleaning Optical Fibres
 - Single Photon Detection
 - Polarisation
 - Optical Time-Domain Reflectometry



Introduction to QuBits, Quantum Algebra, Entanglement and Teleportation

(by Peter Kaufmann (DFN) and the Quantum Training Development Team)

Welcome to this learning unit which is the third in a sequence of units covering the topic of Quantum Algebra. The purpose of the Quantum Algebra class is to introduce the basic theoretical principles of QuBits, their quantum entanglement and the process of teleportation. These aspects are the fundamentals used in quantum computers, quantum networks and quantum security. For the understanding of the physics, some mathematical background aspects from the area of "Operator Algebra" are required.



Formación en tecnologías cuánticas: Acceso vía GLAD

- <https://e-academy.geant.org/>
 - All courses
 - Technical Skills
 - Network
 - Quantum Technology

The screenshot displays the GLAD eAcademy website interface. At the top, a navigation bar includes the GLAD logo and links for Home, Dashboard, My courses, Site administration, and All courses. The main content area is titled 'Quantum Technology' under the 'Technical skills / Network / Quantum Technology' breadcrumb. Below this, there are tabs for Category, Settings, Recycle bin, and More. A search bar and a 'More' dropdown are also present. The section 'Quantum Tech eAcademy' features a promotional text: 'Would you like to learn more about the exciting world of Qubits and all the fascinating new Quantum Technologies that are based on them?'. It describes a series of new courses in the GEANT eAcademy track called 'Quantum Technology', mentioning topics like Qubit fundamentals, Quantum communication, and protocols, and recommends starting with the Quantum Algebra Class for a basic grasp of entanglement and teleportation. Contact information for questions or feedback is provided as qtraining@lists.geant.org. At the bottom, there are six course cards, each with a title, a small image, and a play button icon. The titles are: 'Quantum Algebra: Qubits', 'Quantum Algebra: Operator Multiplication: Variants', 'Quantum Algebra: Mathematical Operators', 'Quantum Algebra: Qubit Entanglement', 'Quantum Algebra: Teleportation', and 'ETSI Standard Key Exchange APIs'.

GLAD
GEANT LEARNING & ENGAGEMENT

Home Dashboard My courses Site administration All courses

Technical skills / Network / Quantum Technology

Quantum Technology

Category Settings Recycle bin More

Technical skills / Network / Quantum Technology Search courses More

Quantum Tech eAcademy

Would you like to learn more about the exciting world of Qubits and all the fascinating new Quantum Technologies that are based on them?

Then follow our series of new courses in the GEANT eAcademy track called "Quantum Technology" Here you can explore Qubit fundamentals, Quantum communication and protocols or explore simulators and simulator platforms.

We recommend starting with our Quantum Algebra Class for an easy grasp of basic concepts of entanglement and teleportation.

Questions or feedback? Please contact qtraining@lists.geant.org

Quantum Algebra: Qubits

Quantum Algebra: Operator Multiplication: Variants

Quantum Algebra: Mathematical Operators

Quantum Algebra: Qubit Entanglement

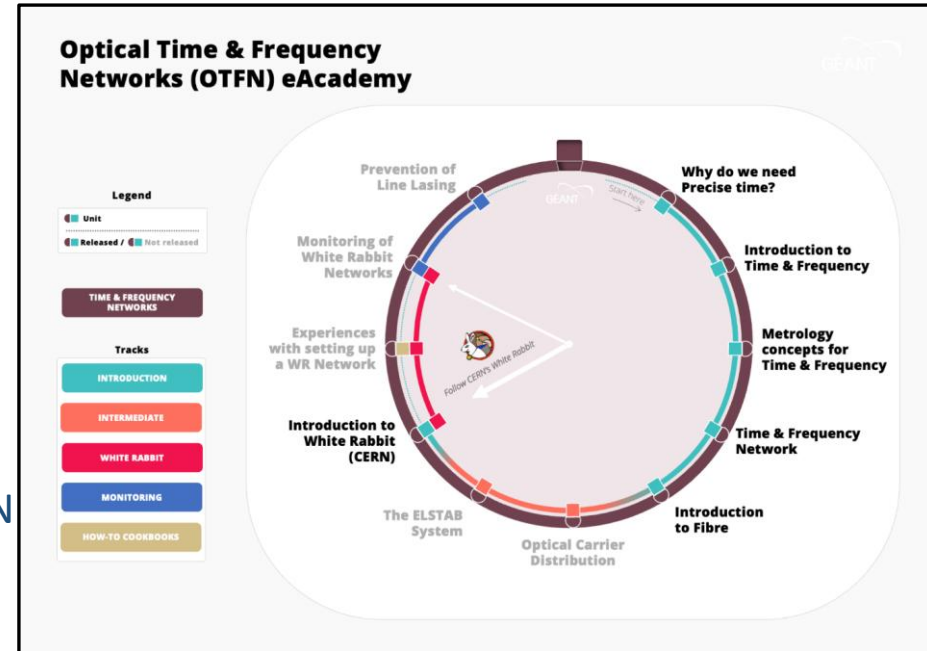
Quantum Algebra: Teleportation

ETSI Standard Key Exchange APIs

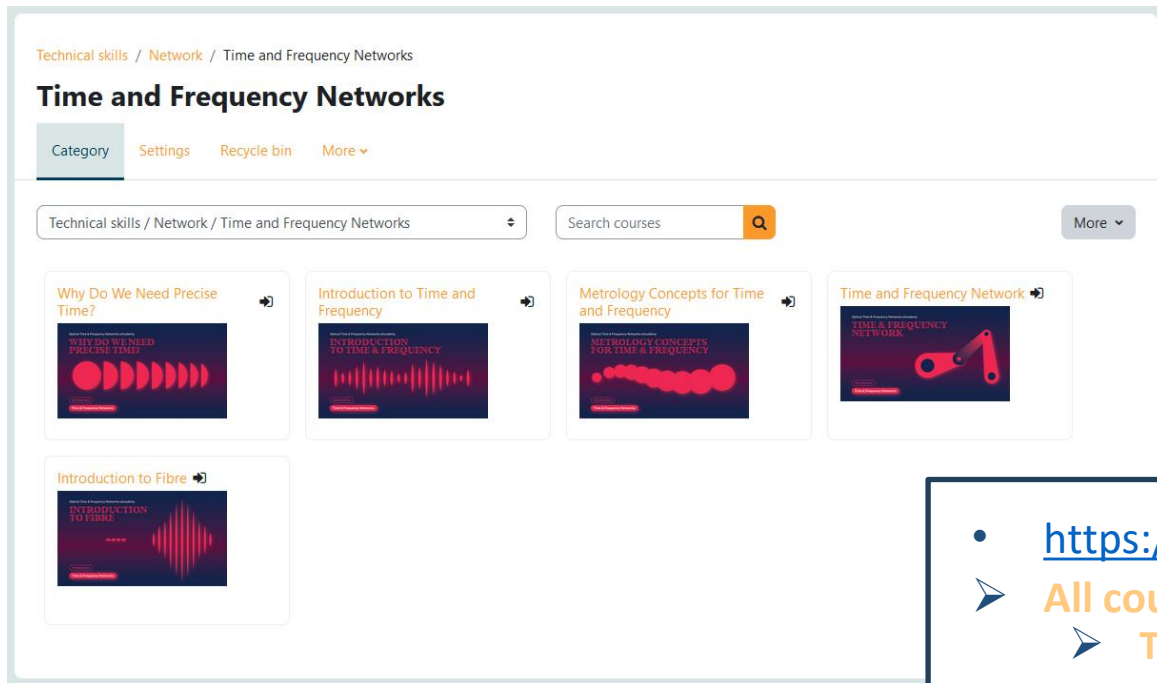
Formación en Optical Time and Frequency Networks (OTFN): Mapa

- <https://wiki.geant.org/display/NETDEV/Time+and+Frequency+Networks+Training>

- Estaciones:
 - Negro → unidades publicadas
 - Gris → unidades previstas
- Líneas:
 - Verde: cursos introductorios.
 - Naranja: avanzados
 - Roja: White Rabbit
 - NeA para material GÉANT
 - Más detalles vía enlace al CERN
 - Azul: monitorización
 - Beige: How-to Cookbooks



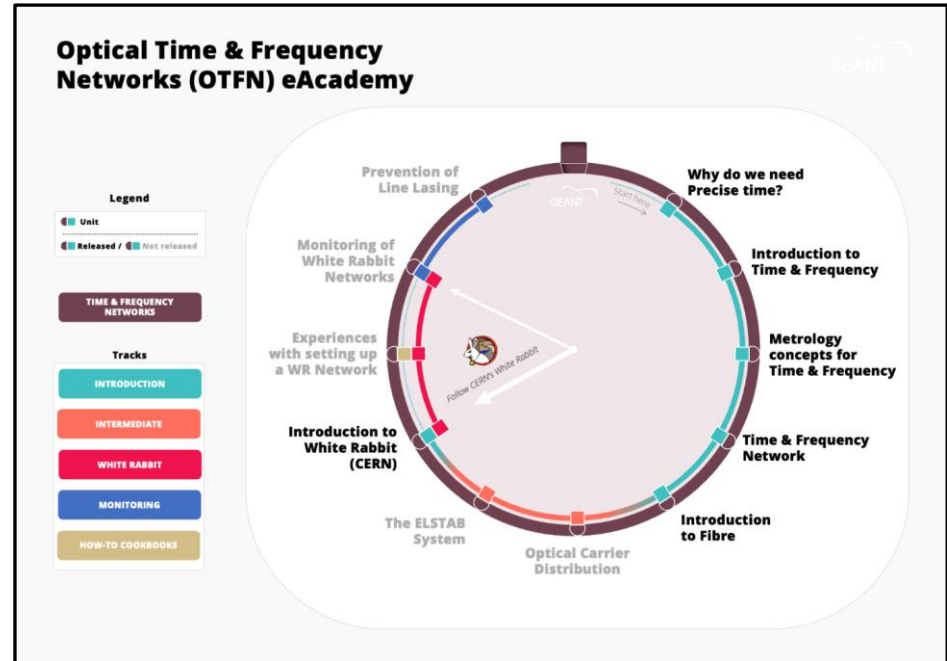
Formación en OTFN: Acceso vía GLAD



- <https://e-academy.geant.org/>
 - All courses
 - Technical Skills
 - Network
 - Time and Frequency Networks

Formación en OTFN

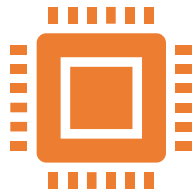
- <https://wiki.geant.org/display/NETDEV/Time+and+Frequency+Networks+Training>
- En breve:
 - Experiences with Setting Up a WR System
 - The ELSTAB System
 - Monitoring of White Rabbit Networks



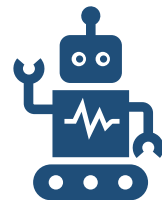
Objetivos del Working Group de la Network eAcademy en GNA-G



Hacer que los contenidos y herramientas de la Network eAcademy estén **disponibles para toda la comunidad de investigación y educación** y sean conocidos mediante reuniones, VCs de la Comunidad GNA-G y otras reuniones.



Ser una herramienta para las instituciones de Investigación y educación el todo el mundo para ayudarles a **comprobar su madurez y comparar su arquitectura** en Orquestación, Automatización y Virtualización con otras organizaciones parecidas



Ser una plataforma para **compartir conocimientos y debatir** para mejorar el contenido de la Network eAcademy en las áreas de Automatización, Inteligencia Artificial, Tecnologías Cuánticas y otras áreas de Desarrollo de red.

Más información en: <https://www.gna-g.net/join-working-group/network-eacademy-wg/>

Thanks all!

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!Gracias!

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