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### Abstract

This deliverable reports on the Network eAcademy—an umbrella of activities to help individuals and organisations advance their knowledge in specific technical domains related to network technologies and services—for Period 1 of GN5-2 (1 January 2025 to 31 March 2026). The service provides a wealth of resources, knowledge-sharing activities and training programmes to foster digital transformation and skill enhancement within the GÉANT and NREN community.

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## Executive Summary

The Network eAcademy is a community-driven service which is designed to support research and education (R&E) institutions in advancing their knowledge, skills, and capabilities in network technologies and services. Developed by the community, for the community, it provides a comprehensive set of resources that foster digital transformation, interoperability and skill development across the GÉANT and the National Research and Education Network (NREN) ecosystem.

Initially established with a strategic focus on Orchestration, Automation and Virtualisation (OAV), the Network eAcademy delivers digital architecture analyses, training programmes, a structured digital transformation maturity model, and shared terminology to support the adoption of advanced digital network practices.

During the reporting period, three Digital Architecture Analyses have been published, with additional mappings being developed at the time of publishing this document. The content of the Digital Transformation Readiness Maturity Model has been improved with extra detail, while the work on terminology documentation has progressed from maintaining a single OAV terminology list to spinning out separate documents covering multiple specialised areas such as AI/ML, OTFN and quantum technologies.

Regarding training resources, fourteen new learning units have been published over the reporting period (six under the Network Automation eAcademy, two under the AI eAcademy, three under the Quantum eAcademy, and three under the OTFN eAcademy). Additionally, a new training programme, the AI eAcademy, has been launched, with the Fibre Sensing eAcademy planned for launch in the months following the reporting period.

Communications and dissemination activities have been a focus of Network eAcademy efforts during the reporting period, with the creation of a new working group under the auspices of the Global Network Advancement Group (the Network eAcademy Working Group), and active participation in several R&E community working groups and events, with 14 presentations, Infoshares and Open Meetings being delivered. 17 articles have been published in GÉANT CONNECT Online to promote and disseminate the work of the Network eAcademy team, and an article about the collaboration with SoBigData Academy was published in Science|Business magazine.

All Network eAcademy outputs are openly accessible through the NETDEV Wiki and related portals. Through continuous development, community engagement and dissemination activities, the Network eAcademy plays a central role in strengthening skills, alignment, and innovation within the R&E networking community.

# 1 Introduction

The Network eAcademy is a service that works as an umbrella of activities and content relating to network infrastructure, technologies and services development, which helps individuals and organisations advance their knowledge in specific technical domains. It supports R&E institutions in their digital transformation journeys by improving technical understanding and encouraging alignment of architectures and practices.

Its activities now include architecture analyses based on the TM Forum Open Digital Architecture (ODA), continuously updated training programmes hosted on the GLAD eAcademy platform, maturity assessments and shared terminology documentation. All relevant materials are curated and published through the NETDEV Wiki - ensuring transparency and accessibility for the wider community.

While the initial focus of the Network eAcademy was on OAV, strong community engagement highlighted the value of extending the same structured approach to other critical and emerging domains as a strategic development. As a result, new training tracks have been established for Artificial Intelligence, Quantum Technologies, and Optical Time and Frequency Networks – with additional areas such as Fibre Sensing currently under development.

This report provides a comprehensive overview of the Network eAcademy and its resources at the time of writing. It describes the work carried out on architecture analysis, training programmes, digital maturity assessment, terminology development, Network eAcademy log analysis, and dissemination activities. It illustrates how these elements together support the R&E community in building skills, aligning practices and advancing digital network services.

Section 2 explains the work done on Digital Architecture analysis for Orchestration, Automation and Virtualisation (OAV): several NREN and service architectures have been analysed through the lens of the TM Forum ODA and the resulting mappings have been published.

Section 3 gives an overview of the portfolio of Network eAcademy training programmes, covering the OAV learning units in the Network Automation eAcademy, followed by descriptions of the Artificial Intelligence, Quantum Technologies and OTFN training programmes and the initial steps taken to develop the Fibre Sensing training programme.

Section 4 outlines the OAV Maturity Model and its dimensions, sub-dimensions and stages against which organisations can assess their current OAV status. The work done to compile the terminology in the R&E community in the areas of OAV, Artificial Intelligence and the Maturity Model is summarised in Section 5.

Section 6 explains the internal work performed on Moodle databases through log data analysis to extract information on users and usage. Section 7 gives details of the dissemination activities carried out by the Network Development team to promote the usage of the resources available in the Network eAcademy. Final conclusions are given in Section 8.

## 2 Digital Architecture Analysis

Digital architecture analysis is the process of describing and comparing how NRENs' digital systems are structured to allow organisations to design, integrate and automate their services more effectively and makes it easier for NRENs to collaborate, reuse components, identify gaps and ensure their systems can interoperate across domains. Architecture analyses conducted across many NRENs and services through the years reveal consistent patterns, such as the move toward modular, decoupled components, increasing adoption of automation and virtualisation, and strong alignment in technical production domains.

The work around digital architecture analysis in the Network eAcademy was initiated during the GN4-3 project to help NRENs and other R&E organisations to more easily interpret different digital architectures and design new digital systems. The TM Forum Open Digital Architecture (ODA) [1] was chosen to serve as a high-level, functional and common reference architecture with which to analyse different digital systems, primarily NREN infrastructure and/or network services, with the aim of simplifying and accelerating possible collaboration and integration of infrastructures, services or processes. As well as serving the initial purpose of understanding and comparing NRENs' architectures, the work on digital architecture analysis is currently applied as a design template for new infrastructures and services that can be automated and orchestrated, and to facilitate interoperability and multi-domain collaboration.

The ODA architecture was selected because it is flexible enough to be used by European NRENs as a reference for the creation of digital platforms, new services and workflows. Once architectures are expressed in the same language, it becomes easier to identify standard APIs or integration points, and enable cross-domain workflows. NRENs and service managers can find overlaps, compare functional gaps and identify candidate components for shared tooling and collaboration. It also allows them to maintain independence in the choice of technical architectures, processes and tools to be used within their domains. More details on the ODA can be found in previously published documents [2] [3] [4]. Its functional blocks [5] are represented in Figure 2.1.

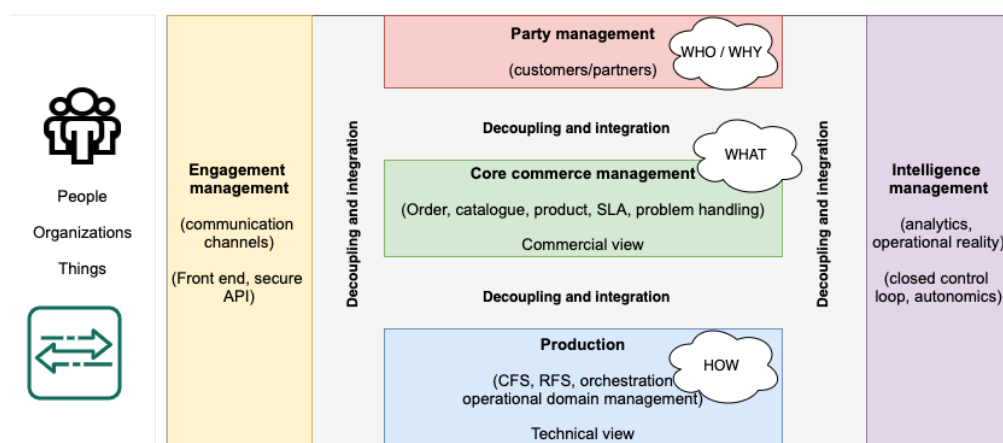


Figure 2.1: ODA Functional block grouping based on the ODA Functional Architecture

Repeating the analysis after several years is also necessary to highlight the evolution and updates made to the components of the architecture over time, and to take stock and determine future steps. Any NRENs seeking to analyse their architecture have two editable templates available on the NETDEV wiki [6]: a graph including the

functional blocks [7] and a supporting analysis template [8], updates to which were made during the reporting period.

Analyses are jointly carried out by the NREN and/or service managers and the WP6 T4 team. NRENs or service managers wishing to map their architectures to the blueprint can contact the Network eAcademy team at [network-eacademy@lists.geant.org](mailto:network-eacademy@lists.geant.org).

During the reporting period, three new architecture analyses were published for MARnet [9], Switch [10], and GARR [11].

Figure 2.2 shows an example mapping of MARnet's OAV architecture using the ODA reference architecture. As can be seen, the analysis allows easy discernment of which of the MARnet OSS/BSS architectural components perform which functionality across each of the five blocks of the reference architecture. Observing the digital architectures of different organisations and services through the lens of the ODA blueprint allows easier comprehension of the constituent parts of each of the systems based on the functionalities they perform. This approach helps NRENs and R&E institutions manage their future development, automation and integration, and advance a single- or multi-domain digital transformation of their network and network operations.

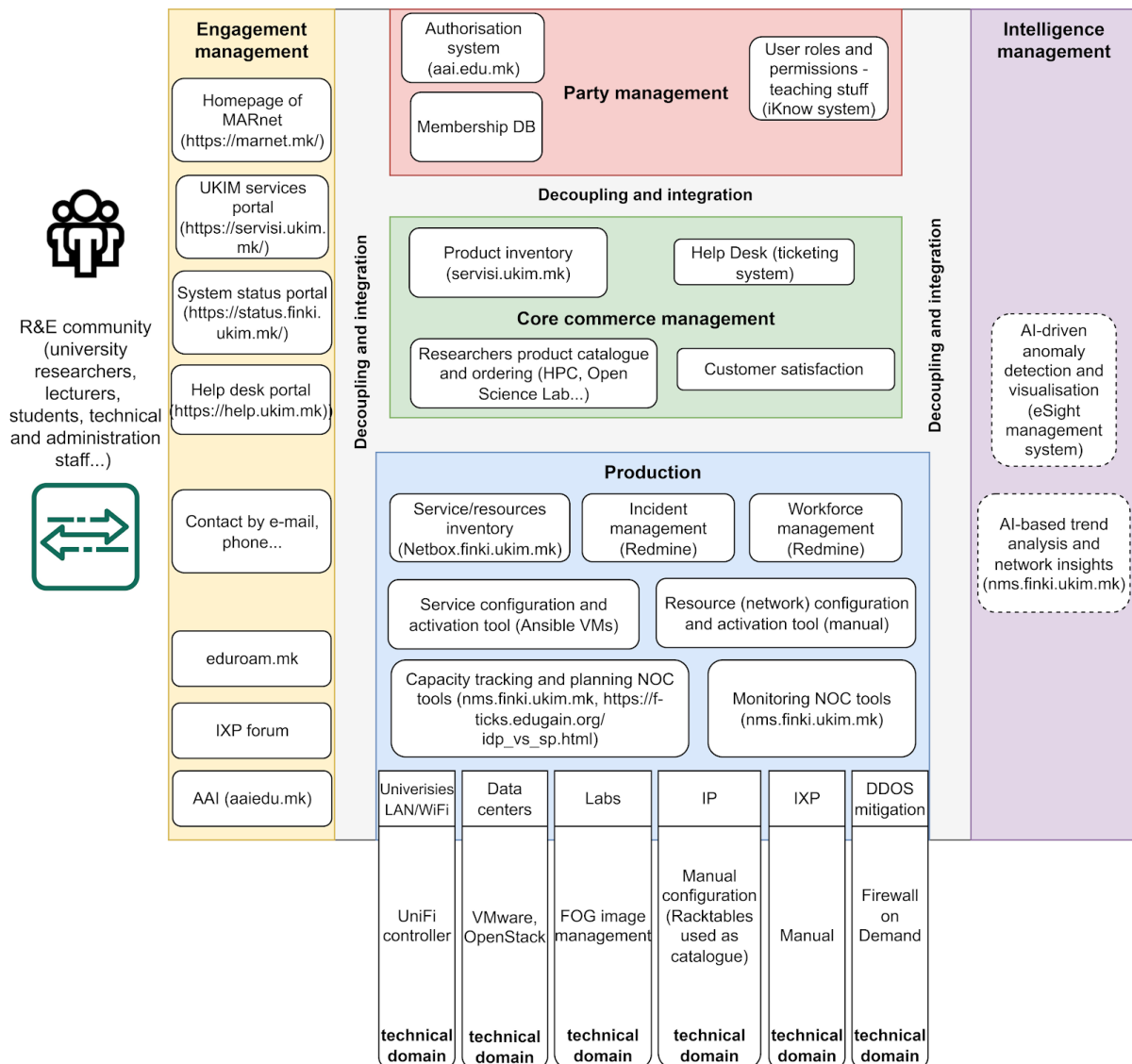


Figure 2.2: MARnet OSS/BSS system components mapped to the TM Forum ODA

Over the lifetime of the Network eAcademy, digital architecture analyses have been published for:

- NRENs: SURF [12], CYNET [13], CARNET [14], HEAnet [15], GRNET [16], PIONIER [17], GÉANT [18], CYNET – Update [19], CARNET – Update [20], and the aforementioned MARnet [21], Switch [22], and GARR [23].
- Services: nmaas [24], Argus [25], PMP [26].
- Analyses of additional architectures (5G, EOSC, ETSI GANA, ETSI OSM, ETSI ZSM, GVM, MEF LSO, Open Baton, ONAP, SENSE, SPA, TALENT) were published in a white paper [27].

Additional architectures are under evaluation at the time of publishing this document, including joint work with at least two more NRENs to analyse their current status and map their OSS/BSS system components to the TM Forum ODA.

Although the NRENs and services analysed cover a wide range of organisational structures and technical environments using diverse tools and technologies, some common patterns emerge in the ODA mappings. For instance:

- Core services and network functions can be decoupled into modular blocks, and identifiable functions can be discerned – even in legacy or bespoke systems. This identification is key for organisations to advance and evolve each of the components and tools independently from the rest.
- Automation and virtualisation are present or emerging – even if implemented differently. Most of the NRENs analysed have components that can support automated provisioning.
- The Production domain – which is the most technical one – is generally the strongest, where NRENs exhibit best alignment with ODA.

Further analysis of recurring patterns uncovered by architecture analyses will be carried out in new and updated architecture mappings.

The OAV architecture blueprint is also used as a reference for the structure and metro map [\[28\]](#) of the Network Automation training track of the Network eAcademy – also known as the Network Automation eAcademy (see Section 3.1).

### 3 Training Programmes

Network engineers, managers and members of the R&E networking community are continuously faced with the challenge of adding knowledge to their existing skillsets. They have to do this while also operating a network, which demands time and attention with the limited resources that are typically available. For this reason, and following the feedback from the NRENs [29], an initial training programme on Orchestration, Automation and Virtualisation (OAV) was created with the help of the GLAD team in GN4-3, called the Network Automation eAcademy [30]. The significant number of trainees following the learning units and their positive feedback encouraged the Network eAcademy team to create more content on Quantum and OTFN in collaboration with WP6 T1 in GN5-1, under the umbrella of the training programmes of the Network eAcademy [31].

In recent times, there has been an explosion of Artificial Intelligence (AI) developments and adoption, and consequently an increase of interest in AI-related topics. In response to this, new learning units were added to the Intelligence Management section of the Network Automation eAcademy, which grew extensively. As AI continued to rapidly evolve from a niche area of computer science into a transformative force in all areas, including network management, during the reporting period the Artificial Intelligence eAcademy was spun out of the Network Automation track in GN5-2 [32] to create a separate learning programme.

In summary, the Network eAcademy currently provides four self-paced training programmes created ‘by the community, for the community’:

- Orchestration, Automation and Virtualisation (Network Automation eAcademy)
- Quantum Technologies (Quantum eAcademy)
- Optical Time and Frequency Networks (OTFN eAcademy)
- Artificial Intelligence (AI eAcademy)

The need for a training programme on fibre sensing has been detected by WP6 T1. To meet this need, experts working on fibre sensing in the GN5-2 project have begun development of training resources for a new Fibre Sensing eAcademy – building on the same approach used for the other eAcademies.

Network eAcademy learning units are published through the GÉANT Learning and Development (GLAD) platform, which is based on Moodle. Direct access to the learning materials is available through both the Network eAcademy Training Portal [33] and the GLAD eAcademy portal [34]. Access to these portals is granted to those with eduGAIN, SSO and social network credentials.

Each Network eAcademy training programme is illustrated via a metro map created in collaboration with graphic designers from WP2. In the metro maps (shown in the following four figures), each Moodle unit is indicated by a circular station symbol (except on the OTFN map), while square stations denote external documents, websites and collaborations offering more information on the topic. The maps are clickable and directly link to the published units and collaborations (named in black); planned but unpublished units are not clickable (and are named in grey). Each learning unit includes a section listing the prerequisites needed to take the course as well as links to recommended follow-on units.

The Network eAcademy is constantly being expanded and developed; more tracks may be added in future in response to the needs of the R&E community.

The following sections provide more information about the training programmes currently available and/or under development in the Network eAcademy.

### 3.1 Network Automation eAcademy

Building on the functional blocks of the orchestration, automation and virtualisation (OAV) blueprint inspired by the TM Forum ODA [35], the Network Automation eAcademy programme introduces the main principles around OAV, DevOps concepts, protocols, tools, real-life examples and resources from the R&E world. The programme provides context and inspires innovation in the R&E world through the short learning units and use-case studies.

Figure 3.1 shows a static snapshot of the metro map. The different levels of the learning paths (introductory, technical, or theoretical) are shown as metro lines that mainly follow the structure of the TM Forum ODA. However, learners can choose to follow different paths – moving from one line to another or skipping “stations”. The interactive metro map is continuously updated for relevance – the latest version can be viewed online [36].

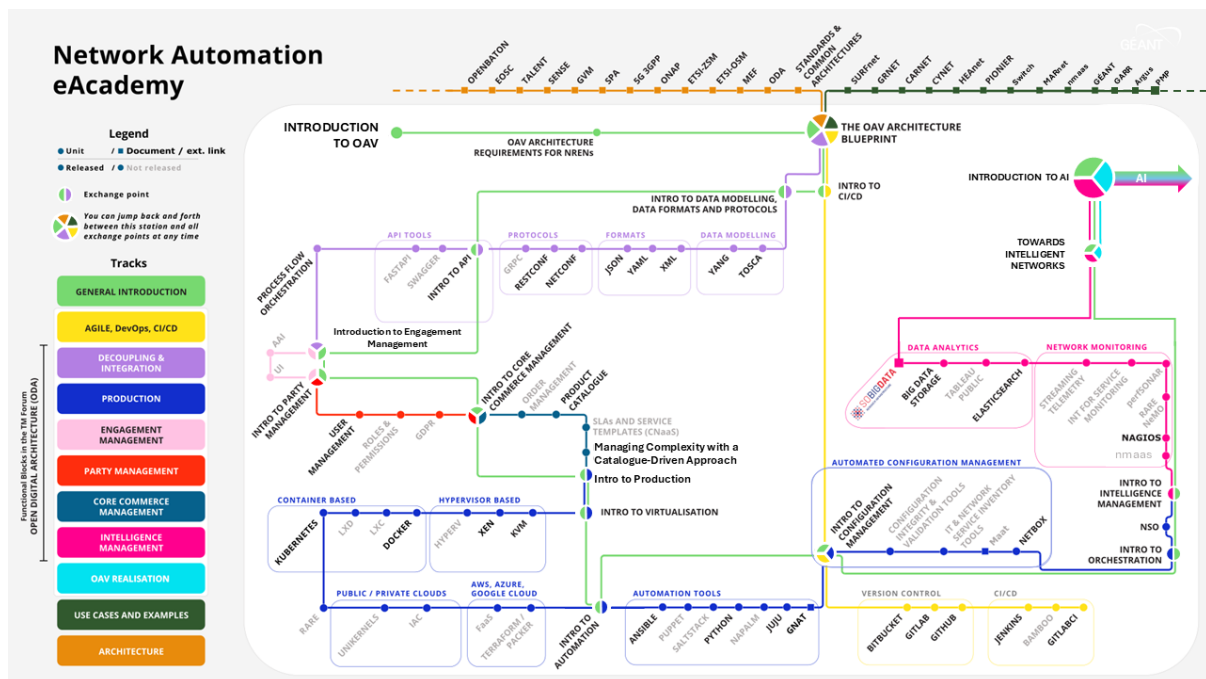


Figure 3.1: Network Automation eAcademy metro map

Learning units are structured according to the OAV blueprint functional blocks and related concepts. Six new learning units were published under the Network Automation eAcademy with the help of the GLAD team in 2025 – NetBox (developed in GN5-1), Bitbucket, Juju, Product Catalogue, User Management, and TOSCA, and one in 2026, Managing Complexity with a Catalogue-Driven Approach.

Two units – Neural Networks and Deep Learning, and Unsupervised Learning – were originally created in the AI section of the Network Automation eAcademy track during the reporting period. Since their creation, the AI section has been spun out into a standalone AI eAcademy, and these units, together with the Introduction to AI, are now reported on under the AI eAcademy (Section 3.2).

Work is ongoing on 15 new learning units. Table A.1 in Appendix A lists the Network Automation eAcademy learning units published so far on the GLAD platform (Moodle) [37]. They are grouped by area, together with their publication or last update dates and the references linking to their content. 27 existing learning units were reviewed and updated in 2025 to keep the contents relevant and useful.

The Network Automation eAcademy team also offers learners support and free consultancy services. Trainees can join trainers in video-conferencing calls and ask questions related to training, the architecture blueprint and

mapping, and suggest the creation of new units. Since the launch of the Network eAcademy, more than 2,400 users have followed more than 4,400 learning units. The team has also worked closely with the Marcomms team in WP2 to regularly publish CONNECT articles on newly released units and collaborations, along with developing a unified look and feel for the learning units, as explained in Section 6.2.

User feedback has been largely positive, with the 784 responses to feedback requests rating the quality of the training and the structure between Very Good and Excellent.

### 3.2 AI eAcademy

Due to the massive uptick in both interest in AI and the public profile of AI systems, a new AI eAcademy training programme was created by detaching the AI content from the existing Network Automation eAcademy. However, both sections are still closely tied and linked to each other in their corresponding metro maps.

The AI metro map outlines paths on AI as a technology and on its applications in network management. Learning units progress from predictive AI to generative AI, with sections on robotics, classical machine learning, natural language processing, transparent and explainable AI systems, and generative AI. Also planned are learning units on specific use cases, structured around the well-known network management FCAPS framework categories: Fault management, Configuration Management, Accounting Management, Performance Management, and Security Management, shown along the bottom of the AI metro map below. These aim to offer tangible examples of how to introduce AI into networking contexts.

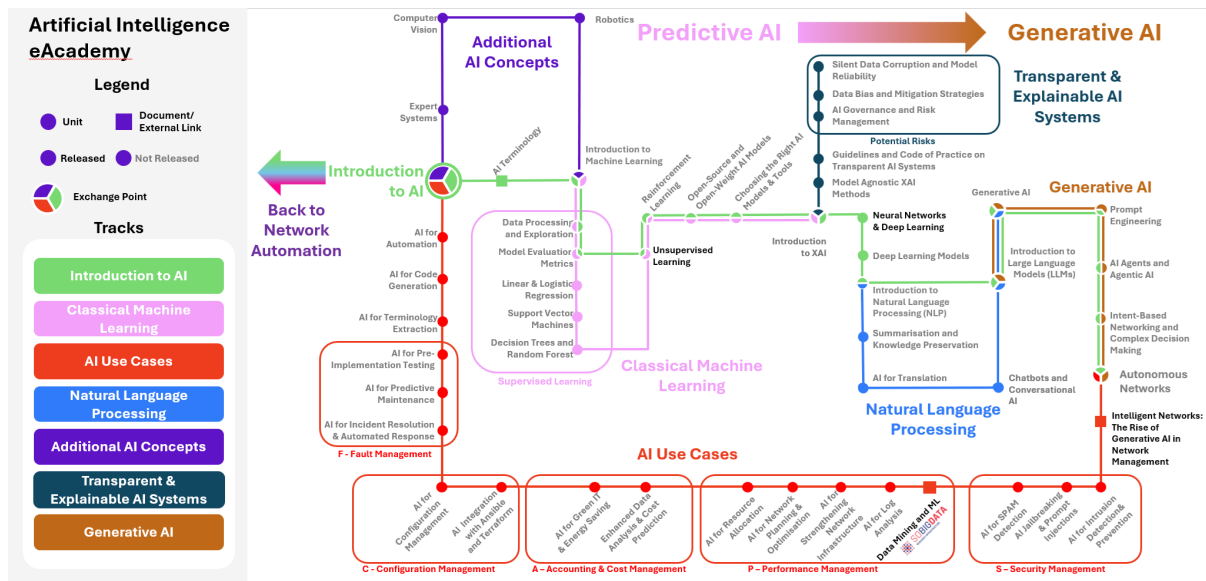


Figure 3.2: Artificial Intelligence eAcademy metro map

Table B.1 in Appendix B lists the learning units published under the AI eAcademy.

### 3.3 Quantum eAcademy

Quantum technologies are expected to play a crucial role in society and will most likely have a disruptive impact in many fields, but most importantly in the areas of quantum computing, quantum communication (including quantum key distribution (QKD)), quantum simulation and quantum sensing.

With advancing progress in quantum computing technologies, it is anticipated that future quantum computing machines will be able to decrypt cyphers in an extremely short time frame – a few seconds or minutes. This will make classical encryption algorithms trivial to break, and public-key cryptosystems will be compromised. This necessitates the development of new and more secure cryptographic systems, and research in the direction of post-quantum cryptography (PQC) is ongoing.

To improve the R&E community’s understanding of quantum cryptography operations, the Network eAcademy and Quantum Technologies teams have collaborated to create nine learning units on quantum technologies since 2022. Three of these were published in 2025 (Introduction to QKD, Introduction to QKD Post Processing, and Single Photon Detection), along with a series of how-to videos with hands-on instructions and guidelines.

The metro map below details the status of the Quantum eAcademy at the end of the reporting period, featuring units spanning quantum algebra, quantum communication, quantum simulations, PQC, applied QKD, quantum resources, and how-to videos.

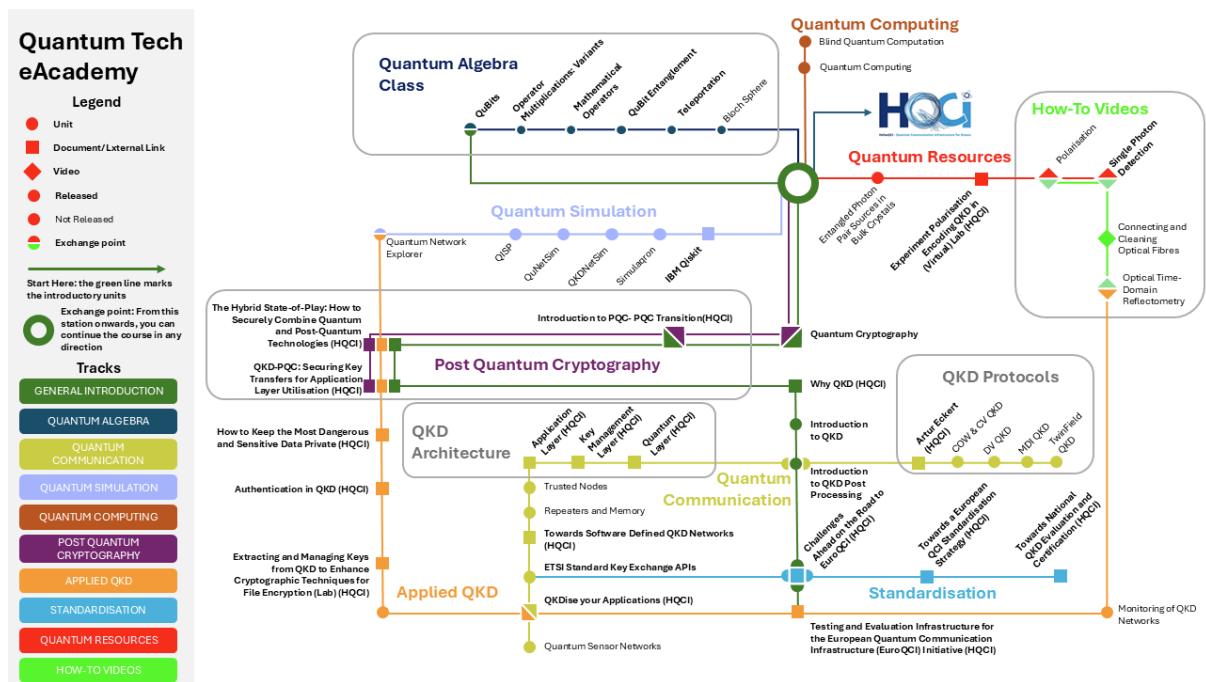


Figure 3.3: Quantum eAcademy metro map

Table C.1 in Appendix C details the units published in the Quantum eAcademy.

Quantum eAcademy learning units have received 472 distinct views since launch from 397 distinct users, with 41 learners providing feedback ranging between Very Good and Excellent, as with the Network Automation track.

### 3.4 OTFN eAcademy

As a result of many European NRENs either supporting or planning to support Time and Frequency (T&F) services for users such as National Metrology Institutes (NMIs), the Network eAcademy team identified an emerging need for resources on these technologies and services. Building on the same approach used for the Network Automation and Quantum tracks, the Network eAcademy (T4) and Technology (T1) teams again joined forces to create the Optical Time and Frequency Network (OTFN) training programme in 2024. The OTFN metro map shown below uses a similar motif to the other metro maps, but takes the form of a clock, reflecting the subject matter.

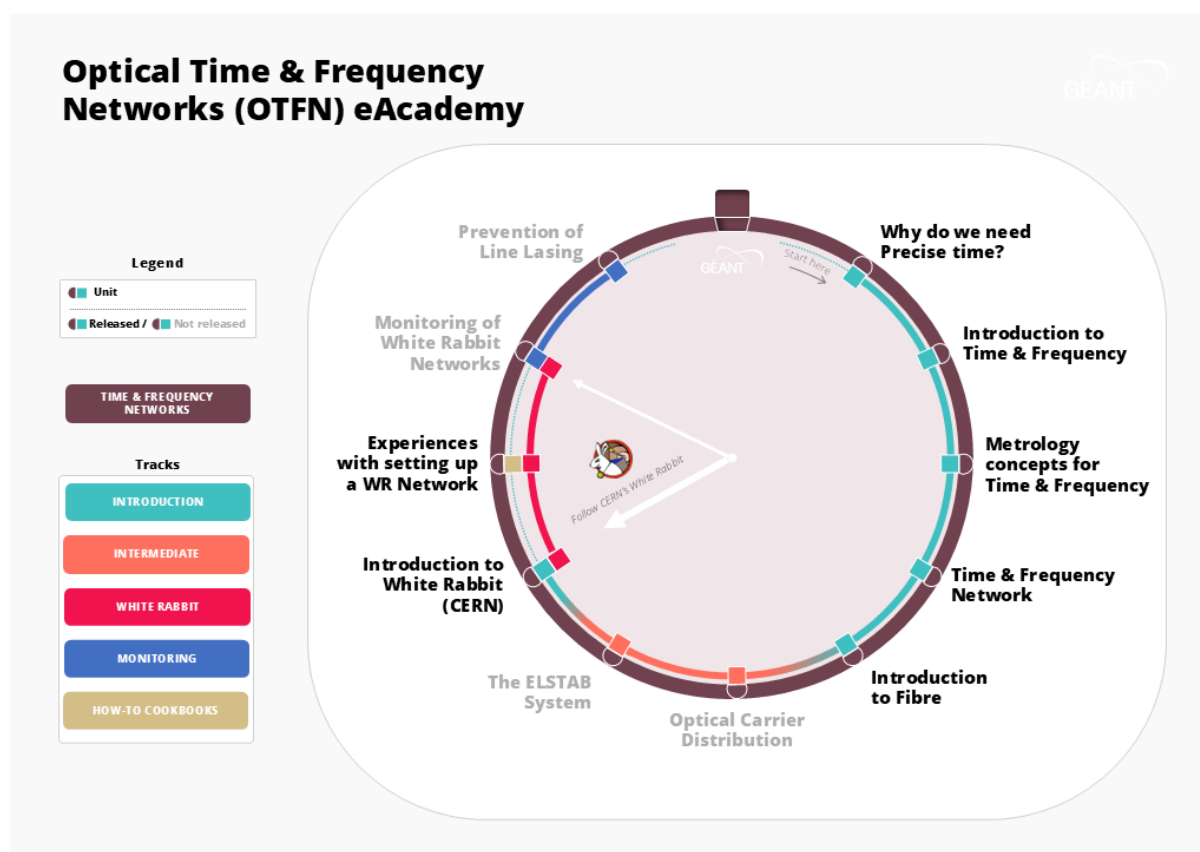


Figure 3.4: OTFN eAcademy metro map

A new external collaboration effort was initiated with CERN, reflected in the programme and metro map by including CERN’s “Introduction to White Rabbit” learning material. Alongside the CERN unit, six OFTN learning units have been developed and published by the Network eAcademy team, three of them in the reporting period (Time and Frequency Network, Introduction to Fibre, and Experiences with Setting Up a WR Network), as detailed in Table D.1 in Appendix D.

OTFN eAcademy learning units have received 140 distinct views from 13 distinct users since launch, with positive feedback received from users.

## 3.5 Fibre Sensing eAcademy

As of the end of the reporting period, a new training programme on fibre sensing is under collaborative development by T1 and T4 teams of WP6, with effort focused on the structure of the training and its corresponding metro map.

## 3.6 External Collaborations

Great interest has been shown in Network eAcademy activities by the global R&E community following presentations at various meetings and conferences (see Section 6.3 for more on dissemination activities). As a result, training content from the following external sources has been integrated into the Network eAcademy.

### 3.6.1 Network Automation eAcademy

#### GlobalNOC at Indiana University

Content from Indiana University's Global Research Network Operations Centre (GlobalNOC) featured in several learning units and as external documents and links [38] in the previous project. This included a unit on the GlobalNOC Network Automation Tools (GNAT), as well as documentation from GlobalNOC being incorporated in the YAML, JSON, XML, Ansible and GitHub learning units.

#### SoBigData Academy

The most recent collaborative initiative was between the GÉANT Network eAcademy and the SoBigData Academy [39], with each party populating their platform with the other's learning units of interest.

Nine learning units from the Network Automation eAcademy have been integrated into the SoBigData Academy, covering a general introduction to data modelling, data formats and protocols, specific formats like XML, YAML, and JSON, and units on big data storage, Docker, Kubernetes, Elasticsearch, and GitHub. Conversely, the Intelligence Management track of the GÉANT Network Automation eAcademy references SoBigData units on databases, data analysis, legal and ethical aspects of data science, information retrieval, data mining and machine learning, data theory and society, complex network analysis, and the use of Spark for data analysis – as shown in the metro maps in Figure 3.1 and Figure 3.2.

As part of this collaboration, the GLAD team redeveloped the unit landing pages to display all unit details without the user needing to log in, improving user experience and information retrieval. By working together, GÉANT and SoBigData aim to share expertise, optimise the use of their free and open learning materials and avoid the duplication of efforts.

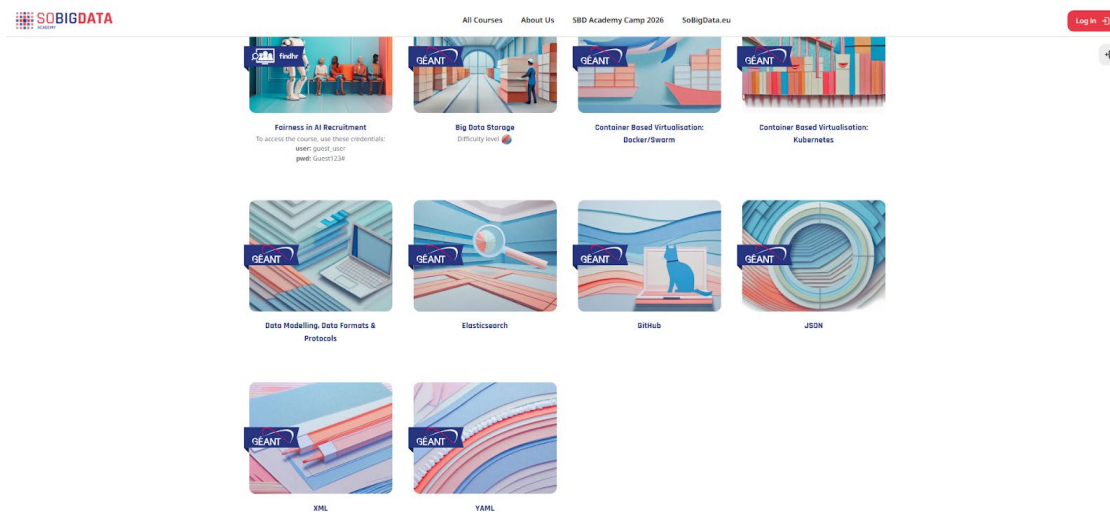


Figure 3.5: Snapshot of the SoBigData Academy, including content from the GÉANT Network eAcademy

### 3.6.2 Quantum eAcademy

Another collaboration effort started in 2025 involved the HellasQCI project [40], with the participation of GRNET, among other R&E organisations and universities. The documentation provided by HellasQCI substantially upgraded the Quantum training programme, expanding the map with many more learning units and metro stations than initially expected. Specifically, alongside a link to the HellasQCI training landing page [41], 19 more learning units and metro stations have been added to the map:

- 'Why QKD?' [42]
- 'Quantum Cryptography' [43]
- 'Introduction to PQC - PQC transition' [44]
- 'The Hybrid State-of-Play: How to Securely Combine Quantum and Post-Quantum Technologies' [45]
- 'QKD-PQC: Securing Key Transfers for Application Layer Utilisation' [46]
- 'Experiment Polarisation Encoding QKD in Virtual Lab' [47]
- 'Quantum Layer' [48]
- 'Key Management Layer' [49]
- 'Application Layer' [50]
- 'Towards Software-Defined QKD Networks' [51]
- 'Artur Ekert' [52]
- 'Challenges Ahead on the Road to EuroQCI' [53]
- 'Towards a European QCI Standardisation Strategy' [54]
- 'Towards National QKD Evaluation and Certification' [55]
- 'How to Keep the Most Dangerous and Sensitive Data Private' [56]
- 'Authentication in QKD' [57]
- 'Extracting and Managing Keys from QKD to Enhance Cryptographic Techniques for File Encryption (Lab)' [58]
- 'QKDis Your Applications' [59]
- 'Testing and Evaluation Infrastructure for the European Quantum Communication Infrastructure (EuroQCI) Initiative' [60]

### 3.6.3 OTFN eAcademy

External collaborations have also been fostered in the OTFN area, with CERN contributing the “Introduction to White Rabbit” learning material. The initial metro map on the OTFN eAcademy was changed to include this collaboration and a link to the whole CERN's White Rabbit Project training was added to the OTFN Training Portal during the reporting period.

## 4 Digital Transformation Readiness Maturity Model

A central aspect of an organisation’s readiness for digital transformation is its level of maturity in orchestration, automation and virtualisation (OAV). Accordingly, an OAV Maturity Model (OAV MM) was developed by the Network eAcademy team in GN4-3 and improved in GN5-1 to help NRENs measure their capabilities, identify their strengths, weaknesses, opportunities and threats (SWOT analysis), and prioritise actions to advance their digital transformation journey.

The Maturity Model has six stages that are mapped to mnemonic actions, as illustrated below.

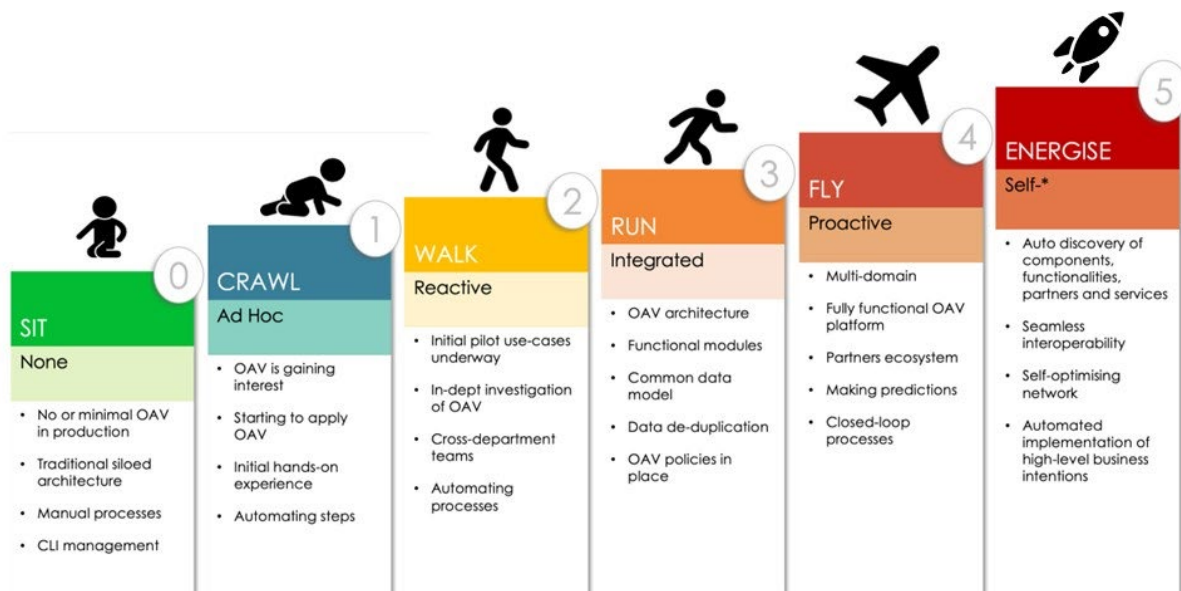


Figure 4.1: OAV Maturity Model stages

Organisational capabilities for digital transformation are assessed in four dimensions, as detailed in Figure 4.2, and further refined into 27 sub-dimensions [61]. A white paper defining the OAV MM dimensions and sub-dimensions, including information on each of the stages, was published in the GN5-1 project [62].

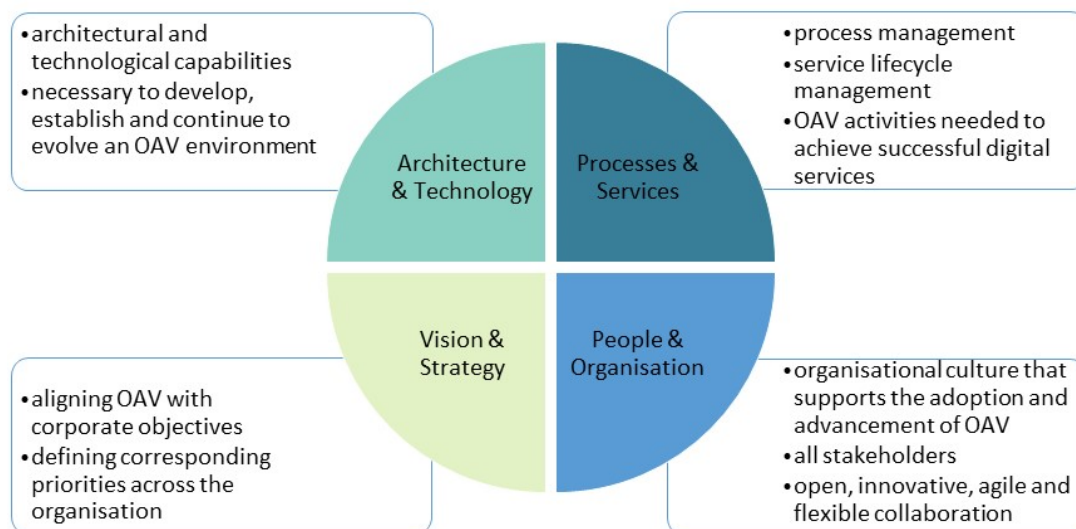


Figure 4.2: OAV Maturity Model dimensions

The Network eAcademy’s Maturity Model is delivered as a 31-question survey [63] covering all key technological and organisational aspects of digital transformation. After completing it, organisations receive a confidential report analysing their results by sub-dimension, assigning an overall maturity score, and benchmarking them against the community average. Using this report, organisations can determine their desired maturity level in each area – identifying quick wins, longer-term efforts, or items to postpone depending on relevance and required resources.

So far, the survey has been completed by 17 organisations, two of which have taken the survey twice to assess their evolution over time. The survey was reviewed during the reporting period, with new and improved tips in the results report to assist organisations in their evolution through the stages of the Maturity Model. A promotional article was published in CONNECT Online [64], and work is ongoing to create a flyer.

## 5 Terminology Documentation

During preparatory work on OAV by the Network eAcademy, it was recognised that the use of different terms for specific OAV functions, services or elements presented a potential obstacle for cross-domain collaboration. Such collaboration is already burdened by differences in technologies, structures, processes, and services.

In order to resolve this by providing a common set of definitions to create a shared understanding of OAV terms, an initial *OAV Terminology* document was compiled in GN4-3 [65]. This document was reviewed and improved three times in GN4-3 [66] and GN5-1 [67][68] to include additional acronyms and definitions on OAV, AI and the Maturity Model. The different versions of the Terminology document have been endorsed by the GNA-G Network Automation Working Group [69].

The team recognises the value of separate *Terminology* documents for different areas of the network technologies domain to keep the documents light and focused. The work on terminology is currently being organised per specialised area. With the increasing complexity and volume of technical documentation, the team has begun adopting AI/ML tools (such as abbreviation and terminology extractors) to improve its workflow efficiency. These tools facilitate the building of frequency lists from domain-specific document sets by extracting terms and abbreviations, allowing the compilation of comprehensive terminology databases.

Shortly after the end of the reporting period, the first document on AI/ML terminology will be published as a spin-off of the *OAV Terminology* document. As new terms continuously come into use in the areas under consideration, the team plans to create updated versions of the documents whenever the need is detected. For instance, the team is planning to include future developments of documentation on network programmability with P4, monitoring tools and platforms, OTFN and quantum technologies.

## 6 Communication and Dissemination

The Network eAcademy team is actively engaged in communicating and promoting its work within the community. These activities cover several aspects – the NETDEV Wiki, developing the Network eAcademy visual brand and presenting eAcademy activities and results at different community events.

### 6.1 NETDEV Wiki

The NETDEV Wiki is regularly updated with information about the work done in the Network Development Work Package (WP6) [70]. Topics covered include WP6 production services, software, research and development, digital architecture, digital transformation and applied use cases. The Wiki is actively maintained to ensure the information within is kept up to date.

The Wiki was updated over the course of the reporting period to contain an archive of previous WP6 work and to improve page categorisation. In the Network eAcademy section of the Wiki, a new landing page [71] and a new Training Portal [72] pointing to each individual eAcademy portal have been created.

Most recently, the following sections of the Wiki were updated:

- Dissemination and events pages
- Architecture Mapping pages
- Network eAcademy Portal
- Network eAcademy Training Portal
- Network Automation Training
- Quantum eAcademy Training
- OTFN Training
- AI Training
- Community Portal
- GNA-G Network Automation Working Group

### 6.2 Branding and Visibility

Network eAcademy branding is created with the help of the Marcomms team in WP2 and the GLAD team in WP1, using distinct brand identities for each track of the Network eAcademy to help learners differentiate and find material. The colour schemes for Network Automation and Quantum Technologies – matching the corresponding metro line colours – allow users to identify whether a learning unit belongs to an Introductory or an Advanced training line. Likewise, the title cards for Network Automation and AI use visual motifs suggesting separated components that can work together through the use of APIs and orchestration. For Quantum, visuals of waves on the title cards are reminiscent of fibres and the wavelengths of light. For OTFN, waves again indicate the usage of fibre optics – but with blue and red colours. Figure 6.1 below illustrates the variety of branding used for learning units in the different eAcademy training programmes.

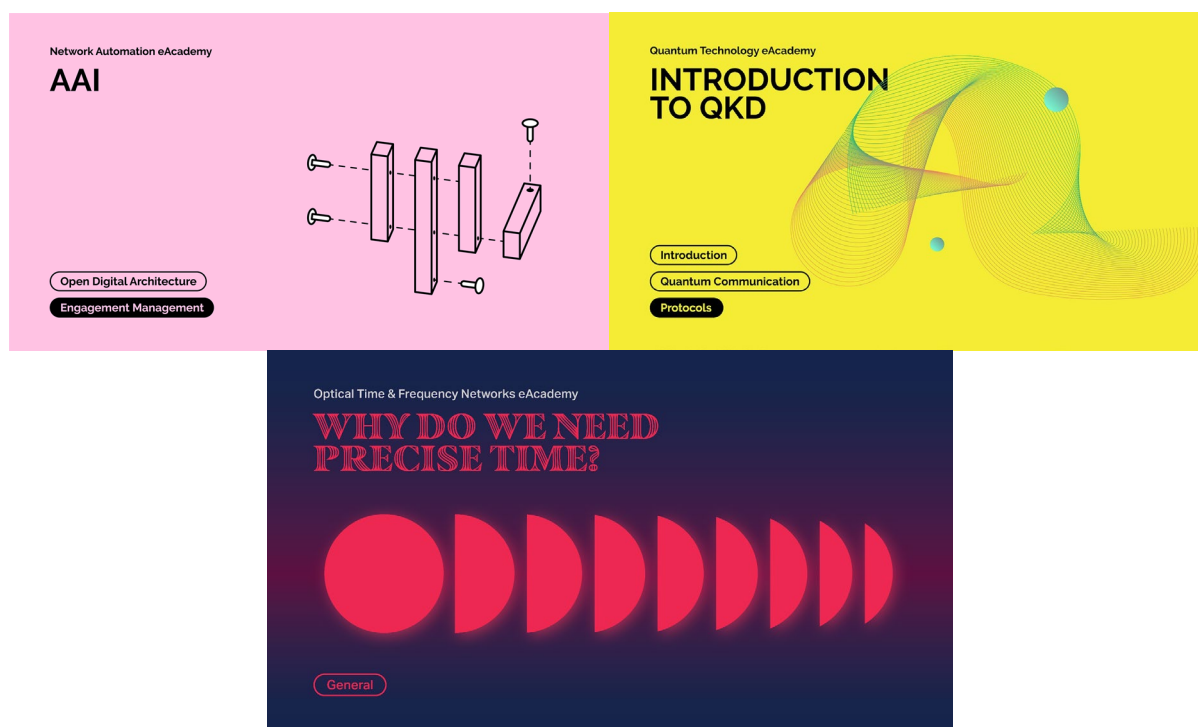


Figure 6.1: Examples of branding for learning units in the Network Automation eAcademy, Quantum eAcademy, and OTFN eAcademy respectively

## 6.3 Dissemination Activities

To reach R&E communities around the world, the Network eAcademy team actively participates in R&E community working groups, conferences and meetings, and publishes articles promoting the team's achievements. New work on data analysis was initiated during the reporting period to produce specific values on user uptake after each of the dissemination activities and publications to demonstrate their impact, and the initial results are clear. The number of active users per month was significantly higher whenever the Network eAcademy was presented in public events – in May, June and November 2025, active users numbered between 75 and 110, compared to 30–50 in months with no dissemination activity. This demonstrates the effectiveness of publishing new learning units and articles, and presenting and organising events, at maintaining the momentum and reach of the Network eAcademy.

### 6.3.1 The Network eAcademy Working Group in GNA-G

The Network eAcademy expanded its reach during the reporting period with the creation of a new working group called Network eAcademy Working Group (WG) under the auspices of the Global Network Advancement Group (GNA-G) [73]. The GNA-G is a community of network professionals from R&E organisations from all over the world [74].

The Network eAcademy WG aims to make the current contents and tools of the Network eAcademy available to the entire R&E community, share knowledge, and discuss with R&E institutions around the world possible improvements to the initiative – particularly in the areas of automation, AI, quantum technologies, OTFN and other fields related to network development. The WG also seeks to support R&E institutions in measuring their OAV maturity status and comparing their OAV architecture with peer organisations.

The WG regularly organises open meetings, having held four during the reporting period, featuring introductory presentations on updates on the Network eAcademy, a focus topic, and feedback from the audience:

- The October 2025 open meeting focused on AI [\[75\]](#)
- The November 2025 open meeting focused on terminology [\[76\]](#)
- The December 2025 open meeting focused on architecture [\[77\]](#)
- The February 2026 open meeting focused on quantum technologies and OTFN training [\[78\]](#)

As well as the web page on the GNA-G portal, the WG also has a section on the NETDEV Wiki [\[79\]](#), with links to the presentations and contact details.

### 6.3.2 Working Groups, Conferences and Meetings

As well as the Network eAcademy WG at GNA-G, the team actively participates in the following R&E community working groups:

- The Network Automation Working Group of the GNA-G [\[80\]](#)
- The Internet2 Automation Working Group [\[81\]](#)
- The Network Automation Forum Slack channel [\[82\]](#)

The Network eAcademy team also participates in sessions on relevant topics and has presented its work in several fora. During Period 1 of the GN5-2 project, the following presentations and dissemination activities were delivered by members of the Network eAcademy team:

- The two GNA-G Community VCs for Q2, “Introduction to the New WG: Network eAcademy” [\[83\]](#)
- Jornadas Técnicas RedIRIS 2025, “¿Cómo estar al día en tecnologías de red?” [\[84\]](#)
- GNA-G Network eAcademy Working Group side meeting at TNC25 [\[85\]](#),
- Jisc Networkshop 2025: Knowledge Sharing and Monitoring for Research and Education [\[86\]](#)
- 10<sup>th</sup> Anniversary SIG-ISM Meeting, “Network eAcademy” [\[87\]](#)
- The two GNA-G Community VCs for Q3, “Network eAcademy” [\[88\]](#)
- CARNET Meeting (THECUC2025), “Network eAcademy” [\[89\]](#)
- Promotional material on the Network eAcademy was displayed in the GÉANT booth at FOSDEM.

In addition to these presentations and collaborations, two Infoshares were held where the Network eAcademy was extensively presented:

- ‘Network eAcademy’ [\[90\]](#)
- ‘How to create learning units for the Network eAcademy and beyond’ [\[91\]](#).

### 6.3.3 Articles

Activities such as Infoshares, the creation of the GNA-G Network eAcademy Working Group or the publication of learning units are announced through articles in GÉANT's CONNECT Online magazine and the GÉANT Project Management Office (PMO) newsletters, and in social media in some cases.

During the reporting period, 17 articles were published in CONNECT Online to promote and disseminate the work of the Network eAcademy team:

- 'New Learning Unit in the Network Automation eAcademy: "Automated Configuration Management: NetBox"' [\[92\]](#)
- 'New Learning Unit in the Optical Time & Frequency Networks eAcademy: "Introduction to Time & Frequency"' [\[93\]](#)
- 'New Learning Unit in the Optical Time & Frequency Networks eAcademy: "Why do we need precise time?"' [\[94\]](#)
- 'New learning unit in the Optical Time & Frequency Networks eAcademy: "Metrology Concepts for Time & Frequency"' [\[95\]](#)
- 'New Learning Unit in the Network Automation eAcademy: "Neural Networks and Deep Learning"' [\[96\]](#)
- 'New learning unit in the Optical Time & Frequency Networks eAcademy: "Time and Frequency Network"' [\[97\]](#)
- 'Infoshare: Network eAcademy' [\[98\]](#)
- 'Orchestration, Automation and Virtualisation (OAV) Maturity Model: a tool to assess where you are and help you reach the next level' [\[99\]](#)
- 'GÉANT Network eAcademy and SoBigData Academy join forces to strengthen their learning initiatives' [\[100\]](#)
- 'GÉANT Network eAcademy expands global scope with new GNA-G Working group' [\[101\]](#)
- 'New learning unit in the Network Automation eAcademy: "Version Control: Bitbucket"' [\[102\]](#)
- 'GNA-G Network eAcademy Working Group Open Monthly Meeting' [\[103\]](#)
- 'New learning unit in the Network Automation eAcademy: Unsupervised Learning' [\[104\]](#)
- 'New learning unit in the Network Automation eAcademy: Product Catalogue' [\[105\]](#)
- 'New learning units for Quantum Technology in the Network eAcademy: "Quantum Key Distribution"' [\[106\]](#)
- 'New skills for the new year: Up your networking game with the Network eAcademy' [\[107\]](#)
- 'New learning unit in the Network eAcademy: Managing complexity with a catalogue driven approach' [\[108\]](#)

Following the corresponding article in CONNECT Online, an article about the collaboration with SoBigData Academy was also published in Science | Business magazine [\[109\]](#).

## 7 Conclusions

The Network eAcademy is a production service run as Task 4 within the Network Development Work Package (WP6) in the GÉANT GN5-2 project. It is a community-driven service that effectively supports the NRENs and R&E organisations in advancing knowledge, skills and capabilities in network technologies and services.

By combining several important areas for digital transformation – such as digital architecture analysis, structured training programmes, digital transformation maturity assessment and shared terminology – the Network eAcademy provides a coherent framework that enables organisations to better understand their current capabilities and plan future developments. The use of the TM Forum Open Digital Architecture as a high-level reference blueprint has proven particularly valuable in supporting architectural alignment, interoperability, and collaboration across heterogeneous systems, while still allowing organisations the flexibility to choose their own technologies and operational approaches. Three organisations have analysed their digital architecture through the Network eAcademy in the reporting period, with fifteen different individual analyses plus a whitepaper on additional architectures being published since the Network eAcademy was launched.

The training programmes offered under the Network eAcademy umbrella represent a significant and tangible contribution to skills development within the R&E community. The Network Automation, AI, Quantum Technologies and Optical Time and Frequency Networks eAcademies provide targeted, self-paced learning resources that accommodate the time constraints and diverse roles of network engineers, managers and architects. Since the launch of the Network eAcademy, more than 3,000 distinct users have followed more than 5,000 learning units under the different training programmes under it. The use of interactive metro maps and clearly defined learning paths enables learners to tailor their training to their individual needs, while collaborations with external initiatives further enrich the available content, give additional value to the projects and avoid duplication of effort.

Recognising the diversity of digital maturity levels across organisations, the OAV Maturity Model offers a practical and structured mechanism for self-assessment and benchmarking that has been followed by seventeen organisations in the R&E community, two of which have taken the survey twice to assess their evolution over time. By addressing both technical and organisational dimensions, the model supports informed decision-making, prioritisation of actions and the definition of realistic roadmaps for progress. Complementary terminology documentation further strengthens alignment within the community by promoting a shared understanding of key concepts across OAV, Artificial Intelligence, and other emerging domains. Four versions of the OAV terminology document have been published over the lifetime of the Network eAcademy, while planned future developments include documentation on other topics such as network programmability, monitoring tools and platforms, OTFN and quantum technologies.

Effective communication and dissemination activities – supported by the NETDEV Wiki, dedicated portals, visual branding, community working groups, and participation in international events – have been instrumental in ensuring broad visibility and uptake of Network eAcademy resources. Further, the continuous collection and analysis of usage data and feedback provide valuable input for the ongoing improvement of the service and help ensure that it remains responsive to community needs.

In conclusion, the Network eAcademy plays a central role in empowering the R&E community to adopt advanced network technologies, improve operational efficiency, and foster collaboration at both national and international levels. Through its flexible, extensible, and community-focused approach, it is well positioned to continue evolving alongside emerging technologies and to remain a key enabler of digital transformation within the GÉANT ecosystem and beyond.

## Appendix A Network Automation eAcademy Learning Units

The following table details the learning units published and updated in the Network Automation eAcademy as of the end of the reporting period.

Area	Learning unit	Publication	Last update
General Introduction to OAV	OAV - Introduction <a href="#">[110]</a>	2020	2025
	OAV Architecture Requirements for NRENs <a href="#">[111]</a>	2021	2025
	The OAV Architecture Blueprint <a href="#">[112]</a>	2021	2025
Introduction to TM Forum ODA Functional blocks	Introduction to Engagement Management <a href="#">[113]</a>	2021	2023
	Introduction to Party Management <a href="#">[114]</a>	2021	2025
	Introduction to Core Commerce Management <a href="#">[115]</a>	2021	2025
	Introduction to Production <a href="#">[116]</a>	2021	2023
	Introduction to Intelligence Management <a href="#">[117]</a>	2021	2025
DevOps	Introduction to CI/CD <a href="#">[118]</a>	2021	2025
	Version control: Bitbucket <a href="#">[119]</a>	2025	
	Version control: GitLab <a href="#">[120]</a>	2023	2025
	Version control: GitHub <a href="#">[121]</a>	2023	2025
	CI/CD: Jenkins <a href="#">[122]</a>	2022	2023
	CI/CD: GitlabCI <a href="#">[123]</a>	2021	2025
Decoupling and Integration	Introduction to Data Modelling, Data Formats, and Protocols <a href="#">[124]</a>	2021	2025
	Data modelling: TOSCA <a href="#">[125]</a>	2025	
	Data Modelling: YANG <a href="#">[126]</a>	2021	2023
	Formats: XML <a href="#">[127]</a>	2022	2025
	Formats: YAML <a href="#">[128]</a>	2021	2025
	Formats: JSON <a href="#">[129]</a>	2021	2023
	Protocols: NETCONF <a href="#">[130]</a>	2022	2025
	Protocols: RESTCONF <a href="#">[131]</a>	2023	2025

Area	Learning unit	Publication	Last update
	Introduction to API <a href="#">[132]</a>	2021	2025
	Process Flow Orchestration <a href="#">[133]</a>	2024	2025
Party Management	User Management <a href="#">[134]</a>	2025	
Core Commerce Management	Product Catalogue <a href="#">[135]</a>	2025	
	Managing Complexity with a Catalogue-Driven Approach <a href="#">[136]</a>	2026	
Production	Introduction to Virtualisation <a href="#">[137]</a>	2022	2025
	Hypervisor-based Virtualisation: KVM <a href="#">[138]</a>	2024	
	Hypervisor-based Virtualisation: XEN <a href="#">[139]</a>	2024	
	Container-Based Virtualisation: Docker / Swarm <a href="#">[140]</a>	2022	2025
	Container-Based Virtualisation: Kubernetes <a href="#">[141]</a>	2022	2025
	Introduction to Automation <a href="#">[142]</a>	2021	2025
	Automation Tools: Ansible <a href="#">[143]</a>	2021	2023
	Automation Tools: Python <a href="#">[144]</a>	2023	2025
	Automation Tools: Juju <a href="#">[145]</a>	2025	
	Introduction to Configuration Management <a href="#">[146]</a>	2021	2025
	Automated Configuration Management: NetBox <a href="#">[147]</a>	2025	
	Introduction to Orchestration <a href="#">[148]</a>	2022	2025
	Orchestration: NSO <a href="#">[149]</a>	2021	2025
Intelligence Management	Data Analytics: Elasticsearch <a href="#">[150]</a>	2023	
	Introduction to Automated Monitoring: Nagios <a href="#">[151]</a>	2024	2025
	Data Analytics: Big Data Storage <a href="#">[152]</a>	2022	2025
OAV Realisation	Towards Intelligent Networks <a href="#">[153]</a>	2022	2023

Table A.1: Learning units published under the Network Automation eAcademy

## Appendix B AI eAcademy Learning Units

The following table details the learning units published and updated in the AI eAcademy as of the end of the reporting period.

Area	Learning unit	Publication
Intelligence Management	Introduction to Artificial Intelligence <a href="#">[154]</a>	2024
	Neural Networks and Deep Learning <a href="#">[155]</a>	2025
	Unsupervised Learning <a href="#">[156]</a>	2025

Table B.1: Learning units published under the Artificial Intelligence eAcademy

## Appendix C Quantum eAcademy Learning Units

The following table details the learning units published and updated in the Quantum eAcademy as of the end of the reporting period.

Area	Learning unit	Publication
Introduction	Quantum Algebra Class: QuBits <a href="#">[157]</a>	2022
	Quantum Algebra Class: Operator Multiplications: Variants <a href="#">[158]</a>	2022
	Quantum Algebra Class: Mathematical Operators <a href="#">[159]</a>	2023
	Quantum Algebra Class: QuBit Entanglement <a href="#">[160]</a>	2024
	Quantum Algebra Class: Teleportation <a href="#">[161]</a>	2024
	Introduction to QKD <a href="#">[162]</a>	2025
	Introduction to QKD Post Processing <a href="#">[163]</a>	2025
How-To Videos	Single Photon Detection <a href="#">[164]</a>	2025
Quantum Standardisation	ETSI Standard Key Exchange APIs <a href="#">[165]</a>	2024

Table C.1: Learning units published under the Quantum eAcademy

## Appendix D OTFN eAcademy Learning Units

The following table details the learning units published and updated in the OTFN eAcademy as of the end of the reporting period.

Area	Learning unit	Publication
Introduction	Why do we need Precise Time? <a href="#">[166]</a>	2024
	Introduction to Time and Frequency <a href="#">[167]</a>	2024
	Metrology Concepts for Time and Frequency <a href="#">[168]</a>	2024
	Time and Frequency Network <a href="#">[169]</a>	2025
	Introduction to Fibre <a href="#">[170]</a>	2025
How-To Cookbooks	Experiences with Setting Up a WR Network <a href="#">[171]</a>	2025

Table D.1: Learning units published under the OTFN eAcademy

## Glossary

<b>AI</b>	Artificial Intelligence
<b>EuroQCI</b>	European Quantum Communication Infrastructure
<b>GLAD</b>	GÉANT Learning and Development
<b>GlobalNOC</b>	Global Research Network Operations Centre
<b>GNA-G</b>	Global Network Advancement Group
<b>GNAT</b>	GlobalNOC Network Automation Tools
<b>NMI</b>	National Metrology Institute
<b>NREN</b>	National Research and Education Network
<b>OAV</b>	Orchestration, Automation and Virtualisation
<b>OAV MM</b>	OAV Maturity Model
<b>ODA</b>	Open Digital Architecture
<b>OTFN</b>	Optical Time and Frequency Networks
<b>PMO</b>	Project Management Office
<b>PQC</b>	Post-Quantum Cryptography
<b>R&amp;E</b>	Research and Education
<b>SWOT</b>	Strengths, Weaknesses, Opportunities and Threats
<b>T&amp;F</b>	Time and Frequency
<b>WG</b>	Working Group
<b>WP</b>	Work Package 6, Network Development

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