

Introduction to OAV

Susanne Naegele-Jackson, FAU/DFN
Maria Isabel Gandia, CSUC/RedIRIS
WP6-T2

TNC

25 June 2021

www.geant.org

OAV Survey - Sections

Existing Network and Services Platform

Current OAV Use Cases and Services

OAV Challenges and Priorities

Future OAV Use Cases and Services

How can the GÉANT Community / the GÉANT Project help?

[*https://www.geant.org/Projects/GEANT_Project_GN4-3/GN43_deliverables/D6-2_Automation-and-Orchestration-of-Services-in-the-GEANT-Community.pdf](https://www.geant.org/Projects/GEANT_Project_GN4-3/GN43_deliverables/D6-2_Automation-and-Orchestration-of-Services-in-the-GEANT-Community.pdf)

Collaborative approach to OAV in the GÉANT Community



Strong need for collaboration and exchange of knowledge and expertise



Knowledge as a gap



We speak different languages

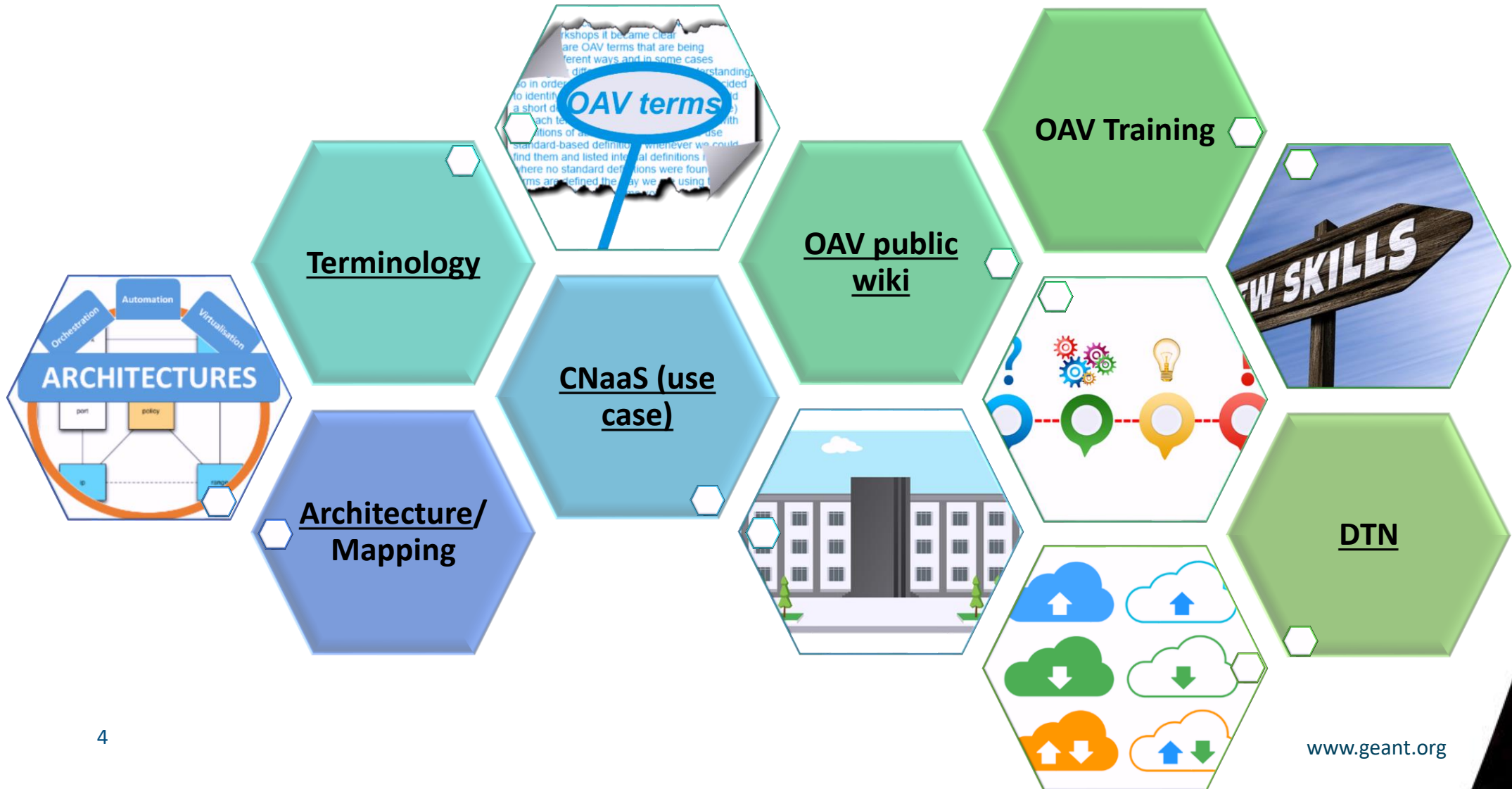


A generally accepted architecture blueprint needed



NRENs are willing to share experiences and learn from others

Consensus Building – OAV focus groups



Terminology

- Need for an agreement on common terminology.
- The idea is to have a common ground of understanding.



Terminology

- The FG identified a list of relevant OAV terms and acronyms.
- There aren't any documents in the literature that include all this information.
- For each term, a short definition with a reference link (source) was included.
- We tried to use standard-based definitions whenever we could find them and listed internal definitions (based on the consensus of all team members) in cases where no standard definitions were found.
- A survey was conducted for final adjustments.
- It was adopted by the GNA-G team as a reference.



<https://wiki.geant.org/display/NETDEV/OAV+Terminology>

<https://www.geant.org/Resources/Documents/GN4-3+White-Paper-Orchestration-Automation-Virtualisation-Terminology-1.1.pdf>

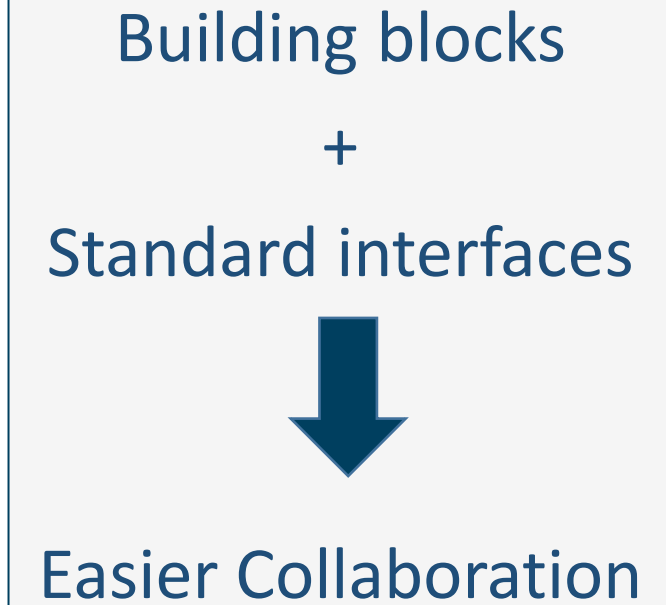
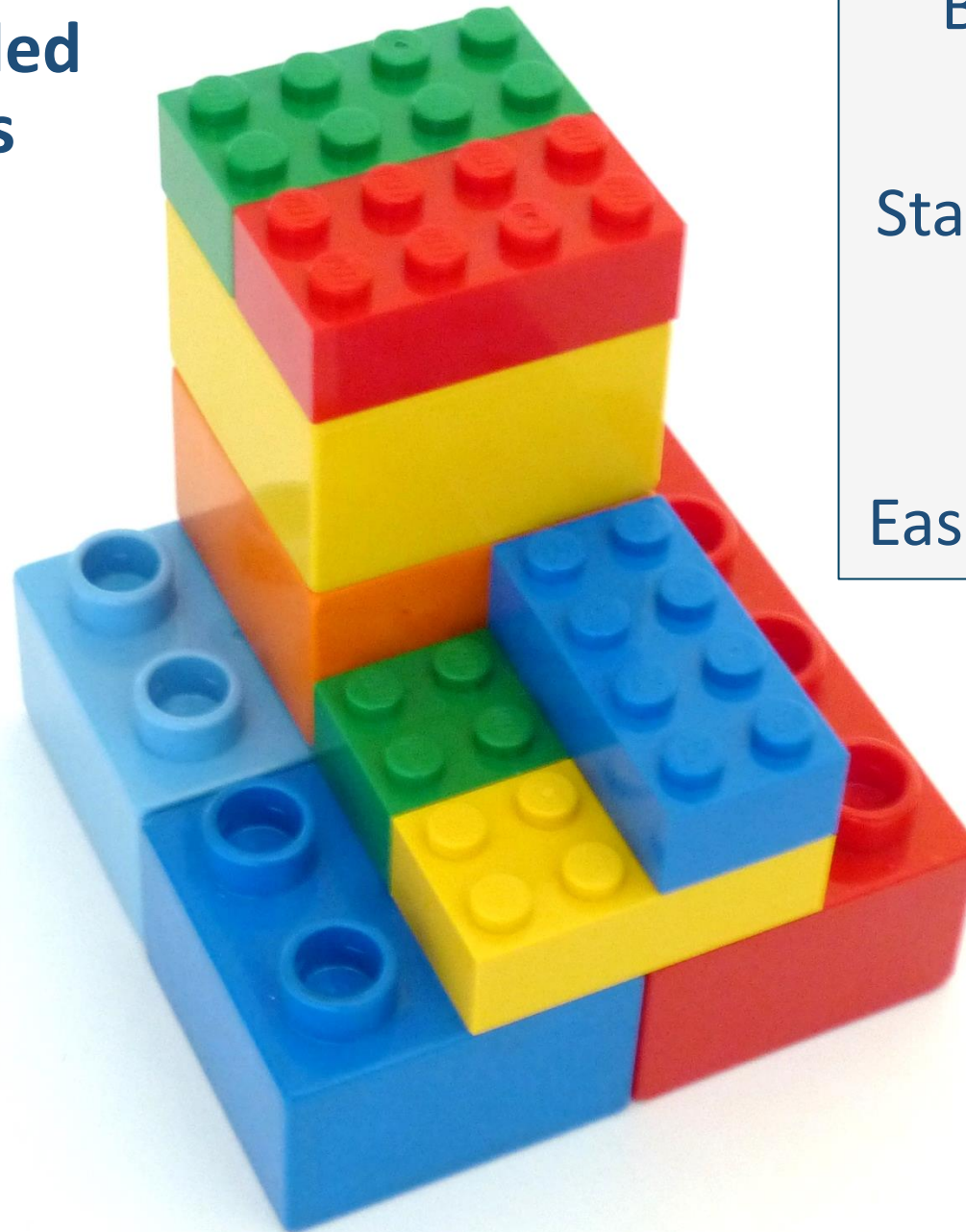
Terminology – Terms and Glossary

OAV Common Terms
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
Glossary

OAV Terms	
Architecture component	Definition and reference An architecture component is a non-trivial, nearly independent, and replaceable part of a system that fulfills a clear function in the context of a well-defined architecture. • TM Forum Reference, TMF071 ODA Terminology, TMF071, Release 19.0.1, October 2019
Architecture principles	Architecture principles define the underlying general rules and guidelines for the use and deployment of all IT resources and assets across the organisation. They reflect a level of consensus among the various elements of the enterprise, and form the basis for making future IT decisions. • based on https://pubs.opengroup.org/architecture/togaf8-doc/arch/chap03.html
API (Application Programming Interface)	An API is a set of commands, functions, protocols, and objects that programmers can use to create software or interact with an external system. Any data can be shared with an application program interface. • based on https://techterms.com/definition/api and https://search.acloudplatform.techtarget.com/definition/application-program-interface-API
Automated service provisioning	Automated service provisioning is the ability to deploy an information technology or telecommunications service by using pre-defined procedures that are carried out electronically without requiring human intervention. • based on https://techterms.com/definition/api and https://search.acloudplatform.techtarget.com/definition/application-program-interface-API
Automation	Processing tasks in a repeatable manner to yield the same result every time without human intervention. • multiple sources including US government documents, e.g. Financial Services and General Government Appropriations for 2016 p.201 (https://books.google.de/books?id=h4D9m33aUcC&printsec=frontcover&hl=de&source=gbs_summary_f&cad=rhl#vonepage&q=2016&f=false)
Blockchain	Blockchain is an expanding list of cryptographically signed, irrevocable transactional records shared by all participants in a network. • internal definition
Cgroups (control groups)	Groups are Linux kernel mechanisms to restrict and measure resource allocations to each process group. Using groups, you can allocate resources such as CPU time, network, and memory. • reduced from TM Forum Reference, TMF071 ODA Terminology, TMF071, Release 19.0.1, October 2019 • https://subscription.pactpub.com/books/application_development/9781765983057/1/ch01we1sect15/namespaces-and-cgroups
Cloud native application	Cloud Native Application (CNA) refers to a type of computer software that natively utilises services and infrastructure provided by cloud computing providers. • reduced from TM Forum Reference, TMF071 ODA Terminology, TMF071, Release 19.0.1, October 2019
Component	A component is a functionally independent part of any system. It performs some function and may require some input or produce some output.

GLOSSARY	
Abbreviation/ Acronym	Description/Definition
ABE	Aggregate Business Entity
AI	Artificial Intelligence
AMC	Autonomic Management and Control
AWS	Amazon Web Services
BPMN	Business Process Model and Notation
BSS	Business Support System
CBP	Ciena Blue Planet
CDE	Component Description
CDN	Content Delivery Network
CNA	Cloud Native Application
CNI	Container Network Interface
CSP	Communications Service Provider
D&I	Decoupling & Integration
DC	Data Centre
DCN	Data Communication Network
DE	Decision Element
DPRA	Digital Platform Reference Architecture
DTN	Data Transfer Node
EACM	Enterprise Architecture Content Metamodel
EGM	Engagement Management
ETSI	European Telecommunications Standards Institute

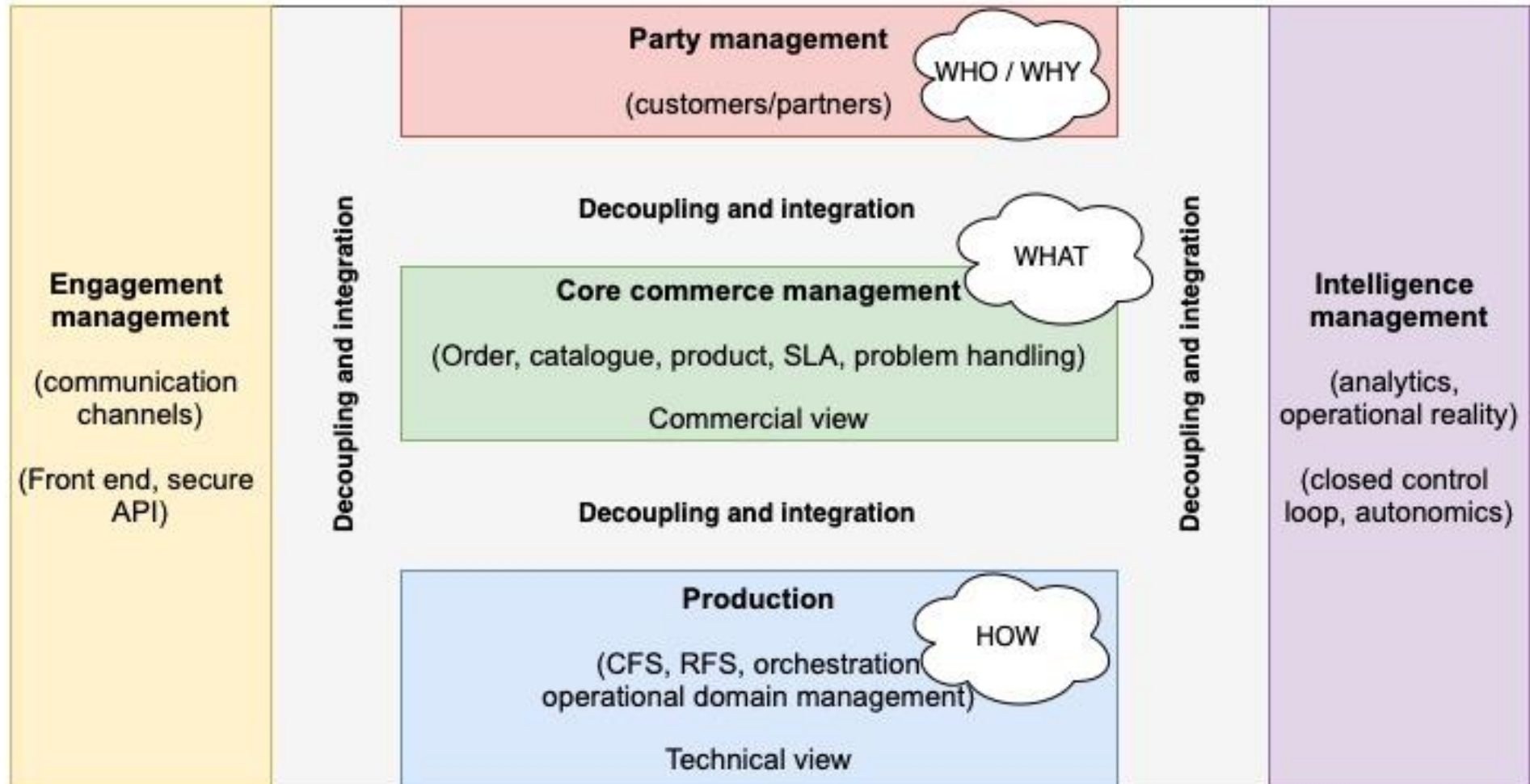
Architecture: Decoupled and Modular Systems



Architecture - The Vegas Rule



Architecture Blueprint: TM Forum Open Digital Architecture



Whitepaper: An Analysis of Existing Architectures

- ETSI (ZSM, OSM(MANO)/NFV, GANA)
- MEF (LSO)
- TMFORUM (ODA, ODF)
- Anuta
- Ciena
- Cisco
- GVM
- SENSE
- TALENT

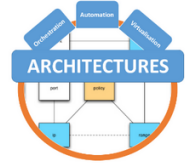
OAV Architectures
Creado por Susanna Naegle-Jackson, modificado por última vez en ene 27, 2021

The Focus Group OAV Architectures is working on identifying a service architecture that allows the creation of new services and workflows that can be shared within the community in a multi-domain fashion with a corresponding orchestration process.






This should result with potential candidate architecture(s) to be used as a blueprint for a common framework upon which the community can develop solutions (or automated agents) that can be orchestrated in a potentially multi-domain environment.

In order to select suitable architecture candidates that could fit the community needs, the OAV FG investigates available architectures that aim to solve all or some of the aspects of OAV. The group then identifies commonalities in terms of module functionalities, APIs and data models and performs a deep dive analysis. This work is followed by a cross comparison with existing proprietary solutions in the community and may enable harmonisation in the multi-domain environment. The work of the FG also involves continuous monitoring of architectures and new solutions as they become available.

Ultimate goal: to provide benefits to the community for the development and implementation on future single and multi-domain digital services.



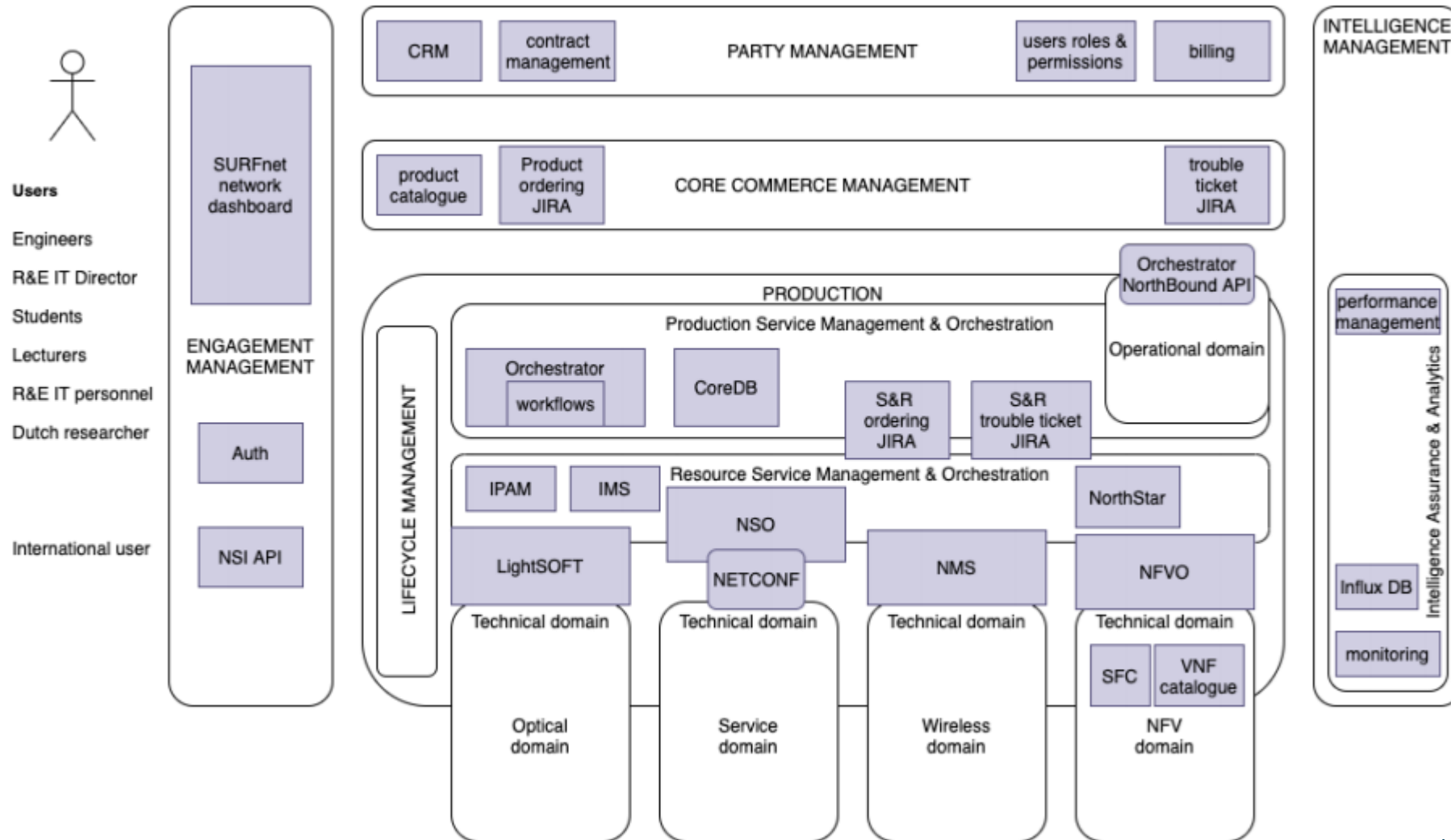
Initial list of identified architectures related to OAV

Standardisation body, organisations, associations based						
Aligned/w	Proposer	Name	Aspects covered by architecture			Link to general info
			Orchestration	Automation	Virtualisation	
	ETSI ZSM	Architectural Framework for End-to-End Service and Network Automation	next-generation management and ops system	fully automated (zero-touch)	NFV + SDN	https://www.etsi.org/technologies/zero-touch-network-service-management
	ONAP	Platform Architecture Dublin Release (blueprints for key use cases)	synchronously orchestrate physical and virtual network functions	closed-loop automation	VNF / SDN / VM / Cloud	https://www.onap.org/architecture
	MEF LSO	Architecture for Lifecycle Service Automation	orchestrated multi-domain services	APIs to automate the entire service lifecycle	NFV, SDN	https://www.mef.net/lso/lifecycle-service-orchestration
	ETSI	OSM (MANO)	Management and Orchestration (MANO) software stack aligned with ETSI NFV	closed-loop automation, policy driven automation	NFV, layering, abstraction	https://www.etsi.org/technologies/nfv/open-source-mano https://osm.etsi.org
	GANA	GVM / GTS	orchestration	automated agents to	virtualisation	https://www.geant.org/Projects/GEANT_Project_GNA/deliverables/D8.9_GE%CC%81ANT-Testbeds-Service-6.0.pdf

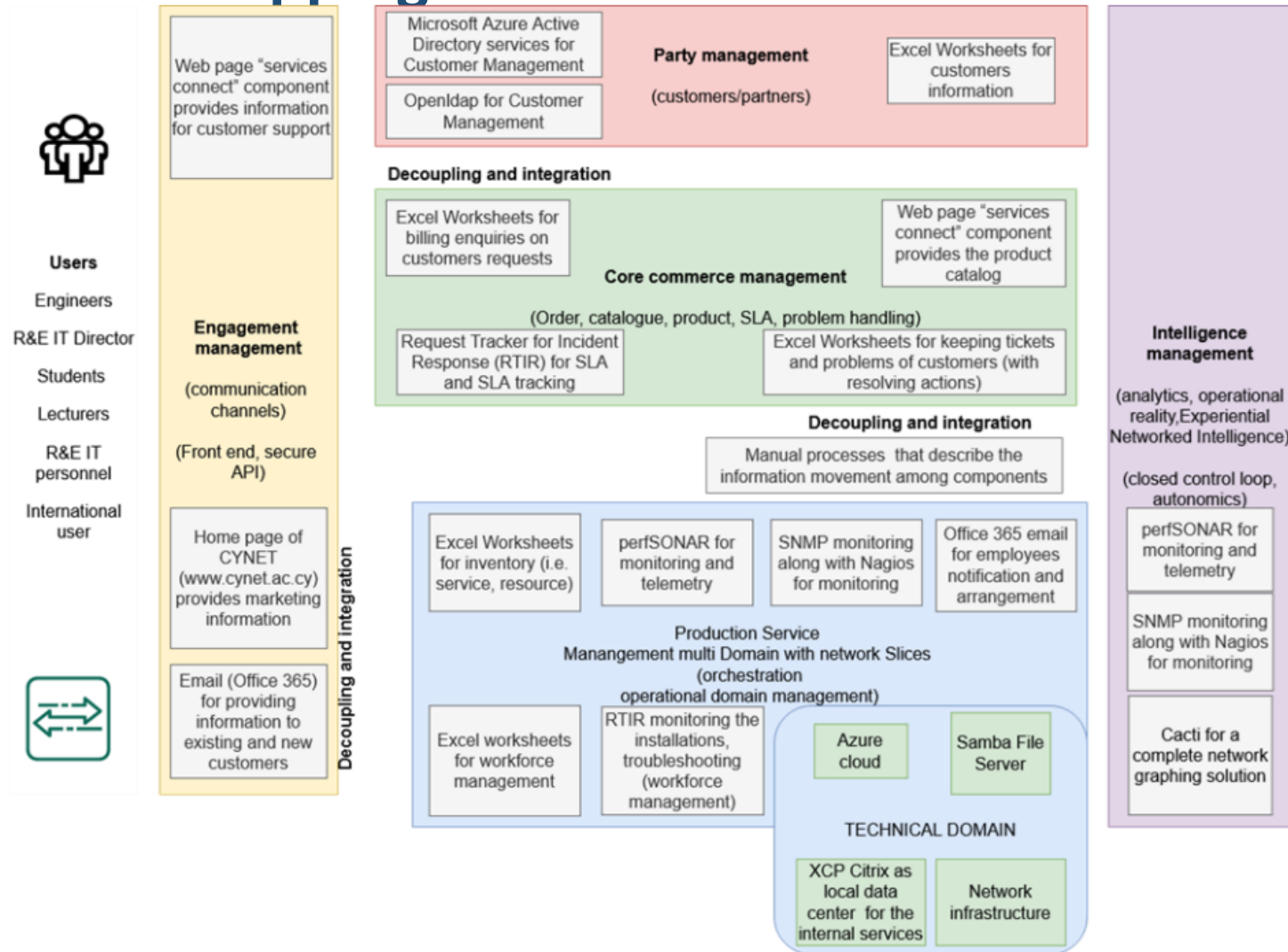
<https://wiki.geant.org/display/NETDEV/OAV+Architectures>

[https://www.geant.org/Resources/Documents/GN4-3_White-Paper_OAV-Architectures%20\(002\).pdf](https://www.geant.org/Resources/Documents/GN4-3_White-Paper_OAV-Architectures%20(002).pdf)

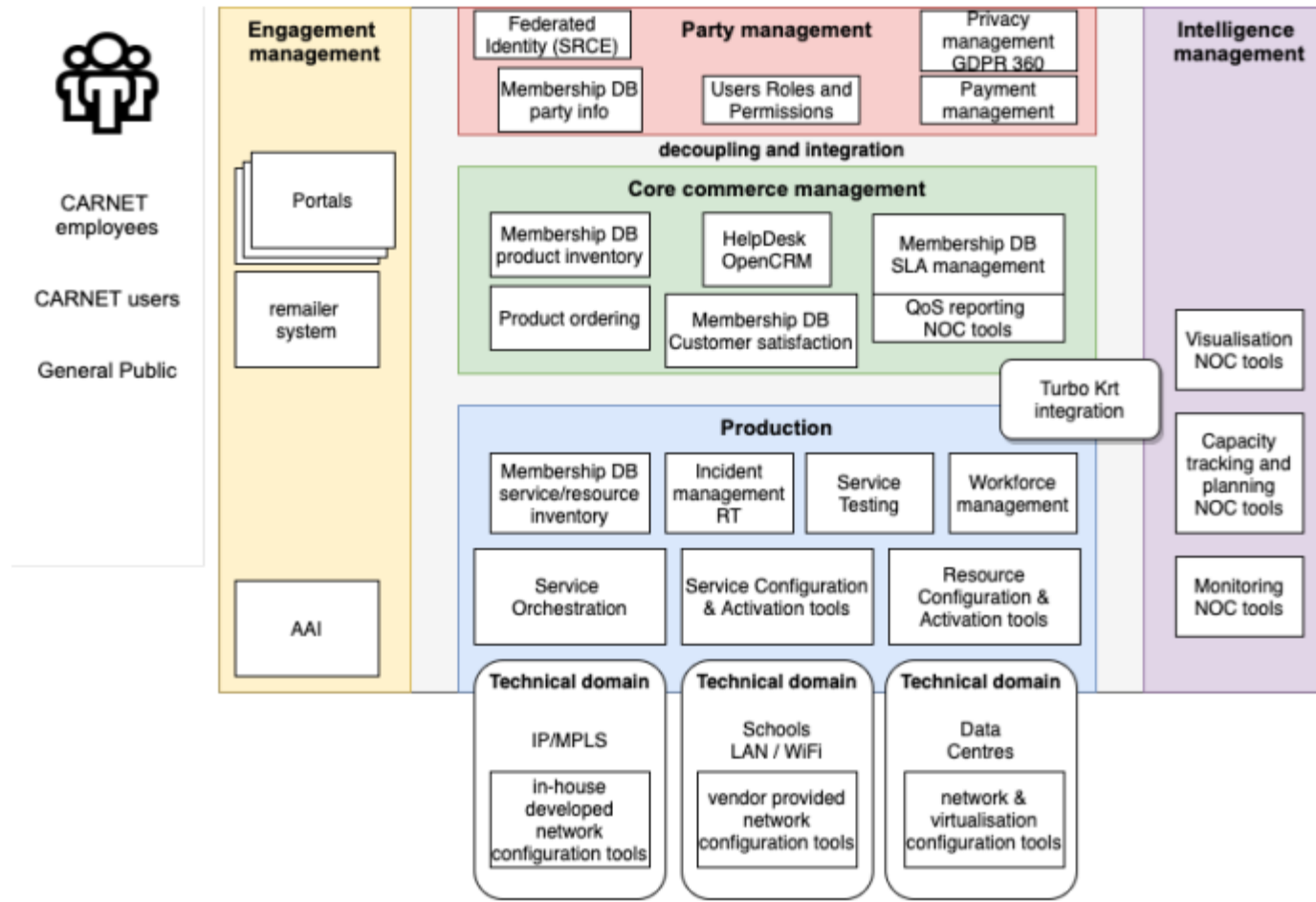
Architecture Mappings: SURF



Architecture Mappings: CYNET

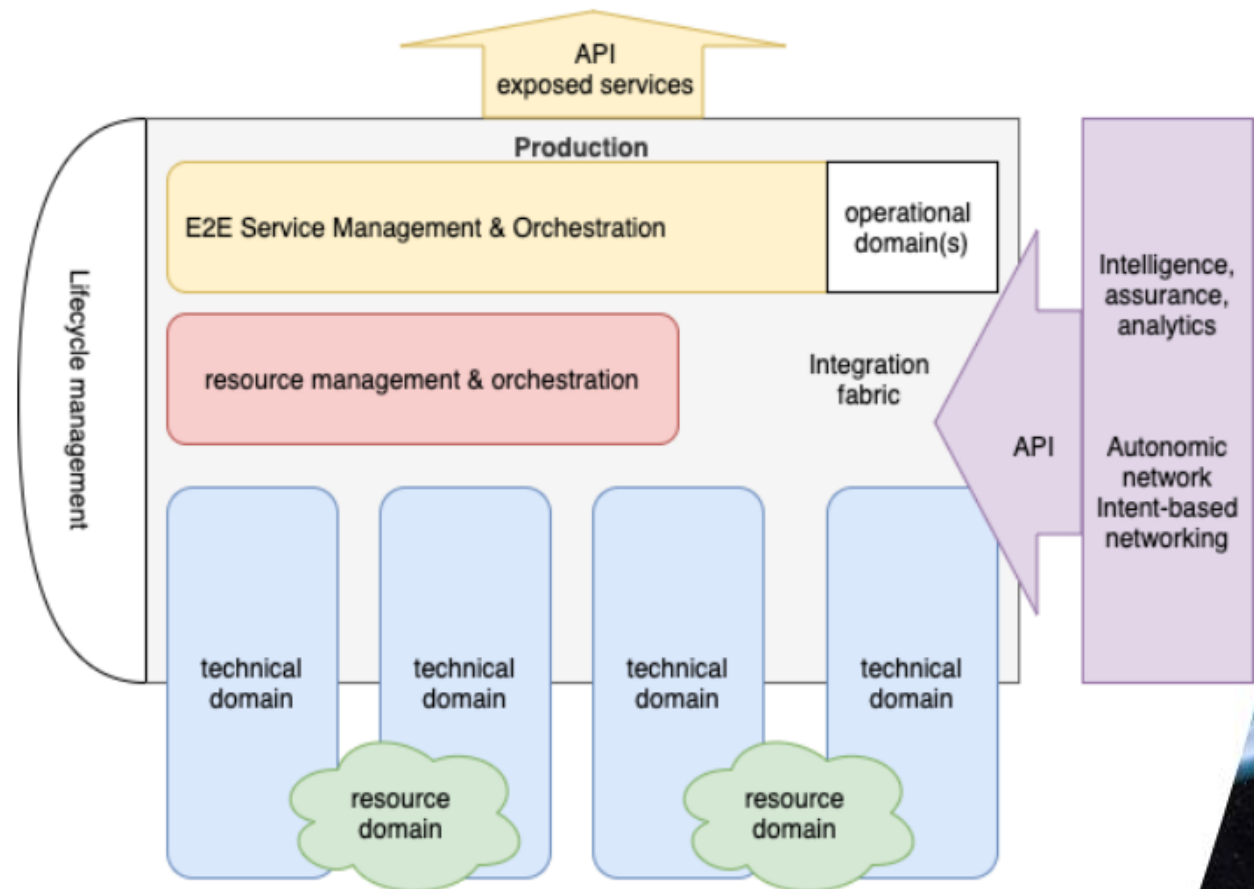


Architecture Mappings: CARNET

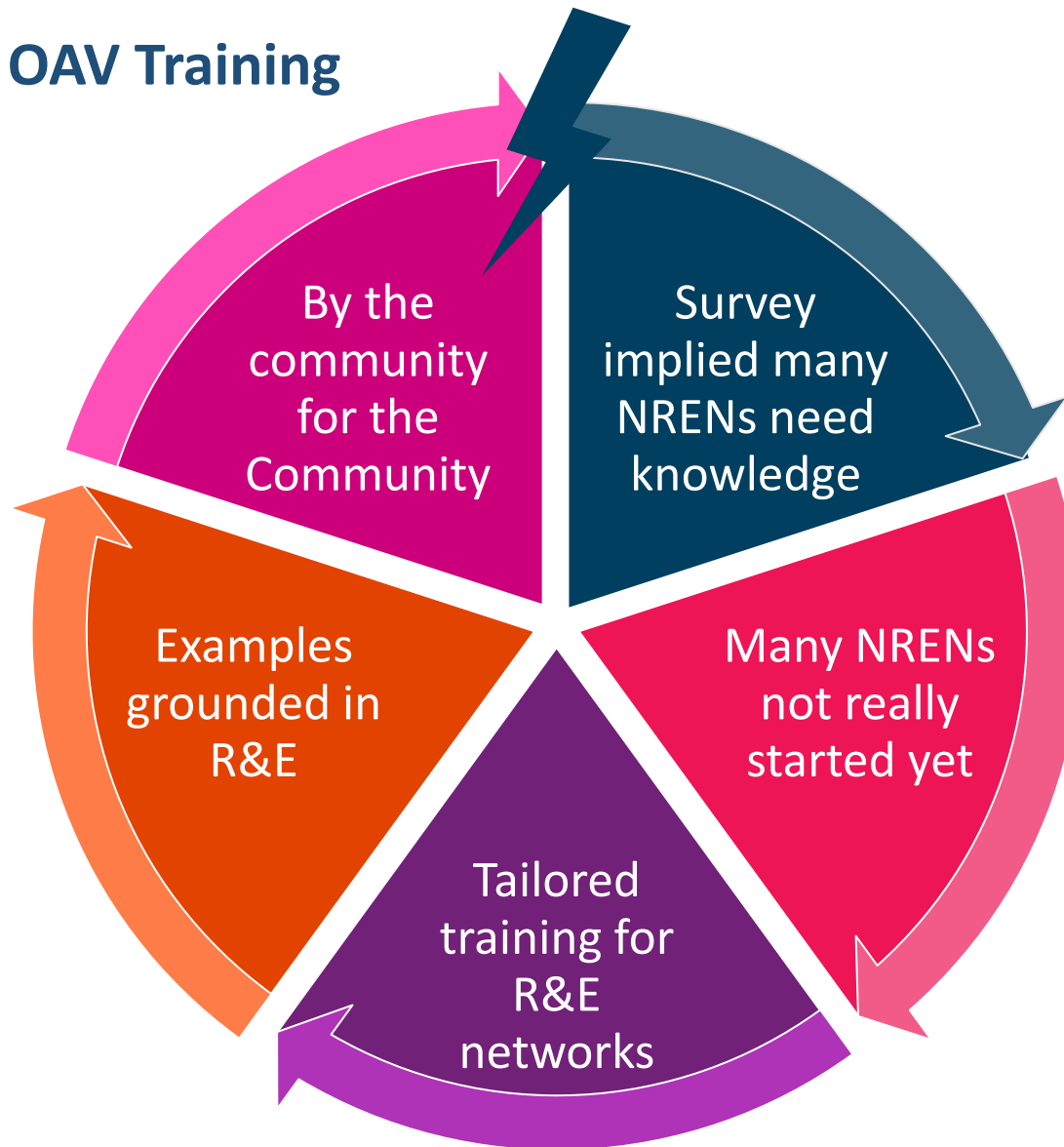


Architecture Mappings

- Currently working on:
 - GÉANT
 - HEAnet
 - GRNET
 - PSNC
 - (your NREN here?)



Training: The Need for OAV Training



Powered by:



www.geant.org

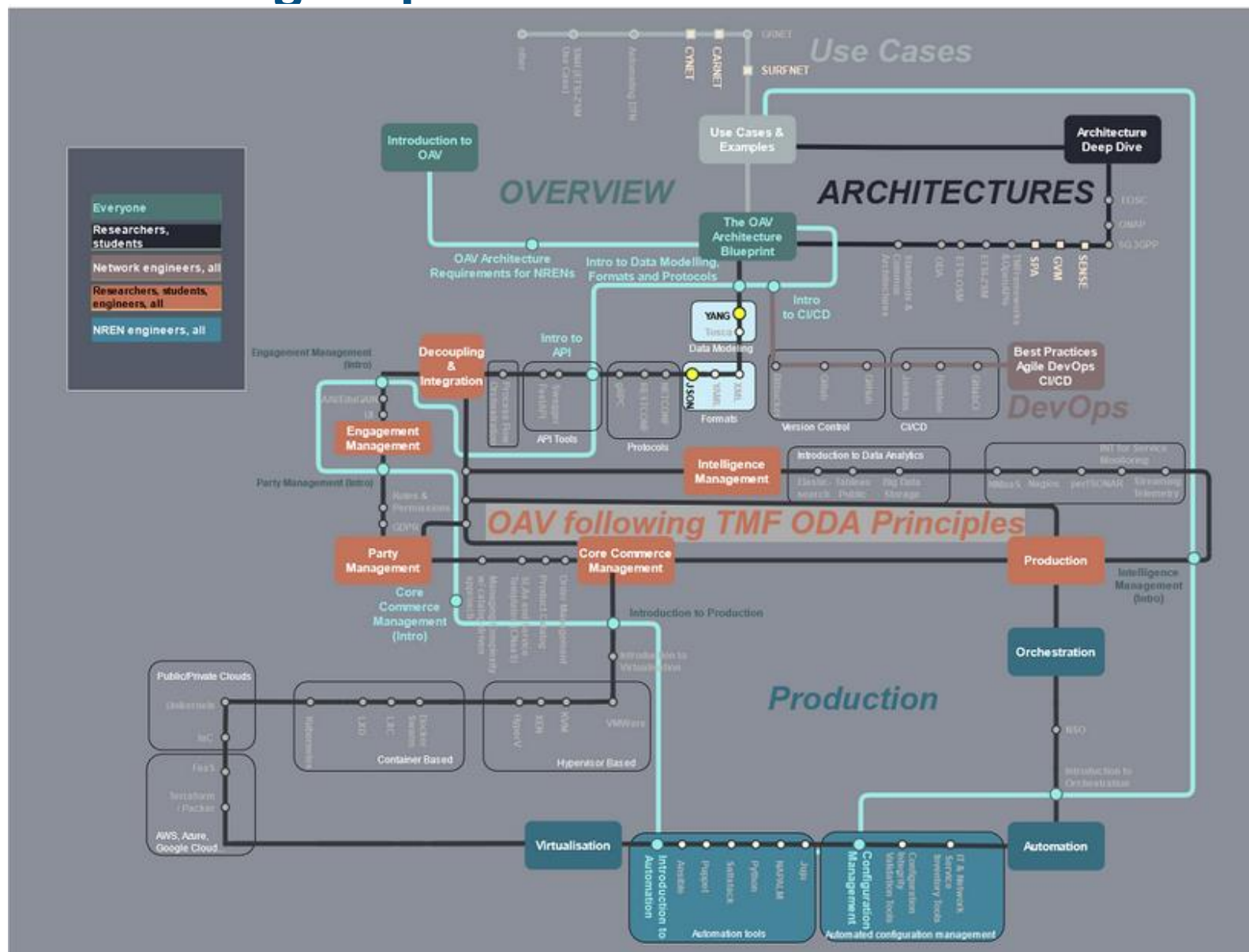


Your Trainers

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)
Martin Dunmore (Jisc)	Simone Spinelli (GÉANT)
Sonja Filiposka (MARNET / USC)	Kostas Stamos (GRNET / CTI)
Maria Isabel Gandia (RedIRIS/CSUC)	Pavle Vuletić (AMRES)
Eduardo Jacob (RedIRIS / UPV/EHU)	Your name here?
Iacovos Ioannou (CyNet)	



The OAV Training Map




Open Window to the Trainers

- By video conference on the first Tuesday every month.
- Just drop us an e-mail: oav@lists.geant.org, we will send you the link.

OAV Training Portal

Creado por Susanne Naegel-Jackson, modificado por última vez ayer a las 09:44



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. The portal will have new classes available for you to explore every couple of weeks; all classes are online courses that you can follow and complete at your own pace.

Courses

Introduction

- [OAV - Introduction](#)
- [OAV Architecture Requirements for NRENS](#)
- [The OAV Architecture Blueprint](#)

DevOps

- [Introduction to CI/CD](#)

TM Forum Open Digital Architecture

- Decoupling & Integration
 - [Introduction to Data Modelling, Data Formats, and Protocols](#)
 - [Introduction to API](#)
 - [Formats: JSON](#)
 - [Data Modelling: YANG](#)
- Engagement Management
- Party Management
- Core Commerce Management
 - [Introduction to Core Commerce Management Processing](#)
- Production
 - [Introduction to Automation](#)
 - [Introduction to Configuration Management](#)

Additional Reading

NREN Architecture Mappings


- CARNET (coming soon)
- CYNET
- GRNET (coming soon)
- SURFNET

Architectures

- GVM
- SENSE
- SPA

Info | Infoshares ++ Events

- [all upcoming and past events](#)



Meet us on the first Tuesday of every month

One hour for questions & answers

Just drop us an email at oav@lists.geant.org and we will send you the link.

OAV Video



<https://youtu.be/Q5Wg1Qnqybg>

OAV Wiki - Knowledge Sharing and Global Exchange

Orchestration, Automation and Virtualisation (OAV)

Introduction

Welcome to the open GÉANT project wiki area for orchestration, automation and virtualisation (OAV).

This area will be used for knowledge sharing and exchange between GÉANT, NRENs, and organisations interested in applying OAV principles to their network operations. It is also intended to serve as a platform to discuss strategies, common use cases and ideas related to network and service orchestration, automation and virtualisation in our GÉANT community and beyond.

More material will be added on a continuous basis.



Important Links

- [OAV Literature](#) - references to OAV related literature
- [Dissemination](#) - presentations and deliverables
- [Standardisation Bodies](#) - useful links to standardization bodies and specific OAV material
- [Highlights](#) - focus areas in OAV

Infoshares ++ Events

- [all events](#)
- [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

Contact Us

We are very interested to hear from members of the community working on OAV, whether you wish to share your knowledge or find out more about OAV yourselves. You can email the GN4-3 WP6 OAV team at

oav@lists.geant.org

For OAV discussions please email to

oav-discuss@lists.geant.org

Current focus



Training Portal

New classes are available on our Training Portal. The current focus is on orchestration, automation and virtualisation, but also on architectures and CI&CD. [Read more...](#)



OAV Architectures

Follow our work with our latest White Paper: "OAV Architectures" ([pdf](#)) (May 26, 2021). Or enjoy our new pamphlet "Towards Collaborative Digital Services" ([pdf](#)) and White Papers of NREN OAV architecture analyses. Latest NREN examples are CYNET ([pdf](#)) and SURFNET ([pdf](#)). [Read more...](#)



OAV Terminology

New definitions based on internal discussions within WP6 and just recently also in consensus with the GNA-G community. This updated whitepaper is now available ([pdf](#)) and can serve as a guideline to members of the community. [Read more...](#)

Applied Automation



SPA - Service Provider Architecture

A service management platform that is based on the TMForum Open Digital Framework. Follow our latest Deliverable D6.6: Transforming Services with Orchestration and Automation ([pdf](#)). [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...](#)











CNaaS - Campus Network Management-as-a-Service

Several European NRENs have started offering Campus Network Management as a Service (CNaaS) to their connected institutions, either because the end-institutions or the governments have requested them to do it. Defining the new model, automating the infrastructure and sharing the management are some of the new challenges to solve. [Read more...](#)

The OAV Community Portal

- Each NREN or connected institution may present their OAV work or provide links.
- NRENs willing to share information or find out more about OAV can reach the team at oav@lists.geant.org.

OAV Community Portal		
Creado por Susanne Naegele-Jackson, modificado por última vez en abr 29, 2021		
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z		
	OAV Examples by Country	
AARNET, Australia		<ul style="list-style-type: none">• https://www.aarnet.edu.au/• Hindrik Buining, David Jericho, Orchestration, Automation and Virtualisation, BOF, TNC19, Tallinn, Estonia, June 20, 2019 (pdf)
ARNES		<ul style="list-style-type: none">• https://www.arnes.si/• ARNES is working on the project WLAN-2020 to offer wireless connection within the schools in the country, hiring consultants during the deployment phase. They are using Automator as the middleware and doing ZTP (Zero Touch Provisioning).• They have built the ARNES network service orchestration stack, automation based on Ansible.• https://geant.app.box.com/s/68pzsqbkbco9683j8qybgol5zlu7jhtz
CARNET		<ul style="list-style-type: none">• https://www.carnet.hr/• Damir Regvar, Lidija Jakovčić, Silvije Milišić, CARNET OAV, BOF, TNC19, Tallinn, Estonia, June 20, 2019 (pdf)• CARNET is also working on a national project to offer wireless connection within the schools in the country (https://www.e-skole.hr/en/results/adequate-ict-infrastructure-in-pilot-schools/), with a network management system built by them (Management system for the educational system). CARNET does the network provisioning and monitoring through an API: https://geant.app.box.com/s/fji5tdbv2dhxifed137k17mj806mmi16• See the lightning talk during the Network Management and Monitoring Workshop.
CSUC		<ul style="list-style-type: none">• https://www.csuc.cat• CSUC has automated the provisioning of new circuits in the L2 and L3 devices using Rundeck, Python scripts and Ansible modules for Anella Científica (Regional Research and Education Network in Catalonia).• For the Internet Exchange, CATNIX, CSUC has an internal portal where customers can add their new MAC addresses and the filters are uploaded in the switches through Python scripts.
CyNet		<ul style="list-style-type: none">• http://www.cynet.ac.cy/• whitepaper: CYNET OAV Architecture Analysis, https://www.geant.org/Resources/Documents/GN4-3_White-Paper_CYNET_OAV_Architecture_Analysis.pdf• Iacovos Ioannou. Active member of OAV working group of WP6-T2.
ESnet, USA		<ul style="list-style-type: none">• http://es.net/• John MacAuley, Service orchestration in ESnet6, BOF, TNC19, Tallinn, Estonia, June 20, 2019 (pdf)
FUNET		<ul style="list-style-type: none">• https://www.csc.fi/funet-kaikki-palvelut

Use cases: CNaaS (Campus Network Management as a Service)

- ✓ NRENs offering CNaaS use OAV techniques
- ✓ As in OAV, there are many different approaches and targets
- ✓ Evidence of high level of NREN interest
- ✓ Clear need to share information



#cnaas
slack channel

cnass-discuss@lists.geant.org
mailing list

Discussion
channels

Community Portal:
<https://wiki.geant.org/display/OAV/OAV+Community+Portal>

Community meetings:

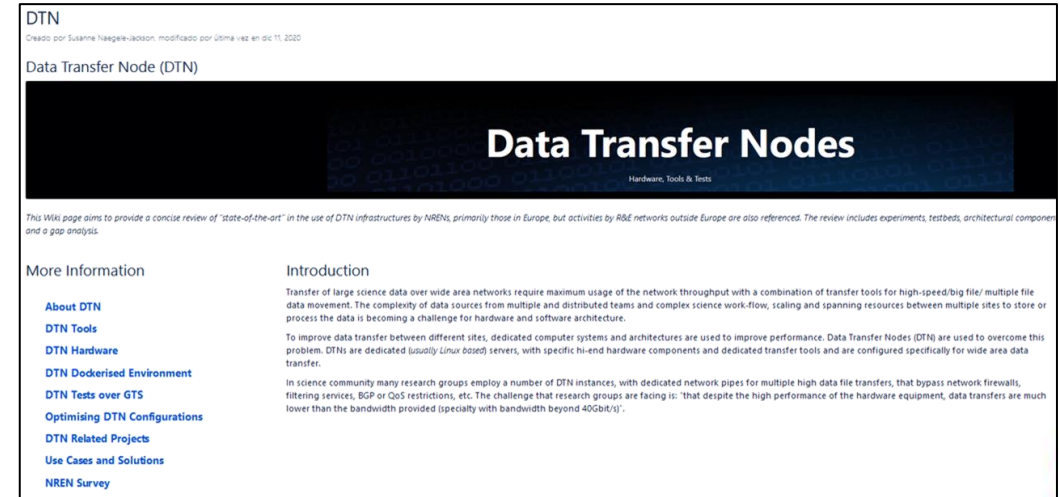
- SIG-NOC meetings
- NEMMO

Infoshares

Use cases sharing

Use cases: DTN (Data Transfer Nodes)

- Tests on the GÉANT Testbed Service (GTS) – Up to 10 Gbps
 - Bare Metal Servers
 - Virtual Machines
 - Containerised infrastructure with Docker
→ Easy way to set up DTNs and test software tools for “long-tail” science
- Guidelines for tuning DTN parameters
 - Networking
 - Storage
 - Architecture



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

OAV: Towards Digital Services



OAV WIKI

<https://wiki.geant.org/display/OAV>



oav@lists.geant.org

The WP6 T2 team
can help you on your
OAV journey.



WHERE TO START?

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

THE AUTOMATION, ORCHESTRATION AND VIRTUALISATION JOURNEY



FROM A TRADITIONAL OSS/BSS

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



VIA A DIGITAL PLATFORM

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



TO AN INTEROPERABLE COMMUNITY

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

Digital Platform Concepts and Principles*

* based on the TMForum Open Digital Architecture



Architecture building blocks

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



open APIs



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

Orchestration and Automation

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



Service abstraction



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




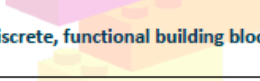
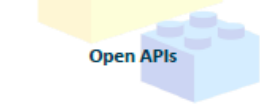
TOWARDS COLLABORATIVE DIGITAL SERVICES

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

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

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

Fostering collaboration and interoperability via common principles and guidelines

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



© GÉANT Association on behalf of the GN4-3 and GN4-3N Projects. As part of the GÉANT 2020 Framework Partnership Agreement (FPA), the projects receive funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 856726 (GN4-3) and Grant Agreement 856728 (GN4-3N).

To learn more about GN4-3/GN4-3N visit www.geant.org/geantproject or use the QR code →



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

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

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

ODA Benefits

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

OAV Wiki Knowledge Base

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



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



Contact us at oav@lists.geant.org

Download it here:

https://wiki.geant.org/display/OAV/?preview=/123792049/188907541/OAV_Arch_text_and_infographics.pdf

Thank you

Any questions?

Or email us:

oav@lists.geant.org

www.geant.org



© GÉANT Association on behalf of the GN4 Phase 3 project (GN4-3).
The research leading to these results has received funding from
the European Union's Horizon 2020 research and innovation
programme under Grant Agreement No. 856726 (GN4-3).