Orchestrate day-to-day operations based on a single source of truth

The case of GP4L

Prof. Sonja Filiposka (UKIM), Roman Łapacz (PSNC)

RIPE NCC, Athens, Greece

22-23 April 2024

GN5-1

Agenda

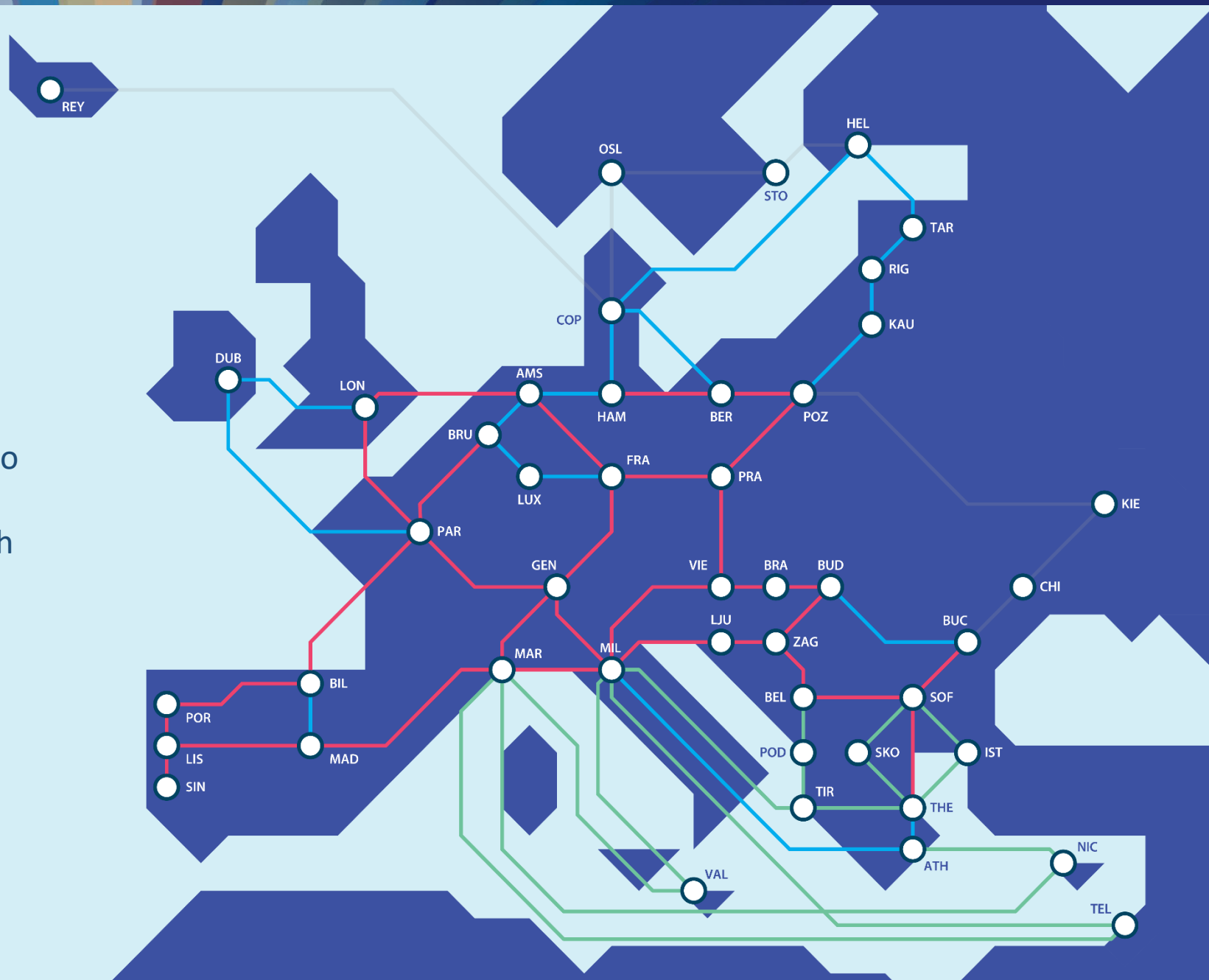
- GÉANT
- The Global Platform for Labs (GP4L)
- Automation and Orchestration in GP4L
  - Components
  - Use cases
  - Service provisioning pilot
  - Future work

- GÉANT
- The Global Platform for Labs (GP4L)
- Automation and Orchestration in GP4L
  - Components
  - Use cases
  - Service provisioning pilot
  - Future work

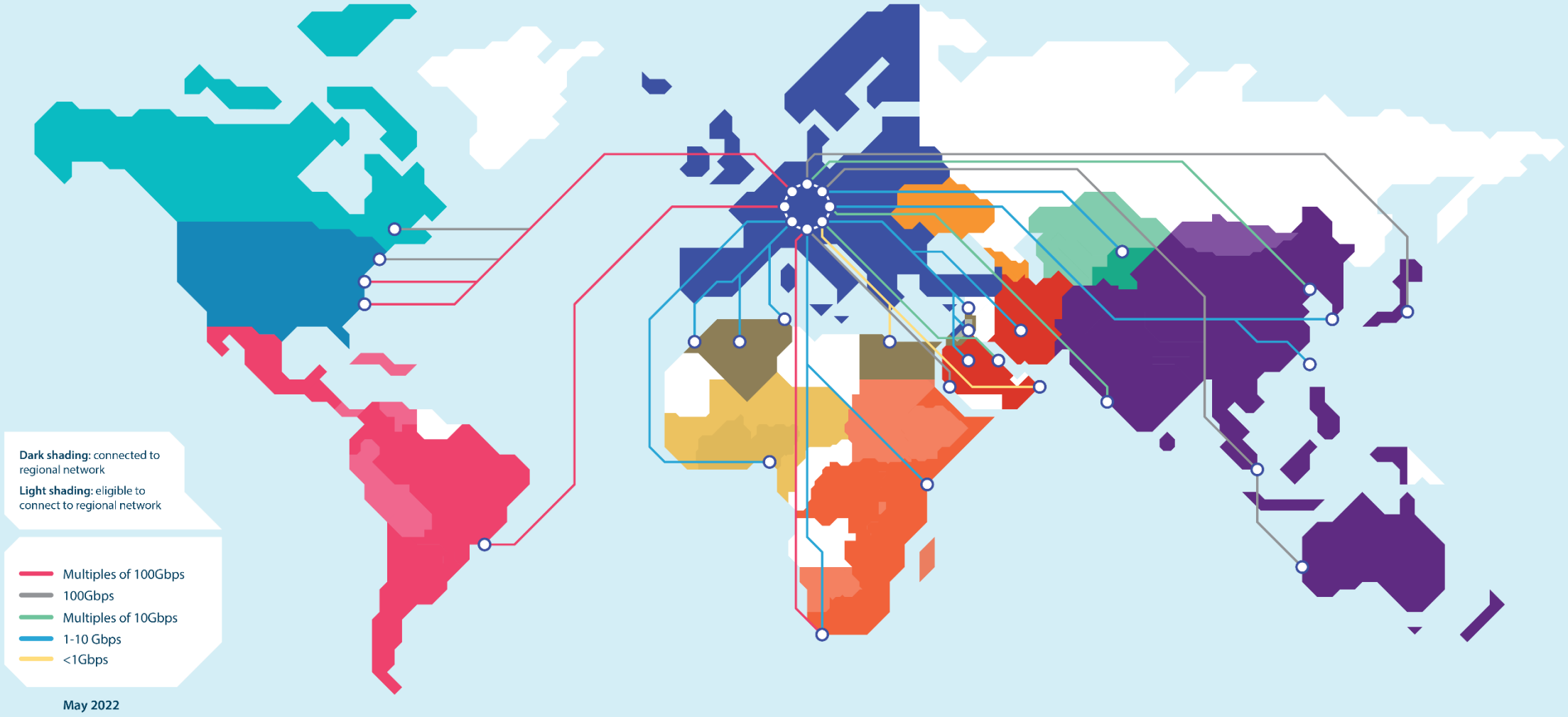
GÉANT Network

The GÉANT network interconnects research, education and innovation communities worldwide, with secure, high-capacity networks.

We design, plan, build and operate the large-scale, high-performance GÉANT network that connects European NRENs to each other and the rest of the world for sharing, accessing and processing the high data volumes generated by research and education communities and for testing innovative technologies and concepts.



At the heart of global research and education networking



- GÉANT
- The Global Platform for Labs (GP4L)
- Automation and Orchestration in GP4L
  - Components
  - Use cases
  - Service provisioning pilot
  - Future work

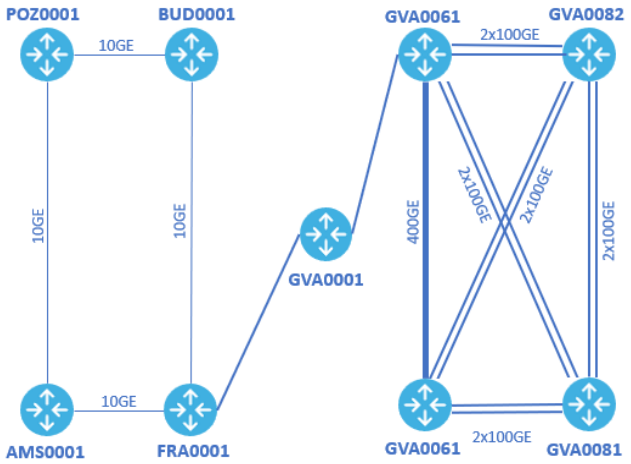
The Global Platform for Labs (GP4L)

1. GP4L infarstructure for experiments
2. GP4L pilots of network orchestration and automation

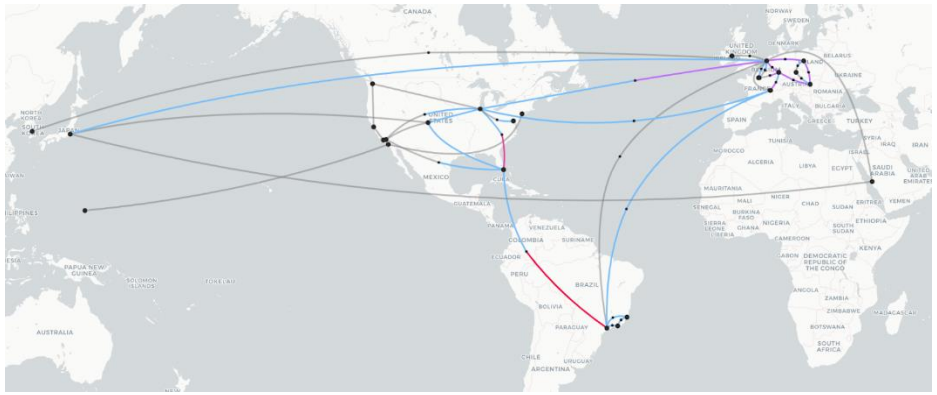
https://wiki.geant.org/display/GP4L/Home

GP4L experiments 1

A programmable network infrastructure for the GÉANT community to run experiments of cutting-edge network technologies.



GÉANT Core & Community



id	node	institution	country
1	ams0001	GEANT	NL
2	fra0001	GEANT	DE
3	bud0001	GEANT	HU
4	poz0001	GEANT	PL
5	bud0002	MC36	HU
6	par0001	RENATER	FR
7	gva0001	SWITCH	CH
8	chi0041	STARLIGHT	US
9	tcd0021	Trinity College of Dublin	IR
10	par0101	GEANT	FR
11	rio0021	RNP	BR
12	pra0101	GEANT	CZ
13	e513-e-yecwh-1	CERN	CH
14	bur0051	CALTECH	US
15	mia0001	AM-Light	US
16	sao0021	RNP	BR
17	vit0071	UFES	BR
18	dub0021	HEANET	IR
19	bwi0001	University of Maryland	US
20	bur0001	CALTECH	US
21	bur0002	CALTECH	US
22	bur0061	CALTECH	US

id	node	institution	country
23	bna0021	Tennessee Tech	US
24	CJJ0001	KISTI	KR
25	jed0101	KAUST	UAE
26	hnd0001	KDDI	JP
27	gva0061	GEANT	CH
28	gva0062	GEANT	CH
29	gva0081	GEANT	CH
30	gva0082	GEANT	CH
31	umu0001	University of Murcia	ES
32	bio0001	University of Pays Basques	ES
33	bio0071	University of Pays Basques	ES
34	hnd0101	KDDI	JP
35	ams0002	University of Amsterdam	NL
36	san0111	San Diego Supercomputer Center	US
37	gum0111	University of GUAM	US
38	nyc0111	NYSERNet	US
39	chi0111	Pacific Wave	US
40	mia0101	Florida International University	US
41	cph0021	Technical University of Denmark	DK
42	lax0111	CENIC - Los Angeles	US
43	sjc0111	CENIC - Sunnyvale -	US
44	sea0111	CENIC - Seattle	US

GP4L pilots – towards digital platforms

2

GP4L as a playground for the work on solutions to orchestrate and automate network operations.

- Digital twin (containerlab)
- Orchestrated and automated network service provisioning (orchestrators, Ansible, SSoT, scheduling, monitoring, backup)
- Network visualization
- Network management in the Cloud (nmaas vNOC)
- Education (Network Automation eAcademy)

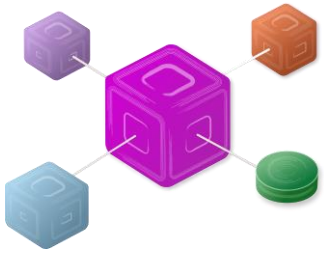
NMaaS

- GÉANT
- The Global Platform for Labs (GP4L)
- Automation and Orchestration in GP4L
  - Components
  - Use cases
  - Service provisioning pilot
  - Future work

Orchestration and automation components

- Orchestrator for workflow management
  - Service lifecycle management modeled as processes
  - APIs for integrating/calling independent tools
- Automation tools
  - Network configuration with Ansible
- Source of Truth
  - Desired state of the network
- Pre-production tests in the virtual twin
  - Verification of network configuration

Source of Truth (SoT) for orchestrated services



- Represents the desired state of the network - declarative approach
- The correct state given in the Single Source of Truth must be mirrored across the infrastructure
- An essential element of Infrastructure as Code (IaC) that facilitates the management and provisioning of infrastructure via code rather than manual procedures

Maat as SoT

Maat

Maat is a microservice for open digital platforms that serves as a single source of truth for physical and logical resources and/or services.

Open standard-based API

- Full CRUD support offers automation and orchestration implementation out of the box
- AuthN with OAuthN 2.0
- TMF638 Service management REST API
- TMF639 Resource management REST API

Extensible data model

- JSON-based data model for resources and services
- Request validation based on data model schema file
- Data model extensions do not require changes in the application code or in the database
- Support for multiple data models defined in schema files provided by the user

Event notifications

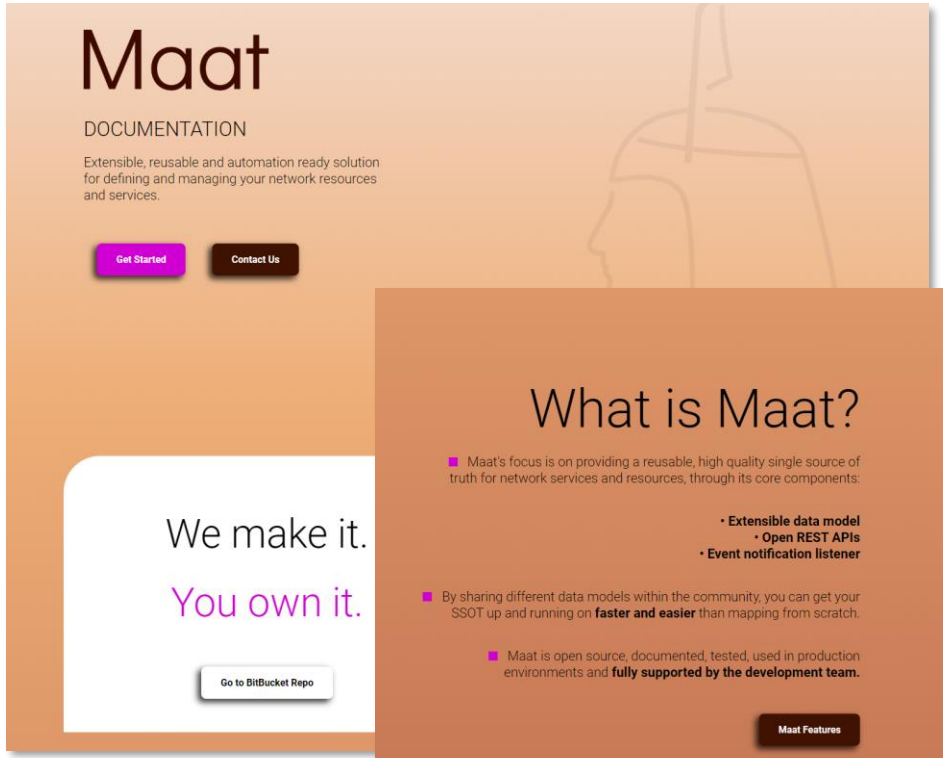
- External applications can register and listen to selected inventory events
- Events can be archived (EventListener)
- TMF standard API

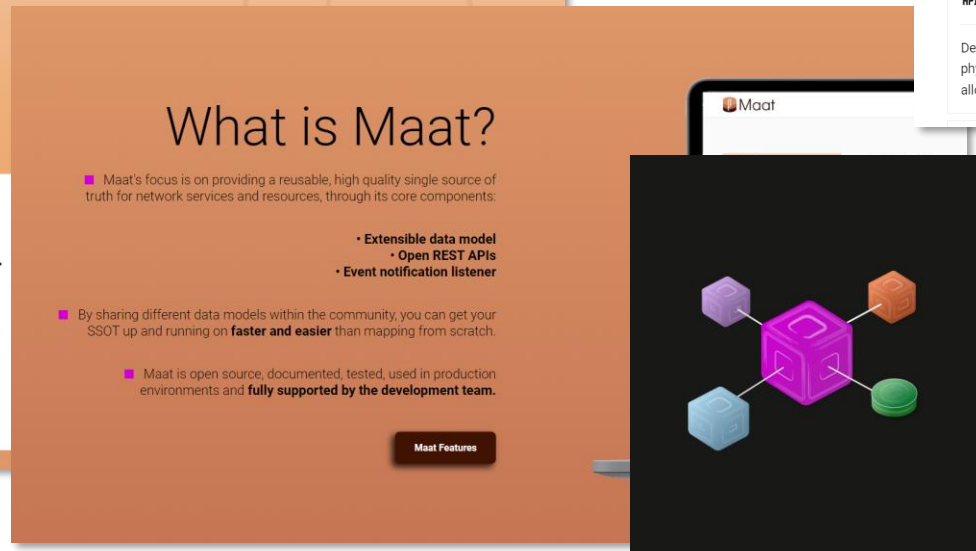
Technology stack

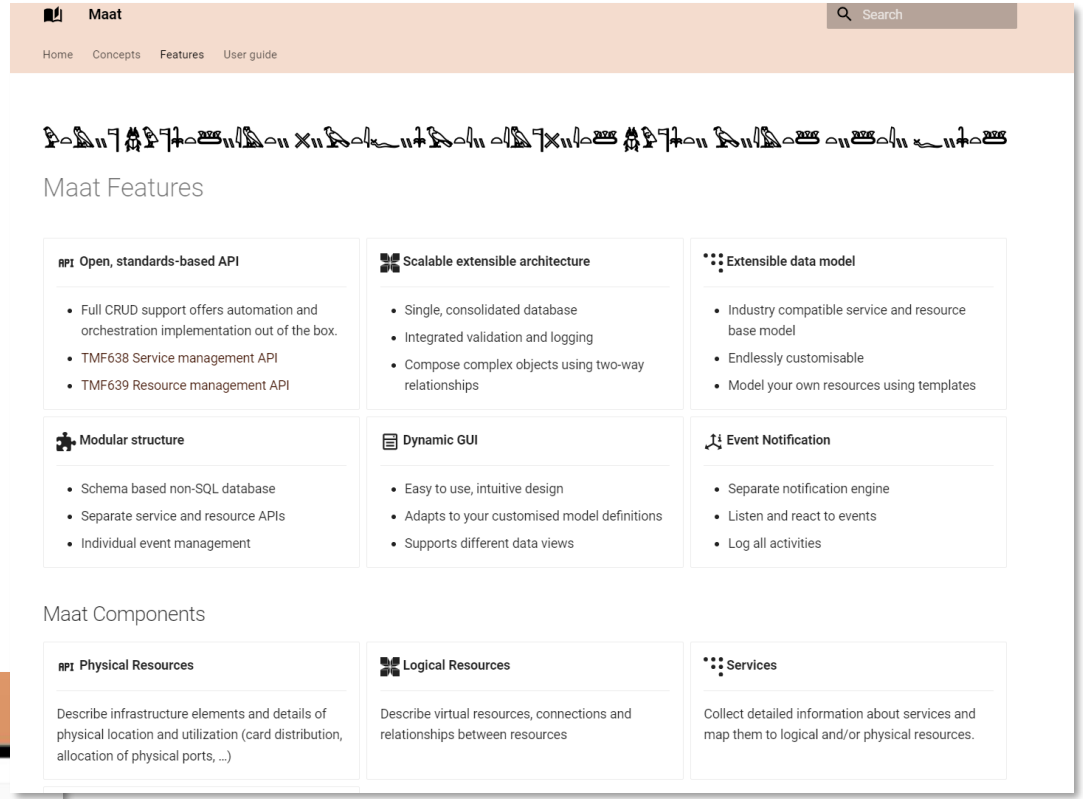
- NoSQL database (MongoDB)
- Spring Boot 3 library
- Docker
- Keycloak

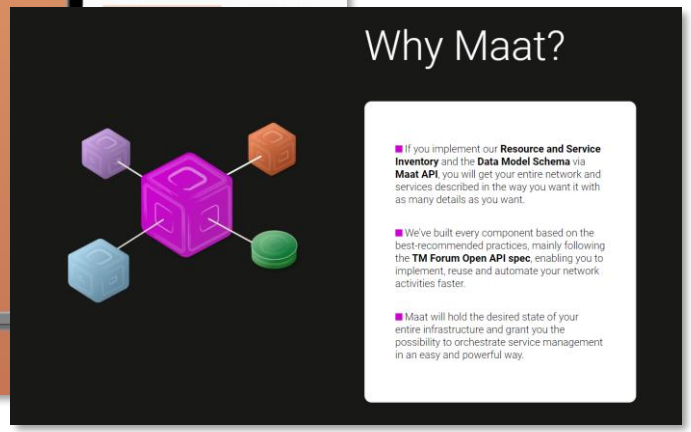
Maat as SoT

https://geant-netdev.gitlab-pages.pcss.pl/MaatDocs/









Digital twin for automation

Digital twin is a virtual copy of the network infrastructure tha can be used for testing network configuration changes before the implementation in the production network.

- Use of containerlab to create a digital twin
- Wide range of virtual routers and Network Operation Systems
- Integration with Source of Truth (NetBox)
  - Netreplica provides nrx software to export a network topology from NetBox which next can be used by containerlab

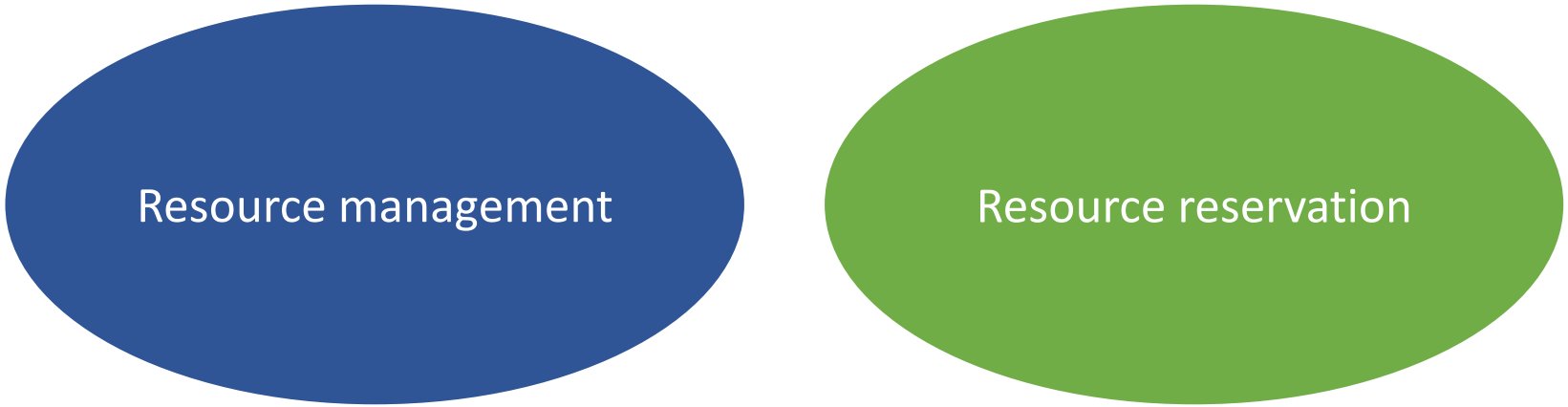
https://github.com/srl-labs/containerlab

https://github.com/netreplica/nrx

https://github.com/netbox-community/netbox

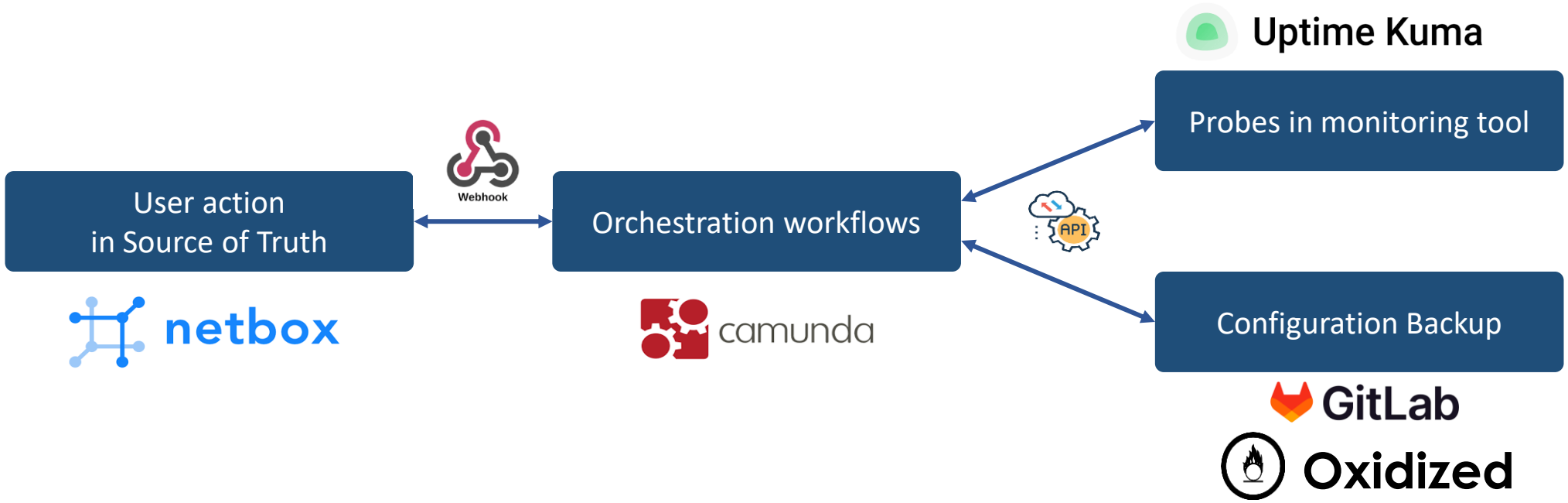
- GÉANT
- The Global Platform for Labs (GP4L)
- Automation and Orchestration in GP4L
  - Components
  - Use cases
  - Service provisioning pilot
  - Future work

GP4L operations use cases



Resource management use case

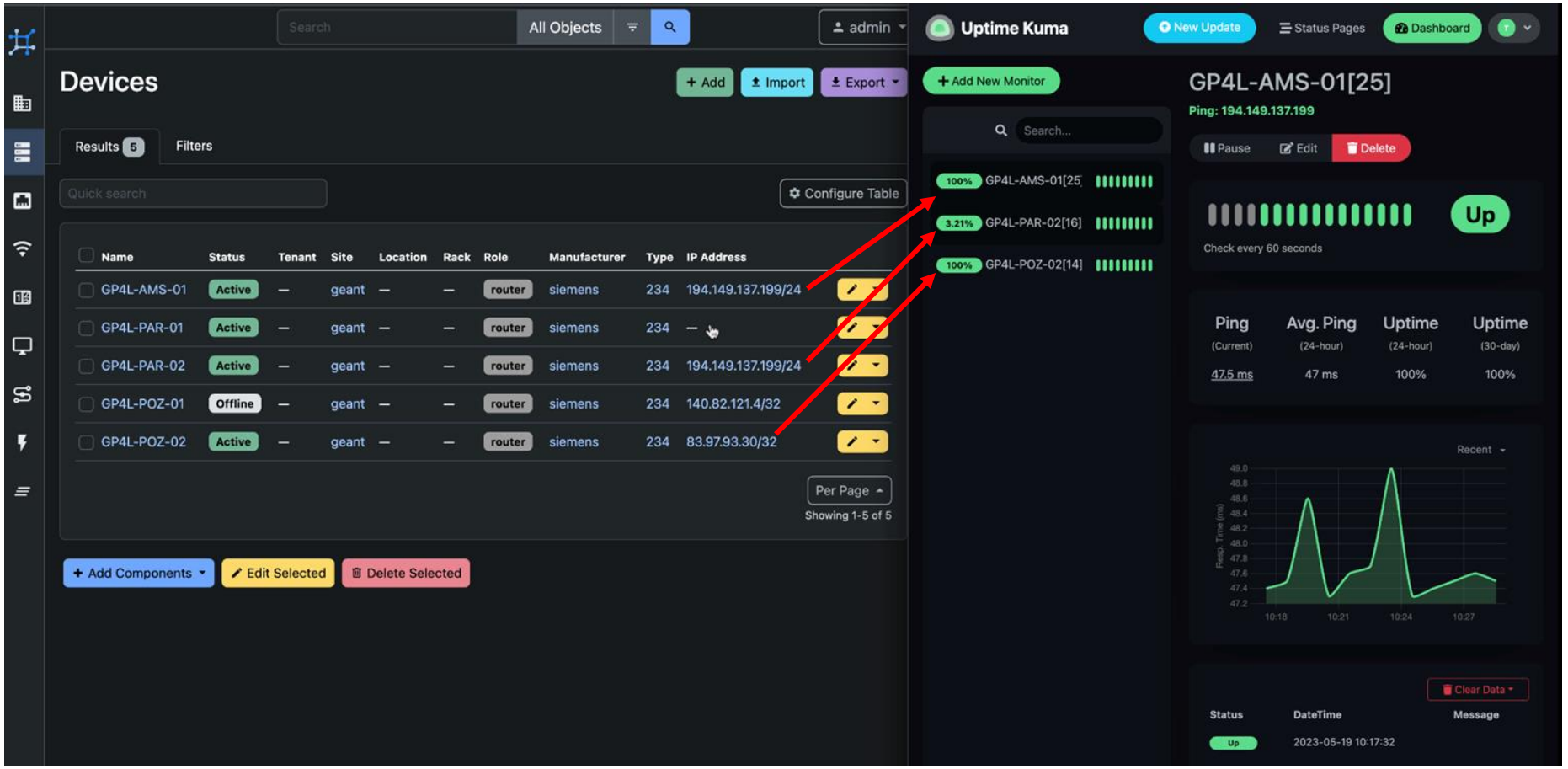
A GP4L partner connects a new programmable switch to the GP4L infrastructure.



Experiment reservation use case

A resercher schedules an experiment in the GP4L infastructure.

NetBox – a key Source of Truth component



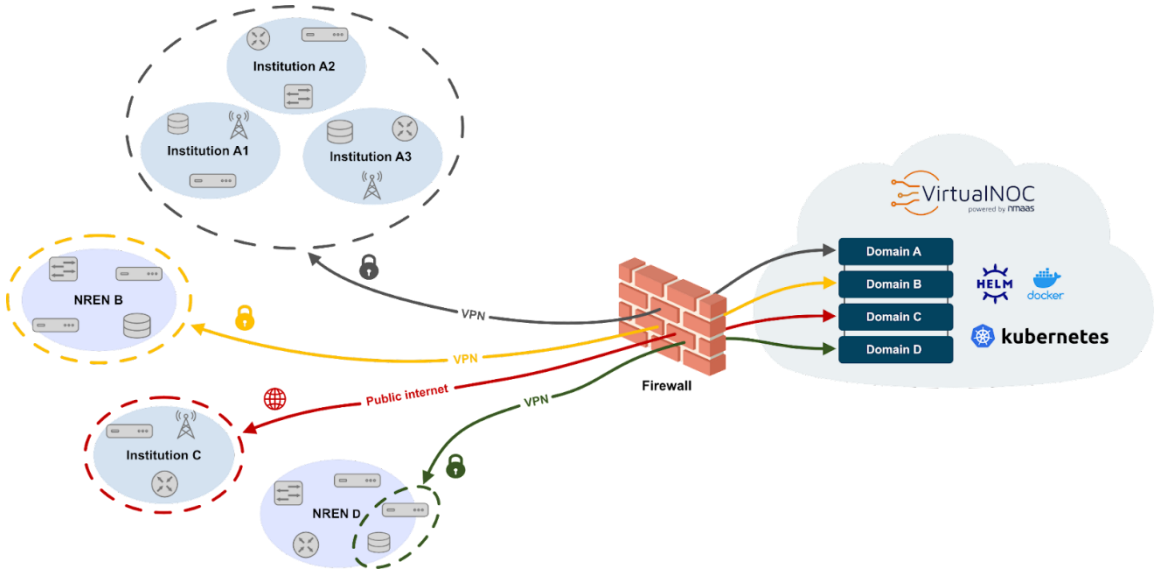
Synchronisation with UptimeKuma (monitoring), Oxidized (backup) and scheduling (LibreBooking)

nmaas – virtual environment for orchestrated operations

NMaaS

nmaas is a multi-tenant platform for effortless, on-demand deployment of software tools and applications.

- Virtual enviornment based on the Kubernates cluster
- The open platform software and the GÉANT production service
- Application catalog
- GP4L use cases implemented in nmaas
  - VirtualNOC



- GÉANT
- The Global Platform for Labs (GP4L)
- Automation and Orchestration in GP4L
  - Components
  - Use cases
  - Service provisioning pilot
  - Future work

GP4L as a testbed for orchestration & automation solutions
Service Provisioning pilot

Development of network service provisioning

- Workflow definitions for network services
- Data model representing resources and network services
- Selection of technology stack (open source)
- Reusable components (identification of elements which could be reused by different implementations of network service provisioning)
- A pilot for Polish National Research and Education Network PIONIER

PIONIER
POLISH OPTICAL INTERNET

- GÉANT
- The Global Platform for Labs (GP4L)
- Automation and Orchestration in GP4L
  - Components
  - Use cases
  - Service provisioning pilot
  - Future work

Future work

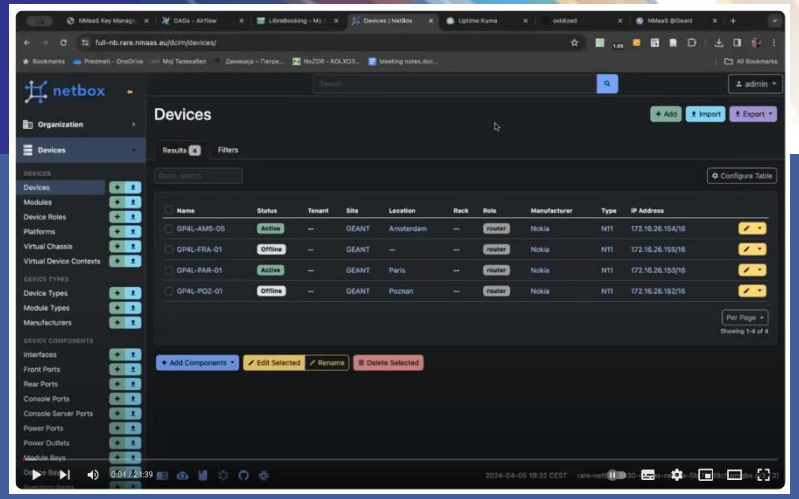
- Development of orchestrated services in GP4L
- Continuation of development and tests of orchestrated services for PIONIER
- Testing various automation and orchestration technologies
- Knowledge sharing via eAcademy learning units

Thank You

Demo video:

https://www.youtube.com/watch?v=KYqpLPBDR3k

netdev@lists.geant.org



www.geant.org

Co-funded by the European Union

The scientific work is published for the realization of the international project cofinanced by Polish Ministry of Science and Higher Education in the years 2019 - 2022 from financial resources of the programme entitled "PMW"; Agreement No. 5023/H2020/2019/2