



Distributed Active Network Monitoring with nmaas

Insights from an NREN production deployment

Vojdan Kjorveziroski (UKIM)

Firat Koyuncu (RENATER)

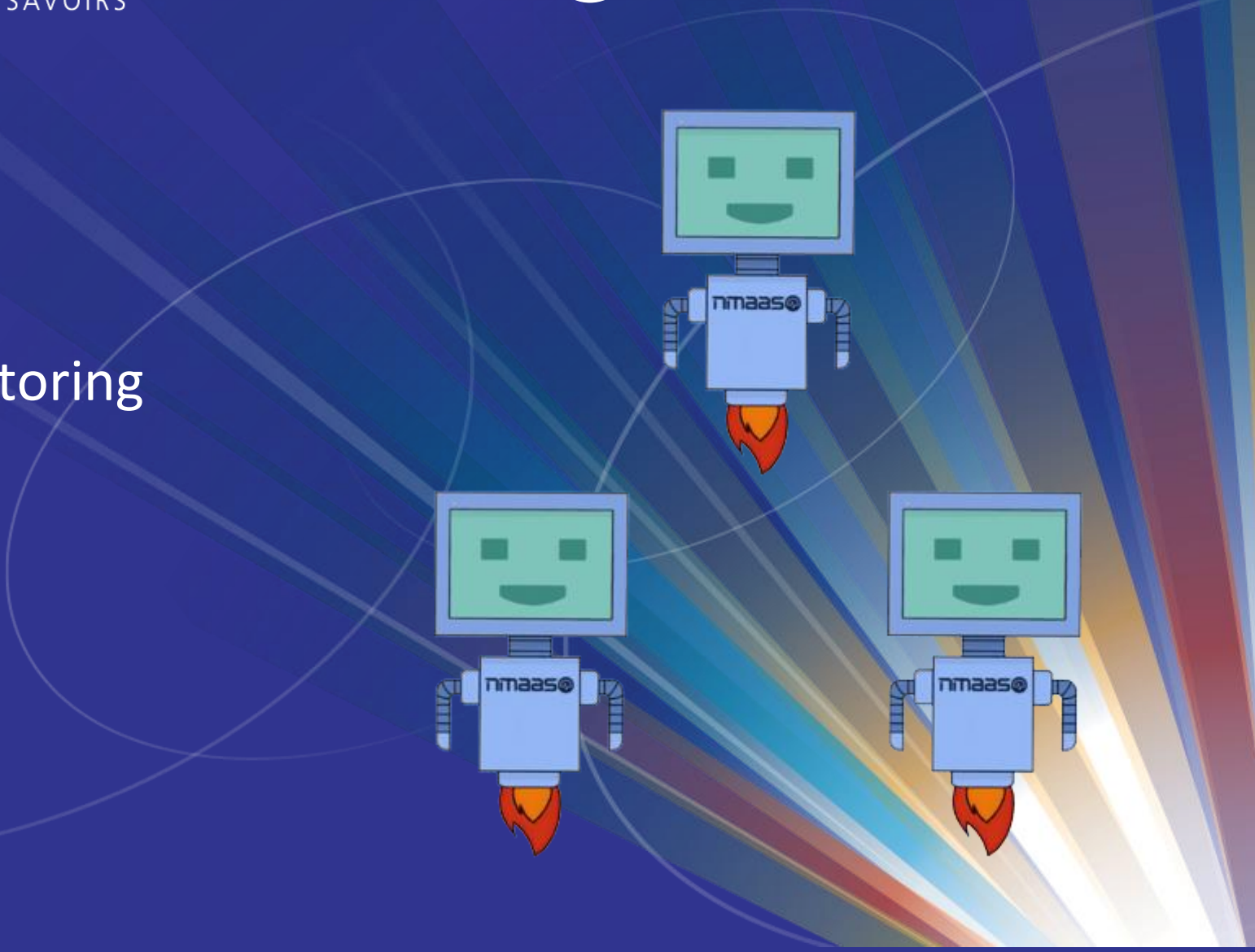
TNC 2026, Helsinki, Finland

10 June 2026

Public (PU)

Agenda

- Introduction to nmaas
- Distributed Active Monitoring
- Operational Insights
- RENATER Experience
- Conclusion





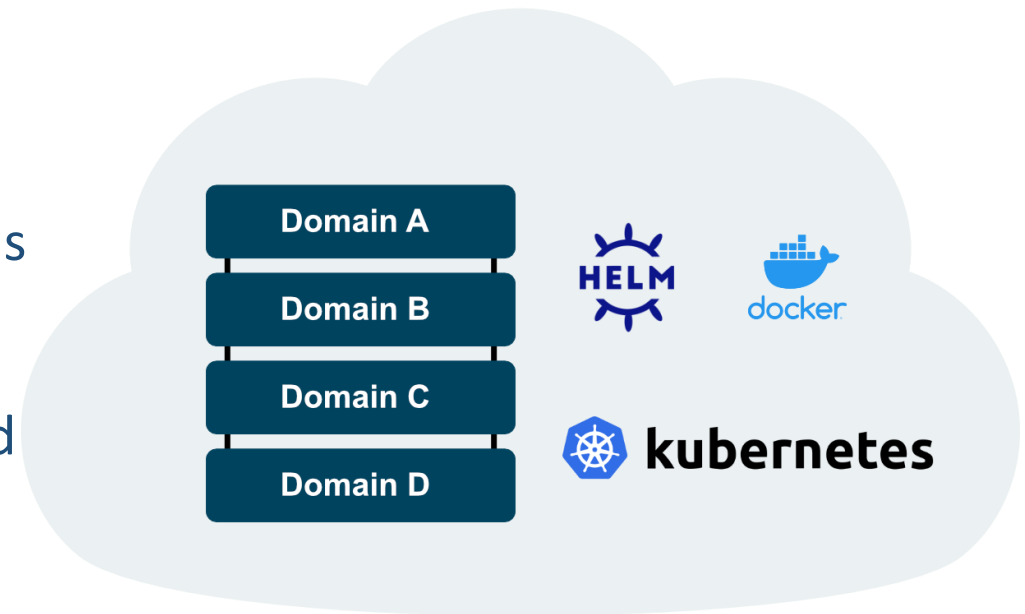
What is nmaas?

A brief introduction to the nmaas Platform

Introduction to nmaas

nmaas is an open-source platform for orchestrated deployment of applications in a cloud environment

- Kubernetes-based infrastructure
- Multi-tenant architecture
- Simple application deployment and upgrade
- Wide and easily extendable portfolio of applications
- GitOps for application instance configuration
- Easy troubleshooting via integrated log viewing and interactive command execution



Source code available at <https://gitlab.software.geant.org/nmaas>

nmaas Flavors and Existing Use-Cases

- Versatility of nmaas as an open-source orchestration platform
- Support for multiple use-cases by providing relevant software features and deployable applications
- Currently supported use-cases on top a common code base:
 - **nmaas for Virtual NOC** (originally referred to as NMaaS - Network Management as a Service)
 - **nmaas for Virtual Lab** (online hands-on exercises in an education context)
 - **nmaas Metrics** (data crawling, analysis, and visualization toolkit)



nmaas Core Functionalities (1)

Simple Application Deployment

- Dedicated application deployment wizard

Applications Customization

- During deployment and at runtime
- WebUI and GitOps

Scalability

- Applications run in a Kubernetes cluster

Multitenancy

- Concept of an nmaas Domain
- Multiple independent parties use the same nmaas instance

nmaas Core Functionalities (2)

Complete Application Lifecycle Management

- Deployment, (automatic) upgrades, pausing, removal

Diverse application ecosystems

- Network monitoring
- Network management
- Data analysis and visualization

Extensibility

- New applications can be added at any time

A Picture is Worth a Thousand Words...

The screenshot displays the user interface for the 'nmaas-metr (Prometheus)' application. On the left, a sidebar contains navigation links for 'PL-LAB', 'Applications', and 'Instances'. The main content area features the application's logo (a red circle with a white flame) and the name 'nmaas-metr (Prometheus)'. Below this, it indicates the version 'v2.55.1' and provides links for 'Apache 2.0', 'WWW', 'Source', and 'Issues'. There are two tabs: 'Monitoring' (selected) and 'Alerting'. An 'Actions' dropdown menu is open, showing options: 'Access', 'Configure', 'Members', 'Disable auto upgrades', 'View logs', 'Pause', and 'Undeploy'. A message states: 'Your application is now active. You can access it using the Access option from the Actions menu. Use the Configure and Members options to update the configuration and the list of application users respectively.' Below this is an 'Installation progress' section with a horizontal timeline of six steps: 1. Subscription validation, 2. Environment creation, 3. Verifying connectivity, 4. Application deployed, 5. Activation, and 6. Application active. The first five steps are marked with green circles, while the sixth is marked with a blue circle. At the bottom left, there is a user profile icon and the name 'Vojdan', followed by an 'Additional Information' section with a checkbox.

PL-LAB

Applications

Instances

nmaas-metr (Prometheus)

v2.55.1 | Apache 2.0 | WWW | Source | Issues

Monitoring Alerting

Active Deployed

Actions

- Access
- Configure
- Members
- Disable auto upgrades
- View logs
- Pause
- Undeploy

Your application is now active. You can access it using the Access option from the Actions menu. Use the Configure and Members options to update the configuration and the list of application users respectively.

Installation progress

- 1 Subscription validation
- 2 Environment creation
- 3 Verifying connectivity
- 4 Application deployed
- 5 Activation
- 6 Application active

Additional Information ☐

Vojdan

Food for Thought...

- Instead of deploying all applications within a single Kubernetes cluster...
- ...why not leverage multiple *distributed* clusters...
- Benefits:
 - Resource usage optimization
 - Data privacy and data sovereignty
 - Multiple vantage points for network monitoring
 - Central management of distributed (edge) systems
- Solution: nmaas Distributed Active Monitoring



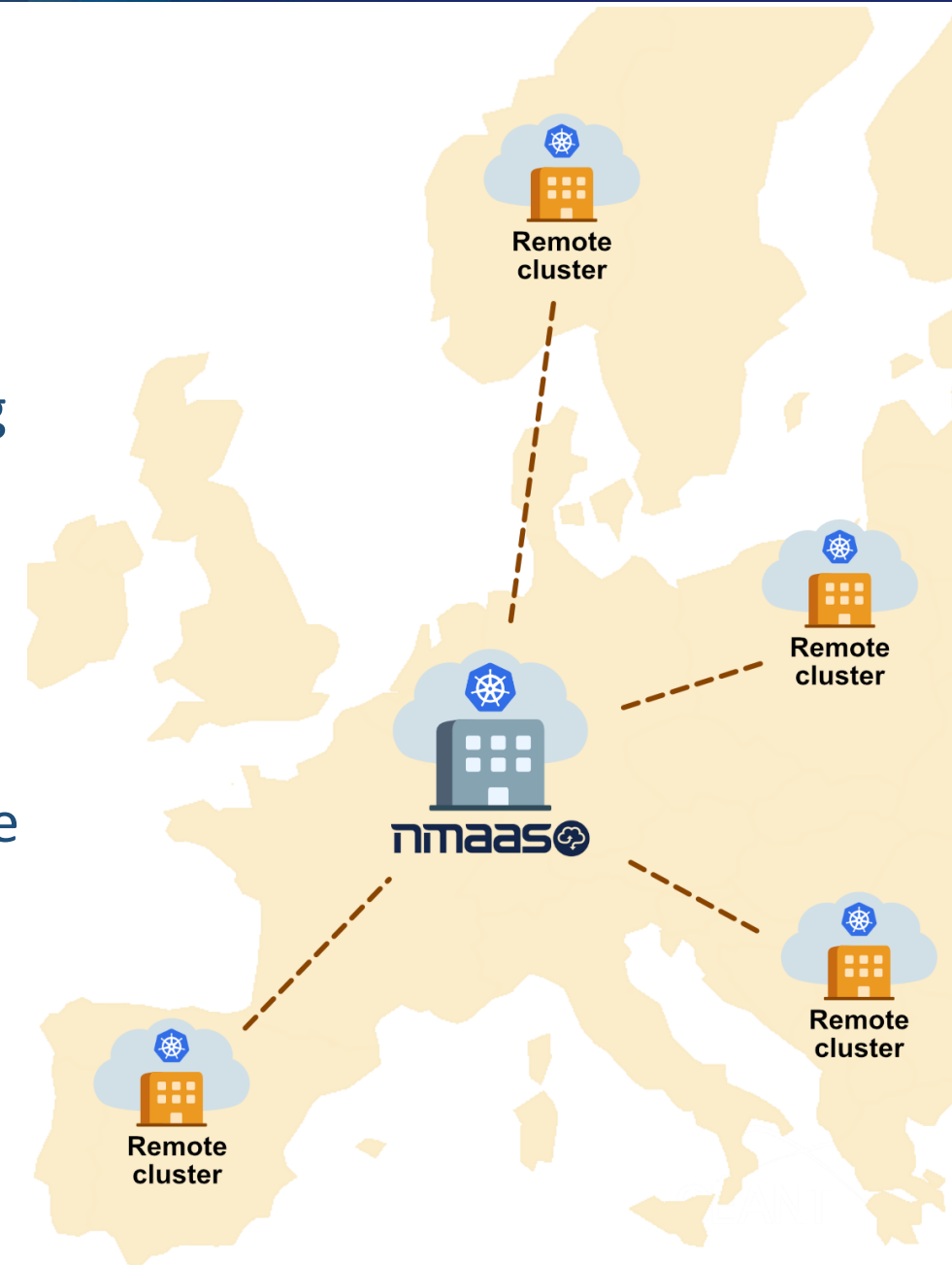


nmaas Distributed Active Monitoring

nmaas as a multi-cluster orchestration platform

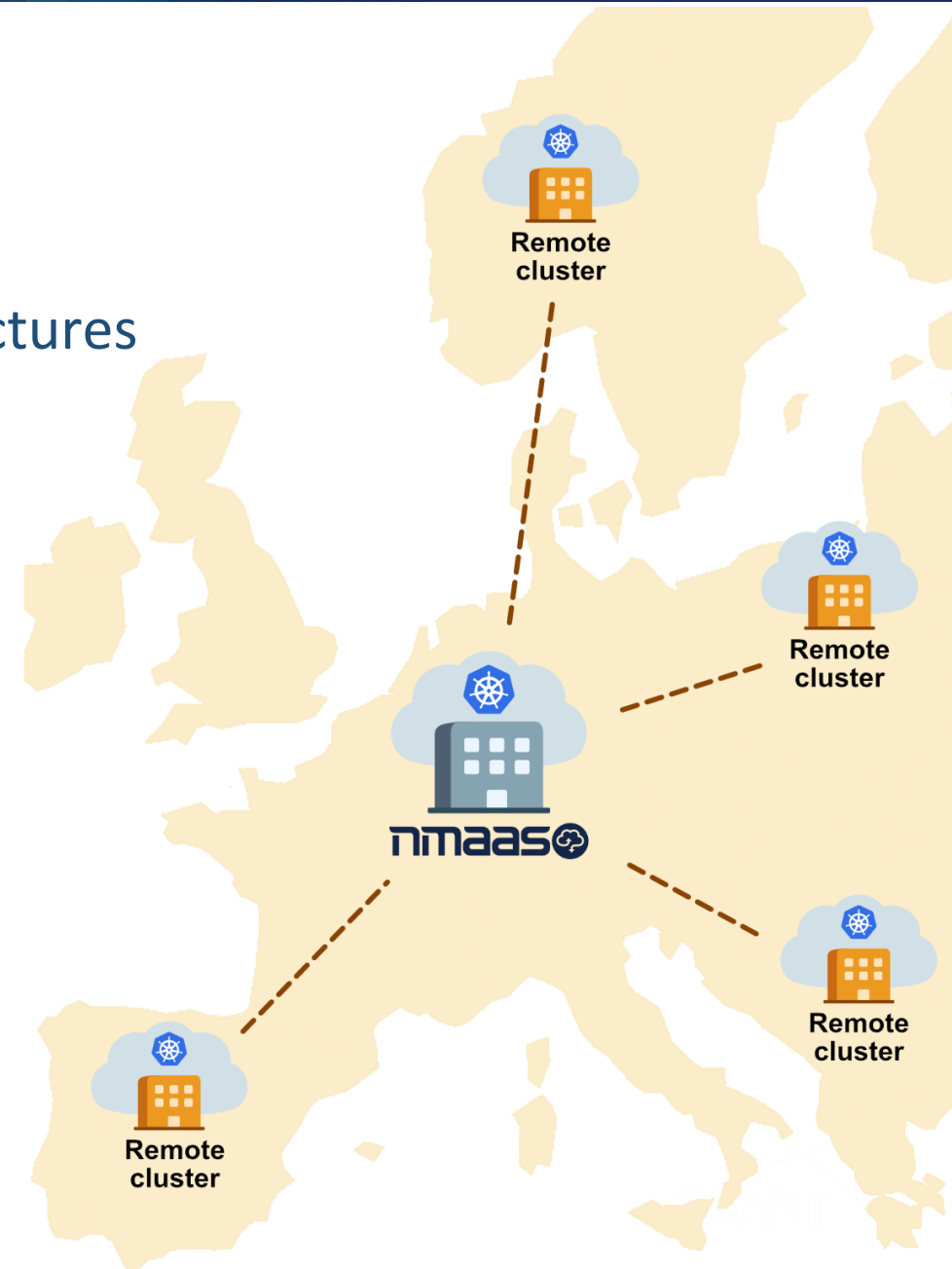
What is Distributed Active Monitoring?

- **Core idea:** a central nmaas instance manages distributed Kubernetes clusters
- **Remote** Kubernetes **cluster(s)** associated with existing nmaas domains
- Solves the problem of managing many diverse environments
- Enables applications deployment at the **network edge**
- nmaas catalogue applications deployable on any of the on-boarded clusters



Distributed Active Monitoring Benefits

- Applications run **on-premise**
- No need for complex connectivity to remote infrastructures
 - Eliminates the need for a site-to-site VPN
- Can use existing infrastructure for (remote) access to applications
 - Dedicated nmaas client access VPN not needed
- **Full control over data**
- Applications can be deployed at **multiple locations**
 - **Local and external network visibility**
- **Reduced infrastructure entropy**
 - A fleet of identical Kubernetes clusters

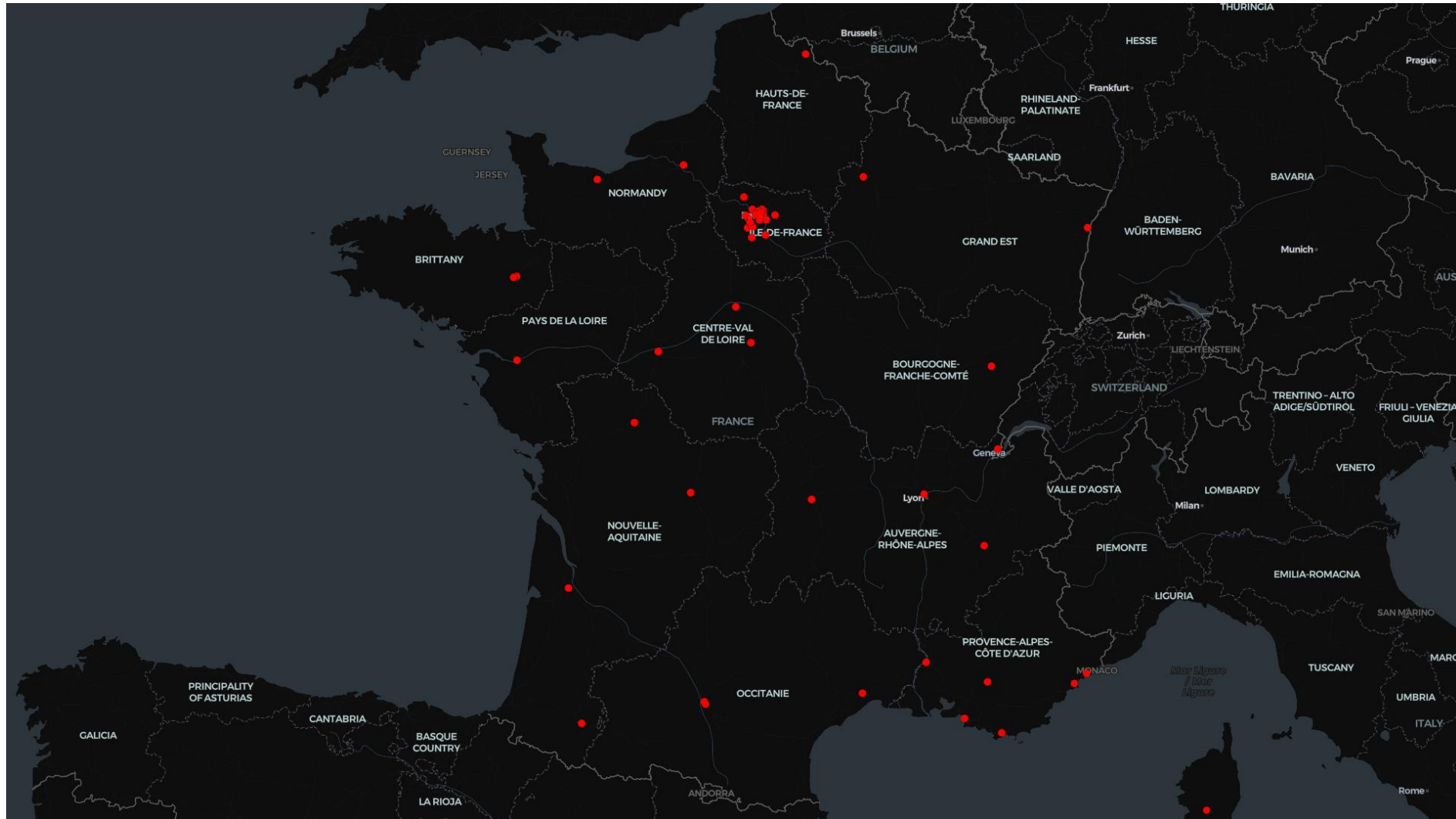




RENATER Experience

Background and rationale

Overall Vision



Historical Context

- In 2017: 40 servers were acquired
 - perfSONAR beacons
 - Other NFV workloads
 - VMware ESXi-6 hypervisors
- 2025: Observations
 - Around 10 servers were deployed
 - No software alignment (ESXi, iDRAC, BIOS, perfSONAR image)
 - Security issues (local heterogeneous login/password for iDRAC, OS, etc.)
 - perfSONAR service globally was not working
- How to improve this situation?
- How to take advantage of this platform unfortunate context?

Technological Context

- In 2023: Broadcom acquired VMware
 - ESXi is no more free / No more perpetual license, and License price x1
 - End of 2025, ESXi 8 license became free again but with limitation
 - Trust is lost / Can not rely anymore
- 2025:
 - Kubernetes maturity
 - Pods/Container networking wide adoption
 - Kubernetes one line installation
 - Super strong community support / Lots of materials, documentation
 - DevOps method adoption
 - Source of Truth / GitOps / Declarative approaches to deploy workloads
 - EURO-HPC
 - Performance measurement requirements
 - Network Management tools complete overhaul



Wishlist

Key constraints and requirements

Wishlist

- Limited workforce
 - Automate what we must
 - Eliminate manual intervention
 - Improve accuracy and efficiency
 - Orchestrate where we can
 - Break silos between teams
 - Enable clear boundary between business processes
- KISS principle but...
 - KISS for targeted user
 - Keep complexity for "us"
- Anticipate future needs
 - Gradually new and unexpected requirement pops up

Foundational Sub-Project

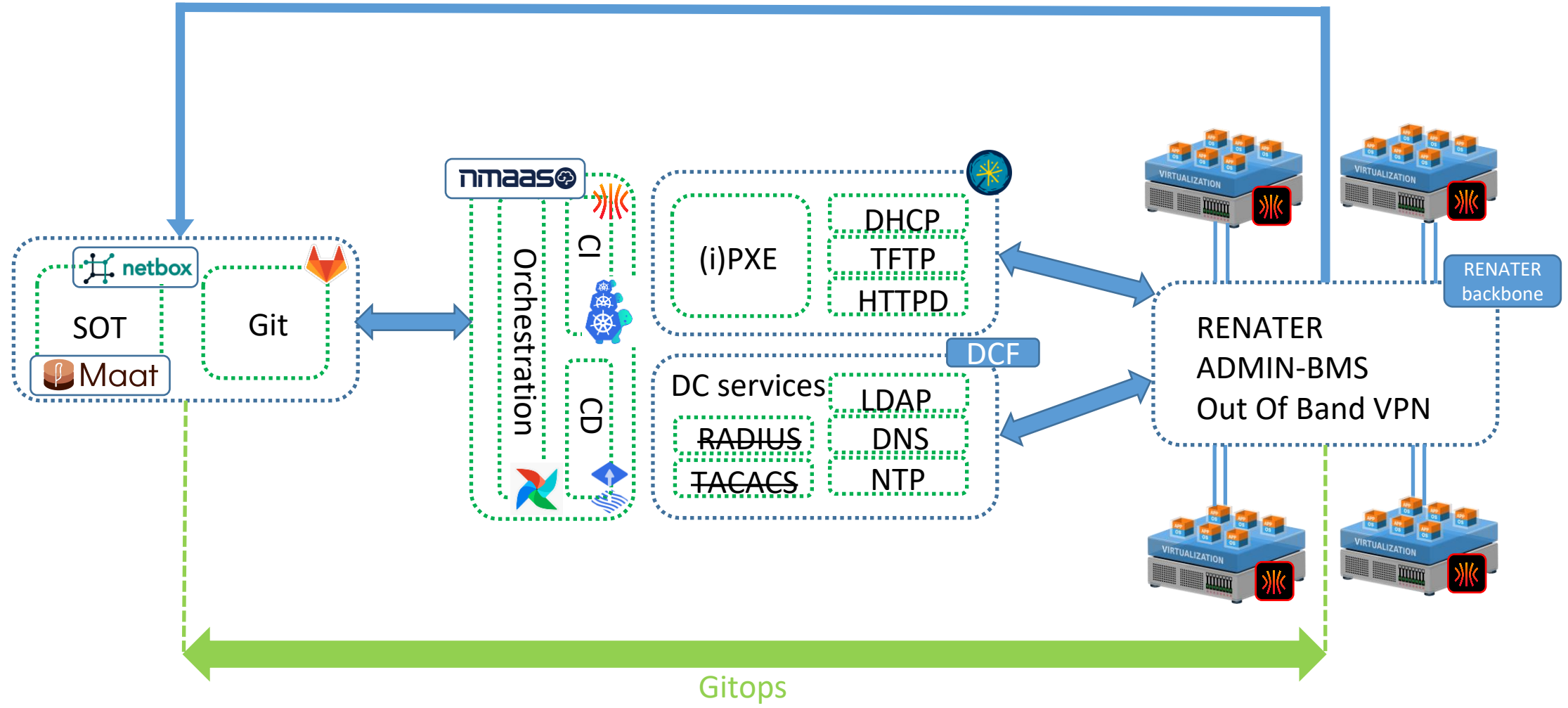
- Source of Truth
 - Source of Truth inventory (NetBox)
 - Source of Truth consolidation (Maat)
 - Data storage is not always the Source of Truth
- CI/CD
 - Provide answers to recurrent questions
 - Up to date data on a daily basis
- GitOps
 - Declarative approach, reconciliation
- Workflow engine (Apache Airflow)
- No (significant) development required, do not reinvent the wheel
- Integration only



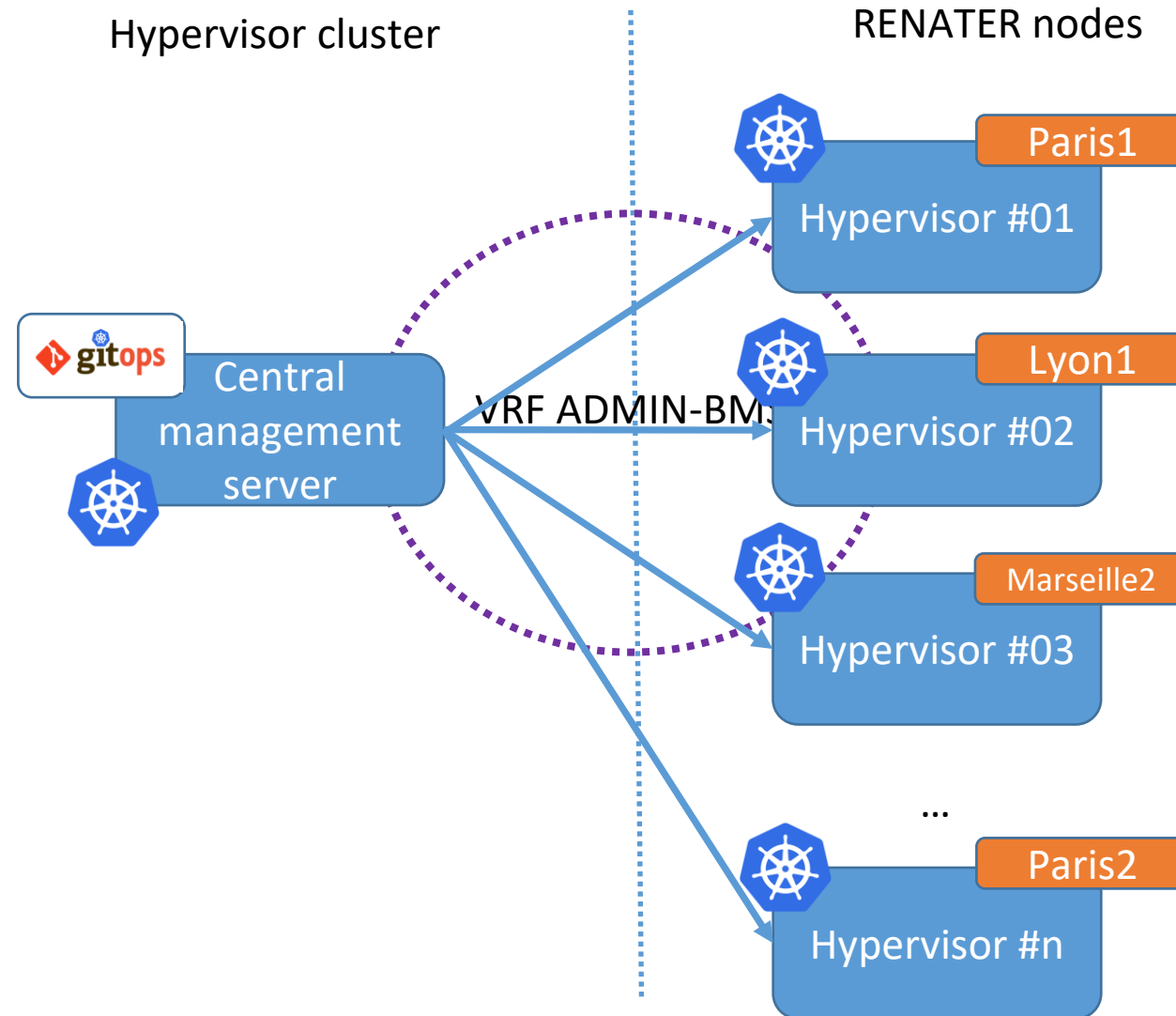
Architecture

Components overview

Overall Architecture



Underlying infrastructure: BMS



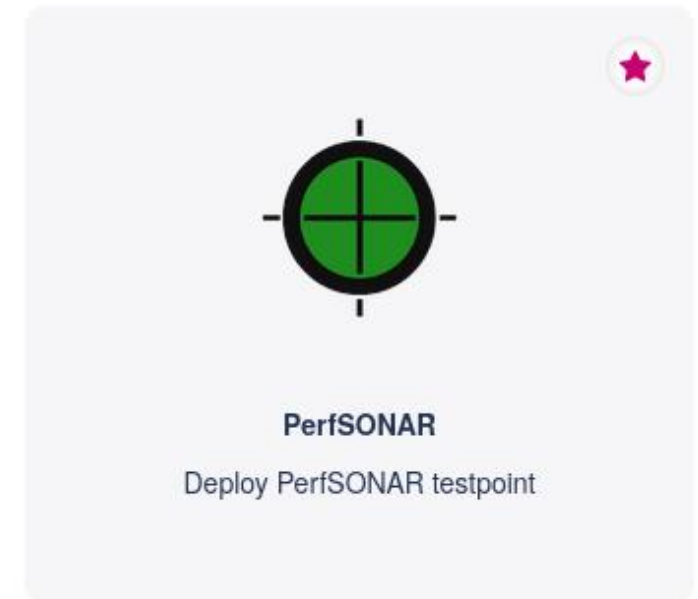


perfSONAR Deployment

Distributed active monitoring from edge nodes

perfSONAR Deployment: Via nmaas

- As simple as possible
 - An application in the catalogue
- 2-steps deployment
 - Local Cluster
 - Creation of the VLAN interface on the remote cluster
 - Initiation of the deployment of the pod
 - Creation of DNS RR for each testpoint
 - Remote Cluster
 - Deployment with all the required ports
 - ConfigMap with the psconfig URL
 - Creation of bridged interfaces



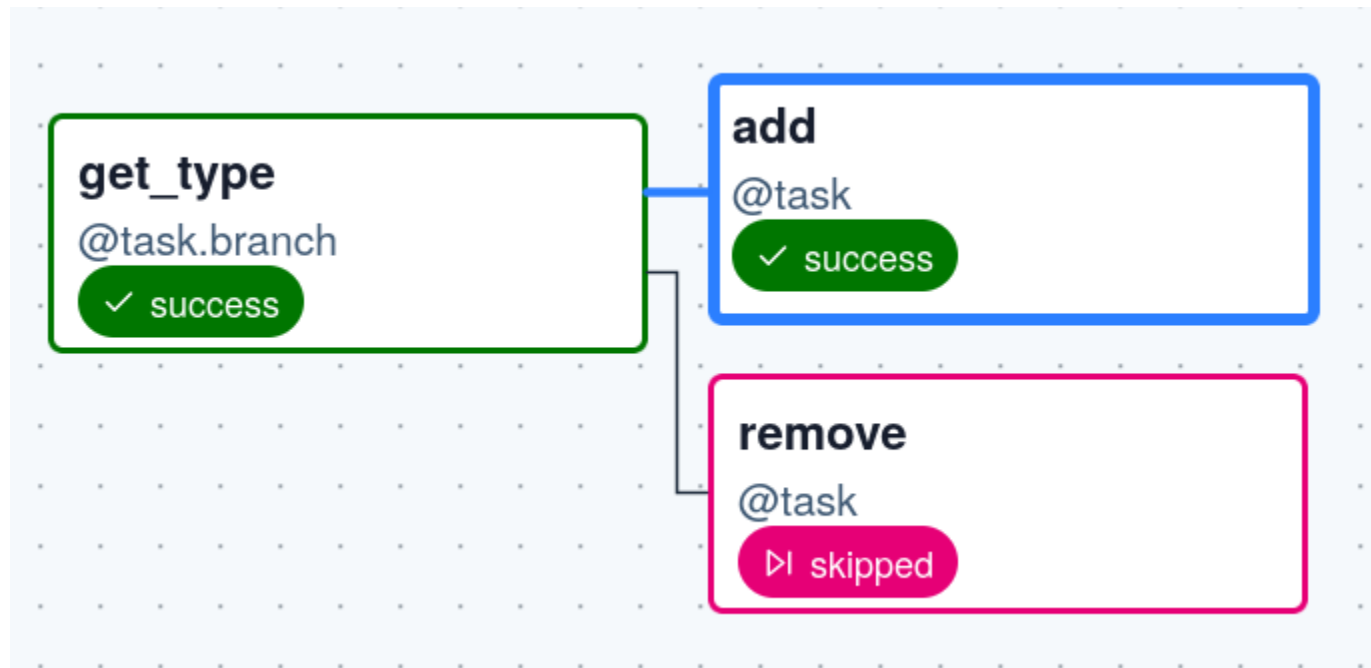
perfSONAR Deployment: nmaas Webhook Feature

- Once deployment is ready
 - Send webhook to Airflow
 - Received by a middleware
 - Simple HTTP webserver, and model it for Airflow
 - Trigger the DAG (Airflow script)

Id ↑↓	Name ↑↓	Webhook event ↑↓	Target URL ↑↓
1	PerfSONAR Add	Application deployment	https://airflow-webhook.nfv.renater.fr/webhook
2	PerfSONAR Remove	Application removal	https://airflow-webhook.nfv.renater.fr/webhook

perfSONAR Deployment: Airflow Script

- Based on the type
 - Deployment or removal
 - Push the new psconfig (configuration file) to the S3 bucket
 - Update Maat



perfSONAR Deployment

- Maat
 - Source of truth for the deployed services
 - Easy to use and integration with nmaas
 - Dynamic configuration

▼ perfsonar.test-point

Avignon

Bordeaux

Bruyeres

Jouy

Jussieu

CREATE NEW PERFSONAR.TEST-POINT

Actions	Name ⓘ	Description ⓘ	Type ⓘ	Category ⓘ
	Avignon	Avignon PerfSONAR test point	Service	perfsonar.test-point
	Bordeaux	Bordeaux PerfSONAR test point	Service	perfsonar.test-point

name:

Avignon

description: ⓘ

Avignon PerfSONAR test point

category:

perfsonar.test-point

@type:

Service

@schemaLocation:

https://minio.nfv.renater.fr/maat/TMF638-ServiceInventory-v4-pionier.json

serviceRelationship: ⓘ

CREATE NEW SERVICERELATIONSHIP

Actions	RelationshipType ⓘ	Service.id ⓘ	Service.href ⓘ	Service.name ⓘ
	bref.cluster	c08dce3f-8969-436d-98f7-381dd719af35	https://maat-renater.nfv.renater.fr:443/serviceInventoryManagement/v4.0.0/service/c08dce3f-8969-436d-98f7-381dd719af35	avignon

Rows per page 10 ▾ 1-1

resourceRelationship: ⓘ

CREATE NEW RESOURCERELATIONSHIP

Actions	RelationshipType ⓘ	Resource.id ⓘ	Resource.href ⓘ	Resource.name ⓘ
	bref.devices.server.bms	490042ce-08c1-43c7-a9df-2497a478cbcd	https://maat-renater.nfv.renater.fr:443/resourceInventoryManagement/v4.0.0/resource/490042ce-08c1-43c7-a9df-2497a478cbcd	avignon-bms-01

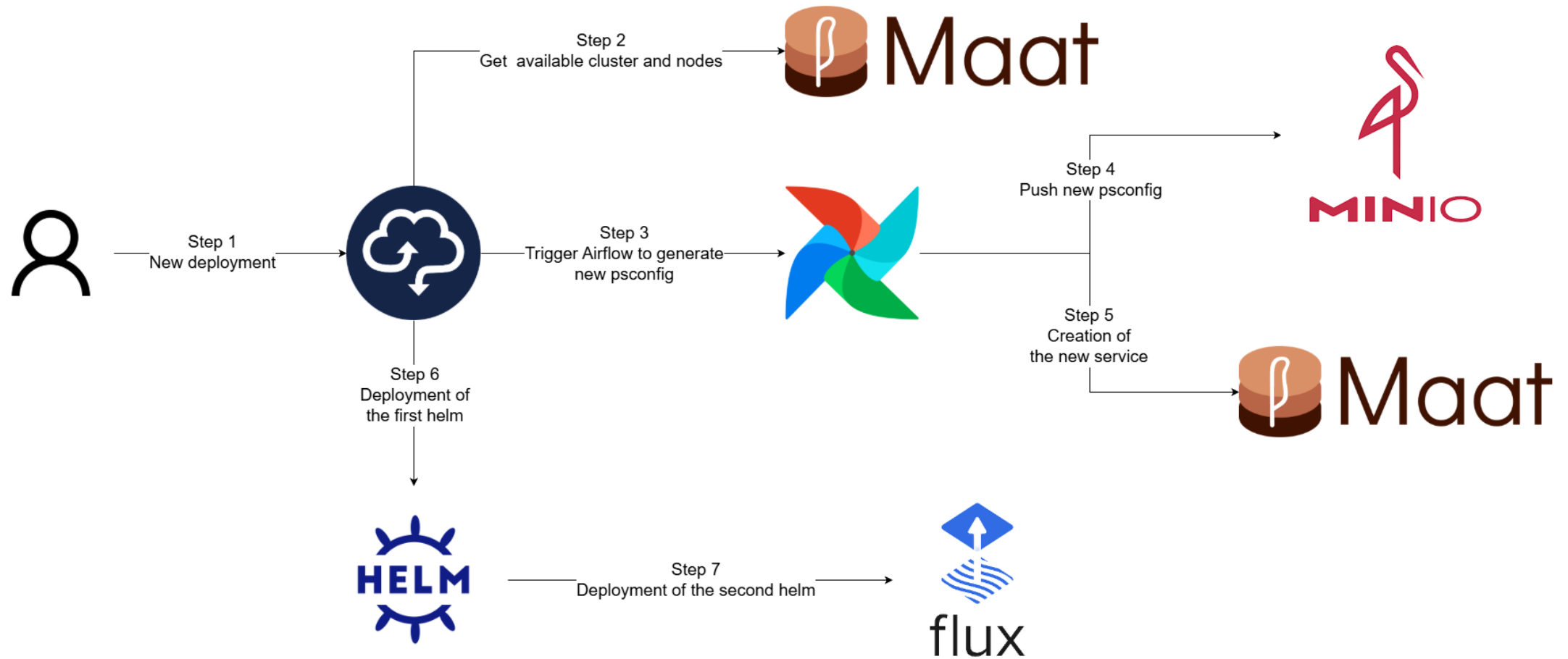
perfSONAR Deployment: nmaas Instance Configuration

- Configuration
 - List of all available clusters
- Less typos

The screenshot shows a web form for configuring an nmaas instance. It includes several input fields and a dropdown menu. The fields are labeled as follows:

- Inband VLAN**: A text input field containing the value "100".
- OOB VLAN**: A text input field containing the value "100".
- Probe name (will create a RR in domain ps.nfv.renater.fr)**: A text input field containing the value "Lab".
- Cluster**: A dropdown menu with a search bar. The search bar contains the text "Type to search". The dropdown list shows several cluster names: "Bruyères", "Cachan" (highlighted in blue), "Jouy-en-Josas", "Jussieu", "Lyon 1", "Montpellier", "Orsay", and "Paris 1".
- IP**: A text input field containing the value "10.130.0.X".
- Groups**: A section header for the bottom part of the form.

perfSONAR Deployment: Complete Workflow





Conclusion

Ideas for future work

RENATER side

- nmaas vNOC is the tip of the iceberg
 - It is envisioned to be the central point
 - From which business workflow are triggered
- Apache Airflow is the workflow engine
 - That is the glue between systems (source of truth, ticketing systems, CRN)
 - Python & declaratively based
- nmaas vNOC interacts with the underlying platform
 - Set of BMS distributed geographically
 - Kubernetes based with Kubevirt capability
 - Talos linux immutable Kubernetes is used
 - Leverage nmaas vNOC capability
 - to stitch nmaas user defined catalogue
 - And existing remote cluster



Conclusion and Future Plans

- nmaas as an open-source multi-cluster application orchestration platform
- Versatile and adaptable to different use-cases
- Distributed Active Monitoring use-case
- Continuous evolvement of the application portfolio
- Extending nmaas with generative AI
 - nmaas MCP, new application addition
- More details during the Community Hub session





Thank You

Documentation
Contact the nmaas team

*<https://docs.nmaas.eu/>
nmaas@lists.geant.org*



www.geant.org



Co-funded by
the European Union