nmaas in Action: Extending PaaS Use-Cases to Distributed Environments

Vojdan Kjorveziroski (UKIM)

Lukasz Lopatowski (PCSS)

Roman Lapacz (PCSS)

17th ICT Innovations Conference, Ohrid, North Macedonia

12 October 2025

Agenda

- Towards PaaS Solutions
- nmaas Architecture
- nmaas Use-Cases
- Conclusion

Towards PaaS Solutions

…and other cloud computing abstraction layers

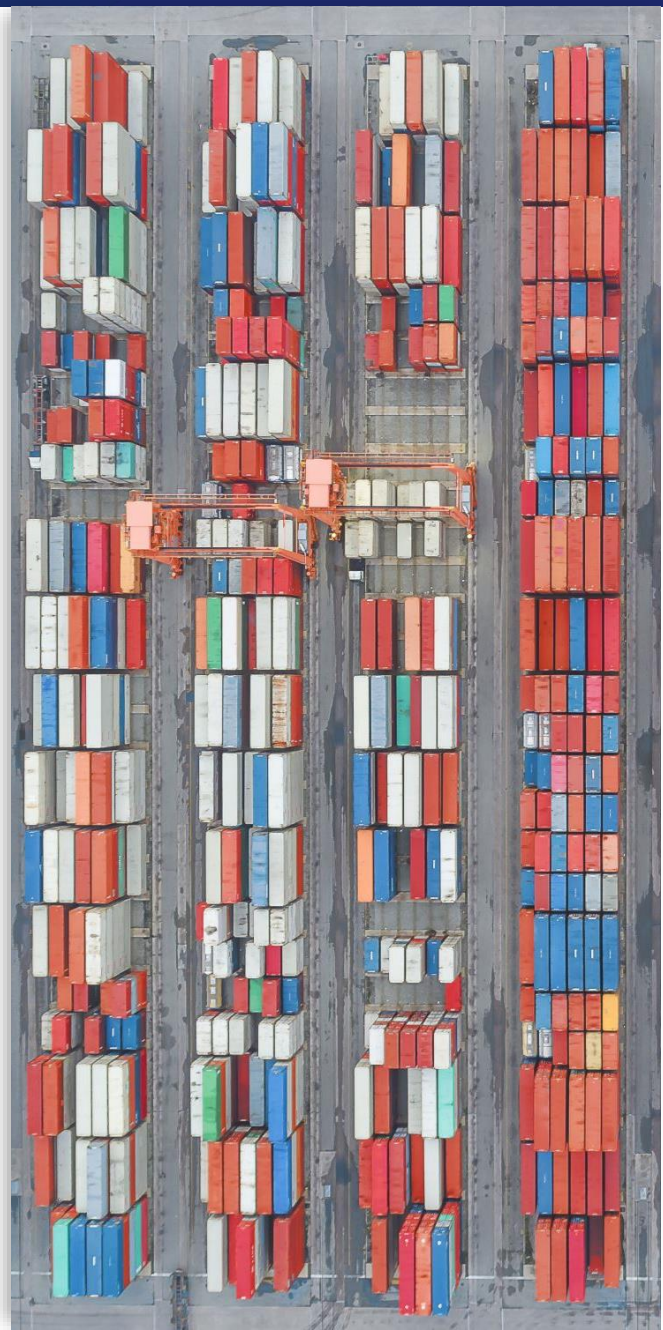
GN5-2

Towards PaaS Solutions

- Advent of cloud computing
- **Democratization** of computing resources
- Introduction of abstraction layers
  - Infrastructure as a Service
  - **Platform as a Service**
  - Software as a Service
- Commonly intertwined between them

State-of-the Art PaaS Platforms

- Containerization
- Use of container orchestrators for multi-node deployments
  - Kubernetes
- Importance of **GitOps**
  - (Limited) GitOps support
  - Deployment, not configuration
- **Education** and **infrastructure federation** aspects
  - Not addressed



Limitations of Contemporary PaaS

- Proprietary, vendor-specific solutions
  - **Vendor lock-in** effect
- No control over (sensitive) data
- Aimed at developers and tech-savvy users
- **Limited** to a **single** application context or **use-case**
- Separate application deployment and application configuration workflows
- **Need for a use-case agnostic**, adaptable, open solution

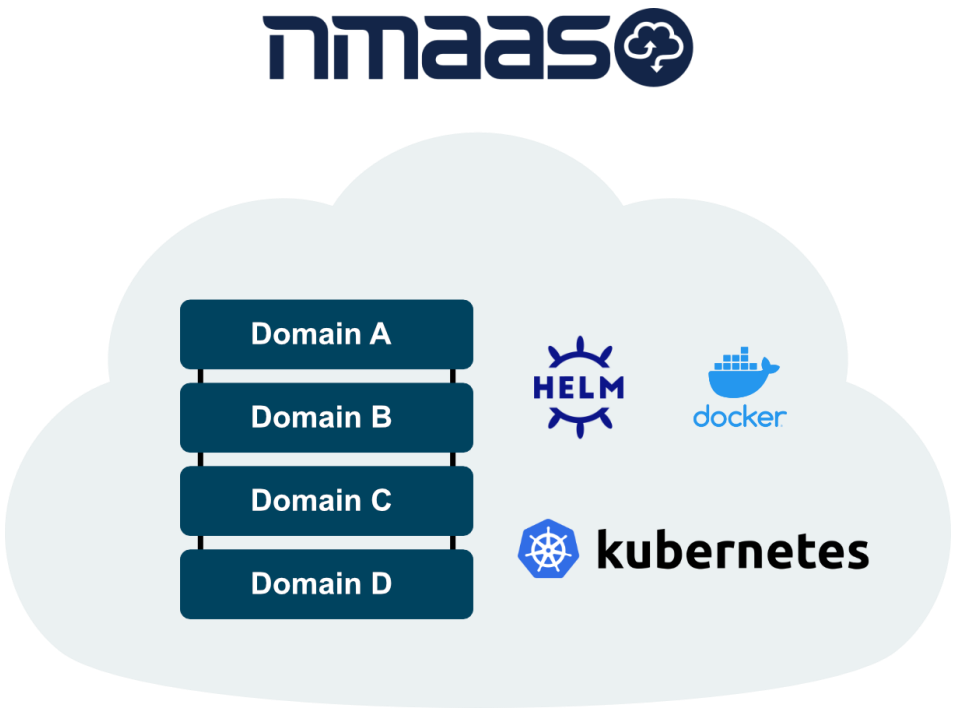
nmaas Architecture

Technology stack and foundational pillars

GN5-2

nmaas Technology Stack in a Nutshell

- 3 software components
  - nmaas Platform (backend)
  - nmaas Portal (frontend)
  - nmaas janitor (maintenance & async tasks)
- Kubernetes environment
  - Management of a single local or **local and remote Kubernetes clusters**
- **Deployment** of **any** containerized **application**
- Fully **open-source**



nmaas Architecture Pillars

Multitenancy and Security

Extensible Application Catalogue

GitOps Configuration

Multitenancy and Security

Concept of an nmaas domain

- Relation between a user and domain

Isolation at an application level

- Kubernetes namespaces

Isolation at a network level

- Network policies
- Client-access VPNs

Extensible Application Catalogue

Support for general-purpose **Helm charts**	• No special modifications needed, used as-is
Extensible application catalogue	• **Application addition wizard**
Applications **customization** during deployment and at runtime	• **Application deployment**
Application version upgrades	• Automatic or manual
Concept of an **application manager**	• **Community building** aspects

GitOps Configuration

- The **GitOps** paradigm
- Any **existing application extended to support GitOps**-based configuration
  - **Exclusive** feature
- GitOps workflow
  - Commit of changes
  - Syncing of changes
- Importance of **GitOps** in **multitenant environments**
  - Versioning and auditability
- Importance of **GitOps** for **dynamic applications**

nmaas Use-Cases

Validating the nmaas Platform in real-world conditions

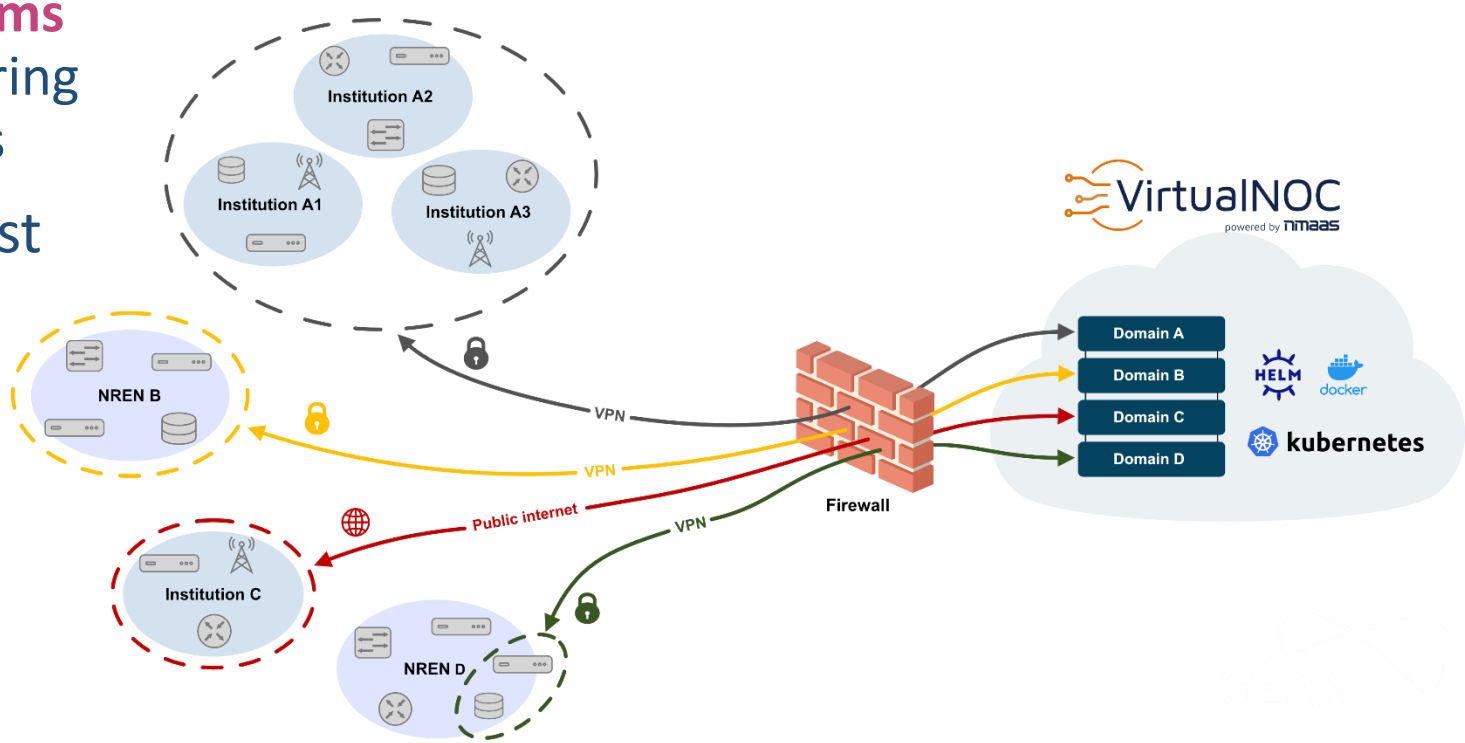
GN5-2

nmaas Use-Cases

- Support for multiple use-cases
- Each use-cases augmented by relevant software features and applications
- Current use-cases on top a common code base:
  - **nmaas for Virtual NOC**
  - **nmaas for Virtual Lab**
  - **nmaas for Remote Environments**

nmaas for Virtual NOC

- Target groups
  - **NRENs or end institutions** with limited capacity for in-house network management
    - Universities, high schools, primary schools
  - International **research projects** with (distributed) hardware resources
  - **Development/infrastructure teams** requiring external health monitoring and alerting for their applications
- Application catalog containing most popular network management applications
- **Production service** offered within the GÉANT project



Virtual NOC Success Stories

VirtualNOC powered by nmaas

IRELANDQCI

- National project
- Distributed team

PCSS projects

- Distributed laboratory Infrastructure
- Software services monitoring and database backups

GP4L

- Global testbed
- Automation of user access

perfSONAR

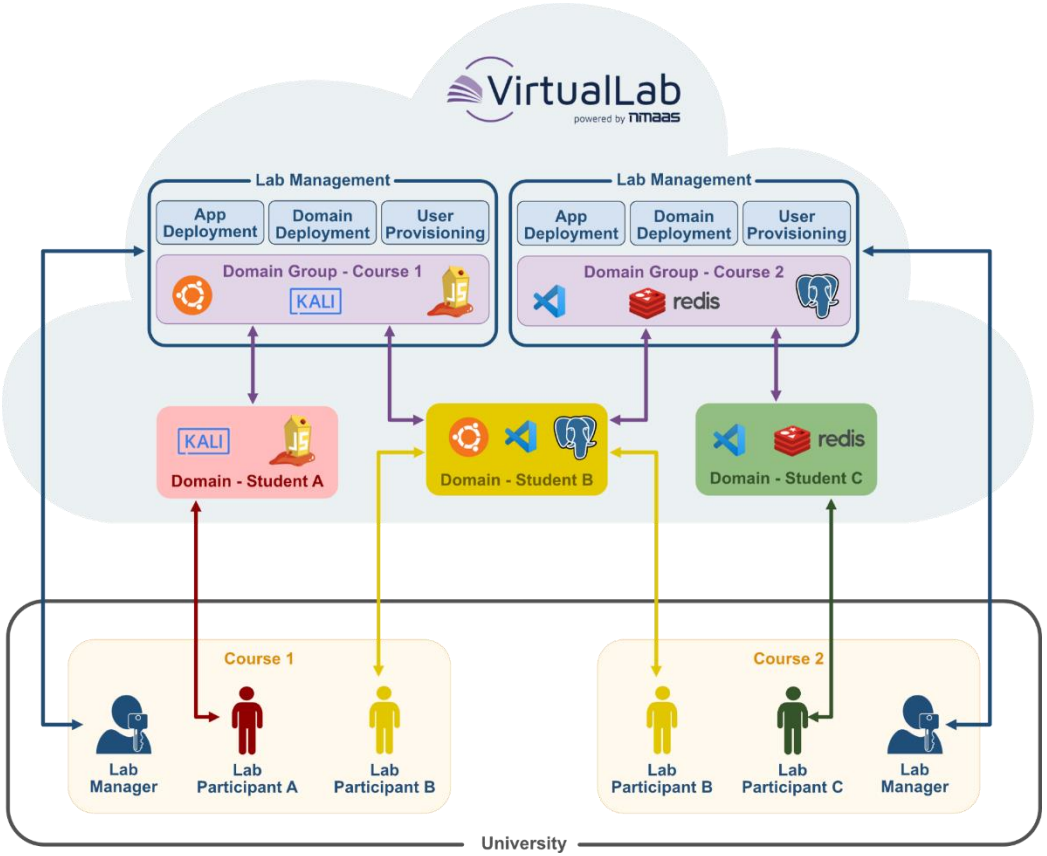
- Public statistics dashboard
- stats.perfsonar.net

Others

- 20+ domains

nmaas for Virtual Lab

- nmaas as a general-purpose application orchestrator
- Adapt to an **educational context**
  - Formal education
  - Informal education
- nmaas for educational exercises
  - **Focus on software use**, not deployment
  - Applications executed on a central infrastructure
  - **Equal opportunities** for each lab participant
- Advantages:
  - Multitenancy
  - Collaboration
  - Lab managers' control



Virtual Lab Pilots and Real-World Use

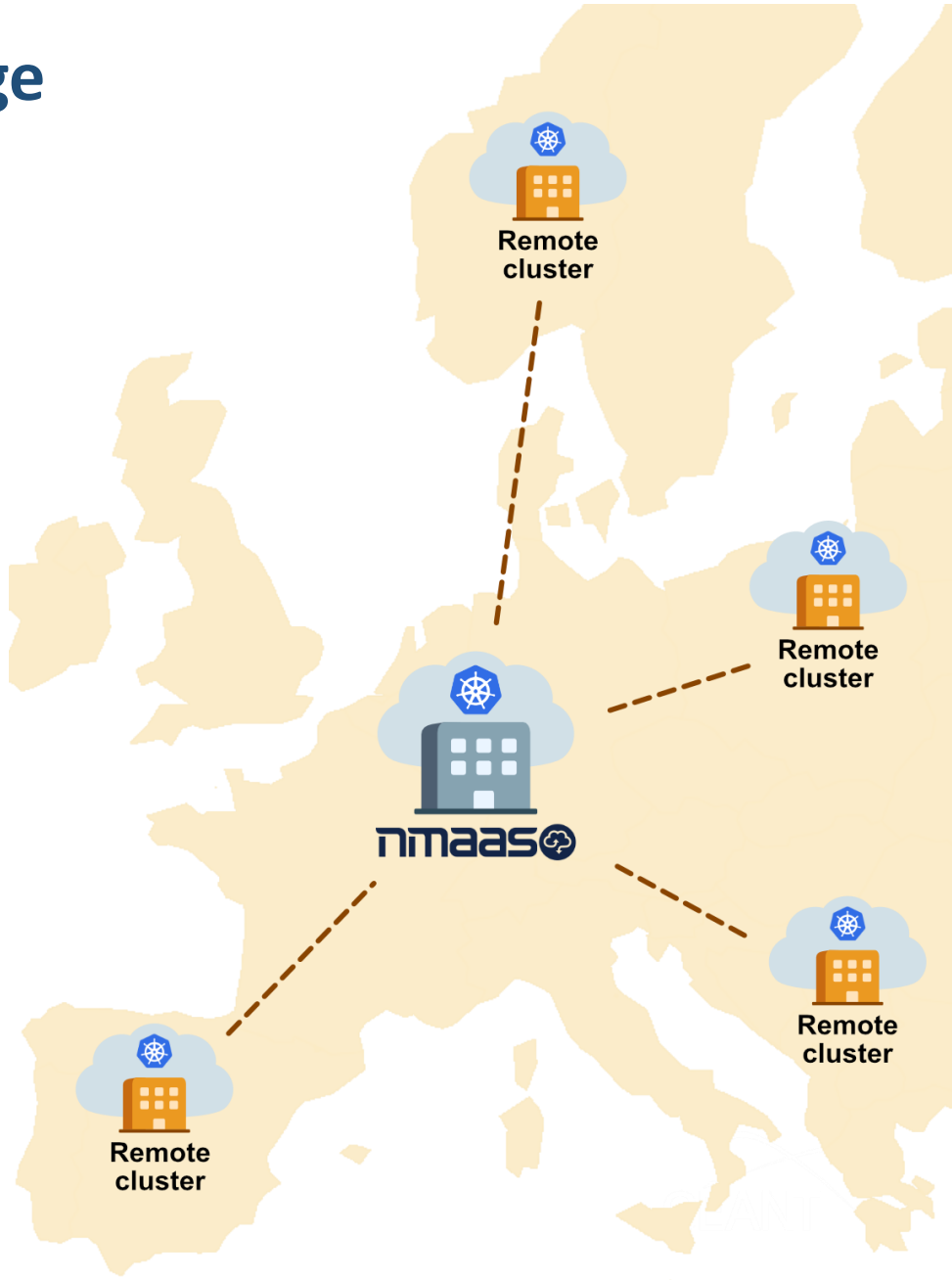
- **3 pilots** with around **80 students** in total
  - 2 pilots at UKIM (**Ss. Cyril and Methodius University, Skopje**)
    - Ethical Hacking and IT Service Management courses
  - 1 pilot at NTUA (**National Technical University of Athens**)
    - Network Management course
- Demo environment available at https://vlab.dev.nmaas.eu for demo and small-scale exercise deployment

Sneak Peak at a new Use-Case: nmaas for Remote Environments

- New use-case, under active development
- **Core idea:** a central nmaas instance manages distributed Kubernetes clusters
  - Adoption of „bring your own infrastructure” model
- **Remote** Kubernetes **cluster(s)** associated with existing nmaas domains
- nmaas catalog applications deployable on any of the on-boarded clusters
- All features to be part of the base software, which is **open-source**

nmaas for Remote Environments: Example Usage

- Monitoring tools deployed from a **single nmaas** instance across Kubernetes clusters in **multiple locations**
- Pooling of distributed scarce resources (GPUs)
  - **nmaas as an enabler for AI workloads**
  - Not limited only to network management
- Next steps: looking into ways for **unattended Kubernetes deployment** and on-boarding



Conclusion

Conclusion

- nmaas as a **state-of-the-art PaaS solution**
- Open-source and adaptable to multiple use-cases
- Tested in practice
- Dedicated development team and **continuous improvement**
- Versatility through promotion of **new use-cases**
- Potential for application in **AI-based context**
  - Pooling of resources
  - Promoting accessibility to scarce hardware (e.g., GPUs)

Thank You

Documentation *https://docs.nmaas.eu/*
Contact the nmaas team *nmaas@lists.geant.org*

www.geant.org

Co-funded by the European Union

The scientific work is published for the realization of the international project co-financed by Polish Ministry of Science and Higher Education from financial resources of the programme entitled "PMW"