Orchestrated Deployment of Virtual Labs for Education with nmaas

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TNC 2024, Rennes, France

11 June 2024

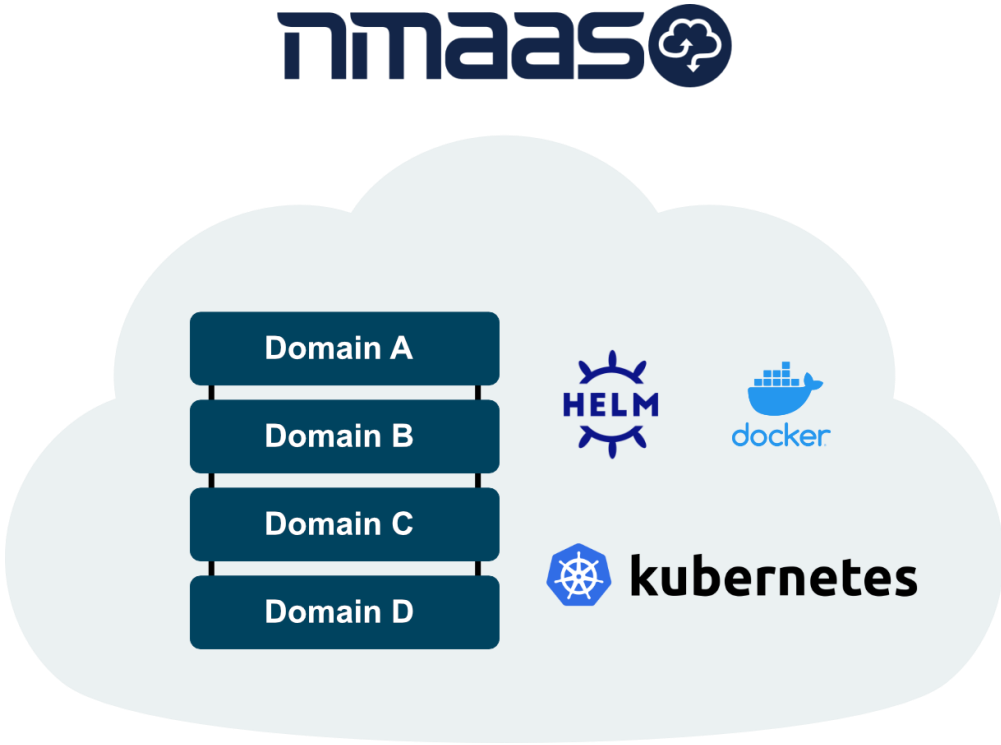
Agenda

- Introduction to the nmaas Platform
  - Orchestration
  - GitOps Configuration
- nmaas in Practice
  - Virtual NOC
  - Virtual Lab
- Conclusion

Introduction to nmaas

nmaas is an open-source framework for orchestrated on-demand deployment of applications in a cloud environment

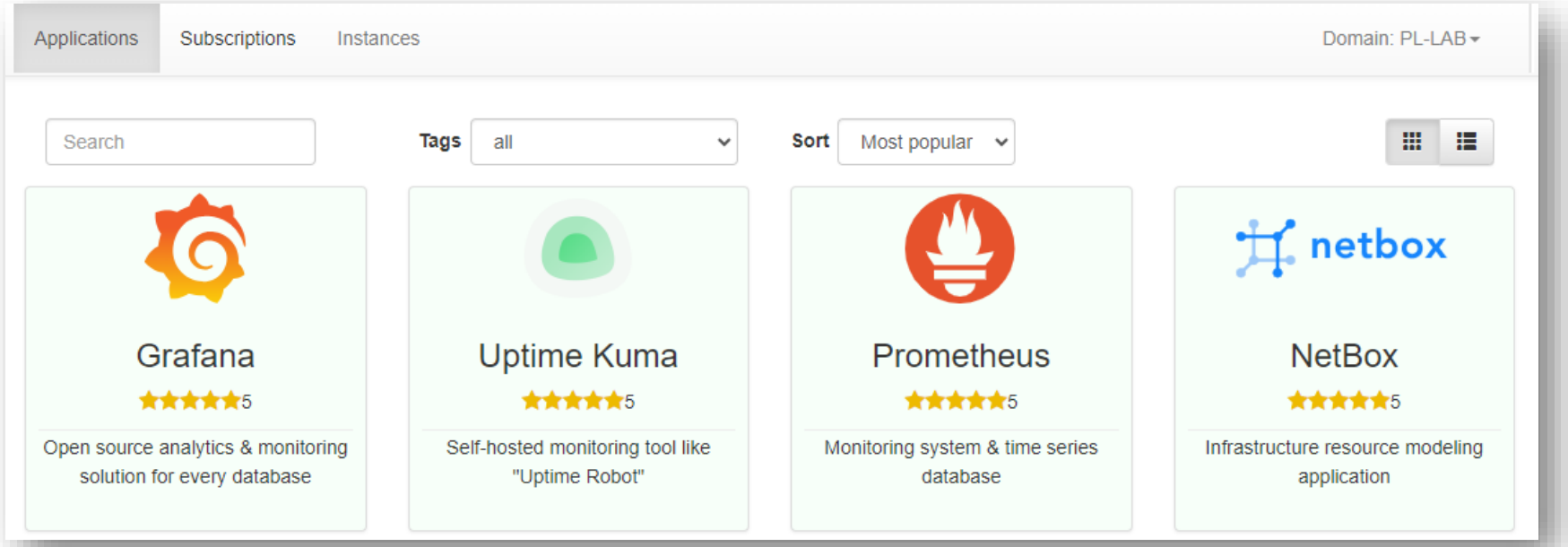
- Kubernetes-based infrastructure
- Multi-tenant architecture
- Simple application deployment and upgrade process
- Wide and easily extendable portfolio of applications
- GitOps approach for application instance configuration management
- Easy troubleshooting



Software available at https://gitlab.software.geant.org/nmaas

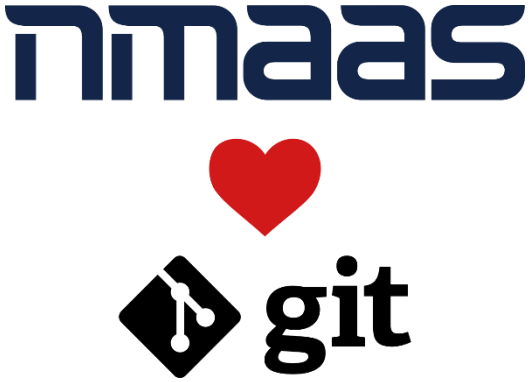
nmaas Feature Highlights: Extensible Application Catalog

- Self-service catalog of deployable applications
- Easily extensible using the industry standard Helm package manager
  - Each application represented by a Helm chart
- Application settings can be customized during deployment or while running



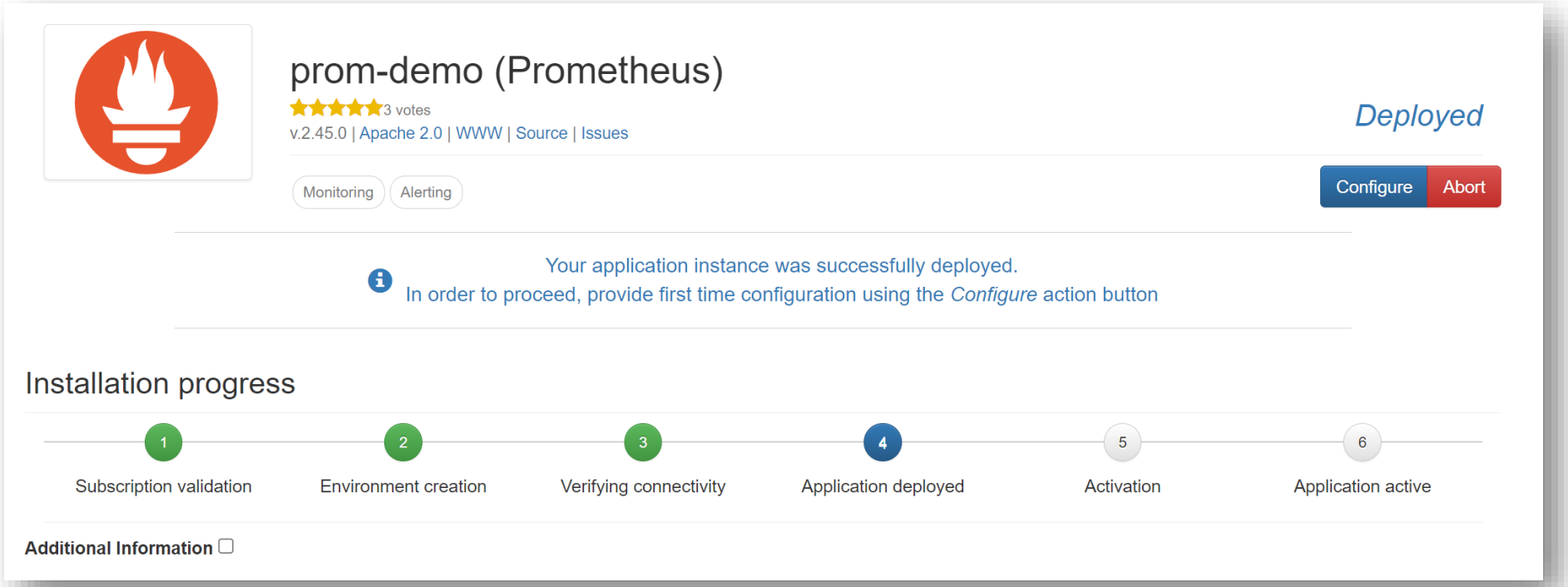
nmaas Feature Highlights: GitOps Configuration

- Problem: Many applications use text-based configuration files. How to manage them at scale in a cloud environment?
- Solution: nmaas adopts the GitOps approach
- Workflow:
  - Configuration files placed in a private Git repository
  - User clones the repository using their credentials
  - Changes are pushed upstream
  - The altered files are synced to the running container
  - The application is reloaded/restarted
- Examples: Prometheus, Zabbix, Icinga2, Airflow

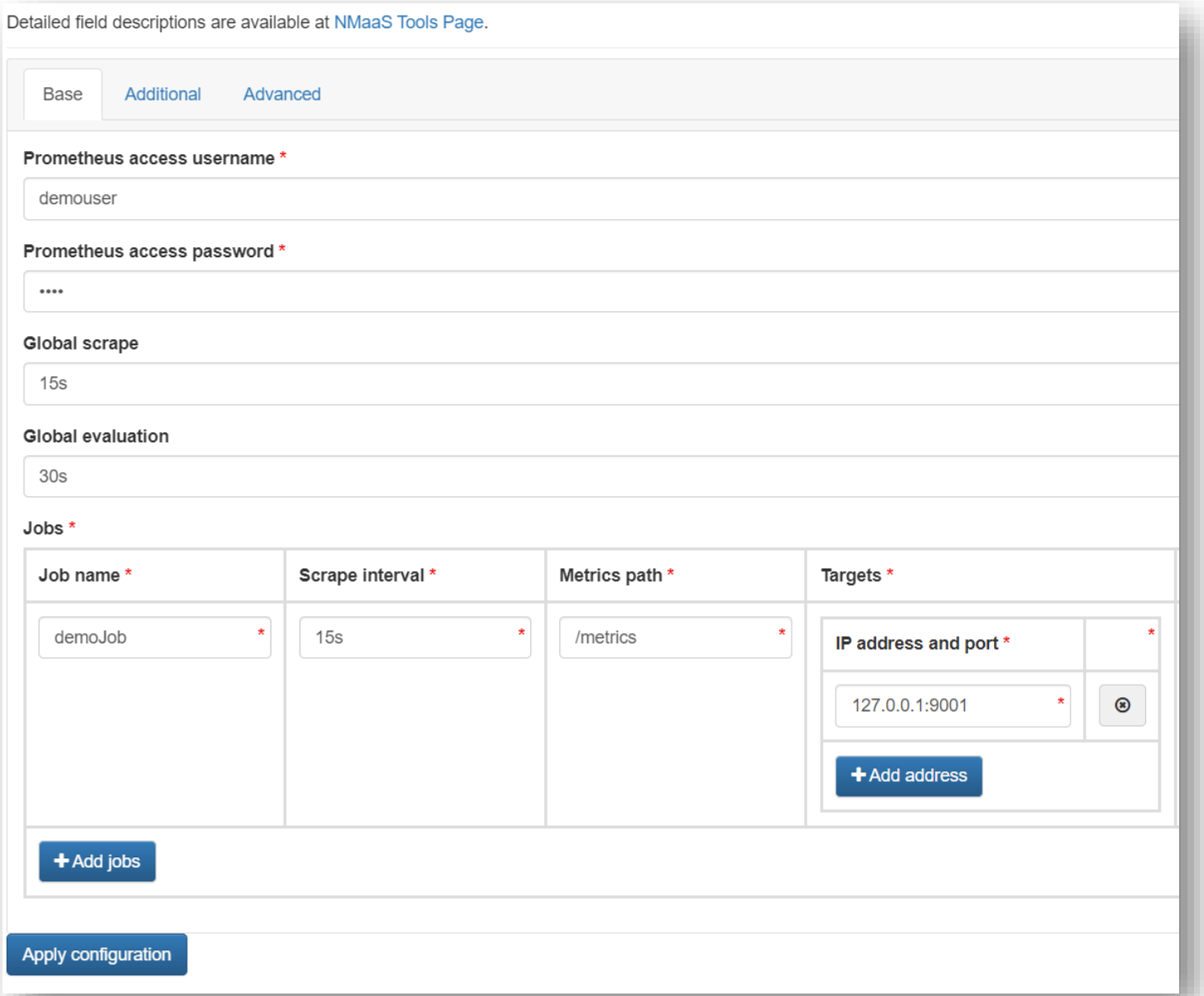


nmaas Feature Highlights: Guided Configuration Wizard (1)

- Configuration wizard to aid initial application deployment
  - Options dependent on the application at hand
  - Possible integration with Git



nmaas Feature Highlights: Guided Configuration Wizard (2)



nmaas Feature Highlights: Guided Configuration Wizard (2)

demo › prometheus-1496 › Repository

master | prometheus-1496 / **prometheus.yml**

Initial commit of prometheus.yml
nmaas bot authored 2 minutes ago

prometheus.yml 296 Bytes

```
1  global:
2    scrape_interval: 15s
3    evaluation_interval: 30s
4  alerting:
5    alertmanagers:
6      - static_configs:
7        - targets:
8  rule_files:
9  scrape_configs:
10   - job_name: 'demoJob'
11     metrics_path: /metrics
12     scrape_interval: 15s
13     static_configs:
14     - targets: ['127.0.0.1:9001']
15       labels:
```

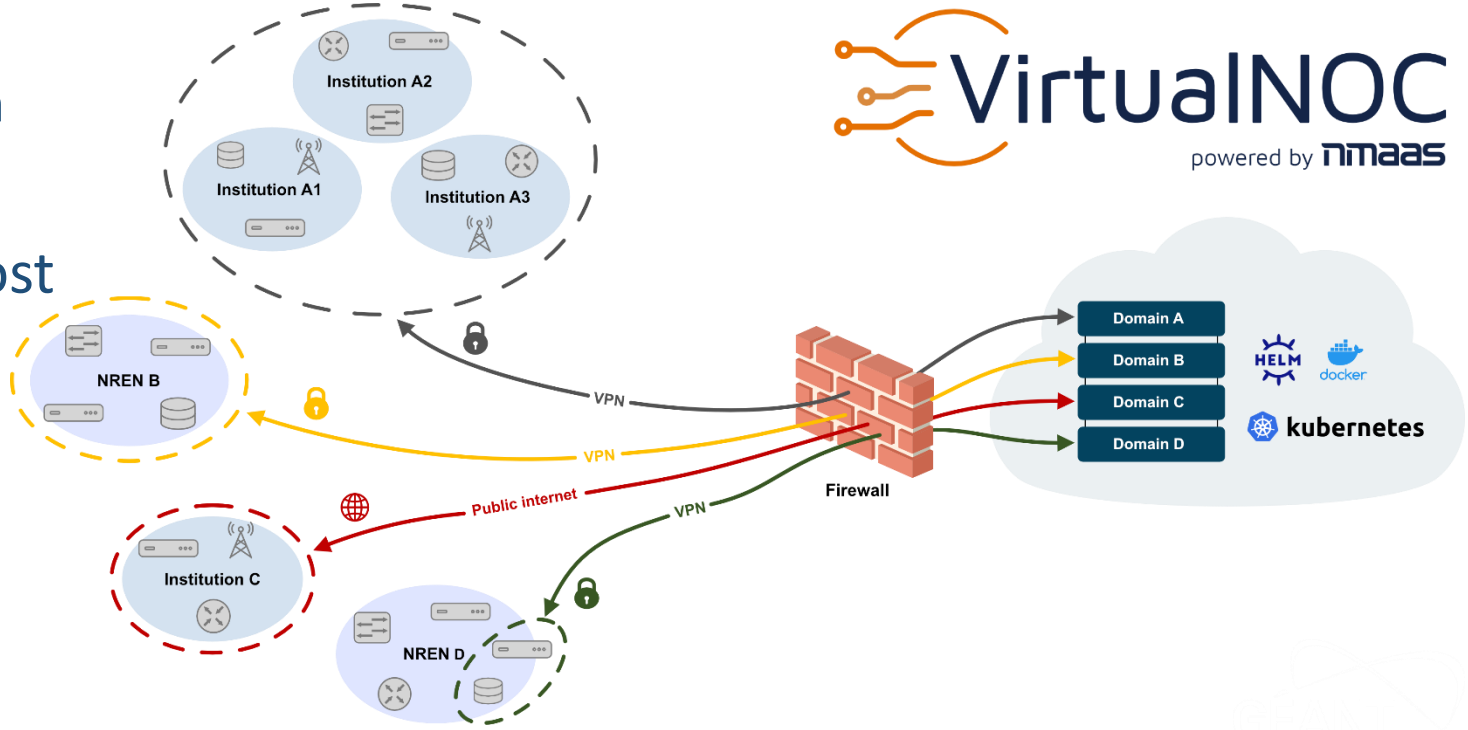
nmaas for Virtual NOC (vNOC)

New name for NMaaS (Network Management as a Service)

GN5-1

nmaas for Virtual NOC

- Versatility of nmaas as an open-source orchestration platform
- Support for multiple use-cases
- NMaaS (Network Management as a Service) as the initial use-case
- Rebranding
  - nmaas – the underlying platform
  - nmaas for Virtual NOC
- Application catalog containing most popular network management applications
- Continuous improvement



nmaas for Virtual NOC: Target Groups and Usage Models

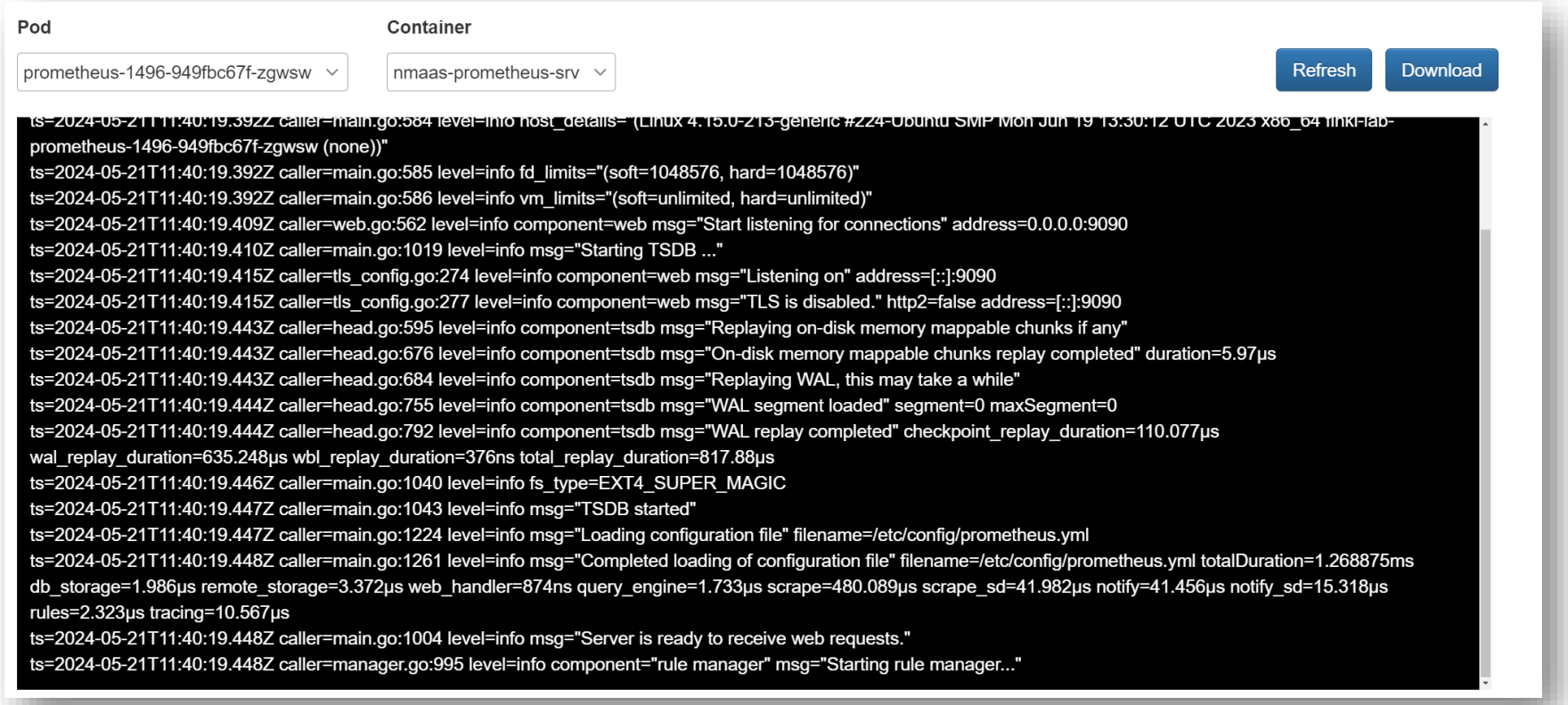
- Target groups
  - NRENs or end institutions with limited capacity for in-house network management
    - Universities, high schools, primary schools
  - International research projects with (distributed) hardware resources
  - Development/infrastructure teams requiring external health monitoring and alerting for their applications
- Can be used either as a self-hosted or managed solution
  - Self-hosting requirement: Kubernetes cluster
  - https://nmaas.eu is the managed production instance for the Virtual NOC use-case

VirtualNOC
powered by nmaas

nmaas for Virtual NOC: Recent Developments

VirtualNOC powered by nmaas

- Manual/Automatic application version upgrades
- Overview of application instance deployment parameters
- **Application log viewing**



nmaas for Virtual Lab (vLab)

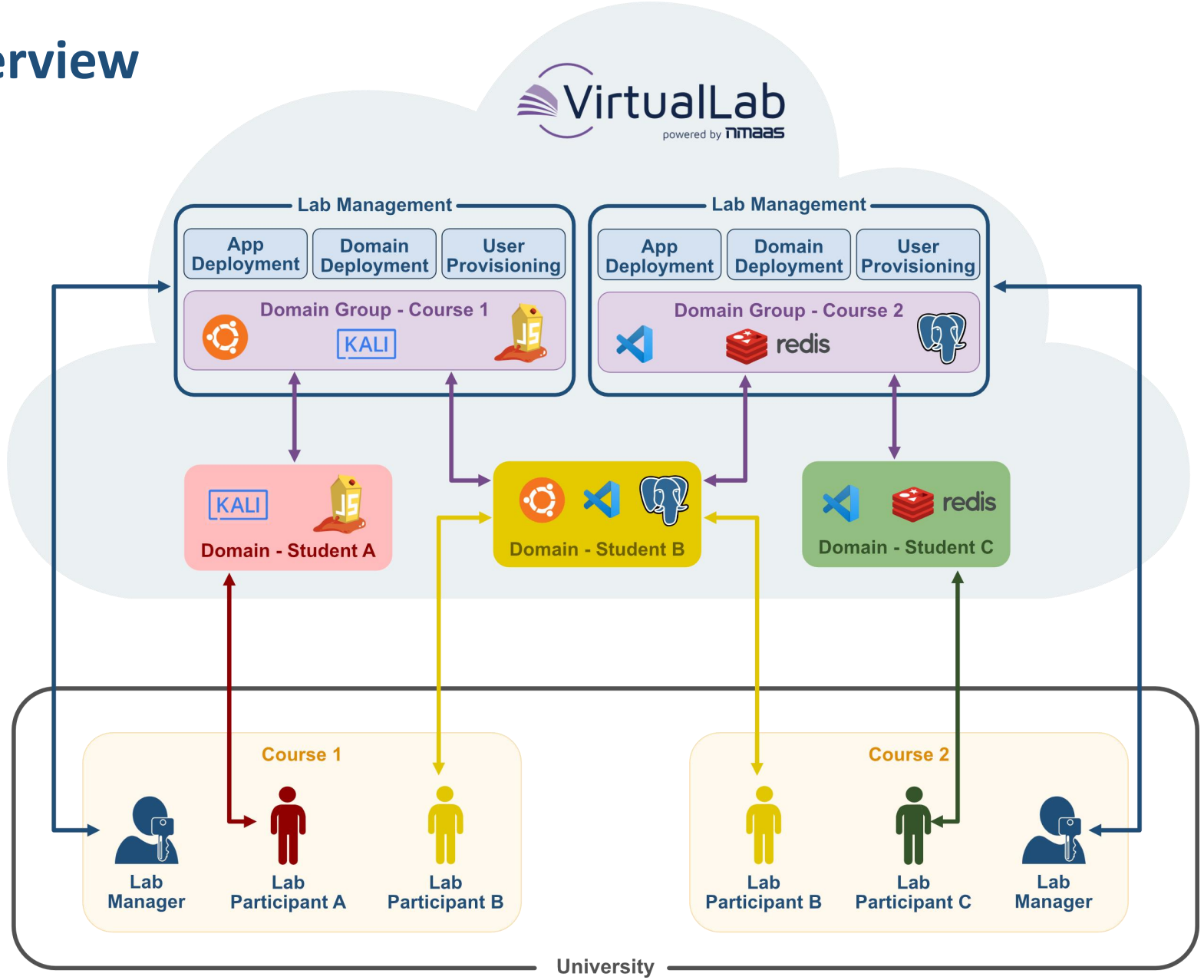
A new use-case for the nmaas Platform

GN5-1

nmaas for Virtual Labs in a Nutshell

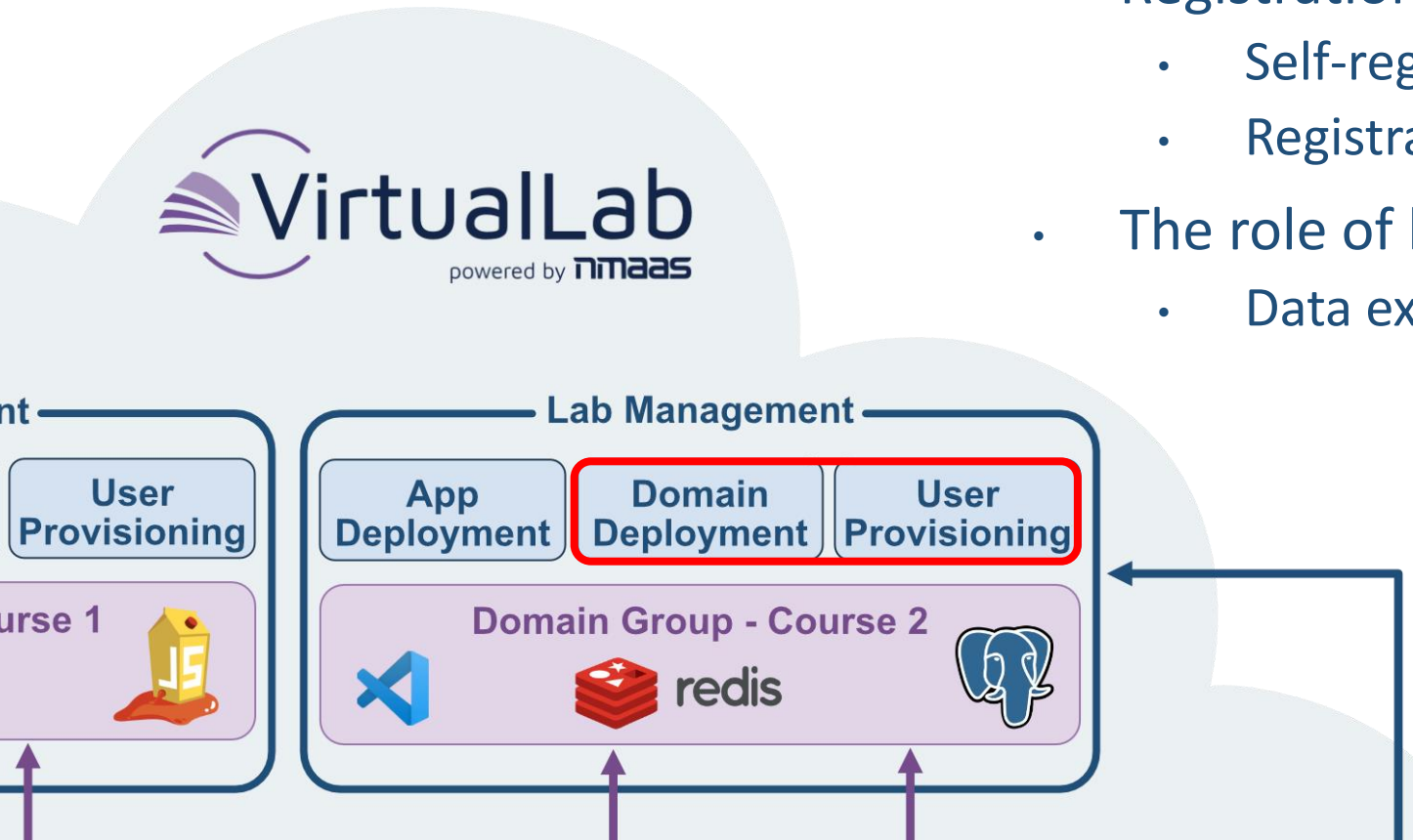
- The challenge of organizing hands-on educational exercises
  - Formal learning
  - Informal learning
- nmaas as a **general-purpose orchestrator** for various applications
- **Core idea:** Deployment of educational exercises not fundamentally different from network management applications
  - Same underlying concept and technologies
  - Containerization, orchestration, isolation, multi-tenancy

Concept Overview



User Provisioning

- Requirements for a new lab participant:
  - User account
  - Dedicated nmaas domain
- Registration options:
  - Self-registration by the lab participant
  - Registration in bulk by the lab manager
- The role of learning management systems (LMS)
  - Data export and import



Network Management as a Service (NMaaS) provides a portfolio of network management applications run as dedicated per-user instances in the cloud.

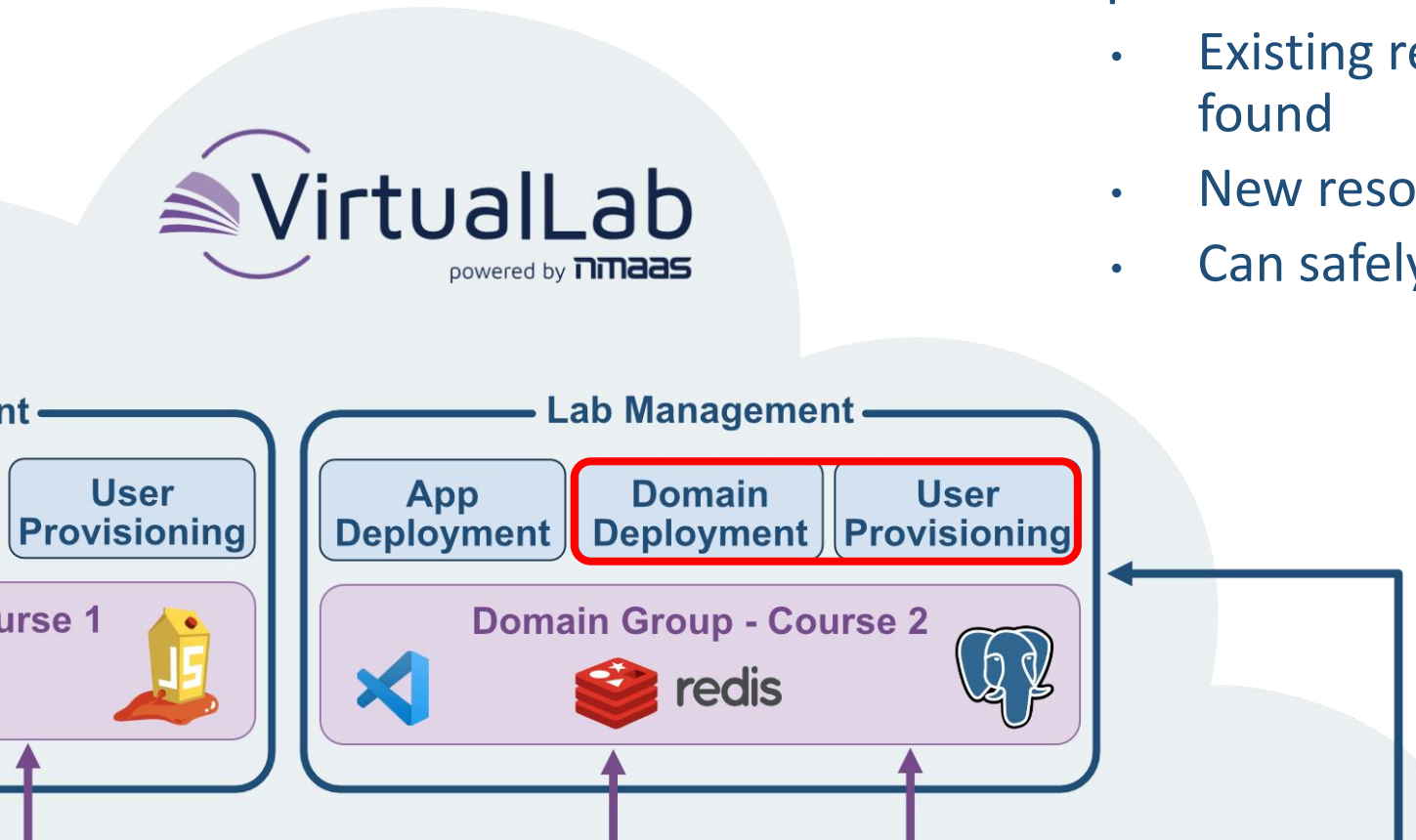
GÉANT's NMaaS service includes three aspects: providing, managing and maintaining the infrastructure of the NMaaS service portal, platform and selected tools, supporting users in using the system, and the selected tools for monitoring their networks via NMaaS, as well as supporting users that contribute their software to NMaaS system.

Target users

NMaaS users are organisations that do not want to own NMS infrastructure themselves and/or want to outsource network management, as well as organisations and/or individuals that are searching for quality network management software or who want to

User Provisioning – Key Takeaways

- Multiple lab managers using a single nmaas deployment
- User and domain creation is an idempotent operation
  - Existing resources are reused when a match is found
  - New resources are created only when required
  - Can safely be repeated multiple times



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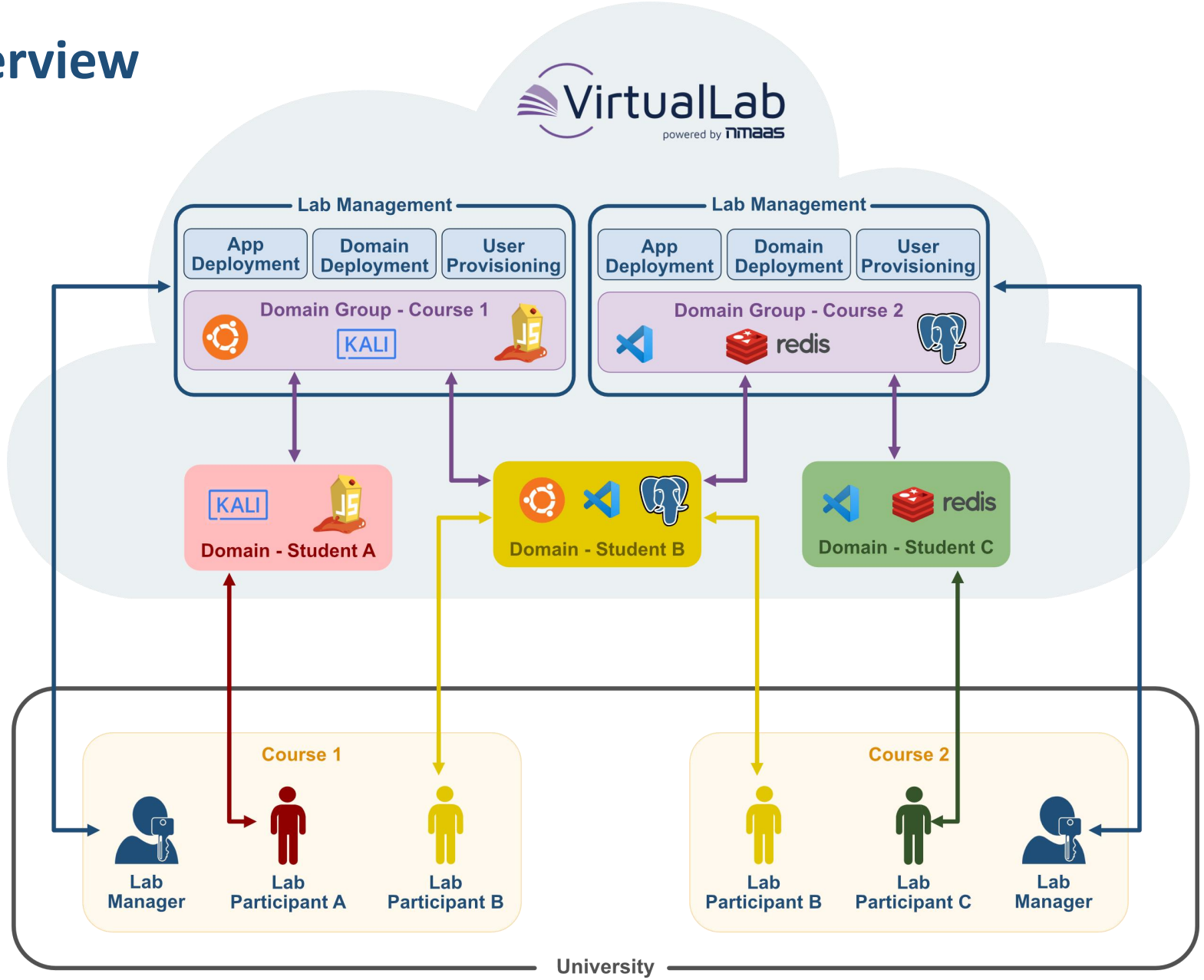
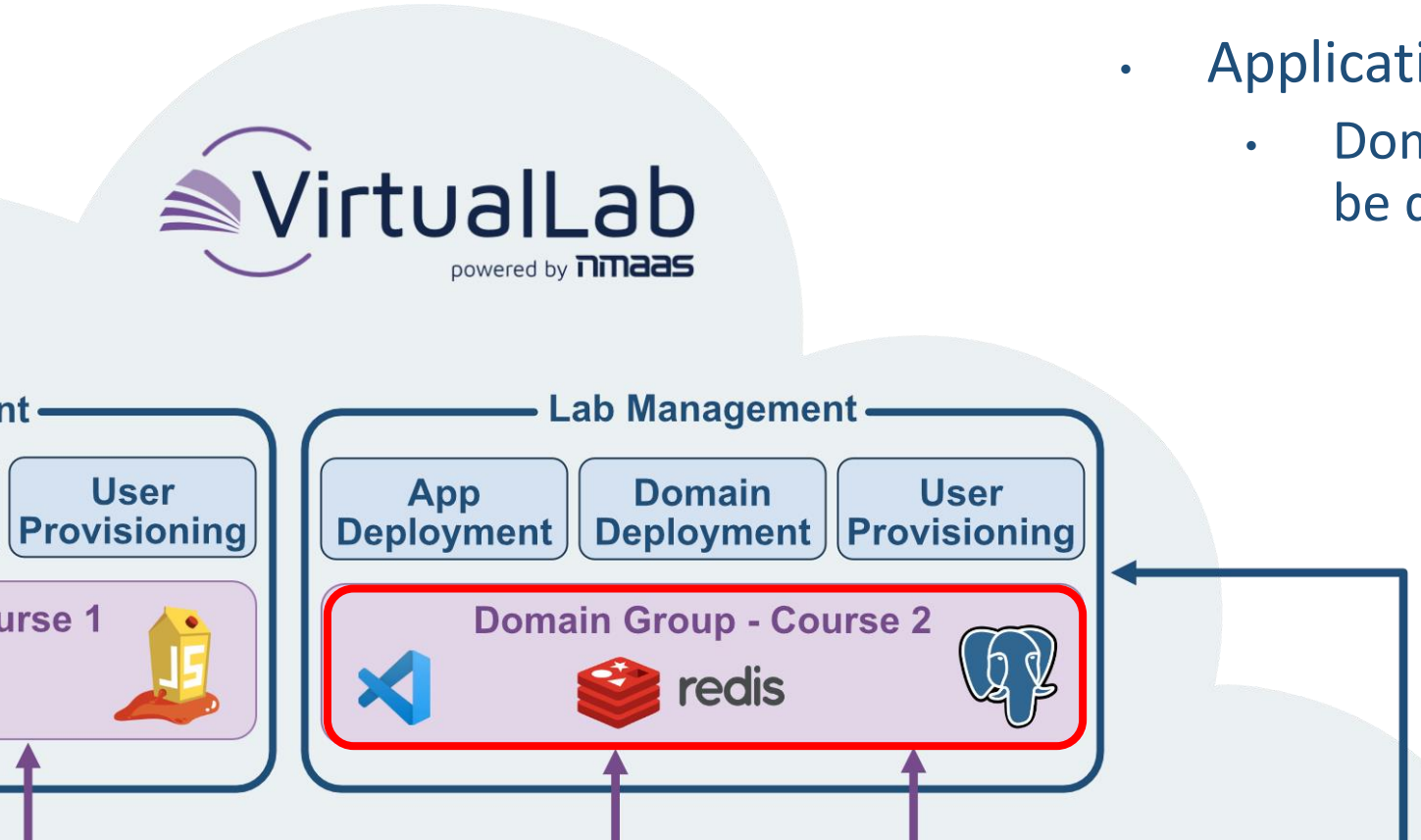


Domain Groups

- Domain groups – core new nmaas concept in dedicated to virtual labs
- Enables the use of a single nmaas instance across multiple courses and/or institutions
- Application whitelisting
  - Domain groups specify which applications can be deployed by participating domains



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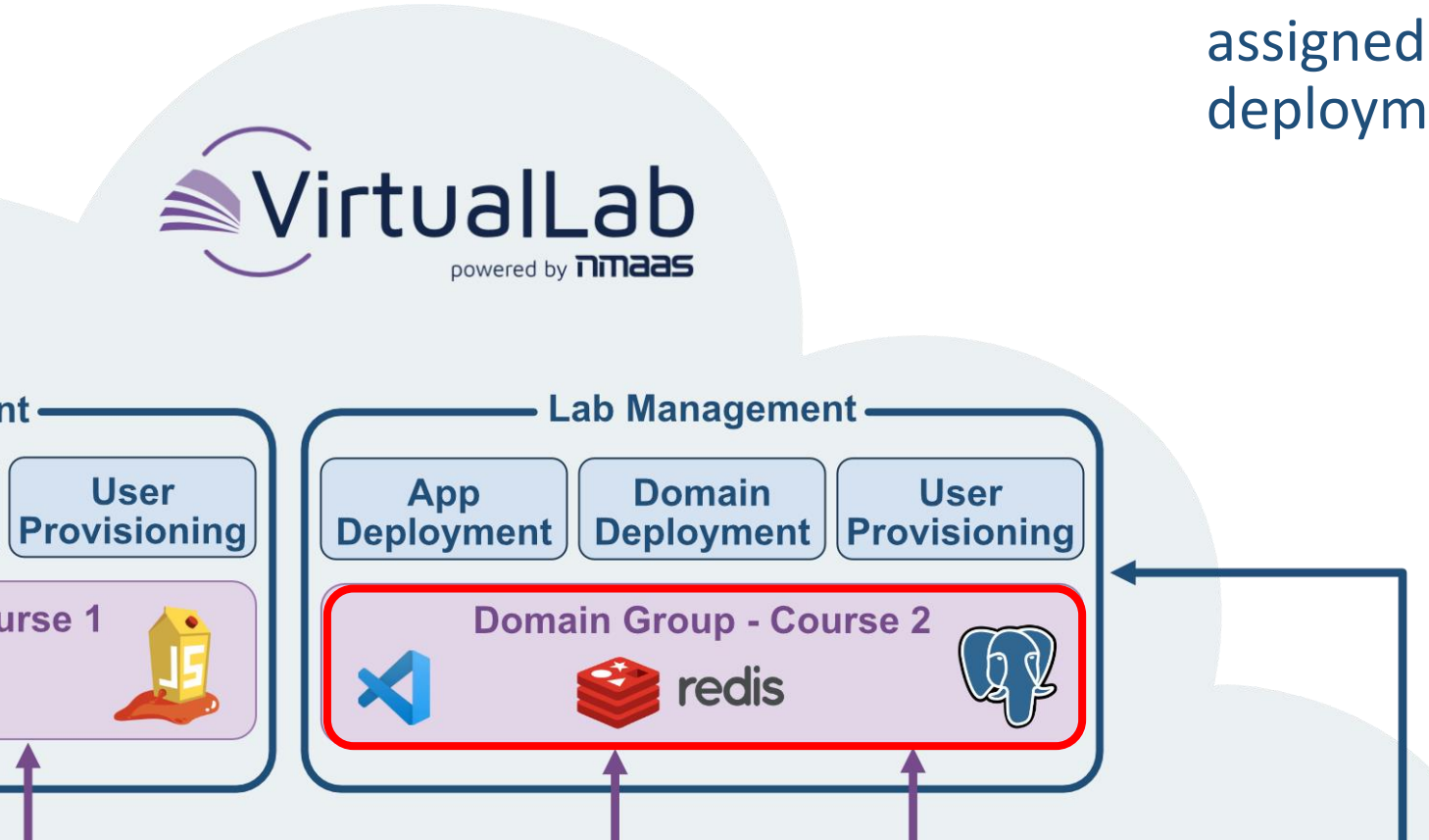
Domain Groups – Key Takeaways

- A domain can be part of multiple domain groups at once
  - A student participating in multiple courses
- All the whitelisted applications across the assigned domain groups are available for deployment



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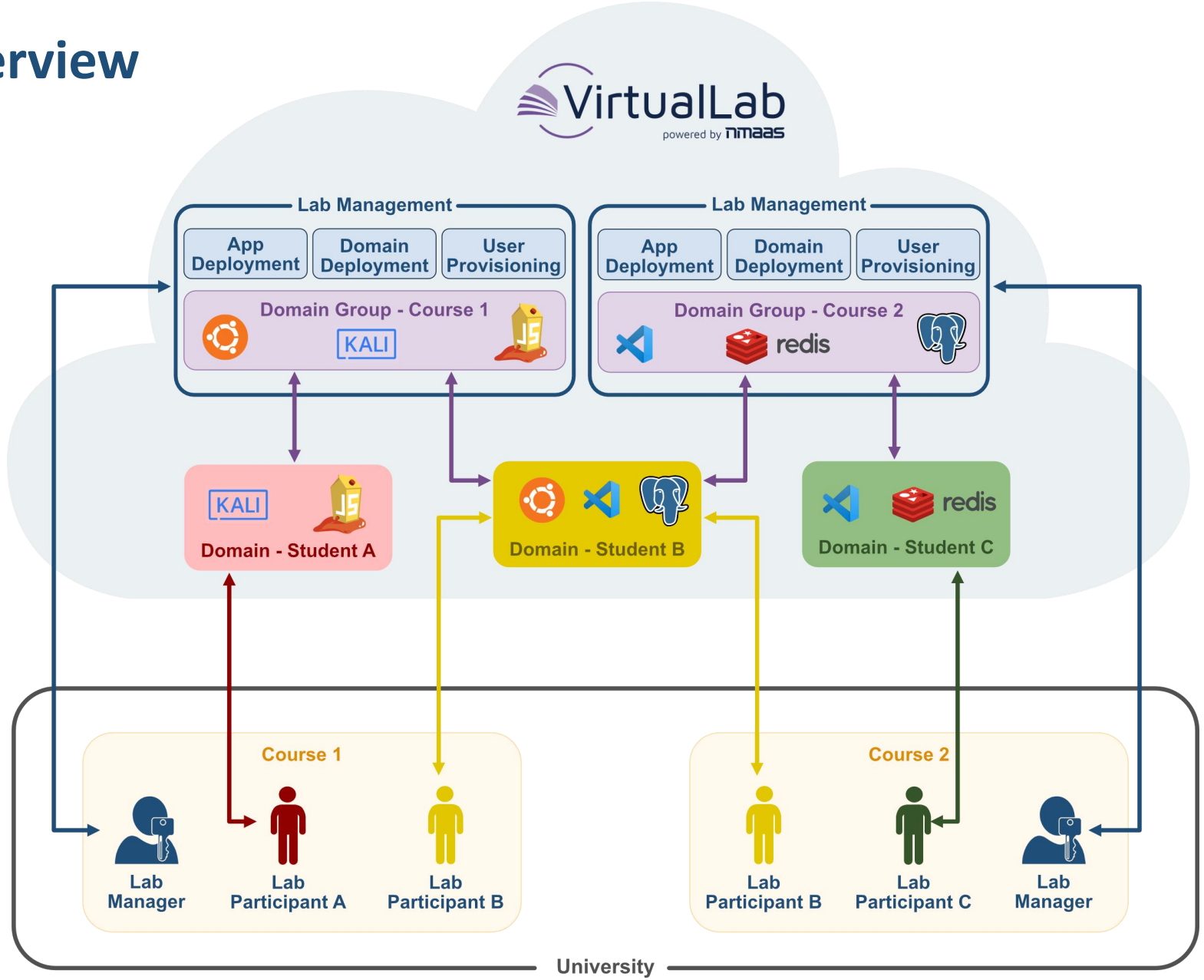
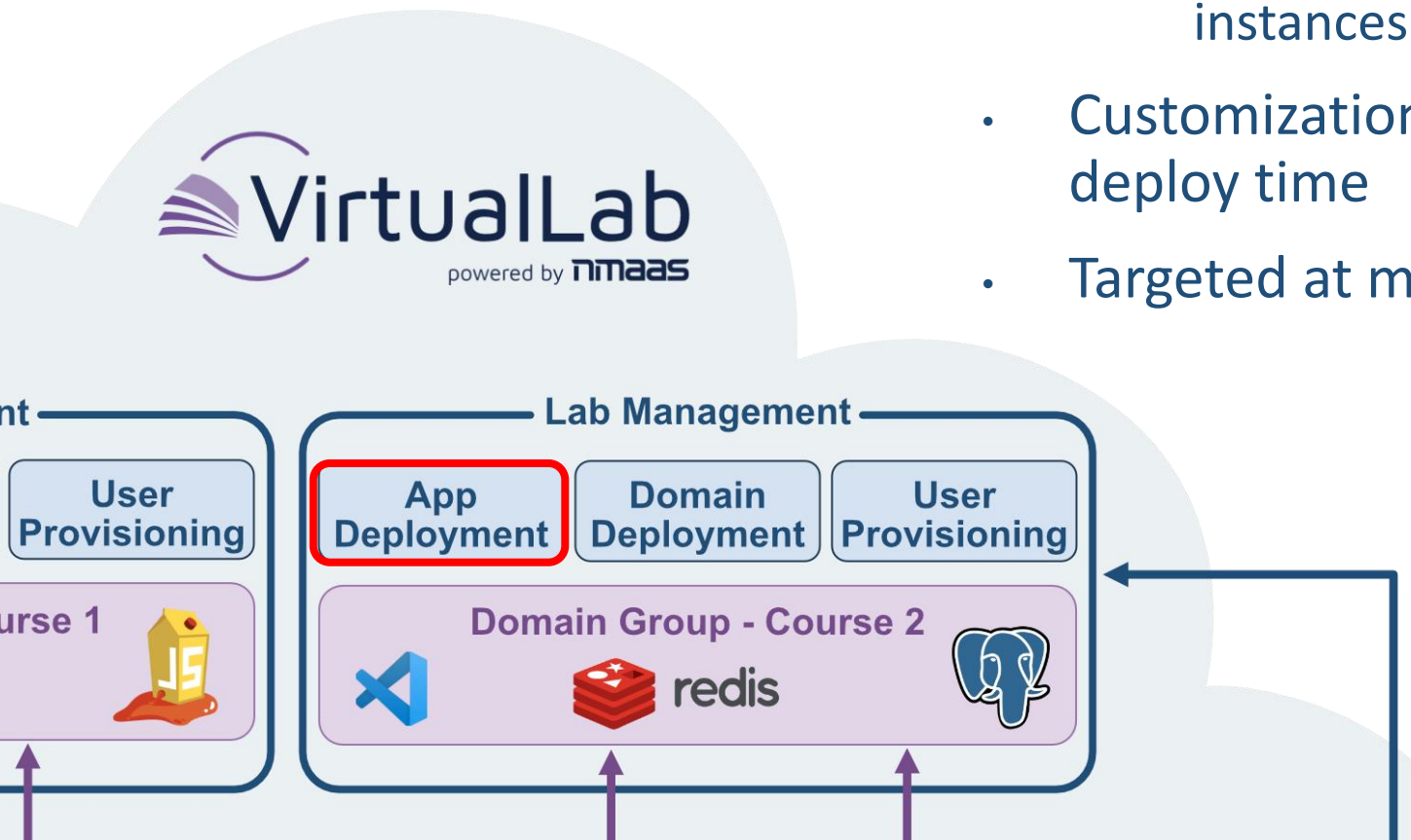


Application Deployments by Lab Participants

- Application deployment options:
  - Individual, each lab participants deploys and configures their own instance
  - In bulk, a lab manager deploys preconfigured instances
- Customization of application parameters during deploy time
- Targeted at more experienced lab participants



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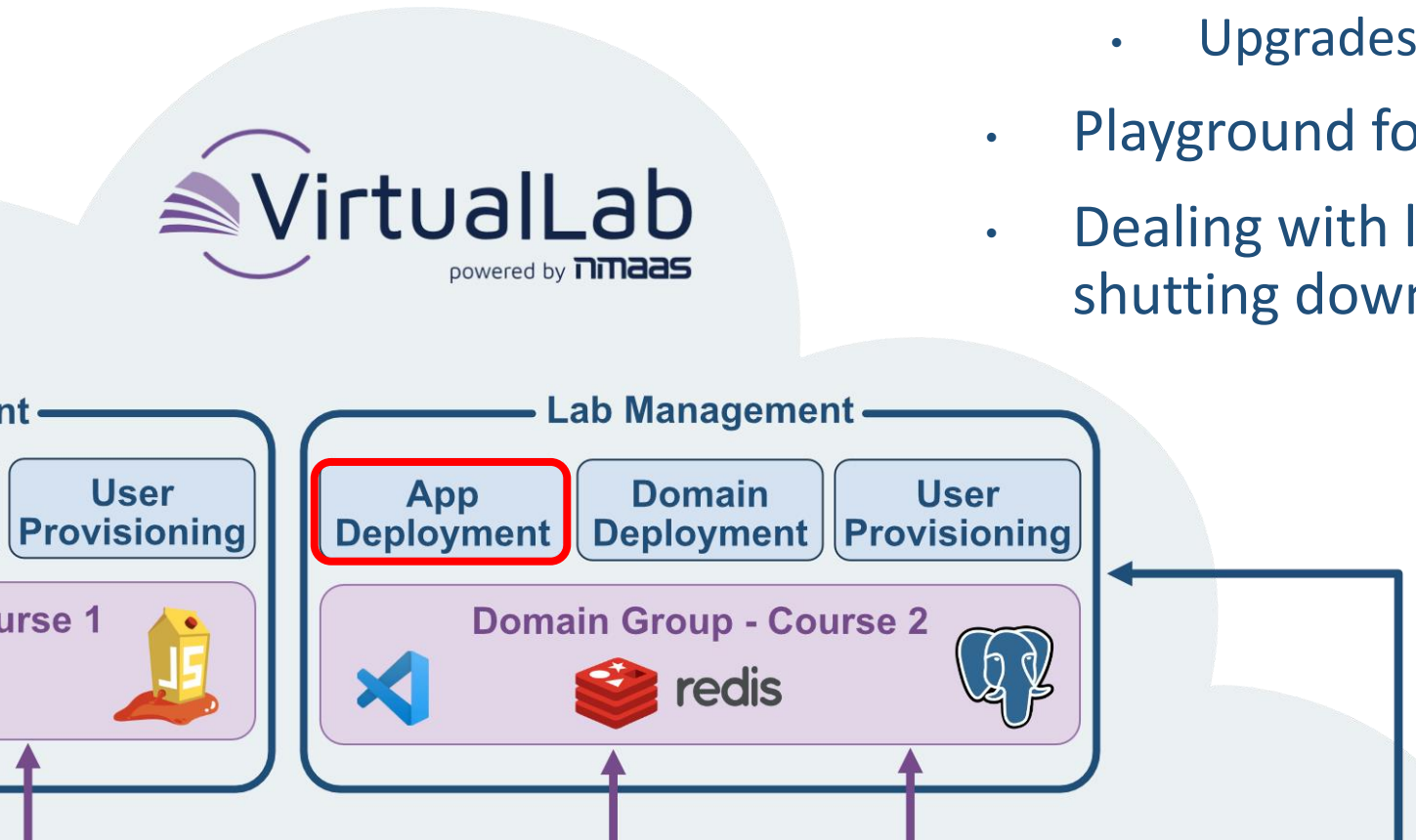
Application Deployments by Lab Participants – Key Takeaways

- Lab participants have full control over the lifecycle of their application instance
  - Deployment
  - Removal
  - Upgrades
- Playground for exploring additional applications
- Dealing with large number of lab participants by shutting down idle instances



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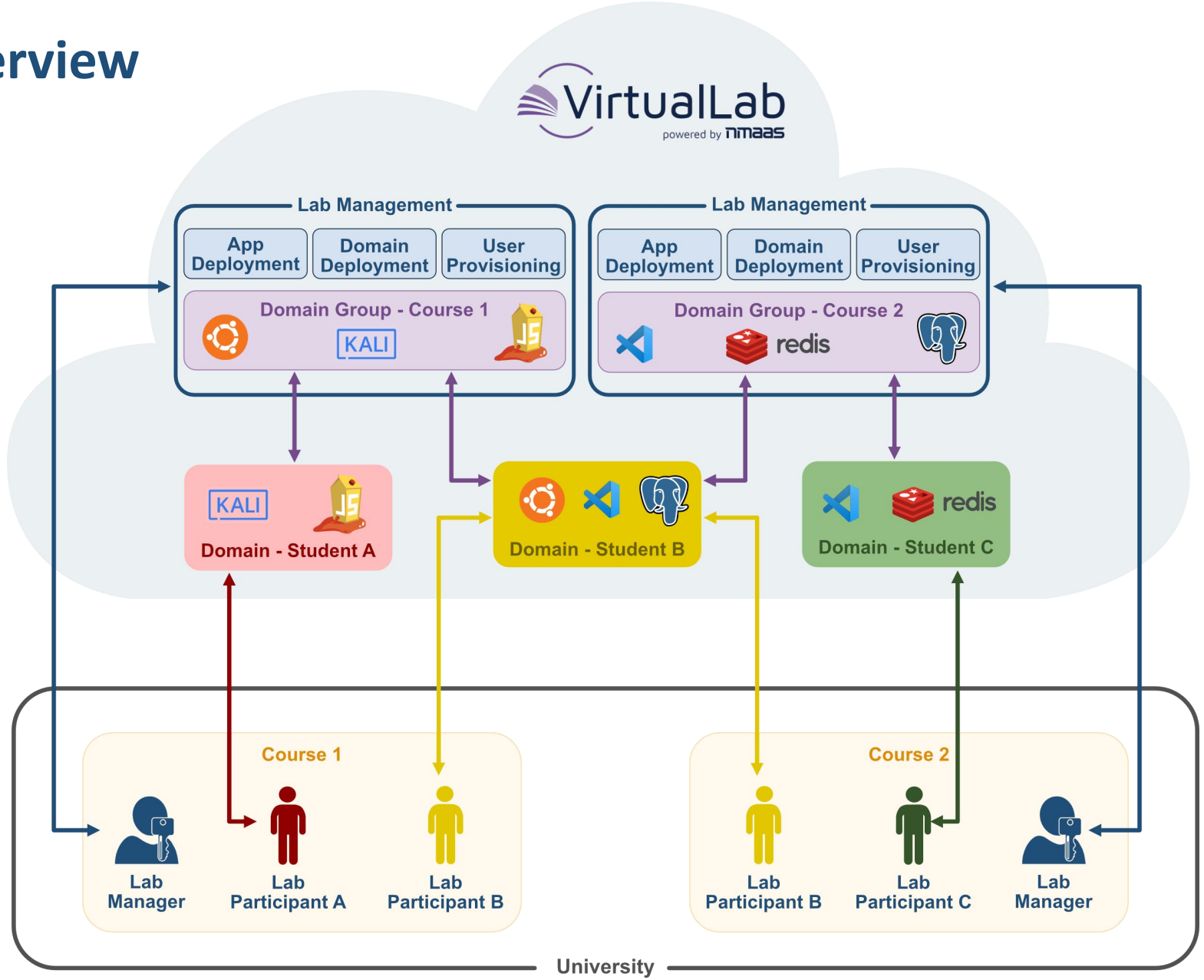
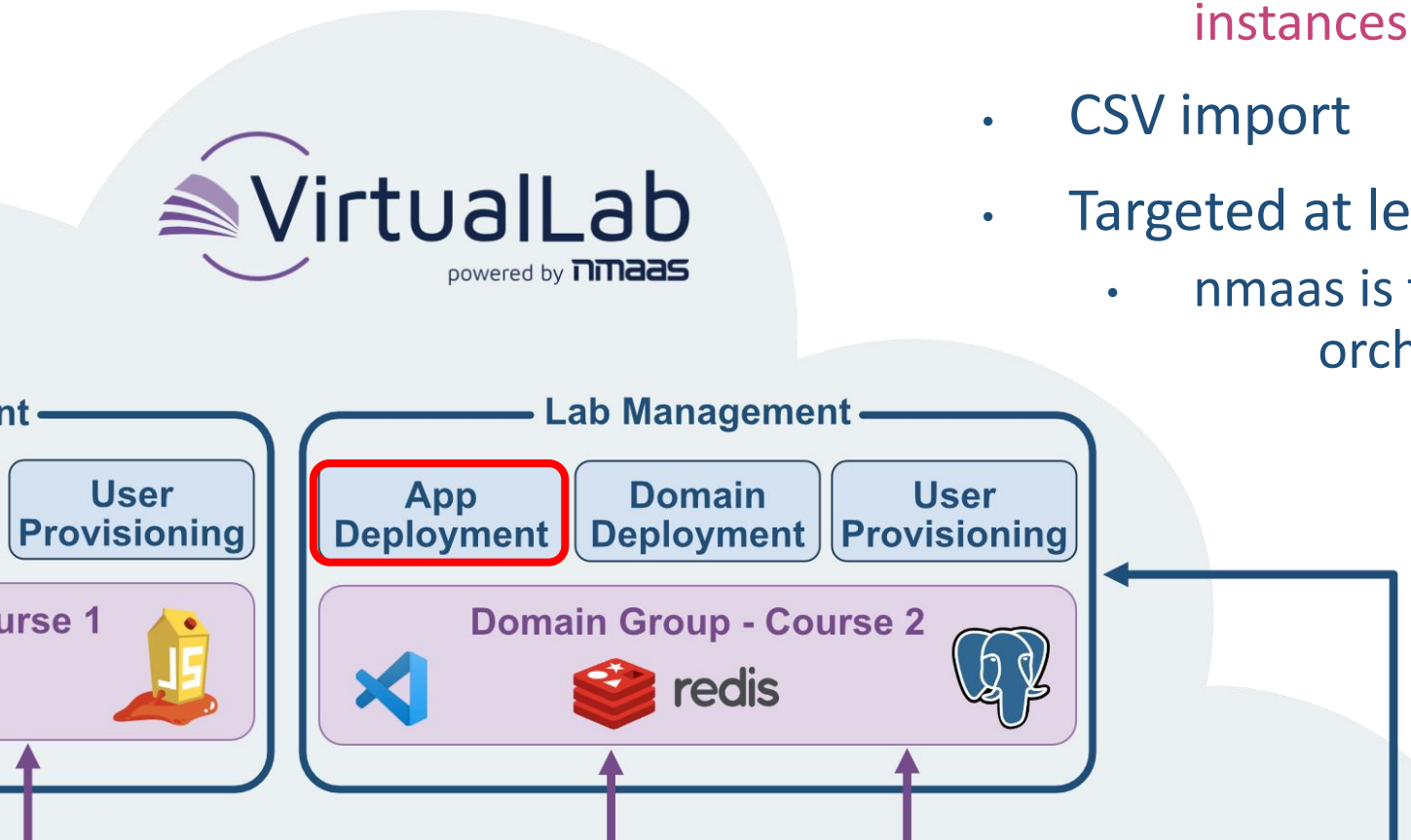


Bulk Application Deployments by Lab Managers

- Application deployment options:
  - Individual, each lab participants deploys and configures their own instance
  - In bulk, a lab manager deploys preconfigured instances
- CSV import
- Targeted at less experienced lab participants
  - nmaas is transparent and used solely as an orchestration tool



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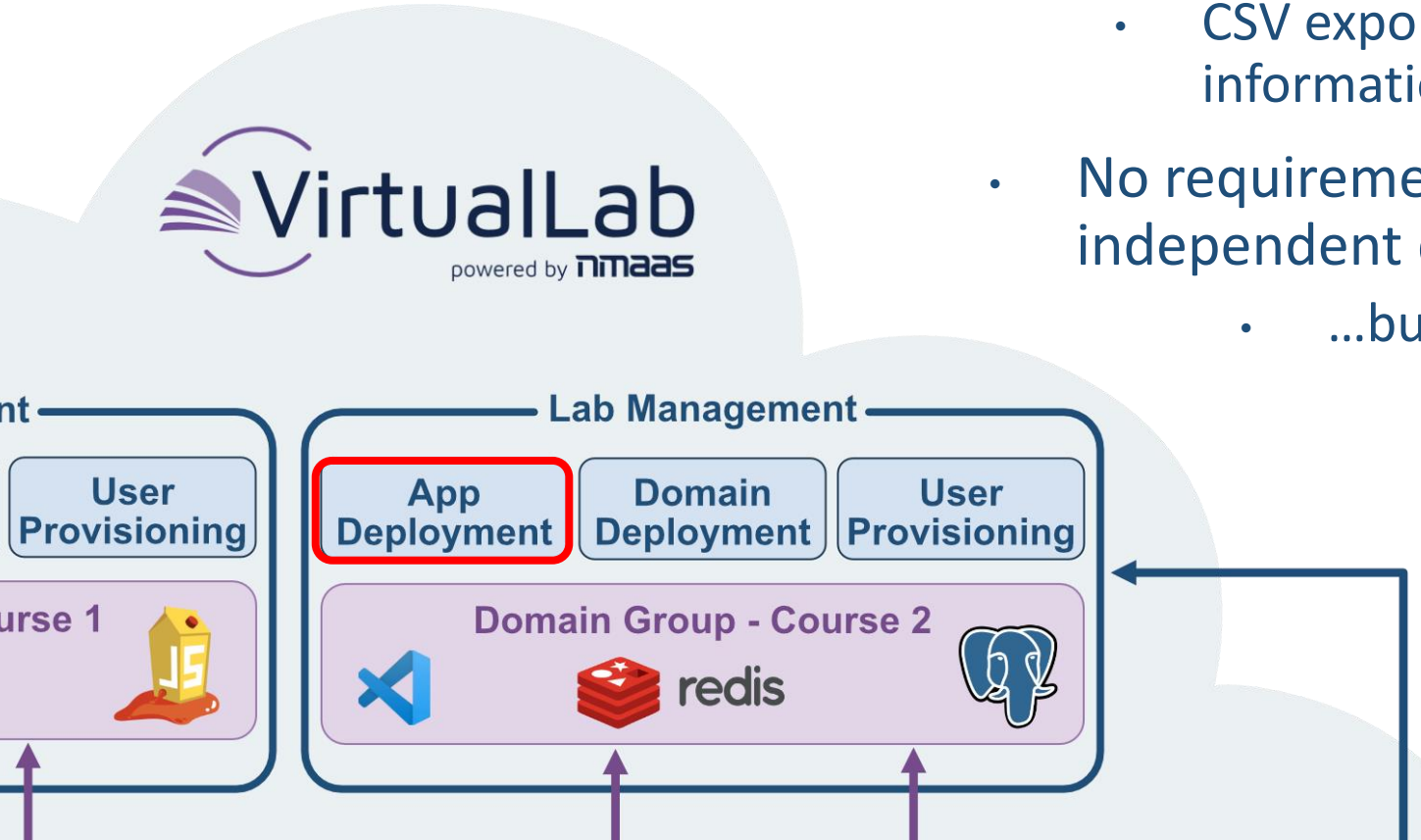
Bulk Application Deployments by Lab Managers – Key Takeaways

- Multiple options for sharing application instance information:
  - Email with a direct access link sent to the lab participant
  - CSV export by the lab manager and sharing the information using a different platform, e.g. LMS
- No requirement for application instances to be in independent domains
  - …but a recommended practice



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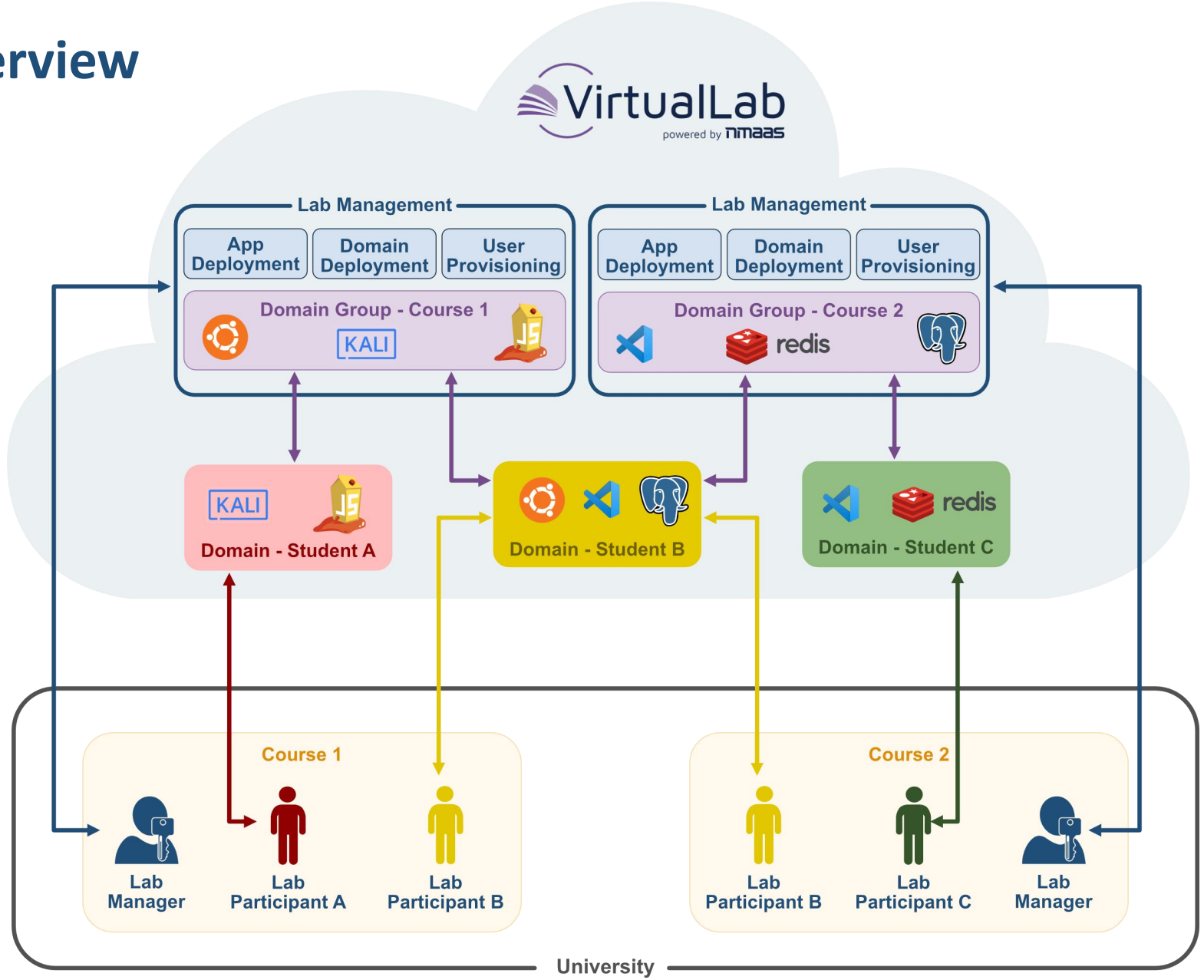


nmaas for Virtual Labs in Practice

- Two pilots at the Ss. Cyril and Methodius University in Skopje, North Macedonia
- Ethical hacking course
  - Capture the Flag competition
  - Deployment of a purposefully vulnerable application by the lab participants themselves
  - Flags exchanged for points towards a final grade
  - Scaling down of inactive instances
- IT Service Management Course
  - Deployment of a ticketing system instance per lab participant
  - Long lived applications throughout the semester
  - Applications deployed in bulk by lab managers and access details shared with lab participants
- Feedback loops for additional features and improvements

VirtualLab powered by nmaas

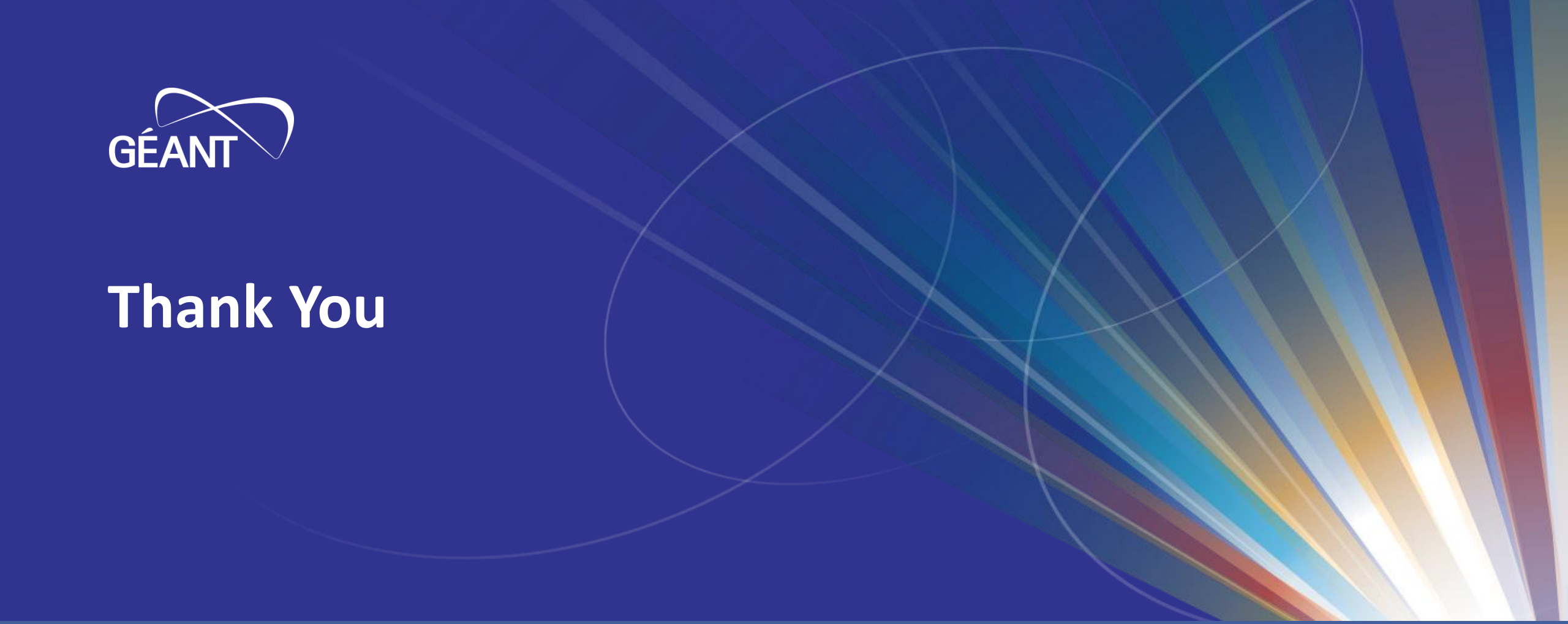
Using nmaas for Virtual Labs

- Dedicated playground instance for virtual lab pilots at https://vlab.dev.nmaas.eu
- Open to the community to evaluate the new features and perform small-scale, real-world trials
- Self-hosted deployment recommended for large-scale use
- Documentation available at https://vlab.docs.nmaas.eu

Conclusion

The Road Ahead

- Discovering additional use-cases
- Improvements to vNOC:
  - Application bundles
  - VPN provisioning
  - Improvements to domain provisioning
- Improvements to vLab:
  - Unattended on-boarding
  - Extending the portfolio of supported scenarios
  - Collaboration with e-Academy



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Co-funded by
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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"