



Deployment of Virtual Labs with NMaaS

Streamlining the Organization of Hands-On Educational Exercises

Vojdan Kjorveziroski (UKIM)

Lukasz Lopatowski (PSNC)

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Public (PU)

Agenda

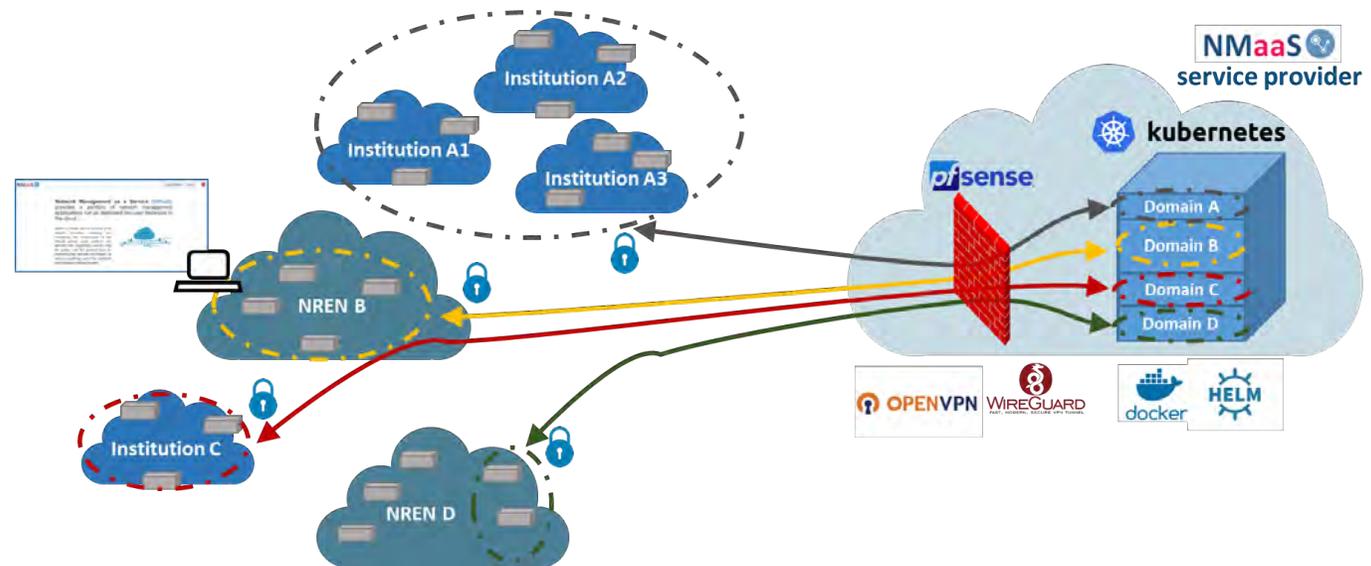
- Introduction to NMaaS
- How can I use NMaaS?
- Adapting NMaaS for Virtual Labs
- Virtual Labs in Action
- Conclusion and plans for the future



Introduction to NMaaS

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

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



ZABBIX

Uptime Kuma

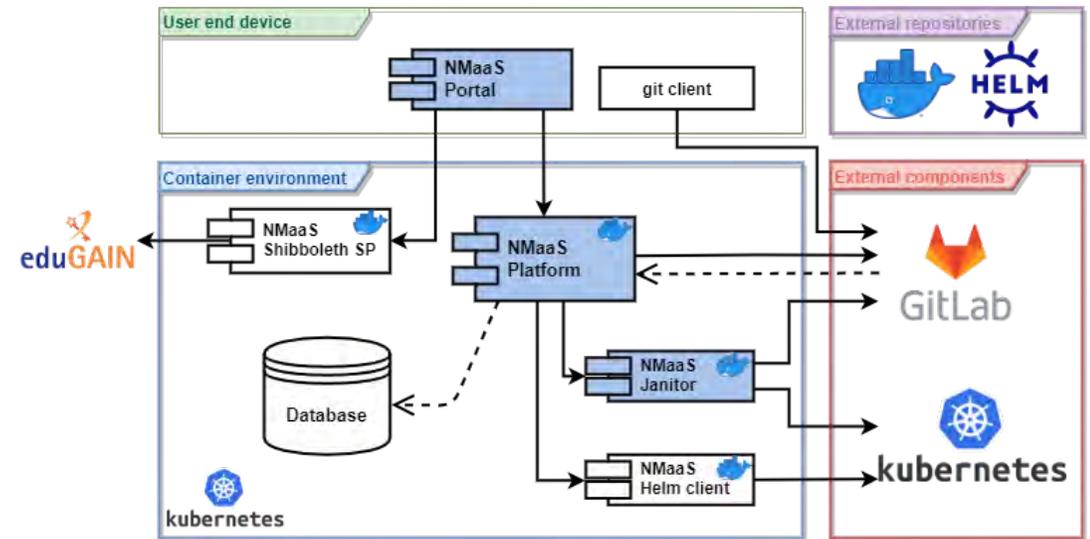
netbox

GEANT



Introduction to NMaaS

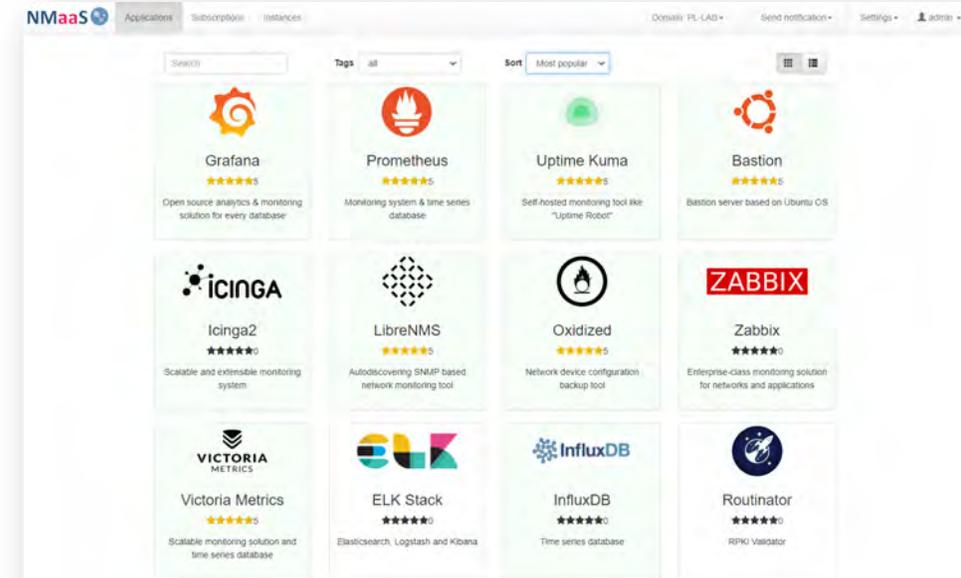
- Developed within the GÉANT Project
- 3 major NMaaS components
 - **NMaaS Platform** – main back-end module exposing a REST API for user and application management
 - **NMaaS Janitor** – supporting module interacting with external services
 - **NMaaS Portal** – web-based front-end application
- Official Helm chart available
- All development is done via <https://github.com/nmaas-platform>
 - **Apache 2.0 License**
 - Contributions are welcome along with issue reports and feature requests
- New documentation page available at <https://docs.nmaas.eu>



Who is using NMaaS?



- Managed NMaaS service operated by the GÉANT Project (access Portal at <https://nmaas.eu>)
 - Production service since 2019
- Current NMaaS users
 - NRENs
 - R&D Institutions and Projects
 - Project Teams (e.g. RARE team for GP4L monitoring)





How can I use NMaaS?

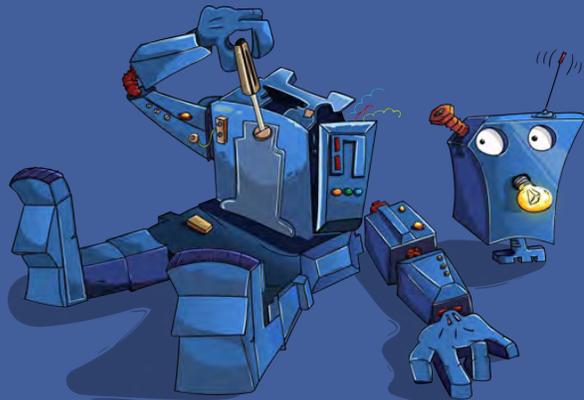
- Run your own self-hosted NMaaS instance
 - On an existing full-fledged Kubernetes cluster
 - Local evaluation environment on a single node cluster
 - Complete guide available
- Request a dedicated domain on the GÉANT managed instance
- Contact the NMaaS Team: nmaas@lists.geant.org
- Subscribe to NMaaS users list: nmaas-users@lists.geant.org

The screenshot displays the 'NMaaS Documentation' website. The main content area is titled 'NMaaS Installation Guide' and is divided into sections: 'Requirements', 'NMaaS Components', and 'Installation'. The 'Requirements' section lists the following: 'Kubernetes version >=1.16', 'Helm v3 support in the Kubernetes cluster', 'Existing ingress controller, preferably with a default TLS certificate set (more information available below)', and 'An integration with an external load-balancer or MetalLB for bare-metal deployments, so that IPs can be assigned to LoadBalancer services'. The 'NMaaS Components' section states that NMaaS is comprised of multiple components and provides a brief description for each in the self-hosting introduction page. The 'Installation' section describes a two-step process: first, an instance of GitLab must be deployed and configured, and then NMaaS itself. The two components cannot be deployed at the same time, as NMaaS requires a GitLab API key during deployment.



Adapting NMaaS for Virtual Labs

A New NMaaS Use-Case



NMaaS for Virtual Labs in a Nutshell

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



What Does NMaaS Bring to the Table?

Benefits for educational staff

- **Reusable infrastructure** across multiple courses, or even institutions
- Granular management of users and scenarios
- Tight access control

Benefits for end-users

- Deployment of complex applications, bypassing hardware requirements
- Eliminating configuration overhead
- Playground for testing new software

Diverse set of applications, from different science domains

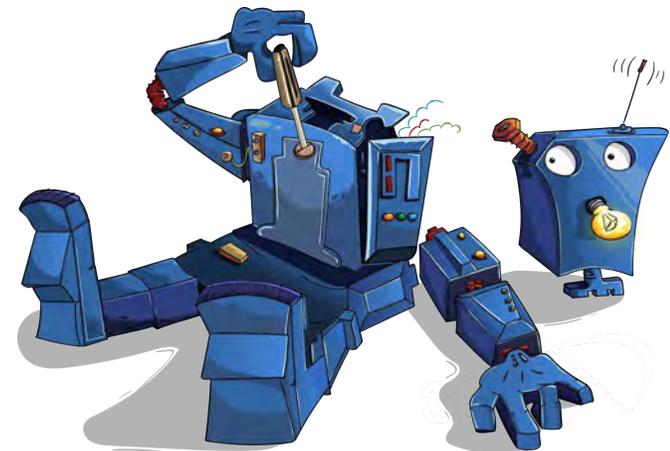
- Not limited only to computer science!

Extending NMaas for Virtual Labs (1)

- Adapting existing and adding new features:
-  Domains
 - Individual users, optional creation of shared domains (e.g., collaboration)
-  Domain groups
 - Domain groupings, facilitating application deployment restrictions
 - The problem of personalized catalogs
-  On-demand applications
 - Utilize the available hardware to its maximum

 = Implemented

 = In Development

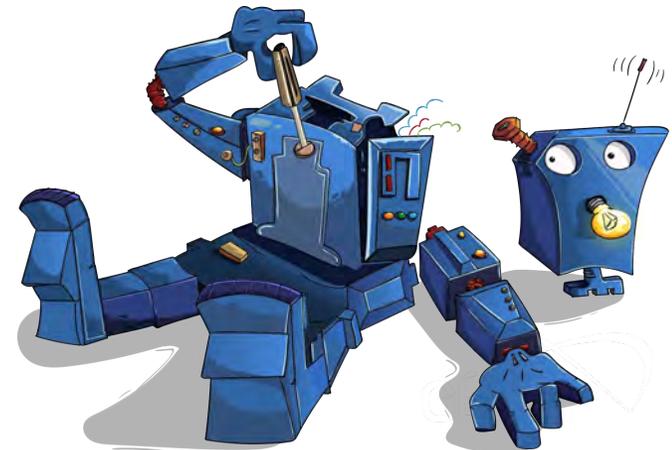


Extending NMaaS for Virtual Labs (2)

-  Bulk domain creation
 - Batch enrolment of large groups of users into the platform
-  Bulk application deployments
 - Hiding NMaaS from end-users
-  Application log viewing
 - Highly requested feature, easier troubleshooting

 = Implemented

 = In Development



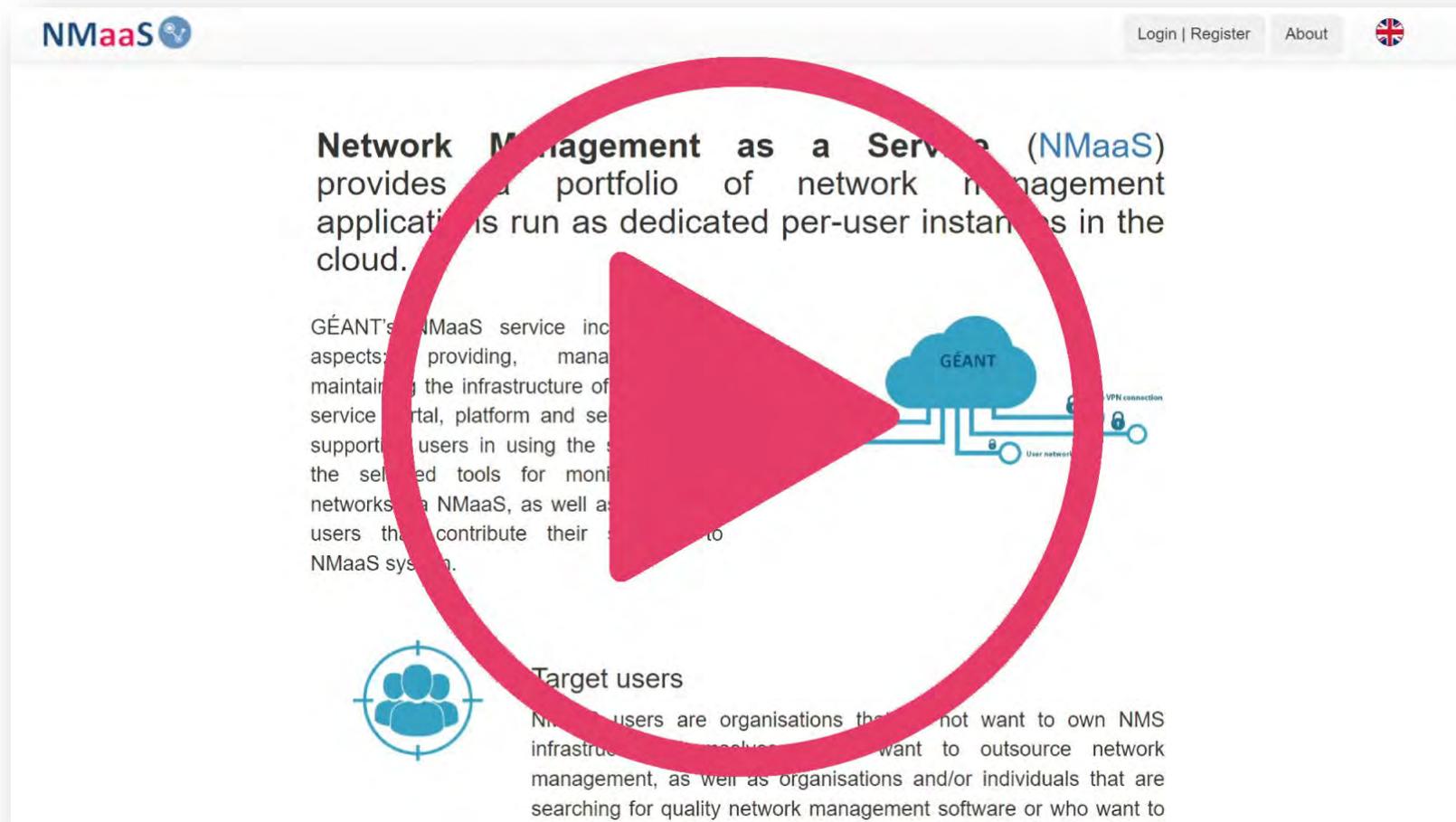


Virtual Labs in Action

Visual walkthrough of the new NMaaS features



Deploying New Domains in Bulk as a Trainer



The image shows a screenshot of the NMaas website. At the top left is the NMaas logo. At the top right are links for 'Login | Register' and 'About', along with a UK flag icon. The main heading is 'Network Management as a Service (NMaas) provides a portfolio of network management applications run as dedicated per-user instances in the cloud.' Below this is a paragraph describing GÉANT's NMaas service, including aspects like providing, managing, and maintaining infrastructure, a service portal, platform, and support for users. To the right of the text is a diagram showing a cloud labeled 'GÉANT' connected to a 'User network' and a 'VPN connection'. A large red play button is overlaid on the page, centered over the main heading and diagram. Below the main text is a section titled 'Target users' with an icon of three people, followed by a paragraph describing target users as organisations that do not want to own NMS infrastructure or want to outsource network management.

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 several aspects: providing, managing, and maintaining the infrastructure of the service portal, platform and service support for users in using the service, the selected tools for monitoring networks via NMaas, as well as supporting users that contribute their resources to the NMaas system.

Target users

Target users are organisations that do not want to own NMS infrastructure 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

More information: <https://docs.nmaas.eu/use-cases/virtual-lab/bulk-domain-deployment/>

Restricting Available Applications with Domain Groups

NMaas Applications Subscriptions Instances Domain: GLOBAL Advanced Send notification vojdank

Domain group

Name: techex-...

Codename: tech...group

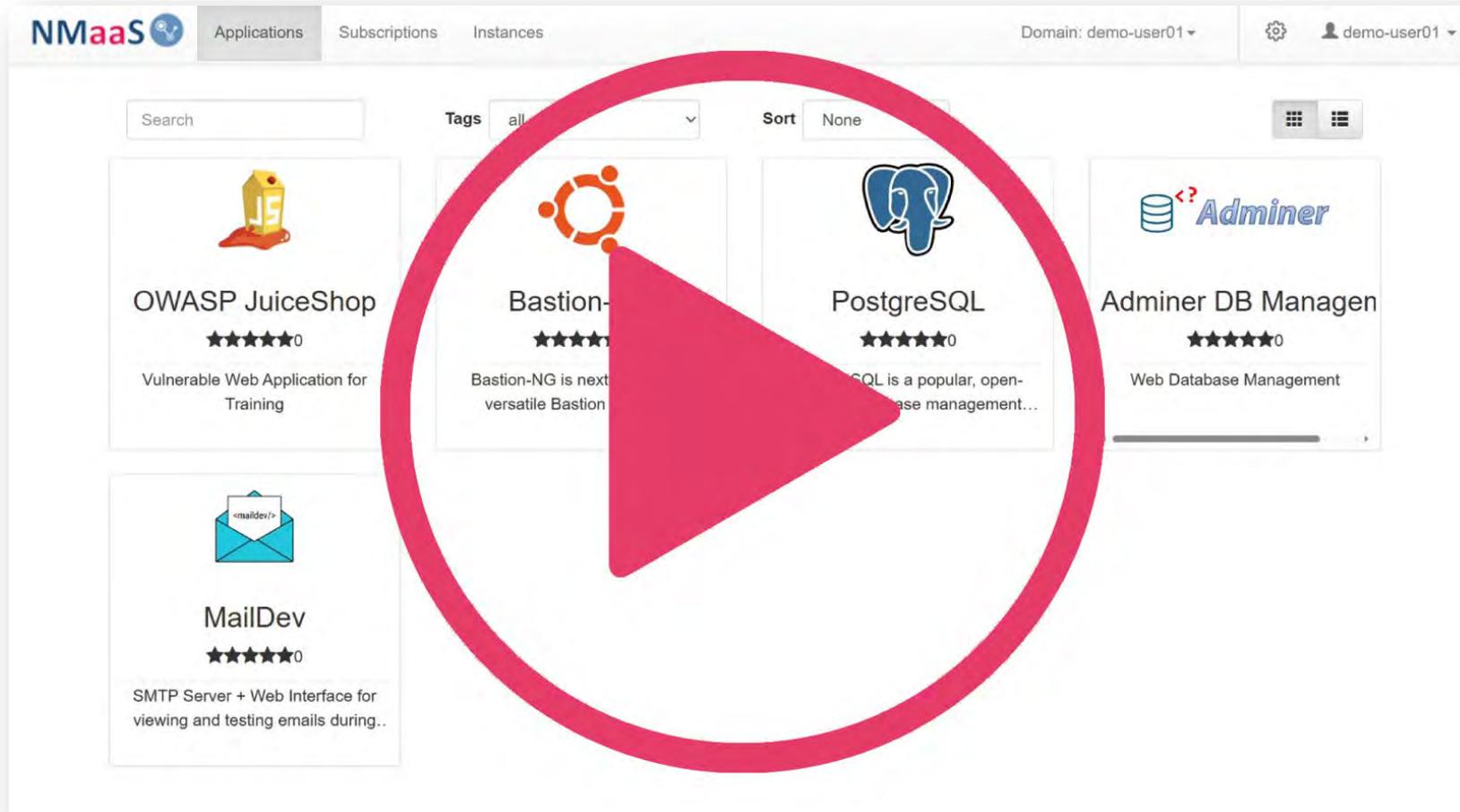
Domains in group

Domain Name	Domain	Action
techex-user99	techex-user99	Remove domain from group
demo-user01	demo-user01	Remove domain from group
demo-user02	demo-user02	Remove domain from group
demo-user03	demouser03	Remove domain from group

Application properties Toggle all

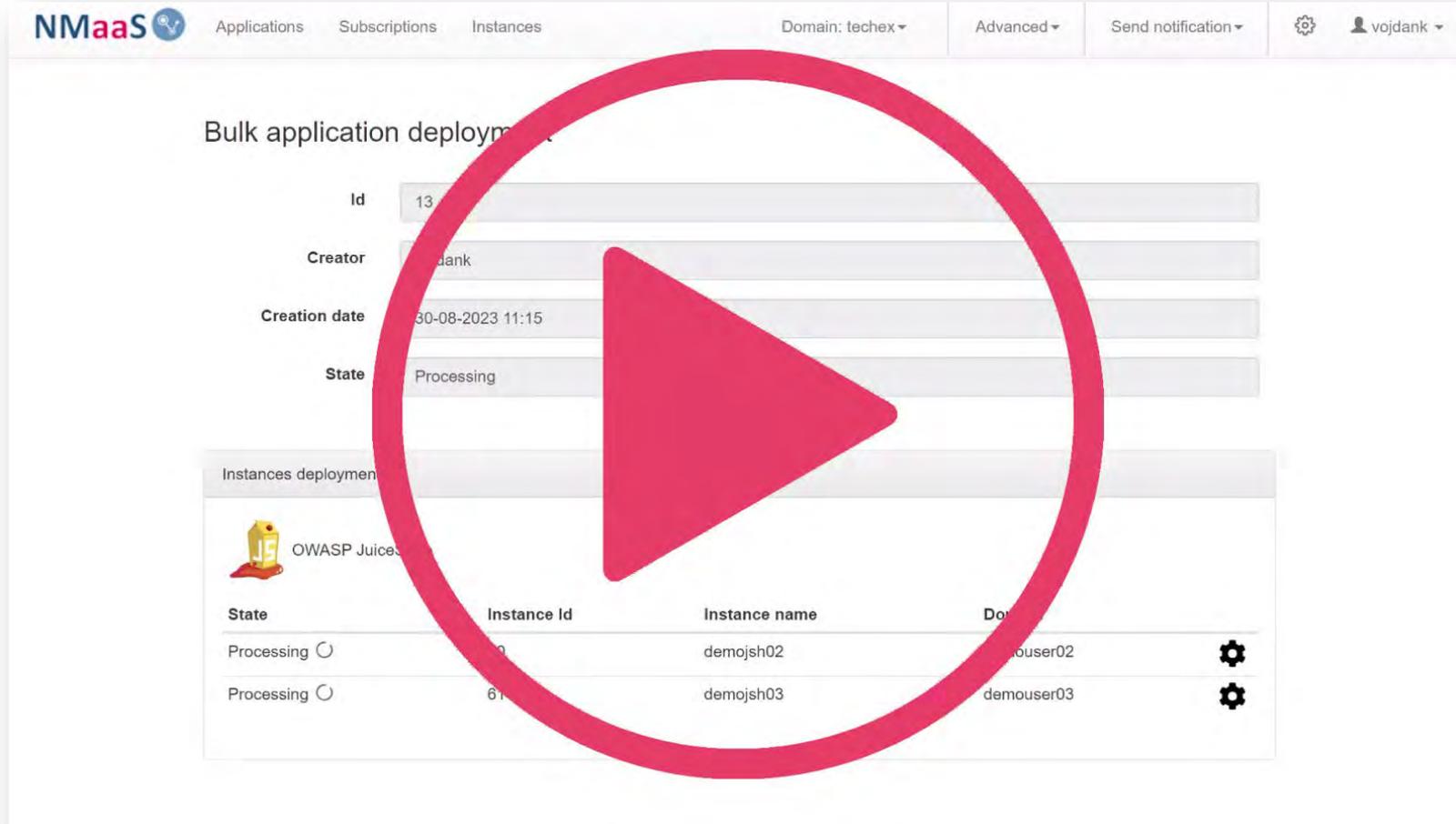
More information: <https://docs.nmaas.eu/use-cases/virtual-lab/domain-groups/>

Deploying an Applications as a Trainee



More information: <https://docs.nmaas.eu/use-cases/virtual-lab/vlab-introduction/>

Deploying Applications in Bulk as a Trainer



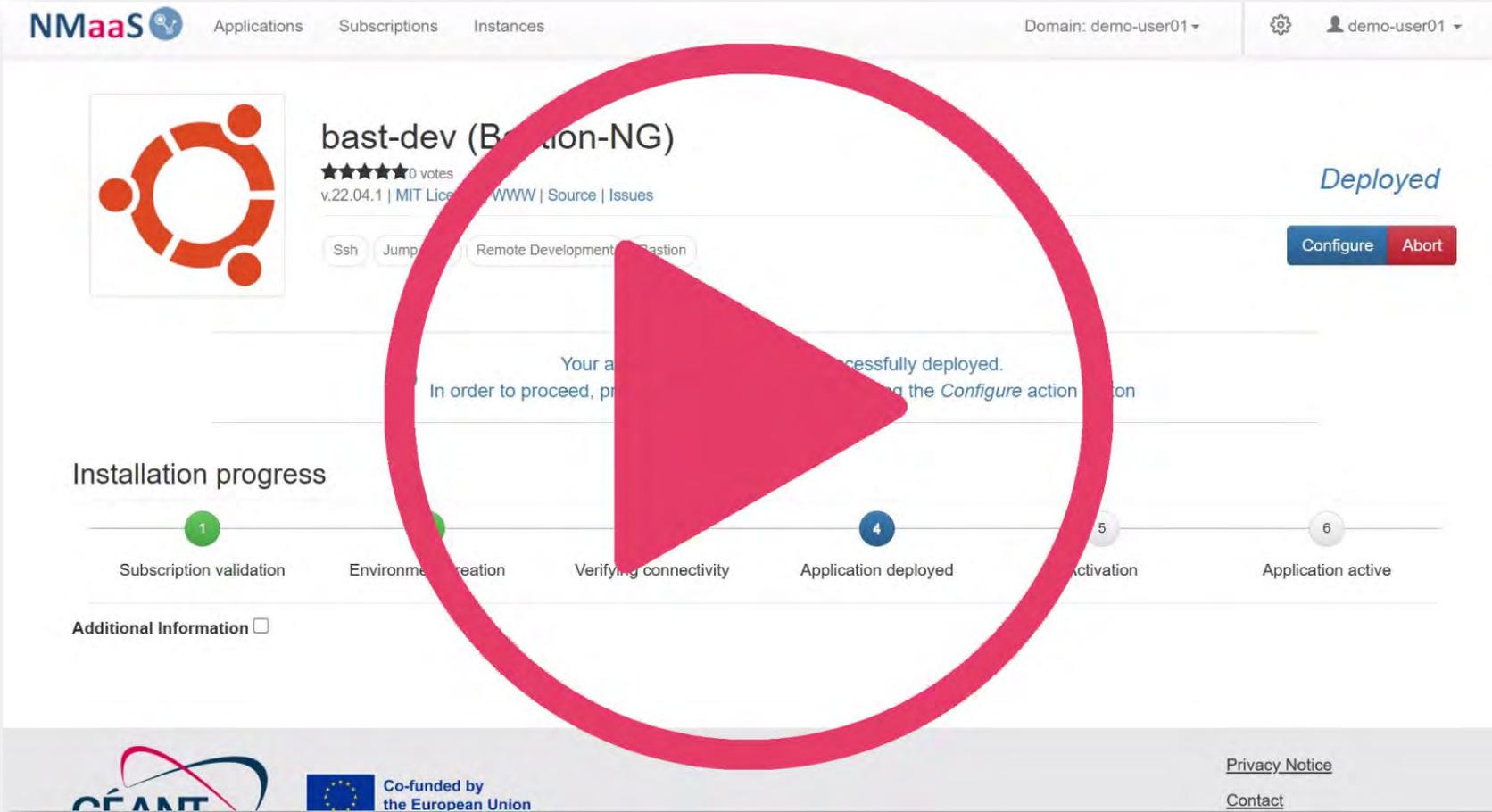
The screenshot displays the NMaas interface for bulk application deployment. The top navigation bar includes the NMaas logo, menu items for Applications, Subscriptions, and Instances, and user information for 'vojdark'. The main content area is titled 'Bulk application deployment' and shows details for a deployment with Id 13, created by 'vojdark' on 30-08-2023 at 11:15, currently in a 'Processing' state.

Below the deployment details, there is a section for 'Instances deployment' for the application 'OWASP JuiceShop'. A table lists the individual instances:

State	Instance Id	Instance name	Domain	Actions
Processing <input type="radio"/>	61	demojsh02	demouser02	
Processing <input type="radio"/>	61	demojsh03	demouser03	

More information: <https://docs.nmaas.eu/use-cases/virtual-lab/bulk-application-deployment/>

Exploring Additional Scenarios



The screenshot displays the NMaas web interface for a user named 'demo-user01'. The main content area shows the details for an application named 'bast-dev (Bastion-NG)'. The application is currently in a 'Deployed' state. The installation progress bar indicates that step 4, 'Application deployed', is the current step, with steps 1 through 6 shown in a sequence. The steps are: 1. Subscription validation, 2. Environment creation, 3. Verifying connectivity, 4. Application deployed, 5. Activation, and 6. Application active. The interface also includes a 'Configure' button and an 'Abort' button. A large red play button is overlaid on the center of the screenshot.

More information: <https://docs.nmaas.eu/use-cases/virtual-lab/vlab-introduction/>



Conclusion and Plans for the Future

Additional features, more use-cases...

Conclusion

- Versatile orchestration platform
- Option to host diverse set of applications
 - Not limited to a single problem domain
- Open-source
- Based on popular and well-known technologies
- Virtual Lab pilots underway as part of various university courses
 - Cybersecurity
 - IT Management
 - Web Development



Plans for the Future

- Additional virtual lab scenarios
 - JupyterLab
 - More vulnerable applications for CTF training
- Open-sourcing both the NMaaS catalog and the related course materials
- Building a community around NMaaS
- Exploring additional use-cases
 - Deployment of virtual machines (not only containers)
 - Use for scientific computing, leveraging specialized hardware (i.e., GPUs)





Thank You

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



www.geant.org



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