

Cloud Federation

Centre of Excellence for Data Sharing & Cloud – Community Event

Erik Langius – erik.langius@tno.nl | 28 sept 2023



Today

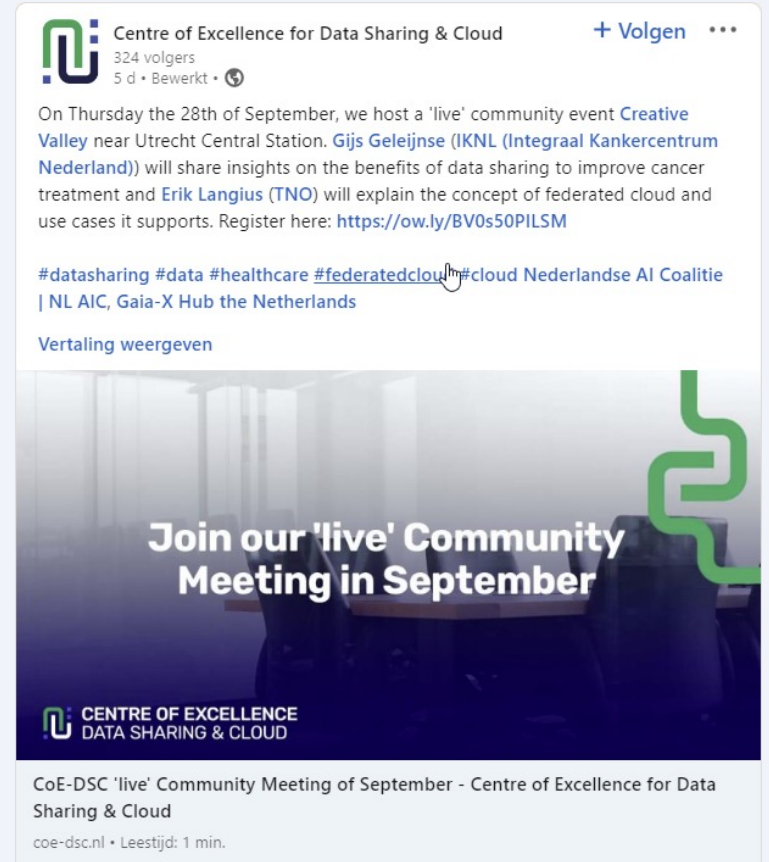
Future digital infrastructures

- Provide an overview on developments on next generation digital infrastructures
- Specifically: federated cloud – edge infra structures

National Cloud Federation testbed

- Proof-of-Concept for Gaia-X Lighthouse Structura-X
- National Pilot experimenting with federation technology

CoE-DSC 'live' Community Meeting of September



 Centre of Excellence for Data Sharing & Cloud + Volgen ...

324 volgers
5 d • Bewerkt • 

On Thursday the 28th of September, we host a 'live' community event **Creative Valley** near Utrecht Central Station. **Gijs Geleijnse** (IKNL (Integraal Kankercentrum Nederland)) will share insights on the benefits of data sharing to improve cancer treatment and **Erik Langius** (TNO) will explain the concept of federated cloud and use cases it supports. Register here: <https://ow.ly/BV0s50PILSM>

#datasharing #data #healthcare #federatedcloud #cloud Nederlandse AI Coalitie | NL AIC, Gaia-X Hub the Netherlands

[Vertaling weergeven](#)

Join our 'live' Community Meeting in September

 CENTRE OF EXCELLENCE
DATA SHARING & CLOUD

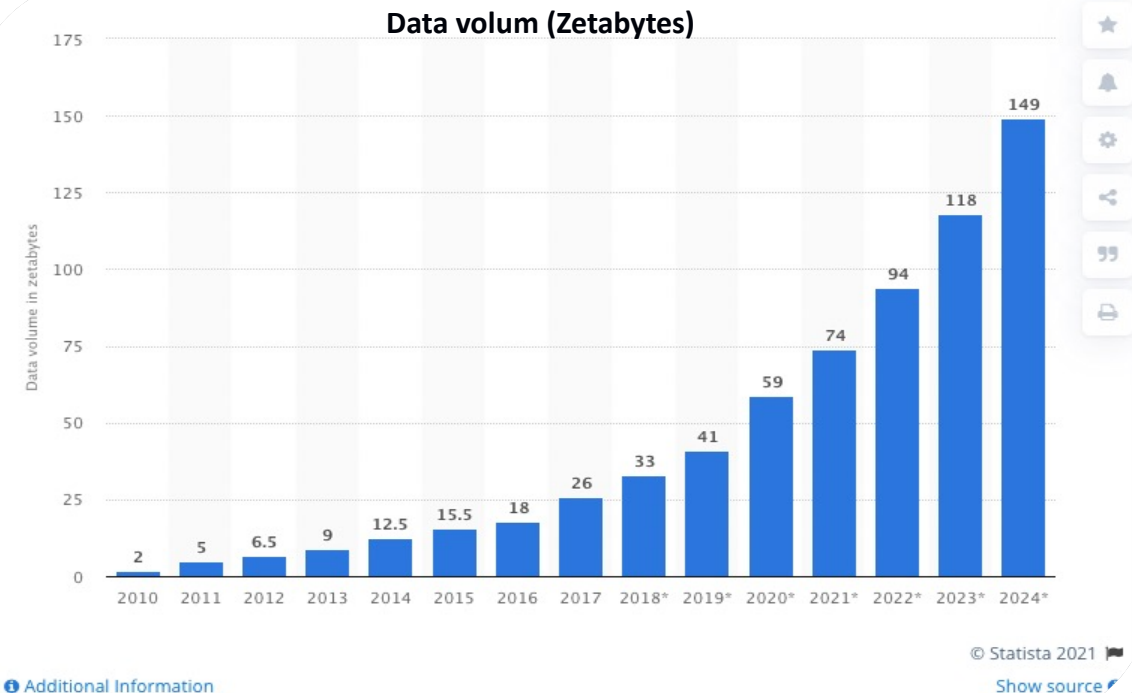
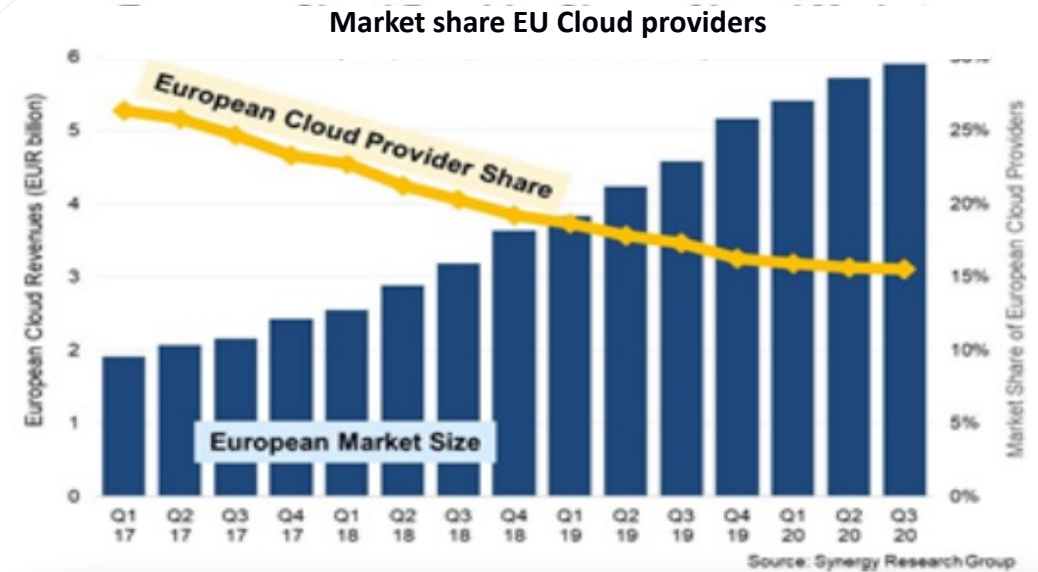
CoE-DSC 'live' Community Meeting of September - Centre of Excellence for Data Sharing & Cloud

coe-dsc.nl • Leestijd: 1 min.

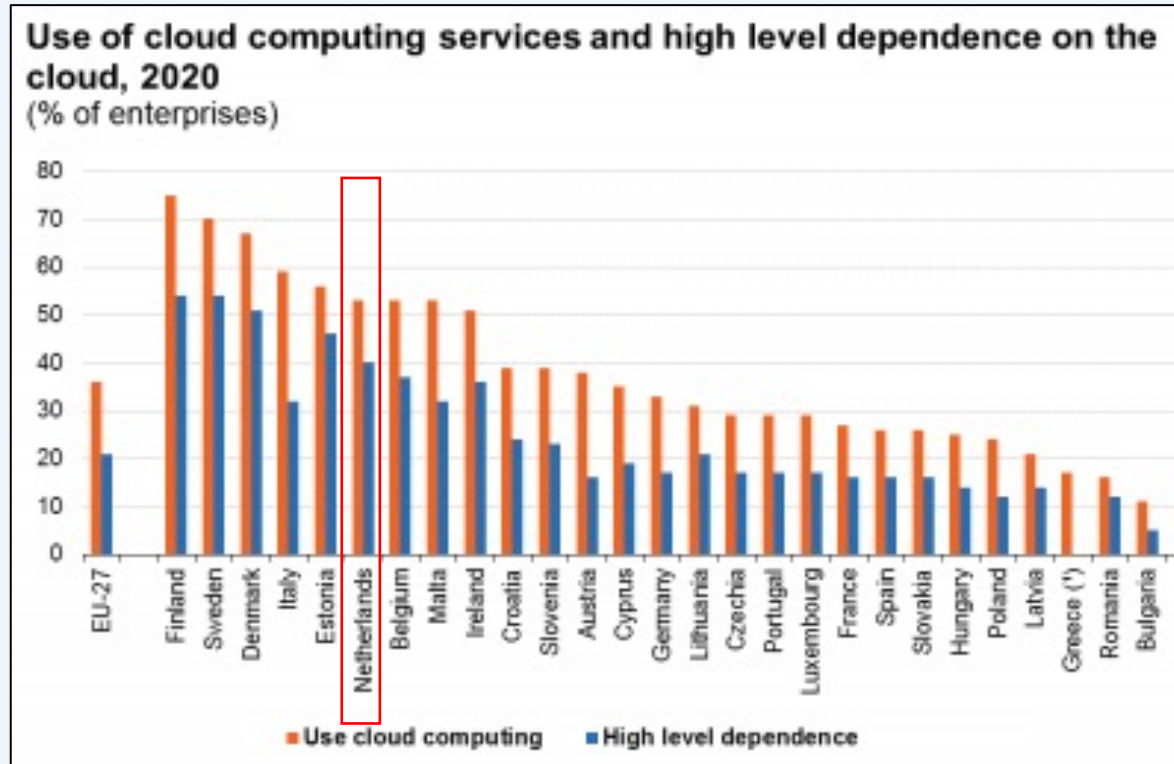
Cloud usage

- Current cloud dominated by 3 technology companies (AWS, MS, Google)
- Strong increase in use of cloud
- 92% percent of Western data is stored in the US, only 4% in Europe.
- The core of the digital infrastructure is provided by non-European parties.

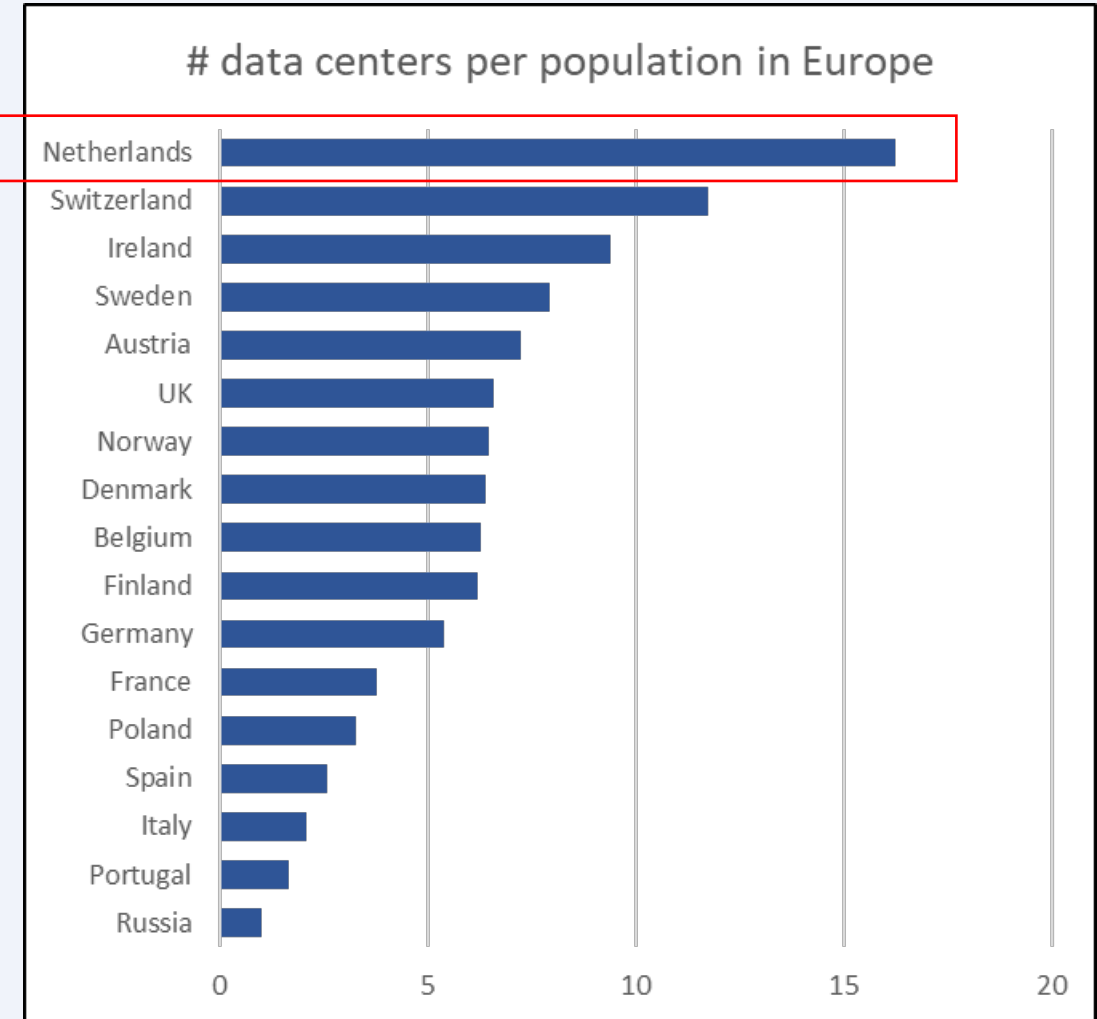
Source: [What is digital sovereignty and why is Europe so interested in it?](#)



Position of NL in EU Cloud statistics



- High Cloud dependence
- High Data Centre density



Lock-in effects investigated in ACM Market Study

In general:

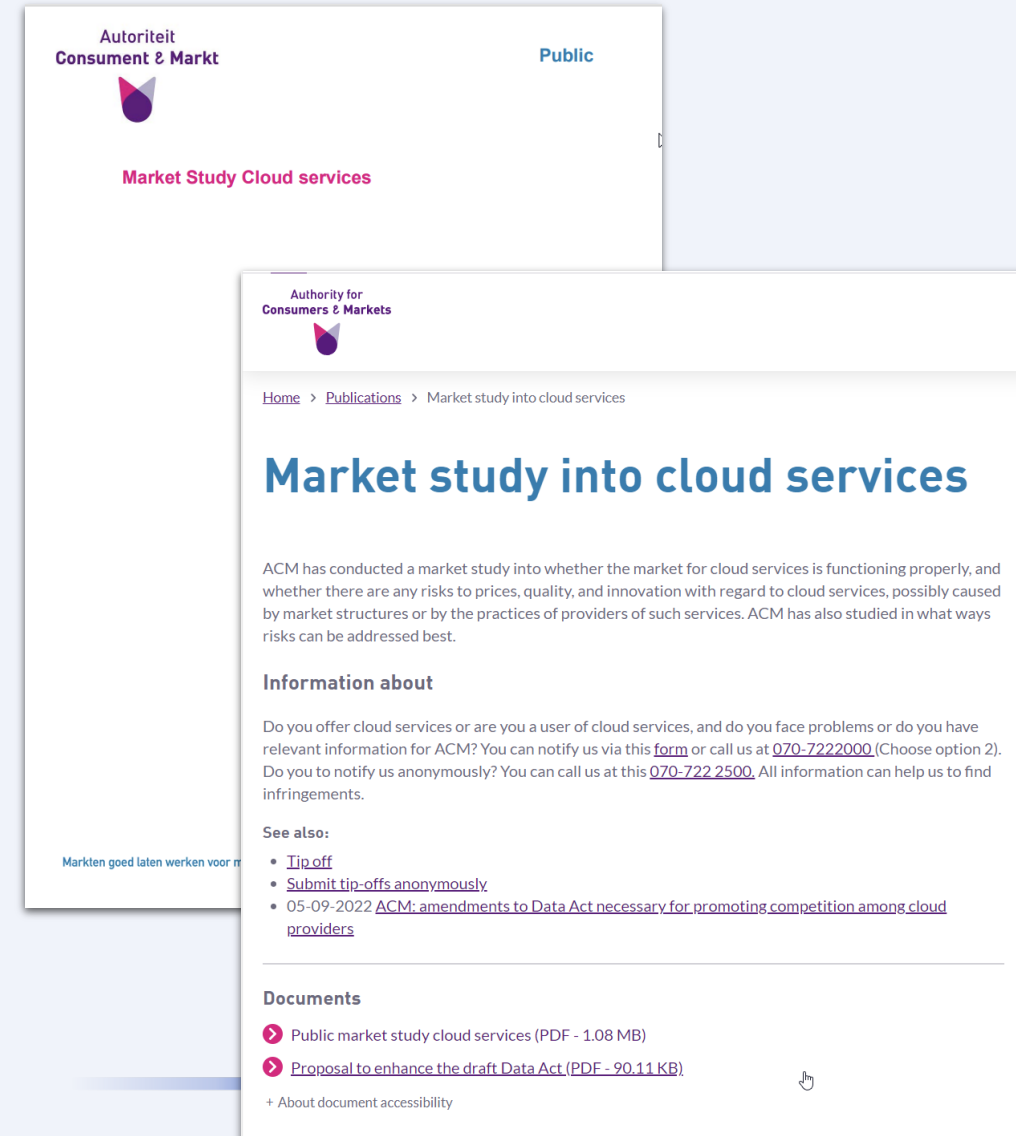
- Low entry barriers, high exit barriers
- Strong vertically integrated offering
- Lack of competition hinders innovation

Financial barriers:

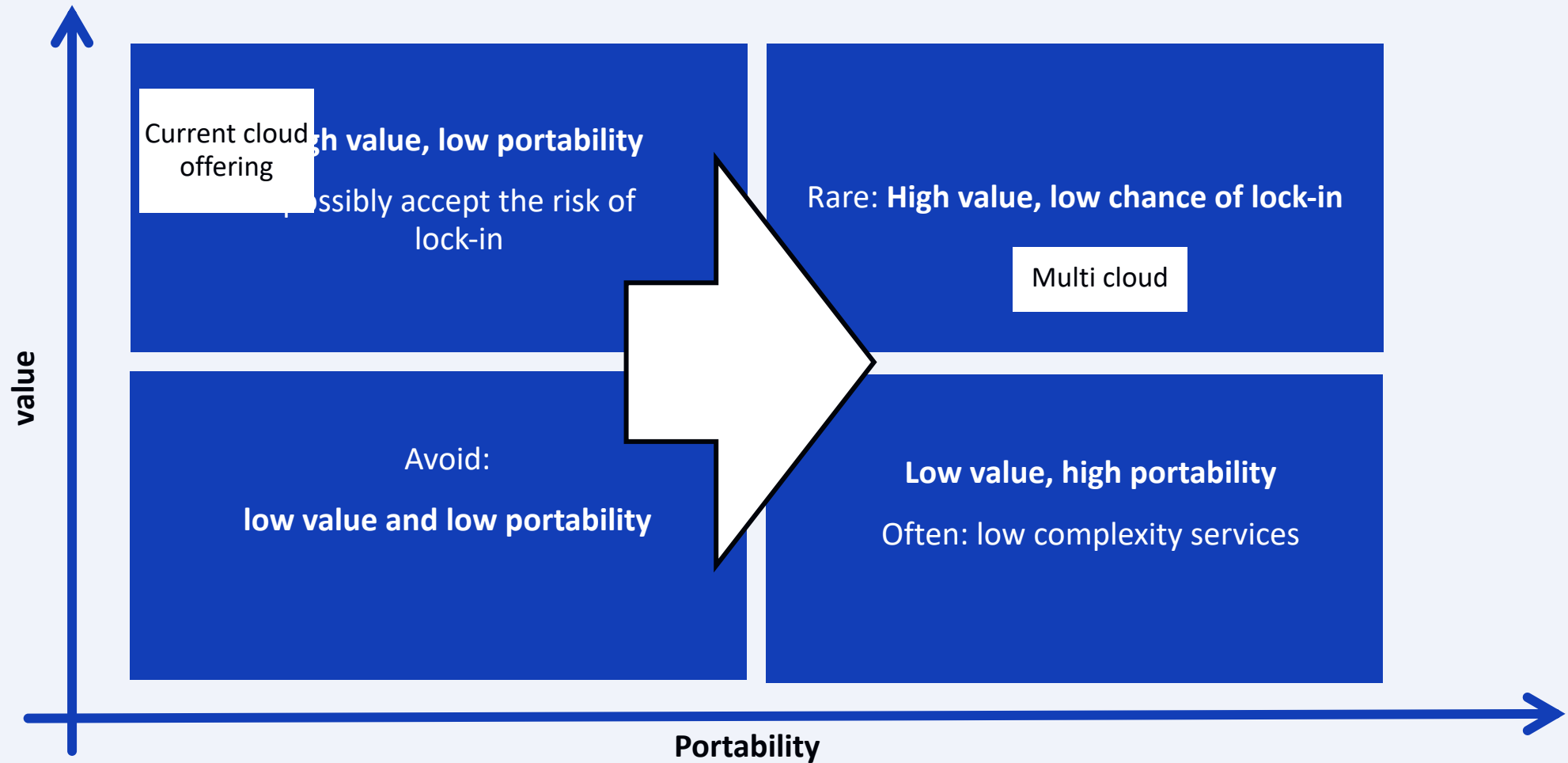
- Non-transparent cost structure
- Data in: free, Data out: expensive (ingress versus egress costs)

Technical barriers:

- Limited portability
- Limited interoperability
- Significant engineering effort when switching



Lock-ins: balance between added value and portability



Ambitions as formulated by EU in IPCEI CIS

Objectives

Strengthen the EU digital industry at both infrastructure and service level and foster European data and technological sovereignty

Main objectives:

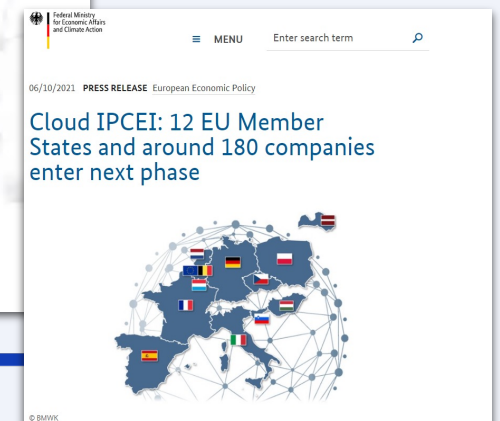
- Establish next generation of infrastructure and services from Edge to Cloud
- Reach hyperscale capacities in Europe
- Implement cutting edge industrial and services highly scalable Use-Cases
- Boost Cyber-Security of cloud infrastructure

Scope:

- IPCEI addresses research, development and innovation (R&D&I) needs
- Supports a first industrial deployment (FID)



Approach by federation:
Provide hyper scale functionality without building a hyper scaler



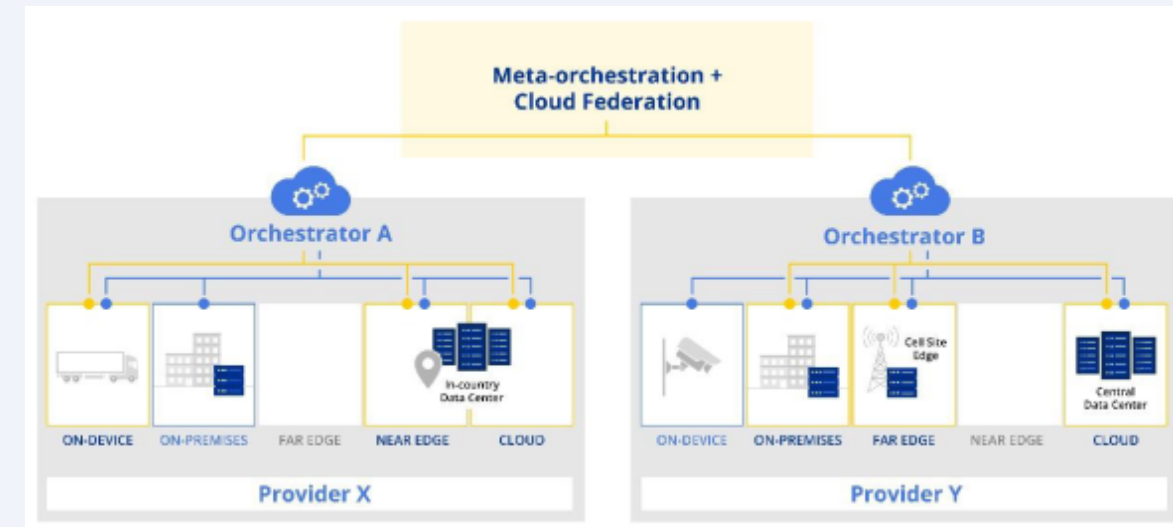
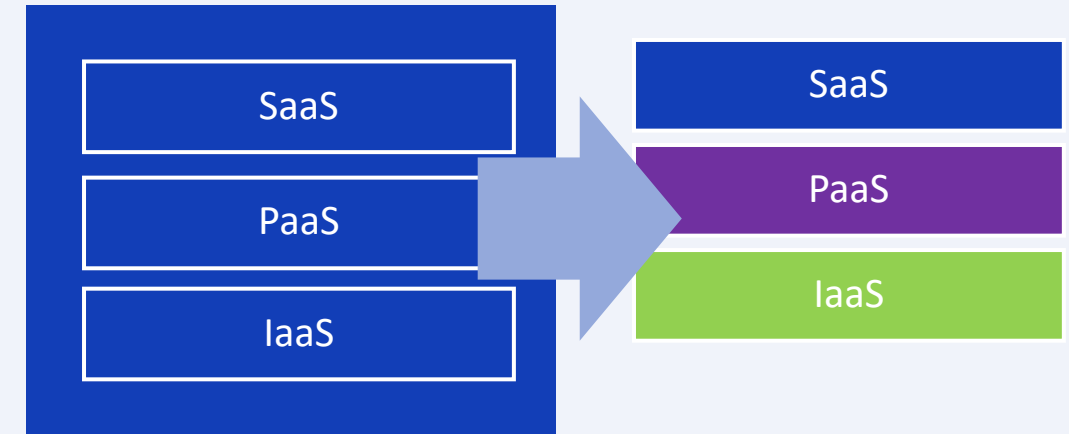
In addition to technology development, also regulations

- Digital Infrastructure is to only vital infrastructure that isn't regulated (yet)
- Personal data already covered in GDPR, "non-personal" via the Data Act

Data Governance Act	Data Act	Digital Markets Act	
Targeting: Data sharing and data reuse	Targeting: - Cloud portability - Data portability	Targeting: prevention of "gatekeeper function" in platform economy	Digital Services Act AI ACT Cyber Security ACT NIS-2

Route to more cloud independence

- “Vertical decomposition” of the cloud stack
- **EU technology priority:** Interoperability and multi-provider Services
 - Tech roadmap:
<https://ec.europa.eu/newsroom/dae/redirection/document/97129>
- EU focuses on **cloud-edge marketplace**:
 - Dome project: <https://dome-marketplace.eu/>
- There is a lot of data center capacity in the EU
 - However, fragmented and not interchangeable
 - Expected change in **Cloud/Edge ratio: 80/20 → 20/80**



To summarize

Changes are emerging in Cloud market, Cloud technology and Cloud regulations

1. Closed Ecosystems --> Open Ecosystems

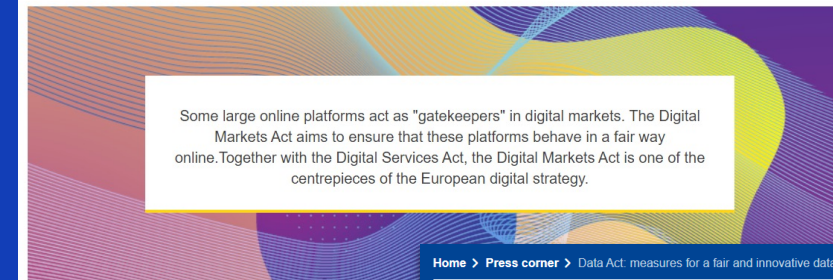
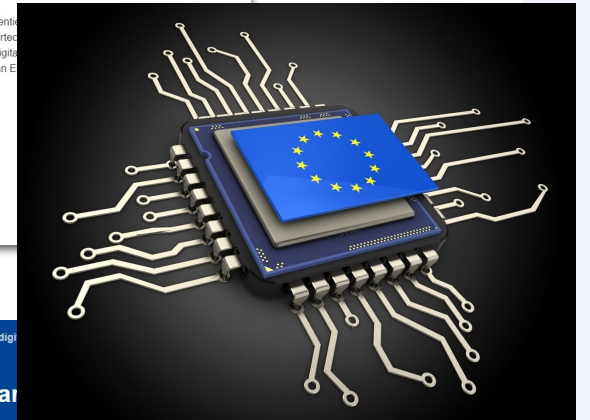
Future Digital infrastructures will become more decentralized and open

2. Centralized control → decentralized control

Future Digital infrastructures will have a distributed character

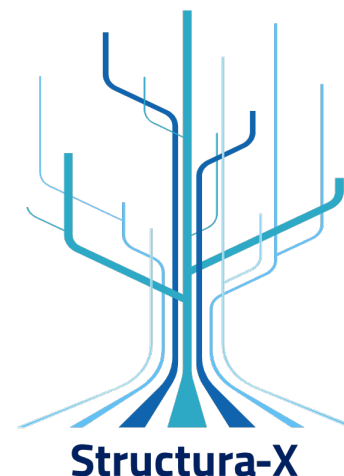
3. Technology stacks: Homogeneous → Heterogeneous

Future Digital infrastructures will become a composition of techniques and suppliers



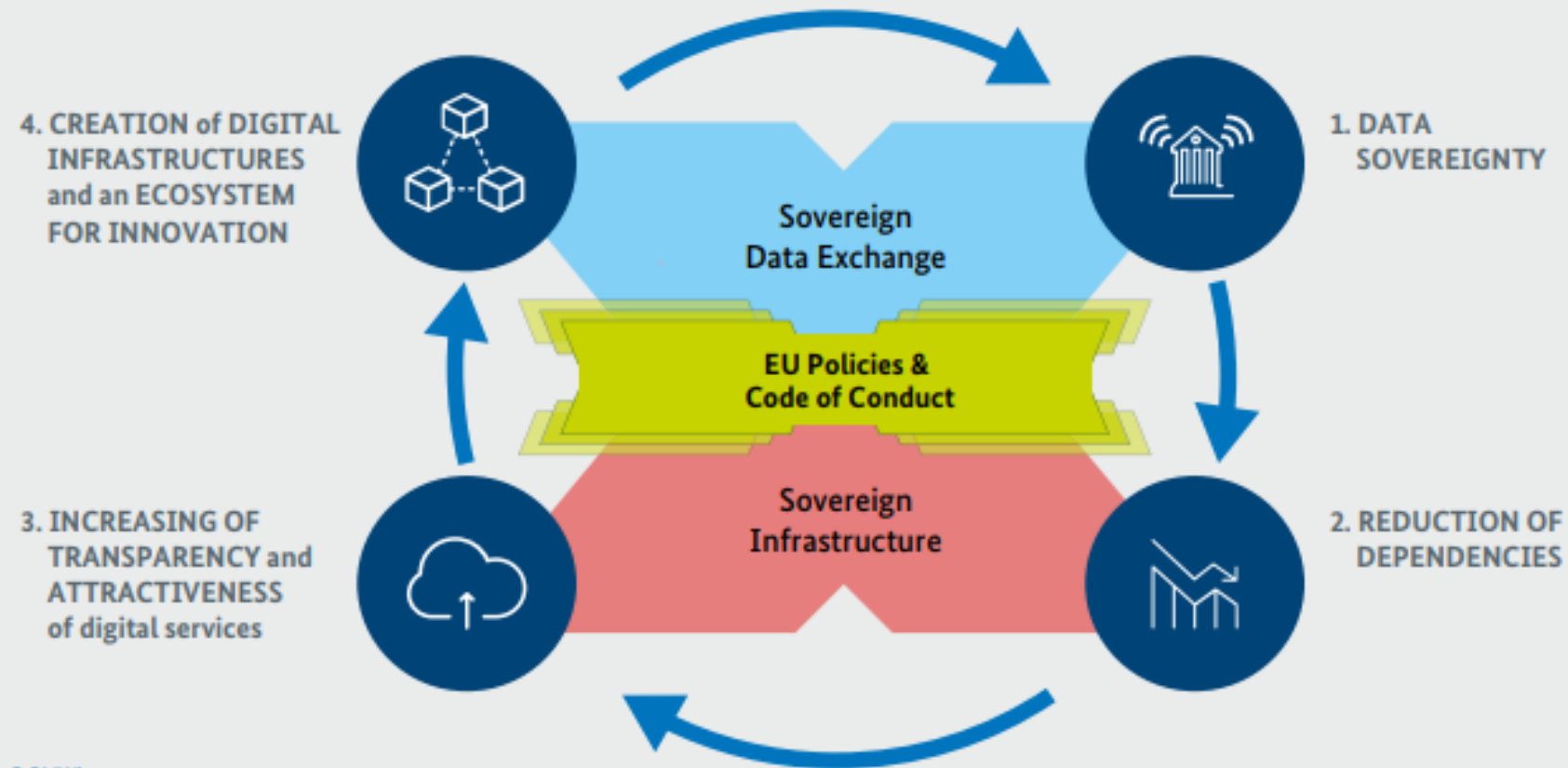
Lighthouse Structura-X within Gaia-X

TNO innovation
for life



GAIA-X goals

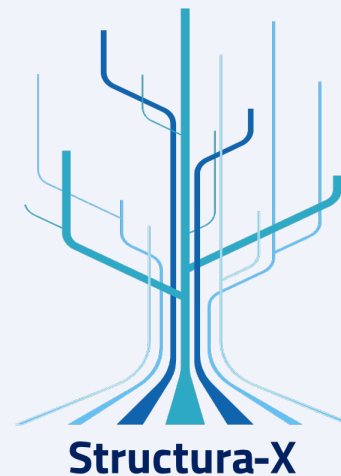
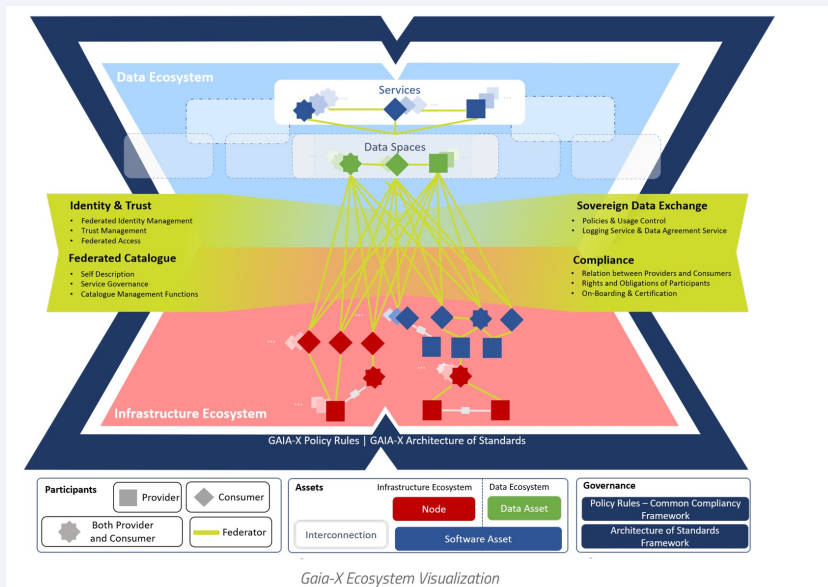
Figure 1: GAIA-X goals



Definition of *Federated* within GAIA-X

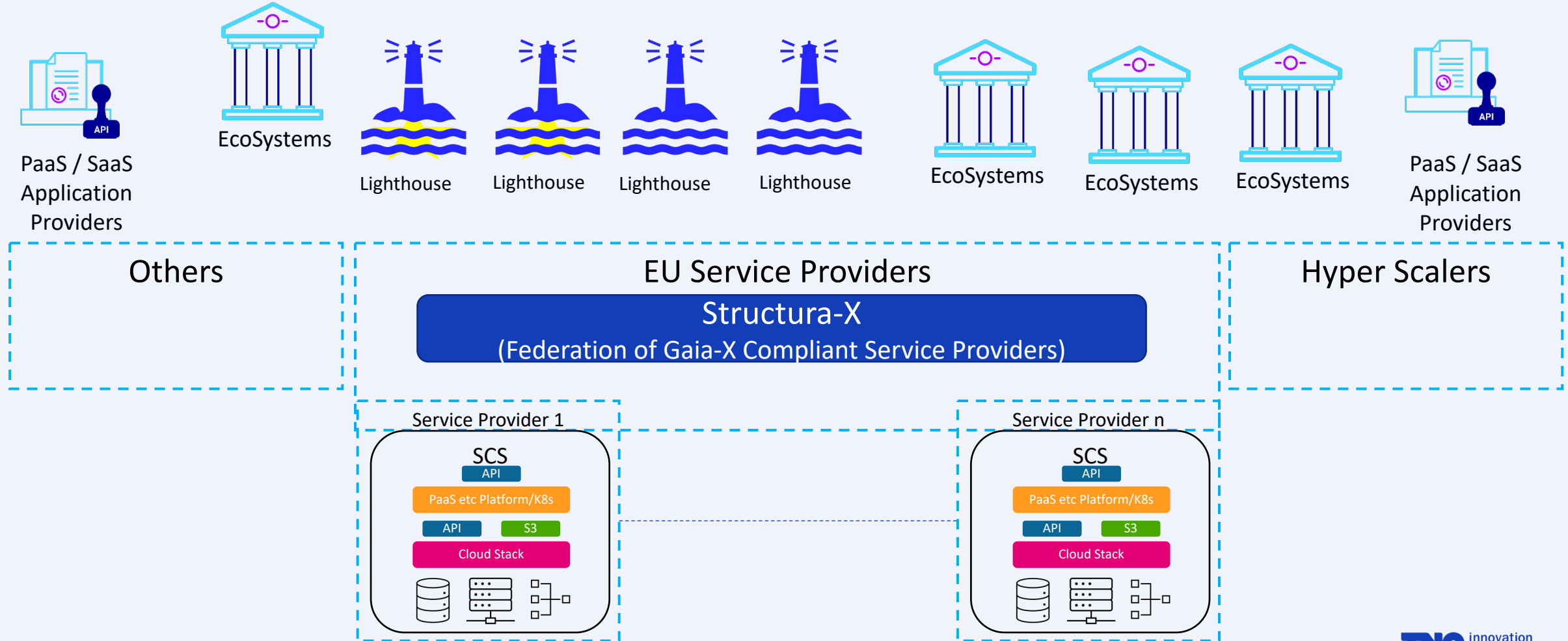
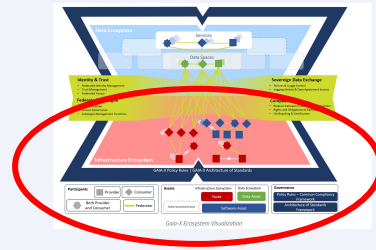
Federated: Gaia-X promotes and implements the concept of Federations. [1] Through Federations, service providers can join up their infrastructures in a trusted manner, to offer a distributed cloud model. [2] Through Federations, data owners (users) can exchange and utilise their data with commonly agreed upon rules and control on whom and for what to grant access. [..]

Cloud Service Providers



Provide
Gaia-X compliant infrastructure services
by an
ecosystem of federated providers
realizing a
choice of interoperability, portability and sovereign services
as a foundation for
Data Spaces and Gaia-X Lighthouse projects

Structura-X is a lighthouse within Gaia-X, focusing on the infrastructure



As part of Structura-X

National PoC on cloud federation

Proof of the pudding is in the eating it...

TNO innovation
for life

bit
internet technology

SURF

intermax

infoSupport
Solid Innovator

amsix
amsterdam internet exchange

Structura-X

gaia-x
Hub Netherlands

National Cloud Federation testbed

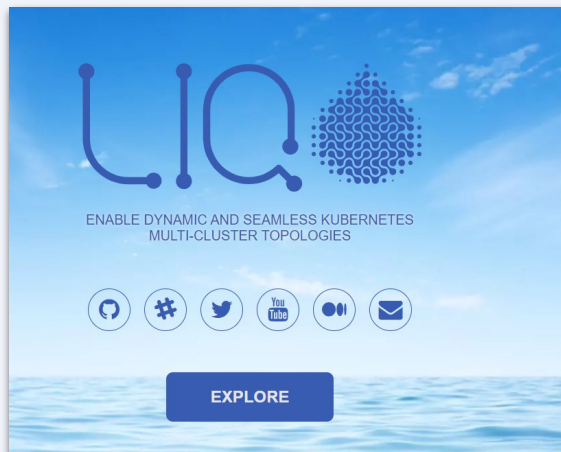
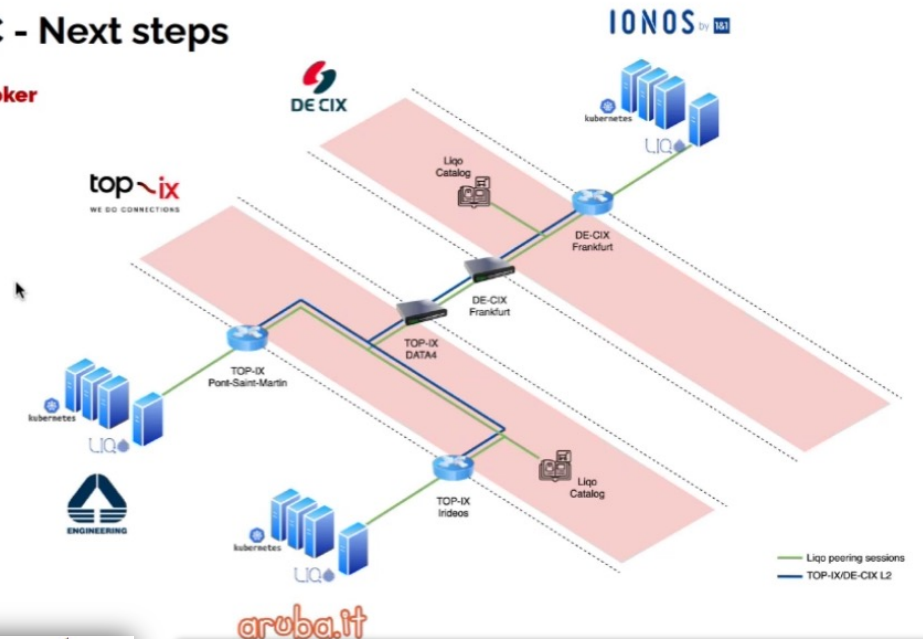
- Experimenting with multi-CSP cloud federation
- Use Ligo open source technology
- Foundation for technical cloud federation use cases
- Gain practical experience
- Contribute to open source development
- Extend to cross border setup with Italy and Spain

STRUCTURA-X PoC - Next steps

Peering sessions with a Ligo Broker

- Each Ligo endpoint establishes a "federating" session with a central Ligo Broker/Catalog*.
- This session is used to scan available resources and join the federation.
- On this session information about shared resources are sent.
- The Broker has full visibility of Ligo members on the peering plan.

* The Ligo Broker, besides operating as a simple Catalog, can extend its functionality and operate on the Control Plane (i.e. manage/orchestrate clusters) and the Data Plane (i.e. aggregate fragmented clusters and act as a traffic peer) too.



Computing Without Borders: The Way Towards Liquid Computing

Marco Iorio, Fulvio Rizzo, Alex Palesandro, Leonardo Camiciotti, and Antonio Manzanini

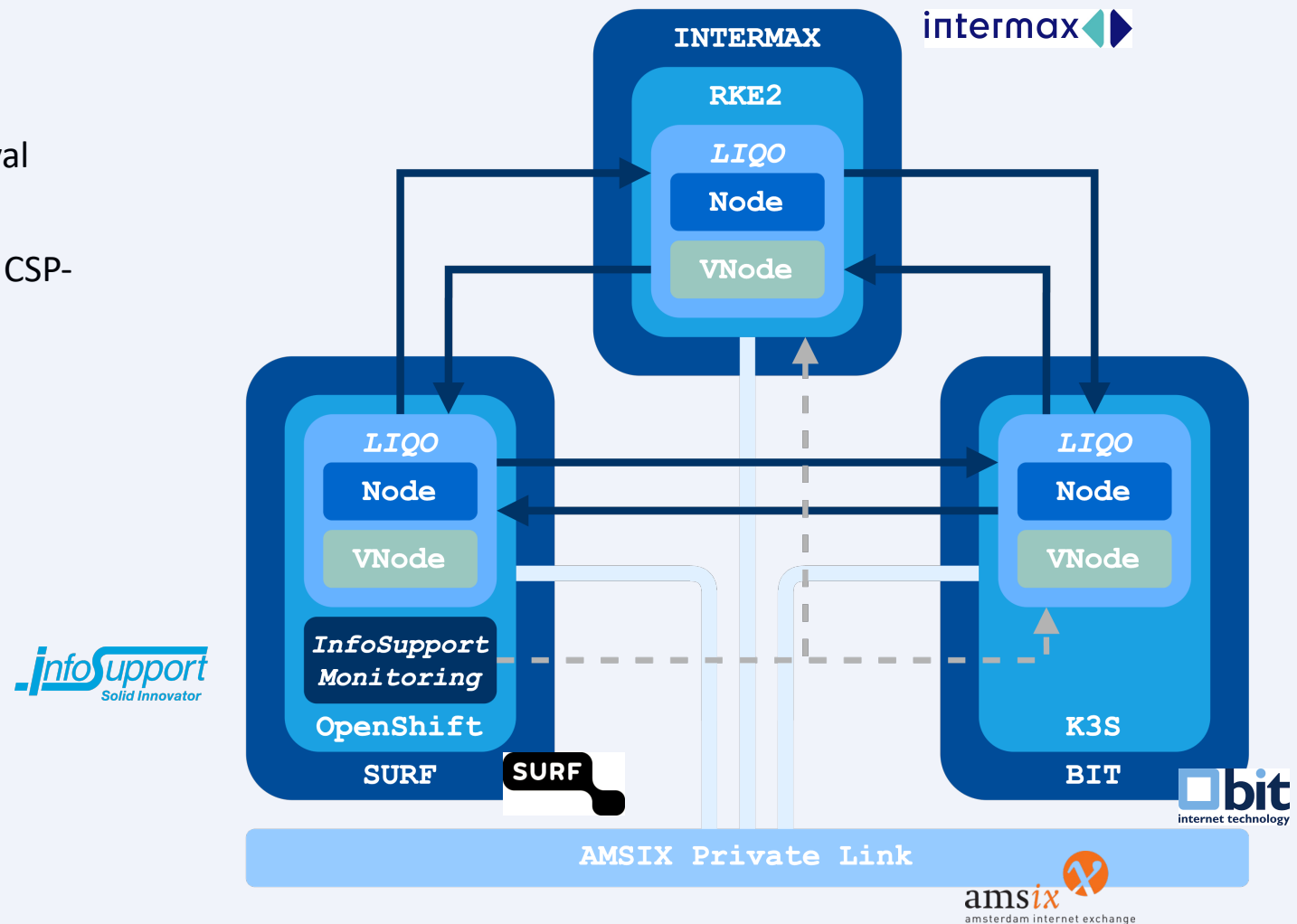
Abstract—Despite the de-facto technological uniformity fostered by the cloud and edge computing paradigms, resource fragmentation across isolated clusters hinders the dynamism in application placement, leading to suboptimal performance and operational complexity. Building upon and extending these paradigms, we propose a novel approach envisioning a transparent continuum of resources and services on top of the underlying fragmented infrastructure, called *liquid computing*. Fully decentralized, multi-ownership-oriented and intent-driven, it enables an overarching abstraction for improved applications execution, while at the same time opening up for new scenarios, including resource sharing and brokering. Following the above vision, we present *ligo*, an open-source project that materializes this approach through the creation of dynamic and seamless Kubernetes multi-cluster topologies. Extensive experimental evaluations have shown its effectiveness in different contexts, both in terms of Kubernetes overhead and compared to other open-source alternatives.

Index Terms—Computing Continuum, Cloud/Edge Computing, Task Offloading, Inter-Cluster Network Fabric, Liquid Computing



Started with NL PoC

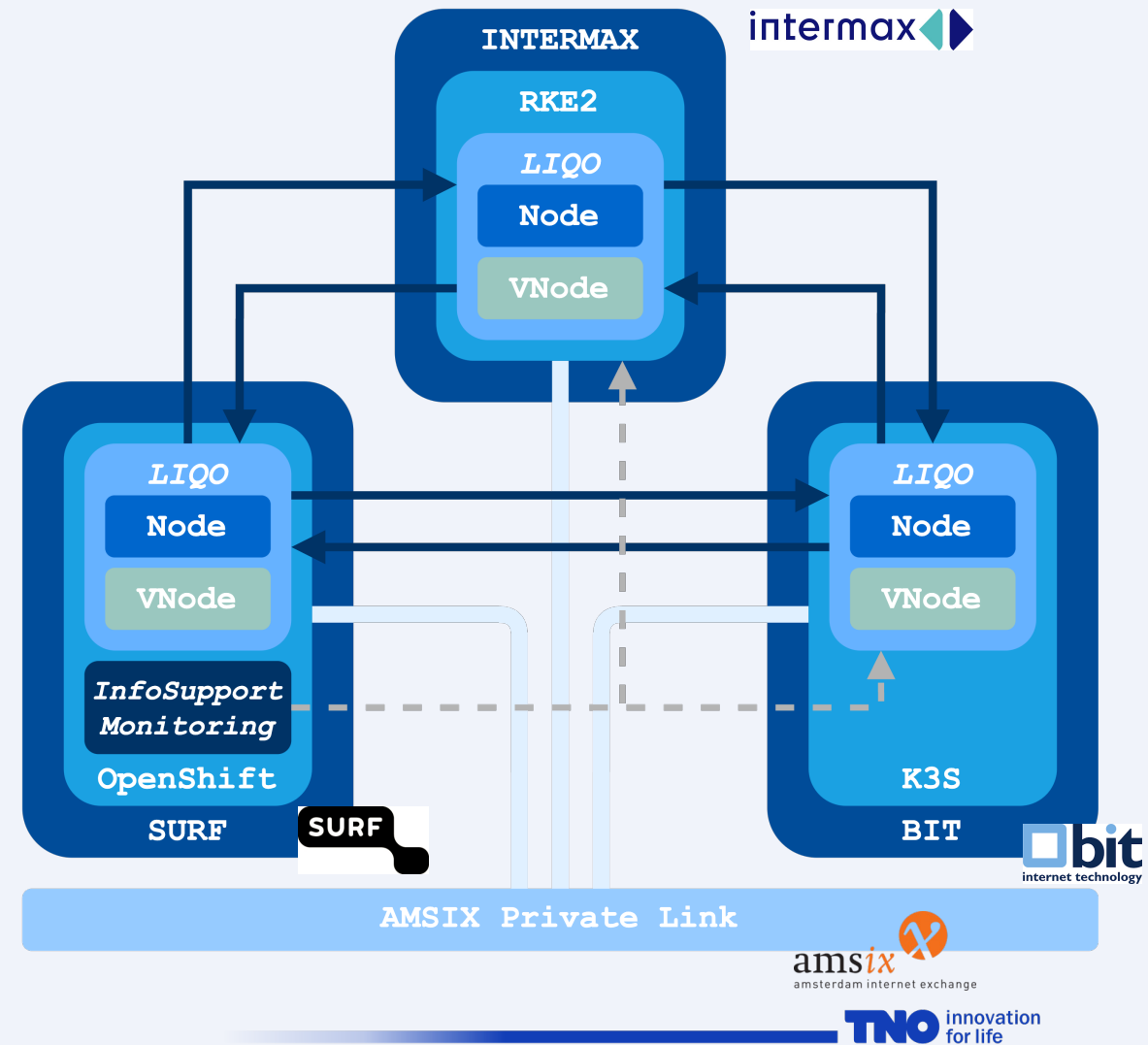
- Experiment with Ligo, based on several Kubernetes clusters
- Expand CSP resources by combining CSP-capabilities
- Move workloads from CSP to CSP



LIQO Proof-of-Concept NL-Setup

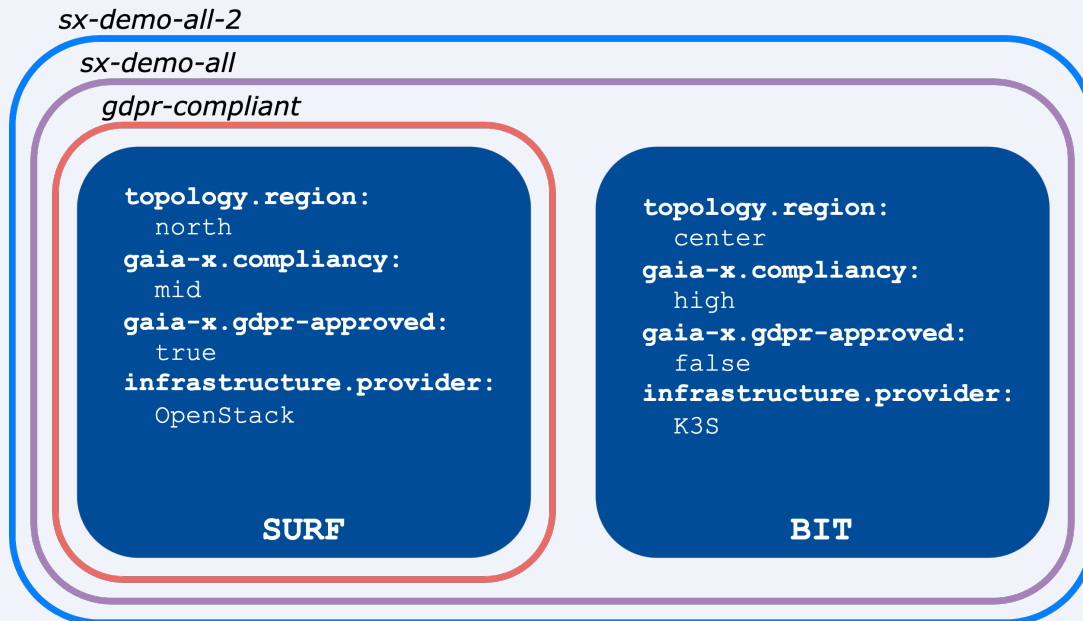
- 3 x Kubernetes (K8S) cluster (SURF, BIT, Intermax)
- 1 x Federation monitoring (InfoSupport)
- 1 x Private L2 VLAN (AMS-IX)
- Heterogeneous technology stacks for Kubernetes clusters (OpenShift, Rancher, K3S)
- Federation with LIQO
 - VNode: CSP-cluster is Virtuele node in other CSP-cluster
 - VNode: aggregated CPS resources
- Technical use case :
 - Workload movement with GDPR-requirements

infoSupport
Solid Innovator

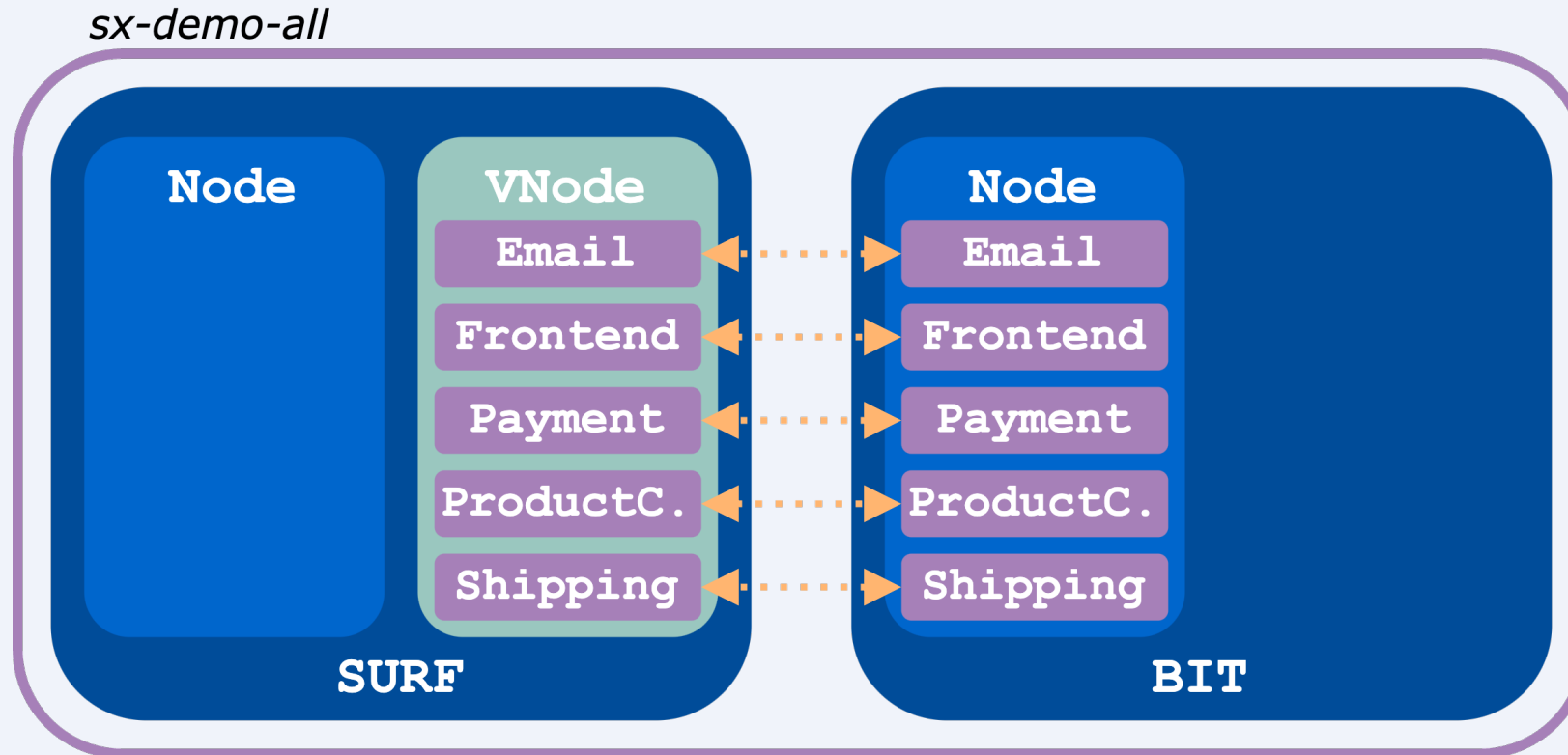


Demo Application: mirco services webshop

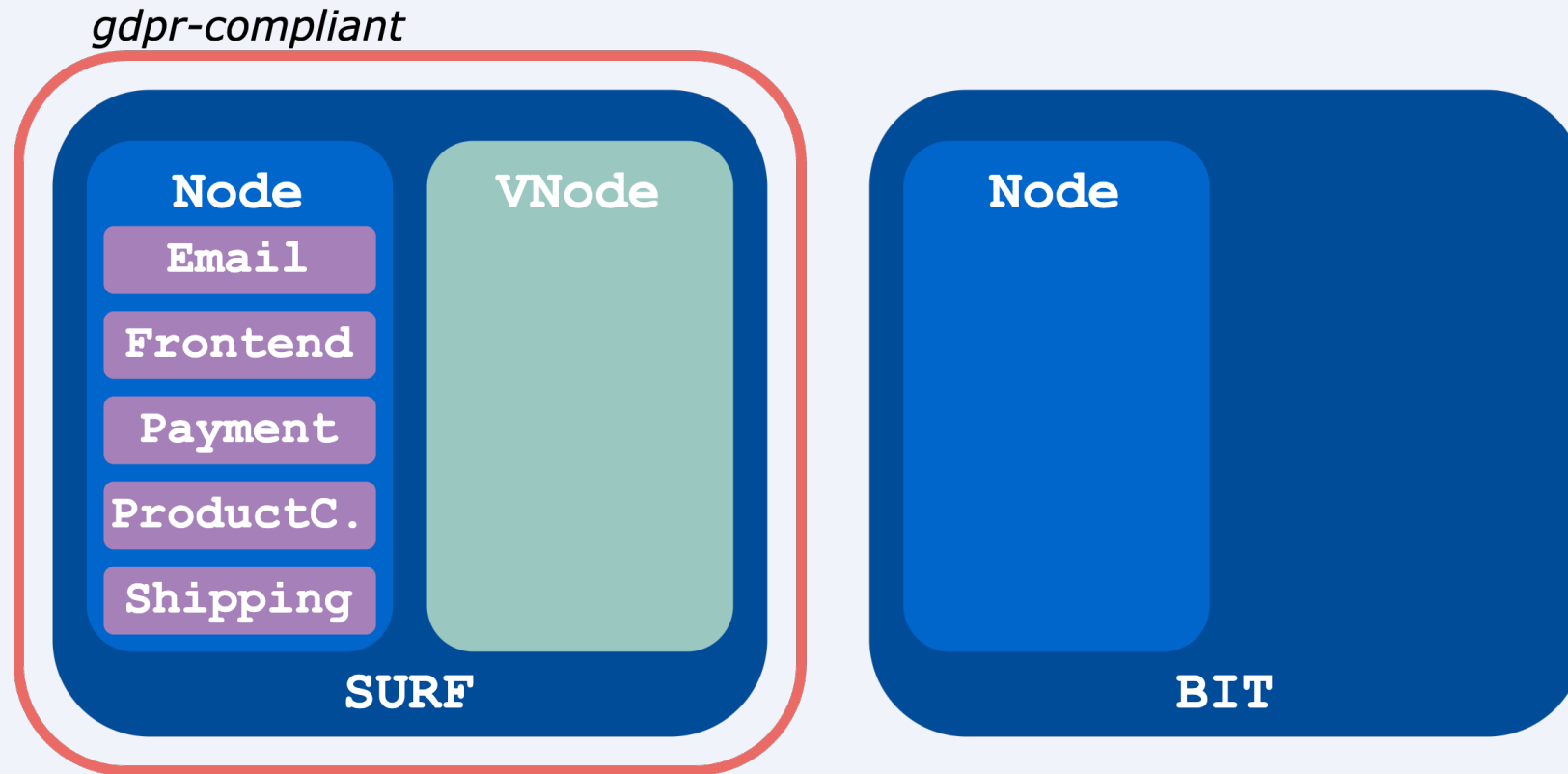
- Google's microservice demo
- Digital storefront
- Runtime constraints



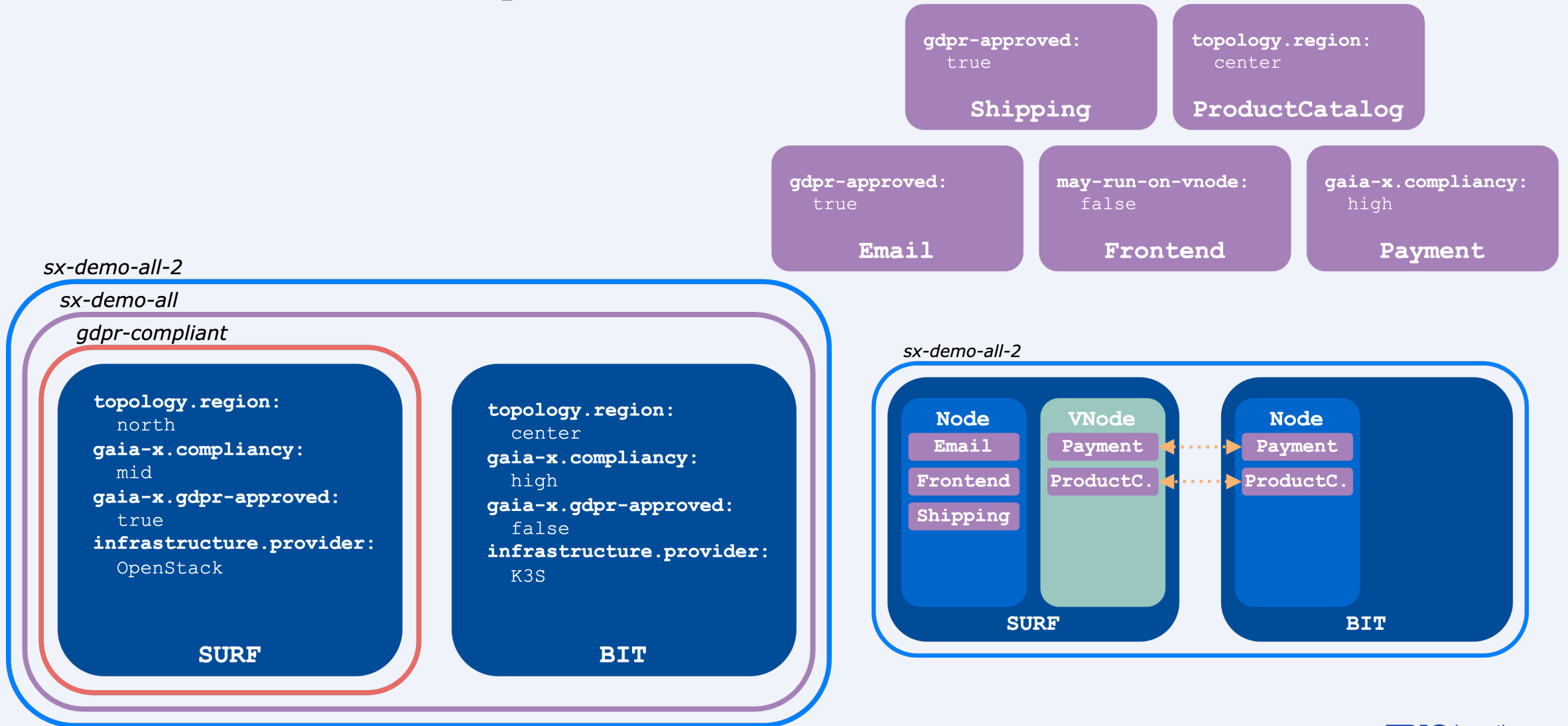
Scenario 1: CSP move, anything goes



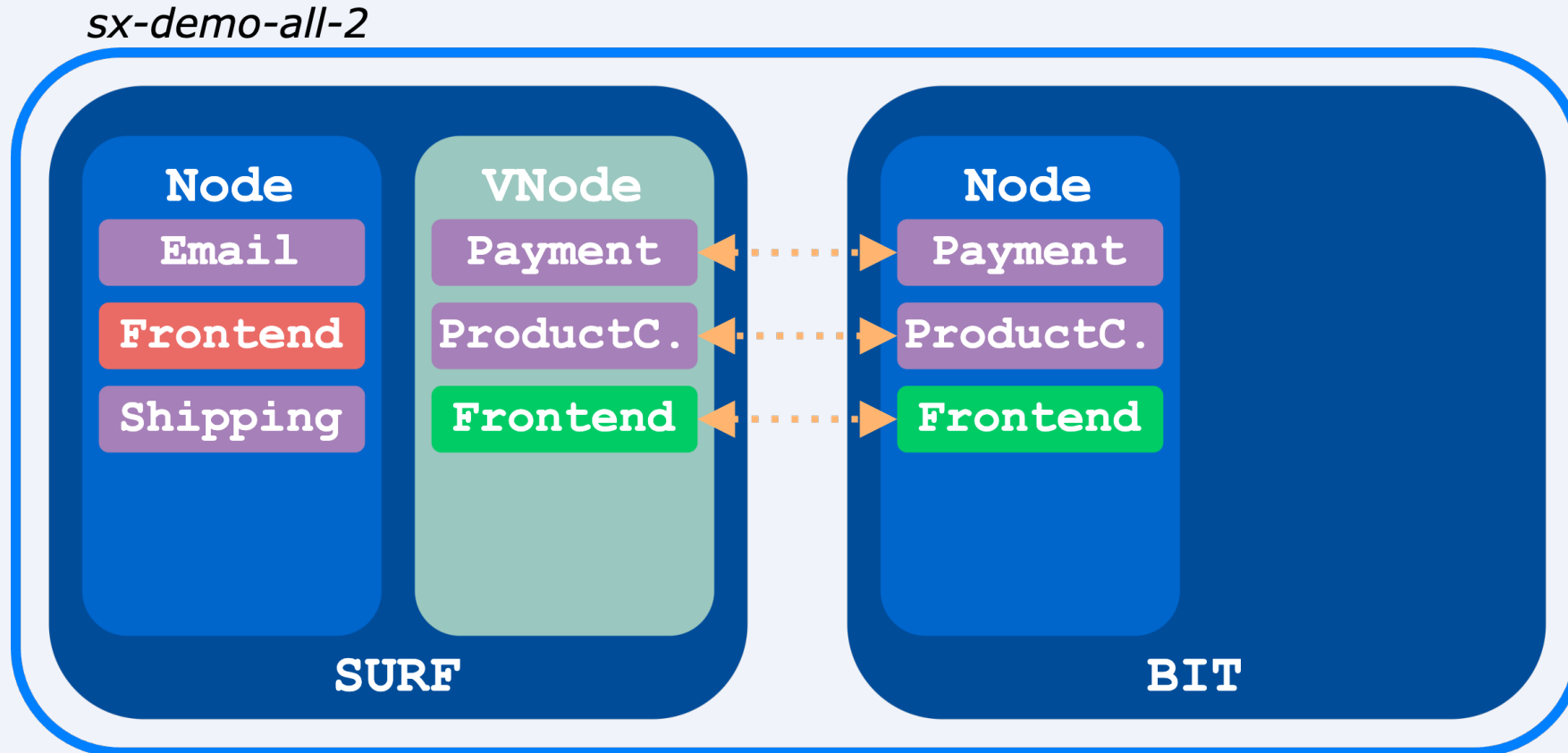
Scenario 2: Offloading to clusters with a certain labels (this case **GDPR-approved**)



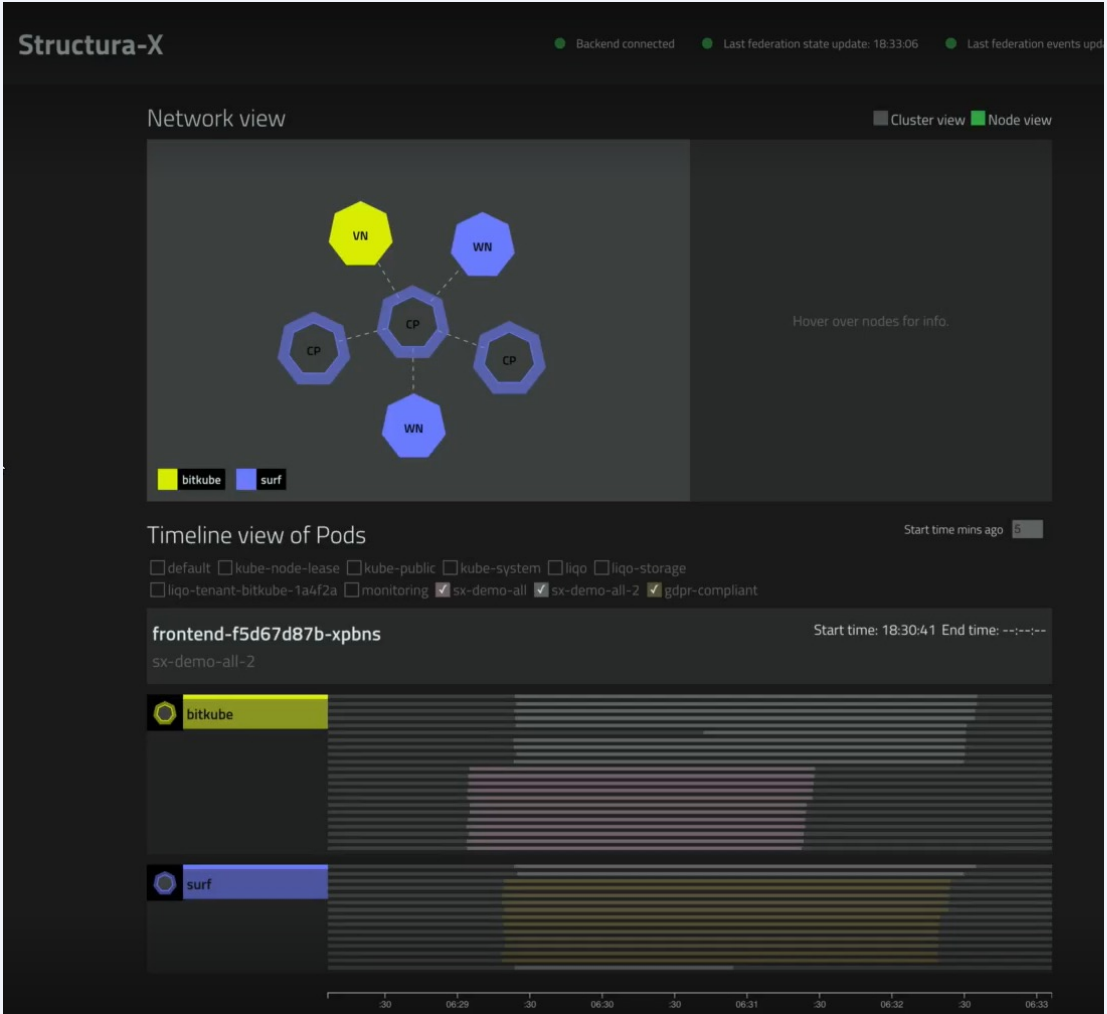
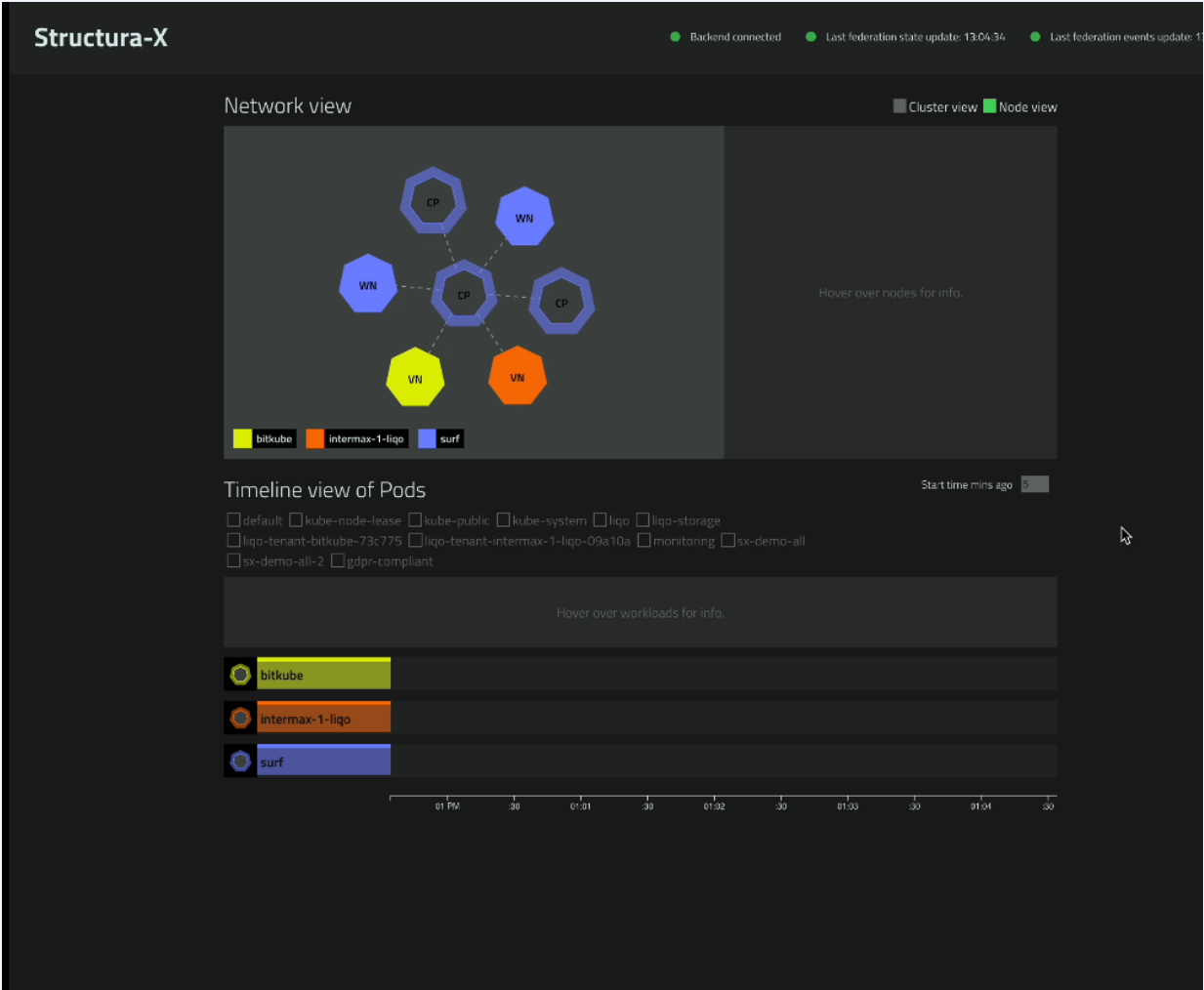
Scenario 3: Multiple constraints



Scenario 3b: move front end close to users geo-locations



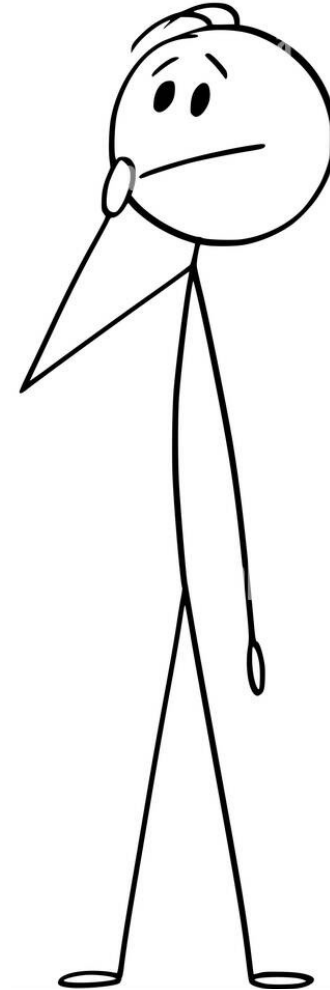
Federation infrastructure view



Questions?

Please reach out if you're interested in participating in (future) projects on cloud-edge federation

contact: erik.langius@tno.nl



References

- [ACM Cloud Marktstudie](#)
- [Managing technical lock-in in the cloud - GOV.UK \(www.gov.uk\)](#)
- [What is digital sovereignty and why is Europe so interested in it?](#)
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- <https://digital-strategy.ec.europa.eu/en/library/building-european-cloud-marketplace-conceptualisation-study>
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- <https://coe-dsc.nl/dutch-parties-build-test-environment-for-gaia-x-cloud-services/>



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