



Framework for Large-scale SDN Experiments via Software Defined Federated Infrastructures

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- Testing of innovative solutions for network control calls for **experimentation** using large-scale testbeds
 - emulate near real-world testing conditions and allow for wide technical and industrial impact
- **Network programmability** via Software Defined Networking (SDN) and dynamic on-demand network service provisioning are key ingredients
- **Experimental research infrastructures** are a reality for this thanks to efforts in Europe, Asia, and the Americas
- **FELIX** is part of this research experimentation infrastructure line of work
 - Future Internet Research Experimentation (FIRE) framework in EU
 - special focus on using SDN and Bandwidth on Demand (based on the Network Service Interface – NSI) for dynamic transit network connectivity

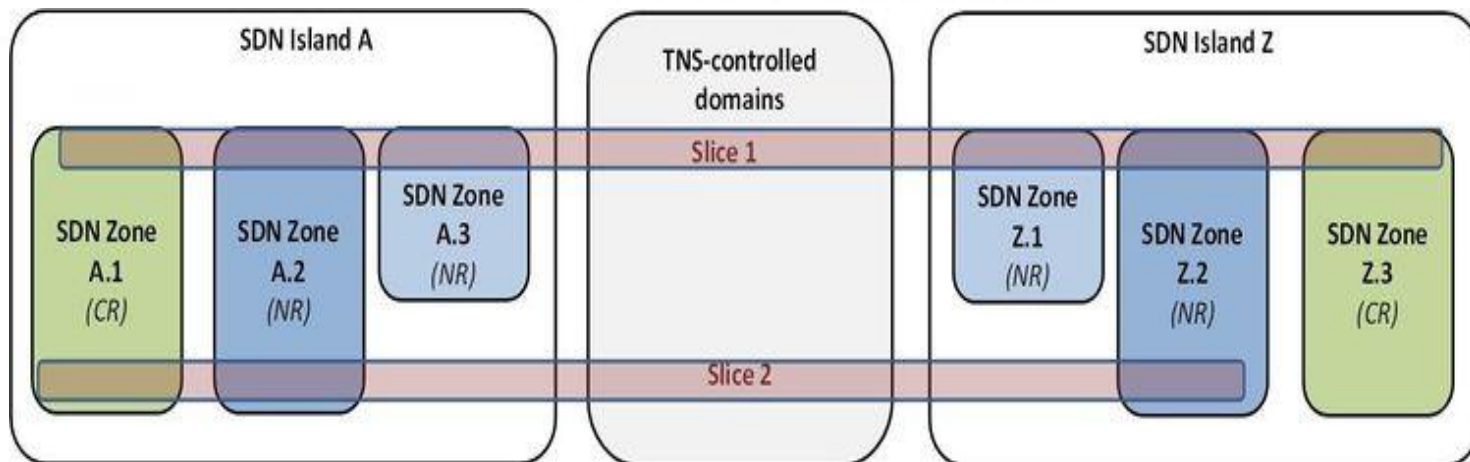
Facts

- EC (EU), MIC & NICT (JP) collaborative project
- Project running from April 2013 till March 2016

Objectives/Results

- A large-scale testbed federated across two continents
- A reference common architecture for SDN testbeds

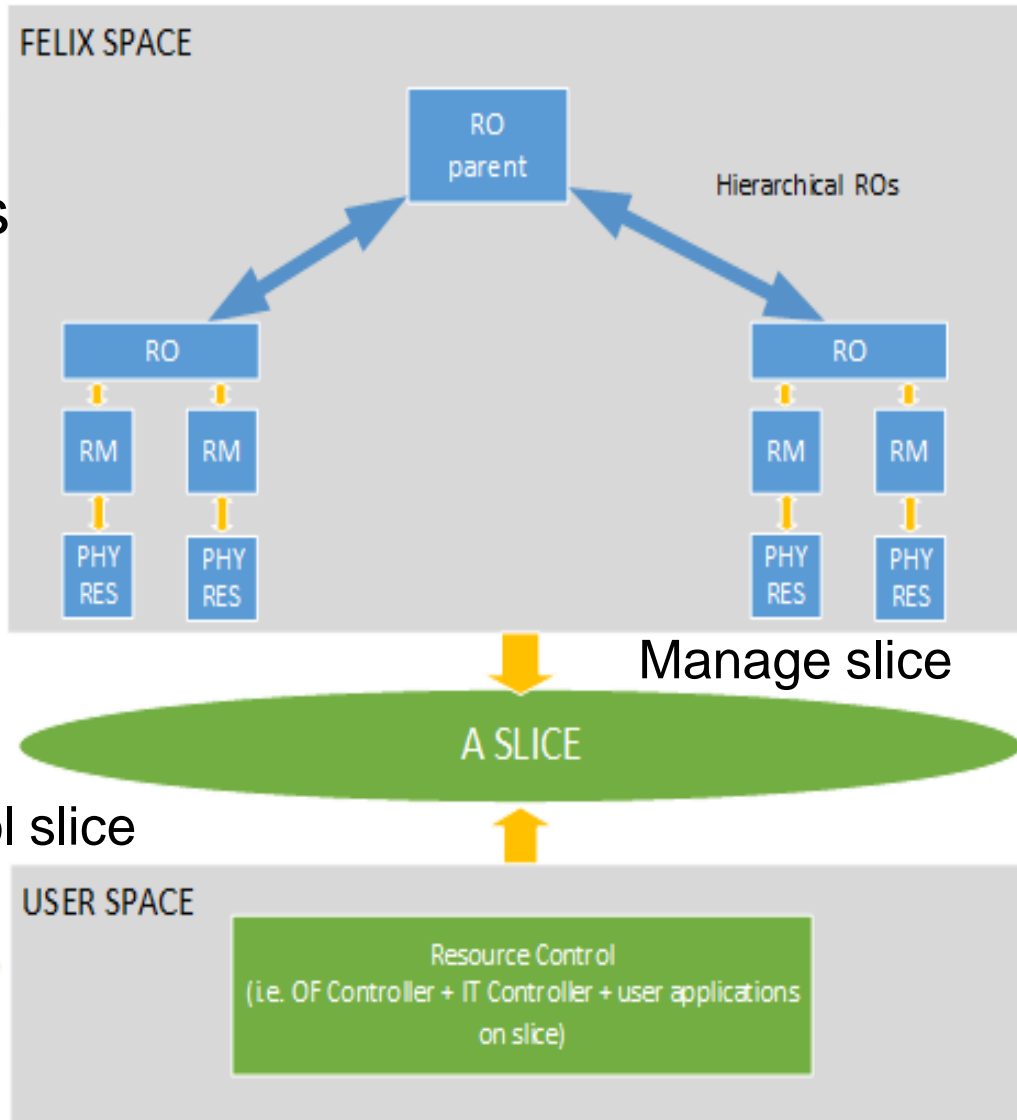




- **Slice**
 - Experimental facilities to be provided dynamically on top of the FELIX physical infrastructure (federated testbeds)
- All experimental facilities are controlled programmatically
 - facilities are composed of computing and network resources (*CR* and *NR*) belonging to distributed SDN islands in FELIX infrastructure
 - resource orchestration in a multi-domain environment
 - in a slice, facilities are interconnected via transit network (TN) service-controlled domains
- User has access and control of a provided slice

Request configuration
of slice(s)

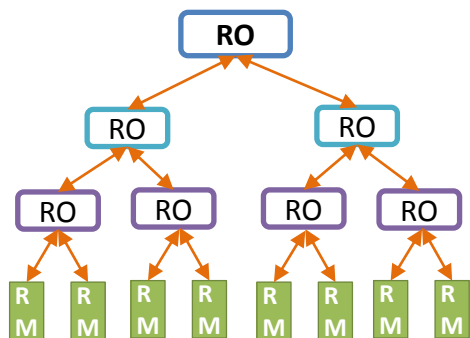
Users



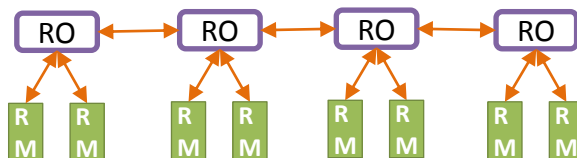
The **FELIX Space** provides users with slices for their own use. Users request slices to an RO.

- RO: Resource Orchestrator
- RM: Resource Manager
- PHY RES: physical resources (testbed)

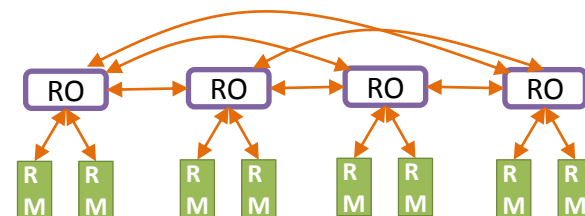
The **User Space** consists of any tools and applications that a user wants to deploy to control a slice or execute particular operations



Centralized

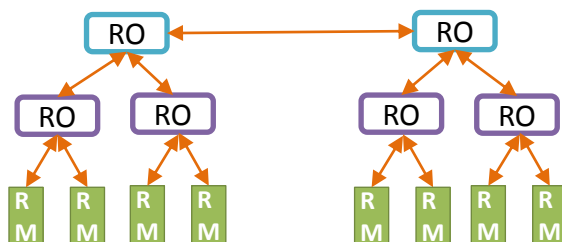


Distributed



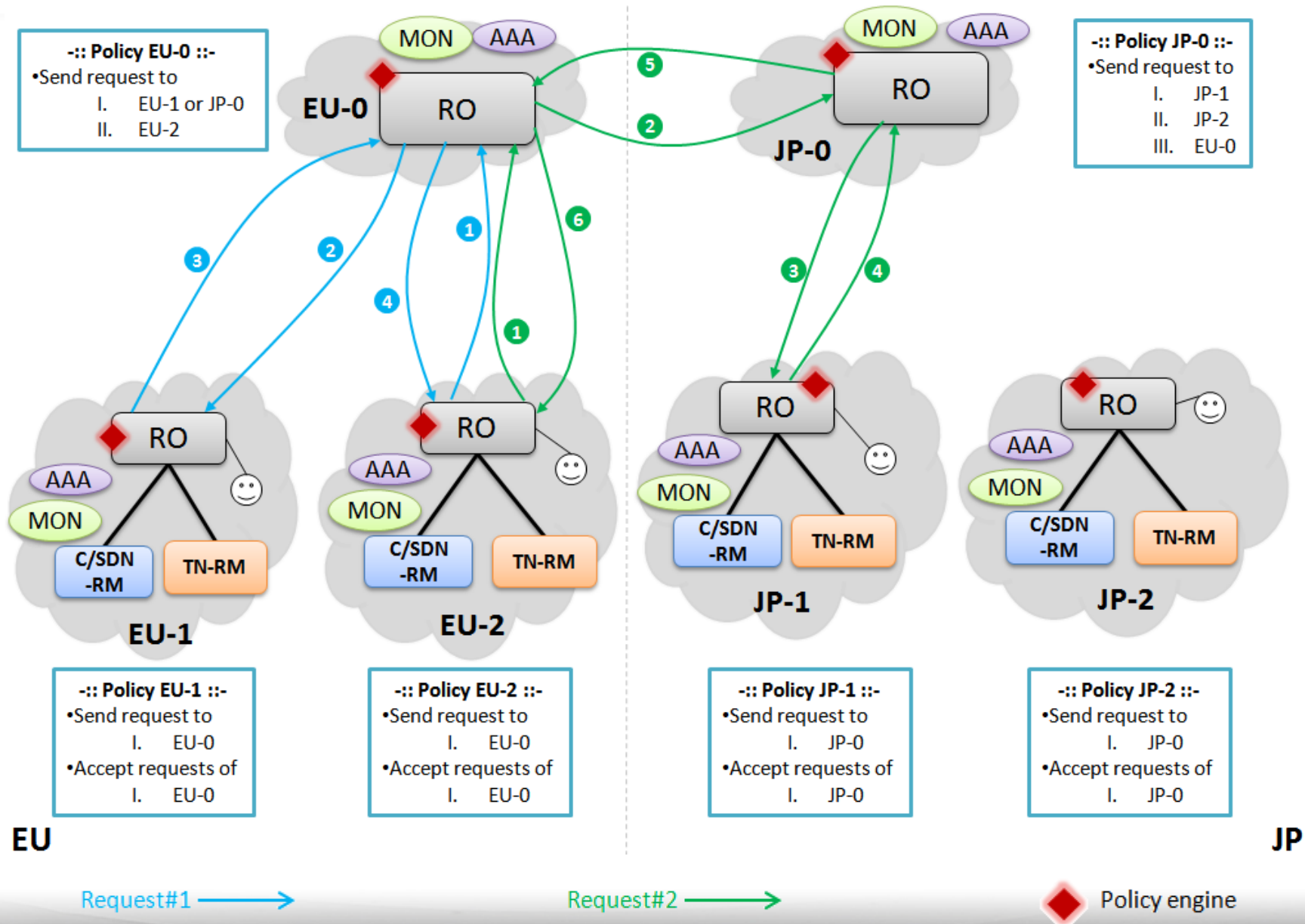
Full mesh

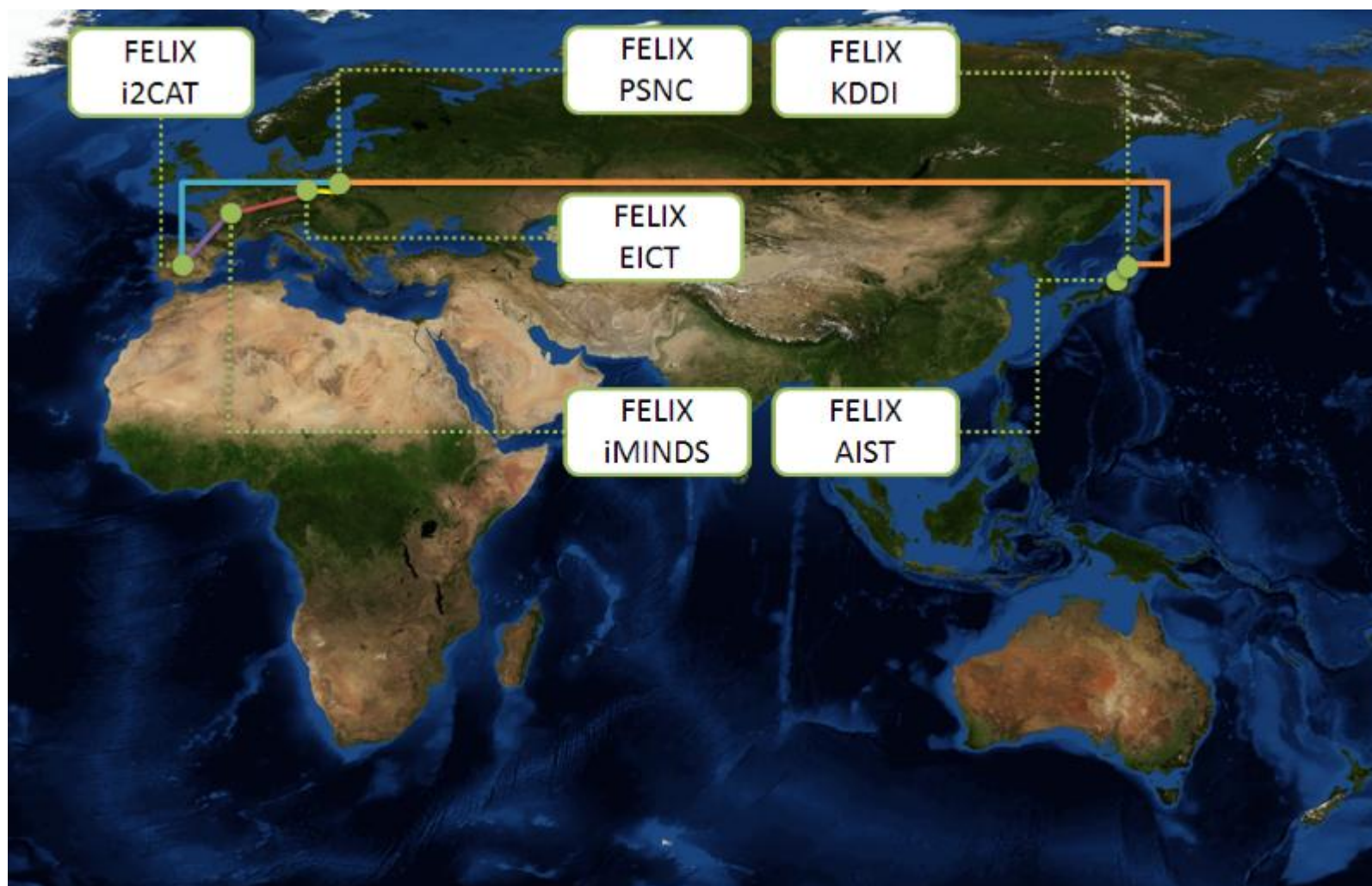
- RO Global RO
- RO Continent RO
- RO Island RO



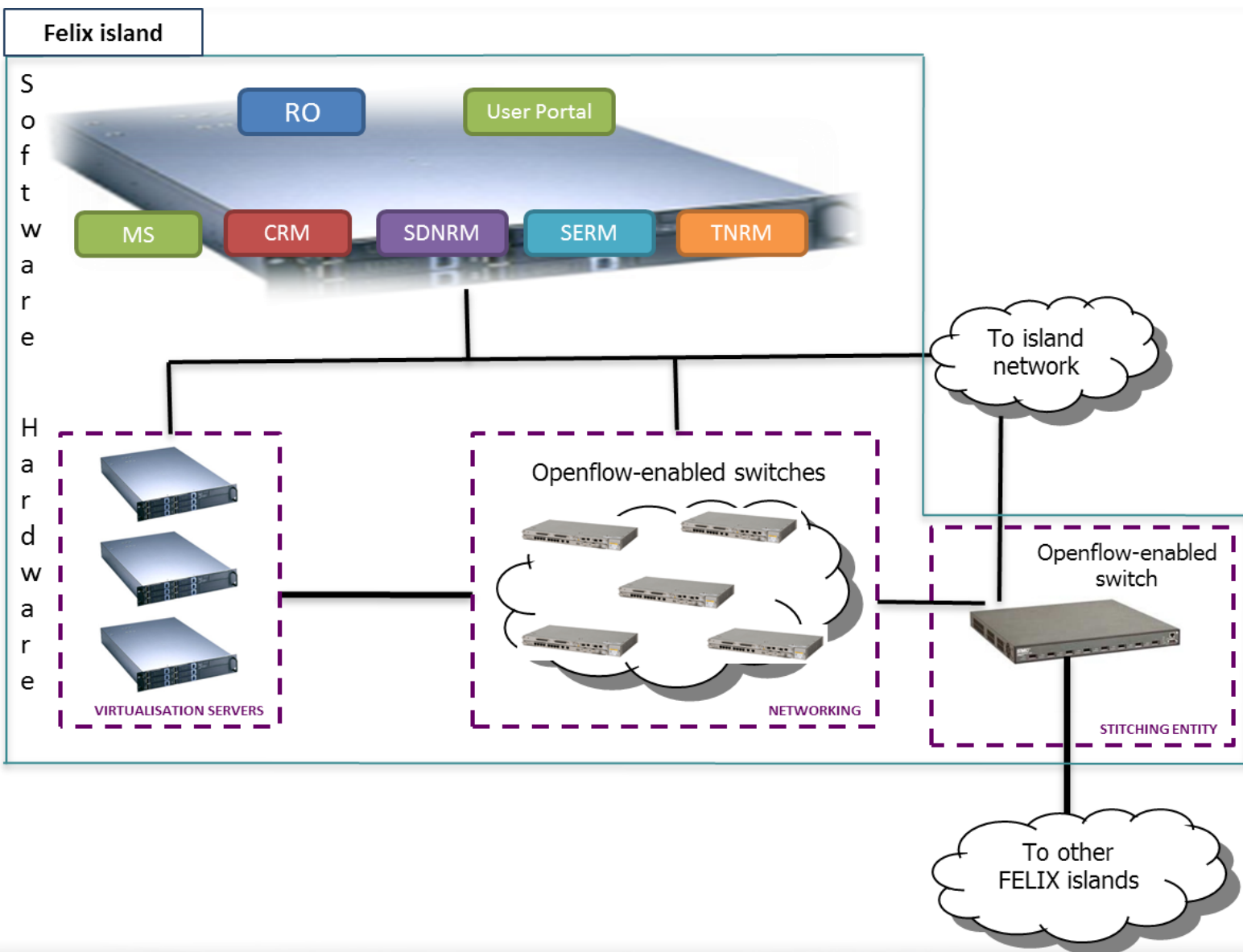
Hybrid

Selected for implementation

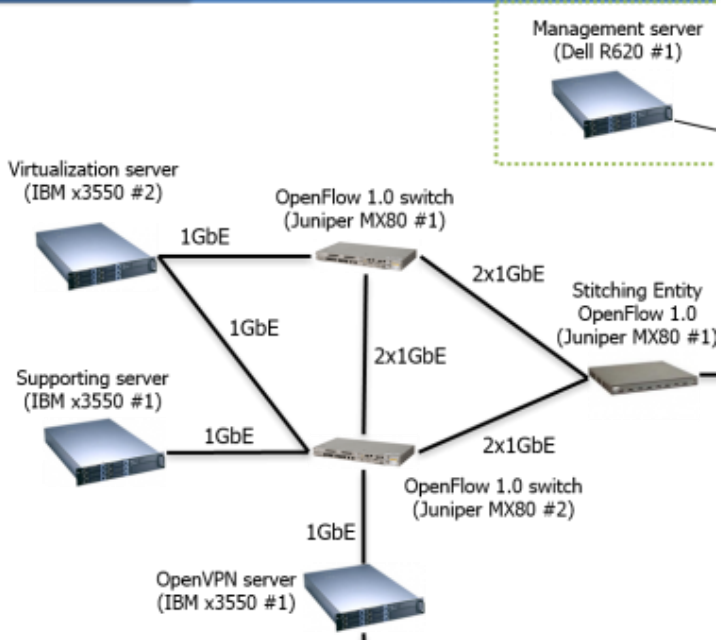




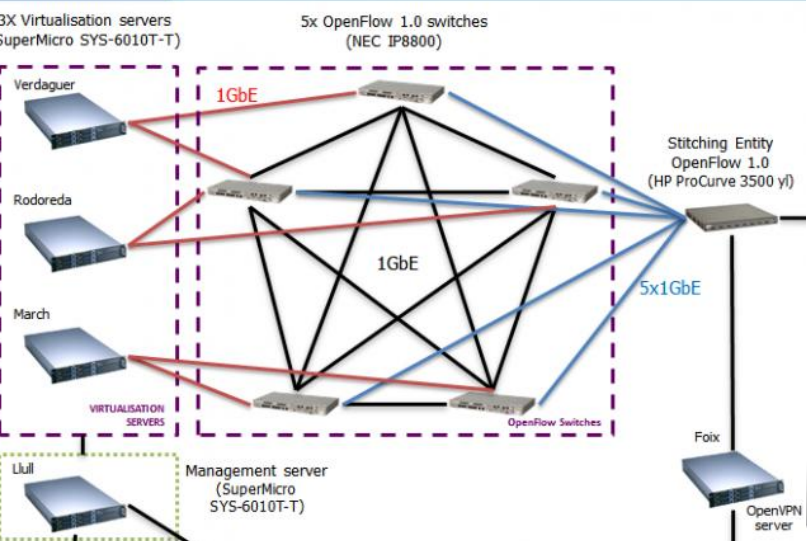
Source: www.ict-felix.eu



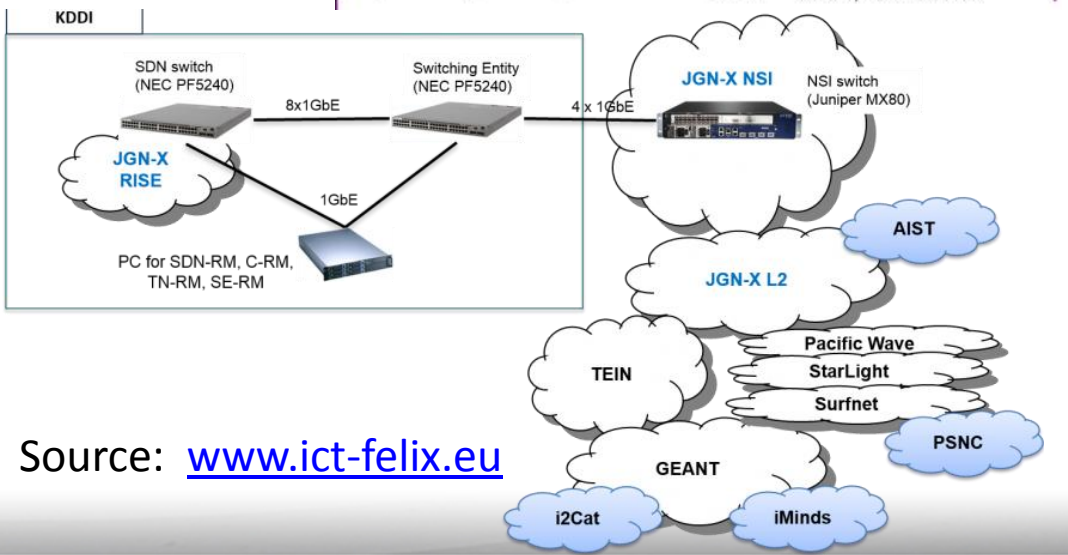
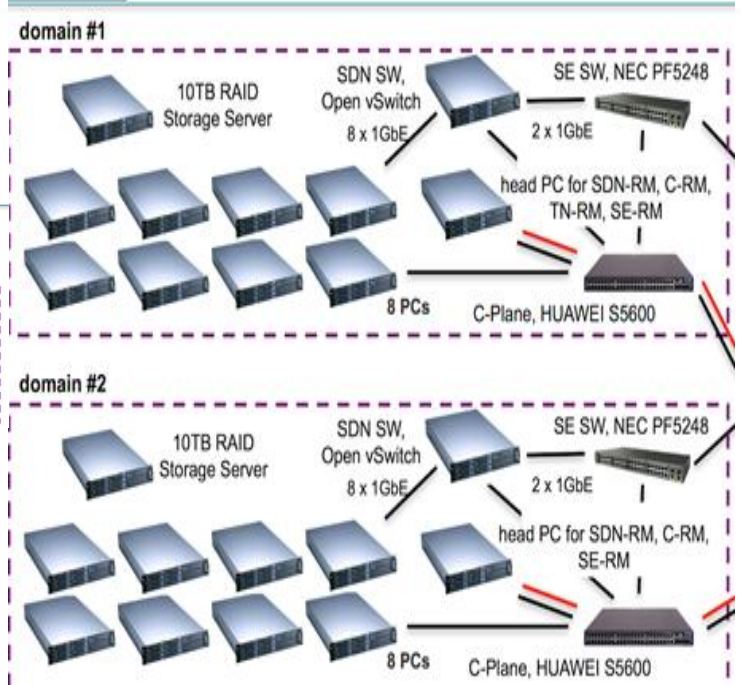
PSNC island



i2CAT island



AIST labs



Source: www.ict-felix.eu

- FELIX facilitates the federation and integration of different network and computing resources controlled via SDN and Network Service Interface (NSI) / bandwidth on demand (BoD) in a multi-domain heterogeneous environment across spanning Europe and Japan
- FELIX designed and implements a common control framework where users can request, monitor and manage a slice provisioned over distributed and distant SDN experimental facilities
- FELIX orchestration and resource management software is currently deployed in a number of interconnected SDN island across Europe and Japan
- The FELIX framework uses a combination of recursive and policy-based hierarchical configurations for orchestration, request delegation and inter-domain dependency management
- Resource orchestrating entities are responsible for the synchronization of resources available in particular administrative domains.

1. G. Carrozzo, et al., “[Large-scale SDN experiments in federated environments](#)”, *Proc. SACONET*, Vilanova i la Geltrú, Spain, June 2014, p 1-6.
2. C. Fernandez, et al., “[A recursive orchestration and control framework for large-scale, federated SDN experiments: the FELIX architecture and use cases](#)”, *International Journal of Parallel, Emergent and Distributed Systems*.
3. G. Carrozzo and K. Pentikousis, “Recursive orchestration of federated virtual network functions”, [draft-felix-nfvrg-recursive-orchestration](#)
4. FELIX Tutorial at EWSDN 2015 (www.ewsdn.org) in Bilbao, Spain.



30 September to 2 October 2015 | Bilbao, Spain





Thanks for your attention!

Questions and comments?

Acknowledgement

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