



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

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IETF 93 SDNRG Meeting
Prague, Czech Republic
22 July 2015

- 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

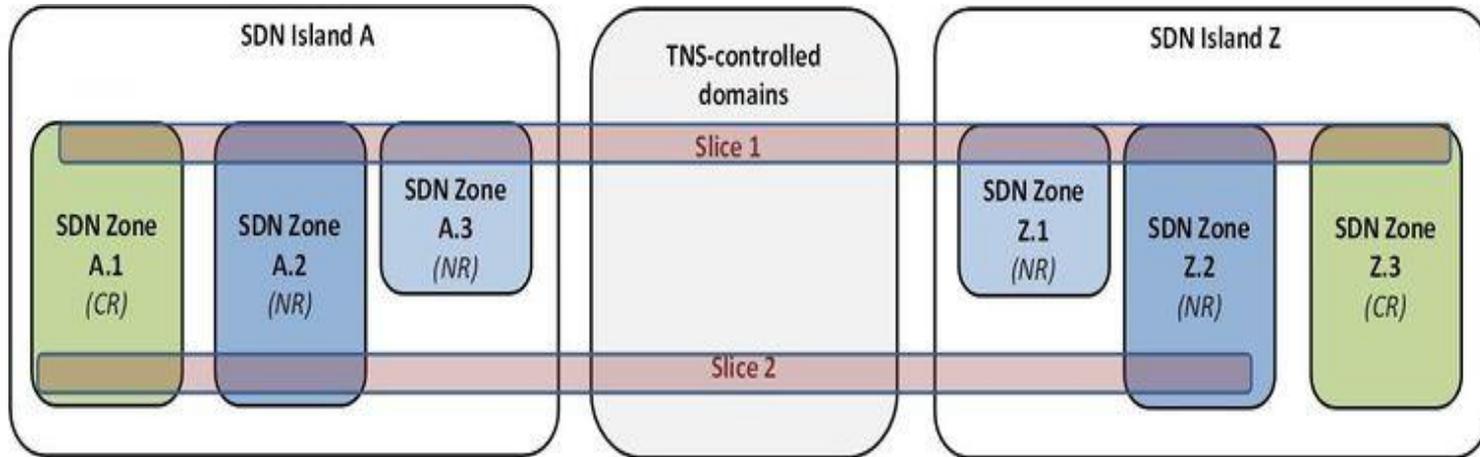
Facts

- 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



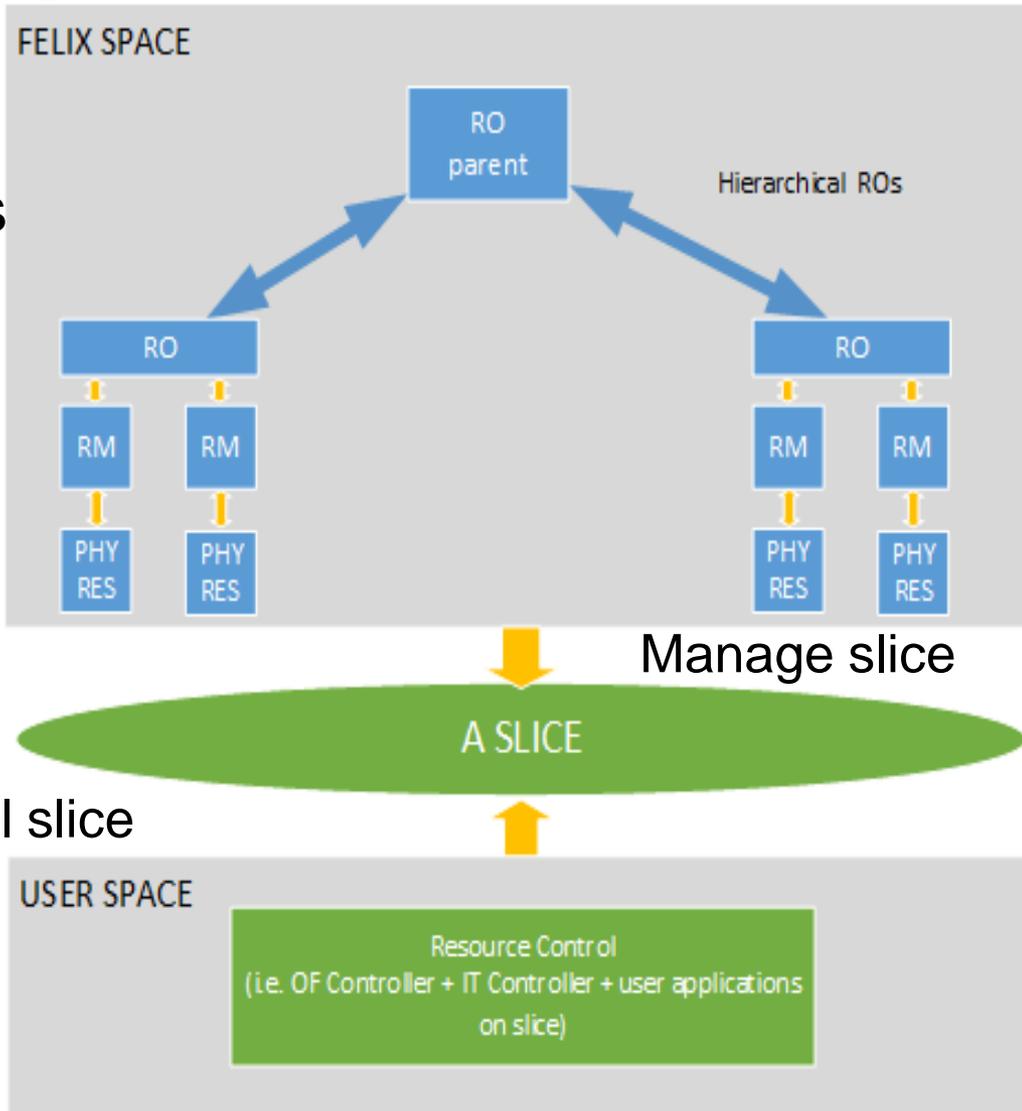


- **Slice**
 - Experimental facilities to be provided dynamically on top of the FELIX physical infrastructure (federated testbeds)
- All experimental facilities are controlled programmatically
 - facilities are composed of computing and network resources (*CR* and *NR*) belonging to distributed SDN islands 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)



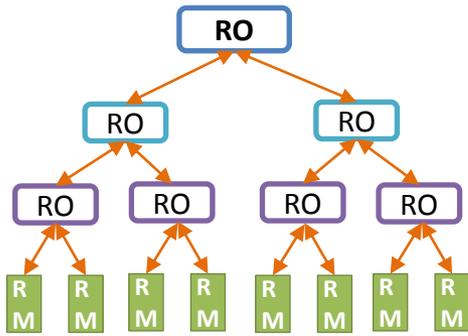
Users



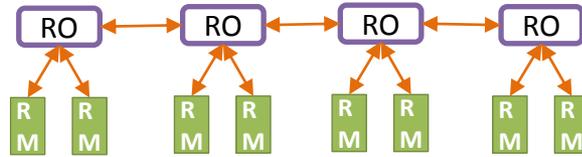
The **FELIX Space** provides users with slices for their own use. Users request slices to an RO.

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

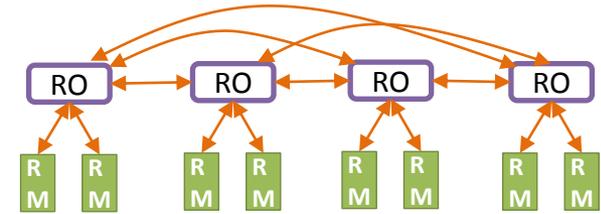
The **User Space** consists of any tools and applications that a user wants to deploy to control a slice or execute particular operations



Centralized

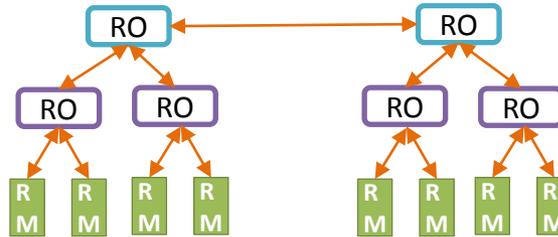


Distributed



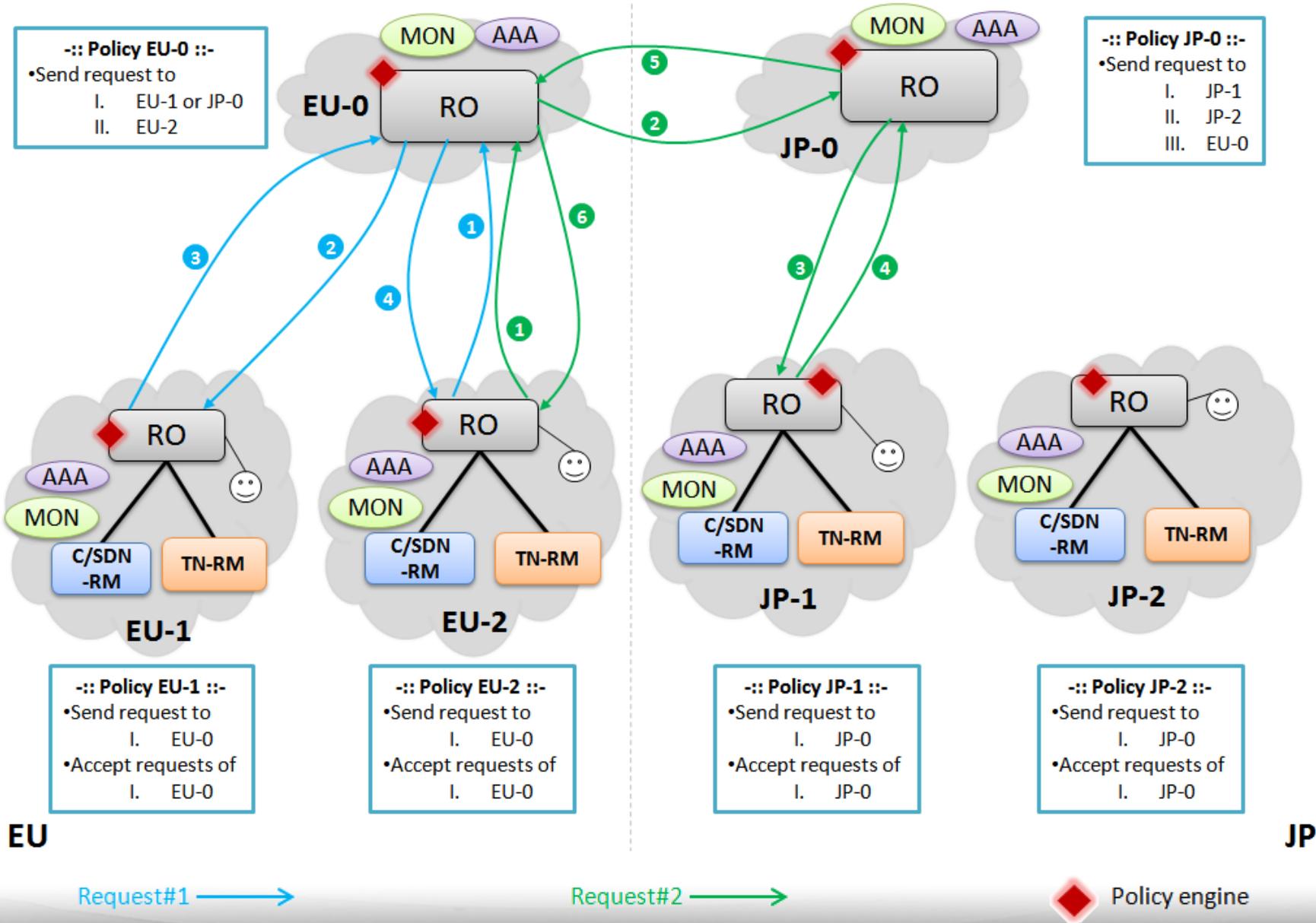
Full mesh

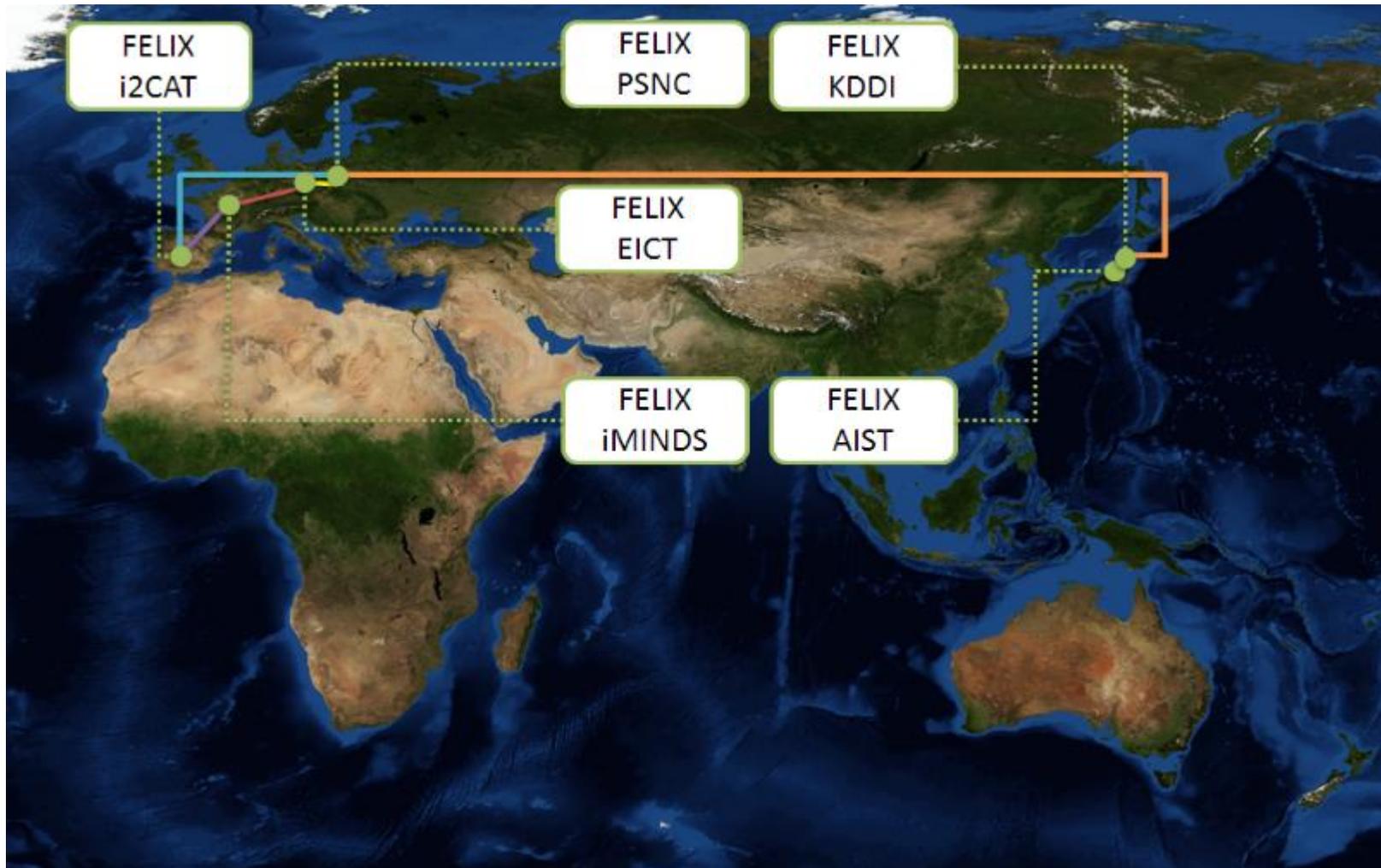
- RO Global RO
- RO Continent RO
- RO Island RO



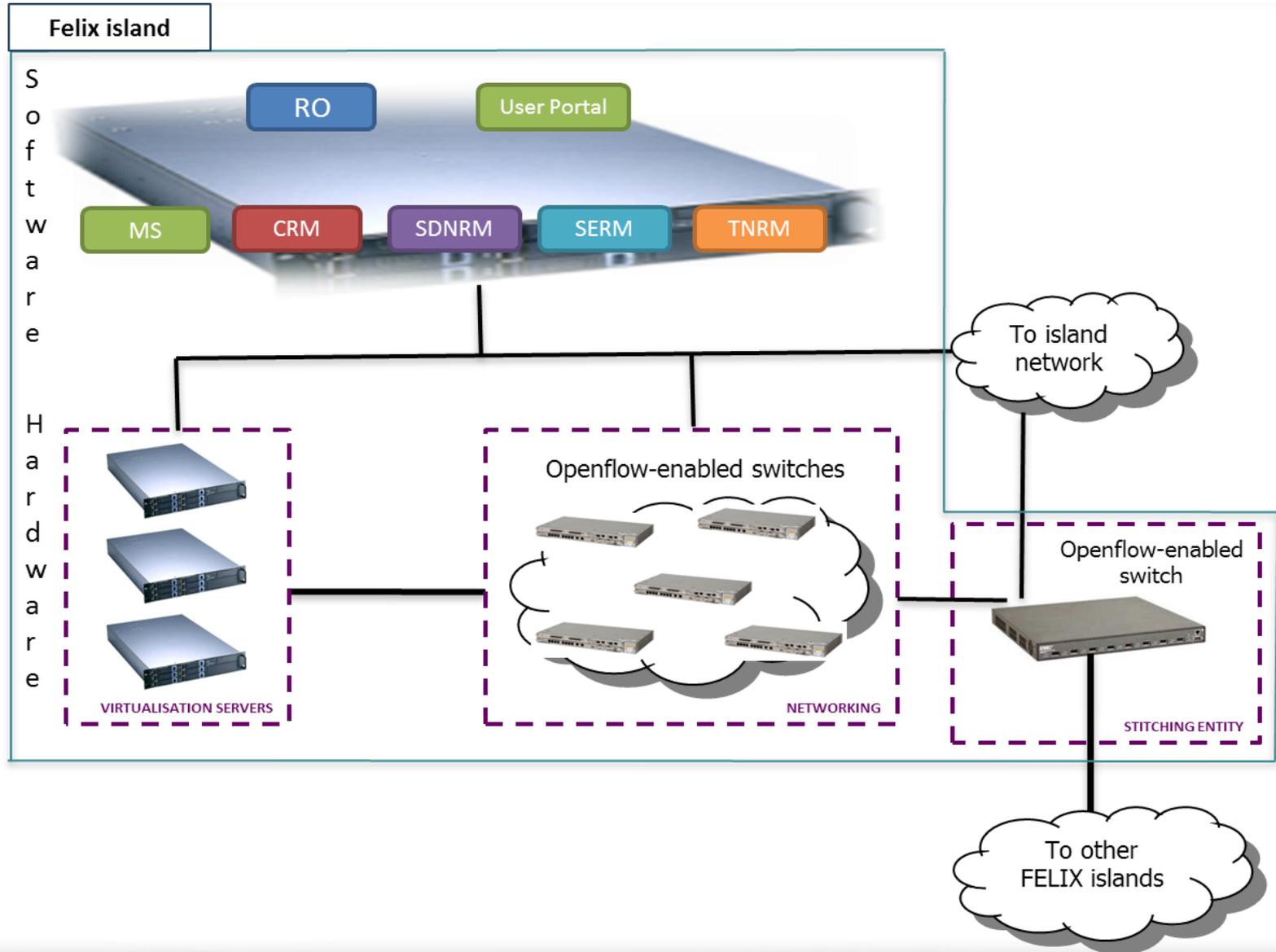
Hybrid

Selected for implementation

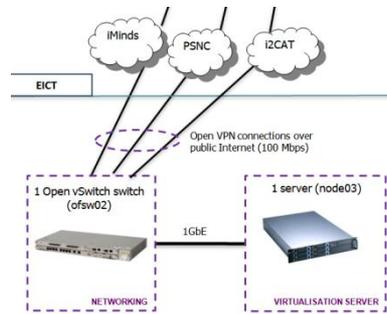
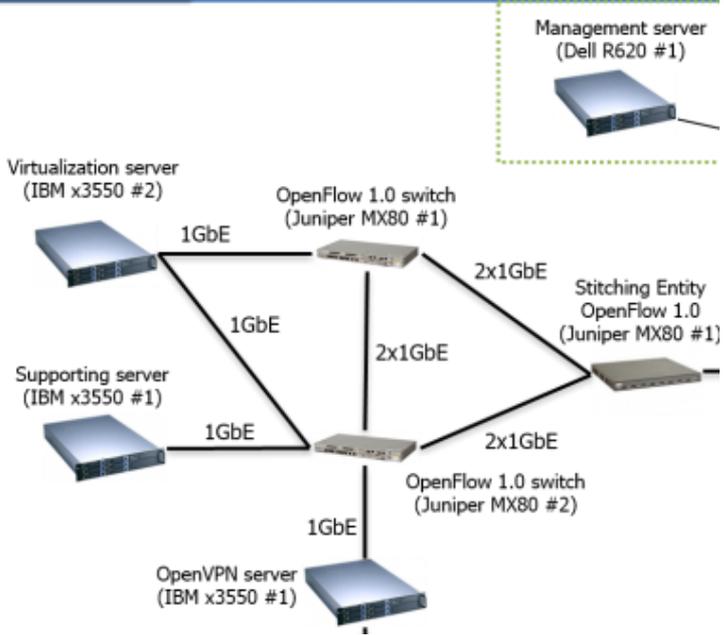




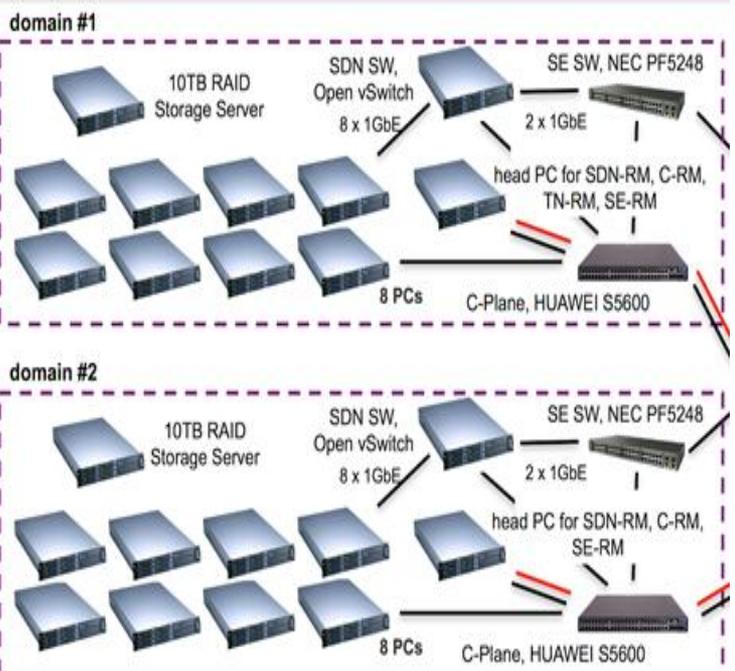
Source: www.ict-felix.eu



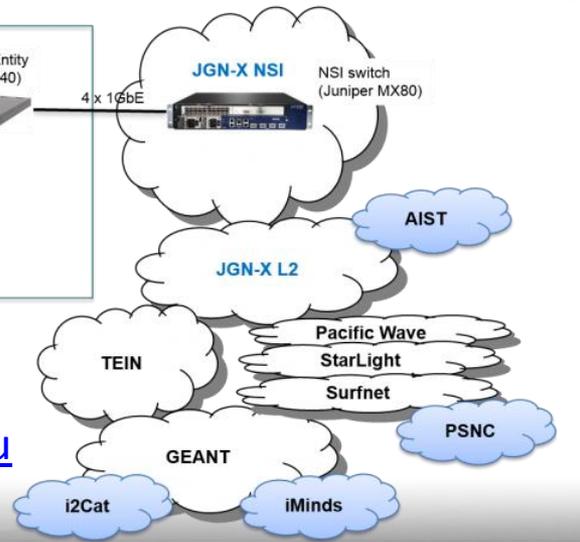
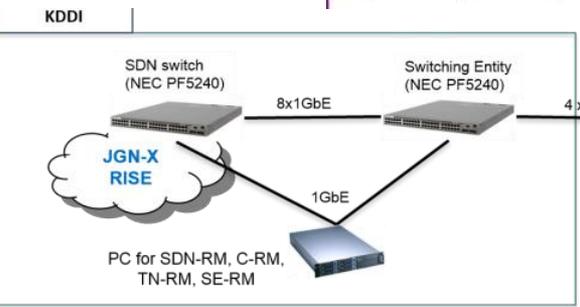
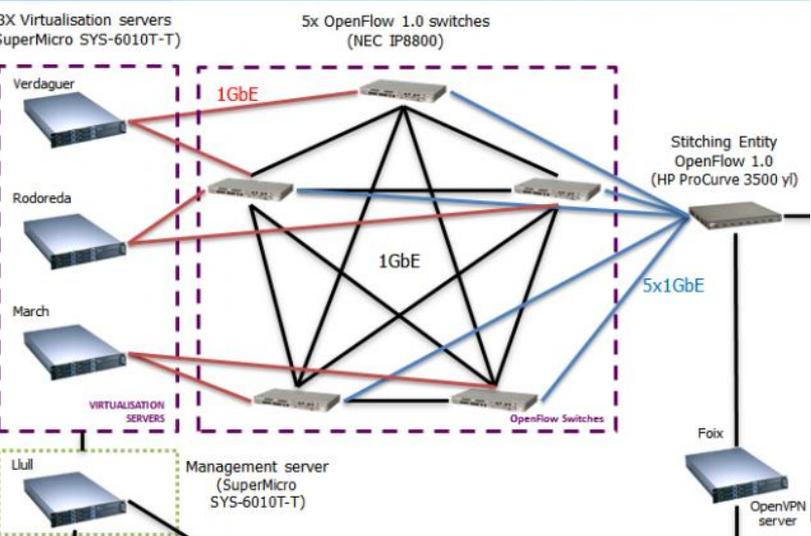
PSNC island



AIST labs



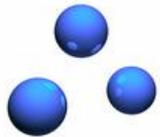
i2CAT island



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.



EWSDN

European Workshop on
Software Defined Networks

30 September to 2 October 2015 | Bilbao, Spain





Thanks for your attention!

Questions and comments?

Acknowledgement

**Part of this work was conducted within the framework of the FP7 FELIX,
which is partially funded by the Commission of the European Union.**

**Study sponsors had no role in the preparation of this presentation. The views expressed do not necessarily represent the views of the
FELIX project, the respective employers, or the Commission of the European Union.**