



Federation of Future Internet Testbeds First experiences from bilateral collaboration between Europe and Japan on SDN

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Future Internet Testbed Workshop

A federation is a union comprising a number of partially selfgoverning regions united by a central ("federal") government under a common set of objectives *

- FELIX works on the interconnection of EU and JP testbeds
 - To increase mutual benefits of European and Japanese researchers by creating more complex environments for specialized research and experiments
 - To create new opportunities for experiments due to geographical dispersion of testbeds

Resources of the global EU-JP Federation will become available for users of individual testbeds

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FEDERATED TEST-BEDS FOR LARGE-SCALE INFRASTRUCTURE EXPERIMENTS

State of the art.: examples of Experimental Facilities in EU and JP

- **OFELIA** (OpenFlow in Europe Linking Infrastructure and Applications)
 - An OpenFlow testbed (incl. IT and L1/L2 network resources) for researchers and other projects in Europe. The concept is based on the federation of resources *"islands"* in BE, DE, ES, CH, IT & UK
 - http://www.fp7-ofelia.eu/
- **RISE** (Research Infrastructure for large-Scale network Experiments)
 - OpenFlow testbed over JGN-X (the largest testbed network in Japan), with wide-area coverage from US West coast to Southeast Asia. Users can experiment and validate their own SDN, cloud, and OF controller solution in the RISE sandbox
 - <u>http://www.jgn.nict.go.jp/rise/english/index.html</u>











- SDN (Software Defined Network) and OpenFlow
 - SDN network testbeds (islands) based on OpenFlow have been constructed and in operation in Europe and Japan (OFELIA/RISE)
 - By federating SDN islands, an integrated infrastructure can be constructed over globally distributed resources
- NSI (Network Services Interface)
 - An interface to request a multi-domain on-demand network connection services
 - Under development by many R&E networks in Europe, Asia and US, can provide inter-island connectivity to SDN
 - Being standardized in Open Grid Forum (NSI CSv2.0 in last call phase)







- Two major clusters of use cases to reflect different applicability area and stakeholders:
 - The FELIX Data Domain use cases to target the area of SDN and dynamic interconnections via NSI.
 - Data on Demand delivery of distributed data by setting data flows over the network
 - Pre-processing and delivery of nearly real-time [satellite] data to geographically distant locations (from EU to JP and vice versa)
 - High quality media transmission over long-distance networks
 - The FELIX Infrastructure Domain use cases to focus more on the efficient use of federated and dispersed FI resources (in different continents), to migrate entire workloads (VMs and data) or virtual infrastructures in a more efficient way (e.g. with energy saving targets) and enhanced features (e.g. data/service survivability in case of disasters)
 - Data mobility service by SDN technologies
 - Follow-the-sun / follow-the-moon principles
 - Disaster recovery by migrating laaS to a remote data center





Data on Demand – delivery of distributed data by setting data flows over the network

A user wants to run an algorithm in a site (Data Processor) over different portions of data located around the world in Data Storages.

Research question. How to efficiently process large amounts of data stored along different and distributed entities sites?

The platform should enable efficient and dynamic data transmission between remote sites, providing data as it is requested: Data on Demand.







Pre-processing and delivery of nearly real-time [satellite] data to geographically distant locations



Satellite sources generate huge amounts of nearly real-time data that can be preprocessed through computational functions placed close to the data producers

Research question. Can we reduce the size of data to be delivered across the transit network and elaborate at the geographically distributed research centers to improve the overall performance?

The FELIX middleware should allocate the proper CPU and caching resources at data source and destination(s) ends, and configure the network segments on-demand with the required bandwidth and delay guarantees to provide an efficient transfer of data across continents





High Quality Media Transmission over long-distance networks

Federation of SDN testbeds interconnected through NSIenabled domains enables opportunities for testing media streaming over **existing network technologies** in backbone networks (DWDM, MPLS, etc.) **in conjunction with OpenFlow** deployed in the testbeds.





Research question. Can we determine the behaviour of transmission mechanisms in streaming of the high resolution media content at a very long distance?

- Investigate negative effects in a network (e.g. jitter)
- Investigate possible problems with synchronization of the 3D streams (i.e. left eye, right eye)





Data Mobility Service by SDN Technologies (Inter-Cloud use case)



A user of a service provided by a cloud system moves to a remote location (e.g., due to a business trip)

Research question. Can the cloud system monitor the performance and move data "closer to the remote location"?

Aim is to let the user temporally access his [business] services with the same level of performance as when at home.





A Follow the Sun/Moon Model – green energy in Data Centers

Research question. How can we move the compute workflow to the nearest & greenest power available in a federation?



FELIX focus is on

- Investigating technical possibilities for using SDN in implementation of the Follow the Moon concept in Data Centers
- Validating the technical viability of relocating computing loads to less energy consuming Data Centers in a federation using FELIX Control Framework

Moving data vs. moving compute loads!





Disaster recovery by migrating laaS to a remote data center

Research question. Can we migrate the entire "laaS" platform to remote data centers for business continuity (e.g. in case of disasters)?

- laaS = a cluster of VMs, including laaS management nodes
- Each laaS is constructed by laaS software (e.g., CloudStack, OpenStack)

By introducing "HaaS (Hardware as a Service)" layer, abstraction of physical resources is realized

- laaS can be migrated to a differently configured data center
- Abstraction is supported by OpenFlow and nested VM







- Six project use cases have been translated into **User Requirements**
 - describe the expectations on the FELIX system in terms of objectives, a use-case environment, constraints and measures of effectiveness and suitability
- In the next step User Requirments are to be translated into System Requirements
 - Prioritizied FELIX Framework requirements which must be taken into account while definining the FELIX architecture
- FELIX architecture is going to be released soon (February 2014) and early implementations are expected by Q1-2015 (January/February 2014)





Total costs requested to EC: Total costs requested to NICT: Duration (36 months): Project resources:

1 499K € 150M ¥ 01.04.2013 - 31.03.2016 302 PM (person months)







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