A user guide to FELIX SDN experimental facilities

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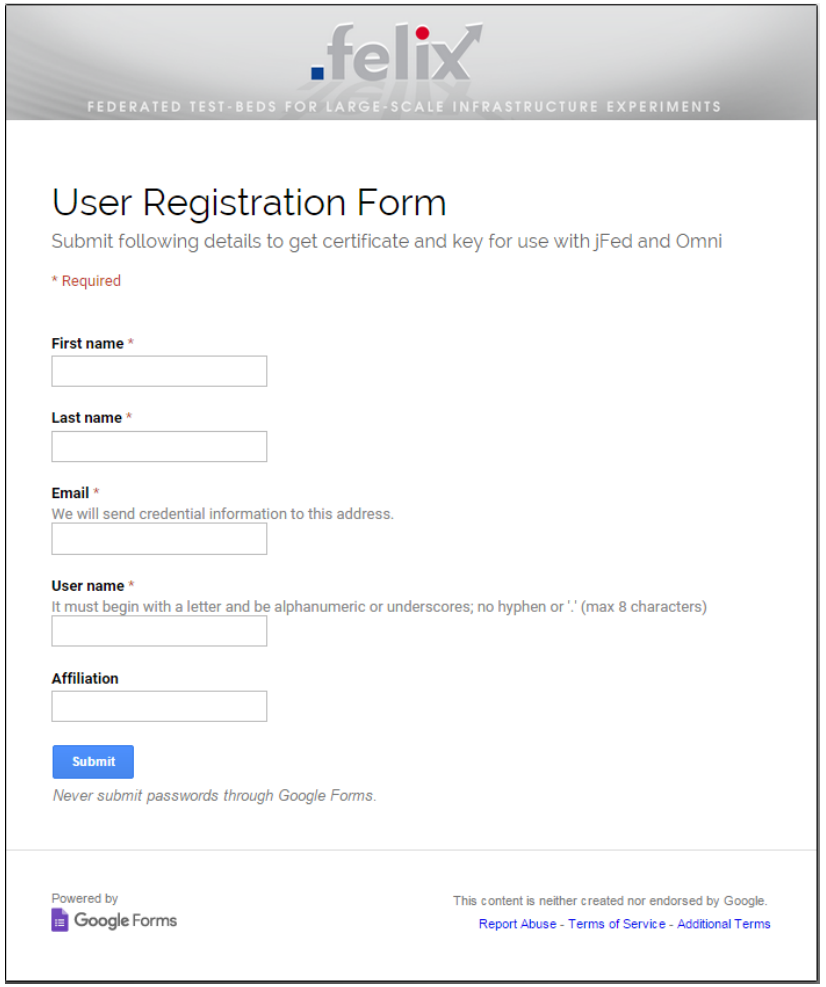
First time access > Getting an account

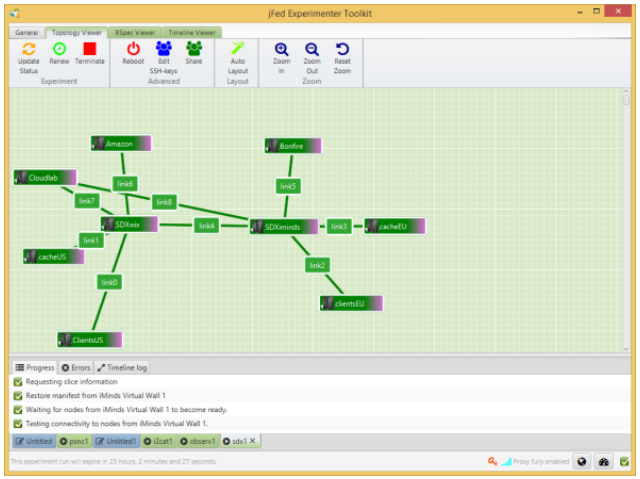
- Accounts can be requested through the form
  - http://goo.gl/forms/jikTkmwdGu

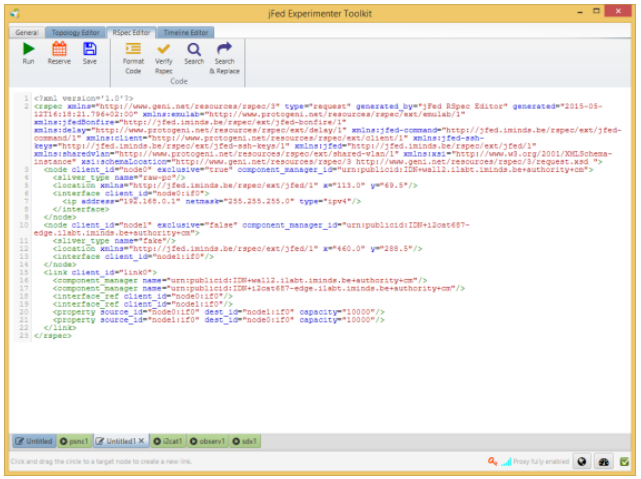
- Experimenter to provide full name, e-mail, affiliation (organisation) and desired user name

- After data is submitted, the experimenter will be provided with a pair of certificate and key for use with User Access tools (jFed, OMNI, Expedient)
  - **OMNI**: initial configuration and set-up to be performed prior to access
  - **jFed**: minimal configuration before access (*NB: enable proxy access*)



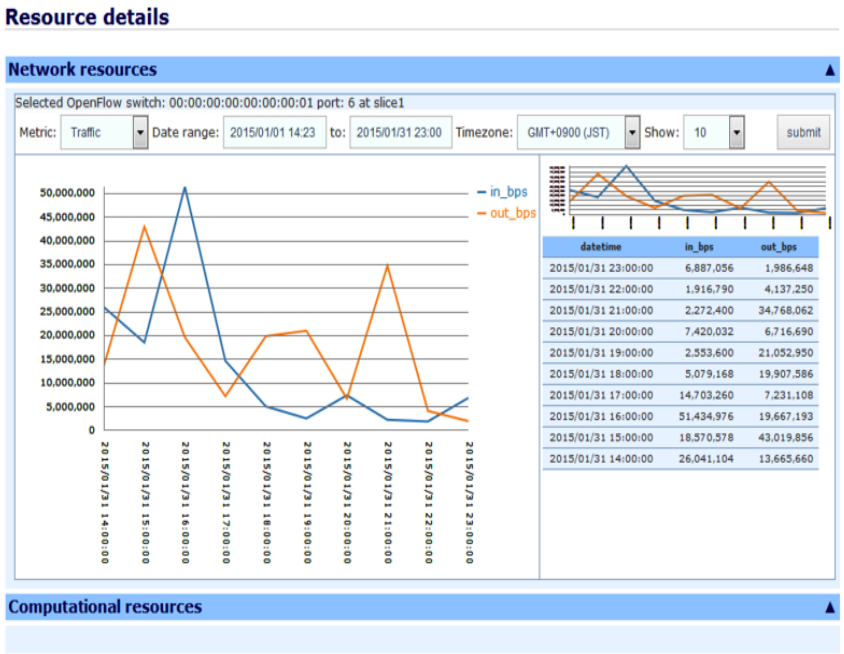
- **jFed**
  - Graphical tool to draw topologies and deploy them through the AM API and clearinghouse APIs
  - RSpec editor
    - Available at: http://jfed.iminds.be/

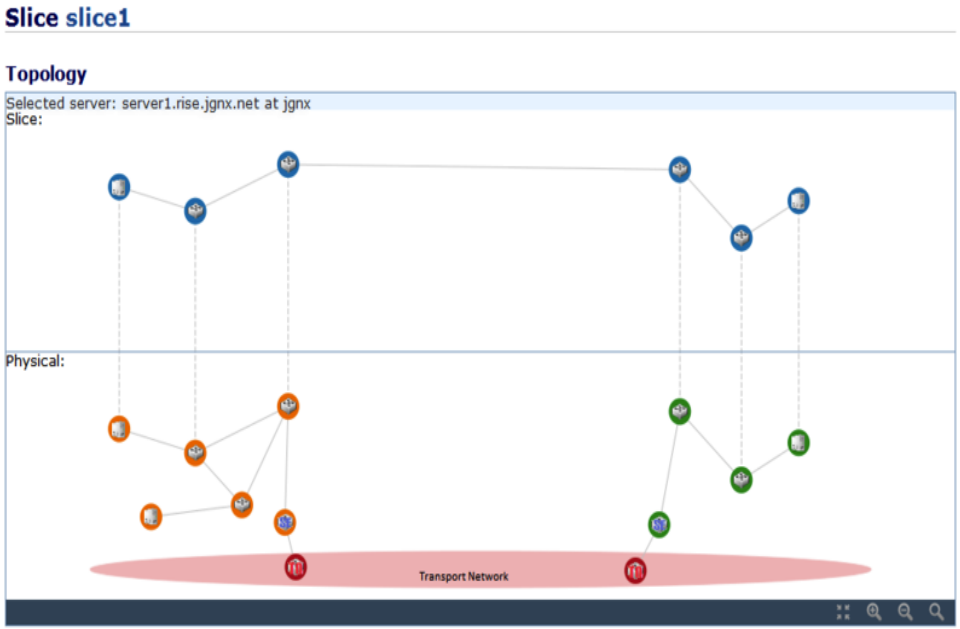




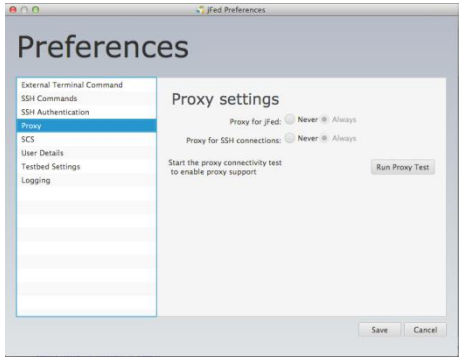
- **OMNI client**
  - CLI part of the GENI Control Framework. Allows managing resources at GENI aggregate managers by running commands using RSpecs as parameters
    - Installation, configuration and technical details: https://github.com/dana-i2cat/felix/wiki/OMNI_client

- **Expedient**
  - GUI access for administrators and experimenters
    - Allows management, control and monitoring of several resources
  - Provides a view of the experiment
    - Show experimenter's slice mapped against the physical federation topology
    - Depicts time-based graphs with metrics on usage of the resources





- **jFed**
  - Check connectivity ("*Connectivity Tester*")
  - Define path to user's certificate (*.pem* file) and password, then log in
  - Enable SSH proxy (under "*Preferences*") to access private networks
    - Run "*Proxy Test*"



- **OMNI client**
  - Copy sample *omni_config*, *gcf_config* files*
  - Place them under /home/<%user_name%>/.gcf
  - Fill them with valid data
    - Connection to CH, URN, path to cert/key pair, etc.

```
[omni]
default_cf = my_cbas
users = <%user_name%>

[my_gcf]
type=gcf
ch=https://localhost:8000
cert=~/.gcf/<%user_name%>-cert.pem
key=~/.gcf/<%user_name%>-key.pem

[my_cbas]
type=chapi
speakv2=true
default_project=default
authority=cbas.i2cat.net
ch=https://localhost:8008/reg/2
cert=~/.gcf/<%user_name%>-cert.pem
key=~/.gcf/<%user_name%>-key.pem

[<%user_name%>]
urn=urn:publicid:IDN+cbas.i2cat.net+user+<%user_name%>
keys=/home/<%user_name%>/.ssh/id_rsa.pub
```

* Available at https://github.com/dana-i2cat/felix/tree/gh-pages/conf/gcf_ch

Creating an experiment:

- Generate an RSpec file with computing and networking resources
- Send request through appropriate User Agent (jFed or OMNI)

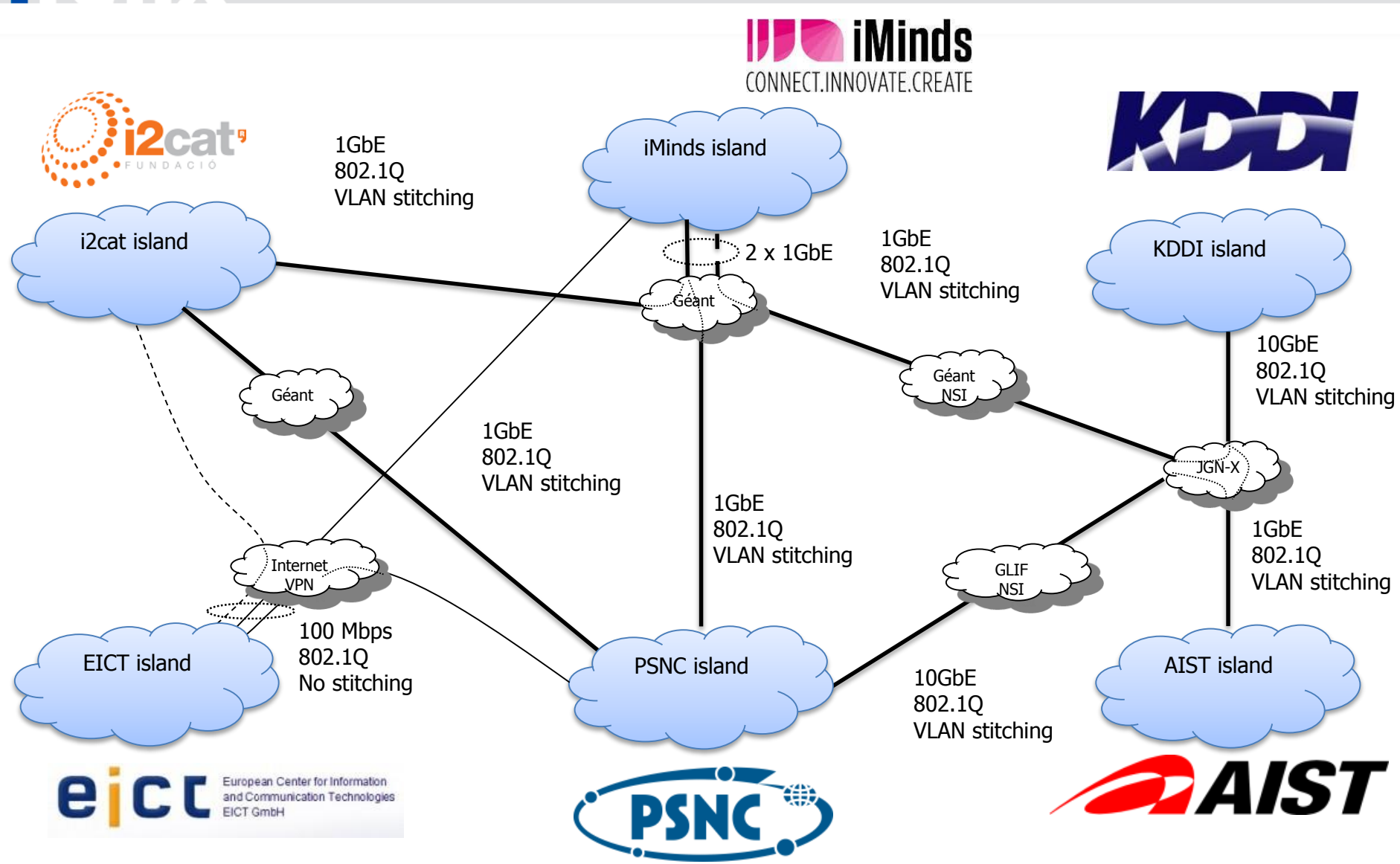
1. Determining domains and ROs/RMs
   - Checking the availability* of resources

Monitor Self Test Status: SUCCESS

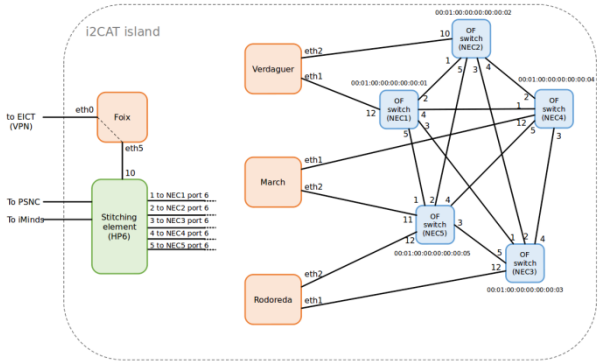
Monitoring Overview for felix

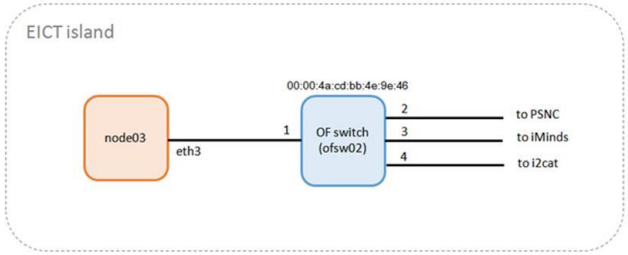
Testbed Name	Ping Latency (ms)	GetVersion Status	Free Resources	Aggregated Status	Login Status
AIST openflow (SDNRM)	315.16	SUCCESS	1	SUCCESS	no data
AIST RO	581.50	SUCCESS	no data	SUCCESS	no data
AIST SERM	576.30	SUCCESS	1	SUCCESS	no data
AIST TNRM	303.13	SUCCESS	1	SUCCESS	no data
AIST VTAM (CRM)	574.02	SUCCESS	1	SUCCESS	no data
EICT openflow (SDNRM)	20.51	SUCCESS	1	SUCCESS	no data
EICT VTAM (CRM)	36.70	SUCCESS	1	SUCCESS	no data
i2CAT MRO	51.34	SUCCESS	18	SUCCESS	no data
i2CAT openflow (SDNRM)	14.68	SUCCESS	5	SUCCESS	SUCCESS
i2CAT RO	51.39	SUCCESS	9	SUCCESS	no data
i2CAT SERM	51.73	SUCCESS	1	SUCCESS	no data
i2CAT VTAM (CRM)	11.09	SUCCESS	3	SUCCESS	SUCCESS
KDDI openflow (SDNRM)	267.99	SUCCESS	1	SUCCESS	no data
KDDI RO	559.56	SUCCESS	4	SUCCESS	no data
PSNC openflow (SDNRM)	34.73	SUCCESS	2	SUCCESS	no data
PSNC RO	34.85	SUCCESS	3	SUCCESS	no data
PSNC SERM	34.70	SUCCESS	1	SUCCESS	no data
PSNC VTAM (CRM)	34.86	SUCCESS	1	SUCCESS	no data
Virtual Wall 1	0.29	SUCCESS	36	SUCCESS	SUCCESS
Virtual Wall 2	0.13	SUCCESS	5	SUCCESS	WARNING
Virtual Wall 2 (openflow)	1.28	SUCCESS	2	SUCCESS	SUCCESS

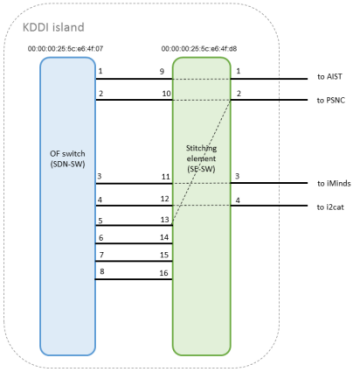
* *Availability of FELIX ROs and RMs per domain: http://flsmonitor.fed4fire.eu/fls.html?testbedcategory=felix&hideinternalstatus*

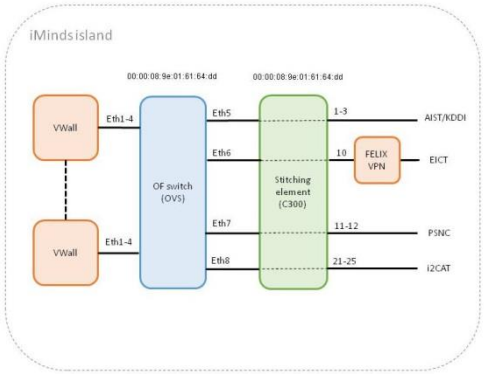

iMinds
CONNECT.INNOVATE.CREATE
i2cat
FUNDACIÓ
KDDI
1GbE
802.1Q
VLAN stitching
iMinds island
i2cat island
2 x 1GbE
Géant
1GbE
802.1Q
VLAN stitching
KDDI island
Géant
Géant
NSI
10GbE
802.1Q
VLAN stitching
1GbE
802.1Q
VLAN stitching
JGN-X
1GbE
802.1Q
VLAN stitching
Internet
VPN
GLIF
NSI
100 Mbps
802.1Q
No stitching
EICT island
PSNC island
AIST island
10GbE
802.1Q
VLAN stitching
eict
European Center for Information
and Communication Technologies
EICT GmbH
PSNC
AIST

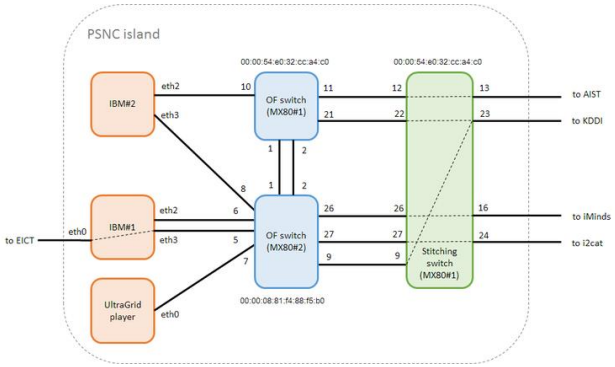
Creating your first experiment > Determining domains

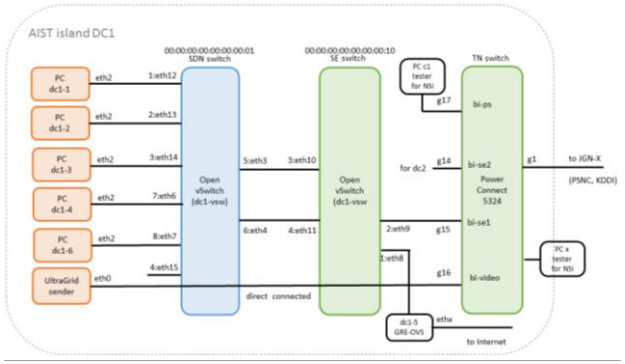












2. Fetching the resources
   - Identify resources available per RM with *ListResources* call
   - Varies from User Agent:
     - OMNI: Explicit call
     - jFed: Implicit call (upon "*Run Experiment*")

```
demo@dc1-ro:/home/carolina/test$ python /home/demo/gcf-2.8/src/omni.py -V3 -a https://aist_sdnrm_dc1:8443/xmlrpc/geni/3/ listresources
19:49:17 INFO    : Loading agg_nick_cache file '/home/demo/.gcf/agg_nick_cache'
19:49:17 INFO    : Loading config file '/home/demo/.gcf/omni_config'
19:49:17 INFO    : Using control framework my_gcf
19:49:17 INFO    : Omni 2.9 was released 5/27/2015. See http://trac.gpolab.bbn.com/gcf
19:49:18 INFO    : Listed advertised resources at 1 out of 1 possible aggregates.
19:49:18 INFO    : <?xml version="1.0" ?>
19:49:18 INFO    :   <!-- Resources at AM:
        URN: unspecified_AM_URN
        URL: https://aist_sdnrm_dc1:8443/xmlrpc/geni/3/
 -->
19:49:18 INFO    :
<rspec type="advertisement" xmlns="http://www.geni.net/resources/rspec/3" xmlns:openflow="http://www.geni.net/resources/rspec/ext/openflow/3" xmlns
:xs="http://www.w3.org/2001/XMLSchema-instance" xs:schemaLocation="http://www.geni.net/resources/rspec/3 http://www.geni.net/resources/rspec/3/ad.x
sd http://www.geni.net/resources/rspec/ext/openflow/3 http://www.geni.net/resources/rspec/ext/openflow/3/of-ad.xsd">
  <openflow:datapath component_id="urn:publicid:IDN+openflow:ocf:aist:ofam+datapath+00:00:00:00:00:00:00:01" component_manager_id="urn:publicid:IDN
+openflow:ocf:aist:ofam+authority+cm" dpid="00:00:00:00:00:00:00:01">
    <openflow:port name="eth14" num="3"/>
    <openflow:port name="eth12" num="1"/>
    <openflow:port name="eth7" num="8"/>
    <openflow:port name="eth15" num="4"/>
    <openflow:port name="eth6" num="7"/>
    <openflow:port name="eth3" num="5"/>
    <openflow:port name="eth4" num="6"/>
    <openflow:port name="eth13" num="2"/>
    <openflow:port name="br0" num="65534"/>
  </openflow:datapath>
</rspec>

19:49:18 INFO    :  ------------------------------------------------------
19:49:18 INFO    :  Completed listresources:

  Options as run:
               aggregate: ['https://aist_sdnrm_dc1:8443/xmlrpc/geni/3/          ']
               api_version: 3
               framework: my_gcf

  Args: listresources

  Result Summary: Queried resources from 1 of 1 aggregate(s).

19:49:18 INFO    :  ======================================================
demo@dc1-ro:/home/carolina/test$
```

3. Define the experiment (that is, the RSpec contents)
   - Nodes: computing resources (VMs), datapath IDs (switches), TN node. These belong to different islands within the FELIX testbed
   - OpenFlow links: links between OF switches inside the islands. Experimenter can define a specific topology for his experiment over the physical topology of the island
   - SDN Controller: software app developed by the experimenter to manage the traffic in the slice; usually deployed in a previously requested node
     - OF switch first receives a packet → contact controller for rule to apply
   - SE links: set up link between OF and TN domain
     - *Experimental: mapping feature to infer from some simple users' requests*
   - TN links: set up NSI circuit between specific islands

Defining the experiment > CRM RSpec fields

```
<?xml version="1.0" encoding="UTF-8"?>

<rspec  xmlns="http://www.geni.net/resources/rspec/3"

        (...)

        type="request">

  <node  client_id="VerdaguerFELIXTestNo812783"

         component_id="urn:publicid:IDN+ocf:i2cat:vtam+node+Verdaguer"

         component_manager_id="urn:publicid:IDN+ocf:i2cat:vtam+authority+cm"

         exclusive="true">

      <sliver_type name="emulab-xen">

        <emulab:xen cores="3" ram="1024" disk="10"/>

        <disk_image name="urn:publicid:IDN+wall2.ilabt.iminds.be+image+emulab-
ops//DEB60_64-VLAN"/>

      </sliver_type>

  </node>

</rspec>
```

Name of the VM to be used

URN of the virtualization server and its authority

Name of the VM to be used

Accepted values/configurations for which VMs are provided

URN that defines a specific configuration/flavour/template for the VM

Full RSpec details in https://github.com/dana-i2cat/felix/wiki/OMNI_client

Defining the experiment > SDNRM RSpec fields

```
<rspec  xmlns="http://www.geni.net/resources/rspec/3"
        (...) type="request">
    <openflow:sliver email="a@b.com" description="OF request example">
        <openflow:controller url="tcp:10.216.12.134:6633" type="primary"/>
        <openflow:group name="fs1">
            <openflow:datapath
                component_id="urn:publicid:IDN+openflow:ocf:i2cat:
                              ofam+datapath+00:10:00:00:00:00:00:01"
                component_manager_id="urn:publicid:IDN+openflow:ocf:i2cat:
                              ofam+authority+cm"
                dpid="00:10:00:00:00:00:00:01">
                <openflow:port name="GBE0/3" num="3"/>
                <openflow:port name="GBE0/12" num="12"/>
            </openflow:datapath>
        </openflow:group>
        <openflow:match>
            <openflow:use-group name="fs1" />
            <openflow:packet>
               <openflow:nw_dst value="10.1.1.0/24" />
               <openflow:dl_vlan value="890,900" />
            </openflow:packet>
        </openflow:match>
    </openflow:sliver>
</rspec>
```

RL and port corresponding to the controller VM

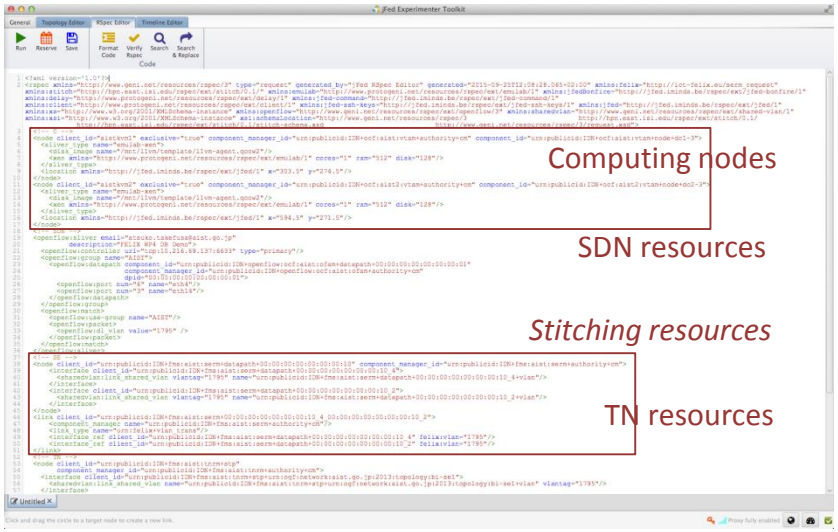
URNs of the desired datapath/switch, the datapath itself and the datapath authority

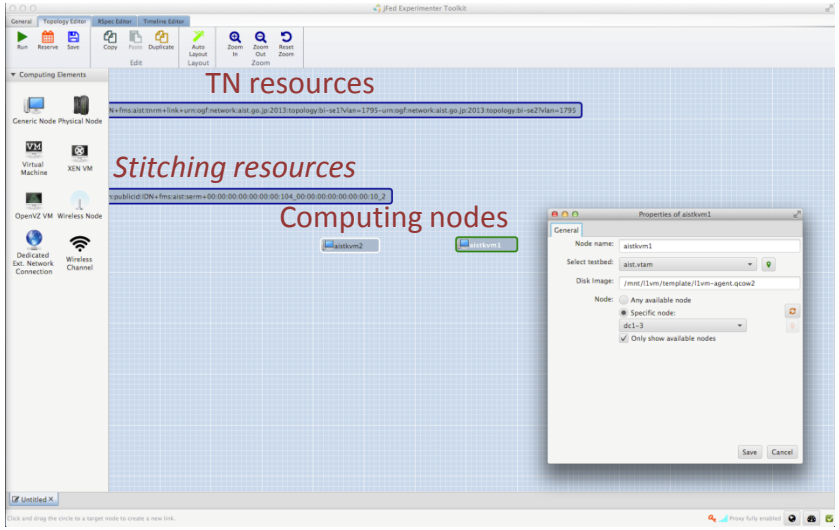
Name and number of each port selected for the flowspace

Matching conditions

Full RSpec details in https://github.com/dana-i2cat/felix/wiki/OMNI_client

4. Sending requests against the ROs or RMs in the different domains
   - Send RSpec with required resources through one of the available tools (OMNI, jFed)
   - Varies from User Agent:
     - OMNI: Manually fill RSpec
     - jFed: Rspec may be composed manually and through GUI





Considerations on the experiments

- Validation and expiration of resources may vary between domains

- Validating and granting resources: manual vs. automatic
  - SDNRM usually requires administrator to manually grant resources
  - CRM, SERM, TNRM automatically grant resources

- Automatic deletion of resources
  - Every provisioned resource in GENI is bound to a slice (with an expiration date)
    - Once expiration date arrives, the resources are automatically released
  - Using jFed: notification is sent to the experimenter before the expiration date
  - Extending resources lifetime is possible:
    - jFed: "*Renew*" button
    - OMNI: *Renew* method (new expiration date following RFC3339)
      - *New expiration date <= user's credential expiration time*

Accessing and using the resources

- Log-in to VMs, adding future keys, manage lifecycle
  - VMs are accessed through SSH to the IP address returned by the provisioning call
    - VMs with private IPs require access to private network:
      - jFed: enable *SSH proxy*

- Configuring VMs to send traffic
  - Experiment traffic must be sent through the VLAN defined during the provisioning of the resources
  - VLAN interfaces at both ends (sender/receiver) must be in the same IP range
  - Configuration:
    - XEN-CRM
      - Linking interfaces must be tagged with the VLAN
        - » `vconfig add <ethX> <vlan_tag>`
    - KVM-CRM, VirtualWall
      - Requested VLAN already preconfigured

PARTNERS

Poznan Supercomputing
and Networking Center
Poland

National Institute
of Advanced Industrial Science
and Technology
Japan

Nextworks
Italy

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