

FGRE Summer School July 11th – July 15th



Wifi – Eduroam or
SSID: UGentGuest
Login: guestUmmers
Password: jBfgQWmT

<http://doc.ilabt.iminds.be/fgre>

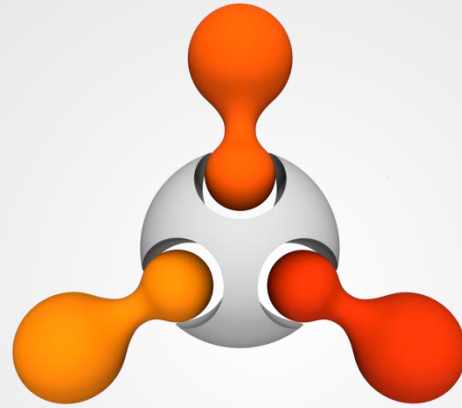
	Monday	Tuesday			Wednesday		Thursday	Friday
Block I (8:30-10)	Welcome Intro to Fed4FIRE Intro To GENI	Bigdata introduction		Wireless/sensor introduction	LTE GENI	Openflow OVS	Team Project	Team Project
Block II (10:30 – 12:30)	Getting started tutorial (Lab zero)	Hadoop		Wireless + robots	LTE FLEX	Openflow hardware	Team Project	Team Project presentations
Block III (1:30 – 3:30)	More advanced tutorial (Lab one) Openflow introduction	Spark	Smart city	Cloudlab	Phantomnet	Team Project	Team Project	
Block IV (4-5.30)	Emulation, scaling up, stitching	Stream processing	IoT Sensors	Automate – genlib ansible chef	Team Project		Team Project	
Evening		Social event (19:00)						

Main organizers



With support of





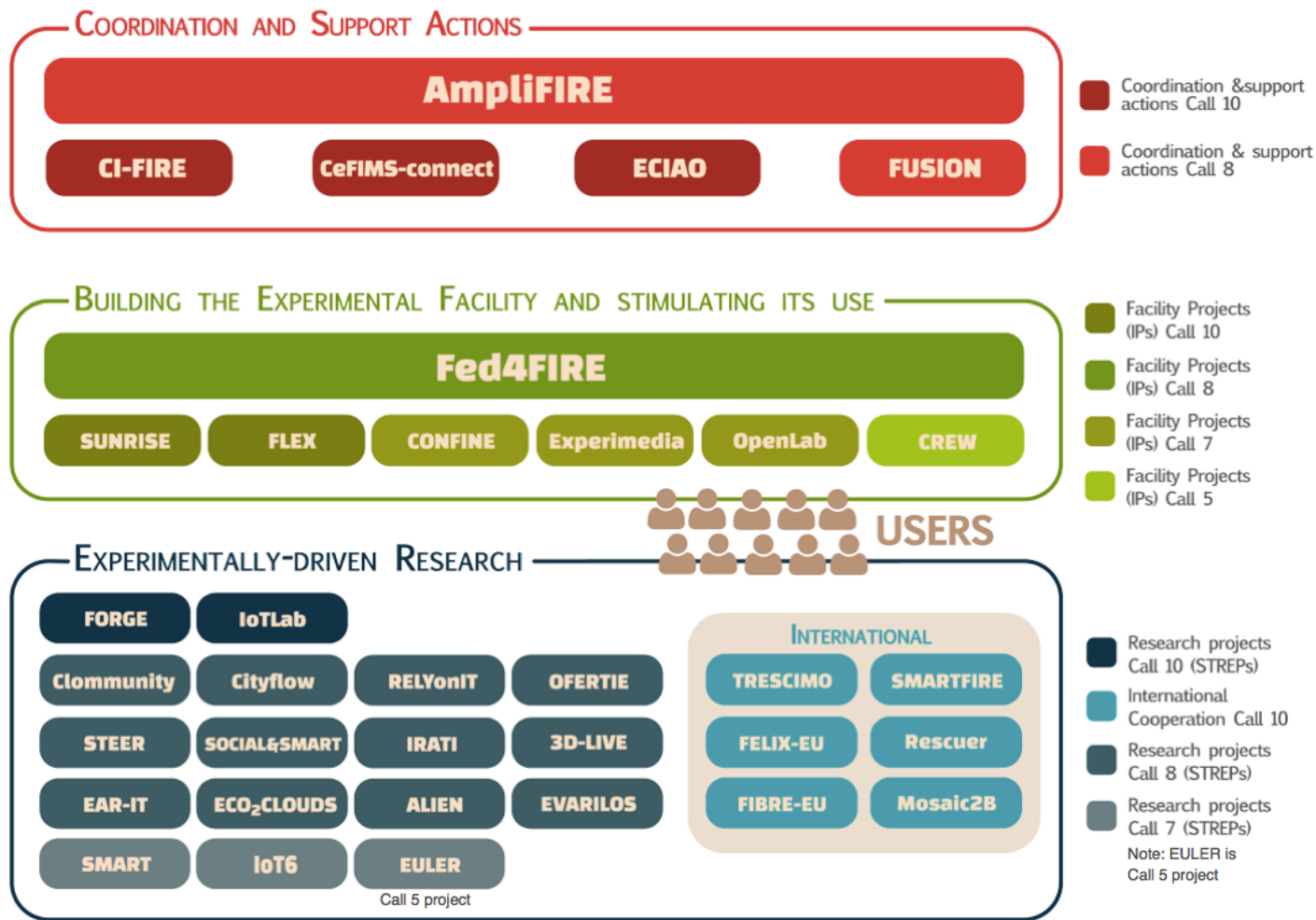
FED4FIRE

FGRE: Fed4FIRE resources



July 11th, Gent
Brecht Vermeulen, iMinds

Fed4FIRE's role in European FIRE projects framework



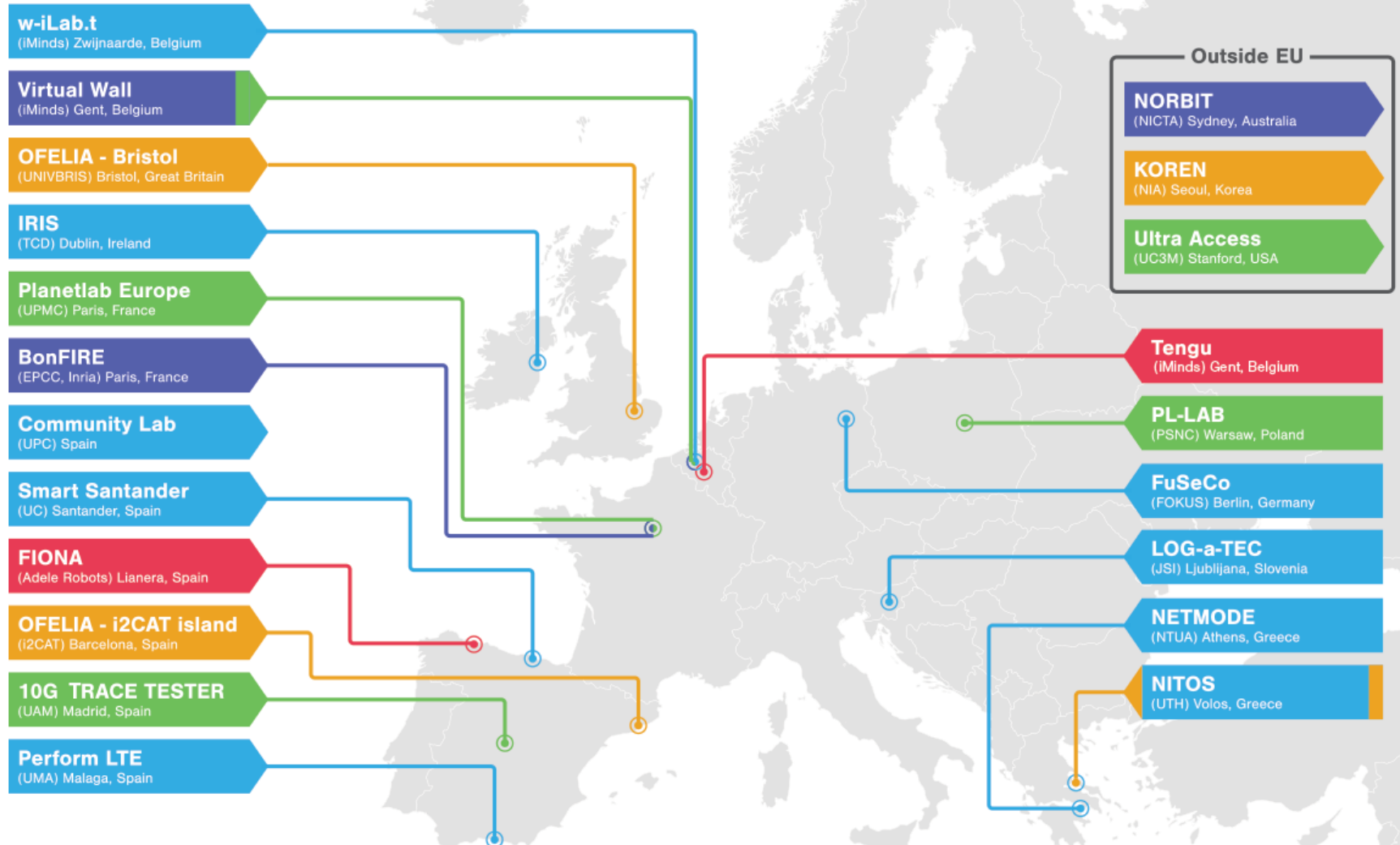
Fed4FIRE – general info

- IP project coordinated by iMinds
- Total budget: 7.75 MEUR
- 10/2012 - 12/2016
- 42 partners



Fed4FIRE assets – facilities (doc.fed4fire.eu)

● Wired ● Wireless ● Openflow ● Cloud ● Other



Fed4FIRE assets – tools



UPMC
SORBONNE UNIVERSITÉS



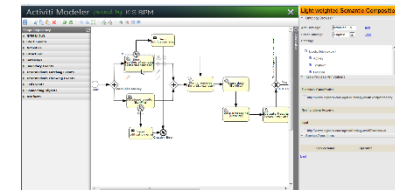
jFed



LabWiki



Inria
informatiques mathématiques



MULTI-DOMAIN
SERVICE DESK

PART OF THE GÉANT SERVICE PORTFOLIO



YourEPM



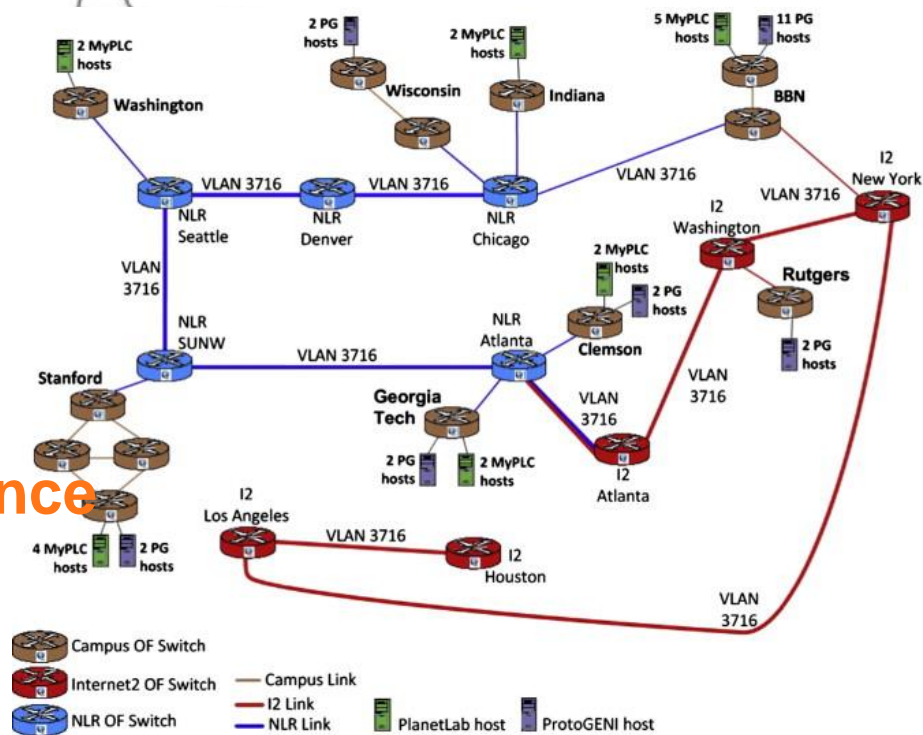
Fed4FIRE facilities

- Diverse technologies
- Diverse implementation stacks

US GENI federation



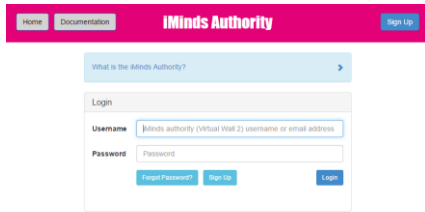
More testbeds
 More uniformity of testbeds
 Designed GENI AM API
 (instageni rack, exogeni rack,
 Openflow, Wimax)
 GEC = Geni Engineering Conference



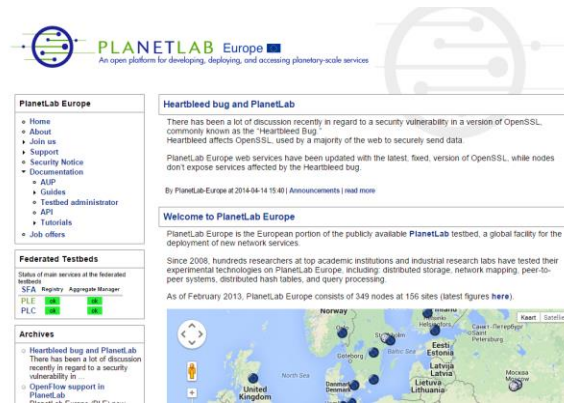
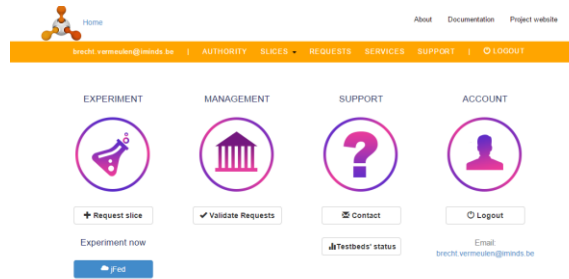
Goals of federation

- Make it easy for experimenters to use multiple testbeds
 - Single account
 - Single (or small number) of tools, choice of tools
- Multiple testbeds
 - To scale up
 - To use/combine special resources (e.g. wireless robots)
 - Redundancy (e.g. testbed in maintenance)
 - To re-use experiments (class exercises, scientifically, ...)
 - To compare environments (e.g. wireless, openflow hardware, ...)

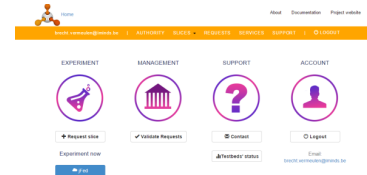
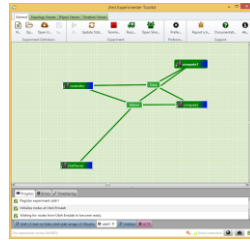
Design principles



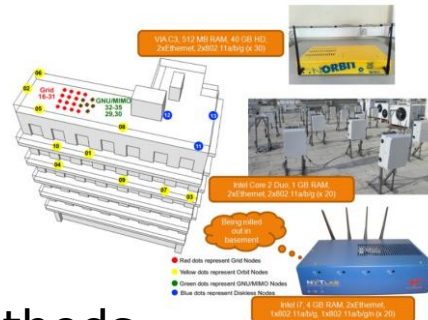
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Multiple identity provider



Multiple tools

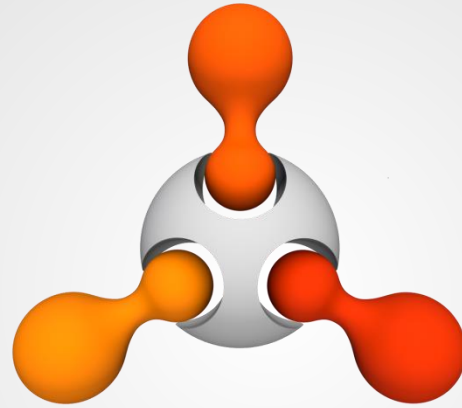


Multiple testbeds

All of them can appear and disappear!

Testbeds trust IdPs in federation



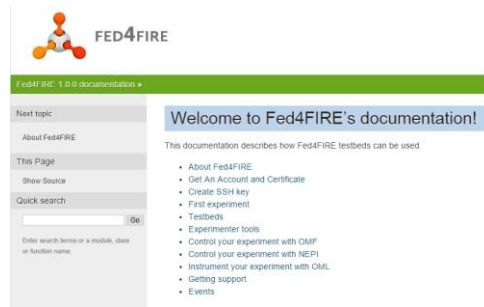


FED4FIRE

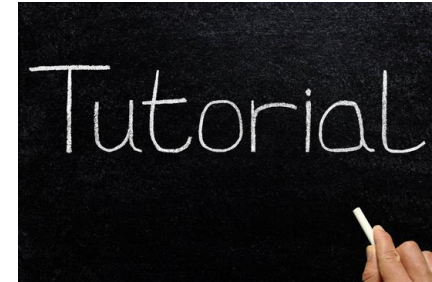
Experiment workflow



Experiment workflow

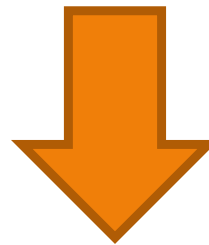


Create Account

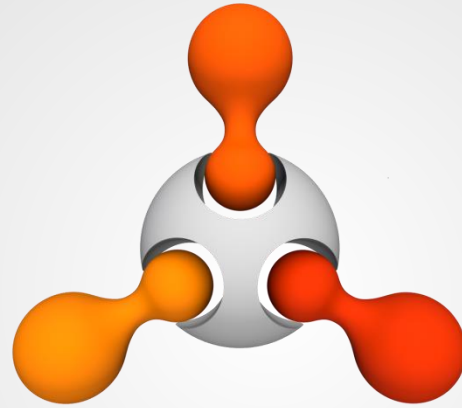


Documentation
<http://doc.fed4fire.eu>

Federation policy:
experimenter can run
tutorial experiments
to learn testbeds



Do more experiments and tutorials:
Provision resources, control resources
(ask more quota to testbeds if needed as testbeds
can have different policies)

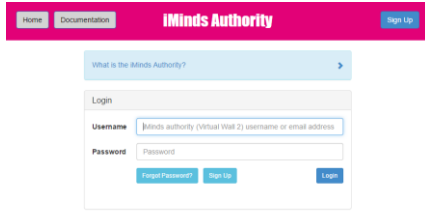


FED4FIRE

Technical workflow between components



Workflow (protocol: XMLRPC over SSL)



Slice Authority API

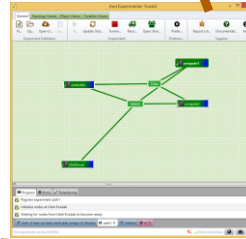
Member Authority API

3. Create slice/get credential (signed XML)

2. Get credential (signed XML)

Create Account and get certificate

1. Use signed certificate in tool

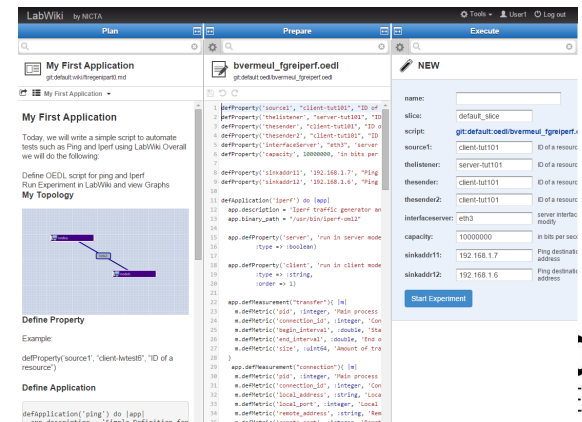


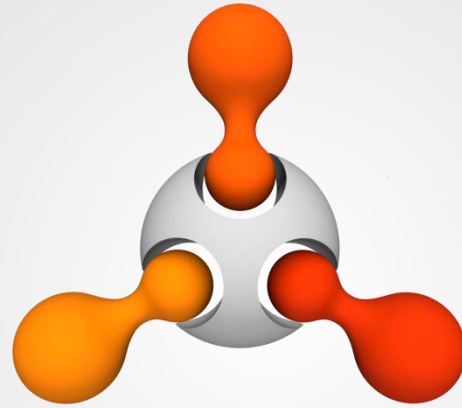
4. Provision resources

Aggregate Manager API



5. Control resources





FED4FIRE

Monitoring



jFed testing and monitoring

<https://flsmonitor.fed4fire.eu>

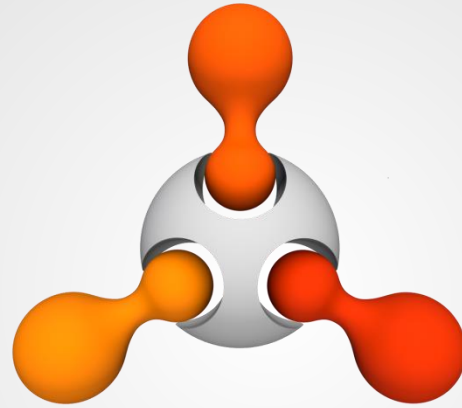
<http://monitor.ilabt.iminds.be>

API testing

Testbed Name	Ping latency (ms)	GetVersion Status	Free Resources	Internal testbed monitoring status	Last chec
BonFIRE	31.17	N/A	N/A	ok	2014-12-0
C-Lab	52.15	ok	113	ok	2014-12-0
FUSECO	15.77	ok	19	ok	2014-12-0
Koren	280.88	ok	3	N/A	N/A
NETMODE	61.02	ok	20	ok	2014-12-0
NITOS Broker	68.11	ok	38	ok	2014-12-0
NITOS SFAWrap	30.34	ok	111	ok	2014-12-0
Norbit	N/A	N/A	N/A	ok	2014-12-0
Ofelia (Bristol openflow)	16.94	ok	48	ok	2014-12-0
Ofelia (Bristol vtam)	16.92	ok	2	ok	2014-12-0
Ofelia (i2CAT openflow)	16.92	ok	5	ok	2014-12-0
Ofelia (i2CAT vtam)	16.98	ok	6	ok	2014-12-0
Planetlab Europe	30.36	ok	273	ok	2014-12-0
SmartSantander	58.9	ok	0	ok	2014-12-0
Virtual Wall 1	0.1	ok	70	N/A	N/A
Virtual Wall 2	0.12	ok	64	ok	2014-12-0
Virtual Wall 2 (openflow)	0.55	ok	2	ok	2014-12-0
w-iLab.t 2	4.71	ok	61	ok	2014-12-0

- ✓ setUp
- ✓ getVersion
- ✓ getTestUserCredential
- ✓ getTestUserInfo
- ✓ retrieveCredentialSomehow
- ✗ createProject
- ✓ createSlice
- ✗ lookupProjectsByUrnNoFilter
- ✗ lookupProjectsByNameNoFilter
- ✓ getSliceCredentials
- ✗ updateProject
- ✓ lookupSlicesNoFilter
- ✗ lookupProjectsNoFilterAfterUpdate
- ✓ updateSlice
- ✗ lookupProjectMembers
- ✗ lookupProjectsForMember
- ✓ lookupSlicesNoFilterAfterUpdate
- ✓ lookupSliceMembers

Test Name	Last Test Start Time (CET)	Last Test Duration	Last Partial Success	Last Full Success	Time since last Failure	Last Log	History
Confine	2014-12-01 21:05:03	10 minutes and 38 seconds	SUCCESS	SUCCESS	4 days and 11 hours	log	history
Fuseco	2014-12-01 21:27:02	27 seconds	FAILURE	FAILURE		log	history
NETMODE	2014-12-01 22:36:37	1 minute and 40 seconds	SUCCESS	FAILURE		log	history
Nitos Broker	2014-12-01 22:38:18	1 minute and 18 seconds	SUCCESS	FAILURE		log	history
Nitos SFAWrap	2014-12-01 22:39:37	14 seconds	FAILURE	FAILURE		log	history
Planetlab Europe	2014-12-02 03:43:26	10 minutes and 49 seconds	SUCCESS	SUCCESS	6 days and 21 hours	log	history
Virtual Wall	2014-12-02 03:39:06	2 minutes and 51 seconds	SUCCESS	SUCCESS	3 days and 22 hours	log	history
Virtual Wall	2014-12-02 03:36:25	2 minutes and 40 seconds	SUCCESS	SUCCESS	3 days and 22 hours	log	history
Virtual Wall 1	2014-12-02 03:32:11	4 minutes and 12 seconds	SUCCESS	SUCCESS	3 days and 22 hours	log	history
Virtual Wall 1	2014-12-02 03:29:14	2 minutes and 56 seconds	SUCCESS	SUCCESS	3 days and 22 hours	log	history
Wilab.t	2014-12-02 03:42:42	44 seconds	WARN	WARN		log	history
Wilab.t	2014-12-02 03:41:58	44 seconds	WARN	WARN		log	history



FED4FIRE

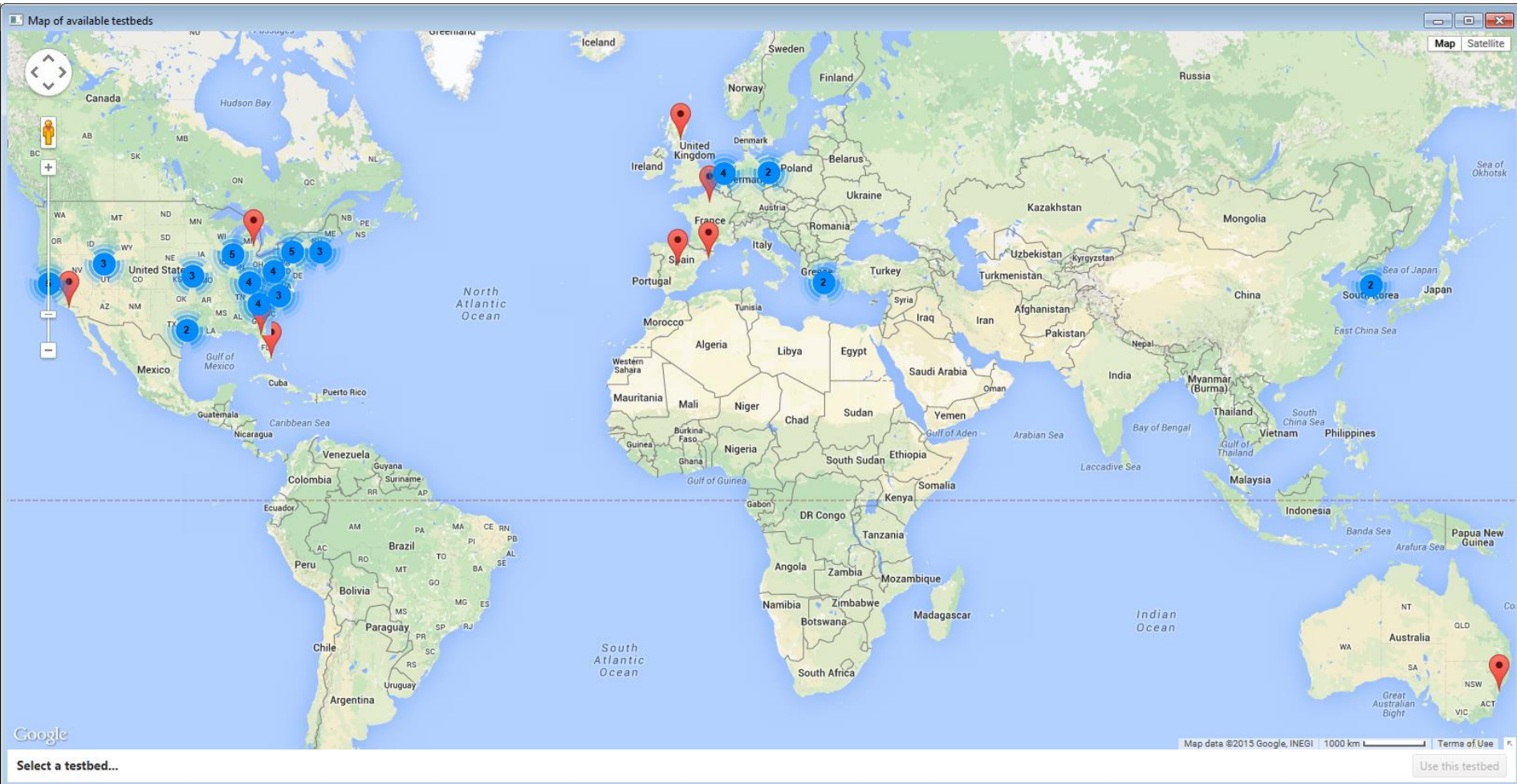
International federation and connectivity



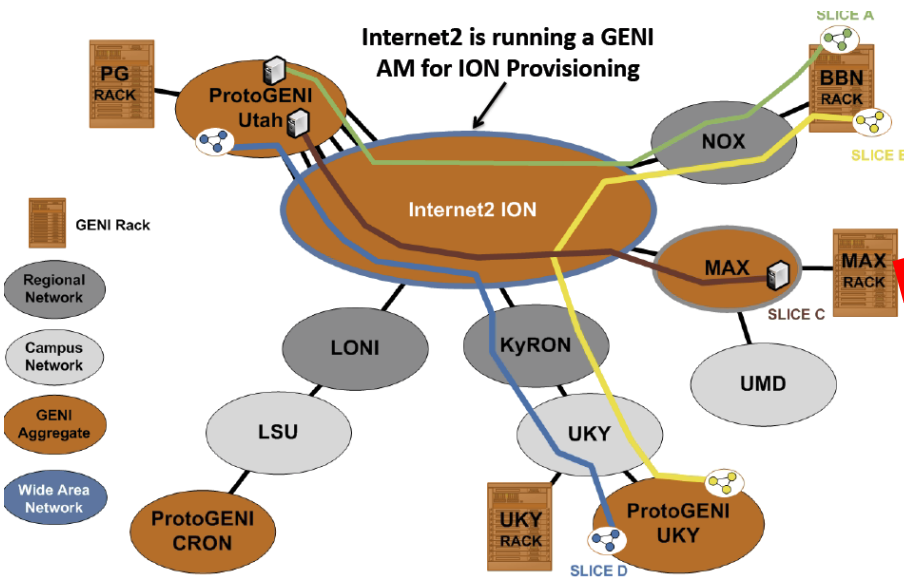
Other compatible initiatives

- South-Korea
- Canada
- Japan
- Brazil
- China
- Russia

Accessible testbeds: single tool and account



Layer 2 connectivity = stitching VLANs

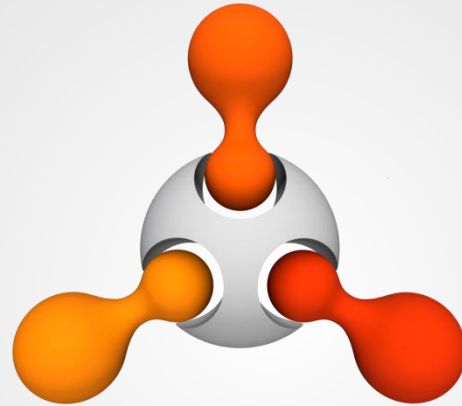


Meshed L2 connections possible

SDX = software defined exchange

eases connectivity (=exchange)

VLAN translation needed + SDN functionality



FED4FIRE

**Tools beyond provisioning:
experiment control**



jFed: timebased experiment control

The screenshot displays the jFed Experimenter Toolkit interface. The window title is "jFed Experimenter Toolkit". The interface is divided into several sections:

- General Viewers:** Includes tabs for "General", "Topology Viewer", "RSpec Viewer", and "Timeline Viewer".
- Control Panel:** Contains buttons for "Update Status", "Renew", "Terminate", "Start", "Pause", "Stop", "Time", "Instant", "Save results", "Add Command", "Add barrier", "Zoom In", "Zoom Out", and "Reset Zoom".
- Timeline View:** Shows a timeline from 0:00 to 00:05:00. The left side shows the "Experiment" view with a list of nodes: "server", "client", "Bonfire", and "node3". The right side shows the "Definition" view with a timeline of events. A red dot is visible on the timeline at approximately 00:03:30.
- Terminal:** Displays the output of a command. The command is: `node3@urn:publicid:IDN+wall2.ilabt.iminds.be+authority+cm: Instant command 1`. The output shows:

```
09:32:27: Your command has started.
09:32:27: -----
09:32:27: Client connecting to server, TCP port 5001
09:32:27: TCP window size: 23.5 KByte (default)
09:32:27: -----
09:32:27: --
09:32:27: [ 3] local 192.168.0.2 port 48699 connected with 192.168.0.1 port 5001
09:32:37: [ID] Interval Transfer Bandwidth
09:32:37: [ 3] 0.0-10.0 sec 1.10 GBytes 944 Mbits/sec
09:32:37: Your command has finished.
```
- Taskbar:** Shows several open windows: "Untitled", "Untitled1", "wal1", "ovs", and "wal2".
- Status Bar:** At the bottom, it indicates "This experiment run will expire in 1 hour, 54 minutes and 14 seconds." and "Proxy fully enabled".

Labwiki experiment control (OMF/OML)

LabWiki by NICTA

Tools User1 Log out

Plan Prepare Execute

My First Application
git:default:wiki/firegenpart0.md

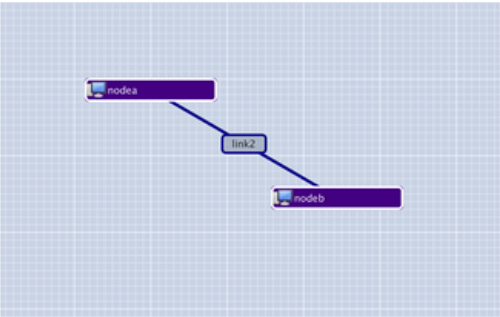
My First Application

My First Application

Today, we will write a simple script to automate tests such as Ping and Iperf using LabWiki Overall we will do the following:

Define OEDL script for ping and Iperf
Run Experiment in LabWiki and view Graphs

My Topology



```
graph LR; nodea --- link2; link2 --- nodeb;
```

Define Property

Example:

```
defProperty('source1', "client-lwtest6", "ID of a resource")
```

Define Application

```
defApplication('ping') do |app|
  app.description = 'Simple Definition for
```

bvermeul_fgriperf.oedl
git:default:oedl/bvermeul_fgriperf.oedl

```
1 defProperty('source1', "client-tut101", "ID of
2 defProperty('thelister', "server-tut101", "ID
3 defProperty('thesender', "client-tut101", "ID o
4 defProperty('thesender2', "client-tut101", "ID
5 defProperty('interfaceServer', "eth3", 'server
6 defProperty('capacity', 10000000, 'in bits per
7
8 defProperty('sinkaddr11', '192.168.1.7', "Ping
9 defProperty('sinkaddr12', '192.168.1.6', "Ping
10
11 defApplication('iperf') do |app|
12   app.description = 'Iperf traffic generator an
13   app.binary_path = "/usr/bin/iperf-om12"
14
15   app.defProperty('server', 'run in server mode
16     :type => :boolean)
17
18   app.defProperty('client', 'run in client mode
19     :type => :string,
20     :order => 1)
21
22   app.defMeasurement("transfer"){ |m|
23     m.defMetric('pid', :integer, 'Main process
24     m.defMetric('connection_id', :integer, 'Con
25     m.defMetric('begin_interval', :double, 'Sta
26     m.defMetric('end_interval', :double, 'End o
27     m.defMetric('size', :uint64, 'Amount of tra
28   }
29   app.defMeasurement("connection"){ |m|
30     m.defMetric('pid', :integer, 'Main process
31     m.defMetric('connection_id', :integer, 'Con
32     m.defMetric('local_address', :string, 'Loca
33     m.defMetric('local_port', :integer, 'Local
34     m.defMetric('remote_address', :string, 'Rem
35     m.defMetric('remote port', :integer, 'Remot
```

NEW

name:

slice:

script: git:default:oedl/bvermeul_fgriperf.oedl

source1: ID of a resource

thelister: ID of a resource

thesender: ID of a resource

thesender2: ID of a resource

interfaceserver: server interface modify

capacity: in bits per second

sinkaddr11: Ping destination address

sinkaddr12: Ping destination address

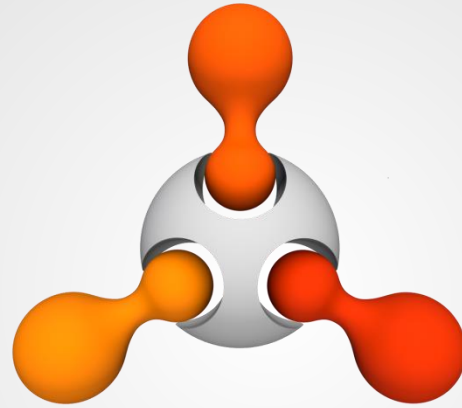
Start Experiment

NEPI experiment control

- <http://doc.fed4fire.eu/nepi.html>

```
n096-09b.wall2.ilabt.iminds.be - PuTTY
ec:~% pice -w ping.py
ec:~% python ping.py
2014-02-25 19:23:39,989 LinuxNode INFO   guid 1 - host n095-26.wall2.ilabt.iminds.be - Deploying node
2014-02-25 19:23:42,070 LinuxNode INFO   guid 1 - host n095-26.wall2.ilabt.iminds.be - Cleaning up processes
2014-02-25 19:23:42,085 LinuxNode INFO   guid 1 - host n095-26.wall2.ilabt.iminds.be - Cleaning up home
2014-02-25 19:23:42,991 LinuxApplication INFO  guid 2 - host n095-26.wall2.ilabt.iminds.be - Deploying command 'ping -c3 node2'
2014-02-25 19:23:43,007 LinuxApplication INFO  guid 2 - host n095-26.wall2.ilabt.iminds.be - Uploading command 'ping -c3 node2'
2014-02-25 19:23:44,246 LinuxApplication INFO  guid 2 - host n095-26.wall2.ilabt.iminds.be - Provisioning finished
2014-02-25 19:23:44,992 LinuxApplication INFO  guid 2 - host n095-26.wall2.ilabt.iminds.be - Starting command 'ping -c3 node2'
2014-02-25 19:23:47,152 LinuxApplication INFO  guid 2 - host n095-26.wall2.ilabt.iminds.be - Retrieving 'stdout' trace all
PING node2-link3 (10.10.1.1) 56(84) bytes of data:
64 bytes from node2-link3 (10.10.1.1): icmp_req=1 ttl=64 time=0.574 ms
64 bytes from node2-link3 (10.10.1.1): icmp_req=2 ttl=64 time=0.207 ms
64 bytes from node2-link3 (10.10.1.1): icmp_req=3 ttl=64 time=0.214 ms

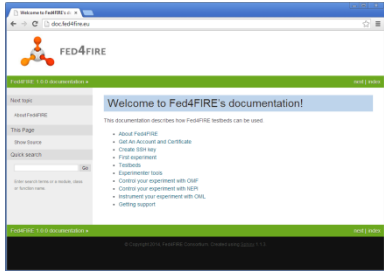
--- node2-link3 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 1998ms
rtt min/avg/max/mdev = 0.207/0.331/0.574/0.172 ms
2014-02-25 19:23:47,186 LinuxApplication INFO  guid 2 - host n095-26.wall2.ilabt.iminds.be - Releasing resource
ec:~% █
```



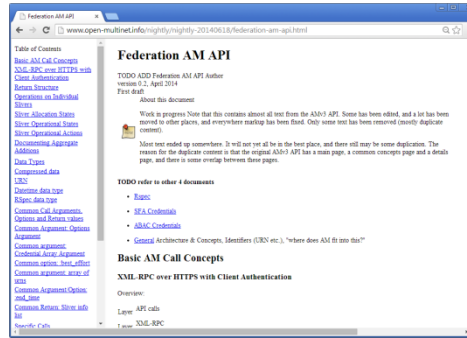
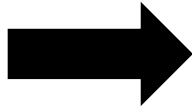
FED4FIRE

**Workflow adding a testbed
to the federation**

Adding a testbed to the federation



doc.fed4fire.eu



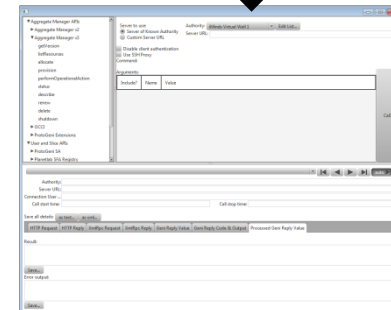
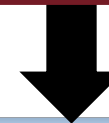
AM API doc



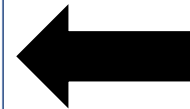
Design RSpecs



Implement AM API on top of testbed



Test with jFed probe



Testbed Name	Ping	latency (ms)	GetVersion	Status	Free Resources	Internal testbed monitoring status	Last check	Internal status
fed4fire	OK	100	OK	OK			2014-04-10 10:00:00	OK
IC-4E	OK	100	OK	OK			2014-04-10 10:00:00	OK
FUTURECO	OK	100	OK	OK			2014-04-10 10:00:00	OK
IC3	OK	100	OK	OK			2014-04-10 10:00:00	OK
NETWAGE	OK	100	OK	OK			2014-04-10 10:00:00	OK
NETOX SPARKING	OK	100	OK	OK			2014-04-10 10:00:00	OK
IC4E (Biosys openflow)	OK	100	OK	OK			2014-04-10 10:00:00	OK
IC4E (Biosys openflow)	OK	100	OK	OK			2014-04-10 10:00:00	OK
IC4E (ICAT openflow)	OK	100	OK	OK			2014-04-10 10:00:00	OK
IC4E (ICAT openflow)	OK	100	OK	OK			2014-04-10 10:00:00	OK
Planetsat Energy	OK	100	OK	OK			2014-04-10 10:00:00	OK
IC4E (Biosys openflow)	OK	100	OK	OK			2014-04-10 10:00:00	OK
Virtual Host 1	OK	100	OK	OK			2014-04-10 10:00:00	OK
Virtual Host 2	OK	100	OK	OK			2014-04-10 10:00:00	OK
Virtual Host 2 (openflow)	OK	100	OK	OK			2014-04-10 10:00:00	OK
IC4E 1.2	OK	100	OK	OK			2014-04-10 10:00:00	OK

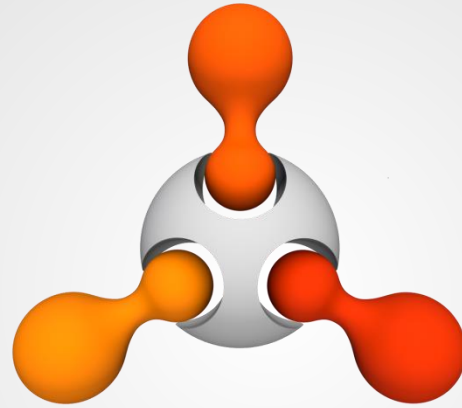
Dashboard and nightly testing (+internal testbed monitoring)



Document testbed



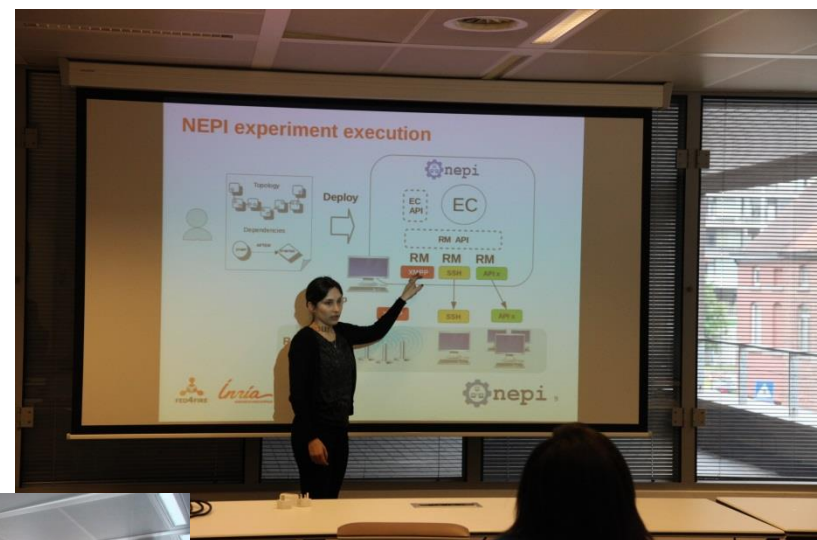
Add testbed in Experimenter tools



FED4FIRE

Use cases





FIRE-GENI
Summer school
2014 - 2015 - 2016



From account creation to first experiment (tutorial with client-server & emulated link)

The screenshot displays the jFed Experimenter Toolkit interface. The main window is titled "jFed Experimenter Toolkit" and features a toolbar with various controls. The toolbar is divided into sections: "Experiment" (Update Status, Renew, Terminate), "Advanced" (Reboot, Edit ssh-keys, Share), "Layout" (Auto Layout), and "Zoom" (Zoom In, Zoom Out, Reset Zoom). The main workspace shows a network topology with three nodes: "server", "link0", and "client" connected in a line. Below this, there are two other nodes: "VM Bonfire" and "node3". The bottom panel shows a "Progress" section with several steps marked as complete, such as "Initialize nodes at iMinds Virtual Wall 2" and "Waiting for nodes from BonFire to become ready." The terminal window, titled "n143-01b.wall1.ilabt.iminds.be - PuTTY", shows the command "ping client" being executed on the server. The output displays five successful ping requests, each receiving 64 bytes of data from client-link0 (192.168.0.2) with a time of 200 ms. The statistics show 5 packets transmitted, 5 received, 0% packet loss, and a time of 4005ms. The terminal prompt is "bvermeul@server:~\$".

General Topology Viewer RSpec Viewer Timeline Viewer

Update Status Renew Terminate Experiment

Reboot Edit ssh-keys Share Advanced

Auto Layout Layout

Zoom In Zoom Out Reset Zoom Zoom

server link0 client

VM Bonfire

node3

Progress Errors Timeline log server@urn:publicid:IDN+wall1.ilabt.iminds.be

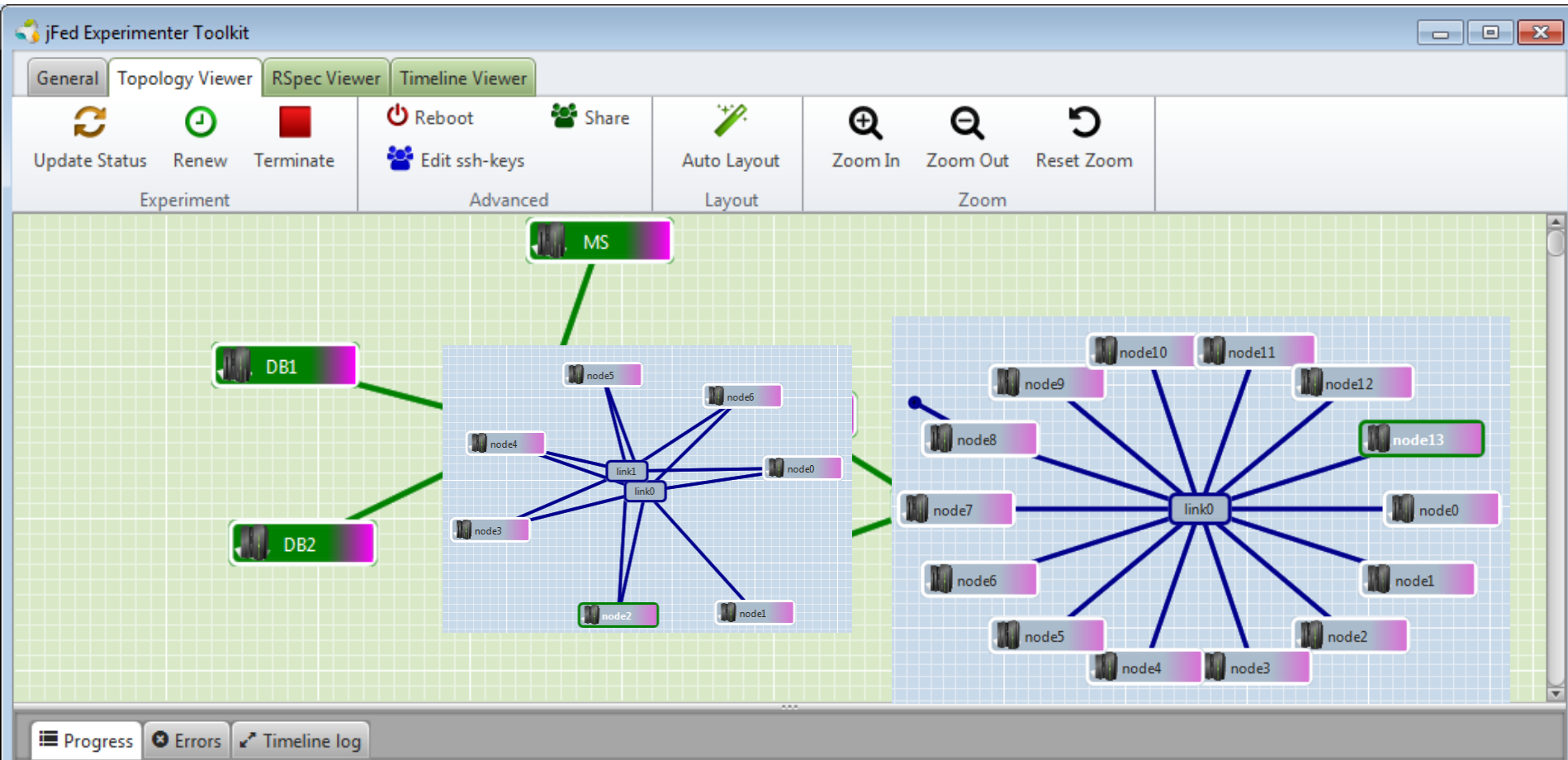
- Initialize nodes at iMinds Virtual Wall 2
- Waiting for nodes from BonFire to become ready.
- Waiting for nodes from iMinds Virtual Wall 2 to become ready.
- Waiting for nodes from iMinds Virtual Wall 1 to become ready.
- Testing connectivity to nodes from BonFire.
- Testing connectivity to nodes from iMinds Virtual Wall 2.
- Testing connectivity to nodes from iMinds Virtual Wall 1.

Untitled Untitled1 wal1 ovs wal2 X

This experiment run will expire in 1 hour, 41 minutes and 39 seconds.

```
n143-01b.wall1.ilabt.iminds.be - PuTTY
bvermeul@server:~$ ping client
PING client-link0 (192.168.0.2) 56(84) bytes of data:
64 bytes from client-link0 (192.168.0.2): icmp_req=1 ttl=64 time=200 ms
64 bytes from client-link0 (192.168.0.2): icmp_req=2 ttl=64 time=200 ms
64 bytes from client-link0 (192.168.0.2): icmp_req=3 ttl=64 time=200 ms
64 bytes from client-link0 (192.168.0.2): icmp_req=4 ttl=64 time=200 ms
64 bytes from client-link0 (192.168.0.2): icmp_req=5 ttl=64 time=200 ms
^C
--- client-link0 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 200.259/200.271/200.276/0.400 ms
bvermeul@server:~$
```

Example: SME does scalability testing



**Experimenters can use exactly the same for private clouds
“cloud-on-demand” service (with size as they want)
Including all other testbeds and connectivity**

Forge: lab in Greece using iMinds testbed

- 200 students in 4 sessions



FORGE: <http://forge.test.iminds.be/wlan/>

Wireless LAN throughput

In this lab session we'll investigate the different Wi-Fi settings and features which impact the throughput in a WLAN hotspot network. This course is provided by Ghent University and iMinds as part of the FORGE project, Forging Online Education through FIRE.

[Learn more about FORGE »](#)

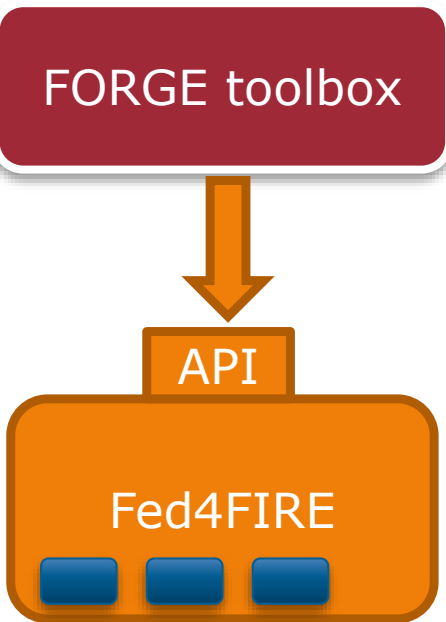
Introduction

You will be using actual hardware (and no simulations) to experiment with different settings and features of Wi-Fi (Wireless Fidelity, based on IEEE 802.11 standards) when deploying a WLAN (Wireless Local Area Network) hotspot network. By using this hardware to solve multiple questions in a set of well-thought-out exercise scenarios, you will gain a better insight in the different aspects which impact the achievable throughput in your WLAN.

Live experimentation

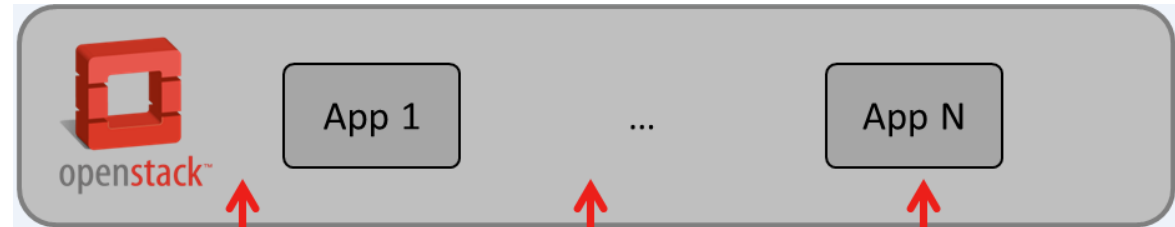
The wireless nodes you will be using are part of the **iMinds w-iLab.t Zwijnaarde** testbed (a.k.a. "wilab2"), which is *physically located at the Zwijnaarde campus in Belgium* but can be configured, managed and tested completely from within the web interface you are currently using. This web interface itself is controlling the wireless nodes and is also dynamically created and hosted at the **iMinds Virtual Wall** testbed, which is *physically located at the Zuiderpoort offices (Ghent) in Belgium*.

These so called **FIRE (Future Internet Research and Experimentation)** testbeds can also be used in research projects to collaborate with industry partners to e.g. study and improve WLAN functionality. However, the configuration and experiments that you will perform during this lab session do not differ from the ones that are also applicable within your own WLAN at home.

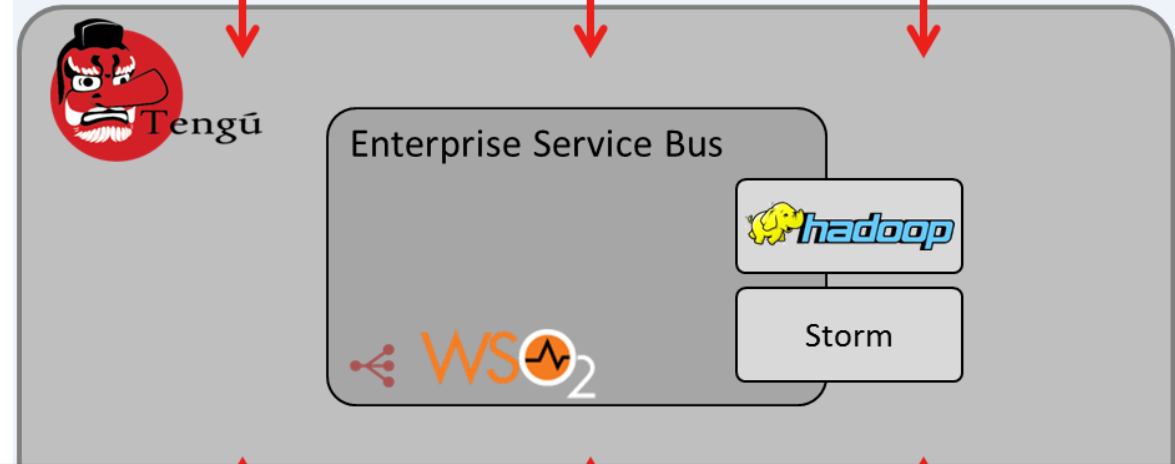


Tengu service platform: <http://tengu.intec.ugent.be>

Cloud-on-demand



Hadoop/Storm/Lambda
-on-demand

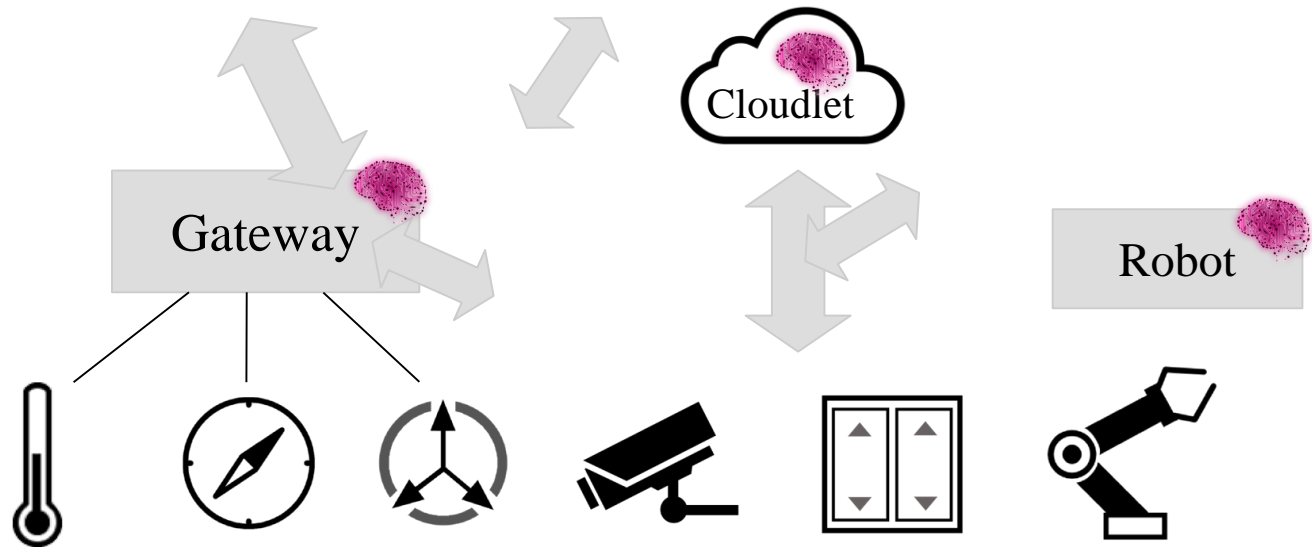


`POST /tengu/{type}?nodes={nr}&testbed={urn}&project{str}`

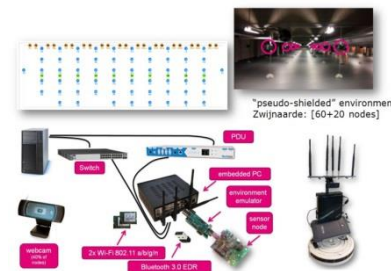
Powered by RSpec
and Chef



IOT EXAMPLE



sensors/
actuators



Use multiple testbeds/technologies with single account and tool

Extend your experimental research to other testbeds: upscale, other hardware

Re-use front-end tools / control tools / tutorials / classes

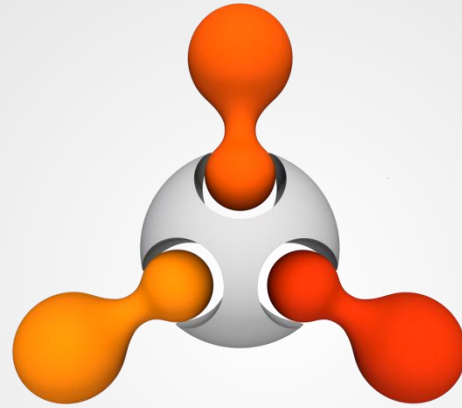
Easy use through federations

<http://www.geni.net>

<http://doc.fed4fire.eu>

<http://www.fed4fire.eu>

Combine and test on all layers



FED4FIRE

Thank you

brecht.vermeulen@iminds.be

www.fed4fire.eu

