OneLab

FUTURE INTERNET TESTBEDS

An Internet of Testbeds

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UPMC SORBONNE UNIVERSITÉS

LINCS

cnrs dépasser les frontières

Outline

- **Vision & Rationale**

  A Facility (TaaS) – A playground for the future Internet

- **Towards an Internet of Testbeds**

  An architecture for federation

  Fundamental components for testbed federation

- **From vision to Implementation: the Offering**

  The OneLab Experimental Facility

  Usage and demos

Vision and Rationale

- Scientific

  Can we **trust** the results that we produce. Can we **reproduce** them?

- Economical

  Plenty of **valuable** resources out there

- Technological

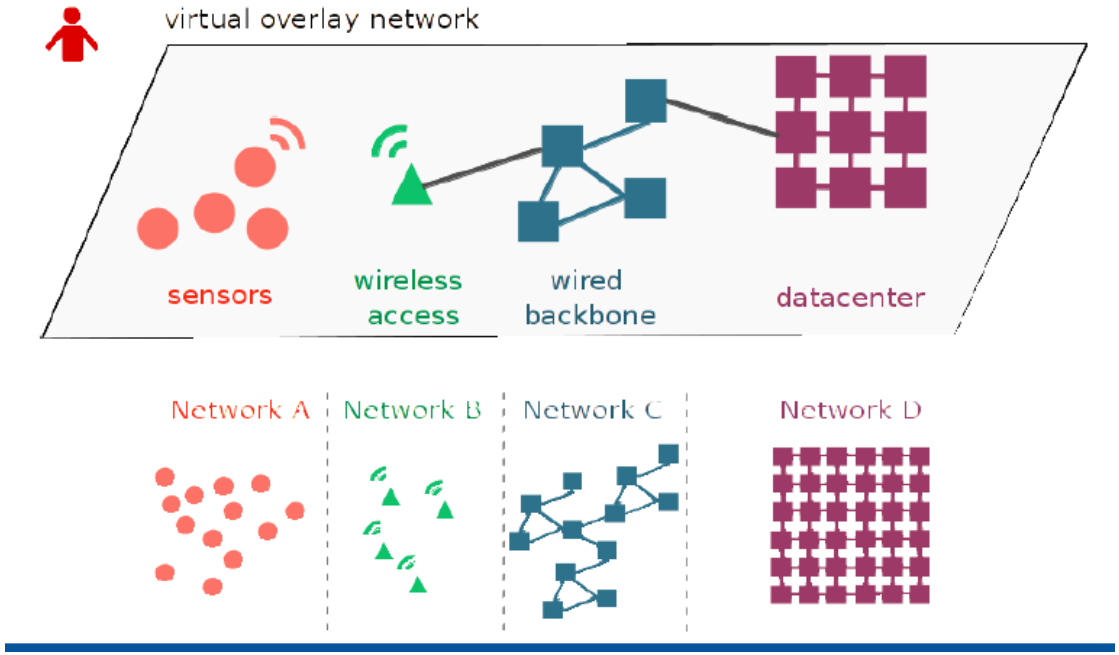
  Original, cutting-edge and diverse technologies

- Architectural

  Federating a wide-variety of eco-systems and develop **openness**

The vision

- Originated in 2005

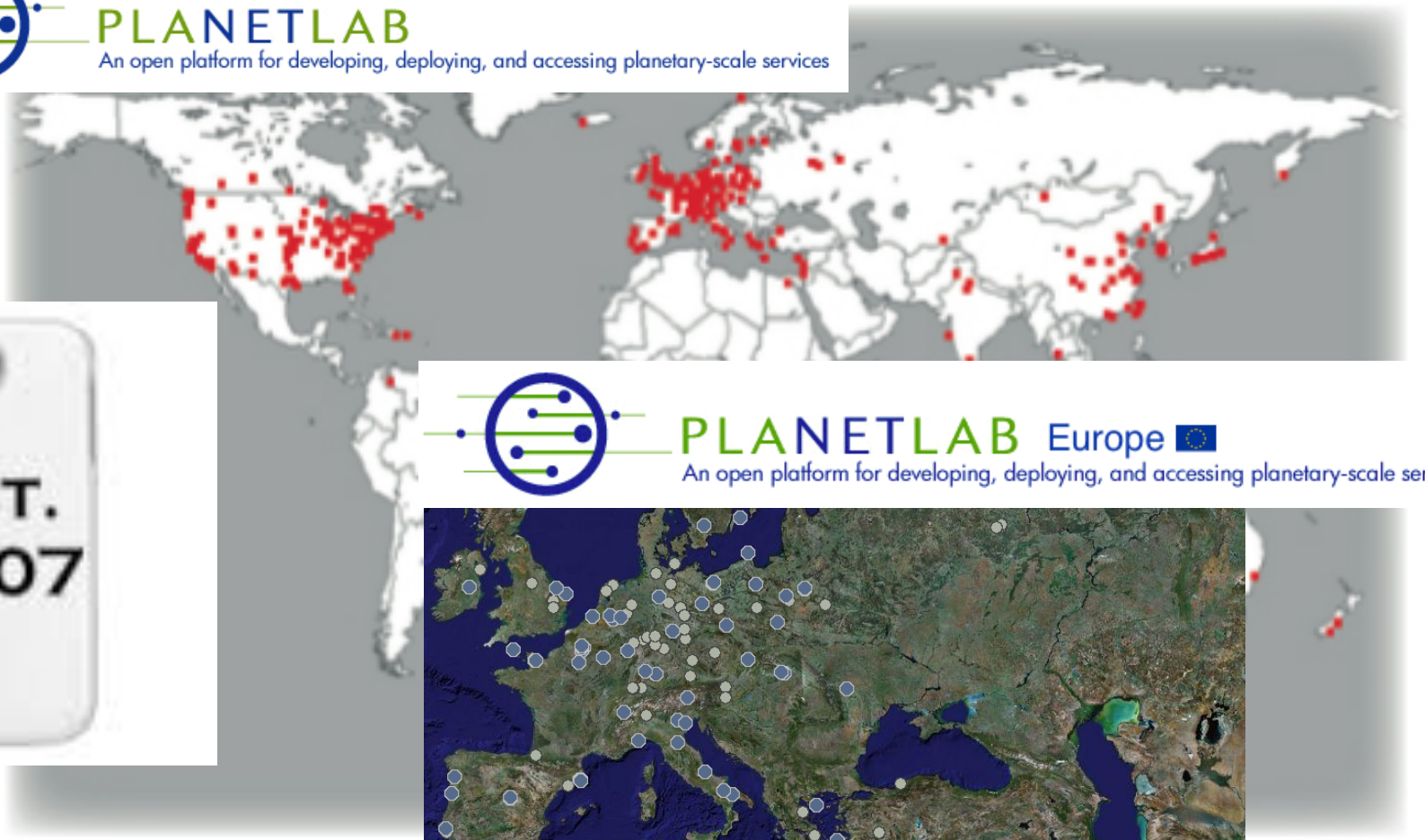


FIRE

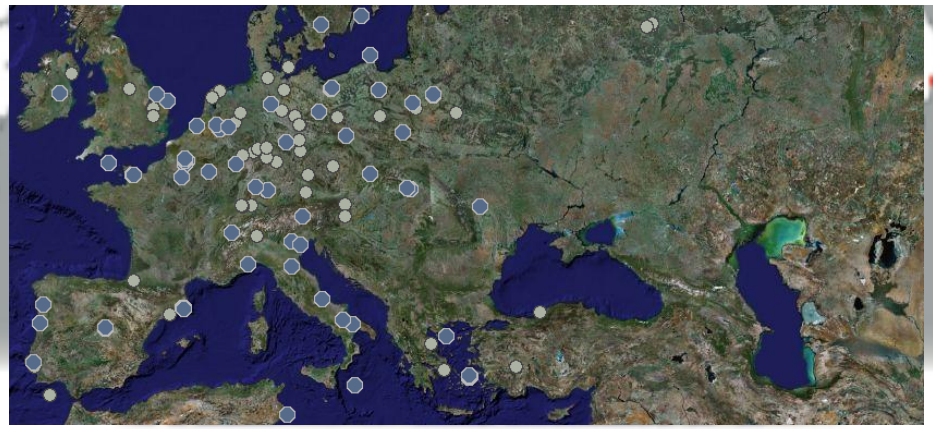
Three main technology accelerators:
- Virtualization,
- Open Source,
- Open Data.

Building International Federation

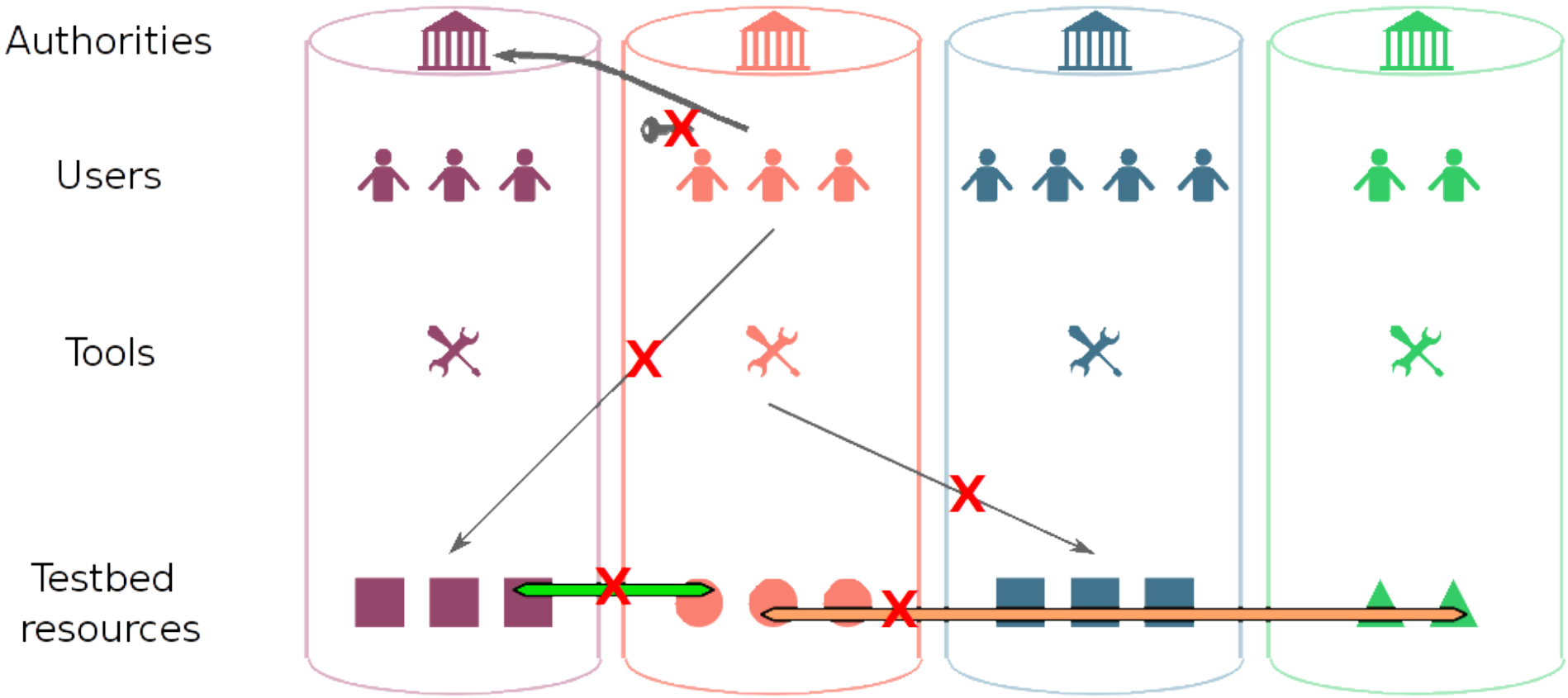
PLANETLAB
An open platform for developing, deploying, and accessing planetary-scale services



PLANETLAB Europe
An open platform for developing, deploying, and accessing planetary-scale services



The issue with testbed isolation



Enabling OneLab vision

A Marketplace for trading testbeds resources

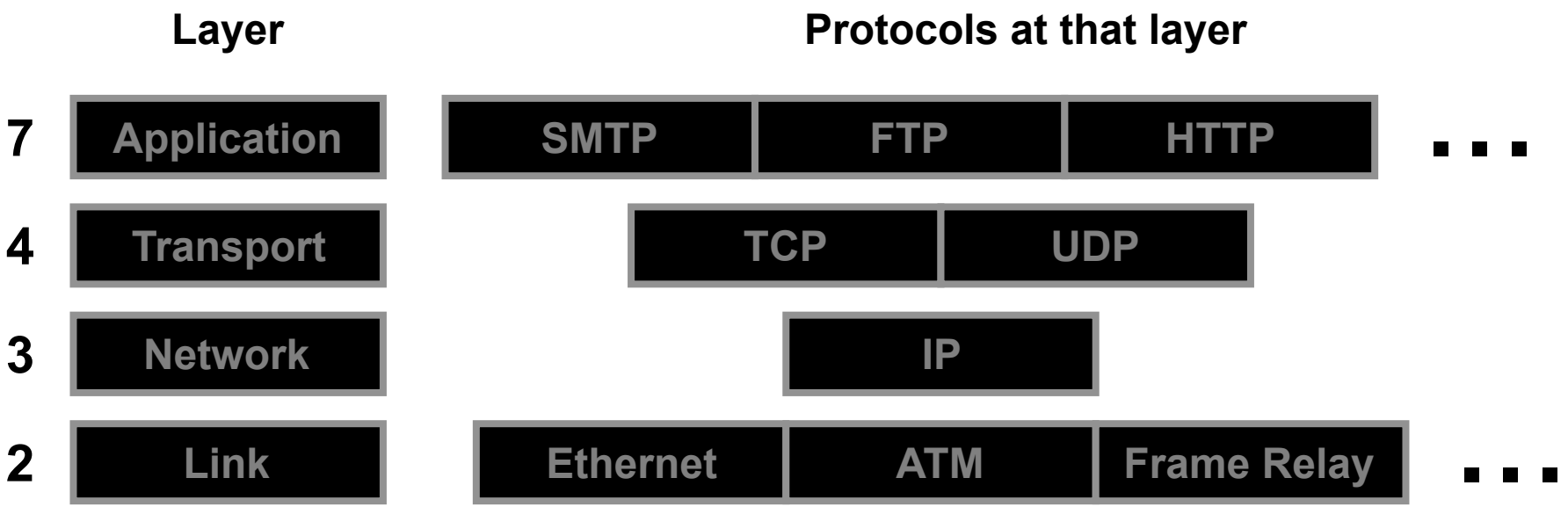
- Considerations about technical, legal, managerial and commercial enablers to achieve this vision
  - What is the right level of abstraction, the **minimum set of functionalities** to be adopted to share resources owned by various authorities?
  - How can we best support the **experimental life-cycle**
  - What is the **governance** model that best supports subsidiarity?
  - What is must have for **Operation** and **Support**
  - and finally, is there a **business** model or how can we contribute to sustainability?

TOWARDS AN INTERNET OF TESTBEDS

Testbed abstractions

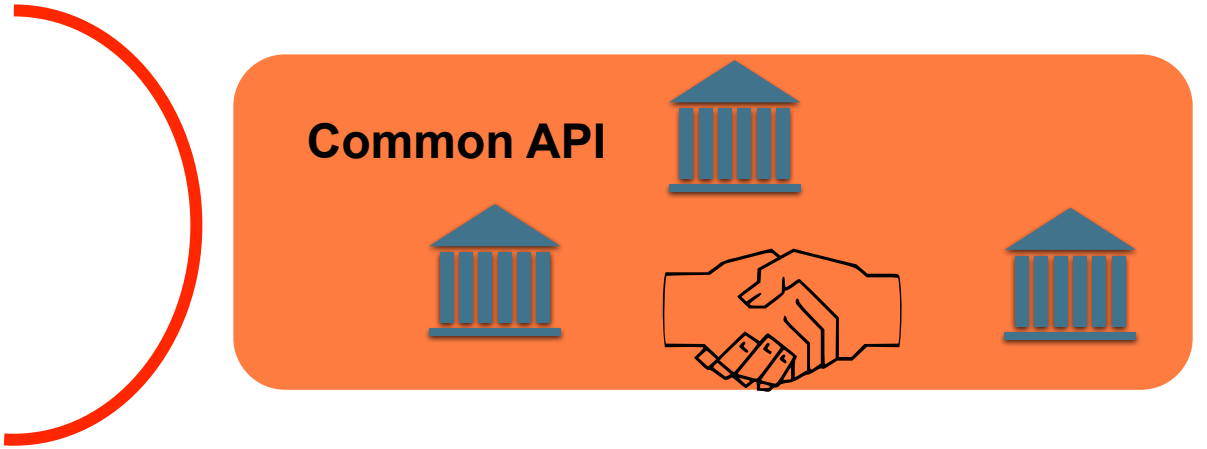
	object	service
	**resource**	Testbed ensures proper management of nodes, links, switches, ...
	**user**	Testbed guarantees the identity of its users
	**slice**	A distributed container in which ressources are shared : • sharing with VMs, in time, frequency, within flowspace, etc. The base for accountability
	**authority**	An entity responsible for a subset of services (resources, users, slices, etc.)

The “Hourglass” as the model

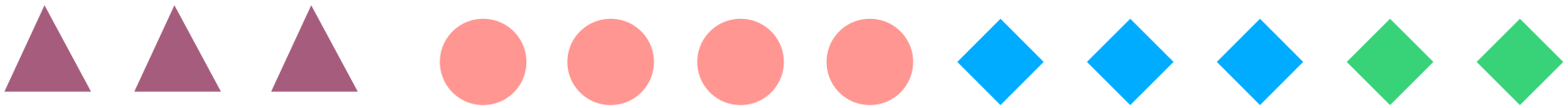


- Getting the right level of abstraction
- A minimum set of functionalities to rule them all

Experimenters



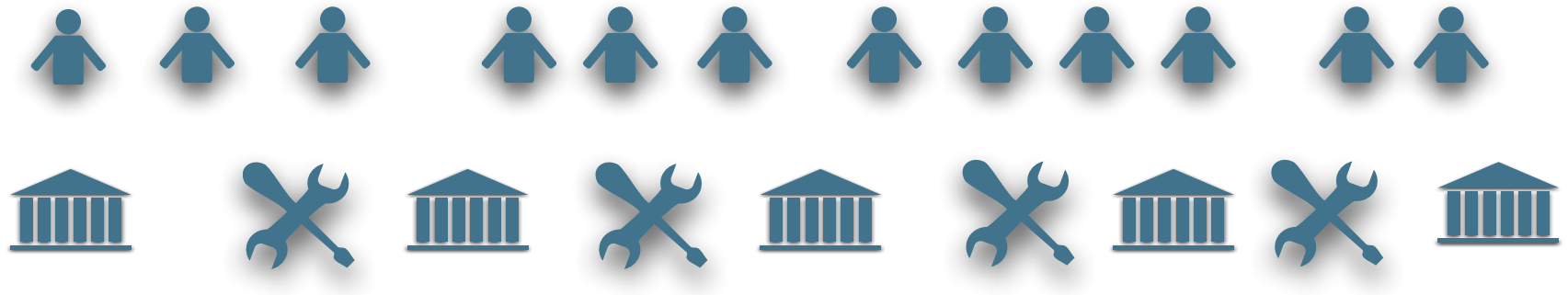
A secure and distributed thin waist



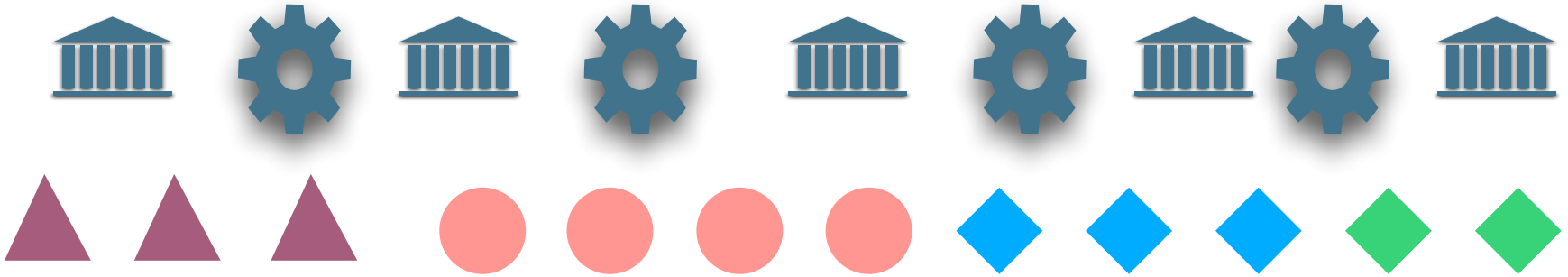
Testbeds resources

Experimenters

SFA: Slice Facility Architecture



SFA aims to provide a **secure** common API with the minimum possible functionality to enable a **global** testbed federation

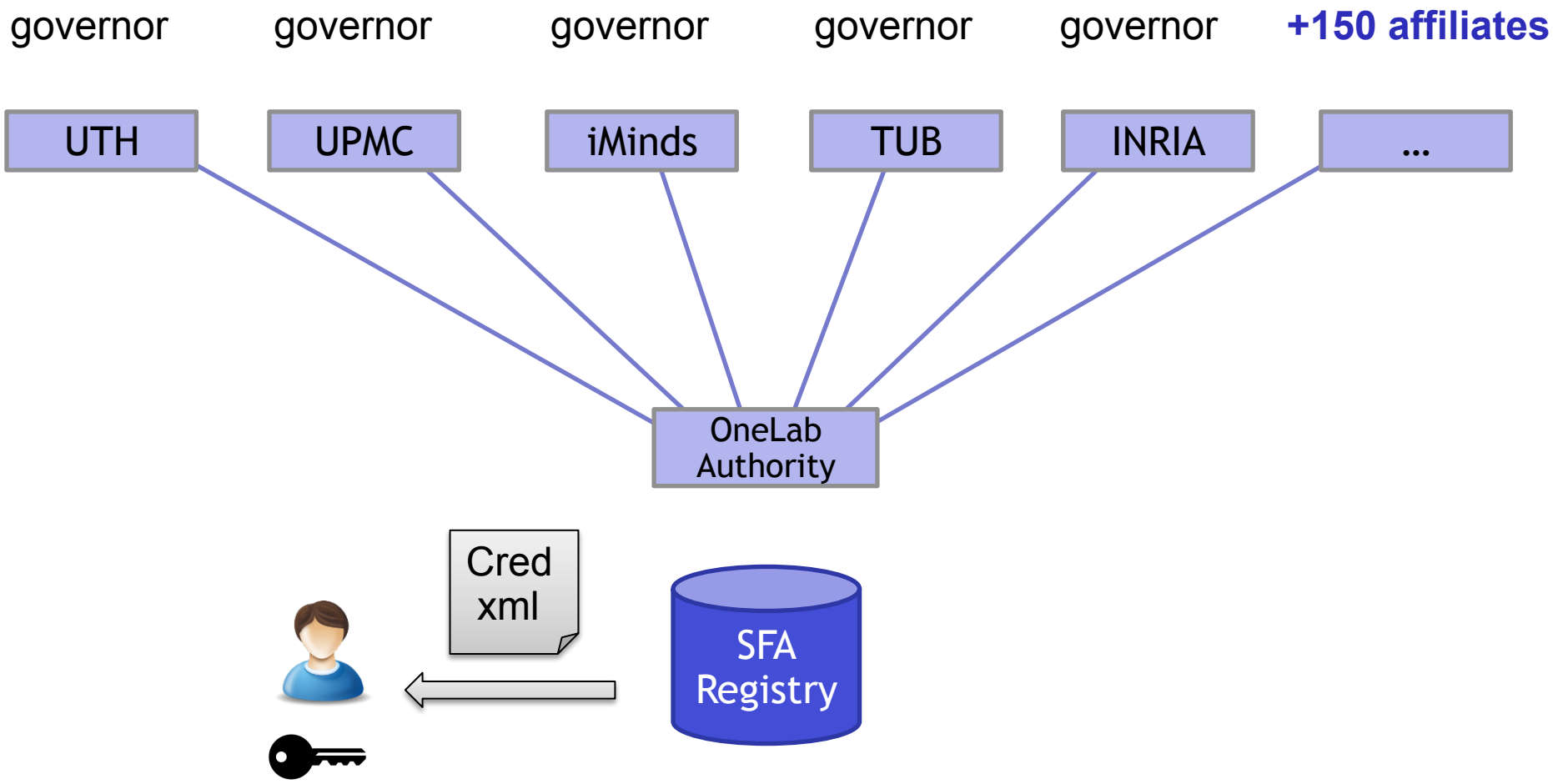


Testbeds resources

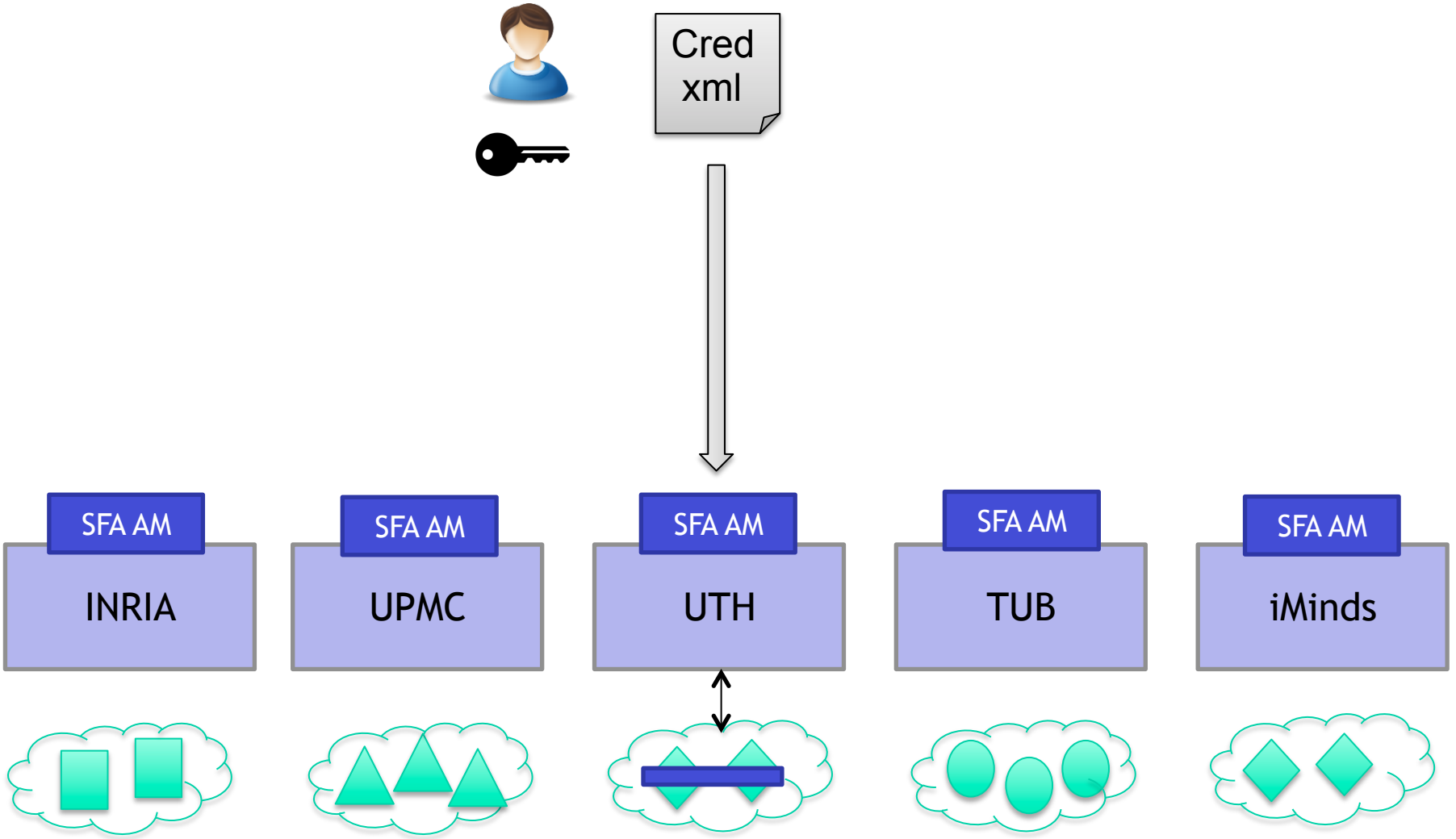
Slice-Based Facility Architecture (SFA)

- A **secure and distributed thin waist** to enable a global federation :
- **Naming** : uniquely identifies objects ; links ; requires sharing of namespace ;
- **Identity / Authentication** : X509 certificates ;
- **Control plane API** : Manipulate objects and their associations ; authorization + policies ;
- **Data model** : Resource description; Independent from SFA.

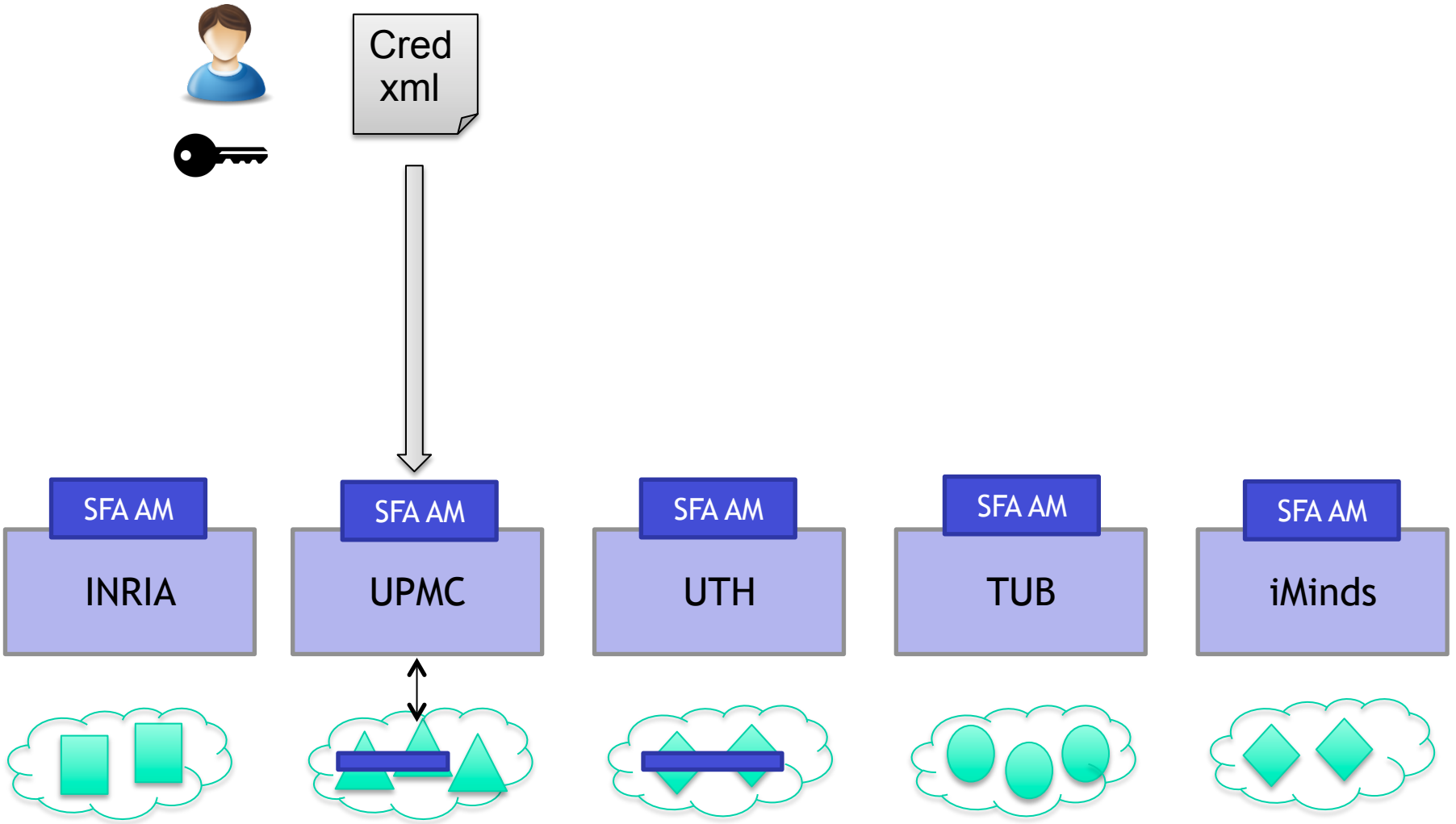
SFA authentication of users



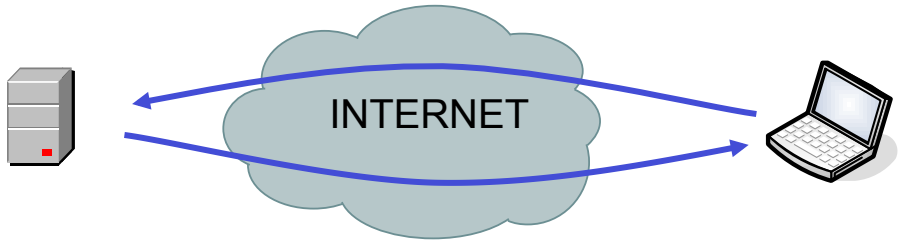
SFA access to resources



SFA access to resources

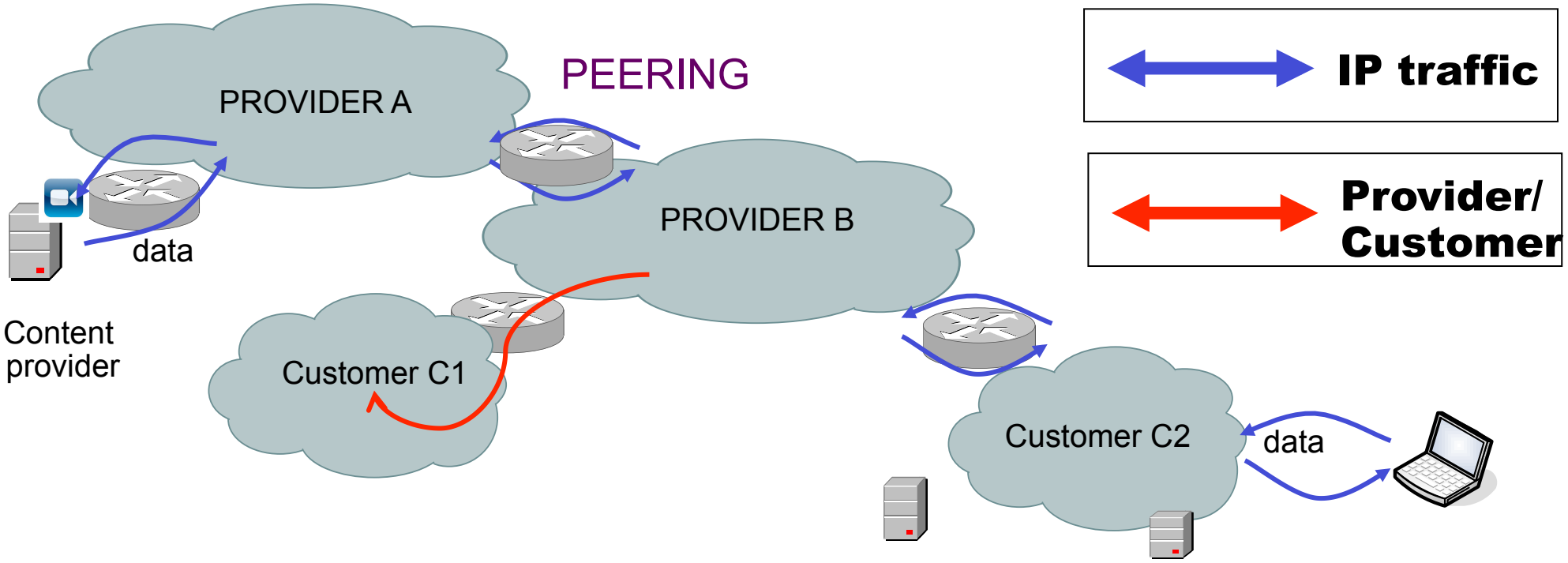


Customers and Providers

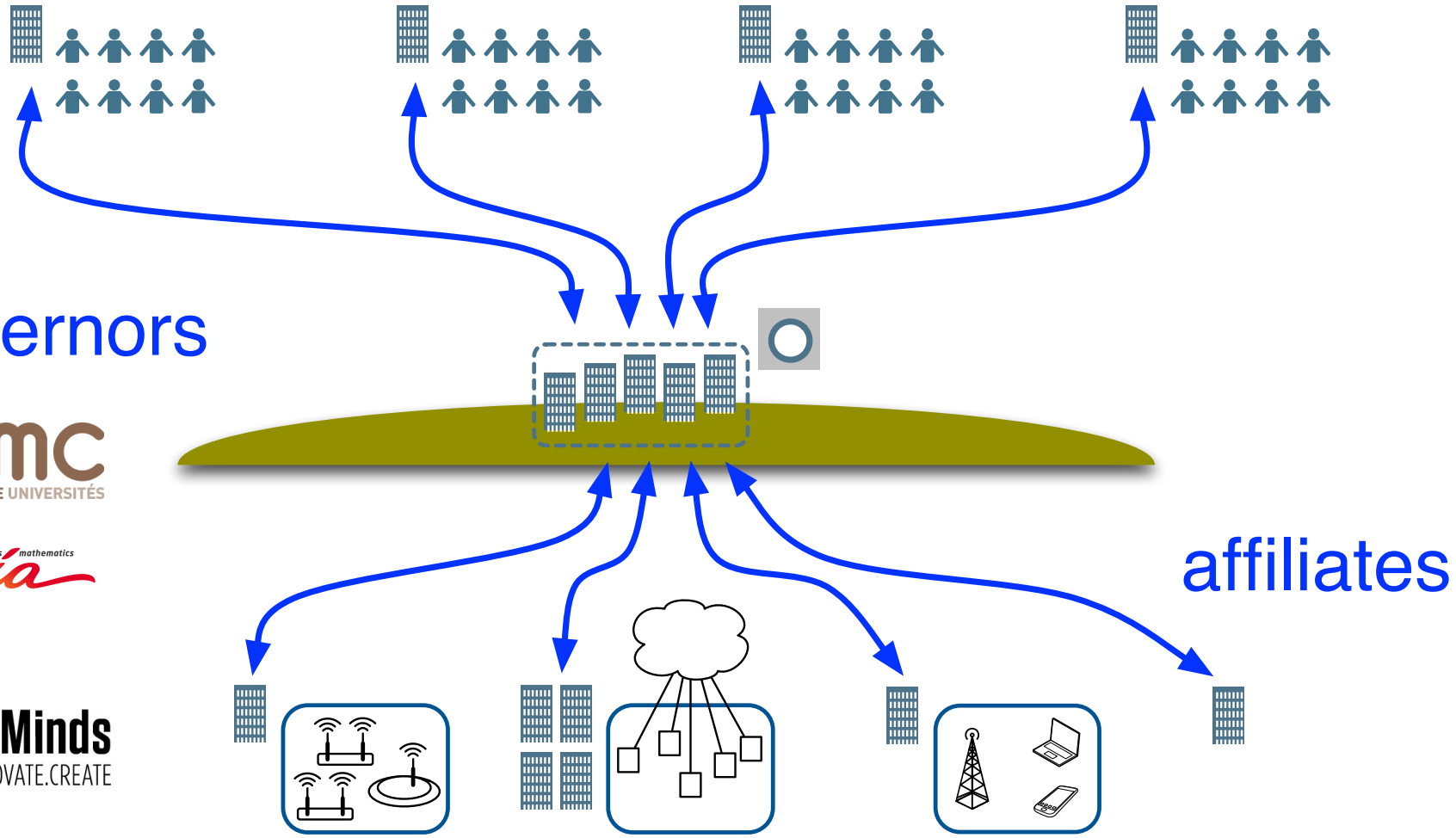


End-to-end communication

- Interconnection and Economics
  - IGP
  - BGP



OneLab Governance & Legal Framework



FUNDAMENTAL COMPONENTS FOR FEDERATION

The experiment lifecycle

- ❶ User account & slice creation
- ❷ Authentication
- ❸ Resource discovery
- ❹ Resource reservation & scheduling
- ❺ Configuration/instrumentation
- ❻ Execution
- ❼ Repatriation of results
- ❽ Resource release

home authority

all authorities

NOT IN SFA
Other components exist

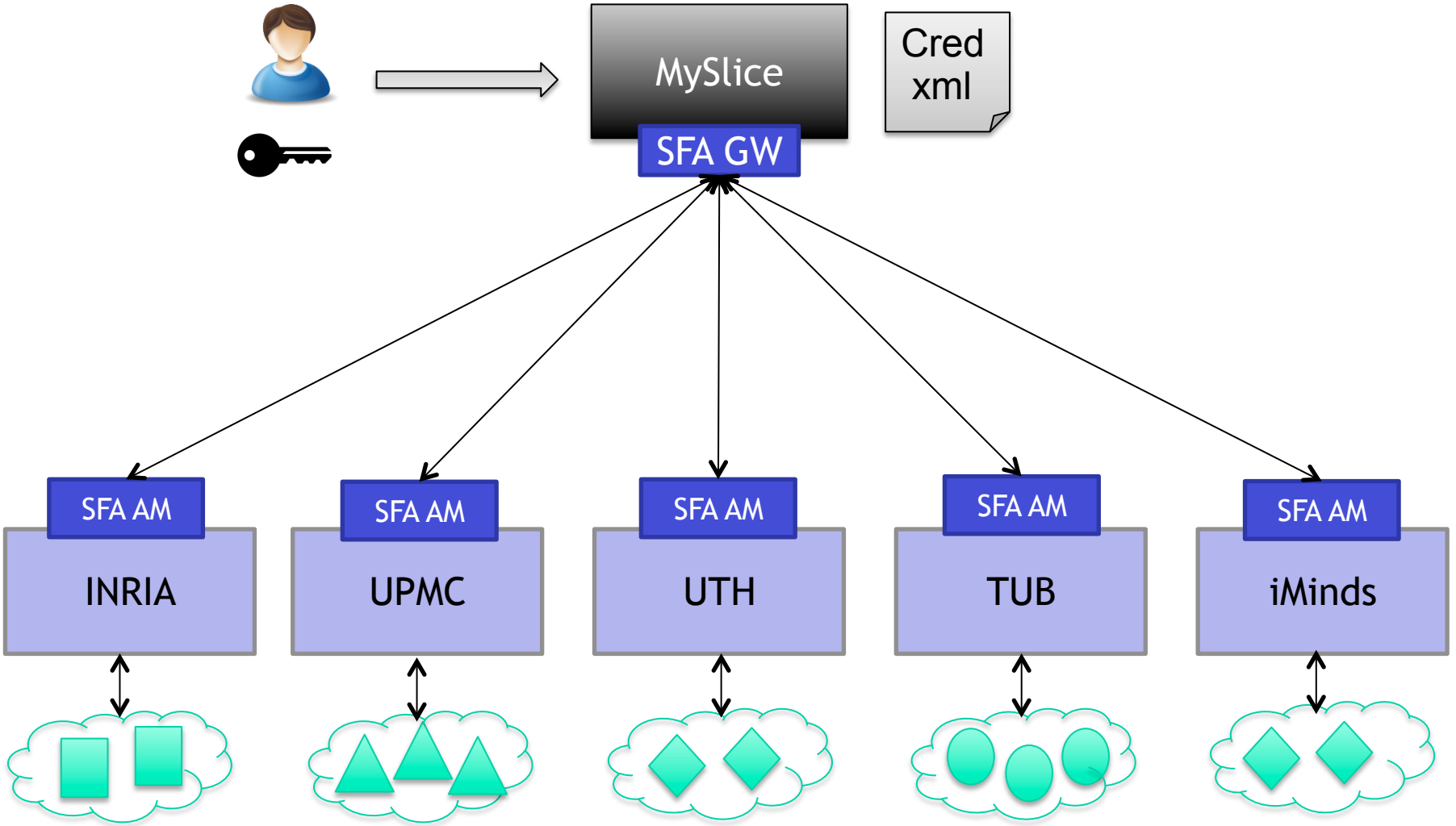
all authorities

UI : The MySlice portal

A **portal** integrates the various tools and services

- organize and visualize data
- Designed to support the full **experimental lifecycle**
- Tight integration with **monitoring**

MySlice access to resources



MySlice contributors & adopters

- UPMC, France
- INRIA, France
- UTH, Greece
- NTUA, Greece
- TUB, Germany
- iMinds, Belgium
- i2Cat, Spain
- Univ Bristol, UK

UNIFACS, Brazil

UFF, Brazil

UFRJ, Brazil

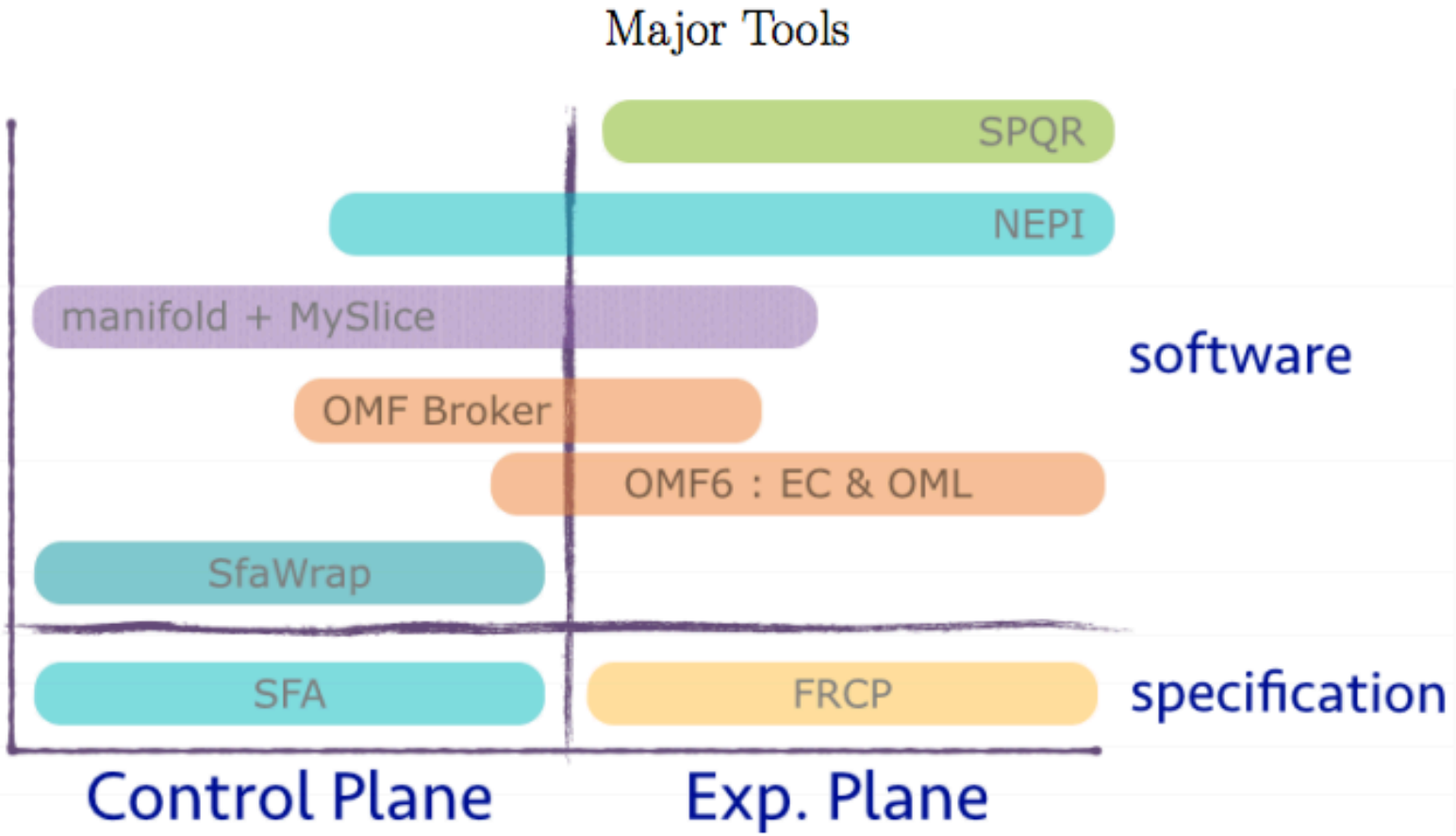
GIS/KAIST/SNU, Korea

III – Taiwan

ICT - CAS, China

Delivering to the community

A summary of the tools contributed by OpenLab



THE ONELAB EXPERIMENTAL FACILITY

OneLab Experimental Facility

First open and independent Portal for **international federation**

- A diversity of **testbeds** technologies
- Operate **services** for federation :

  authority, portal, monitoring, etc.

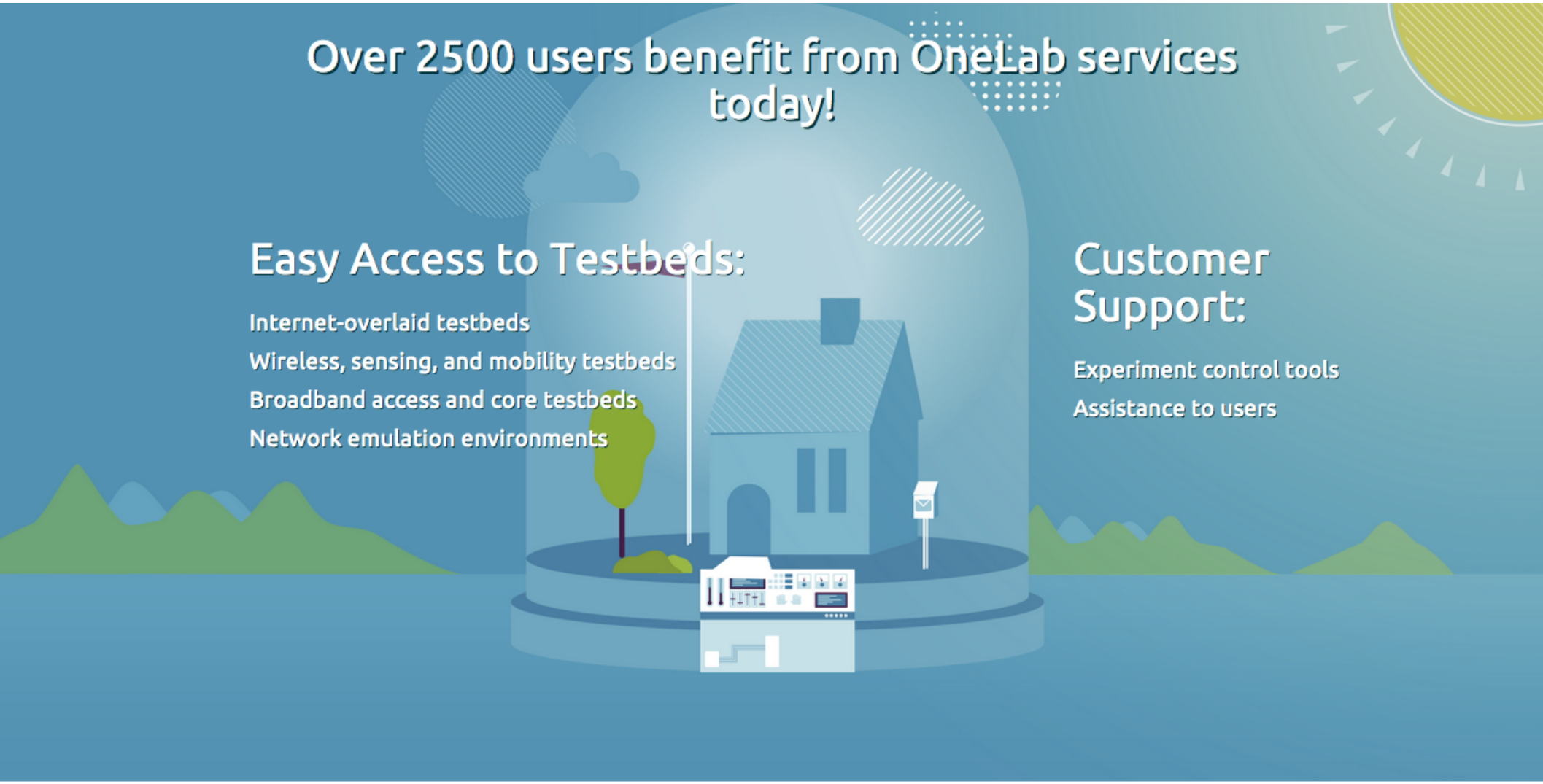
at opening (Q2 2014)

OneLab
FUTURE INTERNET TEST BEDS

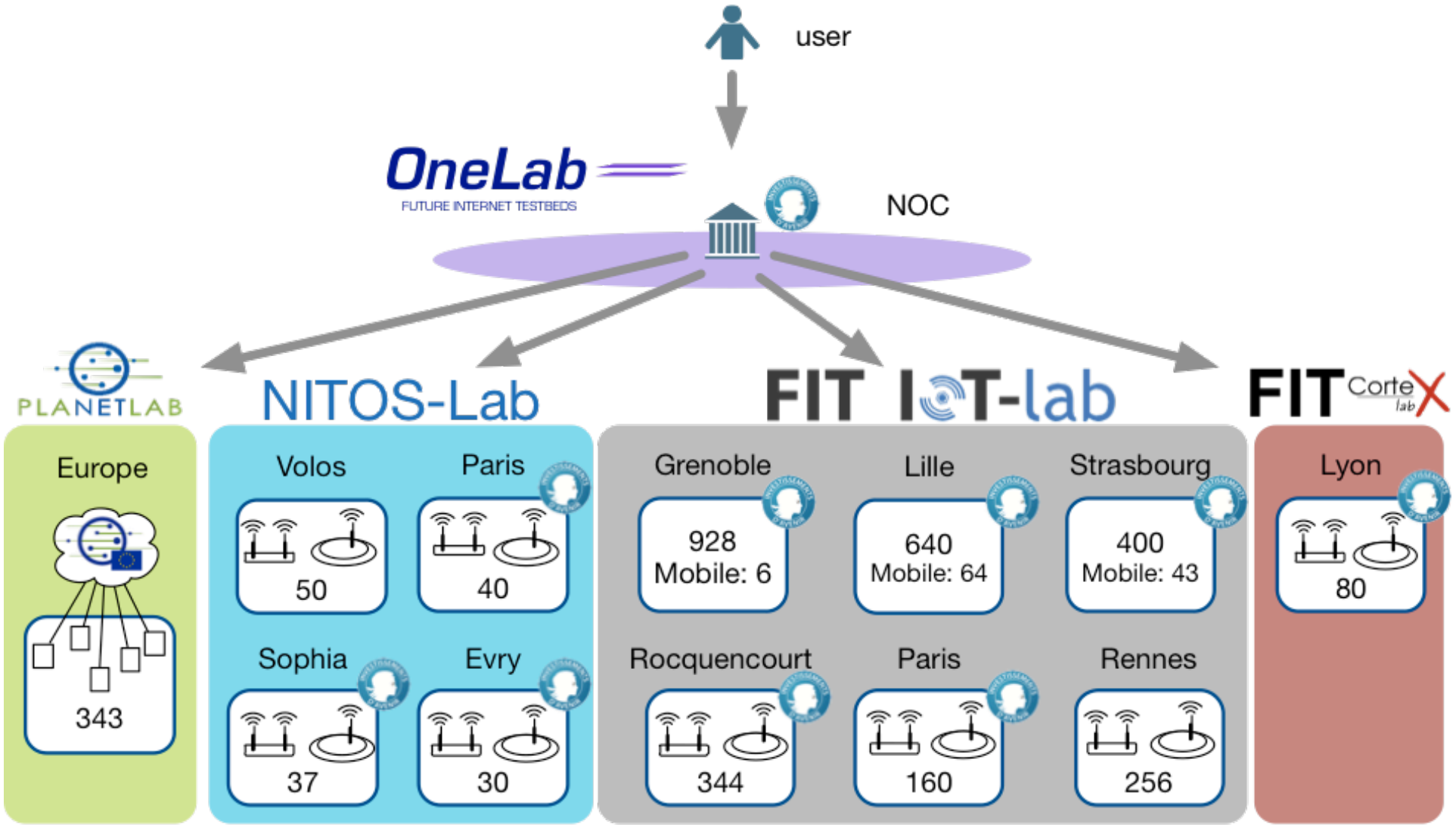
- A large **user community**
- All bound by a **consortium agreement**

http://www.onelab.eu

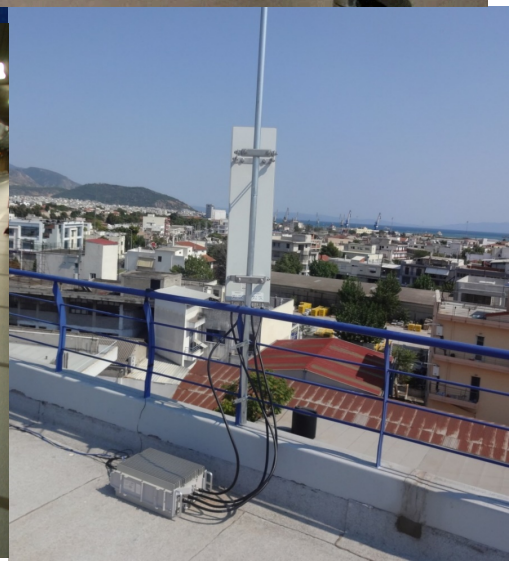
Federated testbeds



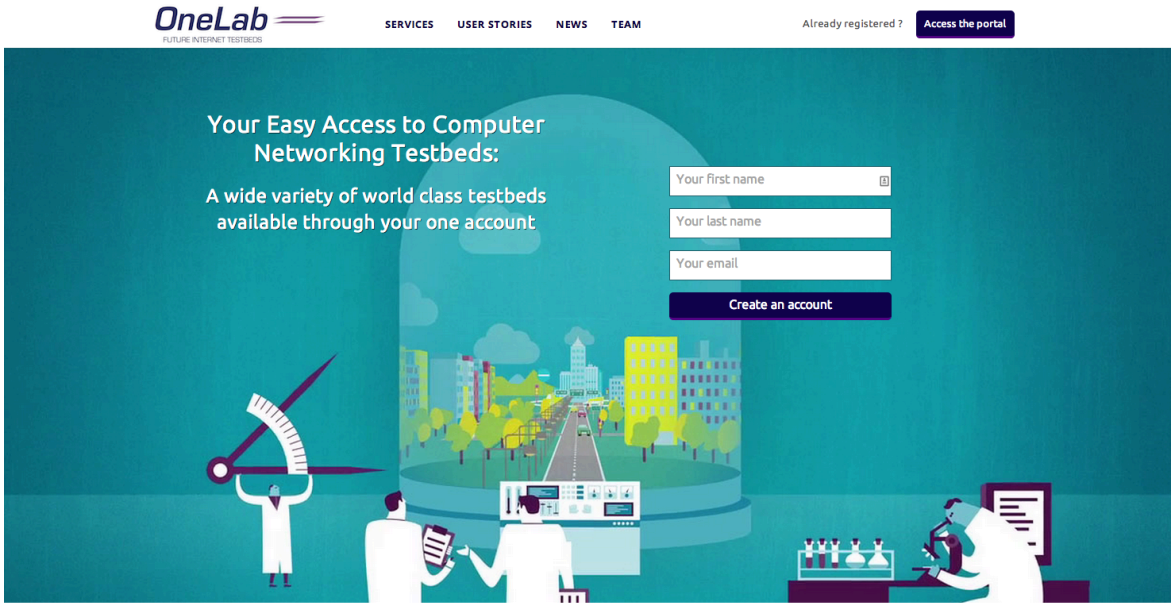
OneLab Experimental Facility



The OneLab NOC

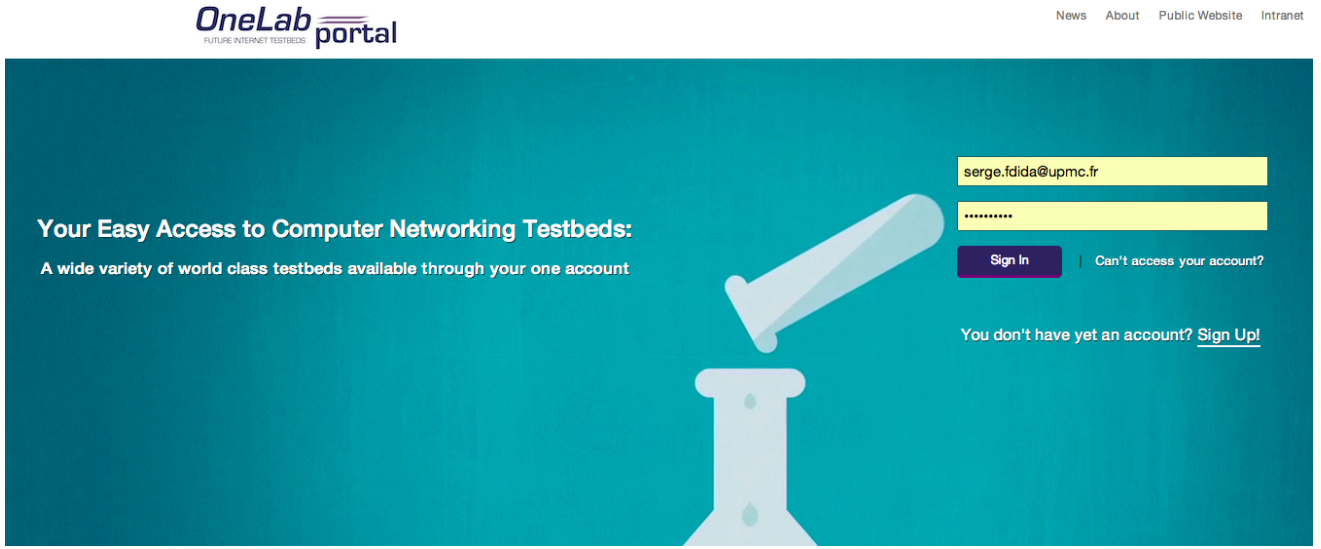


OneLab Web site and Portal



The OneLab Vision

We are approaching the era of the Multinet. Instead of the one Internet, we will have a multitude of parallel



SFAWrap – http://www.sfawrap.info

- **Federate your testbed with the SFA community**

- Handles most of the complexity (crypto, etc.)
- Testbeds focus on their specificities
  - Wrap an existing testbed
  - A base to build a new testbed
- Open community development model
  - Free software – Mutualized developments

SFAWrap adoption

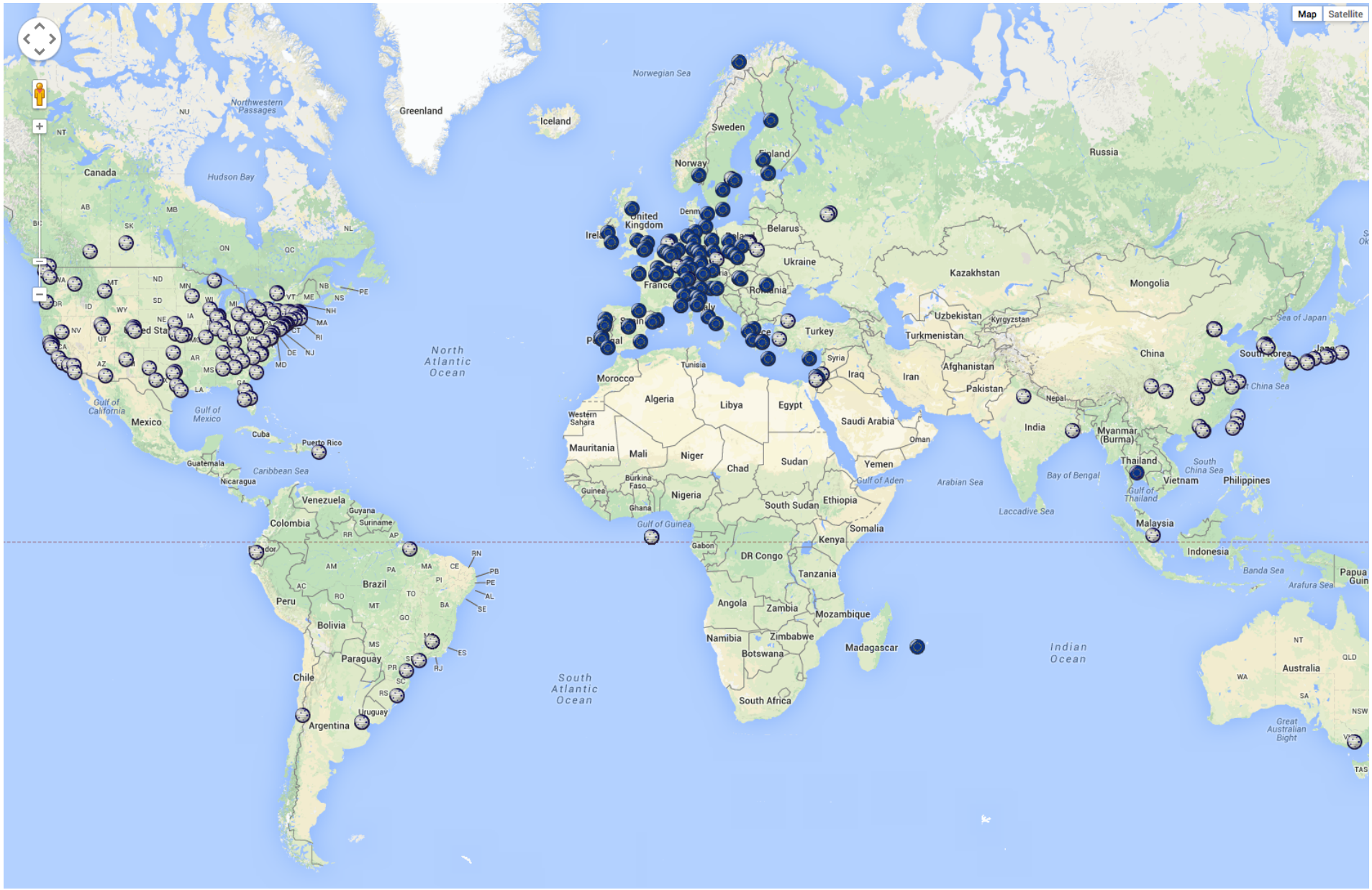
- PlanetLab Europe
- IoT-Lab, FIT testbed, France
- Cortexlab, FIT testbed, France

- NITOS, University of Thessaly, Greece
- Fuseco Playground, Technische Universität Berlin

- IMS, University of Patras, Greece
- Federica, Europe

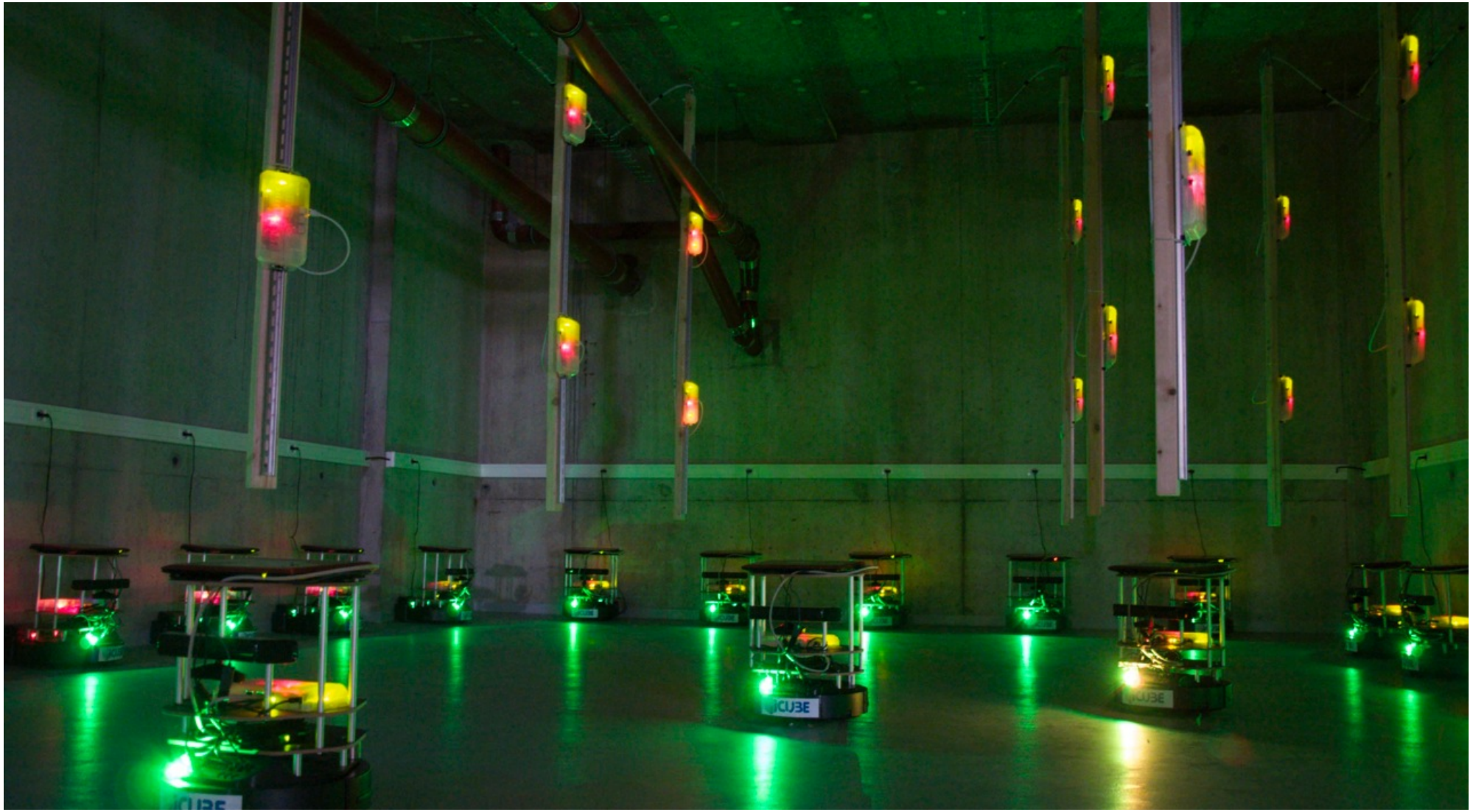
- BonFire (within Fed4Fire), Europe

PlanetLab Sites Worldwide

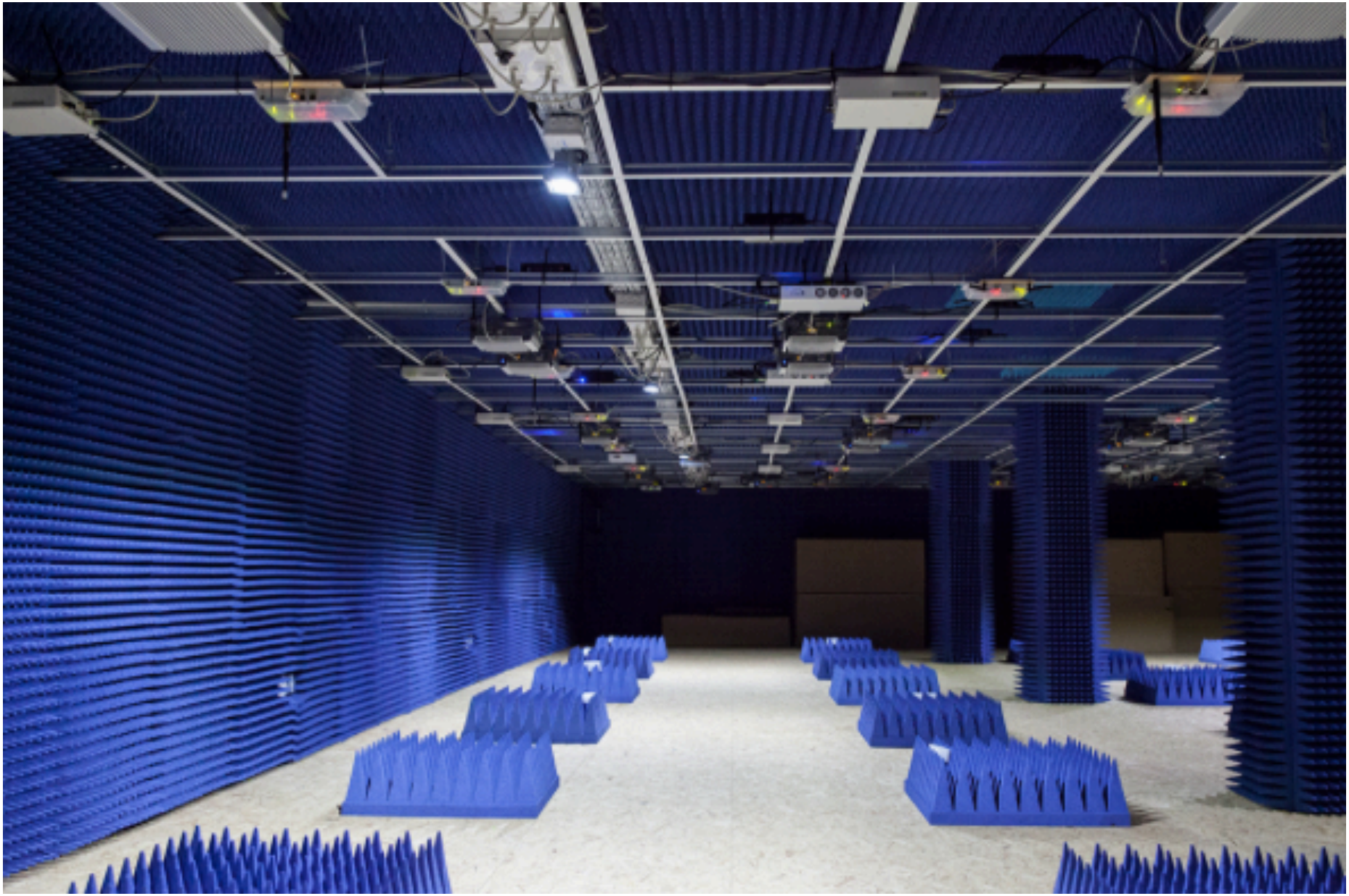


NITOS Wireless Platforms

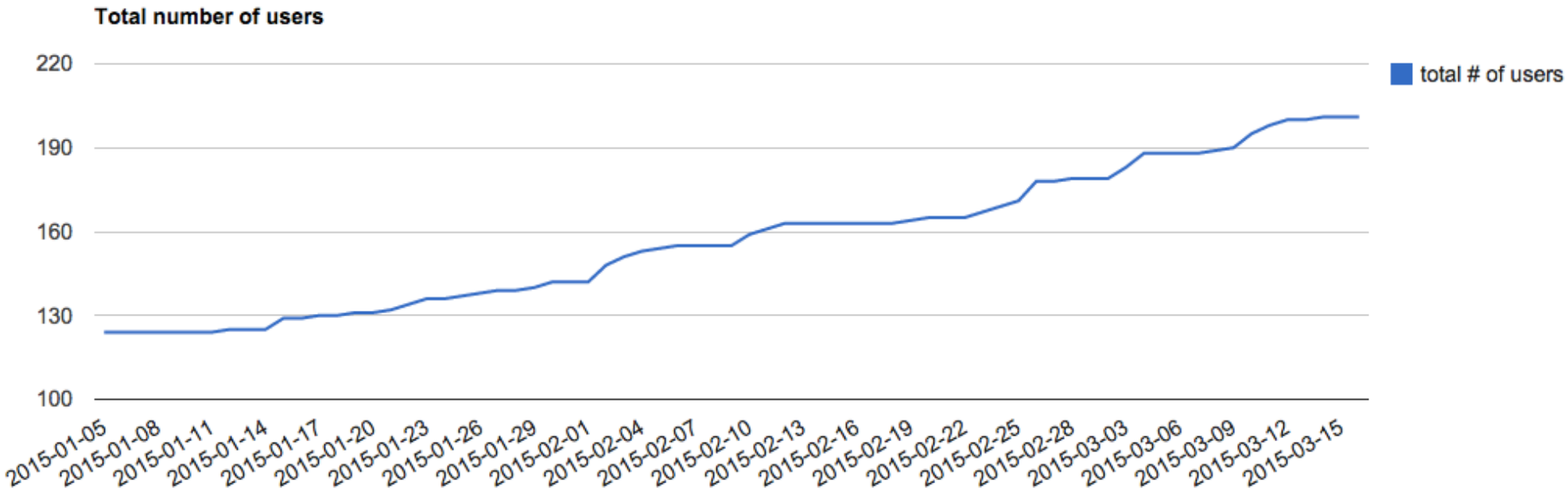
iCube Robots : FIT IoT Lab Strasbourg



CorteXlab's anechoic chamber



OneLab Usage



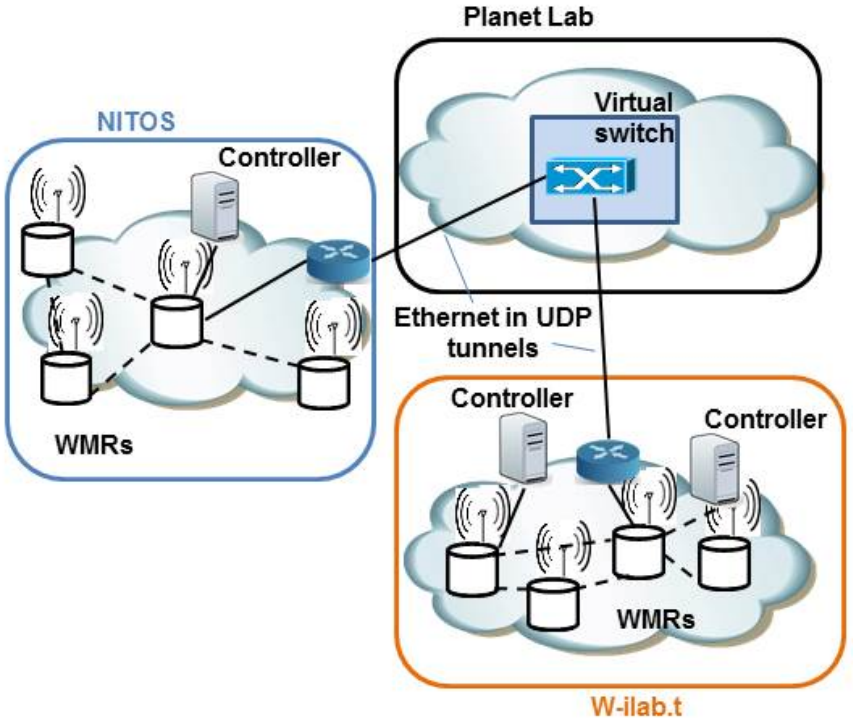
Total number of users: 201
Statistics as of March 16, 2015

NB: Figure represents OneLab Portal unique users : does not include users accessing resources via the individual testbed portals

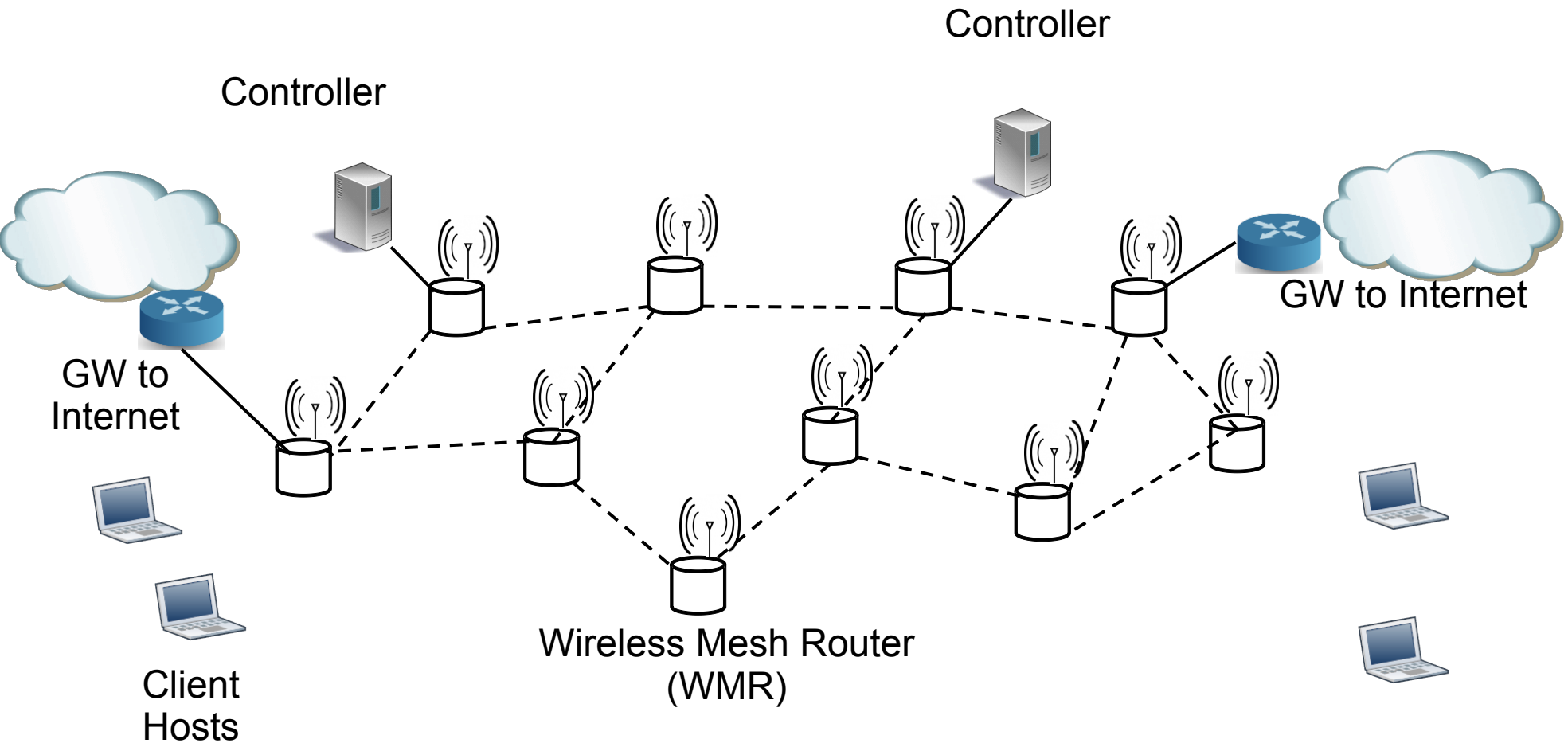
APPLICATIONS,USAGE & DEMOS (recorded) :

What is OneLab good at?

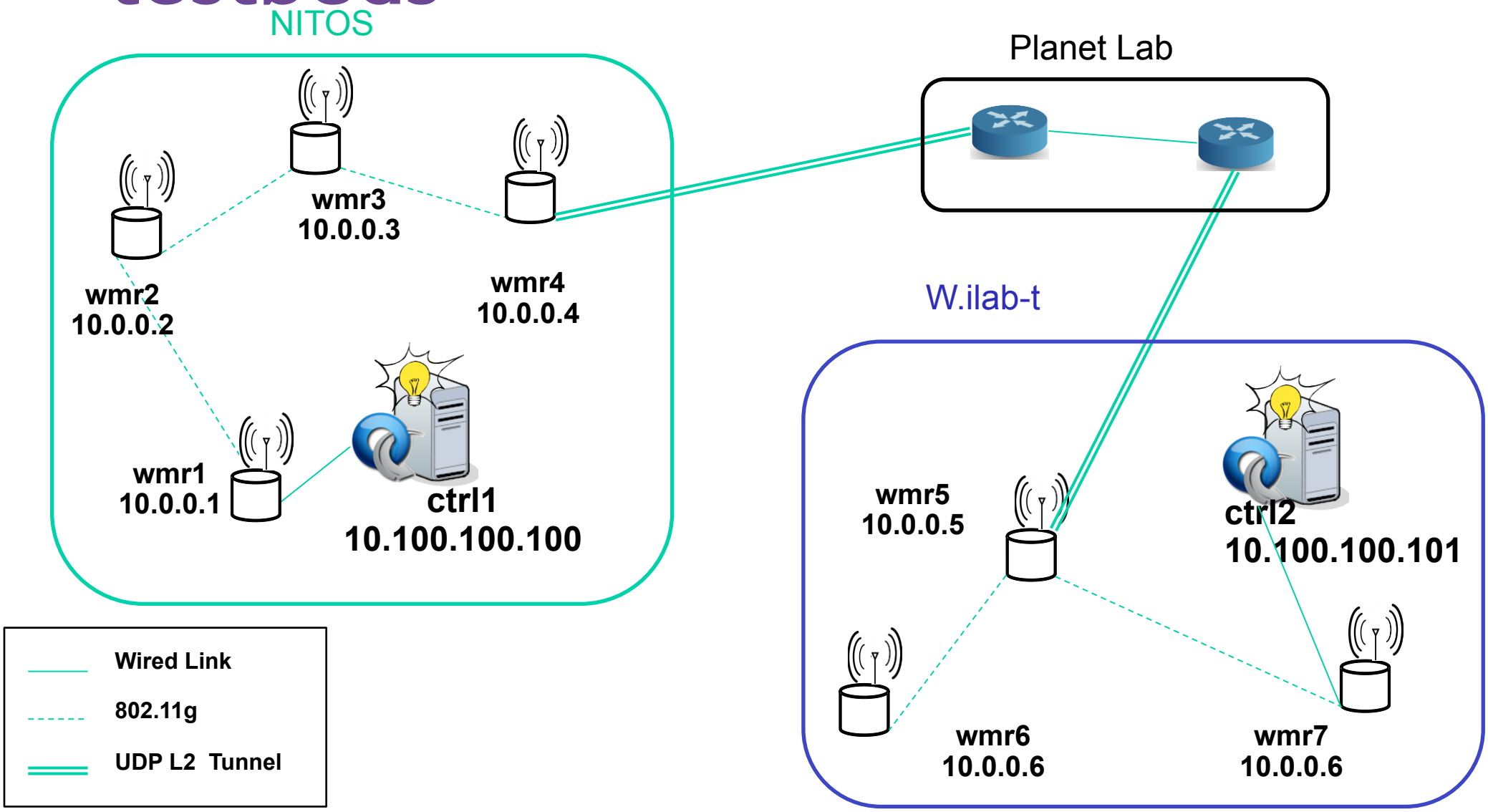
- Can we evidence the added-value for experimenters?
- The Express experiment as an illustration of OneLab capabilities
- Integrated demo: A full experiment lifecycle through the OneLab portal



Setting the scenario
wireless mesh Software Defined Network



Experimenting in OpenLab testbeds



Demonstration

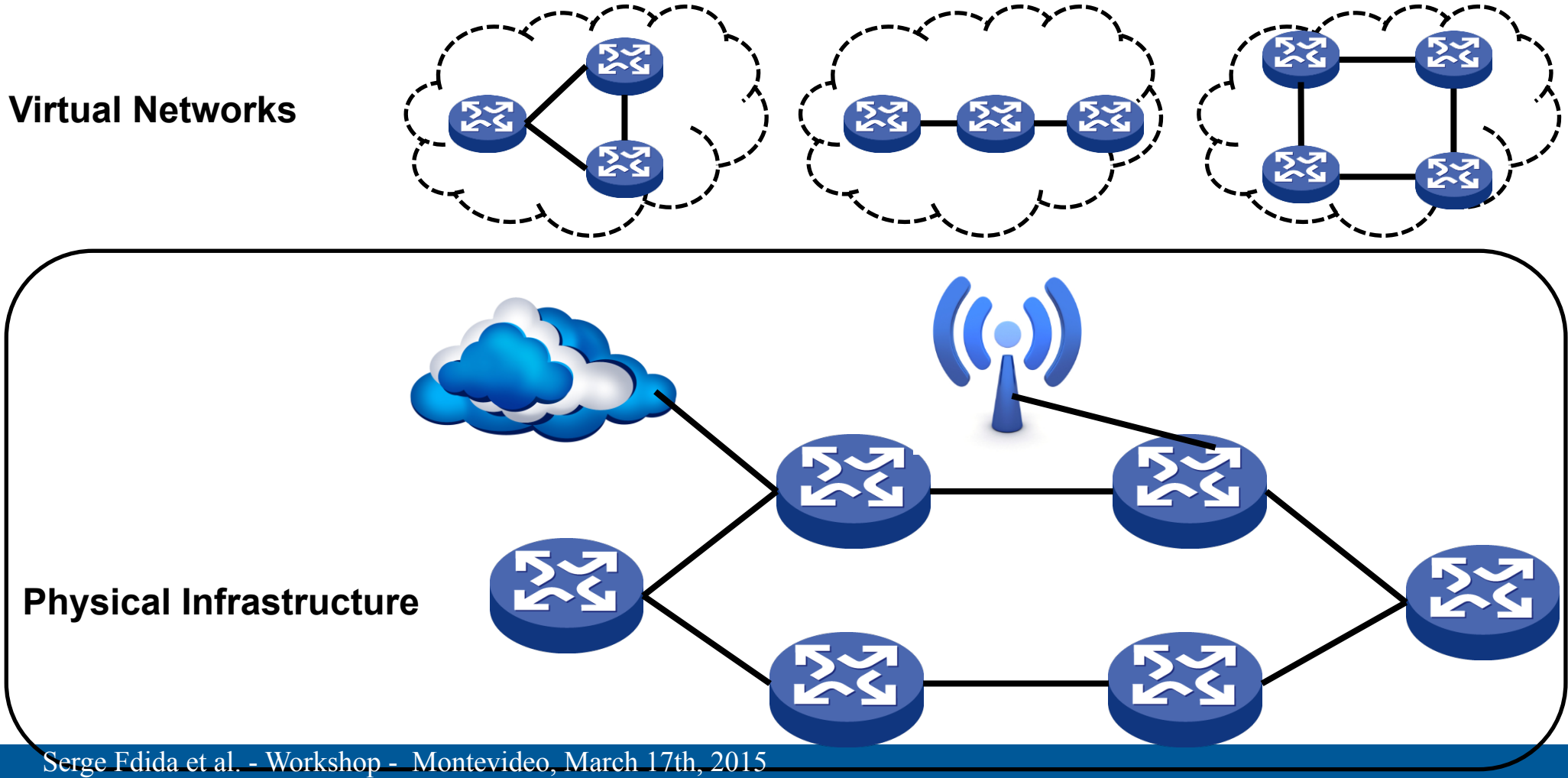
- Video

OneLab in CENI

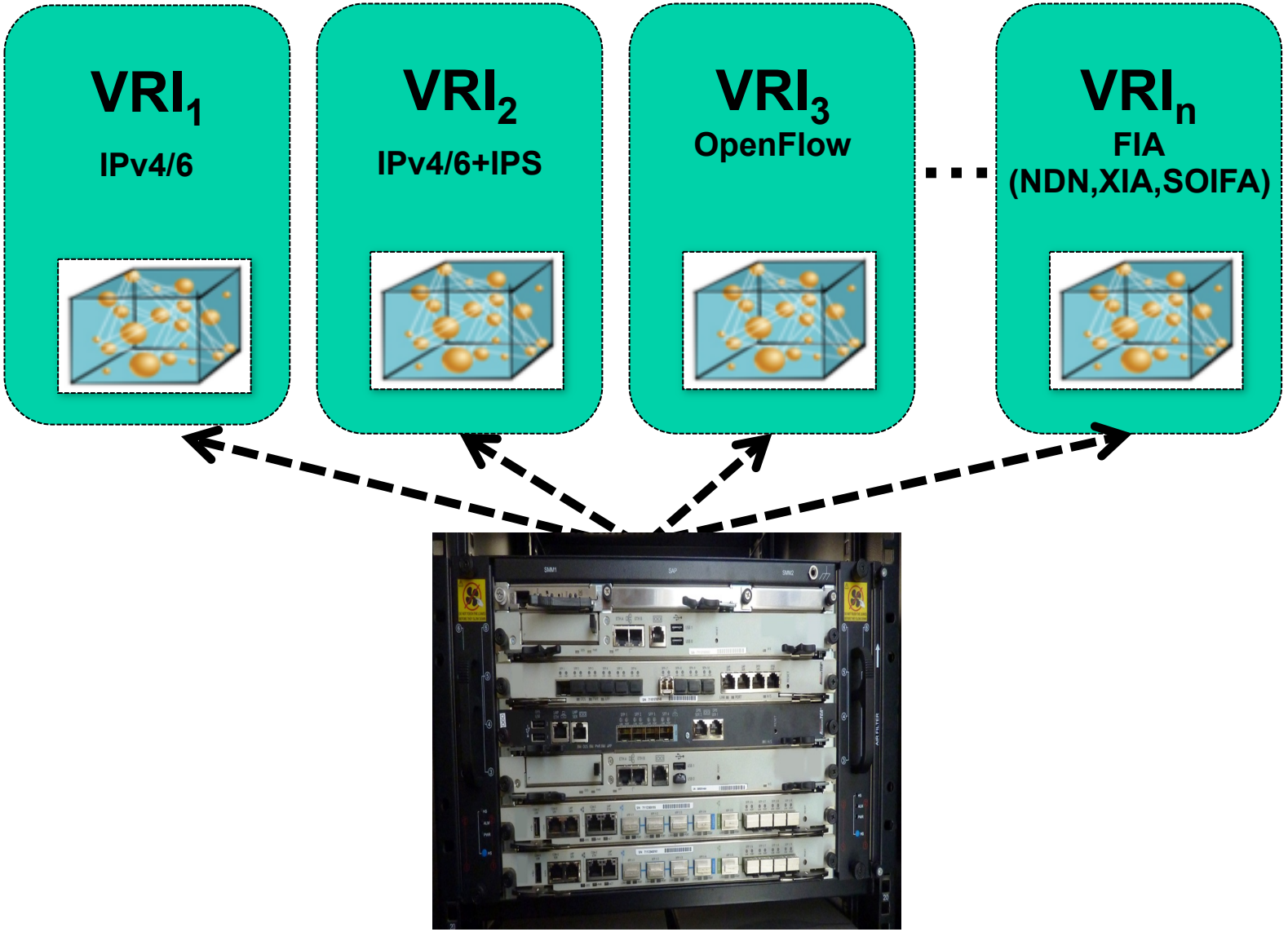
- Research on Internet
  - FIA, protocols and applications
  - Testbeds for experiment
- Two Types of Testbeds
  - Host–based overlay
  - Router-based testbed
- CENI Proposal
  - **China Environment for Network Innovations**
  - Submitted to NDRC in 2010
  - Approved to be listed as one of the 16 national major scientific infrastructures by the State Council on 2013

Overview of CENI Testbed

- Open
- Virtualization with isolation
- Programmability and Configurability

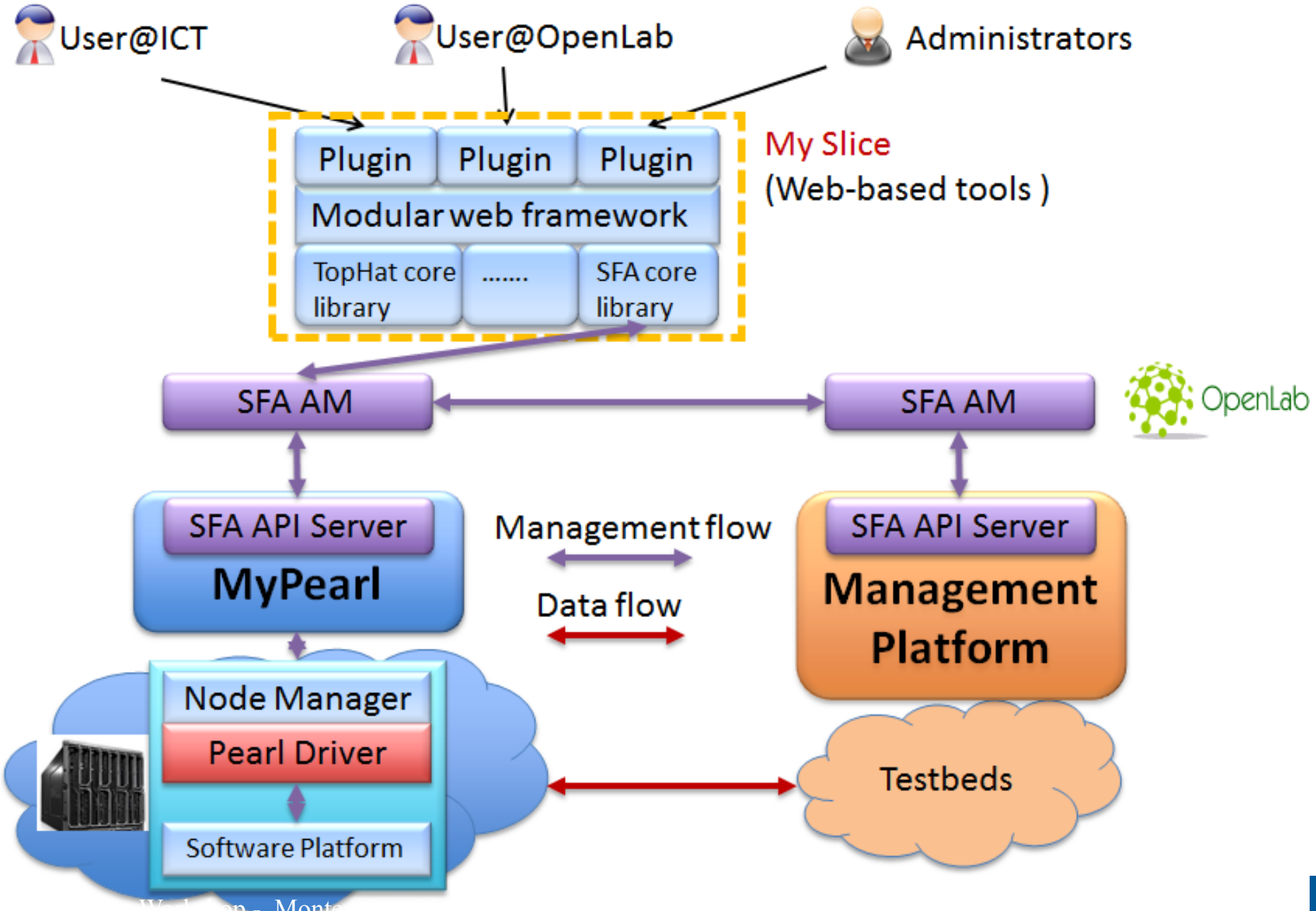


PEARL: ProgrammablE virtuAl Router pLatform

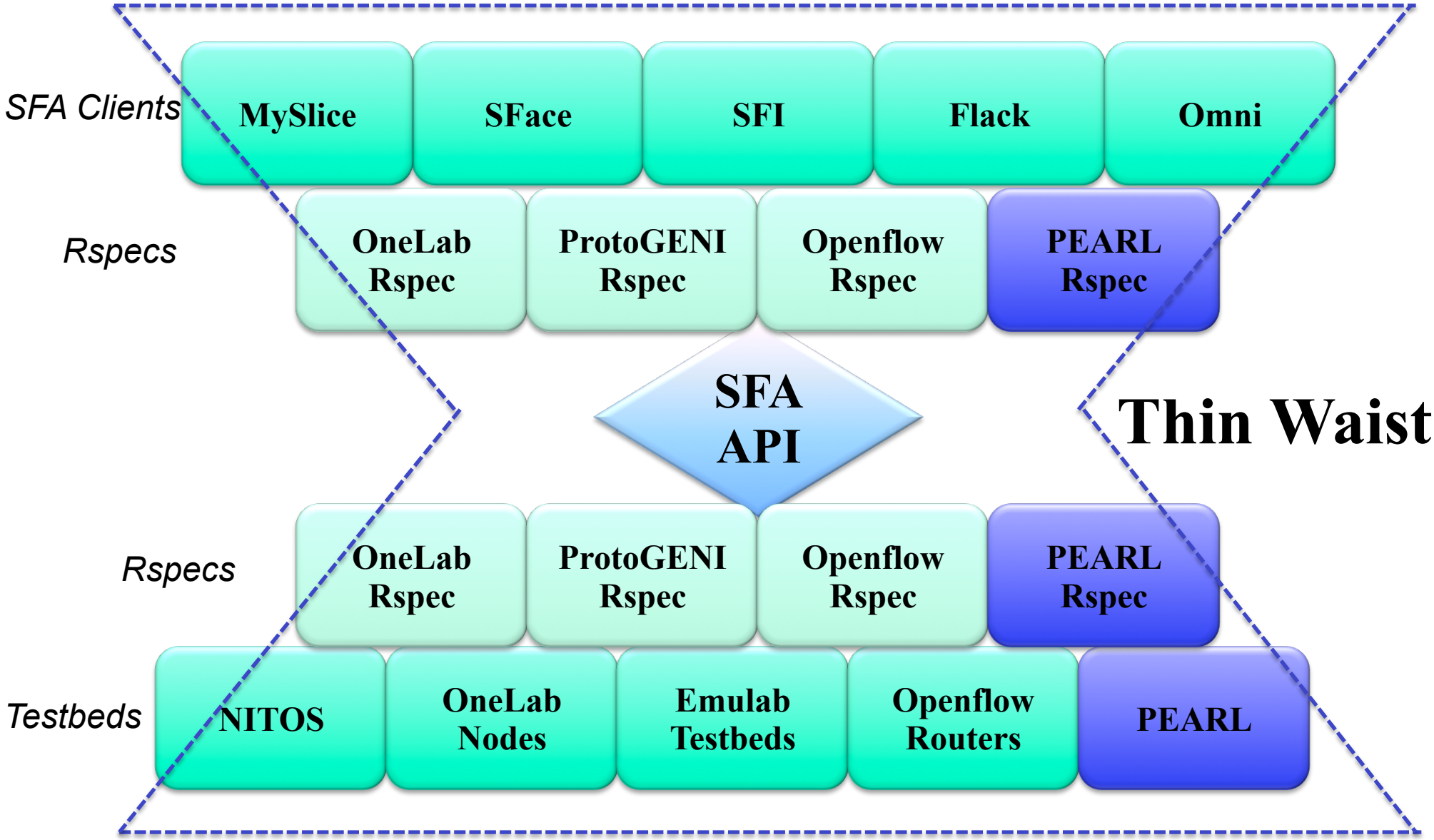


PEARL: A Programmable Virtual Router Platform, IEEE Communication Magazine 2011
VRI: Virtual Router Instance

MP: SFA


User@ICT
User@OpenLab
Administrators
Plugin
Plugin
Plugin
Modular web framework
TopHat core library
.....
SFA core library
My Slice
(Web-based tools)
SFA AM
SFA AM
OpenLab
SFA API Server
MyPearl
Management flow
Data flow
SFA API Server
Management Platform
Node Manager
Pearl Driver
Software Platform
Testbeds

Add New Nodes

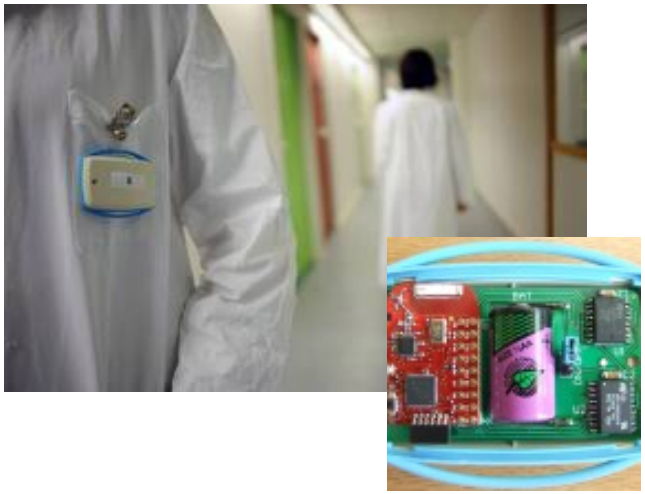


Tool Nodes


任务列表
Finish
时延测试任务集
1 未来网络P1 Trace baidu.com Finish
2 Joy_P1 Ping sina.com 1/10
3 Probe Ping sina.com 5/10
4 Probe Ping sina.com wait
5 Pet_P1 Ping google.com wait
6 未来网络P1 Ping baidu.com 32/50
7 Pet_P1 Ping google.com 32/50
时延测试任务集2
时延测试任务集
1 未来网络P1 Ping baidu.com Finish
2 Joy_P1 Ping sina.com 1/10
3 Probe Ping sina.com 5/10
4 Probe Ping sina.com
5 Pet_P1 Ping google.com
6 未来网络P1 Ping baidu.com Finish
7 Pet_P1 Ping google.com 32/50
始
南京
江苏省
终
青海省
海西藏族自治区
带宽对比：平均 联通 移动 电信
5.56M/S
6.36M/S
7.86M/S
8.02M/S
8.56M/S
南京
全国
南京——海西
海西
测试时间：2013-10-22 17:05:06至2013-10-22 17:08:20
次数：20
工具：Iperf
探针类型：家庭网关型
0M
5M
10M
15M
20M
30M
100M
5/20
Upload
Download
4.56
8.96
M/S
Download Min:4.53M/S Max:6.85M/S Avg:6.58M/S
Upload Min:4.53M/S Max:6.85M/S Avg:6.58M/S
当前测试时间：2013-10-22 15:04:50至2013-10-22 15:05:20 耗时：30s

Applications…

MOSAR & TUBEXPO 08-10
ARIBO



Sand Marathon 2010

French Ski Fed

SmartRoom - Nancy

HiKoB

SensBio

Live Demos

- **OpenLab demo 1:**

Robots' dance @ ICT2013

also available at:

http://myslice.info/download/ict2013demo.avi

- **OpenLab demo 2:**

Mobile sensing and tracking

http://www.ict-openlab.eu/publications/videos.html

A vision comes true

- The OneLab Facility

The purpose was to clearly **establish** an independent facility **OneLab**

An **Internet of Testbeds** can be organized with an incremental growth

Heterogeneity opens new and modern research avenues that cannot be served by the current testbed offering

Authorities can join the OneLab federation and become stakeholders of the global Facility

Experimenters have to register with an authority or directly with the OneLab organization that now has a legal existence

OneLab is providing **various services** (first line support, monitoring of resources, the handling of the user's registration and possibly the dissemination and outreach)

More information

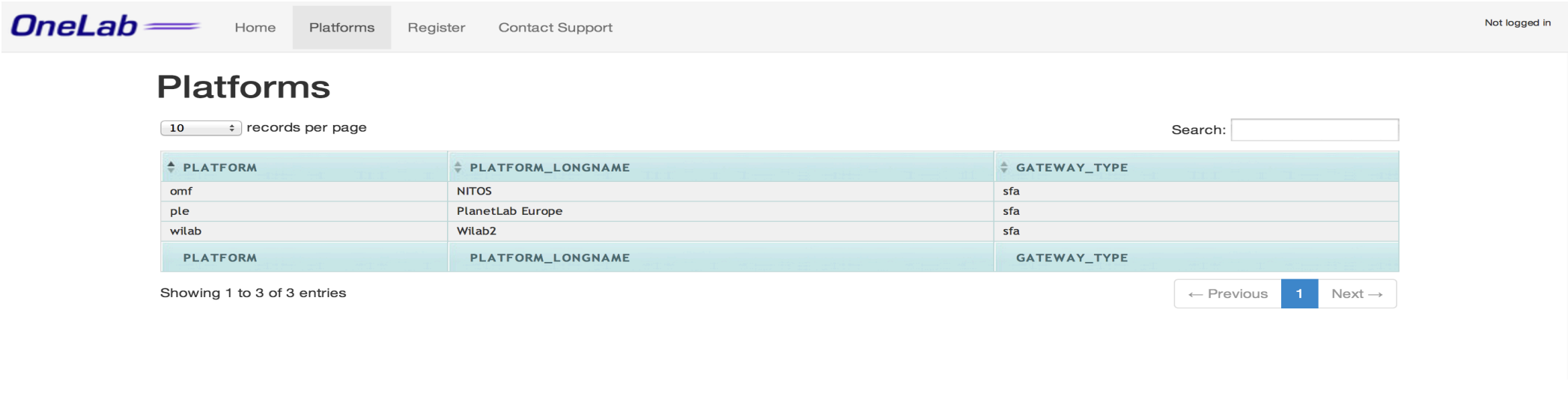
- http://new.fit-equipex.fr/
- http://www.ict-openlab.eu/
- http://www.onelab.eu/
- http://nitlab.inf.uth.gr/NITlab/index.php/testbed
- http://www.ict-fire.eu/home.html
- http://www.fed4fire.eu/
- http://f-lab.fr/
- http://www.geni.net/
- http://www.ict-fire.eu/home.html
- http://fibre-ict.eu

BACKUP SLIDES

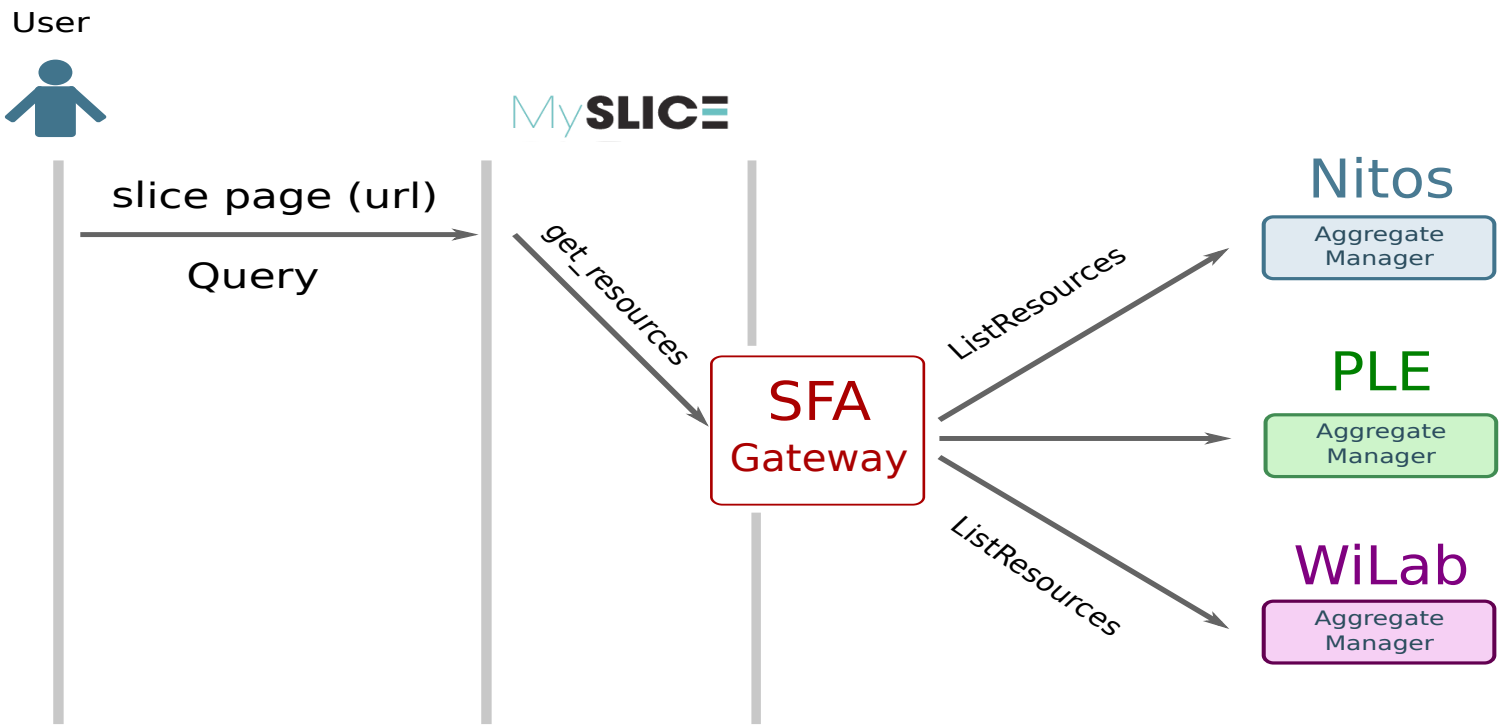
Manage your account

MySlice Account

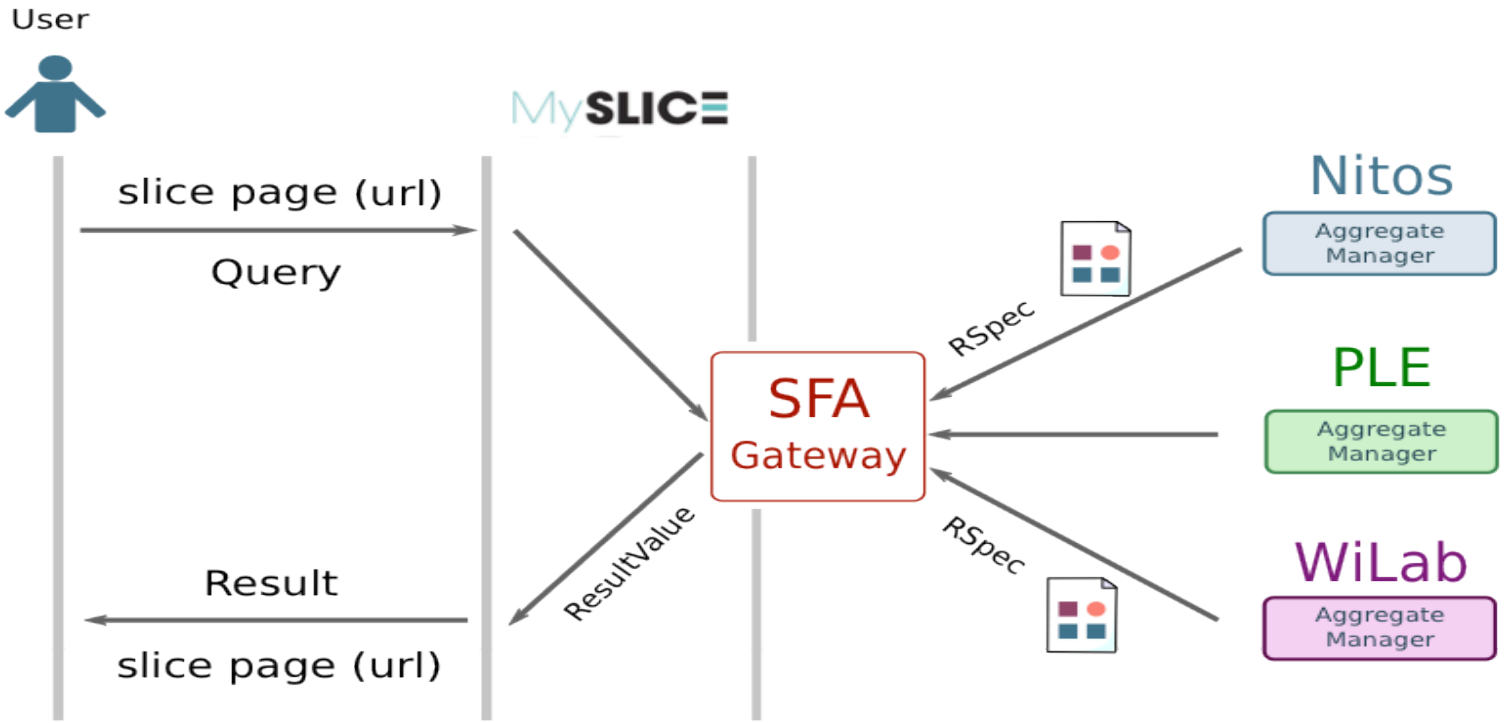
Browse testbeds



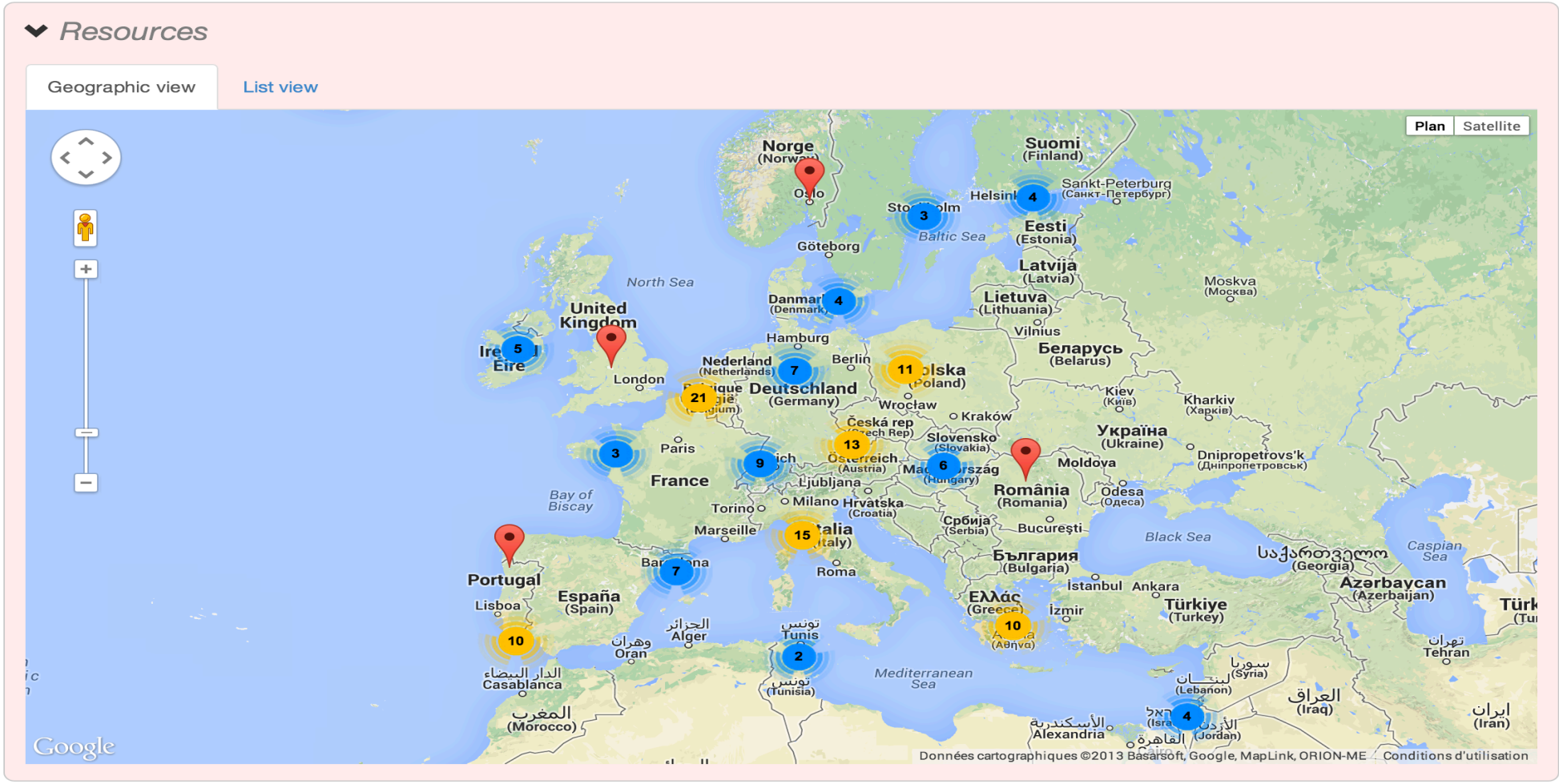
Browse resources: Query



Browse resources: Result



Browse resources



Browse resources

Resources

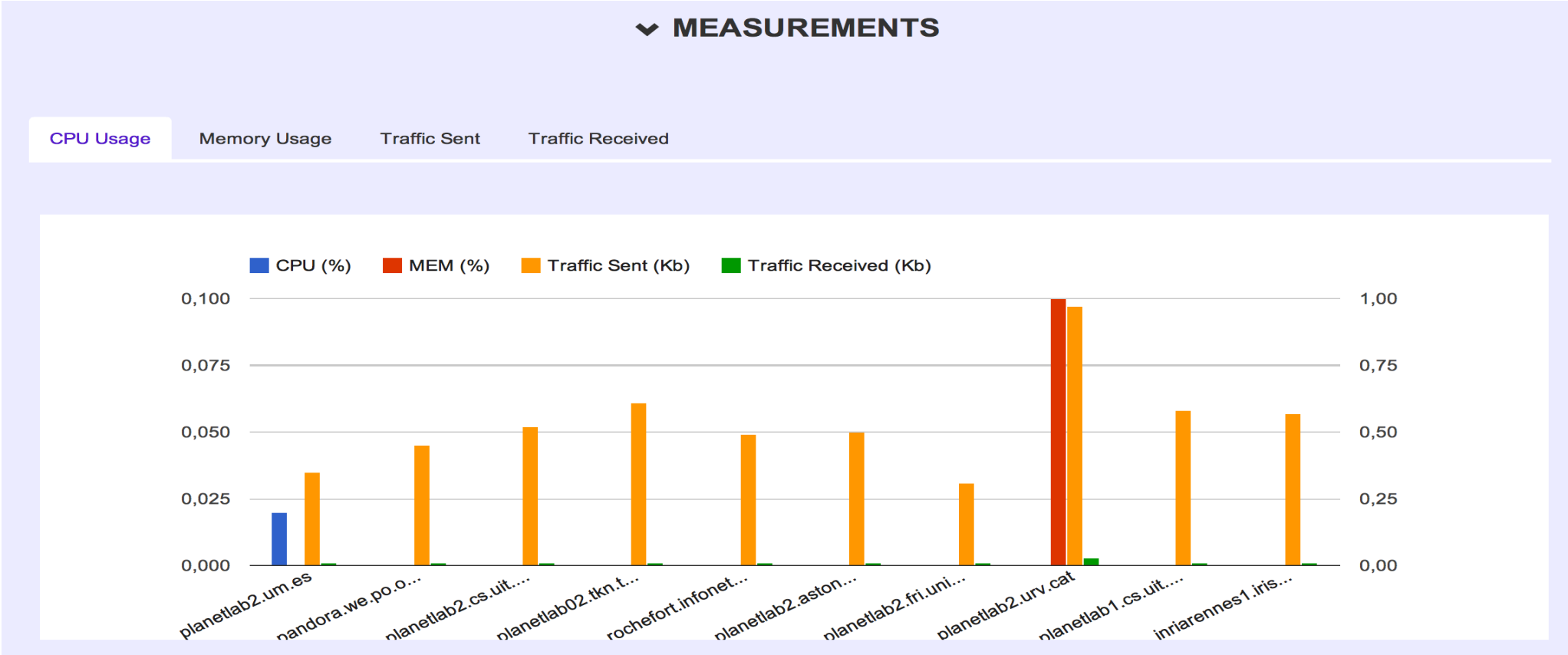
Geographic view | List view

25 records per page

Search:

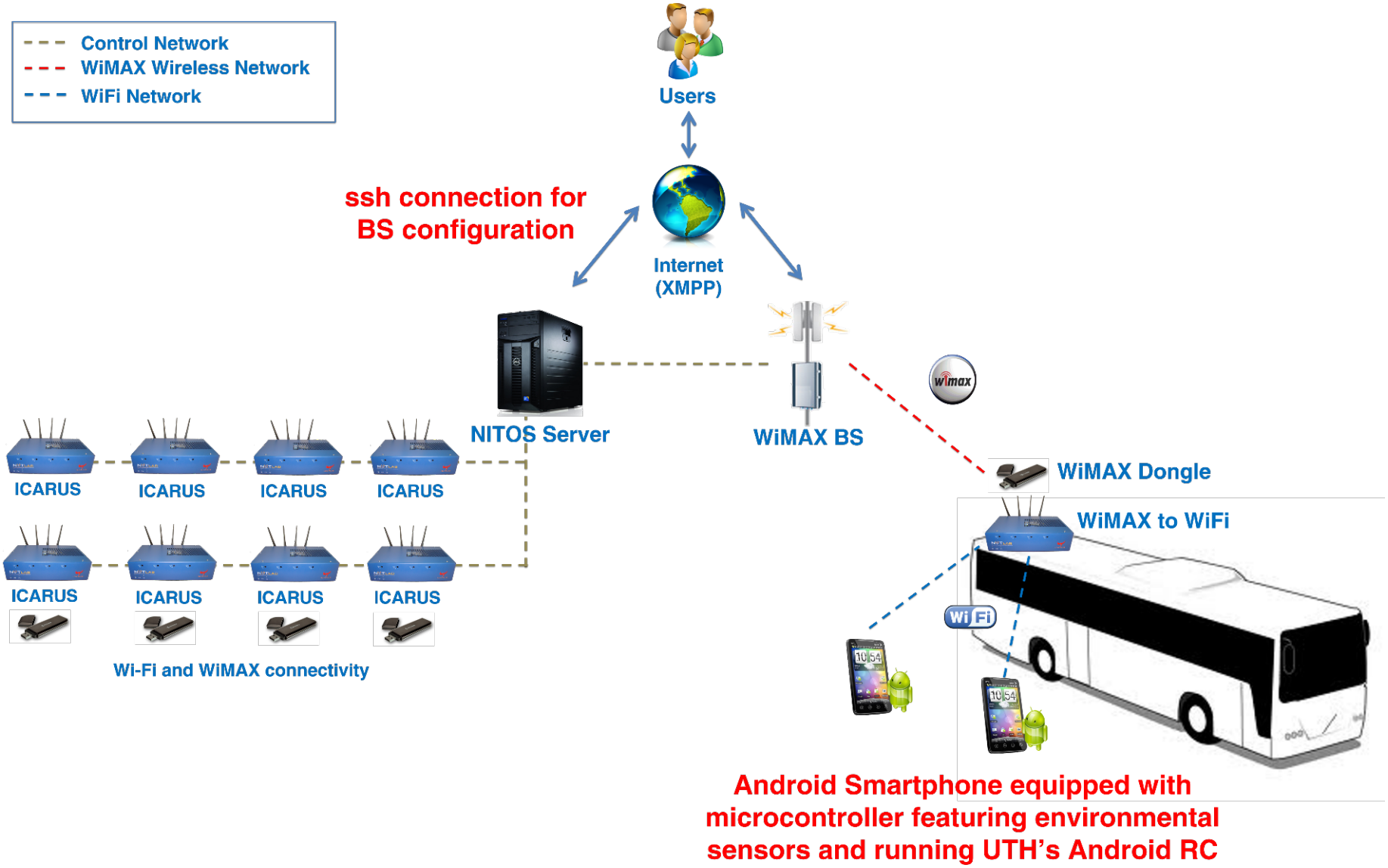
NETWORK_HRN	HRN	TYPE	HOSTNAME	+/-
omf	omf.nitos.node001	node	node001	
omf	omf.nitos.node002	node	node002	
omf	omf.nitos.node003	node	node003	
omf	omf.nitos.node004	node	node004	
omf	omf.nitos.node005	node	node005	
omf	omf.nitos.node006	node	node006	
omf	omf.nitos.node007	node	node007	
omf	omf.nitos.node008	node	node008	
omf	omf.nitos.node009	node	node009	
omf	omf.nitos.node010	node	node010	
omf	omf.nitos.node016	node	node016	
omf	omf.nitos.node017	node	node017	
omf	omf.nitos.node018	node	node018	
omf	omf.nitos.node019	node	node019	
omf	omf.nitos.node020	node	node020	
omf	omf.nitos.node021	node	node021	
omf	omf.nitos.node022	node	node022	
omf	omf.nitos.node023	node	node023	
omf	omf.nitos.node024	node	node024	
omf	omf.nitos.node025	node	node025	
omf	omf.nitos.node026	node	node026	
omf	omf.nitos.node027	node	node027	

Aggregated Measurements



OpenLab use mixing wireless techs

Demonstration



Key technologies for federation

	Component	Description	Technology	Language
TESTBED	**SFAWrap**	Control plane management	SFA	Python
	OMF RC	Experimental plane management	FRCP	Ruby
	TopHat	Measurement plane management – Interconnect measurement systems	Manifold	Python
	sfatables	Policies	SFA	Python
USER	**MySlice**	Federation portal – Web GUI (+ API + library) support experiments from setup through completion Glu between existing services, with a tight integration of measurements and monitoring.	Manifold	Python, HTML5, JS
	NEPI	Tool allowing users to design and run experiments	ssh FRCP Manifold	Python
	OMF EC	OMF Experiment Controller	FRCP	Ruby

Get started with MySlice

- http://myslice.info
- http://trac.myslice.info/
- git://git.onelab.eu/myslice.git

More information

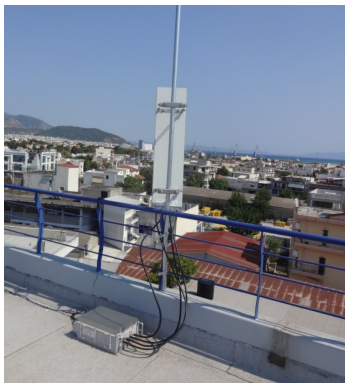
- http://www.ict-openlab.eu/
- http://www.onelab.eu/
- http://nitlab.inf.uth.gr/NITlab/index.php/testbed
- http://www.ict-fire.eu/home.html
- http://www.fed4fire.eu/
- http://f-lab.fr/
- http://new.fit-equipex.fr/
- http://www.geni.net/
- http://www.ict-fire.eu/home.html
- http://fibre-ict.eu

Where are FIT's testbeds?

Wi-fi mesh testbed

Cognitive radio testbed

Embedded communication objects (ECO) testbed



FIT Technology for IoT

1024 nodes at the Inria Grenoble site,

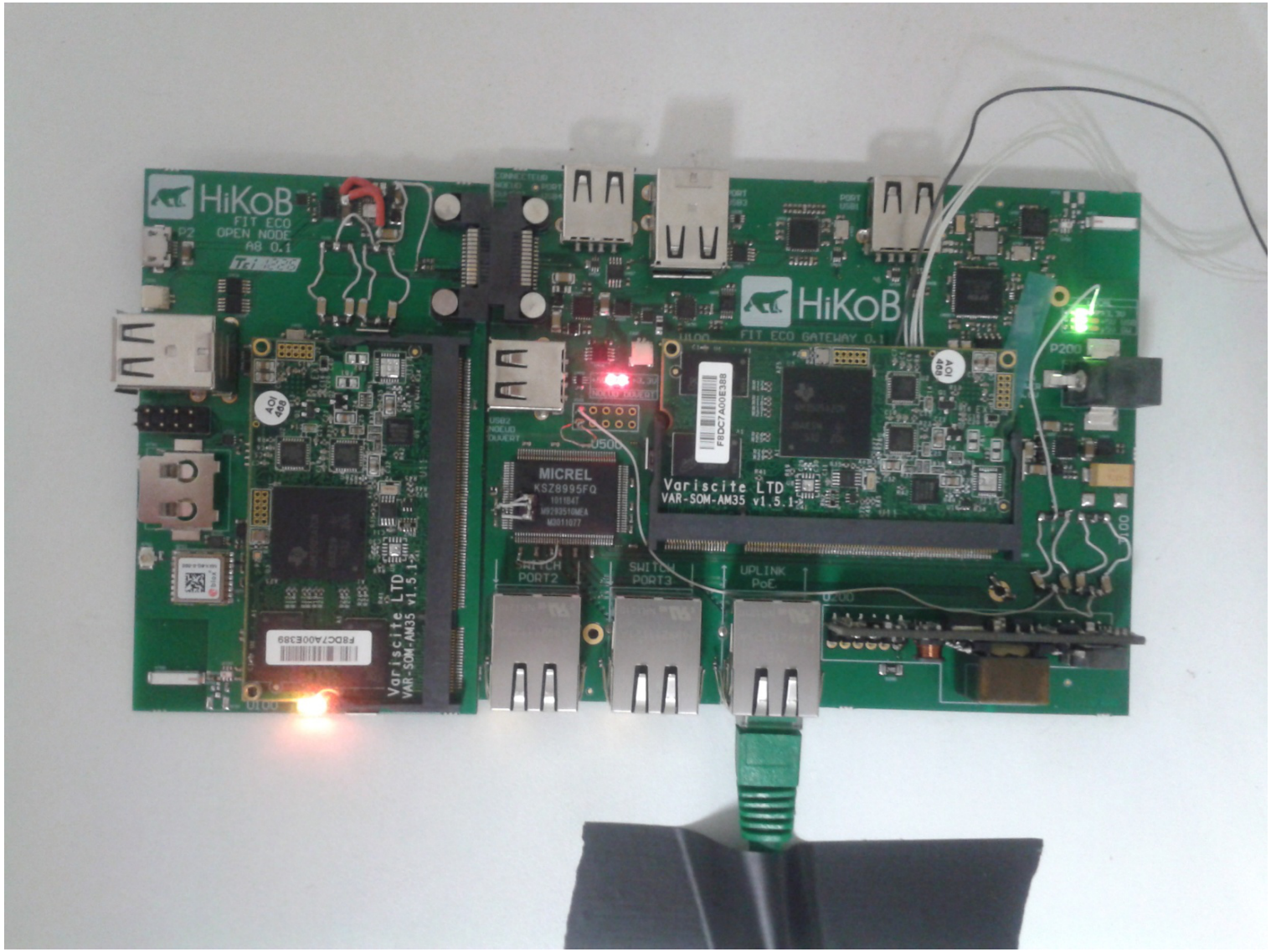
656 in Inria Lille

512 nodes in Inria Rocquencourt,

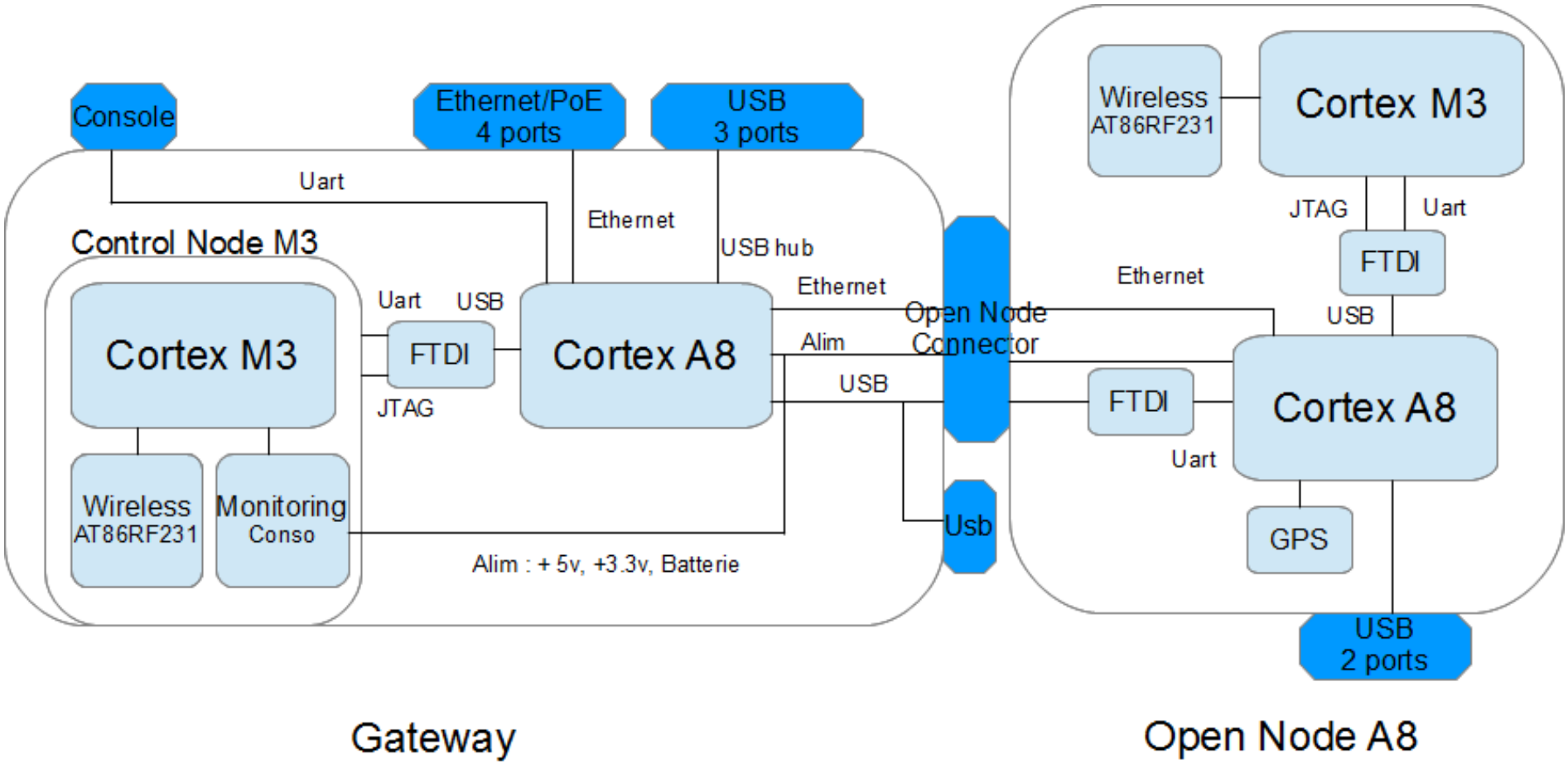
512 in Strasbourg.

128 nodes at Institut Mine Telecom

IoT-LAB Node ARM A8



IoT-LAB Node A8 Architecture



Infrastructure : Mobile nodes

- Lille : 200 m^2, 64 robots
  - wifiBot
- Strasbourg: 250 m^2, 96 rob
  - TurtleBot 2
- Grenoble: 2 aisle of a building, 8 rob
  - Roomba / random trajectories
  - TurtleBot 2 / planed trajectory with Kinect