Brazilian Testbed for Future Internet (FIBRE) and the Research Opportunities Between the US and Brazil

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Miami, January 8th 2014

Index

- PICO Presentation
- FIBRE at a Glance
- Results
- Research & Cooperation Opportunities
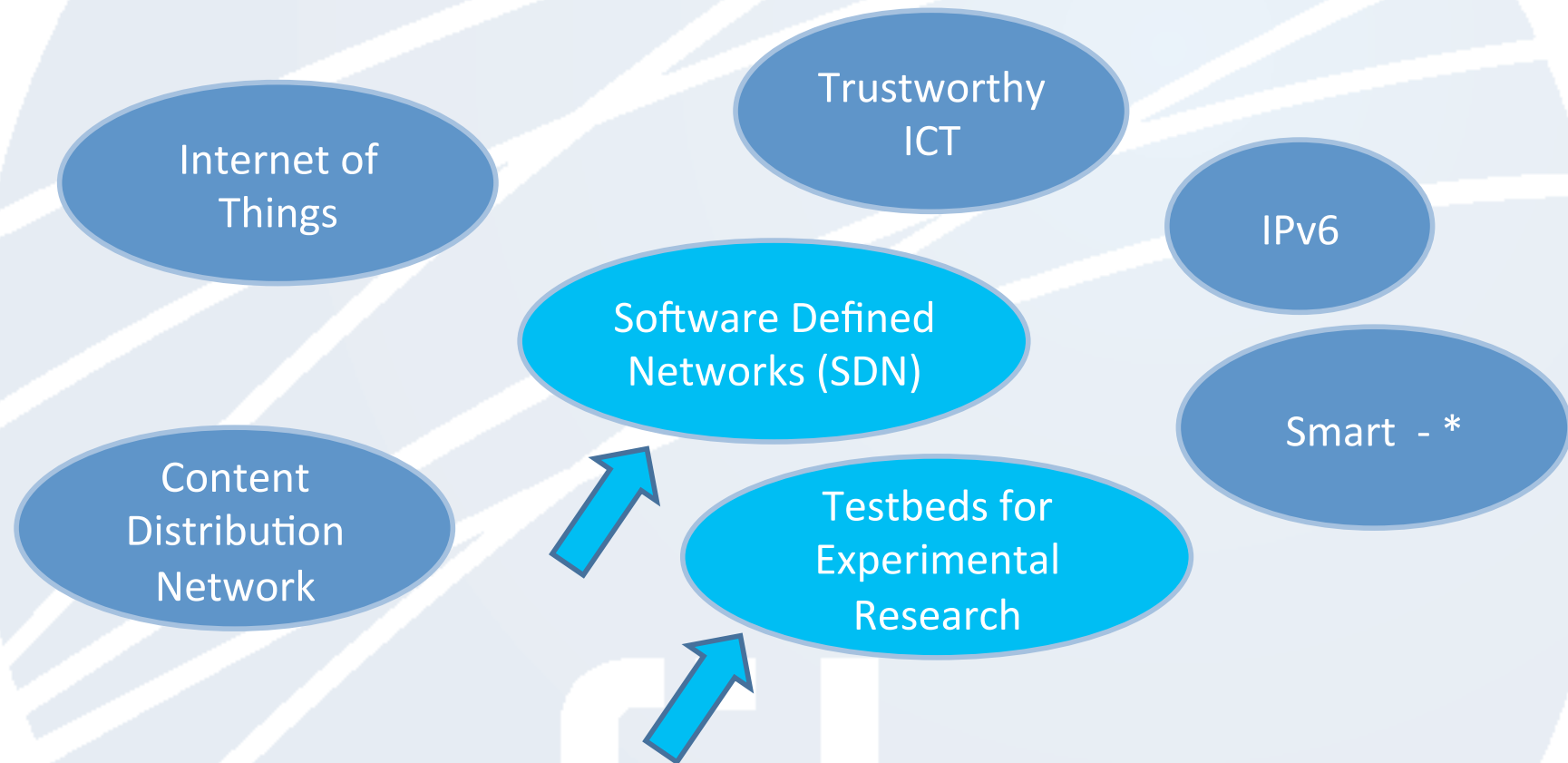- Conclusions

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- Associate Professor at Federal University of Pará (UFPA)

- President-Director of Guamá Science and Technology Park

- Coordinates the Research Group in computer networks and multimedia communication (GERCOM)

- The Brazilian coordinator of the FIBRE project.

Index

- PICO Presentation
- **FIBRE at a Glance**
- Results
- Research & Cooperation Opportunities
- Conclusions

4

Future Internet related topics.
Where are we?

Internet of Things

Trustworthy ICT

IPv6

Software Defined Networks (SDN)

Content Distribution Network

Testbeds for Experimental Research

Smart - *

First ICT EU-Brazil coordinated call, 2011

Five projects with a joint financing of €10M

Theme	Selected project	URL
Microelectronics/ Microsystems	PodiTrodi	www.poditrodi.org
Networked Monitoring and Control	BEMO-COFRA	www.bemo-cofra.eu
Future Internet: Experimental Facilities	FIBRE	www.fibre-ict.eu
Future Internet: Security	SECFUNET	www.secfunet.eu
e-Infrastructures	EUBrazilOpenBio	www.eubrazilopenbio.eu

Main Goal

Create a common space between the EU and Brazil

for

Future Internet (FI) experimental research

into

network infrastructure and distributed applications,

by

building and operating a federated EU-Brazil Future internet experimental facility

The project designed, implemented and validated a shared Future Internet research facility between Brazil and Europe, supporting the joint Future Internet experimentation of European and Brazilian researchers

Project at a glance

- Activities
  - The project was structured in six main activities
  - Three test beds
- Budget
  - Requested to the EC 1.09M€
  - Requested to CNPq MR$ 2.3
- Duration
  - Start date: October 1st , 2011
  - End date: October 31th, 2014.
- 16 partners
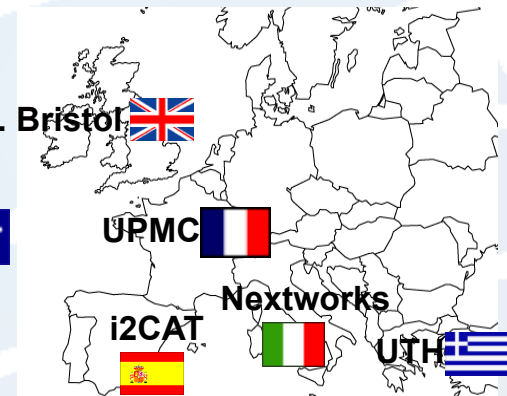 - FIBRE-EU 6 members
  - FIBRE-BR 10 members

Partners

- **FIBRE-EU**
  - i2Cat, Coordinator   Spain
  - Nextworks (NXW)   Italy
  - Universite Pierre et Marie Curie (UPMC) France
  - University of Bristol (UnivBRIS)   U. Kingdom
  - University of Thessaly (UTH)   Greece
  - National ICT Australia Limited (NICTA) Australia

- **FIBRE-BR**
  - Federal University of Pará (UFPA), Coordinator
  - Brazil's National Education and Research Network (RNP)
  - Telecommunications Research and Development Centre (CPqD)
  - Fluminense Federal University (UFF)
  - Federal University of Goiás (UFG)
  - Federal University of Sao Carlos (UFSCar)
  - Federal University of Rio de Janeiro (UFRJ)
  - Salvador University (UNIFACS)
  - University of Sao Paulo (USP)
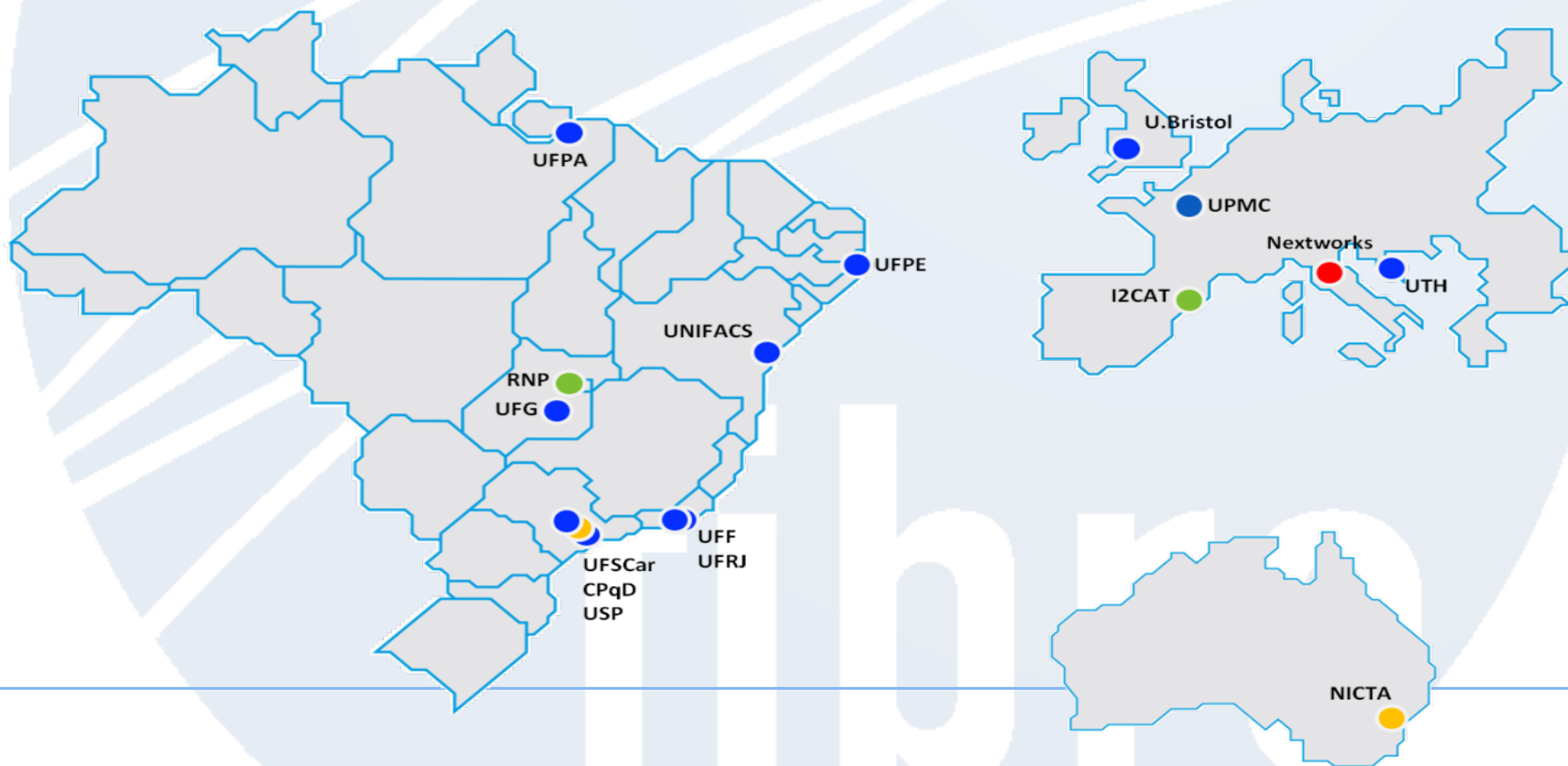 - Federal University of Pernambuco (UFPE)
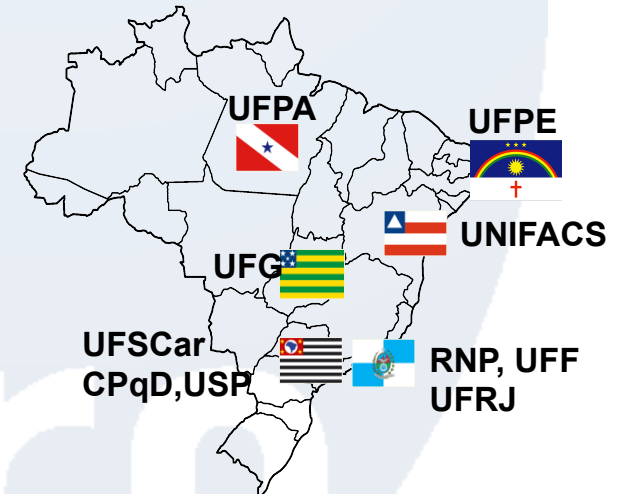
Partners Profile

- Universities, research centers and SMEs participate in the FIBRE project

Index

- PICO Presentation
- FIBRE at a Glance
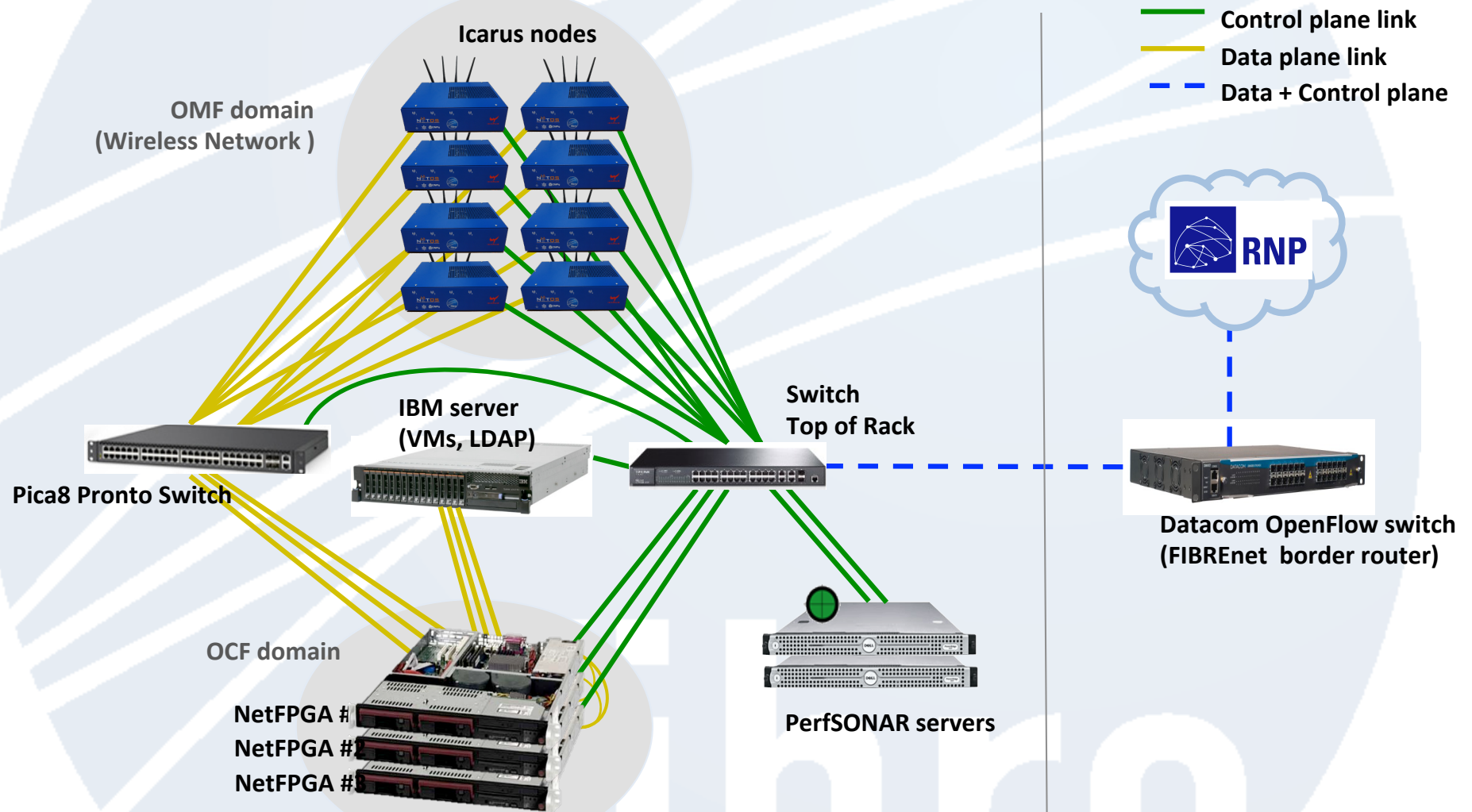- **Results**
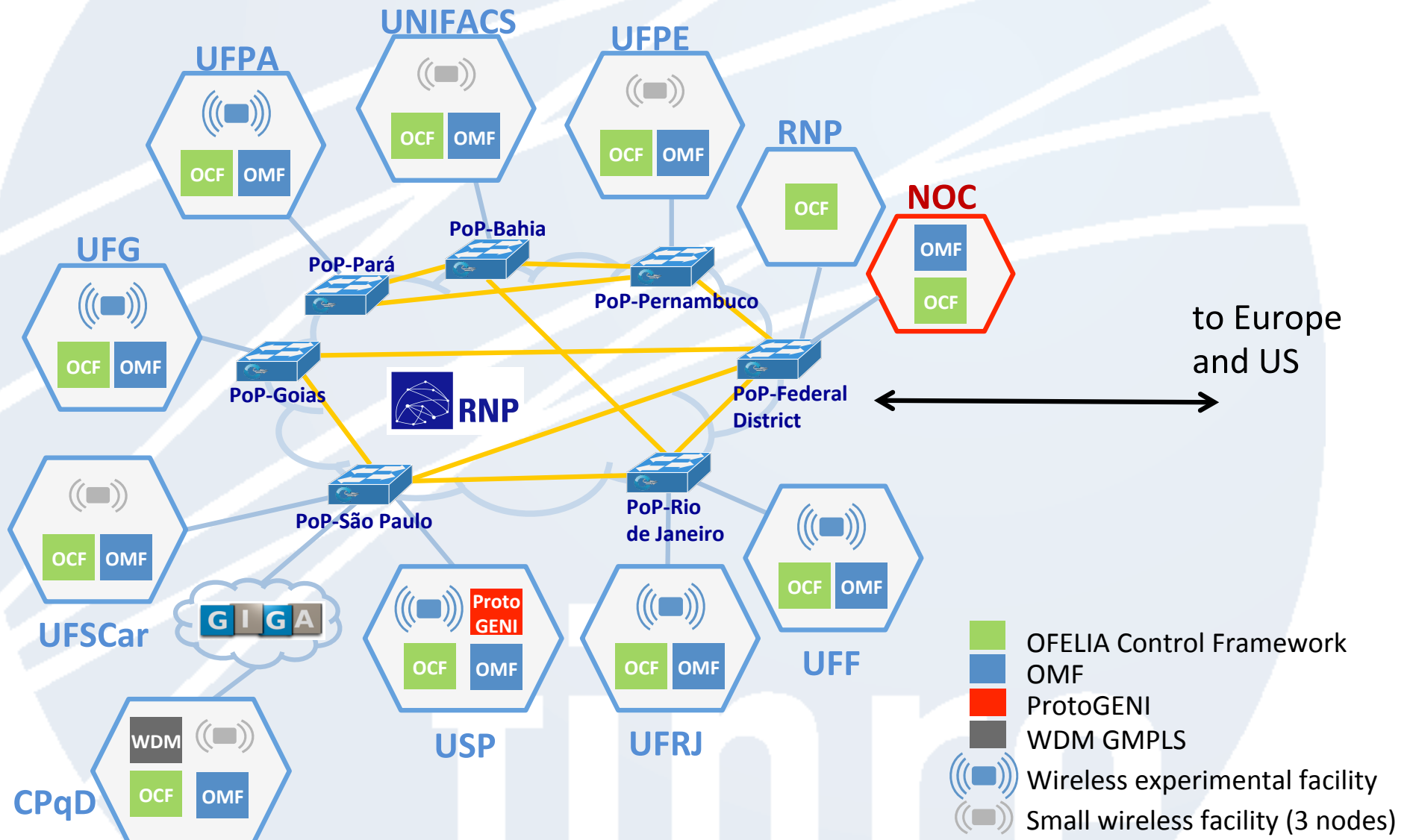- Research & Cooperation Opportunities
- Conclusions

Fibre BR Testbed

- An experimental Brazilian infrastructure of the future Internet research for researchers and advanced users have been designed and deployed

- The infrastructure is composed of:

  ✓ Ten heterogeneous islands with a wire and wireless network infrastructure interconnected by high capacity network

  ✓ Three control frameworks, OMF, OCF and ProtoGeni, managing the infrastructure

  ✓ A federation of resources, looking like a single entity

  ✓ A single FIBRE portal that expose the federated virtual resources of any islands to the researchers or advanced users

  ✓ An integrated monitoring and measuring system

  ✓ A management system centralized at RNP

The structure of a typical Brazilian Island

Icarus nodes

OMF domain
(Wireless Network)

Control plane link
Data plane link
Data + Control plane

RNP

IBM server
(VMs, LDAP)

Switch
Top of Rack

Pica8 Pronto Switch

Datacom OpenFlow switch
(FIBREnet border router)

OCF domain

NetFPGA #1
NetFPGA #2
NetFPGA #3

PerfSONAR servers

Istitution   RNP's PoP
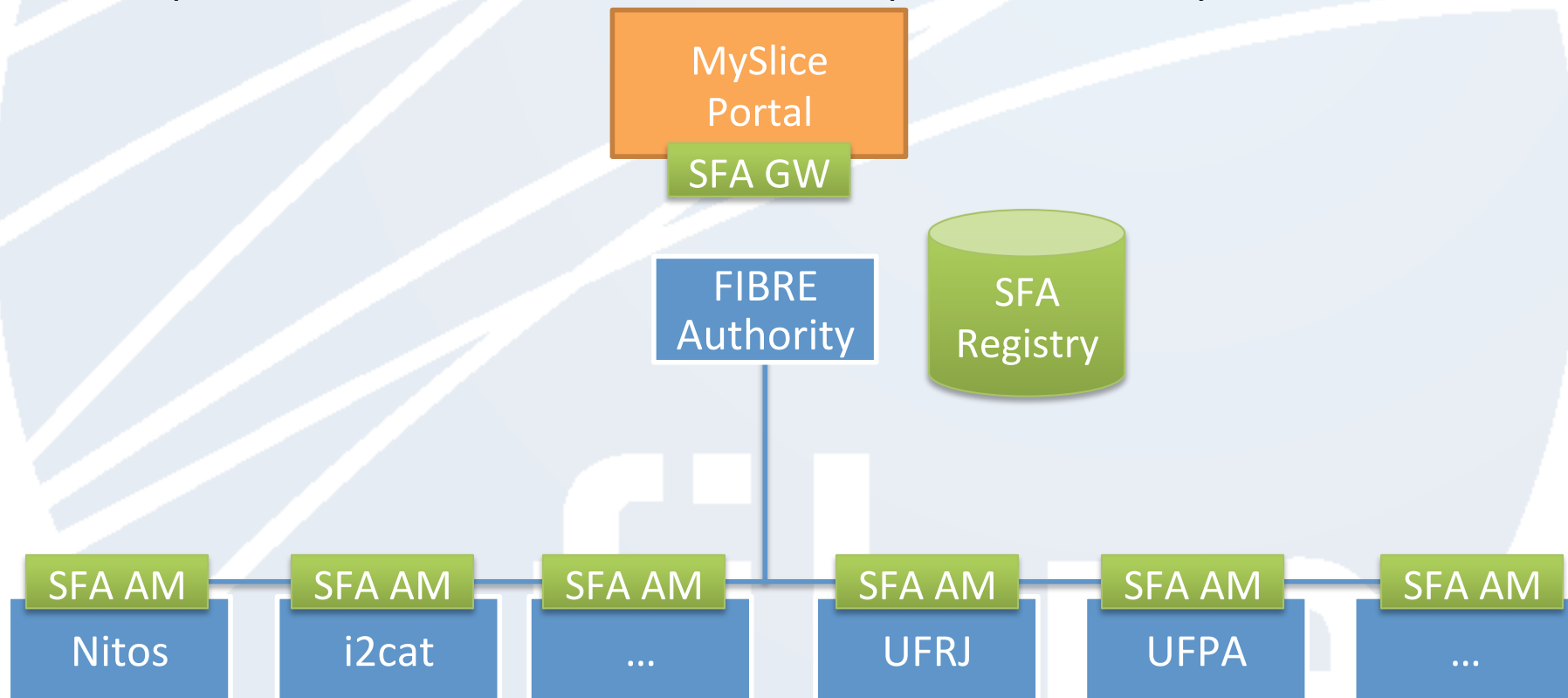
13

FIBRE BR testbed

14

Federation architecture

- FIBRE federates EU and Brazil research infrastructures creating an intercontinental multi-domain, multi-layer and multi-technology Future internet experimental platform:

FIBRE portal is located at RNP with the top-level authority

Federation Portal

Experiment workflow
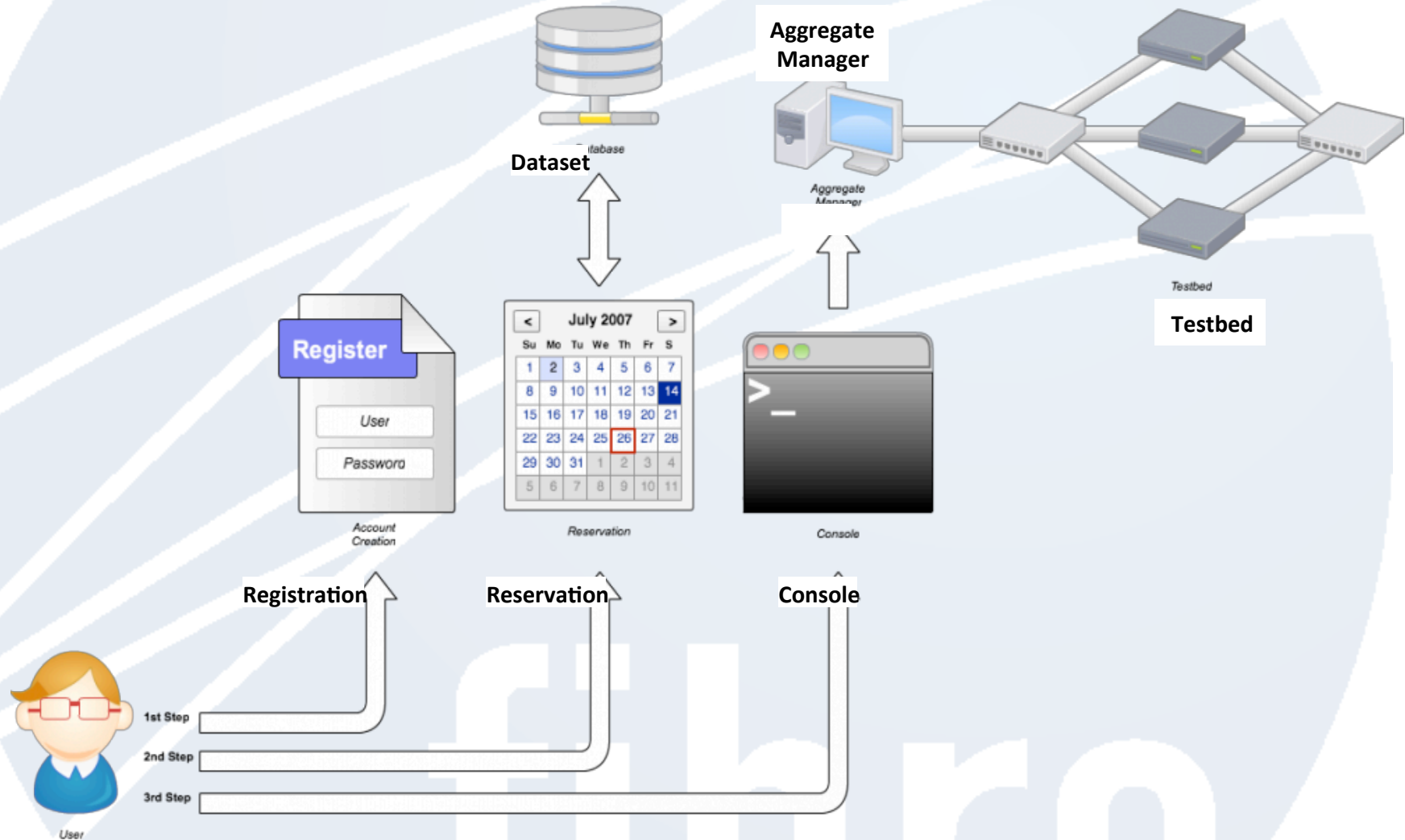
Components of the FIBRE architecture
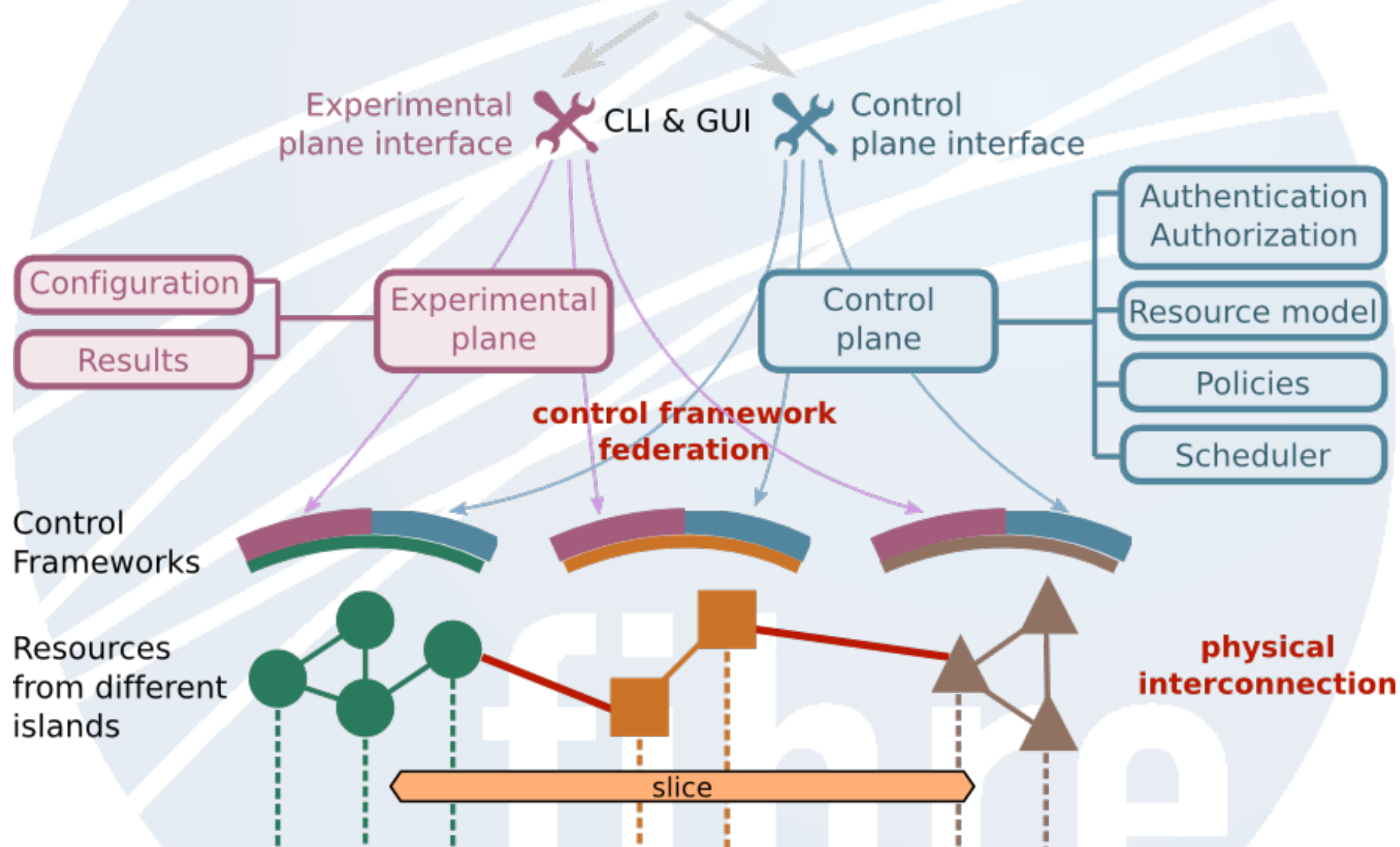
Some results: impact

Index

- PICO Presentation
- FIBRE at a Glance
- Results
- **Research & Cooperation Opportunities**
- Conclusions

Benefits

- FIBRE was a important project in international collaboration in Future Internet
  - Demonstrated local capacity to collaborate with leading projects in this important area
  - Provided local experimental facilities for validating and demonstrating new FI proposals
  - Provided opportunity for extension to and participation by researchers from other countries
  - Promoted involvement of and technology transfer to the industrial sector, to prepare for Future Internet needs, especially involving OpenFlow and SDN approaches.

Future Internet related topics.
Research & Cooperation Opportunities

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Testbeds for Experimental Research
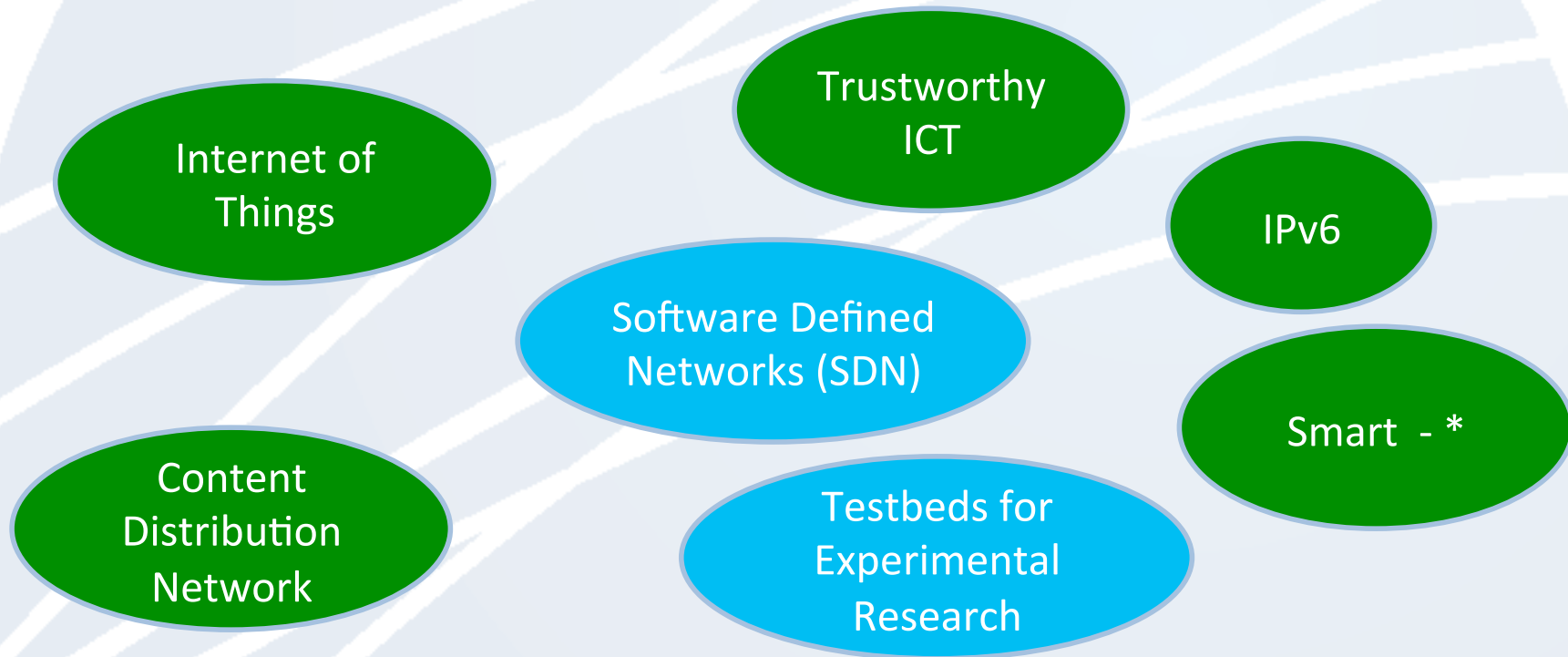
#1: Interoperation of Testbeds and offers it as a Service

- Objective:
  - Provide the network research community with the ability to rapidly and easily create experimental networks to test novel concepts at scale.

- Why do we need it ?
  - To reduce research ramp up time;
  - To provide production service personnel with first hand experience with emerging technologies;
  - To help to understand what happens in real networks and how to better design/manage them.

#1: Testbed as a Service

- The testbed need to be offered "as a service" with:
    - *dynamic circuit fabrics/service;*
    - *Nodes with novel hardware such as OpenFlow switching or novel transport interfaces;*
    - *open cloud computing (OpenStack)*
    - *Common inter-Domain Virtualized Resource Management Protocol;*
    - *Dark Fiber Testbeds (why not).*

Recent Results

- Brazilian representatives from FIBRE WP2 participated at an international meeting held in the US on July 23rd, 2013 to discuss effective interoperation of national/continental testbeds in different countries.

- Participants included:
  - US: GENI
  - EU: OFELIA, G-Lab, Fed4Fire
  - Japan: VNODE
  - Australia: NICTA
  - Brazil: FIBRE

- Decided to work towards effective interoperation (federation) with preliminary results soon.

#2: Federated Cloud Infrastructure

- Objective:
  - Build strong foundations for a federation framework by investigating emerging technologies and Software Defined Networking control frameworks for the practical applicability.

- Why do we need it ?
  - To explore federated policy management, federation of authorization and authentication infrastructures, formal description and brokerage of cloud resources within a federation of FI platforms running over SDN.

  - To ensure interoperability and maximum connectivity of users and services, to encourage strong competition of infrastructure, network, and service providers, and maximize speed and reliability of communications with an efficient usage of the underlying infrastructure.

#3: Future Internet of Things

- Objective:
  - Build a open large-scale testing infrastructure for systems and applications on wireless and sensor communications.

- Why do we need it ?
  - Wireless sensor networks (WSNs) have a significant potential in diverse applications;
  - The real-world adoption of large-scale WSNs is quite slow particularly due to the lack of robustness of protocols at all levels;
  - Large-scale WSNs play a key role in IoT.

Alternatives to fund it?

- Through Cooperation between individual researchers
  - "easy" to implement
  - require that researchers have financial resources or equipment
  - Not scalable

- Through Institutional cooperation project
  - Require align interests of project partners
  - National Research Centers or Foundation for Research Support (FAPs)
    - Foundation for Research Support of the States (FAPs)
    - Brazilian Research and Education Network – RNP
    - NSF
  - Industry

- Through cooperation between Brazil and US
  - Require agreement between representative
  - Many alternatives:
    - Collaborations call between Brazil and US

Index

- PICO Presentation
- FIBRE at a Glance
- Results
- Impact, Links & Cooperation
- **Conclusions**

Conclusions

- FIBRE was a showcase project in international collaboration in Future Internet
  - Provide local/global experimental facilities for validating and demonstrating new FI proposals
  - Demonstrate local capacity to collaborate with leading projects in this important area
  - Provide opportunity for extension to and participation by researchers from other countries
  - Promote involvement of and technology transfer to the industrial sector, to prepare for Future Internet needs, especially involving OpenFlow and SDN approaches
- Opens research opportunities between Brazil and US

FIBRE Brazilian Team

Thank you for your attention

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