FIT EQUIPEX

Future Internet (of Things) - FRANCE

INTERNET DU FUTUR : OBJETS COMMUNICANTS M2M

Timur Friedman, UPMC

Innovation pathways

Various paths to innovation, especially those related to exploring the future internet, using experimentally driven research, prototyping and living labs (user in the loop).

geni
Exploring Networks of the Future

GLab
www.german-lab.de

FIRE

互联网应用创新开放平台联盟
INTERNET INNOVATION UNION

Deploying real applications

- **Build new protocols / applications**
  - specification / design
  - simulation
  - experimentation
- **Large scale in situ experimentation is a nightmare**
  - Fastidious for a dozen of « nodes »
  - Manual handling / time consuming / boring
- **Needs to have a specific scientific tool**
  - Reproducibility is a key factor
  - Scientific experiment

FIT in a nutshell

- **5 partners:**

- **Ambition**: create a first-class ***international*** facility to promote experimentally driven research and to facilitate the emergence of the Internet of the future.

- **Goal**: meet the advanced ***user*** requirements (multiple environments, integration tests, reproducibility, education, …).

- **User driven –** Members of the Steering Committee:
  - Alcatel-Lucent Bell Labs France: Olivier Audoin
  - Orange: Prosper Chemouil
  - Thales: Martine Lapierre

- **Grand Emprunt funding:**
  - 5 M€ Investment (4 years) + 0.8 M€ Operation (6 years 10 months).
  - 22/2/2011 to 31/12/2019 (Effective T0 at 1/6/2011)

FIT in a nutshell

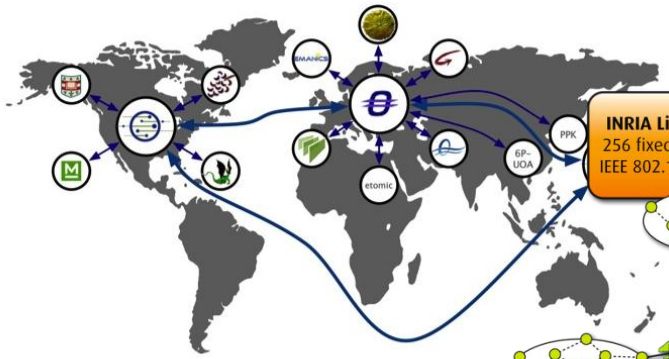
- ***Networked distributed facility*, heterogeneous devices, complementary components, adequate/relevant locations.**
- **A strong and experienced team:**
  - PlanetLab_Europe (PLE), SensLAB
- **4 complementary sets:**
  - Embedded Communication Objects Testbed,
  - Cognitive Radio Tesbed,
  - Wireless OneLab Testbed
  - Network Operations Center (including PLE)
- **9 sites:**
  - Paris (2), Evry, Rocquencourt, Lille, Strasbourg, Lyon, Grenoble, Sophia Antipolis.

A visible Facility

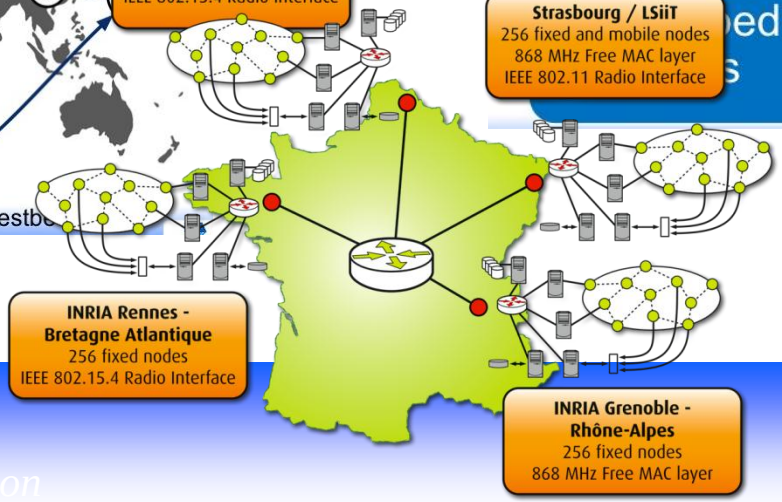
Fitting: KIC ICT Labs Success Story

OneLab testbed federation

OneLab



OneLab's worldwide federation of testbe



OneLab's offers:

OneLab
FUTURE INTERNET TEST BEDS

For testbed users	• **Testbed access** Carry out your networking experiments on OneLab's federation of testbeds
For platform builders	• **Testbed components** Build your own network-based platforms and testbeds using OneLab's specialised building blocks
ed s	• **Testbed federation** Federate your testbed with the OneLab facility

SEVENTH FRAMEWORK PROGRAMME

FIT and its ecosystem

FIT EQUIPEX
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Senslab
Very large scale open wireless sensor network testbed

F-Lab

OneLab
FUTURE INTERNET TEST BEDS

eit Knowledge & Innovation Community
EIT ICT Labs

OpenLab

SensLAB, F-Lab: ANR funded projects
http://www.senslab.info/, http://f-lab.fr/

OneLab: EU Fire facility, multiple sources of funding such as Onelab, OpenLab and KIC ICT Labs Fitting
http://www.onelab.eu/, http://ict-openlab.eu/

Experimental testbed referenced in
ANR Calls
FUI Calls

MINISTÈRE DE L'ENSEIGNEMENT SUPÉRIEUR ET DE LA RECHERCHE
INVESTISSEMENTS D'AVENIR

Equipment's structure

Element	status	Maturity	standards
PART I: Network Operations Center (NOC)			
Element 1: NOC @ UPMC Paris site	extension	mature	yes
PART II: Cognitive Radio Testbed			
Element 2: Cognitive radio testbed @ INSA Lyon site	new	mixed	yes
PART III: Embedded Communication Objects (ECO) Testbeds			
Element 3: ECO testbed @ INRIA Grenoble site	extension	mixed	yes
Element 4: ECO testbed @ INRIA Rocquencourt site	extension	mixed	yes
Element 5: ECO testbed @ INRIA Lille site	new	mixed	yes
Element 6: ECO testbed @ LSIIT Strasbourg site	new	mixed	yes
Element 7: ECO testbed @ Institut Telecom Paris site	new	mixed	yes
PART IV: Wireless OneLab Testbeds			
Element 8: Wireless OneLab testbed @ UPMC Paris site	new	mature	yes
Element 9: Wireless OneLab testbed @ INRIA Sophia Antipolis site	new	mature	yes
Element 10: Wireless OneLab testbed @ Institut Telecom Evry site	extension	mature	yes

Usage scenario

FIT Usage

- Use Cases

Quelques objectif pour le M2M

- **Relever les chalenges**
  - M2M / passage à l'échelle
  - Internet des objets / hétérogènes
  - ouvrir les possibles

- **Design / test / déploiement / monitoring**
  - Applications / protocoles / couche MAC / radio

- **Offrir des scénarios larges / hétérogènes**

M2M scénario

Home Gateway Application

- Managment / monitoring of cloud Android nodes
- FULL end to end IP solution
- Test services development for Telco
- Réservation de « nodes » + OneLab « slices »

M2M scénario

The network is the database

- Several ECO sites linked to Internet / P2P application
- IP6 de bout en bout
- Routage FULL IPV6
- Réservation de « nodes » + OneLab « slices »

M2M scénario

Android in cloud

- Virtualisation / Cloud / Scalabilité
- Déploiement de machines virtuelles
- Test services development for Telco
- Réservation de « nodes » + OneLab « slices »

Infrastructure component

ECO testbed

- **Embedded Communication Object (ECO)**
  - Eric Fleury, INRIA

ECO rationale and objectives

- **Target and challenge**
  - M2M / scaling
  - Internet of Things (heterogeneous)

- **From “sensors” to actuators**
- **Design / test / deployment/ monitoring**
- **Propose general and specific use cases**

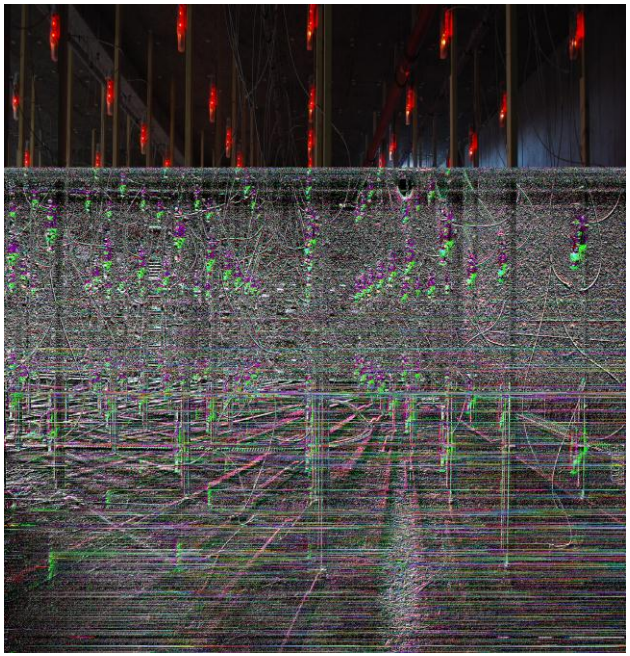
What do you need to run experiments?

A login/password

- Go online & register http://www.senslab.info

At least **one firmware** (in your favorite language / OS)

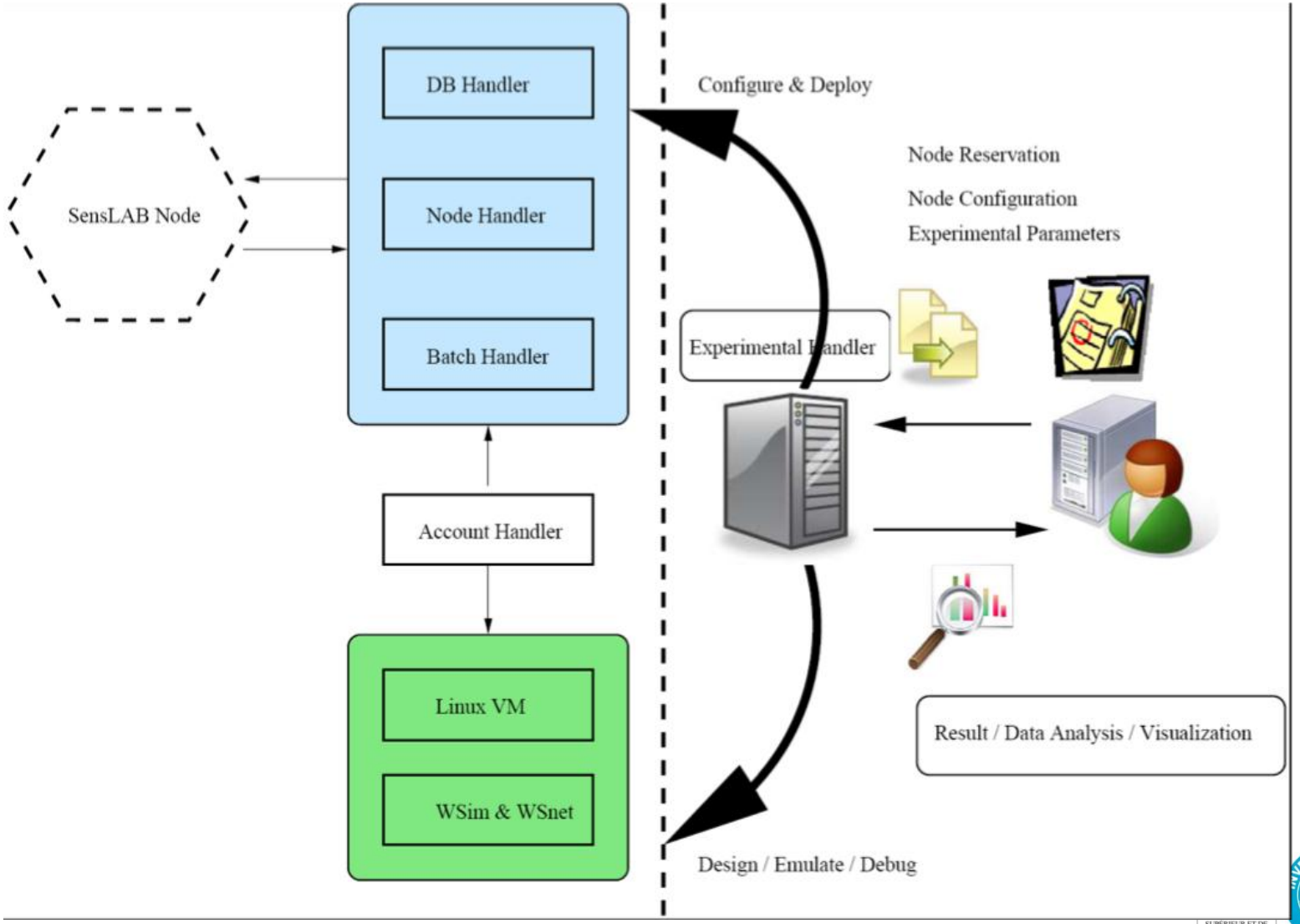
- We provide FreeRTOS, Contiki, TinyOS
- Toolchain: mspgcc, wsim, esimu
- Libraries: MAC Layers, Routing, SimpliciTI...
- Drivers / Communication library
- Contribute to FIT…



A bunch of nodes & slices reserved only for you

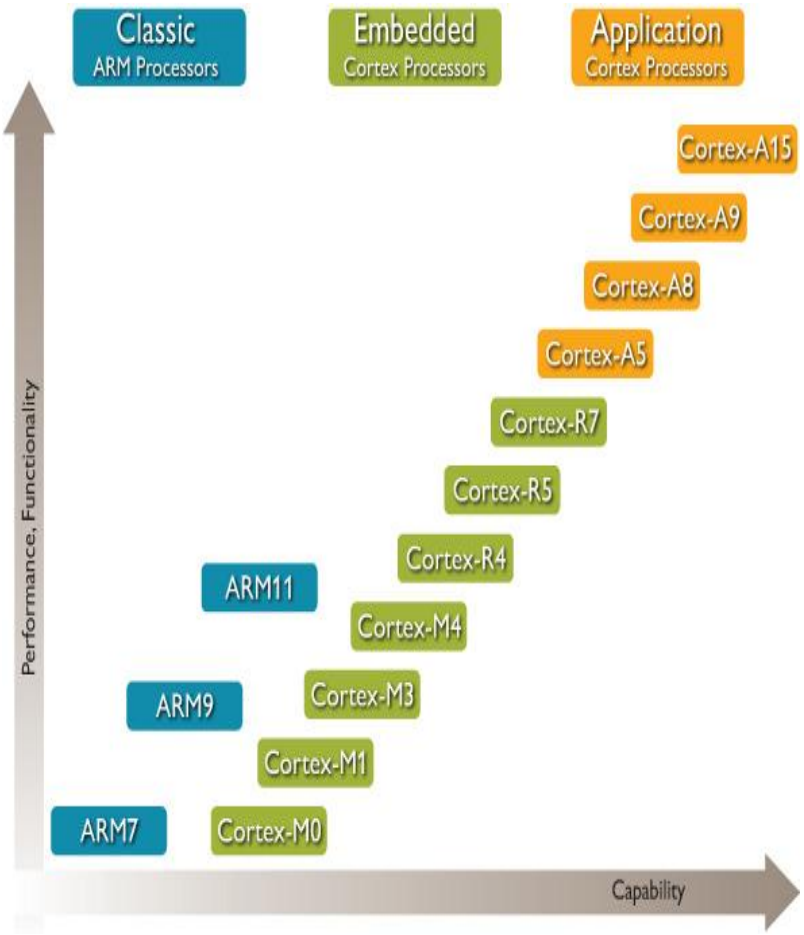
A description of the monitoring you want get

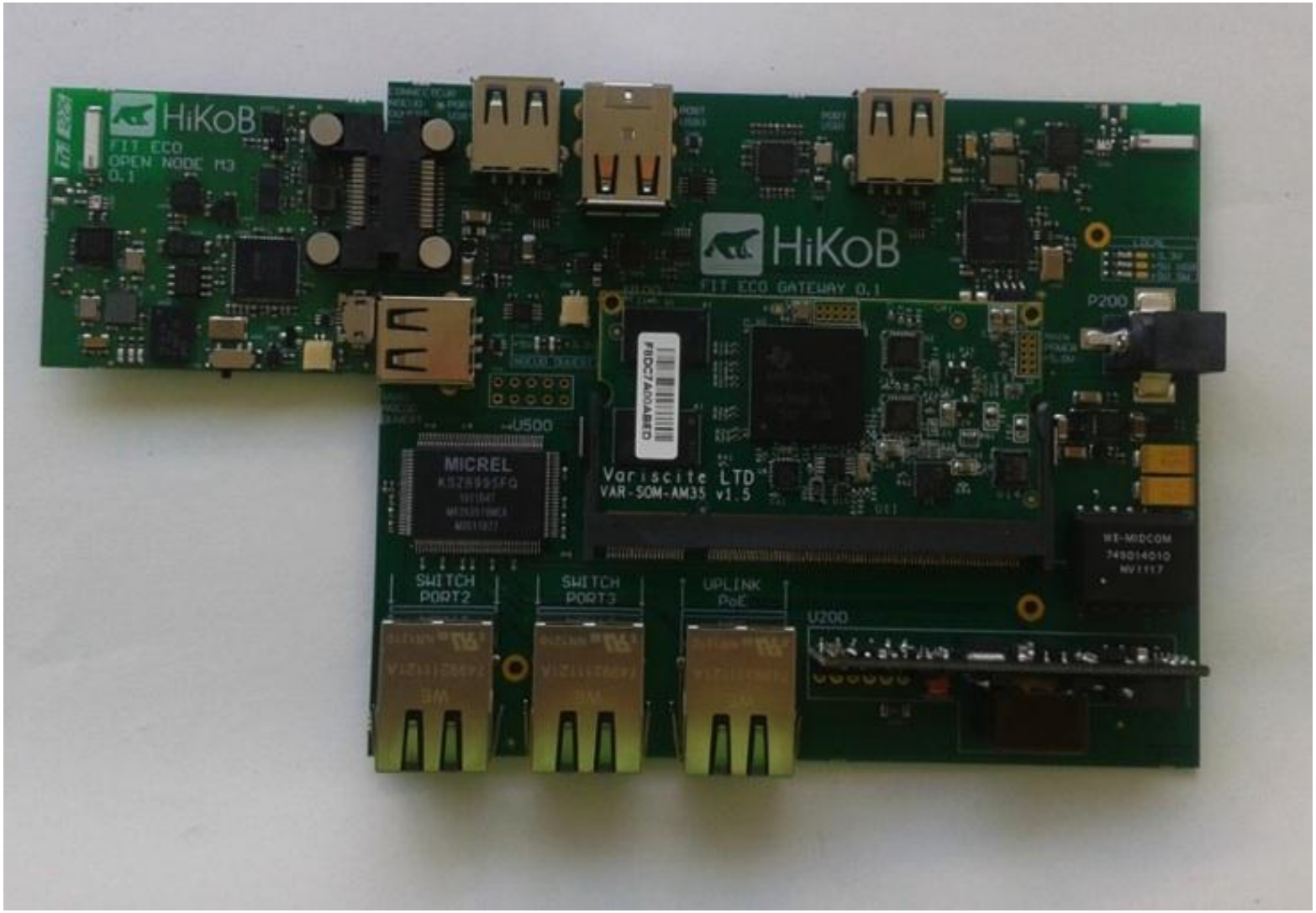
- DB is created for each experiment


DB Handler
Node Handler
Batch Handler
SensLAB Node
Account Handler
Linux VM
WSim & WSnet
Configure & Deploy
Node Reservation
Node Configuration
Experimental Parameters
Experimental Handler
Result / Data Analysis / Visualization
Design / Emulate / Debug

Architecture road map

- **Development of new ECO nodes for all sites**
  - Based on ARM M3 series
    - Easy to program
    - Still low power oriented
  - Based on ARM A series
    - Supports Linux / Android / Chrome
    - Oriented M2M / Smartphones




HiKoB
FIT ECO
OPEN NODE M3
0.1
HiKoB
FIT ECO GATEWAY 0.1
P200
U500
MICREL
KSZ8995FQ
Variscite LTD
VAR-SOM-AM35 v1.5
SWITCH
PORT2
SWITCH
PORT3
UPLINK
PoE
U200

- **Lille : 200 m^2, 64 mobiles**
  - •localisation par pattern + odométrie
  - •Précision de 10cm
- **Strasbourg 250 m^2, 96 mobiles**
  - localisation par tag RFID au sol (en test)
- **Grenoble (2 ailes du bâtiment recherche)**
  - Robot de type roomba / aléatoire
  - Planification de trajectoire avec Kinect.
- **Telecom**
  - Localisation par LED au sol

Services

- Réservation par nœud sur tous les sites (SFA)
- Monitoring de la consommation
- Monitoring des communication zigbee + bibliothèque OML
- Noeuds ouverts pour des partenaires tiers (Lille / Strasbourg / Grenoble)
- Connectivité IPv6 de bout en bout
- Mobilité aléatoire / paramétrable / contrôlable

Global road map / services

- **Fall 2012 : fully connected sensor network platform (P2P experiment on any sensor, global reservation) based on SensLAB nodes.**
- **Spring 2013 : New ECO-NODEs available (ARM-M3, ARM-A8)**
- **Summer 2013 : Large scale mobile nodes**
- **END 2013 : SFA available for reservation**
- **SPRING 2014 : Fully Open IPv6.**
  - FIT ECO + ONELAB reservation
  - M2M and cloud to sensor/HGW

Infrastructure component:

Wireless Onelab testbed

- **Wireless nodes in a real-life environment**
  - Walid Dabbous, INRIA
  - Timur Friedman, UPMC

Wireless Onelab (NITOS) in a few words

- **NITOS wireless testbed integrates *heterogeneous hardware* to provide different communication functionalities under a unified managed infrastructure**
- **NITOS also provisions an *open source-driver* development environment to enable:**
  - Ease of compilation procedure
  - Compatibility support with open-source drivers
  - A simplified procedure for driver~software development
- **Based and already accessible on NitLab**
  - http://nitlab.inf.uth.gr/NITlab/index.php/testbed

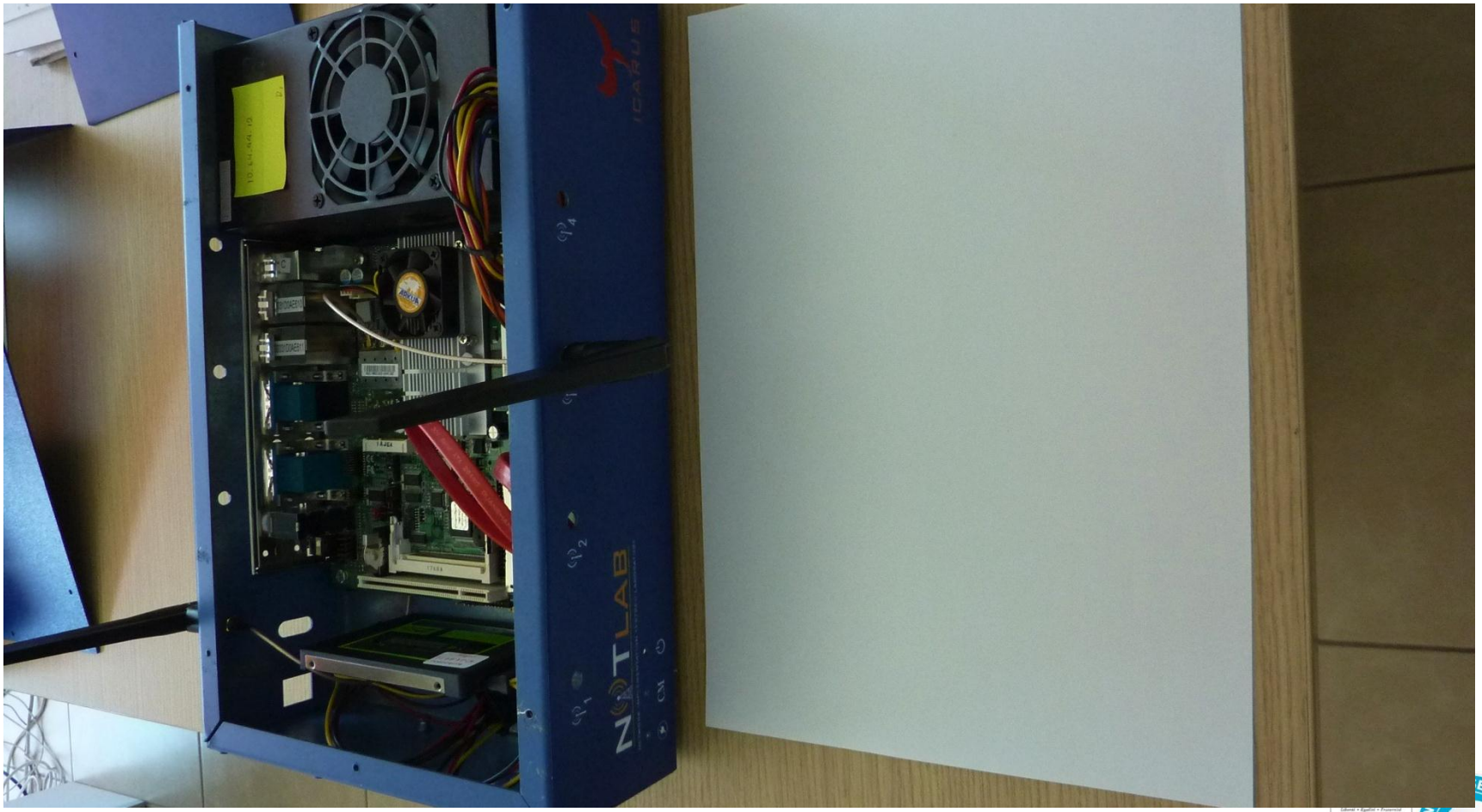
NITOS in a few words (2)

- **The NITOS testbed has the following features:**
  - Heterogeneous hardware (Wi-Fi, …)
  - Remote access (Web based)
  - Scheduler (reservations, slicing)
  - OMF based management
  - Connectivity tool
- **We are working on the interconnection/federation of:**
  - Different wireless testbeds
  - Wireless testbeds and PlanetLab

Wi-Fi Nodes

- **NITOS has developed a framework to support:**
  - Experimentation on MAC-routing schemes
  - Experimentation on Network Coding (N-Crave)
  - Experimentation on traffic scheduling (OPNEX)
  - Experimentation on cooperative networks
  - Video over wireless
  - Sensor wireless networks

Wireless OneLab



Mobile Nodes

- **NITOS extends its management framework for mobile node support, aiming to:**
  - Enable mobility issues and volatile orbits
  - Provide users with experimentation alternatives, enabling diversity issues on multipath fading

Web-Cameras

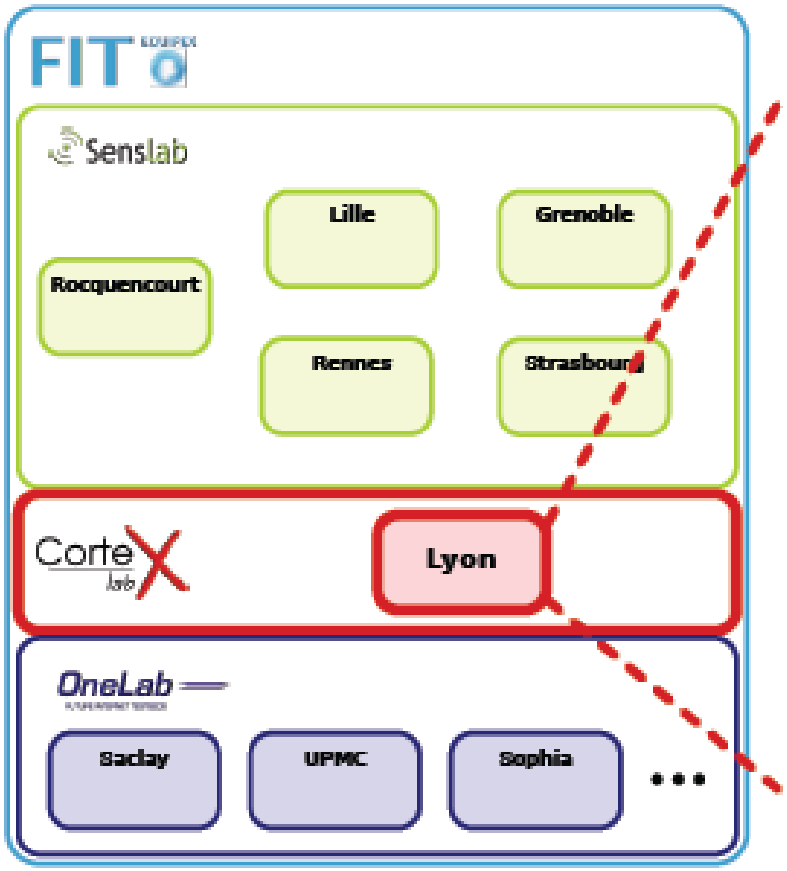
- **NITOS gives the opportunity for conducting video experimentation by:**
  - Monitoring and capturing real time video streams
  - Online/offline video compression using open source software
  - Video transmission over wireless (multihop)
    - Unicast
    - Multicast / broadcast
  - Ability to process video in every node on a multihop route, supporting:
    - Video frames filtering
    - Hop-by-hop video coding
    - Combination with network coding schemes
    - Combination with cooperative schemes

Infrastructure component

COG testbed

- **Radio Cognitive**
  - Jean-Marie Gorce, INSA Lyon

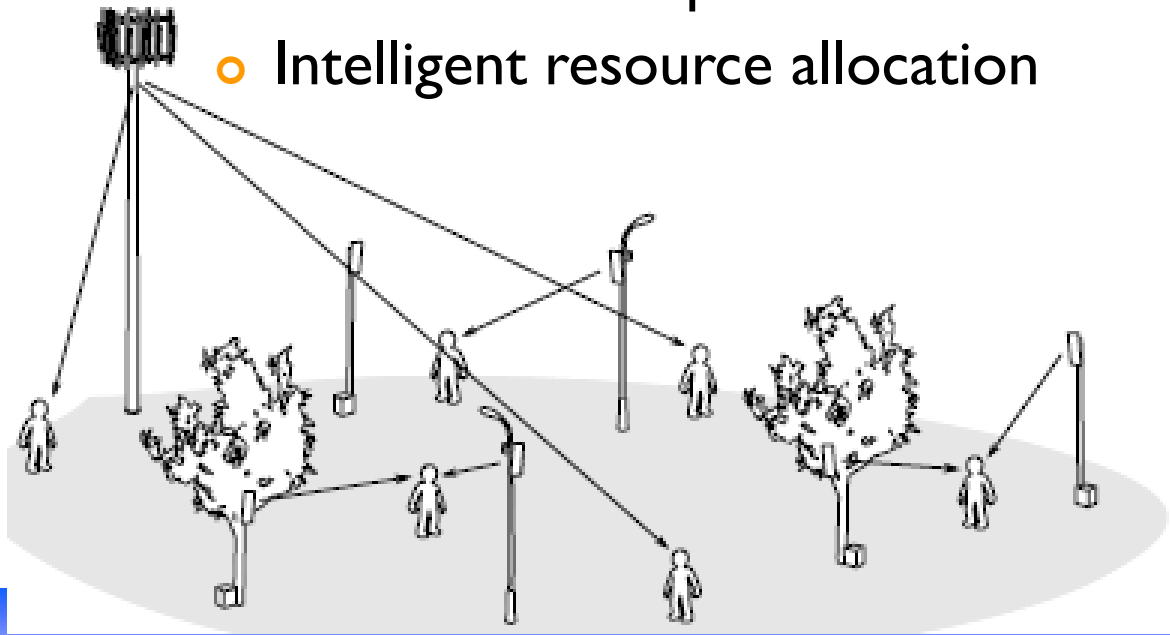
FIT : CorTex LAB



- Scientific goals:
  - Physical layer design and testing
  - Cognitive radio networks
  - Software defined radio
  - State-of-the-art wireless techniques
- Community goals:
  - An open experimentation testbed
  - An easy to use engineering tool
  - Closing the *design loop*

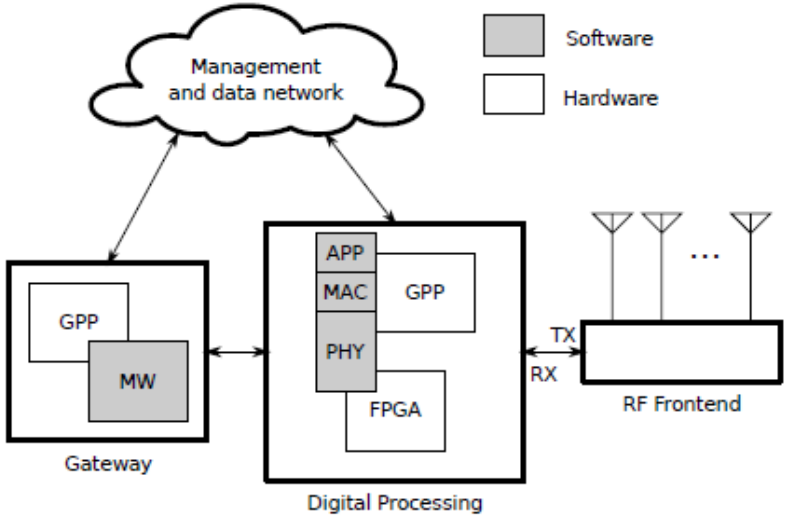
FIT : CorTex LAB

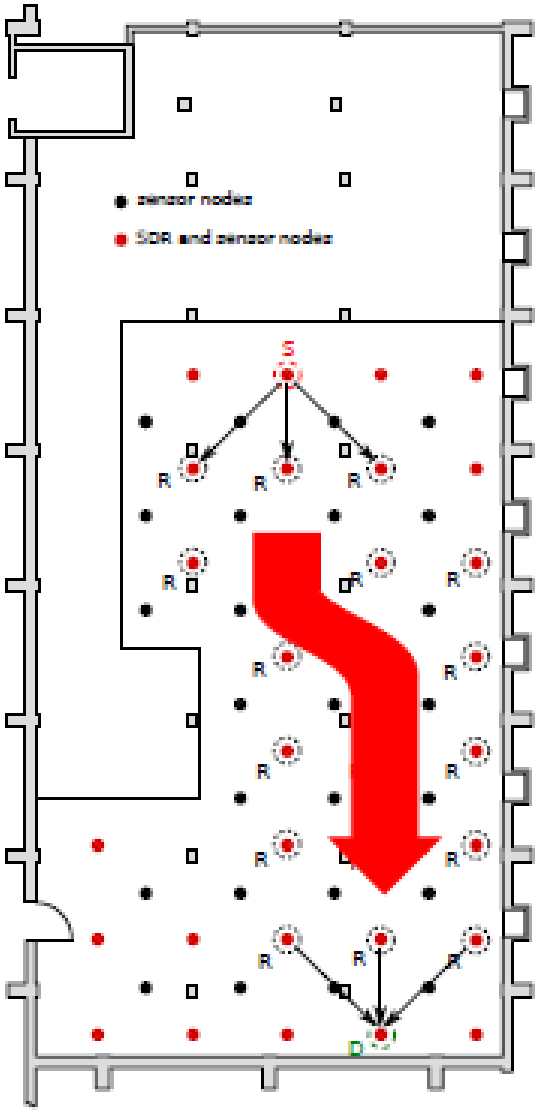
- **Reference scenario : cooperative radios**
- **studying co-existence & cooperative issues of radio equipements**
  - Primary-secondary cognitive radio networks
  - Dynamic spectrum access
  - Inter-nodes cooperation : network/distributed MIMO
  - Intelligent resource allocation



FIT : CorTex Lab

- **Technologies**
  - Shielded room with remote access for studying scenarios without external interference
  - Fully programmable heterogeneous nodes (FPGA, PC units, micro-controller)





Global roadmap / services

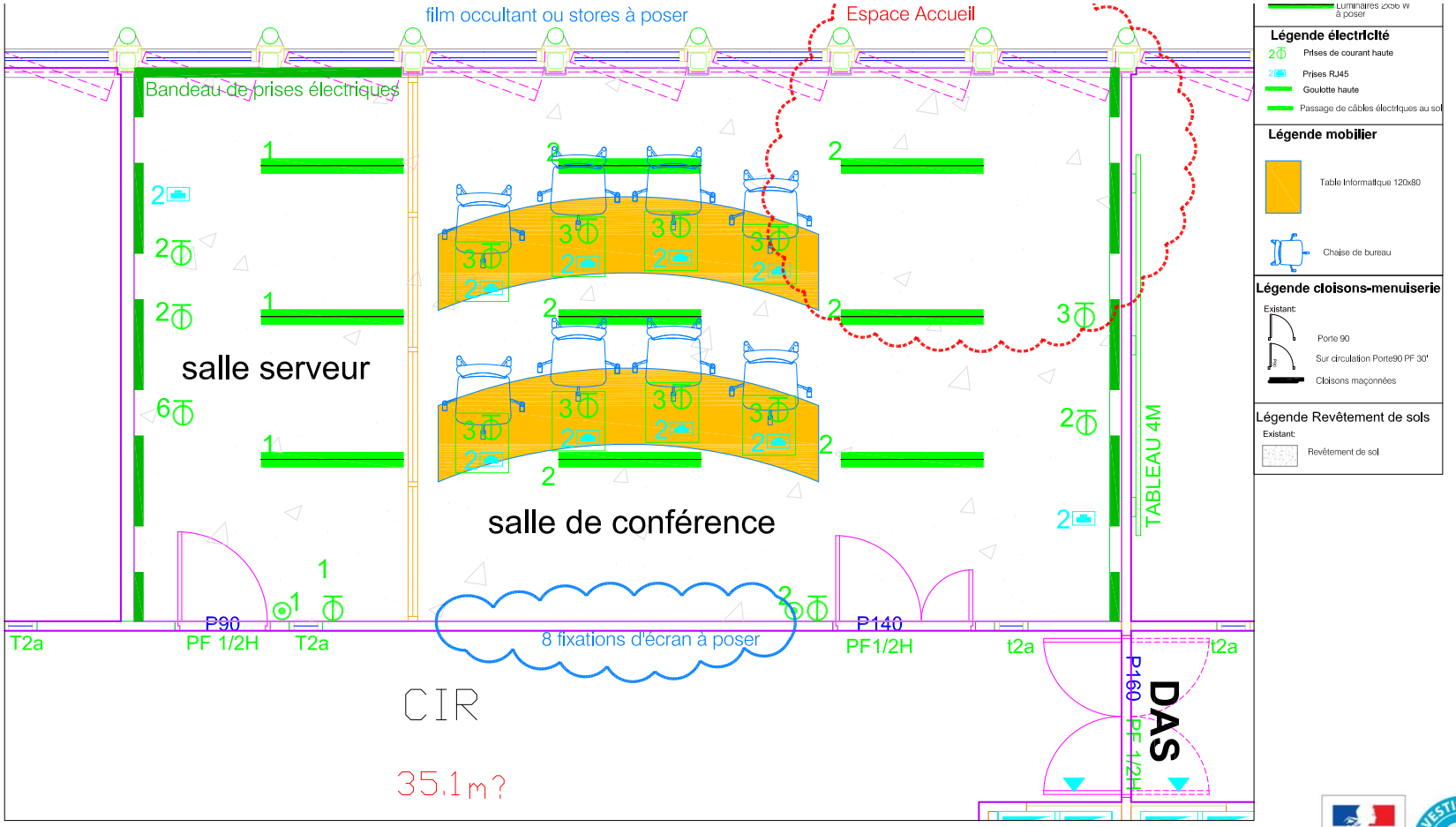
- **Test-bed in a fully virtualized environment : Dec2012**
  - Simulation mode
  - Proof-of-concept (end -to-end chain)
  - Access reserved to selected remote users
- **Simplified initial deployment: April2013**
  - Shielded room : to be ready in december 2012
  - Deployment of a limited amount of nodes
  - Remote access to PC only (FPGA passthrough)
  - Testbed available to the public with limitations (pre-selected radio modes)
- **Full deployment: Dec2013**
  - Deployment of all nodes
  - PC and FPGA developments remotely available
  - Full testbed functionality available to the public

Infrastructure component

NOC

- **Network Operation Center**
  - Timur Friedman, UPMC

NOC



Located at UPMC, co-located with Onelab NOC

FIT NOC

- **Network Operation Center of the FIT facility**
- **Co-located with the OneLab NOC**
  - Access to a larger set of components

- **Operation & Management**
- **Acceptable use policy**
- **Membership agreement**
- **Governance**
  - Evolution of the PLE framework

FIT Evolutions

FIT Roadmap

- User's involvments

Developing synergies

- *Dissemination*
- *Tutorials and hands-on*

- *Understand users' needs*
- *Possibility to provide requirements to the facility*

- *Deploy Toy Scenarios*
- *Use software components*
- *Real testing*
- *Identify means to interact*

More Information

- **http://fit-equipex.fr/**

ainsi que :

- **http://www.onelab.eu/**
- **http://nitlab.inf.uth.gr/NITlab/index.php/testbed**
- **http://www.ict-openlab.eu/**
- **http://f-lab.fr/**
- **http://www.geni.net/**
- **http://www.ict-fire.eu/home.html**
- **http://www.german-lab.de/**
- **http://www.iiu.edu.cn/**