FIT EQUIPEX

Future Internet (of Things) - FRANCE

OWF

Nathalie Mitton, Inria

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.

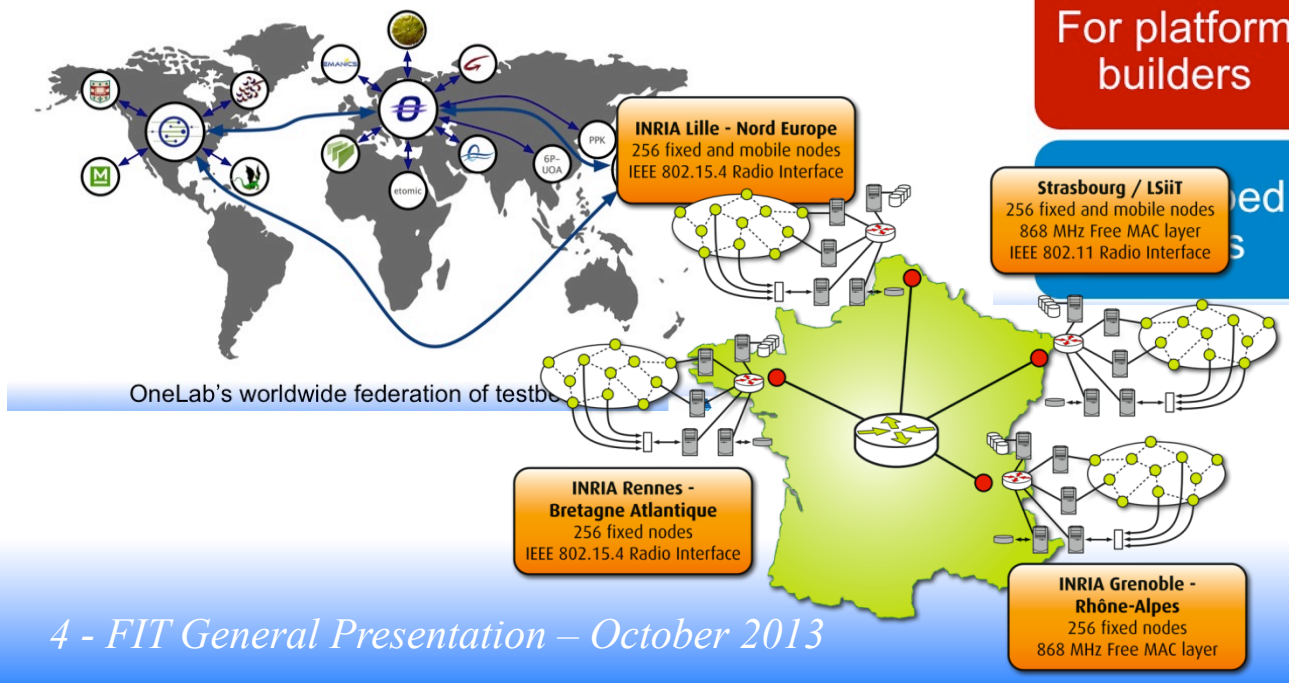
A visible Facility

Fitting: KIC ICT Labs Success Story

OneLab's offers:

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

OneLab testbed federation



OneLab's worldwide federation of testbe

SEVENTH FRAMEWORK PROGRAMME

FIT and its ecosystem

Senslab
Very large scale open wireless sensor network testbed

F-Lab

OneLab
FUTURE INTERNET TEST BEDS

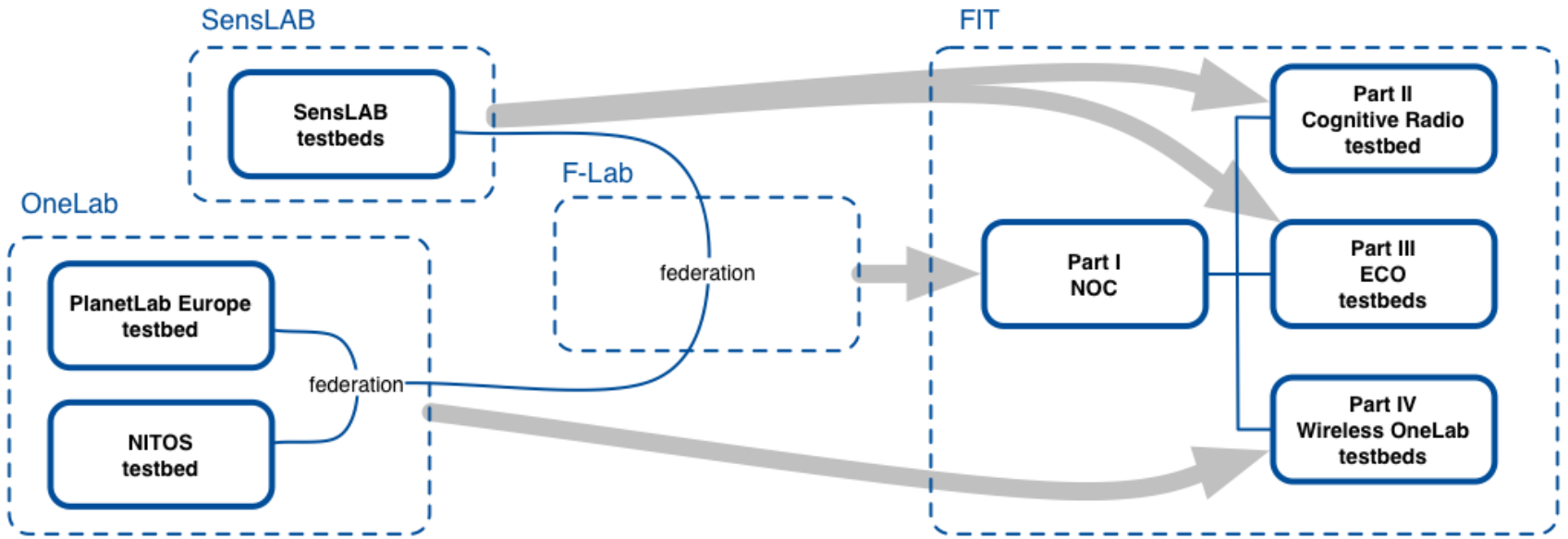
eit Knowledge & Innovation Community
EIT ICT Labs

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/

FIT and its ecosystem



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

Timing

Start: 22 February 2011 — **End: 31 December 2019**

Part	Element	Location	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9 (10M)			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
FIT overall project			Investment																																			
											Operation																											
FIT NOC	E1	UPMC Paris	Building V1				Test				Integr. test				Operation								Up	Operation														
											Build. V2				Test				Integr. test				Operation															
Cognitive	E2	INRIA Grenoble	Building V1				SDR nodes deployment								Operation								Up	Operation														
															Nodes depl.								Operation															
ECO	E3	INRIA Grenoble	Building V1				Nodes depl.				Test				Operation								Up	Operation														
							Building V2				Nodes depl.				Test								Operation															
	E4	INRIA Rocquencourt	Building V1				Nodes depl.				Test				Operation								Up	Operation														
							Building V2				Nodes depl.				Test								Operation															
	E5	INRIA Lille	Building V1				Nodes depl.				Test				Operation								Up	Operation														
							Building V2				Nodes depl.				Test								Operation															
	E6	LSIIT Strasbourg	Building V1				Nodes depl.				Test				Operation								Up	Operation														
							Building V2				Nodes depl.				Test								Operation															
	E7	IT Paris	Building V1				Nodes depl.				Test				Operation								Up	Operation														
							Building V2				Nodes depl.				Test								Operation															
Wireless OneLab	E8	UPMC Paris	Building V1					Nodes depl. & test							Operation								Up	Operation														
								Building							Nodes depl. & test								Operation															
	E9	INRIA Sophia Antipolis	Building V1				Nodes depl.				Test				Operation								Up	Operation														
							Building V2				Nodes depl.				Test								Operation															
	E10	IT Evry	Building V1				Deploy and test								Operation								Up	Operation														
							Building V2				Test												Operation															

Infrastructure component

IoT-Lab testbed

- **Embedded Communication Object**

ECO rationale and objectives

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

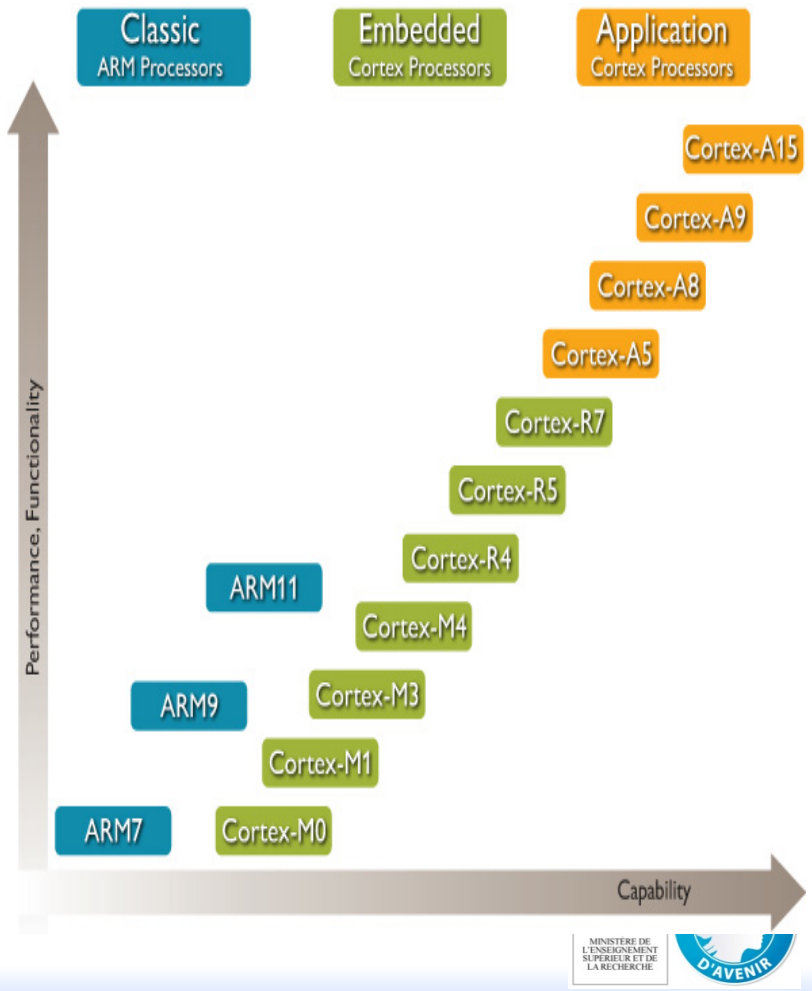
- **From "sensors" to actuators**
- **Design / test / deployment/ monitoring**
- **Propose general and specific use cases**

ECO generic platform

- **M2M scenario**
  - Several ECO sites linked to Internet / P2P application
    - The network is the database
  - ARM-M / WSN430 clustered to one ARM-A 'node GW'
    - Home GW like application
  - Management / monitoring of clouds of ARM-A nodes
  - Full end to end IP solutions
- **Large-scale mobility**
- **Dissemination**
- **Education**

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
    - Support linux / android / chrome
    - Oriented M2M / Smartphones



Global road map / services

- **Since 2013 1st semester : fully connected sensor network platform (P2P experiment on any sensor, global reservation) based on SensLAB nodes.**
- **By end of 2013 : New IoT-Lab-NODEs available (ARM-M3 ARM-A8)**
- **Spring 2014 : Fully Open IPv6.**
  - FIT IoTLab + ONELAB reservation
  - M2M and cloud to sensor/HGW
- **Summer 2014 : Large scale mobile nodes**

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

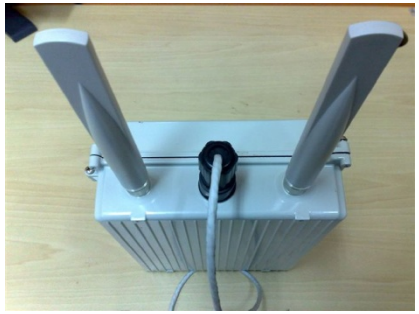
- **NITOS wireless testbed integrates *heterogeneous hardware* to provide different communication functionalities under a unified managed infrastructure**
- **NITOS also provisions an *open source-driver* development environment to enable:**
  - Ease of compilation procedure
  - Compatibility support 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)

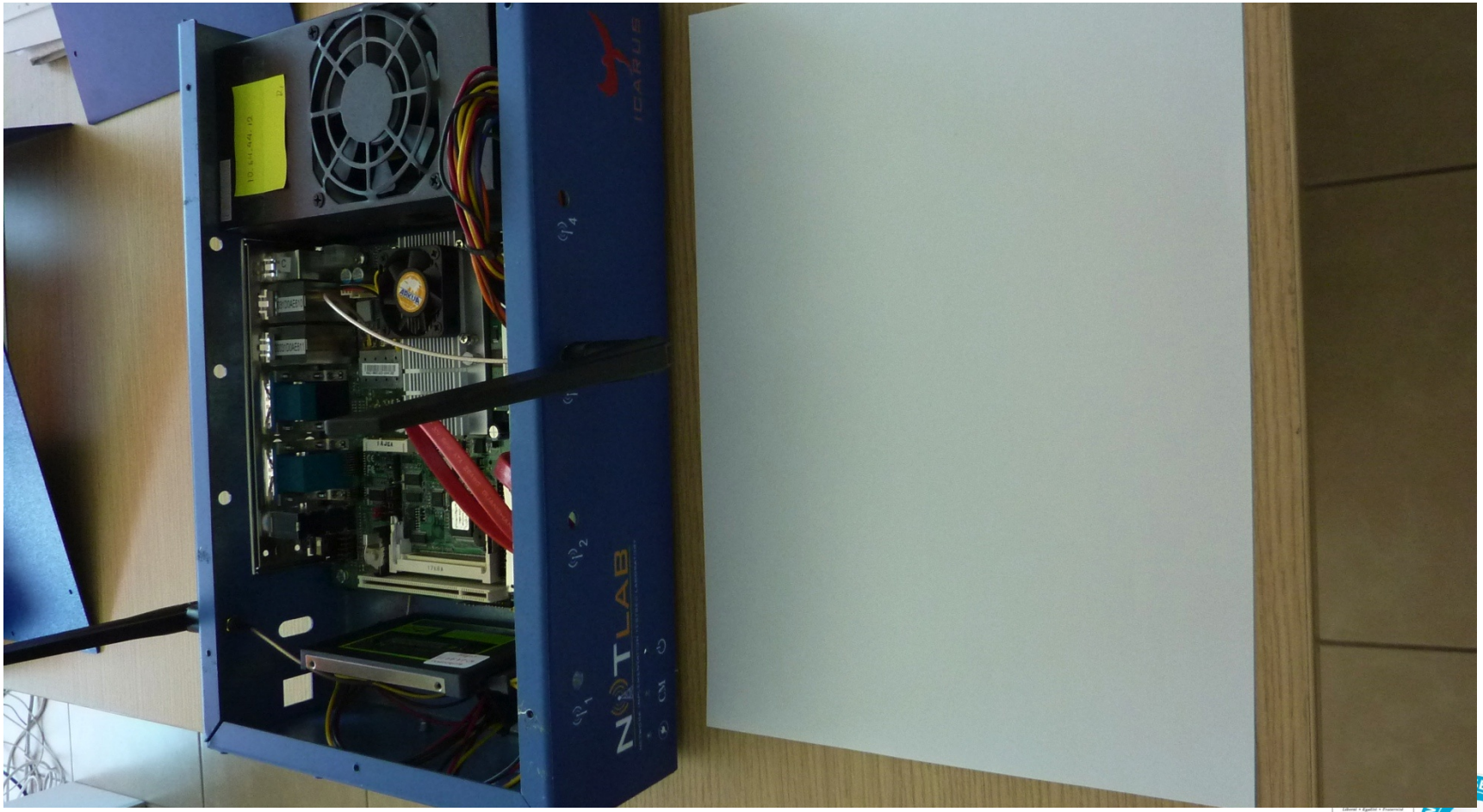
- **The NITOS tesbed has the following features:**
  - Heterogeneous hardware (WiFi, …)
  - Remote access (Web based)
  - Scheduler (reservations, slicing)
  - OMF based management
  - Connectivity tool
- **We are working on the interconnection/federation of:**
  - Different wireless testbeds
  - Wireless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

WiFi 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 nodes support, aiming to:**
  - Enable mobility issues and volatile orbits
  - Provide users with experimentation alternatives, enabling diversity issues on multipath fading

Web-Cameras

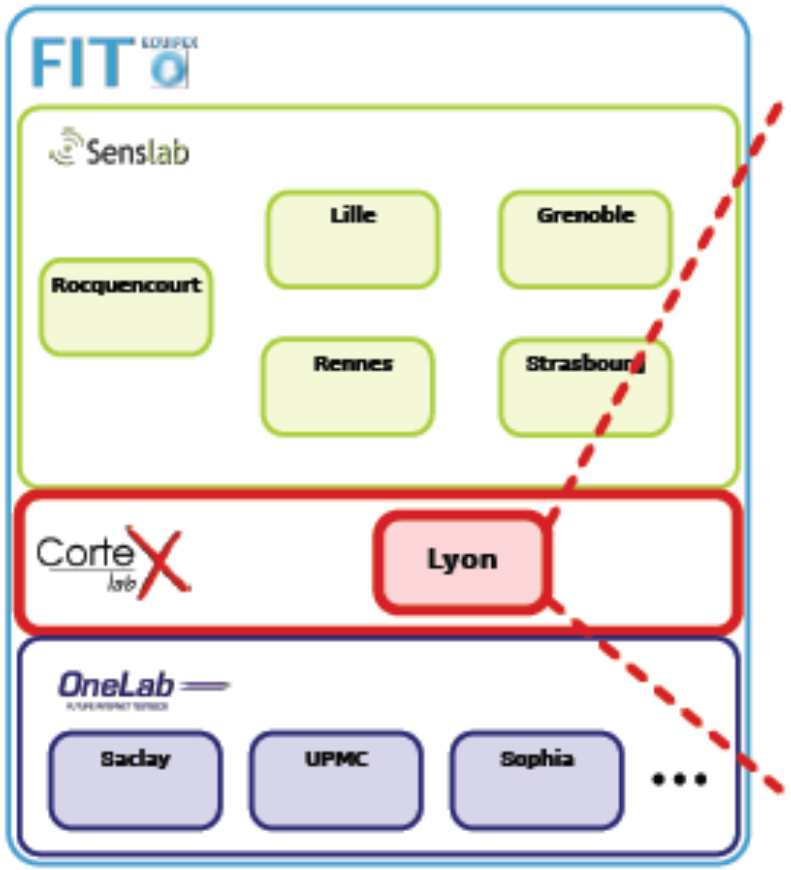
- **NITOS gives the opportunity for conducting video experimentation by:**
  - Monitoring and capturing real time video streams
  - Online/offline video compression using open source software
  - Video transmission over wireless (multihop)
    - Unicast
    - Multicast / broadcast
  - Ability to process 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

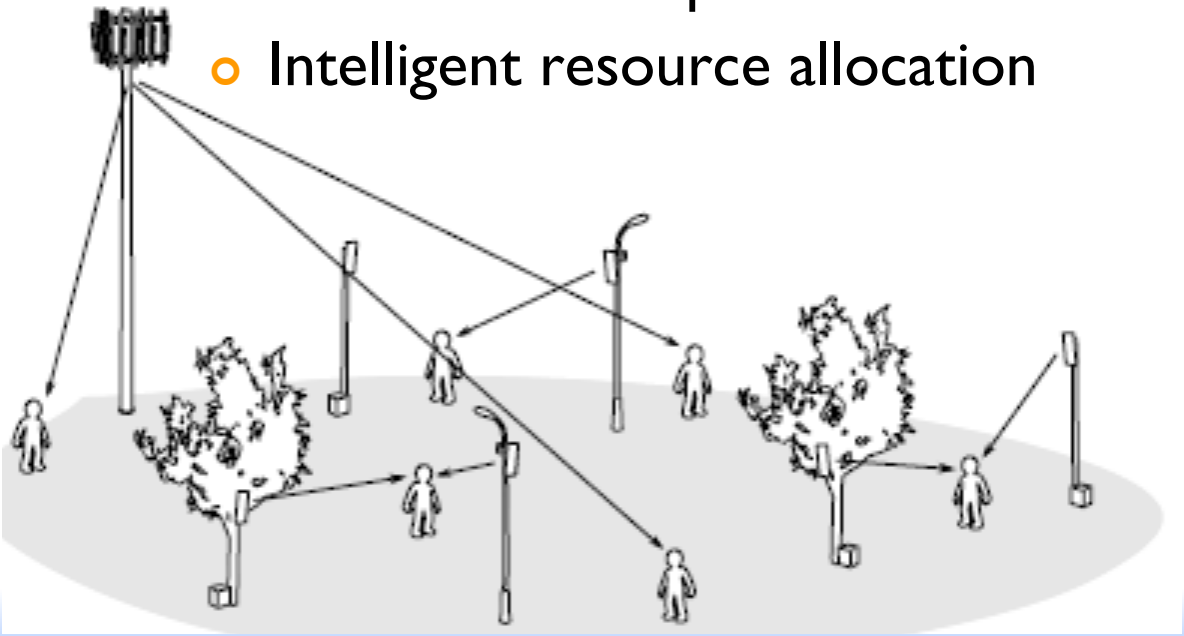
FIT : CorTex LAB



- 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*

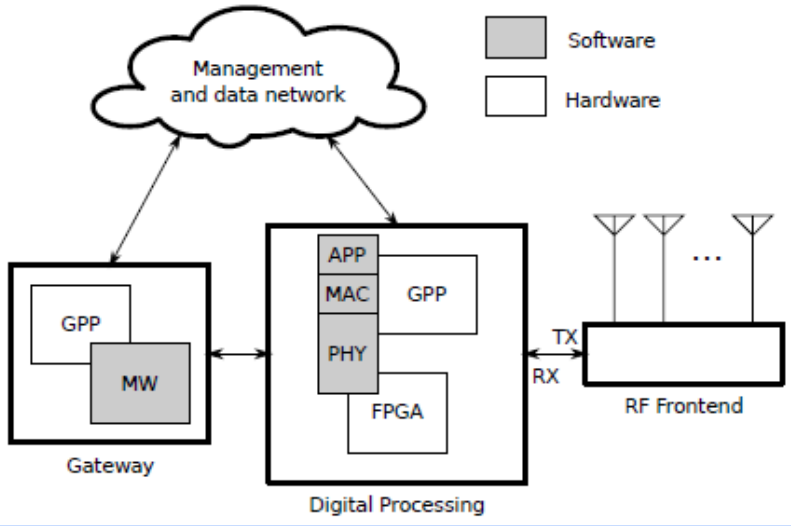
FIT : CorTex LAB

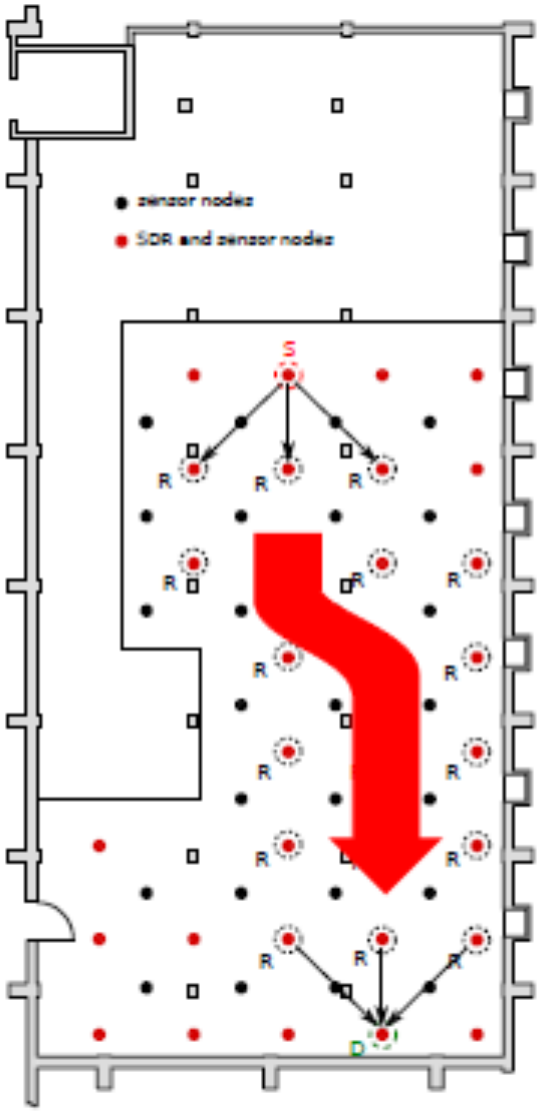
- **Reference scenario : cooperative radios**
- **studying co-existence & cooperative issues of radio equipements**
  - Primary-secondary cognitive radio networks
  - Dynamic spectrum access
  - Inter-nodes cooperation : network/distributed MIMO
  - Intelligent resource allocation



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

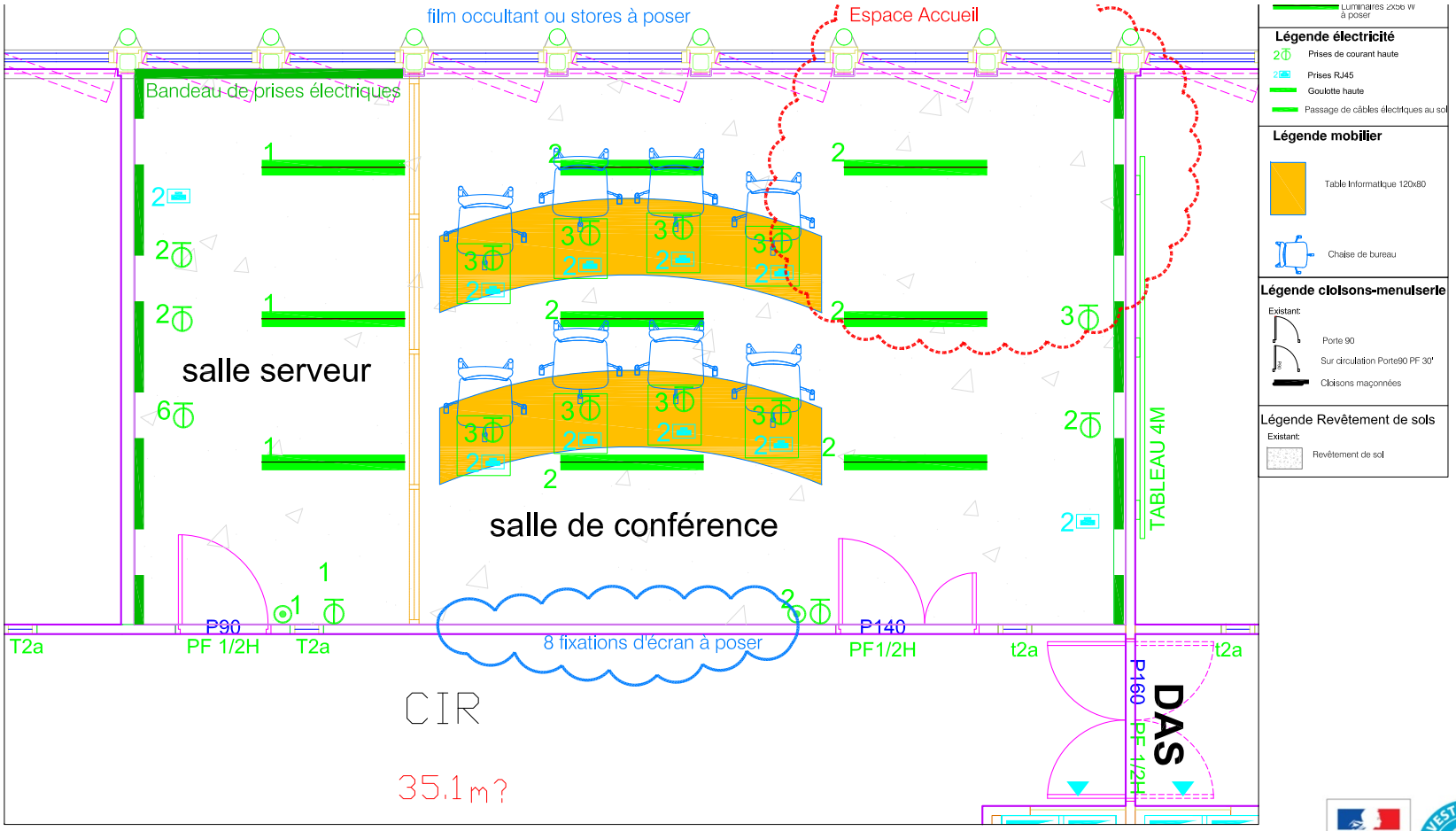
- **Test-bed in a fully virtualized environment : Dec2012**
  - Simulation mode
  - Proof-of-concept (end -to-end chain)
  - Access reserved to selected remote users
- **Simplified initial deployment: Nov2013**
  - Shielded room : to be ready in december 2012
  - Deployment of a limited amount of nodes
  - Remote access to PC only (FPGA passthrough)
  - Testbed available to the public with limitations (pre-selected radio modes)
- **Full deployment: Jan 2014**
  - 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

Usage scenario

FIT Usage

- Use Cases

Use case 1: Sensitive wildlife monitoring
Testbed: FIT ECO testbed

Problem:

- How to monitor vulnerable flora and fauna without disrupting their natural environment?

A coyote wearing a collar fitted with a bio-logging wireless sensor.

Solution:

- Limited human intervention: Data gathered from wireless sensors attached to animals under observation, or installed in locations of interest

Use case 1: Sensitive wildlife monitoring
Testbed: FIT ECO testbed

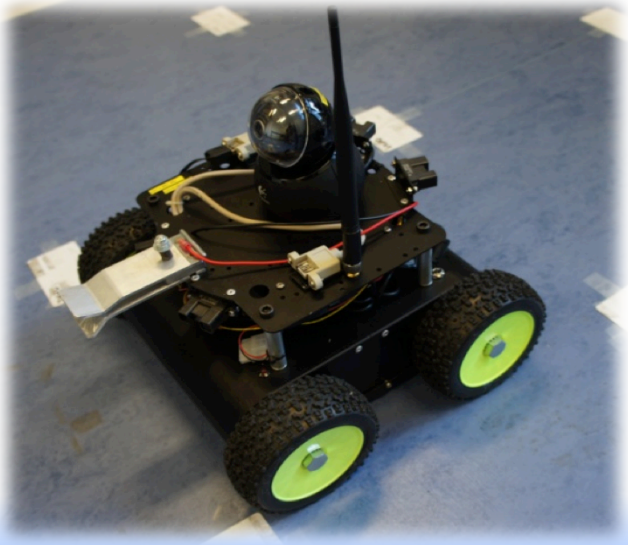
Solution tested on FIT's ECO testbed:

- Deployment of mobile robots, embedded with wireless sensors, in an area of 250m2
- Robots move autonomously to ensure testing of properties such as area coverage and movement
- Location and trajectory of each robot monitored thanks to the geolocation system provided in FIT, which will eventually be extended to be used on living test subjects

Use case 1: Sensitive wildlife monitoring
Testbed: FIT ECO testbed

Who might be interested?

- Ethnologists, botanists, and more generally scientists involved in the various steps of understanding both living populations and environmental evolutions.
- Development and environment Non-Governmental Organizations (NGOs).



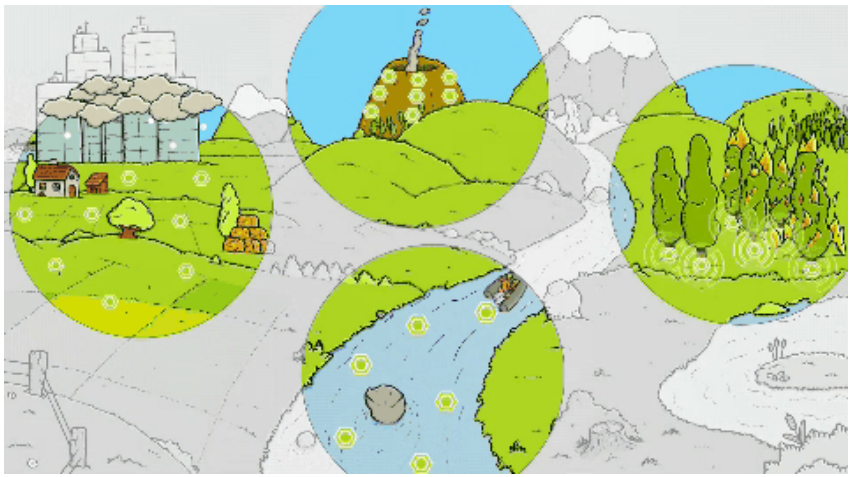
A mobile robot of the kind used in FIT's embedded object testbeds, fitted with sensors and camera.

Use case 2: Safe monitoring after a natural (or industrial) disaster

Testbed: FIT ECO testbed

Problem:

- How to monitor hazardous environments without putting human life in danger?



FIT sensors (embedded objects) in use, including in the monitoring of hazardous natural environments, such as an active volcano (top centre) and forest fire (right)

Solution:

- Mobile robots can transmit measured data and communicate to localize points of interest, ensure area coverage, enable target tracking, etc.

Use case 2: Safe monitoring after a natural (or industrial) disaster
Testbed: FIT IoT Lab testbed

Solution tested on FIT's IoT Lab testbed:

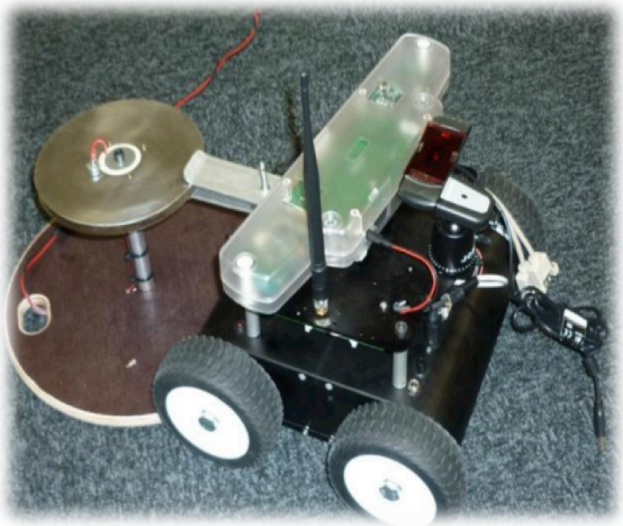
- Deployment of mobile robots, embedded with wireless sensors, in an area of 250m2
- Robots move autonomously to ensure testing of properties such as area coverage and movement
- Location and trajectory of each robot monitored thanks to the geolocation system provided in FIT, which will eventually be extended to be used on living test subjects

Use case 2: Safe monitoring after a natural (or industrial) disaster

Testbed: FIT IoT lab testbed

Who might be interested?

- Power supplier companies
- Development and environment Non-Governmental Organizations (NGOs)



A mobile robot of the kind used in FIT's embedded object testbeds, fitted with sensors and camera, and attached to its charging station.

Use case 3: Whitespace networks: Optimizing the use of radio airspace

Testbed: FIT Cognitive radio testbed

Problem:

- Increasing numbers of mobile communication devices mean more competition for finite resources and lower-quality wireless provision

Solution:

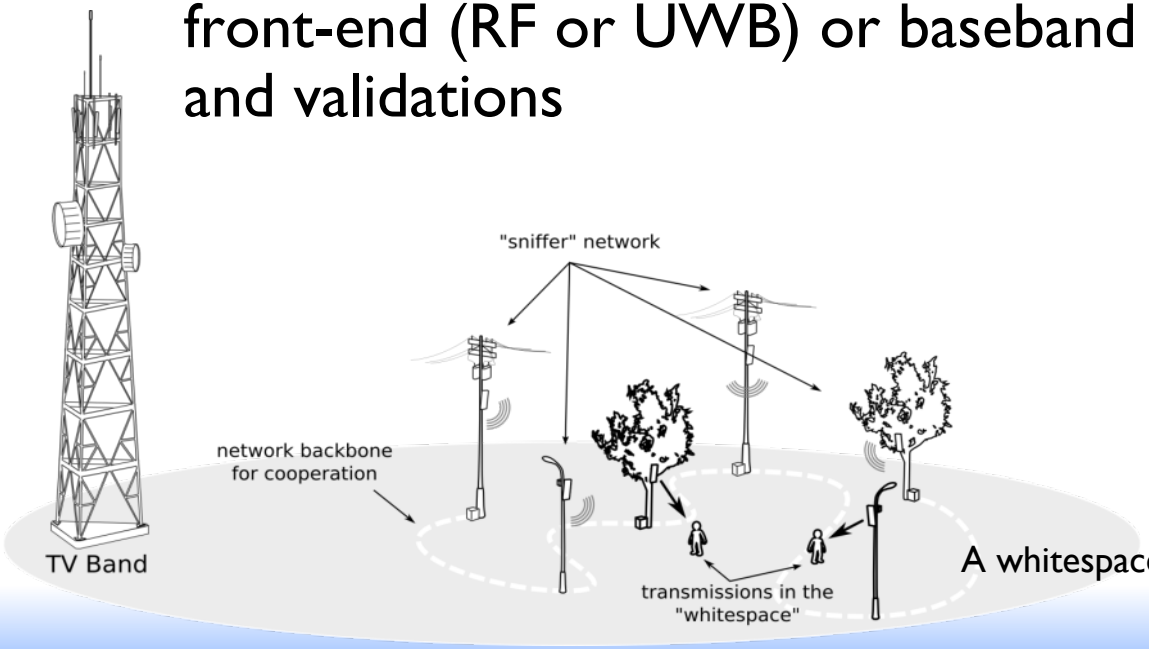
- Whitespace networks allow radio devices to take advantage of the "silent" moments of legacy networks, such as analog TV stations, to transmit their own messages.

Use case 3: Whitespace networks: Optimizing the use of radio airspace

Testbed: FIT Cognitive radio testbed

Solution tested on FIT's Cognitive radio testbed:

- Allows users to design, benchmark, and tune their cognitive radio protocols
- Architecture open to industrials to deploy their own front-end (RF or UWB) or baseband systems for testing and validations



A whitespace network in action.

Use case 3: Whitespace networks: Optimizing the use of radio airspace

Testbed: FIT Cognitive radio testbed

Who might be interested?

- Cellular and TV operators
- Internet providers
- Networking equipment manufacturers
- Wireless telecommunications research academia

A wireless node of the kind used in FIT's Cognitive radio testbed.

Other use cases: Exploiting the federation scenario

Testbed: FIT Wireless Onelab and PLE

Exploiting the federation of multiple testbeds

- Example: Multipath scenario for wired and wireless testbeds

More Information

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