

D-NET

Dynamic Networks

E. Fleury

<http://www.ens-lyon.fr/LIP/D-NET/>

Inria Evaluation Seminar — March 2012



Tiny Dream Team Composition

■ Project Head

- Eric Fleury, Professor, ENS Lyon

■ Permanent Researchers

- Guillaume Chelius, CR1, INRIA
- Christophe Crespelle, MdC, Lyon 1

■ Visitors

- Mariano Beiro
- Ha Duong PHAN
- Renaud Lambiotte
- Artur Ziviani

■ Assistant

- Sèverine Morin

■ Engineers

- Sandrine Avakian (FLAB)
- Guillaume Roche (SensLAB)
- Clément Burin des Roziers (SensLAB)
- Fabien James (SenSAS)
- Gaetan Harter (SensLAB)
- François Lefebvre (SensLAB)
- Fabien Jammes (SensAS)

■ PhD Students

- Andreaa Chis
- Adrien Friggeri
- Lucie Martinet
- Qinna Wang

Outline

- Challenges & Objectives
- Main Projects
- Future

Challenges & Objectives



Vision & goal

- Study of **dynamic evolving interaction networks**
 - Characterization and modeling of complex dynamic properties.
- Study **dynamic processes occurring on dynamic networks**
 - Dynamics **of and on** the network structure.
- Develop **distributed measurement architectures (WSN)**
 - Capture physical phenomena in space and time;
- **Large scale experimental data sets**
- Set up and foster **multidisciplinary collaborations**
 - Life Science Health

Four main scientific axes

■ Measure

- Monitor & sample large scale *in situ* network
- Partial biased view of the dynamic object studied

■ Analyze

- Describe the structure, main properties
- Statistical / structural notions
- Robustness / pertinence of the measure

■ Model

- The dynamic(s)
- Generate random networks that reproduce dynamics/behaviors

■ Algorithmic

- Evaluation & Optimization of distributed algorithms
- Dynamic process on dynamic networks

Measure = Embedded Networked Sensing

Promise of Embedded Networked Sensing (ENS)

Dense monitoring & analysis of complex phenomena over large regions of space for long periods

Objectives

- *Embeddable, low-cost sensor devices*
- *Robust, portable, interactive systems*
- *Data integrity, system dependability*
- *Programmable, transparent systems*
- *Multiscale sensing and actuation*

Constraints

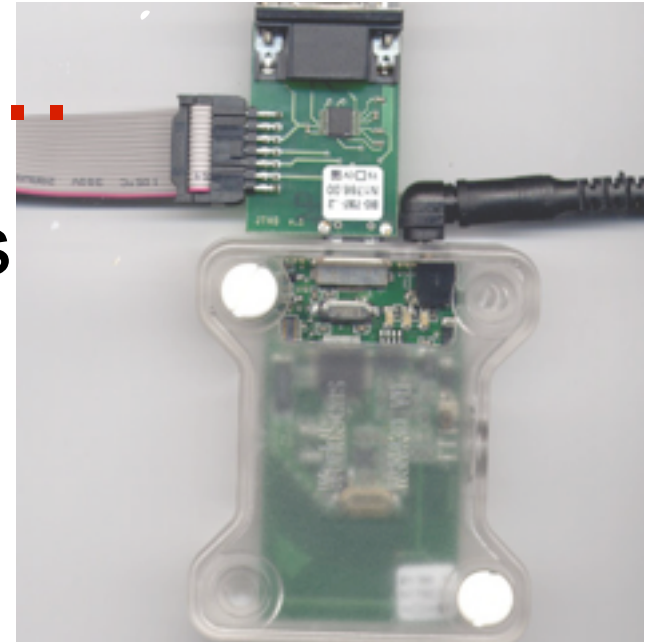
- *Sensing channel uncertainties*
- *Environmentally compatible deployment*
- *Limited resources: node, infrastructure*
- *Complexity of distributed systems*
- *No ground truth*

Main projects



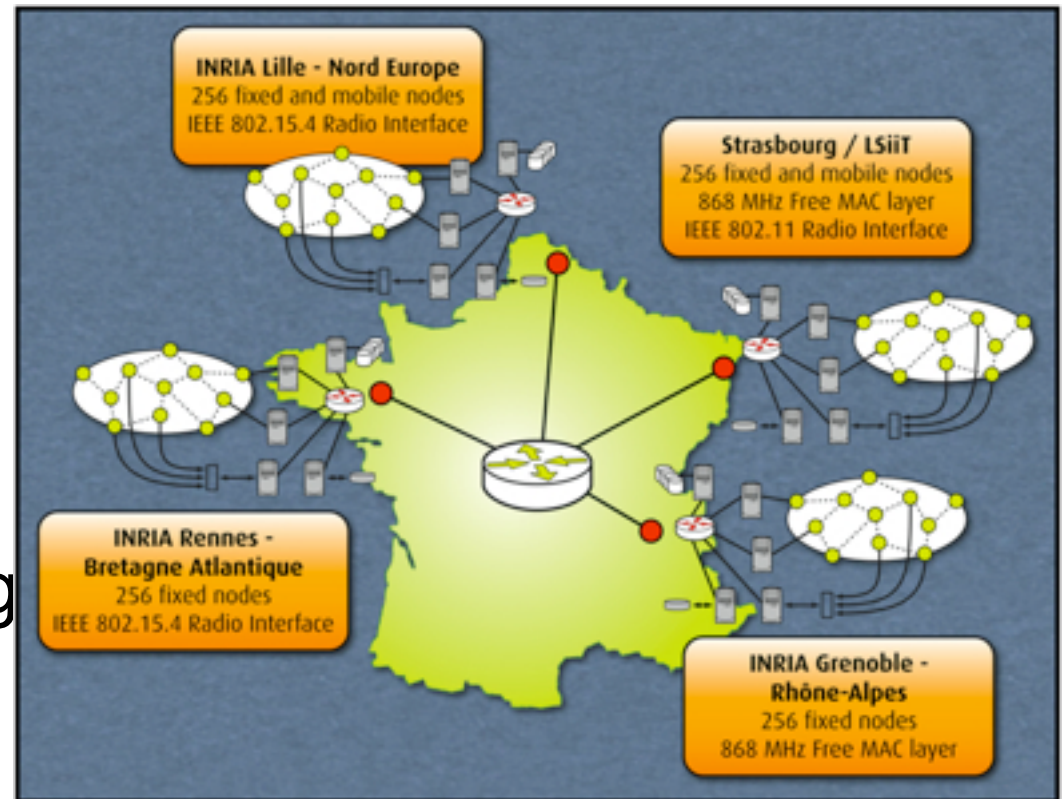
Deploy real applications...

- Build new protocols / applications
 - Specification / Design
 - Simulation
 - Experimentation
- Large scale 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**



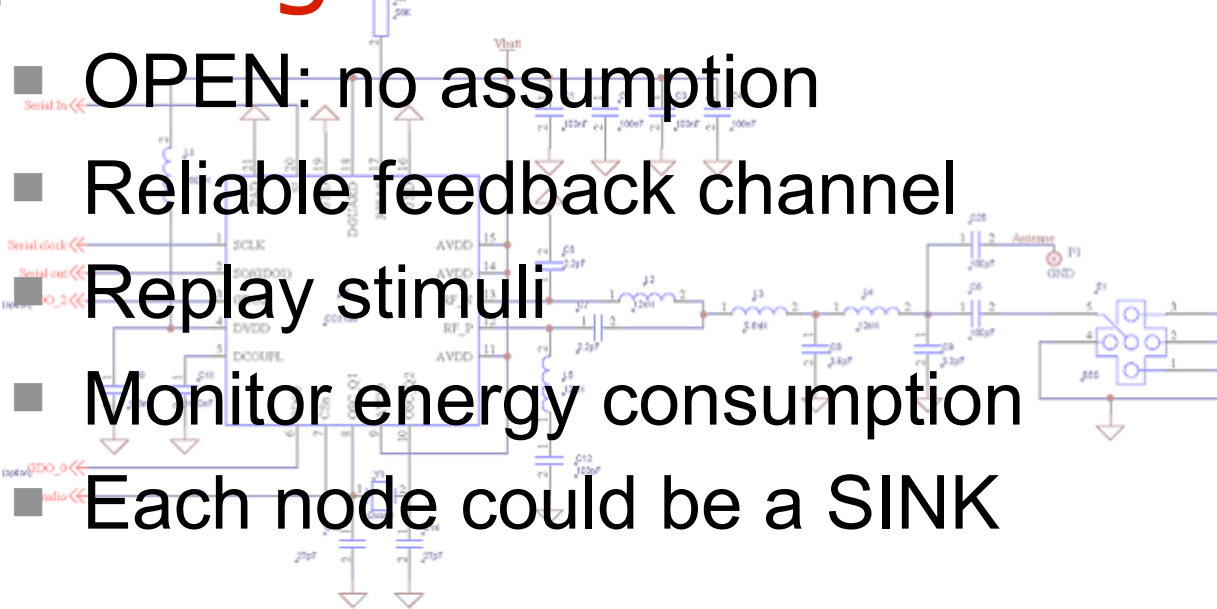
SensLAB: First Class Scientific Tool for Large Scale WSN Experiments

- 1024 nodes
- Generic / Open
- Heterogeneous
- Automation
- Remote access
- Non intrusive Monitoring
- Reproducible



Design of SensLAB: Hard & Soft

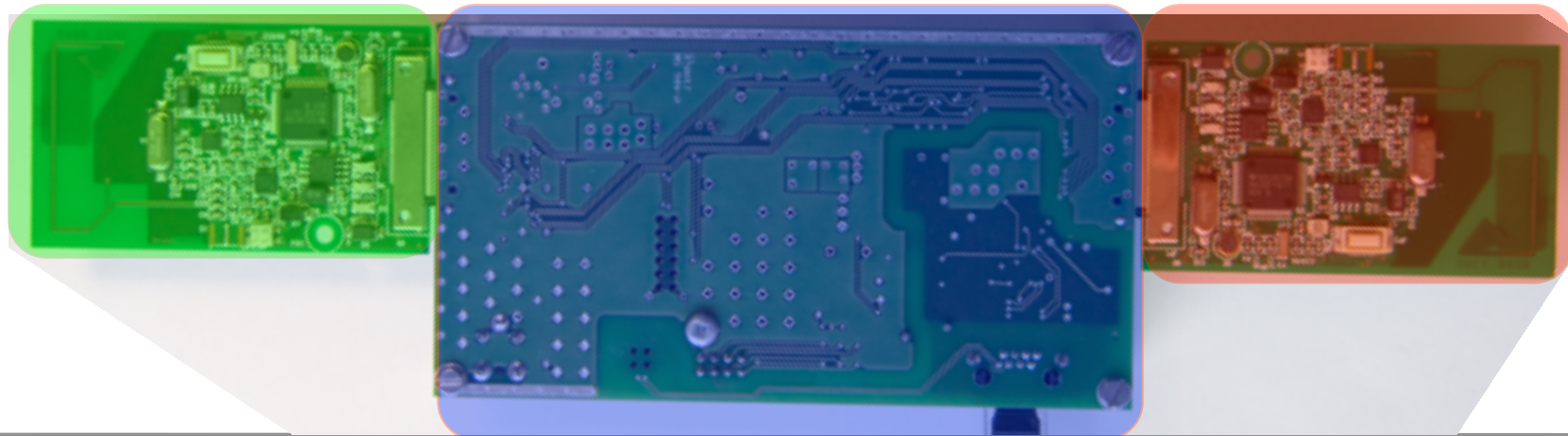
- OPEN: no assumption
- Reliable feedback channel
- Replay stimuli
- Monitor energy consumption
- Each node could be a SINK

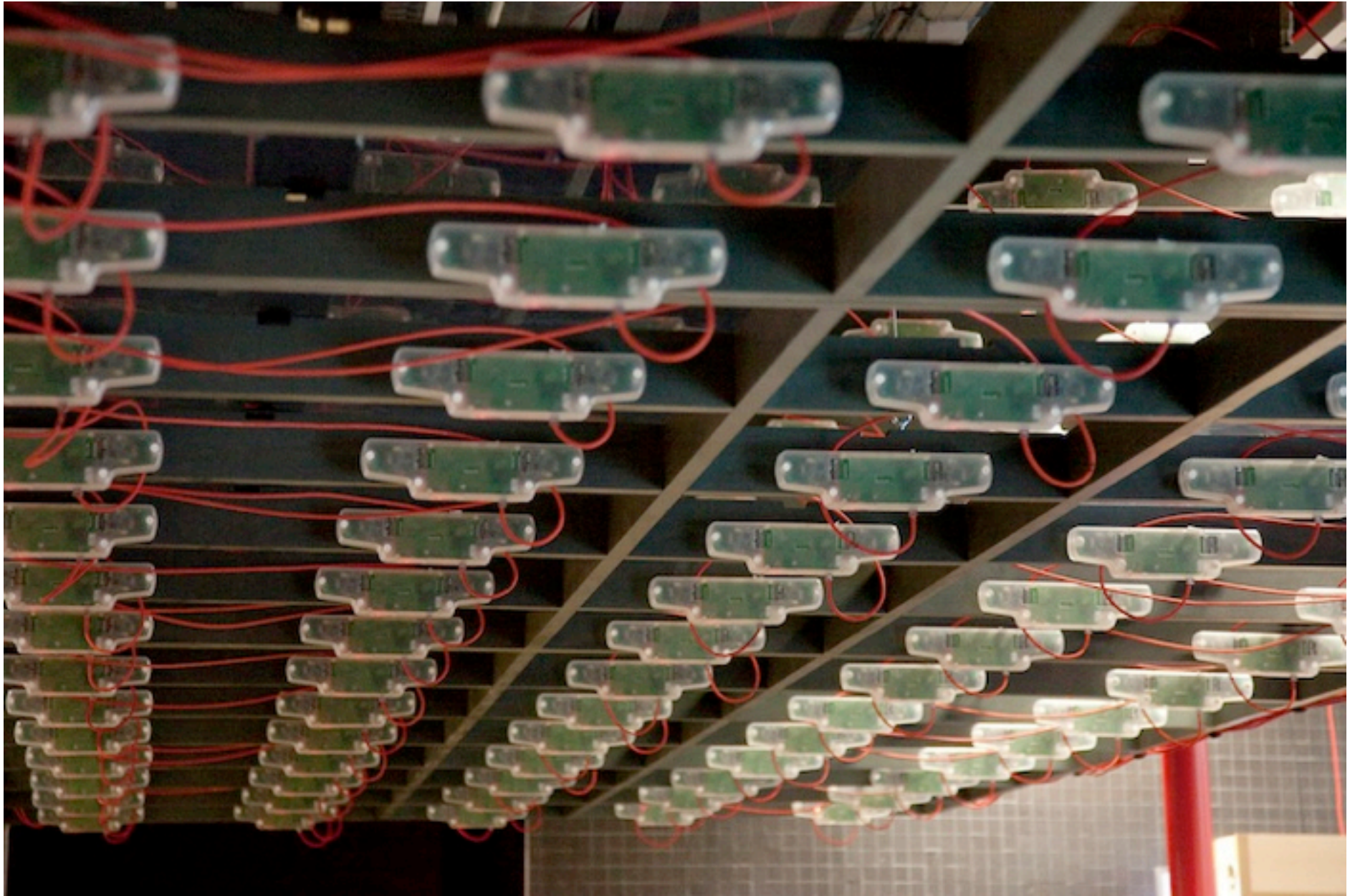


Open Node

SensLAB Gateway

Control Node









Navigation bar: ENS de Lyon, home, D-NET, DI, INRIA, UR, Gmail, IziGFD, Apple, Google Maps, YouTube, Wikipedia, N



Senslab

Very large scale open wireless sensor network testbed



[home](#) [experiments](#) [store](#) [reports](#) [account](#)


Home


Personal dashboard

[New Experiment](#)

Experiments : 1 running experiment
2 coming experiments
2 past experiments

Profiles : 8 profiles in store

Home's quota : 
120 Mo / 500Mo

DB's quota : 
640 Mo / 1 Go

VM's status :

Senslab activity

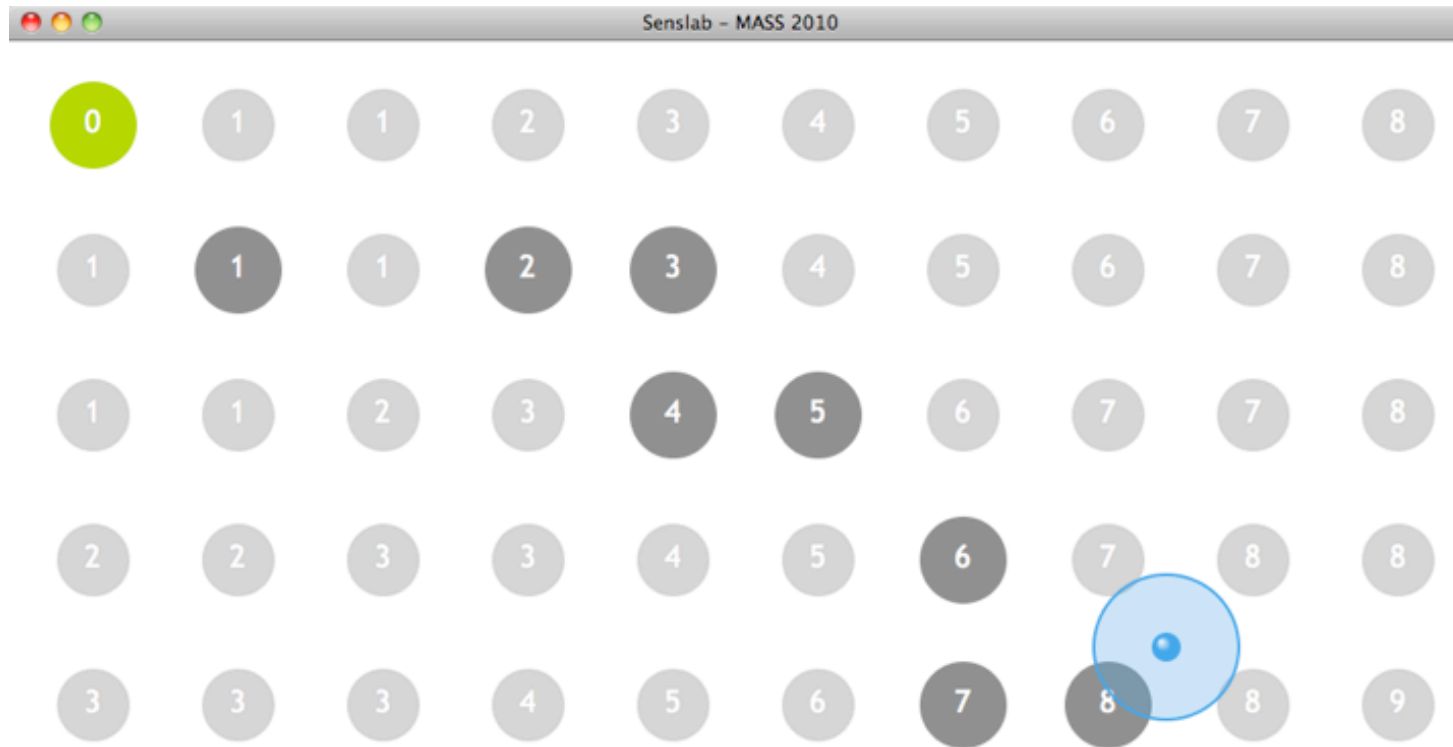
10 running experiments on 128 nodes



123 availables, 128 busy, 5 down

[View nodes status](#) [View Gantt chart](#)

SINK & Mobile Nodes



```
Terminal
The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Thu Jul 29 12:53:16 2010 from srvssh
vandaole@vavandaole:~$ nc experiment 30001
S
SINK node started hw address = 62d8
SENDING BEACON
SENDING BEACON
SENDING BEACON
SENDING BEACON
REPORT RECEIVED from be96 mobile node was 6d7a with RSSI -89
REPORT RECEIVED from f6d8 mobile node was 6d7a with RSSI -102
SENDING BEACON
REPORT RECEIVED from af52 mobile node was 6d7a with RSSI -94
SENDING BEACON

Terminal
Welcome to the Senslab Lille Server
You are being redirected to your own Virtual Machine, named vavandaole
Enjoy your stay!
*****
Linux vavandaole 2.6.26-2-xen-amd64 #1 SMP Wed Jan 13 08:12:41 UTC 2010 x86_64

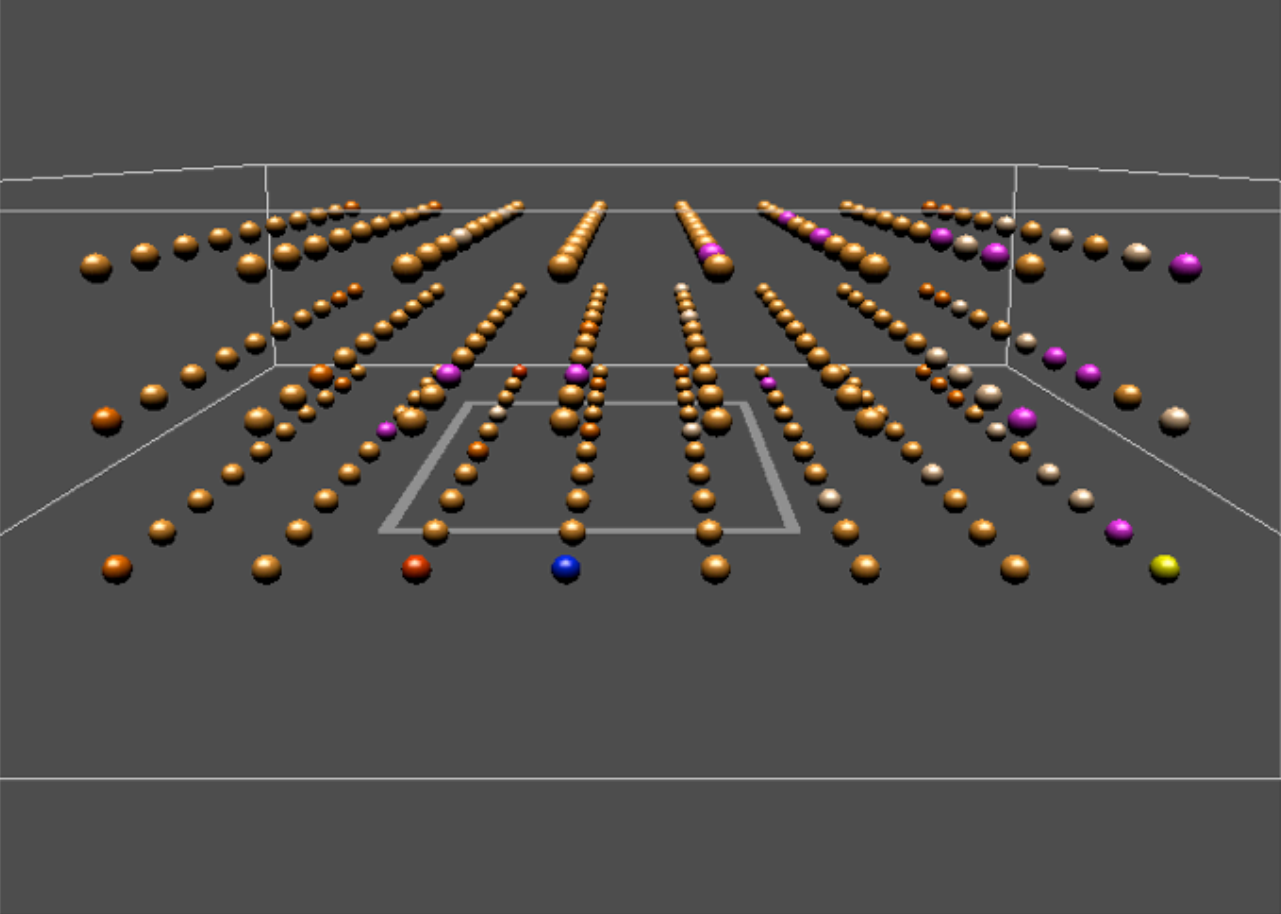
The programs included with the Debian GNU/Linux system are free software;
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individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Thu Jul 29 12:53:16 2010 from srvssh
vandaole@vavandaole:~$ nc experiment 30051
S
MOBILE node started hw address = 6d7a
SENDING HELLO
SENDING HELLO
SENDING HELLO
```


More on <http://www.senslab.info>

LAST ACT (Large scale Sensor Testbed Application Controller) 2.3.0

File View Tools



The central 3D visualization shows a network of nodes represented as spheres. Most are orange, but some are purple, blue, and yellow. They are arranged in a grid-like pattern with several paths connecting them. A white rectangular box highlights a specific area in the center of the network.

Finder

1 Find

Tools

- Login/Logout
- Train Manager
- Camera
- Fullscreen

Node information [226]

Choose an application

Gradient

Application controls

Level : 2
Pkts sent : 0
Pkts received : 0
Pkts forwarded : 0

SRC	SEQUENCE	VALUE
226	0	21
226	1	21

Sink Reset all

Start s... Stop sa...

Light Temper...

Evolution towards **FIT** (Future Internet of Things)



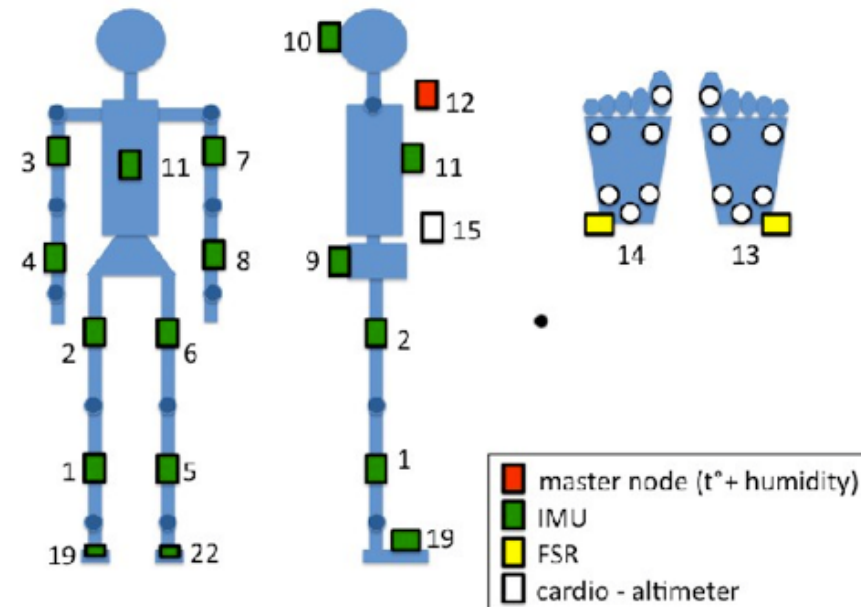
- One of 52 winning projects in the Equipex research grant program
 - Play a bigger role in the ICT Labs
- Federation with OneLAB
 - SFA & OMF compliant
- Extension of the infrastructure & services
 - more nodes / mobiles / powerful / cognitive radio



Other *in situ* deployments

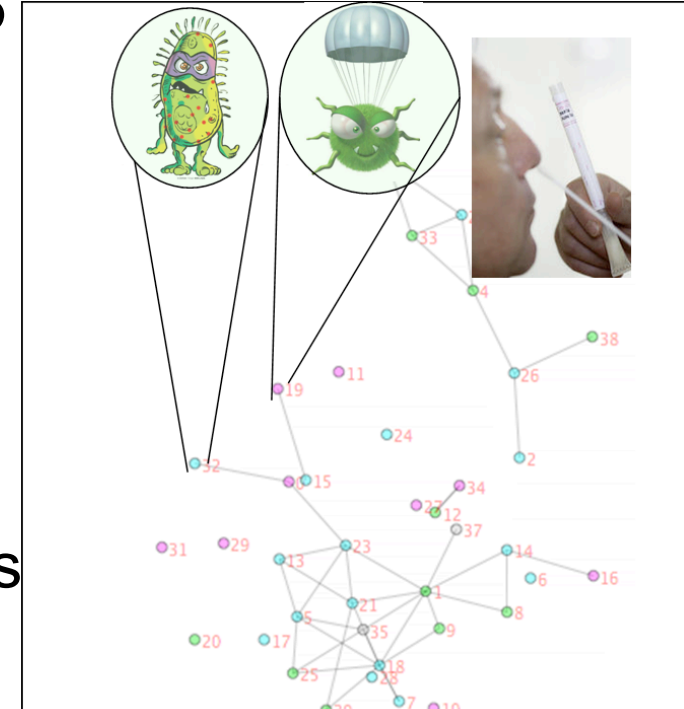
<http://www.inrialpes.fr/Xtremlog>

- Desert marathon: 250km
 - self autonomy
- Heterogeneous measurement architecture



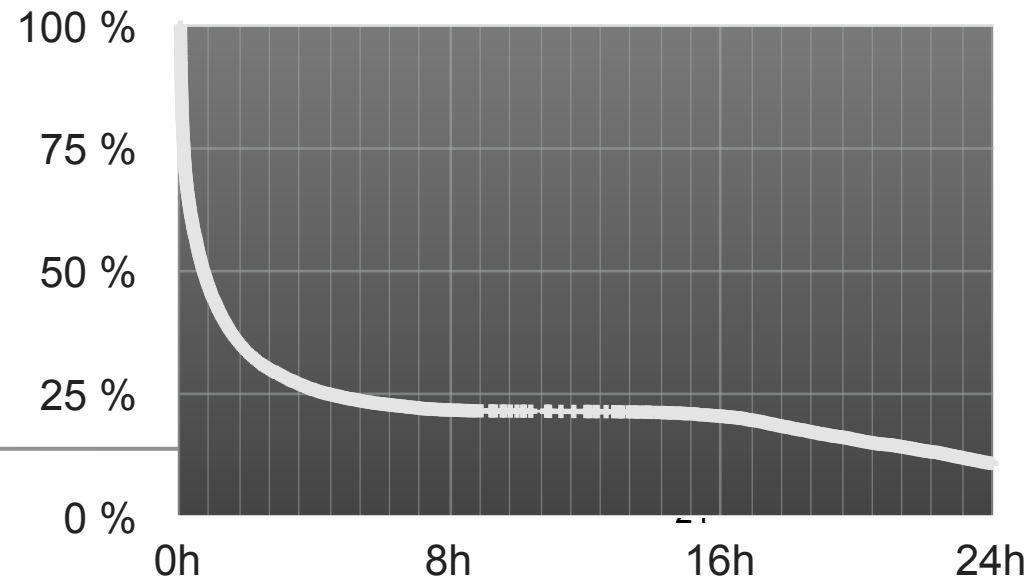
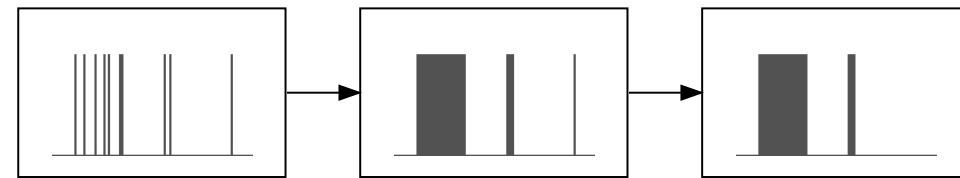
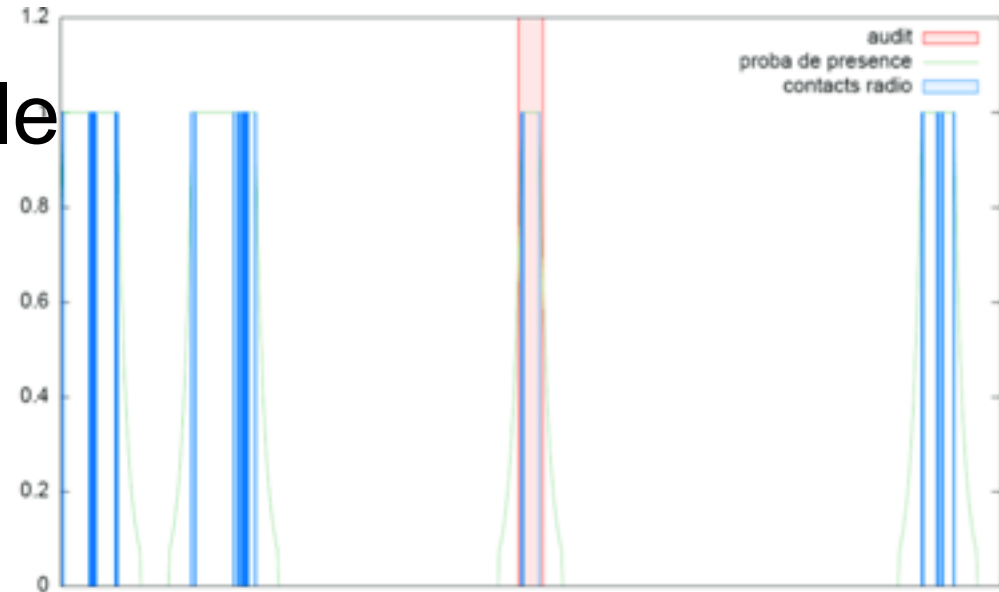
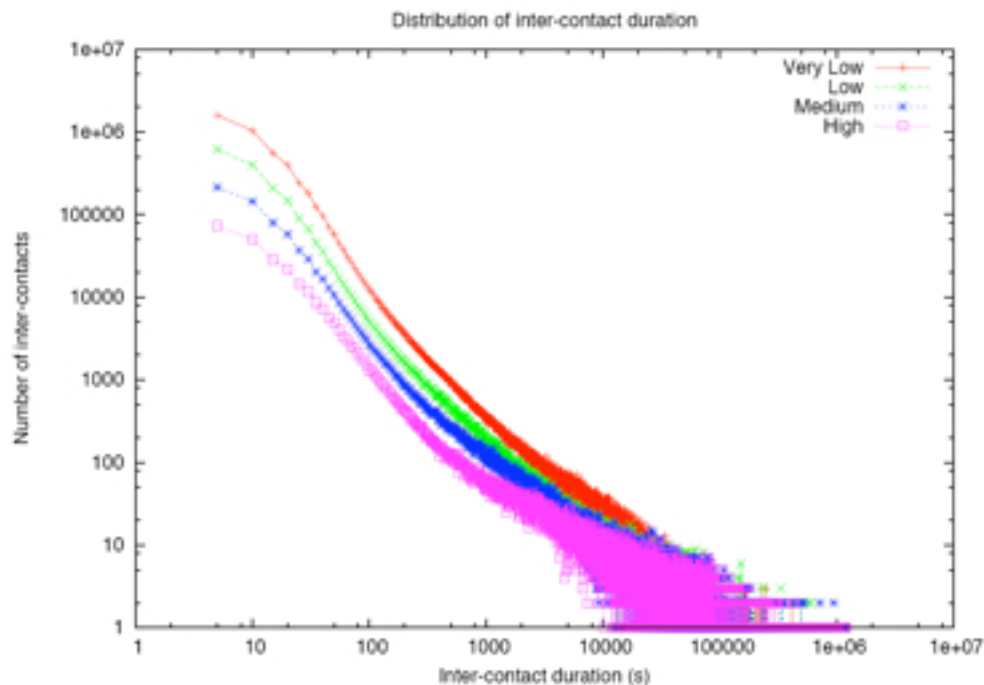


- Understand the dynamic of AMRB
- 1 actor = 1 sensor
- Design hardware & software
- Deploy & Manage
 - All Medical / Nursing staff / Patients
 - 600 people, every 30sec, 24/7, 6 months
 - Individual antibiotic use
 - Swabs every week
 - Characterization of the isolates to determine their epidemicity;



Raw data → observables


- From primitive to analyzable data
- Signal reconstruction
 - Experimental data are “*noisy*”
 - Pkt loss introduces a bias in the measure (e.g., contact time)
 - Statistical signal processing



Future



Evolution(s) & Dynamic !

- G. Chelius, CEO of  HiKoB
- Submission of a new Inria team DANTE:
 - ***Dynamic Networks : Temporal and Structural Capture Approach***
- **Graph-oriented signal processing**
 - **Switching from 1 image to a video sequence!**
 - **Harmonic analysis of dynamic graphs, both in time and space**
 - **Stationarity**
- **Dynamic graph theory**
- **Algorithmic**

