

FIT IoT-lab

A large Scale IoT Testbed

www.iot-lab.info

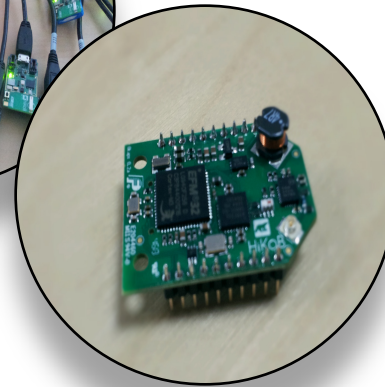
Emmanuel Baccelli & Cédric Adjih



EclipseCon, Oct 24, 2016,
Ludwigsburg, Germany

Challenges for real IoT deployment

- **Build new applications/protocols**
 - Specification / Design
 - Simulation
 - Implementation / Experimentation
 - **Large scale experimentation is a nightmare**
 - Fastidious for a dozen of nodes
 - Manual handling / time consuming / boring
- **Need for large scale scientific tools for scientific & reproducible experiments**



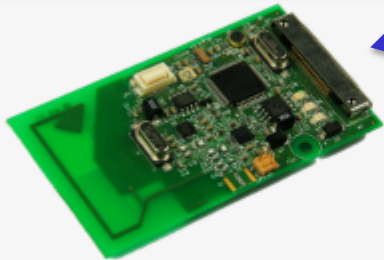
FIT IOT-lab

- ▶ Federated IoT Testbed for large scale experimentation
- ▶ More than 2700+ IoT wireless nodes
 - ▶ microcontrollers
 - ▶ IEEE 802.15.4 or sub-GHz
 - ▶ Distributed on 8 sites
- ▶ **Total Remote Access**
- ▶ **Total Open Access**



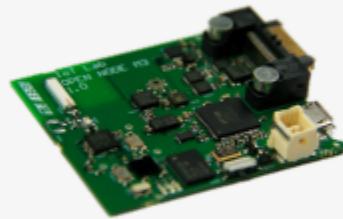
IoT-LAB Hardware

- ▶ WSN430 node : TI **MSP430**
 - ▶ **48 kB Flash, 10 kB RAM**
 - ▶ Radio TI CC1101 / CC2420
 - ▶ Ambient light, Temp



WSN430 Node

based on MSP430F1611 MCU and communication with 802.15.4 PHY Layer (800 MHz or 2.4 GHz)



M3 Node

based on STM32F103REY MCU and communication with 802.15.4 PHY Layer (2.4 GHz)



A8 Node

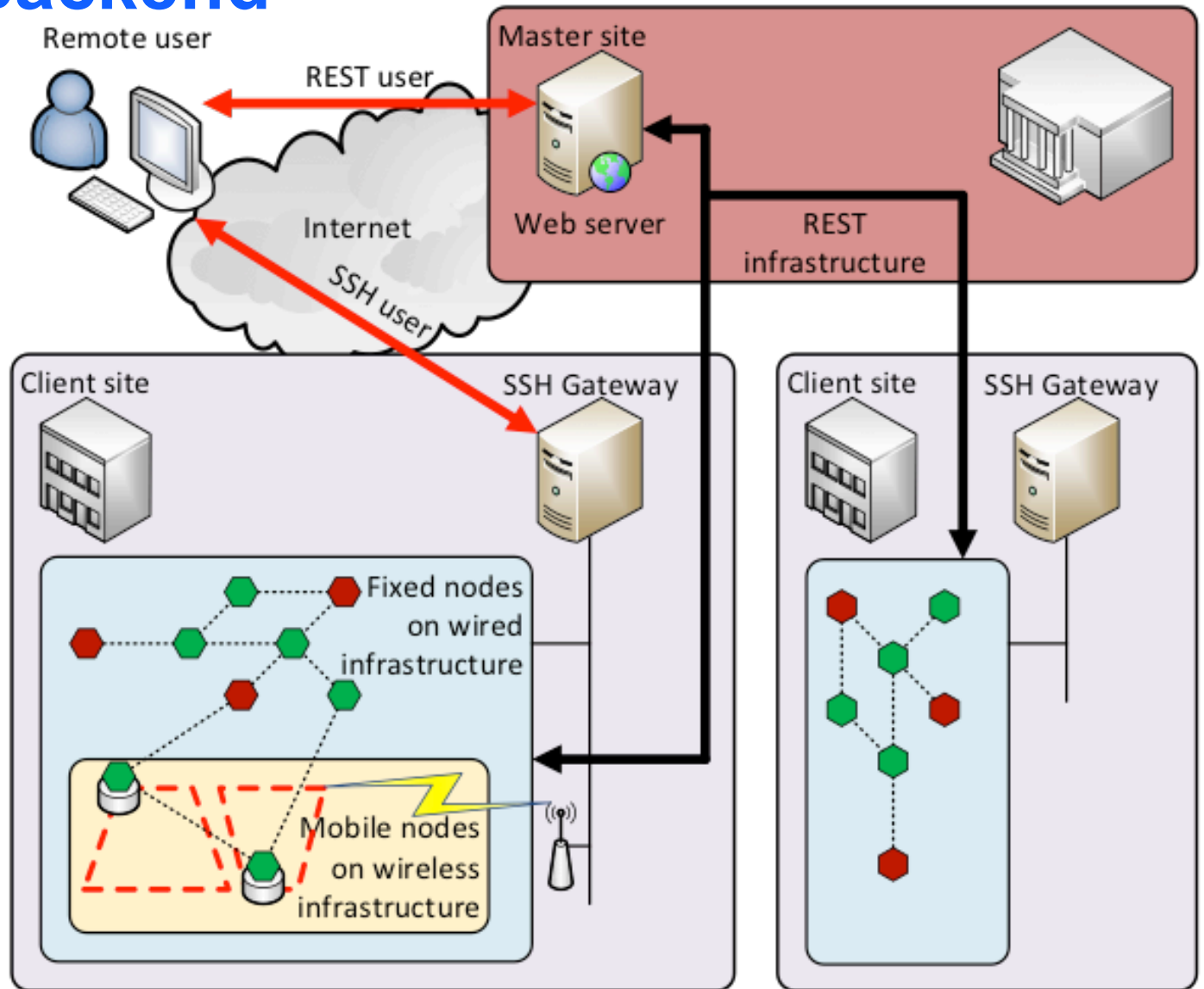
based on TI SITARA AM3505 (Arm Cortex A8) allows to run Linux. This node embeds also a M3 Node with 802.15.4 comm.



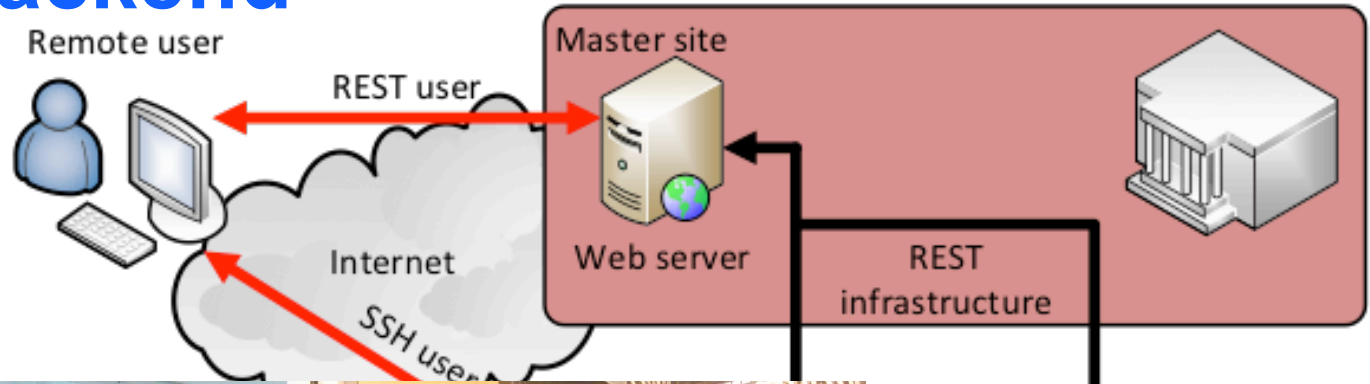
- ▶ M3 node : STM32 (**Cortex-M3**)
 - ▶ **512 kB Flash, 64 kB RAM**
 - ▶ Radio Atmel AT86RF231
 - ▶ Ambient light, Temp, IMU, Pressure

- ▶ **A8** node : TI-SITARA AM3505
 - ▶ **256 MB RAM / 600 MHz**
 - ▶ Ethernet, USB
 - ▶ Linux
 - ▶ Indoor GPS for accurate clock

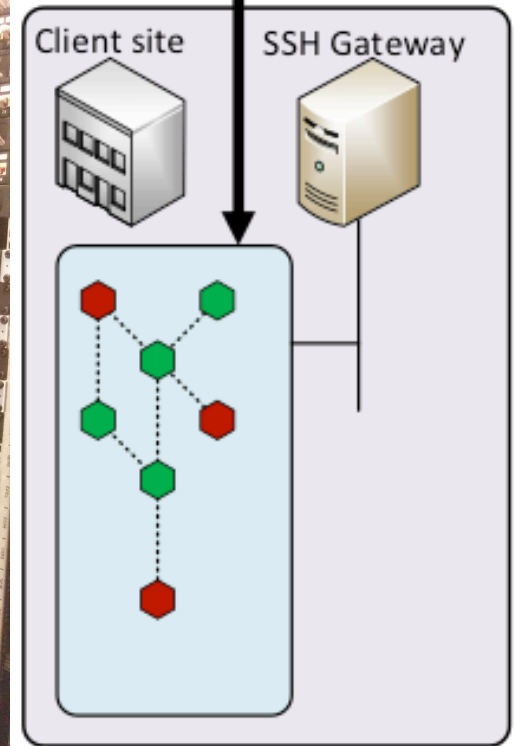
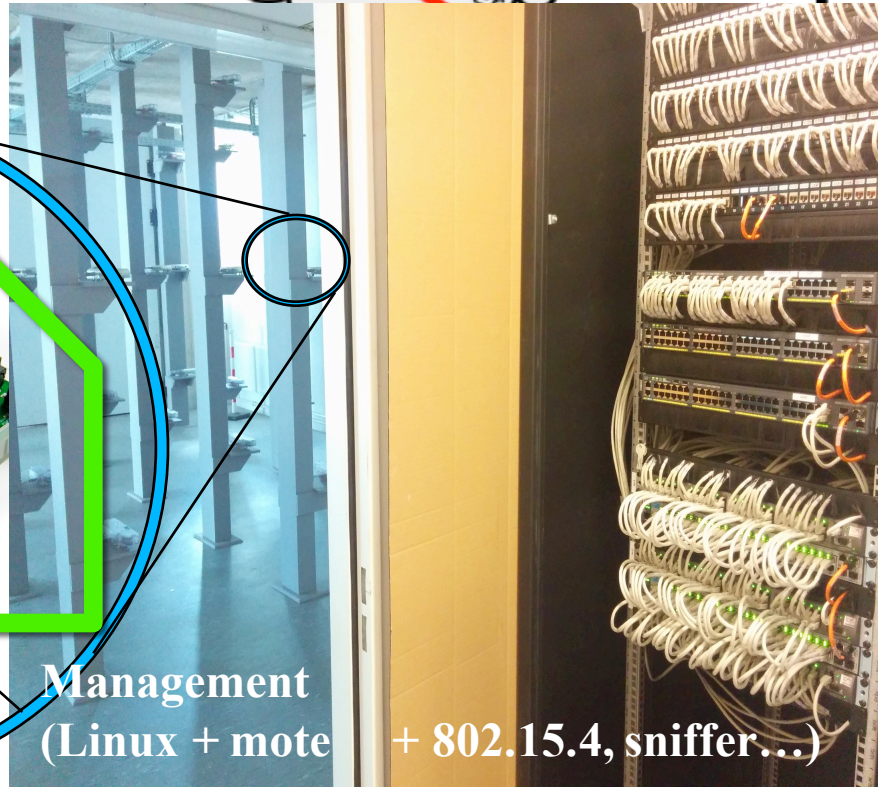
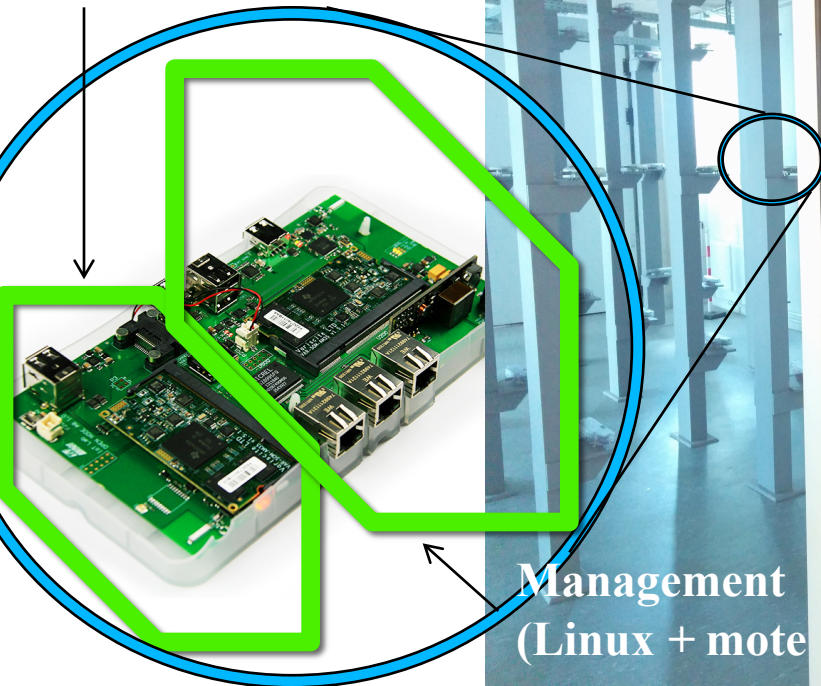
IoT-LAB Backend



IoT-LAB Backend



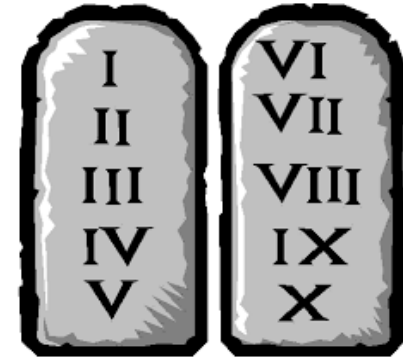
Open A8
+ M3 mote



Ten Rules of IoT-LAB

OPEN Nodes == NO CONSTRAINTS AT ALL

- I. Total remote access to open nodes
- II. Direct access to debugger
- III. Access to serial port / aggregator
- IV. On the global Internet (IPv6 end-to-end)



External Monitoring == NO APP MODIFICATION

- v. Packet sniffer
- vi. Precise end-to-end synchronisation (GPS)
- vii. Accurate power consumption



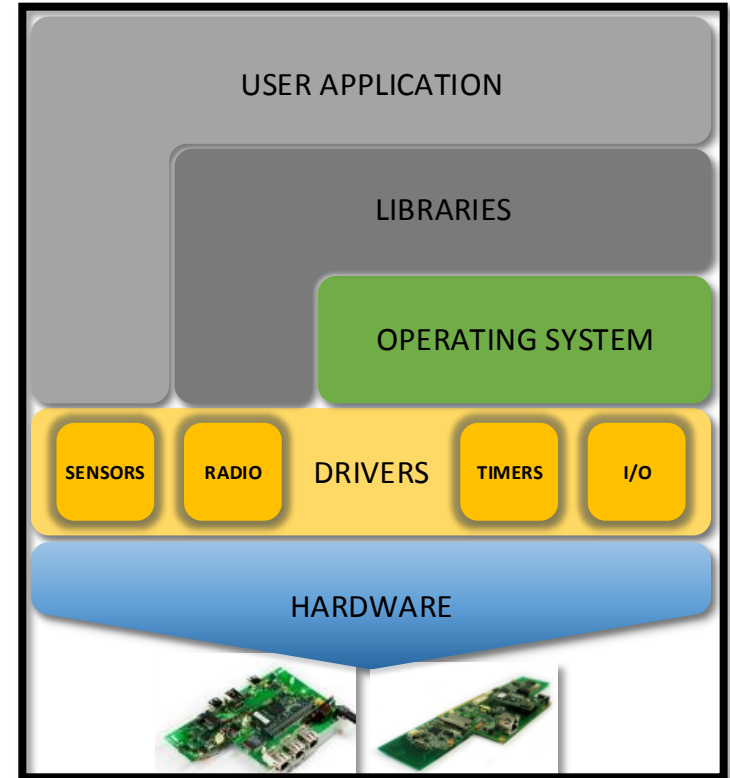
Easy to use / Advance features

- viii. OS support, tutorials, Open-source ...
- ix. Fleet of robots (40 + 60 + 10)
- x. Free open slots for specific hardware (usb node)

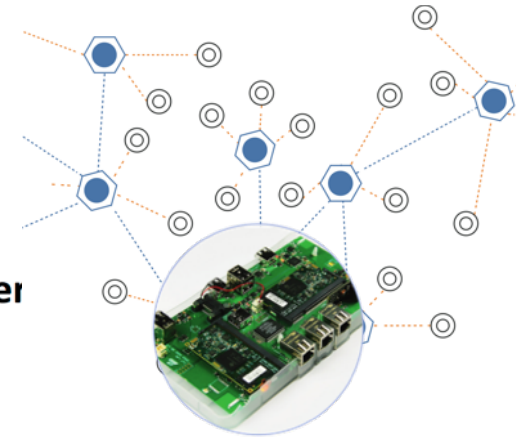
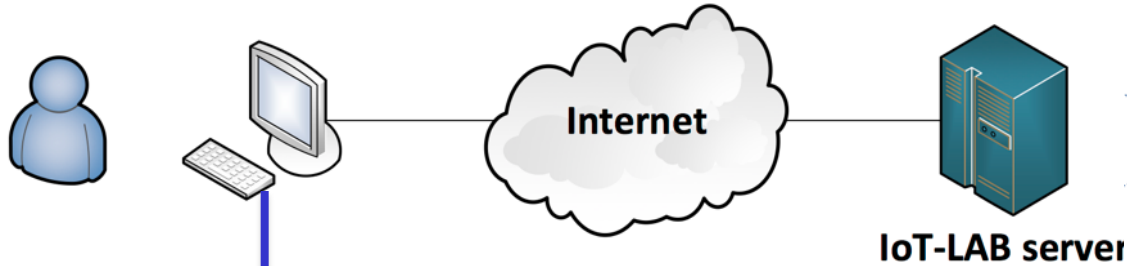


IoT-LAB Software Support

- **Bare metal access...**
- **But also additional software**
 - Low level drivers
 - Libraries (communication)
 - Operating systems



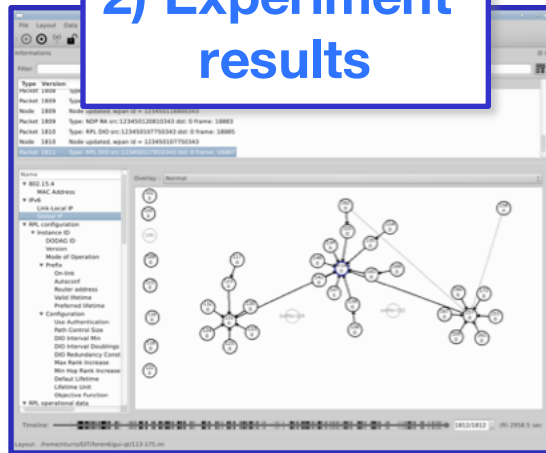
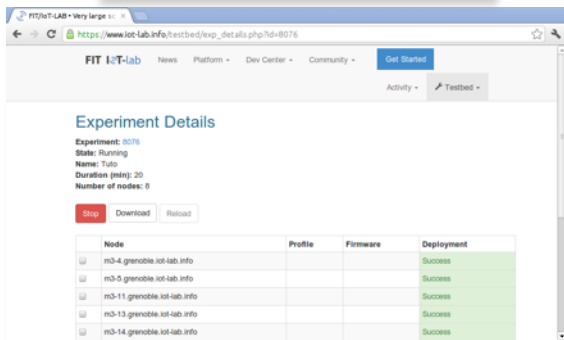
How to run an experiment



Open systems
with IETF protocols
(RPL/COAP/6TiSCH/...)

1) Experiment
configuration

2) Experiment
results



How-to IoT-Lab: Video Demo

- Available on YouTube at https://www.youtube.com/watch?v=VgtTV_NI5k8
- Hands-on tutorials available on <https://www.iot-lab.info/tutorials/>

Communities

The screenshot shows the FIT IoT-Lab website with a navigation menu including NEWS, PLATFORM, DEV CENTER, COMMUNITY, and GET STARTED. The main content area is divided into sections for Contiki, RIOT, and OPENWSN. Each section contains links to various tutorials and resources, such as 'With M3 nodes', 'With A8-M3 nodes', 'Get and compile firmware for M3 nodes', 'How to setup your environment and how to compile and use RIOT with M3 nodes', 'Public IPv6/LoWPAN network with A8-M3 nodes', 'IPv6/LoWPAN network', 'CoAP server with public IPv6/LoWPAN network on A8-M3 nodes', 'CoAP server example', 'Networking example for M3 nodes', 'Use the gnc_networking example provided in the RIOT repository.', 'Running RPL routing on M3 nodes', 'Run an experiment on M3 nodes with the RPL routing protocol provided by RIOT OS.', 'Get and compile firmware for M3 and A8-M3 nodes', 'Compile serial port communication firmware example', 'Testing Board Support Package with A8-M3 nodes', 'Test serial port and radio communication and print EUI64 identifier', and 'Running IPv6/TSCH/RPL network with A8-M3 nodes', 'Run an experiment on A8-M3 nodes with 6TISCH.'

The screenshot shows the GitHub repository page for FIT IoT-Lab issues. The repository is named 'iot-lab / iot-lab' and has 26 watchers, 47 stars, and 20 forks. The page displays a list of issues, with the following details visible:

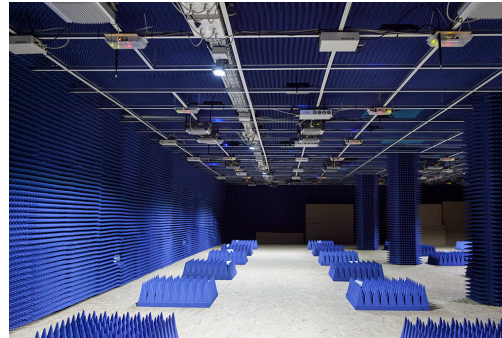
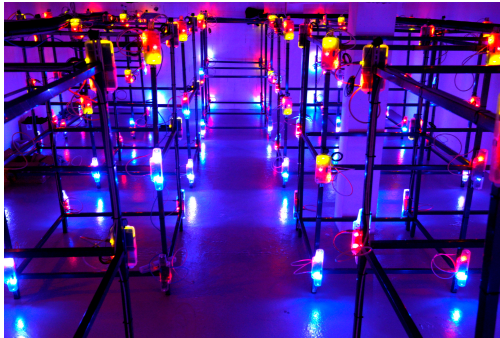
- 43 Open, 165 Closed
- Lille Test-Bed: Lost home directory (#209 opened on Apr 14 by jlope8)
- HTTP 400 Bad Request reply via REST interface (or alternatively sluggishly slow execution) when done from IoT-Lab ssh gateway-- since 2016-03-19 (#208 opened on Mar 21 by andwei)
- AdHocNets 2016 - the 8th International Conference on Ad Hoc Networks Call for Papers (#207 opened on Mar 2 by ChangleLI)
- Provide possibility to trigger power measurement intervals via GPIO (#206 opened on Mar 1 by miri64)

The screenshot shows the GitHub organization page for FIT IoT-LAB. The organization is named 'FIT IoT-LAB' and has the tagline 'Large Scale IoT Experiments'. The page displays a list of repositories, with the following details visible:

- Repositories: riot-upstream (Upstream version of https://github.com/RIOT-OS/RIOT patched for the needs of iot-lab experiment platform. Updated 20 hours ago)
- iot-lab-dev (Private repository, Python, Updated 20 hours ago)
- cli-tools (Python, Updated 4 days ago)
- openlab (Python, Updated 4 days ago, forked from hikob/openlab)

IoT-LAB - testbeds of Equipex FIT

- **Funded project: Equipex FIT**
(<https://fit-equipex.fr/>)
- **FIT: a initial set of testbeds (IoT, Wi-Fi, SDN, SDR, ...)**

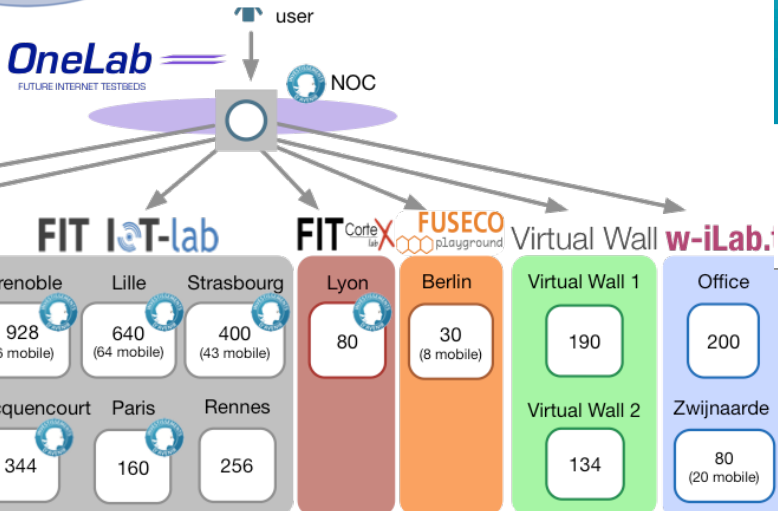
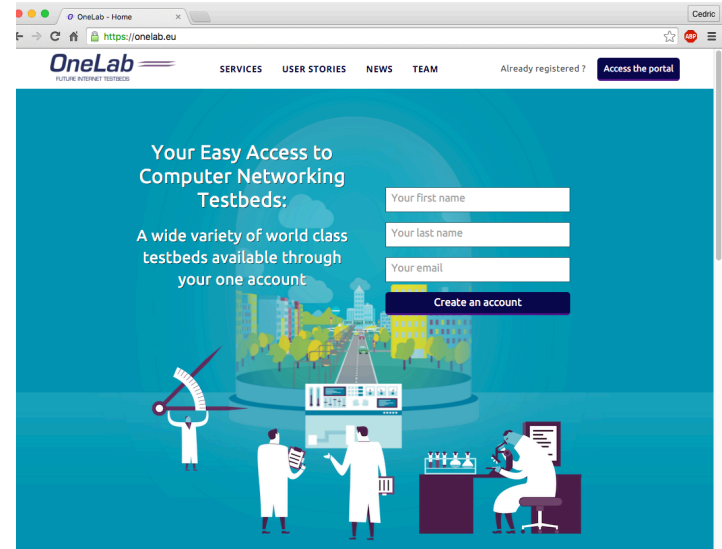


- **Partners**



www.iot-lab.info

FIT: part of the OneLab Federation



The OneLab Vision

We are approaching the era of the Multinet. Instead of the one Internet, we will have a multitude of parallel networks, customized by you to include anything and anyone you wish.

We are a federation of testbed owners, making it easier for scientists and innovators to bring out standardized and safe innovations for the public. We are testing the future today.

OneLAB.eu

N = testbed offering N nodes
 = Part of FIT Equipex

Time to use it !

more than 1000 users registered in more than 45 countries

<https://www.iot-lab.info>

Videos, YouTube channel "FIT IoT-LAB"

Contact: admin@iot-lab.info

**Thank you!
Danke schön!
Questions?**

