iMinds w-iLab.t

Hands-on: running OMF experiments on w-iLab.t Zwijnaarde

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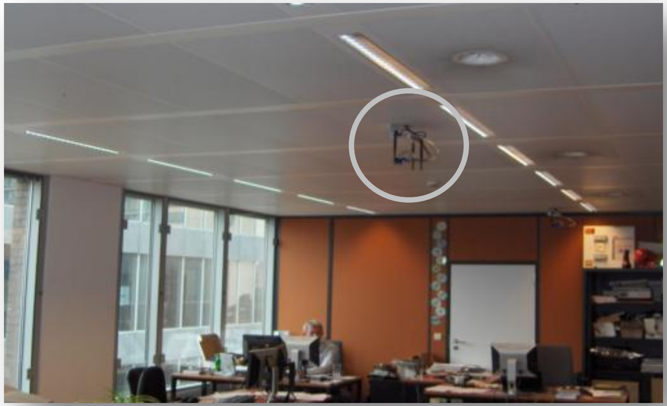
About the iMinds iLab.t

- The iLab.t research centre is located in Ghent

w-iLab.t : Facts and figures

- heterogeneous, generic testbed for wireless networks
  - Sensor networks
  - Wi-Fi based wireless ad-hoc/mesh/vehicular

- 2 testbed locations
  - Office: three office floors of 90m x 18m [200 nodes]
  - “Pseudo-shielded”, Zwijnaarde, 60m x 20m [60 nodes]



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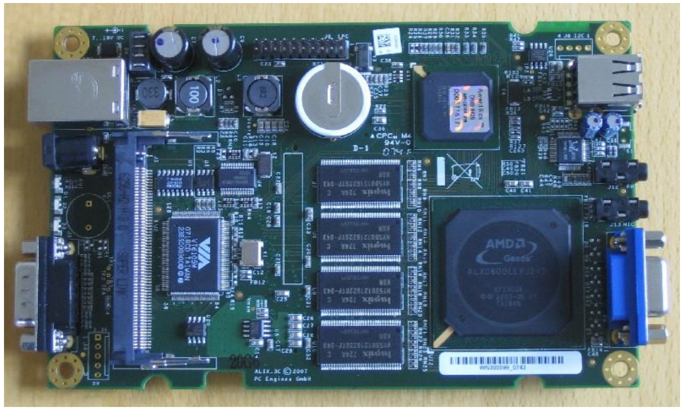
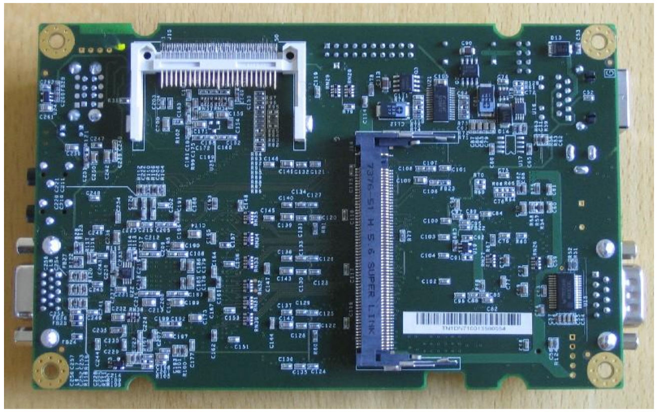
Hardware overview

Hardware – Embedded PC

- w-iLab.t Office
  - Alix 3c3 (500 MHz AMD, 256 MB Ram)
    - Ethernet NIC (100Mbit) / Serial port
    - VGA, onboard audio
    - compact flash storage (2 Gb)
    - 2 x mini PCI slot
    - USB

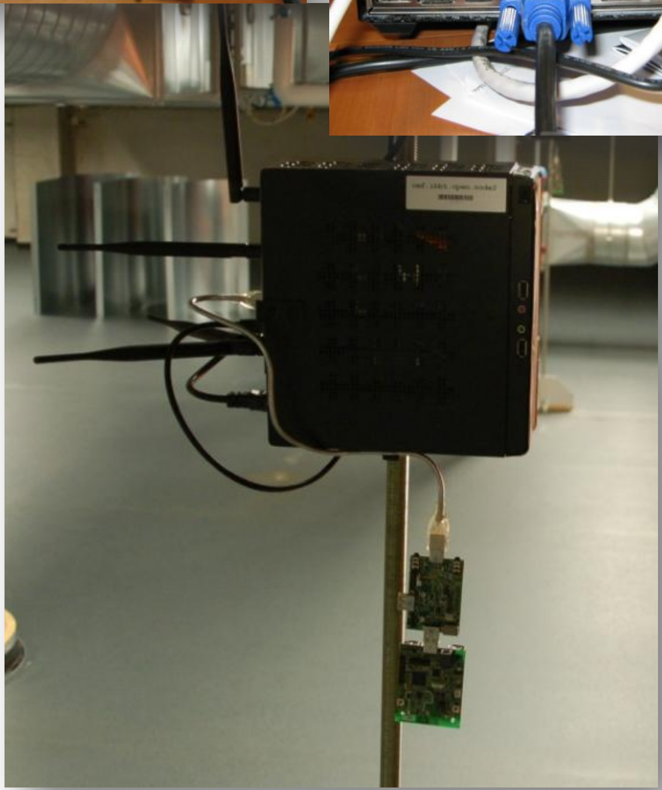




Picture source: www.pcengines.ch

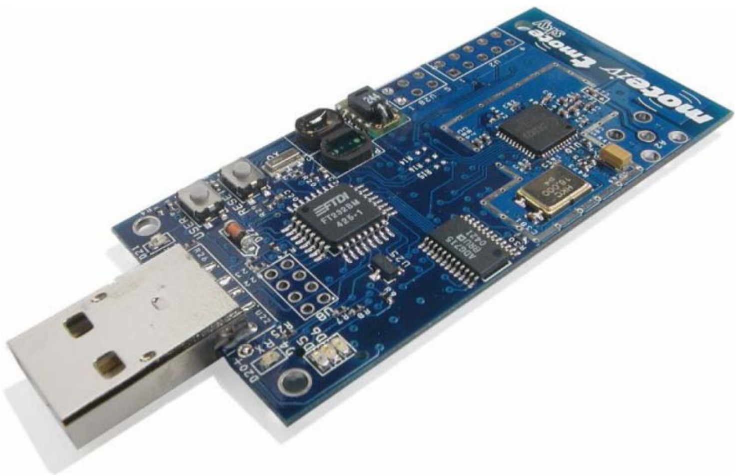
Hardware – Embedded PC

- w-iLab.t Zwijnaarde
  - Zotac
    - 4Gb RAM
    - 160 Gb Hard Drive
    - Intel Atom D510 1.66GHz Dual core
  - Wireless interfaces :
    - 802.11a/b/g/**n** (x2)
    - **Bluetooth**
    - **iMinds Rmoni sensor node** (802.15.4)
  - Environment Emulator
  - **Webcam** (20%)

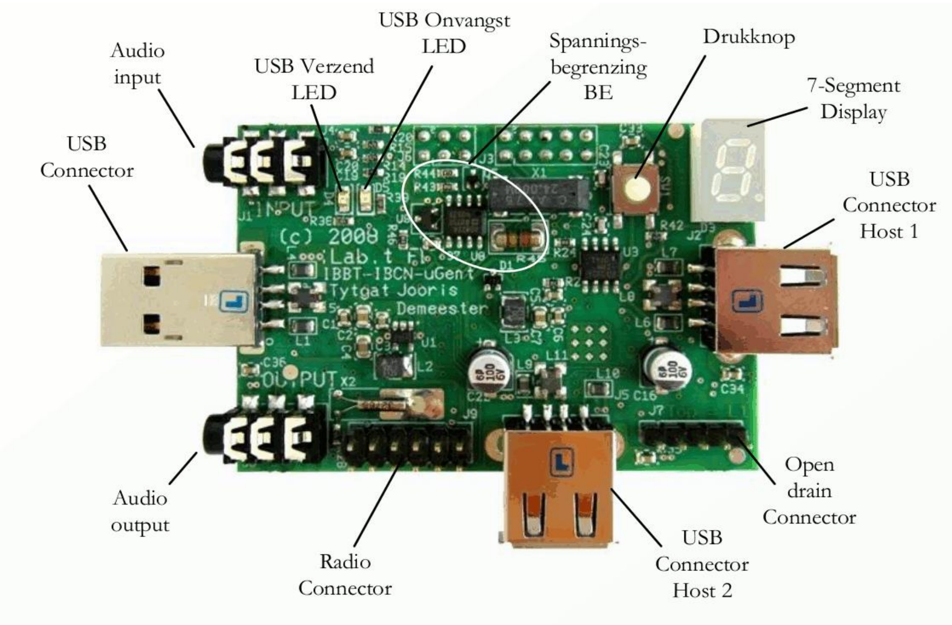


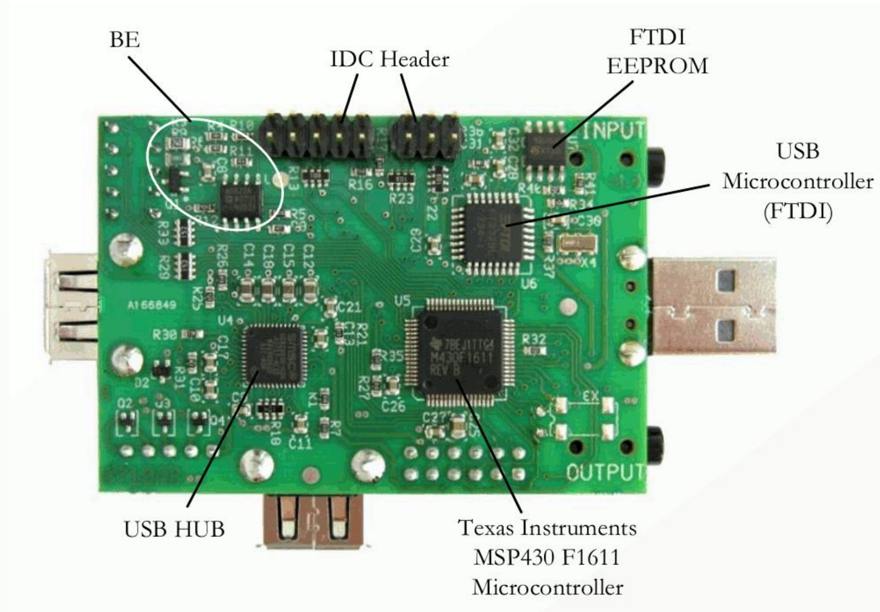
Hardware – sensor devices

- Tmote Sky (office) & iMinds Rmoni (Zwijnaarde)
  - TI msp430
  - CC2420 or CC2520
  - Sensors for temperature and humidity
- Specifications available on www.crew-project.eu/portal



Hardware: environment emulator

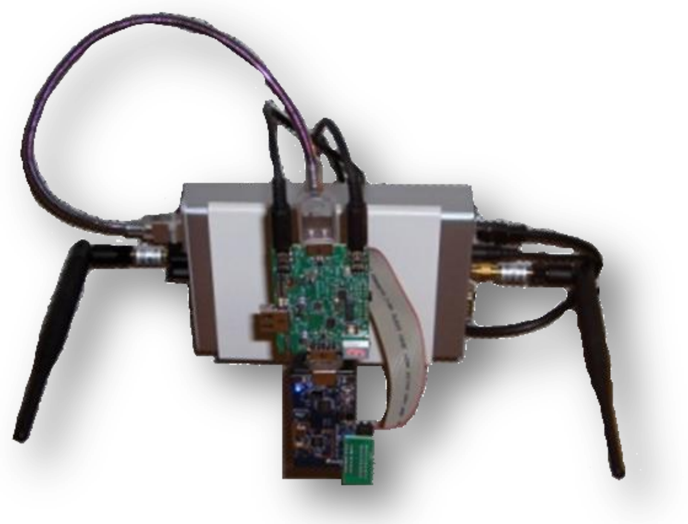




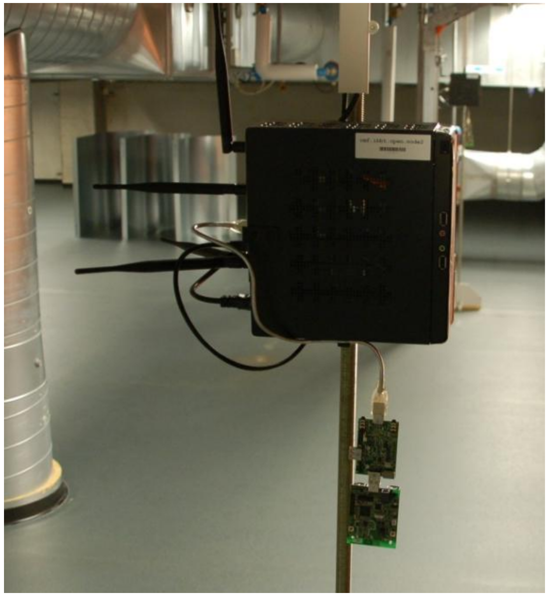
More information: L. Tytgat, B. Jooris, P. De Mil, B. Latré, I. Moerman, P. Demeester, **"Demo abstract: WiLab, a real-life wireless sensor testbed with environment emulation"**, published in European conference on Wireless Sensor Networks, EWSN adjunct poster proceedings (EWSN), Cork, Ireland, 11-13 February 2009

Node locations

- w-iLab.t Office (x200)
  - Node = Embedded PC + EE + Tmote Sky

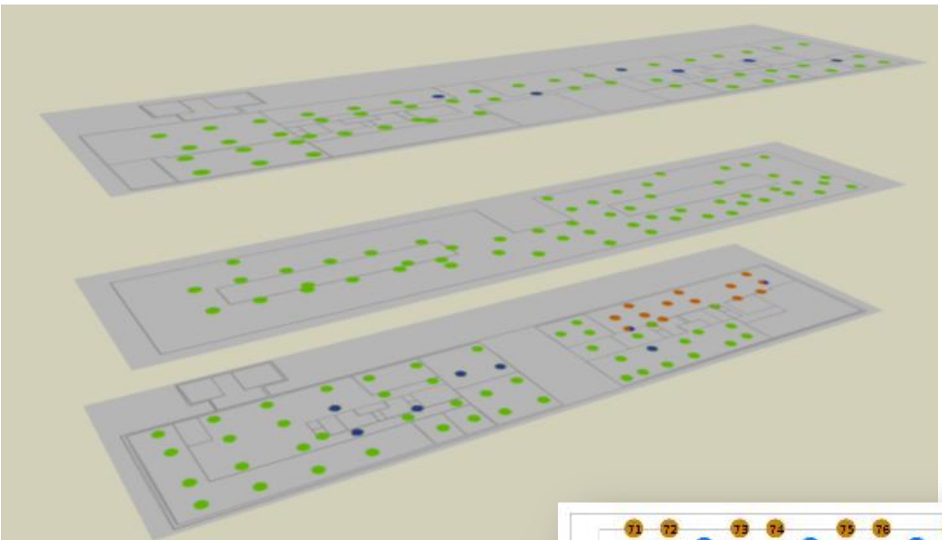


- w-iLab.t Zwijnaarde (x60)
  - Node = Embedded PC + EE + RM090



Topology

- w-iLab.t Office



- w-iLab.t Zwijnaarde

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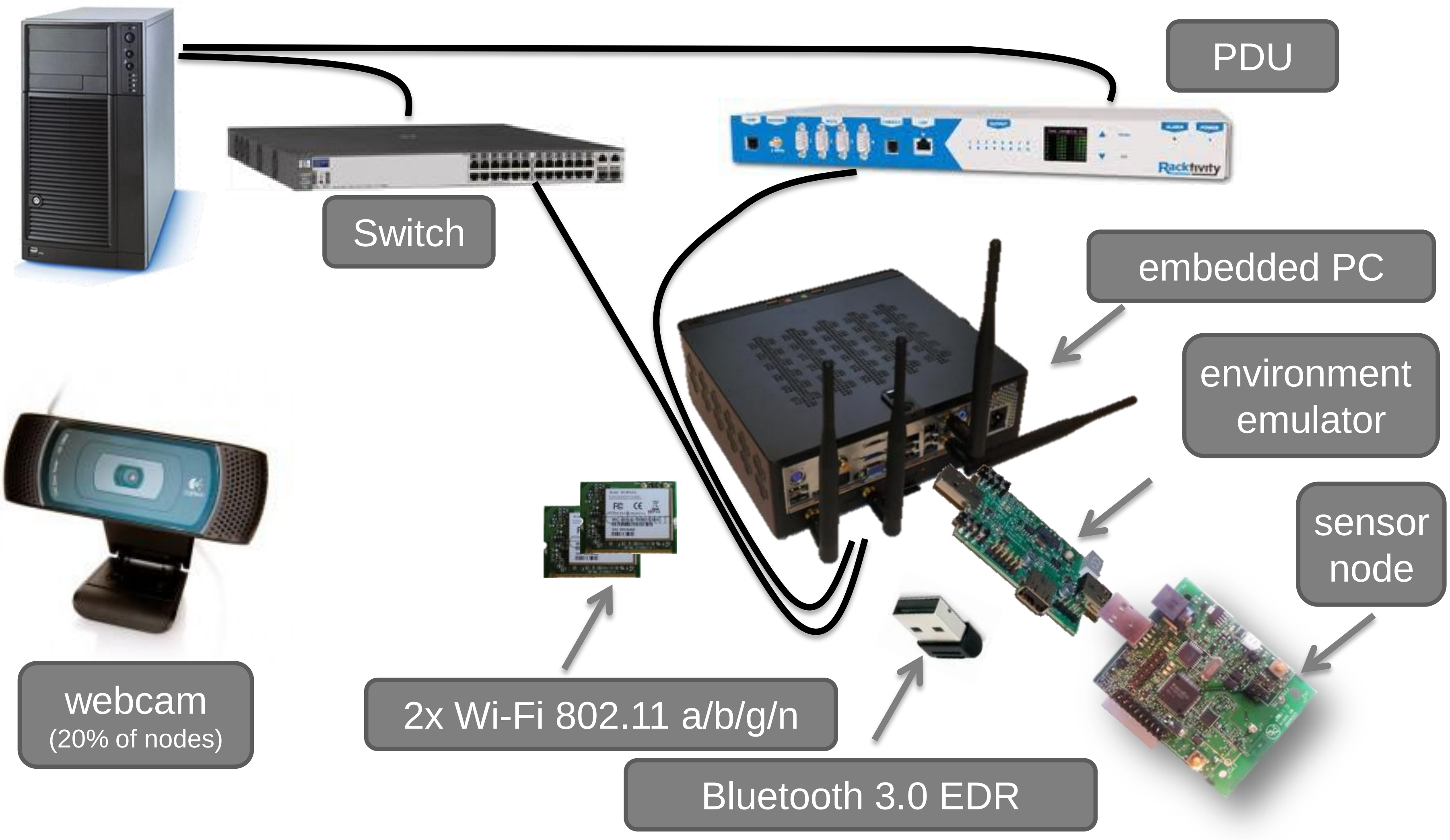
Testbed Architecture & Management

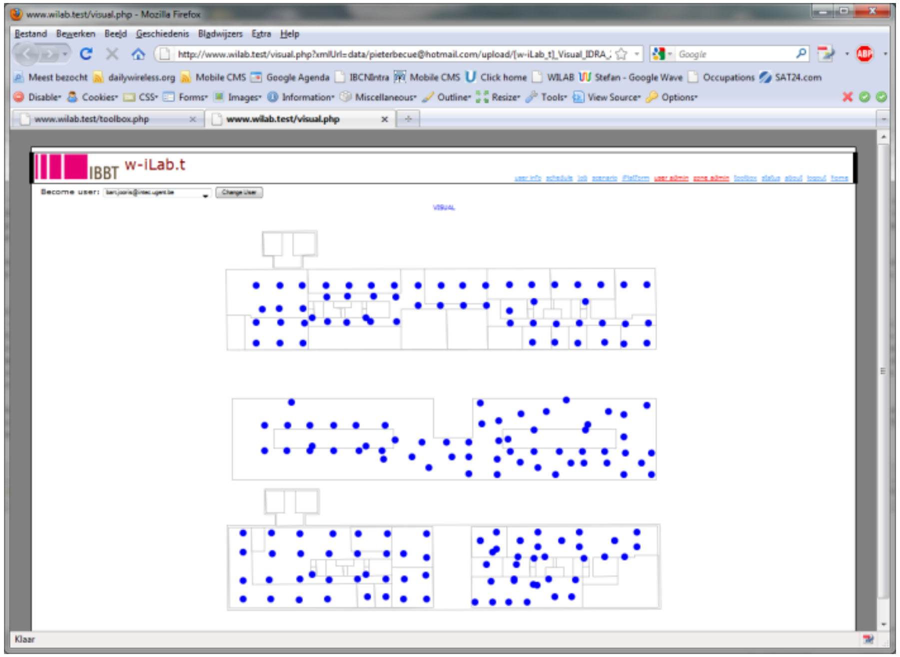
Testbed Architecture

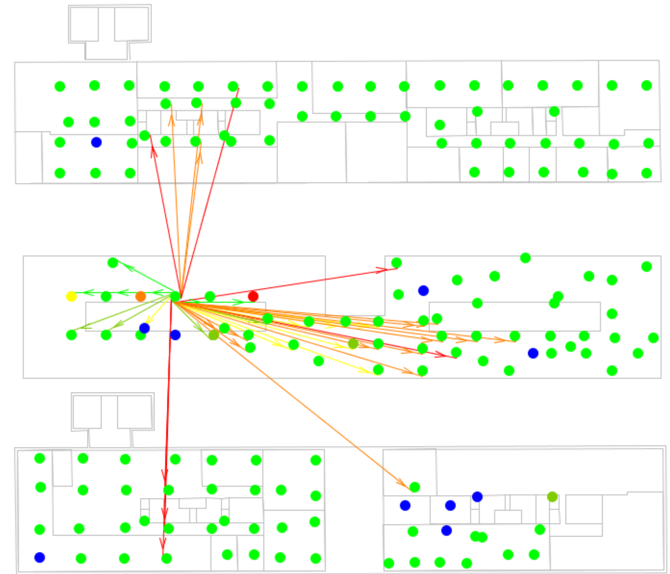


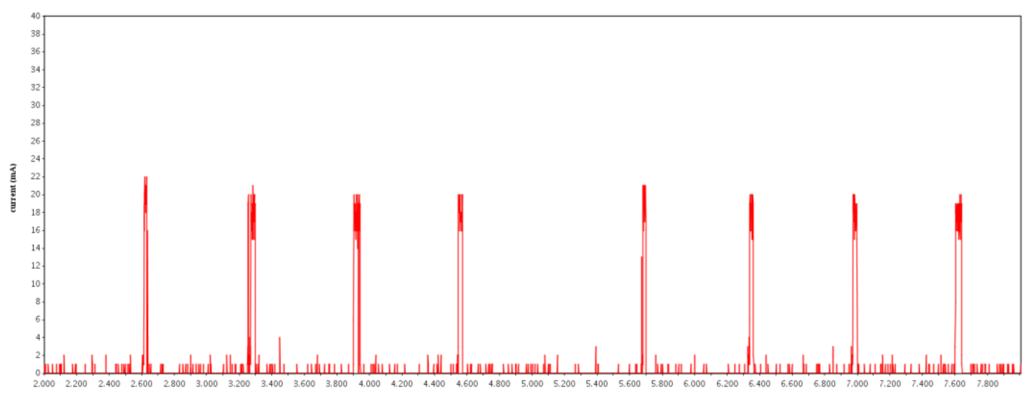
Management Framework & Tools

- OMF (http://omf.mytestbed.net)
- OML for collecting measurements (http://oml.mytestbed.net)

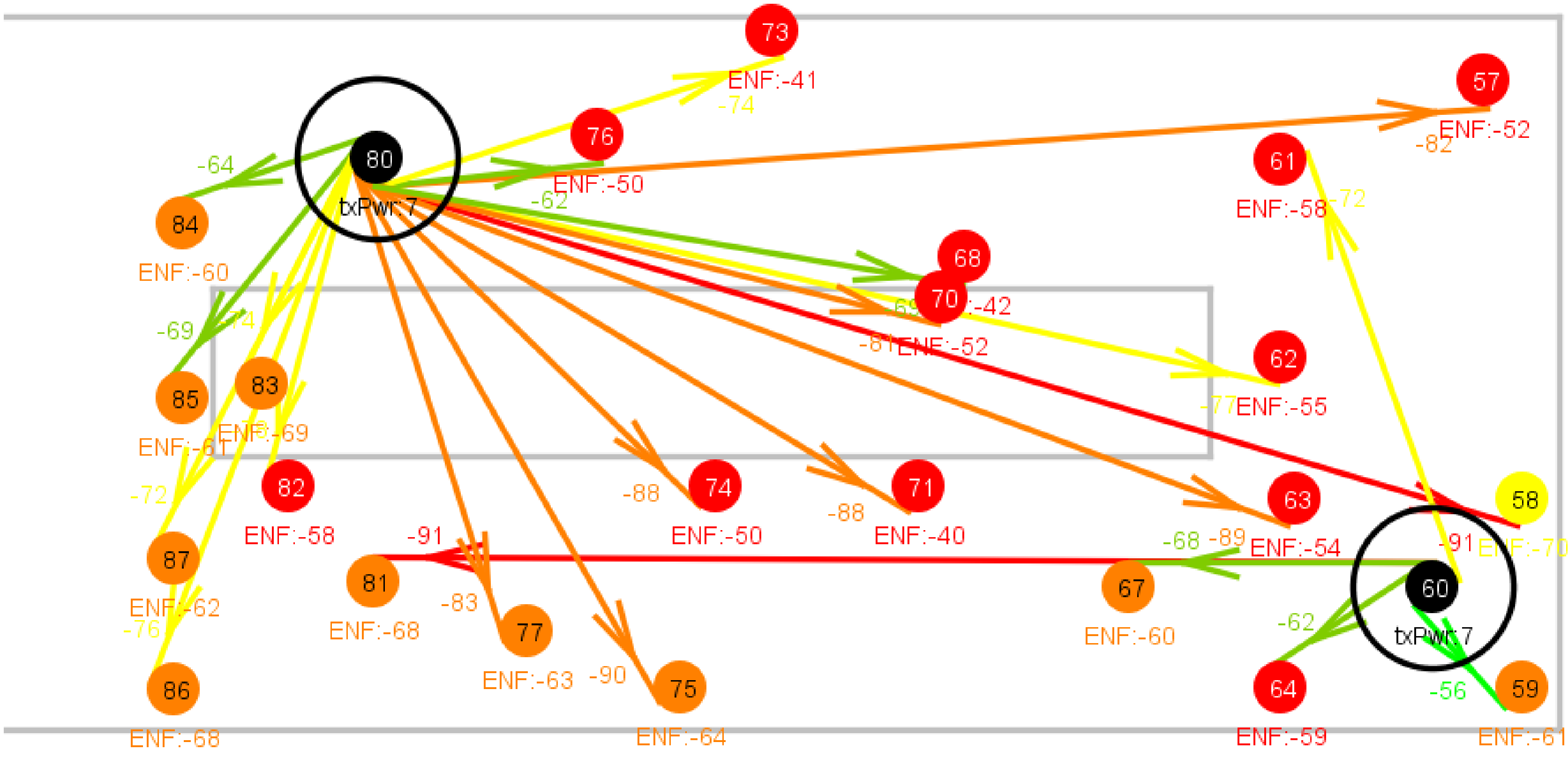
Visualization toolbox







Tx power – RSSI - ENF



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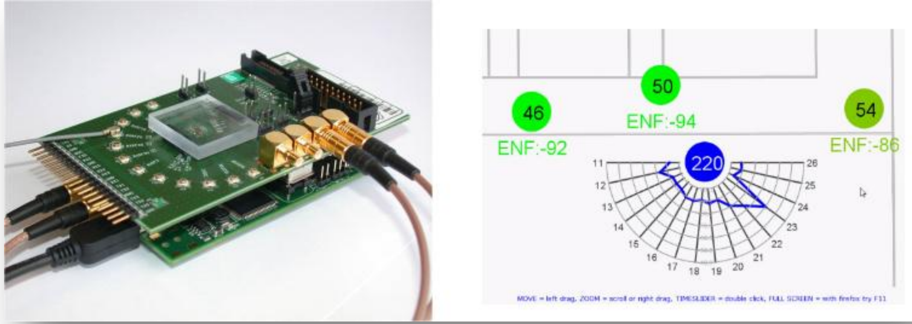
Testbed Hardware Extensions

Shielded testing environment

- shielded from outside interference
- coax connected
- variable attenuators
- emulate mobility

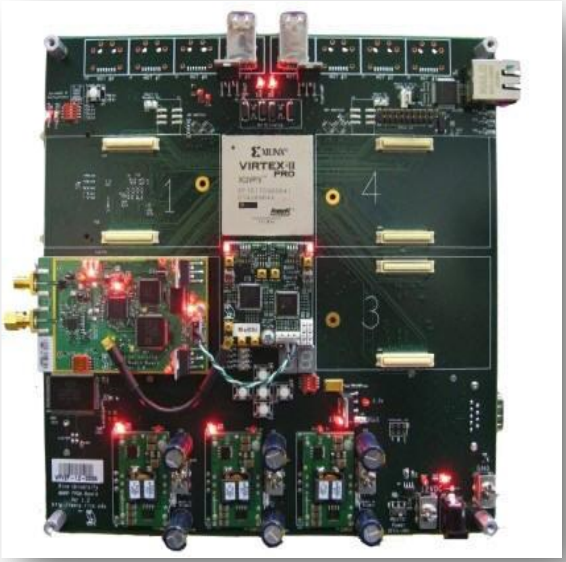
Cognitive components

- imec sensing engine



- USRP2 (SDR radios)

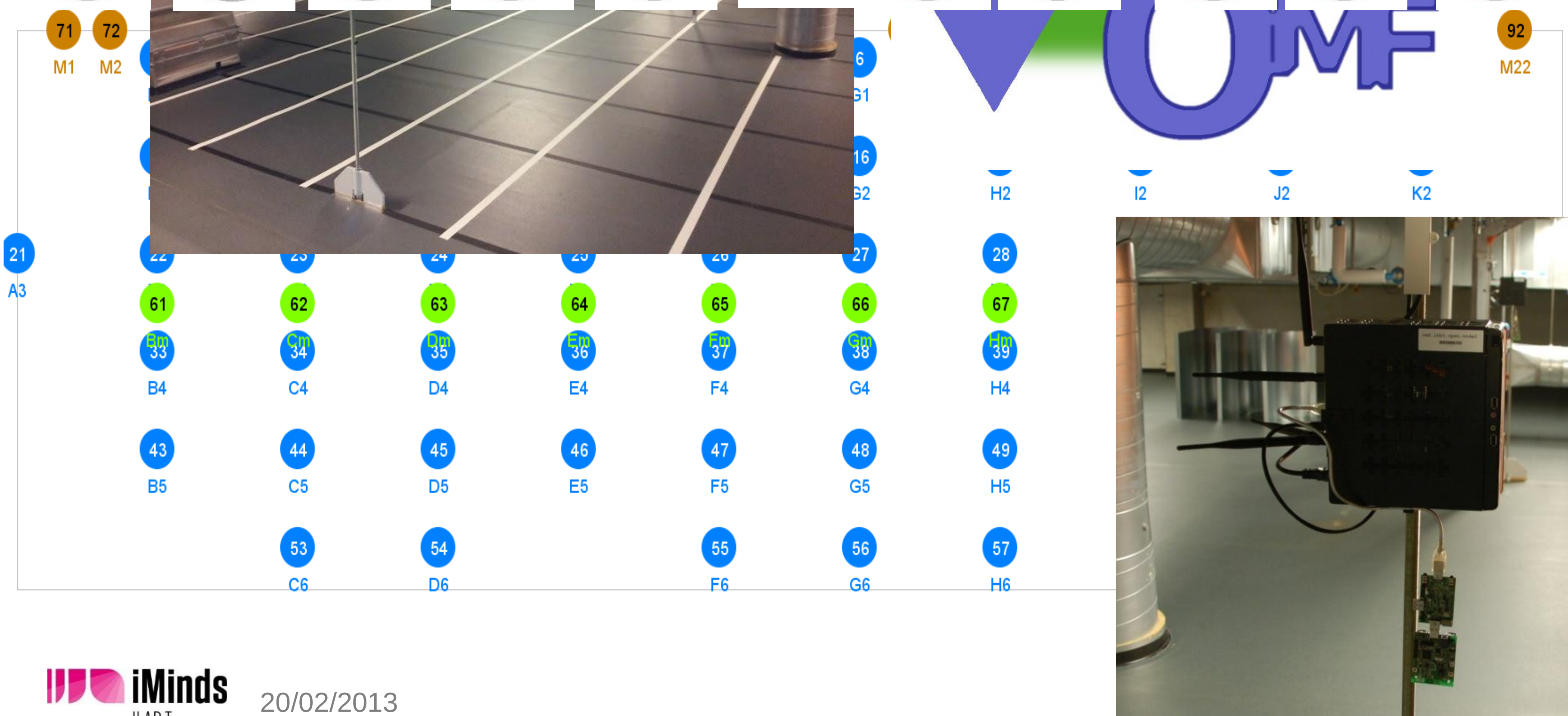
- Rice WARP



Specifications available on
www.crew-project.eu/portal

Mobility @ w-iLab.t

Easy-to-use
Repeatable mobility!



Mobility Extension

- allow experiments with mobile nodes
- based on vacuum cleaning robot
  - extended with:
    - iMinds Robotcontrol
      - In-house designed circuit board (Power control)
      - radio for remote control (ez430 – 868MHz)
    - Embedded PC
      - Powered by external battery pack
      - Webcam
      - Wireless interfaces :
        - 802.11a/b/g/n
        - Bluetooth
        - iMinds Rmoni sensor node (802.15.4)

Robot Demo

1. Robot will drive a rectangular path

2. Toggle its “eye” on a specific coordinate

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OMF Introduction

OMF Tutorial

Thierry Rakotoarivelo

NICTA

Australian Government
Department of Broadband, Communications and the Digital Economy
Australian Research Council

NICTA Funding and Supporting Members and Partners

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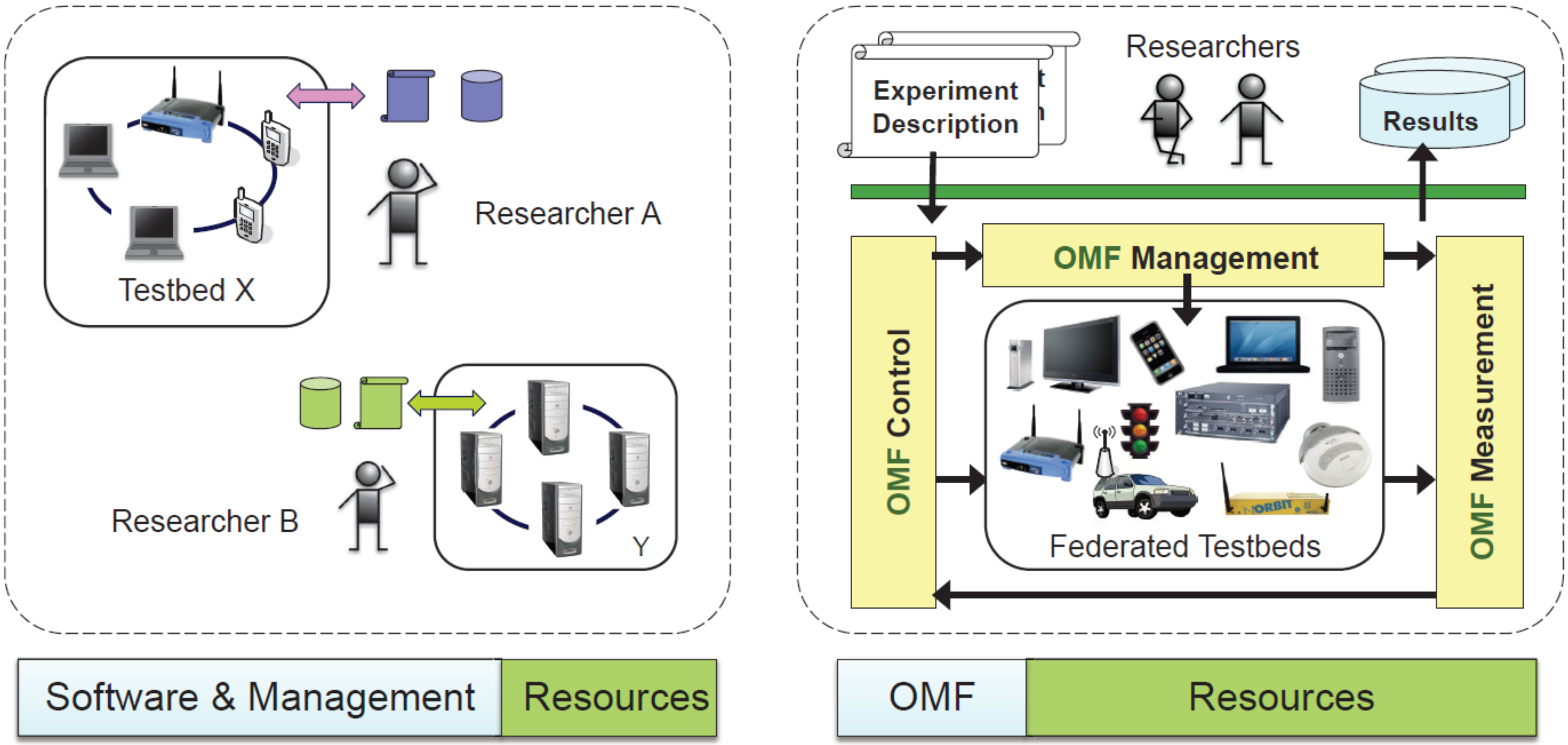
The Problem and Our approach



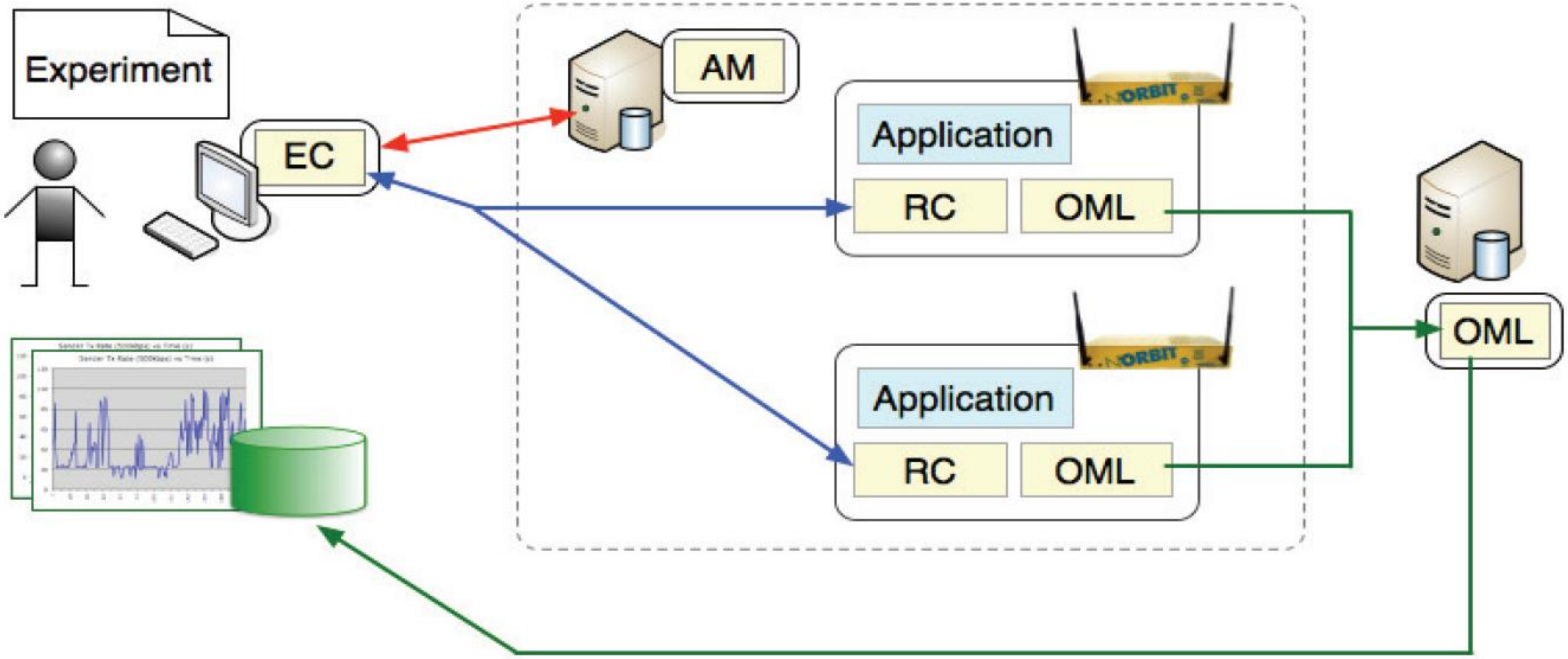
Support & share different resources

Federation of different testbeds

OMF deployment worldwide

How it works from a user's perspective?

NICTA



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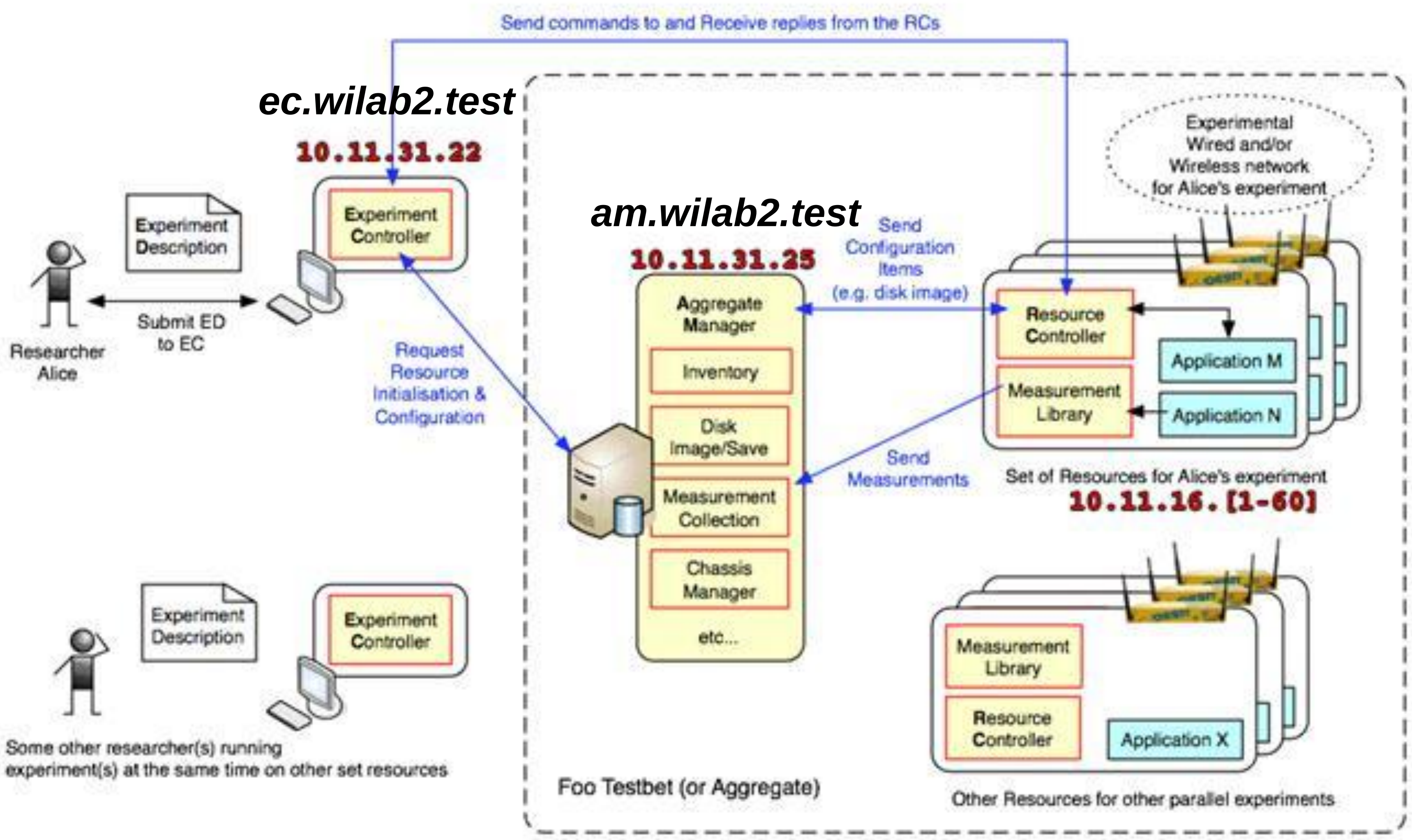
OMF Setup @ w-iLab.t Zwijnaarde



Using sensor nodes with OMF / OML

- Some OMF extensions:
  - to flash the sensor node
  - to start “gateway” applications (i.e. Serial Forwarder)
  - to parse output data (and store it in OML)
  - to send input data to the sensor node (through SF)

- The user has to:
  - Provide its own mapping file (packet layout)
  - Include gateway and parsing scripts in the Experiment Description

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OMF Tutorial – Step by step

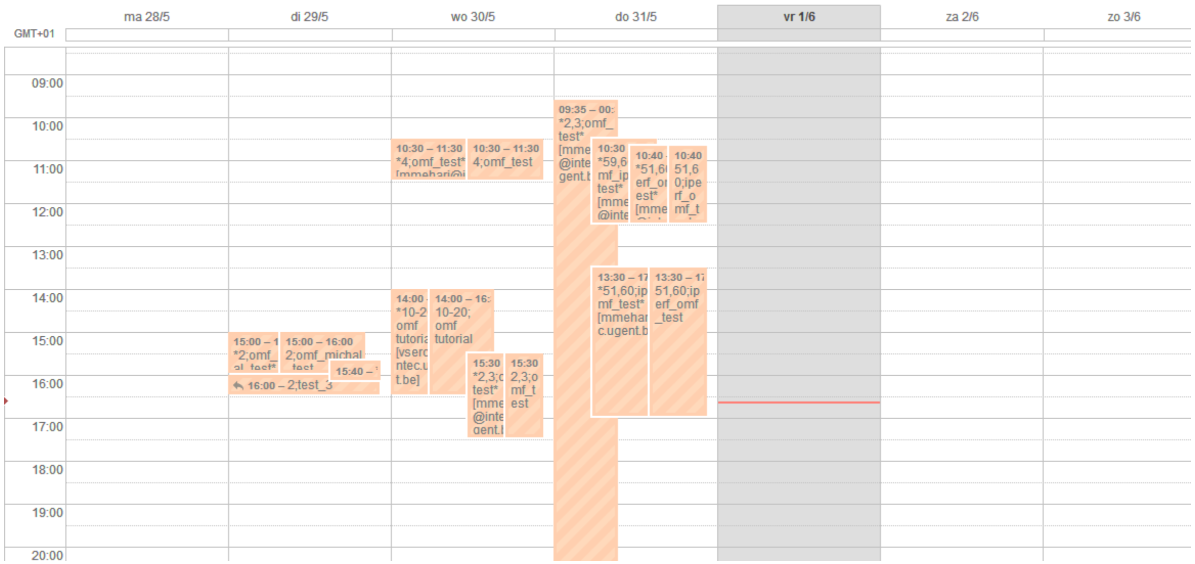
Resource discovery

(make sure your VPN connection is up !)

- w-iLab.t Zwijnaarde webinterface
  - http://wilab2.test/
  - Functionality
    - Nodes availability
    - Node power control
  - Lots of tutorials !

Reservation

- Google Calendar account
  - “Invite ibbtwilab2@gmail.com”
- No real reservation
  - Gentlemen’s agreement
  - Check performed if nodes are still available

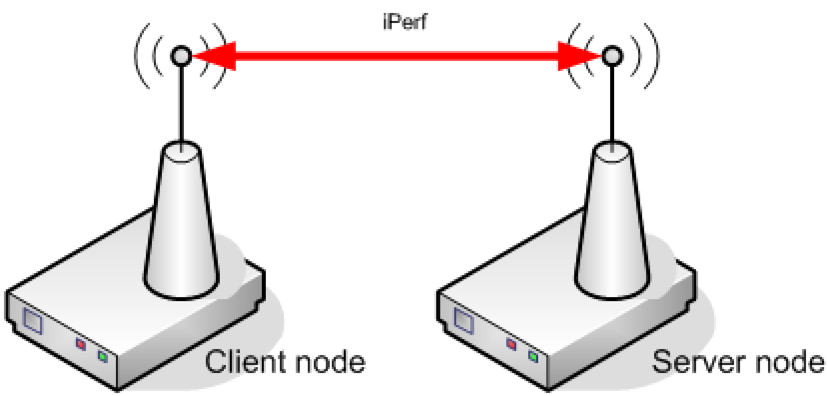


Installation of OS

- Stored in /var/lib/omf-images-5.3 (Experiment Controller)
  - omf load -t omf.ibbt.open.nodeX,omf.ibbt.open.nodeY -i imagename.ndz
- Image is multicasted
  - Loading time independent of nr of nodes
- iMindsBaseline.ndz (login: root/urbis)
  - Ubuntu 12.04
  - Sensor tools (communication and flashing tools)
  - Webcam tools
  - Bluetooth tools

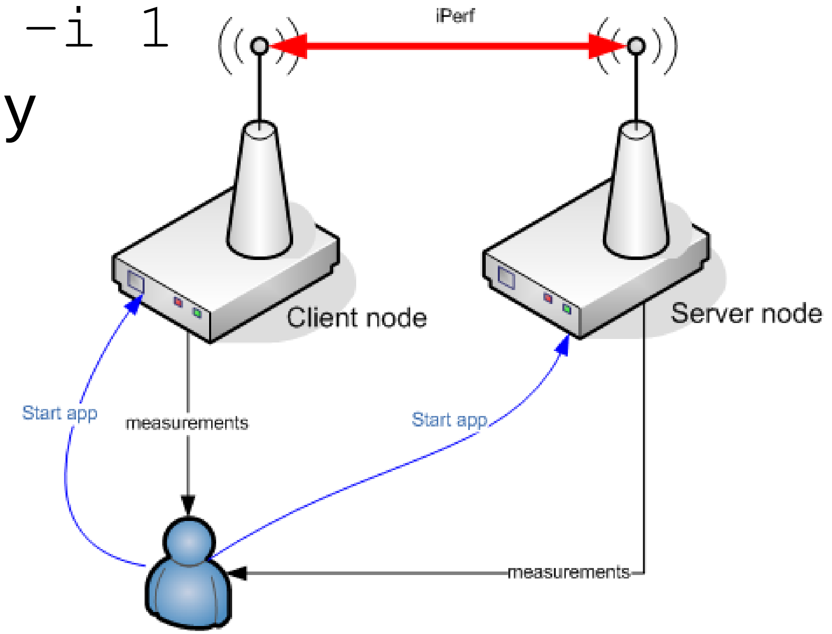
Running basic OMF Experiments: demo case

Goal: Test throughput of Wi-Fi using iPerf



Running basic OMF Experiments: manual approach

1. ssh to the server
2. set up wireless interface
3. start serverside application with `iperf -s -u`
4. ssh to the client
5. set up wireless interface and connect it to the server
6. start clientside application with: `iperf -c [serverip] -u -b 1000M -i 1`
7. collect measurements manually



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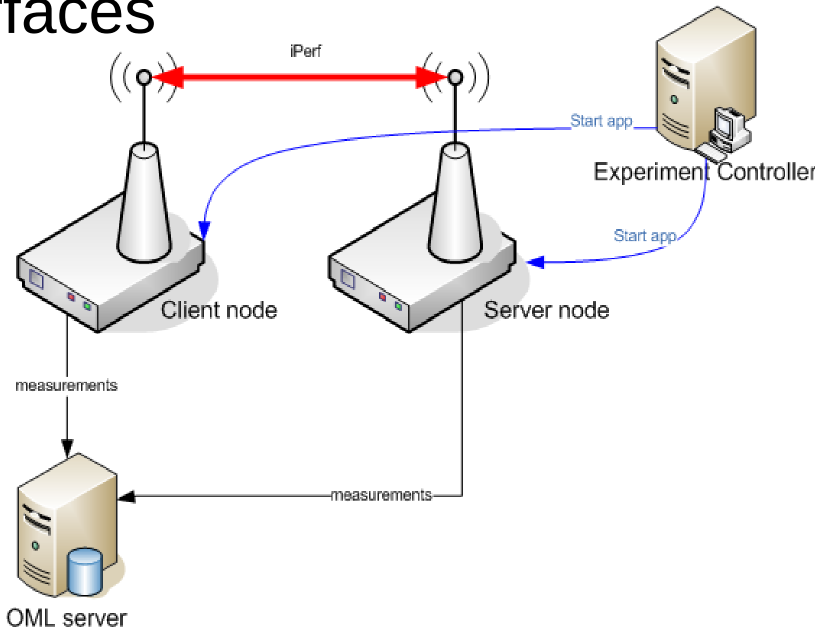
Running basic OMF Experiments: the OMF way

1. ssh to the experiment controller
2. write an **application definition**
   - where can OMF find iPerf?
   - what are valid commandline arguments?
   - what is the output of iPerf?
3. write an **experiment description**
   - configuration of wireless interfaces
   - which nodes?
   - timeline of the experiment
4. execute the experiment
5. read measurements in database



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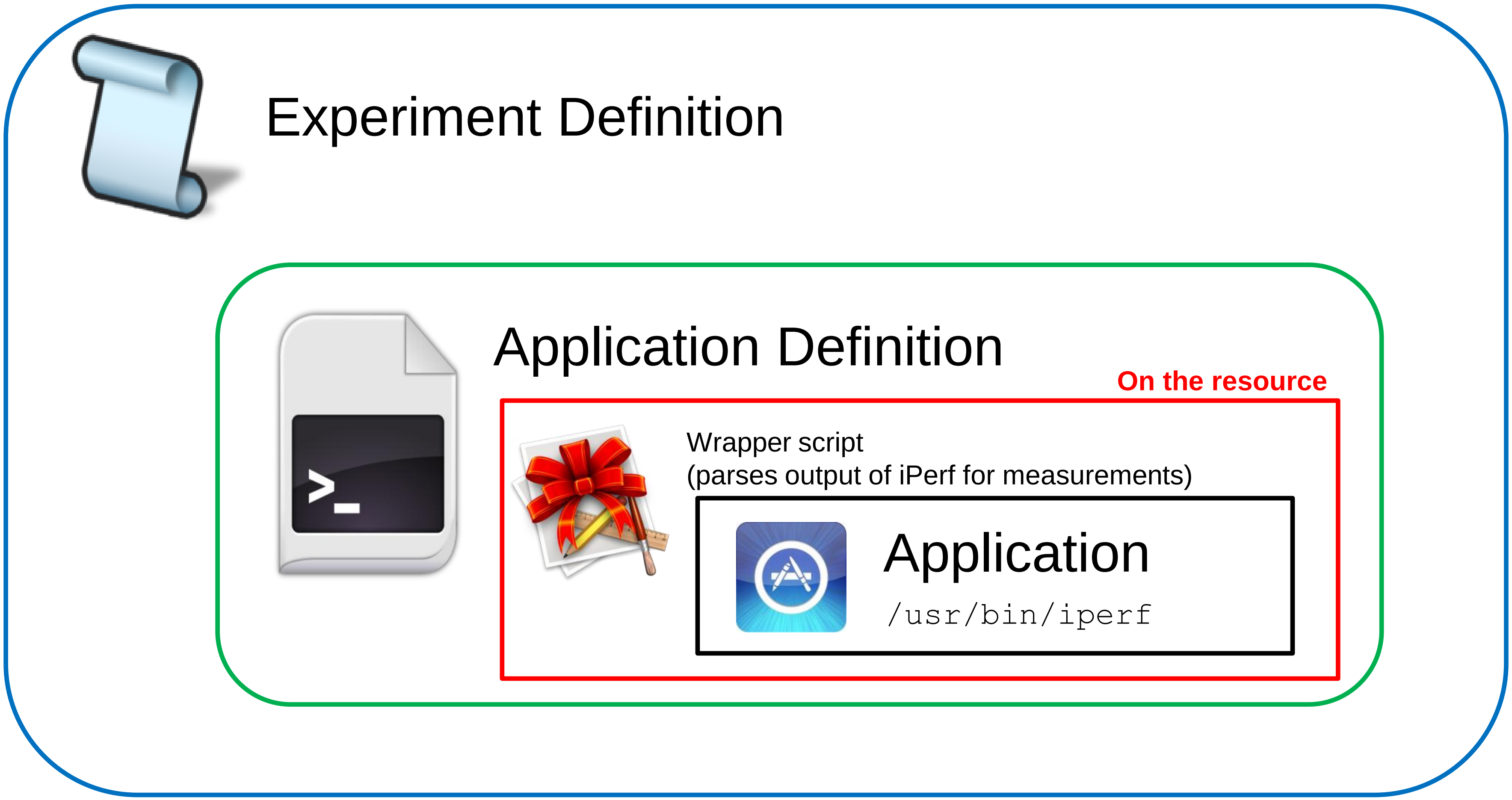
Running basic OMF Experiments



Running basic OMF Experiments

Experiment Definition

```
defGroup("server","omf.ibbt.open.node1")
    <config wireless interface>
    <add application(s)>
defGroup("client","omf.ibbt.open.node3")
    <config wireless interface>
    <add applications(s)>
```

```
defApplication('iperfwrap', 'iperfwrap')
```

```
onEvent(:ALL_UP_AND_INSTALLED) do |event|
  info "iPerf experiment - wait for interfaces to come up"
  wait 5
  group("server").startApplications
  info "Starting stream 1 server..."
  wait 2
  info "Starting stream 1 client..."
  group("client").startApplications
  wait 60
  group("client").stopApplications
  group("server").stopApplications
  Experiment.done
end
```

Application Definition

Wrapper script
(parses output of iPerf for measurements)

Application

`/usr/bin/iperf`

Running basic OMF Experiments

Experiment Definition

Application Definition

```
defApplication('iperfwrap', 'iperfwrap') do |app|
  app.path = File.join(File.dirname(__FILE__), 'iperfwrap.rb')
  app.appPackage = "iperfwrap.tar"

  app.shortDescription = "iPerf wrapper"
  app.description = "Simple iPerf wrapper with OML logging"

  app.defProperty('server', 'Act as server (true/false)', 's' , ...)
<more properties>

  # the measurement definition
  app.defMeasurement('iperfmp') do |mp|
<metrics: i.e. the fields in every record in the database>
  end
end
```

Wrapper script
(parses output of iPerf for measurements)

Application

`/usr/bin/iperf`

Running basic OMF Experiments

Experiment Definition

Application Definition

Wrapper script

(parses output of iPerf for measurements)

```
require "/usr/share/liboml2-dev/oml4r.rb"

APPPATH = "/usr/bin/iperf`

class MPStat < OML4R::MPBase
        name :iperfmp
        param :hostname
        param :interval_begin, :type => :double #sec
        param :interval_end, :type => :double #sec
        <other metric definitions>
end

<logic to pass commandline args to iperf>
<logic to parse output and generate OML>
```

Application

`/usr/bin/iperf`

Run it!

- ssh to ec.wilab2.test as user: **`demoX`** pass: **`demoX`**
- navigate to **`~/ewsn/iperf`**
- inspect **`experiment_description.rb`**
- inspect **`iperf_wrapper.rb`**
- run the experiment using
  `omf exec experiment_description.rb`
- Log in on a node and execute
  `ps -aux | grep iperf`
- paste your experiment ID
  in the textbox on http://wilab2.test/
  measurements tab

	nodeA	nodeB
reserved	25	26
demo1	2	3
demo2	4	5
demo3	6	7
demo4	8	9
demo5	13	14
demo6	15	16
demo7	17	18
demo8	19	20
demo9	22	23
demo10	27	28
demo11	29	30
demo12	33	34

The w-iLab.t testbed

details:
http://ilabt.iminds.be/

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