Experimentation with Wireless Networks using the Federated Infrastructure of Openlab

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Overview

- Introduction
- The Openlab Federated Wireless Facility
  - (testbeds, tools, activities)
- A representative experiment
- Future plans
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- The Openlab Federated Wireless Facility
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- A representative experiment
- Future plans
Partners of the Wireless WP

- UTH
- COSMOTE
- IBBT
- ETH
- NICTA

> NTUA (through the 1st open call)
Where we are now

D3.1: Wireless testbeds Initial report delivered

MS13: Wireless and mobile testbed setup
MS14: Wireless – specific measurement framework

MS21: Wireless testbed Federation Framework
MS22: Reporting on mobility aspects of wireless testbeds

We’re here
Overview

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- The Openlab Federated Wireless Facility
  - (testbeds, tools, activities)
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Wireless Testbeds

- NITOS testbed (UTH)
- W-iLab.t testbed (IBBT)
- ETHZ .SEL (ETH)
- NORBIT testbed (NICTA)
NITOS Testbed (UTH)

- Currently NITOS maintains
  - 70 Wi-Fi Nodes
  - 10 of them with GNU radios
  - All of them are equipped with sensors and cameras
  - 5 mobile nodes
W-iLab.t Testbed (IBBT)

- Currently W-iLab.t maintains
  - 200 Wi-Fi Nodes
  - All of them with sensing capabilities
  - Environmental emulator per node
  - Supports mobility
**ETHZ .SEL Testbed (ETH)**

<table>
<thead>
<tr>
<th>Brand</th>
<th>Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTC</td>
<td>25x Nexus One</td>
</tr>
<tr>
<td>Samsung</td>
<td>10 Galaxy Nexus + 4 Galaxy SIII</td>
</tr>
<tr>
<td>Other</td>
<td>1x Motorola RAZR Maxx, 1x HTC One X, 1x Sony Xperia S, 1x LG P880 Optimius, 1x HTC One V, 1x Samsung Galaxy Y, 1x HTC Wildfire, 1x Motorola Wilder, 1x Huawei ideos X3</td>
</tr>
<tr>
<td>TOTAL</td>
<td>~50 <em>high-end to low-end</em> Android phones (2.3.x and 4.0.x)</td>
</tr>
</tbody>
</table>
Main Activity

- Wireless-specific federation and experimentation tools
- Wireless testbed extensions
- Wireless/mobility-specific measurements
- Mobility support tools and methodology
Main Activity

- Wireless-specific federation and experimentation tools
  - Orchestrating and controlling experiments remotely
  - Accessing the facility remotely
  - Federating the facilities
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OMF Overview
OML Architecture

Foo Testbed (or Aggregate)

Resource - Node 1 "Sender"

OML Measurement Point
send the packet Pi out

begin
......
create a new packet Pi
OML Measurement Point
forwarding measurement on Pi (e.g. seq num)

OML Client Library

Resource Controller

OML Collection Server

Aggregate Manager
Main Activity

- Wireless-specific federation and experimentation tools
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http://nitlab.inf.uth.gr/NITLab/

Network Implementation Testbed Laboratory

Welcome to the Network Implementation Testbed Laboratory of the Computer and Communication Engineering Department at University of Thessaly. NITLab is also affiliated with the Centre for Research & Technology Hellas (CERTH). The research of the lab focuses on the design, study and implementation of wireless schemes and their performance in the real environment. In this context, NITLab has developed a testbed named NITOS, which stands for Network Implementation Testbed using Open Source code.
Reservation Procedure

Welcome to the NITOS Testbed Reservation Tool

Current Slices: iokazdarid.

Current Server Time: 2012-10-12 20:11:00

Click on a date to select the day you want to start the reservation.

<table>
<thead>
<tr>
<th>October 2012</th>
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<tbody>
<tr>
<td>Sun</td>
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<td>28</td>
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</table>

Choose the time you want to start the reservation and for how long (max 4 hours).

Select Slice, Start Time and Duration

Slice: iokazdarid

Start Date: yyyy/mm/dd

Start Time: 00 : hh : 00 : min

Duration: 0.5 : hours

Check Available Nodes
Reservation Procedure

Available Nodes and Channels between 2012-10-15 20:00:00 and 2012-10-15 22:30:00:
Slice: iokazdarid

<table>
<thead>
<tr>
<th>Orbit/Diskless Nodes</th>
<th>Grid Nodes</th>
<th>GNU/MIMO Nodes</th>
<th>802.11a</th>
<th>802.11b/g</th>
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</thead>
<tbody>
<tr>
<td>Node 1:</td>
<td>Node 16:</td>
<td>Node 32:</td>
<td>Channel 36:</td>
<td>Channel 1:</td>
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<td>Node 2:</td>
<td>Node 17:</td>
<td>Node 33:</td>
<td>Channel 40:</td>
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<td>Node 3:</td>
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<td>Channel 12:</td>
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Reserve
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- Channel 60: √
- Channel 64: √
- Channel 100: √
- Channel 104: √
- Channel 108: √
- Channel 112: √
- Channel 116: √
- Channel 120: √
- Channel 124: √
- Channel 128: √
- Channel 132: √
- Channel 136: √
- Channel 140: √

- Channel 1: √
- Channel 2: √
- Channel 3: √
- Channel 4: √
- Channel 5: √
- Channel 6: √
- Channel 7: √
- Channel 8: √
- Channel 9: √
- Channel 10: √
- Channel 11: √
- Channel 12: √

[Reserve]
Main Activity

- Wireless-specific federation and experimentation tools
  - Orchestrating and controlling experiments remotely
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Federating the Facilities

**Current Status**

- Planetlab EU and NITOS are federated (Demo)
  - Single-sign on
  - Full federation of resource provisioning though SFA (work done during the summer):
    - Resource presentation from both the facilities
    - Resource reservation from both the facilities
  - Common control of resources
    - Experiment orchestration
    - Experiment execution
    - Measurements
    - Results visualization
Wireless specific Federation

- **Current Status**
  - w-iLab.t now OMF compatible
  - NITOS - PLE federation achieved
  - NITOS - w-iLab.t federation achieved
    + In the process of first federated experiment (w-iLab.t – NITOS)
Main Activities

- Wireless-specific federation and experimentation tools
- Wireless testbed extensions
- Wireless/mobility-specific measurements
- Mobility support tools and methodology
Nodes developed in NITOS

- ICARUS Node: developed for fixed NITOS testbed, but it can also be used as a Road-Side-Unit (RSU).
- We have also developed a smaller node for easier mounting in vehicles.
Other new NITOS Equipment

Temperature, humidity and CO2 sensor based on Arduino Uno board

Mikrotik R52 wireless cards which are capable of transmitting in the band of 5.9 GHz as 802.11p implies (for fast handoffs)

Chassis Manager Cards for controlling and monitoring nodes operational mode
3G femtocells

- UTH recently acquired 2 femtocell APs from COSMOTE
- The FAPs have been successfully installed, configured and tested
IBBT - Wireless testbed extensions

- Mobility extension to w-iLab.t
  - Emulated mobility
    - Integrated into testbed
    - Not yet OMF compatible
Mobility @ w-iLab.t

- Testbed Mobility extension
Main Activity

- Wireless-specific federation and experimentation tools
- Wireless testbed extensions
- **Wireless/mobility-specific measurements**
- Mobility support tools and methodology
3G Monitoring Android Application

Indicates 3G BaseStation

Indicates 3G Femtocell

Signal strength (dbm)
- <= -105
- > -105 && <= -90
- > -90 && <= -70
- > -69
3G Monitoring Android Application

- RSSI level through the entire experiment
- Each color indicates different associated 3G BaseStation/Femtocell
Spectrum measurements

- We use GNU radio devices for spectrum measurements and we are building a concrete spectrum sensing framework based on OMF/OML.
- We have USRP daughterboards for both the WiFi and cellular bands.
Spectrum measurements

Plot of estimated channel occupancy ratio for all the provided frequencies by the experimenter
Main Activity

- Wireless-specific federation and experimentation tools
- Wireless testbed extensions
- Wireless/mobility-specific measurements
- Mobility support tools and methodology
Disconnected experimentation (vehicular)

- We use internet infrastructure to connect the RSU with the server’s database.
- We use OMF/OML disconnection mode for the experiment (with a few enhancements by UTH)
Mobility @ w-iLab.t

- Controlled mobility
  - High accuracy positioning algorithm
  - Full control over mobile experiment node
  - Fully integrated into testbed (OMF)
    - User can fully control robot behavior
    - Mobile node measurements stored through OML (task 3.3)
Overview

- Introduction
- The Openlab Federated Wireless Facility
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Demonstration

- Experimentation on a wired/wireless scenario based on the federated NITOS and PLE infrastructure
  - Reservation of the needed resources using the SFA PLE-NITOS framework
  - Video streaming service provisioning to wireless users through a caching infrastructure over the federated PLE-NITOS environment
- Introduction
- Progress achieved so far
- Demo presentations
- Future plans
Physical Extension of NITOS with WiMAX and LTE component

- WiMAX base station already ordered from AirSpan company
  - The same kind of equipment successfully deployed and integrated into the GENI infrastructure

- COSMOTE and UTH work together to develop an LTE testbed at UTH, to be available by end/2012 – beg./2013.
Mobility @ w-iLab.t

- Extend robot zone to cover entire testbed
- Increase number of robots
- Provide mobility patterns to experimenters
- Develop tools to increase usability
  - E.g. easy drawing of mobility patterns
THANK YOU

QUESTIONS?