



Driving Innovation in Urban Computing with a Community Testbed

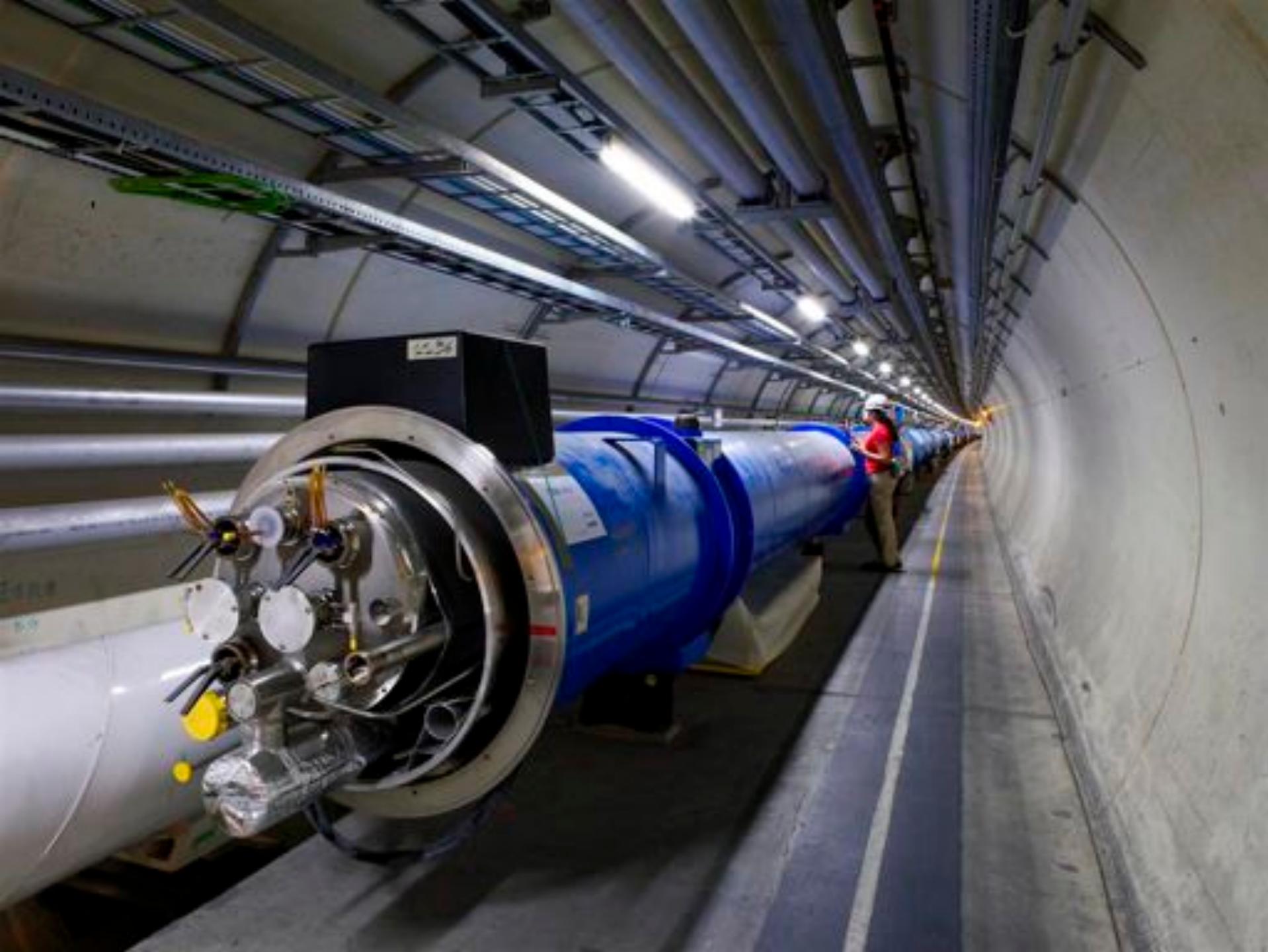
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²**University of Madeira, Portugal**

<http://www.ubioulu.fi>

PURBA 2011 San Francisco, June 12, 2011







You are here: NCAR • RAL • Joint Numerical Testbed

Joint Numerical Testbed (JNT)

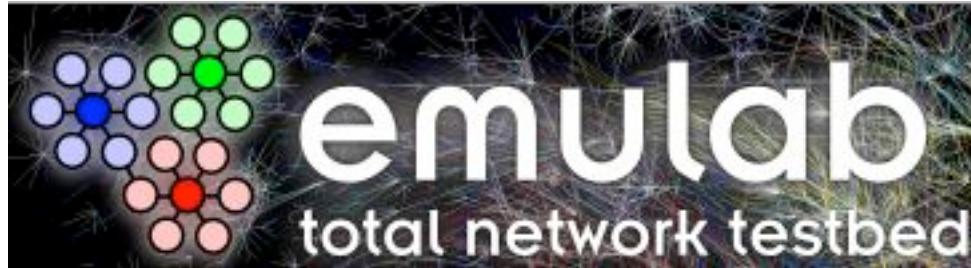
ASSESSING ADVANCED NUMERICAL FORECAST TECHNIQUES FOR OPERATIONS AND RESEARCH





PLANETLAB





Emulab is a **public facility**, available without charge to most researchers worldwide.

A testbed for Urban Computing?

Open urban computing testbed in Oulu, Finland

OPEN APIs
(application development, statistics)

MIDDLEWARE LAYER

Fuego server

BluelInfo

GSN server

Positioning server

MobileIP server

SMSC MMSC

Control server

Nagios server

UBI-hotspot

Resource manager

Layout manager

INFRASTRUCTURE LAYER

panOULU
WLAN

panOULU
BT

panOULU
WSN

Large public
displays

Server
machines

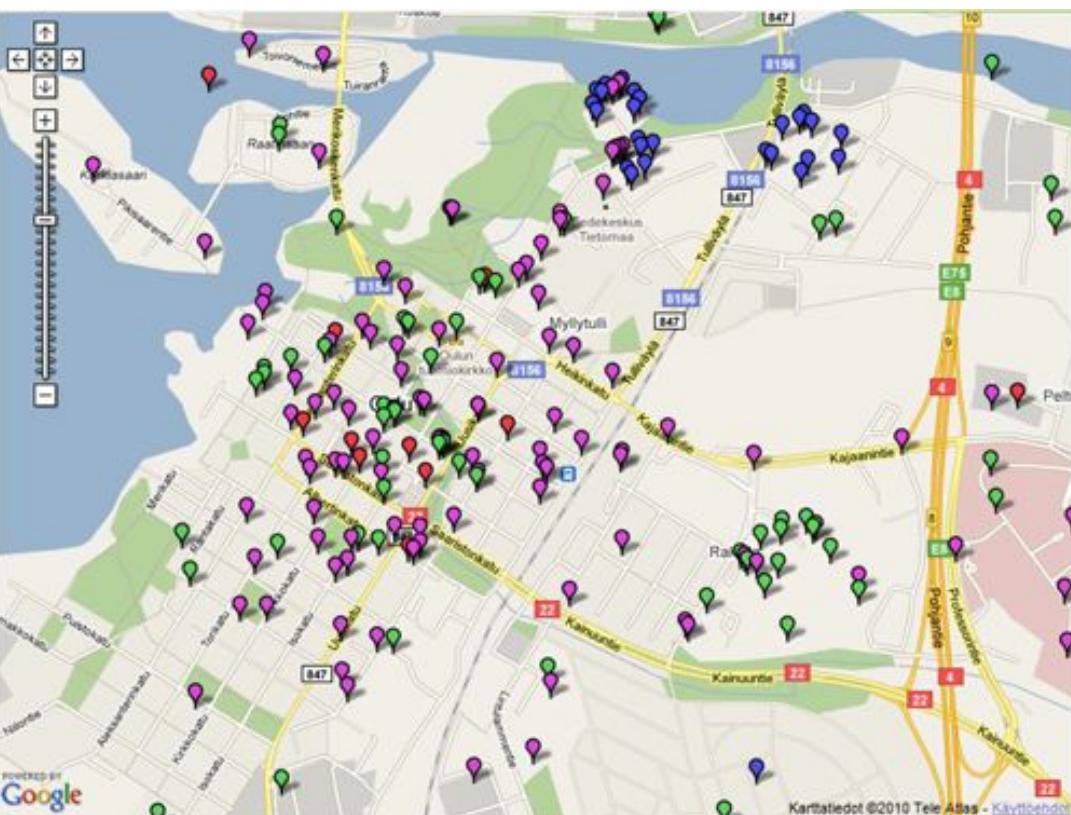
Recorder

"VLAN"



Ojala T, Kukka H, Heikkinen T, Linden T, Jurmu M, Kruger F, Hosio S, Sasin S & Närhi P (2010)
Open urban computing testbed. Proc. TridentCom 2010, Berlin, Germany, 1277-1288.

panOULU WLAN

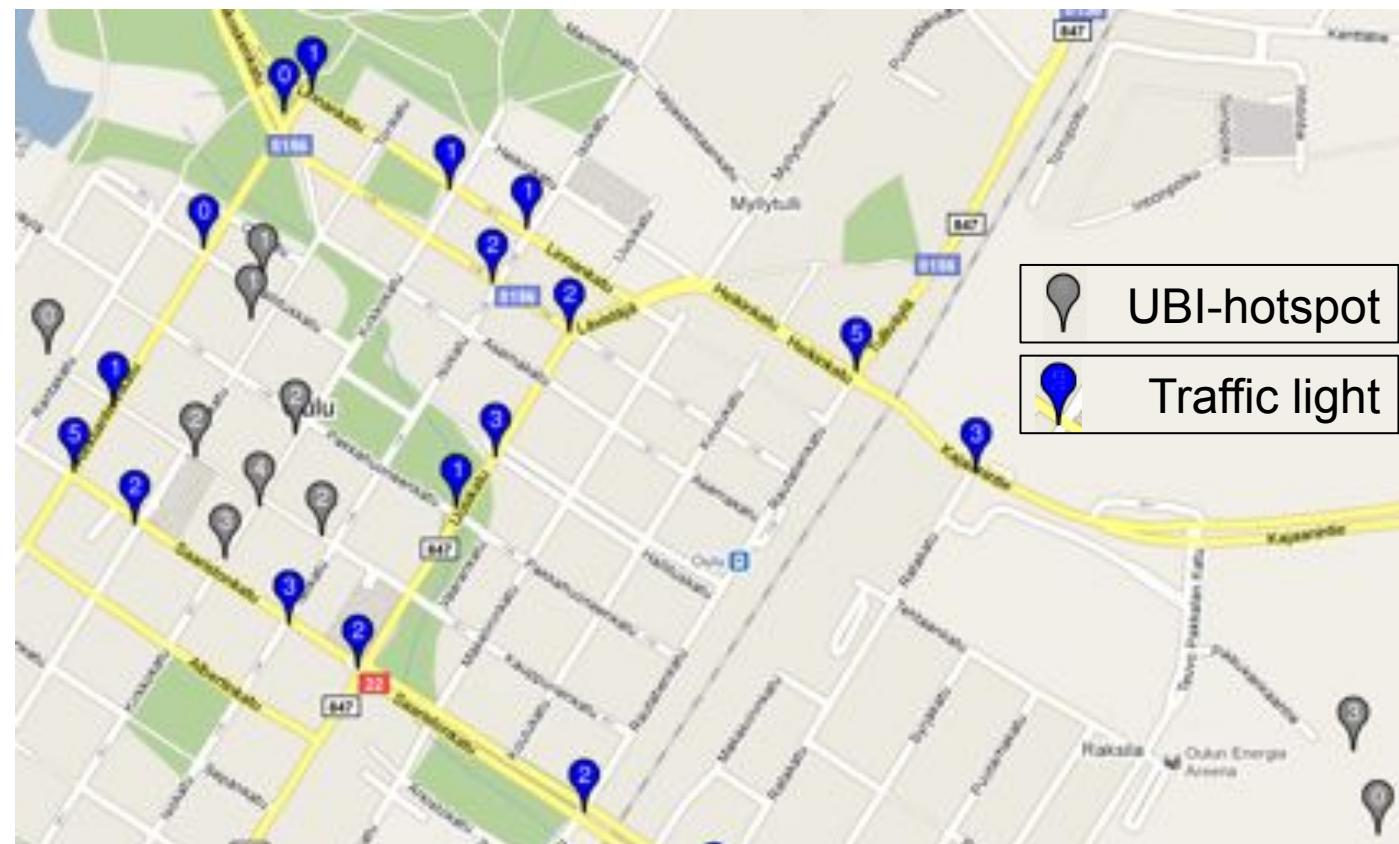


- Provided by a consortium of 9 municipalities, 4 public organizations and 4 ISP's
- ~1300 AP's in total
 - ~500 AP's within 1 km of city center
- Provides open (no authentication) and free (no payment) wireless Internet access to general public
- Used by >25000 devices / month
- <http://www.panoulu.net>
- Promotional video:
http://www.strixsystems.com/video/Strix_PanOULU.html

Ojala T, Oranjärvi J, Puhakka K, Heikkinen I & Heikka J (2011) **panOULU: Triple helix driven municipal wireless network providing open and free Internet access.** C&T 2011, Brisbane, Australia, to appear.

panOULU BT

- 28 BT AP's around downtown Oulu
 - 18 AP's on traffic light poles
 - Use panOULU WLAN for Internet connectivity
 - 10 AP's in UBI-hotspots
- Also 10 BT AP's on Linnanmaa campus



Access point

Bluegiga

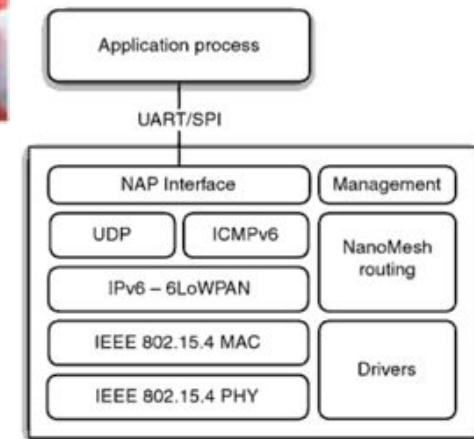
Access Server 2293

panOULU WSN: IP-based wireless sensor network



Edge Router
Sensinode
NanoRouter Ethernet 2.0
Reference Platform

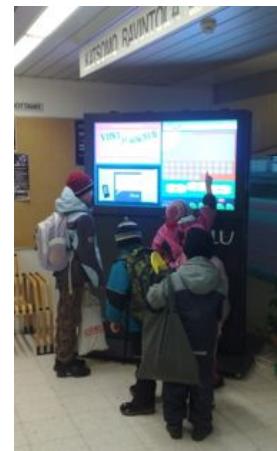
Installation of
Edge Router inside
panOULU WLAN MESH AP



- 13 edge routers around downtown Oulu (3 more upcoming)
- IEEE 802.15.4 PHY/MAC on sub-GHz band (868 MHz)
- 6LoWPAN protocol stack
- ~500 m line-of-sight range with 1 mW transmission power

UBI-hotspots

- 12 interactive public displays around downtown Oulu
- 'Heavyweight' urban probes (Paulos & Jenkins 2005), research enablers
- Offer a wide range of infotainment services to general public
 - Including third party commercial services



Ojala T, Kukka H, Lindén T, Heikkinen T, Jurmu M, Hosio S & Kruger F (2010)
UBI-hotspot 1.0: Large-scale long-term deployment of interactive public displays in a city center. Proc. ICIW 2010, Barcelona, Spain, 285-294.

UBI-hotspot 3.0: Service selection menu

UBI-channel (digital signage)



How to use the UBI Hotspot



UBI Hotspots provide a series of useful services, like a map, public transport schedules, news, multimedia, games and lots of more.

Select the service you wish to use from the list on the right! If you wish to change the service you're using, hit the Start button at the bottom of the screen.

For more information, visit the UBI Program's homepage at www.ubisite.fi

 See the demonstration video and learn more about the Hotspot's features!

UBI Hotspot's Services

Select the service You wish to use

Categories	Services
News	Cityguide Have a video-call to the tourist office and get information about Oulu
City	Ubinion Send your greetings to the city officials in a fun way
3rd Party	Event Calendar Discover future events and download event information to your mobile device
Fun & Games	Rotuaari Renovation Learn about the renovation process of Rotuaari
Multimedia	City of Oulu Browse the latest news and events in Oulu
Help & Survey	
Services	

UBI-portal (interactive)

UBI-hotspot 3.0: Etuovi.com

The screenshot displays the Etuovi.com website interface. At the top left is the Oulu City logo. The top right features the text "Oulun kalleimmat asunnot" and the "ETUOVI.COM" logo with the tagline "Asuntokaupan verkkokauppa". Below this is a large image of a modern glass-fronted building.

A red banner in the center-left contains the text "Katso tästä Oulun:" followed by three buttons:

- Uusimmat asunnot** (Newest apartments) with a right-pointing arrow button.
- Keskusta-asunnot** (City center apartments) with a right-pointing arrow button.
- Kalleimmat asunnot** (Most expensive apartments) with a right-pointing arrow button.

Below these buttons is a blue footer bar with various icons: a white circle with a blue cross, a green square with a white bird, a green square with a white sun, a green circle with a white person, a green circle with a white house, a red calendar icon, and a green map icon.

On the right side, there is a detailed listing for a property: "OMAKOTITALO, RANTA-KOSKELA" with "oh, k, 3mh, takkah, sa, 2kh, khh, vh,..., 189,0 m²". The listing number is "Kohdenumero: 611658" and the price is "Velaton hinta: 975000 €". To the right of the text are four small thumbnail images of different buildings, each with a right-pointing arrow button below it.

Commercial service provided by Alma Mediapartners

UBI-hotspots: Maintenance (1)



UBI-hotspots: Maintenance (1)

Battle for the urban space #1



Maintenance challenges

- 24/7 availability
- Network problems
- Malfunctioning HW and SW
- No dedicated maintenance personnel
- Most hotspots are 5 km from our lab
- Vandalism

UBI-hotspots: Maintenance (2)

Battle for the urban space #2



UBI-hotspots: Maintenance (3)



UBI-hotspots: Maintenance (3)

Battle for the urban space #3



UBI-projectors

- Two fixed projectors at the City Theatre
- One mobile unit



- Sanyo PDG-DET100L projector (7500 lumens)
- Tempest Blizzard enclosure
- MacMini Server
- Amplifier + loudspeakers

UBI-middleware: APIs for different purposes

- Application development APIs

- UBI-hotspot API
- panOULU BT API
- panOULU WLAN API
- panOULU WSN API (under development)

Jurmu M, Kukka H, Hosio S, Riekki J & Tarkoma S (2011) **Leasing service for networks of interactive public displays in urban spaces**. Proc. GPC 2011, Oulu, Finland, 198-208.

- Statistics API (<http://stats.ubioulu.fi>, under development)

- Read-only interface for accessing various statistics
 - UBI-hotspots (clicks, service launches, face detections)
 - panOULU BT (devices)
 - panOULU WLAN (devices)
 - Historical weather data in Oulu
- Provides open view into ubiquitous Oulu

- Maintenance API

Heikkinen T, Lindén T, Jurmu M, Kukka H & Ojala T (2011) **Declarative XML-based layout state encoding for managing screen real estate of interactive public displays**. Proc. MUCS 2011, Seattle, WA, USA, 312-317.

Engaging the community

Opening up the testbed to R&D community

- Students develop new services as course work
- Other research projects are welcome to try out their applications
- Businesses can purchase capacity to provide commercial services in UBI-hotspots
- Researcher training in UBI Summer Schools
- Challenges
 - National UBI Challenge 2010
 - International UBI Challenge in 2010-2011

1st International UBI Summer School 2010

in Oulu on May 31 - June 4, 2010

- <http://www.ubioulu.fi/en/UBI-summer-school-2010>

- Videos, photos, etc.
- 72 students from 20 countries enrolled in 6 parallel workshops

- A: Real World Context-Aware Systems
 - Professor Anind Dey, Carnegie Mellon University, USA
- B: Urban Informatics and Sustainable Cities
 - Professor Marcus Foth, Queensland University of Technology, Australia
 - Dr. Jaz Choi, Queensland University of Technology, Australia
 - Patrick Hofmann, Google Australia
- C: Urban Social Networks Analysis
 - Professor Vassilis Kostakos, University of Madeira, Portugal
- D: Creating and Sharing Artistic Experiences with Ubiquitous Technology
 - Dr. Jürgen Scheible, Aalto University, Finland
- E: IP-based Wireless Sensor Networks
 - Zach Shelby, Head of Research, Sensinode, Finland
- F: Interactive Textures – rethinking materiality
 - Professor Mikael Wiberg, Umeå University, Sweden

2nd International UBI Summer School 2011

in Oulu on May 23-28, 2011

- <http://www.ubioulu.fi/en/UBI-summer-school-2011>
- 3 parallel workshops enrolled 36 students from 6 countries
 - A: Open Pervasive Display Networks
by Dr. Adrian Friday, Lancaster University, UK
 - D: Embedded Web Services
by Chief Nerd Zach Shelby, Sensinode Ltd., Finland
 - E: Social and Cultural Aspects of New Media
by Prof. Leopoldina Fortunati, University of Udine, Italy



1st International UBI Challenge 2010-2011

- <http://www.ubioulu.fi/en/UBI-challenge>
- Call for proposals to develop projects using Oulu's Ubiquitous infrastructure
- 11 proposals submitted
- 4 proposals accepted
 - Germany, Switzerland, Spain, Greece
- Each team gets 10 000 EUR and spends 3 months in Oulu developing, testing and deploying their proposed system

Challenges of this type of "in the wild" research

- Academic research vs development / engineering / business / societal task
- Sustainability (financial, technological)
- Measurement of success
 - Lack of metrics for evaluating real-world deployments
- Urban planning, deployment and maintenance
- Acquisition of high quality service content
- Scalability
- Openness
- Engaging individual citizens and different communities
- Public scrutiny (judgement?)

Warm thanks to our sponsors

- TEKES / Ubicom
- Academy of Finland
- European Regional Development Fund
- City of Oulu
- Ubiquitous Computing Cluster Programme
- Industry
 - Nokia
 - TeliaSonera
 - Bluegiga
 - Digia
 - Galaxo
 - Palko Interactive
 - Pohjolan Mylly
 - Pro Display
 - Sensinode
 - Symbicon

Thank you!

More information

<http://www.ubioulu.fi>

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