



Driving Innovation in Urban Computing with a Community Testbed

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<http://www.ubioulu.fi>

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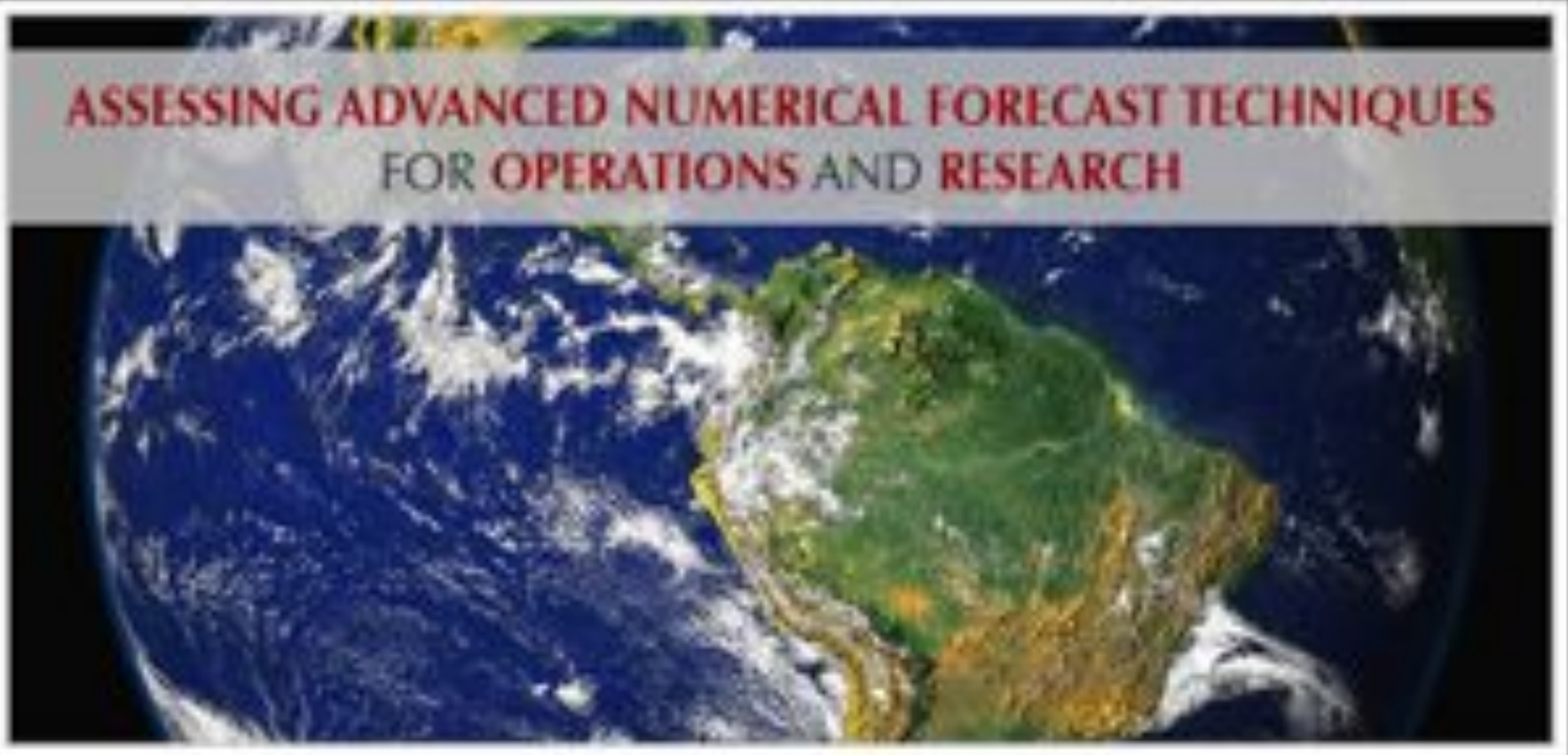






You are here: NCAR • RAL • *Joint Numerical Testbed*

Joint Numerical Testbed (JNT)



ASSESSING ADVANCED NUMERICAL FORECAST TECHNIQUES
FOR OPERATIONS AND RESEARCH



PLANETLAB

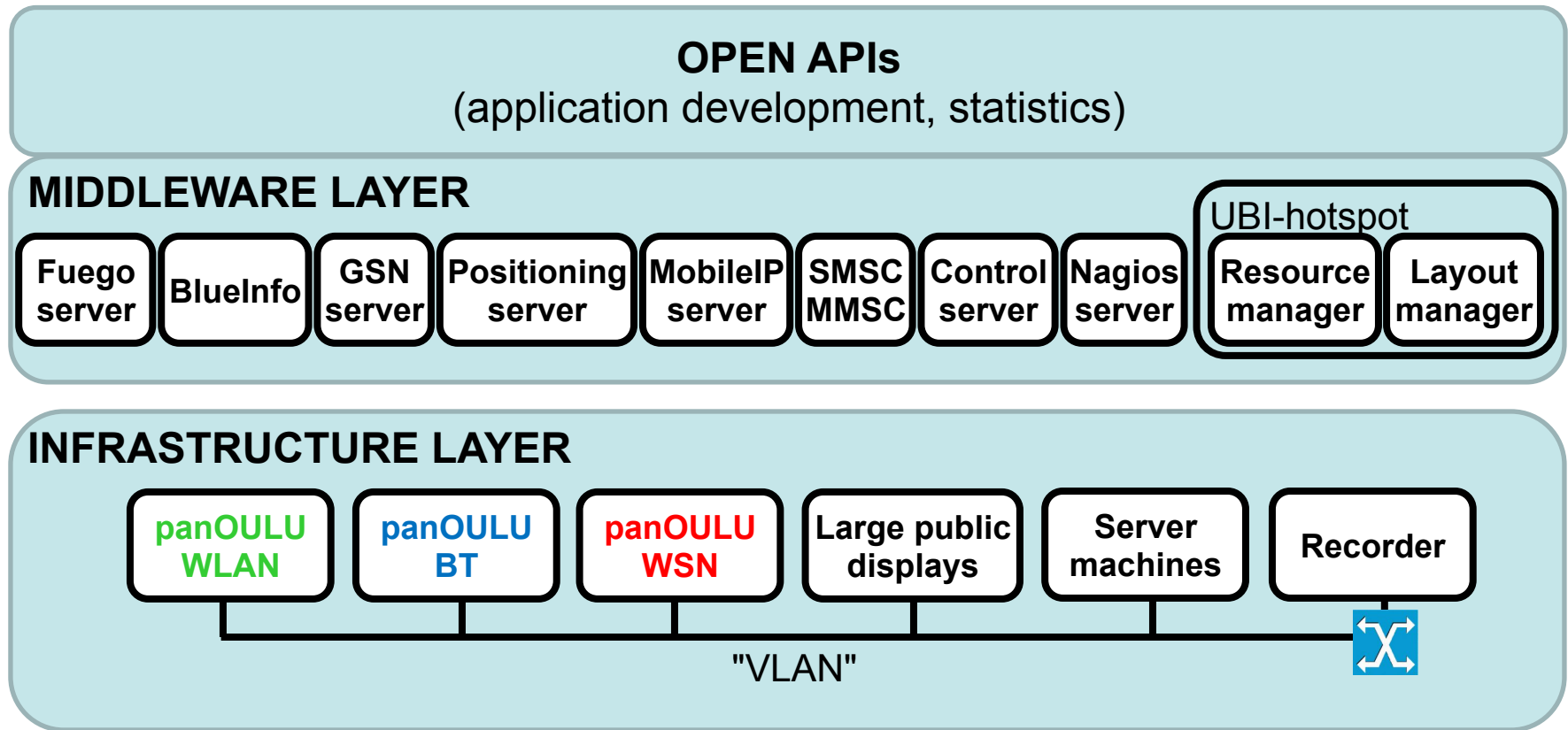




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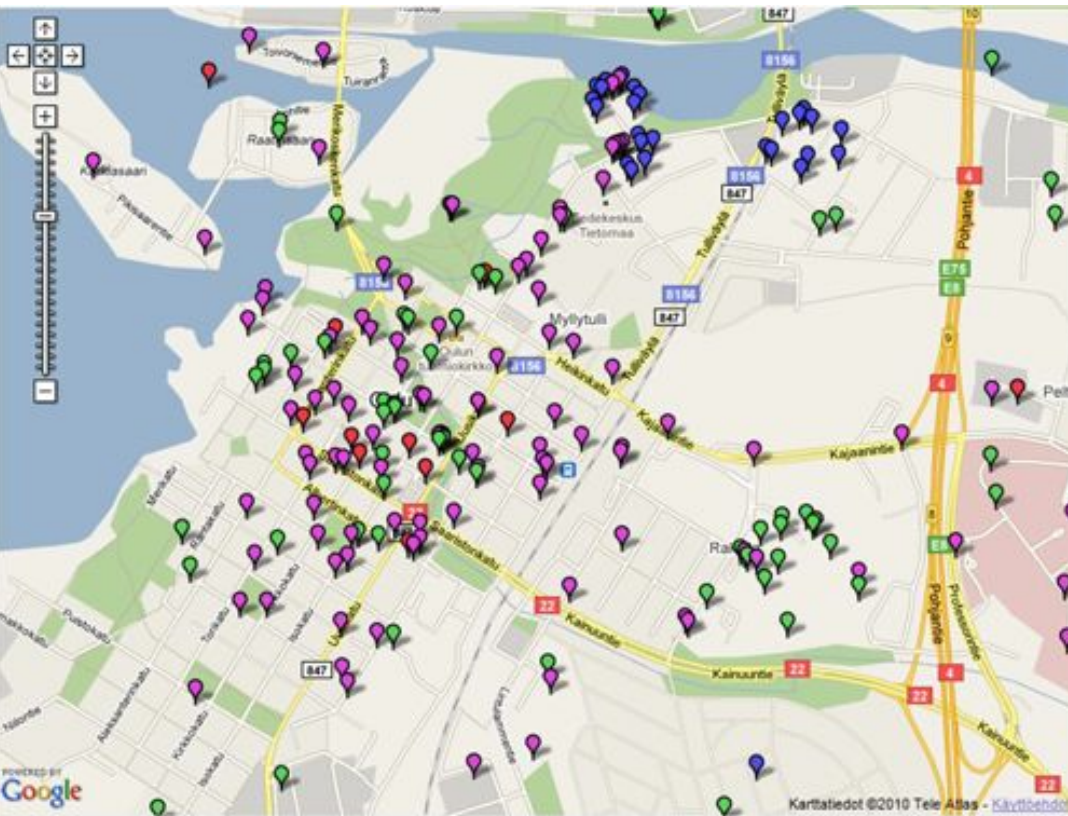
A testbed for Urban Computing?

Open urban computing testbed in Oulu, Finland



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, Orajärvi 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

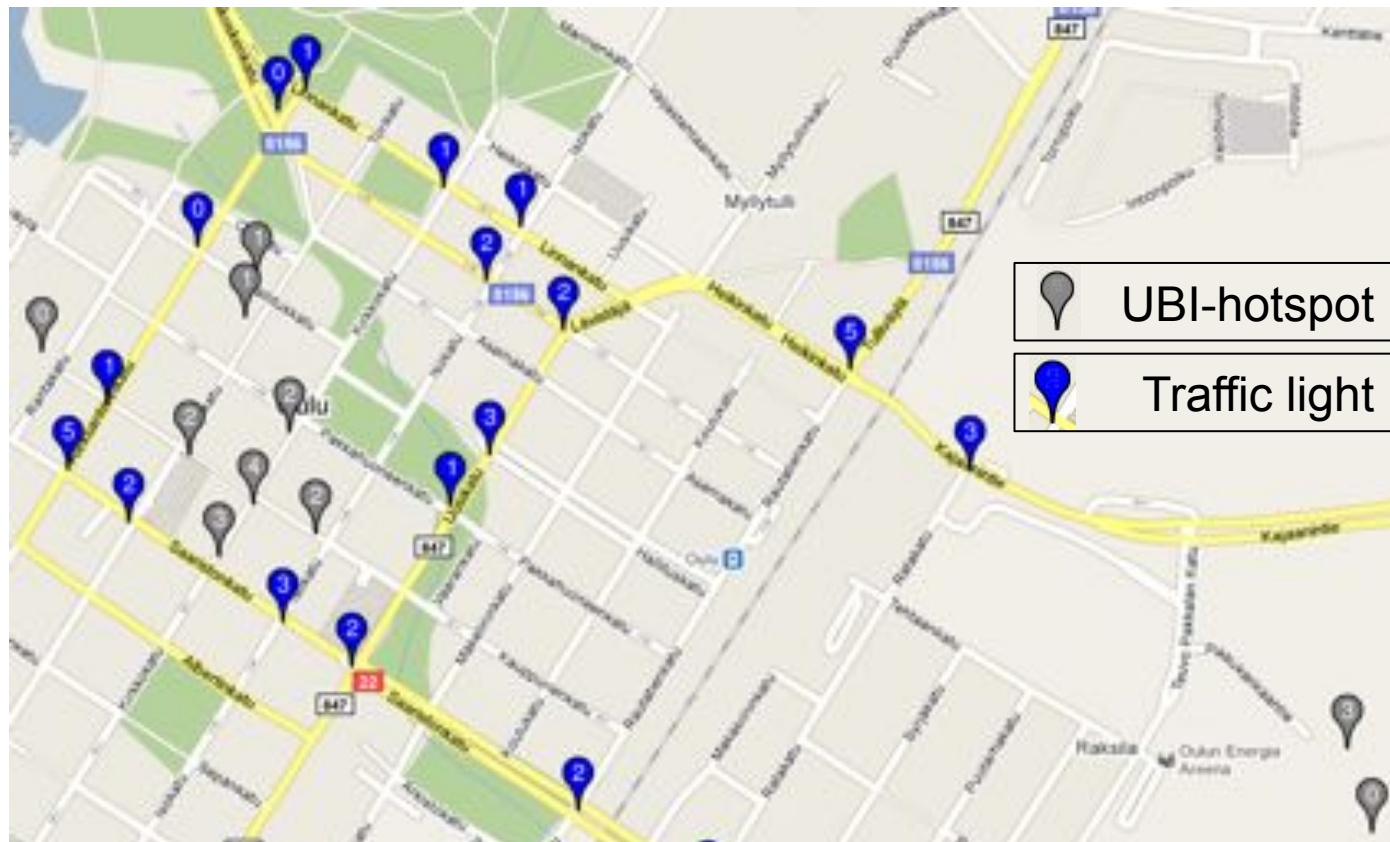
- 28 BT AP's around downtown Oulu
 - 18 AP's on traffic light poles
 - Use panOULU WLAN for Internet connectivity
 - 10 AP's in UBI-hotspots
- Also 10 BT AP's on Linnanmaa campus



Access point

Bluegiga

Access Server 2293



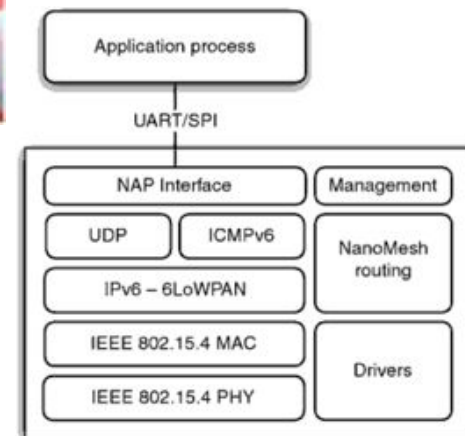
Kukka H, Kruger F & Ojala T (2009) **BlueInfo: Open architecture for deploying web services in WPAN hotspots**. Proc. ICWS 2009, Los Angeles, CA, USA, 984-991.

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

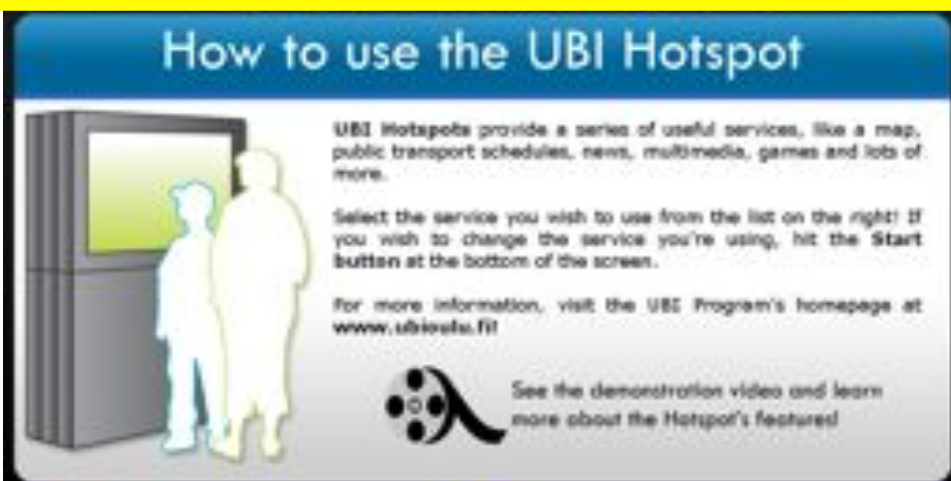
- 12 interactive public displays around downtown Oulu
- 'Heavyweight' urban probes (Paulos & Jenkins 2005), research enablers
- Offer a wide range of infotainment services to general public
 - Including third party commercial services



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)



UBI-portal (interactive)

UBI-hotspot 3.0: Etuovi.com



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, Riekk 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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