Context-based Wireless Mesh Networks: A Case for Network Virtualization

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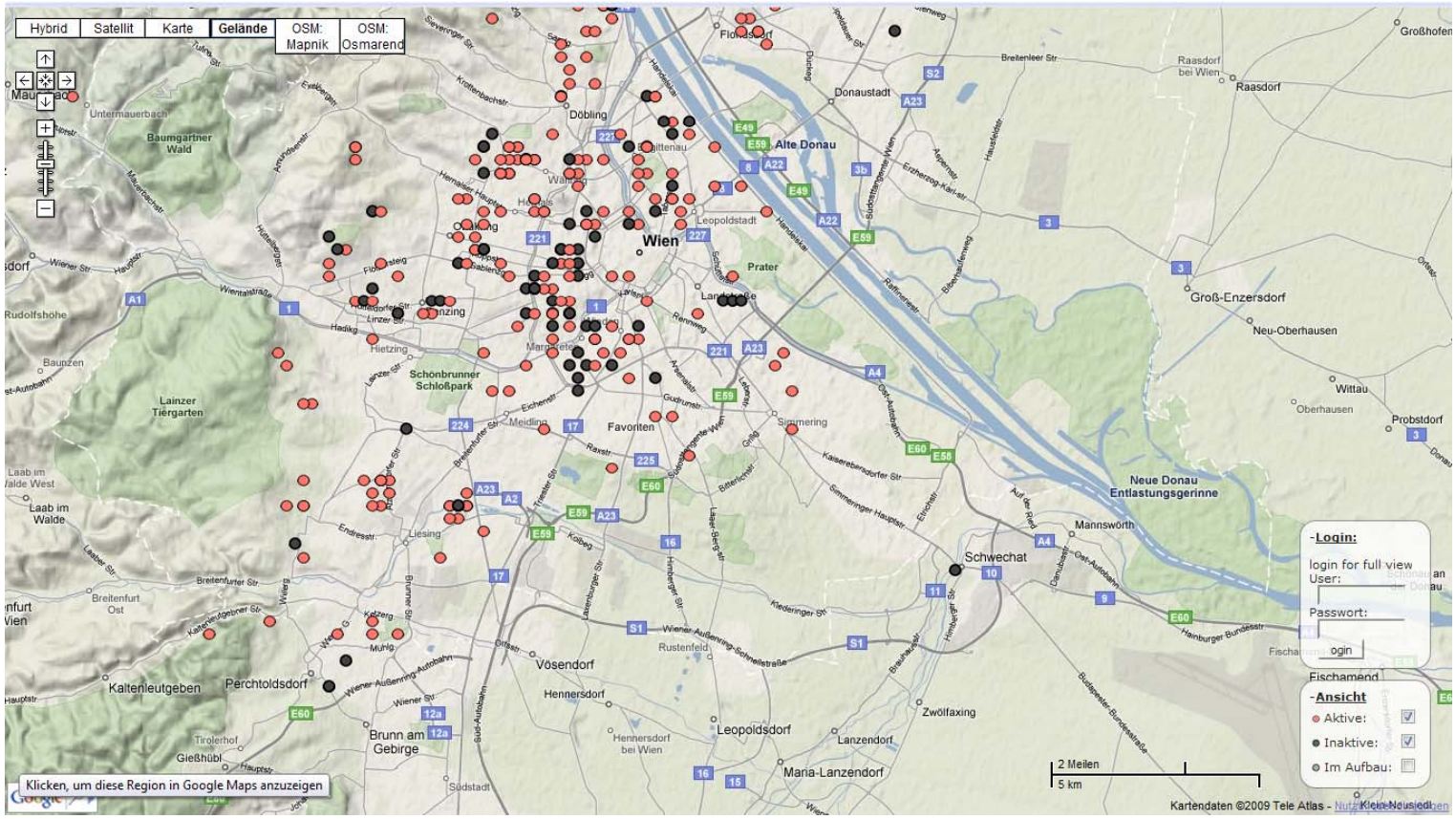
Spreading of WMNs … Ex.: funkfeuer.at

Free city community network
Mesh based on IEEE 802.11, OLSR (extended)



Content

- Introduction to WMNs
- Challenges for user-centric and flexibility
- Approach of multi-overlays
- On how to introduce mobility

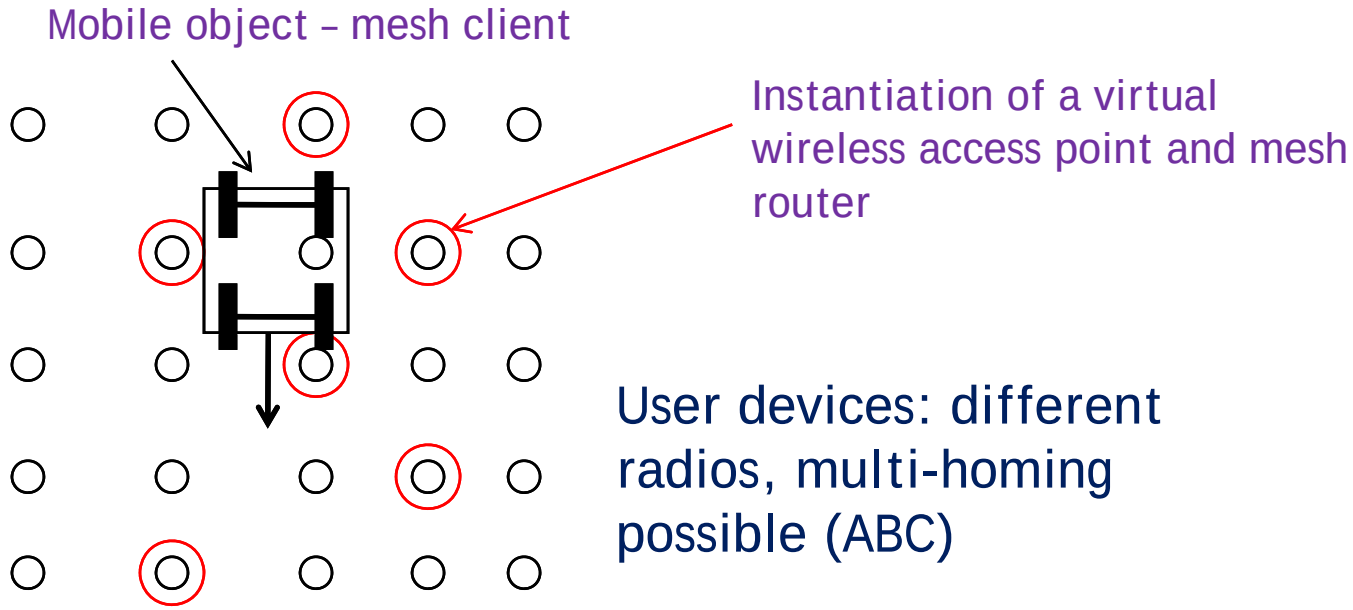
Wireless Mesh Networks

Domains
- Rural areas, city access networks, campus networks
- Cheap, higher bandwidth

Architecture
- Wireless Mesh Routers
- Wireless Mesh Clients
- Probably: Broadband Gateways to the Internet

Properties
- Multi-hop wireless network infrastructure
- Self-forming, self-healing, self-organizing
- Mobility of mesh clients
- Minimal mobility of mesh routers
- Heterogeneous routers
- Multiple wireless access technologies possible
- Multiple radios available at client site

Problem Domain



User devices: different radios, multi-homing possible (ABC)

Users perspective – requirements and preferences - context
- Security and privacy, QoS, pricing, preferred provider
- Mobility

Provider perspective – network context
- Different networks and interfaces, resource provisioning

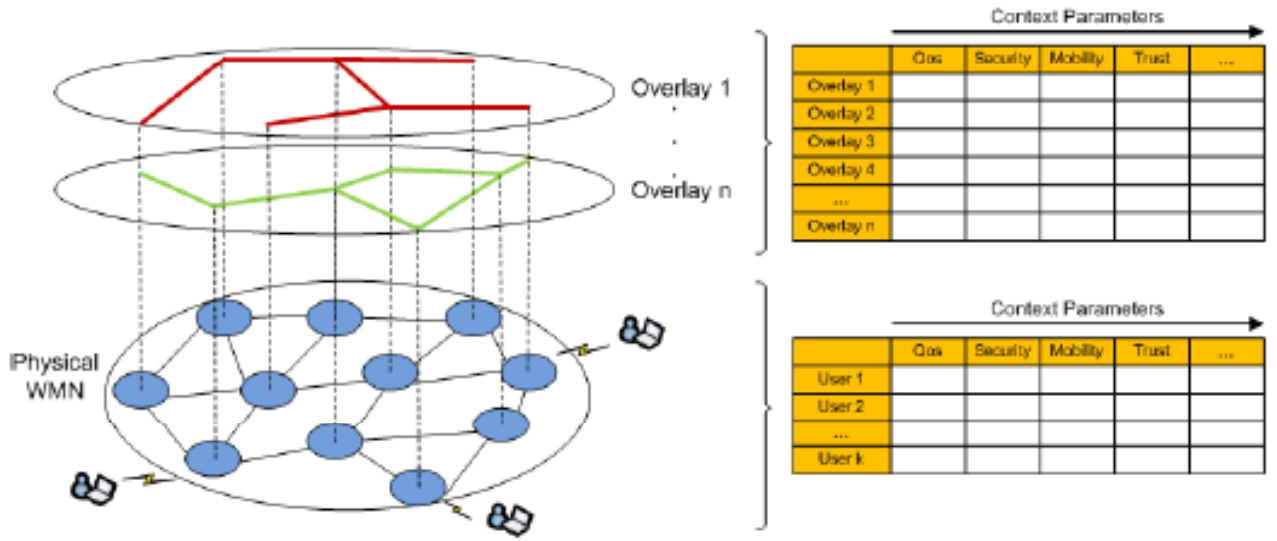
Approach: Network Virtualization

- … aiming for flexibility
- Abstraction concept for data transport resources
- Physical location of transport resource doesn't matter (as long resource is accessible)
- Similar to virtual memory/OS virtualization
- Shared resources and flexible sharing
  - Resources can be located even in different physical networks or administrative domains

Multiple Overlays and Mapping

Virtualization by means of an overlay approach

Overlays correspond to different user preferences and characteristics (according to multi-variate context data)



Ongoing Work: Issues Addressed

Overlay selection

- Matching of preferences with a best fitting overlay network (based on meta-data and minimum distance to the overlay description vector)
  - d (v_u, v_o)

Overlay creation

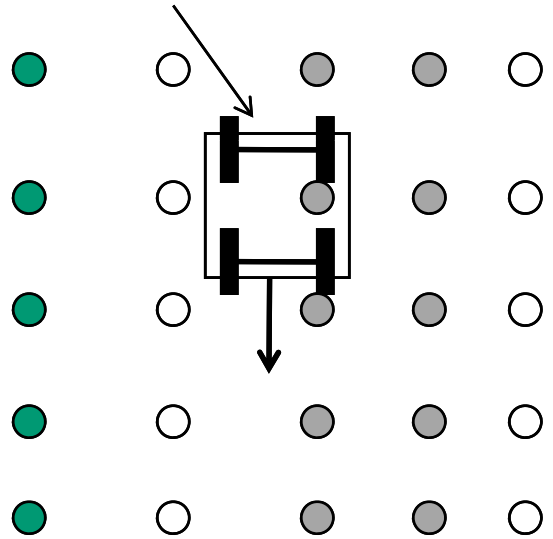
- If no overlay is already supported: Create a new corresponding to user preferences
- Crucial here: to avoid the creation of too many overlays

Overlay reconfiguration

- Identify outdated, not well fitting overlays
- Extend existing overlays with minimal effort (e.g., if mobile client attached to mesh router not part of “best fitting overlay” → include this single router in overlay)

Ongoing (Example Context): Mobility Modelling and Using Mobility

Derive / state mobility patterns



1. Classification according to movement
   - Car
   - Bus
   - Pedestrian

→ Provide best fitting overlay

2. Predict next movement on micro-level for proactive overlay selection
   - Client predicts next step and reacts
   - Include it into the last hop route of an OLSR network (client ← → mesh router) // proactive handover
   - Experience within a recent project on data placement

[J. Gossa, A. Janecek, K.A. Hummel, W. Gansterer, J.-M. Pierson. Proactive Replica Placement Using Mobility Prediction. MDM Workshops 2008]

Pathway patterns

One month GPS taxi traces (Vienna taxi fleet)

Structures emerge and patterns are visible and can be used to determine probabilities of next movement

[J. Gossa, A. Janecek, K.A. Hummel, W. Gansterer, J.-M. Pierson. Proactive Replica Placement Using Mobility Prediction. MDM Workshops 2008]

Summary and Outlook

Approach

- WMNs, user-centric and network-centric context
- Virtualization by means of multiple overlays

Next steps

- Modelling and measuring (simulation-based) the impact/benefits of using multi-overlays
- Estimating the overhead and propose means to keep this overhead low

Involvements in Related Activities

IWSOS 2009 Intern. WS on Self-Organizing Systems (December 2009, Zurich, CH)
http://www.iwsos2009.ethz.ch/
Full Paper submission deadline: July 10, 2009

eEnergy 2010 – University of Passau, D
Contact:karin.hummel@univie.ac.at

CONTEXTCON – EU FP 7 Proposal on Context-Aware Mesh Networks
(academic partners: Univ. of Aveiro, Univ. of Vienna, Paussau Univ.)
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