Wireless Access and the Future Internet

Concepts and Experimental Validation

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Overview

Wireless access and the future internet

- Challenges
- Roadmap
- Concepts
- Experimental Validation

Challenges

- Fast growing mobile internet traffic volume
  - Mobiles are most commonly used consumer product
    - 5.3 billion subscribers; global penetration of 77%; 1,4 billion phones sold 2010
  - Drivers for mobile data volume
    - Smart phones and mobile applications
    - 2015 internet access by mobile will outnumber access per PC
    - 200 million mobile facebook users
    - Mobile apps, video telephony, augmented reality, mobile games, mobile YouTube usage will drive mobile data volume
- Emerging usage areas using mobile internet access
  - M2M for logistics, smart grids, e-mobility, …
    - Ericsson expects 50 billion M2M devices to be connected in 2020
    - Europe: 245 m cars, 320 m e-meters, 25 m containers, automotive, …
    - EU PPP FI program could drive these areas

Challenges

- New usage areas with high requirements on security, real-time capability, availability, and reliability
  - User centricity services (m-payment, e-health, assisted living)
  - Cyber-physical services (automotive, automatic train control, smart production and logistics)
- Faster innovation cycle
  - Replacement rate of mobiles still below 30 months
- Interference and heterogeneous access
  - Interference between radio links
  - Multicasting
- Mobility & roaming
- Heterogeneous landscape of networks and standards

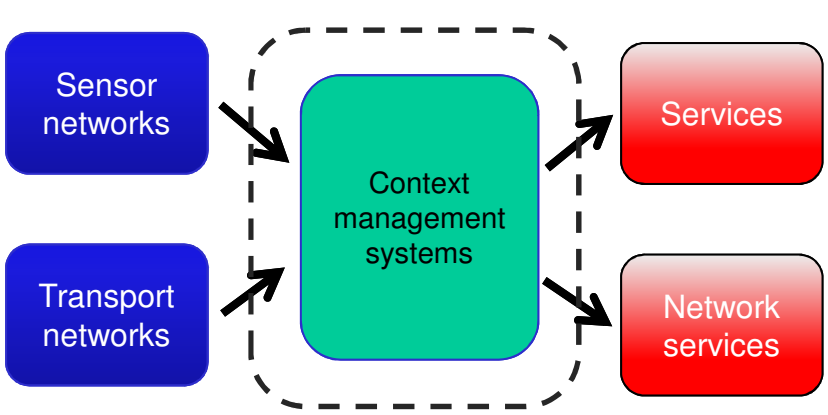
Challenges and Requirements

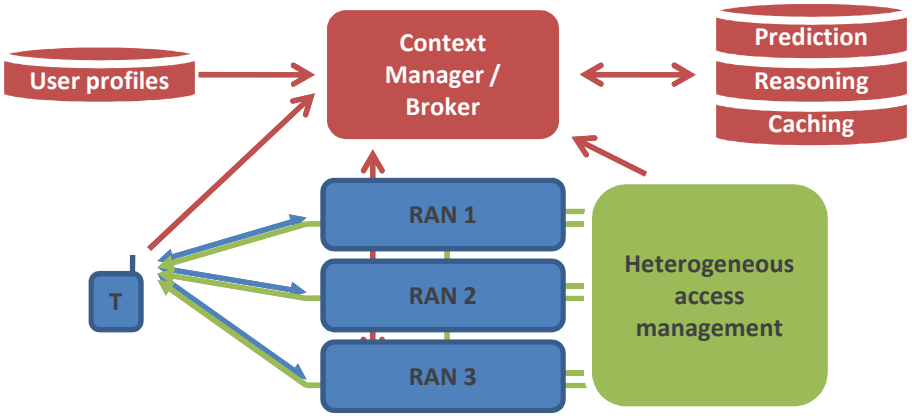
- Ubiquitous network access with scalable requirements
  - Costs, reliability, security, availability
- Real-time networks for cyber-physical systems
- Discovery and management of network elements and connectivity services
- Cost- and energy-efficient networks
- Autonomous mobile mini-networks

- Revision of the protocol and standardization methodology
- Methodology for an evaluation of cyber-physical concepts
- Methodology for reproducible experiments for wireless networks
- Methodology for a quantitative assessment of safety and security problems with wireless networks

Concepts: Context-Aware Networking

- Ubiquitous network access with scalable requirements
  - Heterogeneous network access / SON / network management
  - Connectivity as a service and Communications Delivery Platforms
  - Cognitive / **context-aware** / content & application aware **networking**
  - Off-loading techniques
    - Spontaneous networks for social apps, mobile WSN, …
    - Hot spot (e.g., LTE router) or femto-cell integration

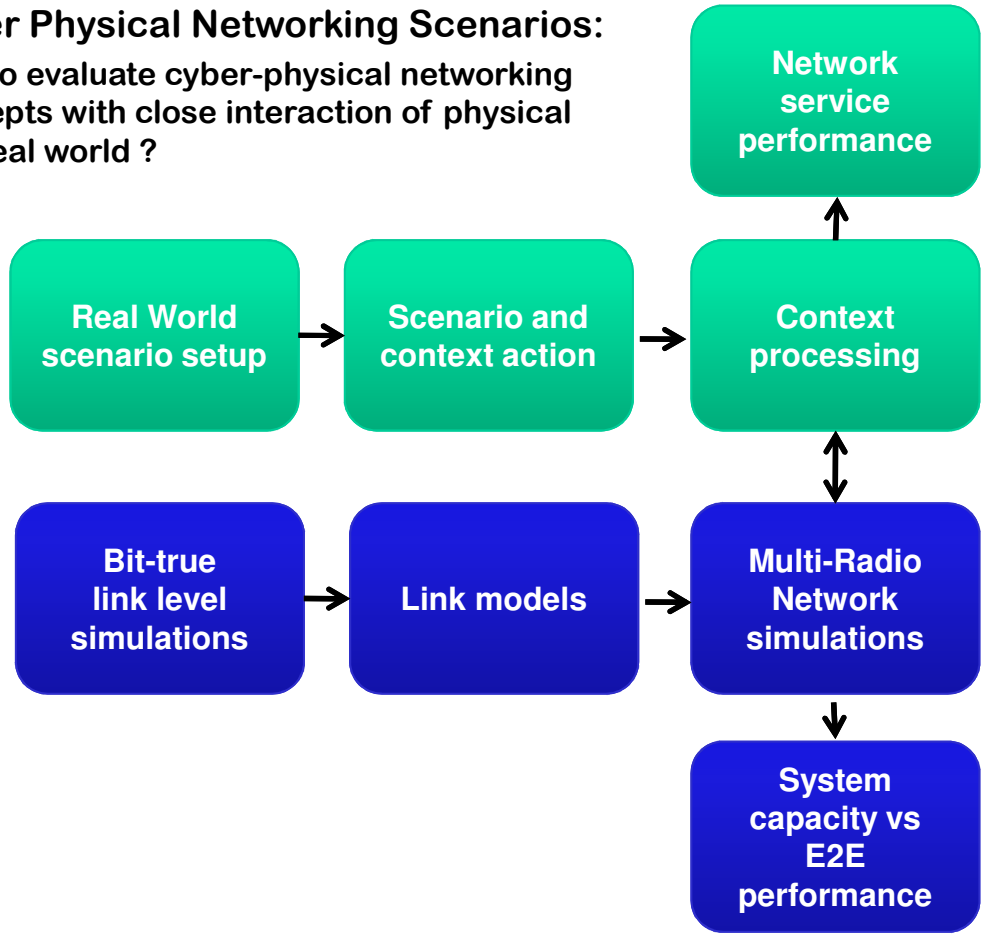


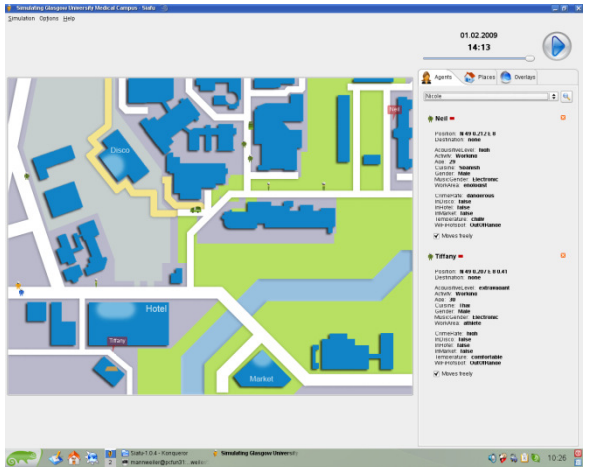


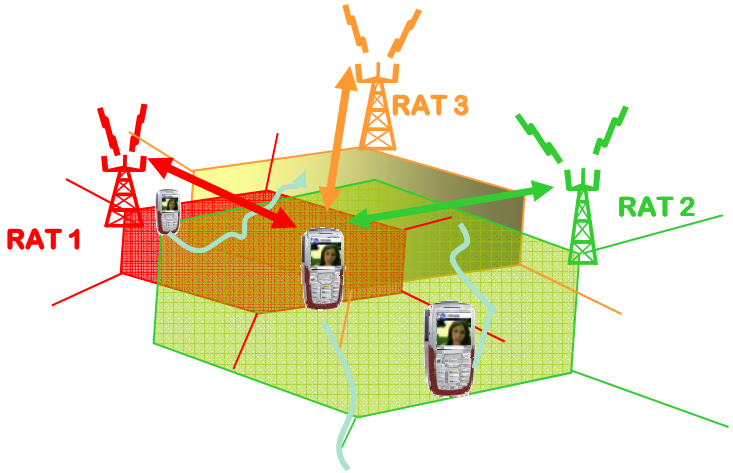
Concept Assessment by Simulations and in our G-Lab Real-World Test Environment

Cyber Physical Networking Scenarios:

How to evaluate cyber-physical networking concepts with close interaction of physical and real world ?







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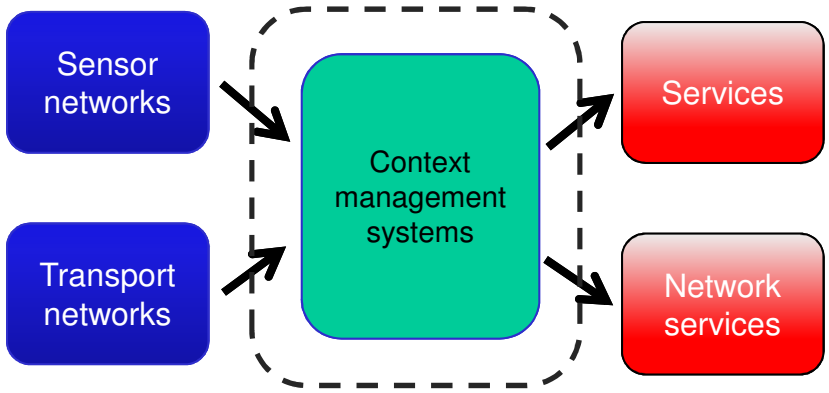
Scalability of Multi-sensor Systems

- Visions (e.g., Ericsson, WWRF) predict tens of billions or trillions of networked sensors.
- Filtering of sensor data by location or other relevant metrics on network level ?



- Potential approaches: hierarchical WSN structures, adaptive push/pull approaches, service controlled caching mechanisms, modified DHT filtering, …
- Assessment requires cross-layer experimental facility (data transport and some example use cases / applications)
- Exact framework specification is tbd.

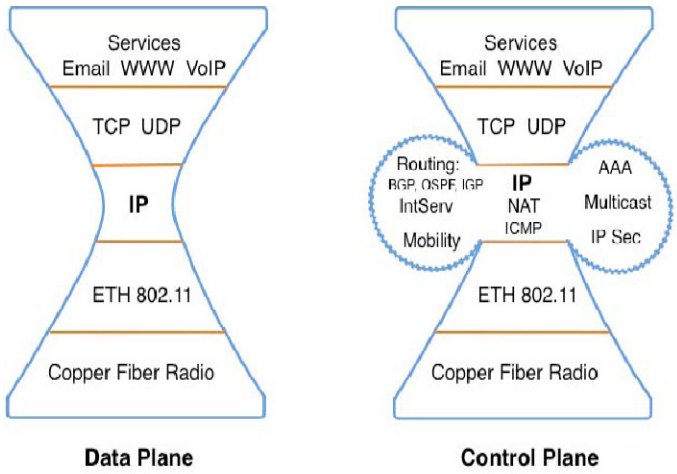
Reliability and Availability

- Many new services require a yet unknown level of reliability, availability and security.
- Limited energy supply, interference from other systems, vendor-specific product variations, sensor ageing, and attacks need to be detected.
- Self-X functionalities for monitoring and self management shall allow to deploy and use multi-vendor sensor environments.

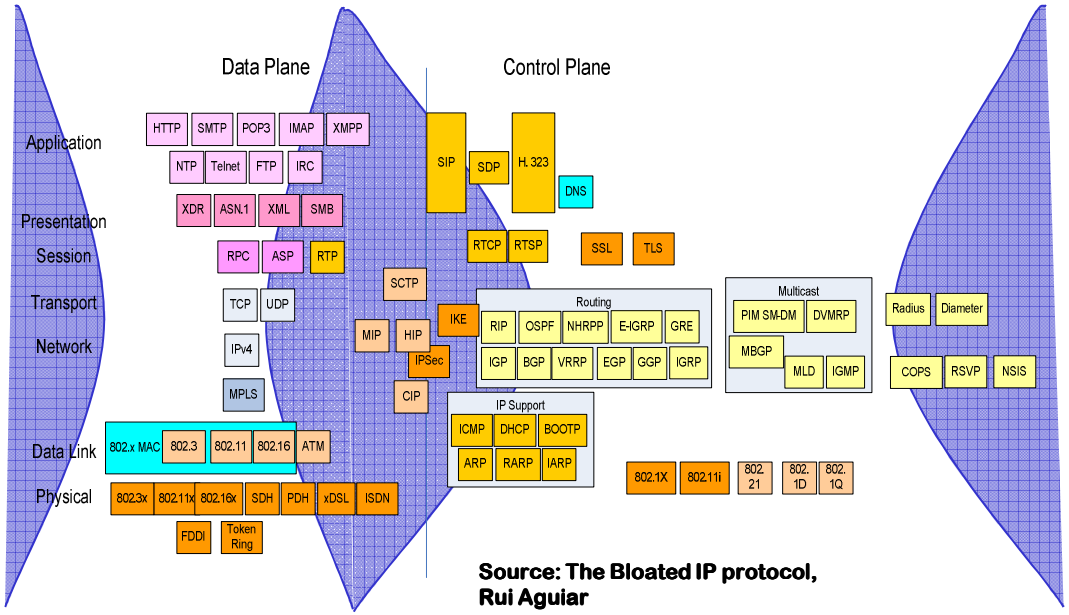
- G-Lab provides a heterogeneous sensor network test environment with a sensor gateway for self-x algorithm implementation.
- Sensor (network and physical world) can be manipulated in order to reflect ageing, attacks, interference, etc.

Specification and Standardization

- Implementation of mobile applications, services and network concepts requires system integration across many standards.
- Known problems of existing internet standards are just one (but the most relevant) problem.

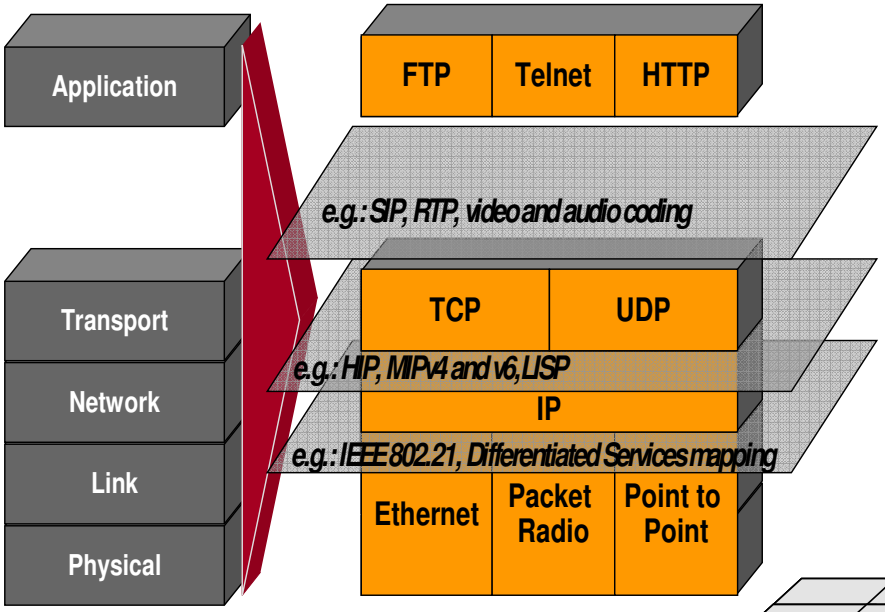


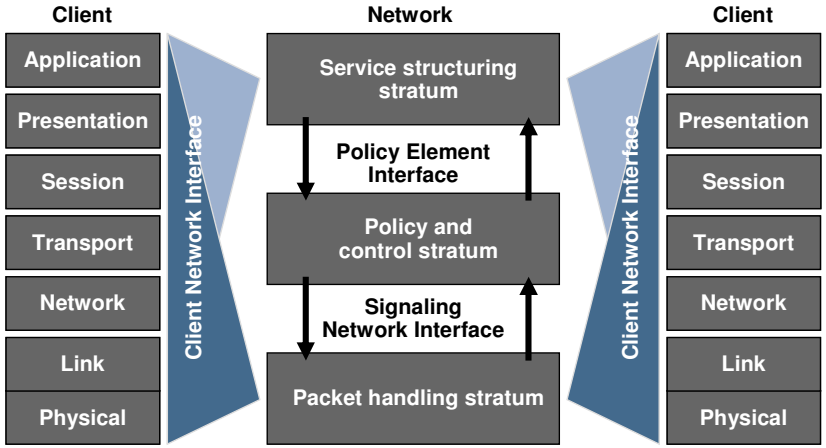
The "Two Hourglass" model

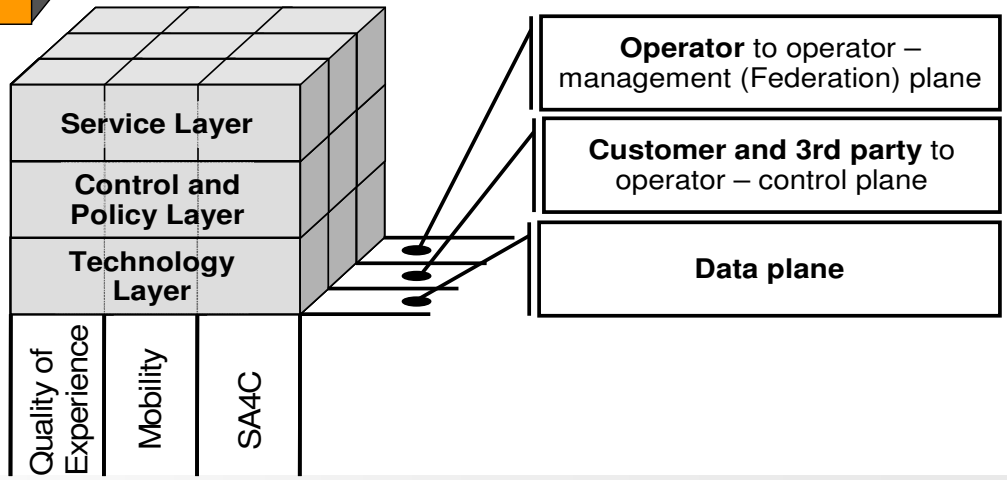


Source: The Bloated IP protocol, Rui Aguiar

Specification and Standardization - Examples







Invitation

- Join us in defining an assessment methodology and experimental setup that allows to quantitatively evaluate key performance indicators of

  - wireless sensor networks,
  - real-time networking,
  - intelligent heterogeneous access concepts,
  - context- and content-aware network solutions, and
  - cyber-physical networking

  with respect to scalability, reliability, security, energy-efficiency, and all relevant network KPIs.

THANK YOU

CV of Hans D. Schotten

- Since 2007: Professor and Head of the Institute of Wireless Communications and Navigation, University of Kaiserslautern
- 2003 – 2007: Director, Technical Standards and Research Coordinator, Europe of Qualcomm Inc.
- 1999 – 2003: Senior Researcher, Ericsson Corporate Research
- 1990, 1997: Diploma and PhD in Electrical Engineering from RWTH Aachen University of Technology

- Company delegate and representative in 3GPP, ETSI, WWRF, e-mobility forum (NetWorks), bmco forum, EICTA and other industry and research for a
- Participants in several EU and German projects (incl. Scientific Council of EU PPP Future Internet Core Platform FI-WARE and G-Lab)