Mobility: Achievements and Challenges

TAIMOOR ABBAS (MODERATOR)

PANEL SESSION

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Panel structure

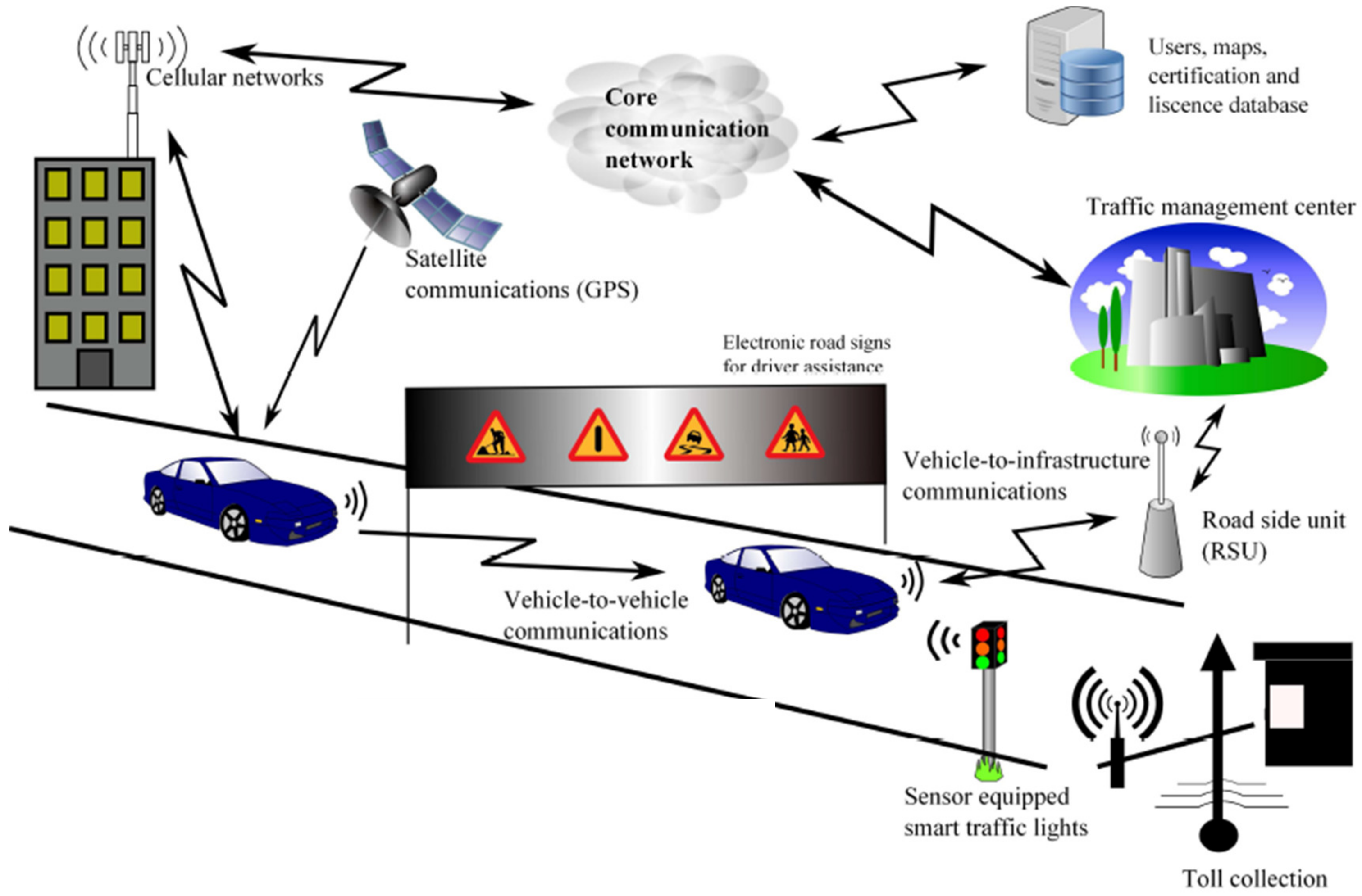
Moderator

Taimoor Abbas, Lund University, Sweden

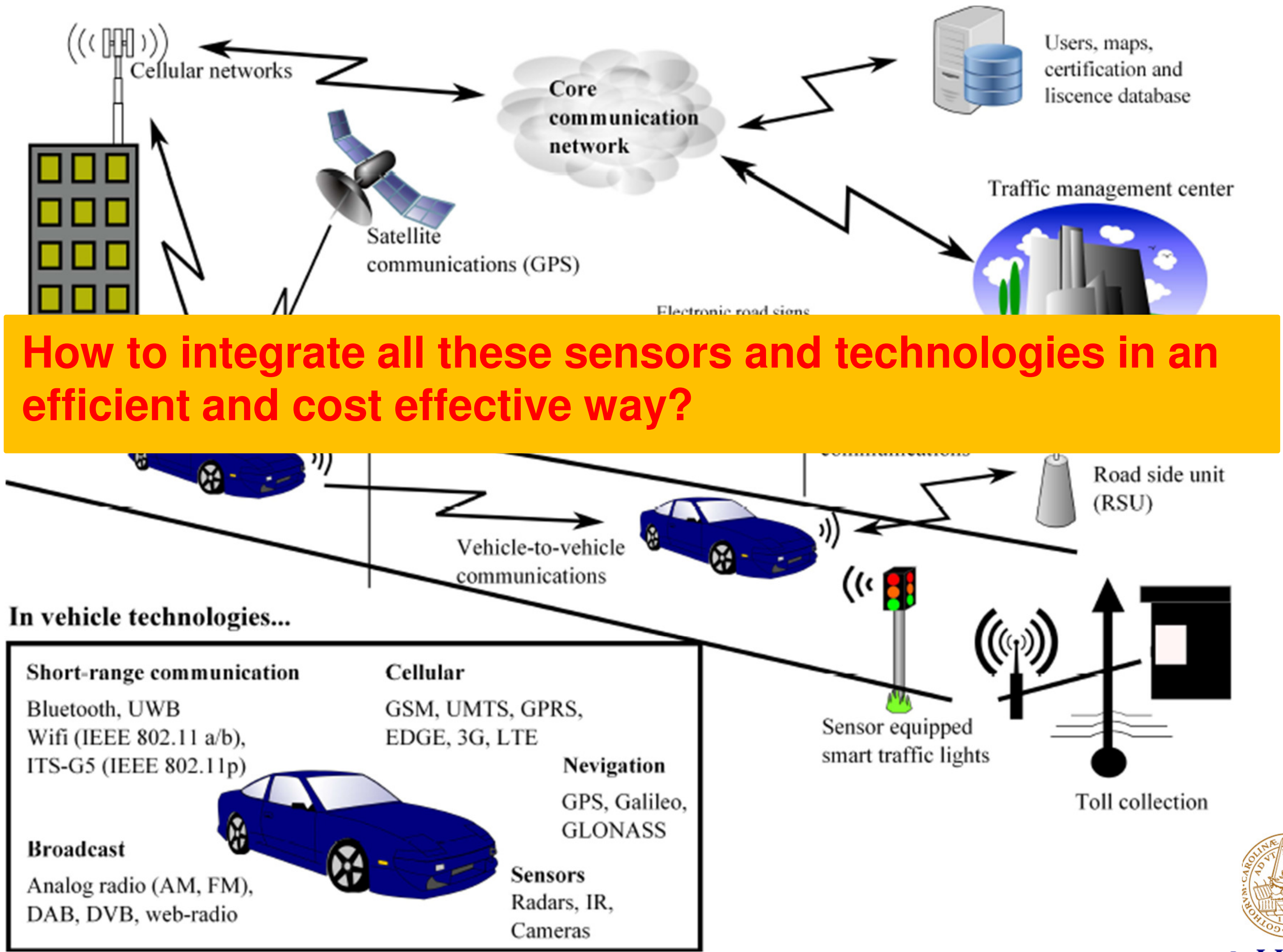
Panelists

Hassan Mohammad, MBtech Group GmbH & Co. KGaA, Germany
Eugen Borcoci, University Politehnica Bucharest, Romania
Sebastian Bittl, Fraunhofer ESK, Germany
Bart Sas, iMinds/University of Antwerp, Belgium

Intelligent Transportation Systems



Intelligent Transportation Systems



How to integrate all these sensors and technologies in an efficient and cost effective way?

LUND UNIVERSITY

Challenges...

- Main technology to be used for smart mobility:
    - Cellular?
    - Ad-hoc communication based vehicular systems?
    - or both, if yes, how to proceed?

- Antenna challenges for vehicular systems: integration of multiple antennas for multi-standard and multi-mode funtionalities.

Other panelists...

Mobility Challenges in Ultra-Dense Networks

Bart Sas (iMinds/University of Antwerp)

University of Antwerp

About Me

Bart Sas

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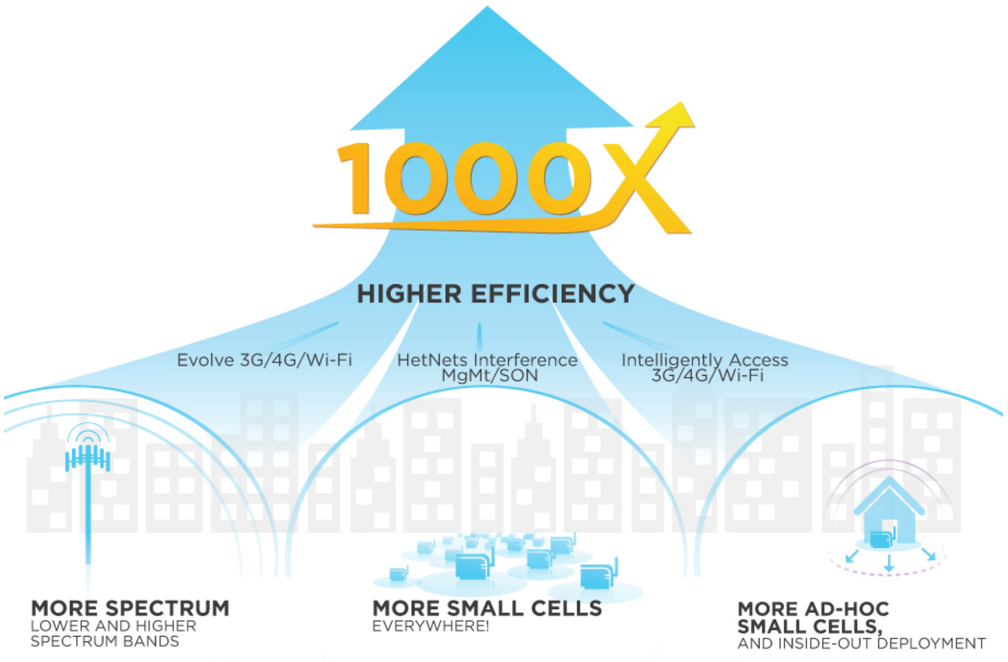
Future Wireless Networks

1000 x challenge

- 1000 x higher mobile data volume per area
- 10 to 100 times higher typical user data rate
- Next 10 years

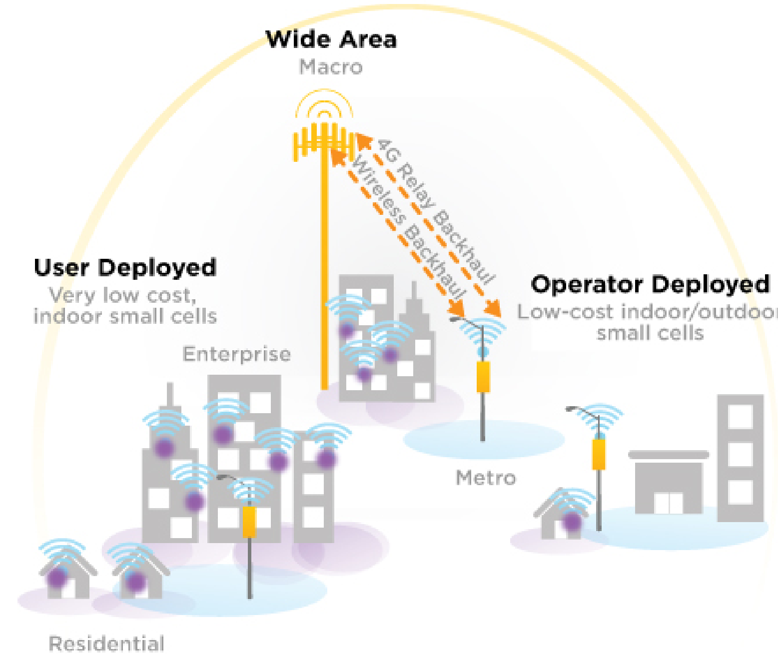


Ultra Dense Networks

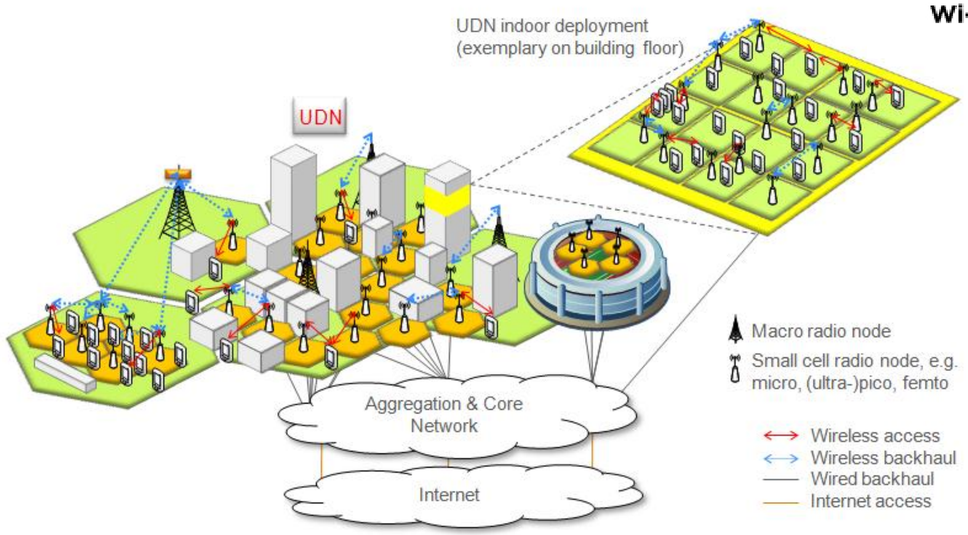
Main solution to 1000x challenge

Properties:

- High number of nodes
- Located in close proximity
- Either heterogeneous or homogeneous



Wi-Fi integrated with 3G/4G for opportunistic offload



Problems

More interference

- Lower spectral efficiency

More nodes

- Higher cost to maintain

Mobility

- More signalling
- More handovers

Mobility Challenges

Handovers will occur more frequently

- More signalling and data overhead in the core
- More data outage
- Shorter cell stay times
  - On top of lower spectral efficiency

Need for more intelligent handover decisions

- Coordination across cell boundaries
- Prediction of handovers
- Machine learning


University
of Antwerp

PANEL ICWMC/VEHICULAR
Mobility: Achievements and Challenges

Mobility and cloud computing: trends and challenges

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Mobility and cloud computing: trends and challenges

- **Facts, solutions:**

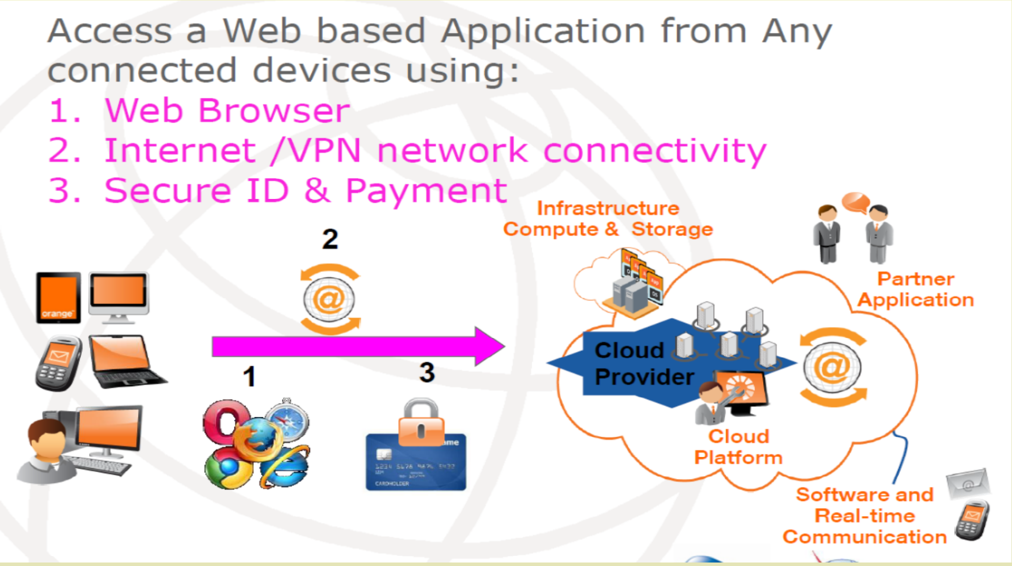
- Significant **increasing of mobile services and needs of mobile computing**
  - consumer and enterprise market for cloud-based mobile applications : ~10 billion at the end of 2014

- However: inherent **problems** exist, like
  - **resource scarcity**
  - **energy consumption issues**
  - **mobility** (terminals, users, services, combinations)
  - frequent **disconnections, ….**

- **Mobile cloud computing can address some of these problems**
  - by executing mobile applications on resource providers external to the mobile device

Mobility and cloud computing: trends and challenges

- **Cloud Computing summary**
  - **Main concept: offload computation to remote resource providers.**
  - **The NIST Definition of Cloud Computing (CC)**
    - (NIST: National Institute of Standards and Technology USA) [1] [2]
- CC: a model for enabling ubiquitous, convenient, *on-demand* network access
  - to *a shared pool* of *configurable computing resources* (e.g., networks, servers, storage, applications, and services) that can be *rapidly provisioned and released* with minimal management effort or service provider interaction.
- Cloud model : five essential characteristics , three service models, four deployment models.
- Basic Cloud Characteristics
  - *On-demand self-service*
  - *Broad network access*
  - *Resource pooling*
  - *Rapid elasticity.*
  - *Measured service.*



Mobility and cloud computing: trends and challenges

- Cloud Computing summary
- **Service Models**
  - ***Software as a Service (SaaS)***
    - Consumer can use the ***provider's applications running on a cloud***
    - Applications are accessible from client devices
    - The consumer *does not manage or control the underlying cloud infrastructure*
  - ***Platform as a Service (PaaS)***
    - Consumer
      - can deploy on the cloud infrastructure ***consumer-created or acquired applications created using programming languages, libraries, services, and tools*** supported by the provider
  - ***Infrastructure as a Service (IaaS)***
    - Consumer
      - can ***provision processing, storage, networks****,* and other computing resources
      - *Can deploy and run arbitrary software*, (including OS and applications)

Extension (ITU-T, etc.) : CaaS, NaaS, ……..(Any) aaS ☺

Mobility and cloud computing: trends and challenges

- **Mobile cloud computing (MCC)**
  - Main feature: executes mobile applications on resource providers external to the Mobile Device (MD)

- **Several existing MCC scenarios:**
  - 1. **Run an application on a remote resource rich server** (e.g. Google's Gmail for Mobile on Google servers) ; the **Mobile Device** acts like a thin client connecting over to the remote server through 3G.
    - **MD <- ---------> Remote Cloud**
    - (other examples: Facebook's location aware services)
    - These apps are popular, but they can perform well only if high speed connectivity is available

  - 2. **Use other MDs as resource providers of the cloud making up a mobile P2P network**
    - collective resources of the neighbours MDs (or stationary) will be utilized.
    - This approach supports user mobility, and recognizes the potential of mobile clouds to do collective sensing as well.
    - **MD <- ---------> Local Cloud**

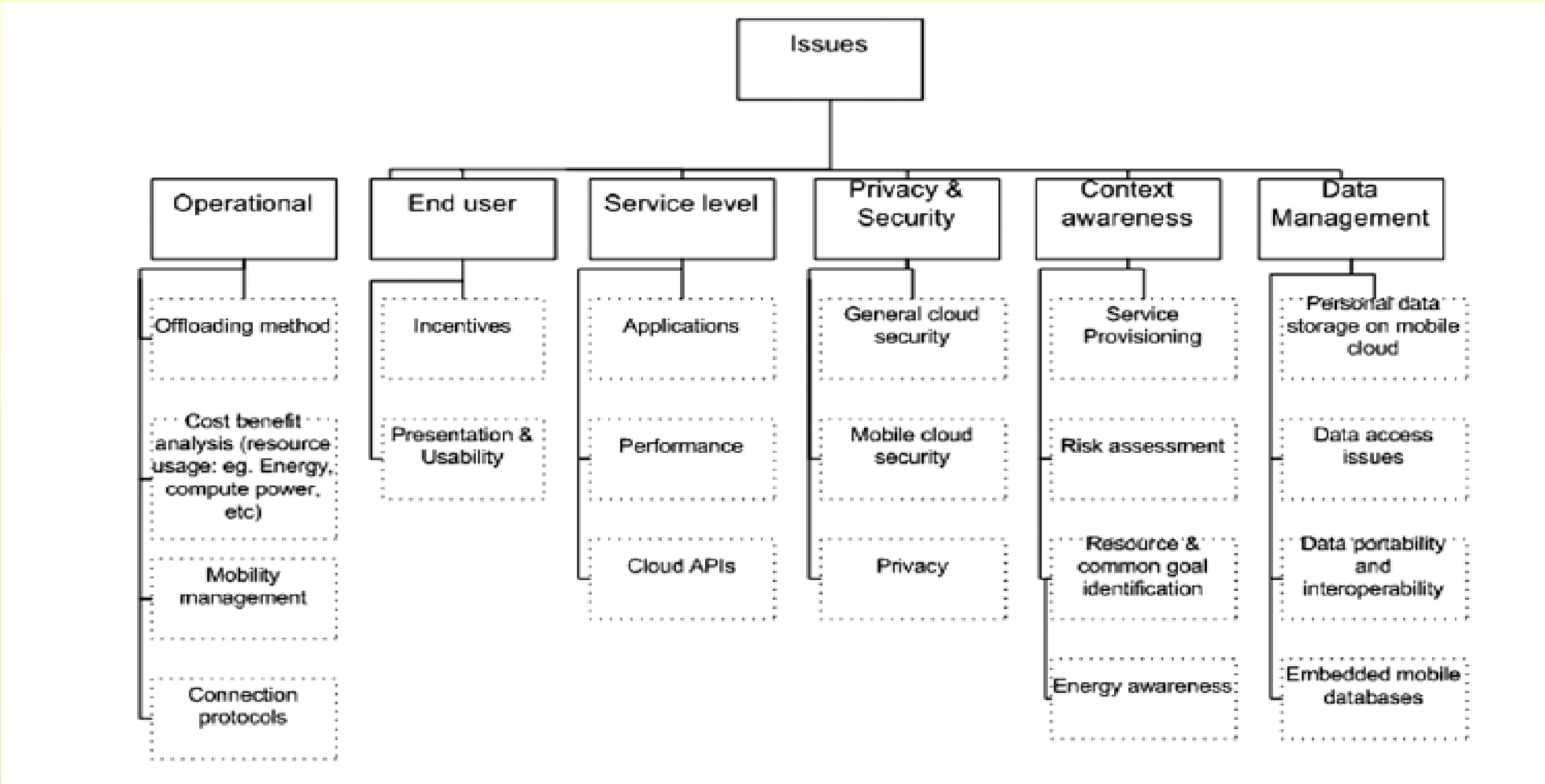
Mobility and cloud computing: trends and challenges

- **Several existing MBC definitions (cont'd)**
  - 3. ***Cloudlet* concept** : the MD offloads its workload to a local 'cloudlet' comprised of several multi-core computers with connectivity to the remote cloud servers.
    - **MD <- -> Local Mobile Cloud <-->Remote Cloud**
    - PlugComputers- examples of candidates for cloudlet servers (good form factor, diversity and low power consumption).
      - general architecture ~ as a normal computer,
      - but less powerful, smaller, and less expensive, ideal for role small scale servers installed in the public infrastructure.
      - cloudlets can be situated in common areas e.g. coffee shops
      - MD can connect and function as a thin client

- A taxonomy of mobile cloud computing [3], [4]
  - based on some key issues in mobile cloud computing
    - Operational level issues
    - End user level issues
    - Service and application level issues
    - Privacy, security and trust
    - Context-awareness
    - Data management

Mobility and cloud computing: trends and challenges

- A taxonomy of mobile cloud computing [3] (cont'd)



Mobility and cloud computing: trends and challenges

- Methods for offloading
  - Note: there are pros and cons for each one
    - Client–Server Communication
      - process communication is done across the MD (offloader) and surrogate device via protocols such as RPC, Remote Method Invocation (RMI) and Sockets.
      - RPC and RMI have well supported APIs and are stable
      - (-) offloading through these two methods mean that services need to have been pre-installed in the participating devices.
    - Virtualization
      - Transfers a VM memory image from a source server to the destination server without stopping its execution
      - the VM memory pages are pre-copied (no interruption of the OS or any of its applications), → an illusion of seamless migration.
      - no code changes are needed when programs are offloaded, relatively
      - secure execution, since the VM boundary insulates the surrogate
      - device.
      - VM migration is somewhat time consuming

Methods for offloading

- Note: there are pros and cons for each one
  - Mobile agents (mobile code)
    - Using a special framework, a MD offloads to one or more surrogates
    - E.g. Scavenger (shortly described in [6])
      - uses WiFi for connectivity, and uses a mobile code approach to partition and distribute jobs.
      - a scheduler for cost assessment.
      - a mobile device offloads code to one or more surrogates
      - tests have shown that parallelism in running the application on multiple surrogates is efficient

Mobility and cloud computing: trends and challenges

Thank you!

Mobility and cloud computing: trends and challenges

References

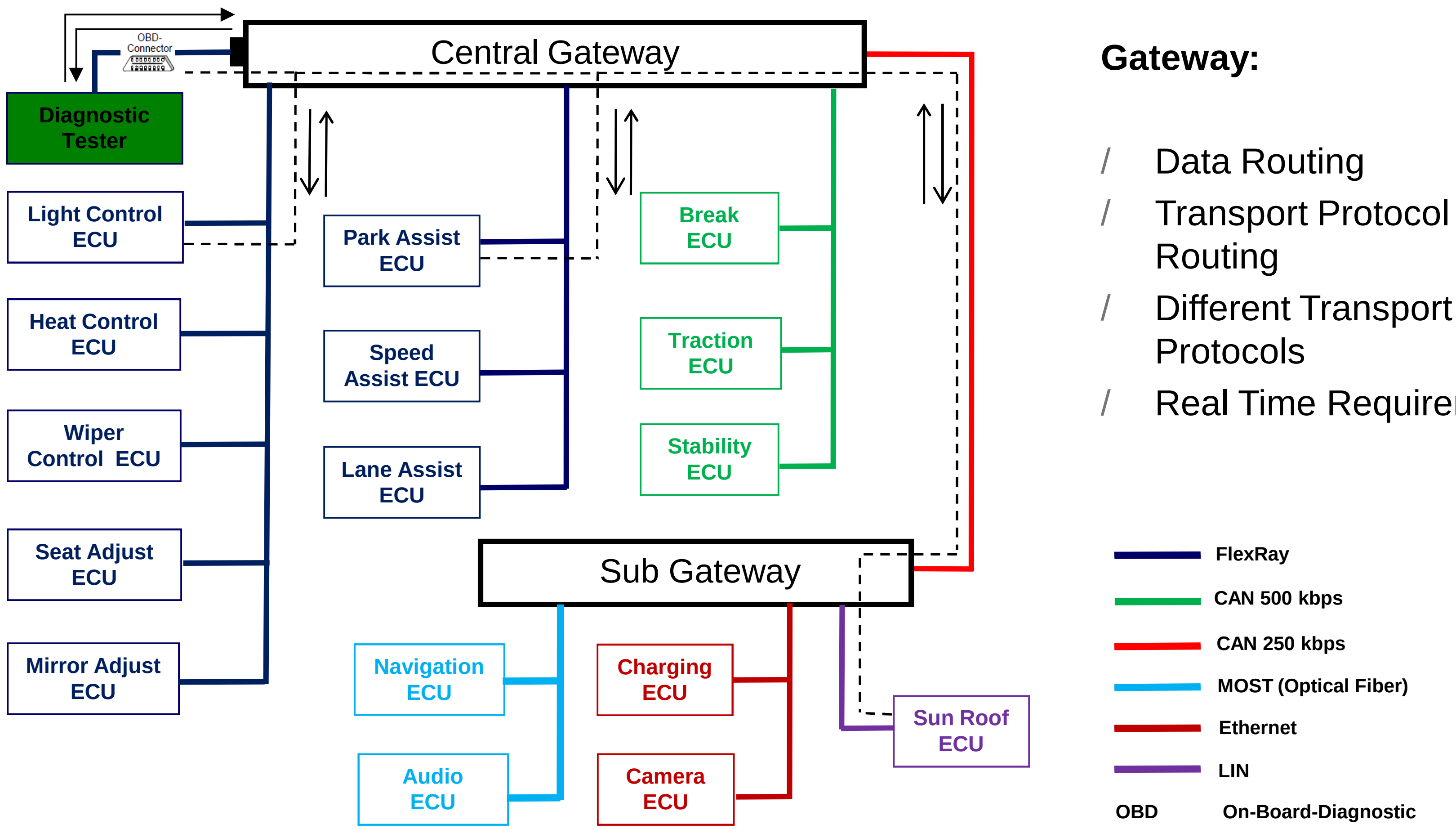
1. Peter Mell , Timothy Grance, The NIST Definition of Cloud Computing, Special Publication 800-145, Recommendations of the National Institute of Standards and Technology , 2011
2. Fang Liu, Jin Tong, Jian Mao, Robert Bohn, John Messina, Lee Badger and Dawn Leaf, Recommendations of the National Institute of Standards and Technology, NIST “Cloud Computing Reference Architecture”, Special Publication 500-292 , 2011
3. Niroshinie Fernando , Seng W. Loke , Wenny Rahayu “Mobile cloud computing: A survey”, Future Generation Computer Systems 29 (2013) 84–106 http://www.google.com/mobile/mail/
4. M. Satyanarayanan, Mobile computing: the next decade, in: Proceedings of the 1st ACM Workshop on Mobile Cloud Computing & #38; Services: Social Networks and Beyond, MCS’10, ACM, New York, NY, USA, 2010, pp. 5:1–5:6

Verification of Transport Protocol‘s Parallel Routing of a Vehicle Gateway System

Seville, Spain, 26.06.2014
Standard Software und Integration / Hassan Mohammad

Background

Gateways in Automotive Electric/Electronic System



Gateway:

- Data Routing
- Transport Protocol Data Routing
- Different Transport Protocols
- Real Time Requirements

Problem Description

Transport Protocol‘s Parallel Routing

- e : Number of Electrical Control Units (ECUs)
- s : Number of Transport Protocol Routing Scenarios
- y : Number of configured parallel transport protocol routing instances

  ➔ Theoretical number of combinations to be tested (Test Cases)

$$X = \left(\frac{e!}{y!(e-y)!} \right).y^{s} + \left(\frac{e!}{(y-1)!(e-(y-1))!} \right).(y-1)^{s} + \ldots + \left(\frac{e!}{1!(e-1)!} \right).1$$

Notice: Equation assumes equal number of scenarios for all ECUs

- e = 50, s = 3, y = 3 ➔ X = 53900050
- 10 seconds are needed to test each possible combination ➔ 62,39 days are required to verify this functionality.

Conclusion

- The amount of data exchanged for inter- and intra-vehicular communication is increasing
- Transport protocols of gateways are used to establish routing of big data packets
- Reducing the number of possible scenarios in order to test parallel routing of gateway’s transport protocols is a challenging task

TOWARDS EFFICIENT METHODOLOGIES FOR RAPID-PROTOTYPING OF COMMUNICATION TECHNOLOGIES AND COOPERATIVE ITS APPLICATIONS

26 June 2014, Sebastian Bittl and Karsten Roscher

How can communication technologies and applications be prototyped for usage both on real target and inside simulation environments? A realization sketch by a combination of the ezCar2X framework with the network simulator ns-3.

IARIA

PANEL ICWMC/VEHICULAR

Fraunhofer Institute for Embedded Systems and Communication Technologies ESK

How are ITS Technologies and Applications typically developed today?

Rapid-Prototyping Frameworks (typ. vendor specific)

Features implemented twice!

Simulation Frameworks

- ns-3
- Riverbed Modeler (formerly OPNET)

Joint Approaches used Elsewhere

- Matlab / Simulink
  - Build-in simulation
  - Code generation for dedicated target platforms
  - But:
    - Expensive and limited features available
    - Complex to extend/modify and maintain interfaces
- Others …

Joint Development for Real Target and Simulation Environment

Central Goals

- Implement features only once
- Minimize requirement for wrapper code

Programming Paradigms

- Object oriented programming, e.g. C++
- Heavy use of design patterns
- Abstraction via interface classes
- High modularization

ezCar2X and ns-3 as an Example of Joint Development

Exchangeable ITS-Stack Software Components

- Basic real world information, e.g. time, GPS position etc.
- Hardware wireless communication interfaces, e.g. RF-Frontend
- Event scheduler

➡ **Switch between simulator and real target via configuration parameters!**

Challenges

- Combination of CMake and WAF build system (solved)
- Combination of ns-3 and boost callback structure (solved)
- Integration of GPS positions into ns-3 (concept phase)
- (Multi-)Threading adjustment
- Others …

One Central Challenge Regarding Future Mobility

Obtain a methodology for joint development of ITS applications, enabling deployment of ITS based ADAS, for usage both on real targets and inside simulation environments.

THANK YOU FOR YOUR ATTENTION!

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