Car-to-Car Communication

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Outline

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- Technologies and Service Types
- Research Challenges
- Selected Research Results
  - GST Telematics Platform
  - Efficient Message Dissemination for C2CC
  - Hybrid Simulation
  - Security – the real challenge
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Motivation for C2C Communication

- Reduce road fatalities with **active safety**
- Use communication for new services
  - Up-to-date traffic information
  - Active & adaptive navigation services
  - Infotainment

**C2C + Car-to-environment!**

- Players in C2C Communication
  - Vehicles
  - Mobile Terminals
Rich Choice of Technologies and Services

- **Wireless Access Technologies**
  - IEEE 802.11 WLAN
  - Dedicated Short Range Communication (DSRC)
  - GPRS/UMTS
  - Down the line: IEEE 802.11p (C2C Comm.)

- **Service Types**
  - Inter-vehicle Services
  - Services provided by Road Side Units
  - Portal-based Services (Infotainment)

- Besides technology:
  Definition of a **business case**!
Possible Services for C2C Networks

- **Car-to-Car Services**
  - Exchange of traffic information
  - Exchange of weather or road conditions

- **Car-to-Infrastructure Services**
  - Active road side infrastructure
  - Road Side Units (RSU) as information points

- **Portal-based Services**
  - Use of a Telematics platform
  - Services like „Pay-as-you-drive“ insurance
  - Fleet management
  - Internet access in the vehicle
Research Challenges for C2C

- Protocols and Wireless Access
  - Scalability: Shared Medium $\Rightarrow$ limited resources & capacity
  - Robust and reliable communication even at high speeds
  - Efficient data dissemination schemes for large networks ($>>100$ nodes)

- Integration and Definition of Security and Privacy
  - Realization of efficient trust environments (PKI)
  - Reliability of nodes, routes, and messages
  - Sufficient anonymity for mobile nodes

- Quality of Service and Realtime Communication
  - Depending on Service class and application
  - Key issue: low latency (e.g. for collision warning)

- „Open“ Platforms

- Realistic Simulation Systems
Overview of Selected Research Results
The GST Telematics Service Platform

- GST: Global System for Telematics
- Vision: Standard for Vehicular Telematics Platforms
  - Open platform with reconfigurable services

http://www.gstforum.org/
GST: Project Details & Status

- Integrated EU project (FP6)
- Consortium with 49 companies
  - **OEMs**: BMW, DaimlerCrysler, Fiat, Ford, Renault, Volvo
  - Project Management: ERTICO
- Vision/Goal: Open environment ⇒ generate a *de facto standard*
- Status: Reference Implementation and Evaluation
- [http://www.gstforum.org/](http://www.gstforum.org/)
C2C Message Dissemination

- Hazard warning & traffic status information
- Dissemination by „smart“ broadcast
- Techniques for scalability and QoS needed
Scalability for Message Dissemination

- Many parallel information services ⇒ Network congestion
- New approach: Use context information to prioritize messages (benefit maximization)

Benefit changing over distance
Hybrid Network Simulation

- **Goals:**
  - Investigation of coverage, connectivity and QoS in realistic environments
  - Vehicle movement on real maps
  - Mobility simulator connected with network simulator (CARISMA, SUMO, ns2)
  - C2C services can be evaluated with realistic settings
  - **Key issue:** Scalability for scenarios with 500 nodes and more
Highspeed and Low Latency for C2C

- Needed for collision warning & intersection assistance
- Research for autonomous and cognitive vehicles (SFB/Transregio 28 „KogniMobil“)

- Conventional Broadcast
  - Interference
  - Collisions lead to delays

- Power Control
  - reduced interference
  - fewer collisions, higher capacity

- Beamforming concepts
  - reduced interference
  - improved connectivity
Security & Trust for C2C Environments

- Trustability of nodes and messages is crucial
- Introduction of Trust with Public-Key Cryptography
- Vehicles use certificates to authenticate

Data
Signature
Certificate

Data
Signature
Certificate
Challenges for Security Integration

- Reduction of data overhead necessary!
  - More efficient protocols with improved scalability
  - Lower delay times
  - Use of improved schemes (e.g. Elliptic-Curve Cryptography)

- Security aware data dissemination & routing
  - Use of efficient \textit{and} secure routing schemes
  - Data dissemination with content verification \& authentication

- Integration of privacy aspects (anonymity)
  - Limited traceability of vehicles
  - Linking of actions, identities, pseudonyms has to be prevented

- Intrusion detection and exclusion of compromised nodes
  - Design of security schemes resistant to internal attackers
Conclusion and Outlook

- New services will be possible with C2CC
- Rich technology variety, however, basic C2C technology will be similar to WLAN
- Open integrated service platform concepts available (GST)
  - Services need to be developed / invented
  - Integration into existing business processes
- New message dissemination approaches
  - Improving e.g. benefit, capacity, and delay times
  - Make schemes more scalable
- Security concepts available; open issues:
  - Realtime, overhead, privacy
  - Fully operable integrated solutions

**C2C Communication will be a key component of future telematics systems**