Wireless Ultra-Reliable Low-Latency Device-to-Device Communication

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Federal Ministry for Transport, Innovation and Technology
50.46%

Federation of Austrian Industries
49.54%

Austrian Institute of Technology (AIT)

- 1300+ employees
- Budget: 120 Mio €
- Business Model: 40:30:30

Strategic Cooperation

Funding Sources
Connected Autonomous Vehicles

- mobile stations (MS) are moving, base station (BS) is fixed
- time-variant multi-path propagation
- interference

- transmitter and receiver are mobile
- safety critical scenarios
Non-Stationary Fading Process

Dispersion in time

**Time-varying** RMS delay spread

![NLOS LOS dispersion in time](image1)

Dispersion in frequency

**Time-varying** RMS Doppler spread

![NLOS LOS dispersion in frequency](image2)

Wireless channel properties determine packet error rate and achievable latency!
Intelligent Production – Industry 4.0

https://www.triad.de/de/themen/schwerpunkte/industrie-40/
Ultra-Reliable Low-Latency Wireless Communications

Vertical markets

- **Autonomous vehicles** - redundant sensor information (radar, optical, etc.)
- **Industrial cyber physical system (CPS)** - replacement of cable connections to mobile actuators or sensor
- **Energy, e-health, entertainment** …

Important properties

- ability to operate in challenging environments – non-stationary fading conditions
- low-latency
- defined error probability
- interface to control algorithms
 Packet error rate depends on position of Tx and Rx due to changing
- delay spread
- Doppler spread
- K-factor
- path-loss

Low-latency requires low-packet error rates by
1. exploiting all available diversity mechanisms
2. utilizing of other nodes as relays
3. establishing distributed channel quality information in a local context
5G Research Focus / Know How at AIT

Goals: Minimize latency, ensure robust and stable operation in a dynamic wireless network.

1. Measurement, modelling and emulation of multi-node communication channels in the targeted 5G frequency bands

2. Low-latency physical layer modulation formats for low packet error rates at short packet lengths - *exploiting wireless diversity mechanisms*

3. Geometry-based system-level test methodologies

4. Software-defined-radio (SDR) test-bed implementations

5. Protocols for low-latency operation in 5G networks – *scheduling for a local context (bubble)*
AIT Austrian Institute of Technology

your ingenious partner

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Publication List (selected)


Road Fatalities in the EU per Year

Source: CARE (EU road accidents database)
Digital Safety & Security Department

### Intelligent Vision Systems (IVS)
- Surveillance & Protection
- Multi-Camera Vision
- Intelligent Camera Networks
- 3D Vision and Modelling
- High Speed Imaging
- High Performance Vision
- New Sensor Technologies

### Highly Reliable SW and Systems (HRS)
- Highest System Reliability
- Assessment and Testing of Autonomous and Safety-Critical Systems
- Verification & Validation

### Future Networks and Services (FNS)
- Large Scale Networked Systems
- Secure Inf. Access in Distr. Systems
- ICT Security
- Optical Quantum Technologies
- Next-Gen Content Mgmt Systems
- Big Data & Open Data
- Quality Assurance & Recommender Systems
- Advanced Apps in Sensor Networks
- Health Information Systems
- Biosignal Processing
- Environmental and Crisis & Disaster Management

- 230 Experts: 1/3 Scientists, 2/3 Engineers, 36% PhD
- Employee growth since 2009: **28%**
- 2/3 of new employees with intern. education
Safety Critical Scenarios

- Road crossing

- General LOS obstructions

- Merging lanes