ON THE ROLE OF 5G IN AUTOMOTIVE INDUSTRY

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Cellular V2X, complete solution on a single unified technology

- "V2X" via Cellular Infrastructure
  - Most V2X use cases

- Networks & Clouds
  - Connectivity to multiple services and stakeholders
5G in automotive industry

Infotainment:
Enable innovative information and entertainment services for the passengers

Cooperative ITS (C-ITS):
Improve safety and comfort by exchanging basic information between vehicles and road infrastructure

Automated Driving:
High volume of data exchanged between cars and the cloud for HD 3D maps, sensor sharing, computational offloading. Remote driving capability for AD vehicles
Some hinders

- Interoperability
- Capable, reliable, scalable communication architectures
- Lack of competitive incentives for a sharing-oriented ecosystem
- Regulatory constraints, liability, data privacy and ownership

Technical hinders  Business hinders  Legal hinders
Interoperability

Cellular networks: cloud-to-cloud communication

- Agnostic to radio technology (4G, 5G, etc.)
- New technology (e.g., 5G) benefits both existing and new services
- Burden of multi-standard support on the network side, not on the device
- Need to agree on cloud-to-cloud communication architecture, protocols and terms

Short-range communication (ITS-G5, PC5): radio-level interoperability

- Interoperability enabled by using the ITS band at 5.9GHz and following all regulations and profiles
- “New” technology (e.g., 5G) cannot benefit already deployed services
- All devices must use the same radio access technology
- “Old” technology cannot be dropped because of backwards compatibility
Coverage is key for Automated Driving (AD) since an Original Equipment Manufacturer (OEM) or transport company are liable and would need to control if in AD or not, remote takeover would also be important.

- Leverage on existing infrastructure and device support
- Using cellular mobile broadband, the deployment of V2N and V2N2I services can start now/ongoing. Even V2N2V is feasible in many countries already now.
- These services can be complemented by (direct) V2V services when support in vehicles is available.
- QoS could be used to prioritize OEM traffic over MBB
- LTE-V2X can be complemented by 5G radio technology for more advanced services.
Services

Commercial Services
- Connected vehicles
- Infotainment
- OEM-cloud proprietary services

Cooperative-ITS Services
- Safer transportation
- Greener and more efficient traffic
- More predictable and productive mobility

MBB evolution
Existing business models for automotive industry

V2X communication technologies
Potential business cases involving multiple stakeholders
5GCAR use cases

- Lane merge
- See-through
- Network assisted vulnerable pedestrian protection
- High definition local map acquisition
- Remote driving for automated parking

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Lane merge coordination

- Connected vehicles make room for an entering vehicle
- Coordinated by a central entity
- Camera system for detection of unconnected vehicles

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Business cases – example

VALUE CHAINS

Telecom sector

TEV → MNO → EU

Connectivity Infrastructure Suppliers → Connectivity Provisioning

Automotive sector

AS → OEM → EU

Vehicle Component Suppliers → Vehicle Makers/Sellers

POSSIBLE ECOSYSTEMS

Transition

AS: Automotive Supplier
OEM: Original Equipment Manufacturer
TEV: Telecom Equipment Vendor
MNO: Mobile Network Operator
OTT: Over-The-Top Service Providers
EU: End User

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5G PPP Automotive Working Group

**White Paper:** A Study on 5G V2X Deployment
- Version 1.0: [https://5g-ppp.eu/white-papers/](https://5g-ppp.eu/white-papers/)
- Version 2.0: ongoing work

### Main Stakeholders

- **Users**
  - Drivers
  - Service providers

- **Policy makers**

- **Road infrastructure operators**

- **Standards Developing Organizations**

- **Automotive industry**

- **5G industry**

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**Profit Estimation**

Accumulated profit over time, Assumption: 10% user penetration per year
Telematics and infotainment using cellular networks are reality today.

New services should leverage scalable technology based on 5G cellular networks.

Autonomous Driving will determine a data explosion ➔ 5G networks optimizations ➔ huge data transfers affordable

Pedestrian protection has great potential

Cooperation between Regulators, Public Sector, Automotive Manufacturers Telecom stakeholders is required to accelerate the societal benefits of connected vehicles
On 5GCAR requirements

— **Automotive requirements**
  — Localization, minimum car distance, mobility, relevance area, etc.

— **Network requirements**
  — Availability, communication range, data rate, latency, reliability, service data unit size
  — Latency may be considered from different perspectives (for different use cases)
  — (Layer-based) latency: similar with user plane latency in 3GPP
  — End-to-end latency: the time it takes to transmit an application message from the application layer of the source node to the application layer of the destination node

— **Qualitative requirements**
  — Cost, power consumption, security

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On the 5GCAR use case classes (1/2)

- **Cooperative maneuver**: sharing local awareness and driving intentions and negotiating the planned trajectories
  - Lane merge

- **Cooperative perception**: perception extension is built on the basis of exchanging data from different sources, e.g., radars, laser sensors, stereo-vision sensors from on-board cameras
  - See-through

- **Cooperative safety**: achieved by exchanging the information about detection of the presence of road users
  - Network assisted vulnerable pedestrian protection

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On the 5GCAR use case classes (2/2)

— **Autonomous navigation**: construction and distribution of real-time intelligent HD map
  — High definition local map acquisition

— **Remote driving**: control the different actuators of the car (steering wheel, brake and throttle) from outside the vehicle through wireless communication
  — Remote driving for automated parking

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