

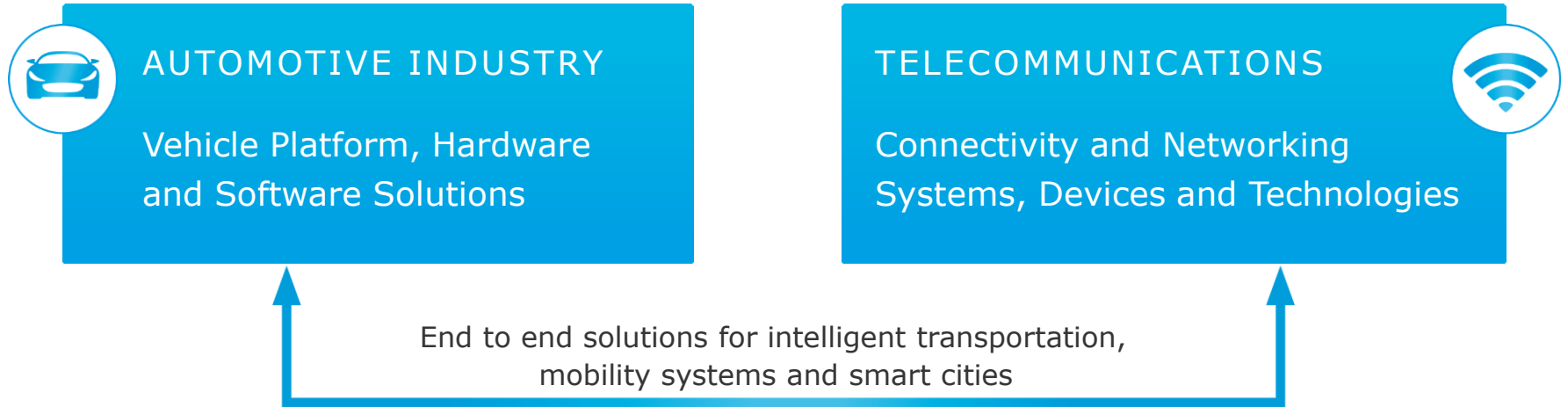
5G V2X

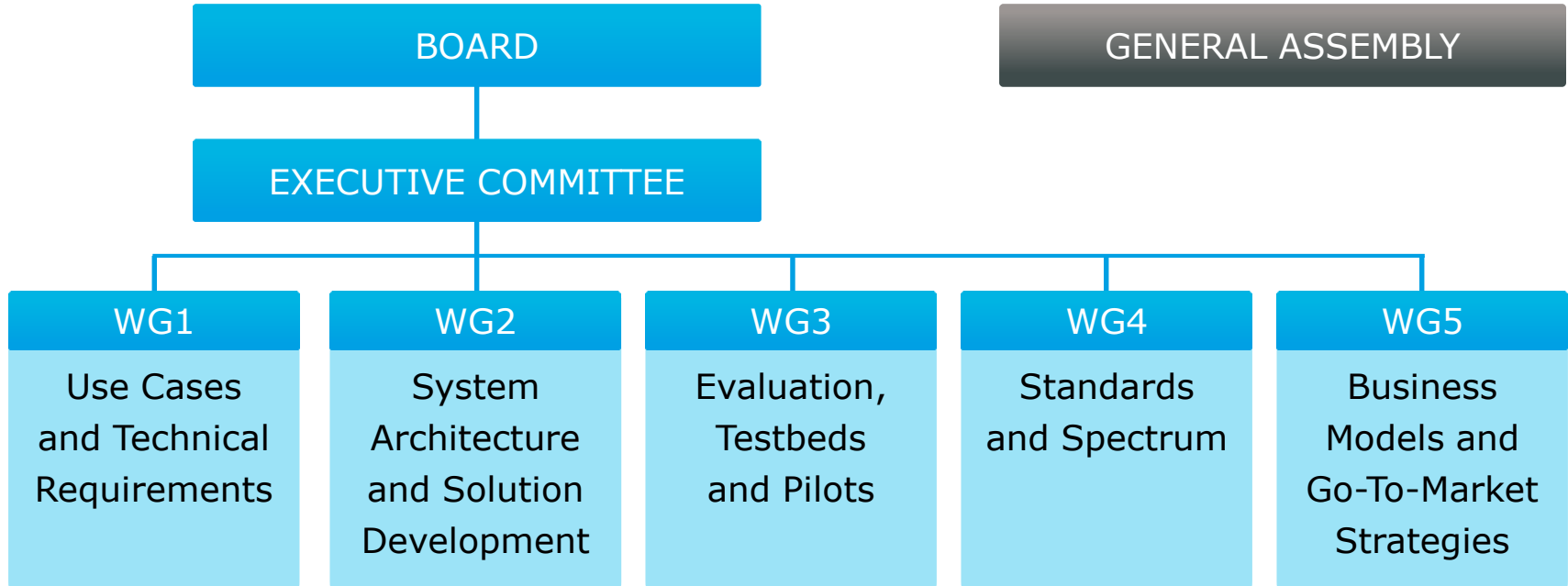
The automotive use-case for 5G

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5GAA Director General

- According to WHO, there were about **1.25 million road traffic fatalities** worldwide in 2013, with another 20–50 million injured or disabled through traffic accidents
- The overall economic impact of road crashes was estimated to be \$518B globally and in some countries this represents 1-5% of the GDP
- Advanced sensing, **communication** and computing technologies should be integrated into vehicles to improve these statistics and save lives.
- Beyond saving people's lives, these technologies will also enable fully autonomous driving, which will profoundly transforming transportation

5GAA created to connect telecom industry and vehicle manufacturers and work closely together to develop end-to-end solutions for future mobility and transportation services







New 3GPP logo for 5G

- The telecom industry is in the process of defining the 5G standards
- 5G will be much more than mobile broadband connectivity, covering a variety of use-cases and industries
- One of the most interesting 5G use-cases is V2X, the framework that will allow vehicles to **communicate** with each other and beyond
- 5GAA will partner with the relevant SDOs to drive the requirements of 5G V2X create a successful V2X ecosystem

Vehicle-to-infrastructure (V2I)

e.g. traffic signal timing / priority



Vehicle-to-network (V2N)

e.g. real-time traffic / routing, cloud services



Vehicle-to-vehicle (V2V)

e.g. collision avoidance safety systems



Vehicle-to-pedestrian (V2P)

e.g. safety alerts to pedestrians, bicyclists



Picture courtesy of Qualcomm

SAMPLE USE-CASES ENABLED BY V2X (1)

Left Turn Assist	Alerts are given to the driver as they attempt an unprotected left turn across traffic, to help them avoid crashes with opposite direction traffic
Intersection Movement Assist	Informs driver when it is not safe to enter an intersection—for example, when something is blocking the driver’s view of opposing or crossing traffic.
Emergency Electronic Brake Lights	Driver is alerted to hard braking in the traffic stream ahead. This provides the driver with additional time to look for, and assess situations developing ahead
Queue Warning	Intended to engage well in advance of any potential crash situation, providing messages and information to the driver in order to minimize the likelihood of his needing to take crash avoidance or mitigation actions later. The infrastructure will broadcast queue warnings to vehicles in order to minimize or prevent rear-end or other secondary collisions.
Speed Harmonization	Determines speed recommendations based on traffic conditions and weather information. It detects the developing roadway or congestion conditions that might necessitate speed adjustments for upstream traffic and broadcasts such recommendations to vehicles long before they reach the affected area.
Real Time Situational Awareness	Provides mechanisms for vehicles to receive real time information about city/roadway projects, lane closures, traffic, and other conditions that may necessitate adjustments to driving patterns.

Software updates	Provides mechanisms for vehicles to receive the latest software updates and security credentials required to ensure their safe operation.
Remote Vehicle Health Monitoring	Provides mechanisms to diagnose vehicle issues remotely. As driving becomes more autonomous this becomes the key mechanism for remote supervision of vehicle functions and its health.
Real-Time High Definition Maps	Provides situational awareness for Autonomous vehicles at critical road segments in cases of changing road conditions (e.g. new traffic cone detected by another vehicle some time ago)
High definition sensor sharing	Provides mechanism for vehicles to share high definition sensor data (Lidar, cameras, etc) to enable better driving coordination for platooning and intersection management
See-Through	Provides ability for vehicles such as trucks, minivans, cars in platoons to share camera images of road conditions ahead of them to vehicles behind them
Vulnerable Road User Discovery	Provides ability to identify potential safety conditions due to the presence of vulnerable road users such as pedestrians or cyclist

- For the access part, 3GPP finalized an initial version of the V2X in Release 14. Discussion is ongoing to define next generation V2X capabilities
- For the upper layers, V2X will leverage ETSI-ITS, ISO, SAE and IEEE standards and tests refined by the automotive industry and others in the ITS community for over a decade
- Multiple trial activities are ongoing (see next slide)

Name, Place	Companies
RACC track, MWC 2017	Audi, Vodafone, Huawei @ MWC
ConVeX (A9), Germany	Audi, Ericsson, Qualcomm, Swarco, Kaiserslautern Univ.
Towards 5G, France	Ericsson, Orange, Qualcomm, PSA Group
Mobilifunk (A9), Germany	Vodafone, Bosch and Huawei
UK CITE, UK	Jaguar Land Rover, Vodafone, et al
DT (A9), Germany	Audi, Deutsche Telekom, Huawei, Toyota
Car2X at A9, Germany	Continental, DT/T-Systems, Nokia, Fraunhofer

Name, Place	Companies
Car2X in Wuzhen, China	CMCC, Continental, Nokia, Fraunhofer
ICV pilot projects, China	CMCC, Huawei, SAIC, et al
MEC pilot project, Germany	Bosch, DT/T-Systems, Nokia
Michigan, US - V2V C-V2X radio performance tests	Ford, Qualcomm
Korea, 5G and cellular communication showcase trials	LGE, Qualcomm

VR Demo in Vodafone FIRA stand



Use cases experience on VR Simulator

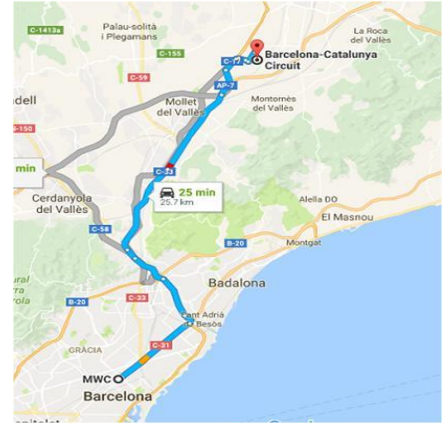
In RACC car Track beside Barcelona F1



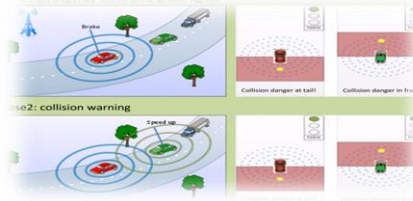
C-V2X demo outside of MWC Venue



Live Demo @ outside track



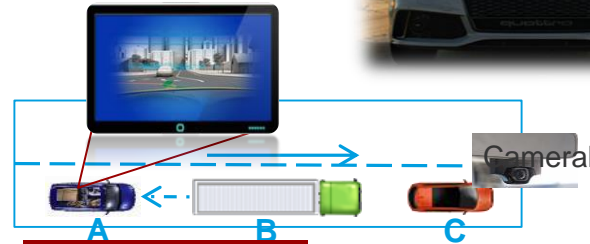
Demo Use cases



V2V: emergency braking



V2I: Optimal speed advisory



V2N: See Through



V2P: Pedestrian alarm



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