5G for Automotive: Key Applications

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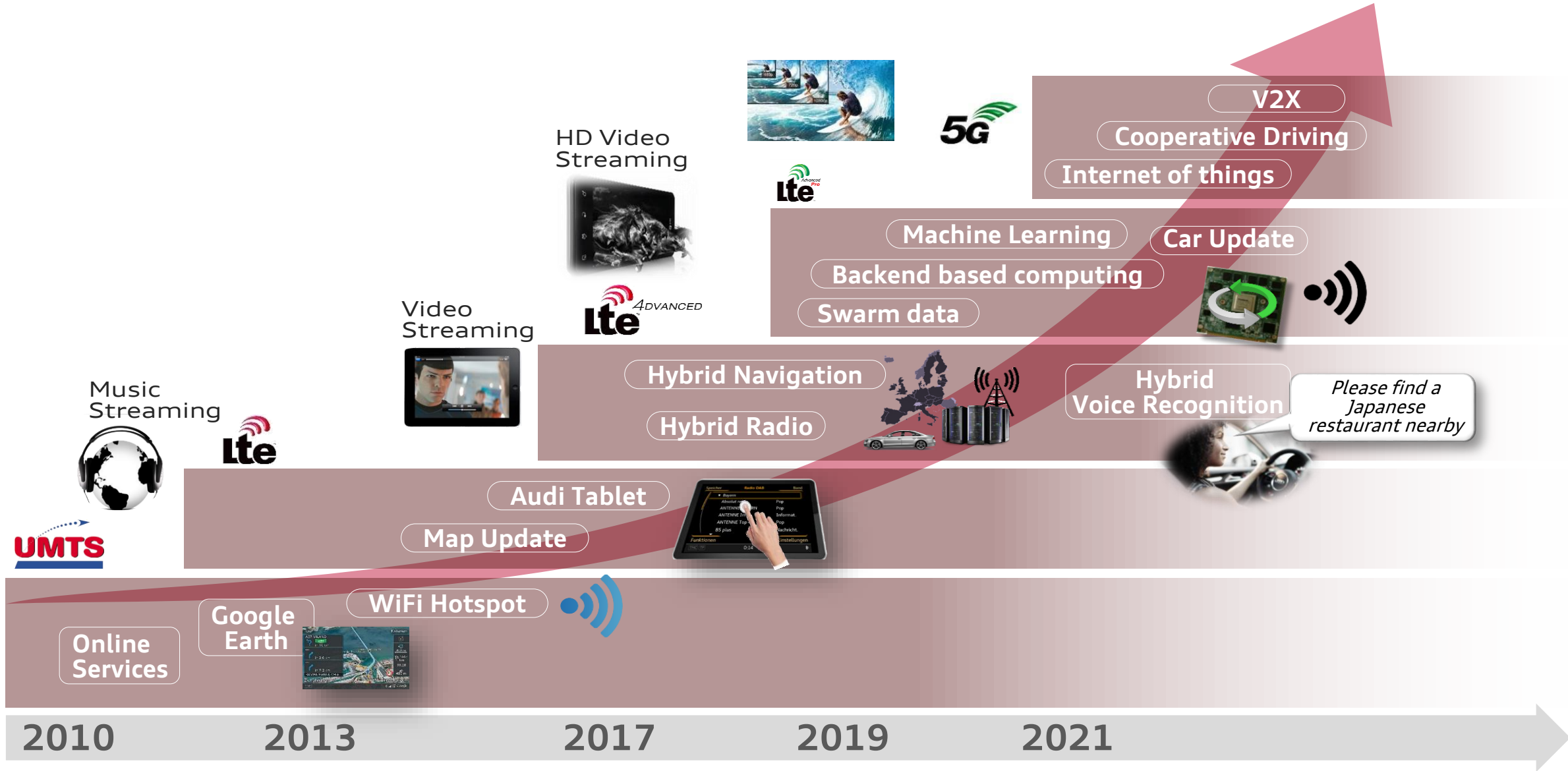
Audi has a strong history in vehicle connectivity and an ambitious roadmap for the future. 5G is the next milestone.



What is 5G for Audi?

Uplink/Downlink

Large amounts of data
can be transferred
upstream and downstream

Network coverage

Data upload and download
reliable and available
everywhere

Latency / Quality of Service

Safety relevant functions
with low latency and
high quality of service

New functionality

Local operations

Low power consumption

Long operating life

Ad-hoc networks

Direct Communication

Relaying Device-to-Device
communication

Joint eco system / „One“ data plan

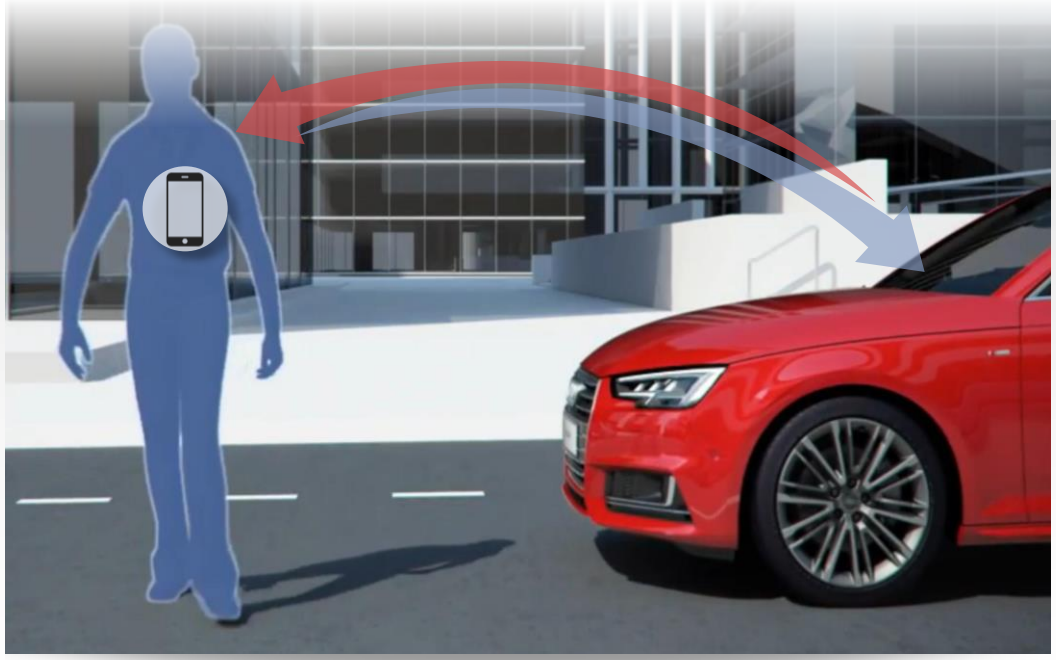
Joint eco system
Car – Home – Smartphone

Improved User Experience

Main Vehicular Use Case Categories for 5G

Extended Safety Use Cases

- **V2P Safety**
- URLLC e.g. for Emergency Trajectory Exchange



Traffic Efficiency

- **Group Start**
- Dynamic Intersection

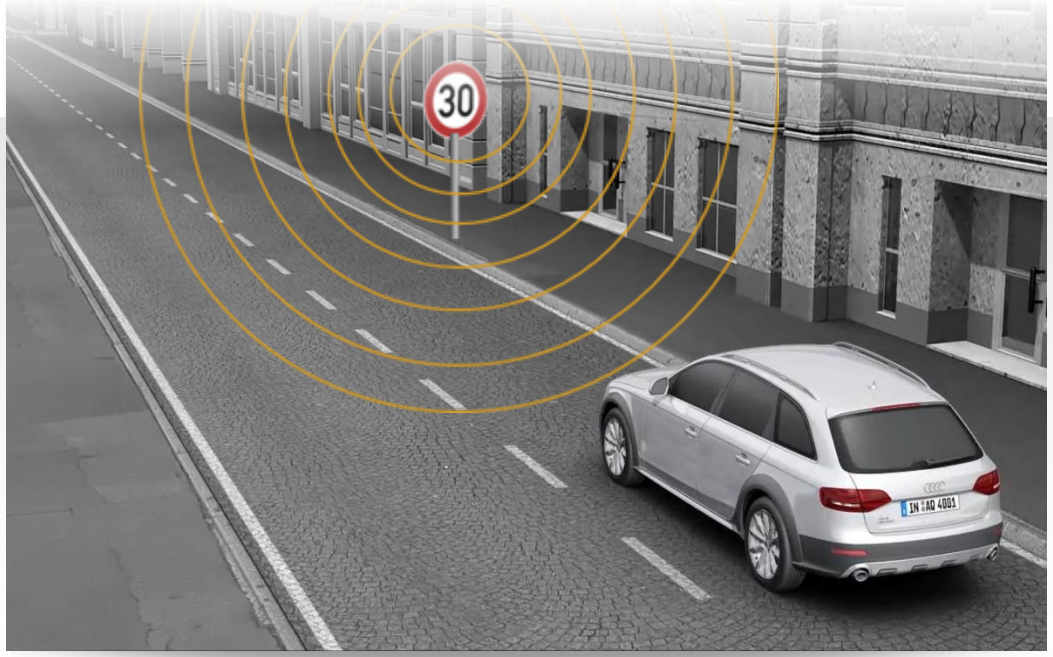
Main Vehicular Use Case Categories for 5G

Driving Comfort

- **Traffic Light Information**
- Obstructed View Assist
- Smooth Overtake

Information Services

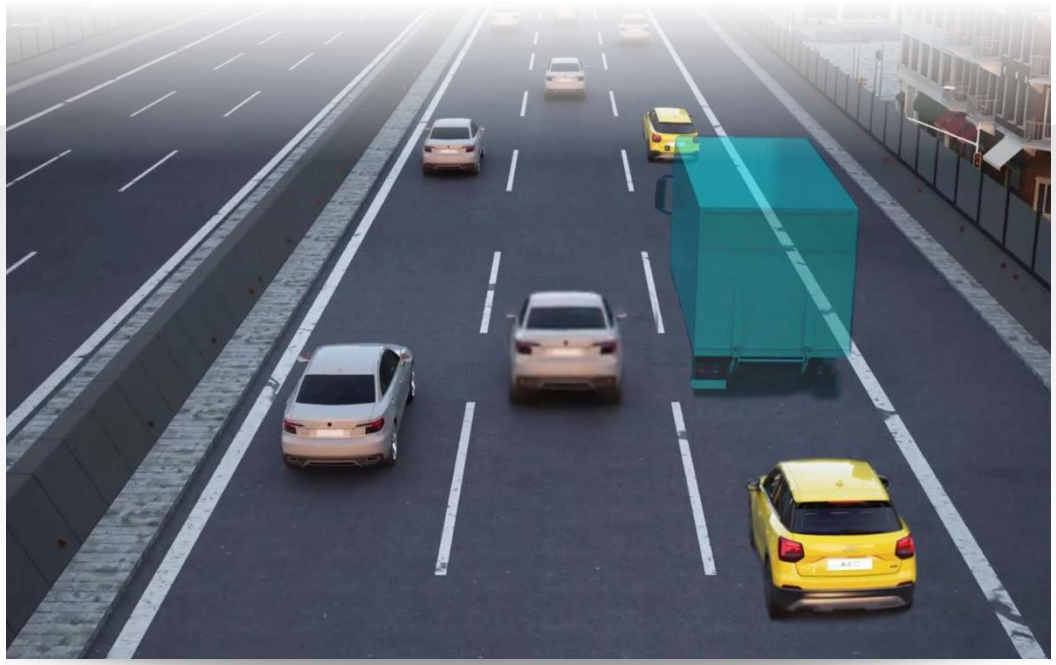
- **Dynamic In-Vehicle Signage**
- Awareness Notification



Main Vehicular Use Case Categories for 5G

Augmentation

- **See-Through**
- Augmented Parking Spot Info
- Virtual Avatar Service Interface



Maintenance and Support

- **Teleoperated Support**
- Efficient OTA Distribution

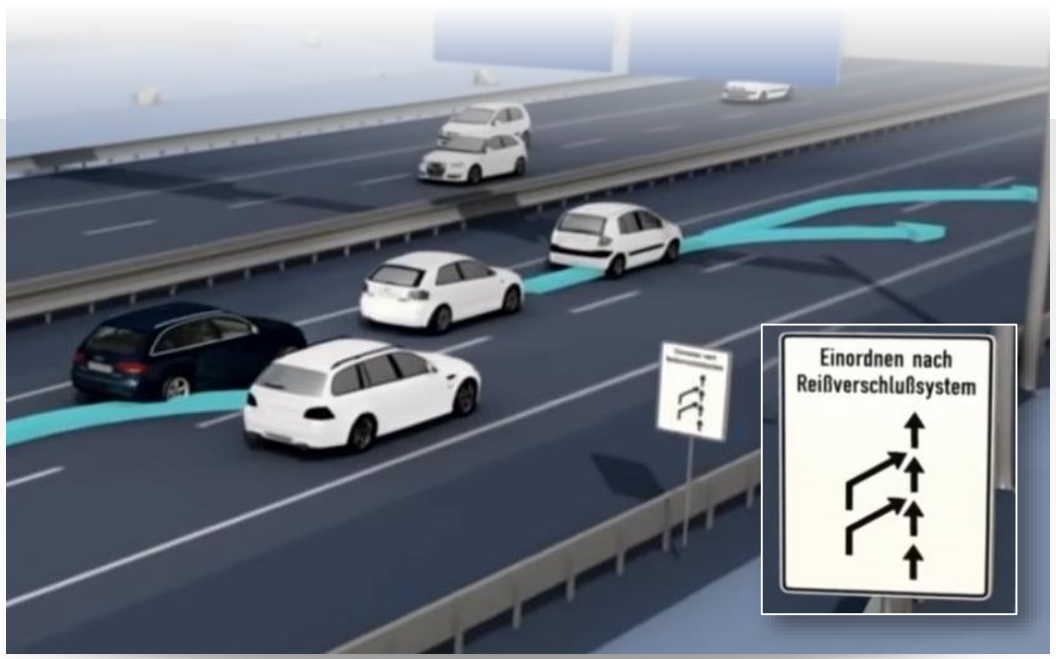
Main Vehicular Use Case Categories for 5G

Entertainment

- **Virtual Reality and Augmented Reality**
- Videostreaming
- Virtual City Tour

Cooperative Driving

- **Cooperative Merging**
- Trajectory Alignment



CONNECTING THE MOBILITY
WORLD WITH 5G-V2X

5GAA Automotive Association

Technical Enablers: Communications Channels

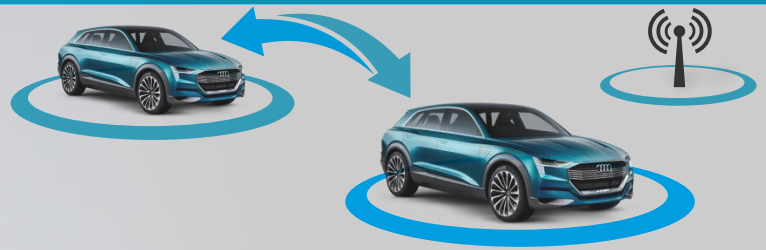
V2N

- V2N Functionality
- Mobile Broadband Services

V2V Unmanaged

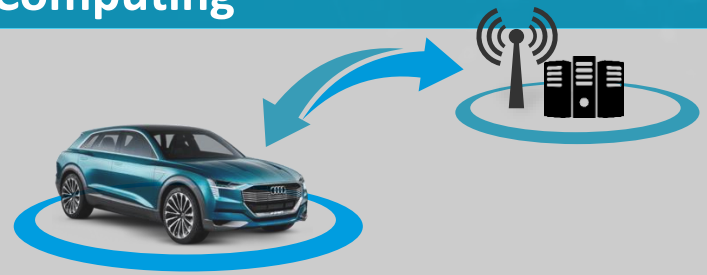
- Direct Communication in pure Ad Hoc Mode
- Best-Effort Radio Access

V2V Managed



- Direct Communication with Radio Ressource Mgmt
- Quality-of-Service

Edge Computing



- Low-Latency Access to Computing Ressources

CONNECTING THE MOBILITY
WORLD WITH 5G-V2X

Technical Enablers: Communications Channels

Evolved Use Cases require more complex interactions between vehicles

- Active Two-Way Communication
- Multi-Message Exchange during a maneuver

Technical Requirements for Complex Interactions

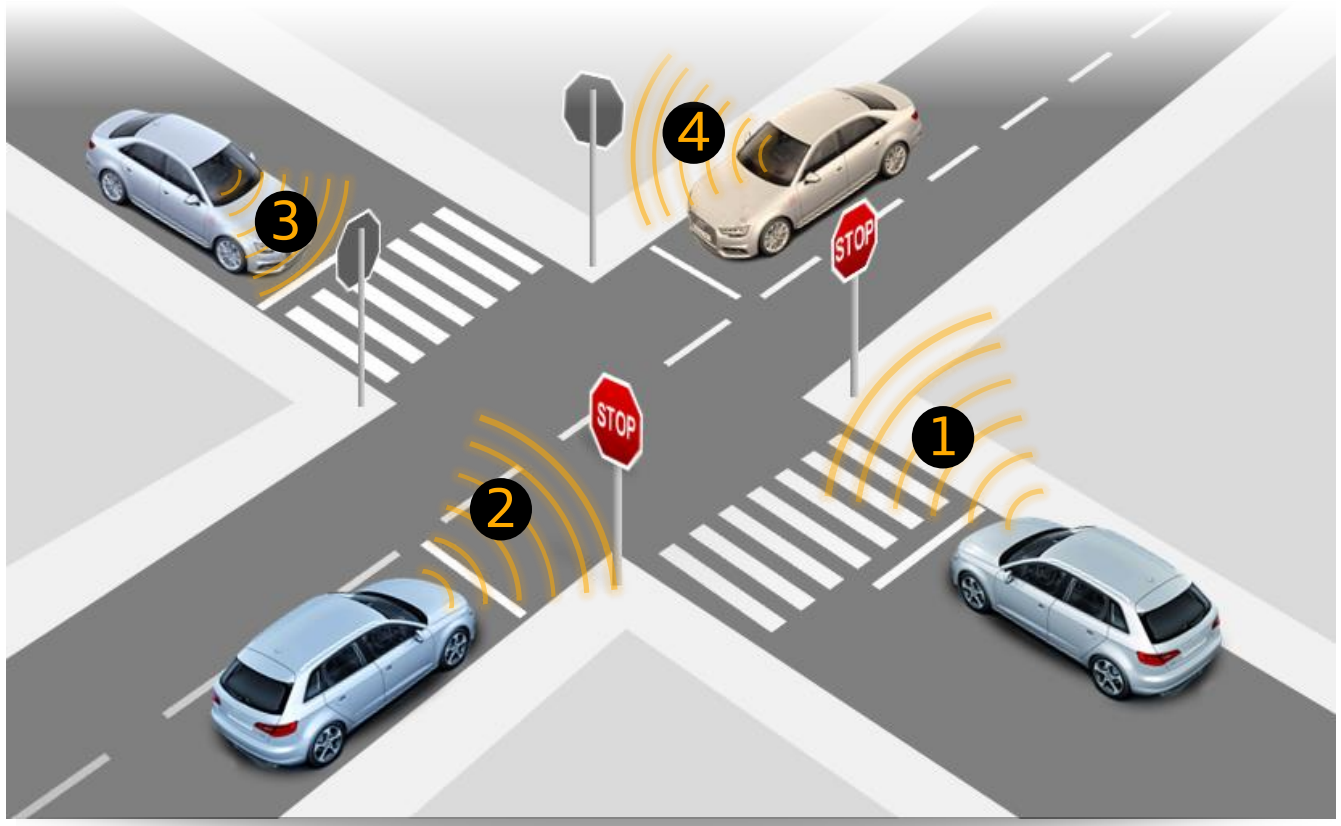
- Reliable Two-Way Communication between vehicles
- Reliable Radio Layer and state information on higher layers

Design of Efficient Protocols on the Higher Layers

- 5GAA is ramping up activities on designing use cases with complex interactions
- 5GAA has started activities on efficient application-layer protocols

Automotive Trial Highlight: Audi, Ducati, Ford, and Qualcomm at CES 2019

- **Next-Level V2X:**
  - **Cooperative Four-Way-Stop**
  - First demonstration of active cooperation between vehicles through C-V2X



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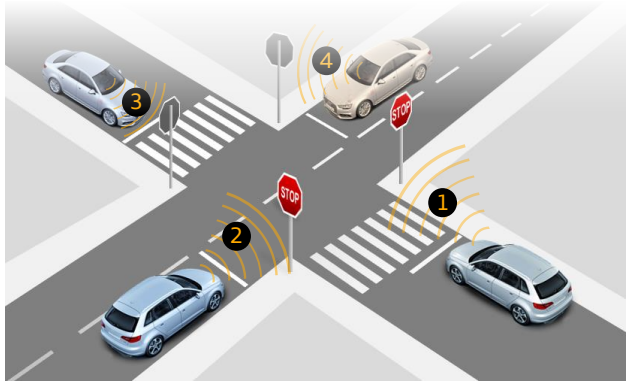

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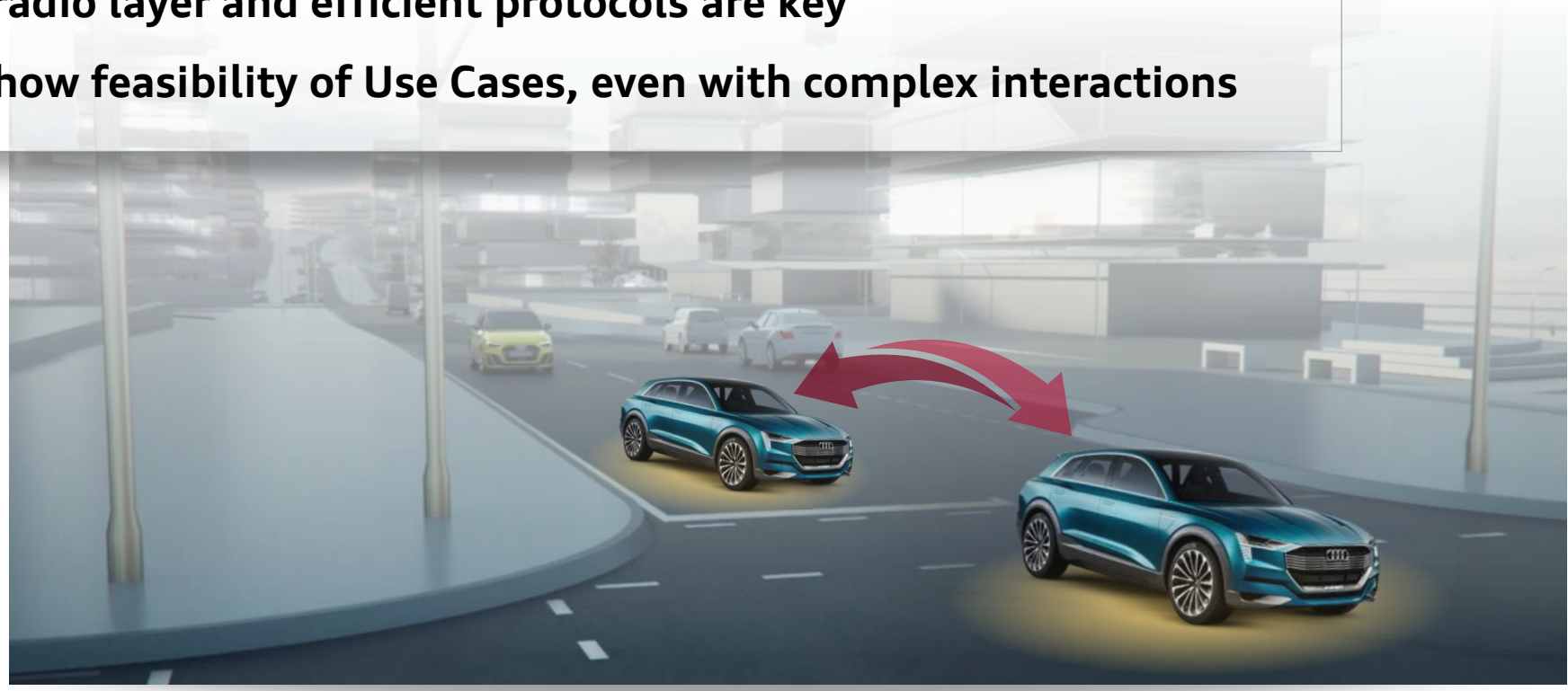
Summary

- Multitude of Automotive Use Cases from various fields
- 5G and 5G-V2X are Enabler Technologies to realize many of these use cases
- Reliability on the radio layer and efficient protocols are key
- Demonstrations show feasibility of Use Cases, even with complex interactions




Thank you!