Automotive industry facing CASE and digitization

Never before in its more than 100-year history has the automotive industry faced such fundamental and sustainable changes. CASE/ACES (connected, autonomous, shared, electrical) and digitization offer a wealth of revolutionary potential, but also – as usual with any revolution – a whole range of challenges.

The race for the first fully autonomous car has flared up. Governments like Norway, for example, will decide to abolish the internal combustion engine by 2025. At the same time, more and more young people are deciding not to own a car and are opting for alternative, usage-oriented mobility models.

Connectivity functions are already indispensable in modern cars – the most popular example is the E-Call, which has had to be installed as standard in new cars since 2018. Cars are no longer just (electro) mechanical objects, but are becoming rolling computers and part of the Internet of Things. The trend towards the “intelligent” car is irreversible. The intelligence first arises in the car itself through sensors and integrated computing units, but also comes from cloud backends, edge computing instances or through interaction with other objects. The intense integration of and interaction with IT and telecommunications components also makes the car a prioritized object of digitization.

In our white paper series we will present the effects of CASE and digitization on specific automotive topics. In this second paper we focus on over the air updates.

Autonomous driving - postponed to 2030 ... or later

A study by Prognos on behalf of ADAC (Allgemeiner Deutscher Automobil-Club/Europe’s largest automobile association) sees 12.4 million vehicles (25.3%) with motorway pilot in an optimistic scenario for 2050, another 8 million (16.3%) with additional city pilot and 2.1 million (4.2%) with a door-to-door pilot, the highest level of automation that also allows country road trips. The institute comes to the conclusion that normal vehicles will continue to dominate the streets of Germany well into the 21st century.

While autonomous driving will further mature in the next few years based on the generated practical data, Teleoperated Driving is establishing itself as an alternative or supplement for driverless transport – depending on the respective use case. At Waymo, for example, there are human drivers who can autonomously maneuver autonomous cars out of difficult situations.

In Teleoperated Driving, a driver operates the car via a network-based remote control from outside the car. Tests show that the distance between the driver and the car only plays a minor role. For example, in a proof of concept a car could be controlled from Stuttgart on the streets of Tel Aviv. Many companies around the world are working on such technologies and are already operating the first fleets. Prominent examples from the USA are Phantom Cars and Scotty Labs, which deliver orders for Postmates and Door Dash. Ottopia is the leading provider in Israel and Bosch in Germany.

Teleoperated Driving not only gives the operators of automated fleets access to their cars, but it can also address a host of other application scenarios in which cars have to be maneuvered independently of people on board (e.g. in shared mobility fleets or in potentially dangerous situations). The application scenarios are not only limited to cars: trucks, construction machinery, ships or mobile robots can be operated remotely as well.
Technology of Teleoperated Driving

Basically, Teleoperated Driving requires three components: cameras, an additional on-board unit in the car and a control center from which the driver controls the car. The on-board unit in the car gives the driver access to functions such as braking, accelerating, steering, etc., which are shown on a console in the control center.

In return, the on-board unit provides him with data for a current visual impression of the road situation so that he can react appropriately. In order to create this current impression, cars need the video streams from at least four HD cameras. These are delivered to the control center via a mobile network on monitors or VR glasses.

In addition, the on-board unit must bring additional logic on board the car: emergency programs that react automatically, for example in the event of a network breakdown or an unforeseen event (object with lateral movement on the road). The emergency programs then initiate braking or an evasive maneuver.

Challenges for Teleoperated Driving

There are two aspects to consider in Teleoperated Driving.

On the one hand, the driver receives only a limited sensory perception – the perception of the traffic situation takes place exclusively via the optics. Noises and sensory perception (when turning, braking, etc.) are not available. This complicates the assessment of the driving situation. In addition, the HD cameras only provide about two percent of the optical impression of a healthy human eye.

On the other hand, the technical latency affects both the control signal and the transmission of the traffic situation. In other words, the car’s response to a control signal is delayed, and the driver also gains an impression of the situation that has already passed. For this reason, experts demand that the latency does not significantly exceed 50 ms to operate a remote-controlled car. This enables a near real-time impression.

Latency as a critical variable

The latency requirements increase with the speed of the car. The faster the car drives, the greater the difference between the true road situation and the display in the control center. At a speed of 30 km/h and a latency of 120 ms, there is a difference of about two meters in the “roundtrip”; that is the position from which the car sends the video data and the position where it receives the control commands. In practice, latencies of up to one second can be observed when using 3G – which precludes this technology for Teleoperated Driving from the outset.

But the prevailing 4G technology also reaches its limits when operating remote-controlled cars: The video streams of the four HD cameras of a single car use about half of the capacity of a radio cell. A driving car receives – under good circumstances – realistically a bandwidth of around 80 Mbit/s. In continuous operation, 50 Mbit/s is a good average value. But street canyons, tunnels, additional radio cells and network coverage as a whole are factors that have a strong impact on the bandwidth actually available. The success of Teleoperated Driving depends on the available network capacities and the ability to make optimal use of them.

Exkursus:

With 5G the situation will change fundamentally:

5G not only brings a 10-fold increase in transmission rates, but the new standard can also manage significantly larger quantities of devices with reliable quality (guaranteed quality of service). Data transfers with extremely low latencies under 10 milliseconds with high availability of up to 99.99 percent are possible. No wonder that 5G suppliers like Ericsson and Huawei are also researching Teleoperated Driving.

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Teleoperated Driving with 4G (LTE)

Scenarios for Teleoperated Driving can already be implemented today on the basis of the 4G network. Prioritized fields for application scenarios are private zones such as company premises, which allow capacities guaranteed by their own network infrastructures.

In addition, the legal framework for the implementation of Teleoperated Driving on these closed properties is much easier to meet.

But Teleoperated Driving cars can also be operated safely in the public environment. Experiments show that the use of intelligent technologies can lower the limit for the operation of remote-controlled cars to 12 Mbit/s and 200 ms to create a quasi-real-time impression.

Currently (in Germany) four SIM cards are installed in the car that can use the capacities of different network providers. On the one hand, this ensures redundancy, and on the other hand, higher performance is achieved in zones with multiple coverage.

In addition, AI functions can be integrated into the on-board unit, which anticipate the development of network capacities and adapt the video data transfer to the currently available capacities. Based on this forecast, the AI optimizes the signal processing regarding the parameters latency, video quality and update rate. For example, it reduces the resolution at the edges of the screen and ensures that the update rate does not become too high (this also creates latencies) and buffers video data (jitter buffering) so that an isochronous data stream is created.

Use cases

Besides the previously described backup solution for autonomous and semi-autonomous vehicles, Teleoperated Driving is also suitable for use in clearly defined areas in which stable network conditions can be established.

For example, multimodal travelers could park rental cars remotely at train stations, hotels, ports or airports at the designated parking spaces or make them available to the car’s subsequent tenants (valet service).

As a variant of this, OEMs can implement end of line logistics based on Teleoperated Driving. In order to park finished vehicles on the company premises until delivery or to load them onto trains or trucks, the employees do not need any additional logistics (pick-up) or foot marches. The processes can be designed more efficiently.

But logistics processes based on mobile robots, forklifts or similar vans can also be operated permanently via Teleoperated Driving – before fully autonomous processes are available. The same applies to mining machines or heavy equipment that is used in potentially dangerous locations. Here, Teleoperated Driving can help protect human lives. For use in tunnel construction or in mines, however, the installation of network infrastructures will be necessary.

Conclusion

Teleoperated Driving can already be implemented with 4G networks. It is foreseeable that it will first prevail in „protected“ private environments, and later – once liability issues have been resolved – it will also be available on public roads. Teleoperated Driving is a technology that ideally complements, accelerates and partwise even substitutes autonomous and semi-autonomous driving. Because it is foreseeable that, in complex situations, humans will be superior to automated and artificial intelligence of autonomous driving for years, if not decades, in decision-making and responsiveness.

With little effort, Teleoperated Driving enables the central management and efficiency increase of fleets of different vehicles. With the nationwide use of 5G, the prospects of remote operation are expanding again.
T-Systems – Partner of the Automotive Industry

T-Systems is one of the largest European ICT providers for the automotive industry. In addition to the provision of classic (outsourcing, on-premises) and modern (cloud, edge) IT infrastructures, the provider has countless connectivity, integration and development projects for well-known automotive companies, 13 of the top 20 OEMs and multinational tier suppliers, realized.

Together with the partner Ottopia, which supplies the core technology, T-Systems is already operating pilots for Teleoperated Driving and is investigating possible scenarios that also add value to target groups outside the automotive industry.

An overview of the white papers in this series:

• Part 1: The Software-Defined Car – Developments in In-Car Software
• Part 2: Over the Air Updates – Online Services for Automobiles
• Part 3: Teleoperated Driving – Remote Vehicle Control
• Part 4: Future Engineering – the New Way of Car Design

Quellenangaben:
[1] Statistics on Connected Cars, Andreas Ahlswede Statista.de, 2019 (German only)
[3] Waymo CEO: Autonomous cars won’t ever be able to drive in all conditions, cnet, Shara Tibken, 2018
[5] This is what it’s like to control an autonomous car from miles away, Sasha Lekach, 2019
[7] Your order is on its way, thanks to teleoperated delivery vehicles, Phil LeBeau, 2019