

## UC3 Teleoperation

Nils Gehrke, Nijinshan Karunainayagam, Xiyan Su  
Institute of Automotive Technology, Technical University of Munich

### Teleoperation – Safety Net of Automated Driving

As the fallback solution for automated driving, teleoperation enables remote operator to support automated driving in critical scenarios by controlling the vehicle via mobile network. Despite its simplicity, teleoperation is still prone to system degradation due to internal and external conditions, like network quality and software errors. In the project ConnRAD, we focus on improve the resilience of the teleoperation system by introduction a framework of resilience concepts to detect, identify, and predict the system degradation.

### Definition of UC3 - Teleoperation

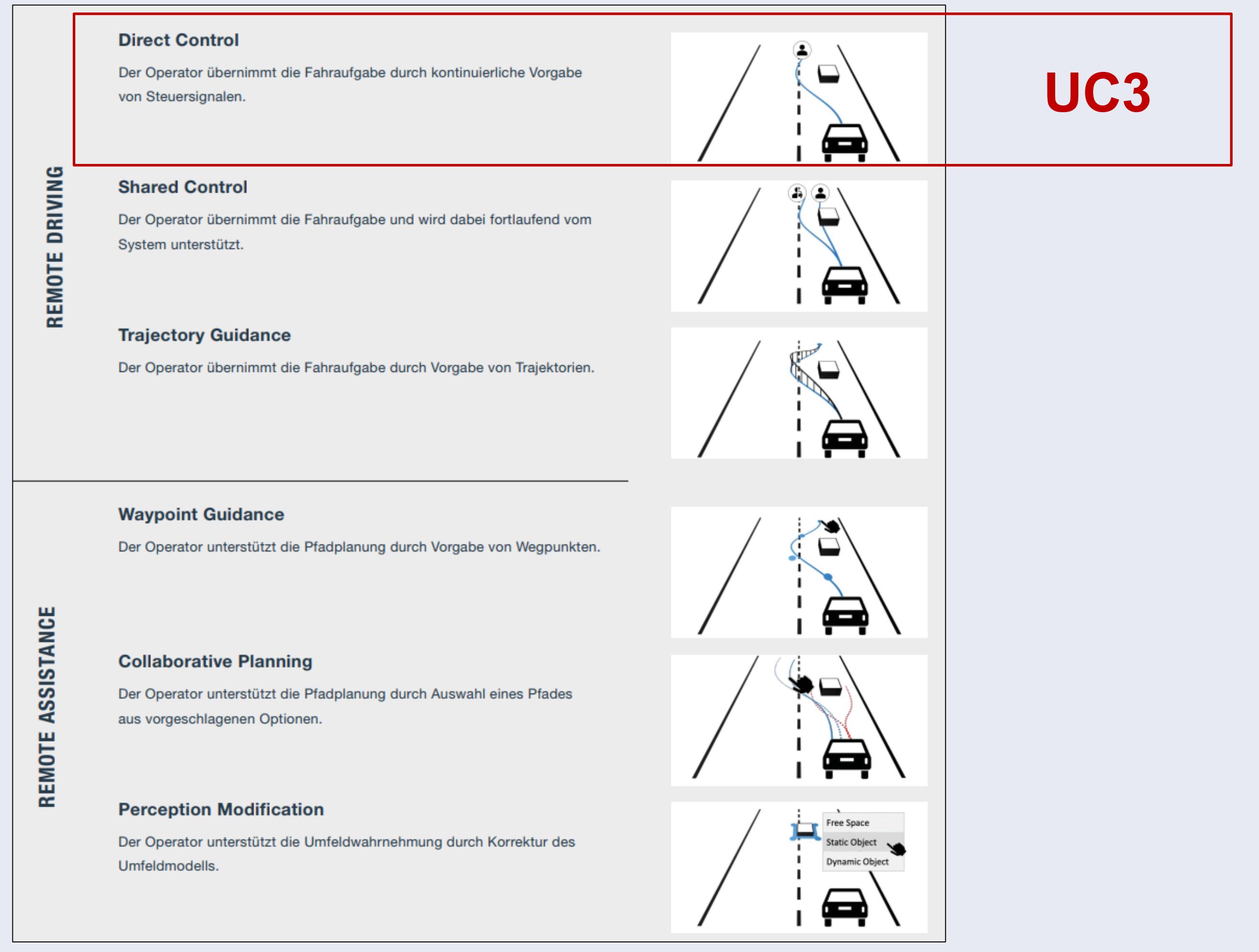
Teleoperation in UC3 defines that a operator in a control center processes an incoming video stream from the vehicle together with additional vehicle data to input control commands related to a steering wheel and pedals. These control commands are then executed by the vehicle. The vehicle does not possesses any intelligence to evaluate or overrule operator maneuvers but can limit the operator control commands during execution.

### UC3 Case Studies

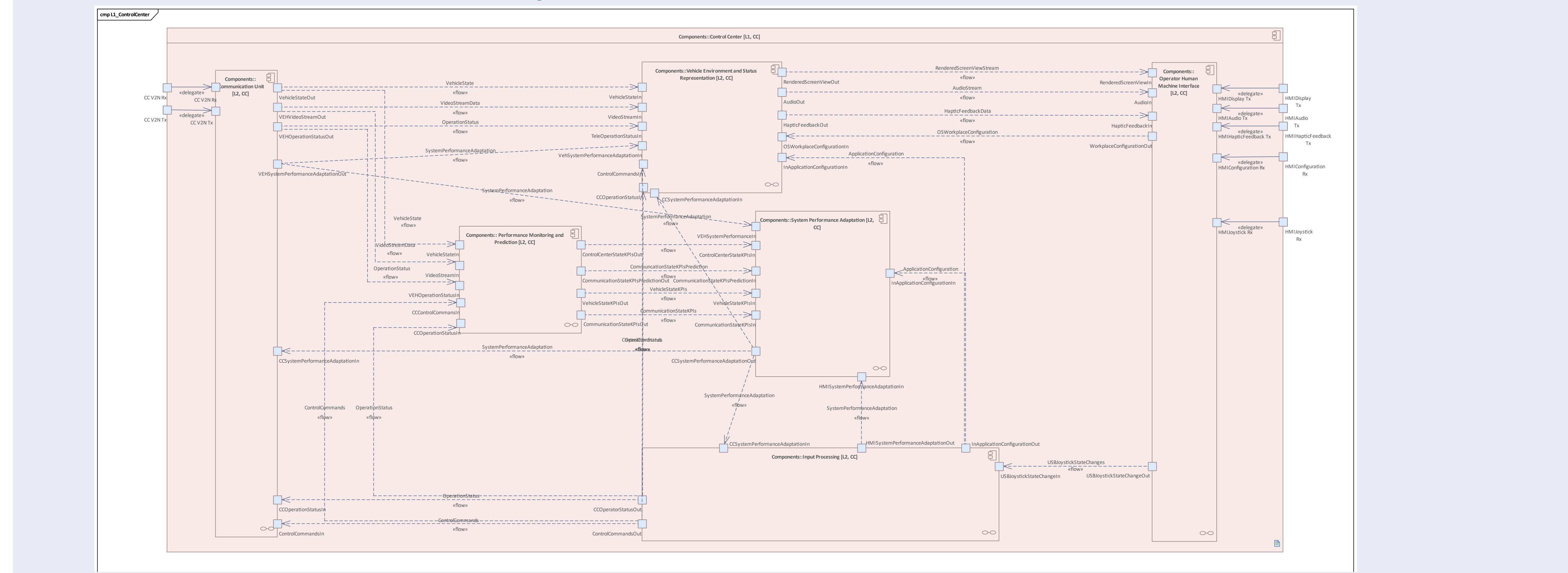
UC3 Teleoperation is exemplary investigated for the following case studies:

- Remote Valet Parking Service
- Temporary AV assistance by overtaking objects blocking the ego lane
- Remote Operated Last Mile with variable network conditions

### Overview Teleoperation



### Reference Architecture for Use-Case Teleoperation



### Resilience Concepts for Teleoperation / Resilience Challenge

The challenge of achieving resilience in teleoperation system comes from its distributed structure. The teleoperation system is divided into the vehicle and the operator sub-systems, which connect with each other through mobile network. Moreover, the teleoperation consists of three phases during its process. To ensure resilience in each phase, we introduce two resilience concepts.

The Ability-Awareness-Protocol ensures the resilience during the phase of connection establishment by using a holistic ability graph to communication ability coverage between the vehicle and operator, whereas the Resilience Key-Performance-Indicators tracks the system performance during run-time.

