

HMI for Automated Driving

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Chassis Systems Control

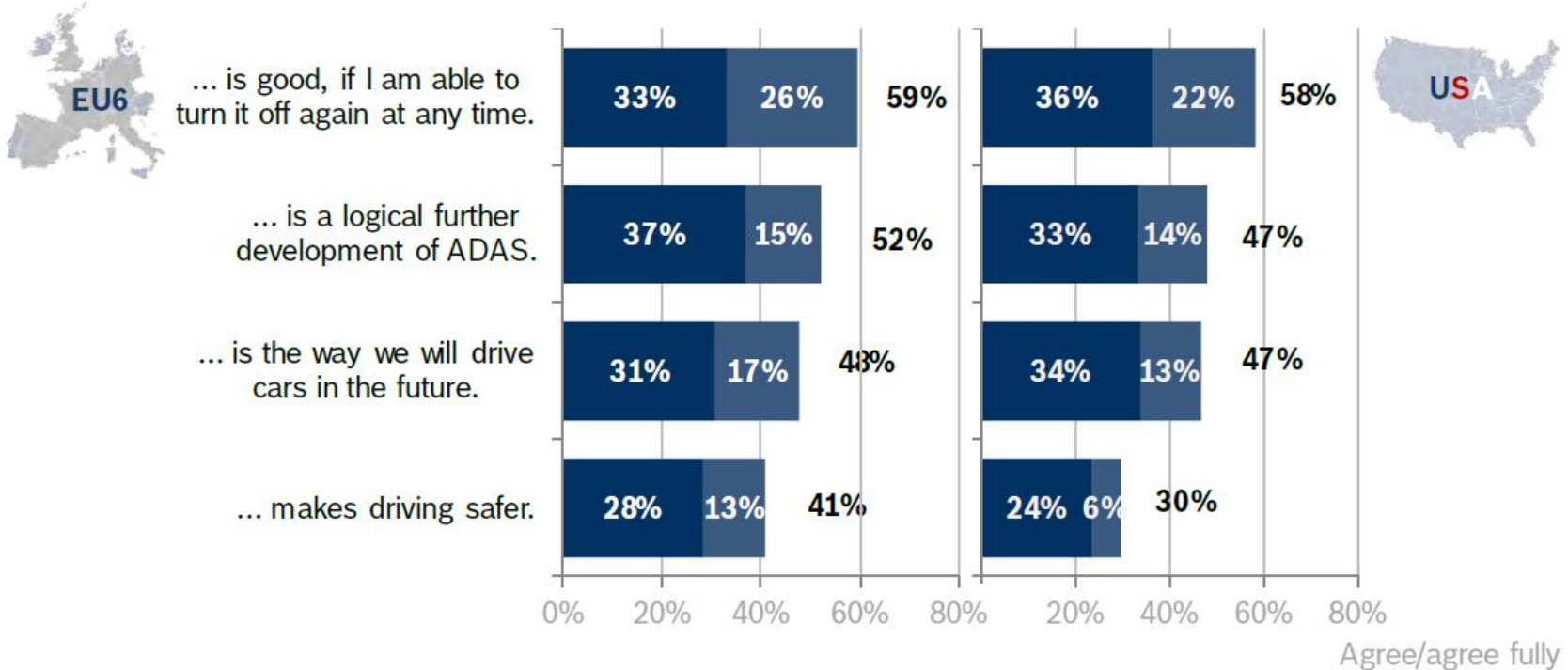
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Chassis Systems Control



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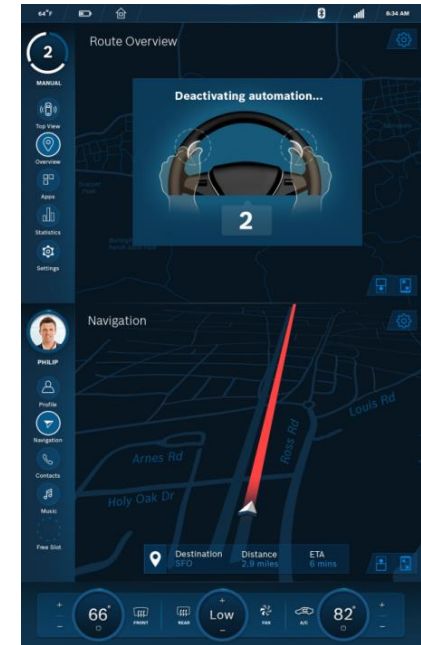
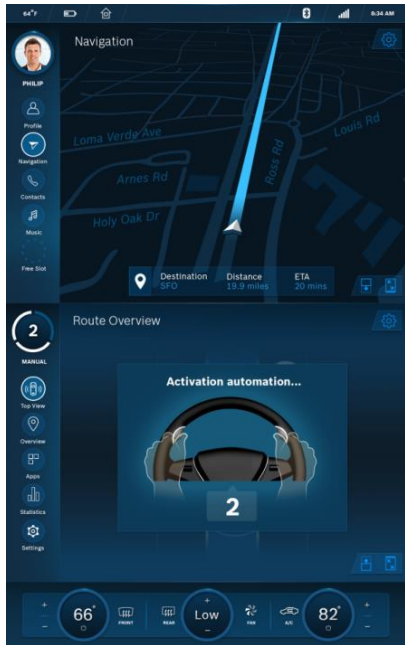
Automated Driving...



- ADAS will pave the way to automated driving with benefits for safety.
- Ability to turn off the system at any time is top priority.

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The Automated Car must Keep the Driver Informed



Activating automation

Driving maneuver

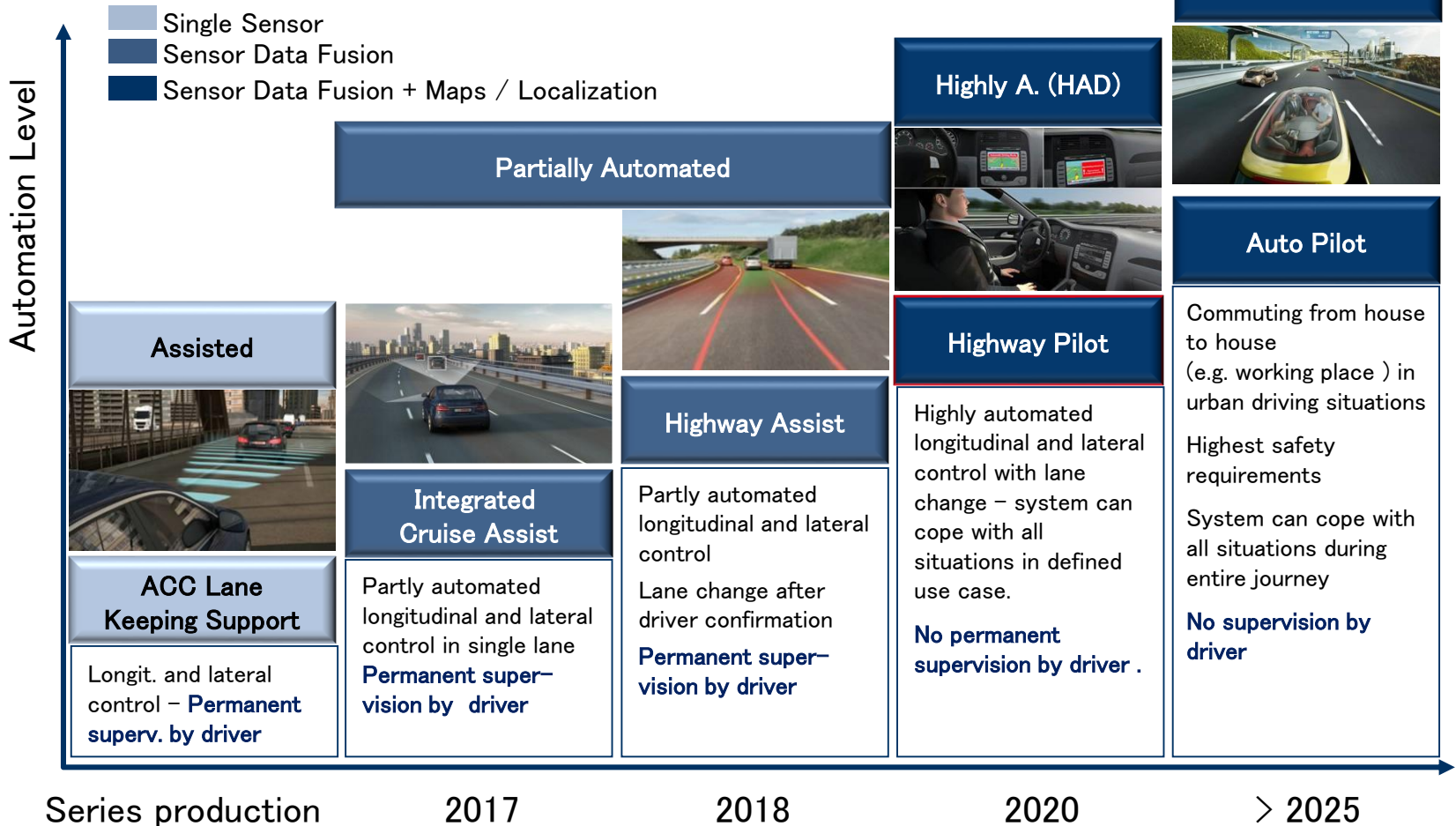
Deactivating automation

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Evolution in Automated Driving



Driver Monitoring and Automated Driving

- **Assisted driving**
 - Adaptation of system through knowledge of driver attentiveness and intention (e.g., reduction of false positive warnings)
- **Partly automated driving**
 - Continuous driver attention is required
 - Driver supervises system
 - System supervises driver (on attention level, no driver input)
- **Conditionally automated driving**
 - Ability to take over requires driver attentiveness and willingness
 - Indicators for situational awareness needed
- **Highly automated driving**
 - Possible w/o driver state information (transition into risk minimal state)
 - Driver take-over useful to avoid transition into risk-minimal state
 - Consequence are some requirements on driver monitoring



Automated Driving: Key Technologies

System engineering value chain

Surround sensors

highly robust
in all use cases



Perception

comprehensive
360° environment
model



Decision making

correct reasoning
and decisions
in all situations



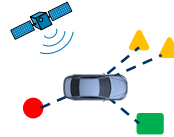
Online map data

precise and
up-to-date
every moment



Localization

accurate
and reliable
vehicle position



Motion control

safe, fast and
precise in all
dimensions



Driver monitoring

for partly and
highly automated
functions



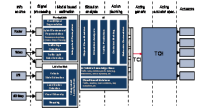
Functional safety

guarantees high
standard at
reasonable effort




Architecture

supports safety,
performance
and cost targets



Driver Monitoring for Automated Driving

	Partly AD	Highly AD
Driver must continuously supervise system (while active)	Yes 	No 
Safe stop	No 	Yes 
Driver take-over requirement	Immediately (~1-2 sec), even without a take-over request	Within a limited time (e.g. ~ 10 sec), after take-over request

Driver Monitoring contrib.

Main requirements to Driver Monitoring	Driver 's presence & attention	Driver' s capacity to take over
Driver model functions	Presence and Position (Face-ID, Head pose)	
	Drowsiness, Micro-Sleep (Eye closure)	
	Distraction (Eyes on Road)	
User benefit	<u>Relaxed driving (maybe hands-off)</u>	<u>Comfortable take-over timing</u>
OEM benefit	<u>Reduce risk of unintended use and product liability</u>	

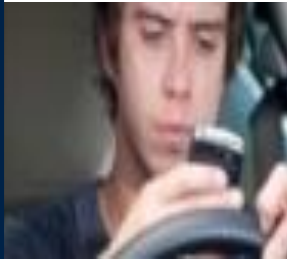
→ Driver monitoring raises user experience and reduces risk of unintended use in automated driving.

Driver Model Functions

Functions

Features

Driver Inattention Detection (DID)



Visual Distraction
Detection (VDD)

- Eyes on road detection
- Fusion w. head pose
- Region of Interest adaptive to driving context



Micro-sleep
detection (MSD)

- Long eye closures
- Fusion with eye gaze
- MS pattern detection



Driver Drowsiness
Detection Plus
(DDD+)

- Drowsiness level classification
- eye blink frequency
- facial features

HMI for High Automation – Conclusions

- In order to build trust during evolutionary step-by-step-approach towards full automation the vehicle must **permanently inform** driver about current system state.
- **Driver monitoring** is a key enabler for partially and highly automated driving.
- **For handover driver to vehicle and vice versa** driver monitoring is of special importance: System must detect if driver is in position to take back control from vehicle or ensuring that driver has taken back control.
- There is need for **user centered development** of automated driving functions.



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Thank you for your attention !
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