



VOLKSWAGEN

AKTIENGESELLSCHAFT

Aria Etemad
Volkswagen Group Research

Warsaw
8 March 2016



AdaptiVe

*Automated Driving Applications and
Technologies for Intelligent Vehicles*

An Introduction to Automated Driving



// Facts

Budget:	EUR 25 Million
European Commission:	EUR 14,3 Million
Duration:	42 months (January 2014 - June 2017)
Coordinator:	Aria Etemad, Volkswagen Group Research
8 Countries:	France, Germany, Greece, Italy, Spain, Sweden, The Netherlands, United Kingdom



// 29 partners

VOLKSWAGEN
AKTIENGESELLSCHAFT

**BMW
GROUP**



BMW Group
Research and Technology



DAIMLER



VOLVO

PSA PEUGEOT CITROËN



Wir leben Autos.



RENAULT



BOSCH
Invented for life

Continental

DELPHI

bast



DLR
Deutsches Zentrum
für Luft- und Raumfahrt
German Aerospace Center

CHALMERS



TNO



**UNIVERSITY
OF TRENTO - Italy**

UNIVERSITY OF LEEDS



wivw



alcor
consulenza innovazione

eict

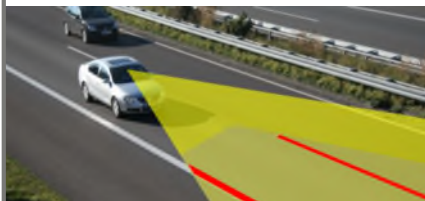
// Examples of driver assistance systems

Longitudinal control



City Break Assist
ACC & Front Assist

Lateral control



Side Assist
Lane Assist

Park assist systems



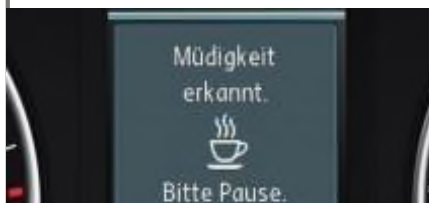
Park Assist Park Pilot
Rear Assist

Light



Light Assist

Recommendation



Pause
Recommendation

Driver information

Road sign



Sign Assist

// Examples for automated driving - industrial projects

Bertha Benz drive



© Daimler

2013 Mercedes

Traffic jam pilot



© Audi

2012 Audi

Motorway pilot



© BMW

2011 BMW

Google car



© Google

2011 Google

Pikes Peak



© Audi

2010 Audi

Junior



© VW

2007 VW

// Examples for automated driving - funded projects

eT!: Follow me!



2011 eT! (BMU)

AutoNOMOUS



2011 FU Berlin (BMBF)

Emergency stop assistance



2011 SmartSenior (BMBF)

Temporary auto pilot



2011 HAVEit (EU)

Platooning



2012 Sartre (EU)

Parking and charging



2011-2015 V-Charge (EU)

// Motivation for automated driving functions

Zero emission

Reduction of fuel consumption & CO₂ emission
Optimization of traffic flow



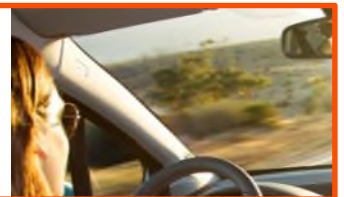
Demographic change

Support unconfident drivers
Enhance mobility for elderly people

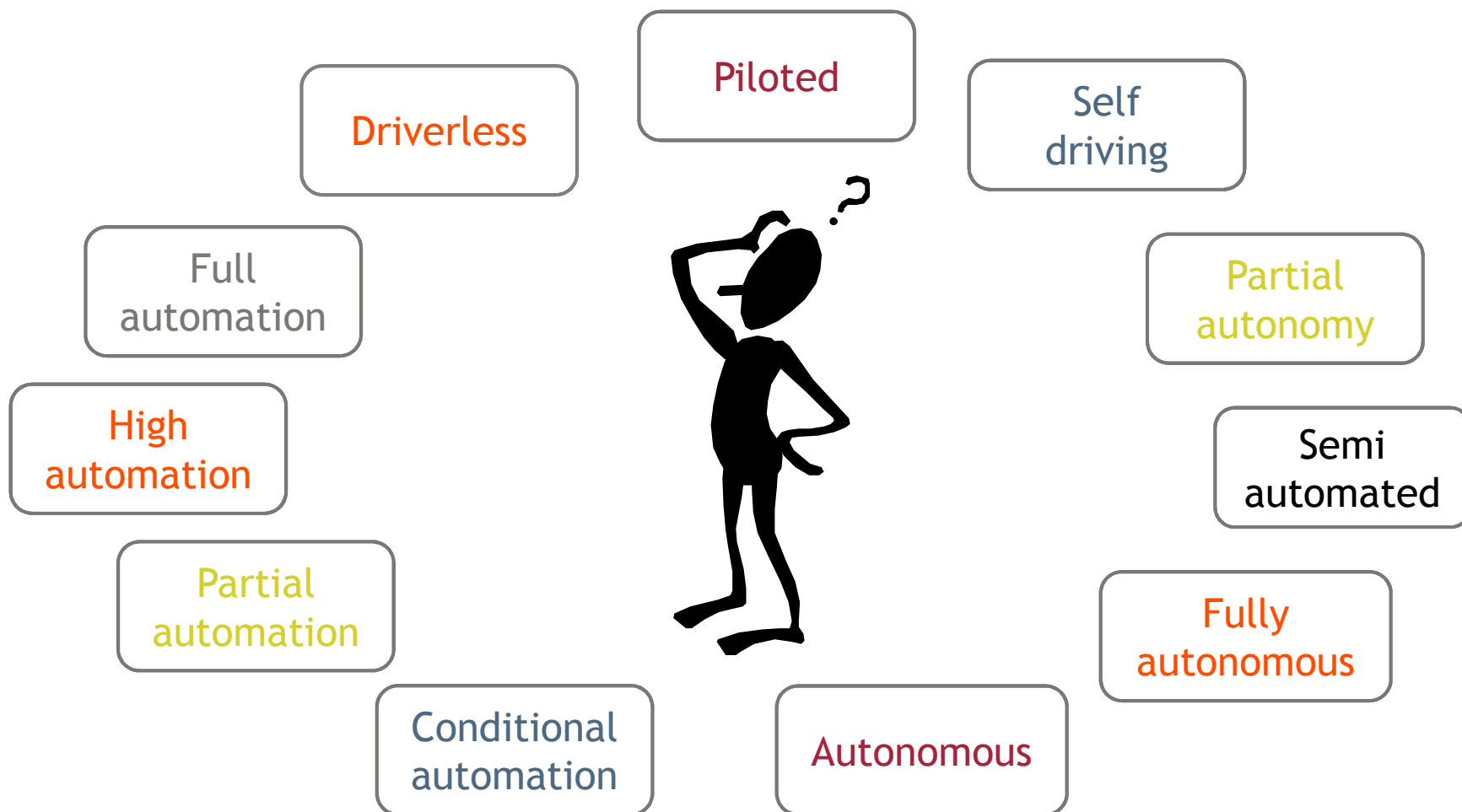


Vision zero

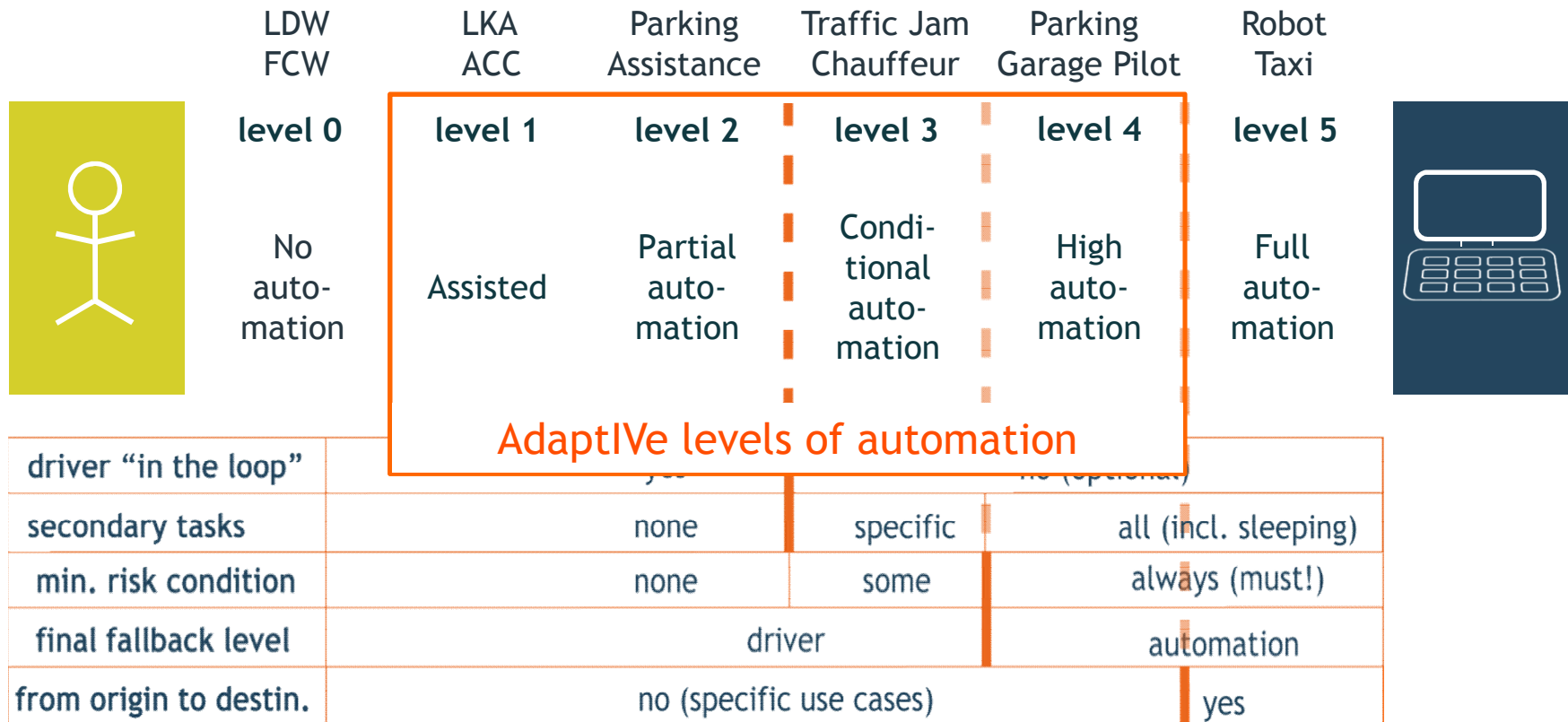
Potential for more driver support by avoiding
human driving errors



//Terms related to automated driving



// Levels of driving automation acc. to SAE and VDA



Source: SAE document J3016, "Taxonomy and Definitions for Terms Related to On-Road Automated Motor Vehicles", issued 2014-01-16, see also http://standards.sae.org/j3016_201401/

// Challenges and project objectives

Widespread application of automated driving to improve traffic safety, efficiency and comfort



// Automation Scenarios



< 30



< 70



< 130

// Introduction scenario

ACC: Adaptive Cruise Control
LKA: Lane Keep Assist

LDW: Lane Departure Warning
FCW: Forward Collision Warning

2	Partial automation		Parking assistant Traffic jam assist.
1	Assisted	ACC LKA	City Cruise Constr. site ass.
0	No automation	LDW FCW	
		ADAS today	ADAS tomorrow



Pilotiertes Ausparken

// Parking assistance // level 2

- **Partial automated parking** into and out of a parking space
- On public parking area or in private garage
- Via **Smartphone** or **key** parking process is started, vehicle accomplishes parking manoeuvre by itself
- Driver is located **outside** of the vehicle
- Driver has to **constantly monitor** the system, stops parking manoeuvre if required
- **Safety benefit** due to avoidance of parking damages and improved environment observation
- **Comfort benefit** because getting into and out of the car is simplified, especially for narrow parking spaces or garages



// Introduction scenario

3	Conditional automation			Traffic Jam Chauffeur
2	Partial automation		Parking ass. Traff. jam a.	
1	Assisted	ACC LKA	City Cruise Constr. ass.	
0	No automation	LDW FCW		
		ADAS today	ADAS tomorrow	Automation Gen. 1



//Traffic Jam Chauffeur // level 3

- **Conditional automated driving** in traffic jam up to 60 km/h
- On motorways and similar roads
- System can be activated, if **traffic jam scenario** exists: detection of slow driving vehicles in front
- Driver must deliberately activate the system, but does not have to monitor the system constantly
- Driver can at **all times override** or switch off the system
- Take over request if traffic jam scenario does not exist any longer
- **Safety benefit** via relief of the driver: no exhausting, manual driving during traffic jams
- **Comfort benefit** via relaxing and use of selected infotainment functionalities



// Introduction scenario

4	High				Parking garage pilot
3	Conditional automation			Traffic jam chauffeur	Highway chauffeur
2	Partial automation		Parking ass. Traff. jam a.		
1	Assisted	ACC LKA	City Cruise Constr. ass.		
0	No automation	LDW FCW			
		<i>ADAS today</i>	<i>ADAS tomorrow</i>	<i>Automation Gen. 1</i>	<i>Automation Gen. 2</i>

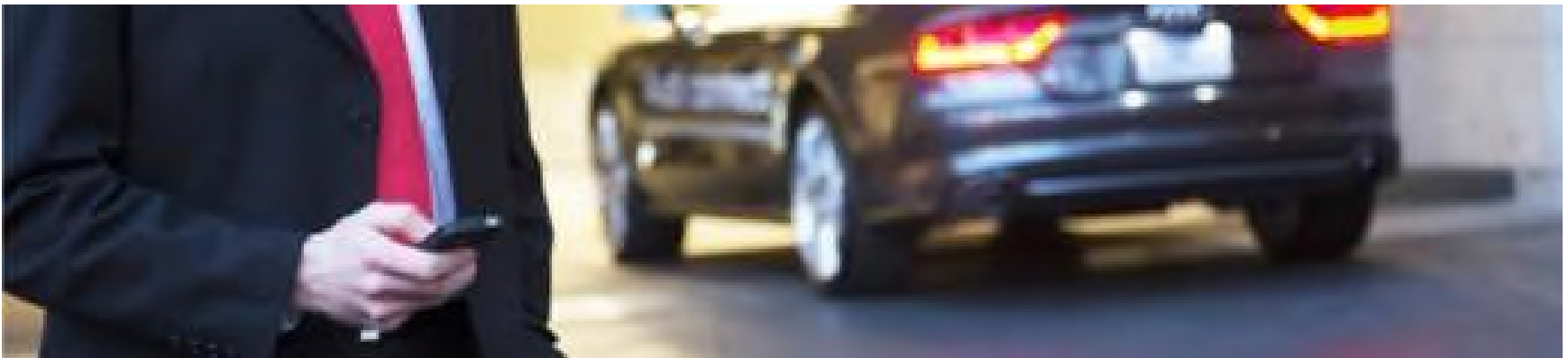
// Highway Chauffeur // level 3

- **Conditional automated driving up to 130 km/h** on motorways or similar roads
- From entrance to exit, on all lanes, incl. overtaking
- Driver must deliberately activate the system, but does not have to monitor the system constantly
- Driver **can at all times override** or switch off the system
- Take over request in time, if automation gets to its system limits
- **Safety benefit** via relief of the driver: no exhausting, manual driving during long distance driving
- **Comfort benefit** via relaxing and use of selected infotainment functionalities



// Parking Garage Pilot // level 4

- **Highly automated parking** including maneuvering to and from parking place (driverless valet parking), in parking garage
- Driver **does not have to monitor** the system constantly, may depart
- Via **Smartphone** or **key** parking manoeuvre and return of the vehicle is initiated
- **Safety benefit** due to avoidance of parking damages
- **Comfort benefit** due to time saving: short distances, customer does not have to access the parking garage





// Highway Pilot



// Introduction scenario

5	Full automation					Robot taxi
4	High automation				Parking Garage Pilot	
3	Conditional automation			Traf. J. Cha. City Chauff.	Highway Chauff.	
2	Partial automation		Parking ass. Traff. jam a.			
1	Assisted	ACC LKA	City Cruise Constr. ass.			
0	No automation	LDW FCW				
		<i>ADAS today</i>	<i>ADAS tomorrow</i>	<i>Automation Gen. 1</i>	<i>Automation Gen. 2</i>	<i>n.a.</i>

// Introduction scenario

5	Full automation					Robot Taxi
4	High automation				Parking garage Pilot	
3	Conditional automation			Traf. J. Cha. City Chauff.	Highway Chauffeur	
2	Partial automation		Parking ass. Traff. jam a.			
1	Assisted	ACC LKA	City Cruise Constr. ass.			
0	No automation	LDW FCW				
		ADAS today	ADAS tomorrow	Automation Gen. 1	Automation Gen. 2	n.a.

// Demonstrators



Parking assistance,
garage, special areas,
multi-level garage,
Stop & go

City cruise, City chauffeur,
Supervised city control

Enter & exit highway,
following lane, lane-
change, filter-in,
overtaking , danger spot
intervention, Stop & go

Safe stop



Co-funded by
the European Union

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Aria Etemad
Volkswagen Group Research

+49-5361-9-13654
aria.etemad@volkswagen.de

Thank you.

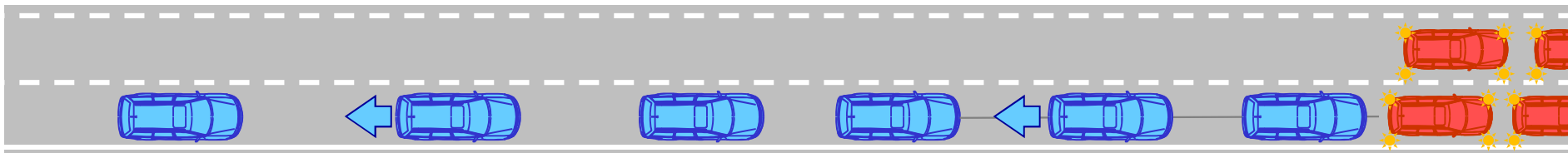


Third party pictures: Fotolia Daddy
Cool, carmeta, Miredi, Christian
Müller, Syda Productions, 06Photo,
kalafoto
Google, Freie Universität Berlin

//Video



Server:
Stauende
in etwa 2 km



**Geschw.
Regelung
130 km/h**

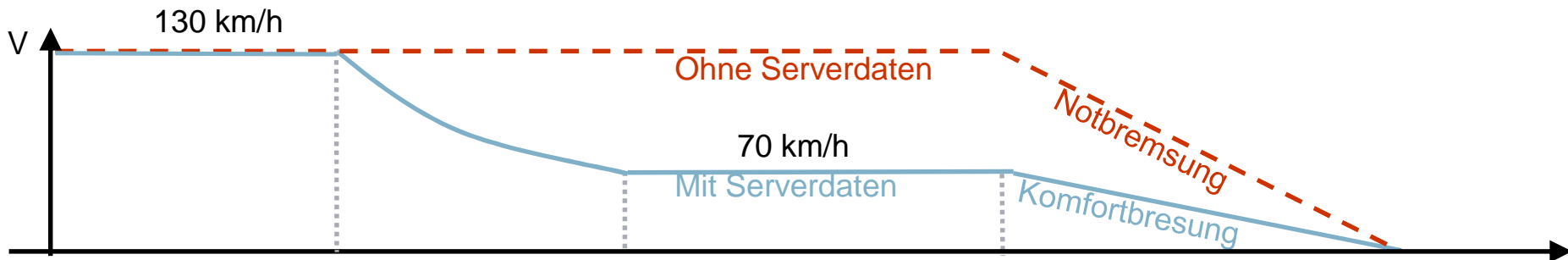
**Verzögerung
auf 70 km/h**

**Geschw.
Regelung
70 km/h**

**Objekt
Detektion**

**Verzögerung
auf 0 km/h**

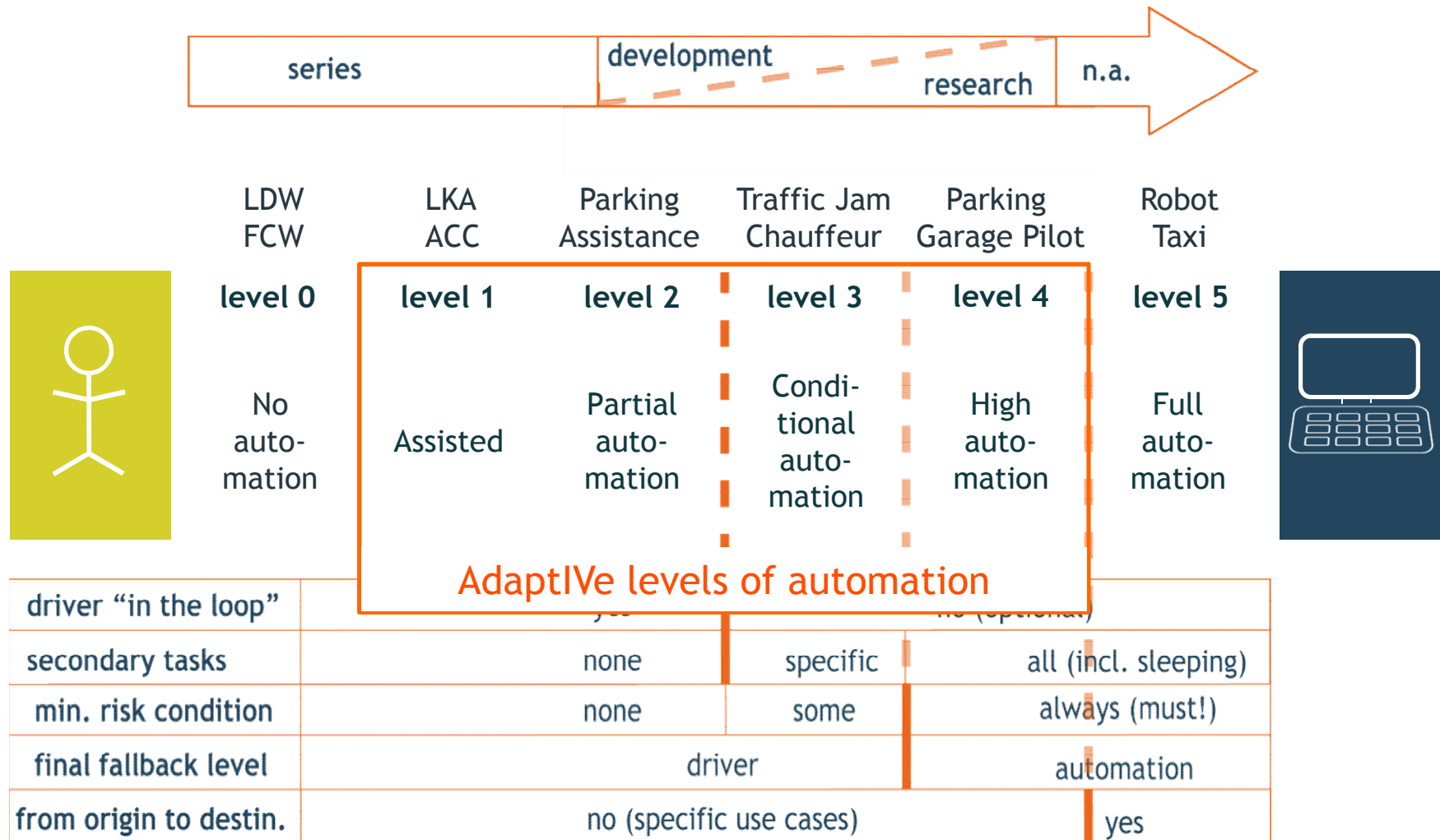
Stillstand



// Examples of ADAS functions

- ACC: Adaptive Cruise Control
- S&G: ACC incl. Stop & Go
- LKA: Lane Keep Assist
- PDC: Park Distance Control
- LCA: Lane Change Assistance
- LDW: Lane Departure Warning
- FCW: Forward Collision Warning
- HHC: Hill Hold Control
- ISA: Intelligent Speed Adaption
- CMBS: Collision Mitigation Brake System
- IPAS: Intelligent Parking Assist System

// Levels of driving automation acc. to SAE and VDA



Source: SAE document J3016, "Taxonomy and Definitions for Terms Related to On-Road Automated Motor Vehicles", issued 2014-01-16, see also http://standards.sae.org/j3016_201401/