Workshop A

Al Bustan Rotana Hotel, Al Rashidya Ballroom C

Ensuring Best Inspection Practice

Chaired by Juan Rodriguez

Member of CITA Bureau Permanent

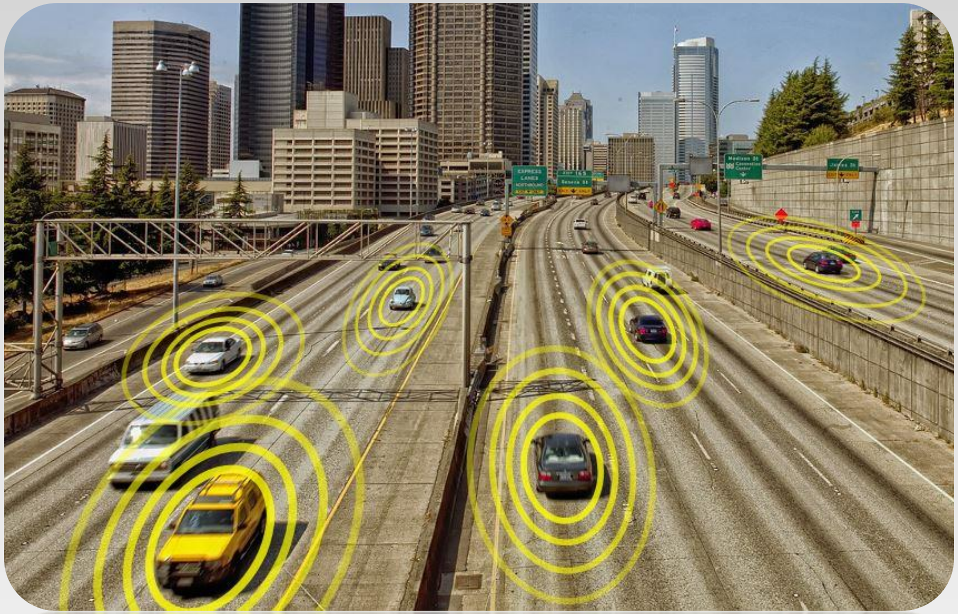
Workshop A

Presentation 1

Advanced Driver Assistance Systems

Heiko Ehrich

Head of Automotive Electronics & Car IT, IFM – Intitut für Fahrzeugtechnik und Mobilität, TÜV NORD Mobility, Germany



Advanced Driver Assistance Systems

CITA Conference

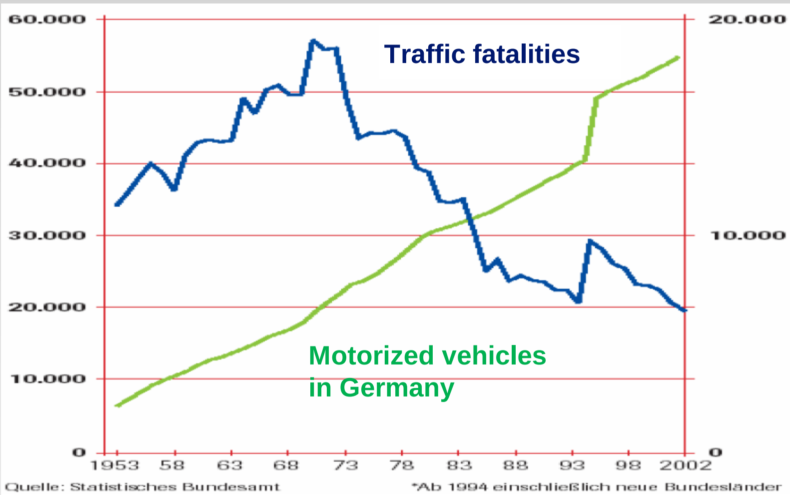
Dubai, April 2015

Heiko Ehrich, TÜV NORD Mobility

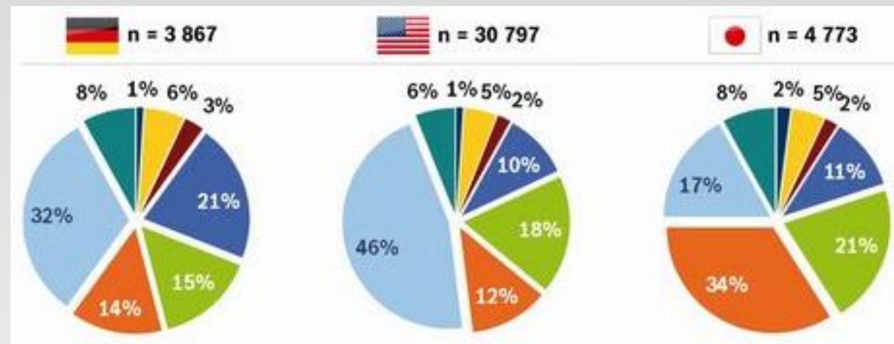
Content

- **Motivation for Assisted Driving**
  - Human capabilities and accident avoidance
  - Improvement of the ecological balance
- **Classification of Driver Assistance Systems**
  - Levels of automated driving
  - Conventional systems and systems with machine perception
- **System Overview**
  - Functional and sensor overview
  - Influences to the E/E system architecture
  - Challenges
- **Regulation, Type Approval and PTI**
  - Current situation
  - Challenges

Motivation for assisted driving



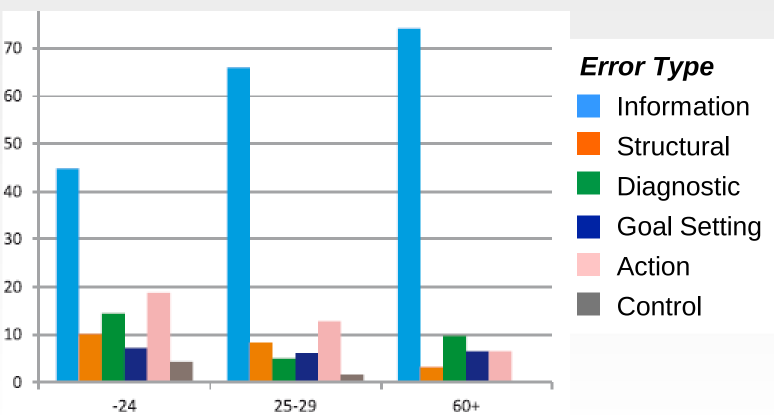
Fatalities according to accident type (2009)



Collision with

- stationary object / vehicle leaves lane
- oncoming vehicle
- ahead or waiting vehicle
- vehicle driving in same direction
- turning or crossing vehicle
- pedestrian
- parking vehicle
- other

Incidence of accident cause depending on driver age



Motivation for assisted driving

Potential for accident prevention

- Perennially trial phase of BG Verkehr, BGL and KRAVAG showed that accident rate with heavy duty vehicles can be reduced **by 34 %** with ADAS
  - 767 heavy duty vehicles equipped with ESP, LDW and ACC
  - 565 comparable vehicles without these assistance systems
- It is assumed that introduction of further ADAS (as Emergency Brake Systems) can prevent more than 70 % accidents

Further studies

Driver Assistance System	Potential
Lane Assistant	4,4 % (GDV)
Emergency Brake	46,5 % (GDV)
Adaptive Cruise Control	12 %[1], resp. 19 %[2]
Night Vision	3 %[1]
Lane Change	1.7 % (GDV)
Park Assistant	31 % (GDV), *only parking accidents*

[1] Accidents with injured and killed participants

[2] Accidents with driver injury

Motivation for assisted driving
Human capabilities for vehicle driving

Main Development Goal for ADAS

- Elimination of discrepancies between requirements of traffic situation and driver capabilities

Human Error

- In ~95 % of all traffic accidents „Human Error“ is involved
- ~75 % of traffic accidents are solely caused by human error

„Looked-but-Failed-to-See“

- Prevalently accident cause by human errors
- Vehicle or obstruction lied in the visual field of the accident causer, but hazardous situation was not detected
  - consequently accident-avoiding measures not performed
- Reasons
  - capacity limits of visual attention
  - selective process of visual scanning
  - faulty integration of relevant characteristics into scenery
- Increasing accident probability when requirements of the traffic situation exceed the performance capabilities of the driver

Motivation for assisted driving
Human capabilities for vehicle driving

Human information processing

- Translation of incoming signals (stimulus) at human receptor into cognitive representation and response
- Processing steps
  - Information reception (Perception)
  - Information processing (Cognition)
  - Information delivery (Motor skill)

No freedom of interference

- Limited resource capacity (sensory channels, working memory etc)
- Overabundance of stimuli exceeds human processing capacity
- Not all information at sensory receptor can be consciously perceived
- Targeted information selection and divided attention

Types of attention can be divided into two dimensions

Selectivity, human has to decide between two different, competitive information resources

Intensity of attention affects the activation level

- Reduced vigilance (low share of relevant stimuli)
- Duration of attention (high share of relevant stimuli)

Motivation for assisted driving
Improvement of the ecological balance

TÜV NORD Mobilität

Increased energy demand for a vehicle equipped with driver assistance systems

- Exemplary estimation for a fully equipped vehicle
  - 0.2 l / 100 km at additional mass of 25 kg and energy demand of 250 W

Optimization of the drive-train to road conditions

- Improvement of the traffic flow and traffic jam avoidance
- Transmission strategy of automatic gearing
- Early speed adjustment according to the traffic situation
- Optimization of acceleration and braking phases
- Boost / cylinder deactivation of combustion engine related to
  - altitude profiles
  - speed limits
  - traffic situation
- Running engine in optimal operating point

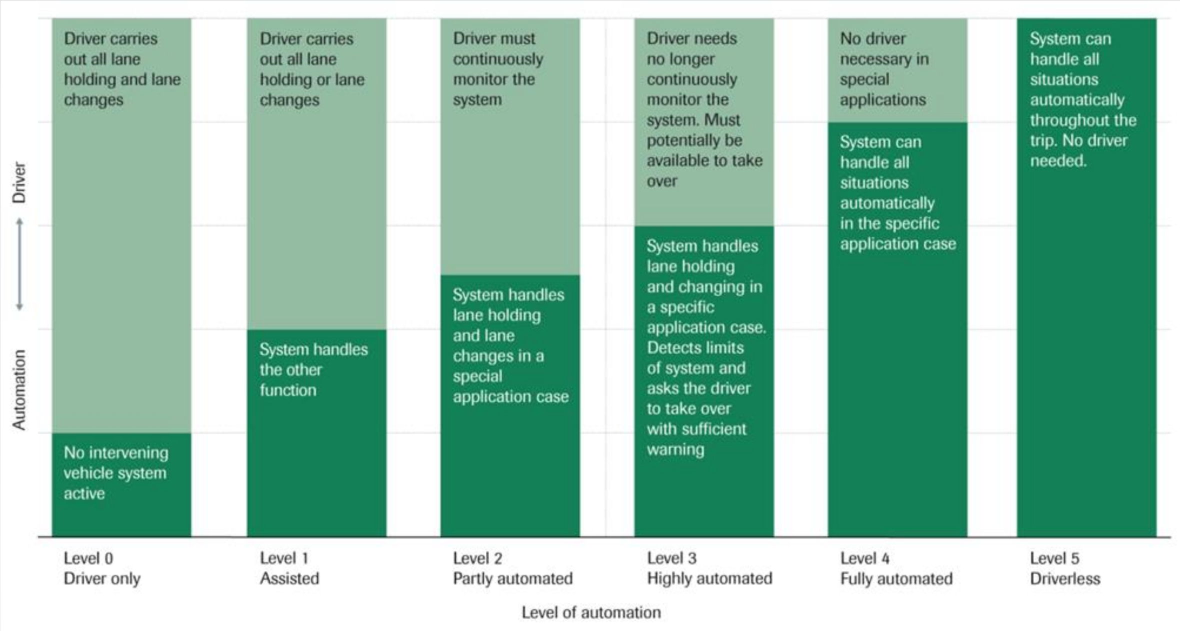
Reduction of total fuel consumption by 10-20 % reachable with ADAS

Advanced Driver Assistance Systems
Classification

Assisted driving
- Redundant-parallel task execution by human and machine
- Interaction by Human-Machine-Interface

With (fully) automated driving
- Human excluded from active and passive driving tasks
- Vehicle solely takes over task execution

Levels of Driving Automation for On-Road Vehicles (source: VDA)



Types of driver assistance systems

Conventional Systems support the driver in situations that are easily measurable

Example:
- ABS controls when wheel threatens to lock up
  - Determination based on wheels speed sensors

Systems with Machine Perception support the driver in situations that have to be interpreted by machine

Example:
- Adaptive Cruise Control
  - Reflections of radar signals are interpreted as vehicles

Advanced Driver Assistance Systems
Functional and Sensor Overview

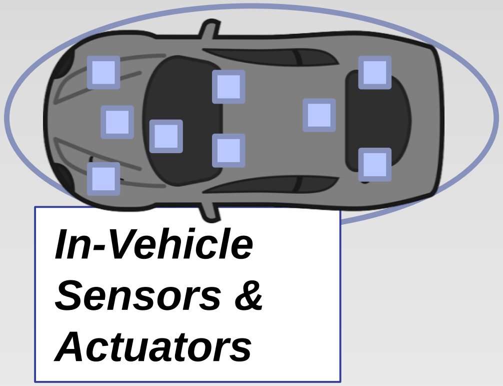
Multiple sensors for capturing vehicle, driving and environmental data

- In-Vehicle Sensors and Actuators
  - Vehicle physics
  - Driver behavior
- Car Sensor Range
  - Vehicle surrounding
- Cooperative Services
  - Environmental conditions
  - Traffic situation

Advanced Driver Assistance Systems
Functional and Sensor Overview

Multiple sensors for capturing vehicle, driving and environmental data

- **In-vehicle sensors and actuators**
  - Vehicle physics
  - Driver behavior
- Car sensor range
  - Vehicle surrounding
- Cooperative services
  - Environmental conditions
  - Traffic situation

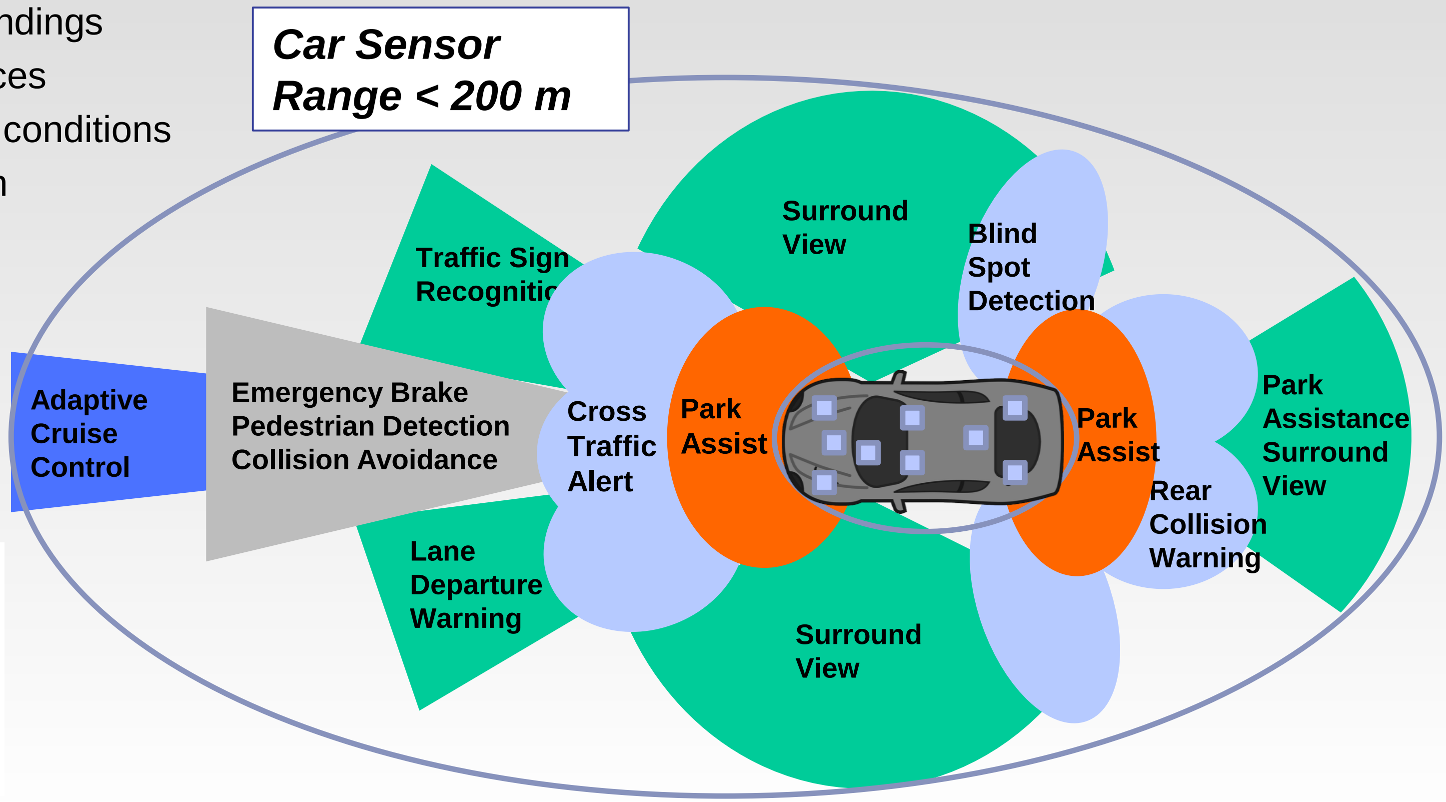


Advanced Driver Assistance Systems
Functional and Sensor Overview

TÜV NORD Mobilität

Multiple sensors for capturing vehicle, driving and environmental data

- In-vehicle sensors and actuators
  - Vehicle physics
  - Driver behavior
- **Car sensor range**
  - Vehicle surroundings
- Cooperative services
  - Environmental conditions
  - Traffic situation

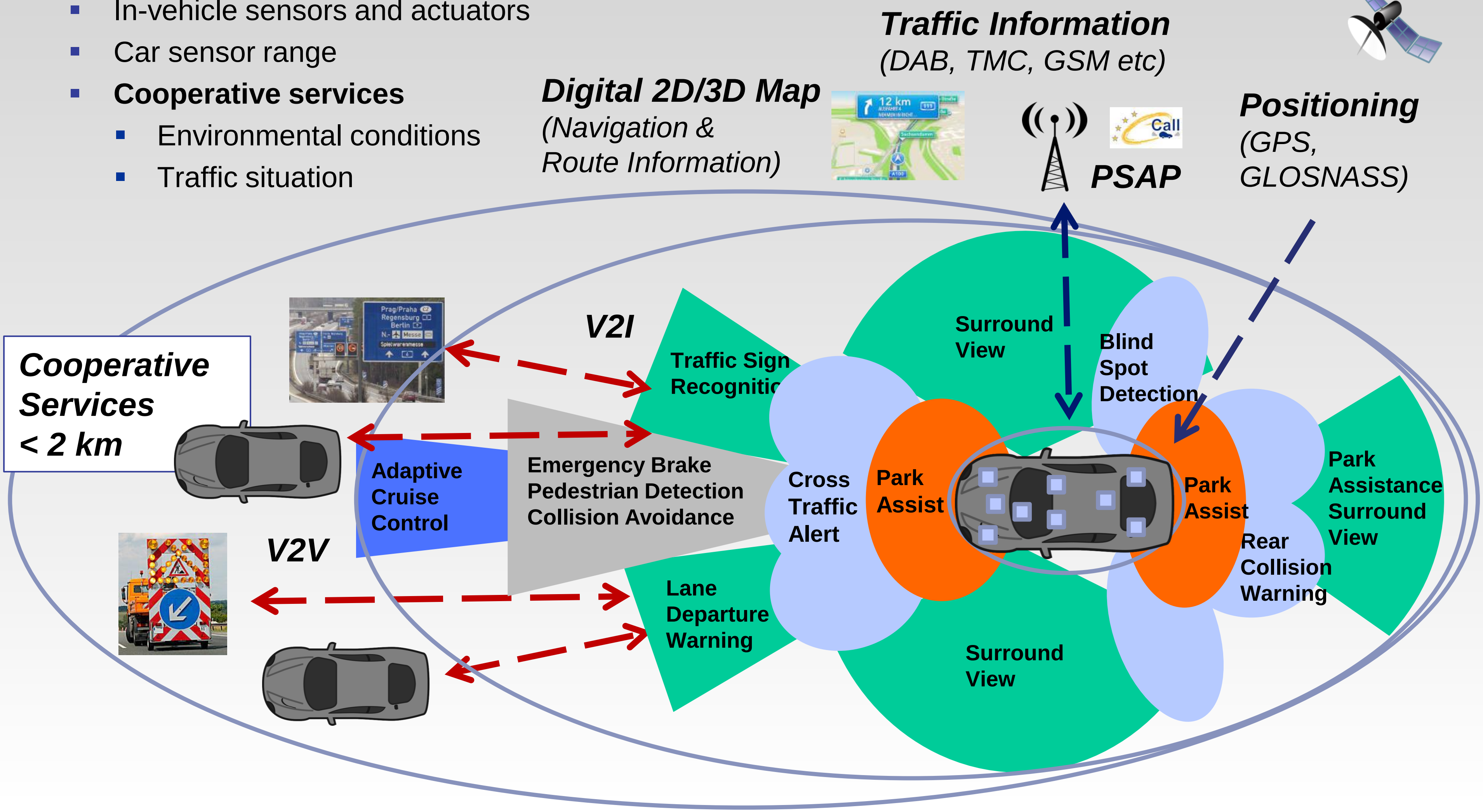


Sensor Type
- Long Range Radar
- LIDAR
- Camera
- Short/Medium Range Radar
- Ultrasound

Advanced Driver Assistance Systems
Functional and Sensor Overview

Multiple sensors for capturing vehicle, driving and environmental data

- In-vehicle sensors and actuators
- Car sensor range
- **Cooperative services**
  - Environmental conditions
  - Traffic situation



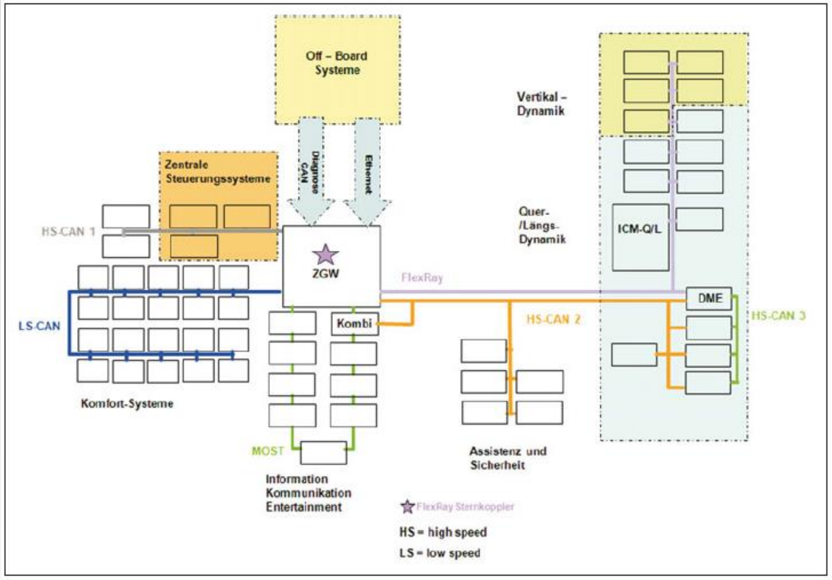
Driver Assistance Systems
E/E System Architecture

Influences to the vehicle system architecture

- Driver assistance systems actively control acceleration, braking and steering activities or supply information and warnings to the driver to set commands

Relevant functions implemented in ECUs of the E/E system architecture

- Sensing (capturing information)
  - Filtering and pre-processing of sensor data
  - Reading control elements
- Thinking (information processing and interpretation)
  - Calculation of warning criteria and control algorithms
  - Calculation of sensor data fusion
  - Diagnosis and calibration
  - Coding of country-specific features
- Acting (display, vehicle control)
  - Control of actuators
  - Display elements



Vehicle system architecture
(source ISBN 978-3-8348-1457, section A.1 Figure 9-1)

Challenges

- Intelligent and efficient use of sensor information to realize wide-ranging driver assistance functions
- Increasing amount of functions and complexity in vehicle network require system management that prioritizes and controls competitive operation of different functions according to the situation

Driver Assistance Systems
Challenges

Introduction of complex ADAS up to highly automated driving functions

- Automotive to robotics
  - Liability and legality
  - Acceptance and trust
  - Robot ethics
  - Changing Mobility Concept
- Complexity and efficiency
  - Car needs to be more intelligent than aircraft
  - Sensor fusion and complementary systems (as v2x)
  - Mass production, cost efficiency, short development cycles
- Increase of safety relevant systems
  - Redundancy
    - Fault tolerance, fail-safe, graceful degradation, self monitoring
  - Separation into non-safety and safety systems in terms of data security
  - Robustness of sensors and systems against environmental and climatic variety
- Human Machine Interface
  - Keep driver in the loop
  - HMI concepts to enable suitable reaction time
  - Information of other road users if vehicle drives autonomously
- Regulation, type approval and periodic inspection requirements

Advanced Driver Assistance Systems
Regulation, Type Approval and PTI

EU regulations 661/2009/EC, 347/2012/EC and 351/2012/EC

- Three important driver assistance systems European-wide for new vehicles mandatory

Electronic Vehicle Stability Control (EVSC) mandatory beginning with

- 1. November 2011 for all road vehicles with new type approval
- 1. November 2014 for all new road vehicles

Lane Departure Warning Systems (LDWS) and Advanced Emergency Braking System (AEBS) mandatory beginning with

- 1. November 2013 for all heavy duty vehicles (>3.5 tons) and busses (> 9 seats) with new type approval
- 1 November 2015 for all heavy duty vehicles and busses

Advanced Driver Assistance Systems
Regulation, Type Approval and PTI

Current situation for introducing new ADAS

Role of type approval regulations for introducing new ADAS functions depending on regulated area (e.g. EU and UN-ECE regulations)

- Multiple safety relevant vehicle systems can be introduced without meaningful type approval because they are not regulated
- Example:
  - For vehicle light technology multiple requirements exists for homologation and periodic inspection
  - Which parameters are currently regulated for introducing adaptive cruise control, lane assist or emergency brake systems?

Distinction of type-approved ADAS products related to safety

- Requirements of lawmakers traditionally focus on passive safety
  - Limited regulations for innovations in active safety
    - Obsolete test and evaluation criteria
    - Subjective and fragmentary evaluation for complex ADAS products
- Existing type approval tests do not distinguish the different safety levels of ADAS products

Advanced Driver Assistance Systems
Regulation, Type Approval and PTI

Challenges

- Industry and science have to provide analyses and empirical data about reliability and technical challenges
- Regulation authorities, vehicle manufacturers and testing facilities have to work out
  - Homologation standards for ADAS performance
  - Validation standards for periodic inspection of ADAS

System parameterization and boundaries

- Hazard identification
- Reaction times
- Situation analysis and decision making
  - such as warning, automated speed reduction, steering intervention, emergency brake pressure etc

Type approval and periodic inspection process

- Validation of system functionality during type approval validation
- Periodic inspection process for ensuring that safety-relevant functionality is given over vehicle lifetime

Thank You Very Much For Your Attention!

TÜV NORD Mobilität

Cars Are Becoming More …

- Connected
- Clean
- Automated

There's the old aviation joke about airplanes of the future having a dog in every cockpit, the pilot's job being to feed the dog and the dog's job to bite the pilot if he tries to touch anything.

Still a ways away from that scenario in road vehicles, but if you listen closely, you might be able to hear barking

Author

Heiko Ehrich

Head of Automotive Electronics & Car IT

TÜV NORD Mobilität GmbH & Co. KG

Workshop A

Presentation 2

Benefits of consideration of the PTI in Homologation

Jörg van Calker

Central Agency for PTI, Germany

FSD Zentrale Stelle

CITA Conference 2015

BENEFITS
OF THE CONSIDERATION OF PTI IN HOMOLOGATION

Jörg van Calker - Dubai, April 15th 2015

AGENDA

1 – The problem
Recent and future challenges for the PTI

2 – The solution strategy
Homologation and PTI in the light of the challenges

3 – The implementation
Consideration of PTI in homologation

1

RECENT AND FUTURE CHALLENGES FOR THE PTI

CHALLENGES - OVERVIEW

A – (Testing of) sophisticated electronically controlled vehicle systems / functions

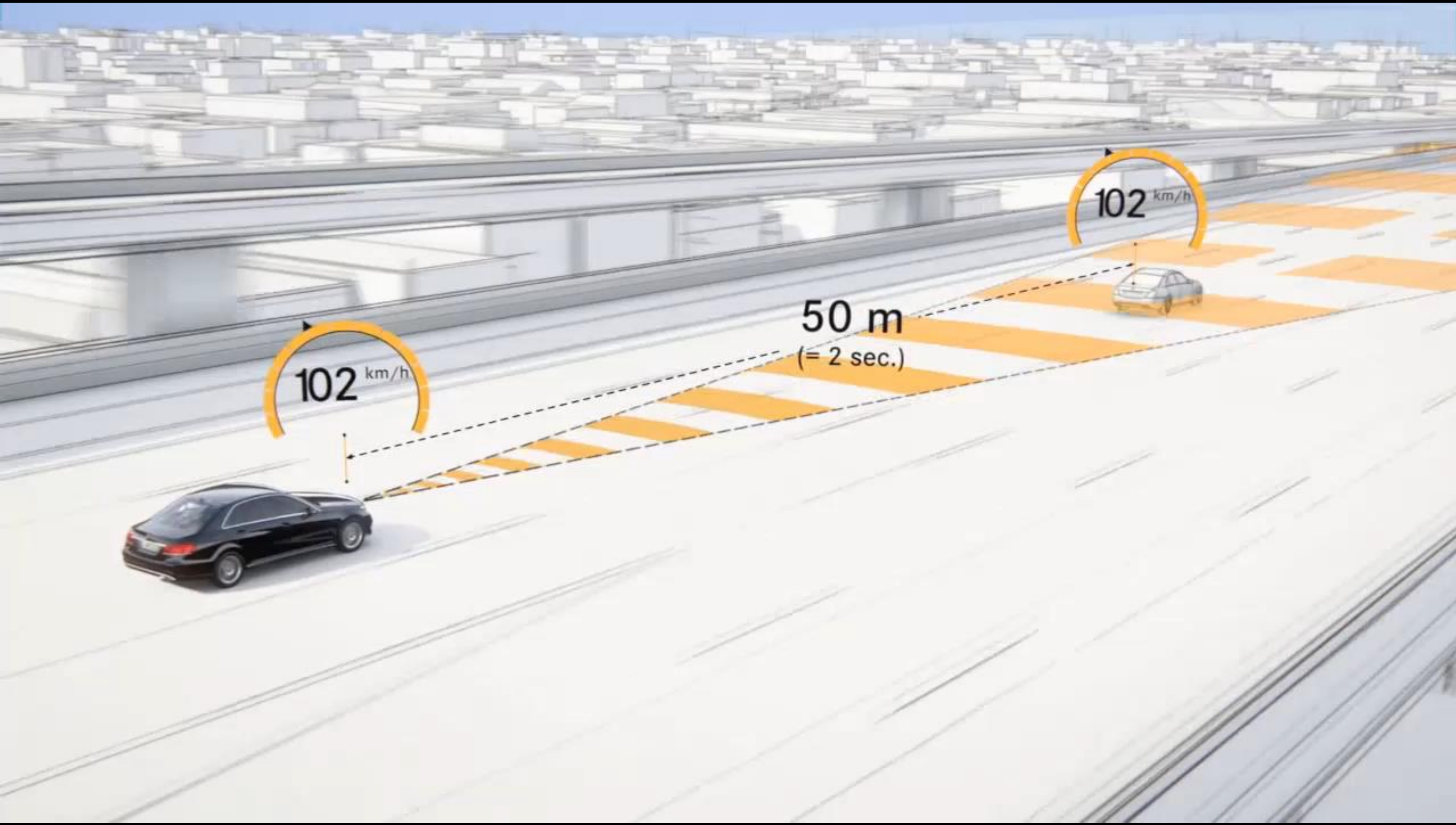
- Advanced driver assistance systems without Car2X
- Advanced driver assistance systems with Car2X
- (Partly) automated driving functions (with Car2X)
- Full automated driving (with Car2X)

B – **Upcoming PTI objectives** (e.g. data security, privacy)

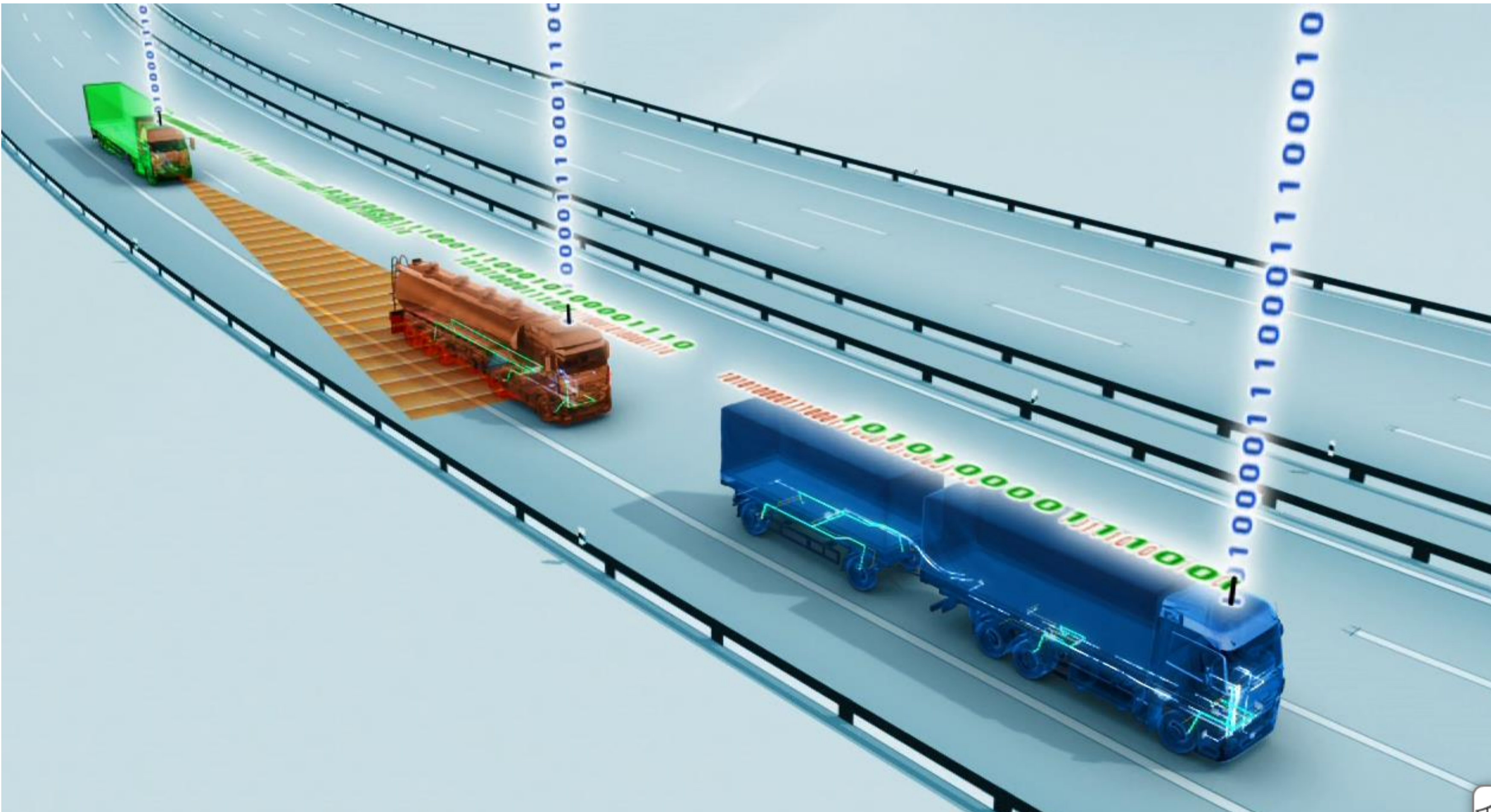
C – **Higher importance / responsibility of PTI**
(because of higher degree of automization)

CHALLENGES – EXAMPLES
A - ADVANCED DRIVER ASSISTANCE SYSTEMS
HIGHWAY CHAUFFEUR

HIGHWAY CHAUFFEUR



CHALLENGES – EXAMPLES
A - ADVANCED DRIVER ASSISTANCE SYSTEMS
PLATOONING



PLATOONING

CHALLENGES – EXAMPLES
B – NEW TESTING REQUIREMENTS
VEHICLE DATA PRIVACY

VEHICLE DATA PRIVACY

CHALLENGES – CENTRAL TARGETS FOR THE PTI

Effective PTI

Achieving the objectives

- Safety,
- Environmental protection,
- Security [future],
- Privacy [future]

Efficient PTI

as simple, quick and unexpensive as possible

2

HOMOLOGATION AND PTI IN THE LIGHT OF THE CHALLENGES

HOMOLOGATION AND PTI TODAY

HOMOLOGATION TODAY

DOES NOT HELP WITH THE CHALLENGE

Vehicle life

Homologation

Rules

- ECWVTA
- UNECE Reg.
- Standards

Tests, data, processes for Homol.

Technical services

Manu-facturers

No support for PTI

PTI

Rules

- PTI-Legisl.
- (Standards)

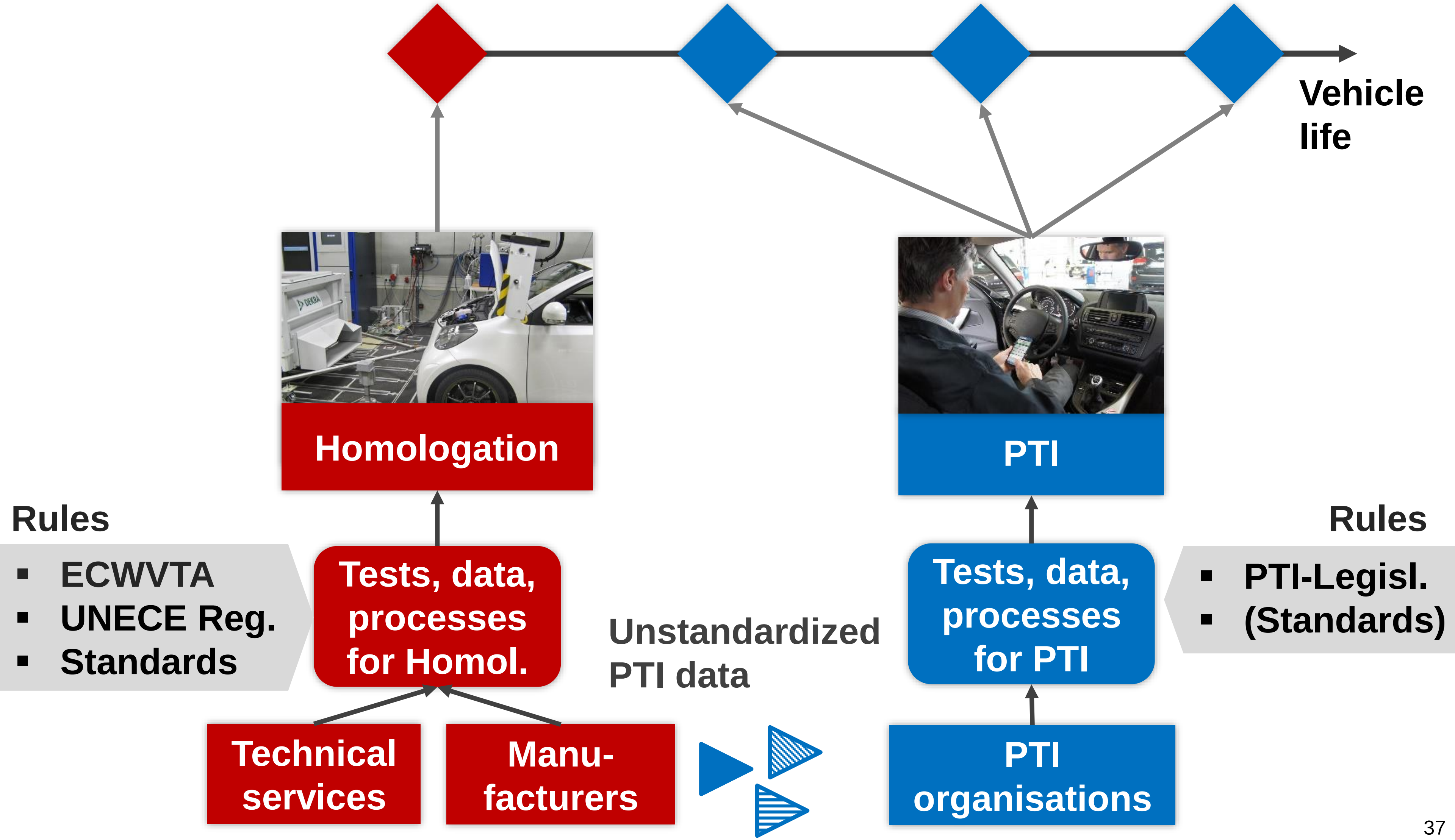
Tests, data, processes for PTI

PTI organisations

UNSTANDARDIZED DATA DELIVERY BESIDES HOMOLOGATION

UNSTANDARDIZED DATA DELIVERY BESIDES HOMOLOGATION

DOES HARDLY HELP WITH THE CHALLENGE



FULL CONSIDERATION OF PTI IN HOMOLOGATION

FULL CONSIDERATION OF PTI IN HOMOLOGATION

DOES HELP WITH THE CHALLENGE

Vehicle life

Homologation

PTI

Rules

- ECWVTA
- UNECE Reg.
- Standards

Tests, data, processes for Homol.

Tests & data for PTI

Technical services

Manu-facturers

Tests, data, processes for PTI

PTI organisations

Rules

- PTI-Legisl.
- (Standards)

CHANCES OF THE FULL CONSIDERATION OF PTI IN HOMOLOGATION

Effective PTI

Achieving the objectives

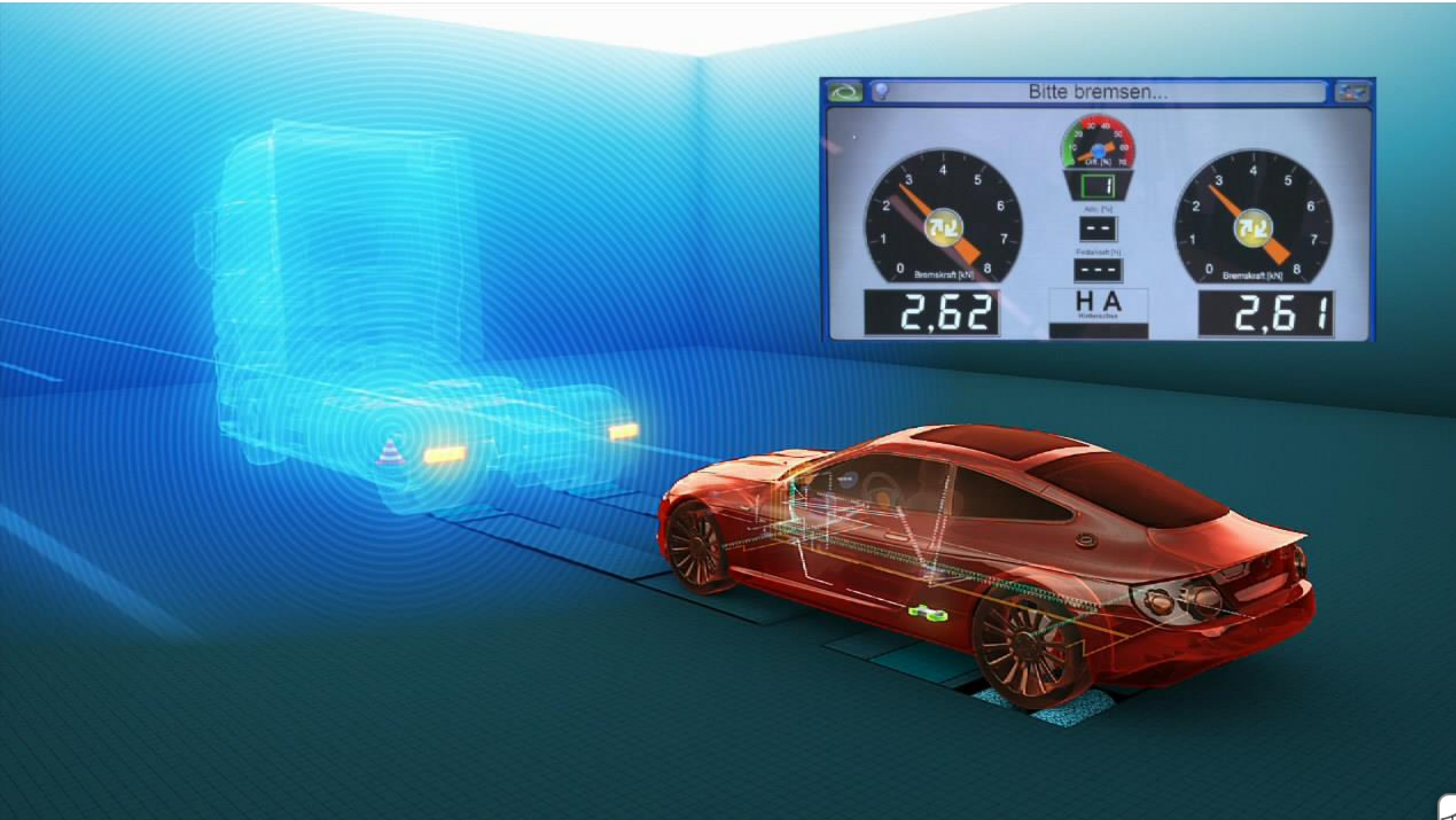
- Safety,
- Environmental protection,
- Security [future],
- Privacy [future]

Efficient PTI

as simple, quick and unexpensive as possible

CHANCES - EXPAMPLE

FUNCTIONAL TEST OF CAR2X ASSISTANCE SYSTEM



FUNCTIONAL TEST OF CAR2X ASSISTANCE SYSTEM

3

CONSIDERATION OF PTI IN HOMOLOGATION

RULES FOR HOMOLOGATION - OVERVIEW

EC Whole Vehicle Type Approval

UNECE Regulations

(ISO) Standards

Homologation

Rules

- ECWVTA
- UNECE Reg.
- Standards

Tests, data, processes for Homol.

Tests & data for PTI

RULES FOR HOMOLOGATION - NECESSARY AMENDMENTS

EC Whole Vehicle Type Approval

General requirements
regarding the necessary PTI test methods and PTI data, their documentation and verification

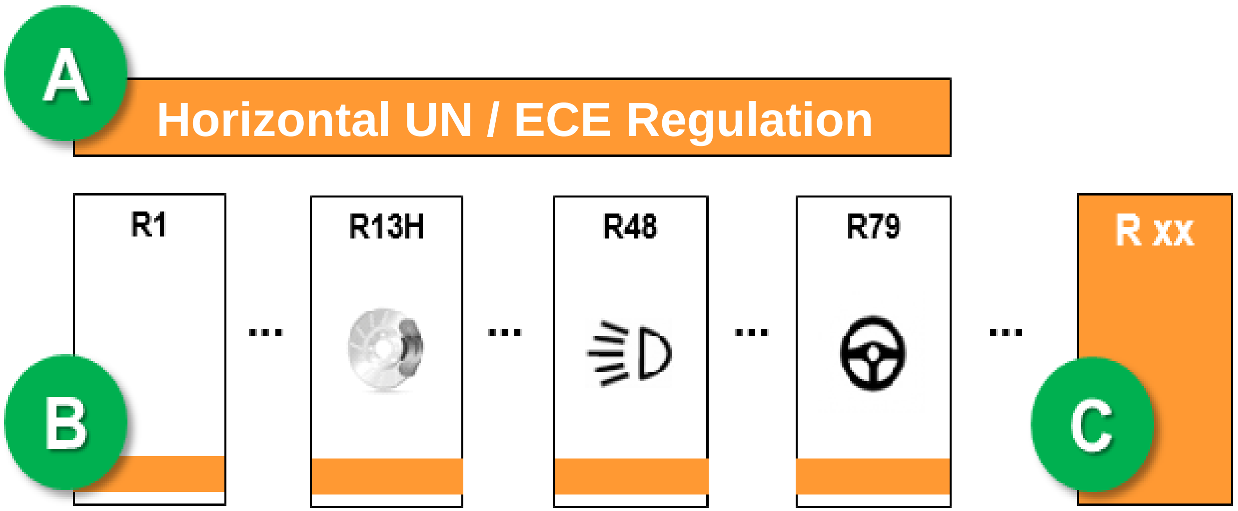
UNECE Regulations

Technical requirements
regarding the necessary PTI test methods and PTI data, their documentation and verification

(ISO) Standards

Technical specifications
of data formats and interfaces

OPTIONS FOR EXTENDING THE ECE-REGULATIONS IN VIEW OF THE ADVENT OF INTEGRATED / AUTOMATED VEHICLE FUNCTIONS



A – Horizontal regulation

B – Part of existing single-rules

C – Additional new regulation

NEXT STEPS

AGREED BETEEN AUTHORITIES, MANUFACTURERS AND TESTING ORGANISATIONS IN GERMANY

EC Whole Vehicle Type Approval

- Addition of test methods (using the vehicle interface) for automated driving functions
- Integration of the test method classes (identification, condition, function and efficacy)

UNECE Regulations

- Addition of test methods (using the vehicle interface) for automated driving functions
- Integration of the test method classes (identification, condition, function and efficacy)

(ISO) Standards

- Developments of standards for efficient and effective PTI test methods for automated driving functions
- Development of standards for PTI data and (vehicle, cloud) interfaces

VISION ZERO.

KEINER KOMMT UM. ALLE KOMMEN AN.

Workshop A

Presentation 3

Harmonisation of Test Procedure and Integration of Type Approval

Frank Leimbach

Director DEKRA Technology Centre, DEKRA Automobil GmbH, Germany

2015 CITA Conference, 14-16th April 2015, Dubai, U.A.E.

Enhancing the Value of Vehicle Inspection

Harmonisation of test procedure and integration of type approval

DEKRA Automobil GmbH, Frank Leimbach, Director Technology Center

Harmonisation of test procedures

- In terms of:
  - type approval
  - insurance rating
  - NCAP test‘s
  - periodical technical inspection (PTI)
  - and integration of testing of electronic components during type approval procedure

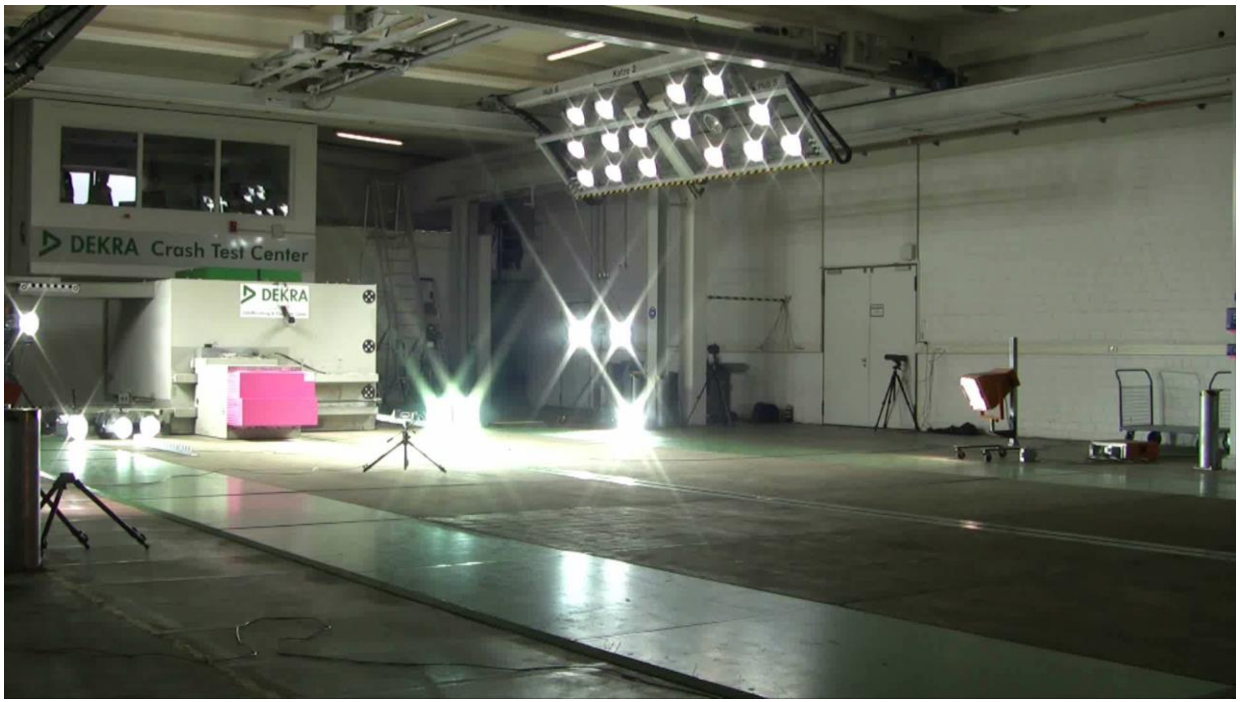
Advanced Driver Assistance Systems – state of the art

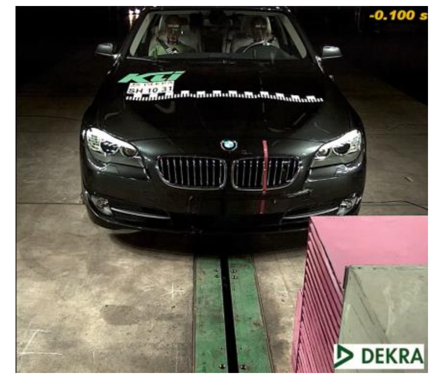
- Driver Assistance systems using the example of BMW 5 Series (F10):

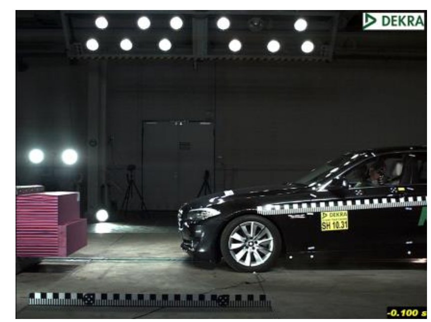
Advanced Driver Assistance Systems – state of the art

- Driver Assistance systems using the example of BMW 5 Series (F10):

Advanced Driver Assistance Systems – state of the art

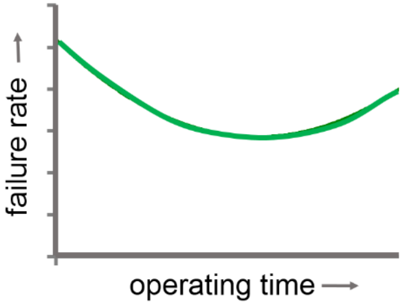


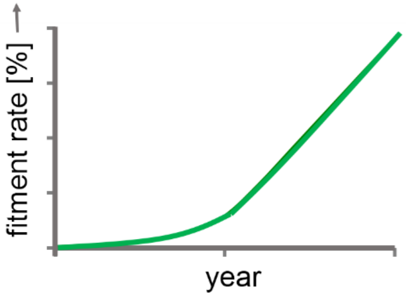




Advanced Driver Assistance Systems – expectations

- Smart ADAS prevent accidents or mitigate accidents
- Functionality of ADAS shall last the vehicle life cycle
- ADAS shall be standard for volume cars as well





Effects of harmonisation

- Harmonisation of requirements will lead to price reduction
- Minimize number of test criteria for a given ADAS in terms of:
  - markets (USA, Europe, Asia)
  - testing bodies
    - type approval
    - insurance rating
    - NCAP test's
    - periodical technical inspection

combine test procedures

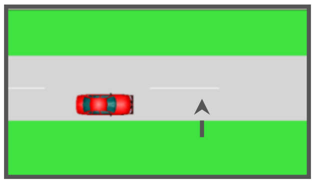
Advanced Driver Assistance Systems - requirements

ADAS

- require maintenance
- have to be addressed within PTI procedures
- shall be integrated in type approval directive‘s

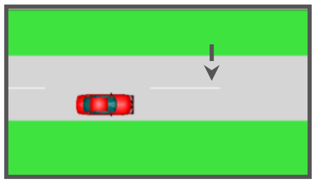
Pedestrian test scenarios

S1



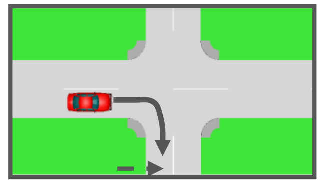
speed 45 - 50 km/h
braking of the car
adult crossing from the right
normal speed (5 km/h)
daylight

S2



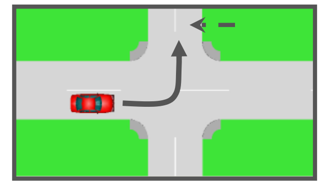
speed 55 - 60 km/h
braking of the car
child crossing from the left
running (8 - 10 km/h)
typical at night

S4



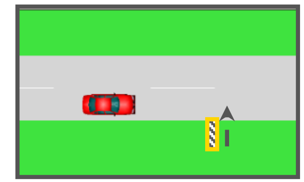
speed 10 - 15 km/h
adult crossing from the right
normal speed (5 km/h)
braking of the car

S3



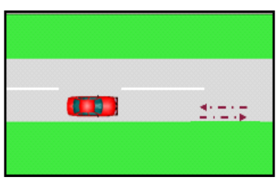
speed 20 - 25 km/h
adult crossing from the right
normal speed (5 km/h)
braking of the car

S5



speed 45 - 50 km/h
child crossing from the right
running (8 - 10 km/h)
braking of the car
typical at night

S6 excluded

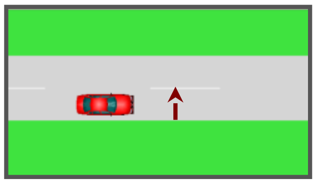


Easy to detect

High speed
(> 70 km/h

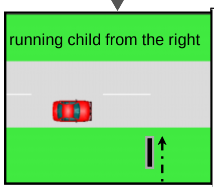
S – Accident Scenario

Pedestrian test scenarios

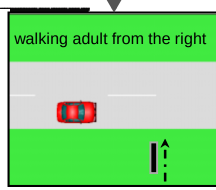


Boundary conditions
- system is working symmetric
- variation of $size_{Ped}$, $speed_{Ped}$, TTC
- obstruction possible

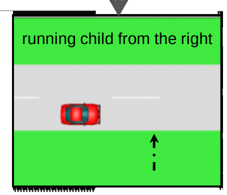
TS1



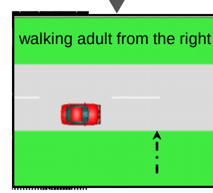
TS2



TS3



TS4



TS – Test Scenario

Pedestrian test

Impact on PTI

- Safety must be kept on an appropriate level
- Therefore ensure that vehicles on the roads are maintained to a high degree of technical roadworthiness
- Increasingly complex and dynamic functionality of vehicle systems
- Critical safety systems that only operate when the vehicle is in motion
- such as ESC or AEBs
- Real testing of safety systems within PTI not feasible (time & costs)

Summary

- Accident statistic will be impacted by smart ADAS systems if they will be standard on the majority of vehicles
- If the systems keep stay in function
- Maintenance and inspection is mandatory to ensure functionality
- Integration of test procedure requirements may enable reasonable testing

DEKRA

Alles im grünen Bereich.

Thank you very much for your attention !