

$$x' = \gamma(x - vt), \quad x = \gamma(x' + vt')$$

$$t' = \gamma \left( t - \frac{xv}{c^2} \right), \quad t = \gamma \left( t' + \frac{x'v}{c^2} \right), \quad v' = \frac{v_2 - v_1}{1 - \frac{v_1 v_2}{c^2}}$$

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$p'_x = \gamma \left( p_x - \frac{Wv}{c} \right), \quad W' = \gamma (W - v p_x)$$

$$u(r, t) = \frac{\hat{u}}{r} \cos(k(r \pm vt)) \quad \vec{E} = \frac{Q}{4\pi\epsilon_0 r^2} \frac{(1 - B^2)^{3/2}}{(1 - B^2 \sin^2 \theta)^{3/2}} \vec{r}$$

$$\vec{E}' = \gamma(\vec{E} + \vec{v} \times \vec{B}), \quad \vec{B}' = \gamma \left( \vec{B} - \frac{\vec{v} \times \vec{E}}{c^2} \right)$$



## TASS INTERNATIONAL OVERVIEW

Visit MOTC - VSCC

# Agenda Items

- Welcome and introduction
- TASS International company introduction
- Euro NCAP at TASS International
- Automated driving at TASS International
- Short tour passive safety facilities Euro NCAP
- Demo Automated driving
- Lunch



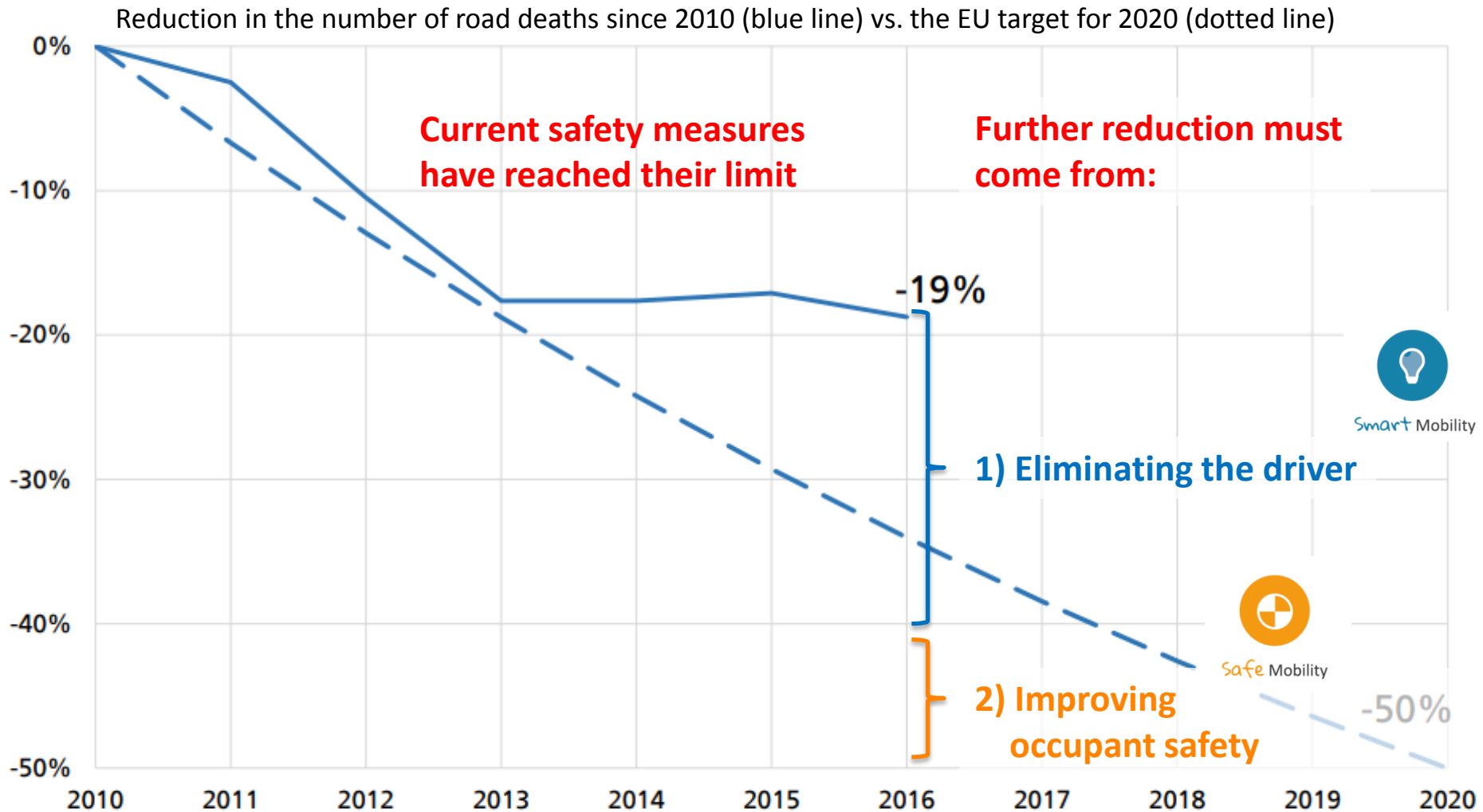


**3 years before...**

# Volvo Trucks using TASS products & methodology...



## Focus on Occupant Safety and Automated Driving

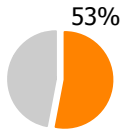


# TASS International: Connecting Simulation & Testing

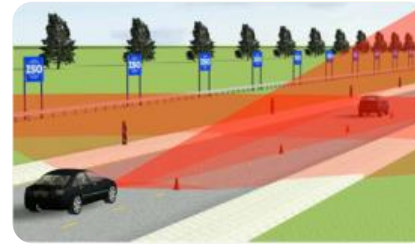


TASS International supports the automotive industry in making vehicles safer and smarter by offering software and services for development and validation of Automated Driving and Integrated Safety systems

## Software



madymo®

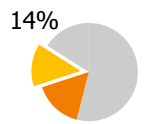
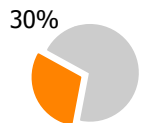
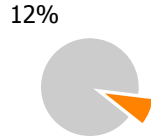


prescan®



delft-tyre®

## Services



Engineering

Testing

Homologation (as part of testing)

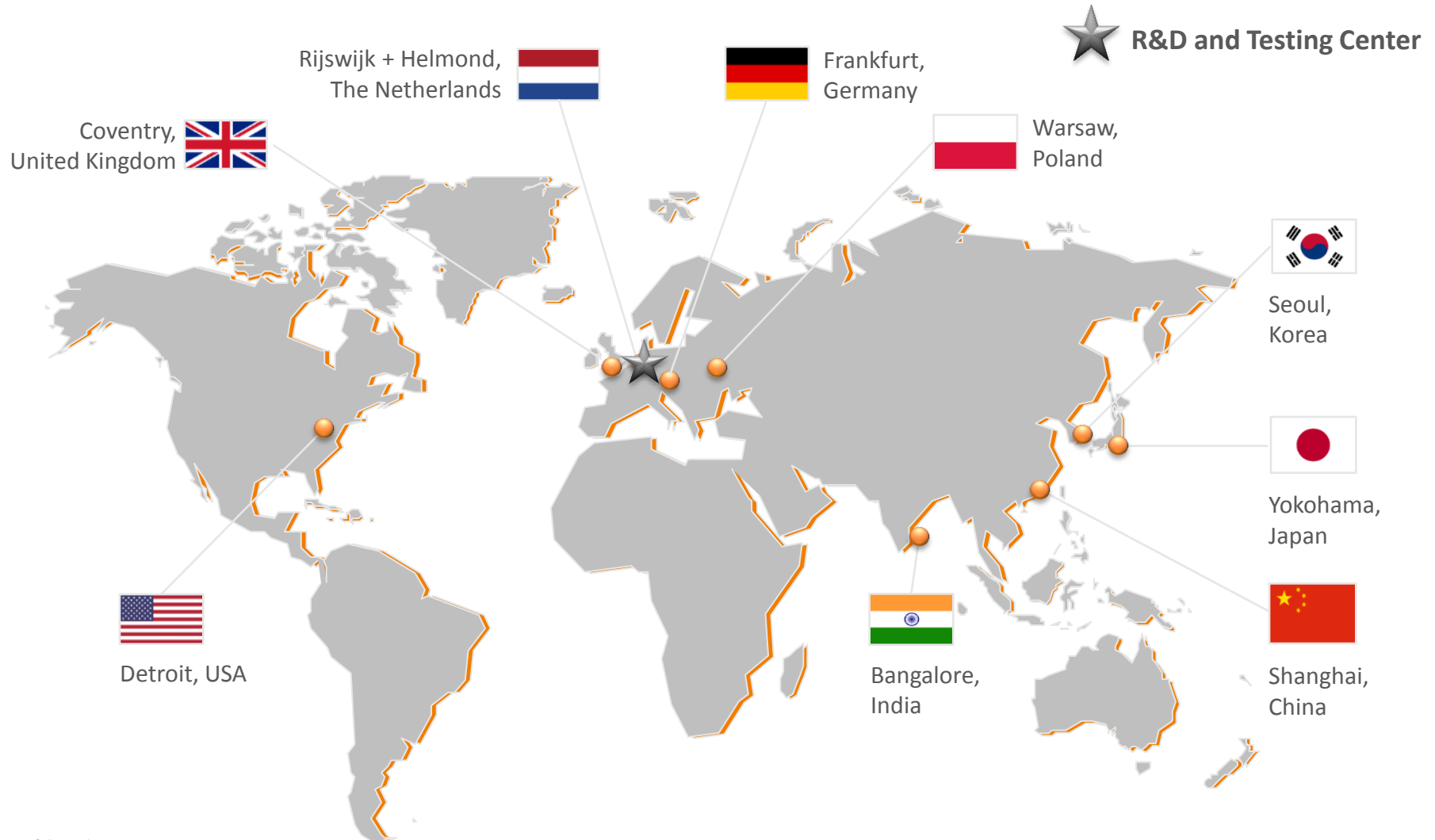
# Our Customers

> 80% of the leading automotive OEMs and 60% of the Top automotive suppliers





# Our Global Presence



# TASS International Testing Services

Mobility Center



Automated Driving



ADAS Testing



Tyre Testing



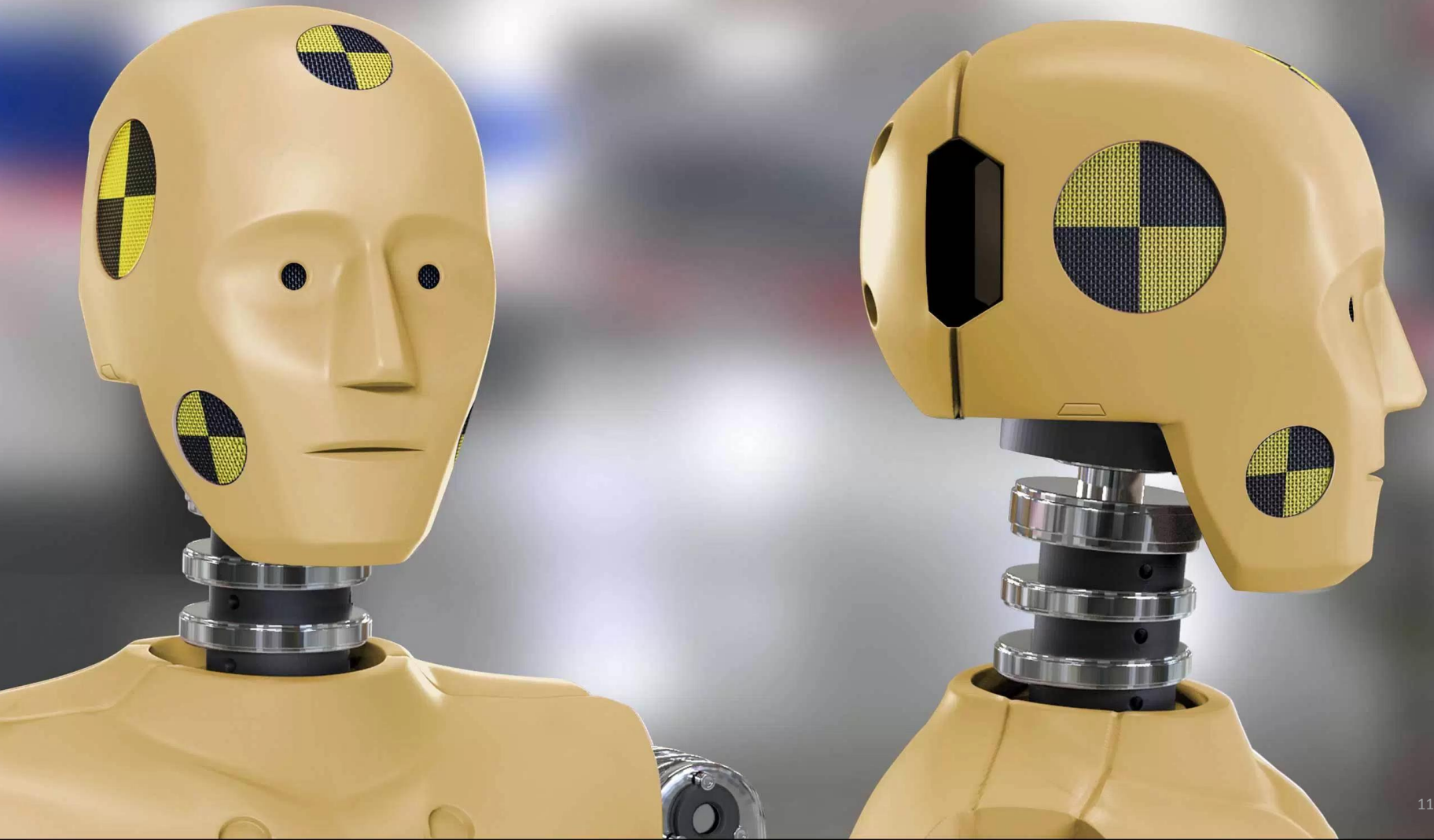
Component Testing



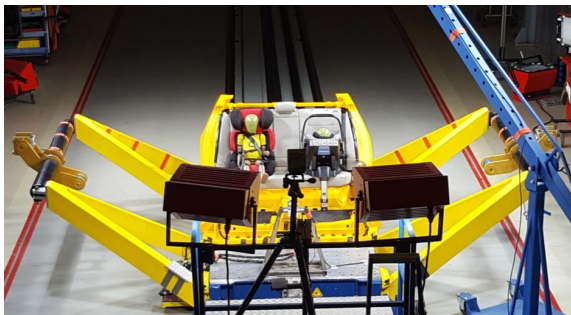
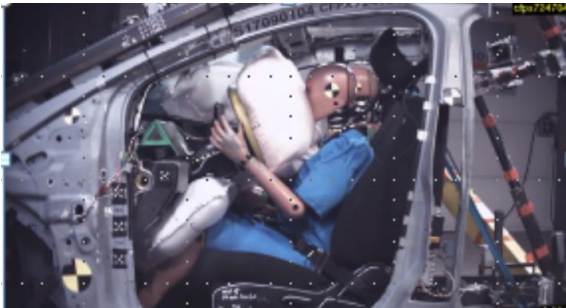
Safety Center



# Occupant Safety



# What do we Need? Testing!

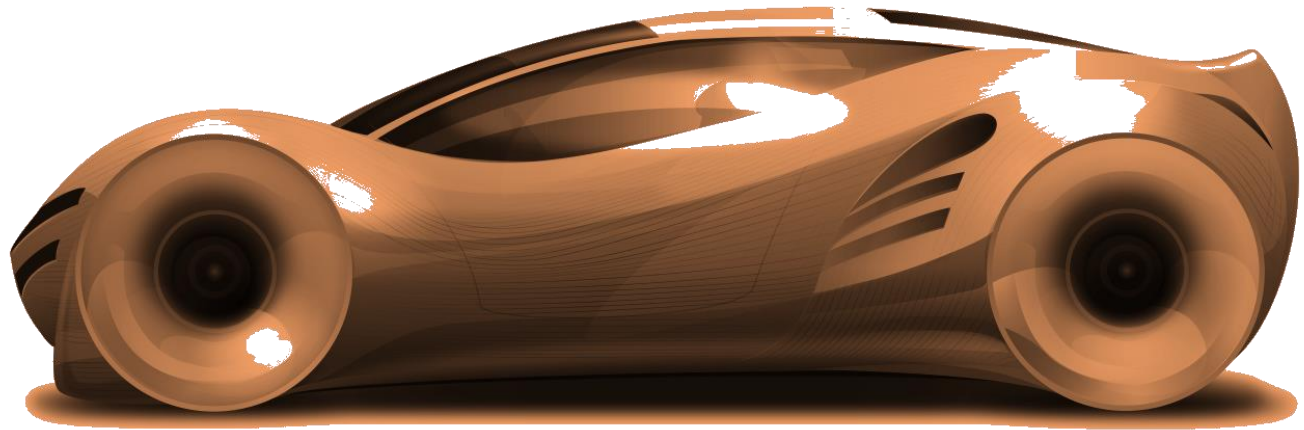


Testing needed to verify and demonstrate that the physical product complies to specific requirements and quality standards (often in an EMULATED ENVIRONMENT representing a SUBSET of real-life use-cases)

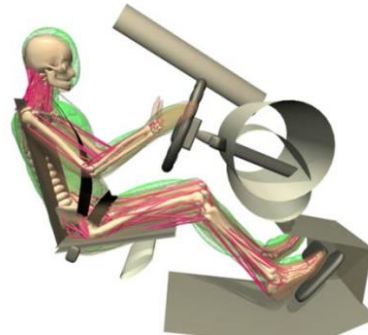
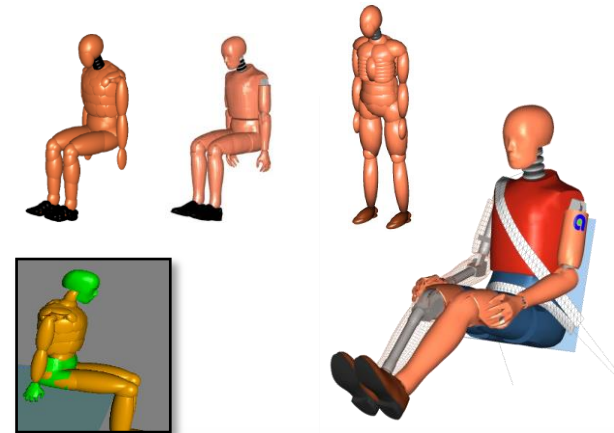
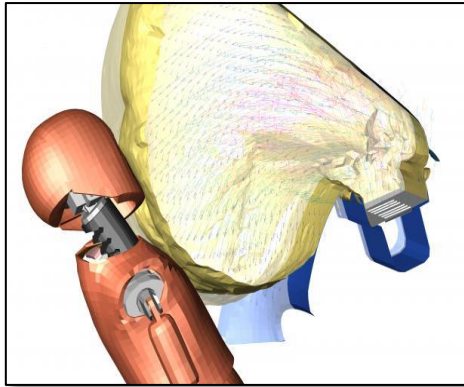
# A changing world...

## Challenges in developing Occupant Safety Systems:

- “Unlimited” number of possible crash scenarios
- Many variation in occupant (age, gender, BMI)
- AD leads to variations in seat positioning
- PreCrash behavior impacts restraint system design



# What do we Need? Simulation!



Simulation needed to make quick and cost-effective design iterations  
and validate the product against ALL relevant real-life use-cases  
in an environment which is safe and offers perfectly reproducible conditions

## Services – Safety Center



- One-stop-shop for passive safety systems crash tests
- Effective solutions based on >30 years of experience
- EuroNCAP certified facility
- Certification of safety belts
- Certification of child restraint systems
- Certification of helmets

## Full Scale Crash Testing

### Vehicle to Vehicle Tests

- Passenger car to passenger car
- Passenger car to heavy duty vehicle
- Heavy duty vehicle to heavy duty vehicle
- Hybrid and full electric vehicles

### Type of tests

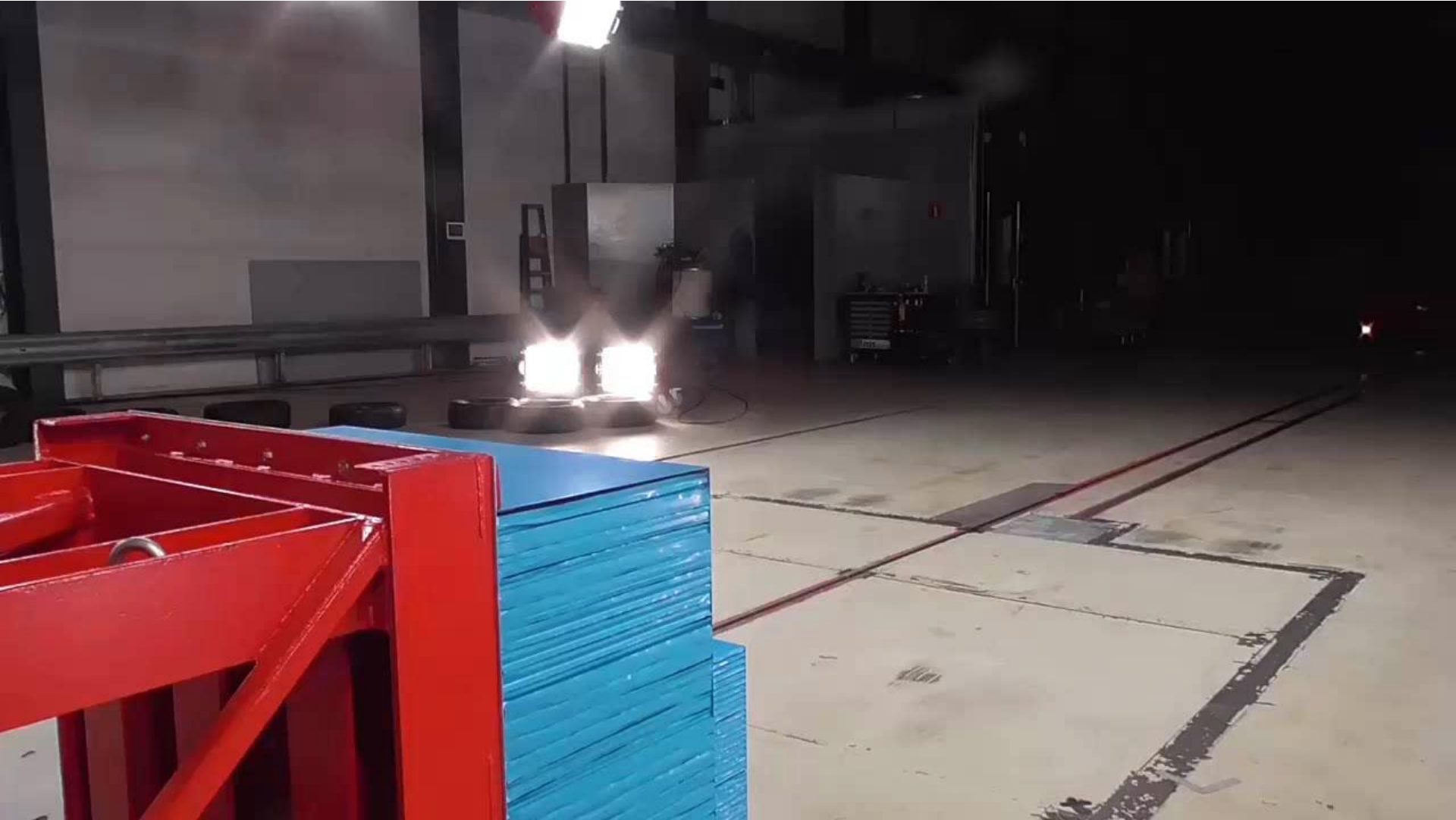
- Frontal Impact
- Rear Impact
- Side Impact
- Outdoor Impact

### Characteristics

- Speed Range: 5-110 km/h
- Speed Tolerance 0.2 km/h
- 160m x 20m Indoor Facility – 150 m track



## Full Scale Crash Testing





**Full-scale Frontal Impact**



**Road Infrastructure**



**VRU Protection Systems**



**Child Restraint System**

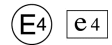
## Services

We offer testing and analysis for:

- Development
  - Regulations & Certifications
  - Conformity of Production
  - Simulation SW validation
- 
- One-stop-shop for passive safety systems crash tests
  - Effective solutions based on >30 years of experience
  - EuroNCAP certified facility



RDW



## Services

### Component and System Testing

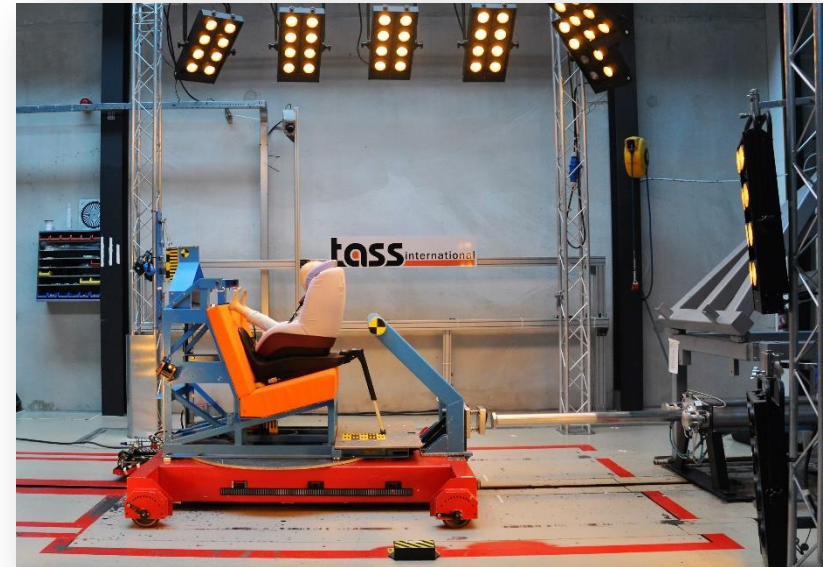
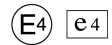
- Seat Belts
- Airbag Systems
- Aviation Seats
- Child Restraint Systems
- Aero Cabins
- Helmets

### Full Scale Crash Testing

### Road Furniture Testing

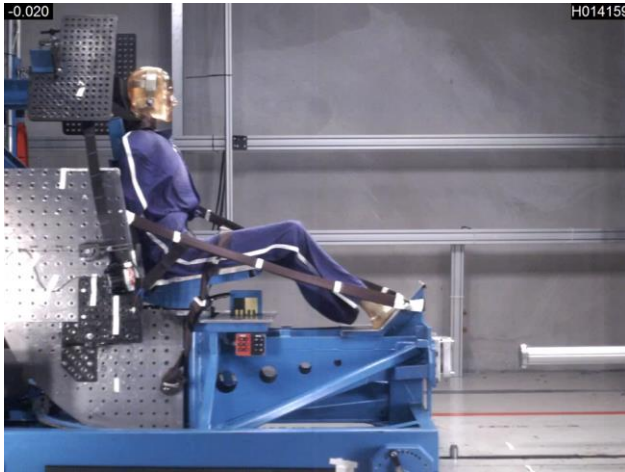


RDW



All activities are [ISO17025 accredited](#)

## Component and System Testing



**Seat Belts**  
**Airbag Systems**  
**Aviation Seats**  
**Etc.**

## Child Restraint Systems Side Impact



## HBS Sled Test Frontal and side impact



## Road Furniture Testing

- Guard rail testing
- Lamp post testing
- Sign post testing

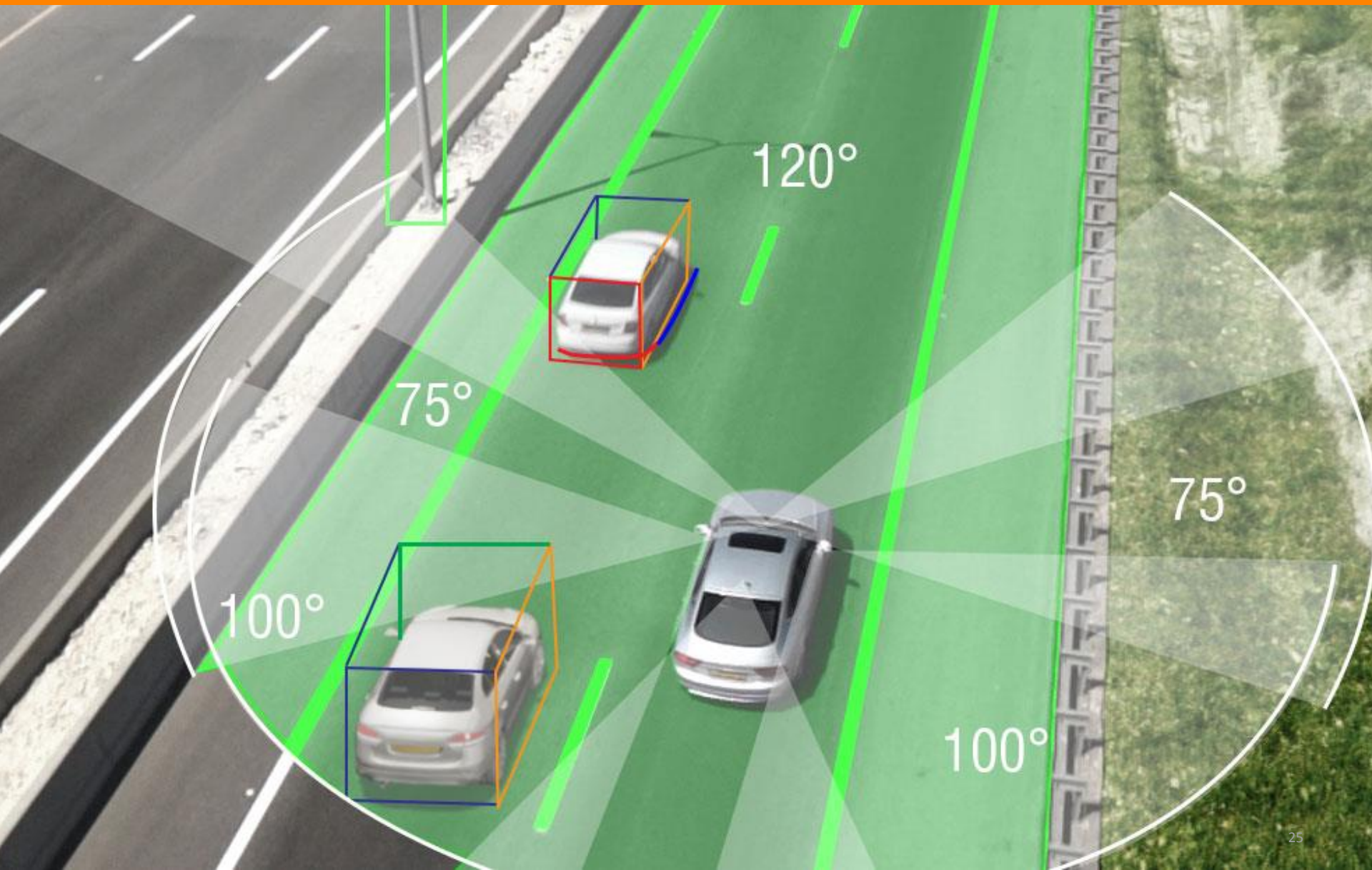


# Dynamic Roll-Over Tests

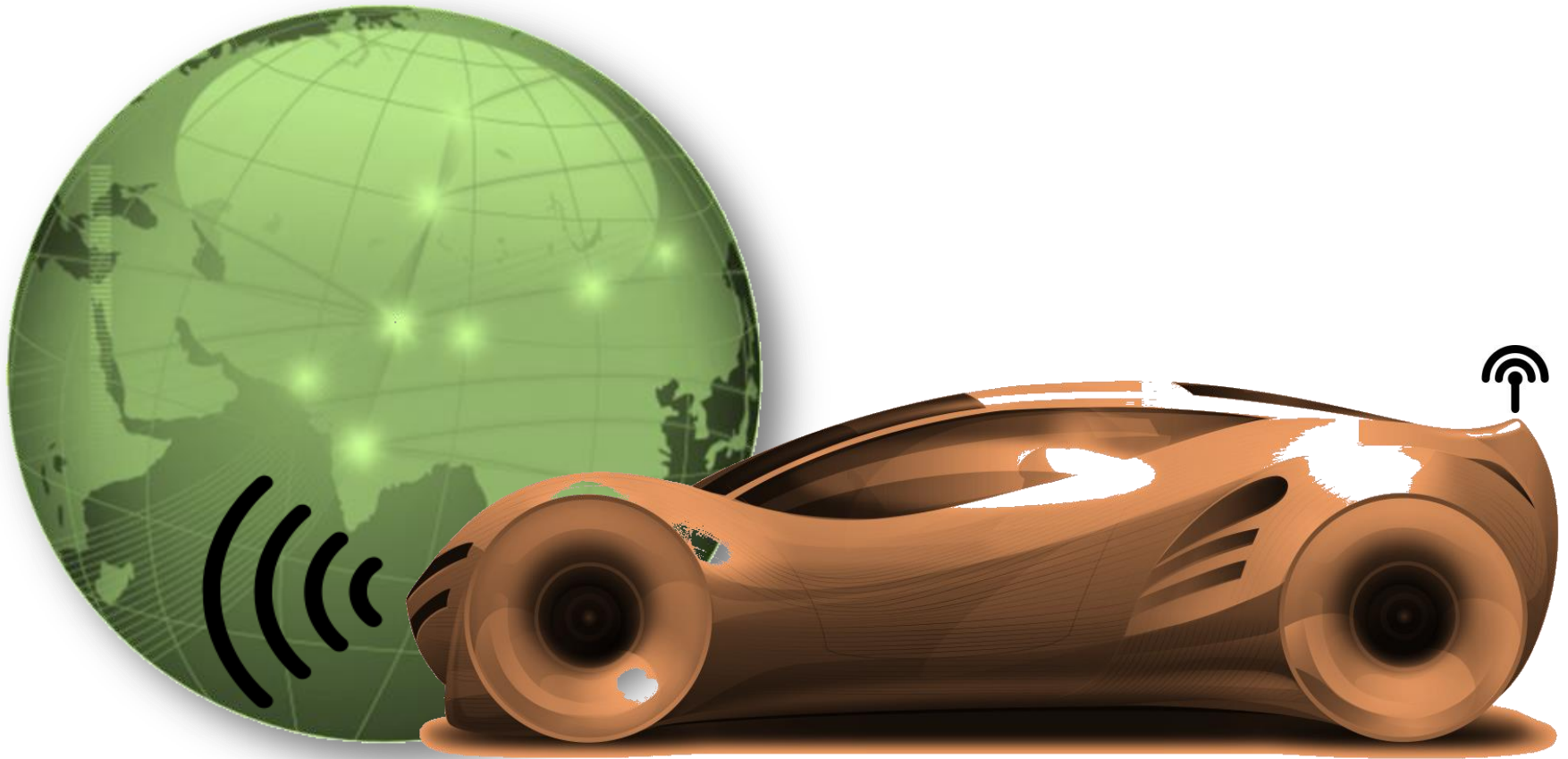




# Automated Driving



# A changing world... from Level 2 to Level 4



# Paradigm Shift

For on-road vehicles



Human driver



Automated system

Human in the Lead

Liability Threshold

System in the Lead

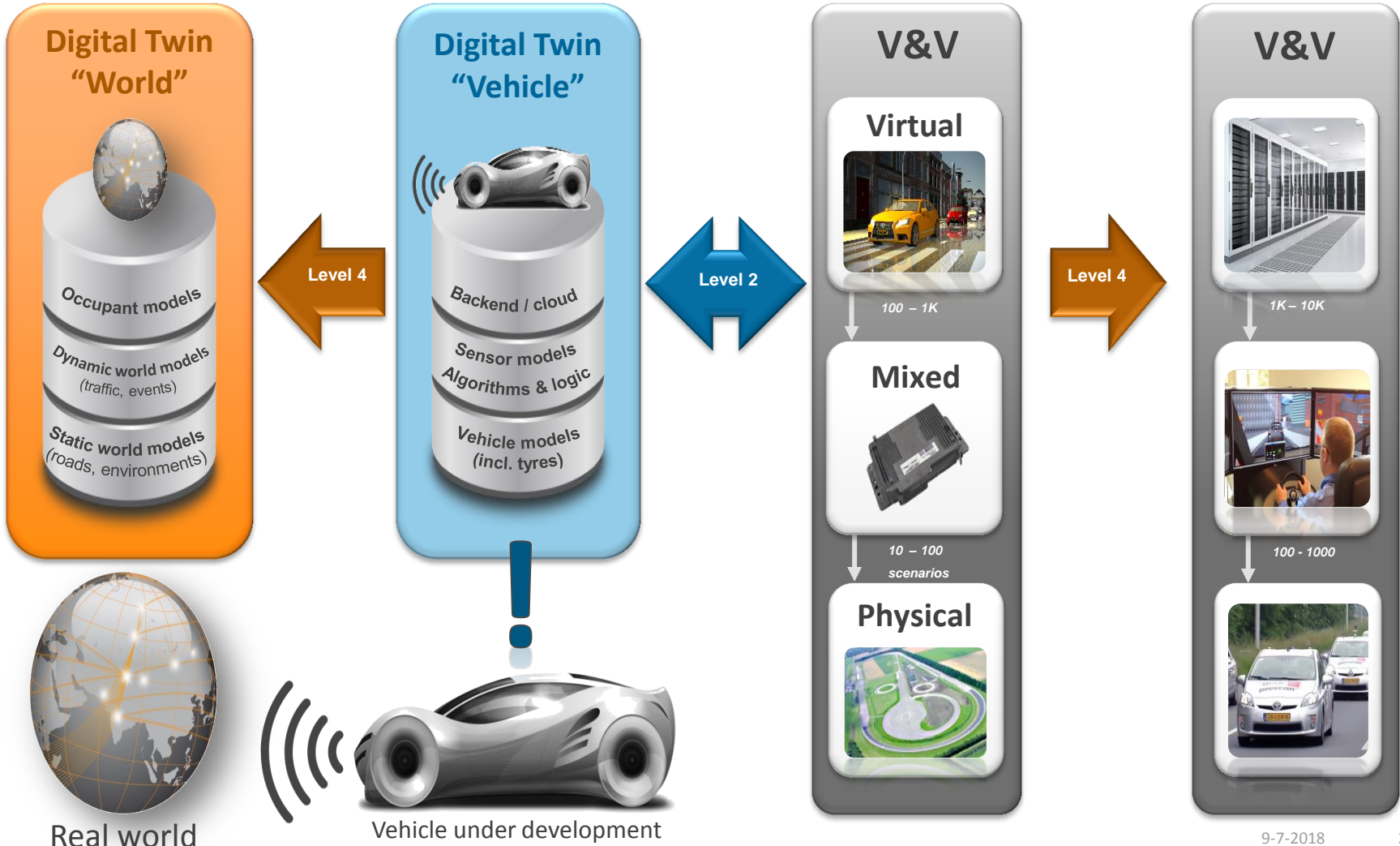
Steering and acceleration/  
deceleration    Monitoring  
of driving  
environment    Fallback when  
automation  
fails    Automated  
system is in  
control

		Steering and acceleration/ deceleration	Monitoring of driving environment	Fallback when automation fails	Automated system is in control
Human in the Lead	<b>0</b> NO AUTOMATION				N/A
	<b>1</b> DRIVER ASSISTANCE				SOME DRIVING MODES
	<b>2</b> PARTIAL AUTOMATION				SOME DRIVING MODES
System in the Lead	<b>3</b> CONDITIONAL AUTOMATION				SOME DRIVING MODES
	<b>4</b> HIGH AUTOMATION				SOME DRIVING MODES
	<b>5</b> FULL AUTOMATION				

# Automated Driving V&V Level 2 to 4

## Requirements

Internal - External



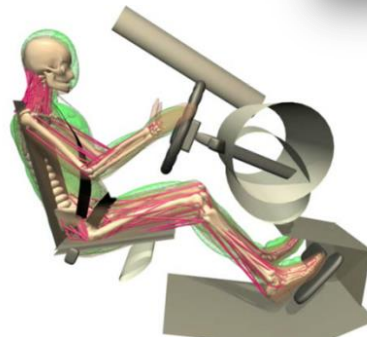
# What do we Need? Testing!



Testing needed to verify and demonstrate that the physical product complies to specific requirements and quality standards (often in an EMULATED ENVIRONMENT representing a SUBSET of real-life use-cases)

# What do we Need?

## Simulation!



Simulation needed to make quick and cost-effective design iterations and validate the product against ALL relevant real-life use-cases in an environment which is safe and offers perfectly reproducible conditions

# Simulation Solutions

**prescan**<sup>®</sup>

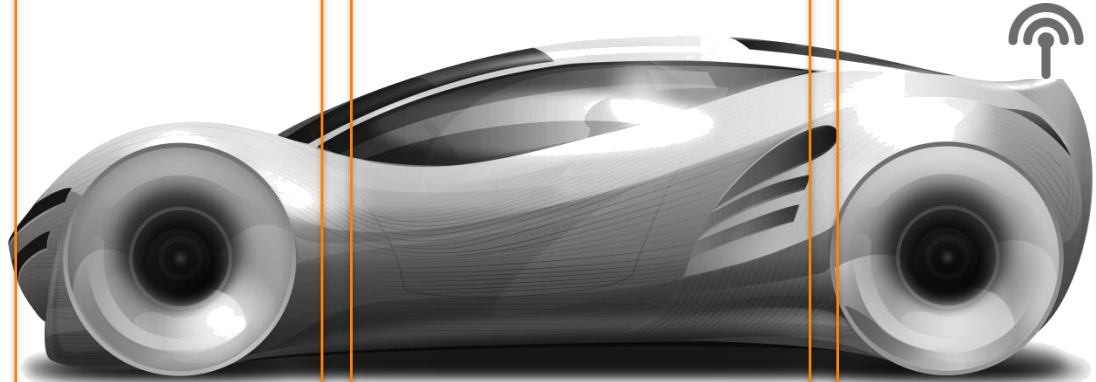
World & Sensor  
Modelling



Environmental sensors  
perceiving the world  
and delivering input to  
Automated Driving  
decision & control logic

**delft-tyre**<sup>®</sup>

Tyre  
Modelling



Tyres transferring  
Automated Driving  
control commands  
to the road

**active human**<sup>®</sup>

Human  
Modelling

Human drivers and  
passengers  
traveling safely and  
comfortably  
from A to B

**prescan**<sup>®</sup>

V2X  
Modelling



Receivers and  
transmitters  
facilitating wireless  
communication

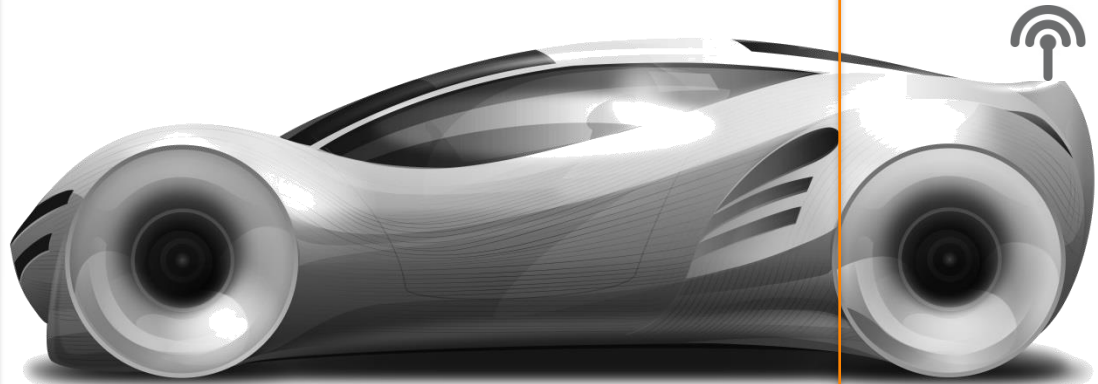
# PreScan™ Simulation Platform

**prescan**®

**World & Sensor  
Modelling**



**Environmental sensors  
perceiving the world  
and delivering input to  
Automated Driving  
decision & control logic**



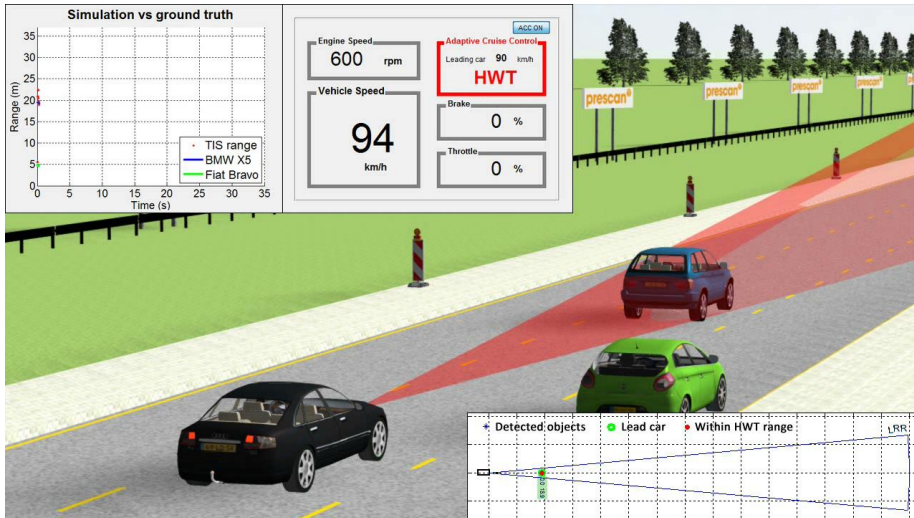
**prescan**®

**V2X  
Modelling**

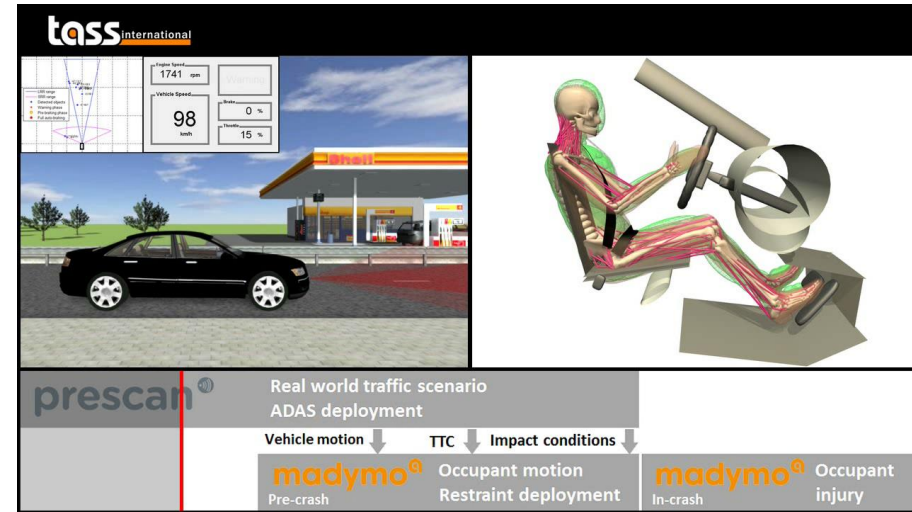
**Receivers and  
transmitters  
facilitating wireless  
communication**



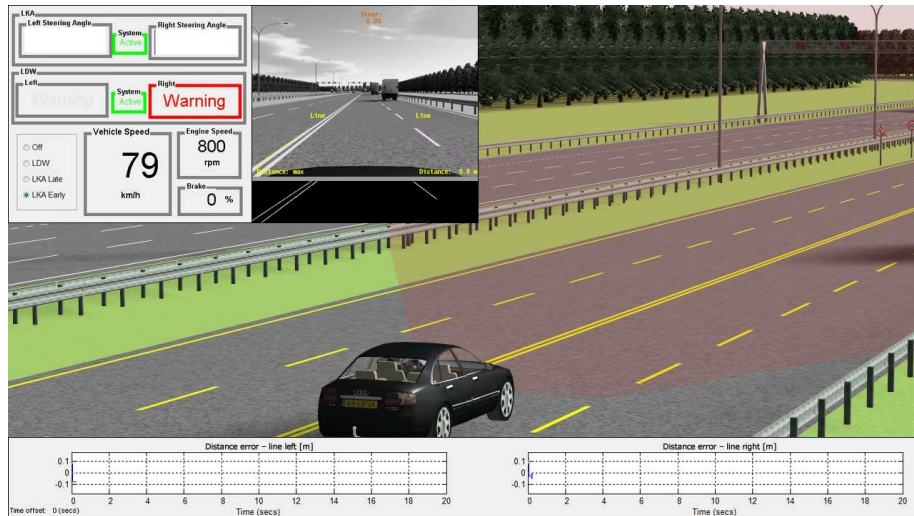




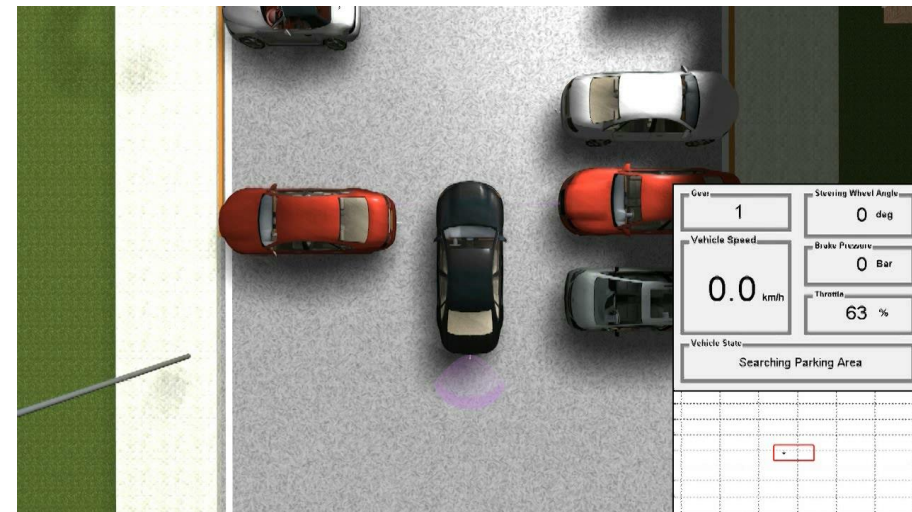
Adaptive Cruise Control



Pre-crash braking (incl. Active Human Model)



Lane Keeping Assistance

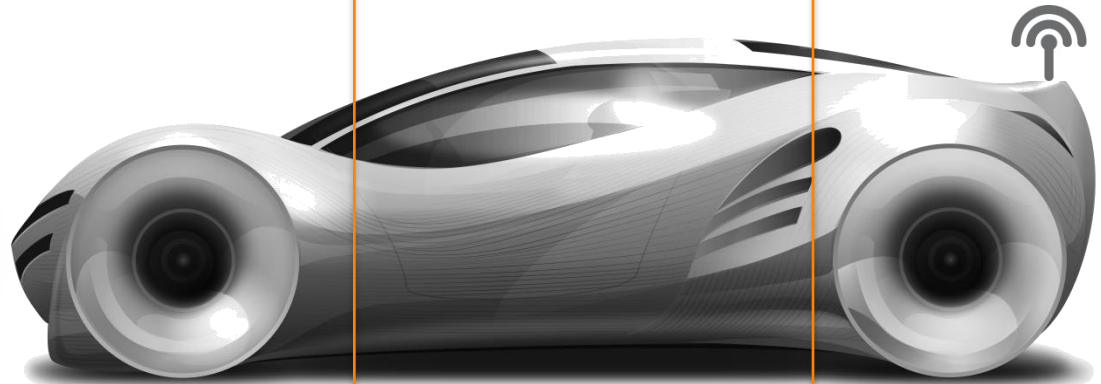


Parking Assistance

# TASS International Simulation Solutions

## active human<sup>®</sup>

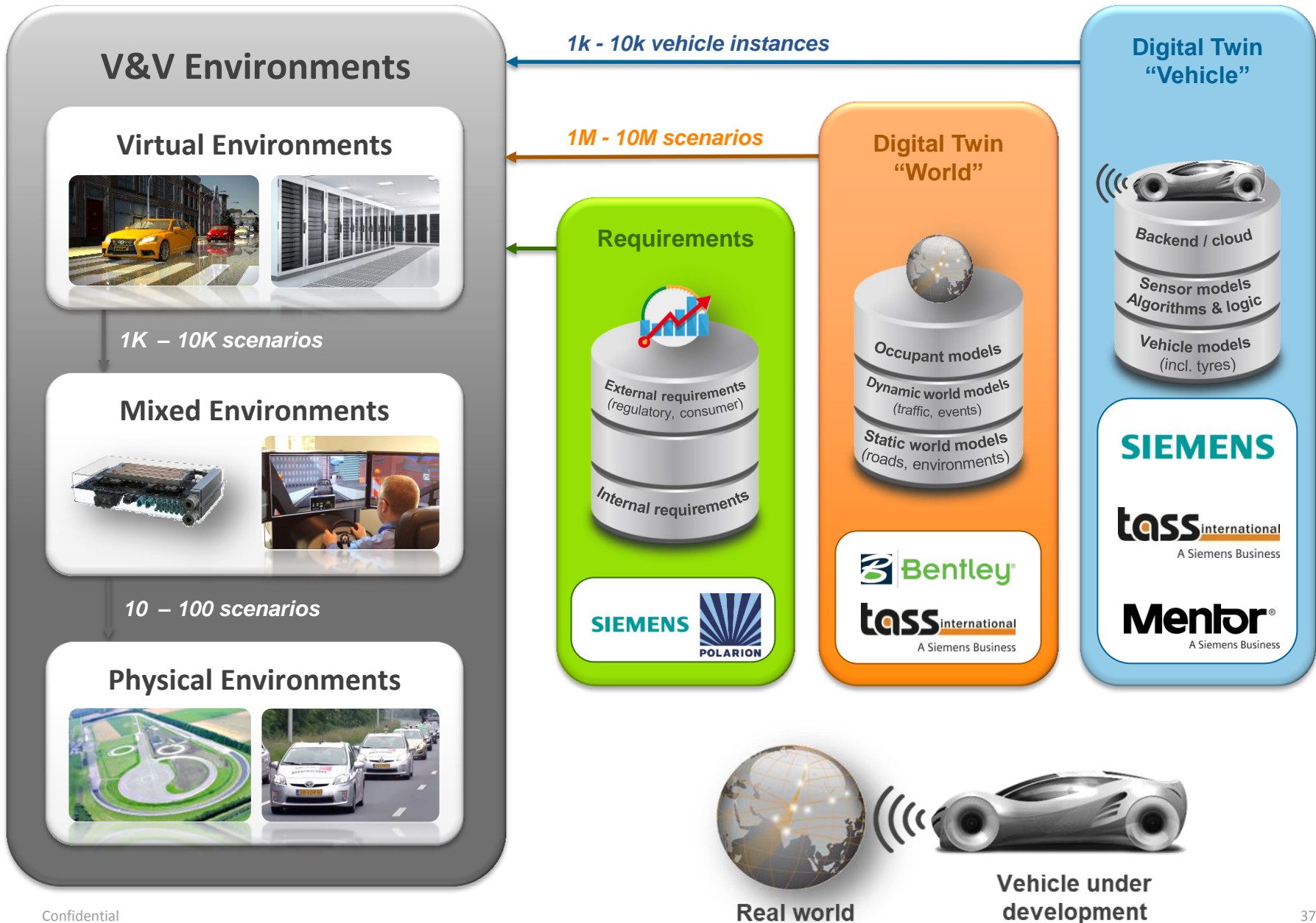
Human  
Modelling



Human drivers and  
passengers  
traveling safely and  
comfortably  
from A to B

# Example: active human in evasive steering manoeuvre





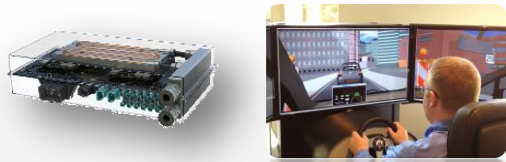
## V&V Environments

### MiL / SiL / Cluster



1K – 10K scenarios

### HiL / DiL / ViL

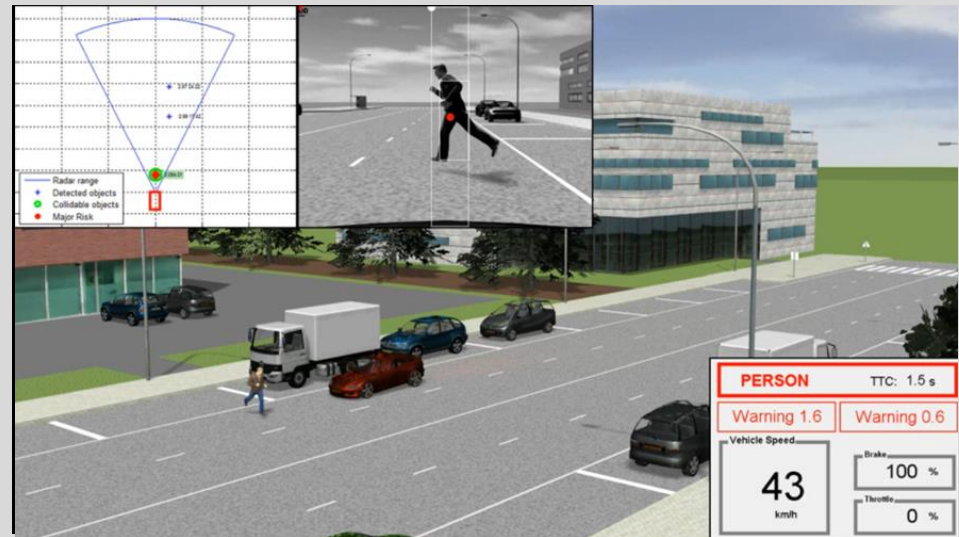


10 – 100 scenarios

### Laboratories / proving grounds / public roads



Run massive amounts of PreScan scenarios for Automated Vehicle development and optimization



- Design space exploration using large scenario databases
- Virtual development, verification and robustness testing
- Optimized automated vehicle designs

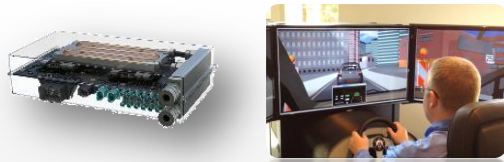
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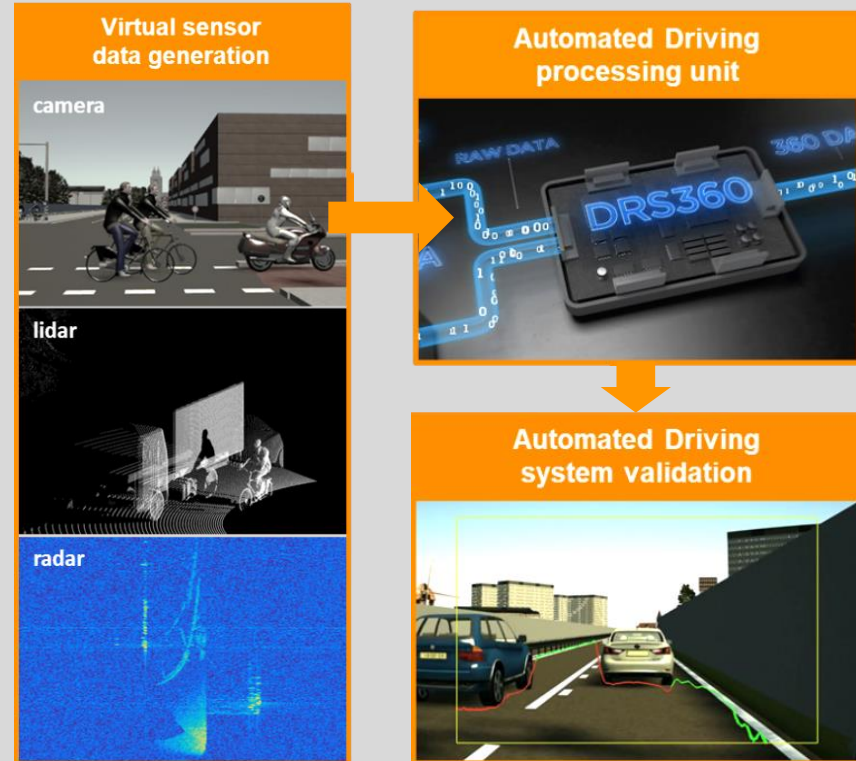


10 – 100 scenarios

### Laboratories / proving grounds / public roads



PreScan synthetic sensor data injection for virtual validation of central AD processing units (e.g. Nvidia Drive PX2, Mentor DRS360)



- Training and evaluating Deep Neural Networks (DNNs)
- Virtual validation of automated driving processing units
- Accelerated automated vehicle development

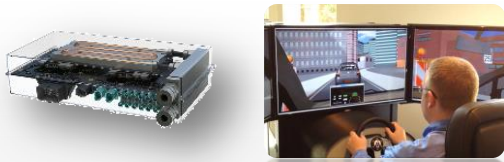
## V&V Environments

### MiL / SiL / Cluster



1K – 10K scenarios

### HiL / DiL / ViL



10 – 100 scenarios

### Laboratories / proving grounds / public roads



**TASS International Services and Siemens Testing Solutions for physical validation of automated and connected driving technology**



- Physical verification & validation services
- Certification of automated and connected systems
- Design consultancy for “next-generation” AD test facilities



# AD Testing Services Overview

1

**ADAS validation:**  
UNECE, EuroNCAP testing programs



2

**Automated Driving validation:**  
Positioning, Sensor referencing etc.



3

**Connected Driving validation:**  
Positioning, Timing, DSRC & LTE Comms



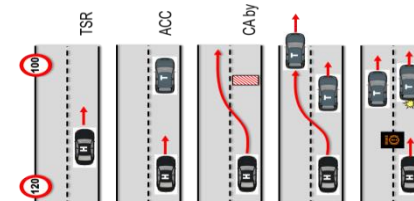
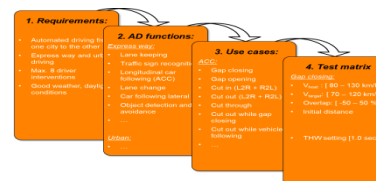
4

**Technical Service for Certification**  
Vehicle & Infrastructure Type Approval



5

**Test Program Consultancy**  
Functions - Protocol – Test Matrix



6

**Test Track Design Consultancy**  
Requirements/Layout AD & Connected



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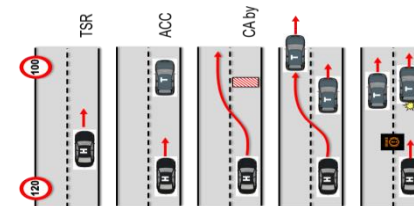
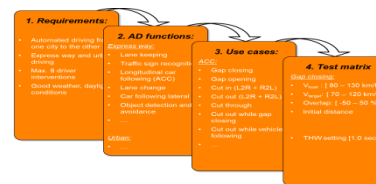
**Technical Service for Certification**  
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Requirements/Layout AD & Connected



# ADAS testing

## TASS International



- UNECE testing
  - TASS International are an ISO 17025 accredited lab



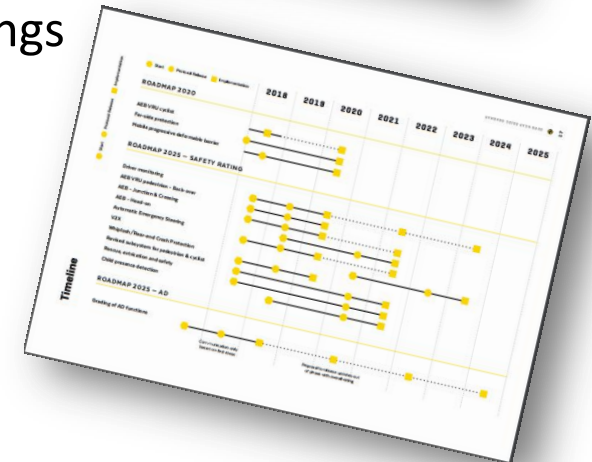
- Euro NCAP testing
  - Contact with Euro NCAP
  - Testing
  - Data acquisition and analysis
  - 2<sup>nd</sup> Euro NCAP Inspector (*via TNO*)
    - SBR, SAS tests



- Euro NCAP Working Groups & InterLab meetings
  - Member of various Euro NCAP WG's
  - TASS representative at the InterLab meetings



- Development testing
  - Test design
  - Test execution



# All current official ADAS protocols can be offered by TASS

## Consumer Testing and Regulatory Testing

All ADAS activities are ISO17025 accredited since 7-12-2016



### Light Duty (passenger cars)

- Euro NCAP 2016
  - AEB CCR
  - AEB VRU - Pedestrian
  - LSS (LDW & LKA)



### Heavy Duty (trucks and buses)

- UNECE regulations
  - AEB for Trucks & Buses (ECE-R131)
  - LDW for Trucks & Buses (ECE-R130)

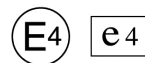
*Regulatory  
Testing*



All UNECE activities are RDW designated since 28-12-2016

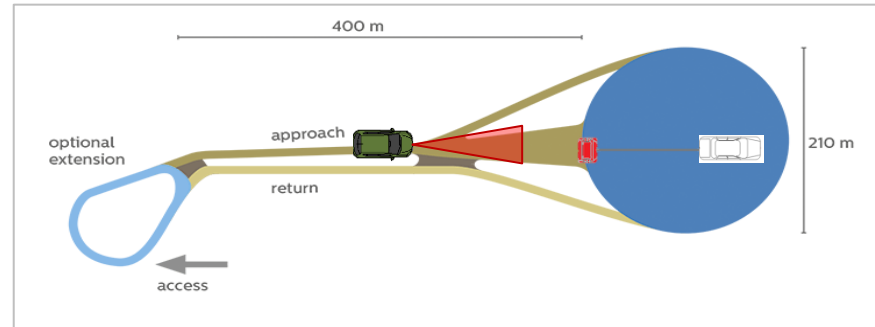


RDW



# Example

## Euro NCAP AEB-CCR (current protocol)



CCR - *moving target*

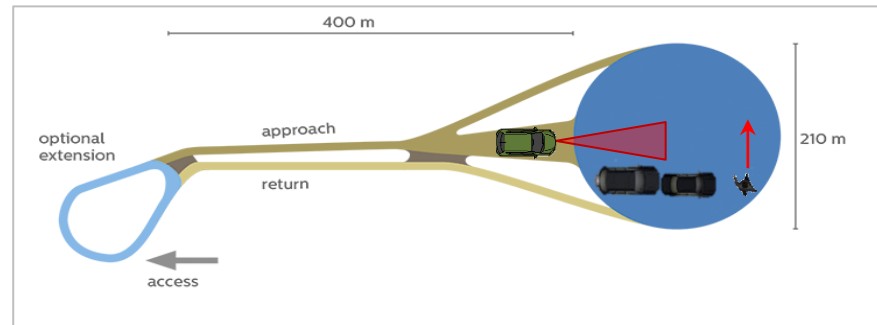


CCR - *braking target*



# Example

## Euro NCAP AEB-VRU (current protocol)



Adult dummy



Child dummy



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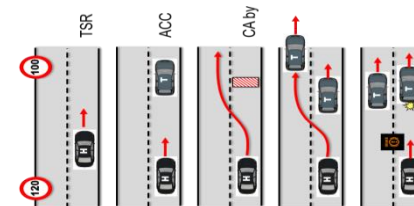
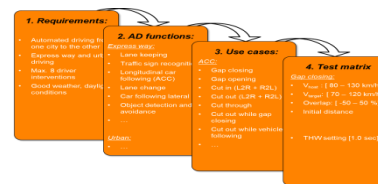
**Technical Service for Certification**  
Vehicle & Infrastructure Type Approval

5

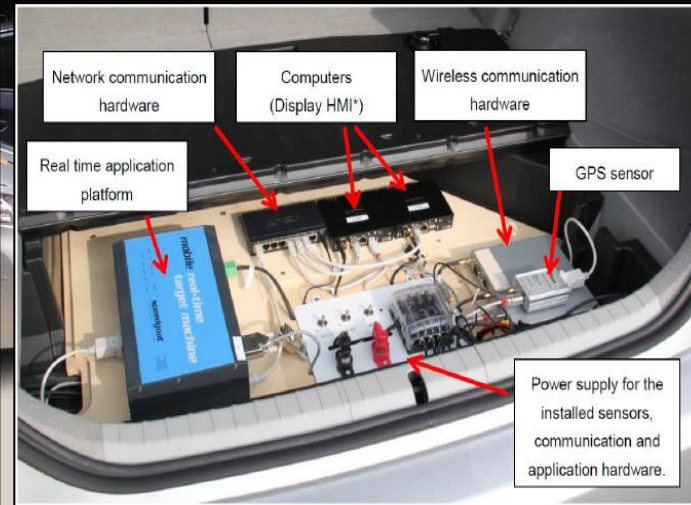
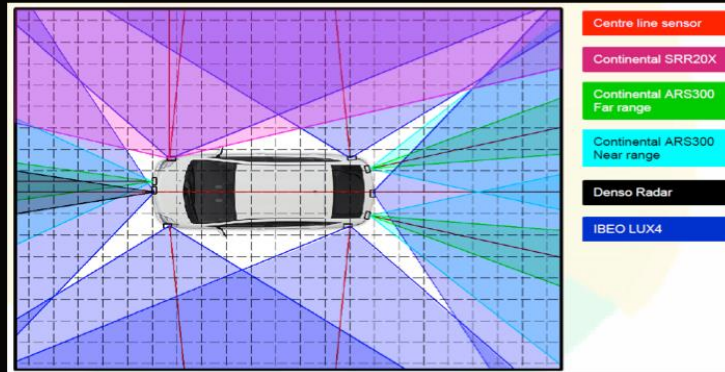
**Test Program Consultancy**  
Functions - Protocol – Test Matrix

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**Test Track Design Consultancy**  
Requirements/Layout AD & Connected



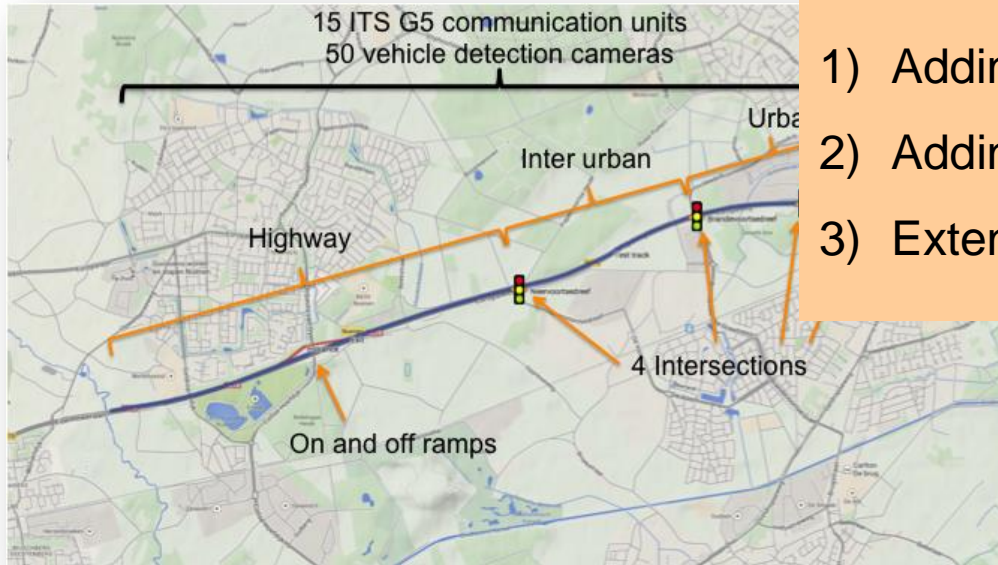
# Carlabs: Rapid Prototyping Platform






# Dedicated test-site for Automated Driving

## A270 in Helmond

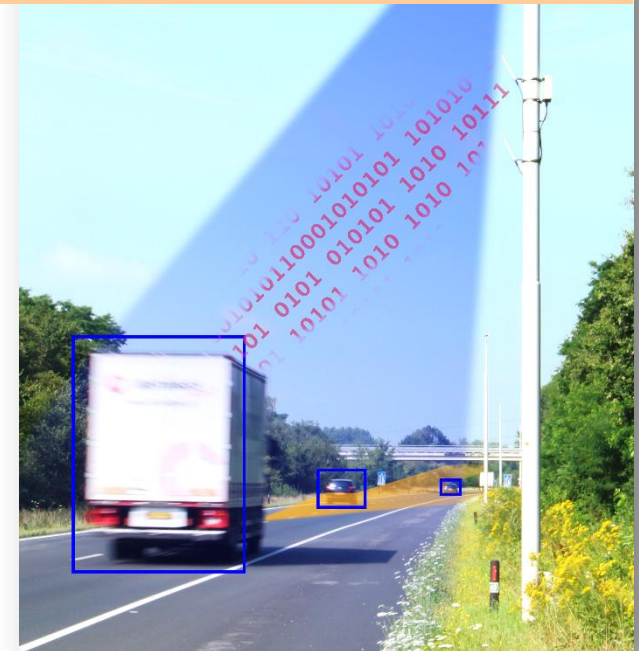


### Next Steps:

- 1) Adding **5G** Capabilities 
- 2) Adding Automated Valet Parking
- 3) Extending Scope to 70km test bed



**Roadside equipment**  
50 fixed cameras @ 100m  
9 dome cameras @ 500m  
15 ITS G5 CCUs @ 500m  
1 dGPS base station





**TASS International's A270 facility is an integral part of the 70km long open test environment that will be established in the Eindhoven region from 2018 onwards**

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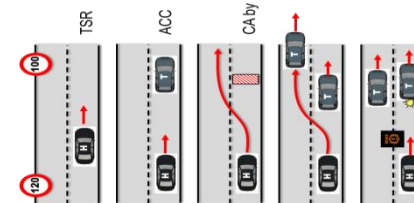
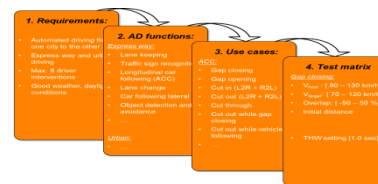
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4

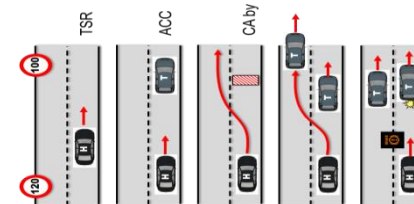
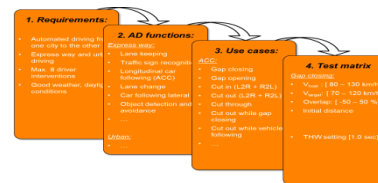
**Technical Service for Certification**  
Vehicle & Infrastructure Type Approval

5

**Test Program Consultancy**  
Functions - Protocol – Test Matrix

6

**Test Track Design Consultancy**  
Requirements/Layout AD & Connected



# AD Testing Services Overview

1

**ADAS validation:**  
UNECE, EuroNCAP testing programs

2

**Automated Driving validation:**  
Positioning, Sensor referencing etc.

3

**Connected Driving validation:**  
Positioning, Timing, DSRC & LTE Comms

4

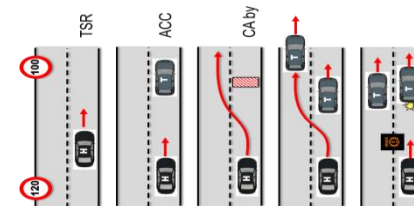
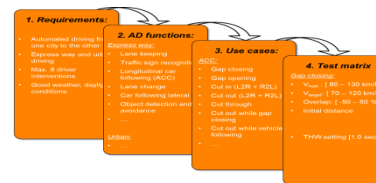
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- Current test-tracks are typically designed for single vehicle tests such as:

- ✓ Durability tests
- ✓ Noise Vibration & Harshness (NVH) tests
- ✓ Ride & handling tests
- ✓ Skid tests
- ✓ Etc.



- But typically lack capabilities for:

- ✓ Testing the vehicle's environmental perception (e.g. performance of camera, radar, lidar)
- ✓ Testing the interaction of the vehicle with the road-infrastructure (e.g. kerbs, guard rails, traffic lights, railway crossings, sources of DSRC radio disturbances & GPS inaccuracies)
- ✓ Tests with large amounts of vehicles (e.g. 10 to 100 vehicles)
- ✓ Tests with other types of road users (e.g. motorcycles, trucks, trains, pedestrians, bicycles)
- ✓ Tests with multiple (competing) companies (e.g. interoperability tests)







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