WORCS 2013

Toward vehicle automation
ADAS, the new challenges

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The Automotive Industry challenges
The 4 Megatrends

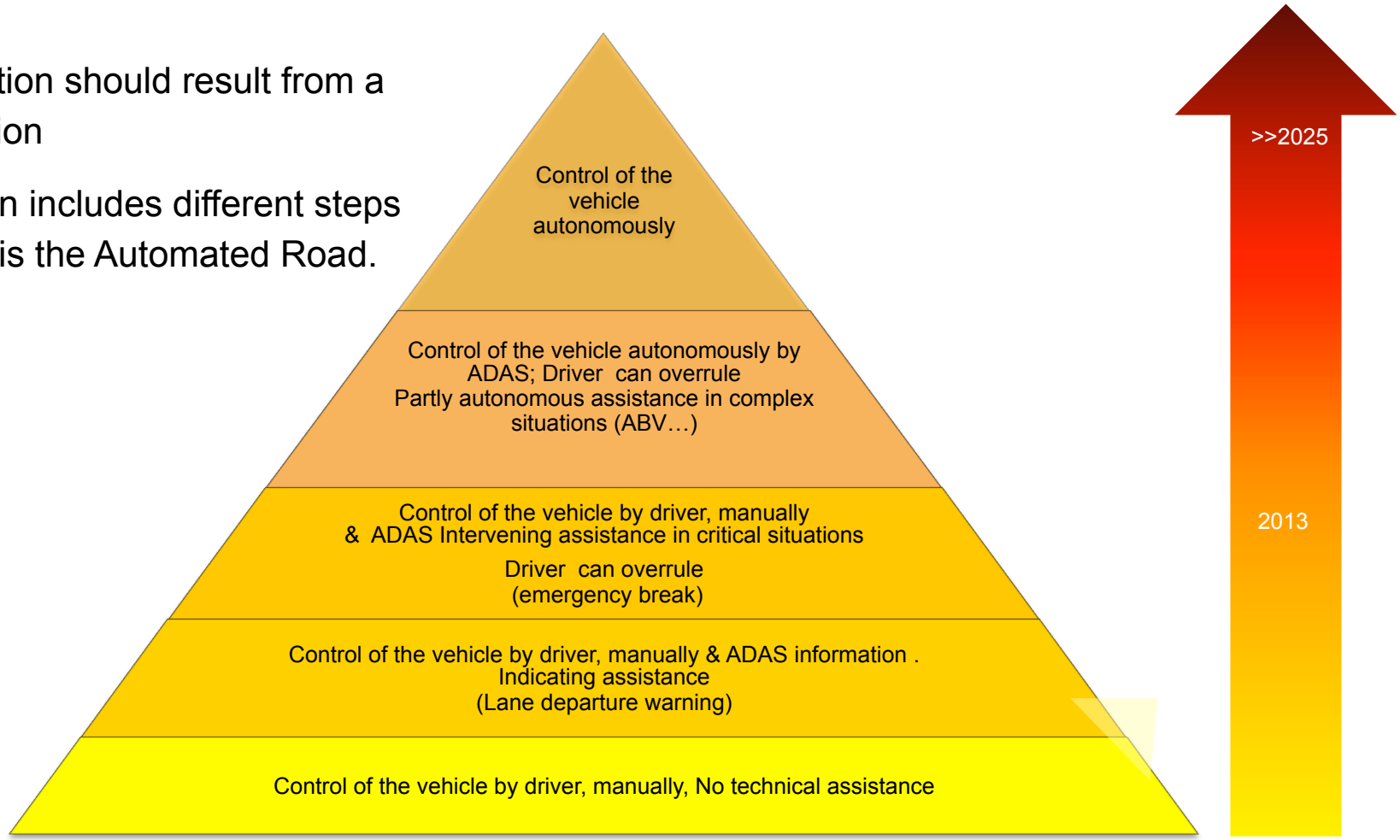
Innovative solutions must be provided to optimize the use of individual vehicles considering three criteria: Safety (zero accident), Mobility (zero congestion), Weak environmental impact

The Automotive Industry challenges
The Vehicle Automation

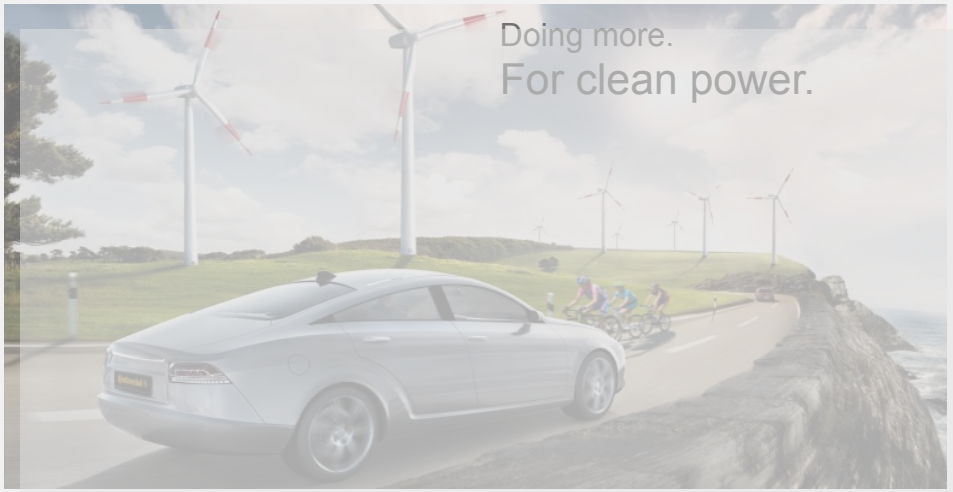
Vehicle automation proposes a global answer to these challenges

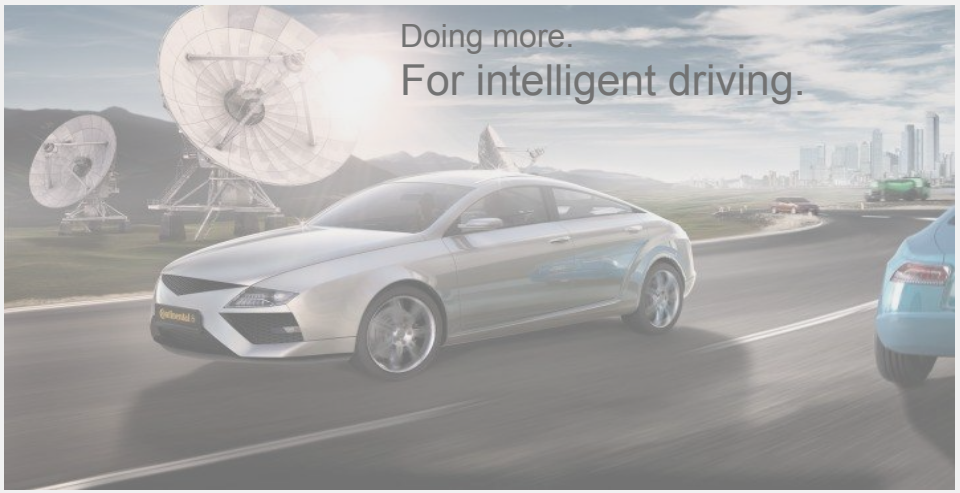
The Vehicle automation should result from a progressive evolution

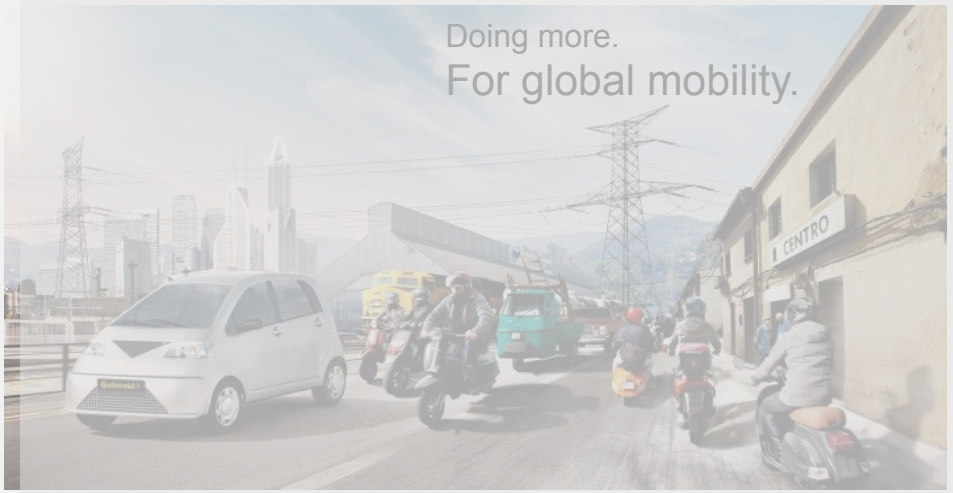
- Vehicle automation includes different steps which higher level is the Automated Road.



The 4 Megatrends in the Automotive Industry
“Safe Mobility” and ADAS technologies



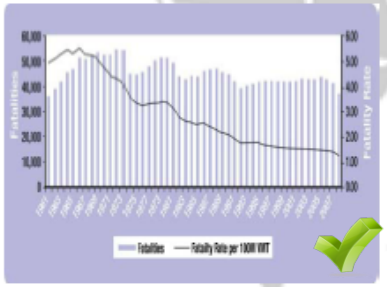




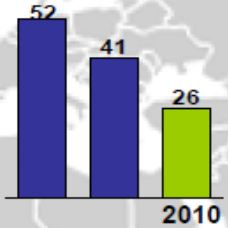
“Safe Mobility”:
A global challenge…

>1 000 000 fatalities /

US Fatalities Per year <34,000



EU Fatalities Per year (000’s)



Asia Fatalities:

Increase of >20%

(source: WHO, 2009)

Division
Busines
January

“Safe Mobility”:
State of the art and the ambitions…

In OCDE countries, the road fatalities have been drastically reduced these last 10 years thanks to

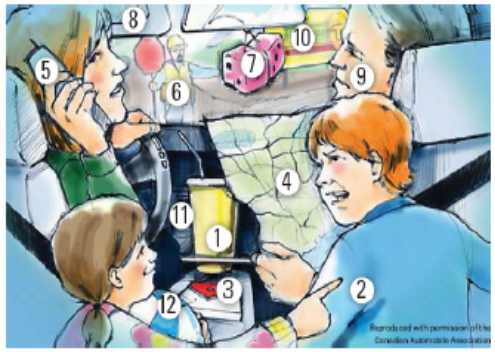
Education and Training, Awareness campaigns, repression and regulation, improved road infrastructure, technological solutions have contributed to this improvement

Europe has the ambitious objective to continue these efforts dividing by two the number of fatalities on its roads within the next 10 years (from 34 000 to 17 000) focusing on inter vehicle accidents, accidents between vehicles and other road users (e.g. VRUs).

Focus will be on the integrated safety associating active, passive, post crash safety and interactivity between the vehicles, the infrastructure and the other road users

Statistics demonstrate that driver’s behaviors are the direct or indirect causes for nearly 90% of accidents

Drivers’ behaviors are the major causes of road accidents



- Bad perception and/or bad knowledge of the driving environment
- Low training ("Sunday" drivers, young drivers, etc)
- Over/under working load
- Socio-economic pressure
- Reduced physiological state (drowsiness...)

- Reduced physical or psychological state(elderly, look but not see…), Driving errors due to distraction
- …

Most of the experts agree that the progressive deployment of passive safety and now active safety systems and in particular ADAS, will efficiently help the driver and contribute to road accident reduction

“Safe Mobility ”
From Passive and Active Safety Systems

ADAS Applications

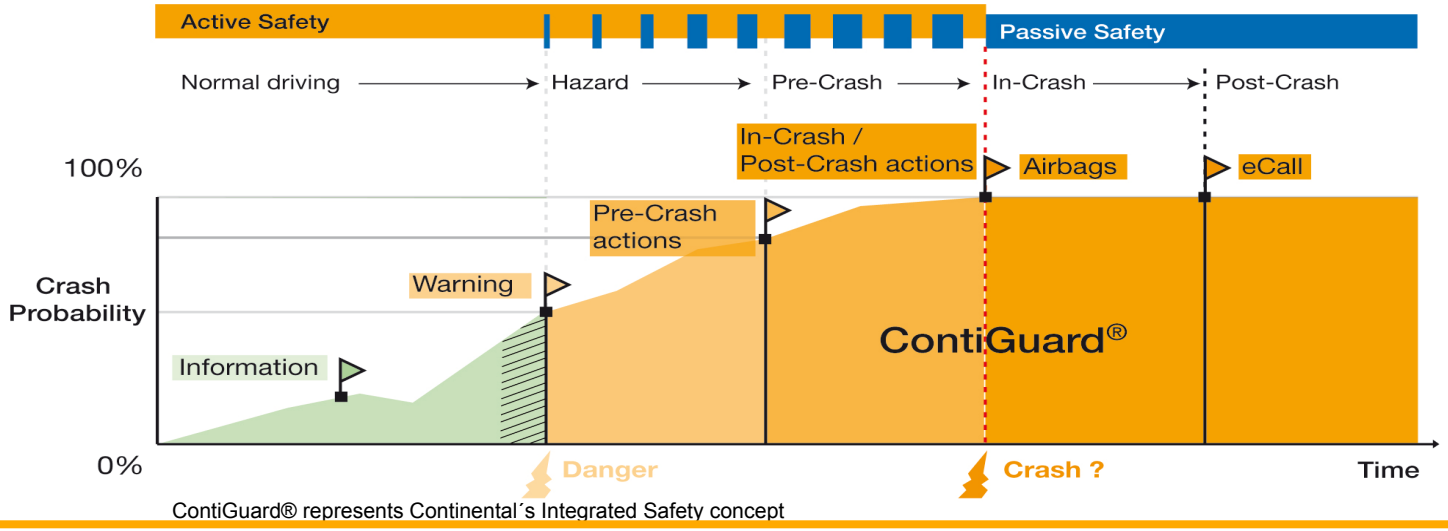
Information

Pre-Crash Action

Accident Prevention

In-Crash Action

Post Crash Action



ContiGuard® represents Continental´s Integrated Safety concept

The active safety systems
ADAS functions overview

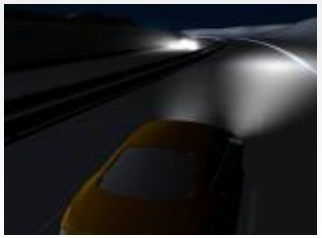
Adaptive Cruise Control
Stop and go

Emergency Brake Assist
Autonomous emergency braking

Blind Spot Detection
Overtake checker

Lane Departure Warning
Lane keeping

Pedestrian & Crossing Traffic Detection



Intelligent Headlamp Control

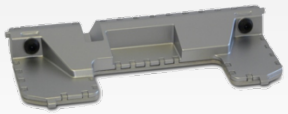
Traffic Sign Recognition

Long Range Radar
Environment Sensor 77GHz

Short Range Lidar Sensor

Short Range Radar Sensor
24GHz

Multi Functional Camera



Stereo Camera

The active safety systems
ADAS and vehicle automation challenges

Technical performances of ADAS technologies are very

promising and are still improving

But

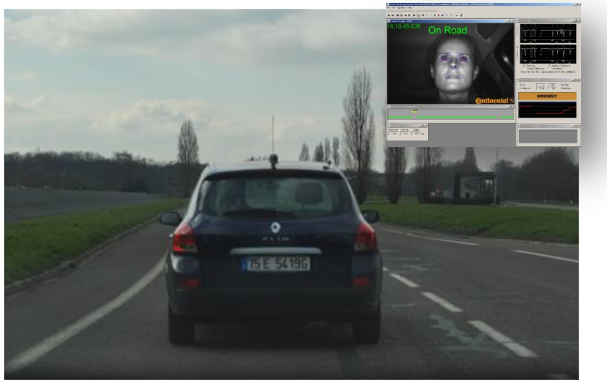
they are providing new challenges

Technical

Human factors

Legal issues

…..



ADAS and vehicle automation challenges
Technical and legal issues

Technical issues

- ✓ System and component reliability and integrity
- ✓ Inappropriate activation (false detection…)
- ✓ No activation (non detection…)
- ✓ Safe and low cost architecture
- ✓ ……

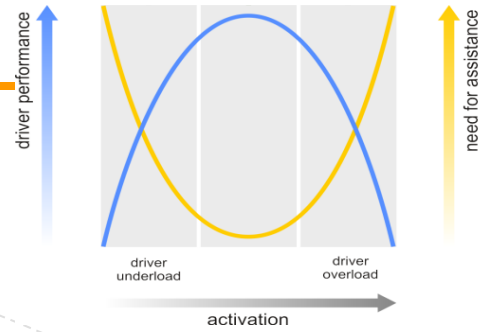
- ➢ Sensing performance improvement
- ➢ Multi source information – redundancy Camera+Lidar; Camera+ Radar, Stereo camera, for example obstacle detected by the radar and need confirmation from the camera before taking any action
- ➢ Parallel processing
- ➢ Detection of non operational situations, (camera blockage…)
- ➢ Internal diagnostic process
- ➢ Functional Safety (ASIL) Automotive Safety Integrity Level
- ➢ …..

Legal issues

- ✓Who is responsible in case of accident ?

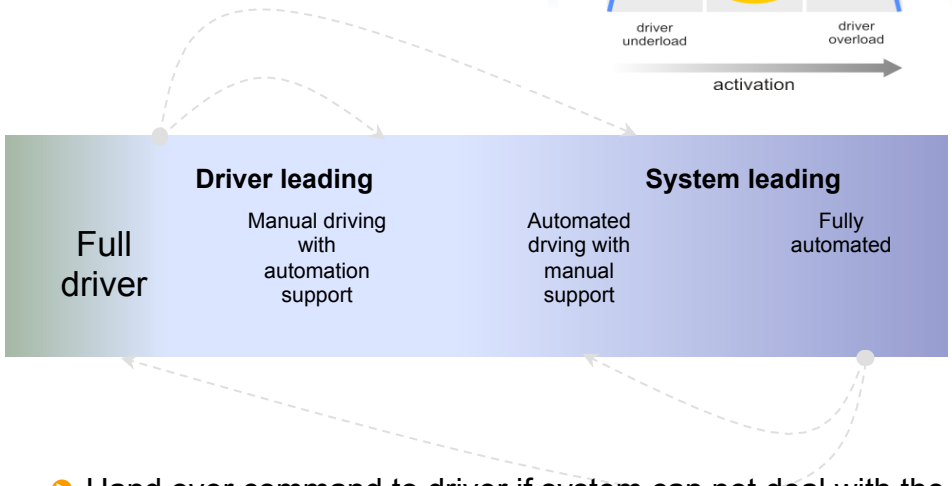
- ➢ Vienna convention establishes that driver must always have the control of their vehicle

ADAS and vehicle automation challenges
Raising problems



Migration from a fully active driving to an assisted / autonomous driving rises new problems

- Trust
- Comprehension,
- Conscience of activated modes,
- Authority
- Situation awareness,
- Workload and capacity of attention especially during transition phases (Automatic to manual and vice versa),
- Acceptability and usability (older population, …),



- Hand over command to driver if system can not deal with the situation
- Assist the driver or even take control if driver can not handle the situation

ADAS and vehicle automation challenges
The safety research trends and gaps

- Reliable and safe systems are mandatory
- Optimize interaction and task repartition between driver and ADAS as a “co-pilot “ (Degrees of freedom…)
- Keep the driver appropriately in the loop (enhancing system acceptance)
- Integrate at the early stages of the system design safe and harmonized interactions with the driver:
- Organization and priorization of the information delivered to the drivers provided through unified human Machine Interface focusing on transparence and personalization.

Continue the improvement of ADAS technologies

New Human Machine Interaction concepts

Achieve reliable and robust models and monitoring of the driver

Multi modal interfaces

ADAS and vehicle automation challenges
The safety research trends and gaps

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Continue the improvement of ADAS technologies

New Human Machine Interaction concepts

Achieve reliable and robust models and monitoring of the driver

Multi modal interfaces

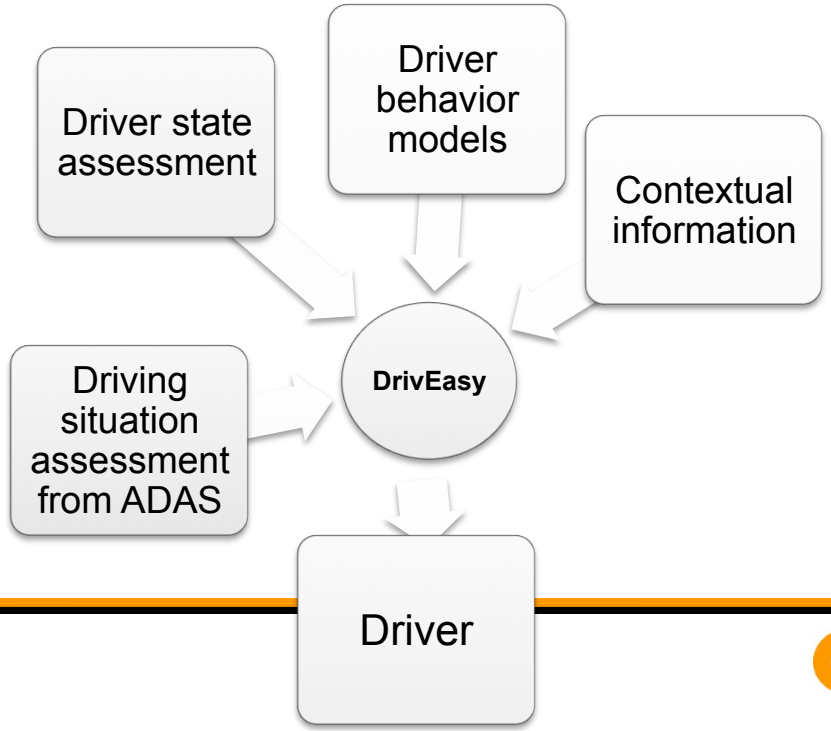
Objectives

A first Human Machine interaction concept

From a simple design process: “one function = one interface".

To a global approach that allows considering the human dimension, driver situation, capacity, needs and requirements

It assumes that a good knowledge about the driver is available



Adaptive Human Machine Interaction
Requirements

- Provide the best assistance, to all drivers, adapted to the situation (driver state, environment)
- Create an emphatic relation between the system and the driver to encourage ADAS usage in a permanent way acting on the long term behavior (prevention)
- **Increase ADAS acceptability (adhesion of drivers)**
- **Improve driver situation awareness in case of fault or impairment**
- Configure assistance in relation with driver's understanding, capacity, availability
- Take into account the individual wishes of the driver
- **Autonomously decide *when* and *how* the driver has to be informed about the current issues.**




Continental

Adaptive Human Machine Interaction
Concept

Driving performance

- Tailgating
- Speeding
- Lateral positioning

Risk assessment

Driver state assessment

- Drowsiness diagnostic (eyelid)
- Visual Time Sharing diagnostic
- Visual Distraction diagnostic
- Cognitive diagnostic (Phone)

Diagnostics

Driver models

- Driver situation assessment
- Driving style assessment

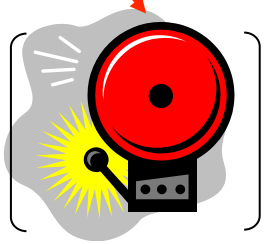
Driving behaviors

Main trigger

Driver state assessment

Decision
Rule
Use cases

Adaptive
ADAS
Warnings



Driver Wishes

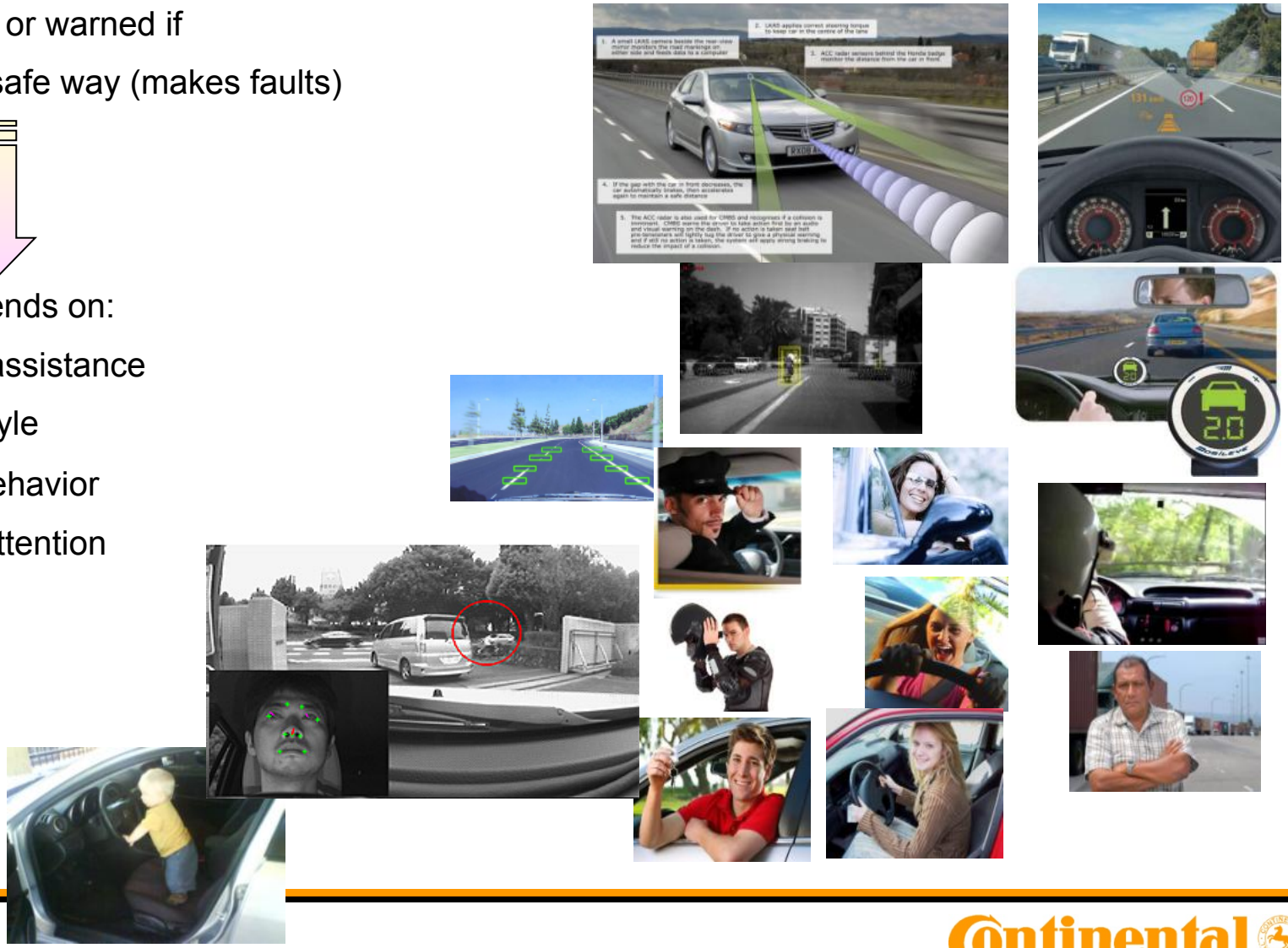
Adaptive Human Machine Interaction
Principles

The driver is informed or warned if

He doesn't drive in a safe way (makes faults)

The alert level depends on:

- His wish for assistance
- His driving style
- His driving behavior
- His level of attention

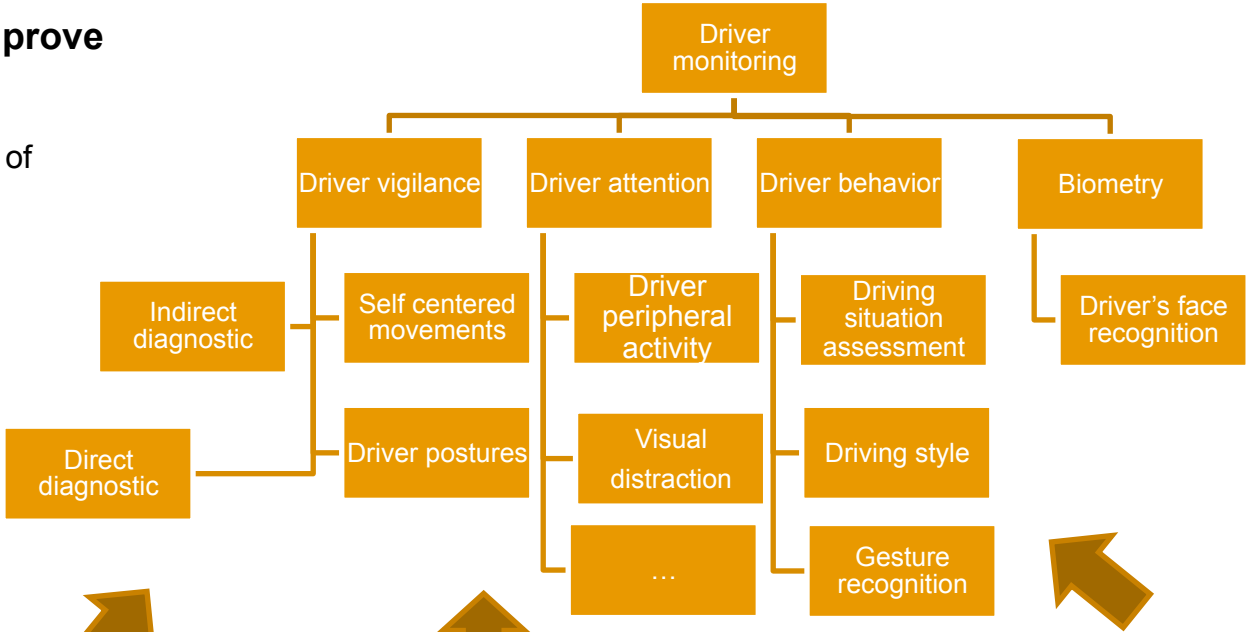


Driver state assessment
Driver Monitoring & modeling

Brick building approach to improve knowledge about the driver

Identification and real time extraction of

pertinent parameters



Physiological Behavior

Breath, Hearth frequency

EEG/EOG

. . .

Eyelid movement

Driver attitudes

Head pose, Eye gaze, attitudes

and postures . . .

Driver behavior

Steering, Pedal, Control panel, Phone. . .

Vehicle behavior

Lane position, Car to car distance, Vehicle speed

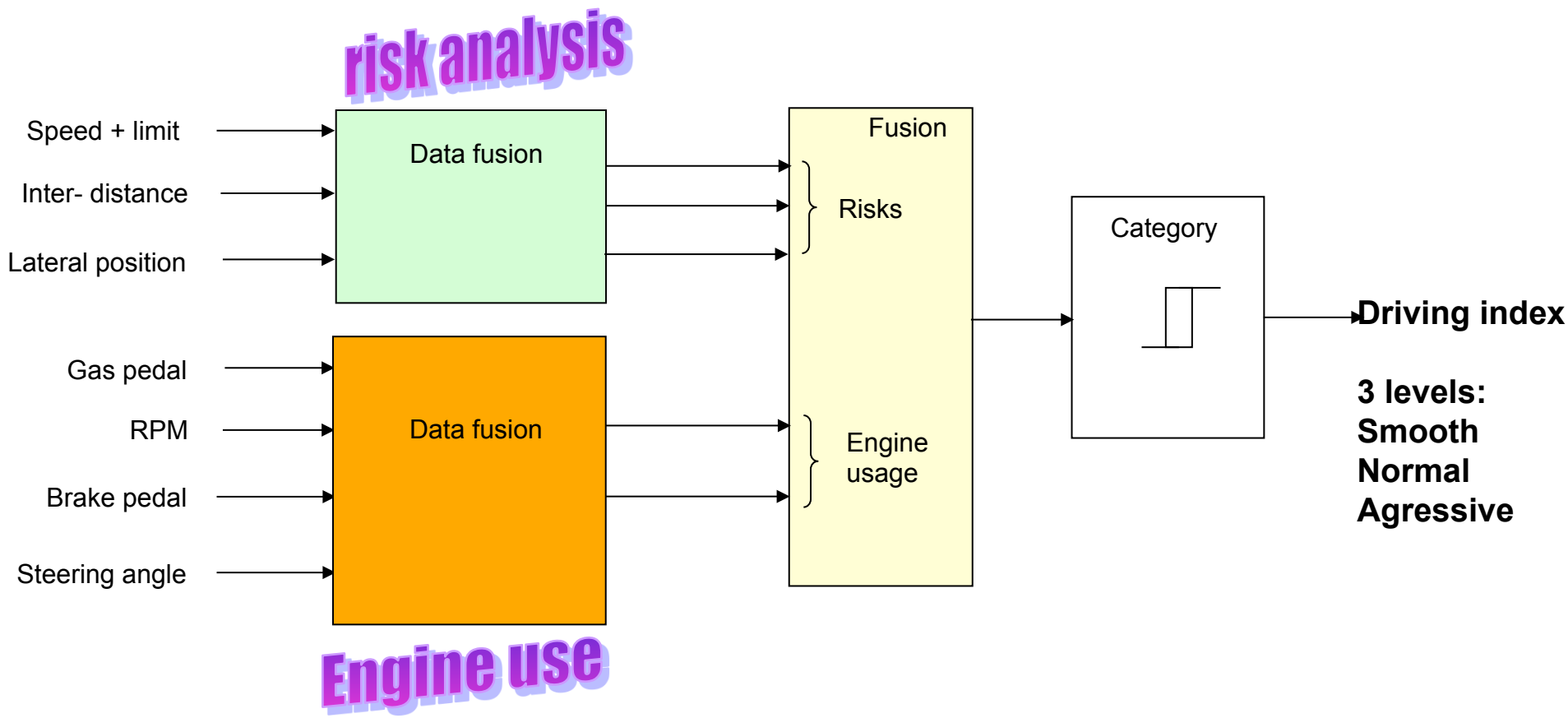
. . .

Intrusiveness

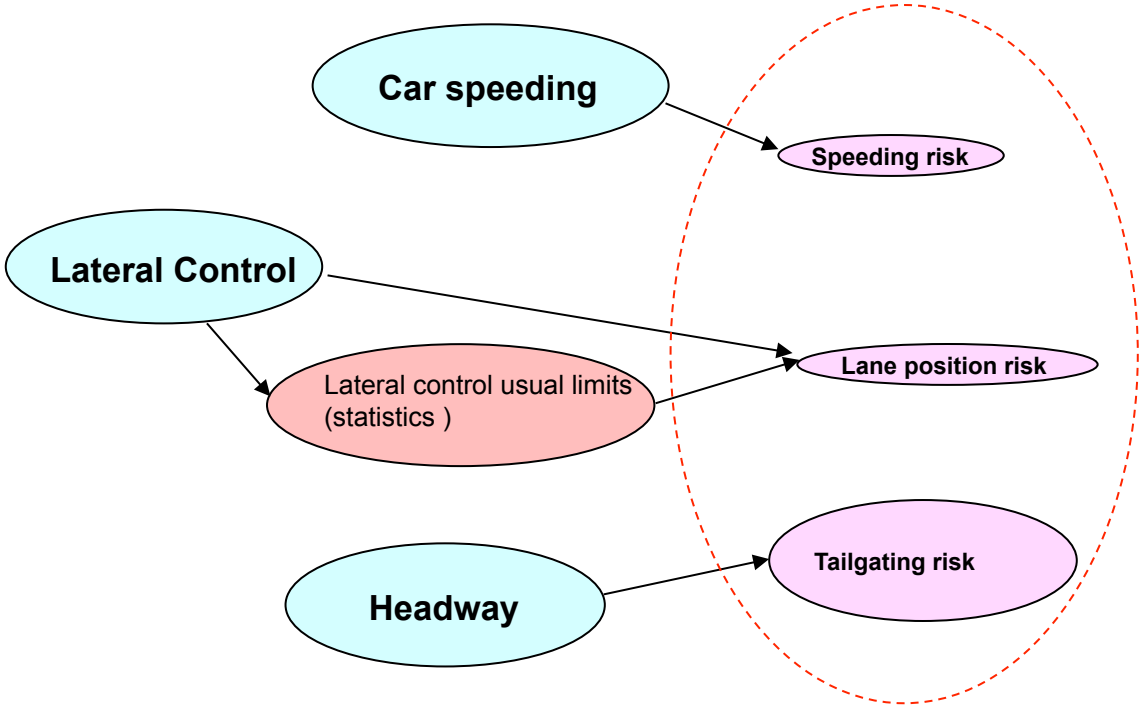
Some Challenges

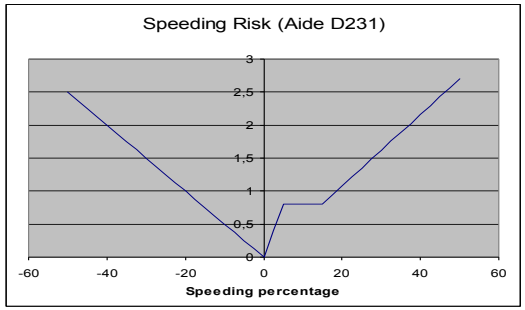
- Non-intrusive measurement set up
- Deal with complex and disturbed environment
- Drivers diversity and variability
- Drivers acceptance
- Realistic and reliable evaluation methodologies
- Real time processing
- Automotive constraints, cost size, robustness condition of use

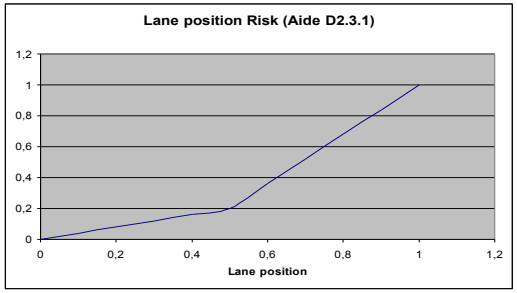
Driver models
Evaluation of the driving style and behavior

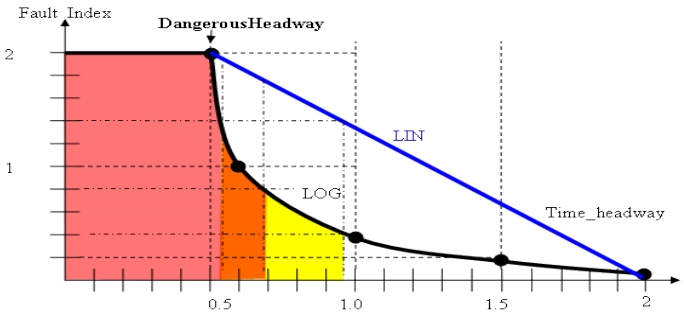


Driving performance
Assessment of risk indicator









Driver wishes
Principles

Driver "**WISH**"

Volunteer personalization

Assistance level

(supported by driver identification or setting)

No Assistance

Silent care
Act to avoid crash

Low Assistance

Inform only on problems
Only critical warnings

"Normal" Assistance

display only abnormal errors
Soft warnings

High Assistance

Care for safety
Tight settings official rules
Maximum support (intrusive)

ECONOMY

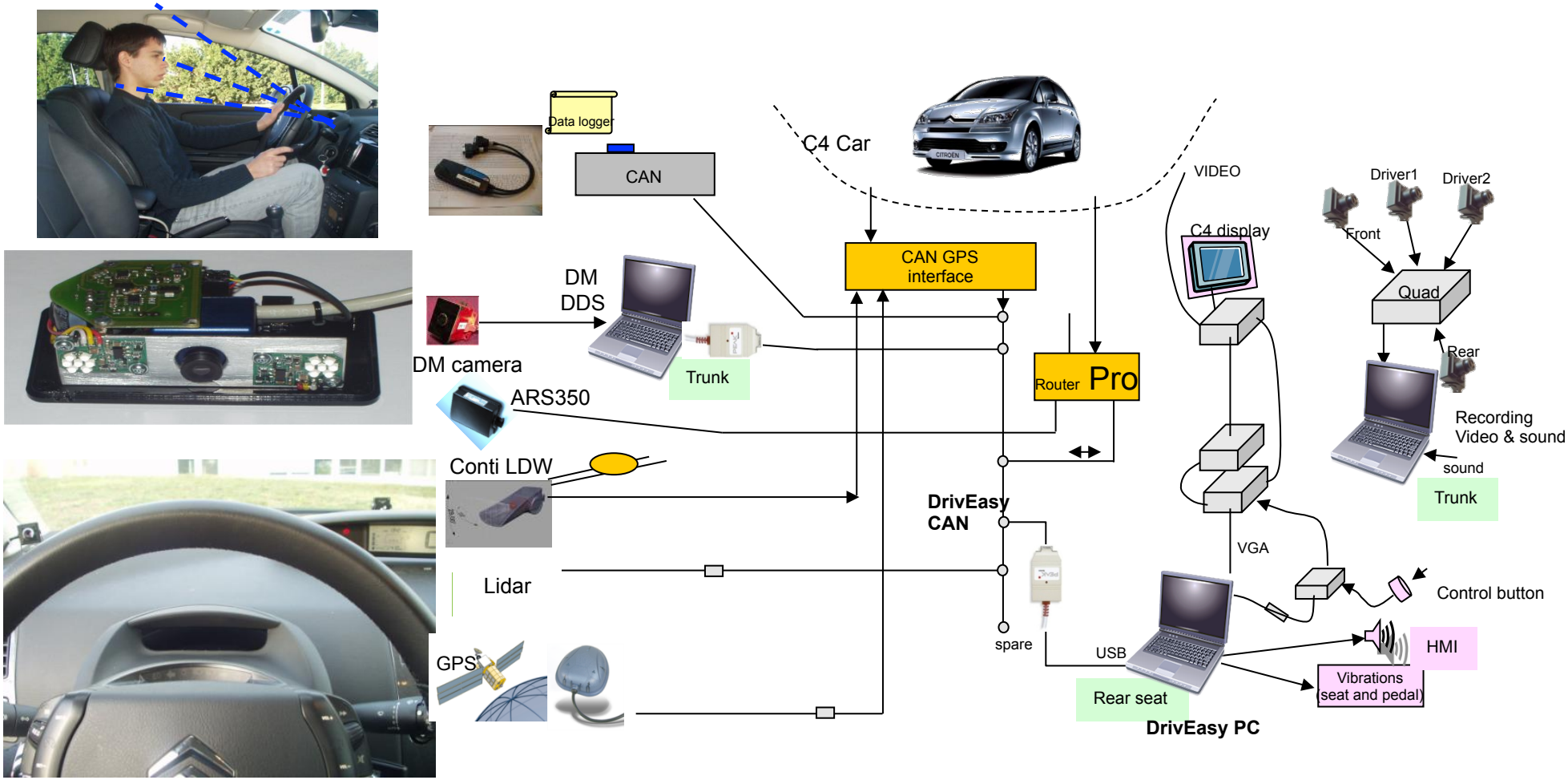
High+
Give some guidance towards engine and gear usage
Maximum support (intrusive)

Driver support

(idea: non assisted ➔ assisted)

Each warning / information can be deactivated

DrivEasy
Vehicle implementation



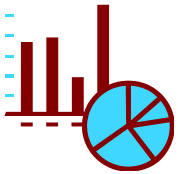
DrivEasy
Description of acceptability study

- Open road ➔ city + normal road + Highway portions
- Former presentation to explain the options to the user

- Free usual driving is asked for
  first part of the test without DrivEasy;
  then way back with DrivEasy

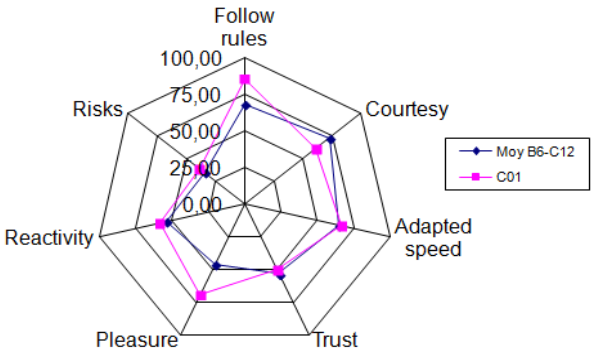
- Small number of people ➔ 15 tests
- Questionnaire at the beginning before driving,
  then after driving; each warning is quoted

- Recording of all parameters + quad video recording (further processing)
- Statistics on the questionnaires is the result of the study



DrivEasy
Driver C01 synthesis

Questionnaire road perception before driving



Driver : **C01**

Questionnaire before driving road perception

C01	Moy B6-C12	C01
Follow rules	68,17	85,71
Courtesy	72,41	61,11
Adapted speed	65,00	66,67
Trust	52,78	50,00
Pleasure	45,83	68,75
Reactivity	53,61	58,33
Risks	34,63	38,89

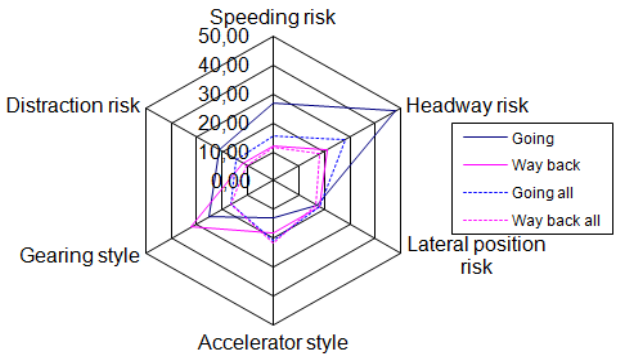
Usual driving style /10: 7

Assistance wish way back: Fort

Great efficiency for:
- headway reduction
- Over Speed reduction

In spite of a willingness to “push”

Mean risks during road test



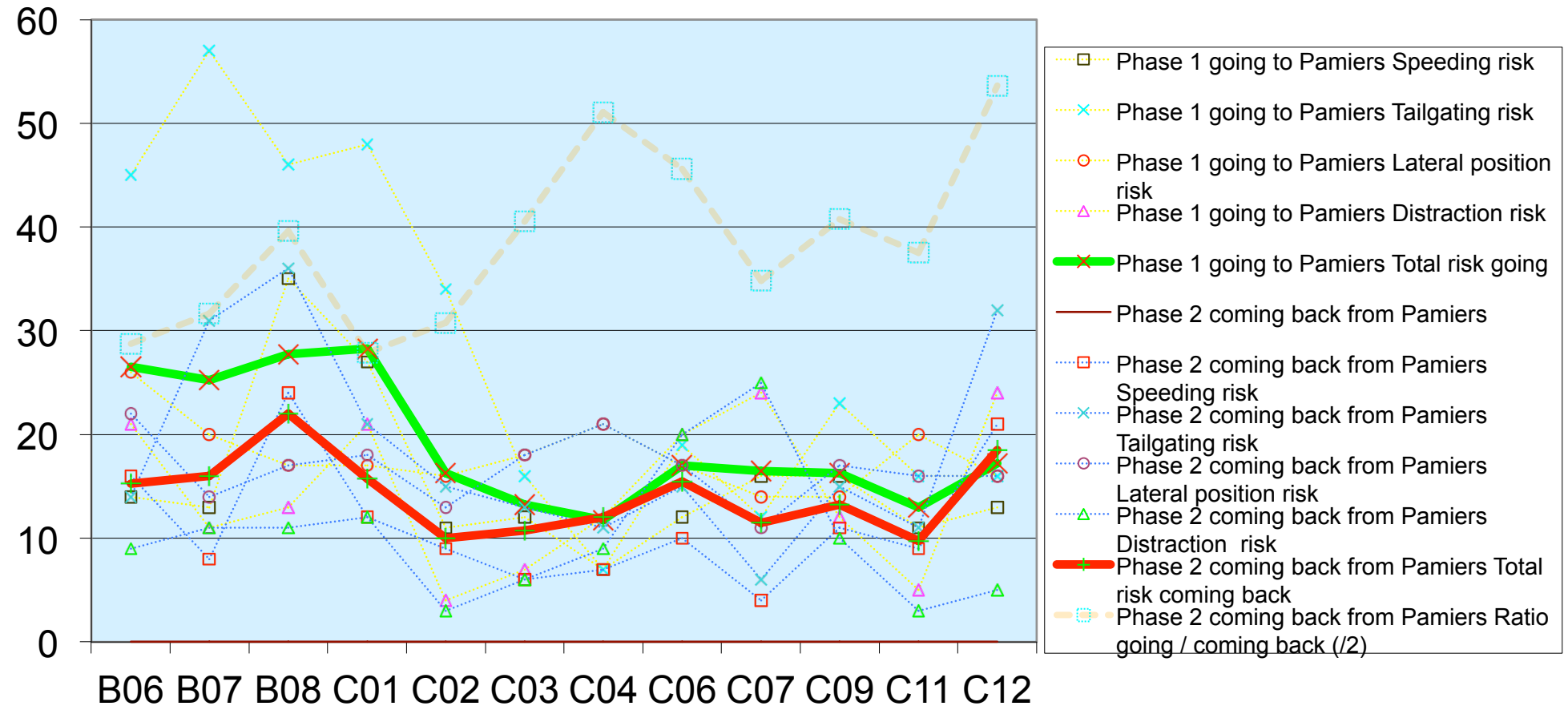
Means using Matlab computation for road test / On tests with DrivEasy

C01	Going	Way back	Going all	Way back all	
Speeding risk	27,00	12,00	15,58	11,42	
Headway risk	48,00	21,00	28,25	18,33	
Lateral position risk	17,00	18,00	18,00	16,67	
Accelerator style	13,00	18,00	20,75	21,75	
Gearing style	25,00	32,00	16,42	16,42	
Distraction risk	21,00	12,00	14,50	10,33	
Test duration (s)	3243,00	3350,00	3356,33	3411,50	0 H 54 mn 3 s going
Mean speed	72,00	70,00	69,17	68,75	0 H 55 mn 50 s way back
Fuel consumption (litres)	5,19	4,99	4,96	4,72	
Météo:	Couvert	Couvert			
Declared driving style /10:	6	4			
Efficiency (km/h per litre):	13,9	14,0	13,9	14,6	
Mean risks:	28,25	15,75	19,08	14,19	

Comment going to Pamiers: 0
Comment way back: 0
General comment: Lunettes et penché de tete pour doubler

Risk analysis

Benefit between 18 et 50% for 75% of tests



DrivEasy
Benefits

Without DrivEasy:

- Each sensor / system generate warnings according to its own criteria

With DrivEasy:

- Usage of all sensors to make a decision “do we alert or not”? (according to situation)
- Warning adaptation (up to inhibition) when “at risk” situation occur
- Each driver may decide the assistance level (from zero to maximum support)
- Driver is informed of the risk without action on the vehicle, in a progressive way
- DrivEasy is aimed for long term driving behavior improvement
- Parameter settings is a compromise (neither too severe, nor too tight)
- Are people ready to accept a system which help them to be careful, to respect the law… (a comprehensive assistant)

Perspectives

The Vehicle Automation
Perspectives

Improving road safety could be partly achieved thanks to the maximization of ADAS use and more and more automatic driving operations

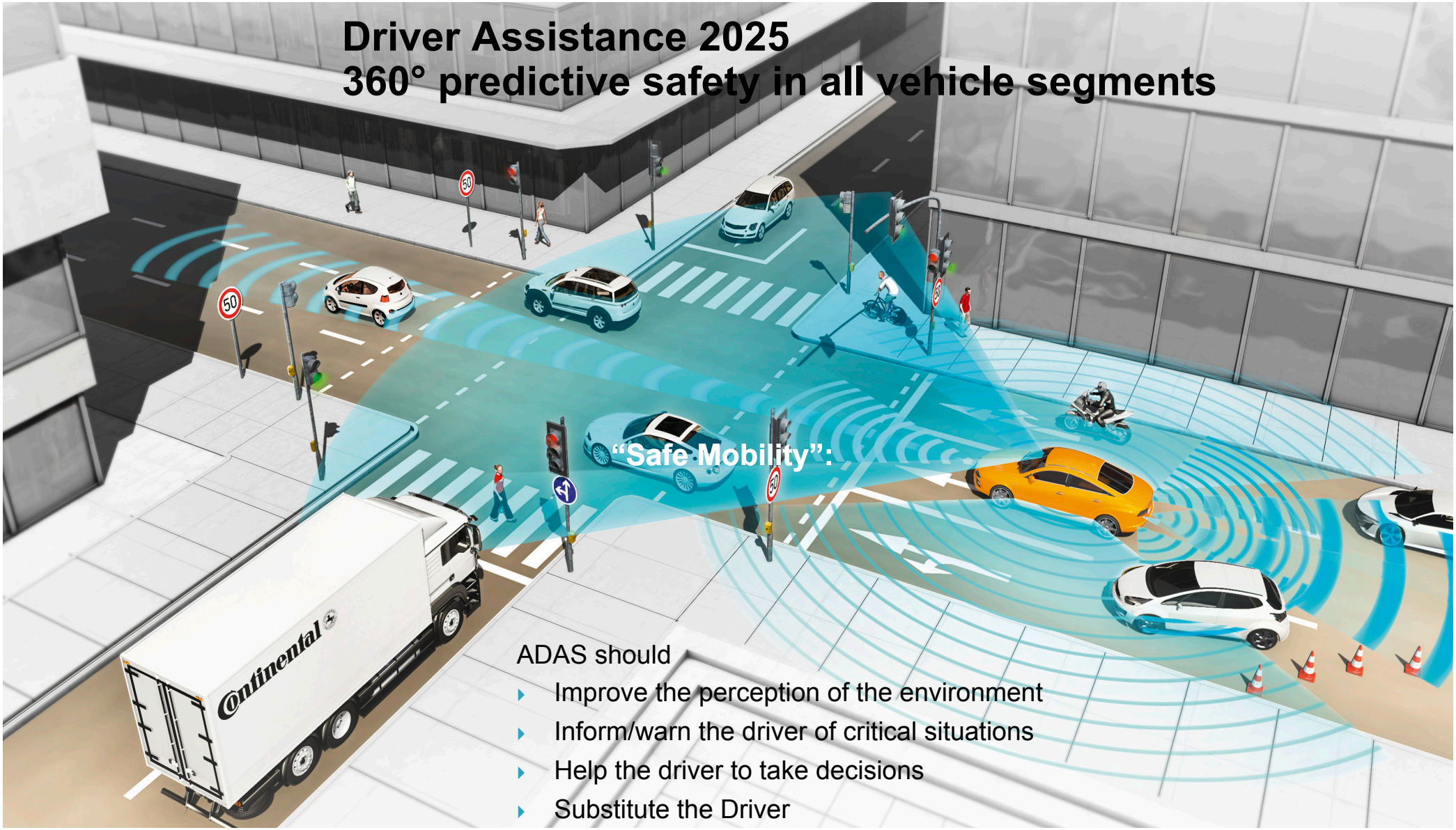
The vehicle automation deployment assumes many technical or non-technical issues to be considered :

- Increase ADAS functionalities and performances (new technologies, car to X…)
- Increase system and component reliability and integrity
- Highly reliable, standardized platform and safe architecture, for compositional development, sharing sensors, actuators and HMI, enabling the low cost development of complex driver assistance systems and applications
- Certification

The Vehicle Automation
Perspectives

- Individual, industrial, public responsibilities
- Road infrastructures improvement and adaptation
- Improve the knowledge about the driver: driver modelling and monitoring
- Consider human factors
- Define new Human Machine interaction concepts and relations between the driver and the vehicle /system to encourage the driver to use the assistances

Driver Assistance 2025
360° predictive safety in all vehicle segments

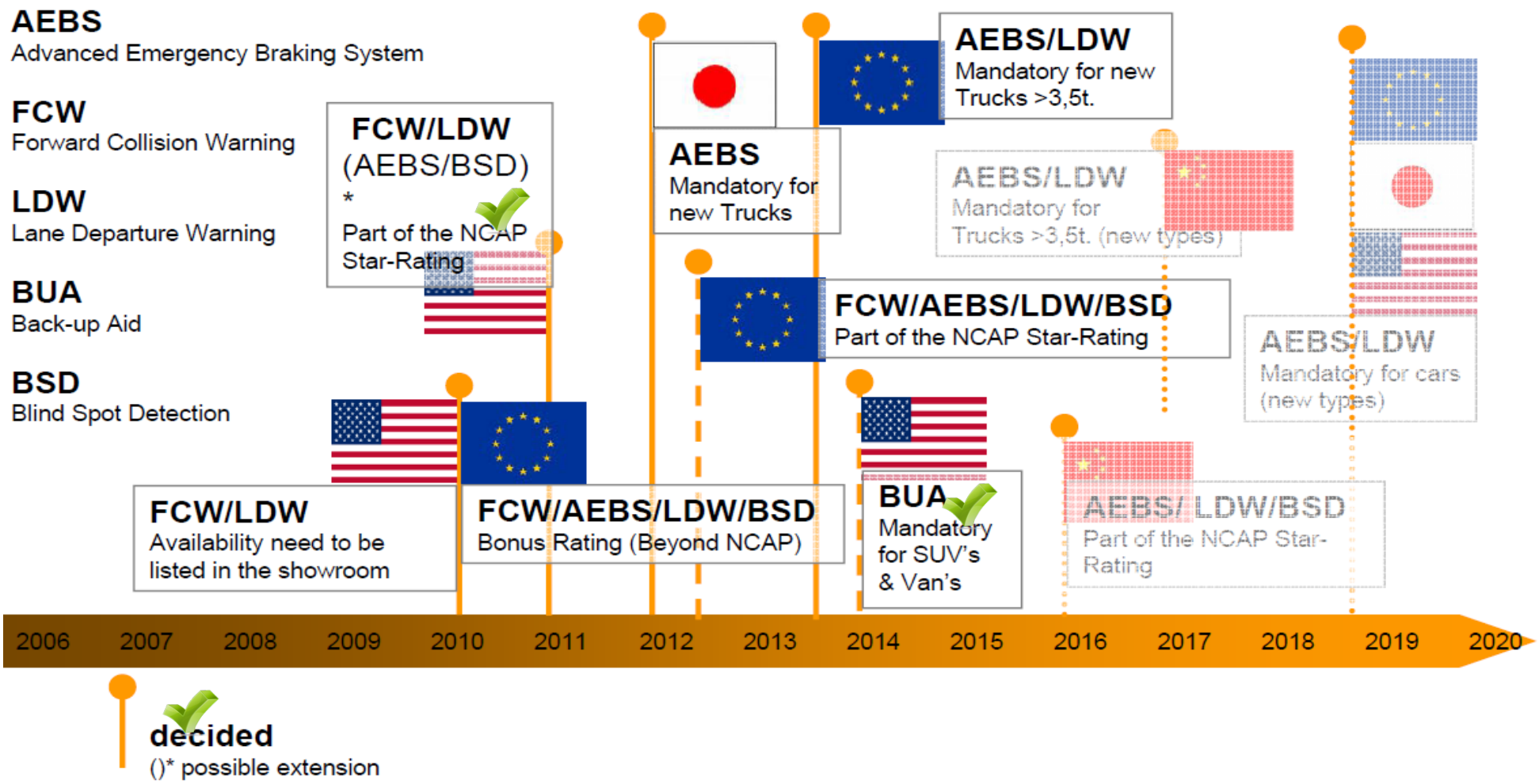


“Safe Mobility”:

ADAS should

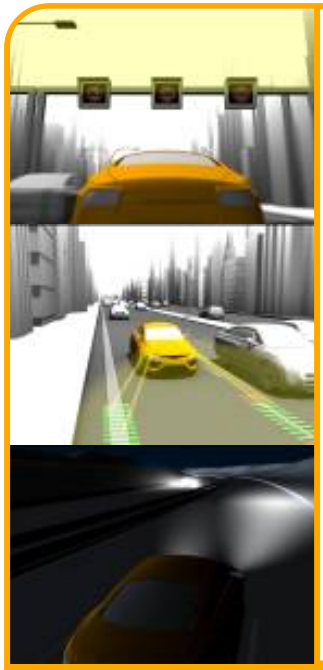
- Improve the perception of the environment
- Inform/warn the driver of critical situations
- Help the driver to take decisions
- Substitute the Driver

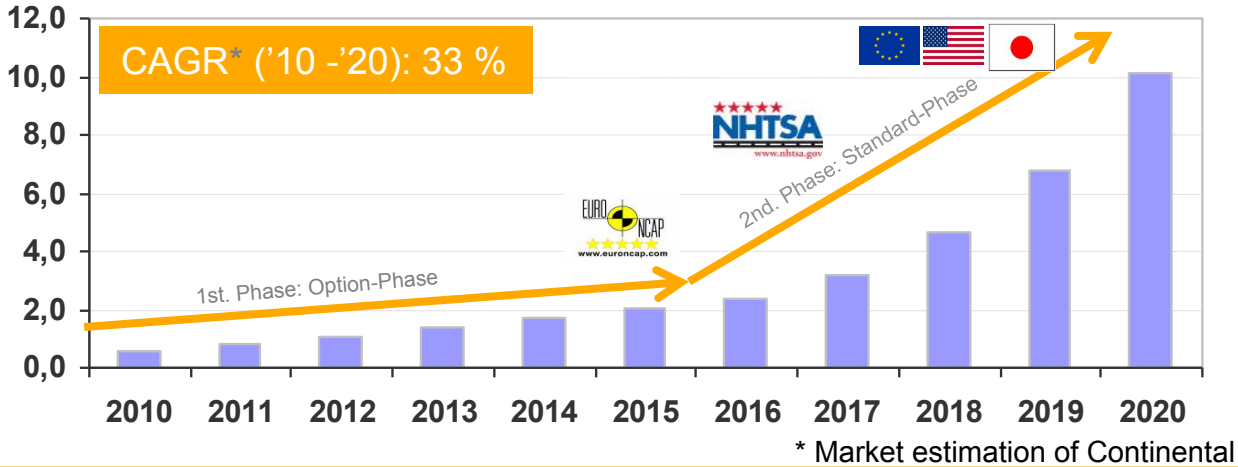
“Regulation” is Driving the ADAS Market

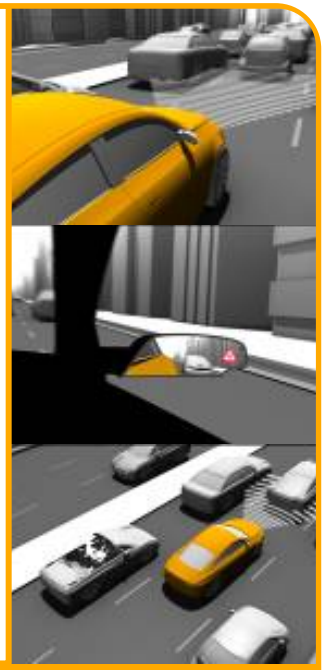


Future Market Growth Projection

Market push - New consumer ratings and expected regulations!







Market Definition: All comfort & safety vehicle control, driver warning and information systems applying surrounding sensors except short range distance monitoring systems based on ultrasonic sensors

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