Road Infrastructure
&
Co-operative, Connected and Automated Mobility (CCAM)

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3M Europe
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Overview

- ERF
- Road Safety Statistics European Union
- Mobility & Road Safety Action Plan
  - Valetta declaration of Road Safety
  - 3rd Mobility Package
- Connected & Automated Vehicles versus Road Infrastructure

European Union Road Federation

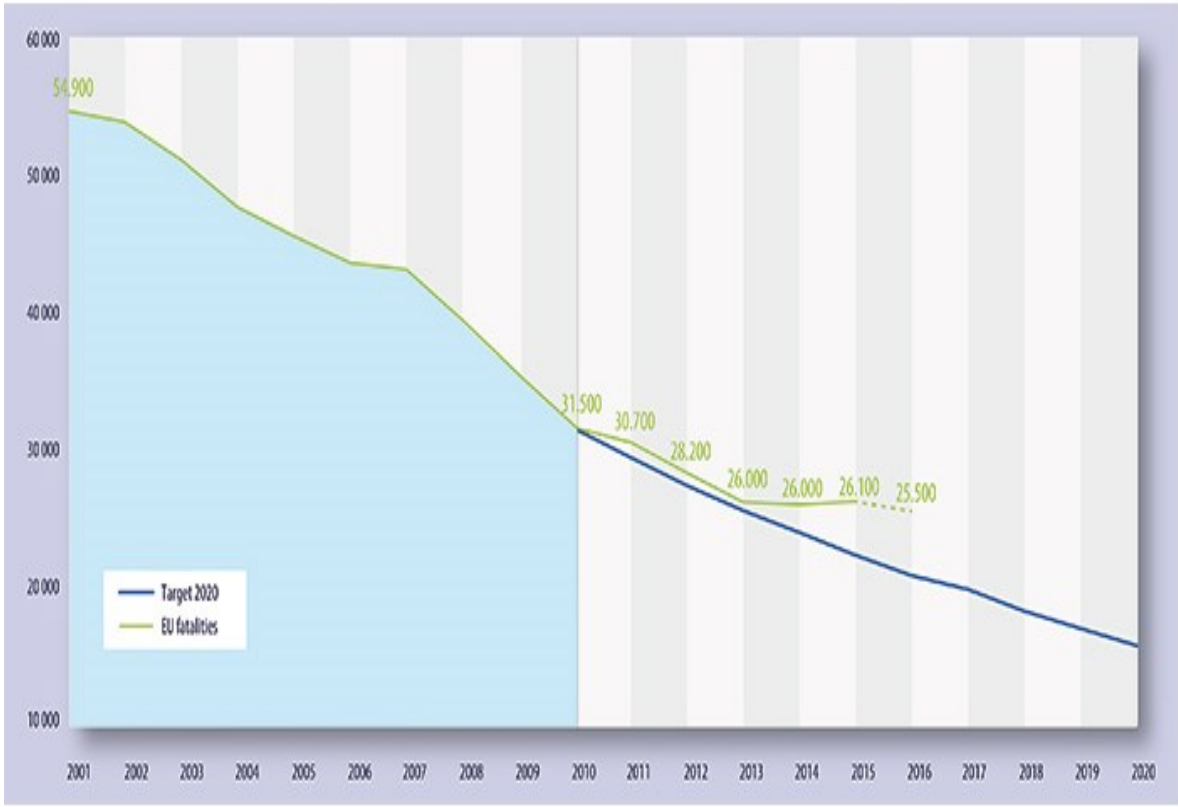
- Non profit organisation, based in Brussels, founded in 1998
- Represents the sector of the road infrastructure (63 members)
  - In the EU, towards the EU institutions and NRA
  - Outside the EU
- Defends the importance of the road network as essential part of Europe's economy and society

- 4 major Programmes
  - Road Safety
  - Sustainable Roads
  - Infrastructure & Financing
  - Smart Roads

European Union Road Federation

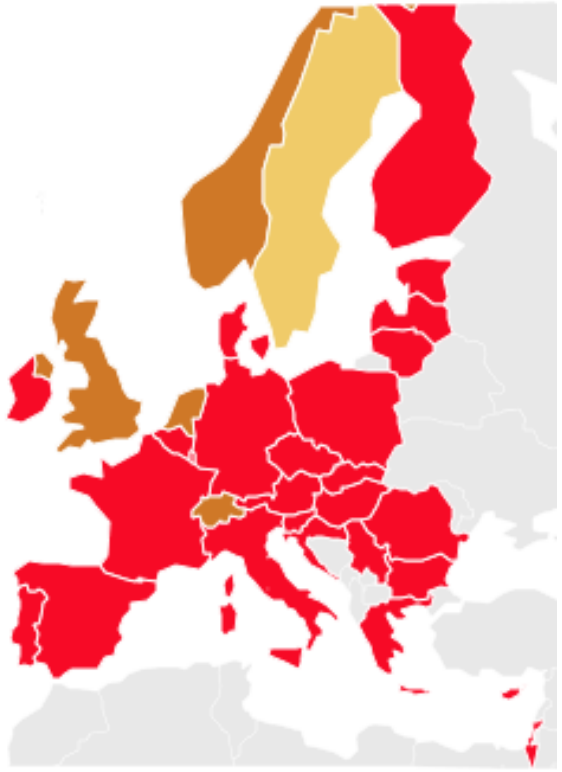
Road Fatalities : Evolution since 2001

- Only 1% reduction since 2013
- Increase in 50% of the EU Member States
- For **every death** on Europe's roads there are an estimated
  - **4 permanently** disabling injuries (>100K) such as damage to the brain or spinal cord
  - **8 serious** injuries (>200K)
  - **50 minor** injuries (1,5 Mil)
- Cost to society is € > 100 Billion

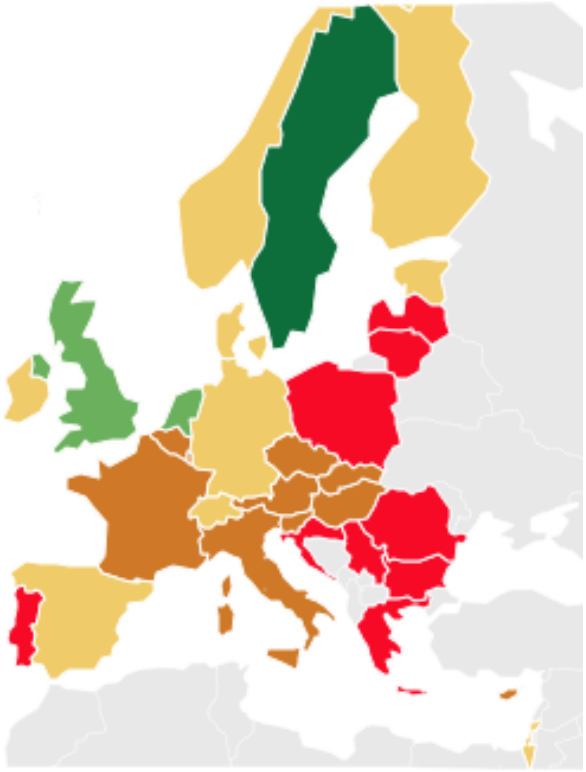


Road Fatalities per million inhabitants

2001



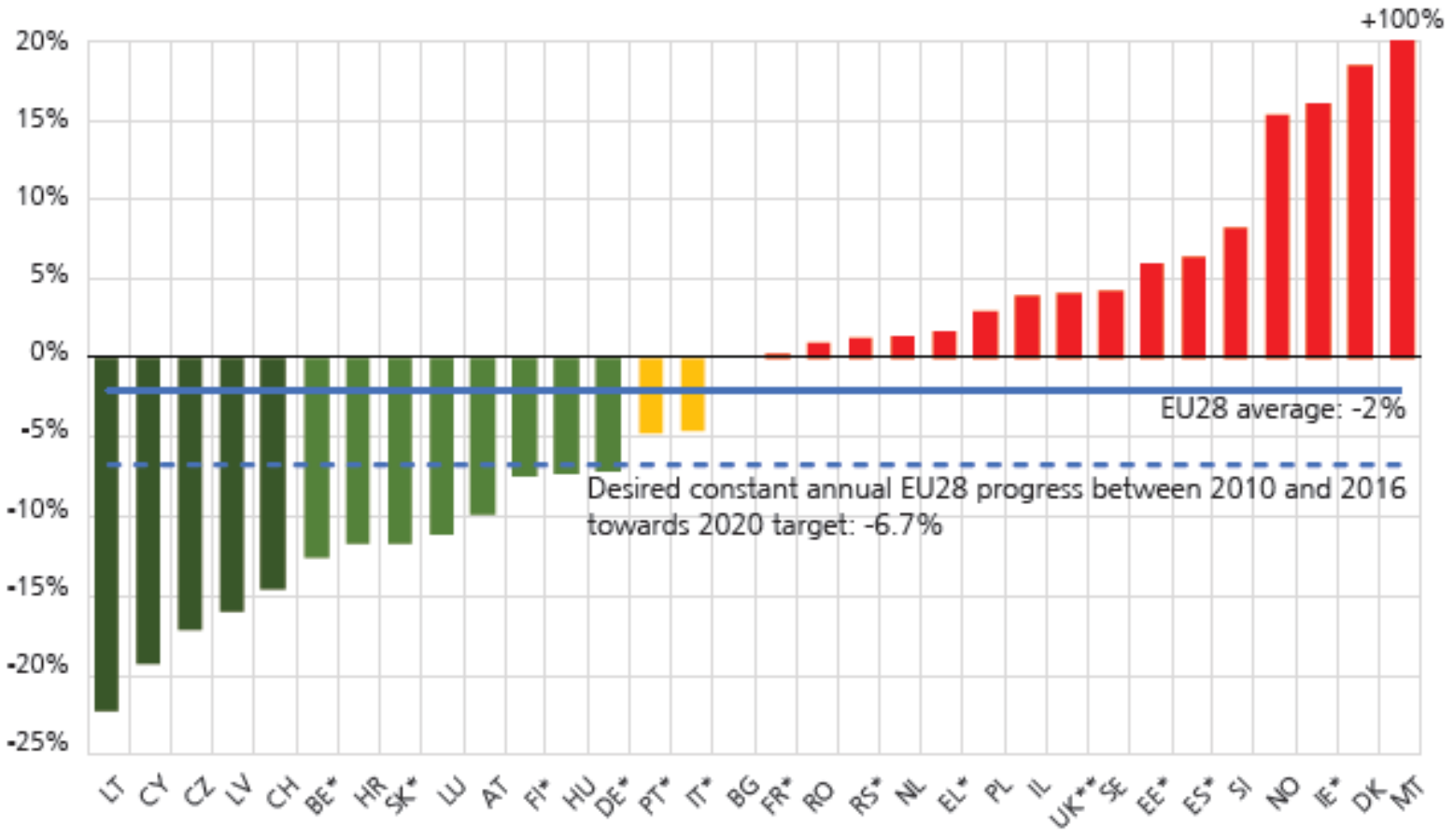
2010



2016

Source : ETSC

Road Fatalities and Injuries : Third Year of Poor Results



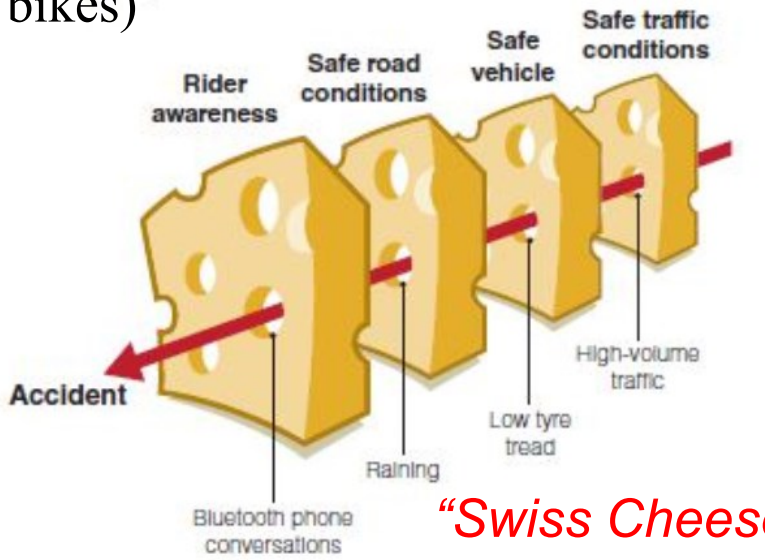
- Fatalities increase in 50% of the EU Member States
- Injuries (MAIS3+) : Average improvement : 2,2% /yr (data collection difficult & inconsistent)
- Shift from fatalities to seriously injured.
- Seriously injured still have a heavy socio-economic impact.

Source : ETSC

Valetta Declaration on Road Safety (3-2017)

Renewed commitment towards road safety initiatives by all EU ministers of transport

- Growing number of fatalities involving pedestrians and cyclists (electrical bikes)
- Need for behaviour change : education and better enforcement
  - Speeding
  - Alcohol and drugs
  - Distracted driving (use of smartphone)
  - Fatigue
- Need for better infrastructure and maintenance
- Follow the "Safe System" approach (ex.www.motorcycleframework.co.uk/safe-systems-approach)
- Better accident analysis
- Safer and smarter vehicles : Advanced Driver Assistance Systems (ADAS) – Connected



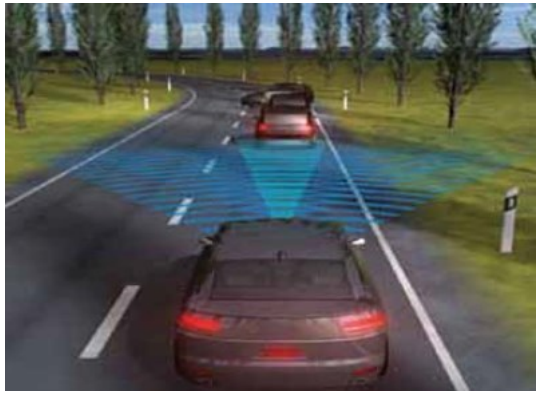
"Swiss Cheese"

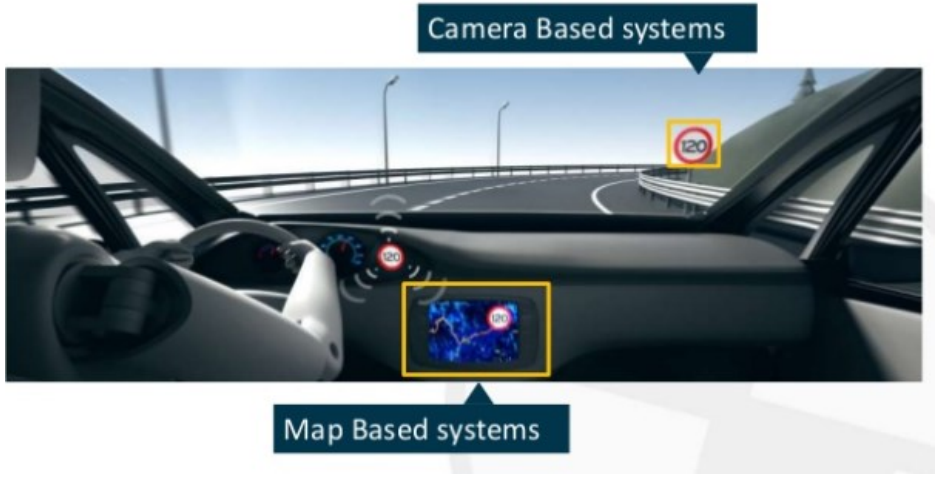
DG Grow / UN ECE : Towards Safe Vehicles

- eCall in-vehicle system automatically dials 112 in the event of a serious road accident

- EC Report: Saving Lives: Boosting Car Safety in the EU (December 2016)

- Identified 19 life-saving technologies that should be considered for the revision of General Safety Regulation
- Three ADAS technologies deal directly with infrastructure:
  - Lane Support Systems (LSS)
  - Intelligent Speed Adaptation (ISA)
  - Automatic Emergency Breaking (AEB)
- Proposal is to make these technologies mandatory for all new vehicles as of 9-2022 for LSS, ISA and 9-2024 for AEB





DG Move : C-ITS II : Physical & Digital Infrastructure

https://ec.europa.eu/transport/sites/transport/files/2017-09-c-its-platform-final-report.pdf

Recommendations :

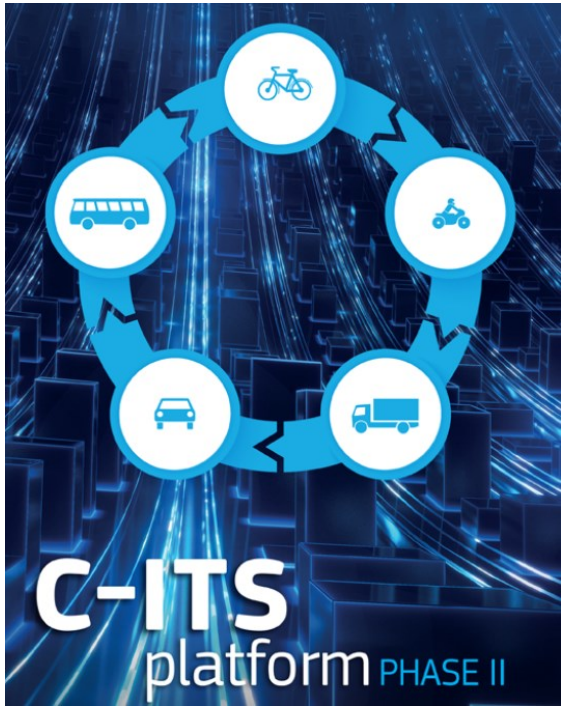
1. Infrastructure will continue to play a role. A true Level 5 possible?

   Infrastructure to help create growing “Level 4” islands!

4a. Road Operators, OEM’s and suppliers to jointly investigate how physical and digital infrastructure can contribute to redundancy and safety in accurate positioning.

   Focus on high risk (eg tunnels, urban canyons,..) and work zones

5a. Standardized C-ITS messages for traffic regulations, to assure vehicle takes the right decisions



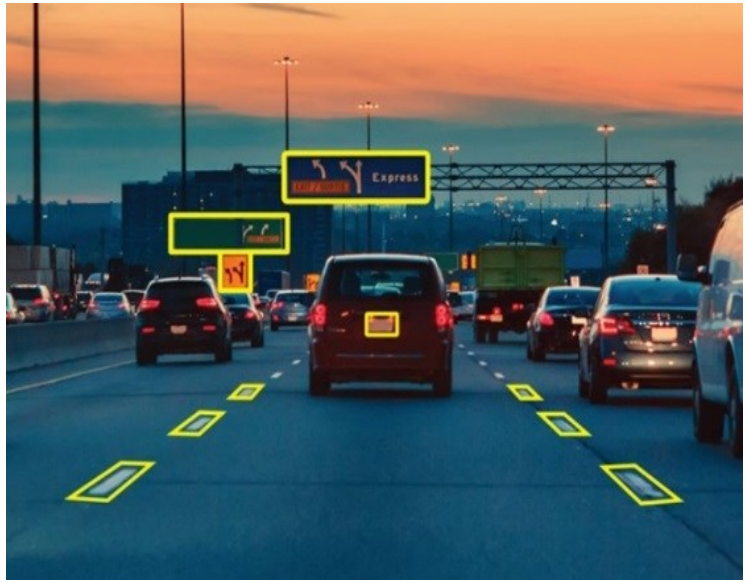
European Commission's 3rd Mobility Package

Road Infrastructure Safety Management (RISM) Directive.

Art.1.1 modifying Art.1.2: Extending the scope of the Directive beyond the trans-European transport network (TEN-T) to dramatically reduce road fatalities

Art. 1.5 adding the new Art. 6c: High-quality road signs and markings are crucial to support drivers as well as connected and automated vehicles

New Annex IIa: Road infrastructure, road signs and markings need to be visible under all circumstances for the highest levels of road safety



European Commission's 3rd Mobility Package

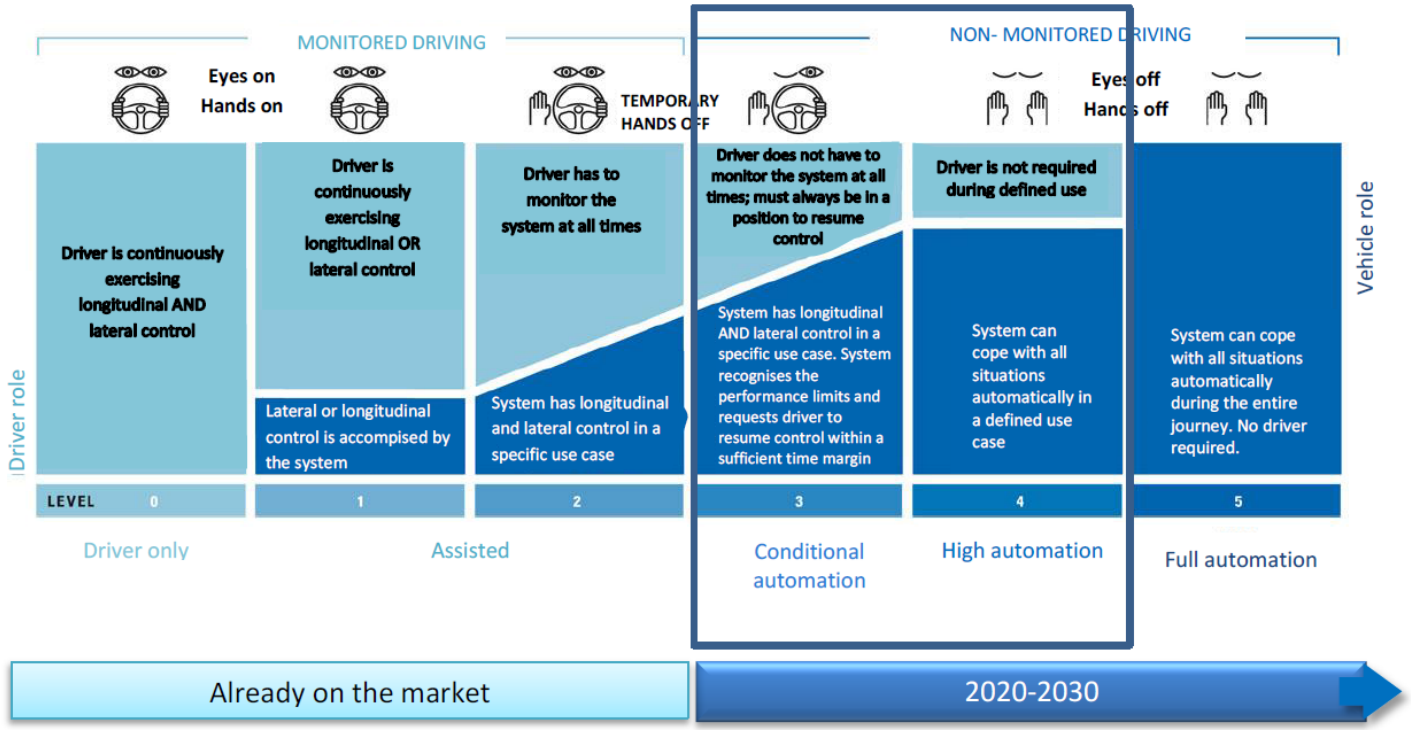
Guidelines on the exemption procedure for the EU approval of automated vehicles :

- Fast ad-hoc approval by EU memberstates for low volume production series.

- Within a defined "operational domain" : minimum criteria re : Road conditions, road infrastructure, environmental conditions, speed,…

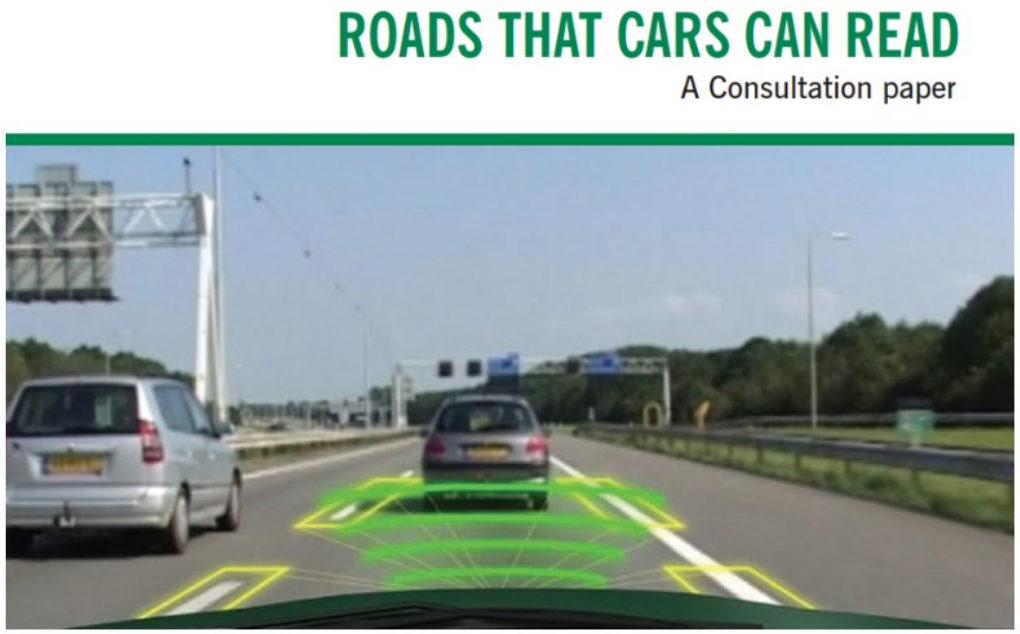
In line with the priorities of work proposed in the CAM strategy, the focus on these guidelines will be on automated vehicles that can drive themselves in a limited number of driving situations (SAE levels 3 and 4- see figure below) which are already being tested and are expected on a commercial basis by 2020.

Figure: Different levels of automation (source: Society of Automotive Engineers-SAE)



iRAP – EuroRAP : Roads that Cars can Read (1,2,3)

http://www.eurorap.org/portfolio-items/roads-that-cars-can-read-a-consultation-paper/



Roads That Cars Can Read 1: A consultation paper

" Most countries believe they adhere to the Vienna Convention on Signs but there can be marked variation between countries even on the most common signs"

ROAD SIGNS	Great Britain (GB)	Greece (GR)	Netherlands (NL)	Poland (PL)	Serbia (SRB)
Stop (and give way)	STOP	STOP	STOP	STOP	STOP
Give way (to traffic on major road)	GIVE WAY				
No entry for vehicular traffic					

By 2025 , 50% of vehicle fleet will have LKA and /or ISA.

Role of infrastructructe to boost the confidence, and add to road safety?

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Stop (and give way)					
Give way (to traffic on major road)					
No entry for vehicular traffic					

Recommendations :

- More strict implementation of the "Vienna Convention for Traffic Signs"
- Need for harmonisation between countries
- Road design in general should be more logic
- Improved road quality and maintenance
- TEN-T (Trans European Transport Network) as example and best practice
- Understand deferences and tolerances between perception by "human eye" and "machine vision".

iRAP – EuroRAP : Roads that Cars can Read (1,2,3)

https://www.eurorap.org/wp-content/uploads/2015/03/roads_that_cars_can_read_2_spread1.pdf

BOX 2 - THE ROAD MARKING STANDARDS REQUIRED

Based on a collection of data of intervention and maintenance standards from a number of European countries[2], the ERF has determined a good road marking to be one whose ***minimum performance level under dry conditions is 150 mcd/lux/m² and which has a minimum width of 150 mm for all roads; for wet conditions, the minimum performance level should be 35 (RW2).*** Given that these requirements are already in place in some EU member states; the ERF believe this proposal is realistic, technically feasible and cost-effective

New ERF Recommendations :

New research indicates that camera vision LDW and LCA algorithms work on edge recognition between road surface and markings:

High levels of contrast ratios will provide easy detection and avoid false positives.

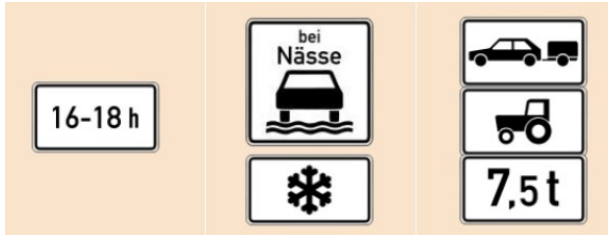
EuroNCAP : Vehicle Star Rating Adjusted

ADAS will be required for a vehicle to achieve a 5 star rating.

ISA and speed limits ?
Info by navigation system and traffic signs

EuroNCAP : Difficulties for sensors

Conditional Subsigns



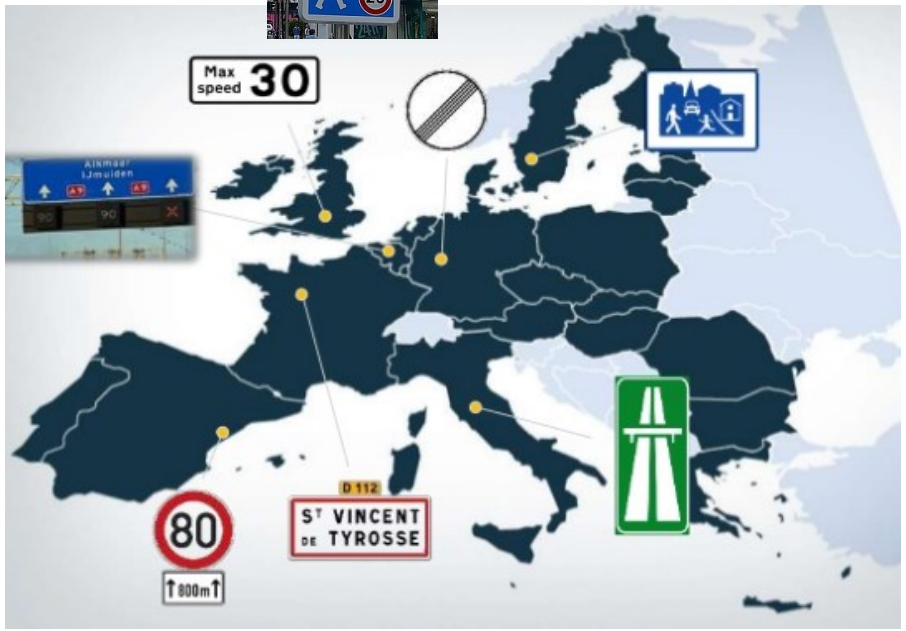
Used Signs

Conditional Signs

Misleading if subsign is missed

Ambiguity

VMS



Implicit speed limit signs

CEN TC226 WG12 : Road Interaction – ADAS / CAM

New Adhoc expert group with 4 Task Groups

TG 1: Better understanding of sensors,
TG 2: Synthesis of projects,
TG 3: Focus on the work zones and toll gates,
TG 4: Supply Road databases and protocols.

TG 1 :

- Understand how machine vision and sensors are experiencing the road infrastructure
- TC226 standards : from «human vision» only, to also include new performance requirements for « machine vision »?
- Provide public procurement tools for future road infrastructure

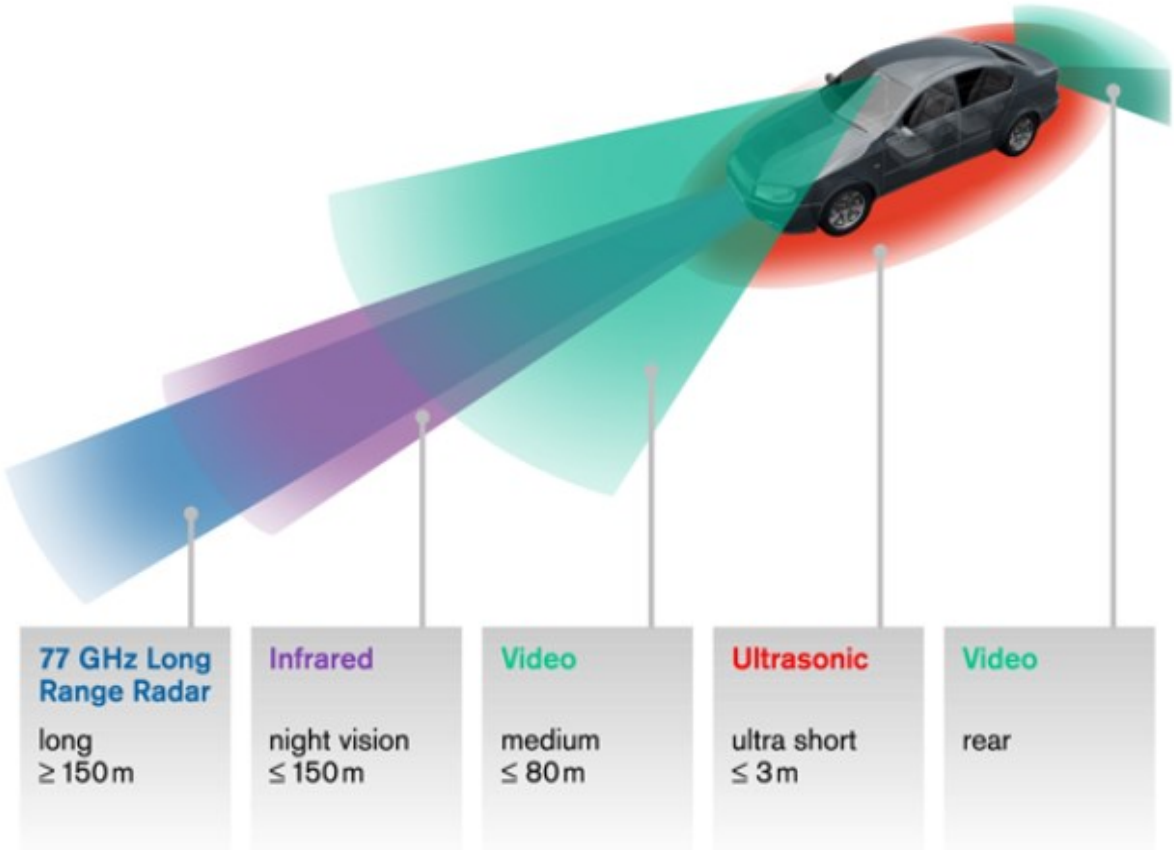
CEN TC226 WG 12 : Road Interaction – ADAS / CAM

ERF proposed research :

Road markings and LDWS/LKA

- Various sensors : Video camera, LIDAR
- Various road markings
  - Performance levels according to EN 1436
  - Structures
  - Removed (gostlines) + Blacked Out (covered)
- Various weather conditions day and night
- Public roads and test tracks

→ Confidence levels human eye vs machine vision



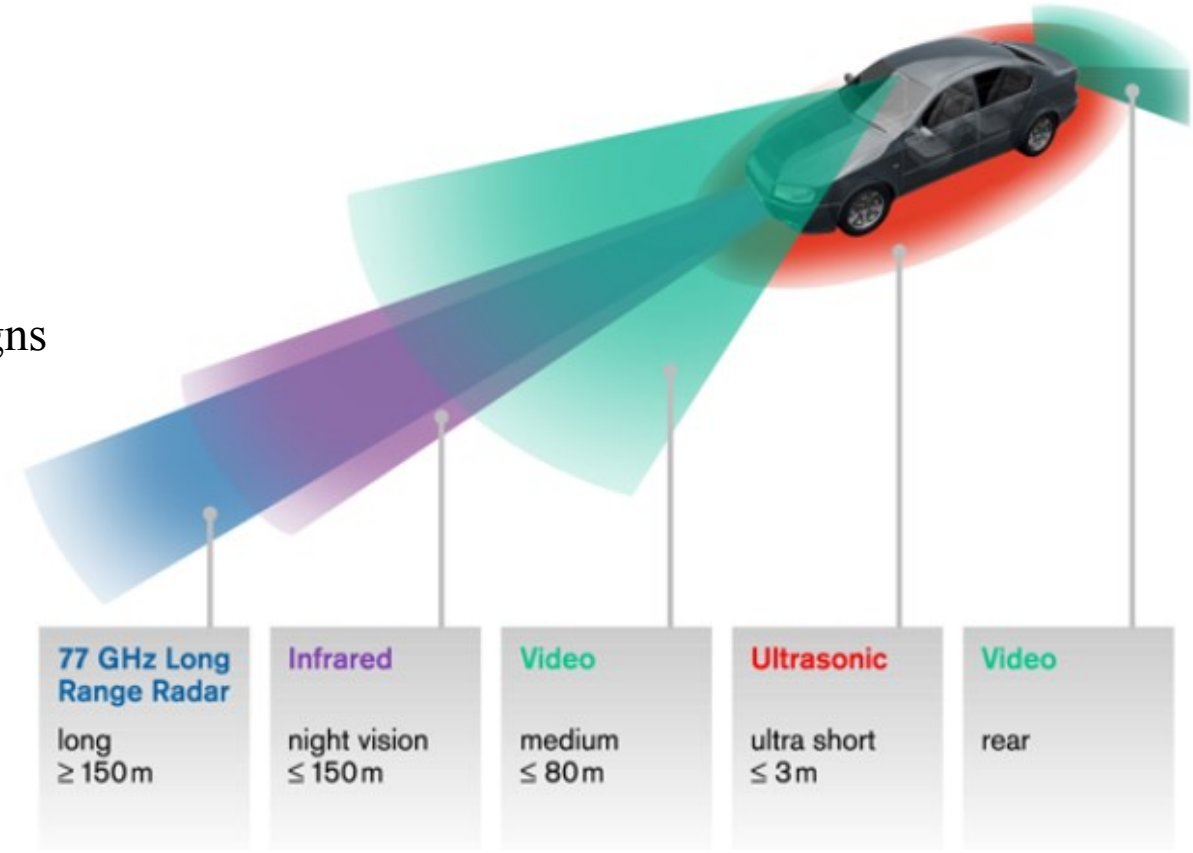
CEN TC226 : Road Interaction – ADAS

ERF proposed research :

Traffic Signs and ISA

- Various Sensors: Video camera, LIDAR
- Speed Signs : Standard, Conditional, Implicit, Subsigns
- Variable message signs (VMS)
- Font types for letters and numbers (TERN)
- Brightness levels versus EN12899-1

→ Comprehention levels machine vs human



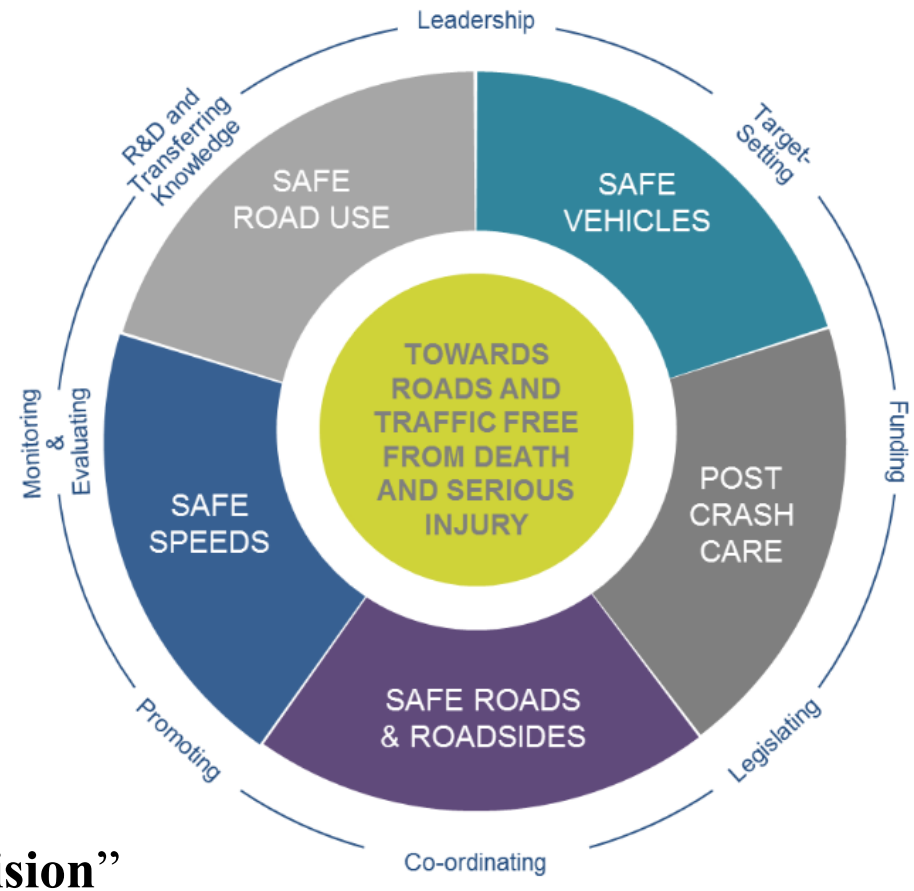
Conclusion : Safe Roads of the Future

- A sustainable **Road Safety Strategy** requires
  - High level leadership
  - Multi disciplinary approach (public & private sector)

- Addresses all aspects : "Safe System"
  - Road Users
  - Vehicles (**Changing SAE level mix**)
  - Infrastructure

- Infrastructure & CAV : Current ADAS sensors:

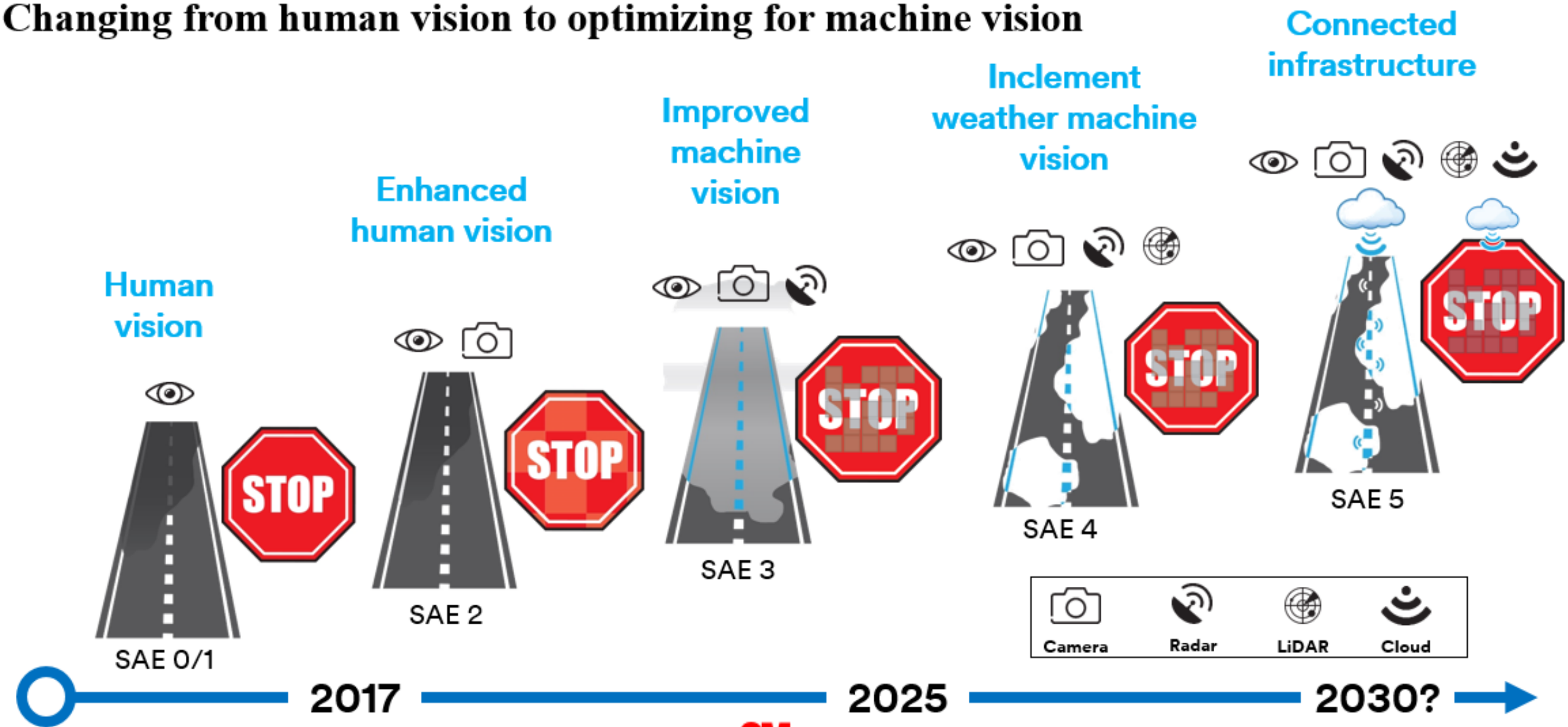
  " **What is good for the human eye, is good for machine vision**"



www.pacts.org.uk/safe-system

Enabling Intelligent Infrastructure : 3M™ Connected Roads

Changing from human vision to optimizing for machine vision

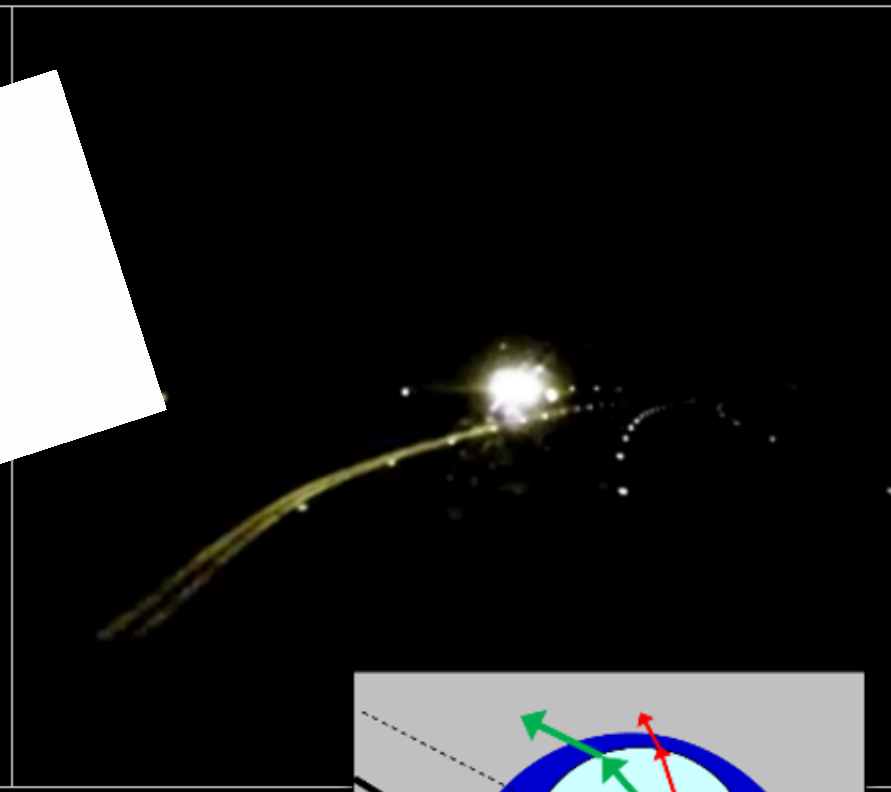


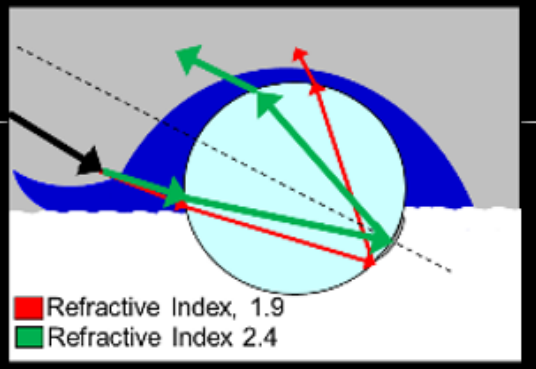
Wet-retroreflection In Action

Dry Daytime Conditions

Dry Nighttime Conditions

Wet Nighttime Conditions





Yellow Line = Optimized for wet reflectivity

White Line & Arrow = Not optimized for wet reflectivity

Optimized Messaging: Machine Readable Signs

Solutions to enable more accurate sign detection and classification

Human Optimized Diamond Grade™ (DG^3) DG^3 Fluorescent

Machine Vision Optimized with Decoded Metadata

Current 3M Signs

- Up to 58% light return to *all* drivers
- Superior (human) legibility

Future 3M Signs

- Secure localization
- Reliability - Sign class redundant
- Embedded digital information and metadata
- Dynamically changeable
- Digital certainty

Thank You!

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