

Road Markings and Connected Automated Vehicle (CAV)

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Road Marking Systems

3rd Mobility Package and Green Deal Impact on Traffic and Mobility in the European Union

What does policy aim for?



Road safety: Vision Zero

- Increase in road safety
- Reduction of human driving errors
- 90% of all accidents are caused by human error



Reduction of emissions

- Reduction of fuel consumption and CO₂ emissions
- 23-29% reduction of fuel consumption on highways



Innovation

- Encouragement of innovation
- Competitiveness / Highly skilled jobs
- 56 minutes per day for other activities



Traffic management

- Optimization of traffic flow
- Pleasant and time-efficient driving
- 80% improvement in terms of traffic flow



Demographic changes

- Support of insecure drivers
- Mobility increase for ageing population
- Access to mobility for many different age groups

General Safety Regulation

VEHICLE SAFETY

The Commission proposes to make the following safety and driver assistance features mandatory:



- INTELLIGENT SPEED ASSISTANCE

- REVERSING DETECTION AND REVERSING CAMERA

- DRIVER DISTRACTION AND DROWSINESS RECOGNITION



- LANE KEEPING ASSISTANCE

- ADVANCED EMERGENCY BRAKING



- DIRECT VISION REQUIREMENTS

- PEDESTRIAN/CYCLISTS DETECTION

INFRASTRUCTURE SAFETY

The Commission proposes to **update the European rules on infrastructure safety management**:



- SCOPE EXTENDED BEYOND MOTORWAYS

Only 8% of fatalities occur on motorways, while 39% happen on primary/main roads.

- NETWORK-WIDE RISK MAPPING

- REINFORCED PROVISIONS FOR VULNERABLE ROAD USERS

EXPECTED IMPACT (2020-2030):

7,300
lives saved

38,900
serious injuries avoided

3,200
lives saved

20,700
serious injuries avoided

Road Infrastructure Safety Management Directive

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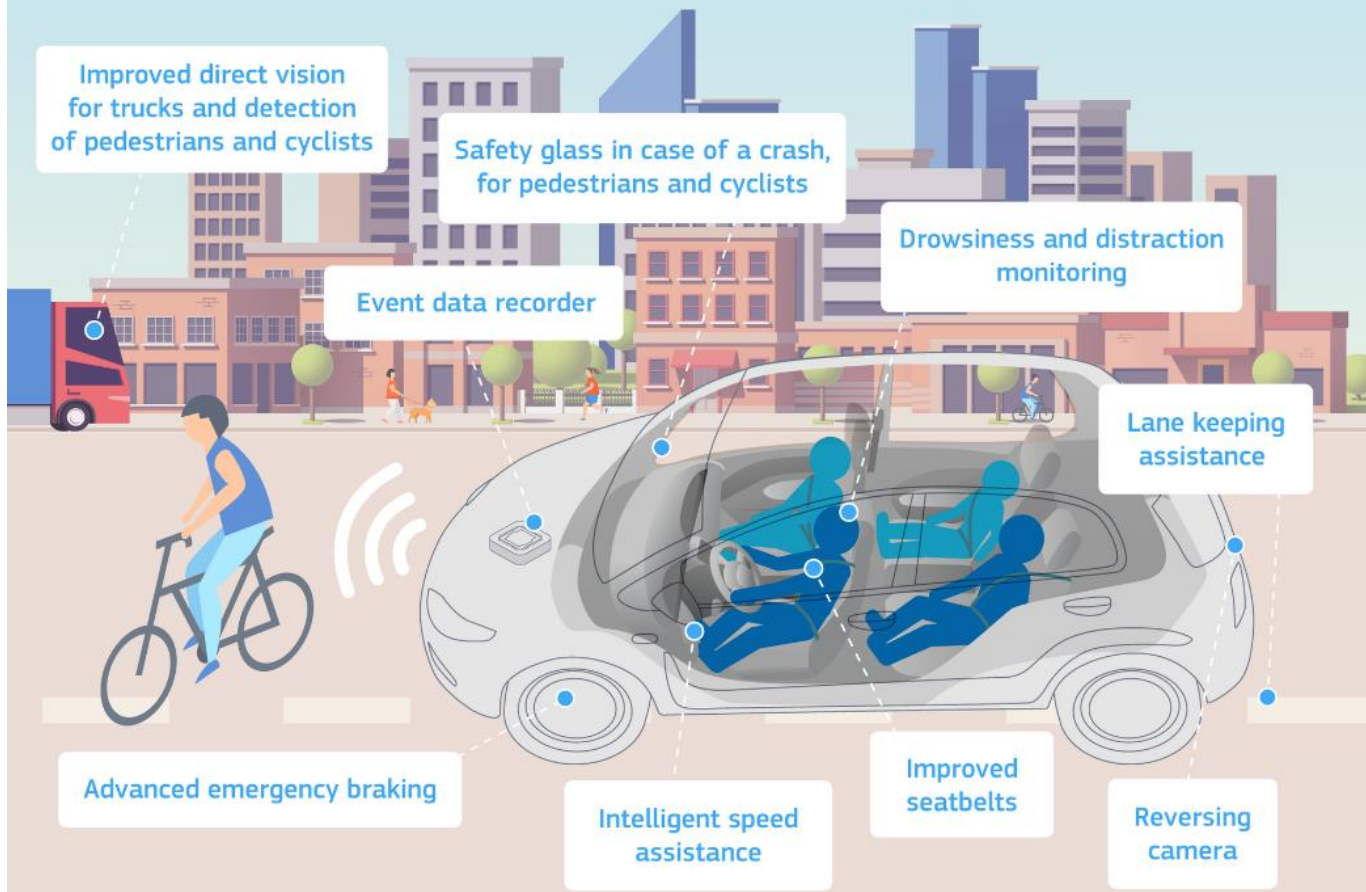


- DIRECT VISION REQUIREMENTS
- PEDESTRIAN/CYCLISTS DETECTION

Regulation on the type approval for vehicles



New safety features in your car



Mandatory for all newly certified vehicles as of 2022

From 2024 for all newly registered vehicles

RISM Guideline

Road infrastructure safety management

INFRASTRUCTURE SAFETY

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- **NETWORK-WIDE RISK MAPPING**

- **REINFORCED PROVISIONS FOR VULNERABLE ROAD USERS**



Scope is extended - from now on TEN, EU-fin. projects, freeways and major roads (with exceptions)



Evaluation of traffic safety across the entire road network, categorization and ongoing monitoring.



Extended provisions regarding

- Vulnerable road users
- Information and transparency
- Milestones and reporting
- Road marking and signs

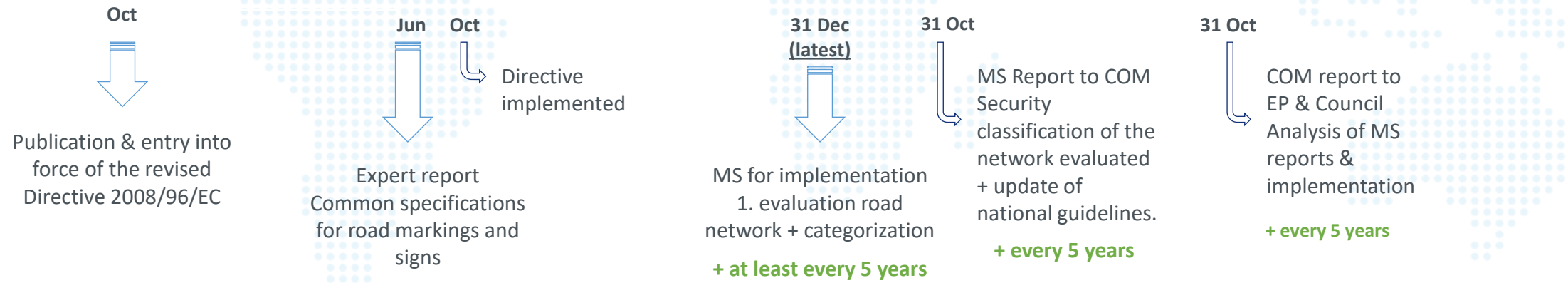
Roadmap for EGRIS

Revision of Directive 2008/96/EC

Scope extension

Network-wide road safety assessment

Enhancing provisions
Vulnerable Road Users
Road markings & signs
Information & Transparency
Milestones & Reporting



Activity within EGRIS and current status

SUMMARY EGRIS presentation on 14th October 2021 - **UNCHANGED !!!**

Cluster by HM	Area as in the working paper	Scope / Title	Decision on way forward (possible options to be investigated)	Agreement	Disagrmt.	Conditional Agreement	Undecided
Perf.	1	Increase use of more durable products / systems in wet conditions on motorways	Concentrate on visibility/detectability and explore further the likely benefits of each material, Prioritize certain line markings	20%	10%	20%	50%
Perf.	2	Implement common minimal levels for daytime visibility of new road markings	Explore on a meaningful value as a minimum daytime visibility; prioritize certain lane markings, Question: same approach or differentiation between primary roads and motorways	20%	7%	23%	50%
Perf.	3	Define minimal levels for night-time visibility of road markings for motorways and primary roads in dry conditions	Explore on meaningful minimum values; focus on human drivers, prioritize certain lane markings; open question if differentiation on motorways vs primary roads	17%	7%	27%	50%
Perf.	4	Implement common minimal levels for night-time visibility of new road markings in wet conditions	Explore meaningful minimum values; differentiate between motorways and primary roads; prioritize certain lane markings	10%	13%	23%	53%
Perf.	5	Implement common minimal levels for night-time visibility in rainy conditions	Not further explore this area at this stage	3%	33%	10%	53%
Unif.	6	Implement common minimal width of road markings	Differentiate road types or keep a single approach; Explore the meaningful minimum	30%	0%	20%	50%
Unif.	7	Improve continuity of road markings at exit ramps or intersections	Not further explore this area at this stage	17%	17%	10%	57%
Perf.	8	Improve the contrast of markings on concrete road surfaces with contrast	Not further explore this area at this stage	0%	20%	23%	57%
Perf.	9	Improve the removal of old markings	Not further explore this area at this stage	9%	44%	13%	33%
Unif.	10	Improve uniformity (design) of road	No further explore this area at this stage	13%	20%	13%	53%
Unif.	11	Implement common configuration of dashed longitudinal road markings	Not further explore this area at this stage	10%	30%	7%	53%

Camera and LiDAR



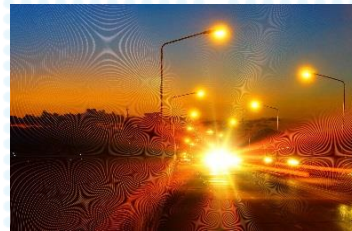
Source: Bosch, Kostal, ZF TRW, Continental, Quanergy

Challenges for sensors



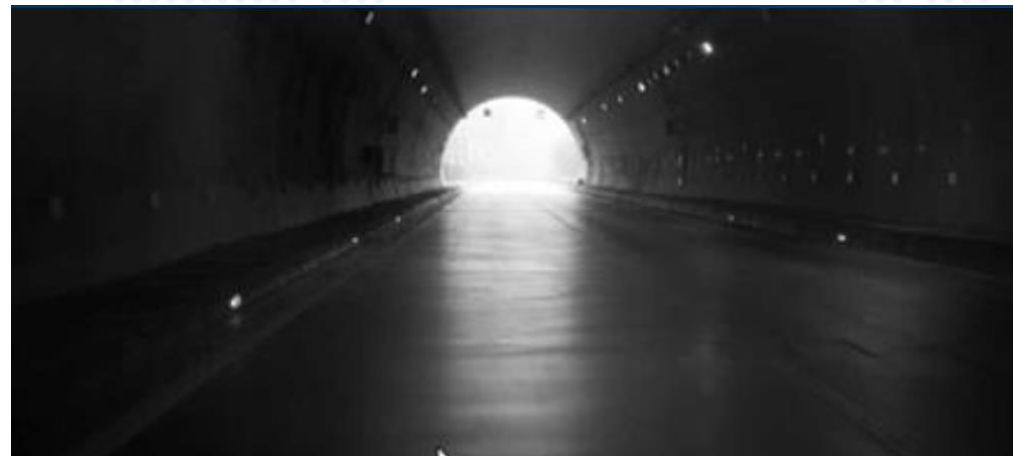
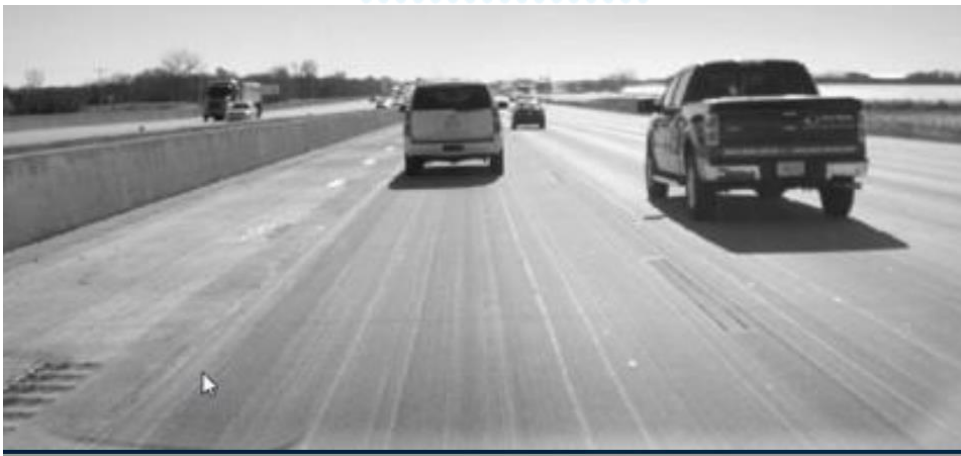
Potholes, cracks, repairs, wheel ruts

Low sun, glare, temporary detours, driving constrictions



Snow, ice, rain, fog, spray

How do cameras see it?



What can cameras see?



Rule of thumb:

If you can't see it, the camera can't see it either.

(On the other hand if you can see it, the camera doesn't necessarily see it)

- Maintenance (i.e re-painting weak lane marks) is of the utmost importance.
- Robust markings which are visible in various lighting/weather conditions

- Exploits retroreflectivity of lane markings



Embedded glass beads

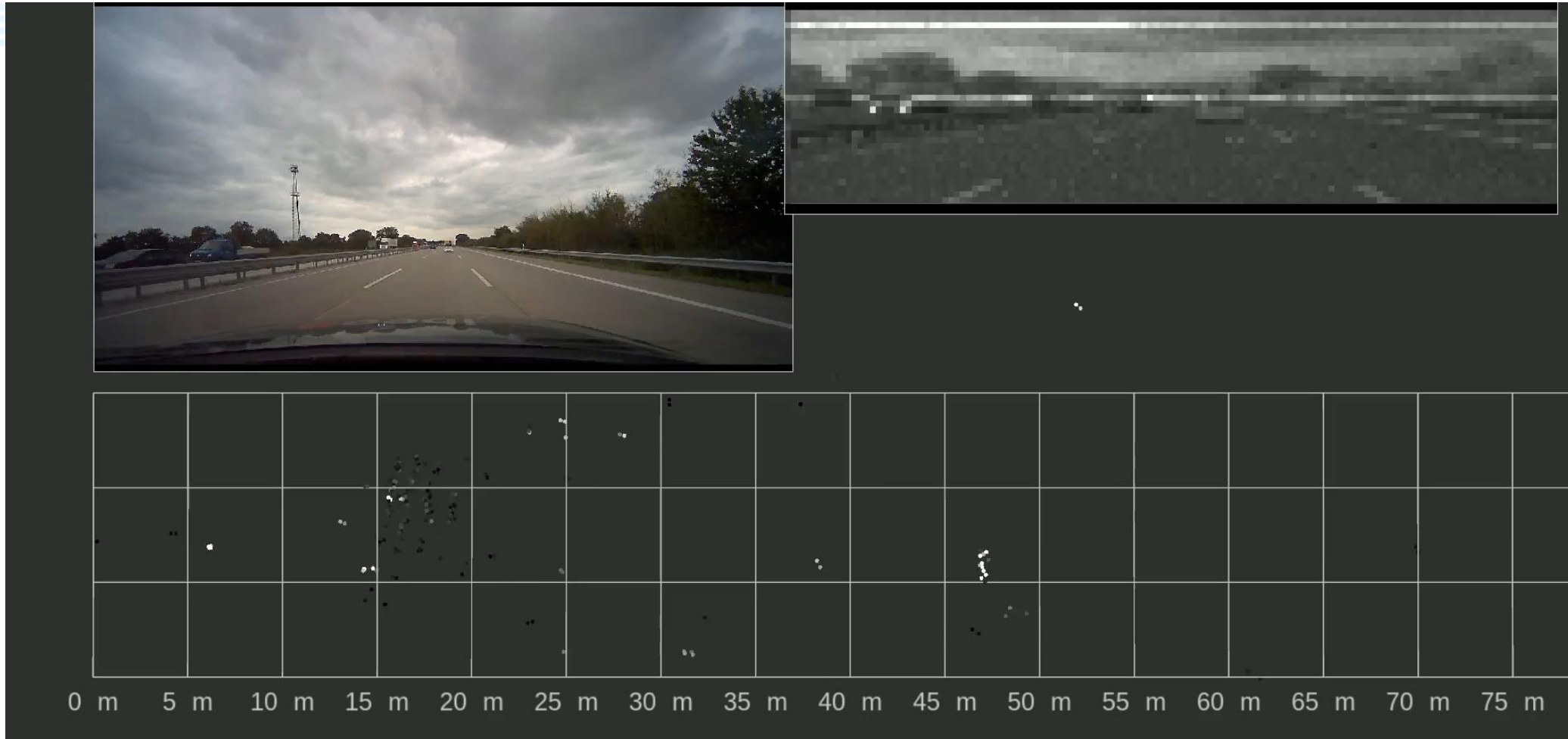


Principle of light reflection in lane markings

- As an **active system** LIDAR does **not suffer from typical camera issues** such as low light conditions, abruptly varying illumination or cast shadows
- Most important is reflectivity **contrast between road marking and road surface**

Image sources: www.adbruf.com, www.pqj.co.jp

How does LiDAR see it?



What is going on in the world?



USA



China



Notice of Proposed Amendment (NPA)

- 647 changes
- 145 New Figures
- 11 New Tables
- Creation New Part 5 (Avs)
- Comment Process: May 14, 2021
- 35,000 individual docket comments
- September 2022 (Est. Final Rule)

Source: Mercer Strategic Alliance





MUTCD Proposed Changes – Markings

- Line Width: 6” wide (freeways, expressways and ramps)
- Line Width: 6” wide (Roads) > 40mph
- Wide line: 10” with 6” Line
- Dotted Lines:
Exit/Entrance now mandatory from option
- Edge Lines: If used, ‘normal width’ 6”
- Chevron Markings Require Engineering Study (Waive)
- Botts Dots Prohibited

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Government targets

- Autonomous driving and smart transport are named key areas in the 14th Five-Year-Plan (2021-25)
 - Develop autonomous driving and vehicle-road collaboration travel services.
 - V2X pilot zones on a national level, accelerating the construction of intelligent connected vehicle road infrastructure.
- Target for 2035
 - Operation of various connected vehicles with highly automated driving capabilities across vast areas of China.



Entering commercial phase

- Permits for robotaxis (e.g. Beijing):
 - Apollo Go (Baidu)
 - Pony.ai (a.o. Toyota)
 - AutoX (Alibaba)
- Loosening restrictions
 - Nearly driverless robotaxis to operate during the day
 - Pony.ai robotaxis get same designation as traditional taxis (Nansha district)



Example: AutoX

- Fully driverless RoboTaxi without safety driver
- Car is handling the dynamic traffic scenarios in urban cities
- RoboTaxi fleets operate in Shenzhen, Guangzhou, Shanghai, Beijing
- Company has a RoboTaxi permit in California



AutoX



Thank you for your attention!

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