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International Conference
**SMART CITIES &
MOBILITY AS A SERVICE**

**CONNECTIVITY AND NEW VEHICLE TECHNOLOGIES:
CHALLENGES OF THE HIGHWAY OPERATORS**

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INTRODUCTION

Car industries are developing technologically-advanced vehicles to deal with current challenges:

- ▶ Road Crashes: 1.2 million deaths / year & Injuries & Material Damages



2-3% of Gross World Product (GWP) *

- ▶ Traffic Congestion
- ▶ Global Warming / Air Pollution

* Source: World Health Organization (WHO)



WHAT ARE CONNECTED VEHICLES?

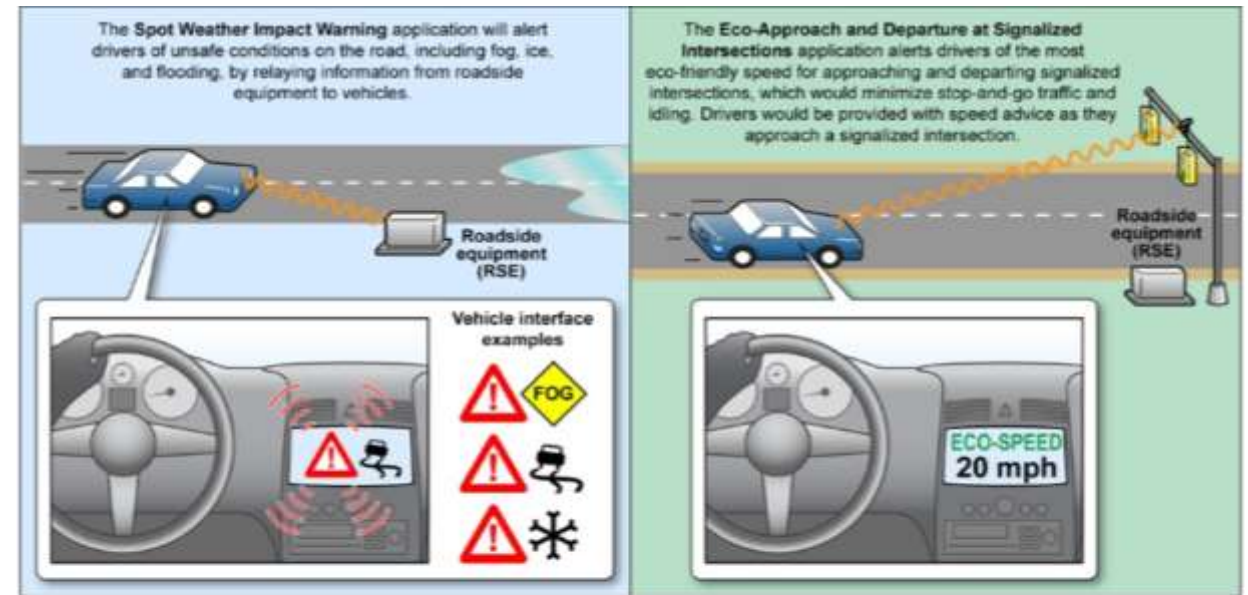
Connected vehicles are vehicles that provide connection to at least one of the following:

- ▶ The Internet
- ▶ Other vehicles (V2V)
- ▶ Infrastructure (V2I)
- ▶ Everything (V2X) i.e. Internet – Vehicles – Infrastructure – Devices – Pedestrians – Grid



APPLICATIONS OF CONNECTED VEHICLES

- ▶ Navigation assistance
- ▶ Front-collision warning
- ▶ Lane-departure warning
- ▶ Intersection assistance
- ▶ Left-turn assistance
- ▶ Park assistance / Park garage pilot
- ▶ Highway pilot
- ▶ Red signal violation warning
- ▶ Weather conditions warning (fog, snow, ice)
- ▶ Eco-approach at signalized intersections



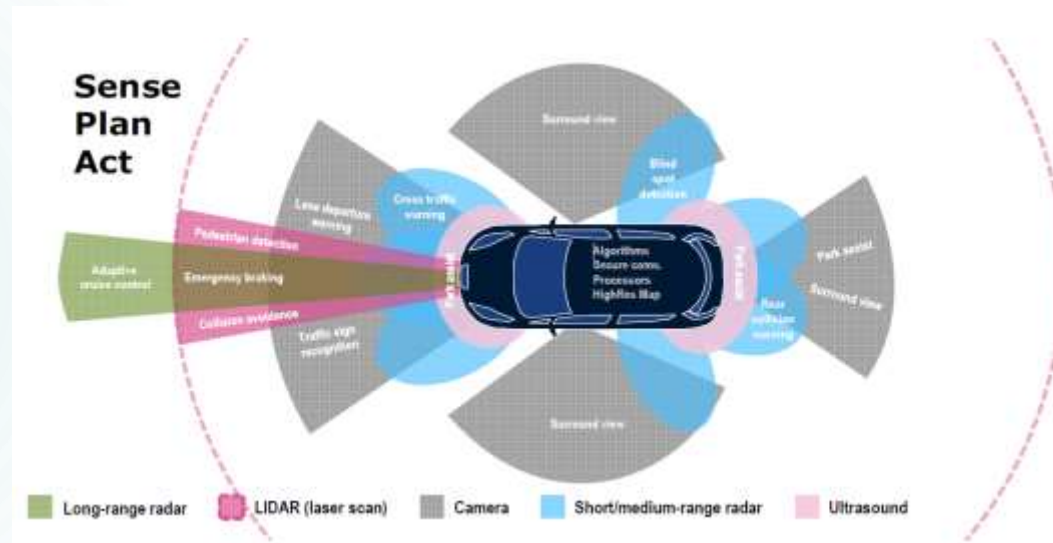
Source: United States Government Accountability Office Report to Congressional Requesters. Intelligent Transportation Systems (September 2015)

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WHAT ARE AUTONOMOUS VEHICLES?

- ▶ The evolution of connected vehicles will lead to vehicles that will not need human operation, called "Autonomous Vehicles".
- ▶ Autonomous Vehicles will perceive their surroundings through Radar, Lidar, GPS, odometry and machine vision.



Source: International Transport Forum (2015)

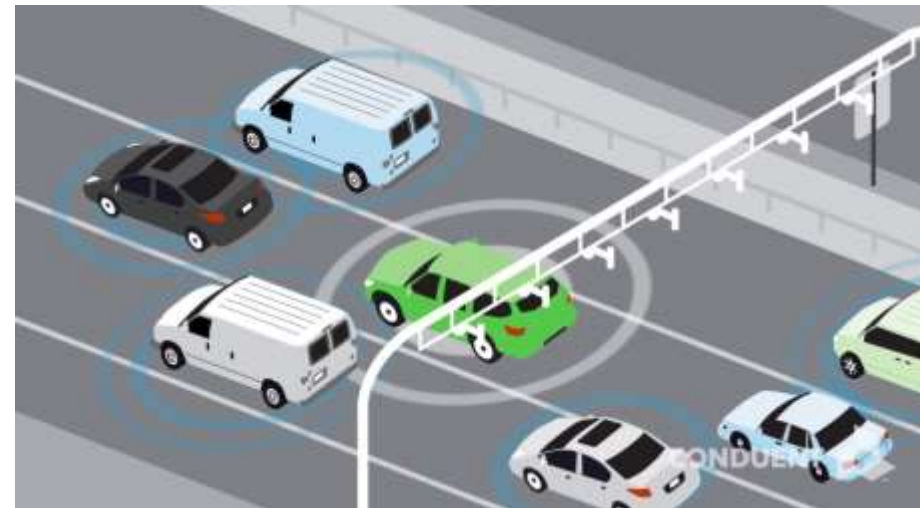


ADVANTAGES OF CAVs

- ▶ Travel time reduction / ease in finding parking space
- ▶ Truck platooning / reduced costs of transporting goods
- ▶ Better traffic control and incident management
- ▶ Ease in toll collection
- ▶ Reduction of crashes / fatalities / injuries
- ▶ Fewer greenhouse emissions



Source: Logisticsmanager.com (2016)



DISADVANTAGES OF CAVs

- ▶ Possibility of cyber attack
- ▶ Reluctance/resistance to release control of vehicle to a computer
- ▶ Significant cost of installation and maintenance of road-side equipment
- ▶ Risk of ignoring safety instruction/alert (e.g. seatbelt) or overall lack of attention
- ▶ Driver inexperience in case of need to take control of the vehicle



MAIN QUESTIONS TO BE ANSWERED

▶ **Legal and regulative framework:**

Who will be responsible for a crash? The driver? The automaker? The programmer?

▶ **Influence of autonomous fleet on transport design and road operation:**

Fewer/narrower highway Lanes? Mixed traffic?

▶ **Cost of equipment:**

Who is going to pay for installation and maintenance? The State? The operator? The Concessionaires?

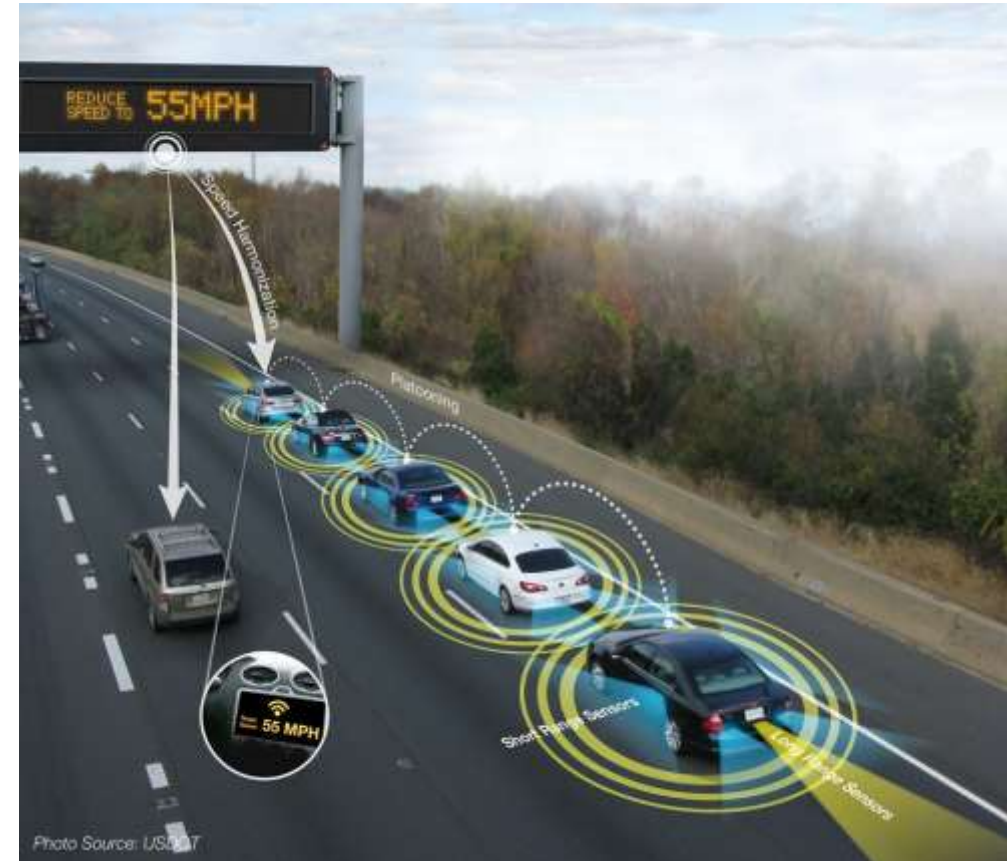
▶ **Developing technical standards / interoperability**

▶ **Driver training? Age limits? Need for driver to oversee autonomous systems?**



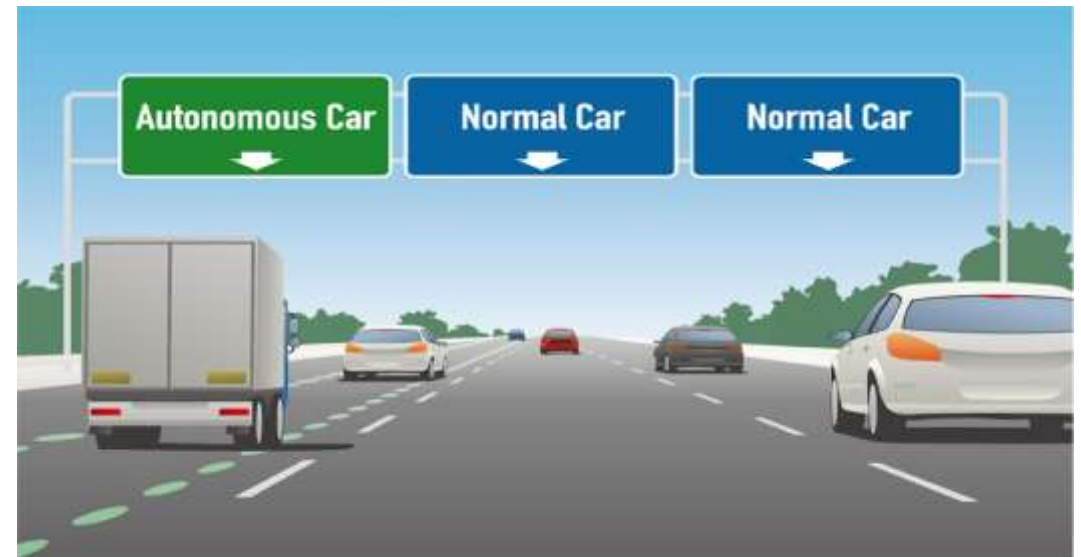
CAVs AND CONVENTIONAL VEHICLES – MIXED TRAFFIC

- ▶ Simultaneous existence of conventional and CAV vehicles in the same road seems very complex. The reason is that driving attitude will be different, such as safety distance, braking distance etc.
- ▶ For that reason, separation of traffic is recommended.



CAVs AND CONVENTIONAL VEHICLES – LANE SEPARATION

- ▶ Use of the left lane only for CAVs or in combination with other categories (High Occupancy Vehicles, emergency vehicles etc.)
- ▶ Installation of sensors in the left lane to communicate with vehicles for safety maximization.
- ▶ Surveillance of left lanes? Cameras? Police? Use of lane separators? Fines?



Source: Inhabitat.com (2016)



CAVs AND CONVENTIONAL VEHICLES – HYPERLANE

- ▶ Special lane only for autonomous vehicles inside or outside an existing road
- ▶ Speed up to 160 kph
- ▶ Sensors on the lane
- ▶ Controlled by centralized computer system
- ▶ \$12 million / mile



Source: www.inverse.com



CREATION OF A THINK TANK TO PROMOTE SUSTAINABLE TRANSPORT AND MOBILITY

- ▶ Members will be road operators, state authorities, software companies, universities and other stakeholders.
- ▶ The mission will be: exchange of ideas, formation of common positions, networking for problem solutions, participation in R&D and pilot applications.
- ▶ A challenging start could be the development of pilot application for new technologies and CAVs on motorways, as motorways offer a well protected environment.



CONCLUSIONS

- ▶ Car industries are currently performing many tests/pilots of CAV technologies.
- ▶ It is essential to ensure that tests are performed in real conditions for better integration of technologies and risk identification.
- ▶ Stakeholders need to cooperate with road operators for maximization of the advantages of CAVs.
- ▶ The road operators have to follow the vehicle evolution and adapt to the new technologies.





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THANK YOU FOR YOUR ATTENTION!

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