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ISO 9001:2015

Study Paper

on

AI in Automotives

Content

Abstract

The purpose of this study paper is to bring into the limelight, the Artificial Intelligence in the automotive industry. AI is a broad term using which artificial things can be made intelligent. AI provides intelligence to automotives to achieve more and more ease in driving. In this era, focus is on driverless cars, which is due to the influence of artificial intelligence in the industry. Vehicles need to connect and communicate over road regarding various factors such as traffic, weather conditions, etc. The paper covers the necessary protocols and architecture of vehicle communication. Security & Privacy issues in smart automotive system lie in wide ranges across WiFi, LAN; tracking of vehicle, etc. All this works as per the Standardization in AI for Automotives: International and National. FGAI4AD lays down standards for dealing with accident situations. FG-AI4AD supports suspension operations and services enabled by AI programs through independent and assisted driving. Lastly, it focuses on challenges with such cars and cyber threats which are liable to occur. Also, the ethical issues over which debate is ongoing: who is liable for a mishap? have been covered here.

1.0 Introduction

In this era of smart technology and rising expectations and demands, there lies the need of enriching the automotive sector. The paper "AI in Automotives" enlightens the latest technologies being worked upon in automotives. Also it highlights the ongoing HPC (High Performance Computing) concept. It explains the significance, usage and applications of AI, various protocols, to the status of the technologies going on in various countries and various car models.

According to ITU News Magazine titled 'Technology driving tomorrow's cars', By the shift of artificial intelligence capabilities — in support of automated driving and digital assistants — shifting from the cloud to in - vehicle systems in the form of more powerful processors, improved vehicle networks and on-board storage, we are leading to technological advancements in automotives. Cars are getting smarter at understanding what humans are doing and helping them move and arrive at their destinations accurately and safely. HERE is working to integrate location information related to navigation with sensor based contextual information compiled from Audi, BMW and Daimler vehicles to help drivers avoid obstacles and road hazards along their path.

AI has the capability to sense various characteristics of the driver and the car. It can sense the speed and position of the vehicle, attention of the driver (if he deviates from actual path), weather situation, traffic levels, etc. If the driver deviates from original and expected track, it senses that there is some problem and stops the car. This is how useful is AI in Automotives.

2.0 Artificial Intelligence

Artificial intelligence (AI) refers to the imitation of human intelligence in machines designed to think like humans and imitate their actions. The term can also be applied to any machine that displays features that resonate with the human mind such as learning and solving problems. New paradigm shift has been created by deep learning and machine learning. Fig.1 shows how these terms are related through a Venn diagram.

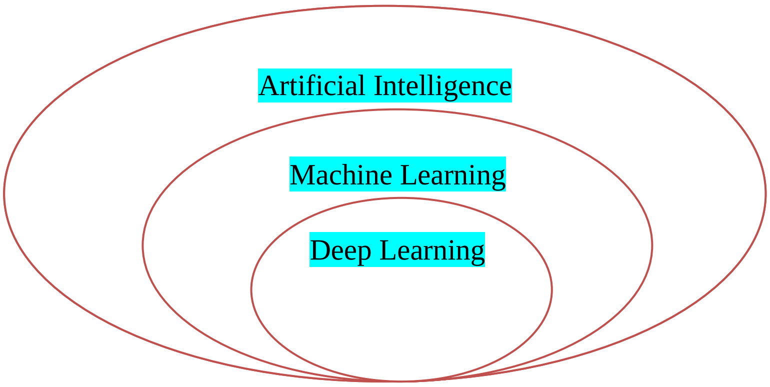

Fig. 1 Artificial intelligence

The automotive industry has a long running track record to make use of the latest technologies to bring the efficient, innovative and safe vehicles to the market. These technologies nowadays include artificial intelligence and high performance computing- two keys of automotive success.

For many years, HPC has been used to manufacture good products in the modeling, design and simulation applications; today this focus is broadening to substantial investments in AI. AI usage is moving ahead to drive semi-autonomous and autonomous cars.

These advanced capabilities, coupled with rising consumer expectations have pushed the automotive industry into a period of digital transformation. These new technologies have helped reduce the costs and give consumers more of what they want.

There are three main protocols for vehicle connectivity and communication:

- V2V- Vehicle to vehicle communication: This is a smart technology which enables vehicle data to exchange from one vehicle to another. This is for short range communication, approx. 300 meters, sharing the details on speed and position of vehicles.
- V2I- Vehicle to infrastructure communication: This captures data from surroundings, such as traffic congestion, bridge clearance levels, weather forecast, and then wirelessly transmits it to other drivers so that they can remain safe.
- V2X- Vehicle to everything communication: This encompasses the above two, V2V and V2I. This makes the automobile smarter and gives the power to communicate with the traffic system, including cars and infrastructure.

3.0 Essential elements of Artificial Intelligence

3.1 Machine Learning

Machine learning is the use of artificial intelligence (AI) that gives systems the ability to automatically learn and develop from experience without being clearly planned. Machine learning focuses on the development of computer programs that can access data and use it for self-study.

The learning process begins with looking at or data, for example, direct experience, or instruction, to look at patterns in data and make better decisions in the future based on the examples we provide. The main purpose is to allow computers to read automatically without human intervention or assistance and to correct actions accordingly.

3.2 Deep learning

Deep learning is an artificial intelligence (AI) activity that mimics the functioning of the human brain in data processing and decision-making patterns. Deep learning is a type of machine learning in artificial intelligence with readable networks that can be directed from random or unlabeled data. Also known as deep neural learning or a deep neural network.

Deep learning has emerged in the digital age, which has brought about the explosion of data by all means and in all regions of the world. This data, known simply as big data, is taken from sources such as social media, online search engines, commerce platforms, and online movie theaters, among others. This enormous data is easily accessible and can be shared with fintech applications.

However, the details, commonly constructed, are so vast that it can take decades for people to understand and extract relevant information. Companies are recognizing the incredible power that can come from exposing this wealth of information and are becoming increasingly accustomed to AI automated support systems.

3.3 Big data

Big data is a combination of systematic and informal data collected by organizations that can be mapped and used in machine learning projects, prediction modeling and other advanced analytics applications.

Systems that operate and store large amounts of data have become commonplace in the structure of data management in organizations. Big data is usually seen in 3Vs: *Volume*: large data volumes in multiple locations, *Variety*: different types of data stored in large data systems and *Velocity*: the speed at which data is processed, collected and processed. These qualities were first identified by Doug Laney, who then became an analyst at Meta Group Inc., in 2001. Recently, some Vs have been added to various definitions of big data, including authenticity, value and variability.

Big data comes from many different sources, such as business transactions, customer information, medical records, online click logs, mobile applications, social networks, scientific research repositories, digital data and real-time data sensors used in Internet of Things (IoT) environments. Data can be left untouched in large data systems or processed using data mining tools or data preparation software and is therefore suitable for use in certain analytics.

3.4 Blockchain

The blockchain is a growing list of records, called blocks, connected using cryptography. Each block contains a cryptographic hash of the previous block, time stamp, and transaction data. Blockchain has been trending these days because of the world's most popular currency - Bitcoin. Many governments and leading banks have decided to bring their standard transactions based on the Blockchain concept. The use and power of this framework is enormous and is considered to change the way work is performed in various domains.

4.0 Autonomous cars

4.1 Definition

Autonomous cars are self-driving cars. Drivers do not need to worry about steering here. This depends on the degree of independence that will be easily provided in the model. These vehicles operate like traditional vehicles, without the need for human passenger control or any human passenger required to be in the vehicle.

4.2 Levels of automation

There are *six levels of automation*:

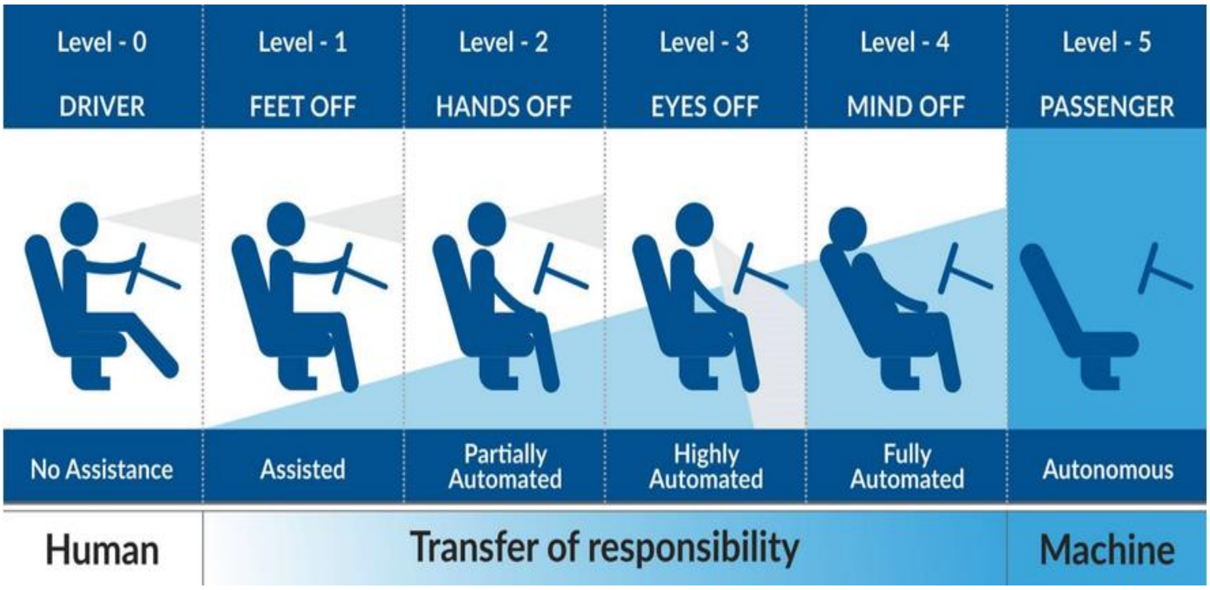

Fig. 2 Levels of automation
Source: [1]

Level 0: No automation means manual control, like traditional car

Level 1: Driver assistance means that it features a single automated system, e.g., it monitors speed through cruise control.

Level 2: Partial automation means vehicle can perform steering and acceleration on its own. Driver can still monitor and take control at any time.

Level 3: Conditional automation means Environmental detection capabilities. The vehicle can take on most driving tasks, but human override is still required.

Level 4: High automation means the vehicle performs all driving tasks under specific circumstances. Geofencing is required. Human override is still an option.

Level 5: Full automation means the vehicle performs all driving tasks under all conditions. Zero human interaction required.

5.0 AI in Automotives

Autonomous vehicles rely on sensors, actuators, complex algorithms, machine learning systems, and powerful software processors.

Independent vehicles create and maintain a map of the environment based on a variety of sensors located in different parts of the vehicle. Radar sensors monitor the position of nearby vehicles. Video cameras detect traffic lights, learn traffic signals, track other vehicles, and detect pedestrians. Lidar sensors (light detection and lightning) jump light edges in areas close to the car to measure distances, find road edges, and indicate line markings. Ultrasonic sensors on wheels receive curbs and other motors during parking.

Sophisticated software then processes all of these sensors, paves the way, and sends instructions to car actuators, speed controls, braking, and driving. Strong codes, avoidance techniques, predictable modeling, and object recognition help software to follow traffic rules and navigate.

Fig. 3 shows the components in Advanced Driver Assistance System. ADAS not only assists with parking, locking of car doors (using mobile phones) but also collects information on the car, driver, driving habits and passenger. Based on this information, ADAS makes an informed decision.

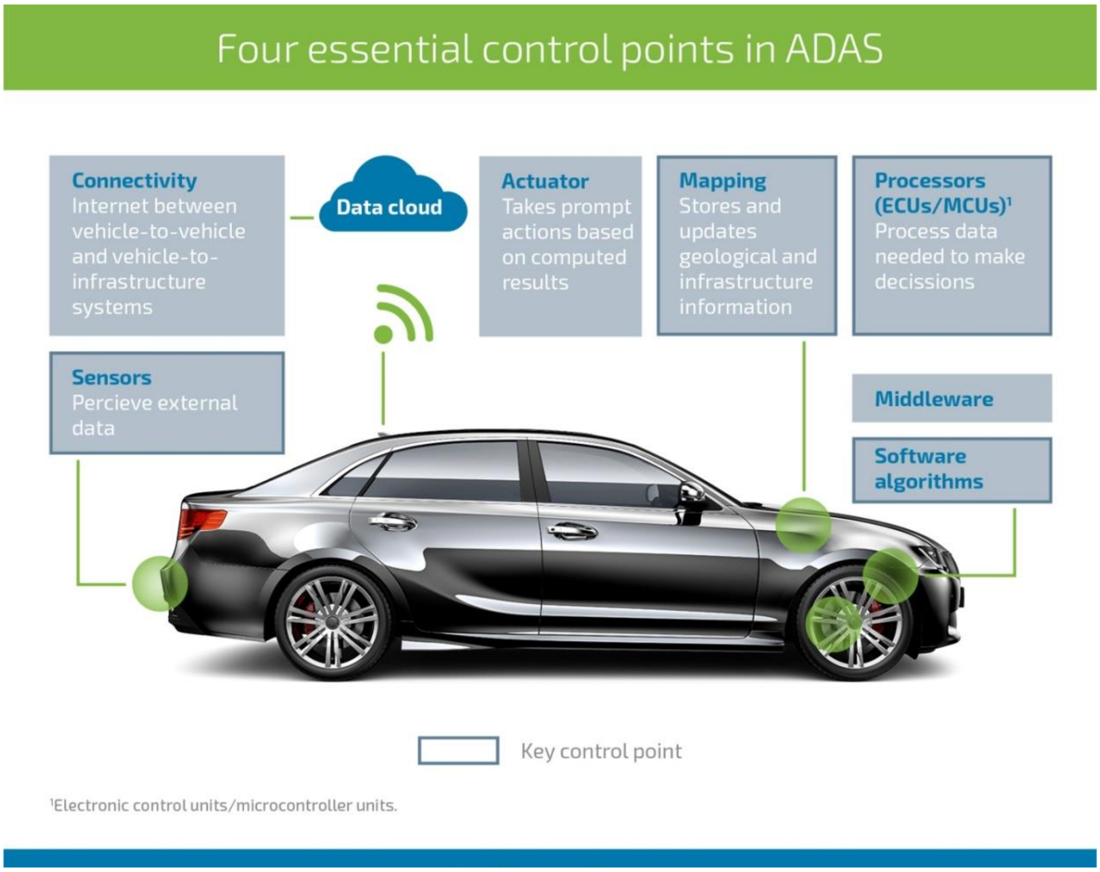

Fig. 3 Components of autonomous cars
Source: [2]

5.1 Vehicle Communication Architecture

Advanced vehicular communications and services in V2X (Vehicle to Everything) & Internet of Vehicles (IoV):

- The V2X, which stands for 'everything in the world', is the umbrella term for a car communications system, where data from sensors and other sources travels with high bandwidth, low-latency, high reliability links, which opens up a completely independent driving mode.
- There are several V2X features, including vehicle-to-car (V2V), car-to-infrastructure (V2I), pedestrian (V2P), and vehicle communication (V2N). In this multicultural ecosystem, cars will communicate with other vehicles, in infrastructure such as robots or parking lots, pedestrians on smartphones, and on mobile network operators. Different operating cases will have different set of requirements, a communication system that must be handled efficiently and costly. IoV global network of vehicles – enabled by various Wireless Access Technologies (WAT) involves Internet and includes heterogeneous access networks
- IoV–can be seen a special use case of Internet of Things (IoT)
- IoV Target domains:
    - Vehicles driving and safety (basic function – in Vehicular Ad hoc Network (VANET))
    - Novel domains:
      Traffic management, automobile production repair and vehicle insurance, road infrastructure construction and repair, logistics and transportation, etc.
- Commercial , objectives, architecture
    - Business oriented architecture
    - High opportunities for various apps (safety, traffic optimization and efficiency, infotainment, etc.)
- Collaboration capabilities:
    - collaboration between heterogeneous nets, reliable Internet service
- Communication types:
    - includes all V2X types of communications
- Processing power and decision capabilities:
    - high capabilities – (cloud based), big data, data mining, …
- Compatibility with any personal devices
- Scalability:
    - Scalable (and it integrates various access: VANET, WiFi, 4G/LTE, 5G...)
- Connectivity:
    - “always-connected”-feature is possible; one can use the best network type
- Network/environment awareness:
    - global network awareness is possible (cloud-assisted)
- Cloud Computing/Edge computing (CC/EC) compatibility:
    - the main operations can be based on CC/Edge computing services

Fig. 4 & 5 show the architecture of IoV and V2X respectively. In IoV, data is obtained from outside sources (vehicle, infrastructure, sensor, etc.). This data is collected, cleaned and stored in database, in the nearby ***edge/device/vehicle*** (in case of less latency).
Data is saved in the ***cloud*** as per its requirement after proper feature extraction, as the main data center with AI functions working thereby also. Latency time is more in this case.

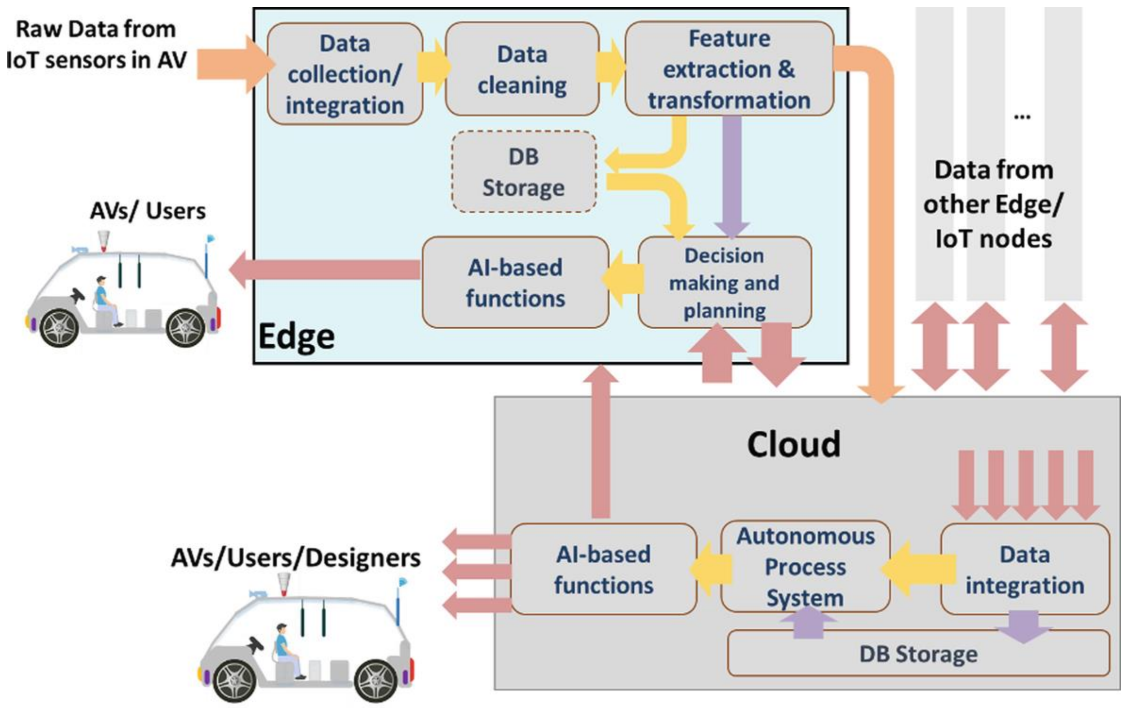

Fig. 4 Data Flow in IoV
Source:[3]

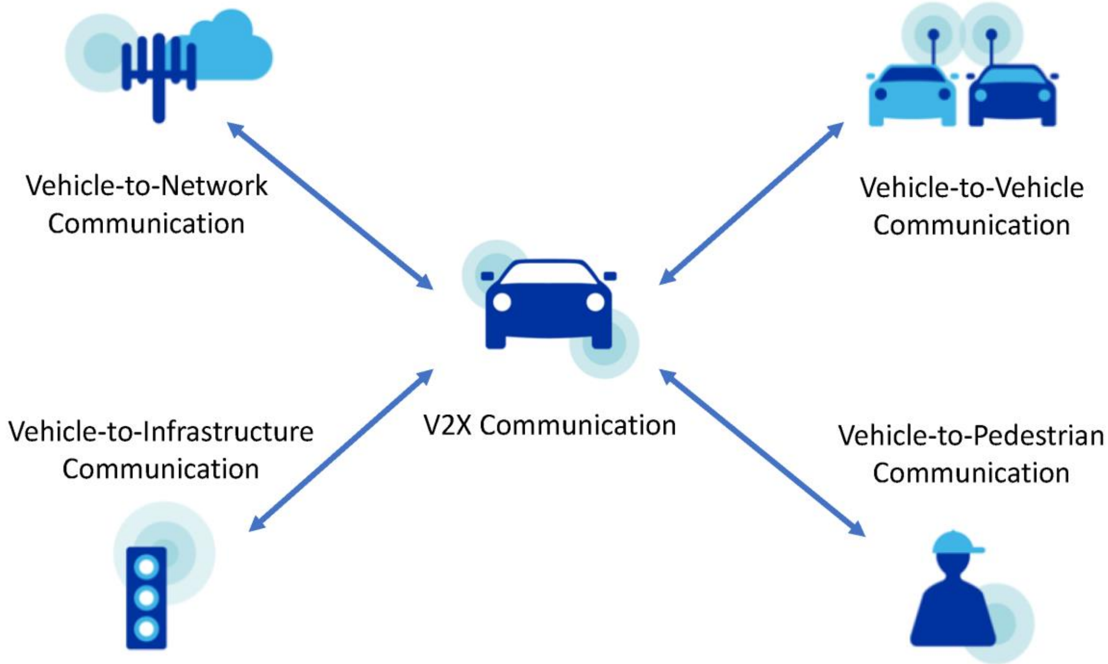

Fig. 5 Vehicle communication architecture
Source: [4]

5.2 AI in ITS

According to the U.S. Department of Transportation, "Intelligent Transportation Systems (ITS) uses a variety of technologies to monitor, evaluate, and manage transportation systems to enhance efficiency and safety." Putting the ideas of the science fiction style model aside for now, this explanation can be simplified in the following concepts of what makes intelligent transport: management, efficiency, and safety. In other words, smart transport uses new and emerging technologies to make traveling around the city much easier, more expensive (city and individual), and safer.

What emerging technologies support these new opportunities? Mainly an increase in IoT devices and 5G communication technologies. The first offers inexpensive sensors and controls that can be installed on almost any controlled and remote-controlled body machine. The latter provides the high-speed communication required for managing and controlling travel systems in real time with minimal latency. Fig. 6 & 7 support this concept.

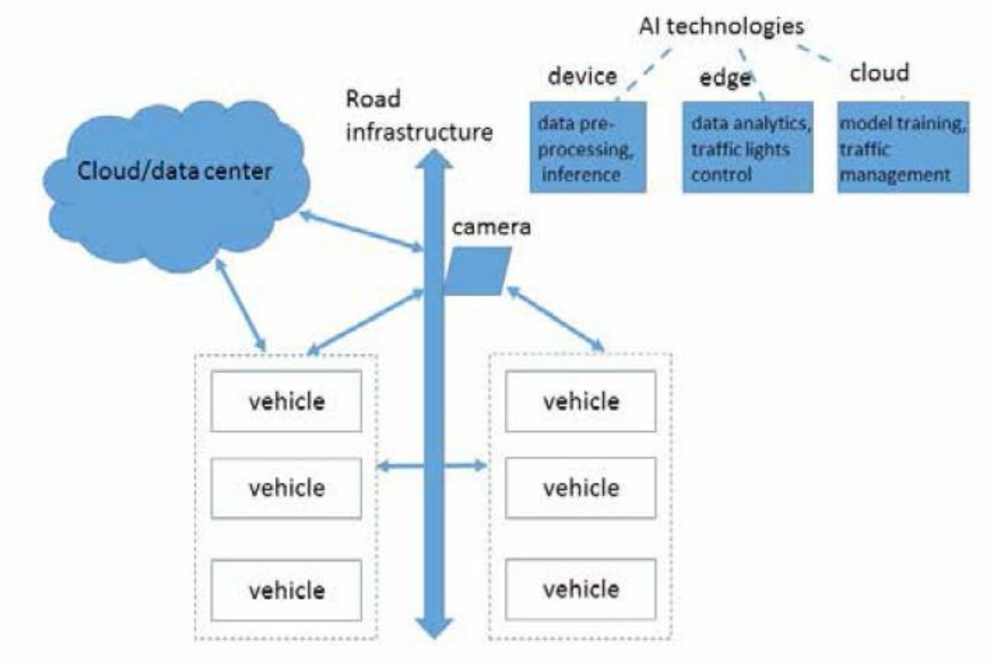

Fig. 6 Application of AI technologies in smart transportation
Source: Artificial Intelligence across Industries IEC

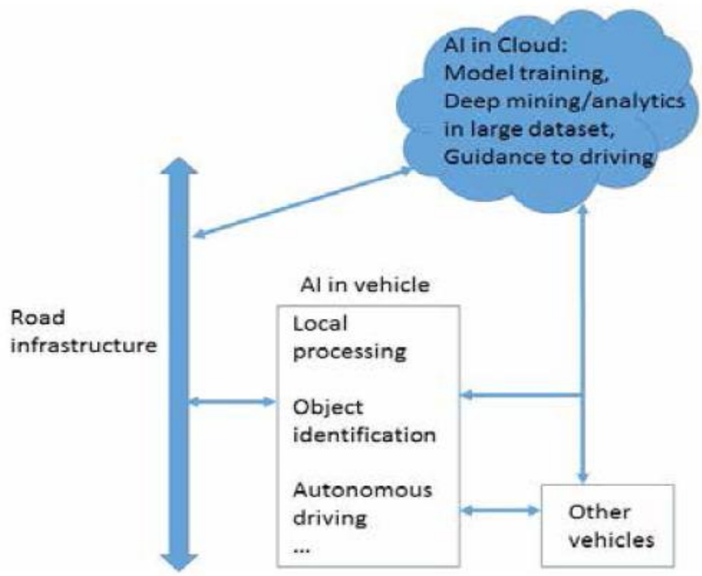

Fig. 7 Enabling autonomous vehicles with AI technologies
Source: Artificial Intelligence across Industries IEC

5.2.1 Elements of ITS

5.2.1.1 AI in Advanced vehicle control systems

Advanced vehicle control systems are oriented to complementing major portions of the driving task.

a) *Longitudinal collision avoidance*: AI helps to prevent head-on, rear-end or backing collision between vehicles, vehicles to objects or pedestrians. The overall system structure for multiple-vehicle collision avoidance and impact mitigation could be depicted in Fig 8 It includes remote sensor detection of relative distance and speed detection/estimation, V2V (Dedicated Short Range Communication), control, and decision making. An algorithm for frontal-rear collision avoidance and impact minimization should take the following factors into account:
(i) Multiple-vehicle collision scenario,
(ii) Mechanical definition of impact,
(iii) Vehicle mass,
(iv) Relative distance and relative speed at braking,
(v) Relative distance and speed at collision (time instant of impact),
(vi) Deceleration capability (braking capability) of each vehicle in the coupled group,
(vii) Constraint to the first vehicle in the front end of the coupled group,
(viii) Constraint to the last vehicle in the rear end of the coupled group.

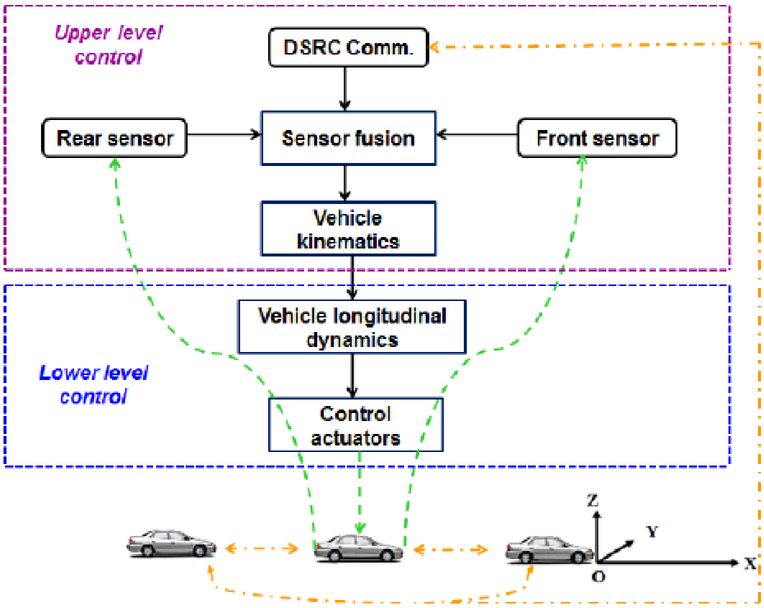

Fig. 8 Longitudinal collision avoidance
Source: [6]

b) *Lateral collision avoidance*: AI helps prevent collisions when vehicles leave their lane of travel.

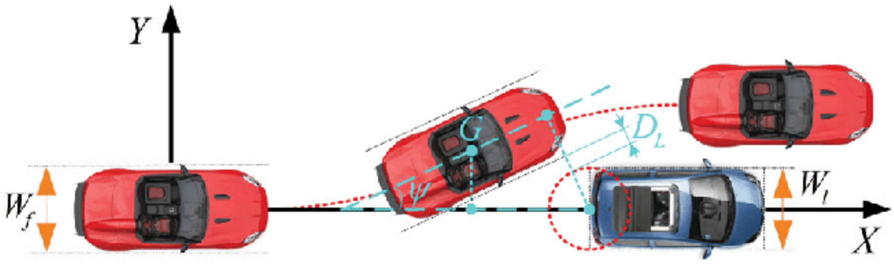

Fig. 9 Lateral collision avoidance
Source: [7]

c) *Intersection collision avoidance*: AI helps prevent collisions at intersections.

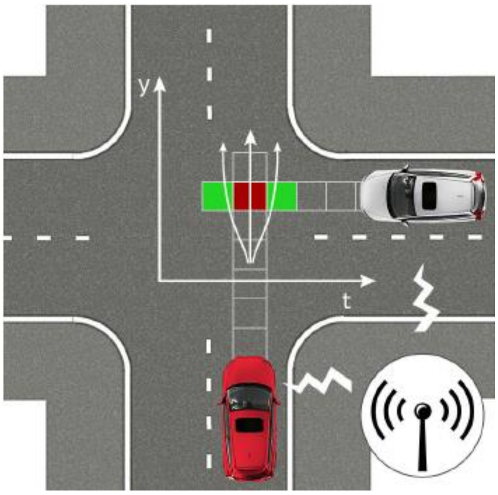

Fig. 10 Intersection collision avoidance
Source: [8]

d) *Vision enhancement systems*: AI improves driver's ability to see the roadway and objects on or along the roadway.

Fig. 11 Vision enhancement system
Source: [9]

e) *Pre-crash restraint deployment*: AI anticipates an imminent collision and activates passenger safety systems before the collision occurs earlier than is currently feasible.

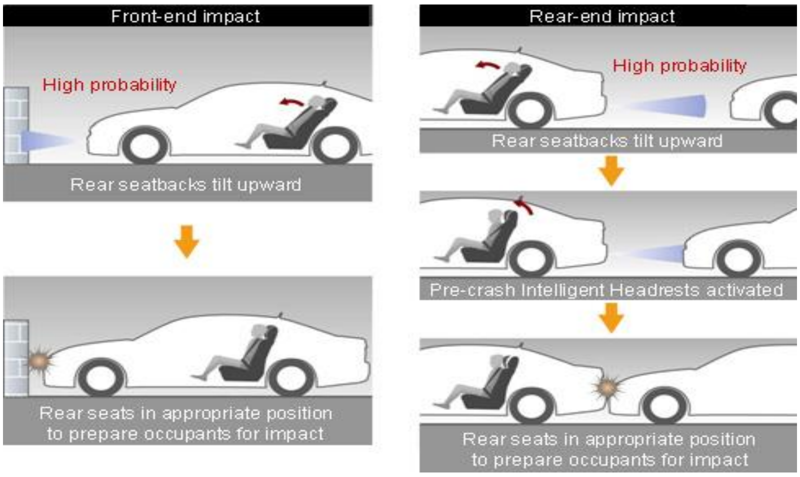

Fig. 12 Pre-crash restraint deployment
Source: [10]

f) *Automated road systems*

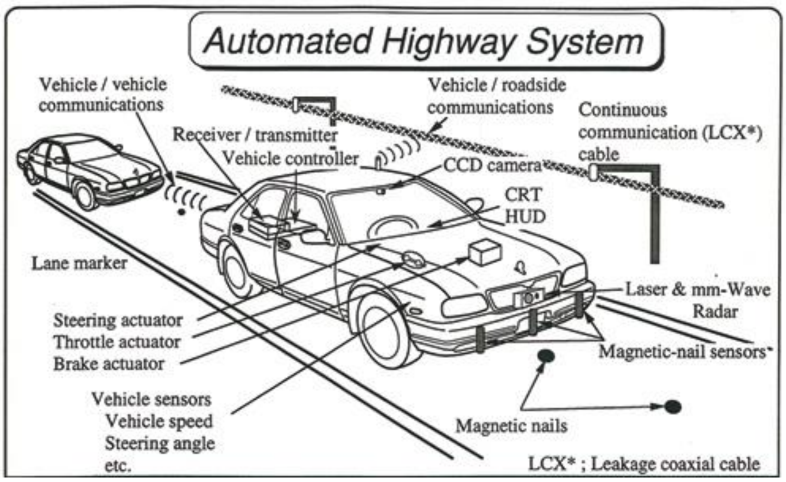

Fig. 13 Automated road systems
Source: [11]

g) *Safety readiness*: AI provides warnings about the condition of the driver, the vehicle and the roadway.

Automotive safety Integrity Level (ASIL) refers to the level of vehicle safety. It is a risk classification system defined by ISO 26262 standards for road safety performance.

The standard defines operational safety as "the absence of unreasonable risk due to accidents caused by malfunction of electrical or electronic systems." ASILs introduce safety requirements - depending on the possibilities and acceptance of risks - so that car parts comply with ISO 26262.

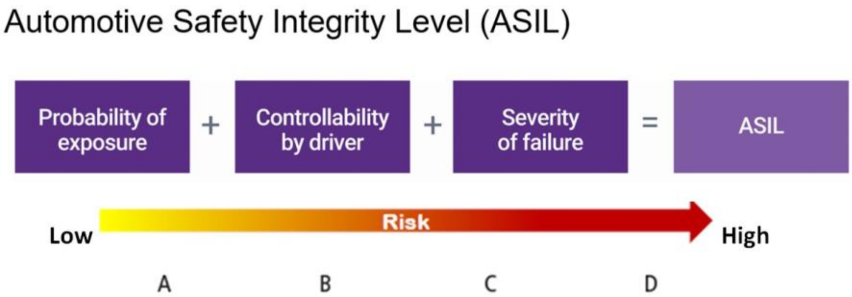

Fig. 14 Safety readiness
Source: [12]

5.2.1.2 AI in Advanced traffic management systems

a) *Traffic network monitoring and control*: AI manages the movement of traffic on streets and highways.

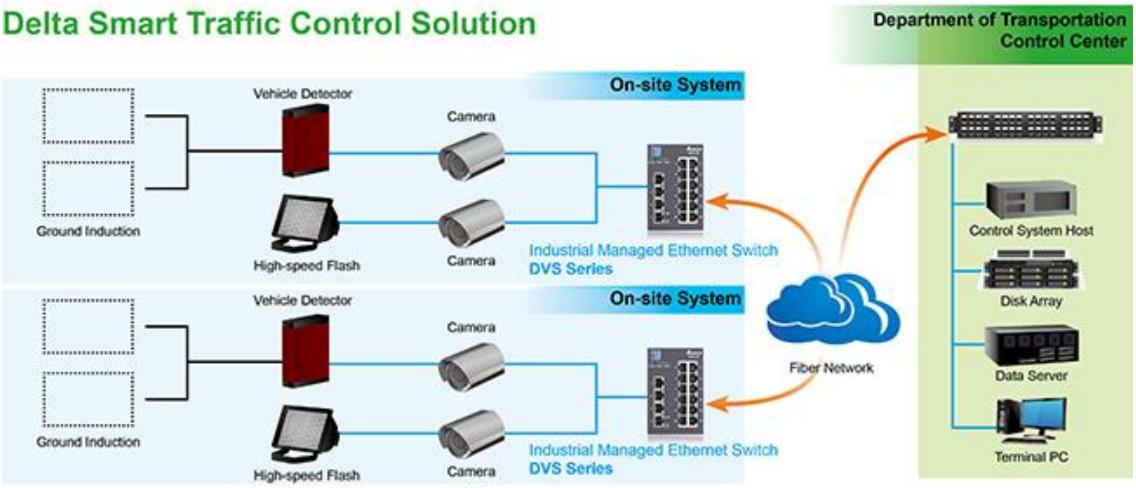

Fig. 15 Traffic network monitoring and control
Source: [13]

b) *Travel demand management*: AI supports policies and regulations designed to mitigate the environmental and social impacts of traffic congestion.

Fig. 16 Travel demand management
Source: [14]

c) *Incident detection and management*: AI helps public and private organizations quickly identify incidents and implement a response to minimize their effects on traffic.

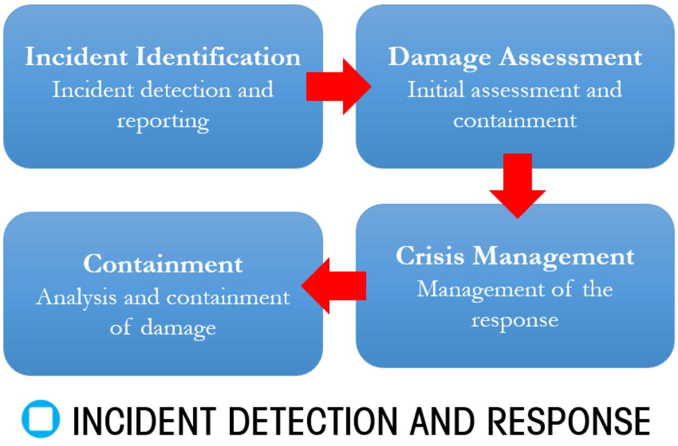

Fig. 17 Incident detection and management
Source: [15]

d) *Emissions testing and mitigation*: AI provides information for monitoring air quality and developing air quality improvement strategies.

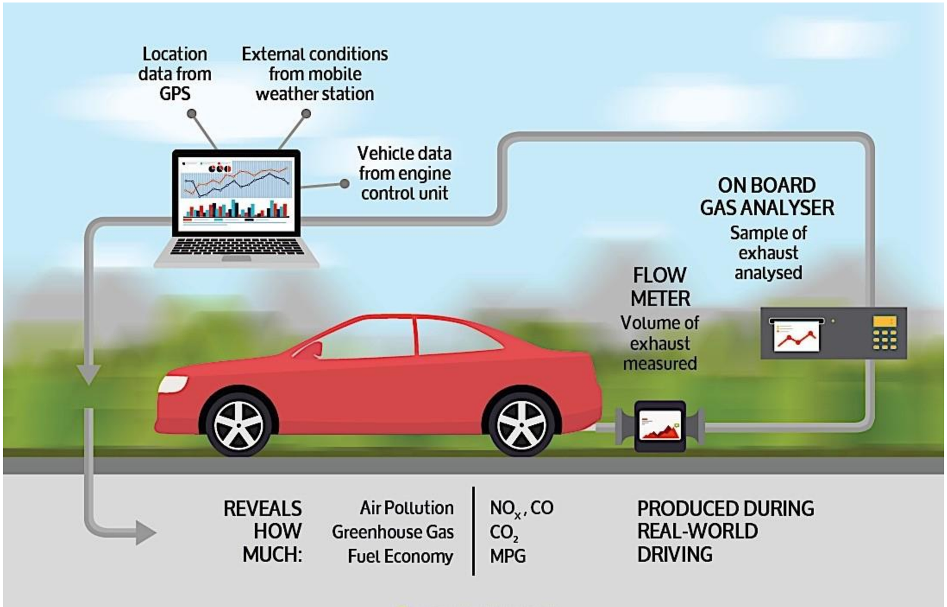

Fig. 18 Emissions testing and mitigation
Source: [16]

e) *Parking management:* AI provides information of parking lots or manages the entry and exit of vehicles.

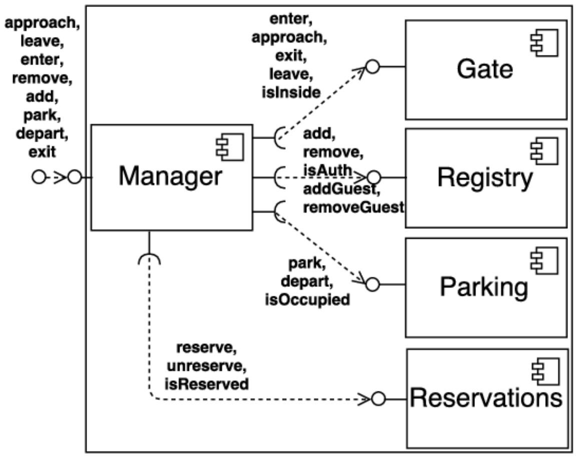

Fig. 19 Parking management
Source: [18]

5.2.1.3 AI in Advanced traveller information systems

a) *__Pre-trip travel information__*: AI provides information for selecting the best transportation mode, departure time and route.

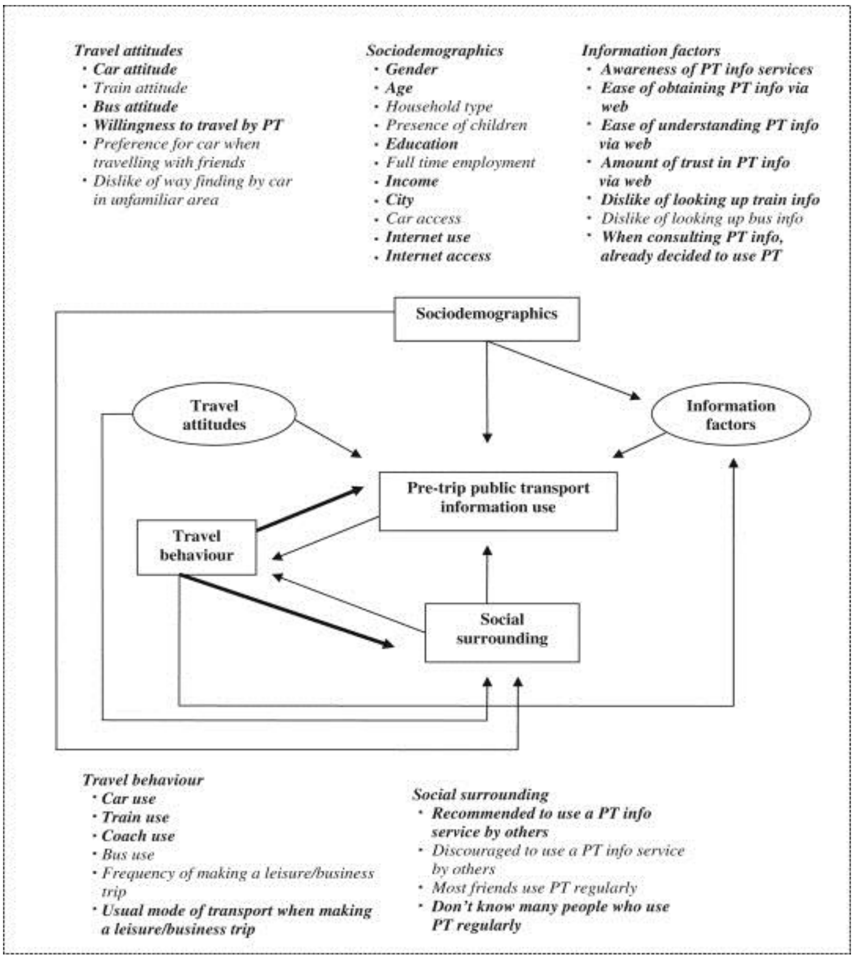

Fig. 20 Pre trip travel information
Source: [39]

b) *__En-route driver information__*: AI provides driver advisory and in-vehicle signing for convenience and safety during travel.

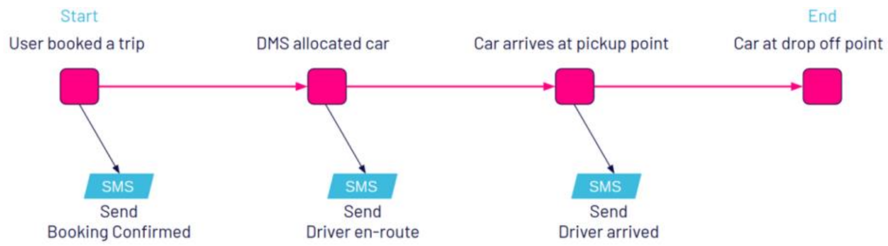

Fig. 21 En-route driver information
Source: [20]

c) *En-route transit information*: AI provides information to travellers using public transportation after the start of the trip.

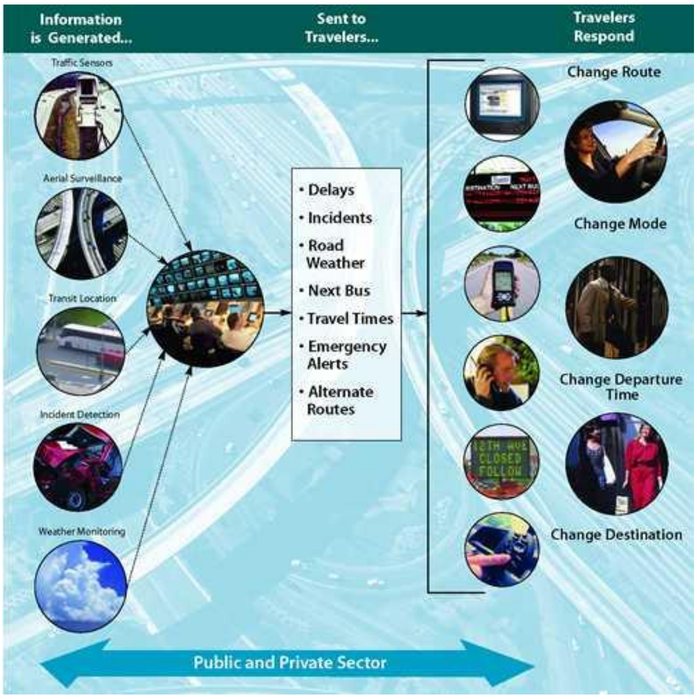

Fig. 22 En-route transit information
Source: [30]

d) *Route guidance*: AI provides travellers with simple instruction on how to best reach their destinations.

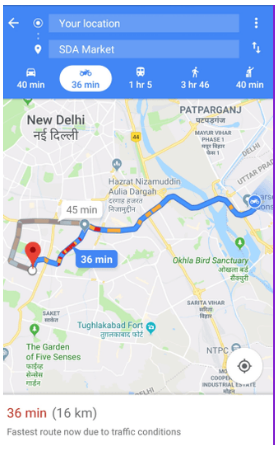

Fig. 23 Route guidance
Source: [16]

e) *Ride matching and reservation*: AI makes ride sharing easier and more convenient.

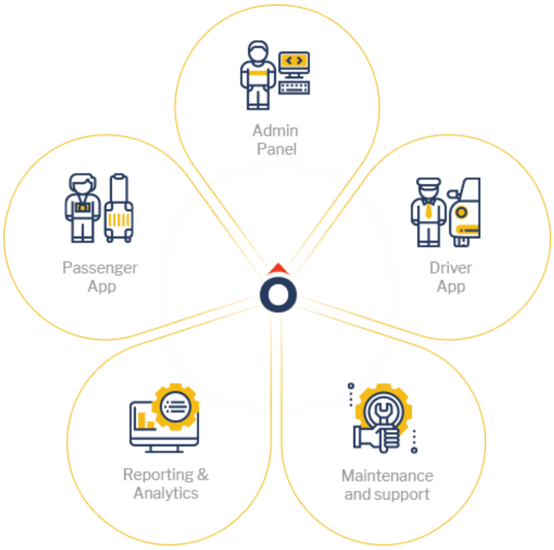

Fig. 24 Ride matching and reservation
Source: [17]

5.2.1.4 AI in Advanced public transportation systems

a) *Public transportation management*: AI automates operations, planning and management functions of public transit systems.

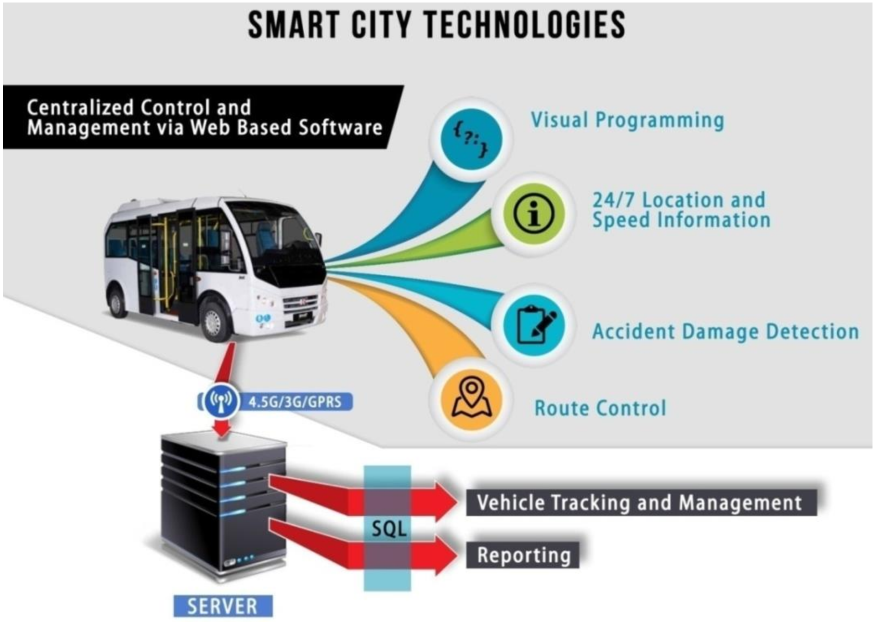

Fig. 25 Public transport management
Source: [22]

b) *Personalized public transportation*: AI offers flexibly routed transit vehicles for more convenient service to customers.

Fig. 26 Personalized public transportation
Source: [23]

5.2.1.5 AI in Advanced fleet management systems

a) *Vehicle administration*: AI provides electronic purchasing of credentials and automated mileage and fuel reporting and auditing.

b) *Safety monitoring and tracking*: AI senses the safety status of a commercial vehicle, cargo and driver.

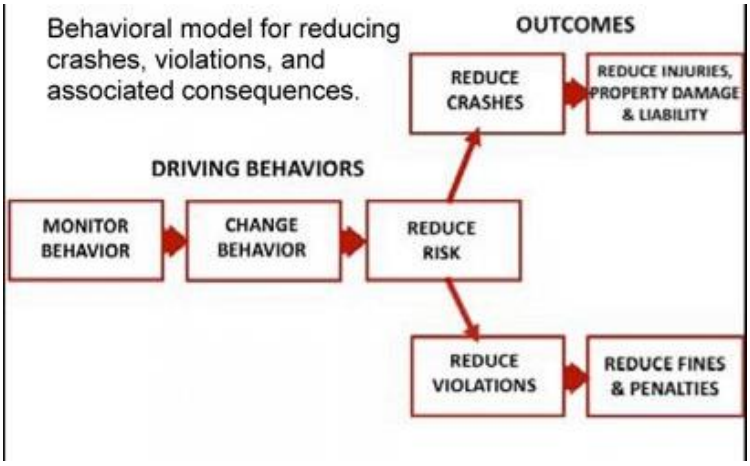

Fig. 27 Safety monitoring and tracking
Source: [20]

c) *Fleet management*: AI facilitates the fleet management system.

d) *Vehicle preclearance*: AI facilitates domestic and international border clearance, minimizing stops.

e) *Automated roadside safety inspections*: AI facilitates roadside inspections.

f) *Hazardous material incident response*: AI provides immediate description of hazardous materials to emergency responders.

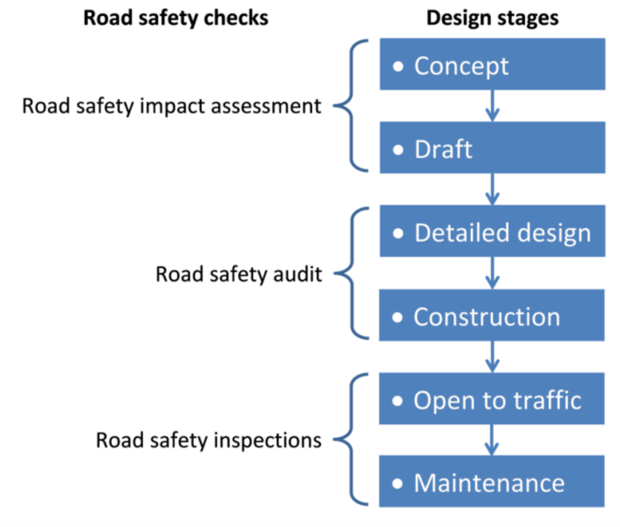

Fig. 28 Road safety and fleet management
Source: [25]

5.2.1.6 AI in Emergency management systems

a) *Emergency notification and personal security*: AI provides immediate notification of an incident and an immediate request for assistance.
b) *Public travel security*: AI creates a secure environment for public transportation operators.
c) *Emergency vehicle management*: AI reduces the time it takes emergency vehicles to respond to an incident.

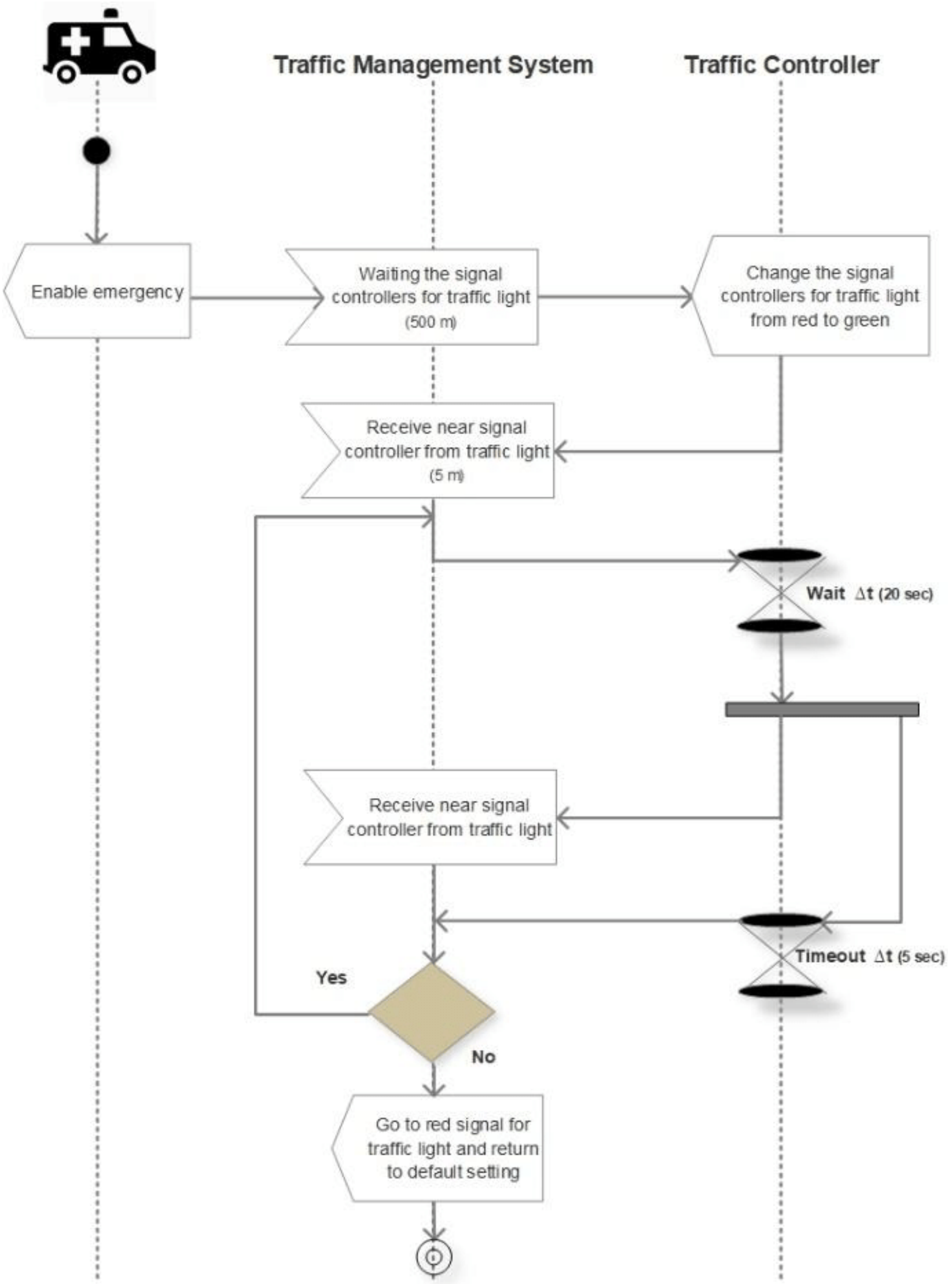

Fig. 29 Emergency management system
Source: [29]

5.2.1.7 AI in Electronic payment services

a) *Electronic payment services*: AI allows travellers to pay for transportation services electronically based on short-range vehicle-to-infrastructure communication.

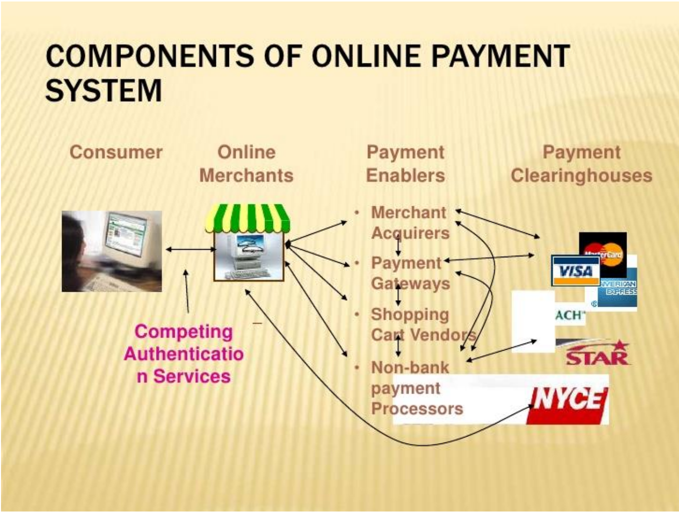

Fig. 30 Electronic payment service
Source: [27]

It also allows travellers to pay for transportation services electronically based on GNSS and wide area communication.

5.2.1.8 AI in Pedestrian supporting systems

a) *Pedestrians' route guidance*: AI helps pedestrians to find appropriate directions to go to destinations.

b) *Vehicle-pedestrian accident avoidance*: AI detects dangerous situations, and to provide necessary alarm both for pedestrians and drives.

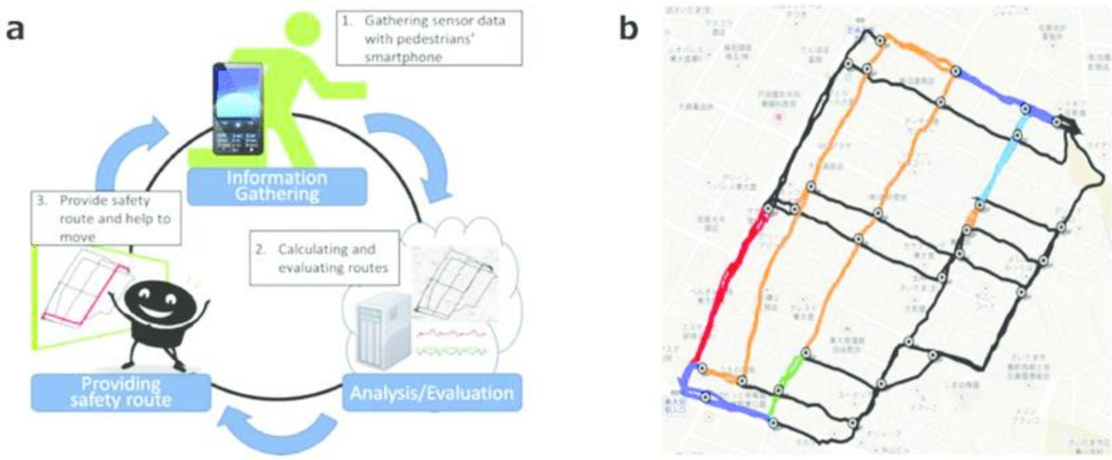

Fig. 31 Pedestrian supporting system
Source: [21]

6.0 Security & Privacy for "AI in Automotives"

As the development of self-driving technology continues, the hope of driverless cars operating on roads is at hand. Industry experts predict that driverless cars will be commercially available in the next five to ten years. However, the use of these technologies raises important privacy and safety issues that need to be checked and repaired before these vehicles can be fully sold.

 Security risks of LTE-V2X/DSRC

- Dynamic changes of network topology make it difficult to detect attacks.
- Lack of security key update management mechanism to manage the legality and timeliness of the vehicle identity
- The mechanism of isolation and punishment has not yet been established to the vehicle nodes which are untrusted or out of control.

 Security risks of cellular mobile comm. (2G/3G/4G)

- Based on the cellular mobile communication systems, vehicular system can *provide remote WiFi hotspots, which brings potential an attack portal*
- Through the cellular mobile communication system, the sound and data are transmitted between vehicle devices by means of microphones. Once an attacker breaks through the cellular mobile communication system**,** *it will cause the abnormality of automobile system*

 Security risks of WiFi

- It could be a springboard for attackers to launch an attack on the vehicle.
- Through WIFI, devices can access to the car's internal network, soattackers can get the internal data of vehicles
- By setting up pseudo AP, attackers can access the vehicle communication data by cheating the users.

 Security risks of satellite comm. (GPS/BEIDOU, etc.)

- There are *security defects* in the satellite communication module equipped on on-board system.
- Navigation location data spoofing, location data replay, etc.

 Security risks of wireless LAN communication (Bluetooth, Zigbee, etc.)

- Attacks mainly concentrate in three aspects: authentication process forsecurity specifications, simple matching process, and data encryption and decryption

Privacy issues

- Location tracking
- Leakage of passenger and owner data
- Stealing of sensor data, e.g., voice recognition system and control system

7.0 Standardization in AI for Automotives

7.1 International

Global SDOs ITU and IEC / ISO have developed appropriate standards, and created more AI-focused focus groups, many of which were highlighted during the March 2019 GSC-22 conference on AI.

ISO/IEC

- The ISO / IEC JTC1 SC42 Artificial Intelligence team operates at all levels of the operating environment (ISO / IEC NP TR 24030), ethics and management (ISO / IEC AWI TR 24368, ISO / IEC AWI 38507), terminology 22989), big data (ISO / IEC AWI TR 20547-1) and selection (ISO / IEC NP TR 24027), big data and AI architecture (ISO / IEC DIS 20547-3.2, ISO / IEC WD 23053), risk management (ISO / IEC AWI 23894), reliability and robustness (ISO / IEC PDTR 24028, ISO / IEC NP TR 24029-1).
- ISO/TC 184 Automation systems and integration team

ITU-T

Since 2019, road injuries have been the leading cause of death among children and young adults aged 5-29 (in addition to HIV and TB). AI can play a key role in reducing 1.3 million road deaths and 25 million injuries (SDG 3.6) occurring annually, and also promotes safe, affordable and sustainable security systems (SDG 11.2). However, widespread AI distribution, which is socially acceptable, depends on technology to achieve public trust.

FG-AI4AD supports suspension operations and services enabled by AI programs through independent and assisted driving. FG-AI4AD will focus on the evaluation of AI behavior responsible for dynamic driving activity in accordance with the 1949 and 1968 UNECE Global Road Safety Forum. To build public trust it is important that AI performance on our roadway integrates, or exceeds, the performance of a competent and caring driver. FG aims to create international synergies in the definition of a minimum performance limit for these AI programs (such as AI as Drive).

IEEE

- The IEEE P7000 addresses specific issues at the intersection of technical and ethical approaches, program design, system definition, data confidentiality, bias, terminology and ontologies, KPIs for face recognition.
- IEEE ECPAIS (Ethics Certification Program for Autonomous and Intelligent Systems) aims to create certification data and marking methods that improve transparency, accountability and reduce algorithmic bias in Autonomous and Intelligent Systems (A / IS).
- IEEE A-IS is the IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems and aims to ensure that all stakeholders involved in the design and development of independent and intelligent systems are educated, trained and empowered to prioritize ethical considerations.

Compliance with the EU ethical guidelines

The EC HLEG Reliable AI Guidelines (see the Trusted AI Code of Conduct Guidelines, published 8 April 2019) include the seven required categories. Within the current structure of ETSI, each technical body will need to find ways to apply the guidelines in their AI-related work, each focusing on the same "learning curve". ETSI should develop AI approach based on sharing and collaboration between groups.

As a first step, ETSI TBs should agree to analyze the technology proposed by HLEG to evaluate reliable AI, whenever AI capabilities are demonstrated at ETSI levels.

To ensure the prioritization of ethical issues relating to the use of AI, ETSI and its members must consider their commitment to the ETSI code of conduct, to develop standards compliant with the Universal Declaration of Human Rights and EC HLEG guidelines and EU guidelines on ethics in artificial intelligence: Context and implementation as it evolves.

SAE

SAE was founded in 1905 by Henry Ford, Andrew L. Riker, Edward Birdsall and John Wilkinson. The organization has contributed to many well-known people including Thomas Edison, Charles Kettering, Glenn Martin and Orville Wright. Another first SAE member, Elmer Sperry, coined the word automotive, derived from Greek cars, meaning independence, and Latin motus, meaning movement.

SAE International is a professional organization and organization that develops standards in the engineering industry, focusing on transport sectors such as automotive, aerospace and commercial vehicles. The organization was originally founded as the Automotive Engineers Association.

SAE is best known for its horsepower ratings and standards in the aerospace industry. While none of their recommendations or standards is legally binding, they are generally accepted by state-owned enterprises and organizations.

US SAE offices in Troy, Michigan and Warrendale, Pennsylvania. The organization works with 138,000 individual members worldwide through major initiatives that include consolidation, promotion of STEM (science, technology, engineering and mathematics), technology development and certification. SAE also hosts conferences, releases publications and sponsors of co-building competitions.

7.2 National

The standards making process for AI in Automotives is in nascent state/ under progress.

8.0 Use Cases of AI for Automated cars

8.1 International

Country	City	Car Company	Autonomy level
USA	California	Tesla	4,5
Germany	Stuttgart	Daimler	2

EU	Munich	BMW AG	5
US	Michigan	Ford	4
US	CA	AutoX	4
China	Beijing	Baidu	4
Singapore	Bendemeer	LTA	3,4,5

Tbl 1: Implementation of AI in various car models worldwide

8.2 National

Although the Govt of India has denied manufacturing driverless cars citing job loss as the reason, a few models are being constructed which have their genre in foreign countries.

City	Company	Model	Autonomy Level
Gurugram	Maruti	-	-
New Delhi	Tata	Elxsi	1,2,3
New Delhi	Tata	Syntiant	1,2,3
Halol, Gujarat	MG Hector	MG Gloster	1

Tbl 2: Implementation of AI in various car models in India

9.0 Challenges with Autonomous Cars

Fully independent vehicles (level 5) are being tested in several international packages, but none are currently available to the general public. We are still far from that. Challenges range from technical and legal to environmental and philosophical. Here are some of the unknown ones.

9.1 Cyber Security Threats to Autonomous Cars

- Remote Hijack- The hacker can hijack the car anytime and anywhere.
- Private Information Access- The hacker can steal all the information once he gets access, leaving the product unable to use.

9.2 Ethical issues

- *Artificial vs. Emotional Intelligence*

Human drivers rely on subtle clues and non-verbal communication - such as eye contact with pedestrians or learning the facial expressions and body language of other drivers - to make instant judging calls and guess the behavior. Will driverless cars be able to duplicate this connection? Will they have life-saving emotions as human drivers?

- *Accident Liability*

Who has to deal with accidents caused by driverless vehicles? Manufacturer? A human passenger? Recent plans suggest that a fully standard Level 5 car will not have a dashboard or steering wheel, so a human passenger would not have the opportunity to control the car in an emergency.

If at times, any mishap occurs, such as accident, some component failure, unpredictable stopping of car, who should be held responsible for the same. There are four agents in this system:

- Driver
- Manufacturer (OEM)
- Owner
- Retail

This is a hot issue going on in-hand with the development of driverless cars. Technically moving, falters occur due to driver's carelessness. So, if, in case, component failure occurs, it is the driver who is responsible for the situation and he should handle the same.

FGAI4AD, as discussed above, focuses on the behavioral evaluation of AI when used on roads. Because road injuries are leading cause of deaths of children. FGAI4AD standardizes the activities for use of AI in automotives. Using its methodology, components, structure and various paradigms it covers, we can reach to the conclusion of this ethical issue.

9.3 Others

- *Lidar and Radar*

Lidar is expensive and still trying to find the right balance between distance and solution. If more private cars were to drive on the same road, would their lidar signs interfere with each other? And if more radio waves are available, will the frequency range be sufficient to support mass production of private vehicles?

- *Weather Conditions*

What happens when a driverless car travels in heavy rain? When there is a layer of snow on the road, the road dividers disappear. How will cameras and sensors track line marking if marking is hidden by water, oil, ice or debris?

- *Traffic Conditions and Laws*

Will private cars have a problem with the tunnel or bridges? What are they going to do with the huge traffic that will bounce? Will private cars be returned to a specific line? Will they be given carpool road access? And what about legacy ships that share the road for the next 20 or 30 years?

- *State vs. Federal Regulation*

The regulatory process in the U.S. has recently changed from state directives to state-owned driverless car licenses. Some states have even proposed a tax on driverless cars to prevent the rise of "zombie" cars traveling around without passengers. Lawmakers also drafted bills suggesting that all driverless cars should be zero-emission vehicles and be fitted with a shock button. But will the laws vary from government to state? Will you be able to cross state lines in a private car?

What solutions does US have for autonomous cars?

Today's cars have 100 million lines of code. Tomorrow’s private cars will have more than 300 million lines of code, so cyber security is a growing problem. *Synopsys*, a US leader in app security testing and software design analysis, helps automotive customers build security in their software throughout the life cycle of development and in every transaction.

Synopsys also offers a comprehensive portfolio of automated IP, certified by *ISO 26262 and ASIL B & D* readiness, to help its customers have excellent chip applications for applications such as *ADAS, infotainment, and standard MCUs*. Embedded vision processor solutions help customers integrate skills such as object recognition and facial recognition, night vision, and flexible cruise control.

Conclusion

Artificial intelligence is transforming the automotive industry. Significant investments have been made in technology leaders such as Google, Tesla, Uber, and major car companies in the region. It is not an opportunity for big companies but also a start. It will not only help modernize the automotive area, but also provide safety to the passengers. This document has served as an introduction to the integration of AI, IoT, and automotive industry. Vehicle communication has been discussed in detail and is being greatly stressed by OEMs to develop a safe and standard product. Although security, privacy issues and few challenges are here but AI in automotive sector is achieving limelight and will grow in upcoming years.

Glossary

ADAS	Advanced Driver Assistance System
AV	Autonomous Vehicles
DSRC	Dedicated Short Range Communication
ETSI	European Telecommunications Standards Institute
GPS	Global Positioning System
HLEG	High Level Expert Group
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
ITU	International Telecommunications Union
LAN	Local Area Network
LTE	Long Term Evolution
MCU	Micro Controller Unit
OEM	Original Equipment Manufacturer
SDG	Sustainable Development Goals
SAE	Society of Automotive Engineers
TB	Technical Body
UNECE	United Nations Economic Commission for Europe
V2R	Vehicle to Roadside Unit
V2S	Vehicle to Sensor
VANET	Vehicular Ad hoc Network

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