Intelligent, Connected and Automated Mobility (ICAM)

An IEEE European Public Policy Committee Position Statement

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Connected vehicles, autonomous driving, intelligent transport systems and the Internet of Things (IoT) have emerged as major technological driving factors of automotive digitalization. With a global economic potential of over EUR 100 billion revenue per year in connected vehicles equipment[1] (both hardware and software), the digitalization of the automotive industry is set to radically transform our transport and mobility behaviours.

The expected future development and large-scale deployment of intelligent, connected and autonomous vehicles has led to a new paradigm of road traffic that focuses not only on public safety and environmental sustainability, but also on ensuring an adequate level for ownership, privacy, security and protection of the collected data that cannot be guaranteed only by GDPR. With the evolution information and communication technologies impacting all sectors of the economy, vehicles and the automotive industry, as well as transportation in a broad sense, are also changing rapidly.

Over the past years, the European Commission, EU Member States, and industry, in collaboration with other stakeholders, have worked together to achieve the EU's vision for connected and automated mobility in a Digital Single Market and to shape more incisive policies relating to privacy, data use and protection, connectivity, cybersecurity and dependability of vehicles, vehicle producers and road infrastructures (i.e., reliability, availability, maintainability, safety and security). These efforts have included both policy and legislative initiatives, as well as funding of research and innovation projects, and the development of standards[2].

The Position Statement of the IEEE European Public Policy Committee (EPPC) aims to offer specific recommendations to policy makers and other policy stakeholders in Europe with a view to further promoting the full-scale development and deployment of intelligent, digitalized, connected and autonomous vehicles (i.e., smart transportation). Not only are the related technologies relevant to the engineering profession and within the technical interest of IEEE, but their development will also be instrumental in making Europe a leader in smart cities, achieving the objectives set out in the European Green Deal, and ensuring an adequate level of European digital and industrial strategic autonomy.

Against this backdrop, seven major issues and axes of action are highlighted, and possible solutions that have been agreed with the wider IEEE membership are put forward. These recommendations apply generally to all types of mobility although the major focus is on road vehicles.

[1] See "Unlocking The Full Life Cycle Value From Connected Car Data", McKinsey report 2021.
[2] See https://transport.ec.europa.eu/index_en for the full spectrum of initiatives by the EU in the area of mobility.

Recommendations

Issue #1 – Privacy and Data Protection

The combination of the future technologies of 5G/6G, Artificial Intelligence and IoT, utilized by ICAM systems, will realize the possibility to obtain, store, process and deliver Big Data related to personal sensitive information acquired with or without the awareness of the interested subjects. Some critical examples in ICAM systems are position tracking, automatic profiling and automatic image recognition. These examples of the access and processing of personal data might not be compliant with the GDPR. New privacy and data protection technologies are necessary to face these challenges and opportunities, in addition to the full compliance of the new ICAM systems to the normative of GDPR. Moreover, the European sovereignty of all accessed and processed data must be guaranteed.

Therefore, the IEEE EPPC recommends that EU policy makers consider the following points:

1. Full compliance of the new ICAM systems to GDPR normative and in particular:
    - "privacy by design" and "data ownership rules" since the initial stages in the development of ICAM systems for all involved stakeholders, e.g., vehicle producers, vehicle owners and passengers;
    - minimizing data processing to the service provided and restricting data sets to a limited number of authorized and trusted parties only for compliance with legal requirements and the provision of the respective service;
    - anonymizing personal data and encrypting all data collected for storage, transmission and processing.
2. In addition to full compliance with European regulations and guidelines with respect to data protection and management, complete control by the owners of access and use of their data must be guaranteed. This can be achieved by implementing the new scientific and technical paradigm of "individual a priori data usage control" (i.e., except in cases of force majeure or emergency, any use in any form and for any purpose of personal data must be authorized in advance and explicitly by its owner, correctly informed of the purpose of use). The EU should promote intensive research activities on this subject;
3. To preserve European sovereignty, data processing, storage-cloud and edge computing must be implemented on servers based in Europe and, as far as possible, on semiconductor hardware and software provided by European manufacturers.

The benefits will be broad and will include secure and trustworthy ownership and management of citizens and governments' data.

Issue #2 – Cybersecurity

Increased connectivity of ICAM devices and vehicles and interconnections amongst systems, including the grid and communication infrastructures, increase the risk of cyber attacks, as attackers would have a larger number of individual nodes and weak points to access. To address potential cybersecurity threats and prevent unauthorized access, specificities of the cybersecurity risks and vulnerabilities need to be identified and effective solutions put forward.

Recommendations presented in the 2020 EPPC Position Statement on Cybersecurity[3] can be leveraged on:

1. Strengthening cyber resilience and response to cyber attacks for critical infrastructures, systems, assets and associated processes;
2. Rationalizing the European cybersecurity regime into a common framework;
3. Supporting the development of effective cybersecurity certification schemes;
4. Facilitating regulatory compliance by stakeholders;
5. Promoting cybersecurity education, awareness and 'hygiene' habits;
6. Supporting research and innovation in cybersecurity.

The benefits will be broad and will include secure and trustworthy management of citizens and governments' communications and data.

Issue #3 – Public Safety

Improving and assuring the safety of vulnerable road users (e.g., pedestrians, drivers, passengers, animals, goods, etc.) is imperative, and systems for automated mobility at all driving automation levels will need to adhere to these requirements just like conventional cars. The most important design objective for ICAM systems must be to guarantee these needs under all circumstances. This requires that information provided under any weather conditions by every sensor, satellite-assisted navigation systems (e.g., Galileo) and/or Inertial Navigation Systems (INS), RADAR, LiDAR, roadside infrastructures and cameras must be interpreted correctly and reliably, considering other assisting information such as maps, V2V communications and car connectivity. Based on these inputs, the decision-making process and behaviours exposed by automated vehicles based on ICAM systems logic must be understandable for drivers and passengers and, finally, must consider the safety of the pedestrians, driver, passengers and any other persons, animals or goods potentially involved.

In this regard, the EPPC recommends that EU policy makers:

1. Build upon existing policies and initiatives with respect to smart road infrastructure research and to the development of pilot road segments allowing for rigorous evaluation and certification of vehicular and system safety prior to large-scale deployment;
2. Consider a legislative approach to safety norms, grounded on rigorous research that may include the definition of liabilities of mechanisms for estimating, prioritizing and acting upon the risks and consequences resulting from automated interventions, especially in the event of injuries and/or death resulting from accidents. Such mechanisms may require enforcement, potentially coming into conflict with the driver, passengers, vehicle manufacturers, suppliers, sub-suppliers and vehicle owner rights;
3. Expand the existing safety recall framework, regulating the mandatory disclosure of incidents in which automated perception, control and decision mechanisms played a role, including when such incidents are not attributable to malfunction or defect, but also to design choices, algorithmic or technical limitations, or third-party tampering.

The benefits will be broad and will provide the regulatory contest that is needed to implement safe automated mobility scenarios.

[3] See "Cybersecurity for a stronger and more resilient digital Europe", https://www.ieee.org/about/ieee-europe/publications.html

Issue #4 – Product Dependability

Intelligent, digitalized, connected and autonomous vehicles must be dependable (i.e., reliable, available, maintainable, safe and secure) and readable/understandable with respect to possible hazardous conditions occurring during their operation in the field. The pivotal role played by electronics in such systems makes the dependability of the electronic circuits and systems of autonomous vehicles of primary relevance. Their dependability should be guaranteed with respect to faults and aging phenomena affecting the hardware, as well as with respect to faults affecting the software. Hardware and software design approaches to guarantee high dependability electronics exist, even though there are several technological challenges that have to be overcome for their adoption in highly autonomous systems. Such design approaches imply a cost, which typically increases with the achievable level of dependability. Guaranteeing the appropriate level of dependability for all circuits and systems with respect to any possible hazardous condition possibly occurring in the field is of utmost relevance for the trustworthy adoption of automated mobility.

In this regard, the EPPC recommends that EU policy makers:

1. Support research and innovation in dependable systems;
2. Promote education and awareness on hardware and software strategies for dependable systems;
3. Support and promote the creation of a unified dependability standardization platform, covering all aspects of system dependability and accounting for all risks related to any hazardous condition possibly affecting the software and hardware in the field;
4. Support the development and standardization of dependability certification processes.

The benefits will be broad and will cover all technical aspects that are needed to implement safe, reliable and available (i.e., dependable) automated mobility scenarios.

Issue #5 – Interoperability

Today's ICAM systems require communication and networking with each other, infrastructure and charging systems. It becomes necessary to work on standards that guarantee the interoperability of the systems and, at the same time, ensure all the aspects highlighted in the previous issues. This interoperability is also necessary for the provision of new services and for the billing of operational costs.

In particular, the EPPC recommends that EU policy makers:

1. Create a European Framework for Interoperability and Data Exchange for ICAM Systems Management. In particular, the promotion of a common communication infrastructure between vehicles and infrastructure would enable new services related to ICAM, such as standardized in-vehicle access to a European network of available and supported charging systems;
2. Create a European Common Data Space for data exchange independent from extra-EU firms that guarantee privacy and data protection, as well as free and democratic access to data for the creation of new services related to ICAM also by third parties and citizens.

The benefits will be broad and will cover all technical and normative aspects related to a "standardized" communication scenario for automated mobility.

Issue #6 - Accessibility

Private vehicles are currently commonplace. Autonomous vehicles might be used within mobility-on-demand systems and car-sharing, where vehicles are no longer owned by the users but by a transportation company. These vehicle fleets have enormous potential to improve accessibility and equal access to transportation, but this will require vehicles adequately equipped to be used by a wide range of users without discrimination, such as the elderly or handicapped.

In this regard, the EPPC recommends that EU policy makers:

1. Encourage the development of accessible and inclusive autonomous vehicles;
2. Regulate or provide incentives for future mobility-on-demand services that employ self-driving vehicles to ensure accessibility and services to a wide range of citizens.

The benefits will be broad and will cover all normative aspects enabling to improve automated mobility experience.

Issue #7 - Land use and traffic

With fully autonomous vehicles, there are novel challenges for the cities in terms of land use for parking and trips without any passengers on board, e.g., for rebalancing. Regulations are required in terms of empty kilometres travelled by autonomous vehicles, and the algorithms employed for route planning and task assignment. For example, empty vehicles could be driven along streets and areas where traffic and congestion are of lower concern. Parking space could also be adjusted, taking into account the fact that shared autonomous vehicles are expected to have a significantly higher utilization and consequently less parking time.

In this regard, the EPPC recommends that EU policy makers:

1. Invest in research on the effect that autonomous and intelligent vehicles have on traffic and congestion;
2. Invest in research on new traffic management strategies and associated infrastructure;
3. Evaluate mechanisms to control and discourage long journeys of empty vehicles;
4. Evaluate mechanisms to control and incentivize appropriate parking locations for autonomous vehicles.

The benefits will be broad and will cover all normative aspects enabling to improve automated mobility sustainability.

This statement was developed by the IEEE European Public Policy Committee (EPPC) Working Group on ICT and represents the considered judgment of a broad group of European IEEE members with expertise in the subject field. IEEE has nearly 60,000 members in Europe. The positions taken in this statement do not necessarily reflect the views of IEEE or its other organizational units.

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