INTELLIGENT TRANSPORT SYSTEMS

1 Introduction

Intelligent Transport Systems (ITS) achieve dramatic improvements in road traffic safety, transportation efficiency, and comfort by connecting people, roads, and vehicles using communication technologies. They have also been contributing to the realization of a vigorous society that is convenient for its citizens in various ways, including conserving energy through the alleviation of traffic congestion and the protection of the environment. Recent technological breakthroughs and new services such as connected, autonomous, shared, and electric (CASE) technologies and mobility as a service (MaaS) have expanded the scope of ITS from the stage of adapting cutting-edge technology to the domain of road traffic to a broader set of systems intended to support the lifestyles of diverse people and build a thriving society. Based on the information concerning the Japanese government ITS initiatives contributed by the Cabinet Secretariat, Cabinet Office, National Police Agency, Ministry of Economy, Trade and Industry (METI), and Ministry of Land, Infrastructure, Transport and Tourism (MLIT) for the 2020 edition of the annual report published by ITS Japan, and that organization's summary of the 26th ITS World Congress hosted by Singapore, this article introduces ITS trends in and outside Japan, as well as the strategy of the Japanese government in that field.

2 ITS Strategy of the Japanese Government

In 2000, Japan established the Basic Act on the Formation of an Advanced Information and Telecommunications Network Society (Basic IT Act) that defines the basic IT vision for the country. It has since continued to issue IT policies congruent with the digital age.

In the field of ITS, the June 2013 Declaration to be the World's Most Advanced IT Nation[1] spurred discussions on the *Public-Private ITS Initiatives/Roadmap* focusing on driving safety support systems and the application of traffic data aimed at laying out a concrete roadmap for initiatives that require close collaboration between the public and private sectors to achieve the goal of building and maintaining the world's most advanced ITS. In June 2014, the IT Strategic Headquarters finalized the roadmap with the inclusion of both society-oriented metrics such as reducing traffic accidents, alleviating congestion, and supporting the mobility of the elderly, and of industry-oriented metrics that include propagating automated driving systems, vehicle production and exports, and exporting infrastructure. An updated *Public-Private ITS Initiatives/Roadmap* has been finalized every year thereafter.

Since 2018, discussions on commercializing Level 3 and higher autonomous driving systems and establishing the regulatory systems necessary to allow the provision of services have continued. Following the formulation of the *Charter for Improvement of Legal System and Environment for Automated Driving Systems* in April 2018, the government agencies in charge of those regulatory systems evaluated specific legislative measures. As a result, in September 2018, the MLIT drew up the *Guideline Regarding Safety Technology for Automated/Autonomous Vehicles*, which clearly stipulates the safety requirements that must be met by autonomous vehicles. The May 2019 revision of the Road Transport Vehicle extended the scope of the safety regulations to cover autonomously operated devices to ensure safety integrally throughout all processes for autonomous vehicles or other devices, from their design and manufacturing to their use. At the same time, the assignment of conditions on the use of autonomously operated devices was vested in the Minister of Land, Infrastructure, Transport and Tourism. The Road Traffic Act was also revised in May 2019 to include stipulations on driver obligations with respect to the commercialization of automated driving technologies.

In the wake of such amendments to regulatory sys-

tems, the *Public-Private ITS Initiatives/Roadmap 2019*[3] presented a clear vision of what autonomous driving should look like to fully achieve the goals set for the imminent realization of autonomous driving on highways and unmanned autonomous driving mobility services in designated areas. The roadmap also summarizes remaining issues and initiatives such as sustainable business models. In light of the various initiatives launched over the past few years, MaaS in the age of autonomous driving was also assessed from the perspective of road traffic. The *Public-Private ITS Initiatives/Roadmap 2019* was finalized in June 2019.

3 ITS Trends in Japan

3. 1. VICS[4]

The Vehicle Information and Communication System (VICS) transmits the road traffic information compiled and processed at the Vehicle Information and Communication System Center using (a) FM multiplex broadcasting, (b) radio wave beacons, and (c) infrared beacons for display in three forms (text, simple graphics, and maps) on navigation systems and other onboard devices. Traffic information such as travel times, congestion conditions, and traffic restrictions are sent to navigation systems in real-time, offering not only greater convenience for drivers, but also contributing to smoothing traffic flow and improving fuel efficiency through appropriate route guidance. Nationwide spread of the system was completed in February 2003.

The new VICS WIDE system launched in April 2015 offers route guidance with high-precision avoidance of congestion based on travel times provided by links on ordinary roads, more detailed traffic information relying on taxi probe data, pop-up advisories for all special weather, tsunami, or volcanic eruption warnings, and information on areas struck by heavy rains (50 mm/h or more).

In 2019, work on integrating all probe data from civilian probes, infrared beacons, and ETC 2.0 to significantly reduce congestion, build a precise, autonomous driving-ready road traffic information network, and offer stable and accurate information in the event of a disaster has been conducted jointly with the Japan Road Traffic Information Center (JARTIC)[5] in the context of realizing the world's most reliable road traffic information network. Field tests are planned in Tokyo and six other prefectures in the Kanto region starting in April 2020.

3. 2. UTMS[6]

The aim of the Universal Traffic Management System (UTMS) is the realization of a safe and comfortable traffic environment with a low environmental load. It achieves this through sophisticated use of information communication technology, including two-way communication between individual vehicles and traffic management systems using infrared beacons. This enhances the safety and smooth flow of road traffic, and also alleviates traffic pollution.

(1) Main Applications of UTMS

(a) Advanced mobile information systems (AMIS): These are systems that aim to naturally disperse of traffic streams and alleviate congestion by complementing information from sources such as traffic information signs and radio broadcasts with traffic information sent to on-board devices via infrared beacons. As of the end of March 2019, all prefectures in Japan had adopted AMIS.

(b) Fast emergency vehicle preemption systems (FAST): These systems use infrared beacons to detect emergency vehicles in areas where call outs are frequent and control traffic signals to give priority to those vehicles. The aim of FAST is to shorten the time required for emergency vehicles to reach an incident scene or medical facility and to help prevent traffic accidents involving emergency vehicles. As of the end of March 2019, 16 prefectures had adopted FAST.

(c) Public transportation priority systems (PTPS): These systems control traffic signals to give priority to buses and other public transportation. The system aims to reduce journey times and increase user convenience. As of the end of March 2019, 40 prefectures had adopted PTPS.

(d) Traffic signal prediction systems (TSPS): These systems aim to reduce driving stress and prevent traffic accidents due to sudden braking and sudden starts by providing advance information such as what color the signal will be when drivers reach a signalized intersection. As of the end of March 2019, 46 prefectures had adopted TSPS.

(e) Pedestrian information and communication systems (PICS): These systems aim to support the safety of pedestrians, (particularly the elderly and people with visual impairment), this system uses approaches such as audio notification of traffic signal states and extending the duration of green lights to prevent accidents.

As of the end of March 2019, 33 prefectures had adopted, or made preparations to adopt, PICS.

(f) Driving safety support systems (DSSS): These systems aim to prevent traffic accidents and otherwise enhance road safety by providing drivers with visual and auditory information on surrounding traffic conditions, alerting them to potential dangers and creating an environment that reduces driving stress. As of the end of March 2019, 9 prefectures had adopted DSSS.

3. 3. Smartways

The aim of the Smartway Project is to enhance traffic safety and to develop measures for improving congestion and the environment. In this project, a Smartway is defined as a next-generation road that uses ITS technology to link people, vehicles, and roads by information.

(1) Progress of ITS Propagation

(a) Extensive provision of road traffic data: The number of vehicle navigation systems in Japan exceeded roughly 93 million units at the end of December 2019. Of these, approximately 66.65 million are compatible with real-time VICS road traffic information.

(b) Electronic toll collection (ETC) popularization and effectiveness[7]: ETC has gained widespread acceptance since its full-scale introduction of in March 2001. As of the end of December 2019, over 69.02 million on-board units had been set up, and 24 nationwide expressway and public road management companies use a single nationwide ETC system, which has a utilization rate of roughly 90%. ETC has virtually eliminated congestion at toll booths, which accounted for about 30% of expressway congestion throughout Japan. Consequently, ETC also helps lower the burden on the environment by reducing CO_2 emissions.

(2) Nationwide Spread of ETC 2.0 Services

(a) Start of ETC 2.0 services: These services include setting roadside devices at roughly 10 to 15 km intervals on inter-city expressways, and at roughly 4 km intervals on inner city expressways, and the launch of the world's first infrastructure-vehicle cooperative ITS spot service in August 2011 (by April 2018, roadside units had been set at approximately 1,700 locations along expressways throughout Japan).

The name of the services was changed from ITS spot services to ETC 2.0 in October 2014, and the introduction of services making use of route data, as well as a well-rounded lineup of private services, are being promoted. Full-scale sales of ETC 2.0 on-board units began in August 2015, and new installations of such units had reached a cumulative total of approximately 4.61 million at the end of December 2019.

(b) Initiatives in the fields of transportation and logistics: Although the use of ETC in the fields of transportation and logistics has been limited to the payment of tolls, the initiatives below seek to optimize transport by truck via the application of data on routes traveled and usage times collected with ETC 2.0.

- Streamlining of passage permits for ETC 2.0-equipped special vehicles
- ETC 2.0 support services for vehicle operations management

3. 4. Advanced Safety Vehicles (ASVs)[8]

Since 1991, the Road Bureau of MLIT has promoted the development, commercialization and popularization of ASVs through coordination between government, industry, and academia. In accordance with the sixth phase of the Advanced Safety Vehicle Project, the study of various advanced safety technologies necessary to achieve automated driving, including an extensive popularization strategy for already commercialized ASV technologies and of technical requirements for driver emergency response systems expanded to pull over on the road shoulder, as well as for intelligent speed adaptation (ISA) systems, continued in 2019. In addition, the ASV Project continues to play a supporting role for the commercialized advanced safety technologies it promotes (such as collision damage mitigation brakes, lane departure warning systems, and vehicle stability control systems).

3. 5. Autonomous Driving

Many ministries and agencies are pursuing initiatives to commercialize autonomous driving.

(1) ITS Initiatives in the Strategic Innovation Promotion Program (Cabinet Office) Based on the mid- to long-term direction stipulated in the basic plan for science and technology, the June 2013 Comprehensive Strategy on Science, Technology and Innovation[9] and the Japan Revitalization Strategy[10] Cabinet decisions established the Strategic Innovation Promotion Program (SIP)[11] to enable the Council for Science, Technology and Innovation to fulfill its role as a control center and realize scientific and technological innovation.

Research and development on systems for autonomous driving, one of the SIP challenges, was initiated in June 2014. The initiatives carried out over five years during

the first phase of SIP led to the formulation of unified cross-industry specifications for dynamic maps and other high-accuracy three-dimensional maps required for autonomous driving. One notable achievement of the program was the launch of the commercial distribution of high-accuracy three-dimensional maps for approximately 30,000 kilometers of expressway in March 2019.

For the second phase of SIP, a new Automated Driving (Expansion of Systems and Services) project aimed at reaching the next level was launched in recognition of the need for autonomous driving development that will help resolve social issues such as reducing traffic accidents and congestion, securing transportation in depopulated regions, and alleviating driver shortages. The second phase also features a strong desire to commercialize logistics and transportation services that make use of automated driving technology as early as possible in addition to expanding the scope of automated driving from expressways to ordinary roads. Accordingly, there is a strong push for both coordination with the international community and government-industry-academia collaboration to combine the Tokyo Rinkai area field tests and the development of basic technologies, as well as to surmount the three obstacles presented by technology, legal systems, and the fostering of social acceptance.

(2) Assessment the Legal System and Other Issues (National Police Agency) Based on its responsibility to enforce the Road Traffic Act, which stipulates the rules of the road, the National Police Agency (NPA) has assessed the legal system and various issues involved in realizing autonomous driving. The results led to the passing of revisions to parts of the Road Traffic Act to establish stipulations addressing the commercialization of autonomous driving in automobiles at the 198th session of the Japanese parliament in May 2019.

Similarly, in September, the Regulations Applicable to the Handling of Applications for Approval for Use of Road to the Field Operational Testing of Remotely Controllable Automated Driving Systems on Public Roads were revised, and the Regulations Applicable to Approval for Use of Road to the Field Operational Testing of Remotely Controllable Automated Driving Systems on Public Roads were established and released. Those standards expand coverage to the testing of vehicles operated with devices different from the normal steering wheel and brakes used in manual driving. Looking ahead to businesses offering transportation services relying on autonomous driving, they also include an extensive range of safety and other measures.

(3) *Roadmap for Deployment of Autonomous Driving Services* by the Subcommittee on Business Discussions on Autonomous Driving Technologies (METI) The Subcommittee on Business Discussions on Autonomous Driving Technologies, which involves the participation of automakers, suppliers, and other experts, was established in February 2015 under the auspices of the Director-General of the Manufacturing Industries Bureau of METI and of the Director-General of the Road Transport Bureau of MLIT to support an all-Japan government-industry-academia framework to commercialize autonomous driving. It has been analyzing and assessing current issues in the autonomous driving field, and promoting initiatives to address them.

In 2019, the subcommittee went beyond encouraging initiatives based on the process stipulated in Version 3.0 of the *Roadmap for Deployment of Autonomous Driving Services* and monitoring their progress. Confronted with the lack of a concrete plan in the *Public-Private ITS Initiatives/Roadmap 2019* for the achievement of the nationwide deployment of driverless autonomous driving services, the working group charged with assessing future issues looked at the state of demonstration tests in and outside Japan and at the goals for commercialization set by the public and private sectors, and formulated a roadmap to realize and deploy driverless autonomous driving focusing on the period between 2020 and 2025. That roadmap proposes starting with driverless autonomous driving operated only by remote monitoring in limited areas such as abandoned railway facilities in 2022 at the earliest. These services could potentially expand to 40 or more locations by 2025. In addition, assessing not only technical development, but also systems, infrastructure, acceptance, costs and other approaches is crucial to achieving such services. Therefore, stakeholders in the public and private sectors must share the roadmap and take on the challenge of making it a reality. In May 2020, the results of the 2019 assessments were compiled and released as the *Roadmap for Deployment of Autonomous Driving Services*, Version 4.0.

(4) Autonomous Driving Services in Semi-Mountainous Regions Using Michi no Eki Roadside Stations as Hubs and Support from Road Administration Authorities (Road Bureau, MLIT)

There are high expectations that autonomous driving

will prove effective at resolving issues such as reducing traffic accidents and securing transportation for the elderly. The MLIT is working to achieve the government-wide goal of providing autonomous driving services in limited areas such as semi-mountainous regions by 2020.

In such regions, the aging of the population and termination of public transportation services is making securing transportation for people and goods a pressing issue. Consequently, field tests to establish autonomous driving services based on the hubs represented by *michi no eki* roadside stations, where goods for sale, clinics, and administrative and other everyday life services tend to concentrate, have been carried out at 13 locations throughout Japan since 2017.

The 2017 field tests consisted of short-term (about 1 week each) evaluations primarily intended for technical validation. The 2018 field tests were longer term evaluations (one to two months each) that focused on issues such as validating measures to secure driving space for autonomous vehicles and building business models to offer sustainable services. In November 2019, a social implementation based on the field test results was initiated at the Kamikoani *michi no eki* in Akita Prefecture.

(5) Assessment of New Communication Technologies for Autonomous Driving Systems (MIC)

In the context of SIP phase 2, the Ministry of Internal Affairs and Communications (MIC) is focusing on wireless communications systems as it collaborates with other government agencies involved in ITS to pursue research and development aimed at realizing autonomous driving.

Specifically, research and development for technologies that collect the dynamic data available from various sources in real time, forms an integrated picture of traffic conditions, and transmits the necessary relevant subset of details to autonomous vehicles has been initiated as part of the SIP phase 2 policies that seek to acquire a comprehensive view of surrounding traffic conditions.

Investigations into new communication technologies for autonomous driving systems also continued in 2018. International studies led by Europe, the U.S. and China have moved the investigation of wireless communication systems (particularly in the 5.9 GHz band) for autonomous driving forward. With respect to wireless communication systems with a promising scope of utilization in that field, international discussions concerning their detailed analysis and other communications have been brought on the same page. Based on those investigations, promising use cases for such wireless communication systems were compiled in 2019 to form the basis of discussions held during SIP phase 2 on the communications required in autonomous driving.

3. 6. Promotion of ITS That Uses Radio Beacons

With respect to the use of wireless systems, the Ministry of Internal Affairs and Communication (MIC) is responsible for allocating the use of new frequencies and forming policies for technical standards, taking the actual usage of radio waves and interference with other wireless communication into account. In the field of ITS, MIC has already allocated frequencies and formulated technical standards for VICS, ETC, ETC 2.0, and ITS Connect (700 MHz band intelligent transport system). It has also been promoting the popularization of these systems.

(1) Initiatives to Spread and Enhance 700 MHz Band Intelligent Transport Systems In December 2011 the MIC revised ministerial ordinances and other documents to cover 700 MHz band intelligent transport systems, laying the legal groundwork for the introduction of ITS wireless systems designed for safety support systems. This was followed by the compilation of security requirements for driving safety support systems in the 700 MHz band in June 2014 and of security guidelines for the building of driving safety support systems in the 700 MHz band in July 2015.

As a result of those initiatives, the first vehicles in the world equipped with those systems were commercialized in October 2015. The vehicles make use of vehicle-to-vehicle or vehicle-to-infrastructure communication, enabling the use of driving safety support services such as crossing collision prevention, right-turn collision prevention, rear-end collision prevention, and the provision of information on emergency vehicles.

(2) Initiatives for the Realization of the Connected Car Society In the context of promising new forms of wireless communication for the connected car society, a two-year study of new wireless systems for connected cars was initiated in 2018 to review (a) enhancing existing ITS wireless systems in the 5.8 GHz band (DSRC) and potential introduction of a new ITS wireless system (cellular V2X), (b) enhancing 700 MHz band intelligent transport systems and the potential introduction of millimeter wave band communication systems, and (c) a data platform used to integrate the various ITS wireless systems and the technical requirements

for the security technologies employed in such systems. In 2019, the feasibility of various use cases was evaluated through simulations and demonstrations on test courses used to assess the performance of both existing and new ITS wireless systems. Potential interference with existing wireless systems was also examined to identify the requirements for concurrent use and consider technologies to prevent interference. For topic (a) in particular, the results for the required separation distance obtained from the analysis of potential interference with existing ITS wireless systems (ETC/ETC 2.0) demonstrated that with the ITS FORUM RC-005 and LTE-V2X (PC5) protocols, introducing next-generation V2X communication systems in the 5.8 GHz band would be problematic. Consequently, in 2020, the MIC initiated a study on the introduction of such next-generation systems in the 5.9 GHz band.

(3) Initiatives to Make Use of Fifth-Generation Mobile Communication Systems (5G) More than just an ultra high-speed development of the current mainstream 4G cellular phone technology, 5G—which became available as a commercial service in the spring of 2020—is a next-generation mobile communication system offering superior features such as multiple simultaneous connections that allow many personal devices to connect to the network simultaneously, and ultra-low latency that enables the smooth operation of robots or other equipment even from remote locations. High expectations are being placed on its use as an ICT foundation for a fully established IoT era. The MIC is currently working to secure, carry out research and development on, and collectively validate the frequencies allocated to 5G. At the same time, it is seeking to intensify international coordination efforts and take other actions related to the advancement of international standardization activities.

Given the expectations placed on 5G in automated driving technologies, the MIC has been conducting comprehensive field tests carried out to create new markets via the application of 5G since 2017. In 2019, vehicle-to-vehicle communication based on 5G NR wireless communication was put to use in field tests of truck platoons that relied on autonomous driving to maintain a following distance of 10 meters carried out on the Shin-Tomei Expressway. The Ministry of Internal Affairs and Communications is conducting further studies on the applications of 5G in autonomous driving.

3. 7. Promotion of International Standardization

(1) International Standardization Activities Concerning Smart Mobility Systems (METI) The reduction of CO_2 emissions in the automotive sector is a necessary aspect of measures to address global warming, and a decrease in CO_2 is expected to result from the more efficient traffic flow achieved by the spread of autonomous driving. The need to reduce traffic accidents and provide assistance to vulnerable road users also means that autonomous driving systems are growing in importance year after year. ISO/TC 204 (Intelligent transport systems) has been working on international standards for autonomous driving systems. Japan has played a leading role in the related field of vehicle control technologies in its capacity as convener for WG 14 (Vehicle/Roadway Warning and Control Systems), which is in charge of international standardization activities in that field. However, standardization efforts aimed at the early adoption of various autonomous driving systems gaining more momentum in the U.S. and Europe year after year, along with the rapid rise of vigorous standardization activities in China, South Korea, and other Asian countries, are expected to further intensify the jockeying to take the lead in international standardization efforts. Consequently, in terms of advanced driving support systems and related systems such as dynamic maps and vehicle control systems, and in light of the progress of regional standards in the U.S. and Europe and of the formulation of consortium standards, this project has focused on participation in international conferences to reach consensus with the international community, supporting the preparation of a draft of international standards for performance requirements, and other international standardization activities related to standardization items proposed by Japan in ISO/TC204 without losing sight of global interoperability.

(2) International Standardization Activities Concerning Autonomous Driving & Advanced Driving Support Systems (METI) With respect to basic technologies for autonomous driving, ISO/TC204/WG3 (ITS database technology), led by Japan as the WG3 convener, has been advancing the international standardization of dynamic maps. In this field, however, the push for standardization is extremely active, particularly on the part of European consortiums whose own standards are becoming the de facto norm, with various players vying fiercely to take the lead.

Consequently, in light of the progress of regional standards in the U.S. and Europe and of the formulation of consortium standards and keeping global interoperability in mind, efforts concerning dynamic maps and related systems affecting autonomous driving have focused on participating in international conferences to reach a consensus with the international community, preparing draft international standards, and supporting other international standardization activities involving the items proposed by Japan.

Another area of Japanese involvement is the preparation of various standards related to autonomous driving safety at ISO/TC22 (Road Vehicles). Through support for international standardization activities, Japan is making sure its voice is heard in areas such as cybersecurity, software (e.g., vehicle control software) updates, SOTIF (safety of the intended functionality), and human-machine interfaces (HMI).

(3) International Standardization Activities Concerning the Field of Information and Communication (MIC) The MIC is actively making proposals to the ITU, a specialized agency of the United Nations, on matters concerning standards and recommendations. The ITS initiatives are conducted primarily as part of Working Party 5A (WP 5A, responsible for land mobile service) of the ITU-R Study Group 5 (SG 5) and consist of proactively presenting proposals based on current frequency band use in Japan. Activities have centered on preparing recommendations for ITS wireless communication systems that use the 700 MHz and 5.8 GHz bands and harmonizing global and regional frequencies for ITS.

To contribute to further developing and spreading ITS wireless systems that use the 700 MHz band, WP 5A of the ITU-R SG 5 has proposed creating a new Recommendation for vehicle-to-vehicle and vehicle-to-infrastructure communications. This activity was supported through the proposal of a structure that compiles the standards in the U.S., Europe, and Japan for those forms of communication for the working documents used to formulate this new Recommendation. On the basis of that proposal, Japan filled in the contributing documents concerning its own vehicle-to-vehicle and vehicle-to-infrastructure communication standards. With assistance from Europe, South Korea and other regions, it also compiled that same information for various countries. Through cooperation with the U.S., Europe, and Asia-Pacific nations at related international conferences such as APG, ITU-R Recommendation M.2084 was released in September 2015. The technical requirements for the wireless interfaces for vehicle-to-vehicle and vehicle-to-infrastructure communications stipulated in that Recommendation reflect the European (ETSI), IEEE, and South Korean (TTA) standards, as well as the Japanese (ARIB) standards concerning 700 MHz band intelligent transport systems, and have been set as international standards.

To strengthen its international competitiveness, Japan actively engaged in international standardization activities at WRC-19 that included joint public-private sector efforts to support the adoption of a recommendation on the desirability of globally harmonizing the disparate frequencies used for ITS in various countries, as outlined in Agenda Item 1.12, Global or regional harmonized frequency bands for evolving Intelligent Transport Systems. In addition, based on the proposal by Japan, SG5 Question 261, *Radiocommunication requirements for connected automated vehicles (CAV)*, was assigned at the Plenary Meeting of the Radiocommunication Assembly (RA-19).

4 ITS Trends outside Japan[12]

Based on information from the 2019 ITS World Congress in Singapore, this section presents trends in autonomous driving and MaaS, for which many themes were proposed.

4. 1. Overview of the ITS World Congress 2019[13]

The 2019 ITS World Congress, the first in Southeast Asia, was hosted by Singapore over five days from Monday, October 21 to Friday, October 25, under the theme "Smart Mobility, Empowering Cities".

- Congress theme: Smart Mobility, Empowering Cities
- Dates: Monday, October 21 to Friday, October 25, 2019
- Venue: Suntec Singapore Convention and Exhibition Centre
- Organizers: Singapore Land Transport Authority (LTA) and ITS Singapore
- Scope: Total number of participants: 14,500
  Number of registrants: 3,100
  Number of exhibiting organizations: 321
  Participating countries and regions: 90

4. 2. Autonomous Driving Technology Trends[14]

The promise of Level 5 fully autonomous driving has

prompted a shift toward initiatives grounded in reality, such as the gradual development of safety support technologies for private cars, and autonomous driving technology applied to public transportation or freight transport managed by operators on predefined routes.

In next-generation urban traffic, the concept of autonomous driving as one option among various mobility services will take hold, and MaaS and urban planning will be viewed as a package. A transition to open data is a prerequisite to achieving this vision. The resulting new mobility services also have the potential to create a new value chain.

More and more discussions on evaluation methods and the establishment of systems and legal frameworks to move from the field testing of mobility services to their commercialization are being held worldwide. The topics cover who will be responsible for determining the rules and operational design domain for autonomous driving in addition to making safety the highest priority in its realization. At the same time, social acceptance in the form of infrastructure support and cooperation from citizens is essential to realizing Level 4 autonomous driving for mobility services.

The U.S., China, and Singapore are strategically conducting field tests following their planned steps of moving from closed testing to open testing, and then to commercialization.

4. 3. MaaS Trends[15]

High expectations have been placed on MaaS at the key to solving traffic and other issues stemming from urbanization, economic inequality, and the aging of the population. Following the 2017 example set by Helsinki, Finland, many countries are conducting field tests and moving forward with commercialization. However, dispatch services that provide door-to-door transportation such as Uber and Lyft, the increase in the volume of traffic due to the rapidly growing number of users, and the obstruction of traffic flow resulting from pick ups and drop offs at the curb are all factors that worsen congestion. Moreover, curbside congestion caused by the growing popularity of Amazon and other rapid delivery services has also been observed, and curbside management that extends to slowing down demand is becoming necessary. At the same time, the modal shift effect of MaaS has fallen short of expectations, and more pragmatic issues, such as the need for management that encompasses road traffic as a whole, have come to light.

In both Europe and the U.S., individual cities face different traffic-related problems, and the respective local authorities have been introducing MaaS on their own. However, France passed a mobility orientation law (November 2019), which earmarks 13.4 billion euros (approximately 1.62 trillion yen) until 2022. This law aims to deploy MaaS throughout the French territory with the intent of addressing global warming, nurturing new traffic-related industries, and securing competitiveness. In Europe, MaaS is viewed as one element of the public services, and despite ongoing issues concerning acquiring sufficient resources, initiatives directed at commercialization are becoming more widespread.