INTELLIGENT TRANSPORT SYSTEMS

1 Introduction

Intelligent transport systems (ITS) have been developed to help resolve various social issues through the adoption of innovative technologies. Examples of these issues include traffic accidents, congestion, and the increasing burden placed on the environment by emissions. Information and communication technology used to connect vehicles with roadside infrastructure, other vehicles, pedestrians, and motorcycles has become more widely adopted, and the scope of its contribution has been expanding.

In June 2013, as part of Japan's new IT strategy, the Cabinet Office issued the Declaration to be the World's Most Advanced IT Nation[(1)], which aims to make IT a cornerstone of Japan's growth strategy and a driving force in achieving sustainable growth and development.

A subcommittee for road traffic was established in October 2013 under a specialized investigation body charged with promoting the new strategy. In line with the statement on assessing the 10 to 20 year targets set in the Public-Private ITS Initiatives & Roadmap and drawing up that roadmap based on the IT strategy and the schedule for the Declaration to be the World's Most Advanced IT Nation (determined by the IT Strategic Headquarters in June 2013), the subcommittee held discussions in relation to the roadmap centered on driving safety support and automated driving systems, as well as the application of traffic data.

The Public-Private ITS Initiatives & Roadmap was agreed upon at the fifth meeting of the subcommittee for road traffic on March 18, 2014, deliberated at the fourth meeting of the specialized investigation body charged with promoting the new strategy, and finally approved by the IT Strategic Headquarters in on June 3, 2014.

The document outlines the general principles and lays out a concrete roadmap for initiatives that require close collaboration between the public and private sectors, with the aim of build and maintaining the world's most advanced ITS, as well as contributing to society in Japan and the world. This establishes a basis for discussions beyond 2014 focused on securing and maintaining the world-first ranking not only for social metrics such as reducing the number of traffic accidents, alleviating congestion, and supporting the mobility of the elderly and others with limited mobility, but also industrial metrics including the spread of automated driving systems, vehicle production and exports, and infrastructure exports. The roadmap also defines different levels for automated driving systems, which are currently the object of worldwide research and debate, and for driving safety support systems, and sets expected time frames for commercializing such systems.

In anticipation of rapid changes in ITS-related technologies and industries, the IT Strategic Headquarters is committed to applying a PDCA cycle, generally on an annual basis, to review the Public-Private ITS Initiatives & Roadmap and make any changes necessary. At the same time, the Automated Driving Systems Promotion Committee, made up of members from a broad cross-section of industry, academia and government, was established as the body responsible for promoting research and development of automated driving systems as part of the Cabinet Office's Strategic Innovation Promotion Program (SIP). This led to assigning the role of promoting ITS-related policies to a joint committee consisting of the Road Committee and the SIP Automated Driving Systems Promotion Committee, which convenes twice a year to evaluate future courses of action and discuss revisions to the roadmap.

In that context, discussions continued to be held in sessions of the subcommittee for road traffic and the Public-Private ITS Initiatives & Roadmap 2015 revision to the roadmap was approved by the IT Strategic Headquarters on June 30, 2015. This revised Public-Private ITS Initiatives & Roadmap explicitly laid out strategies

to disseminate various technologies and presented (a) automated driving systems that contribute to strengthening competitiveness in the global market, (b) regional public transportation systems featuring automated driving functionality and, (c) compact automated driving systems for local communities, as specific examples of systems that should be targeted for development and dissemination for the time being. Explicit strategies regarding the application of traffic data included (a) more advanced maps and the overlaying of various data, (b) the application of probe data and vehicle-related information and, (c) the utilization of traffic and other big data in various policies and measures, as initiatives to be pursued at present while formulating a basic policy addressing changes in data flow structures.

After the release of the Public-Private ITS Initiatives & Roadmap, ambitious research and development plans for automated driving systems were successively announced by private sector companies. In the second Public-Private Dialogue towards Investment for the Future in November 2015, Prime Minister Abe stated: "We will realize transport services and automated driving on highways via unmanned automated driving systems for the 2020 Tokyo Olympic and Paralympic Games. Therefore, by 2017, we will develop the required systems and infrastructure, including the implementation of demonstrations."

In light of the above, the subcommittee for road traffic continued to assess revisions to the Public-Private ITS Initiatives & Roadmap. The main points of those revisions are new definitions of semi-autopilot, autopilot, and unmanned automated driving services representing automated driving on highways, as well as clearly setting a process schedule and identifying specific issues to examine for the implementation of those services by 2020.

The resulting Public-Private ITS Initiatives & Roadmap 2016 was agreed upon at the 15th meeting of the subcommittee for road traffic on April 12, 2016, deliberated at the seventh meeting of the specialized investigation body charged with promoting the new strategy on April 13, and finally approved by the IT Strategic Headquarters in on May 20, 2016.

In addition, the comprehensive strategy and the Japan Revitalization Strategy that was approved in a June 2013 Cabinet decision[2] established the Strategic Innovation Promotion Program (SIP)[4] to enable the Council for Science, Technology and Innovation[3] to fulfill its role as a control center and realize scientific and technological innovation. Benefiting from a budget that extends beyond ministerial and industry boundaries allocated directly by the Council for Science, Technology and Innovation, the SIP program fosters research and development that promotes everything from basic research to forward-looking end results (application and commercialization).

In 2016, the Council for Science, Technology and Innovation appointed Seigo Kuzumaki, of Toyota Motor Corporation, as the leader (Program Director) of research and development on automated driving systems, in which SIP has been investing efforts since June 2014. In 2016, the research and development plan drawn up in May was followed by the ongoing pursuit of activities for international harmonization and coordination, including a November international workshop on automated driving. With national goals such as the reduction of traffic accidents in mind, these activities were carried out in parallel with diligent work on more sophisticated dynamic maps and the use of ITS predictive data aimed at realizing and spreading automated driving.

In 2017, large-scale field tests, further research and development, and the enhancement of technologies and systems will focus primarily on the five critical issues determined to require priority action in 2016 (dynamic maps, human machine interface (HMI), information security, pedestrian collision mitigation, and next-generation urban transportation). Other planned initiatives include identifying technological and institutional issues, and fostering social acceptance.

2 ITS Trends in Japan

2. 1. Vehicle Information and Communication System (VICS)[5]

VICS compiles and processes road traffic information (related to congestion, traffic restrictions, and the like) at the VICS Center. This information is then transmitted by radio wave and infrared beacons and FM multiplex broadcasting for display in three forms (text, simple graphics, and maps) on navigation systems and other onboard devices.

2. 1. 1. FM multiplex broadcasting

Regional NHK and FM broadcasters provide traffic information for roads in and around their respective prefectures (congestion or travel times, traffic restrictions due to accidents, disabled vehicles, roadwork, natural disasters, or weather conditions, as well as information on

parking locations and the availability of spaces there).

2. 1. 2. Radio beacons

Radio beacons set along the road provide traffic information within approximately 1,000 km ahead of the vehicle (travel time between interchanges, congestion or junctions as well as traffic restrictions due to accidents, accidents, disabled vehicles, roadwork, natural disasters, or weather conditions).

2. 1. 3. Infrared beacons

These beacons are mainly set along ordinary roads and provide traffic information within approximately 30 km ahead of, and 1 km behind the vehicle (congestion or travel times, traffic restrictions due to accidents, disabled vehicles, roadwork, natural disasters, or weather conditions, as well as information on parking locations and the availability of spaces there).

As shown above, VICS provides various information, including travel times, congestion statuses, and traffic restrictions to navigation systems in real-time, offering greater driver convenience as well as contributing to smoothing traffic streams and improving fuel efficiency through appropriate route guidance.

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 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).

2. 2. Universal Traffic Management System (UTMS)[6]

The aim of UTMS is to help achieve 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 helps to enhance the safety and smooth flow of road traffic and also alleviates traffic pollution.

The main applications of UTMS as of the end of March 2015 are as follows.

• Advanced Mobile Information Systems (AMIS)

AMIS 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 2015, all prefectures in Japan had adopted AMIS.

• Fast Emergency Vehicle Preemption Systems (FAST)

These systems use infra-red 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 2016, 16 prefectures had adopted FAST.

• Public Transportation Priority Systems (PTPS)

PTPS 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 2015, 40 prefectures had adopted FAST.

• Traffic Signal Prediction Systems (TSPS)

TSPS 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 2016, 24 prefectures had adopted TSPS.

2. 2. 1. Initiatives to Commercialize and Refine Infrastructure-Vehicle Cooperative 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.

In 2014, a research study on reducing infrastructure costs for DSSS using radio waves to help prevent failures to notice crossing pedestrians and right-turn collisions was conducted. In 2015, the functionality of applicable DSSS was validated on test courses. In 2016, to further enhance these systems, support information required when traveling straight and turning left was gathered, and a research study on whether moving objects other than vehicles and pedestrians could be detected was conducted.

2. 2. 2. Refinement of Traffic Control Information That Use Probe Data

Information from existing roadside sensors was combined with probe data (driving history data recorded by on-board devices) to build a more detailed traffic signal

control system based on extensive traffic information in an effort to smooth traffic flow. In 2016, the system was installed in 4 prefectures in conjunction with updates to the central units in the traffic management centers.

2.2.3. Establishment of Disaster Traffic Data Service Environment That Uses Probe Data

In the event of a disaster, traffic data collected from existing information gathering devices will be combined with police and private sector probe data to promptly identify usable roads. Such information will not only be passed on to the local population, but also prove useful for police activities on-site (setting extraordinary traffic restrictions or securing emergency routes). In 2016, the system was installed in 3 prefectures in conjunction with updates to the central units in the traffic management centers.

2.2.4. Development of PTPS That Uses Radio Beacons

The Tokyo Olympic and Paralympic Games will be held in 2020, with the pre-Olympics and pre-Paralympics schedule for the preceding year. To ensure the safety and smooth transportation of participants and tourists during these events, a new PTPS with features such as the use of radio waves to detect the location of buses and sending them traffic signal information is being developed. The basic design for demonstration tests was created in 2015, and a model system was prepared in 2016.

2.3. Smartway

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. Since the announcement of ITS, Second Stage in August 2004, government, industry and academia have worked in concert and, following the research, development, and field testing of new infrastructure-vehicle cooperative systems, launched ITS spot services, primarily offered along expressways nationwide, in August 2011. These services were renamed ETC 2.0 in October 2014, with full-scale sales of ETC 2.0 on-board units beginning in August 2015, and the introduction of services that capitalize on route information is under consideration.

2.3.1. Extensive and Effective Provision of Road Traffic Data

The number of vehicle navigation systems in Japan exceeded roughly 75.09 million units at the end of December 2016. Of these, approximately 53.29 million are compatible with real-time VICS road traffic information (services started in 1996). VICS provides various information, including travel times, congestion statuses, and traffic restrictions to navigation systems in real-time for greater driver convenience. Appropriate route guidance from VICS is also effective in reducing CO_2 emissions and the burden on the environment by smoothing traffic streams and improving fuel efficiency. As a result, VICS helped to reduce CO_2 emissions in 2012 by roughly 3.2 million tons.

2.3.2. 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 2016, over 54 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.

2.3.3. Nationwide Spread of ETC 2.0 Services

2.3.3.1. Start of ETC 2.0 Services

The Ministry of Land, Infrastructure Transport and Tourism (MLIT) set roadside devices at roughly 10 to 15 km intervals on inter-city expressways, and at roughly 4 km intervals on inner city expressways, and launched the world's first infrastructure-vehicle cooperative ITS spot service in August 2011 (by December 2016, roadside units had been set at approximately 1,700 locations along expressways throughout Japan).

In addition to ETC and services providing congestion avoidance support and driving safety support information, the roadside devices are used to collect probe data. 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 1.34 million at the end of December 2017.

2. 3. 3. 2. Progress of Awareness Activities Related to Further Popularization

Expositions such as the October 2016 ITS World Congress in Melbourne and the CEATEC Japan 2016 trade show featured events and booths to increase awareness of ETC 2.0 services. The booths included panels and videos presenting initiatives that make wise use of those services, as well as, in cooperation with the manufacturers, exhibits of ETC 2.0 on-board units and compatible navigation systems. In addition, proactive initiatives to promote greater implementation of these services at nationwide *michi no eki* roadside stations, as well as expressway parking and service areas were carried out.

2. 3. 3. 3. 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, initiatives to optimize transport by truck via the application of data on routes traveled and usage times collected with ETC 2.0 are being promoted.

- Streamlining of passage permits for ETC 2.0-equipped special vehicles:

Under the current system, special vehicles can only travel on routes for which individual applications have been submitted. Not only does this burden applicants for special vehicle permits with cumbersome application paperwork for each route, it also requires following renewal procedures every two years.

Since the route used by ETC 2.0-equipped vehicles can be identified, a free choice of routes is permitted for vehicles traveling on roads designated as sections allowing the passage of heavy-duty vehicle by the national government. This initiative will enable special vehicles to use an alternative route to avoid congestion or accidents, making more efficient transport possible. At the same time, the biannual renewal for vehicles following the application procedure for passage will be made automatic. These streamlining initiatives started in January 2016.

- ETC 2.0 support services for truck operations management

ETC 2.0 allows real-time acquisition of data such as routes traveled, usage times, or acceleration and deceleration. Allowing transportation and logistics operations to make use of that information would enable operations management that leads to greater productivity by reducing delivery wait times through accurate prediction of arrival times, as well as make drivers safer through pinpoint identification of dangerous truck driving locations.

The first phase of applications for participation in support services for truck operations management using ETC 2.0 opened in November 2015, with tests starting in February 2016, and the second phase of applications was carried out in September 2016. Effects such as the reduction of delivery wait times are under evaluation.

2. 4. Advanced Safety Vehicles (ASV)[8]

Since 1991, the Road Bureau of MLIT has promoted the development, commercialization and popularization of ASVs through coordination between government, industry, and academia. Initiatives based on the 6th ASV promotion plan began in 2016. In the context of advanced safety technologies required for automated driving, the planning of a strategy for the full-scale dissemination of commercialized ASV technologies, as well as the study of technical requirements for enhanced systems that respond to driver abnormality through actions such as pulling over to the road shoulder.

In addition, the ASV Project continues to play a supporting role for the commercialized advanced safety technologies it gave birth to (such as collision damage mitigation brakes, lane departure warning systems, and vehicle stability control systems).

2. 5. Automated Driving Systems

Japan regards automated driving as a growing field and will be pursuing its implementation as laid out in the Declaration to be the World's Most Advanced IT Nation and the Japan Revitalization Strategy (June 14, 2013 Cabinet decisions) as well as the Comprehensive Strategy on Science, Technology and Innovation (June 7, 2013 Cabinet decision).

In February 2015, the heads of the Manufacturing Industries Bureau of the Ministry of Economy, Trade and Industry and the Road Bureau of the Ministry of Land, Infrastructure Transport and Tourism jointly established the Panel on Business Strategy of Automated Driving to establish the entire Japanese automotive industry, including suppliers, as a global leader in the field of automated driving, as well as to proactively work on reducing traffic accident fatalities and contribute solutions to other social issues.

The panel identified initiatives requiring nationwide government-industry-academia examination and (a) clarified the future vision of automated driving for ordinary cars, (b) identified, intensified and expanded areas requiring cooperation, (c) established a framework to strategi-

cally respond to the creation of international rules (criteria and standards), (d) discussed the promotion of industry-academia coordination, and compiled the Action Plan for Realize Automated Driving (*sic.*) (March 2017).

ISO/TC204 (Intelligent transport systems) has been working on international standards for the fundamental basic technologies in automated driving systems. Japan has played a leading role in the related field of vehicle control technologies, such as by, for example, obtaining the position of convener for WG14 (Vehicle/Roadway Warning and Control Systems), which is in charge of international standardization activities in that field. However, with standardization efforts aimed at the early adoption of automated driving systems gaining momentum in the U.S. and Europe, jockeying to take the lead in international standardization efforts is expected to intensify.

Consequently, based on the progress of regional standards in the U.S. and Europe, and while keeping global interoperability in mind, METI has supported the preparation of a draft of international standards for performance requirements as well as international standardization activities (in response to ISO/TC204 (ITS)) concerning automated driving systems and related systems such as cooperative active cruise control (CACC) and pedestrian collision mitigation systems[9].

The study of *michi no eki* roadside station-based automated driving services in semi-mountainous regions has also begun. Such regions have a super aging population, and the transportation of people and goods in everyday life is becoming an urgent problem.

At the same time, approximately 80% (870) of the 1107 *michi no eki* roadside stations throughout Japan are found in semi-mountainous regions, providing goods for sales as well as acting as clinics and offering administrative and other everyday life services.

Setting such *michi no eki* as regional hubs and capitalizing on the autonomous vehicles showing remarkable technological evolution would

(a) ensure day-to-day life mobility for the elderly for shopping or traveling to and from the hospital,
(b) secure logistics services such as home deliveries and the shipping of agricultural products,
(c) be useful for sightseeing and the creation of new workplaces,

and other initiatives to carry out demonstration tests aimed at building vehicle-to-infrastructure transportation systems to maintain local lifestyles and revitalize the regions are underway.

2. 6. Promotion of ITS That Uses Radio Beacons

The use of radio beacons is crucial to the introduction and refinement of ITS, and the Ministry of Internal Affairs and Communications (MIC) has already allocated frequencies and formulated technical standards for VICS, ETC, and ITS spot systems, formulated technical and other standards, and worked to promote the spread of ITS.

2. 6. 1. Realizing 700 MHz Band Intelligent Transport Systems

In addition to allocating part of the 700 MHz band freed up by the switchover to digital terrestrial television to DSSS using that frequency band to achieve a safe road traffic environment, MIC has conducted studies on interference with other systems. In December 2011, it set up the necessary frameworks. Field tests to secure communication reliability, interconnection, and security functions, as well as ensure actual applications function properly, have been conducted with an eye toward early commercialization since 2014.

In October 2015, the initiatives led to the world-leading commercial release of vehicles equipped with the vehicle-to-vehicle and vehicle-to-infrastructure systems. Vehicles featuring on-board units with these systems receive information via vehicle-to-vehicle or vehicle-to-infrastructure communication, allow the use of driving safety support services such as right-turn collision prevention, rear-end collision prevention, and the provision of information on emergency vehicles.

2. 6. 2. Refining 700 MHz Band Intelligent Transport Systems

Supplementing existing vehicle-to-vehicle and vehicle-to-infrastructure communications with the addition of infrastructure-to-infrastructure communication in these systems will make it easier to ensure coordination between traffic signals in the event of a disaster, and is expected to contribute to the building of a robust ITS infrastructure. At the same time, expanding the scope of information provided on approaching emergency vehicles and nearby traffic signals will make driving safety support more sophisticated and increase the benefits of the service, which is also expected to spur the spread of these systems. Therefore, a technical panel on the introduction of infrastructure-to-infrastructure communications was established in October 2016 under the auspices of the Institute for Information and Communications

Council. In March 2017, a report on technical requirements for the enhancement of 700 MHz band intelligent transport systems was presented. Based on that report, MIC is planning to set up the necessary frameworks to introduce infrastructure-to-infrastructure in these systems.

2. 6. 3. Expansion of Frequencies for 79 GHz Band High Resolution Radars

In 2013, comprehensive testing was conducted on 79 GHz band radar systems, which have sufficiently high resolution to detect smaller bodies such as pedestrians, and the validation of their performance has been completed. After the 77.5–78 GHz frequency band was allocated to radiolocation services at the World Radiocommunication Conference 2015 (WRC-15) held in November 2015, preparations for the necessary framework to expand the frequency band for these radars were carried out in January 2017. This upgrades the frequency span available to these radars from the original 3 GHz to 4 GHz, and allows the development of on-board radars with even higher resolutions.

2. 6. 4. Studies Aimed at Realizing the Connected Car Society

Recent advances in mobile network speed and capacity, big data, AI, and other areas has raised expectations that connected cars will revolutionize the field of ITS. As automakers and manufacturers of communication equipment worldwide are becoming increasingly active at establishing tie ups, MIC established the Study Group Focusing on the Realization of Connected Car Society in December 2016 to work toward the realization of a safe and secure connected car society that creates new value and business.

More specifically, although the spread and development of connected cars is anticipated to bring about a society where anyone can enjoy save and convenient transportation services, issues such as security threats arising from connecting to networks have also been raised. Consequently this study group will assess

(a) new services and businesses for the upcoming connected car society,
(b) the structure of wireless communication networks that will support that society and,
(c) various other promotion measures

and prepare a summary by the summer of 2017.

2. 6. 5. International Standardization Concerning ITS Wireless Systems

Japan is participating in ITS standardization activities through actions such as the proactive presentation of proposals based on its current frequency band use to Working Party 5A (WP 5A, responsible for land mobile service) and Working Party 5B (WP 5B, responsible for the radiodetermination service) of the ITU-R Study Group 5 (SG 5). Activities have centered on preparing recommendations for ITS wireless systems that use the 700 MHz band, revising the Recommendations for, and allocating frequencies to, 79 GHz band high resolution radars, and harmonizing global and regional frequencies for ITS.

The standardization of driving safety support systems for ITS wireless systems that use the 700 MHz band has been moving forward in Japan, the U.S., Europe, and other regions. To contribute to further developing and spreading this standardization, WP 5A of the ITU-R SG 5 had proposed the creation of a new Recommendation for vehicle-to-vehicle and vehicle-to-infrastructure communications, an activity supported through the proposal of a structure for the working documents used to formulate the new Recommendation that compiles the standards for those forms of communication found in the U.S., Europe, and Japan. On the basis of that proposal, Japan not only filled in the information concerning its own vehicle-to-vehicle and vehicle-to-infrastructure communication standards, but also, with assistance from Europe, South Korea and other regions, 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.

2. 7. Other

In preparation for welcoming between 40 and 60 million foreign travelers to Japan, and aiming to provide a pleasant stay as well as enhance the appeal of, and provide smooth transportation to, tourist sites, the Japan Tourism Agency, The Road Bureau of the Ministry of

Land, Infrastructure Transport and Tourism, and other organizations set up a subsidy program in 2016 to stimulate emergency measures designed to establish a favorable environment for those travelers. Subsidies were granted for bus IC card systems, bus location systems, and other projects designed to enhance the convenience of transportation services, which represents part of the policy on those projects.

3 ITS Trends outside Japan[11]

3. 1. Asia/Pacific

Organizations involved in ITS in the Asia-Pacific region have formed ITS Asia-Pacific (ITS AP), which currently includes eleven member countries.

In 2016, the ITS World Congress[11] was held from October 10 to 14 in Melbourne, Australia, one of the ITS AP constituent countries. Attended by 11,496 visitors, a number well above the goal of 7,000, the Congress was a resounding success. The central subjects of discussion are outlined below.

Discussions on cooperative systems and automated driving ranged from vehicle technologies (e.g., sensing and control) to social acceptance and the building of common foundations, and even countries without an automotive industry are actively endeavoring to accumulate the necessary knowledge through automated driving tests on public roads.

The integrated use of traffic data encompassing all movement data on people and objects, both for public purposes and by the private sector, raises the issue of building a framework that ensures mutual access to data, as well as privacy and security, across the barrier between corporations and government institutions. Congress participants agreed that achieving this would require collaborating with new players who are instigating drastic structural changes without the involvement of traditional ITS parties.

At the same time, several countries introduced various Smart City projects in which local authorities take the lead in using ITS to fundamentally reform urban transportation with the goal of achieving sustainable urban development and improving everyday life through innovations in urban transportation.

3. 2. The U.S.

Government-led projects based on the ITS Strategic Plan 2015–2019 issued by the U.S. Department of Transportation (USDOT) in November 2014, such as the Automation Program and the Connected Vehicle Pilot Deployment Program, are being carried out.

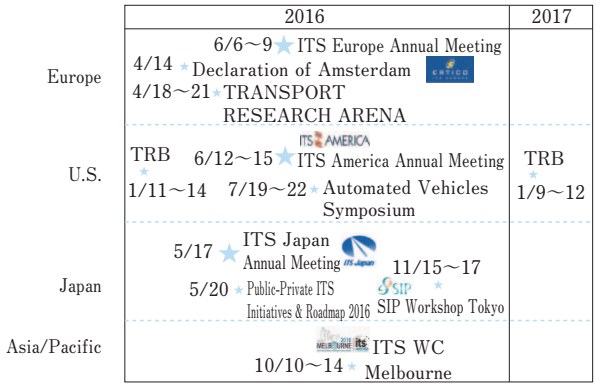

Fig. 1 World events related to ITS (mainly focused on international conferences)

In connection with such projects, California has issued a draft regulation the testing of self-driving vehicles on public roads, while Michigan has adopted legislation permitting the testing of unmanned autonomous vehicles and truck platoon driving on public roads.

Amidst stepped up efforts to apply innovative urban transportation to solve the problem of transportation for elderly people arising from the concentration of the population in cities, as well as social issues such as poverty, the city of Columbus, Ohio, won the Smart City Challenge against 77 other cities across the U.S. Many other projects, such as Go Denver by the city of Denver, Colorado, have also been launched.

3. 3. Europe

Europe is currently transitioning from the European Commission's Seventh Framework Programme (FP7) projects on automated driving to their Horizon 2020 successors.

Moreover, various European countries are actively pursuing initiatives related to automated driving.

The main European Commission initiatives include the automated driving-related projects under Horizon 2020, the GEAR 2030 High Level Group for the automotive industry, and the roadmaps announced by the European Road Transport Research Advisory Council (ERTRAC). Individual countries are also making rapid advances with projects or the start of field tests, including the Strategy for Automated and Connected Driving in Germany, Drive Me in Sweden, the Dutch Automated Vehicle Initiative in the Netherlands, government-supported projects in France, Driverless Cars in the U.K., and the European Truck Platooning Challenge.

On April 14, 2016 at the Informal Transport and Environment Council, EU member nations endorsed the Declaration of Amsterdam to coordinate work on developing technology for, and commercializing, connected and automated driving. With a shared recognition of the social benefits offered by these technologies, the members agreed to build a collaborative framework with the required cross-border interoperability for traffic systems and services by 2019.

3. 4. International Activities

The government ministries and agencies involved in ITS, namely the Cabinet Secretariat, Cabinet Office, NPA, MIC, METI, and MLIT Road Transport Bureau held sessions and presented exhibitions at the ITS World Congress and other ITS-related events in Western nations, and also engaged in meaningful exchanges with specialists from all over the world.

Among other activities aimed at international cooperation and coordination, the third international workshop on automated driving, held in November 2016 under the auspices of the Cabinet Office SIP, provided a venue for discussion for government officials from Japan and abroad.

Government ministries and agencies are actively making proposals and joining discussions on the standardization of the technologies in their charge. At the same time, international harmonization relationships are being built through international partnership conferences and memorandums of understanding, not only with the U.S. and Europe, but also with Asian countries. Such initiatives will contribute significantly to Japan's future global harmonization efforts.

The relevant ministries and agencies are leading the way in actively promoting various Japanese initiatives and engaging in exchanges as the country continues its efforts to lead the world through its technological development.

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