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Towards the Realization of a Connected Car Society

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About ITU-AJ

The ITU Association of Japan (ITU-AJ) was founded on September 1, 1971, to coordinate Japanese activities in the telecommunication and broadcasting sectors with international activities. Today, the principle activities of the ITU-AJ are to cooperate in various activities of international organizations such as the ITU and to disseminate information about them. The Association also aims to help developing countries by supporting technical assistance, as well as by taking part in general international cooperation, mainly through the Asia-Pacific Telecommunity (APT), so as to contribute to the advance of the telecommunications and broadcasting throughout the world.

Towards the Realization of a Connected Car Society

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Ministry of Internal Affairs and Communications

1. Introduction

Broadly speaking, the evolution of motor vehicles in recent years has progressed in two directions: self-driving and connected vehicles.

With the aim of promoting connected car technology and creating a connected car society against a background of developments in the 5th generation (5G) mobile communication system and other mobile networks, artificial intelligence (AI) and big data processing, we have studied topics including (1) new services and businesses created by the use of data, (2) the implementation of wireless communication networks to support a connected car society, and (3) measures for the construction of a safe and highly reliable platform. To this end, and with the participation of diverse stakeholders including experienced academics, automobile manufacturers, communication carriers, equipment manufacturers and providers of related services (insurance, tourism, home security, etc.), our study group was founded in December 2016, and has since held six meetings to discuss these issues.

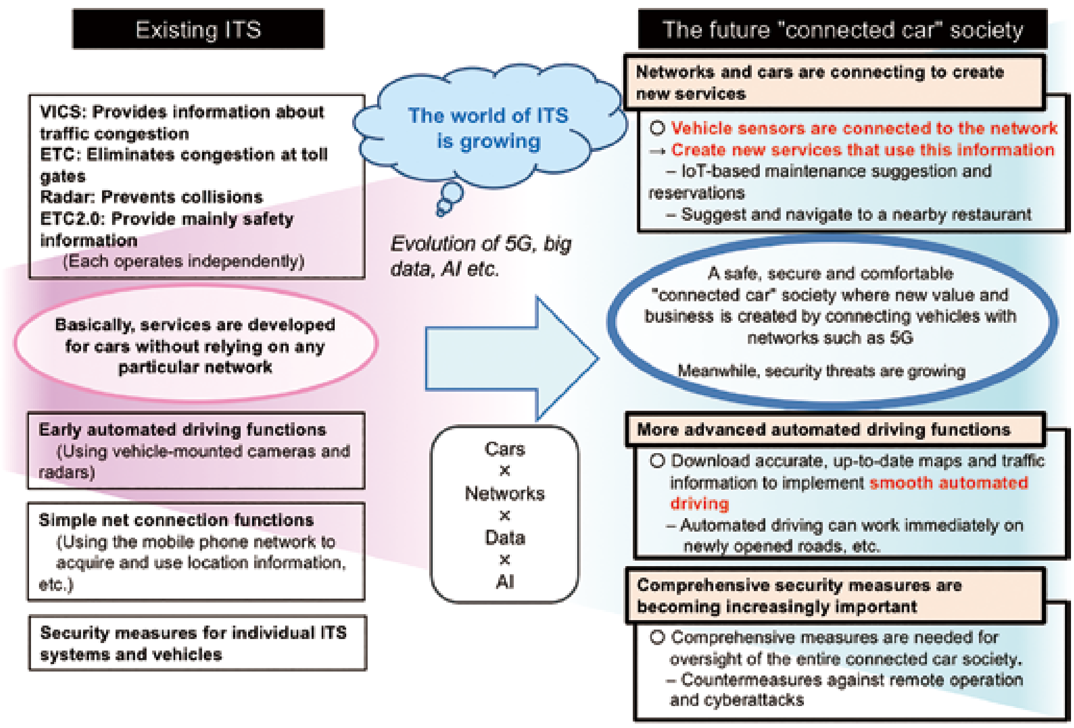
2. Study group report summary

2.1 What is a connected car?

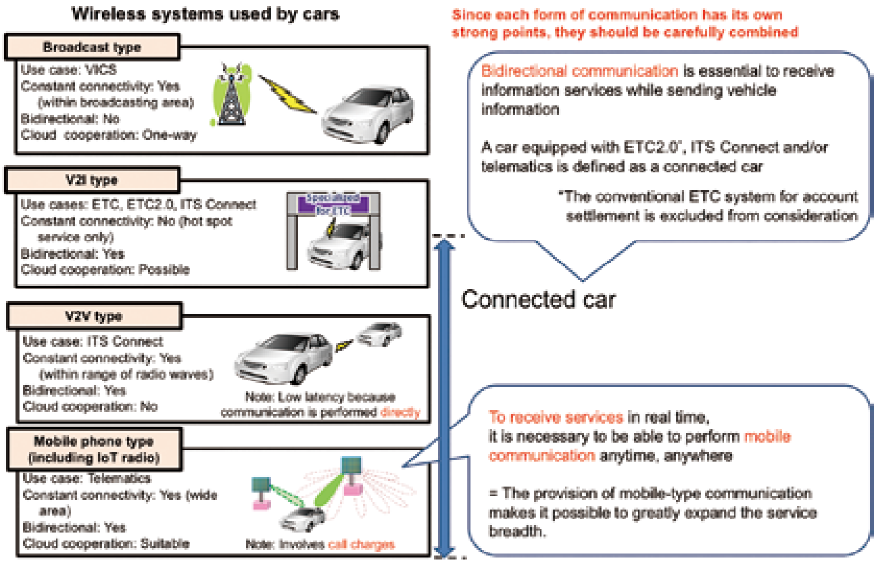
There are currently about 80 million cars on the road in Japan. Cars perform an essential role in people's livelihoods and leisure activities. As shown in Figure 1, a variety of useful ITS (intelligent transport system) technologies have been developed and used in practice, including VICS (Vehicle Information and Communication System) and ETC (electronic toll collection system). So far, these ITS technologies have basically operated independently, resulting in services that cars can without relying on any kind of network.

However, the world of ITS has recently been changing and expanding. In particular, in addition to the advances that are being made in communication networks in preparation for the arrival of 5G, dramatic changes are also being made to the vehicle environment, including advances in the application of big data in tandem with the spread of IoT technology, and the evolution of AI based on new theories such as deep learning. These changes are expected to bring about a "Connected Car Society" where

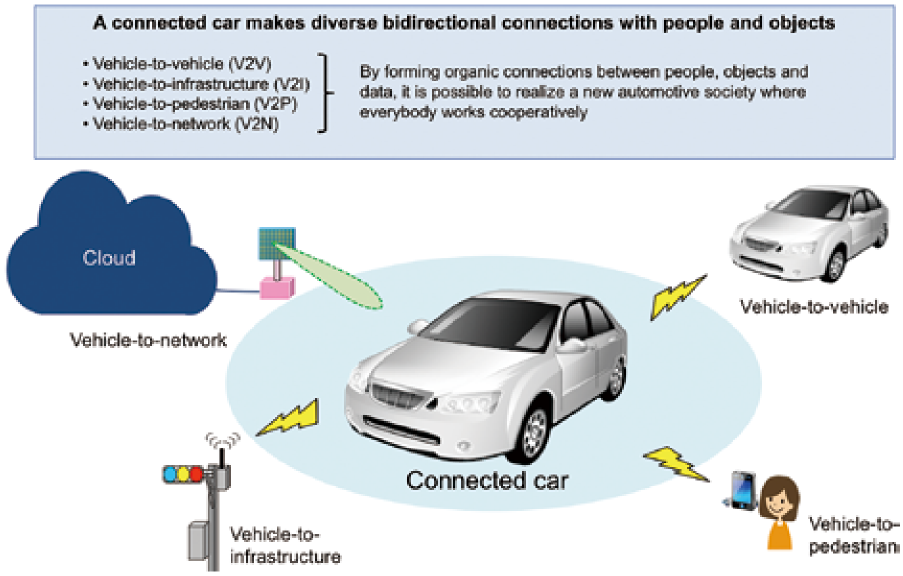
Figure 1: A connected car society



■ **Figure 2: Connected car concept (1)**



■ **Figure 3: Connected car concept (2)**



most cars are connected to the network, creating new value and business.

The images brought to mind by the phrase "connected car" differ from one person to the next. For the purposes of our study, we concentrated on the mode of connection and defined a "connected car" as a vehicle with the ability to communicate bidirectionally as shown in Figure 2 and 3.

In the data-driven society that is expected to be result from the use of connected cars, cars will need to be capable of bidirectional communication so that data can be collected from cars for analysis and provided to cars as feedback based on the results of the analysis.

2.2 National and international trends in connected cars

Efforts related to connected cars and automatic driving are being actively promoted both in Japan and overseas.

In Japan, work is under way to develop technology in cooperation with industry, academia and government based on "the Public/Private-Sector ITS Initiative Roadmap", which was drawn up by the government's IT Strategic Headquarters on June 3, 2014 and revised on May 30, 2017. In 2014, the cabinet office created the Cross-ministerial Strategic Innovation Promotion Program (SIP), which included automatic driving systems among its ten themes. Research and development efforts were then promoted with the participation of related government ministries and agencies.

Connected cars and automatic driving are also becoming global trends, especially in developed countries that are actively pursuing connected cars and automatic driving as sources of innovation.

In 2016–17, for example, the European Commission invested about €100 million in projects related to automated driving in a project called "Horizon 2020", and is working on projects with practical goals such as infrastructure improvements, demonstrations on public roads, and evaluating the acceptability of this new technology.

Meanwhile the US Department of Transportation is working on programs based on a 2015–19 ITS Strategic Plan with strategic themes that include safety improvements and increasing the efficiency of mobility systems. As a specific example, based on the same plan, they are setting up an ITS research infrastructure called M-City including a traffic control system and high precision digital maps, and implementing demonstration experiments in collaboration with industry, academia and government.

In addition, there is growing interest in the use of mobile systems such as 4G and 5G in the ITS field, including V2X (Vehicle to everything) which is based on cellular technology. On the other hand, studies related to the use of radio waves for connected cars and automated driving are not necessarily sufficient, and there is currently a need for studies from the viewpoint of what sort of technology will gain popularity in the future.

Recently, the level of cooperation between the automobile and ICT industries has been growing at an accelerating pace around the world. This trend is also occurring in Japan, where the major automobile manufacturers are increasingly cooperating with telecommunications carriers and cloud service providers. Similar moves are taking place at businesses based in other countries, including Volkswagen in Germany and LG Electronics in South Korea. In September 2016, three German companies — BMW, Daimler and Audi — announced that they had established the 5GAA (5G Automotive Association) to collaborate with other businesses including communication equipment manufacturers and semiconductor manufacturers in the development of connected car services using 5G technology. Since then, the 5GAA has been growing, and its members now include dozens of communication providers and equipment manufacturers, including some from Japan (Figure 4).

Efforts relating to connected cars include the evolution of mobile communication systems. 4G is currently in widespread use, but efforts are under way to introduce 5G technology from 2020. As shown in Figures 5 through 7, this will result in ultra-fast communication, support for large numbers of simultaneous connections, and ultra-low latency. In Japan, R&D and demonstration trials of 5G are already under way.

Some automobile manufacturers are planning to standardize in-car communication equipment to make it compatible with almost all vehicles sold in Japan and US by 2020. One of the benefits of connected cars is that they are able to communicate at any time over a wide area, and it is expected that this capability will contribute to the expansion of services.

Figure 4: Collaboration between the automobile industry and the communication industry (5GAA)

- Three German companies (BMW, Daimler and Audi) have joined forces with communication equipment manufactures and the like (Ericsson, Huawei, Intel, Nokia and Qualcomm) to develop connected car services, and established the 5GAA (5G Automotive Association) (announced in September 2016).
- Their aim is to lead the world in the fused area of vehicles and ICT (including connected cars).
  - Harmonization of use cases, technical requirements, implementation strategies, etc.
  - Investigation of wireless connections, security, privacy, authentication, cloud architecture, etc.
- Thereafter, other companies including vehicle manufacturers and mobile operators announced their participation. (As of the end of June 2017, there are approximately 50 member companies/groups)

[Vehicle manufacturers]

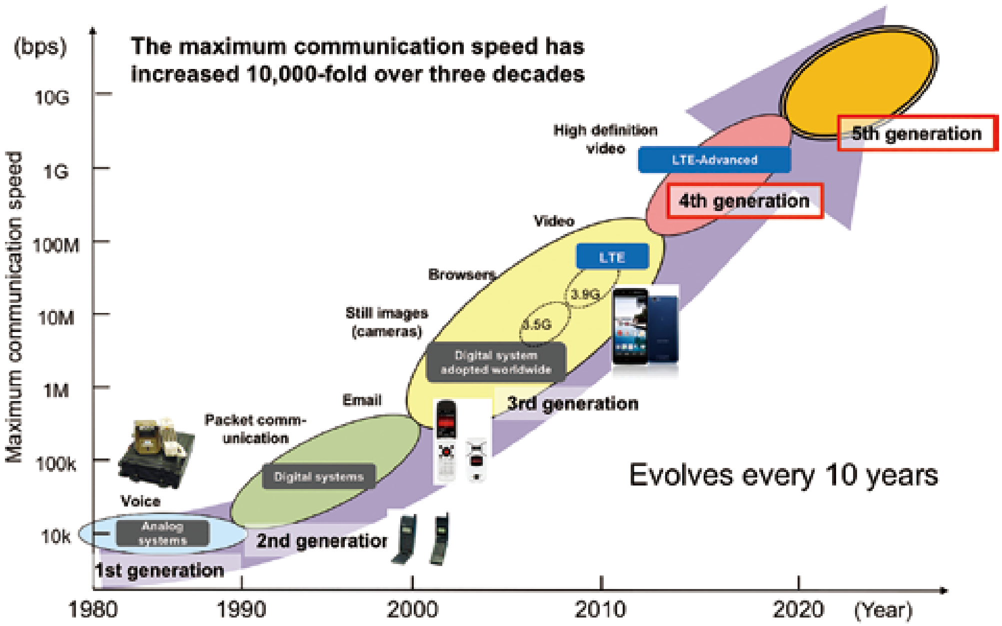
[Communication equipment manufacturers]

[Communication carriers]

[Others]

Source: http://5gaa.org

Figure 5: Evolution of mobile communication systems



Furthermore, if 5G systems become available at any time for high-speed, large-capacity and low-latency communication, then further improvements of services can be expected such as VR and advanced inter-vehicle communication available in cars.

As shown in Figure 8, progress is being made in other countries. For example, the automotive field is one of the main fields of 5G utilization in Europe and is interested in the 5G development for vehicles, so it will be interesting to see how 5G develops in this field.

As can be seen from the abovementioned activities of the 5GAA, the use of 5G in the automotive field is attracting interest not just in Japan but throughout the world. We must ensure that Japan plays a key role in the future of the connected car market by successfully seizing the opportunities presented by the introduction of 5G.

Trends related to AI including automated driving are also important movements with regard to connected cars. The performance of AI has recently improved due not only to technical breakthroughs such as deep learning but also to the increased computing power and the decreasing cost of memory, and the technology has evolved greatly over the last few years. For example, although there was once the accepted opinion that AI would be unable to defeat humans in the game of Go, where each move has to be selected from a huge number of possibilities, there have already been cases where professional Go players have lost to AI systems.

As shown in Figure 9, earlier systems achieved automated driving by relying on physical infrastructure such as tracks or magnetic markers to estimate the vehicle's position and perform steering. However, with advances in AI, it has become possible for vehicles to recognize their surroundings by means of on-board equipment such as sensors and radars, and by combining the information with high-precision maps, we can now expect vehicles to analyze and estimate their position and steering by themselves.

AI used in automated driving has the potential to bring about profound developments in ITS. As shown in Figure 10, when driving support is performed using conventional ICT, the road traffic information is conveyed to the driver, but since it ultimately has to be provided to the driver after it has been transformed into a form that can be understood by the driver (e.g., on displays), there are limits to the amount of information that is available. However, in automated driving vehicles, the AI processing is all performed digitally at high speed, so the amount of information available can be dramatically increased.

As a result, in the future ITS centered

Figure 6: 5G requirements

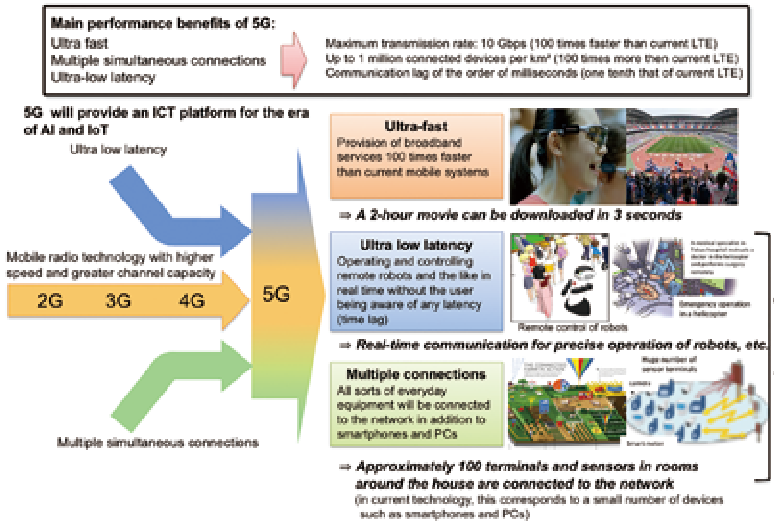


Figure 7: R&D and integrated demonstration trials aimed at the realization of 5G

- Bearing in mind that 5G will be implemented at a societal level, comprehensive demonstration trials in specific fields such as logistics and sports are being performed in Tokyo and in rural areas (Budget for FY2017: ¥2.51 bn)
- Contributing to international standardization activities by establishing an open environment where companies and universities around the world can participate in

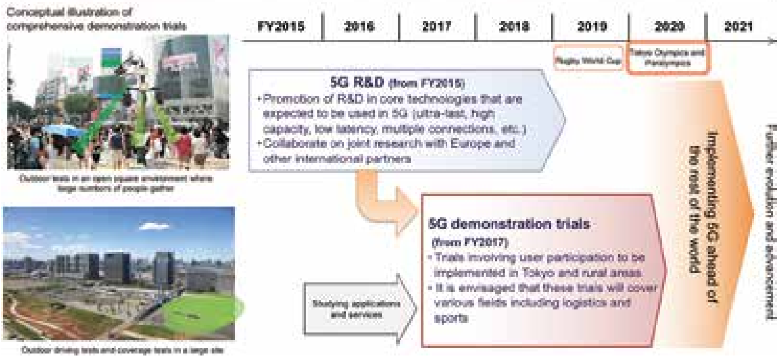
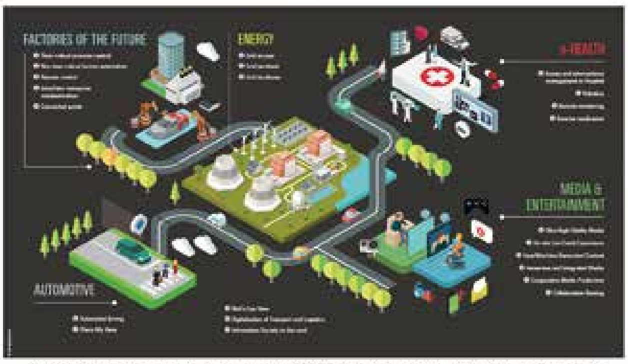


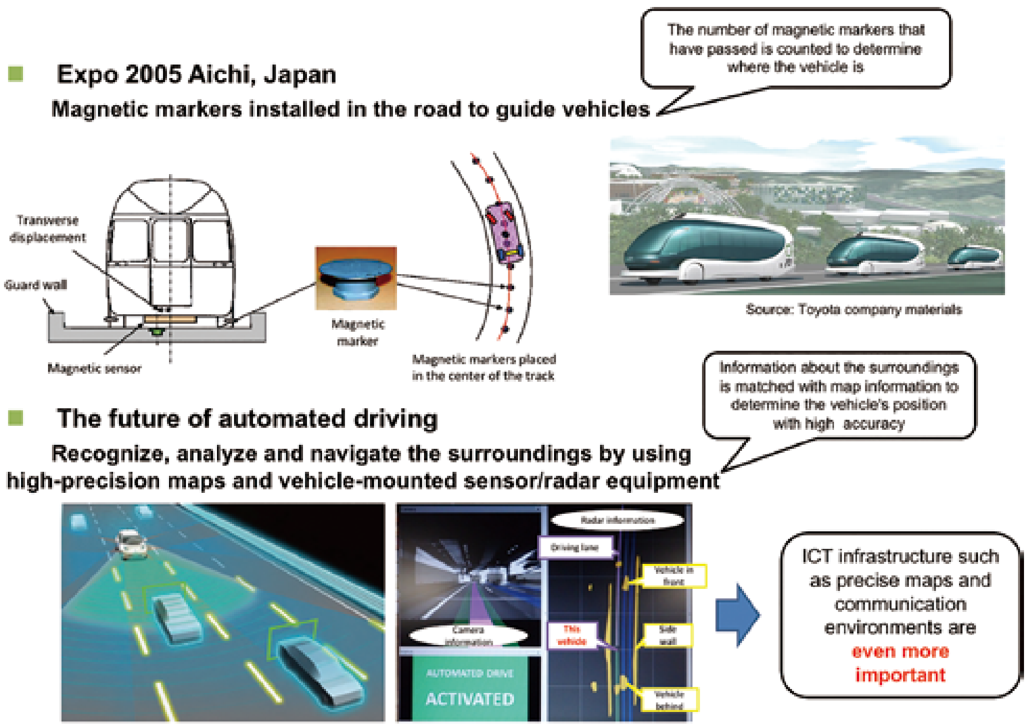
Figure 8: Cooperation between multiple fields in 5G (European example)

- In other countries, plans to promote the use of 5G are being studied by identifying fields where 5G can be used, and promoting close cooperation between these fields. In Europe, for example, five fields have been identified: (1) automobiles, (2) factories/manufacturing, (3) energy, (4) medicine/health, and (5) media/entertainment. Stronger collaboration between these fields is now being studied.

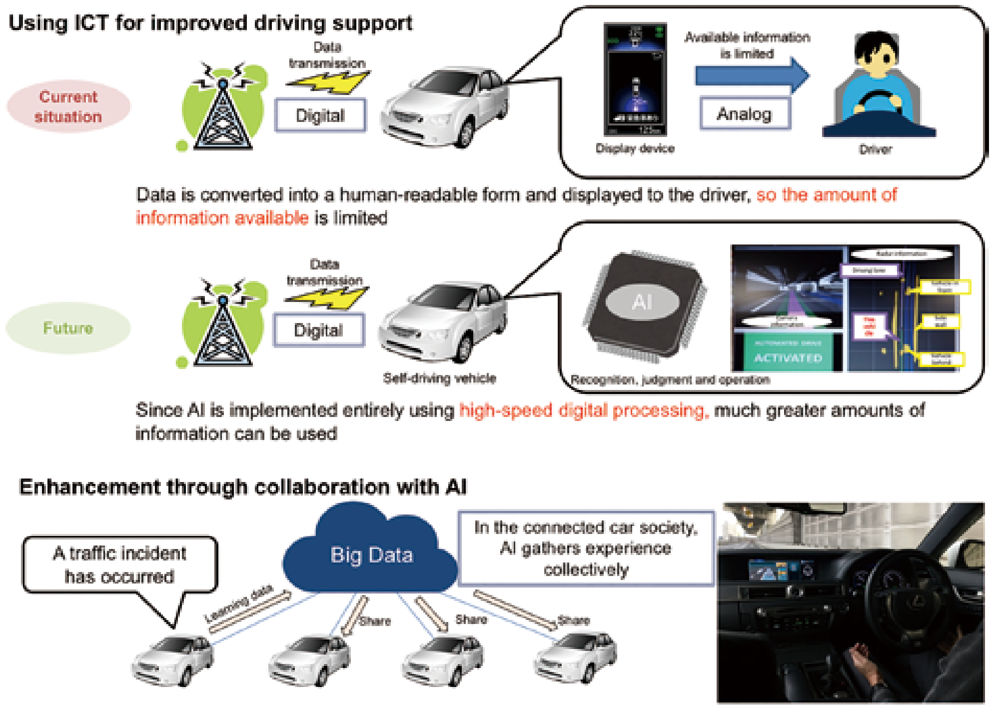


Source: Presentation materials provided by 5GPPP (a European organization) at the EU–Japan Symposium on 5G (8th–10th February, 2016)

■ **Figure 9: The effect of AI on automated driving**



■ **Figure 10: The potential of automated driving AI and connected cars**



on connected cars and automated driving, it is also possible to use information provided through cooperation and integration between various sensors in roads and cars, and this could make automated driving safer than human drivers.

Furthermore, in a connected car society, AI data gathered by one car can be shared with other cars, thereby increasing the group awareness of all automated driving vehicles equipped with AI.

It will require medium- to long-term efforts to bring the functions of automated driving to the critical point ("singularity") where AI will completely overtake humans in terms of safety. As shown in Figure 11, the levels of automated driving in Japan is currently defined by "the Public/Private-Sector ITS Initiative Roadmap". Basically, this roadmap adopts the definition of the SAE (Society of Automotive Engineers), which specifies six levels of automated driving from level 0 to level 5.

Figure 11: Automatic driving levels (from “the Public/Private-Sector ITS Initiative Roadmap”)

○ Definitions of automated driving levels ("Public/Private-Sector ITS Initiative Roadmap 2017", IT General Strategic Headquarters, May 2017)

Level		Summary	Who is responsible for awareness and safe driving
Level 5 Full automation	An automated driving system performs all driving-related tasks	• The system performs all driving tasks (not limited to any area) • In case of difficulty, a human driver is not expected to step in	System
Level 4 High automation		• System performs all driving tasks (within a limited area) • In case of difficulty, a human driver is not expected to step in	System
Level 3 Conditional automation		• System performs all driving tasks (within a limited area) • In case of difficulty, a human driver is expected to respond appropriately to system intervention requests, etc.	System (Human driver in case of difficulty)
Level 2 Partial automation	A human driver performs all or some of the driving tasks	• The system implements a subset of tasks related to controlling the vehicle's position in the lateral and longitudinal directions	Human driver
Level 1 Driver assistance		• The system implements a subset of tasks related to controlling the vehicle's position in either the lateral or longitudinal direction	Human driver
Level 0 No automation		• A human driver performs all driving tasks	Human driver

○ When commercial automated driving systems and services can be expected (ibid.)

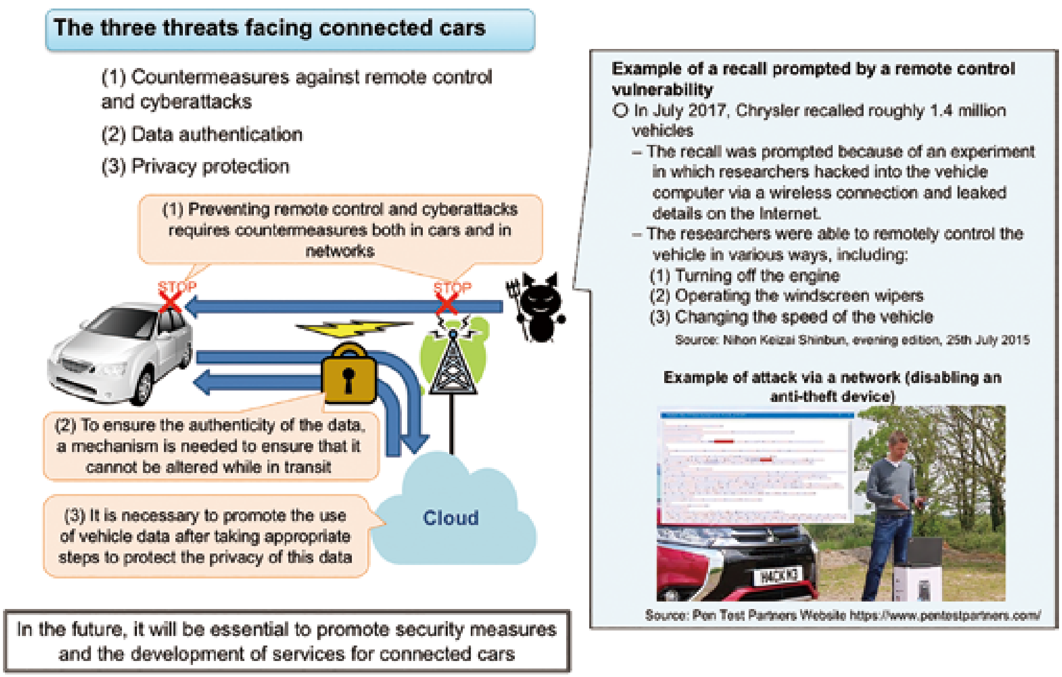
		Level	Expected technologies	When expected
Advanced automated driving	Private use	Level 4	Fully automated driving on expressways	2025 (target*)
		Level 3	Automatic pilot	2020 (target*)
		Level 2	Semi-automatic pilot	By 2020
	Logistics services	Level 4	Fully automatic driving of trucks on expressways	After 2025*
		Level 2 or higher	Platooning of trucks on expressway	After 2022
	Transport services	Level 4	Unmanned automated driving transport services in limited area	By 2020
Advanced driving support	Private use		Advanced safe driving support services (tentative name)	(Early 2020s) Subject to future deliberation

Note 1: The 2017 Public/Private-Sector ITS Initiative Roadmap uses the definition of automated driving systems given by SAE International (the Society of Automotive Engineers) in Report No. J3016 of September 2016.

Note 2: For remote-type automated driving systems and the technology of SAE levels 3 and above, consistency with the conventions of road traffic will be a prerequisite when the time comes for commercialization. The timing of commercialization will be adjusted based on domestic and overseas industry and technology trends, including progress in the development of automated driving systems in other countries.

* Set as the target period in which the government aims to enable commercialization by private enterprises

Figure 12: New online threats

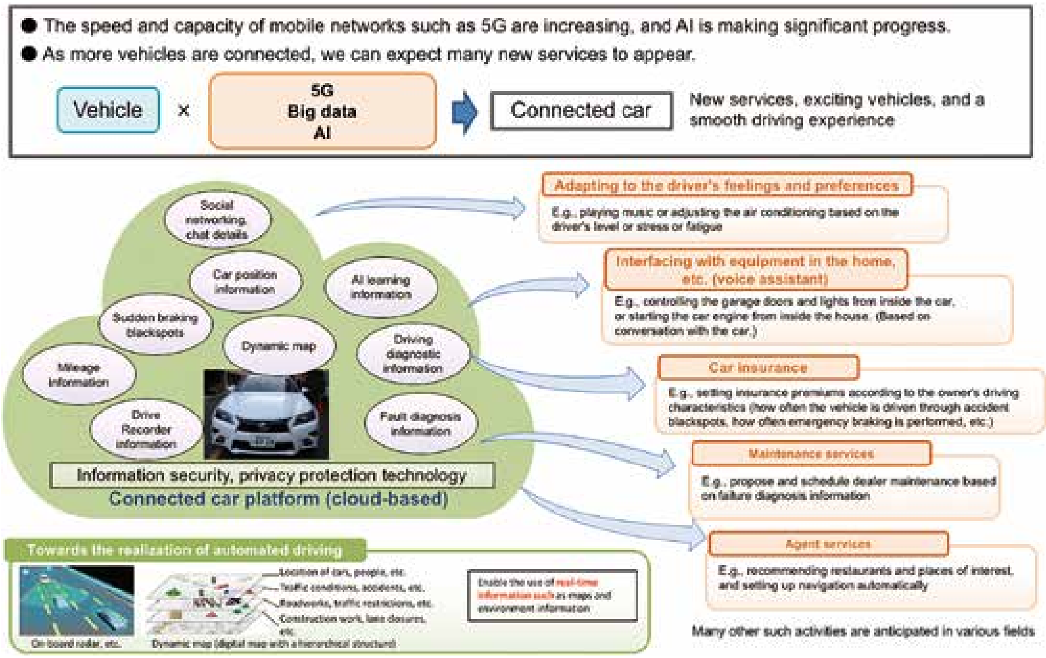


Vehicles currently on the market in Japan are said to have the functions of level 2, where driving is partially automated. A level 2 system supports the longitudinal and lateral movement of vehicles while assuming that the driver bears the responsibility for any collisions. Specifically, they include functions such as staying in the same lane while following the vehicle in front. It is expected that a greater level of sophistication will make it possible for a vehicle to change lanes based on an instruction provided by the driver, such as operating the turn signal lever.

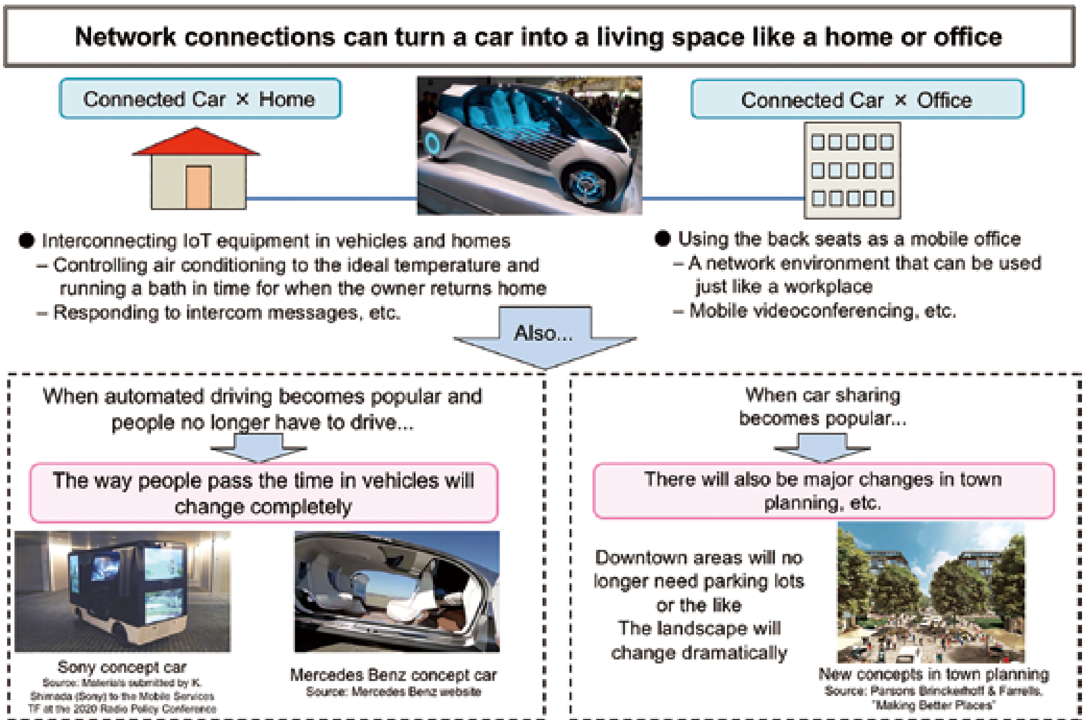
Currently, efforts are under way to develop products that are compatible with level 3 (conditional automated driving) by 2020. For example, progress is being made in the development of technology whereby driving on expressways can be almost entirely handled by automated driving systems.

Efforts are also being made to implement level 4 (advanced automated driving) in limited areas, and studies are being made of the technical and institutional aspects of this technology as a new means of transport, which is expected to promote regional development.

■ **Figure 13: New services for connected cars**



■ **Figure 14: The potential impact of connected cars on society and lifestyles**



Security is becoming an increasingly important consideration in initiatives related to connected cars. As shown in Figure 12, a connected car connected to a network can be exposed to diverse security risks, and these risks have to be properly controlled.

In particular, it is important to have appropriate measures in place to deal with (1) remote control and cyberattack threats, (2) data authenticity, and (3) privacy protection, which means that security measures will be an essential feature of the connected cars in the future. Since an attacker launches an attack by scanning the entire system for vulnerabilities, it is essential that the automobile and communication industries cooperate with each other to ensure the overall security of their systems.

Security-related initiatives in other countries include a joint effort of the United States Department of Transportation Road Traffic Safety Authority and 18 automobile manufacturers, which have agreed to cooperate by sharing information related to cyberattacks (January 2016).

Meanwhile, the automotive and telecommunication industries in Europe joined forces by holding an EU Industry Dialogue on automated and connected driving (launched in September

2015), where they agreed to cooperate on (1) connectivity, (2) standardization, and (3) security.

Other new initiatives are also under way in the private sector. Tesla, a US electric vehicle manufacturer, has developed a bug bounty program that rewards people who report software bugs or vulnerabilities. When vulnerabilities have been detected, Tesla vehicles can download security patches via mobile phone networks, thereby keeping them updated at all times.

2.3 Expected services and businesses

This section discusses the new services and businesses that can be expected to arise as progress is made in the introduction of connected cars. In the future, as progress is made in big data technology, AI technology, and high-speed and large-capacity mobile networks such as 5G, we can expect to see various new services by connecting cars to networks (Figure 13).

These services will have the potential to bring about substantial changes to society and our everyday lives. For example, as shown in Figure 14, by connecting a vehicle to the home or office, the driver can spend time relaxing as if he were at home, or working as he were at office. This has the potential to make traveling a much more relaxing or productive experience.

2.4 Service typing and modeling

In a connected car society, it is expected that diverse services will be provided without being limited to services that are directly related to cars. With further advances in connected car technology in the future, we can expect developments such as:

- creating new services and businesses across a wide range of sectors including tourism and entertainment,
- addressing various social issues in each region, and
- forging new ties with diverse stakeholders associated with these developments.

Assuming that a wide variety of services will be made available to connected cars, we should consider how to realize a connected car society. Firstly, it is important to organize and classify these

Figure 15: Service classification (example)

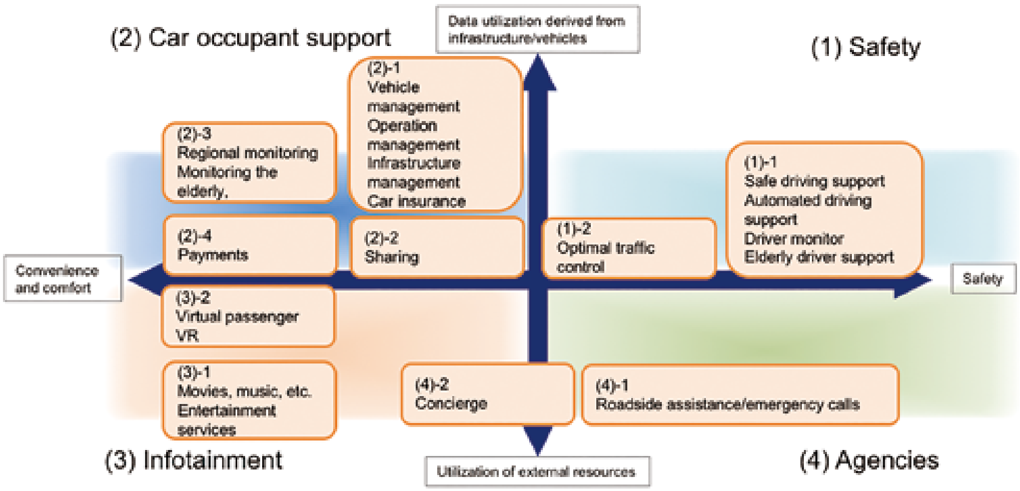
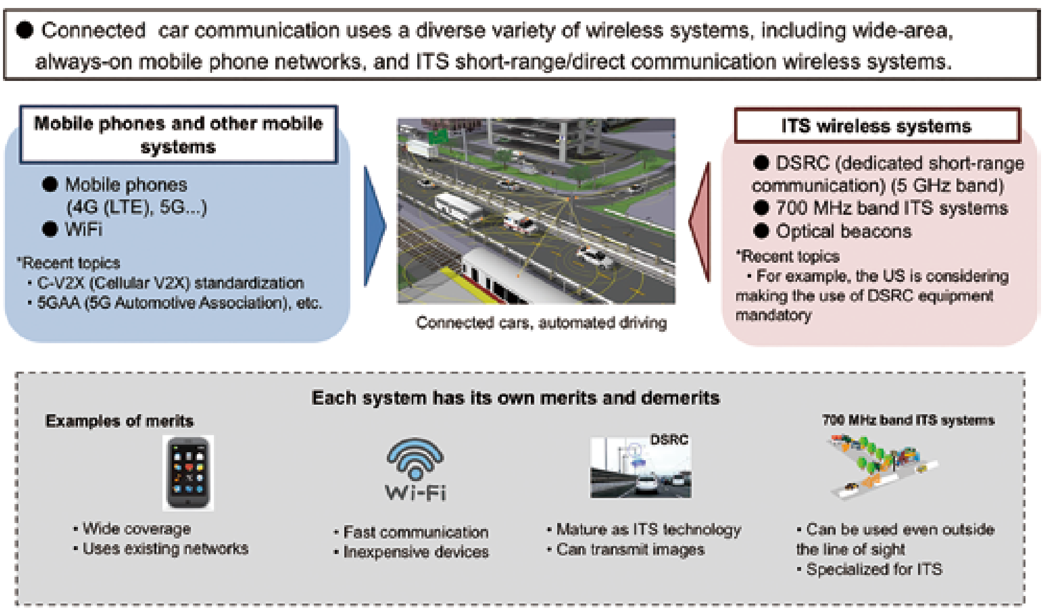
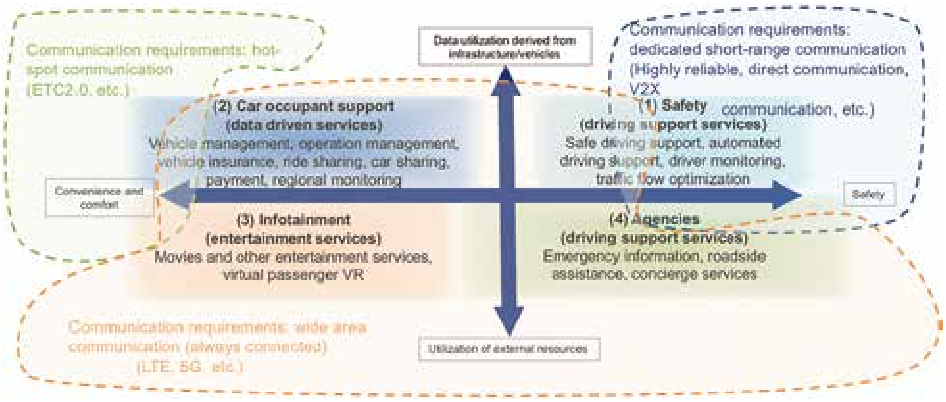


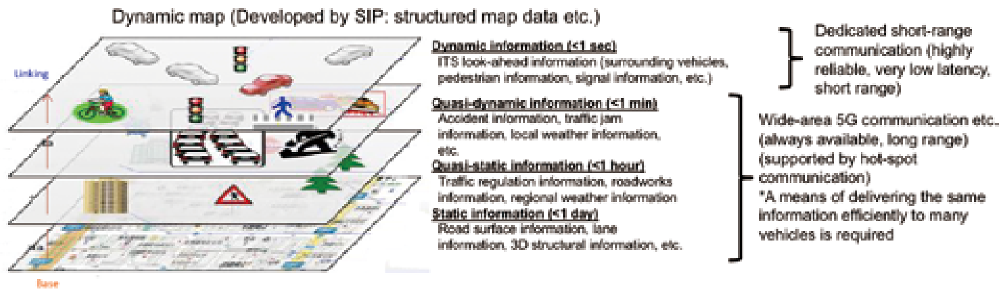
Figure 16: Wireless systems used by a connected car society



■ Figure 17: Communication required for the implementation of a connected car society (role-sharing of communication systems)



■ Figure 18: Communication requirements of a connected car society (dynamic map)



services.

In this study group, our most important aim in realizing a connected car society is to address social issues such as ensuring the safety and security of citizens, and providing them with a convenient and comfortable lifestyle. We defined one axis of analysis as follows:

- Is safety a primary objective?
- Is convenience and comfort a primary objective?

Furthermore, since "connected" implies the distribution of data, we defined another axis of analysis as follows:

- Is data obtained from the surrounding road traffic environment (vehicles, infrastructure etc.)?
- Is data obtained from external resources such as servers?

By classifying services according to these two axes (safety/convenience and comfort and data sources), we have grouped the diverse services provided by connected cars into the following four categories:

(1) Safety (driving support services)
(2) Car occupant support (data driven services)
(3) Infotainment (entertainment services)
(4) Agents (driving support services)

Figure 15 shows how the main connected car services can be mapped according to these two axes.

2.5 Communication requirements of a connected car society

To clarify the problems that should be solved in promoting the connected car society, it is useful to analyze what sort of communication and other technologies are needed by each kind of service.

As shown in Figure 16, connected car communication is expected to involve the use of multiple wireless systems with various features, for example, mobile phone networks offering constant coverage over a wide area, dedicated ITS wireless systems that are restricted to short range or hot-spot communication, and so on.

Since each wireless system has its own advantages and disadvantages, they must be appropriately combined to satisfy the diverse communication requirements of connected car services.

When considering the roles of radio communication systems, their characteristics can be broadly divided into three types:

Hot-spot communication: communication between a car and a server in a specific place

Dedicated short-range communication: Communication over short distances, such as between vehicles, or between vehicles and infrastructure

Wide-area communication: communication between vehicles and remote servers over a wide area

Figure 17 shows what sort of communication is required for each field based on the communication requirements of each individual service.

Since many different kinds of information are needed to realize and advance a connected car society, it is necessary to use a combination of radio communication systems that are suited to the characteristics of each kind of data.

Furthermore, it is expected that further improvements such as improving information precision and lowering lag times will also be required to keep up with the enhancement of services as the connected car society evolves in the future. To achieve this,

Figure 19: Useful forms of communication for an automatic pilot

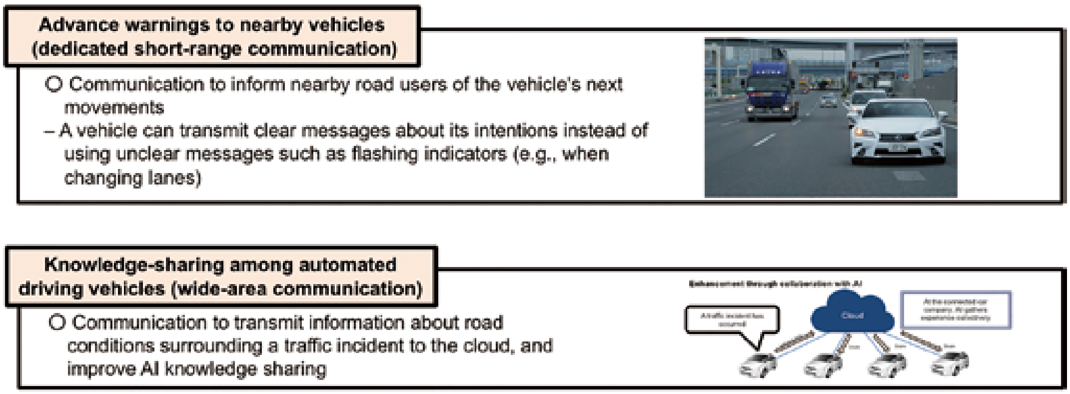


Figure 20: Data needed for the implementation of a connected car society

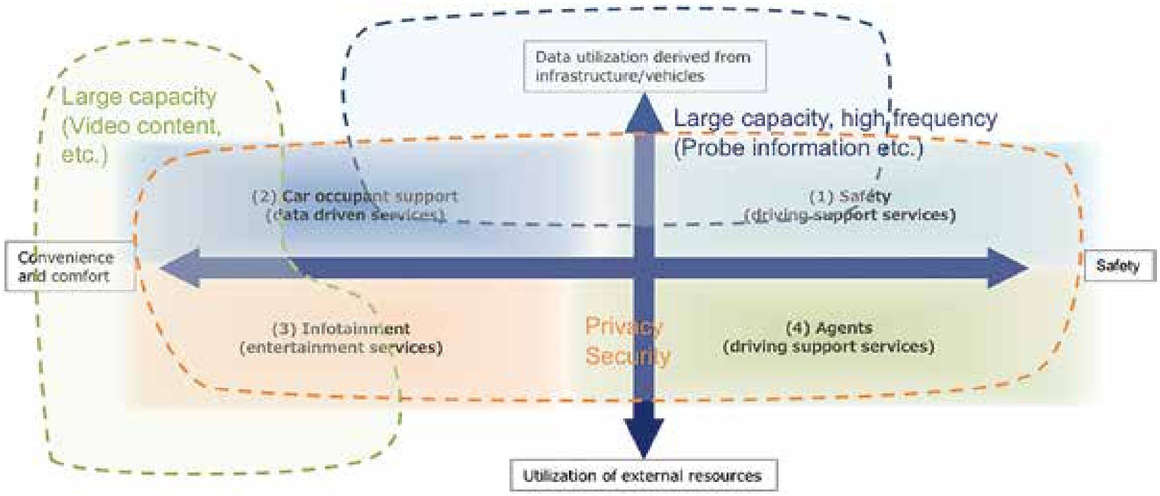
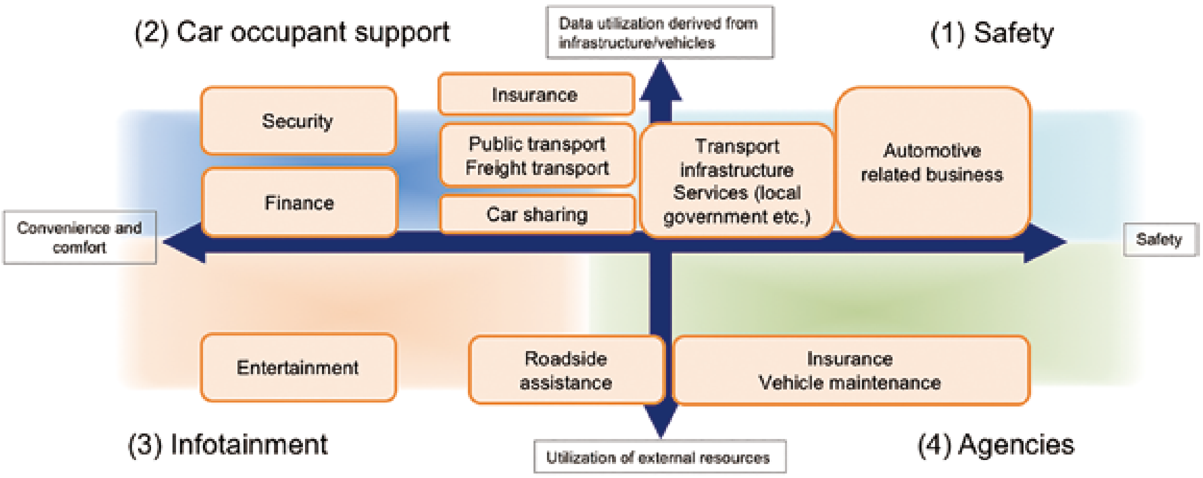


Figure 21: The explosive growth of data derived from vehicles

	2025 (Connected car society)	2035 (Automated driving society)
(1) Number of connected cars in Japan	Approx. 10 million (Fuji Keizai forecast)	
(2) Monthly data communication bandwidth per vehicle	Approx. 50 MB/month (Assuming a travel rate of 300 km/month)	If we include image data from devices such as cameras and LiDARs in automated driving, this could rise by a factor of 100
(3) Annual amount of communication data of all vehicles in (1)	Approx. 6 PB/year (10 million × 50 MB × 12 months)	Approx. 600 PB/year
(4) Number of servers (per year) (*Assuming the data transmitted in (3) will be stored in the cloud)	Approx. 200 per year	Approx. 20,000 per year

Source: Presentation materials by Mr. Sasaki (NTT Data) at the 3rd Connected Car Research Conference

■ Figure 22: The diverse players involved in a connected car society



it will also be necessary for the communication systems used by connected cars to evolve dynamically.

On the other hand, it should be noted that automobiles are durable consumer goods and are often used for more than 10 years from manufacture to disposal. We must therefore provide connected cars with future-proof communication systems that can support the evolution of communication systems while ensuring compatibility with existing vehicles.

For example, a dynamic map system as shown in Figure 18 consists of four layers of information linked to a high-accuracy map. These are combined for use inside the vehicle, and communication is needed to ensure that these layers accurately reflect the current situation in the outside world. Although this requires a fairly advanced level of communication, it is likely that even more advanced communication systems will be necessary in the future to keep up with the evolution of automated driving along with the need for information in greater quantities and with greater precision.

As automated driving systems become more advanced in the future, it is thought that other communication will also become necessary in addition to dynamic maps, including the following:

As shown in Figure 19, an automatic pilot is required to cooperate with AI by extending telematics services and enhancing V2I and V2V communication through the use of ITS communication.

The utilization of data is a major theme of connected cars, and this data can be classified into the abovementioned four quadrants as shown in Figure 20. Connected car services can be supported by using data with these diverse characteristics.

When considering the communication requirements of connected cars, it is also necessary to consider how the volume of data traffic will increase over time.

As shown in Figure 21, the volume of data is expected to grow explosively due to the increasing number of connected cars with more sophisticated data requirements.

In Japan, we will have to develop communication and data storage/processing infrastructures to accommodate the increased volume of data, based on the recognition that this data will become a source of considerable added value.

2.6 Cooperation among various players

For the creation of new connected car services, it will be essential for the automobile industry to establish wide-ranging ties with other industries. For example, Figure 22 shows how relationships with various industries can be mapped to the four quadrants of Figure 15.

To realize services that are suitable for a connected car society, we should build frameworks and mechanisms for collaboration and cooperation with other industries while bearing in mind the clear division of roles of automobile manufacturers, equipment manufacturers, telecommunications carriers and so on.

2.7 Issues to be resolved in order to realize a connected car society

Our study group has identified three issues and one interdisciplinary issue as problems to be addressed in order to realize a connected car society:

[Issue 1] Construction of a reliable real-time wireless communication network

- Based on the widespread use of LTE as a general-purpose network, we will consider the technical and business aspects of various communication technologies (including newer LTE-based methods such as LTE-V2X) while keeping an eye on international trends.
- In the future, we will combine 5G and various other technologies to support services aimed at ensuring and improving the safety of communications. This will involve making improvements to characteristics such as reliability, robustness and real-time responsiveness in order to satisfy the individual requirements of these services in the best way possible.

[Issue 2] Use of data to promote the creation of new industries and businesses

- Improving the collection, storage and utilization of data handled by connected cars requires not only technical measures but also the creation of a supportive environment (e.g., with bigger incentives to promote data utilization).

[Issue 3] Establishment of an environment for innovation and creation

– To construct a model where the added value of new services remains in Japan, we need a forum where diverse foreign and domestic stakeholders can meet the challenge of new initiatives.
– We need to establish an environment where data can be strategically collected, stored and utilized, and cooperate with local authorities to promote cutting-edge demonstration trials with diverse stakeholders. This will lead to the development of new services and promote social acceptance. By broadening the scope of these results, we will secure and strengthen Japan's international competitiveness.

[Interdisciplinary issue] Securement of privacy and security for safe and secure use

– It is important to accelerate efforts aimed at ensuring privacy and security are maintained to facilitate safe and secure use.

2.8 Measures for the implementation of a connected car society

To build the world's most advanced connected car society here in Japan, we need to strategically and comprehensively address the issues discussed in the previous section.

Promoting the Connected Car Society Project shown in Figure 23 should be an effective way of achieving this.

A specific problem-solving approach could be to set up projects corresponding to each of the three issues mentioned above, and to promote collaboration between these projects while using testbeds to resolve interdisciplinary issues.

To promote each project, we will set up and work from an advanced model based on the specific use of each technology.

[Responding to the construction of a reliable real-time wireless communication network]

- The Connected Network project
  – Edge computing utilization model for driving support
  – Infrastructure cooperative driving support model
  – Vehicle-to-vehicle information sharing model

[Responding to the use of data to promote the creation of new industries and businesses]

- The Connected Data project
  – Efficient data collection model
  – A cloud data utilization model that offers convenience and comfort

[Responding to establish an environment for innovation and creation]

- The Connected Platform project
  – System architecture model
  – Cooperative platform model

[Ensure privacy and security for safe and secure use]

Privacy and security are defined as interdisciplinary issues in each project. We will accelerate initiatives such as using a

Figure 23: Connected Car Society Project

Project name	Model name	Concept
Connected Network Project Optimize and improve the functions of reliable real-time radio communication systems that support driving by appropriately connecting with information systems, infrastructure sensors and other vehicles	Edge computing utilization model for driving support	The ultra-fast response times of edge computing are used to improve safe driving and automated driving support services that are required real-time performance and severe restriction of lag
	Infrastructure cooperative operation support model	Provides better driving support by using various communication technologies including LTE and millimeter-wave communication to connect between roads and the vehicles (V2I radio system)
	Vehicle-to-vehicle information sharing model	Information about each vehicle's future movements is shared with other vehicles by various forms of communication such as LTE and millimeter wave communication to support automated driving (V2V radio system)
Connected Data Project Efficiently gather and store diverse kinds of data produced by vehicles by using radio systems suited to the current situation, and use this data appropriately via the network	Efficient data collection model	An efficient mechanism for collecting and rapidly organizing data by segregating and smooth switching between various communication methods
	A cloud data utilization model that offers convenience and comfort	Effective storage and cloud processing of collected data to implement services such as prediction and optimization that contribute greater convenience and comfort
Connected Platform Project By designing and evaluating a system architecture that supports a connected car society, create an internationally competitive connected car platform that can be used by diverse stakeholders	System architecture model	Design and evaluate a system architecture for all connected cars, including data centers that can support huge amount of uploads of vehicle information and advanced information processing for driving support
	Cooperative platform model	Make a model to efficiently promote shared use of data, and build a platform where diverse stakeholders can collaborate

testbed while developing stronger systems for ensuring privacy and security.

With this Connected Car Society Project, as shown in Figure 24, we aim to implement a safer, more secure and more comfortable society with connected cars while achieving our major goals by solving individual issues.

2.9 Connected car society road map

Figure 25 shows the roadmap for realizing a connected car society, which was formulated based on the government's overall strategy on automatic driving technology in the "2017 Public/Private-Sector ITS Initiative Roadmap".

In this roadmap, we decided to promote the Connected

Figure 24: Measures for the promotion of a connected car society

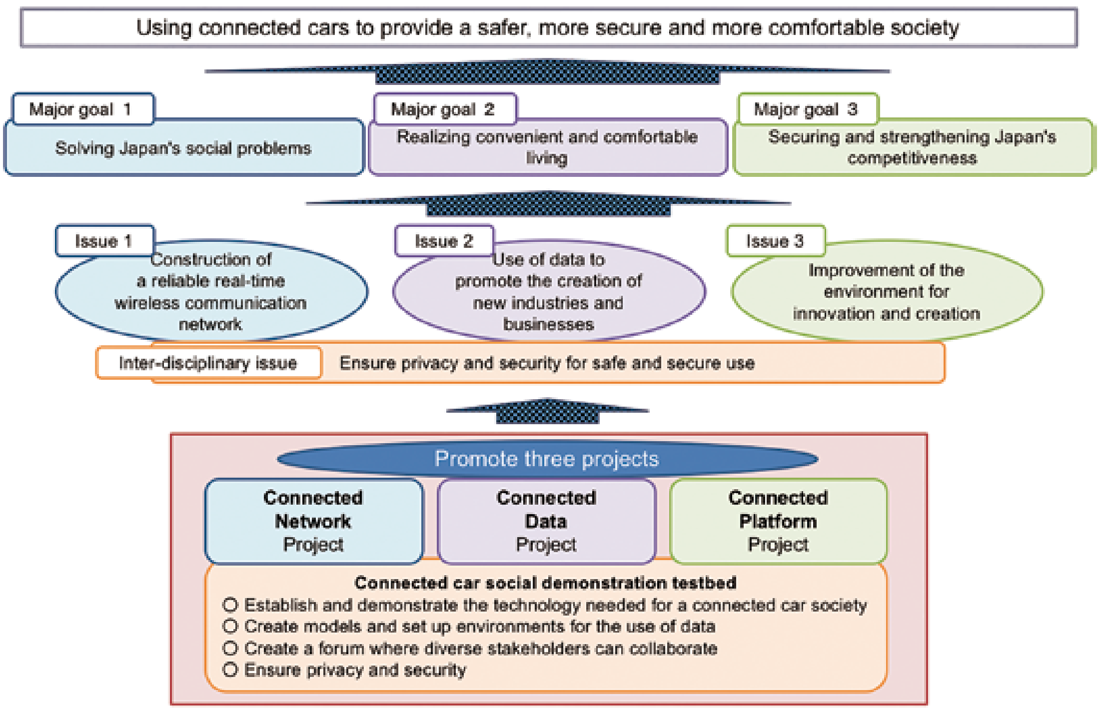
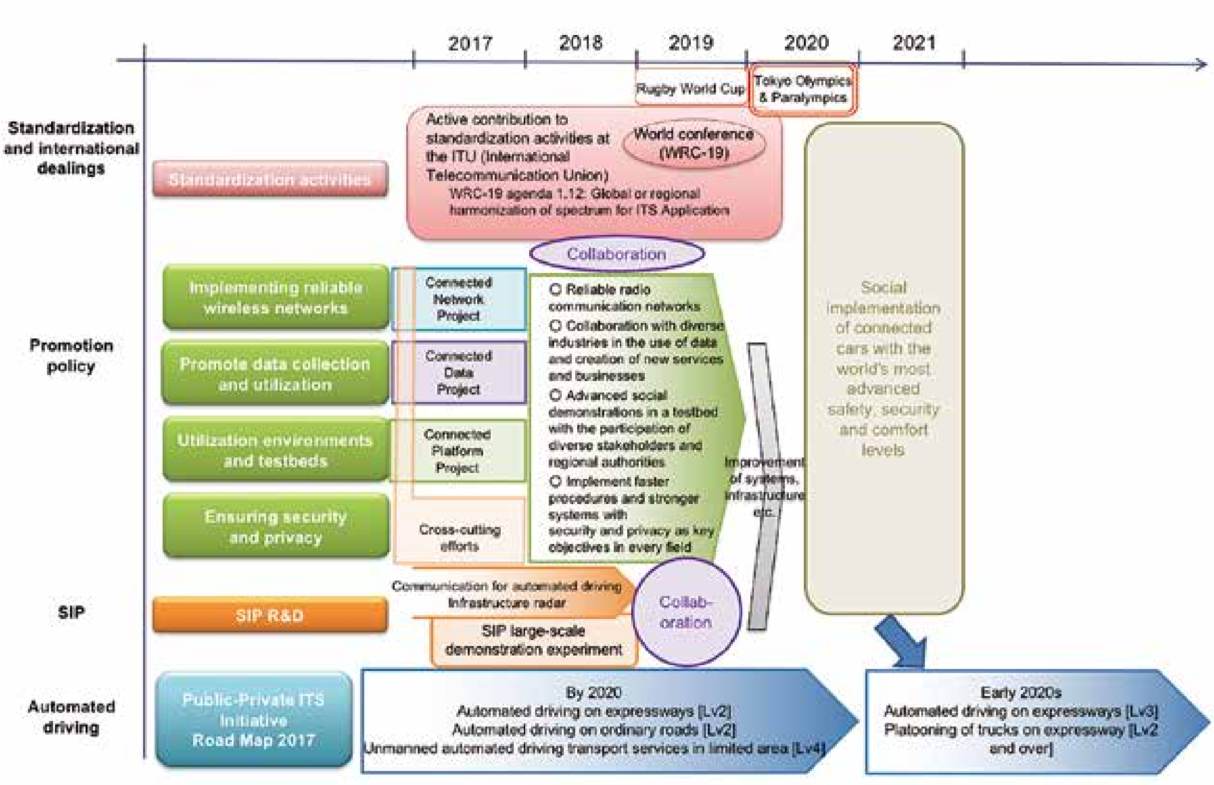


Figure 25: Connected car society roadmap



Car Society Project as a core initiative in conjunction with SIP activities and standardization activities at the ITU.

Specifically, we have decided that from FY2018 we will work on the development and demonstration of technologies that are assumed to be necessary for specific usage models, and we will utilize a test bed where diverse players are able to participate.

Through these efforts, we will implement the world's most advanced safe, secure and comfortable connected car society by 2020 by not only enhancing the capabilities of connected cars themselves, but also by treating them as tools for new mobility services and businesses, and we will also contribute to the realization of more advanced automated driving technology.

2.10 Conceptual images of a connected car society

For reference, a concrete conceptualization of a connected car society is described below.

Figure 26: Conceptual image 1 (concierge service)

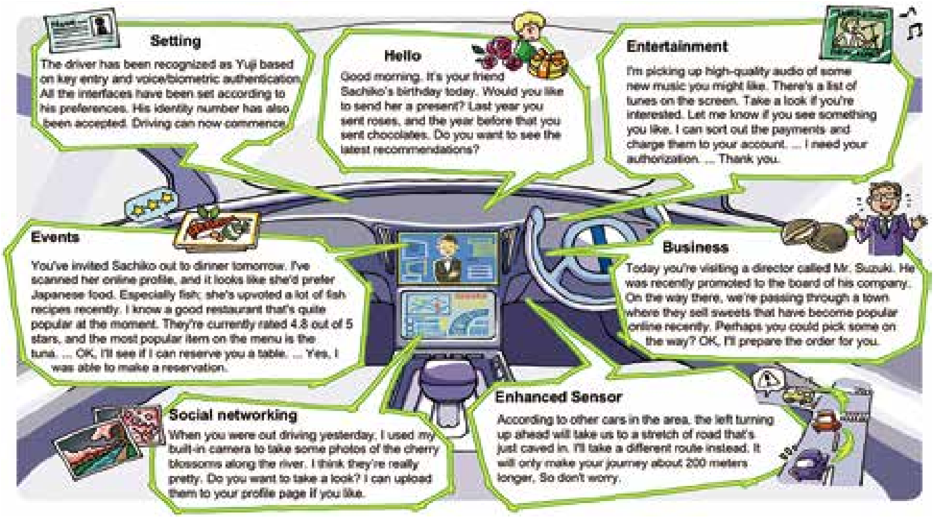
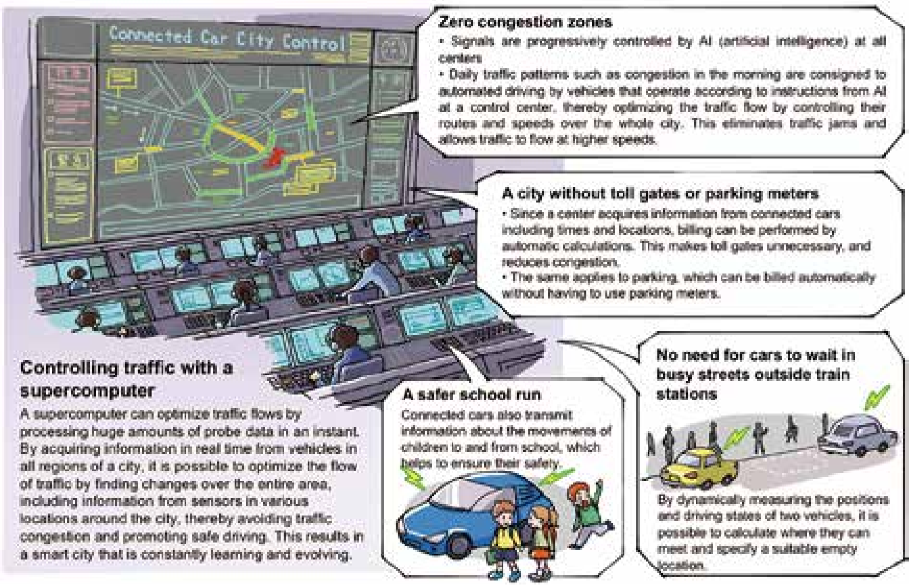


Figure 27: Conceptual image 2 (smart city)



Various sensors installed in a vehicle are connected to the network and seamlessly connected with online services. As shown in Figure 26, this makes it possible for the vehicle to offer concierge services that make various recommendations to the driver.

Also, by using a supercomputer that instantaneously processes information obtained from connected cars and other sources, it could be possible to optimize traffic flow, avoid congestion and promote safe navigation. It is expected that this will lead to the emergence of smart cities, where the entire city constantly learns and evolves autonomously based on this data processing capability (Figure 27).

3. Main points of discussion and issues raised at the meeting

This section summarizes the discussions on the major issues that are covered in the study group: infrastructure development, security, costs, and testbeds.

3.1 Infrastructure development

3.1.1 The role of each player

Building and maintaining a connected car society entails the establishment and operation of a new communication infrastructure.

Recently, attention has been drawn to V2X technology based on the cellular technology used in mobile phones. In the past, cellular technology with relatively large latency was basically used for infotainment purposes such as downloading maps. However, due to advances in technology such as mobile computing and edge computing, the latency has been reduced. Cellular technology is now starting to be deployed in a wide range of applications including safety support. However, this raises the question of who installs and operates the communication infrastructure that makes up these cellular networks, such as cloud computing and edge computing.

The cost of installing communication infrastructure can be borne by the public sector, or by private business. In a connected car society, since a very diverse variety of stakeholders are involved, it is essential to sort out the role to be performed by each stakeholder. For example, it would be reasonable for facilities such as communication base stations to be installed either by communication carriers or by road administrators. There could also be cases where other stakeholders such as traffic managers might be involved.

To enable the communication infrastructure itself to develop soundly, some areas need to be standardized as a common infrastructure while others need to facilitate competition between businesses, and this also affects how the facilities are deployed and operated. From now on, it is important to firmly discuss how roles will be shared among the public and private sectors.

3.1.2 Improvement of communication infrastructure

The discussion of communication infrastructure for the construction of a connected car society was based on the premise that servers and networks could be used freely. However in other countries, there has been a high degree of specialization of servers, operating systems, CPUs and the like, and it is becoming impossible to build systems that can be used freely by combining general-purpose components. There was also a discussion of how it is not possible to rule out the possibility of a society where all the systems related to connected cars in Japan depend on foreign components and are operated in large-scale cloud services situated overseas.

In the world of ICT, there is a tendency for a small number of global players to dominate the industry. This move towards global consolidation will continue to accelerate. Unless Japan gets involved in this movement, we run the risk of becoming sidelined. We must therefore consider what sort of role we are going to play. As systems are consolidated and moved to cloud, ultimately all that is left is data. It is vital that each industry and business considers how to protect data in the future.

As for the servers, it is thought that the scale of data collected from vehicles will grow exponentially in the future, which raises the question of how this data will be stored. The volume of data currently being collected corresponds roughly to that of a Controller Area Network (CAN). But when big data becomes widespread, data collected from vehicle control information, video cameras and so on will also be uploaded to data centers. If every car in the country functions in this way, we will need an enormous group of servers to handle all the data. It would be difficult for a single manufacturer to invest in this infrastructure independently. But if we rely entirely on overseas servers, all the data will go abroad and we will lose not only the ownership of the data but also all of its value.

On the other hand, if there is a delay of several milliseconds in round-trip communication between Japan and the US, it may not even be possible to use overseas servers from inside Japan. In fields such as connected cars where response time is particularly important, it will be necessary to construct certain systems in Japan.

Also, if people depend on foreign operating systems and CPUs because they are cheap and convenient, there will be nothing left in Japan in the future. Japan will also have no resources for dealing with any problems that may develop in the future.

For this reason, it is very important for Japan to maintain a certain level of technology and to create circumstances where it is possible to supply and operate equipment domestically. Demand for cloud-based data management will rapidly increase in the future. Even though some companies may seem to have a large share now, the absolute size of these shares will seem tiny in 10 years. Instead of depending on overseas providers, it is essential that Japan constructs its own technology.

One of the major issues is how to establish a communication infrastructure at a national level. In realizing a connected car society, it is important to think about how to build mechanisms that add value in Japan. From now on, we should reduce the entry barriers in this field, perform testbed studies, and consider the role each stakeholder should play.

3.2 Security

3.2.1 Viruses

In general, cyber criminals use various direct and indirect means to attack products and servers. Since a malfunctioning connected car is potentially a risk to human life, security measures are particularly important.

Recently, viruses called “cyber debris” have caused problems. For example, there is a computer virus called Slammer that was actually released fourteen years ago but is still active. Some viruses can be very difficult to eradicate once they have made it out into the wild. Since connected cars usually have a very long life, they must be able to deal with this sort of threat.

Also, viruses called bots have caused in the telecommunications industry for a long time. Unlike debris, bots are viruses that can remain dormant for a period of time without anyone knowing how or when they entered a system, until some later date when they become active and cause problems. By this stage, they cannot be blocked at the entrances to the system because they have already made it past the system’s defenses. Although it is very important to apply communication security measures and software updates as quickly as possible, it is difficult to find bots that have already made it into the network.

3.2.2 Security

Although connected cars can be thought of as a type of IoT, cars and their on-board equipment tend to have targets that are more clearly defined than those of ordinary IoT equipment. As a result, it can be easier to handle their security requirements. For example, the world of IoT includes items whose owners are unknown, whereas a connected car is obviously owned by someone, as can be demonstrated by performing proper authentication. However, viruses are not always delivered by intrusions from the outside. In some cases, backdoors can be formed in the original components of a system, or a bot may be hidden within its software. Even if no problems arise at the testing stage, a system can still be vulnerable to attack. Therefore it is necessary to guarantee the origins and authenticity of products and components used in a connected car.

Also, if an incident such as hijacking is detected in a connected car network, it is possible to adopt a new viewpoint by linking the vehicle’s emergency measures and cybersecurity measures, such as using the automated driving functions to make the vehicle stop suddenly at the side of the road. On the other hand, getting the car to stop may have been the original purpose of the cyberattack, so it is also possible that the vehicle’s emergency stop function could be targeted and abused.

Security measures generally assume that there will be incidents that have to be dealt with retroactively after they have taken place. This is equivalent to the way people resort to surgical or medical remedies when they get sick or injured. In both cases, it is necessary to stop before getting back up again. For example, when assessing a human patient with an unknown condition, a doctor will collect various data, listen with a stethoscope, look at the patient's state of health, and combine this information with many years of experience and medical knowledge to make a diagnosis and decide what measures to take. If a similar diagnostic process can be applied to the big data collected by servers from connected cars, it might be possible to prevented security incidents before they actually occur.

Security is an essential factor in the use of data in connected cars. Since security is an ongoing battle and connected cars take charge of human life, the security measures must be updated constantly. From now on, we must engage the public and private sectors on the issue of connected car security.

3.3 Costs

It is well-known that the free use of data collected by connected cars in diverse locations will have far-reaching benefits. However, while the data gathered by connected cars is public data, it is also private data collected through the efforts of each company involved. The positioning of the data is therefore very important. We must consider how to compensate for the social costs of sharing data within or between industries. However, the connected car society is expected to become an enormous ecosystem involving vehicle manufacturers, parts manufacturers, communication carriers, cloud service providers, servicing companies, and companies that generate and lease out secondary data. Since the data is expected to be created, stored and used in different places, this makes the issue very complicated. We must discuss how an entire country or industry can cover the cost of promoting mutual utilization of data collected by connected cars.

The cost of maintaining and updating security and other systems is expected to be huge, but since this is essential for ensuring safety, we must also consider how these costs will be shared.

Unless these matters are studied in depth, it will be difficult for society and individuals to accept a connected car society. It has been estimated that the infrastructure investment costs of a connected car society could exceed ¥1 trillion per year. If we are not conscious of the need to engage in a project of such size in the future, then we will not progress beyond the discussions of technology. In the future, it will also be important for the public and private sectors to unite and discuss cost sharing.

3.4 Testbeds

The field of connected cars involves various stakeholders from diverse industries, including automobile industry, telecommunications industry and service industry, as well as national and regional governments. These will have to be brought together in order to resolve issues and make the connected car society a practical reality.

The automobile industry has traditionally excelled at implementing its own safety measures such as CO_2 reductions and NCAP safety tests. However, the creation of completely new technologies and services that cross between different industries will benefit from the provision of a testbed. A testbed is a place where it is possible to try out new approaches one after another in a short period of time. It is felt that this is a preferable development environment because it is possible to switch to the next idea straight away if one idea fails. Since multiple stakeholders cooperate not only with desktop studies but also with actual designs in the testbed, this should promote technical innovation, the use of diverse technologies, and the combination of different use cases to create new ideas that can be used in the creation of a connected car society.

On the other hand, there are various questions we will have to answer. Will Japan simply follow other countries who lead based on the development of connected car networks and cloud technology resulting from over a trillion yen of investment? What sort of technology will we use, and what will we do with it? What sort of characteristics should our testbed have? For example, if we perform R&D with other businesses and industries using previously unavailable probe data in new methods, this could become globally unique. Also, on the infrastructure side of things, there are, for example, about 200,000 traffic lights in Japan, only about 100 are currently equipped with sensors that can communicate with cars. If all the traffic lights in some region could be equipped with these sensors, then this would create a testbed not available anywhere else in the world.

Currently, the Ministry of Internal Affairs and Communications shares the personal information of volunteer visitors to Japan with hotels and cultural facilities as part of its "IoT Hospitality Cloud Business" initiative. We are performing demonstration trials in which the information is used to provide various services, and in FY2016 the number of participating tourists reached approximately 2,000. However, a number of restrictive and technical issues came to light. Unless we proactively engage in characteristic projects like this, there will be little point in us repeating the work of studies that are already being performed in other countries. In the future, we hope to discuss the specific details of the testbed in more depth, and gather opinions from many other fields of industry.

4. Future initiatives

Through six study group discussions, we have carried out an analysis of the current situation and the tasks to be performed in order to realize a connected car society. The Ministry of Internal Affairs and Communications also plans to promote efforts toward realizing a connected car society based on the points raised in this study. On the other hand, connected cars represent a new field that combines automobiles and communication, and the stakeholders involved in this technology are far more diverse. Since we have to trust our cars with our lives, it is not sufficient to pursue the idea of a "best effort" as in other fields. Instead, we must build systems that reliably ensure the safety of drivers and pedestrians. In this sense, it will become necessary to promote the development of technology while checking that the technical requirements match the actual situation of road users and their needs. The government as a whole will go ahead with full-scale field demonstration tests with the aim of realizing a connected car society.

= A Serial Introduction Part 4= Winners of ITU-AJ Encouragement Awards 2017

In May every year, The ITU Association of Japan (ITU-AJ) proudly presents ITU-AJ Encouragement Awards to people who have made outstanding contributions in the field of international standardization and have helped in the ongoing development of ICT.
These Awards are also an embodiment of our sincere desire to encourage further contributions from these individuals in the future.
If you happen to run into these winners at another meeting in the future, please say hello to them.
But first, as part of the introductory series of Award Winners, allow us to introduce some of those remarkable winners.

Amane Miura

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Fields of activity: Satellite Communications

International Standardization of Integrated MSS Systems

It is my great honor to receive the ITU-AJ Encouragement Award.

Entering the 2000s, satellite operators in Europe and the United States drafted specifications for integrated Mobile Satellite Service (MSS) communication systems, with terrestrial systems using the same frequency bands as mobile satellite communication systems in a complementary way. These terrestrial systems are called Ancillary Terrestrial Component (ATC) in the United States and Complementary Ground Component (CGC) in Europe, but they are both based on the same concept. Both aim to improve transmission services by operating complementary services through terrestrial base stations (ATC/CGC) on the same frequency band as MSS. Several plans were drafted by multiple satellite operators for MSS/ATC systems using the L/S band, and satellites were launched in the period from 2008 to 2010 (although commercial services have not yet begun). Recently, the company Inmarsat proposed a satellite/terrestrial S-band frequency-sharing mobile communication service for aircraft use in Europe, called Aviation CGC (ACGC).

Discussions on international standardization of integrated MSS systems began at the Asia-Pacific Telecommunity Wireless Group (AWG) and the International Telecommunication Union Radiocommunication Sector (ITU-R) in around 2013-2014. During 2008-2012, NICT had conducted R&D on the Satellite/Terrestrial Integrated Mobile Communications System (STICS), which is a kind of integrated MSS system, as commissioned research for the Ministry of Internal Affairs and Communications of Japan. I joined both the AWG and ITU-R meetings to promote STICS technologies.

2013-2014 meetings in AWG included activity to create the APT Report, “Studies within the Architecture and Performance of Integrated MSS Systems and Hybrid Satellite/Terrestrial Systems below the 3 GHz Band.” In ITU-R, 2014-2016 SG4 WP4B meetings included similar activity to create the ITU-R Report on Question 291/4, “System architecture and performance aspects of integrated MSS systems.” I have continuously contributed input on the achievement of STICS R&D in both of these meetings. These reports have been finalized and published successfully, as APT/AWG/REP-57 and ITU-R Report M.2398.

In the future, I would like to continue to contribute to standardization activities in the field of satellite communications.

Dai Yamakami

NTT East, International Division (On assignment to: Japan Telecommunications Engineering and Consulting Service)
yamakami@jtec.or.jp http://www.jtec.or.jp/english/
Fields of activity: International cooperation activities

Telecommunications cooperation in developing countries

I am honored to have been chosen to receive the ITU-AJ Encouragement Award.

I was originally sent out to assist in restoration of telecom services after a devastating hurricane, and working together with local counterparts, we engaged in troubleshooting and repair of subscriber lines and infrastructure around the capital city of Port Vila in the Republic of Vanuatu.

The Vanuatu mission was hugely successful, for I was able to maintain and repair subscriber lines, identify weak points in the infrastructure thanks to trouble reports submitted by subscribers, and quickly isolate faults and restore service.

Inspired by this initial assignment to Vanuatu, I participated in a number of other telecom projects taking me to Cambodia, Myanmar, and Vietnam. My eight years of service working for NTT Vietnam are especially memorable. Working in close collaboration with the Vietnam Posts and Telecommunications Group (VNPT), we made remarkable progress developing Vietnam's telecom infrastructure, deploying FTTH, and rolling out new services.

Looking ahead, I plan to continue working with personnel from local telcos dealing with problems in developing countries, struggling to overcome local obstacles, and promoting telecom cooperation in developing countries.

Kazuhisa Yamagishi

NTT Corporation, Network Technology Laboratories
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http://www.ntt.co.jp/qos/eng/person/yamagishi/index.html
Fields of activity: Performance, QoS and QoE

Standardization of quality assessment methodology for video communication services

I feel greatly honored to receive the ITU-AJ Encouragement Award, and would express my appreciation to the Selection Committee and to all those who helped me along the way. This award recognizes my contribution to standardization of quality-estimation models for video communication services.

Since joining ITU-T SG12 in 2005, my work has focused on the standardization of quality-estimation methods for video communication services. These methods are extremely useful in designing applications and networks, and for monitoring the quality of services that are up and running.

During the 2004-2008 study period, I worked on a quality-estimation model, called a planning model, for videophone services. Designated ITU-T Recommendation G.1070, the model takes application and network parameters into account such as bitrate and packet-loss ratio. The model is used in designing applications and networks for videophone services, and is the first quality-estimation model for video communication services developed by ITU-T SG 12. Being the first model, it has informed all subsequent standardized video-quality-estimation models. Although this was my first involvement in ITU-T standardization work, I was exposed to the whole process of standards making: I proposed the scope, the terms of reference, identified a candidate model, verified the quality-estimation accuracy of the model, and as editor, I drafted the final recommendation with support of other SG12 colleagues.

Subsequently, I participated in a study to develop quality-monitoring tools for IPTV services (ITU-T Recommendation P.1201) and adaptive-bitrate streaming services (ITU-T Recommendation P.1203), and helped draft quality-estimation model proposals and recommendations in the 2009-2012 and 2013-2016 study periods, respectively. The range and depth of these various activities sharpened my analytical skills and greatly extended my network of professional colleagues.

I am convinced that these activities will help address the operational challenges of service providers and promote sound development of video communication services.

NEC Corporation Transportation and City Infrastructure Division (currently NEC Corporation Safer City Solutions Division)

https://www.nec.com/en/global/solutions/biometrics/index.html
Fields of activity: Face recognition

Contribution to wider utilization of face recognition around the world

It is a great honor for NEC to receive this award. We would like to thank the ITU Association of Japan (ITU-AJ) and other organizations and individuals who have made this possible. NEC has been involved in research and development on fingerprint identification and face recognition for over half a century. The technologies resulting from these initiatives have been used to ensure safety and security around the world and have contributed to job creation, human resource development, and other economic activities in different countries. We are therefore truly honored to have our efforts recognized through this award. Our face recognition solutions continue to be deployed by more and more customers. We have also continued our research and development initiatives to not only increase their accuracy and speed, but also to strengthen measures against identity fraud, and make the solutions available to a wider range of users. Moreover, since biometric technologies have different characteristics, combining multiple technologies, such as face recognition and fingerprint identification, enables recognition with higher accuracy and utility value. NEC, therefore, has pursued research and development on various biometric technologies. One of them, iris recognition, has been ranked number one in a recent accuracy testing (April 2018). Going forward, we will continue these initiatives to make biometric technologies from Japan available to more users around the world.

Takaaki Matsushima

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Fields of activity: ITU-R SG4 WP4A, SG5 WP5A/5D

Studies of sharing and compatibility between Mobile and Satellite services

It is a great honor to receive the ITU-AJ Encouragement Award for my studies of sharing and compatibility between Mobile and Satellite services.

After WRC-15, the decision was made to study the compatibility of IMT and BSS (sound) in the frequency band from 1,452 to 1,492 MHz in Regions 1 and 3 (Issue 9.1.2 of the WRC-19 Agenda). Normally, only one group is responsible for each agenda item or issue. But for issue 9.1.2, two responsible groups have been assigned. WP 4A is responsible for studies relating to BSS (sound), and WP 5D is responsible for studies relating to IMT.

Since 2015, I have been attending the ITU-R WP 4A meetings as a satellite expert, and the WP 5D meetings as a mobile expert in order to discuss sharing and compatibility between Mobile and Satellite services. After WRC-15, WP 5D asked WP 4A to provide relevant technical characteristics of BSS (sound) systems and related information to support discussions of issue 9.1.2 between WPs 5D and 4A. To promote more effective collaboration between both WPs, I have not only participated in WP 5D meetings as a DG chairman specializing in MS/BSS 1.5GHz compatibility, but I have also launched a joint study by two WPs and contributed to studies of BSS (sound) in WP 4A meetings.

Not many members attend both WPs 4A and 5D. In particular, there are very few experts on issue 9.1.2. I look forward to continuing with my participation in both WPs as an expert in both satellite and mobile technology, and I hope these studies will have an acceptable outcome for both satellite and mobile members.

Cover Art

Ichikawa Danjuro (Picture of kabuki actor Ichikawa Danjuro VII (1791-1859). It is said that he is playing the role of Matsuomaru in Sugawara and the Secrets of Calligraphy (1823).)

Utagawa Kunisada (1786–1865)

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Cybersecurity Research Ethics and Related Activity in Japan

Mitsuaki Akiyama
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1. Cybersecurity Research Ethics

The rapid development of the Internet has brought convenience and efficiency to our daily lives, but it has also brought increases in cyberattack occurrences and availability of sensitive information that can be used to identify individuals. ICT research, and cybersecurity research in particular, has also had major effects on our living environments, from both research results and the research processes themselves.

To conduct cybersecurity research, it is essential to observe actual incidents on the Internet. However, such measurement research can deal with a wide range of communications beyond just that of the attack being observed, so it involves various security risks related to privacy and other issues. To minimize such risks, appropriate planning and accountability for any potential risks must be achieved before proceeding.

Further, if a security hole (defect) in a particular piece of software is discovered in the process of such research, there is a risk that it will be exploited maliciously in an attack if it is brought to light before being dealt with adequately in affected systems and services.

Since the year 2000 as the Internet has spread, there has been ongoing ICT research on a large scale. However, since there have been no appropriate guidelines for ethical research, there is no doubt that some research has been done without adequate ethical review. As such, discussion of research ethics related to ICT and cybersecurity has been on the increase since 2010, particularly in the USA, new ethical principles have been established, and technical research papers are starting to be reviewed from the perspective of research ethics. Research ethics is unavoidable with any innovative research in cybersecurity, and has become an essential aspect of work for all researchers and technologists creating globally competitive technologies.

The importance of research ethics in cybersecurity has also become more widely recognized in Japan recently. Symposiums are being held, mainly by academic institutions, and organizations to develop and promote research ethics in cybersecurity have been established.

This article describes principles of cybersecurity research ethics, introduces global trends and recent cases, and discusses the current state and outlook for cybersecurity research ethics in Japan.

2. Principles of research ethics

No suitable guidelines related to research ethics were available for early ICT research, and in many cases, research was done without adequate ethical review. This includes handling of malware, counter attacks for cyberattacks, attacks on or publication of vulnerabilities, and collection of detailed vulnerability and attack information. As such, the approach taken in the Belmont Report, which was produced in 1979 to establish research ethics in the biomedical field, had to be interpreted in the context of ICT research. Then in 2012, the US Department of Homeland Security issued the Menlo Report, compiled mainly by researchers in the USA. This article introduces the research ethics principles in the Belmont Report and discusses differences between biomedical and ICT research, and then introduces new research ethics principles stipulated by the Menlo Report.

2.1 Belmont Report

The Belmont Report defines research ethics for the biomedical field, based on the following general principles.

- Respect for Persons. Participation in research is decided freely by each participant, based on informed consent (respecting their right to make decisions based on adequate explanation of the details).
- Beneficence. Maximizing the potential benefit and minimizing the potential harm resulting from the research. An assessment of risk, harm and benefit is done.
- Justice. Individuals must receive fair consideration for how they are treated. Also benefits of the research must be fairly distributed, and the burden also shared equally among research subjects.

2.2 Differences between biomedical and ICT research

The ethical principles cited in the Belmont Report are a basis for biomedical research, but they also suggest a basic code of conduct that can be applied broadly in other fields.

However, it must be noted that ICT research is now being done based on environmental conditions that could not have been imagined at the time the Belmont Report was created. Specifically, differences between biomedical and ICT research include the following.

- Scale
  The Belmont Report assumes biomedical research in which the researcher and subjects are able to interact face-to-face, dealing with tens or thousands of subjects, while ICT research is able to collect and analyze data from millions of people. In such cases it is not easy to obtain informed consent from each person.
- Speed
  Most biomedical research involves manual processes (conducting interviews in a laboratory, etc.), so if problems occur, research can be suspended before damage spreads. Conversely, ICT research has the potential to adversely affect millions of devices in an instant, so risks and damage must be assessed rapidly and accurately.
- Aggregation and interrelation of information
  In ICT research, information resources are interconnected through networks, and are strongly related. For example, smartphones store information including email addresses, lists of contacts of friends and associates, and SNS account information. Thus, they could leak personal information of not only the owner, but also others connected to the owner.
- Decentralization
  With ICT, various technologies are interdependent and communication content is located in various locations as text, audio, or video, and is controlled by various entities. As such, it can be difficult to identify from whom informed consent should be obtained.
- Non-transparency
  Biomedical research involves meeting with subjects, but ICT research is done involving many people indirectly, via ICT. Subjects are not met directly so it is difficult to anticipate who will be affected by the research and how.

Researchers in ICT are obliged to design and execute research plans ethically, with consideration for these sorts of condition.

2.3 Menlo Report

As the Internet developed, differences between biomedical and ICT research (Sec. 2.2) become clearer, and it became necessary to interpret the approach taken in the Belmont Report in the context of ICT research. As such the Menlo Report[1], modeled after the Belmont Report, was established in 2012. In addition to interpreting the three main principles in the context of ICT research, the Menlo Report adds the following new research ethics principle.

- Respect for Law and Public Interest. Research methods and results must maintain transparency and take responsibility for such behavior.

This ethical principle interprets the Beneficence principle from the Belmont Report in the context of ICT research and clarifies new issues that need to be addressed, such as opposition or ambiguity between laws of different regions, stakeholder-specific difficulties, and discrepancies between laws and public interest.

If a security hole is discovered in the research process, there is an obligation to practice Responsible disclosure, taking responsibility to identify the stakeholders that could be affected and disclose the information in a way that minimizes damage. Note that the Menlo Report is accompanied by a summary of discussion and responses based on example cases[2].

3. Global trends

Given the increase in concern for cybersecurity research ethics, new international academic conferences focusing on cybersecurity research ethics have been held between 2013 and 2015, including CREDS, CREDSII, and NS-Ethics[3][4][5]. Activities at these conferences deal with changing ICT environments and support better ethical research, including review of past research projects for which discussion of research ethics was inadequate, sharing of best practices, and ethical research design.

Since 2013, there has also been a steadily increase in mentions of research ethics in calls for papers for conferences, including the top cybersecurity conferences (IEEES&P, ACM CCS, USENIX Security, ISOC NDSS). Specifically, calls for papers are asking for "Clear descriptions of research ethics in papers that could stimulate discussion on research ethics. Such papers must also be approved by the research ethics committees of their own organizations."

So how is ethical cybersecurity research actually being practiced around the world? In the results of a survey of research ethics descriptions in papers at a top international conference in the past several years (approximately 300 papers presented at USENIX Security 2012 to 2016), discussion and assertions on research ethics were classified mainly into the following categories.

- Obtaining consent/agreement
  User (subject) consent, service operator agreement, research ethics committee (IRB) consent.
- Legal/legitimate procedures, performance of anonymization, conformance to policies/guidelines, assertion of legality, no-alternate options, performance of responsible disclosure.
- Risk/Damage control. Minimizing risk, preventing new damage.

- Benefits, sharing best practices, public benefits.
- Research application that does not affect other persons.

In this way, the experience of earlier researchers with concrete methods can be used as reference case studies for researchers and technologists starting similar research in the future.

4. Research case studies

This section introduces cases of research by organizations in Japan that are particularly relevant to research ethics.

4.1 Sandbox detection

Yokoyama et al. from Yokohama National University has studied sandboxes, which are a tool used for analysis and detection of malware. They provide a run time environment for running a program being investigated, to study its behavior so it can be detected, and to analyze its functionality. They have been able to clarify typical characteristics of sandboxes and identify the potential to inhibit malware analysis and detection using a sandbox[6].

For this study, they first investigated the state of sandboxes actually in operation. To gather information about the features of the sandboxes being used by the services, they created data-gathering samples and submitted them to online malware analysis services that perform sandbox analysis. They used machine learning based on feature data to show that the sandboxes and ordinary user environments can be accurately discriminated, and reported that their discriminator is also effective for commercial sandbox products.

These test results and test samples were provided to the sandbox product vendors and malware analysis service providers beforehand, to contribute to improvement of these products and services. Also, the product names and particular internal information for these products and providers were anonymized in papers, and collected features were presented as statistical data, to minimize any effect on particular products or services. By publishing research results in this way, effort was made to maximize the benefits and minimize any damage caused.

4.2 Social account detection

Watanabe et al. from the NTT Secure Platform Laboratories has discovered a new type of privacy attack able to identify the account of any targeted user on a social Web service[7]. This attack uses the blocking functions that are provided as standard on social Web services maliciously, so it has the potential to affect social Web services widely around the world, and users are vulnerable to such an attack.

This research involved experiments on real services to verify the attack, and these tests were designed very carefully to minimize the risks and other negative effects. In particular, to avoid attacks on real users, experiments were conducted on accounts owned by the researchers, and were planned carefully to avoid any unnecessary increase in load on the service.

They also contacted the 12 service operators and major browser vendors being checked for the vulnerability beforehand, and shared information regarding how to reproduce the attack method and how to counter it. As a result, service operators and browser vendors each changed their specifications, so this research contributed to social Web services that are safer for users. These results were also presented at the international conference, IEEE Euro S&P 2018, raising awareness of the threat around the world and contributing to the public good.

5. Current and future state in Japan

Since 2016 in Japan, the sharing of knowledge regarding cybersecurity research ethics and serious discussion of ethical research practices has begun in a domestic research community called the "anti Malware engineering WorkShop (MWS)"[8].

Later, cybersecurity experts gathered under one roof and discussed awareness of issues and action plans for the future at the largest security technology symposia in Japan, the Symposium on Cryptography and Information Security (SCIS)[9], and a symposium held by the Japan Society for the Promotion of Science (JSPS). However, little research in Japan requires discussion of research ethics, so more research is needed for these initial steps and to push it further.

5.1 Emerging issues

- Sharing knowledge and practices
  Impact and benefits around the world varies by case, and cannot be determined in a uniform way. As such, researchers and technologists must accumulate more case studies. Responsible disclosure is particularly complex, from stakeholder estimates to practical procedures. In Japan, reports can be submitted to the "Information Security Early Warning Partnership" operated by IPA and JPCERT/CC, which provides a mechanism for performing responsible disclosure of vulnerabilities in products and software. On the other hand, there are cases that would not be considered vulnerabilities in software or products, but still require responsible disclosure (examples in Sec. 4). These must be handled mainly by the researchers themselves. It is difficult for a single organization to accumulate enough know-how for this, so a venue for discussion and knowledge sharing across organizations is needed.

- Research significance
  In research requiring discussion of research ethics, there is research value in the attack methods and vulnerabilities discovered, but also in the computer science and engineering techniques used to find them. Spreading these detection techniques throughout the world also provides global benefits such as enabling developers to check for and find them at the development stages. Clarifying common pitfalls and the basic ways to deal with them also has research value. Spreading and popularizing these issues and solutions throughout the world also has benefits for the future.
- University-industry collaboration
  Substantial solutions are only possible through collaboration between academia and industry. As such, discussion involving industry is necessary, since the consensus on issues, such as grace periods for implementing solutions and methods of responsible disclosure, could differ in different areas of industry. Researchers must also work to build trust relationships between academia and industry so that, for example, responsible disclosure, adequate information, grace periods, and work-arounds can be presented.

5.2 Future initiatives

Among the initiatives receiving wide recognition in Japan is the Cyber Security Research Ethics Working Group, established in February 2018 at the 192nd Committee on Cyber Security in a group of University-Industry Cooperative Research Committees from JSPS[10]. This working group is intended to promote activities supporting the understanding and practice of cybersecurity research ethics, with a neutral perspective spanning academia and industry.

Even looking globally, there are still very few research facilities that maintain a research ethics committee capable of making proper judgments regarding cybersecurity research ethics. In light of this, the Computer Security Symposium (CSS) in Japan is considering having a desk for consultation on cybersecurity research ethics. The desk would enable researchers who have questions on research ethics to discuss them before proceeding with their research.

6. Conclusion

The ethical principles stipulated in the Menlo Report are essential knowledge that researchers and technologists should have access to when conducting research in ICT and cybersecurity.

We anticipate that innovative activities promoting ethical research in cybersecurity in Japan will contribute to ongoing creation of advanced and competitive security technologies from Japan.

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Development of Practical Problem-solving Skills: Building Networks to Bridge the Digital Divide in Regional Communities

International Cooperation Department
The ITU Association of Japan

From December 4th to December 15th, 2017, the ITU Association of Japan held an APT* training course in Tokyo on the theme of "Development of Practical Problem-solving Skills: Building Networks to Bridge the Digital Divide in Regional Communities". This was the ITU-AJ's first APT training course since our space communication training course seven years previously in 2010. This time, the training was conducted in a rental conference room at the south exit of Shinjuku Station in Tokyo, and the trainees stayed at the nearby Hotel Sunroute Plaza Shinjuku.

There were nine trainees at this course, each from a different country (Afghanistan, Bhutan, Cambodia, China, Mongolia, Sri Lanka, Tonga, Vanuatu and Vietnam) (Photo 1).

Our aim was to equip them with the ability to tackle issues arising from the information gap between urban and rural areas of their own countries by drawing up a plan of action based on an analysis of the current situation in their home country and creating the overall design of a communication network that addresses these issues. To help the trainees understand the problems in their own countries and acquire the skills needed to propose and evaluate solutions to these problems, they not only attended lecture sessions, but also acquired practical skills by taking part in hands-on training and presentations. This sort of practical work is a major feature of the training course.

To make the trainees aware of the issues originating from the digital divide in their own countries, they were asked to report on the current situation and problems of ICT environments in their own countries before coming to Japan. Before the course began, they all gave presentations to report on the situation in their own countries. Through these presentations and the subsequent discussions with lecturers and other trainees, we aimed to provide the presenters with a deeper understanding of the issues faced by their own countries, and to provide all the trainees with a shared understanding of the situation in other countries. These presentations were preceded by a country report on Japan and an overview of the telecoms situation in Japan presented by Kazuhiko Tanaka, Secretary-General of the ITU-AJ.

At this short training course of less than two weeks, we focused on two subjects: project cycle management (PCM) and network construction.

PCM is a method for the preliminary analysis of problems in order to find a solution. In this course, we aimed to introduce practical, general-purpose methods for identifying the issues that are necessary for the solution of problems originating from information gaps in each participant's country, and to provide the trainees with a chance to share their knowledge in group discussions (Photo 2). Furthermore, PCM training was performed before the participants created their final action plans (for solving problems in their own countries), giving each of them the opportunity to organize themselves with regard to the formulation of methods for solving ICT issues in their own countries through discussions with other participants.

For network construction, case studies were conducted on six model areas assuming sufficient basic knowledge of transmission and radio wave propagation

■ Photo 1: Opening ceremony

■ Photo 2: PCM drill

* The Asia-Pacific Telecommunity

(Table, Photo 3). The trainees designed and planned communication networks for each of these six model areas. By presenting their results and discussing them with the lecturers, the trainees acquired basic knowledge about network construction methods for resolving the digital divide in each country, learned how to apply them later on in their action plans, and became able to use the techniques and knowledge gained here to solve various problems in their countries after returning.

After acquiring basic knowledge of PCM and network construction through practical training in this way, the trainees applied their new-found knowledge to their pre-prepared draft proposals for regions affected by an information gap in their own countries and were able to formulate their proposals as action plans.

On the final day, each participant presented their action plan. These action plans described how PCM and network construction methods can be used to design and build communication networks that solve the issues of each participant's country and were actively discussed. Based on these discussions and the advice of the lecturers, the trainees brushed up their action plans, and shared them with the other trainees before returning to their own countries. In this way, the trainees were able to acquire knowledge of general purpose problem solving methods and learn about practical problem-solving skills through a solution creation process.

In addition to the lectures and practical training in the classroom, the participants also spent one day on a field trip to a Japan Radio Co., Ltd. factory in Nagano Prefecture, including a demonstration of portable LTE equipment for disaster countermeasures (Photo 4). In the morning before visiting the factory, they stopped by at Zenkō-ji temple in Nagano, which was introduced to them in detail by a local English-speaking volunteer guide (Photo 5). This tour enabled the trainees to learn about Japanese cutting-edge technology by seeing it for themselves, and to deepen their understanding of Japanese culture.

At the end of the training, we asked the trainees for their opinions and suggestions regarding the course content, text materials and site visits with the aim of making further improvements to courses run in the future. By analyzing and examining their feedback, we identified some points where the course can be improved, and we hope to introduce these improvements starting with next year's program.

Last but not least, we would like to express our gratitude to the APT and the Ministry of Internal Affairs of Japan for their help and cooperation in setting up this course, to the lecturers who created the lecture materials and taught the trainees, and to everyone who worked for such a long time to ensure the smooth running of the field trip.

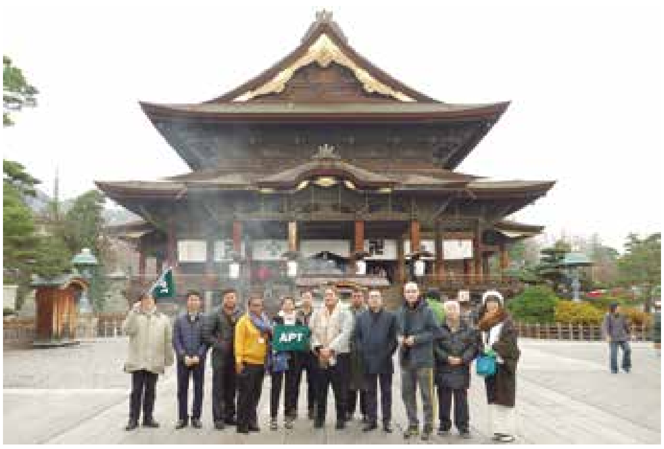
Table: Six model areas used in the network construction exercises

Area	Characteristics
A	Sparse villages in a mountainous region
B	Small towns strung out along the path of a river
C	A town, a village remote from the town, and a smaller town situated even further away from the village
D	Towns situated along a coastal road
E	Sparse islands situated in a coastal region
F	Sparse hamlets in a desert region

Photo 3: Network construction exercise

Photo 4: Field trip to JRC in Nagano

Photo 5: Visiting Zenkō-ji temple



50th Celebration of World Telecommunication and Information Society Day

17. May 2018 at KEIO PLAZA HOTEL

The ITU Association of Japan

Ceremony at Keio Plaza Hotel, Tokyo

Award winner and Honorable guests

MIC Minister's Award winner Dr. INOUE

Honorable Guest : Mr. SAKAI, State Minister, MIC

ITU-AJ Special Achievement Award winner Mr. PUN

Honorable Guest : Mr. TSUKADA, Deputy Assistant Minister, MOFA

Anniversary Keynote Presentation : Dr. TOKUDA, President, NICT

List of the Award Winners on 17 May 2018

MIC Minister's Award

Yuji INOUE (ITC)

ITU-AJ Special Achievement Award

Mahabir PUN (ENRD, Nepal Wireless)

ITU-AJ Accomplishment Awards

Shinji IMAGAWA (HIRAIWA)
Hideyuki IWATA (NTT)
Hiroyo OGAWA (NICT)
Kuniomi KANAI (NTT-East)
Eiji KITO (NEC)
Takatsugu KITO (KDDI)
Kozo SAKAE (NTT DOCOMO)
Ken-ichi SUZUKI (NTT)
Lan CHEN (NTT DOCOMO)
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Motohiro ABE (NTT DOCOMO)
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Toru UCHINO (NTT DOCOMO)
Nobuo OKABE (Sharp (Retired))
Masaaki OBARA (KDDI)
Ataru KOBAYASHI (NEC)
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Hiroki HARADA (NTT DOCOMO)
Mami MIYAZAKI (NTT-East)
Melody International Ltd.
Toru YAMADA (NEC)

Achievements of each winner are shown in the following URL.
https://www.ituaj.jp/wp-content/uploads/2014/05/180517wtisd_panf.pdf

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