Japan's Approach Toward Realization of Automated Driving

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Overview of JASIC

Roles of Japan Automobile Standards Internationalization Center (JASIC)

- JASIC was established under the Japan Automobile Transport Technology Association (JATA) in 1987 to support the government's activities of promoting the internationalization of vehicle regulations and certification systems, etc.
- It operates as a **public-private partnership and as a coordinator**.

Operational system

JATA

JASIC
Established in 1987; Headquarter (Tokyo)
3 Oversea offices (Geneva, Washington DC, Jakarta)

Activities:
- Conducts tests and researches to support the justification of the government's proposals
- Share information on tests and researches conducted by other countries that are necessary for the development of regulations
- Assists other Asian countries in joining the UN Activities

Supports MLIT's activities to harmonize regulations

Representatives of CPs attending WP.29 to develop international regulations

Consolidates and coordinates the government's and industry's opinions through holding meetings of various specialized committees

Collects technical information, etc.

Knowledge on laws and regulations, etc.

Knowledge on the current status of automotive technologies

Ministry of Land, Infrastructure, Transport and Tourism (MLIT)

JAMA

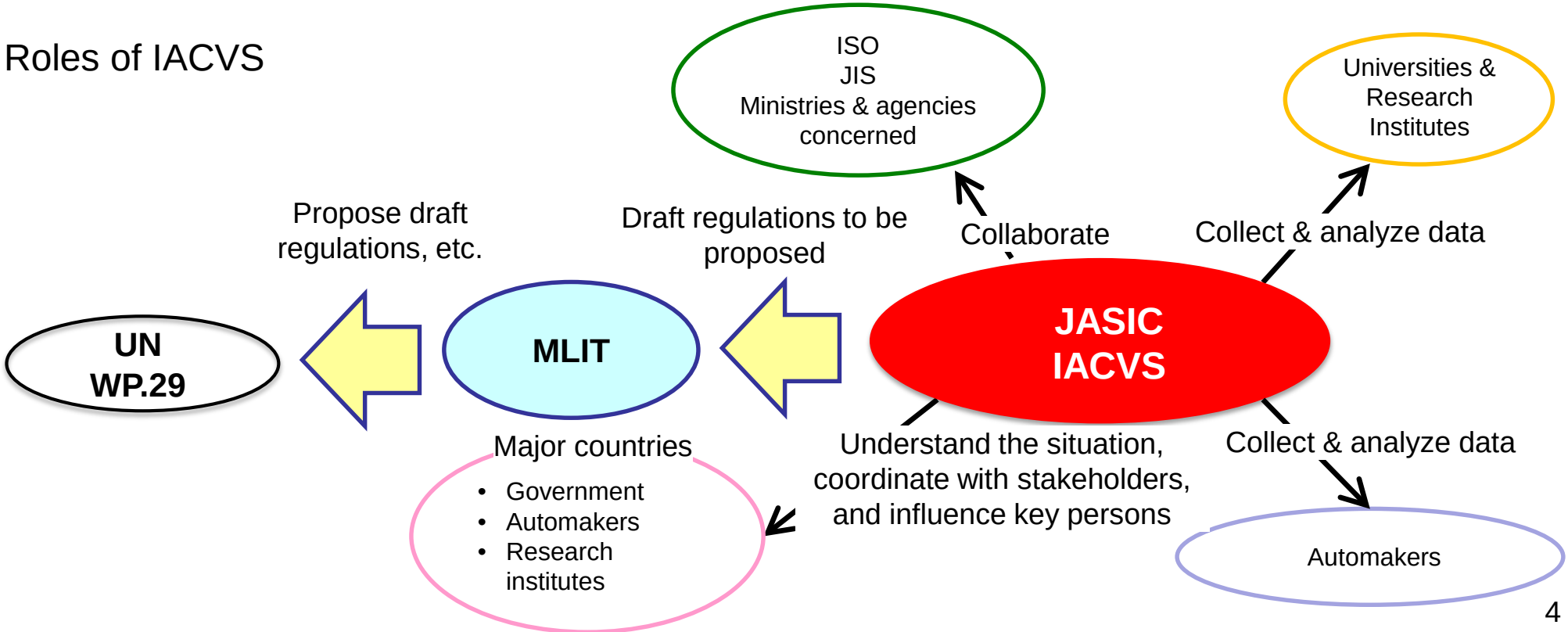
Automotive industry, etc.

JAPIA

Institute for Automated and Connected Vehicle Standardization (IACVS)

- Established on May 24, 2016 as a public-private partnership organization so that all sectors in Japan can jointly address the issues related to the international regulations and standards for automated and connected driving
- In addition to formulating overall strategies for developing international regulations for automated and connected driving, the IACVS supervise the following activities:
  (1) Examine how to deal with discussions at the UN World Forum for Harmonization of Vehicle Regulations (WP.29) on automated and connected driving;
  (2) Conducts basic researches and studies to address the issues mentioned in above (1);
  (3) Collaborates with influence the governments of the major countries, manufacturers, and research institutes;
  (4) Coordinate with standardization activities related to automated and connected driving (Ministry of Economy, Trade and Industry with ISO and JIS);
  (5) Organizes symposiums, etc. on trends inside and outside Japan on automated and connected driving.

Roles of IACVS



Japanese Government’s Approach Toward Realization of Automated Driving

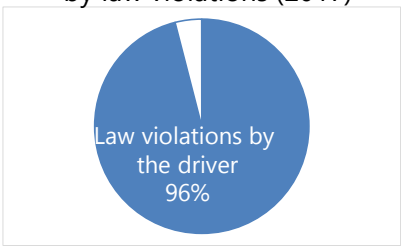
Effects expected from automated driving

Reduction of traffic accidents

Current issue

About 3,700 fatalities per year due to traffic accidents

Number of fatal accidents caused by law violations (2017)



Expected technologies

- Advanced emergency braking
- Safe speed control
- Lane keeping, etc.

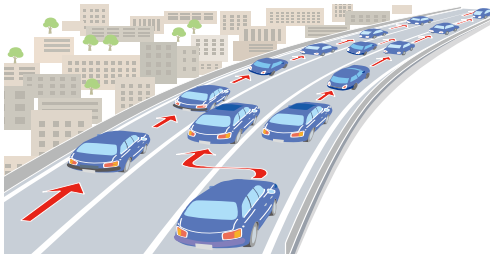
Effects

Prevent accidents resulting from driver error

Easing of traffic congestion

Current issue

Reducing traffic congestion



Expected technologies

- Maintaining proper inter-vehicle distance
- Proper speed control (prevention of sudden acceleration / deceleration), etc.

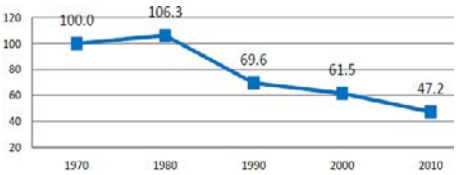
Effects

Prevent driving by driver that causes traffic congestion

Responding to aging society

Current issues

- Reduction in means of transportation for the elderly, particularly in rural areas
- Lack of truck drivers



Number of services by regular-route buses (1970 as 100)

Expected technologies

- Automated driving for a few kilometers between a public transportation station/stop to destinations
- Truck platooning on expressway, etc.

Effects

- Secure means of transportation for the elderly
- Reduce burden on driver

Definition of automated driving levels

System monitoring

Driver monitoring

Level 5

– Full automation
The system performs all driving tasks at all times.

*6

Level 4

- Full automation under predetermined conditions
The system performs all driving tasks under predetermined conditions.

Level 3

– Conditional automation
The system performs all driving tasks, but the driver needs to respond appropriately when the system requests intervention, etc.

*5

Level 2

– Automation under predetermined conditions (with enhanced functions)
E.g.: Mode with functions for automated driving on expressways
1. Automatically pass slow cars, if any
2. Automatically merge/branch out on expressways

*4

– Automation under predetermined conditions (combination of Level 1 functions)
E.g.: Stay in the lane and follow the car ahead (LKAS+ACC)

Level 1

– Driver assistance The system controls the vehicle either forward/backward or laterally.

E.g.: Stop automatically (AEBS)

*1

Follow the car ahead (ACC)

*2

Stay in the lane (LKAS)

*3

ACC: Adaptive Cruise Control, LKAS: Lane Keep Assist System

Created based on Public-Private ITS Initiative/Roadmaps 2017, etc.

*1 Subaru Corporation's website *2 Nissan Motor's website *3 Honda Motor's website
*4 Toyota Motor's website *5 Volvo Car Corp.'s website *6 CNET JAPAN's website

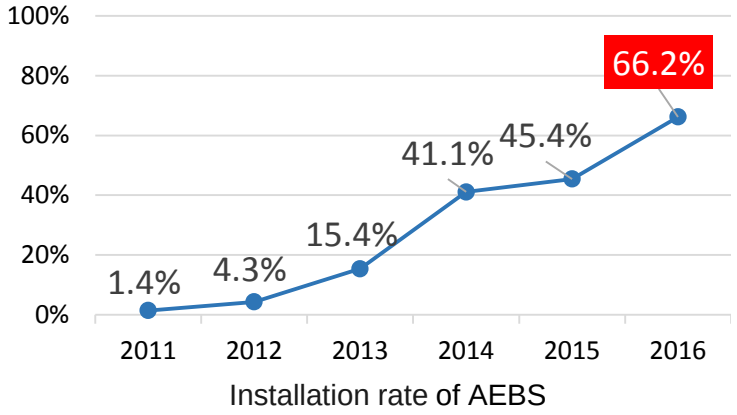
Development of automated driving technology in Japan

	Current (commercialized)	By 2020		Around 2025
	Level 1 Level 2	Level 2 Level 3 (Around 2020)	Level 4	Level 4
Automated and connected driving technologies expected for commercialization	• Automatic braking • Keep distance from the car ahead • Stay in the lane  (from Honda Motor's website)	• Automated steering on expressways - Automatic overtaking - Automatic merging/branching out  (from Toyota Motor's website)	• automated driving transfer services in limited areas  (from Toyota Motor's website)	• Full automation on expressways  (from Rinspeed's website)
Development status	Already installed in commercially available cars	Already installed in some commercially available cars	Conceptual phase by some companies	Clarification of issues involved

Promotion of “Safety Support Car”

Background

As part of the efforts for preventing elderly drivers from causing car accidents, in March 2017, MLIT and related ministries and agencies, decided to conduct measures for dissemination and raising awareness of “automobiles with safety-driving assist functions,” i.e., automobiles with built-in AEBS(Advanced Emergency Braking System) and acceleration control systems responding to drivers’ mistaken operation of acceleration pedals.



Installation rate of AEBS

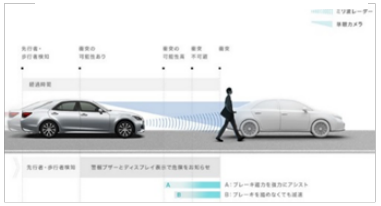
Objective

Raise the installation rate of AEBS for new vehicles up to 90% by 2020

WIDE

BASIC , BASIC+

AEBS


（トヨタ自動車HPより）

Acceleration control system

（日産自動車HPより）

Lane departure warning system

Adaptive front lighting system

（スズキHP、トヨタ自動車HPより）

サポカーS
Safety Support Car S

◆With the nickname “Safety Support Car S” (Suppo-car S), we are promoting spreading awareness in cooperation with the public and private sectors.

◆Consider formulating safety standards, including international regulations, for advanced safety technology that has reached the level where certain safety effects can be expected.

◆MLIT has been studying the creation of a system to confirm and publicize the performance of advanced safety technologies such as AEBS according to the requests of automobile manufacturers until the standards are formulated.

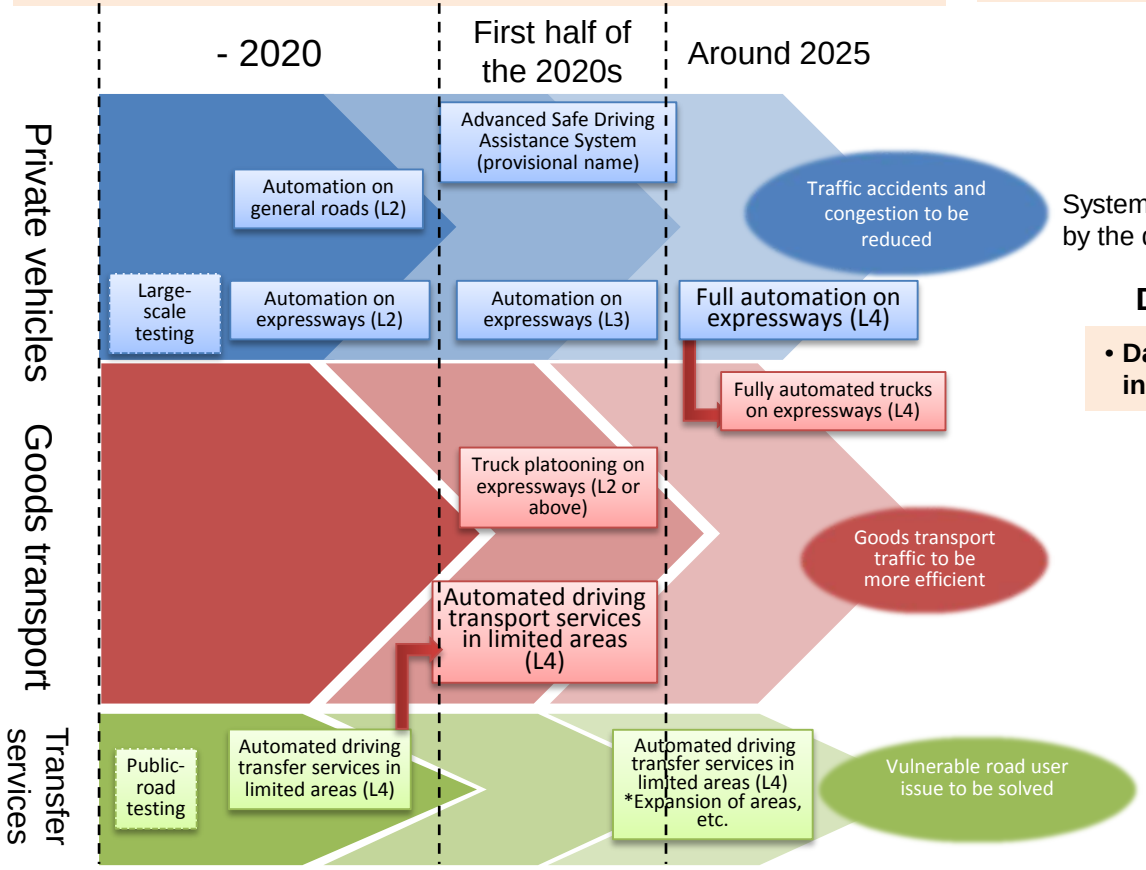
◆We will promote Safety Support Car S by expanding automobile assessment and introducing ASV discount of arbitrary car insurance

Public-Private ITS Initiative/Roadmaps 2017 (Overview)

- Public-Private ITS Initiative/Roadmaps, a national strategic plan relating to ITS and automated & connected driving, was revised based on the latest changes (4th revision since the 2014 version).
- Items covered in the 2016 version have progressed steadily. The 2017 version sets scenarios up to the year 2025 for realizing highly automated & connected driving and focuses on preparing the regulatory system for commercialization and on strengthening the technologies.

Scenarios for realizing automated & connected driving:

• Scenarios up to 2025 for realizing highly automated & connected driving were developed, for private vehicles, goods transport services and transfer services, respectively.



Outline of policies for preparing the whole government system:

• With a view to commercializing highly automated & connected vehicles in 2020, an outline of policies for preparing the whole regulatory system toward reviewing traffic-related regulations will be developed around FY2017.

System based on "driving by the driver"

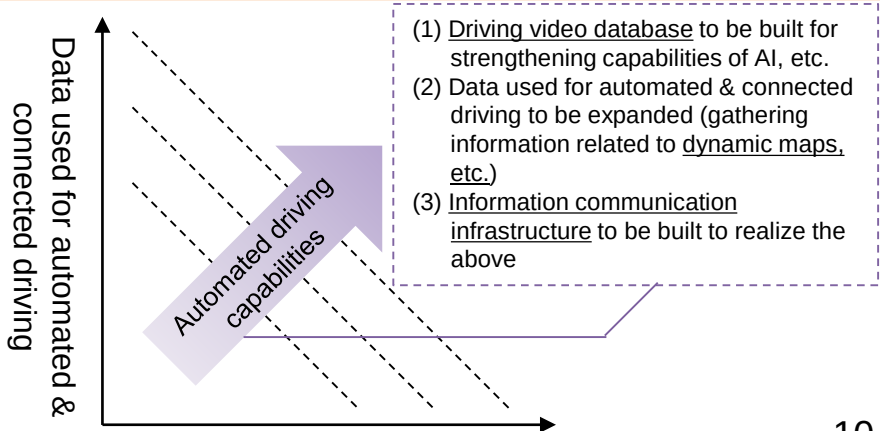
Items to be discussed by the whole government

Automated & connected vehicles to be specified; desirable safety standards; desirable traffic rules; responsibility issues such as insurance, etc.; others

System assuming "driving by the system" as well

Data strategy relating to automated & connected driving:

• Data strategy for strengthening artificial intelligence (AI) technologies indispensable for highly automated & connected driving is described.



Development of policies for preparing the regulatory system for realizing fully automated driving (Outline)

Material for the 5th meeting of the Council on Investments for the Future (Feb. 16, 2017)

Course of Action for the Near Future

Goal set in view of the expected arrival of the automated & connected driving society in 2025: to commercialize highly automated & connected vehicles (Level 3 or above), including fully automated vehicles, and include them in the services market by 2020. Actions should be planned working backward from this goal to prepare the regulatory system as necessary.

Targets to be newly set

Expected commercialization time targets to be set relating to commercialization of highly automated & connected vehicles (Level 3 or above) and their inclusion in the services market; e.g.

- ☐ Automated driving transfer services in limited areas (Level 4): by 2020
- ☐ Highly automated & connected driving on expressways (Level 3 or above): 2020 or beyond

Level	Vehicle driven by	Expected commercialization time and regulatory system
Level 2 or below	Driver	Feasible under the current regulatory system (Technologies already put into practice)
Highly automated & connected driving (Level 3 or above)	System	To be commercialized in 2020 or beyond Need to review traffic-related regulations

Issues in achieving the goal

To commercialize highly automated & connected vehicles (Level 3 or above) and include them in the services market, we need to review the current traffic-related regulations which are based on "driving by the driver".

- ☐ Various items need to be discussed and are correlated with one another, e.g.
  - ✓ Automated & connected vehicles to be specified and desirable safety standards
  - ✓ Desirable rules for the Road Traffic Act, etc.
  - ✓ Responsibilities to be clarified, including insurance
- ☐ Regulatory system to be designed with international trends and innovations taken into account

Need to be addressed by the whole government

Specific Actions

Policies for preparing the whole regulatory system for realizing fully automated driving, etc. (Outline) will be developed by around the end of FY2017.

- ✓ To be finalized by the IT Strategic Headquarters, with active cooperation from related ministries and agencies.
- ✓ Basic principles, discussion procedures, etc. for developing the Outline will be included in Public-Private ITS Initiative/Roadmaps 2017, which is scheduled to be formulated by this summer.

Cross-Ministerial Strategic Innovation Promotion Program (SIP)

- SIP is a program which aims to innovate both basic and practical research in a cross-ministerial/sectional framework.
- "Automated driving system" is selected to be promoted in this program.
- MLIT is contributing to this program by promoting measures to realize and deploy automated driving systems.

Members of the automated driving system promotion committee

- Academics
- Automobile manufacturers
- Parts manufacturers
- Related ministries
  - Cabinet Office
  - National Police Agency
  - Ministry of Internal Affairs and Communications
  - Ministry of Economy, Trade and Industry
  - MLIT

etc.

Expected schedule for the commercialization of automated driving technology

		Level	Specific Technology	Schedule
Development of automated diving technology				
	Private Use	SAE Level 2	Semi-Automated Pilot	Until 2020
		SAE Level 3	Automated Pilot	Around 2020
		SAE Level 4	Fully Automated Driving in Limited Areas	Around 2025
	Logistics Service	SAE Level 2 and over	Truck Platooning on Expressways	Beyond 2022
		SAE Level 4	Fully Automated Driving of Trucks on Expressways	Beyond 2025
	Passenger Transport Service	SAE Level 4	Driverless Transport Service in Limited Areas	Until 2020
Development of technology to support the driver				
	Private Use		Advanced Safety Driving Support System	First half of 2020 (The schedule may vary depending on discussions.)

Measure to enable public road testing of automated vehicles (Related to the Safety Regulations for Road Vehicles)

● To **realize public road testing relating to unmanned driving transfer services by FY2017**, a measure* was implemented in February 2017 **to allow the operation on public roads of those automated vehicles that do not require any driving operations, etc. by the driver in the vehicle** on condition **that alternative measures to ensure safety** are taken.

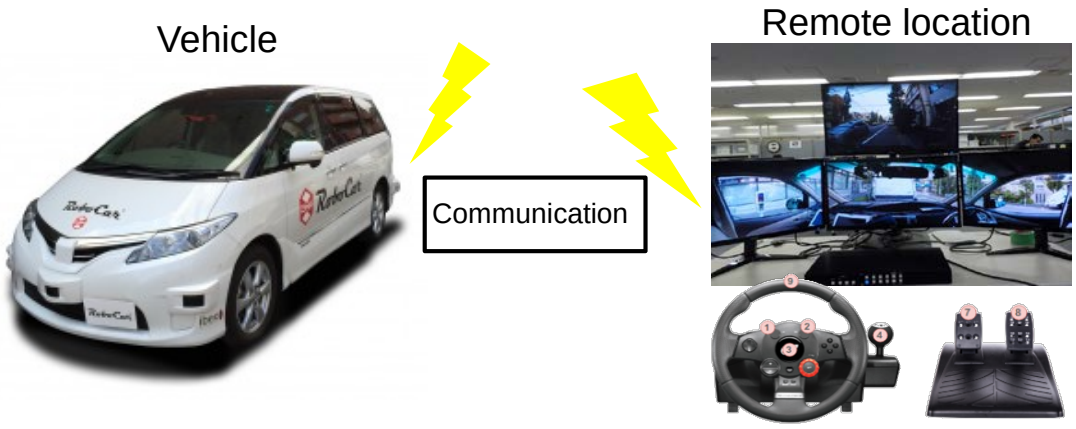
(* Relaxation of the Safety Regulations)

Background

- In remote-type automated driving systems, the driver is not present in the vehicle since the necessary monitoring, etc. of the vehicle is done by the driver stationed at a remote location.
- On the other hand, because the current Safety Regulations assume that the driver inside the vehicle undertakes the necessary driving operations, the compliance of remote-type automated driving systems with the Safety Regulations cannot be determined simply.

Overview of the Measure

In the case of remote-type automated driving systems as shown below, operations on public roads are allowed by, for example, taking the safety measures listed on the right.



Main alternative measures to ensure safety (examples):

- Installation of various operational devices (steering wheel, brake pedal, wiper, headlamp, etc.) at the remote location
- Installation of monitors, etc. at the remote location to ensure the fields of vision in front of and around the vehicle
- Limited testing environment (time, weather, etc.)
- Limited vehicle speed (with the effect of communication delays taken into account)
- Limited travel routes
- Installation of an emergency stop switch
- Safety personnel on board

Public Road Testing of Automated Driving in Japan

Public road testing of automated driving in Japan

As of Jan. 22, 2018

Automated driving mobility services at roadside rest areas (called Roadside Stations; *Michi-no-Eki* in Japanese), etc. (MLIT)

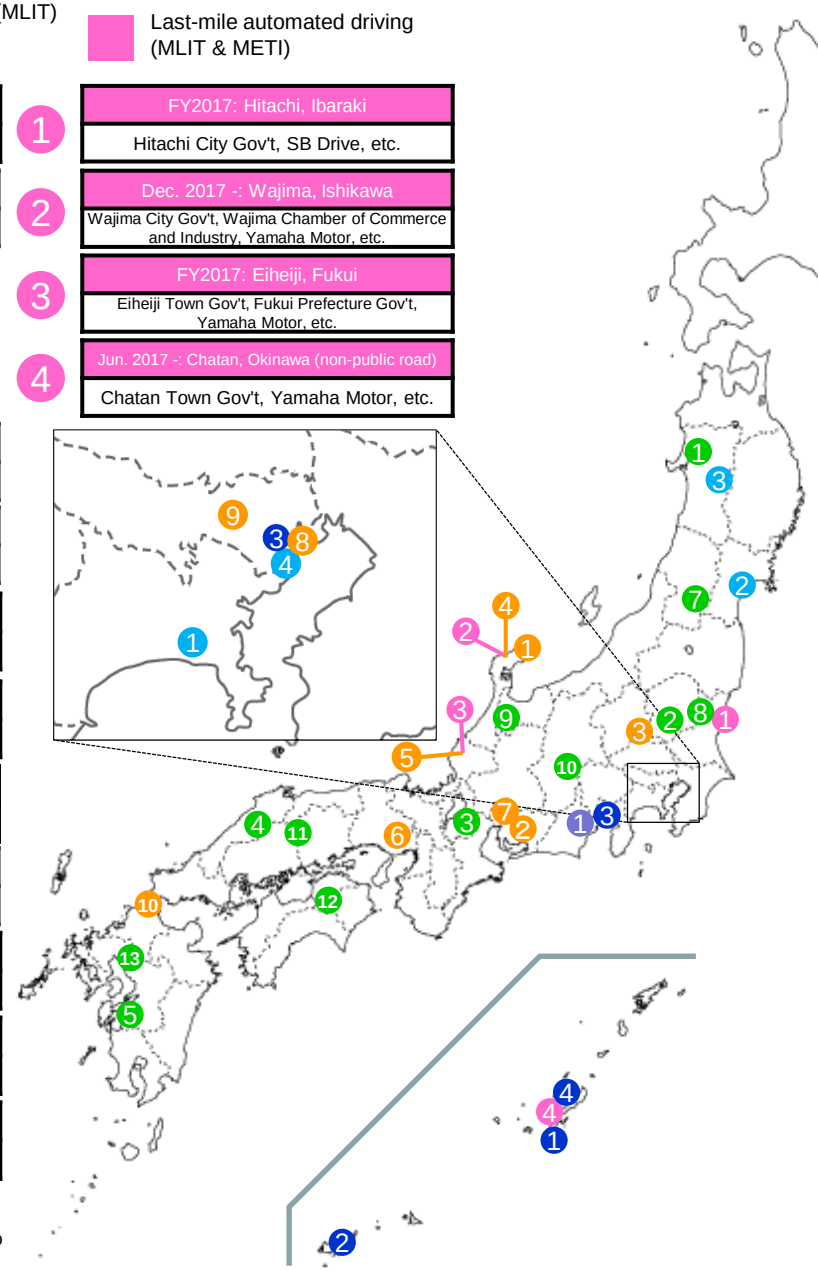
Verification tests conducted sequentially from Sep. 2017

1. Dec. 2017: Kamikoani, Akita — Roadside Station “Kamikoani”
2. Sep. 2017: Tochigi, Tochigi — Roadside Station “Nishikata”
3. Nov. 2017: Higashiomi, Shiga — Roadside Station "Okueigenji Keiryu no sato"
4. Nov. 2017: Iinan, Shimane — Roadside Station ”Akagi Kogen”
5. Sep. - Oct. 2017: Ashikita, Kumamoto — Roadside Station “Ashikita Dekopon”
6. Dec. 2017: Taiki, Hokkaido — Roadside Station “Cosmall Taiki”
7. Takahata, Yamagata — Roadside Station “Takahata”
8. Nov. 2017: Hitachiota, Ibaraki — Roadside Station "Hitachiota"
9. Nov. 2017: Nanto, Toyama — Roadside Station “Taira"
10. Ina, Nagano — Roadside Station "Minami Alps Murahase"
11. Niimi, Okayama — Roadside Station "Koigakubo"
12. Dec. 2017: Miyoshi, Tokushima — Roadside Station "Nishi-iya / Kazurabashi Yumebutai"
13. Miyama, Fukuoka — Yamakawa Branch of Miyama City Hall

* In addition to the above, 5 locations were selected for conducting feasibility studies to improve the business models.

Last-mile automated driving (MLIT & METI)

1. FY2017: Hitachi, Ibaraki — Hitachi City Gov't, SB Drive, etc.
2. Dec. 2017 -: Wajima, Ishikawa — Wajima City Gov't, Wajima Chamber of Commerce and Industry, Yamaha Motor, etc.
3. FY2017: Eiheiji, Fukui — Eiheiji Town Gov't, Fukui Prefecture Gov't, Yamaha Motor, etc.
4. Jun. 2017 -: Chatan, Okinawa (non-public road) — Chatan Town Gov't, Yamaha Motor, etc.



SIP Project (Cabinet Office)

1. Mar. 2017: Nanjo, Okinawa — Nanjo City Gov't, SB Drive, Advanced Smart Mobility
2. Jun. - Jul. 2017: Ishigaki, Okinawa — Ishigaki City Gov't, SB Drive, Advanced Smart Mobility
3. Oct. 2017 - Mar. 2019: Shin-Tomei Expressway and other roads exclusively for motor vehicles, general roads around the Tokyo waterfront area, etc. — Japanese and foreign automakers, auto parts makers, universities, etc.
4. Oct. 2017 - Dec. 2017: Ginowan & Kitanakagusuku, Okinawa — Ginowan City Gov't, Kitanakagusuku Village Gov't, SB Drive, Advanced Smart Mobility

National Strategic Special Zones Project (Cabinet Office)

1. Feb. - Mar. 2016: Fujisawa, Kanagawa — Fujisawa City Gov't, Robot Taxi
2. Mar. 2016: Sendai, Miyagi — Sendai City Gov't, Tohoku University, Robot Taxi
3. Nov. 2016: Semboku, Akita — Semboku City Gov't, DeNA
4. Term to be determined: Around Haneda Airport — Tokyo Metropolitan Gov't

Projects of local governments, private companies, or universities

* Main verification tests are listed.

1. Feb. 2015 -: Suzu, Ishikawa — Suzu City Gov't, Kanazawa University
2. Jun. 2016 -: 15 cities/towns in Aichi Prefecture — Aichi Prefecture Gov't, Aisan Technology, etc.
3. Oct. 2016 - Mar. 2021: Kiryu, Gunma — Kiryu City Gov't, Gunma University
4. Nov. 2016: Wajima, Ishikawa — Wajima City Gov't, Wajima Chamber of Commerce and Industry
5. Oct. 2017 – Mar. 2019: Eiheiji, Fukui — Fukui Prefecture Gov't, Eiheiji Town Gov't, Panasonic
6. Nov. – Dec. 2017: Kita, Kobe — Kobe City Gov't, Kobe Minato Kanko Bus, Gunma University, etc.
7. Dec. 2017 – Feb. 2018: Kota, Kasugai and Nagoya, Aichi — Aichi Prefecture Gov't, Aisan Technology, etc.
8. Dec. 2017: Koto, Tokyo — ZMP
9. Jan. 2018: Suginami, Tokyo — Suginami City Gov't, Aisan Technology, University of Tokyo, etc.
10. 2018 (scheduled): Kitakyushu, Fukuoka — Kitakyushu City Gov't, SB Drive

Truck platooning (MLIT & METI)

1. Jan. 2018: Shin-Tomei Expressway — National gov't, Toyota Tsusho, Japanese truck manufacturers, etc.

* Created by MLIT based on documents of Cabinet Secretariat, etc.

Last-mile automated driving (Testing)

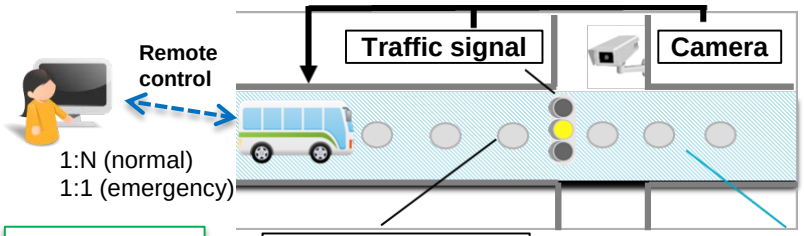
- MLIT and METI are promoting the development of vehicle technologies to realize **last-mile automated vehicle mobility services in FY2020.**
- MLIT verifies the **safety of vehicle technologies through testing under various conditions**.
- Testing is planned **jointly by local government, the private sector and universities**.

Compact cart model

Compact cart

- Open structure for easy access based on golf carts
- A multiple-passenger version will be available

Compact bus model



Compact bus image

- Automated bus travels on public roads where magnetic markers are embedded.
- A camera is installed to obtain traffic signal information.

(1)Town area model: Wajima, Ishikawa

(2) Rural area model: Eiheiji, Fukui

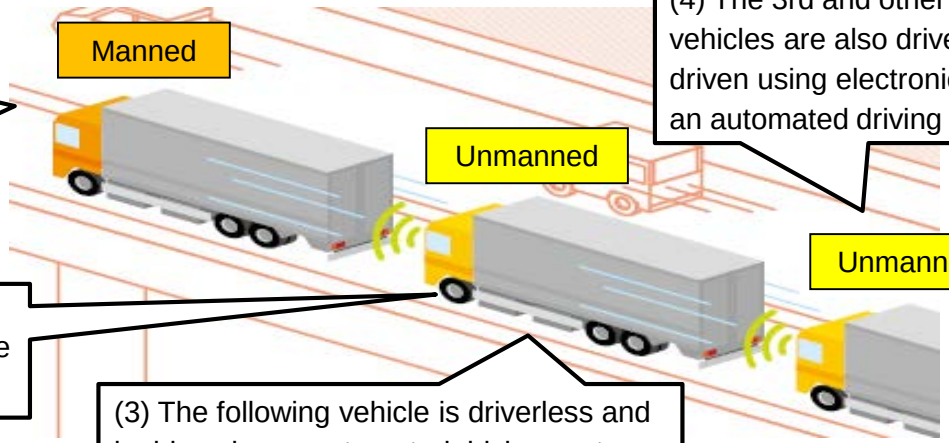
(3) Tourist site model: Chatan, Okinawa

(4) Community bus (BRT): Hitachi, Ibaraki

Improvement of distribution productivity — Approach toward realizing truck platooning

To **realize truck platooning in which following vehicles are unmanned on expressways in FY2020, the requirements and framework necessary to establish and maintain such truck platooning as a business** will be **studied in collaboration with vehicle manufacturers, goods transport service providers, etc.**, while **encouraging vehicle manufacturers, etc. to develop vehicle technologies**.

Image of truck platooning in the future



(1) The lead vehicle is controlled by the driver seated in the vehicle.

(2) A platoon is formed by coupling the lead vehicle and the following vehicle electronically.

(3) The following vehicle is driverless and is driven by an automated driving system.

(4) The 3rd and other following vehicles are also driverless and driven using electronic coupling and an automated driving system.

Vehicle image

(courtesy of Hino Motors)

25-ton heavy-duty cargo truck

Schedule

FY2017:	Verification testing with drivers in the following vehicles
FY2018 - FY2019:	Verification testing of the truck platooning system with no driver in the following vehicles (starting with drivers present in the following vehicles)
FY2020:	Realization of truck platooning with no driver in the following vehicles on Shin-Tomei Expressway
FY2022 & beyond:	Commercialization of truck platooning with no driver in the following vehicles on expressways (Tokyo - Osaka)

Realization of truck platooning with no driver in the following vehicles, which is expected to solve the shortage of drivers, save manpower, improve fuel economy, etc.

Development of Regulations for Automated Vehicles at the UN

World Forum for the Harmonization of Vehicle Regulations (WP29)

- The World Forum for Harmonization of Vehicle Regulations (WP.29)
⇒ Global Forum to discuss the international harmonization of vehicle regulations and the mutual recognition of vehicle certification
- 1958 Agreement
⇒ Harmonization of vehicle regulations + Mutual recognition of vehicle certification
- 1998 Agreement
⇒ Only the harmonization of vehicle regulations
*Japan is joining both agreements and is playing an active role in the work of harmonizing regulations and the mutual recognition of certification.

United Nations

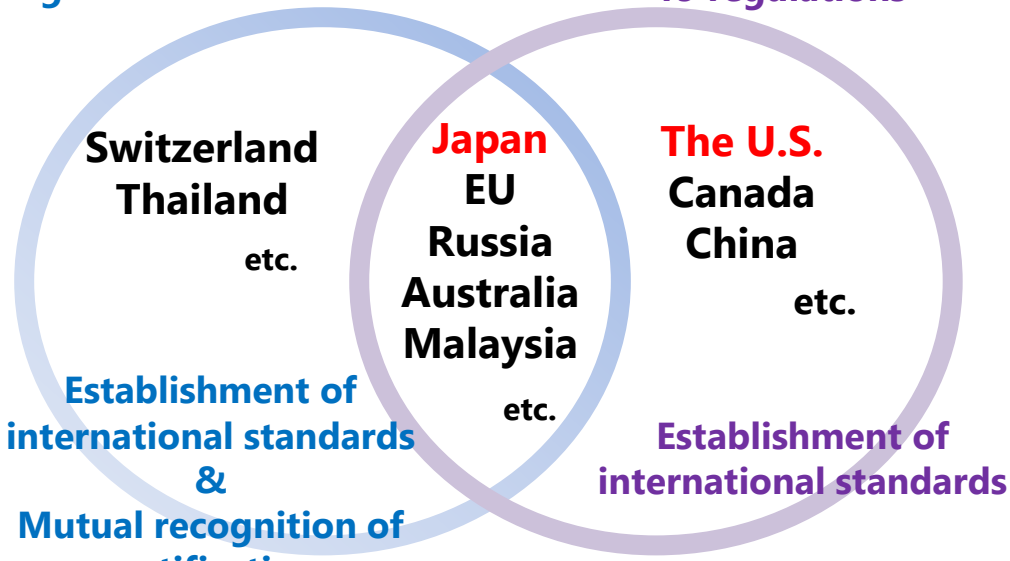
The U.N. Economic Commission for Europe

World Forum for Harmonization of Vehicle Regulations

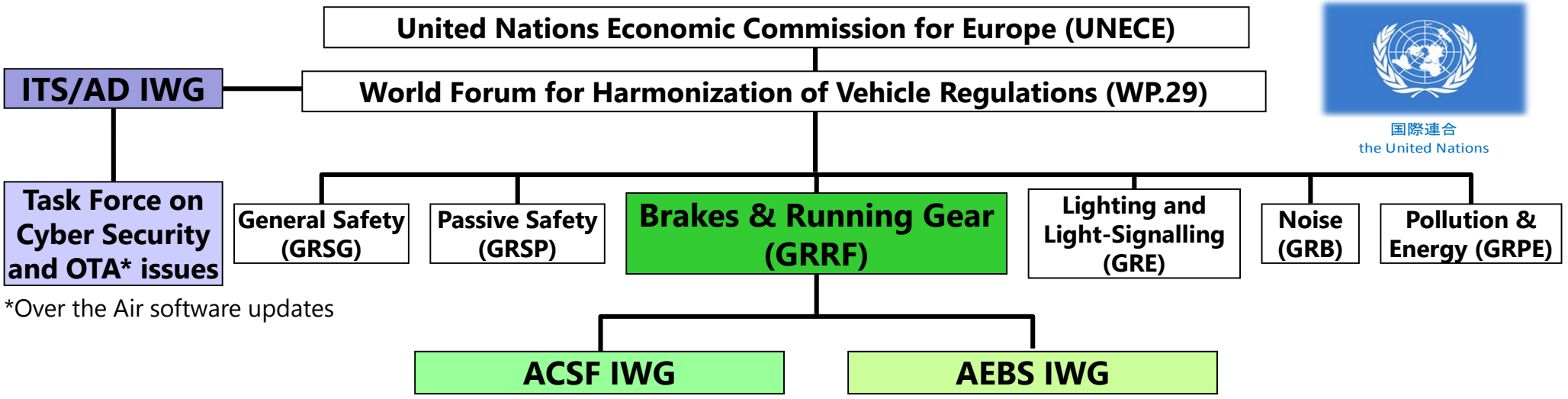
- General Safety Provisions (GRSG)
- Passive Safety (GRSP)
- Brakes and Running Gear (GRRF)
- Pollution and Energy (GRPE)
- Noise (GRB)
- Lighting and Light-signalling (GRE)

1958 Agreement
54 countries and regions
144 regulations

1998 Agreement
36 countries and regions
19 regulations



Discussions at the UN on technical regulations for automated vehicles



*Over the Air software updates

Working Party/Group	Post	Recent activities
Informal Working Group on Intelligent Transport Systems/Automated Driving	Chairpersons: **Japan**, UK	- Started discussions on safety regulations on automated driving systems of level 3 or higher.
Task Force on Cyber Security and OTA issues	Chairpersons: **Japan**, UK	- Agreed on a guideline on cyber security and data protection (November 2016); - Considering detailed recommendations.
Working Party on Brakes and Running Gear (GRRF)	Chairperson: UK Vice-chairperson: **Japan**	Finalized various draft regulations related to automated driving systems, such as Advanced Emergency Braking Systems (AEBS);
Informal Working Group on Automatically Commanded Steering Function	Chairpersons: **Japan**, Germany	- Established the regulation on the automatically commanded steering function that automatically keeps the vehicle in lane (March 2017); - Considering a draft regulation on systems that automatically change lanes and keep the vehicle in its lane (without the driver's hands on the wheel).
Informal Working Group on Advanced Emergency Braking Systems	Chairpersons: **Japan**, EC	Will develop a regulation on advanced emergency braking systems for passenger cars (set up in November 2017).

Status of development of technical regulations for automated steering at the UN

Current international regulation

Automated steering* at speeds of 10 km/h or above is prohibited. (In Japan, a measure to delay application of this prohibition provision has been implemented.)

*** Excluding the function that assists the driver's steering**

Status of amendment of international regulation

(Automated steering of Level 2 or below)

(1) Currently, the relevant forum at the UN is discussing:

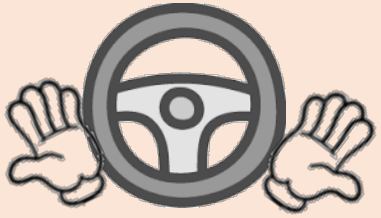
Automated steering at speeds of 10 km/h or above with the driver's hands on the steering wheel

- **Automated lane keeping: Established in March this year and scheduled to enter into force in October this year.**
- **Automated lane changing: Draft to be agreed upon in September this year. Scheduled to be established in March next year and to enter into force in October next year.**

Major requirements:

- The driver shall be able to turn the system ON/OFF.
- The system's operational status shall be indicated to the driver while it is ON.
- The driver shall be able to override the steering.
- In the event of the system's failure or malfunction, the driver shall be informed.
- When the driver's hands are off the steering wheel for 15 seconds or longer and it is detected, a warning shall be given, and if the driver does not respond, the system shall be stopped eventually.

(2) The forum at the UN is scheduled to discuss:



Automated steering at speeds of 10 km/h or above with the driver's hands off the steering wheel

- **Automated lane keeping**
- **Continuously automated driving**

Major requirements:

- In the event of the system's functional limit, the driver shall be warned 4 seconds in advance.
- The driver's attentiveness shall be monitored at all times; if the driver is dozing off, etc., he/she shall be warned.
- If the driver does not respond to the warning, the system shall stop the vehicle safely.
- Automatic emergency braking while the vehicle is traveling on expressways
- Storing the vehicle data before and after the system's functional limit

Discussion on vehicle hacking countermeasures at the UN (Guidelines Established)

- **The declaration of the G7 Transport Ministers at the meeting in Karuizawa, Nagano in September 2016 acknowledged the need to develop guidelines on cyber security relating to automated & connected vehicles** to prevent unauthorized access.
- **In November 2016, the informal working group on automated driving under WP.29 agreed** upon **guidelines proposed by Japan and Germany**. These guidelines were deliberated and **established at WP.29 in March 2017**.

Vehicle safety principles indicated in the guidelines

✓ Safety in the connection and communication of automated & connected vehicles to be ensured
- The vehicle's internal control networks shall not be influenced by external networks.
- Shall be equipped with a "safe mode" in case of system malfunction.

✓ When fraudulent manipulation by a cyber-attack is detected, the system shall warn the driver and control the vehicle safely.

- Vehicle manufacturers of Contracting Parties will develop vehicles based on the principles indicated in the guidelines.
- Discussion will continue; i.e., more specific requirements, etc. will be discussed by experts at the UN.

Examples
- As a threat analysis, external attack techniques and their danger levels, etc. will be identified and categorized.
- Based on the results of the threat analysis, necessary countermeasures will be specified.

Conclusions

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- Realization of automated driving is expected not only to reduce traffic accidents but also to address issues related to the falling birthrate and aging population, such as reductions in public transportation systems and the shortage of truck drivers in Japan.

- Targets set by the government of Japan to be achieved by 2020: Realization of automated driving (Level 3) on expressways and automated driving mobility services (Level 4) in limited areas.

- To achieve the government's targets, verification testing, including public road testing, of last-mile mobility services, truck platooning, etc. is now being implemented in various areas of Japan.

- Japan will continue to make efforts to develop international regulations for automated driving by leading the related discussions at UN WP.29.