MIC's Initiatives for Automated Driving Society

ITS Promotion Office
Telecommunications Bureau,
Ministry of Internal Affairs and Communications (MIC)
JAPAN

Evolution of Intelligent Transport Systems (ITS)

Advanced Driver Assistance

Information Provision Toll Collection

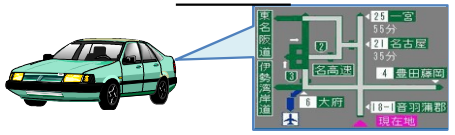
Highway radio

Optical beacon

Radio beacon

FM multiplex broadcasting

VICS*



Displays traffic congestion, road closures, etc.

*Vehicle Information and Communication System

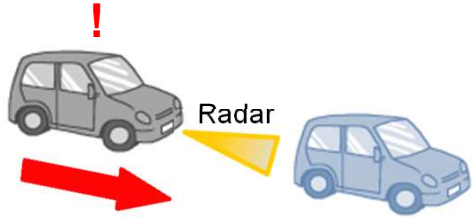
ETC

Electric toll collection

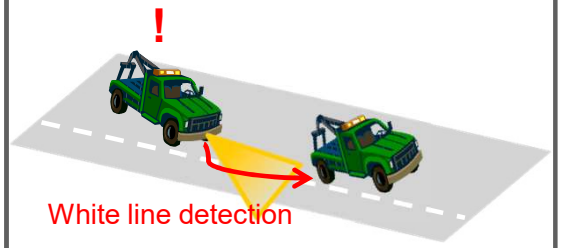
Autonomous

On-Board Sensors

The system uses on-board sensors such as cameras and radars to provide advanced driving assistance.



Autonomous Emergency Braking



Lane Departure Prevention System

Cooperative

V2X* Communication

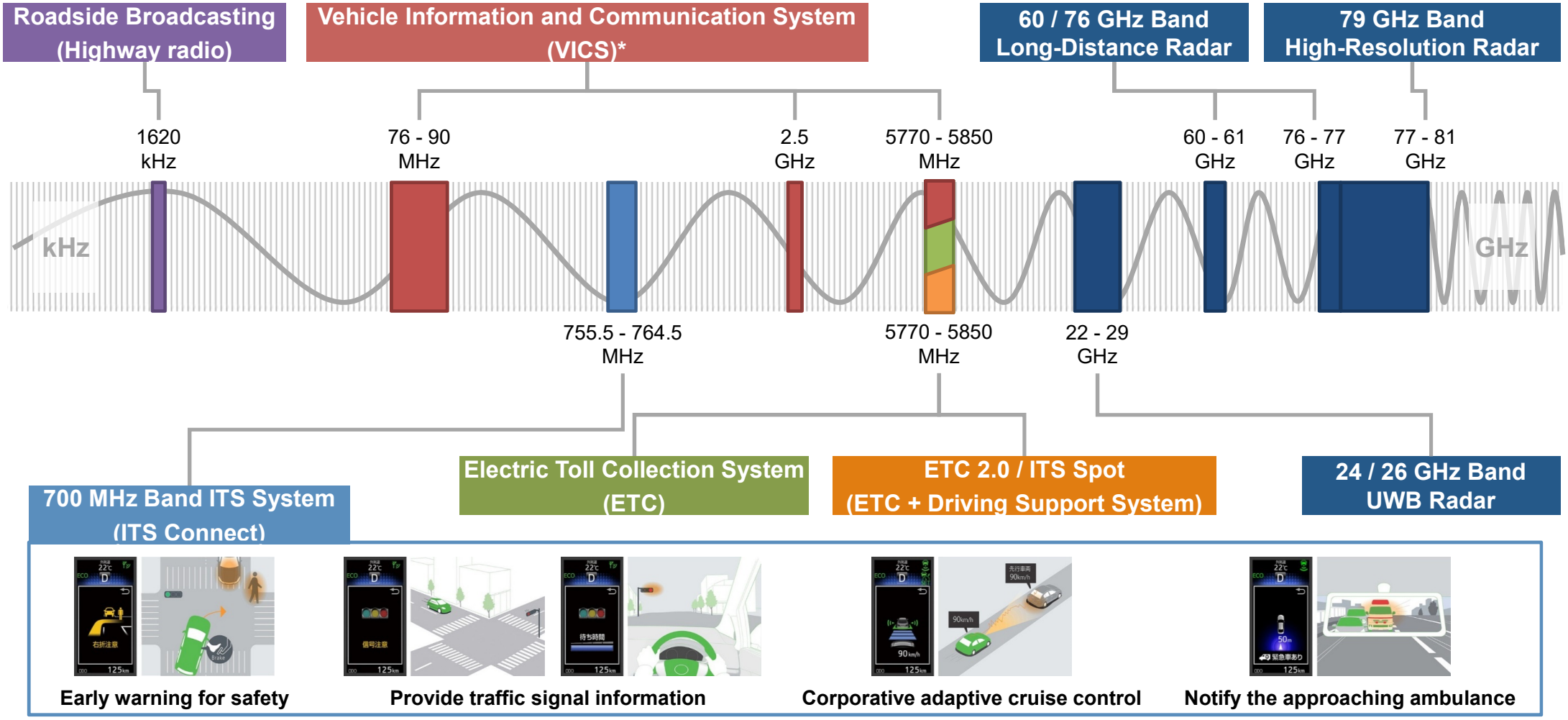
Advanced driving assistance by combination of V2X

*vehicle-to-everything

Connected Car

Automated Driving Systems

Frequency Allocation for ITS in Japan



*Vehicle Information and Communication System

ITS Connect

"ITS Connect" is the commercialized cooperative system (V2X) using 760 MHz frequency. Toyota released the models with ITS Connect from 2015.

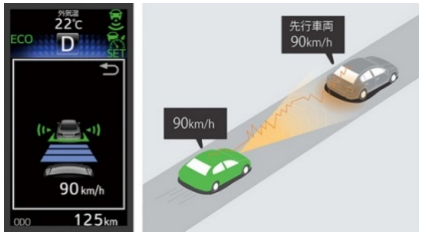
ITS Connect

- ITS Connect is V2X system connects vehicles and infrastructure using dedicated frequency band (760MHz). This system provides various information for driving-safety.
- Cars with this system alert and notify the driver through the speakers and the display on the dashboard.

[Vehicle to Vehicle]

Notify the approaching ambulance

When an ambulance approaches, this system informs driver the ambulance's position, direction, and distance.

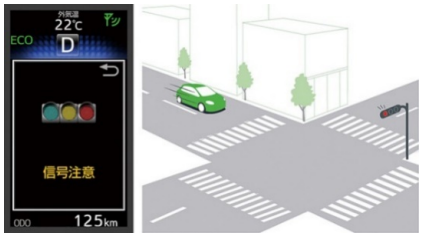


Corporative Adaptive Cruise Control

The system offers Cooperative Adaptive Cruise Control (C-ACC) using information provided by the preceding vehicle, which enables smoother ACC than radar-only.

[Vehicle to Infrastructure]

* Use information on laser vehicle detector installed at intersection



Alert red light

The system alerts the driver when the car is approaching the intersection without slowdown during red light.

Provide traffic signal information

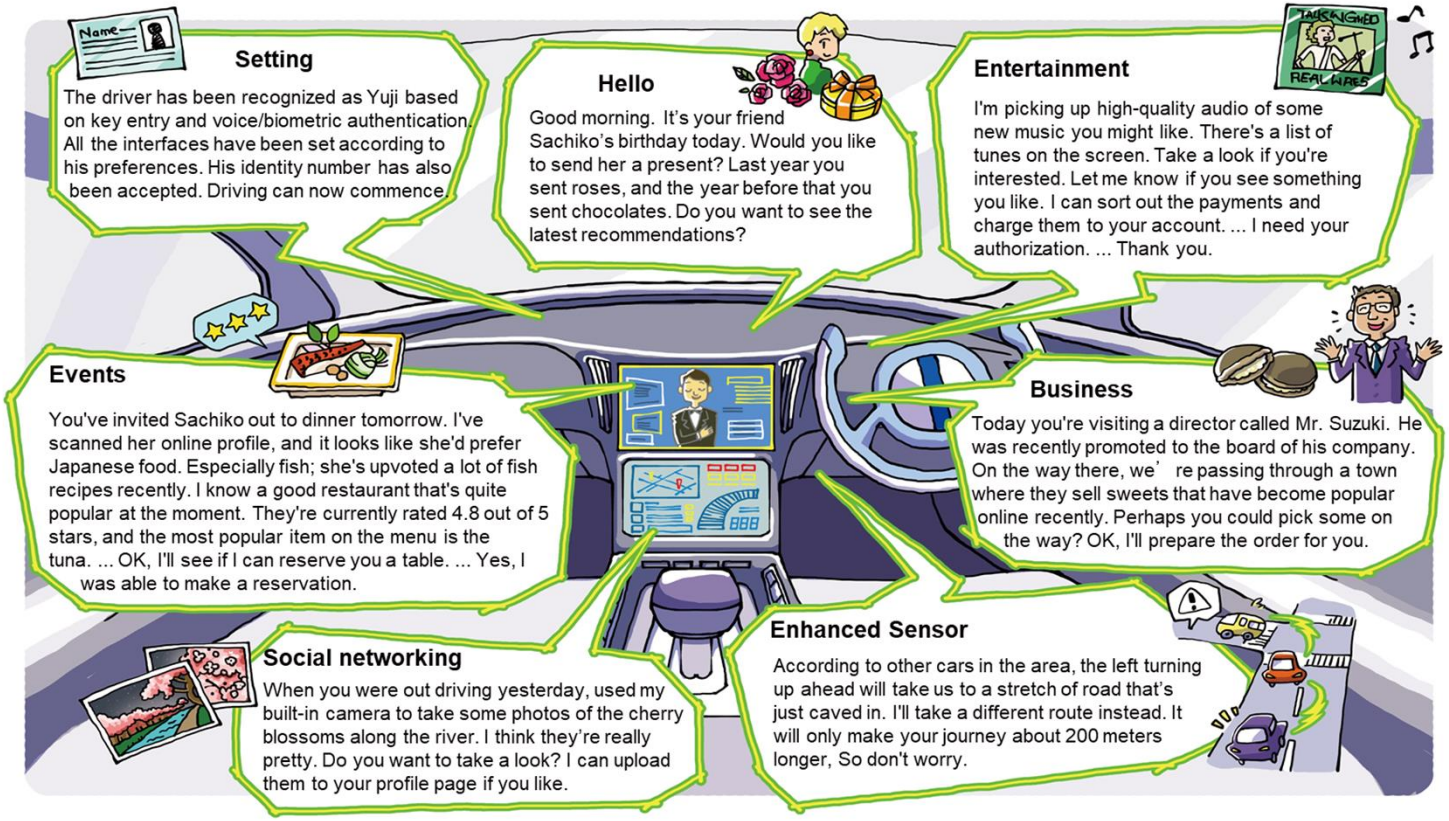
The system provides the traffic signal information on waiting time for green light.

Collision avoid assistance for Turns

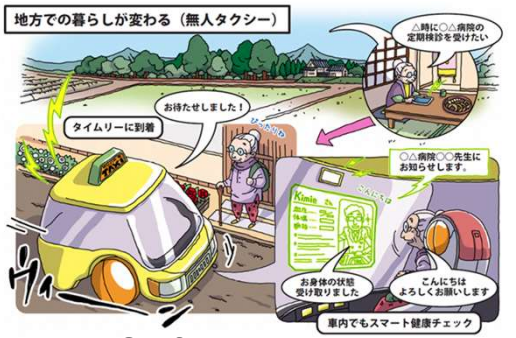
The system warns the driver by informing the existence of the approaching car on the opposite lane and the crossing pedestrian on the roads if the driver moves forward.

*ref.: website of TOYOTA MOTOR CORPORATION, etc.

Concept images: Connected Car



New mobility experience provided by Connected car



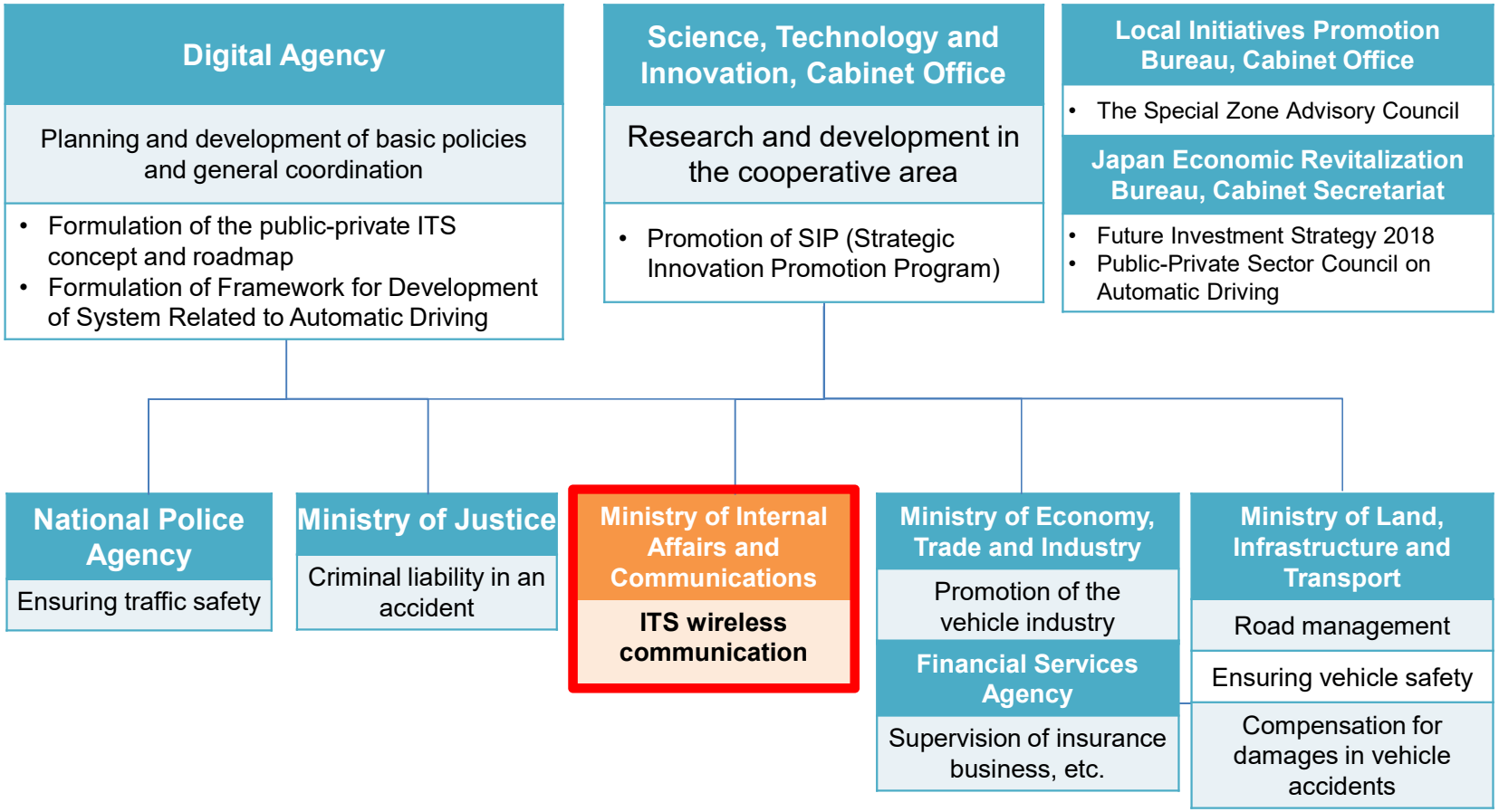
Self driving taxis

Shared vision of the vehicle in front

Ref.: Valeo S.A.'s XtraVue

Promotion ITS in Japanese government

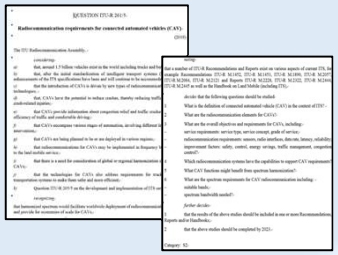
The ministries and agencies are working together to promote ITS to realize advanced self-driving.



MIC promotes wireless communications for ITS in coordination with related stakeholders

International Standardization

Contributing to ITU-R activities

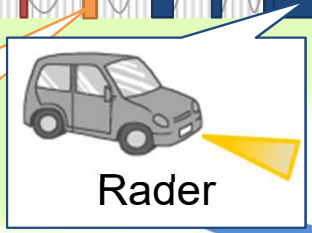


Requirements for CAV

Regulation

Frequency allocation

ETC



Rader

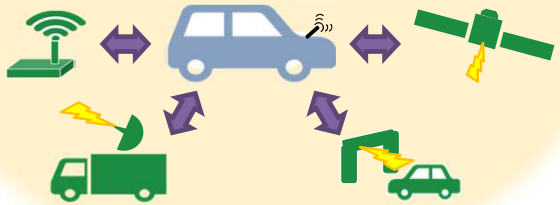
Overseas Cooperation

Promoting global use of ITS

Trials in foreign countries

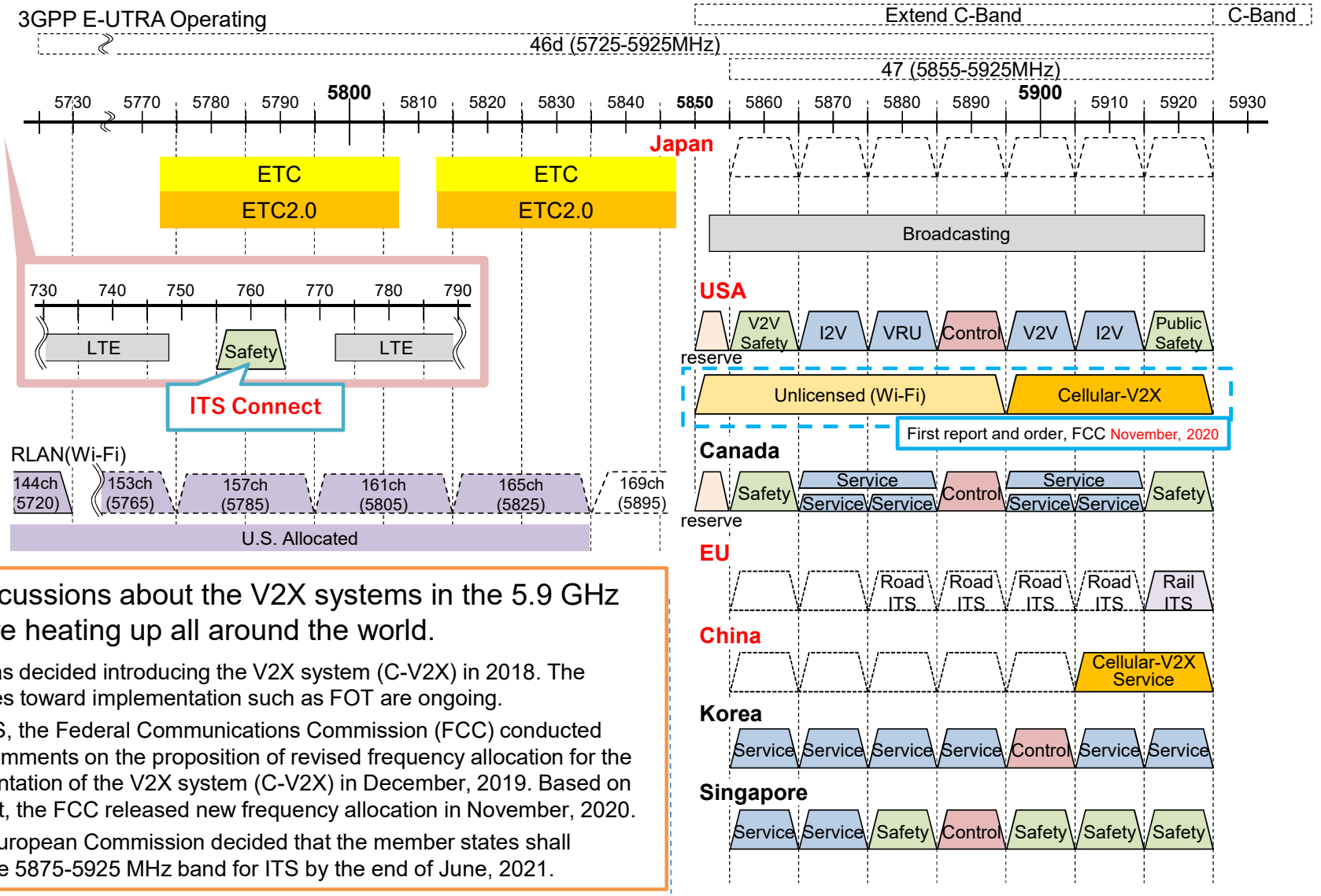
R&D and FOT

Technology development for advanced ITS



Technical studies for introduction V2X

The global trends of frequency allocation for V2X



The discussions about the V2X systems in the 5.9 GHz band are heating up all around the world.

- China has decided introducing the V2X system (C-V2X) in 2018. The processes toward implementation such as FOT are ongoing.
- In the US, the Federal Communications Commission (FCC) conducted public comments on the proposition of revised frequency allocation for the implementation of the V2X system (C-V2X) in December, 2019. Based on the result, the FCC released new frequency allocation in November, 2020.
- In EU, European Commission decided that the member states shall designate 5875-5925 MHz band for ITS by the end of June, 2021.

Chapter 3 Priority Initiatives Ⅲ Initiatives for a Self-Driving Society

Based on the progress and importance of automatic driving systems (including safe driving support), a study is being carried out, **which will finish by the end of FY 2021, into the technical conditions for frequency sharing with needed existing wireless systems, for example when introducing V2X communications, and with consideration for existing wireless systems on frequency bands being studied internationally (5.9 GHz band)**, in addition to the existing ITS frequency bands (760 MHz band, etc.).

In addition, based on the results of these studies, **a conclusion will be reached within FY 2022 regarding frequency allocation policy, such as frequency sharing and migration/reorganization when introducing V2X communications in the same frequency band, etc.**

Chapter 4 Reorganization Policy for Each Frequency Range Ⅶ 5.85～23.6GHz Band

5. Commercial Broadcasting Radio Stations and Fixed-Satellite Services［5.9GHz band］

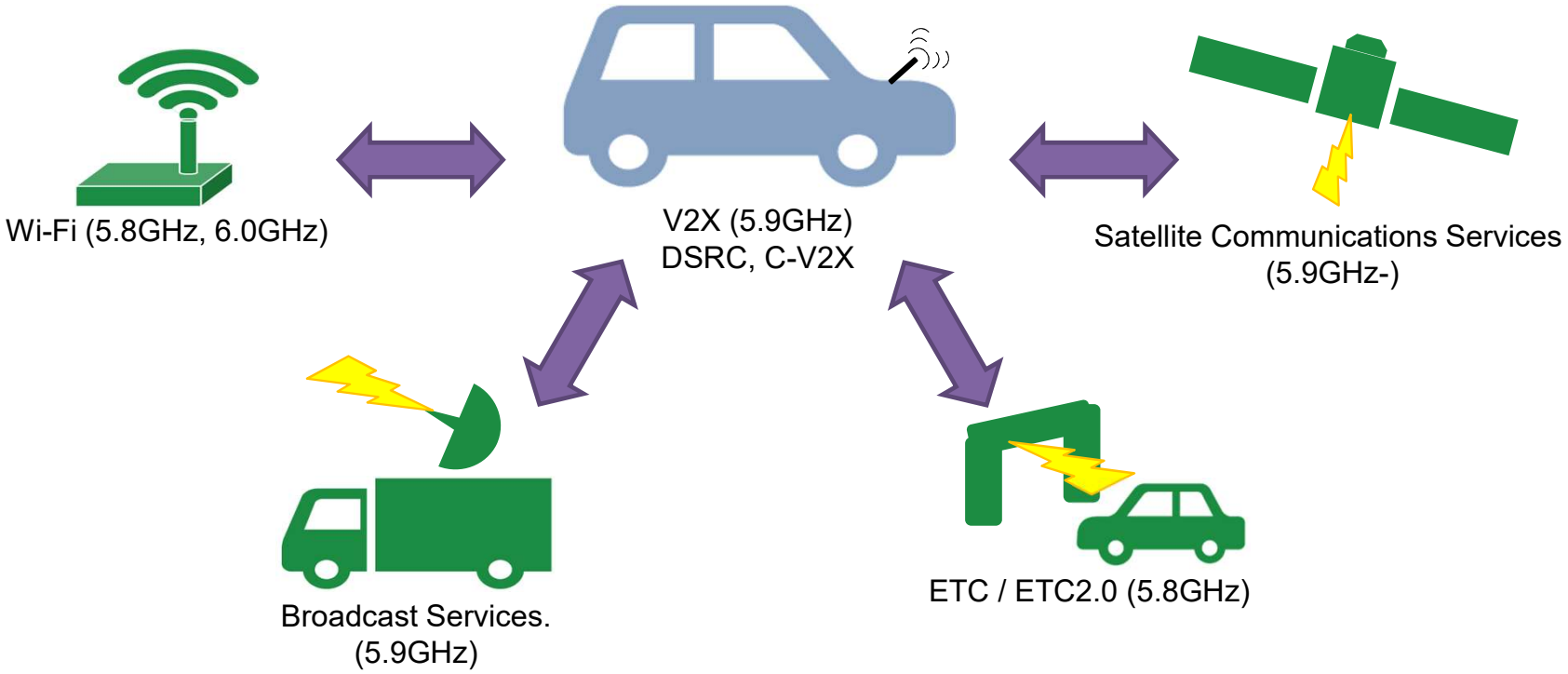
Based on the progress and importance of automatic driving systems (including safe driving support), a study is being carried out, which **will finish by the end of FY 2021, into the technical conditions for frequency sharing with needed existing wireless systems, for example when introducing V2X communications,** and with consideration for existing wireless systems on frequency bands being studied internationally (5.9 GHz band), in addition to the existing ITS frequency bands (760 MHz band, etc.,).

In addition, based on the results of these studies, **in cases where V2X communications are to be introduced on the same frequency band, there is a goal to allocate frequencies to V2X in FY 2023 after the necessary frequency bandwidth has been secured by migrating existing wireless systems, etc.**

Technical study of 5.9 GHz band for V2X (FY2021 - 2022)

MIC has been conducting technical study for the introduction of the V2X system in the 5.9 GHz band.

A technical study is conducted on the possibility of sharing with existing radio systems.



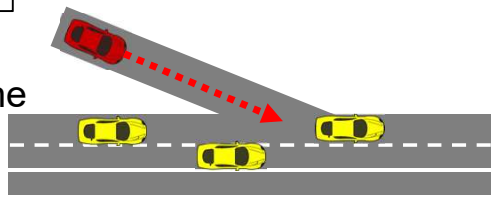
Technical study of V2X communication for self-driving (SIP: FY2020 - 2022)

- In order to define the technical requirements of V2X communication, MIC conducted a technical survey and developed 25 use cases in FY2020.
- MIC are making a draft roadmap of communication requirements, with consideration of the technical study and the future usage rate of self-driving vehicle.

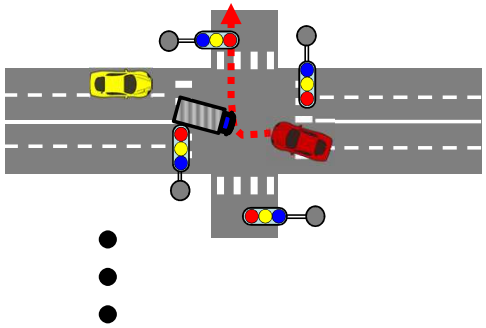
Example of Use Case

25 use cases

Joining the main lane on the highway

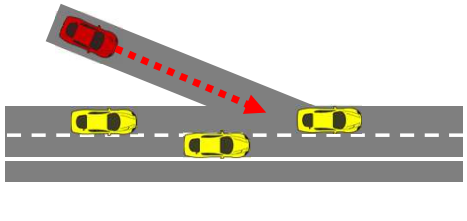


Turning right



→Define requirements for V2X in 700 MHz and 5.9 GHz band

Example of a roadmap



			20XX	20XX		20XX
The stage of spread of self-driving cars			Introduction	Growth		Maturity
			Speed adjustment	Providing the information of the gap on the main lane	Adjustment the gap between the cars on the main lane	Arbitration among self-driving cars
Technical Requirement	V2V / V2I		V2I	V2I		
	Message / Size		Estimated time of merging lanes	Estimated time of merging lanes		
			Average speed on the highway	Average speed on the highway		
Communication Requirement	Delay		XX ms			
	Amount of data		XX bps			
	Consecutive emission		X times / 100 ms			
	Packet arrival rate		XX %			
	Distance		XX m			
Communication Method	Short Range	ARIB STD-T75				
		ARIB STD-T109				
	Long Range	LTE				
		5G				
	Frequency		XX	XX		
	Band		YY	YY		

→Technically evaluate the possibility of introducing V2X in 5.9 GHz band

R&D of small-scale and mid-scale NW information usage (SIP: FY2020 - 2021)

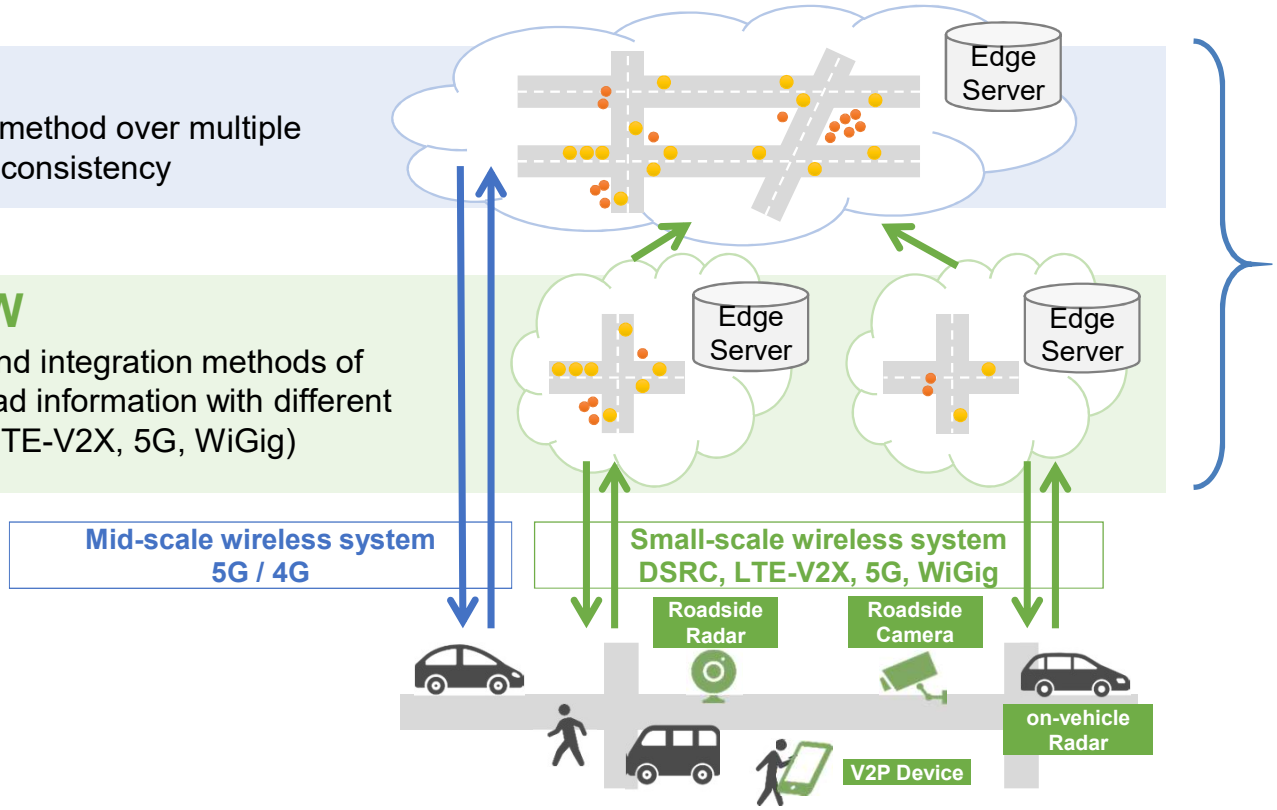
MIC has been carrying out a R&D project to develop an optimized method of collecting and providing the dynamic information about traffic environment from small/mid-scale areas.

Mid-scale NW

Optimization of distribution method over multiple Small-scale NWs with high consistency

Small-scale NW

Optimization of collection and integration methods of sensor data for dynamic road information with different wireless systems (DSRC, LTE-V2X, 5G, WiGig)

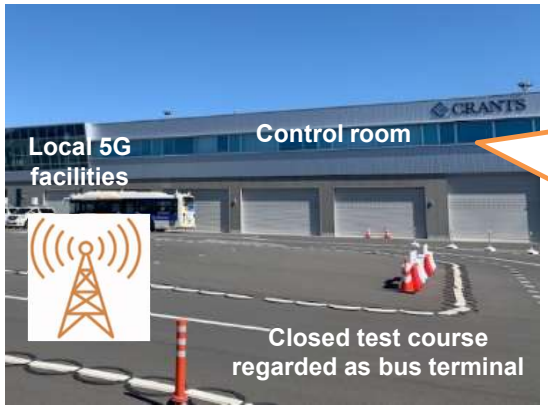


Compiling generated data from several sources, analyzing and optimizing the data depending on the situation, and delivering it to automated vehicles.

Local 5G demonstration experiment project: Establishing safety automated drive system (FY2021)

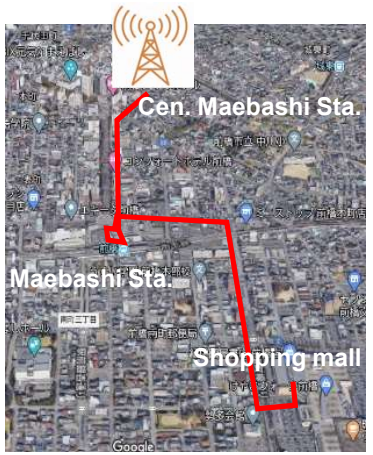
Location	Maebashi city, Gunma prefecture	**Project Consortium**	The Organization for the Promotion of ICT Community development and Common platform (Local NGO), Local government, Gunma University, NEC, NTT Docomo
Mission	Establishing remote monitoring and control system for automated driving to maintain transportation for local residents and reduce driver's workload		
Overview	Test : Controlling automated driving bus remotely, using images of cameras on-board and of the Road Side Units Evaluate : Conducting performance evaluation of "5G services on public-owned roads" and "Local 5G on private-owned roads"		

Automated driving bus



[Monitoring and control]
Taking advantages of Local 5G, such as hi-speed and large capacity, Operator monitors or controls automated driving bus with Full HD video

MNO's 5G facilities



[V2I communication]
Transmitting the information from the sensors on the roads to automated vehicles utilizing edge computing

Realizing automated driving bus transportation by cooperation between 5G services (nationwide) and Local 5G services (limited areas)

Overseas Cooperation: 700 MHz Band V2X in Asia-Pacific region (FY2020 -)

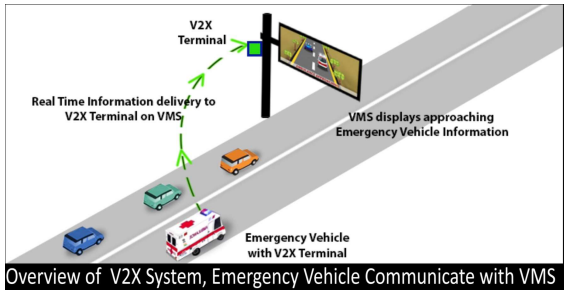
Providing ambulance-approaching-information to drivers (FOT in India in FY2021, FY2022)

OBJECTIVE

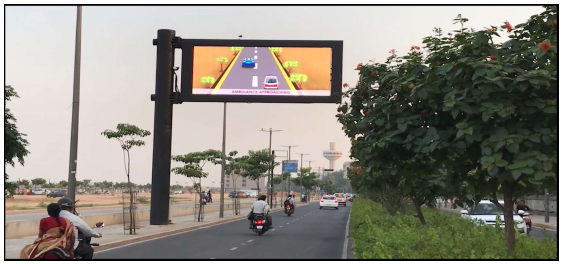
Solve the problem that ambulances cannot arrive on time due to traffic jam.

ABSTRACT

When an ambulance approaches the RSU (Road Side Unit), RSU displays ambulance-approaching-information for drivers. Therefore, drivers can give way to the ambulance beforehand, which makes ambulance reach the destination earlier.



Overview of V2X System for EV & VMS



Trial in Ahmedabad, Gujarat, INDIA

Driving safety support with RFID tag (FOT in Philippine in FY2021)

OBJECTIVE

Reduce a head-on collision, especially between motorcycles and cars at the intersection by supporting the recognition of non line of sight (NLOS).

ABSTRACT

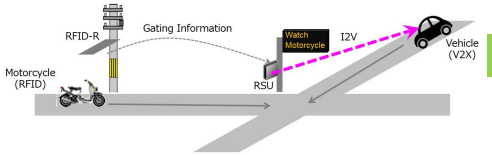
Using Passive RFID or Sensor

RSU collects motorcycles' positions and speeds from RFID or with sensor, and sends it to vehicles via I2V, or display it on RSU Monitor.

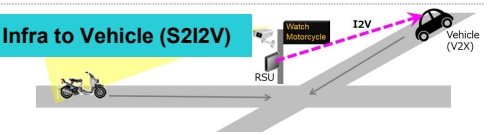
Using Active RFID

The vehicle near a motorcycle collects its positions and speeds, and sends the information to other vehicles via V2V.

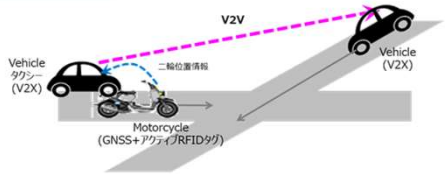
RFID reader to Infra to Vehicle (M2I2V)



Sensor to Infra to Vehicle (S2I2V)



RFID (active) to Infra to Vehicle (M2I2V)



MIC's contribution to ITU-R in ITS field

WRC-19 Agenda Item1.12

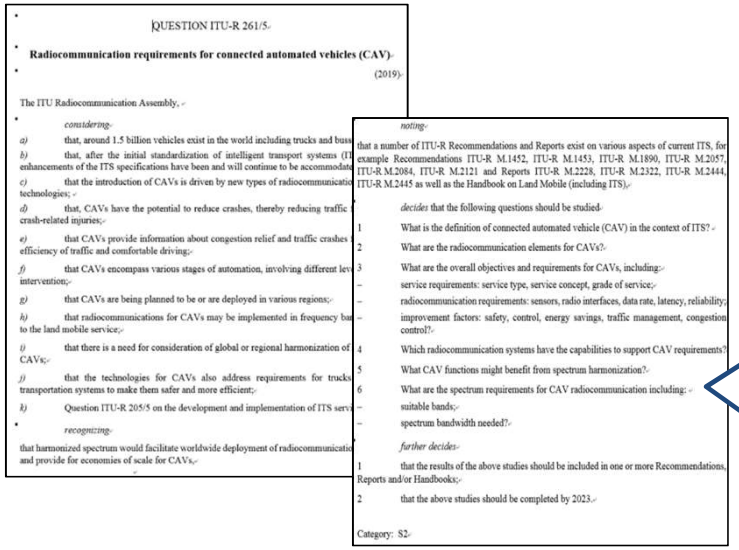
In ITU-R Study Group 5 (SG5: Terrestrial Services), for the implementation of evolving ITS under existing mobile-service allocations to the maximum extent possible, conducting technical studies and considering possible global or regional harmonized frequency bands

WRC-19 Result: Recommendation 208

Recommendation 208 which recommends that administrations consider using globally or regionally harmonized frequency bands when planning allocating frequency band to ITS was approved. As the harmonized frequency bands, ITU-R M.2121 which includes 760MHz and 5.8GHz allocated to ITS in Japan is specified.

Question 261

In WRC-19, Question 261 "Radiocommunication requirements for connected automated vehicles (CAV)" was also approved as a new question. In this question, conducting studies related to radiocommunication requirements for CAV and completing them by 2023.



QUESTION ITU-R 261/5

Radiocommunication requirements for connected automated vehicles (CAV)

(2019)

The ITU Radiocommunication Assembly,

considering

a) that, around 1.5 billion vehicles exist in the world including trucks and buses;

b) that, after the initial standardization of intelligent transport systems (ITS), enhancements of the ITS specifications have been and will continue to be accommodated;

c) that the introduction of CAVs is driven by new types of radiocommunication technologies;

d) that, CAVs have the potential to reduce crashes, thereby reducing traffic crash-related injuries;

e) that CAVs provide information about congestion relief and traffic crashes efficiency of traffic and comfortable driving;

f) that CAVs encompass various stages of automation, involving different levels intervention;

g) that CAVs are being planned to be or are deployed in various regions;

h) that radiocommunications for CAVs may be implemented in frequency bands to the land mobile service;

i) that there is a need for consideration of global or regional harmonization of CAVs;

j) that the technologies for CAVs also address requirements for trucks transportation systems to make them safer and more efficient;

k) Question ITU-R 205/5 on the development and implementation of ITS services

recognizing

that harmonized spectrum would facilitate worldwide deployment of radiocommunication and provide for economies of scale for CAVs,

noting

that a number of ITU-R Recommendations and Reports exist on various aspects of current ITS, for example Recommendations ITU-R M.1452, ITU-R M.1453, ITU-R M.1890, ITU-R M.2057, ITU-R M.2084, ITU-R M.2121 and Reports ITU-R M.2228, ITU-R M.2322, ITU-R M.2444, ITU-R M.2445 as well as the Handbook on Land Mobile (including ITS),

decides that the following questions should be studied

1 What is the definition of connected automated vehicle (CAV) in the context of ITS?

2 What are the radiocommunication elements for CAVs?

3 What are the overall objectives and requirements for CAVs, including:

– service requirements: service type, service concept, grade of service;

– radiocommunication requirements: sensors, radio interfaces, data rate, latency, reliability;

– improvement factors: safety, control, energy savings, traffic management, congestion control?

4 Which radiocommunication systems have the capabilities to support CAV requirements?

5 What CAV functions might benefit from spectrum harmonization?

6 What are the spectrum requirements for CAV radiocommunication including:

– suitable bands;

– spectrum bandwidth needed?

further decides

1 that the results of the above studies should be included in one or more Recommendations, Reports and/or Handbooks;

2 that the above studies should be completed by 2023.

Category: S2

ITU-R SG5 Question 261/5 :

Radiocommunication requirements for connected automated vehicles (CAV)

- Questions should be studied;
  - ✓ What is the definition of CAV in the context of ITS?
  - ✓ What are the radiocommunication elements for CAVs?
  - ✓ What are the overall objectives and requirements for CAVs, including service requirements and radiocommunication requirements?
  - ✓ Which radiocommunication systems have the capabilities to support CAV requirements?
  - ✓ What CAV functions might benefit spectrum harmonization?
  - ✓ What are the spectrum requirements for CAV radiocommunication including stable bands and spectrum bandwidth needed?
- . . . That the above studies should be completed by 2023.

ITS can help us to achieve these SDGs goals.

Goal 3:

Ensure healthy lives and promote well-being for all at all ages

Target 3.6:

By 2020, halve the number of global deaths and injuries from road traffic accidents

Goal 11:

Make cities and human settlements inclusive, safe, resilient and sustainable

Target 11.2:

By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons

Thank you for your attention