Study of Communication Technologies for Use by Automated Driving Systems

Introduction

During the process of consideration regarding driving environments, the road traffic information formats and communication requirements needed for automated driving are to be decided and standardized.

[Study Goal]

(1) Conduct detailed studies and analyses of use cases.

(2) Study and analyze debates regarding the expectations of companies and organizations, with a focus on 5 GHz band V2X, and debates within individual countries regarding its deployment.

Summary

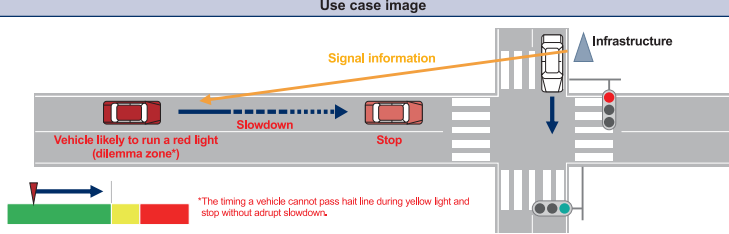### Current status of considerations (countries, regions, company, etc.)

We assessed and organized information regarding 5 GHz communications trends of several countries, regions, companies and industry organizations.

EU	European Commission selected ITS-G5 as main communication technology for C-ITS in 2018. However, this policy was rejected by the European Union Council in 2019.
U.S.	5.9GHz was assigned for DSRC, though Federal Communication Commission (FCC) announced a draft 5.9GHz Reallocation Proposal as a public comment in Dec 2019. Until now, 5.9 GHz allocation plan is not decided yet. (DSRC:75 MHz ⇨ Wi-Fi:45 MHz, C-V2X or DSRC:10 MHz, C-V2X:20 MHz)
China	China allocated 20 MHz of frequency to C-V2X In 2018. In line with "Made in China 2025", China aims to create a society of smart cars and automated driving using LTE-V2X and 5G.

Wireless communication systems use cases for automated driving systems formulated as a result of discussion in Cooperative Automated Driving Communications Method Deliberation Task Force

As a member of Secretariat for Cooperative Automated Driving Communications Method Deliberation Task Force, we summarized wireless communication systems use cases for automated driving systems and sorted out the requirements to realize them. Reviewing use cases studied overseas and referring use cases developed in Japan Automobile Manufacturers Association, Inc., 25 use cases were selected regarding definition of cooperative autonomous driving system discussed in the Task Force, which were summarized into the final draft.

b-1-1. Driving assistance using signal information (V2I)

Use Case	Driving assist using signal information (V2I)		
Target area	Local street	Target vehicle	Passenger vehicle, Commercial vehicle
Summary	The infrastructure provides vehicles heading into the intersection with information transmitted by traffic light such as signal color and signal cycle in order to assist the slowdown and stop of vehicle and avoid the dilemma.		
Referenced use cases	8-1 Notification by traffic light before tunnel 8-2 Intersection passage and stop with signal information, 8-3 Alert to the veliche likely to run a red light, 8-4 Alert to vehicle which crossed against the light, 8-5 Notification on an approaching vehicle likely to run a red light, 8-6 Slowdown and stop for the approaching high-priority vehicle		

Use case image

Signal information

Infrastructure

Vehicle likely to run a red light (dilemma zone*)
Slowdown
Stop

*The timing a vehicle cannot pass hait line during yellow light and stop without adrupt slowdown.

Requirements and other notes	Communi-cation	V2I	Data classification and content	Message	Signal color, signal cycle	Criteria	①Data acquisition undetectable by vehicle sensor	a) Instant response required	◯	①Information on the remaining second of traffic signal, which is undetectable by sensor, is required for a vehicle in dilemma zone to safely stop before the intersection.
	Connection	One-to-many		Sensor data	—			a) Instant response not required		②No probe data is provided.
	Vehicle Control	Speed adjustment, stop		Rich contents	—		②Provision of information owned by the vehicle			③There is no V2I negotiation as traffic signal unilaterally provides vehicles with signal information.
	Instancy	Required		Data amount	Small		③Necessity of negotiation via V2V or V2I communication			→ Adopted as SIP use case by ①