



ITS and V2X study on SIP-adus

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JASIC Vehicular Communication WG

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INDEX

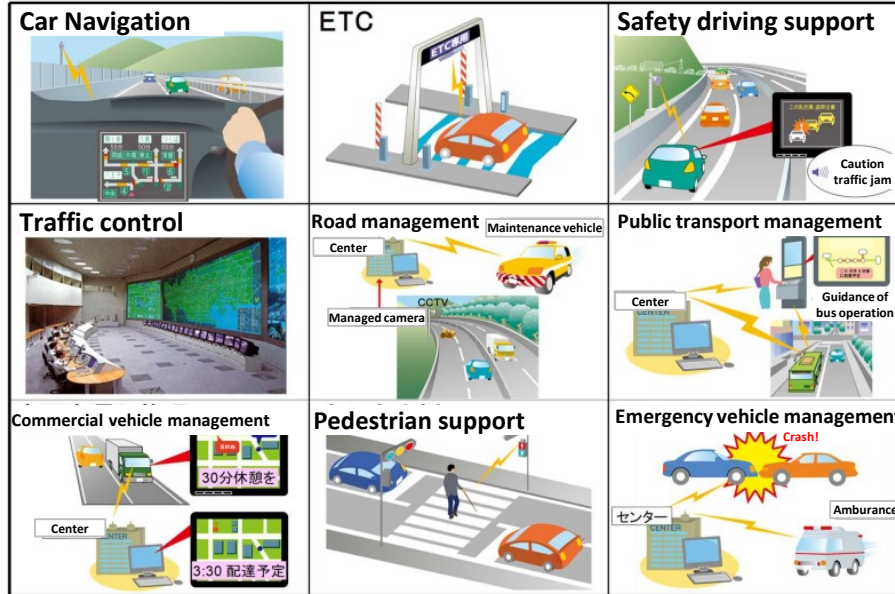
1. ITS development in Japan
2. ITS Roadmap and SIP-adus
3. SIP-adus activities
4. TF on V2X communication for CDA
 - Choosing Use cases
 - Extract Requirement
 - Technical examination
 - Making Roadmap
5. Summary

This presentation

- In this presentation we would like to suggest that...
 - Generally, There should be hard technical requirement for communication qualities for the usecases related to safety. So we cannot support to make a regulation far before to make a clear roadmap for these implimentation with a full agreement of stakeholders.
 - We believe that it is important to classify use cases carefully based on communication technology requirements based on future technology predictions, and to create a roadmap that considers the difficulty of realization.
 - It is our pleasure if you could refer our experience so far for making the upcoming plan.

ITS development in Japan

ITS (Intelligent Traffic Information System) system architecture(1999.11)

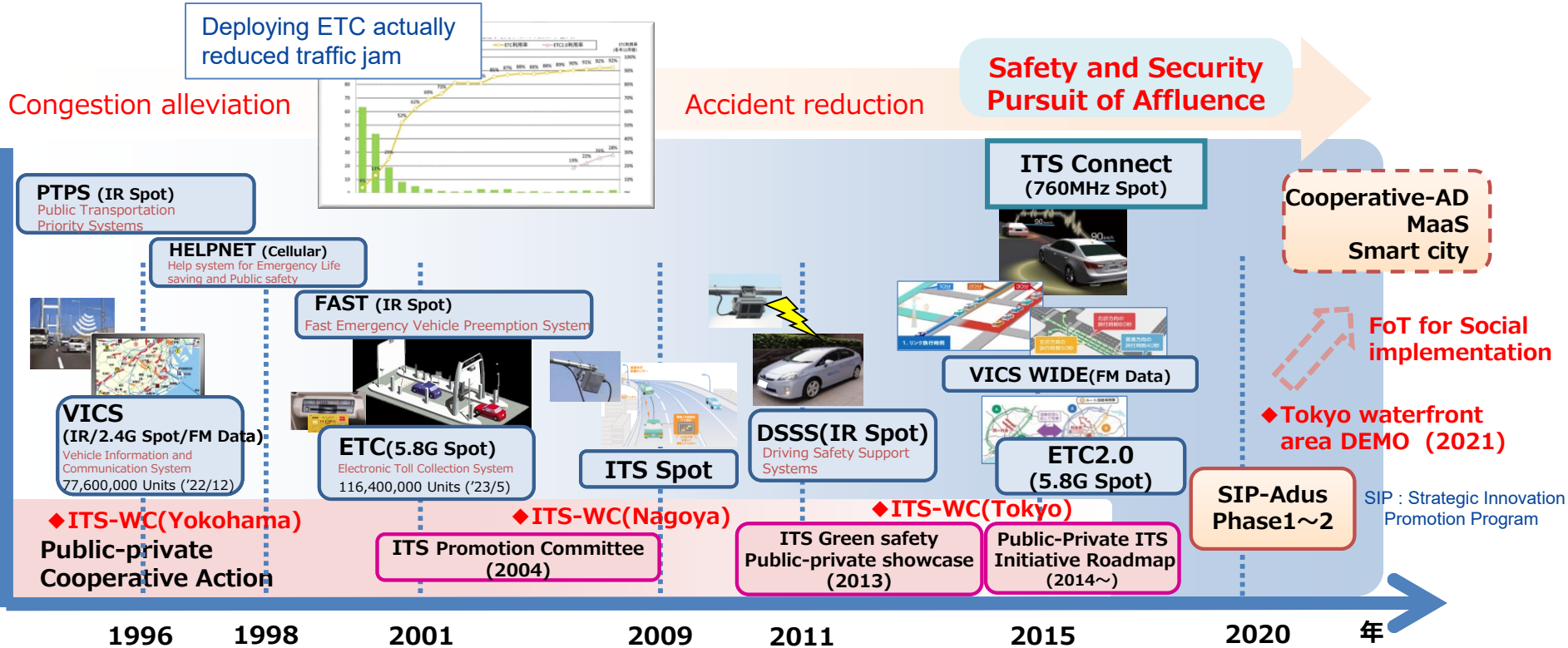


Ministry of Land, Infrastructure, Transport and Tourism
National Police Agency
Ministry of Internal Affairs and Communications
Ministry of Economy, Trade and Industry

In 1999, we established the ITS system concept consisting of nine fields through collaboration among five related ministries and agencies (at that time) and collaboration between the public and private sectors.

ITS development in Japan

- ITS starts with traffic flow smoothing and congestion alleviation, and expands to safety services such as accident reduction
- In the future, it is expected to develop into autonomous driving and smart cities.



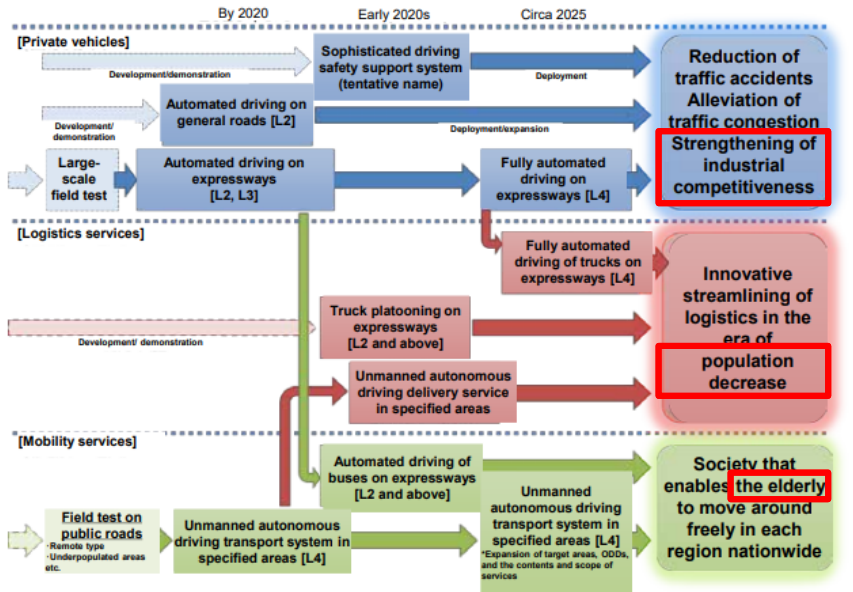
Carefully examining the UC realized by each era, selecting the appropriate communication media to realize ITS

Public-Private ITS Initiative/Roadmap and SIP

- In 2014, the IT Strategy Headquarters determined the "Public-Private ITS Initiative and Roadmap," which is a government-wide strategy related to ITS and autonomous driving. Since then, it has been revised every year in light of recent changes in the situation.

Public-Private ITS Initiative/Roadmaps 2019

Scenario for the commercialization and service of fully automated driving by 2025



Strategic Innovation Promotion Program

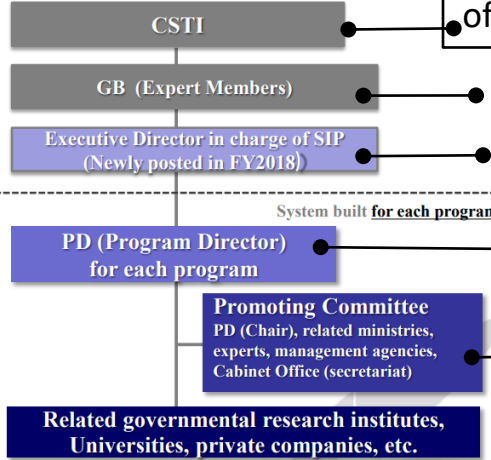
- To establish the **cooperative areas** technologies essential for implementation by 2023
- To create **multiple example cases for commercialization through FOTs** by involving various **businesses and local government**

SIP in Japan



SIP stands for Cross-ministerial Strategic Innovation Promotion Program.

It is a national program led by the Council for Science, Technology and Innovation (CSTI) of the Japanese Government.



The GB (Governing Board) consisting of CSTI expert members is held as necessary to provide evaluation and advice for all programs.

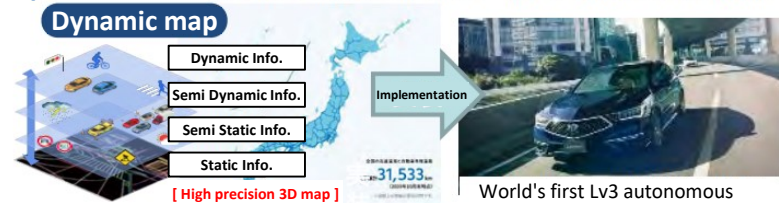
The executive director was posted to support the GB

PD break through ministerial silos, managing programs from a cross-ministerial perspective.

The promoting committee chaired by the relevant PD and composed of related ministries, etc. was therefore set up.

SIP-adus : Automated Driving for Universal Services

Activities for 1st phase High-precision 3D maps required for autonomous driving are maintained on all expressways based on the results of SIP. Installed in the world's first Lv3 AD.



Activities for 2nd phase Conducted traffic information distribution experiments such as signal information for highly automated driving and confirmed its effectiveness

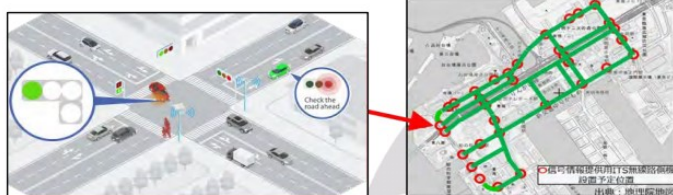
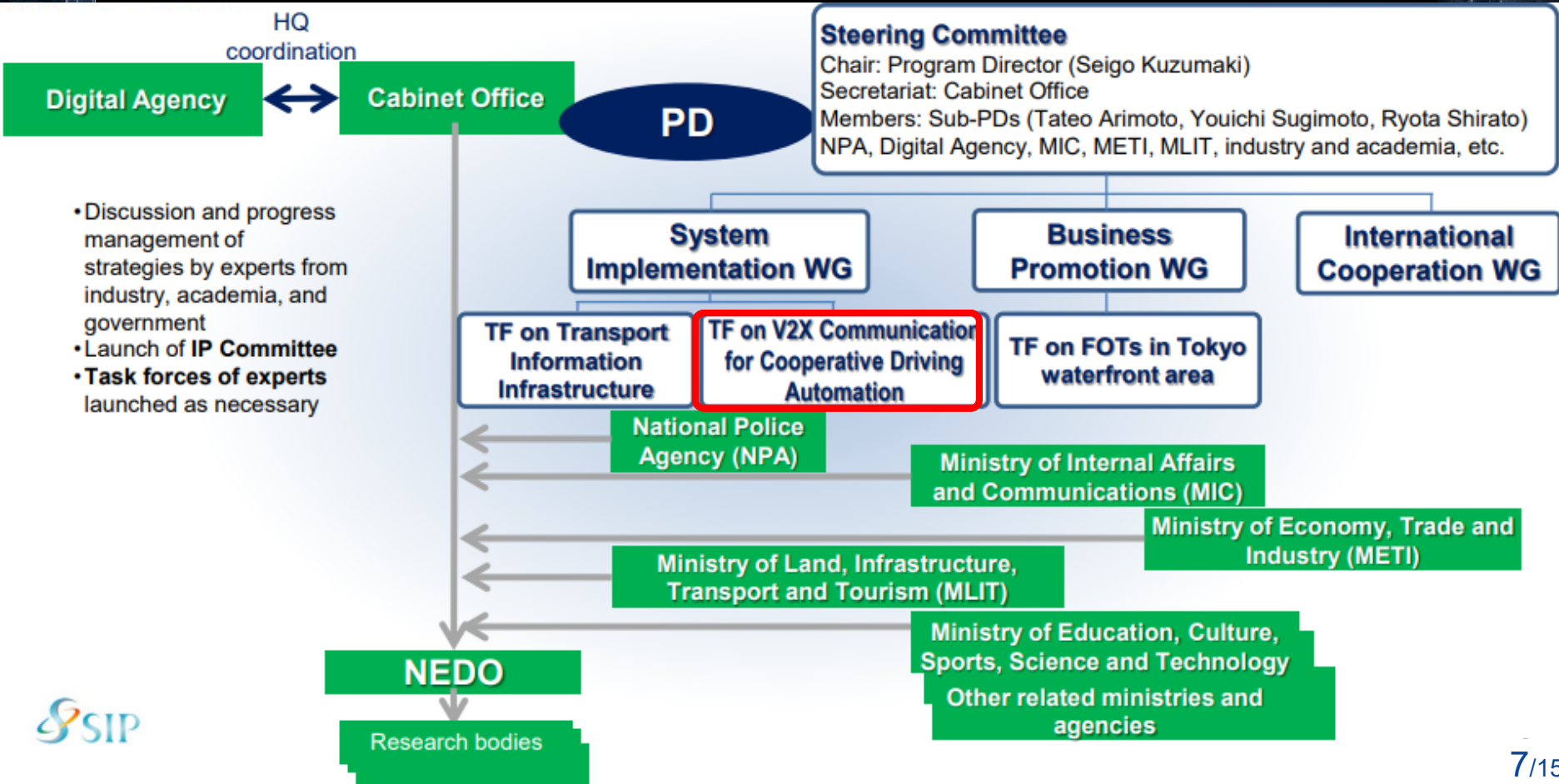


Image of signal information provision

Location of Signal information pro Availability in Tokyo Waterfront

Promoting structure of SIP-adus



TF on V2X communication for CDA

◆ Schedule of TF activity

CDA : Corporate Diving Automation

	FY2019		FY2020		FY2020		FY2021		FY2021		TF member	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
Phase-1	✓ Define CDA ✓ Develop use cases for CDA based on the definition										NPA, MILT, MIC, METI, CAO(SIP) JAMA Academia of communication eng.	
Phase-2			Define communication requirements based on use cases									Members of Phase-1, UTMS society of Japan, NIMIL, ITS-Forum, JEITA, Assignee(NEC, Kyocera)
Phase-3			Study of communication system and methods (freq. , bandwidth)				Proposal of roadmap for CDA					

Goal

- Propose the optimal communication method for CDA
- Draw the roadmap for communication method (requirement)

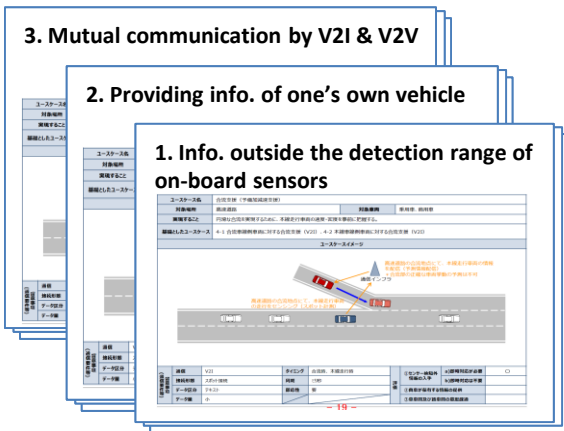
TF on V2X communication for CDA

◆ Outcomes

3. Mutual communication by V2I & V2V

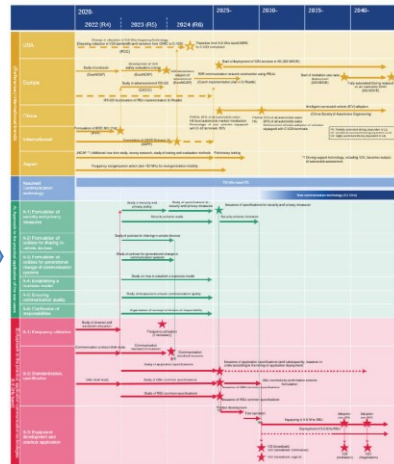
2. Providing info. of one's own vehicle

1. Info. outside the detection range of on-board sensors



機能分類	a.合流・車線変更支援
ユースケース	本線隙間狙い合流支援
No.	a-1-2
メッセージ名	位置情報提供
通信形態	V2I (I → V)
通信相手	非特定車両
対象エリア(最小範囲)	合流起点6秒前から合流起点まで
エリアあたり送信台数	1台
必要通信距離	66.7~116.7m
最大相対速度	連絡路: 20~70km/h
最大データサイズ	1942 byte (1692+250) 想定台数: 62台
周期型もしくは非周期型	周期型
送信周期	100ms
1/パケット当たりPAR	PAR≥99% (仮)
無線区間許容遅延	規定しない
無線区間許容遅延	規定しない

technical verification



SIP Use Cases for CDA 1st edition
(<https://en.sip-adus.go.jp/rd/rddata/usecase.pdf>)

Communication requirements for CDA




Roadmap of communication methods for CDA

- ✓ Release “SIP Use Cases for Cooperative Driving Automation 1st Edition”
- ✓ V2X communication requirements for CDA (with ITS Info-communications Forum)
- ✓ Confirmed necessity of new communication method through technical verification of the requirements
- ✓ Propose the roadmap of communication methods for CDA

SIP Use Cases for CDA (1st edition)

◆ Definition of 25 use cases for CDA

(<https://en.sip-adus.go.jp/rd/rddata/usecase.pdf>)

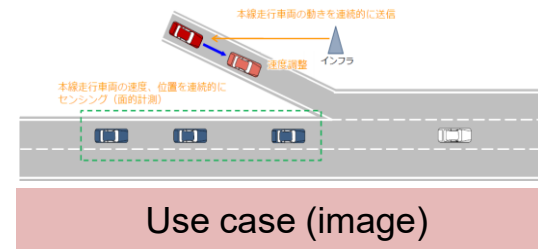
Comm. style	SIP use cases	
<p>V2I</p>  <ul style="list-style-type: none"> • Specific location • Low latency and high reliability 	<p>a-1-1. Merging assist by prior acceleration and deceleration a-1-2. Merging assist by searching the gap on the main lane a-1-3. Cooperative merging assist with vehicles on the main lane by roadside control b-1-1. Driving assistance using traffic signal info. (V2I) c-2-2. Driving assistance using intersection info. (V2I)</p>	
<p>V2V</p> <ul style="list-style-type: none"> • Everywhere • Low latency and high reliability 	<p>a-1-4. Merging assist based on negotiation between vehicles a-2. Lane change assist in heavy traffic a-3. Entry assist from non-priority roads to priority roads in congested traffic c-1. Collision avoidance assist when a vehicles ahead stops or decelerates suddenly c-2-1. Driving assist based on intersection info. (V2V)</p>	<p>c-3. Collision avoidance assist using hazard info. e-1. Driving assist using emergency vehicle info. g-1. Unmanned platooning of following vehicles by electronic towbar g-2. Adaptive cruise control and manned platooning of following vehicles using adaptive cruise control</p>
<p>V2N</p> <ul style="list-style-type: none"> • Latency is not critical to some extent 	<p>b-1-2. Driving assist using traffic signal info. (V2N) d-1. Driving assist by notification of abnormal vehicles d-2. Driving assist by notification of wrong-way vehicles d-3. Driving assist using traffic jam info. d-4. Traffic jam Info. prior to JCT/IC d-5. Driving assist using hazard info.</p> <p>e-1. Driving assist using first responder info. f-1. Rescue request (e-Call) f-2. Collection of info. to optimize traffic flow f-3. Update and automatic generation of maps f-4. Distribution of dynamic map info. h-1. Operation and management of mobility service fleet</p>	

- Define some characteristics for communication with each V2X category
- There could be some use cases which can be realized on more than single category

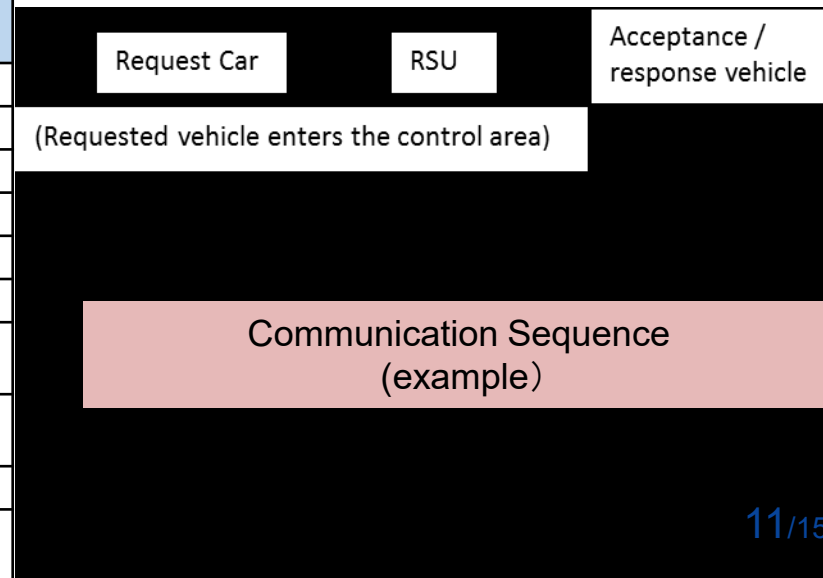
Communication requirements

◆ Examination of similar cases implemented in the past or currently under consideration

- ✓ Experimental guidelines for communication systems for CDA (ITS FORUM RC-015 1.0 version)
- ✓ Experimental demonstrations by ITS-related organizations, etc.



Functional classification	a. Merging / lane change support
Use case	Main line gap aiming merge support
No.	a-1-2
Message name	Location information provided
Communication form	V2I (I → V)
Communication target	Non-specific vehicle
Target	Communication requirements (example)
Number per area	
Required communication distance	66.7~116.7m
Maximum relative speed	Connection route : 20~70km/h
Maximum data size	1942 byte (1692+250) Estimated number : 62 vehicles



Technical verification

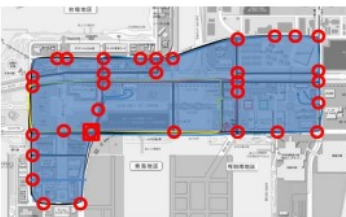
Demonstration experiment [Tokyo Waterfront Subcenter ~ Haneda area]

In the fall of 2019, in anticipation of the 2020 Tokyo Olympic and Paralympic Games, we began an open demonstration experiment in the Tokyo waterfront area (waterfront subcenter area/Haneda area on general roads and the Metropolitan Expressway).

Demonstration details

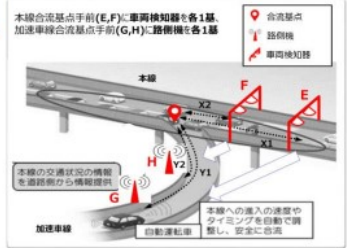
Provision of signal information

Even in environments that are difficult for in-vehicle cameras to recognize, it receives **signal display and switching timing information** to ensure safe and smooth passage.



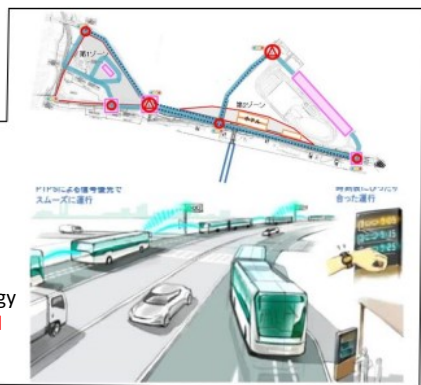
Highway Main Line Merging Support

Provision of mainline vehicle information



Public Transportation System (AD Bus)

Demonstration of next-generation ART utilizing autonomous driving technology on public roads under **mixed traffic**



Key findings from verification

- New communication methods which has negotiation functions are required
- New communication methods need to be introduced due to 30% penetration of CDA

Issues to be solved for introduction

- Reserve new radio band
- Standardization of communication methods
- Security and privacy protection
- Plan for generational change of communication

Proposal of communication method and roadmap

◆ Assumption for the timing to implement use case

Assumed timeline to implement the SIP use cases while referring to “Public-Private ITS Initiative Roadmap”, market diffusion forecast of AD vehicles, international trend of V2X, etc.

V2I use cases

	2025-	2030-	2035-	2040-	
安全運転支援	<ul style="list-style-type: none"> ▼路側サービスの提供状況の特定 (契約先確定) ①-1. 路側サービスの実行可能 (V2I) ユースケースの一部はITS connectによりサービス開始済み (自動車法改正、標準化等先行実施可能) ▼路側サービスの提供状況の特定 (契約先確定) ②-2. 交通量の情報による実行可能 (V2I) ユースケースの一部はITS connectによりサービス開始済み (契約先確定) 		<ul style="list-style-type: none"> ▼ユースケース開始時期に関する想定 ● 標準化等コンソール標準化が完了後 (標準化等コンソール標準化が完了後) 		
	<ul style="list-style-type: none"> ▼実行中の機能 - ロードマップ (2025年以降の標準化) 40箇所以上入場 ①-1. 標準化等コンソール標準化が完了後 (契約先確定) ②-2. 交通量の情報による実行可能 (V2I) ● 路側サービスの提供状況の特定 (契約先確定) ③-2. 交通量の情報による実行可能 (V2I) ▼実行中の機能 - ロードマップ (2025年以降の標準化) 40箇所以上入場 ①-1. 標準化等コンソール標準化が完了後 (契約先確定) ②-2. 交通量の情報による実行可能 (V2I) ● 路側サービスの提供状況の特定 (契約先確定) ③-2. 交通量の情報による実行可能 (V2I) 				
協働型自動運転	<ul style="list-style-type: none"> ▼実行中の機能 - ロードマップ (2025年以降の標準化) 40箇所以上入場 ①-1. 標準化等コンソール標準化が完了後 (契約先確定) ②-2. 交通量の情報による実行可能 (V2I) ● 路側サービスの提供状況の特定 (契約先確定) ③-2. 交通量の情報による実行可能 (V2I) 				

※1 a-1-1: 予備型連携合流支援
a-1-2: 本線降速合流支援

V2V use cases

	2025-	2030-	2035-	2040-	
安全運転支援	<ul style="list-style-type: none"> ▼路側サービスの提供状況の特定 (契約先確定) ②-1. 交通量の情報による実行可能 (V2V) ユースケースの一部はITS connectによりサービス開始済み (契約先確定) 		<ul style="list-style-type: none"> ▼ユースケース開始時期に関する想定 ● 標準化等コンソール標準化が完了後 (標準化等コンソール標準化が完了後) 		
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協働型自動運転	<ul style="list-style-type: none"> ▼安全運転のための路側サービスの提供状況の特定 (契約先確定) ②-1. 交通量の情報による実行可能 (V2V) ※1 (1). 緊急車両の優先による実行可能 (V2V) ※1 ▼実行中の機能 - ロードマップ (2025年以降の標準化) 40箇所以上入場 ①-1. 標準化等コンソール標準化が完了後 (契約先確定) ②-2. 交通量の情報による実行可能 (V2V) ● 路側サービスの提供状況の特定 (契約先確定) ③-2. 交通量の情報による実行可能 (V2V) 				

※1 緊急車両の優先による実行可能 (V2V) ※1
①-1. 標準化等コンソール標準化が完了後 (契約先確定)
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③-1. 緊急車両の優先による実行可能 (V2V) ※1
③-2. 交通量の情報による実行可能 (V2V) ※1
④ 標準化等コンソール標準化が完了後 (契約先確定)

V2N use cases

	2025-	2030-	2035-	2040-	
安全運転支援	<ul style="list-style-type: none"> ▼路側サービスの提供状況の特定 (契約先確定) ②-1. 交通量の情報による実行可能 (V2N) ユースケースの一部はITS connectによりサービス開始済み (契約先確定) 		<ul style="list-style-type: none"> ▼ユースケース開始時期に関する想定 ● 標準化等コンソール標準化が完了後 (標準化等コンソール標準化が完了後) 		
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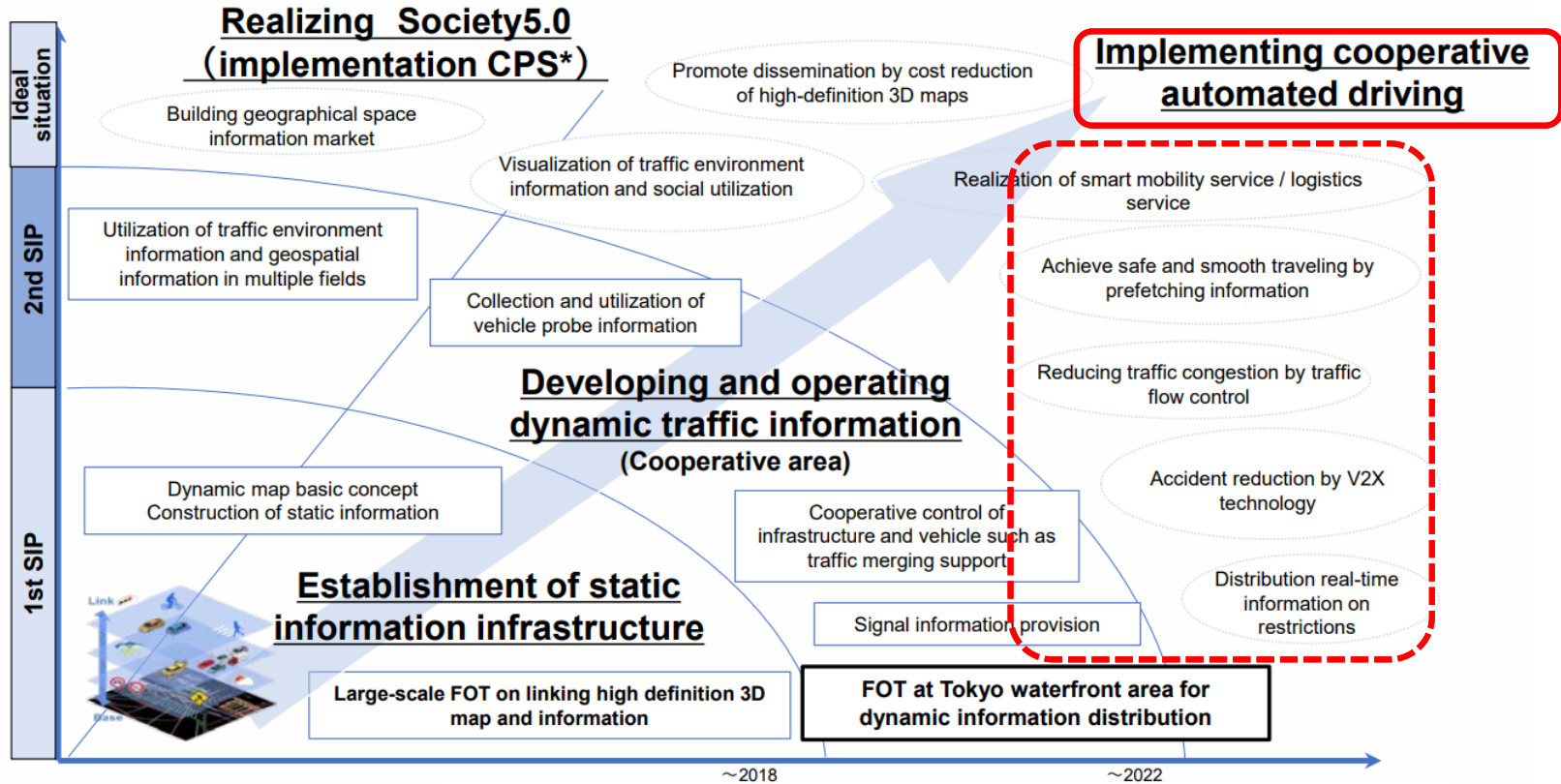
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④ 標準化等コンソール標準化が完了後 (契約先確定)

Summary

◆ Summary of TF activity on V2X communication for CDA

- Under 5 years investigation in SIP program, establish concrete roadmap for the next step
 - Defined what the CDA should be.
 - Studied and published 25 use cases for CDA.
 - Formulated technical requirements on communication to achieve the use cases.
 - Examine communication method throughout verification of use cases
 - Made a roadmap with forecasting when the use cases will be realized
 - Proposed the timing to require the new communication method based on the roadmap.

Building the Traffic Environmental Info. Framework



*CPS : Cyber Physical System



Thank you