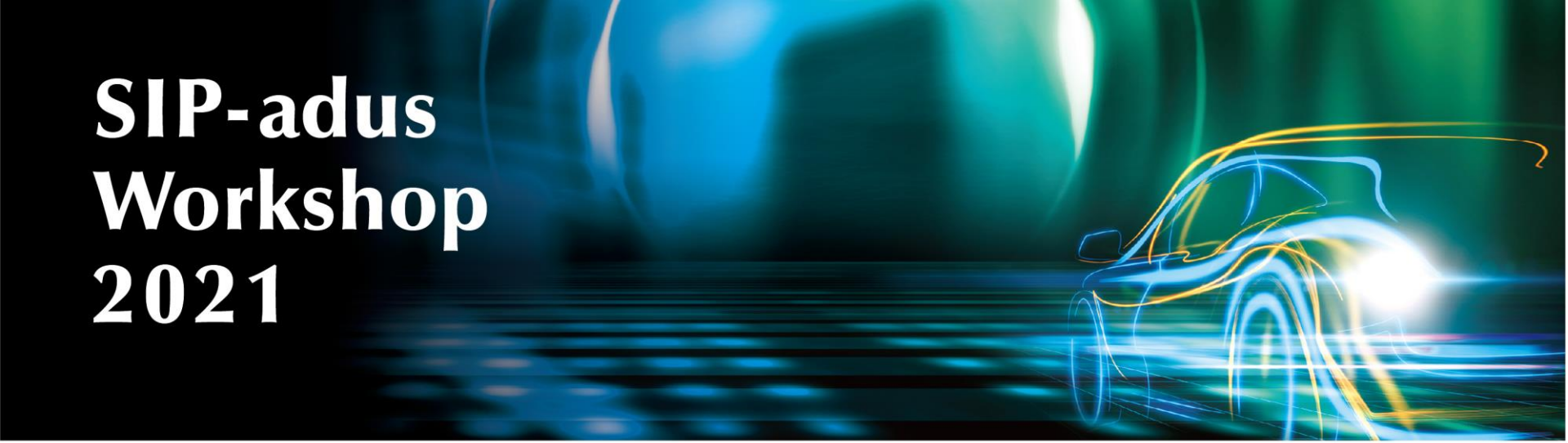

Research of V2X communication for Cooperative Driving Automation

Norifumi Ogawa (Mazda Motor Corporation)
SIP Task force on V2X communication for Cooperative Driving Automation

10.Nov.2021

SIP
Cabinet Office

SIP-adus Workshop 2021

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1.Research status of V2X communication for cooperative driving automation

- **TF on V2X communication for Cooperative Driving Automation (CDA) has been established in 2019**
- **Started research for communication methods for CDA**

【Purpose】

Draw the ideal form of cooperative driving automation and the roadmap to realization, while considering international standards, establish the optimal communication method policy by ALL JAPAN

【goal】

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

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◆ Activities of TF on V2X Communication for CDA

- Define CDA
- Develop CDA use cases based on the definition

Phase1
Done

- Define communication requirements based on use cases

Phase2
Done

- Examination of applicability of existing ITS communication
- Technology verification for Communication methods (frequency / bandwidth) for CDA
- Proposal of communication method and the roadmap

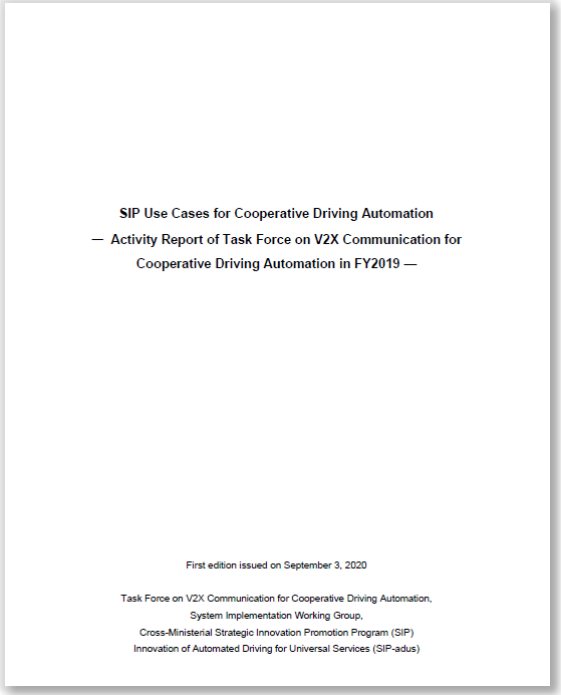
Phase3
On going

Phase1

◆ SIP Cooperative Autonomous Driving Use Case 1st Edition released

Contents

- CDA system definition
- Scope of study
- Use case review process
- SIP CDA use cases


SIP Use Cases for Cooperative Driving Automation
— Activity Report of Task Force on V2X Communication for Cooperative Driving Automation in FY2019 —

First edition issued on September 3, 2020

Task Force on V2X Communication for Cooperative Driving Automation,
System Implementation Working Group,
Cross-Ministerial Strategic Innovation Promotion Program (SIP)
Innovation of Automated Driving for Universal Services (SIP-adus)

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

2. Communication requirements

◆ Activities of The ITS Info-communications Forum

Phase2

Examining communication requirements to realize use cases as an expert in ITS communication

- General assembly
  - Administration(ARIB)
  - Executive Committee
    - Advanced ITS Info-communication System Committee
      - Radio System Technology TG
        - Investigation / analysis of SIP use cases
        - Examination of SIP use case communication scenarios
        - Examination of SIP use case communication requirements
        - Review of SIP use case verification method
      - Cellular System TG
        - Review of cellular (V2N)
        - Review of cellular (V2I / V2V)
    - 700MHz Band ITS Implementation Committee
      - Review of 700MHz band ITS verification method
      - Review of 700MHz band ITS evaluation results

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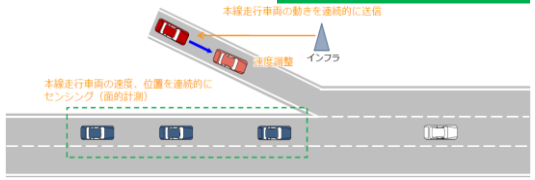
2. Communication requirements

◆ Examined with reference to similar cases implemented in the past or currently under consideration

Phase2

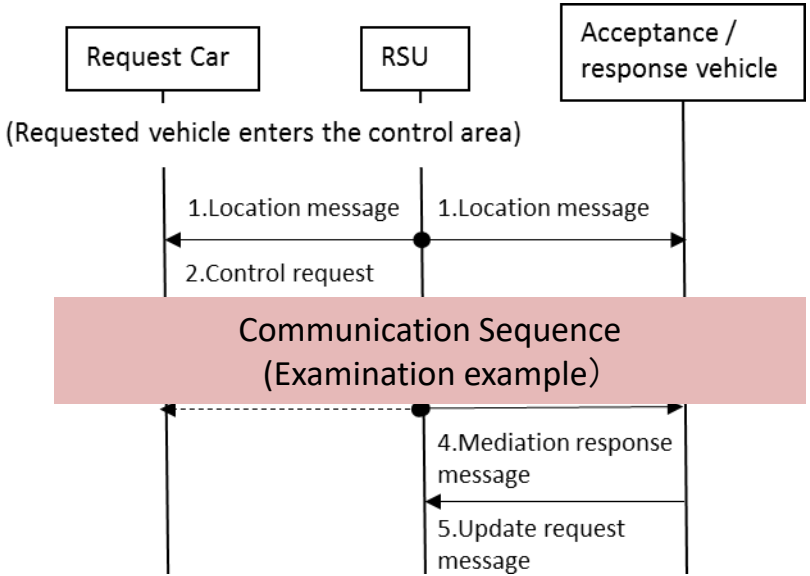
- ✓ Experimental guidelines for communication systems for CDA (ITS FORUM RC-015 1.0 version)
- ✓ Demonstration experiments by ITS-related organizations, etc.



Use case (image)

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）
[illegible]	[illegible]rging
[illegible] per area	1 vehicle
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

Communication requirements (examination example)



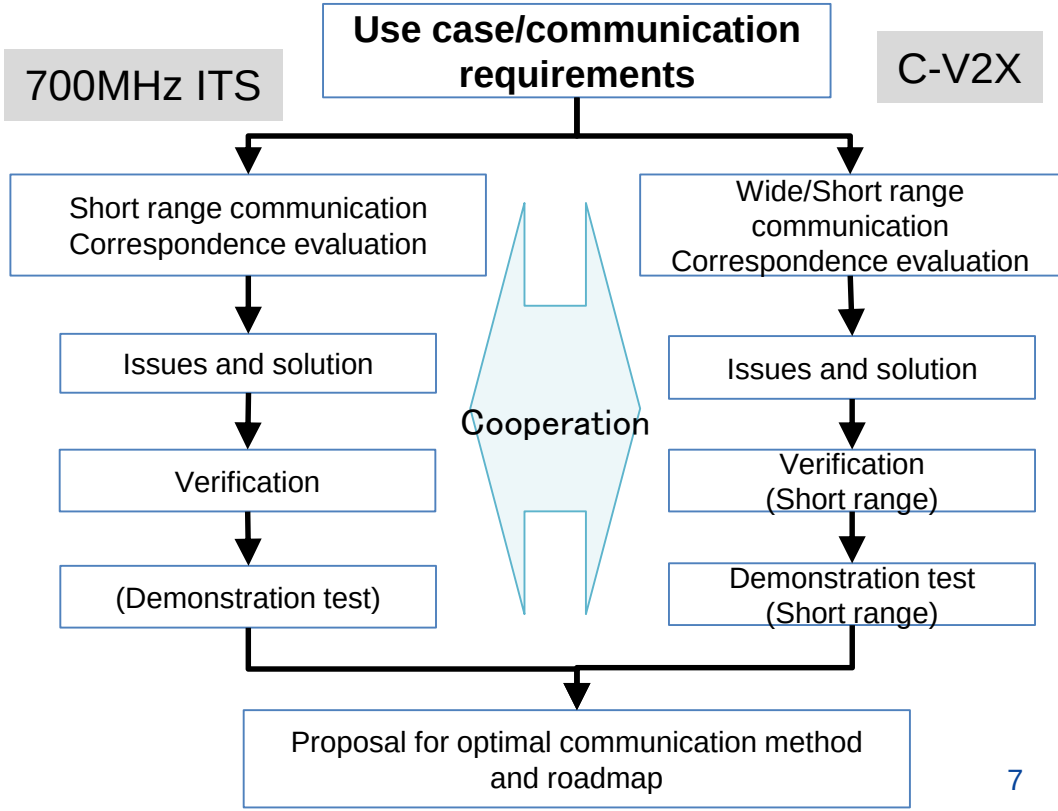
Communication Sequence (Examination example)

3. Examination of application to communication technologies

◆ Consider issues and solutions when applying use cases and communication requirements to ITS radio communication

Phase3

- Applicability of existing ITS radio communication (700MHz band)
- Application study and experiments of cellular V2X
- Proposal for optimal radio communication method and roadmap



3. Examination of application to communication technologies

700MHz band ITS radio communication

Phase3

◆ Examination of applicability of existing ITS radio communication and issues / countermeasures

Possibility of sharing with existing services on the 700MHz band ITS radio communication by verification/ simulation

【Scope of verification /simulation】

Evaluation	Type	Verification	Simulation
Area / quality	V2I V2V	Reception level at the end of the area	The packet arrival rate at the end of the area
Delay	V2I V2V	Packet size	Wireless communication delay (W/O internal processing delay)

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3. Examination of application to communication technologies

Cellular V2X

Phase3

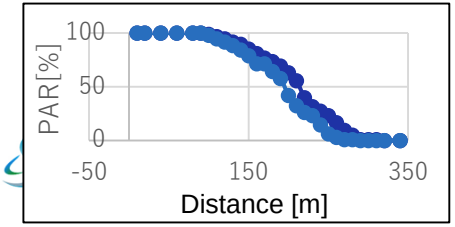
- Use case for wide range communication (V2N)
  - Main issue : Communication delay on remote assistance, remote driving, etc.
    Information transmission method to a wide range of target vehicles

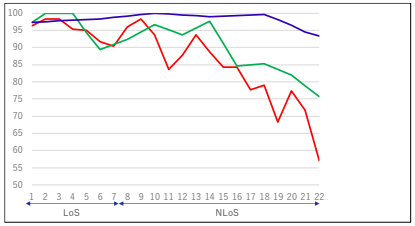
Determine application measures based on technological trends of wide area communication networks (5G, 5G and later)

- Use case for short range communication (V2I / V2V)
  - Main issue : Communication quality deterioration and delay due to communication with many vehicles and overlapping of use cases

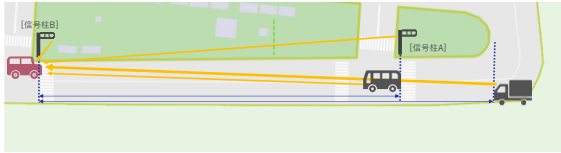
Under evaluation through verification and demonstration test

[Simulation]





[Demonstration test by test course]



4. Proposal of communication method and roadmap

Phase3

- ✓ Predicting the deployment of automated vehicles and vehicles equipped with radio instruments
- ✓ Predict the practical use timing of use cases in chronological order in consideration of these deployment
- ✓ Estimate the possibility of communication congestion due to the increase in automated vehicles and overlapping use cases
- ✓ Clarify the communication requirements that can maintain communication quality even under communication congestion
- ✓ Determine the need for a new communication method to meet the communication requirements
- ✓ Propose communication methods (requirements) and introduction timing required for cooperative driving automation

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5. Summary

- TF on V2X communication for Cooperative Driving Automation started to research in order to propose the communication method for CDA
- Phase 1: Define and publish SIP use cases
- Phase 2: Prepare communication requirements in collaboration with the ITS Info-communications Forum
- Phase 3: Examine issues and countermeasures when 700MHz band ITS radio communication and C-V2X are applied to use cases
- Propose communication methods and roadmaps required for CDA

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Thank you