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**Status of ITS radio-communications
toward automated driving**



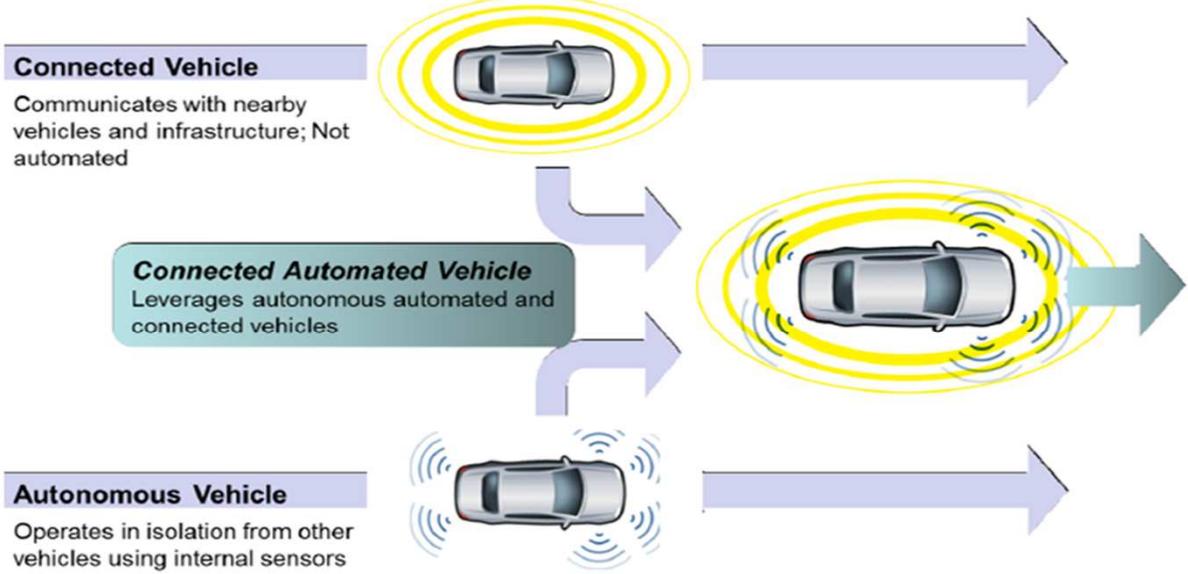
Contents

1. How should we address the automated vehicle with connectivity?
2. Automated driving use case for radio-communication by JAMA
3. Use of common use case
4. SIP Connected Vehicle activities
 - 1) V2V Application for Merging scenario
 - 2) V2Pedestrian application
5. Summary



1. How should we address the automated vehicle with connectivity?

The autonomous vehicle and the connected vehicle should be integrated into ultimate automated vehicle



USE CASE should be starting line

2. Automated driving use case for radio-communication by JAMA

JAMA defined 4 typical USE CASE

Traffic information from V2I

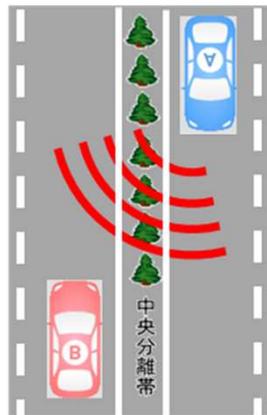
Realize smooth automated driving by using the safety related information from the road which couldn't get by vehicle sensor



Collect and distribute the information

A Send the information

B automated vehicle



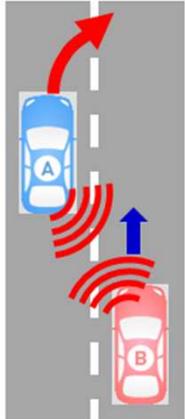
1. Collect hazardous information on the road by automated vehicle sensor and distribute the information
2. Receive the information from other automated vehicle and re-distribute to on coming automated vehicle in advance

2. Automated driving use case for radio-communication by JAMA

Highway junction is one of the most critical scenario to evaluate communication protocol capability

Highway junction / Lane Change

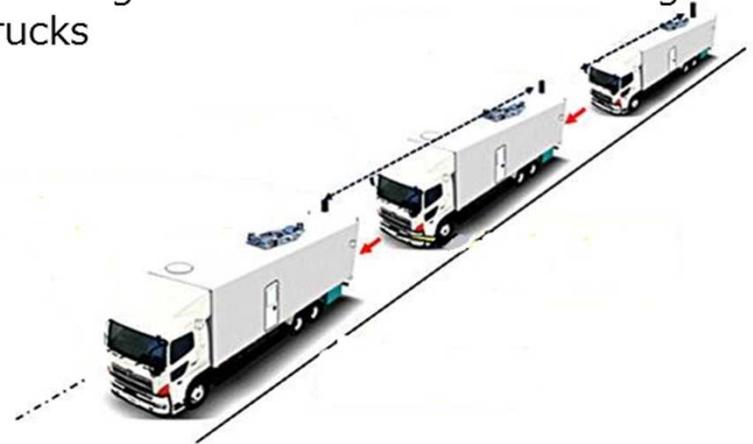
A Merging vehicle
B Following vehicle



- ① Merging or Lane change request from merging vehicle
- ② Following vehicle respond and make gap
- ③ A detect the safe gap and start merging
- ④ Done safe and smooth merging and lane change

Truck Platooning

Exchange control information among trucks



3. Use of common use case

MIC (Ministry of Internal Affairs and Communications)



Study policy of radio-communication

NILIM (National institute for Land and Infrastructure Management)



Study V2I application

SIP adus (Cabinet Office)



Study communication performance by proving test

JAMA (Japan Automotive Manufacturing Association)

Establishing use case for automated driving



**USE
CASE**

ITS Forum (ARIB)



Study radio-communication protocol and standardization

Studying radio-communication application by using **common use case.**

4. SIP Connected Vehicle activities

SIP Connected Vehicle activities for radio-communication

- 1) **V2V Application for Merging scenario based on the use case**
 - Clarify capability of current communication protocol
 - Study improvement of communication quality

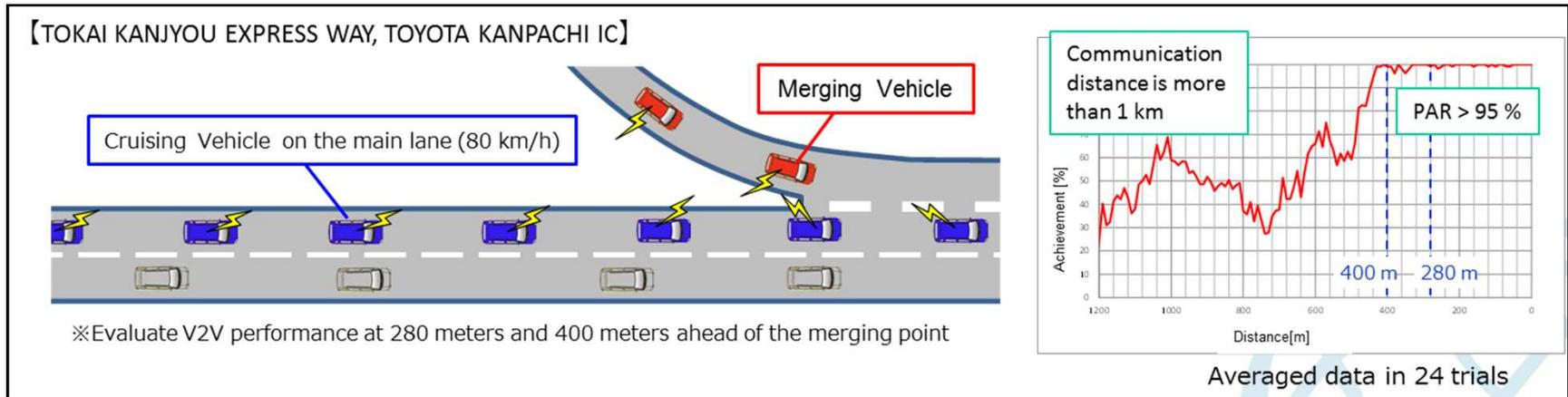
- 2) **V2Pedestrian application**
 - Development of portable communication equipment
 - Study pedestrian location identification



4. SIP Connected Vehicle activities

1) V2V Application for Merging scenario based on the use case

-Current ITS communication protocol in Japan is capable under the open air condition (use of 760MHz)

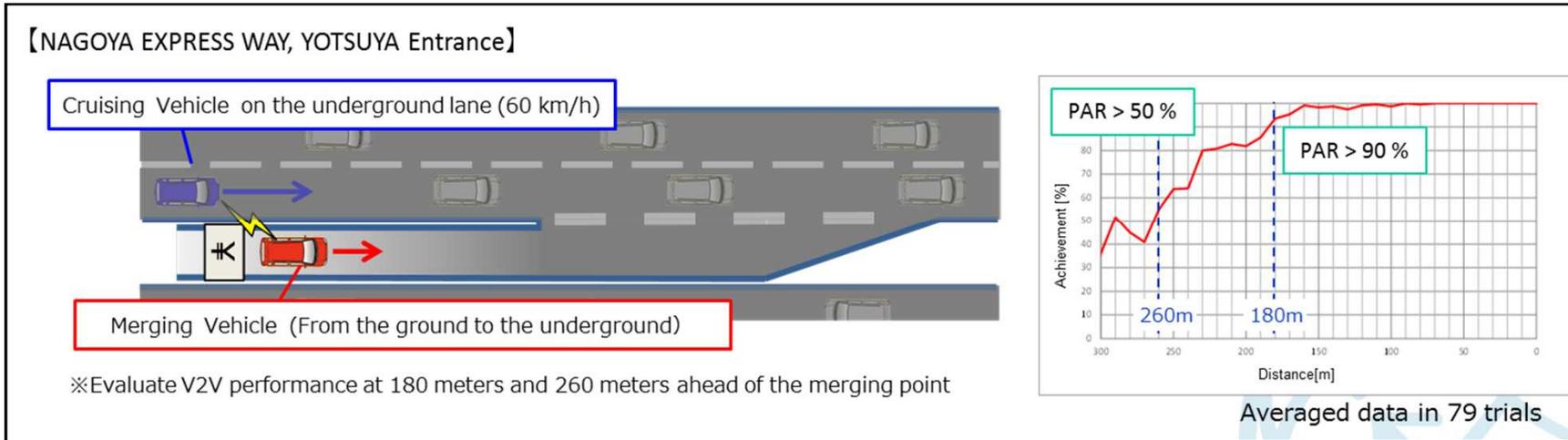


4. SIP Connected Vehicle activities

1) V2V Application for Merging scenario based on use case



-Communication performance is not enough under the isolated condition between merged road and main lane. (e.g. tunnel)



4. SIP Connected Vehicle activities

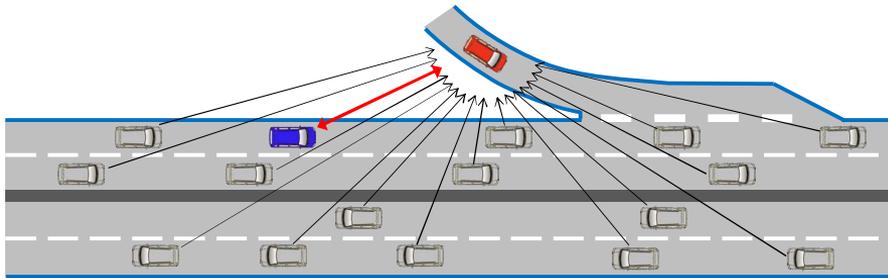


1) V2V Application for Merging scenario

-Study the possibility of V2I application under difficult situation of communication

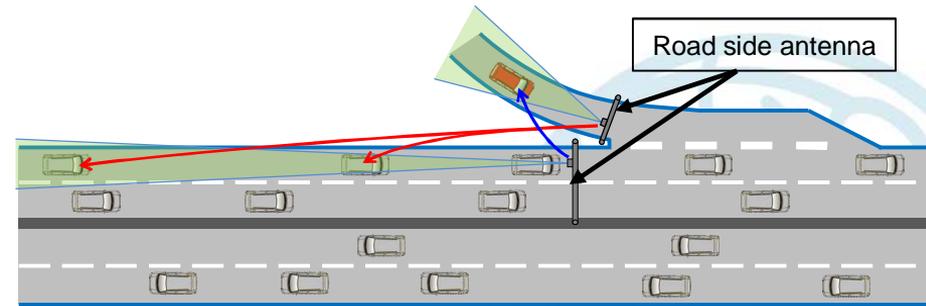
V2V application

- Identify the vehicles location for mutual communication
- Messages for mutual communication



V2I application

- Required messages to merging vehicle and vehicles in main lane

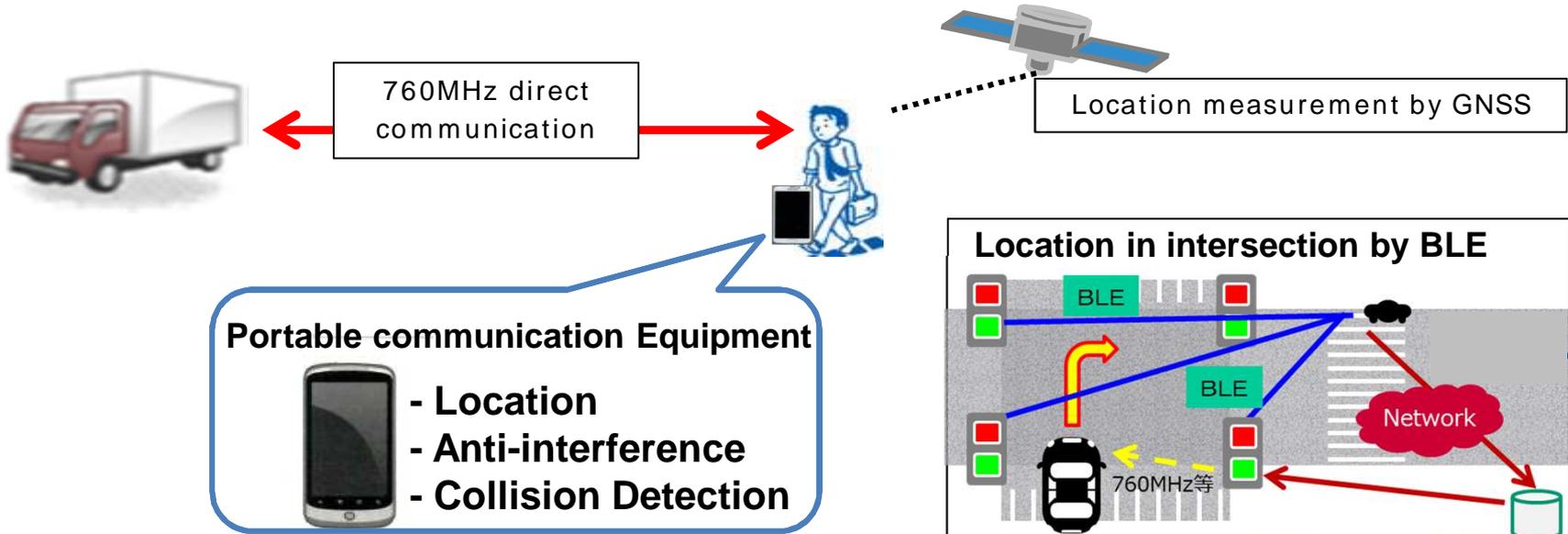


4. SIP Connected Vehicle activities



2) V2Pedestrian application

- Develop portable equipment for the pedestrian collision warning
- Pedestrian location measurement performance in urban area
- Communication performance in crowded condition



5. Summary

1. **Common use case is the starting line to consider radio-communication for the connected and automated vehicle.**
2. **SIP is studying required performance of radio-communication for V2V and V2P applications**



Thank you for your attention

