Global Standards Collaboration (GSC) 14

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ITS Radiocommunication Systems in Japan

Vehicle-to-Vehicle and Vehicle-to-Infrastructure communication systems using 700MHz band

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Highlight of Current Activities

- Activities toward realization of Safe Driving Support Systems in Japan
  - NEW IT Reform Strategy: a policy on traffic safety announced as one of the strategy
  - Public-Private Co-operation formed
  - ITS-Safety 2010 (National project)
  - Spectrum allocation for ITS in 700MHz band
  - MIC-MLIT joint experiment in simulated environment (intersections and streets) and on public road
  - Study Group on advancement of ITS Radio systems

Strategic Direction(1)

- Contribute to reduction of the number of traffic fatalities and serious injuries by deploying Cooperative Safe Driving Support Systems
- Realize the Safe Driving Support Systems using Vehicle-to-Vehicle(V2V) and Vehicle-to-Infrastructure(V2I) communications
- Public-Private Co-operation in ITS-Safety 2010 (National project)
- Observation: Further Public-Private Co-operation will be necessary for the system deployment.

Strategic Direction(2)

- Effective utilization of radio frequency for ITS in 700MHz band, available from July 2012
- The first V2V feasibility test done. Packet Delivery Ratio of more than 95% was verified in the case of more than 80m transmission around the blind corner
- The feasibility test specification is based on the guideline; “ITS Forum RC-006”
- Standardization based on the guideline with feedback from feasibility tests.
- Observation: Additional feasibility tests are necessary for technical issues, such as evaluation on inter-system interference and integration of V2V and V2I in a single channel.
- Promotion of further feasibility tests will be effective for acceleration of system development and the standardization.

Challenges

- Challenge: to reduce the number of traffic fatalities and serious injuries by deploying Cooperative Safe Driving Support Systems.
- Requirements: Proof of feasibility, solution to technical issues and standardization by 2011
- Issues: many issues to be solved other than the requirements
  - Reliability and Security of the system, Product liability, Privacy
  - Service effectiveness and Social acceptability
  - Cost effectiveness user benefit

Next Steps / Actions

- Field Operational Test
- Standardization and International harmonization
- Further Public-Private Cooperation
- Measures for Introduction and penetration of the Safe Driving Support systems to the market

Supplementary Slides

Radiocommunication systems for ITS

Broadcasting Type

Wide Area (Broadcasting)

FM Multiplex Broadcasting
(76 - 90MHz)

-VICS- (Vehicle Information and Communication System)

Public Traffic information

GPS

Radio Beacon
(2.5GHz, 5.8GHz)

Communication Type

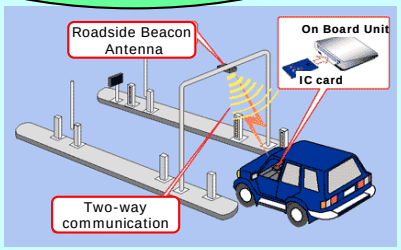
Wide Area (Interactive)

Mobile Phone
(800MHz,2GHz, etc.)

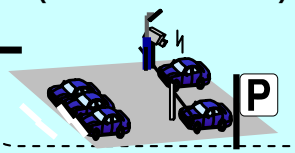
Vehicle to Infrastructure
(5.8GHz)

ETC / DSRC

ETC : Electronic Toll Collection
DSRC : Dedicated Short Range Communication



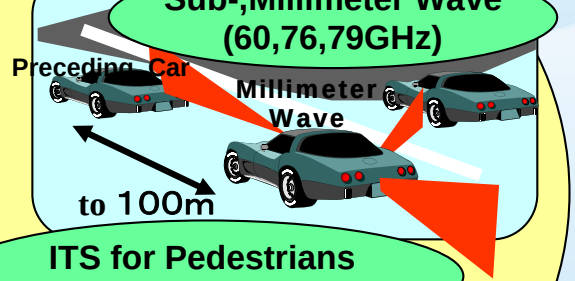
Parking lot (Auto Fee collection)



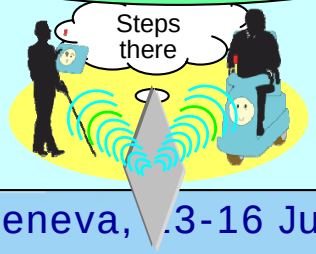
Gas Station

Sensor Type

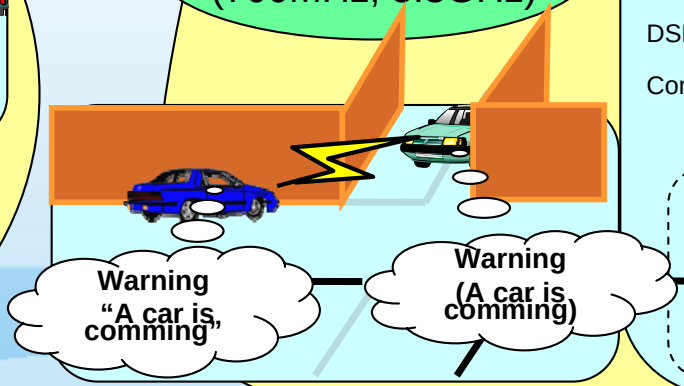
Sub-,Millimeter Wave (60,76,79GHz)



ITS for Pedestrians (13.56MHz, 950MHz, 2.4GHz)

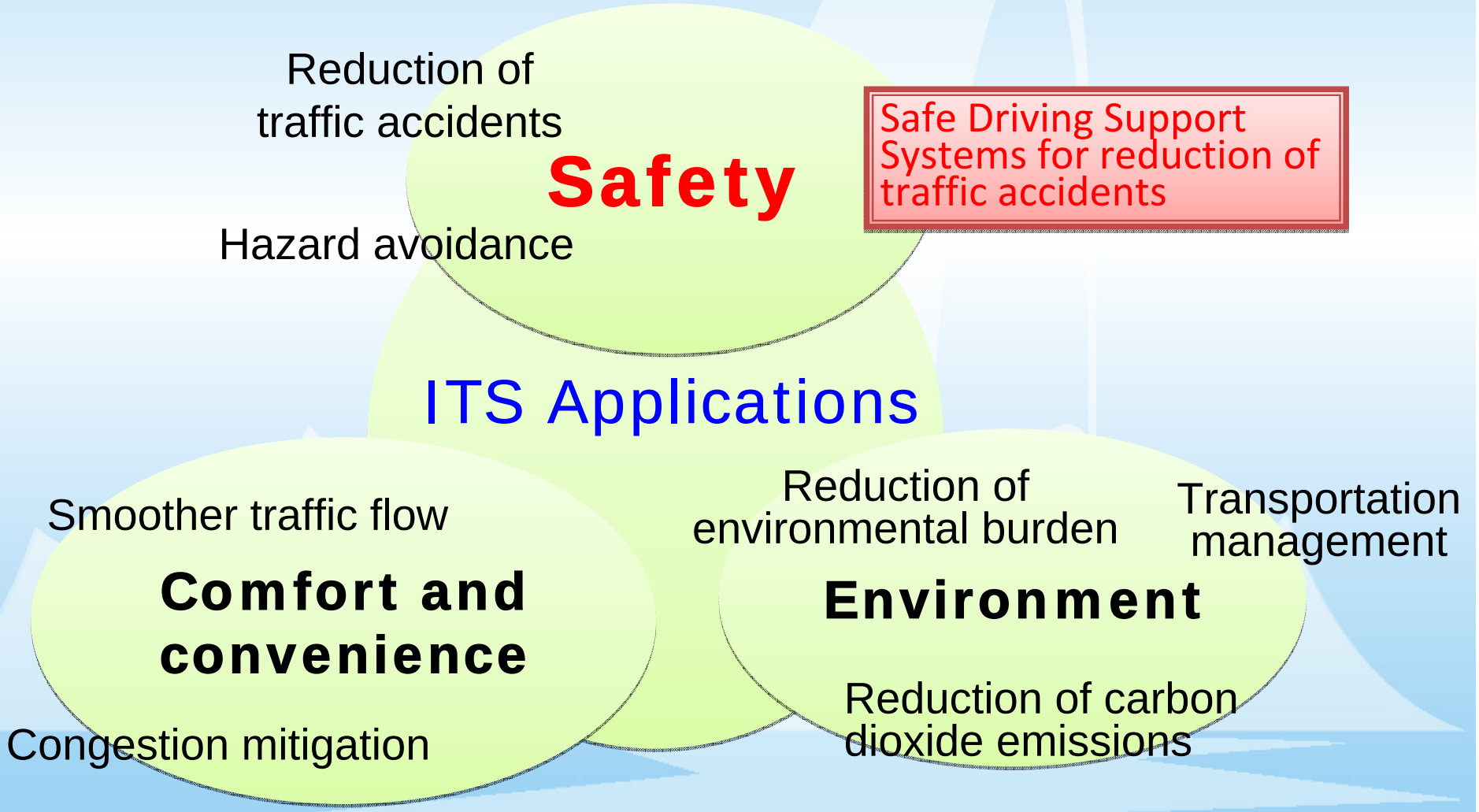


Vehicle to Vehicle
(700MHz, 5.8GHz)



Purpose of ITS (Intelligent Transport Systems)

Systems to resolve problems of road traffic by reducing traffic accidents, mitigating congestion, improving environmental efficiency, etc.



ITS-Safety 2010: Public-Private Co-operation

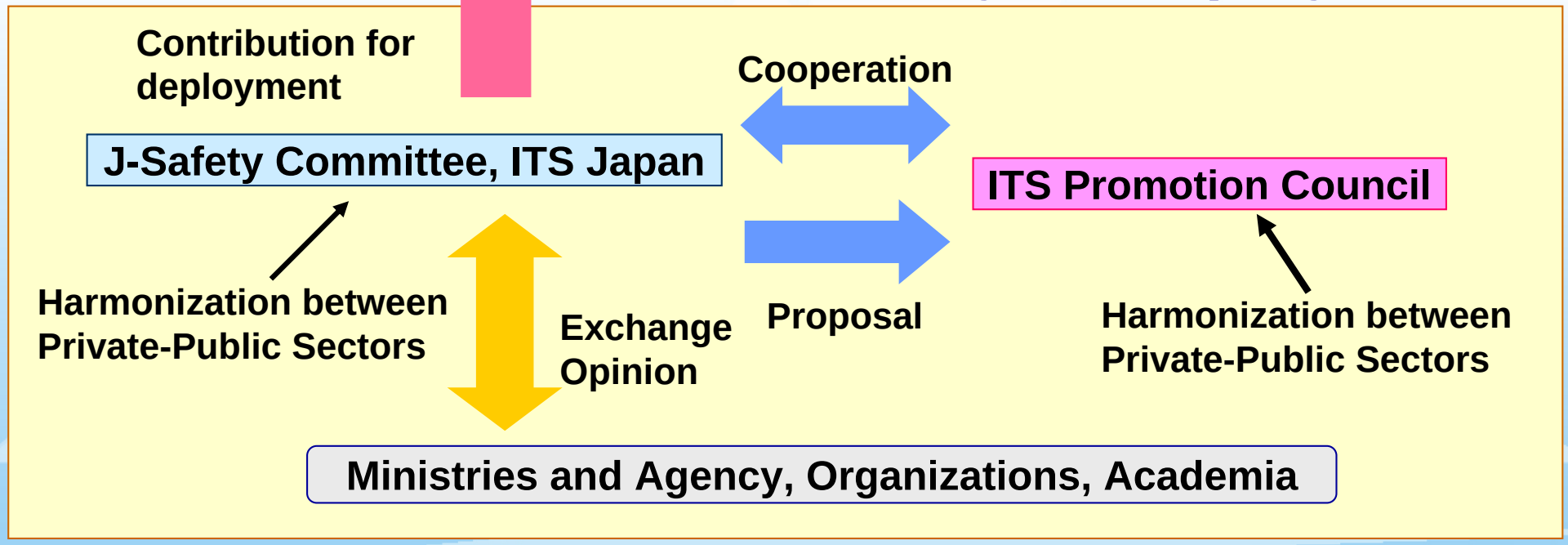
New IT Reform Strategy

The world's safest road traffic environment

[Targets]

Reduce the number of traffic fatalities and serious injuries by deploying Cooperative Safe Driving Support Systems.

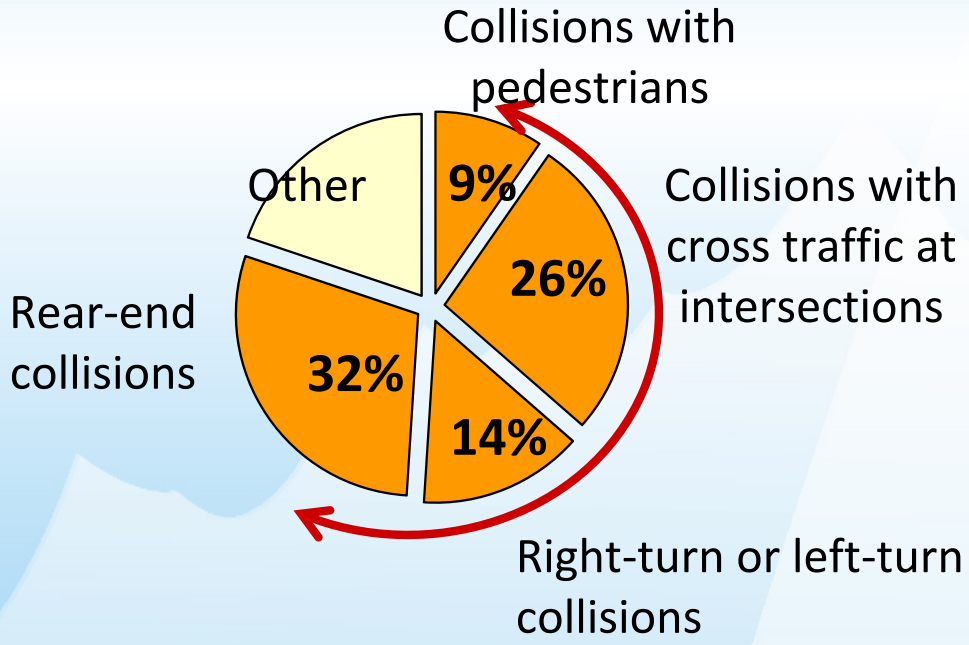
ITS-Safety 2010 project



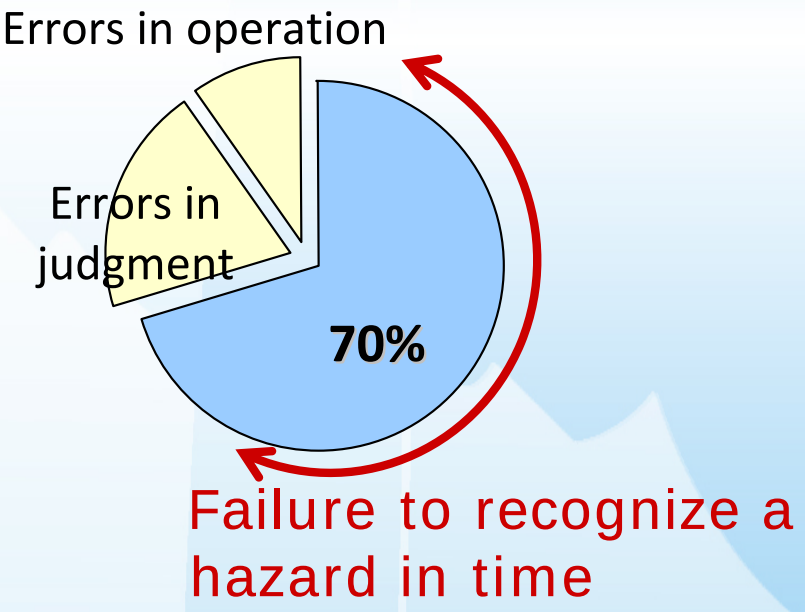
Effects of Safe Driving Support Systems

80% of traffic accidents occur at intersections or locations with poor visibility. 70% of traffic accidents are caused by failure to recognize a hazard in time.

[Types of traffic accidents]

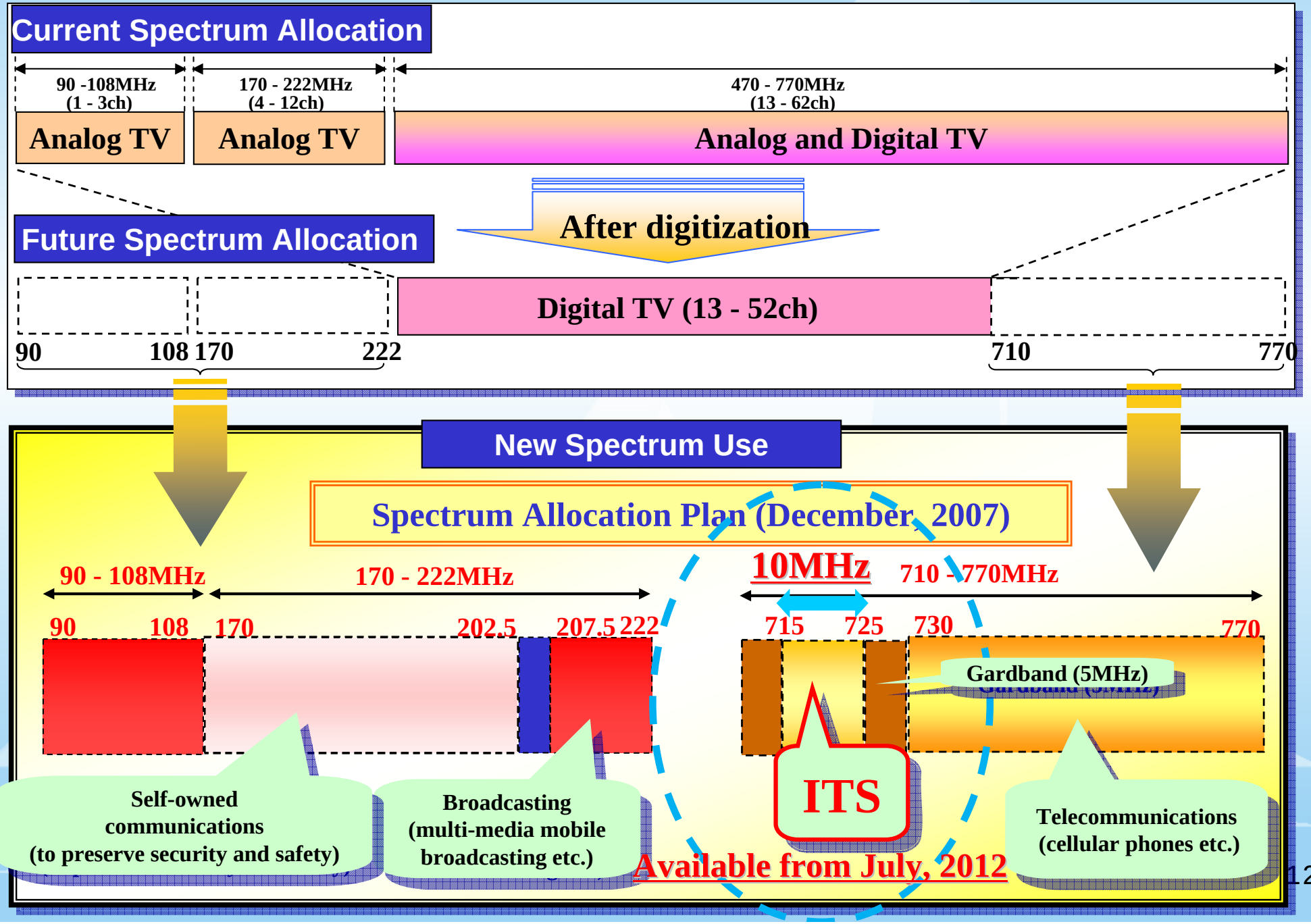


[Types of human error]



Safe driving support systems utilize radio systems to effectively supply information on hazards that may not be visible to the driver.

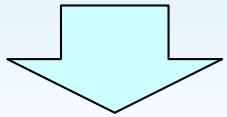
Spectrum Use After “Digital Dividend”



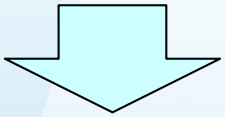
Characteristics of 700MHz band

In comparison of 5.8GHz band

- **Reach longer distance**
- **Cover wider area**
- **Diffract to behind buildings**



- **Suitable for vehicle to vehicle communications at blind intersection**
- **700MHz band would be better spectrum for Safe Driving Support System which requires high reliability.**



- **Conducting various verification tests and R&D to realize vehicle to vehicle communications for Safe Driving Support System**

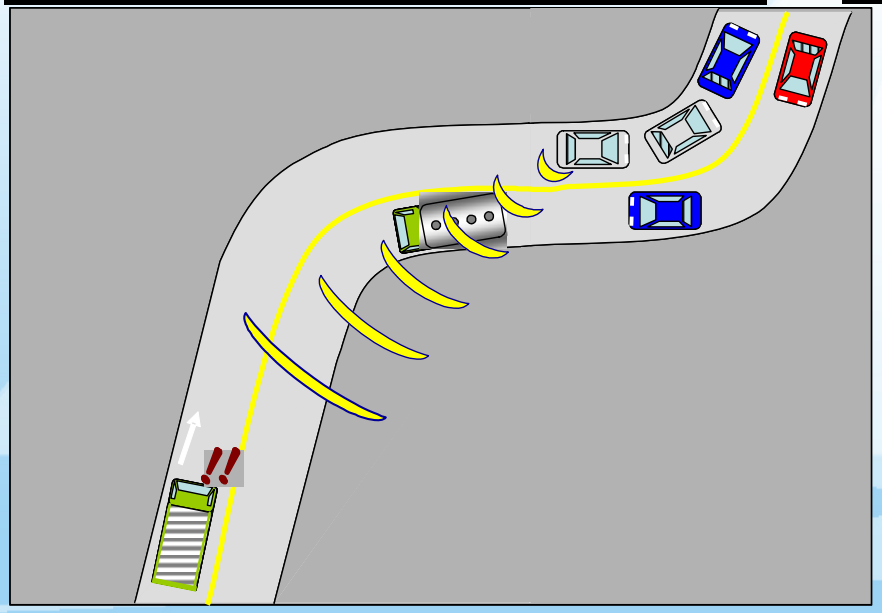
Tests of Safe Driving Support Systems by MIC

Investigations and verifications for the practical use of safe driving support telecommunication systems (2007–2009 [scheduled])

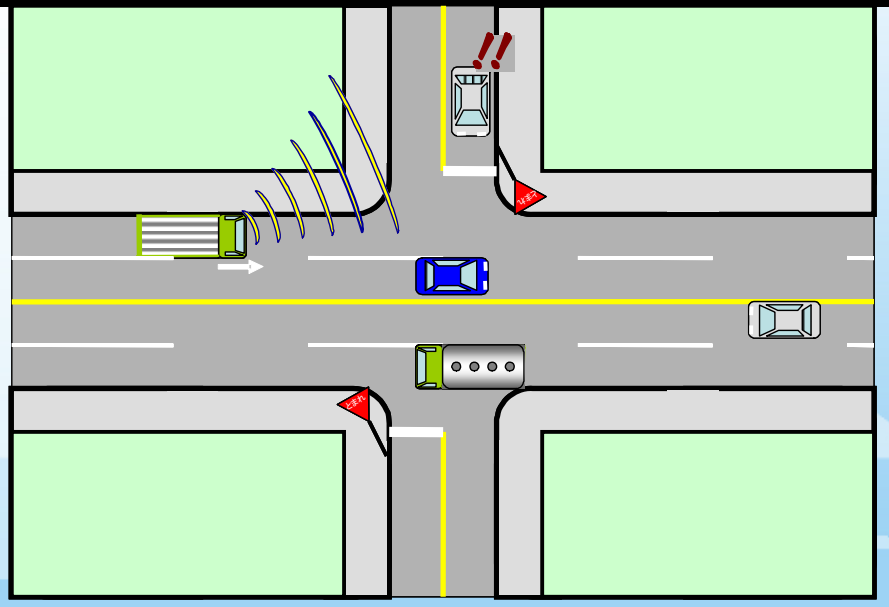
Overview: In actual environments, verify the effectiveness of a number of radio spectrum media in vehicle-to-vehicle communication systems and vehicle-to-infrastructure communication systems that support safe driving.

Contribute to pre-testing in FY2007 and large-scale demonstration tests in FY2008

Case 1: Rear-end collisions



Case 2: Collisions with oncoming vehicles



MIC–MLIT joint tests

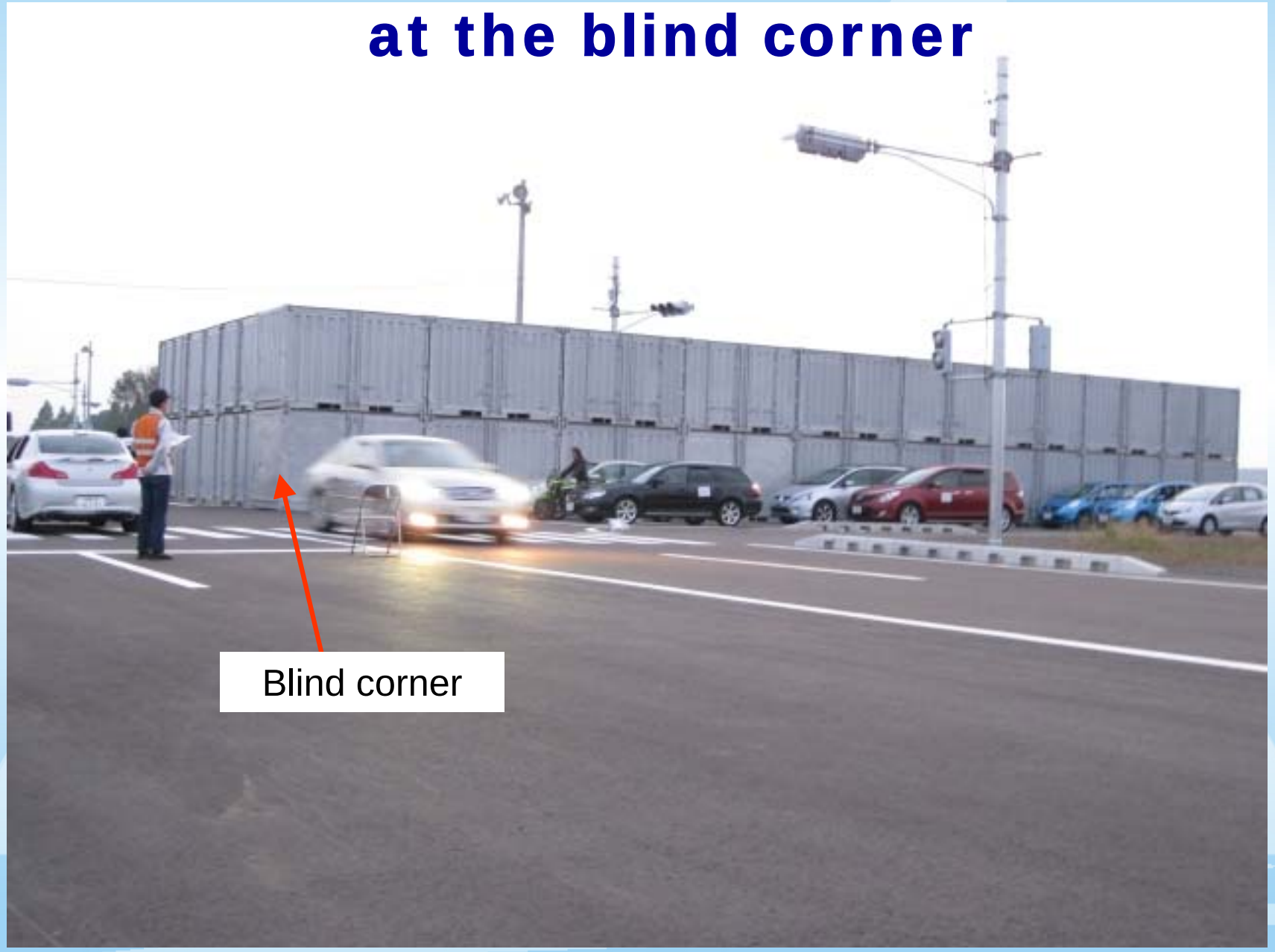
- Purpose:
  1. Finding out the feasibility of V2V application
  2. Evaluation and verification of transmission performance
- Date: in October and November, 2008
- Place:
  1. Test truck at JARI (Japan Automobile Research Institute)
  2. Public road at Odaiba (Tokyo bay area)
- Content:
  1. Transmission tests among 30 vehicles in simulated accident models
  2. Transmission tests between 2 vehicles on the public road based on accident-prevention scenario

Feasibility test guideline for Safe Driving Support Systems in 700MHz Band "ITS FORUM RC-006"

- Radio frequency: 720MHz (Single channel)
- Type of transmission: Broadcast
- MAC: CSMA/CA
- Modulation: BPSK/OFDM, QPSK/OFDM, 16QAM/OFDM
- Number of subcarriers: 52
- Max TX Power: 10mW/MHz
- Occupied bandwidth: Less than 9MHz

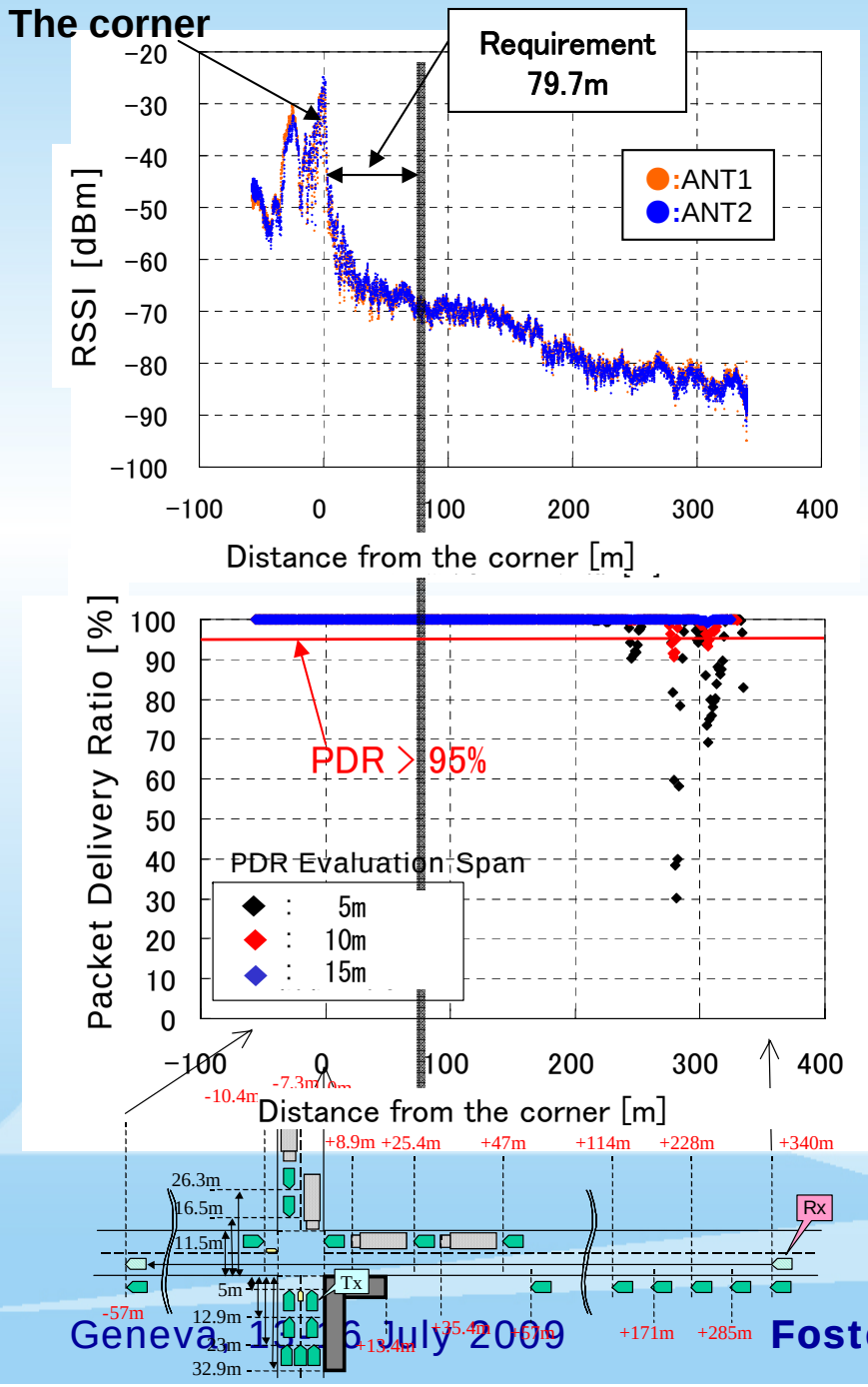
Wide view of simulated intersection and street

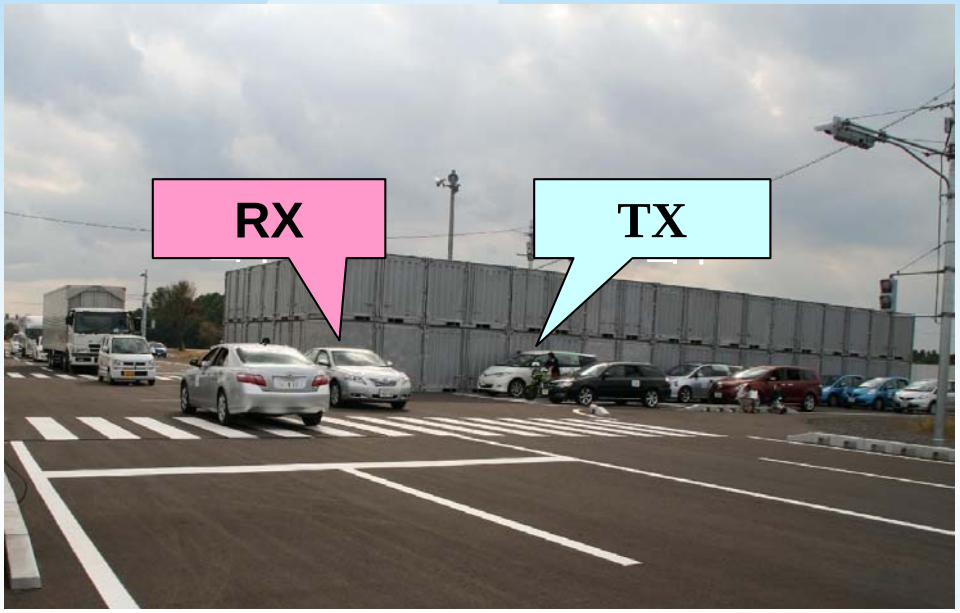
Transmission among many vehicles at the blind corner



Transmission among many vehicles at the tail of traffic jam

Transmission around the blind corner

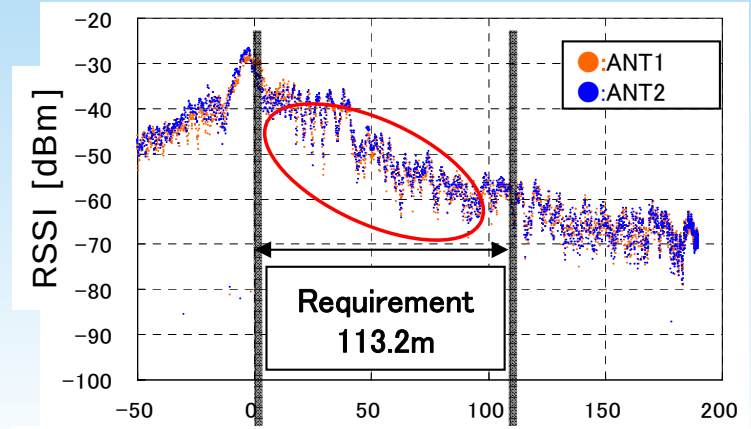


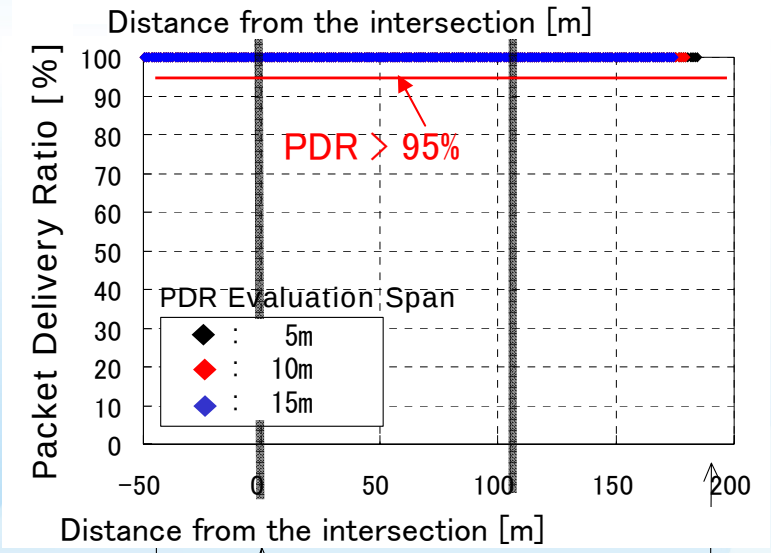


Verified to meet the requirement:

PDR > 95% at 79.7m from the center of the corner

Right turn scenario on public road





Public road (Odaiba)

Verified to meet the requirement:

PDR > 95% at 113.2m from the center of the intersection

Study Group on Advancement of ITS Radio Systems

Aiming to facilitate effective use of spectrum for ITS as well as to clarify the requirements for radio systems used in safe driving support systems, including the vision for vehicle-to-vehicle communications, MIC establishes the Study Group on Advancement of ITS Radio Systems.

Purpose

- To formulate the vision for vehicle-to-vehicle communications
- To clarify the requirements for radio systems used in safe driving support systems

Study Items

(1) Vision of usage for ITS radio systems for safe driving support systems

(2) Radio system functions desired for vehicle-to-vehicle communications and requirements for the system

(3) Issues and strategies toward the realization of vehicle-to-vehicle communications

Study Group Members

Academic experts , Automakers, Electrical manufacturers, Related organizations, users, ITS-related agencies/ministries (NPA, METI, MLIT)

Study Period

From October 2008 to June 2009.

Approach to ITS Safe driving support systems

Approach to V2V and V2I communications

- In order to provide more benefits to users, develop a more rational system configuration, and achieve better cost performance, ITS radio systems should support shared use by both vehicle-to-vehicle communications and vehicle-to-infrastructure communications.

Approach to the 700 MHz band and 5.8 GHz band

- The 700 MHz band is suitable for supplying information on hazards that are not visible to the driver, a function that is expected of vehicle-to-vehicle communications. Therefore, in studies for the implementation of radio systems to support safe driving, we are giving priority to the 700 MHz band, which will become available in 2012, as the frequency band to be used.

Directions in international coordination

- In Orthogonal Frequency Division Multiplex (OFDM) and Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), we will ensure conformity with formats that are currently being considered in North America and Europe.
- Regarding factors such as architecture, we will pursue conformity with formats that are currently being considered in North America and Europe as far as this is possible.

Toward the implementation of ITS radio systems to support safe driving

Technical issues

- Integration of V2V and V2I communication
- Inter-system interference
- Shadowing and Hidden node problem
- Accuracy of position information
- Information Security

Operational issues

- To facilitate the smooth provision of services, it is necessary to identify the content of services, operation and management formats, and other factors for each function.

Further advancement

- Effective utilization of data obtained from vehicles for extended multiple applications; “Safety”, “Environment” and “Comfort and convenience”
- Continuous R&D for further advancement of ITS radio systems to make the effective use of spectrum for ITS.

Promotion measures

Measures for introduction

Constructing a proving test environment that can be used anytime

Suitable and timely international coordination

Early formulation of technical conditions for safe driving support systems

A variety of measures are needed for the introduction and widespread adoption of ITS radio systems to support safety driving.

Cooperation among industry, academia, and government for smooth introduction

Measures for widespread adoption

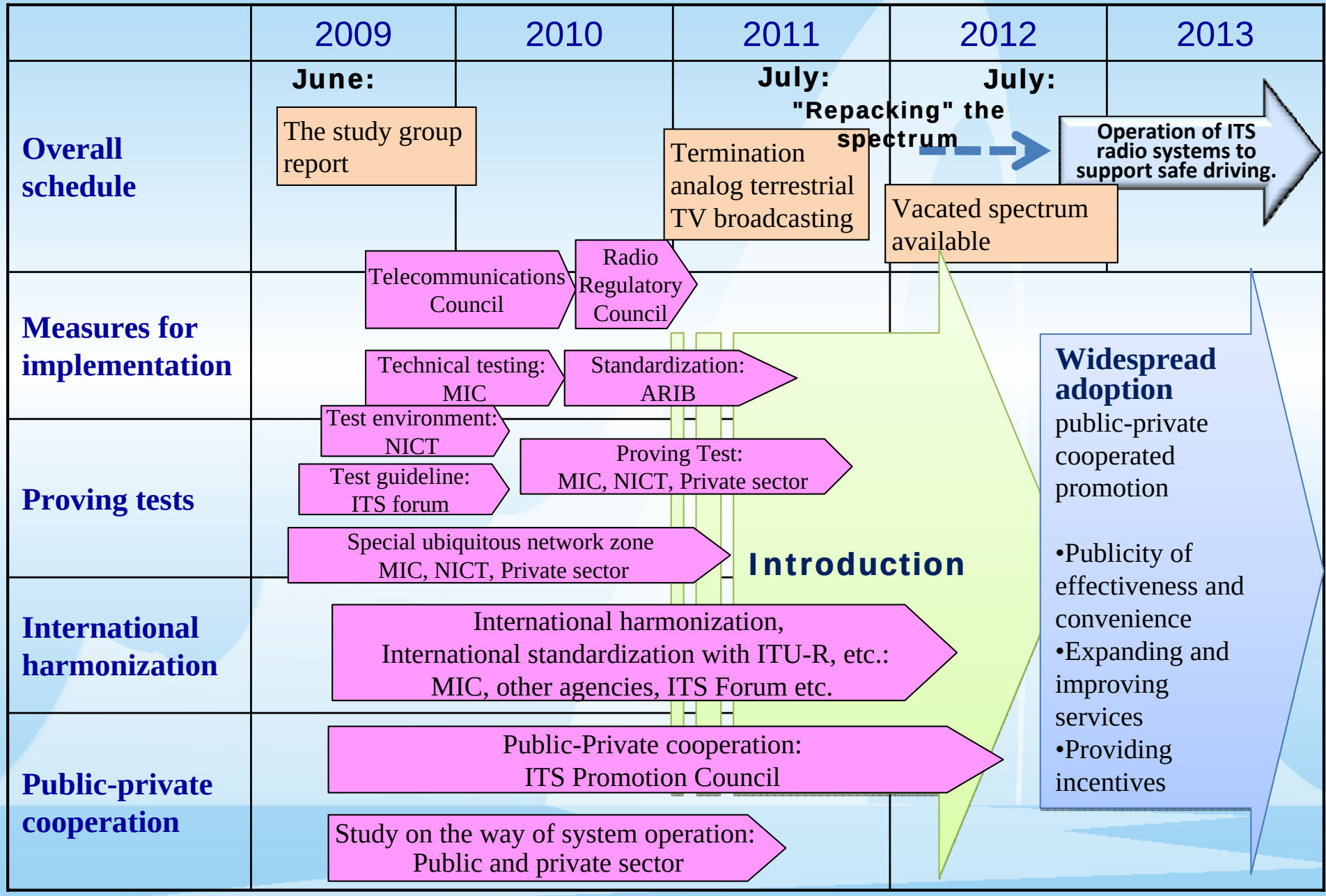
Promoting a rapid pace of adoption

Publicity of effectiveness and convenience of services to support safe driving

Expanding and improving services

Providing incentives

Schedule for introduction and widespread adoption



ITS Radiocommunication Standardization in Japan