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<td>CONTACT(S):</td>
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**ITS Radiocommunication Systems in Japan**

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

**Takeshi Yamamoto**
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.
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)

Sensor Type
- Public Traffic information
- Radio Beacon (2.5GHz, 5.8GHz)

**Communication Type**

*Wide Area (Interactive)*
- Mobile Phone (800MHz, 2GHz, etc.)

**Vehicle to Vehicle**
- Sub-Millimeter Wave (60, 76, 79GHz)
- ITS for Pedestrians (13.56MHz, 950MHz, 2.4GHz)
- Warning “A car is coming”

**Vehicle to Infrastructure**
- ETC / DSRC
  - ETC: Electronic Toll Collection
  - DSRC: Dedicated Short Range Communication
- Gas Station
  - 60 liter
  - 5500 yen
- Parking lot
  - (Auto Fee collection)
- Warning (A car is coming)

GPS

Gas Station
60 liter
5500 yen
Parking lot
(Auto Fee collection)

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Purpose of ITS (Intelligent Transport Systems)

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

- **Safety**
  - Reduction of traffic accidents
  - Hazard avoidance

- **ITS Applications**
  - Smoother traffic flow
  - Congestion mitigation
  - Reduction of environmental burden
  - Reduction of carbon dioxide emissions
  - Transportation management

- **Environment**
  - Safe Driving Support Systems for reduction of traffic accidents

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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

Contribution for deployment
J-Safety Committee, ITS Japan

Cooperation
ITS Promotion Council

Harmonization between Private-Public Sectors

Exchange Opinion
Proposal

Ministries and Agency, Organizations, Academia

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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.

Safe driving support systems utilize radio systems to effectively supply information on hazards that may not be visible to the driver.
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Spectrum Use After “Digital Dividend”

Current Spectrum Allocation

- 90 - 108MHz (1 - 3ch)
- 170 - 222MHz (4 - 12ch)
- 470 - 770MHz (13 - 62ch)

Analog TV

Analog TV

Analog and Digital TV

Future Spectrum Allocation

After digitization

- Digital TV (13 - 52ch)

New Spectrum Use

- 90 - 108MHz
- 170 - 222MHz
- 470 - 770MHz

Available from July, 2012

Spectrum Allocation Plan (December, 2007)

- 10MHz

- Gardband (5MHz)

Self-owned communications (to preserve security and safety)

Broadcasting (multi-media mobile broadcasting etc.)

ITS

Telecommunications (cellular phones etc.)
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
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

Tail of the line of vehicles
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

Verified to meet the requirement:

\[ \text{PDR} > 95\% \text{ at } 113.2\text{m from the center of the intersection} \]
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.
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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.
A variety of measures are needed for the introduction and widespread adoption of ITS radio systems to support safety driving.

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
- Cooperation among industry, academia, and government for smooth introduction

Measures for widespread adoption

- Promoting a rapid pace of adoption
- Expanding and improving services
- Providing incentives
- Publicity of effectiveness and convenience of services to support safe driving

Geneva, 13-16 July 2009
## Schedule for introduction and widespread adoption

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<th>2011</th>
<th>2012</th>
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<tr>
<td><strong>Overall schedule</strong></td>
<td><strong>June:</strong> The study group report</td>
<td>Radio Regulatory Council</td>
<td>Termination analog terrestrial TV broadcasting</td>
<td>Vacated spectrum available</td>
<td>Operation of ITS radio systems to support safe driving.</td>
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<td>Standardization: ARIB</td>
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<td>Test guideline: ITS forum</td>
<td>Proving Test: MIC, NICT, Private sector</td>
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<td>Special ubiquitous network zone MIC, NICT, Private sector</td>
<td>International harmonization, International standardization with ITU-R, etc.: MIC, other agencies, ITS Forum etc.</td>
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<td>Study on the way of system operation: Public and private sector</td>
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### Widespread adoption
- public-private cooperated promotion
  - Publicity of effectiveness and convenience
  - Expanding and improving services
  - Providing incentives

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**Geneva, 13-16 July 2009**

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ITS Radiocommunication Standardization in Japan

ISO TC204

ITS National Committee (JSAE)

ITU-R

ASTAP

Information and Telecommunications Technology Council (MIC)

ARIB (Association of Radio Industries and Businesses)

ITS Standards (DSRC, V2V, V2I etc.)

ITS Info-communications Forum

ASTAP: Asia-Pacific Telecommunity Standardization Program

(MIC: Ministry of Internal Affairs and Communications)

ITS Standards (DSRC, V2V, V2I etc.)

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