ITS Application to Express Safety
- Japanese Experience -

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- **Main Concern:**
  - **Safety on Expressways**
  - **ITS Application to enhance Safety Circumstance**

<At the beginning>

- Expressways in Japan
  - Total Length of expressways in Japan: 8,000km
    - Land area of the nation: about 1/9 of India
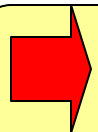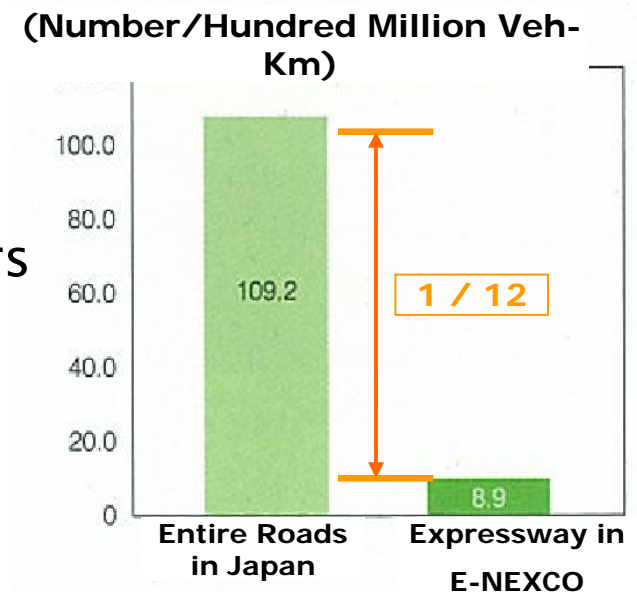   - Population: about 1/9 of India

  Expressway that is high standard highway with:
  - Limited access: vehicles can access only through interchanges
  - Mostly toll highway: all toll gate has at least non-stop ETC lane
  - Speed limit regulation: 100km/hr and 80km/hr

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Accidents on Expressway

- Specific features regarding accidents on access controlled expressways
  - What is the difference between expressway and national highway?

  (Number/Hundred Million Veh-Km)

  - Access controlled
    - No crossing vehicle and/or passengers
  - Smooth alignment
    - Easy handling, swift acceleration

  100.0

  80.0

  60.0   **1 / 12**

  40.0

  20.0

  0

  109.2

  8.9

  Entire Roads in Japan   **Expressway in E-NEXCO**

➡ less accident ratio,
but more fatal accidents possibility on expressways

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Road Safety Measures on Expressway

- From three aspects
    - Road structures (conventional hard approach)
    - Traffic operation (conventional soft approach)
    - High-tech traffic management (conventional to ITS, new approach)

Porous Pavement

Regular Pavement

<Example of hard approach>

Introduction of Porous Pavement
Improvement of driving condition under rainy

<Example of soft approach>

Routine patrol and safety notification to drivers

Information Collection

All the information is accumulated at traffic control centre.

Traffic Counter

Emergency Telephone
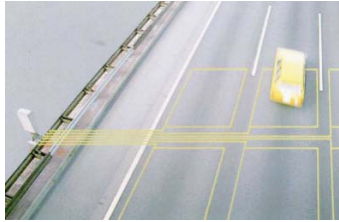
Meteorological Observation Unit

Traffic Control Centre

Traffic Monitoring Camera

Periodical Patrol

IT Technology in Traffic Management (2)

Information Provision

Information is provided to road users through various tools from control

Traffic Control Centre

<Various Type of Information Boards:

Diagram routes information

**Free-pattern informat at Toll Gate**

Through PC Internet

Cell Phone Internet & Mailing Service

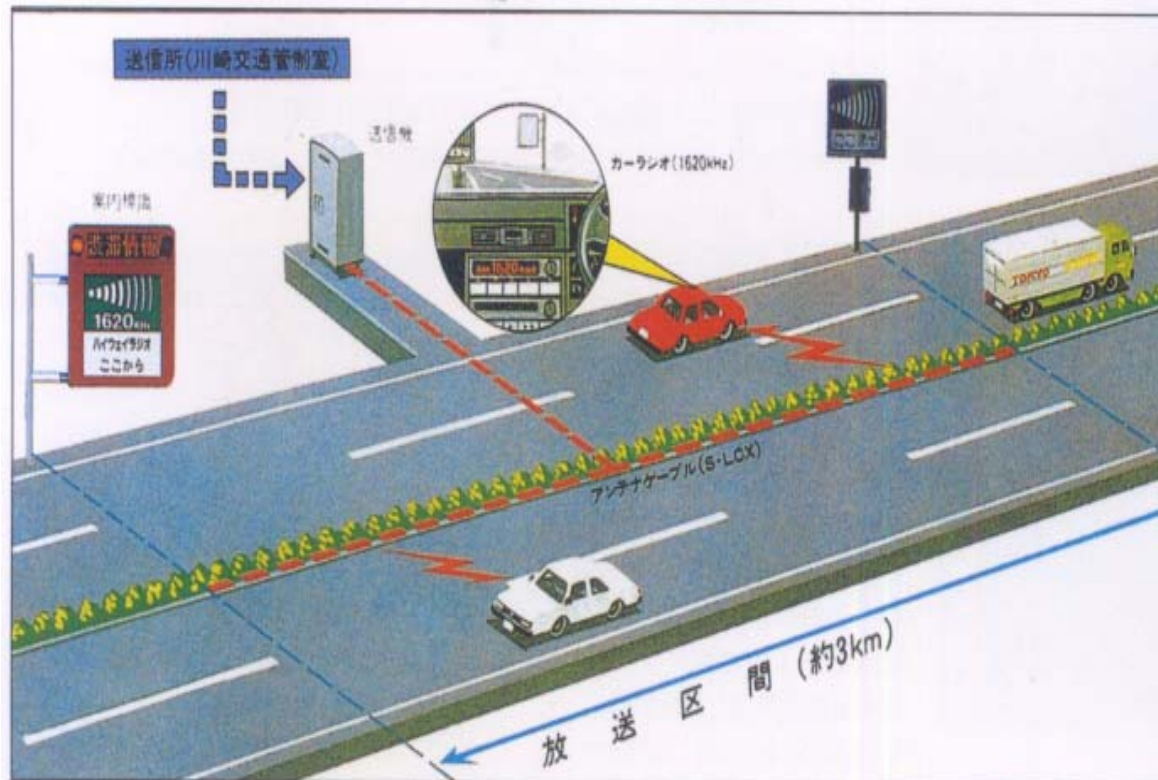**Rest area informati**

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Traffic Counter System

- There are two kinds of traffic detector systems. One kind senses changes in the inductance of loop coils installed under the road surface. The other consists of sensors installed by roadside to detect motor vehicles base on the reflection of ultrasonic waves from passing vehicles.
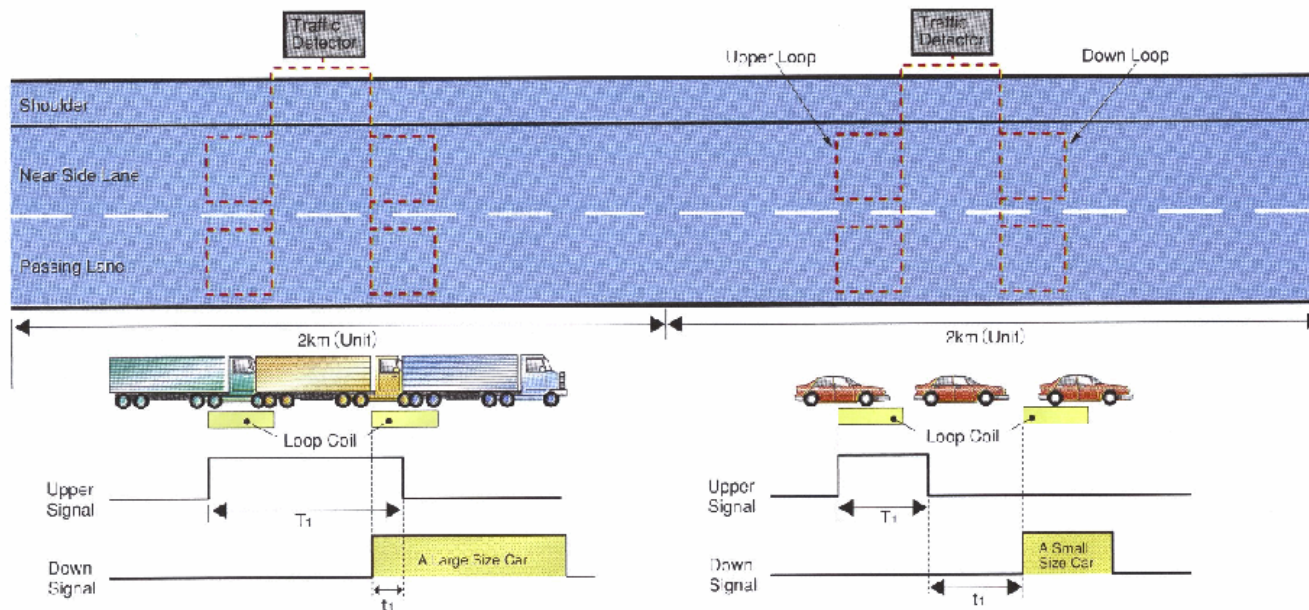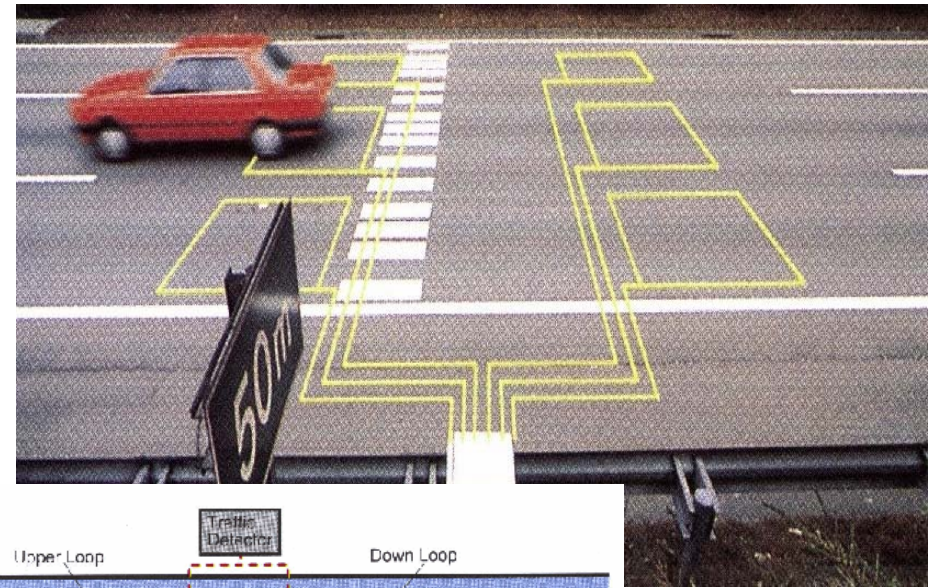
Highway Radio

- Radio transmitters installed by the side of expressways to transmit announcements of detailed road traffic information that cannot be fully displayed on road information boards to car radios in the vehicles of expressways users.

Information Terminal

- Installed at rest facilities to help expressways users plan their trips by providing them with wide area information, guidance to leisure facilities, etc. on the route ahead.

Route Selection

- Diagram routes information of road closure and congestion information providing the time required on selective routes and is installed upstream from sections where congestion frequently occurs and routes consisting a network.

Further application of ITS technology

- Road operation
  (Asset management, etc)
- Various problems
  (Traffic accidents, Traffic congesti
  Environmental burden, etc)

⬇
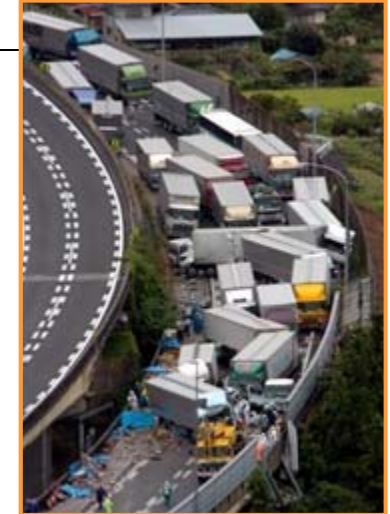
- **Information & Communication Technology (ICT)**
  resolves problems that could not be fully corrected by
  conventional road operation issues.

⬇

ITS application !

Amount of
congestion
(km h/day)

ETC use rate
(%)

Amount of congestion

56.2

73.0

65.3

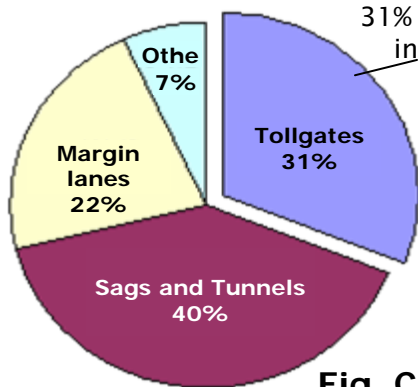**ETC utilization rate**

38.1

31% of congestion is due to inadequate capacity at tollgates.

21.2

12.1

Congestion Cleared

6.1

19.8

3.9

2.8

Othe 7%

Margin lanes 22%

Tollgates 31%
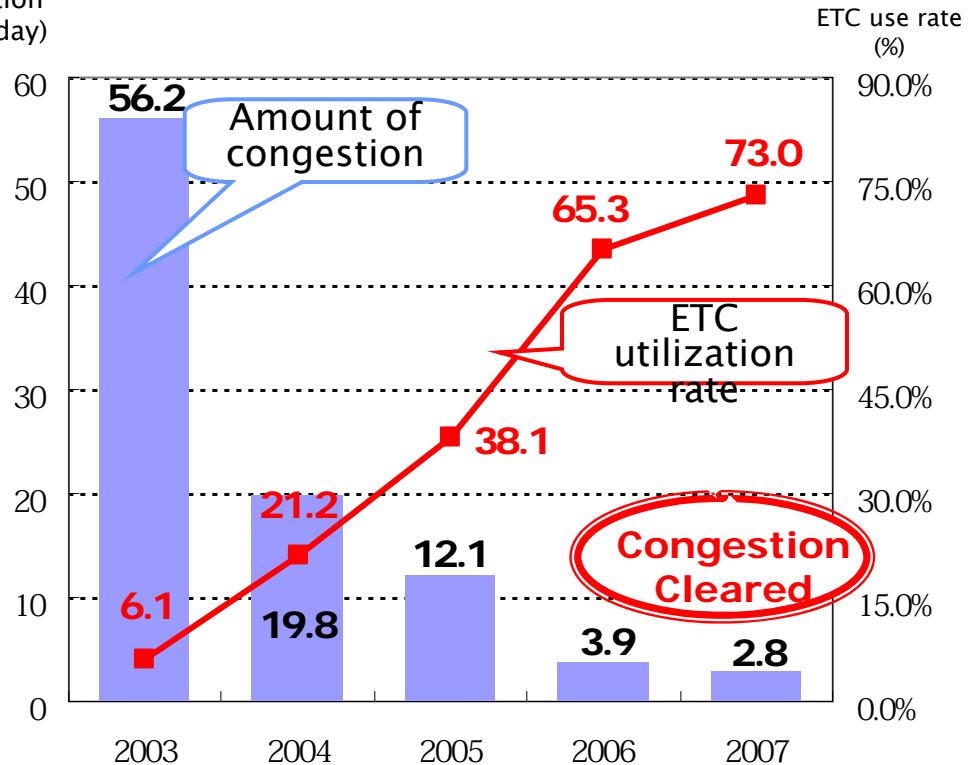
Sags and Tunnels 40%

Fig. Causes of congestion on expressways

Fig. Status of traffic congestion

· **Estimated economic effects: annual savings of 2.7 billion US dollars (utilization rate 50%)**
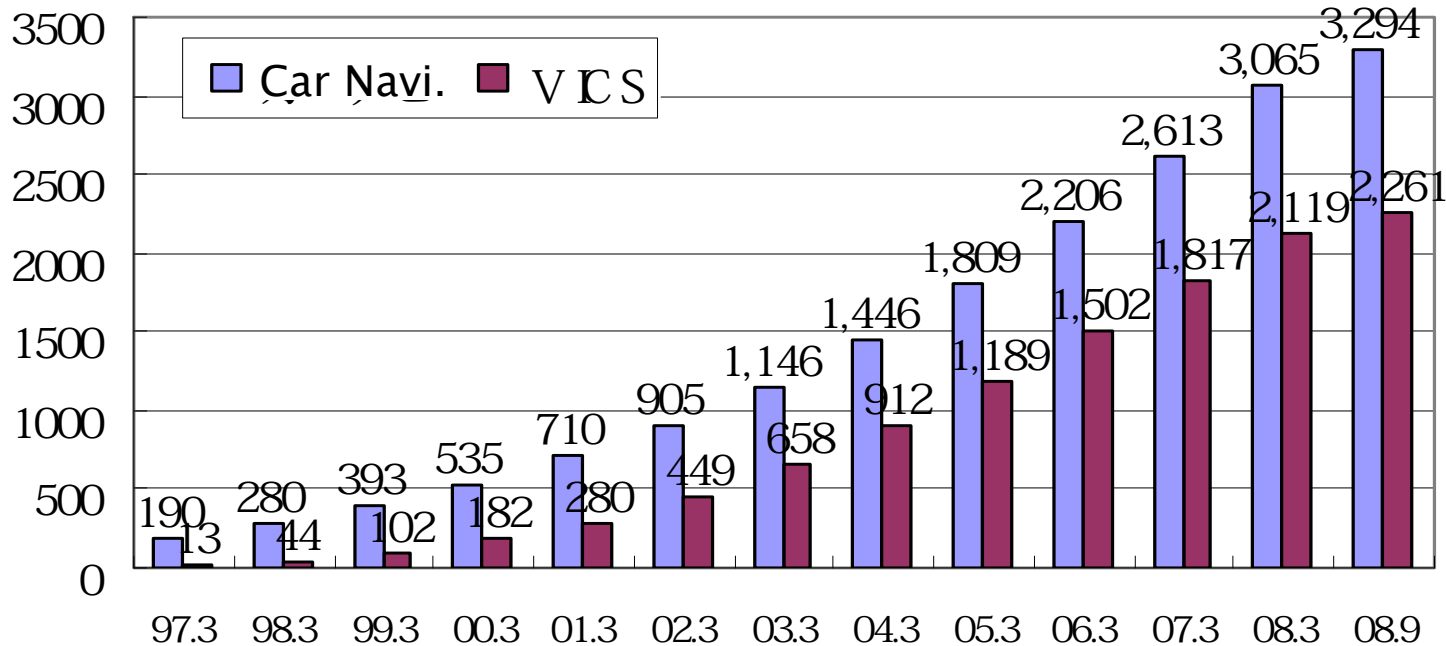· **Reduce environmental burden**

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Status of Road Related ITC Technology 2 - Car Navigation Systems

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> A cumulative total of **33M car navigation systems** and **22M VICS※ units** have been shipped. (Total vehicle ownership is 79 M.)

Trend in the cumulative totals of Car Navi and VICS units shipped

Car Navi. ■ VICS

	97.3	98.3	99.3	00.3	01.3	02.3	03.3	04.3	05.3	06.3	07.3	08.3	08.9
Car Navi	190	280	393	535	710	905	1,146	1,446	1,809	2,206	2,613	3,065	3,294
VICS	13	44	102	182	280	449	658	912	1,189	1,502	1,817	2,119	2,261

(Display of VICS)

Text

VICSとうきょう　　　(01/13)　09：24
桜田通り下り
霞が関→田園調布署前約35分
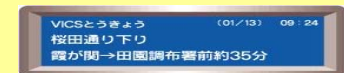
Simple diagrams

Map Display

※ VICS (Vehicle Information Communication System) :
An information and communication system which displays information on traffic congestion and traffic regulations to car navigation systems and other vehicle-mounted devices.

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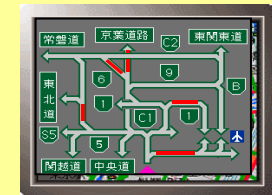
➢ Road operation includes three primary functions.

Toll Collection

ETC

Traffic Control & Information

ICT

VICS, Highway Radio, Traffic Control System, Traffic Sensor, Camera,

Road & Facility Management

Road optical fiber, Wireless systems for road management (Radar rain gauge, Effluent alarm, Image transmission, etc)
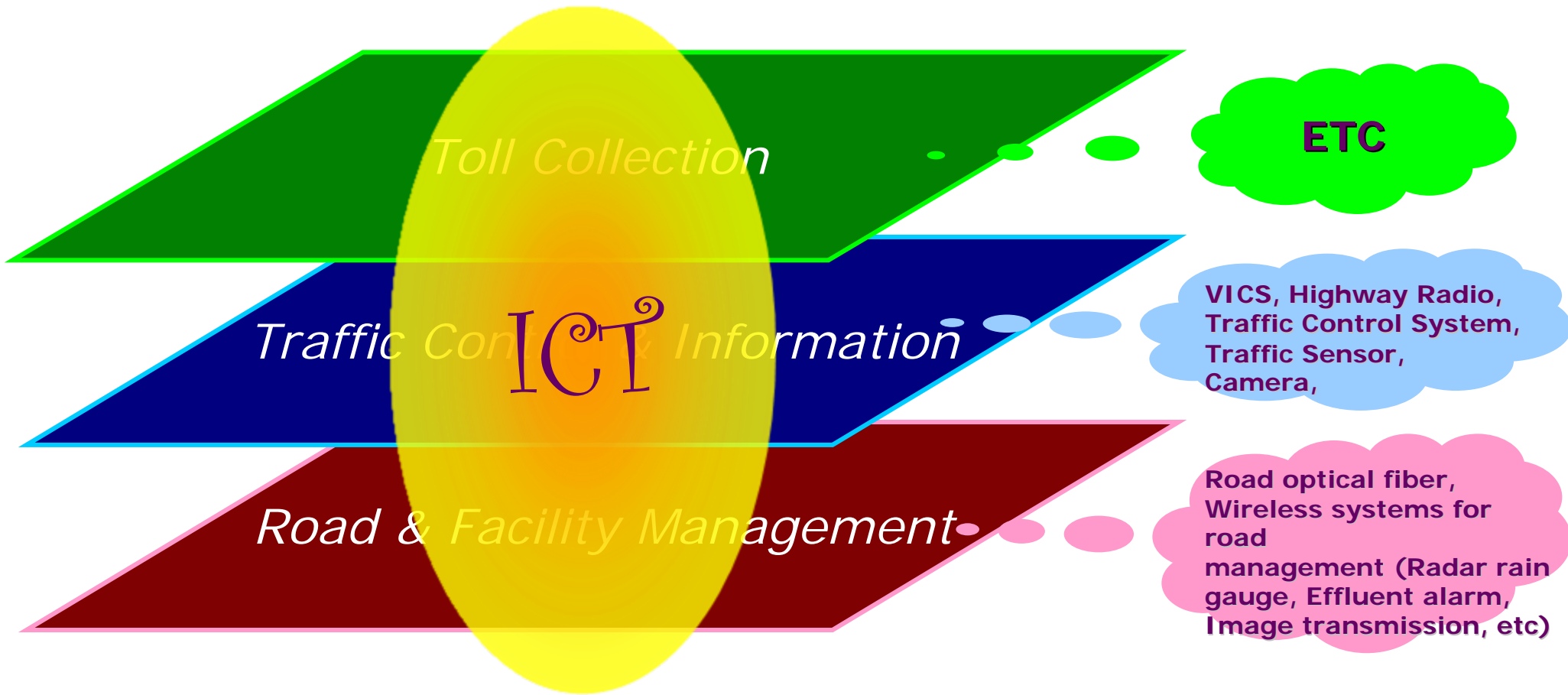
Various ICT technologies are used to integrate these functions, as the Intelligent Transport Systems (ITS). Smartway

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Future Vision on ITS with ETC system

Once VICS and ETC integrated,
   various next-generation services will be provided **by a single c**

Multi-purpose payment

Information Services

Gas Station

Toll Gate

During Driving

Access Control

DSRC beacon

At Rest Areas

Public Parking
Residential Parking

Gas Station
Convenience Store

speaker

antenna

navigation display

on-board-unit
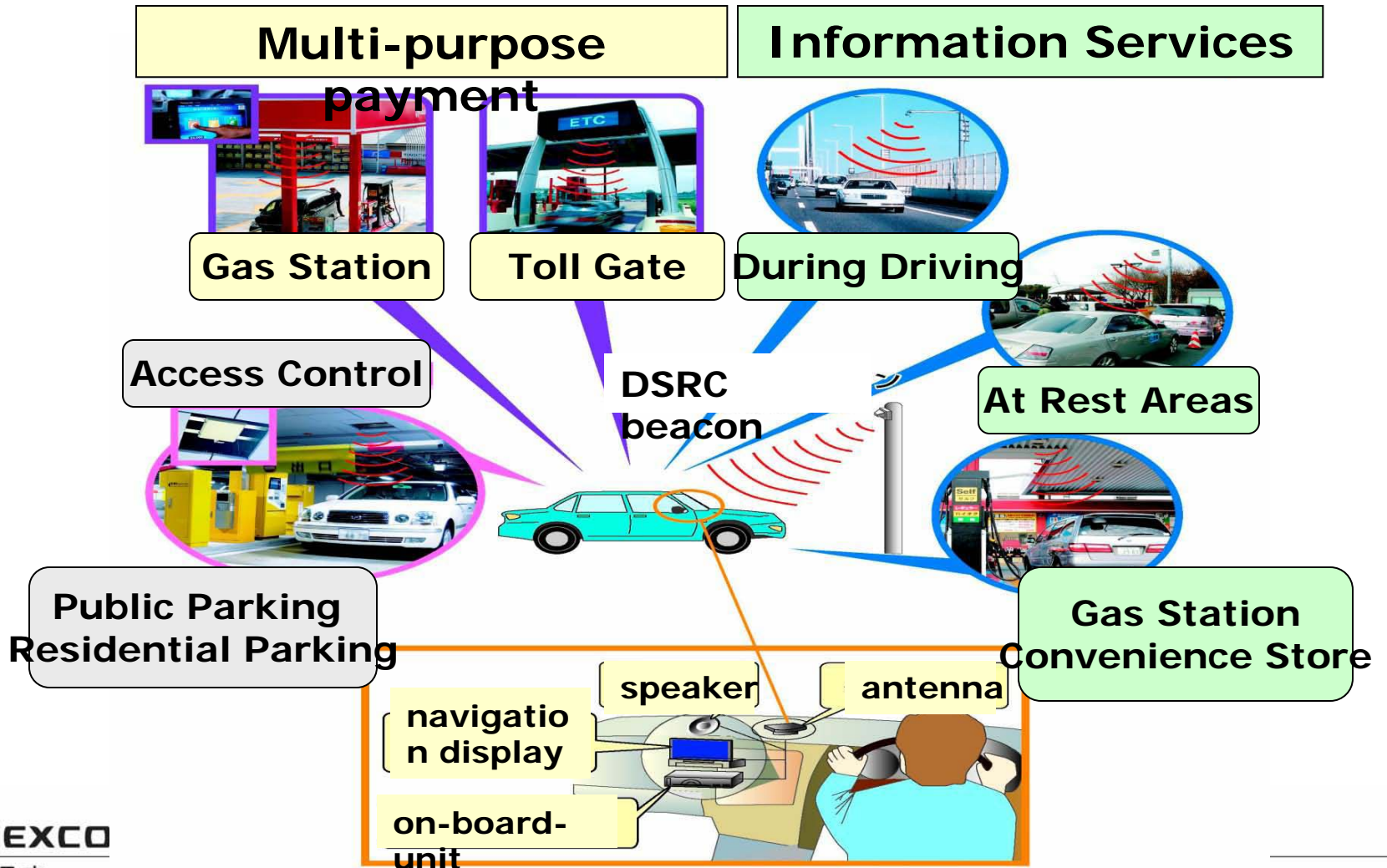
Smartway: Expansion of ETC technology

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> ➤ "*Smartway*" services is expanded Japanese ETC technologies combined with car navigation system

Diverse media

VICS receiver (2.4 GHz)

+

ETC on-board unit (5.8 GHz Active DSRC)

+

Car navigation system

➤

ITS on-board unit (5.8 GHz Active DSRC)

+

Car navigation system

VICS (wide-area, detailed road traffic information)

Shinjuku–Dori Ave. near Yotsuya–Mitsuke: Congested for 0.5 km

Fee payment at parking facilities, etc.

In-car Internet access

Driving safety support services

Congestion ahead. Take care to avoid a rear–end collision.

✧**Information on "Smartway" is courtesy of Metropolitan Expressway Co. Ltd and national Institute for land and Infrastructure Management.**

Smartway: **Project Purpose**
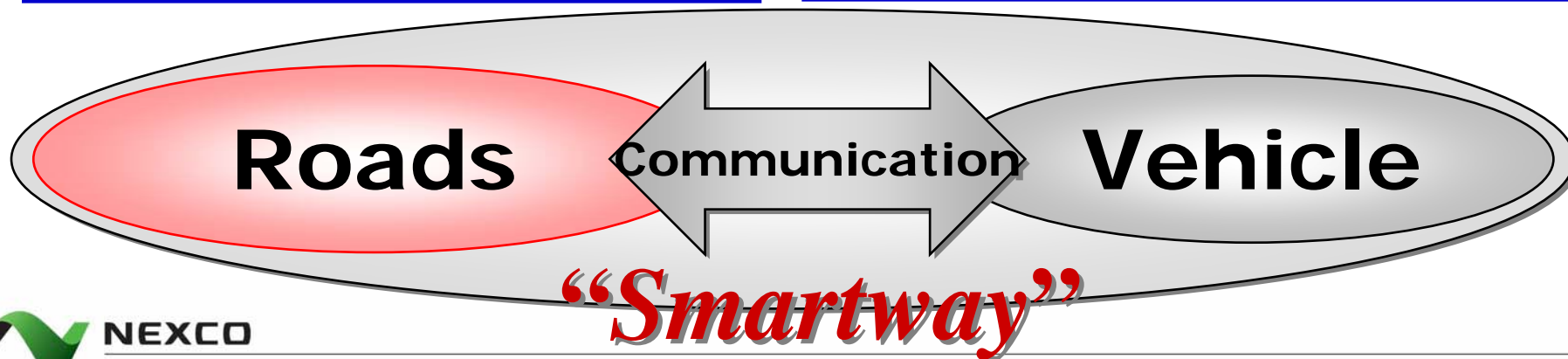
Definition of *Smartway*

information among cars, drivers, pedestrians, and other roadway users.

Foundation for the deployment of various ITS services

·Realize integrated ITS to provide safe, smooth road transportation and positive environment.

Foundation for affluence and comfort in life and society

·Realize efficient mobility for people, goods, and information
·Realize comfortable living spaces
·Build infrastructure that provides safety and security

Roads ⟷ **Communication** **Vehicle**

"Smartway"

◇**Information on "Smartway" is courtesy of Metropolitan Expressway Co. Ltd and national Institute for land and Infrastructure Management.**

Feature of *Smartway*
- Road-Vehicle Cooperation System

・ **Develop new "Road-Vehicle Cooperation Systems" using 5.8 GHz Active DSRC and ITS On-board Units (OBUs) for *Smartway***

<Road-Vehicle Cooperation Systems>

DSRC Anten

ITS OBU

Stand-alone Type

Car navigation linked type

5.8GHz Active DSRC (Dedicated Short Range Communication)

◇**Information on "Smartway" is courtesy of Metropolitan Expressway Co. Ltd and national Institute for land and Infrastructure Management.**
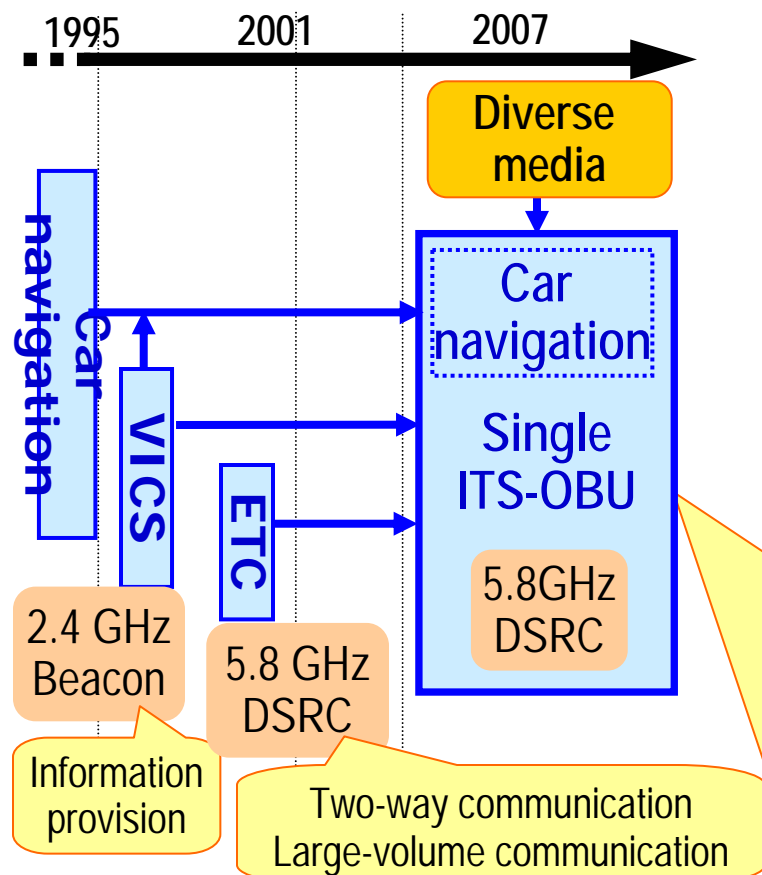
Concept of *Smartway*

1) Active DSRC and advanced Car-Navigation System enables Driving Safety Support
2) Enhanced capacity of Active DSRC enables information provision through images and voices
3) Interactive communication of Active DSRC can be applied to credit card transaction or Internet Connection

5.8 GHz Active DSRC

Safety Drive Support

VICS

On-board GPS

ETC

Transaction at Parking

Internet Access

左から合流車、注意

東日本 ◇Information on "Smartway" is courtesy of Metropolitan Expressway Co. Ltd and national Institute for land and Infrastructure Management.

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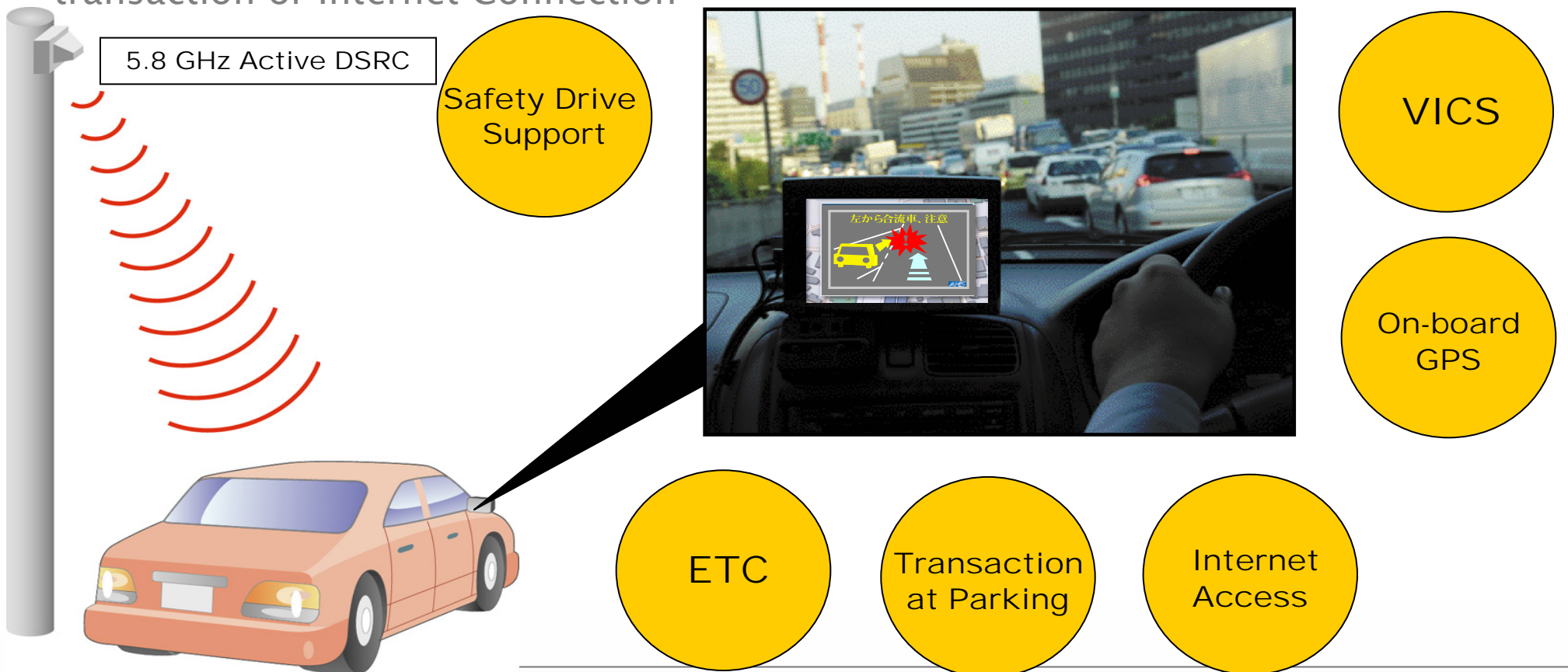
Feature of *Smartway*
- Realize Various Services through a Single OBU

· **A single ITS on-board unit (OBU) will provide various services according to establishment of common platform**

1995　　　2001　　　2007

Diverse media

Car navigation

Car navigation

Single ITS-OBU

5.8GHz DSRC

VICS

ETC

2.4 GHz Beacon

5.8 GHz DSRC

Information provision

Two-way communication
Large-volume communication

Providing information on assisting safe driving

Vehicles merging from the left.
Drive carefully!

首都高速情報 AHS

Wide range traffic congestion information

Providing information on conditions ahead

1 km ahead. Gaien

Parking lot payment

P

：Service　　　：On-board unit

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Smartway Field Test - Two Types of OBU

Voice ITS OBU

Beep! Congestion ahead. Drive Carefully!

Car Navigation Correlated ITS OBU
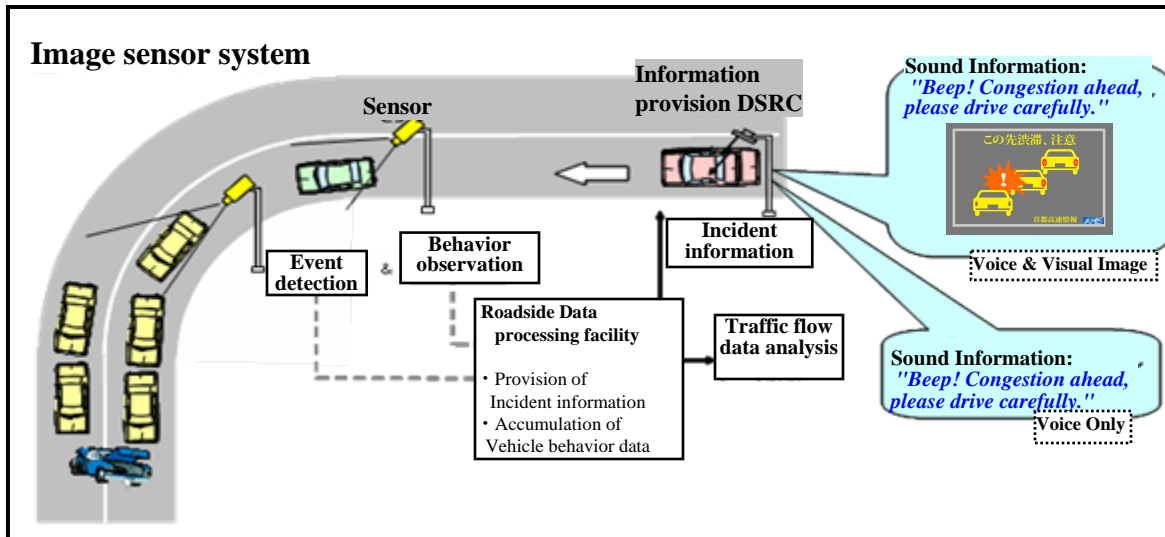
Beep! Congestion ahead. Drive Carefully!
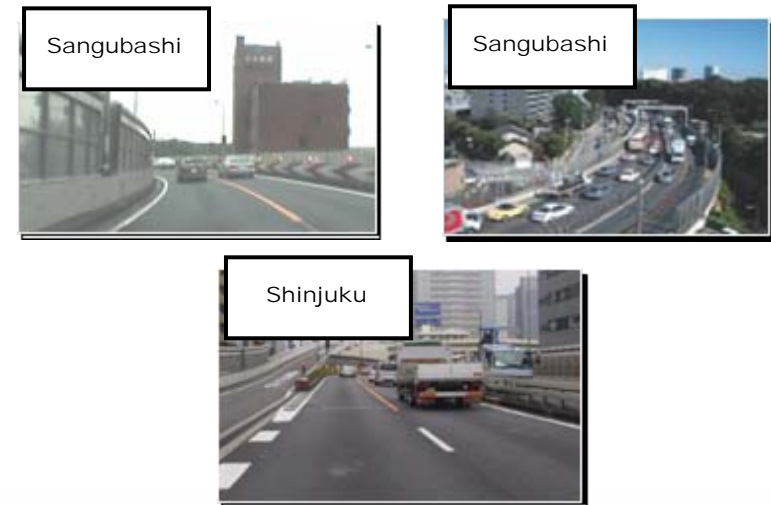
1) Providing information on obstacles ahead

- Roadside sensors detect stopped vehicles or congestion beyond a curve with poor visibility, and drivers entering the curve are warned using visual and audio information.
- Information is provided at 5.8 GHz Active DSRC (visual plus audio, or audio alone).
- Adequate detection performance and lower implementation costs are taken into consideration.

Conceptual image of system

Image sensor system

Sensor

Information provision DSRC

Event detection & Behavior observation

Roadside Data processing facility
· Provision of Incident information
· Accumulation of Vehicle behavior data

Incident information

Traffic flow data analysis

Sound Information:
"Beep! Congestion ahead, please drive carefully."

この先渋滞、注意

首都高速情報

Voice & Visual Image

Sound Information:
"Beep! Congestion ahead, please drive carefully."

Voice Only

Anticipated benefits

- Fewer rear-end collisions beyond curves with poor visibility
- Lower frequency of near-misses (rapid deceleration)
- Lower speeds when entering the curve

Sangubashi

Sangubashi

Shinjuku

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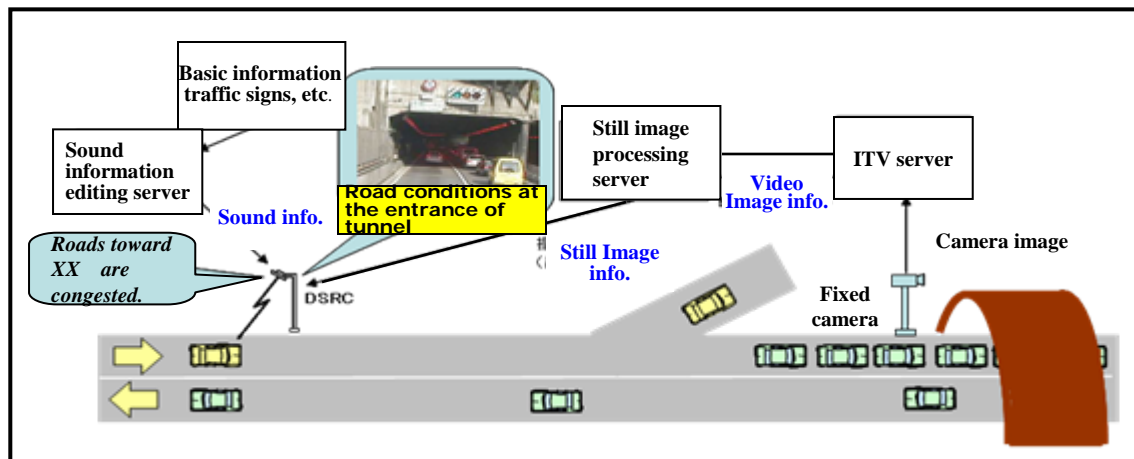
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2) Providing information on conditions ahead (audio + visual)

- In the service to provide information on conditions ahead, drivers receive visual information on road conditions ahead as a means of support for their route selection.
- Using 5.8 GHz Active DSRC, camera images of tunnels and locations of frequent congestion are provided as still images; and the content of nearby information signs is supplied in audio form

Conceptual image of system

Basic information traffic signs, etc.

Sound information editing server

Road conditions at the entrance of tunnel

Sound info.

Roads toward XX are congested.

DSRC

Still image processing server

Video Image info.

Still Image info.

ITV server

Camera image

Fixed camera

Anticipated benefits

- Providing visual information on road conditions ahead
  -> Improved peace of mind for drivers; improved safety margin when driving; assistance for route selection by drivers.

- Providing audio information on road conditions ahead
  -> Improved recognition rate when combined with visual information; improved peace of mind for drivers.

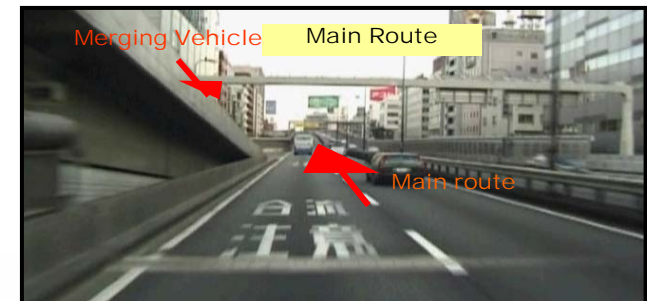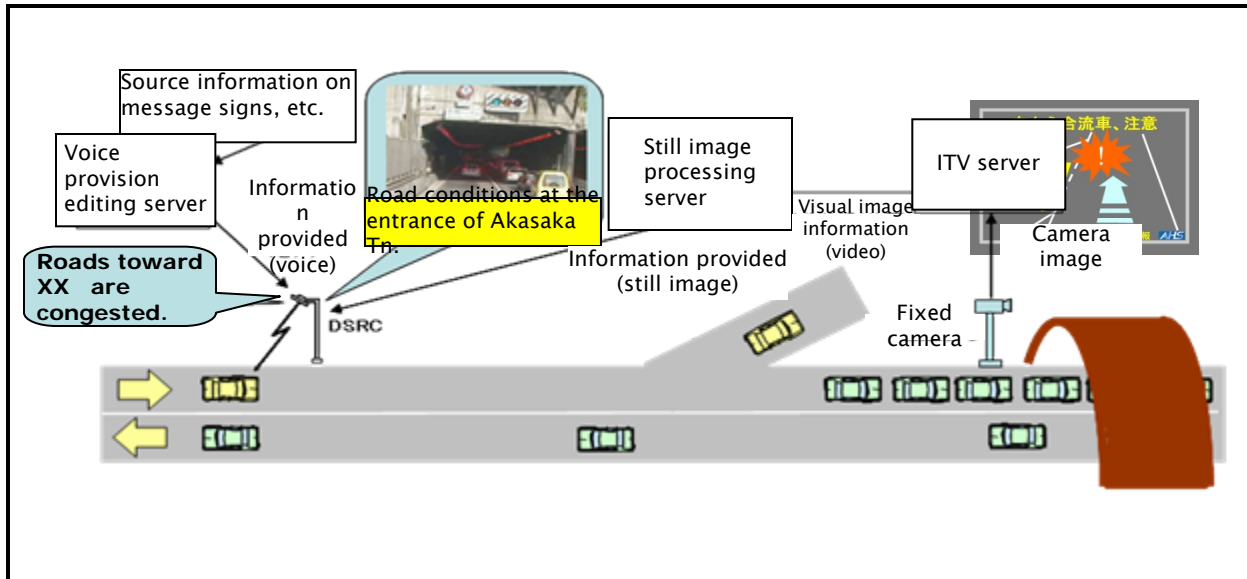Kasumigaseki TN

Gaien

Edobashi JCT

Kitanomaru TN

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3) Merging assistance

- To prevent impact accidents at merge points, vehicles approaching a merge point are detected from the roadside; and just before the merge point, easy-to-understand information on the presence of other merging vehicles is provided to drivers.
- 5.8 GHz Active DSRC is used to call attention by sending information either in both audio and visual form, or in audio form only.
- Only vehicles at the main leg will receive information at initial phase of the development. At the next step of the development, merging vehicles will also receive information. This will then be expanded to include information that will support cooperation between vehicles on both the main route and the merging lane.

Conceptual image of system

Source information on message signs, etc.

Voice provision editing server

Information provided (voice)

Road conditions at the entrance of Akasaka Tn.

Still image processing server

ITV server

Visual image information (video)

Information provided (still image)

Camera image

Roads toward XX are congested.

DSRC

Fixed camera

Higashi-Ikebukuro

Merging Lane

Merging Vehicle   Main Route

Main route

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4) Map-linked services to call attention and provide information

- Car navigation systems are used to provide information to support safe driving over a broad area, including locations with relatively low accident densities.
- Based on map databases in car navigation systems, including road curvature and gradient data, drivers are alerted in accordance with their speed of travel and other factors when entering a curve, and information is provided at locations with frequent accidents
- The effectiveness of information service are verified.
- Absence of hazardous behavior such as sudden braking and abrupt steering is confirmed at the development stage.

Conceptual image of system

Support for hazard prevention when entering a curve
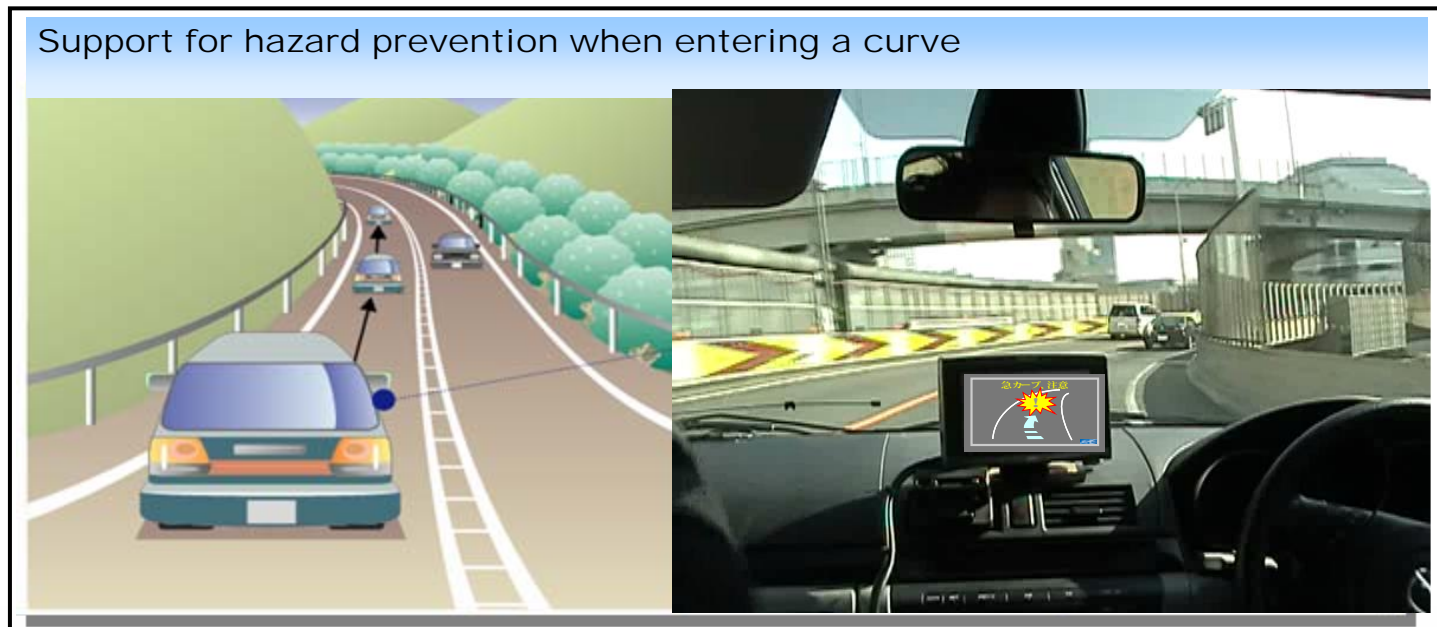
5) Information supply (IP data connection)

- To provide added convenience, users in parked cars at service areas, parking areas, and the like are provided with an Internet connected environment using 5.8 GHz Active DSRC and wireless LAN.
- The home page provides road traffic information, weather information, and information on the local area, including stores.
- Store information and the like is provided in audio form at the entrance to the service area or parking area.
- The effectiveness of this information service in improving driver convenience will be verified.

Conceptual image of system
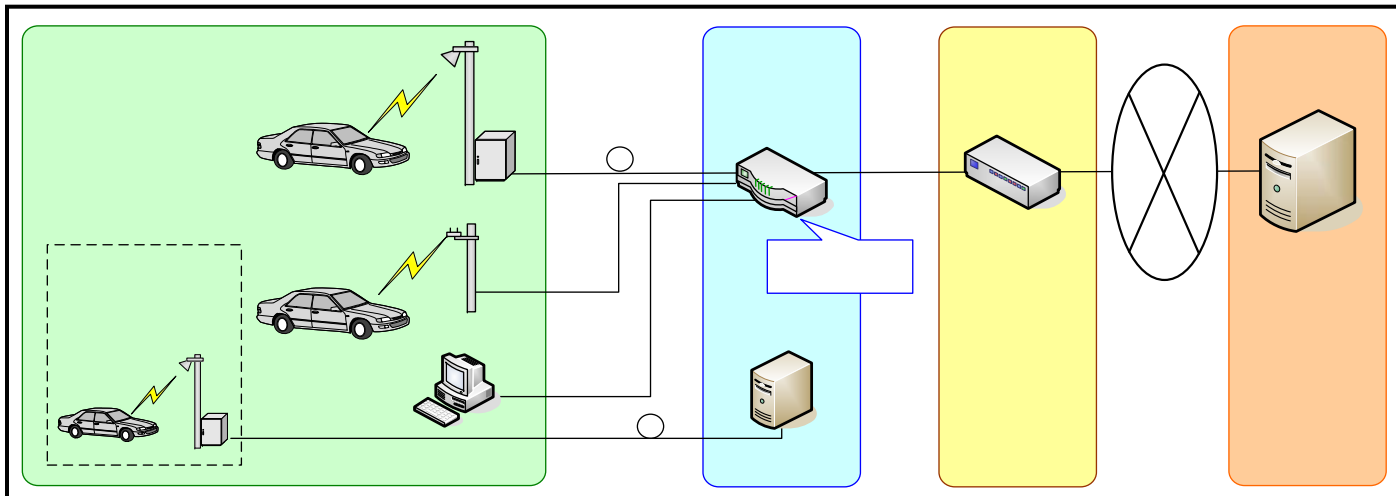
6) Smart parking areas (virtual parking areas)

- There are a few parking areas on the Metropolitan Expressway, and they are small in scale. There is a low level of service compared to the needs of users to take breaks to relieve the stress of driving and use restrooms during periods of traffic congestion.
- To resolve this problem, parking area services based on ETC on-board units, using ETC user ID numbers, will be provided to vehicles equipped with ETC on-board units.
- It is anticipated that these smart parking areas will be used as rest areas on the Metropolitan Expressway main line. The possibility of providing a discount on main line tolls are studied when these parking areas are used.
- The effectiveness of this service in improving driver convenience will be verified.

Conceptual image of system
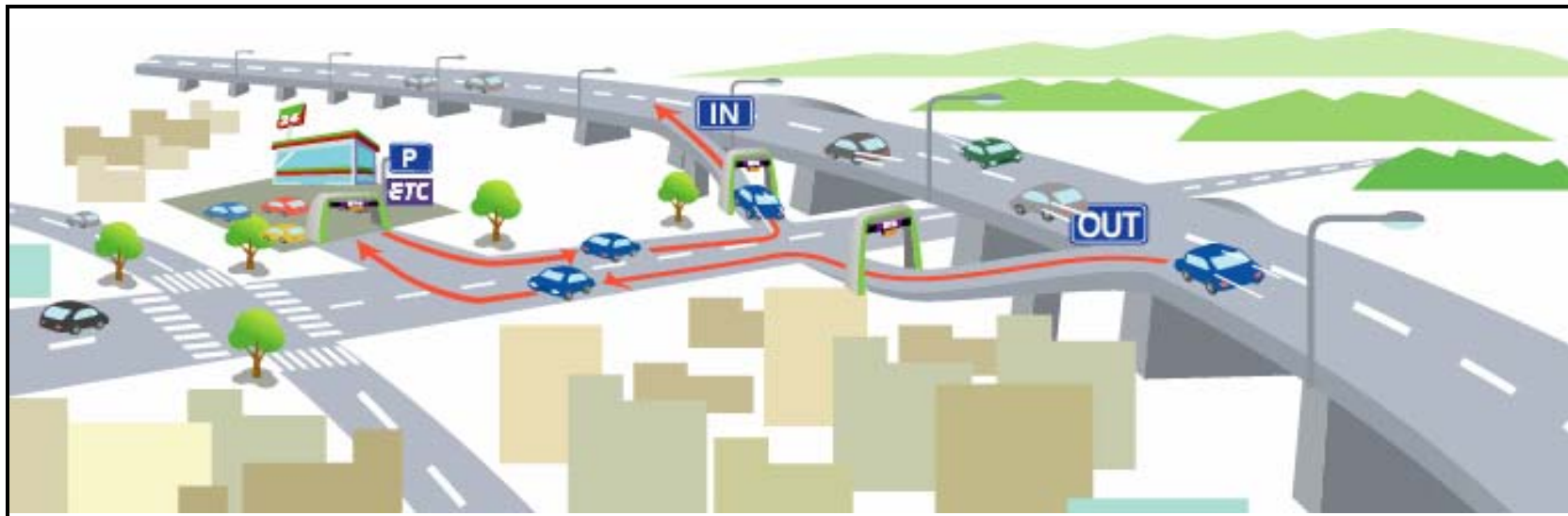
7) Electronic signs (Information Supply)

- In order to provide assistance for determining one's location, electronic signs are installed at entrance ramps and other places where car navigation systems tend to mistake the vehicle's position.
- Simple sign information is provided.
- The effectiveness of this supply of information in improving driver safety will be verified.

Conceptual image of system

Metropolitan Expwy. Route 4

Test Site
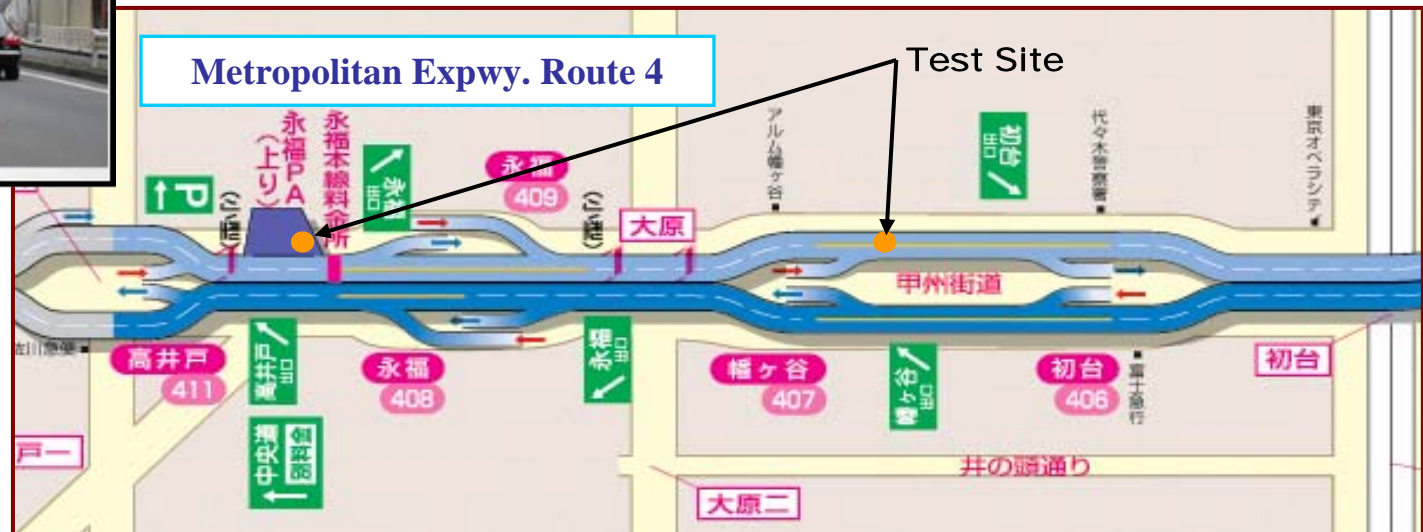
Future Plan of *Smartway* Services

- *Smartway* services will begin from FY 2009 on Several Expressways in Urban Areas

		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010 and on
Deployment of RSE for *Smartway* services	Tokyo Metropolitan Expressway (MEX)	Demo 2006 ▼	Smartway 2007 ▼ FOTs on MEX	Trial operation on MEX	Operation (MEX, Hanshin Exprssway)	Nationwide deployment
	Three major metropolitan areas (Mainly Expressways)			FOTs on three major metropolitan areas		
	Other Areas — Expressways					
	Other Areas — National Highways					
ITS OBU for *Smartway* services		Public-Private Joint Research			Available to the market	

Thank you for your kind attention.

"the Best-way for your country"

To seek the best choice & practice on development of Highway is our main concern. E-Nexco shall closely and continuously cooperate with Indian authorities for "the Best-way."