# DEVELOPMENT OF NEXT-GENERATION ROAD SERVICES ON SMARTWAY PROJECT

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## Abstract

In Japan, efforts are being made to promote “SMARTWAY” next-generation roadways, which incorporate a variety of services using advanced ITS technologies. One of the efforts of the National Institute for Land and Infrastructure Management (NILIM) of the Ministry of Land, Infrastructure and Transport in recent years is to carry out public-private joint research on next-generation ITS services using ITS technologies. NILIM has also carried out SMARTWAY Demo 2006, a proving ground for reporting and publicizing the research results. SMARTWAY 2007 Demo in Tokyo is set to be held as starting point in aiming to realize the trial operation of next-generation services from autumn 2007 onward. This paper covers the efforts being made in order to realize next-generation ITS services.

## Background

In Japan, the development and practical use of ITS has been actively promoted in order to resolve problems such as traffic congestion, frequent occurrences of traffic accidents, and the worsening traffic environment. (Figure 1) Car navigation System which began to spread around 10 years ago has come to be almost standard equipment for cars, with an increase in the volume of shipments to approximately 50% of the current number of new car registrations. The Vehicle Information and Communication System (VICS) which began service in 1996

completed its nationwide deployment in February 2004, and recently around 80% of shipped car navigation systems have come to be equipped with VICS functions. (Figure 2) The Electronic Toll Collection System (ETC) which began service in 2001 has come to be installed in approximately 1,800 vehicles as of June 2007 with the national average use ratio at 68% and the use ratio on the Metropolitan Expressway at 76%. (Figure 3) As a result, congestion has been almost completely eliminated at the tollgates of all main lines of the Metropolitan Expressway, and it has thus been possible not only to smooth the flow of traffic, but also to improve the environment of the areas surrounding the tollgates by reducing noise and exhaust emissions.

As such, ITS in Japan has moved from the first stage of being cutting-edge and trendy to arrive at a new era, which should be considered the second stage in which ITS will transform society and people's way of life.

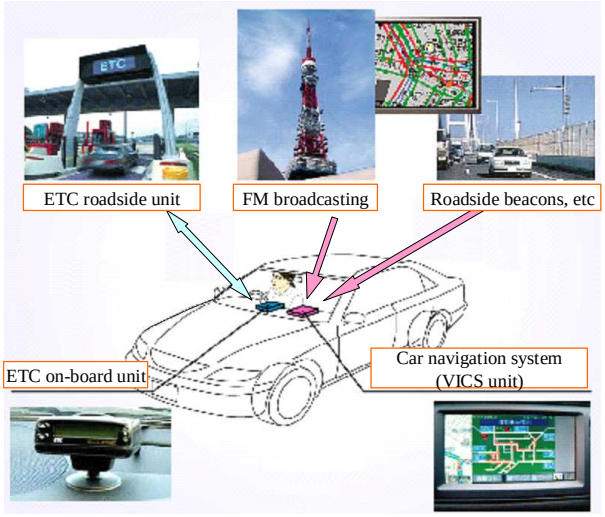


Figure 1 Current ITS

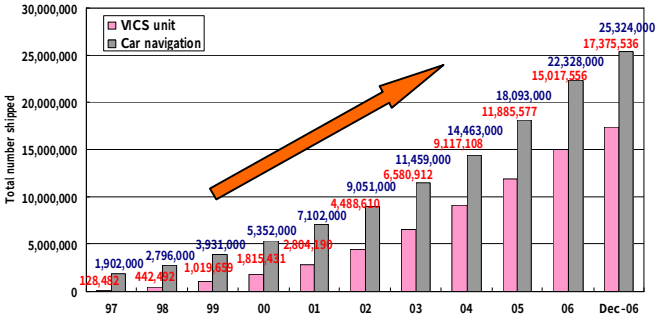


Figure 2 Total number of shipments of car navigation systems and VICS units

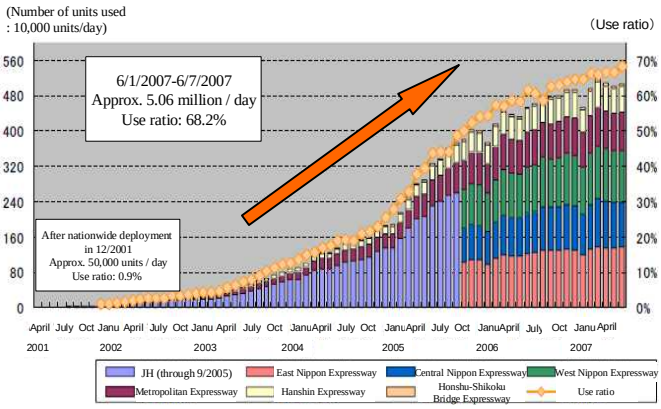


Figure 3 Movements in the use of ETC

# Toward the Realization of Next-Generation ITS Services

## SMARTWAY and its goal

SMARTWAY is not just a foundation for the deployment of ITS on roads where it is possible for various information to be exchanged between vehicles, drivers, pedestrians, and other users, it also serves as a foundation leading to the creation of a comfortable and affluent way of life and society. SMARTWAY needs to possess two functions: the function of realizing in an integrated manner ITS which will provide safe and smooth road traffic and a good

environment, as social infrastructure, and the function of serving as a platform (common foundation) for creating new value in society.

The goal of SMARTWAY is thus to realize a smart and mobile society through improving the quality of transportation and traffic. Specifically, it is expected to realize the following four items.

• "Making up for the negative legacy" that a motorized society has brought in terms of traffic accidents, environmental impact, and traffic
• "Ensuring mobility for elderly persons and disabled persons" which will enable them to travel with peace of mind
• "Affluent living and local communities" in which the vitality of regions is increased and affluence is perceptible, through promotion of the use of expressways and public transportation
• "Improvement of the business environment" based on making information seamless and boosting the efficiency of distribution

**ITS as a national project**

In January 2001 in Japan, the Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society (IT Strategic Headquarters) was established with the Prime Minister as chair in order to promote IT reforms, and the four ministries and agencies of the Ministry of Land, Infrastructure and Transport, National Police Agency, Ministry of Internal Affairs and Communications, and Ministry of Economy, Trade and Industry are collaborating to promote ITS. In January 2006, the IT Strategic Headquarters has formulated the "New IT Reform Strategy" with the objective of pursuing IT structural reform capabilities in Japan. One of the goals presented in this strategy is "reducing traffic fatalities to 5,000 or below and thereby realizing the world's safest road traffic environment" through the practical use of infrastructure-cooperative driving safety support systems. In order to accomplish this goal, the strategy sets forth the policies of forming a joint committee from the public and private sectors in 2006 regarding the practical application of driving safety support systems, conducting large-scale demonstration experiments, verification, and assessments on driving safety support systems through 2008, and deployment of driving safety support systems throughout Japan from 2010 onward with accident prone locations prioritized. .

## Public -private joint research

As mentioned above, ITS has entered a second stage, and car navigation systems, VICS, ETC, and various other services have spread. In deploying various services with a view toward a smart mobile society, however, it seems that realizing individual services separately would detract from convenience for users and dramatic progress cannot be expected. Accordingly, rather than realizing individual services separately, it seems important to build a

foundation (platform) in which various services can be used jointly, based on the appropriate division of roles among related parties.

NILIM has thus implemented public-private joint research on systems to provide next-generation road services together with 23 companies recruited from the private sector, in order to realize an in-car environment in which it is possible to use a variety of ITS services with a single on-board unit. (Chart 1)

Chart 1 Companies participating in public -private joint research
(by company, in the order of the Japanese

| Category | Name of Company | Category | Name of Company |
|---|---|---|---|
| Automobile manufacturers | Toyota Motor Corp. | Navigation system manufacturers | Aisin AW Co.,Ltd. |
| | Nissan Motor Co., Ltd. | | Clarion Co.,Ltd. |
| Electronics appliance manufacturers | Oki Electric Industry Co, Ltd. | | Kenwood Corp. |
| | Sumitomo Electric Industries, Ltd | | Xanavi Informatics Corp. |
| | Toshiba Corp. | | Denso Corp. |
| | NEC Corp. | | Pioneer Corp. |
| | Japan Radio Co., Ltd. | | Fujitsu Ten Ltd. |
| | Hitachi, Ltd. | Others | NTT DoCoMo,Inc. |
| | Fujitsu Ltd. | | Tokico Technology Ltd. |
| | Matsushita Electric Industrial Co., Ltd. | | Park 24 Co.,Ltd. |
| | Mitsubishi Heavy Industries, Ltd. | | Fujitsu Laboratories Ltd. |
| | Mitsubishi Electric Corp. | | |

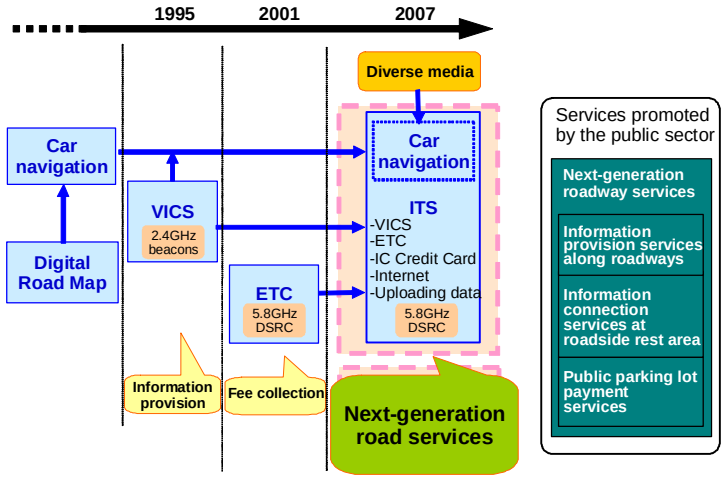


Figure 4 Items examined in the public-private joint research

Of the ITS services, this joint research examined the functions of roadside devices, on-board units, and so forth necessary for realizing next-generation road services. Specifically, the research was conducted over the approximately one year from February 2005 through March 2006 with the objective of creating the technical data that would be needed in practical application when formulating standards and specifications that should be set in common.

As it is important to firmly realize a variety of services, the joint research aimed for an in-car environment in which it would be possible to enjoy the existing services of VICS and ETC in addition to the three new public services of “information provision services along roadways,” “information connection services at roadside rest areas,” and “public parking lot payment services” with a single on-board unit. (Chart 4) Furthermore, SMARTWAY Demo 2006 was carried out over the three days from February 22 through 24, 2006 as a proving ground to demonstrate the results of the public-private joint research. This demonstration for the public took place at a testing track of NILIM. Roadside devices, which had been examined in the joint research, were set up along the testing track, on-board units were equipped in demonstration vehicles, and services were experienced while riding in the vehicles. In the joint research and in SMARTWAY Demo 2006, it was confirmed that the systems which were examined have been developed to a practical level in terms of technology.

# SMARTWAY 2007 Demo in Tokyo

SMARTWAY 2007 Demo in Tokyo has been positioned as a technical tour of the ITS World Congress in Beijing. In this event, participants will experience multiple in-vehicle services while riding in demonstration cars. The event is scheduled over the four days from October 14 to 17. (Figure 5) The holding of this event is also positioned as the start of the trial operation of services brought to the general public.

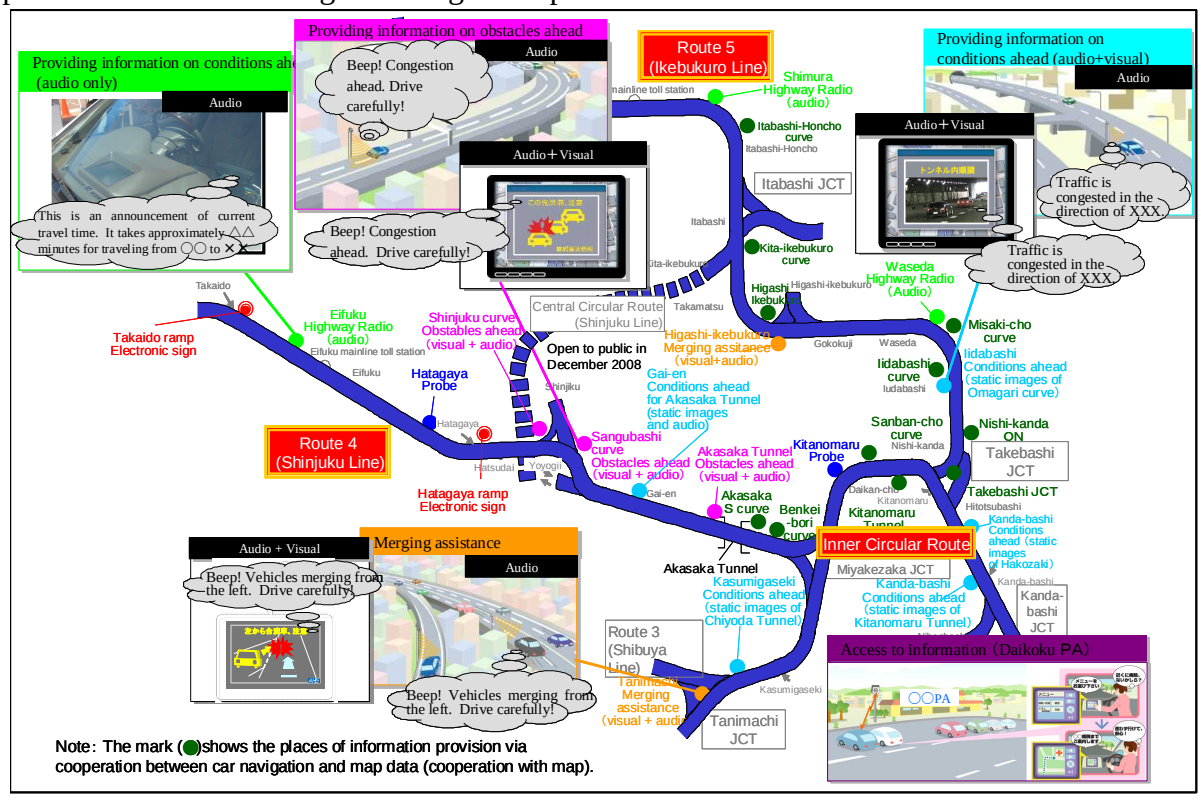


Figure 5 SMARTWAY 2007 Demo image

As is shown in Figure 6, standards and specifications were formulated for the ITS on-board units and roadside devices of the 5.8GHz -DSRC standard equipment in March 2006 based on the public-private joint research in FY2005, and currently the building of infrastructure has begun on the Metropolitan Expressway. In selecting routes on which to build the infrastructure, routes where safety measures are needed (Metropolitan Expressway Inner Circular Route, Route 4 Shinjuku Line, Route 5

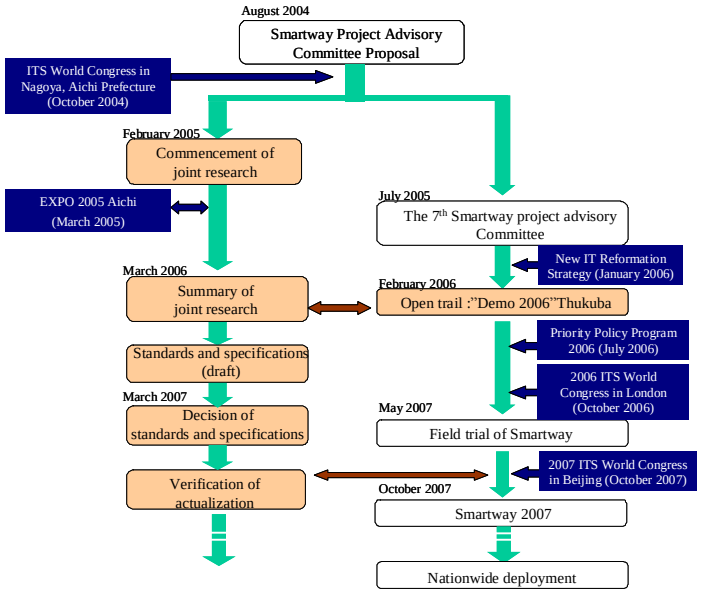


Figure 6 Flow of efforts toward trial operation

Ikebukuro Line) were selected taking into consideration the “New IT Refrom Strategy” and in particular based on the status of accident rates and accident density. Demonstration experiments on various systems to provide next-generation road services have been carried out on the routes since May 14, 2007.

The objective of the demonstration experiments is to verify and assess the effectiveness of services and the receptivity of drivers to services by providing various services on a test basis which utilize audio and visual information, with the aim of realizing services that have characteristics as follows.

• Timely services

Timely provision of information regarding safety based on the road traffic situation of the route being driven on

• Reliable and easy-to-understand services

Provision of information regarding safety and so forth reliably and without delay to drivers by utilizing 5.8GHz-DSRC which is highly reliable for communications and can provide large volumes of information instantly

• Services that are easy for drivers to recognize

Carrying out information provision (visual and audio) using on-board units with high recognition rates for drivers relative to roadside display boards and so forth

An image of a specific example of the experiment is shown in Figure 7. Stopped vehicles or jammed flow is detected at the end of a blind curve with roadside sensors, and subsequent drivers entering the curve are warned with images and sounds. As a result, a decrease in collision accidents at the end of the blind curve, a decrease in the frequency of close calls (rapid reductions in speed), and a reduction in speeds when entering the curve can be expected. As for verification, a comparison of vehicle detection accuracy using multiple verification methods, the effect that the provision of information had on improving safety, and the receptivity of drivers is scheduled to be assessed.

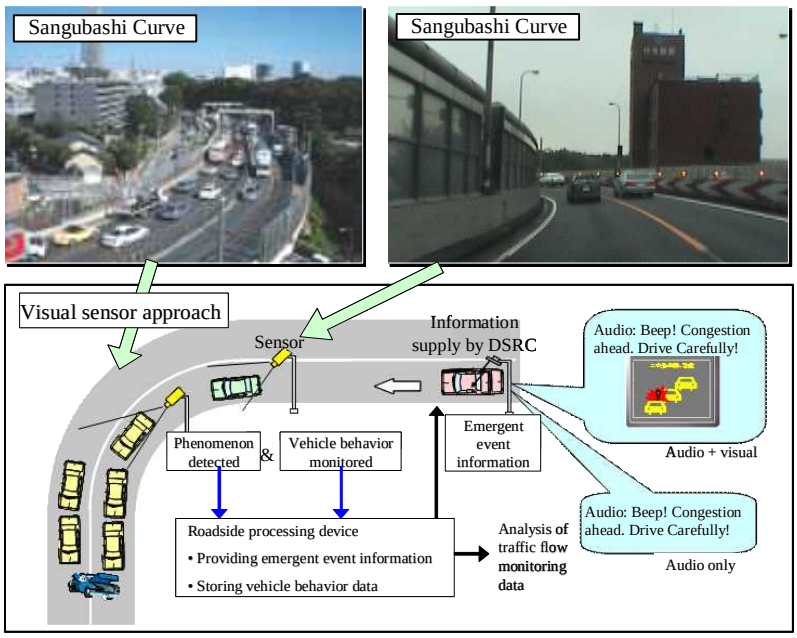


Figure 7 Image of specific example of test (provision of information on forward obstacles)

For the verification of on-board units, assessment will be carried out driving monitor vehicles which have been equipped with test ITS on-board units. The verification will cover “ITS on-board units cooperating with car navigation systems,” which carry out the provision of information with sound and images in cooperation with car navigation systems, and “independent ITS on-board units,” which carry out the provision of information with sound only, for large vehicles (freight vehicles and buses), mini-vehicles (Japanese smallest category of vehicles) and so forth for which car navigation systems are less penetrated. (Figure 8)

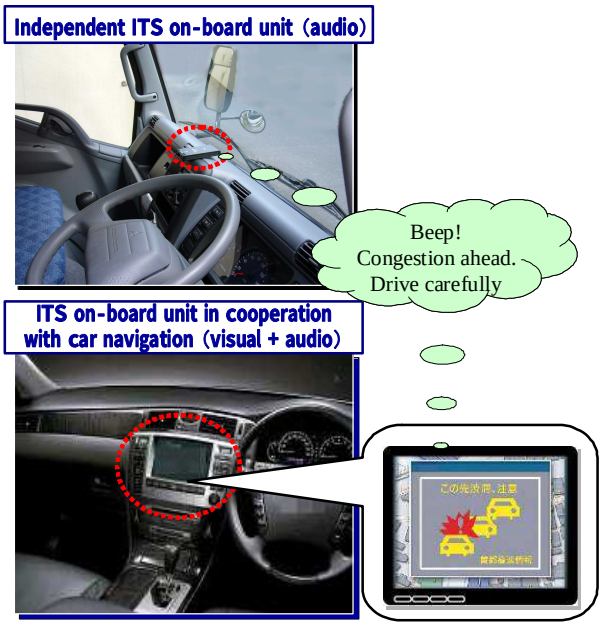


Figure 8　Image of on-board units

At the time of this demonstration, exhibitions and symposiums will be held in conjunction with the driving experiences, so we hope that many people will come to Japan.

## Efforts toward International Standardization

In Japan, technologies related to SMARTWAY are being proposed to ISO/TC204. (Chart 2) Specifically, these include technologies used during distribution between centers and car navigation systems and mechanisms with regard to basic API (application interface) used in next-generation road services (Figure 9), and there is an aim of international standardization for various technological specifications with a view toward the realization of SMARTWAY.

Chart 2 Major items proposed to ISO/TC204 from Japan based on technologies related to SMARTWAY

| Name of proposal case | Overview |
|---|---|
| Update-type map data delivery technology (WG3) | Standardization regarding technology when delivering map data between centers and car navigation systems |
| Probe data definition (WG16) | Standardization regarding formats for probe data |
| Application update technology (WG16) | Standardization of methods regarding the method of updating the applications of on-board units |
| CALM-Mail（WG16） | Standardization regarding the DSRC transmission protocol of Japan |
| CALM-non-IP transmission method （WG16） | Standardization regarding the method for realizing non-IP transmission method services of various countries including the technological method for basic API and non-IP transmission of Japan |

CALM：Communications Air-interface for Long and Medium range

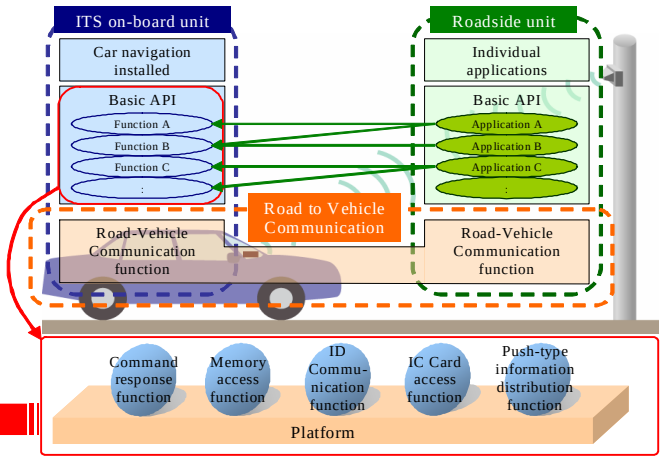


Figure 9　Mechanism using basic API which is used in the next-generation road services

# Future Development

As for future development, it is important to develop strategic deployment scenarios. (Figure 10) As for support for driving safety, based on the test operations in Tokyo, tests in real traffic in major metropolitan areas (Osaka, Aichi, Hiroshima etc.) is scheduled. As a broader sense of promotion, there appears to be an expansion toward versatile services such as fee settlement services for private-sector parking sites and ferriy boarding areas. Going forward, we intend to aim for further development of services and the full-fledged realization of an ITS society.

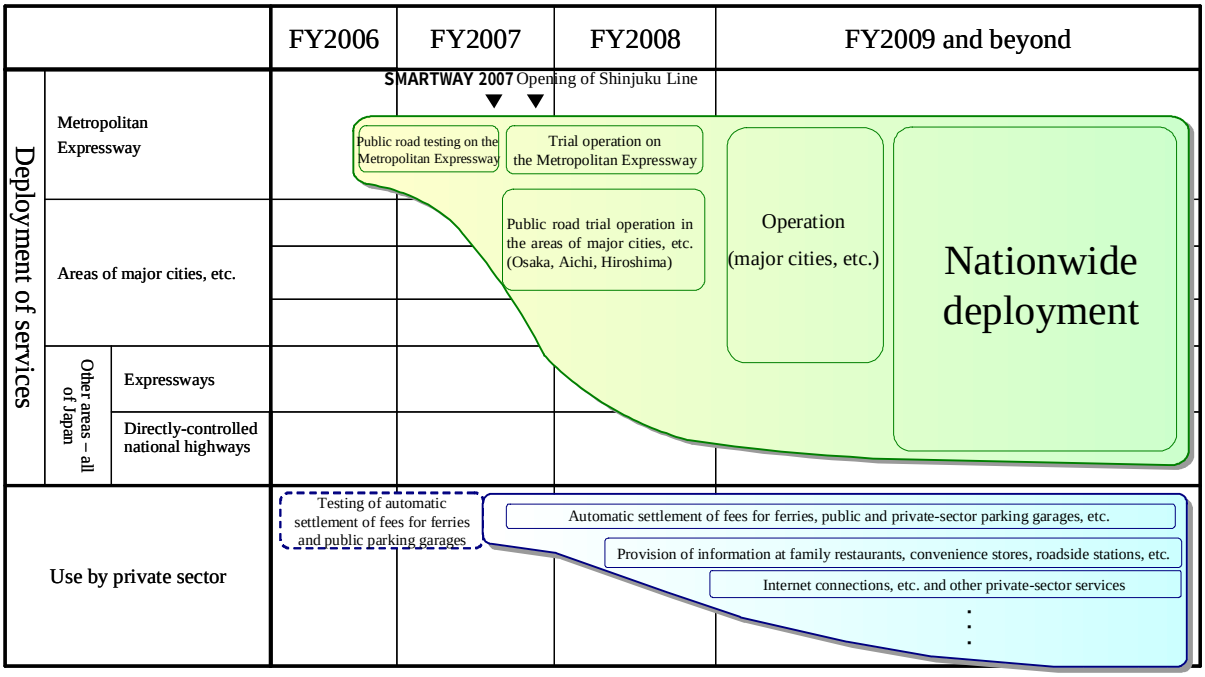


Figure 10 Scenario for the development of new systems for road-vehicle coordination

# Reference


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