# ITS Enter the Second Stage

- Smart Mobility for All -

Proposal

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Smartway Project Advisory committee

## Introduction

As we enter the twenty-first century, services and products using the Internet, cell phones, and other information and telecommunications technologies (IT) have become firmly established as indispensable, everyday parts of daily life in Japan. In addition, Intelligent Transport Systems (ITS) are starting to take root as a part of life and society. The number of vehicles equipped with car navigation systems has risen past 15 million as these systems are becoming standard automotive equipment, and over 3 million vehicles are now equipped with Electronic Toll Collection System (ETC) devices.

Studies are moving ahead concerning the content of services that can be provided through ITS, and some pioneering services are already being realized, affording greater convenience to users. In the future, as individual services are linked or combined and as more users are added, ITS will enter a second stage in which it will become a deeply integrated part of life and culture in Japan, leading to changes in society.

This proposal is a summary of measures for the concrete realization of Smartway as a common infrastructure for the development of ITS in its second stage, based on our 1999 proposal entitled "Making Smartway a Reality." When Smartway becomes a reality, it will contribute significantly in responding to social problems and promoting economic revitalization and community development with an eye to the future.

We anticipate the early realization of Smartway as infrastructure that will contribute to the resolution of social problems through further efforts by concerned parties, based on the guidelines given in this proposal.

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## 1. Development of ITS

### (1) Current Situation of ITS

While the growth of automotive transportation in Japan has greatly improved the convenience of transportation, it has also created a negative legacy which includes frequent traffic accidents, traffic congestion, and adverse effects on the environment due to exhaust gases, noise, and other factors. To resolve these problems, Japan has been actively promoting the development and application of Intelligent Transport Systems (ITS), which consist of systems that use advanced information and telecommunications technologies to link humans, roads, and vehicles.

The "Comprehensive Plan for Intelligent Transport Systems (ITS) in Japan" was formulated in 1996. Thereafter, a variety of services were begun, including vehicle information and communication systems, or VICS(*1) and ETC(*2); and there was rapid growth in vehicle-mounted devices such as car navigation systems(*3) and ETC on-board units.

ITS is also expected to contribute to economic development. One result has been the expansion of related markets including the automotive industry and the information and telecommunications industry.

1) Spread of car navigation systems

The widespread adoption of car navigation systems began around 1994, and more than 15 million units have already been shipped. One in five vehicles is equipped with a car navigation system, and these are becoming standard automotive equipment.

At present, car navigation systems do more than just navigating. In addition, they have become driver's assistants that support comfortable, safe, and convenient driving by providing area maps, voice output, and information on tourist attractions, restaurants and the like.

2) Spread of VICS

VICS services first began in 1996, enhancing car navigation systems by adding real-time information on road traffic, parking lot vacancies, and restrictions due to construction or accidents. The nationwide deployment of VICS was completed in February 2004, and about 80% of all car navigation systems currently being sold are equipped with VICS features.

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(*1) VICS/Vehicle Information and Communication System: a system to offer to the car navigation system vehicle information on road congestion, travel time, construction work, traffic restrictions, etc.
(*2) ETC/Electronic Toll Collection System: a system to enable drivers to make an automatic payment of tolls through wireless communication without stopping at the toll gate.
(*3) Car navigation system: a system to assist drivers in arriving at destinations which uses GPS and other technologies to locate where the vehicle is and show the driver the shortest route, distance, and direction of the destination.

3) Spread of ETC

ETC services first began in 2001, and this service has spread rapidly. Over 3 million vehicles are equipped with ETC on-board units as of June 2004. More than 20% of all vehicles passing through toll gates now use ETC, as ordinary users are recognizing the convenience of automatic, non-stop toll collection.

4) Enhancement of advanced safety vehicles (ASV) [*1]

Efforts are underway to improve safety through ASV based on the world's most advanced vehicle control technologies in Japan. In 1995, adaptive cruise control or ACC [*2], which automatically maintains an appropriate distance from the car ahead, was implemented for the first time in the world. Since then, Japan has led the rest of the world in its efforts for the practical application of driving support systems, and a variety of advanced functions have become commercially available, including steering control to avoid lane departure and braking control to reduce collision damage.

5) Bus location information services

Bus location systems[*3] provide greater convenience for bus users by announcing where a bus is located and when it is approaching the bus stop. These systems were previously introduced in certain areas, but began to spread rapidly around 1999. At present, about 80 bus operators, or approximately 16% of all bus operators in Japan, have installed these systems on over 13,000 buses.

6) Using web sites to provide information

Regional development bureaus and other organizations are now using their web sites to provide information on road restrictions, weather conditions, road surface conditions, and other road-related information as appropriate for each region. Road users access this information for transportation with greater ease and safety. The information on road conditions includes data collected by cameras and other types of sensors installed for this purpose. Information on these web sites is becoming an essential resource for road users, who access the web sites more frequently at times when roads are restricted more often, including the rainy season, during typhoons, and in the wintertime.

The Japan Road Traffic Information Center began providing a road traffic information service on its web site in 2000. Since then, the web site has been

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[*1] ASV (Advanced Safety Vehicle): a vehicle with remarkably enhanced safety and comfort through electronics and other new technologies.
[*2] ACC (Adaptive Cruise Control): a system that automatically adjusts vehicle speed to maintain a safe distance between vehicles.
[*3] Bus Location System: a system that is mounted on GPS-equipped vehicles which obtains locational information of buses in real time and provides users with information regarding their current locations, delay in traveling, etc.

accessed with increasing frequency every year; it received 250 million hits in FY2003.

### (2) Current State of Markets Related to ITS

The total ITS market scale has now grown to a total of about ¥12 trillion, including all ITS-related services, equipment, and infrastructure. The ITS market is currently estimated at about ¥6 trillion in the field of information provision, including car navigation systems and equipment for VICS and ETC; ¥5 trillion in the field of infrastructure, including optical fibers and CCTV cameras(*1); and ¥1 trillion in the field of services, including map software and content.

There are positive expectations for market expansion with regard to systems using dedicated short range communications, or DSRC(*2), which will enable consumers to pay fees at gas stations, parking lots, and drive-through facilities as a new kind of ITS-based service. It has been forecast that these systems, in sum, will account for about 40% of the overall service market by 2015. As ITS continues to develop in the future, it is anticipated that the spread of on-board units and other products will lead to growth in existing markets, along with additional market creation in new information services and other areas.

(*1) CCTV camera (Closed Circuit Television Camera): a camera for cable TV, which is also known as exclusive TV, closed-circuit TV, etc. CCTV camera is used to detect traffic volumes and contingencies, or other purposes.
(*2) DSRC (Dedicated Short Range Communication): wireless communication for road-to-vehicle communication with the ETC and the commercial vehicle operation systems. Usually, the communication range is within a few to some hundreds of meters from the roadside unit.

## 2. ITS in the Second Stage

### (1) Effects of ITS Beginning to Emerge

As ITS continues to develop, its effects are beginning to emerge in terms of improved safety, smoother road traffic, and an improved living environment. These effects include greater convenience and safety due to car navigation systems and VICS, greater use of buses due to bus location systems, reduced congestion at toll gates due to the spread of ETC, and the development of diversified fee schedules.

1) Greater convenience and safety due to car navigation systems and VICS

In addition to car navigation systems indicating the best driving route and VICS providing real-time road traffic information, these systems also contribute to safe driving by warning the driver of curves and the like. Elderly drivers, in particular, report that this gives them confidence.

2) Greater use of buses due to bus location systems

Bus location systems are spreading rapidly along with the development of technologies that use location information, including GPS[*1]. For bus users, these systems let them spend less time waiting for buses and use their time more effectively; and for bus operators, the advantages include increased ridership and more efficient scheduling which leads to cost savings.

3) Reduced congestion at toll gates due to the spread of ETC

With over 20% of vehicles using ETC at toll gates, this service is already having an effect on alleviating congestion at toll gates. For instance, at Kawaguchi Toll Plaza on the Metropolitan Expressway, congestion has been reduced by half while the overall number of vehicles passing through the toll plaza has increased.

4) Development of diversified fee schedules

When the Metropolitan Expressway experimented with a range of different prices that were available to ETC users depending on the time of day, the number of vehicles using ETC at night, when tolls are lower, increased by about 20%. There was an accompanying decrease in traffic volume on ordinary roads, contributing to an improved roadside environment at night. Effects are starting to be seen as ETC is being used in schemes such as flexible pricing based on types of vehicle or times of day.

[*1] GPS (Global Positioning System): a position measuring system to obtain three-dimensional position of objects on the ground by means of signals from GPS satellites.

5) Development of Smart Interchanges

A field trial of Smart Interchanges[*1] using ETC technology began in 2004. Smart Interchanges contribute significantly to stimulating and revitalizing a community. Doubling the number of interchanges nationwide will bring ¥3 trillion to communities in direct benefits alone, including time savings. Even greater benefits are anticipated when effects on the local economy are included.

6) Local efforts for ITS

Based on the effects of ITS which are starting to be seen all over Japan, in recent years, local governments, universities, and other organizations in various regions have engaged in active efforts for the local use and development of ITS in order to respond to various needs related to the region's natural or social conditions, forming closely knit alliances among industrial circles, private citizens' groups, government, academia, and the like.

## (2) Second Stage of ITS

1) Second stage in fields of information and telecommunications

With the rapid development of telecommunications technologies and information processing technologies since the latter half of the 1990s, a variety of services using information technology (IT) such as personal computers, cell phones, and electronic money have become part of our everyday lives. These IT-related services have been refined in functional quality and their use has become more widespread as the respective systems evolve and are combined with other IT systems. They have become accepted as a part of everyday life and culture by nearly all the Japanese people, from children to senior citizens. In addition to the convenience and comfort that these services afford to their users, they have led to social changes and brought a great deal of progress to Japanese society as a whole.

2) Second stage of ITS

Although Japan's road administration does take the necessary measures with regard to the quality of mobility and transportation, it still fails to ensure sufficient travel speed, punctuality and comfort. There are also negative aspects including traffic congestion, traffic accidents, and a growing environmental burden. People spend a considerable amount of time in their daily lives on mobility and transportation, and during this time, they are cut off from the rest of the world.

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[*1] Smart Interchange: an interchange that enables unmanned operation and distribution of toll gates by the use of an ETC technology-using toll collection system. It reduces the construction and operation costs of interchanges and facilitates their extension and other improvements.

Based on this situation, efforts have been made to improve user convenience by means of ITS, including car navigation systems, VICS, and ETC. The spread of ITS has led to a social benefits such as the provision of real-time road traffic information to facilitate smooth traffic flow, the alleviation of congestion at toll gates by allowing non-stop utilization, and the development of diversified fee schedules.

In its second stage, ITS will resolve various social problems that have been difficult to solve in the past, contributing to changes in society and daily life. It is anticipated that Smartway will provide strong support for the second stage of ITS.

### (3) Development of Society of Smart Mobility

In its second stage, ITS will improve the quality of mobility and transportation in terms of safety, affluence/the environment, and comfort/convenience. The aim should be to contribute to the resolution of the following kinds of social issues and to bring about a society of smart mobility.

- Reversing the negative legacies of motorization such as accidents, environmental burden, and congestion.
- Building a society of "universal design" in which the elderly and the disabled can have mobility without anxiety.
- Developing an affluent standard of living and dynamic communities in the provinces.
- Improving the business climate with seamless access to information and greater efficiency in industries related to road, transportation, distribution, and so on.

### (4) Social Changes to be Effected by ITS

1) Reversing the negative legacies of motorization

[1] Although the advancement of motorization has led to economic progress and more convenient mobility, there are also a large number of fatal traffic accidents every year. Studies have found that 75% of all traffic accidents in Japan are the result of failure to notice a hazard in time, mistaken judgment, misoperation, and other human errors. To prevent these kinds of accidents, it is important to take measures to promote road traffic safety and vehicular safety and to utilize ITS, including road-to-vehicle cooperation; and the aim should be to eliminate all fatal traffic accidents.

[2] The Kyoto Protocol on climate change[(*1)] sets the target of reducing greenhouse gas emissions, including carbon dioxide, to 6% lower than their 1990 levels in

[(*1)] Kyoto Protocol: the protocol agreed upon at The 3rd Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP3) in December 1997 which mandates reduction in gas emissions and their target values.

Japan. About 20% of carbon dioxide emissions in Japan are from the transport sector, and about 90% of that amount comes from motor vehicles.

Of all the measurement stations in areas designated for countermeasures under the Law on Control of Nitrogen Oxide and Particulate Matter Emissions from Motor Vehicles(*1), about 70% meet the clean air standards with regard to nitrogen dioxide, and only about 20% meet the clean air standards with regard to suspended particulate matter(*2).

In order to reduce the burden on the global environment and the roadside environment, in addition to the necessary road construction, ITS should be used as a policy tool to ensure suitable traffic volumes and travel speeds, to develop diversified fee schedules, and to promote the use of public transportation.

[3] Losses from road congestion in Japan amount to 3.81 billion person-hours every year, the equivalent of about ¥12 trillion. Congestion is a serious problem for road traffic.

About 70% of expressway congestion occurs at toll gates, sags(*3), and tunnels. ETC and driving support systems should be developed to improve this situation. Efforts should also be made to scientifically analyze the amount of congestion based on probe data(*4) and take measures that are focused on specific points, to promote the spread of ETC as standard equipment, to develop diversified fee schedules, and to promote the use of expressways in order to reduce congestion on ordinary roads.

2) Ensuring mobility for the elderly and disabled

[1] The trend toward lower birth rates and an older population is expected to accelerate in Japan, and the structure of the nation's population is changing rapidly. At present, Japan has 8 million elderly drivers, but this figure is expected to more than double to 17 million by 2030. Driving support services should be provided so that the elderly and others can go out and travel without inconvenience. In the provinces in particular, where cars are the primary means of transportation, the task of ensuring mobility for the elderly is directly linked to issues of their welfare and well-being, so this is expected to become increasingly significant.

[2] The disabled report that difficulties in going out and getting around are among their most serious problems. There is a great deal of dissatisfaction among the

(*1) Law on Control of Nitrogen Oxide and Particulate Matter Emissions from Motor Vehicles: the law that stipulates emission standards, etc., of exhaust gases from automobiles (revised in June 2001).
(*2) Suspended particulate matter: particles of size diameter up to 10 μm suspended in the air. The residual of burned exhaust gas from vehicles makes up a large portion of such matter related to roads.
(*3) Sag: the point on a road where downhill becomes an uphill, the area at which traffic jam is often caused.
(*4) Probe data(floating car data): data including traveling speed, position and other information collected from on-board equipment.

disabled with regard to the use of various means of transportation. Cars are an important mode of transportation used by the disabled.

To ensure that everyone in Japan can travel safely, and with comfort in the future, efforts should be made to use ITS to provide services that are suited to the circumstances of individual users.

[3] To optimize mobility in our future society, it will be important to provide appropriate information and warnings to pedestrians, users of public transportation, drivers, and others, including the elderly and disabled, so that they can go out and travel without fear and with convenience.

For safe and comfortable mobility, it is also necessary to take steps to reduce the burdens related to going out and traveling by the elderly and disabled, by means such as providing road guidance easy to understand, offering suitable driving support and information, seamless mobility by public transportation, establishing an environment that allows wheelchair users and others to pass with safety, and facilitating smooth fee payment at parking lots and the like.

3) Developing affluent communities and lifestyles

[1] The improvement of expressway interchanges not only contributes to lowering the environmental burden and reducing congestion and accidents on ordinary roads through the suitable assignment of functions among roads, but also contributes significantly to stimulating and revitalizing communities near the interchanges.

It is considered desirable to introduce Smart Interchanges in order to double the number of interchanges nationwide, contributing significantly to community revitalization. It has been estimated that doubling the number of interchanges nationwide will bring ¥3 trillion to communities in direct benefits alone, including time savings. Even greater benefits are anticipated when effects on the local economy are included.

[2] Buses and other modes of public transportation play an essential role as the "legs" of a community. However, the ridership of buses is showing an overall declining trend nationwide. There are many examples of cases in which user convenience has been improved by bus and tram services with location information systems or by on-demand bus services(*1).

Each region has its own distinct characteristics in the field of public transportation, including the assignment of roles between business operators and local government, or the position that the local government gives to public transportation. Based on these regional characteristics, efforts should be made

(*1) On-demand bus: a bus available on demand, as dispatched to the points on call from users by following detours established in the bus routes.

to use ITS in order to improve the convenience of public transportation, as the kind of measure that is feasible for the time being.

[3] When disasters occur, roads play an important role in safe evacuation, recovery work, and the delivery of emergency supplies. Therefore, it is important to use ITS to detect disasters as early as possible, and after the occurrence of a disaster, to ensure suitable detour routes and provide information to road users.

To ensure safe and highly reliable road transportation, it is important to use a broad-area information network, based on a nationwide optical fiber network and so on, in order to share information among all related organizations and conduct efficient facility management as well as crisis management for disasters and other events.

4) Improving the business climate

[1] When seamless information services become a reality, integrating cell phones and personal computers in vehicles and linking them with the outside, the vehicle will function not merely as a mobile space but also as an open space. This is anticipated to help improve productivity as travel time is used more effectively. Thorough care will be necessary to prevent this from leading to problems with safe driving or problems with security and privacy related to communication between on-board terminals and the outside world.

[2] The reduction in distribution efficiency, which is related to traffic congestion and lower loading rates, is a major problem, and urgent measures are needed to resolve it. Improving the efficiency of distribution will lead to higher business productivity, greater international competitiveness, and a reduced burden for consumers as well.

It is anticipated that using ITS to obtain detailed information on congestion, weather conditions, and the locations of trucks and cargo will make it possible to conduct delivery, collection, and operational management in a well-planned manner, contributing to more efficient distribution.

[3] As many as 10 million persons are directly involved in businesses related to roads and motor vehicles, and they play a part as key industry. Improving the quality of mobility and transportation will greatly improve their working environment, including a reduction in the hours and burden of their work. It is also anticipated that effective use of road space will improve business performance, enhancing efficiency by raising the productivity of society as a whole while also contributing to a safer working environment.

## 3. Measures for the Promotion of Smartway

### (1) Promoting Further Acceleration as National Strategy

1) Goals of Smartway

The goals of Smartway are to improve the quality of mobility and transportation in order to realize a society of smart mobility by means of the following four goals: reversing the negative legacy of motorization including accidents, environmental burden, and congestion; ensuring the mobility of the elderly and disabled so that they can get around with confidence; developing affluent communities and lifestyles by promoting the use of expressways and public transportation in order to improve community vitality and bring a sense of affluence; and improving the business climate by ensuring the seamless flow of information and improving the efficiency of distribution. Smartway should be designated as a national strategy to achieve these goals, and it is necessary to more strongly accelerate and promote efforts in these areas.

2) Clear targets

To achieve the above goals, Smartway should be implemented with the clear targets of eliminating fatal traffic accidents, making ETC standard equipment, supporting safe driving by elderly drivers, whose numbers will double, doubling the number of expressway interchanges, improving the convenience of public transportation, and ensuring safe road transportation.

To this end, it will be important to link many areas including information and telecommunications, motor vehicles, and community-building. In order to make Smartway a reality as a common infrastructure for society, it is necessary to give sufficient consideration to the different timelines of technological innovation and other aspects with regard to each of these areas.

3) Intensifying efforts in Europe and North America

In Europe and North America as well, efforts are intensifying under national strategies aimed at promoting ITS. In the U.S., the Safe, Accountable, Flexible and Efficient Transportation Equity Act (SAFETEA), which is the reauthorization proposal for the Transportation Equity Act for the 21st century (TEA 21), is expected to amount to about ¥30 trillion, or 1.4 times more than the amount of funding under the current law. With regard to ITS, this clearly incorporates safety targets and driving support services based on road-to-vehicle cooperation.

In 2002, the European Community adopted the eSafety initiative with the aim of building a safe highway network throughout Europe. More than 40 programs will be administered under eSafety, including a map database that will cover all of Europe and driver support systems that will include road-to-vehicle cooperation

systems. It has established the target of reducing traffic accident fatalities by half by 2010.

### (2) Strengthening Involvement of Public and Private Sectors

1) Transmitting information to the world

Various efforts are underway that involve both the public and private sectors in the promotion of ITS in its second stage. The 11th World Congress on ITS (Nagoya, Aichi 2004) will be held in October 2004 on the theme of "ITS for Livable Society." It is expected to draw a record number of participants and congress registrants. At this congress, the ITS technologies and services promoted by Japan should be made known to the world.

Later, private businesses and organizations with advanced technologies related to IT and ITS will cooperate in Expo 2005 Aichi, Japan, which will begin in March 2005. Transportation services will be demonstrated, including a general traffic information service(*1) and an intelligent multimode transit system, or IMTS(*2), and it is anticipated that this will provide a good opportunity to acquaint the public with ITS as it comes to play an important role in regions and communities.

2) Structure for sustained promotion

For the sustained promotion of efforts that involve both the public and private sectors, working committee is to be established under the Smartway Project Advisory Committee, and this working committee will study specific efforts from a practical standpoint. It is also desirable to establish a structure, centered around private businesses, in which new service models will be studied collaboratively by both the public and private sectors. The Smartway Project Advisory Committee will provide advice and arrange for exchanges of opinion whenever necessary while cooperating with these efforts.

### (3) Scene of ITS Based Services

1) Safety and safe driving

[1] It is desirable to enhance the current systems and services with regard to road traffic information provided by VICS, based on the needs of users. Thorough consideration is needed with regard to calling the attention of drivers by

(*1) General traffic information service: a service that by using a single system, offers a variety of traffic information from congestion to parking lots, bus stops, and the location of buses.
(*2) Intelligent Multimode Transit System : enables automatic travel of bus platoons without a driver's assistance on dedicated roads; while on general roads, driven by drivers, the same as regular buses. This system has a combined function of the punctuality, high speed, and mass transportation of the track transit system such as railway, and the economy and flexibility of the local bus system.

providing information, and efforts should be made to improve the provision of information by voice.

It is desirable to promote efforts for driving support information including the provision of information and warnings on obstacles ahead, curve configuration, and so on in order to support safe driving in hazardous sections of urban expressways and other exclusive motor vehicle roads that may be difficult for a vehicle to handle alone.

The establishment of roadside units and other infrastructure should be based on international standards such as international telecommunication union (ITU) and the like, and on trends of multi function of on-board units.

[2] Overweight vehicles not only have an adverse effect on the maintenance of road structures, but also can sometimes cause serious traffic accidents. It is necessary to use ITS for stronger management of specially permitted commercial vehicles, dealing strictly with illegal vehicles and taking steps to preserve roads and prevent traffic hazards.

[3] A variety of research and development is already underway in Japan with regard to measures to support safe driving based on road-to-vehicle cooperation systems, which are being studied around the world.

It will be desirable to support safe driving by providing information and warnings on locations where there are many accidents and near misses and on road structures such as curves, linked with digital map data.

It is also desirable to pursue efforts for announcements and warnings based on functions for the provision of information from the roadside, as well as the use of driving control functions to provide support for prevention of collisions with forward obstacles, support for prevention of over shooting on curve, and support for prevention of crossing collisions.

2) Affluence and the environment

[1] ETC dedicated interchanges (Smart Interchange) are compact in structure, so they occupy less land and construction costs are lower. Development of Smart Interchanges also improve accessibility to expressways in areas where cars formerly just passed through, and this can lead to improved distribution and commercial functions in the area around the interchange. Therefore, it is anticipated that based on the results of the advance field trial, the establishment of Smart Interchanges will be promoted and the number of expressway interchanges will be doubled, leading to regional revitalization and promoting expressway utilization.

[2] To promote the use of public transportation and help alleviate congestion by making it more convenient, it is desirable to pursue the nationwide deployment

of bus location systems, which are now being implemented individually in various regions and to improve road-based public transportation services by linking them with cell phones, introducing highway bus location systems, pursuing the unified provision of information, and supporting the operation of trams, on-demand buses, and taxis.

It is also desirable to study the use of ITS to equip the areas around stations as hubs of community revitalization, through the integrated establishment of ITS technologies which will enable the seamless linkage of pedestrians, buses, railroads, and vehicles.

[3] It is also desirable to promote the formation of ubiquitous society(*1) by making effective use of cell phones, GPS, IC tags(*2), and other technologies to provide information on public transportation, barrier-free access, and road crossing to support pedestrians including the elderly and disabled, and by making efforts to ensure smooth mobility among differing means of transportation including the use of public transportation.

[4] In cities, there is an important need for countermeasures with regard to trucks and on-street parking for loading and unloading, which causes congestion and burdens the roadside environment. Therefore, it is considered desirable to take measures to improve distribution in cities by enhancing data collection, providing the necessary facilities for loading and unloading, introducing ITS-based systems to promote their utilization, and developing more advanced systems for joint collection and delivery.

As regards distribution between cities, it is important to take measures to improve the efficiency of distribution by data collection, enhancing operation management using ITS, and improve the distribution station by introducing Smart Interchange.

Recycling is being promoted from the standpoint of building a recycling society, and it is essential to take measures for the reverse logistics. Therefore, it is considered desirable to make the distribution of waste and recyclables more efficient by establishing joint collection routes for recycling that uses ITS.

3) Comfort and convenience

[1] It is anticipated that efforts will be made to promote the further spread of ETC through discounts for ETC users and various field trials using ETC, in order to improve user convenience by eliminating congestion at toll gates and allowing non-stop utilization.

(*1) Ubiquitous society: a society in which all the related equipment is connected to one another in a network with complete accessibility, regardless of time, place and kinds of equipment.
(*2) IC tag/Integrated circuit tag: a tag that can read out data by radio, including one's own ID code, which are recorded in IC microchips.

It is now possible to establish highly diversified fee schedules by means of toll collection systems using ETC. It is considered desirable for these kinds of fee schedules to be gradually deployed, based on the results of diversified fee schedules such as the night time discounts that are currently being tested in a field trial, in order to improve the environment by alleviating traffic congestion on ordinary roads in relation to the increased use of expressways.

[2] Information should be provided in a more understandable way in collaboration with private businesses, using the Internet and other means to supply information on road construction work, weather conditions, snow accumulation, and other road conditions. To improve driver convenience and comfort, it is considered desirable to provide more opportunities to obtain information in vehicles and to expand the scope of information provided. This can be done by supplying regional information, providing Internet connection services, and offering downloads of music and map data at service areas and parking areas on expressways or at Michi-no-Eki (road stations) on ordinary roads.

[3] It is desirable to create seamless mobility by eliminating the bother of fee payment and to enable smooth entry and exit management of parking lots, apartment parking facilities, etc. through the gradual introduction of cashless fee payment services, beginning with facilities where demand is higher, such as parking facilities, gas stations, and drive-through facilities.

[4] Because the stock of road is limited, it is important to pursue road construction management and transportation demand management or TDM(*1), along with lane marking systems(*2) and other measures for the effective use of road space. A timely supply of detailed information on road construction and suitable information on current road traffic conditions will contribute significantly to the effective use of road space.

[5] Efforts are already being made to use outcome criteria when evaluating measures with probe cars, and data from probe cars is used to evaluate factors such as lost time due to congestion. It is desirable to continue to improve data collection actively and promote greater transparency and efficiency in the road administration.

### (4) Widespread Adoption of ITS by 2007

1) Development of various ITS services

There is a wide range of user services based on ITS, but the following are the basic services. The utilization and combination of these basic services will lead to the

(*1) TDM/Transportation Demand Management: an approach system to ease traffic congestion on urban and regional roads by encouraging vehicle users to change their traveling style. Its specific measures include Park and Ride, and road pricing.
(*2) Lane marking system: a system that switches points of emitting light to give marks on traffic lanes depending on traffic demand and situations in order to achieve flexible road operation.

realization of ITS services for safety, affluence/the environment, and comfort/ convenience.

[1] Vehicular information transmission services, in which information from vehicles is transmitted to the roadside or a center, and this information is used and combined in order to provide services. Example: Bus location services.

[2] Fee payment services, in which various types of cashless payments are made in vehicle. Example: Cashless payment of parking fees.

[3] Information and warning services, in which drivers are provided with warnings to support their driving or timely information. Example: Enhanced VICS services.

[4] Information provision services, in which various types of road traffic information or information on roadside facilities is provided on demand, or Internet services are provided via the on-board unit.

[5] Other types of services, including services aimed at pedestrians and services using communications from vehicle to vehicle or wired communications.

2) Deployment scenario

In the second stage, it is important to make steady progress in the realization of a variety of ITS services. Therefore, it is desirable to launch the following ITS services by 2007 through the use and combination of basic services. It is also considered desirable that users should be able to access all of the services with a single on-board unit (ITS on-board unit).

[1] Smooth passage through all types of gates:

Enabling smooth passage by means of cashless payment of fees other than ETC, including parking fees.

[2] Regional guides according to location and needs:

Collecting and delivering road information and regional or tourist information to improve convenience and revitalize the local community.

[3] Timely driving support information:

Instant providing of information while driving, including locations with frequent accidents, detailed road construction information, and notification when approaching a congested section, in order to improve safety.

To achieve these goals, based on a suitable division of roles among those concerned, it is desirable for the public and private sectors to conduct joint

research and formulate standards and specifications by 2005, and to promote infrastructure building and the fabrication of ITS on-board units by 2006.

It is also desirable to pursue linkage with cell phones carried by pedestrians, personal computers in homes, and other terminals to promote the development of a seamless information environment, not only in vehicles but elsewhere as well.

In addition, it is considered desirable to promote research and development on warnings and vehicle control to ensure safety by means of road-to-vehicle cooperation, and to launch services at an early time.

3) Establishing a common infrastructure

When various services are being developed, it will be very inconvenient for users if different kinds of on-board units and infrastructure are established for the respective services, and this could increase the user costs and the costs of infrastructure building. Therefore, it is desirable to promote an open platform, or infrastructure that can be used in common by many business operators, including private businesses, based on a suitable division of roles among related parties.

[1] Promotion of ITS on-board units

An on-board unit is the interface which connects a vehicle to the road and to people. Various services which will be developed in the future should be provided through common on-board units. These units should be upgradeable and should permit the addition of new services as more ITS services are deployed. With regard to the means of communications, it is desirable to allow the linkage of multiple types including cellular, DSRC, and wireless LAN(*1).

Consideration should be given to allowing the mutually interconnected use of various devices (roadside units, on-board units, cards, etc.) in order to facilitate the participation of more service providers. It will also be important to establish efficient installation procedures, ensure security, and establish mechanisms that provide users reliance, such as a common symbol.

It is desirable to standardize the specifications of ITS on-board units, with an eye to international standardization and the trend of multi-functionalization of on-board units for integration of ETC, VICS, and so on. Thorough consideration is necessary to avoid calling the drivers' attention away from the driving when using the services in order to maintain traffic safety.

(*1) Wireless LAN: Local Area Network to transmit and receive wireless communication data. The typical specification is the IEEE802.11 series.

[2] Promoting a unified data structure with open, shared data

It is desirable to unify data structures (definitions, numeric representations, units, and levels of precision) to allow more efficient use of various types of data handled by roadside units, on-board units, and business operators in order to develop more advanced services based on data collection, facilitate smooth utilization of information based on system linkage, and lower the costs of establishing related systems. It is also desirable to make effective use of probe cars to collect data, and to actively promote open access and sharing of the collected data.

In order to promote the development of a variety of services, it is desirable to study mechanisms for the management of applications using roadside units and on-board units.

[3] More advanced digital maps

In Europe and North America, national projects are already underway to develop next-generation digital road data which will help to support safe driving, and digital map creation based on public-private cooperation is being actively studied. In Japan as well, vigorous work is underway to gather and update digital map data that can be used in car navigation systems through the efforts of private companies in addition to infrastructure building by the public sector. It is desirable for this work to be actively promoted with an eye to the establishment of a mechanism that will allow such data to be updated rapidly and enable its use in driving support systems.

[4] Establishment of optical fiber network, etc.

About 17,500 kilometers of optical fibers for road management have already been laid, primarily along national highways that are under the direct control of the national government. Optical fibers are used to facilitate telecommunications among road managers, and they are starting to be made available for use in services offered by the private sector.

The importance of a high-speed, high-capacity, stable telecommunications infrastructure is expected to increase in the future. Therefore, there is a need to promote the establishment of an optical fiber network as a part of the common infrastructure needed for ITS. For suitable and efficient road management, it is necessary to continue to install sensors such as CCTV cameras to determine the conditions of the roads under management.

### (5) Promoting Mutual Cooperation and Collaboration

1) Promoting technological research and development

[1] Since ITS encompasses a wide range of industries, specialized fields, and governmental areas, it is considered desirable for the national government to actively support cutting-edge basic research and technological development based on new concepts and perspectives. It is important to include consideration to ensure that a variety of persons can continue to be actively involved in the planning of systems development and other processes.

[2] It is important to evoke the interest of the private sector to participate in technological development and investment with regard to ITS, as well as to promote understanding and build agreement among the general public. Therefore, it is considered desirable to further enhance efforts for public information and awareness with regard to trends in research and development and the content of services which are to become a reality in the future, so that the public can experience the results.

[3] Many technologies related to ITS are becoming international commodities, and it is necessary to promote international cooperation in order to achieve lower costs and so on. Therefore, it is desirable to promote international cooperation by conducting a thorough exchange of opinions among the countries concerned and providing opportunities for joint research.

2) Collaboration with communities and the public

[1] Since Smartway is a new infrastructure for social systems, it is necessary to accurately determine the needs of users with regard to services. Therefore, when determining needs and developing practical services based on the standpoint of users, it is desirable to engage in steady efforts, such as field trials and model business endeavors, in concert with related organizations such as local governments, national highway offices, local economic circles, NPOs, and citizens' groups.

[2] To make specific services a reality, it is important to form alliances among various governmental fields and industrial circles in the region, to develop a suitable climate for the realization of the services, and to contribute to the improvement of regional mobility. To promote understanding and build agreement among users, it is desirable to conduct educational activities aimed at all users, in concert with regional NPOs and citizens' groups.

3) Promoting international cooperation

[1] It is effective to establish and use international standards with regard to communication interfaces and functions in order to ensure user convenience and lower the costs of development and utilization by participating businesses.

The formulation of international standards also contributes to more efficient research and development by concerned countries and to earlier market creation in foreign countries. Therefore, it is desirable to continue to actively contribute to international standardization activities under ISO(*1) and ITU(*2).

[2] It is necessary to continue to promote efforts for education, training, and technological and human exchange both within Japan and with other countries. Cooperative transmission of information by industrial, academic, and governmental organizations is also desirable, making effective use of opportunities such as the World Congress on ITS (Nagoya, Aichi 2004) which will be held in October 2004, and Expo 2005 Aichi, Japan, which will begin in March 2005.

[3] It is anticipated that the mutual interchange of information among various countries will continue to contribute to each country's measures and policies, business development, and technological research. For example, Japan had pursued research and development on road-to-vehicle cooperation, and this concept later was helpful in promoting research and development in Europe, North America, and elsewhere.

Japan should also actively seek the technological cooperation of other countries with regard to ITS-related technologies which have been developed in Japan, such as VICS and ETC.

(*1) ISO (International Organization for Standardization): a non-government body to promote international standardization of products and services, aimed to facilitate their worldwide distribution. It was established in 1947 and has 147 member nations.
(*2) ITU (International Telecommunication Union): a special organization of the United Nations with primary purposes of standardization and technological assistance activities in the telecommunication sector.

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| | | |
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