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Intelligent Transport System (ITS): Current State and Future Prospects

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Intelligent Transport System (ITS): Current State and Future Prospects

Summary

1. Outline of ITS

To sustain Japan's transport system, bolder initiatives on road-vehicle safety and environmental issues are required. The rising number of traffic accidents as well as elderly drivers underscores the need for safer cars, while severe traffic congestion is causing economic losses and environmental damage. ITS is expected to help mitigate these problems.

Intelligent Transport Systems (ITS) are intended to make vehicles safer, improve public convenience, and reduce environmental costs by improving vehicles using electronics and communication technologies and by networking them with the road infrastructure. Thus, ITS has enormous implications for Japan's economy and society, including the creation of a ubiquitous society, the generation of new industries, and enhancement of the auto industry's competitiveness.

In 1996, Japanese government agencies jointly established the "Comprehensive Plan for Intelligent Transport Systems (ITS)". This has led to new services such as VICS, which provides real-time road traffic information, and ETC, which permits non-stop collection of road tolls. Many services of ITS are expected to come into wide use, such as safe driving assistance, more convenient public transportation, provision of in-vehicle services and information, vehicle and road management, and more efficient distribution systems.

2. Widespread Use of VICS and ETC

Around 10 million VICS units have been sold and ETC devices have been installed in about 5 million vehicles, accounting for about 30% of expressway traffic, resulting in less congestion in some areas. Both of these systems have succeeded by actively building infrastructure under government leadership, and by making users aware of the benefits. Moreover, a variety of public subsidy programs were used to stimulate initial demand for ETC. As volumes increased, costs came down and triggered further demand.

The government and public corporations are working hard to achieve installation of ETC in 70% of all expressway traffic by early 2006. To ensure full use of ETC infrastructure and boost usage, it is necessary to promote multiuse ETC, which means ETC employing the DSRC communication method, for applications other than toll collection. Next-generation ETC units capable of multiple applications are expected to be released from 2006, and are expected to lead to new services and business models.

3. Initiatives for Improved Vehicle Safety

Since around 2000, the development and marketing of safety equipment has increasingly focused on active safety, which means measures designed to prevent accidents before they occur. Statistics show that driver errors, such as slow reactions or errors of judgment and responses, account for 75% of all traffic accidents. Cars are therefore expected to be more intelligent to assist the awareness, decisions, and actions of drivers, and such Advanced Safety Vehicles (ASV) equipped with intelligent assistance functions can cut the number of traffic accidents, fatalities, and injuries.

The keys to spreading ASV are price and user acceptance. For the former, it is worth considering a subsidy policy to stimulate initial demand as was done with ETC, to complement cost-reduction efforts by manufacturers. Gaining user acceptance requires both making automobiles easier to use and building awareness of ASV among users.

ASV expansion is likely to speed up the incorporation of electronics in automobiles and prompt more alliances and competition for technical leadership among carmakers, automotive

parts manufacturers, and electronic parts manufacturers.

4. Information Service Provision and Communication Infrastructure Establishment

New trends are emerging in services, such as providing in-vehicle information by using existing communication technologies and infrastructure. For example, telematics allows car manufacturers to add value to their products and to strengthen their customer-relations management (CRM), which is different from the conventional automotive business. It therefore requires business models based on future development communication technologies and business structures, that simultaneously provide customer benefits and deliver profit by controlling the value chains of communications, hardware, and content.

To achieve diverse ITS functions, communications technology and infrastructure that can convey various information among cars, systems, and people are required. Several communication media are already in use for extravehicular communication. But to connect these to the Internet and create a seamless information environment, it is necessary not only to improve the performance of each communication media and build more infrastructure, but also to establish common platforms and standards for hardware (car-mounted equipment) and software. In these standardization processes, it is important to encourage the creativity and motivation of private corporations to develop technology and create early markets.

5. Future Outlook

ITS offers a sustainable transportation system for a ubiquitous society, and is expected to bring new technologies and business structures to the automotive and related industries as well as to foster new industries. ITS is also expected to assist regional economic development as some regions begin leveraging their local competencies through ITS.

Encompassing roads, transport, vehicles, and communications, ITS involves both localities and citizens along with many industries and government agencies. A liaison committee has been set up among related government agencies, and cooperation between government, industry, and academia is progressing. However, in view of the significance of ITS, time to completion, and size of initial investment, more unified initiatives and sharing of responsibilities among the major players are required.

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Introduction

Nagoya hosted the ITS World Congress in October 2004. This was the second time the ITS World Congress met in Japan; the first was in 1995 in Yokohama. In those ten years, there has been rapid technical progress and the accumulation of expert knowledge, and ITS has started to affect the daily lives of the general public in various areas. The organizers of the 2004 ITS World Congress in Nagoya made it open to the general public and focused on demonstrations to shift the driving force of ITS from experts to users. ITS is moving away from the conceptual stage and demonstrating technical potential, toward solving practical real-world issues and disseminating ITS into the fabric of life.

In this context, the DBJ conducted a survey on corporate capital spending behavior and innovation efforts for the 3,638 firms covered by the Survey on Planned Capital Spending for Fiscal Years 2004 and 2005 (conducted in November 2004), in order to understand corporations' attitude toward capital spending and to predict the trend in the coming years.

This paper summarizes the state of ITS today and the issues it is facing. It is frequently remarked that if the basic functions of a car are "driving," "turning," and "stopping," then ITS provides a new "linking" function. However, ITS must also offer linkages between technology and problems to be resolved, and linkages between manufacturers and users.

It is interesting to note that although the "T" in ITS is "transport," suggesting wide-ranging transportation modalities, ITS has been narrowly interpreted in Japan to mean road traffic systems, as the focus of ITS is on road transportation. Consequently, although it is important to achieve the best mix of transportation modalities through modal shifting and other measures, this paper deals primarily with road vehicles and automotive transportation systems.

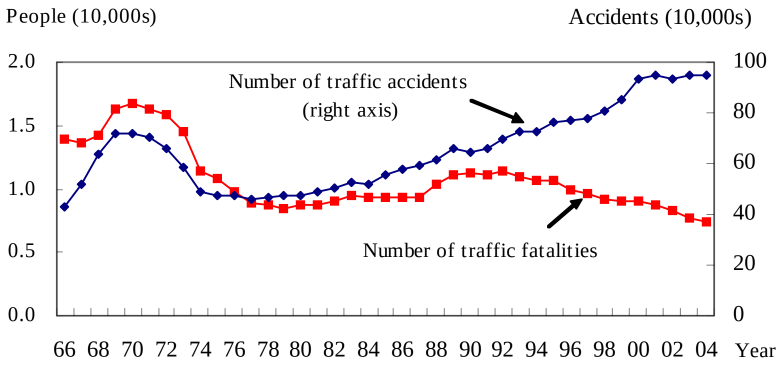
I Significance and Outline of ITS

1. Impact of ITS on Japan's Economy and Society

It is difficult to imagine life without automobiles; economic activities would grind to a halt without cars and trucks. Because of the transportation system's heavy reliance on cars and trucks, even as we seek the best mix of transportation modalities through modal shifting and other measures, we must develop automotive transportation in a sustainable form. Government agencies and industry players have been individually combating the massive economic losses caused by atmospheric pollution from vehicle exhaust emissions and escalating traffic fatalities; for automotive transportation systems in the 21st century to be sustainable, safety and environmental problems must be resolved.

For example, statistics show that fatalities due to traffic accidents are declining, from a peak in 1970 of 16,765 deaths, and 2004 marked the third consecutive record-low number of traffic deaths at 7,358. Yet the number of traffic accidents is actually increasing, and the number of traffic-related injuries closely parallels these figures (Figure 1-1). Meanwhile, estimates show that nearly one in five licensed drivers (23%) will be elderly[1] by 2020 (Figure 1-2), and observers worry[2] that more elderly drivers will lead to a higher accident rate and unchecked increase in traffic accidents and injuries unless preventive measures are taken. Car manufacturers are therefore being urged to build safer cars to cope with the issues of mounting traffic accidents and aging drivers.

The social and economic losses attributable to traffic congestion have long been clear. Road traffic censuses[3] since 1994 show that overall rush-hour travel speeds remain steady or are rising slightly. However, the weekday traffic problems in the Tokyo Metropolitan area and



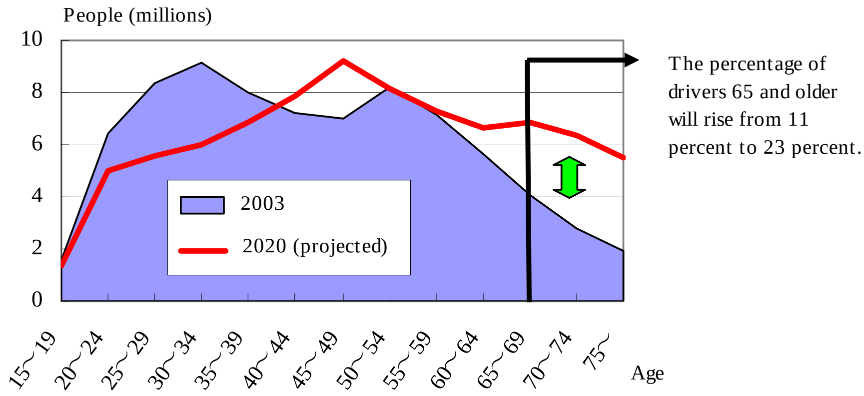
Source: Prepared by the Development Bank of Japan from "Traffic Statistics 2003" and other materials issued by the National Police Agency.

Figure 1-1. Transitions in Traffic Accidents

1 This paper considers those aged 65 or older to be elderly people.

2 Data indicates that the average braking reaction time of drivers aged 60 or older is 1.35 times that of drivers under 60 (0.5 seconds versus 0.37 seconds) (from "People and Cars (1988)," Japan Traffic Safety Association).

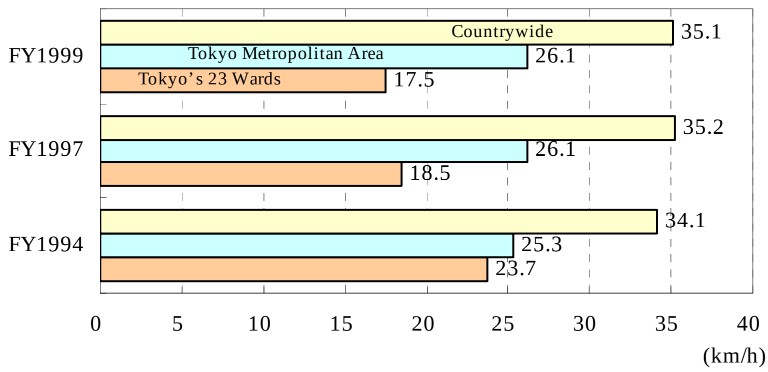
3 These surveys (officially called the "Road Traffic Census") are conducted by the Ministry of Land, Infrastructure and Transport in conjunction with local governments and public highway corporations to accurately ascertain the true state of Japan's roads and road traffic. Recent censuses have been conducted in 1994, 1997, and 1999.



Note: The projection for 2020 was arrived at based on transitions over the past 15 years in licensed-driver rates and estimates from the National Institute of Population and Social Security Research.

Source: Prepared by the Development Bank of Japan from annual traffic statistics reports and estimates from the National Institute of Population and Social Security Research.

Figure 1-2. Licensed Drivers (current figures and future estimates)



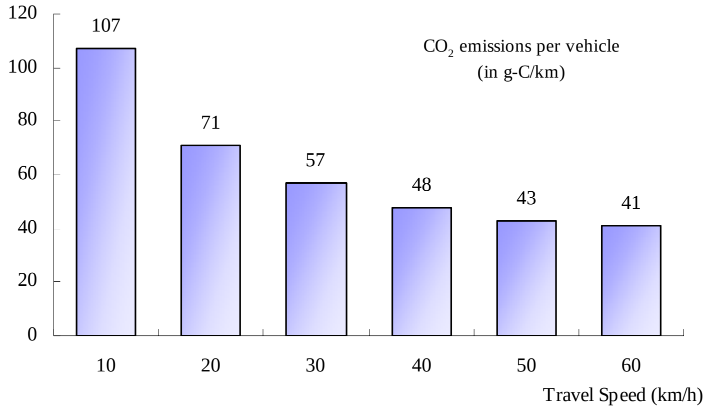
Note: Tokyo Metropolitan Area: Simple average of figures for Saitama Prefecture, Chiba Prefecture, Metropolitan Tokyo, and Kanagawa Prefecture.

Source: Prepared by the Development Bank of Japan from the 1999 "Road Traffic Census" and other sources.

Figure 1-3. Comparison of Average Rush-Hour Traffic Speeds (weekdays)

throughout Tokyo's 23 wards are worsening (Figure 1-3). The Ministry of Land, Infrastructure and Transport made an estimate using road traffic censuses and found that 3.8 billion people-hours were lost in 2002 due to traffic congestion, equivalent to 12 trillion yen.

Besides economic costs, congestion also has adverse effects on the environment. Cars and trucks cause some 90% of CO_2 emissions in the transport sector, which have already doubled from 1990 levels. In addition, the Ministry of Transport (now the Ministry of Land, Infrastructure and Transport) estimated in 1995 that of the 89 million kiloliters of fuel consumed by cars and trucks that year, 11% was wasted in traffic jams. On the other hand, as Figure 1-4 illustrates, an increase in average travel speed from 20 kph to 30 kph reduces CO_2 emissions by 20%. Thus, reducing traffic congestion is crucial for reducing CO_2 emissions in the transport sector.



Source: Ministry of the Environment, "2000 White Paper on the Environment."

Figure 1-4. Association Between Vehicular Travel Speed and CO_2 Emissions

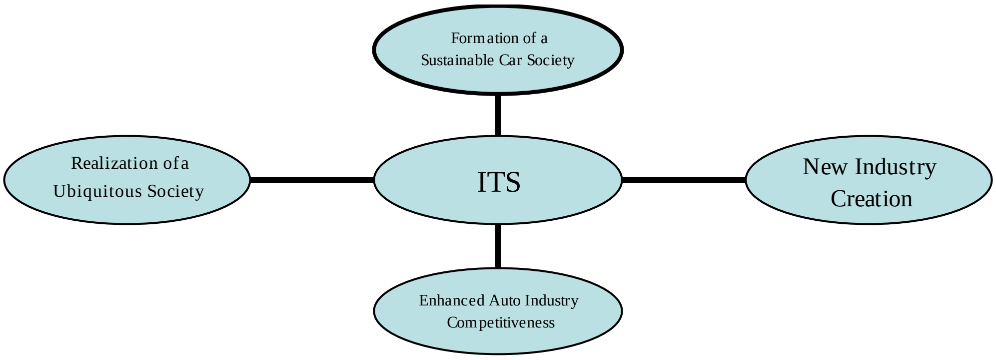


Figure 1-5. Significance of ITS

Many consider that Intelligent Transport Systems (ITS) can solve two major issues, safety and the environment, to make the road-traffic system sustainable in the 21st century. Leveraging the latest electronics and communications technology, ITS will create sophisticated new functions for cars as well as improve the safety and convenience of cars and lessen their environmental impact by connecting vehicles with road infrastructure through communication networks. ITS will also boost Japan's economy and industry by realizing a ubiquitous society, creating new industries, and enhancing the competitiveness of the automotive, electronic, and communication industries (Figure 1-5).

The 1990s witnessed progress in the office through computers and the Internet, which are closely related to the ubiquitous society, and among people through cellphones and PDAs. Similarly, the 2000s are likely to see the digitization of goods, with IC tags and electronic money. The rapid growth in the application of IT to cars will be driven by ITS over the same 10-year span in the early 21st century as goods and money. As these movements converge, a seamless, ubiquitous information society will emerge.

The contribution of ITS to the creation of new industries has been cited in the devices and services field related to the environment and energy, which is one of seven strategic fields[4] outlined in the Ministry of Economy, Trade and Industry's "New Industry Promotion Strategy" report (May 2004). Elsewhere, priority cross-cutting

[4] The "New Industry Promotion Strategy" outlines seven strategic fields: fuel cells, digital consumer electronics, robots, (Internet) content, health and welfare related devices and services, environment and energy related devices and services, and business-support services.

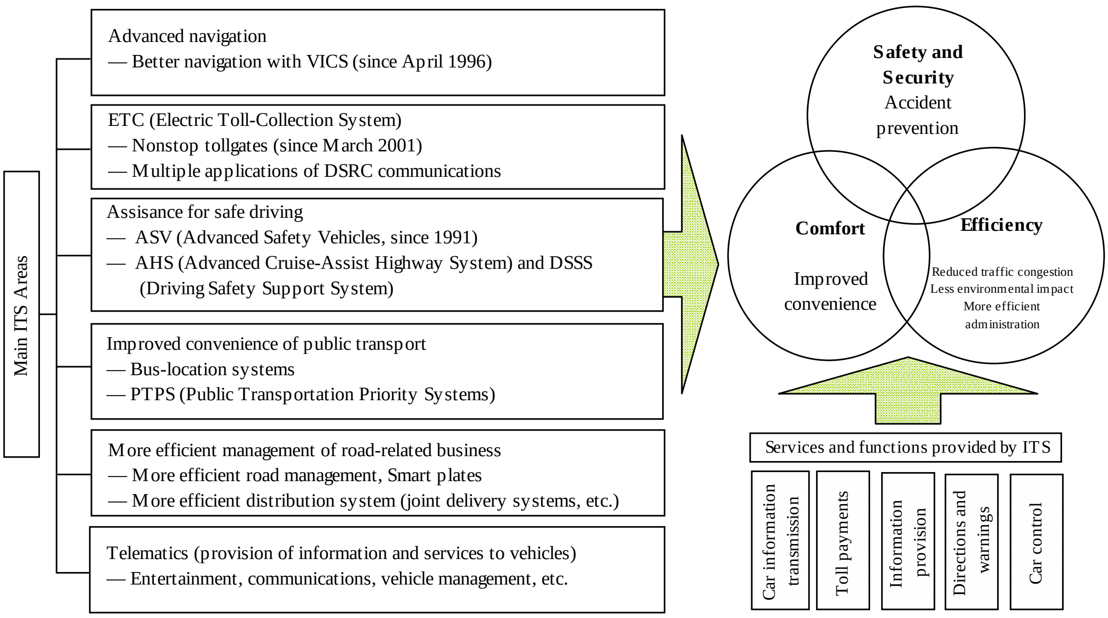
strategies have pointed out the importance of ITS as a common IT business platform.

Thus, ITS will have major benefits not only for specific sectors and industries, but also for the economy and society as a whole.

2. Outline of ITS

The Japanese government defined a policy to promote ITS as part of its "Basic Guidelines on the Promotion of an Advanced Information and Telecommunications Society" in February 1995. In August of the same year, five government agencies (represented today by the National Police Agency, the Ministry of Internal Affairs and Communications, the Ministry of Economy, Trade and Industry, and the Ministry of Land, Infrastructure and Transport) selected nine areas in which to construct ITS under the "Basic Government Guidelines of Advanced Information and Communications in the Fields of Roads, Traffic and Vehicles."[5] The "Comprehensive Plan for Intelligent Transport Systems (ITS) in Japan" was formulated in 1996 and new services such as VICS which provides road-traffic information, and ETC which is a nonstop road-toll collection system, have been emerging since then. Going forward, ITS will be expanded in various areas including assisting safe driving, improving the efficiency of public transportation, providing information and services to vehicles, managing vehicles and roads, and raising the efficiency of distribution.

Figure 1-6 shows the diverse nature of ITS; the ITS categories have no well-defined boundaries, and ITS has the potential to spread further in



Source: Prepared by the Development Bank of Japan from the "Comprehensive Plan for Intelligent Transport Systems (ITS) in Japan" and other materials.

Figure 1-6. Main ITS Areas and Impact of ITS Growth on the Car-Oriented Society

[5] The nine development areas stated were: advances in navigation systems, electronic toll collection systems, assistance for safe driving, optimization of traffic management, increasing efficiency in road management, support for public transport, increasing efficiency in commercial vehicle operations, support for pedestrians, and support for emergency vehicle operations. See page 85 of the "ITS Handbook 2004–2005" for details. (The nine areas were originally published in the "Comprehensive Plan for Intelligent Transport Systems (ITS) in Japan.")

line with emerging demands and technical breakthroughs. For example, the first studies of Smart plates[6] did not begin until 2000, several years after the Comprehensive ITS Plan was released. Although many issues remain before Smart plates can be used in practice, digitizing the management of vehicle information, from purchase to disposal, is expected to greatly streamline administrative services. With regard to efficiency of the distribution system, truck transport using digital tachographs and GPS[7] and joint delivery systems employing ITS are being implemented. By combining these systems with IC tags in the future, distribution efficiency will be increased further.

With regard to the process of diffusion of ITS products and services, whereas conventional products pass steadily through the lifecycle of adoption, growth, maturity, and decline, high-tech products do not move so steadily as their scope widens from one consumer segment to the next (that is, moving up one stage in the product lifecycle). The greatest barrier between two segments is called the *chasm* between the adoption and growth stages. This chasm makes it difficult for products to enter the mass market. The Chasm Model is a suitable framework for considering penetration patterns of goods and services such as ITS, where consumer acceptance is as important to growth as technical integrity and cost.

Applying this model to the main ITS areas and services, only VICS and car navigation have breached the chasm and entered the growth stage. ETC looks increasingly likely to make the leap from the adoption stage to the growth stage. Almost all other fields and services, such as Advanced Safety Vehicles (ASV, see Chapter III) and telematics (see Chapter IV), are still in the early adoption or pre-adoption (testing and demonstration level) stages. Thus, whether these fields and services will progress steadily along the growth curve depends on the initiatives of related players and consumers' acceptance of those initiatives. Furthermore, ITS is intrinsically dependent on the underlying infrastructure, so there are significant cost hurdles to expanding penetration. As a result, both government policies and industry efforts need to be finely tuned to each stage of ITS proliferation.

[6] A smart plate is a license plate with an attached IC tag that stores the license plate information and various information about the car. Smart plates are currently in the verification testing stage.

[7] GPS: Global Positioning System. GPS is a positioning system making use of US Department of Defense satellites to provide accurate position and time information 24 hours a day anywhere on the surface of the earth.

II VICS and ETC: From the Adoption Stage to the Growth Stage

1. VICS

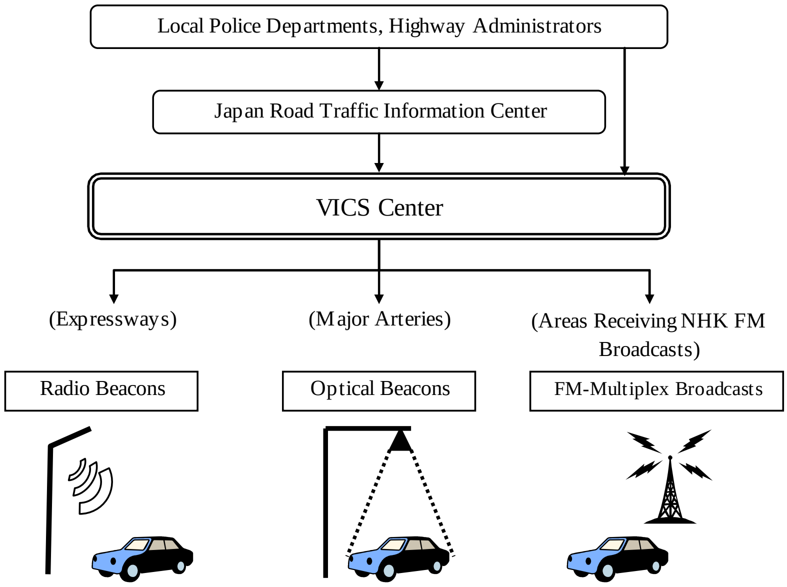
1.1. What is VICS?

VICS stands for Vehicle Information and Communication System, the aims of which are to improve road-traffic safety and ease traffic flows. By providing drivers with real-time traffic information, the system both reassures drivers psychologically about where they are going and helps them to select optimal routes. This improves safety on the roads, eases traffic jams, and thus shortens commuting times through better traffic-flow distribution.

VICS works as follows. The VICS Center (Road Traffic Information and Communication System Center) first obtains information on traffic conditions and road closures in real time via the Japan Road Traffic Information Center from local police departments and traffic control centers run by highway administrators. (The VICS Center acquires some information, such as parking lot information, directly.) The VICS Center processes and edits the information it collects and then passes it on to drivers through three media:[8] radio beacons, optical beacons, and FM-multiplex broadcasts (Figure 2-1, 2-2[9]).

1.2. Trends in VICS Services and Users

VICS information services got underway in April 1996. Originally, the plan was to cover the seven prefectures comprising Japan's three largest metropolitan areas in the first seven years and then extend the services across the country over the next 10 years. The countrywide coverage plan was revised twice, however, and expansion of VICS services across the country was completed in just seven years (by 2003), less than



Source: Prepared by the Development Bank of Japan from Road Traffic Information and Communication System Center, "The VICS Challenge," and other materials.

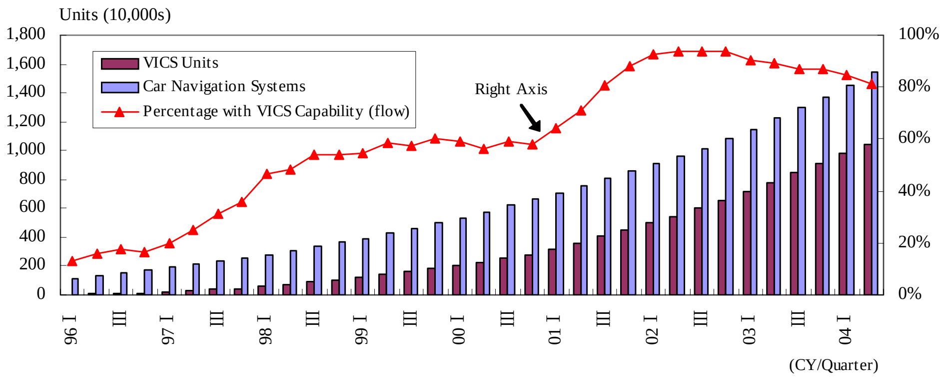
Figure 2-1. How VICS Works

[8] Table 2-1 gives details on each media. (More details can be found on the Road Traffic Information and Communication System Center website (http://www.vics.or.jp/).

[9] VICS information can be displayed on car-mounted units in three ways: level 1 (character display), level 2 (simple-diagram display), and level 3 (full map display). See the Road Traffic Information and Communication System Center website (http://www.vics.or.jp/) for more information.

Source: Road Traffic Information and Communication System Center website (http://www.vics.or.jp/).

Figure 2-2. VICS Display (at level 3)



Note: The percentage of navigation systems with VICS capability is the average of the movement during the previous three quarters.

Source: Prepared by the Development Bank of Japan from data released by the Road Traffic Information and Communication System Center and the Japan Electronics and Information Technology Association.

Figure 2-3. VICS Unit Shipments in Japan

half the original estimated time. As a result, shipments of VICS units in Japan have grown steadily in line with the installation of infrastructure and the popularity of car navigation systems. By July 2004, the cumulative number of onboard VICS units shipped exceeded 10 million and more than 80% of new car navigation units are VICS capable (Figure 2-3).

1.3. VICS Achievements

VICS has performed well, allowing drivers to use traffic-condition information, and the pace of diffusion and number of installed units have progressed favorably. One factor behind this success was the rapid buildup of infrastructure under government supervision, but more importantly VICS is easy for users to understand and system costs are invisible to users. Users actually pay a VICS viewing surcharge of 315 yen (per unit) when they purchase a VICS-enabled car navigation system, but this is hidden in the cost of the unit.

Although the success of VICS in alleviating traffic congestion and improving safety is difficult to quantify from official statistics, feedback from drivers has been positive.[10] Of course,

[10] Before starting VICS services, the VICS Center Prepara-

VICS still faces a number of issues (see the next section); there are aspects where the full potential of VICS is not being utilized, such as the poor growth of three-media VICS (few users attach a beacon reception antenna to receive information from all three media).

1.4. Future Issues

More than 10 million in-vehicle VICS units have been shipped and traffic-condition information from VICS is widely used. The next step is to develop the information provision process. Currently, it takes about 10 minutes after getting in a car for VICS data to download before it can be used. Furthermore, users are not happy with the coverage of VICS, which includes only the area surrounding the unit's current position, which on long trips makes finding the best route for the entire trip impossible. But such problems can be addressed with services provided by the telematics businesses that car makers are just starting, and VICS is not obliged to resolve all these problems itself taking into account its public nature. The one outstanding issue for VICS is the promotion of three-media VICS.

At present, most VICS users receive information from FM-multiplex broadcasts; few users receive information from all three media. The main reason is that users must directly absorb the costs of using three-media VICS by purchasing a separate beacon reception antenna. Another factor is lack of awareness among users that they can receive the full range of VICS functions from beacons. Specifically, having a beacon reception antenna allows auto re-routing, traffic-jam avoidance, traffic-condition updates, and acquisition of more detailed information by accessing traffic-condition information delivered by beacons.

This problem must be resolved as information will need to be received from optical beacons in order to deploy the Driving Safety Support System (DSSS, see Chapter III. 3) in the future. Hence, steps are needed to support three-media VICS. Working from the characteristics of each consumer segment given in Chapter I, suppliers and related players in the VICS market must convince users of the advantages of adopting three-media VICS and strive to increase to cost-benefit levels that satisfy consumers.

Table 2-1. The Three VICS Media

	Radio Beacons	Optical Beacons	FM-Multiplex Broadcasts
Media Operation	• Installed along expressways • Uses radio signals (quasi-microwave signals)	• Installed along major trunk roads • Uses optical signals (near-infrared waves)	• VICS-FM broadcast stations are set up across the country • Uses FM broadcast signals
Information Received	• Provides traffic information on expressways up to 200 kilometers ahead	• Provides traffic information on arteries up to 30 kilometers ahead	• Provides road-traffic information for an entire prefecture

Source: Prepared by the Development Bank of Japan from the Road Traffic Information and Communication System Center website (http://www.vics.or.jp/).

2. ETC

2.1. How ETC Works

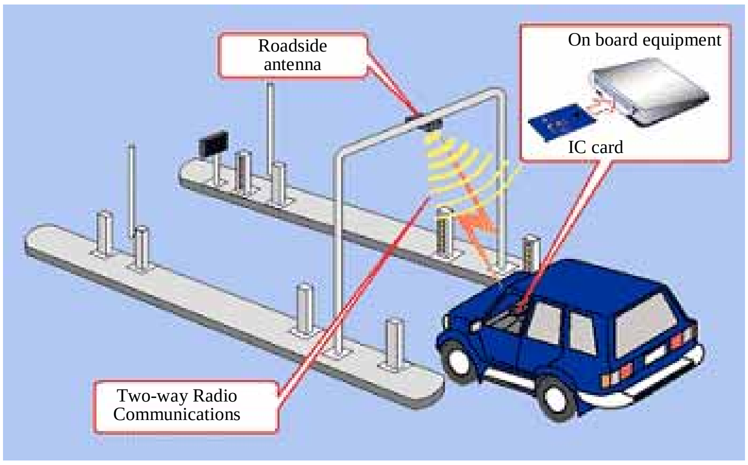
The Electronic Toll Collection (ETC) system collects tolls using radio signals so that vehicles do not need to stop at tollgates. A device installed in the vehicle communicates with an antenna at the collection point on a toll road.

As outlined in Chapter I, one of the primary targets of ITS is to eliminate traffic congestion. ETC is expected to contribute greatly to this target by eliminating traffic backups at tollgates, where nearly a third of expressway congestion occurs (Figure 2-5). Other significant benefits of ETC are the convenience of cashless toll payments and the better conditions at toll collection points (less air pollution and noise). With these expectations, ETC research began in 1993 and ETC went into service in March 2001. It took more than two years to reach one million ETC

tion Department made a rough cost-benefit projection for the first 20 years of service. The analysis showed the direct costs of setting up and running the VICS Center to be 33 billion yen, the indirect costs of installing and maintaining the beacons to be 370 billion yen (300 billion for installation and 70 billion for maintenance and operations), and the purchase costs of car units to be 800 billion yen, giving a total of 1.203 trillion yen. On the benefits side, the analysis estimated the savings in time to be worth 7.3 trillion yen and the fuel savings to be 450 billion yen, giving a total of 7.75 trillion yen. However, many of the assumptions used for the analysis have changed greatly since the estimates were made, so it is difficult to verify if the actual cost-benefits have exceeded or missed this projection.

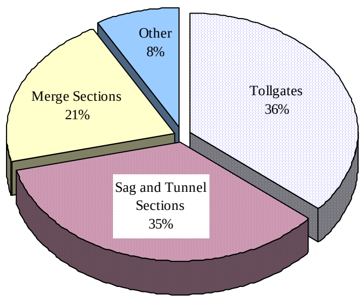
installations, but since then one million installations have been added every six months: the figure reached 4 million by October 2004 and 5 million just three months later in January 2005. (As Figure 2-6 shows, the actual installed base at the end of January was 4.88 million excluding re-installation). The ETC usage rate has risen sharply in tandem with installations, reaching 29% in January 2005.[11]

Two factors for this surge in ETC have been suggested: the rapid government-led rollout of ETC installations and, like VICS, that users can clearly identify the benefits of using ETC. Quick expansion of ETC infrastructure was clearly a factor in its popularity. ETC was initially available at 63 tollgates when launched in March



Source: ITS website (http://www.mlit.go.jp/road/ITS/j-html/) of the Road Bureau, Ministry of Land, Infrastructure and Transport.

Figure 2-4. How ETC Works (conceptual diagram)

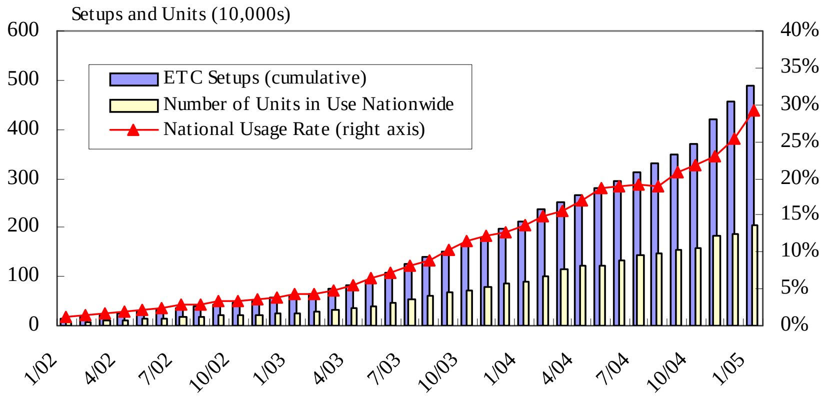


Note: Sag refers to a section where an expressway changes from a downward slope to an upward slope.

Source: "ITS Handbook 2004-2005" (originally taken from 2002 data from the Ministry of Land, Infrastructure and Transport).

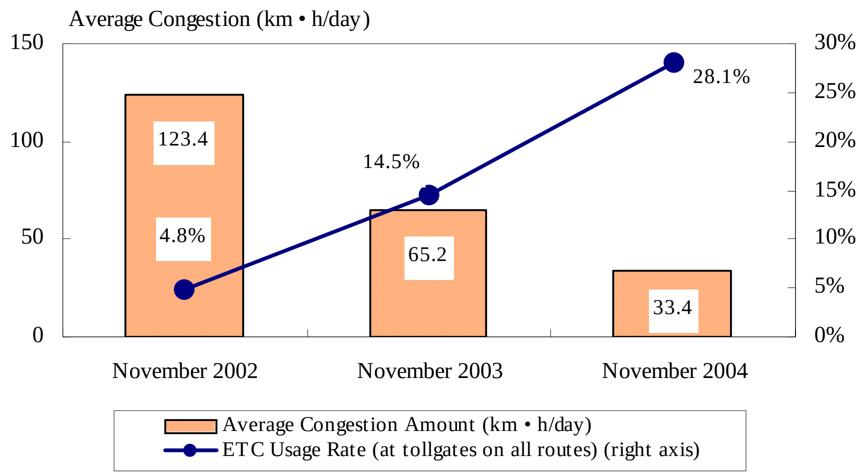
Figure 2-5. Causes of Traffic Jams on Expressways

[11] A usage rate of 29% indicates that one in ten vehicles using expressways have ETC installed. The ETC usage rate on the Metropolitan Expressway exceeded 30% in January 2005.
(See http://www.mex.go.jp/press/2004/050112/index.html.)



Note: Installation figures do not include re-installations.
Source: Prepared by the Development Bank of Japan from materials released by the Ministry of Land, Infrastructure and Transport.

Figure 2-6. ETC Adoption Rates

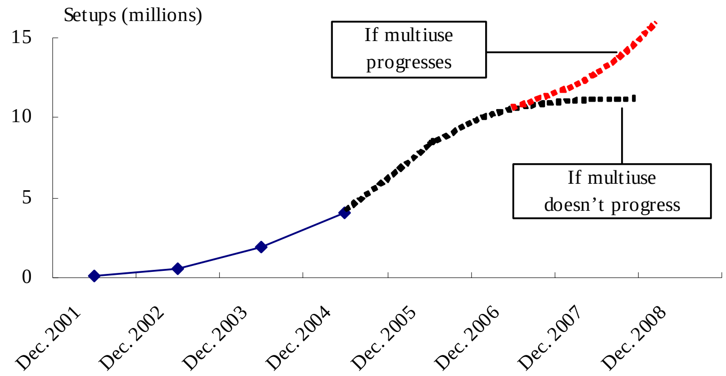


Note: Average congestion amounts are the averages of 18 tollgates.
Source: Prepared by the Development Bank of Japan from the "ITS Handbook 2004–2005" (original data from the Metropolitan Expressway Public Corporation).

Figure 2-7. Congestion Reduction Accompanying ETC Growth (at 18 tollgates along routes of the Metropolitan Expressway)

2001. By the end of 2003, this figure had reached 850 and at the end of 2004 ETC had been installed at all tollgates (about 1,300) of the four highway public corporations. At the same time, the government instituted various subsidy programs to stimulate initial demand for ETC units.[12] The resulting scale merit of mass production drove down prices (for ETC units), spurring further demand and initiating a virtuous cycle. As a result of these coordinated efforts, ETC continues to progress from the adoption stage to the growth stage.

[12] In addition to the prepayment discount system started in July 2002, several other special discount systems and purchase assistance programs have been run. (See the "ITS Handbook 2004–2005" for details.)



Note: Installation figures do not include re-installations.
Source: Prepared by the Development Bank of Japan from industry interviews and meetings.

Figure 2-8. Estimate of ETC Setups

2.2. Results of ETC Introduction

The introduction of ETC has already helped ease traffic congestion at tollgates. As the use of ETC has risen, the average traffic congestion has fallen at all tollgates on the Metropolitan Expressway; the average congestion in April 2004 dropped by almost half from two years before (Figure 2-7). Surveys[13] have also shown that ETC tollgate lanes process about 3.5 times the number of vehicles compared with manned tollgate lanes: ETC lanes process about 800 vehicles per hour; manned lanes about 230 vehicles per hour. Greater ETC deployment will further reduce and eventually eliminate queues at tollgates.

As ETC progresses furthers, construction of a diversified toll system to offset external diseconomies becomes more feasible. There has been a glaring need for time distribution (to lessen or eliminate traffic backups) of traffic loads, through connection discounts and peak road pricing,[14] as well as physical distribution of traffic loads through environmental road pricing. However, the cost and difficulty of implementation has made road pricing impractical. Yet, with ETC-equipped cars and cashless payments, it is possible to identify the routes used by each vehicle. Greater use of ETC makes sophisticated toll systems not only feasible but also eminently achievable. The Metropolitan Expressway Public Corporation[15] and the Hanshin Expressway Public Corporation[16] have already introduced limited environmental road pricing.

2.3. Future Outlook

The Ministry of Land, Infrastructure and Transport and the four highway public corporations redoubled efforts to promote ETC from the last half of 2004, setting ETC usage targets of 50% for the spring of 2005 and 70% for the spring of 2006 (Table 2-2). This program will boost the use of ETC for now, but when usage rates reach a certain level, the effect of promotion programs will gradually weaken. Proliferation due to the present stimulation incentives is likely to level

[13] A study by the Japan Highway Public Corporation (figures taken from the Organization for Road System Enhancement portal site (http://www.go-etc.jp/riyouhouhou/riyouhouhou.html).)

[14] Road pricing is a pricing strategy to reduce traffic on sections of highway prone to traffic jams or air pollution by collecting tolls (or charging higher tolls) from vehicles passing through such sections. Examples include peak road pricing, which reduces congestion at peak hours, and environmental road pricing, which lessens environmental impacts.

[15] To improve the environment next to the Yokohane Line, the Metropolitan Expressway Public Corporation has instituted environmental road pricing for large vehicles on the Bay Shore Route to shift traffic from the Yokohane Line to the Bay Shore Route and the Kawasaki Line. See the Metropolitan Expressway Public Corporation website (http://www.mex.go.jp/ryokin/road_p/road_p.html) for details.

[16] To improve the environment around the No. 3 Kobe Route, the Hanshin Expressway Public Corporation has instituted environmental road pricing to encourage large vehicles to use the parallel No. 5 Wangan Route. See the Hanshin Expressway Public Corporation website (http://www.hepc.go.jp/torikumi/03/03_05.html) for details.

Table 2-2. Overview of the ETC Promotion Plan for the Second Half of 2004 (including continuing programs)

Implementer	Specific Promotion Programs (figures in parentheses show targets or start dates)
Japan Highway Public Corporation	• Purchase assistance for ETC onboard units (300,000 units) • Toll reductions for bulk and frequent users (1 million units, from April 2005) • Mileage discounts for ordinary users (1 million units, from April 2005) • Commuter discounts (excluding sections in outlying urban areas, from January 2005) • Early-morning and late-night discounts (on sections in outlying urban areas, from January 2005) • Late-night discounts (from November 2004) • Tokyo Bay Aqua-Line public-acceptance test (from March 2005)
Metropolitan Expressway Public Corporation	• Toll reductions (500,000 units, from October 2004) • Metropolitan Expressway special segment discounts • Environmental road pricing • Public-acceptance test of Metropolitan Expressway late-night discounts (from March 2005) • Time-limited Metropolitan Expressway ETC discount (from November 2004 to the summer of 2005)
Hanshin Expressway Public Corporation	• Purchase assistance for ETC onboard units (128,000 units) • Toll reductions (250,000 units, summer of 2005) • Environmental road pricing • Time-limited ETC point discount (from January 2005 to the summer of 2005) • Time-limited ETC promotion discount (from November 2004 to the summer of 2005)
Other institutions	• Partial refund of installation charges (Organization for Road System Enhancement) • Special discount for the Honshu-Shikoku bridge (Honshu-Shikoku Bridge Authority) • Local government assistance with public-acceptance tests of smart ICs

Source: Prepared by the Development Bank of Japan from the Organization for Road System Enhancement portal site (http://www.go-etc.jp/) and other materials.

off at about 10 million ETC installations (Figure 2-8). Conversely, Japan's ETC system uses Dedicated Short Range Communications (DSRC),[17] featuring an active technique (cars can transmit back to the system) and a two-piece arrangement whereby vehicle information is contained in the onboard unit and personal information is contained on an ETC card. The ETC system can thus be easily extended to cover multiple applications and functions.

These figures indicate that other applications beyond payments on toll roads must be developed for both effective utilization of ETC infrastructure and higher ETC usage rates. The ETC market is expected to continue to grow once next-generation ETC car units, capable of multiple applications, are released in 2006 if new services and businesses appear. Note that as ETC usage rates increase, dedicated ETC lanes at tollgates will have to be added and upgraded.

Both the government and the private sector have made some moves in the multiuse ETC arena. The Ministry of Internal Affairs and Communications paved the way for private-sector ETC applications by amending its ordinances related to radio signals in April 2001. The Ministry of Land, Infrastructure and Transport released a study group report on applications for ETC-related technology in March 2004. This report summarized the group's findings on ensuring security and protecting personal information when using ETC-related technology on the premise of using some of the functionality of present-day ETC car units.[18] Additionally, the Ministry of Land, Infrastructure and Transport is running demonstration tests of parking-lot services using ETC communication technology partnered with next-generation ETC units.[19] Following these government efforts, the private sector is gradually commercializing ETC applications. The DSRC Forum Japan, established in December 2003, is now planning the early deployment of DSRC. Examples from individual

[17] The reception area has a radius of about only 15 meters, but it can achieve data speeds as high as 4 Mbytes/second.

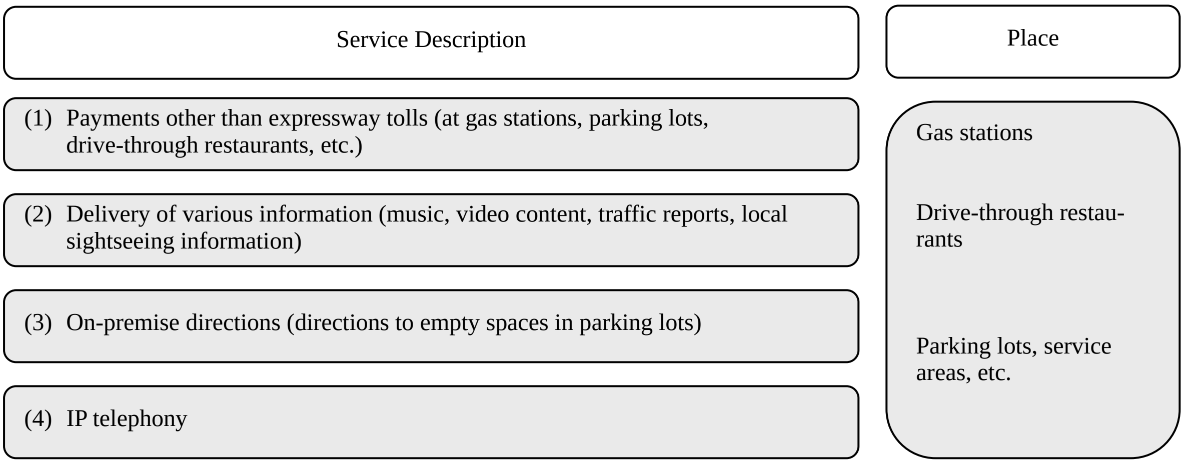
[18] See the report on the Ministry of Land, Infrastructure and Transport website (http://www.its.go.jp/ITS/j-html/Etc/ETCkanren/gaiyou.pdf).

[19] Demonstrations were held in March 2004 at the Toyota Stadium in Toyota, Aichi Prefecture. Next-generation ETC units are those with the capability to read ordinary IC cards.

corporations include Toyota Tsusho Corporation, which installed a DSRC system in the parking lot at its headquarters, and ITS Business Applications Inc., established by Mitsubishi Corporation and other companies, which has been developing non-stop parking-lot services and other businesses using multifunction ETC car units since 2003.[20]

There is huge potential for various ETC services, as Figure 2-9 illustrates, and companies are now working out how to turn services into viable content and business models, although problems with roadside infrastructure and hardware (car units) platforms must also be overcome.

The Ministry of Land, Infrastructure and Transport has been studying the introduction of dedicated ETC interchanges (Smart ICs) to make better use of existing expressways and to stimulate local economies. As part of these studies, the Ministry is making social experiments of Smart ICs connected to SA and PA. Chapter V.2 covers this area in more detail.



Source: Prepared by the Development Bank of Japan from various materials.

Figure 2-9. Potential of Multiuse ETC

[20] See the ITS Business Applications website (http://www.itsbiz.co.jp/index.html).

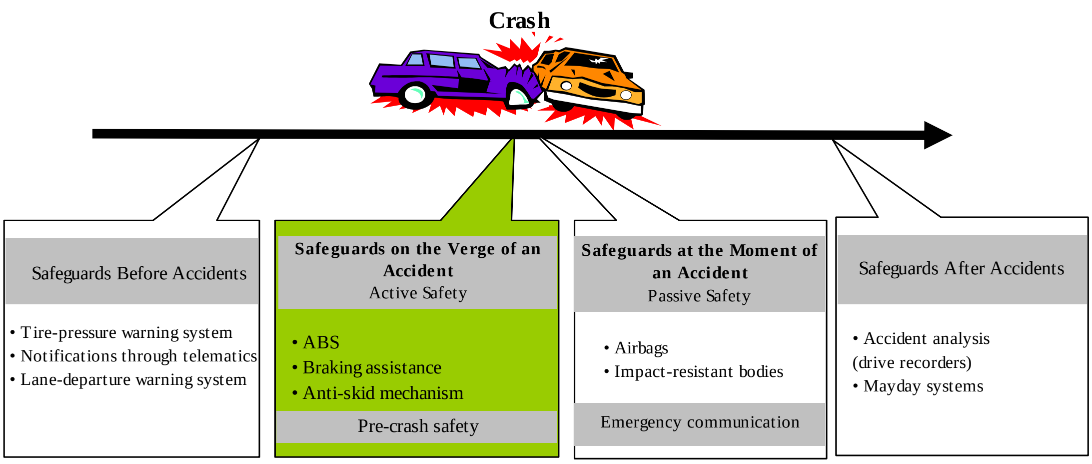
III Advances in Vehicle Safety through ITS

1. Outline of Vehicle Safety: From Passive Safety to Active Safety

Safety devices for cars came into being in the 1990s. The use of passive-type safety devices (collision safety), such as airbags and crash-safe bodies that afford protection upon impact grew throughout the 1990s. In contrast, since 2000 there has been more development and marketing of active-type safety devices, which are designed to anticipate and prevent accidents.

The crash-safe body emerged as a response by car manufacturers to changes in safety standard amendments and tougher regulations in Japan and other countries. Toyota (GOA[21]) and Nissan (Zone body) started the trend in 1996 and soon other makers started using new crash-safe bodies. Even as carmakers improved the structural crash worthiness of their cars, they also improved car-interior safety with airbags and seatbelts. Car manufacturers also launched marketing campaigns around this time promoting the all-round "safety" of their products. The changeover was quick. In the early 90s less than 10% of new cars were equipped with even driver's seat airbags, but the installation of airbags climbed rapidly from 1995 and by 2000 nearly 100% of new cars came with driver's seat airbags and more than 80% with passenger seat airbags (Figure 3-2). So while passive safety progressed swiftly in the 1990s, work remains to be done; future revisions of safety codes will demand more sophisticated crash-safe bodies and more airbag systems, such as side and curtain shields.

Although the introduction of pre-crash accident-avoidance systems was delayed due to technical limitations and other factors, efforts picked up from 2000.[22] Since the ultimate aim of automobile safety measures is to eliminate all accidents, or eliminate all automobile collisions with other vehicles and pedestrians, accident-avoidance and pre-crash safeguards will become more widespread. Statistics show that 75% of traffic accidents are caused by driver error, due to slow reactions or errors in judgment

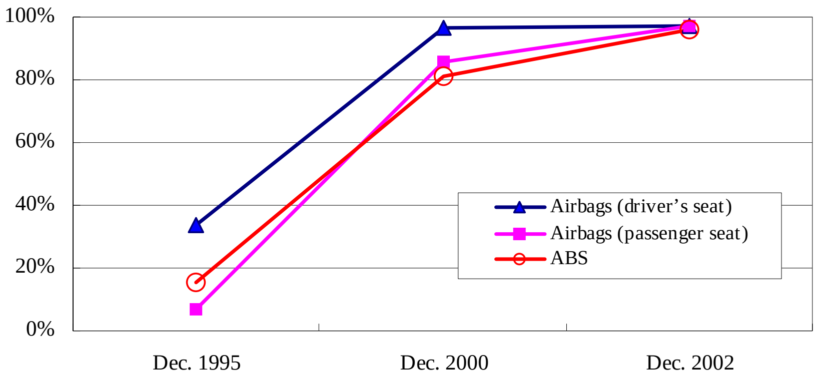


Note: Pre-crash safety combines both passive and active safety. In addition to anticipating a collision, pre-crash safety consists of safeguards to automatically control collisions and thus minimize injuries (see Table 3-1 for details).
Source: Prepared by the Development Bank of Japan from Ministry of Land, Infrastructure and Transport materials.

Figure 3-1. Outline of Vehicle Safety Measures

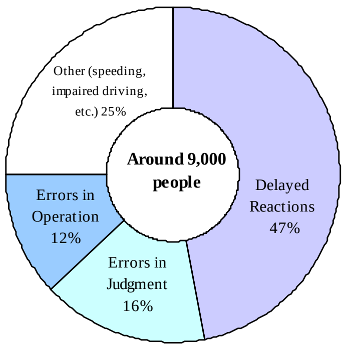
[21] GOA: Global Outstanding Assessment. Under this program, Toyota began using crash-safe bodies on Starlets, Coronas, and Premios in January 1996 and incrementally expanded the range of models using these bodies. The program ended about two years later when all Toyota's passenger vehicles featured crash-safe bodies.

[22] One form of active safety, anti-lock braking (ABS, a system that prevents a vehicle's wheels from locking up and skidding during emergency braking or when braking on slippery surfaces), was already commonplace in the 1990s (see Figure 3-2).



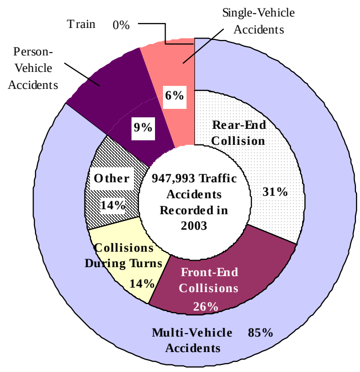
Source: Prepared by the Development Bank of Japan from Ministry of Land, Infrastructure and Transport, 2003 and 2004 White Papers.

Figure 3-2. Cars Equipped with Airbags and ABS



Source: Prepared by the Development Bank of Japan from traffic accident statistics for 2000.

Figure 3-3. Causes of Accidents



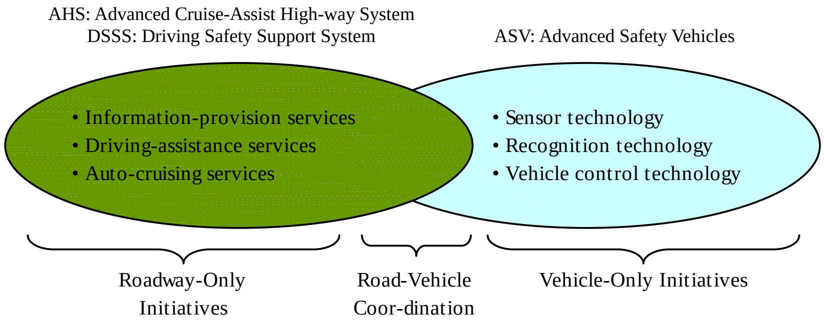
Source: Prepared by the Development Bank of Japan from the "Road Statistics Yearbook 2003."

Figure 3-4: Traffic Accident Percentages in 2003

or operation. By making cars more intelligent to assist drivers' perception, judgment, and actions, accident rates will be reduced substantially (Figures 3-3 and 3-4).

The addition of effective accident-avoidance and pre-crash safeguards to vehicles and their widespread deployment are expected to reduce the number of accidents, deaths and injuries. The Ministry of Land, Infrastructure and Transport and car manufacturers are developing road vehicles, referred to as Advanced Safety Vehicles[23] (ASV), equipped with the latest such safety devices. The Ministry is also pursuing infrastructure-side safety support with the Advanced Cruise-Assist Highway System (AHS) and the National Police Agency with the Driving Safety Support System (DSSS) (Figure 3-5). The ultimate aim is to greatly improve safety and reduce accidents by disseminating safety systems that unify both infrastructure and vehicle safety successes (road-vehicle coordination).

[23] ASV refers to cars equipped with advanced safety technology, using the latest electronics to collect and process various information and use this information to give feedback and warnings to the driver and to assist driving through car control. In other words, these cars come with advanced intelligence (from the Ministry of Land, Infrastructure and Transport website).



Source: Prepared by the Development Bank of Japan from various materials.

Figure 3-5. Accident-Avoidance and Pre-Crash Safety Initiatives (ASV, AHS, and DSSS)

2. ASV

2.1. How ASV Works

The Study Group for ASV Promotion, which was established jointly by the Ministry of Land, Infrastructure and Transport, academic experts, and car manufacturers, has been working on the development and deployment of ASV since 1991.[24] Typical features of an ASV are outlined below and in Figure 3-6.

1) Perception assistance
   - Adaptive front-lighting system: When negotiating a curve at night, the headlights automatically adjust the area they illuminate according to the angle of the steering wheel and the speed of the car.
   - Night-vision assistance system: When driving at night, this system uses infrared cameras or radar to assist the driver's night vision by displaying images of the road in front of the vehicle.

2) Judgment assistance
   - Lane-departure warning system: When driving on expressways, this system warns the driver when the vehicle is about to drift out of the lane by using a camera to recognize the white lane markers and the car's position.
   - Parking-assistance system with voice guidance: When backing a car into a garage or parallel parking, a monitor shows the expected path when backing up and an automated voice gives steering directions.

3) Driving assistance
   - Integrated braking/cruise-control system: When traveling at a constant speed preset by the driver and a slower car is encountered ahead, this system reduces the speed to keep a constant following distance from the vehicle in front.
   - Navigation-coordinated transmission control: Based on curve and road-grade information from the navigation system's map data and on information about the driver's maneuvers, this system automatically controls the transmission's gear changes.

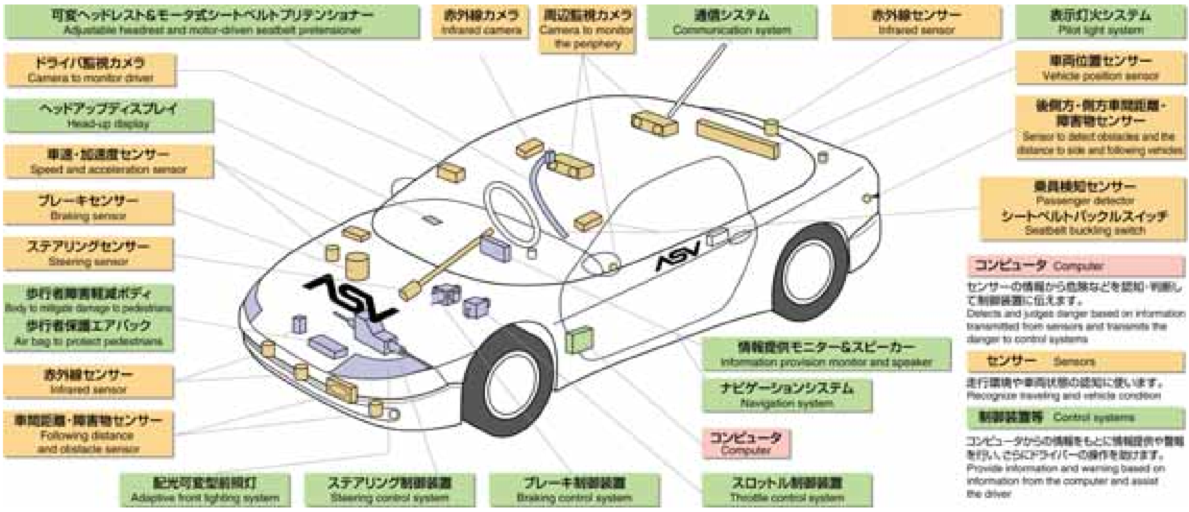
4) Integrated assistance
   - Obstacle-avoidance system (pre-crash safety): This system monitors following distances, relative speeds, and the presence of obstacles with cameras and radar and sounds a warning to the driver when there is potential for a collision. When a crash is unavoidable, the system automatically tightens seatbelts and applies the brakes.

[24] The Study Group launched the ASV project in 1991 and is now in the project's third phase (2001 to 2005). In the third phase, the Study Group has been examining means of promoting the widespread use of ASV in addition to new technical developments such as advanced autonomous vehicles and application of communication technology.

Table 3-1. Typical ASV Products by Function

Category		Typical Products
Perception Assistance	Visual Assistance	Adaptive front-lighting system Night-vision assistance system
	Information Provision	Identifies accident-prone locations on the navigation monitor
Judgment Assistance		Lane-departure warning system
		Parking-assistance system with voice guidance
Driving Assistance	Driving-Stress Reduction	Integrated braking/cruise-control system Navigation-coordinated transmission control
	Danger Avoidance	Electronic Stability Control (ESC)
Integrated Assistance		Obstacle-avoidance system (pre-crash safety)
		Unified control of ABS, ESC, and other mechanisms (VDIM*)

Note: *VDIM: Vehicle Dynamics Integrated Management (trademark of Toyota Motor Corporation).
Source: Prepared by the Development Bank of Japan from Junzo Ooe, "Course of Telecommunications Technology in Automobiles (part 1)," ("Information Processing," September 2004) and other materials.



Source: Taken from Study Group on the Promotion of ASV.

Figure 3-6. ASV Conceptual Image

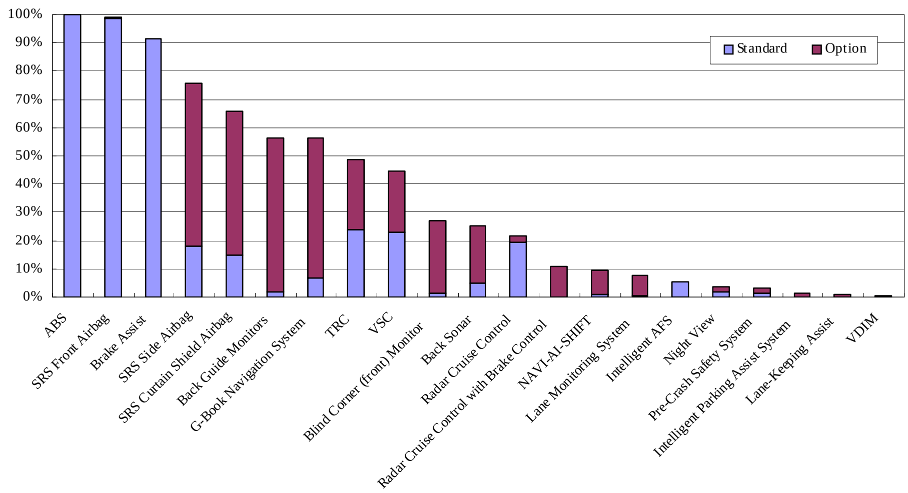
Table 3-2. Implementation Rates of ASV Technology (four-wheel vehicles)

(Vehicles)

	2000	2001	2002	Penetration Ratio
Curve-warning devices	8,106	10,720	10,335	0.2%
Integrated brake/cruise-control systems	3,389	9,619	24,102	0.5%
Lane-keeping assist devices	–	947	422	0.0%
Navigation-coordinated transmission control devices	193	203	192	0.0%
Drowsiness-warning devices	8,032	10,737	48,334	1.1%
Number of surveyed (four-wheel) vehicles	4,575,795	4,456,909	4,472,920	–

Notes:
1. Surveyed (four-wheel) vehicles: passenger vehicles produced in Japan for the Japanese market (including mini vehicles).
2. See the end of this chapter for a summary of each ASV technology.

Source: Prepared by the Development Bank of Japan from press releases by the Road Transport Bureau, Ministry of Land, Infrastructure and Transport.



Notes: 1 The installation percentages were found by dividing the number of Toyota classes with the above devices and functions as standard or optional equipment by the total number of Toyota passenger car classes excluding Century and Hiace vehicles. (Calculations were made based on information valid at the end of October 2004.)

2. The safety device names given here are Toyota trade names. See the end of this chapter for their relationship with ordinary terms.

Source: Prepared by the Development Bank of Japan from Toyota Motor Corporation's new car catalogs and its website.

Figure 3-7. Installation Rates of Safety Devices and Functions (by class)

When the Ministry of Land, Infrastructure and Transport surveyed how many vehicles were equipped with ASV devices in 2002, it found the penetration rate to be less than 1% in almost all surveyed categories (Table 3-1). ASV products are thus at the very early adoption stage of their lifecycle. Whether ASV will gradually take root in the market or die out due to consumer indifference depends largely on the actions of manufacturers and industry. The next section looks at the penetration rates of all safety devices.

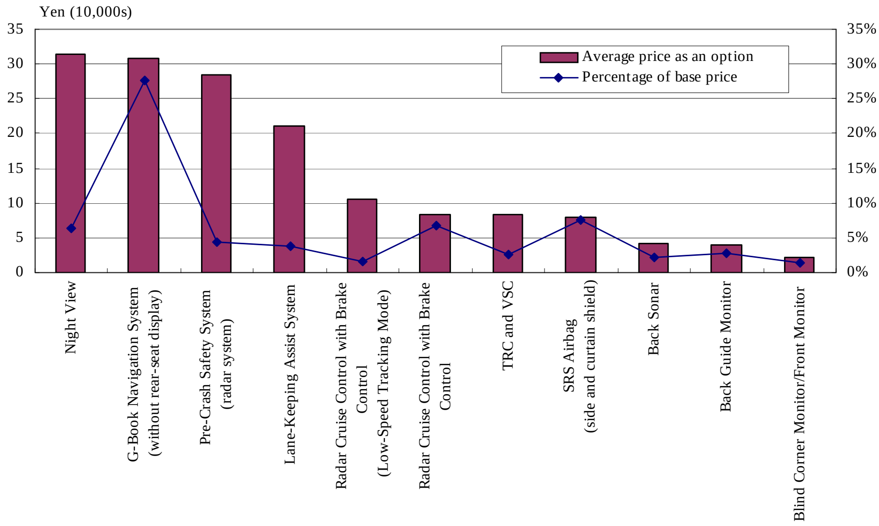
2.2. Present Installation Rate of Safety Devices

There is no public data showing the extent of safety-device installation in vehicles for 2003 and 2004 other than the Ministry of Land, Infrastructure and Transport statistics in Table 3-2 above, which are from 2002. In lieu of official statistics, we gauged the penetration rates of major safety devices by taking Toyota Motor Corporation as an example and calculating the percentage of cars by class equipped with these safety devices (Figure 3-7).[25] (We divided the number of classes available with the devices as standard or optional equipment by the total number of classes.)

This informal survey showed that ABS, SRS front airbags,[26] and brake assist are currently installed on more than 90% of cars, so nearly all users benefit from these safety devices. In the installation range of 50 to 80% were airbags (side and curtain shield), back-guide monitors, and telematics-ready navigation systems (G-Book). However, these were mainly options, and less than 20% of vehicles included them as standard equipment. Ranging between 20 and 50% were traction control (TRC), vehicle stability control (VSC), blind-corner and front monitors, back sonar, and radar cruise control. All other devices were installed on no more than 10% of Toyota's vehicles.

[25] Toyota's data was selected as representative of general trends because its model range covers all segments of the domestic auto market.

[26] See Reference at the end of this chapter for definitions of safety devices unless noted otherwise in the text or footnotes.



Notes: 1. The average option prices are the median value from the classes equipped with the most safety equipment and functions from each car series. The percentages of base prices were calculated by dividing the average option price by the lowest base price among the classes equipped with the option. (Calculations were made based on information valid at the end of October 2004.)

2. The safety device names given here are Toyota trade names. See the end of this chapter for their relationship with ordinary terms.

Source: Prepared by the Development Bank of Japan from Toyota Motor Corporation's new car catalogs and website.

Figure 3-8. Price Levels of Main ASV Components

2.3. Issues Facing the Dissemination of ASV Technology

The installation rate of ASV functions is expected to rise with each model change, and automobile manufacturers appear to have drafted marketing strategies aimed at fully popularizing ASV.[27] However, whether and how fast ASV grows in line with expectations depend on cost and user acceptance.

In terms of cost, manufacturers must reduce the cost to consumers of introducing ASV. Currently, the most expensive ASV components can exceed 300,000 yen (Figure 3-8). Considering the base price of cars, the cost must be greatly reduced before real growth can occur. This involves more than just slashing the price of ASV technology itself; the costs of existing parts and processes also need to be reduced. Meanwhile, to complement industry initiatives, the government should consider instituting incentive programs and other assistance for ASV-equipped vehicles. As the ETC experience has proven, purchase subsidies and discounts to trigger initial demand can be enormously effective under certain conditions. Thus, the government should verify the effectiveness of policies to curb the increasing number of traffic accidents and traffic injuries and establish pertinent measures.

Even if cost barriers are lowered, the ASV market will not expand unless users accept ASV functionality, as explained in Chapter I; consumer acceptance will dictate the future expansion of ASV technology. Experts frequently point out that for a high-tech product to gain acceptance in the market, the product must be 1) technically viable (is the technology practical?), 2) reasonably priced (what is the cost-benefit ratio?), and 3) be truly acceptable to users. This implies that promoters need to convey clearly how buying an ASV will actually help drivers. Another problem is the increasing complexity as

[27] According to newspaper reports, Toyota has decided to popularize ASV technology while holding down prices despite the initial expense. For instance, Toyota plans to equip 80% of its cars in 2006 with AFS (adaptive front-lighting system), which is currently available on three series and four models, and all car series by 2008. (July 9, 2004 edition of the *Nikkan Jidosha Shimbun*)

Table 3-3. Major ASV Technologies for Commercial Vehicles

Available in Commercial Forms	Under Development
• Electronic Stability Control • Integrated brake/cruise-control systems • Lane-drift warning systems • Tire-pressure monitors • Blind-corner assistance systems (left-side cameras)	• Obstacle-avoidance system • Driver-condition monitoring systems • Night-vision assistance systems • Pedestrian recognition systems • Periphery awareness systems

Note: Names are used giving priority to terms used by the Ministry of Land, Infrastructure and Transport.
Source: Prepared by the Development Bank of Japan from pamphlets of various companies.

more ASV features are added. Therefore, as the adoption of ASV proceeds, ingenuity must be exercised to simplify operations, otherwise growth cannot be expected. This problem extends beyond makers especially in view of the increasing number of elderly drivers. The auto industry and public-private concerns must work together to make users aware of ASV.[28] Presenting its true merits is pivotal for ASV not to become a “chasm” victim, selected only by those who like the mechanics of ASV or the shimmer of new toys.

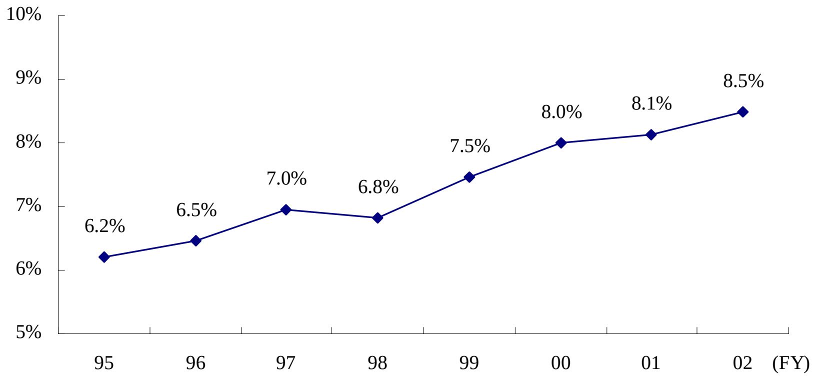
2.4. ASV for Commercial Vehicles

There were 2,093 large-scale accidents involving trucks in 2002, killing 1,132 people, according to the “Annual Report on Accidents Involving Commercial Transport Vehicles” (Ministry of Land, Infrastructure and Transport). Though commercial vehicles make up only a small portion of the number of vehicles in Japan, they account for a disproportionate share of travel distances and cause more damage when accidents occur. Therefore, developing ASV technology for commercial vehicles is essential for improving the safety of today’s car society. Many companies have already committed themselves to making progress in this area (Table 3-3). A number of manufacturers have announced plans to install automatic emergency braking systems in large trucks in the next one to two years. One problem is the difficulty of addressing product liability concerns due to the characteristics of large trucks not found in passenger cars, such as secondary accidents caused by load spillage, their greater likelihood of overturning due to sudden braking, and overloading of trucks. Solutions will require strong government leadership as such issues develop.

2.5. Incorporation of Electronics in Cars and Its Effect

Electronic components account for 15% of the production cost of today’s cars, a percentage that will increase as the adoption of ASV technology precipitates the shift to more automotive electronics. Thus, carmakers cannot escape the fact that electronics technology is spearheading the development of ASV and associated safety devices and functions. Several trends reflect this. Vehicles of the 1980s used about 10 microcomputers on average but this figure rose to 20 in the early 1990s, to 30 in the late 1990s, and now stands at about 40. Cars now also use ten times as many as onboard semiconductor devices than 10 years ago: around 100 to 150 devices for ordinary cars and more than 200 for some sophisticated models. Figure 3-9 indicates the make up (real base) of electronic devices in the intermediate inputs to the auto industry as seen in the “SNA Input-Output Tables for Japan.” This percentage has jumped from 6.2% in 1995 to 8.5% in 2002. Macro statistics also confirm the trend toward more electronics in automobiles.

[28] For example, familiarizing people with ASV technology, such as holding hands-on events for people renewing their driver’s licenses, is an effective way to spur growth. Furthermore, standardization is needed among manufacturers concerning ASV product names, operation methods, and display methods. Large differences in terminology and operations between manufacturers (that is to say, when no dominant design is established) will likely confuse users and hinder acceptance and growth.



Source: Prepared by the Development Bank of Japan from the "SNA Input-Output Tables for Japan."

Figure 3-9. Percentage of Electronic Devices in the Intermediate Input to the Car Industry (real base)

The move to more electronics in automobiles holds many implications for industry players. It presents a chance for electronics manufacturers and other new players to enter the market as well as for shakeups in the profit-distribution patterns over processing (parts) among existing players. As sources of added value will be sought in parts and components, the market strength and profitability of auto-parts manufacturers may improve. Alternatively, automakers and electronics manufacturers may carve up the component market, even if it becomes a center of added value, and cut out auto-parts manufacturers. In any likely scenario, automakers, electronics makers, and auto-part makers will compete and form strategic alliances to seize the technical initiative. Corporations unable to ride this wave of technology will struggle to survive.

3. Demonstration Stages of AHS and DSSS

AHS (Advanced Cruise-Assist Highway System) and DSSS (Driving Safety Support System), which assist safe driving from the infrastructure side, are still at the testing and demonstration stages. Practical installations are not expected until 2007 or later (Table 3-4).

AHS attempts to prevent accidents before they happen by giving drivers (through displays and other means) real-time information on accidents and traffic jams ahead. AHS uses sensors and road-to-vehicle communications to provide this information. Testing of AHS for eventual application is centering on seven services (Figure 3-10) selected by analyzing traffic accident causes. AHS is now being tested along highways at seven locations across the country, and accident rates have fallen dramatically at some of these sites, prompting hope that AHS is the key to reducing accident rates.[29] Current plans aim to install AHS roadside devices at 100 locations nationwide where AHS is thought to be especially beneficial, and commercial-type AHS receivers are due to be installed in 2007.

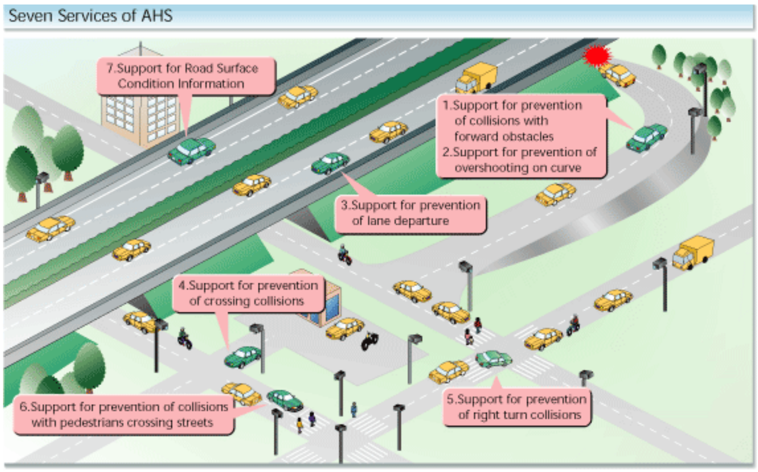
DSSS, on the other hand, attempts to reduce traffic accidents by informing drivers in real time about what is in the vicinity of their cars (such as pedestrians or two-wheeled vehicles behind them). DSSS displays this information on outdoor message signboards and/or employs optical beacons to send information to car navigation units. DSSS will be important since 56% of traffic accidents occur at intersections (Figure 3-11).

[29] Testing uses radio signals in the 5.8 GHz band to provide information to cars. Since operating in this band requires a radio license, testing has been limited to test cars only. Private automobiles, as yet, cannot benefit from AHS. The test site along National Route 24, however, uses roadside signs to warn of danger so that all vehicles on the highway can make use of the AHS information. The number of accidents at this site has plummeted. Therefore, officials expect even greater reductions in accidents after the envisioned system is fully integrated with in-vehicle displays and alarms in the future.

Table 3-4. AHS and DSSS Demonstrations

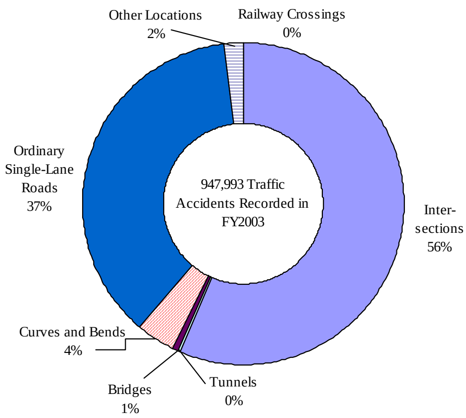
AHS	DSSS
• Demonstrated in seven locations nationwide • Tested providing information on upcoming obstacles in areas of poor visibility and signaling warnings when entering curves • Upcoming infrastructure is being prepared for application in 2007	• Demonstrated in Toyota, Aichi Prefecture • Tested providing rear-end collision avoidance information, pedestrian crosswalk information, and speed information

Source: Prepared by the Development Bank of Japan from various materials.



Source: Advanced Cruise-Assist Highway System Research Association website (http://www.ahsra.or.jp/).

Figure 3-10. AHS Overview (seven systems)



Source: Prepared by the Development Bank of Japan from "Traffic Statistics 2003."

Figure 3-11. Accident Locations in 2003 (by road type)

At a test site in Toyota, Aichi Prefecture, tests of providing rear-end collision avoidance information, pedestrian-crossing information, and speed information are underway.

It will take time and money to launch and nurture AHS and DSSS services, and both require the prior development of infrastructure and onboard devices. Thus, the government must take the lead to shorten rollout timeframes and to sustain private corporations' interest in development. It is also important to prioritize the basis of AHS and DSSS services as existing ITS services are expanded. For instance, DSSS is due to upload information from optical beacons to car-mounted devices, but as mentioned in Chapter II.1, very few current VICS navigation systems can receive optical beacons. The government should address this by taking measures to promote the use of three-media VICS.

Reference: Names of Safety Devices in Figures 3-7 and 3-8

Product (Option) Name	General Name and/or Description
ABS	Anti-lock braking system (see page 17)
SRS airbag (front)	Airbag installed in front of the driver and passenger seats. SRS stands for supplemental restraint system, meaning the airbag supplements the use of seatbelts.
Brake assist	Mechanism that judges sudden braking by the speed and force of the brake pedal's movement and applies stronger braking force based on this decision
SRS airbag (side)	Airbag installed beside seats (near chest height)
SRS airbag (curtain shield)	Airbag that cushions against side impacts; opens between the side window and the front-seat passenger's head
Back guide monitor	Automatically displays a view behind the car on a monitor when backing up
G-Book navigation system	Car navigation system capable of receiving G-Book services, a telematics service run by Toyota
TRC	Mechanism that senses when the car is skidding and controls the car's braking and engine output to maintain the car's stability
VSC	Mechanism that keeps the drive wheels from spinning when driving or accelerating on slippery surfaces and maintains the appropriate drive power to support smooth acceleration and car stability (normally called ESC, Electronic Stability Control)
Blind corner monitor/front monitor	Mechanism using a front-mounted camera that shows the driver's blind spots on a monitor
Back sonar	Driving-support mechanism that uses a buzzer or indicator lamp to indicate when the car is approaching an obstacle
Radar cruise control	Mechanism that maintains a constant speed
Radar cruise control with brake control	Integrated brake/cruise-control system (see page 18)
Navi-AI-Shift	Navigation-coordinated transmission control (see page 18)
Lane monitoring system	Lane-drift warning system (see page 18)
Intelligent AFS	Adaptive front-lighting system (see page 18)
Night view	Night-vision assistance system (see page 18)
Pre-crash safety system	Obstacle-avoidance system (see page 18)
Intelligent parking assist	System that assists with steering when parking in a garage or when parallel parking
Lane-keeping assist system	Mechanism that helps the driver stay in lane
Vehicle Dynamics Integrated Management (VDIM)	System that controls ABS, TRC, VSC, and other functions in an integrated fashion based on factors such as accelerator and steering wheel movements and information from other sensors

Source: Prepared by the Development Bank of Japan from Toyota Motor Corporation's website and Ministry of Land, Infrastructure and Transport's Road Transport Bureau's website (some items are quoted directly).

IV Advanced Information Services and Communication Networks

ITS will not suddenly sweep the country because it requires public infrastructure to be built. Nevertheless, telematics, which provides information and services to vehicles via existing communication structures, is growing gradually under the direction of carmakers. This chapter examines telematics offered by automobile manufacturers, as a case study of the increasing sophistication of information services, as well as other information services and evolving efficiencies of distribution systems.

1. Telematics[30] by Automakers

1.1. What is Telematics?

The term "telematics" was coined from "telecommunications" and "informatics." In the ITS context, telematics refers to the provision of information and other services made possible by bidirectional communications between cars and their surroundings. Telematics includes services similar to those received by computers or cellphones (ordinary services) as well as native services to cars, such as emergency-support services and remote maintenance. Different providers offer different services through telematics (see below).

Table 4-1. Classes of Telematics Services

Class	Ordinary Services	Car-Specific Services
Service content	• General information (news, parking info, etc.) • Entertainment (music downloads, karaoke, etc.) • Communications (e-mail) • Shopping	• Navigation • Emergency support (road assistance) • Remote maintenance (notifications of when to replace parts) • Management of travel logs

Source: Prepared by the Development Bank of Japan from various materials.

1.2. Efforts by Automakers

Major car companies launched the first generation of telematics services in the late 1990s. First-generation services were hampered by high communication fees and low communication speeds and only a few thousand people subscribed. (Other reasons preventing growth included high device prices and the inability to provide services suitable for cars.) Since the second generation's arrival in 2002 with a greater variety of services, consumers have become acquainted with telematics due not only to lower communication prices and improved speeds but also to other technical advances (navigation systems with built-in HDD and voice guidance) and its prevalence in society (growth of the Internet and cellphones)[31].

On the development side, the telematics business is a huge investment for automakers, and it is difficult for companies with small market shares to follow the trajectory of the telematics business on their own because its products exhibit network effects.[32] As a result, some corporations are employing other companies' products instead of developing their own.

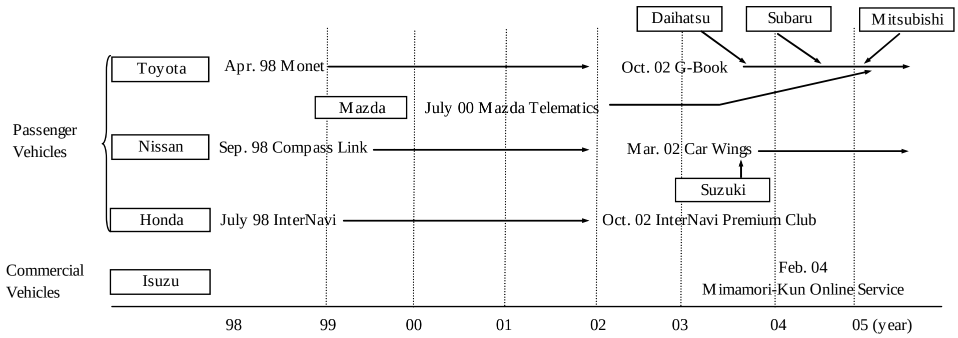
1.3 Importance of Telematics to Car Companies

Car companies are drawn to telematics because of its effectiveness in adding value to cars and as a customer-relations management (CRM) tool. These in turn lead to more earnings opportunities for the auto business.

[30] This section covers telematics services for passenger cars. The next section briefly deals with telematics services intended for commercial vehicles.

[31] For example, permitting the business of providing road-traffic information to the private sector (see page 30) is also contributing to the development of the second telematics generation.

[32] There are both direct and indirect network effects. With direct effects, the benefit of buying the product or service is determined by the number of people owning (using) the product or service. Examples include telephones and fax machines. Indirect effects occur with two complementary (mutually dependent) products or services. For example, as more people buy DVD players, more DVD titles are released, thus attracting more people to buy DVD players.



Source: Prepared by the Development Bank of Japan from various materials.

Figure 4-1. Commercialization of Telematics by Car Manufacturers

Telematics is a critical link in improving what cars are meant to do: arrive at the destination quickly. As already described, it is difficult with today's VICS to display the shortest route to the destination and update the route in real time. If telematics can deliver information that VICS cannot and suggest optimum routes to drivers, it will boost sales of carmakers' products. Furthermore, telematics can provide various information services and so make cars more comfortable and fun. This will be an important marketing tool toward young users, who are tending to move away from cars.

Telematics will also help automakers in the field of CRM, with a renewed focus on after-sales service, a notoriously weak area, and in new-car sales promotion by perpetuating contact points with customers. Indeed, several companies have apparently made CRM the true aim of their telematics services.

1.4. The Telematics Value Chain and Future Prospects

The telematics value chain closely resembles that of the cellphone. Many observers anticipate participants from outside the auto industry to enter the markets for telematics hardware, communications, and content provision. For example, since the cellphone market for voice is projected to level off at around 80 to 90 million subscribers, cellphone firms (corresponding to connection service providers in Figure 4-2) are eyeing data communications and data-communication terminals as their future growth engines. Already cellphone companies are starting to compete in the car arena with expectations that telematics will be a central data communications market.[33]

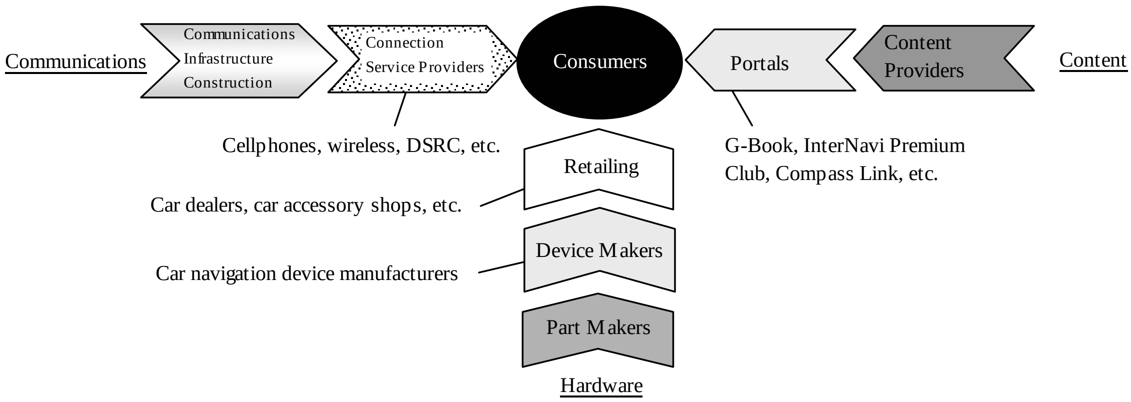
The telematics market is potentially huge; there are more than 70 million cars in Japan, but the switch to IT in this area has only just begun. The pursuit of telematics business models should spur competition and strategic alignments. For example, while cellphone companies and automakers will collaborate in certain areas as shown below, they will also compete to deliver information and services to cars via cellphones. Similarly, manufacturers of third-party car navigation devices are expected to try to preserve and expand their customer bases by rolling out their own telematics business in resistance to carmakers, while broadening their production and sales of genuine-brand car navigation devices compatible with automakers' telematics services.

[33] KDDI provides dedicated data communications modules compatible with next-generation high-speed wireless data communication systems (CDMA 2000 1x with a data rate of 144 kbps) to Toyota's G-Book and Pioneer's Air Navi (a communicating car navigation unit providing telematics services from commercial unit makers). NTT DoCoMo has started full-wireless services with Bluetooth in association with Nissan and Nissan's Car Wings service.

Table 4-2. Summary of Telematics Services for Passenger Vehicles

	Service Characteristics	Members	Cost (not including sign-up charges)
G-Book (Toyota)	• Ordinary information services > navigation information • More emphasis on security services (included in basic packages) • Built-in communicator (can be used with cellphones too) • Subaru, Daihatsu, Mitsubishi Motors, and Mazda plan to participate	60,000 (as of the end of August 2004)	16,080 yen/year (includes communication fees) or 5,160 yen/year (communication fees are separate)
Car Wings (Nissan)	• Navigation information > ordinary information services • Communicator is separate (user's cellphone is needed) • Suzuki is also participating	55,000 (as of the end of July 2004)	Free for three years
InterNavi Premium Club (Honda)	• Navigation information > ordinary information services • Delivers road traffic information such as traffic-jam predictions made by Honda • Communicator is separate (user's cellphone is needed) • Unique to Honda (no tie-ups with other firms)	146,000 (as of the end of September 2004)	Free for three years (remains free after first three years except for the costs of map updates)

Sources: Prepared by the Development Bank of Japan from company websites and newspaper reports.



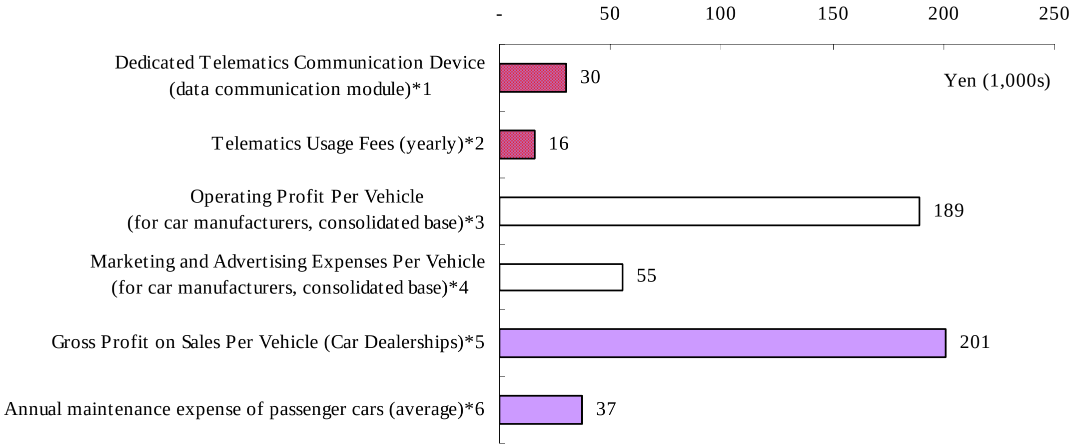
Source: Prepared by the Development Bank of Japan from various materials.

Figure 4-2. Telematics Value Chain

With this background, the top priority for car companies is attracting members. For instance, some manufacturers mine the actual driving data from their members (known as probe data) to improve the accuracy of destination route searches. This type of service relies on direct network effects, so the number of members affects the quality of the service. Meanwhile, through indirect network effects, the more members, the more attractive content that can be supplied to customers. Several companies are using free membership and free communication devices to lure new users, but to radically boost membership companies will probably have to support add-on navigators (users buying third-party car navigation units) as well. Currently, only cars equipped with manufacturer-installed car navigation systems can receive telematics services, but there are many more users who install third-party units or dealer optional units. To strengthen their CRM, companies will have to reach out to these users as well.[34] Alternatively, producers of third-party navigation systems may develop and incorporate their own telematics businesses for this market segment (resulting in a more fragmented market).

Regarding the position of telematics in the

[34] Some telematics services are premised on the idea of conveying information with onboard LANs, but it is possible to develop telematics businesses to added-on navigation units not connected to any onboard LAN as well by narrowing down the scope of services.



Notes:
1. *1 Unit price of Toyota's G-Book communication device at dealerships (as of January 2005).
2. *2 Usage fees for a one-year contract with Toyota's G-Book (as of January 2005).
3. *3 Toyota's consolidated operating profit/consolidated vehicle sales.
4. *4 Toyota's consolidated marketing and advertising expenses/consolidated vehicle sales.
5. *5 Combined gross profits from all model dealerships in the survey.
6. *6 Annual maintenance expense is a total for inspection, tire change, oil change and other maintenance expenses.

Source: Prepared by the Development Bank of Japan based on the Toyota Motor Corporation Web site, 55th Car Dealership Sales Survey Report (Japan Automobile Dealers Association and the questionnaire survey conducted in Nov. 2003 by the Ministry of Land, Infrastructure and Transport).

Figure 4-3. Relative Costs of Telematics Businesses

car value chain, telematics is a promising tool to maintain and strengthen precise contact with customers for new-car sales. In other ways, however, the car business differs from the mobile-phone business; it is essentially a one-off sales business and does not collect continuing fees from customers once the car has been sold. For this reason, customers will resist any mechanism that collects monthly or yearly fees. Nevertheless, telematics is a powerful tool in the overall car value chain for keeping brand loyalty and building the customer base. It also offers value in the inspection and repair business, particularly in strengthening dealership sales systems.

Companies in the telematics business have yet to deliver satisfactory services (value) to customers or receive increased returns. Based on business characteristics driven by improved communication environments (which further improve the business viability of telematics) and network effects, car manufacturers are anxious to create business models by fusing hardware, communications, and content, that can deliver customer value and profits.

2. Information Service Businesses other than Telematics

New developments are emerging in information service businesses outside the telematics business. These information service businesses can be grouped into three classes: safety (emergency reporting, etc.), comfort and entertainment (traffic information, broadcasting, multiuse ETC, etc.), and environment (fuel conservation assistance, car-sharing, etc.). When viewed by business structure, they can be classified as services that add value to existing businesses (fuel conservation assistance for commercial vehicles), new industry services (completely new businesses such as emergency reporting or traffic information) and new business type services (new forms of existing businesses such as broadcasting or multiuse ETC). Providers of these services encompass from large corporations to venture enterprises, but in many sectors groups of companies are likely to form business alliances.

The government, through regulatory reforms, has a role to play in creating these new information service businesses. For example, the Ministry of Land, Infrastructure and Transport and the National Policy Agency released the "Basic Concept on Approaches to Providing Road Traffic Information" report in March 2002. The release of road traffic information to the private sector based on this document paved the way to new entrants in the traffic information services sector.

Although these information service businesses are still developing in both size and revenue, they are expected to expand steadily in the medium to long term through integration with the Internet. The establishment of probe information systems[35] may lead to broader and more substantial services, such as providing real-time traffic and weather conditions or deploying taxis more effectively. The Internet ITS Consortium (formed by concerned corporations) is considering linking the Internet with ITS and is conducting tests required to construct the underlying structures. Work is still in the preliminary stages and, as described below, many issues must be solved such as the standardization of infrastructure and onboard devices.

Table 4-3. Main ITS-related Information Service Businesses (other than passenger vehicle telematics)

Service Class	Company and Product Name	Description
Emergency Reporting Services	Japan Mayday Service/Helpnet	Began in 2000 an emergency reporting service for cars using navigation systems
	Emergency Medical Network of Helicopter and Hospital/Doctor Heli	Facilitates the active use of helicopters by emergency physicians
Traffic Information Services	Advanced Traffic Information Service (ATIS) Corporation	Converts traffic information collected by the Japan Road Traffic Information Center to traffic-condition maps or text information and provides these to cellphones or computers
	Edia	Developing an information content business for cellphones and car navigation units
Position Information Services	Zenrin DataCom	Provides map information and position-related information via computers, cellphones, and car navigation units
Broadcasting Services	Mobile Broadcasting Corporation	Started a satellite broadcasting service business for mobile users in October 2004 (announcement planned soon for a car-mounted receiver)
Energy-Saving Driving Assistance	Isuzu Motors/Mimamori-Kun Online	Telematics for commercial vehicles (in addition to creating fuel-consumption reports, the service also analyzes trip times and warns of accident-prone locations)
	Nissan Diesel/ "Nenpi-Ou" (Mileage King)	Fuel-conservation assistance systems that give directions to the driver in real time, by automated voice or warning tones, on ideal driving (details of services vary among the providers)
	Hino Motors/Hino Drive Master	
	Mitsubishi Fuso Truck and Bus/Next-generation FTSS (under development)	
Multiuse ETC	ITS Research Institute	Studying the provision of services for downloading music and data
	ITS Business Applications	Implementing non-stop parking services
Car-sharing	Various sites nationwide	Tests are being conducted at about a dozen sites across Japan to alleviate traffic congestion and reduce environmental impacts through car-sharing

Source: Prepared by the Development Bank of Japan from various materials.

[35] Probe information systems regard cars as mobile sensors. By extracting such information as traffic conditions, time requirements, and weather conditions from individual cars, the system can collect and analyze this data for provision purposes.

3. More Efficient Distribution System Making Use of ITS

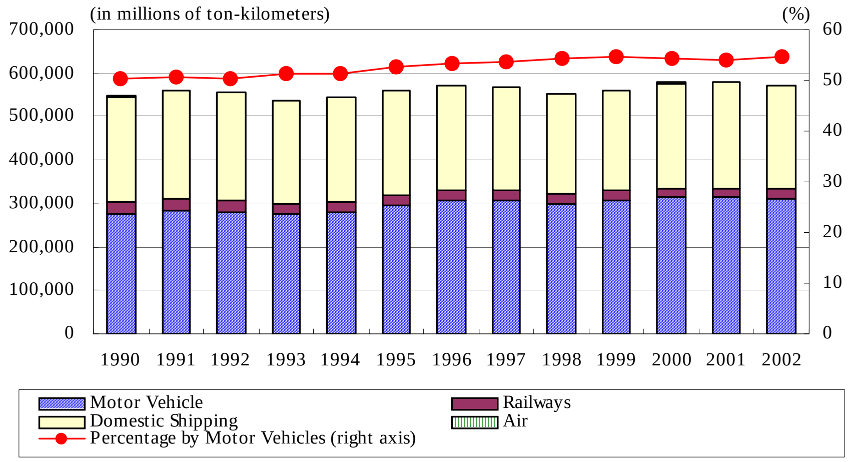
Information services may yield ways to make the distribution industry more efficient. Japan's distribution system is highly dependent on truck transport, which has adverse effects on traffic congestion and the environment (Figure 4-4). Although the need for a modal shift has long been recognized, due to a series of problems the industry has made little headway. ITS technology offers a way to achieve this modal shift and improve efficiency in the distribution industry.

For example, the truck distribution industry is finally starting to raise driving efficiency using digital tachographs and GPS and investigating joint delivery systems using ITS. Cargo handling at nodal points (railway-to-truck and truck-to-railway), a notorious weak point, will become much more efficient when ITS is integrated with IC tag technology, leading to a real modal shift. Although the effect will be limited in the short term since it will take time to build the infrastructure to share product information among multiple businesses, with government backing[36] distribution efficiency will be improved through ITS. Furthermore, such efficiency improvements are not limited to B2B and B2C transportation; improved efficiencies in on-premise distribution can raise operational efficiencies and safety.

Overloaded vehicles put excessive strain on road fixtures and frequently cause major accidents. ITS may even be able to remedy this problem with the installation of roadside vehicle-monitoring systems to strengthen management, guidance, and controls on special-use vehicles.

4. Communication Networks for ITS Implementation

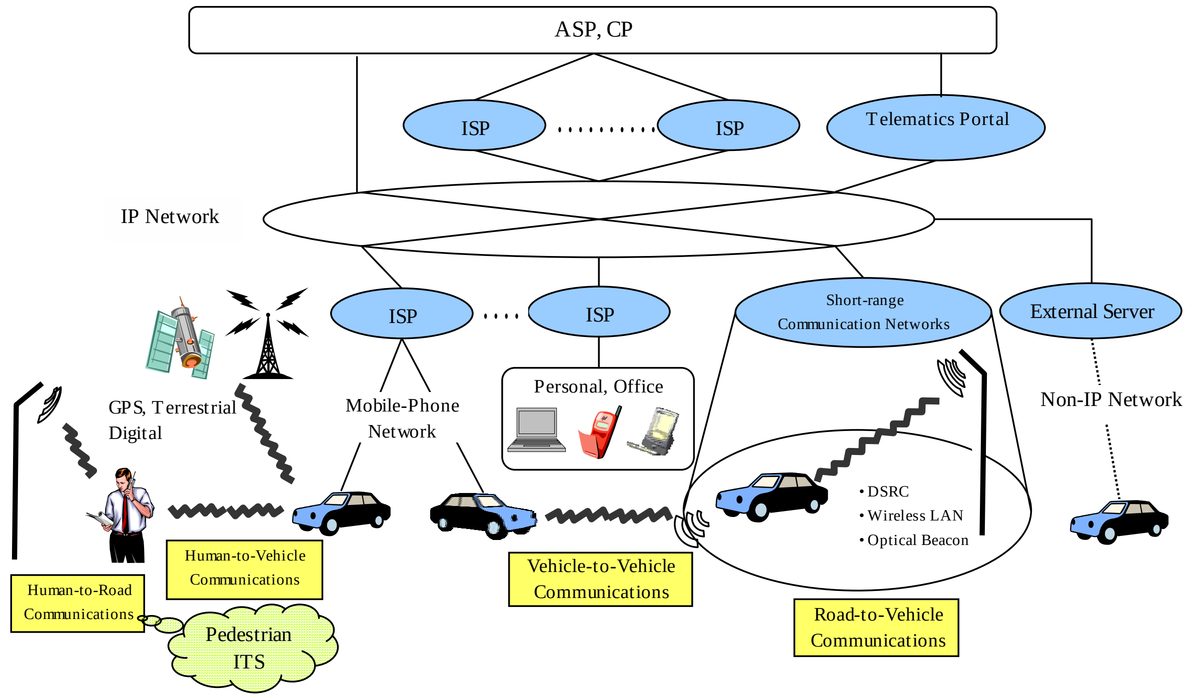
The information services described above and the many ITS functions are premised on the exchange of information between vehicles and roads, vehicles and other vehicles, vehicles and roads with people, and vehicles and Internet gateways. Thus, ITS depends on telecommunication technology and communication structures.



Source: "Land Transport Statistics Directory 2003."

Figure 4-4. Trends in Transportation Ratios by Conveyance

[36] The Ministry of Economy, Trade and Industry and the Ministry of Land, Infrastructure and Transport set up the Green Partnership in association with Nippon Keidanren, Japan Federation of Freight Industries, and Japan Institute of Logistics Systems in September 2004 and have announced various initiatives to cut the environmental impact of the distribution industry through joint deliveries and other measures.



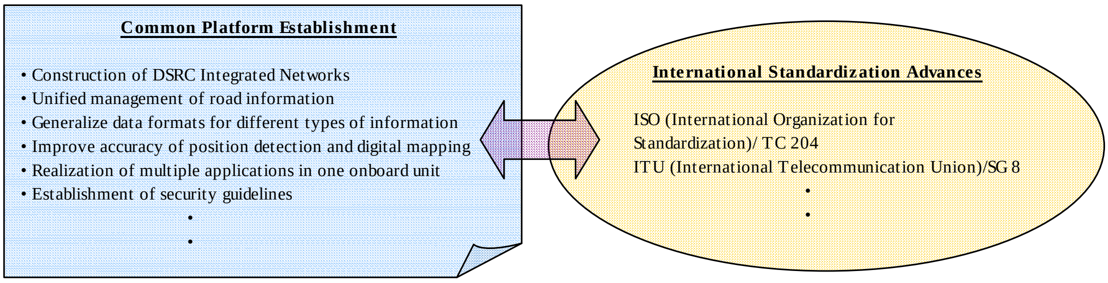
Note: ISP: Internet Service Provider, ASP: Application Service Provider, CP: Content Provider.
Source: Prepared by the Development Bank of Japan from Internet Council materials and other sources.

Figure 4-5. Future Car Communication Networks

Various wireless communications, such as GPS, DSRC, cellphones, and beacons, are used for extravehicular communications. For ITS to move forward, however, a seamless information environment which links these communication media with the Internet needs to be constructed. This includes improving the performance of each communication media and establishing infrastructure, as well as standardizing both hardware (onboard devices) and software on common platforms (Figure 4-6). For this standardization and platform establishment, it will take time to harmonize the interests of the various players, but the work will be driven by private-sector corporations using their ingenuity to seek early market introduction, and the incentives to develop technology will strengthen.

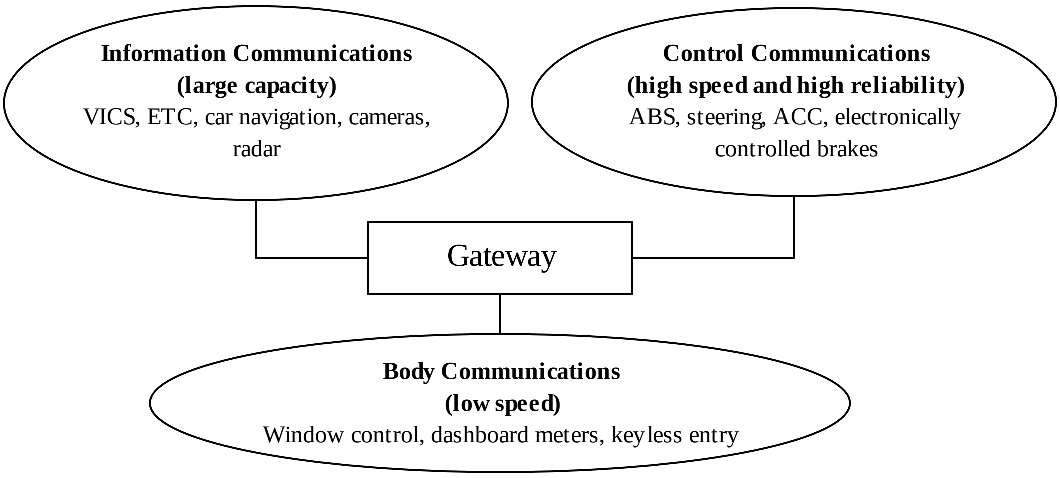
For communications within a vehicle (that is, communications linking onboard electronic components), wire harnesses are used. But to minimize the number of wires, multiplexed communications are frequently employed. These networks are classed as body type, operation type, and information type according to the purpose of the communications (Figure 4-7). The requirements for each type are different and each year in-vehicle communications become more complex. Japan is becoming involved in standardization in this area.[37] Regarding vehicle-to-vehicle communications, consortiums have already been established in Europe and the United States, and in response Japan is setting up an investigative body to develop standards that are advantageous for the country. Some car manufacturers are also looking into the future by participating in US consortiums.

[37] Toyota, Nissan, and others formed the Japan Automotive Software Platform and Architecture (JASPAR) nonprofit organization in September 2004. JASPAR is embarking on efforts in standardization and shared use of networks and software in electronic control systems on vehicles.



Source: Prepared by the Development Bank of Japan from various materials.

Figure 4-6. Standardization Efforts and Common Platform



Source: Prepared by the Development Bank of Japan from various materials.

Figure 4-7. Vehicle Communication Systems

V Future Prospects

1. Multiple Effects of ITS

As noted in Chapter I, ITS provides a sustainable transportation system leading to a ubiquitous society. The process of building ITS will bring new technologies and business structures to the automotive and automotive-related industries, thus strengthening the competitiveness of the Japanese car industry and spawning new industries. Through development of the many technologies needed for ITS, Japanese car manufacturers will build a world-leading foundation in auto safety, paving the way for venture businesses in the ITS field. Opportunities will also emerge for both quantitative and qualitative growth in the software industry as automobiles becomes increasingly dependent on software. The auto industry has a greater impact on Japan's economy and industry than any other.[38] And as the telecommunications and distribution industries, which are an integral part of ITS, are also extremely large, ITS has the power to drive the entire industry of the nation.

ITS will also make administration more efficient. For instance, administrative services can be run more efficiently by using Smart plates, which digitize the management of vehicle data. ITS can also lead to the optimization of Plan-Do-Check cycles in roadway administration by collecting information from probe cars.[39] Currently, there are few visible effects of ITS, but its full potential is expected to become clearer as it develops.

2. ITS and Regional Development

ITS also has a major effect on regional development. As mentioned in Chapter II, environmental road pricing with ETC can improve the roadway environment, and using VICS to provide information on traffic conditions can speed up access to urban areas. Moreover, as ETC expands, low-cost, space-saving dedicated ETC interchanges (Smart ICs) are becoming more practical, which will improve regional access to expressways and thus stimulate economic development. The Ministry of Land, Infrastructure and Transport is conducting demonstration projects of Smart ICs in 27 locations nationwide to identify potential issues.

Table 5-1. The Impact of ITS on the Earth

ITS Service Example	Impact on the Earth
ETC pricing strategies (large night-time discounts)	Improved environments near expressways and trunk roads
Provision of traffic-condition data with VICS	Better access to core areas
Establishment of dedicated ETC interchanges (smart ICs)	Better access to expressways
Introduction of bus-location system	More convenient public transportation
Introduction of PTPS (Public Transportation Priority Systems)	More convenient public transportation

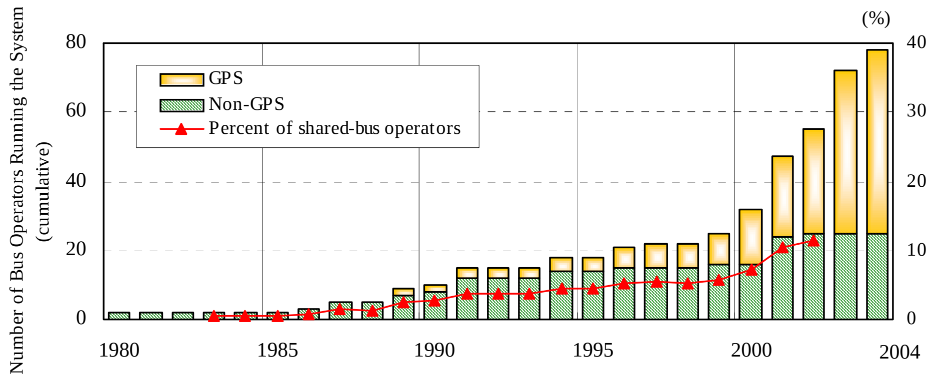
Source: Prepared by the Development Bank of Japan from various materials.

ITS is also making public transportation more convenient, as evidenced by the bus-location system and Public Transportation Priority Systems (PTPS). The bus-location system shows users in real time the current location of a bus, its estimated time of arrival at a given bus stop, and the scheduled time to a destination. The first GPS-capable system arrived in 1989 and it has been spreading gradually ever since, and around 80 bus operators (10% of all operators) have now adopted the system (Figure 5-1). Trials are underway on providing this information via the Internet to cellphones.[40]

[38] The Ministry of Economy, Trade and Industry's Simple Extended Input-Output Table shows that the passenger-vehicle sector had the largest production impact in 2003. The automotive sector including all other vehicles was second.

[39] By collecting traffic-congestion information in real time that was previously difficult to obtain, administration officials can determine what strategies are effective in cutting congestion, decide what activities should receive priority budgeting, and measure and evaluate the effectiveness of policies and activities.

[40] The Chubu District Transport Bureau of the Ministry of Land, Infrastructure and Transport conducted a trial in 2003 of an optimal routing system (Yuri Navi) combining buses and subways in Nagoya. See the Ministry of Land, Infrastructure and Transport website (http://www.mlit.go.jp/jidosha/sesaku/koukyo/businfo/20040204-1pamphlet.pdf) for details.



Source: "ITS Handbook 2004–2005" (originally taken from materials by the Road Bureau of the Ministry of Land, Infrastructure and Transport).

Figure 5-1. Bus Operators Adopting the Bus-Location System

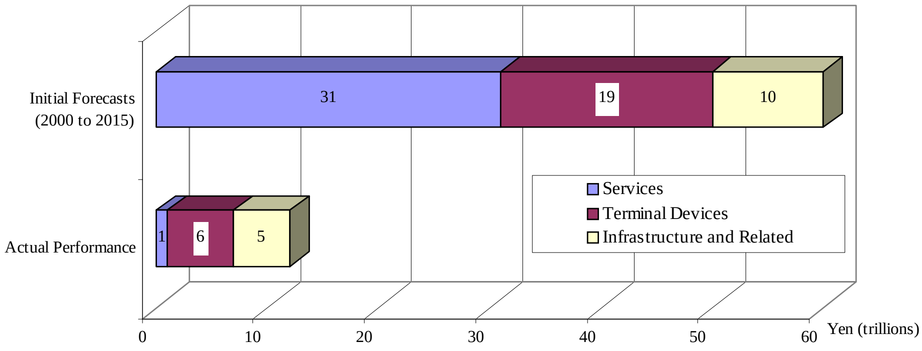
Meanwhile, PTPS (public transportation priority systems) are helping buses to run on schedule. The system works by sending the vehicle's ID from a device mounted on the bus to the local traffic control center via optical beacons installed along roadways (near intersections). Based on the bus's ID, the traffic control center slightly adjusts upcoming traffic signals, such as extending green signals or shortening red signals, to let the bus pass through more quickly than other vehicles. A report by the National Policy Agency at the end of October 2004 stated that 75 operators (98 routes, for a total distance of 480 kilometers) in 34 prefectures had introduced PTPS. Under the "e-Japan Priority Policy Program," PTPS is to be deployed nationwide by the end of 2005, and the National Policy Agency, other authorities, and bus operators are continuing to examine PTPS adoption.[41] If public transportation can be made more convenient through such means, PTPS may help balance the load distribution among transportation modes and reduce car traffic and traffic congestion.

There is no single universal format for ITS to address the unique issues of each region and community. Indeed, localizing ITS is important to reach out to people in each community to foster familiarity in coordination with policies at the national level. To raise awareness and build interest in ITS among local residents, some local regions have set up liaison bodies and launched industry-academia projects for local coordination. It is hoped that such industry-academia cooperation and testing in model areas will continue.

3. Conclusions: Strengthening Japan's Economy and Industry with ITS

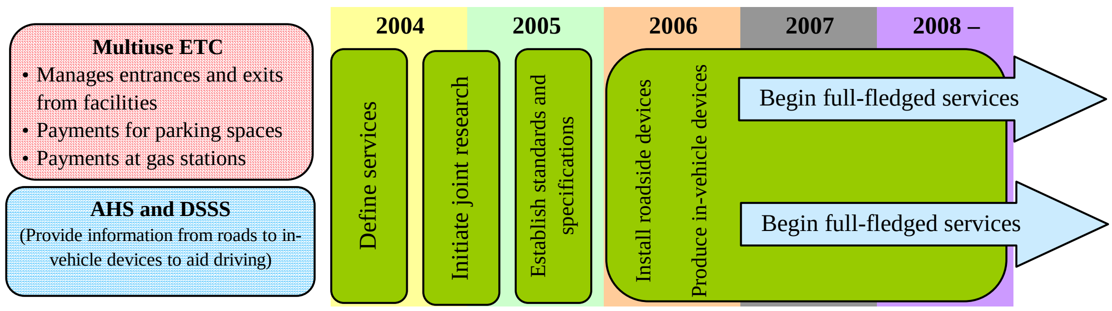
The "Comprehensive Plan for Intelligent Transport Systems," formulated in 1996, envisioned that ITS would move from Phase 1 to Phase 2 around 2005 and that many user services would come online. The paper also forecast that the ITS market would grow from 2000 to be worth 60 trillion yen by 2015, growing about 2.6 trillion yen per year in 2005. Comparing today's conditions with this projection, some pioneering services such as ETC and VICS are indeed in widespread use and new services are emerging. In terms of market size, ITS already has an accumulated worth of 12 trillion yen and so appears to be on target with the plan in both market scale and schedule (Figure 5-2). Nevertheless, corporations leading the ITS wave are facing a tougher business environment than imagined when the plan was drawn up, and the present state of progress is not entirely satisfactory for sustaining corporate efforts. Government initiatives must therefore be redoubled to accelerate deployment timetables and encourage early market expansion, in order to encourage cor-

[41] See the IT Strategic Headquarters website at http://www.kantei.go.jp/jp/singi/it2/kettei/ejapan2004/040615-34.html.



Source: Prepared by the Development Bank of Japan from a report by the Telecommunication Technology Council (February 1999) and materials from the Smartway Project Advisory Committee.

Figure 5-2. ITS Market Size (initial forecasts and actual performance)



Source: Prepared by the Development Bank of Japan from “ITS Handbook 2004–2005” and materials from the Smartway Project Advisory Committee.

Figure 5-3. Implementation Process of Multiuse ETC, AHS, and DSSS

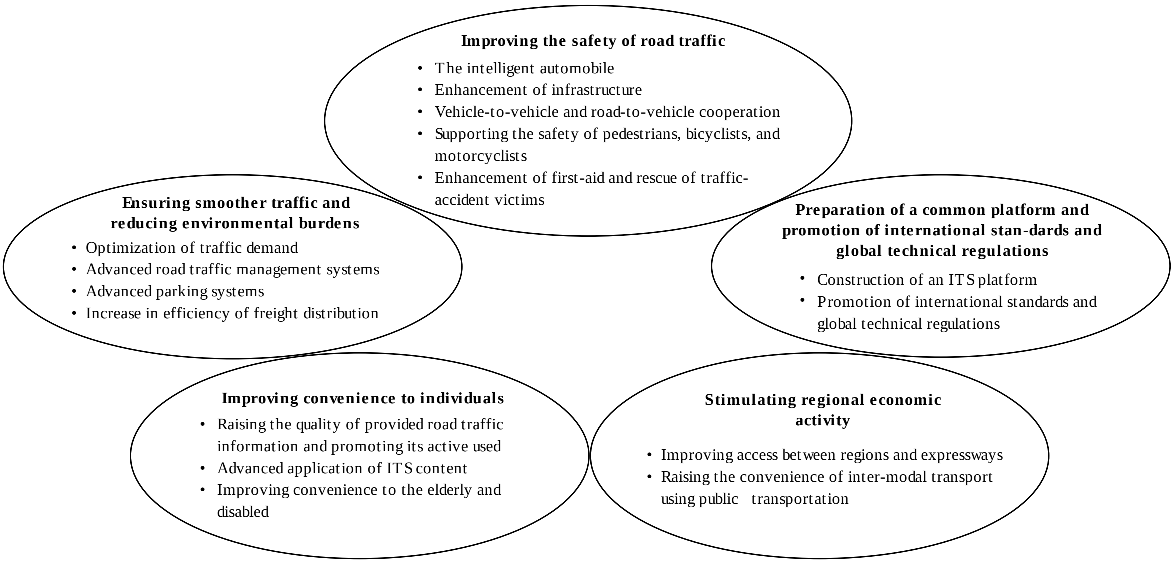
porations to develop ITS.

As mentioned previously, because of the importance of ITS-related industries (automotive, distribution, and telecommunications) to Japan’s overall economy, the government must continue to pursue policies that enable ITS to raise the international competitiveness of Japanese industries. It is no longer sufficient to consider the Japanese domestic market alone; we must consider to what degree ITS will contribute to the global business expansion of Japanese corporations.

Encompassing roads, transport, vehicles, and communications, ITS is a huge project involving both local regions and citizens along with many industries and government agencies. The examples cited in this paper — multiuse ETC (Chapter II) and AHS and DSSS (Chapter III) — indicate that widespread deployment will take several years of steady progress.

A liaison committee between related government agencies has been established and partnerships between government, industry, and academia have been started. The Japan ITS Promotional Conference, which was established as a venue for meetings between high-level representatives of government, industry, and academia, released the “Executive Summary of ITS Promotion Guideline” in October 2004. This document split ITS into five themes and 16 areas and recommended the promotion of ITS while prioritizing projects, encouraging users and society to adopt ITS, and maintaining transparency in the evaluation of target attainment. Whether these recommendations are incorporated in actual government policies or corporate activities is key to the future development of ITS.

In consideration of the time and initial investment sums needed to develop social awareness of ITS and fulfill projects, a more unified approach and more appropriate role-sharing among the major players are required. If lead times to market creation can be reduced even slightly, user demand and the ingenuity of private corporations will drive further ITS development.



Source: Prepared by the Development Bank of Japan from the "Executive Summary of ITS Promotion Guideline," Japan ITS Promotion Conference.

Figure 5-4. Priority Areas in the "Executive Summary of ITS Promotion Guideline"

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