

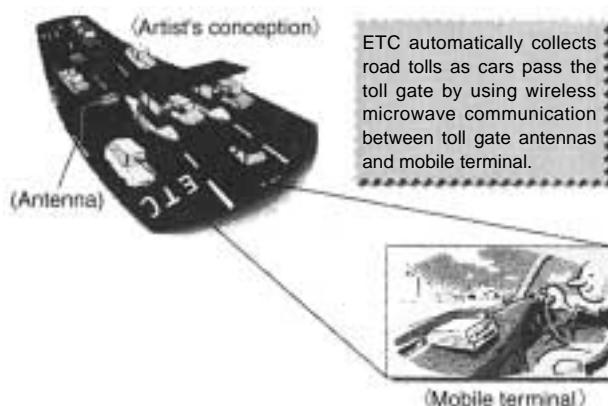
# Electronic Toll Collection (ETC) Systems — Is the Government's Showcase Policy on Track?

by Mashu Kato  
Economic & Industrial Research Group

## 1. Introduction

Of the government's many monetary and fiscal policies to revive the economy, public investment initiatives in information and communications have been highly rated for having almost twice the demand creation effect as traditional public works projects. As part of this thrust, the government proposed in fiscal 1999 the promotion of Intelligent Transport Systems (ITS) — a new transport system that utilizes advanced information and communication systems — and is allocating funds in both general and supplementary budgets to provide sustained funding. Electronic toll collection (ETC) is a showcase ITS project beginning operation in fiscal 2000.

Figure 1 Artist's Conception of ETC



Source: Ministry of Construction web site

## 2 What is the ETC System?

ETC, also known as a nonstop toll collection system, enables the automatic, cashless payment of road tolls as vehicles drive through toll gates, by means of wireless communications between toll gate antennas and terminals mounted in vehicles.

As with present systems in other countries, Japan's new ETC system will alleviate toll road congestion near tollbooths (35% of expressway congestion occurs near tollbooths). But unlike

other countries, Japan's system will also be expandable into a comprehensive system for mobile payment and information services. That is, it is designed to become a backbone system for e-commerce that expands convenient cashless transactions into parking lots, roadside stores, gas stations, etc. It is also expected to reduce maintenance costs and provide additional services.

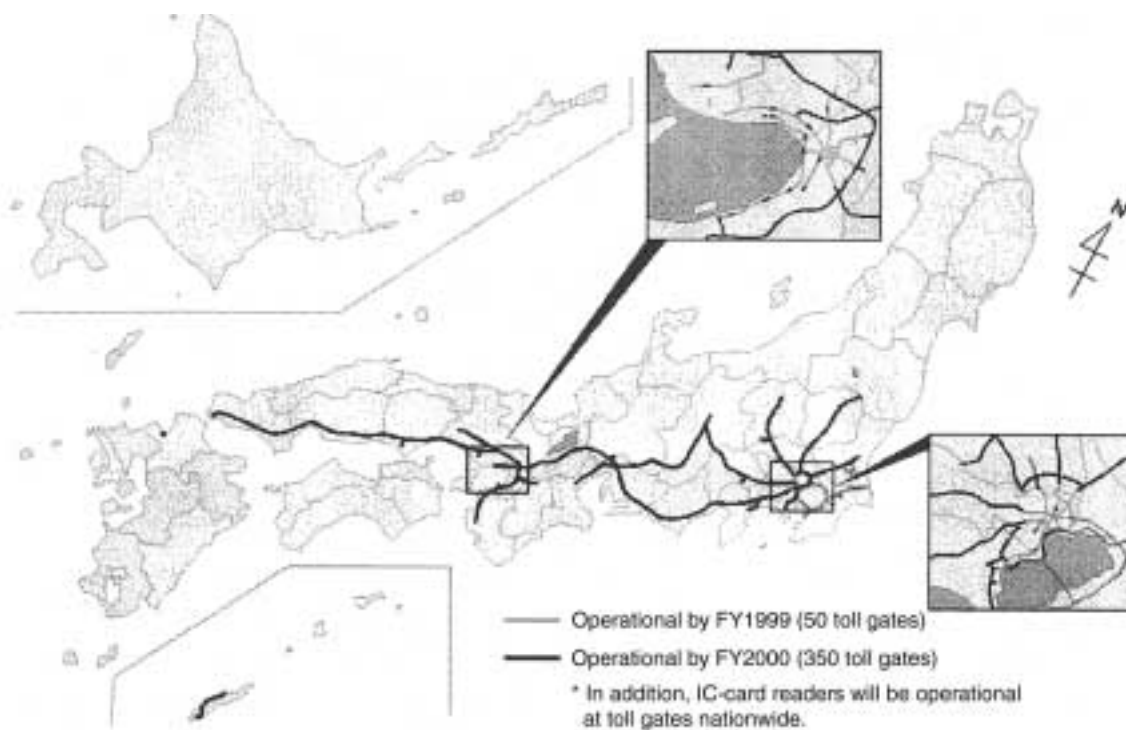
While ETC systems are currently operating in more than ten countries including the U.S. and across Europe and Asia, most are used for paying flat-rate road tolls based on vehicle type (like the Shuto Expressway in Japan). The Japanese system, in contrast, is an advanced version offering additional features: (1) it collects different tolls based on type of vehicle and distance traveled, as on the Tomei Expressway, and (2) incorporates Dedicated Short Range Communications (DSRC), a broadband technology for two-way communications over a distance of several dozen meters that can accommodate additional services in the future.

### **3. ETC Construction Plan**

Japan's first ETC services are scheduled to begin by the end of March 2000 at 43 Japan Highway Public Corporation toll gates in Chiba Prefecture and nine Tokyo Expressway Public Corporation tollbooths in Chiba Prefecture and on the Omiya Line (see map), making nonstop travel possible on the expressway from Narita Airport to central Tokyo.

In fiscal 2000, the MOC will promote as priority measures those related to the development of next-generation roads (Smartways) that form the basis of ITS. By the end of fiscal 2000, non-stop toll collection (ETC) service will be operational at 400 major toll gates on the Tomei and Meishin expressways, Tohoku Highway, Sanyo Highway, and Hanshin Expressway, while ETC service using IC cards will be operational at toll gates nationwide.

Figure 2 ETC Service Area Map



Source: Ministry of Construction web site

#### 4. Market Trends

Procurement of ETC equipment is under way in preparation for the start of the service in March 2000. Private-sector companies are keen participants in the development of ETC-related equipment, and ETC-related markets are beginning to form. There are three main ETC markets — infrastructure equipment such as toll gates installed at interchanges, mobile terminals, and user services expected to emerge on the DSRC platform.

##### (1) Infrastructure Market Factors — The MOC Budget and Growth of User Services

Under the government's Five-Year Plan for Road Construction starting in April 1998, ETC is to be installed at 730 toll gates nationwide by March 2003 at an investment of ¥210 billion. The longer-term goal is to install ETC at 1,300 toll gates.

Industry sources suggest that the cost of installing toll gates and other ETC equipment will account for about ¥10 billion of the ¥210 billion budget. Because the infrastructure equipment market now has a fully competitive bidding system, orders have been won at lower prices than initially estimated by the industry, which may accelerate deployment of ETC on Japan's major roads.

Maintenance and replacement investment also account for a significant portion of the market. The basic replacement cycle is estimated to be 10 years for an entire toll gate, and five years for each item of equipment, but this will vary according to how the system is operated. Replacement cycles could shorten and cause the market to expand if new user services besides toll collection become available.

## **(2) Mobile Terminal Market Factors — Price and Penetration Rate**

In contrast to the steady progress in infrastructure construction ETC services in 2000, interest in mobile terminals has been flagging among major trucking companies, truck manufacturers, and the general public. This is because:

- 1) The price of terminals is much higher than what trucking companies and individual users consider reasonable. Manufacturers expect terminals to retail initially at ¥40,000-50,000 and decline to ¥20,000-30,000 with market penetration, but users are only prepared to pay about ¥10,000.
- 2) For ordinary drivers who are not frequent toll road users, dedicated ETC terminals are not as useful as car navigation systems.

Regarding the first point, terminal manufacturers obviously need to cut costs further, but until the mass market is reached, additional incentives besides toll discounts are needed to lure large users like trucking companies.

With respect to ordinary drivers, in addition to the incentives and price reduction, the cost to users must be minimized by combining ETC equipment with car navigation systems (like the VICS traffic information system) or providing optional modules.

Although incentive programs are needed to increase the penetration rate among individual users, no major programs currently exist. Current car ownership totals 70 million vehicles, of which about 4 million use expressways once a week or more. Two scenarios are conceivable:

- 1) If incentive programs are offered, these 4 million vehicles could have terminals installed within two or three years, and a virtuous cycle could develop whereby advances in DSRC-based user services stimulate demand from individual users.
- 2) If no incentive programs are offered, penetration among individual users will be slow, and the ETC market will be mainly limited to commercial trucks (with a load of over two tons; current ownership is 2.6 million vehicles). Thus a vicious cycle develops whereby the market's slow growth restricts economies of scale and impedes price declines, while DSRC-based services struggle because of the small consumer base.

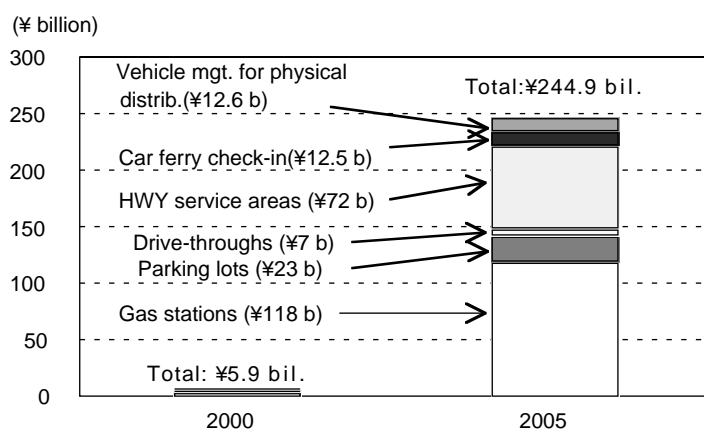
### (3) DSRC-based User Services

Although a wide range of DSRC-based user services has been considered, specific market growth prospects remain uncertain at the current stage. The Telecommunication Technology Council (TTC) forecasts a market worth more than ¥200 billion for the start-up years to 2005, and has drawn a scenario of demand driven by user services available at gasoline stations. Interviews reveal, however, that the business community is skeptical about a sharp rise in DSRC system penetration for making payments at gas stations because: (1) the gasoline retail sales industry is undergoing consolidation, and companies lack the capital to invest in DSRC systems, and (2) the number of self-service gasoline stations suited to automatic payments is not increasing.

Thus, it is possible that DSRC systems may only be installed at larger gas stations and those directly managed by oil companies. In addition, although some also suggest that gasoline stations are suited for providing low priced, high volume information services requiring a minimal investment (e.g., downloading music, road maps, and event information in the ¥500-1,000 price range), this would mean competing with cellular phones and other modes of communication.

Others believe that DSRC has great potential for services whose main purpose is automated payment, such as urban parking lots and drive-through facilities. Japan's DSRC is a sophisticated system that can be easily applied to parking lot fee collection and drive-through facilities, and once security specifications are simplified and gate installation is deregulated, installation costs will decline, making it more profitable for companies to install the system.

**Figure 3 Market Projections for DSRC-based Services**



Note: Vehicle operation management is expected to include non-DSRC services.  
 Source: Telecommunications Technology Council (TTC), *Information and Communication Systems in ITS*.

## **5. Requirements for Increased Penetration**

Prior to full operation of ETC in 2000, trucking companies have shown little enthusiasm for adopting mobile terminals, and interest among the general public is low. Compared with planned infrastructure investment of ¥210 billion to March 2003, estimated terminal shipments are 4.7 million units if incentives are offered — creating a modest private-sector demand of only ¥9.4 million at a unit price of ¥20,000. This is not a very efficient way of creating a market. In this context, the following factors are essential to market growth: (1) incentive programs, (2) price reduction, and (3) efforts by the private sector to develop DSRC-based user services and generate demand.

### **(1) Incentive Programs**

Specific advantages of buying mobile terminals must be demonstrated to both large users like trucking companies and individual users (i.e., a cost-benefit analysis showing that the cost of buying the equipment can be recouped quickly). This is particularly important at the start-up phase, but at present it is uncertain whether incentives will be offered to individual users. To increase penetration significantly, incentives other than the fixed rate discount must be offered to terminal purchasers— for example, preferential discount rates that meet or exceed the existing rebate for business users (discount rates ranging from 5-30%) and the Highway Card discount scheme for individual users (4-14%). A limited time discount scheme could be effective with individual users when the market is starting up, while a frequent user program such as those in other industries (a point system based on mileage, frequency of use, etc.) is also a possibility. Also, an off-peak discount could be offered to improve rush hour traffic flow.

### **(2) Price Reduction**

The price of mobile terminals will depend on how quickly the market expands and achieves economies of scale, but the main issues are: (1) integration of car navigation systems with ETC terminals, and (2) installation of terminals by automakers as standard equipment.

- 1) Most current car navigation systems have built-in, multiscreen displays that can be easily integrated with ETC displays. Once the two are integrated, and the additional cost of the ETC function is little more than the cost of buying the antenna and IC card, prices should fall when car navigation systems are factory installed in cars.
- 2) As with airbags and ABS in the past, once the equipment becomes a standard feature, volume production will ensure a steep fall in price - the price of equipment has dropped 90% in some cases. If penetration increases sharply, the business model for DSRC consumer applications would become more feasible.

### **(3) Expansion of DSRC-based User Services by the Private Sector**

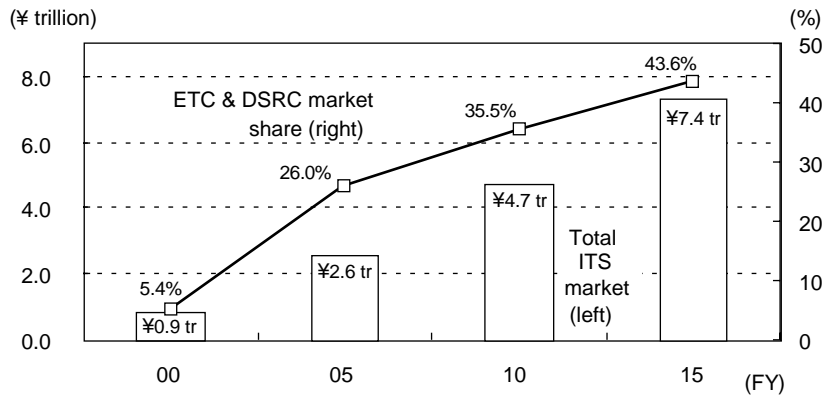
The following are required to expand the range of DSRC-based user services: (1) development of general-purpose mobile systems, and (2) development of user services by the private sector.

- (1) The main problem in developing a general-purpose system for vehicles is the cost of systems development, which ultimately affects service prices. The currently proposed system attempts to apply the rigid public-service ETC system to user services provided by the private sector (i.e., payment at gas stations, parking lots, and drive-through facilities), which could result in a higher cost for more sophisticated specifications.
- (2) The development of user services is essential for market expansion not only among individuals but service providers and commercial users like trucking companies. If penetration rates are slow to increase, the sophisticated and highly expandable DSRC system will suffer from "overspec" (under-utilization of system specifications), strengthening the argument that simpler specifications adopted in Singapore and Malaysia are sufficient. Consequently, the following factors are essential to increase penetration among ordinary users: (1) deregulation to allow installation and use of DSRC antennas on private premises such as distribution centers and driveway gates, and (2) provision of private-sector user services that meet the needs of the general public.

In the longer term, the ETC and DSRC service markets have tremendous growth potential. A TTC report published in February 1999 forecasts that the ITS information and communication systems market will be worth ¥7.36 trillion in fiscal 2015, of which ETC and DSRC services will account for more than 40%.

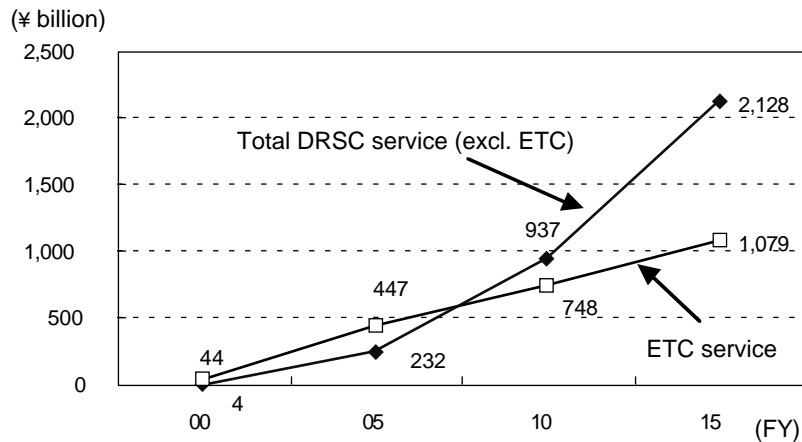
For this to happen, we need to consider not only the advantages to individual users, but to businesses that install the system to provide services. Gas stations and drive-through chain stores, for example, compete fiercely for slim margins in ¥100 units. These businesses obviously need to minimize system installation costs. Other features that would strongly motivate businesses to introduce the system are: (1) services to attract customers (e.g., broadcasting event and store information to all vehicles passing through, activating a menu for taking orders on car navigation screens of all vehicles entering a drive-through facility, and streaming voice and video data on recommended products to cars parked in a lot), and (2) customer information services that can access customer information not available on POS systems.

**Figure 4 Market Projections for ITS**



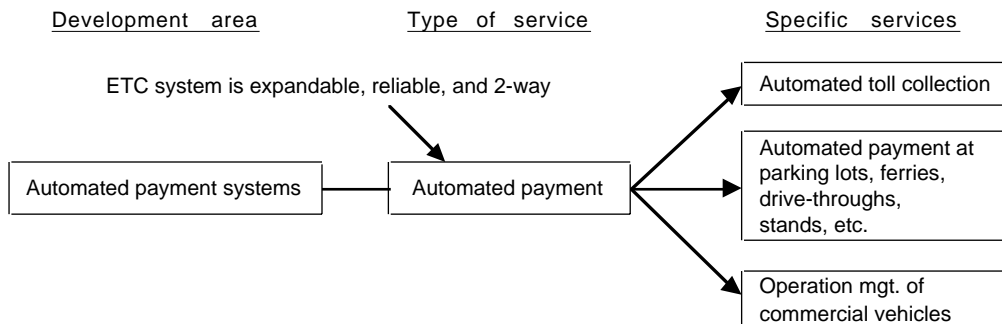
Source: TTC, *Information and Communication Systems in ITS*.

**Figure 5 Market Projections for DSRC Services**



Source: TTC, *Information and Communication Systems in ITS*.

**Figure 6 New Services Expected in the ETC Market**





## Note

\* *Dedicated Short Range Communications*: Unlike long-range communications such as cellular phones and satellite broadcasting, it provides two-way communication over short distances and in small areas. It can be adapted for use with many different applications. Applications include road-to-vehicle communications, which are based on spot area communications technology using microwave and infrared media. ETC in Japan uses DSRC, a highly reliable and sophisticated system that employs: (1) 5.8GHz microwave band (high reliability and expandability, and complies with international standards), and (2) two-way active communication.