4. The Freeway Traffic Management System (FTMS)

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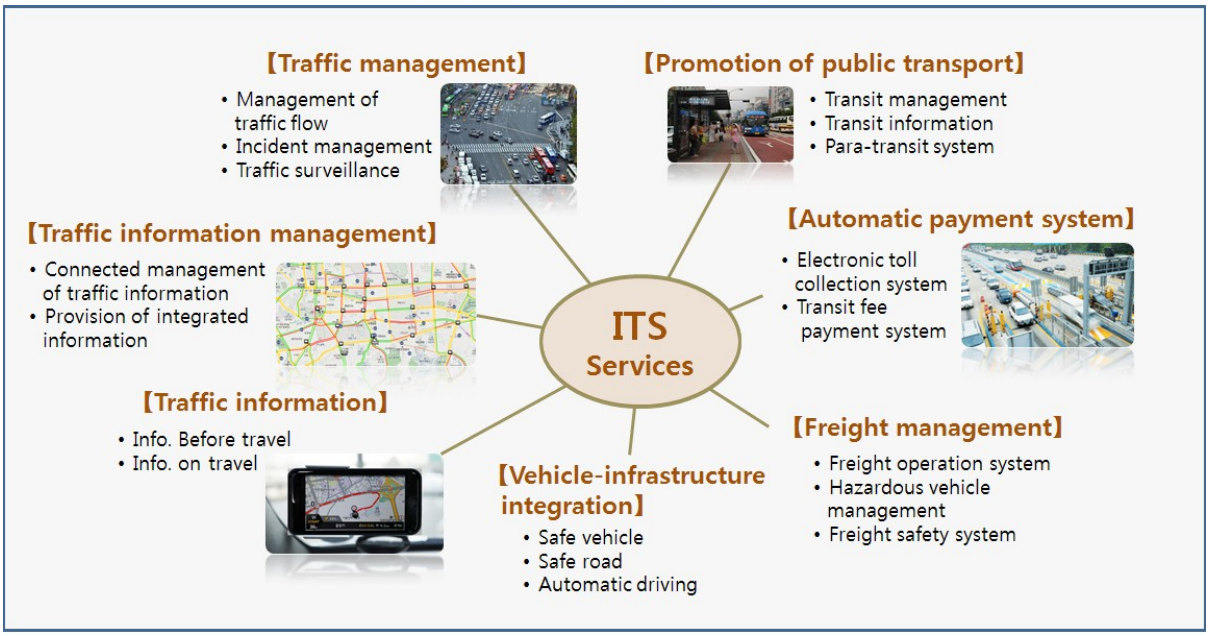
Policy Area: Transportation

Introduction of the ITS Program & Installation of the FTMS in Seoul

As the number of vehicles grew rapidly in the 1990s, prohibitive social costs were incurred by such results as road congestion and traffic accidents in the City of Seoul. Accordingly, decision makers were compelled to seek a new path, through transportation policy, away from the old, supply-oriented approach and towards investment. At the time, other countries were actively involved in studies on the Intelligent Transportation System (ITS) – the application of cutting-edge technology to transportation facilities and infrastructure. The ITS efficiently manages traffic flow at a more affordable cost than building additional infrastructure such as new roads, and major cities around the world were increasingly adopting this system. Seoul also adopted advanced ITS from overseas and sought to localize it.

The ITS efficiently manages traffic flow through a combination of technologies, both "hardware" (road construction, transportation, communications, electricity, electronics, automobiles, etc.) and "software" (operating methods, information processing techniques, etc.). The principal purpose of the ITS is to ensure travel convenience and safety by providing information on optimal routes to individual travelers and to maximize overall efficiency of the transportation system. South Korea pursued various ITS research and development programs and pilots in the 1990s. The ITS that was introduced to Korea included such elements as a traffic control system that controls traffic flow on highways and arterial road networks; and various subsystems such as the transportation information system that provides road information in advance or in real time.

Figure 1 -Types of ITS Services & their Roles: South Korea



In the early days of the ITS, Seoul seriously pursued the Freeway Traffic Management System (FTMS) program. The FTMS is one of the ITS programs that upgraded the efficiency of urban expressways in Seoul. With introduction of the FTMS, it became easier to manage traffic on urban expressways in real time and allowed automatic collection of information, significantly revamping the existing manually operated traffic system to make it more efficient. It also enabled immediate response to various situations on the road.

Implementation of the FTMS

The Olympic Expressway: First in Seoul to Be Managed by the FTMS

The first urban expressway in Seoul to embrace the FTMS was the Olympic Expressway, providing a wealth of transportation information towards improving the traffic flow as well as to detect and respond to traffic incidents rapidly, thereby enhancing the transportation environment and driver convenience. The Olympic Expressway FTMS was first designed by the Seoul Development Institute in August 1995, and implemented in July 1997. The pilot project was in operation from August 1997 to January 1998, with full service beginning in February 1998, now covering an 18 km leg (from Yeouido to Jamsil) of the 41 km long Olympic Expressway. This first FTMS collected data through a video detection system and analyzed traffic flow, all in real time. Data was interpreted and delivered to drivers and system operators through various media such as screens over the roads, ARS, fax messages, and the internet.

Figure 2 - View of the Olympic Expressway

Source: The Academy of Korean Studies, The Electronic Encyclopedia of the Korean Culture

Establishment of a Comprehensive ITS Plan for Seoul, Including Expansion of the FTMS

Beginning with the Olympic Expressway FTMS, Seoul steadily expanded the ITS, but each program was pursued independent of each other, thereby lacking in systematic structure and consistent directionality. To rectify this, the City of Seoul established a "Comprehensive ITS Plan for Seoul" to create a more systematic structure and consistent directionality while preventing redundant investment and creating a platform for more aggressive investment. In this Plan, the city set out its mid to long-term strategies for the ITS program and plans for phased construction of 15 systems in 5 areas, including the FTMS, a comprehensive traffic information center, and the bus guidance system. With a goal to introduce a data-based transportation management system for its major arterial roads and urban expressways, the city developed detailed action plans. The purpose and expectations for the FTMS in the Comprehensive ITS Plan for Seoul are as follows:

- Identify traffic and road situations on urban expressways in real time, analyze the causes for congestion and improvements to be made, and ensure overall efficiency of the transportation management system;
- Shorten travel time on urban expressways;
- Reduce transportation system costs by automatically detecting and rapidly responding to unexpected incidents; and
- Provide information on roads and traffic flow to drivers and create a more convenient transportation environment.

Phased Expansion of the FTMS in Seoul

After introducing the FTMS to the Olympic Expressway, Seoul expanded the system in phases.

Phase 1: Naebu Inner Beltway

The FTMS was introduced to the 40.1 km stretch of the Naebu Inner Beltway. The program began in May 2000, with a pilot program in place from November 2001 to June 2002. The FTMS enabled real-time management of traffic flow, keeping it at a reasonable speed. It also enabled rapid response to unexpected incidents and greatly contributed to enhancing user safety.

Phase 2 Zone 1: Remaining Segment of Gangbyeon Riverside Expressway & Bukbu Northern Arterial Road

The program for Zone 1 of Phase 2, began in November 2001 and completed in June 2004, expanded the scope of management by the transportation management system from the existing segments (Naebu Inner Beltway and Olympic Expressway) to include the 21.7 km segment of the Gangbyeon Riverside Expressway and the Bukbu Northern Arterial Road. This increased the number of messages displayed on electronic screens above the roads, and screen displays were modified as a result to include graphics to aid readability; helping drivers better understand the information and overcoming existing information display limitations. Additional host computers and databases were added to facilitate the increased data processing. An intrusion

detection system was added to the existing firewall to enhance system security and respond more effectively to hacking and other types of intrusion.

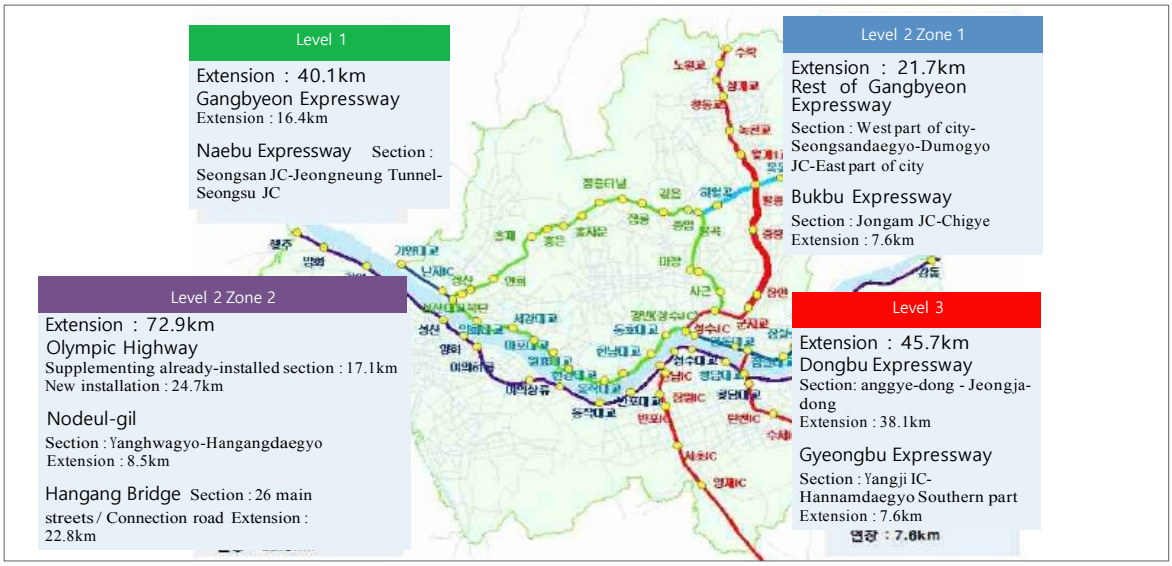
Phase 2 Zone 2: Olympic Expressway, Nodeul Road, & Han River Bridge

In Zone 2 of Phase 2, the transportation information system was implemented for the 49.3 km segment of the Olympic Expressway, Nodeul Road, and the bridge. Beginning in October 2003 and finishing in September 2005, the system began offering traffic information on urban expressways via mobile phone and PDAs, in line with the development of wireless communications infrastructure and the increasing use of wireless devices. Moreover, the Road Weather Information System (RWIS) was introduced, which collects weather data from humidity and temperature sensors installed on road surfaces and weather devices at roadside. Drivers can receive information on sudden and localized weather changes, as well as road use in real time, significantly improving traffic flow and driver safety.

Phase 3: Dongbu Eastern Arterial Road & Gyeongbu Expressway (Managed by the City of Seoul)

In Phase 3, the FTMS was installed on the 45.7 km of Dongbu Eastern Arterial Road and Gyeongbu Expressway (managed by the City of Seoul). Beginning in April 2005 and finishing in April 2007, this phase included response plans for the flood-prone Dongbu Eastern Arterial Road and the urban expressways near the Han River. Data was provided upon a rise in water level; strategies were set up to prevent vehicles from entering the flooded roads; and operational plans were developed to limit entry to all segments of the road. Furthermore, roadside electronic message displays were changed to ensure that information on unexpected incidents were given priority and automatically shown in affected areas.

Figure 3 -The FTMS in Seoul



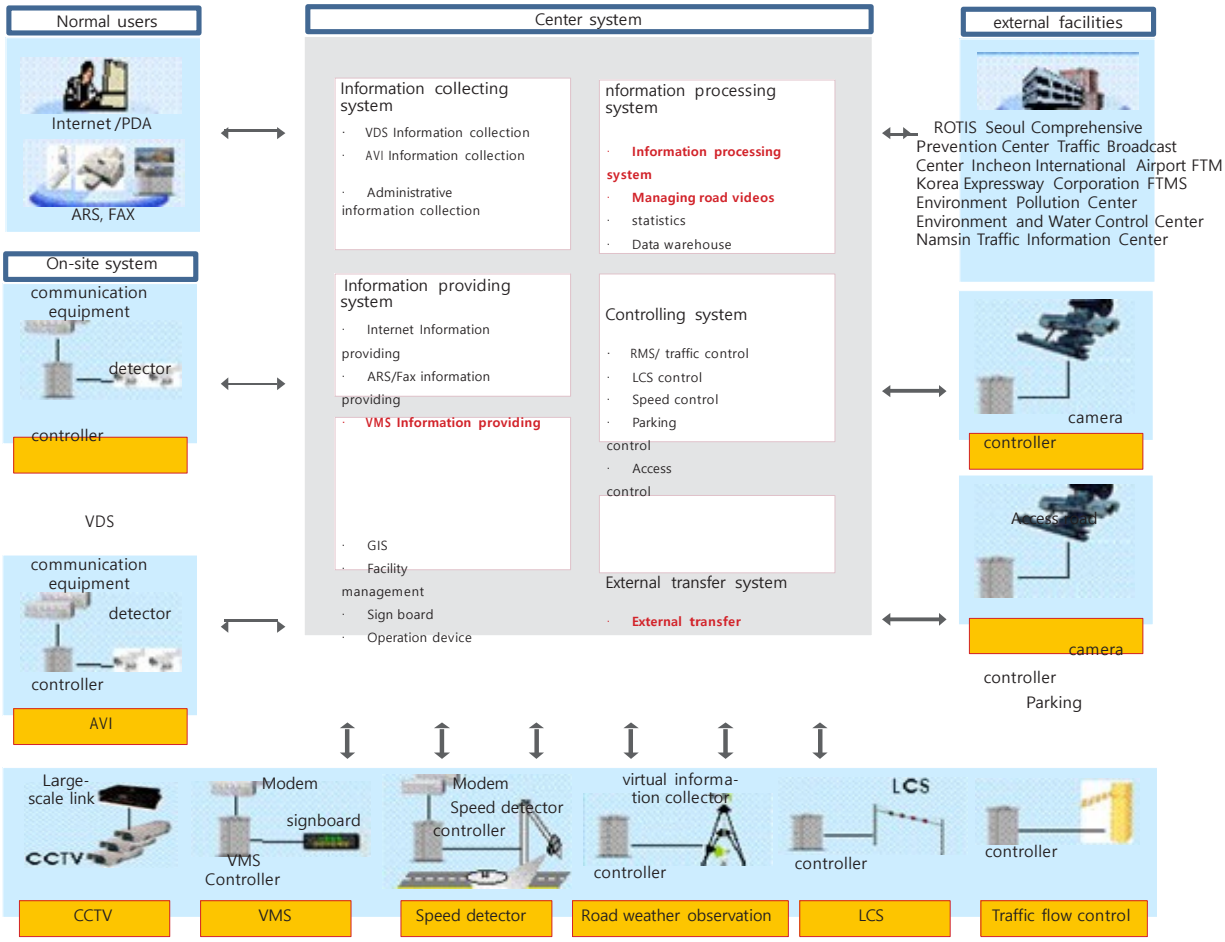
Source: Seoul Metropolitan Government (2007)

Establishment of the Urban Expressway Traffic Control Center & External Data Connection

In December 2000, the City of Seoul developed an "Urban Expressway Traffic Control Center Plan" which specified the name of the center and operation methodology. In March 2001, detailed action plans were set up for operation, and the necessary manpower was assigned to build the center. In April 2001, while the transportation management system for the Naebu Inner Beltway was underway, the FTMS Operation Plan was developed, describing organizational structure, operation and management plans, and an expressway patrol. By March 2002, the Urban Expressway Traffic Control Center was in operation.

The Urban Expressway Traffic Control Center is comprised of i) a local system for collection and provision of traffic information; ii) a traffic information processing and analysis system; and iii) a center system that oversees system operation and links to external entities. The system was built to share traffic data and weather information collected from the detection system, CCTV (closed-circuit television), and RWIS with other institutions such as the Korea Expressway Corporation, the Seoul Metropolitan Police Agency, and the Seoul Emergency Operations Center.

Figure 4 -The FTMS Concept



Source: Seoul Metropolitan Government (2013)

As of 2013, the number of local system facilities installed for data collection, provision, and control of information on urban expressways stood at 1,193 (Vehicle Detection System (VDS): 1,047; CCTV: 144; RWIS: 2), the facilities for information provision and traffic flow control stood at 325 (Variable Message Signs (VMS): 260; Ramp Metering System (RMS): 30; Lane Control System (LCS): 33; Interruption 2), in addition to websites and notification through ARS or fax.

Table 1 -The FTMS on Urban Expressways in Seoul

Category	Data Collection					Information Provision					
	VDS		AVI	CCTV	RWIS	VMS	RMS	LCS	Inter-rup-tion	Inter-net	Oth-er
	Video	Loop									
Phase 1	215	24	-	38	-	62	12	-	-	Web-site	ARS/ FAX
Phase 2	120	2	-	21	-	43	-	-	-		
	217	124	Removed	40	2	81	-	19	-		
Phase 3	194	10	-	36	-	61	18	14	2		
Namsan Zone	-	141	Removed	9	-	13	-	-	-		
Phase 4	Underway										
Phase 5	To be implemented										

Source: Seoul Metropolitan Government (2013)

Table 2 - External Links to the FTMS

Category		Information Details	Frequency	Use of the Information
From	Seoul Metropolitan Police Agency	Traffic flow at a fixed point (1 min interval), traffic flow at a fixed segment (1 min interval), unexpected incidents	1 min	-
		CCTV feed	-	-
	Korea Expressway Corporation	Traffic flow at a fixed segment (1 min interval)	5 min	-
	Traffic Broadcasting Station (TBS)	CCTV feed	-	-
	Seoul Transport Operation & Information Service (TOPIS)	Traffic flow at a fixed segment (1 min interval)	5 min	-
		CCTV feed	-	-
	Expressway to Incheon International Airport	Traffic flow at a fixed segment (1 min interval), unexpected incidents	5 min	-
To	Expressway to Incheon International Airport	Traffic flow on the Incheon Airport Expressway (Bukno JC – Airport)	10 min	Traffic information provided online
	Korea Expressway Corporation	Traffic flow on the Gyeongbu Expressway (Hannam – Shingal), Oegwak Outer Beltway (Toegyewon – Ilsan)	5 min	Traffic information provided online, displayed on operation devices and online maps
	Seoul Metropolitan Fire & Disaster Headquarters (Seoul Emergency Operations Center)	Weather data	1 min	Weather information provided online
		Data on dams, Han River level, and precipitation	-	Operation devices
	Namsan Zone Traffic Data	Traffic flow at a fixed segment (1 min interval)	1 min	Traffic information on the Namsan Zone via VMS

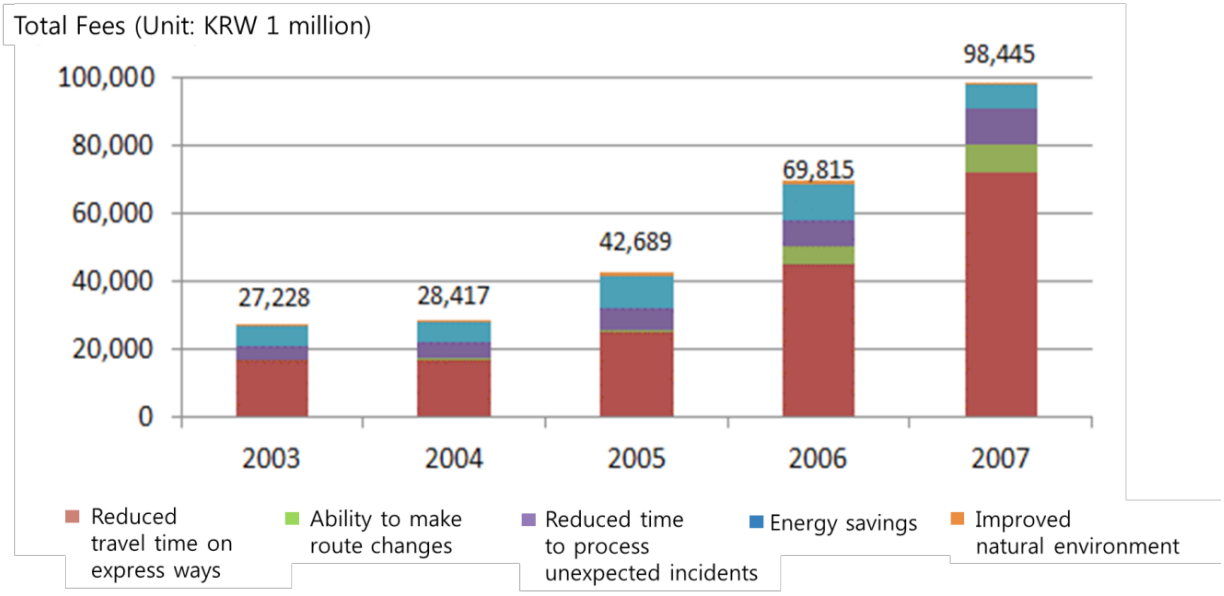
Source: Seoul Metropolitan Government (2013).

Major Achievements

Socioeconomic Benefits from the FTMS

According to a 2007 report by the Seoul Metropolitan Government, the FTMS has resulted in several benefits: reduced travel time on main roads; improved ability in making effective route changes; reduced time in processing unexpected incidents; energy savings; and improvement of the driving environment. As Phase 1 transitioned into Phase 2, the FTMS gradually expanded, thereby adding socioeconomic benefit as shown in Figure 5. Of these, reduced travel time on the main urban expressways was the greatest, followed by energy savings, reduced time to process unexpected incidents, improved ability to make effective route changes, and improved the driving environment.

Figure 5 - Socioeconomic Benefits from the FTMS: By Year

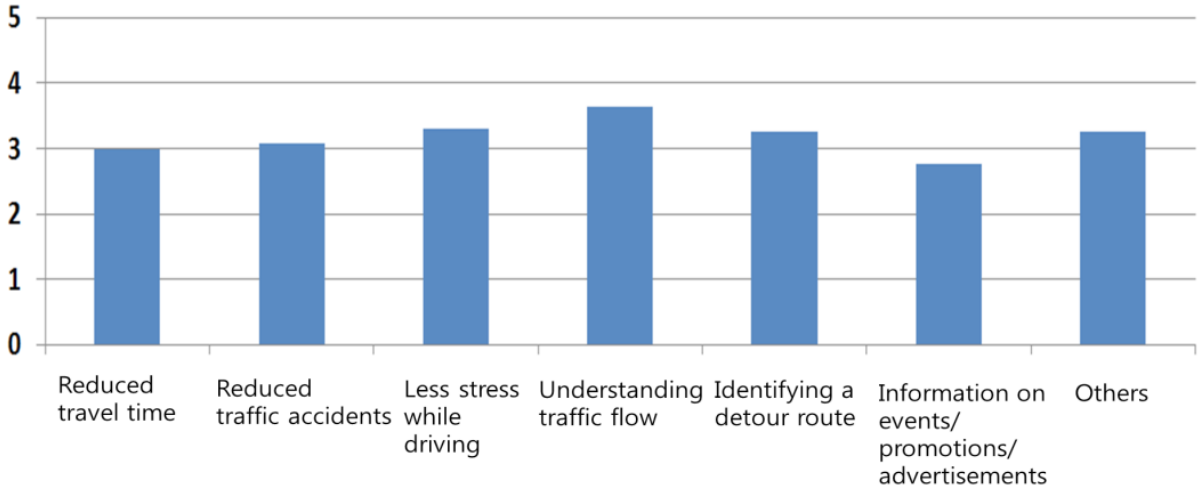


Source: Seoul Metropolitan Government (2007).

FTMS Reliability & High Degree of Public Satisfaction

According to 2007 data provided by the Seoul Metropolitan Government, the FTMS traffic information system helped expressway users with their trips. In a survey, many drivers responded that VMS information was helpful in the use of their vehicles on the road. Specifically, the system was most helpful in understanding traffic situation (3.65 points), followed by finding less stress (3.3 points).

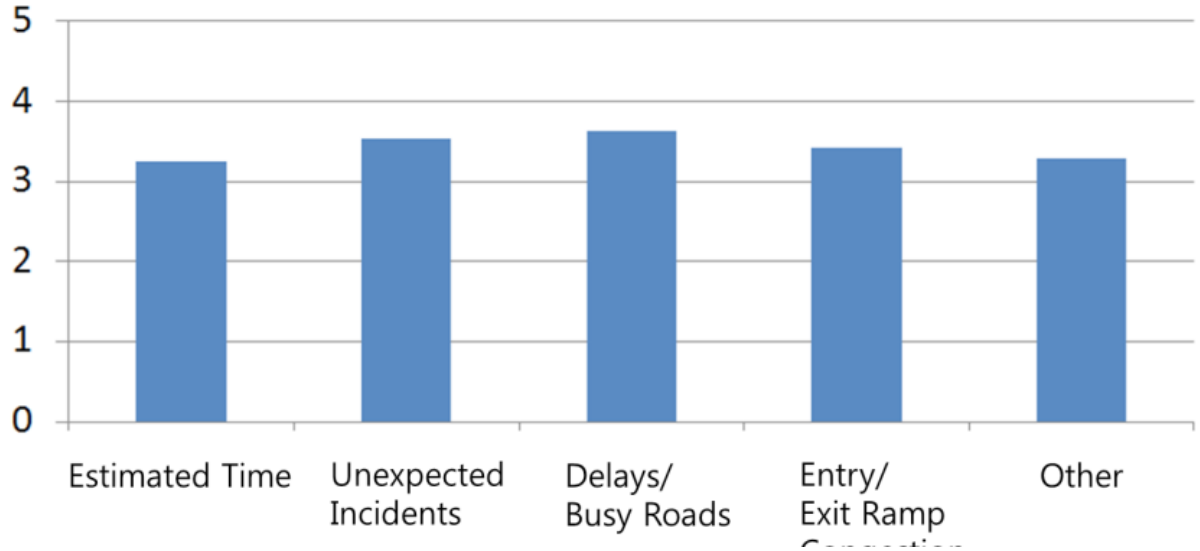
Figure 6 - Ways VMS Information Assists Drivers



Source: Seoul Metropolitan Government (2007).

In a survey on reliability of the estimated travel time data displayed on the VMS, respondents generally found it dependable, with expected delays and busy road information most reliable (3.64 points), followed by information on unexpected incidents (3.54 points).

Figure 7 - Reliability of VMS Information (By Type)



Source: Seoul Metropolitan Government (2007).

Increasing Use of the FTMS

More drivers are using information generated by the FTMS. According to the 2013 FTMS Operation Report by the city of Seoul, the number of information users in 2003 – during the early phase of analysis – was approximately 2.2 million but jumped 520% to 11.7 million by 2013. Use of the website to find needed information was especially high. Reflecting the rapidly increasing number of smart phone users, mobile device access instances amounted to 5.8 million in 2013. Access via social networking sites is also expected to grow in the future.

Table 3 - Access to FTMS Traffic Information by Media

(Unit: No. of accesses/year)

Category	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total No. of Access Instances	2,256,940	2,780,286	3,026,974	4,276,123	4,593,626	4,862,232	5,930,403	10,449,609	18,117,411	13,612,320	11,777,260
Internet (excluding Twitter)	2,025,411	2,584,203	2,822,365	3,932,823	4,059,065	4,294,350	5,337,458	9,904,212	17,759,764	13,364,052	5,726,604
Mobile Phones	No Records										5,811,771
ARS/FAX	222,342	185,664	192,151	321,624	501,039	528,204	545,110	491,263	316,693	178,101	122,922
Phone Communication	9,187	10,419	12,458	16,742	16,493	14,335	12,955	10,077	7,709	6,226	4,972
Feature Phones, PDAs	-	-	518	4,934	17,029	25,343	34,880	44,057	25,155	54,753	7,794
Twitter	-	-	-	-	-	-	-	-	8,090	9,188	9,584

Source: Seoul Metropolitan Government (2013).

Future Direction

The City of Seoul has so far invested much of its human and financial resources into building the FTMS and continual expansion of the system. However, limitations were found in the process, with indications that the systems collecting traffic data should be improved due to the delays in delivering data to users or failing to repair devices that did not meet performance requirements. The following are ways to enhance FTMS performance and ensure continued development.

Reduce Delays in Display of Commercial Data (e.g., Traffic Volume, Speed, Occupancy Rate)

Accuracy, immediate response and convenience are keys to optimizing reliability and use of the FTMS traffic information, all of which can be enabled by a system that minimizes the time required to collect, deliver, process, and provide traffic data. The current FTMS detects data from vehicle detection sensors at various locations and uses it as commercial data or displays it on an electronic map released by the traffic information center. This process takes time, and for some road segments, the information may not be in real time. Server capacity needs to be increased, server loads dispersed, and renewal intervals reduced to see improvements to the system.

Building a "Smart Highway"

The FTMS generates traffic information through detectors and data collecting equipment to manage the urban expressways in Seoul, but this is undermined by some limitations with the collected data. The Ministry of Land, Transport & Maritime Affairs is now pursuing the "Smart Highway" program to place more advanced technology on expressways to correct the above-mentioned limitations. This program includes the development of "smart" technologies to improve mobility and safety through: "smart" toll booths that offer various automatic payment methods; automatic detection of all situations on an expressway using real-time panoramic video; and the WAVE system which uses high-speed wireless communication technology installed on a fast-moving car to send and receive all data on the expressways and adjacent roads. In the long-term, Seoul will be better equipped to combine cutting-edge information technology with the FTMS to build a safer, smarter, and more reliable expressway management system.

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