Introduction to Urban Traffic Information System (UTIS) in Korea

Cheolsun KIM [a], Hyunkyung LEE [b], Hyo-Chul SHIN [c], Dongik HA [d]

[a,b] *Department of Civil and Environmental Engineering, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul, 151-744, Korea*
[a] *E-mail: kcs529@snu.ac.kr*
[b] *E-mail: lyla219@snu.ac.kr*
[c] *Korean National Police Agency, 97 Tongil-ro, Seodaemun-Gu, Seoul, 120-704, Korea; E-mail: 971024@hanmail.net*
[d] *Integrated Research Institute of Construction and Environmental Engineering, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul, 151-742, Korea; E-mail: dongikha@snu.ac.kr*

Abstract: The purpose of this paper is to introduce Urban Traffic Information System (UTIS) in Korea. UTIS is an advanced traffic information system built in major cities which was developed by National Police Agency and local administrative organizations. Collected and processed traffic information are provided to the public for the free of charge. Currently, UTIS is constructed in 26 major cities, 13 cities are in a progress and it is planned to build in additional 24 cities. UTIS is not only a single method of providing traffic information but it also acts as an important infrastructure for the country. This transportation infrastructure can be used further as an urban management system to manage crimes and disasters by using advanced technology.

Keywords: UTIS, Traffic Information, Infrastructure, Advanced Technology

1. INTRODUCTION

The exponential increase in the use of cars consists many side effects such as pollution (McHugh *et al*., 1997; Puliafito *et al*., 2003), congestions and accidents. Controlling those side effects has been a crucial issue in many countries since it touches almost every division of a country. Therefore, constructing and managing sound transportation system has become one of the key goals in many countries. These days, with an increase use of a ‘smart’ system, transportation system has adopted information technology (IT) to manage overall transportation effectively and efficiently. Korea, known as IT powerhouse, also has put its effort into a development of Intelligent Transportation System (ITS) (An *et al*., 2011; Martinez *et al*., 2010).

Korea has participated in ‘smart’ transportation system (Jayakrishnan *et al*., 1994) by constructing UTIS. UTIS was developed by National Police Agency and local administrative organizations. Since National Police Agency is in act, UTIS is not only built to control traffic but also to accommodate ‘smart’ urban management such as crime prevention, provision of parking information, and disaster management system. The purpose of UTIS is to install advanced transportation information infrastructure which collects and provides for real-time traffic information in major cities (Calabrese *et al*., 2011; Jou and Chen, 2013). By providing traffic and accidental information either directly or indirectly to the public, citizens can benefit from enhanced traffic safety and uninterrupted flow. The ‘smart’ urban management system, one of the main purpose of UTIS, helps to integrate various administration works which further can purse budget savings and automation of administration process. UTIS also contributes to create new markets and employment and vitalize related industries.

The project UTIS was first announced by the government in 2004. It was mentioned in the investment plan for IT. In the next year, it established the plan to enlarge the fundamental base of urban area traffic information project. The pilot project was carried out for 4 major cities on Seoul metropolitan area; Seoul, Incheon, Bucheon, Gwangmyeong. In March 2005, it established the plan to build nationwide traffic information integration and distribution system which consist of nationwide node link database (DB). After several changes were discussed during 6 years, in 2011 UTIS strengthening plan was established. The plan included more accurate traffic information collection and provision, sales of UTIS devices to private market and consideration of subsidy policy. During the year 2012, the enlargement of UTIS project to the whole country area was discussed with a goal of building UTIS at 62 cities until the year, 2022. Also, UTIS reinforcement project was established to increase number of base stations and devices in partial area because at the initial stage of the project, the budget was insufficient to provide them all. In 2013, the plan for subsidizing devices to enlarge UTIS device supply was in act. (see Figure 1)

UTIS is currently performing in 26 cities including Seoul metropolitan area and the system is planned to be installed in 13 cities. The goal is to complete the project in 63 cities in Korea until the year 2022.

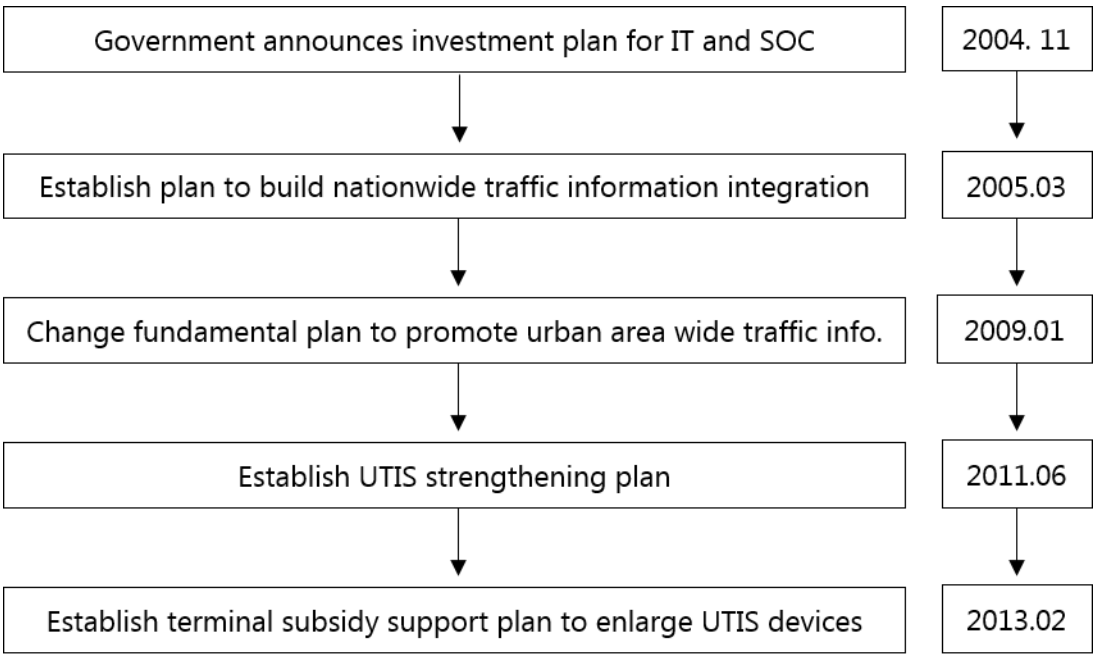

Figure 1. History and process of UTIS development

2. COMPOSITION OF UTIS

2.1 Elements of System Composition

UTIS consists of, largely, 3 main parts; GPS, Road Side Equipment (RSE), On Board Equipment (OBE) (see Figure 2). The role of RSE is being a base station on the road side. Wireless transmitting and receiving equipment transmits the traffic information received from the vehicle device through UTIS wireless communication. It also transmits the traffic information provided from the center to vehicle terminal. RSE is installed to a CCTV iron pole

or a dedicated support built at downtown main crossroads. The role of OBE is a vehicle device. A device inside the vehicle transmits traffic information based on GPS and electronic map through UTIS wireless communication with RSE. The device displays the traffic information provided by the center. Usually, the OBE is installed at the dash board inside the vehicle. Other than RSE and OBE, UTIS consists of closed circuit TV (CCTV), variable message signage (VMS), and optical exclusive network. CCTV acts as traffic condition video collection equipment, it is utilized for surveillance of crossroad and accidents. VMS displays traffic flow information, unexpected situation information, and other electronic board. Optical exclusive network is the infra communications network connecting traffic information center and field equipment (RSE, CCTV, VMS etc.)

UTIS adopted 'ToWay' system. ToWay is the core technology that derives traffic data from vehicle's moving route and speed as data by using GPS and transmits it to the center through wireless communication between OBE-RSE (see Figure 2). In other words, ToWay means that two-way wireless communication between RSE and OBE which are separate field equipment for the real time traffic information collection and provision. The functions for each compositions of the system are as follows. Navigation collects driving information (GPS coordinates and vehicle move time) of the road and transmits to base station. A regional traffic information center collects driving information from each base station to produce regional traffic information and transmits it to central traffic information center. Central traffic information center integrates traffic information of each region to produce nationwide traffic information and provide it to citizens, regional centers and relevant institutions. Each regional center transmits the nationwide traffic information received from central center to navigation through base station, and provides the driver with the information.

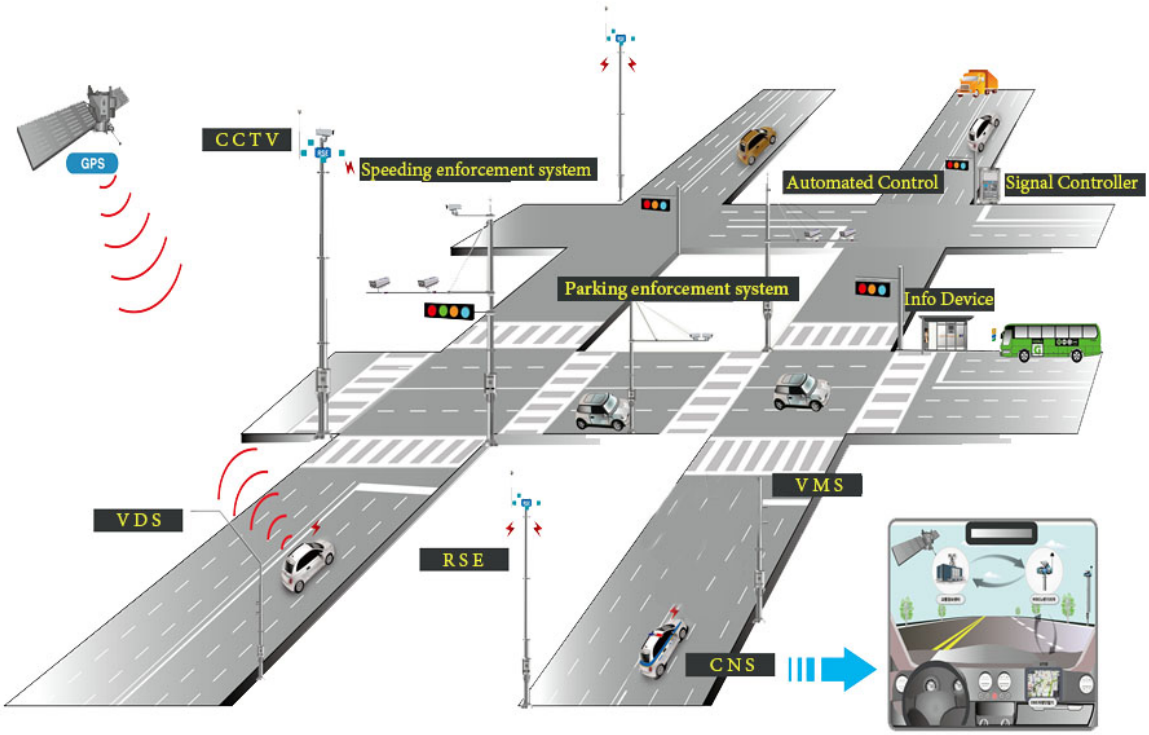

Figure 2. Elements of UTIS composition

2.2 Comparison with ToWay and other ITS communications

Table 1 compares the features of UTIS communication method, ToWay, with the standard communication method, dedicated short range communication (DSRC) and wireless access in vehicular environment (WAVE) (Dar *et al*., 2010; Li, 2012). UTIS is based on e-map and GPS, devices which create its own traffic information. Therefore, device specification is unnecessary and the base station construction at each crossroad is unnecessary. The purpose of traffic information collection and provision can be achieved only by installing a small number of base stations. It is also applicable to various data communication for moving objects. ToWay can be easily applied to other related fields in the future because of its various functions.

Table 1. Comparison with ToWay and other ITS communications

Classification	UTIS	DSRC	WAVE
Overview	Two-way traffic information collection & provision	Dedicated short range communication	Wireless access in vehicular environment
Year of development	Domestic development in 2005	Overseas development in 2000s	Specification determined in 2010
Performance	Communication speed: maximum 54Mbps Bandwidth: 20MHz Communication radius: longer than 500m	Communication speed: maximum 1 Mbps Bandwidth: 10MHz Communication radius: within 100m	Communication speed: maximum 27Mbps Bandwidth: 10MHz Communication radius: longer than 1000m
Features	V2I-base traffic information collection & provision	V2I-base ETC and traffic information collection	Specialized traffic safety service through V2V
Collection	Moving, terminal calculates by itself speed information of each section, and delivers it to center	When terminal passes base station, passing time is checked and analyzed at center (beacon type)	Undetermined (UTIS service acceptance is necessary for compatible application service)
Provision	Center provides in a lump, and direct provision to terminal is possible (smooth traffic, unexpected event, CCTV video etc.)	Center provides in a lump (Internet and electronic board etc.), and direct provision to terminal is limited (some text)	
Device	UTIS navigation, UTIS OBE	Hi-pass terminal	Undetermined

3. APPLICATIONS OF UTIS

3.1 Provision of UTIS Traffic Information

As of June of 2014, central traffic information center is collected nationwide speed, unexpected event, and CCTV video in linkage with 26 cities of capital area and regional provinces where

UTIS was built, and 38 cities where UTIS is scheduled to be built will be added until the year 2022. Central traffic information center integrates the urban traffic data collected through UTIS and nationwide expressway and national road traffic data through linkage to Ministry of Land, Infrastructure and Transport. Then it makes corrections of missing intervals to create wide area traffic information, and starts provision service. Traffic information management system was built at the end of 2012 and is now operating to perform as an effective systematic storage and management of large traffic data.

Direct services to the public through various media such as internet website (http://www.utis.go.kr) and smart phone application (traffic notice-e), are available. UTIS traffic information to public sector is provided through a connection to public institutions such as Ministry of Land, Infrastructure and Transport, Blue House, and National Emergency Management Agency. UTIS also considers to make an agreement with private sector to increase number of users by providing UTIS traffic information to internet portal companies, and communication companies.

Figure 3. Provision of UTIS traffic information

3.2 Urban Management System

UTIS emphasizes that it is not limited to provide traffic information. It acts as one of the major infrastructure which every government should provide. It is because UTIS can cover urban management system which includes transportation, security, and cleaning of a city. The usages of the urban management system are as follow.

Police in Korea operates ‘road danger prediction system’. The system manages real time unexpected information such as traffic accidents or road construction and traffic safety data such as dangerous roads or protective areas using electronic map, and prediction of dangers such as regularly freezing section in connection with Korea Meteorological Administration. Also, using police force at the site, it manages unexpected information. It separates types of unexpected events and collects information for each events. The case for noticed construction or events are dealt in police stations to record in UTIS website. The case of emergency, the site police makes a judgment and put the information quickly through smart phone application

(traffic notice-e) at the site to improve quickness. This dual collecting system raises quickness of information collection and enhances timeliness of information provision. Also, police manages traffic safety data using UTIS. To efficiently collect, integrate and manage diverse traffic safety data stored in non-standard document form at each department of nationwide police stations, web-based traffic safety data integration system is built and operated. For improvement of convenience of field police officers who move frequently, an icon is created for each item of safety data based on GIS. Then, the system can automatically record the information by simply clicking these icons on the location mark of map.

The local governments have successfully reduced their budgets by using UTIS information which are given out for the free of charge. 14 cities which are included Seoul metropolitan area utilize integrated management system including anticrime CCTV. Integrated operation of anticrime CCTV, signal control, and bus information system (BIS). Budget were saved by using UTIS self-communications network built over the whole city. Using UTIS, communication expense of about 4,500,000 USD is saved yearly. Installing UTIS device (OBE) on snow removal vehicles, it is possible to remove snow quickly by checking and managing moving route real time through collected location information (see Figure 4).

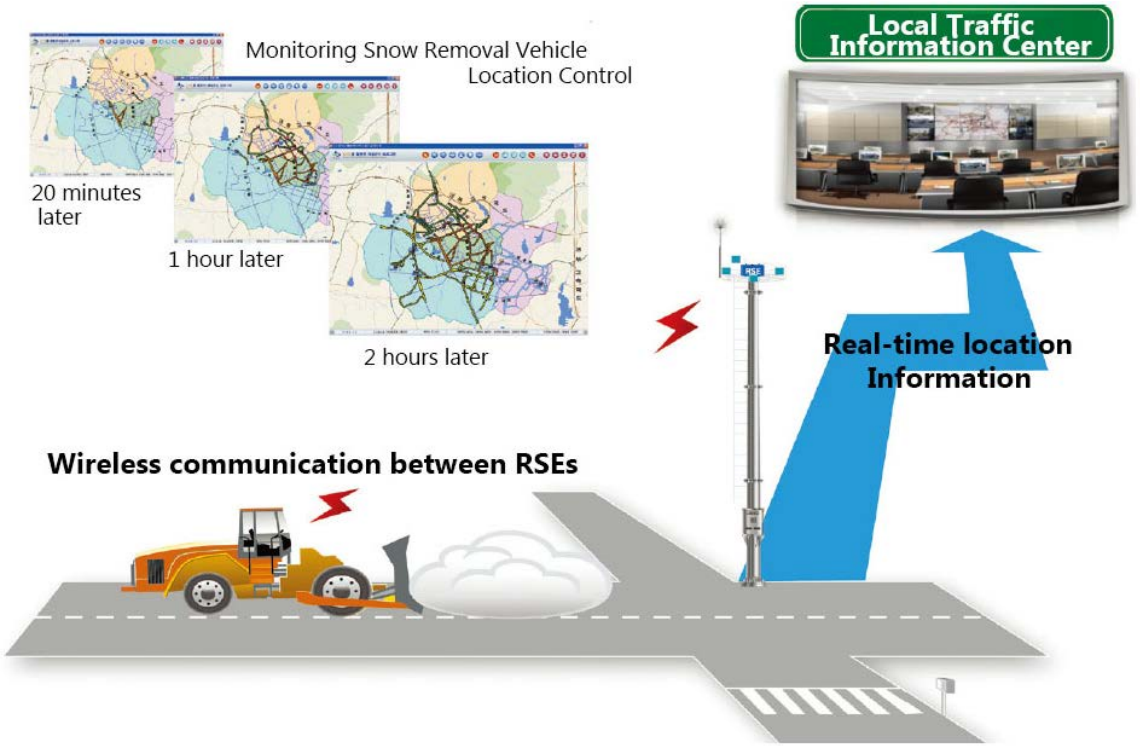

Figure 4. Snow removal vehicle management system

Digital tachograph (DTG) linkage system will be constructed in the future. If the ‘Digital tachograph data transmission using UTIS’ plan is carried out, traffic information can be collected from more than 400,000 vehicles including taxies and trucks without installing any other separate communication devices. Ministry of Land, Infrastructure and Transport is promoting to build ‘big data’ of commercial vehicles by using DTG data (see figure 5).

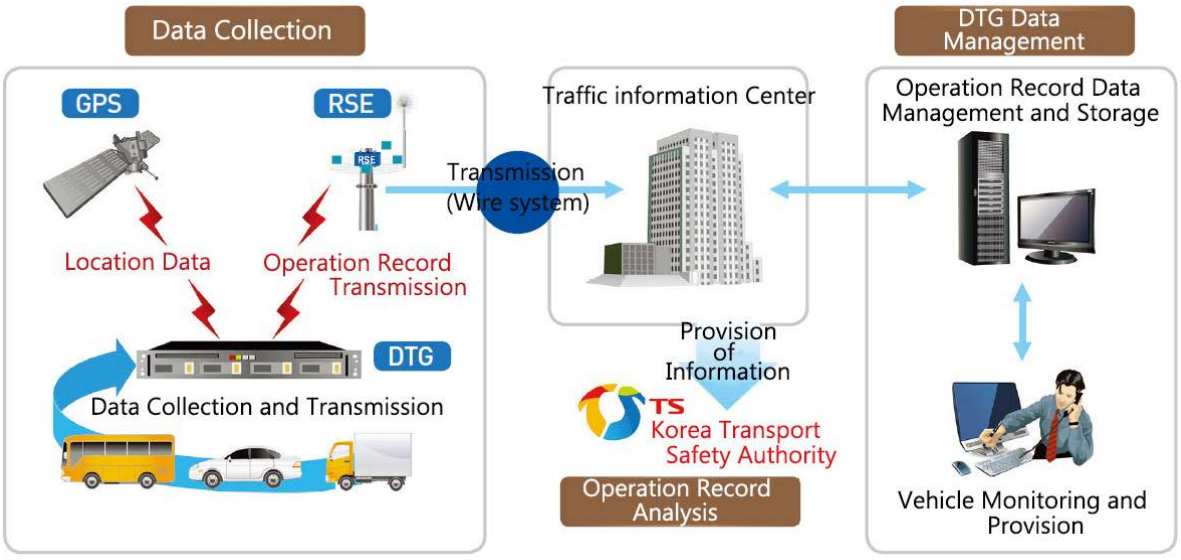

Figure 5. DTG linkage system

4. CONCLUSION AND FUTURE PLAN

Many researches has been carried out using advanced IT technology in the field of transportation. Collection and provision of transportation information was the first step. Then it improved to an integrated signaling system, and public transport information system which operates nationally. UTIS is a result of complied efforts on ITS. Ultimately, it should aim for combined solution to manage the entire city. (see Figure 6)

Figure 6. Expansion of functions for urban management system

Police, who operates UTIS, and government and related authorities are building close network. The network allows to establish strategies which satisfies the need of both operators and users. For the short term, traffic flow can be controlled efficiently on main roads in downtown where delay or congestion occur frequently. The system will be able to predict short term traffic situation in the corresponding region at the time of holidays, vacation season, events and rally, and serviced. For the long term, vehicle total care service, driving habit linked insurance discount, dashboard camera automatic reporting, and location based relievable service for kids are suggested.

Private companies can benefit from UTIS because the primary raw data of traffic information is freely given which lowers the sunk cost to enter newly growing industries. Citizens can benefit from safe and comfortable driving by using high quality custom-made traffic service and social anxiety can be removed by securing safety of vulnerable social group (location-based safety service). The government can reduce social costs due to traffic safety enhancement and to secure rich big data. The production of high quality traffic information can be used for more advanced traffic administration.

REFERENCES

An, S. H., Lee, B. H., Shin, D. R. (2011) A survey of intelligent transportation systems. In Computational Intelligence, Communication Systems and Networks (CICSyN), 2011 Third International Conference on IEEE, 332-337.

Calabrese, F., Colonna, M., Lovisolo, P., Parata, D., Ratti, C. (2011) Real-time urban monitoring using cell phones: A case study in Rome. *Intelligent Transportation Systems*, 12(1), 141-151.

Dar, K., Bakhouya, M., Gaber, J., Wack, M., Lorenz, P. (2010) Wireless communication technologies for ITS applications. Communications Magazine on IEEE, 48(5), 156-162.

Jayakrishnan, R., Mahmassani, H. S., Hu, T. Y. (1994) An evaluation tool for advanced traffic information and management systems in urban networks. *Transportation Research Part C: Emerging Technologies*, 2(3), 129-147.

Jou, R. C., Chen, K. H. (2013) A study of freeway drivers' demand for real-time traffic information along main freeways and alternative routes. *Transportation Research Part C: Emerging Technologies*, 31, 62-72.

Li, Y. J. (2012) An overview of the DSRC/WAVE technology. *In Quality, Reliability, Security and Robustness in Heterogeneous Networks* (544-558). Springer, Berlin.

Martinez, F. J., Toh, C. K., Cano, J. C., Calafate, C. T., Manzoni, P. (2010) Emergency services in future intelligent transportation systems based on vehicular communication networks. Intelligent Transportation Systems Magazine on IEEE, 2(2), 6-20.

McHugh, C. A., Carruthers, D. J., Edmunds, H. A. (1997) ADMS–Urban: an air quality management system for traffic, domestic and industrial pollution. *International Journal of Environment and Pollution*, 8(3), 666-674.

Puliafito, E., Guevara, M., Puliafito, C. (2003) Characterization of urban air quality using GIS as a management system. *Environmental Pollution*, 122(1), 105-117.