Application of Intelligent Transportation Systems in Vietnam: Challenges and opportunities for sustainable transportation

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Abstract

The rapid development of information technology and communications has created an opportunity to improve the efficiency of road traffic by using Intelligent Transportation System (ITS). The combination between transport participants, vehicles and road traffic infrastructure through using roadside equipments and traffic control centers takes a part in improving the efficiency of the transportation system and quality of transportation services. ITS has been studied and successfully applied in many developed countries in the world like the USA, Europe, Japan, Korea, ... for over 30 years and has become an important part of their transportation development policies in the 21st century, especially for expressway network and urban transportation. The main applications of ITS on the expressway and urban transportation include Traffic Management Systems (TMS), Electronic Toll Collection (ETC) and monitoring and surveillance of vehicle overloading system, which will help the use and operation of infrastructure easier and faster. Vietnamese Government has planned to build more 6,000 km of expressway from now to 2030[1]. Also, the Government has a plan of implementing ITS for expressway systems and integration ITS with urban transportation. The present paper presents an overview of ITS development and application in order to provide a suitable solution for applying ITS in expressway and urban transportation according to specific stages of development of Vietnam. Also, the paper provides an evaluation of ITS projects in Vietnam to draw lessons and recommendations for further implementing ITS in Vietnam. The study results may help transport agencies in effective applying ITS in operation and management of transportation systems in Vietnam and other Asian countries where ITS has been newly introduced.

Keywords: Vietnam, Intelligent Transportation Systems, expressway, draw lessons, newly introduced

[1] The comprehensive study on the sustainable development of transport system in Vietnam (VITRANSS 2)

1. Introduction

ITS has been developed since the year 60s of previous century and applied widely in the world. In America, Japan, Euro and developing countries such as Thailand, Malaysia, ITS is an important part in traffic system. ITS's applications are to improve efficiency of traffic system by reducing 3 negative effects in transport: traffic jam, traffic accidents, and environment pollution.

At present, Vietnam is on the first stage of ITS development process. ITS development includes two big parts: superstructure development and infrastructure construction. Along with them is to educate and develop human resources of operation and maintenance and build up the habit and user guide. ITS in Vietnam will be developed for traffic on the express way and urban transportation.

2. ITS Definition

The Intelligent Transportation Systems (ITS) denote the applications of new information technologies and communications to transportation. They are called "intelligent" because their development is based on functions generally associated with intelligence: sensory, memory, communication, information processing and adaptive behavior [1, 2].

ITS combines 3 basic factors in traffic including drivers, vehicles, and traffic infrastructure in order to create efficiency in operation and reduce negative effect caused by traffic.

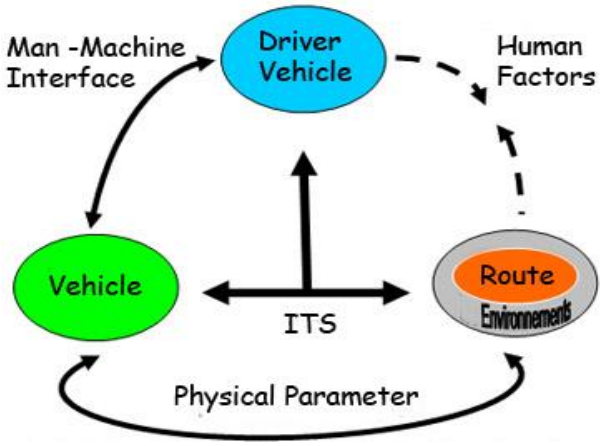


Fig. 1 ITS in the interface Driver – Vehicle -Route
Source: Volpracht, Hans-Jochim [2003]

ITS development goes along with information technology development. Basically, it can be divided into 4 phases:

- Phase 1 from 1960-1970: the beginnings
- Phase 2 from 1980-1995: investment in the road information
- Phase 3 from 1995-2000: interoperability, ticketing and automated highway
- Phase 4 from 2000-2005: sustainable mobility, multimodality and road safety

At present, ITS applications orient to sustainable mobility, mutimodality and ensure road safety.

3. Current Condition of ITS Implementation in Vietnam

3.1 Traffic Information

The road/traffic monitoring of the Voice of Vietnam (VOV) is implemented in Hanoi and HCM city currently and it will be extended to whole NH1 route. Although the road/traffic information is collecting from Closed-circuit television camera (CCTV), major information is provided by the people who are driving on the roads and by the VOV reporters and collaborators. The collecting information is mainly traffic jam, heavy traffic, and construction site.

VOV installed 66 CCTV cameras in major intersections in urban area of Hanoi city, and the monitored moving image is transmitted to VOV center with wireless communication. The cameras are able to control from VOV center. The collected images are provided to traffic police also and utilized for its purpose.

On the other hand, the traffic police installed 20 CCTV cameras at major intersections within the area of Ring Road 3 in Hanoi and monitoring them. The Hanoi Traffic Police has a plan to install 60 CCTV cameras additionally in 2011. The monitored moving image is transmitted to traffic police center through optical fiber cable. In this system, the image processing technology is not applied, and only utilized for visual judgment. The monitored images are provided to VOV also.

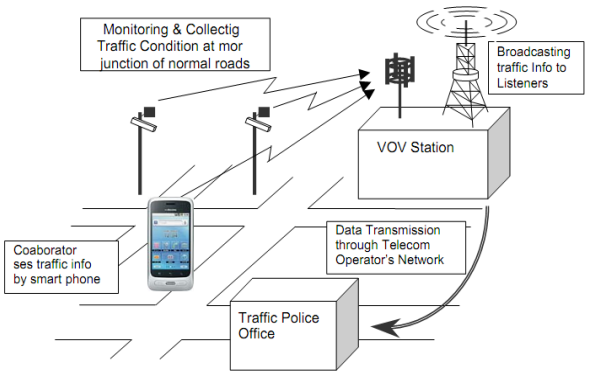


Fig. 2 Structure of Collection and distribution of traffic Information by VOV
Source: VITRANSS 2 [1]

Fig. 3 Traffic Information centre of VOV

3.2 Location Information Service based on GPS

In Vietnam, some bus and truck company have already installed the GPS monitoring system for their driving location at their own operation centre. If actual traffic conditions is able to be acquired from these systems more reliable and systematic traffic data will be provided in future.

3.3 Electronic Toll Collection (ETC)

In Vietnam, the "infrared type" and "DSRC type" has been implemented for the ETC system. Near Hanoi city, the pilot project has been implemented DSRC system at Dau Giay Tollgate on National Highway No.1 Such systems implemented by ViettinBank, all of the equipments implemented by using the Build – Operation – Transfer (BOT) scheme.

According to the plan, 4 tollgates are already equipped. 15 tollgates supposed to be equipped at the end of this year, some contracts have been signed. Additionally, up to 20 tollgates next year, new contracts are coming. In the future, they target 80% of tollgates will be equipped in Vietnam. The DSRC system of Dau Giay Tollgate which is using Passive DSRC method. It is the same system already in operation at Can Tho Bridge.

Fig. 4 ETC lane in Long Thanh – Dau Giay Expressway

4. Itinerary of ITS development in Viet Nam

4.1 Expressway development planning in Viet Nam

Prime Minister promulgated the Decision No. 1734/QĐ-TTg on the first of December 2008 approving expressway network development planning in VietNam to 2020 and vision after year 2020 [3].

This Decision shows clearly the government opinion about expressway construction: building completely national expressway network for long term national development with the target of becoming industrial country in 2020.

In this Decision, there are some purposes for expressway construction such as: connecting major centers, raising the the connectivity with other carriers, ensuring environment, and solving traffic congestion. ..

Table 1 Expressway Development Plan of Vietnam

Item	Total Length (km)	Expressway (Number)	Executants
Details	5,753	39	Vietnam Expressway Corporation

Source: Ministry of Transportation, 2002 [4]

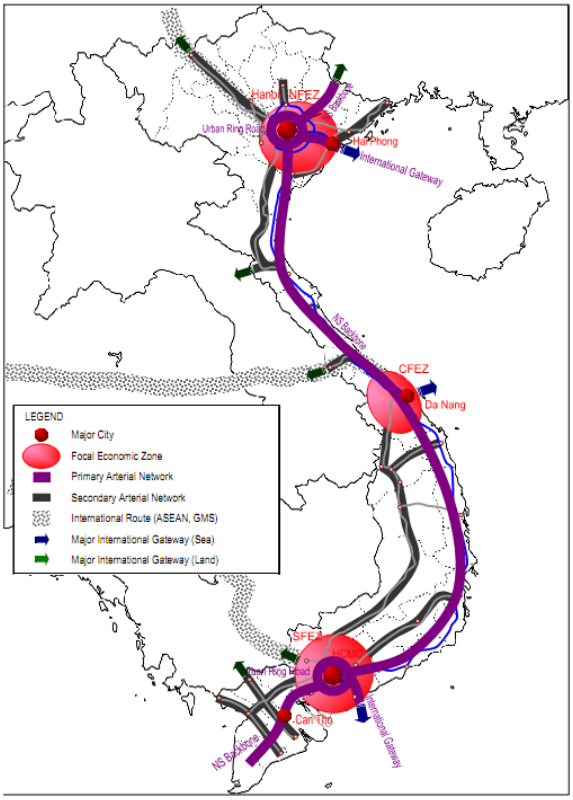


Fig. 5 Planning for Expressway system of Vietnam to 2020 and vision after 2020
Source: VITRANSS2, 2010 [5]

4.2 Itinerary of ITS development in Viet Nam

By Vitranss 2 master planning, infrastructure development in VietNam is divided into 3 phases. First phase to 2015, the second phase to 2020 and third phase to 2030. Along with building the operating centres and communication network, there are 3 priority services for advance inplemention including: traffic information system, nonstop toll collection system, heavy truck controlling system. Other services to be introduced in the future are inter-city bus assistance, convinient parking assistance and road pricing.

Fig. 6 Road Map of ITS for Inter-city Road Network
Source: VITRANSS2, 2010 [5]

General planning of information network

As in the planning, ITS model by national scope is divided into 5 layers: the highest layers are national ITS center and regional ITS centres. The lowest layer are toll lanes. Each layers are connected with each others by high-speed optical cables.

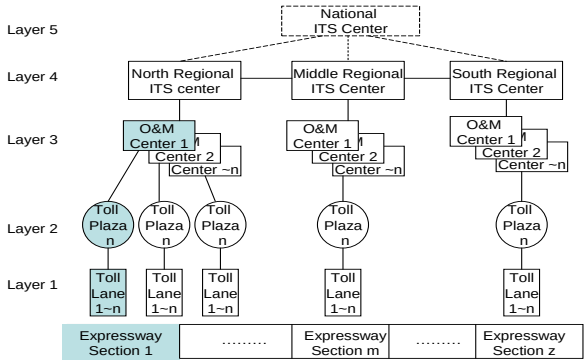


Fig. 7 Five layers in National ITS architecture
Source: VITRANSS2, 2010 [5]

Three regional main centers in Ha Noi, Da Nang and Hochiminh city will be in construction. These centers will receive information form road management centres and transfer to national main center.

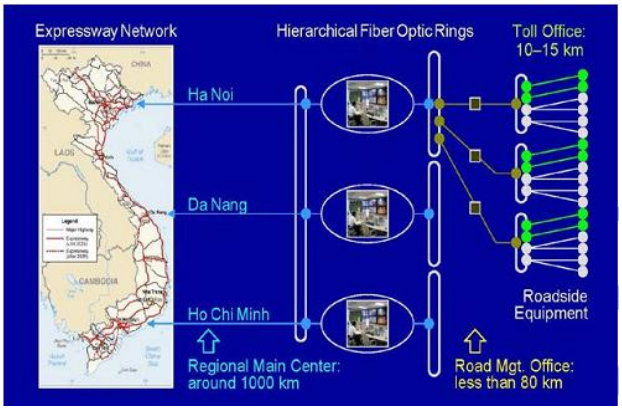


Fig. 8 Three regional main center
Source: SAPI, 2012 [6]

At present, Vietnam Expressway Corporation (VEC) has implemented 10 expressway projects with total length about 1000km. The ITS construction for these expressways will be also destroyed. The Table 2 shows this road line in detail

Table 2 Expressway project implementation

Expressway project implementation					
Name of project	**Length (km)**	**Funded by**	**Construction status**	**ITS system Funded by**	**ITS install-ation status**
Cau Gie – Ninh Binh	50	Government	Complete	Gove-ment	Under construction
HCM – Trung Luong	40	N/a	Complete	ODA Korea	Basic design
Hanoi – Hai Phong	105	Domestic (Vidifi)	Under construction	ODA Korea	Basic design
Hanoi – Thai Nguyen	62	JICA	Under construction	JICA	FS
HCM-Long Thanh – Dau Giay	55	ADB, JICA	Under construction	JICA	Bidding
Noi Bai – Lao Cai	264	ADB	Under construction	ODA Korea Keximbank	FS
Ben Luc – Long Thanh	45	ADB, JICA	Detail design	JICA	Basic Design
Da Nang – Quang Ngai	131	WB, JICA	Detail design	JICA	Basic Design
Hanoi – Lang Son	N/a	ADB	FS	ADB	FS
Phap Van – Cau Gie	30	Nexco	FS	Grand Aid, Govement	Approuve

Source: VEC [2012]

5. Basic advantages

5.1 Telecommunication and information infrastructure at good situation

Vietnam started the process of ITS infrastructure and superstructure planning and development at the time when telecommunication and information infrasture is in good development. There are three big domestic mobile operators now including: Viettel, Mobiphone, Vinaphone, which have already supplied 3G high-speed service. Other Internet service suppliers such as FPT, Megavnn..have their own optical cable networks and are ready to hire. Nowadays, Vietnam Post and Telecommunications Group (VNPT) is negotiating with VEC about benifit exchange. By this way, VNPT will use technical pipes along expressways developed by VEC for passing cables, and VEC will have right to use VNPT's cable cores for transfering ITS service in exchange. At this time, some agreements have been signed.

5.2 Preferential borrowing capital from financing agencies and investors

ITS projects which have been implementing in Vietnam, attract the interest and attention from domestic and overseas investors. Present expressway construction projects using capital from Japan International Cooperation Agency (JICA) and Asian Development Bank (ADB) will be supplied ODA by JICA for continuing ITS system building. Korean investors as Korea Eximbank or Korea International Cooperation Agency (KOICA) also participate actively into domestic projects. Besides, some other domestic investors as also take part in construction investing and exploiting for benefit. In October, 2011, JICA also put Grand Aid project of $7 million into ITS system building for Ring road 3 and first section of line Phap Van- Cau Gie. This project has been approved by Government and will be conducted by this year.

In conclusion, the capital resources for ITS are very exuberant, which is an advantage for ITS infrasture and superinfrasture architecture planning and building in Vietnam. Viet nam government must have reasonable borrowing policy for mobilizing and using efficiently capital and paying back

Table 3: Foreign Investment Trend in Vietnam by Years (unit: US$ million)

Item	2006	2007	2008	2009	2010
Number of New Investment	987	1,544	1,557	839	969
Amount of New Investment	7,838.9	18,718.4	66,499.9	16,345.4	17,229.6

Source: Ministry of Planning and Investment (MPI), Vietnam

6. Difficulties in ITS construction in Vietnam

6.1 Disgree about using communication technology in ETC in different projects

Now, a existing problem in ITS projects of Vietnam are disagreement about communication technolgy in Electric Toll Collecton (ETC) .

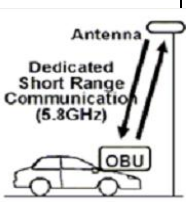
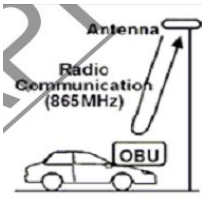
In some projects of ITS construction using Goverment capital (bond capital and other resources..), techonology used in Electric Toll Collection ETC is Radio-frequency Identification (RFID) technology 860 -960Mhz. For example : on the expressway Cau Gie- Ninh Binh, RFID is used.

In projects using ODA capital (JICA, ADB, WB,..), technology DSRC 5.8GHz is studied in using. For example, project Ho Chi Minh- Long thanh- Dau Giay, technology DSRC 5.8Ghz active is studied and encouraged to be used.

This leads to the necessity to study about system integration avoiding conflict when connecting national ITS network. However, for long time, it is neccesary to using only one kind of technology.

Basically, there are differenced between RFID & DSRC. DSRC is used in some countries as Japan, Korea because of their good telecommunication infrastructure. However in developed countries as America or India and Thailand, they still used RFID technology because it is suitable with their demand and infrasture.

Table 4: Compair between RFID & DSRC active

Name	RFID	DSRC active
Figure		
Detail name	Radio Frequency Identification	Dedicated Short-Range Communications
Frequency	2.4Ghz	5.8GHz
Data transfer	Up to 100 Kbit/s	6-27Mbps
Effect distance	Up to 10m	Up to 1000m
Vehicle equipment	RFID tag	OBU
Price	Cheap	Expensive
Payment possible	Credit card	debit card & credit card
Use countries	Thailand, American, India…	Japan, Korea…
Accuracy	Lower	Higher
International standard	Established	Established
Roadside equipment cost	Low	Low

Source: Dinh Van Hiep et al., 2012 [7]

Current difficultes is technology integration and priority technology selection for depelopment.

6.2 Difficulties in management, operation and using

Management and Operation

It requires to have highly educated technical teams in ITS management and operation. The education process need to be conducted in line with sytem construction. Nowadays, Vietnam does not have any experience in any ITS management and operation. Therefore, it is neccessary to have education program so that one technical team is ready for management and operaton right after the first complete system goes into activation.

Problems about users

To make use of benifit from ITS, users must have knowledge of terminal equipment and information access. Now, there is still limitaion in new technology access, drivers still get accquainted with old driving method. So, when using new teecjchnology, they are still at fault and need more time to use. Therefore, along with building, it is neccessary to propagate, educate and instructe operation to ensure effeciency in using.

Problems about investment phasing

Investment phasing is very neccessary to ensure the efficiency in investing and using capital. In Viet nam, it is important to consider following factors:

- Investment efficiency, reimbursability and payback period.
- Traffic demand in line. ITS services are only supplied if enough big traffic volume
- Users demand and efficiency

Table 5: Investment phasing alternative in Noi Bai – Lao Cai ITS project

Item	1st Phase		2nd Phase	3rd Phase	Total
	1-A	1-B			
VDS	2	67	55	124	248
CCTV	50	63	84	18	215
VMS	10	20	16	32	78
LCS	-	7	-	-	7
CSS	-	-	66	-	66
Weather Observation	-	-	4	-	4
Toll Collection System	One-stop 23Entrances 26 Exits Non-stop 2 Entrances 2 Exits		One-stop 14Entrances 16 Exits Non-stop 11Entrances 12 Exits	All Non-stop	One stop(2nd) 14Entrances 16 Exits Nonstop (2nd) 11Entrances 12 Exits

Source: F/S of ITS system for Noi Bai – Lao Cai Expressw ay, Ministry of Transport, 2012 [8]

7. Conclusion

With the current requirement of expressway network development for economic development, the key to ensure the efficiency of operation, exploitation and maintenance is to apply ITS.

Using ITS not only takes part in reducing negative effect caused by traffic but also raises the ability of exploitation and operation, leading to economic and social benefits. This is also a premise to build stable and frendly traffic system.

Besides advantages, there are some difficulties as aboved analysis, which creates obstacles for ITS application and development in traffic management and operation. Therefore, it is neccessary to educate human resources with high skill, and technology knowledge for system operation. It is also to phase investment stages for using effeciently. Besides, to unify standards used in national ITS infrasture can not be ignored to ensure the connectivity and continuation between systems.

One traffic system with high speed and effecient operation by modern ITS infrasture will be an unshakeable trafice system, a basis for ecomomic development/.

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