STUDIES ON SOME PROBLEMS MET IN DEVELOPING ELECTRONIC TOLL COLLECTION (ETC) SYSTEM IN CHINA

Liu, Weiming
Associate Professor
Traffic Control Dept.,
Changsha Communications University,
45 Chiling Road, Changsha,
Hunan, 410076   China
86-0731-5210306 or 5219058
Fax: 86-0731-5219108
E-mail: Lwmyxxjf@public.cs.hn.cn.

Wang, Baifu
Associate Professor
Traffic Control Dept.,
Changsha Communications University,
45 Chiling Road, Changsha,
Hunan, 410076   China
86-0731-5210306 or 5219058
Fax: 86-0731-5219108

Abstract: Some experiences have been accumulated since China began to import and at the same time to develop it's own electronic toll collection (ETC) system in 1994. The problems met in developing ETC in China are discussed in this paper, such as the standard of ETC, the compatibility of system, clearing accounts system of network, auto-classification of automobile and prevention of toll evade. The methods to deal with the above problems are discussed. By Comparing the ETC standards of USA, Europe and Japan, and at the same time considering the situation and the needs of ITS development in China. The ETC standard of Japan is considered more suitable for China. The weight limit classification should be changed to model classification. The laws and rules related should be drafted.

Key words: ETC, ITS, Toll, Computer.

1. CURRENT STATUS OF ETC IN CHINA

The time delay caused by passing through toll station includes slowing down, accelerating , waiting , and service time. Among them, the service time, especially operating and cash exchange time, is the key element. The derivative of service time in each lane is the traffic capacity of each lane, the sum of each lane's traffic capacity is the traffic capacity of the toll station.   The air pollution is mainly affected by slowing down, accelerating and idling. So, in the middle of 1990's, some provinces began to import or to develop Non-stop ETC to resolve the problem. Non-stop ETC is a kind of electronic auto toll collection system   which is being broadly developed by many countries, especially by developed countries.   Because of its highly automation, non-stop ETC system can greatly promote the traffic capacity, it's 4 times that of opened man cash exchange, 7 times that of closed man cash exchange toll collection. So, the Non-stop ETC system is the best

way to resolve the above problems.

A non-stop ETC system (read only) developed by TI C0.,USA was imported by Guangdong Foshan High Tech Co. in 1994, and its non-stop ETC software was developed. The system has being used in Foshan, Shunde and Hainan. Non-stop ETC system has begun to show its great advantages. In October 1996 China Highway Research Institute and Toyota Campany hold a Tech exchange meeting on ITS and non-stop ETC system. In the end of 1996, Amtech operated a three-month testing of non-stop ETC system on Beijing airport expressway. At the same time, many similar tests were operated by such as Guangzhou North Loop Expressway Co., Guang-Fo Expressway Co., Hu-Ning Expressway Co. and Shanghai Tunnel Co.. Now, most of the provinces are very interested in non-stop ETC system. Meanwhile, Non-stop ETC technologies are being used in other fields, for example, Premid's non-stop ETC technology was adopted by Modern Auto system Co. in Jiulong customs Shenzhen to resolve vehicle auto classification.

The operating and testing of Non-stop ETC showed that it is safe, reliable, stable and accurate. However, we have to face the fact in China that different (incompatible) Non-stop ETC system installed by different company, lead to sacrifice its compatibility, one of the main advantages of Non-stop ETC by which "One card passing" system can be realized. Now, this problem has been noticed by the Ministry of Communications′ and some local governments. Some research projects are being launched to resolve the problem.

Followings are discussions on some problems met in developing Non-stop ETC system in China.

2. THE CHARACTERISTICS OF NON-STOP ETC SYSTEM

2.1 Definition and its components

Non-stop ETC system is a kind of technology, by which techniques of electronics, computer and communications are used to carry out toll collection in Non-stop situation to relieve the queuing up caused by toll collection, so as to avoid time delay and to reduce operation cost of toll road. After a electronic tag is in stalled in the vehicle of user,   toll collection can be finished by one of the following ways: to deduct the fee directly from the tag, or to deduct the fee from the computer in toll station according to the data received from the tag, or to deduct the fee from the tag after treating the data given by the tag. Perfect Non-stop ETC system should include cheating prevention assistant systems, such as vehicle detector, vehicle auto classification, camera equipment and remaining sum caution, so as to achieve auto toll collection and to prevent toll evade.

2.2 The Main Advantages of ETC System

■   Can avoid traffic jam, so as to raise the efficiency of toll collection.
■   Can greatly cut the operating cost (both publicly and personally), and can also effectively prevent corruption from happening.
■   It's good for safety driving. Because no need to slow down and to accelerate, and no need to carry too much money for cash exchange.

■   Can greatly reduce land use, which is especially good for toll stations in cities.

■   Can reduce fuel consumption and air pollution.

■   Can realize crowded extra fee collection, so as to control traffic requirement.

■   Can easily get traffic information and realize on-line O-D estimation. And it can also be used in other auto toll collection.

2.3 The Main Principles and Requirements in Designing Non-stop ETC   System

■   Reliable

It must be reliable at any conditions (including any weather conditions)

■   Safe

It must be highly safe, and can prevent corruption and toll evades from happening.

■   Customers friendly

It must be easy for customers to use, to buy vehicle electronic tag, to get information, to prepaid or postpaid, to know his or her account, etc.

■   Compatible

It must be compatible with neighbor non-stop ETC system (at least in certain area). Can be used in other ITS.

■   Economic

It must be economic, especially the vehicle electronic tag should be cheap.

■   Respect private right

It should prevent the operator from accessing any customer's private information.

3. THE PROBLEMS SHOULD BE RESOLVED IN DEVELOPING NON-STOP ETC SYSTEM IN CHINA AND THE WAYS TO COPE WITH

3.1.The compatibility of non-stop ETC system

In order to get beneficial results, Non-stop ETC system needs great number of customers. To achieve this goal, it's necessary to build a lot of Non-stop ETC stations, and to make them compatible   with each other, and if it is possible to let them become a network in one district or in inter-district or even more in inter-province, so as to realize "one card in one district" or "one card in one province" or "one card in China". Otherwise, the troubles brought about by using different electronic tag will overwhelming the conveniences given by using non-stop ETC system.

Compatibility is an ability to build up a common data network based on different non-stop ETC system in which the basic equipment are independent, the up-grade data can be shared with each other. The basic requirement to utilize this one is that same or compatible electronic tag be used, the information (such as entry and exit gate, vehicle model etc.) can be written down and be transmitted to management center and be stored in vehicle electronic tag . The necessary data can be easily sent from management center to district center.

To get compatibility, it's necessary for the short distance communication (DSRC) between the

vehicle electronic tag and the lane microwave antenna to use same standard. All information related to toll collection should be commonly coded to let it easy to separate account commonly. A toll collection computer wide-area network and a clearing center accepted by different toll road should be set to take the responsibility of toll management and account clearing in all district. The clearing center should be connected with the bank pointed to finish the account clearing.

Considering the distribution of wireless frequency in China, disturb resistance of DSRC, reliability and needs for ITS. We think Japanese DSRC standard more suitable for China, and should be recommended in China.

Because of the policy of "The one who invests gets the benefit", the right of management belongs to the investor (generally for 30 years). So, they will consequently consider their own ETC system and its operating model from their own needs. As we know, the problems met in non-stop ETC can not be resolved by only one toll road manager. It should be considered by all toll road managers and related organizations. And, It's also related to the public attitude. So, to realize "One card passing", "The government action" is needed. The planing and standard of Non-stop ETC system should be drafted under the auspices of related government, laws and rules should be drafted to coordinate the building of non-stop ETC system in different places, so as to finish non-stop ETC building under the related laws and rules. In district where the non-stop ETC system is needed, it's necessary from the government's point of view to plan scientifically and to organize experts to make feasible research and to work out planing report. It must be avoided that to develop "One card passing" by the time when many different non-stop ETC systems have been set up.

It's necessary to let the managers and customers know that the district non-stop ETC system is good not only for the district economic development, but also good for themselves. Independence, reliability, reasonableness and safety should be assured in terms of administration, technology and operating rules to dispel their misgivings.

3.2. Selection of electronic tag and distribution of IC card

There are many sub toll collection systems in one district Non-stop ETC system. Some of them are opened toll collection, such as that in bridge and tunnel. Some of them are mileage toll collection, such as that in expressway. Some of them open special non-stop lane in traditional toll station. Some of them have not traditional toll station, and can realize multi-lane non-stop toll collection. And, some of them are prepaid or postpaid. Electronic tag should have the ability to write down the route of vehicle to assure reasonableness, so the electronic tag should be read-write type, and can be used in special lane or multiple-lane.

It's possible in China that there are more than two persons to use a same car. In order to assure toll collection is to person not to car, and assure the safety of the card, the electronic tag should have two pieces. The IC card should have multiple usage, be used by touched or untouched way in parking, subway, public transportation, telephone, and should have the function of electronic wallet and ID. So, the IC card should be distributed jointly by bank and non-stop ETC management center. Only by this way, can the users of non-stop ETC system be increased, the rights of users be assured,

and the toll evaders be fined.

3.3. Auto classification of vehicles

To assure the reasonableness of toll collection, the vehicles must be classified. In China now, the classification of vehicles is based on weight limit (or the number of sets). It is obviously impossible to determine the weight limit and the number of sets directly. But it's not so difficult to determine the outline parameters. The problem is that there is no direct relation between weight limit (and number of sets) and outline parameters (the classification accuracy should be more than 99.95%). So it becomes the first important thing to draft national classification standard on vehicle outline.

3.4. Prevention of toll evade

Non-stop ETC system permits vehicle to pass through toll station without stop. There will be some vehicles intentionally or unintentionally to evade toll collection. So there should be some ways to prevent the toll evade from happening and to fine the toll evaders. The most popular one is to identify the evade car and stop it. it's easy by this way to cause accident and at same time to reduce traffic capacity. Some time video camera tape are taken, the car number is written down (some time the picture of driver is also taken down), the operator can stop the car, or by mailing fine bill to the evaders. By stopping the evade car, the fine can be gotten surely, but it's dangerous. By mailing fine bill, a data network is needed for the manager to get vehicle registration information. Otherwise, it's possible for the manager to get a small fine by spending much more money. There is a database in one city or county, but there is no such a database in one province now in China. Most of the drivers in China have not set their own account. In addition, China is a very big country. It seems difficult to fine evaders by mailing fine bill at the moment.

3.5. Mixed toll ways

There are always some vehicles that pass through toll stations occasionally, or pay in cash.. So it's inevitable to face the fact that it's necessary to keep some cash toll collection lanes even when non-stop ETC systems have become very popular. So, in designing mixed way toll station, the number of lanes for non-stop toll collection must be carefully calculated, so as to get the highest efficiency.

3.6. Testing and assessment of system

There are many kinds of Non-stop ETC systems in terms of standards, conditions in which they can be used. Before importing or developing any non-stop ETC, the standards, requirements, maturity and market must be considered respectively, and test as well as assessment must be taken, so as to get the most suitable Non-stop ETC system for the users. Generally, test should be taken in fields of function, reliability, manipulation, disturb resistance, weather resistance, extreme situation, data save and protection of private right, while assessment should be taken in fields of service quality, economy, technique feasibility, social and environmental influence etc.

3.7. Related laws and rules

Building and using of Non-stop ETC systems based on perfect laws and rules, and it is related to many aspects of society. So there are many works need to be done by government in this field.

4. CONCLUSION

China is just being in a great development period of expressway. The network of expressway is being set up. The number of toll station is increasing. With the development of economy, traffic flow increases rapidly. Some of the toll station, especially that in cities, become more and more crowded. It has become one of the most important things in Chinese transportation to resolve the toll collection jam and air pollution caused by stop toll collection.

To raise passing efficiency, shorten service time, and build up Non-stop ETC systems are all feasible ways. But non-stop ETC system is the best way. District non-stop ETC system is a large system. Many problems will be faced. In 1999, a small district Non-stop ETC system is going to be set up in China. It is estimated that in the next several years, one district or one province non-stop ETC system will be developed in China. China is going to embrace a new era of electronic toll collection

REFERENCE

Liu, Weiming(1999) "The theory and method of expressway toll collection system",   People's transportation publishing house, Bejing,China