

*intelligent transport systems,
electronic fee collection,
positioning systems*

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ELECTRONICS FEE COLLECTION AND ITS APPLICATION IN THE SLOVAK REPUBLIC

Electronics Fee Collection (EFC) is among priority elements of transport telematics. According to categorization of basic services of ITS (Intelligent Transport Systems) defined by European project KAREN, EFC is the part of financial services and transport control groups, emergency, and demand which is one of the main services in wide portfolio of IDS users needs. Fee collection is a typical transport service highly dependent on identification of vehicle type and position. In my contribution I would like to concentrate on transport performance payments.

ZASTOSOWANIE ITS I ELEKTRONICZNEGO POBIERANIA OPŁAT W REPUBLICIE SŁOWACKIEJ

Elektroniczne pobieranie opłat (EFC) należy do priorytetowych elementów telematiki transportu. Zgodnie z kategoryzacją podstawowych usług ITS (inteligentne systemy transportu) zdefiniowaną w europejskim projekcie KAREN, EFC jest jednym z narzędzi finansowych wykorzystywanych w kontroli transportu, stanach awaryjnych i wymaganiach, oraz stanowi jedną z głównych usług w szerokim katalogu potrzeb użytkowników IDS. Pobieranie opłat jest typową usługą transportową w wysokim stopniu uzależnioną od identyfikacji typu i pozycji pojazdu. W referacie skoncentrowano się na płatnościach za realizację usługi transportowej.

1. INTRODUCTION

These systems have been used for a long time in abroad for transport performance payments, where road usage for selected vehicle categories is paid. EFC is not only the source of fair incomes, where performance is paid, but it is also efficient regulator because it is possible to make use of progressive payments which can be raised multiply if driver goes to the town centre and does not use means of public transport. It is also supposed that transits through certain road parts (e.g. tunnels) will be paid. In my contribution I would like to concentrate on transport performance payments.

Electronic fee collection for road using is a medium for fair payments according to distance travelled regarding external costs caused by vehicle operation (air pollution,

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accidents, climatic changes, noise and vibrations, influence on environment, etc.). That is to say that users pay precisely for what they cause.

Electronic fee collection is being introduced to simplify vehicle clearance and it influences traffic restrictions in town centres. Important condition for providers is to keep compatibility and advantages for using one card for more services. Another advantage of EFC is the possibility of traffic situation monitoring in particular region and according to the data make public transport schedules, affect transport organization, make fare etc.

According to physical realization subsystem can be divided into: [3]

- ✓ road fee collection,
 - entrance fee which can be e.g. in town centres or particular zones,
 - transport performance payments which are derived from the distance and are often combined with vehicle category (passenger, lorry above 3,5t etc.), can be realized by DRSC and GPS/GSM systém,
- ✓ parking fee,
- ✓ public transport fares.

2. TECHNOLOGY OF EFC SYSTEMS

Nowadays we know possibilities of EFC systems as follows: [3, 4, 5]

- ✓ DSRC (Dedicated Short Range Communication) enables transmission between RSE (Road Side Equipment) and OBU (On Board Unit) in the vehicle. Communication is realized in microwave or infrared bands,
- ✓ GSM-GPS (Global System for Mobile Communication/Global Positioning System), for positioning and distance driven GPS System is used, for transmission into centre GSM technology can be used if necessary,
- ✓ LSVA (Swiss system), technology is based on intelligent OBU, which reads distance from electronic tachometer and can use distance correction from GPS.

2.1 DSCR (DEDICATED SHORT RANGE COMMUNICATION)

DSCR (Dedicated Short Range Communication) is technology based on radio communication in 5,8GHz band. This frequency range is completely reserved for telematic applications. Regarding the amount of data transmitted (cca 500 kbit/s) this device is perspective also for large amount of data transmission when passing stationary device placed by road communication. Nowadays, this technology is being used for electronic toll collection but it is perspective also in following fields:

- ✓ vehicle communication with intelligent road signs or variable signs,
- ✓ priority of public transport vehicles at traffic lights,
- ✓ transmission of road transport information into means of public transport,
- ✓ selective transport information service.

Operation is usually based on existence of three physical gates:

- ◆ The first gate contains device for detection of incoming vehicle. Vehicles are classified according to size here too.
- ◆ The second gate provides transaction between communication RSE unit and OBU. If a vehicle equipped with OBU unit enters monitored area, communication between RSE and OBU is realized. In the meantime fee collection checking must be done very quickly before the vehicle reaches the third gate.
- ◆ Third gate checks if the electronic transaction has been successful. It is very easy to use OBU on the base of DSRC from the point of view of both user and installation. Managing alternative way of fee collection will determine complexity of the system from user point of view. According to European regulations it is necessary to provide this possibility for fee collection systems that are being built.

2.2 GSM-GPS (GLOBAL SYSTEM FOR MOBILE COMMUNICATION/ GLOBAL POSITIONING SYSTEM)

Unlike DSRC system which works with real infrastructure made by gates along the road, GPS works with virtual toll gates. These are created and stored in OBU and if vehicle drives through this road area which is identified by GPS, OBU records time of driving in and other data if necessary. Satellite navigation is limited in densely built up areas and in tunnels. Nowadays accuracy is +/- 30m. Fees are collected at virtual gates. Their function is the same as the one of physical gates but they are stored only in programmed charts in OBU. If vehicle passes this virtual point, transaction is realized. It can be realized by either GPS transmission of the information or by recording this data on chip card and processed afterwards.

Function principle can be described as follows:

- ✓ vehicle detection is realized by satellite navigation via at least 4 out of 24 satellites
- ✓ whenever passing along toll collection device, OBU either shows particular fare and takes the sum off from electronic card or the system records vehicle move monthly,
- ✓ transaction can be realized via GPS lines and with delay time needed for information transmission.

Surveillance system is not in general different from DSRC system surveillance

3. EFC TECHNOLOGIES COMPARISON

In case of building EFC based on DSRC, main financial demands are in building infrastructure along toll roads. If we want passenger vehicles (e.g. business/company cars) to pay toll, financial demands rise steeply (for expensive OBU) and DSRC technology is much more advantageous. If we approach to these problems as cautious investors we won't make the possibility of EFC application for all vehicle categories impossible because, according to calculations, company cars can be one of most significant financial sources.

DSRC technology is nowadays profiled in Europe like this: (existing system based on DSRC or system in construction): Austria, Denmark, Sweden, France, Norway, Italy, Slovenia, Spain, Portugal, Greece, Great Britain.

Mentioned technologies are compared in chart 1. [1,2,3]

Table1

DSRC – chart with technologies based on GPS/ GSM/ DSRC

Parameter	GSM/GPS	DSRC
Price of infrastructure depends on number of toll gates:	needed collection gates	for each toll sector, expensive infrastructure
On board equipment price:	high-cca 18.000,-SK	low-cca 1.500,-SK
Equipment installation:	inevitable intervention into vehicle electrical distribution	only on windscreen without any intervention
Standardization	in preparation	yes, TC278/WG1
Applications:	nowadays in no operation	worldwide, widely spread in Europe
Fee collection control:	very bad – in check points via DSRC only and by police mobile device	excellent – in many sectors of road network
Production norms:	don't exist	binding European norms with CEN standards nearly finished
Selection of several contractors:	when having been chosen, the contractor is exclusive during all existence of the system	possibility of choosing technology provider even in further operation
System reliability:	full dependency on GPS (will be eliminated by Galileo)	highly reliable system
Driver protection:	continuous surveillance	short distance surveillance
Receipts demands for system operation	20 %	8 %

Germany : EFC system will be limited to lorries above 12t has been brought into operation this year.

Federal government follows four aims by introducing toll for heavy lorries:

1. heavy lorries affect road quality and that is why they will participate more in financing the infrastructure,
2. by introducing toll there will be equal competition position of road, railroad and waterborne transport,
3. toll will bring further income for road building
4. Germany will become a pioneer in this field by introducing automatic toll collection system which will bring new vacancies and business possibilities.

Since 2004 toll will be collected according to the distance. All vehicles above 3,5t will have to pay toll on motorways and speedways. Fee collection will be via DSRC technology. Nowadays there are 6 additional toll sectors in Austria where toll is collected although toll road labels are used (tunnels and bridges in the Alps). When EFC system is in operation these sectors will become part of the whole motorway network.

The Czech Republic : Czech Ministry of Transport is preparing amendment of road communications law which will set general rules for toll collection and make possible paying toll in a different way from toll road label. If it is supported by the government and passed by parliament it should come into effect at the beginning of 2004.

The Slovak Republic: Aim of ITS building under Slovak conditions is to define responsibility rules when providing services connected with transport. Selected technology should meet compatibility of neighbouring countries in European territory. That is why state's aim is to integrate ITS into transport policy and to declare architecture of ITS and national uniqueness. Regarding this, all transport services need open architecture development especially for variety of technologies used by transport.

Nowadays Slovakia uses the same system of toll collection as in the Czech Republic (toll road labels). But EFC is being prepared which should be in operation in 2007. Preparations are carried out in the form of studies. EFC will be limited to vehicles above 12t, others will go on using labels.

4. CONCLUSION

Effort of European Commission is to support member countries to introduce standardized fee collection systems. That is why law regulations for their introduction have been prepared. But it is still possible to find enough space between these boundaries to create different systems. By comparing different systems introduced in Germany and Austria we get following comparison:

- ✓ German system is focused on vehicles above 12t, Austrian above 3,5t
- ✓ For the time being Germany is not considering any tax reduction connected with fee collection, Austria will change present state. German haulage companies are rather upset about their further existence.
- ✓ On the other hand Austrian conveyers are afraid of higher fees. They should be 0,10 – 0,17 EUR/km in Germany and 0,13 – 0,27 EUR/km in Austria. But in both countries this fees are derived from real costs for road network.
- ✓ To finish it off it is necessary to add that both systems have different technical solutions.

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