

Towards Interoperability of the Electronic Road Toll Systems in the European Union. Case of Poland

Elżbieta Załoga¹, Sylwia Kowalska¹

¹Faculty of Management and Economics of Services, University of Szczecin, Poland

Abstract The road toll is a significant tool of transport politics due to its economic and social characteristics. Both of those fields search for integrity in activities for a balanced transport. While the road toll is an attempt of the country for internalisation of external transportation costs, the method of collecting the toll is a factor of improvement of public roads. The electronic road toll system (EETS) fulfils those purposes, under the condition of interoperability. The article describes the functionality of the road toll, its meaning for the internalisation of external costs, the interoperability of systems which collect road tolls in EU, and the results of incorporation of the electronic road toll systems in Poland. Subject literature, EU law regulations and institutional data were used in the elaboration.

Keywords road toll, interoperability, electronic road toll

JEL R42, R48

1. Introduction

The road toll system is nowadays considered as an effective tool for limiting negative effects of industrial and social acceptance for car transportation. Road tolls originated as a tool for securing the means for construction and maintenance of the transport infrastructure. As K. Button observes [13], among the three economical functions – allocative, informative, and profitable – road tolls serve mostly as a tool for the last of the mentioned functions. However, the dynamic development of car transportation forces changes in the attitudes towards road tolls. Nobel-prize winner R. Coase stated that [13], policies such as road pricing are not market solutions, but the most effective way of achieving an externally determined target traffic flow. In result, the road tolls are currently used for achieving wider goals of transportation politics such as change of behaviour on transport users, optimisation of infrastructure usage, limitation of natural resources usage, reduction of external costs, and prevention of congestion. The need for internalisation of the external costs generated by the car transport is a great justification for expansion of the road toll systems across EU and for improvement of means of tax collection.

The internalisation of external costs is a tool used to induce transformation on the market branches connected with transport services, to change the level of demand, and to set up the profiles of mobility [8]. As a political goal, it is included in the so called transport pricing, being a part of the entirety of subjects concerning the establishment of prices in transportation. While the rates of transport services are dictated by free market rules (with exclusion of public

transport), the external effects of transport distort those rules. Therefore, the issue of transport pricing is considered as a need to equalise the competitiveness outside and inside of the branch and the influence of the external effects of transport. The tolls for exploitation of transport infrastructure are the essence of the transport pricing.

Considering internalisation as a tool of transport politics it is possible to indicate many favourable results for roads users and for society. Beside the general aim to lower the environmental inconvenience of transport, it is believed that the empowerment of external costs will bring the following results [8]:

- reduction of traffic in most congested roads, mostly in city centres,
- increase of movement speed,
- lowering of accident rates,
- branch displacements in transport,
- rise of attractiveness (mainly in prices) of public transportation in view of the need to commute.

When it comes to the selection of internalisation tools, the clear vision was presented by J.E. Stiglitz [12], who stated that economists endorse solutions connected with the market mechanisms, while governments support direct regulations since they provide higher certainty of results.

The sustainable development strategy of transport utilises three rules of charging transport users: polluter pays, user pays and full costs recovery. Those rules allow conducting the right postulates, among others, providing a direct connection between the access to common resources and payment for them, to ensure better usage of the available resources, to eliminate the distortions in competitiveness, to

reduce external costs and to acquire means for modernisation of the sector [1].

The aim of this article is to emphasise the meaning of interoperability of the toll collection systems in EU for realisation of the goals of the EU transportation politics. The theoretical layer of the article is based on Polish and foreign literature on the subject. In the pragmatic part the diversity of the electronic road toll systems in EU and the law regulations for interoperability of those systems have been described. The empirical data concerns the effects of introduction of the electronic road toll system in Poland.

2. Interoperability of road toll systems

Lack of interoperability of road toll systems in the European Union is a significant problem for the users of roads, and for those who manage them. Interoperability is defined as ‘a characteristic of a product or system, responsible for ability of different systems to cooperate’. This term can be understood as interoperability in the context of technical systems, or more broadly, as a cooperation of systems with social, political and organisational significance. The Polish regulation of 2012 concerning the National Interoperability Framework [13] determines the methods of achieving interoperability in frames of three activities: unification (by utilisation of compatible standards and procedures), interchangeability (by ability to replace the product, process or service), and conformity (suitability of products or services, fulfilling determined conditions).

Interoperability in reference to the electronic road toll systems is an act happening on two levels: national and international. The first one concerns the integration of national road toll systems with systems of concession sections of the roads. The second, international, is connected with higher level of complexity in view of many factors. Nevertheless, interoperability is possible by incorporation of external on-board units, which will provide the ability to exchange information between different systems.

The European Electronic Toll Service (EETS) is a response to the need for interoperability of the electronic road toll system. This system allows for use of electronic road toll on the areas of EETS, by using one on-board unit (OBU), one user account in the system and one contract with the provider of the service [6]. The service involves: a) providing the users with OBU device, adjusted to their needs and its maintenance; b) guaranteeing that the subject collecting the toll will receive the tolls charged from the users; c) sharing the methods of payment with the users, or accepting the existing method; d) collecting fees from the users; e) managing consumer relations with the users; and f) implementing and complying with strategies of data security and protection in systems of electronic road tolls [6].

The issue of the interoperability of road toll systems is an important area of many scientists’ research. This subject has been studied (among others) by Mertner and Skov [11] in the context of harmonisation and standardisation of the

road toll systems in three fields: technical-procedural, operational and institutional. The interoperability of the road toll systems was also studied by Hamilton and Eliasson [3], who indicated harmonisation or adaptation as a method of achieving interoperability. The subject of implementation of the European electronic road toll was described in elaboration of Van Haaften, Van Engers [21] and Maes [22]. Analyses of road tolls were included in Polish literature in works of Siergiejczyk, Rosiński [15], Muślewski, Lewalski, Skibicki, Bojar [14] and Lewandowski [18]. The economic and technical aspects of interoperability in accordance to the implemented EETS were described in the elaborations of Nowacki, Mitraszewska, Kamiński, Potapczuk, Kallweit [10].

3. Regulations for interoperability of electronic road toll systems

Since the 90s, electronic systems of road tolls have been implemented on local and national levels. Lack of cooperation on international level caused them to be not interoperable. It leads to the generation of additional costs, and creation of obstacles for the users of roads, which are obliged to buy and assemble different OBU devices in their vehicles, in order to make collection of the road toll in different European systems possible.

Directive 2004/52/WE of 29 April 2004 [7], concerning the interoperability of the electronic road toll systems in the European Union, was the first attempt to harmonise the systems. The directive established conditions for ensuring the interoperability of electronic road toll systems, narrowed the range of utilised technologies to DSRC (dedicated short range communications), mobile network (GSM) and satellite localisation (GPS). It also established the conditions for implementation of the European electronic road toll.

The Decision of the European Committee 2009/750/WE of 6 November 2009 [5] defined the European service of road toll (EETS). It was incorporated into the national legal order [3] as a service, that allows the users of roads in the European Union to fulfil the duty of payment for using the roads on which the tolls are being collected (with use of electronic road toll system), on the bases of the contract with the EETS provider.

The most recent regulation of the European Union in the elaborated subject is a Directive of the European Parliament and of the Council (2019/520) of 19 March 2019 [6] on interoperability of electronic road toll systems and facilitating the cross-border exchange of information on the failure to pay road fees in the Union. It is applicable only to the road toll systems based on travelled distance, charged after passing the particular point. It does not concern fees connected with time of use (vignettes) and parking fees. The important goal of this regulation is to simplify recovery of failed payments, by introduction of a new system of data exchange.

4. European road toll systems

The road toll as defined by the EU regulation [5] refers to a fee that should be paid by the road user for use of the given road, road network, object (such as a bridge or a tunnel) or a ferry. In fact, the charge is based on the distance (distance-based charges), time (time based charges) or on the particular point (cordon fee). In example, truck users in EU meet the following forms of road tolls:

- euro vignettes, vignettes (time-based fees),
- passing fees (depends on the distance and the type of vehicle),
- fees for crossing bridges and tunnels,
- fees for entering cities,
- fees for entering low emission zones.

In existing road toll systems utilised in the EU member states, the most common is the electric road toll system with a high level of diversification (Table 1).

Table 1. Road toll systems in EU member states, for trucks

Road toll system	Utilised technology	Country
Free-flow	GNSS with ARTR or DSRC	Hungary, Slovakia, Belgium
Free-flow	GNSS with infrared mode or DSRC	Germany
Free-flow	DSRC	Austria, Czech Republic, Poland, Portugal, Great Britain (Dartford Crossing)
Free-flow	ARTR	Great Britain (Dartford Crossing)
Free-flow	ARTR and DSRC with use of on board devices	Portugal (A22, ..., A25)
Network of fee collection points	DSRC	Croatia, France, Greece, Ireland, Italy, Poland, Portugal, Spain, Great Britain
Vignette	Electronic euro vignette	Denmark, Luxembourg, Holland, Sweden
Vignette	Electronic euro vignette	Great Britain, Latvia
Vignette	sticker	Bulgaria, Lithuania, Romania

The most common technology is that of dedicated short range communication, based on two directional communication between the fixed devices on the side of the road and the on-board devices. Devices on the side of the road have to identify the user of the road (and his vehicle) in order to charge the fee. In Bulgaria, Lithuania and in Romania tradi-

tional vignettes in the form of a window sticker are used [15]. This technology is also used in the Polish system of electronic road toll. The new Polish system should be based on the satellite communication, but currently it is allowed to use the mobile connection system, based on the GSM-GPRS standard and on radio waves [2].

EETS should work in three technologies mentioned above. The service is offered by the provider, who is a legal entity providing the EETS user with access to the service. The user can choose services of any provider, regardless of his nationality, place of registration and place of vehicle registration. In the European Union the following providers of EETS service have already been registered:

- Czech Republic: Eurowag
- France: Axess SAAS, Eurotoll, Total Marketing Services S.A.;
- Germany: AGES EETS GmbH;
- Italy: Telepass S.A.;
- Poland: Telepass S.A.

In Poland, the section of the motorway A4 from Katowice to Balice (around 60km) is covered with EETS, which is a little percentage of roads on which the toll is charged. The payment is charged by the General Inspectorate of Road Transport, who has been managing the electronic road toll system since November 3, 2018. The electronic toll constitutes income for the National Road Fund.

5. Electronic road toll system in Poland

The Polish electronic road toll system – ViaTOLL - was introduced in Poland on July 2011. It was created by Austrian group Kapch Telematic Services Ltd. In the first phase, there were 1565 km of national roads, expressways and motorways which the General Director for National Roads and Motorways covered with the toll obligation. Currently (April 2019), the length of paid roads equals around 3660 km, of which 1080 km are motorways, 1275 are expressways and 1155 km are highways (Figure 1).

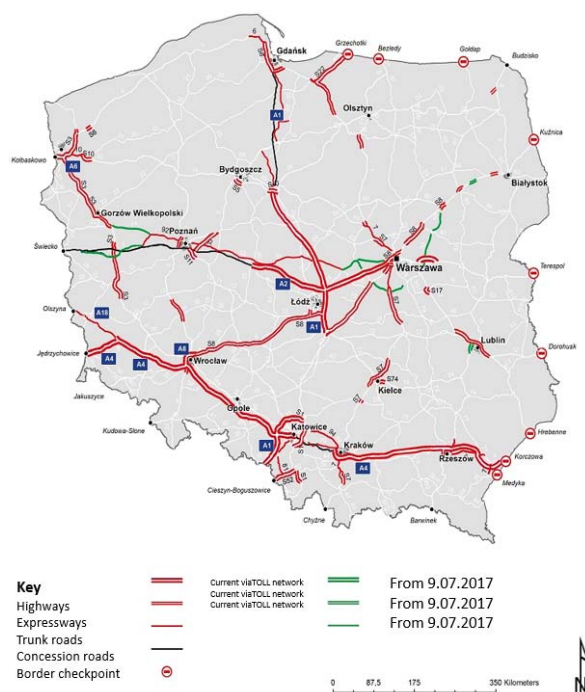


Figure 1. Map of the toll road network in Poland.

One of the functions of road tolls, which is dependable on the level of interoperability of electronic road toll systems, is to provide financial income to the country budget and internalise external transport costs.

Income from road toll goes to the National Road Fund (KFD – Krajowy Fundusz Drogowy), which supports road investments in Poland. The National Road Fund was established on the grounds of the Act of 27 October 1994, on Toll Motorways and the National Road Fund [3]. The main goal of the Fund is to bring together the asset which can be used for construction and reconstruction of the road infrastructure, and to cover expenses connected with payments for the operators of toll motorways as well as for the creation and exploitation of road in toll systems. Management of the Fund means is presented Figure 2.

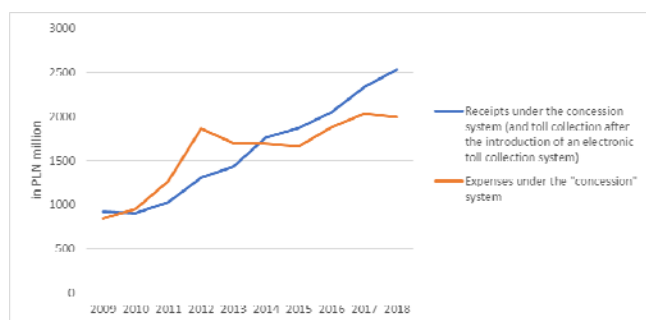


Figure 2. Amount of receipts and expenses to KFD during 2009-2018 for the maintenance of road toll systems in Poland

In 2009, income to the Fund for the maintenance of the concession system amounted to PLN 922 million and that amount doubled in 2016 (PLN 2047.6 million). The biggest increase in revenue can be seen between 2011 and 2012. During this period, exactly on July 1, 2011, the electronic road toll system was introduced. At the same time the expenses on the road toll system had been increasing up to 2012, because the electronic road toll system was being constructed at that time. Since 2014, income from the road toll system in Poland has been bigger than the expenses on the system's maintenance.

The responsibility for the electronic road toll system lies on the General Inspectorate of Road Transport. It is planned to create the National Electronic Toll System, with priorities on the public side such as:

- the system should be based on the latest global solutions, with utilisation of GNSS technology, data transmission in mobile systems (LTE/5G) and Big Data,
- the system should be open for new functionalities, by expansion with use of new modules,
- the system should contain sensitive data within the area of Poland, and should grant supervisory services with access to that data without mediation of private companies,
- the system will use the existing road toll infrastructure,
- the system will cooperate with other road toll systems in the European Union.

The new system ought to cooperate with other toll systems utilised in the European Union.

Currently in Poland there is one section on the A4 motorway, with a length of 61 km, on which the EETS service is available. The concessionaire has made an agreement with the Italian provider Telepass, resulting in the possibility to use the toll section with the use of devices provided by the EETS provider.

6. Conclusions

The effectiveness and usefulness of road toll systems is a complex issue due to the profitable and allocative function of those fees. The discussion on road pricing has a long story. Despite the common attitude to the issue expressed by EU transport politics, according to studies in UE, road pricing still has national characteristics. Creation of a framework for the interoperability of electronic road toll systems is an appropriate step towards making easier use of toll roads and countering the rising congestion. It also serves for the fiscal goals of the member states. However, it does not solve the general problem of internalisation of external expenses on car transport. A valuable indication for further work on the issue is to adopt the dynamic pricing rule, which allows to maximise the attractiveness of the road network to users.

ACKNOWLEDGEMENTS

The project is financed within the framework of the program of the Minister of Science and Higher Education under the name "Regional Excellence Initiative" in the years 2019 - 2022; project number 001/RID/2018/19; the amount of financing PLN 10,684,000.00.

REFERENCES

- [1] A..S. Grzelakowski, M. Matczak, „Współczesne porty morskie. Funkcjonowanie i rozwój”, Akademia Morska w Gdyni, Gdynia 2012.
- [2] Act of 13 May 2016 amending the Act on Public Roads, the Act on Toll Motorways and the National Road Fund.
- [3] Act of 27 October 1994, on Toll Motorways and the National Road Fund.
- [4] C., J., Hamilton, J. Eliasson, “Costs and benefits of the European directive on road tolling interoperability”, *Transportation Research Part C Emerging Technologies* 30, pp. 221–238, May 2013.
- [5] Commission Decision of 6 October 2009 on the definition of the European Electronic Toll Service and its technical elements (2009/750/EC).
- [6] Directive (EU) 2019/520 of the European Parliament and of the Council of 19 March 2019 on the interoperability of electronic road toll systems and facilitating cross-border exchange of information on the failure to pay road fees in the Union.
- [7] Directive 2004/52/EC of the European Parliament and of the Council of 29 April 2004 on the interoperability of electronic road toll systems in the Community.
- [8] E. Załoga, „Trendy w transporcie lądowym Unii Europejskiej”, Szczecin: Wydawnictwo Naukowe Uniwersytetu Szczecińskiego, 2013.
- [9] Encyklopedia zagadnień międzynarodowych, pod red. E. Cała-Wacinkiewicz, R. Podgórska, D. Wacinkiewicz, Wydawnictwo C. H. Beck, Warszawa 2011.
- [10] G. Nowacki, I. Mitraszewska, T. Kamiński, W. Potapczuk, T. Kallweit, “Some interoperability problems of European electronic tolling service”, *Logitrans VII Konferencja* of 12 April 2012 on the National Interoperability Framework, minimum requirements for public registers and information exchange in electronic form and minimum requirements for ICT systems (Dz.U. 2012 poz. 526).
- [21] Reports of Bank Gospodarstwa Krajowego, Available on the Internet: <https://www.bgk.pl/o-banku/bank-w-liczbach/> (access: 27.04.2019).
- [22] W. F. Van Haaften., T.M. Van Engers, “EETS: How to get it on the road”, 9th ITS European Congress 2013. Available on the Internet: https://pure.uva.nl/ws/files/1956716/137320_20130114_20nota_20EETS_vanHaaftenvanEngers_University_20of_20Amsterdam.pdf.
- [23] W. Maes, „European interoperability and the EETS: An update”, 2007 IET Seminar on Road Pricing, 2007. Available on the: <https://ieeexplore.ieee.org/document/4238617>.
- [24] www.viatoll.pl.
- naukowo-techniczna, 2010. Available on the Internet: <https://www.logistyka.net.pl/bank-wiedzy/transport-i-spedycja/item/83233-some-interoperability-problems-of-european-electronic-tolling-service?tmpl=component&text=1>.
- [11] J. Mertner, M. K. Skov, “Harmonisation and interoperability of national tolling schemes”, *Research in Transportation Economics*, no. 11, pp. 133-151, 2005.
- [12] J.E. Stiglitz, „Ekonomia sektora publicznego”, Wydawnictwo Naukowe PWN, Warszawa 2013.
- [13] K. Button, „Transport economics”, Edward Elgar Publishing, 2010.
- [14] Ł. Muślewski, M. Lewalski, A. Skibicki, P. Bojar, „Analiza i ocena zastosowania wybranych systemów telematycznych”, *Logistyka*, no. 3, pp. 4531-4539, 2014.
- [15] M. Siergiejczyk, A. Rosiński, “Analiza automatycznych systemów poboru opłat na drogach płatnych”, *Prace naukowe Politechniki Warszawskiej*, no. 2, pp. 341-350, 2018.
- [16] Ministry of Infrastructure, Ministry of Digitization, General Inspection of Road Transport, "New National System of Toll Collection", Joint project of the Ministry of Infrastructure and the Ministry of Digitization implemented in cooperation with GIRT. Available on the Internet: https://www.gov.pl/documents/905843/1047987/NKSPO_przezencja.pdf/8aab0abe-ee00-858b-0e74-f9dd1a85698c.
- [17] Opinion of the European Economic and Social Committee Proposal for a Directive of the European Parliament and of the Council on the interoperability of electronic road toll systems and facilitating cross-border exchange of information on the failure to pay road fees in the Union (recast)[COM(2017) 280 final– 2017/0128 (COD)], Rapporteur: Vitas Maciulis. Available on the Internet: http://www.europarl.europa.eu/meetdocs/2014_2019/plmrep/COMMIT-TEES/TRAN/DV/2018/01-22/EESC-2017-02887-00-00-AC-TRA_EN.pdf.
- [18] P. Lewandowski, “System opłat za korzystanie z infrastruktury drogowej”, Akademia Morska w Szczecinie, *Autobusy: technika, eksploatacja, systemy transportowe*, vol.17 no. 12, pp. 1113-1117, 2016.
- [19] Regulation of the Council of Ministers