

*road rolling toll,
GPS navigation system*

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CONCEPT OF A SYSTEM OF REMOTE FEE COLLECTION FOR USE OF ROAD INFRASTRUCTURE IN KATOWICE

The paper presents a concept of implementation of another fee collection mechanism for use of infrastructure in the city center than traditional vehicle parking fees. The project proposes information technologies promoted by the transport policy of European Union and implemented in Austria, Switzerland and Germany, Oslo, London and many other European countries

KONCEPCJA SYSTEMU ZDALNEGO POBORU OPŁAT ZA UŻYTKOWANIE INFRASTRUKTURY DROGOWEJ W KATOWICACH

W artykule przedstawiono koncepcję wdrożenia innego mechanizmu poboru opłat za użytkowanie infrastruktury w centrum miasta niż tradycyjne opłaty za parkowanie pojazdów. W projekcie zaproponowano technologie informatyczne promowane przez politykę transportową Unii Europejskiej i wdrożone w Austrii, Szwajcarii i Niemczech, Oslo, Londynie i wielu innych miastach europejskich.

1. TRANSPORT POLICY IN TERMS OF FEE COLLECTION FOR USE OF ROAD INFRASTRUCTURE

A dynamic collection of selective charges for use of roads is not a new issue, as the fees were collected already in ancient Rome. In Poland such payments were called "toll" and collected for travel on suburb roads, passage through bridges and fords, for ferry and for entrance to the city. In the post-war period the issue of selective road fees collection was abandoned altogether. Development of transport and its infrastructure belonged solely to the authorities' priorities and was seen as a free public use goods. A quick development of motorized transport involving consequently the increased need for road infrastructure whose costs of construction and maintenance often exceed budget possibilities of governmental organizations and local authorities resulted in a re-consideration of dynamic and selective charges for use of road infrastructure, including linear road infrastructure in the cities. At the beginning, these charges served exclusively the purpose of financing construction and further operation of road infrastructure. Presently collection of charges for travel on the road, bridge,

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tunnel, access to the city center or leaving the car at the parking place in the city center became an important element of transport policy. [9]

Present objectives of European Union's transport policy were formulated in the White Book of September 2001 "European Transportation Policy till 2010 – time for a decision", where the basic objectives of transportation policy till 2010 are presented together with the plan containing ca. 60 activities. One of objectives of this policy is development of new common principles of charging for use of infrastructure, taking into account the external costs of transport and construction of certain infrastructure facilities [17], [7], [2], [14]. This document tells among others about the necessity to charge the user of transport with full external costs in line with the "user pays", "polluting pays" principles.

As the target solution in the area of road fees the White Book indicates systems of electronic fee collection over the entire road system. These systems will use the most recently implemented telecommunication and satellite communication technologies – systems of location, identifying and following the vehicles together with their entire cargo, Toll rates should take into account the road class and character of the area. They should take into account the vehicle category, level of road traffic and period of travel. This fee should be also equal to the rate per kilometer multiplied by number of kilometers and [17], [18]. Thus, the policy assumes broad application of remote toll collecting system over the entire road network [17] and is aimed at finding the fairest method of payment for use of infrastructure.

Payments collected for use of road infrastructure may have various purposes and significance, depending of the situation. We may discern three basic types of charges [9]:

- road rolling toll,
- peak period or variable rolling toll,
- rolling toll on crowded road objects

Road rolling toll – is established by the government or private consortium. First it serves the purpose of recovery of new road construction costs or modernization costs of the existing one, and subsequently is the source of revenue. Such charges are applicable in many countries in Europe and worldwide, primarily on the highways and motorways.

Peak period or variable rolling toll – is a payment for travel on the road that varies depending of the time of day, year, usually depending of the traffic intensity on this road. This method enables traffic management through increase or decrease of amount of charges, and consequently encourages or discourages the drivers to use this road [9]. Instance of such a charge is the toll collected in San Diego, California. The drivers pay a toll of various amount for use of the separated road lane called "HOL" (High Occupancy Lanes) called express lane, depending of the time of day and especially of the traffic intensity on this lane. [5].

This charge is aimed at discouraging the drivers who don't want to pay and have a possibility to use other means of transport to use the existing roads, parking lots, tunnels. These charges enable reduction of traffic to a predetermined level on the analyzed road section or city area, taking into account the value of time lost in the travel [9]. This form of payment is now introduced in many cities, also Polish ones. They are charges for parking in the center of the city to discourage some drivers to leave their cars in the center and forcing them to use public transport. Another example of such type of payment may be payments for a possibility to drive to the center of the city. The most recent instance of implementation of such charges is London [16]. These charges were aimed at protecting the city against congestion of its central part [7]. Before these charges were implemented, the calculated number of drivers accessing the city of London was 40000 vehicles per hour. [11].

Area charges collected from the vehicles passing the border of a certain zone, most frequently the center of city, are not yet collected in any of Polish cities. Such charges are

prohibited by Polish law. In accordance with Polish regulations, payments may be connected only for [8], [13]:

- Travel on the highway,
- Parking of vehicles on the public roads in the areas of paid parking lots,
- Travel of non-standard vehicles on public roads
- Travel through bridge facilities and tunnels located within the public roads,
- Ferry travel on the public roads.

The most recent document concerning transportation policy of Poland – „Polityka Transportowa Państwa na lata 2005-2025” (Transport Policy of the State for years 2005-20025) announces the need of revision of Polish law in order to enable implementation by the local authorities of payments for access to the designated areas of the city in order to control their availability and protect the center against constriction [19], [4]. Such a protection seems to be of more and more importance for Polish cities as the infrastructure of most of them is several tens of years old and was calculated for lower traffic.

2. COONCEPT OF IMPLEMENTATION OF AREA TELE-CHARGES FOR CITY OF KATOWICE

City of Katowice has not a historically defined city center as Kraków and Gliwice, The central area of the city is called city center, but has no defined boundaries. Thus it is difficult to indicate the area of the city where the traffic could be limited by implementation of charges for entrance. The concept was supported by the general City Center plan and the area designated by the City Council as a zone pf paid parking, presented on Fig.1.

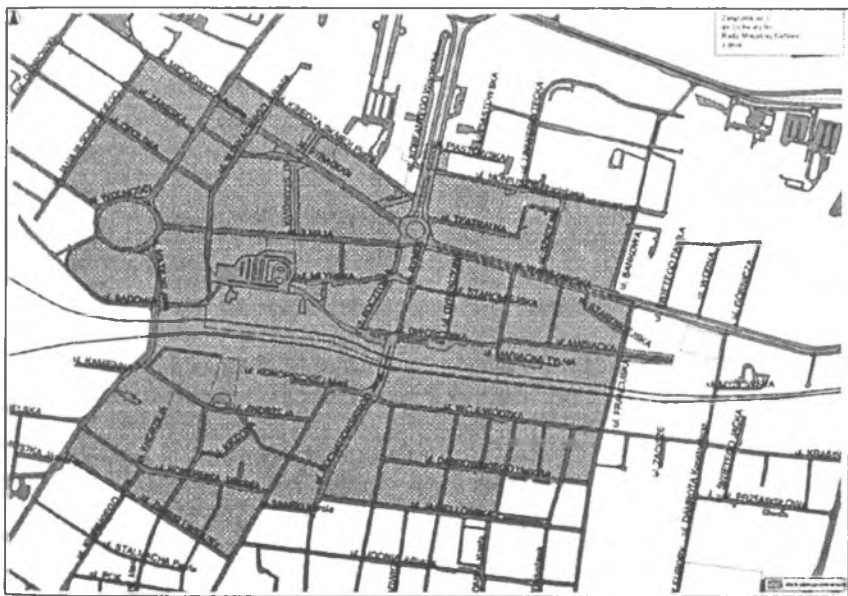


Fig.1. Area of paid parking zone in Katowice

The system of remote area fee collection in Katowice could cover two zones of the city. Users of vehicles would pay for passing these boundaries.

First zone would cover an area mostly overlapping with the paid parking area. The streets bordering this zone would be: A. Mickiewiczza, Al. W. Korfantego, S. Moniuszki, Szkolna, Warszawska, Francuska, Jagiellońska, Plac Miarki, T. Kościuszki, Żwirki i Wigury, Mikołowska, J. Matejki, Plac Wolności, Sokolska. Each street enabling entrance to this area should have installed equipment automatically collecting the payments from the passing vehicles. This payment would be collected at each passing independently of the number of such travels in one day. As the streets adjacent to the boundaries of this zone are mostly unidirectional, such as Wojewódzka or Mariacka Street, the number of gates necessary for outlining this zone would be 13.

The streets where such gates shall be installed are as follows (starting from gate No 1 located in the Al. W. Korfantego and going clockwise):

- Al. W. Korfantego – gate No 1,
- Teatralna – gate No 2,
- Warszawska – gate No 3,
- H. Dąbrowskiego – gate No 4,
- H. Sienkiewicza – gate No 5,
- J. Kochanowskiego – gate No 6,
- Drzymała – gate No 7,
- M. Skłodowskiej Curie – gate No 8
- J. Kilińskiego – gate No 9,
- M. Kopernika – gate No 10,
- Andrzeja – gate No 11,
- J. Słowackiego – gate No 12,
- F. Chopina – gate No 13.

Second zone would cover the Center of Katowice. The fee would be collected using the same principle that in the first zone i.e. during the passage through the gate. The number of gates necessary to designate the area is 15. The streets where such gates shall be installed are as follows (starting from gate No 30 in the Al. W. Korfantego and going clockwise):

- Al. W. Korfantego – gate No 30,
- Olimpijska – gate No 31,
- Nowograniczna – gate No 32,
- 1 Maja – gate No 33,
- Graniczna – gate No 34,
- K. Damrota – gate No 35,
- Z. Krasińskiego – gate No 36,
- Powstańców – gate No 37,
- Francuska – gate No 38,
- Wita Stwosza – gate No 39,
- T. Kościuszki – gate No 40,
- Mikołowska – gate No 41,
- Gliwicka – gate No 42,
- Stęślickiego – gate No 43,
- Sokolska – gate No 44

Such location of fee collecting gates would enable the drivers to move within the indicated area without paying. Only passing the boundary of designated zone i.e. entry to the designated zone of the city would require payment.

The boundary of zone I area was designated in such a way that there will be a possibility to travel from one part of the city to the other without paying for passing the zone I.

Location of fee collection gates for II zone would force the drivers who want to travel to the other part of the city and not pay for it to use the following lanes and streets: Al. W. Roździeńskiego, Murckowska, Al. Górnosłaska, Bocheńskiego i Bracka, that constitute a kind of ring road around the Center of Katowice.

In the case when the user of vehicle wants to cross the city (for example from south to north) passing through the center, he will pay only for passing the II. When wanting to access the area of the city square, he would have to pay for passing two zones, one for passing the boundary of zone II and second for passing the boundary of zone I.

The payments would be collected from 07:00 to 18:00 in weekdays and from 09:00 to 12:00 in Saturdays. As an option it should be possible to implement two fee rates to apply during the day. Higher one in the morning and afternoon peak hours and lower one in the rest of time. The fees should be established very carefully to not burden the user of the system excessively. Instances of amounts of fee rates are shown in the table 1 below:

Table 1

time	Charge rates applicable during weekdays [PLN]	
	Zone I	Zone II
07:00-09:00	1,0	0,75
09:00-15:00	0,8	0,50
15:00-17:00	1,0	0,75
17:00-18:00	0,8	0,50
	Charge rates applicable during Saturdays [PLN]	
09:00-12:00	1,0	0,50

Source: Own study

The payments would not be applicable for vehicles of Police, city guards, fire brigade, emergency rescue, public transport buses, vehicles used exclusively for road works, including those for cleaning and winter maintenance of the roads.

Appropriate configuration of charges would further on in the development of the system to withdraw from the fees in the paid parking zone.

3. TECHNICAL AND ORGANIZATIONAL CONDITIONS OF REMOTE TELECHARGES CONCEPT IN THE CITY OF KATOWICE

The systems of remote fee collection use the most state of the art achievements of the telecommunication, satellite transmission and navigation. They enable collection of fees of various amount depending of road class, character of the area where the vehicle moves (urban or non-urban area), vehicle category (including emission of flues, pressure of wheels on the road), level of traffic on the road and time of day [18]. These systems do not require construction of stationary fee collection posts, thus being more comfortable for the drivers who do not have to stop to pay, but they are expensive and their implementation requires well thought over and organized system. Block diagrams of two remote fee collection systems implemented recently in Europe are shown on Fig 2.

The upper part of this drawing presents a system of remote fee collection using the DSCR (Dedicated Short-Range Communication). Technical specification of DSRC is specified in the European Standard CEN TC 278 (among others operation of the system at frequencies close to 5,8 GHz) [5, 6, 59]. The principle of operation of this system is as follows: The transponder – i.e. transmitter and receiver combined, is located in the vehicle. This device keeps the payment data or amount of credit for travels (depending of the system) and at the moment of passing the gate (radio-emitter) it is scanned by an infrared beam sent

by the reader. In this way the system follows the route of a vehicle and knows exactly with what amount this driver is to be charged. In the less complicated systems this charge is recorded in the charge collection center on the driver's account. In more complex systems a special electronic card is put into the transponder and the payment is "written off" from the card's account. The systems based upon the radio communication were implemented in Switzerland in 2001 and in Austria in 2004 [1], [10], [2], [15].

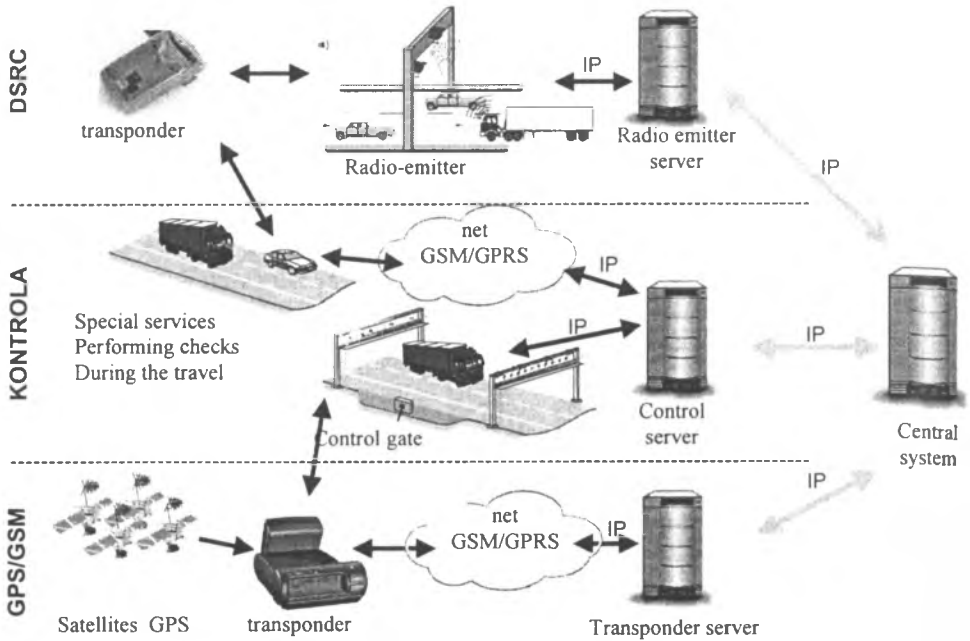


Fig.2. Block diagrams of two remote fee collection systems [15]

In the bottom part, the drawing presents a system of remote charge collection using satellite navigation system GPS and mobile telephony GSM. The operating principle of the system is similar to the above mentioned. They differ but with one thing – in the radio-emitter system. The vehicles are located but at the moment of passing through such a radio-emitter, whereas in the second system the vehicle equipped with a transponder is continuously being located using the satellite GPS navigation system. The system based upon the GPS satellite navigation system and mobile phone network GSM was implemented in Germany in January 2005 [1], [10], [2], [12], [15].

The middle part of the drawing presents a system of vehicle drivers' control using both of these systems [15].

The system of remote payment collection for Katowice city should consist of two basic components:

- a transponder mounted onboard of a vehicle
- fee collection gates installed in the designated location in the city streets

The system would operate based upon the short-distance radio communication principle. Thus the transponder itself would be small, and the fee collection devices could be mounted partially on the structures supporting the light signals on the level crossings, which would contribute greatly in the reduction of system costs and would limit building of new structures of toll gates to the minimum.

The transponder would not require a special installation in the specialized workshops, but it would be simply glued to the front window pane of the vehicle (it could be similar to the transponders used in the systems being in operation in San Diego or Oslo).

The devices installed on the toll gates are small thus they are not very visible and they do not interfere with the city looks. Instance of such a device is presented on Fig.3. (the devices come from the system in Oslo).



Fig.3. Devices serving the purpose of fee collection in the DSRC system installed on the structure designed to support the light signals [6]

Each passing of the vehicle equipped with a transponder under the toll collecting device (Fig.3) would cause collection of an appropriate fee. Such a system is relatively simple. The payment would be collected in a Pre-Pay system. This means that the transponder would work in the similar way as parking cards several years ago. Such a payment system is simpler than the down-payment system because it does not require establishing of special accounts, signing agreements and checking of liquidity of system's users etc. Moreover, issue of transponders without recording the users' data does not require establishing of large databases and thus reduces the costs of system operation.

At the special point located inside the Zone I and in the most gas stations located at the entry points to the city as well as at the border of Zone II it would be possible to purchase and „load” the transponder. The purchased transponder would have on its “account” an amount of 10, 25, 50 PLN. At the moment of passing the gate, the system would collect a predetermined fee from the amount contained on the transponder’s “account”. In the case when the user states that the amount remaining on the transponder’s account is insufficient, he may take it with him (by removing it from the window) and “charge” it s “account” in one of special service points or at the gas station. A minimum amount of such “charge” should be 10 PLN. The transponder could be able to emit a sound when the “account” is reduced below a determined minimum amount. Moreover in the points where such “charging” is possible a possibility to check the amount remaining on the “account” should be possible,

As such device like transponder is more expensive than a normal parking card, the token money should be collected for a transponder. Such token money could be for example 40 PLN and could be collected at the moment of transponder’s purchase and reimbursed when the user for some reason would want to return the transponder.

In order to check the payments it could be possible to use digital cameras, similarly as in the Austrian, German and Swiss systems. These cameras make pictures (In Poland this picture should include both the driver and numbers of the car) at the moment of vehicle’s passing through the toll gate without payment. At the beginning of system operation also a properly trained and authorized services could be used for detailed control to stop the non-payers right after their passing through the gate without payment.

4. SUMMARY

The most recent transport policy foresees a necessity to revise the regulations rendering impossible collection of payments for use of road infrastructure for example in the city centers. The concept of implementation of tele-charging system in the center of Katowice presented in the paper should be ready by then, as the next step in the future could be withdrawal from parking charges in the center of Katowice.

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