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SELLING MASS TRANSPORT SERVICES
USING MOBILE TELEPHONE SYSTEMS

Performance of public transportation's services is connected with fees collecting. Traditional information carrier which informs about collected fee is a paper ticket. Nowadays with electronics and IT development, that paper ticket is more often replaced by chip card or SMS's tickets. This article presents conditions and reasons that stand behind the usage of cellular phone network in collecting fees for public transportation's services.

SPRZEDAŻ USŁUG TRANSPORTU ZBIOROWEGO
Z WYKORZYSTANIEM TELEFONII KOMÓRKOWEJ

Świadczenie usług transportu zbiorowego związane jest z pobieraniem opłat. Tradycyjnym nośnikiem informacji o pobranej opłacie jest bilet papierowy. Obecnie wraz z rozwojem elektroniki i informatyki coraz częściej bilet papierowy zastępowany jest kartami elektronicznymi lub biletami mającymi postać SMS-ów. W artykule przedstawione są uwarunkowania oraz przesłanki wykorzystania telefonii komórkowej do pobierania opłat za usługi transportu zbiorowego.

1. INTRODUCTION

The provision of mass transit services is connected with collecting of fares. Traditionally, the information about collected fare has been provided on the hard copy (paper) ticket. Initially, such tickets had been sold by conductors, later the sales of tickets were transferred to stationary points of sale (kiosks, shops, vending machines) additionally in some cities also vehicle drivers sell tickets.

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2. CARRIERS USED IN SELLING SERVICES OF MASS TRANSIT SYSTEMS

The carriers used in selling mass transit services contain: paper tickets, tickets with magnetic strip, as well as electronic cards (with memory or chip - microprocessor).

Paper tickets, are still very popular, despite the development of modern technologies. The basic requirements for those tickets include prevention of forgery by a third party, either by printing or introducing changes, eg. Wiping out or removing the codes of the invalidating machines, or other marks important for the ticket validity. Also the overall aesthetics of the ticket, and legibility of information contained are of importance. Over the years, changes have been made in the production tickets. Various types of paper are available, regarding both weight and colours, with various protective elements. Printing in full colour poses no problem, neither does the addition of extra protective elements during printing.

Tickets with magnetic strips are usually made of thicker paper or plastic-based materials, and have one or several magnetic strips on them. The paper or plastic material has inscriptions with information necessary for the passenger, such as ticket validity or travel range. The magnetic strip contains encoded data meant to be read by suitable devices, during that procedure the ticket validity is checked, and suitable amount is deduced from the value of the ticket. The information encoded in the magnetic strip may also be used for opening the turnstiles at the entrance to stations or stops. They have a limited validity: a certain number of journeys or specified time limit. It is possible to count passengers and to block the passage, by not opening the turnstile if the ticket proves not valid. Magnetic strips are reliable and safe information carriers in case of closed transactions of limited value. Magnetic carriers have a limited memory capacity, are prone to external disturbances, and have a low durability of encoded message.

The application of electronic cards in mass transit systems makes it possible to broaden the range of ticket prices, to match prices with actual services provided, to have a potential to use information for the planning of routes and lines, as well as to implement loyalty programmes. Limitations in wider use result from substantial costs of purchase, implementation, and operation of such a fare collection system. Moreover, difficulties have been encountered in data collection, due to the legal protection of personal data, and problems that passengers experienced when identifying the value remaining on their cards. In towns and cities where such electronic cards fare collection systems have been implemented, the necessity of selling single tickets in paper form still remains, for example drivers sell them. It would not be practicable to demand from people using mass transit systems only occasionally to purchase such cards and to pay deposit for them. Re-loading of cards requires particular equipment and connection to information network. The ticket inspectors also need to provided with proper reading devices.

3. PREREQUISITES FOR USING MOBILE TELEPHONE SYSTEMS AS SYSTEMS OF FARE COLLECTION IN MASTRANSIT SYSTEMS

The access to GSM technologies became common in Poland over a few years, at the end of 2002 Poland had 13.9 million users of mobile phones, in 2003 this number increased to some 17.3 million, reaching 19 million users of mobile phones at present. This provides the possibility of implementing solutions which will enable numerous activities in a simpler and more convenient manner. One of those is the use of mobile phones, in particular the SMS (Short Message Service) as a form of payment for services, without having to use cash.

WAP technology provides a much higher level of interaction than SMS, which entails, however, the necessity of having a longer connection time between the mobile phone and the application server, which provides the logical functionality of the service. Due to the above, this technology is surely more suitable for purchasing of tickets in more complex tariff systems and for obtaining passenger information (timetables, routes, etc.). For example, as of the end of June 2004, in Poland WAP technology that is mobile phones allow for access to information about timetables of mass transit system in Warszawa, Poznań, and the Katowice agglomeration. The Universal availability of mobile phones which allow access to Java applications allows for downloading of software the makes it possible to order tickets with diversified access rights. Regsdless the above, much hope is connected with the development of voice recognition systems. These will allow passengers to order tickets in easy and natural way, while the system will be fed with required data.

The implementation of a system for selling tickets making use of mobile telephones is not connected with substantial expenditures for the purchase and installation of additional equipment (devices for re-loading of cards, invalidating machines, readers for ticket inspectors, etc.). The existing telecommunication infrastructure is used instead. The main costs are related to the functioning of telecommunication and information infrastructure, allowing to communicate with passengers, to process and transmit data, and to settle the fares. It is possible to currently monitor the amount of registered ticket accounts, the ticket purchase transactions, the types of tickets and, depending upon the solution selected, possibly also the locations at which tickets have been purchased.

The prepared solutions may be classified in relation to the passenger groups which are targeted. The solution preoposed may have a target group consisting of passengers using mass transit services occasionally – several times a year. It is expected then that the purchase of a ticket will not require registering earlier, will be possible from all networks/operators available in a given area, using one common telephone number. It seems that in such a case the fact that the costs of purchasing the ticket via mobile phone will be higher should not pose a problem. They will be related to the fare and additionally to the costs of telecommunication services. The fact that costs will be higher will also be related to having a transaction without cash payment and to the risk of collecting the receivables thus generated. The payment for tickets is, then, made together with the payment of the telephone bill. Here, a useful solution for entities that organize municipal mass transport may be to use the offer of so-called „special" SMS [1], [2]. In Poland, these are SMS-es sent to a four-digit numbers starting with a 7, where the subsequent digit informs about the amount to be paid. Depending upon the arrangements made, the service operator sends a reply using SMS – in this case it will be the ticket, while the service operator takes over the responsibility for collecting the fare from the

ticket purchaser, making settlements with the organizer of urban transport. An advantage of such a solution is that it can function for all GSM networks/operators in Poland, and there is no need for the passenger to register or do anything else (e.g. purchase of a card, etc.).A disadvantage is surely going to be a relatively high commission for the service operator, thus a ticket purchased using this system would cost much more to the passenger. However, such a solution should not be excluded as potentially possible, because a percentage of people, especially those using mass transit systems occasionally, would accept having to pay for a ticket twice the normal amount (nominally that amount is not substantial), as the advantage gained is the access to tickets practically anywhere and at any time.

There are also solutions for the purchase of tickets via mobile phones by people using local mass transit systems on a regular basis. They are then competitive in relation to standard sale systems of tickets in paper form or in the form of electronic cards. They are characterised by the necessity of registering beforehand and making a prepayment for the service, while the operator of the system takes over the cost of telecommunication services, and charges passengers only the costs of tickets purchased, also a rebate system can be used, similar to that when season tickets are purchased. The problem here is to maintain the costs of ticket purchase within an acceptable limit. In traditional systems of sales via stationary sales points, the latter charge a commission of some to several percent, depending whether they sell only tickets, or sell tickets alongside various other products. Purchasing a ticket via cellular phone requires two SMS-es, one ordering the ticket, and the other (confirmation) being the ticket itself, or making one phone call and sending the SMS being the ticket. Bearing in mind the prices of single tickets in Poland for zone one, between 0.70 PLN (reduced fare) and 2.40 PLN, the costs of the above can hardly be within the limits of commissions charged otherwise.

At present (July 2004), the cheapest SMS-es in pre-paid systems are offered by Idea – 0.2 PLN both to the same operator and to other operators, while Heyah offers SMS-es at 0.18 PLN to the same operator, and at 0.28 PLN to other operators/networks. Of course, should the service be used for the purpose of selling tickets, those costs may be reduced through negotiations with operators, yet it seems out of the question to achieve a price equivalent to a commission of a few percent charged in case of paper tickets by stationary sales points. On top of that, there are costs related to the functioning of the IT system processing the sales of tickets via SMS-es, registration and settlement of tickets purchased, and information about such a sale system [3].

So far, no satisfactory protection of the system of ticket sales via SMS could be proposed. There are a few problems related to that. The first of these relates to developing a solution to prevent the purchase of tickets after the ticket inspection has been announced in a vehicle. In urban transport vehicles, even those smaller ones, the passenger still has some time between the announcement of ticket inspection and the moment his/her ticket is actually inspected. Traditionally, when the ticket inspection is announced, the invalidating machines get blocked, or people who should have valid tickets do not have the possibility of using the ticket-punchers, as the devices are installed by the entrance. Purchase of tickets via SMS is possible practically at any place and any time, it can be made in a discreet manner after ticket inspection has been spotted. It is not possible to limit the access to GSM networks, as mass transit vehicles constitute public space, and such limitation would also affect the use of mobile phones for other purposes, besides the purchase of tickets.

It is possible to block the sending of ticket via SMS, yet only when the solution entails purchasing a ticket to a given vehicle, for example when ordering the ticket via SMS the passenger is required to provide the internal number of the vehicle. Starting the inspection, the ticket inspector may – using a mobile phone - block the transmission of tickets with a given internal number of vehicle, that is the vehicle being inspected. This is very rarely used by ticket inspectors in Poland. This is due to the fact that tickets purchased via SMS constitute only a small percentage of all tickets, thus it is hardly possible to find such a ticket, also additional costs and activities before and after the inspection are involved (it is necessary to send information that ticket inspection has been completed).

4. CHARACTERISTICS OF THE SOLUTIONS CONCERNING SELLING TICKETS WITH THE USE OF MOBILE TELEPHONES

4.1. THE SYSTEM OFFERED IN SELECTED TOWNS IN POLAND

In a few towns in Poland the service selling tickets via mobile phones has been introduced, utilising SMS-es. The service is provided in co-operation with Axel Springer Kontakt sp. z o. o., thus the solutions used in specific towns are almost identical. Briefly speaking, the procedure of using SMS tickets is as follows [4], [5]:

1. A passenger purchases an SMS coupon-book in a point of sale, with a multiplicity of single ticket price in a given town (16 PLN in Słupsk, 20 PLN in Poznań, 22 PLN in Jaworzno, 15 PLN in Zamość, 19 and 38 PLN in Jelenia Góra). The SMS coupon-book is the size of a credit card, and contains a unique code coated with a scratchable coating. The code needs to be sent by SMS to the number 7003, in order to activate the ticket account of the passenger.
2. Getting on the bus, the passenger is obliged to send an SMS to order a ticket. The text that needs to be sent in order to obtain a ticket has been conceived in such a way that it is easy to remember and does not take long time to enter. A reply is then received, by SMS confirming the purchase of ticket, with the unique ticket number. The message also contains information about the type of ticket purchased, the time of purchase, ticket validity, as well as ticket account number and balance. Each purchase of a ticket results in reducing the amount available on the ticket account. The message - SMS ticket has been designed in such a way that the basic information necessary to determine the ticket validity and authenticity are available for the ticket inspector to see, without having to scroll the phone screen. A person with active ticket account may also purchase tickets for others.

    The advantages of such a system include: availability of the service, following the same principles, via three cell phone networks/operators in Poland; laso the reasonably simple and quick implementation – sales of coupons is via the network of sales points distributing paper tickets. Of importance here is also the clear division of payments for the transport service and the telecommunication service, which is substantial from the point of view of registering sales of various types of services for VAT purposes. The passenger purchases the coupon-book, which is settled in the same way as municipal transport tickets are – the revenue goes to the organizer of transport or the service

provider. Sending SMS–es is a telecommunication service, the revenue from which goes to the system operator, who later makes settlements with specific operators of GSM networks. It is also possible, in case of having a few organizers of mass transit services, to have a system for settlements between them. What is important is the fact that the system may be based upon the transport services actually provided, not on estimates in that respect, as is often the case.

Disadvantages of the solution include the necessity of purchasing the SMS coupon-book earlier, as well as charging passengers additionally for sending the SMS. At present, the cost of a single SMS is 0.61 PLN (with tax). This means that in the towns where the system is in use, the total cost of an SMS ticket is higher than that of a paper ticket. The requirement of purchasing the coupon-book earlier limits the possibilities of using such a solution by people who use public transport only occasionally, whereas adding the cost of SMS to that of the ticket results in making the solution not attractive for people who use public transport frequently. For the above reasons, maintaining the same level of prices for tickets purchased via SMS and adding the charge for sending the SMS makes the system doomed to account for only a marginal share in the ales of mass transit system tickets. For example, in Poznań between November 4, 2002 and January 4, 2003 the holders of ticket accounts purchased over 1600 tickets [6] , which gives the average of some 26 tickets daily. This is really not much, in comparison with the daily number of journeys by municipal transport in the city having the population of over 570 thousand. Also in other towns, such as Jaworzno or Zamość [7], the service does not enjoy a great popularity. It is obviously up to the transport services provider whether and how much will the price of ticket purchased via SMS get reduced (as is the case in Słupsk), so that together with the payment for sending the SMS, the total price of such ticket is similar to that of a traditional paper ticket.

Another problem is connected with ticket inspection. An SMS, being the order for a ticket, may be sent at the moment when the ticket inspection starts. The reply SMS should come within several seconds, which may be enough to avoid the eine for riding without a ticket. Any possible delay may be explained by the time required for data processing, and overloading of the telecommunication network. The ticket inspector looks at the information displayed in the mobile phone and assesses its compliance with what is required. It is assumed, however, that the inspector should be provided with a mobile phone as well, so that in case of doubts he may do a checking.

4.2. THE SYSTEM IN USE IN HELSINKI

The system of fare collection by means of SMS-es became available for the users of public transport in Helsinki in December 2001. The system operator is the company Plusdial [8]. Passengers accepted that form of service sales very quickly, as a result of which by December 30, 2002 that is practically during one year, one million tickets were sold by SMS. Only over 16 months were required to sell the next two million tickets via SMS. On May 11, 2004 three million tickets were sold using that service. The use of that service appears very simple. All that passengers wanting to buy tickets need is a mobile phone and an active phone number with a GSM operator. Before using public transport, the passenger send an appropriate code via SMS and receives a message back within a few seconds, thus receiving the ticket. The fee for system operator is included in the ticket price, thus the passenger does not have additional costs to pay. The ticket sold that way is valid for one hour and costs 1.90 Euro. Purchases of tickets are settled with the telephone bill, or exacted from the account in pre-paid systems. The popularity of the system may be confirmed by the sales volume and its

increase, which in turn allowed to reduce the stationary network of ticket distribution, to reduce the costs of printing and storing of tickets. In the solution offered by Plusdial the convenience of ticket purchase was the main priority, unfortunately there is little possibility of differentiating prices of tickets, in for example in relation to the distance travelled. Despite a big promotion campaign, the system has not become widespread. Among the reasons for that one may quote its lack of flexibility and non-compliance with the tariff systems used in many European cities.

4.3. THE SYSTEM USED IN SELECTED GERMAN TOWNS

Another system of fare collection in public transport is the Teltix system, developed by Teltix GmbH [9]. The system has been implemented in Osnabrueck and Bonn in Germany. The Teltix system allows passengers to purchase tickets using their own mobile phone, in all cellular phone networks in a given area. It is, however, necessary to register earlier, for example in customer service bureau, via Internet or mail. As a result of registration the person is linked with the mobile phone number, and a ticket account is established, which is later fed by transfers of declared amounts from bank accounts, payments by money orders, or the purchase of cards. All the transactions on the opened ticket account are registered and sent via mail or e-mail as the monthly settlement. The ticket system operator, in turn, transfers the money collected, minus commission, to the transport service provider. In order to purchase a ticket, the passenger dials a special telephone number, waits for the announcement, e.g. „We wish you a nice journey", after which the ticket is sent to the his/her mobile phone in the form of SMS. It is assumed that the ticket account may be used only by the person owning the mobile phone, who already registered in the system.

The Teltix system has been designed for both simple and more complex tariffs. The passenger, by dialling-up, roders a single ticket each time, however, the settlement of ticket purchases over a longer period, for example one month, allows to charge for fares in line with the tariff plan which is most convenient for the passenger, for example as for day, week, or monthly tickets. It is assumed that the full tariff offer will be utilised, without the participation of the passenger, who thus does not have to search for the optimum solution in the – sometimes complicated – options. It is also possible to differentitate the tickets ordered, e.g. in relation to the distance planned to be travelled. This is possible by establishing different telephone numbers (the last digit changes, for example) used for ordering tickets. Different numbers are associated with specific stops or stops within a given zone, which enables identification of the place where the journey starts. However, on the negative side is the fact that the solution gets thus complicated and surely more difficult for passengers to use. They do not have just two phone numbers to dial to order a ticket (one for normal, one for reduced fares), instead the amount of phone numbers increases depending upon the number of zones into which the whole area is divided. So far, this is quite a substantial limitation especially in big agglomerations, as a result the existence of time-related tariffs is assumed in cities where such a solution is implemented.

Another problem is the manner of ordering tickets. In the Teltix system the choice made was not to use SMS, but to dial and have a short connection with the operator to identify the telephone number, to which the SMS being the ticket should be sent. Surely, one of the reasons was the presumed lower cost of a few seconds connection with the telephone operator, in comparison with the cost of SMS sent to order a ticket. However, it would be hard to assess to what extent those presumptions will be true in specific conditions. This depends upon the cost of SMS-es and the cost of phone calls assuming charing per every

second. At preset, in Poland the GSM operators do not offer the solution where the cost of call is not to be paid by the caller but by the entity receiving the call. Neither is a standard, common for all operators, toll-free number available. The introduction of such a number would surely entail costs of adjusting equipment technically for it, yet for GSM operators the economic dimension matters more. This means how much it will increase the number of calls in the network, in which they are definitely interested, but also how much it will change the charging for calls and thus reduce their revenue. One needs to realise that many people have tariff plans in which they are charged for every minute or half minute started, although charging only for seconds actually used becomes more common. In case of short, several seconds long connections, some users would still have to pay for at least 30 seconds or one minute, in case of tariffs where users are charged only for time actually used, also the fixed fee element can be encountered. Thus the fact of transferring fees from caller to the entity receiving the call, with the assumptions these will be short calls and the receiving entity will pay only for the seconds actually used, regardless the tariff plan of the caller, will surely not be advantageous for the operator.

At present, the cheapest SMS-es in pre-paid systems cost about 0.20 PLN. Connections are offered for the price of 0.80 PLN per minute, where callers are charged only for the seconds actually used. Assuming a 5-second long connection, which will give the caller the possibility to hear the message and thus be sure s/he dialled the right number, this means paying about 0.07 PLN. This is cheaper, bering in mind the assumptions made earlier, still it requires making a system for charging for such connections, as it is not within the scope of solutions and services offered by operators.

5. FINAL CONCLUSIONS

Paper tickets are still commonly used in public transport as fare information carrier. They meet the basic requirements imposed. However, in order to enhance the possibilities of differentiating prices and increase availability, modern systems of fare collection should be added to them.

The tickets with magnetic strip or magnetic cards require a costly infrastructure and target mainly those who use public transport regularly. They appear to be quite inconvenient in case of using mass transit systems occasionally.

The advantages of using mobile phones for fare collection apply to the service providing entities themselves, as well as to the public authorities responsible for provision of local public transport and often owning the service-providing entities, also for ticket sales operators and GSM operators.

Purchasing tickets using mobile phones means broadening the distribution network. However, the service should target mainly those passengers who use local public transport occasionally. Such people do not have season tickets, they also often use public transport at times when ticket offices are not open. The introduction of sales of tickets applying the principles valid for frequent travellers (earlier registration, season tickets) would definitively increase the volume of ticket sales via SMS, yet only to a limited extent shall simplify the purchase of tickets by those who use public transport infrequently.

The problems to be solve include: protective measures, possibility of differentiating prices/fares, ticket inspections, and – in selected cities where underground systems exist – the passage through gates and turnstiles installed at stations and places where people change lines or means of transport, which are at present opened using tickets with magnetic strips or electronic cards.

BIBLIOGRAPHY

[1] Website www.phonesat.pl
[2] Website www.admobile.pl
[3] Websites of GSM operators in Poland.
[4] The website of Axel Springer Kontakt sp. z o.o.: www.axelspringer.com.pl
[5] Websites of MPK Poznań sp. z o.o.: www.mpk.poznan.pl, PKM Jaworzno sp. z o.o.: www.pkm.jaworzno.pl, MZK Słupsk sp. z o.o: www.mzk.slupsk.pl, MZK sp. z o.o. w Zamościu: www.mzk.zamosc.pl, MZK Jelenia Góra: www.mzk.jgora.pl
[6] RUSAK Z., Bilet SMS w MPK Poznań sp. z o.o. (SMS ticket in MPK Poznań) Biuletyn Komunikacji Miejskiej No. 69. IGKM, Warszawa, 2003.
[7] Information provided here, including the interview with the president of Miejski Zakład Komunikacji (Municipal Transport Company) in Zamość provided in the portal Roztocze online: www.roztocze.net
[8] Website of Plusdial: www.plusdial.net
[9] Website of Teltix: www.teltix.de

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