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traffic control in the cities, dispatchers systems

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DISPATCHER'S CONTROL IN THE CITIES – MAIN DIRECTIONS OF DEVELOPMENT

This paper approaches the basic issues related with the increased traffic in the cities, and presents methods of their solution using telematic systems. The author intends to draw special attention to the systems giving a priority role of the public transportation, constituting one of the more important elements of sustainable development in the cities.

STEROWANIE DYSPOZYTORSKIE W MIASTACH – GŁÓWNE KIERUNKI ROZWOJU

Tematem referatu jest przybliżenie podstawowych problemów związanych ze wzrostem ruchu w miastach oraz przedstawienie sposobów ich rozwiązania przy pomocy systemów telematycznych. Szczególną rolę zwrócono na systemy dające priorytet środkom komunikacji zbiorowej, będące jednym z ważniejszych elementów polityki zrównoważonego rozwoju w miastach.

1. INTRODUCTION

As a result of motorization and changes in the users' preferences at the end of the eighties of the last century, a process of deterioration of city transport in Poland has occurred. This process is hard to stop [6]. This is expressed mainly by the following phenomena: reduction of central and local government expenses for urban transport, depreciation of the rolling stock, increased prices of tickets, reduced frequency of travel and transport speed of vehicles. According to GUS (RP's Statistical Annual of 1998 and earlier) the total number of passengers transported by the urban transport companies dropped from 9,1 billion in 1986 to 5,2 billion in 1998. The process of passengers' outflow is still progressing (although at a lower rate) especially in the small and medium-sized towns, with tendency to stabilization in the large cities.

In the European countries, similarly, as in Poland, the public transport underwent a significant drop in the area of passenger transport, but this process already started in late sixties [6]. That is understood as a consequence of economical growth (and consequently increased wealth) giving the citizens access to the alternative and strongly competitive transport means, namely passenger cars. That is also an effect of stagnation in the quality of public transport services. "Outflow" of the users to the private cars systematically contributes

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in crowding of streets and results in many disadvantages related with this situation (noise, flue gases, accidents, and destruction of the landscape).

In the developed European Countries State and local authorities responsible for the condition of transport, use now every effort to raise the quality of public transport services. This is caused by a need to conserve the present number of customers and attract new ones, as well as trying to convince the passenger cars' users to return to the public transport.

2. BASIC AREAS OF APPLICATION FOR TRANSPORTATION TELEMATICS IN THE CITIES

The application areas for transport telematics in the cities may be divided into five basic groups [4].

a) Urban Traffic Control:
These are systems whose basic purpose is to improve safety and flow of traffic in the streets. These traffic control systems operate on the basis of observation of the traffic courses, road and weather conditions. The control is realized and based upon the data obtained from these observations.

b) Public Transportation Management / Transport Services with Demand Variable in Time:
The telematics enters also into such application areas as: ticket distribution systems, public transport fees, and information for passengers. Efficient operation of these systems is an indispensable factor for enhancing the quality of the public transport services.

c) Information and Control Using Variable Transport Signs [1]:
Variable Transport Signs serve mainly the purpose of forwarding information to the drivers and public transport passengers. They considerably improve the urban traffic control through dynamic warnings about bottlenecks or road accidents, informing about alternative routes or delivering parking information.

d) Current Information for Passengers:
Establishing a simple and reliable traffic information system for passengers is one of the basic elements improving quality of the public transport services. The passenger should be provided on a current basis with information concerning time of travel, its target and cost. Frequently for this purpose Variable Transport Signs are used.

e) Demand Management:
Telematics enables more selective and efficient traffic control by controlling the entry of vehicles to certain areas and electronic charging systems.

3. ADVANTAGES ARISING FROM USE OF TELEMATICS IN THE CITIES

Implementation of telematics systems in the cities results in a considerable reduction of road accidents (thus increasing the safety of road traffic). It is mainly related with a possibility of vehicle speed management as the vehicle movement and driver's behavior monitoring. As it was shown in the tests performed during realization of pilot projects in telematics, safety was increasing even by 30%. Another advantage is a significant growth in the transport network capacity (not only in the public, but also in the individual transport area), and reduction of bottlenecks. Removal of the bottlenecks on the roads entails also savings in time, fuel, better use of infrastructure, and transport cost in broad meaning of this word. Besides we have to also mention improvement of travelers' needs management, such as parking and its organization, charges in the public transport, and management of entrance to certain areas. And important and increasingly frequently advantage of implementation of telematic systems is improvement of environment conditions. Contamination of natural environment resulting from motorization development is an issue of considerable importance not only in the Western European countries.

Thus, it arises a need to implement such changes to the traffic policy that are likely to ensure an efficient environment protection. Telematics, featuring possibility of integration and coordination of various transport means, may ensure increased ease of travel (reliability and speed of travel). Utilization of telematic solutions results also in reduced operating costs, thus improving economical effects.

4. INSTANCES OF TRANSPORT TELEMATIC SYSTEMS IN THE EUROPEAN CITIES

4.1. INTEGRATED TRAFFIC CONTROL SYSTEM (IRTE)

In 1992 the city of Turin started realization of a large-scale telematic project called 5T (Telematic Technologies for Transport and Traffic in Turin). This project was established within a Quartet program and was financed by the European Union and Italian Ministry of Environment Protection funds.

This system constitutes an integrated solution connecting together 9 component subsystems; they are as follow [8]:

a) Urban Supervision System -
It integrates all component subsystems, supervises their operation and takes basic decisions about general strategy of operation of the entire system. All subsystems operate based upon this strategy, in its individual operational strategies taking into account decisions of the supervision.

b) Urban Traffic Control -
It is a subsystem managing the operation of the light signals over the entire area covered by the project. Its main task is dynamic control of the traffic on the traffic lights intersections level, based upon local traffic measurement. This subsystem is also responsible for giving priority to the public transport vehicles at these points.

c) Public Transport Management -
It manages and monitors on a current basis the operation of all the public transport vehicles working within the system. In addition, this subsystem oversees the operation of information boards providing information to the travelers waiting on the stops, as well as the onboard devices informing about the next stop and those counting the number of passengers.

d) Reduction of Environmental Impact -
It uses the weather forecast and data collected from 11 pollution measurement stations and makes them available to the Urban Supervision System that uses them to take decisions in accordance with the requirements resulting from the needs to environment protection.

e) Parking Management -
Management of parking places located within the system effect area providing the drivers that have intelligent parking cards with an early reservation of the parking places.

f) Information Media Control -
It provides a current information about the status of the public transport, parking places and environment. It manages 10 automatic information stands located at the key locations in the city.

g) Public information -
It uses the Variable Transport Signs (VMS) for transfer the information about the easiest access routes to the various points of the city and informs about free places at the parking lots that are provided with the automatic systems.

h) Automatic Account Charging -
It enables automatic payments without stopping at the gates for the drivers of appropriately equipped vehicles; it also enables purchase of tickets to the public transport means using intelligent cards.

i) Highest priorities -
The subsystem ensures priority for the rescue ambulances when they cross the intersection, served by the Urban Traffic Control System.

j) Routing -
This subsystem enables drivers of appropriately equipped vehicles to make them pass through the street network in a way that optimizes travel time.

The project of the testing stage was completed in 1997. Analysis of costs and benefits showed a considerable reduction of average travel time both the car traffic and public transport (17% and 13% respectively) the increased travel efficiency resulted in drop in emission of flue gases and reduction of fuel consumption.
In addition, upon carrying out the analyses, two component subsystems have been shut down to the benefit of expanding the Urban Traffic Management and Reduction of Environmental Impact.

4.2. TRAFFIC MANAGEMENT SYSTEM WITH DISTRIBUTED INTELLIGENCE (UTOPIA SPOT)

The concept of this system was a result of common efforts of the European Union countries. It consisted in joining the optimization of adaptation control (SPOT – Signal Progression Optimization Technology) with a supervision and diagnostic program (UTOPIA – Urban Traffic Optimization by Integrated Automation) [7].

This system enables the following: synchronization of intersections located within the urban transport network, unconditional privilege for the public transport vehicles and special vehicles, and conditional and multilevel privileges of public transport vehicles depending on their deviation from timetable.

UTOPIA SPOT as a decentralized system consists of the following component levels: central module UTOPIA supervising and monitoring the operation of the entire transport network; an intelligent SPOT controller that optimizes control on insulated intersections and small networks as well as based on cooperation with the center, and local traffic controller that may be integrated with SPOT. The local traffic controller realizes the task of the intersection control based upon instructions received from the SPOT controller. The communication between the center and SPOT controller may be interrupted from time to time, as this does not contribute to the interruption of system operation (as it is the case with the centralized systems).

An important feature of the system is a possibility to assign priorities to the vehicles in three levels of privilege. The lowest level results in an equal privilege for the public and individual transport vehicles. The middle level assigns to the public transport vehicles a priority equal to 25 individual vehicles. It is used in the case of deviation from the timetable. The last and highest priority may be assigned only to the special vehicles (such as ambulances, police, and fire brigade). In most cities the equivalent for a special vehicle amounts to 25o, however in certain areas (such as Goteborg) it may reach 2000 [7].

Due to the solution applied as proposed by UTOPIA system it is possible to achieve a significant reduction of travel time (public transport vehicles, individual vehicles, pedestrians), increased number of public transport passengers resulting from growing attractiveness of such transport, reduction of vehicle operating costs, emission of flue gases and increased traffic safety.

4.3. URBAN TRANSPORT TRAFFIC CONTROL SYSTEM – KOMFRAM

The Komfram system (used among others in Goteborg and Helsinki) serves primarily the following purposes: supervision of traffic of the urban transport vehicles, actions taken in the case of traffic disruptions, and preparation of a full passenger information with its adequate distribution [3].

This system is built of two inter-linked systems: Traffic Supervision Center (Fig.1.) and Passenger Information Center (Fig. 2.)

Each vehicle (constituting a part of Traffic Control Center) has an onboard computer C90 installed, having in its memory information concerning timetables. The onboard computer operates the direction indicating boards, internal information boards, announcing devices on the stops, ticket punchers, data collection system about the vehicle condition, and counter of passenger flows. Present location of the vehicle is transmitted to the Traffic Supervision Center (CNR) using a radio network. The computers installed in CNR follow locations of all vehicles connected into the subsystem. Disruptions in the traffic are signaled immediately and the dispatchers may use their best efforts to remedy them.

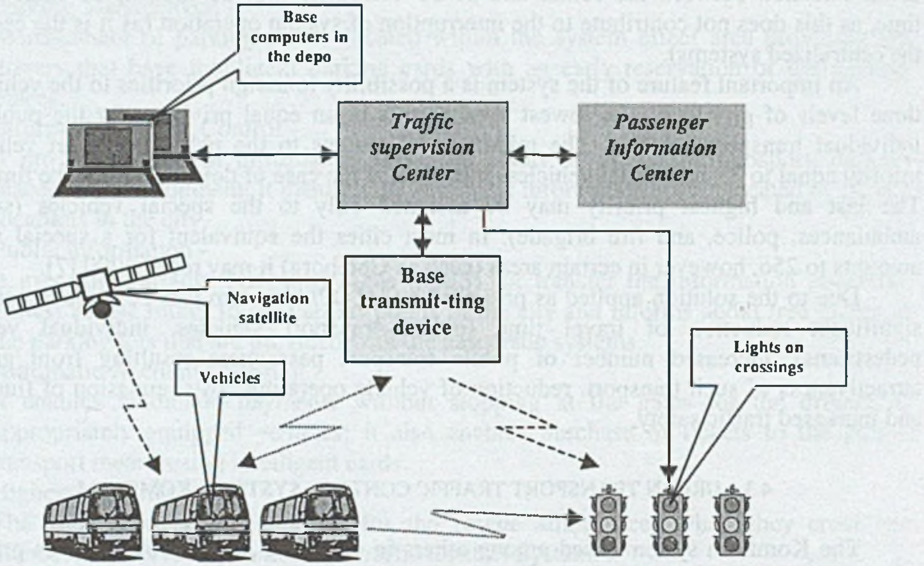

Fig.1. Traffic Supervision Center Subsystem

The Passenger Information Center subsystem cooperates with CNR in order to obtain information concerning location of all the vehicles. Using this information it is possible to forecast the time of arrival and departure for all vehicles and stops. Thus obtained, these data are transmitted to the terminals located at the more important points of the city, to the information boards on the stops. This information is also available for cellular phones, Internet and pagers. This subsystem also provides information in the case of malfunction or longer interruption in the traffic.

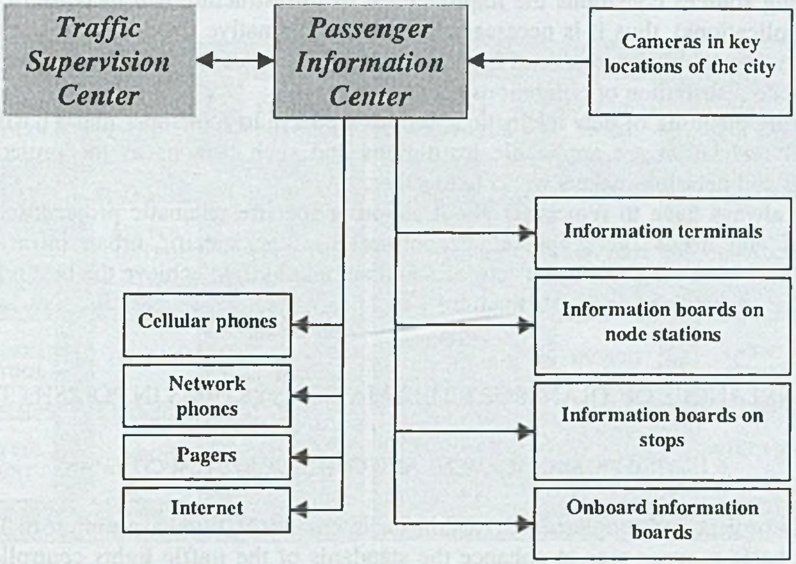

Fig.2. Subsystem of Passenger Information Center

5. CONDITIONS NECESSARY FOR TRANSFER OF EXPERIENCE FROM THE EUROPEAN COUNTRIES TO POLAND

When comparing the situation of Poland on the background of the Western Europe Countries, the most important problems seem to be those related with economical transformation and changes that affected the entire transportation sector.

Poland is a country with high share of public transport in the urban transportation. Maintaining this direction is justified by technical, economical and environmental reasons [5]. This requires, however, constraining many disadvantageous tendencies resulting in a permanent growth of crowding in Polish cities. As it is widely know, it is not possible to follow the expanding motorization with development of roads and parking lots. This results in an expanding support for the idea that supplies should be matched to demand for the public transport services. This idea is becoming increasingly popular in the European Union countries. One of the basic factors for realization of this policy is a priority treatment given to the public transport (in relation to the individual one). The development of transport telematics gives new opportunities to meet these challenges.

As shown by researches, the application of telematic solutions to the traffic engineering gives far more advantages that the geometric solutions [7]. Thus it is purposeful to implement such solutions in Poland (where additionally poor technical condition of transport infrastructure results in a growing crowding of city streets).

An important condition is improvement of availability of knowledge concerning transport telematics between the decision-makers. This is a sine qua non condition to obtain from them, political support and funds for telematics. Thus a need arises to review various international telematics solution and development of cooperation between countries with similar transport requirements. Limited funds still remain a problem (an insufficient quantity of financing sources constrains the improvement of infrastructure and increase of telematic system applications), thus it is necessary to look for alternative financing for transportation projects. A special attention should be paid to the cooperation of private and public sectors and adequate distribution of obligations between them [4].

During planning of new telematic solutions we have to remember that a basis for their successful realization are applicable institutions and such persons as the project authors politicians and decision-makers working together.

We always have to remember about adopting specific telematic projects to the local conditions and needs (geographical, economical aspects, specific urban infrastructure a present status of development of electronics and automation), to achieve the best relationship between benefits gained and costs incurred.

6. INSTANCES OF TRANSPORT TELEMATICS SYSTEMS IN POLISH CITIES

6.1. TRAFFIC MANAGEMENT AND CONTROL SYSTEM CITYMAN

This project was implemented within an international Eureka program in Poznań in 1998. Its basic purpose was to enhance the standards of the traffic lights controllers in the urban area covered by the program (including the main transport artery). For this purpose, each of the controllers was provided with a "black box". It is a single-chip computer communicating with the controller located at the intersection and controlling specific traffic parameters. For this purpose, each "black box" was provided with a universal protocol of the "master" type while the independent controller was provided with the "slave" type adapted protocol [4]. Now it is possible to control taking into account the present traffic level, central supervision and optimization of network operation. The block diagram of the "black box" together with the concept of communication with the existing controller is presented on Fig. 3 [9].

The implementation of Cityman system enabled improved coordination and increased capacity of the main artery of the city by ca 30%. In order to realize the project tasks the consortium consisting of a leading Dutch supplier and Polish consulting company PolTraffic applied for financial support within the international Eureka program. This project constitutes a good instance of cooperation between the public and private sectors (Poznań City and the consortium). In the situation that the public sector is unable to carry out single-handed certain investment projects and incur the operating costs, such model of cooperation is often profitable.

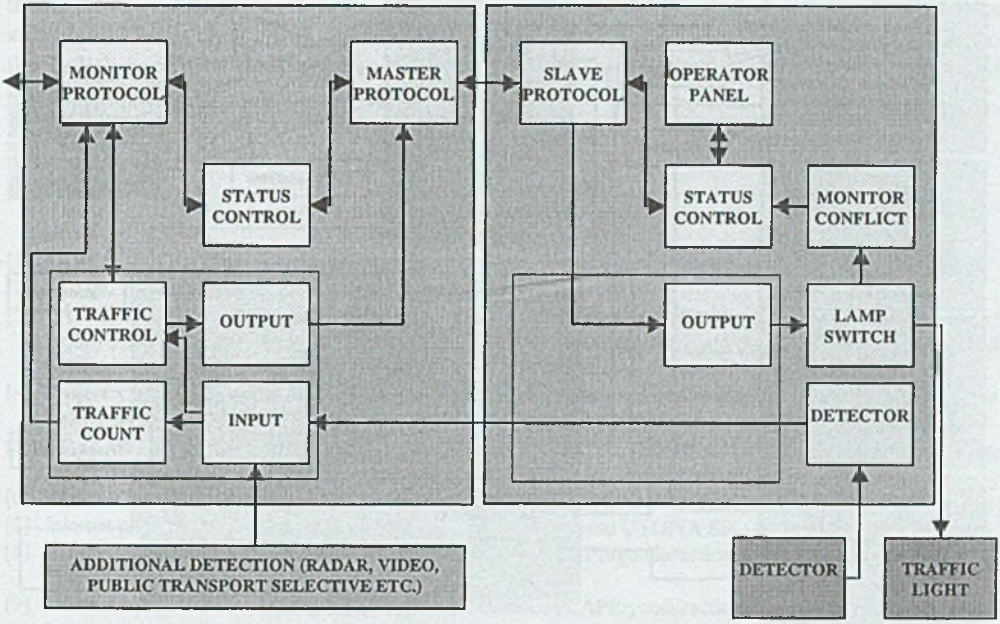

Fig.3. Block diagram of „Black box"

6.2. TRAMWAY TRAFFIC SUPERVISION SYSTEM SNRT 2000

This system was installed in the year of 2000 in Warsaw and now it controls 350 appropriately equipment tramways [10]. The SNRT 2000 system consists of the following basic parts (Fig. 4.): Dispatcher Center that coordinates and supervises operation of the entire system, Communication Center with its base station for transmission and phone communication; Depot Centers connected and cooperating with the Traffic Supervision Center and Traveling Device located onboard at the driver's stand, serving the purpose of data transmission and phone communication with the Dispatcher's Center. The Traveling Device has a built-in GPS receiver enabling determination of current geographic coordinates of the supervised vehicle. These coordinates are used to calculate the compliance with the timetable and when transmitted to the Center they enable visualization of present location of each train on the dispatcher's monitor.

After installation of this system, the improvement of quality of the transport services was immediately visible in improvement of travel conditions, such as timely arrivals and departures, support of generally understood safety in the city, possibility of instantaneous reaction to the malfunctions notified, better use of rolling stock and its increased durability; reduction of the operating costs.

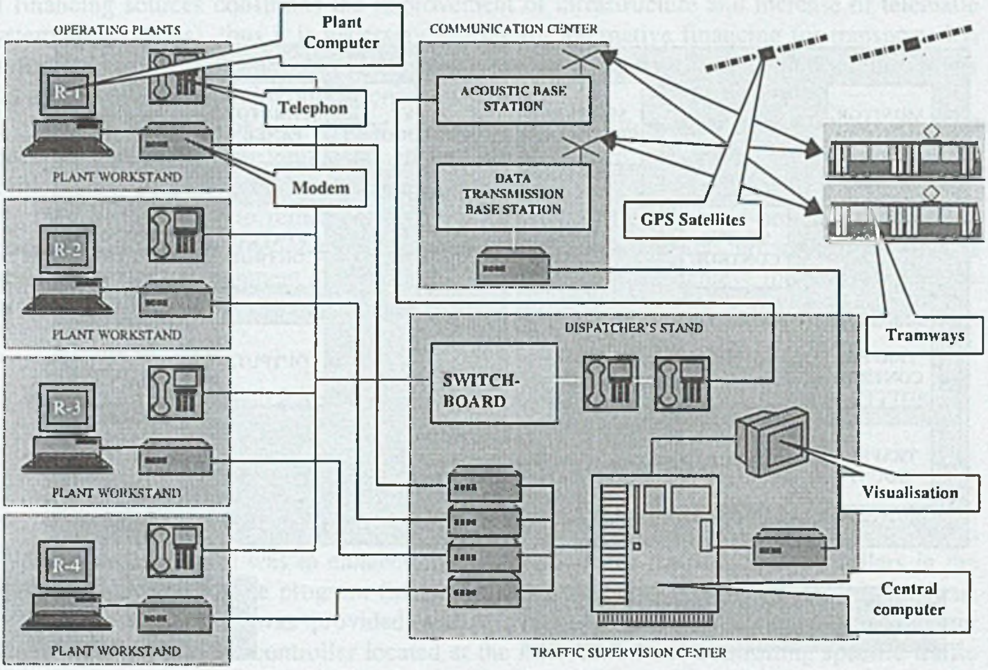

Fig.4. Basic components of SNRT system

7. CONCLUSIONS

Comparison of Poland with the developed European countries is not favorable, when it comes to the implementation of the urban traffic control system. However, the process of degradation of public transport in Poland, lasting for over 10 years shows certain limited tendencies. The global number of passengers transported becomes more stable, the service quality and management efficiency in the transport companies are improved. Polish transport companies now start to see enormous opportunities offered by the solutions already implemented and renowned in the Western European countries. European experience shows that the investments related with implementation of telematic systems in the cities are several times more efficient that the traditional improvement of geometry.

In the conditions of limited funds for the improvement of transport system in Polish cities, implementation of Intelligent Transport Systems seems to be difficult. However, we have to remember about the possibility to acquire funds from international aid programs. Poznań is a good instance of such aid as it obtained support from international Transport Project Eureka in amount of 1 million Euro for realization of the Cityman project.

14 July 2000 Polish Lower House of the Parliament has passed a Decision about establishing base for Information Community in Poland. This act applied also to the transport systems. It was a response of Poland to the European plan “eEurope” concerning a general action plan for modernization of European economy. One of its objectives was expansion and implementation of ITS systems.

Presently several Polish cities undertook actions to improve the quality of the public transport services. Several among them have already implemented transport telematics solutions. This is comforting, because it shows that the issue of adapting such technologies to the Polish condition does not have to necessarily become an insurmountable technical and financial obstacle.

BIBLIOGRAPHY

[1] LEŚKO M., GUZIK J., Sterowanie ruchem drogowym. Wydawnictwo Politechniki Śląskiej, Gliwice 2000.
[2] PAJĄK A., Zielona fala. Enter, nr 9, September 2001.
[3] PAPIERKOWSKI K., Sterowanie ruchem w komunikacji miejskiej w Skandynawii na przykładzie systemu Komfram. Zeszyty Naukowo – Techniczne Oddziału Stowarzyszenia Inżynierów i Techników Komunikacji w Krakowie, book No 64, Kraków 1998.
[4] Project CAPE (TR 4101/IN 4101), Final list of appropriate practices (transport telematics) – review of telematics application in Middle European countries, November 1999.
[5] ROZKWITALSKA C., RUDNICKI A., SUCHORZEWSKI W., Rozwój miejskiej komunikacji zbiorowej w Polsce w latach 1995 – 2000 i kierunki rozwoju po 2000 roku. Publication of IGKM, 2001.
[6] RUDNICKI A., Jakość komunikacji miejskiej. Publisher SITK, Kraków 1999.
[7] Internet page: www.peektraffic.nl – materiały dotyczące systemu UTOPIA SPOT.
[8] Internet page: www.rec.org/REC/Programs/Telematics/CAPE/goodpractice/trnsprt/doc/TURIN-pl.doc. – Internet page concerning project 5T.
[9] Internet page: www.rec.org/REC/Programs/Telematics/CAPE/goodpractice/trnsprt/pdf/poznanen.pdf – Internet page concerning project Cityman.
[10] Telekomunikacja & Telematyka. No 4 September 2000, No 7 August-September 2001, No 4 October 2001.

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