

*Intelligent Transportation Systems,
traffic management,
freeway systems*

Kazimierz JAMROZ¹
Jacek OSKARBSKI²

INTELLIGENT TRANSPORTATION SYSTEM CONCEPT FOR THE TRI-CITY RING-ROAD

Intelligent Transportation Systems provide many tools such as advanced management traffic systems or emergency systems to improve transportation systems. Towns of Tri-City Agglomeration started to work out conceptions of traffic management systems according to agreement established in Sopot in 2002. The first stage of conception works was the agglomeration system. The paper concerns description of the second stage of conception works – an integrated freeway traffic management system on the Tri-City Ring-road.

KONCEPCJA INTELIGENTNEGO SYSTEMU TRANSPORTU DLA OBWODNICY TRÓJMIASTA

Jednym ze sposobów udoskonalenia układów transportowych jest zastosowanie Inteligentnych Systemów Transportu. Systemy te dostarczają szeroki wachlarz narzędzi począwszy od zaawansowanych systemów sterowania ruchem za pomocą sygnalizacji świetlnej do systemów ostrzegania o możliwości wystąpienia wypadku. Zgodnie z ustaleniami podjętymi w Sopocie w 2002 roku, miasta Aglomeracji Trójmiejskiej przystąpiły do opracowania koncepcji systemów zarządzania ruchem na podległych sobie drogach. Pierwszym elementem prac było przygotowanie koncepcji trójmiejskiego systemu aglomeracyjnego. W referacie przedstawiono opis drugiego etapu prac koncepcyjnych – zintegrowany system zarządzania ruchem na Obwodnicy Trójmiasta.

1. INTRODUCTION

An effective and convenient transportation system is the basis for developing business and improving the quality of life. The public expects to be able to drive to work, school and to places of recreation. While the car helps meet those needs, it also poses a risk to the environment and health. In particular, the car itself makes its life more difficult. This situation sets the context for many cities worldwide to introduce intelligent systems for managing

¹ Department of Highway Engineering, Technical University of Gdańsk, Narutowicza 11, 80-952 Gdańsk, kjamroz@pg.gda.pl

² Department of Highway Engineering, Technical University of Gdańsk, Narutowicza 11, 80-952 Gdańsk, joskar@pg.gda.pl

transportation [1], [2], [3], [4]. In an effort to build an ITS, the cities of the Tri-City Conurbation at a 2002 meeting in Sopot, made the decision to develop a concept of traffic management. The underlying studies are already finished, i.e. a general concept of the Intelligent Transportation System in the Tri-City Conurbation and a general concept of an integrated traffic management system on the Tri-City Ring-road [5] and general concepts of urban traffic management systems in Gdynia [6] and Sopot [7].

The study in question will help to gather knowledge about Intelligent Transportation Systems, begin work on building a professional team to build and operate the Conurbation Transportation System, identify and justify the need for integrated traffic management systems on the Tri-City Ring-road, in Gdynia and Sopot and in Gdańsk, Pruszcz, Rumia and Reda, develop detailed traffic management systems, develop an action plan, prepare a pilot project and an application for national and international assistance for the project.

2. WHY ITS

Intelligent Transportation Systems (ITS) are used to improve transportation systems to make them more efficient, effective and safe. These systems offer a wide range of possibilities, beginning with advanced traffic control systems using light signalisation to accident warning systems. Studies in the USA, Japan and Europe show that by using ITS [2], [3] we can:

- reduce expenditure on transport infrastructure by as much as 30 – 35 %, and obtain the same effects in terms of system efficiency,
- increase by as much as 20 % the efficiency of transport systems (in terms of capacity) without having to spend money on road works,
- significantly reduce the number of incidents and casualties,
- reduce travel time,
- significantly reduce CO₂ emissions,
- help the economy by increasing production of electronic equipment.

Transport development programmes across Europe make extensive use of intelligent transportation systems and integrated traffic management. Poland too has recognised the need for modern transportation systems. Relevant work, however, still remains uncoordinated. The National Development Plan 2004 – 2006 [8] in its transport section includes an operational plan Transport – Maritime Economy. The programme includes two priorities:

1. Sustainable development of the transportation system.
2. Safer road infrastructure.

Priority 2 Activity 3 says “development of traffic control systems” and will be eligible for European Union funding. The government’s document “e-Poland” sets out plans to develop intelligent transportation systems in Poland [9]. With the upcoming membership in the European Union, Poland decided to adopt main development goals in the area of intelligent transportation. These include:

- development of an intelligent system of safe transportation,
- development of systems for collecting information and databases,
- development of a databank on hazardous materials,
- reduction of urban congestion.

A diagnosis of the Tri-City Ring-road transportation system identified a number of transportation problems [5]:

- high level of congestion, in particular during peak times, negatively affecting the conditions and quality of travel for transportation, loss of time and poorer quality of life of the community and negative impact on the environment,
- high costs of incidents and high costs incurred when traffic is stationary as a result of road incidents,
- rescue operations are affected because of the difficulty with identifying the scene of the incident, reaching it and providing help,
- lack of information about traffic and driving conditions both before and during travel.

Because of the above factors, the decision was made to implement the ITS in the cities of the Tri-City Conurbation as a way to alleviate or solve the problems. Priority number one is the development of a conurbation-wide ITS and implementation of an integrated system for managing traffic. This work is necessary not just because of the national and international trends in the area, but because of the current traffic conditions in the Tri-City Conurbation, making an integrated traffic management system a must. This is further justified by the following factors:

1. With more business and social activity, traffic and mobility in the Tri-City Conurbation are rising too, making traffic conditions more difficult, while the existing road infrastructure, traffic systems and control do not meet the needs of the types and volumes of traffic.
2. An integrated traffic management system is one way to improve traffic and make optimal use of the Tri-City Conurbation's traffic capacity. The traffic management system itself, however, does not mean that the road system needs no further development. Work must run parallel, i.e. system development and infrastructure development.
3. The Pomorskie region's spatial policy includes a sustainable transportation policy designed to reduce the demand for the passenger car and increase the use of public transportation. To implement the policy more decisive steps are needed to improve the effectiveness and convenience of public transportation.
4. The Tri-City Conurbation with its sea ports and maritime economy businesses carries a lot of freight transportation leading to substantial traffic of heavy goods vehicles in the city. With the growth of national and international traffic in the area, including the establishment of the Pomorskie Logistic Centre, telematics will have to be introduced into goods traffic management.

It is important to remember that ITS measurements will not solve all of the transportation problems on the Ring-road, but can reduce them. Besides ITS measures applying the other activities should be made:

- development of the street network which cooperates with Ring-road,
- building of new interchanges and modernization of existing ones,
- building of new freeway sections (A-1, S-7).

The assumptions to the Gdansk Conurbation's ITS presented below are the result of analyses and comparisons between European and American advanced traffic management systems and the identified transportation problems. The Tri-City ITS should include all elements of the Tri-City Conurbation transportation system which need to be co-ordinated between the industries, areas and organisations providing the service and organisations using the system. The Tri-City ITS should include the requirements and needs of the local systems and ensure co-operation between them and ways to integrate them. The Tri-City ITS should include national and international needs and allow for the involvement of a number of companies and organisations, become part of international programmes and gain access to international funding. Before work on the system begins, standards of procedures and equipment must be developed. The system can then be divided into stages to be managed by local authorities and agencies responsible for Tri-City traffic and transportation. The standards and procedures will help ensure compatibility of all ITS elements and identical traffic management.

The Tri-City Intelligent Transportation System **TRISTAR** (acronym from the Polish words: **TR**ójmiejski **I**nteligentny **S**ystem **T**ransportu **A**glome**R**acyjnego „**TRISTAR**”) should be a set of tools for efficient and effective transportation infrastructure management and efficient traveller service across the Tri-City Conurbation. TRISTAR will consist of an intelligent infrastructure, intelligent vehicles and an intelligent management system. Because no national guidelines on system architecture are available, the system is based on European, Japanese and American models. The freeway traffic management system on the Tri-City Ring (TRISTAR OT) will comprise integrated road traffic management sub-system, integrated goods traffic management sub-system (logistic centres), integrated rescue management sub-system (integrated rescue system), integrated incident management sub-system, integrated transportation information sub-system.

The system architecture is illustrated in Figure 2.

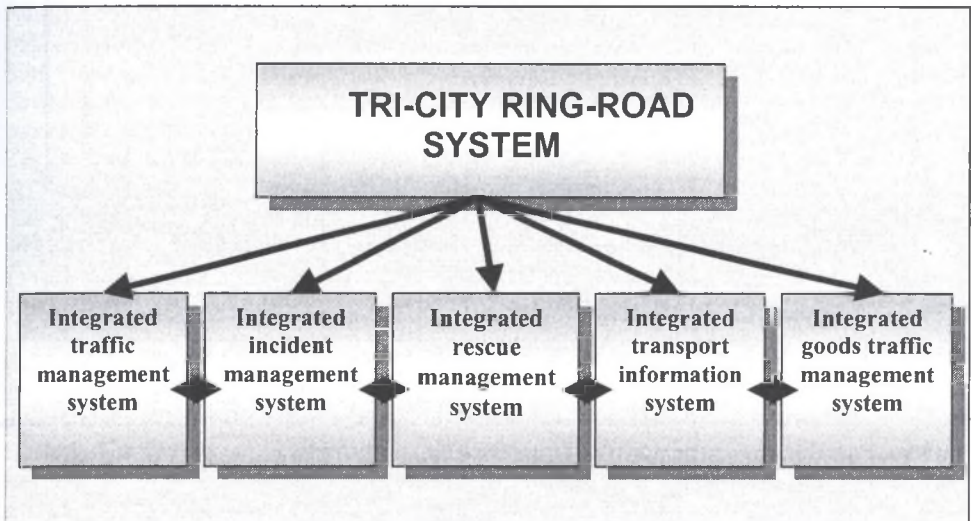


Fig.2. Overall system architecture

The objective of implementing the ITS on the Tri-City Ring-road is to make a more effective use of the existing road and transportation infrastructure, reduce accidents, reduce congestion, improve travel conditions, monitor and protect the environment, better manage all elements of the transportation system, better manage the roads, increase the effectiveness of rescue, improve systems for informing drivers about traffic conditions.

The objectives can only be achieved by integrating and co-ordinating all elements of the transportation system as well as co-ordinating with other TRISTAR systems (Fig.3). The Tri-City Conurbation integrated road traffic management system was divided into several systems to manage the elements of the road network in sub-areas of traffic control. Each system manages a specific type of traffic in a specific area through a number of sub-systems. The sub-systems operation will be integrated in their respective management centres. Because traffic control is a complex process and covers a number of problems of Tri-City traffic, a Co-ordination Centre will be established to co-ordinate all sub-systems in the conurbation. The structure of the road traffic management system in the Tri-City Conurbation, including sub-areas and areas managed by road authorities, should be as follows:

- urban traffic management systems,
- freeway traffic management system,
- national non-urban traffic management system.

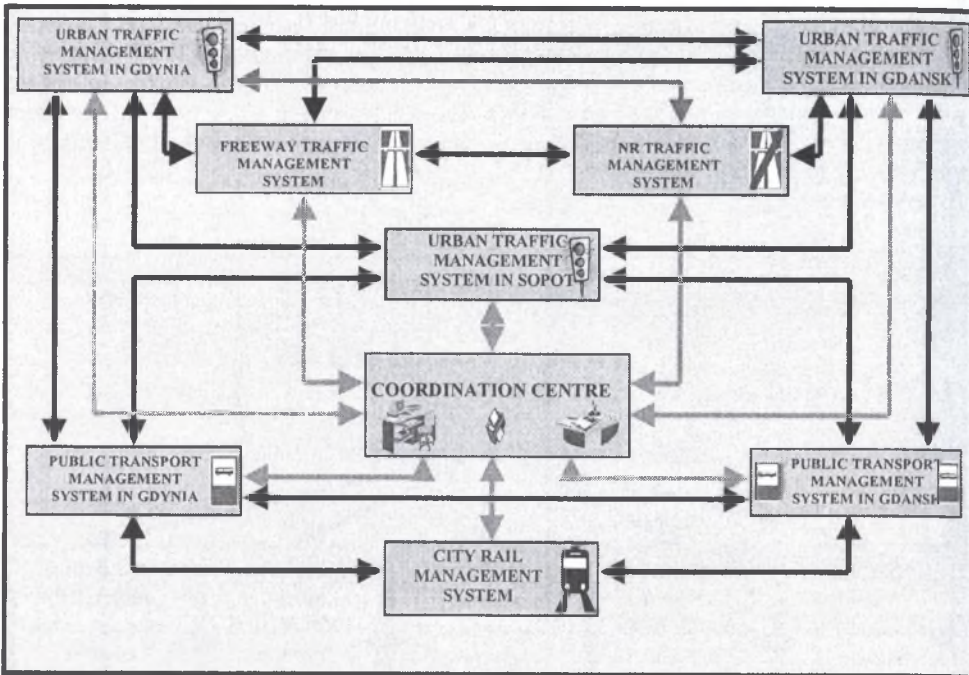


Fig.3. Proposed integrated traffic and transportation management system in transition in the Tri-City Conurbation TRISTAR

3.1 TRAFFIC MANAGEMENT SYSTEM

Integrated Traffic Management System on express roads (Ring-road) will consist of the following sub-systems and cover three elements traffic management system on express road interchanges, traffic management system on express road main carriageway, traffic management system in the express road corridor. The presented architecture shows the targeted traffic management system on the Tri-City Conurbation express roads, however, initially the system will only cover the Tri-City Ring-road as an express road and roads that are part of the Ring-road corridor. Each sub-system of ring-road traffic management will carry out a few functions. The ring-road traffic management system cannot operate efficiently unless co-ordinated with the Gdańsk and Gdynia traffic management systems and the entire Tri-City Conurbation traffic management system. This function will be delivered by the planned Coordination Centre. And traffic management systems in Gdańsk, Gdynia and Sopot will not be fully operational unless co-ordinated with the ring-road traffic management system. On national roads managed by the Gdańsk branch of the General Directorate of National Roads and Motorways, i.e. national road 1 in Pruszcz Gdański, national road 6 in Rumia, Reda and Wejherowo there are more than 25 signalised junctions. To control and improve traffic on these roads, the Directorate's traffic control systems will be used. As separate urban traffic management systems will be introduced, these systems will change their functions.

3.2 INCIDENT AND RESCUE MANAGEMENT SYSTEMS

Systems for managing rescue are usually linked with road incident management systems. These include systems for automatic vehicle localisation, computer-aided vehicle dispatch, priority vehicle fleet management and vehicle positioning. Each of the systems helps reduce the time to reach the scene of the incident. Using the tools offered by ITS requires a specific logical structure of the road incident management system. Structures for the Tri-City Ring-road system were proposed. Incident management begins when the operator at the Rescue Information Centre receives information about an incident. Incident management terminates when normal traffic is restored. Incident information can be passed on to the Rescue Information Centre via the Ring-road Management Centre (for automatic incident detection) or directly by radio (taxi drivers, delivery vehicles) or by telephone (a single number 112). The police, fire service and those responsible for breakdown recovery reach the scene of the incident independently from one another. The road service and public transportation operator become involved when a major repair is required or a long lasting detour. The Centre will play a major role, managing traffic to minimise disturbance and inform drivers (by variable message signs, text messages, the Internet, RDS) about the incident or the preferred routes. Incident management systems help to reduce the detection time, arrival time and time to restore normal traffic. The system of automatic incident detection and camera surveillance (CCTV cameras) helps detect road incidents on the street network. The system can be used by a number of operators who identify and register incidents location, the number of vehicles involved, projected time to recovery). Incident management systems also help to reduce congestion caused by the incident and consequently, reduce time loss, fuel usage and exhaust emissions.

3.3 TRANSPORTATION INFORMATION SYSTEM

There will be 2 basic sub-systems of Tri-City Ring-road transportation information, each of which working together with a wide range of communications devices and information media operators. The idea is to provide traffic information and traffic updates to the biggest possible number of users. The information to be provided to traffic users will include 2 groups of information traffic conditions as well as weather and environment.

3.4 GOODS TRAFFIC MANAGEMENT SYSTEM

ITS systems are also used for managing heavy goods and delivery vehicles traffic. Management techniques using ITS benefit the drivers of delivery vehicles, transport companies and logistic centres who co-ordinate goods traffic. ITS helps to increase the effectiveness of management without investing in the infrastructure. ITS can be used in the following areas of delivery vehicles management:

- safe transit (exchange of information, automatic vehicle and driver inspection),
- shipment administration (vehicle registration, permits for special shipments, automatic fees),
- electronic vehicle monitoring (document inspection, border traffic, inspecting loads),
- managing shipments at logistic centres (travel schedules, routing, route information, shipment monitoring).

ITS enables a more efficient exchange of information among drivers, operators and logistic centres, in particular in case of long haul transport. The use of advanced information exchange systems helps to improve HGV traffic and save time. Because of the efficient exchange of information and automatic monitoring of loads vehicles are not overloaded. The use of ITS helps monitor the technical condition of the vehicles.

4. CONCLUSION

The assumptions to the Tri-City Conurbation intelligent transportation system, show the system's final vision, but a lot needs to be done before it is complete. To build the system, we need to build a team of people taking an interest in the system, finalise the concept as part of "roundtable" discussions involving the relevant organisations, local authorities, road and traffic authorities, include TRISTAR in the strategies and plans of the region, cities and road and traffic authorities, promote the idea of the system on seminars and training courses, develop a pilot project, prepare applications for financial assistance (national and international sources), prepare designs and specifications, carry out the pilot project (projects), continue to develop the system based on experience from the pilot project. The first pilot project could be the Integrated Traffic Management System for the Tri-City Ring-road.

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