intelligent transport system, traffic accidents, safety

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THE FUTURE IN THE TELEMATICS APPLICATIONS AS SUPPORT FOR INCREASED SAFETY

Summary. Traffic is a key-factor in modern economics. Despite of this, there is a continual conflict between mobility satisfaction and increased delay. Nowadays, many specialists are trying to find out the reasons why some traffic events occur. ITS are systems which help to make efficient use of road and urban communication network, using information, communication and directing technologies. They make basic conditions for high quality communication and information society that we are approaching also in our country.

We have to remember that, according to current statistics 93% of traffic accidents are caused by human error.

Assistance systems are the main challenge. They are based on communication (data exchange) not only among vehicles themselves but also vehicles and infrastructure. These so called Intelligent Assistance Systems promise great benefits in the sphere of efficiency of transport systems and road safety. These benefits include mainly increase in the capacity of the road network congestion and pollution reduction, shorter and more predictable driving time, improving traffic safety for all participants of road traffic, lower operational costs of vehicles, better organization and management of road network.

In this paper, I first review all the available techniques for communication between various vehicles among themselves and with the infrastructure. The aim of this is to have a complete overview of all the possible communication techniques that the world of electronics and telecommunications has proposed in the last years that can be applied for accomplishing the task of enabling vehicles to communicate and interact with other vehicles as well as with the infrastructure.

AVENIR DES SYSTÈMES TÉLÉMATIQUES EN TANT QUE MOYENS DAUGMENTER LA SÉCURITÉ

Sommaire. Le transport est le facteur clé de l'économie moderne. Malgré cela, il y a une contradiction subsistante entre la satisfaction de la mobilité et l'augmentation des retards. Aujourd'hui, de nombreux spécialistes cherchent à trouver les causes de certains phénomènes de transport. Les systèmes de transport intelligents sont les systèmes qui aident à utiliser de manière efficace les infrastructures routières ainsi que les infrastructures urbaines en utilisant les technologies de l'information, de la communication et de la gestion. Ces systèmes établissent les conditions fondamentales d'une société de communication et d'information de qualité à laquelle nous accédons même dans nos conditions.

Rappelons que selon les statisques actuelles jusqu‘à 93 % des accidents de la route sont provoqués par la faute de l‘homme. Le défi principal consiste en systèmes d’assistance basés sur la communication (échange des données) non seulement entre les véhicules-mêmes mais aussi entre les véhicules et les infrastructures. Ces systèmes dites systèmes d’assistance intelligents promettent un apport important au niveau de l’efficacité des systèmes de transport et de la sécurité routière. Les apports principaux concernent l’augmentation de la capacité du réseau routier, diminution des embouteillages et de la pollution, raccourcissement et prévisibilité de la durée du trajet, amélioration de la sécurité routière de tous les usagers de la route, réduction des frais d‘exploitation des véhicules, optimisation de l’organisation et de la gestion du réseau routier.

Dans le présent article, je vais décrire les techniques accessibles de la communication d’une part entre les véhicules-mêmes et d’autre part entre les véhicules et l’infrastructure.

1. ANALYSIS OF TRAFFIC ACCIDENT RATE IN SR

The Slovak Republic as a full member of the European Union respects the recommendations of the European Commission in the sphere of road safety and is trying to accomplish them.

The development of transport in all its sectors is linked to the integration to the advanced countries and with developing of the society. Year by year in the road transport is increasing the number of vehicles on the roads as well as new drivers and with this situation is associated a lot of negative effects. The number of road accidents and their consequences increases in the aftermath to lack of conditions for the realization of transport education, low discipline, aggressive driving, violation of fundamental duties, and low legal awareness of drivers and other participants of road traffic.

Traffic accident rate as a serious social problem requires a comprehensive and effective solution that shows features of a coordinated and aimed procedure by all stakeholders and institutions with a broad public support.

The year 2010 has been able to be assessed from the point of the consequences of road traffic accidents as one of the best since 2000. In 2010 we recorded 21 595 accidents. Overview of the last 10 years is shown in Figure 1.

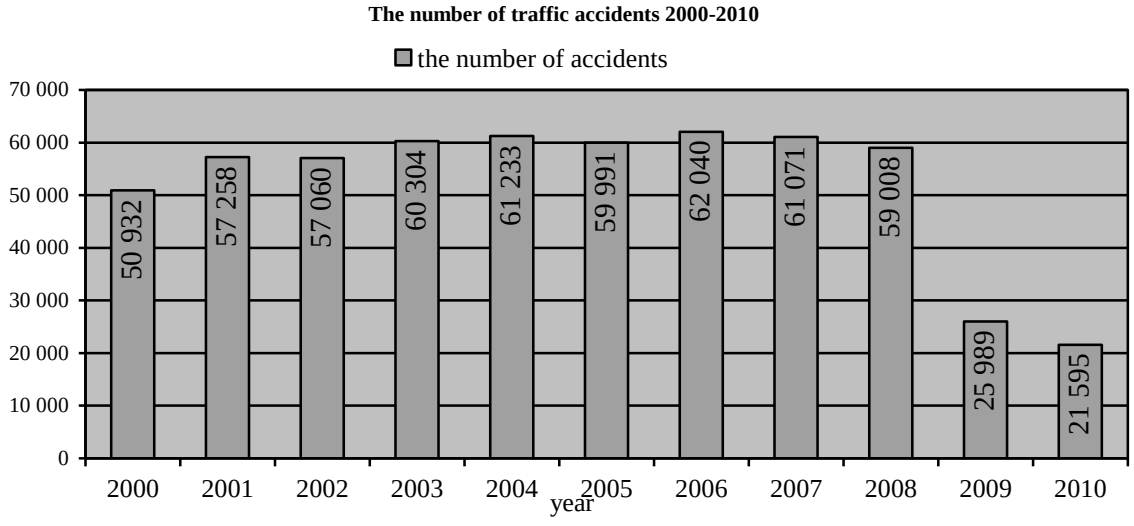

Fig. 1. The number of traffic accidents 2000- 2010 (police presidium)
Abb. 1. Die Anzahl der Verkehrsunfälle von 2000 bis 2010 (Polizeipräsidium)

The number of casualties in traffic accidents in Slovakia in 2009 was the most reduced of all European Union countries. While in 2008 there were 558 casualties on Slovak roads last year it was 345, which has been the least in police statistics since their archiving since 1966. See Figure 2.

Out of the total of casualties, based the people in the vehicles there were 112 pedestrians, 25 motorcyclists, and 19 cyclists. The promise of European Union to reduce the number of casualties hasn't been met.

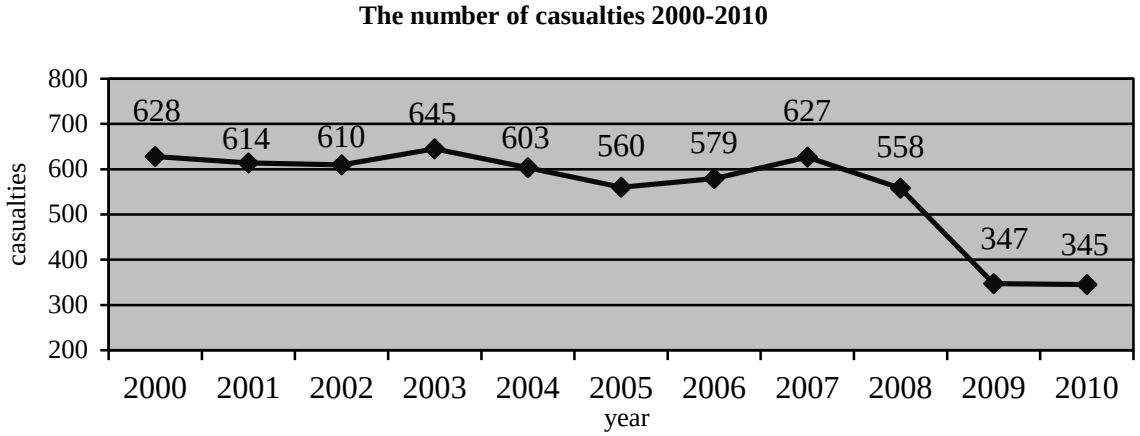

Fig. 2. The number of casualties 2000- 2010 (police presidium)
Abb. 2. Die Zahl der Verkehrstoten von 2000 bis 2010 (Polizeipräsidium)

In Slovakia as well as in whole Europe, are being constantly constructed new and wider roads, highways, tunnels, and urban bypasses. However none of it is enough because the level of congestion and accrue of traffic accident in the morning peak is everywhere the same. Experts are convinced that the solution or at least improve the transport situation in Europe can be otherwise and still cheaper than constructing new transport communications. An important way to improve safety and fluidity is the introduction of intelligent transport systems.

2. ITS FUNDAMENTALS

The number of casualties in Europe (40,000 casualties per year) due to road traffic is still unacceptably high, even if it has reduced significantly over the years due to safer vehicles and infrastructure and transport policy. Car ownership and its usage have continued to grow steadily, and the resulting congestion in built-up areas and on main highways has become a significant overhead cost and burden for travellers, for economy and for environment.

Interest in ITS (intelligent transport systems) comes from the problems caused by traffic congestion worldwide. Congestion reduces efficiency of transportation infrastructure and increases travel time, air pollution and fuel consumption.

Intelligent Transport Systems and Services integrates information and telecommunication technologies with transport engineering under the support of other related industry, in order to provide for the existing traffic infrastructure an advanced system of control of traffic and transport processes – enhancing the transport performance, traffic efficiency, road safety, and comfort of transportation, etc. The main objectives of transport telematics are to offer intelligent services, which must be considered at several levels: for travellers and drivers (users), infrastructure administrators, transport operators (carriers), security and rescue system, financial and control institutions.

The basic components of transport telematic systems include the following fields:

- electronic payments,
- management of security and rescue measures,

- management of traffic processes,
- management of public passenger transport,
- support at management of means of transport,
- support of people's mobility,
- support of supervision over adherence to regulations,
- management of freight transport and forwarding agents,
- transport and traffic database.

3. COOPERATIVE VEHICLE- INFRASTRUCTURE SYSTEMS- THE FUTURE OF INTELLIGENT TRANSPORT SYSTEMS

Assistance systems are the main challenge. They are based on communication (data exchange) not only among vehicles themselves but also vehicles and infrastructure. These so called Intelligent Assistance Systems promise great benefits in the sphere of efficiency of transport systems and road safety. These benefits include mainly increase the capacity of the road network, reduce congestion and pollution, shorter and more predictable time of driving, improving traffic safety for all participants of road traffic, lower operational costs for vehicles, better organization and management of road networks.

Cooperative systems for transmitting information in real-time use communication among vehicles (Vehicle-to-vehicle, V2V) and between vehicle and infrastructure (Vehicle-to-Infrastructure, V2I). They hold the promise of major improvements in the efficiency of the transport system, improve safety for all road users and increase the convenience that the mobility provides. The work on cooperative systems started in Europe in the fifth and sixth Framework Programme. In connection with the industry a consortium Car2Car has been set up [5], which promote a common progress of industry. The key prerequisites and the main objective of the Commission include the development of harmonized and interoperable system architecture, an architecture of common communications that can meet the needs of public and private sector, as well as the availability of suitable frequency.

To this end, as a part of the specific action COMeSafety [5], which was funded by the 6RP, the Working Group on Communications Architecture was established. This working group coordinates and consolidates the work of European and national projects as well as other key initiatives, and represents an interface for standardization in ISO and other standardization authorities.

Cooperative vehicle-infrastructure systems (CVIS) project is a project where 60 European companies have now joined forces in order to create new Intelligent Transport Systems opportunities.

Several engineering based research projects have shown that CVIS could potentially improve safety. It is also widely documented that 75 % of road crashes are due to human failure. Since pertain to the drivers decision-making process, it is important to understand how CVIS could improve driver's decision making and reduce failure.

Figure 3 illustrates how passive safety systems could contribute to crash rate reduction minutes and seconds prior to crash. The earlier an on-board system could anticipate crash risk (left side of the Figure) the more effective it can reduce crashes. However, the effectiveness of any ITS systems milliseconds before crash are limited (right side of the Figure). The blue box represents the area where CVIS, seen as an extended map, could contribute to crash reduction.

Cooperative vehicle-infrastructure systems offer truly the most promising new services for all participants involved in road transport, to the extent that they represent a revolution in both the way the transport system could work in the future, and in the scale of benefits available to infrastructure owners and operators and to individual road users.

So, if cooperative systems are so effective and produce such benefits, one could ask why there are none today, in either vehicles or at roadside. The answer is clear: the technologies that are needed to create applications where vehicles and roadside infrastructure can talk to each other

directly are not yet fully developed and validated. Also, the main entities involved are not yet persuaded of the utility and benefits of investing in cooperative system.

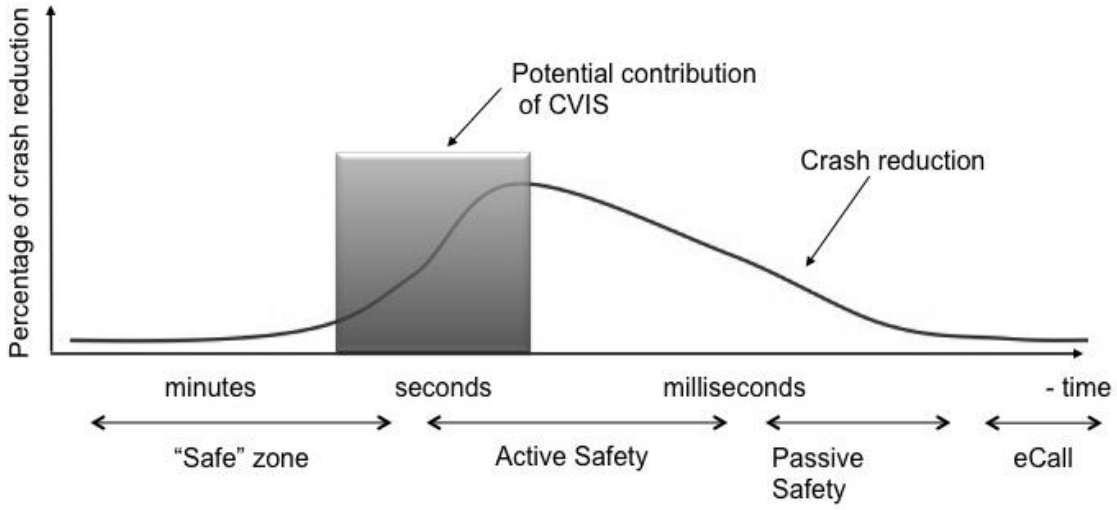

Fig. 3. Safety scope of Cooperative systems
Abb. 3. Sicherheit Umfang der Kooperative Systeme

Fig. 4 shows how cooperative systems can break the "vicious circle" of ever-worsening traffic problems by offering – for the first time – new ways for drivers and their vehicles to interact (and not just react) with a more intelligent infrastructure. And that new intelligence is due to new kinds of information that come, at least partly, from individual road users.

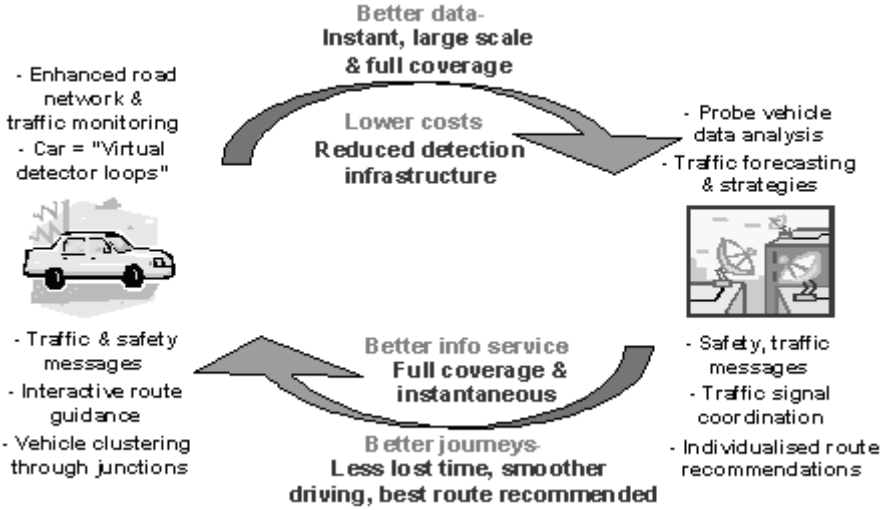

Fig. 4. Graphic representation of interaction of a driver, vehicles and an intelligent infrastructure
Abb. 4. Grafische Darstellung der Interaktion von Fahrer, Fahrzeug und eine intelligente Infrastruktur

4. ITS AND SLOVAK REPUBLIC

The Slovak Republic faces a lot of transport problems, which does not come out only of the uncompleted transport infrastructure, but they concern many areas such as transport safety, impact of transport on the environment or quality of service, of which solution was not sufficiently secured

in the past. The Government of the Slovak republic adopted a project of an action plan, formulated in several areas which are aimed at:

- optimization of the use of the latest road data and data access,
- the synergy of combined applications and services in area of commercial transport,
- data security and protection of personal and commercial data,
- strengthening the effect of public authorities in the field of ITS,
- a framework for integration and coordination of programs,
- a framework for promotion of diversity and acceptance of ITS.

A supporting program of the development of intelligent transport systems - National System of Traffic Information- represents comprehensive solutions of intelligent transport systems based on information and communication systems and technologies in road transport in Slovakia. It is oriented to the use of a single system surrounding for the collection, processing, sharing, distribution and use of transport information in concrete information, guiding and telematics applications

Basic system requirements are:

- minimize the creation of congestion,
- increase the efficiency of traffic that is expressed by saving time
- increase mobility and quality of transport services,
- create space for an efficient multimodal transport,
- make available information in real-time for passengers, carriers and users of communications,
- improve productivity of commercial activity of transport processes in society,
- reduce energy consumption,
- increase the quality of the environment.

As mentioned recently, the growth of road transport is an attendant phenomenon of development, which manifests in a significant growth of negative impact of transport on the environment, growth in congestion in conurbation, and growth in traffic accidents common both for developed countries, and in conditions in the Slovak Republic.

Forthcoming Action Plan of ITS aims to:

- decrease transport congestion by 25% and increase the quality of travel,
- increase transport safety by 25% and thereby contribute to the overall European goal to reduce number of death by 50%,
- reducing CO2 emissions by 10%, mainly in urban areas.

5. CONCLUSION

As transportation engineers, we are interested in knowing the schemes that can be applied to the field of transportation engineering to alleviate traffic problems like safety, congestion, environmental degradation and off late, energy consumption by the vehicles, to name a few. Intelligent Transportation Systems are undergoing a transition from demonstration projects to becoming part of the mainstream set of options available to transportation planners. Hence, evaluation of ITS is one of the most critical and important steps to be taken before any ITS technique can be deployed. Safety has been recently emerging as an area of increased concerns, attention and awareness within transportation engineering. It has been extremely difficult to evaluate safety for new and innovative traffic treatments.

Modern transport systems for road networks include many different intelligent transport and telematics systems mainly built for traffic monitoring, control operation and electronic fee collection purposes. Furthermore, a wide range of sensors monitoring weather conditions, traffic status, vehicle types and their speeds are used to enable the applications mentioned above. The increase of data network capacity, processing power within the traffic control center (TCC) and development of sophisticated sensor fusion algorithms enables the concept of a single, consistent, central database which serves all applications and customized information distribution channels such as variable message signs (VMS) or wireless traffic information via the radio data system – traffic message

channel (RDS-TMC). The maximum benefit for the stakeholders can be achieved if the services do not only use common databases, but contribute actively to it and share their complementary data in order to operate in a co-operative manner. Current FP6 integrating projects like COOPERS, "cooperative vehicle infrastructure systems (CVIS)" and "co-operative vehicles and road infrastructure for road safety (SAFESPOT)" are elaborating this co-operative system approach.

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