Using Telematics in Transport

Jerzy Mikulski

Silesian University of Technology, Faculty of Transport,
Krasinskiego 8, 40-019 Katowice, Poland
jerzy.mikulski@polsl.pl

Abstract. Design and development of telematics transport systems represents a new approach to solving transportation problems. Telematics offers large opportunities to strengthen the positive features of transport (availability, mobility), while minimizing its negative impacts (e.g. environmental pollution, energy consumption, congestion, accidents, infrastructure construction costs) without any additional spending on investment.

Keywords: Transportation, ITS, Telematics applications.

1 Introduction

As a technical term, “telematics" is a portmanteau of “telecommunication” and “informatics”, while as a science, it integrates research in telecommunication, automatics and information technologies. Currently, telematics is defined as telecommunication, information and IT solutions, as well as automation solutions adapted to the needs of physical systems (and often integrated into these systems).

Physical systems with such telematic solutions are called "Intelligent Systems". Intelligent systems use numerous devices (and software), such as:

- electronic communication systems,
- data acquisition systems,
- operator data presentation systems,
- user data presentation systems.

2 Applications of Telematics

Telematics is a modern field in technology. One can say that "telematics has become trendy recently". In recent years, telematics can be found in various areas of economy, often accompanied with a qualification of its applications: construction telematics, medical telematics, transport telematics, etc (see Table 1).

We are concerned with transport telematics, which encompasses all means of transport. Transport telematics means the application of teleinformatics technologies in managing transport systems. Various telematics systems apply to different types of transport infrastructure and to different means of transport. Therefore, telematics applies to all means of transport.

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Table 1. Applications of telematics

Sector	Area	Application
Construction	institutions, industry	safety, security, lighting, transport, fire and access control
Power engineering	power supply, electricity, oil, gas, alternative fuels	turbines, generators, batteries, backup supplies, wind power plants fuel cells,
Household	infrastructure, safety, comfort	power, supply, washing machines, dishwashers, lighting, heating, ventilation, safety cameras, supervision
Medicine	healthcare, nursing, medical examinations, science	telemedicine, telesurgery, monitoring
Industry	resources, automation, distribution, science	manufacturing, engines, motors, pumps, valves, conveyors, processing, assembly, packaging,
Transport	means of transport, infrastructure, transport systems	vehicles, vessels, airplanes, signalling, navigation, signs, payments
Commerce	warehouses, deliveries	terminals, cash registers, ticket vending machines
Safety	supervision, tracking, equipment, public structures, crisis management	police, ambulances, helicopters, fire brigades, monitoring, internal safety
IT	public, industrial, personal	power supplies, UPS, routers, memory, switches

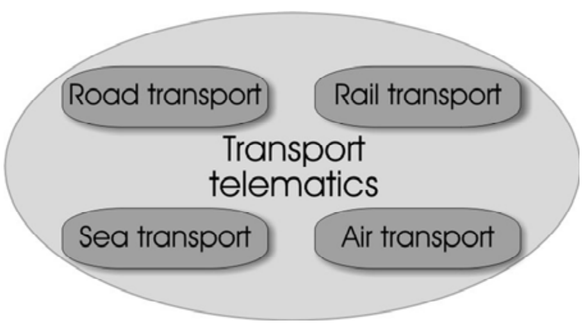

Fig. 1. The scope of transport telematics

In transport, telematics allows for influencing the transport process (both passenger and cargo) in order to improve the effectiveness, enhance planning and safety as well as to reduce the environmental impact. Telematic systems enable a more effective use of transport infrastructure, increase traffic quality and flow as well as facilitate transport systems operation. The ability to retrieve, process and transfer traffic data in real time provides new opportunities in mobility.

Table 2. Types of telematic systems

Applications	Services
Traffic management	Traffic control Law enforcement Planning support Incident and accident management Demand management Infrastructure maintenance Priority vehicles
Safety	Intelligent intersections Transport safety Safety of weaker vehicles
Public transport	Public transport management On-demand transport management Information concerning travel time Pre-travel information Information during the travel Personal information services
Means of transport	Guiding along a route Navigation Visibility enhancements Automated driving Collision avoidance Advanced monitoring systems Automated inspection Internal driving safety monitoring Vehicle fleet management
Support	Accident information and personal safety Rescue vehicle management Hazardous materials and accident notification
Electronic payments	Electronic financial operations

All over Europe, the implementation of intelligent transport systems (ITS) is performed according to plans and EU recommendations. In Poland, the process of implementing the telematic systems is slow and, thus, less beneficial than expected.

Transport telematics means the systems allow for influencing the behaviour of drivers, the operation of vehicle elements, or the route through information transfer and analysis.

2.1 Rail Applications

In railroad transport, traffic control applies to the gaps between trains, speed and security against entering wrong routes. Due to long braking distances, railroad traffic is controlled from an external control room, while the engine driver is informed about the traffic circumstances by light signals or in the cockpit. On-board instruments can take over when the driver disregards signalled situations (or is unable to drive).

Ensuring the safety of high-speed railroad traffic requires constant exchange of information between the rails and the vehicle. Operations are currently under way to implement the latest traffic control systems using new communication technologies for data transmission.

European railroads are trying to unite the widely diversified national traffic control systems according to ERTMS/ECTS project (European Rail Traffic Management System/European Train Control System), and to increase the throughput by abandoning the traditional system of linear barriers and implementing the movable distance system (virtual barriers), which is enabled by constant train tracking from the control centre, and transferring the extreme traffic parameters directly to the train. The system requires precise train positioning and train continuity tracking.

2.2 Road Applications

The purposes of telematic systems in road transport:

- Traffic control,
- Traffic flow control,
- Cargo flow tracking and optimisation,
- Fee collection,
- Travel information and booking.

The systems should therefore be able to control traffic lights and changes in traffic directions, regulate the merging process, influence driving speed and gaps between vehicles as well as warn against hazardous situations (such as congestions, surface damage, weather conditions, etc.).

In order to warn the drivers about hazardous situations, the dynamic content can be used in addition to static signs. In controlling the traffic en route, there is a problem of the drivers not obeying the limitations, even though such matters are regulated by the Highway Code. In the future, such information could be transferred directly to the vehicle. There are already systems to enforce a certain driving style using technical solutions (such as limiting the top speed or automatically keeping the distance from the preceding vehicle). Navigational information is especially important, although they should be accompanied by information concerning the real arrival time. Navigation systems are very popular, and static data concerning the roads (maps) allow for reliable routing, when combined with the GPS signal. Such navigation devices can provide dynamic information concerning traffic and detours over radio frequencies or cellular data connections. Personalised (dedicated) routing service is also possible. Current traffic information could also be provided via an Internet connection. Such system could be warning against long-term (e.g. roadworks) or temporary (e.g. traffic jams) obstacles.

2.3 Management Applications

Parking management systems allow for directing individual vehicles to a free spot using the shortest route. This can be a solution to the long search for free parking spots, and could allow for more even car park utilisation. The dynamic parking system becomes especially handy in rush hours.

The main task of the transport system operator is to control the traffic of municipal transport. Any disruptions, caused mainly by overloads on certain sections, are avoided owing to the dynamic transfer of information or commands. Public transport allows for route changes (by an operator), as well as for decisions made by the passenger themselves (changing their means of transport). By controlling the traffic flow in the streets, detours can be organised for overloaded or blocked sections. The throughput of certain sections of the road network can thus be enhanced by using alternative routes.

Public transport has been using telematic systems for the last several years to identify disruptions in scheduled runs (delays, disrupted connections with other routes) and to remove them or limit their effects. This applies to both rail and road urban means of transport.

2.4 Automated Charging Applications

There are already systems for automated charging in public transport. There is, however, an issue of specifying the correct fee. Currently, the system uses (apart from normal tickets and proximity cards) a "entry/exit" card, which records the moment of getting on and off the vehicle, and uses this information to calculate the rate. The system also considers any discounts for retired people, students and regular passengers. There is also a system, which uses the passengers' mobile phones to charge them. Both systems (recording passengers getting on and off at stops) provide information concerning the traffic and the direction, which used to be collected by surveying passengers. The knowledge of current passenger needs may lead to a wider adoption of flexible transport systems, e.g. on demand transit.

The ticket card systems allow for adopting various methods of serving passengers, such as creating different tickets for different routes, rate selection, but also using the card as a library card, parking card, cinema ticket, etc.

In road transport, just as in the railroads, any congestion can be overcome by directing the vehicles to a different route, which can have a vast significance in municipal traffic.

In the last couple of years, telematics has led to a vast improvement in quality and optimisation of transport, especially in freight transit. The most important element of the system is the online cargo and vehicle localisation, with the ability to compare the location to a planned route. This provides the customers with up-to-date information. It also allows for remote access to the data concerning the state of the goods carried, such as the temperature inside the vehicle and other similar parameters, and for notifying the sender in case any of the parameters are exceeded. This makes shipping hazardous materials far safer than before. The technical condition of a vehicle can also be controlled remotely.

Cargo can be tracked, giving full control over the whole shipping chain. Many of the opportunities provided by telematics give the road freight shipping an edge over other means of transport. The high quality achieved through telematics is becoming a standard among forwarders.

Telematic systems allow for paying for paid roads without the need to stop the vehicle. It requires an appropriate road infrastructure as well as the installation of special devices that would enable telematics charging. This applies to both commercial and personal transport. The charging systems calculate the fare according to the distance travelled. The fares are charged using telematic infrastructure and satellite navigation or radio communication.

2.5 Other Applications

Information concerning travel conditions should be available both before the departure and during the trip. Such information include a wide array of data: from the statistics concerning the road network for personal transport and public transport routes, schedules and fares, to dynamic data concerning road conditions and traffic (congestions, delays). Data used in statistical information originate from the infrastructure management systems.

Dynamic information for personal use are compiled based on reports concerning road conditions and traffic obtained from automated measurements, surface sensors, automated assessment of video feeds as well as reports sent directly from traffic vehicles. In public transport, traffic data come directly from the vehicles to the traffic control centres.

Such information concerning travel conditions can be accompanied by further tasks needed when travelling (e.g. ordering a taxi, luggage handling, hotel booking, booking tickets to cultural events, etc.), but it mainly applies to ordering transport tickets.

The potential of transport telematics to resolve traffic overloads and enhance passengers' comfort seems unquestionable. We should, however, bear in mind that there are certain factors that can hinder the development of transport telematics.

Telematic systems require costly technical components (such as measuring and information equipment, telecommunication devices, software). The operating costs of telematics consist mainly of equipment cost (hardware and software), the costs of accessing data and of providing the service. These costs are borne by both system operators and the end users. The benefits of transport telematics cannot be precisely specified until the influence and effects of all the systems are sufficiently known. The benefits to transport should be separated from benefits to the environment, the economy and the society.

When directing the traffic in individual sections as well as in the whole network, the conflict concerning the optimal telematic system arises. Telematic systems operators want all the participants to achieve the shortest possible trip time, the highest possible safety with low environmental impact. Therefore, they strive for the most evenly distributed traffic in order to avoid concentrated overloads. Individual drivers, on the other hand, care most about minimising the cost and time of travelling. A combination of these two goals can only be achieved when passenger behaviour becomes beneficial for the user when obeyed (e.g. using a non-optimal route would cause increased fares).

The potential of telematics in tracking the environmental impact of transport is vast. This may include routing with consideration to environmental limitation, using telematic information, charging and control systems. The systematic implementation of telematic technologies will lead to the inclusion of all transport systems, which may limit the dominating positions of road transport.

One of the biggest obstacles in further development of transport telematics is the technical integration of many different systems. This stems from fast innovation and the lack of standards in the field. In this situation, the search for common system architectures seems well-grounded.

3 Implementation and Legislation

Another problem faced by transport telematics is the duration of the implementation process. This time is often longer than the development cycle for the new technology. When such system is finally ready to be used in practice, it often turns out to be technologically outdated. For the sake of progress in telematics, we cannot abandon an affective technology, even though new solutions appear.

There are also certain legal issues hindering popular acceptance of telematics. Effective implementation of some telematic systems in transport requires people to obey certain norms of co-existence. A question of legal responsibility for personal data protection thus arises. Many transport telematics systems collect personal data from unknowing passengers. One such example may be a GSM phone, which constantly records its user's location. All GSM-based telematic technologies allows for tracking user's location. The same applies to ticket purchases, etc. Combining such data with other information may afford the authorities, such as law enforcement officers, a far-reaching supervision of citizens. This is a violation of current personal data protection laws. This is why further development of telematics should use system architectures that provide a high level of anonymity to all concerned parties.

4 Conclusions

Individual transport telematic systems are currently at different stages of development. Today, we should concentrate on supporting the development of telematics to better meet our obligation to provide safe and unobstructed transport. Our R&D efforts should be tackling the problems of telematic systems' operation and integration.

As the technological possibilities keep expanding, telematics will quickly enter into all areas of our lives, especially transport. Telematic systems will become an increasingly indispensable element of transport. In order to provide the society with the most benefits, we have to recognise the positive influence of telematics as well as any risks and obstacles to its development.

Telematics will never replace investing in transport infrastructure. It can provide potential improvements to the safety and comfort, but will not increase the efficiency of a road network.

Telematic systems are an integral part of a transport infrastructure. The current rapid development in telematic technologies often comes from private company initiatives.

One should, therefore, remember to build a strategic public-private partnership (PPP), which will allow for implementing effective transport telematics systems in chosen important areas. The safety of transport telematics should be enhanced. A growing scope of applications for telematics creates the need for protection against equally growing criminal threats. A basic telematic architecture, which would be sufficiently protected against external interference, is advisable.

References

1. Mikulski, J.: Charakterystyka ogólna telematycznych systemów transportowych. In: Telematyka Transportu Drogowego, Wydawnictwo ITS, Warszawa, pp. 73–103 (2009)
2. Mikulski, J.: Wizja Rozwoju Inteligentnych Systemów Transportowych w Polsce. Magazyn Autostrady 10, 34–40 (2009)
3. Bartczak, K.: Scenarious for ITS services deployment in Poland. In: Zeszysty Naukowe Politechniki Śląskiej, Gliwice, vol. 1657 (2002)
4. ITS Planning Handbook, ITS City Pioneers Consortium (1998)
5. Miles, J., Chen, K. (eds.): ITS Handbook. PIARC (2004)