



Interoperability of Intelligent Transport Systems

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ABSTRACT

This paper presents selected problems of Intelligent Transport Systems (ITS) interoperability. Their nature is related to the determination of interoperability, communication aspects in functional areas – ITS subsystems and to European and national interoperability frameworks..

KEYWORDS: information systems, transport systems, telecommunication law

1. The Nature of Interoperability

The interoperability is a broad term and understood in different ways. For example:

- popularly – the interoperability is a capability to cooperate of people, products and various systems;
- the interoperability stands for a possibility of cooperation of various separate organisations to achieve objectives agreed and favourable for all parties, at simultaneous sharing the information and knowledge between those organisations through the supported business processes, by means of data exchanges via appropriate systems – *European Interoperability Framework*;
- the interoperability is a capability of information systems of public administration units to work together for the public tasks implementation – *National Interoperability Framework*;
- the interoperability of services – is a capability of telecommunication networks to work effectively to ensure a mutual access of users to services provided in those networks – the *Telecommunication Law*.

The interoperability is an extremely extensive term. It covers many areas, which are usually thought of as entirely separate. For the sake of order and clarity it is worth adopting an interoperability definition in the area of our interest, i.e. in the field of Intelligent Transport Systems (ITS).

In popular terms the interoperability is understood as systems or products capability to interact collision-free and to work compatibly together, providing services to those systems users. The interoperability is a characteristic of products or systems, which functionalities are implemented without disturbances. The interoperability applies both to the systems operated and to the systems planned for implementation in the future, if the interaction with the operated systems is required.

Referring the interoperability term to the resource and product of the information society, which is information, and especially to systems enabling its transmission, processing and presentation, this term seems to be clearly specified. In modern telecommunication and ICT systems and networks the integration of data and a collision-free information transfer is a fact, it is the essence of those systems and networks interoperability. The interoperability means a collision-free provision of telecommunication and ICT services to users, consisting not only in the information and data transfer, but also in the data processing, storing, presenting and making available in a user-friendly way.

The interoperability in telecommunication systems and networks is implemented in three aspects – semantic, technical and organisational. The semantic aspect enables the formation of a common layer for systems communication, the technical aspect creates the grounds for a collision-free information exchange, while the organisational aspect creates the organisational-legal conditions to ensure the interoperability. It is worth emphasising that telecommunication systems are an integral part of ITS. The

very systems enable the creation of modern ITS solutions and architectures and their operation for the information society. The European FRAME architecture is an example of such architecture.

The interoperability of telecommunication and IT systems used in the field of ITS is a capability to interact of various telecommunication and IT systems operating now and planned for implementation within the ITS. This interaction consists in a collision-free and safe processing of data and in transferring the information and data of specific structure for the needs of ITS stakeholders and users. The interoperability of such systems also means a capability of various computer systems to communicate with each other and to implement the processes of information and data exchange to be used by ITS stakeholders and users.

2. Communication Aspects in Functional Areas – ITS Subsystems

Synthetically, from the functionality and subsystems point of view, in the ITS area we specify:

- a. data and communication for ITS management – this applies mainly to the data acquisition and processing in ICT networks for the needs of road conditions determination;
- b. co-modality of passenger transport and information services – this applies to travellers, it is related to providing information for travellers and to using various types of transport for their needs and with the construction of various Traffic Management Centres and ICT networks for the needs of providing information for travellers;
- c. co-modality of freight transport and information services – this applies to transported goods, it is related to monitoring and providing various entities (organisations, institutions, companies) with the information on the roads condition and capacity, prevailing safety of transported (especially dangerous) goods, their optimal use; the monitoring and informing of interested parties is performed by means of information and data transferred in specialised ICT networks;
- d. traffic management – applies to the road traffic management in real time in a strategic and tactical dimension; it is carried out by Traffic Management Centres and ICT systems for the needs of providing information for drivers and for public and freight transport users, of traffic managing and controlling, of traffic and events monitoring;
- e. safety, regulations enforcement and emergency responses – applies to the reduction of accidents, injuries and damages in transport, enforcement of regulations, provision of help to the injured and saving lives of transport participants; the ICT structure and provided services are used for that, with the *e-Call* as an example;
- f. public transport management – applies to the execution of tasks in the field of transport services planning and creating schedules, timetables, providing the travellers and drivers with information in real time; it applies to the public transport vehicles fleet management, selective vehicles detection, their automated localisation etc.;

- g. toll collection – applies to the collection of charges for the road and communication infrastructure used, in an electronic and traditional form.

As mentioned above, the indicated functional areas and at the same time ITS systems have ICT resources enabling the data and information transmitting, processing, collecting and presenting for the ITS needs. Those resources refer to the telecommunication and ICT systems and networks, both public and special, dedicated to the ITS needs. Without such systems existence the indicated ITS functionalities cannot be executed. Frankly speaking: intelligent systems do not exist without such resources and it is difficult to imagine the ITS interoperability.

3. European and National Interoperability Framework

The telecommunication and ICT systems are a resource, a means and a tool for a safe management of the transport infrastructure, conditions and vehicles monitoring, for informing the ITS contractors and users as well as for implementing other ITS functions. It is obvious that these systems should be interoperable. The legislation and standardisation documents in an international, national and regional dimension attach significance to those problems. They indicate optimal ways for resolving the interoperability problems in the field of ITS, aiming at the integration of operated systems, designing, building and implementing compatible systems and cancelling the island systems.

The European Commission takes care of the ITS and telecommunication systems interoperability problems. It has issued a number of documents on this issue and the *European Interoperability Framework* EIF deserves attention.

Issuing this document the European Commission took the position of maximisation of the social and economic potential of information and communication technologies, to ensure the interoperability of information and communication services in Europe. The point is to create and use an interoperable and single European market for the needs of work, education, transport, travel etc. The need for effective interoperability within the EU is a central part of the digital agenda, one of the leading initiatives under the Europe 2020 strategy.

According to those statements the EIF defines, recommends and promotes the interoperability problems on the European market, making them problems open and prone to development. The document does not impose a specific technology for ITS problems resolution. An assumption was made that the open standards and solutions should be implemented in an optimum software.

Under the European digital agenda the European Commission has been implementing the European Interoperability Strategy (EIS) and the European Interoperability Framework (EIF), hence two key documents promoting the cooperation between public administrations of European states and the interoperability issues. Both EIS and EIF recognise that the interoperability has a legal, organisational, semantic and technical dimension. The issued documents create the interoperability foundations in the

organisational- standardisation dimension and clear the way for those foundations implementation into practice.

In the organisational-legal field of systems interoperability in Poland the *Regulation of the Council of Ministers of 12 April 2012 on the National Interoperability Framework, minimum requirements for the public registers and exchange of information in an electronic form as well as minimum requirements for the ICT systems* becomes significant. This regulation, consistent with the EU directives recommendations, specifies areas important for the interoperability problems, namely: the National Interoperability Framework, minimum requirements for the public registers and exchange of information in an electronic form as well as minimum requirements for the ICT systems. These are issues significant mainly for the ICT systems performing public tasks in the country in various areas of operation, including ITS. It is important that they have been covered and presented in the form of a legal document to be implemented, which provides a good basis to create interoperable systems.

The National Interoperability Framework has an important role here, specifying the ways of entities conduct, in the field of measures selection (for the needs of systems establishing, building, implementing, operating and developing), ICT systems methods and standards as well as organisational procedures aimed mainly at ensuring the availability of electronic services, their efficiency and cost optimisation.

The ways of entities conduct in the field of interoperability norms, standards and recommendations are important here, where this scope applies to the organisational, semantic and technical interoperability, ensuring a technological impartiality, which should be considered very important.

In the most general approach the ICT systems interoperability is achieved through:

- a. unification – the application of compatible norms, standards and procedures, starting from the stage of system designing;
- b. interchangeability – e.g. of a product (subsystem, service, process) in a way imperceptible to ICT systems recipients/users;
- c. compatibility – product suitability for use, once the requirements are met and there are no undesirable impacts.

The interoperability on the organisational level is ensured by informing the interested parties by the entities performing public tasks about services provided by the considered systems, indicating the place of information about that disclosure, standardisation and unification of procedures for the cooperation between the interested entities.

The interoperability on the semantic level is achieved mainly by the use of structures and meaning of the data comprised by these structures and indicated in the *Regulation* in question.

Instead, the interoperability on the technological level is ensured by the use of minimum requirements for the systems indicated in the *Regulation* and by the use of various regulations, and if they are not in place – of Polish and international standards.

It should be emphasised here, apart from the *Regulation*, that the interoperability problems from the technical point of view refer in particular to the used systemic and syntactic aspects. The systemic aspect refers mainly to the diversity of equipment and systems used by the network users, to the diversity of communication

protocols in various network types and levels and to the diversity of the used operating systems. Instead, the syntactic aspect refers to the domain of data formats and representation languages, where the syntactic analysis plays a significant role.

The *Regulation* defines precisely the minimum requirements for the ICT systems. The requirements and specific parameters refer to the interoperability problems not only on the national scale, but also on the European and global scale. Such situation enables resolving the interoperability problems in a national and international dimension, which is now especially important. In the area of our interest the ICT systems are designed, implemented and operated taking into account the required functionality consistent with the needs of users, reliability, productivity, mobility and maintenance using proven and professional standards and methodologies. In the field of systems interoperability the problems of provided services availability, their quality and in particular safety are also important.

The *Regulation* presents a number of specific standards to be implemented in the field of IT systems functionality. At the same time it orders to adapt the currently operated ICT systems performing public tasks to those indicated standards within 3 years. This is important to the extent, that the implementation of considered systems interoperability is not a fiction but the fact.

4. Conclusion

The ITS interoperability is a complex problem. The problem seems to be the more important, if we refer it to the current situation. If the issues of various transport types and systems interoperability are noticeable and resolved mainly on the international and national level, the involvement on a regional level is much smaller, simply unnoticeable. Moreover it should be stated that there are no specific projects related to the ITS interoperability in the country and also the tools for this problem monitoring, evaluation and management are missing. This unfavourable phenomenon results in the origination of island systems. The paper authors consider that the neglecting of interoperability problems at the stage of ITS design, construction and implementation and ensuring their integration with the already operated systems at a later stage is an incorrect, uneconomical and non-optimal activity.

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