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REQUIREMENTS FOR INTEROPERABLE INTELLIGENT TRANSPORT SYSTEM DEPLOYMENT IN SOUTH EAST EUROPE

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Abstract

Transport integration in South East Europe (SEE) is a fundamental pre-requisite for regional cohesion and development. Intelligent Transport Systems (ITS) applications can play an important role in transport infrastructure management and traveler information provision throughout the SEE area. This study focuses on the identification and description of the requirements for interoperable ITS for integrated traffic management and ITS deployment. The key outcome of the study is the identification of the requirements for interoperable ITS along regional, national an urban transport networks.

Keywords

Intelligent transport systems, ITS directive, Interoperability

INTRODUCTION

South East Europe (SEE) is one of the most diverse areas in Europe, including both EU and non-EU member states (candidates, potential candidates and other countries). This diversity is also reflected in various levels of economic, social, infrastructural, technological and administrative – institutional aspects. One of the prime requirements for economic development, growth and territorial cohesion is considered to be the "Accessibility" which can be enhanced through the systematic deployment of Intelligent Transport Systems (ITS) along road transport networks at local (urban/periurban), regional and transnational level.

However, the current status of ITS deployment in SEE is rather fragmented and a lack of an integrated multimodal transport approach that will effectively adopt and take into account the EU ITS (2010/40/EU) Directive's guidelines in all SEE countries is observed. ITS integration is limited only to a small degree mainly at regional or national level and rarely between states. Moreover, the lack of standards for ITS implementation at EU level creates a huge variety of different standards on ITS development and operation and poses additional barriers in the required interoperability.

The purpose of this study is to identify the requirements for interoperable ITS applications and services for achieving integrated traffic management and ITS deployment at a comprehensive level. Starting point is the description of the regulatory framework of existing standards for interoperability. In Europe, the creation of standards is governed by the three European Standardization Organizations (ESOs) but these are not the only ones that have provided impetus for creating standards for interoperability on European level.

This report shows also examples of operational systems for interoperable ITS initiated by regional and national authorities all over Europe. The descriptions focus on four major aspects (organizational, technical, operational and financial). The report summarizes the current status of interoperability in SEE countries, encompassing activities ranging from single operators to cross-border initiatives. Ultimately the requirements for deploying interoperable ITS in terms of organization, operation, and technology according to the identified issues are being identified.

REGULATORY INSTRUMENTS FOR INTEROPERABLE ITS

According to the 2010/40/EU Directive: "Interoperability means the capacity of systems and the underlying business processes to exchange data and to share information and knowledge". Under the European digital agenda, the European Commission has been implementing the European Interoperability Strategy (EIS) and the European Interoperability Framework (EIF). These two documents aim at promoting the cooperation between public administrations of the EU members on interoperability issues while creating the foundations in the organizational – standardization dimension of interoperability.

Article 8 of the 2010/40/EU Directive highlights that interoperability should strongly be supported by the provision of standards from the relevant standardization bodies. Standards are required in order to address interoperability at different layers in ITS architectures taking into account data compatibility across ITS applications and services. Standards also ensure

that local and regional systems unite into a coherent national system and allow integration of its components into European and international systems.

On a European level there are three European Standardization Organizations (ESOs), namely:

- CEN (European Committee for Standardization). CEN is the EU body that provides the platform for the development of European standards and other technical specifications.
- CENELEC (European Committee for Electro-technical Standardisation), which creates standards in the electro-technical engineering field on European level. CENELEC also cooperates with the International Electro-technical Commission (IEC) for the adoption of international standards.
- ETSI (European Telecommunications Standards Institute), which is an industry member based standardisation organisation responsible for the production of standards in the Information and Communications Technologies (ICT) field (including fixed, mobile, radio, converged, broadcast and internet technologies).

The CEN/TC 278 (Road Transport and Traffic Telematics) and the Technical Committee (TC) ITS for the ETSI (5 working groups) are responsible for managing the preparation of standards within the field of Intelligent Transport Systems. These committees also collaborate closely with various CENELEC Technical Bodies that are associated with ITS (i.e. CLC/BTTF 69-3 "Road traffic signal systems" CLC/TC9X "Electrical and electronic applications for railway"), as well as with ISO (International Organization for Standardization) in developing standards that may be applied globally. The Technical Committee of ISO that deals with ITS is ISO/TC 204 "Intelligent Transport Systems". Collaboration is also promoted with SAE International, IEEE (developer of industry standards) and IETF (Internet Engineering Task Force) which is responsible for the production of internet standards.

Standards are designed and created through a transparent, open, technically coherent and consensual process. Proposals for the introduction of a new standard can be submitted by any interested party (i.e. as part of European projects, through trade federations, etc.) to the relevant ESO. Usually, most standardization work is proposed through the National Standards Bodies (NSBs). However, it should be stated that within the EU, only standards ratified by CEN, CENELEC and ETSI are recognized as "European standards". Nonetheless, after the publication of a European Standard by an ESO, all member countries of the ESO should transpose this European standard into a national one.

Apart from the ESOs, other organizations active in Europe deal with the design and creation of standards as part of their overall activities, as well. As such, some are mentioned below:

- TISA (Traveller Information Services Association). TISA is a non-profit, market-driven membership association focusing on traffic and travel information services and products. TISA has developed the TPEG traffic and travel information (TTI) data protocol, which is described in the following sections.
- OMG (Object Management Group), which is an international, open membership, not-for-profit computer industry standards consortium. OMG closely collaborates with ISO for publication of its standards. OMG has created and manages the CORBA architecture (Common Object Request Broker Architecture), which is an open, vendor-independent architecture and infrastructure that computer applications use to work together over networks (for description see also sections below).

SYSTEMS DEVELOPED BY REGIONAL AND NATIONAL AUTHORITIES

This chapter gives an overview of typical operational systems for interoperable Intelligent Transport Systems in SEE.

The best practices focus on four major aspects:

- Organizational
- Technical
- Operational
- Financial

AUSTRIAN GRAPHIC INTEGRATION PLATFORM (GIP)

Organizational aspect

The GIP Project was initiated by the Austrian federal states government administration (Bundesländer) in order to establish and support e-government processes stored in a digital traffic network graph. GIP is an important step towards the harmonization of administrative processes throughout all Austrian federal states. In the GIP project the administrative units responsible for traffic were involved in the development of GIP systems to make sure that the GIP data model and software meets the requirements of the administrative processes. Once the system was developed, GIP as the new system for the data storage of e-government processes was introduced at the federal state administration which is the responsible body for traffic networks. As a next step the GIP system is rolled out to the local and regional administrational units. On a political level a commitment of all federal governments as well as the Austrian Ministry of Transport – Innovation and Technology (BMVIT) to establish GIP as the general and nation-wide reference system for traffic network information has been established.

Technical aspect

Within the GIP project, the software development process defined data models, software, user needs, use cases and technical specifications which were then technically realized by a single software development company. GIP is a distributed system where every administrative body provides a GIP system and GIP data maintenance tools to the users in

the subordinate local and regional administration units. The GIP system provides web-based data management and editing clients as well as such clients embedded in the ESRI and INTERGRAPH environment. It also provides a programming interface to access GIP native server/database functions. The GIP system enables data exchange between the administrative bodies and allows the provision of a nationwide network graph covering all modes of transport at a very detailed level. The data exchange and update can be done in very short time intervals – currently update cycles of GIP data of one week are envisaged. This nationwide network graph can be used by secondary systems such as traveler information services as well as for the fulfilment of legislative obligations (infrastructures for spatial information in the EU – INSPIRE).

Operational aspect

Every federal administration provides GIP systems and services to its administration units at the different levels (local, regional, federal administration). In order to provide nationwide GIP data and to ensure harmonized data quality standards and the consistent development of the GIP system in the future, an organizational superstructure has been established. The resources for this superstructure brought in as 'in-kind' contributions of manpower or by monetary contributions. The organizational superstructure is arranged in a steering board, a management team and two working groups (one for data and one for software). Per definition the superstructure shall replace the time-limited project working structure and ensure the long term sustainability of the GIP.

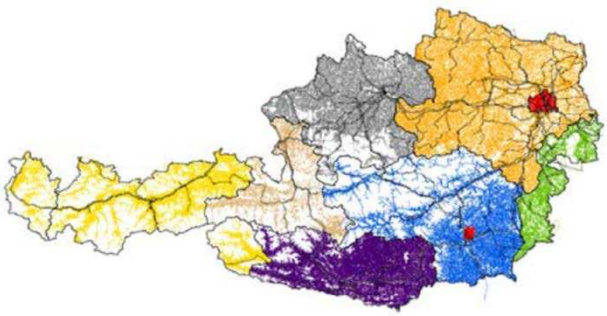

Figure 1: The cooperative traffic graph for entire Austria

Financial aspect

GIP.at is in fact a series of four consecutive projects that were financed by the Austrian Climate and Energy Fund (Ministry of Transport in cooperation with Ministry of natural resources). Each of the projects received a 50% subsidy under the framework programme "Public Transport".

HIT PORTAL (Greece)

Organizational aspect

HIT PORTAL (also named "KOMVOS") - "Online Portal for Integrated Transportation Data Management and Processing" (www.komvos-imet.gr) is a web-based data management and service provision system that manages raw and processed data and delivers aggregated information services to its users (transport planners and operators, policy makers, authorities, fleet managers, end users, etc.). HIT PORTAL information provision includes all transport systems (national road, rail, maritime, air and multimodal transport systems). Nonetheless, interoperability with other existing systems/databases has been established in the urban areas of Thessaloniki and Athens, in terms of traffic data exchange between HIT PORTAL and other data providers. Furthermore, HIT PORTAL communicates with the Hellenic Statistical Authority (EL.STAT.) for accident data exchange in a national level.

HIT PORTAL has been created as part of a European funded project and is currently (2005 – 2007) operated and maintained by the Hellenic Institute of Transport of the Center for Research and Technology Hellas (CERTH-HIT) The VIAJEO EU funded project ("International Demonstrations of Platform for Transport Planning and Travel Information", 2009 – 2012, www.viajeo.eu) provided, through its pilot implementation and testing in Athens, an expansion of HIT PORTAL, namely the VIAJEO Observatory (www.viajeo.imet.gr), which is a web-based application providing travel and traffic information and indicators also possessed and maintained by CERTH-HIT.

Access to the information of HIT PORTAL (and VIAJEO Observatory) is provided free of charge to all interested users (registration procedure is required).

Technical aspect

HIT PORTAL is installed on high-tech hardware including powerful servers, distributed systems, desktop and mobile workstations, mobile phones, palmtops and GPS receivers. It uses state-of-the-art databases to store and distribute the accident, traffic and transportation data. These databases are organized, depending on the data they manage, either by services function or by type of data and, when required, they interface with other database services such as the GIS server and the Web server. The exchange of data is realized through windows services and web services (FTP) in specific intervals of up to 5'. Proprietary interfaces for the exchange of traffic data have been created also based on the DATEX II standard (see also operational aspect below).

Operational aspect

HIT PORTAL has established interoperability with the following data providers:

- The Athens Traffic Management Centre (ATMC), which provides traffic flow (veh/h), average speed (km/h) and road occupancy (%) per measurement point. Data exchange is achieved through web services (FTP) in intervals of 5'.
- The Hellenic Statistical Authority (EL.STAT.), which feeds HIT PORTAL with statistical accident data (updated per year).
- MISTIC, which feeds HIT PORTAL (including the VIAJEO Observatory) with flow (veh/h), average speed (km/h), travel time (sec) and density (veh/km) for the road networks of Athens and Thessaloniki (5' intervals). The exchange of data between MISTIC and HIT PORTAL is achieved through a proprietary interface that is based on the DATEX II standard. It is worth mentioning that, among other traffic data, the MISTIC module also integrates floating car data (FCD) using the SIMONE protocol.
- The Traffic Management Centre of the Thessaloniki Ring Road, which feeds HIT PORTAL with traffic flow (veh/h) and speed (km/h) in 5' intervals.

Financial aspect

HIT PORTAL was funded under the 3rd Community Support Framework and the Operational Programme "Competitiveness" with a budget of 1.275.039 Euros. The VIAJEO project that established the HIT PORTAL VIAJEO Observatory was funded by the 7th Framework Programme of the European Commission.

ROAD SAFETY INFORMATION COORDINATION CENTRE (CCISS)

Organizational aspect

The Italian CCISS – Road Safety Information Coordination Centre – was set up in 1990 and performs its legally assigned role of collecting, processing and selecting information on traffic and the road network as well as circulating useful information about traffic flow and safety and preparing and delivering road safety campaigns.

The CCISS is coordinated and managed by the Ministry of Infrastructure and Transport in collaboration with Traffic Police, Carabinieri, ANAS, Dealers motorway, RAI (national TV) and ACI.

CCISS provides traveler information services concerning road transport in order to enhance the quality of mobility and the personal safety of people. The Coordination Centre is a great opportunity for metropolitan areas, municipalities, provinces and regions that need a reliable institutional partner that can undertake the dissemination of information on traditional channels.

Technical aspect

The CCISS operates its own proprietary information platform (RTTI) developed to provide native support for the DATEX protocol used to exchange data with other national and European DATEX hubs. CCISS collects information on events that disturb the regular flow of traffic and circulates it through the following channels:

- Broadcast and satellite TV bulletins
- Radio bulletins on RAI channels
- Internet (www.cciss.it)
- Call-center: with a free phone number (1518) operational 24 hours a day with the option of four macro-regional bulletins, weather bulletin, and latest radio bulletin broadcast or direct interaction with the operator.
- Geo-referenced news on smartphone mobile apps (iCCISS –iCCISSpro)
- RDS-TMC (digital channel superimposed on FM radio transmissions) operated by the RAI that can be displayed on satellite navigation systems as well.

Operational aspect

In 2009 the Ministry of Infrastructure and Transport established an Operative Centre in the Ministry's offices in Rome where all the information provided by the operators mentioned above, called info-mobility information, are received, processed, stored and transmitted (accidents, delays, disturbances static and dynamic - congestion, weather events, etc.) to the users by several ways of communication as web site, radio, internet. The Operative Centre is characterized by an office area of about 1,000 square meters, more than 60 operators, an information system consisting of 60 servers, a software platform in line with global best practices in the area of info-mobility and automatic connection with operating centers of major infrastructure operators and the forces of police.

The collective interest, of which the Ministry is the guardian, requires the extension of audience reached by the information of CCISS. It is therefore necessary to operate on two distinct fronts. First it is important to identify new information channels (SMS, MMS, DAB, web radio, etc.) over which it is possible to merge information in a timely manner in the territory. The second focus is on enhancing the services of "traditional" information channels (radio, television and systems navigation) also considering the possibility to involve new actors in a wider scenario.

Financial aspect

The CCISS is financed by the Ministry of Infrastructure and Transport and the Ministry of Internal Affairs. Dealers motorway are involved through a contractual relationship with the Ministry. The relationship with RAI and ACI is governed by conventions for consideration of the rest of the costs incurred for operational support activities.

GIM - GESTIONE INFORMATA DELLA MOBILITÀ

Organizational aspect

The project GIM involves the provinces of Milan (coordinator), Florence, Pesaro-Urbino, Macerata, Ascoli Piceno, Ancona, Ravenna, Rimini, Forlì-Cesena, Ferrara, Piacenza, Reggio Emilia (the coordinating body for the Emilia Romagna and Marche) and the towns of Reggio Emilia, Piacenza, Ferrara, Cesena, Forlì, Venice and Milano. The mission is to find answers and solutions to the problem of public as well as private transport, and of goods as one of the most important problems of large metropolitan areas with the main objective of providing the citizens with information on mobility in a framework coordinated both on a local and national level. Achieving this goal will happen necessarily through a government of the "widespread mobility" public-private large-scale (regional or metropolitan areas) providing measurements of traffic through the management of fleets of TPL and control the flows of heavy vehicles even in case of critical events such as accidents.

The control of the implementation of the project is entrusted to technical committees which include representatives of organizations involved in GIM:

- Steering Committee: Consisting of political representatives and technicians of local authorities
- Supervisor: Guarantees quality and compliance of the contents with regard to the implementation plan of the project, taking into consideration technical and economic aspects. The supervisor is also the chair of the Scientific Committee for Coordination.
- Scientific Committee for Coordination: It consists of a group of experts in the field of systems management, and technologies applied to transport.

The project was initiated in 2009. In 2011 the Executive Plan was elaborated and the regional single tender for the acquisition of supplies by local regional bodies, as provided by GIM project, was concluded. Activities are still ongoing.

Technical aspect

The ITS applications under implementation consider the following services:

- Supervision, traffic control and data exchange on a local and regional level
- Management of public transport fleets (AVM - Automatic Vehicle Monitoring)
- Traffic management and safety (traffic light management, intelligent parking management)
- Freight transport fleet management (e.g. City Logistics)
- Advanced vehicle control (intelligent navigation systems)
- Traffic forecasting analysis
- Support to critical events (accidents, weather, construction sites, emergencies)
- Dissemination of information to the user: traffic data, travel planner in real time, information about the area (e.g. Variable Message Signs)
- Proposal of guidelines for standard "open" electronic ticketing, to host even the current standard national and international regulations for micro-electronics, and a first paper in the area of interoperable draft as to use all the facilities of mobility will be provided

To do that in Emilia Romagna there will be set up a Central Operative Unit that will collect and circulate information for the users.

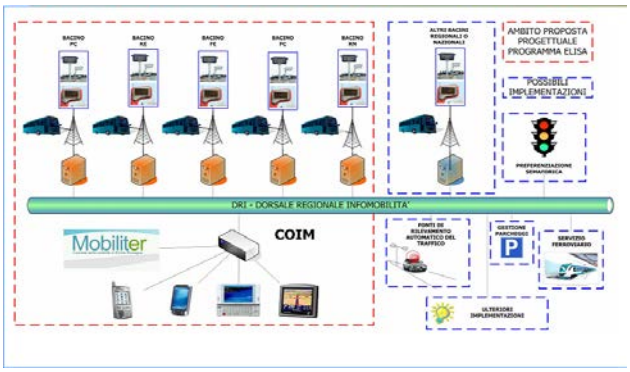

Figure 2: Communications architecture of GIM

Operational aspect

In Emilia Romagna, the region guarantees the correct application of the rules while local entities (provinces and municipalities) prepare the way to collect and provide data to the central unit that operates at regional level. The business model is anyway under construction. The project has an open and integrated architecture which brings together public and private stakeholders (governments, businesses, TPL managers, citizens).

Financial aspect

The project's budget is 11.72 Million Euros, of which 2.8 Million Euros are financed by the ELISA programme. The financing is distributed among eleven local authorities in Emilia Romagna region, Milan and Marche region. As for Emilia Romagna the total cost of the project is 7 Million Euros, of which 1.2 Million Euros are financed by the Ministry of Transport and Infrastructure. Regional funds are 2.7 Million Euros. The remainder is covered by various public and private stakeholders involved in the project (local bodies, transport companies and mobility agencies). For completing the

installation of AVM in the regional fleet of buses (about a third of the total fleet) the Region provides an additional funding of 1 Million €, with a co-financing (another 1 Million €) of the organizations and companies involved.

ISSUES IDENTIFIED FOR THE EXISTING SYSTEMS

The previously mentioned systems are some typical examples of existing systems that provide interoperable ITS services and where examined as part of the technical activities of the European Funded project SEE-ITS. In the framework of SEE-ITS additional systems were examined in terms of organizational, technical, operational and financial aspect. These systems included the Traffic Information Austria (VAO), Greek EFC toll ways, e-Call in Greece, the Dutch National Data Warehouse for Traffic Information and others. Analyzing them in terms of interoperability, the following issues were identified:

- Only few of them integrate real-time traffic and timetable information regarding the modes of transport they use
- They concern mainly about road network traffic with limited or no information on trip planning using public transport
- The services are available only at national level

Looking at the presented systems, it seems that they are divided in trip planners and road traffic data collection. Therefore there is no interoperability between public transport operators and road network administrators.

The systems that focus on trip planning and combined information from different urban public transport modes with rail transport travel information provide mainly static information although some of them have the option to be fed with real-time timetable information.

Finally, one of the most important issues regarding the interoperability of the existing systems is that their services are limited to national level with no cross-border information exchange.

ORGANISATIONAL AND OPERATIONAL REQUIREMENTS

In order to ensure the interoperability between different ITS services and applications, their organizational structure needs to be very clearly defined in terms of responsibilities of each party and their influence level: strategic or technical. Another important aspect is to have the mechanisms to involve all the stakeholders and administrations that can provide or receive data. In terms of operation, the systems should provide information for reliability and accuracy. This is important because each system has to trust the information received from other systems.

TECHNICAL REQUIREMENTS FOR INTEROPERABILITY

In order to be interoperable, from a technical point of view, ITS services and applications have to use the same international, existing standards. This applies firstly to the services provided. In this way the user experience will be the same when passing through different systems. This can be achieved if the system is designed according to the approved standards in the field of ITS.

Secondly, the interfaces of the systems have to be standardized so they can easily connect and exchange information. When proprietary protocols are used, it is very difficult and often not desired for other parties to adapt their systems in order to make them interoperable.

PROPOSAL FOR FUTURE MEASURES TO SUPPORT AND INCREASE INTEROPERABILITY

A major drawback in increasing Interoperability between countries is that each European country has its own structure in terms of operators and responsibilities. For example in Austria there is only one operator of the high-level road network (ASFINAG) and this company is owned by the state. In Croatia there are three private motorway operators and one government-run responsible for the high-level road network. Yet there are also similarities in terms of stakeholders. Additionally to the obligatory transport operators there is often the police involved as well as national broadcasting agencies.

Another problem is the national funding landscape for ITS which is entirely missing in some countries. Consequently it is very difficult for those countries to independently develop ITS services and applications on a national level, forcing them to participate in European projects and therefore neglecting the national progression which would again serve as a good basis for a more effective and efficient participation on European level.

It can be observed that ITS services and applications are not only being developed for commercial purposes any more. With governmental and political commitment to ITS increasing, commercially available systems for traffic management were found to be insufficient. In many cases data are expected to come from third-party suppliers and their user communities as well as from bilateral data exchange between third-party suppliers and infrastructure operators. There is however reasonable doubt in this matter since discussions with third-party suppliers (e.g. Google) show that they are faintly interested in buying or sharing infrastructure data (especially when it comes to safety and security-relevant information) but

rather in selling their own data. Thus the collection of high-quality data will and should probably remain on the part of infrastructure operators.

Especially when it comes to national or even cross-border solutions it is important to ensure interoperability from the beginning in order to guarantee a consistent flow of data and information amongst all stakeholders. But also on regional level authorities begin to recognize the importance of interfaces being compatible to European standards. Consequently national and regional authorities start to define their own specifications based on interoperable standards.

Within this process it can be difficult to break out of gradually grown and often inflexible organizational structures. Based on the best practice examples provided by some European countries, this is just what would be necessary to comprehensively implement in practice what has apparently been already recognized on paper. With this escape from outdated bureaucracy more efficient working will be made possible on all levels which is necessary in view of the rapid technological progress. Otherwise, due to organizational barriers, technically appropriate solutions could remain trapped in the planning stage until they become outdated and therefore obsolete.

To achieve cross-border interoperability it is crucial to consolidate the country-specific structures on all levels. Consequently it is important both to increasingly initiate transnational projects and to foster the national development of ITS.

CONCLUSIONS

There are many aspects to be considered before comprehensive integrated ITS deployment can actually be achieved. Along with an appropriate political and organizational framework it is equally important to identify the requirements for the technical interoperability of ITS and align them from small-scale to a transnational level. With the juxtapositioning of regulatory instruments and real use cases and the detailed description of current national activities this study aims to support the further development of ITS Interoperability.

Standards are necessary in order to address interoperability at various levels of the whole ITS architecture as well as dealing with issues of data compatibility across ITS applications and services. They also facilitate the joining of local and regional systems into a coherent national application and enable the integration of its components on European and international level.

There is indeed a reasonable number of standards that were developed by European Standardizing Bodies and are being refined on a more or less regular basis. In comparison with reality, it becomes visible that common standards like DATEX II, XML, or TPEG are being preferred to proprietary solutions. Unfortunately it is difficult in some cases to gain detailed insight into the system architectures of the respective products and consequently it is not always possible to determine which standards and interfaces are being utilized by the companies. Still the use of open standards seems to be an important feature as it is emphasized in most cases, even if the standards used are not described in detail.

It can also be observed that all SEE-ITS countries (apart from Croatia) defined their status quo regarding interoperability as “National”. Basically this is correct however there are sometimes considerable differences regarding the respective development stage. Up to now Austria and Hungary are the only countries in the SEE area that implement actually national solutions, namely the Austrian GIP and the Hungarian KIRA, covering the whole national territory. Other countries’ solutions rather emphasize single aspects of their national transport like the high-level road network, certain conurbations or single modes of transport. Against the backdrop of geographical conditions differing from country to country this is comprehensible. In countries like Greece and Croatia that comprise a large number of islands the premises are different to comparatively “compact” countries like Slovenia or Austria.

All SEE-ITS countries have however started or are at least planning cross-border activities including international graph integration platforms, interoperability solutions for waterway and rail transport as well as cross-border traveler information services. Despite there is much talking about cooperation and deployment all over Europe, stakeholders still act all by and for themselves way too often, thus creating “deployment silos”. There must be increasing initiative to break out of the habit of just focusing on core business and not taking additional tasks in collaboration with third parties. Real cooperation has to be achieved in order to actually create and utilise synergies for the end users.

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