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1   **ABSTRACT**
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3   Intelligent Transportation Systems (ITS) is a powerful vehicle, not only for gaining traffic and
4   transport benefits, as for example less congestion and shorter travel times, but also for economic
5   growth. The European Union (EU) has already published a Directive (2010/40/EU) in order to
6   regulate the coordinated and coherent deployment of ITS in all member states. However the
7   deployment in different EU member states has yet to be integrated. According to the European
8   Commission, South East Europe (SEE) is an area, where ITS deployment is very "fragmented
9   and uncoordinated and cannot provide geographical continuity of ITS services throughout the
10   region". This paper provides information on the current status of ITS deployment and
11   implementation in SEE Area through the status of nine SEE countries. The results demonstrate
12   the assets and drawbacks for further deployment in these countries and the level of
13   harmonization of their national laws to the European Directive, a prerequisite that could alleviate
14   the fragmentation of the ITS provisioning along different regions within the nations but also at
15   cross-border areas. Afterwards, the methodology for creating national roadmaps on ITS
16   deployment is presented as well as the final roadmaps for each of the nine countries. The
17   findings of these roadmaps are crucial for future ITS deployment in SEE considering that the
18   level of maturity of ITS deployment in each country has been taken into account.

1. Introduction

The efficient use of transport infrastructures is a fundamental pre-requisite for a region's cohesion and further economic development. Intelligent Transportation Systems (ITS) are key tools not only for supporting efficient transport infrastructure management but also seamless traveler information provision [1]. Therefore, the deployment of ITS is imperative, for operational and strategic management and traveler information provision in every region.

In South East Europe (SEE), integration of transport services has not been achieved to a sufficient extent. SEE is one of the most diverse areas in Europe, including both European Union (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. Regarding accessibility, the existing networks in SEE include several main transport corridors and are, in most cases, heavily fragmented serving primarily single states and regions. In most cases these networks are of inferior quality, with critical and heavily used road infrastructure. The level of ITS deployment is also considered limited and in some cases in its infancy [2].

In July 2010, the European Commission published the Directive 2010/40/EU (ITS Directive) "on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport". This Directive "establishes a framework in support of the coordinated and coherent deployment and use of ITS within the Union, in particular across the borders between the Member States, and sets out the general conditions necessary for that purpose" [3]. ITS Directive identifies four priority areas (PA) for ITS projects and measures:

- PA 1: Optimal use of road, traffic and travel data
- PA 2: Continuity of traffic and freight management ITS services
- PA 3: ITS road safety and security applications
- PA 4: Linking the vehicle with the transport infrastructure

The ITS Directive has been transposed to national legislation in all member states, who subsequently are obliged to account for these priority areas in their future ITS deployment plans. In order to maximize benefits out of ITS deployment in the SEE area, there is a need to identify the existing gaps in its current deployment, possible shortcomings in the development of a regionally integrated multimodal transport approach and the necessary steps that need to be followed for effectively adopting the ITS Directive.

The present paper provides an overview of the current (2014) status of ITS deployment in nine countries within SEE, namely Albania, Austria, Bulgaria, Croatia, Greece, Hungary, Italy, Romania and Slovenia. The contents are based on desk research using official EU and national sources and follow the four PA of the ITS Directive, taking into account the existence or not of National ITS Architectures in the above mentioned countries. Finally, it describes the methodology followed, based on which new National ITS Roadmaps were created.

The paper is structured as follows; initially the existing legislative framework in SEE countries is presented followed by the current status of ITS deployment in the same countries. Each country is then evaluated in relation to the assets and drawbacks of its ITS deployment, and the extent to which they might promote or hinder future ITS development. Finally, the methodology and the results for the creation of the national roadmaps are described before drawing overall concluding remarks concerning the deployment of ITS in SEE.

2. Legislative framework for ITS in SEE countries

The Directive 2010/40/EU (ITS Directive) *"establishes a framework in support of the coordinated and coherent deployment and use of Intelligent Transport Systems (ITS) within the Union, in particular across the borders between the Member States, and sets out the general conditions necessary for that purpose"* [3]. After its launch in 2010, several countries in the SEE area adopted it to various extents in their national laws. Table 1, summarizes the actions taken by each country in relation to the transposition of the ITS Directive into national law:

Table 1: National Law enforcement towards adopting ITS Directive in SEE countries.

Austria	In 2012 the ITS Directive became national law and additional ITS law was developed providing the legal basis for the implementation of ITS in Austria
Bulgaria	The main part of the Directive has already included in a new law on Road Transport. The technical elements of the Directive will be implemented through a future Decree of the Council of Ministers
Greece	A Presidential Decree [4] enforces the ITS Directive as a national law by defining the way of approving the ITS specifications that have been or will be issued by the European Commission through Ministerial Decrees
Hungary	The Ministry of National Development implemented ITS on the TEN-T network, in Budapest and the largest cities of Hungary
Romania	A Governmental Ordinance and two national strategies refer to ITS as key technologies for the implementation of transport sustainability [5]
Slovenia	In 2013 a Roads Act [6], enforces the ITS Directive as a Slovenian legal order
Italy	There is no national law dedicated to ITS. An article of a national law transposes the ITS Directive [7].
Croatia	Being a relatively new member of EU, there was no obligation to transpose the ITS Directive until recently therefore ITS do not have a regulated status in the current legislation [8].
Albania	Not being a member of EU, there is no obligation to transpose the ITS Directive, therefore there is no specific law for ITS deployment in the country [9].

Apart from national legislation dedicated to ITS deployment, a national ITS Architecture is essential for coordinated, effective ITS development [10]. A national ITS Architecture provides a common framework for planning, defining and integrating ITS. It defines the functions that are required for ITS, the physical entities of subsystems where these functions reside, as well as the information flows and data flows that connect the functions and physical subsystems together into an integrated system.

A national ITS Architecture provides specifications that enable [11]:

- Compatibility of information delivered to end-users through different media;
- Compatibility of equipment with infrastructures, thus enabling seamless travel across Europe;
- A basis for national and/or regional authorities to produce master plans and recommendations to facilitate ITS deployment;
- An open market for services and equipment where compatible sub-systems are offered (no more ad-hoc solutions);
- A known market place into which producers can supply products with reduced financial risk.

In SEE only half of the involved countries have established a national ITS Architecture. More specifically, Hungary, Romania, Slovenia and Italy have developed and put into force national Architectures (HITS, NARITS, SITSA-C and ARTIST respectively), while Greece, Austria, Bulgaria and Croatia have yet to develop one [12].

The EU has already developed a European ITS Framework Architecture (FRAME) [13]. FRAME provides a reference for the terminology, a decomposition of an ITS system and a methodology to build new ITS architectures. These aspects are used to allow harmonization with national ITS architectures. FRAME does not define technology, thus enabling the freedom to apply it in order to implement different ITS systems that use different technological solutions. Its distinctive characteristic is that it contains more than one way of performing a service, thus it enables the user to select the most appropriate set of functionalities.

3. CURRENT STATUS OF ITS DEPLOYMENT IN SEE COUNTRIES

In order to define the current status of ITS deployment in the SEE countries, necessary data (number and type of already developed projects, description of provided services already available, results from services evaluation reports, location of services provision, users acceptance of the provided measures) were gathered from various sources. All the collected data were examined in terms of their accuracy (only data from trustworthy sources were used), their relevance to the ITS activities and their coverage regarding the four Priority Areas that are specified within the ITS Directive. In order to collect information, the following methods were used:

- desk research
- interviews, discussions and consultations with major private and public stakeholders (Ministries, Local authorities, transport infrastructure operators, transport services providers, technology developers and technology providers)

In most countries National ITS Association provided support by sharing their knowledge and facilitating connections with stakeholders. The starting point for data collection was the report submitted to the EU by each Member State in August 2011 in fulfilment of the obligations of the ITS Directive. Additional main data sources used were the following:

- Current national legislation on transport and in particular road transport
- National ITS/Transport Plans
- Deliverables of national and European projects related to ITS
- Official websites of ITS companies (related products and reports)
- Official websites of public transport companies (annual reports, announcements, provided services, etc.).

3.1 Albania
The deployment of ITS in Albania is in its initial steps. There is only limited utilization of ITS in the country regarding road transport [9]. Since June 2014 Albania is an EU candidate country and has the opportunity to develop strategies based on EU's legislative framework. A starting point for deployment of ITS in Albania is considered to be the establishment of adequate framework conditions for accelerating and coordinating ITS deployment [9]. At the same time an ITS Action Plan is needed for Albania focusing on the interaction between central and local government, as well as between public and private sectors. The country has the potential to

implement necessary infrastructure for ITS deployment and contribute in the increase of the European road safety level and traffic/travel data exchange as well as comply with the priority areas of the EU legislation for the deployment of ITS.

3.2 Austria

The status of ITS deployment in Austria is significantly advanced. Since 2004, considerable number of travel information services based on ITS have been deployed in the country. However, these services were provided by few transport services providers, infrastructure operators and private companies. Therefore there are several isolated services, which mainly concentrate on areas and means of transport and are not interconnected. In terms of individual transport, private suppliers of navigation tools and services have also been established in the national market.

Considering that harmonized data exchange between various transport and infrastructure operators is a basic requirement towards seamless ITS deployment [14], measures to create a consistent organizational and legal framework are taken at national level. In this matter, quality requirements for data exchange as well as rights and duties of all stakeholders involved are being defined and analyzed by the national authorities.

3.3 Bulgaria

The top priority for the transport sector in Bulgaria is the building of new highways and road infrastructure rehabilitation, in order to achieve better levels of road safety and accessibility. Taking this into account, the deployment of ITS in the country is relatively low. The main drawback in ITS introduction in Bulgaria is the lack of planning of ITS infrastructure as part of new road infrastructure. Moreover, there is lack of information systems for road users and lack of integrated traffic management systems. The ITS deployment in Bulgaria is a responsibility of the Ministry of Transport, Information Technology and Communication, while the responsible Ministry for Highway Administration is the Ministry of Regional Development and Public Work. This fragmentation of legal and administrative responsibilities hinders ITS deployment to a large extent.

3.4 Croatia

In 2005, national ITS association "ITS-Croatia" was established and new ITS implementation projects started. Since then, a significant number of ITS has been implemented mainly along the newly constructed road networks. The country has recently become an EU member state (July 2013). During the negotiations with the EU, Croatia harmonized significant parts of its legal framework and initiated implementation of specific information systems. However, as regards ITS implementation, full compliance with EU legislation and especially the ITS Directive has yet to be achieved.

3.5 Greece

In Greece, a considerable number of ITS have been implemented, mainly in the two largest urban areas of Athens and Thessaloniki. There is also an integration of many regional ITS projects in funding mechanisms, a fact that indicates the large potential for deploying ITS applications in a wider regional level by exploiting various funding opportunities. One crucial issue for Greece is to explore and report these opportunities, but at the same time formulate a national strategic plan for the wider promotion of ITS deployment in the country, something

which is currently lacking. It is also crucial for such a strategic plan to combine legislative interventions and the monitoring of the compliance to the legislation [15], as well as the development and implementation of standards for the interoperability of ITS systems and mechanisms for the durability of such systems [16]. One issue that remains unsolved for many years in Greece is the participation of the private Sector in the development of large ITS projects [17]. Moreover, the majority of industries in Greece lack a Research and Development department that would give a major boost to the country's research and innovation.

3.6 Hungary
Hungary is also a country with a large number of ITS projects. The most characteristic examples of ITS applications are the traffic management and control systems of motorways, electronic fee collection (road toll), route guidance/ navigation and urban traffic management. ITS implementations in the road sector are diverse and generally many stakeholders, such as network operators, network providers, content providers and road users (drivers, public transport users, pedestrians etc.) are involved.

3.7 Italy
In Italy, the ITS sector operates since the '80s. ITS for traffic management are operational in many Italian cities (e.g. Rome, Turin, Milan, Genoa, Naples, Florence). Besides that, more than 50% of Local Transport providers are equipped with monitoring systems of fleets. A recently conducted survey within the Infocity project (Elisa Program) [7] revealed that a high percentage of the local authorities adopted a mobility plan that includes a section devoted to ITS. Concerning the automotive sector, considerable efforts have been made for the development of tools and solutions in order to increase safety, mobility efficiency and consumption reduction.
Italy is one of the three countries in SEE (the other two being Greece and Austria), which has a National ITS Action Plan. The Action Plan "Piano d'Azione ITS nazionale", issued in December 2012 [18], identifies the national priorities until 2017. The plan goes beyond the EU priorities, for which specific actions are defined for each priority, and defines necessary actions, at national level, to support the coordinated development of ITS in Italy.

3.8 Romania
In Romania, ITS are in an emerging stage of deployment. However, there are already some systems deployed, both at local, urban level and on national roads. That is why almost all projects address the PA 3 of the ITS Directive. Another important aspect is the enforcement of the decision of the National Motorways Company, stating that all new motorways need to include intelligent infrastructure. However, there is no national strategy for the deployment of ITS. Regarding financial sources, the most common source is National funding [5]. The main reason is that public administrations are not well trained to comply with the requirements for developing and managing projects financed by EU. Another reason is bureaucracy, as ITS projects impose the cooperation and coordination of multiple agencies, in order to be set up and monitored.

3.9 Slovenia
In Slovenia, the transposition of the ITS Directive has not been fully and legally regulated. However, various ITS have been implemented, in order to provide smooth and safe traffic flows. The focus during the previous years has mainly been on the expansion of the transport

infrastructure (new motorways, tunnels etc.) and therefore the ITS implementation is limited to the road transport sector. In 2007, Slovenia entered the Schengen area, a fact that resulted in the development of new information systems throughout custom controls mainly regarding freight transport check procedures at boarders.

3.10 current status of SEE

Overall, the status of ITS penetration in the SEE area is quite mixed. Although there is a common set of European and national funding mechanisms, the extent to which every one of them is used varies from country to country. In terms of implementation, it ranges from only a few initiatives (for instance in Albania or Bulgaria) to numerous systems and services (for instance in Italy or Austria). In terms of policy, Austria, Greece and Italy already have National ITS Plans, while all others have neither national strategies related to ITS, nor to the transport field in general. In addition, there are some EU member states that have not yet transposed the EU ITS Directive in their national legislation (e.g. Croatia). Table 2 provides an overview of ITS development status of all the above mentioned SEE countries.

Table 2: Level of ITS Development and number of projects per priority area of the EU ITS Directive per SEE country

		Albania	Austria	Bulgaria	Croatia	Greece	Hungary	Italy	Romania	Slovenia
Level of ITS Development	High		●					●		
	Average					●	●			●
	Low	●		●	●				●	
EU Directive Priority Areas Projects	PA 1	2	6	5	4	17	3	8	12	5
	PA 2	0	3	7	4	11	3	17	4	6
	PA 3	0	5	1	2	5	1	12	6	7
	PA 4	1	2	0	2	2	0	1	1	1

4. ASSETS AND DRAWBACKS OF ITS DEPLOYMENT

The assets and drawbacks of ITS Deployment has been analyzed for each individual country resulting in observations and outcomes, which in most cases concern more than one country. Table 3 summarizes the most important assets of the involved countries.

Table 3: Main assets of ITS deployment in SEE countries

Asset	Albania	Austria	Bulgaria	Croatia	Greece	Hungary	Italy	Romania	Slovenia
Science, Research and Educational Capacities		•		•	•			•	•
Former successful ITS implementations		•			•	•			
High-tech ITS applications				•					•
Geographical location	•			•					

In most SEE countries there is adequate scientific and research workforce [2]. This capacity combined with the previous experience from successfully implemented ITS projects can support future deployment in SEE countries. Finally, the geographical location of each country can promote the multinational implementation of ITS in the framework of unified transport services. The drawbacks have been also identified, in order to formulate an objective view of the capabilities of SEE countries in promoting ITS. Table 4 summarizes the main drawbacks that are encountered in SEE region.

Table 4: Main drawbacks of ITS deployment in SEE countries (ordered by the level of importance)

Drawback	Albania	Austria	Bulgaria	Croatia	Greece	Hungary	Italy	Romania	Slovenia
Non-existent national ITS Architecture and Framework	•		• (*)	• (*)	• (*)			• (*)	
Financial issues				•	•			•	
Legal and administrative issues				•	•				
Lack of previous ITS implementation	• (*)			•					
Cooperation between Research and Business				•	•	• (*)			
Integration between levels (national, regional, EU)				•	•				• (*)
Institutional data exchange		• (*)	•	•					

The * indicates the most important drawback for each country

The lack of a National ITS Architecture seems to be the main drawback for a more coordinated national ITS implementation. The lack of cooperation between the private sector (business) and academia combined with the fragmented data exchange pose additional barriers in further ITS implementation. Finally, the absence of dedicated national legislation and the inefficiencies in absorbing funding from the various financing mechanisms (EU funds, regional and national

funds etc.) justify the rather limited ITS deployment in some of the SEE countries during the previous years.
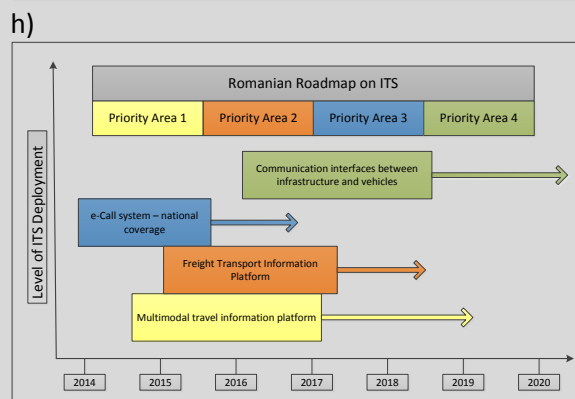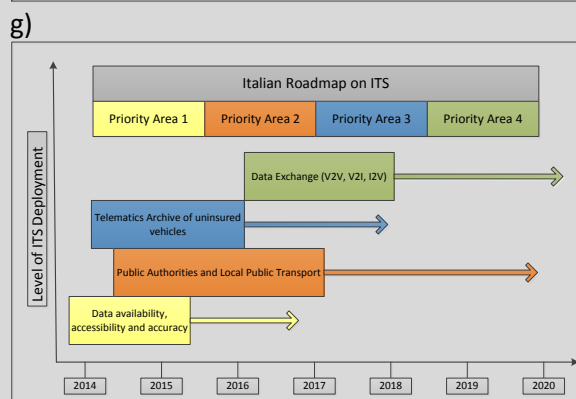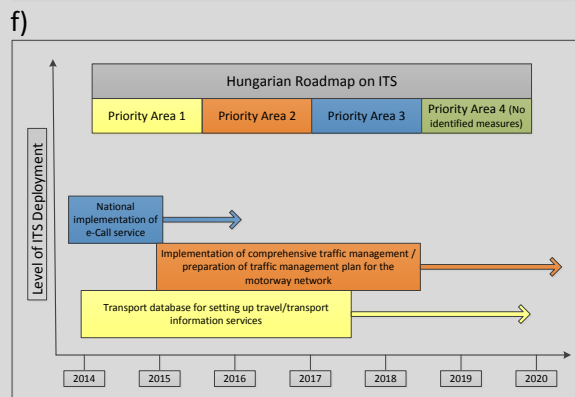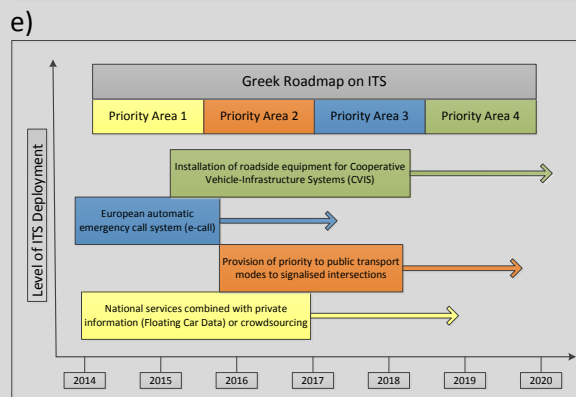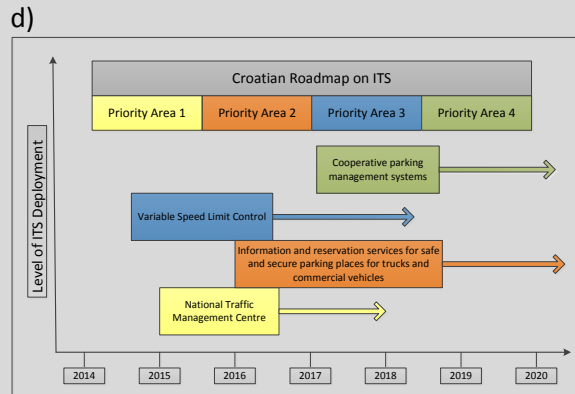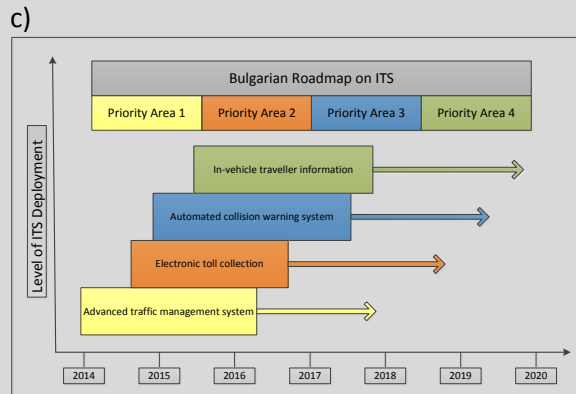
5. NATIONAL ITS ROADMAPS
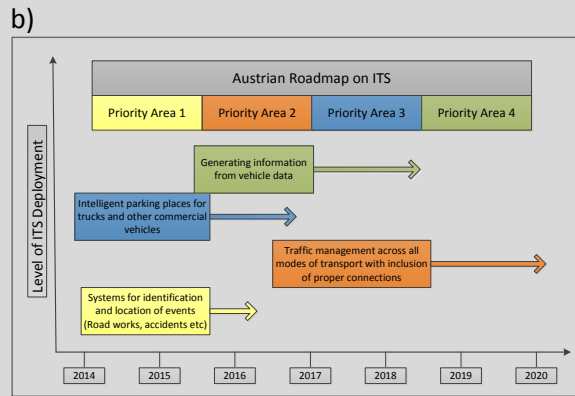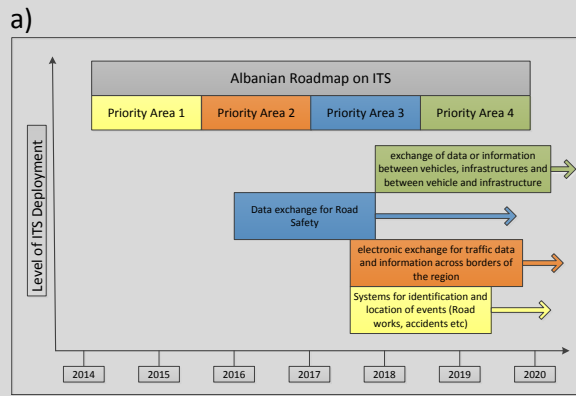
Following the identification of the current status of ITS deployment in the SEE region, the next step identifies the future plans of all countries towards further ITS deployment at regional, national and transnational sense. This part of the study includes the collection and analysis of the priority measures in each country of SEE. Prioritization of the measures has been carried out with the use of a questionnaire survey that evaluated each measure against the following seven criteria:

1. Efficiency (based on traffic related parameters e.g. reduction of travel times per person)
2. Financial and social reciprocity (according to cost-benefit principles)
3. Accessibility (in terms of creating improved use of a transport service)
4. Environment (reduction of negative environmental impacts)
5. Safety and security
6. Strengthening of the transport sector (e.g. increased turn-overs, new jobs)
7. ITS-related innovation and technology (e.g. development of new innovative products)

The general aim was to assess the proposed measures that have been identified or proposed against the background of the four priority areas of the EU ITS Directive in each participating country, based on their contribution to the achievement of the above mentioned criteria. The final objective was to prioritize the activities and projects and to formulate an implementation roadmap for ITS in 9 SEE countries.

In order to reach the aforementioned target, representatives of local institutions, organizations and companies related to ITS, from each country, were reached and asked to complete the questionnaire. Further to the rate of the criteria that the respondents attributed to each measure, the participants were asked to indicate the level of confidence of their assessment for each specific action/project (1 = very low, 5 = very high). This question was actually used in order to assign weights in each criterion (from 1-for very low confidence up to 5-for very high confidence). Based on that, each measure was attributed a general rank (sum of the rates that were given for each criteria) and based on that rank the top measures for each Priority Area were selected to be described in the following sections. The optimal period for the measure's implementation (short term = 1-3 years, medium term = 3-6 years and long term = 7 and more years) was also provided by the questionnaire survey participants in order to form the timeline of the roadmap.

The following figures provide the top measures for each country for the following 1 to 7 years:

a) Albanian Roadmap on ITS

b) Austrian Roadmap on ITS

c) Bulgarian Roadmap on ITS

d) Croatian Roadmap on ITS

e) Greek Roadmap on ITS

f) Hungarian Roadmap on ITS

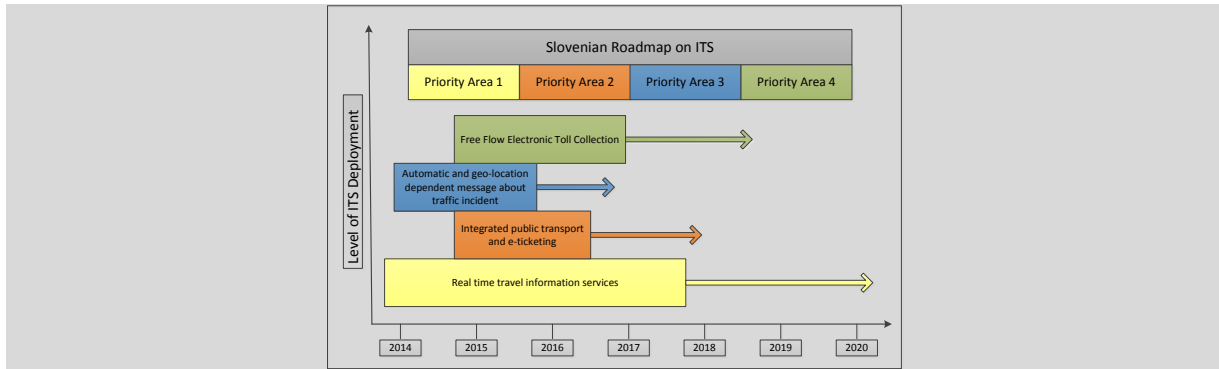g) Italian Roadmap on ITS

h) Romanian Roadmap on ITS

i)

Figure 1: ITS Roadmaps in SEE countries: a)Albania, b)Austria, c)Bulgaria, d)Croatia, e)Greece, f)Hungary, g)Italy, h)Romania, i)Slovenia

Based on the above charts it can be seen that in most cases projects and measures related to priority area 1 of the ITS Directive are those considered to be the most crucial for the enhancement of ITS deployment in the short term. Measures of priority area 3 are also considered to be quite mature in order to get implemented within the next couple of years. Projects of priority area 4 are those that are considered to be in an early stage of development, therefore in most cases there deployment is expected to start after some years (after 2016). Finally, measures of priority area 2, in all cases are considered as follow-up of the measures of priority area 1, thus their deployment is expected after the deployment of priority area 1 measures.

5. CONCLUSIONS

The deployment of ITS in SEE is strongly influenced by the availability of funds and the existence or not of an appropriate policy and legislative framework in the SEE countries. In terms of implementation, policy context and future priorities, a mixed picture is revealed both in terms of current status and priorities. This is mainly attributed to the different time period that each state became a member of the EU and the different level of experience of the various actors to absorb and effectively use EU and other national or regional funds, which are the main sources of financing for all states in the SEE area.

The identification of the current status of ITS deployment in SEE countries demonstrates some major variations among the countries. This fact is justified by the different levels of available funds in each country as well as the differences in strategic national policies the previous years. With the exception of Austria, half of the countries have an average level of ITS deployment strategy and half of them are in the initial steps for organizing such a strategy. Most of the countries have an adequate research background and can already deploy existing and successful ITS applications, thus avoiding initial problems. However, the total absence, in some cases, of previous deployment and the inadequate integration between levels (national, regional, EU) are major drawbacks for further successful deployment. The existing and forthcoming funding mechanisms should play an important role in achieving optimal ITS implementation and in developing interoperability between different regions. Next steps that need to be followed include the identification of a suitable bundle of measures for each country; the finalization and prioritization of proposed interventions in order to reach a desired level of ITS services

deployment; and finally the harmonization of ITS national strategies with EU ITS policy, in order to achieve an acceptable level of interoperability.

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