Deploying harmonized ITS services in the framework of EasyWay project: Traffic Management Plan for corridors and networks

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ABSTRACT
In the last decade, the use of new technologies in the transportation domain has made possible the development of the Intelligent Transport System (ITS). However, the ITS services were deployed isolated. The purpose of the EasyWay Project is to involve all the European countries to deploy harmonized ITS services taking into account the European citizen as final user. In this paper, an introduction of EasyWay project is done, including the ITS concept services and the Deployment Guidelines. A deployment guideline for traffic management and corridors is presented. Using this guideline, a real Spanish Traffic Management Plan is analyzed.

Categories and Subject Descriptors
K.4. [Computer and Society Languages]:

General Terms

Keywords

1. INTRODUCTION
In the last decade, the use of new technologies in the transportation domain has made possible the development of the Intelligent Transport System (ITS) [1]. ITS can significantly contribute to a cleaner, safer and more efficient transport system and the goal is to create the momentum necessary to speed up market penetration or rather mature ITS applications and services in Europe.

The European Union has been supporting several ITS R&D projects in different frameworks from the year 1990 initially in the DRIVE Programme in the old DG-XIII, currently under Directorate General of Information Society and Media (DG-INFSO) umbrella. [2]

The results in the ITS research area have been moved to real ITS deployment. Several projects, funded via Directorate General of Mobility and Transport (DG-MOVE) [3], have been arranged. In the frame there are the old Euro-regional projects (from year 1995) and currently EasyWay (from year 2007). EasyWay is a multiannual project for the deployment of harmonized Intelligent Transport Systems and services across Europe in fields like Traveller Information, Traffic Management and Freight and Logistics.

The White Paper, to which the EasyWay Programme is linked, sets targets for 2020 to make a positive impact on traffic flow, traffic safety and the environment. The EasyWay programme activities stretch over a seven-year period, from 2007 until 2013, but set the targets for 2020 similar to the White Paper. To promote future creativity, more ambitious targets are set for future years according to the experiences gained by the Swedish “Vision Zero” and the Hessian “Zero Congestion Vision” which will be transferred to a European scale.

The paper is organized as follows: In Section 2, the strategy and policy of the European commission is presented. In Section 3, the EasyWay project is introduced. Next, in Section 4, the concept of ITS core services, including the deployment guidelines and their objectives are presented. Section 5 presents an example of use of the deployment guidelines. In concrete a Spanish Traffic Management Plan for the Atlantic corridor is presented and evaluated using the Deployment guideline requirements and the level of services. Finally, in Section 6, the conclusion of the work is presented.

2. EUROPEAN STRATEGY AND POLICY
In the 90’s decade, ITS projects are related to the deployment of systems. In that decade, several projects for monitoring systems, communications and incident detections systems [4], [5], [6],[7], [8] were deployed to obtain real traffic information from road network. The evolution of communication technologies have made possible the creation of new Traffic Control Centres (TCCs). These TCCs incorporate the new Advanced Traffic Management Systems (ATMS) allowing traffic management and control in real time.

However, all these projects were developed isolate. In 2006, the European Commission decided to act forwards harmonizing the deployment and use of ITS in road transport across Europe by means of the ITS Action Plan and the European ITS Directive. The purpose of this approach is to increase the ITS services
harmonization and to reach a sustainable mobility as it’s shown in Figure 1.

Figure 1.- Evolution of Projects and programs in Europe. (Source [9])

The ITS Action Plan suggests a number of targeted measures and a proposal for Directive laying down the framework for their implementation. EasyWay has a clear key role to play in several actions of this Action Plan and the technical specifications of the EC ITS Directive.

3. THE EASYWAY PROJECT

EasyWay is a project for the deployment of harmonized Europe-wide ITS on the Trans European road network (TERN). It is formed by national road authorities and operators. Currently it involves 27 countries and more than 150 partners, including the automotive industry, telecom operators and public transport stakeholders.

EasyWay is structured in several Euro Regions. Figure 2 shows the different EasyWay euro regions. It is important to note that countries could be part of several regions. For example, Spain is part of SERTI (with France, Italy, Germany and Switzerland) and ARTS (With France and Portugal) regions.

The main objectives of the EasyWay Programme are [9]: to improve road safety; to reduce congestions / to improve traffic flows and to improve environment.

4. ITS CORE SERVICES

EasyWay is structured in 4 main areas to deploy ITS services:

- Traffic Information
- Traffic management
- Freight and logistics
- Connected ICT infrastructure.

Each area focuses on the deployment of the identification of core services.

In traffic management activity, three core services were identified:

- Strategic Traffic Management for Corridors and Networks, focused on the development of Traffic management plans for huge road networks, specially focused on cross border areas.

- Incident management, centered in the activation of traffic measures to manage and control incidents once they happened.

- Management of sensitive roads. These core services group different ITS services for different sensitive road segments like tunnels, hard shoulders, etc. It is classified in:
  - Dynamic lane management. It is focused on the dynamic allocation of lanes to improve traffic flows.
  - Speed control. It is centered on the dynamic control of the maximum speed in on segment.
  - Ramp metering, focused on the control of the traffic flows in on-ramps accesses to main carriages.
  - Hard shoulder running. It is centered on the use of the hard shoulder in specific situations to improve traffic flows.
  - Incident warning, focused on warning users when and incident occurs.
  - Heavy good vehicles overtaking ban. It is focused in the restriction to overtake in certain traffic situations to heavy good vehicles.
4.1 Deployment guidelines
In 2007, EasyWay project started and established a framework of knowledge and consensus for the harmonized elaboration of the above ITS services. This knowledge has been done through the EasyWay Deployment Guidelines (DGs).

The purpose of DGs is to be a reference for deployments on the selected ITS service. It supports the planning and it provides best practices examples to do the implementation.

In 2011, a new improvement of the current guidelines was done. Since then, DGs are structured in two parts:

- Part A – focused on recommendations and requirements that have proven to contribute to successful elaboration and have been agreed by the EasyWay partners
- Part B – focused on providing more valuable but less descriptive information. So additional information is included in this part. For example, regional and national best practice examples, business model aspects like stakeholder involvement or cost/benefit analysis results and future implementation plans and expected evolution.

Part A is structured in several sections:

- General Framework, describing the general use and application of the DG.
- Organizational Requirements, focused on the different organizational requirements to deploy the ITS service
- Technical Requirements, describing the different technical requirement to deploy the ITS service
- Common Look & Feel, focused on find an harmonized way to present the information to end users
- Level of Service Definition, describing the adequate level of ITS deployment depending on the operative environment to be applied.
- Interaction with other services, identifying the possible ITS services related to the DG service.

Part A is fundamental to develop harmonized ITS services. In the next section, an example of the deployment guideline for traffic management and corridors is shown.

5. A DEPLOYMENT GUIDELINE EXAMPLE: STRATEGIC TRAFFIC MANAGEMENT FOR CORRIDORS AND NETWORKS

The deployment guideline for Traffic Management Plans (TMPs) is developed under the EasyWay European study 2 Traffic Management. This guideline is identified as TMS-DG07 [10].

A TMP is developed in order to cope with road traffic disruptions that call for coordinated actions from the authorities and the different services responsible for road / traffic management on a given road or network.

A TMP is the pre-defined allocation of a set of measures to a specific situation in order to inform and control the real-time [11]. The measures are always applied on a temporary basis and not permanently. Four spatial levels are suited for the elaboration of such complex TMPs:

- Regional TMPs for networks within areas or regions on the TERN network that can be extended, under certain conditions, to link with neighbouring regions for cross-regional and cross-border levels.
- Cross-regional TMPs for national networks and key corridors on the TERN
- Cross-border TMPs for international networks and key corridors on the TERN
- TMPs for conurbations: conurbations and the circumfluent highway network with relevance to the long-distance traffic.

The purpose of TMPs is to solve or minimize the consequences of incidents. Usually, traffic management tasks (identified by measures and actions) developed in a TMPs involves different organizations: traffic managers, traffic polices, civil works, etc.

As described in the DG07 [10], “Traffic Management Plan Service for Corridors and Networks” is not comparable to other traffic management services, described in other EW-TMS guidelines. This DG is a management service which uses and applies other services. Thus, other DGs have to be taken into account for the individual development of traffic management measures. The principle is shown in the Figure 3

![Figure 3.- Allocation of Traffic management plan service for corridors and networks in distinction to other ITS-services. (Source[10])](image)

Two main types of TMPs are identified: rerouting TMPs and multimeasure TMPs. First ones are focused to activate a rerouting itinerary when some incident occurs in the main road network. On the other hand, the multi measure TMP is a generic traffic management that defines the agreement to activate different traffic management measures. These measures are close to the other ITS core services and could be grouped in:

- Traffic information exchange: not only between Traffic Control Centers and organizations involved in the TMP activation, but also to end users.
- Traffic rerouting. This measure implies the activation of an alternative route. Similar to the rerouting TMP, but in this case it is only a measure of a big TMP.
- HGV storage. When it exists traffic restrictions, especially for heavy good vehicles, a specific traffic
storage measure is activated to support end users to find the adequate rest area to park.

- Access control. Several ITS measures could be activated to improve traffic flows. Dynamic lane management, hard shoulder running, and even the closure of the road network.

5.1 A multi measure TMP for the Atlantic corridor

Following the Dirección General de Tráfico (DGT) methodology for Traffic Management Plans, several traffic management plans have been developed. [12],[13]. These TMPs are focused on big incidences, like adverse weather situations, tunnels incidences and emergency situations.

In the frame of adverse weather situations, a coordinated TMP has been deployed between Spain and France. This plan intends to establish the performance lines for the Traffic Management in case of possible weather problems. This is a TMP for adverse weather problems which develops several possible scenarios and the measures to implement each one. This TMP has been followed as one the examples for the creation of the Deployment Guideline on Traffic management plans.

The TMP coverage area is in the corridor located between Bordeaux and Valladolid at Irun Border (see Figure 4) corresponding to the ARTS region. This border is one of the most important borders to cross the Pyrenees Mountains. Several public traffic organizations are involved in the TMP.

![Figure 4.- Coverage area of the TMP](image)

In the Spanish area there are two public traffic organizations in charge of traffic management: the regional administration of the Basque Country, DT, and the national administration, DGT. In the French area, there are two organizations involved: the public traffic administration, the Centre Regionale d’Information et Coordination Routiere (CRICR) and a private organization: Autoroutes du Sud de la France (ASF) in charge of the management of French the toll motorway in the corridor.

Traffic situations in the area have the following characteristics:

- High values of AADT in the border
- High percentages of HGV, including different HGV restrictions for Spain and France (at regional and national level in regional in Spain),

- Adverse weather conditions (more than 64 days of weather problems last winter)
- The road network is part of the corridor for summer migrations and important cities close the corridor (Valladolid, Bilbao, San Sebastian, Bordeaux).

Once the coordination protocol has been defined between the organizations involved, the core of the TMP has to be deployed. The core of the TMP is structured in three levels of information: scenarios, measures and actions [12]. The scenario level defines the current status of the incident. The measures level defines the set of procedures suitable to be applied based on the information of the scenario level. The actions level defines the activities to develop each procedure of the measures level.

5.1.1 Scenarios

The scenarios for adverse weather situations are related to the presence of snow on the road surface.

For this TMP four scenarios were defined:

- **S1 or Green level**: Caution. It starts to snow. Although the driving conditions are not affected, it is necessary to be cautious. It is recommended not to overpass 100 km/h in highways and 80 km/h in the rest of the roads. Trucks should drive on the right lane and not overtake other vehicles.
- **S2 or Yellow level**: Precaution: snow on the road. The road is starting to be covered with snow. The driving of trucks and articulated vehicles is prohibited. Private cars and buses shall not exceed 60 km/h.
- **S3 or Red level**: Difficult, the road is covered with snow. It is only possible to drive with chains. The maximum speed is 30 km/h. The driving of articulated vehicles, trucks and buses is prohibited.
- **S4 or Black level**: Closed road. No vehicle can drive. There is a risk to get stuck on the road for a long period of time.

The scenarios are defined taking to account the risk for end users. For example, in S1 there is only risk in specific mountain passes; for S2 the risk is related to the slipperiness of the surface. There are segments when snow and frost could cause problems to drivers. In S3 the snow is present in the major part of the road, so incidents due to slipperiness are frequent. Finally, in S4, it is possible to get stop in the road without possibility to circulate in any sense.

5.1.2 Measures

Each scenario has a set of traffic measures to manage the current incident situation. Main measures are:

- Information exchange between the organizations involved in the TMP. This measure includes the use of DATEX II [14] to exchange information.
- Activation of traffic information services to diffuse the required information to drivers. This measures includes the RDS-TMC alerts, the use of Variable message Sings and other information services.
- Traffic control. In several scenarios, traffic police has to control the access to avoid the restricted vehicles go inside the incident area. Furthermore, in S2 it is
impossible to use the overtaking ban for HGV. In S3 and S4 the storage of HGV is mandatory.

- Control and security with the DGT helicopter service. From the air, the Traffic Management Centre has a unique global view of the traffic situation, which allows to improve the traffic management and control tasks.
- Rerouting. Alternative routes are activated to rerouting road users to their destination.

5.2 Checking the TMP with the Deployment Guideline DG07TMP requirement

To analyze the degree of compliance of a certain Deployment a check list with different issues about requirements has been developed. These requirements are related to functional, organizational and common look and feel requirements. Moreover, requirements are defined in 5 areas: MUST, MUST NOT, SHOULD, SHOULD NOT and MAY.

Tables 1, 2, 3 and 4 show the analysis of the check list in the presented TMP.

Tables 1 presents the compliance checklist for the functional requirements. These requirements are structured in 3 groups: the requirements in the elaboration phase of the TMP the requirements during the execution of the TMP (application phase) and finally the requirements in the evaluation phase.

| Table 1.- List of functional requirements for TMPs and the compliance of the presented TMP |
|----------------|----------------------------------|
| Functional requirements | Check |
| **TMP elaboration phase** | |
| FR1 | Functional decomposition | Yes |
| FR2 | A TMP feasibility study must be elaborated | Yes |
| FR3 | A TMP feasibility study document must be delivered as input for the TMP framework development. | Yes |
| FR4 | Based on the results of TMP feasibility study a TMP framework must be elaborated and established. | Yes, it includes a information exchange protocol |
| FR5 | A TMP framework development document must be delivered as input for the TMP development. | Yes |
| FR6 | Based on the results of TMP framework applicable TMPs must be elaborated and established. | Yes |
| FR7 | The sub-function must provide applicable TMPs profiled in a predefined information structure | Yes |
| **TMP application phase** | |
| FR8 | Functional decomposition (in case the service is carried out by more than one organisation) | Yes |
| FR9/F R10 | Use of the scenario activation request information set interface (SARIS) in case of cross-organisational TMPs | No at this moment. |
| FR11/ FR12 | Use of the scenario deactivation request information set interface (SDRIS) in case of cross-organisational TMPs | No at this moment. |
| **TMP Evaluation phase** | |
| FR13 | Existing TMPs must be assessed and periodically adjusted. Hence an evaluation model and an evaluation process must be defined. | Yes, meetings are hold twice per year |

Table 2 is related to the requirements of the organizational aspects of the TMP. It is focused on the role definition and the structure organization.

| Table 2.- List of organizational requirements for TMPs and the compliance of the presented TMP. |
|---|---|
| Organisational requirements | check |
| **Role definition** | |
| OR1 | All different roles needed in the three phases of the service must be considered and defined (role concept) | Yes, All involved roles are defined in the TMP creation |
| **Processes** | |
| OR2 | Application of the recommended steps For the TMP Feasibility study process | Yes |
| OR3 | Application of the recommended steps For the TMP framework development process | Yes |
| OR4 | Application of the recommended steps For the TMP development process | Yes |
| **Arrangements and contracts** | |
| OR5 | Application of the recommended content of the common arrangement in case of cross-organisational TMPs | Yes, protocols are agreed in the TMP creation phase |
| OR6 | MoU - Memorandum of understanding setup in case of cross-organisational TMPs | Yes |
| OR7 | MoU - Memorandum of understanding Annex setup in case of cross-organisational TMPs | Yes |
| OR8 | Extensive off-line and on-line testing of proposed TM strategies and measures | Not currently |
| OR9 | Contracts between stakeholders in case of cross-organisational TMPs | Not necessary |
| **Centralised organisational structure** | |
| OR10 | Centralised structure: One pre-defined coordinator must be defined, which is responsible for the whole TMP activation and deactivation process in case of cross-organisational TMPs | Not in this case. The activation depends on the location of the incident |
| OR11 | To carry out scenario activation/deactivation workflow a “command communication pattern” must be used in case of cross-organisational TMPs | Yes |
| **Mixed organisational structure** | |
| OR12 | To carry out scenario activation/deactivation workflow a “request/confirm communication pattern” must be used in case of cross-organisational TMPs | No |
| OR13 | To carry out scenario activation/deactivation there must be used both “Command communication pattern” and “Request/confirm communication pattern” according to organisational structure applied to sub organisations. | Yes |
Table 3 presents the technical requirements of the TMP. These technical requirements are related not only for the aspects related about the deployment of the TMP but also related on the activation.

**Table 3.- List of technical requirements for TMPs and the compliance of the presented TMP.**

<table>
<thead>
<tr>
<th>Technical requirements</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR1</td>
<td>The “command” communication pattern must be applied</td>
</tr>
<tr>
<td>TR2</td>
<td>The “request/confirm” communication pattern must be applied</td>
</tr>
<tr>
<td>TR2</td>
<td>The “EasyWay TMP profile” must be applied</td>
</tr>
<tr>
<td>TR4</td>
<td>The “Scenario activation/deactivation request Information set (SARIS/SDRIS) profile” must be applied</td>
</tr>
</tbody>
</table>

Finally, Table 4 presents the requirements related to the look and feel of the TMP taking into account the TMP user point of view.

**Table 4.- List of common look and feel requirements for TMPs and the compliance of the presented TMP.**

<table>
<thead>
<tr>
<th>Common Look &amp; Feel</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>L&amp;F1</td>
<td>For cross-border re-routing signage the road sign icons identified in the Vienna Convention (Annex X, G23, re-routing) must be used</td>
</tr>
<tr>
<td>L&amp;F2</td>
<td>recommended common structure for the TMP-elaboration document</td>
</tr>
</tbody>
</table>

In addition to these requirements, the DGs provide a level of service table describing the adequate level, minimum and optimum, of ITS deployment depending on the operative environment to be applied. Figure 5 presents the level of service for Operative Environments (OE) allow the classification of the road network [15]. Currently, there are 18 OEs. Operating environments are defined as a combination of the following key factors:

- physical characteristics of the road section
- road section network topology
- traffic flow impact and/or road safety concerns

Furthermore, a specific road section may be characterized by attributes such as recurring weather problems, a particular sensitivity for environmental impacts or particular importance for freight transport. The classification method allows for such attributes to be added to the operating environment identified

**Figure 5.- Level of Service for Traffic Management Plan ITS core service. Operating Environment for S1 and S2 levels.**

The operative environment related to the corridor is S1. S1 defines a motorway corridor or network, with seasonal flow-related impact, and possibly safety concerns. The corridor has impact of HGV and adverse weather conditions.

For Operating environment S1, the minimum level of service must be (see Figure 5):

- Coverage: LOS A. Critical spot coverage. The presented TMP reach LOS C (Optimum). It covers not only the critical spot in the road network, but also all road networks.
- Availability to time: LOS A. Service periodically ensured during critical periods. The TMP reach LOS C (more than the Optimum). The service is guarantee 24 hours, 7 days per week.
- System availability: LOS A. one sole system available. The TMP reach level C (Optimum). Each TCC has several systems to monitor the road network and to inform users and other organizations.
- Consistency. LOS A. Consistent local road user advice along routes. The TMP reach level C (Optimum). The information is agreed between the traffic organizations involved in the TMP.
- Level of coordination. LOS A Knowledge scenario sharing between neighboring regions.
- The TMP reach level B (Optimum) cross border scenario consistency. Currently, new traffic measures are being developed. Once they will be implemented the Los to be reached will be C.
6. CONCLUSIONS
EasyWay project is a great opportunity to deploy harmonised Intelligent Transport Systems and services across Europe. The project supports not only the deployment at national level but also at regional and international level. EasyWay focus the results not only in the road operators but also in the end users.

Several ITS core services were identified during the first phase of the project. For each core service a deployment guideline is developed. DGs compile the experience of road organizations in in the specific item. The purpose of the DG is to support road organizations in the deployment of harmonized ITS core services.

In the paper, the ITS core service for strategic traffic management for corridors and networks has being presented. Traffic management plans are a useful tool to solve or minimize the incidences in the road network, especially when these incidences affect a huge road area network like for example adverse road weather situations.

The current TMP for the Atlantic corridor has been presented and analyzed using the DG. The major part of functional, organizational and common look and feel requirements is reached by the Spanish TMP. The recommended level of service for the operating environment where the road network is located has been also analysed. The results are very positive: not only the minimum level in reached in all cases, but also the optimum.

7. ACKNOWLEDGMENTS
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8. REFERENCES