PUBLIC TRANSPORT STANDARDIZATION
– A CONTRIBUTION TO THE STATE OF THE ART REVIEW –

Inês Soares
Grupo de Transportes, Território e Desenvolvimento Sustentável - GuITTS, Instituto Superior de Engenharia de Lisboa (ISEL), Portugal
Email: isoares@ceec.isel.pt

Paulo Matos Martins
Grupo de Transportes, Território e Desenvolvimento Sustentável - GuITTS, Instituto Superior de Engenharia de Lisboa (ISEL), Portugal
Email: paulo.martins@dec.isel.pt

ABSTRACT

This paper analyzes the role nowadays information play in the seamless provision of sustainable mobility. We stress the importance of current data needs and ways to delivery this information to users. The role and major problems the use of standards can imply is also put in evidence. Standards are proposed and promoted by standardization bodies (like CEN or ISO) and other related entities. We review some of the major initiatives for public transport normalization. First we summarize the role and actions originated from the CEN/TC 278 ITS Standardization committee. Some of the relevant initiatives related to the provision of information systems in the public transport domain, such as the Transmodel, SIRI, IFOPT and NeTEx standards are also described. Due to its importance and spreading as a common structure to publish public transport data and schedules, Google Transit Feed Specifications (GTFS) is also analyzed. The INSPIRE and ITS Directives are also presented. Both imply a robust effort for standardization and are valid initiatives from the European Union. Some reference details about the initiatives described are highlighted and some of their specificities are noted. Finally, special attention is given to the European network and consortium INTEGRA as a global facilitator for sustainable mobility. Its vision: "*INTEGRA: the European quality brand for seamless travel and sustainable mobility*" is emphasized and its role as an effective provider of standardization guidance is explained.

Keywords: Standardization, Public Transport, harmonization, INSPIRE Directive, ITS

INTRODUCTION

Nowadays, information plays a major role in the quotidian of societies. We live in a "Information Society", where the access, storage, processing, valorisation, transmission and sharing of the information are essential to stimulate the wealth creation, improve the quality of life and for the development of the Society (MSI, 1997).

The "true", complete and relevant information is crucial in all stages of development and implementation of a competitive strategy (Beal, 2001). According to Moniz & Kovács (2001), the economy and society grow and develop themselves around information. The information represents the central core of the new Society.

The need for quality and harmonized information is more frequently felt in the public sector. The public authorities are the biggest producers of information in the Europe. The Green Paper on Public Sector Information in the Information Society (European Commission, 2008) states that information plays a fundamental role in the proper functioning of the internal market and the free circulation of goods, services and people. The provision of information is an essential condition for the competitiveness of the European industry.

One of the major obstacles to the growth of new pan-European Traffic and Traveller information services is the difficulty faced by potential service providers in gaining access to the required travel information (Lyoen et al., 2010):

> If travellers could be informed, they could make better decisions, whether before the journey, or in the course of a journey.

The establishment of coherent European services is essential, including the creation of a consistent framework to allow public and private sector to access the relevant public transport information.

However, it is common that information is fragmented, duplicated and unavailable, being difficult to identify, access and use. This is often a result of the separate legislation which is practiced in several countries or even regions of the same country. In the European Union this circumstance is most visible between Member States (MS). This situation brigs additional difficulties on how to access the information, due to the existence of multiple and repetitive practices that restricts the availability of the data (Soares & Martins, 2012).

The main issues and barriers identified are the lack of availability and access to transportation data and the lack of a viable commercial business case for service delivery. It is very difficult to collect and maintain the data, because of the associated high costs, and the users are not willing to pay for the resulting limited services (Lyoen et al., 2010).

The transport systems are distributed systems with very complex information requirements. So, the full interoperability of these systems can only be achieved through the existence and implementation of adequate standards, properly conceived by experts, tested and understood by practitioners. Strong standard for transportation data are important for the safe and efficient operation of the systems.

In the last decades, several international projects and international standardization bodies have gathered efforts to develop a set of basic standards and procedures to ensure the

interoperability of public transport, enabling the effective sharing of information between the different transport systems.

This research aims to contribute to the review of the state of art on the standardization of the public transport information systems and correspondent data structures, considering some of the major contributions developed in recent years in this field. Thus, this research intends to study the major European and global projects undertaken on this field.

The goals of this paper are to identify and understand the main standardization organizations, bodies and initiatives that contribute to the normalization of public transport information from the point of view of sharing or storage the information. It is our intention to present the most significant initiatives and standards in order to gather the existing information, and contribute to the knowledge and normalization of public transport data.

As will be detailed at the final part of the paper, this effort will be used in the future as input for the definition of strategies for the development of guidelines and recommendations[1]. These will be the base for the development of open and interoperable initiatives for the provision of travel information in a seamless integrated shape to travelers and citizens across Europe.

This paper is divided into 7 sections. In the first section, the intention is to present a brief introduction to the theme, exposing the major problems at the level of the storage and sharing of the public transport information. In the following sections are presented some standardization bodies and initiatives with focus on public transport information, as well as Directives not so related with public transport but that may be adopted as doctrines in public transport information system. In the second section are presented the CEN/TC 278, the ITS Standardization, thus the principal standards developed by this technical committee related to the information systems of public transport information, such as the Transmodel, SIRI, IFOPT and NeTEx standards. Then, in third section is presented the Google Transit Feed Specifications. In the fourth section is explained the INSPIRE Directive, not so related with public transport information, but a good example of a normalization doctrine, being fundamental the knowledge and understanding of this directive. The ITS Directive is explained in fifth section, followed by the presentation of the European Association INTEGRA. Finally in last section, are presented our conclusions and future prospects for the development of normalization of the public transport information in Europe.

CEN/TC 278 – ITS STANDARDIZATION

The European Committee for Standardization (CEN) represents a business facilitator in Europe, removing the barriers for European industry and consumers. Have as mission to foster the European economy in global trading, the welfare of European citizens and the environment. Through its services it provides a platform for the development of European Standards and other technical specifications (European Committee for Standardization, 2013).

[1] These guidelines and recommendations will be implemented in the framework of INTEGRA network and consortium as is explained at the end of the paper. For further references about INTEGRA and its origin, see

CEN is a major provider of European Standards and technical specifications. It is the only recognized European organization for the planning, drafting and adoption of European Standards in all areas of economic activity[2].

The standards of the European Committee for Standardization cover a wide range of products and services, with incidence also in the *Transport* sector, along with the *Packaging* sector. The Transport and Packaging sectors can further be breakdown as specified in the scheme of Figure 1.

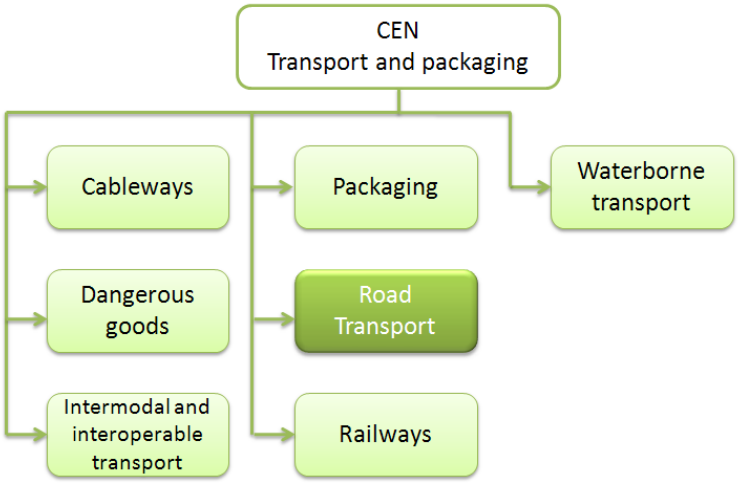

Figure 1 – CEN Transport and packaging sector

The 'work programme' (as is called by CEN) of *Transport and packaging* sectors is also further divided in about thirty technical committees. The technical committee responsible for the development of standards related to Public Transports is the Technical Committee 287 (CEN/TC 278). According to CEN (European Committee for Standardization, 2009), the standards for road transport are mostly elaborated within the International Organization for Standardization (ISO), however, some specific topics, such as the Intelligent Transport Systems (Road Transport and Traffic Telematics) are addressed in Europe and covered by CEN.

CEN/TC 278 was the first ITS standardization body, and TC 278 has laid the ground works for global ITS standards. The initial ideas derived from the European framework programme DRIVE[3]. The Road Transport and Telematics, normally referred to as Intelligent Transport Systems (ITS) is playing an ever greater role in increasing the efficiency of public and private transport, and is responsible for the development of the European standards and technical specification in the domain of ITS. ITS standards contribute to ensure the interoperability across countries and harmonise technical solutions (Peelen, 2011).

The ITS standards are needed because they enables interoperability of systems and services, encourages innovation, foster enterprises, creates trust and confidences in

[2] With the exception of electrotechnology (CENELEC) and telecommunication (ETSI).
[3] The European Program DRIVE (Dedicated Road Infrastructure for Vehicle safety in Europe) was the first telematics program of research and development established by the European Commission, starting in 1988. This program aimed to promote the efficiency of road transport, road safety and environmental protection within the European Community through the implementation of RTI – Road Transport Informatics and telecommunications.

products and services, expand the market, helps to prevent duplication of effort, support confidence in procurement ad interchange ability of system component suppliers (Peelen, 2011).

The CEN/TC 278, ITS, has more than ten Working Groups (WG) in which the actual work is carried out. Each of these groups is dedicated to a more specific aspect of the overall road transport thematic. The present review will be given more relevance to the Working Group 3 (WG3) because it deals with the Public Transport, the focus of this paper.

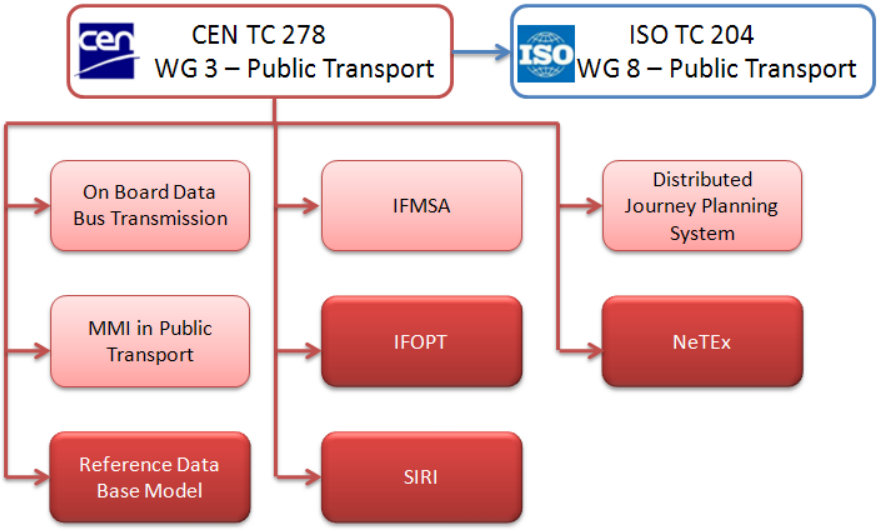

Figure 2 – CEN/TC 278 Working Group 3 – Public Transport

The CEN/TC 278 operates in close cooperation with ISO/TC 204 - Intelligent Transport Systems (cooperation regulated by the Vienna Agreement[4]), which is the world responsible for the development of the international standards. Several standards are prepared in joint working groups, in order that the expertise from around the world can be used to set the best standards for Europe, promoting the optimal use of available resources in both organizations (CEN/TC 278, 2012).

The WG3 is currently sub-divided in eight subgroups covering the several themes summarized in Figure 2. Each subgroup is responsible for a theme. This communication will only deepen standardization initiatives that are related to the information systems in public transport, which correspond to the Reference Data Base Model (SG4), SIRI (SG7), IFOPT (SG6) and NeTEx (SG9).

Reference Data Base Model - Transmodel

The Transmodel Standard (CEN/TC 278 WG3/SG4, Reference Data Model for Public Transport) is the European reference data model for Public Transport operations developed within several European Projects. The present version of Transmodel (V5.0) uses an Entity-Relationship modeling approach and covers the following topics:

[4] Agreement on technical co-operation between ISO and CEN: http://isotc.iso.org/livelink/livelink/fetch/2000/2122/3146825/4229629/4230450/4230458/01__Agreement_on_Technical_Cooperation_between_ISO_and_CEN__Vienna_Agreement_.pdf?nodeid=4230688&vernum=0

- Tactical planning;
- Personnel disposition;
- Operations monitoring and control;
- Passenger information;
- Fare collection;
- Management information/statistics.

This standard is a conceptual data model for public transport that provides an architectural framework for understanding the information needs of public transport companies or operators and for constructing an integrated information system to service end users with the information they require to run their business (CEN/TC 278 WG3, 2001). According to Bourée (2012), a Common Reference Data Model offers the possibility to establish a data repository or exchange messages based on a common semantics base.

It intend to provide a solution to operators, authorities and software suppliers that want to develop an integrated system, offering a sound architectural framework for understanding the necessary information of a PT company and for building an integrated information system to service end users with quality information required to run their businesses. It is essential that the applications no longer need to be dependent on one specific operating system or hardware platform. They need to be standardized and harmonized in order to reduce the associated adaptions.

The reference data model, Transmodel, can support the establishment of software applications, their interaction or combination in an integrated information system, and the systems organization and information management.

Transmodel describe the elementary data needed for the network description and version management that are used in different functional domains as basic concepts. It describes as well as the information needs related to the tactical planning (vehicle scheduling, driver scheduling, rostering), personnel disposition, operations monitoring and control, passenger information, fare collection and management information and statistic domains (CEN/TC 278 WG3, 2001).

> The reference data model for PT has to be considered as a generic model, because this model represents the practices of most PT operators and authorities considered representative in Europe, rather than some particular solutions. Includes the semantics of a variety of practices and takes into account a range of specific needs.

This standard takes into account the multimodal public transport operation, which consists in the co-operations between different public transport modes. Transmodel addresses the bus, trolley bus and light rail (tramway, metro) needs.

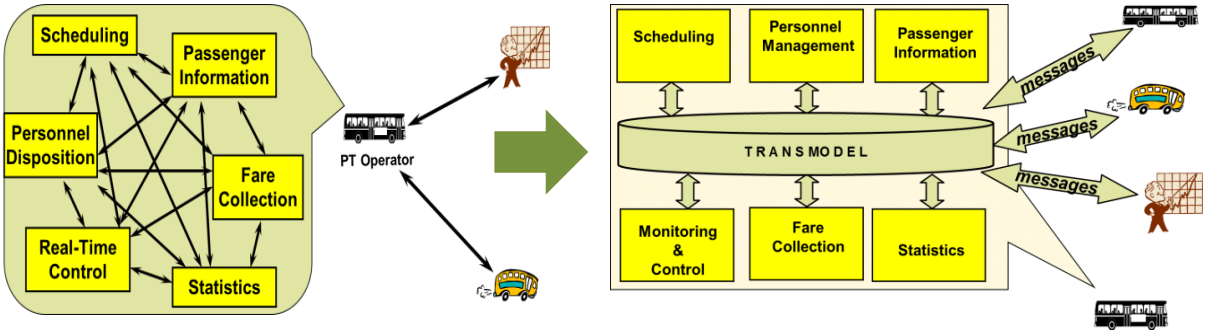

Figure 3 – Transmodel interoperability
Source: (Bourée, 2012)

The Transmodel System Architecture aims to contribute to the simplification of complex information systems architecture. The previous figure present how a complex information system, with lack of interoperability and several proprietary applications, can be convert into a harmonized and interoperable system using Transmodel reference data model.

In the past decades the Transmodel standards family[5] was the source for the development of several concrete data models at national and European level, including the TransXchange UK standard (2001-2005), the Trident (1999-2003), SIRI (2001-2005) and IFOPT (2006-2007).

SIRI – Service Interface for Real-time Information

The Service Interface for Real-time Information (SIRI) consists in an XML protocol that allows distributed computers to exchange real-time information regarding public transport services and vehicles. SIRI is a CEN standard created by equipment suppliers, transport authorities, transport operators and transport consultants from several European countries, such as France, Germany, Scandinavia, and the United Kingdom. As was said before, SIRI is based on the Transmodel standard.

The SIRI specifies a European interface standard for exchanging information about the planned, current or projected real-time public transport operations between different computer systems (CEN/TC 278 WG3, 2005).

According to Bruns (n.d.), SIRI comprises a carefully modularized set of discrete functional services for operating PT information systems, aims to incorporate the existent national and proprietary standards in Europe and delivers these using a modern XML schema and Transmodel terminology and modeling concepts.

SIRI comprises the following functional services:

- Production Timetable Service;
- Estimated Timetable Service;
- Stop Service;
- Vehicle Monitoring Service;
- Connection Protection Services;
- General Messaging Service.

[5] We call Transmodel a family, because Transmodel origins date from 1989 and the Cassiope project.

SIRI was designed to be extensible. News services can be added within the SIRI framework and individual services might be enhanced by additional function, following a systematic versioning scheme (CEN/TC 278 WG3, 2005)

Since 2005, SIRI has been implemented in France, Germany, Netherlands, Norway, Sweden, Ireland, UK, Israel, Australia and also in the USA. In the next subsections a short summary of these applications is presented.

Trafikanten real-time App (RuterReise) - Norway

The Trafikanten real-time app, know called RuterReise, is the real-time information application in Oslo and Akershus. With this application is possible to plan a journey and find out about any delays or cancellations in services which may arise while the users are travelling. Over 320.000 passengers have already downloaded the application for iPhone, Android, Windows Mobile or Java.

In October 2010 all services for real-time information has been based on SIRI standard. The application is based on Trafikanten´s SIRI StopMonitoring (Knowles, 2011).

Traveline - UK

The UK Traveline Service provides in a larger scale examples of the usage of SIRI services to integrate real-time stop data.

The Traveline Information Ltd is a partnership of transport operators and local authorities designed to provide impartial and comprehensive information on public transport, powered since 2000 (Traveline, n.d.).

SIRI is used in three separate capacities (Knowles, 2011):

- Provide a uniform API with which to deliver data to the client SMS and Web applications;
- Provide a uniform API with which to deliver data to the client third party applications powering smartphones and other apps;
- Provide a standardized API with which to obtain real-time information from over 20 different local real-time systems.

Certu - Ile de France

As part of the “Grenelle de l´Environnement” (French government´s environment round table) emerged the Certu program, under the ensign of “Promoting sustainable cities”. Certu was created by French decree nº 94-134 of 9 February 1994 (Ministère de l´écologie du Développement Durable et de L´énergie, n.d.). In this case, SIRI is used to exchange data between various operator´s systems in the Ile-de-France (metropolitan region Paris).

CERTU through the publication of the document “Normalisation des échanges de données d´information voyageurs temps reel” presents in detail the SIRI “Local Agreement”, applied to Ile-de-France. Actually, consists in a document that explains the contracts established between the public transport operators (L´autorité organisatrice de vos transport en Ile de France, 2010).

MTA Bus Time – New York

The MTA Bus Time uses GPS (Global Positioning System) hardware and wireless communications technology to track the real-time location of buses. This technology enable users to use the computer, cell phone, smartphone or other technological device to obtain information about when the next bus will arrive at the stop point, even if they are still at home, the office, shopping, etc. (MTA info, n.d.).

The MTA did not wanted to develop another real-time transit data standard, therefore after some research and consultation with the local developer community, identified the SIRI standard as a great option and are using it in the MTA Bus Time Project.

IFOPT

The IFOPT (Identification of Fixed Objects in Public Transport) project is a pre-CEN technical standard that provides a Reference Data Model for describing the main fixed objects related to public access to public transport, such as stop points, stop areas, stations, connection links, entrances, etc.

The IFOPT specification intends to (CEN/TC 278, 2008):

- Identify the main functions that require a unique ID for fixed objects, especially for the passengers information in a multimodal context;
- Identify the main fixed objects in public transport system, considering a certain level of detail in the description, taking into account the needs of the identified functions;
- Provide a typology for these objects along with their definitions;
- Unambiguously describe the objects through their properties/attributes;
- Describe the location of objects by their coordinates.

The technological specification was built on the Transmodel Standard in order to define four related sub-models (Fixed Object Sub-models). Each sub-model is described as a set of entities, attributes and relationships with other models.

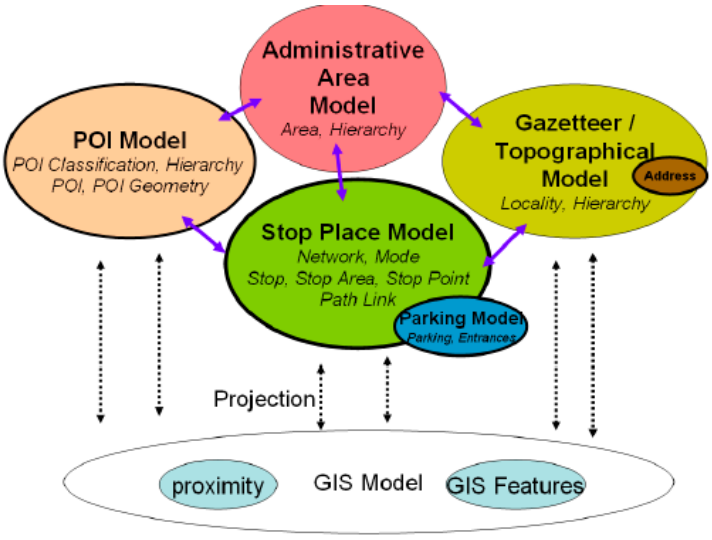

Figure 4 – Fixed Objects Sub models (CEN/TC 278, 2008)

The Stop Place Model describes the structure of a Stop place (i.e. station, airport, a bus stop, etc.) including physical points of access to vehicles and the paths between the points. The Stop Place Model describes the stops and paths as actual physical locations in space.

The Point of Interest (POI) Model describes the structure of the points of interest, including physical points of access such as entrances. It also provides a model for a standardized point of interest classification hierarchy.

The Gazetteer Topographical Model provides a topographical representation of the settlements between which people travel - the paths between Stop Places and/or Stop Places and Points of Interest.

Finally, the Administrative Model provides an organizational model for assigning responsibility to create and maintain data as a collaborative process, involving several stakeholders.

The primary use cases in the scope of IFOPT are the scheduling and timetables, through stop identifications, journey planning, guidance, navigation (stop finding, interchange paths, walk to POI, in station navigation), accessibility and AVL/real-time information. As additional use cases are the public transport operations, vehicle stop position control, equipment management, general GIS, local authorities and fare collection.

The IFOPT aims to enabling large scale public information service across Europe, improving data and products economics and improving the data quality (Slevin, 2009).

NeTEx

The Network and Timetables Exchange (NeTEx), CEN/TC 278 WG3/SG9, is a pre-CEN/technical standard currently in development. NeTEx aims to become an efficient European standard for exchanging public transport schedules and related data.

This technical standard intends to provide a mean to exchange stops, routes and timetables between different computer systems, in a harmonized way. It comprises the following components: a specification, a modular NeTEx XML schema, description of protocols for exchanging data, supporting documents and examples of schedules encoded as NeTEx XML documents (CEN/TC 278, 2009).

NeTEx is based on Transmodel, IFOPT and SIRI. It can be seen as a complement to the SIRI standard, supporting action to complete SIRI services on network, timetables and fare exchanges.

It uses a fully articulated model that represents public transport concepts in order to make efficient and updateable the exchange of complex transport data between distributed systems. NeTEx intend to facilitate the usage of data in modern web services architectures and support passenger information and operational applications.

NeTEx is divided in three parts. The Part 1 of NeTEx provides a Network Topology Model composed by three main sub models: the Network Description Model (describes the roads, railways and routes), the Fixed Object Model (describes stations, POI, etc.) and the Tactical Planning Mode (describes reusable planning information) (CEN/TC 278, 2009).The Part 2

regards the Networking Timing Information (CEN/TC 278, 2011) and Part 3 is related to Fare Collection.

GENERAL TRANSIT FEED SPECIFICATION (GTFS)

The Generic Transit Feed Specification defines a common structure for public transportation schedules and associated geographic information, enabling the public transit agencies to publish their transit data and developers to create applications that use the data in a interoperable and harmonised way (Google, 2012).

The GFTS feed consists in a set of text files, each file models a particular element of public transit information, such as stops, routes, trips, agencies, etc. The different text files that comprise a GTFS transit feed are explained and defined in the GTFS reference (Google, 2013a). The agencies can produce GTFS feeds to share PT information with developers, which build up tools that consume this information and incorporate into their applications. These files help to provide transit directions to users on Google Maps website.

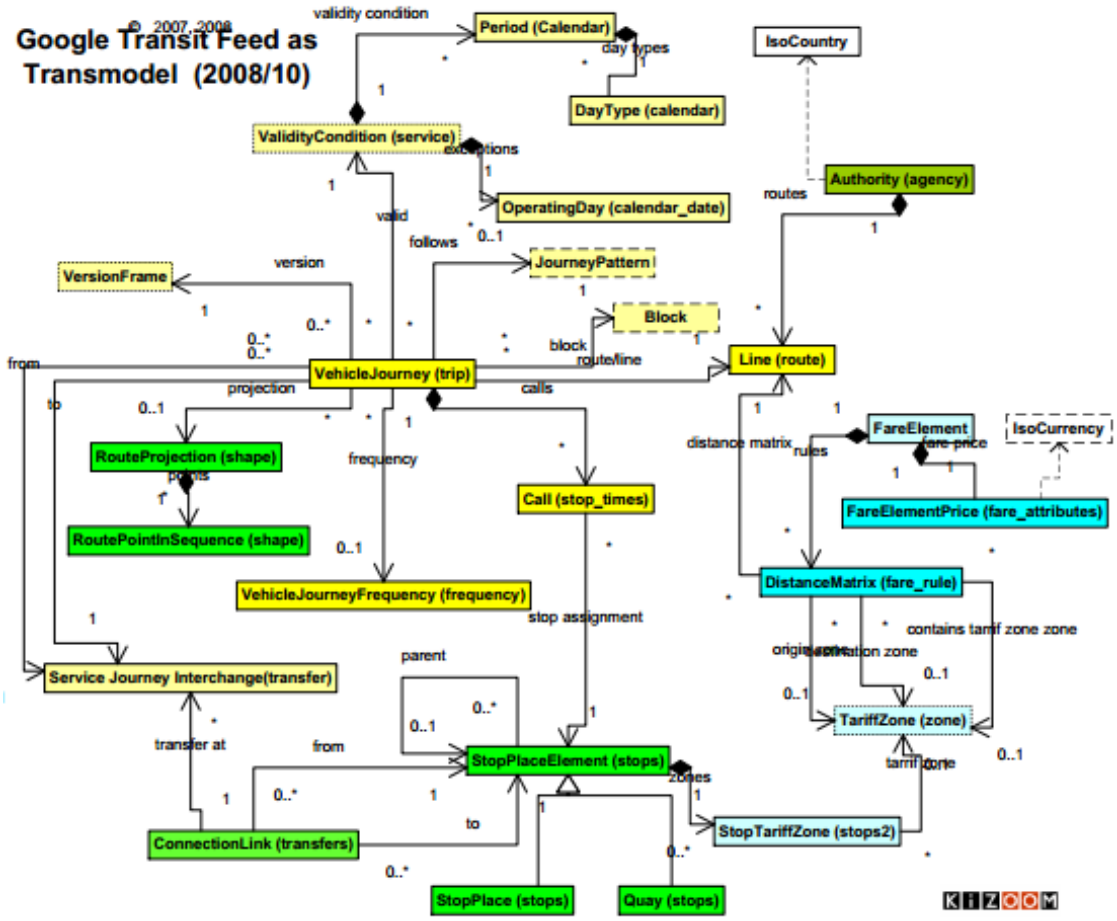

Figure 5 – Google Transit Feed Specification as Transmodel
Source: (Kizoom & Miller, 2008)

Primarily, Google Transit focuses on the metropolitan area transport networks, comprising bus, metro and ferry. Any agency with responsibility for oversight the public transport in a city can use this specification to provide information on schedules and geographic information to Google Maps and other applications that used transit information. Nowadays, several transit

agencies have made their GTFS available such as TriMet (Portland), BART (San Francisco), DART (Dallas) and others (Google, 2013).

The GTFS/Transmodel Comparison & Schema (Kizoom & Miller, 2008) compares the GTFS with then equivalent elements from Transmodel and propose the creation of a Transmodel based XML schema for exchanging transit stop and timetable data. This schema should be harmonized and interoperable with both Google GTFS and Transmodel based datasets.

One of the principal benefits of relating GTFS and Transmodel is the possibility to use Transmodel as a design tool, allowing its use as a conceptual language and model, necessary to understand the GTFS capabilities.

The establishment of a successful schema can be a great contribution towards an ISO standard for Public Transportation Models.

INPIRE DIRECTIVE

The problems related to the access, share, storage and use of information are well known and felt by many communities and governments around the world. In order to solve the problems related to geographic information in Europe, the European Commission has met efforts to create one of the most ambitious projects ever developed in the EU: the Inspire Directive. The Directive entered in force on the 15th of May 2007 (Directive 2007/2/CE of the European Parliament and of the Council), establishing an Infrastructure for Spatial Information in the European Community.

As mentioned, we live in the information society, where the information is essential to simulate the development and growth of the modern world. However, geographic information represents about 80% or 90% of the information in the universe, so the information society is no more than the geographic information society (Julião, 1999). This Directive aims to provide integrated spatial information services. These services should allow the users to identify and access, locally and globally, spatial information from a wide range of sources, in an interoperable way.

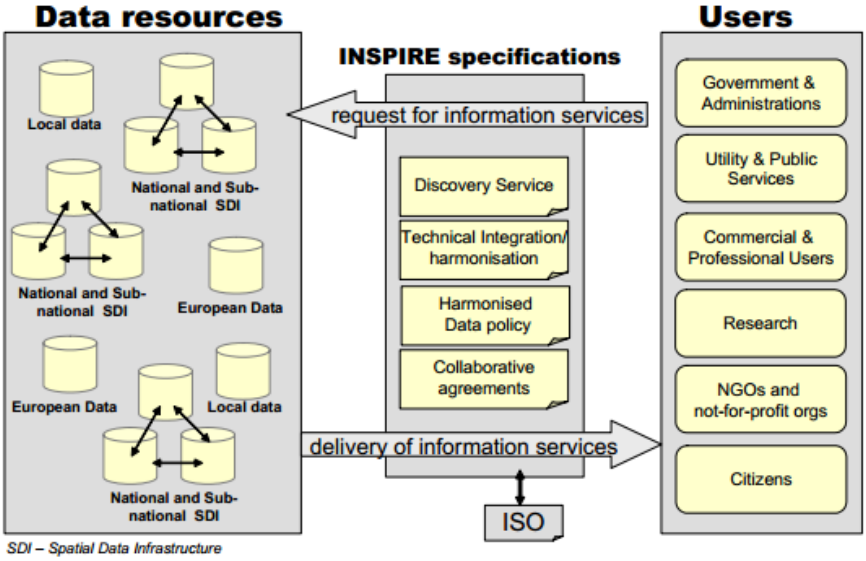

Figure 6 – INSPIRE Information Flow
Source: (Architecture and Standards Working Group, 2002)

The scope of INSPIRE Directive focuses on the infrastructures for spatial information established and maintained by the 27 Member States of the European Union, covering 34 themes arranged in three annexes as required for sustainable environmental development. The Directive includes several "key" components. The Transport Network theme is described in the first annex of the Directive and in 2010 the data specifications for the theme were released. The document intends to provide the guidelines to establish the conceptual schema for the Transport Networks, ensuring the interoperability and the harmonization of the geographic data sets and services.

The INSPIRE initiative, subsequently adopted as a European directive, represents a fundamental milestone in the process of harmonization of information in Europe. The wide range of themes and its mandatory character aims to resolve the main problems associated with the sharing, use and access of the geographic information in Europe. Although it was originally developed from an environmental perspective, the INSPIRE Directive can be considered as a doctrinal initiative, regarding the strategic approach for the standardization of Transport related information in Europe.

However, INSPIRE Directive also has its limitations. Regarding the theme of Transport Networks, it only provides guidelines for structure and modeling information about the transport infrastructure. Transport services are not contemplated. According to Knowles & Drummond (2009), the INSPIRE Directive apparently doesn´t taken into account CEN European standards, such as the Transmodel and IFOPT. The Directive makes no mention of Transmodel or the Identification of Fixed Objects in Public Transport (IFOPT), while Transmodel is the long established CEN standard and provide well founded representations for significant parts of the theme's scope, for example elements for public transport networks.

The integration between INPIRE Directive and some CEN standards, as mentioned, could still contribute to the future creation of a unifying framework for standardization practices, which can/should also include GTFS schemas and other similar standards. The goal is not to have an unique world standard for the theme of Transport Networks, but to have a seamless approach for the use of existing standards and, when these standards accomplish and fulfill the needs, promote their use, independently of their origin. The use of SIRI for the MTA Bus Time in New York is a good example of what the authors consider the right way.

ITS DIRECTIVE

On the 7th of July 2010 another European Directive entered in force. We refer to the so called ITS Directive or *Directive 2010/40/EU for the deployment of the Intelligent Transport Systems in field of road transport and for interfaces with other modes of transport* across Europe. This Directive defines the framework in support of the coordinated and coherent deployment and use of ITS within Europe, in particular in the borders regions between the Member States, and sets outs the general conditions for that purpose (European Commission, 2010).

The first steps for the deployment and use of ITS in road transport started in 2008 by the adoption of the ITS Action Plan (European Commission, 2011a). The ITS Action plan accelerated and coordinates the deployment of ITS in road transport and was adopted after a preparatory work and a long consultation with stakeholders. It contains measures intended to

mobilise industry, the EU Member States, infrastructure and service providers and other stakeholders.

The ITS Action plan comprises a wide range of measures. Thus, the plan have grouped into six priority areas 24 specific actions, with target dates for completion spanning the years 2009-2014, for the development and use of specifications and standards (European Commission, 2010):

1. Optimal use of road, traffic and travel data;
2. Continuity of traffic and freight management ITS services;
3. ITS road safety and security applications;
4. Data security and protection, and liability issues;
5. Integration of the vehicle into transport infrastructure;
6. European ITS cooperation and coordination.

Due to the limitations imposed by the extension of the paper we focused on the first priority area of the ITS Action Plan. This priority area is the one directly related to the sharing and use of harmonized road, traffic and travel information and more related with public transport standardization and information systems, one of the main goals of our research, associated with the INTEGRA network which we will address the next section.

We will further detail the specific actions for the first priority area, *"Optimal use of road, traffic and travel data*", in which the specification and standards should include:

Real-time traffic and travel information:

The establishment of EU-wide real-time traffic and travel information services should address the provision of traffic information services by the private sector, the traffic regulation data by the transport authorities, guarantee the access by public authorities to safety-related information by private companies and guarantee the access by private companies to relevant public data (European Commission, 2011a).

The main objectives are: to share private traffic information (safety-related) with public authorities, ensure fair and transparent access to public traffic and travel data, promote the cooperation between private and public sector to improve the quality of traffic and travel information, increase the quality of the data and multimodal cooperation and encourage the data exchange in EU.

This action intends to facilitate the introduction of new, innovative services involving new partnerships between public and private sector, ensuring the identification of the measures necessary to provide access to consistent travel and traffic information (Ven & Wedlock, 2011).

Optimized collection and provision of road, traffic and travel data:

This specific action aims the optimisation of the collection and provision of road data and traffic circulation plans, traffic regulations and recommended routs, once precise road data is essential for in-car navigation devices as well as for travel planners and all types of traffic applications. According to ITS Action Plan, the EU Member States don´t have nationally

binding rules, procedures or specifications related with the provision, quality format or updating of traffic management road data (European Commission, 2011a).

This actions intend to establish common minimum requirements, attributes and data formats for the collection of road and traffic data in all Member States, develop common requirements and standards regarding the timely and coordinated updating of these data and create requirements, attributes and data formats for recommended routes.

Availability of accurate public data for digital maps

This action defines the procedures for ensuring the availability of accurate public data for digital maps and their updating through cooperation between the important public authorities and digital map providers.

The European Commission prepared a detailed assessment of the stat-of-the-art concerning road data collection for digital maps and technical and standardisation needs. Some research projects, such as ROSATTE[6], and the INSPIRE Directive are taken in account in the preparation of this study.

The study Availability of Public Data for Digital Maps (Ven & Long, 2011) concluded that ROSATTE has aligned its activities to be consistent with the INSPIRE specifications, so this project should be adopted as an enrichment/enhancement version of INSPIRE.

Traffic safety information services

The traffic safety information is delivered essentially by radio and as a public service, however in recent years private services have been entering the traffic information market in conjunction with real time navigation services. The ITS Action Plan intents to establish free minimum information across EU, providing wider and easier access to safety information (for example danger warnings for objects on the road and scenes of accidents) improving the road safety.

This action defines the specifications for the data and procedures for the free provision of minimum universal traffic information services, including the definition of the repository of messages to be provided (European Commission, 2011a).

Promotion of multimodal journey planners

This last actions aims to consolidate travel information into national journey planners, in order that they can be connected, address issues of data availability, data quality and data sharing, move from regional and national systems to a European door-to-door information system and multimodal journey planner (European Commission, 2011a).

The ITS Directive expects the establishment of technical specifications for the creation of a EU-wide multimodal travel information service.

[6] The ROSATTE project was completed in 2011 and aimed to establish an efficient and quality data supply chain from public authorities to commercial map providers with regard to safety related road content. It built on standards, rules and procedures used by or developed for INSPIRE Directive (ISO TC 211) and work of ISO TC 204 (http://www.ertico.com/rosatte), (ERTICO - ITS Europe, 2011).

The EU should adopt the necessary specifications to ensure the compatibility, interoperability and continuity for the deployment and use of ITS for priority actions by February 2013.

According to the Working Programme on the Implementation of the Directive 2010/40/EU, the following table presents a general overview of the main activities to be performed during the period 2011-2015 regarding the implementation of the ITS Directive.

Table 1 – ITS Directive Roadmap (European Commission, 2011b)

Activities	2011	2012	2013	2014	2015
Adoption of Work Programme					
Creation of the European ITS Advisory Group					
Adoption of guidelines for reporting					
Adoption of Specifications for the six Priority Actions					
Reports on implementation progress (2013) and delegated powers (2015)					

EUROPEAN NETWORK INTEGRA

The European network INTEGRA is one of the results of project START[7] - Seamless Travel across the Atlantic area Regions using sustainable Transport. START is a project partially funded by the Transnational Territorial Cooperation Programme of the Atlantic Arc and runs from January 2009 to June 2013 (including two project extensions).

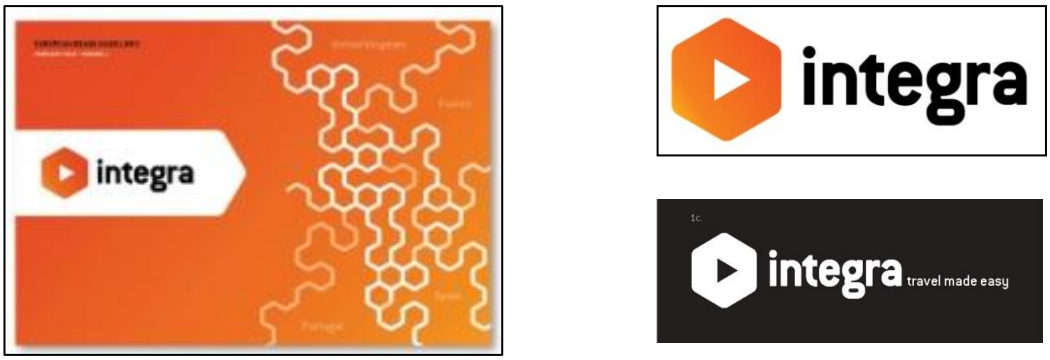

Figure 7 – The brand INTEGRA: image and logos (right)

A detailed description of the INTEGRA initiative is provided in Martins & Soares (2013). This initiative is focused on achieving “seamless travel across and within European regions” by removing as much as possible the barriers related with information. One of the main goals of

[7] The START Project, composed by a consortium of 13 partners from 4 countries of the Atlantic Area (PT, UK, ES, FR) aims the simplification of travel between and within the Atlantic Area Regions, by improving the accessibility to transport systems and promoting the use of more environmentally friendly transport modes: http://www.start-project.eu/en/Home.aspx

INTEGRA is to increase the 'feasible choice set' of sustainable travel solutions presented to citizens around Europe. To achieve this goal, one of the main strands of work is the harmonization of information related with transports, travel opportunities and points of interest (tourism, culture, sports and so) and how they inter-relate.

The main objective of INTEGRA is to facilitate the movement of European citizens all around European regions using the sustainable options available in Europe for passengers mobility. This vision can be summarized by the sentence: "***INTEGRA: the European quality brand for seamless travel and sustainable mobility***"

The INTEGRA concept (and brand) is characterized essentially:

- As an European brand that symbolizes ***quality informatio***n in public transport and sustainable mobility, including electric and soft modes - see Figure 7;
- By promoting and developing strategies for an ***inclusive approach***;
- As a new brand which hasn´t been created to replace the existing brands, but rather to ***complement & cooperate*** with them;
- By bringing a ***new vision*** and a ***systemic approach***, integrating various types of players around sustainable mobility and the development of a transnational potential;
- By the implementation of ***practical supporting measures*** (tools and services, but also other soft initiatives) for the mitigation and elimination of travel barriers, helping also the strengthening of an harmonized market for sustainable mobility in Europe;
- By working simultaneously in the following dimensions:
  - Institutional;
  - Technical;
  - Physical;
  - Cultural;
  - Social;
  - Transnational

  to achieve the objectives already defined.

All of this is done on the base of the unifying principle that ***"perfect information promotes sustainable mobility and increases the benefits for all stakeholders"***.

Regarding ITS standardization, the Integra Consortium doesn't aim to have a technical role, neither to have any standardization committees as producer of standards. For that purpose there are already several international bodies that play this role excellently. Instead, we intend to be an aggregative initiative, focused on identifying and promote best standards and the more appropriate technical specifications and the best circumstances for their application. Summarizing, it is our intention to create a quality framework for the application of existing standardization processes within INTEGRA framework.

At a first stage, the players of INTEGRA network are encouraged to disseminate their best practices and success stories about standardization and interoperability, enabling this way the share of experiences across the various authorities and operators, through networking. So, INTEGRA will act firstly as a forum where players from several backgrounds (cities, transport operators, tourism players and others) can present their difficulties and drawbacks, discuss them and find the best available solutions to deliver citizens the right quality information.

This kind of dissemination allied with the guidelines and orientation of INTEGRA will develop a stable framework to help stakeholders future decisions about investments (in information systems and tools). This will allow, on a second stage of commitment, that future tactical and strategic decisions of members can incorporate appropriate approaches that generate economies of scale and avoid these entities eventually become hostage to proprietary solutions imposed by the market[8].

One of the fundamental vectors of INTEGRA's intervention will be the correct specification of the design needs for the implementation of information systems (whether internal to institutions or dedicated to the public). This will be done, for instances, with the supply of template documentations and specifications that may be used by members in the future in their future tenders. With the proper specifications new solutions are framed to develop along with the best standardization and harmonization practices and can play a fundamental role in the implementation of the quality guarantee of information services in the framework of INTEGRA.

CONCLUSIONS

This paper pretends to be the first of a series related to *Public Transport & Sustainable Mobility standardization and harmonization*. The papers won't intend to analyze the depths of the technical implementation of the several standardization initiatives available. Rather to promote a holistic view and discussion about the harmonization problems the providers of public transport and mobility solutions (the suppliers) face and how to overcome the difficulties felt by the integration of the several solutions offered by existing players. Our main focus is somehow related to the non-technical difficulties, like tuning players from several backgrounds to deliver inter-related information in a seamless way, where users and citizens can understand and attain their own travel goals with trust and confidence.

The standardization initiatives most significant for the framework of INTEGRA were identified and shortly described, allowing the interested parties to access further references about these initiatives. Focus was given on CEN/TC 278, INSPIRE Directive, ITS Directive, but attention was also given to GTFS as it is currently one of the most used standards for data share and transference.

This research tries to present a summary insight regarding the global evolution of public transport standardization. It allows the identification of some of the drawbacks related with the lack of generalized high quality seamless PT information, available for users from local, to the regional and European level. We intend also to contribute with this research for the establishment of a global review of the state of the art regarding the sharing, storage, interaction and use of standardized information about sustainable mobility supply (PT, electric & soft modes) to help users in their seamless travel choices across Europe.

[8] This kind of situation is less probable to occur in the big metropolitan regions or cities around Europe, where transport authorities have the necessary technical skills to fully understand the danger of specific solutions and have technical capability to incorporate the right specifications in tender documents. However, in small and medium size cities the authorities may need more of this kind of guidance and INTEGRA intervention might be important.

After the extended analysis of the standardization initiatives relevant for INTEGRA our focus must be pointed to the need for further integration of these initiatives, avoiding the duplication of approaches and standards. In future research a special attention must be given to the identification of the areas of each standardization initiative which are the most consensual and welcome by the community. These 'parts' must be the main pieces of an overall standardization and harmonization puzzle.

The need to promote bridges between initiatives like INSPIRE and some CEN/TC 278 standards is also an important conclusion that we must emphasize. Good practices of overall harmonization, like the example presented of the adoption by MTA Bus Time – New York of SIRI standards must also be evidenced. On another dimension, democratization of the access, dissemination and use of standards is also a key issue to INTEGRA. Standards shouldn't be and can't continue to be a 'closed box' only available physically to some and understandable only by a minority, due to the hermetic dialectics chosen and the technical complexity sometimes avoidable.

The adoption of standards in Europe is also focus of our attention and the example of two paradigmatic approaches can be followed. The INSPIRE approach, were a unique European Directive was produced on the base of the work of two technical committees (CEN/TC 287 and ISO/TC 211). Currently, all Member States have to begin providing EU-normalized information regarding thirty four themes related to infrastructures, including Transport infrastructures. The CEN/TC 278 approach, were we have several subgroups and initiatives that flow into several standards, like for instances, the Transmodel family or the ITS Directive, already summarized.

Finally, a special attention was given to the European network INTEGRA. It is not a standardization initiative. Is a framework, a network and a consortium with a broader scope, but needs to base its actions on stable and sustainable standardization initiatives. One of the several challenges INTEGRA will face in the short run is the effective provision of ITS guidance to its members and to initiate the development of common initiatives which will include the need for standardization and harmonization.

In December 2012, about thirty entities comprising cities, regions, transport operators, technological companies and other institutions have already signed a Letter of Intent, becoming honorary members of the new European consortium INTEGRA. The recent extension of INTEGRA to tourism, electric and soft mobility, will allow the inclusion of relevant players of these areas and will increase the holistic potential (and the responsibilities) of INTEGRA as a global facilitator for sustainable mobility.

Given the excellent initial adhesion, our expectation is that by the end of 2013 between sixty and one hundred entities in the Atlantic Arc have declared their intention to join the INTEGRA Consortium and become honorary members. The consortium will be formalized at European level during 2014 and will promote the use of different tools and services, giving technical assistance for its use and encouraging the integration and the networking between members. Further information and details about INTEGRA can be found in the paper *"Seamless Travel across Europe – The INTEGRA Concept and Development"* (Martins & Soares, 2013), also presented on the same conference.

AKNOWLEDGMENTS

INTEGRA initiative was developed under START (START Consortium, 2010), which is a project from the *Transnational Cooperation Operational Programme Atlantic Area*, being co-financed by the European Union through ERDF - European Funding for Regional Development. START is framed in *Objective 3.1: Promote interoperability and continuity of existing transport networks and intermodality between maritime, road, rail and air* from the *Priority 3: Improve accessibility and internal links* of the Programme. The authors are grateful for the co-financing provided by the European Union, which allowed the development of INTEGRA and also the presentation of this communication.

The authors are the solely responsible for the contents of this paper. The research presented and prospects are their sole responsibility. The text does not represent the opinion of the European Union or even START institutions which are not responsible for any use that may be made of the information contained in the communication.

BIBLIOGRAPHY

Architecture and Standards Working Group. (2002). *INSPIRE Architecture and Standards Position Paper*. *Presidency* (Vol. 0).

Beal, A. (2001). Introdução à Gestão de Tecnologia da Informação. Retrieved from http://2beal.org/ti/manuais/GTI_INTRO.PDF

Bourée, K. (2012). European Standardisation for Public Transport Data and Interface Standards. *ITS Conference*. Beijing.

Bruns, W. (n.d.). SIRI - Service Interface for Real-time information.

CEN/TC 278. (2008). *Road traffic and transport telematics fixed objects in public transport Public transport Identification of Contents*.

CEN/TC 278. (2009). *NeTEx — Network and Timetable Exchange — Part 1 Network Topology Contents*.

CEN/TC 278. (2011). *NeTEx — Network and Timetable Exchange — Part 2 Network Timing Information Contents*.

CEN/TC 278 WG3. (2001). *The European Reference Data Model for Public Transport - Transmdel V5.0 revised ENV 12896*. Paris.

CEN/TC 278 WG3. (2005). SIRI White paper.

CEN/TC 278. (2012). *Developing Standards for Smart and Sustainable Transport*.

ERTICO - ITS Europe. (2011). *Organisational aspects and expected benefits* (Vol. 2011).

European Commission. (2008). Commission Regulation (EC) N^{o} 1205/2008 og 3 December 2008 implementing Directive 2007/2/CE of European Parliament and of the Council as regards metadata. *Regulation*.

European Commission. (2010). Directive 2010/40/EU of the Parlamiant and of the Council 0f 7 July 2010 on the framework for the deployment of the Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport. *Official Journal of the European Union*, L207/1–L207/13.

European Commission. (2011a). *Intelligent Transport Systems in action*. doi:10.2832/44199

European Commission. (2011b). *Commision Decision of 15 February 2011 concerning the adoption of the Working Programme on the implementation of Directive 2010/40/EU*. Brussels.

European Committee for Standardization. (2009). CEN - European Committee for Standardization - Road transport. Retrieved March 18, 2013, from http://www.cen.eu/cen/Sectors/Sectors/TransportAndPackaging/Roadtransport/Pages/default.aspx

European Committee for Standardization. (2013). CEN - European Committee for Standardization. Retrieved February 20, 2013, from http://www.cen.eu/cen/AboutUs/Pages/default.aspx

Google. (2012). Google Transit Feed Specification. Retrieved March 19, 2013, from https://developers.google.com/transit/gtfs/

Google. (2013). Google Transit Data Feed. Retrieved March 19, 2013, from https://code.google.com/p/googletransitdatafeed/wiki/PublicFeeds

Google. (2013a). General Transit Feed Specification Reference - Transit — Google Developers. Retrieved January 22, 2013, from https://developers.google.com/transit/gtfs/reference

Julião, R. P. (1999, June). Geografia , Informação e Sociedade. *GEOINOVA*, 95–108.

Kizoom, N., & Miller, P. (2008). A Transmodel based XML schema for the Google Transit Feed Specification With a GTFS / Transmodel comparison, 1–44.

Knowles, Nicholas. (2011). SIRI CEN/TS 15531, Service Interface for Real Time Information. Real Time Interest Group. Retrieved February 21, 2013, from http://www.kizoom.com/standards/siri/

Knowles, Nick, & Drummond, P. (2009). INSPIRE – Transport Network Data, *1*(February), 1–3.

L´autorité organisatrice de vos transport en Ile de France. (2010). *Normalisation des échanges de données d'information voyageur temps réel*.

Lyoen, C., Ven, T. Van, & Lim, karin K. (2010). *ITS ACTION P LAN - Study regarding guaranteed access to traffic and travel data and free provision of universal traffic information* (pp. 1–80).

Martins, P. M., & Soares, I. (2013). *Seamless Travel Across Europe - The INTEGRA Concept and Development* (pp. 1–19). *13 World Conference on Transport Research*. Rio de Janeiro.

Ministère de l´écologie du Développement Durable et de L´énergie. (n.d.). Certu. Retrieved March 18, 2013, from http://www.certu.fr/en/_Tout_sur_le_Certu-n517/Certu_was_created_by_French_decree_no._94_134_of_9_February_1994-a1339-s_page_footer.html

Moniz, A., & Kovács, I. (2001). *Sociedade da Informação e Emprego*.

MSI. (1997). *Green Paper on the Information Society in Portugal*.

MTA info. (n.d.). MTA Bus Time. Retrieved February 20, 2013, from http://bustime.mta.info/wiki/Developers/SIRIIntro

Peelen, M. (2011). CEN / TC 278 ITS standardization.

Slevin, R. (2009). *Distributed Journey Planning standards What ' s what ?*

Soares, I., & Martins, P. M. (2012). *Implementation of the INSPIRE Directive on Road Infrastructure in Portugal*. Lisbon Superior Institute of Engineering, Lisbon.

START Consortium. (2010). START Project - Home. *Seamless Travel across the Atlantic area Regions using sustainable Transport*. Retrieved January 16, 2013, from http://www.start-project.eu/en/Home.aspx.

Traveline. (n.d.). Traveline. Retrieved February 20, 2013, from http://traveline.info/about.html

Ven, T. Van, & Long, J. (2011). ITS A CTION P LAN - Availability of Public Data for Digital Maps, 1–112.

Ven, T. Van, & Wedlock, M. (2011). *ITS A CTION P LAN - Study regarding guarantweed access to traffic and travel data and free provision of universal traffic information*.