



Study on ITS Directive, Priority Action A: The Provision of EU-wide Multimodal Travel Information Services D5 Final Report

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Executive Summary

Policy context

Seamless door-to-door travel across Europe is one of the European Commission's goals set out in the 2011 Transport White Paper to "by 2020, establish the framework for a European multimodal transport information, management and payment system" (EC 2011). Multimodal travel information for people wishing to travel cross-border across Europe is one of the pre-requisites of seamless travel, ideally using a single point of access to information about services using any mode and operating in any European country. There is a large amount of cross-border travel demand in Europe as indicated by Eurostat¹. In 2013, there were almost 300 million cross-border journeys in the EU. This figure does not include single day return trips or those made by non-EU residents. Taking into account that many cross-border journeys in Europe can be easily made as return journeys within one day and some 609 million international tourists visit the EU each year², this figure and thus the demand for such travel information will be considerably higher.

The Intelligent Transport Systems (ITS) Directive allows for the provision of technical, functional and organisational specifications that can make "EU-wide multimodal travel information services accurate and available across borders to ITS users", that is travellers using such services. In particular, the Directive highlights a number of policy measures to support this objective, namely: the accessibility of information and data, facilitating electronic data exchange between stakeholders across borders, and timely updating of information. Moreover, it also identifies the need for equitable rights to access, use and present data. As stipulated in article 5 of the ITS Directive, such rules and provisions would only apply to a Member State when the ITS service and data already exists; there are no requirements to start collecting travel and traffic data in a machine readable format or to create a multimodal travel information service.

This report summarises the results of a study which aimed to build on top of previous studies³, in order to support the European Commission in developing specifications for the measures that are needed to overcome the remaining obstacles to realising EU-wide multimodal travel information services. Moreover, other delegated acts of the ITS Directive are now established, which prescribe mechanisms to enhance the access and exchange of real-time traffic, safe and secure parking and safety related data. The study also analysed whether the requirements in those delegated acts could be used here for Priority Action 'a'. The European Commission's role is to be an enabler, not a provider of services. The consultations which have already been carried out have identified that activities such as establishing a legal framework and promoting standardisation are seen by stakeholders as key roles for the European Commission.

Effective travel information systems are significant for both travellers and operators. Such systems make it easy for travellers to find and use the best means of transport available. They help operators to run their systems and reduce the costs of interacting with travellers. The rapid evolution of delivery systems (that is the process to convey a service to a customer) and of personal devices, has greatly increased the availability and usefulness of such services to travellers. In a congested, carbon-conscious Europe, multimodal travel information services will be important for encouraging the use of sustainable transport and for making efficient use of the road system in future. Thus, in addition to providing benefits for travellers and operators, multimodal travel information services also contribute to high level public policy objectives such as reducing congestion and emissions and improved network management through modal shift, and contributing

¹ Eurostat <http://ec.europa.eu/eurostat/data/database> Table code tour_dem_ttr

² <http://media.unwto.org/press-release/2016-01-18/international-tourist-arrivals-4-reach-record-12-billion-2015>

³ http://ec.europa.eu/transport/themes/its/studies/doc/2011_09-multimodal-journey-planner.pdf

to the development of the digital economy by increasing the demand for EU-wide online services.

Objectives and methodology

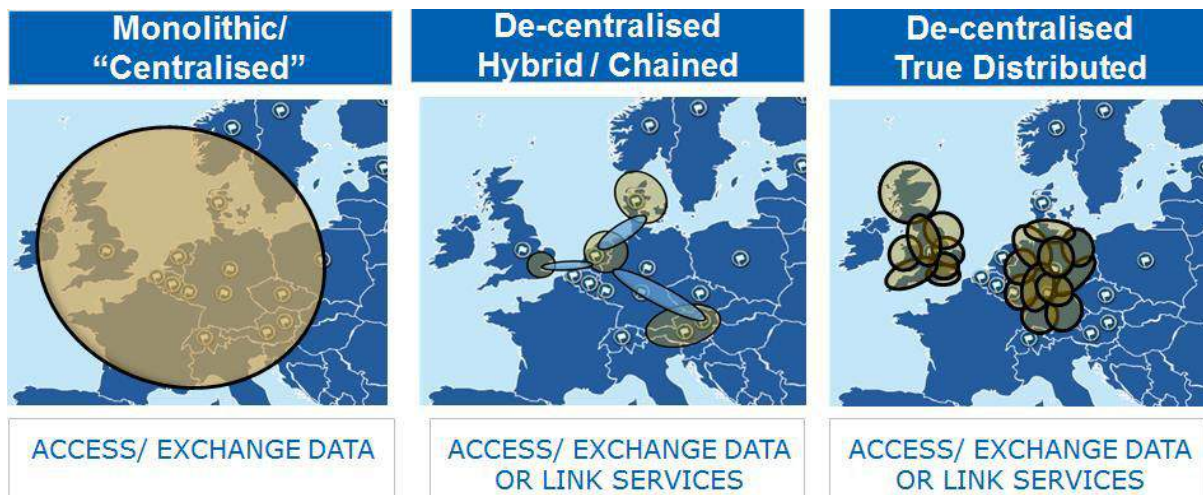
The objective of the study overall was to support the European Commission in the development of a policy framework to enable the provision of EU-wide multimodal travel information services (MMTIPS). This policy framework will remove existing barriers that prevent existing services from becoming more comprehensive and new services to emerge. It will take the form of technical, functional and organisational specifications as foreseen in the ITS Directive.

In order to address these objectives, the study carried out an extensive review of the current situation, also known as the 'baseline review'. An extensive consultation with stakeholders was carried out, involving a workshop with more than 100 representatives of stakeholder groups and an online public consultation which received more than 175 responses across the entire stakeholder value chain and Member States of the EU. The baseline review and consultation results were used to define a 'problem tree' summarising the issues contributing to the fragmented development of multimodal travel information services in Europe. This part of the study identified the full range of barriers and preferences for potential approaches to overcoming fragmented and non-interoperable information and planning services across the EU. In doing so, it also identified the main costs and benefits of improving interoperability.

Using the information from the baseline review and stakeholder consultation, four core policy options were identified by the European Commission to be assessed.

Facilitating EU-wide Multimodal Travel Information

This report highlights that EU-wide multimodal travel information services can be delivered in a variety of ways with no 'one size fits all'. The role of the Commission is not to determine which solution should be used or give any priority, but rather to provide the framework to support all possible solutions and let the market ultimately determine which solution will be the most successful. As the image below demonstrates, two kinds of approaches known as 'centralised' and 'de-centralized' can be used:



In order to provide EU-wide multimodal travel information, the continuity of services and interoperability of systems is essential. The report sets out the technical challenges to achieving this. These include the diversity, complexity and scope of integrating and managing many different travel and traffic data and systems to provide the services and the operational costs of software to provide online information services, and to manage the complex, dispersed and continuously changing data. The report shows that there is no single solution: different types and levels of information service require different systems and data feeds, while there are different possible service architectures: centralised, decentralised and a hybrid approach.

To support all of the identified approaches, the access and exchange of interoperable traffic data and the exchange of interoperable routing results are required.

A single point of entry to either locate or directly access data is essential to support the growth and efficient operation of multimodal travel information services. Such a point of entry demands a common set of harmonized data formats and exchange protocols, understood by all relevant players.

Additionally, a standardised interface to exchange routing results to perform distributed journey planning with different travel information services would enhance the exchange of travel and traffic information between stakeholders and services that can support the growth and efficient operation of multimodal travel information services.

Current status of services in Europe

The report provides an overview of the current status of multimodal travel information services in Europe. A total of 125 providers were found to be offering 160 services.

Across the board, the review demonstrated that travel information services are provided by both public and private actors. In many cases, the local authority or the transport operator is also the travel information service provider playing a double role. By definition, services provided by local authorities and transport operators are concentrated on a specific region but provide a more detailed and extensive travel information service than pan-European services.

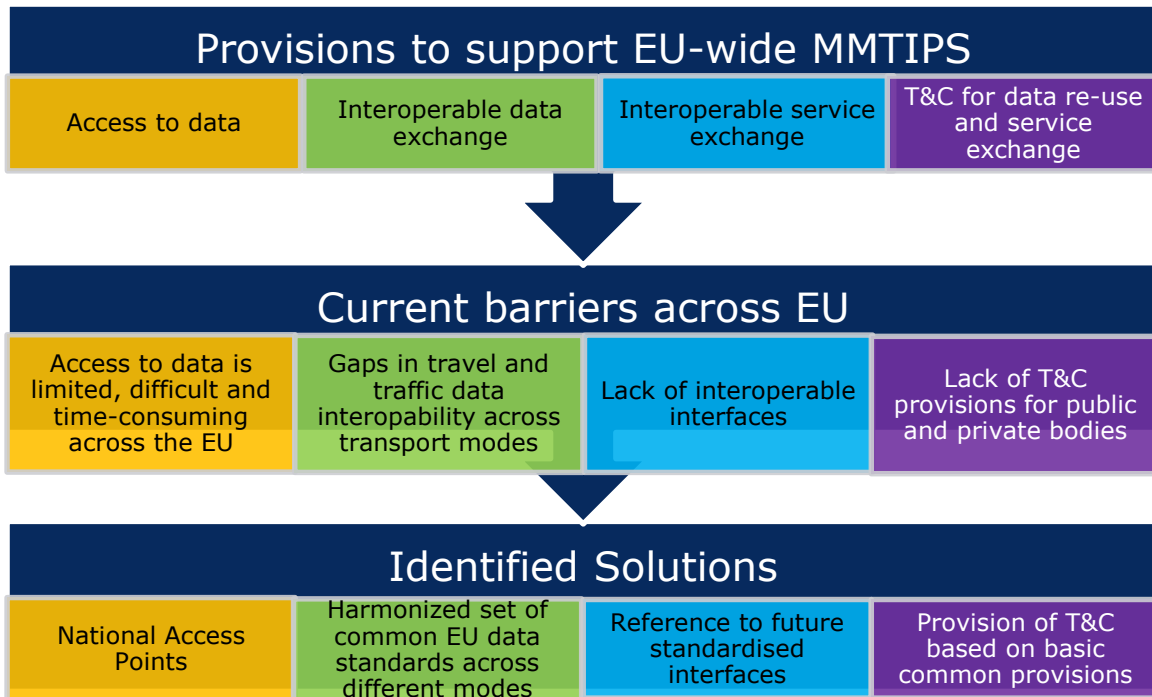
The 'pan-European' services, i.e. those offering travel information to many destinations in Europe, were primarily offered by private actors but were much less detailed and offered more simplified travel information. The local services offered travel information for more transport modes but in most cases did not cover all possible travel options. This was even more limited at the pan-European level. In addition, several Member States had national multimodal travel information services (primarily across northern, southern and central Europe) which were provided by both private and public service providers. The level of modal coverage, however, varied from service to service.

In terms of the type of information provided, most services are still primarily based on static data (i.e. data that does not change on a regular basis). In contrast, dynamic data (i.e. data that does change on a regular basis) was generally found at local level. Therefore, the review showed that whilst the travel information market is thriving in terms of the number of services offered to the user, the level of service remains limited, especially concerning the 'door-to-door' element.

Barriers and solutions

A key aspect of the supporting study was the identification of the barriers causing the current level of provision of EU-wide multimodal travel information services and the potential solutions to address such problems. The barriers and solutions were identified by two key activities: the evidence review and the stakeholder consultation. A high level summary of the main provisions needed to support EU-wide multimodal travel information services and their associated barriers and potential solutions is shown overleaf. A detailed problem tree can be found on page 52.

The evidence review revealed that across the EU, travel and traffic data is predominantly accessed in a decentralized approach via the original data source directly and the stakeholder consultation revealed that access to data is still limited and a major barrier. The concept of the national access point, also adopted for other priority actions of the ITS Directive, was identified as a solution to support both public and private actors in accessing travel and traffic data and was welcomed overall by stakeholders.



The evidence review and the stakeholder consultation also revealed that the interoperability of travel and traffic data is varied across the transport modes and that interoperability is key to enabling the access and exchange of data. It identified that there is no single data exchange protocol for all transport modes, but rather one per mode. In this context, some sectors already use standards or technical specifications based on other relevant legislation or are 'de-facto' standards due to industry activity. For the road sector, the DATEX standard is used, for rail it is the TAP-TSI technical specification and for air the IATA data standard is used. This report identifies that therefore in a multimodal context, other modes of transport, i.e. public transport and long-distance coaches, need interoperability requirements to be included in the specification. Such data exchange protocol standards exist at CEN level (NeTex, SIRI) but most Member States use either national standards based on Transmodel or Google's GTFS. The conversion to the European standards, however, has been identified as a relatively straight forward process. Views on data quality also indicated that minimum requirements would need to be established and suggested that feedback processes would be useful for maintaining data quality.

Distributed journey planning is currently being performed in some parts of Europe but technical improvements are necessary to improve results. Additionally, there is a lack of standardised interfaces at European level. An OPEN API standard is currently being developed which promises to be the main standard to be flagged at a European level. The stakeholder consultation also highlighted support for distributed journey planning and for this to be included within the scope of the specification.

In addition, the study also identified other aspects which need to be considered. These include organisational models, data integration, divergent rules for access, high costs of data aggregation, costs of scaling capacity of computer servers to meet demand, commercial confidentiality, and variations between different Member States in the roles of public and private sector organisations in the information chain.

Scope of the Stakeholder Consultation

The implementation of the specifications and fulfilling the different requirements will ultimately have a direct impact on the operations of various stakeholder groups along the value chain and it is therefore essential to extensively consult the relevant groups: those affected by laws understand better than anyone what impact they have, and can provide useful considerations to improve them.

In the frame of the supporting study, the stakeholder consultation was conducted in two key stages: the stakeholder workshop⁴ and the 12-week online public consultation⁵.

In the first stage, a dedicated workshop was held in Brussels on 4th November 2015 which brought together more than 100 stakeholders from across the entire value chain. Through a set of thematic sessions and panels of distinguished speakers representing the different sectors, the different barriers and potential solutions were discussed. In a second stage, a 12 week online public consultation was held which was disseminated to all of the key stakeholder groups and received more than 175 contributions. The detailed analysis of the results of both activities is presented in this report. Overall, the perception from the different stakeholder groups was that the envisaged policy measures are suitable to address the identified barriers, but views were split across the groups regarding whether they should be mandated or not.

Policy options and synthesis of cost-benefit results

The evidence review and stakeholder consultation identified that the scope of the various envisaged rules and provisions (policy measures) to address the aforementioned barriers could vary in terms of for example their extent and who they apply to. The cost involved in fulfilling the different requirements of scenarios will vary, as will the overall benefit. A detailed Cost Benefit Analysis (CBA) was conducted by looking at different scenarios in which different elements of the policy measures are considered (policy options). Together with the Commission, four core policy options were identified based on the different ways to support EU-wide MMTIPS and the identified solutions. The CBA covered the potential economic, social, and environmental impacts and the special impacts (such as the impact on existing markets, fundamental rights, consumers, SMEs and innovation) of the different policy options. They were assessed against their compliance with the principles of the ITS Directive, and the budgetary implications and risks of the policy options for the key stakeholder groups were analysed as costs will vary from one stakeholder group to another. The policy options were compared using both quantitative and qualitative results of the Cost Benefit Analysis to provide an overall assessment of the benefits and drawbacks of the policy options analysed.

A high level overview of the four main policy options assessed in the CBA is detailed below (the policy option numbers are used in the summary graphs which follow). Each option was analysed based on the effects of fulfilling the different rules and requirements for a) solely the comprehensive TEN-T network including Urban Nodes and b) the entire EU transport network.

1 Minimal intervention – in this scenario, basic requirements concerning the use of a national access point for static data and recommendations of data and service standards and quality requirements are envisaged.

2 Data focus – in this scenario, requirements that are focused on the access and exchange of public and private data (static and dynamic) is included via national access point, a harmonized set of standards and a detailed quality framework.

3 Linking services - in this scenario, requirements that are focused on the linking of all available travel information services and the use a standardised interface to perform distributed journey planning are included. Some data elements including the national access point are envisaged without data standardisation or quality requirements.

4 Comprehensive approach - in this scenario, a balanced combination of requirements to support the access and exchange of public and private data and linking of services to perform distributed journey planning are included. Data requirements for static data include the national access point, data standards and general quality provisions. Service requirements include a demand based approach to link services to perform distributed journey planning and the recommended use of a standardised interface.

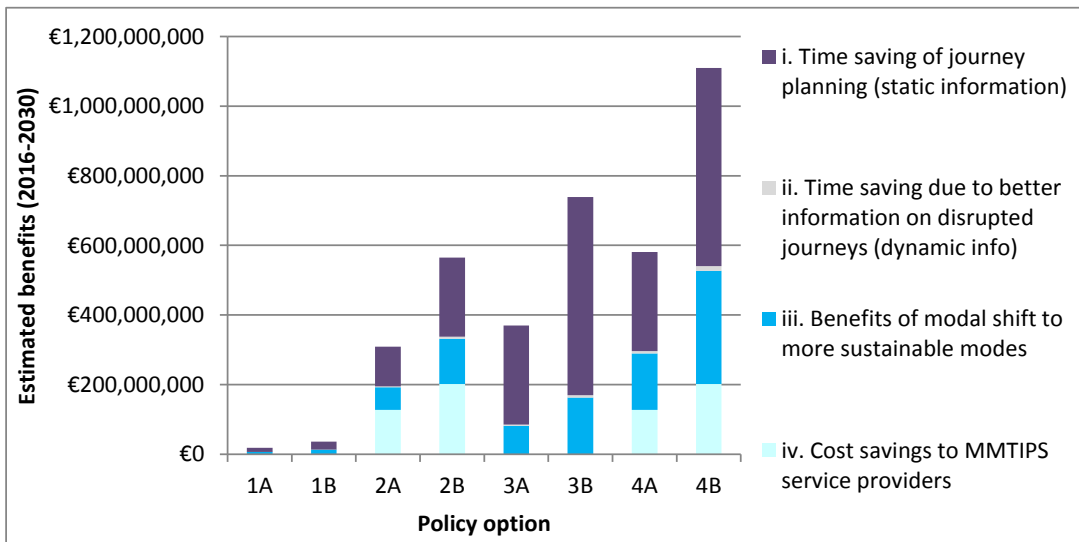
⁴ http://ec.europa.eu/transport/themes/its/events/2015-11-04-its-directive-mmtips-workshop_en.htm

⁵ http://ec.europa.eu/transport/themes/its/consultations/2015-its-mmtips_en.htm

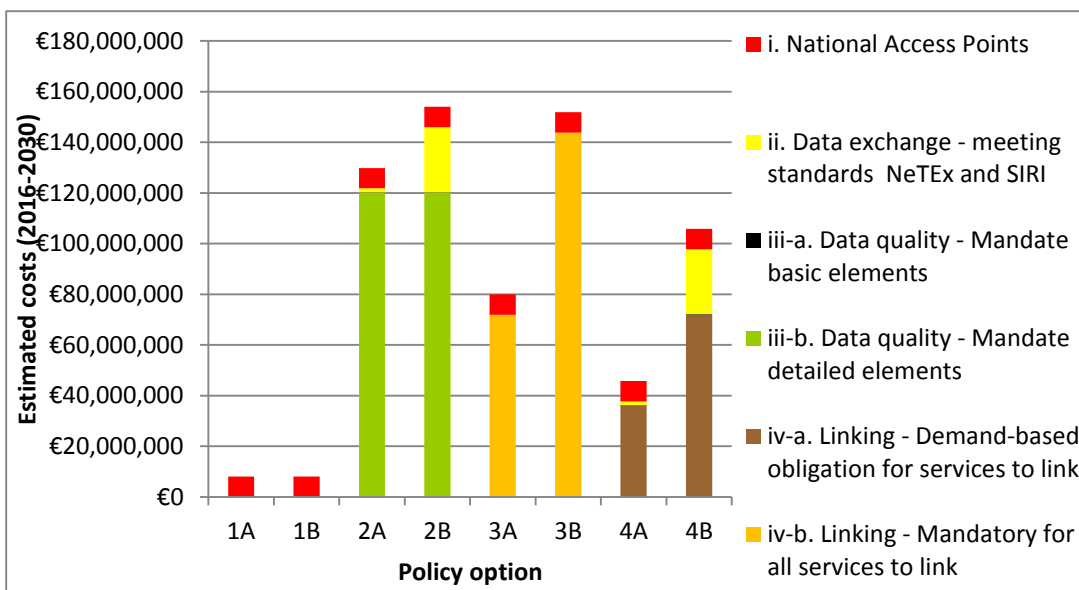
The assessment took account of the economic, social, environmental, and market impacts that the policy options might have over a 15 year period, with implementation of the different elements phased in over varying timescales. Using input from experts nominated by Member States and existing services, the study identified the implementation and operational costs associated with the key deployment measures. The calculations assumed that stakeholders would incur the costs of meeting the basic requirements of each policy option and would therefore incur these 'minimum' levels of cost; in practice some Member States might choose to implement a more complex approach (for example the different types of National Access Point described in Section 2.3), which would involve higher costs.

The benefits included in the assessment were: time savings in planning journeys; time savings using real time information during disrupted rail journeys; societal benefits arising from switching to more sustainable modes at the destination end; and cost savings for service providers through reduction in data discovery, data aggregation and interfaces. Data used to assess the scale of the benefits came from European statistical sources, supplemented by national data and with a series of assumptions about the scale of benefits. The following three graphs show how the costs and benefits vary for each policy option. The overall results of the CBA are detailed below, with the best benefit cost ratio found with Policy Option 4.

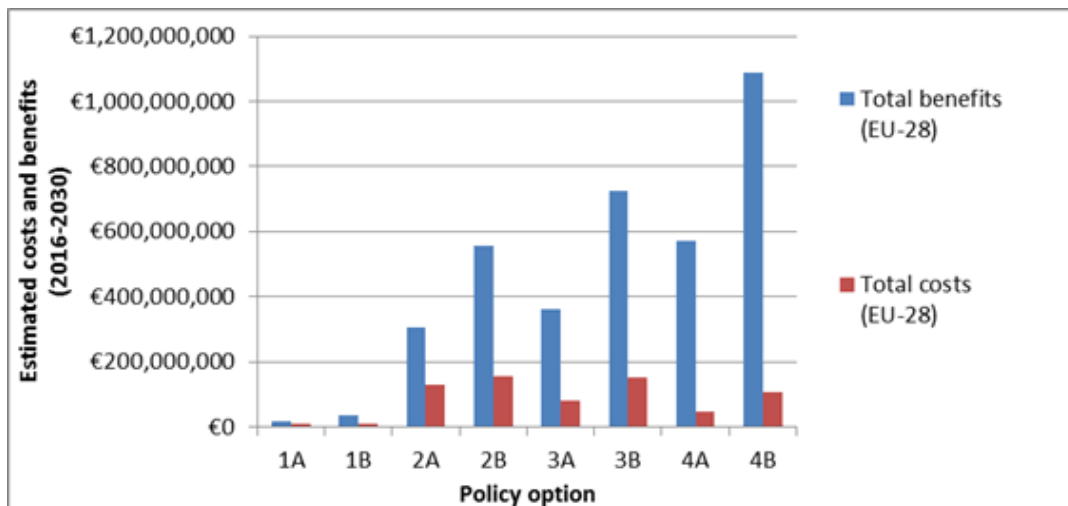
Summary of accrued benefits of policy options 2016-2030 (EU-28)



Summary of accrued costs of policy options 2016-2030 (EU-28)



Summary of accrued benefits and costs of policy options 2016-2030 (EU-28)



The graphs show that the combined impacts of the four different types of benefit are expected to be greatest in the case of Policy Option 4 (the Comprehensive Approach) for two reasons: all four types of benefit would be realised in this case but in only one other policy option, while the monetary value of benefits would be higher than in the case of other policy options, particularly those arising from modal shift at the destination and time savings in journey planning. At the same time, the costs involved in implementing the two most costly elements (data quality and linking services) are expected to be lower for Policy Option 4 where these are not mandatory, than in the case of the policy options where these would be mandatory.

Recommendations

On the basis of representations during the stakeholder consultation and the cost benefit analysis and assessment of policy options, the report makes recommendations in the following areas:

- Establishing a collaborative forum to act as the governing body for implementing pan-European services and facilitate the exchange of best practice;
- The dataset and minimum functions to provide comprehensive multimodal travel information and planning systems and services and the geographical coverage;
- National Access Points for data and scope of data standards and data exchange and Data and information service quality;
- Linking travel information services;
- Terms and conditions for data re-use;
- Monitoring framework and performance indicators for tracking progress with implementation;
- A co-operative research programme and funding;
- Continued standards development and engagement with international standards.

Note de synthèse

Contexte politique

Voyager de façon fluide à travers toute l'Europe est un des objectifs mises en place par la Commission Européenne en 2011 lors de la publication du Livre Blanc. L'objectif est que d'ici 2020 une structure soit mise en place pour créer un service de provision d'information pour les systèmes de transport multimodal européens, ainsi qu'un système de gestion et de paiement. La provision d'information pour les personnes désirant voyager à travers toute l'Europe est une des composantes principale nécessaires pour établir un système de transport européen fluide. Idéalement toute information devrait être fournis grâce une unique plateforme de communication, qui pourrait être accessible dans tous les pays européen. Comme l'indique Eurostat, la demande pour un système de transport transfrontalier est très élevée. En 2013, presque 300 million trajets transfrontalier ont été réalisés à travers l'union européenne. Ce chiffre ne prend pas en compte les allers-retours fait au cours d'une journée, ni ceux réalisé par des voyageurs ne faisant pas parti de l'UE. Quand on prend en compte le nombre d'aller-retours transfrontalier réalisés au cours d'une journée (ex: vivre en France et travailler en Suisse) ainsi que les 609 million de touristes non-européens qui visitent les pays de l'UE chaque année il est évident que le nombre de trajets réellement effectués est beaucoup plus élevés que 300 million. En conséquence il est clair qu'un service d'information commun à tout pays européen est aujourd'hui devenu une nécessité.

La directive des systèmes de transport intelligent (ITS) permet de fournir des spécifications techniques, fonctionnelles et organisationnelles qui permettent de développer et fournir un service d'information en temps réel fiable à un niveau européen, et pour tout utilisateur des systèmes de transport intelligent. En effet la directive a permis d'établir de nombreux décrets qui encourage le développement des éléments fondamentaux de ce système tel: la qualité d'accès aux informations fournis, faciliter l'échange d'information transfrontalier entre parti-prenantes, et la provision d'information en temps réel. De plus, les directives reconnaissent l'importance d'assurer que l'information puisse être accédée, utilisée et présentée de manière similaire. Comme le suggère l'article 5 de la directive ITS, toutes règles ne s'appliquent qu'aux pays membres ou les services et données ITS sont déjà mise en place. Il n'y a aucune obligation envers les pays membres de recueillir des données de façon électronique ou dans le but de créer un service de provision d'information pour les systèmes de transport multimodal.

Ce rapport résume les résultats d'un projet de recherche ayant pour but d'accroître les connaissances actuelles, afin d'aider la commission européenne à développer les mesures nécessaires pour surmonter les obstacles restant qui empêche le développement d'un service européen d'information pour les systèmes de transport multimodales. De plus, un nombre d'actions identifiés dans la directive ITS sont aujourd'hui mise en place, tels que ceux qui prévoient les mécanismes pour améliorer l'accès et l'échange d'information en temps réel, ceux qui permettent un stationnement sure et sécurisé et ceux qui permettent d'assurer la sécurité des données. De plus, le projet analyse si les exigences présentes dans les directives pourraient être utilisées pour la partie A des 'Actions Prioritaires'. La Commission Européenne doit ici prendre un rôle de facilitateur et non pas de fournisseur de services. Les consultations organisées avec les parties prenantes ont identifiés que certaines activités, telles la mise en place d'un cadre juridique et d'un standard européen, sont considérés comme des rôles clés pour la commission européenne.

Des services d'information fiables sont essentiels pour les voyageurs, mais aussi pour les opérateurs. Ils permettent aux utilisateurs de voyager de manière facile, et d'emprunter le mode de transport le plus approprié à leur trajet. D'autre part ils permettent aux opérateurs de gérer leur systèmes de transport, ainsi que réduire les coûts générés par l'interaction avec les passagers. Le développement rapide des systèmes de distribution (soit le processus de transmettre un service a un client) ainsi que les dispositifs personnels, n'ont fait qu'augmenter l'utilité et la disponibilité de tels services pour les

voyageurs. Dans une Europe soucieuse de son empreinte carbone et souvent victime d'embouteillage, la provision de services d'information pour les systèmes de transport multimodale est essentielle pour encourager l'utilisation de transport durable ainsi qu'une utilisation plus efficace du réseau routier. Il est évident que la provision d'un tel service n'est pas qu'une source d'avantage pour les utilisateurs et opérateurs, mais aussi pour le gouvernement et la société en général, car il pourra permettre de réaliser des objectifs politiques et sociaux, tels réduire les émissions de véhicules, les embouteillages et une meilleure gestion des réseaux routiers grâce à une amélioration des transferts modales, ainsi que le développement d'une économie digital en augmentant le besoin des services en ligne à travers l'union européenne.

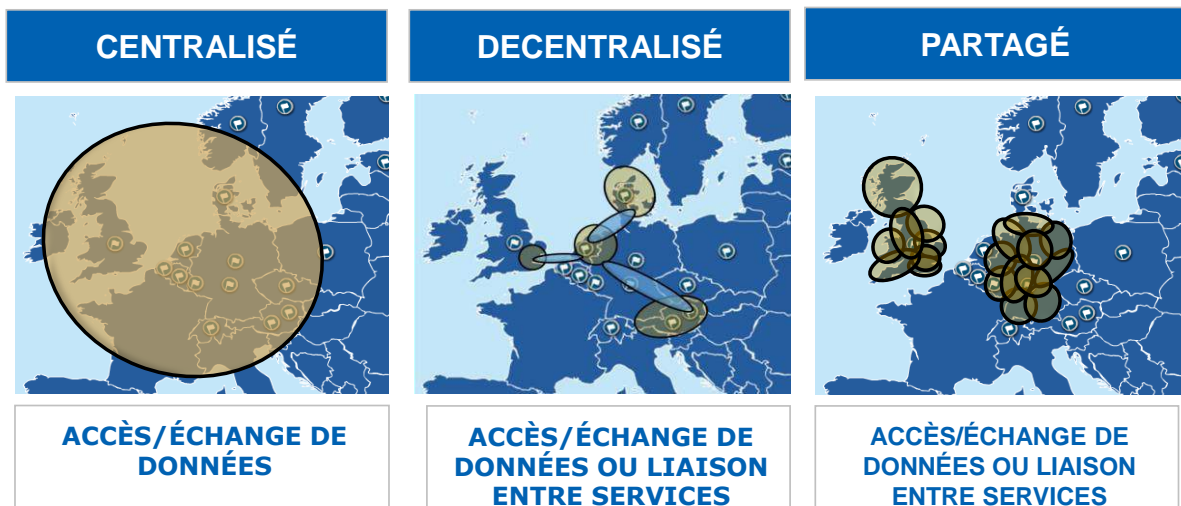
Objectifs et méthodologies

Ce projet avait pour but de venir en aide à la Commission Européenne pour soutenir le développement d'un cadre politique afin de permettre le développement et la provision d'un service d'information pour les voyages multimodaux à un niveau européen (MMTIPS). Ce cadre permettra de résoudre les obstacles restants qui empêchent la mise en place de nouveau service, et les services déjà présents d'être plus compréhensifs. Il comprendra des spécifications techniques, fonctionnelles et organisationnelles, comme décrit dans la directive ITS.

Afin d'adresser les objectifs identifiés dans la directive, une revue détaillée de la situation actuelle a été effectuée. Un nombre de consultations avec des parties prenantes ont été réalisées, ainsi qu'un atelier, avec plus de 100 représentants des secteurs qui seront affectés par les résultats de ce projet et une consultation publique (enligne) grâce à laquelle plus de 175 réponses de représentants de chaque pays membre tout au long de la chaîne de valeur ont pu être obtenues. Cette étape du projet a permis d'identifier les obstacles et les solutions préférés pour répondre à la fragmentation et le manque d'interopérabilité entre les services d'information et de prévision à travers l'UE. Ceci a aussi permis d'identifier les coûts et l'avantage associé avec l'amélioration de l'interopérabilité des données. Grâce aux résultats quatre options politiques ont pu être identifiés.

Permettre la provision d'information concernant le transport multimodal à travers l'UE

Ce projet a démontré qu'il est possible de fournir l'information nécessaire pour voyager de façon multimodale à travers l'UE, et de plus que ces informations peuvent être délivrés de multiples façons. Le rôle de la commission n'est pas de décider qu'elle méthode est la plus appropriée, mais de mettre en place les fondations pour permettre le développement de toutes méthodes de communication. Le diagramme ci-dessous montre les deux approches qui peuvent être utilisées, soit une méthode centralisée et une décentralisée:



Pour assurer la provision d'information à un niveau européen il est essentiel d'assurer la continuité et l'interopérabilité des services. Ce rapport présente les défis techniques qui doivent être surmontés pour accomplir ceci. Les obstacles à surmonter comprennent la diversité, complexité et quantité de systèmes de transports qui doivent être intégrés ainsi que le coût de ces programmes afin de pouvoir fournir des services d'information en ligne et gérer la complexité des données pour assurer que les informations sont aussi précises que possible. Les résultats de ce projet suggèrent qu'il n'y a pas une solution unique pour répondre à ces difficultés. Chaque type de services exige une solution différente.

Afin de pouvoir utiliser toutes les solutions identifiées, il est nécessaire de pouvoir accéder et échanger les données de transport interopérables, ainsi que les itinéraires de transport interopérables.

Afin de permettre le développement et le bon fonctionnement des services d'information pour les transports multimodaux il est préférable de créer une seule base de données où les informations nécessaires peuvent être identifiées ou accédées directement. Ceci exige la mise en place de standards, acceptés par toutes parties concernées, d'une part pour harmoniser les données collectées et d'autre part l'échange de ces données.

De plus, le développement d'une seule interface, commune à tout mode de transport, permettrait de faciliter l'échange d'information obtenue grâce au routage, et en conséquence d'améliorer l'échange d'information entre les parties prenantes et, à long terme, d'améliorer les services d'information concernant le transport multimodal.

Situation actuelle des services en Europe

Ce rapport résume la situation actuelle des services de provision d'information concernant les voyages multimodaux dans chaque pays Européen. En tout, il semblerait que 125 opérateurs offrent environ 160 services.

Ces services sont fournis par des opérateurs des secteurs publics et privés. Généralement, il semblerait que les autorités publiques, ou les opérateurs des services en question, fournissent aussi bien les informations nécessaires durant le trajet que les services eux-mêmes. Par définition, les services fournis par les autorités locales et les opérateurs de transport locaux sont limités à un niveau régional, mais les informations fournies sont beaucoup plus détaillées que les informations fournies par les services pan-européens.

Les services pan-européens, soit ceux qui fournissent des informations pour toutes destinations européennes, sont fournis principalement par des organisations privées et sont beaucoup plus restreintes. Bien que les informations fournies par les autorités locales ont tendance à inclure un plus grand nombre de modes de transport que les informations fournies par les services pan-européens, à présent il ne couvre toujours pas tous les moyens de transport disponibles. Certains pays membres ont déjà des services d'information à un niveau national pour les transports multimodaux (principalement à travers l'Europe du Sud, Central et du Nord), qui sont fournis par des organisations publiques et privées. Cependant, la quantité et la qualité d'information disponible pour chaque mode semble varier entre chaque service.

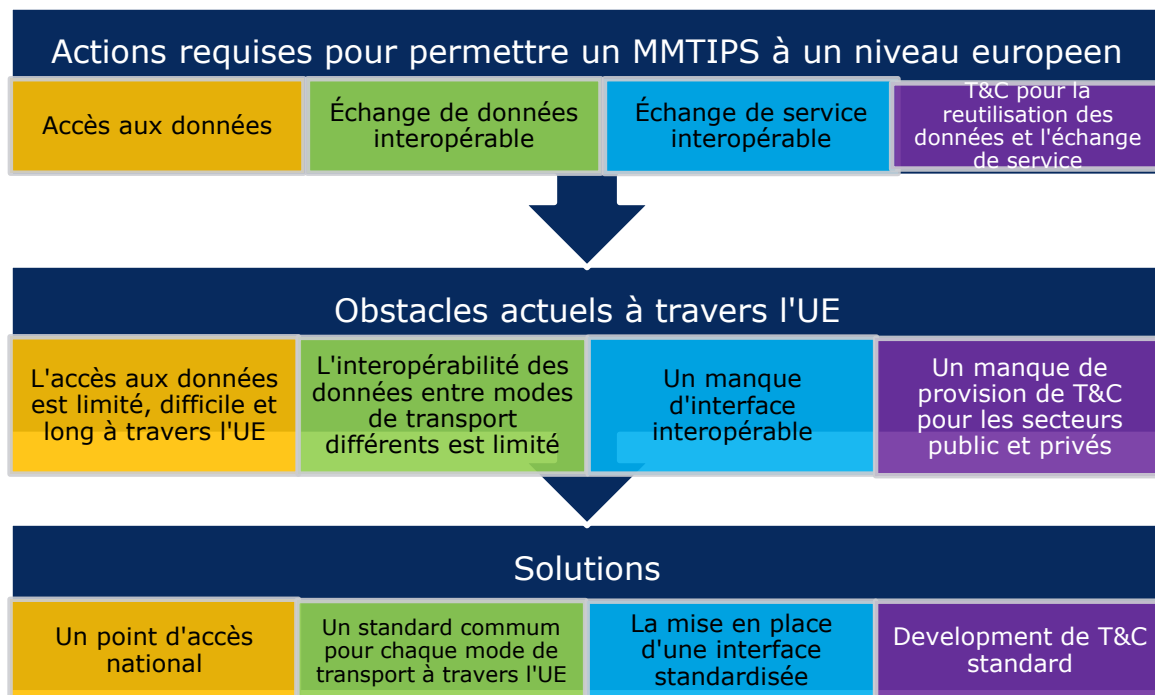
En général, les services d'information fournissent des informations qui changent très peu. Les services fournissant des informations plus précises et en temps réel, ont tendance à être des services locaux. En conclusion, bien que la demande et le besoin de tel services ne cessent d'accroître le nombre de services disponibles et la qualité de ces services est-elle encore très limitée.

Obstacles et solutions

Le but de l'étude complémentaire était d'identifier les causes de la qualité actuelle des services d'information, ainsi que les solutions potentielles pour surmonter ces obstacles afin de permettre d'améliorer les services disponibles. Ces barrières et solutions ont été identifiées grâce à deux étapes du Project: la revue de base et les consultations avec les parties prenantes. Un résumé des éléments nécessaires pour faciliter la mise en place d'un service de provision d'information à un niveau européen sont présentes ci-dessous,

ainsi que les obstacles et solutions possibles associés avec chacun d'entre eux. Un graphique plus détaillé peut être trouvé page 52.

Il semblerait qu'à travers l'UE la majorité des informations sont obtenues grâce à un système décentralisé et provenant directement des opérateurs. De plus, les consultations ont révélé que l'accès aux données est encore très limité, et ceci est un des plus grands obstacles à surmonter. L'idée d'une base de données nationale a été identifiée comme étant une solution pouvant répondre aux besoins des secteurs publics et privés, permettant au deux secteur d'accéder à une base de données complète. Cette idée a été très bien reçue par les parties-prenantes.



La revue de base et les consultations ont aussi révélés que l'interopérabilité des données de transport varie énormément entre modes de transport et que cette interopérabilité est essentielle pour permettre l'accès et l'échange des données. A présent il n'y a pas de méthode commune pour échanger des données entre modes de transport différents. Néanmoins, certains secteurs ont déjà adopté une méthode plus standardisée, ou utilisent des techniques communes à la suite d'autres lois, ou en conséquence de certains standards imposés dans leur secteur. Dans le domaine routier, le standard DATEX est utilisé, dans le milieu ferroviaire c'est le TAP-TSI et dans le secteur aérien le standard IATA est imposé. Il est donc clair qu'afin de pouvoir mettre en place un service multimodale efficace il est nécessaire d'assurer que l'interopérabilité des données obtenues soit inclus dans les standards pour tout mode de transport (ex: les transports en communs). De tels standards pour l'échange de données sont déjà en place à un certain niveau, grâce à CEN (NeTEx, SIRI), mais la majorité des États Membres utilisent des bases de données nationales fondées sur le Transmodel ou les GTFS de Google. La transition vers un standard européen a été identifiée comme étant relativement simple. De même, concernant la qualité des données, il semblerait qu'un minimum d'effort serait requis pour mettre en place un service de haute qualité. De plus, un système de retour d'information pourrait permettre de maintenir un système de haute qualité.

Dans certains pays d'Europe la planification des modes de transports est déjà faite de manière décentralisée, mais des modifications techniques sont nécessaires pour améliorer les résultats. De plus, à un niveau européen il y a un manque d'uniformité entre les interfaces. En ce moment un standard OPEN API est en cours de développement, afin d'être le standard principal au niveau européen. Les consultations ont aussi permis d'identifier qu'un grand nombre des parties-prenantes était en faveur d'un système de planification des transports décentralisé, et que ce type de planification devrait être encouragé lors de l'élaboration des spécifications.

De plus, l'étude complémentaire a permis d'identifier d'autres facteurs qui doivent être pris en compte, tels des modèles de gestion, d'intégration des données, les règles d'accès (et la façon dont elles peuvent varier), le coût nécessaire pour regrouper les données, le coût associé avec la modernisation des systèmes électroniques, le niveau de confidentialité commerciale, et les différences entre les rôles pris par les secteurs privés et publics dans chaque pays membre vis-à-vis la distribution d'information.

Consultations avec les parties-prenantes

La mise en place des spécificités et des exigences requises vont avoir un impact direct sur les actions d'un nombre de parties-prenantes tout au long de la chaîne de valeur, et il est donc nécessaire de consulter tous ces groupes avant de prendre des décisions définitives.

Les consultations avec les parties-prenantes se sont déroulées en deux étapes : la première était un atelier de travail, et la deuxième une consultation en ligne (accessible pendant 12 semaines).

La première étape était l'atelier tenu à Bruxelles le 4 Novembre 2015, rassemblant plus de 100 représentants des parties prenantes impliquées. Durant l'atelier un nombre de séances, chacune abordant un sujet différent, ont pris place et ont permis d'aborder et de discuter chaque obstacle et les solutions identifiées au cours des étapes précédentes du projet. La deuxième étape (la consultation publique) fut partagée avec les parties prenantes et a permis d'obtenir plus de 175 contributions. L'analyse des données requises lors des deux activités est présentée dans ce rapport. Globalement, les parties prenantes semblaient penser que les mesures politiques considérées étaient suffisantes et appropriées pour surmonter les obstacles identifiés.

Options politiques et résumé des résultats de l'analyse coût-avantage

La revue et les consultations ont permis d'identifier que les limites de chaque mesure législatif (ayant pour but de répondre aux obstacles identifiés) peuvent varier sur un nombre de points. Il est clair, par exemple, que les coûts et les avantages associés avec la mise en place de chaque solution vont varier. Afin de pouvoir évaluer chaque solution, et mesurer l'impact de chaque élément inclus dans les options politiques, une analyse coût-avantage très détaillée fut réalisée. En accord avec la Commission européenne, quatre options politiques ont été établies, dans le but de pouvoir soutenir la mise en place d'un MMTIPS au niveau européen. L'analyse coût-avantage a permis d'évaluer les impacts économiques, sociaux, environnementaux et certains impacts peuvent être plus spécifiques (ex : l'impact sur les marchés préexistants, les consommateurs, les droits fondamentaux et l'innovation) de chaque option politique. Chaque option a été évaluée par rapport à leur conformité avec les principes de la directive ITS, les implications financières et les risques potentiels envers les parties prenantes (il est fortement probable que le coût de chaque option puisse varier entre parties-prenantes). L'analyse coût-avantage a été réalisée en utilisant des méthodes qualitatives et quantitatives afin de produire une évaluation complète des avantages et désavantages de chaque option politique.

Ci-dessous se trouve un résumé de l'analyse de chaque option politique. Chaque solution a été analysée par rapport à sa capacité de répondre aux règles et exigences requises pour a) le réseau TEN-T (y compris les nœuds urbains) et b) l'intégralité du réseau de transport de l'union européenne.

1) Intervention minimale: Les exigences de base pour un point d'accès national pour les informations statiques, les recommandations pour les standards requis pour les données et les services, ainsi que les exigences concernant la qualité des services et des données sont considérées.

2) Concentration sur les données: Les exigences concernant l'accès et l'échange des données, aussi bien publiques que privées, inclus dans un point d'accès national, ainsi que des standards communs sont considérés.

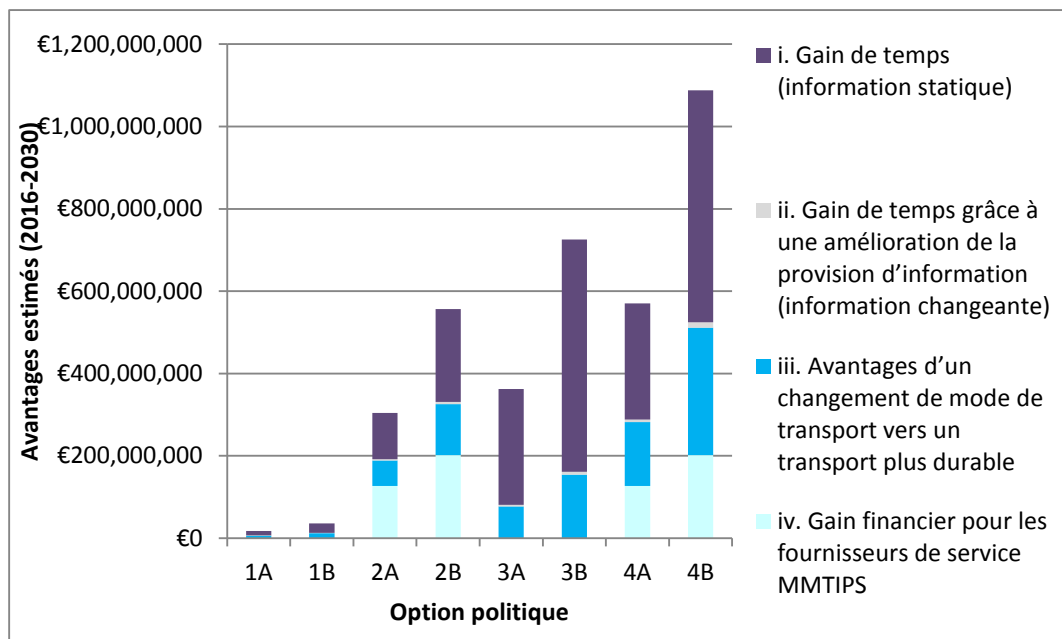
3) Liaison entre services: Les exigences concernant les liens entre les services d'information disponibles et l'utilisation d'interface standardisée pour permettre la planification des transports de façon décentralisée sont considérés. Certains éléments, tels les points d'accès nationaux sont évalués de plusieurs façons (soi sans exigences de qualité ou standard requis pour les données).

4) Approche globale: Une combinaison d'exigences facilitant l'accès et l'échange de données publiques et privées, ainsi que la liaison entre les services pour permettre une planification décentraliser des transports. Les exigences pour les données statiques inclus un point d'accès national, ainsi que des exigences concernant les standards de données et leur qualité. Vis-à-vis la provision des services et de leur liaison (afin de permettre une planification décentraliser des transports) le choix et de fournir un service uniquement en cas de demande.

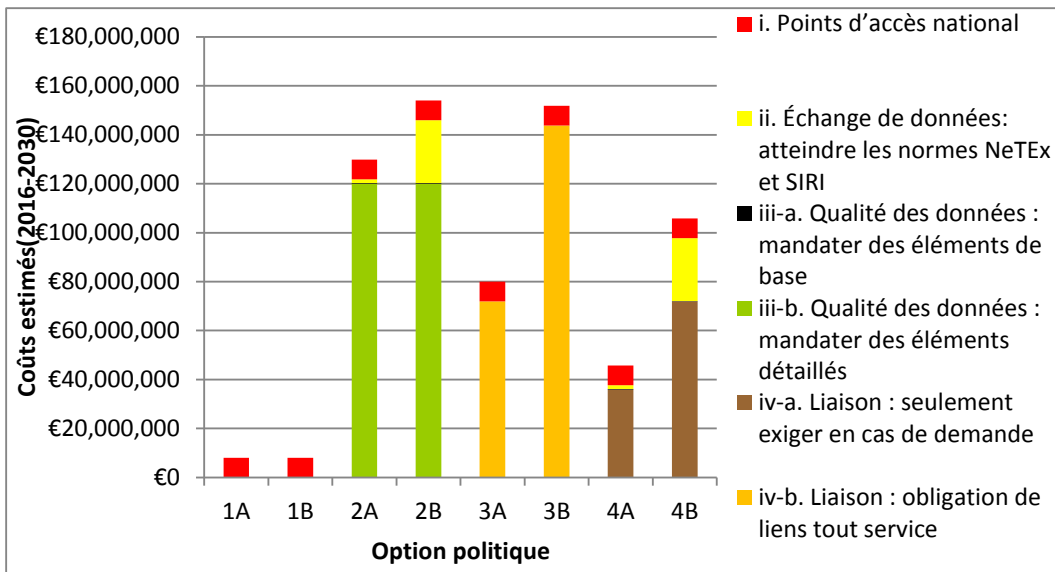
Les évaluations ont pris on compte les impacts économiques, sociaux, environnementaux et commerciaux potentiels que les options pourraient avoir pendant les 15 prochaines années. Grâce aux contributions fournis par des experts des pays membres, le projet a pu identifier les coûts d'implémentation et opérationnels associées avec la mise en place de chaque option. Les résultats assument que les parties prenantes couvriront les coûts nécessaires pour atteindre les exigences minimums. En pratique il est possible que certains pays membres choisissent de mettre en place un système plus complexe qui pourrait générer des coûts plus élevés (par exemple les différents types de point d'accès national décrites à la section 2.3).

Les avantages compris dans l'analyse étaient: les gains de temps dans la planification des trajets, les gains de temps grâce à la présence d'information en temps réel, les gains sociaux grâce à un changement vers des modes de transport plus durables, réduction des coûts pour les fournisseurs des services grâce à une réduction de découverte de données et du nombre d'interfaces. Les données utilisées pour évaluer l'ampleur des avantages proviennent de sources statistiques européennes, et ont été complémentées par des sources nationales et un nombre d'hypothèses concernant l'ampleur d'avantages. Les trois graphiques ci-dessous montrent les coûts et avantages pour chaque option politique. Un résumé des résultats de l'analyse coût-avantage est présenté ci-dessous ainsi que le meilleur rapport coût-avantage lié avec option 4.

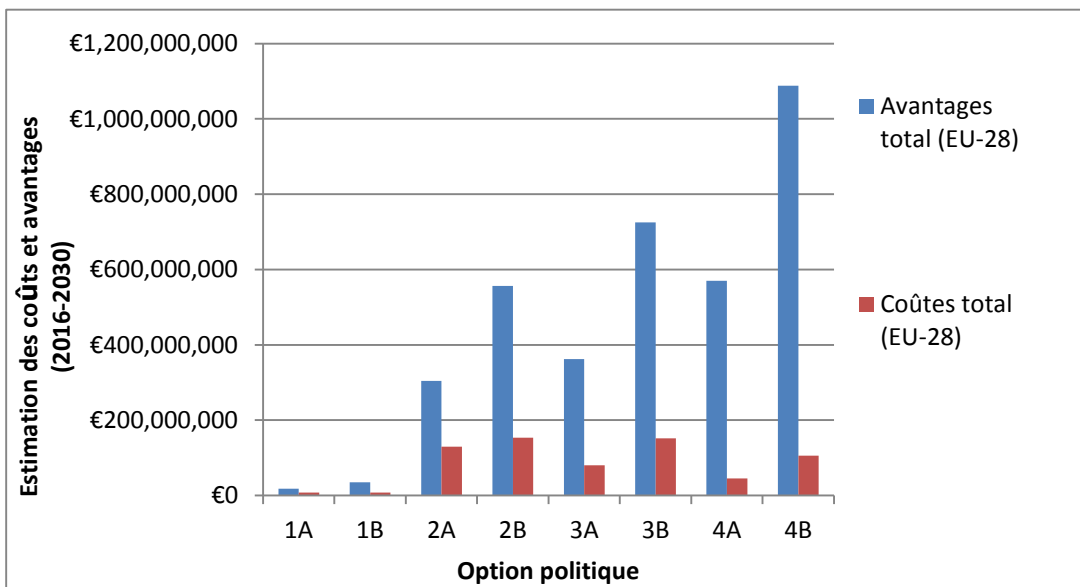
Résumé des bénéfices accumulés par chaque option politique entre 2016-2030 (UE-28)



Résumé des coûts accumulés par chaque option politique entre 2016-2030 (UE-28)



Résumé des bénéfices et des coûts accumulés par chaque option politique entre 2016-2030 (UE-28)



Les graphiques ci-dessus montrent que l'option 4 (l'approche globale) est celle qui permettra d'obtenir le plus grand nombre d'avantages pour deux raisons : les quatre avantages peuvent être réalisés grâce à cette approche, et les avantages financiers seront beaucoup plus élevés que pour les trois autres options (en particulier grâce aux économies possibles suite aux changements de mode de transport utilisé, et les gains de temps lors de l'organisation des voyages). D'autre part, il semblerait que pour cette option, les coûts associés avec la mise en place des deux éléments les plus chers (la qualité des données et la liaison entre les services) soit moins élevées, particulièrement lorsque que la provision de ces services n'est pas exigée de façon systématique (soit l'option 4-a)

Recommandations

Sur la base des représentations lors de la consultation des parties prenantes et l'analyse coûts-avantages et de l'évaluation des options stratégiques, le rapport fait des recommandations dans les domaines suivants:

- La mise en place d'un forum de collaboration, qui prendrait un rôle de gouvernance pour la mise en place de services pan-européens, et faciliterait la communication des méthodes acceptées par la communauté scientifique.
- Une base de données ainsi que ces fonctions doivent être établis afin de fournir un service global d'information pour les voyages multimodaux, un système et des services de planification et l'étendue géographique couverte
- Un point d'accès national aux données, ainsi qu'un plan pour les standards requis, l'échange des données, et la qualité des données et des services d'information
- La liaison entre les services d'information
- Les termes et conditions d'utilisation
- Le développement d'un cadre de suivi et d'indicateurs de performance afin d'observer les progrès réalisés au cours de l'implémentation
- Un programme de recherche et de financement coopératif
- Poursuive le développement des standards, ainsi qu'une collaboration avec les standards internationaux.

Kurzfassung

Politischer Kontext

Nahtloses reisen von Tür-zu-Tür in ganz Europa ist eines der von der Europäischen Kommission dargelegten Ziele im 2011 veröffentlichten Weissbuch Verkehr (EC 2011), "bis zum Jahr 2020 den Rahmen für ein europäisches multimodales Verkehrsinformations-, Management- und Zahlungssystem zu etablieren". Multimodale Reiseinformationen sind für Menschen, die grenzüberschreitend in ganz Europa reisen möchten, eine der Voraussetzungen für eine nahtlose Reise, idealerweise über einen einzigen Zugangspunkt für Informationen über Dienstleistungen mit einem beliebigen Verkehrsträger in jedem europäischen Land. Nach Angaben von Eurostat¹ herrscht eine große Nachfrage an grenzüberschreitendem Verkehr innerhalb Europas. Im Jahr 2013 gab es fast 300 Millionen grenzüberschreitende Fahrten in der EU. Diese Zahl beinhaltet nicht Hin- und Rückfahrten, die am selben Tag unternommen wurden oder auch Reisen von Nicht-EU-Bürgern. Wenn man beruecksichtigt, dass viele grenzüberschreitende Hin- und Rückfahrten in Europa leicht innerhalb eines Tages unternommen werden können und dass rund 609 Millionen internationale Touristen jedes Jahr die EU besuchen, ist anzunehmen, dass diese Zahl als auch die Nachfrage nach solchen Reiseinformationen erheblich höher ist.

Die EU Richtlinie über Intelligente Transportsysteme (ITS) schafft den Rahmen für technische, funktionale und organisatorische Vorgaben, die "EU-weite multimodale Reiseinformationsdienste genau und über die Grenzen hinweg verfügbar für IVS-Nutzer" machen und diese für Reisende, die diese Dienste in Anspruch nehmen möchten, bereitstellen. Insbesondere stellt die Richtlinie eine Reihe von politischen Maßnahmen zur Unterstützung dieses Ziels heraus, wie die Folgenden: die Zugänglichkeit von Informationen und Daten, die Erleichterung des elektronischen und grenzüberschreitenden Datenaustauschs zwischen den Beteiligten, und die zeitnahe Aktualisierung von Informationen. Darüber hinaus wird auch die Notwendigkeit für gleiche Rechte auf Zugang, Nutzung und Darstellung von Daten herausgestellt. Wie in Artikel 5 der ITS-Richtlinie festgelegt, würden solche Regelungen und Bestimmungen nur in Mitgliedstaaten gelten, in denen ITS-Service und Daten bereits vorhanden sind; es gibt keine Anforderungen dahingehend, dass Reise- und Verkehrsdaten in einem maschinell lesbaren Format oder ein multimodaler Reiseinformationsdienst zu erschaffen sind.

Dieser Bericht umfasst die Ergebnisse einer Studie die sich auf vorangegangene Untersuchungen bezieht, mit dem Ziel die Europäische Kommission bei der Entwicklung von Spezifikationen für Maßnahmen zur Überwindung noch bestehender Hindernisse für die Realisierung der EU-weiten multimodalen Reiseinformationsdienste zu unterstützen. Darüber hinaus gelten nun weitere delegierte Rechtsakte der ITS-Richtlinie, die Mechanismen vorschreiben, um den Zugang und Austausch von Echtzeit-Verkehrsinformationen, sicherem Parken und sicherheitsrelevanten Daten zu verbessern. Die Studie untersuchte ausserdem, ob die Anforderungen in diesen delegierten Rechtsakten hier vorrangig behandelnd werden könnten (Priority Action "a"). Die Rolle der Europäischen Kommission ist es, ein Wegbereiter, nicht aber ein Anbieter von Dienstleistungen zu sein. Die Konsultationen, die bereits durchgeführt wurden, haben festgestellt, dass Tätigkeiten, wie die Schaffung eines Rechtsrahmens sowie die Förderung der Standardisierung, von den Beteiligten als eine Schlüsselrolle für die Europäische Kommission gesehen werden.

Effektive Reiseinformationssysteme sind für Reisende als auch für Betreiber entscheidend. Solche Systeme machen es Reisenden einfach, das beste Ihnen zur Verfügung stehende Transportmittel zu ermitteln und zu nutzen. Betreibern helfen sie, ihre Systeme zu betreiben und die Kosten für die Interaktion mit Reisenden zu reduzieren. Die schnelle Entwicklung von Vermittlungssystemen (d.h. der Prozess einen Dienst an den Kunden zu vermitteln) und mobile Endgeräten, erhöht die Verfügbarkeit und den Nutzen solcher Dienste für Reisende erheblich. In einem verkehrsreichen und durch Kohlenstoff belasteten Europa werden multimodale Reiseinformationsdienste zur

Förderung der Nutzung nachhaltiger Transportsysteme und einer effizienten Nutzung des Straßennetzes in der Zukunft wichtig sein. Somit können multimodale Reiseinformationsdienste, zusätzlich zum Nutzen für Reisende und Betreiber, ebenfalls zur Verwirklichung politischer Ziele beitragen, z.B. durch die Verringerung von Staus und Emissionen, verbessertes Netzwerk-Management durch Verkehrsverlagerung und die Förderung der Entwicklung der digitalen Wirtschaft durch die zunehmende Nachfrage nach EU-weiten Online-Diensten.

Ziele und Methodik

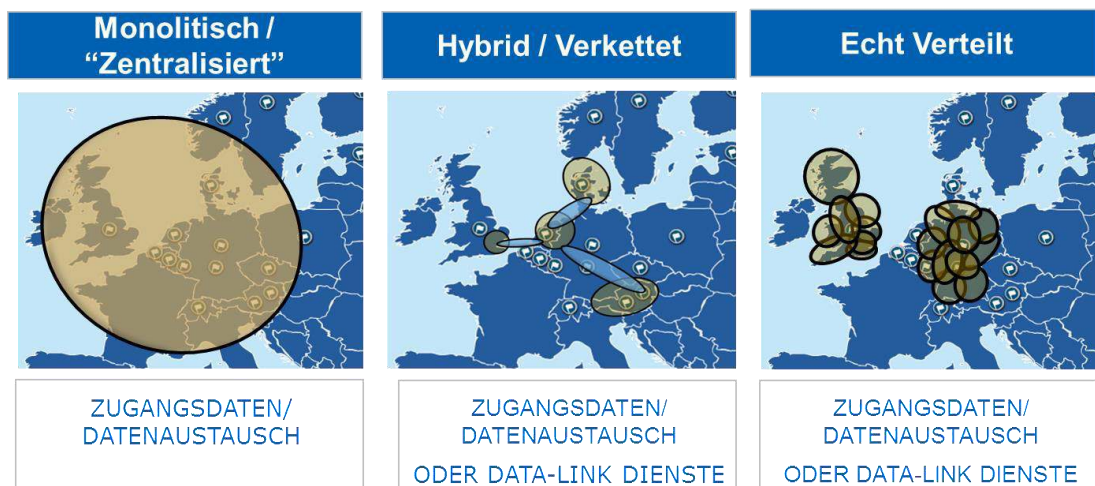
Das übergeordnete Ziel der Studie war es, die Europäische Kommission bei der Entwicklung eines politischen Rahmens zur Unterstützung der Bereitstellung von EU-weiten multimodalen Reiseinformationsdiensten (MMTIPS) zu unterstützen. Dieser politische Rahmen hat zum Ziel, die bestehenden Hindernisse zu beseitigen, welche bestehende Dienste von einer umfassenden Weiterentwicklung abhalten und neue Dienste am Entstehen hindern. Wie in den ITS-Richtlinien vorgesehen, wird dies in Form von technischen, funktionalen und organisatorischen Vorgaben geschehen.

Um diese Ziele umzusetzen, wurde im Rahmen dieser Studie eine umfassende Überprüfung der aktuellen Situation, eine sogenannte "Ausgangsbewertung", durchgeführt. Diese umfasste eine umfangreiche Konsultation der Interessengruppen, einen Workshop mit über 100 Vertretern von Interessengruppen und eine öffentliche Online-Konsultation, welche über 175 Antworten aus der gesamten Wertschöpfungskette und den Mitgliedstaaten der Europäischen Union erhielt. Die Ausgangsbewertung und Ergebnisse der Konsultationen wurden genutzt, um einen all umfassenden "Problembaum" zu definieren, um insbesondere die Probleme darzustellen, welche zu der fragmentierten Entwicklung multimodaler Reiseinformationsdienste in Europa beigetragen haben. Dieser Teil der Studie identifiziert die gesamte Bandbreite an Barrieren und Prioritäten für mögliche Ansätze zur Überwindung der fragmentierten und nicht-kompatiblen Informations- und Planungsleistungen in der EU. Auf diese Weise wurden so auch die maßgeblichen Kosten und Nutzen zur Verbesserung der Interoperabilität identifiziert.

Mit Hilfe der Informationen aus der Ausgangsbewertung und Stakeholder-Konsultationen entwickelte die Europäischen Kommission vier Kernstrategievarianten zur weiteren Beurteilung.

Erleichterung EU-weiter multimodaler Reiseinformationen

Dieser Bericht hebt hervor, dass EU-weite multimodale Reiseinformationsdienste auf viele verschiedene Weisen und nicht durch eine Universalmethode bereitgestellt werden können. Die Rolle der Kommission ist nicht zu entscheiden welche der Lösungen angewendet oder bevorzugt werden sollen, sondern den Rahmen zu schaffen, alle möglichen Lösungen zu unterstützen und den Markt letztlich darüber entscheiden zu lassen, welche Lösung Erfolg hat. Wie die Abbildung darstellt, können zwei Arten von Ansätzen, der "zentralisierte" und der "de-zentrale" Ansatz, verwendet werden:



Um EU-weite, multimodale Reiseinformationen zur Verfügung stellen zu können, ist die Kontinuität der Dienste und die Interoperabilität der Systeme von wesentlicher Bedeutung. Der Bericht stellt die technischen Herausforderungen heraus, dies zu erreichen. Diese umfassen Vielfalt, Komplexität und Umfang der Integration und Handhabung verschiedenster Reise- und Verkehrsdaten, Systeme zur Bereitstellung von Diensten, Betriebskosten der Online-Informationendienste, und die Verwaltung komplexer, verstreuter und sich kontinuierlich ändernder Daten. Der Bericht zeigt, dass es keine allumfassende Lösung gibt: verschiedene Arten und Ebenen von Informationsdiensten erfordern unterschiedliche Systeme und Daten-Feeds, während es verschieden mögliche Service-Architekturen gibt: zentral, dezentral und ein Hybrid-Ansatz.

Der Zugang und Austausch von interoperablen Verkehrsdaten und der Austausch von interoperablen Routing-Ergebnisse ist erforderlich, um alle identifizierten Ansätze zu unterstützen,

Ein einziger Zugangspunkt, zur Lokalisierung von oder dem direkten Zugriff auf Daten, ist ein wesentlicher Bestandteil, um die Ausbreitung und den effizienten Betrieb von multimodalen Reiseinformationendiensten zu unterstützen. Ein solcher Zugangspunkt fordert ein einheitliches Paket an harmonisierten Datenformaten und Austauschprotokollen, die von allen relevanten Akteuren erfasst und verarbeitet werden können.

Zusätzlich würde eine standardisierte Schnittstelle für den Austausch von Routing-Ergebnissen, um weitreichende Reiseauskünfte von verschiedenen Reiseinformationendienste realisieren zu können, den Austausch von Reise- und Verkehrsinformationen zwischen den Beteiligten und Dienstleistern verbessern. Diese können das Wachstum und den effizienten Betrieb von multimodalen Reiseinformationendienste unterstützen.

Aktueller Stand von Dienstleistungen in Europa

Der Bericht gibt einen Überblick über den aktuellen Stand der multimodalen Reiseinformationendienste in Europa. Insgesamt wurden 125 Anbieter gefunden, welche 160 Dienste anbieten.

Im Allgemeinen zeigte die Überprüfung, dass Reiseinformationendienste von öffentlichen und privaten Akteuren zur Verfügung gestellt werden. In vielen Fällen ist die lokale Behörde oder das Verkehrsunternehmen auch der Reiseinformationdienstleister und hat demnach eine Doppelfunktion. Per Definition sind Dienstleistungen von lokalen Behörden und Verkehrsunternehmen auf eine bestimmte Region konzentriert, aber stellen einen detaillierteren und umfangreicheren Reiseinformationdienst als europaweite Dienste zur Verfügung.

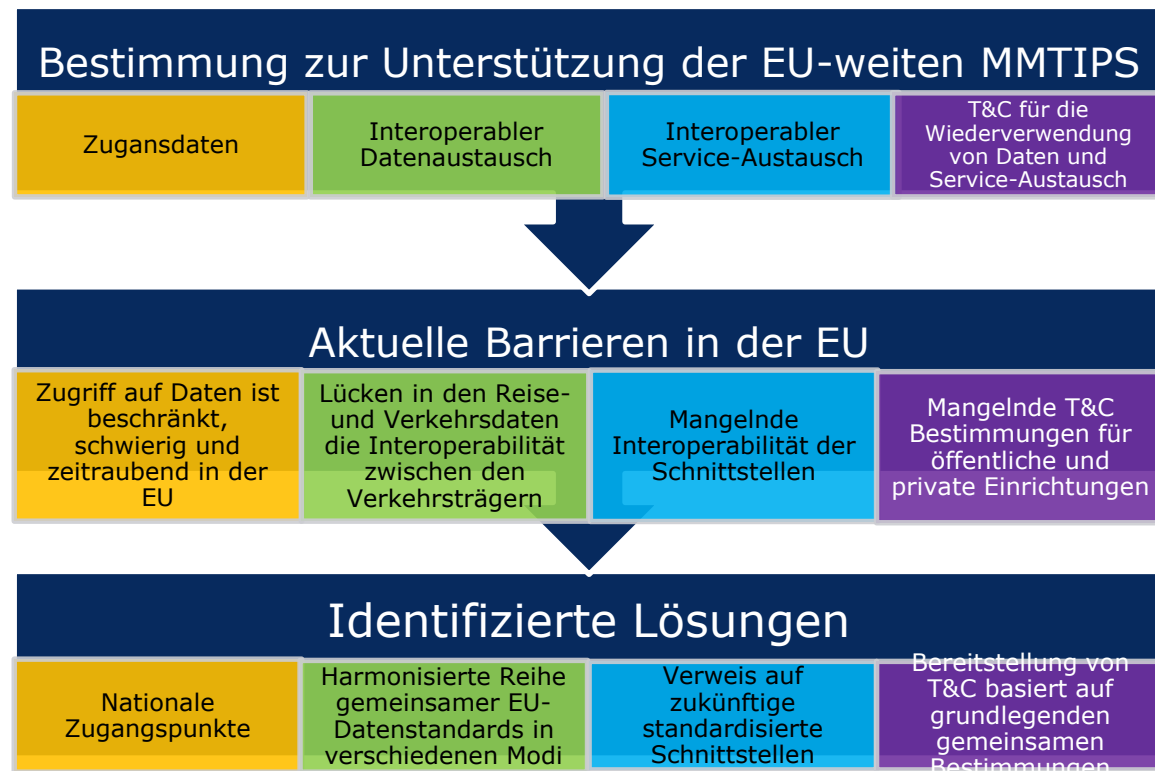
Die europaweiten Dienste, das heißt diejenigen die Reiseinformationen zu vielen Zielen in Europa anbieten, wurden in erster Linie durch private Akteure angeboten, aber waren weniger detailliert und boten vereinfachtere Reiseinformationen an. Die lokalen Dienste boten Reiseinformationen mehrerer Verkehrsträger an, aber deckten in den meisten Fällen nicht alle möglichen Reiseoptionen. Auf gesamteuropäischer Ebene waren diese Dienste noch begrenzter. Darüber hinaus hatten mehrere Mitgliedstaaten nationale multimodale Reiseinformationendienste (vor allem in Nord-, Süd- und Mitteleuropa), die von privaten und öffentlichen Dienstleistern zur Verfügung gestellt wurden. Das Niveau hinsichtlich der Abdeckung der verschiedenen Verkehrsträger variierte jedoch von Dienstleister zu Dienstleister.

In Bezug auf die Art der bereitgestellten Informationen sind die meisten Dienste in erster Linie noch auf der Basis statischer Daten (das heißt Daten, die sich nicht in regelmäßigen Abständen ändern). Im Gegensatz dazu wurden dynamischen Daten (das heißt Daten, die sich auf einer regelmäßigen Basis ändern) im Allgemeinen auf lokaler Ebene vorgefunden. Daher zeigte die Überprüfung, dass, während der Markt für Reiseinformationen in Bezug auf die Anzahl der für den Benutzer angebotenen Dienstleister floriert, das Serviceniveau, vor allem in Bezug auf die "Tür-zu-Tür" Element, jedoch begrenzt bleibt.

Barrieren und Lösungen

Ein wesentlicher Aspekt der unterstützenden Studie war die Identifizierung der Barrieren, die den aktuellen Stand der Bereitstellung von EU-weiten multimodalen Reiseinformationsdienste verursachen und die möglichen Lösungen, solchen Probleme zu begegnen. Die Barrieren und Lösungen wurden durch zwei Schlüsselaktivitäten identifiziert: die Überprüfung der Beweise und die Konsultation der Interessengruppen. Eine detaillierte Zusammenfassung der wichtigsten Bestimmungen, welche erforderlich für einen EU-weiten multimodalen Reiseinformationsdienst, sind und die damit verbundenen Hindernisse und mögliche Lösungen, ist umseitig gezeigt. Ein detaillierter Problembaum ist auf Seite 52 zu finden.

Die Beweisüberprüfung ergab, dass in der gesamten EU auf Reise- und Verkehrsdaten überwiegend in einem dezentralen Ansatz und demnach direkt über die ursprüngliche Datenquelle zugegriffen wird. Die Konsultation der Interessengruppen ergab, dass der Zugang zu Daten noch begrenzt und eine große Barriere darstellt. Das Konzept eines nationalen Zugangspunktes, der auch auf andere vorrangige Maßnahmen der ITS-Richtlinie angewendet wird, wurde als Lösung identifiziert, um sowohl öffentliche als auch private Akteure beim Zugriff auf Reise- und Verkehrsdaten zu unterstützen und wurde insgesamt von den Beteiligten begrüßt.



Die Beweisüberprüfung und die Konsultation der Betroffenen ergab weiterhin, dass die Interoperabilität der Reise- und Verkehrsdaten zwischen den Verkehrsträgern variiert und dass die Interoperabilität der Schlüssel ist, um den Zugang und Austausch von Daten zu ermöglichen. Es hat sich herausgestellt, dass es keine einheitlichen Datenaustauschprotokoll für alle Verkehrsträger gibt, sondern eines für jeden Verkehrsträger. In diesem Zusammenhang verwenden einige Sektoren bereits Normen oder andere technisch einschlägige Rechtsvorschriften auf der Grundlage anderer relevanter Spezifikationen oder diese sind "de-facto" Standards aufgrund von Industrietätigkeit. Für den Straßenverkehr wird der DATEX Standard verwendet, für den Schienenverkehr ist es die TAP-TSI technische Spezifikation und für Luftverkehr wird der IATA-Daten-Standard verwendet. Dieser Bericht zeigt, dass daher in einem multimodalen Kontext, für andere Verkehrsträger, zum Beispiel der öffentliche Personennahverkehr und Fernreisebusse, Interoperabilitätsanforderungen in den Spezifikation enthalten sein müssen. Solche Datenaustausch-Protokoll-Standards existieren auf CEN-Ebene (NETEX, SIRI), aber die meisten Mitgliedstaaten nutzen

entweder innerstaatliche Normen basierend auf Transmodel oder Googles GTFS. Die Umstellung auf die europäischen Normen wurde jedoch als relativ geradliniger Prozess angesehen. Ansichten über die Datenqualität zeigten ausserdem, dass Mindestanforderungen festgelegt werden müssten, und indizierten, dass Feedback-Prozesse für die Aufrechterhaltung der Datenqualität von Nutzen sein würden.

Verteilte Reiseplanung wird derzeit in einigen Teilen Europas durchgeführt, aber technische Verbesserungen sind notwendig, um die Ergebnisse zu verbessern. Darüber hinaus gibt es einen Mangel an standardisierten Schnittstellen auf europäischer Ebene. Ein OPEN API Standard wird derzeit entwickelt und könnte der Hauptstandard auf europäischer Ebene werden. Die Konsultation mit den Beteiligten hat die Unterstützung für die verteilte Reiseplanung hervorgehoben und unterstützt deren Aufnahme in den Rahmen der Spezifikation.

Darüber hinaus identifizierte die Studie auch andere Aspekte, die in Betracht bezogen werden müssen. Dazu gehören Organisationsmodelle, Datenintegration, voneinander abweichende Regelungen für den Zugang, hohe Kosten für die Datenaggregation, Kosten für Skalierungskapazitäten von Computer-Servern um die Nachfrage zu decken, Schutz von Geschäftsgeheimnissen, und Unterschiede zwischen den verschiedenen Mitgliedstaaten in den Rollen von öffentlichen und privaten Organisationen in der Informationskette.

Konsultation der Interessengruppen

Die Umsetzung der Vorgaben und das Erfüllen unterschiedlicher Anforderungen haben letztendlich einen direkten Einfluss auf die Tätigkeit der verschiedenen Anspruchsgruppen entlang der Wertschöpfungskette. Es ist daher wichtig, die relevanten Gruppen zu konsultieren: diejenigen, die durch die Gesetze direkt betroffen sind, verstehen besser als jeder andere, welche Auswirkungen diese haben und können demnach nützliche Überlegungen hinsichtlich Verbesserungsmöglichkeiten einbringen.

Im Rahmen der unterstützenden Studie wurde die Konsultation der Interessengruppen in zwei entscheidenden Phasen durchgeführt: der Stakeholder-Workshop und die 12-wöchige öffentliche Online-Konsultation².

In der ersten Phase wurde am 4. November 2015 ein Workshop in Brüssel gehalten, der über 100 Interessenträger aus der gesamten Wertschöpfungskette zusammenbrachte. Durch eine Reihe von thematischen Sitzungen und Foren mit anerkannten Experten, die die verschiedenen Sektoren vertraten, wurden die verschiedenen Hindernisse und mögliche Lösungen diskutiert. In der zweiten Phase wurde eine 12-wöchige öffentliche Online-Konsultation durchgeführt, die allen wichtigen Interessengruppen zugänglich gemacht wurde und welche mehr als 175 Beiträge erhielt. Die detaillierte Analyse der Ergebnisse der beiden Tätigkeiten wird in diesem Bericht dargestellt. Die generelle Ansicht der verschiedenen Interessengruppen war, dass die geplanten Maßnahmen geeignet sind, um den ermittelten Hindernissen zu beseitigen. Allerdings gab es unterschiedliche Ansichten hinsichtlich dessen, ob diese verbindlich sein sollten oder nicht.

Strategische Varianten und die Synthese von Nutzen-Kosten-Ergebnisse

Die Beweisüberprüfung und die Konsultation der Interessengruppen zeigten, dass der Umfang der verschiedenen geplanten Vorschriften und Bestimmungen (Maßnahmen), um die genannten Hindernisse zu beseitigen, variieren könnten, zum Beispiel im Hinblick auf ihr Ausmaß und für wen die Regelungen gelten. Die Kosten zur Erfüllung der unterschiedlichen Anforderungen der Szenarien variieren demnach, ebenso wie der Gesamtnutzen. Eine detaillierte Nutzen-Kosten-Analyse wurde für verschiedene Szenarien, in denen verschiedene Elemente der politischen Maßnahmen berücksichtigt werden (Varianten), durchgeführt. Zusammen mit der Kommission wurden vier Kernvarianten auf der Grundlage der verschiedenen Möglichkeiten zur Unterstützung EU-weiten MMTIPS und der identifizierten Lösungen herausgearbeitet. Die Nutzen-Kosten-Analyse umfasste die möglichen wirtschaftlichen, sozialen und ökologischen Auswirkungen, sowie die besonderen Auswirkungen (wie z.B. die Auswirkungen auf die

bestehenden Märkte, Grundrechte, Verbraucher, KMUs und Innovation) der verschiedenen strategischer Varianten. Diese wurden hinsichtlich ihrer Übereinstimmung mit den Prinzipien der IVS-Richtlinie bewertet. Da die Kosten von einer Interessengruppe zur anderen variieren, wurden die finanziellen Auswirkungen und Risiken der strategischer Varianten für die wichtigsten Stakeholder-Gruppen analysiert. Um eine allgemeine Bewertung der Vor- und Nachteile der verschiedenen Varianten zur Verfügung zu stellen, wurden für den Vergleich der Strategievarianten sowohl quantitative als auch qualitative Ergebnisse der Nutzen-Kosten-Analyse genutzt.

Ein detaillierter Überblick über die vier wichtigsten Varianten, die in der Nutzen-Kosten-Analyse betrachtet wurden, ist unten detailliert dargestellt (die Ziffern für die politische Option werden in den folgenden Übersichtsgrafiken verwendet). Jede Option wurde hinsichtlich der Auswirkungen der Erfüllung aller unterschiedlichen Vorschriften und Anforderungen entweder für a) ausschließlich das umfassende TEN-T-Netz einschließlich der städtischen Knoten und b) das gesamte EU-Verkehrsnetz analysiert.

1 Minimale Intervention - in diesem Szenario werden grundlegende Anforderungen in Bezug auf die Verwendung eines nationalen Zugangspunktes für statische Daten und die Empfehlungen von Daten und Service-Standards und Qualitätsanforderungen in Betracht gezogen.

2 Fokussierung auf Daten - in diesem Szenario werden Anforderungen, die auf den Zugang und Austausch von öffentlichen und privaten Daten (statisch und dynamisch) fokussieren, über nationale Zugangspunkte, eine harmonisierte Reihe von Standards und einen detaillierten Qualitätsrahmen mit einbezogen.

3 Vernetzung von Dienstleistungen - in diesem Szenario sind Anforderungen, die sich auf die Verknüpfung von allen verfügbaren Reiseinformationsdiensten und die Verwendung einer standardisierten Schnittstelle zur Durchführung verteilter Reiseplanung konzentrieren, enthalten. Einige Datenelemente, einschließlich der nationalen Zugangspunkte, sind ohne Datenstandardisierung oder Qualitätsanforderungen vorgesehen.

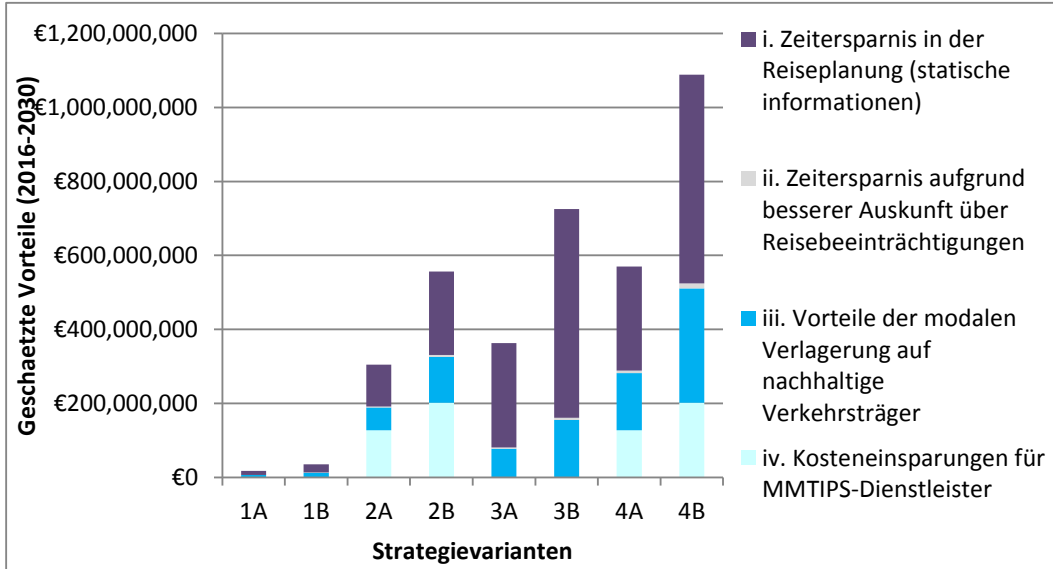
4 Ganzheitlicher Ansatz - dieses Szenario betrachtet eine ausgewogene Kombination an Anforderungen, um den Zugang und Austausch von öffentlichen und privaten Daten sowie der Verknüpfung von Diensten zur Unterstützung der verteilten Reiseplanung zu unterstützen. Die Datenanforderungen für statische Daten umfassen den nationalen Zugangspunkt, Datenstandards und allgemeine Qualitätsvorschriften. Service-Anforderungen beinhalten einen Nachfrage-basierten Ansatz zur Verknüpfung von Diensten zur Ausführung der verteilten Reiseplanung und beinhalten die empfohlene Verwendung einer standardisierten Schnittstelle.

Die Bewertung berücksichtigte die wirtschaftlichen, sozialen, ökologischen Auswirkungen sowie die Einflüsse auf den Markt, die die strategischer Varianten über einen Zeitraum von 15 Jahren haben könnten, basierend auf einer über unterschiedliche Zeitrahmen gestaffelten Umsetzung der verschiedenen Elemente. Mit Hilfe von Beiträgen von den Mitgliedstaaten nominierten Experten und bestehenden Diensten, identifiziert die Studie die mit der Einführung und dem Betrieb verbundenen Kosten der wichtigsten Einführungsmaßnahmen. Die Berechnungen gehen davon aus, dass die Beteiligten die Kosten zur Erfüllung der grundlegenden Anforderungen der einzelnen strategischen Varianten und somit das entstehende "Mindestniveau" an Kosten übernehmen würden; in der Praxis könnte es dazu kommen, dass einige Mitgliedstaaten einen komplexeren Ansatz wählen (zum Beispiel die verschiedenen Arten von nationalen Zugangspunkten beschrieben in Abschnitt 2.3), deren Implementierung mit höheren Kosten verbunden wäre.

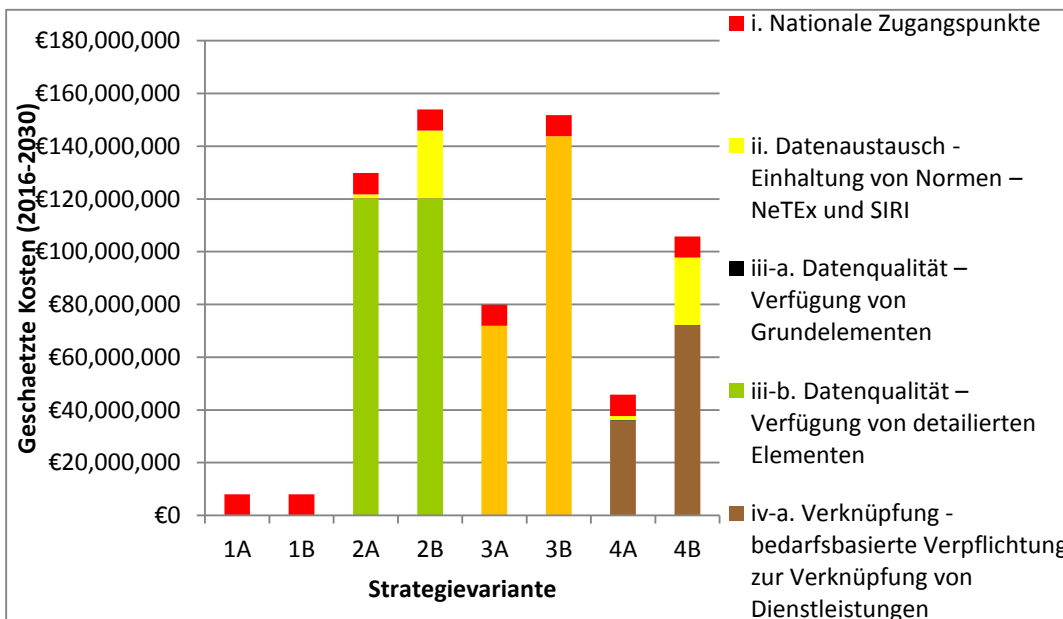
Die Nutzen die in die Bewertung einbezogen wurden, waren: Zeitersparnis bei der Reiseplanung; Zeitersparnis bei beeinträchtigten Bahnreisen durch Nutzung von Echtzeitinformationen; gesellschaftlicher Nutzen durch die Umstellung auf nachhaltigere Verkehrsträger am Reiseziel; und Kosteneinsparungen für Service-Provider durch Reduzierung der Datenerkennung, Datenaggregation und Schnittstellen. Daten zur Beurteilung des Ausmaßes der Vorteile wurden europäischen statistischen Quellen entnommen und durch nationale Daten in Zusammenhang mit einer Reihe von

Annahmen über den Umfang der Leistungen ergänzt. Die folgenden drei Diagramme zeigen, wie die Kosten und Nutzen für die einzelnen Strategievarianten variieren. Die Gesamtergebnisse der Nutzen-Kosten-Analyse sind unten aufgeführt, das beste Nutzen-Kosten-Verhältnis wurde für Option 4 ermittelt.

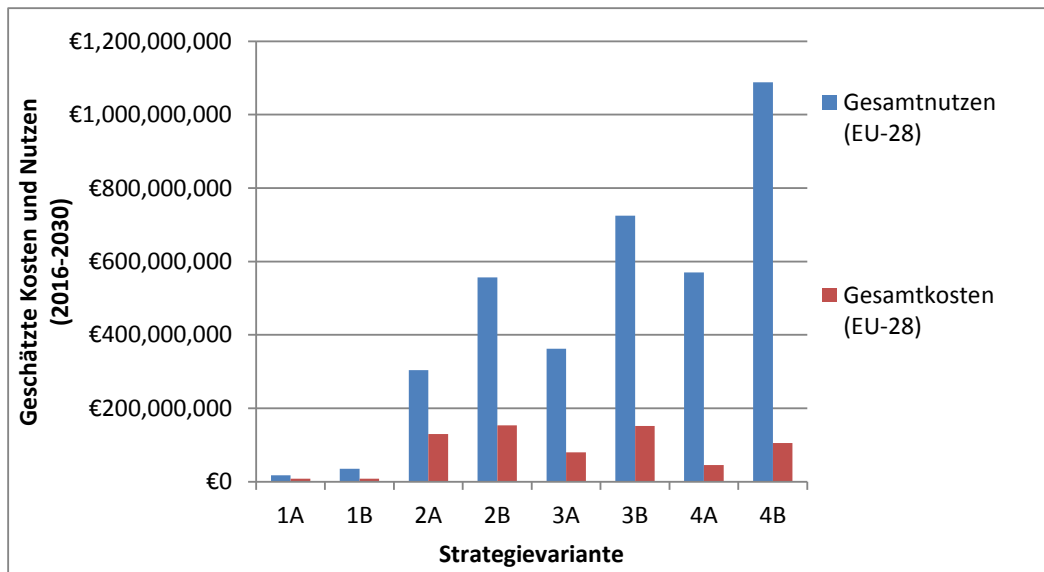
Zusammenfassung der Anwartschaften der strategischer Varianten 2016-2030 (EU-28)



Zusammenfassung der aufgelaufenen Kosten von Strategievarianten 2016-2030 (EU-28)



Zusammenfassung der aufgelaufenen Kosten und Nutzen der Strategievarianten 2016-2030 (EU-28)



Die Diagramme zeigen, dass die zu erwartenden kombinierten Auswirkungen der vier verschiedenen Arten von Nutzen, für Option 4 (Ganzheitlicher Ansatz) aus zwei Gründen am größten sind: bis auf eine weitere Option würden in diesem Fall alle vier Typen von Nutzen freigesetzt werden, während der monetäre Wert der Leistungen höher wäre als im Falle anderer strategischer Varianten, insbesondere entstehend aus der Verkehrsverlagerung aus den Ziel- und Zeitersparnis bei der Reiseplanung. Zugleich werden für Strategievариante 4 die mit der Umsetzung verbundenen Kosten für die beiden teuersten Elemente (Datenqualität und die Verknüpfung von Dienstleistungen) voraussichtlich niedriger sein, da diese, im Gegensatz zu allen anderen Varianten, nicht obligatorisch sind.

Empfehlungen

Auf der Grundlage der Darstellungen der Interessengruppen und der Nutzen-Kosten-Analyse sowie der Bewertung der strategischer Varianten, gibt der Bericht in den folgenden Bereichen Empfehlungen:

- Aufbau eines kollaborativen Forums, welches als Dachverband für die Umsetzung europaweiter Dienste handelt und den Austausch bewährter Verfahren erleichtert;
- Der Datensatz und ein Mindestmaß an Funktionen für die Bereitstellung umfassender multimodaler Reiseinformationen, Planungssysteme, Dienstleistungen und geografische Abdeckung;
- Nationale Datenzugangspunkte und der Umfang der Datenstandards, sowie des Datenaustausches und die Daten- und Informationsdienstqualität ;
- Verknüpfung von Reiseinformationsdiensten;
- Bedingungen für die Wiederverwendung von Daten;
- Überwachungsrahmen und Leistungsindikatoren für die Verfolgung der Fortschritte bei der Umsetzung;
- Ein kooperatives Forschungsprogramm und Finanzierung;
- Fortsetzung der Entwicklung von Standards und Engagement mit internationalen Standards.

1. Introduction

1.1. Focus of the study

The Executive Summary set out the policy context for this study to support the European Commission in developing specifications for the measures that are needed to overcome the remaining obstacles to realising EU-wide multimodal travel information services. Within this context, the focus of the study is on identifying and assessing potential policy interventions from the point of view of the various stakeholders and then establishing ways of stimulating the market and enabling appropriate business models to emerge that will support the most beneficial policy option(s).

1.2. Key issues

Multimodal travel information services are currently available at regional/national levels in many parts of the EU. However in order to provide EU-wide multimodal travel information for citizens, the continuity of services and interoperability of systems is needed to support this.

Therefore the European Commission needs to define a policy framework which will encourage cooperation between the various organisations involved in the information value chain. Challenges arise from the fact that the value chain includes both the public and private sectors (with their different objectives), the need to adapt as this value chain evolves (for example with technological advances) and that all stakeholders will need to be able to realise benefits from this cooperation. At the same time, cooperation must be achieved without thwarting innovation – if the policy is too prescriptive, for example, services will not readily be adaptable to take advantage of new developments, which is not in the long term interests of either travellers or service providers.

The development of pan-European transport information services should be understood as a long term process that is currently constrained by economic factors, technology and user demand. The costs of data and systems must be low enough to warrant the business model, while technologies (increasing computation power, bandwidth and consumer mobile devices) are radically changing what is possible for a given cost while at the same time, user habits and demands are also changing. These forces will, to some extent, dictate the rate of progress that is possible, regardless of the policy intentions of government, and it is important to understand the limits to intervention by any government (or the European Commission). However it is also important to recognise that the European Commission and national governments have an important part to play in setting data access policies and dealing with data protection and privacy issues. For example there may be conflicts between a public interest in having data freely available and the commercial objectives of owners of that data. This is especially the case for public timetable and real-time data: timeliness and accuracy of data are critical to how useful it is, and it is easy for a reluctant supplier to stifle competition by taking advantage of its own ability to provide a higher quality information feed.

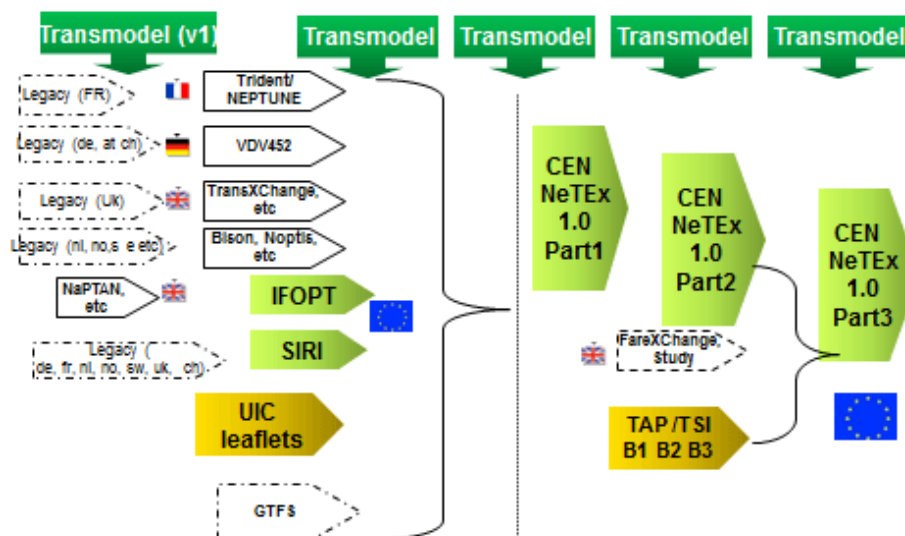
1.2.1. Data standards and formats

Data standards are a key enabler for the development of large-scale services, reducing both the costs and the complexity of data management. Standards facilitate the interoperable exchange of data between different travel information services which aid: the integration and distribution of information; the dissemination of know-how on proven data representations; and provide a common basis for promoting access rights to use the data. The standards for multimodal traveller information and planning services (MMTIPS) need to be suitable for international use (i.e. multi-lingual, multi-currency, multi-time-zone etc.) and include the necessary metadata, such as version identification and responsibility attributes to support automated aggregation, validation and integration processes, in a pan-European context (since automation is essential for reducing costs). The study has compared key European standards for passenger and traveller information data and information services to the data elements needed to enable the target information services, and identified a number of gaps.

Since in the late 1990s there have been notable strides towards harmonising European transport data models in a number of areas. Examples at a conceptual level include the CEN Transmodel / IFOPT; concrete standards in use include rail timetables (TAP/TSI), bus real-time systems (SIRI), road status and real-time information (DATEX II); RDS-TMC ALERT C and TPEG for driver-centred road traffic information services; GDF and OGC/ ISO 19000 series standards for GIS (although there are competing and unaligned but widely adopted standards for GIS). A new pan-European defined format covering many types of data on public transport has been formulated as NeTEx. Many national standards have been slowly moving towards a European level of interoperability. For example, the timetable format in Part 2 of the new NeTEx standard includes explicit mappings to a number of European national timetable standards including VDV 452 (in Germany), Neptune (France), TransXChange (UK) and Bison (Netherlands) as well as Google's GTFS. NeTEx Part 3 additionally sets out a new format for multi-modal fare data that includes mappings to TAP/TSI fares, giving access to a crucial base fare data set comprising all European standard rail fares. There is a public sector obligation to provide INSPIRE-compliant transport network data. Developments such as Open Street Map for GIS data have also been important for reducing data costs and creating detailed road path sets across Europe that are free to use. Google's GTFS in particular has been significant both as a "proof of concept" that it is possible to represent basic timetable data from many modes and many countries in a common format, and as an efficient format for distributing the finalized data for certain types of timetable and basic journey planning service.

Figure 1 Harmonisation of European public timetable standards

Evolution of NeTEx



1.2.2. Data tools and processes

To be successful, standards require a supporting system of compliant products, data management tools, workflows and validation processes (e.g. CHOQUETTE in France), as well as a pool of expertise in how to use them effectively. A number of policy measures for accelerating and promoting the use of standards and the related markets are considered; the report also identifies certain properties that standards must have in order to allow cheap automated workflows. Harnessing Europe's world-class specialist suppliers of public transport (PT) software to lower the costs of processing data is likely to be especially important for achieving success.

For certain types of data it may be necessary to think beyond traditional approaches. For example, both pedestrian and cycle paths, as well as accessibility data for interchanges and destinations, require the large scale collection and maintenance of data that is reliant on local knowledge. One of the most viable (and maybe only viable) business

models for this is crowdsourcing, as has been used with great success for Open Street Map to create a free GIS data set with wide-scale global coverage.

1.2.3. Linking travel information services

Several different architectures are possible for constructing wide-scale journey planning implementations, as identified in the 2011 Rapp report and other papers (Tempier and Rapp 2011a). These range from a fully centralized to a fully distributed approach, each with advantages and disadvantages in cost, complexity and functionality. No single approach is a panacea and alternative approaches are required to meet different operational requirements and business models. D1 (Fell, Knowles and Harrod Booth, 2015) summarised the technical characteristics that distinguish the approaches in order to identify the data standards and data services needed and the differences in functionality available through each approach.

Standards for interregional distributed journey planning systems currently include EU Spirit, Delfi, and JourneyWeb, with a new initiative to specify a common journey planning API currently being led by CEN.

1.2.4. Access points and discovery services

Both at a national and European level, there have been moves over recent years towards improving access to public sector information, through data access policies. As such the opening of travel and traffic data is one aspect of a wider initiative that covers a range of domains. The benefits of data access include: new uses and applications of data; allowing third parties to augment the dataset or correct erroneous data (e.g. OpenStreetMap data); and breaking down existing monopolies of use.

Access points to allow a wide range of users other than just operators to obtain static and dynamic data can potentially be provided on a European, national, regional or local level. These might take the form of common databases, data warehouses, data marketplaces or data registries.

Discovery services, to find the access points to information services and the types of data, are also needed. These are relevant both for computer systems (e.g. to find servers providing a particular type of feed, as proposed by the European Open Journey Planning system (OJP)) and for human interfaces (e.g. in web browser search engines to find a type of website such as a journey planner or stop departure board covering a particular area).

Information systems access points are already in place in a minority of Member States to different degrees; this study has explored these in more detail.

1.2.5. Functional domains

The European Commission's Expert Group which is working on the specifications for multimodal travel information services identified a set of specific domains within which information can be categorised. The Expert Group recommended that specifications be developed which look at data by domain rather than by mode. This also serves to identify the data which necessarily must come from operators (e.g. timetables) and the data which may be sourced elsewhere (e.g. map and network topology data). Consideration also needs to be given to the relative volatility of data, that is how often it changes, the level of confidence in its accuracy, and the separate formats and services needed to exchange it as static or as dynamic data. These provide a means of classifying different functionality and to characterise the data elements needed for basic and more advanced capabilities. The data needed to provide useful services potentially includes the following domains:

- **Map data** needed to provide a topological geographical spatial context (e.g. roads, rivers, building, and other features).
- **Public Transport Network Information** describing access nodes (stations, stops, car parks etc., and their accessibility properties), network topology, lines, tariff zones, etc.

- **Road network data** including nodes, links, direction, number of lanes, capacity and turn constraints, speed limits and vehicle and other restrictions.
- **Pedestrian and cycle path data** as nodes and links, including attributes for the quality of accessibility, cycle friendliness, etc.
- **Place data:** Descriptions of the destinations that end users may seek to travel to, (e.g. addresses, map points, post codes, places of interest, with accessibility) and their relation to named localities such as counties, towns and villages (i.e. gazetteer).
- **Timetables:** Information relating to the routings and timings of scheduled services, potentially including last minute changes, facilities and accessibility of vehicles providing services. This requires the ability to specify precise temporal conditions as to when services do/do not operate.
- **Available facilities at stop and on board** (e.g. WCs, accessible WCs, communications, buffets, etc.).
- **PT Real-time data:** vehicle positions with resulting predicted arrival and departure times, control actions to cancel or divert services.
- **Road travel time data** including historic, real time observations and real-time future predictions (e.g. link average speeds or travel times, journey time reliability, queue lengths, etc.)
- **Planned and unplanned** disruptions affecting scheduled services and road networks (e.g. major events, planned engineering works, incidents, weather-related and other disruptions) and their implications for the transport networks.
- **Road tolls/charging.** Tariffs, times, locations, access times, "vehicle" park charges, facilities.
- **Basic fare data** describing products and conditions (e.g. fare structures by zone, segment, route, time period etc., fare products (single, return, eligible user types, purchase conditions, conditions of use, etc.).
- **Fare distribution data** identifying where and how products may be purchased (e.g. distribution channels, payment methods associated with fare products etc.).
- **Fare Prices** for products (e.g. standard products, special products, special offers, etc.).
- **Self-organised** on demand services such as taxis, matatu ("fill up and go"), bicycle hire, car sharing etc. (e.g. pick up locations, payment methods, conditions of use, charges) – and accompanying real-time data on availability of resources for which there is competitive demand (e.g. cycles, return slots, charging/refuelling points, etc.).
- **Flexible / Demand responsive Public Transport** services that run to flexible routes or at flexible times according to demand (e.g. areas covered, times of operation, methods for ordering).
- **Historic data** generated by recording real-time data for use in predictions of travel time and assessing reliability and schedule adherence (e.g. day types, historic arrival and departure times, historic road link and travel times).
- **Personal data** as to preferred locations and journeys, eligibility for fare products, current location, etc. Normally this will be generated by use of a service - and will be subject to privacy considerations. Certain types of user generated data can be aggregated and anonymized to create useful data feeds (e.g. floating car data from mobile phones).
- **Current pollution** levels (e.g. NOx levels, particulates, etc.) that may affect choice of route or even the decision to travel.
- **Information service demand data;** anonymized logs of the queries made by end-users using information services; these can be used to analyse users' information needs and also to determine how people are intending to travel at specific times – this provides an additional insight into demand for transport and can be used to predict crowding and availability.

1.3. Transport modes covered

The modes of transport which are considered to be within the scope of Priority Action A are listed below.

- Air (scheduled flights)
- Bike sharing
- Bus (including Bus Rapid Transit)
- Car-pooling (e.g. ride sharing)
- Car sharing (e.g. car clubs, car hire)
- Cycling
- Dial-a-ride services (e.g. demand responsive buses)
- Long distance coach
- Metro (including underground and light rail)
- Rail
- Road - passenger cars, motorcycles (including refuelling/ charging points for different vehicle types)
- Taxi
- Tram
- Trolleybus
- Walking
- Waterborne (scheduled waterborne services)
- Water taxi.

Modes which are excluded are all modes of freight transport, private air transport and private waterborne transport (i.e. not a scheduled service or water taxi).

1.4. Methodology

1.4.1. Baseline identification

The first task of the project was to establish the current baseline situation as part of the wider study objectives contributing to an evidence-based specification to meet these policy objectives. That report (D1 – Fell et al, 2015) provides an overview of the current state of play of multimodal travel information services in Europe, a summary of identified barriers and gaps in the provision of EU-wide multimodal travel information services and analysis of the identified solutions and measures to address these problems and policy options available to the European Commission. During this phase of the study a 'problem tree' was defined to summarise the issues contributing to the fragmented development of MMTIPS in Europe. This was then elaborated on during the stakeholder consultation phase of the study.

Key barriers identified are: the availability and accessibility of travel and traffic data, the interoperability of systems and services, the level of quality and common provisions for the re-use of data. The D1 report (Fell, Knowles and Harrod Booth, 2015) identified that problems of data availability (in terms of stakeholders collecting relevant travel and traffic data not already digitalized) are not within the scope of the specifications as defined by the ITS Directive, and therefore this issue cannot be addressed without additional measures by Member States requiring public transport operators in particular to make their data available in a digital form.

The D1 report (Fell, Knowles and Harrod Booth, 2015) identified the full data needs for comprehensive multimodal travel information services based on use cases and a set of possible system functions. These functions were classified into three levels (i) minimum expected (reflecting functionality which the majority of systems already provide); (ii)

additional (those functions which are increasingly common in systems in response to user needs); and (iii) nice-to-have (those functions which only a few systems are starting to exploit but for which there would be benefits to the end traveller to be able to use).

1.4.2. Stakeholder consultation

Stakeholder engagement within the study was carried out through two channels. A workshop with 100 expert participants held in Brussels on 4th November 2015 which involved dialogue between participants exploring views on three thematic areas (i) Travel data interoperability and quality; (ii) Points of access and linking of travel information services; and (iii) Terms & Conditions of re-use.

The purpose of this workshop was to discuss the findings of the study so far and explore in more detail the refined policy options and their implications, data provision business models, and liability issues and mechanisms for addressing this. It was important to identify any strong differences of view, or previously unidentified options from the diverse set of organisations present.

The content and outcomes of the workshop were documented in study deliverable D2.1 (Fell, McLean and Knowles, 2015).

An online questionnaire was developed and published on the European Commission's website on 2nd September 2015. This was originally intended to be open for responses for a twelve week period though this was subsequently extended by a further two weeks in response to requests from potential participants. Alongside the online questionnaire an offline version was available for respondents to complete and submit.

The consultation featured a common section on the use of multimodal travel information systems which was open to both citizens/travellers and stakeholder organisations to respond, in order to understand the needs and expectations of multimodal travel information. Further sections were designed to explore in technical detail the nuances of the current situation and potential policy options with experts from the latter group.

Associations representing key stakeholder groups in the information chain were approached to promote the consultation to their members. Further promotion was carried out through social media within appropriate and targeted channels.

The public consultation closed on 8th December 2015. The responses received were primarily from organisations with roles in the travel information chain or who can be considered experts in the field.

The analysis of the 165 unique responses received is documented in study deliverable D2.2 (Fell, 2016) and the overall findings of the workshop are explored within that report as a point of comparison with the results of the parallel public consultation.

1.4.3. Assessment of policy options

The third main task in the project was an assessment of policy options. These policy options were identified by the Member State Expert Group in December 2015, informed by the results of the work on the first two tasks in the project, which identified the baseline and consulted stakeholders. The assessment covered the implications of introducing four sets of policy measures: National Access Points for public and private travel and traffic data, data exchange arrangements, a quality framework and arrangements for linking services. These measures are combined into policy options with different levels of intervention and different areas of focus: 'Minimal Intervention', 'Data Focus', 'Linking Services Focus' and 'Comprehensive Approach'. In each case the assessment examined two different levels of geographic scope: the Comprehensive TEN-T network and the EU-wide transport network.

The detailed Cost Benefit Analysis and the comparison of policy options were carried out in accordance with EC guidance on impact assessment and policy evaluation. The results were summarised in a single report covering Deliverables D3 and D4 (Wedlock et al, 2016). The impact assessment covered the potential economic, social, and environmental impacts and the special impacts (such as the impact on existing markets,

fundamental rights, consumers, SMEs and innovation) associated with the policy options. The policy options were assessed against their compliance with the principles of the ITS Directive, and the budgetary implications and risks of the policy options for the key stakeholder groups were analysed.

The policy options were compared using both quantitative and qualitative results of the impact assessment to provide an overall assessment of the benefits and drawbacks of the policy options that were analysed.

1.5. This report

This report summarises the main findings of the project.

This chapter provides a description of the overall study background and provides a summary of the project methodology.

Chapter 2 provides an overview of the current provision of traveller information services in Europe.

Chapter 3 provides an overview of the potential problems to be addressed in the existing provision of MMTIPS Services in Europe including a problem tree. It also summarises the results of the stakeholder consultation. The findings of the evidence review are summarised by identifying the findings against the research questions posed at the start of the study and by describing the forecast outlook if the baseline situation continues.

Chapter 4 summarises the cost benefit analysis and impact assessment.

Chapter 5 makes a proposal for the draft operational objectives that could be adopted for the action to guide the implementation of the policy options and supporting their long term monitoring and evaluation. The objectives have been defined such that it facilitates unbiased monitoring and evaluation based on quantitative information as much as possible.

Chapter 6 outlines the conclusions and recommendations for consideration by the EC in developing the specifications for Priority Action A.

The first two appendices (Appendix A and Appendix B) provide a glossary of terms and bibliography which have been assembled throughout the study. Then Appendix C to Appendix K to provide detailed results of the investigation covering existing services, European and Member State policies, functions, data exchange, the public consultation, Cost Benefit Analysis, and organisational models to be considered to support EU-wide multimodal travel information services. Finally, Appendix L provides the management summary of the study.

2. Overview of the current situation

2.1. Provision of traveller information services

The existing travel information services identified in the study are listed in Appendix B. The relevant European and national policies and initiatives which were identified during the project are summarised in Appendix D. The expected functions of multimodal information services and their data needs are set out in Appendix E. An overview of the services provided is presented here.

Multimodal travel information services are currently available at regional/national levels in many parts of the EU. Furthermore, there are also some private pan-European services but the modal coverage is limited. In both cases, the 'door-to-door' coverage is limited. In order to provide EU-wide multimodal travel information for citizens, the continuity of services and interoperability of systems is essential.

There are technical challenges in achieving this. The travel and traffic data and back-end systems needed to provide such services present a number of challenges for system development even with a single region, yet alone for harmonisation at a European level. The coverage of public transport information services ranges from the local to the very large scale (e.g. from village bus to national or international railway systems, or world city multimodal networks). There are many different types of information (maps, place finding, stop finding, journey planning, real time progress, real time disruption, facilities, accessibility for persons with reduced mobility [PRM], retail information, etc.) that are useful and necessary. Such information relies on the outputs from many different back-end systems and processes (planning, operational and real-time), which are all subject to different economic considerations. Information services for the road transport network present similar system challenges - but have a quite different set of economic drivers, with in car navigation products, fleet management and vehicle operation considerations being important, although probe data harvested from vehicles is limited in content, scope and commercial availability. The dynamic of the private vehicle centred driving experience is also different from public transport use, without operating schedules, little pre-trip planning and increasing reliance on personal navigation devices, while the operating environment is also dynamic and reactive.

The software engines required to provide online information services incur significant operational costs and require a business model sufficient to cover this expense on a continuing basis. The data is inherently complex (since the nature of the networks, services and operational processes needed to run them are complex). Data is continuously changing (as the transport systems and transport services evolve, or even just with seasonal variations in the operation of transport, or because it is real-time data reflecting current conditions) and there may be pressing real-time deadlines for processing and propagating data in order to be useful. Further, many of the systems are distributed amongst many different stakeholders (since the systems need to be embedded in the locations where the physical networks are and where the main customer use is, these are scattered all over Europe). In the road environment, many of the operator systems are primarily focused on road network operational management and are not tailored to information service provision, with few providing direct outputs for journey planning purposes.

However, Europe has always been at the forefront of travel and traffic data and has many advanced systems, both for its rail networks (e.g. national rail systems such as Deutsch Bahn, SNCF, and Network Rail), its many world cities (e.g. Berlin, London, Paris, Turin, Stockholm, Munich, Zurich) and many local urban real time systems. Some of its major cities, especially those that have adopted data access policies such as Amsterdam, Barcelona, Copenhagen, Helsinki, London (Meeuwissen 2015), are able to demonstrate a wide range of travel information services in addition to those provided by the operator (notable examples such as Google Transit and Citymapper). As such, these data access policies have allowed significant innovation to take place at minimal risk to the operator, although there is an issue with service level expectations for such services, especially those that are available free of charge.

2.1.1. Back-end systems and data needs

It is important to recognise that different types and levels of information service require significantly different back-end feeds and systems, with significant differences in costs to deliver. For example, the delivery of a journey planning service based on the annual planned timetable requires less elaborate back-end systems and fewer computational resources than one which includes daily modifications to the timetable, let alone one which is capable of taking into account real-time vehicle progress for journeys involving immediate travel. The former needs only the periodic asynchronous (i.e. intermittent) exchange of data; the latter needs sufficient bandwidth and continuous processing capability to keep itself current at all times. Planning and operational systems will also typically need to hold additional representations (e.g. running board information) and data that simple end feeds such as Google's GTFS timetable feed do not consider, but which are useful for advanced passenger information systems. An effective strategy will target a wide coverage of the more straightforward services in order to build a useful backbone service. This can then be developed over time to have additional capabilities – as has happened across Europe in the development of regional journey planners. In addition, in the road sector, there is a need to further integrate road data and planning services.

2.1.2. System architecture options

EU-wide multimodal travel information services can be based on three system architectures, depicted in Figure 2, Figure 3 and Figure 4 below. It is not the role of the European Commission to determine which one of these architectures should be used in Europe, but rather to build a framework to support all possible scenarios with a market driven outcome determining the overall success of each. The policy specifications need to support effective implementations of these approaches:

- (1) **In a centralized or monolithic approach**, all the data - stops, routes, interchanges, journeys etc. are loaded into a single engine and queries run against it. The algorithm used to find the best possible path is able to operate within a single shared memory space and so carry out a very large number of comparisons very quickly. In a densely connected network an engine will compute a large number of possible routes for the given time of travel and then select a shortlist of the "best" for presentation to the



Figure 2 Geographic coverage provided through a monolithic planner approach

user. Ancillary information, for example messages about planned and unplanned disruptions, vehicle types, fare types, facilities etc. may be kept in a database or fetched by a data service and be used to annotate the results of the basic trip query. A monolithic engine will typically comprise a cluster of servers and might cover a region, many regions combined, or even the whole or Europe.

- (2) **In a decentralized or distributed journey planning approach**, a network of journey planners collaborate to compute journeys over a wide area; a first planner computes the

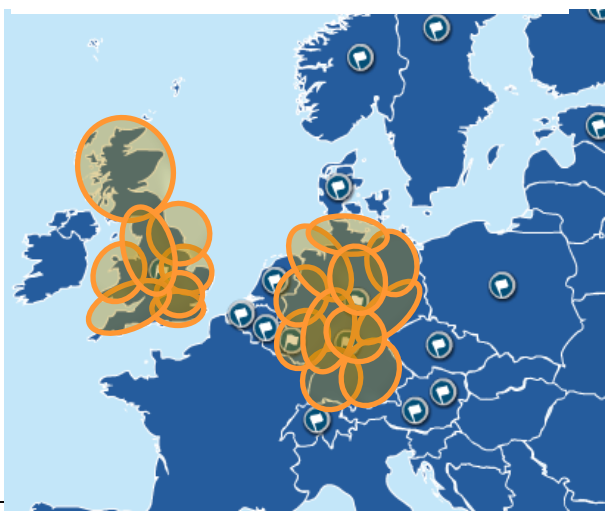


Figure 3 Geographic coverage provided by a distributed journey planning model

journeys from the origin to a number of handover points (also called handover points, transition points, exchange points or ring points) and then asks a second journey planner to compute journeys on from those handover points to the destination point. The results, as possible journey legs to and from the handover points, are combined and integrated as a whole and then ranked for presentation. In order to collaborate, the journey planners must have a shared data set of handover points, and furthermore know to which additional planner they should go for journeys covering a particular area (using a shared API). The API itself will also be more complex, requiring the sharing of some additional state about the calculations being made (e.g. the number of changes so far) in order to be at all efficient. The approach has the advantage that the full network and timetable data does not have to be shared, so each region manages and builds its own data set; further scale can be achieved flexibly just by linking to more engines. However it is slower, and requires all participants to operate to a sufficient quality of service together.

- (3) In a **chained (or 'hybrid') journey planning approach** a first journey planner allows a user to plan between trunk destinations such as stations, airports or town centres, and then provides access to a further local journey planner, able to provide a detailed routing from the trunk destination to a final destination. The access may either be transparent, querying the second planner in the background to present a composite journey, or in a more simple manifestation, explicit, by a "deep link" landing on the onward planner with relevant details such as the stop and start time already filled out (in effect guiding the user to the correct planner for an unfamiliar place). Only a limited sharing of information is needed to link up the systems in

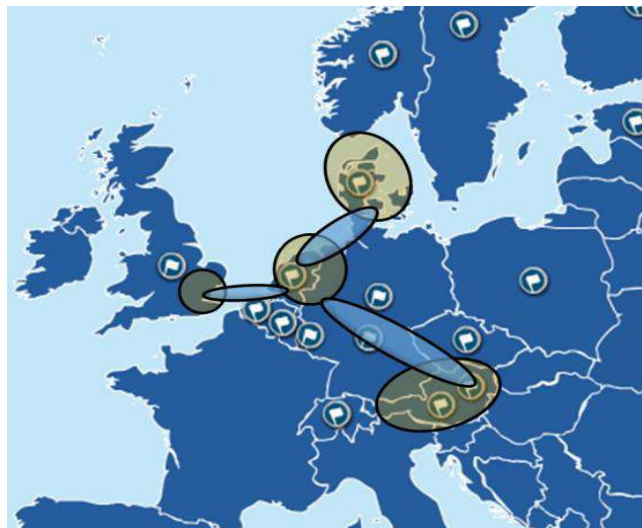


Figure 4 Geographic coverage provided through a chained/hybrid journey planning approach

this way: the first planner needs to know how to call the second planner and which local areas are covered by it, but not the timetable data for the other region. It gives only a superficial joining of the journey planning, in effect at the application or user interface level rather than in the engines, which remain distinct.

To support both the centralised or de-centralised approach (when data access is more suitable than linking services due to poor results), direct access and exchange of data can be used to support this functionality. Therefore single points of access to either locate or directly access the relevant data and interoperable data formats and exchange protocols are essential. Generally speaking, data access points can be at a regional, national or European level. There are several different types of access points, including: databases/data portals; data warehouses; data marketplaces; registers/lists. Each Member State is required to set up a national access point for access to road and traffic data for Priority Action B and a variety of approaches in different countries have been used to meet these requirements. Increasingly across Europe, more public transport operators are making their data openly accessible. In the context of public transport, the type of information stored within access points falls into three categories: i) data-related access points, i.e. raw data sources such as timetables; ii) data service-related access points providing feeds of real-time and other data, iii) application service-related access points, e.g. journey planning services. Although open access is a key enabler for multimodal travel information services, this must be accompanied by a coordinated approach to access points across transport operators. For the implementation of Priority Action A, in some cases, it may be appropriate to adopt the same national access point that has been nominated for Priority Action B; however, in other situations a new

national access point or several regional access points within a country may be a more suitable approach.

2.1.3. Availability of standards

There is a core set of standards in place to cover the minimum expected functionality: for GIS, GDF and OGC/ISO 19000 series standards relate to initiatives such as INSPIRE and TN-ITS (although there are also competing and unaligned but widely adopted standards for GIS), NeTex and SIRI for public transport - along with Transmodel as a unifying conceptual model; TAP-TSI for rail; IATA SSIM for aviation; DATEX II, RDS-TMC ALERT C and TPEG for driver-centred and road traffic information services. There are a number of gaps in specific standards that should be addressed; in other cases, new standards are available to describe data but no substantial data has yet been collected (e.g. multimodal fares). However, even with comprehensive data standards, some types of existing data are unlikely to be made available on an even footing to an open market without some regulatory mechanisms. Software tools for capturing and managing data are key enablers and policy measures which encourage existing suppliers and promote new participants, including those based on open source, are of particular importance for enabling the market.

In the second and third of the approaches described, the progressive linking of services over several years has been shown to be possible, though presenting certain performance challenges to scale. As highlighted in D1 (Fell, Knowles and Harrod Booth, 2015), the suitability of linking information services, in terms of producing good or bad routing results, is dependent upon the local context. When the linking of services provides good results this architecture is more suitable, however when the linking of services is likely to produce poor results it is more suitable to directly exchange data. There have been different examples, notably EU Spirit, JourneyWeb and Delfi. The development of a European Open Journey Planning (OJP) common standard for this (through CEN), is in its latter stages and builds on these previous national and regional standards to define a common interface. This study has identified that the future adoption of the CEN OJP standard could be a policy option for the European Commission.

A multimodal journey planning engine needs to have a reasonably complete set of good quality data for the services in its coverage area and target modes; otherwise it will fail to provide information on the optimal journeys. The ISO 21707 technical report 'ITS – integrated transport information, management and control – data quality in ITS systems' identified quality provisions that could be applicable at both a data and service level: (i) Veracity; (ii) Completeness; (iii) Timeliness; (iv) Coherence; (v) Compliance; and (vi) Data currency and versioning. A quality framework for raw data and for multimodal travel information services could be developed and implemented to provide a structure for improving the overall quality of data and services.

2.1.4. Geographic scope

Regarding the geographical scope of the specifications, from an EU-wide perspective, multimodal travel information services need to include coverage of the extended transport network to deliver an effective 'door-to-door' solution. However, if there is no available data at that granularity or no existing information service in a region, then there is value in building up a level of service on an incremental basis by covering less detailed network levels first (e.g. urban zones and the TEN-T Network).

2.2. Policy measures to support EU-wide multimodal travel information services

The above discussion indicates that in order to support EU-wide multimodal travel information services, policy measures in the following areas will be required:

- National Access Points
- Standardise data formats and exchange protocols
- Data and service quality

- Linking travel information services
- A definition of geographic scope.

The remainder of this report is structured around assessing policy options in these areas.

2.3. National Access Points

Both at a national and European level, data access policies have been introduced over recent years towards making public sector information accessible for re-use, a movement known in some quarters as 'open data' but described in this report as 'data access' to avoid confusion that such access is for free and without any terms and conditions for re-use which is how 'open data' is implied in some parts of Europe. As such the opening of access to travel and traffic data is one aspect of a wider initiative that covers a range of domains. The benefits of data access include: new uses and applications of data; allowing third parties to augment the dataset or correct erroneous data (e.g. OpenStreetMap data); and breaking down existing monopolies of use.

Access points to allow a wide range of users other than just operators to obtain static and dynamic data can potentially be provided on a European, national, regional or local level. These might take the form of common databases, data warehouses, data marketplaces or data registries. Access points add value in particular by reducing the "costs of assembly", involved in aggregating data, saving the need for a large number of suppliers and consumers of data to communicate directly with each other. The costs involved may include (a) finding out where to get data (b) getting permission to use the data (c) setting up a secure communication link to obtain the data (d) checking that scheduled data updates have indeed been provided (e) validating, pre-integration and 'deduplication' of data; (f) providing the ability to select just particular sub-sets of data.

The suitability of the form of such access point shall be determined by the local context within each Member State and will vary from Member State to Member State. It is not the role of the European Commission to prescribe which form of National Access Point (NAP) each Member State should take.

Discovery services, to find the access points to information services and the types of data, are also needed. These are relevant both for computer systems (e.g. to find servers providing a particular type of feed, as proposed by the OJP system) and for human interfaces (e.g. in web browser search engines to find a type of website such as a journey planner or stop departure board covering a particular area).

Generally speaking, access points can be at a regional, national or European level and this should be determined by the Member State according to its local context. There are several different types of access points, including:

- A **database** in common usage refers to a single organised collection of data held on a common media/set of server, i.e. the data is held within one conceptual location.
- Databases can be accessed online through a **data portal**; some data portals have multiple levels of access for different datasets, for example public access or secure login access. Example: Rejseplanen, Denmark (Woolridge 2015).
- A **data warehouse** is a joint database for sharing data between multiple authorities. Typically an organisation will maintain data for a particular region or mode and share this data with other organisations; in return they are given access to data for neighbouring regions / other modes, which are maintained by other organisations. A data warehouse is a virtually co-located set of databases; the data held in each database may be distinct and with no interconnection other than a directory service provided by the warehouse as a whole. The import services of a data warehouse will typically perform clean up and some integration services actively ensure the data set is current and will have an error resolution process in place. Examples: Ruter in Oslo, Norway (Storhaug 2015) and the National Data Warehouse (NDW) in the Netherlands.
- A **data marketplace** is a platform for connecting data providers and data consumers. This involves advertising and search functions, as well as a brokerage

function for data exchange once two interested parties are identified. This is a similar concept to an online marketplace, such as eBay. A data marketplace collects references (catalogues) to a range of services that may be accessed either in co-location or remotely.

- A **data register** is a website that centrally lists different services with links to where they can be accessed. The terminology 'register/list' has been used rather than 'registry', because 'registry' has a specific meaning in the context of ISO14817, i.e. a list of data concepts (ISO 2002). Each Member State is required to set up a national access point for access to road and traffic data for Priority Action B and a variety of approaches in different countries have been used to meet these requirements.

Increasingly across Europe, more public transport operators are making their data openly accessible. In the context of public transport, the type of information stored within access points falls into two categories: i) data-related access points, i.e. raw data sources such as timetables; and ii) service-related access points, e.g. real-time and journey planning services. Although data access is a key enabler for MMTIPS, this must be accompanied by a coordinated approach to access points across transport operators. Supposing every public transport operator made their data publicly available on their own, the number and variety of access points would be too unwieldy for most data integrators to make use of. Service access points raise questions of scalability – and in particular who will pay for a potentially uncapped level of demand.

For the implementation of Priority Action A, in some cases, it may be appropriate to adopt the same National Access Point that has been nominated for Priority Action B; however, in other situations a new National Access Point or several regional access points within a country may be a more suitable approach. In Sweden a new national single point of access for public transport is currently being set up, whereas in France a regional approach with around ten access points is the preferred option. The consensus from interviews with experts was that access points for Priority Action A should be at the national or sub-national level and that it would not be appropriate to have one European-wide access point. There are two main reasons for this: 1) the difficulty of handling such a large volume of data, which would mean that the cost involved in setting up and operating it would be prohibitive; 2) conflicts over control over data between individual stakeholders providing data and the National Access Points wishing to manage it.

However, it could be envisaged that the European Open Data Portal could list and identify the National Access Points of all Member States.

For the purposes of the analysis it has been assumed that as a minimum, each Member State will be required to establish a **Data Register**. Beyond this minimum requirement, the Member States would then decide which form of National Access Point to establish, not the European Commission.

2.4. Data formats and exchange protocols

The current data exchange protocols and formats are summarised in Appendix F, while an analysis of the existing formats and exchange protocols against data needs is summarised in Appendix G. This section provides an overview of the findings.

For the context of this study and the gap analysis of data formats and interfaces, it is useful and important to note that across Europe there is a considerable variation in the existence of data between modes and in the policies on accessibility. The standards in use are summarised in Figure 5 below.

The key existing standards are GDF and OGC/ ISO 19000 for GIS data, NeTEx, SIRI, SSIM, for data on public transport (with Transmodel as an underlying conceptual standard), DATEX II for road, and RDS-TMC ALERT C and TPEG for driver-centred road traffic information services (with UTM in the UK and OCIT/ OCA in Germany). TAP/TSI is also relevant as an industry format that can be interoperable and that provides rail requirements but in the long term might be better replaced by a subset of NeTEx Part 3. Of these standards, Transmodel is especially important as a unifying design standard

that makes it possible to align different legacy and current data sets and standards. It is worth highlighting that there is currently a gap in the level of maturity and adoption of the NeTEx standard, especially as regards to fares, which is key in providing the breadth of coverage needed. Currently few data providers and system suppliers have adopted NeTEx standards, which would play a key role in exchanging data between service providers to support EU-wide multimodal journey planning.

For the road sector, although strong and prevalent standards exist in the “traffic information/data” arena, notably DATEX II, and TPEG as the most modern exchange formats in use, there continues, as for the public transport sector, to be an insufficient regulatory framework that promotes these standards as the mechanism for exposing road operator and service provider data in a shared common manner. To create ubiquitous access to common traffic data, there needs to be regulation to enforce use of a formally recognised standard, with DATEX II as the first choice. The Commission Delegated Regulation 2015/962 (Priority Action B) demands availability of traffic data (defined sets of both static and dynamic traffic data) “in DATEX II (CEN/TS 16157 and subsequently upgraded versions) format or any machine-readable format fully compatible and interoperable with DATEX II”. However there needs to be confirmation that these defined data types meet the needs of a MMTIS journey planner and that the geographic coverage meets the required need.

For the air sector, SSIM provides a standard format for static airline data with different bespoke APIs provided through international data aggregators for non-airlines⁶ to access data (subject to fees).

Therefore, for multimodal travel information services, the gap that needs to be filled with new standardisation requirements involves covering other scheduled modes (public long distance coach, ferry etc.), while NeTEx for static data and SIRI for real-time data have been identified as the preferred standards at an EU level.

⁶ PADIS EDIFACT provides a rich data format for sharing a wide range of passenger and operational data between airlines but it is designed to be used within the airline and travel industry, rather than for sharing data with MMTIPS providers

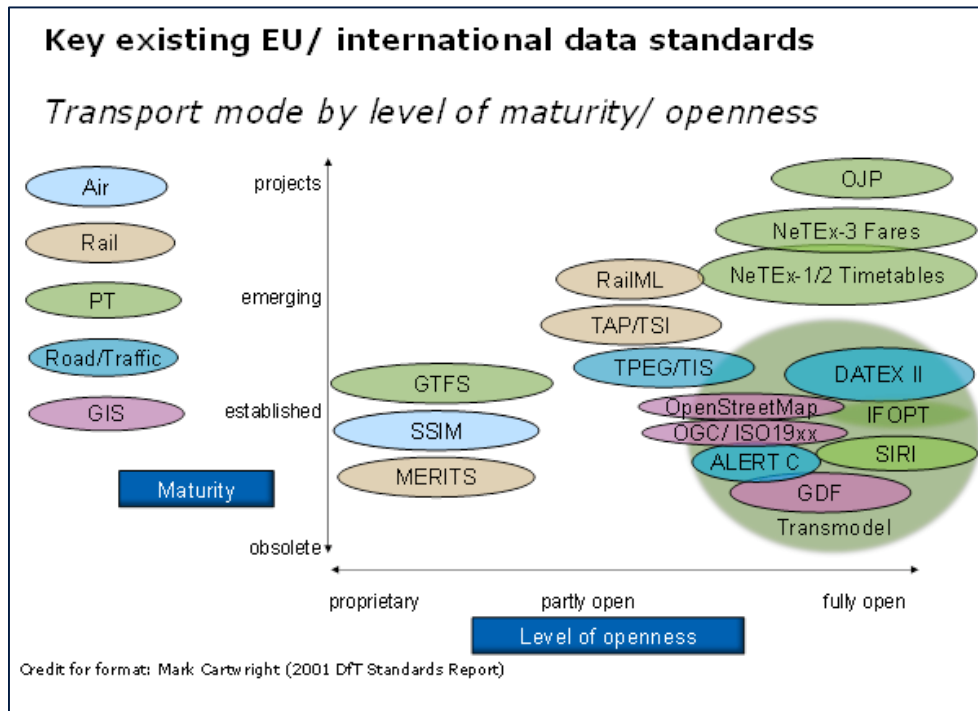


Figure 5 European and national data standards relevant to multimodal travel information

As an overview, it is useful to provide some categorisation of Member States in their level of sophistication in addressing the provision of data through policy. The three categories identified used are: (i) leaders, (ii) followers and (iii) future followers.

- **Leaders:** These Member States are more advanced in their implementation of MMTIPS, data availability and adoption of standards. This group includes Austria, Denmark, France, Germany, Netherlands, Sweden and UK; these Member States have developed predominantly national standards which conform to existing EC standardisation initiatives (PSI Initiative, INSPIRE, TAP-TSI, RTTI etc.), and some already operate national or regional access points.
- **Followers:** These Member States have either a lower level of adoption or an existing policy objective to enhance the availability of data and MMTIPS services: Belgium, Hungary, Slovakia, Slovenia and Spain.
- **Future followers:** These do not currently have national approaches to the use of standards or provision of data, with few, if any, MMTIPS in place beyond city level: Greece, Italy, Malta, Poland and Portugal.
- **Others:** Insufficient information was available from sources and experts on the status in Croatia, Cyprus, Estonia, Latvia, Lithuania, Luxembourg and Romania.

A gap analysis of data formats and interfaces was carried out. The gaps identified were categorised under three headings:

- **Lack of infrastructure data:** For example, not all Member States have full sets of bus stop data or the workflows in place to gather or maintain them. It typically takes several years to gather and cleanse such a dataset and even once collected, some coordination effort is needed to maintain it.
- **Lack of real-time data** including incomplete coverage in deployed systems generating the raw data (e.g. bus AVMS systems, road monitoring systems).
- **Lack of static data**, which includes issues such as:
 - **Lack of cost effective data collection tools for smaller operators:** The biggest gap in the existence of data on public transport for delivering the minimum expected level of system functionality is in sourcing bus and coach data for small and medium sized operators. Currently this can only

be addressed through cities/local authorities preparing data on their behalf to ensure completeness.

- **High labour costs associated with data collection:** Electronic codification of data is not a simple or quick task, especially in environments where it does not already exist or where there is a fast-changing transport network. These ongoing revenue costs make it difficult for all operators/cities to undertake the task.

The policy specifications should reflect the need to raise the overall minimum standards on data availability and quality. Moving away from national standards would aid in reducing barriers to entry, especially for systems intended for cross border situations, but also in general because it would open up a pan-European market for software tools to support data management; it is the availability of these tools at a reasonable price that is the fundamental enabler for travel and traffic data exchange.

European legislation has focused on opening up datasets developed or owned by the public sector. This is a significant enabler to the provision of MMTIPS by third parties (Deloitte Belgium 2011). However, core travel and traffic datasets are owned by private sector (or publicly owned) companies across many Member States, resulting in an incomplete availability of data. It will be important for the specifications to include data in the private.

Many Member States have also rightly focussed on improving the availability of data for traditional public and private modes. Emerging transport modes which are characterised as being demand based in nature or part of the 'sharing economy' are not yet well supported or considered. Taking account of these modes within the specifications is therefore important.

The policy options that were taken forward for the detailed Cost Benefit Analysis were:

- Any static public and private travel and traffic data in National Access Points (NAPs) shall be in a machine readable format – other legislation with relevant standardisation requirements/industry activities shall apply (TAP TSI, INSPIRE, RTTI and IATA)
- Any static and dynamic public and private travel and traffic data in NAPs shall be in a machine readable format – other legislation with relevant standardisation requirements/industry activities shall apply
- Any static public and private travel and traffic or transport data in NAPs shall be in NeTeX and IFOPT, any dynamic public and private travel and traffic data in NAP shall be in SIRI (exceptions for SMEs) - other legislation with relevant standardisation requirements/industry activities shall apply.

2.5. Data and service quality

To ensure a given minimum standard of data quality, a quality framework would be required. The definition of this framework depends on the data quality issues involved in providing multimodal traveller information services.

There are a further three specific issues identified which the policy specifications should seek to overcome:

- Lack of availability of validation tools for checking data quality which could be addressed through the provision of open-source software tools.
- Lack of enforcement measures to ensure data quality is upheld. Currently the end users of travel information services decide if they can sufficiently rely on information given or not. Potential policy measures to address this might include Member State level enforcement of accurate data from sources and/or a form of labelling scheme for services which could operate at a European or national level.
- Lack of defined processes for data correction which will be an increasing factor as a wider number of services reuse data for different purposes. To ensure the least impact on quality of service it is important that the data can be corrected at source and in a prompt fashion. This needs to be considered within the

specifications, particularly as part of a quality checking framework and also within common terms and conditions for data reuse.

The policy options that were taken forward for the detailed Cost Benefit Analysis were:

- Recommend basic elements - recommend that service providers must be transparent in the way travel options are ranked and neutral in the way information is provided to the user (i.e. why one travel option is ranked higher than another – non-biased display of travel information); data is up-to-date and changes are updated in a timely manner and the metadata in the NAP must define the level of data quality available.
- Mandate basic elements – require MMTIPS providers to be transparent in the way travel options are ranked and neutral in the way information is provided to the user (i.e. why one travel option is ranked higher than another – non-biased display of travel information); data is up-to-date, changes are updated in a timely manner and the metadata in the NAP must define the level of data quality available.
- Mandate detailed elements - require MMTIPS providers to be transparent in the way travel options are ranked and neutral in the way information is provided to the user and for data owners and service providers to put checks in place to ensure that information is accurate, complete, updated within a specified time period and the metadata in the NAP must define the level of data quality available.

2.6. Linking travel information services

A review of arrangements for linking travel information services is presented in Appendix H. This section provides an overview.

There are differing views on the approach to linking travel information systems and the optimal architecture. Distributed journey planning has been shown to be successful over several years through implementations such as JourneyWeb and Delfi, and EU-SPIRIT (the latter coming closer to a chained/hybrid approach), but subject to certain constraints on performance. The CEN OJP work is building on this experience to create a common European specification.

Criticisms of distributed journey planners tend to focus on the robustness of the approach (in terms of volume of queries it can handle without impact on performance) and slower speed of response of such systems. The proponents of the architecture will rightly argue that it ensures ownership and control of data remains close to the source which ensures better quality. Nonetheless achieving adequate performance for a reasonable cost remains a serious consideration.

Enabling chained journey planners would give good results (and be cost effective) for the straightforward use case of adding a final leg to plane or long distance train journeys. It is likely to give poorer results for trip planning between adjacent regions with richly linked networks – where either distributed or monolithic journey planning is a more suitable approach.

Potential policy options include:

- Encouraging the 'opening' of delivery systems though specifications need to consider how this would work for both public and private bodies
- Adopting the CEN OJP standard for purposes of distributed journey planning
- Completing gaps in geographic and modal coverage of systems across Europe
- Promoting the use of chained/hybrid journey planners with appropriate simple interfaces.

The policy options that were taken forward for the detailed Cost Benefit Analysis were:

- No requirements for services to be linked but a recommendation for CEN Open API standards to be used

- Demand based obligation for services to link with CEN Open API standard recommended
- Mandatory for all services to link with CEN Open API standard mandated.

2.7. Geographic coverage

An important variable in the definition of specifications is the geographic extent to which data requirements should apply. The scope of policies need to be sufficient to have a useful benefit to enable wider MMTIPS services but also need to be finely balanced so they do not specify overly costly and difficult requirements that are unrealistic. Careful selection of the geographic scope from the three approaches outlined below is therefore essential.

- **Core network** - only provides trunk modal information. For the majority of cross border journeys this might be reasonably sufficient. However, from the perspective of being used as a variable in the definition of policies it is probably insufficient to be of significant benefit to promoting the uptake of further MMTIPS services. From a multimodal perspective the core network would include limited but key non-local waterborne, rail, road, coach and air services.
- **Comprehensive network** - provides a good level of coverage for the majority of users, assuming that major urban centres have been well defined and included at a local level. This includes a wider range of waterborne, rail, road, coach and air services as well as metro, tram and urban bus services. In practice this is the most useful foundation for information provision which can then be built upon, but the user expectation will more closely align this level of detail with that of a single-mode service providing responses for 'station-to-station' type queries.
- **Extended transport network** - provides the coverage which allows for 'door-to-door' journey planning. This level of data is required for providing detail such as walking legs; local bus services; and full road journeys. A number of previous studies have shown that user expectation on multimodal journey planners is that this level of coverage is provided as a minimum (AECOM 2010; Everson 2015; Tempier, Rapp, et al 2011). However through the linking of existing systems which provide this coverage, it need not be a requirement that the full set of underlying data is also made available.

The criteria for selecting the appropriate geographic scope need to be based on who the end-user need is and what is a realistic and achievable target to deliver.

From an EU-wide perspective, a multimodal journey planning system in practice needs the extended transport network to deliver an effective 'door-to-door' solution, but if there is no available data at that granularity or no existing information service, then there is value in building up a level of service on a phased basis by covering the less detailed networks first. Therefore policy options may be best aligned with an incremental approach to implementation to ensure a minimum expected level of service across the EU which improves over time.

For the purposes of the analysis in the detailed Cost Benefit Analysis the following geographic scopes were taken forward:

- Comprehensive TEN-T Network
- EU-wide or extended transport network.

2.8. Functional scope

From a policy point of view, the prioritisation of different types of static data (stops, timetables, real-time, fares, accessibility, etc.) will largely need to reflect the logical order of the dependencies between data types. Thus for example, stops are needed for timetable, timetables are needed in order to provide real-time, etc. In the long term all types of data are desirable. A particular question however is the extent to which fare data should be included in the initial scope of the data to be aggregated at National Access Points. While desirable from a point of view of encouraging applications that help market transparency and multimodal comparison, in reality the provision of fare data is

not as well advanced as for other forms of data, such as say timetable data, and consequently will involve higher costs to collect and to systemise. A realistic compromise might be to prioritise certain components of fare data, such as standard fares (and the classes of user) together with certain usage information about distribution, but to make a fuller coverage (e.g. for special fares and complex products) a future goal.

A second policy question is the priority to which accessibility data should be given. While highly desirable for certain categories of user (and a legal requirement in some countries), the provision of detailed accessibility data is a more expensive and ambitious requirement and it is important to ensure that more fundamental requirements (such as basic stop and time-table data) are met first.

As far as real-time data is concerned, SIRI in fact covers a number of different types of service (stop departures, vehicle movements, incidents messages, connections, timetable changes, etc.). In effect two of these are more fundamental than the others; the Stop monitoring service is fundamental for real-time departure information, and the Situation Exchange service valuable for providing information about planned and unplanned disruptions.

3. Current issues, opportunities and outcome of the consultation

3.1. Issues and gaps in current provision

A 'Problem Tree' was defined at the outset and then further developed during the study as further issues were identified. This section discusses the issues and gaps and summarises them graphically in the updated Problem Tree in Figure 6 on page 52.

The review of existing common data formats for providing data in a raw electronic form highlighted certain gaps in coverage; the exploration of data quality issues identified a range of different quality criteria that are important to ensuring credible and reliable MMTIPS. The review identified what the preferable existing common standards are that the specification could adopt and the enabling measures to overcome gaps and weaknesses (e.g. low current adoption rate of NeTEx).

The study also looked at different approaches to providing access to data through a range of access point types (at city, regional, national and multi-national level) such as registries, data warehouses and data marketplaces. Alongside this the leading API standards for linking systems were examined, together with the different background approaches (i.e. 'linked' only or decentralised journey planning) and comparing this to the traditional monolithic engine model.

The three potential levels of geographic coverage that could be supported by new policies were examined, from both the perspective of user needs and also what would be a logical phased approach to improving the overall standard of data availability for the whole of the EU.

Finally the current European policy framework and national Member State uptake of standards and supporting policies was reviewed. This showed that there is a multi-speed level of uptake of policies and standards with the north western Europe region and Scandinavia broadly leading the way.

It is clear from this range of issues that the data integration challenges are significant given the range of multi-dimensional aspects of the problem: geographic coverage; modal complexity; existing standards uptake; missing or 'under-development' standards; lack of supporting business models; cost and technical challenges.

3.1.1. Data quality

Six main types of data quality issue were identified:

- **Lack of completeness** where the dataset does not contain all the expected information, e.g. not 100% of all public transport services are present, or certain types of data are available.
- **Lack of veracity** where the information does not reflect the 'true' situation, i.e. where a measurement is not close to the true value. Related to this is the **lack of precision** where data on locations or timings are not sufficiently detailed to provide useful information, e.g. possibly through missing some key operational insight such as details of cancelled services.
- **Lack of timeliness of update** where there is insufficient time between revised data becoming refreshed and the changed event occurring for systems to include those changes. For example, in the UK bus services must be registered 56 days⁷ in advance which helps ensure data on those services can be updated in MMTIPS in time for a reasonable future window of enquiry (e.g. what time does the bus leave on Tuesday in two weeks' time). This also covers the issue of **Latency** – the delay between the message being sent and picked up [not really relevant to timetables, but possibly is for real-time data].

⁷ <https://www.gov.uk/run-local-bus-service/how-to-register>

- **Lack of data currency and versioning** where a system may not be using the latest available data and is therefore at risk of misrepresenting the 'true' situation. This may be a result of not processing the latest available data or through lack of versioning of data components within the information chain such that it is not possible to tell that incorrect data has been used.
- **Lack of coherence**, i.e. that the data is not compatible and self-consistent, with identity (e.g. a set of summer timetables and stops that are operated in the winter).
- **Lack of compliance**, i.e. that the data does not match the rules of the format (e.g. a data format may specify a 36 hour clock and the data incorrectly uses a 48 hour clock).

A further three specific issues were identified which the policy specifications should seek to overcome:

- **Lack of availability of validation tools for checking data quality** which could be addressed through the provision of open-source software tools.
- **Lack of enforcement measures** to ensure data quality is upheld. Currently the end users of travel information services decide if they can sufficiently rely on information given or not. Potential policy measures to address this might include Member State level enforcement of accurate data from sources and/or a form of labelling scheme for services which could operate at a European or national level.
- **Lack of defined processes for data correction** which will be an increasing factor as a wider number of services reuse data for different purposes. To ensure the least impact on quality of service it is important that the data can be corrected at source and in a prompt fashion. This needs to be considered within the specifications, particularly as part of a quality checking framework and also within common terms and conditions for data reuse.

3.1.2. Availability of data

Across Europe there is a considerable variation in the existence of data between modes and in the policies on availability. These gaps have been categorised under three headings:

- **Lack of infrastructure data:** For example, not all Member States have full sets of bus stop data or the workflows in place to gather or maintain them. It typically takes several years to gather and cleanse such a dataset and even once collected, some coordination effort is needed to maintain it.
- **Lack of real-time data** including incomplete coverage in deployed systems generating the raw data (e.g. bus AVMS systems, road monitoring systems).
- **Lack of static data**, which includes issues such as:
 - **Lack of cost effective data collection tools for smaller operators:** The biggest gap in the existence of data on public transport for delivering the minimum expected level of system functionality is in sourcing bus and coach data for small and medium sized operators. Currently this can only be addressed through cities/local authorities preparing data on their behalf to ensure completeness.
 - **High labour costs associated with data collection:** Electronic codification of data is not a simple or quick task, especially in environments where already exists or where there is a fast-changing transport network. These ongoing revenue costs make it difficult for all operators/cities to undertake the task.

3.1.3. Access to data

There are a number of different approaches which can be taken to provide consistent access to data, but currently only a small number of Member States or cities are doing this. Issues include:

- **Divergent rules for accessing data across Member States (public and private sectors)**
- **Limited access to data in the desired form (raw vs. processed):** For example, data for public transport modes typically exists for large conurbations and cities at least in those countries with well-developed MMTIPS systems, but is not necessarily available in a suitable format to other parties unless data access policies have been adopted. For many services, though not all, it is simpler to take a set of data that has already been processed into a common format rather than taking numerous raw feeds from many sources which require aggregation and a higher level of data quality checking. There is also the issue of availability and suitability of road data – there is a need for confirmation that the defined data types specified for Priority Action B meet the needs of a MMTIS journey planner and that the geographic coverage meets the requirement
- **High costs of data aggregation:** The study identified examples of actual data aggregation costs which increase in line with geographic and modal scope. An approach to reducing these costs which can be considered in the specifications is to require high quality data, prepared in common formats with common referencing at source.
- **Costs of scaling up server capacity and resilience to respond to levels of demand:** Providing APIs to sources of dynamic data (e.g. SIRI real time feeds) or existing travel information services requires a supporting business model to cover the costs of the additional server capacity, bandwidth and security associated with servicing the demand from third parties. As a result some existing services such as Traveline Information Ltd in the UK charge those third parties an appropriate share of the additional operating costs. Such an approach could be considered within the specifications regarding common terms and conditions for data access. A further risk is estimating future demand and ensuring the service will be resilient at times when there is additional demand (e.g. extreme weather disruption to transport).
- **Commercial confidentiality over certain data (e.g. seat availability):** In those sectors where ticket pricing is connected to yield management (mainly trunk route modes) there is a stated concern that they would be placed at a commercial disadvantage by releasing data on space availability.
- **Significant variations between Member States in roles of public and private bodies in information chain:** The variations in public and private sector ownership between Member States is significant and not just with operators as several of the national travel information service providers are private or public-private partnerships. Further to this, some sectors such as bus and rail perceive a difference between publicly subsidised operations and solely commercially operated routes. Therefore existing European and national legislation which requires travel and traffic data to be released has varying levels of impact dependent on each Member State.

3.1.4. Terms and conditions of re-use

Inconsistent and unclear conditions for reuse of different forms of data results in a situation where a significant amount of resource is required to navigate the potential risks associated with using a disparate range of source data, thus deterring investment by business. Areas of particular note include liability and privacy issues.

- **Current arrangements do not ensure fair and equal access to data**
 - **The lack of transparency on service quality levels** causes uncertainty in data being able to provide a reliable service. For example, if source servers providing dynamic data are suddenly unavailable for a period of time for unannounced system maintenance, then that will impact on all downstream services.

Another example is with rail real-time data which exists in many Member States but policies vary as to availability to other parties. Even if some data is accessible (which is not uniformly the case), there may be an unwillingness to supply data of as high a quality as that available to the rail operators' own

systems (relating to the previously mentioned 'veracity' issue). Also, data on standard main-line rail fares (i.e. TAP/TSI B1) mostly exists but is not necessarily widely available to non-operators; this is further complicated by rail operators moving more towards yield managed fares as in the economy airline industry (thus moving from static to dynamic data).

- **Costs of opening access** for the data provider or an existing travel information service provider can be significant. Providers will need to modify their systems to support a common API standard (or a bespoke API), and may need to add extra levels of security to protect themselves from hacking and denial of service attacks. To ensure compliance with a common standard this may require work to the underlying data structures which will be a further cost. In addition to this there will be the aforementioned hosting costs. Even if third party demand is low it will likely require a higher level of system security to reduce the scope for external disruption.
- **Difficulties in ensuring that data is used for providing non-discriminatory information:** The original sources of many forms of data are the original transport operator (whether that is a bus operator or car parking provider etc.). Those operators will be naturally inclined to promote their services above those of competing services but increasingly recognise the benefits of data on their services being available as part of independent non-discriminatory services. A risk however is that some services may wish to include a wider range of modes but prioritise certain responses in the results. This may dissuade the original sources from making their data available. Experts interviewed in France stated that major concerns were raised during debates on new open public data laws, about the potential of dominant international companies to use data access arrangements for travel and traffic data in this way.
- **Lack of confidence on the expected continuity of service:** Associated with lack of transparency on service levels it is difficult to invest in systems which will make use of particular data feeds if there is no certainty that those data feeds will remain available for the long term.
- **Non-compatible licensing regimes for data reuse.** Data may come with terms that prevent it from being used by third parties in ways that would be useful to the encouragement of new MMTIPS. For example, terms which do not allow for the data to be changed in any way (which would prevent corrections to data by a third party) or claiming intellectual property rights on any downstream data derived from the source data. Some Member States have sought to reduce the impact of this by establishing legal entities which manage contracts with the numerous data sources and then provide common licenses for third party use – for example "Trusted Third Party" in Austria and Rejseplanen in Denmark.

An important consideration for the policy specifications is the issue of protection of any **personal data** involved in delivering or using MMTIPS.

There are two identified areas where personal user data may be collected by systems:

1. Personal mobile phone or vehicle movement data can be recorded to help build datasets on population movement and congestion traffic speeds for systems. It is essential that this data is anonymised when used by MMTIPS, particularly in any derived data feeds provided to third parties.
2. Retaining records on journeys requested or undertaken by a system user, or even journey preferences or source IP addresses. It is important that this data is held anonymously or securely and should not be made available to third parties in any derived data feeds unless it is anonymised.

An important consideration is where personal data is held. It is becoming the norm for personal information to now be held locally within a phone app, transport service provider or telecoms service provider rather than on an MMTIPS provider's server.

The specifications need to ensure compliance with the EU's Data Protection Directive such that personal data can only be gathered legally under strict conditions and for a legitimate purpose. Furthermore, persons or organisations which collect and manage personal information must protect it from misuse and must respect certain rights of the data owners which are guaranteed by EU law. This should ensure there is no conflict between different data protection legislation between Member States and also covers specific rules for the transfer of personal data beyond the EU when it is exported abroad.

3.1.5. Interoperability

Gap analysis was used to compare the functional requirements identified at the start of the project against the set of existing data formats and interfaces. This process identified certain 'missing' data elements not covered in current (or imminent) standards.

- **Data formats and exchange protocols are not fully interoperable:**
 - **Existing data formats do not give full coverage of data needs:** D1 (Fell, Knowles and Harrod Booth, 2015) showed that the current coverage of data formats and standards to support the exchange of the necessary data for MMTIPS is well advanced. However the analysis identified the following gaps that are only currently covered by non-standard bespoke formats:
 - Car and/or bike sharing fares (which would best fit as an addition to NeTEX)
 - Public transport network control data (which would best fit as an addition to SIRI)
 - Car sharing and bike sharing availability
 - A common standard for querying carpooling systems.

It should also be noted that there is no direct alignment or interoperability between the data model concepts in the public transport arena (particularly Transmodel) and the 'roads' arena (DATEX II). This impacts the ease, efficiency, and systematic transformation of relating events and status conditions in one arena to the other, or vice versa. Also DATEX II (a centre-to-centre operator oriented protocol) and TPEG (an end-user information distribution oriented protocol) are not compatible/ interoperable; this is important for efficiently and systematically distributing road traffic information from multiple DATEX II sources and also to apply traffic conditions from 'road' data to other users of that network e.g. buses. Although Transmodel does provide a conceptual framework (Link Projection) for reconciling different transport layers and location systems (as say road and bus route network links) integrating such networks takes significant effort. The SIRI-SX Situation Exchange format establishes a mapping between DATEX, TPEG and public transport incident messages for use in back office systems. Further steps should be taken to encourage development of defined mappings between the Transmodel and DATEX II data concepts and similarly between DATEX II and TPEG.

Merging GIS data from different sources (OSM/NavTEQ etc.) is an issue as there may be small gaps in the networks, or different representations of transport network features, which do not reflect the actual situation or do not support common representation of the same feature between different map sources. An example of this would also be the many different sources of walking and cycling route data which, through lack of alignment, can lead to gaps in any 'merged' network from a systems perspective. The most viable solution to this, which could be considered by the specifications, is likely to be crowdsourced data for a full European network – perhaps using an existing platform such as Open Street Map. Alternatively an extension of INSPIRE compliant mapping to fully cover cycling and pedestrian routes may be more consistent with other EC policies. The previous mentioned approach of

improving the adoption of NeTeX which is designed to overcome these issues would also be a positive step.

As mentioned in Section 3.1, the traffic information/data provision landscape does not use a singular map representation, and a variety of different reference map databases are in common usage. This variation undermines the simple interoperability of data.

Conversely, as well as gaps there are also areas of overlap amongst those standards which might be considered the key common formats e.g. NeTeX and TAP/TSI both provide for rail schedules and fares.

- **Lack of adoption by suppliers and data providers of common data formats:** The key existing standards are GDF, OGC/ISO19000, NeTeX, SIRI, SSIM, Transmodel, DATEX II and TPEG. TAP/TSI as an industry format that can be interoperated with and that provides rail fare requirements but in the long term could be better replaced by a subset of NeTeX Part 3. However, since NeTeX is a relatively recent development, there is a current gap in the level of maturity and adoption of it which is key to providing the breadth of coverage needed. This lack of adoption by data providers and system suppliers needs to be addressed through specification recommendations provided by this study.

As with NeTeX, although strong and prevalent standards exist in the "traffic information/data" arena, notably DATEX II and TPEG as the most modern exchange formats in use, there continues to be an insufficient regulatory framework that promotes these standards as the mechanism for exposing road operator and service provider data in a shared common manner. To create ubiquitous access to common traffic data use of a formally recognised standard is needed; the delegated regulation for Priority Action B demands availability of traffic data in DATEX II or any machine-readable format compatible and interoperable with DATEX II, However there needs to be confirmation that these defined data types meet the needs of a MMTIS journey planner and that the geographic coverage meets the requirement.

It is likely that formal approval of these standards by the EC in the form of inclusion within the policy specifications would provide the assurance needed by data suppliers and system suppliers to invest in supporting them

It should also be noted that there is no direct alignment between the data sets used in the public transport field (particularly Transmodel/NeTeX) and the 'roads' field (DATEX II), although in principle the Transmodel model does include data model concepts for integrating different layers of points and links (i.e. the 'directed graph' representation used in computers for both road and public transport networks) even if represented in different locating systems. The main consequence of this is it is complex to relate road-real time data to road based public services. Also DATEX II and TPEG are not compatible/interoperable.

- **Proper interfaces between travel information services are missing** as up until now there have been no common European standards.
 - **European CEN standards for distributed journey planning still at developmental phase:** Once the CEN OJP technical standard is finalised (*expected: early 2016*) it will need to be piloted ahead of wider promotion as the recommended standard for Distributed Journey Planning. Until that point it remains a 'gap'; however it should address the majority of issues which, prior to its development, existed. The significant exclusion to that standard, for which there is no current or prospective API, is one which supports the returning of multimodal ancillary fare information, (e.g. types of product etc.) – this will need to be given due consideration in the policy specifications.
 - **Lack of common referencing on interchange points:** To enable the linking of existing travel information services (using either a decentralised or

chained/hybrid journey planning approach) it is essential that exchange point locations where journeys are matched (e.g. trunk termini rail stations) use common references. Otherwise complete journeys cannot be generated (without risk of some nonsensical journey legs).

- **Regularity of review and refinement of common data standards is insufficient:** Concerns were raised by experts involved in standardisation activities that the current timetable for reviewing and revising data standards though CEN is probably insufficient given the pace of change within the transport sector. As a result they advise it would not be appropriate to mandate the use of common standards as without flexibility this is likely to cause issues.

Another gap is the lack of a European level 'discovery site' which organises existing MMTIPS by area and function, which presents examples of existing journey planners, into a public tool for providing a master index of different services. This would ideally include the necessary information required by each system for other MMTIPS to link to them via the 'chained journey planning' model.

3.2. Opportunities

The research identified a number of enabling opportunities which could be used to address the barriers and issues identified with data integration for enabling MMTIPS. These include:

- Providing clear guidance as to which are the designated standard common data formats that may be safely invested in by MMTIPS data providers and data management suppliers.
- Ensuring a uniform system of identifiers for stops, operators, journeys etc. across Europe – for example by establishing national profiles for the use of designated CEN standards in each national context so as to fit in with existing national systems and legacy data sets.
- Encouraging greater adoption of data access policies as well as promoting the transport-related elements of the PSI Directive to ensure greater adoption.
- Open processes to evolve and enhance standards to accommodate technical change.
- Providing open source components to build tools for data management, compliance and quality validation. Internationally, such tools are beginning to emerge⁸ but it is not yet clear if they fulfil the demands of the European transport system.
- Establishing a data quality framework through guidance materials which covers: (i) Veracity (truthfulness); (ii) Completeness; (iii) Timeliness; (iv) Coherence; (v) Compliance; and (vi) Data currency and versioning.
- Sponsoring the development of automatic validation tools and services that can be used to verify and 'kite-mark' products and their output as conforming to the designated standards. These can also be used as trouble shooting tools to regression-test new versions and to resolve specific issues.
- Providing clear guidance on what are the designated standard service APIs.
- Conducting pilots of the 'under development' CEN OJP Technical Specification between adjacent Member States.
- Building on the foundations provided by the national access points being established to support Priority Action B RTTI – evolution not reinvention.
- Developing standardised legal terms and conditions for travel and traffic data use and for the information provided by MMTIPS, including liability.

⁸ <https://github.com/luqmaan/awesome-transit> contains a range of open source tools supporting GTFS data creation and use

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- Training and education activities to ensure common understanding in the information chain of the appropriate approaches to data integration.
 - Regularly review and publish status which would give a status report of MMTIPS activity against a range of indicators which is published at a European level highlight best and worst performing Member States.
 - Crowdsourcing of data (enabled through open-tools and their promotion) to complete gaps in the network (e.g. bus stop locations; cycle and walking paths; PRM data for interchanges etc.).
 - Encouraging the demand-driven progress in the introduction of MMTIPS alongside the supply driven, top-down approach through investment in business incubators/accelerators to help launch innovative SMEs (small and medium sized enterprises) and start-ups.
 - Provide clear guidance on the roads-related data that is required to support the road based MMTIS journey planning services.

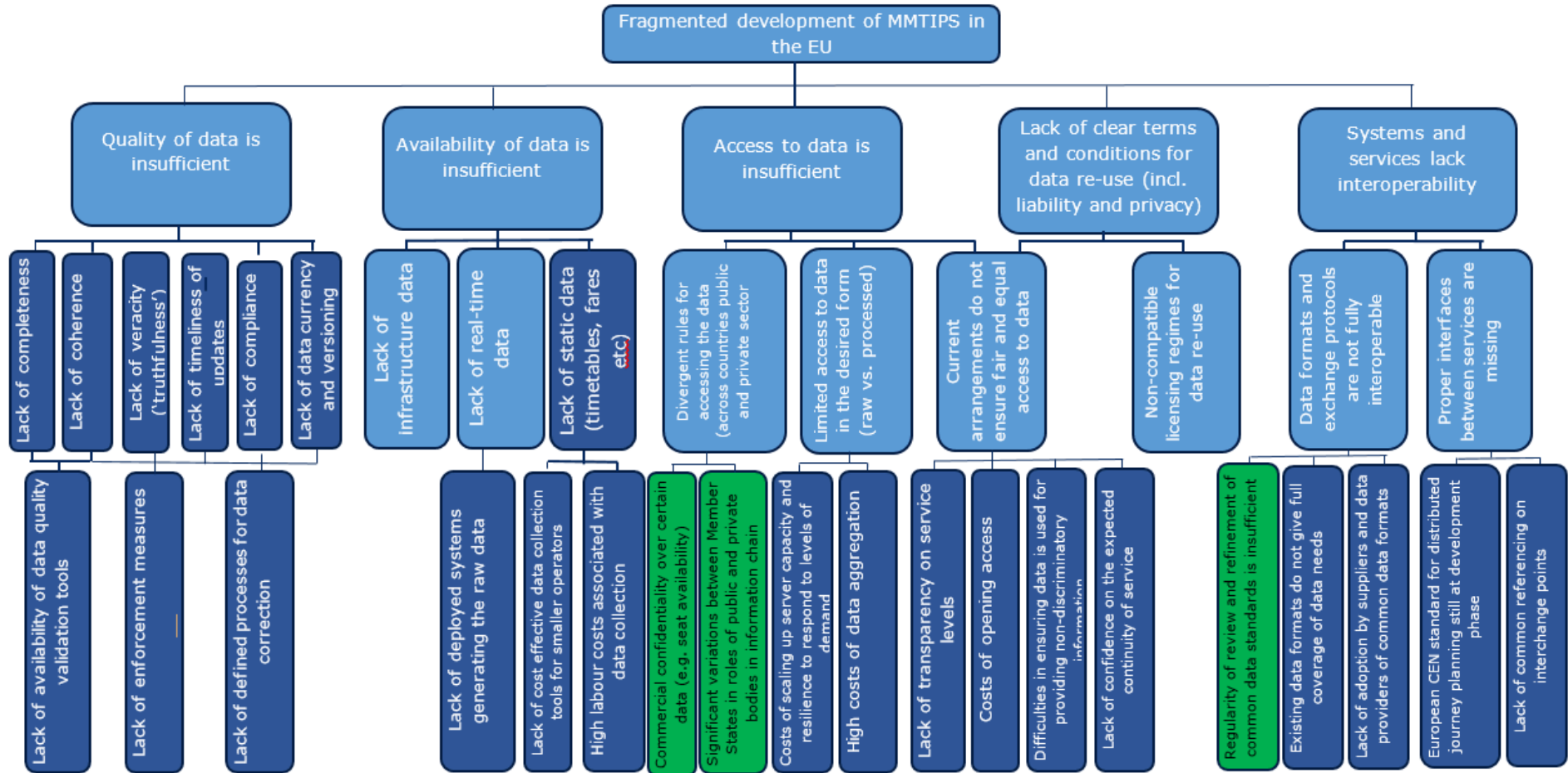


Figure 6 Updated MMTIPS Problem Tree (light blue: identified at start; dark blue: identified in evidence review; green: identified in consultation)

3.3. Outcome of the stakeholder consultation

The methodology adopted for the stakeholder consultation was summarised in Section 1.4.2.

The majority of respondents (two-thirds) do not feel that existing services provide sufficient geographic or multimodal coverage for their travel information needs. Travel information for cross-border and within other EU countries is particularly difficult due to availability and access to appropriate services – this may be a result of awareness of local services or lack of multi-lingual services.

Travellers predominantly seek information through online channels. This is from a mix of operator and independent sources. The former is currently more popular but not substantially so – it could be envisaged that this will change in the favour of independent sources in the coming years as the pace of innovation and technology further develops.

There is a high level of willingness to change modes amongst respondents if a greater level of multimodality was included within travel information services for comparison. These also include low-carbon modes such as cycling, rail and public transport.

Broadly, the views of various stakeholders and Member States on current barriers and potential enablers were aligned, with variation based on the approach to intervention rather than objections to it. However, the sector with consistent views against possible forms of intervention was the rail industry, with a desired preference for retaining the current status quo.

The key points from the consultation relevant to the policy measures considered are summarised below. The detailed results of the consultation are presented in Appendix I.

3.3.1. National Access Points

There is a need for access to data and the provision of National Access Points would be a useful tool to enable this. Stakeholders were supportive of the provision of a National Access Point or points for traffic and travel data, but there was a desire for flexibility in the approach so that Member States could choose how to implement their own National Access Points.

A European level registry which provides a portal linking to the 28 Member State Access Points would aid third party data users with data discovery.

3.3.2. Data formats and exchange protocols

There is a strong need for and support for the concept of data interoperability, but this is limited at present. Stakeholders responded positively to the idea of harmonising data formats and exchange protocols, indicating a desire for a set of preferred data formats and protocols for use when exchanging data for travel and traffic information.

Compliance with EU legislation should ensure that an appropriate level of accessibility (data to meet the needs of Persons with Reduced Mobility) is enforced in the policy specifications.

There was support for a minimum set schedule for releasing updated static data sets, though many thought this should vary depending on the data concerned (e.g. monthly for timetables, annually for address data). However the dominant view was that data providers should be recommended to make data available within at least three days of when changes occur. Data availability should be equitable, that is suppliers must make it available to all users on a similar timescale, and not use a delay to give themselves competitive advantage.

Guidance on terms and conditions of data re-use would be welcomed.

3.3.3. Quality framework

The majority of stakeholders thought that the current quality of multimodal information services in the EU is insufficient. This indicates that minimum data quality requirements need to be established. Guidelines on data and information quality standards which clearly set out both a minimum-expected and a recommended level of quality would support the stakeholders' desire for consistent levels of information quality across the EU.

Stakeholders suggested that feedback processes, established by data owners and users with an onus on data correction at source, would be a useful mechanism for maintaining data quality. The responses also supported the view that data providers should be transparent with any known issues with a data set or data feed, for example, within supporting information in Access Points.

3.3.4. Linking services

Stakeholders were supportive of the idea of linking services to provide greater modal and geographic coverage. A large majority were in favour of some form of intervention, but there was little support for mandating measures to link services.

However CEN standards for open distributed journey planning are under development which if adhered to, would support the linking of travel information services; there is also a need for travel information services to provide Application Programming Interface linked access to their systems to enable third parties to use the data.

3.3.5. Geographic coverage

Stakeholders were in favour of the geographic coverage of the policy specifications being 'all trunk routes and urban networks (the comprehensive European transport network)' at a minimum but there was recognition that some Member States would welcome the flexibility to cover the extended 'door-to-door' European transport network.

3.4. Summary of findings against research questions

At the outset to the study the project team identified twelve key research questions. The baseline study and the consultation results were used to provide findings against these, as listed below.

1. What are the *functions* which the MMTIPS services should provide? Which of these should be provided as a *minimum* to meet implied traveller expectations/needs, as well as those which are *desirable* and those which are *nice to have*, and what criteria should be used to determine whether functions are minimum, desirable or nice to have?

D1 set out the expected functions, organised by functional domains, into the three levels of 'need'. This initial organisation was based upon experience of the project team, external experts, long standing and emerging systems' levels of functionality and previous studies.

The further insights gathered during Task 2 have tested our original assumptions and have resulted in the following amendments:

- Real time information (e.g. predicted arrival times based on real world status) should be a 'minimum' requirement (previously classified as 'additional desirable').
- Interchange facilities (e.g. Status of access node features (including dynamic platform information, catering, operational lifts/escalators, closed entrances and exit locations) should be an 'additional desirable' requirement (previously classified as 'nice to have').

2. What datasets are required to provide these levels of service?

D1 set out the datasets which are required to meet the defined functional system features. This view did not change as a result of the consultation which agreed that nice-to-have functions regarding the real-time availability of park & ride, bike & ride, vehicle charging points, parking place reservations etc. were of less importance than those data sets previously identified for providing a minimum or desirable level of service.

3. What are the preferred data formats and exchange protocols for these datasets in order to provide MMTIPS services? What criteria should be used to determine this preference?

D1 analysed the existing common European standards against the defined list of required datasets and identified the preferred formats and exchange protocols. Key criteria include compliance with Transmodel (as the conceptual standard) for consistency and whether they are European standards (national standards, even if technically sufficient are deemed to be unlikely to be acceptable to a full range of Member States). Fundamentally if they are technically viable, then good existing uptake and adoption levels by suppliers and systems in the data management and MMTIPS markets provide a strong case for their preference.

There is a core set of standards in place to cover the minimum expected functions, namely GDF, NeTEx, SIRI, Transmodel, TPEG, DATEX II, and SSIM (air industry). This has been revised to remove UTMC from the D1 list. Additionally, XML TAP/TSI as an industry format that can be interoperable and that provides rail fare requirements but in the long term could be better replaced by a subset of NeTEx Part 3.

GTFS remains popular amongst some transport authorities (particularly in Scandinavia) and with data users for its relative simplicity. However its scope is limited to distributing basic timetable information and it does not support all the required functions. It is also recognised that as a non-open standard it would not be suitable for recommendation as a harmonised European standard but it provides an indicator that a useful development would be a travel information profile of NeTEx that can be used for data exchange which simply consisted of basic stop and timetable data.

4. What issues with data formats and exchange protocols prevent the provision of MMTIPS services?

D1 explored many of the issues relating to data formats and exchange protocols. One of the main challenges, reaffirmed through the consultation is that there is no current direction at a European level, outside of CEN, on which data formats and protocols are the ones to invest in. Instead many local data or MMTIPS providers resort to national standards in their place – some stakeholders even highlighted that they had delayed investment for several years for fear of outlaying funds in the wrong technologies.

A small number of respondents raised concerns that for non-transport-industry third party data users, many of the national and European data standards were overly complex for their needs. Therefore it will be important to develop simplified 'travel information' profiles for NeTEx to meet this requirement.

Consistency and quality of data is a significant challenge, however this can also be partly addressed, and more cost effectively overcome, by linking existing travel information services rather than being reliant on bringing all raw data up to a common high standard.

5. What are the approaches and implications for linking services in order to provide wider access to data?

As D1 and the consultation workshop explored, once the concept of having single monolithic journey planners for pan-European services has been set aside, there are two main approaches to linking existing travel information services – which is more suitable

depends on the information available in the different source MMTIPS. The first is to have a distributed journey planning system where separate servers hold information for specific geographic areas and solutions are produced by knitting together two halves of a journey through an agreed set of 'Exchange Points' that provide the linking points between systems. The second is to chain journey planners together. The usefulness of chained/hybrid journey planners depends on the specific topology of the networks being covered. It is likely to give good results (and be cost effective) for the straightforward use case of for example adding a final leg to plane or long distance train journeys. It is likely to give poorer results for trip planning between adjacent regions with richly linked networks – as these effectively constitute a single conurbation either side of an administrative or national border.

Therefore from a computer science perspective and from the stakeholder expert responses it is clear that flexibility needs to be provided to service providers to select the approach that best suits the topography involved. To enable this choice there needs to be consistent availability of data, willingness of existing services to open up their systems and common interfaces for linking these services.

6. What *interoperable systems interfaces* are needed to provide MMTIPS services? How should such interoperability occur?

As D1 explored, a European standard has been needed to support distributed journey planning which has, EU-SPIRIT aside, been largely confined to national usage only. The draft CEN OJP Technical Specification currently being prepared will provide that common European standard (certain limitations aside such as the lack of support for fares information) but this will need to be piloted and uptake promoted.

The stakeholder consultation has highlighted that many actors would prefer a degree of flexibility to be applied to ensure existing fit-for-purpose local arrangements do not need to be replaced. At the same time there is a desire for direction to be given on which common API to invest in for new links between travel information services.

Therefore it would be appropriate for the European Commission to recommend the use of the CEN OJP Technical Specification once finalised and support measures to pilot and promote this.

Travel information services should also only be linked when there is a business case or sufficient user demand for doing so.

7. What are the *technical barriers to, and enablers of, provision of sufficient data and interfaces to assist in the emergence of comprehensive and interoperable EU-wide multimodal travel information and planning services?*

D1 explored and summarised the barriers and issues associated with the current provision of data for MMTIPS. It also highlighted a series of potential enablers and opportunities which could be taken to address these barriers.

The stakeholder consultation however was able to further prioritise these barriers in relative importance. The five most significantly identified are (*in decreasing order of scale*):

- Low quality of data
- Lack of data available in common formats
- Lack of adoption of existing common data formats
- Lack of adoption of existing common interfaces
- Lack of common interfaces for the dynamic linking of travel information services

The consultation responses suggest that recommendations to actors in the travel information chain on preferred common data formats, data interfaces and interfaces for the dynamic linking of services would all be beneficial. Similarly, a focus on improving the ability for third parties to identify and use data would be welcomed – e.g. data

access points and common use of metadata to aid discovery.

8. What are the *legal implications* for providing access to data to the wider information chain? Where does *liability* belong and what should be the terms and conditions for reusing data?

As D1 identified, the most significant legal implication of providing wider access to data is that the costs of developing and agreeing case-by-case legal terms is expensive and will reduce the likely involvement of some stakeholders.

Common terms for the re-use of data would provide clarity and allow organizations to invest with confidence. The use of ready-made terms (e.g. open Creative Commons (CC) licences would help to reduce the costs of data management.

The consistently expressed view of liability from external experts is that, unless the MMTIPS are being provided directly by the transport operator concerned, then other travel information services are providing an independent guide to prospective or current transport information where terms and conditions of use can clearly express that no warranty applies. However, should such services provide ticketing transactions then that liability may change (this is of course beyond the scope of the current objective).

Stakeholders are broadly supportive of the following terms and conditions for re-use of data:

- Provision of data in a fair and equal way (note that the rail sector dissents from this view).
- Exclude any transfer of ownership of data (note that some private sector technology companies disagree with this view).
- Transparency of the calculation basis for any financial charge associated with providing data.
- Transparency in the criteria used to rank travel options and neutrality in the way that information is provided to the user.
- Safeguards for the reputation of the data owner (the strength of these terms vary amongst stakeholders with the rail sector keen on provisions which include the ability to audit third party data users).
- Access to data on a cross-sector basis.

9. How would the specification fit within the *context of the existing legislative framework* e.g. TAP/TSI and INSPIRE?

As D1 explored, gaps in the current legislative framework exist in the coverage of non-geographic static and dynamic data from modes beyond rail and private car/traffic. This was further illustrated by as many of the correspondents to the public consultation were involved in local public transport – either in local policy, operations or information provision.

A further gap in existing legislation is with data arising from organisations which are not in the public sector – which in many Member State regions will include the transport operators themselves.

Specifications for Priority Action A would aid in completing a legislative gap on data for multimodal transport information from a modal and private sector consideration.

10. What is the most appropriate *geographic coverage* for MMTIPS services and what criteria should be used to determine this?

As D1 explored, the criteria for selecting appropriate geographic coverage of MMTIPS and data related policies are straightforward. The guiding factor needs to be the requirements of the end-user. For trunk services they require the comprehensive network level of coverage but for full door-to-door journey planning incorporating local transport services they require the extended transport network. With that requirement

in mind we must also consider the best phased approach to the consistent provision of MMTIPS across the EU – with the responses from the stakeholder consultation taken into consideration it would be to adopt the comprehensive European transport network (i.e. trunk routes and urban networks) in the first instance but with flexibility, and encouragement to deliver MMTIPS at the extended European transport network level (i.e. door-to-door) in the future.

11. What are the *basic data requirements* necessary for ensuring *service quality* and how should service quality be defined?

As outlined in D1 the basic data requirement for ensuring service quality can be defined as (i) Veracity; (ii) Completeness; (iii) Timeliness; (iv) Coherence and (v) Compliance. A quality framework for raw data and for MMTIPS could be developed and implemented to provide a structure for improving the overall quality of data and services.

Stakeholder responses suggest that the disciplines instilled through use of ensuring data compliance with standards would make a positive improvement to overall quality as would the availability of system tools for checking data integrity, conformance and running automated test routines. Improved transparency on known issues and service levels with feedback loops for correcting identified issues would all make further positive improvements to data quality.

A number of stakeholders share the view that the market will drive improvements in information quality, particularly with private sector provided services which will need to retain users.

12. What are the potential options for ensuring services are non-discriminatory in the way that they use data?

The D1 report identified that some data providers, particularly private sector transport operators are concerned about losing direct control of their data. This view was reflected to an extent within the stakeholder consultation though primarily for the rail industry.

One of the drivers behind this is an identified risk to their businesses of their transport services being inaccurately represented by third party MMTIPS. There are four different options to addressing this: (i) regulatory: requiring MMTIPS to be non-discriminatory; (ii) accreditation: provide independent accreditation of 'trusted' MMTIPS providers; (iii) establish within the terms and conditions of data re-use that services must be non-discriminatory (as per the answer to Question 8 above); and (iv) 'do nothing' on the basis that only MMTIPS providers that can be trusted by operators to be provided with data will thrive. This latter option comes with the risk that some businesses will be disadvantaged which could impede innovation.

3.5. Forecast outlook if the baseline situation continues

One of the policy options is for the EC to take no further action and let the current baseline scenario evolve naturally. The following analysis is based on the evidence review and views of contributors to the study on what may occur in that situation.

The current development of the CEN 'Open API for Distributed Journey Planning' is likely to provide a technical solution to the barriers which are faced by markets which are predominantly national standards oriented. Currently there does not appear to be great interest from Member States that this is in development and no policy drivers from them to ensure any future uptake of this. This appears to be a result of minimal Member State focus on cross-border travel information integration. However it is likely that a

small number of important market players may adopt this where closer commercial agreements with major international service providers come into play.

Increasing improvements in computing power and costs ('Moore's Law'⁹ in effect) have made it viable to build monolithic journey planners for increasingly large datasets. This could result in an increasing preference by third party providers to have data made available rather than linking to existing travel information services.

The dominance of Google's GTFS across multiple Member States as the most common data format to output timetable data to third party journey planners is a strong indicator that the commercial sector, particularly larger international players, will dictate the selection and uptake of formats and standards for static data exchange as well as dynamic data interfaces. The terms on which this is done could create new impartiality barriers limiting the ability for new companies and solutions to emerge.

A similar commercial risk may lie with the emergence over the last decade of more international and increasingly multi-modal transport operators. These operators may take the view that it is not in their interest to provide data in common formats or provide open access to their existing services. That could result in significant gaps across the EU. However it can be noted as a positive example that after some initial reticence, the provision of open public transport data to the market in the UK is led by a collaborative approach and collective view from the larger passenger transport operators.

Many of the larger Member States have already adopted something akin to national access points for data discovery, often in conjunction with 'data access' policies. This trend should expect to be continued and over time any gaps in provision by the public sector are likely to be filled by the crowd sourcing community or the private sector as the information economy continues to grow – however there may continue to be certain modal or geographic gaps where there is little interest from these sectors in ensuring good available data.

National and commercial policies on both open interfaces and data access particularly may be subject to changes in future political climates. The current trajectory is for more Member States (or certainly regions and cities) to adopt these policies but that progression is by no means guaranteed.

Without a business need, or policy driver for the adoption of new standards, it can be assumed that only at points of the data management system (a term used in its widest sense including systems generating useful data such as real-time status information) replacement systems will conform with the latest data requirements to be considered for adoption. Those timescales can be lengthy and may result in delays of 10-20 years for different organisations to reach.

Information quality would likely continue to be an issue, particularly as the providers of MMTIPS become increasingly removed from the sources of the data. For example, can an international travel information provider give the same level of confidence in its results on a local bus service as the operator of that service can through its own website or helpdesk? Gaps in the current availability of data may be gradually filled through a mixture of crowdsourcing through online tools and by MMTIPS providers themselves who have a business case in ensuring wider coverage of service. The latter approach may result in those providers retaining strict control over the data to preserve the competitive advantage associated with being a sole source of information. However it is likely that data coverage would be concentrated on metropolitan and suburban areas with dense networks and coverage of other areas will be limited by lack of tools and processes.

⁹ Moore's Law: The observation made by Gordon Moore of Intel in 1965 that processing power would double for the same price or halve in cost for the same processing power every 2 years for the foreseeable future. This has broadly proven to be the case since.

4. Assessment and cost benefit analysis of policy options

The D3/4 report on the assessment carried out in the project (Wedlock, Ball and Hopkin, 2016) provides a detailed investigation of the Cost Benefit Analysis results for each deployment option; an excerpt from this document is included in Appendix J. This section summarises those results and is structured as follows:

- Section 4.1 provides an overview of the policy options that were assessed
- Section 4.2 provides an overview of the assessment methodology including details of the underlying model
- Section 4.3 provides an overview of the underlying assumptions
- Section 4.4 presents the detailed assumptions for each of the policy option elements
- Section 4.5 presents the results of the impact assessment including Economic Assessment (4.5.1), Special Impacts (4.5.2), assessment against ITS Directive Principles (4.5.3) and the results of the Risk Assessment (4.5.4).
- Section 4.6 provides a comparison of the policy options in terms of impacts on stakeholder groups (4.6.1), trade-offs and synergies (4.6.2) and assessment against objectives (4.6.3).
- Section 4.7 provides a synthesis of the findings from the Assessment of the Policy Options

Appendix J provides further details of:

- Identification of impacts
- Details of the economic assessment for each of the policy options
- Details of the data used in the Cost Benefit Analysis model including costs, distribution of costs and benefits
- Sensitivity analysis on the key assumptions and data elements

4.1. The policy options assessed

The policy measures to be assessed were identified by the European Commission and the Member State Expert Group for Priority Action A, taking account the results of the review of evidence and stakeholder consultation carried out in this project and reported in D1 (Fell, Knowles and Harrod Booth, 2015) and D2.2 (Fell, 2016).

The individual policy measures assessed were:

- National Access Points
- Standardised data exchange
- Quality framework
- Linking services
- Geographic coverage.

The details of these policy measures are summarised in Sections 2.2 to 2.7. The individual policy measures combine to form a set of policy options. Figure 7 summarises how these policy measures were combined into the policy options analysed, comprising four policy options (1 – 4) with different levels of intervention. Colour coding in Figure 7 is used to identify the common elements of policy measures which feature in different policy options.

In each case, the policy options were analysed for two sub-options covering different geographical areas: the Comprehensive TEN-T Network (A) and the EU-wide transport network (B).

Figure 7 Proposed policy options

Policy Measure	Policy Option			
	1 – Minimal Intervention	2 – Data Focus	3 – Linking Services Focused	4 – Comprehensive Approach
National Access Point (NAP)	At least static data – dynamic optional	Static and dynamic data	At least static data – dynamic optional	At least static data – dynamic optional
	All forms of NAP allowed. [As with the other delegated acts of the ITS Directive, the NAP can come in different forms (with differences in cost) and it is up to the Member States to decide which is best suited for them. The basic NAP as a data register will be the minimum requirement for the delegated act; this is the form of NAP assessed here.]			
Data exchange¹⁰	Static public and private travel and traffic data in NAP shall be in a machine readable format	Static public and private travel and traffic t data in NAP shall be in NeTEx and IFOPT, any dynamic public and private travel and traffic data in NAP shall be in SIRI	Static public and private travel and traffic data in NAP shall be in a machine readable format	Static public and private travel and traffic data in NAP shall be in NeTEx and IFOPT, any dynamic public transport data in NAP shall be in SIRI
	Other legislation with relevant standardisation requirements/industry activities shall apply [TAP TSI applicable for railways, INSPIRE applicable for spatial data, Priority action 'B' applicable for road, IATA applicable to aviation]			
Quality framework	Recommend basic elements. [Updates are 'timely'. The metadata in the NAP describes the frequency of updates and the level of quality/ validation.]	Mandate detailed elements. [Detailed elements would also include requirements to make sure the information is accurate, complete, updated within a specified time period, and the metadata in the NAP defines the level of quality available]	Recommend basic elements [Updates are 'timely'. The metadata in the NAP describes the frequency of updates and the level of quality/ validation.]	Mandate basic elements. [Updates are timely. The metadata in the NAP describes the frequency of updates and the level of quality/ validation.]
Linking services	No requirements (but CEN open API standard recommended)		Mandatory for all services to link	Demand-based obligation for services to link
	CEN Open API standard recommended		CEN OPEN API standard mandated	CEN Open API standard recommended

¹⁰ Standards already prescribed for the rail sector through TAP-TSI, road and traffic data through Priority Action 'B' of the ITS Directive and the technical formats adopted by the airline sector through IATA shall apply in all scenarios. The gap to fill in the specification and what is included in the policy options above concerns scheduled modes of transport (public transport, long distance coach, ferry etc.)

4.2. Assessment methodology

4.2.1. Overview

The methodology that was used for the impact assessment and cost benefit analysis was based on the European Commission's 'Better Regulation Guidelines'¹¹ and followed the following process:

- Options Identification
- Cost Benefit Analysis scoping
- Cost Benefit Analysis options shortlisting
- Baseline generation
- Detailed assessment.

The policy measures to be assessed were identified by the European Commission based on the discussions with experts nominated by the Member States in the dedicated Expert Group for Priority Action A, in December 2015, taking account the results of the review of evidence and stakeholder consultation carried out in this project and reported in D1 (Fell, Knowles and Harrod Booth, 2015) and D2.2 (Fell, 2016).

Since identifying the policy measures for assessment, the Expert Group has worked in parallel with the Cost Benefit Analysis; ideas on some aspects of how the policy options might be implemented have been further developed within the Expert Group, but the policy measures are fundamentally the same. The Cost Benefit Analysis reflects the Expert Group's overall view of the policy measures as it was in December 2015.

4.2.2. Cost Benefit Analysis model overview

The Priority Action A Cost Benefit Analysis support study took account of the economic, social, environmental, and market impacts that a range of scenarios might have. It was conducted in line with the advice set out in the EC 'Better Regulation Guidelines'.

The impacts are the changes which would not occur without the implementation of the policy; for example Member States which already have a National Access Point meeting the requirements of a particular policy option would not incur further costs or benefits as a result of that policy option being implemented. Thus the impacts included in the assessment are in comparison with this baseline or 'no intervention' option.

The Cost Benefit Analysis period was 15 years (i.e. 2016-2030), with implementation being phased in over varying timescales for different elements across the period of 2016-2023.

The Cost Benefit Analysis took the form of a spreadsheet-based model.

It identified the implementation and operational costs, using the EC Standard cost model approach, associated with the key deployment measures (e.g. creation or modification of the national nodes for sharing the required static and dynamic public transport information).

The Cost Benefit Analysis identified the benefits of each scenario on the basis of:

- The number of journeys for which travellers would save time pre-trip when planning cross-border journeys by using one comprehensive multimodal journey planner instead of several
- The number of rail journeys during which travellers would reduce the on-trip time spent during disrupted journeys by being able to change their plans during

¹¹ http://ec.europa.eu/smart-regulation/guidelines/toc_guide_en.htm

disrupted trips as a result of better access to real time information at all stages of their journey

- The number of cross-border journeys where travellers switch modes for the 'last leg' of their outward journey and 'first leg' of their homeward journey from hire car or taxi to more sustainable modes as a result of easier access to journey planning information at their destination, resulting in primarily in reduced congestion but also benefits such as reduced emissions and improved air quality; (note that to avoid double counting with the assessment of Priority Action B, the impacts on car journeys were not assessed here)
- Cost savings for MMTIPS providers through reduction in data discovery, data aggregation and interfaces.

These were the key benefits assessed. Other potential benefits were not assessed, but such benefits would not necessarily vary significantly between the various policy options, so would not contribute to the process of prioritising policy options and were therefore not included in the quantitative assessment. These include:

- Benefits for existing service providers and transport authorities of a general increase in the quality of information and of having access to data
- A switch in times of travel by some users in response to better information, leading to more efficient use of transport
- An increase in visits to tourist attractions once information on reaching them by public transport becomes more readily accessible.
- An increase in economic activity once comprehensive information on the cheapest means of travel (from fare data) is available¹²
- Quality of Life/health benefits of reducing stress by having reliable information during real-time disruptions.

The benefits derived from each scenario varied depending on:

- Whether or not the scenario included a mandatory element (i.e. whether it would accelerate deployment compared with the baseline)
- Whether the scenario involved dynamic data (i.e. real time information) or only static data (such as timetables and bus stop locations)
- The geographic coverage of the scenario.

The data used in the model are presented in J.2.5. This also contains other relevant data gathered during the study but not used in the final version of the model.

4.3. Underlying assumptions

The following assumptions were made:

1. The services set up in response to Priority Action A will be independent of those for Priority Action B on road traffic information; therefore Member States which do not have a National Access Point for multimodal travel information will need to set one up, rather than adapting an access point for traffic information.
2. All Member States (that already have pre-existing dynamic data) shall choose to include dynamic data in the National Access Point and therefore conform to the data standardisation requirements.

¹² Note that dynamic fare data is not included within the scope of the data initially required for multimodal travel information services.

3. Implementation would be achieved in 2019 for a basic level of service, with full service available on the Comprehensive TEN-T network by 2021 and on the EU-wide network by 2023. Preparatory activities would involve incurring some costs between 2016 and 2019; various different assumptions were made about the timing of preparatory activities for different elements of the policy options.
4. A 4% discount rate was used for calculating the net present value of costs and benefits incurred in future years.
5. Value of time in 2016 was assumed to be €16.89/ hour for air passengers and €8.14 / hour for rail, bus, coach and waterway passengers, derived from the HEATCO (2002) guidelines, updated by growth in GDP.
6. Growth in Gross Domestic Product assumptions mirror the joint work of DG ECFIN and the Economic Policy Committee, presented in the 2015 Ageing Report. The average EU GDP growth rate is projected to remain relatively low in the short to medium term at 1.2% per year for 2010-2020, down from 1.9% per year during 1995-2010. In the medium to long term the higher expected growth rates (1.4% per year for 2020-2030 and 1.5% per year for 2030-2050) are taking account of the catching up potential of countries with relatively low GDP per capita, assuming convergence to a total factor productivity growth rate of 1% in the long run.
7. It was assumed that there are 75 long distance bus and coach operators on the Comprehensive TEN-T network and 8050 local bus, tram and light rail operators on the EU-Wide transport network (Source: DfT Bus Statistics and DfT Transport Statistics Great Britain¹³, scaled up by population to EU-level).
8. It was estimated that there are currently 125 journey planning service providers and 160 multimodal journey planning services (based on D1, Fell, Knowles and Harrod Booth, 2015); although these are likely to increase in number over time, no increase has been assumed.
9. EU-wide journey planning services would enable people travelling across borders to save time while planning their journey; a 10-minute time saving was assumed per trip. The number of trips assumed is shown in Table 1 below. It should be noted that the Eurostat data on the number of cross-border trips in 2013 covers trips by EU residents and those trips that require at least one night stay. This was factored up by 5% to take account of visitors staying overnight, based on UK data¹⁴.
10. EU-wide journey planning services with real time information would enable people travelling across borders by rail to save time during disrupted trips as in some cases it is possible to revise the journey plan to reduce the impact of disruption; on the basis of statistics on rail service delays for a selection of cross-border and long distance routes and operators, 3% of rail trips were estimated to be disrupted¹⁵, 20% of these were assumed to be re-planned, with a 30-minute time saving assumed per re-planned trip. It was assumed that air passengers would not be in a position to revise their journey plans during disrupted trips and

¹³ Source: Department for Transport 2015. Transport Statistics Great Britain: 2015 Notes and Definitions: Public Transport

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/483880/public-transport-notes.pdf

¹⁴ Source: Office for National Statistics 2015. Travel Trends 2014, Table 2.15

<http://www.ons.gov.uk/ons/rel/ott/travel-trends/2014/rft-travel-trends--section-2--overseas-visits-to-the-uk--2010-to-2014.xls> and Table 3.15 <http://www.ons.gov.uk/ons/rel/ott/travel-trends/2014/rft-travel-trends--section-3--uk-residents-visits-abroad--2010-to-2013.xls>

¹⁵ Source: ERADIS data for 2014 in Railway Undertakings Service Quality Reports for Belgium, Romania, Spain and the Paris-Venice service and Which? 2015 data for the UK

that passengers using other modes would not be in a position to save time in the case of delays of less than 30 minutes. However a sensitivity analysis was carried out to assess how the Cost Benefit Ratios would change if real time information available through additional channels enabled passengers on local public transport to save time on their journeys. The results are summarised in Appendix J.2.6.

11. EU-wide journey planning services would enable people travelling across borders to switch to more sustainable modes on the last leg of their outward journey and the first leg of their return journey. Travelling from airports, 5% of trips were assumed to switch from taxi or hire car to public transport, with an average distance of 10km between airport and final destination. Travelling from train stations, 12% of trips were assumed to switch from taxi to public transport with an average distance of 5km between train station and final destination. These switches to more sustainable modes at the destination would result primarily in reduced congestion but also benefits such as reduced emissions and improved air quality. The value was estimated using the marginal external cost of congestion which is €0.18 per km (derived from Department for Transport TAG)¹⁶.
12. The benefits would be smallest in the case of the 'Minimal Intervention' option, somewhat higher in the case of the 'Linking Services Focused' option, higher again in the case of the 'Data Focus' option and greatest in case of the 'Comprehensive Approach'. Within each of these options, the benefits would be greater if implementation covered the EU-wide transport network than the Comprehensive TEN-T network. The assumptions about how these vary are shown in Appendix J.2.5.2.
13. At some point in the future it might be expected that there would be a convergence in the tools use to prepare, store and exchange data, reducing costs compared with the current situation in which there are a number of different and incompatible tools in use, many of which are quite expensive. For the purpose of this assessment, it has been assumed that such economies of scale will not be achieved prior to 2019.

Table 1 Estimated number of cross-border trips, including an estimate for overnight trips, 2013¹⁷

Type of trip	Number
Total cross-border trips excluding road	213,948,581
Total cross-border trips arriving into airports	163,149,315
Total cross-border trips arriving into other main interchanges, such as train stations	50,799,266

The sensitivity of the model to the key assumptions and cost estimates is summarised in J.2.5, Section J.2.6.

¹⁶ Source: DfT TAG Data Book Table A.5.4.4 Marginal External Costs

¹⁷ Source: Eurostat <http://ec.europa.eu/eurostat/data/database> Table code tour_dem_ttr.

4.4. Detailed assumptions

4.4.1. Scenario Elements – National Access Points

Baseline

The review of evidence carried out at the start of this project (Fell, Knowles and Harrod Booth, 2015) identified five Member States which either have a National Access Point or which are in the process of setting one up (The Czech Republic, Italy, The Netherlands, Slovakia and Sweden). However, although it could be assumed that only 23 Member States would incur the costs of setting up a National Access Point for multimodal travel information services or even less if small Member States share a common access point, as Member States shall decide whether or not to re-use existing access points, for the purpose of the cost benefit analysis it was assumed that all 28 shall set up an access point for Priority Action 'A'.

National Access Point Static

The introduction of National Access Points would result in costs for Member States (as the delegated authority for EC policy) which do not have one.

The costs of setting up a National Access Point involve creating a web site containing links to service providers and services. The basic costs of a 'data register' were assumed here. The set up costs were assumed to be €49,000, derived from the IM Data Index portal in the UK which provides access to a range of travel and traffic data sets and APIs¹⁸. Further data on the costs involved in setting up different forms of National Access Point (data warehouse, database) are included in J.2.5 Section J.2.5.1, Table 46.

There are also on-going annual costs of checking links and hosting, maintaining, and updating the web site. This was assumed to be €25,000 per year.

The implementation costs were assumed to be phased in over the period 2016 – 2019, with all Member States having an operating National Access Point by 2019.

National Access Point Dynamic

As the National Access Point consists of a web site, it was assumed that the costs would be the same whether this provided static data or both static and dynamic data. For those Member States that have pre-existing dynamic data, it was assumed they would choose to include dynamic data in the National Access Point.

4.4.2. Scenario Elements – Data Exchange

Baseline

In order to be able to exchange data with other service providers or other services, the minimum requirement is that any data on the network and timetables that is made available to the National Access Point is in machine-readable form. It was assumed that those operators which do not have data in machine-readable form would not be required to do so (assumed to be 10% of long-distance bus operators and 20% of local bus operators).

A further basic requirement is for a web interface to provide the data. It was assumed that those operators who have the data in machine readable form either have a web interface or an electronic means of data exchange with the transport authority.

¹⁸ Source Fell, Knowles and Harrod Booth 2015, Section N.1.8

In order to implement more developed policy options, that data would need to be in specific formats: NeTeX for static data or SIRI for real time data. The review of evidence found that NeTeX implementations are currently rare, so it was assumed that 5% of operators would have their data in this format (Transforming existing stop and time data into NeTeX should be straightforward, supporting extra data elements, such as for accessibility and fares, would be much more onerous). SIRI implementations are more widespread. Based on estimates from IT TRANS¹⁹ it was assumed that for both the Comprehensive TEN-T and EU-wide scenarios, 25% of operators do not have dynamic information, 5% have dynamic information not in SIRI, and 70% have dynamic information in SIRI format.

Static (Meeting Standards)

The introduction of data exchange requirements would involve additional costs to Member States, transport authorities and transport operators to provide the static data to the NAP, with potential conversion costs to ensure that the data format meets the required standards. Costs to adapt to NeTeX can be in two different ways. One method is to convert the national standard to NeTeX by translation from the national format, which involves developing a national translation tool to perform the data mapping from the national schema to NeTeX. Typically this will be done at the NAP, (but could also be done elsewhere) so that the NAP has a representation in NeTeX format. A second method is to change to NeTeX completely, which requires each operator/authority to change their data tools to support NeTeX at the back office level (i.e. at least for export) and no longer use the national format to submit data to the NAP; this requires more effort and time and thus higher cost (an example from Grand Lyon is included in J.2.5, Section J.2.5.1, Table 47). The CBA is based on the first of these methods and as such it was assumed for Member States there would be a one-off cost to develop a national NeTeX profile and conversion tool, but there would be no costs to operators. The one-off cost of developing the national NeTeX profile and conversion tool was estimated at €50,000 per Member State.

There would be cost savings for MMTIP service providers in reduced data discovery costs, reduced aggregation costs and a reduction in the number of interfaces required. Based on data gathered during the stakeholder consultation (Fell, 2016), cost savings for MMTIPS providers were estimated to involve an initial saving of €100,000 each, with an on-going saving of €200,000 per year.

Dynamic (Meeting Standards)

The introduction of data exchange requirements would involve additional costs to some transport operators to provide the dynamic data to the NAP in the SIRI format, and cost savings for MMTIP service providers in reduced data discovery costs, reduced aggregation costs and a reduction in the number of interfaces required.

Based on the stakeholder consultation (Fell, 2016) and information from the Priority Action B (van de Ven and Wedlock, 2014), the cost for an operator of converting data to another format to meet a new standard is €50,000, with an annual operational cost of €5,000 for the first five years (after which it was assumed that this task would be part of normal operations with no additional cost). (Note that these costs are likely to vary between operators of different sizes and with different volumes of data to process.)

The data conversion and operational costs were only applied to the 5% of operators that were assumed to have dynamic information but not in SIRI format.

¹⁹ IT Trans 2016: Conference on IT Solutions for Public Transport, March 2016

As in the case of static data meeting standards, cost savings for MMTIPS providers were estimated to involve an initial saving of €100,000 each, with an on-going saving of €200,000 per year; estimates were derived from data gathered during the stakeholder consultation (Fell, 2016).

4.4.3. Scenario Elements – Quality Framework

Baseline

A quality framework involves providing transparency in the way that information is displayed, that information is up-to-date and updated in a timely manner. The National Access Point would include metadata to define the quality level/ validation of the data. It was assumed that such a framework is already in place for 20% of operators on the Comprehensive TEN-T network and 10% of operators on the EU-wide transport network.

Recommend Basic

Under this scenario no additional data quality measures would be provided. It was assumed that this would have limited impact with no additional costs and no additional benefits.

Mandate Basic

Under this scenario no additional data quality measures would be provided. However because this level of quality is mandated, it was assumed to affect MMTIPS providers with some minor changes in how they present data, involving a one-off cost of €2,000.

Mandate Detailed

Under this scenario, in addition to the baseline provisions, a range of centrally provided validation checks are envisaged, ranging from (a) checking that the data has been updated within the specified time period; (b) checking it conforms to the schema and national profile; (c) checking the data references are correct; (d) checking it can be pre-integrated without issues; (e) de-duplication, as well as a cost to resolve a certain number of issues with the suppliers.

Costs for data quality could come at both the level of the operator and the Member State. For the purpose of the CBA the enforcement costs incurred by the Member States to check that the data meet the standards were included, plus a small cost for service providers to make software changes to their web sites to meet basic quality requirements. Member States were assumed to incur an initial cost of €4.2m and €52,000 per year after the data quality had improved (based on information in Fell et al 2015 on the Data Improvement Group of Transport Direct). The costs to MMTIPS providers were assumed to be €2,000 each.

4.4.4. Scenario Elements – Linking Services

Baseline

The evidence review carried out at the start of the project (Fell et al, 2015) established that distributed journey planning has been shown to be successful over several years through implementations such as EU-SPIRIT, JourneyWeb and Delfi. There is also a pilot on the border between France and Germany to create a distributed journey planner for static data. (See Section 6 of Fell et al 2015 for further information.) However the Delfi service is now moving away from a distributed architecture to a data warehouse approach because the response times were perceived by users to be inadequate; it was

therefore assumed that the baseline is a very small of number of distributed journey planners.

The CEN Open API work is in the process of creating a common European specification.

Demand-based obligation for services to link - STATIC / PRE-TRIP

The assumption about the demand for services to link was based on the number of journey planner services identified (160). It was assumed that 100 journey planning services on the Comprehensive TEN-T and 200 EU-wide would be required to link on the basis of demand for travel between their areas. The initial cost of linking was assumed to be €75,000 with an annual fee of €30,000 (based on industry sources). While the costs are known to vary depending on the volume of use, the country in which the service is based and the complexity of the service, it was necessary to assume a 'mid-range' value for the purpose of this assessment.

Demand-based obligation for services to link - DYNAMIC / ON-TRIP

Current trends indicate that linking of dynamic information is more likely to be done through data exchange of the source real time data set from the operators, rather through linked journey planners; this is at least in part because linking of dynamic on-trip information has not yet been demonstrated to work sufficiently well. Thus linking of dynamic information is assumed to be included in data exchange. Although in future, the new CEN standard for Open Journey Planners may improve the feasibility of linking, this has not been included in the assessment.

Mandatory for all services to link / CEN OPEN API standard mandated – STATIC

The requirement for services on the Comprehensive TEN-T network to link was assumed to be double the number with a demand-based obligation (200 on the Comprehensive TEN-T network and 400 on the EU-wide network; the latter is similar to the number of nodes on the network – i.e. 458. As above, the initial cost of linking was assumed to be €75,000 with an annual fee of €30,000 (based on industry sources).

4.5. Cost Benefit Analysis findings

4.5.1. Economic Assessment Results

The overall results of the Cost Benefit Analysis are summarised in Table 2. On the Comprehensive TEN-T Network this shows a relatively low Net Present Value of €10 million for Policy Option 1 (Minimal Intervention), a higher Net Present Value of €175 million for Policy Option 2 (Data Focused), a higher value of €283 million for Policy Option 3 (Linking Services Focused) and the highest €525 million Net Present Value for Policy Option 4 (Comprehensive Approach).

On the EU-wide transport network, Table 2 shows the Net Present Value for each policy option to be higher than on the Comprehensive TEN-T network: €27 million (Policy Option 1), €402 million (Policy Option 2), €573 million (Policy Option 3) and €982 million (Policy Option 4).

Generally investments are made in policy measures which are expected to yield a Benefit Cost Ratio greater than 3. Table 2 shows that the Benefit-Cost Ratios are estimated to be lower than 3 in the case of Policy Option 1A Minimal Intervention, Comprehensive TEN-T network (2.2) and Policy Option 2A Data Focus, Comprehensive TEN-T network (2.3).

The policy options with Benefit Cost Ratios greater than 3 were:

- Policy Option 1B Minimal Intervention, EU-wide transport network (4.4)
- Policy Option 2B Data Focus, EU-wide transport network (3.6)

-
- Policy Option 3A Linking Services Focus, Comprehensive TEN-T network (4.5)
 - Policy Option 3B Linking Services Focus, EU-wide transport network (4.8)
 - Policy Option 4A Comprehensive Approach, Comprehensive TEN-T network (12.5)
 - Policy Option 4B Comprehensive Approach, EU-wide transport network (10.3).

Table 2 Overall Results of the Cost Benefit Analysis for each Policy Option

	1A	1B	2A	2B	3A	3B	4A	4B
Accrued benefits 2016 - 2030 (EU-28)								
i. Time saving of journey planning (static information)	€11,278,181	€22,556,362	€112,781,809	€225,563,619	€281,954,523	€563,909,046	€281,954,523	€563,909,046
ii. Time saving due to better information on disrupted journeys (dynamic info)	€264,596	€529,192	€2,645,958	€5,291,916	€3,307,448	€6,614,895	€6,614,895	€13,229,791
iii. Benefits of modal shift to more sustainable modes	€6,186,951	€12,373,903	€61,869,515	€123,739,030	€77,336,894	€154,673,787	€154,673,787	€309,347,575
iv. Cost savings to MMTIPS service providers	€0	€0	€127,080,541	€201,785,928	€0	€0	€127,080,541	€201,785,928
Total benefits (EU-28)	€17,729,728	€35,459,456	€304,377,823	€556,380,493	€362,598,864	€725,197,729	€570,323,747	€1,088,272,340
Accrued costs 2016 - 2030 (EU-28)								
i. NAPs	€8,043,949	€8,043,949	€8,043,949	€8,043,949	€8,043,949	€8,043,949	€8,043,949	€8,043,949
ii. Data exchange - meeting standards NeTEx and SIRI	€0	€0	€1,519,393	€25,661,266	€0	€0	€1,519,393	€25,661,266
iii-a. Data quality - Mandate basic elements	€0	€0	€226,868	€226,868	€0	€0	€226,868	€226,868
iii-b. Data quality - Mandate detailed elements	€0	€0	€120,028,625	€120,028,625	€0	€0	€0	€0
iv-a. Linking - Demand-based obligation for services to link	€0	€0	€0	€0	€0	€0	€35,944,173	€71,888,345
iv-b. Linking - Mandatory for all services to link	€0	€0	€0	€0	€711,888,345	€143,776,691	€0	€0
Total costs (EU-28)	€8,043,949	€8,043,949	€129,818,835	€153,960,708	€79,932,294	€151,820,639	€45,734,383	€105,820,428
BCR	2.2	4.4	2.3	3.6	4.5	4.8	12.5	10.3
NPV (total benefits minus total costs)	€9,685,780	€27,415,508	€174,558,988	€402,419,785	€282,666,571	€573,377,090	€524,589,364	€982,451,912

Figure 8 shows the value of the benefits of the various policy options over the period until 2030, and Figure 9 shows the value of the costs of each of the policy options over this time period. Figure 10 shows the total benefits and total costs on the same graph. Table 3 shows the total costs split by stakeholder for each Policy Option.

Figure 8 Summary of accrued benefits of policy options 2016 - 2030 (EU-28)

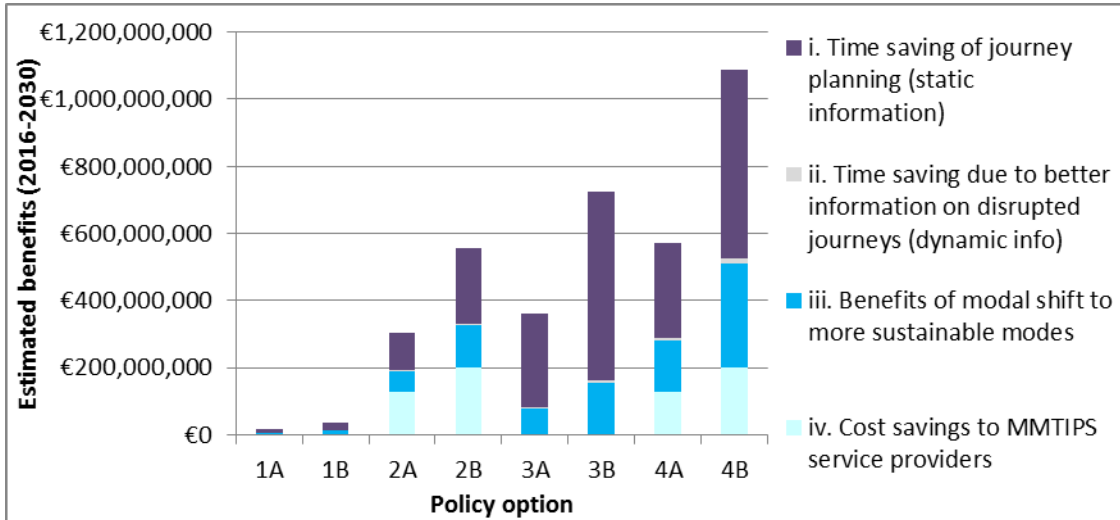


Figure 9 Summary of accrued costs of policy options 2016 - 2030 (EU-28)

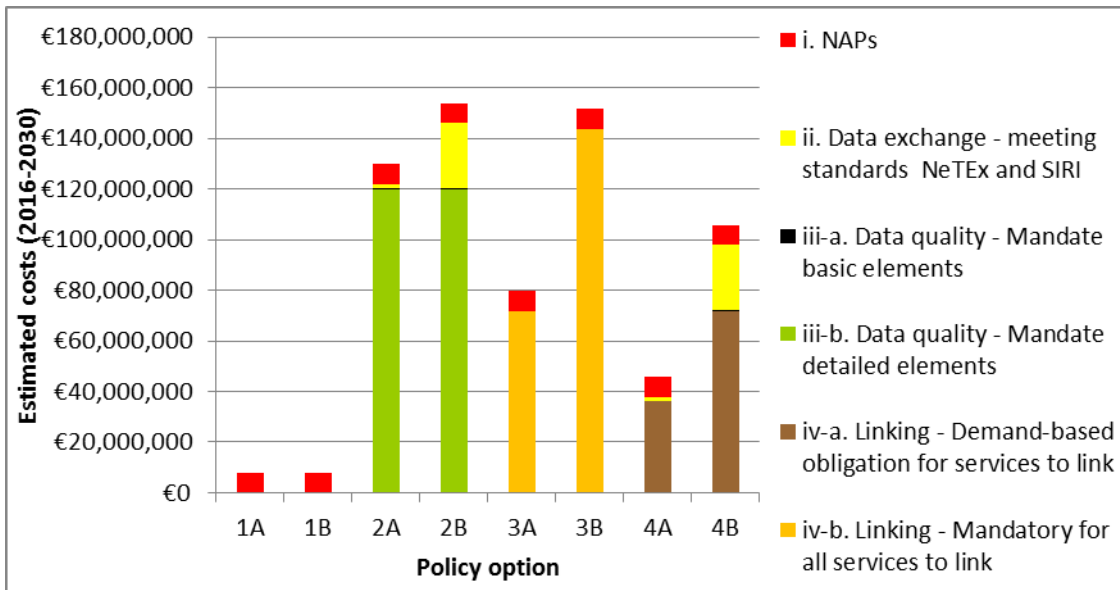
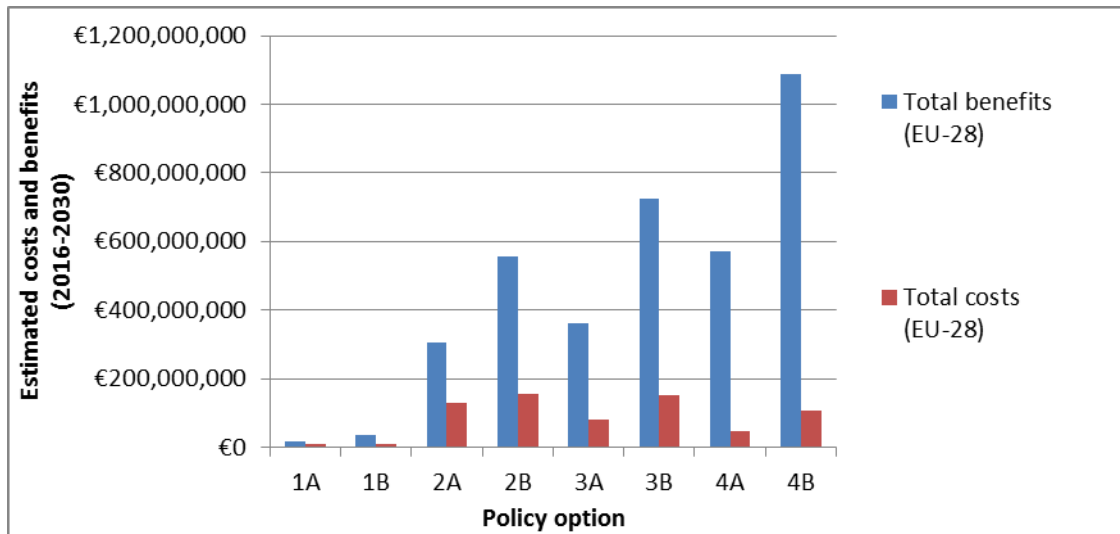


Figure 10 Summary of accrued benefits and costs of policy options 2016 - 2030 (EU-28)**Table 3 Total costs, split by stakeholder for each Policy Option**

Option	Member State	MMTIPS providers	Transport operators	Total
Option 1A	€8,043,949	€0	€0	€8,043,949
Option 2A	€129,343,037	€226,868	€248,930	€129,818,835
Option 3A	€8,043,949	€71,888,345	€0	€79,932,294
Option 4A	€9,314,412	€36,171,041	€248,930	€45,734,383
Option 1B	€8,043,949	€0	€0	€8,043,949
Option 2B	€129,343,037	€226,868	€24,390,803	€153,960,708
Option 3B	€8,043,949	€143,776,691	€0	€151,820,639
Option 4B	€9,314,412	€72,115,214	€24,390,803	€105,820,428

The graphs show that the combined impacts of the four different types of benefit are expected to be greatest in the case of Policy Option 4 (the Comprehensive Approach) for two reasons: all four types of benefit would be realised in this case but in only one other policy option, while the monetary value of benefits would be higher than in the case of other policy options, particularly those arising from modal shift at the destination and time savings in journey planning. At the same time, the costs involved in implementing the two most costly elements (data quality and linking services) are expected to be lower for Policy Option 4 where these are not mandatory, than in the case of the policy options where these would be mandatory.

4.5.2. Special impacts

Assessment of Impacts on Existing Markets

By definition, due to the scope of Action A, the adoptions of specifications will have an impact on the existing markets for MMTIP Services in Europe. However, the intention of the specifications in accordance with the scope of the ITS Directive Priority Action A is to make EU-wide multimodal travel information services accurate and available across borders to end users. The State of the Art Review identified that there was a need to address a number of barriers including data availability, interoperability and the need to

make the value chain work better for all stakeholders involved. The EC Expert Group developed a draft set of policy measures to be analysed which included as a minimum:

- The provision of National Access Points for public and private travel and traffic data
- Requiring data in the NAP to be in a set of standardised/ identified format
- Recommending the usage of the CEN Open API standard as a basis for linking MMTIP services
- Specifying a minimum geographic scope of the Comprehensive TEN-T network.

Feedback from stakeholders during the consultation phase has indicated that the majority of respondents (two-thirds) do not feel that existing services provide sufficient geographic or multimodal coverage for their travel information needs. Travel information for cross-border and within other EU countries is particularly difficult due to availability and access to appropriate services – this may be a result of awareness of local services or lack of multi-lingual services.

Broadly, the views of various stakeholders and Member States on current barriers and potential enablers were aligned, with variation based on the approach to intervention rather than objections to it. However, the sector with consistent views against possible forms of intervention was the rail industry, with a desired preference for retaining the current status quo.

The following paragraphs summarise the feedback from the stakeholders on the areas for perceived needs for policy intervention.

Scope of data standards and data exchange - there was a strong sense from stakeholders that they would prefer the EC to recommend preferred common standards for data exchange rather than to mandate them. Mandating pan-EU harmonisation is seen as unnecessary with concerns raised that this may constrain the development of local and regional markets, especially where there is a stable established infrastructure already using open specifications. Many data consuming services are local and do not need wider harmonisation. Those that are, will normally be able to cope with a small number of parallel recommended common specifications. However the recommendation of specific common standards would be helpful in reducing the overall number of formats in use and in making more effective procurement decisions.

Access to data - it should be recognised that whilst there is a great deal of support for making data more consistently available there was a large majority of stakeholders who objected to the view that Access Points should be mandated. However within the detail of their responses it is evident that a reasonable proportion of these are cautiously in agreement with the approach subject to them being mandated at the right administrative level and with flexibility on how they are implemented. Access to data is more important and more fundamental than linking travel information services for enabling MMTIPS; furthermore some access to data e.g. stops and handover points is needed to provide the commonality to support any form of linked service.

Linking travel information services - workshop delegates and consultation respondents were broadly supportive of the principle of linking existing travel information services but it was clear that this should be on the basis of using the best fit solution to the local situation. At the same time there was a stated desire from some leading experts that direction from the European Commission on a preferred standard for this would be well received and would provide confidence to investment decisions. Stakeholders also discussed the importance of prioritising the linking of existing travel information systems in areas where it is known there is demand from cross-border travellers (e.g. frequent commuters). There were concerns raised about investing in

providing this inter-system functionality in areas where there is little or no demand for it that might otherwise divert resources from other areas of research and development.

Data and information service quality - there was broad support for the view that current quality of services is inconsistent and for measures to help address this. The list of measures which can be applied to enhance this is lengthy and there is no 'silver bullet' solution which can be simply prescribed. There is good recognition that if intervention measures are taken which if successful will result in the further uptake of systems and coverage of MMTIPS, then market forces will help ensure that it is the highest quality services which thrive and thus an upward self-improving cycle will be underway.

Terms & conditions of data re-use - support for a set of common terms and conditions which could be used for data use were well supported within the consultation. As there are some regional variances on the extent to which these should also apply to the private sector it would be reasonable to propose that these are for recommended use only.

Geographic coverage - The geographic coverage within the policy specifications should be for 'all trunk routes and urban networks (the comprehensive European transport network)' at a minimum however there is also a small majority in favour of these covering the extended 'door-to-door' European transport network so flexibility could be offered to Member States to allow them apply the delegated regulations to that level of higher granularity. Care should be taken in the definition of the structure and scope of the Governance Framework to ensure that there is not an adverse effect on existing commercial markets.

Assessment of impact on fundamental rights

The potential impact of the adoption of the Action A Specification on the fundamental rights (as defined in Annex 8 of the Commission's Impact Assessment Guidelines) has been assessed. The results of the assessment showed that no impact is expected other than a 'possible' impact on:

- The freedom to conduct a business
- The right to property

The impact on potentially affected Fundamental Rights is elaborated below.

Freedom to Conduct a Business: Adoption of specifications to harmonise the availability of MMTIP Services in the EU, can affect the existing market of travel and traffic data provision and MMTIP Services. Caution should be taken not to issue specifications that might undermine current business models and cooperation models in the various Member States.

Right to Property: Both public and private organisations create travel and traffic data and information, and hold property rights to these. The specifications should respect these property rights.

Impacts on consumers

The ultimate objective for the interventions under Priority Action A is to improve the level of quality and geographic coverage of door to door Multi Modal Traveller Information and Planning systems and Services in Europe. It is expected that the adoption of a specification under Priority action A of the ITS Directive will speed up the availability of the underlying data sets that are required to support MMTIPS which will enable users to more efficiently plan and optimise their 'door-to-door' journeys and to minimise the travel delays experienced due to disruptions in the transport network.

Impacts on SMEs

One of the issues with the current market for MMTIPS Services is that there is a very high cost of entry for new providers particularly those wishing to provide pan-European 'door-to-door' services due to the costs of discovering and interfacing with the large number of data owners in Europe. Currently the market for pan-European MMTIPS Services are provided by five commercial organisations, however in cities with data access policies there are significant numbers of SMEs which are providing city or regional MMTIPS Services.

It is anticipated that through policy interventions in the areas of National Access Points, data accessibility and linking services are expected to reduce the costs of entry and are likely to have beneficial impacts on SMEs in Europe.

This has been demonstrated in a number of Member States where adoption of data access principles has stimulated the creation of new SMEs and innovative services

Impacts on technological development & innovation

As has been seen in a number of Member States which have adopted the data access approach, the act of making data sets available for reuse has catalysed innovation leading to the development of new and innovative services which combine and make use of data sets from a variety of sources. It can be expected that making new data and information available across Europe in a harmonised form will also act as a catalyst for innovation.

4.5.3. Assessment against ITS Directive principles

Table 4 provides a qualitative assessment of the Cost Benefit Analysis scenarios against the principles of the ITS Directive using a simple scoring methodology.

The analysis shows that the minimum intervention scenarios have the lowest alignment with the principles of the ITS Directive and that Scenarios 2 (Data Focus) and 3 (Linking Service Focus) have a similar level of alignment due the focus in different areas. Scenario 4 which includes measures covering NAPs, Data Exchange Standards and a demand based obligation for linking services has the highest alignment with the ITS Directive, primarily because they provide the greatest enablers for the development of 'door-to-door' MMTIPS Services. For all scenarios, the EU wide transport network scope increases the level of alignment due to the greater impact on the availability of data and linking services to provide pan-European coverage.

Table 4 Assessment against ITS Directive Principles

		Minimal Intervention – Comprehensive TEN-T Network	Minimal Intervention - EU-wide Transport Network	Data Focus – Comprehensive TEN-T Network	Data Focus - EU-wide Transport Network	Linking Services – Comprehensive TEN-T Network	Linking Services - EU-wide Transport Network	Comprehensive Approach – Comprehensive TEN-T Network	Comprehensive Approach - EU-wide Transport Network
Be Effective	make a tangible contribution towards solving the key challenges affecting road transportation in Europe (e.g. reducing congestion, lowering of emissions, improving energy efficiency, attaining higher levels of safety and security including vulnerable road users)	1	1	3	4	3	3	3	4
Be Cost Efficient	optimise the ratio of costs in relation to output with regard to meeting objectives	1	2	1	2	2	3	4	4
Be proportionate	provide, where appropriate, for different levels of achievable service quality and deployment, taking into account the local, regional, national and European specificities	1	1	2	3	2	3	4	4
Support continuity of services	ensure seamless services across the Union, in particular on the trans-European network, and where possible at its external borders, when ITS services are deployed. Continuity of services should be ensured at a level adapted to the characteristics of the transport networks linking countries with countries, and where appropriate, regions with regions and cities with rural areas	1	1	2	3	3	4	3	4
Deliver interoperability	ensure that systems and the underlying business processes have the capacity to exchange data and to share information and knowledge to enable effective ITS service delivery	1	1	3	4	3	4	3	4
Support backward compatibility	ensure, where appropriate, the capability for ITS systems to work with existing systems that share a common purpose, without hindering the development of new technologies	1	1	2	2	4	4	3	3
Promote equality of access	do not impede or discriminate against access to ITS applications and services by vulnerable road users	0	0	2	3	0	0	2	3
Support maturity	demonstrate, after appropriate risk assessment, the robustness of innovative ITS systems, through a sufficient level of technical development and operational exploitation	0	0	1	1	2	2	2	2
Facilitate inter-modality	take into account the coordination of various modes of transport, where appropriate, when deploying ITS	1	2	2	3	2	3	2	3
Respect coherence	take into account existing Union rules, policies and activities which are relevant in the field of ITS, in particular in the field of standardisation	1	1	3	4	3	4	3	4
Average		0.8	1.0	2.1	2.9	2.4	3.0	2.9	3.5

4.5.4. Risk assessment results

The results of the risk assessment for each of the policy options are summarised in Table 5 below.

Table 5 Risk Assessment Summary

Policy Option	Overall Risk Score
Policy Option 1A - Minimal Intervention Comprehensive TEN-T Network	3
Policy Option 1B - Minimal Intervention EU Wide Transport Network	4
Policy Option 2A - Data Focus Comprehensive TEN-T Network	13
Policy Option 2B - Data Focus EU Wide Transport Network	21
Policy Option 3A - Linking Services Comprehensive TEN-T Network	13
Policy Option 3B - Linking Services EU Wide Transport Network	30
Policy Option 4A - Comprehensive Approach Comprehensive TEN-T Network	9
Policy Option 4A - Comprehensive Approach EU Wide Transport Network	16

The results from the stakeholder consultation has shown that there is broad consensus on the issues that need to be addressed to improve the provision of MMTIPS Services across Europe, and that in addition there is broad agreement with the range of policy interventions that have been analysed in the Cost Benefit Analysis.

The main issue to be addressed is the availability and accessibility of the underlying data from Transport Operators in a machine readable format that is required to support MMTIPS Services. Given that Member States will be required to enact new national legislation, it is anticipated that the additional cost of compliance to be borne by existing Transport Operators would be compensated and therefore the risks are reduced.

The details of the risk analysis for each policy option are presented in Table 6 to Table 13.

Table 6 Risk Analysis - Policy Option 1A - Minimal Intervention Comprehensive TEN-T Network

Risk Area	Risk Discussion	Impact (L/M/H) (1/2/3)	Likelihood (L/M/H) (1/2/3)	Risk Score (I x L)
Institutional	Low risk due to the Policy Option only placing an obligation on Member States to implement a National Access Point, which as a minimum shall provide links to existing machine readable static data relevant to MMTIPS	1	1	1
Subsidiarity	Low risk of challenge to the subsidiarity principle as the policy option limits the geographic scope to the comprehensive TEN-T network	1	1	1
Compliance	Low risk of compliance by Member States / Public Transport Operators as only existing machine readable static data will need to be linked to in the NAP.	1	1	1
MMTIPS Service Provision	No risks identified	0	0	0
Risk Score				3

Table 7 Risk Analysis - Policy Option 1B - Minimal Intervention EU Wide Transport Network

Risk Area	Risk Discussion	Impact (L/M/H) (1/2/3)	Likelihood (L/M/H) (1/2/3)	Risk Score (I x L)
Institutional	Low risk due to the Policy Option only placing an obligation on Member States to implement a National Access Point, which as a minimum shall provide links to existing machine readable static data relevant to MMTIPS	1	1	1
Subsidiarity	Medium risk of challenge to the subsidiarity principle as the policy option covers the entire Transport Network, but the obligations associated with are limited to the provision of existing machine readable data in the NAP	1	2	2
Compliance	Low risk of non-compliance by Member States / Public Transport Operators as only existing machine readable static data will need to be linked to in the NAP.	1	1	1
MMTIPS Service Provision	No risks identified	0	0	0
Risk Score				4

Table 8 Risk Analysis - Policy Option 2A - Data Focus Comprehensive TEN-T Network

Risk Area	Risk Discussion	Impact (L/M/H) (1/2/3)	Likelihood (L/M/H) (1/2/3)	Risk Score (I x L)
Institutional	Medium risk that implementation timeframes will not be adhered to due to the fact that the Policy Option will require Member States to place obligations on Public Transport Operators to comply with specified standards for both static and dynamic data. In some Member States some of these bodies will be private organisations which would seek compensation for costs associated with compliance.	2	3	6
Subsidiarity	Low risk of challenge to the subsidiarity principle as the policy option limits the geographic scope to the comprehensive TEN-T network	1	1	1
Compliance	High risk of non-compliance by Member States / Public Transport Operators as this option requires existing machine readable data feeds to be converted to specific standards and in additional Member states will have to establish and monitor a detailed quality framework within their territory	2	3	6
MMTIPS Service Provision	No risks identified	0	0	0
Risk Score				13

Table 9 Risk Analysis - Policy Option 2B - Data Focus EU Wide Transport Network

Risk Area	Risk Discussion	Impact (L/M/H) (1/2/3)	Likelihood (L/M/H) (1/2/3)	Risk Score (I x L)
Institutional	High risk that implementation timeframes will not be adhered to due to the fact that the Policy Option will require Member States to place obligations on Public Transport Operators to comply with specified standards for both static and dynamic data. In some Member States some of these bodies will be private organisations which would seek compensation for costs associated with compliance.	3	3	9
Subsidiarity	High risk of challenge to the subsidiarity principle as the policy option covers the entire Transport Network, and places obligations on all Public Transport Operators some of which will be SMEs to comply with specific data standards but the obligations associated with are limited to the provision of existing machine readable data in the NAP	3	2	6
Compliance	High risk of non-compliance by Member States / Public Transport Operators as this option requires existing machine readable data feeds to be converted to specific standards and in additional Member states will have to establish and monitor a detailed quality framework within their territory	2	3	6
MMTIPS Service Provision	No risks identified	0	0	0
Risk Score				21

Table 10 Risk Analysis - Policy Option 3A - Linking Services Comprehensive TEN-T Network

Risk Area	Risk Discussion	Impact (L/M/H) (1/2/3)	Likelihood (L/M/H) (1/2/3)	Risk Score (I x L)
Institutional	Medium risk that implementation timeframes will not be adhered to due to the fact that the Policy Option will require Member States to place obligations on MMTIPS Providers to comply with the requirement to providing linking APIs. In some Member States some of these bodies will be private organisations which would seek compensation for costs associated with compliance.	2	2	4
Subsidiarity	Low risk of challenge to the subsidiarity principle as the policy option limits the geographic scope to the comprehensive TEN-T network	1	1	1
Compliance	Low risk of non-compliance by Member States / MMTIPS Providers as only services which provide coverage for the TEN-T network will be affected, the majority of city based MMTIPS services will be unaffected, only those organisation providing services on a National or international basis will be affected.	1	2	2
MMTIPS Service Provision	Medium Risk that this option will have an adverse effect on the MMTIPS market ensuring that National MMTIPS providers will have to provide pan-European coverage squeezing out SMEs proving localised services	2	3	6
Risk Score				13

Table 11 Risk Analysis - Policy Option 3B - Linking Services EU Wide Transport Network

Risk Area	Risk Discussion	Impact (L/M/H) (1/2/3)	Likelihood (L/M/H) (1/2/3)	Risk Score (I x L)
Institutional	Medium risk that implementation timeframes will not be adhered to due to the fact that the Policy Option will require Member States to place obligations on MMTIPS Providers to comply with the requirement to providing linking APIs. In some Member States some of these bodies will be private organisations which would seek compensation for costs associated with compliance. Non-European MMTIPS service providers would not be affected by the specification.	2	3	6
Subsidiarity	Medium risk of challenge to the subsidiarity principle as the policy option covers the entire Transport Network, and will place obligations on every Journey planning service in Europe to implement and comply with CEN Open API standard	3	2	6
Compliance	High risk of non-compliance by Member States / MMTIPS Providers as all journey planning services will be affected including some services that only have a localised geographic scope such as a city or region.	3	3	9
MMTIPS Service Provision	High risk that the cost of compliance for SME MMTIPS providers will force them to withdraw their services from the market, reducing consumer choice and levels of innovation in the sector	3	3	9
Risk Score				30

Table 12 Risk Analysis - Policy Option 4A - Comprehensive Approach Comprehensive TEN-T Network

Risk Area	Risk Discussion	Impact (L/M/H) (1/2/3)	Likelihood (L/M/H) (1/2/3)	Risk Score (I x L)
Institutional	Medium risk that implementation timeframes will not be adhered to due to the fact that the Policy Option will require Member States to place obligations on Public Transport Operators to comply with specified standards for both static and dynamic data. In some Member States some of these bodies will be private organisations which would seek compensation for costs associated with compliance. In addition where there is demand MMTIPS provider must provide linking APIs.	2	2	4
Subsidiarity	Low risk of challenge to the subsidiarity principle as the policy option limits the geographic scope to the comprehensive TEN-T network	1	1	1
Compliance	Low risk of non-compliance by Member States / MMTIPS Providers as only services which provide coverage for the TEN-T network will be affected, the majority of city based MMTIPS services will be unaffected, only those organisation providing services on a National or international basis will be affected.	1	2	2
MMTIPS Service Provision	Low Risk that this option will have an adverse effect on the MMTIPS market as the geographic coverage is linked to the Comprehensive network and the requirement to link will be based on demand, and use of the CEN Open API is only recommended	1	2	2
Risk Score				9

Table 13 Risk Analysis - Policy Option 4B - Comprehensive Approach EU Wide Transport Network

Risk Area	Risk Discussion	Impact (L/M/H) (1/2/3)	Likelihood (L/M/H) (1/2/3)	Risk Score (I x L)
Institutional	Medium risk that implementation timeframes will not be adhered to due to the fact that the Policy Option will require Member States to place obligations on Public Transport Operators to comply with specified standards for both static and dynamic data. In some Member States some of these bodies will be private organisations which would seek compensation for costs associated with compliance. In addition where there is demand MMTIPS provider must provide linking APIs.	2	2	4
Subsidiarity	Medium risk of challenge to the subsidiarity principle as the policy option covers the entire Transport Network, and will place demand based obligations for linking of Journey planning services	2	2	4
Compliance	Medium risk of non-compliance by Member States / MMTIPS Providers as only linking requirements will only be required where there is a demand and is likely to have similar coverage to the comprehensive network but would include localised MMTIPS services for the nodes of the comprehensive network.	2	3	6
MMTIPS Service Provision	Low risk that the cost of compliance for SME MMTIPS providers will force them to withdraw their services from the market, reducing consumer choice and levels of innovation in the sector	2	1	2
Risk Score				16

4.6. Comparison of policy options

This section presents an assessment of the implications that the key policy options may have for the different stakeholder groups (Member States, Transport Operators, MMTIPS Providers and Users).

4.6.1. Impacts on Stakeholder Groups

Member States

The requirements of a delegated regulation of the ITS Directive are binding in their entirety and affect both the Member State directly and the relevant stakeholders.

However, Member States also have a responsibility to act in the interests of all stakeholders, and that includes the private sector and users. Consequently, increased market competitiveness can present a benefit to Member States. As a result, if the policy options result in a greater level of information being made available, then that can boost innovation and competitiveness to industry, and those benefits (in terms of quality and price) should filter through to users accessing relevant services. Furthermore, if making the necessary data available results in the identified levels of congestion savings, then it has the potential to boost the economy and network efficiency (and therefore reducing the risk to the economy in that Member States).

In a congested, carbon-conscious Europe, multimodal travel information services will be important for encouraging the use of sustainable transport and for making an efficient use of the road system in future - as reflected in Goal 9 of the EC 2011 White Paper on Transport, to "by 2020, establish the framework for a European multimodal transport information, management and payment system."

National Access Points: The Member States would be expected to bear the costs of setting up and maintaining the National Access Points. These costs would be the same under all of the policy options.

Data Exchange: The Member States would be expected to fund the one-off cost of developing a national NeTex profile and a conversion tool so that static data in the national format could be represented in the NAP in NeTex format. This cost would be incurred under Policy Options 2A and 2B (Data Focus) and 4A and 4B (Comprehensive Approach).

Quality Framework: The Member States would be expected to bear the cost of enforcement to check that the data meet the required standards. These costs would be incurred under Policy Options 2A and 2B (Data Focus) and 4A and 4B (Comprehensive Approach). Costs of checking would be expected to be greater on the EU-wide network than on the Comprehensive TEN-T network due to the larger volume of data and services requiring checks.

Linking Services: The Member States would not be expected to incur any of the costs involved in linking services.

Transport Operators

The main issue for Operators is compliance with standards for static and real-time information and any requirements relating to data quality. However, MMTIPS help operators to run their systems and reduce the costs involved when interacting with travellers (again especially during disruptions).

Broadly, the views of various stakeholders and Member States on current barriers and potential enablers were aligned, with variations based on the approach to intervention rather than objections to it. However, the sector with consistent views against possible forms of intervention was the rail industry, with a desired preference for retaining the current status quo.

Overall, there is a low risk of challenge and broad agreement that action is required to eliminate the barriers to pan European 'door-to-door' MMTIPS services. However the inclusion of accurate and comprehensive unbiased roads journey planning may be seen as a risk to business for public transport operators.

National Access Points: The Transport Operators would not be expected to bear any of the costs of setting up and running National Access Points.

Data Exchange: Transport Operators which do not already have dynamic data in SIRI format would be expected to bear the cost of providing data to the National Access Point in SIRI format. These costs would be incurred under Policy Options 2A and 2B (Data Focus) and 4A and 4B (Comprehensive Approach). Data exchange costs would be expected to be greater on the EU-wide network than on the Comprehensive TEN-T network due to the larger volume of data to be converted to SIRI.

Quality Framework: The Transport Operators would not be expected to bear any of the costs of meeting quality requirements.

Linking Services: The Transport Operators would not be expected to bear any of the costs of linking services.

MMTIPS Providers

The MMTIPS Providers are generally the group that might expect to gain the most from the enhanced availability of data on the network as there are significant challenges in obtaining data, particularly real-time data. The availability of information on a pan-

European basis potentially opens up a wider market for the private sector providers, and so reduces the level of risk to their business planning process.

Additionally a greater level of information availability can assist the innovation within the market, thus bringing further benefit to ITS Service Providers and reducing the risk of funding innovation projects. This is due to the fact that the supporting data is mandatory for a particular geographic area.

However, if data was made available through particular interfaces it could pose a risk to the private sector's sunk investment. This is because if a publically provided source becomes available for some information that was previously collected directly by the MMTIPS provider, it could make the existing data collection technique redundant.

National Access Points: The MMTIPS providers would not be expected to bear any of the costs of setting up and running National Access Points.

Data Exchange: The MMTIPS providers would not be expected to bear any of the costs involved in meeting data exchange requirements.

Quality Framework: The MMTIPS providers would be expected to bear the cost of meeting requirements for the quality of information provided. In Policy Options 2A and 2B (Data Focus) and 4A and 4B (Comprehensive Approach), it would be expected that MMTIPS providers would make minor changes to the way that data is presented, with a small initial cost. Under Policy Options 2A and 2B (Data Focus), the MMTIPS would in addition bear the cost of ensuring that the mandated data quality requirements were met.

Linking Services: The MMTIPS providers would be expected to bear the costs involved in linking services under the demand-based obligation to link in Policy Options 4A and 4B (Comprehensive Approach) and the mandate for all services to link under Policy Options 3A and 3B. These costs would be expected to be greater on the EU-wide network than on the Comprehensive TEN-T network due to the larger number of services to be linked.

Cost savings: The MMTIPS providers would be expected to benefit from cost savings in reduced data discovery (a one-off cost) and on-going savings through reductions in the number of interfaces and in data aggregation costs. These cost savings would be realised under Policy Options 2A and 2B (Data Focus) and 4A and 4B (Comprehensive Approach). In all of these scenarios, these cost savings would exceed the additional costs incurred by MMTIPS providers for linking services and meeting data quality requirements. These cost savings would be expected to be greater on the EU-wide network than on the Comprehensive TEN-T network due to the larger number of services involved.

Users

The rapid evolution of delivery systems and personal devices has greatly increased the availability and usefulness of MMTIPS to travellers. Such systems make it easy for travellers to find and use the best means of transport available (even, or perhaps especially, during disruptions). The benefits to users tend to increase when the geographical deployment coverage is extended to include the EU-wide transport network.

All of the policy options should result in MMTIPS Providers enhancing the quality of their services, and the users realising the benefits of the improved services, including reduced trip planning time and reduced delays due to disruptions on journeys.

There is expected to be a higher level of willingness to change modes amongst respondents if a greater level of multimodality is included within travel information services for comparison. These also include low-carbon modes such as cycling, rail and public transport. These modal shifts were assessed in terms of the expected reduction in congestion and improved environmental quality in urban areas.

Time saving of journey planning (static information): The time savings during journey planning would be expected to arise under all of the policy options. However, these benefits would be expected to be small in the case of Policy Option 1 (Minimal Intervention), higher under Policy Option 2 (Data Focus), and even higher under Policy Options 3 and 4 (Linking Services Focused and Comprehensive Approach). Under each policy option, the time saving benefits would be higher if coverage were the EU-wide transport network than if the coverage were restricted to the Comprehensive TEN-T network.

Time saving due to better information on disrupted journeys (dynamic information): The time savings due to better information on disrupted journeys would be expected to be minimal under Policy Option 1 (Minimal Intervention), higher under Policy Option 2 (Data Focus), and higher again under Policy Option 3 (Linking Services Focused) and highest under Policy Option 4 (Comprehensive Approach). Under each policy option, the time saving benefits would be higher if coverage were the EU-wide transport network than if the coverage were restricted to the Comprehensive TEN-T network.

Benefits of modal shift to more sustainable modes: The benefits of reduced congestion costs through modal shift to more sustainable modes were expected to be realised under all of the policy options, but to be relatively low under Policy Option 1 (Minimal Intervention), higher under Policy Option 2 (Data Focus), higher again under Policy Option 3 (Linking Services Focused) and highest under Policy Option 4 (Comprehensive Approach). Under each policy option, the benefits would be higher if coverage were the EU-wide transport network than if the coverage were restricted to the Comprehensive TEN-T network.

4.6.2. Trade-offs and synergies

This section presents a summary of the trade-offs and synergies associated with the key policy options explored in this impact assessment across the whole value chain. Each set of policy options consist of trade-offs and synergies at both a policy level and service level. The policy option groupings are summarised in Table 14.

Table 14: Policy Option Grouping

Policy Option Grouping				
Policy Option	Minimal Intervention	Data Focus	Linking Services Focused	Comprehensive Approach
National Access Points	✓	✓	✓	✓
Data Exchange				
Machine Readable	✓		✓	
Common Standards for other scheduled modes, NeTeX & SIRI for public transport		✓		✓
Quality Framework				
Recommend Basic	✓		✓	
Mandate Basic				✓
Mandate Detailed		✓		
Linking Services				
No Requirement	✓	✓		
Demand Based Linking				✓
Mandated Linking for all MMTIPS Services			✓	

Policy Option 1 – Minimal Intervention

The trade-offs and synergies are summarised in the table below:

Table 15 Policy Option 1: Trade-offs and synergies

	Trade-offs	Synergies
Policy related	<ul style="list-style-type: none"> Only static data mandated in the NAP, dynamic data remains optional 	<ul style="list-style-type: none"> Requirement for NAP in each Member State for public and private travel and traffic data Reduced costs of data discovery for MMTIPS Providers
Service related	<ul style="list-style-type: none"> Static data to be made available but not in common standard – no reduction in integration costs for MMTIPS Providers No improvement in on-trip information to Users 	<ul style="list-style-type: none"> Likely increase in the geographic coverage of MMTIPS pre-trip planning services

Policy Option 2 – Data focused

The trade-offs and synergies are summarised in the table below:

Table 16 Policy Option 2: Trade-offs and synergies

	Trade-offs	Synergies
Policy related	<ul style="list-style-type: none"> High cost of compliance for Member States and Transport Operators to comply with the data quality framework No requirements for linking services 	<ul style="list-style-type: none"> NAPs must link to all available static and dynamic data sources within the geographic scope All static and dynamic data to be in a common format
Service related	<ul style="list-style-type: none"> Quality of existing pan-European Services will be improved, but unlikely to see new market entrants 	<ul style="list-style-type: none"> Greater underlying data availability is expected to improve the quality / cost of existing services to users Greater availability of data may lead to new innovated services being developed and offered to users

Policy Options 3 – Linking Services Focused

The trade-offs and synergies are summarised in the table below:

Table 17 Policy Option 3: Trade-offs and synergies

	Trade-offs	Synergies
Policy related	<ul style="list-style-type: none"> NAPs are only required to link to static data sources Mandating of common standards only cover static data Cost of compliance for MMTIPS Providers 	<ul style="list-style-type: none"> Mandatory for all MMTIP services to link using CEN Open API standards
Service related	<ul style="list-style-type: none"> No requirements for Transport Operators to provide data – existing patchwork coverage of MMTIPS Services will remain 	<ul style="list-style-type: none"> MMTIPS Services are required to link providing 'door-to-door' services where underlying data is available

Policy Option 4 – Comprehensive Approach

The trade-offs and synergies are summarised in the table below:

Table 18 Policy Option 4: Trade-offs and synergies

	Trade-offs	Synergies
Policy related	<ul style="list-style-type: none"> NAPs are only required to link to static data sources Detailed Quality Framework is not mandated CEN Open API is not mandated 	<ul style="list-style-type: none"> NAPs must link to all available static and dynamic data sources within the geographic scope All static and dynamic data to be in a common format
Service related	<ul style="list-style-type: none"> Accuracy of under-lying data is not address so accuracy of information provided may not be improved 	<ul style="list-style-type: none"> Demand based obligation for MMTIPS Services to link to provide 'door-to-door' services

4.6.3. Assessment against objectives

This section presents the results of the assessment of how the described scenarios contribute to the specific objectives of Priority Action A relating to multi-model journey planners.

These objectives are:

- The definition of the necessary requirements to make EU-wide multimodal travel information services accurate and available across borders to ITS users, based on:
 - the availability and accessibility of existing and accurate traffic and travel data used for multimodal travel information to ITS service providers without prejudice to safety and transport management constraints
 - the facilitation of the electronic data exchange between the relevant public authorities and stakeholders and the relevant ITS service providers, across borders
 - the timely updating of available travel and traffic data used for multimodal travel information by the relevant public authorities and stakeholders
 - the timely updating of multimodal travel information by the ITS service providers.
- The definition of the necessary requirements to make road, traffic and transport services data used for digital maps accurate and available, where possible, to digital map producers and service providers, based on:
 - the facilitation of the electronic data exchange between the relevant public authorities and stakeholders and the private digital map producers and service providers
 - the timely updating of the digital maps by the digital map producers and service providers.

Each scenario was rated as follows:

- Negatively affects the objective
- 0 Does not affect the objective
- + Positively affects the objective
- ++ Contributes to achieving the objective
- +++ Strongly contributes to achieving the objective

The results are presented in Table 19.

The analysis shows that the minimum intervention policy options (1A and 1B) have the lowest alignment with the objectives of Priority Action A.

The Linking Services Policy Options (3A and 3B) score slightly higher due to the requirements for MMTIPS Services to link via a recommended standard.

The Data Focus Policy Options (2A and 2B) have the highest alignment with the objectives of Priority Action A as they address the issues of the underlying availability of public and private travel and traffic data and ensuring that this is available in a common standard in the NAPs.

The Comprehensive Approach Policy Options (4A and 4B) include recommendations for all elements of all policy measures but do not mandate in 2 key areas – availability of dynamic data and linking services and therefore the expected contribution to the objectives are lower.

For all policy options, the EU-wide transport network scope increases the level of alignment due to the greater impact on the availability of data and linking services to provide pan-European coverage.

Table 19 Assessment of Policy Options against ITS Directive Priority A Objectives²⁰

Objectives	1A	1B	2A	2B	3A	3B	4A	4B
The availability and accessibility of existing and accurate road and real-time traffic data used for multimodal travel information to ITS service providers without prejudice to safety and transport management constraints	+	++	++	+++	+	++	++	+++
The facilitation of the electronic data exchange between the relevant public authorities and stakeholders and the relevant ITS service providers, across borders			+++	+++			+++	+++
The timely updating of available road and traffic data used for multimodal travel information by the relevant public authorities and stakeholders	+	+	++	++	+	+	+	+
The timely updating of multimodal travel information by the ITS service providers			+++	+++	+++	+++	++	++
The facilitation of the electronic data exchange between the relevant public authorities and stakeholders and the private digital map producers and service providers	+	++	++	+++	+	++	++	+++
The timely updating of the digital maps by the digital map producers and service providers			+++	+++			++	++
Overall	0	+	+++	+++	+	+	++	++

4.7. Synthesis

This section provides an overview of the results of the Cost Benefit Analysis, the analysis of the scenarios against the ITS Directive Principles and objectives of Priority Action A, and the Risk Assessment.

In qualitative terms, the 'Data Focus' policy option shows more positive results than the 'Linking Services' options. The 'Data Focus' option shows greater alignment with the

²⁰ The key difference between the 'data focus' and the 'comprehensive approach' is the difference in scores for the timely updating of the travel and traffic data and travel information services which is more specific and detailed in the data focus option.

principles of the ITS Directive and objectives of Priority Action A and lower levels of risk. However it has a lower Benefit Cost Ratio than the 'Linking Services' option.

The 'Comprehensive Approach' option, although slightly less well aligned with the principles of the ITS Directive and the objectives of Priority Action A than the 'Data Focus' option and involving slightly higher levels of risk, provides greater benefits to End Users than all of the other policy options. On both the Comprehensive TEN-T network and the EU-wide network, costs would also be lower than for the 'Data Focus' and 'Linking Services' options, due to the less rigorous requirements for data quality and linking only on the basis of demand in the case of the 'Comprehensive Approach' option. Thus the results indicate that the Benefit Cost Ratios and Net Present Values would be higher in the case of the 'Comprehensive Approach' option than for the other options; the values would be higher for the Comprehensive TEN-T network scenario than for the EU-wide transport network because the additional benefits achieved on the EU-wide network would be less than the additional costs involved in meeting requirements for data exchange and linking for all services.

If the 'Minimal Intervention' option were selected, this would only have a benefit cost ratio of greater than 3.0 if implemented on the EU-wide network. Similarly, the 'Data Focus' option would only have a BCR of greater than 3.0 on the EU-wide network. In both cases this is because the Benefit Cost Ratio below the threshold that would normally be considered for investment decisions, with relatively low benefits in relation to the scale of the costs on the Comprehensive TEN-network.

Policy options with Benefit Cost Ratios less than 3 would not be expected to be taken forward for further consideration. There are six policy options with Benefit Cost Ratios greater than 3:

- 'Comprehensive Approach' on the Comprehensive TEN-T network - has the highest Benefit Cost Ratio, the third highest Net Present Value, good alignment with the principles of the ITS Directive, and contributes to achieving the objectives of Priority Action A, with a slightly higher level of risk
- 'Comprehensive Approach' on the EU-wide transport network - has the second highest Benefit Cost Ratio only slightly lower than 4A, so in budgetary terms is an option to be considered, while it is also the option that is best aligned with the principles of the ITS Directive and contributes to the objectives of Priority Action A; however it involves higher risk to stakeholders due to the cost of transport operators meeting SIRI standards
- Compared with the Comprehensive Approach, the 'Linking Services' options have lower Benefit Cost Ratios, are less well aligned with the principles of the TIS Directive, make less contribution to the objectives of Priority Action A and in the case of the EU-wide network, involve greater risk due to the costs associated with the linking services where there is little demand; the assessment results for these options are similar on the Comprehensive TEN-T network and the EU-wide transport network
- 'Minimal Intervention' on the EU-wide transport network - has a similar Benefit Cost Ratio to the 'Linking Services' options but is less well aligned with the principles of the ITS Directive than other options, makes only a small contribution to the objectives of Priority Action A and has a relatively low Net Present Value of €1 million per Member State per year so is not recommended
- 2B – Data Focus on the EU-wide transport network – has the sixth highest Benefit Cost Ratio, but has the highest level of contribution to the objectives of Priority Action A and aligns well with the principles of the ITS Directive, with no obvious

risks involved. The main difference between this and Option 4B is the high cost associated with mandating the detailed elements of data quality without much additional benefit.

Table 20 Overall Assessment of the Policy Options²¹

	1A	1B	2A	2B	3A	3B	4A	4B
Accrued benefits 2016 - 2030 (EU-28)								
i. Time saving of journey planning (static information)	€11,278,181	€22,556,362	€112,781,809	€225,563,619	€281,954,523	€563,909,046	€281,954,523	€563,909,046
ii. Time saving due to better information on disrupted journeys (dynamic info)	€264,596	€529,192	€2,645,958	€5,291,916	€3,307,448	€6,614,895	€6,614,895	€13,229,791
iii. Benefits of modal shift to more sustainable modes	€6,186,951	€12,373,903	€61,869,515	€123,739,030	€77,336,894	€154,673,787	€154,673,787	€309,347,575
iv. Cost savings to MMTIPS service providers	€0	€0	€127,080,541	€201,785,928	€0	€0	€127,080,541	€201,785,928
Total benefits (EU-28)	€17,729,728	€35,459,456	€304,377,823	€556,380,493	€362,598,864	€725,197,729	€570,323,747	€1,088,272,340
Accrued costs 2016 - 2030 (EU-28)								
i. NAPs	€8,043,949	€8,043,949	€8,043,949	€8,043,949	€8,043,949	€8,043,949	€8,043,949	€8,043,949
ii. Data exchange - meeting standards NeTEx and SIRI	€0	€0	€1,519,393	€25,661,266	€0	€0	€1,519,393	€25,661,266
iii-a. Data quality - Mandate basic elements	€0	€0	€226,868	€226,868	€0	€0	€226,868	€226,868
iii-b. Data quality - Mandate detailed elements	€0	€0	€120,028,625	€120,028,625	€0	€0	€0	€0
iv-a. Linking - Demand-based obligation for services to link	€0	€0	€0	€0	€0	€0	€35,944,173	€71,888,345
iv-b. Linking - Mandatory for all services to link	€0	€0	€0	€0	€711,888,345	€143,776,691	€0	€0
Total costs (EU-28)	€8,043,949	€8,043,949	€129,818,835	€153,960,708	€79,932,294	€151,820,639	€45,734,383	€105,820,428
BCR	2.2	4.4	2.3	3.6	4.5	4.8	12.5	10.3
NPV (total benefits minus total costs)	€9,685,780	€27,415,508	€174,558,988	€402,419,785	€282,666,571	€573,377,090	€524,589,364	€982,451,912

²¹ This assessment demonstrates that the highest CBA ratios lie with the comprehensive option '4' and the highest amount of benefits with option '4b'

ITS Directive Principles	0.7	0.8	2.8	2.4	2.0	2.5	2.4	2.9
Risk Assessment Score	3	4	13	21	13	30	9	16
Priority Action A Objectives	0	+	+++	+++	+	+	++	++

5. Monitoring and Evaluation KPIs

To enable the effectiveness of the adoption of the specifications related to the availability of static and dynamic data on public transport and other real time traffic and travel information within the scope of Priority Action A MMTIPS, it is necessary to propose and define a set of measurable indicators. These indicators will be used to identify the progress made in reaching the operational objectives.

5.1. Operational objectives

The following draft operational objectives have been defined for each of the identified elements of the specifications that were considered in this study.

The exact selection of the operational objectives can only be made once the content of the specification for Action A MMTIPS is finalised and should be considered in the light of how they contribute to the overall policy objectives:

- National Access Points
 - Operational Objective NAP1 - National Access points for public and private travel and traffic data shall be established by 20xx and these shall constitute a single point of access for users to at least the static travel and traffic data and historic traffic data of different transport modes, including data updates (Policy Options 1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B)
 - Operational Objective NAP2 - Member States shall define a common national approach for metadata that will facilitate data discovery within the National Access Point (Policy Options 1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B)
 - Operational Objective NAP3 - Member States will ensure that Data Owners provide the appropriate metadata in order to allow users to discover and use the datasets to which access is provided through the NAP (Policy Options 1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B)
- Data Exchange
 - Operational Objective DE1 - Member States shall establish a national NeTEx profile for static data in the NAP by 20xx (Policy Options 2A, 2B, 4A, 4B)
 - Operational Objective DE2 - Member States shall establish a national SIRI profile for dynamic data in the NAP by 20xx (Policy Options 2A, 2B, 4A, 4B)
 - Operational Objective DE3 - Machine readable static data in the NAP should be converted to NeTEx by 20xx (Policy Options 2A, 2B, 4A, 4B)
 - Operational Objective DE4 - Machine readable dynamic data in the NAP should be converted to SIRI by 20xx (Policy Options 2A, 2B, 4A, 4B)
- Quality Framework
 - Operational Objective QF1 - Member States shall establish a national quality framework which shall be used in the metadata descriptions within the NAP (Policy Options 1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B)
 - Operational Objective QF2 - Member States shall introduce a self-declaration scheme for the quality of travel and traffic data sets (Policy Options 1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B)
 - Operational Objective QF3 - Member States shall establish national requirements for the timeliness of updates to public and private travel and traffic data accessed via the NAP (Policy Options 2A, 2B).

- Linking Services
 - Operational Objective LS1 - To facilitate 'door-to-door' routing local, regional and national travel multimodal travel information services, Member States should support the adoption of the CEN Open API as a mechanism for linking MMTIPS Services within their territory (Policy Options 3A, 3B, 4A, 4B)
 - Operational Objective LS2 - Member States shall establish a monitoring mechanism to ensure that requests to link are dealt with by MMTIPS Providers in their territory in a timely manner (Policy Options 3A, 3B, 4A, 4B).

5.2. Ex-post monitoring indicators

In order to monitor Member States' progression towards achieving the above operational objectives, a number of potential indicators have been identified for each operational objective. These are presented in Table 21 below.

The exact selection of monitoring indicators to be used will be dependent on the contents of the Specifications that are prepared under Priority Action A of the ITS Directive.

Table 21 Operational objectives and proposed indicators for monitoring

Operational objective	Indicator	Contribution to operational objective	Achievability
Operational Objective NAP1 - National Access points for public and private travel and traffic data shall be established by 20xx and these shall constitute a single point of access for users to at least the static travel and traffic data and historic traffic data of different transport modes, including data updates	<ul style="list-style-type: none"> • Date of implementation of NAP 	Date of implementation, allows deployment curve to be generated	Date of implementation
	<ul style="list-style-type: none"> • Number of Static Data Sources in the NAP 	Indicator that provides an overview of the number of static data sources in the NAP and the evolution over time	Simple total of the number of static data sources in the NAP
	<ul style="list-style-type: none"> • Number of Dynamic Data Sources in the NAP 	Indicator that provides an overview of the number of dynamic data sources in the NAP and the evolution over time	Simple total of the number of dynamic data sources in the NAP
	<ul style="list-style-type: none"> • Number of unique visitors to the NAP in the last 12 month period 	Indicator which provides an indication of the level of usage of the NAP	Should be simple to obtain from NAP web statistics
Operational Objective NAP2 - Member States shall define a common national approach for metadata that will facilitate data discovery within the National Access Point	<ul style="list-style-type: none"> • Date of publication of metadata standards 	Date of implementation, allows deployment curve to be generated	Date of Publication
Operational Objective NAP3 - Member States will ensure that Data Owners provide the appropriate metadata in order to allow users to discover and use the datasets to which access is provided through the NAP	<ul style="list-style-type: none"> • % of Transport Data Owners who populate metadata 	Indicator that provides an indication of the discoverability of data sets in the NAP	Should be simple to obtain from analysis of the metadata records in the NAP
	<ul style="list-style-type: none"> • % of data sets in the NAP where the metadata is complete 	Indicator that provides an indication of the discoverability of data sets in the NAP	Should be simple to obtain from analysis of the metadata records in the NAP
	<ul style="list-style-type: none"> • % of data sets in the NAP where the metadata has been updated in the last 12 months 	Indicator that provides an overview of the timeliness of updates to datasets in the NAP	Should be simple to obtain from analysis of the metadata records in the NAP

Operational objective	Indicator	Contribution to operational objective	Achievability
Operational Objective DE1 - Member States shall establish a national NeTEx profile for static data in the NAP by 20xx	<ul style="list-style-type: none"> Date of publication of national NeTEx profile 	Date of Publication	Date of Publication
Operational Objective DE2 - Member States shall establish a national SIRI profile for dynamic data in the NAP by 20xx.	<ul style="list-style-type: none"> Date of publication of national SIRI profile 	Date of Publication	Date of Publication
Operational Objective DE3 - Machine readable static data in the NAP should be converted to NeTEx by 20xx	<ul style="list-style-type: none"> % of static data sources available in NeTEx 	Indicator which provides an indication of the deployment progress for transition to NeTEx	Should be simple to obtain from analysis of the metadata records in the NAP
	<ul style="list-style-type: none"> Number of NeTEx data feeds in NAP 	High level indicator of the number of NeTEx feeds in the NAP	Should be simple to obtain from analysis of the metadata records in the NAP
	<ul style="list-style-type: none"> % of Transport network by mode where static data is available in NeTEx 	High level indicator providing an overview of the geographic coverage of the static data fields	This should be relatively straight forward for Member States to collate and report
Operational Objective DE4 - Machine readable dynamic data in the NAP should be converted to SIRI by 20xx	<ul style="list-style-type: none"> % of static data sources available in SIRI 	Indicator which provides an indication of the deployment progress for transition to SIRI	Should be simple to obtain from analysis of the metadata records in the NAP
	<ul style="list-style-type: none"> Number of SIRI data feeds in NAP 	High level indicator of the number of SIRI feeds in the NAP	Should be simple to obtain from analysis of the metadata records in the NAP
	<ul style="list-style-type: none"> % of Transport network by mode where static data is available in SIRI 	High level indicator providing an overview of the geographic coverage of the dynamic data fields	This should be relatively straight forward for Member States to collate and report
Operational Objective QF1 - Member States shall establish a national quality framework which shall be used in the metadata descriptions within the NAP	<ul style="list-style-type: none"> Date of Publication 	Date of Publication	Date of Publication

Operational objective	Indicator	Contribution to operational objective	Achievability
Operational Objective QF2 – Member States shall introduce a self-declaration scheme for the quality of traffic and travel data sets.	<ul style="list-style-type: none"> % of data sets in the NAP for which the which quality metadata has been completed 	Indicator which provides an indication of the quality of the data discovery within the NAP	This should be relatively straight forward for Member States to collate and report
Operational Objective QF3 – Member States shall establish national requirements for the timeliness of updates to traffic and travel data accessed via the NAP.	<ul style="list-style-type: none"> % of static data sources in the NAP which meet the national timeliness updates 	Indicator which provides an indication of the quality of the static data within the NAP	Should be an output from the quality regime based on Transport Data Owner self-declaration
	<ul style="list-style-type: none"> % of dynamic data sources in the NAP which meet the national timeliness updates 	Indicator which provides an indication of the quality of the dynamic data within the NAP	Should be an output from the quality regime based on Transport Data Owner self-declaration
Operational Objective LS1 - To facilitate ‘door-to-door’ routing local, regional and national travel multimodal travel information services, Member States should support the adoption of the CEN Open API as a mechanism for linking MMTIPS Services within their territory.	<ul style="list-style-type: none"> Number of MMTIPS providers providing CEN Open API 	High level indicator which provides evidence of the level of adoption of CEN Open API	Simple List
	<ul style="list-style-type: none"> Number of linking requests by source country 	High level indicator which will provide an overview of the demand for linking services	Should be straightforward for Member States to collate
	<ul style="list-style-type: none"> Proportion of transport network (by mode) covered by CEN Open API services 	High level indicator which provides evidence of the level of adoption of CEN Open API with respect to geographical coverage	This should be relatively straight forward for Member States to collate and report
Operational Objective LS2 - Member States shall establish a monitoring mechanism to ensure that requests to link are dealt with by MMTIPS Providers in their territory in a timely manner	<ul style="list-style-type: none"> % of linking requests dealt in accordance with national guidance 	Indicator which provides a measure of whether linking requests are being dealt with in a timely manner	Should be straightforward for Member States to collate

5.3. Monitoring means

There are a number of alternatives for monitoring the above indicators and for some indicators it may be more efficient to monitor the indicators centrally rather than for each Member State to establish a separate reporting function.

5.4. Reporting results

Typically Member States are required to report annually on progress towards the achievement with the specifications prepared under the ITS Directive. It is recommended that the following indicators (if taken forward within the specification) are reported annually by Member States to the European Commission:

- Date of implementation of NAP
- Number of Static Data Sources in the NAP
- Number of Dynamic Data Sources in the NAP
- Number of unique visitors to the NAP in the last 12 month period
- Date of publication of metadata standards
- % of Transport Data Owners who populate metadata
- % of data sets in the NAP where the metadata is complete
- % of data sets in the NAP where the metadata has been updated in the last 12 months
- Date of publication of national NeTEx profile
- Date of publication of national SIRI profile
- % of static data sources available in NeTEx
- Number of NeTEx data feeds in NAP
- % of Transport network by mode where static data is available in NeTEx
- % of static data sources available in SIRI
- Number of SIRI data feeds in NAP
- % of Transport network by mode where static data is available in SIRI
- Date of publication
- % of data sets in the NAP for which the which quality metadata has been completed
- % of static data sources in the NAP which meet the national timeliness updates
- % of dynamic data sources in the NAP which meet the national timeliness updates
- Number of MMTIPS providers providing CEN Open API
- Number of linking requests by source country
- Proportion of transport network (by Mode) covered by CEN Open API services
- % of linking requests dealt in accordance with national guidance

6. Conclusions and Recommendations

6.1. Considerations for Priority Action A policy specifications

The following recommendations can be made based on the balance of representations from stakeholders made during Task 2 of the project and from the Cost Benefit Analysis and impact assessment of policy options carried out in Task 3 and summarised in this report.

All recommendations are based on their application to pre-existing data and do not relate to the creation of new data to address coverage gaps as this is beyond the scope of the policy specifications – but is covered in part within Section 6.2.

6.1.1. Establishing a Collaborative Forum

Establishing a collaborative forum where public and private stakeholders that are involved in the provision of MMTIPS Services and the underlying travel and traffic data find a platform to regularly discuss technical, organisational and legal issues would allow for the gradual incorporation of new technologies, development of new cooperation models, coordinated development of new data coding, location coding and quality standards, etc.

This forum could act as a governing body, enabling Member States, public transport operators, ITS Service Providers and Users to discuss and agree the scope and direction of any pan-European MMTIPS Services, supporting the more rapid development of coordinated MMTIPS services which meet the requirements of both Users and Transport Operators. The forums should be open to public and private organisations and should encourage newcomers (SMEs) to join.

It is expected that the introduction of such a forum would accelerate deployment and market development, by bringing together the actors required to agree and coordinate the delivery of services which meet the compatible goals of the actors involved.

The benefit of adopting a community based approach to defining the governance framework and overseeing the delivery of services, is that the whole value chain (and not just a sub-set such as Member State representatives or major Public Transport Operators) has the opportunity to contribute their views and expertise. This approach helps to reduce the risk of different stakeholders feeling isolated and disconnected from the developments, and subsequently can help to raise the profile of the outputs of the governance framework with the wider community. Additionally, a more consensus led approach allows any proposed outputs to be market tested with members of the stakeholder community during the development phase.

The recommendations are as follows:

- 1) Establish a forum where public and private stakeholders in the Multi Modal Traveller Information and Planning systems and Services find a platform to regularly discuss technical, organisational and legal issues concerning the development of MMTIPS services in Europe.
- 2) The forum should be open to public and private organisations and should encourage newcomers to join.

6.1.2. Dataset and minimum functions to provide comprehensive MMTIPs

- 3) The data needed to provide useful services potentially includes the domains:

Function	Data
Map data	Provides a topological geographical spatial context

Function	Data
Public transport network information	Describes access nodes (stations, stops, car parks etc., and their accessibility properties), network topology, lines, tariff zones
Road network data	Includes nodes, links, direction, number of lanes, capacity and turn constraints, speed limits and vehicle and other restrictions
Pedestrian and cycle path data	Nodes and links, including attributes for the quality of accessibility, cycle friendliness, etc.
Place data	Descriptions of the destinations that end users may seek to travel to, (e.g. addresses, map points, post codes, places of interest, with accessibility) and their relation to named localities such as counties, towns and villages (i.e. gazetteer).
Timetables	Information relating to the routings and timings of scheduled services, potentially including last minute changes, facilities and accessibility of vehicles providing services. This requires the ability to specify precise temporal conditions as to when services do/do not operate.
Available facilities at stop and on board	WCs, accessible WCs, communications, buffets, etc.
Public Transport Real-time data	Vehicle positions with resulting predicted arrival and departure times, control actions to cancel or divert services.
Road travel time data	Includes historic, real time observations and real-time future predictions (e.g. link average speeds or travel times, journey time reliability, queue lengths, etc.)
Planned and unplanned disruptions	Disruptions affecting scheduled services and road networks (e.g. major events, planned engineering works, incidents, weather-related and other disruptions) and their implications for the transport networks.
Road tolls/charging	Tariffs, times, locations, access times, "vehicle" park charges, facilities.
Basic fare data	Describes products and conditions (e.g. fare structures by zone, segment, route, time period etc., fare products (single, return, eligible user types, purchase conditions, conditions of use, etc.).
Fare distribution data	Identifies where and how products may be purchased (e.g. distribution channels, payment methods associated with fare products etc.).
Fare Prices	Standard products, special products, special offers, etc.
Self-organised services	On demand services such as taxis, matatu ("fill up and go"), bicycle hire, car sharing etc. (e.g. pick up locations, payment methods, conditions of use, charges) – and accompanying real-time data on availability of resources for which there is competitive demand (e.g. cycles, return slots, charging/refuelling points, etc.).
Flexible / Demand responsive public transport services	Services that run to flexible routes or at flexible times according to demand (e.g. areas covered, times of operation, methods for ordering).
Historic data	Data generated by recording real-time data for use in predictions of travel time and assessing reliability and schedule adherence (e.g. day types, historic arrival and departure times, historic road link and travel times).
Personal data	Data on preferred locations and journeys, eligibility for fare products, current location, etc. Normally this will be generated by use of a service - and will be subject to privacy considerations. Certain types of user generated data can be aggregated and anonymized to create useful data feeds (e.g. floating car data from mobile phones).
Current pollution levels	e.g. NOx levels, particulates, etc. that may affect choice of route or even the decision to travel.

Function	Data
Information service demand data	Anonymized logs of the queries made by end-users using information services; these can be used to analyse users' information needs and also to determine how people are intending to travel at specific times – this provides an additional insight into demand for transport and can be used to predict crowding and availability.

- 4) The European Commission should promote data collation and management for those geographic and modal 'holes' in the Comprehensive TEN-T network.

6.1.3. Access to data: National Access Points

It should be recognised that whilst there is a great deal of support for making data more consistently available there was a large majority of stakeholders who objected to the view that Access Points should be mandated. However within the detail of their responses it is evident that a reasonable proportion of these are cautiously in agreement with the approach, subject to them being mandated at the right administrative level and with flexibility on how they are implemented. Access to data is more important and more fundamental than linking travel information services for enabling MMTIPS; furthermore some access to data e.g. stops and handover points is needed to provide the commonality to support any form of linked service.

Therefore the recommendation is:

- 5) The European Commission should mandate the provision of a National Access Point for each Member State. This should be done in consideration of the following:
- a) Flexibility should be provided for Member States in the National Access Point approach they select. For example:
 - i) This may expand on the existing National Access Points being established as a requirement under delegated acts for other Priority Action areas
 - ii) This may act (in part) as a registry linking to regional or city Access Points which already exist
 - iii) This could take the form of a data marketplace or alternative model
 - iv) Member States could share an Access Point which covers more than one country
 - v) Member States should be recommended to provide multi-lingual search and descriptor facilities within their Access Points
 - b) A European level registry which provides a portal linking to the 28 Member State Access Points should be also established to aid third party data users; promotion of the pan-European data portal by the European Commission would provide an existing access point for data discovery from all data portals. The European Commission could also provide a European wide web site discovery portal for MMTIPS, defining key characteristics such as geographic coverage, modes and functions and with an accreditation scheme to rate the quality of services.
 - c) A common metadata standard for information in the National Access Points should be established so that the metadata in the National Access Points can be described in a common way

6.1.4. Terms & conditions of data re-use

Support for a set of common terms and conditions which could be used for data use were well supported within the consultation. As there are some regional variances on

the extent to which these should also apply to the private sector it would be reasonable to propose that these are for recommended use only.

Therefore the recommendation is:

- 6) The European Commission should recommend that Member States establish a set of model terms and conditions for use by the public and private sector whilst allowing flexibility for other approaches to be taken. An appropriate baseline for these terms could be an open licence such as the UK Open Government Licence which a number of organisations (including beyond UK) have stated was the foundation of their terms or open Creative Commons (CC) licences.

Specific points which should be covered within these model terms include:

- a. A non-ambiguous definition of the term "fair and non-discriminatory access".
- b. Where operational costs are being charged for data by a public sector organisation, the calculations behind these costs should be transparent.
- c. A provision for misuse which includes damaging the reputation of the data provider
- d. A provision for definition of the feedback loop for highlighting issues identified with data
- e. An optional clause on attribution of the source (e.g. Transport for London approach)
- f. Rights or limitations on any other intellectual property rights (e.g. operator logos)
- g. Rights or limitations on the resale of the data
- h. Notice period for discontinuation of data supply or access
- i. Warranties, obligations and liabilities relating to data re-use.

6.1.5. Scope of data standards and data exchange

There are a number of gaps in coverage of standards for data that should be addressed; specifically non-geographic static and dynamic data for modes other than rail and private car/ road traffic and those arising from organisations which are not in the public sector – which in many Member States will include transport operators.

There was a strong sense from stakeholders that they would prefer the EC to recommend preferred common standards for data exchange rather than to mandate them. Stakeholders want a degree of flexibility, but would welcome direction on which common API to invest in.

Mandating Pan-EU harmonisation is seen as unnecessary with concerns raised that this may constrain the development of local and regional markets, especially where there is a stable established infrastructure already using open specifications. Many data consuming services are local and do not need wider harmonisation. Those that are, will normally be able to cope with a small number of parallel recommended common specifications. However the recommendation of specific common standards would be helpful in reducing the overall number of formats in use and in making more effective procurement decisions.

To avoid recommending or mandating standards to a degree which is uneconomic for stakeholders in the information chain to support, it will be important to identify minimal profiles of those standards which are more cost effective to adopt.

Whilst the use of common data standards for sharing data sets (or APIs) is supported, it is recognised that upstream data management tools and systems would continue to use existing bespoke or national formats for the foreseeable future (e.g. many of these have a 10-15 year typical system replacement cycle).

Therefore the recommendations are:

- 7) The European Commission should seek to influence standards organisations with a view to addressing the gaps in coverage of data, particularly static and dynamic data for modes other than rail and road, and data from organisations which are not in the public sector.
- 8) A set of preferred data formats and protocols should be recommended for use when exchanging data for travel and traffic information:
 - a) Compliance with Transmodel as a conceptual model
 - b) GDF/ OGC/ ISO19000
 - c) NeTEx (with additional mappings to GTFS)
 - d) SIRI
 - e) DATEX II
 - f) TPEG
 - g) In addition, specific modal standards SSIM (air), and some parts of XML TAP/TSI (rail) may be appropriate.
- 9) Compliance with EU legislation should ensure that an appropriate level of accessibility (data to meet the needs of Persons with Reduced Mobility) is enforced in the policy specifications.
- 10) Member States should develop a national travel information profile for NeTEx to define a common subset for timetable exchange which is simple to use yet in line with wider travel and traffic data standards, and create a tool for converting data to match this national profile.

6.1.6. Linking travel information services

The stakeholders consulted were broadly supportive of the principle of linking existing travel information services but it was clear that this should be on the basis of using the best fit solution to the local situation (for example the specific topology of the networks covered). At the same time there was a stated desire from some leading experts that direction from the European Commission on a preferred standard for this would be well received and would provide confidence for investment decisions.

Stakeholders also discussed the importance of prioritising the linking of existing travel information systems in areas where it is known there is demand from cross-border travellers (e.g. frequent commuters). There were concerns raised about investing in providing this inter-system functionality in areas where there is little or no demand for it, because this might divert resources from other areas of research and development.

Therefore the recommendations are:

- 11) The European Commission should recommend the use of the CEN standard for open distributed journey planning (once finalised) as the preferred method for linking travel information services. However flexibility should be given to information service providers to use alternative approaches where they prefer.
- 12) Travel information services should be obliged to provide API access to their systems where a reasonable business case can be made that it is justifiable to do so. Costs for providing this access can be charged, in a transparent manner, with agreement to third party users requesting access. If a third party is willing to pay the costs of access then it is reasonable to assume that a business case exists for accessing that data.

6.1.7. Data and information service quality

There is broad support among stakeholders for the view that the current quality of services is inconsistent and for measures to help address this. The list of measures which can be applied to enhance this is lengthy and there is no 'silver bullet' solution which can be simply prescribed.

Measures from Section 6.1.5 recommending harmonisation and uptake of common data and interface standards would instil greater data preparation and validation discipline.

Furthermore, measures detailed above in Section 6.1.4 would seek to improve terms and conditions of data re-use, including service levels and feedback loops for data correction.

There is good recognition that if intervention measures are taken which if successful will result in the further uptake of systems and coverage of MMTIPS, then market forces will help to ensure that it is the highest quality services which thrive and thus an upward self-improving cycle will be under way.

Therefore the recommendations are:

- 13) Member States should establish a minimum set schedule for releasing updated static data sets and data providers should be mandated to commit to meeting this schedule. The schedule may vary depending on the data concerned (e.g. monthly for timetables, annually for address data). However data providers should be recommended to make data available within three days of when changes occur. Emergency timetables, as say after flooding or major infrastructure disruptions are needed on a daily basis.
- 14) The Commission should recommend the establishment of feedback processes by data owners and users for highlighting issues in information provided or source data; these should be present at all stages of the travel information service chain. The onus should be on data correction at source wherever possible.
- 15) Where dynamic data is provided, there should be a mandate to ensure that data providers make such data available on an equitable basis, i.e. of a quality of content and quality of service equivalent to that available to their internal systems.
- 16) Data providers should be transparent with any known issues with a data set or data feed. For example, by providing supporting information and meta data meeting common standards to National Access Points.
- 17) A set of guidelines should be commissioned on data and information quality standards which clearly set out a minimum expected level and a recommended level. These should cover both the accuracy of the data content and in the case of real-time feeds, the quality of service of the systems delivering the data.

Beyond the specification for Priority Action A there is a wide range of quality improvement measures which the European Commission can provide leadership on. These are explored within the further recommendations within Section 6.2.

6.1.8. Geographic coverage

The stakeholder view was that geographic coverage within the policy specifications should be for the Comprehensive TEN-T network at a minimum, however there was also a small majority in favour of covering the EU-wide 'door-to-door' transport network.

However apart from the case of Policy Option 4 (Comprehensive Approach) this majority view is not supported by the impact assessment; the assessment results for the other policy options tended to be better in the case of implementation on the EU-wide transport network than on the Comprehensive TEN-T network.

One option would be to offer flexibility to Member States to enable them to apply the delegated regulations to that level of higher granularity.

The recommendation is that:

- 18) If Policy Option 4 (Comprehensive Approach) is selected, this should initially be mandated for the Comprehensive TEN-T network, with the option for Member States to apply the delegated regulations to the EU-wide network if they wish.
- 19) If Policy Option 1 or 2 is selected, this should be mandated for the EU-wide transport network.

6.1.9. Monitoring framework and KPIs

To enable the effectiveness of the adoption of the specifications related to the availability of static and dynamic data on public transport and other real time traffic and travel information within the scope of Priority Action A MMTIPS, it is necessary to propose and define a set of measurable indicators. These indicators will be used to identify the progress made in reaching the operational objectives.

Monitoring of the operational objectives can be achieved through a combination of Member State reporting and monitoring by the Governance Bodies.

The recommendations are as follows:

- 20) Agree a common subset of the proposed KPIs that are relevant to the Policy interventions that are taken forward.
- 21) Establish a monitoring system based on Member State and 3rd Party reporting, and monitoring of indicators by the Governance Bodies.

6.2. Further considerations for the European Commission

Beyond the immediate definition of the policy specification for Priority Action A there are several themes which have emerged from the stakeholder consultation which should be considered by the European Commission. These can be categorised into four distinct areas:

1. A co-operative research programme
2. Exchange of best practice between stakeholders
3. Funding
4. Continued review and renewal of common standards.

As the findings of the public consultation reported in Fell (2016) showed, there is an equal request for support across the first three of these categories. The fourth is an area which was raised several times within the workshop and the qualitative responses to the public consultation.

6.2.1. Co-operative research

The study has identified recurring requests from associations, technical experts and transport authority stakeholders in particular for further co-funded research into specific topics that would contribute to the broader aims associated with Priority Action A.

Therefore the recommendations are:

- 22) Quality improvement
 - a) Establishment of a MMTIPS specific data and information service quality framework.
 - b) Development of open-source software to automate data quality checks.
- 23) Data discovery improvement: improving 'semantic interoperability' across Member States to provide common terminology, building on initial work informally under way between some of the leading public administrations in this field.

- 24) Progressing the linking of travel information services on the basis of demand
- a) Development of an EU roadmap for improving passenger multimodality and geographic coverage. This would fund the necessary research to provide empirical data and relevant information for viable service linkages to be realised. This roadmap would identify key European multimodal passenger corridors to bring together public and private resources, and align existing initiatives.
 - b) Targeted cross-border partnering pilots and demonstration projects linking travel information systems in order to provide a desirable level of geographic and modal coverage.
- 25) Software to support data management
- a) Development of open source data visualisation and conformance tools to aid the preparation of data in recommended common European data formats.
 - b) Development of simple but sufficient multilingual open-source software, supported by local data management processes to provide a cost effective measure for producing multimodal data in those parts of the European Union where data coverage is weak.
- 26) Business models and business case for public authorities and transport operators:
- a) Investigate current successful business models between Public Transport Operators, private sector service providers and the users/travellers that have led to investment into data quality and access and therefore improving service quality.
 - b) Research into the business cases for data collection, development and exploitation which can be promoted to enhance overall data quality, availability and consistency.

6.2.2. Exchange of best practice

The study identified requests from stakeholders, particularly those not currently at the forefront of MMTIPS provision, for a supporting programme of best practice exchange. These requests have been reviewed against the barriers involved and refined accordingly.

The recommendations are:

- 27) The European Commission should provide support for training programmes and materials to upskill technicians' understanding and abilities in dealing with common standards for data formats and exchange protocols.
- 28) The European Commission should create opportunities for Member States and transport authorities (in particular) to share best practice in data management and data accessibility.
- 29) The European Commission should develop guidance materials for Member States, transport authorities, transport operators and travel information service providers to support the implementation of the Priority Action A specifications.
- 30) A European registry of information to support the requirements of the Priority Action A specifications should be established. This would include links to relevant data standards, supporting and guidance materials.

6.2.3. Funding

This issue is cross cutting across these areas of potential further support and action but is also a concern among the consultation responses from many transport authorities and Member States, in a climate of reduced public expenditure. Beyond the separately identified recommendations, funding might be used to incentivise conformance with the

non-prescribed elements of the policy specifications and to co-fund modal and geographic gaps in data availability.

The recommendation is:

- 31) The European Commission should provide match funding for improving data quality and coverage – particularly in Eastern and Southern Europe.

6.2.4. Continued standards development and engagement

A concern of experts at the forefront of European data standardisation is the risk of common data standards lagging behind innovations within the market.

The recommendations are:

- 32) Review and maintenance of European common standards. A concern raised in the consultation was the potential uncertainty of the long term relevancy of common data standards that needs to be considered when mandating or recommending them. A repeated view was that the current review process for CEN standards was insufficient and that additional investment was required to ensure continual involvement of experts and Member States to ensure continued relevancy. A particular area of concern from the CEN committee is a support organisation for the continued maintenance and support of NeTEx and SIRI²². Responsibilities of this organisation would include:
- Technical artefact maintenance
 - Commissioning of validation tools and test platform
 - Technical support and advice (particularly with the preparation of subset profiles)
- 33) International engagement with standards: To ensure compatibility with international developments in travel information (and the ability of European companies to compete internationally) it will be valuable for the European standards scene to be engaged with and aligned with any emerging global standards, such as those developed by ISO.
- 34) Further standards work in aligning DATEX II and NeTEx/Transmodel to aid the integration of data in the future.
- 35) Engagement with the private sector regarding 'de facto standards': It was highlighted in the consultation that there would be value in engagement with the industry regarding inter-operability between the identified common standards and existing de facto standards e.g. GTFS.

²² CEN TC 278 WG3 SG9, 'Proposal and requirements for a NeTEx & SIRI support organization'

Appendix A Glossary of Terms

This Glossary of Terms has been developed during the course of the project, and includes terms not mentioned specifically in this report.

Access to data	The extent to which a data user can obtain suitable data at the time it is needed. Elements to be assessed in this study are arrangements for allowing access to data, including time frames, charging, conditions of use, validity of data, continuity of service etc.
Access Point (for data)	A digital interface where data together with its corresponding metadata are made accessible to users, either from a local store, or by redirection to other external sources. Access points may provide protocols to access both static and dynamic data.
Accessibility	The properties of accessibility of a site or vehicle for users with special needs, such as PRMs, travellers with baggage, etc.
Address	A traditional locating system using relative positions on road network features to pinpoint spatial positions. May be augmented by Postcodes as a concise approximation.
Adjacent-region	A federated region of a distributed journey planning system which is physically contiguous to the local region.
Administrative zone (for data)	Under a distributed system for managing data, stakeholders in different localities are responsible for collecting and aggregating the data from their area. To coordinate this activity regions will be split into distinct administrative areas, each responsible for data of certain types within their jurisdiction and designated responsibilities.
ALERTC	TPEG and DATEX include a locating standard, ALERTC, that allows the location of incidents affecting road travel to be expressed in terms of the road network rather than a simple geospatial position, e.g. a particular lane or direction or stretch of road rather than a point on a map.
API	Application Program Interface. A set of functions and procedures that allow the creation of applications which access the features or data of an operating system, application, or other service.
Architecture	The conceptual design that defines the structure, behaviour and integration of a given system in its surrounding context.
Availability of service (for data)	A Quality of Service measure prescribing requirements for the continuous availability and resilience of a data service. For example, to ensure that real-time arrival information is available for all bus services for nearly all of the time rather than on an intermittent basis. Can be quantified with metrics such as percentage uptime.
AVMS	Automatic Vehicle Management Systems which provide the source for real-time positional data for passenger transport vehicles. Also known by the briefer term AVL (Automatic Vehicle Location).
Backwards compatibility	Property of a data format or protocol such that a system capable of processing a new version of the format may still also process older versions of the format. Highly desirable for widely used data standards as it allows for an incremental rollout of upgrades, with systems that are at different version levels nonetheless being interoperable.
Baseline (ITS action)	The naturally evolving situation that would happen without any further intervention from the European Commission.
BCR	Benefit Cost Ratio
Car pool	Multiple travellers pooling together to travel in a private vehicle for a similar journey. Also known as ride sharing or lift sharing.
Car share or car club	Model of car use where travellers book the use of a car for a fixed period for an agreed cost rather than having direct ownership.
CBA	Cost Benefit Analysis
CEN	The European Committee for Standardisation. CEN is a platform for the development of European Standards and other technical documents in relation to various kinds of products, materials, services and processes. CEN issues both European Standards (EN), definitive European standards for adoption across Europe and Technical Standards (TS) suggested standards with a more tentative status.

Chained journey planning	A hybrid architecture for linking journey planners that uses a monolithic journey planner covering trunk modes (long distance rail, air etc.) for the main route, and separate local journey planners (or simple deep linking) to plan the local route from the trunk stops to the end. The termini found by the trunk planner are used as the handover points for linking the systems.
Coherence (of data)	The property of consistency of a data set such that all the elements belong to compatible versions that may be used together, resulting in accurate information. For example, a set of summer timetables and stops that are operated in the summer.
Compatibility	The general ability of a device or system to work with another device or system without modification.
Completeness (of data)	The property of correctness of a data set such that all the elements corresponding to all the relevant real world entities are present. (e.g. all timetables for all modes for a region are present in a dataset).
Compliance (of data)	The property of correctness of a data set such that all the elements are encoded according to the rules of the format in which the data is exchanged (e.g. the right tags are used in the right order, all mandatory elements are present, values are punctuated as required, etc.).
Connection link (PT)	A designated place in the transport network suitable for interchanging between stops of the same or different modes. May have associated timing and accessibility properties relevant for journey planning.
Connecting services (PT)	Transport services that are intended to connect through a planned or guaranteed interchange at a designated connection link.
Continuity of Service	Commitment to provide a service or to support a format for at least an agreed period, necessary to justify investment by data users.
Control actions	Control decisions as to the operation of the transport system, such as cancellations, diversions or short running of trains that materially affect the real-time running of the system. These can be given a structured representations in a data format and constitute a distinct type of real-time data (coming from a control room source rather than tracking systems) that is especially important for making accurate and timely real-time predictions.
Coverage (of data)	The extent to which data of a given type is available for a given mode and region.
Creative Commons license	A Creative Commons (CC) license is a public copyright license enabling the free distribution of an otherwise copyrighted work. A CC license is used when an author wants to give people the right to share, use, and build upon a work that they have created. CC provides flexibility (for example, allowing only non-commercial uses of data) and protects users from concerns of copyright infringement as long as they abide by the conditions that are specified in the license.
Crowd sourcing	The use of mass internet based tools and processes to enable volunteers acting in the public interest to collect large distributed data sets, such as GIS data, accessibility data, stop data or timetables.
Currency of data	That property of correctness of a data set such that all the data is applicable within a given period, i.e. not yet superseded by a later state.
Data access	Term here used to refer to a policy that data should be made available to third parties for any arbitrary legitimate use. It does not preclude charging for data or the setting of reasonable conditions of use, but data must be accessible on a non-discriminatory basis to all data users. Known in some quarters as 'Open Data'
Cycle hire / bike share	A formal bicycle hire scheme, usually implemented on a city/town basis often with multiple cycle hire stations for collecting and returning cycles.
Data aggregation	The process of collecting together data of one or more types from multiple distributed sources and stakeholders to a single access point. Aggregation does not necessarily imply integration, which may require further normalization and validation of the data to create a consistent dataset that is ready to use.
Data availability	The existence of relevant data elements in an electronic or equivalent (i.e. machine readable format). Availability can be assessed by different criteria, for example, by category of data, transport modes, data format, quality of data, data holder, restrictions on use, etc.

Data attribution	The explicit public identification of information as being originated or supplied by a named stakeholder, for example that real-time data is supplied by Deutsch Bahn. Attribution may have implications as to authoritativeness (for the data user) and to reputation (for the data supplier); therefore the rights or requirements to attribute data may feature in terms of use or be a consideration in characterising non-discriminatory access.
Database	A single organised collection of data held on a common media/set of server, i.e. the data is held within one conceptual location.
Data exchange protocols	A set of rules governing the exchange or transmission of data between devices, done using an API or other transmission method.
Data discrimination	The favouring of certain data users, (including possibly the data owner or supplier as a data user) by limiting access to data or by giving privileged access to a higher quality of data (e.g. more accurate, more timely, more complete); or a higher quality service (e.g. a faster or more robust real-time feed).
Data, dynamic	Data which changes very frequently and typically represents a state at a precise moment in time. For example, availability of seating on a plan journey or real-time predicted arrival of a bus at a stop, or unplanned disruptions. Such data requires a live data service to be kept up to date; either a push service or an API to fetch it as needed.
Data identity	The means of uniquely distinguishing a specific data element within a specific context (regional, national, European etc.) in a persistent manner that allows for repeated update of data sets – and also the detection of duplicate instances. Necessary for the integration of aggregated data to be possible.
Data integration	The process of taking heterogeneous data from many different sources and validating and normalizing it so that it can be computed over as a whole. May involve resolving clashes of identity, removing duplicate instances of elements, normalising names, classifications and other corrections.
Data marketplace	A platform for connecting data providers and data consumers. This involves advertising and search functions, as well as a brokerage function for data exchange once two interested parties are identified. A data marketplace collects references (catalogues) to a range of services that may be accessed either in co-location or remotely.
Data ownership	Possession of legal rights as to the use and control over data and any commercial exploitation as governed by Terms of Use.
Data, processed	Data which has been collection and manipulated to produce meaningful information.
Data provider	The stakeholder who collects data in an electronic format and provides it to data users.
Data, raw	A term for data collected from a source. Raw data, also referred to as primary data, requires processing or transforming in some way in order to turn it into a useful output. For example, vehicle positions are raw data for computing arrival times. Raw feed types exist for both static and dynamic data.
Data register	A register is a website that centrally lists different data services with links to where they can be accessed.
Data, static	Non-volatile data which changes relatively infrequently and so may be exchange by periodic updates rather than continuously. For example, stop data. Some types of data may need to be treated as static for some applications, and as dynamic for others. For example, a real-time journey planner requires a dynamic timetable feed while a simple journey planner may treat the timetable as essentially static.
Data user	A stakeholder who uses available data for further purposes such as provision of information to end users.
Data warehouse	A data warehouse is a virtually co-located set of databases; the data held in each database may be distinct and with no interconnection other than a directory service provided by the warehouse as a whole. The import services of a data warehouse will typically perform clean up and some integration services, actively ensure the data set is current and will have an error resolution process in place.

DATEX II	DATEX II is a CEN Technical standard (CEN TS 16157) developed for information exchange between traffic management centres, traffic information centres and service providers. It provides an XML protocol to distribute a number of different types of data, including traffic flows, planned works, disruptions, VMS, parking data etc., and is supported by a conceptual model and documentation.
Day Type	A way of categorizing days by their characteristic activity, such as being a particular day of the week, holiday, season, market day, match day etc. so that accurate conditions of operation and / or predictions of travel time can be made. Fundamental to the standardisation of temporal conditions for both road and public transport data; such conditions can be complicated so- a consistency of approach is needed in order to be able to integrate different data sets.
Deduplication	The process of removing duplicate instances of data when data being integrated has come from multiple sources. For example, the timetable data sets for two adjacent regions may both include the journeys that run between the regions, or a timetable for the same region for two different period may have some journeys that run in both periods. The process can be made more accurate and more efficient by establishing globally unique identifiers for stops and operators and by standardising the way temporal conditions are expressed.
Demand Responsive Transport (DRT)	DRT or flexible services are public transport services which run within a defined geographical scope (which may be defined as general pickup areas, road sections, stops or any combination) but vary their routing and / or timing to meet user demand. Their "timetable" denotes the areas served and times of operation, with a method of requesting services, but does not necessarily include specific departure times.
Demand Competitive Transport Information	Some modes of transport involve resources (taxis, bicycle hire schemes, electric vehicle charging points, etc.) for which the demand may outstrip local supply during busy periods. Real time information on the availability of the resources (e.g. cycles, slots to return cycles, empty charging points, etc.) can be made available as a dynamic feed – complementing a static data set as to the location and capacity of the resource points.
Discount rate	Rate used to calculate the 2016 value of future costs and benefits accrued over the period of the assessment.
Discovery services	Automated services allowing for the search for sources of particular types of data, typically making use of metadata associated with the data. Discovery services are relevant both for computer systems (e.g. to find servers providing a particular type of feed) and for human interfaces (e.g. in web browser search engines to find a type of website such as a journey planner or stop departure board covering a particular area.
Disruptions	Disruptions cover a range of network impacts that deteriorate the levels of service of the transport network. This can include road blockages, lane closures, weather related impacts, poor driving conditions, events, activities, etc. as well as vehicle related causes such as breakdowns.
Distributed journey planning	An architecture for journey planners that splits the computation of the trip legs up among multiple engines, each covering a separate region. The engines each compute trip legs between agreed handover (or "transition") points, which are then combined to create a single set of end-to-end trips for the user. The determination of the effective set of handover points typically requires pre-computation over the whole data set and further tuning to accommodate the specific topology of the joint networks and available modes. The distributed journey planners may nonetheless be "centralized" that is, all be placed in the same physical location in order to reduce communication times.
Door-to-door journey	A journey that takes the user from a starting position to a destination, as specified by an address, postcode, point of interest or map location, (rather than just from a public transport stop to a public transport stop).
End point	The destination point of the journey.
End user	A passenger or other person who uses an information service to plan or manage their travel.
Environmental impact factors	Data and heuristics used to compute the environmental impact of travel by a given mode. For example carbon usage per passenger mile on a given vehicle type at a given level of occupancy.
ETM	Electronic Ticket Machines

Exchange Points	Pre-identified locations used in a decentralised journey planner approach to join up journeys from multiple systems – these are typically, but not exclusively, trunk modal nodes.
Facilities	The amenities available to travellers at stop and on-board vehicles such as restaurants, toilets, wi-fi, etc. Access to some facilities may depend on fare class.
Fare data	Data describing the tariff structures of a network, including fare structures, fare products conditions of purchase and of use, user types, and prices of a transport system. The fare structure describes the basis and scope (origin destination pairs, zones, etc.) and access rights (single, multiple travel, class of use etc.) the fare products assemble these as permitted combinations with specific usage and commercial conditions attached; fare prices assign a monetary cost. Fare distribution channels and payment methods may also be described. Some aspects, such as prices or availability of seats, may be dynamic. Others such as the zones and routes, classes of use, available fare products, etc. may be static.
Fare distribution channel information	A specific aspect of fare data describing where fares of different sorts may be purchased, and how they may be paid for, important for passengers using a network with which they are unfamiliar.
Fare Query	A type of trip plan optimized to find the cheapest fares, rather than the fastest or most convenient routes.
Floating car data	Road real-time data generated by the GPS tracking of vehicles, either with dedicated devices, or by processing of generic mobile phone data to identify moving vehicles.
Format	The organization of information according to a pre-defined specification that dictates the precise presence, syntax and content of data elements.
FSM (Full Service Model)	UIC led project to develop rail data exchange standards covering the end-to-end traveller process for rail in Europe.
Fundamental rights	The implied rights of a customer for example to protect personal data, equality and non-discriminatory treatment.
Gazetteer	A geo-located database of named places for regions, cities, towns, villages, etc. that provides a topographical context. A public transport gazetteer for use in journey planners is used to associate places with designated stops for access. It may include information that cannot be decided just by the geospatial boundaries of the place (for example the airports of a city outside its boundaries, or the best train station for a town without a station, or which stop to treat as the city centre).
GDF	Geographic Data Files or GDF is an interchange file format for geographic data. It is an international standard that is used to model, describe and transfer road networks and other geographic data. (CEN GDF 5.0, or ENV14825:2011).
GIP	Austrian national data standard specification (Graphs Integration Platform)
GIS data	A data set of geographical data describing the topographical features and buildings and their spatial relationships that is used to create maps and spatially located applications. Such data sets are needed for point-to-point journey planners –and (See INSPIRE) exist in a number of coordinate systems and formats under different business models; both public (e.g. Ordnance Survey); commercial (e.g. Navteq) and crowd sourced (e.g. Open Street map). Common location reference systems are needed in order to integrate different GIS sets and the public transport data sets.
Headway	The distance or time between consecutive trains, buses, etc., on the same route. This is sometimes used within schedules instead of a timetable particularly in dense urban areas.
Historic data	Data generated by recording the real-time operation of the transport system such as arrival times at stops, travel times over road links, etc. Such data is relevant for improving predictions for future services (for example to establish average travel times on road links at particular types and times of day) and for informing passengers about operators' schedule adherence.
IFOPT	IFOPT (Identification of Fixed Objects in Public Transport) is a CEN Technical Specification that provides a Reference Data Model for describing the main fixed objects required for public access to Public transport, that is to say Transportation hubs (such as airports, stations, bus stops, ports, and other destination places and points of interest, as well as their entrances, platforms, concourses, internal spaces, equipment, facilities, accessibility etc.).
Inclusive mobility	Mobility/transport systems that are accessible for everyone including the elderly, parent+child, visually impaired, disabled etc.

Information chain (also known as the value chain)	The chain of stakeholders involved in delivering information, beginning with the transport operator and finishing with the traveller.
INSPIRE directive	The INSPIRE directive (2007) aims to create a European Union spatial data infrastructure. This will enable the sharing of environmental spatial information among public sector organisations and better facilitate public access to spatial information across Europe.
Internationalised (data)	A property of data formats such that they can be used without modification to support different national languages and presentation conventions (such as date and time formats), and also have parameterised those aspects which may vary between regions such as currencies and time zones.
Interoperability	Capacity of systems and the underlying business processes to exchange data and to share information and knowledge.
Inter-modality	Use of more than one mode of transport to make a trip.
Interface	The point where two systems interact. Also the formal specification of the protocols and APIs to be used for the interaction by machine.
Inter-regional	Across two or more Member States or between different regions (with different service providers) within one Member State.
Journey plan (Trip Plan)	An optimised route for a passenger to take for a specific trip, potentially involving several modes of transport from a journey start point to a journey end point on a particular date and time, made up of one or more trip legs.
Journey planner	An application that computes a trip plan from a start point to an end point.
Journey planning API	An interface for requesting a trip plan from a journey planner. It may also support additional queries such as to find origin and destination points (by name, place, POI, map reference etc.) or to supply real-time departure times for a given stop. A distributed journey planning API exposes additional elements to manage the distributed processing.
KPI	Key Performance Indicator. A qualitative measure use to monitor conformance to quality criteria.
Location reference system	A coordinate system such as WGS84 or Lambert used to spatially locate data, in particular map features and the nodes and links of road and public transport networks.
Linked journey planning services	Any architecture for combining separate journey planners so as to cover a wider area or additional modes - in contrast to a centralized or monolithic architecture which uses a single planner over a single integrated data set. Possible linked architectures include either distributed or chained/hybrid planners.
Local network	The extensive network of minor transport links that is peripheral to the main Trans-European Transport Networks (TEN-T).
Local region	The territory for which a journey planner can plan journeys without information from other federated systems.
MaaS	Mobility as a Service - a mobility distribution model in which a customer's major transportation needs are met over one interface and are offered by a service provider acting as a broker.
Metadata	A structured description of the structure and content of data facilitating the discovery and use of this data.
Micro Journey Planner	A journey planner that provides detailed information on pedestrian routing within a limited area, for example path ways through a large interchange between entrances, platforms etc., normally including in particular accessibility options for PRMs.
MMTIPS	Multi Modal Traveller Information and Planning systems and Services.
Monolithic (Centralized) journey planner	A centralized (and classical) architecture for journey planners that integrates all the data into a central data store covering all represented regions so that an engine may compute the entire journey plan within a single memory space.
MS	Member State.
Multi Modal	Consisting of two or more modes of transport.

NeTEx	A CEN Technical standard for the exchange of public transport data. It defines an XML schema based on Transmodel concepts and is divided into three parts; Part 1 Covers the core concepts and the description of the public transport network. Part 2 covers timetables, Part 3 covers fares.
NPV	Net Present Value – the total of the benefits (discounted to current values) minus the total of the costs (discounted to current values).
OJP	Open API for Distributed Journey Planning. A CEN standard API for Journey Planning being developed by TC278W G10
Open data	A policy that data should be made available to third parties for any arbitrary legitimate use. Open data does not preclude charging for data or the setting of reasonable conditions of use, but data must be accessible on a non-discriminatory basis to all data users.
Open data licence	A free legal IPR licence governing use of data that grants well defined rights to data users.
Operator Identifier	A code that uniquely identifies an operator within a given region; may be used to establish uniqueness of journeys, vehicles and other elements within a region, especially when integrating data from multiple sources.
Operational Calendar	Temporal conditions for Timetables are often expressed in terms of day types, e.g. "Service runs Monday to Friday year round, but not on holidays". In order to resolve a general timetable into a specific operational timetable for a specific day of travel, an operational calendar is used that will indicate the day type of a particular day. E.g. "the 10 April 2015 is a Public Holiday in Ruritania".
Passing time	The time at which a vehicle arrives or departs a stop.
Planned disruption	A disruption to normal transport operations which is scheduled in advance and will be in effect for a fixed period of time, for example engineering works, street carnival etc.
Point of Interest (POI)	A named place that is a commonly desired destination of travel such as a cultural attraction, sports venue, park, shopping precinct, prison, town hall, church etc., and may be sought in a journey planner. Geocoded POI data for journey planners may be specifically associated with designated stops for access, describe the accessibility, and also be categorised by type of POI.
Pre-journey information	Information required by a traveller before they begin a journey, for example arrival and departure times, interchange locations, ticket costs and purchase methods.
Private transport	A transportation service which is not available for use by the general public, for example privately owned cycles, cars, boats and airplanes.
Profile	A set of metadata specifying how a generalised standard such as NeTEx or SIRI should be used in a specific implementation context. The profile may cover which elements should or should not be present, choice of aggregation granularity, packaging options, code spaces, national languages, time zones, default values etc. It may also prescribe workflow processes and data quality criteria such as timeliness.
PRM	Persons with reduced mobility (including visually or hearing impaired citizens).
PSI Directive	EC Directive on the re-use of public sector information.
Public Transport Network Link	A link between two stops in the scheduled transport network connected by a scheduled service. The public transport network representation is a separate information layer from the GIS representation, omitting low level detail and adding in additional concepts such as directionality. A representation of the topology is not needed as a distinct data set for journey planning as the link are implicit in the stop sequence of the timetable, but is useful for creating maps and schematic presentations.
Public transport	Passenger transport services of general economic interest provided to the public on a non-discriminatory and continuous basis (EC regulation 1370/2007/EG). Passenger transport modes including bus, coach, rail, tram, trolleybus and metro/subway/underground (<i>as opposed to private transport – car, bike</i>).
Pull service (data)	A dynamic data service that works by a client application requesting current data on demand from a data server when it requires it.
Push service (data)	A dynamic data service that works by a data publisher distributing new changes to all subscribers whenever a change of state occurs. Depending on the application and the pattern of data exchange this may be more or less efficient than a pull service.

Quality of Service (QoS)	The measures characterising the quality of a data service as to resilience, speed of response, bandwidth, etc.; used to define performance criteria on a data supplier necessary for supporting a commercially viable service.
RailML	An XML standard for railway operations including detailed track topology, signal systems, assets, rolling stock, crew rostering etc.
Real-time information	Data generated continuously by changes of state of the real-world objects of the transport system. For example vehicle positions, vehicle arrival times, availability of car club vehicles, or incident information. Real-time data needs to be exchanged using a dynamic service and may also be recorded to create historic data.
Remote-region	A federated region of a distributed journey planning system which is not adjacent to the local region.
Responsibility	The right and obligation to act in a particular role in managing a transport network or data. Data responsibility may be separate from data ownership (for example a data owner may contract another party to manage their data). Data responsibilities for a given data set may be partitioned between different administrative jurisdictions. A number of different roles may be identified and the different data responsibilities for the same data elements (e.g. collection, aggregation, validation, integration, supply) may be split among multiple stakeholders depending on organizational boundaries.
Road link	An identified link between two nodes in the road network which may be associated with speed limits, vehicle restrictions and historic and real-time travel times. Such links, together with their equivalents for pedestrian and cycle paths, provide the basis both for collecting road real-time data, and for road journey planning.
RTTI	Real-time Traffic Information, comprising the different types of road travel data (real-time road link travel times, incidents, queue lengths etc.) available through dynamic services.
Schedule adherence	The measurement of an operator's performance in running services to the timetable. Can be computed from historic real-time data. Relevant to passengers for assessing their journey options, and in some circumstances for claiming compensation.
Semantic interoperability	The ability to automatically and accurately interpret the information exchanged between two systems in order to produce useful results as defined by the end users of both systems.
Sharing economy	A socioeconomic system built around the sharing of resources on a demand basis. A mobility related example of this is the sharing of cars rather than sole use direct ownership.
SIRI	Server Interface for Real Time Information. A CEN Standard protocol for exchanging public transport real-time data. It comprises a common reusable framework and a number of specific functional services, such as SIRI-SM (Stop Monitoring) for exchanging real-time bus arrivals and departures; SIRI-VM (Vehicle Monitoring) for exchanging real-time bus positions; SIRI-ET (Estimated Timetable) for exchanging real-time timetables; SIRI-CM (Connection Management) managing dynamic connections; and SIRI-SX (Situation Exchange) for exchanging incident messages. Additional functional services can be added, for example to exchange NeTeX data.
Situation data	Structured incident data used to describe events and planned and unplanned disruptions to the network and their likely consequences for passengers. Computer readable data must be in a tagged format with quantitative measures that can be processed automatically (for example, to provide as annotations on journey plans of likely delays) and also be rendered into a human readable form. Several standards such as TIS (TPEG), DATEX II and SIRI-SX describe formats for situation data.
Specifications (ITSD)	Within the ITS Directive context, binding measures laying down provisions for requirements, procedures or rules. For Priority Action A binding measures laying down provisions for requirements, procedures or rules for the interoperability of data access and continuity of services for MMTIPS.
SSIM	Standard Schedules Information Manual. The IATA aggregated dataset (and format) for sharing static scheduled flight information.
Stakeholder groups	Parties with an interest in the creation and dissemination of passenger data; in particular, Passenger representative bodies; Member States; cities/regions; transport operators; system providers; industry associations, and third party information service providers.

Standards	A defined procedure for the provision of information in the field of technical standards and regulations. A data standard has a machine readable embodiment in a software interface or format (standards may also apply to physical objects or "soft" such as quality measures, workflow processes, or aspects of Human Machine Interfaces).
Standard Fares	A core set of fare products offered by a transport operator (often at regulated prices) that is available to all the main classes of user at all times, (as distinct from special offers, season passes, or niche fare products subject to additional conditions). These standard fares typically comprise a static data set that gives an indicative price for comparing the costs of different transport modes for occasional users but often will not be the cheapest option.
Start point	The origin point of the journey e.g. a postal address, map coordinate or stop.
Static information	Information which does not change on a dynamic basis.
Stop	A node on the transport network – e.g. bus stop, station, airport, ferry landing etc.
Stop Event	A real-time arrival or departure at a stop, with an associated passing time.
Stop-to-stop	A journey from one public transport stop to another stop.
Subsidiarity (EC)	The principle that the Commission should have a subsidiary function, performing only those tasks which cannot be performed at a more local level in Member States.
Syntactic interoperability	The capability of two or more systems to communicate and exchange data through specified data formats, communication protocols.
TAP/TSI	Telematics Applications for Passenger Services Technical Specifications for Interoperability. The purpose of TAP/TSI is to define European-wide procedures and interfaces between all types of railway industry actors. It contributes to an interoperable and cost-efficient information exchange system for Europe that enables the provision of high quality journey information and ticket issuing to passengers.
Temporal condition	A time-dependent validity rule as to when a transport service or stop is operational or a fare is available.
TEN-T core network	The Trans-European Transport Networks (TEN-T) are a designated set of road, rail, air and water transport networks covering Europe. The core network has strategic importance for major European and global transport flows, and has extensive real-time data coverage of many of its links.
TEN-T comprehensive network	A multi-modal network of relatively high density that is important for the economic, social and territorial development of the European regions (including peripheral and outermost regions) as well as for the mobility of their citizens.
Terms of use (of data)	Legal conditions granted by a data owner as to the access, use and onwards distribution of data by data users. May include disclaimers as to liability for inaccuracies, attribution and credit etc.
Timeliness (of data)	The property of correctness in a data set such that data is available in sufficient time to be useful. For example, changes to a timetable need to be made available in time to incorporate them in journey planners ahead of users planning trips, or real-time predictions need to arrive before the vehicle.
Timetable	A fixed schedule of daily operation with arrival and departure times defined (or for frequency based services, a target frequency within a particular time band).
Transmodel	The European Reference Model for public transport. A CEN standard that provides a systematic conceptual model for all the data entities found in public transport information systems. It is used to analyse and compare different systems and to design interoperable standards.
TRIAS	The German 'Travellers' Real-time Information and Advisory Standard' for enabling access to journey planning systems using standardized and manufacturer-independent client systems ("apps").
Trip plan (or 'journey plan')	An optimised route for a passenger to take from a journey start point to a journey end point on a particular date and time, and potentially involving one or more trip legs on various modes of transport.
Trunk leg	The greater part of a non-local journey – typically provided by a fast long distance mode such as rail, coach, air, ferry or private car, and possibly connecting to local legs on other modes at either end.

Unplanned disruption	A disruption to the transport network which is not planned in advance. For example: an accident, equipment failure, or weather related impact on the network causing diversions, delays or cancellations to service.
UTMC	Urban Traffic Management Control specification; a UK ITS standard for exchanging traffic data. It provides a uniform model for the efficient exchange of both the reference and real-time data for road link speeds, journey times, measurement devices, queues, flows, traffic signals, events, incidents, VMS, CCTV, parking, air quality, weather, etc.
Validation (of data)	The process of checking that data supposedly in a given data format actually conforms to the format and is correct as to identity, completeness, accuracy, consistency, etc., of data elements.
Vehicle journey	A journey made by a public transport vehicle following an operational timetable (as opposed to a trip made by a passenger with one or more legs serviced by vehicle journeys).
Vehicle type	The characteristics of the vehicle used to deliver a particular vehicle journey; such properties, e.g. number of wheel-chair places, steps, hoists, etc., may be important for accessibility. Also used to calculate environmental impact.
Veracity (of data)	The property of correctness of a data set such that all the elements in the data set exactly correspond to the real world entities they represent. (For example, that stops are located where their coordinates indicate they are and are identified by the names or labels given; or that a timetable includes only vehicle journeys that will actually be made on the indicated days, and that the departure times are true.) Completeness of data is a further specific aspect of accuracy.
Version	The mechanism of assigning a simple signature to indicate and manage the compatibility and interoperability of different successive evolutions of data, data formats or data services.

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Appendix C Existing travel information services

Table 23 lists the significant travel information services that were identified during the initial stage of the study.

Table 23: – List of significant existing travel information services (non-exhaustive)

Name of service	Geographic scope	Transport modes	Data information (types of data, formats, interfaces or sources used)
9292	Netherlands	Bus, tram, rail, subway, waterborne	Static and real time data Fares
AA Route Planner	Europe	Private car	Routing and real time traffic information
AirRail	Belgium, Netherlands, Germany, France	Rail, air	-
A-nach-B / Verkehrsverbund Ost-Region (VOR)	Vienna & East Austria	Bus, rail, cycling, walking, private car, Park & Ride, Bike & Ride.	ITS Vienna Region uses the Austrian national Graph Integration Platform (GIP) – compliant with INSPIRE. GIP is continuously updated by the public authorities and includes details for cyclists and pedestrians as well.
ATM (Azienda Transporto Milano)	Milan, IT	Public transport, bikes, car sharing, walking.	
Bayern Fahrplan (Bayern Transport)	Germany	Bus, rail, tram, metro.	
Belgianrail.be	Belgium	Bus, rail.	-
Berline Verkehrsbetriebe (BVG)	Berlin, DE	Public transport, walking	
Bilkom	Poland	Rail	
BKV	Budapest, HU	Public transport	
Brahe Trip Planner	Turku, FI	Public transport	
CityMapper	Specific cities: Paris, Madrid, Barcelona, London, Manchester, Rome, Madrid, Berlin and Hamburg.	Local transport modes (e.g. cycle, bus, walk, metro, taxi).	
Consortio Transportes Asturias (CTA)	Asturias, ES	Public transport	
CRTM transport information system	Madrid, ES	Public transport	

Name of service	Geographic scope	Transport modes	Data information (types of data, formats, interfaces or sources used)
Cyprus By Bus	Cyprus		
De Lijn	Flemish region of Belgium	Rail, bus, tram, metro, walking.	
DELFI (Durchgängige Elektronische FahrplanInformation)	Germany	Bus, rail, air, taxi	Distributed journey planning service linking together regional journey planners with trunk journey planners (i.e. Deutsche Bahn)
Destineo	Pays de la Loire, FR	Rail, bus, air, car-share, cycling, ferry.	-
Deutsche Bahn	Germany	Bus, rail, air	-
DPP	Prague, CZ	Rail, bus, tram, walking.	
EFA - BW	Baden Württemberg, DE	Rail, public transport, cycling, walking	
EMT Valencia	Valencia, ES	Public transport	
E-podróżnik	Poland, Czech Republic & Germany	Road, rail, car pooling.	
EU-SPIRIT	Certain regions within France, Luxembourg, Germany, Denmark, Sweden and Poland: Alsace; Baden-Württemberg; Berlin-Brandenburg; Denmark; Gothenburg; Luxembourg; Lorraine; Northern Germany; Rhein-Neckar / Rheinland-Pfalz; Saarland; Scania; Sweden; Warsaw.	Rail, bus, metro	EU-SPIRIT connects existing travel information systems through open interfaces and harmonised meta information. Central technical components are used which allow the generation of complete travel information. Optimising techniques are used in order to best meet the user's information demand via their preferred travel information service website. This also means that every update to the local system is automatically available in the EU-SPIRIT service. The local systems keep their user interface (GUI), algorithms and database structures and are capable to display international itineraries in their local format. In the background all central data that are required as metadata (in order to generate itineraries) are maintained and updated. This process covers the definition or redefinition of central data. This data is stored in the RRDB and consists of: List of city and town names within the participating regions; Information about participating servers; harmonised data that are necessary to meet the customer demand (e.g. selection of train categories and symbol codes); transition points (nodes where different partial itineraries from the participating information systems must be connected in order to retrieve optimal itineraries).
GoEuro	UK, Germany, Spain, Italy, Belgium, Netherlands, Luxembourg and Switzerland.	Bus, rail, air	Information is compiled from multiple data sources, including GeoNames, OpenFlights, OpenStreetMap and ATOC

Name of service	Geographic scope	Transport modes	Data information (types of data, formats, interfaces or sources used)
Google Transit	Most of Europe excluding: Czech Republic, Belarus, Serbia, Moldova, Bosnia & Herzegovina, Montenegro, Kosovo, Albania, FYR Macedonia.	Bus, rail, metro, car, cycling, walking.	<p>Google Transit is based on the General Transit Feed Specification (GTFS), an open source format that allows transport operators to publish their stops, routes, schedules and fare scheme in a digital format. Google Transit will integrate any GTFS-feed provided by public transport operators.</p> <p>Google prepared a Best Practices document, and provides a Feed Validator and Schedule Viewer. These tools allow transport operators to independently develop and test their GTFS-feed. The feed is then provided in a zip-compressed format over HTTP or HTTPS to Google. After signing an agreement with Google the transport operator can test their data.</p> <p>The Google Transit routing is in a private preview environment. Once launched the information in the GTFS feed can be updated by simply replacing the zip-file. Open source tools are available that can create a basic GTFS feed from for example a spreadsheet.</p> <p>Travel planning is currently supported by providing traffic conditions and alternate routes, by suggesting which trains or buses are next when coming close to the station, and by displaying train connections based on GTFS feeds, a standardized data format for public transport schedules and route information originally developed by Google.</p>
Helsinki Journey Planner	Helsinki region, FI	Public transport	The same kind of data access is also available in other major cities like Tampere, Turku and Oulu. http://developer.reittiopas.fi/pages/en/home.php
Hit the Road	Dublin, IE	Rail, bus, tram, coach, car, walking	
Hopstop	France, UK, Germany, Ireland, Netherlands, Norway, Sweden and some wider international locations	Rail, bus, metro, taxi, walking (local journeys, non-trunk)	NB: bought by Apple in 2013 – features being integrated into Apple Maps with separate services being withdrawn.
HVV	Hamburg, DE	Public transport, walking.	
HŽ PUTNIČKI PRIJEVOZ	Croatia	Rail	
IDOS	Czech Republic	Bus, rail, air	<p>The company CHAPS was authorized by the Ministry of Transport of the Czech Republic to run the CIS JR (Central Information System of timetables) as a part of the Information System of the Public Administration (ISVS) and to collect timetables of bus, railway, air, water and municipal public transport.</p> <p>The service has its own standards (although it is integrated with international coach and train information services) and is not integrated with road information. First considerations of such options should be made within the EasyWay project in 2011/2012.</p>

Name of service	Geographic scope	Transport modes	Data information (types of data, formats, interfaces or sources used)
IDSJMK	South Moravia, CZ	Bus, tram, walking	
Imhd.sk	Bratislava, SK	Public transport	
Informatica Feroviara	Romania	Rail	
InfoTBC	Bordeaux, FR	Bus, tram	
INFOTEC	Belgium	Bus, tram, rail	-
INSA	Saxony-Anhalt, DE	Rail, public transport, walking	
Jakdojade	Specific cities in Poland	Public transport, regional rail, walking.	Coverage of 21 cities.
Journey.fi	Finland	Rail, bus, air, walking	<p>Not 100% complete coverage, dependent on data availability in local areas.</p> <p>The Finnish Transport Agency (FTA) offers third party access to Journey.fi API when the application or service supports public transport usage and public transport information provision. Development and testing as well as commercial use of interfaces is free of charge.</p> <p>There are three possible ways to access timetable and route data: HTTP GET interface, which gives a response in XML format Kalkati.net formatted XML database dump file, which includes the whole Matka.fi stop, route and timetable information in a single file. GTFS dump.</p>
JourneyOn	Brighton & Hove, UK	Public transport, walking, cycling	
JV-malin	Central France	Bus, car, rail, tram, car share, cycle, cycle hire	-
KVV	Karlsruhe Verkehrsverbund	Rail, public transport, walking	
Latvian Railways		Rail	
Lignes d'Azur	Nice, FR	Bus, tram.	
Liguria regional planner	Liguria, IT	Rail, bus, tram	
Lithuanian railways	Lithuania	Rail	
Marsrutai	Lithuania	Bus, rail,	

Name of service	Geographic scope	Transport modes	Data information (types of data, formats, interfaces or sources used)
Mav-start	Hungary	Rail	
Mobiliteitszentral	Luxembourg (nb: rail is for across NW Europe)	Bus, rail	-
Mobithess	Thessaloniki, GR	Public transport	
Mou-te	Catalonia, ES	Rail, public transport, walking	
Mouversi in Toscana	Tuscany, IT	Rail, public transport, car, walking, intermodal.	
Move-me	Porto, PT	Tram	
Moveuskadi	Basque region, ES	Public transport	
Multitud	Grand Lyon, FR	Public transport	
MVV Farhplanauskunft	Munich, DE	Rail, public transport, walking	
Nah.sh	Schleswig – Holstein, DE	Rail, public transport, walking	
National Rail Enquiries (NRES)	UK	Rail	-
NMBS-SNCB	Belgium	Rail	-
OASA	Athens, GR	Public transport	
OptiTrans (Athens)	Specific cities: London, Athens	Subway, bus, trolley, tram, suburban railway, taxis, walking	Developed in an FP7 project by the same name
Passenger Portal	Poland	Rail	Operated by PKP Polskie Linie Kolejowe
Peatus	Estonia (local); into adjacent countries (trunk)	Bus, rail, air	-
RATP	Paris, FR	Public transport	
Regione Marche	Regione Marche, IT	Public transport	
Rejseplanen	Denmark	Bus, rail, cars and park & ride, cycling, waterborne.	-
Renfe	Spain	Rail	
Resrobot (Samtrafiken)	Sweden	Private car, rail, bus, air, subway and tram	-
Rhein - Main Verkehrsverbund (RMV)	Rhein – Main, DE	Rail, public transport, walking	
Rheinland Pfalz (VRN)	Rheinland, DE	Rail, public transport, walking	

Name of service	Geographic scope	Transport modes	Data information (types of data, formats, interfaces or sources used)
Rome2Rio	Europe (with exceptions)	Bus, Rail, air, ferry, taxi and other public transport	Uses open-API data sources
Route-Rank.com <i>(no longer available)</i>	Switzerland	Rail, air, car	-
Rutebok.no	Norway	Rail, air, bus, coach	-
Ruter#	Oslo and Akershus, Norway	Bus, waterborne, tram, rail, metro	-
Saarfahrplan	Saarland, DE	Rail, bus, tram, walking	
SBB Online Fahrplan	Switzerland, Germany and Austria	Rail and metro	-
SCOTTY	Austria	Rail, bus, tram, walking	
SITkol	Europe (rail); Poland (local bus)	Rail and local bus	The system includes railways throughout Europe and the Warsaw metropolitan public transport and cycling and walking, information on national railway carriers timetable (PKP Group) and other Polish and European ones as well as public transport information of Warsaw agglomeration. There are also available links to purchase the tickets online.
SKGT - SOFIA	Sofia, BG	Public transport, bike, car, parking.	
SL.SE	Sweden	Bus, Metro, Rail, Light rail, Trams, Waterborne	-
Slovakian Rail	Slovakia	Rail	
Slovenske zeleznice	Slovenia	Rail	
Spoti	Marseille, FR	Public transport	
STIB	Brussels, BE	Rail, bus, tram, metro, walking	
Stotis	Lithuania	Bus, rail, air, ferry, taxi	
Tallinn journey planner	Tallinn, EE	Public transport	
TEC	Wallonia, BE	Bus, tram	
Thuringen Verkehrsverbund (VMT)	Thuringia, DE	Rail, public transport, walking	
Tisseo	Toulouse, FR	Public transport	
TMB	ES	Public transport	
TomTom route planner system	Europe	Private car	Routing and real time traffic updates
Trafiken.nu	Specific cities in Sweden	Cycling, public transport, private car	-

Name of service	Geographic scope	Transport modes	Data information (types of data, formats, interfaces or sources used)
Transilien	Paris and the Ile-de-France (FR)	Bus, rail, metro and RER regional rail	-
Translink journey planner	Northern Ireland	Rail, public transport	
Transpole	Lille, FR	Public transport, bike, car	
Transport Direct (closed in September 2014)	UK	Bus, rail, air, ferry, coach, taxi, private car, cycling and walking	Facilities have been integrated using standard (national) protocols (e.g. JourneyWeb) and data exchange processes and schemas (e.g. TransXChange, RtigXml, CycleNetXChange).
Transport for Ireland	Ireland	Bus, rail, ferry, light rail, walking. Real-time and fares information.	Have adopted use of UK data standards for scheduled information and coding with SIRI for real-time information feeds.
Transport for London journey planner	UK	Bus, rail, air, ferry, tram, underground, cycling and walking.	Includes scheduled data supplemented by real-time information feeds with unexpected delay information. Fares information is also provided. Underlying system provided by MDV.
Transporturban.ro	Bucharest, RO	Public transport	
Traveline	UK	Bus, rail, tram, metro, waterborne, walking, Coach.	
Trenitalia	Italy	Rail, bus, ferry	
Utvonalterv	Hungary	Rail, bus, car, bike, walking, taxi	
Vasttrafik	Västra Götaland, SE	Public transport	
Verbundlinie	Styria, AT	Rail, bus, tram, walking	
Verkehrsverbund Tirol (VVT)	Tirol, AT	Rail, public transport, walking	
Verkehrsverbund Berlin Brandenburg (VBB)	Berlin-Brandenburg, DE	Rail, public transport, walking	
Verkehrsverbund Bremen Niedersachsen (VBN)	Bremen, DE	Rail, public transport, walking	
Verkehrsverbund Mittel Sachsen (VMS)	Mid-Saxony, DE	Rail, public transport, walking	
Verkehrsverbund Region Kiel (VRK)	Kiel, DE	Rail, public transport, walking	
Verkehrsverbund Rhein – Rhur (VRR)	Rhein – Rhur, DE	Rail, public transport, walking	
Verkehrsverbund Stuttgart (VVS)	Stuttgart, DE	Rail, public transport, walking	

Name of service	Geographic scope	Transport modes	Data information (types of data, formats, interfaces or sources used)
Via Michelin	Europe	Private car with real time traffic information	-
Vialsace	Alsace region	Bus, tramway and regional trains, cycling, parking, private car	
Vianavigo	Paris and the Ile-de-France (FR)	Bus, tramway, subway, rail, ferry	
Vorarlberg Mobil	Vorarlberg, AT	Rail, public transport, walking	
Voyages-sncf.com	France	Rail	
VVO	Dresden and Oberelbe Region, DE	Rail, public transport, walking	
Waymate	Europe (trunk); Germany (local)	European rail, air, private car, local bus (Germany)	In order to gather information, Waymate has access to transport operator's web services APIs, and is also able to manage raw data rooted via the GTFS standard. Waymate is a combination of a meta search engine and an online travel agent. It crawls information from every available source and also sells tickets, e.g. for Deutsche Bahn, on a commission basis.
Wiener Linien fahrplanauskunft	Vienna, AT	Rail, public transport, walking	
Xephos (closed May 2013)	UK	Rail, bus and coach.	-
ZSR	Slovakia	Rail, public transport	
ZTM	Warsaw, PL	Public transport	
Zurich Verkersverbund (ZVV)	Zurich, CH	Public transport	
ZVON	Upper-Lusatia & Lower-Silesia, DE	Rail, public transport, walking	

Appendix D European and national policies and status

D.1 Overview of the European policy framework

Since 2008, in the ITS Action Plan, the Commission has been working to harmonize and accelerate market uptake of travel information services. The ITS Directive (2010/40/EU) established a series of priority areas where specifications needed to be developed to establish delegated regulations to Member States. Delegated regulations are binding in their entirety and directly applicable in all Member States.

Priority Action B of the Directive, the Real-time Traffic Information (RTTI) specification was completed in 2014. Subsequently the focus is on Priority Action A: Multimodal Travel Information Products and Services. This specification will build on previous policy initiatives.

Existing policy initiatives which affect the provision of data for Multimodal Travel Information Products and Services include INSPIRE, PSI, RTTI and TAP/TSI).

D.1.1 INSPIRE

INfrastructure for SPatial InfoRmation in the European community (INSPIRE), is an EC Directive which came into force in May 2007, concerning the sharing and harmonisation of spatial datasets across Europe. It requires the creation of standardised metadata (descriptions of the spatial data), as well as having to provide access to data (search, view, download and transform) that has been collected or created in standard form.

The Directive addresses 34 spatial data themes needed for environmental applications, with key components specified through technical implementing rules. This makes INSPIRE an example of a legislative "regional" approach. The transport specification was established in 2009 (INSPIRE 2014).

The transport data specification is extensive, covering major transport networks types that are defined in the five distinct transport sub-themes: Rail (including tracks and their uses, stations, bridges, tunnels etc. importantly "rail" includes all rail types including underground, tramways, cable cars etc.); Road (including types, lanes, restrictions, speed limits, toll plazas etc.); Water (ports, internal waterways, ferry links etc.); Air (airports, heliports, air corridors etc.); and Cableways.

The sub-themes are defined in a way that they can be used together to support an integrated approach to transport and they may be used with other spatial data themes.

The model of the transport network provided, in particular 'D2.8.I.7 INSPIRE Data Specification on Transport Networks – Guidelines', is essentially a topographical model of the network as a geospatial feature. This comprises a quite separate layer from the representation needed for timetables and PT network operation; in order to be able to create an integrated dataset of map and PT data for journey planners etc, the models and reference systems of the two layers should be compatible.

The Address concept of INSPIRE is relevant to the GIS datasets used to provide address data to journey planners. INSPIRE also includes basic gazetteer and administrative jurisdiction concepts that can usefully be related to transport related equivalents in NeTEx and Transmodel; this allows for the population of systems from and integration with INSPIRE-derived data.

In 2014 a Transportation Pilot was launched as a collaborative effort between the INSPIRE community and TN-ITS. TN-ITS (an ERTICO led initiative) is a deployment platform to facilitate the provision and exchange of ITS spatial data between Member State road authorities and ITS map providers. TN-ITS is concerned with the exchange of information on changes in static road attributes. Static means that the attributes are of a more or less permanent nature, even though they may sometimes change. TN-ITS is not

concerned with the exchange dynamic information, for which other channels are being used.

The Pilot goal is to demonstrate the use of INSPIRE (beyond the environmental sector) as well as to boost implementation of the TN-ITS concept. The Pilot has two phases. Phase 1 has TN-ITS implementations in Norway and Sweden, both mature countries in terms of TN-ITS implementation. It will be followed by Phase 2, running until end of 2015, with TN-ITS implementation in two to be selected countries that are less advanced in terms of TN-ITS infrastructure.

Includes: A framework for the exchange of spatial data primarily between public authorities covering a cross-border connectivity mechanism; multimodal transport infrastructure; and the multimodal transport routing network. This ensures the underlying geographic data on networks which MMTIPS require is available.

Use of a common default XML based encoding (Geography Markup Language, GML) as defined for all INSPIRE data themes.

INSPIRE respects current Member State legislation on intellectual property rights and requires Member States to adopt harmonised high-level access and re-use conditions.

An important feature of INSPIRE is the development of (non-binding) Technical Guideline documents that specify implementation details and best practices in order to help Member States in the implementation of the legal requirements laid down in the Implementing Rules. The INSPIRE data specifications are an example of such Technical Guideline documents.

The Transport elements included are (by INSPIRE subcategory and type):

- Common elements
 - Access Restriction; Access Restriction Value
 - Condition Of Facility; Maintenance Authority; Owner Authority
 - Marker Post
 - Restriction For Vehicles; Restriction Type Value
 - Traffic Flow Direction
 - Transport Area
 - Transport Link; Transport Link Sequence; Transport Link Set
 - Transport Network; Transport Node; Transport Object; Transport Point
 - Transport Property
 - Vertical Position
- Rail (incorporating heavy/light rail, metro/underground and tram):
 - Design Speed
 - Form Of Railway Node Value
 - Number Of Tracks; Nominal Track Gauge
 - Railway Area; Railway Line
 - Railway Electrification
 - Railway Link; Railway Link Sequence; Railway Node
 - Railway Station Area; Railway Station Code; Railway Station Node
 - Railway Type; Railway Type Value
 - Railway Use; Railway Use Value

- Railway Yard Area; Railway Yard Node
- Road:
 - Road Name; Road Area
 - Road Link; Road Link Sequence; Road Node; Road Part Value
 - Road Service Area; Road Service Type; Road Service Type Value
 - Road Surface Category; Road Surface Category Value
 - Road Width; Number Of Lanes
 - Service Facility Value
 - Speed Limit; Speed Limit Source Value
 - Vehicle Traffic Area
 - Vehicle Type Value
 - Weather Condition Value
- Water:
 - Beacon; Buoy
 - CEMT Class
 - Condition Of Water Facility
 - Fairway Area
 - Ferry Crossing; Ferry Use; Ferry Use Value
 - Form Of Waterway Node Value; Inland Waterway; Marine Waterway
 - Port Area; Port Node
 - Restriction For Water Vehicles
 - Traffic Separation Scheme; Traffic Separation Scheme Area; Traffic Separation Scheme Crossing; Traffic Separation Scheme Lane; Traffic Separation Scheme Roundabout; Traffic Separation Scheme Separator
 - Water Link Sequence; Water Node
 - Water Traffic Flow Direction
 - Waterway; Waterway Link; Waterway Node
- Air:
 - Aerodrome Area; Aerodrome Category; Aerodrome Category Value; Aerodrome Node; Aerodrome Type; Aerodrome Type Value
 - Air Link; Air Link Sequence; Air Node
 - Air Route; Air Route Link; Air Route Link Class Value; Air Route Type Value
 - Air Use Restriction Value
 - Airspace Area; Airspace Area Type Value
 - Apron Area
 - Condition Of Air Facility
 - Designated Point
 - Element Length; Element Width
 - Field Elevation

- Instrument Approach Procedure
- Lower Altitude Limit; Upper Altitude Limit
- Navaid; Navaid Type Value
- Point Role Value; Procedure Link
- Runway Area; Runway Centreline Point; Runway Type Value
- Standard Instrument Arrival; Standard Instrument Departure
- Surface Composition; Surface Composition Value
- Taxiway Area; Touch Down Lift Off
- Use Restriction
- Cableways
 - Nodes, links and sequence
 - Cableway Type Value.

Does not include: Non-geographic data such as timetables, availability, tariffs; specific routes of transport services.

INSPIRE does not force Member States to collect specific spatial information.

D.1.2 PSI Directive

Directive 2003/98/EC on the re-use of Public Sector Information (PSI) encourages Member States to make as much public sector information available for re-use as possible – whether it is held electronically or not with supporting intellectual property guidance. This directive provides a common legislative framework to remove many of the barriers that hinder the re-use of public sector information throughout the EU. The scope of 're-use' means using public sector information for a purpose different from the one for which it was originally produced, held or disseminated. Amendments were made in 2013 ensured greater alignment with open government data concepts.

Some transport data, namely data produced and held by public undertakings or private companies does apply to the scope of the PSI Directive, however a reasonable proportion of transport data is produced and held by public sector bodies. This balanced varies between Member States dependent on the nature of the way which each mode of transport is organised. As such, the use and re-use of all the data by public bodies will automatically have to be arranged according to the provisions of the PSI Directive. Given that the deadline for transposition of the 2013/37/EU directive which amends the original 2003/98/EC Directive has recently passed (18 July 2015), we may expect to see more significant amounts of public transport data being made open for commercial re-use.

In itself, however, this will not be sufficient to address the 'data access gap' and could be complemented by further policy actions implemented on a national level:

- through specific legislation applying to all transport operators (whether publicly or privately owned)
- as a condition of the licence to operate passenger services
- as a condition for receipt of a subsidy
- by an administrative instruction where the transport itself is publicly owned
- through negotiation of a voluntary agreement with operators

Some of these measures could be taken up within the policy specifications on the EU level.

The ePSIplus web portal (since renamed as "ePSIplatform") was set up as a result of this directive. This provides an EU level data discovery portal on a range of thematic open government data sources including transport (ePSIplatform 2015).

Subsequently, the pan-EU Open Data portal, is to be launched in November 2015, will provide an existing access point at European level. This is because the upcoming pan-EU OD portal will allow for data discovery from all national and regional public data portals, including those hosting transport data.

Includes: Minimum obligations on Member States to ensure that public entities make data available for use by others; a European level data discovery portal.

Does not include: Specific transport related requirements to the degree which this study is considering therefore there may not be consistent interpretations between how this has been applied in each Member State; nor does it include any obligation on non-public entities.

Additionally, as explored in Lyoen, Briand et al (2010), the PSI Directive does not provide a definition of "public data". The Directive specifies that "Public Data" or "Public Sector Information" is: "*existing documents held by public sector bodies of the Member States*" (article 1); "*public sector bodies*", are "*State, regional or local authorities, bodies governed by public law and associations formed by one or several such authorities or one or several such bodies governed by public law*". And "*bodies governed by public law*", are: "*established for the specific purpose of meeting needs in the general interest, not having an industrial or commercial character*".

There are also a number of exclusions included in the Directive on the right of re-use which may be likely to be invoked in some instances within the field of transport data, namely:

- Third party intellectual property rights (e.g. private transport operators)
- Personal data protection (though this seems to be a less significant issue regarding MMTIPS)
- Statistical and commercial confidentiality (e.g. private transport operators)
- Public security (which might prevent the sharing of real time vehicle locations in certain instances)

Therefore, transport data sourced from private companies, even where it relates to a commercial public service (on behalf of a public body) fall out of the scope of PSI and shall be regarded as private data.

D.1.3 Real-Time Traffic Information (RTTI) Delegated Regulation

In December 2014, the EC adopted new rules (EC 2014a) to help provide road users with more accurate, accessible and up-to-date traffic information related to their journeys. This can include information about expected delays, estimated travel times, information about accidents, road works and road closures, warnings about weather conditions and any other relevant information.

The Delegated Regulation is intended to provide appropriate framework conditions enabling the co-operation of all the relevant stakeholders (road authorities, road operators and ITS service providers) involved in the traffic information value chain, and to support the interoperability, compatibility, and continuity of real-time traffic information services across Europe. In return, higher quality information services are expected for both passengers and freight operations.

To achieve this, the Delegated Regulation (specifications) to Member States require:

- That road status and traffic data are made accessible via national access points in a standardised format to improve interoperability. The specifications also establish rules on data updates including timeliness of these updates.

- The specifications apply to the comprehensive Trans-European road network and motorways not included in this network as well as to "priority zones" (especially interurban/urban busy roads) when national authorities voluntarily identify such zones.
- The specifications do not make RTTI services obligatory. However, when services are already available the specifications have to be followed.
- The specifications foresee that each Member State sets up a national access point for the exchange of data to ease access to the latest information.

Includes: Real-time and static road traffic data (events and disruptions, levels of service, journey times); establishing of national access points.

Does not include: Non-road traffic modal information (e.g. passenger transport data).

D.1.4 Telematics Applications for Passenger Services Technical Specifications for Interoperability (TAP/TSI).

In May 2011 the EC formally adopted the TAP/TSI as the Commission Regulation (EU) No 454/2011.

The purpose of the TAP/TSI is to define European-wide procedures and interfaces between railway industry actors (passengers, railway undertakings, infrastructure managers, station managers, public transport authorities, ticket vendors and tour operators). It is designed to contribute to an interoperable and cost-efficient information exchange system for Europe that enables the provision of high quality journey information and ticket issuing to passengers in a cost effective manner.

The TAP/TSI implementation is in three phases:

- Phase 1: implementation preparation, containing detailed IT specifications, a master plan and a governance model (2011-2012);
- Phase 2: development of the data exchange system; and
- Phase 3: deployment of the data exchange system (2013-2021 – with initial results expected from 2016 onwards).

Includes: Interoperability of information and data exchange mechanisms covering rail industry operations including those required for MMTIPS.

Does not include: Non-rail modal information.

TAP/TSI can be interoperated with by stakeholders in the information chain and provides rail requirements. However as it is an industry format it would be beneficial to replace it in the long term by a subset of NeTEx Part 3 as an open standard for use with MMTIPS.

D.2 Member State Overviews

This section provides greater detail on the situation in each Member State to that summarised within Section 8. Each Member State differs in terms of progress with providing multimodal travel information services and of engagement with the development of associated European standards and the existing level of standardisation within each country.

This section of the report provides an overview of the current status of Member States with a focus on the following:

- Current national policy on data standardisation in this field
- The nature of existing standards
- Service quality requirements

- Current level of uptake of formal or informal standards within the country
- Issues identified at a Member State level.

The information has been gathered following consultation with ITS representatives from each Member State, a review of ITS Member State reports and a wider review of publicly available literature.

D.2.1 Austria

Austria's legislation, based on European standards follow the requirements of TAP/TSI, PSI, Inspire and the ITS-Directive with European standards (CEN TC278 WG3) translated into national standards by the Austrian standardisation institute ON.

The Austrian Association for Research on Road, Rail and Transport ([FSV](#)) publish Standard descriptions such as RVS 05.01.14 Intermodal Transport Reference System for Austria. Furthermore, the [GIP Standard Specification](#) (Graphs Integration Platform) defines regulations which are aimed at guaranteeing the consistency of partial graphs which are required for the Austria-wide exchange of transport related reference data. This standard, which is the basis for all Austrian ITS Services by the Austrian ITS Law, is mandatory to be used by all public administrations and includes several static spatial data outputs.

In order to maintain international standards Austria follow testing and validating recommendations as set within [EIP+](#).

Consultation with the Austrian ITS representative highlighted difficulties in integrating all data and service owners under one umbrella and in setting up a national multimodal traveller information service ([VAO](#)). Austria have experience of sharing transport related data with other countries (European Digital Traffic Infrastructure Network for Intelligent Transport Systems (EDITS project 2014)) and provided their views based on this experience. As the system becomes operational, all stakeholders see the benefit of cooperation and merging resources. The organisational barriers were far bigger than the technical ones. Common concerns surrounded ambiguity surrounding the benefit or incentive in sharing the data, each data owner wanted to control the project and was distrusting on sharing data with competitors. Subsequently, the following was agreed upon: *"Every partner is responsible for his data, he is responsible to integrate them into the national platform and the final service is a discrimination free routing"*. To ensure that, a neutral national body was set up, called "Trusted Third Party".

D.2.2 Belgium

A representative from Belgium indicated that the country has an open market which supports the development of new applications using data. It was further stated that there is a need for data availability and subsequently they are keen to push the public market so the data is available across the EU.

The following list highlights the current data standards which SNCB (the national rail operator) adheres to:

- The Line, TEC and STIB exchanging data via the BLTAC format (HASTUS)
- There are plans to incorporate companies such as Google where it is envisaged that data will be shared
- Exchange of rail schedule data within Europe is done through the MERITS platform
- The exchange of multimodal information shared through EU SPIRIT.

D.2.3 Bulgaria

The Bulgarian Ministry of Transport, Information Technology and Communications are responsible for overseeing the national transport policy. In line with the European transport policy and its objectives they are working towards developing intelligent information systems (ITS) within the country but no further information was made available.

D.2.4 Croatia

Croatian national policy on transport data standardisation is defined within the constitution and operation of the Croatian Standards Institute. This is undertaken through acceptance of all European standards within the scope of technical committee CEN / TC 278, Intelligent Transport Systems into the National standards, and the withdrawal of conflicting ones. Only two technical reports are not accepted:

- CEN ISO/TR 17424:2015: Intelligent transport systems - Cooperative systems - State of the art of Local Dynamic Maps concepts (ISO/TR 17424:2015); and
- CEN/TR 16742:2014: Intelligent transport systems - Privacy aspects in ITS standards and systems in Europe.

Current key stakeholders driving the standards agenda are Members of Technical Committee (HNZ/TO 524, Intelligent Transport Systems) who are the representatives of universities, public and private companies.

No further information specifically on data for multimodal travel information was made available.

D.2.5 Czech Republic

The Czech Republic has a legally defined process of data provision and quality control concerning their National Information System of Timetables (CIS JR). They have an Act on road transport (Act No 111/1994 Coll., as amended, its implementing Decree No 122/2014 Coll.) and an Act on railways (Act No 266/1994 Coll., as amended).

Transport law enables sub-contracting of system development and maintenance. The CIS JR (nationwide information system of public transport timetables) database is administrated by the Czech Ministry of Transport (MoT). Based on the contract the CIS JR database is operated by private company CHAPS and contains timetabled data on trains, metro, trams, trolleybuses and city and regional buses. Scheduled data is provided by public transport operators (by law at least 15 days before a change in the schedule to the local regional administration).

CIS JR also contains the following registers/databases:

1. Public transport terminals, stations and stops, numbers of public transport lines and routes; and
2. Public and private public transport companies.

Nationwide the Multimodal Journey Planner, IDOS, uses the data as a commercial product (www.idos.cz, www.jzdnirady.cz).

The information chain to feed IDOS incorporates data acquisition (from public transport operators with verification by regional administrations); and data fusion and information supply (this is subcontracted by MoT to private company CHAPS).

The MoT has a framework which complies with the PSI Directive in order to make public transport data accessible. From 1 September 2015 this will be available on a non-discriminatory basis for all potential multi-modal journey planners' service providers in the csv based "jdf".

D.2.6 Denmark

In Denmark the public transport companies jointly own the national travel planner (Rejseplanen.dk). Data is collected from private and public data and both submit data to the national planner to ensure people use their services. There is also an open API and cooperation with an international organisation. A key focus now is data formats and standards, rather than the data itself. The adopted policy is as follows:

- a) All public and private passenger transport companies deliver data to Rejseplanen on a voluntary basis utilising the Rejseplanen data format. This includes public and private companies. Real-time data is delivered when available.
- b) Traffic information (congestion) is delivered by companies to a common system at Rejseplanen.
- c) Ticket prices are calculated and showed, however Rejseplanen do not sell tickets.

The current standards in use are the Danish Bus format, Hafas raw format, GTFS format and for real-time information VDV454.

The standards from Rejseplanen are widely used by the transport companies who use Rejseplanen as their only data platform. Currently, real-time information is delivered in other formats such as "HRX2", "Pubtrans" and "TROG" because Rejseplanen has only recently adopted standards for real-time information.

Within Denmark the quality of plandata from companies has been an issue and the period of time for delivery of data is still in discussion. Companies have agreed that a period of at least 2 months in advance should be standard. The levels of services differ from company to company, some are running with real-time data and some are running with "push messages to customers" and some are only sending schedule data.

D.2.7 Finland

Finland use formal CEN/ISO standards wherever applicable. However, national and informal standards are also used. National standards have been developed where no applicable CEN/ISO standards have been available. In addition, informal international standards like GTFS are used.

The Finnish national database on transport data has an open interface, which enables both easy access and utilization of data. The specifications on the interface are freely available.

The current existing standards commonly in use include:

- INSPIRE
- Dynamic Road traffic data – Datex and Alert-C location coding.
- Public transport static route and timetable data – kalkati and GTFS
- Dynamic bus data is available in major cities
- Dynamic rail traffic data provided by Finnish Transport Agency (FTA).

The current level of uptake of standards depends on data availability. The services rely on the quality of the existing available data. Services are obliged to use the latest data and feedback to data providers on quality issues is welcome. Most Finnish multimodal transport data is produced or financed by the public sector and the coverage and quality is dependent on public sector resources.

The public transport companies and authorities in Finland are obliged to provide their static route and timetable data to FTA according to Finnish legislation.

Nationwide multimodal services have not appeared on the market because reliable data is not available for complete travel chains. The public sector is tackling this issue to make data available i.e. through legislation and open data platforms.

As an ongoing project the Finnish Transport Agency and Helsinki Region Transport (HSL) are developing a new nationwide Journey Planner based on open data and open source (Open street map, Open Trip Planner): www.digitransit.fi.

D.2.8 France

Relevant policy leaders on transport data standardisation are the Ministry of Transport, the local and regional transport authorities, and the big operators. French stakeholders wish to extend standardisation to "new transport modes" such as car-pooling, car-sharing, ride-sharing, bicycle-parking etc.

The national policy is to foster the use of the CEN TC 278 standards (Transmodel, IFOPT, NeTEx, SIRI), and to develop national guidelines, profiles and tools for their implementation. Under the TC 278 standards, there is presently a shared stop point model under Transmodel/IFOPT, three national profiles under NeTEx. A project led by two major French actors in the field of passenger information also defined a state of the art API for distributed journey planning and benched it as a proof of concept. Such standardized API was provided to TC 278 SG8 on TC route planning APIs.

The standardisation is supported by tools and dissemination platforms: in particular, the open-source software CHOUETTE for importing/exporting and validating different exchange formats, and the website www.normes-donnees-tc.org.

A partial survey on adoption levels of standards was conducted for the Ministry of Transport in 2012 and again in 2015. Uptake of the CEN standards was slow. GTFS was used in Bordeaux and Nantes amongst others. Native bespoke CSV formats were also encountered. Service quality requirements on data provision were practically non-existent, with rare exceptions (e.g. bilaterally agreed API response times).

A national debate was conducted through 2014 and the report was published earlier this year (2015). The report recommends the opening of data and describes conditions for re-use, such as neutrality of re-use, completeness and quality of information, cost coverage for sourcing and sharing the data. On the technical level, the standardisation policy described above is backed.

Since then, a new legal framework ("Loi Macron") has been voted by the French Parliament during the summer. Transport data (e.g. as stops, planned and real-times schedules etc.) of private and public transit operators are to be opened for re-use. New transport modes (car-pooling, car-sharing etc.) are also in the scope of the framework.

D.2.9 Germany

Standardisation is a crucial policy element for Germany, which has a complex structure of public transport organisations and providers. Standards for public transport data are mostly issued and maintained by the VDV (national association of transport operators). In most cases they conform to CEN-Standards like SIRI, IFOPT and NeTEx.

Standards are used to allow the exchange of data between service operators (bus operators, railway operators: VDV standards, also for electronic ticketing systems) or between service providers (DELFI, EU-SPIRIT, TRIAS). TRIAS is promoted as the standard for web-services.

National standards tend to conform to international standards. However, outside public transport few standards exist (e.g. for bike sharing, car sharing infrastructure); proprietary and ad-hoc solutions are used.

The uptake of standards is generally high and there has been a significant input from German national standards from VDV standards such as SIRI or OJP, with some

realigning of VDV terminology to conform to Transmodel. Parts of SIRI standards are widely used in D. Components of SIRI are e.g. National Recommendations 453 and 454 of the VDV (Association of German Transport Companies).

Recent standards like NeTEx, which enlarge the scope of previous ones but require in many cases considerable investment to implement, are not yet in use. NeTEx 3 however is not widely used as a significant investment to cover the costs of migration will be needed. These standards will need the backing of the Commission to win recognition.

A national PT stop database (conforming to IFOPT) is under preparation and due to be available in early 2016. A nationwide data platform on all PT information (planned timetables) will be available for future Europe-wide services once complete.

New Delfi services in Germany will not be established before 2016 but it is the goal of the Federal Republic and the Federal States to limit the effort by using existing national data sets for European use, either as open data or (preferably) as open services or via open interfaces. This will be specified during 2016 as soon as the new organisation in charge has been founded.

Service quality requirements are dependent on the nature of the data exchange, they are high for the use of data on dynamic signs at stops or for the popular traveller information services. They may be reduced (in coverage, timeliness or accuracy) for the free delivery of data to third-party providers.

Issues which have been experienced include:

- Data ownership
- Commercial re-use
- Copyright of databases
- Possible effects on competition (in particular for real-time data)
- Delivery of data to providers who don't show the source
- Quality of information (in particular for transport chains) by third party providers
- Differences in regulation between regions
- Limitations in inter-/multimodal data usage due to own commercial interests
- Integration of data for long-distance-bus services.

D.2.10 Greece

In Greece travel information is provided only for Athens and only for interconnection between suburban railways, metro, urban buses, trams, trolleys and flights. Interregional (long distance) buses are not connected. In other cities in Greece only simple (if any) applications exist.

It was reported that in Greece there are no relevant national policies or generally adopted data formats or standards.

D.2.11 Hungary

Hungarian representatives reported that Hungary is currently building a nation-wide ticketing system which will have a central information hub. It was stated that regulation is required to ensure the quality of the data for the passenger. It was noted that the price of data varies depending on whether it is supplied by private or public organisations.

No information was available on the use of data formats or standards to support this.

D.2.12 Ireland

Irish representatives indicated they provide advanced real-time and on-trip information on public transport connections. This is based notably on two components of the SIRI standard (Service Interface for Real-time Information) focusing on CM; Connection Monitoring and CT; Connection Timetable.

The national view is that IFOPT (Identification of Fixed Objects in Public Transport) Technical Specification should be used more broadly, as it could also provide internal routing through stations, assisting with interchanges. No further data was obtained surrounding data standards or issues.

D.2.13 Italy

In terms of road traffic data, (or its provision by public authorities to private actors, i.e. information service providers), Italy have developed a Public Index of Information. The aim is to provide a national observatory for transport, with aims of collecting (via a number of innovative technologies), processing and sharing data among stakeholders.

The main barrier identified to the adoption of standards is the lack of available sources which might be encouraged to adopt them and provide that data for free. No further data was obtained surrounding data standards or issues.

Italy has one of the first large implementations of NeTEx – the 5T BIP project in Turin.

D.2.14 Malta

The contacted representative for Malta declared that there is no national journey planner or use of data standards currently due to the size of the country where buses are the only public transport mode.

D.2.15 Netherlands

Available data includes both traffic data (including parking data) and public transport data. The data is available through major national organisations, such as the National Data Warehouse (NDW) and National Data Project for Public Transport (NDOV), with also a number of regional initiatives, such as Open Data FWD. When the data is made available, the necessary attention is paid to standardisation using platforms such as MOGIN, BISON and DVM Exchange.

The State, the Provincial Governments and the City Regions launched the National Data Project Public Transport (NDOV) in 2009. PT and rail operators (and government organisations for public transport stop data) make their source data available to a point of access that passes on the unchanged data to purchasers. Interested parties can apply for the data to set up a service (<https://ndovloket.nl> and <https://ndovloket.wordpress.com> (both Dutch language only)). The focus of NDOV is on opening sources of raw data and validating them. As of 2015, NDOV covers PT and rail service information nationwide. Access to the data can cost maximum 1k€/yr. After the first multimodal travel information/planner service, 9292, ten more services/apps were developed by the market, providing door to door multimodal advice, including on Google maps. Also real-time information is now available.

The Netherlands is implementing an Open Data policy, reaching beyond the provisions of the PSI Directive, and re-organising the National Data Warehouse's principles of data exchange with service providers. In terms of format of traffic data exchange, most of the times, DATEX is used. The Netherlands highlighted challenges and concerns in bringing all access points together due to the variances in data held by public and private bodies.

D.2.16 Poland

In Poland, the general provisions setting out the requirements for the ICT systems used for the public sector purpose and public registries as well as exchange of information in electronic form are regulated by the "Act on the Informatization of Activities Undertaken by Entities Fulfilling Public Tasks" (2005).

Access to static data as well as relevant standards are regulated by the "Spatial Information Infrastructure Act" as well as further implementing legislation.

The timetables publication in Poland has been regulated in the Act of 15 November 1984 Transportation law, the Act of 16 December 2010 of the collective public transport and the regulation of 10 April 2012 of Minister of Transport, Construction and Maritime Economy on timetables. The regulation defines the content of timetables, their approval procedure, methods and timing of announcement and updates, as well as the conditions for incurring the costs and posting information on timetables and rules of publication. The operator of regular carriage of persons is obliged to publish the timetable on the website (if there is one). Moreover, the operator submits the timetable to the public transport organizer (e.g. the Marshal Office) in order to publish it in the passenger information system in PDF format and in electronic version enabling text edition.

D.2.17 Portugal

The provision of reliable information to travellers has been a policy concern in Portugal. As a result, public investment has been made resulting in a national multimodal national journey planner as well as travel information services for the two main metropolitan areas.

Furthermore, in recent years the transport sector in Portugal faced several structural changes (also including IMT), with implications for the national ITS strategy and priorities. Current policy is that access to data should not be discriminatory and Public Transport Operators should not be obliged to provide information. Portugal's PTO/PTAs websites cover information with tariff information prioritised.

The majority of transport operators in Portugal have information on stops, however it is not available in a consistent electronic format for the entire country.

D.2.18 Slovakia

Compliance with the approved ITS (Information Transport System) Law is required to respect existing standards and requirements of the ITS implementation plan in cases of information systems' implementation. The valid Slovakian technical standards and obligations are in line with EU Directives.

Services quality requirements are generally defined in the approved ITS Law. Details are determined in the National system of traffic information, which is currently in preparation. These requirements must be followed by each ITS services contractor/provider.

A Slovakian representative indicated the country has good quality transport information, particularly for road transport. They have developed a national public transport portal, which aims to offer developers of transport applications the ability to further elaborate, evaluate and offer information to the public.

In addition, it was reported that for a small country data standardisation is considered to be a burden.

D.2.19 Slovenia

Slovenia does not have any special national policies on transport data standardisation. Databases and data are owned and managed by different stakeholders, separately for

road and railway transport. However, there are many internal rules (not standards) about database models of different transport databases, such as BCP - Road and Traffic Data Bank, TIC database (Information Centre for National Roads), AVRIS (Bus schedules and routes) in use. There is a trend, when sharing data, that existing data is converted by using a formal European standard data model.

Travel information services are not centralized and are operated by different operators, especially for public transport. Existing information services lack both intermodality and integration at national level. Raw data is not typically shared, however some information is shared for free (business to business) or via formal contracting. In this case the data manager of that service is responsible for the information quality.

D.2.20 Spain

The Spanish policy view is that stakeholder cooperation in the information chain should be encouraged due to the benefits to travellers. The public sector had been working on the basis that private companies would assume that it is good for their services. However, the willingness to exchange data between different modes (road, rail, air, inland and maritime) is a barrier and companies are afraid that they could lose clients to other modes/competitors if their data is made available in common formats. Another identified barrier is how to exchange underlying data that is already used in the private companies and the need for common referencing to be able to combine it with other sources.

The Spanish National Road Safety Authority (DGT) offers services for public dissemination of traffic information in DATEX II format.

The Spanish representative indicated that their view that a global mobility platform would serve as a good model for cloud-based services. No further data was obtained surrounding data standards or policies.

D.2.21 Sweden

For the Swedish Transport Administration (STA) and Swedish Transport Agency, the policy is to use existing standards for road and railway data. The public transport (PT) actors in Sweden also aim to use existing standards when possible rather than develop new standards. The PT actors in Sweden are working towards use of the CEN TC 278 standards (Transmodel, IFOPT, NeTEx, SIRI). It will take some years of transition to fully achieve this goal.

According to the Swedish public transport law (2010:1065) and regulation TSFS (2012:2) all public transport companies and public authorities are obliged to provide their static data to a central national database. The regulation also requires the actors to provide information about their traffic services electronically to Samtrafiken AB (neutral national PT organization owned jointly by 38 transport companies). TSFS (2012:2) indicates "common transport format for traffic data" as a suitable format when providing information to Samtrafiken.

For national real-time traffic information for road the Swedish Transport Authority (STA) provides this via the DATEX II standard to third parties. This data is free of charge with limited agreements. STA has decided to take this further with an data access policy (this concept goes further than the provision of data set out in the PSI Directive) to make it easy for third parties to use the data. An API is also available for real-time traffic information for road and for railway. The API uses both an XML-format and JSON. There is also another interface for railway operators called UTIN that uses TAP for distributing data. Information about all state, municipal and private roads in Sweden is available in the national road database, NVDB.

Regional Public Transport operators use APIs for providing static data free of charge. On an national level we have a access point called Trafiklab, an open interface, that use

GTFS as the format to provide static data (e.g. timetables) to third parties. National standards (e.g. NOPTIS) have been developed where no applicable CEN/ISO standards were available at that time. More than 80% of all traffic data (planned and real time) in Sweden uses the NOPTIS de facto standard. On a national level no real-time data is collected, however some real-time data is available free of charge from regional public transport operators via an access point. The Swedish government has developed a national portal for data access. This portal promotes the use of DCAT for public authorities.

Sweden is participating in EIP+ (European ITS platform), particularly in the work for the validation of quality methods, but also the work with recommendations for a single point of access and metadata catalog.

A Swedish representative indicated that the quality of data collected within the country is considered sub-standard. Another issue is the ambiguous definition of which standards and formats to use as well as lack of clarity on roles and responsibilities in the information chain.

D.2.22 United Kingdom

Within Great Britain's public transport area there is full uptake of the use of formal standards, with a gradual decline in the use of bespoke informal standards.

In order to link regional journey planning systems for British regions across England, Scotland and Wales, it was essential to establish standards for location data (the National Public Transport Access Nodes (NaPTAN) standards for station and stop data, and the National Public Transport Gazetteer (NPTG) for localities), and to follow Transmodel in establishing the underlying basis for standardisation that was necessary to exchange data between systems using JourneyWeb. British standards also cover the electronic transfer of route and timetable information through the XML format, TransXChange and its predecessor, ATCO-CIF – this still currently co-exists with a lot of data being transferred in non-digital formats.

At local authority, regional, and national levels, there is full adoption of NaPTAN and NPTG, with TransXChange usage increasing. It is worth noting that there is no regulatory requirement for local authorities to create and maintain data according to these standards, but local authorities and others recognise the benefits of doing so, particularly for NaPTAN and NPTG, and willingly and regularly provide data that meets these standards.

Whilst there are no formal quality requirements, the Department for Transport (DfT) has an expectation of data being correct on a weekly update cycle. In practice, there is room for improvement in some areas of bus stop data can be less reliable, although timetable data is generally kept up to date. A small percentage of services data can be out-of-date; there is an expectation that data service changes should be available for inclusion in journey planning systems at least two weeks before changes happen, which is met in the majority of cases.

The UK rail sector makes a standardised dataset of schedules and fares information available in a flat file format called CIF (Common Interchange Format) free but under license. This provides a three month advance window of schedules. Real-time status information for rail is also available under license.

UK public transport (non-rail) schedules data is made available freely under license through Traveline Information Ltd (TIL), a partnership company between transport operators and the public sector. This organisation coordinates the amalgamation of data from eleven regional travel information service providers. This complete national UK dataset is published in the xml format TransXChange. A supporting transport nodes (e.g. bus stops) database is also published by DfT in xml and csv – NaPTAN. This national data set can be converted into the GTFS format for use by Google and/or others. Further

supporting databases include the National Public Transport Gazetteer (villages/towns/cities) and the National Coach Services Database (NCSDB), containing coach services not found in Traveline data. Bus fares information in electronic format exists in some regions of the UK but typically fares enquiries are referred to the relevant transport operator. There is currently no policy requirement or preferred data formats for the provision of bus fares information.

Door to door journey planning is available throughout Britain on a range of services from various providers, such as regional Travelines and Google. As a result there is investment from operators, local authorities and data users (such as Google) to improve the quality of data.

An incomplete centralised source of real-time bus information is also provided by TIL using the SIRI interface format. This has reasonable coverage of the UK but with a number of significant gaps. Access to this is also provided under license at a minimal cost (to cover IT infrastructure costs). It is a voluntary participation approach for operators and cities to decide to publish their real-time data this way.

The UK Government seeks to promote consistent data standards such as TransXChange and SIRI as well as a Data access agenda (with a national access point portal data.gov.uk). Now that a number of national datasets are available the expectation is that the private sector will deliver MMTIPS services using these data sources.

The Department for Transport (DfT) initiated the Urban Traffic Management and Control (UTMC) programme in 1997 in order to help urban local authorities in the development of a more open approach to the use of ITS in urban areas. UTMC systems use a common database to share relevant information between individual ITS applications, such as traffic signal control systems, air quality monitoring, car park management and bus priority, often all managed from the same control centre. These services can be provided individually, but greater benefits can be gained by integrating them into a UTMC system. UTMC systems can provide a cost-effective and flexible means to manage transport in urban areas, to support a wide range of transport policy objectives.

Some of the benefits of working towards common standards include:

- Less duplicated effort designing requirements (for users) and interfaces (for suppliers).
- Applications can share PCs and communications, resulting in a reduction of costs and management effort for the IT infrastructure.
- Having a common data base with all the data in a consistent format allows intelligent monitoring and intervention, e.g. car park guidance systems can be connected to key links in the network, intelligent traffic signal control strategies to incident detection systems on key links.
- Developing all these systems collectively improves the quality of the specifications and reduces the opportunity for contractual squabbling (user-supplier or between suppliers). UK road data makes widespread use of the UTMC (Urban Traffic Management Control) standard) which provides both a conceptual model, a data exchange format and a protocol for exchanging both static and dynamic road data of all types and is used in most large UK cities. It includes road links, travel times, queues lengths, detectors, parking capacity and availability Variable Message Signs (VMS), jam cams, planned and unplanned incidents. It is highly modular so only particular services need to be implemented. UTMC scope is broadly equivalent to DATEX II, but also includes upstream services to collect and aggregate raw feeds.

Finally, a UK cycling data standard was developed by the DfT: CycleNetXChange, which specifies a set of standards for exchanging cycle path links as attributes. It is based on the UK Ordnance Survey Integrated Transport Network (ITN) paths.

D.2.23 Others

No information was available for the status in Cyprus, Estonia, Latvia, Lithuania, Luxembourg and Romania.

Appendix E Expected functions of MMTIPS and data needs

The following three tables provide an outline of expected functional content of MMTIPS and supporting data requirements. These are categorised into:

- Minimum expected functionality and supporting data requirements
- Additional desirable functionality and supporting data requirements
- Nice to have functionality and supporting data requirements

For the purposes of discussing the required functionality and supporting data requirements, different modes of transport have been partitioned into the following groups:

- Scheduled (rail, tram, metro, bus, long distance coach, park and ride bus, air, ferry, funicular/cable car)
- Demand-responsive (taxi, car share, car pool, 'ring-and-ride' bus, car hire, cycle hire, charter air)
- Personal (car, motorcycle, electric vehicle (EV), cycle, walk)

Additionally different types of network have been numbered as 1. Rail network; 2. Road network; 3. Road and cycle network; 4. Pedestrian network; and 5. Other network. The following table assigns each mode to one of the three groups and also to one of the network types.

	A. Scheduled	B. Demand-responsive	C. Personal
1a. Trunk Public Transport networks	Rail, long distance coach, air, ferry	[Charter air, charter waterborne]	
1b. Local Public Transport networks	Metro, tram, bus, light rail, Park and ride bus, water bus, cable car	'Ring-and-ride' bus, shuttle bus,	
1c. Other Public Transport networks	Air, ferry	Shuttle ferry	
2a. Road network		Taxi, Car share, Car pool, Car hire	Car, Motorcycle, EV
2b. Road and cycle network		Cycle hire	Cycle
3. Pedestrian network	Passenger ferry		Walk

E.1 Minimum expected functionality and supporting data requirements

MINIMUM Content	MINIMUM Application Functionality	Supporting data requirements	Type	Network type	Pre-Trip / In-Trip	Static/ Dynamic
All	Location search (origins, destinations)	Address identifiers (building number, street name, postcode)	All	All	Pre-Trip	Static
		Topographic places (city, town, village, suburb, administrative unit)	All	All	Pre-Trip	Static
		Points of interest (destinations such as cultural attractions, sports venues, parks, prisons, transport interchanges) to which people may wish to travel	All	All	Pre-Trip	Static
	Trip plans (All)	Operational Calendar, mapping day types to calendar dates	All	All	Pre-Trip	Static

MINIMUM Content	MINIMUM Application Functionality	Supporting data requirements	Type	Network type	Pre-Trip / In-Trip	Static/ Dynamic
PT Network	Locations (calling points, stations and interchanges)	Identified access nodes (public transport stops, railway stations, airport terminals, ferry terminals)	A. Scheduled	All	Pre-trip	Static
		Other Access nodes – e.g. taxi ranks, areas served by demand-responsive bus services	Some B. Demand-responsive (e.g. taxi)	2. Road network	Pre-Trip	Static
	Trip plan computation (PT)	Connection Links where interchanges may be made, recommended transfer times between modes at interchanges	A. Scheduled	All	Pre-Trip	Static
PT Schedules	Trip plan computation (PT)	Operators – needed to distinguish journeys when aggregating timetables; service identifiers (e.g. route number/name), mode indicator	A. Scheduled	Various networks (1, 2, 5)	Pre-Trip	Static
	Passing \ stopping times, Trip plan computation (PT)	Timetabled journeys with scheduled sequence of route, days of operation, departure and arrival times – assuming no unplanned disruptions	A. Scheduled	Various networks (1, 2, 5)	Pre-Trip	Static
	Trip plan computation (PT)	Planned & guaranteed interchanges between scheduled services.	A. Scheduled	Various networks (1, 2, 5)	Pre-Trip	Static
	Trip plan computation (PT)	Hours of operation (especially for frequency based and Ring-and-Ride services that do not have set journey times)	A. Scheduled B. Demand Responsive	Various networks (1, 2, 5)	Pre-Trip	Static
PT Information	Info Service (PT)	How to book Ring-and-Ride bus – URLs and phone numbers	Some B	Various	Pre-Trip / In-trip	Dynamic
Road Network	Trip plan computation (road)	Driving restrictions and permissions: turning permissions/restrictions; toll road (tolled or not – not tariff); access regulations (vehicle type; vehicle usage); fuel type; tunnels; bridges;	All road modes	2. Road network	Pre-Trip	Static
	Trip plan computation (road)	Cycle network (topology/gradients, surface quality, segregated cycle lanes, on-road shared with vehicles, on-path shared with pedestrians)	All pedal cycles	3. Road and cycle network	Pre-Trip	Static
	Trip plan computation (PT)	Pedestrian network and accessibility facilities	C. Personal (walking)	4. Pedestrian network	Pre-Trip	Static
Road "Schedule"	Trip plan computation (road)	Road speed limits	All road modes	2. Road network	Pre-Trip	Static

E.2 Additional desirable functionality and supporting data requirements

DESIRABLE Content Group	DESIRABLE Application Functionality	Supporting data requirements	Type	Network type	Pre-Trip / In-Trip	Static / Dynamic
Road Network	Location search (Road)	Park & Ride stops	A. Scheduled	2. Road	Pre-Trip	Static
	Location search (Road)	Bike sharing stations	B. Demand-responsive	3. Road and cycle	Pre-Trip	Static

DESIR-ABLE Content Group	DESIRABLE Application Functionality	Supporting data requirements	Type	Network type	Pre-Trip / In-Trip	Static / Dynamic
	Location search (Road)	Car-sharing stations	B. Demand-responsive	2. Road	Pre-Trip	Static
	Location search (Road)	Car-pooling pick-up points	B. Demand-responsive	2. Road	Pre-Trip	Static
	Location search (Road)	Publicly accessible charging/refuelling stations	C. Personal	2. Road	Pre-Trip	Static
	Location search (cycle)	Bike parking (secure)	C. Personal	3. Road and cycle	Pre-Trip	Static
PT Network	Trip plan computation (PT if no timetable)	Network topology and routes /lines (topologies)	A. Scheduled	Various networks (1, 2, 5)	Pre-Trip	Static
PT Real-time	Passing times	Predicted departure and arrival times of services	All	All	Pre and in-trip	Dynamic
	Passing times auxiliary info, Trip plans (PT) auxiliary info	Unplanned disruptions	All	All	Pre and in-trip	Dynamic
	Passing / stopping times, Trip plans (PT)	Real-time status information - delays, cancellations, guaranteed connections	A. Scheduled	Various	Pre and in-trip	Dynamic
Road Real-time	Trip plans (PT)	Current Road link travel times; future predicted road link travel times	All road modes	2. Road	Pre and in-trip	Dynamic
	Trip plans (Road)	Road closures / diversions / capacity restrictions / temporary speed limits (car)	All road modes	2. Road	Pre and in-trip	Dynamic
	Trip plans (Road)	Network closures / diversions (cycle)	All cycle modes	3. Road and cycle	Pre and in-trip	Dynamic
	Trip plans (PT)	Network closures / diversions (pedestrian)	Walk	4. Pedestrian	Pre and in-trip	Dynamic
PT Fare Retail/ Distribution information	Info Service (PT)	Where and how to buy tickets (all PT Modes) – URLs and phone numbers	A & B	Various	Pre-Trip	Static
	Info Service (Road)	Where and how to pay for car parking , Charging/refuelling stations for vehicles – URLs and phone numbers	Some C	Various	Pre-Trip / In-trip	Dynamic
Fare Structure	Trip plans (PT),	Fare structure: tariff zones, business rules and restrictions or link to a source of this information	A. Scheduled	Various	Pre-Trip	Static
PT occupancy	Trip plans (PT) auxiliary info Availability check (PT)	Passenger transport (booking databases or APIs)	A. Scheduled	Various	Pre-Trip	Dynamic /Static
Road Schedule	Trip plan computation (road)	Historic travel times by day type and time-band	All road modes	2. Road network	Pre-Trip	Static

DESIR-ABLE Content Group	DESIRABLE Application Functionality	Supporting data requirements	Type	Network type	Pre-Trip / In-Trip	Static / Dynamic
PT Facilities	Trip plans (PT) auxiliary info, location search, auxiliary info	Stop facilities (including platform information, help desks/information points, ticket booths, opening hours, staffing hours, toilet and bathroom facilities, walk time around site, lifts/stairs, entrances and exit locations) or URLs to appropriate sources	All	All	Pre-Trip	Static
	Trip plans (PT)	Vehicle facilities classes of carriage, onboard Wi-Fi, buffets, etc	All	All	Pre-Trip	Static
Access-ibility information	Trip plans (PT)	Vehicles (low floor; wheelchair accessible etc)	All	All	Pre-Trip	Dynamic / Static
	Trip plans (PT)	Accessibility of stops, and paths within an interchange (indicating, for example if there is 'step free access')	All	All	Pre-Trip	Static
	Trip plans (PT) auxiliary info,	Existence of assistance services	All	All	Pre-Trip	Static
	Trip plans (PT) auxiliary info, location search, auxiliary info, Availability check	Availability of assistance services (e.g. hours)	All	All	Pre-Trip	Dynamic / Static

E.3 Nice to have functionality and supporting data requirements

NICE TO HAVE Content Group	NICE TO HAVE Application Functionality	Supporting data requirements	Type	Network type	Pre-Trip / In-Trip	Static / Dynamic
Fare Products	Fare query	The access rights given by a product (point to point travel, zonal, pass, coupon, etc)	A. Scheduled	Various	Pre-Trip	Static
	Fare query	Special Fare Products : Offers with additional special conditions	A. Scheduled	Various	Pre-Trip	Static
	Fare query, Fare Info Service	Terms & conditions of use, refunds, returns, transfers etc	A. Scheduled	Various	Pre-Trip	Static
Fare Tariffs	Trip plans (PT), Fare query	Standard Fare Prices : Scheduled passenger services	A. Scheduled	Various	Pre-Trip	Static
	Trip plans (PT), Fare query	Special Fare Prices	A. Scheduled	Various	Pre-Trip	Static
Road Distribution information	Info Service	How to book (Car sharing, taxis, cycle hire)	Some B	Various	Pre-Trip / In-trip	Dynamic
	Info Service	How to pay tolls		Various	Pre-Trip	Static
	Info Service (Road)	Where and how to pay for Car parking , Charging/refuelling stations for vehicles	Some C	Various	Pre-Trip / In-trip	Dynamic

NICE TO HAVE Content Group	NICE TO HAVE Application Functionality	Supporting data requirements	Type	Network type	Pre-Trip / In-Trip	Static / Dynamic
Road Availability	Availability check (Road)	Car sharing availability, Bike sharing availability (Normal & Real-time) via APIs	B. Demand-responsive	Various	Pre-Trip and in-trip	Dynamic /Static
	Availability search (Road)	Car parking spaces available (on- and off-street), parking tariffs, road toll tariffs. Publicly accessible charging/refuelling stations	C. Personal	2. Road	In-trip	Dynamic
Road Availability / occupancy	Availability Check (Road)	Car parking spaces (on-street)	C. Personal	2. Road network	In-trip	Dynamic
	Availability Check (Road)	Estimated time required to find a parking space at a destination	C. Personal	2. Road network	In-trip	Dynamic
Road Network	Trip plans (Cycle)	Detailed cycle network attributes (side-by-side cycling, shared surface, on/off road, lit/unlit, scenic route, 'walk only', turn or access restrictions (e.g. against flow of traffic))	C. Personal	3. Road and cycle network	Pre-Trip / In-trip	Static
	Trip plan computation (road)	Allowed maximum weights and dimensions.	All road modes	2. Road network	Pre-Trip	Static
	Trip plan computation (PT)	Detailed pedestrian network (security, lighting, winter maintenance etc)	C. Personal (walking)	4. Pedestrian network	Pre-Trip	Static
PT Facilities & Accessibility	Trip plans (PT)	Status of access node features (including dynamic platform information, catering, operational lifts/escalators, closed entrances and exit locations)	All	All	Pre-Trip, In trip	Dynamic
Ecological impact factors	Trip plans (PT)	Parameters such as carbon per vehicle type or passenger mile needed to calculate an environmental factor	All	All	Pre-Trip,	Static
	Trip plans (Road)	Parameters such as fuel consumption C)2 emissions needed to calculate cost	C. Personal	Road	Pre-Trip,	Static

Appendix F Review of current data exchange protocols and formats

This appendix provides an overview of the current data exchange protocols and formats available for sharing datasets.

F.1 The data supply chain

The data needed to enable the multimodal PT and Road journey planning engines that support MMTIPS applications is of different types, coming from many different stakeholders and subject to continuous change. Some of it (e.g. mapping, road network, addresses, POIs) comes from sources other than operators.

F.1.1 PT data origination

For operators of any significant size, passenger information data is to some extent a by-product of the operational data needed to plan and run their services. Information about stops, routes, lines is developed along with the long term fixed infrastructure of the network and updated to reflect changes. Timetables are planned in advance along with tariff structures, vehicle schedules, crew rosters etc and are subjected to refinement (and some cases regulatory controls) before being finalised and distributed to the operator's operational and passenger information systems, and to third parties. The timetable data will reference a matching set of stop and interchange data, which will normally be exchanged separately since it is common to many timetables and changes less often.

The upstream representations used in planning and operations may include reusable intermediate components used to construct timetables, such as routes, timing patterns, operational calendars, planned connection times etc, that are not needed for the final passenger information content (but may be useful to other upstream and downstream stakeholders) The ability to represent exchange these intermediate components is one of the features that distinguishes NeTEx (and some national standards) from GTFS. Operational demands and external events may require further changes to the original plans to be circulated subsequently, so the workflow has to allow for updates to specific components such as individual timetables, journeys, stops, and provide mechanisms for matching changes to the corresponding baseline elements.

For small operators the situation may be quite different, there may possibly be no electronic representation of the timetable (other than for example as a text document used to print publicity), nor indeed any real time system or other online passenger information system.

F.1.2 PT data aggregation

To create a data set for a region, data from individual operators or local authorities needs to be aggregated, and placed it in a central store (for example by FTP transfer from each operator). A number of validation processes need to be performed before the data is integrated. For example, is the data the latest available version? Is it consistent? Does it conform to the format specification? It is more efficient if these checks can be done by a central service rather than by each downstream user, especially if errors are found and there has to be a dialogue to resolve them. In order to automate this efficiently it is crucial to have metadata.

F.1.3 PT data integration

In order to integrate PT data to create a uniform data set that may be computed over, further processing steps will typically be needed. These may include, in particular: (a)

normalizing identifiers (different operators may use different identifiers for the same stop, or the same identifier for a distinct entity – as when both operators have a 'Route 25'); (b) removing duplicates (for example different timetables may include the same journeys if journeys interconnect); (c) normalizing location references (e.g. geospatially tagged data may use different coordinate systems, or spatial located structures in different layers may need to be reconciled, such as road links and PT route links). Each of these processes adds complexity and potentially can introduce errors; certain standardisation measures can significantly ease the difficulties in particular: (i) adopting a uniform stop identifier and naming system largely removes the need to normalise stops; (ii) establishing unique identities for journeys and timetables (typically done by establishing unique identities for operators) simplifies deduplication; and (iii) using uniform coordinate systems and compatible representations of spatial structures simplifies the construction of network graphs. Again it is more efficient if at least some integration can be done by a central service rather than by each downstream user.

Another complexity of integration concerns the handling of temporal conditions. The timetables for data exchange or presentation to the public are normally represented in a compact generic form, such that rather than listing every single journey running on every separate calendar day, a single week's journeys are given along with temporal conditions such as "runs on weekdays except for 25th December", or "runs during school terms" "runs only on holidays". Timetables for frequent services may compress data further by replacing individual journey times with a frequency like "Every 4 minutes between 7am and 6pm" In order to resolve a generic timetable into a specific operational timetable for a specific day of travel (for example Thursday 25th June 2015), as for example a journey planning engine needs to do, an operational calendar is needed that will indicate the day type being used to classify each particular day (day of week, whether a holiday, school term day etc). A uniform way of representing day types and the various conditions greatly simplifies the integration process and improves data accuracy.

F.1.4 Data Distribution and Consumption

In the last stage of the supply chain, validated (and possibly pre-integrated) data is collected by data factory processes of the downstream user systems, which will typically reintegrate the data, along with data from other sources, into the databases and internal formats needed to support their delivery engines and client passenger information applications. Some types of data (e.g. timetables changes) may be changes to previously exchanged data, and be processed as 'deltas', only selectively modifying particular elements in an existing dataset build.

Operators typically keep their own passenger information systems significantly more up to date than do third parties, making their systems more accurate and authoritative. For example, the UK National Rail Enquiries includes daily timetable changes (which during bad weather may number 30,000 modifications in a single day) as well as real-time data.

The successive steps of the supply chain for static data can be relatively loosely coupled, with a periodic refreshment of datasets as bulk files using standard file transmission methods, or by an occasional pull request by the aggregator using a data exchange protocol. In between the systems can be disconnected. Bandwidth needed for some of the key data can be significant – for example the full timetables with routing for a national rail system can be 100MB.

F.1.5 Real-time data supply chain

The data supply for real-time data comprises a separate chain much more closely coupled, with systems being connected continuously with a high availability and quality of service. Furthermore it may require the downstream participants to have been

previously supplied with common static reference data sets (such as stop data and timetables) needed to interpret the real-time elements.

For PT data, a raw feed of vehicle positions collected by AVMS systems is processed into predicted arrivals and departures by real-time engines that are able to integrate other feeds such as control actions and road link times. Normalisation of some elements may be needed for example to resolve the tracked vehicle identifiers into the timetabled journey known to the passenger information. Separate systems are required to capture and tag structured incident data. These come both from operators, and from commercial organisations that specialise in providing traffic and travel data to broadcasting and fleet management markets.

The observed real-time data can be logged to create a historic record that has several uses; for schedule adherence and to improve the quality of predictions. There is not a well-established process for collecting and sharing such data as a publicly available resource.

F.1.6 Road data origination and aggregation

Road traffic information and data primarily is drawn from two distinct sources: (1) road operators; (2) traffic information service providers. In the first case, many road operators initially collected road network performance characteristics (time-segmented point speeds, traffic volumes, etc. for network performance and operational planning purposes. As the political and consumer demand has driven improved exposure of network performance and end-user impacts, it has become common-place for road operators to publish traffic event and incident information including both planned and unplanned events. This has subsequently been augmented in some cases by the provision in near-real time of network traffic speeds and journey times. Much of this information provision traditionally is provided through the information services of the road operator directly (web services, VMS, provision of data to information service providers/radio service providers). Additionally for city or conurbation authorities, who also operate parking facilities it has become common for them to publish parking information in relation to their facilities.

Importantly, allied to the provision of traffic information and traffic data from roads operators, entrepreneurs have sought to establish traffic and travel information service provider commercial ventures. These service providers have sought syndicated information and data provider from the road operators, in conjunction with other sources of data – including their own monitoring systems which include road-side monitoring equipment and traffic data sourced from vehicles, either by way of in-vehicle satnav devices, mobile telephony telemetry or data sourced from the vehicles.

This is a market place rich with diversity, often with the focus of the road operators on provision of road traffic information services that differentiate themselves from other road operators.

The emergence of traffic information service providers has promoted the demand for road operators to make data and information available in more commonly recognised formats – with the stated preference of some of the more major information service providers to be use of accepted standards (e.g. DATEX II, TPEG). In some cases, road operators have also adopted policies, to support the simplification of the number of disparate interfaces they need to support and have chosen to only support information provision using one of these recognised standards.

As with PT systems, real-time data may be used in two ways: (i) simply to visually decorate routes to show their current flow properties; and (ii) to actually modify suggested trip plans to minimise travel times according to current real-time data.

F.2 Key standards in the data supply chain

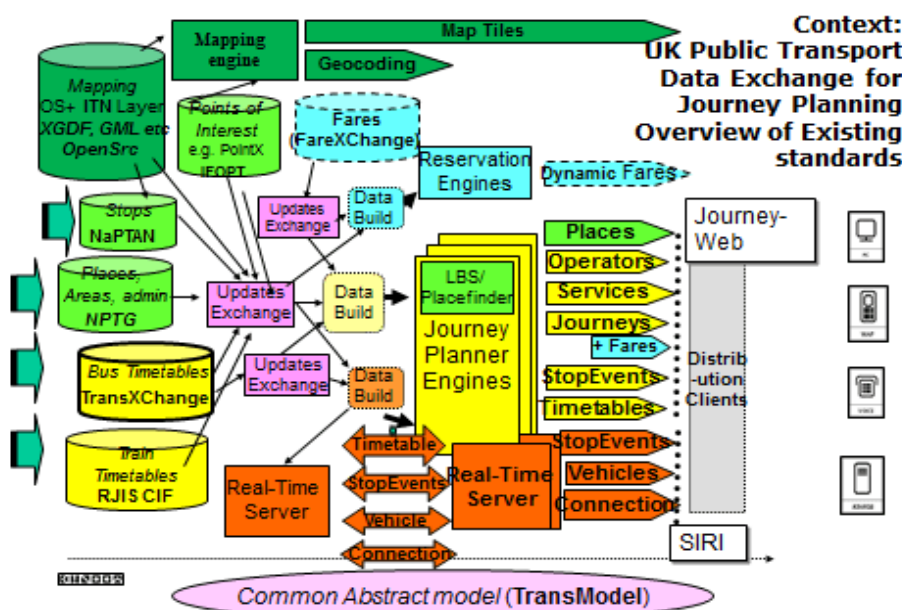
The data supply chain thus combines formats and protocols in a work flow that assembles data into a form that a journey planning and other engines can use to service requests. Because many operators and modes are involved, it is essential to use standards both to reduce complexity and avoid the costs involved in supporting many different formats for the same types of data.

F.2.1 An example of PT standards in the data supply chain

As a simplified, but concrete example, we summarise the main data formats used in the UK to aggregate PT data to enable third party journey planning and real-time engines, and the APIs used by (the now discontinued) Transport Direct to expose the data as services.

- To enable journey planning engines, stop data (in NaPTAN format), PT Gazetteer data (in NPTG format), is aggregated along with timetable data (In TransXChange or rail CIF format). (GTFS is also used as an alternative but interoperable format to send data to the data build processes of Google Transit). A number of validation checks are performed centrally before data is distributed. The stop data is collected locally by authorities working in concert with operators, then centralised and validated by the DfT (UK Department for Transport) before being distributed back to all interested stakeholders. Timetable data comes from operators by mode with rail data aggregation already centralised by the rail industry using its own format.
- The data build processes of the journey planning engines combine the operator’s data with point of interest data (in proprietary formats) and GIS data (in Ordnance server, open street map or proprietary format such as NavTech). The journey planners support the JourneyWeb API which allows applications to locate stops, plan journeys, get stop arrival and departure times, etc.
- Bus real-time data is collected by AVMS systems and processed by separate real-time engines in each city into predictions. The SIRI-SM protocol is used to make predictions available to client applications.

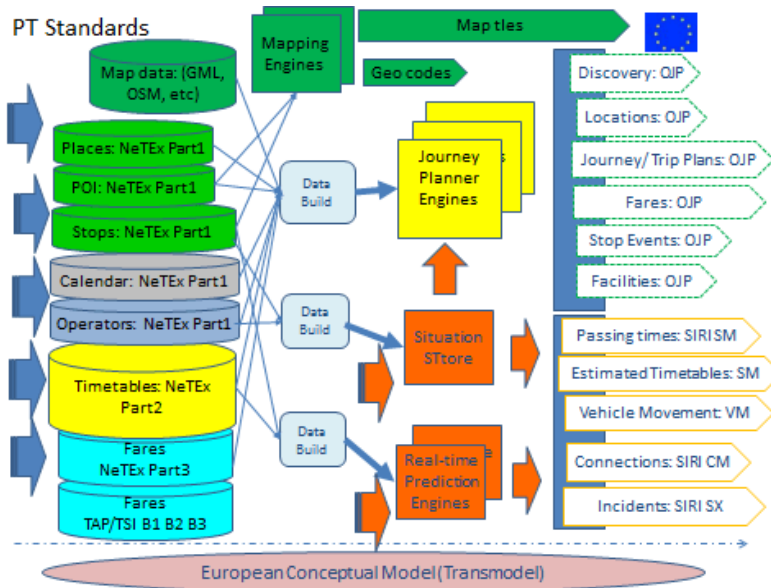
Figure 11 Example: UK standards for public transport data exchange



F.2.2 European standards for the data supply chain

To enable interregional aggregation of data across Europe, and to achieve a European economy of scale, data standards are needed to support an equivalent data supply chain for the collection and aggregation of data. The following diagram gives a simplified view of a number of the key data components. As in the previous diagram, file 'Cylinders' are used to indicate a standard data format used for bulk exchange of static data, while an "Pointed box" is used to indicate an interface. As well as NeTeX, two key sets of interface are indicated: the Open API for Distributed Journey Planning (OJP) (CEN 2015) which is still under development, and SIRI.

Figure 12 Key European public transport data standards



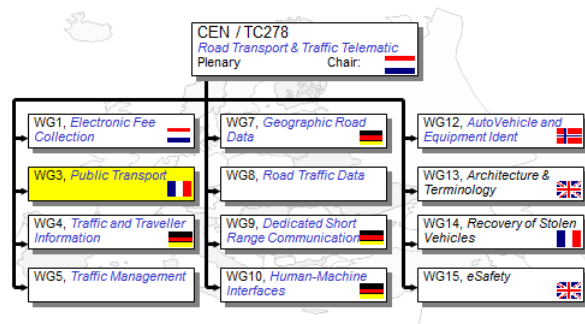
F.3 Scope of Standards

Standards may be adopted at a national level, European or global level through formal standardisation processes such as that of the respective national standardisation bodies (AFNOR, VDV, BSI, NEN, etc.), the pan European standards body CEN, or the global ISO (International Standardization Organisation) that are accord or treaty based and have well defined governance processes.

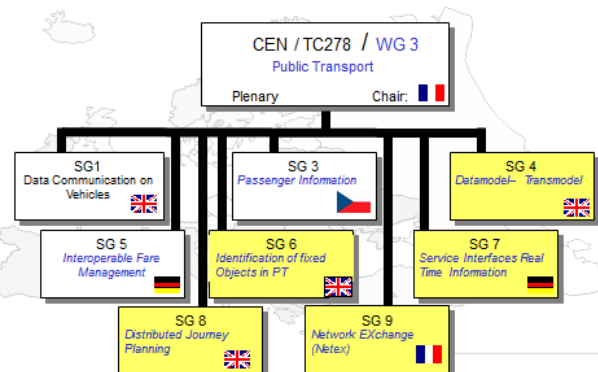
Within the European Standardisation process managed by CEN, The PT data formats fall under Technical Committee TC278, which has separate working groups for different domains, and number of subgroups, each responsible for a different standard. There are processes to develop standards by consensus and to allow changes to be requested and reviewed by Member States. In practice CEN operates a two tier system, issuing both European Standards and Technical Specifications.

- European Standards (EN) guarantee the commitment of National

CEN TC278 Working Groups



CEN TC278 /WG3 Subgroups



Standardization Bodies (NSBs) to adopt them as identical national standards and withdraw any conflicting national standards. There is an agreement between CEN National Members not to publish national standards on the same subject as a European standard.

- Technical Specifications are produced where the subject matter is still under technical development, or the technology is immature, or where there is not enough consensus for an EN. CEN National Members announce the existence of the TSs in the same way as for the ENs and make them available but they are not obliged to adopt them as national standards or to withdraw any conflicting national standards.

Transmodel is an EN, SIRI began as a TS and was consolidated in version 2.0 as an EN. DATEX II and NeTEX are TSs.

In some cases **de facto standards** produced by individual companies or organisations also achieve significant traction (e.g. Open Street Map's OSM XML format, or Google's GTFS and GT RTTI formats).

Beyond Europe, other countries around the world also have national standards; these include the United States, Japan and Korea.

It is the intention of ISO/TC 204, *Intelligent Transport Systems* that by highlighting and encouraging the use of these already available national and regional standards in countries currently without their own standards, this will avoid duplication of cost and time. (As, for example, SIRI is in use in the US, Israel and Australia). This will aid more rapid development and deployment of public transport information systems. A new international standard: ISO17185 is also under development to provide the foundation for a surface public transport user information provision framework (ISO 2015).

F.4 Types of standards

Standardisation is applicable to many different aspects of data; in particular it is helpful to understand the following distinctive usages;

- A **protocol or API** (application program interface): a standardised set of messages that request and return data for use in a particular context (for example the SIRI functional services, or a Journey Planning API such as OJP, JourneyWeb or Delfi, or the DATEX II services for data exchange. Such APIs will typically use a specific internet technology such as http and XML, WSDL, or JSON. They will incorporate both data elements to manage the service, and "payload" data elements that relate to content model, based on a conceptual standard that explains their meaning (the payload will be structured in a general purpose data language such as XML, apache thrift, JSON, etc). The payload may use a format specific to the protocol (as in the case of the SIRI real-time services or DATEX II), or may be expressed in a specific data format embedded in the message, as in the case of NeTex data formats exchanged with SIRI messages.
- A **data format**: a concrete format for serialising data into a computer file for example, for example legacy national formats such as VDV452 for timetable (De), Trident for Timetable (FR) NaPTAN (UK) for stops, TAP/TSI B1 for rail fares, or a CEN data format such as NeTex. Different technologies may be used for rendering such standards such as CSV files (a flat file format used by GTFS that is efficient but simplistic), or XML (as used by NeTex or TransXChange) that allows for built-in integrity checks. (The more complex the data structures involved [for example, if there are many nested or related entities] the more valuable it is to use representations with integrity checks to catch errors). Different methods or protocols may be used to exchange data in a given format; for example by FTP, email, http etc. Concrete formats typically include some metadata to support

workflow and processing of the actual payload data through the data supply chain.

- A **conceptual model**: Standards can be used at the design level to systemize and clarify data architectures; this is especially valuable when dealing with complex, highly interrelated data sets such as are found in public transport. Conceptual standards cannot be used directly to exchange data, but are used to harmonise concepts and terminology and to design data structures (data bases, data formats and protocols etc) that are well-abstracted so they are reusable and fit for purpose. This is important both for reducing complexity (since elements are uniform and reusable) and for future-proofing; the models give a road map for implementing functions, and are furthermore designed to be extensible. CEN Transmodel was specifically developed for this purpose and represents a fifteen year project to systemise and harmonize European national PT system models. Transmodel cannot itself be used to exchange data, but has been used to design a concrete format NeTeX and had previously been used develop national standards such as NEPTUNE, BISON and TransXChange and VDV452.

Other “Soft” aspects of data services and service provision can benefit from the adoption of best practice or a degree of formal standardisation:

- **User interface and presentation standards**: Considerable diversity can be found in the way the same types of data services may be presented to the user in existing software interfaces. Some of this diversity is the natural result of optimizing for a particular device (browser, web, touch screen etc), or for a particular context (for example the tasks of picking one stop out of for example 20 on a local bus route is likely to be done differently from picking one stop out of 500,000 in an entire country) but some of it is arbitrary. One of the ways of making it easier to find out about PT in an unfamiliar place is to provide familiar interfaces with common terms and common behaviour – as Google Maps does.
- **Quality management**: it is possible to develop and promulgate standardised methods and measures for validating data, for example that data exchanges must contain data of a certain granularity (operator, mode city, region etc) and timeliness, completeness and coherence (for example the complete summer timetable for rail, along with all referenced stops).
- **Work flows**: how will data actually be exchanged? How often will be exchanged? Who is responsive for integration? How will it be validated? What is the process for correcting errors? What is the time requirement for responding? etc. **Process Framework** standards are used to identify the actors, roles and responsibilities needed to organize collaborating stakeholders in complex supply chains so as to achieve organizational structures capable of working together and with the necessary feedback processes to detect and correct errors.
- **IPR and terms of use**: Organizations using data need clarity as to the legal rights and terms of use, especially if they are to invest for the long term with confidence. Agreeing and setting down legal terms is expensive and the promotion of ready-made terms (e.g. Creative Commons License (CC)) and best practice help to reduce the costs of data management.

F.5 Roundup of relevant European standards

F.5.1 Transmodel

Transmodel is the European Standard EN 12896:2006, the ‘Reference Data Model for Public Transport’ that covers most aspects of public transport operation. It provides a **conceptual model** for various types of public transport data within the following domains of Network Description; Scheduling; Operations Monitoring and Control;

Passenger information; Fare Collection; Personnel Disposition; and Management Information (ISO 2015).

Transmodel v5.1 primarily concerns the needs of urban bus, trolleybus, tramway and light rail, including metro with the latest Transmodel v6 being extended to take into account heavy rail requirements (Transmodel 2014).

National standards, based on Transmodel include Neptune (French) and VDV (German), TransXChange (UK), and BISON (NL).

As a conceptual model Transmodel (and IFOPT) are valuable for harmonising and designing other concrete standards, but cannot themselves be used to exchange data. Transmodel does not address various technical details such as identity, packaging, granularity of transfer, metadata, for all of which specific decisions have to be made

F.5.2 IFOPT

IFOPT (Identification of Fixed Objects in Public Transport) is a CEN published standard (EN 28701). IFOPT is complementary to Transmodel and defines a **conceptual model** for the main fixed objects related to Public Transport (e.g. stop points, stop areas, stations, entrances, etc.). It also defines navigation paths through complex stop places. It defines four related sub-models: (i) Stop place model; (ii) POI model; (iii) Administrative area model; and (iv) Gazetteer / Topographical model (DfT 2008).

F.5.3 NeTEx

NeTEx (Network Exchange standard) is a CEN Technical Specification specifying a **concrete data format** for the exchange of public transport²³ schedules and related data. NeTEx is based upon Transmodel and IFOPT, providing a physical implementation including packaging mechanisms and metadata for managing distributed data. It is split into three parts: Part 1: describes the public transport network topology e.g. stops, routes, interchanges, lines, timing patterns, operators etc. Part 2: describes scheduled timetables; and Part 3: covers fare information (NeTEx 2015).

NeTEx is for the interoperable exchange of data for any mode between collaborating PT systems involved in collecting managing and using various types of passenger information; it can also be used to distribute to third party systems. It includes mappings to a number of national data standards such as VDV and NEPTUNE. There is also a mapping to TAP/TSI B1 B2 and B3 and to GTFS. The ability of NeTEx to operational details of passenger information such as on board stop announcements, train make up, detailed transfer and connection times, or information on the joining of splitting of trains, means that it has many capabilities not covered by a simple timetable distribution system such as GTFS. This makes it more complex to use – but also permits greater precision in describing systems

Data in NeTEx format can be used with several different protocols, including both bulk exchange of files with simple ftp, and a dynamic exchange using a NeTEx exchange service based on the SIRI framework.

NeTEx has only recently been developed and as yet there are few tools that provide support for it, although test transformations have been achieved from a number of existing data sets e.g. VDV452 timetables, and UIC leaflet locations/stations. NeTEx includes uniform metadata and many new elements and attributes drawn from looking at existing PT systems across Europe; although the core stop and timetable elements

²³ Public transport within NeTEx includes bus (including Bus Rapid Transit), long distance coach, metro (including underground rail and light rail), rail, tram, trolleybus, air and scheduled waterborne services.

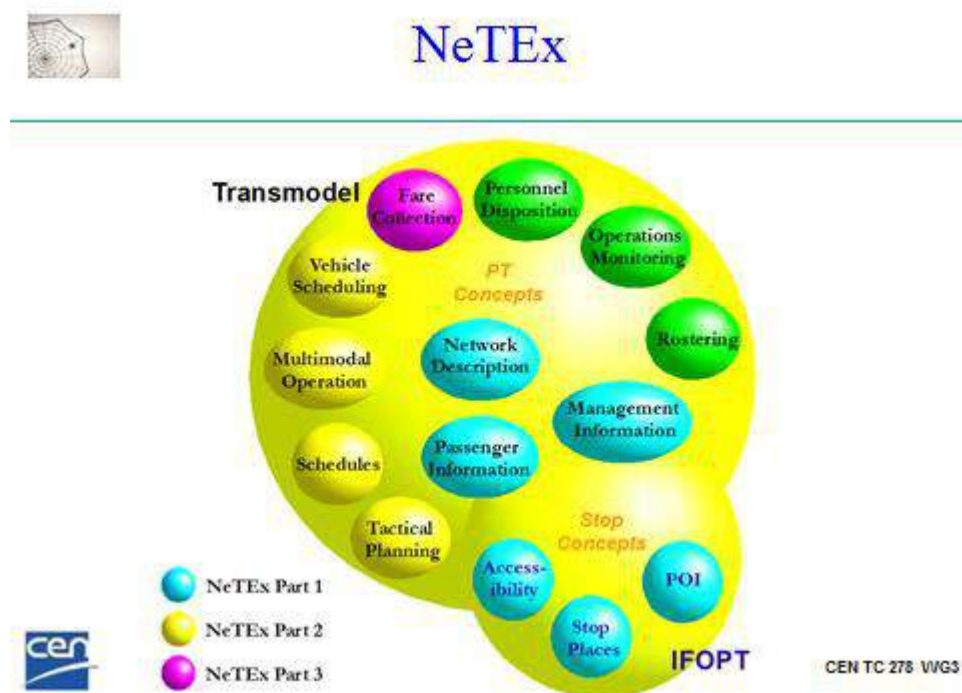
correspond to well established legacy data, many of the new elements are not yet supported by existing systems.

The standardisation of Fares in NeTEx Part3 in particular represents a novel standardisation and is not yet proven by extensive use. It is noted that use cases for modern card based ticketing (IFM Alliance 2012) imply a need for NeTEx Part3 Fare standards.

NeTEx covers only a subset of the PT operational domains addressed by Transmodel, but is nonetheless a large and substantial standard not all of which will be relevant for a given application. To deploy it in a specific region to meet the needs of a specific application, a NeTEx 'Profile' is used, which specifies which elements should be present, which data identifier systems should be employed, and other implementation details that may vary according to local requirements and legacy data usage. Profiles have been developed for France and some other regions which can be used as models for elsewhere.

Not all parts of NeTEx are normative standards – some areas are merely informative.

Figure 13 NeTEx Components (from CEN TC 278 WG3)



It is important to note that some parts of NeTEx, such as the passenger information model, are informative rather than normative.

F.5.4 TAP/ TSI B1, B2, B3 and B4

The European Rail Authority oversees manages several standards for exchanging rail data between European rail operators. Associated documents produced describe models and formats for various types of data such as UIC Locations (Stations) and code sets such as classifications of facilities its specifications include three separate formats for exchanging different fare data.

- B1: Describing standard (NRT Fares) – non reserved standard fares.
- B2: Describing standard (IRT reservable fares)
- B3: Describing special fares (not yet implemented in any country) (NeTEx 2015).

The technical document "Implementation Guide for EDIFACT Messages Covering Timetable Data Exchange (TAP/TSI technical document B.4) annexed to the TAP/TSI defines the exchange of timetable data by the passenger railway undertakings. It covers network (e.g. stations and their facilities) and timetable data using an EDIFACT based format. Separate mappings have been established of data for stations "Locations" (TSDUPD) and timetables (SKDUPD).

Other UIC leaflets describe models and formats for various types of ancillary data such as code sets giving classifications of facilities, classes of use etc.

UITP (2011) provides a critique of TAP/TSI, namely:

- The need for regular critical review with regard to scope and commercial impacts
- The existence of functional differences on local and urban systems and integration with other modes which need to be considered
- Need for consideration of the subsidiarity principle where the needs of 95% of local rail public transport users are at stake and its needs to reflect customer-oriented multimodal integration at a local level.

F.5.5 MERITS Database

MERITS (Multiple European Railways Integrated Timetable Storage) is a single database containing the timetable data of 32 major European railway companies which is integrated and reproduced on a monthly basis. MERITS is designed to allow each railway company to have rapid access to all the data it needs to produce timetables, and to operate with one single source of data, thereby doing away with the large number of multilateral exchanges.

MERITS is not an application for the general public, but a tool designed for railway companies, which decide themselves on how their information and distribution channels are supplied based on their own commercial policy. MERITS data is exchanged using messages in an EDIFACT based format (a legacy technology predating XML and the semantic internet, using a hierarchical block based representation) – this can be transformed into more modern representations automatically.

F.5.6 RailML

RailML is an XML standard for operating railways including detailed track topology, signal systems, assets, rolling stock, crew rostering, etc, running through to operational timetables. It is well engineered, originally involving DACH (Germany, Austria and Switzerland) but now with SNCF, Danish rail and other major rail operators involved. It covers the very complex and detailed model need to plan and run services. As a standard it seems to have critical mass with substantial involvement from several German academic institutions, who have developed third party validators, visualisers etc. An appropriate long term goal would be to achieve interoperability between RailML and downstream passenger facing standards such as NETEX/ SIRI etc so that information can flow from operational systems to MMTIPS seamlessly.

Looking at some of their uses cases and conference papers helps to convey the difference between the very detailed models needed to plan a railway and the simplified views passengers needed for passenger information.

F.5.7 SIRI

SIRI (Service Interface for Real-time Information) is a CEN Technical Specification (TS 15531) and from v2.0 onwards a European Standard. It enables data exchange between servers of real-time information about schedules, vehicles and connections, together with general informational messages related to the operation of the services.

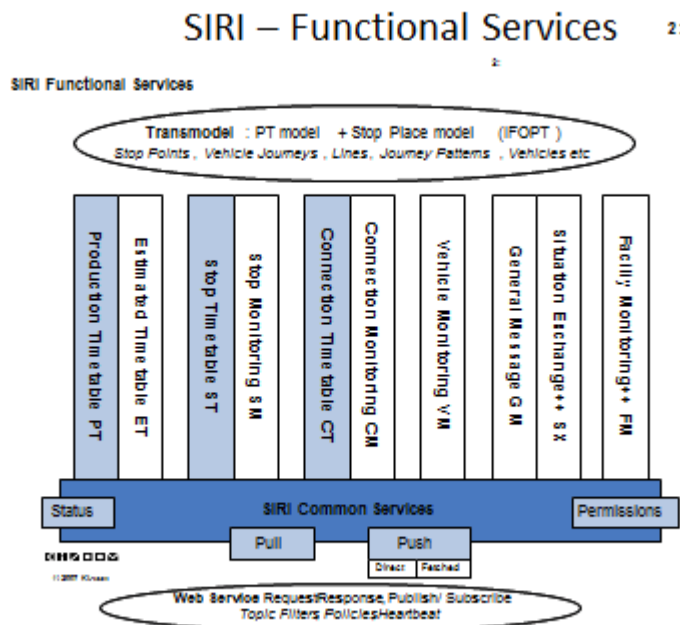
SIRI can be considered as having two distinct components:

- A general framework for defining PT data exchange services and supporting both pull (i.e. request response) and push (i.e. publish/subscribe) protocols.
- A set of specific concrete functional services, each providing a specific API to exchange a specific type of real-time data (in some cases there is a matching service to exchanging corresponding static data).

The SIRI framework in general purpose can be used to define additional functional services for other standards (for example to exchange data in NeTEx format, or to exchange UTM data in UTM XML).

The SIRI functional services are largely based on the German VDV 453 and 454 services, harmonised with other national legacy systems, and provide services to provision and operate real-time AVMS systems. This for example there are services to exchange scheduled and real-time stop events (SIRI-ST and SIRI SM), dynamic and real-time timetables SIRI (PT and ET), vehicle positions (SIRI-VM), incident messages (SIRI-GMS and SX) and to manage vehicle connections (SIRI-CT and CM).

Figure 14 SIRI Framework diagram



SIRI uses http / XML technology but can also be mapped to lightweight technologies such as JSON that are suitable for mass requests by end user applications.

F.5.8 ISO 17185-3 ITS – Public transport user information – Part 3: Use cases for journey planning systems and their interoperation

ISO 17185 is a new international standard that intends to establish a solid foundation for a surface public transport user information provision framework. This is intended to address the current issue that whilst many public transport operators already have transport-related information systems, public transport users are often not provided with travel information regarding their journey in an appropriate and timely manner. In essence it is a **Process Framework** rather than a concrete standard.

The intention is that ISO 17185 will be fully consistent with currently available regional and national standards related to international public transport. Given that requirements and standards for public transport user information provision vary from country to

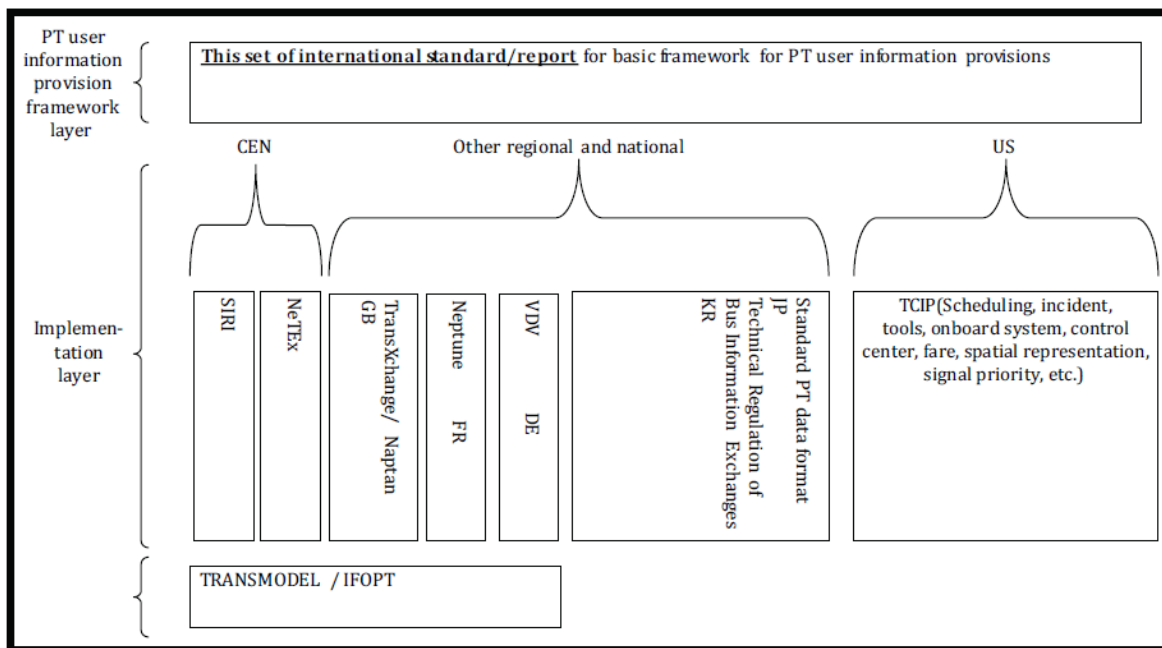
country, this international standard will provide a guiding framework rather than new rules regarding how MMTIPS should be implemented.

ISO 17185 is composed of the following parts: Part 1: Standards framework for public information systems; Part 2: Data and interface standards catalogue and cross reference; and Part 3: Use cases for journey planning systems and their inter-operation.

The goal of the framework is to facilitate inter-operability of public transport-related information using different national and regional standards, help to guide evolution of standards worldwide to a common framework, identify gaps in existing standards and translate between existing standards, to facilitate public transport users including worldwide travellers (ISO 2015).

A visualisation of how the ISO 17185 standard fits with already available national and regional standards is shown below:

Figure 15: Relationship of ISO 17185 and existing regional/national standards



F.5.9 General Transit Feed Specification (GTFS)

The General Transit Feed Specification is a data exchange format originally formulated by Google in 2005 which it has now placed in the public domain. It is intended to allow Transport Authorities and operators to make their schedules available to third parties. It uses an efficient CSV format; a GTFS feed is composed of a series of text files collected in a compressed ZIP file. Each file models a particular aspect of transit information: stops, routes, trips, and other schedule data. It does not include intermediate components to build or manage schedules or integrate data, nor any operational detail other than what is needed for basic journey planning. It does not cover complex aspects of timetables or passenger information such as trains that join or split or train makeup. Each user has a code allocated through Google to establish unique identifiers. It has a very limited representation of fares. It can be regarded as complimentary to NeTeX and national standards and has achieved widespread global uptake. Tools exist to output it from the majority of national standards in use.

Google has also developed a real time protocol GTFS-Real-time, which provides three dynamic data APIs. (a) 'Trip Update' allowing the exchange of real-time predictions for stops and vehicles (c.f. SIR-SM and SIRI ET services) (b) 'Vehicle Position' (c.f. SIRI VM)

and (c) 'Alert' (Allowing an exchange of simple incident messages, equivalent to DATEX Situation service or SIRI SX).

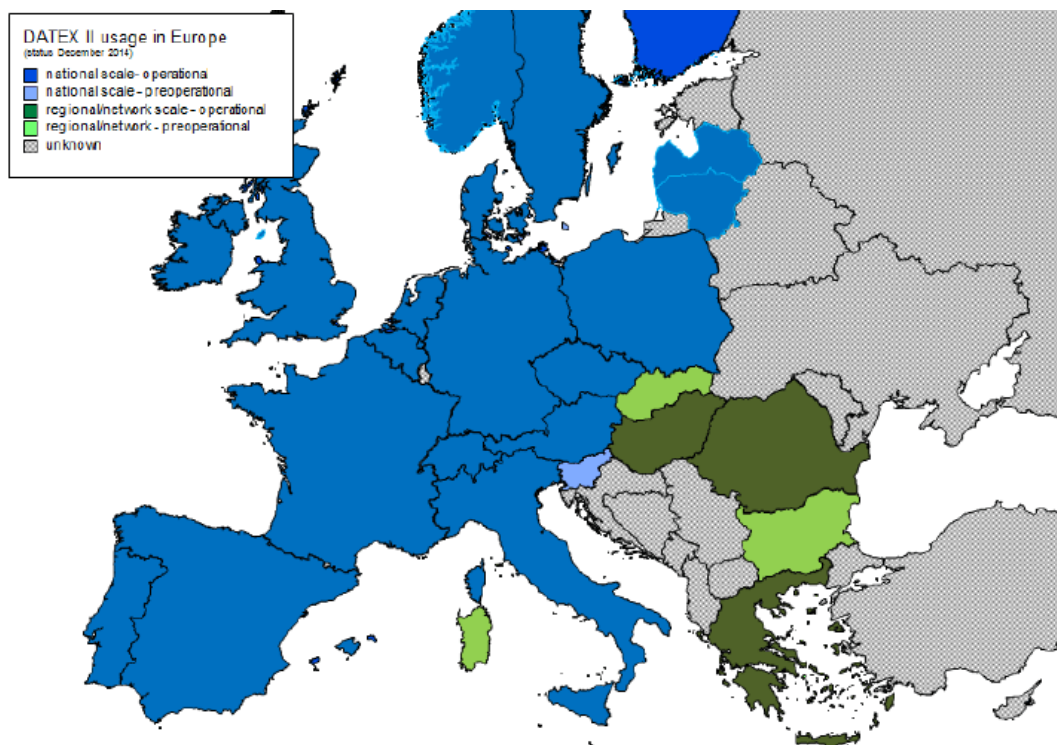
F.5.10 DATEX II

DATEX II is a multi-part standard (CEN 16157 series), for exchanging real-time road data, covering situation information covering levels of service, incidents, events, travel times, and status information and static reference data. Recent extensions also include VMS messages and settings, traffic data and parking information. The DATEX II standards are maintained by CEN Technical Committee 278, CEN/TC278 (Intelligent Transport Systems). The standard consists of six parts: Part 1: 'Context and framework' describes the modelling methodology; Part 2 defines a number of mechanisms for carrying location referencing information; Part 3 defines a service and content model for publishing situation information (covering planned and unplanned incidents, levels of service, weather-related road conditions, etc.); Part 4 supports the publication of VMS message and setting information; Part 5 covers the publication of traffic data and travel times, including static reference data on traffic monitoring stations; Part 6 supports the publication of both dynamic status and static reference data for parking.

At present, all Parts are CEN Technical Specifications, but Parts 1 – 3 are currently beginning the transition to full European Standards (ENs). Collaborative work is also being undertaken between ISO/CEN to standardise the mechanisms for exchange of data.

The map in the figure below provides an indicator of the level of uptake for DATEX across the EU.

Figure 16 DATEX usage December 2014 (source: EasyWay)



DATEX II is the prevalent method of encoding traffic information for exchange between national road administrations in the EU. It is also recognised by many commercial traffic and travel information service providers as the preferred standard for the receipt of traffic information.

DATEX II is in effect (a) a conceptual model; (b) a framework for creating pull/push services (similar to SIRI); and (c) a set of functional services implemented using XML, called "Publications". The full list of these is:

- Situation Publication
- VMS Publication
- VMS Table Publication
- Measurement Site Table Publication
- Measured Data Publication
- Elaborated Data Publication
- Parking Table Publication
- Parking Status Publication
- Parking Vehicles Publication.

The DATEX II Parking Publications model, capturing CEN16157 Part 6, supports the definition of a range of facilities (e.g. fuel) that can be related to parking facilities. Part 6 has been adopted and is in the process of being published.

Note that DATEX II supports the transfer of meta-data concerning 'jam-cam' cameras but does not support the streaming of camera images themselves.

F.5.11 GDF

GDF is commonly used CEN/ISO standard data format for exchanging road network information for ITS applications used in industries such as automotive navigation systems, fleet management, dispatch management, road traffic analysis, traffic management, Automatic Vehicle Location.

Originally developed as a flat plain-text file (ISO14825:2004), GDF was not intended to be used directly for any large scale geographic application and normally requires conversion into a more efficient format, but nonetheless provided a universal transform for exchanging data between formats. A revised version GDF 5.0 (ISO14825:2011) with UML & XML representations improved GDF's interoperability. Further work is currently underway on a GDF to allow multi-sourced data sets.

F.5.12 TPEG

TPEG (Transport Protocol Experts Group) specifications were originally created by the European Broadcast Union B/TPEG groups and is now promoted and extended by TISA (Traveller Information Services Association). TPEG has been standardised initially through CEN and ISO and more latterly ISO only. TPEG is presented as three series of standards: Generation 1 binary (the 18234 series); Generation 1 XML (the 24530 series); and Generation 2, which is replacing Generation 1, which supports a range of information provision in both binary and XML forms (the 21219 series). TPEG offers a method for transmitting multimodal traffic and travel information, regardless of client receiver type. TPEG services are designed to be support on a wide range of delivery channels (e.g. DAB, HD radio, Internet, DVB-x, DMB, GPRS, Wi-Fi etc). Language independence has also been a prime principle in the design.

TPEG-2, the Generation 2, standards support a portfolio of information services:

- Part 11: Universal location reference
- Part 14: Parking information
- Part 15: Traffic event compact
- Part 16: Fuel price information and availability application (*under development*)

- Part 18: Traffic flow and prediction application
- Part 19: Weather information
- Part 23: Road and multimodal routes application
- Part 25: Electromobility information.

At present production TPEG services remain limited in comparison to RDS-TMC (ALERT C) services, but their presence continues to grow.

F.5.13 RDS-TMC (ALERT C)

The ALERT C protocols (the 14819 standard series) are jointly standardised by CEN and ISO. The ALERT C protocol supports the broadcast of traffic and travel information using the FM sub-carrier, i.e. narrow bandwidth, in the Radio Data System – Traffic Message Channel (RDS-TMC). The highly efficient binary encoding enables the dissemination of critical attribution for road traffic events, incidents, levels of service etc. using encoded event lookup tables. Due to the constraints of the efficient compact coding ALERT C coding of location references are provided which reference pre-defined locations given in pre-distributed location reference tables. TPEG and DATEX II include elements to tag data for use in messages distributed using ALTERC.

RDS-TMC /ALERT C based traffic information services are internationally wide-spread, with services offered in most EU countries and many other non-European nations. ALERT C has also been adopted as a means for encoding for many business-to-business exchanges, especially in the public sector.

F.5.14 Air transport data standards

International Air Transport Association (IATA) produces Standard Schedules Information Manual (SSIM²⁴) an aggregated international air schedules dataset in a bespoke data format. This format is used by other value-adding resellers in the information chain (e.g. OAG).

Leadership of data standards in the airline industry is through IATA's The Passenger and Airport Data Interchange Standards (PADIS) Board. Specifically they are focussed on developing and maintaining electronic data interchange and XML message standards for passenger travel and airport-related passenger service activities. PADIS EDIFACT message standards support seven application areas, three of which are relevant in the context of MMTIPS: the publication of schedules and slot management; reservations and electronic ticketing, including electronic miscellaneous documents; data exchange between airlines and airports for operational flight related data (AIDX).

The PADIS Board is supported by a number of expert working groups and two committees: Communications Standards Coordination Committee (CSCC), which promotes interoperability on the level of communications protocols and general implementation of data exchanges; and the Data Dictionary and Schema Coordination Committee (DDSCC), which promotes semantic interoperability across IATA standards and recently started building a common 'Industry Data Model'.

IATA's 'Industry Data Model' will establish a new conceptual model which would support the upgrade of the messaging standards, with industry-agreed vocabulary, data definitions and their relationships as well as the related business requirements. It aims to become a common point of reference to generate messaging standards that are "interoperable across the entire spectrum of services providers and agents, who work with airlines to provide a seamless travel experience" (IATA 2015).

²⁴ <http://www.iata.org/publications/Pages/ssim.aspx>

The November 2014 'Simplifying the Business' IATA White Paper outlined several related initiatives that were underpinned by the Industry Data Model (IATA 2014). One of the initiatives was the 'Travel Communication' idea, the vision of which is, "*Reducing complexity and providing consistent, truthful,...accurate and real-time...travel communications to passengers, across all touch points, through transparent and up-to-date information from a single trusted source*". The project will use a trusted source to certify the data and provide the information in a standardised way, so the information can be accessed by multiple parties to ensure the information provided to the passenger is consistent and correct. The white paper lists six items in relation to the 'Travel Communication' idea that are to be addressed as next steps: "Type of information to provide; Trusted source of information; Potential recipients of the information; Information delivery methods and timing; Information type, static/dynamic; Customer touch points (physical and digital).

However, various commercial data aggregators draw together real-time airline feeds (including fares, availability, delays and departures etc) for third party consumption (e.g. including for MMTIPS). These have their own APIs which can be used for a fee and are much more suitable for the purposes of Priority Action A. On this basis we do not think that any further action is required regarding scheduled air data within the policy specifications.

Additionally we note that NeTEX and IFOPT together, provide for the modelling of airports as transport interchanges. This enables the multimodal element for integration between air data and wider modes. NeTEX includes constructs derived from modelling the time that needs to be allowed for passengers to undergo check-in, security and other processes at different times of day so that this can be taken into account in computing intermodal connections.

F.6 Roundup of relevant national standards

A number of Member States have well established national standards for stop and timetable data with high levels of uptake from data providers and systems in their countries.

F.6.1 VDV (Germany, Austria, Switzerland)

Verband Deutscher Verkehrsunternehmen (VDV) manages a wide range of Transport data standards in widespread use in the German speaking world. The "VDV Standard Interface Network / Timetable" (VDV 452) is used to transfer network definitions and timetables from a source system into a target system, mainly for the purpose of transit operations. The VDV Standard Interface "Network / Timetable" comprises the following data:

- Calendar data (day types and their validity in the company calendar)
- Operational data (vehicle stock, vehicle types,
- Location data (bus stops, stopping points, beacons, depots)
- Network data (route sections, distances, running time groups, running times, stopping times)
- Line data (lines and courses for different routes)
- Timetable data (runs and run-dependent stopping times, blocks)
- Connection information definitions together with their validity, for example from a journey planning system to an AVMS, providing static data for real time connection management.

The VDV Integration Interface for Automatic Vehicle Management Systems – VDV 453 formed the basis for many of the SIRI real time services.

F.6.2 NEPTUNE (France)

NEPTUNE (Norme d'Echange Profil Transport collectif utilisant la Normalisation Européenne - PR NF P99-506 Décembre 2009) is the French AFNOR standard for multimodal exchanges for passenger information.

It was based on the outputs of the European project TRIDENT project (TRansport Intermodality Data sharing and Exchange NeTwork 2003) a first generation exchange format based on Transmodel. It provides a format for stop and time table data in France and a mapping to NETEX has been formulated.

F.6.3 TransXchange / NaPTAN (UK, Ireland)

TransXChange is the UK nationwide xml standard for exchanging bus schedules and related data. It is used for:

- the electronic registration of bus routes with Vehicle and Operator Services Agency (VOSA) and Traffic Area Networks; and
- the exchange of bus routes with other computer systems such as journey planners and vehicle real-time tracking systems (UK Government 2011).

NaPTAN provides a unique identifier for every point of access to public transport in the UK, together with text descriptions of each stop point and its location. This enables both computerised transport systems and the general public to find and reference the stop unambiguously. Stops can be related to topographic regions via the National Public Transport Gazetteer (UK Government 2014).

NaPTAN comprises a standard for identifying and naming access points to public transport; a database of all the access points in the UK; an XML Schema for exchanging stop data as XML documents describing the content. All or part of the database may be exchanged in this format; and an exchange format for exchanging stop data as csv files.

The UK has adopted SIRI for bus real-time data, but typically only the most common services, such as SIRI SM for stop departures are implemented.

F.6.4 BISON (Netherlands)

In the Netherlands the BISON platform (Beheer Informatie Standaarden OV Nederland – Netherlands Public Transport Information Standards Management), managed by the GOVI (Grenzeloze Openbaar Vervoer Informatie – Public Transport Information without frontiers), defines standards for exchanging public transport information. A mapping to NeTEx has been established.

The transport companies deliver the following to GOVI:

- Interface 1: Specifies planned timetables and information about routes and stops.
- Interface 6: messages in which each vehicle reports its position at least once a minute and any deviation from the timetable
- Interface 15: free text from transport controllers for the displays at the stops (extreme weather conditions, strikes, roadworks)
- Interface 17: changes to the planned timetable by transport controllers for the displays at the stops ('service cancelled').

GOVI supplies the following to users:

- Interface 7: planned timetable per stop for a few days
- Interface 8: live departure times per stop based on the position of vehicles
- Interface 55: live departure times per stop for mobile applications.

F.6.5 NOPTIS (Sweden, Denmark)

The Nordic Public Transport Interface Standard (NOPTIS) is a set of Transmodel-based interfaces supporting the interconnection of subsystems within a public transport information system including planning systems, schedule databases, GIS-systems, real-time vehicle reporting systems, traveller information systems, travel-planning systems etc.

The NOPTIS initiative (is a *de facto* standard rather than a formal one) was taken by the four major public transportation authorities in Sweden and Denmark: Movia (Copenhagen and wider region), Skånetrafiken (Malmö and wider region), Storstockholms Lokaltrafik (Stockholm and wider region) and Västtrafik (Göteborg and wider region) encouraged by Swedish Transport Association ("SLTF") and Swedish Bus & Coach Federation (BR).

NOPTIS is currently used in the majority of public transport systems in both Sweden and Denmark.

There are five interfaces in NOPTIS. One of the interfaces is NOPTIS DII which is a XML/XSD-based interface for transferring planned data prepared in advance from different planning, geographic information and similar systems into, for example, a central public transport database. There is a mapping of a subset of DII to NeTeX Timetables, Vehicle Schedule and Calendars.

F.6.6 Other national standards (beyond Europe)

In the USA, TCIP (Transit Communications Interfaces Profiles) is a standard developed by APTA, for introducing advanced ITS technologies into public transport to improve safety, security, and efficiency.

In Japan there is a standard specification for public transport and information provider data exchange data formats. It provides implementation level specification for basic database of multi-modal, multi-public transport operator systems.

In Korea there is the Korean Technical Regulation of Bus Information Exchanges, the standard for message exchange between bus information centres.

F.7 Current level of coverage and uptake

Table 24 provides an overview of these data exchange protocols and standards, with an indication of their level of maturity and level of uptake (in the views of our team of experts and those consulted).

Table 24 – Summary of data exchange protocols and standards

Data exchange protocol or standard	Type	Scope	Domains	Modes	Level of maturity	Indicative level of uptake	Reasons for level of uptake
International							
Transmodel	Conceptual	CEN EN	Most PT functions	PT	15 Years	Adopted by majority of data management systems in Europe	Well established, used to design concrete standards
IFOPT	Conceptual	CEN EN	Stops and Interchanges	PT	8 years	Selective uptake in a small number of countries	Existing national equivalents for basic stop data; additional cost of collecting accessibility data
NeTEx	Data format	CEN TS	PT Networks, PT timetables, PT Fares. E.g. bus (including Bus Rapid Transit), long distance coach, metro (including underground rail and light rail), rail, tram, trolleybus, air and scheduled waterborne services.	PT	1 year (Part1 & 2)	Restricted to a few urban centres (e.g. Turin)	New standard hence little existing uptake
DATEX II	Conceptual + Data format + API	CEN EN	Road real-time and status information, situations, VMS settings, traffic data, Parking information (multiple forms of location referencing)	Road	10+ years	Widespread across Europe (15+ countries)	Well established; Prescribed within Priority Action B specifications
TPEG	Broadcast oriented – conceptual + data format	ISO / CEN	Road real-time and status information, situations, levels of service, disruptions, parking information, PT service and disruption information (multiple forms of location referencing)	All	15 years	Emerging widespread (European + international)	Well established for broadcast industry
RDS-TMC (ALERT C)	Broadcast oriented – conceptual + data format	ISO/ CEN	Road real-time and status information, situations, levels of service, disruptions, parking information, limited PT service and disruption information (ALERT C location referencing)	All	20 years	'Global' update of traffic services	Well established over two decades
TAP/TSI B1	Data format	ERA/UIC	Standard Fares	Rail	3 years	Extensively used across Europe	Required by TAP/TSI directives
TAP/TSI B2	Data format	ERA/UIC	Standard Fares	Rail	3 years	In partial use across Europe	Required by TAP/TSI directives

Data exchange protocol or standard	Type	Scope	Domains	Modes	Level of maturity	Indicative level of uptake	Reasons for level of uptake
TAP/TSI B3	Data format	ERA/UIC	Special Fares	Rail	N/A	Unused by rail operators ²⁵	Little need for additional data beyond B1 and B2 at this time.
TAP/TSI B4	Data format	ERA/UIC	Rail timetables	Rail		Extensively used across Europe	Required by TAP/TSI directives
GTFS	Data format	De facto	PT Stops Timetables & Fares	All PT	8 years	Widespread across Europe (and beyond) through a mix of national, regional and cities.	Simple, well established, gives Google Transit & Map coverage – take up fostered by Google.
SIRI-PT/ET	API	CEN EN	Real-time timetable	All PT	10 years	Limited; mostly DACH countries	Advanced capability (real time timetables)
SIRI VM	API	CEN EN	Real-time stop departures	All PT	10 years	Widespread (though not full) adoption by the majority of existing AVMS systems	Provided an overdue approach to enabling reuse of data beyond a single-supplier ecosystem. Demand from MMTIPS providers and bus operators has led to fairly quick adoption.
SIRI-ST/SM	API	CEN EN		All PT	10 years		
SIRI GMS/SX	API	CEN EN	Situations	All			
SIRI CT/CM	API	CEN	Service interchanges/ connections	All PT	10 years	Limited; mostly DACH countries	Advanced function (Connection protection)
SIRI FM	API	CEN TS	Real-time facilities	All PT	5 years	Limited; mostly France	Advanced function
GTFS-Real time	API	De facto		All PT	5 years	Widespread USA, limited in Europe	Does not include some European operational
OJP	API	[CEN TS]		All	N/A	N/A	Yet to be finalised
SSIM	Data format	IATA	Scheduled data	Air	40 years	Complete uptake	The only standard used for sharing aggregated schedules data
Bespoke²⁶	API	IATA	Dynamic data	Air		Widely used in a range of MMTIPS	From being the formats used by cost effective pre-aggregated data services
National							
BISON	Data format + API	National	Networks, Timetables	All PT		Netherlands	National drive for standardisation to reduce issues related to numerous bespoke formats
Neptune	Data	National	Networks, Timetables	All PT	6 years	France	

²⁵ Source: NeTEX. (2015).

²⁶ Bespoke APIs provided by international data aggregators such as OAG, Flightradar24 and Flightaware. The IATA standard for sharing data on flights and passengers is PADIS EDIFACT but this is not an open standard due to the nature of some of the information held therefore bespoke APIs provide the viable alternative.

Data exchange protocol or standard	Type	Scope	Domains	Modes	Level of maturity	Indicative level of uptake	Reasons for level of uptake
	formal						
NOPTIS	Data format + API	Commercial in nation use	Networks, Timetables	All PT		Sweden Denmark	
TransXChange	Data formal	National	Timetables	PT Bus	10 years	UK, Ireland	Government-sponsored; used in Transport Direct and for electronic bus registrations (policy driver).
CycleNetXChange	Data formal	National	Cycle routing	Cycle	8 years	UK	Government-sponsored; used in Transport Direct but little demand beyond this.
UTMC	Conceptual + Data format + API	National	Road real-time, status, and disruption information; parking information	Road	10 years	UK, Ireland	Local authority requirements
OCA	Conceptual + Data format + API	National	Road real-time, status, and disruption information; parking information	Road	10 years	Germany, Austria	
VDV 452	Data format + API	National	Timetables	All PT	11 years	Germany, Austria, Switzerland	German industry requirements

Appendix G Analysis of existing formats and exchange protocols against data needs

This appendix provides a series of tables which detail the relationships between functional components and existing CEN data formats and APIs.

Table 25 – Relationships between functional component and data standards (PT)

	Conceptual Model	Data format	Data Exchange time API	Real--time Data Exchange API	MMPTIS Application API
Access points & interchanges	Transmodel	NeTEx P1	SIRI-NX (or with FTP)	n/a	OJP-Places
Networks	Transmodel	NeTEx P1	SIRI-NX (or with FTP)		
Timetables	Transmodel	NeTEx P2	SIRI-NX (or with FTP)	SIRI-PT/ET	
Stop to stop journey planner	Transmodel	NeTEx			OJP-Journey Plan
Point to point journey planner	Transmodel GIS	NeTEx, [GIS]	FTP	n/a	OJP-Journey Plan
Arrival and departure	Transmodel	NetEX P2	SIRI-ST, SIRI-PT OJP-Stop EVent	SIRI-SM, SIRI-ET	OJP-Journey Plan
Disruption	Transmodel 6.0	SIRI-SX, TPEG	SIRI-SX, TPEG	SIRI-SX	OJP-Journey Plan
Facilities	Transmodel	NeTEx	OJP-Facilities	SIRI-FM	
Accessibility	Transmodel, IFOPT	NeTEx P1	SIRI-NX / or FTP	n/a	OJP-Journey Plan
Fare Distribution INFO	Transmodel	NeTEx P3	SIRI-NX / or FTP	n/a	<i>Missing</i>
Fares structure products	Transmodel	NeTEx P3	SIRI-NX / or FTP	n/a	<i>Missing</i>
Fares/ charges	Transmodel	NeTEx P3	SIRI-NX / or FTP	n/a	OJP-Fares

Table 26 – Relationships between functional component and data standards (Road)

	Conceptual Model	Data format	API ²⁷	Real-time API
Parking	DATEX II; TPEG	DATEX II (XML) – P6; TPEG II Binary / XML		
Facilities e.g. Fuel & Charging points	DATEX II; TPEG	DATEX II (XML) – P6; TPEG II Binary / XML		
Road Networks²⁸	DATEX II; TPEG; ALERT C GIS mapping data sets (including INSPIRE)	DATEX II (XML); TPEG II Binary / XML; ALERT C Binary;		
Simple Travel times	DATEX II; TPEG	DATEX II; TPEG; ALERT C (levels of service)		
Historic Travel Times	DATEX II; TPEG	DATEX II; TPEG; ALERT C (levels of service)		
Real-time Travel Times	DATEX II; TPEG; ALERT C (levels of service)	DATEX II; TPEG; ALERT C (levels of service)		
Disruptions	DATEX II; TPEG; ALERT C	DATEX II; TPEG; ALERT C		
VMS	DATEX II			
Jam Cams	No commonly accepted standard			

Developing these relationships further we can identify what the range of coverage is amongst existing standards to aid in the identification of gaps. The table below details the coverage of both data exchange formats and standards for APIs.

Table 27 – Summary of coverage of data by standards and APIs

Data Type	Description	Examples of data exchange formats	Examples standards for service APIs
Topography	Description of general topographic features including relief, natural and artificial features. It determines the position and shape of any feature.	INSPIRE GDF GML Open Street Map	
Transport infrastructure	A specific subset of the topography, describing roads, rails, bike lane, walking paths, etc.	GDF INSPIRE transport layer	

²⁷ DATEX II provides a conceptual data model with wide coverage of road-related information (situations, levels of service, incidents, weather related travel information, VMS settings, parking information, traffic data). The DATEX II standards also provide a standardised XML representation of DATEX II data. No standardised APIs exist. These are a CEN/ISO work item under preparation. Similarly TPEG provides a rather equivalent data model and information coverage (oriented towards broadcast services) but no standardised APIs exist.

²⁸ DATEX II, TPEG and ALERT C support a variety of forms of location referencing (ALERT C more limited). These location references in general do not require a standardised definition of the road network but transmit shared characteristics that support forms of map matching. There is no singular prevalent road network standard, or defacto standard, in use. Many common mapping data sets are used, sourced from both commercial and governmental map data providers.

Data Type	Description	Examples of data exchange formats	Examples standards for service APIs
Point of interest	A specific subset of the topography, describing well known place that user may want to search for as the start or the destination of a trip. May also include classification, entrance points and accessibility	NeTeX Part1 GDF INSPIRE	NeTeX-Siri
Parking, park&ride and car stopping places	Parking locations, including bike parks, relates to the topography including entrances and exits. May include characterisation terms of other features for example car in one side, and public transport, walking or bike on the other, and connection links to other modes of transport such as rail or air: Also may include service related information: number of places, opening time, etc. Note that there may also be a fare product aspect to parking e.g. if included in a park&ride offer, which would be described by a NeTeX Part 3 Carpooling spaces can also be seen as a specific stopping place.	DATEX II NeTeX Part1 GDF INSPIRE	DATEX II
Car sharing station	Places (usually parking or part of a parking) where a car sharing service is available. They have set of service related attributes: number of places/cars, link to the booking and fare offer, connection with other services (PT), etc.	NeTeX Part1	NeTeX-Siri
Bike sharing station	Specific places where a bike sharing service is available. They have set of service related attributes: number of places/cars, link to the booking and fare offer, connection with other services (PT), etc.	NeTeX Part1	NeTeX-Siri
PT stops	Places where people can board and alight the PT vehicles. Covers both simple on street stops and complex interchanges with many points of access such as stations and airports	NeTeX Part1 GTFS TAP TSI	NeTeX-Siri OJP
PT network description	The structural part of the PT network; lines, routes, connections, etc. This may be projected to a topographical layer	NeTeX Part1	NeTeX-Siri
PT timing description	The time factors for using a network; independently of any specific journey	NeTeX Part1	NeTeX-Siri
PT Schedules	The timetable information part of the PT offer: vehicle journeys, passing times, calendars, day types, etc.	NeTeX Part 2 TAP/TSI / MERITS	NeTeX-Siri
PT Schedule changes		NeTeX Part 2	SIRI
PT Fare offer	The available fares on a PT offer (as distinct from ticketing, which is applying this offer). It describes concepts like fare products, access rights, usage parameters, prices, etc.	NeTeX Part 3 TAP/TSI B1, B2	NeTeX-Siri
PT Fare prices		NeTeX Part 3 TAP/TSI B1, B2	NeTeX-Siri
PT Point to Point Journey Plans			
Parking and toll fares	The description of fares for tolls and parking (prices with associated timing information, season tickets, etc.).	DATEX II NeTeX	NeTeX-SIRI
Car sharing fares	Car sharing fares describe the, access rights, fare products, related timing information and prices for car sharing services.	Could be added to NeTeX	
Bike sharing fares	Access rights, fare products, related timing information and prices for bike hire services.	Could be added to NeTeX	
PT Real-time positions	PT Real-time positions of Vehicles	n/a	SIRI VM
PT Real-time stop predictions	The real-time arrivals and departure sat a stop,	n/a	SIRI SM,ET, CM GTFS RT
PT Real-time vehicle journey predictions	The real-time passing times, journey status, interchange status	n/a	SIRI, ET, CM GTFS RT

Data Type	Description	Examples of data exchange formats	Examples standards for service APIs
PT Real-time Incidents	Planned and unplanned situations, including incidents, accidents, planned events, engineering works, etc	n/a	SIRI-GMS, SX DATEX II
PT Control data	The control actions (usually involving an AVMS) on the PT networks.	n/a	<i>Could be added to SIRI</i>
Road RT traffic	The status of the road network: status of road occupancy, mean speeds, incident and accidents (situations), jam cams etc. It also include car parking real-time occupancy.	n/a	DATEX II TPEG
Road speed camera locations		UTMC	UTMC-xml
Road speed restrictions			
Road 'jam cam' locations		UTMC	UTMC-xml
Road 'jam cam' images		n/a	UTMC-xml
Parking RT	It also include car parking real-time occupancy.	n/a	DATEX II UTMC
Road traffic control	The actions from control centres to manage the road traffic (road closure, alternate traffic, temporary limits, VMS Sign settings,	n/a	DATEX II
Car-pooling offers	The offers (starting point, destination, data and time, contact mean, etc.)	<i>RDEX (open, but not a standard)</i>	
Car sharing availability	The availability of cars for each car sharing place, and also available places to return a car.	<i>Only proprietary formats for now</i>	
Bike sharing availability	Bike sharing availability describes the availability of bikes for each bike sharing place, and also available places to bring back a bike.	<i>Only proprietary formats for now</i>	

Although strong and prevalent standards exist in the "traffic information/data" arena, notably DATEX II and TPEG as the most modern exchange formats in use, there continues to be an insufficient regulatory framework that promotes these standards as the mechanism for exposing road operator and service provider data in a shared common manner.

Whilst DATEX II is increasingly the standard being adopted, what we have in reality is a blend of some DATEX II services, some TPEG based services, some RDS-TMC based services, as well as other bespoke approaches. In the UK, with minor exception, the only road operators using DATEX II are the national level authorities (Highways England, Traffic Wales, Traffic Scotland, Road Directorate in NI). The UK may not be typical because the DfT, have actively at first and then passively promoted our own national "standard" UTMC (which is not a standard in the formal sense).

The specification for Priority Action B does endorse the use of DATEX II, but this is limited to (1) new deployments and (2) the TERN network and motorways. To address multimodal journey planning requirements this is unlikely to provide sufficient coverage of road status information to enable a genuine comparison of private car versus scheduled public transport services (or a mix thereof), other than on the trunk routes as defined by the TERN. At present DATEX II is heavily adopted by the national and strategic road operators but uptake by lower levels of government (local and city high authorities) is significantly more limited. Measures need to be taken to improve uptake and therefore provide a wider coverage of standardised (DATEX II) traffic data across a wider range of roads.

Therefore there is a strong argument that if the EC wishes to create ubiquitous access to common traffic data – there needs to be regulation to enforce use of a formally recognised standard i.e. DATEX II.

It should also be noted that although the original teams that created DATEX II and the precursor to SIRI were the same people there is no alignment between the data model concepts in the PT arena (particularly Transmodel) and the 'roads' arena (DATEX II). Also DATEX II and TPEG are not compatible/ interoperable.

Appendix H Review of linking travel information services

This appendix begins with an important contextual discussion of the different application architectures for MMTIPS (Section H.1) and standards for linking MMTIPS services (Section H.2). Related to these two aspects is the need for discovery services to make it easier to find individual journey planners (Section H.3).

H.1 General application architectures for MMTIPS

The purpose of this section is to convey the limitations of different approaches to linking multi-modal journey planners. In particular it is intended to explain why the linking of separate planners with APIs would be insufficient on its own to provide all the required services.

One of the complexities in comparing and understanding MMTIPS data and data services is that several different levels of data exchange are involved, and some care is needed not to mix up the different tiers in the architecture and to be clear which standards apply to which purpose. One may make a basic distinction between (a) high-level services used by passenger facing applications; (b) low-level services providing the data to service such queries; and (c) the back-office data services for exchanging raw data to provision engines in the first place. Standards are relevant for all types of services, but there are distinctions between their nature and content. High level services will typically be APIs optimized for mass online delivery of specific subset of information to the end user's client application in a human readable form ; low-level services will also be APIs designed for efficient extraction of specific query data (b) back office services will be used only between a small number of systems but require the exchange of whole data sets and all the meta data needed to integrate them correctly; they are likely to use simple protocols (e.g. just FTP or http) but complex data formats.

In general (as in all online applications), a front-end application for an end user (which may reside on as a 'thick-client' or on a server through a browser) is able to call different back-end engines to fulfil different computational tasks; for example to find stops meeting search criteria, to make specific point to point journey plans, or to get the real-time departures for a given stop. These engines, as well as performing computations on their own data, may themselves call other services to augment their results, for example to get current real-time incidents which might be affecting particular routes, or to add facilities available on board or the standard fare for a given type of user.

The same MMTIPS may be packaged for use by the end user in different combinations in different contexts and on different devices. For example a stop finding service might be used within a real-time departure service to create a real-time departure board application, or within a journey planning service to create a journey planner, or be presented quite differently on a map on a large device than on a list on a small device.

It should be noted that some types of enquiry require only a relatively small and localised data set (e.g. departures from a stop) while others may require a large integrated data set assembled from many sources (e.g. a multimodal journey planner). The former may be aggregated simply by a brokerage service that knows which distributed service to call for a given stop (as for example the UK bus real-time service does, in effect providing a central index of bus stop numbers to control delegation to the appropriate real-time server that has the data for a given stop). The latter needs to be serviced by engines that use data processed from many different sources (and that are updated when the data changes). Often this raw data is fetched using distribution services produced or consumed by the data factories that process data.

H.1.1 Ways of building "seamless" multimodal PT journey planners

Here we summarise the different possible architectures for large-scale multimodal public transport journey planning, and the key differences in the resulting services. This discussion complements that of the ITS Action Plan Framework Service Contract TREN/G4/FV-2008/475/01 Study "Towards a European Multi-Modal Journey Planner" D6 – Final Report Lyon, 13 September 2011, and additionally tries to indicate critical functional differences and computational constraints on the different architectures (Tempier and Rapp 2011a).

- (1) In the simplest form of **centralised or monolithic** journey planner, all the - data- stops, routes, interchanges, journeys etc. – are loaded into a single engine and a query engine runs against it.

The algorithm used to find the best possible path is able to operate within a single shared memory space and so to carry out a very large number of comparisons very quickly. Different algorithms allow for different optimisations; for example, fastest, least changes, most accessible, cheapest, etc. and under different constraints; leave by time, arrive by time, flexible as to time, etc. In a densely connected network, an engine will compute a large number of possible routes for the given time of travel and then selecting a shortlist of the "best" for presentation to the user. Ancillary information, for example messages about planned and unplanned disruptions, vehicle types, fare types, facilities, etc. may be kept in an auxiliary database or fetched by a dynamic data service and be used to annotate the results of the basic trip query.

The time and effort needed to find paths increases non-linearly as the number of nodes and links in the network increases; so finding a long journey in a large richly connected network with lots of journeys will take significantly more computational resource than in a small network. For large or complex transport networks, typically a binary representation of the network is created by pre-processing all the data into a highly optimized compact form that allows rapid in-memory processing; the representation may also be attributed to allow different cost functions (e.g. time, accessibility, price) to be used to satisfy different types of query. Because of the many thousands of data accesses needed to make a search, such an efficient in memory structure is essential to give usable response times. In principle a planner can be on a large scale (e.g. the whole of the rail network for Europe, or the comprehensive road network) if there are adequate computer resources available for the number of nodes, but obviously it is wasteful in terms of resources to build and query over a large data set if only a particular region or mode is of interest (for example, including the Greek bus timetables in an Irish rail journey planner). Point-to-point journey planners, for which every junction in the road network is also a node, typically are much larger than stop-to-stop networks (and pedestrian planners even larger). There are several orders of magnitude difference between the sizes of the trunk, local, and point-to-point road networks (a large European country might have for example 3000 stations, 350,000 bus stops, but millions of individual addresses, and tens of millions of nodes and links in the pedestrian path network).

There may be significant overhead / time needed to aggregate and exchange the different types of data needed by an engine; to check and normalize it, and then rebuild the optimized representation; also the representation needs updating whenever a timetable or other pertinent data changes. The workflows and processes needed to aggregate, integrate and exchange the data from a large number of stakeholders are typically complex and need validation steps to avoid the introduction of errors. The complexity of this imposes practical limits on scaling. Real-time data has additional implications on scalability and is discussed separately below.

- (2) In a **decentralised or distributed journey planner**, a network of journey planners collaborate to compute journeys over a wide area; a first planner computes the journeys from the origin to a number of boundary points (also called transition points, exchange points or ring points) and then asks a second

journey planner to compute journeys on from those boundary points to the destination point. The results, as possible journey legs to and from the boundary points, are combined and integrated as a whole and then ranked for presentation.

In order to collaborate, the journey planners must have a shared data set of boundary points, and furthermore know to which additional planner they should go for journeys covering a particular area (using a shared API). The API itself will also be more complex, requiring the sharing of some additional state about the calculations being made in order to be at all efficient. The approach has the advantage that the full network and timetable data does not have to be shared, so each region manages and builds its own data set; further scale can be achieved flexibly just by linking to more additional remote engines. However, distributed planning is typically more complex to implement and is significantly slower, as multiple distributed queries are needed, incurring the penalties of marshalling data between separate memory spaces over a communications network (which is many times slower than in memory calculation). Both the German Delfi and the UK JourneyWeb planner architectures use distributed approaches and have faced performance challenges. The DfT Transport Direct site, JourneyWeb, eventually consolidated the "separate" regions into the same hosting facility in order to overcome these issues, but still was measurably slower compared for example to a centralised planner like that of the National Rail Enquiries engine or a statically precompiled monolithic architecture such as Google Transit.

- (3) In a **chained (or 'hybrid') journey planner** a first journey planner allows a user to plan between trunk destinations such as stations, airports or town centres, and then provides access to a further local journey planner, able to provide a detailed routing from the trunk destination to a final destination. The access may either be transparent, querying the second planner in the background to present a composite journey, or in a more simple manifestation, explicit, by a "deep link" landing on the onward planner with relevant details such as the stop and start time already filled out (in effect guiding the user to the correct planner to use to make a second journey plan in the 'remote' an unfamiliar place). The same technique can be used to link to micro-journey planners for example to explore the detailed path through an interchange or into a large building.

Only a limited sharing of information is needed to link up the systems in this 'hybrid' way: the first planner needs to know how to call the second planner and which local areas are covered by it, but not the timetable data for the other region. It gives only a superficial joining of the journey planning, in effect at the application or user interface level rather than in the engines, which remain distinct. Nonetheless it can be useful, not least in guiding a user going to an unfamiliar destination to find the relevant local resources for journey planning. However, unlike monolithic or true distributed journey planners, in some circumstances a chained journey planner may fail to find the best journeys between two points, as the trunk end stations may not in fact give the best routing. This will be the case especially for journeys between two richly connected regions if the trunk journey is relatively short, or the start and end points are not close to a trunk station (see below).

The usefulness of chained/hybrid journey planners thus depends on the specific topology of the networks being covered. It is likely to give good results (and be cost effective) for the straightforward use case of for example adding a final leg to plane or long distance train journeys.. It is likely to give poorer results for trip planning between adjacent regions with richly linked local networks – as these effectively constitute a single conurbation either side of an administrative or national border.

We illustrate the above discussion with the following diagrams. Figure 17 shows a trip plan computed between two points in a network topology comprising two distant areas (for example Paris and London) where the trunk termini represent the most effective boundary points to use. A simple linking of engines in a chained architecture will give optimal results similar to those returned by other planner architectures.

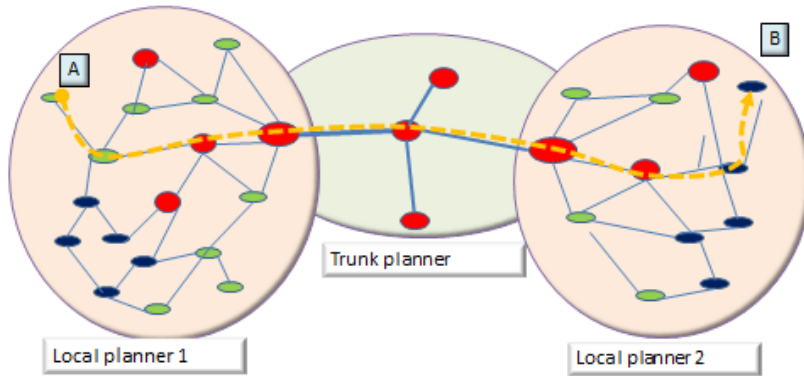


Figure 17 Chained/hybrid planners giving good results

Figure 18 shows a trip plan computed between two points in a network topology of two richly connected areas (for example adjacent areas of Holland and Belgium) where a simple chaining via the trunk termini could give suboptimal results in many cases, as if the boundary points are insufficient, many shorter routes are not found.

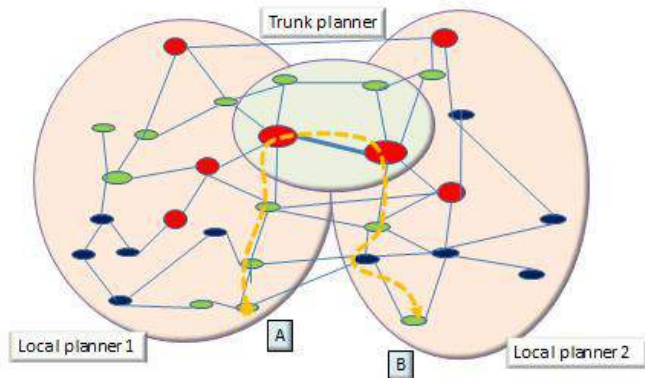


Figure 18 Chained/hybrid planners giving poor results

Figure 19 shows that a monolithic planner architecture for the same network topology of two richly connected areas should always give optimal results as it can find all possible paths within the integrated single data set.

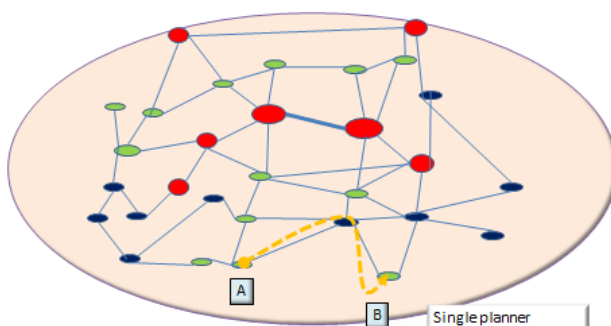


Figure 19 Monolithic planner giving good results

Figure 20 shows that a linked distributed planner architecture for the same network topology of two richly connected areas can also give optimal results, provided the boundary points (shown with thick outlines) are well chosen (that is, the connecting points that are known to both local and remote engines are sufficient). However finding the effective boundary points requires a compromise between efficiency and accuracy as

if there are too many the calculation is too slow. Computing a distributed query is inherently slower and the number of “foreign legs” needs to be minimised.

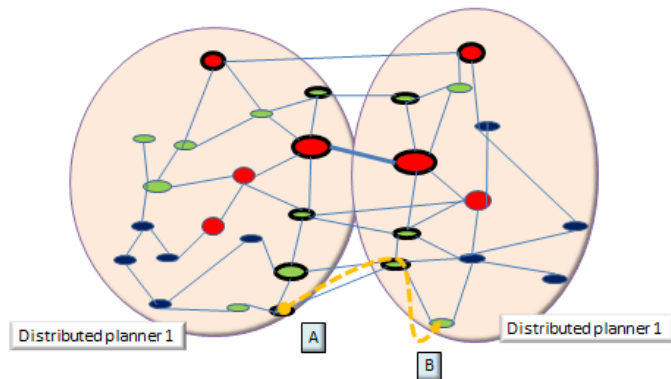


Figure 20 Distributed planners giving good results

Figure 21 shows that if the boundary points are insufficient, a linked distributed planner architecture for the same network topology of two richly connected areas may also give suboptimal optimal results.

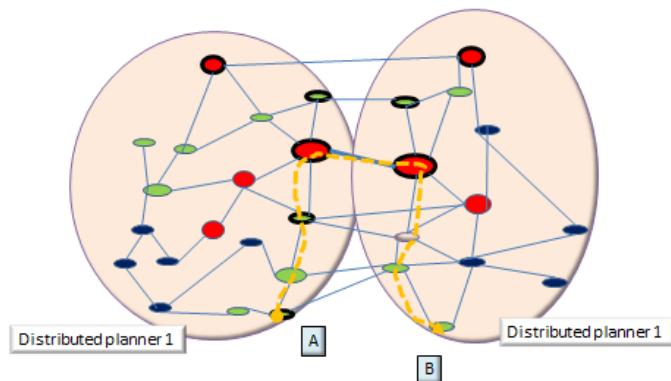


Figure 21 Distributed planners giving poor results

H.1.2 Performance considerations of linked architectures

Performance is a particular concern for large scale multimodal journey planner architectures, since a reasonably fast response time is essential for usability, especially as users will often want to explore many different options interactively. To achieve this, most planners perform a high degree of static precomputation to prepare data so that run-time queries are fast; this represents a trade-off, as optimising the data also takes resource (it can take many hours to integrate the data for a large region) and if data changes frequently, pre-processing may make the data less timely. Since an external system call is computationally many times more extensive than an in system call there are very real practical limits on the number of remote journeys which may be fetched to make up a given plan. Furthermore both a distributed and/or chained/hybrid architecture closely couples the overall performance of the component planners when making a remote plan; the response time will be throttled to the response time of the slowest system in the query chain.

In addition to the optimizations discussed above, a number of other techniques may be used to achieve speed, for example prefetching certain anticipated results such as map tiles, or a multimodal journey planner might make separate calls in parallel to a PT journey planner, a road journey planner and a cycle journey planner, and then combine the results into a single set of answers.

H.1.3 Cost considerations of linked architectures

The different architectures also have different implications for the allocation of operational costs between the different stakeholders. In a monolithic architecture, the provider of data for a given mode and or / region has no ongoing costs (other perhaps than the cost of bandwidth to access data and changes to the data they originate). In a linked system, the operator of each linked journey planner must fund the operation of the journey planning systems to whatever level of demand is required (this might of course be as a charged service, but that requires the development of a shared business model).

H.2 Standards for linking MMTIPS

This section provides an overview of the existing examples of linking MMTIPS across the EU along with corresponding interoperability standards and approaches. Existing obstacles and problems that have been identified with these are described.

H.2.1 EU Spirit, JourneyWeb, Delfi

There are several well-established examples of distributed journey planning systems in Europe and some of these are discussed below.

EU-Spirit is a cross-border and Internet-based travel information service for customers of public transport (EU Spirit 2015). It is based on existing local, regional, and national travel information systems which are interlinked via technical interfaces. The following countries offer the EU-Spirit service: Denmark; Germany; Luxembourg; Sweden; Poland; France. The service provides the calculation of an itinerary between stops, addresses or points of interest in the participating countries. The information service includes any carrier of local and long-distance public transport as well as additional services, for instance map service and fare information. The information of the EU-Spirit service is available for free and is provided via the customer's local information system in their mother tongue.

JourneyWeb is a protocol to allow remote journey planners to communicate in order to provide journey planning across all of Great Britain (UK Government 2013). JourneyWeb allows two or more journey planning engines with knowledge of different areas or transport modes to carry out distributed journey planning, that is to dynamically combine data from both servers to build up composite journeys that span the respective areas covered by the different engines. JourneyWeb depends on NaPTAN, the UK standard for identifying stops, stations and other access points to Public Transport, and NPTG a gazetteer that relates stops to regions. Together they provide a uniform stop representation for everywhere in the country; each stop can be associated with a region covered by a specific regional planner. A set of explicitly stated "exchange" points" points are used to determine the boundary points for linking federated journey plans.

The **Delfi** (Germany-wide electronic timetable information) system was introduced in June 2004 (Federal Ministry of Transport, Building and Housing 2004). This is a multi-modal electronic timetable information system covering almost the entire Federal Republic of Germany. Users can obtain seamless, door-to-door public transport and travel information for their entire journey throughout Germany, and no longer have to consult different timetables or information points. This information includes DB AG's long-distance train services as well as local public transport services in the traveller's areas of origin and destination or timetable information from regional competitors on the transport market. The information service providers, who act independently and in competition with one another, are interlinked by an open network that guarantees access throughout Germany. The project promotes the international competitiveness of all system providers involved and can be widened to include other European information systems without companies having to be sited at pre-defined locations. The service uses

a true distributed architecture, with a shared set of metadata to relate stops to the respective engines.

H.2.2 TRIAS

Recent work in Germany's IP-KOM research project has brought together the lessons learned from various information systems (including EU-Spirit, JourneyWeb and Delfi) and developed the TRIAS schema to support future information systems in Germany (MDV 2014). TRIAS, which stands for 'Travellers' Real-time Information and Advisory Standard', was primarily focused on mobile applications and is described in the VDV documents 431-1 and 431-2.

The TRIAS interface includes a number of services which enable access to journey planning systems using standardized and manufacturer-independent client systems ("apps"). A client system can use the TRIAS services to send requests to any journey planning system – regardless of its region and manufacturer. The only requirement is that the system server offers TRIAS interfaces.

Using TRIAS, transport companies and authorities can now make PT-related information available to the public as services. This includes the community of open source programmers. The availability of features like journey planning and departure boards as collaborative services (Open-API) remedies the need for cumbersome editing of the many individual timetables of each route, which due to discrepancies in interpretation, had often resulted in inconsistent passenger information in the past.

A further innovation in TRIAS is that the passenger's phone can establish two-way communication with the vehicle.

H.2.3 CEN "Open API for Distributed Journey Planning"

The working document TC 278 WI 00278374, by CEN TC278 WG3 SG8, defines the Technical Specification for an "Open API for Distributed Journey Planning". This will provide the previously missing common European standard for distributed public transport journey planning and will be in final draft form by late 2015.

This Technical Specification provides defines an Open Journey Planning API schema (OJP) that can be implemented by any local, regional or national journey planning system in order to exchange information with any other participating journey planning systems. This is done in a way that is completely agnostic about the architecture of those systems, i.e. the overall principle is to standardise the exchanging of messages, rather than being concerned with the organisation or logic of the federated journey planning engine, through which the user's enquiry is broken down into appropriate components. An advantage of this distributed process is that it is a way of avoiding the costs associated with integrating data.

Following a review of EU Spirit, JourneyWeb and Delfi, it was found that, whilst the architecture differed, the nature of the enquiries sent between the systems, and the content of the responses sent in return, were fundamentally the same. This established that it would be possible to define a single Open API to support all distributed systems.

The basis of the proposed OJP API is the TRIAS schema, with syntactic and terminology revisions to align it with other CEN standards (functionally it is almost identical). This does not expose the more sophisticated distributed query features found in say Delfi, but offers a simpler and easier to implement API that gives an adequate level of accuracy.

"The Open API will therefore allow a system to engineer just one interface that it can make available widely (to authorised users or openly as they so choose) rather than having to engineer separate APIs for each bipartite exchange arrangement that may be required with other systems" (CEN 2015).

The specification further notes that some journey planning systems may still require their own specific APIs for use with their closest partner systems: *"where the volume of enquiries is such that efficiency considerations demands a tightly specified API for such clients. The intention of the Open API is to provide an opportunity for just one universal gateway to exchange information to lower-volume users – once created then there is little reason not to allow as many users of this API that may wish to use it"*.

In an interview with two of the developers of the standard, a key point discussed was that often local journeys contained within one MMTIPS make up the vast majority of user queries, while typically less than 5% are long-distance journeys crossing into multiple planners. As such, there is not a strong perceived business case for providers of MMTIPS to place substantial effort into this minority of long-distance trips. Thus in order to achieve pan-European MMTIPS, the aim should be very much to build on what has already been achieved by linking existing MMTIPS.

The specification is designed for handling public transport passenger journey information and is not primarily focused on private car routing. Reasons for this were that pan-European car journey planning tools are already well established through centralised systems and that the two types of journey planner have fundamental differences. Nevertheless, it was considered that the new standard would enable car journey planners to access public transport journey planners and vice versa, thus being an enabler to achieve MMTIPS. An exclusion to the current scope of the Technical Specification is the handling of fares information.

It was considered that liability was not a large issue for distributed journey planning because similar to all types of MMTIPS, typically there would be a disclaimer that although efforts have been taken to provide the best information possible, no liability is accepted. However, it was discussed that perhaps some kind of accreditation on the quality of the data could be undertaken.

H.2.4 CityWay/CanalTP "Distributed Journey Planning trials" (France)

In 2014 AFIMB in France commissioned CanalTP (a subsidiary of SNCF) and Cityway to carry out a research and development project to develop and test a distributed journey planning architecture in France.

As with the other standards above, the project investigated a common API for distributed journey planning systems. However, whilst this is a French led initiative it is not intended for linking French regions but it is instead intended for distributed systems across French and neighbouring Member State borders.

This project is due to be completed during 2015.

H.3 Discovery process for journey planners

For a user unfamiliar with an area (and possibly also its language), discovering the appropriate journey planner to use is the first hurdle. Public transport journey planners are often presented in quite different ways on web sites since the bundling of services often reflect the regulatory environment; for example there may be a single transport site for a whole city, or different sites for different modes such as rail or bus or ferry, or different sites for individual operators, or different sites for different services, such as one for journey planning and one for real-time arrival and departure boards. Furthermore the way in which different sites work may vary. One of the most basic and useful task that sites such as Google Maps and Microsoft / Bing do is to seamlessly present the available transport services in a consistent interface, so the user is helped with the discovery process, that is to find the appropriate local resources regardless of place.

Simply improving the visibility and ease with which available journey planning resources are found would itself be helpful and would be one of the easiest things to do. One of the

simplest measures that could be taken to move towards consistent journey planning in Europe would be to encourage the indexing and presentation of existing services in a consistent way so that they can be found by search engines and used in a reasonably consistent way (by promoting a uniform layout and terminology in each European language). Thus for example if you want to find the multimodal journey planner for Munich or Brussels, or bus stop departures for Helsinki or Naples you would be able to use consistent keywords.

This could be done hand-in-hand with an EC-sponsored master site that organises all such planners by area and function, in effect refining the concept of the current EC site, which presents examples of existing national journey planners, into a public tool for providing access to journey planners when travelling to an unfamiliar region and a master index of different services. Such a site could also serve as a means to monitor the availability and nature of MMTIPS for the European Commission to see if policies are being effective.

For distributed journey planning, discovery services that allow computers to find which other computers provide data for an area, and which specific services are available (and the version levels of the interfaces) are part of the standardised architecture - and are included in the CEN OJP (under development).

Appendix I Stakeholder consultation results

This appendix presents the results of the 165 responses to the public consultation.

I.1 Stakeholder organisations

I.1.1 Countries of operation

Respondent organisations were asked to detail the countries in which they operate. Figure 22 shows these responses which are broadly in line with the population sizes of each Member State (and non-Member State). There are a disproportionately high number of responses from Portugal (almost the same number as Germany) which is not a particularly advanced Member State in this field (as identified in the D1 Baseline Report).

There were a number of responses from organisations with operations in Eastern Europe however the majority were from Western, Central, Scandinavian and Mediterranean Europe. Organisations could also identify themselves as operating EU-Wide or globally, the former of these was the most common response. There were no specific responses from organisations based in Member States Estonia, Lithuania, Malta, Romania, Slovenia, Slovakia (notably all accession countries in 2004 or 2007, many of which also having relatively small populations).

Figure 22 Country of operation of responding organisations



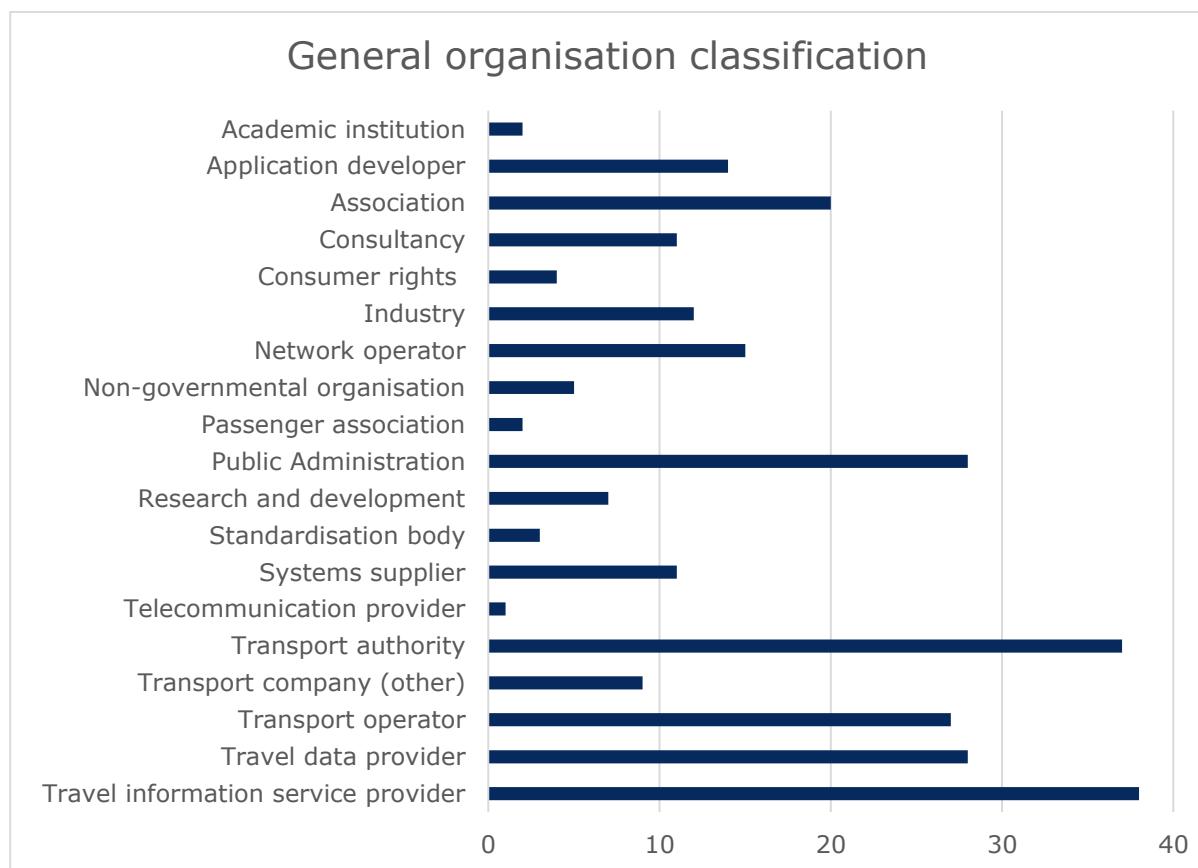
1.1.2 Organisation categorisation

Organisations were asked to categorise themselves in two ways, in both approaches they could select multiple descriptors. The first was their general organisation type from a long list of options. The second was their role within the travel information chain.

Figure 23 below details the breakdown of responses to the first categorisation. 36% of respondents indicated that they were transport operators, transport authorities or both. These represent the traditional organisations within the MMTIPS arena that would be involved in producing data and likely to have had some direct involvement in the provision of a travel information service. 23% of respondents consider themselves providers of travel information services.

The respondents represent a good reflection of the stakeholders in this area – significant representation from public/transport authorities, transport operators, service providers, data providers with expertise and insights drawn from academia, consultancies industry associations, standards bodies and passenger/consumer bodies.

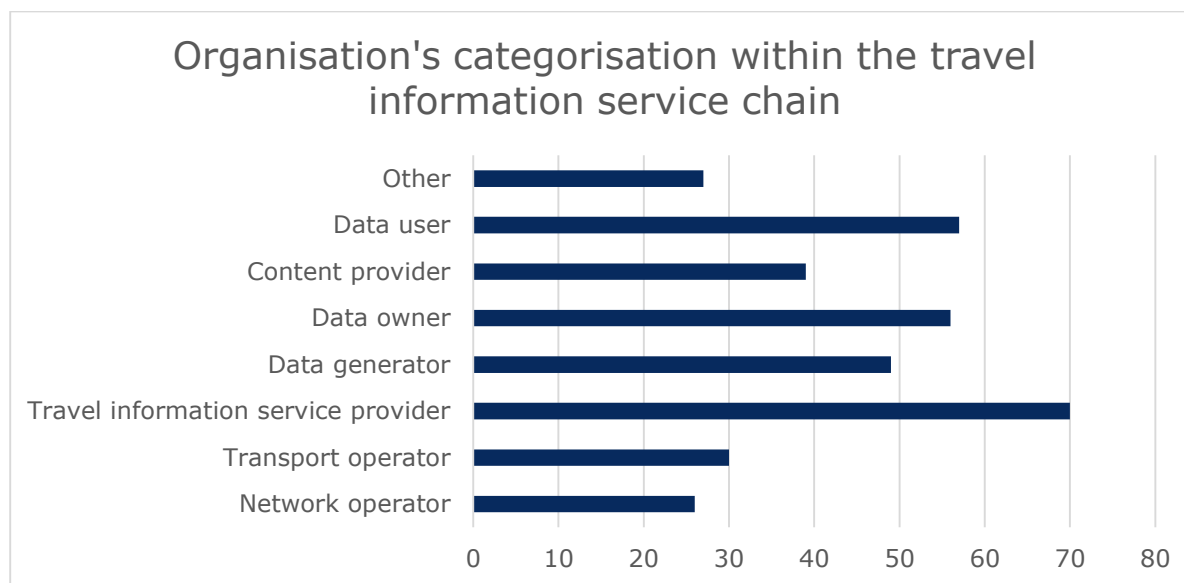
Figure 23 Respondent organisations categorised by type



Respondents were also asked to categorise themselves in the travel information chain which was a shorter list of seven options (Figure 24 below). These categorisations have been used in this report to analyse variations in response to other questions in the consultation between different stakeholder groups.

Just under 20% of respondents categorised themselves as transport operators with 42% describing themselves as existing travel information service providers (an interesting variation in response from the previous question, likely to be a result of reconsidering their role against a shorter list of options in the context of the information chain). The difference between the traditional providers of travel information (operators and authorities) and those now describing themselves as such can be explained by the emerging third party commercial (or public-private) travel information service providers.

Figure 24 Respondent organisations categorised by role within travel information service chain (multiple categories allowed)



Respondents who had described themselves as 'other' included planning department, local regulator, ITS designer, national governments, service conceptualization, development and evaluation, ITS or passenger associations, partner organisation within sub-region for the use of data and management, software provider and broadcast Experts responsible for developing transportation planning. These are effectively organisations with expertise relevant to MMTIPS but who sit outside the information chain itself in an advisory and supporting capacity.

Respondents were not asked which modes of transport they represented (if any) however a brief analysis of the organisation names shows a number of responses from the following sectors:

- Rail
- Urban public transport (e.g. local bus, metro, tram etc.)
- New mobility modes (e.g. car sharing)

1.1.3 Summary

In summary the coverage of respondents is strong across the different stakeholder elements within the travel information chain which provides opportunity for assessing variances in responses based on that categorisation. The geographic coverage provided by respondents is also good with a small amount of over representation (e.g. Portugal) and low or zero representation from some of the more recent EU accession states. Analysis for certain questions in the following sections has therefore been conducted using a regional geographic categorisation as this is more meaningful – but specific variations for Member States will be drawn out where relevant.

1.2 Analysis of existing use of multimodal travel information services

1.2.1 Perspective as a traveller

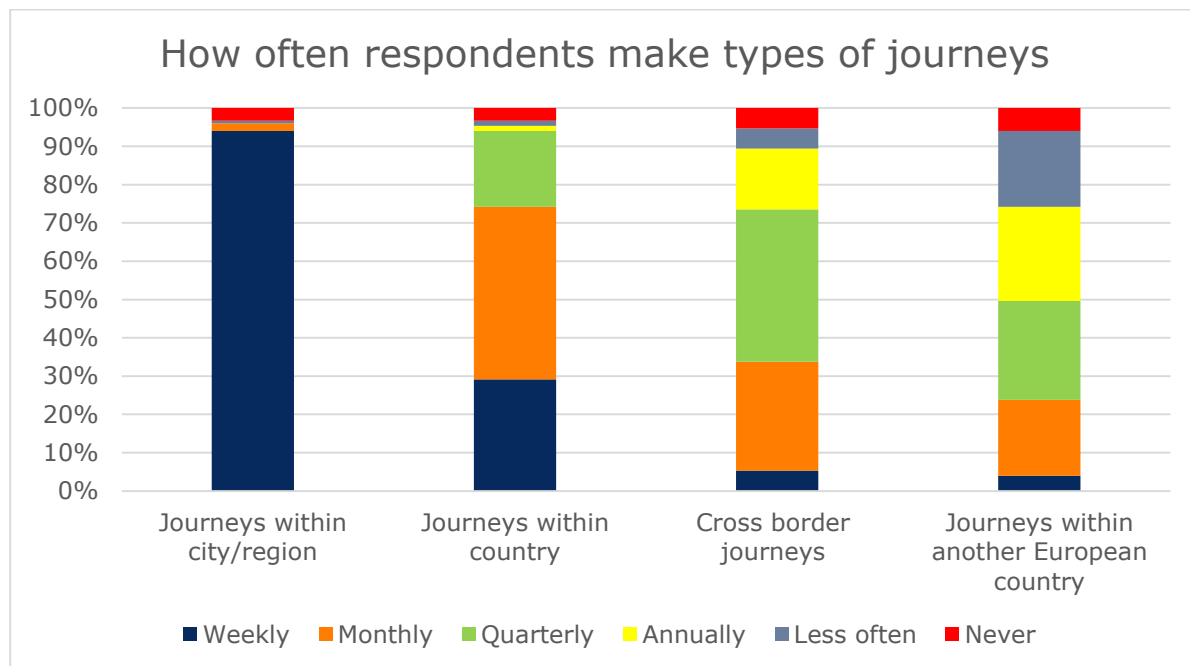
151 of the respondents completed Part 2 of the consultation which explored the existing use and need for multimodal travel information services from the perspective of a traveller (i.e. an independent individual rather than organisational perspective). The

following subsections review these responses, presenting a summary of the results with analysis of what this means.

I.2.1.1 Use of multimodal travel information services

The initial questions explored the current mix of journeys which respondents undertake. Not unexpectedly, as shown in Figure 25 these include a high proportion of regular weekly journeys within the local city or region with other journeys decreasing in frequency as they become longer. Of interest is that nearly $\frac{3}{4}$ of respondents stated that they made a cross-border journey between Member States on at least a quarterly basis. It should be noted that this does not claim to be a representative picture of the typical European citizen but is still nonetheless a useful illustration of the travel habits of professionals working within Europe.

Figure 25 Frequency of different journey types typically made by respondents



Respondents were then asked to identify for which journeys they sought out information prior to travelling (Figure 26) and whilst travelling (Figure 27). The results show that this is much more common in the case of pre-journey information than in-journey but for local journeys the difference is not small and can probably be explained by the greater availability of pre-journey information than in-journey services.

Certainly, when in another European country the respondents are much more likely to seek travel information in advance, almost certainly due to lack of familiarity with the transport network. However a significantly smaller proportion would then seek real time status information during that journey compared to other types of journey they would undertake. This suggests that real time information is either more important when on a familiar network, perhaps making regular journeys than when travelling in a stranger environment when pre-planning is the priority. It may also be explained by the greater difficulty in locating sources of real time information on a journey compared to being in an environment where language, word-of-mouth, media/press etc. may mean these sources are more easily identified.

Figure 26 For which types of journeys do respondents seek information before travelling?

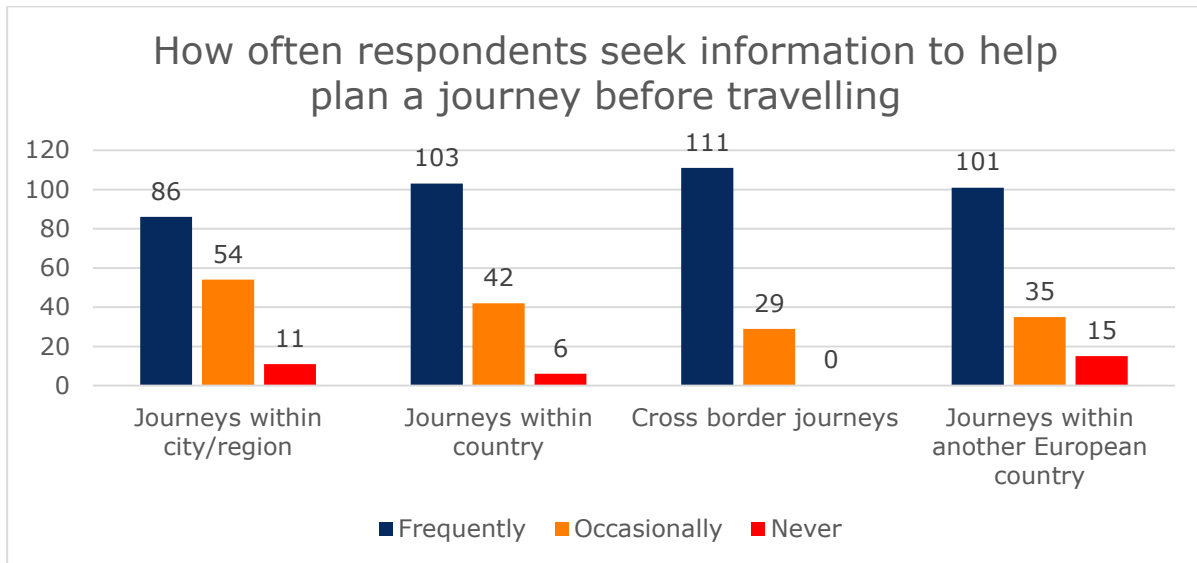
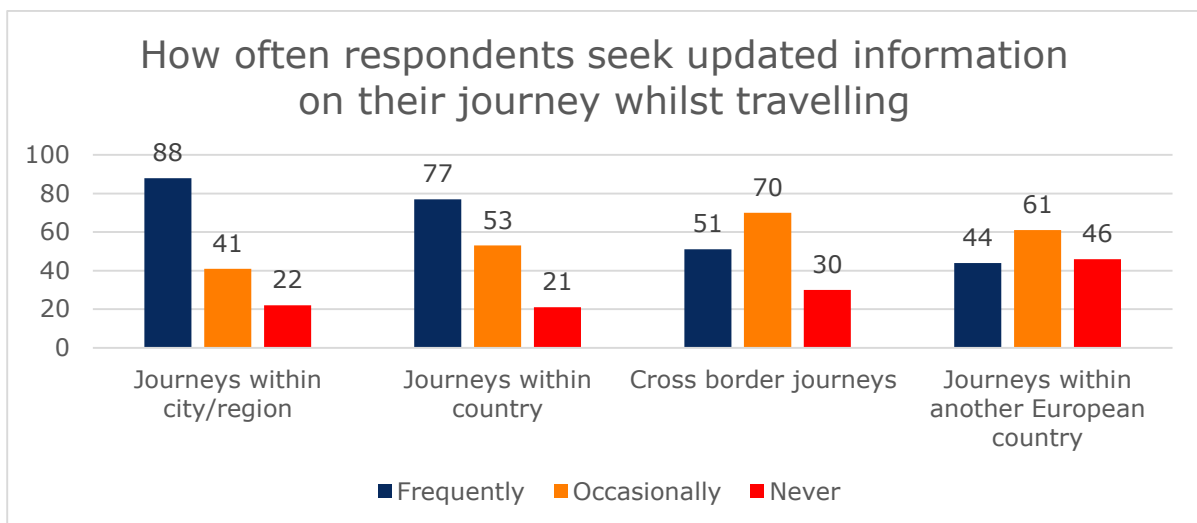
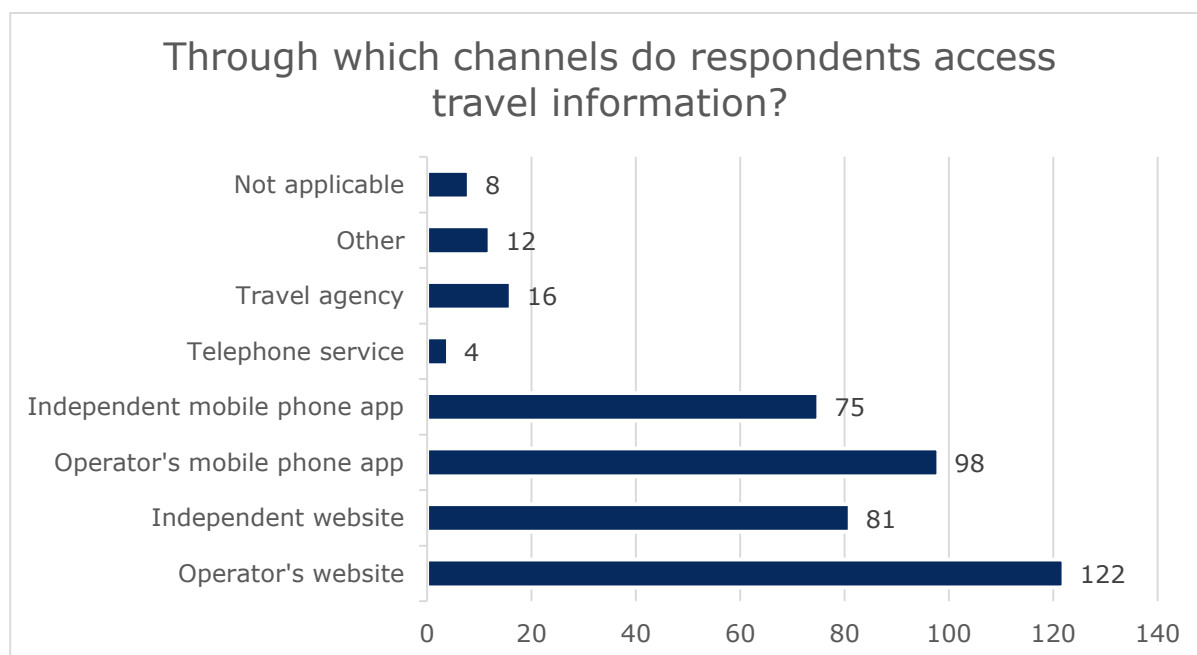


Figure 27 For which types of journeys do respondents seek information during a journey (i.e. real time status)?



Travellers were then asked to consider how they access travel information. A short list of common channels was provided as well as the option of listing others. As Figure 28 indicates, the most popular are the websites and phone applications (“apps”) provided by transport operators directly. However, non-operator independent sources are also high in popularity. There is also a variation across cities, regions and Member States as to the availability of different channels which should be considered in interpreting these results.

The rise of online sources of information followed by the growth of phone applications in the last 6-7 years means that this picture is surely changing on a near-annual basis. As recently as 15 years ago it seems likely that the most popular response would have been telephone services yet only four respondents reported using this channel now. This highlights the fast pace of change in this sector which, as we will see, is a recurring theme in the views of many of the respondents.

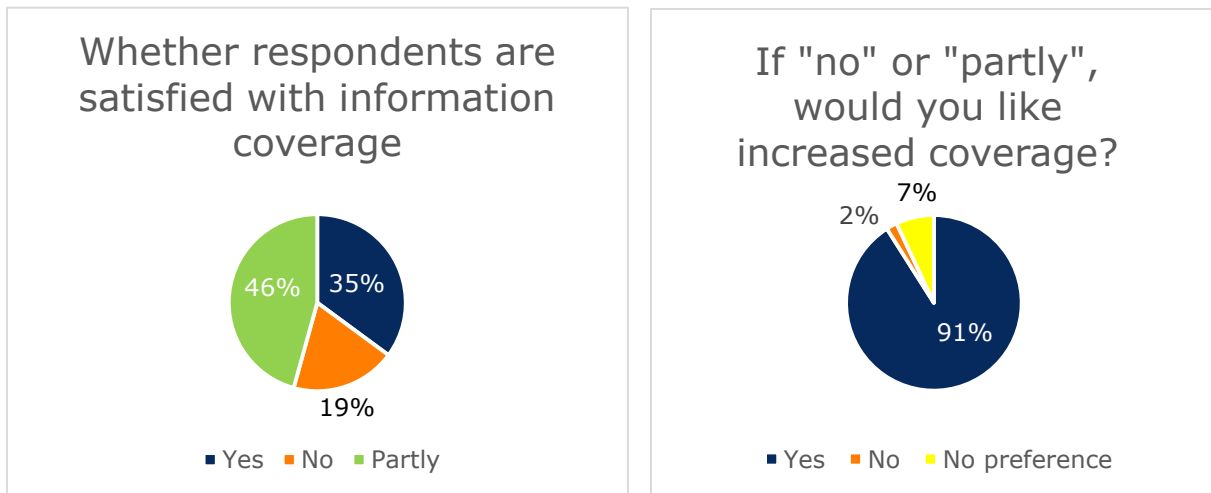
Figure 28 How do respondents access travel information?

Other examples given included satellite navigation devices; subscriptions to 'push' email or SMS alert notifications; traditional printed timetables or non-electronic information boards; real time departure information screens; and radio.

1.2.1.2 Geographic coverage of information

An important element for the policy specifications to consider is the geographic coverage that may be applied. To support the understanding of where current issues are, respondents were asked to provide their view on whether or not they are satisfied with the level of geographic coverage provided by travel information services.

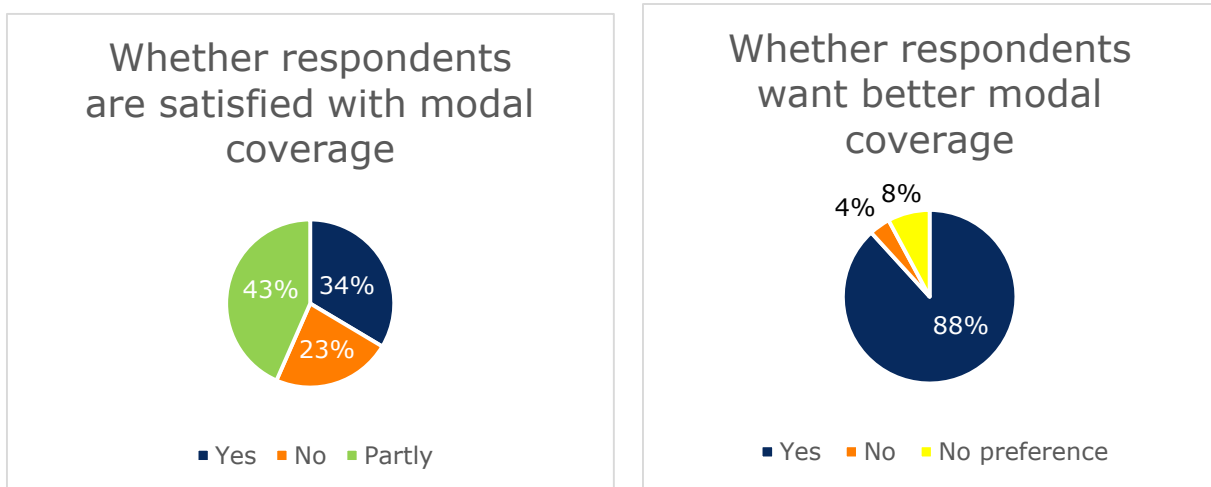
The pair of graphs within Figure 29 show that 35% are already satisfied with geographic coverage with a further 46% partly satisfied. We consider that these results appear more positive than they might otherwise be due to the geographic representation of those who have responded to the survey. Nonetheless it does suggest that geographic coverage, whilst needing improvement is close to being at a reasonable level. Unsurprisingly, of those who had stated No (i.e. unsatisfied), 91% of them would like to see an increased level of coverage.

Figure 29 Respondents view on geographic coverage of existing information services

I.2.1.3 Multimodality of information

With the same considerations in mind to the previous question on geographic coverage, the views on modal coverage were also sought.

Figure 30 shows that the overall satisfaction rate is approximately the same as with geographic coverage, however the dissatisfaction levels are higher with close to a quarter of participants unhappy with the level of multimodality. Of these, 88% would seek to have better modal coverage.

Figure 30 Respondents view on modal coverage of existing information services

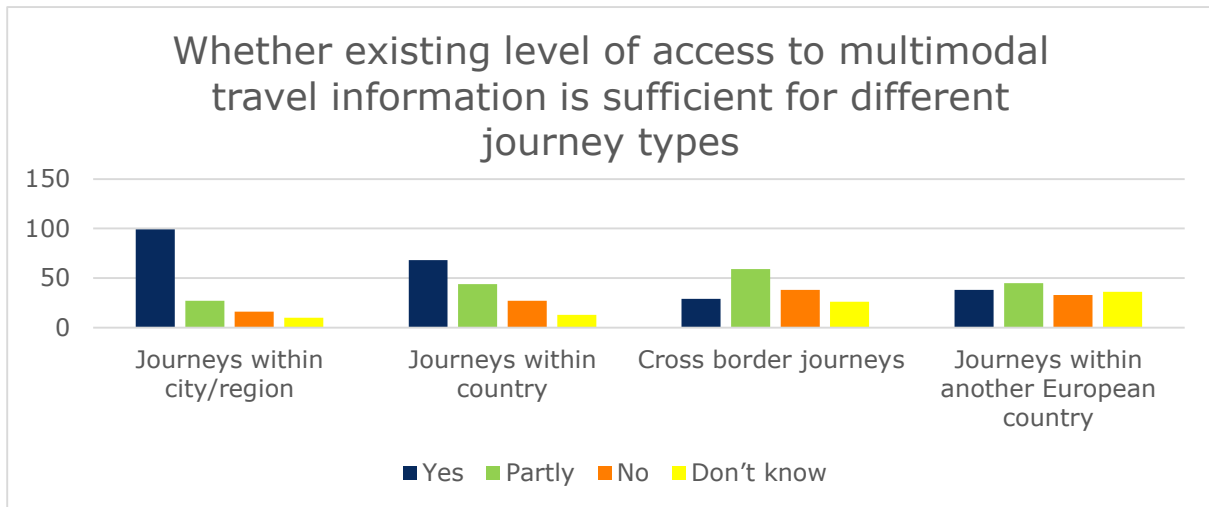
The subsequent question sought to explore this issue of multimodality in more detail. Specifically, respondents were asked to share their views on how multimodal their information sources were for the four different journey types they had previously described their frequency of taking.

Figure 31 shows that the concerns of multimodality relate to longer distance journeys or journeys within another European country. In fact the type of journey where existing services used were most frequently cited as only partially or not able to meet needs was for cross-border journeys – this was the view of almost two-thirds of all respondents.

An interesting finding is that the high level of access to multimodal services that respondents found in their home city was felt to be much less when travelling in another European country. Again, this may simply be due to awareness of what multimodal

services are on offer (perhaps defaulting to a local operator's single modal information source), multi-lingual limitations or recalling 'worst case' recent experiences.

Figure 31 Respondents views on whether existing level of access to online multimodal travel information services is sufficient (for different types of journey)

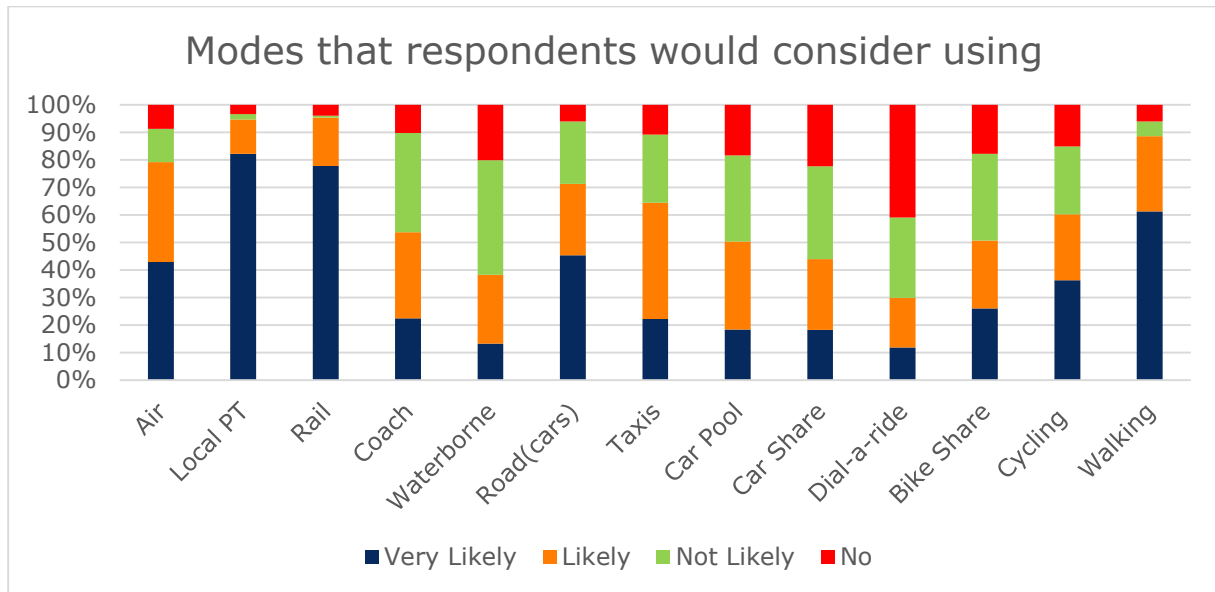


To understand which modes were important to travellers in the context of multimodality respondents were asked which modes (from a list) they would consider using for an appropriate journey.

Responses, detailed in Figure 32, must be considered in the context of the career choices of the respondents – many of whom are transport professionals and therefore are not a representative data set. However the responses are still useful and interesting, with local public transport, rail and walking the three most popular choices – with approx. $\frac{3}{4}$ of respondents citing the former two. Walking is almost certainly rated highly as respondents recognise the importance of this for the first or last leg of a journey using a non-private mode.

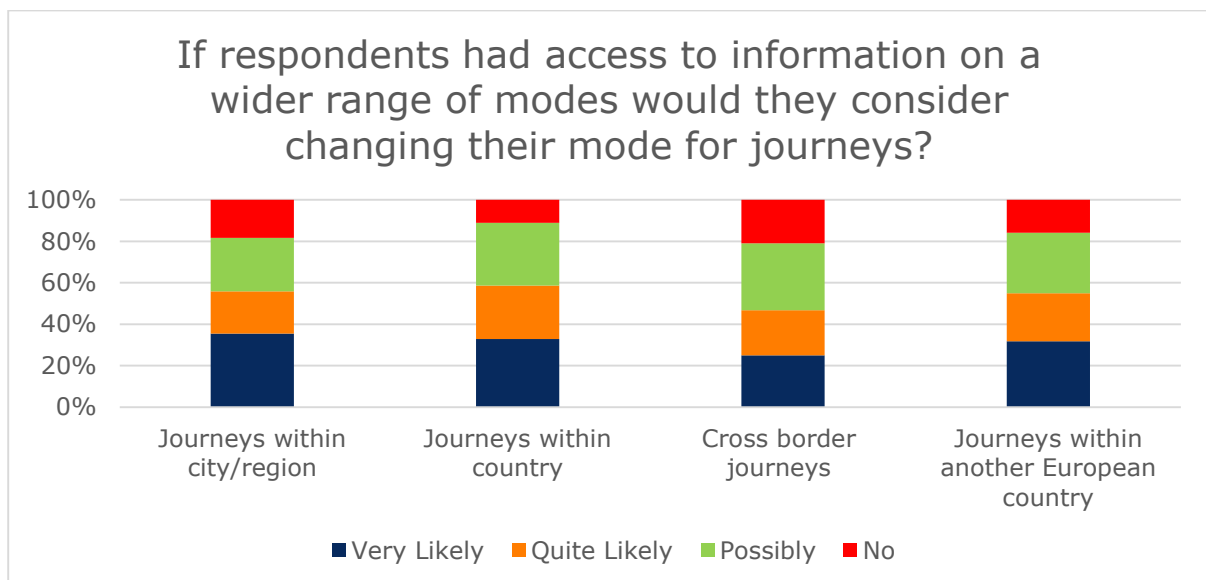
Interestingly, cycling comes in close behind use of a private car as an option. This may suggest the untapped potential for greater levels of cycling should sufficient travel information services be available to support this need. However cycling information (except for cycle hire or rental) has a more difficult business model than many other modes as there is no ticket transaction where revenue can be generated. Instead the benefits are social in nature (improved health, reduced congestion etc.).

Figure 32 Transport modes which respondents would consider using for appropriate journeys



The final modal question explored likely willingness to change to alternative modes of transport if sufficient travel information was available to inform that decision. The overall variations in responses (Figure 33) are slight, with the cross-border journeys being the type where the willingness to change reduced from mid-thirties to low twenties (in terms of percentages). This may be due to reduced options for many cross-border journeys mean that respondents have a clear preference for how to make such journeys. However only a small minority (21%) felt they would rule out the likelihood completely so even in this instance there is a high potential for change if the supporting multimodal travel information services were in place.

Figure 33 Willingness of respondents to consider changing to alternate modes if sufficient travel information was available



1.2.1.4 Quality of information

The next set of questions put to respondents concerned the quality of information which they would expect to receive – i.e. what quality criteria is most important to them.

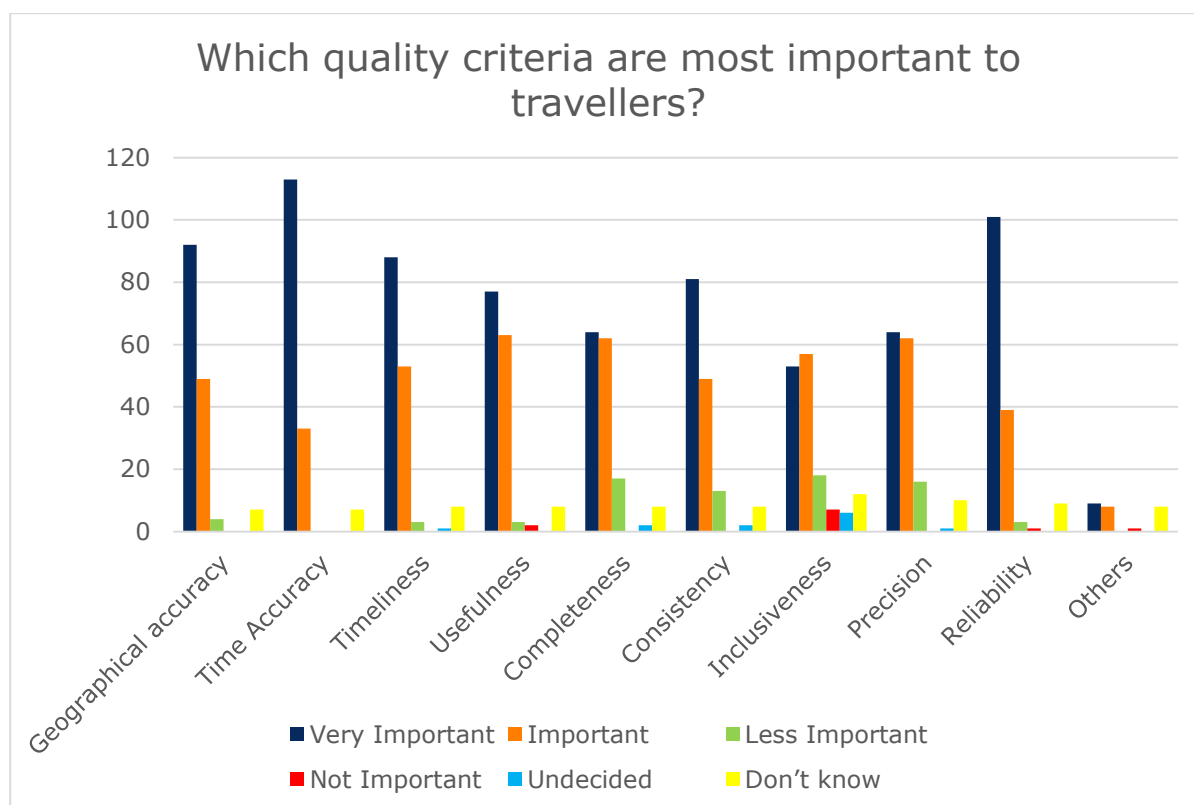
Figure 34 shows how respondents rated nine pre-identified forms of quality criteria as well as an optional tenth option of 'Others'.

Geographical and time accuracy, reliability and timeliness of information are the four areas highlighted as being of greatest importance with usefulness and completeness close behind. It is understandable that travellers would seek geographic and time accuracy as very important given the potential repercussions of being in the wrong place and/or at the wrong time might be a failed journey. Interestingly whilst rated highly, reliability is not seen as important as time accuracy. This may be because information if unreliable can be valued on those terms (perhaps prompting further research or local knowledge to supplement information) whilst inaccurate information only has an impact once a journey has failed (or needs to be re-planned).

Overall there are no unexpected surprises in the responses to this question, at least two-thirds of respondents rate every category (except the optional 'Other') as being 'Very Important' or 'Important'.

A small but notable minority of responses expressed a view that completeness, consistency and inclusiveness were of less or no importance. This reflects the view of some of the stakeholders in later responses that it is more important to have a travel information service in place which has gaps that can be filled and improved on than having no service at all.

Figure 34 Aspects of information quality which are most important to respondents



Others included a range of additional responses of which usability and breadth of functionality are the most relevant additions to those preselected criteria shown in Figure 34. Additional responses within the 'Other' category referred mainly to system functionality which is explored within the next subsection.

1.2.1.5 Functionality of travel information services

Travel information services can comprise a wide range of different functionalities. In the context of identifying the gaps in service provision which require a European approach to

addressing, it is first essential to identify what forms of service functionality are of most importance to travellers.

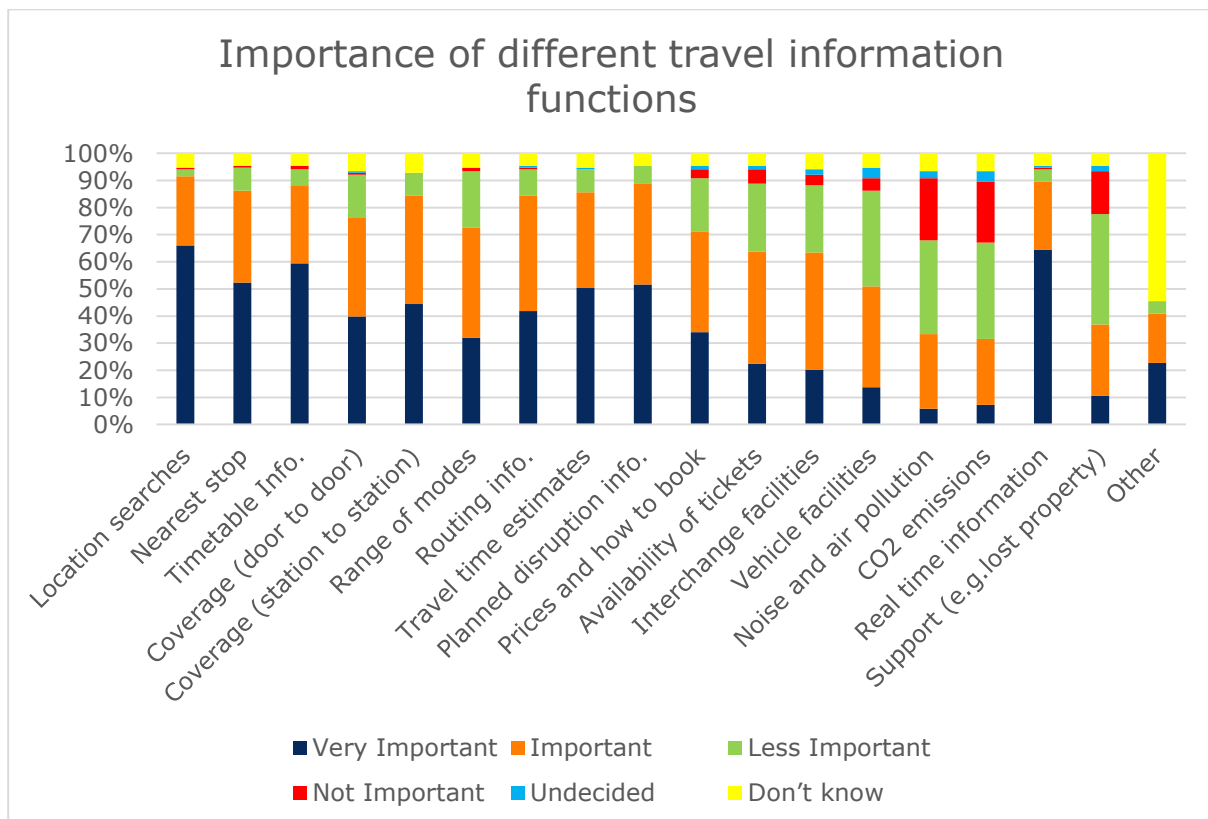
Figure 35 shows the relative importance attributed to 17 predefined types of functionality along with an 'Other' option which respondents could self-define.

It is interesting that there is only a small variation between expectations on the coverage that such systems should have station-to-station journey searches being only marginally of more importance than door-to-door planning. This indicates that a high majority of travellers would now expect door-to-door planning as a minimum level of service.

This data is useful in comparing the classifications developed within the D1 Baseline Report on the (i) Minimum expected; (ii) Additional desirable; and (iii) Nice to have functionality. These results would indicate that the following items from that report should be reclassified to reflect traveller expectations:

- Real time information (e.g. predicted arrival times based on real world status) should be a Minimum requirement (*previously classified as Additional desirable*).
- Interchange facilities (e.g. Status of access node features (including dynamic platform information, catering, operational lifts/escalators, closed entrances and exit locations) should be an Additional desirable requirement (previously classified as Nice to have)

Figure 35 Respondent views on the relative important of different functions within travel information services



The following issues were raised under the category of 'Other'. The most important of which would be the considerations for PRM travellers raised in the first bullet point:

- Support for blind and low vision travellers e.g. in clear print, audio or braille output and in a predictable manner. There should be a range preferences such as print and background colour, font size and style, and, if on screen (particularly on a smartphone), minimal clutter.

- An integrated ticketing experience (recognising that this is beyond the scope of Priority Action A).
- A feedback loop for users of the service
- Comfort information relating to the journey and vehicles (e.g. 'quiet' coaches, toilets, baby-changing facilities, wi-fi, refreshments)
- Whether or not the information service is accessible through an open-API

1.2.2 Benefits of travel information services

From the perspective of a traveller, participants were asked to identify with an open response, the most important benefits to them of using MMTIPS.

These responses can be summarised into the eight key benefits described within Table 28. These could be further refined into a list of benefits to the individual (time saved, better informed, quicker) and those which are societal benefits (reduced pollution, congestion etc.).

Table 28 The eight key benefits identified in the consultation responses

Increased behaviour change to less polluting modes	More personal time for the traveller (on the journey)	A better informed journey with seamless travel	Identification of quicker or more cost effective journey options
A more quickly organised journey	Reduction in traffic congestion	Liquidity - Disposal of personal capital assets (i.e. car ownership)	A more accessible transport network

In addition, supporting the case for MMTIPS as a tool for delivering modal shift, a study provided by one respondent (Eurobarometer 2011) showed that 49% of surveyed Europeans car drivers said that the lack of information about schedules of other forms of transport was a problem preventing their consideration as an alternative modal option.

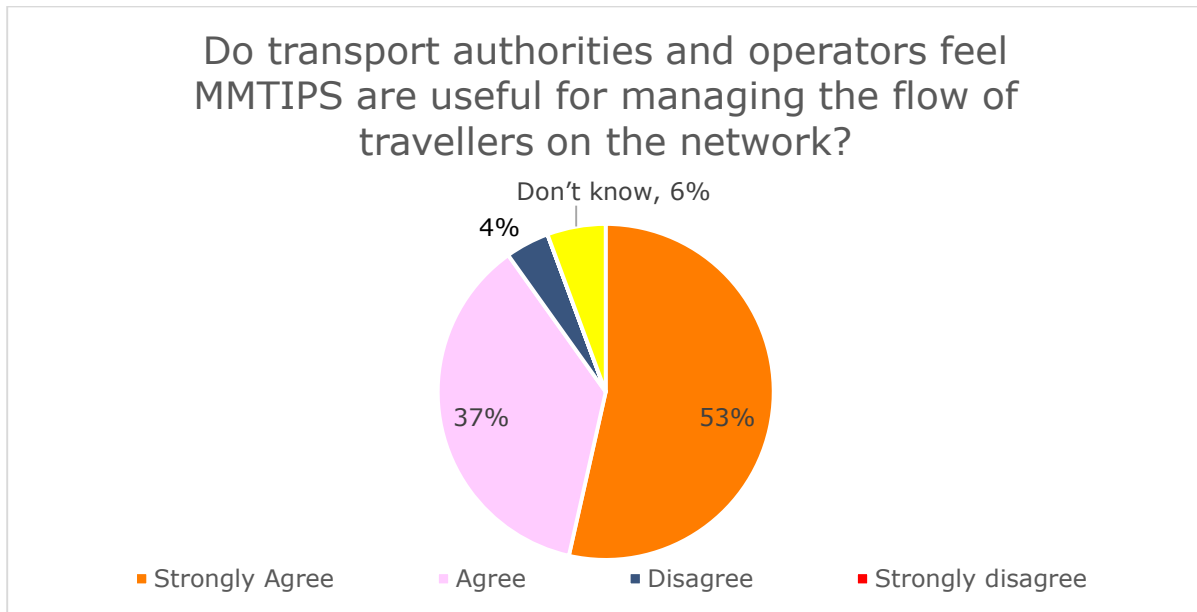
The Austrian research project SMILE²⁹ which piloted a multimodal travel information tool which combined new mobility modes with traditional forms of transport identified behaviour change amongst its users, including: 48% respondents increased usage of public transportation (urban PT 26%, regional PT 22%). 10% increased the use of bike sharing offers while 4% increased the usage of e-car sharing as well as another 4% increased the usage of e-bike/pedelec. 21% of the surveyed pilot users stated to have reduced the usage of their private car.

1.2.3 Use of travel information services by transport authorities and operators

An additional short set of questions was asked of these specific stakeholders, as to whether MMTIPS were used effectively for coordinating and managing the flow of travellers across the transport network i.e. as a tool to provide greater network resilience. This is an interesting area that utilises MMTIPS as operational tools for optimising use of the available network rather than simply aiding passenger decision making (and seeking increased ticket sales).

²⁹ <http://smile-einfachmobil.at>

Figure 36 Are travel information services useful for coordination and flow management of travellers across the transport network?



Further to this, 59% of the respondents stated that they currently do use multimodal travel information services to help coordinate and manage the flow of travellers across their transport network. This can work through weighting journey plan responses away from network congestion hot spots or by pushing out updates via social media and to pre-registered travellers (via text message, app alerts or emails) to avoid certain modes, routes or locations at particular times.

1.2.4 Summary

1.2.4.1 Summary of consultation responses

Whilst recognising that a sample size of 151 self-selecting respondents, mainly consisting of degree-educated professionals, cannot be used as a representation of Europe's 503 million population, the results here do reinforce the position identified within the ITS Directive that there is scope and demand for an enhanced multimodal travel information systems offering to citizens within the EU.

The majority of respondents (two-thirds) do not feel that existing services provide sufficient geographic or multimodal coverage for their travel information needs. Travel information for cross-border and within other EU countries is difficult due to availability and access to appropriate services – this may be a result of awareness of local services or lack of multi-lingual services.

Travellers predominantly seek information through online channels. This is from a mix of operator and independent sources. The former is currently more popular but not substantially so – it could be envisaged that this will change in the favour of independent sources in the coming years as the pace of innovation and technology further develops.

There is a high level of willingness to change modes amongst respondents if a greater level of multimodality was included within travel information services for comparison. These also include low-carbon modes such as cycling, rail and public transport. Modes such as air and private car were rated as being of lower consideration than might be expected.

Travel information service accuracy of geographic and timing information is seen as essential quality criteria (with others). Some travellers seem to be willing to trade off access to complete data rather than having no information at all.

Previously unidentified quality criteria, usability and breadth of functionality are important characteristics to users of travel information services. Both of these would be considered by advocates of open-data and market led approaches to be rated by the end users rather than being elements that would need consideration by the European Commission.

Finally, there are eight key benefits which travellers identify that they derive from good multimodal travel information services. These include both direct benefits to the individual and wider social positives.

1.2.4.2 Summary of travellers perspective from further sources

Through the consultation phase a number of further studies and position papers from consumer and passenger associations were provided. These have been reviewed to add further understanding to the traveller's perspective.

It is clear from these further reports that there is significant support to the view that action on improving the availability and coverage of MMTIPS is required:

- Consumer association BEUC³⁰ (2014) are clear that "a **European vision** for a *door-to-door intermodal passenger transport information must be developed*".
- The European Disability Federation (EDF) states that they "fully support the move towards integrated and comprehensive multi-modal travel information and planning services (MMTIPs) as it makes traveling between different Member States easier for all passengers." (EDF, 2015)

I.3 Main Findings

This section draws together the main findings from stakeholders who responded to the public consultation as well as from the workshop. In addition, relevant views and findings in papers or studies which have been submitted during the consultation process have been extracted for analysis here.

1.3.1 Understanding barriers

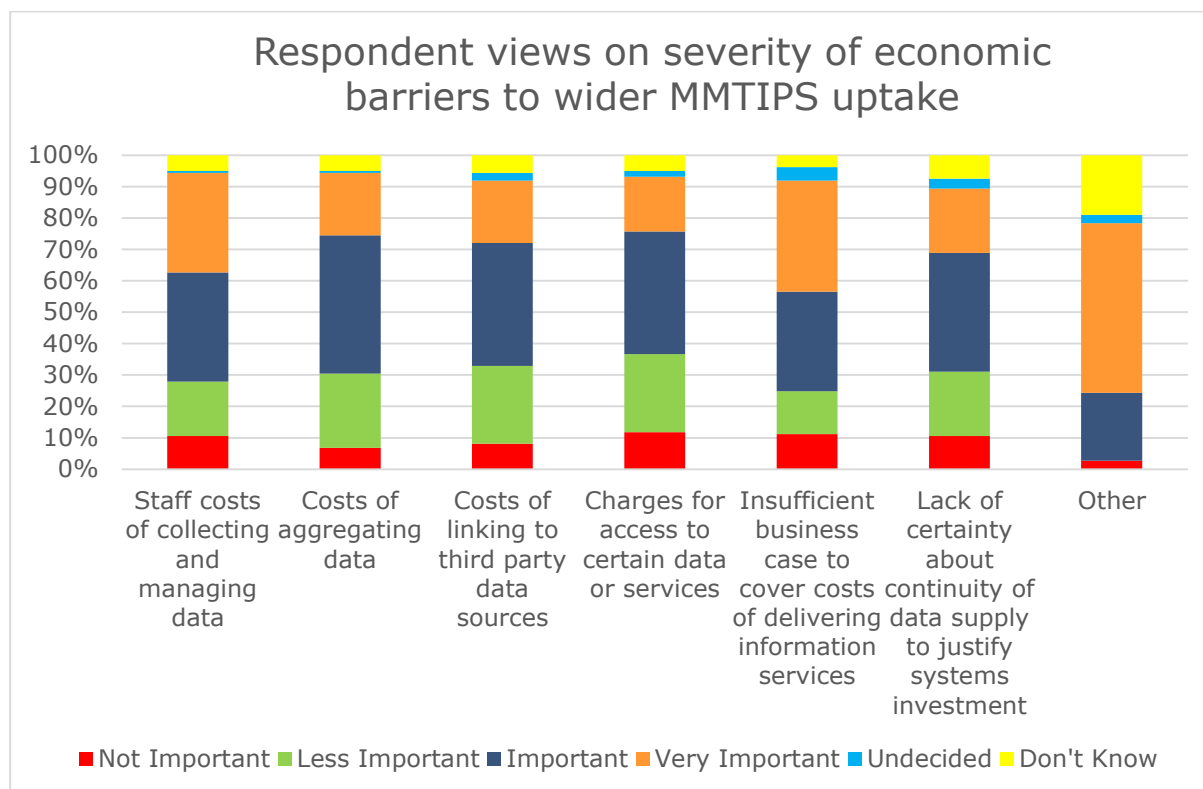
As explored within the D1 Baseline Report there are a wide range of barriers limiting the further growth and availability of MMTIPS. This section explores stakeholder views on these barriers and their relative importance.

1.3.1.1 Economic, legal and technical barriers

Firstly, stakeholders were asked to consider financial and economic barriers to wider MMTIPS uptake. A predefined set of options were provided for respondents to rate on a scale of 'Very Important' through to 'Not Important'. The option of providing additional economic barriers was also included. The results are summarised in Figure 37.

³⁰ Bureau Européen des Unions de Consommateurs (translation: The European Consumer Organisation)

Figure 37 Perceived severity of current economic related barriers to the wider deployment of MMTIPS



The most significant perceived economic barrier was that of an insufficient business case to cover the costs of delivering information services. This is a recurring theme in responses particularly in relation to the costs involved in meeting potential mandatory requirements which may arise from the EC policy specifications. Feedback through the consultation focuses on four key points in relation to this:

(1) Ability to extract value from the end user: the difficulty is that this is not the case in the short term because of citizen unwillingness to pay directly for a service (All Ways Travelling, 2014). The primary business case for travel information relates to ticket sales therefore it is challenging (from a business cost perspective) to consider these independently.

(2) The business case lies with the transport operator typically (though not exclusively) but costs in many cases to improve services (or the data behind them) lie with public authorities.

(3) The costs involved in improving services may not be recoverable, i.e. there is not a business case without considering the social benefits.

(4) Judging the balance between reliability and quality of information that can be provided against the investment required to meet those expectations.

An area for potential further research which may address one or more of these concerns might be into viable business models behind the provisions of good quality multimodal travel information.

All other stated economic barriers had a majority response stating their significance (Very Important or Important) which highlights that they each need to be considered in the range of potential solutions.

Within the Other category a range of further suggestions or observations were made:

- **Affordability of 'big data'**: for example, mobile phone data from operators has previously proven to be highly expensive but if it was affordable it could be used

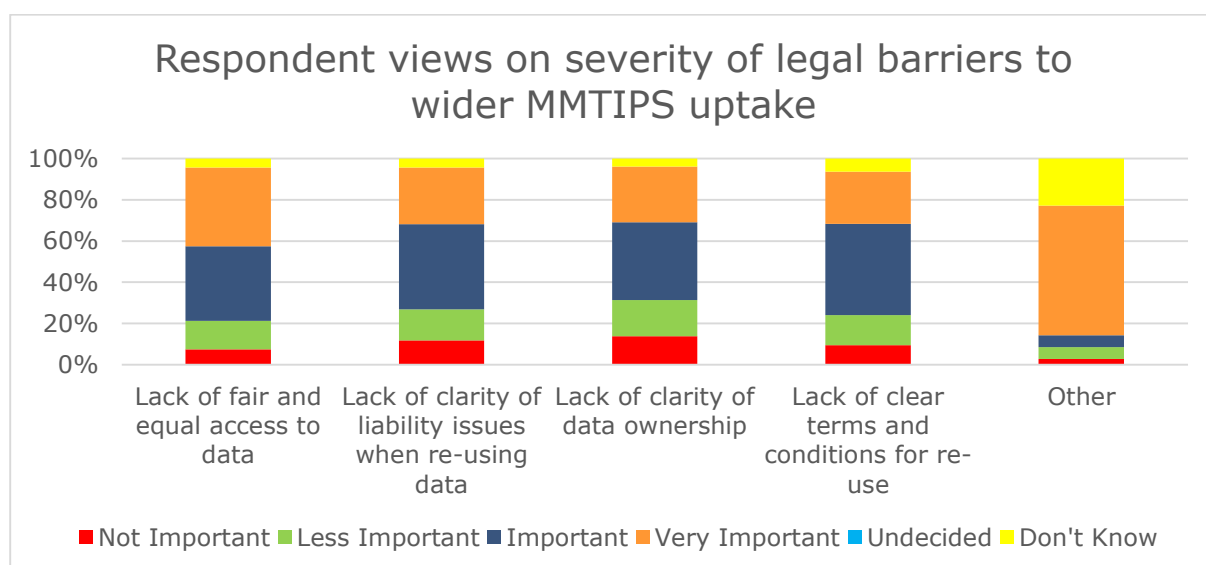
in an anonymised format to better understand the movements of vehicles and people across the transport network.

- **Handling proprietary data and formats** resulting in restriction to market which might otherwise lower costs. In conjunction with this is the cost issue of needing to handle a large number of data formats through conversion tools (software development and skills retention costs – as also highlighted in Floristean et al (2014)).
- Fear of losing **competitive advantage** of exclusive control of own data.
- **IT infrastructure costs** including servers, security and bandwidth for supporting APIs

Five pre-identified legal barriers were presented for respondents to rate in the same way. These results can be seen in Figure 38 which shows that the top concern is with the Lack of Fair and Equal Access to Data. This is rated as the most significant of all barriers explored in this section (jointly with the two technical barriers: 'lack of data available in common formats' and 'low quality of available data').

It is noted that the perceived legal barriers vary slightly depending on mode, country and form of data. Specifically, there were significantly more comments provided on the restricted access to fares and seat availability data than timetable data in many Member States. This is likely to be due to the good availability of data access in several of the Member States best represented in the responses – the limitations to the available data in many countries remains fares information due to its commercial sensitivities (and perhaps due to limitations as to how well it is handled electronically).

Figure 38 Perceived severity of current legal related barriers to the wider deployment of MMTIPS



An analysis of those respondents who rated these barriers as 'Not Important' shows that they all belong to the rail industry (the majority are rail operators). However those who used the rating 'Less Important' are more broadly representative of wider stakeholders. A recurring theme within the responses is this difference of opinion from rail operators which seems to reflect a resistance to change, perhaps due to concerns over retaining competitiveness of their large businesses and a desire to retain strong control of their data. It may also be due to there being no barriers within the rail industry – *"in the rail sector, the technical and organisational aspects of data provision are good. Other modes may have more of a problem"*. However that view is not particularly reflected by data users.

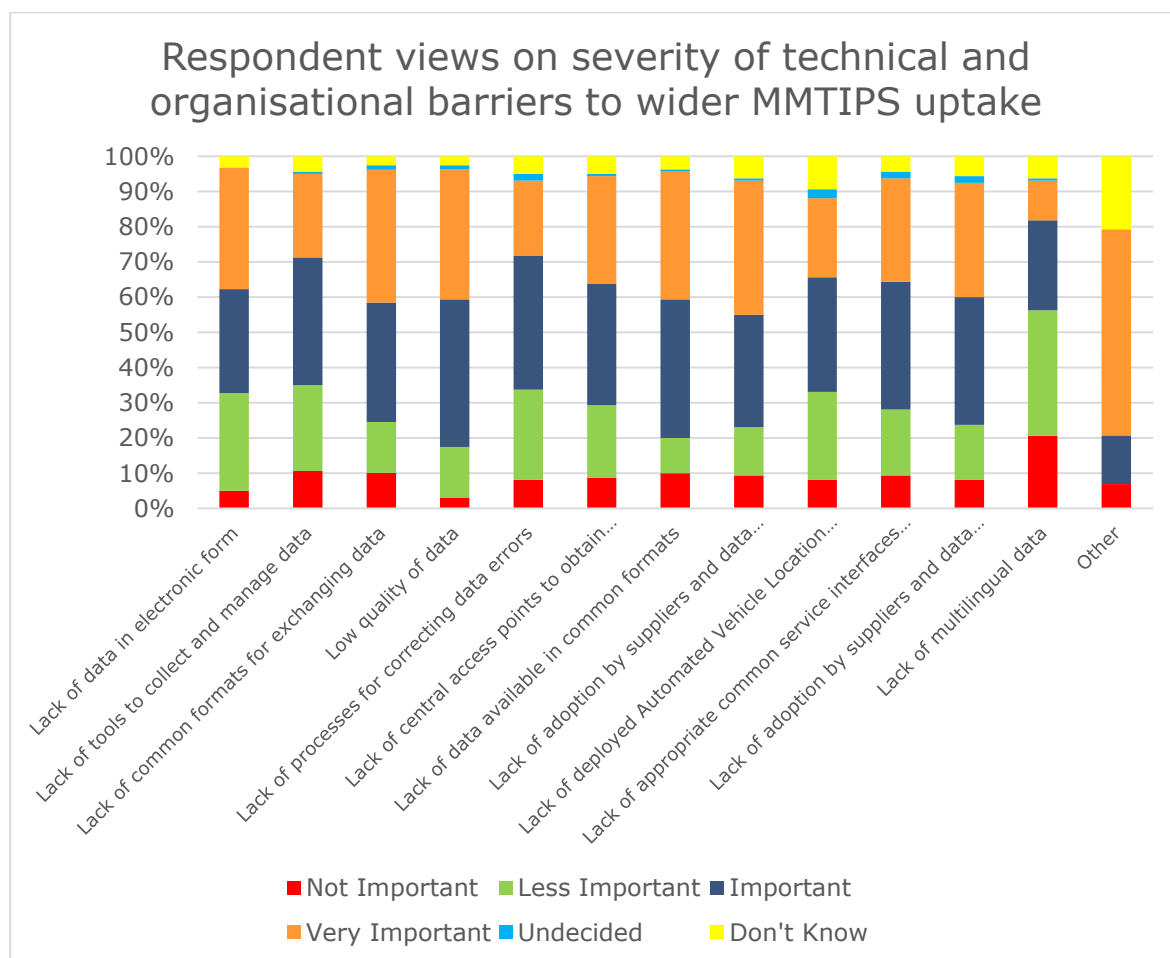
Further responses received within the 'Other' category can be summarised as:

- Barriers relating to competition law
- Procurement laws
- Variations in data access legislation and guidance between Member States
- Intellectual property associated with data ownership
- Views that different rules should apply for public and private sector elements of the transport network (e.g. with data access)
- Fear of legal issues
 - Lack of clarity on what may be personal data
 - Lack of clarity of responsibility for misrepresentation of an operator’s data
- Lack of clarity on the rules for data update, accuracy, reliability, responsibility for data refreshment.

All the responses to the same question on technical and organisational barriers receive majority support identifying these as Very Important / Important (Figure 39). The one exception is the lack of multilingual data which still has support from a significant minority.

The two barriers with greatest support are ‘lack of data available in common formats’ and ‘low quality of data’. The latter is reinforced by some survey respondents and workshop participants who invest in further work to enhance and improve data to get it to a level which they deem sufficient for use in their systems.

Figure 39 Perceived severity of current technical and organisational barriers to the wider deployment of MMTIPS



'Other' responses, which also included justifications for certain viewpoints included:

- The lack of access to "raw" transport data (highlighting that for some data users it is access to any data which is more important than access to data in common formats).
- Co-existence of multiple local, regional and national public administrations involved which need coordination – this would impact on service providers who are drawing together data for a wider modal or geographic area of coverage.
- Inconsistent or non-consistent use of metadata which makes data discovery and use challenging.
- Lack of protocols for sharing data between geographically neighbouring systems
- The importance of non-electronic information as there is a risk of only relying on electronic data which would not meet the needs of all users or provide a fall back when electronic systems fail.

The responses within this section clearly demonstrate a strong majority view that the pre-identified economic, legal, technical and organisational barriers are all significant and need to be addressed to improve the uptake of MMTIPS.

1.3.1.2 Data formats and exchange protocols

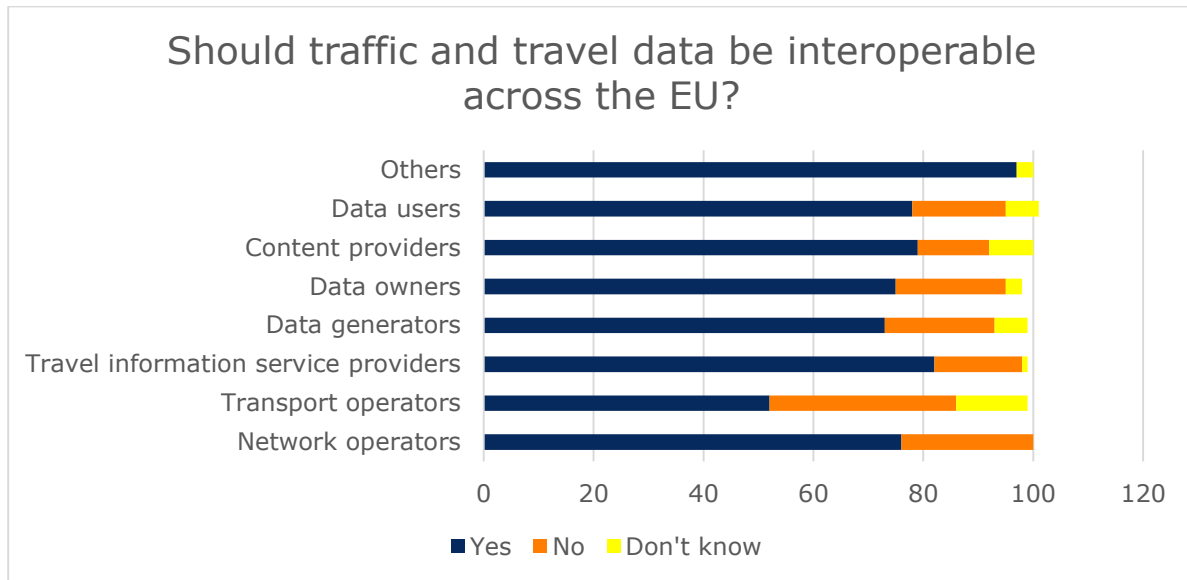
The next section of the consultation explored views on the harmonisation of common data formats across the EU, forms of static and dynamic data and what can be considered a useful frequency of data update.

The initial question asked whether traffic and travel data should be interoperable across the EU. The responses (Figure 40) are useful to view as a comparison between different stakeholder types in the travel information chain.

At least $\frac{3}{4}$ of respondents from each group say yes except for transport operators where it is only a small majority who share that view. To some extent this might be informed by previous steps towards data standardisation within transport operations which has proven to be an expensive process that has often required the recruitment of new specific expertise. From some of the other responses it appears that this statement has been interpreted in two ways: (i) to replace existing standards with common European ones (which is not the intention); and (ii) to use converter/export tools to transform existing data formats into common standard formatted data (which is the actual approach being explored). Some of the transport operator concerns may be due to considering the former approach rather than the latter.

Note that the travel information service providers and data users are overwhelmingly in support of the view that these should be interoperable. This is probably explained by the benefits to them of dealing with a reduced number of potential data standards – whilst there might be an initial cost in adaptation there will be cost and risk reductions over time.

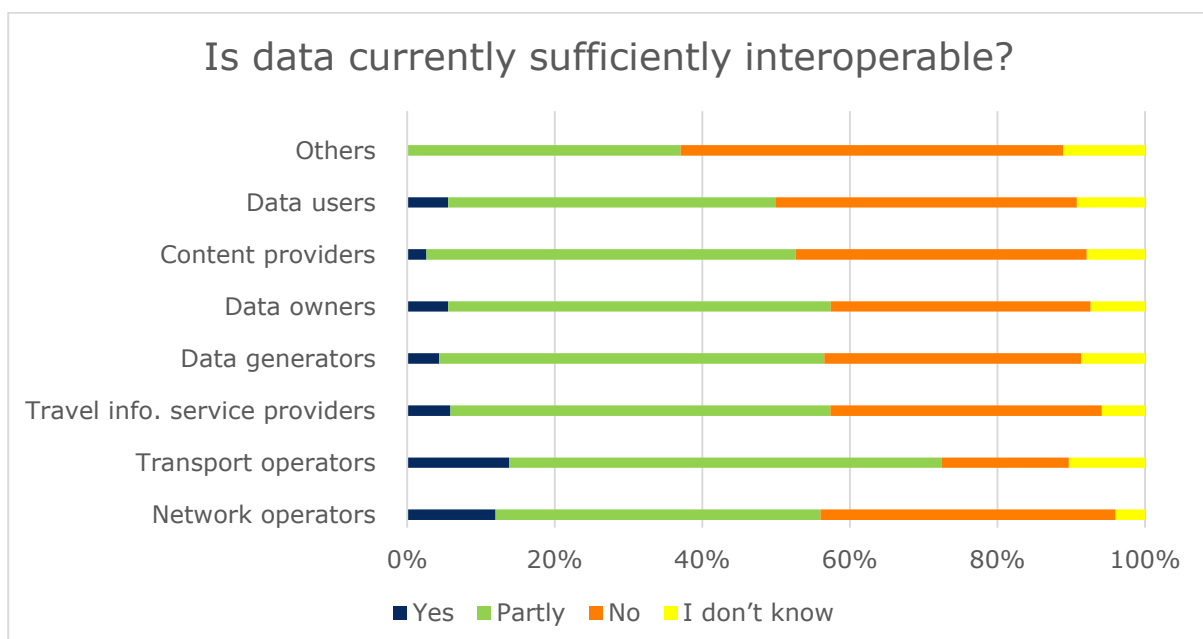
Figure 40 Views on whether data should be interoperable across the EU - by stakeholder type



The next question asked for views on the current situation regarding data interoperability. The responses to this were more varied (see Figure 41). Whilst the transport operators held the most optimistic view (16%) that standards were sufficiently interoperable, it is useful to consider that most operators with have a mono-modal view in comparison to data users, travel information service providers and others (the miscellaneous experts). This is likely to skew views to focus on the use of data standards within a particular modal sector rather than across the full multimodal traffic and travel data space.

Interestingly, many respondents of all categories opted for 'partly' as their response. This suggests that there is a good baseline of standards for interoperability but there are issues with the availability, uptake and use of these which needs action to progress.

Figure 41 Views on whether data is currently sufficiently interoperable across the EU - by stakeholder type

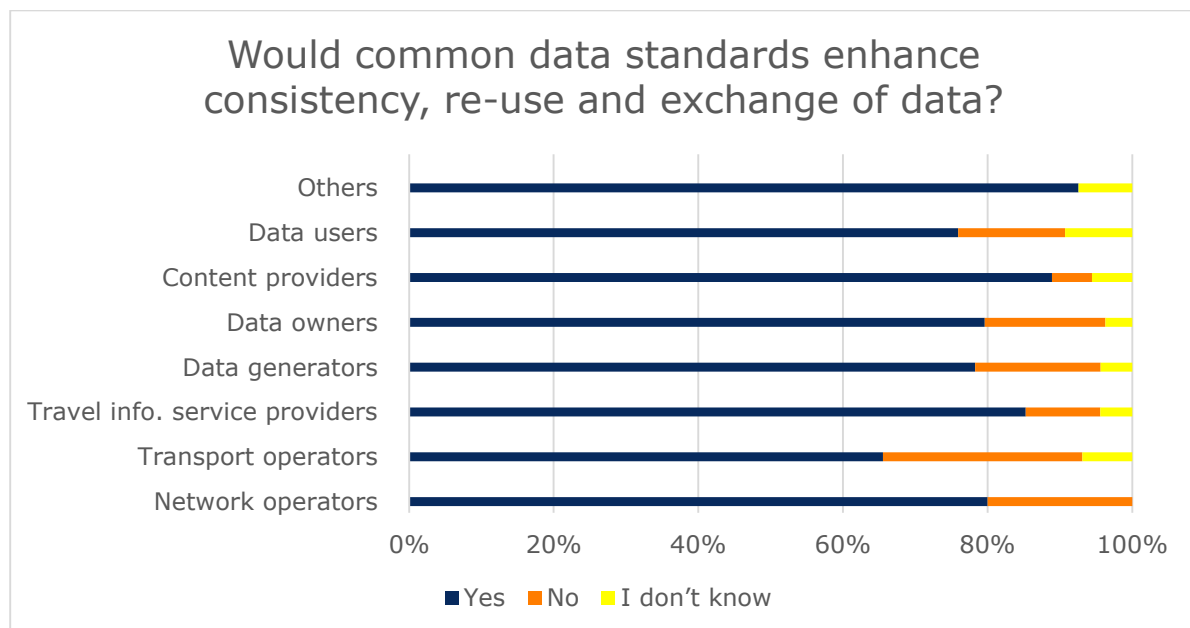


Views were then sought on whether the use of common data standards can help enhance the consistency, re-use and exchange of travel and traffic data across the EU – in effect, is this an approach to aid the reduction of those major barriers identified by stakeholders in the previous section?

Figure 42 shows that again there is broad majority support for this view across all stakeholders including transport operators, however the latter is again the segment of respondents who have a less consistent view than others.

15% of data users stated No which is worthy of further investigation. Interestingly all those data users who put a negative view again belonged to the rail sector (eight respondents).

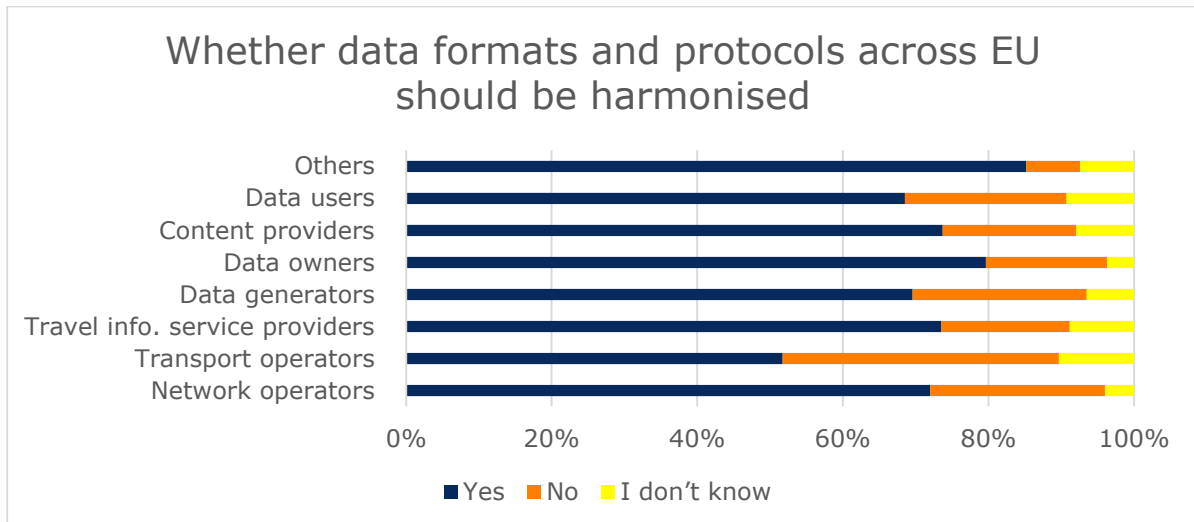
Figure 42 Views on whether the use of common data standards can help enhance the consistency, re-use and exchange of travel and traffic data across the EU



The next question more specifically asks respondents on whether data formats and exchange protocols should be harmonised across the EU.

Again, all stakeholder groups responded with majority views positively to this however amongst transport operators this dropped down to just 52%. All groups but particularly data generators and data users were less supportive compared to the previous question which asked whether common standards would improve consistency, re-use and exchange. It is likely that the slight change in question caused respondents to consider the impact on their organisation in greater detail and factoring in changes in processes and associated costs resulted in more conservative responses.

Figure 43 Views on whether data formats and exchange protocols should be harmonised across the EU - by stakeholder type



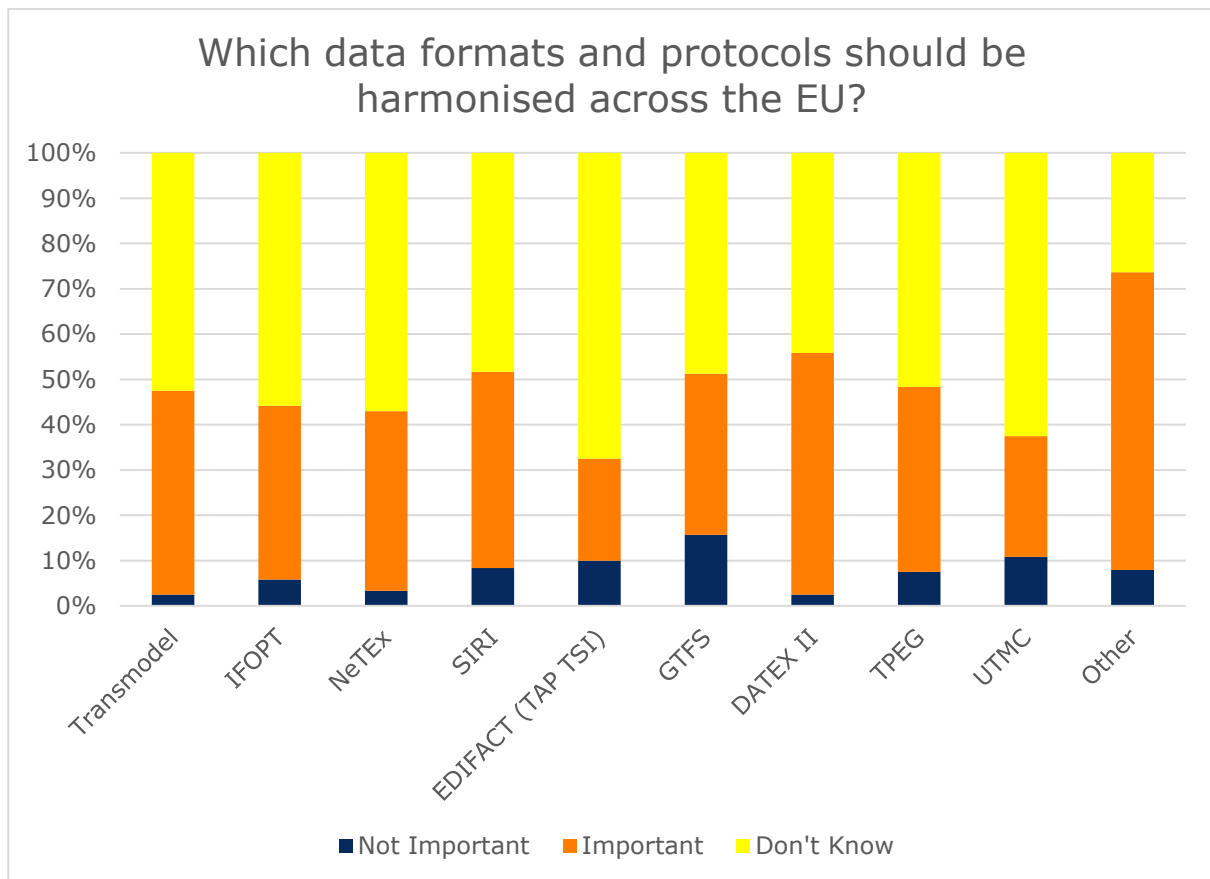
The D1 Baseline Report identified a set of existing common or de facto European standards. Respondents were asked to assess, in their expert opinion, which of these should be harmonised across the EU.

Many respondents highlighted that they either have no experience in the common standards proposed or only with those most directly relevant to their area of work hence a significant proportion of 'don't know' responses in the results within Figure 44.

The only standard with majority support was for DATEX II which really reflects its existing inclusion within Priority Action B and its subsequent higher level of visibility and understanding by stakeholders – as highlighted by TISA³¹ (2015) "DATEX II now represents a widely accepted and used standard for content encoding of Road Traffic Information".

³¹ Traveller Information Services Association

Figure 44 Respondent's view on which data standards should be harmonised?



GTFS, EDIFACT (TAP TSI) and UTMIC had the most significant 'Not Important' figures although these were still in the minority. The feedback on these can be summarised as:

- **GTFS** – concerns over recommending a non-open data standard as a common European standard as well as an impression that it best fits urban transport systems and not some of the wider variants in operational behaviour seen within rural areas. However a few data user respondents commented that GTFS (and GTFS-realtime) was much easier to understand and use than many of the more detailed common European formats – this is not surprising since it covers a much smaller functional area than Transmodel/NeTEx.
- **EDIFACT (TAP TSI)** – concerns from respondents that the underlying technology is outdated and not sufficient for meeting meta-data data discovery needs of third party users. A few rail industry respondents proposed RailML or XML (TAP TSI) as a more suitable alternative. An alternate view is that the travel information community would be sufficiently well served by use of NeTEx for rail information.
- **UTMC** – considered to be more of an operational standard than one appropriate for traveller information.

Other standards proposed by respondents for harmonisation included GDF (three respondents), an opposing view which agreed that a GIS format should be recommended but that it should be based on outputs from the Open Geospatial Consortium specification and not GDF. The upcoming CEN TC278 Open Distributed Journey Planning standard was highlighted as were a number of different national or regional standards (including DELFI, NOPTIS and VDV452).

The other future standard highlighted in one response was TISA's development of TPEG2-SPT (Shared Passenger Transport), which will be the first of a modular and

scalable set of TISA applications for multimodal travel information. This would aim to cover multimodal real time information requirements. However it is noted that a previous multimodal standard by TISA (Public Transport Application TPEG1-PTI), was too complex to find its way into practical applications (TISA, 2015).

The responses of many participants were supportive of the EC recommending common standards rather than mandating them. This view is summarised within the response: *"Different formats are used for different purposes and are often tailored to specific modes and coexist without difficulties today and market actors know how to use them and combine them"*. Concerns over the mandating of European common standards related to constraints on the development of local and regional markets

An important point was made about the need to continue international engagement to ensure alignment with future global standards (TISA, 2015), this is an area which would be valuable for the EC to retain involvement.

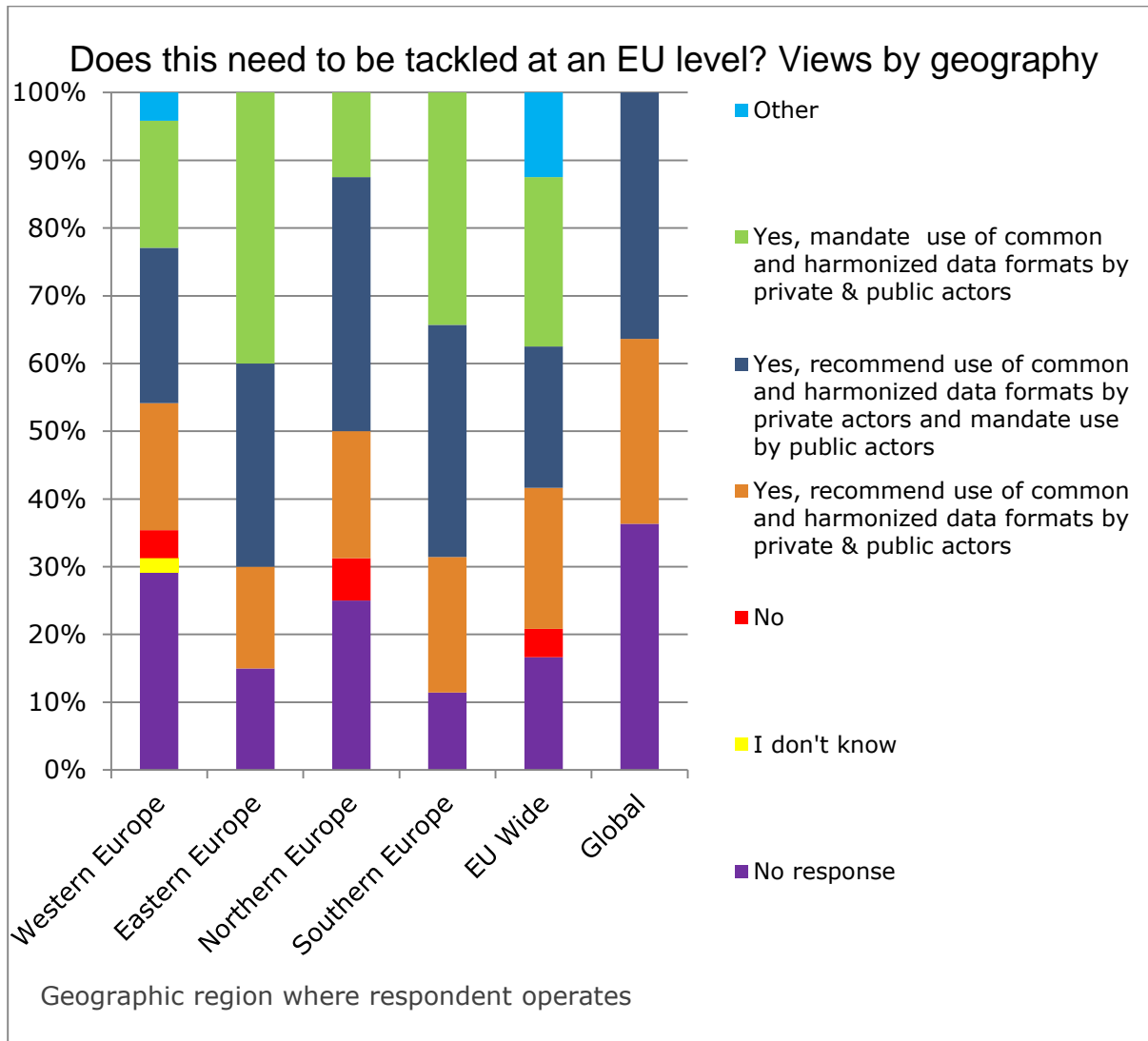
Respondents were then asked their views on whether the use of common data formats and exchange protocols should be addressed at an EU level. Figure 45 shows responses by region whilst Figure 46 shows the same responses by stakeholder type.

The views on the three policy options (mandating public sector use; mandating public sector and recommending to private sector; and recommending to both) vary across Europe, however there is strong support for action with little dissent to the view that at the least there should be recommendations in the use of common data standards.

The region with greatest support for mandating standards is Eastern Europe with almost 70% of respondents there in favour of requiring either public sector or both public and private sector to use common standards when making data available.

Western Europe was the most split with no particular approach gaining more than 30% support. This appears to be due to the wider variety of stakeholders in this region with a greater mix of public and private respondents, operators and independent third party data users.

Figure 45 Views on whether there should be action at an EU level to ensure use of common and harmonised data formats – split by geographic region

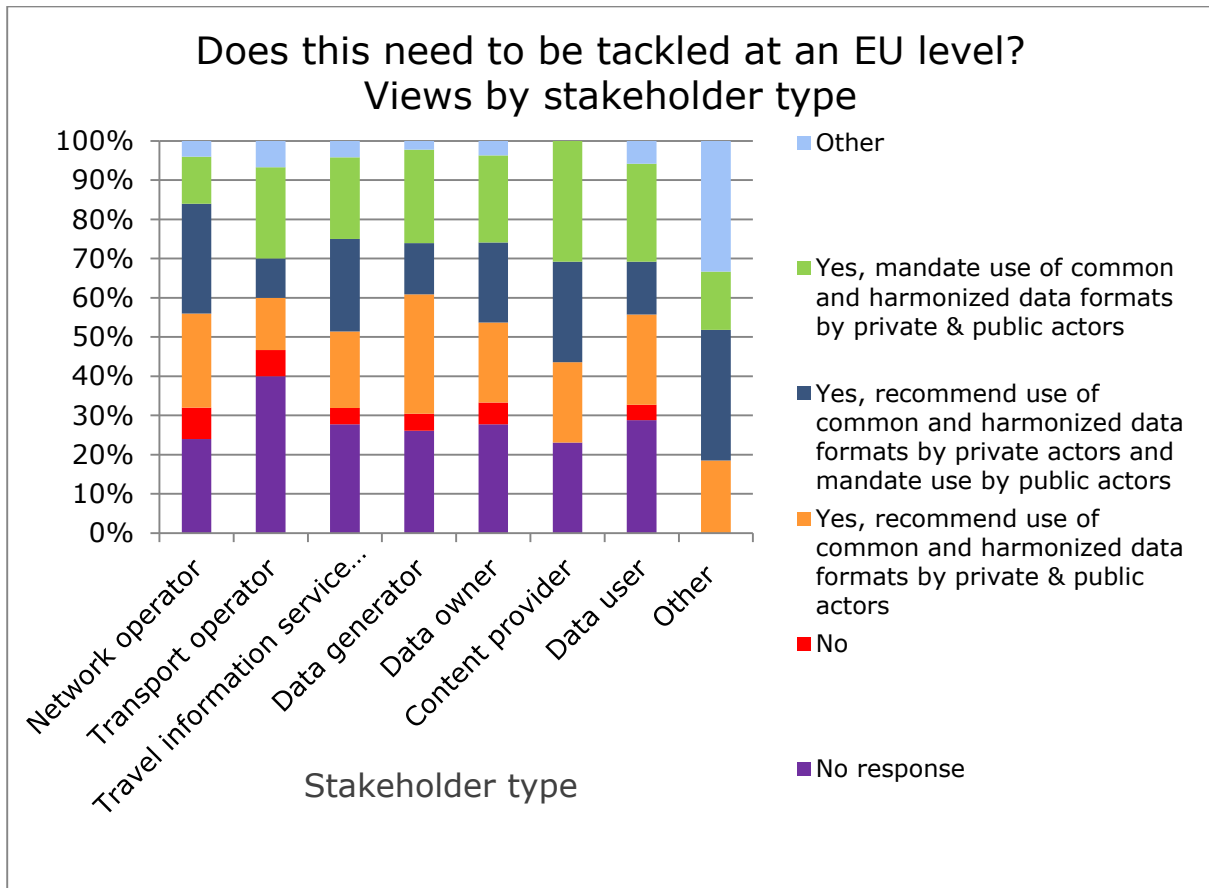


Analysing those who stated 'No' in more detail, these are more varied than in previous question responses and include a local technology cluster, a city region, a global travel information provider and technology company, a rail operator and a rail association. This is an intriguing mix from which it is difficult to draw particular conclusions from except that nearly all of these will have a multinational perspective.

One of these cited the view that no intervention should be made on this topic as CEN's³² management of standards (for public transport) is sufficient and there is no need for further action from the Commission within the public transport (sic) sector.

³² The European Committee for Standardisation

Figure 46 Views on whether there should be action at an EU level to ensure use of common and harmonised data formats – split by stakeholder type

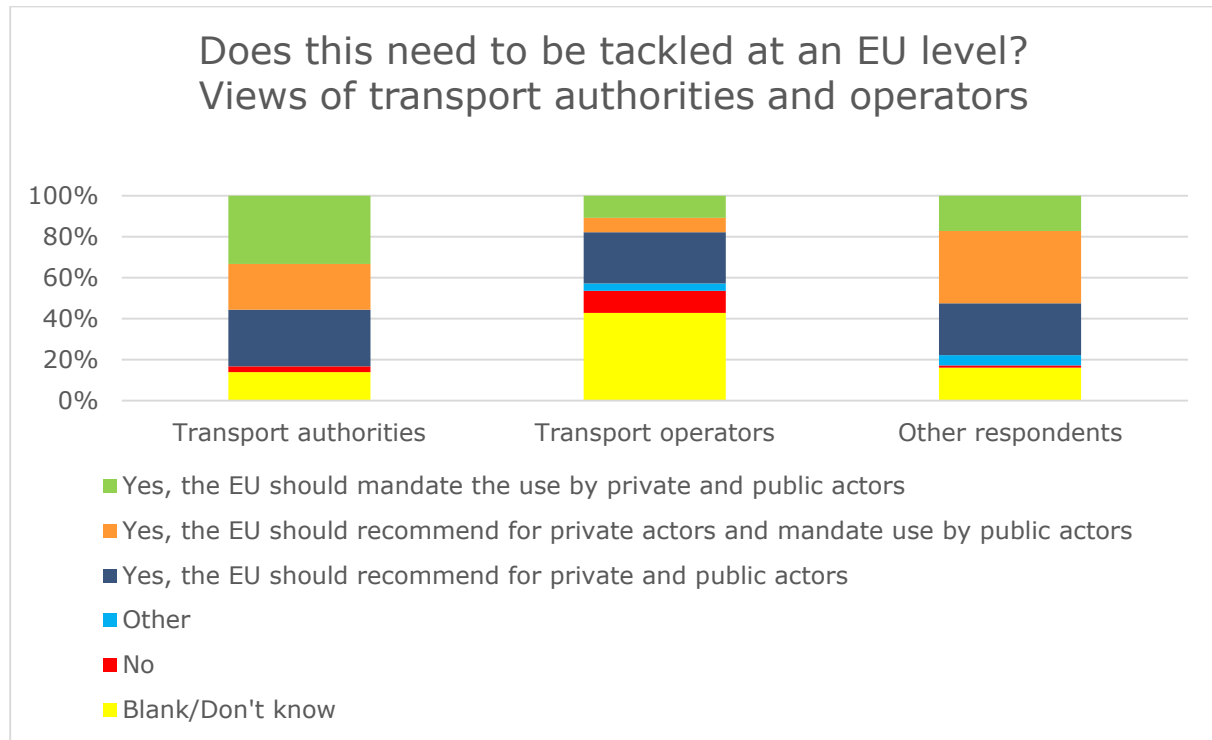


A small number of respondents (eight) provided commentary to support their view that 'Other' action was required. These points can be summarised as:

- Specific concerns relating to the need to ensure rail sector compliance
- Standards, after publication have to be maintained and users guided. Financial support for those who are standards-compliant would encourage users (as in USA)
- Support to users should be provided: user groups supported, training courses etc.
- The EU should delegate responsibility to TISA to develop mandatory common data standards for multimodal travel information.

Figure 47 provides a third view of the responses, with the focus on those organisations self-identified as transport authorities and transport operators. Just over half of the authorities are supportive of public actors being mandated to adopt common data standards which is broadly in line with the 'Other' respondents. Transport operators would prefer data formats and exchange protocols were recommended only (however close to half of all operators participating were not in a position to offer a view in response to this question).

Figure 47 Views on whether there should be action at an EU level to ensure use of common and harmonised data formats – focus on transport authorities and operators

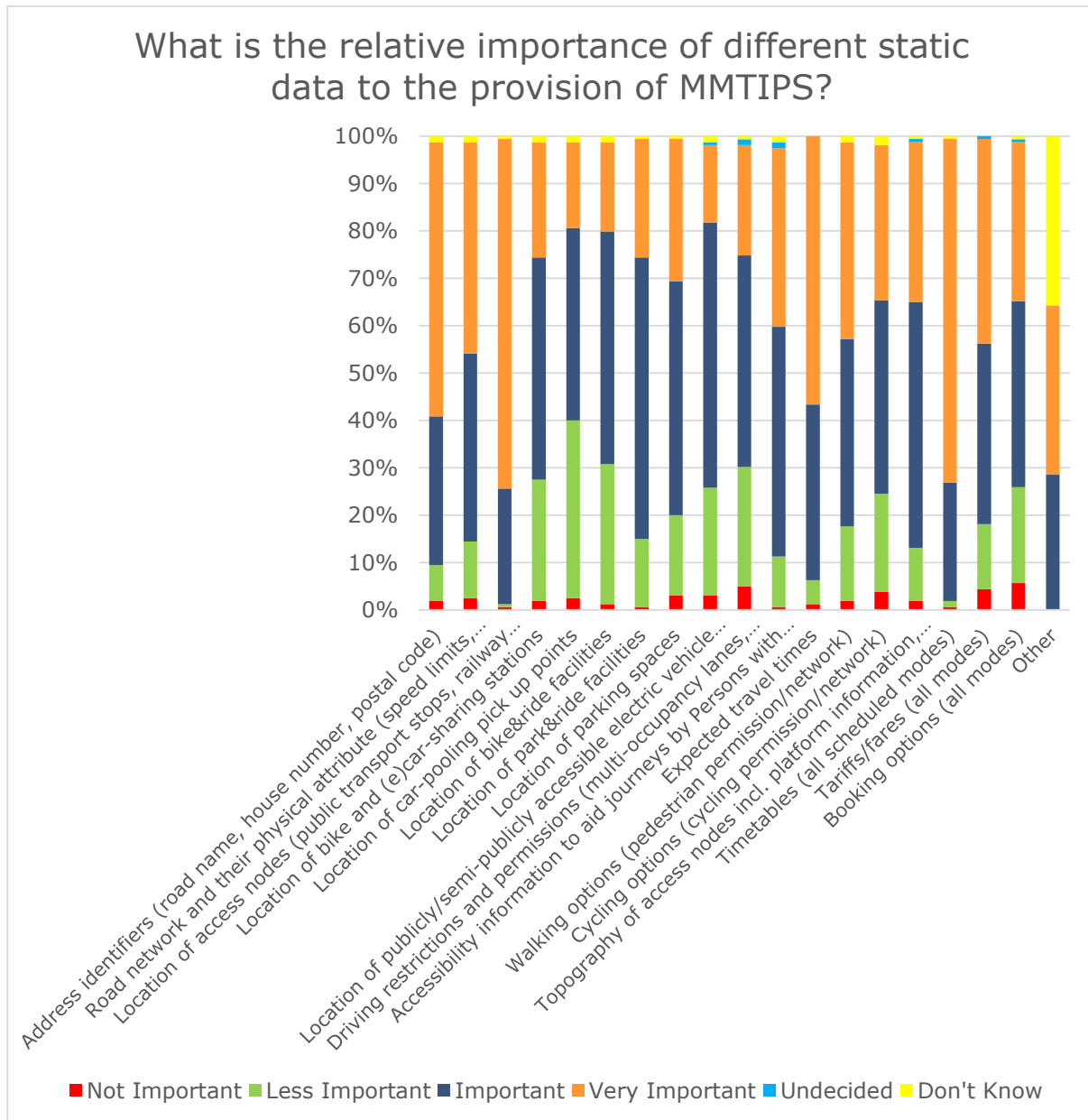


Respondents were then asked to consider the relative importance of different forms of static and dynamic data in the provision of travel information services.

Firstly, within Figure 48 at least 60% of responses to each category of data have assessed them as being 'Very Important' or 'Important' in nature. The categories which are rated as being of less importance than others are all emerging new mobility modes – car pooling, bike & ride, electric vehicle charging points etc. In this assessment it should be considered that these are the modes where respondents and organisations are likely to have least experience (e.g. most citizens will have experience of bus travel but relatively few of driving and charging an electric vehicle).

The most highly rated elements are (i) location of transport access nodes (e.g. stations, stops); (ii) expected travel times; and (iii) timetables. This is not unexpected as these are the core functions at the heart of most multimodal travel information systems.

Figure 48 Respondent views on the importance of different forms of static data



A significantly sized dissenting group rated fares/ticketing and booking information as 'Not Important' or 'Less Important'. A review of those respondents who proffered this shows them to be primarily rail industry organisations (mostly operators) but also some technology companies (providers of MMTIPS systems to service providers) and a few cities. The technology companies' view may be informed by particular market insight into system users or their customers (cities, transport operators) or perhaps by the relative added complexity of including fares information within a multimodal dataset.

A number of respondents (primarily transport operators, particularly rail) stated within their supporting comments they strongly believed that ticket booking should not be considered a user need within MMTIPS. The opposite view was promoted by the consumer organisations who responded that they feel this is a key requirement for travellers – a view also iterated strongly in the stakeholder workshop. As ticketing/booking is beyond the scope of Priority Action A, that difference of opinion needs only noting at this stage. However there are some implications which relate to the provision of fares information through third party services which several transport operators also objected to due to the inability to confirm the accuracy of figures being

provided to travellers by third parties and the intrinsic commercial confidentiality of their fare structures.

Respondents also provided additional user requirements which had not been captured within the predefined list. These can be summarised as:

- Links to transport operators/providers concerned.
- Demand responsive bus, ferry, taxi or private hire services operating in an area.
- Personalized advice, according to the traveller's profile (age, family, participation to a congress, a cultural event or sport event) needs to be available.
- Customer services; where and how to complain if anything didn't go well (delays, cancellations, etc.); passengers rights.
- On-vehicle facilities (wifi, tables, cinema, catering, luggage provisions).
- Probabilities that journey interchanges succeed – a function which appears in some Scandinavian services but rare elsewhere.

It can be noted that most of the above can be represented in the NeTEx format, but data is typically available only for certain aspects such as on-board facilities. The provision of personalised preferences is a task for the end user applications rather than for upstream systems managing transport data.

Data on accessibility for Persons with Reduced Mobility (PRM)

It is essential that MMTIPs solutions proposed are accessible to all passengers, including persons with reduced mobility. Accessibility means in this case not only the technical access but also the type of information provided and how it is presented. (EDF, 2015)

Barriers experienced which can be overcome through the availability and incorporation of the right data include:

1. Websites of transport operators are not always accessible so it is difficult to find information in the first place.
2. Existing travel information services do not always take into account accessibility in their travel planners by e.g. calculating longer transfer times or transfers only at stations that are accessible.
3. Even if information is available in different accessible formats, unfortunately it is not always specified what those are.
4. Information about the right to travel with a personal assistant should be made easily available for all transport modes in the travel chain.
5. To ensure inclusivity and accessibility when developing new MMTIPs, representative organisations of persons with disabilities should be consulted systematically.

If the provision of data is to be recommended or mandated within the policy specifications then it will be important to provide a timescale to these to avoid leaving a loophole which disinterested organisations could exploit. On that basis, respondents were asked to consider what a reasonable frequency for updating static data and making it available would be?

The twin graphs in Figure 49 capture the responses to this topic. Nearly half of respondents feel that static data should be made available when changes occur with a

similar proportion believing that this data should be made available within three days. The level of dissenting voices to this timetable would make it difficult to suggest as a mandated approach but it would be reasonable to recommend this. It might be not be unreasonable to mandate data providers to commit to a minimum level of data refresh (which might vary depending on the type of data involved).

Figure 49 Respondent views on how frequently static data should be updated and made available for re-use

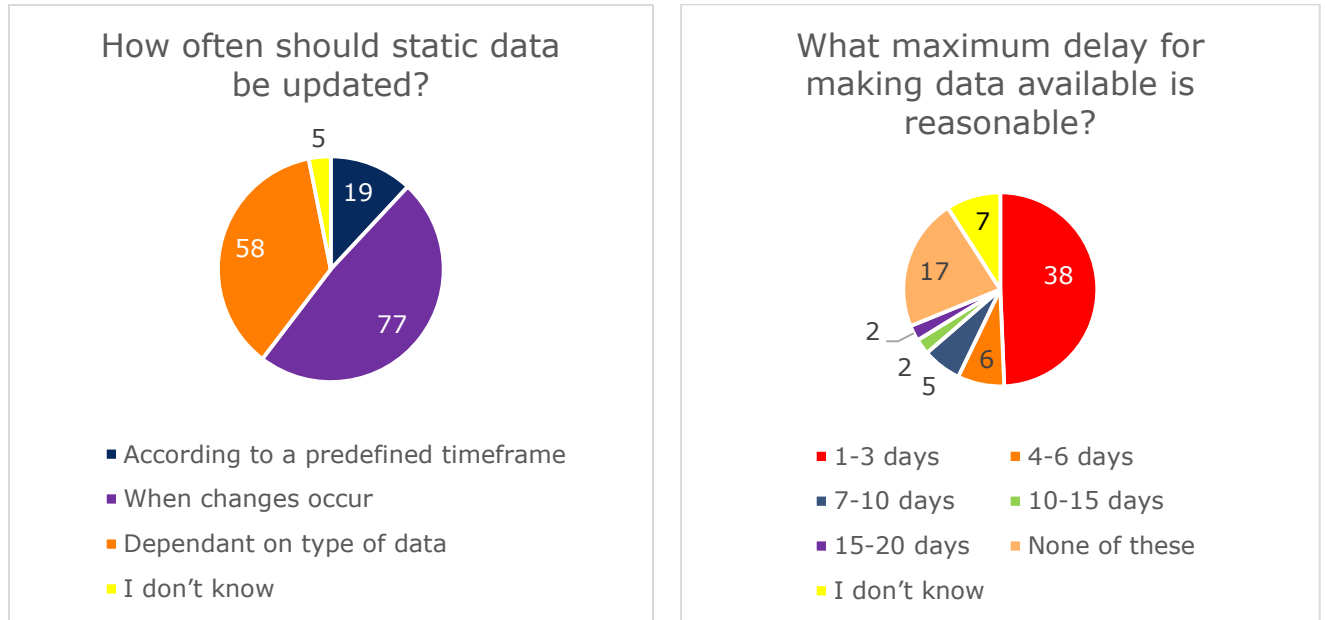


Figure 50 shows the views on the relative importance of forms of dynamic data. These have a greater range of response than those on static data, reflecting that many of these are newer sources of information that have become available (or more common) recently.

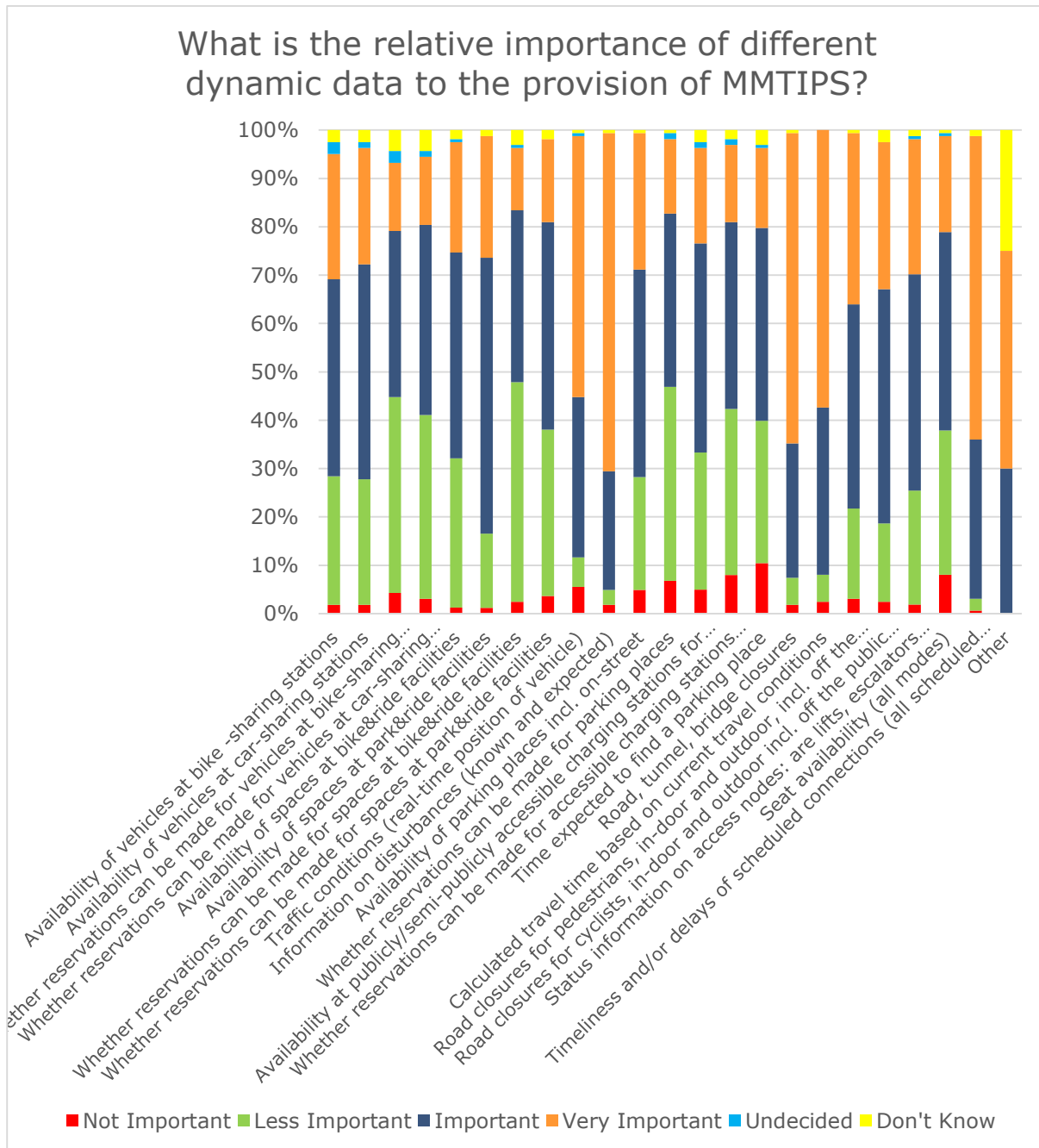
The two elements with over 90% positive support are (i) the timeliness updates / delays to scheduled times; and (ii) known and expected disruption information on journeys. These are key elements that affect the pre-planning and during-journey re-planning of all forms of journey hence their near universal support.

With such high levels of support it is interesting again to review who the dissenting voices were. Real time delay information was objected to by three operators (covering rail and bus modes), an operator's association and one third party travel information service provider. The latter is unusual as this is a feature they provide in their system so may be an error in their response. The operator's may be concerned by the costs of providing such information or the reputation risks associated with publishing information on their adherence to schedules.

A wider range of organisations rated the publication of known and expected disruption information as unimportant. These included two operators (one bus, one rail), an operator's association, an automobile association, a German city and three travellers.

The least supported elements were those around 'park & ride' and 'bike & ride' space availability and space reservations. These may be considered rarer features than others and might also indicate that space availability is less of an issue for many of these types of facility. General parking space reservations and time predictions for locating parking spaces were also rated less favourably. This is likely to be due to the limited existing deployment of technology solutions in the field currently that can provide the information on these.

Figure 50 Respondent views on the importance of different forms of dynamic data



In addition to expressing views on the predefined list of options, they were also able to provide additional dynamic data requirements. These can be summarised as:

Passenger transport

- Dynamic fares information (i.e. yield based) should be included – although the opposing view is also strongly expressed by operators (CER, 2015).
- Boarding / alighting platform information for trains, though it is noted that, when known in advance this is not always provided as public information in order to safely manage the movement of passengers within the station environment (i.e. avoiding overcrowding at the platform edge).
- Current distribution of passengers on board a service to allow new customers to board in less busy zones (note that this data is not widely

collected currently and may also be unattractive to provide on security grounds).

- Level of network performance during strike conditions.

Traffic & road network

- Official diversion routes during planned roadworks/closures.
- Real-time traffic light states and schedules of when temporary lights are in operation.
- Known accident safety hotspots (e.g. historic data) for cycle route planning amongst other uses.

General

- Exceptional weather and its relationship to the network.
- Real-time prediction on the success probability of the current journey. Alternatives if the success probability drops too low.

Seat availability is considered too closely tied to yield information many operators particularly within the rail and long distance coach sectors that it is therefore commercially confidential information that competing companies (within and between modes) would benefit from accessing.

A few respondents raised concerns about the security implications of providing real time location information on vehicles as dynamic data feeds and that only real time delay information relative to their scheduled arrivals should be provided. It is noted that the latter should provide sufficient information and in any case the former has been approximately derived from the latter by enterprising developers in some locations.

In summary of other comments made in response to this topic, challenges of dynamic data are with (i) availability (e.g. data generation) and (ii) aggregation of dynamic data feeds is a time intensive activity which could be overcome through the deployment of a coordination function required to establish Access Points.

1.3.1.3 Data sharing and access

The following section looks at stakeholder views on how data should be shared and how to provide third party users with effective access.

Respondents were initially asked whether they felt that there needed to be an EU approach to making traffic and travel data consistently accessible. The results showed 86% in favour and 9% against (5% responded 'don't know').

The dissenters to this view were nearly all transport operators and transport operator associations – covering various passenger transport modes. It should be noted that the majority of transport operators in the consultation did respond positively to this question.

Respondents were then asked whether points of access where the data is either stored (database, data warehouse, data marketplace) or signposted/indicated to where the data is can be found (registry) would help ensure consistency in the sharing of data.

78% of respondents stated 'Yes' with 9% stating 'No' (13% indicated 'don't know'). The decrease in those stating 'Yes' compared to the previous question is due to them opting for 'don't know' to this more specific line of enquiry.

Those respondents who answered 'No' were asked to provide commentary on the reasons for their response, these included:

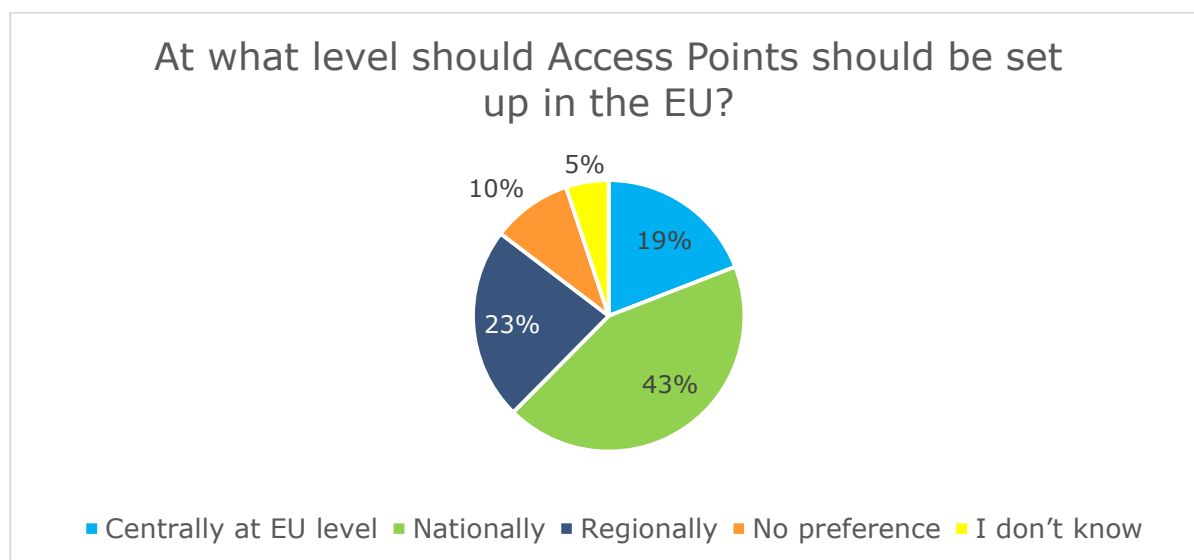
- A preference for flexibility for local decision makers to deploy an approach that best fits their circumstances (e.g. no mandating of an Access Point approach).

- A preference for supporting distributed rather than centralised forms of data Access Points.
- Concerns that centralised Access Points (on an EU or national level) are too risky from a single point of failure and a security perspective.
- A preference for API services for all data access rather than any sharing of static datasets.
- A specific viewpoint from a rail operator that the results of the Shift2Rail project will provide further evidence on what would be the best approach.

A review of the responses show common objections from the rail sector which in particular appears to be resistant to a single European Access Point being established. Responses from other sectors recognise that Access Points, if recommended, are more likely to be at a Member State or regional level.

Figure 51 shows the responses to the question on what administrative level should Access Points be established. The largest response was for national Access Points which is in line with the Priority Action B specifications which a significant number of respondents will be familiar with. It was certainly remarked upon that it would be more cost effective for Member States to expand the scope of existing Access Points than deliver something new at a different administrative level.

Figure 51 Preferred administrative level of Access Points



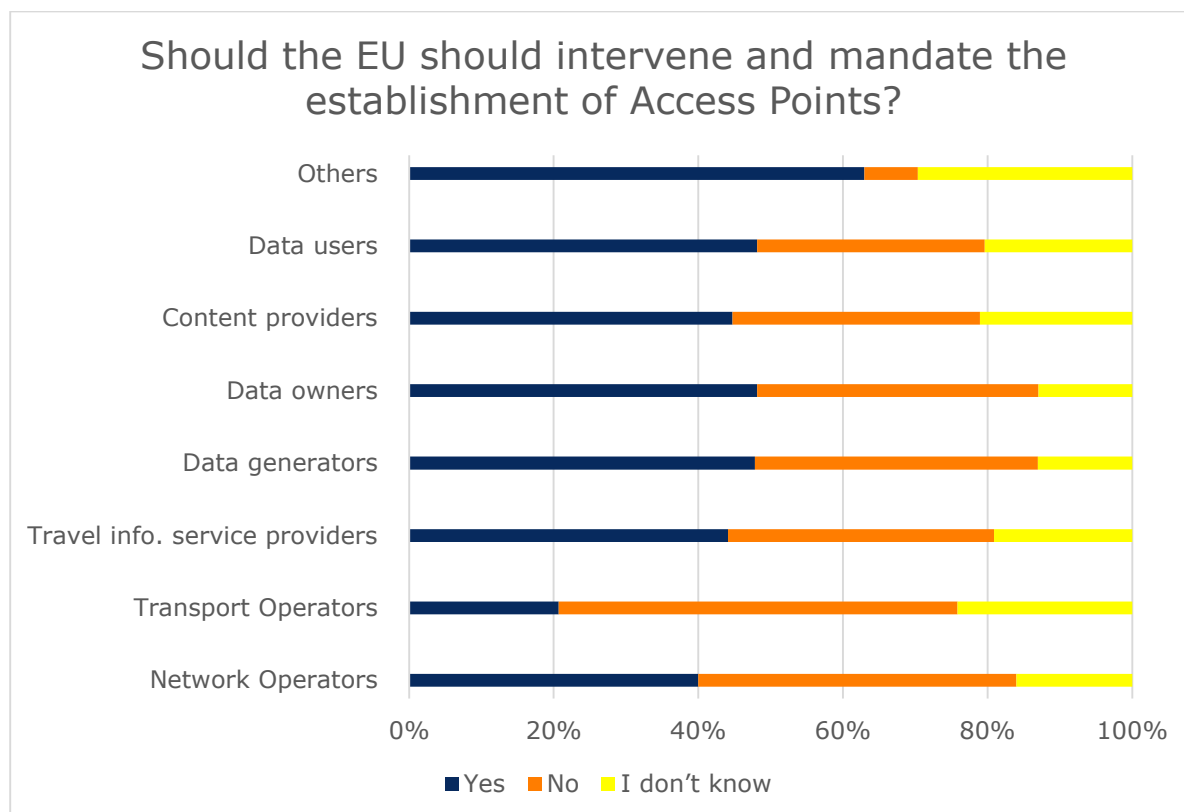
The position paper from TISA supports the concept of national Access Points and recommends they are implemented as cross-referenced registries. A single European Access Point is seen as unlikely to work, as implementation has to happen step-by-step at regional and national levels first (TISA, 2015).

It is worth noting that some respondents recommended multiple administrative levels in their responses. This may be to provide different types of data at the administrative level most appropriate. These could then be linked through a registry function within each Access Point to ensure data discovery remained as simple as possible.

The next question specifically asked stakeholders if the EU should mandate that Access Points are established within the Priority Action A priority specifications.

Responses to this question are separated into stakeholder type within Figure 52. Excluding the 'don't knows' this is seen positively by data owners, data users, data generators and content providers on balance. However the majority of transport and network operators are not in favour. Travel information service providers are evenly split.

Figure 52 Do participants think that the EU should intervene and mandate points of access to be set up in the frame of the policy specifications?



In the supporting commentary from respondents views are split into three similarly sized groups:

- Those who welcome a mandatory approach to Access Points, preferably at a Member State level and see this as a real potential benefit in improving access and reducing time required to find data.
- Those who cautiously support the idea but have concerns about a mandatory requirement, either on cost grounds; because the private sector may wish to provide this function; or because they would prefer a greater degree of flexibility in how this was deployed. This group includes city transport authorities that have already invested in local access points that they are keen not to drive demand away from to sites where they have less control.
- Those who disagree that these should be implemented and that the market should be allowed to find its own natural level. It is primarily transport operators proposing this view.

Several respondents highlighted that whilst the optimal solution might be Access Points at Member State level there would be a benefit in having a European registry of access points to aid with data discovery. One response suggested that this also allowed data users to rate/score each Access Point as a guide to others (and to motivate poorly rated Access Points to improve).

51% of total respondents supported this approach but there is a significant minority against (24.5%) with 'don't knows' also 24.5%. Therefore there would be stakeholder management required to support the introduction of a policy which mandated the introduction of Access Points.

1.3.1.4 Linking travel information services

The stakeholder workshop saw broad support for the use of linking travel information systems through open APIs to deliver MMTIPS with wider geographic and modal coverage. A further benefit of this approach is that the local data source / travel information service provider retains direct management of the data so that improvements in quality immediately flow through to downstream users.

Examples of where this would be particularly suitable were quoted by respondents to the consultation. These are locations where they believe there to be good demand from regular cross-border travellers and included adjacent regions to Luxembourg; Malmo-Copenhagen-Hamburg; the Upper-Rhine region; Vienna metropolitan urban area and north-east France-Belgium.

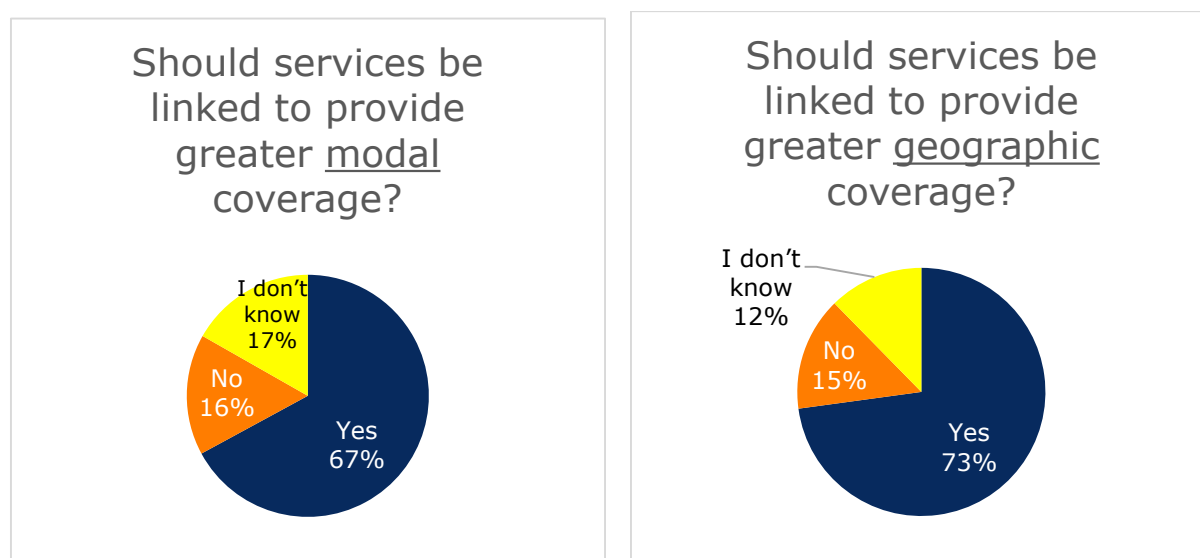
Within the consultation, respondents were initially asked whether they also supported this principle of linking travel information services for increasing modal and geographic coverage. As can be seen in Figure 53 this was supported by two-thirds of respondents for the former and 73% for the latter. This difference is likely to reflect that geography has been the primary reason for existing examples of services being linked.

Only a small proportion of respondents stated 'No' (16% and 15% respectively). A review of who these were shows that half were rail industry operators who offer the view that the market will resolve this challenge if there is user demand for it.

The other dissenters were a range of stakeholders including a systems supplier who provides the journey planning engine for a number of European cities/regions and beyond who has previously remarked that they have performance concerns over linked journey planning solutions (with a preference for a monolithic architecture) as results can be suboptimal in either speed or optimisation of route (depending on the topography of the network). Another dissenter is a recently emerged private sector travel information service provider operating in multiple Member States. It is interesting to consider that these two organisations are ones who might be expected to make significant use of the ability to link services but it seems from their responses that this would be unlikely.

Another organisation shared the belief that there is insufficient market research which identifies cross border travel as an area of user demand.

Figure 53 Views from respondents on whether they support the principle of linking of travel information services to increase coverage?



Another initially dissenting view was offered by TISA which considers the Linking Services model to be a complex solution particularly for Cross-border Travel. Their

position paper (TISA, 2015) highlights concerns in getting the right balance on handover points which may need to be very high, or if the number of handover points is chosen too small, the resulting routing may be suboptimal. However, they concur with the general view that this model may serve some local and long-distance travel well and state that their preferred approach is that of distributed route planners using data retrieved from Access Points via Service Providers. These can then evolve over time, where existing standards and services are expanded to step-by-step to cover more transport modes, geographical areas and changing requirements of travellers.

The Community of European Railway and Infrastructure Companies identifies that current technologies require a fundamental shift away from the conventional mechanism of making data available to the concept of open distributed system architecture. Efforts should now be focused on IT architectures and on semantics, rather than data format: data should be designed for an open environment, rather than reformatted to be shared. *"The result should be 'linked data', related in a flexible manner through standardised interfaces, without the need for system re-design or centralisation of data"* (CER, 2015).

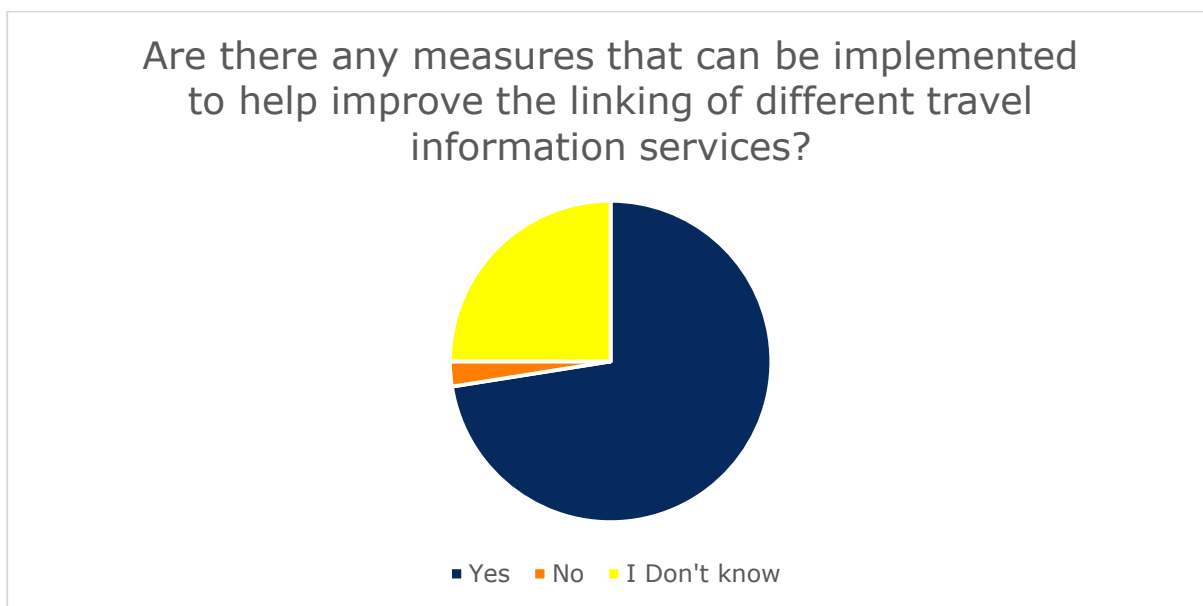
Respondents were asked if there are any technical barriers or circumstances preventing different (multimodal) travel information services effectively linking:

- No commonly accepted standard API protocol leading to multiple current APIs in use
- Implementation effort of a new or existing API within more services
- Challenge in dealing with multiple public and private third parties to agree ability to link
- Business case is usually for the third party service not for the source systems which they wish to access
- Cost of implementation
- Data mapping issues (coding of handover/transition points; transport nodes etc.)
- Lack of a coordinating body who can provide technical support or arbitrate over issues
- Data ownership issues
- Language issues
- Confidence in data quality within third party systems

Several respondents highlighted that there have been a number of existing implementations of this approach thus the only issues are non-technical in nature, e.g. organisational, political and commercial.

Respondents were then asked if they thought there were measures which could be implemented to help improve the linking of travel information services.

Figure 54 Views on whether there are any measures that can be implemented to help improve the linking of different travel information services



Just over half the respondents then provided suggestions on approaches which could be taken to support their response. These can be summarised as:

- A central EU-wide planner which provides trunk route journey information which local services can link into
- A European directory of traveller information services with APIs
- Bilateral access agreements for linking journey planners
- Common data interfaces and exchange protocols such as the upcoming CEN Open Distributed Journey Planning API specification
- Common European data gazetteers (localities, transport nodes)
- Definition of an EU roadmap for passenger multimodality funding research to provide empirical data and relevant information for service linkage to be realised. This roadmap would identify key European multimodal passenger corridors to bring together public and private resources, and align existing initiatives.
- Enable open-APIs on commercial terms
- Facilitate all Member States reaching an equivalent basic level as regards the existence of systems and geographical coverage. Recommendations and financial help for the less covered countries is necessary at the first place. Once in place then a link across the border becomes useful
- Financial support for enhancing existing geographic coverage of current 'linking' initiatives (e.g. EU-Spirit, Shift2Rail, FSM and CEN/TC 278 Open Distributed Journey Planning)
- Help and advice from experts with experience in implementing linked services
- Mandate that any public funded service must provide an open-API
- More frequent data refreshes in linked journey planners to aid in confidence of use
- Standardisation of metadata and data semantics with the provision of central "meta" services, i.e. a register of available journey planning services and a register of handover points.

- Targeted engagement programme with transport operators across modes.

Participants were then asked to identify whether the EU should intervene in the area of linking travel information services and the extent to which that intervention should take place.

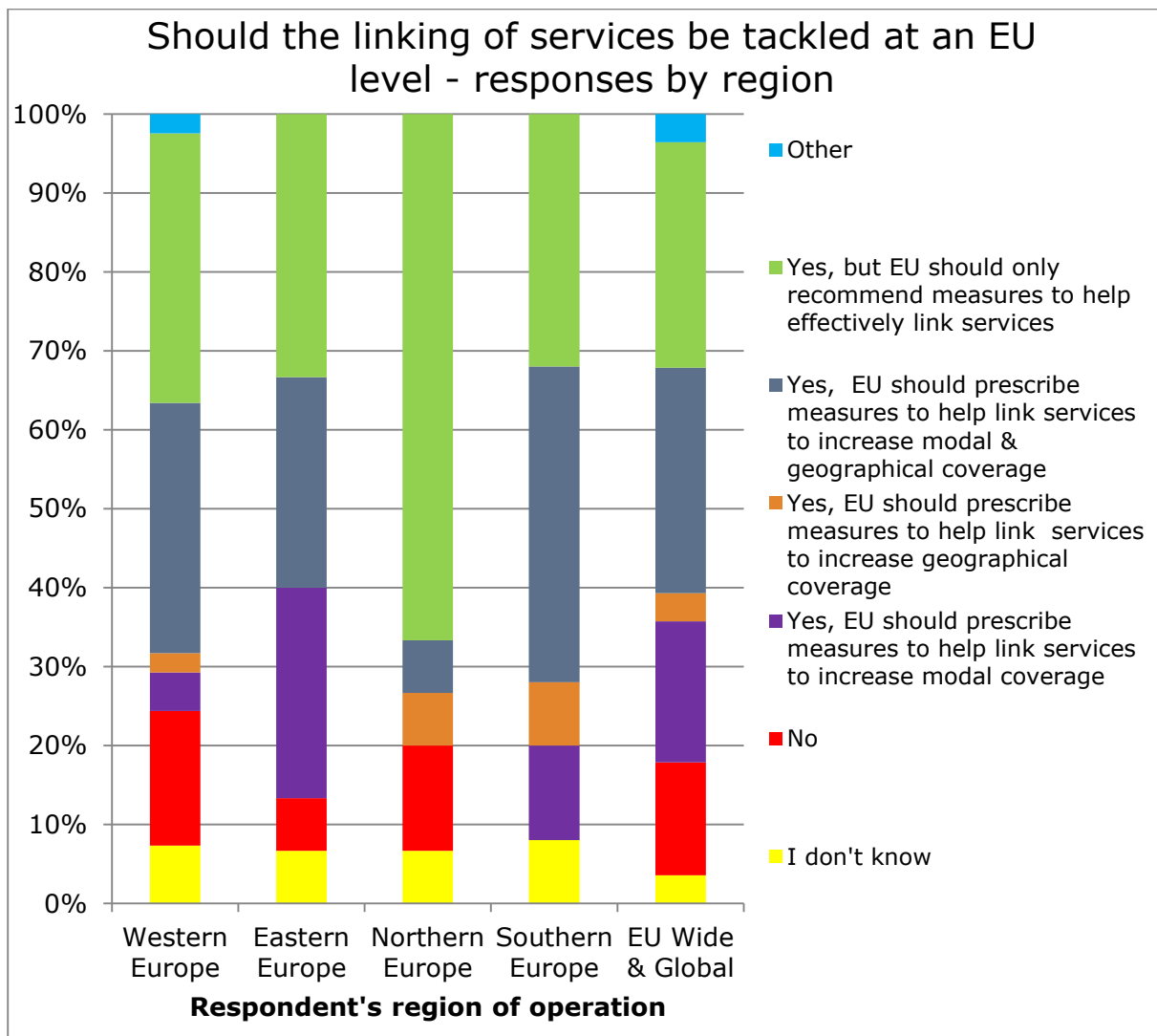
The responses to this question are presented both in categorisation by geographic region (Figure 55) and by stakeholder role in the travel information chain (Figure 56).

There is a variance in response across the EU, with no dissenting voices against action from Southern Europe but a split view on whether action should be recommended or mandated – weighted towards the latter with a focus on improving geographic coverage. This is interesting as Southern Europe is one of the two main regions where the provision of systems is low beyond the major cities – this has perhaps resulted in a situation where stakeholders seek mandation in order to make a more significant step forward.

Northern Europe has a much stronger preference (over 65%) for recommended measures with less than 15% seeking a mandated approach. This is likely to be due to the significant participation level within linked service already in place through EU-Spirit.

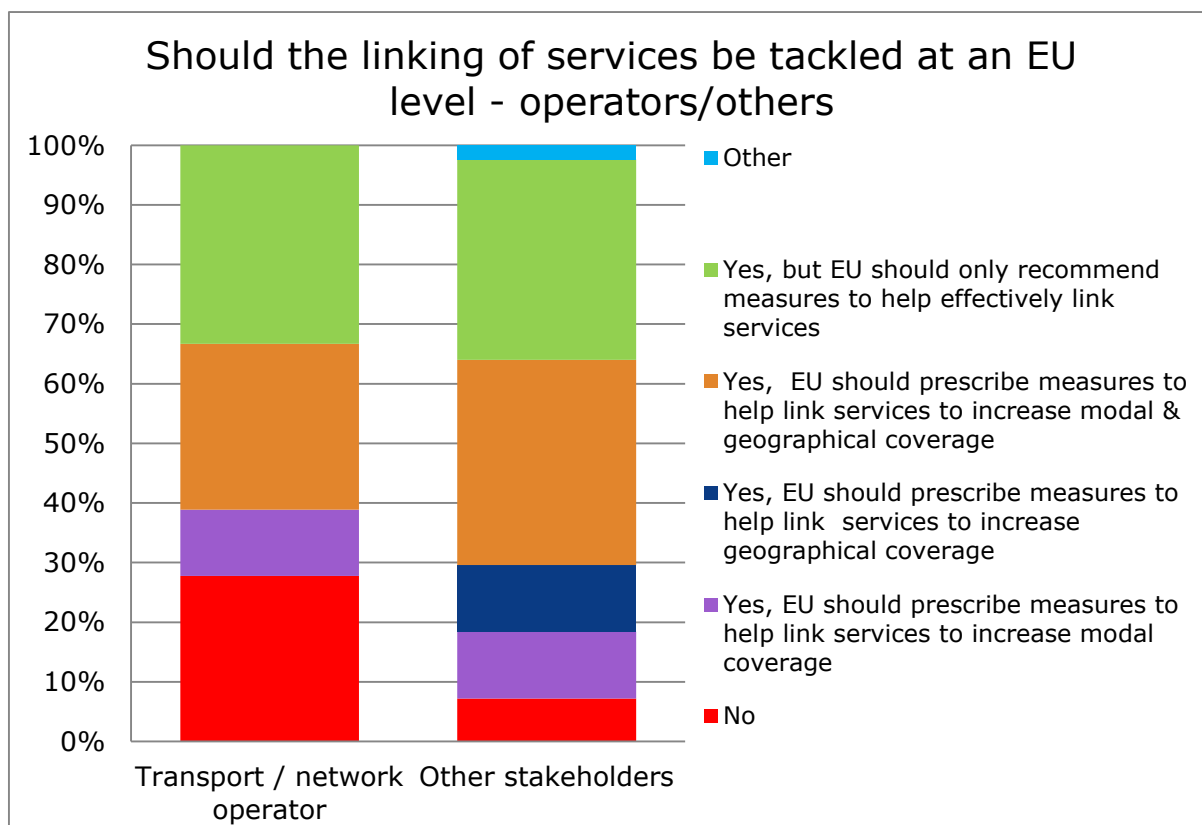
Eastern Europe has a much higher share interested in focussing solely on modal share. This would probably reflect that many of the existing systems in place within that region (identified in D1) are monomodal.

Figure 55 Views on whether the linking of travel information services needs to be tackled at an EU level – by organisations’ region of operation



Looking at the split between stakeholder responses, we specifically separate out the network and transport operator views to compare them with others in the information chain. From this we can see that there is a significant minority (over a quarter) of the former who seek no intervention from the EU. Amongst the other views expressed it is clear that there is much more interest in linking services to provide multimodal information rather than for expanding geographic coverage. This is interesting and perhaps reflects on many operators being at greater ease with the idea of being integrated into a wider transport network with other modes than appearing within an information service that may include more of their same-mode competitors. It may also reflect that the significant number of rail respondents within the operator segment are comfortable that the inter-mode geographic provision is at a sufficient standard and that the challenge is on how to link in with other modes.

Figure 56 Views on whether the linking of travel information services needs to be tackled at an EU level – by stakeholder type



Several of the respondents supportive of prescribing measures felt that without guidance from the Commission, transport authorities and/or operators will be highly reluctant to provide APIs for linking services.

Of those respondents who answered 'No' on whether the linking of services should be tackled at an EU level the concerns can be summarised as:

- Concerns that a linked region-specific services approach would result in organisations having a controlling monopoly on the scope of information provision in their regions, if the source data is not also open and available.
- The rapid pace of technology development makes it hard for legislation to keep pace in a meaningful way.
- Financial costs concerned could be substantial and not deliver sufficient economic benefits to justify the expenditure.
- The view that this topic should be left to market players and standardisation bodies without legislative intervention.

Approaches suggested by respondents for the implementation of policy measures to link travel information services included:

- Encouraging operators to conclude their own collective arrangements in the first instance, backed by a 'safety net' reserve power to mandate this if operators do not deliver.
- Focus initially on single transport modes and delivering those at a pan-European level and then move onto multi-modal information systems afterwards.
- Set recommendations that provide local decision makers with flexibility in how they meet them.

- Prescribe approaches to linking services but not mandate that services have to adopt and join. This will attract those that see this as a lucrative and worthwhile market but allow those that see regional or national provision as a priority to maintain their existing service offerings.
- Address the linking of travel information systems should be a future step after improvements have been made in the availability of data and the impact of that can be judged.

In summary a large majority of respondents are in favour of some form of intervention however the level of support for mandating measures is probably not sufficient across Member States and stakeholder types.

1.3.1.5 Quality levels

Responding to the concerns which travel information service users have about the quality (of information and the source data) as explored in Section I.2.1.4, this subsection explores the stakeholder views on the scale of this issue and the potential for EC intervention.

Respondents were initially asked if they felt that the current quality of multimodal travel information services in the EU was sufficient. 69% stated No, with just 14% stating 'Yes' and 17% answering 'don't know'.

Those who answered 'Yes' were primarily rail operators and highways/motorway operators. From supporting comments it appears that both sectors are responding with a monomodal view that they are comfortable with the quality of information for their modes.

The majority of respondents provided further information in support of their view on quality. These are summarised here:

User experience

- Building user trust – no way for users to have knowledge on which information services are good quality – apart from 'app' store ratings
- Seamless planning and booking not possible in most cases.
- Need to ensure services meet the requirements of blind, low vision and print impaired citizens, including seniors who cannot cope with advanced technology.
- Lack of consistent multi-lingual support in systems (including those which claim to be).
- Market Darwinism: A multitude of competitors offering high quality services, will have the effect of pushing all services towards excellence. Poor quality services will disappear when users abandon them for better alternatives.

Geographic and modal specific concerns

- There are significant gaps in data coverage in a number of countries. Smaller areas and regions with fewer resources may be less well served with information.
- Intermodal information is difficult to acquire.
- Poor quality of cross-border travel information in Europe. *"It is impossible to plan door-to-door multimodal travels between EU countries"*. One respondent also drew attention to the importance of transport links with non-EU countries to many citizens (e.g. Switzerland, Serbia etc.).
- Poor quality of rural data and information.

- Significant lack of data on walking & cycling routes.

Presenting a true picture

- Timetables are often not up-to-date.
- Real time incident information is missing.
- Variances in result based on underlying architecture approach.
- Many multimodal travel planners only show the selective content that transport operators have provided them with.

Quality improvement cycle

- Could be better but is it sufficient already in many places?
- This quality is currently sufficient, but can of course always be improved.
- Data and information is continually improving.
- This is a highly complex area of software development and it will never be perfect. The goal should be to continuously improve the quality of the data.

Data management/aggregation issues

- Challenges of integrating data of varying degrees of quality.
- Lack of detail in data (e.g. how does the traveller interchange between two services in a result).

Views were then sought on whether multimodal travel information should be consistent across the EU or if variation in information quality was a reasonable feature of the transport landscape. 67% answered 'Yes', it should be consistent. 24% stated 'No' with 9% answering 'Don't know'. These answers are very close to the earlier question 'is it sufficient' as would be expected with a small number of respondents of the view that it isn't currently sufficient but it needn't be consistent across the EU either.

Stakeholders were then further asked if the EC should intervene to prescribe or recommend measures to improve the quality of data and information (results by region - Figure 57; and by stakeholder type - Figure 58).

There is broad support for the EU to recommend measures to improve quality, however that support varies across regions. The Western region and those organisations who identified themselves as EU-wide or Global each included a significant minority (approx. 17% for the former and 14% for the latter) who expressed the view that no action should be taken. This is explicable from the high number of operators present within the Western region and the higher level of quality present in many services (likely to be due to the longevity of existence and maturity of national data standards).

The Southern region was much more in favour of a prescribed approach, again perhaps reflecting a desire for firmer action to move forward the sector more substantially than is needed in most other regions.

Within the stakeholder split, the biggest difference is with the network and transport operators where a quarter are against any intervention compared to just 6% of the other information chain stakeholders.

Figure 57 Views on whether the improvement of quality levels of multimodal travel information services should be tackled at an EU level - comparison of responses by region

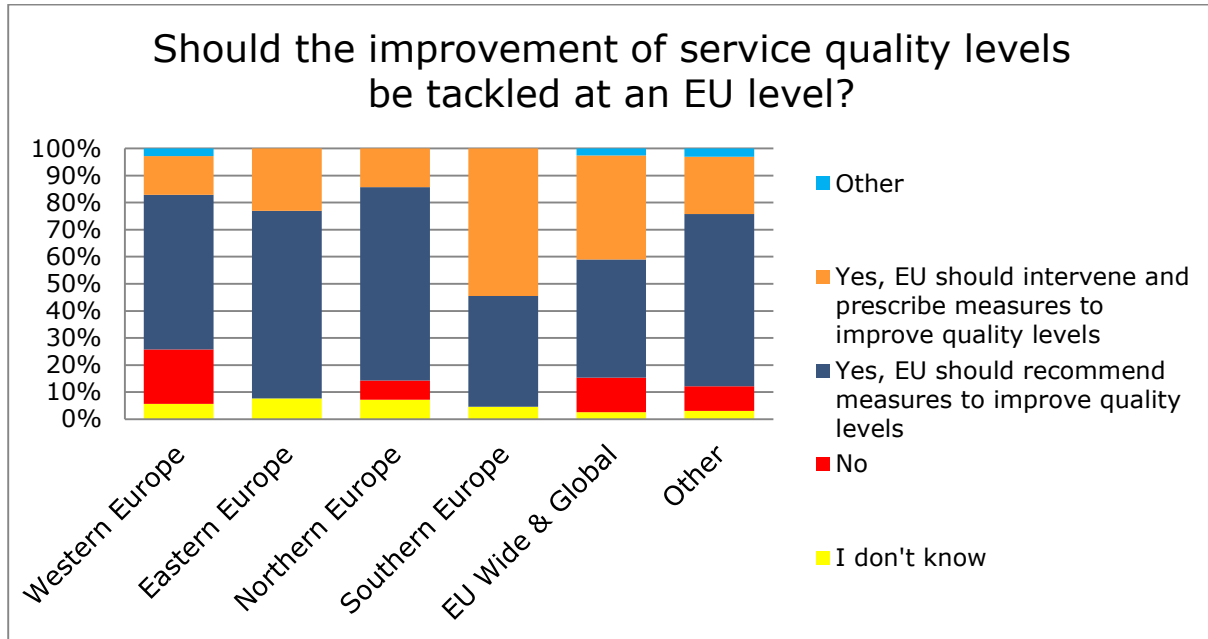
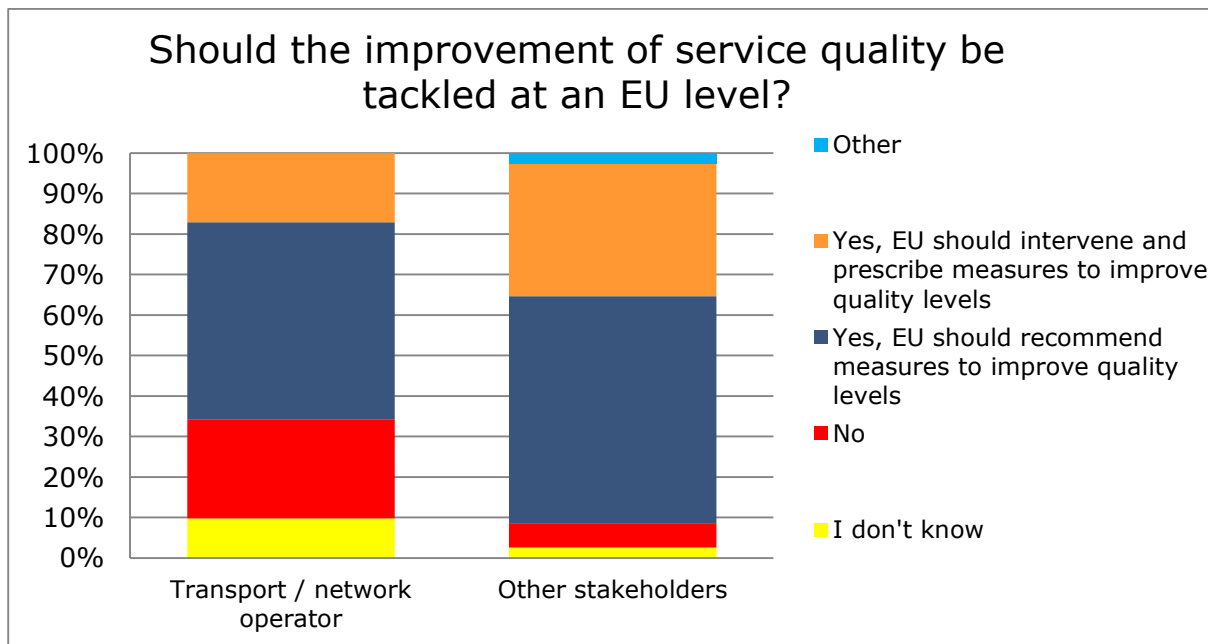


Figure 58 Views on whether the improvement of quality levels of multimodal travel information services should be tackled at an EU level - comparison of operator and non-operator responses



Respondents were asked to provide further comments to support their responses and advise on their preferred approaches for any EU intervention. These can be summarised as:

- Clear feedback mechanisms:
 - Ensuring clear ultimate ownership defined for each element of data with mandated feedback loops to ensure data is corrected at source (and within a fixed time).

- Enablement of operator led quality improvement activities to correct data at source.
- Guidelines:
 - Establish minimum acceptable and recommended standards for data quality.
 - Provision of common quality assessment guidelines.
- Labelling:
 - Recognition of good quality services (e.g. labelling or inclusion within a registry).
 - Labelling on the quality of data so users can judge its reliability - i.e. definition of a common European traffic and travel data classification system.
- Funding for improved data management:
 - Provision of funds to support data quality improvement actions.
 - Mandate and/or fund data management work to complete gaps in the European network.
 - Funding of open-source data quality checking tools.
- Exchange of best practice.
- Data formats and access:
 - Open all transport data to prevent any selective choice by operators on what they choose to release.
 - Improve uptake of data standards that inherently raise the overall quality of data.
 - Implementation of common metadata to aid data discovery and understanding.

However, a few words of caution were also raised within these responses:

- A preference for allowing market actors to define the terms and conditions for use and re-use of their data according to their needs and preferences. Consumer demand will then help regulate the quality of the services in market-driven manner. A top-down quality approach mandating quality levels may not add value in this context
- Flexibility in the specification policies to reflect size of local populations and transport networks
- Ensure distinction between requirements on public and private sector data owners and travel information service providers.

1.3.1.6 Terms and conditions of data re-use

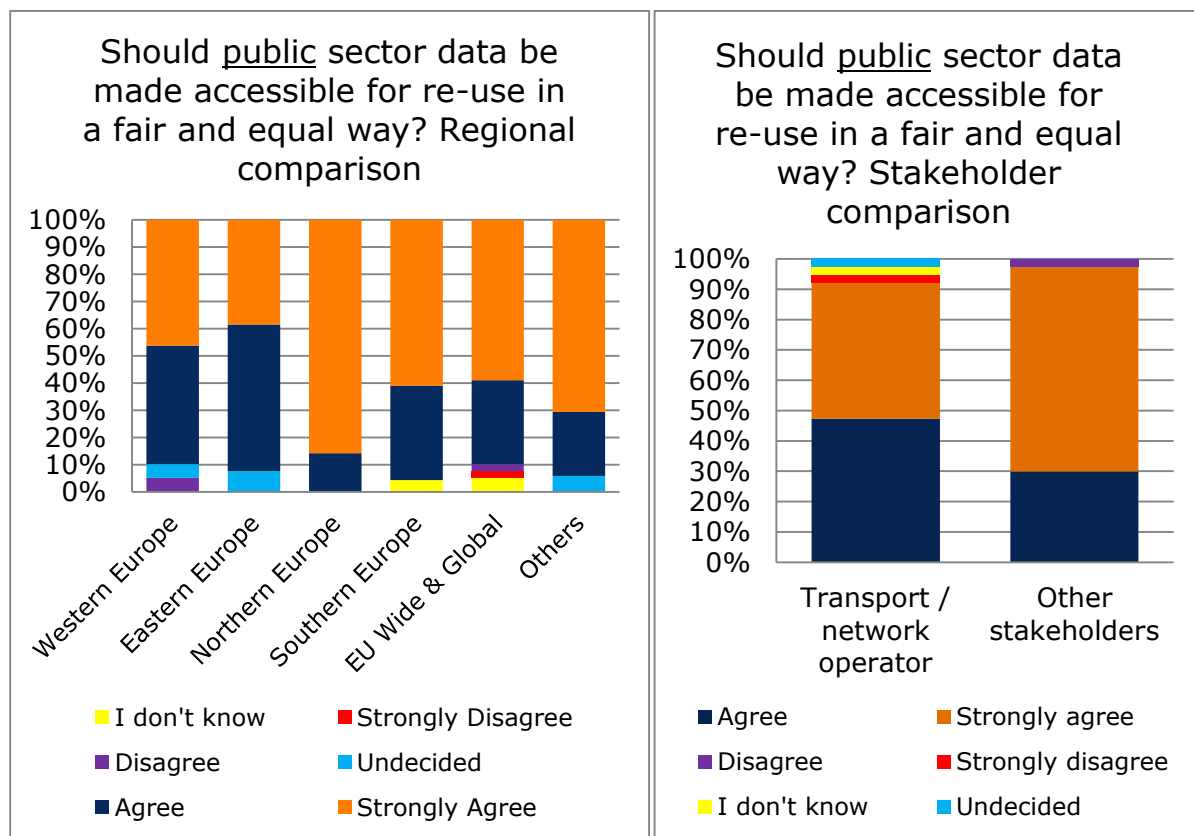
The final set of barriers explored with stakeholders was with the legal terms and conditions of data re-use by third parties. This is an area where differentiation between public and private sources of data needed particular investigation to identify any variances in view that may need to be considered within the policy specifications.

Figure 59 details the responses from participants to the question of whether public sector traffic and travel data should be made accessible to third parties for re-use in a fair and equal way. 92% of responses gave positive responses to this question.

The responses very much reflect the current status of data availability and particularly the 'data access' agenda in different parts of Europe. For example, the views from Northern Europe where most Member States have a significantly mature data availability agenda over 85% of respondents 'Strongly Agree'. In Eastern Europe however the same agenda is very much in its infancy, as a result the views from that region, whilst still positive, are less enthusiastic with 'Agree' being the majority response.

Only a small proportion of total respondents stated that they 'Disagreed' or 'Strongly Disagreed' (3%). These organisations are a French rail operator; a German city, a Central European travel information service provider; and the German operation of a multinational systems and consultancy company.

Figure 59 Views on whether data across different modes of transport from the public sector should be made available for re-use to service providers in a fair and equal way (including possible financial compensation) – comparison by region and between operators and non-operators



Transport operators had a high level of agreement with the statement, though, like the Eastern European responses, this was not as strongly felt as by the other stakeholders – however it was still very positive compared to similar questions on other themes. This is likely to be because operators seek this as an opportunity to ensure good and common legal protection for their data, and with helping to get data from other modes to extend their own systems – a benefit to them rather than a cost which seems to be how the other areas explored were often perceived.

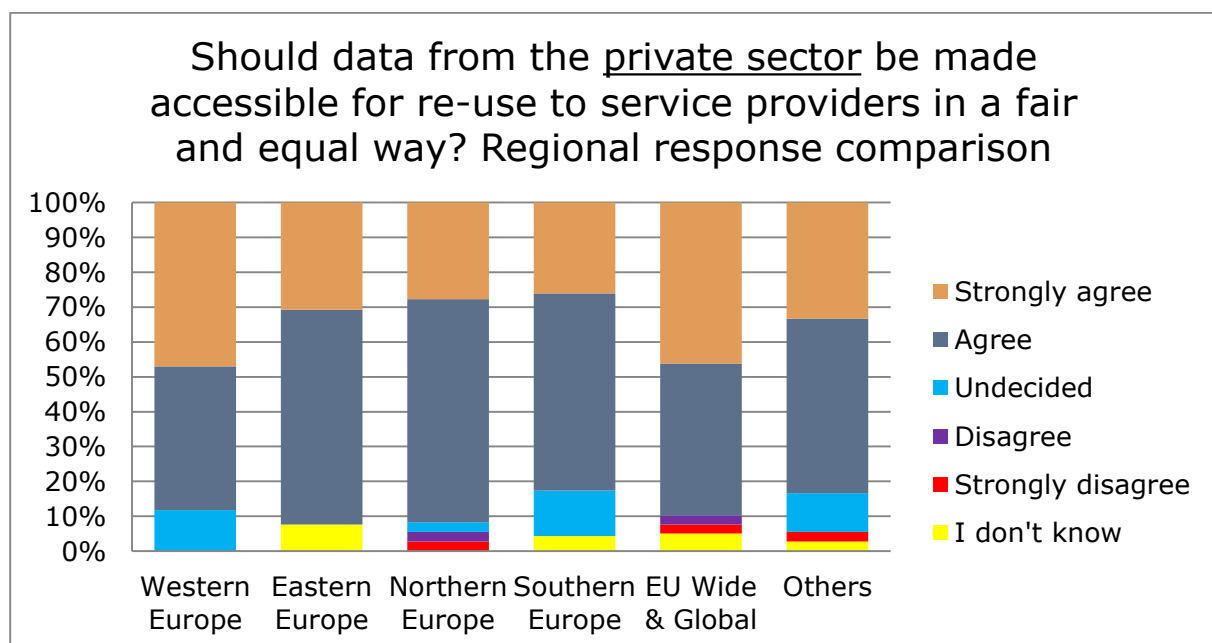
On 'fair and equal access to data', Floristean et al (2014) highlighted in their findings into the access and availability of multimodal travel information that there are concerns from MMTIPS providers that some transport operators and authorities are selecting which private sector information providers they share data with, thereby putting others at a competitive disadvantage. There may be reasonable justifications for this, such as concerns over misuse, but the view is reinforced in the consultation responses and supporting submissions from some transport operators (and associations) who are keen to be able to select different commercial terms for different data users.

The same question was asked but this time focusing on data from the private sector. Figure 60 shows the results as a regional comparison.

Interestingly there is very little deviation from the question on public sector data in terms of the overall positivity. One small shift is that there is closer alignment between responses from stakeholder types so this is not included as a graph for brevity. The number of negative responses has increased from 4 to 5. Some of the respondents have also changed their perspective here with another large multinational technology company objecting – this is likely to be over concerns regarding their own intellectual property.

The most substantial shift are the views switching from Strongly Agree for public data to Agree for private data. This is most visible in the responses from Northern Europe where the strength of feeling has shifted from 44% Agree / 46% Strongly Agree (public) to 64% Agree / 28% Strongly Agree (Private). This is likely to be a reduction in confidence that what has proven to work well for the public sector would also be reasonable for the private sector.

Figure 60 Views on whether data across different modes of transport from the private sector should be made available for re-use to service providers in a fair and equal way (including possible financial compensation) – comparison of regional responses



Floristean et al (2014) research with stakeholders in the travel information chain identified that whilst most were satisfied that current arrangements were “fair and non-discriminatory” the view of MMTIPS providers as downstream data users was less positive. The research also identified that there were varying interpretations of the two terms which part-explained the difference in views between stakeholders – therefore a clear common definition of these terms is important.

The next subtopic explored was whether or not there should be any transfer of ownership of data as third parties amend and add value to data they have been provided with from others. Figure 61 and Figure 62 shows the responses to the specific statement “the re-use of travel and traffic data should not include any transfer of ownership of data”.

The responses are much more divisive to this question, there is a large majority of support for this from Western and Northern European respondents. This reflects that this is broadly the approach already being taken and is also a condition which transport operators seem to be much more comfortable with as it protects their intellectual property rights (only 6% disagree with the statement). However a quarter of

respondents in Eastern and Southern Europe, a significant minority disagree with this approach, instead preferring to keep some flexibility regarding changes in data ownership. The reasons for this are not fully clear, and do not appear within the supporting comments to this section provided by respondents. It may be that there is a different commercial perspective regarding the promotion of innovation by rewarding innovators who add value to data with commercial benefits for that investment.

In total it is 10% of respondents who responded negatively to this statement. Operators were more likely to respond positively than technology companies. However there is a very high level of support amongst all groups for this exclusion.

Figure 61 Views on whether the re-use of travel and traffic data should exclude any transfer of data ownership – regional responses compared

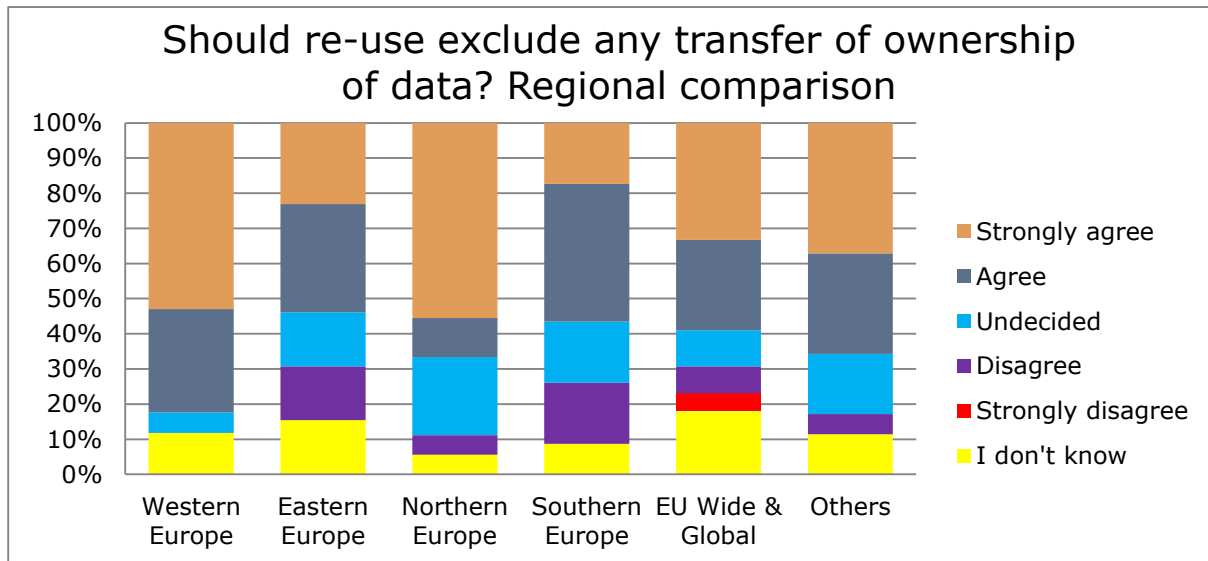
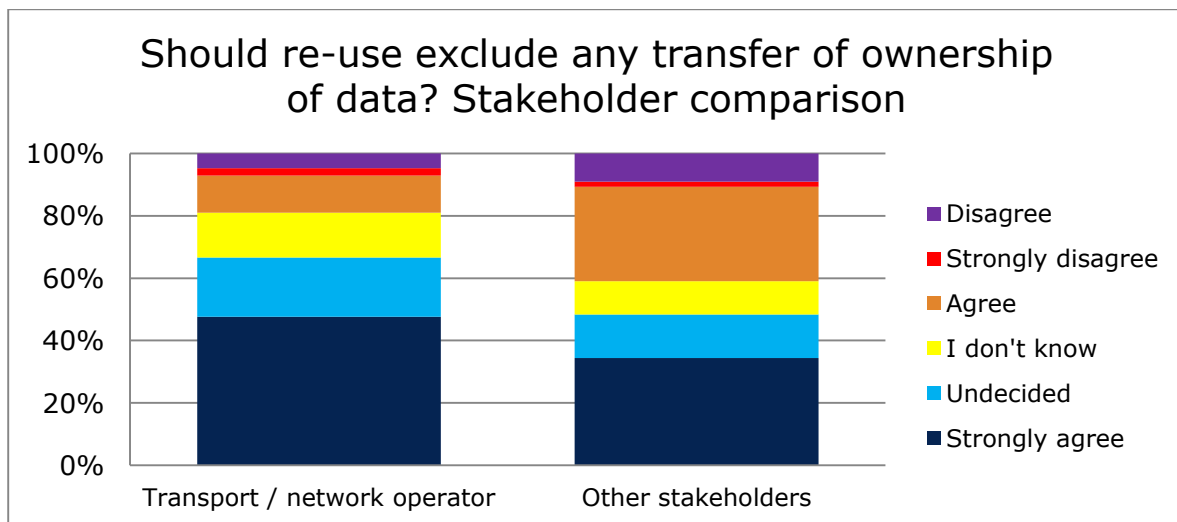


Figure 62 Views on whether the re-use of travel and traffic data should exclude any transfer of data ownership – operator and non-operator responses compared

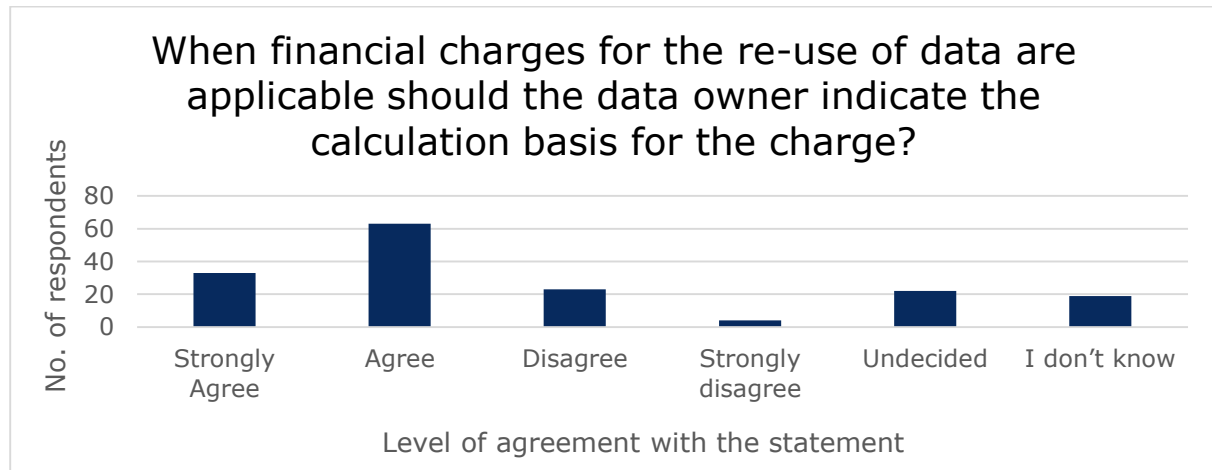


A repeatedly stated concern by many data provider stakeholders was that they should not incur charges for providing data which benefit others without some form of recompense. The next question explored how this could be done in a fair and transparent way with all consultation respondents

The results in Figure 63 indicate that a large majority of respondents agree with the principle of a transparent calculation cost (basis and factors) for any charges associated with data.

The minority of respondents (16%) who disagreed (or strongly disagreed) with this view were rail operators and motorway/highway network operators. The direct evidence provided in the responses doesn't provide a supporting explanation for this view but it is likely to relate to commercial sensitivities relating to the costs associated with the calculations.

Figure 63 Views on when the data owner should indicate the calculation basis for the applicable published charges and indicate which factors were taken into account in the calculation of the charge



More information is available in some of the supporting evidence submitted however. The rail industry association (amongst other data owners) highlights that "*data generation and processing have a very tangible cost*". The view expressed by these respondents is that the financial burden should be placed (or at least shared) with data users (in particular private sector data users) and operators should retain the right to charge them to cover the cost of data sharing. CER also seeks the non-exclusive right for its members to retain the right to adapt their data charging policies to fit their specific constraints, or to offer incentives to newcomers or smaller players in the field of information provision (CER, 2015). This would need to be carefully handled as it might also allow data owners to pick or exclude certain companies from using their data (which could be an anti-competition activity).

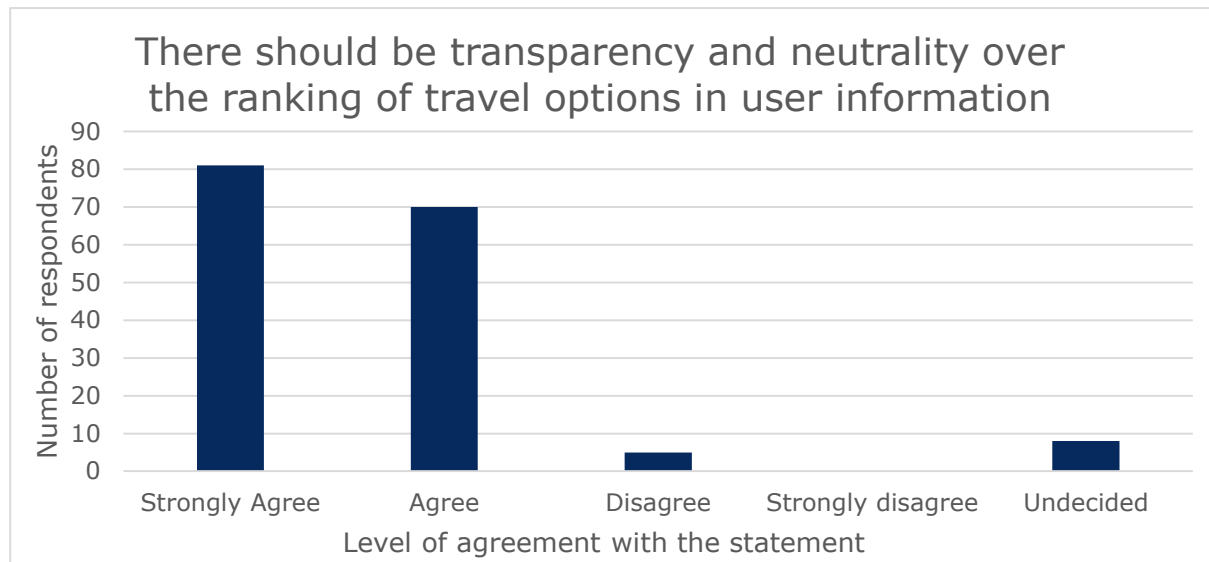
The previous EC commissioned study on access and availability of data (Floristean et al, 2014) highlighted a range of existing pricing schemes for data being used, including 'freemium' models, packaged or volume charging and also commission charging. The results in Figure 63 however, suggest that the majority of stakeholders are now in favour of a transparently calculated cross charge.

A stated concern from some data providers regarding providing greater access to their data to third parties is that the data may be misused or may be unfairly represented as an option to travellers, e.g. a rail operator provides data but despite providing a fast and cheap solution it appears in the results ranked lower than some of their competitors. To provide greater confidence to data owners it would be possible to require data users to be neutral in the way that information is presented and transparent regarding the approach taken to ranking options (e.g. sorted by timeliest journey with a clear definition of what that means).

There were only five objections to this point, two of which were from the Swedish traffic and highways sector, a German ITS Cluster, a German regional government and a UK-based international travel information systems provider. A reasonable objection that might be used draws on the views shared within D2.2 which explored the use of MMTIPS and operational tools for managing flows of travellers around the network. If all presentation of journey options needed to be neutral that might limit the ability to promote subtle behaviour change to more sustainable or less congested routes –

especially if those options were not quicker but would provide a greater network resilience and a wider social benefit. Such approaches could be explained within the criteria used to rank travel options but might still be challenged by a transport operator as not being neutral.

Figure 64 Views on whether there should be transparency in the criteria used to rank travel options and neutrality in the way information is provided to the user



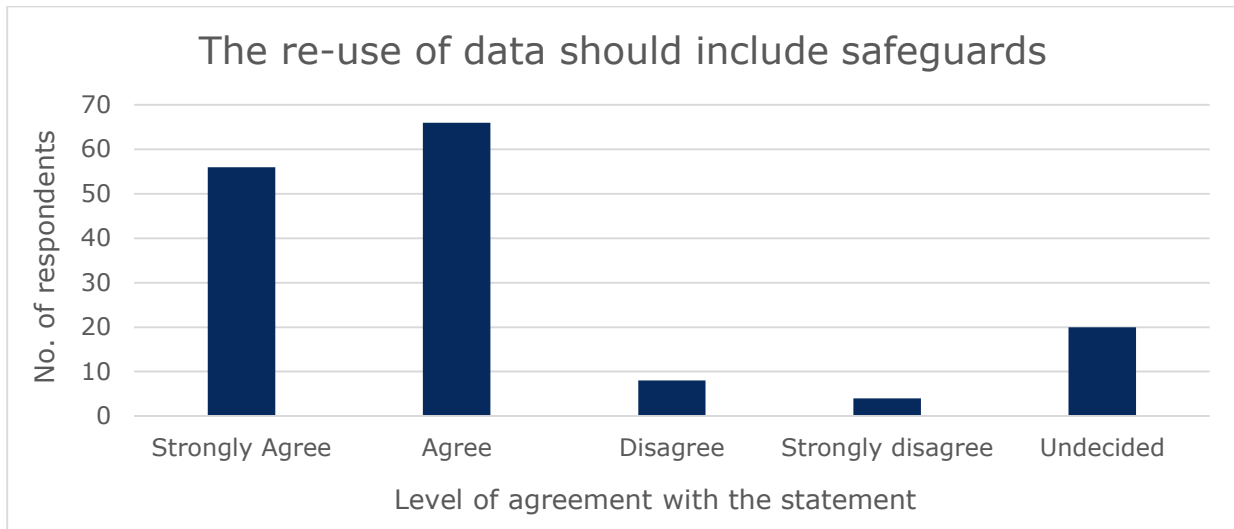
Supporting position papers provided by stakeholders were very supportive of the view that neutrality was essential: The rail industry view is that *"a strong emphasis should be placed on guaranteeing a neutral and accurate display of the information by third parties. Strict framework conditions should be in place to guarantee the quality of the data displayed. Who is responsible for the display of information and where a complaint can be made in case of erroneous displays"* (CER, 2014). This was also supported in the French government response: *"Platforms (e.g. third party data users) must especially make clear the existence or not of a contractual relationship...re-use should not mislead third parties with regard to the information content and the date of update"* (NAF 15-185).

To further consider ways to address data owner concerns regarding their rights if a third party misuses their data in some way, we explored the views of stakeholders on whether safeguards should be in place for the reputation of the data owner.

Figure 65 shows the high level of support for the inclusion of safeguards, although the level of support is less than for the previous question on neutrality of information.

There were twelve objections, of which seven were from local or national administrations. Nearly all of these specific administrations are known to have an data access strategy for transport. An important principle of data access is for authorities to relax terms and conditions on data re-use, therefore it may be that the imposition of safeguards is felt to have the potential for restricting innovation in the uses of that data.

Figure 65 Views on whether the re-use of travel and traffic data should include safeguards for the reputation of the data owner



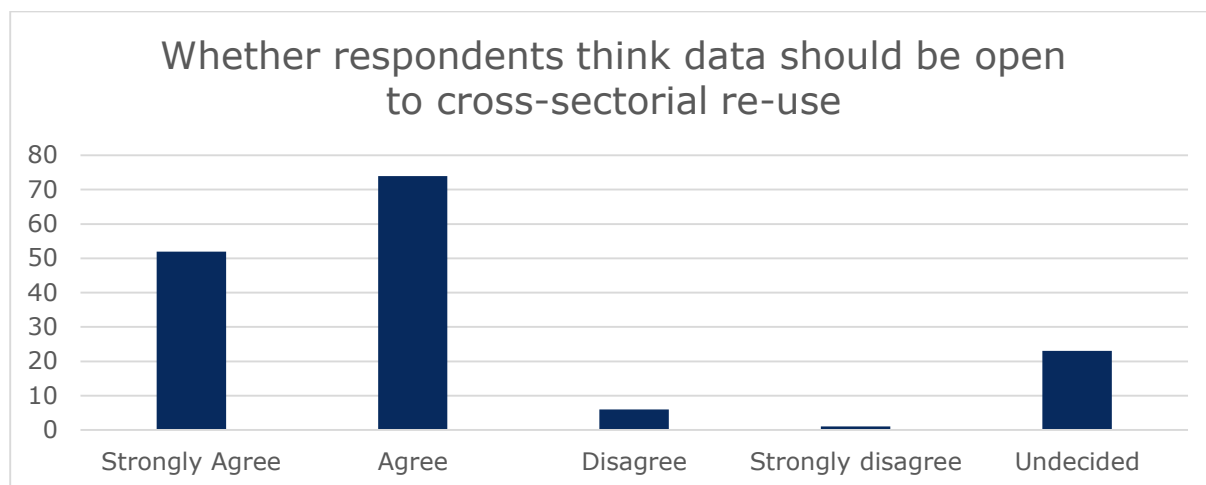
Again, the rail sector has a clearly defined view that *"data users should have an obligation to remedy the issue in a prompt manner, and failure to do so should result in a suspension of the access rights. Data owners should also retain the right to conduct quality audits and to terminate a given collaboration in case of data mismanagement"* (CER, 2015).

Regarding the overall objective of improving the availability of multimodal information systems it was important to identify if there was any specific resistance or objections to the sharing of data on a cross-sector basis. This may equally relate to concerns with sharing data with technology companies who may be perceived as not having sufficient knowledge to interpret and understand operationally derived data. Further levels of innovation in systems using transport data may take place by third party users in an alternative sector such as health or education which again may be objected to by some actors.

However the results in Figure 66 show a high level of support for data to also be open on a cross-sector basis. Only seven respondents had a negative view and whilst these are cross sector, they tend to focus on downstream users rather than operators – e.g. service providers, data users etc. Interestingly four of the dissenters are German organisations. It is not clear why that might be the case though perhaps the term 'cross-sector' has a particularly nuanced use in Germany – it may be a particular preference to focus innovation within a sector and concerns about eliminating market barriers than may introduce new market players from other sectors. It may also be a coincidence that most responses came from one Member State.

The low levels of objections indicates that this is not a viewpoint which the Commission needs to be concerned about (the majority of objections are also rated at the lower grade of Disagree rather than Strongly Disagree).

Figure 66 Views on whether the re-use of travel and traffic data should also be open to cross-sectorial use



Respondents were asked if the establishment of terms and conditions for the re-use of traffic and travel data should be tackled at an EU level. The options provided to the respondents varied between the online and the offline consultation surveys so both sets of result are provided here (Figure 66 and Figure 67 respectively).

In the first form of the question, there was a very high level of support from Eastern Europe (85%) with no dissenters, close to this is the level of support from Southern Europe – both a further indication that these regions see this as a high priority for action to help close the gap in multimodal information provision. The more mature markets of Western and Northern (Scandinavian) Europe, along with EU-wide and global organisations were still broadly supportive but at a lower level (with approximately two-thirds in support). Non-EU based organisations were less supportive of EU intervention, but this feels likely to be as a concern of being disadvantaged in comparison to those organisations within the EU.

In the second form of the question which close to a third of total respondents used, there was a strong preference for measures which recommended approaches rather than prescription. The overall level of support was higher from these respondents.

Figure 67 Views on whether the establishment of terms and conditions for the re-use of data should be tackled at an EU level - online responses (116) categorised by region of response

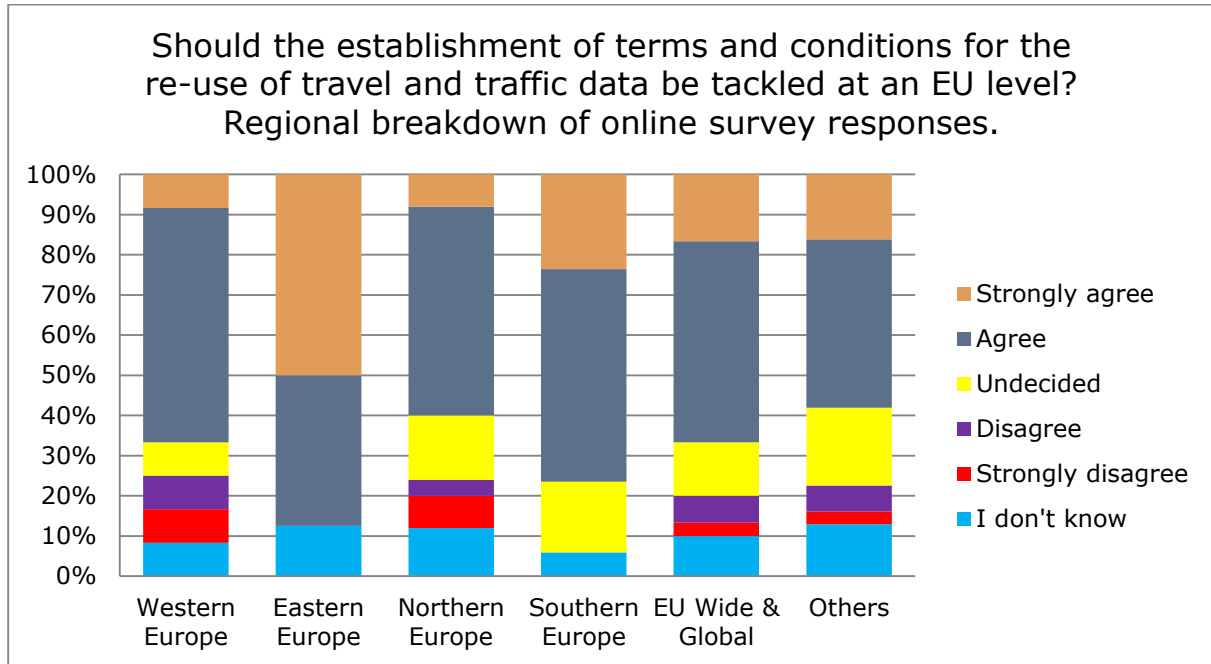
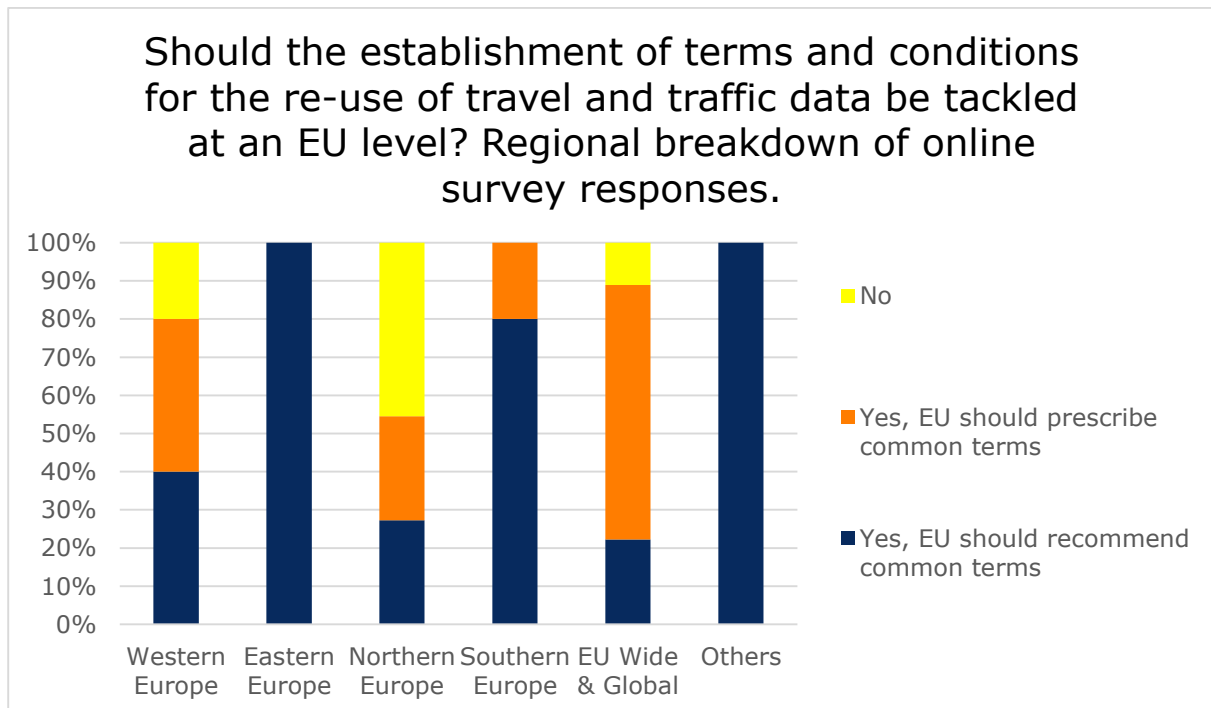


Figure 68 Views on whether the establishment of terms and conditions for the re-use of data should be tackled at an EU level - offline responses (49) categorised by region of response



The dissenting views to the two versions of this question were predominantly from the rail sector in Western and Northern Europe. As has been seen in the CER position paper this is due to the rail industry keen to be able to be more selective in whom uses and how it is used by third parties. There were only three other organisations who shared this view who were not from that mode – two German cities and one national technology association (UK), both of these are mature markets for travel information and data who

have handled such issues on a local basis thereby are less likely to perceive the need for action.

1.3.2 Need for European Union intervention

There is a high level of support for EU intervention across stakeholders to improve the uptake and coverage of MMTIPS, particularly for cross-border journey information. However this support varies depending on the particular barriers involved.

BEUC (2014) states that from a consumer perspective, *"European legislation should be developed to ensure that travel planning information, produced by transport operators, must be made accessible in a standardised way"*.

The one group with consistent reservations within the consultation has been transport operators and more specifically the rail operators – the one area where they were more supportive was for improved terms and conditions for data re-use (for terms which empower the data owner) where it is likely they see more of a direct commercial benefit.

The paper put forward by the House of Representatives of the States General (Netherlands) raised a concern echoed by others in the both the workshop and the public consultation responses. This is the risk of over regulation through setting mandatory requirements which might *"constitute an obstacle to multimodal interoperable travel information. After all, developments in this area – primarily market-driven – are moving fast"*.

The official French response expressed a desire for the delegated regulation to specify common standards for data formats, exchange protocols and the main rules for access to data and the connection information (NAF 15-185, 2015).

In summary these views reflect a desired for a formal European position on preferred approaches (i.e. recommendations) but with some concerns over negative impacts on innovation and costs which might arise from mandated provisions.

Table 29 below provides a summary of the percentage positive and negative perspectives views, sorted with preference by actors for EC action.

Table 29 Summary of views on whether the European Commission should intervene

Theme	% support for intervention	Positive for intervention	% Against intervention	Preferred approach to intervention
Quality improvement	82%		10%	Recommend measures to improve quality levels.
Linking of services	79%		12%	Recommend approaches to linking travel information services.
Data scope and exchange	70%		4%	Small majority for mandating standards to public bodies and recommending standards to private sector. Therefore would be preferable to recommend to both (greater support).
Terms and conditions of data re-use	70%		10%	Recommend common terms and conditions.
Data access	50%		24%	Mandate Access Points.

This prioritisation by stakeholders is interesting. Quality improvement is put as the highest collective priority yet many of the approaches to achieving this involve implementing the measures within the other categories. It is quite likely that stakeholders such as transport operators which are more resistant to harder measures feel comfortable with softer measures and objectives as it provides more scope for local interpretation and investment decisions – it might also be seen as a problem which happens elsewhere not with their own data therefore it becomes a little or no cost measure to them. It might be reasonable to assume that a number of respondents also saw this as an area which may come with additional funding from public administrations.

The linking of travel information services is also broadly supported. This is likely because it only affects a smaller proportion of respondents and a significant proportion of them have already undertaken some works in this area. The formal recommendation of a common European approach would be broadly welcomed by many who are otherwise concerned about investing in the 'wrong' approach.

The recommendation of common European data standards is ranked lower on positive preferences but actually had the least number of objections of any of the themes. The higher number of 'don't knows' is reflective on the status of this as a more technical topic beyond the interests of respondents with more of a commercial or monomodal perspective.

Terms and conditions for data re-use are also well supported. An interesting aspect of this one is the strong support from transport operators and the variation in the different stakeholders who had objections to specific points. There is an underlying concern from a minority of respondents that any proposed common terms and conditions should not inhibit the potential commercial benefits of innovation.

Support for improving data access was much smaller with only half of respondents positive on action in this area. It should be noted that this was an area where actors could not select between 'recommend' or 'prescribe' as alternate options so may have voted against rather than for the mandating option. However it is also likely that public administrations were dissuaded from this option by concerns over additional costs which would need to be borne to establish and maintain Access Points.

Stakeholders were also asked to identify (multiple choice) their preferred forms of EU intervention: (i) Legislation; (ii) Exchange of best practice; (iii) Funding; and (iv) Promotion of sector cooperation.

The results of these are shown in the two graphs below - Figure 69 (geographic regional response comparison) and Figure 70 (Transport and Network operators compared to all others).

The sharing of best practice (71%) was the preferred form of intervention with legislation least preferred (55%). Funding received (66%) support and the promotion of sector collaboration (58%). Operators had a slightly stronger preference than other stakeholders for funding. Respondents within EU Member States also had a slightly higher preference for funding, whereas non-EU organisations (or uncategorised ones) preferred the exchange of best practice.

Figure 69 Preferred form of EU intervention by geographic region

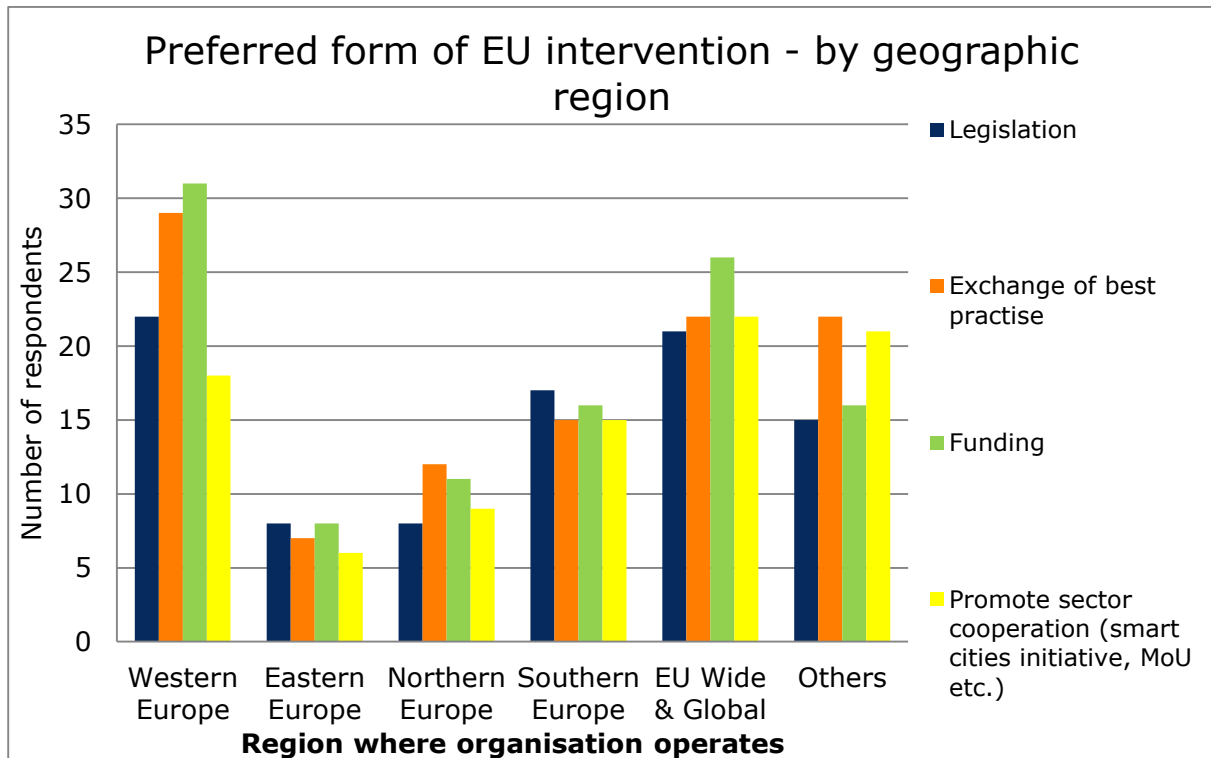


Figure 70 Views on the preferred form of EU intervention – operator responses compared with non-operators

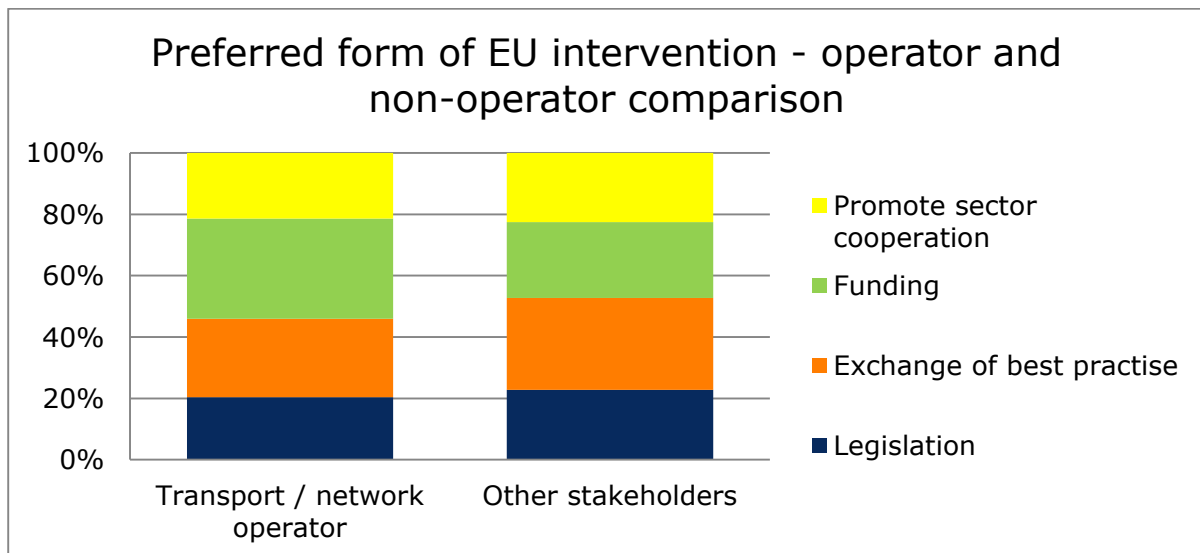


Table 30 summarises the views from stakeholders as to what specific measures might be considered by the EC under each of those categories as well as the percentage of respondents who preferred particular forms of action.

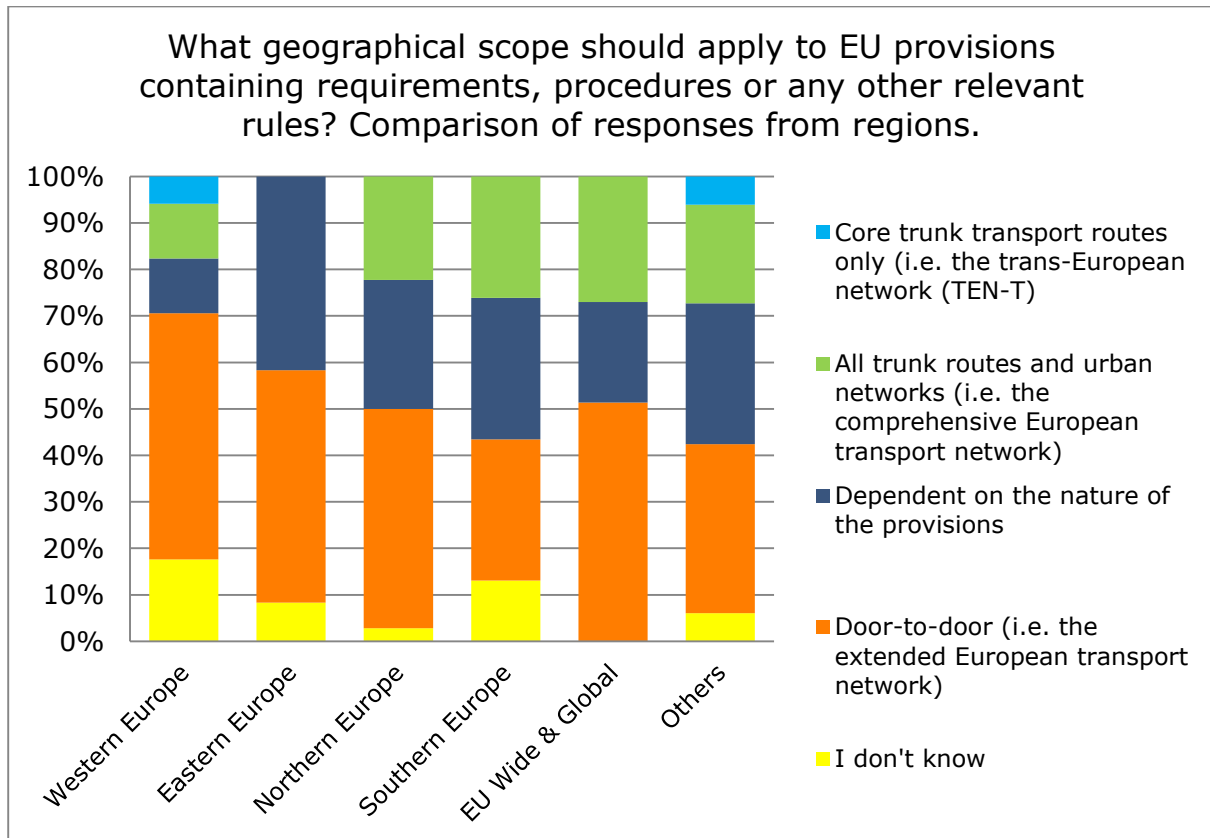
Table 30 Summary of respondent views on best forms of EU intervention

Intervention category	In favour	Intervention approaches and commentary
General	N/A	<ul style="list-style-type: none"> Phased interventions, initially sharing of best practice supported by funding and promotion of cooperation before legislation is introduced at a later date to address any remaining issues. The approach may depend on the mode. For example, PT funding isn't necessary, but legislation could help to ensure compliance. For other modes, where there is no mature business case yet funding may be more important (e.g. cycling, emerging modes) The financial responsibility for introducing new terms and conditions should not rest solely on transport operators Preference for voluntary agreements - mandatory as the last resort. Development of an EU MMTIPS Research Roadmap to provide supporting evidence of demand, business models and set geographic priorities of focus (e.g. specific borders)
Legislation	55%	<ul style="list-style-type: none"> Legislation should have clear and simple wording and not attempt to define any specific technical standards. <i>In contrast:</i> Legislation should set common standardisation for data formats/interfaces and rules for minimum data quality level and ownership of data. Concerns with the ability of helpful legislation to keep pace with technological change. Focus on improving the availability of data access in common formats by authorities and operators. Given the maturity of the market and the closeness of this to commercial activity (i.e. ticket selling) legislation mandating actions may be difficult.
Exchange of best practice	71%	<ul style="list-style-type: none"> Exchange of best practices across Member States and modes (within EU and internationally). Establishing best practice guidance.
Funding	66%	<ul style="list-style-type: none"> Support actions which would include a best practice community; an open directory of data and APIs which include information about the current quality level (e.g. conformance to standards, or to a series of tests). Cooperative research actions which would include development of test suites; open source tools for checking quality (i.e. implementing the tests), viewing and converting data of various types; "plug fests" for improving interoperability between APIs (like the EU funded FOT-net cooperative ITS support action). Complete gaps in regional or national multimodal journey planners that will form the foundation for linking services. Support for new and existing standardisation activities and piloting of these. Training and support for users of standards.
Promote sector cooperation	58%	<ul style="list-style-type: none"> Mentoring the technology sector into the complexities of delivering accurate transport information and the transport sector in keeping things simple. Cooperative research actions (as above). Collaborative platforms and forums crossing modal and organisational types, particularly public and private sector. Involvement of local level actors as well as transnational organisations.

The final area for consideration within the Priority Action A policy specifications which views were sought on was on the geographic scope which measures, particularly mandatory ones, might apply to. Figure 71 shows that across each European region there is support for applying measures at the door-to-door level (40-50% of respondents depending on region) with a large minority supporting the less complex scope of the comprehensive European transport network (except in Western Europe where many systems are already 'door-to-door').

It would be reasonable from this to extrapolate that there is strong support for policy specifications to be set at the comprehensive European transport network level where trunk routes and urban networks are included (thereby supporting the majority of the population) with flexibility for Member States to extend provisions to the full door-to-door network.

Figure 71 Views on what the geographic scope should be for any EU action - regional comparison of responses



1.3.3 Overall perceptions

1.3.3.1 Perceptions by stakeholder group

There was, for the majority of topics explored, a strong consensus across different stakeholder groups. However, rail sector respondents were consistently against legislation mandating behaviour in this sphere, however they would welcome additional funding for research, knowledge transfer and collaborative actions to further the ITS Directive objectives for Priority Action A. They are keenest on common terms and conditions which provide protection to the data owner but are less keen on terms which empower the third party data user.

From a railway operator viewpoint, *"The Commission should continue supporting positive business and technological developments through EU funding for research and innovation, and act as an innovation enabler"*. (CER, 2015). Whilst this is appealing for an 'Influencer' role from the Commission rather than a regulatory one, the same position paper seeks that local bus operations across the EU are required by legislation to abide by the same rules as the rail sector as to the sharing of transport data and information. However, *"this obligation should be placed on **data owners**, rather than operators, since for services under PSO (Public Service Obligation), data owners are often the contracting authorities rather than the operator"*.

Conversely one of the notable themes amongst other stakeholders was wariness towards the rail sector with concerns that incomplete data was being made available and that

attitudes to data availability and information provision were more conservative than in other transport modes.³³

It was also noted that many of the rail operator/associations who responded had prepared joint responses as the same wording appeared in a number of their qualitative answers.

Two large multinational technology companies were amongst the small number of dissenting views on terms and conditions for data re-use. This appears likely to be over concerns relating to their own intellectual property in this field.

1.3.3.2 Perceptions across Member States

It is interesting to observe that the two travel information markets which are most mature – Western and Northern Europe, were more considered in their responses. Whilst broadly in favour of EU intervention, the enthusiasm of responses was less than in other regions and certainly favoured a preference towards recommendations from the European Commission rather than prescribed approaches. This is likely to reflect a desire for flexibility to avoid the need to revisit approaches taken and also that there are fewer gaps with information provision in these regions.

It was noted that a few of the Swedish authorities who responded had prepared joint responses as the same wording appeared in a number of their answers. The Scandinavian responses were also often aligned with the principles of 'Data access' and therefore were focused on empowering the data user rather than the data owner.

Organisations from Eastern Europe are more in favour of EU action than elsewhere, though there is typically a preference for measures which recommend approaches to be taken rather than prescribed actions. There are likely to be two reasons for this, first the less mature multimodal transport information market in these countries and secondly the smaller proportion of transport operators (particularly from the rail sector) in the responses from this region who were typically the dissenting voices.

Southern Europe, a region where many larger cities have a multimodal information service in place but where there are few services covering wider geographic areas was much keener on mandatory measures rather than recommendations. This suggests that a more significant intervention is seen as desirable here to move the sector forward. This is likely due to a legacy where travel information policy has been consistently set at a local level rather than at national or regional level as has been the case in many Western/Northern/Central Member States (even if only intermittently).

It was also clear that, for the majority of respondents their frame of reference was considering the current status and aspirations within their own Member States rather than a transnational viewpoint. The exception to this are the associations, transnational operators, systems providers and multinational service providers.

Those respondents in Central Europe often had the most practical insight as to the challenges and preferable measures to address barriers in cross border information service provision. This is a result of there being several mature larger scale information services, smaller member states sharing multiple land borders and urban areas spanning some of those borders.

Finally, CEDR (the association for national road authorities) highlighted that views from their membership on the functionality and data needs for MMTIPS were not of a unanimous opinion across Member States.

³³ Similar views appearing within additional evidence submitted (Transport Focus, 2014), (BEUC, 2014), (Floristean et al, 2014)

1.3.3.3 Perceived benefits and costs of improved MMTIPS

Across the four policy areas of (i) harmonised data formats and exchange protocols; (ii) Access Points; (iii) quality; and (iv) common terms and conditions; stakeholders were asked to provide insight as to the perceived costs and benefits for their organisation should action be taken in those areas.

Table 31 Perceived benefits and costs of policy options

Policy area	Perceived potential benefits	Perceived potential costs
Harmonised data formats and exchange protocols	<ul style="list-style-type: none"> • Handling of fewer data formats • Ability to provide services on a larger and more cost effective scale • Procurement benefits (particularly public sector) • Lowered barriers to market entry • Stability and confidence for third party data providers • More cost effective data quality checking regimes 	<ul style="list-style-type: none"> • Potential limitations on market responsiveness • Investment required to migrate or adopt new standards • Implementation of APIs • Increased barriers to market entry • Supporting European or national governance infrastructure/administration
Access Points	<ul style="list-style-type: none"> • Reduced data discovery and aggregation costs • Savings from reducing number of access points • Lowered barriers to market entry • Improved consistency and accountability of data providers 	<ul style="list-style-type: none"> • Technical and resource costs for establishing and maintaining Access Points (lead body) • Resource costs for synchronising data with Access Points (data owners) • Implementation of APIs
Quality	<ul style="list-style-type: none"> • Improved customer experience of travel information services • Improved customer journey experience • Reduced need for in-person customer support (i.e. less complaint handling) • Reduced data rework 	<ul style="list-style-type: none"> • New quality checking tools • Staff time for conducting quality monitoring • Additional lead times, impacting speed of data availability, to conduct further quality checks
Common terms and conditions	<ul style="list-style-type: none"> • Reducing administrative and legal costs • Reduced liability and data protection risks • Reducing market barriers 	<ul style="list-style-type: none"> • Implementation of the common terms • Addressing issues of data misuse
General	<ul style="list-style-type: none"> • Ability to cut public funded services as sufficient provision from private sector is achieved • Greater range of choice of service 	<ul style="list-style-type: none"> • Benefits may turn to costs if regulated practices fall behind the pace of change in the market.

The VDV Position Paper reflected concerns shared by many other respondents that it is important not to introduce unnecessary additional costs into the travel information chain which have to be borne by either the tax payer or the ticket buying passenger. Therefore it is important to allow flexibility for common approaches to be implemented when appropriate rather than in all cases.

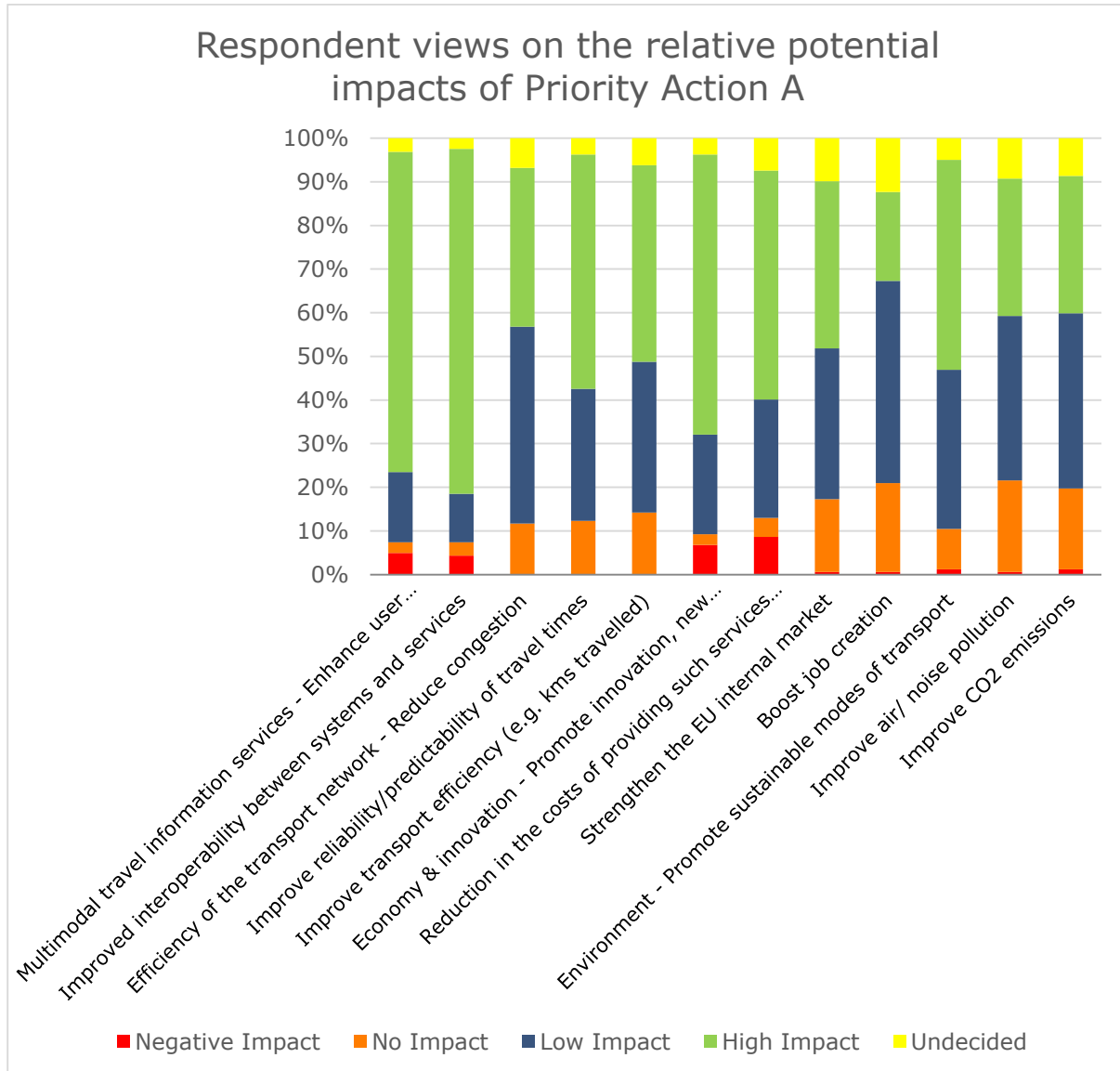
Overall there are perceived to be a significant range of tangible and intangible positive benefits which can be derived from the introduction of new policy measures for

enhancing the uptake and scope of MMTIPS. These need to be weighed against the costs involved – as will be explored further in Task 3 of this study.

1.3.3.4 Perceived impacts of improved MMTIPS

Respondents were asked to identify the impacts, such as social benefits/costs as well as the operational costs/benefits focussed on elsewhere in this study.

Figure 72 Views on the potential impacts associated with increased usage of MMTIPS



In conjunction with these responses stakeholders were asked to provide evidence to support their views (e.g. published studies). A common view was that it was difficult to evidence the specific benefits of MMTIPS when considering wider social impacts as it is one factor of several which influences modal choice and travel behaviour.

A number of respondents highlighted the number of technology start-ups using transport information data from 'data access' champion cities such as London and Helsinki as evidence of a thriving and innovative market sector.

Of the evidence submitted on quantifiable impact of MMTIPS, the most useful was from the final report of the All Ways Travelling consortium (2014):

"[MMTIPS have] the potential to achieve significant improvements for safety, mobility and environment. Survey results indicate that the effect ... is at least a 21% increase in the willingness to shift transport mode from private cars. In addition to the annual 651 million EUR savings of emission costs at this level of modal shift from private cars, the additional estimated costs savings are:

- 10,091 million EUR time cost savings per year
- 456 million EUR accident cost savings per year
- 2,018 million EUR vehicle operating cost savings per year for a total of 13.22 billion EUR per annum.

A more positive assumption of modal shift of +41% to just above 4 percentage points provides an estimated total cost saving of 17.5 billion EUR per year."

A further interesting observation is that electromobility, currently on the verge of becoming mainstream will benefit more substantially than other transport modes from the availability of related information within MMTIPS. This is partly due to responding to potential user concerns on charging locations but also 'normalises' these modes alongside traditional forms of transport and links with electric versions of car or bike sharing schemes enabling potential users to gain initial experience with these modes.

1.3.3.5 Variations between the workshop and public consultations

There was a significant overlap between the 100 participants in the workshop and the 165 respondents to the consultation. Broadly views expressed through these two channels were similar but the nature of the two engagement approaches did result in drawing out useful viewpoints that would not have occurred using a single method.

The workshop provided debate that allowed views to be tested for robustness and identified certain areas which may be more contentious than others. For example, recommended approaches to harmonising common data standards and exchange protocols, linking travel information services and common terms and conditions for data re-use were preferable to being mandated policy measures. The consultation responses gave more weight to the separation of considerations for public and private entities than was evident in the views shared within the workshop – it was also evident that certain stakeholders – notably rail operators, were much more willing to put across a dissenting view to the general discussions within the public consultation format compared to the workshop.

In addition, workshop participants were generally representing traditional transport modes, which whilst still forming a near majority of journey types are being joined in the mainstream of transport by new mobility modes such as vehicle sharing and short notice vehicle hire. A pertinent remark was made by an organisation representing a new mode:

"By protecting, and extending the life of existing city journey planners [through linked journey planning], and their software suppliers and system integration providers, innovation will be discouraged. Existing journey planners are typically associated with 'traditional' modes of transit and these will be slower to incorporate evolving sustainable alternatives such as Car share, Ride share, Taxi etc."

BEUC (2014) also supports the view that new mobility solutions must be better combined with public transportation systems, with due attention given in the development of public policy.

A final variation between the two formats was the presence within the consultation of new and emerging independent commercial travel information businesses that are an important voice for gathering viewpoints from – interestingly feedback from two technology players in this field was more dissenting on the benefits of linking travel information systems than those present within the workshops.

Appendix J Details of the Impact Assessment

J.1 Scoping the Impact Assessment

J.1.1 Scoping the Impact Assessment

In accordance with the Commission's 'Better Regulation Guidelines', this section summarises the results of the identification of the potential impacts that are likely to occur following intervention by the Commission relating to development of specifications for the provision of MMTIPS across Europe in accordance with the ITS Directive.

The following identified areas of potential impacts were taken forward into the detailed impact assessment. These cover economic impacts, social impacts and environmental impacts.

Table 32 Identified Potential Economic Impacts

Key Questions	Expected Impacts
What impact (positive or negative) does the option have on the free movement of goods, services, capital and workers?	The actions proposed for MMTIPS could lead to more effective network management and more efficient transport of people through more efficient journeys and optimized travel choices reducing travel delay hours. The transport of goods could also benefit as freight operators can utilize real-time travel and traffic information about delays and disturbances to optimize freight operations.
Will it lead to a reduction in consumer choice, higher prices due to less competition, the creation of barriers for new suppliers and service providers, the facilitation of anti-competitive behaviour or emergence of monopolies, market segmentation, etc.?	The actions proposed have the potential to stimulate new services to consumers based on the wider availability of MMTIPS across Europe, this may lead to increased consumer choice for services and an increase in the pan-European coverage offered by existing services.
What impact does the option have on the global competitive position of EU firms?	The actions proposed have the potential to stimulate new services to consumers based on the wider availability of MMTIPS data across Europe.
Does it impact on productivity?	May have a limited impact on increased productivity due to a reduction in the time required for planning cross-border trips for businesses.
Will it impose additional adjustment, compliance or transaction costs on businesses?	Policy options that mandate the provision of data on public transport will have an impact on Transport Operators. Policy options that mandate the use of specific standards will have an associated implementation cost for public transport operators and MMTIPS providers.
Will it entail stricter regulation of the conduct of a particular business?	Yes – requirements to make data accessible and standards to be adopted.
Will it lead to new or the closing down of businesses?	Maybe – reduction in market entry costs for MMTIPS may lead to new market entrants.
Does it affect the nature of information obligations placed on businesses (for example, the type of data required, reporting frequency, the complexity of submission process)?	Yes – some options require public transport operators to make data accessible in a standardized format via the National Access Point.
What is the impact of these burdens on SMEs in particular?	Geographic scope of EU-wide transport network will affect many SME public transport operators.

Key Questions	Expected Impacts
Does the option have budgetary consequences for public authorities at different levels of government (national, regional, local); both immediately and in the long run?	Yes – requirement for implementation of National Access Points. This depends on the type of NAP selected by the Member State. If Member States choose to go beyond the minimum requirement for a data register, local Transport authorities may incur costs to feed data to the NAP; however this assessment is based on the minimum requirement for a data register. Costs of conforming to data standards will also depend on the Member States' decision to continue using national standards and translate to EU standard or to fully implement EU standard.
Are property rights affected (land, movable property, tangible /intangible assets)?	Data on public transport will be required to be made available to 3 rd parties.
Does it facilitate the introduction and dissemination of new production methods, technologies and products?	Greater availability of MMTIP Data may lead to the development of new products due to the lower costs of data discovery and data access.
Does the option affect the prices consumers pay?	Unlikely to have a direct impact – price information is outside of the scope of the proposed policy options under consideration.
Does it have an impact on the quality and availability of the goods/services they buy, on consumer choice and confidence? (cf. in particular non-existing and incomplete markets – see Annex 8)	The policy actions are intended to stimulate the market for the provision of MMTIP services in Europe – should provide more transparency to consumers.
Does the option have significant effects on certain sectors?	Yes. Public transport operators and public and private MMTIPS sectors will be affected by the proposed policy options.

Table 33 Identified Potential Social Impacts

Key Questions	Expected Impacts
Does the option facilitate new job creation?	Possibly, MMTIP policies should support the emergence of new services and thus job creation.

Table 34 Identified Potential Environmental Impacts

Key Questions	Expected Impacts
Will it increase or decrease the demand for transport (passenger or freight), or influence its modal split?	Yes – the wider availability of MMTIP services may encourage shifts in modal split for cross-border journeys – most likely impact will be at the destination on the last leg of the outward journey and first leg of the return journey, but promotion of more sustainable modes for the 'trunk' part of the journey (i.e. rail) is also possible.

J.2 Economic Assessment

J.2.1 Options 1A and 1B - Minimal Intervention

Table 35 shows the monetised benefits and costs for the 'Minimal Intervention' option on both the Comprehensive TEN-T network (1A) and the EU-wide transport network (1B).

Table 35 Benefits and costs for the 'Minimal Intervention' option

	1A	1B
Accrued benefits 2016 - 2030 (EU-28)		
i. Time saving of journey planning (static information)	€11,278,181	€22,556,362
ii. Time saving due to better information on disrupted journeys (dynamic info)	€264,596	€529,192
iii. Benefits of modal shift to more sustainable modes	€6,186,951	€12,373,903
iv. Cost savings to MMTIPS service providers	€0	€0
Total benefits (EU-28)	€17,729,728	€35,459,456
Accrued costs 2016 - 2030 (EU-28)		
i. NAPs	€8,043,949	€8,043,949
ii. Data exchange - meeting standards NeTEx and SIRI	€0	€0
iii-a. Data quality - Mandate basic elements	€0	€0
iii-b. Data quality - Mandate detailed elements	€0	€0
iv-a. Linking - Demand-based obligation for services to link	€0	€0
iv-b. Linking - Mandatory for all services to link	€0	€0
Total costs (EU-28)	€8,043,949	€8,043,949
BCR	2.2	4.4
NPV (total benefits minus total costs)	€9,685,780	€27,415,508

Costs

- The only costs involved are those that would be incurred by Member States while setting up the National Access Points: €8 million by end of 2019 (see Section 4.4.1 for details)
- These costs would not vary between the Comprehensive TEN-T Network and the EU-wide transport network.

Benefits

- The largest benefits relate to users' time saved when planning their journeys (€11.3 million for the Comprehensive TEN-T network); this was assumed to be double for the EU-wide transport network (€22.6 million)
- The next largest benefits relate to modal shift from taxi and hire car to public transport as a result of improved access to information for the last leg of the outward journey (and first leg of the homeward journey) on cross-border journeys (€6.2 million for Comprehensive TEN-T Network); this was assumed to be double for the EU-wide transport network (€12.4 million)
- There would also be relatively small benefits arising from travel time savings as a result of better on-trip dynamic information for some of the rail journeys that were substantially delayed (€0.26 million for the Comprehensive TEN-T Network); this was assumed to be double for the EU-wide transport network (€0.53 million).

The Benefit Cost Ratio of the 'Minimal Intervention' option would be 2.2 if it were implemented on the Comprehensive TEN-T Network and 4.4 if it were implemented on the EU-wide transport network.

Table 36 shows the distribution of costs associated with the 'Minimal Intervention' option for each of the stakeholder groups. The costs involved in implementation on the Comprehensive TEN-T network and the EU-wide transport network would be the same in the case of National Access Points.

Table 36 Distribution of costs between stakeholder groups for Policy Option 1A

Cost	Member States	MMTIPS providers	Transport operators	All stakeholders
i. NAPs	€8,043,949			€8,043,949

J.2.2 Options 2A and 2B - Data Focus

Table 37 shows the monetised benefits and costs for the 'Data Focus' option on both the Comprehensive TEN-T network (2A) and the EU-wide transport network (2B).

Table 37 Benefits and costs for the 'Data Focus' option

	2A	2B
Accrued benefits 2016 - 2030 (EU-28)		
i. Time saving of journey planning (static information)	€112,781,809	€225,563,619
ii. Time saving due to better information on disrupted journeys (dynamic info)	€2,645,958	€5,291,916
iii. Benefits of modal shift to more sustainable modes	€61,869,515	€123,739,030
iv. Cost savings to MMTIPS service providers	€127,080,541	€201,785,928
Total benefits (EU-28)	€304,377,823	€556,380,493
Accrued costs 2016 - 2030 (EU-28)		
i. NAPs	€8,043,949	€8,043,949
ii. Data exchange - meeting standards NeTEx and SIRI	€1,519,393	€25,661,266
iii-a. Data quality - Mandate basic elements	€226,868	€226,868
iii-b. Data quality - Mandate detailed elements	€120,028,625	€120,028,625
iv-a. Linking - Demand-based obligation for services to link	€0	€0
iv-b. Linking - Mandatory for all services to link	€0	€0
Total costs (EU-28)	€129,818,835	€153,960,708
BCR	2.3	3.6
NPV (total benefits minus total costs)	€174,558,988	€402,419,785

Costs

- In addition to the costs for setting up the National Access Points (€8 million), the main cost would be for meeting the data quality requirements (see Section 4.4.3 for details). This is predominantly a cost of €120 million for the data quality

checking costs borne by the Member States, but also includes a €0.2 million cost for meeting the basic data quality requirements which would be borne by the MMTIPS service providers. None of these costs vary between the Comprehensive TEN-T and EU-wide networks

- The combined cost of meeting data exchange standards would be €1.5 million on the Comprehensive TEN-T network and €25.7 million on the EU-wide network. This is made up of the costs to Member States of developing a national translation schema to conduct data mapping to NeTEx (see Section 4.4.2) for which the implementation cost would be €1.3 million, plus the cost of converting the real time information data to the SIRI format (€0.2 million on the Comprehensive TEN-T Network and €24.4 million on the EU-wide transport network, which would be borne by transport operators).

Benefits

- The types of benefit would be similar to those in the case of Option 1, but they would be a factor of 10 higher to reflect the additional improvements due to improved data quality and content
- The largest benefits relate to users' time saved when planning their journeys (€113 million for the Comprehensive TEN-T network); this was assumed to be double for the EU-wide transport network (€226 million)
- The next largest benefits relate to modal shift from taxi and hire car to public transport as a result of improved access to information for the last leg of the outward journey (and first leg of the homeward journey) on cross-border journeys (€62 million for Comprehensive TEN-T Network); this was assumed to be double for the EU-wide transport network (€124 million)
- There would also be relatively small benefits arising from travel time savings as a result of better on-trip dynamic information for some of the rail journeys that were substantially delayed (€2.6 million for the Comprehensive TEN-T Network); this was assumed to be double for the EU-wide transport network (€5.3 million)³⁴
- Additionally there would be a benefit arising from cost savings to MMTIPS service providers. There would be a one-off cost saving in reduced data discovery costs, as well as an ongoing cost saving in reduced aggregation costs and a reduction in interfaces required (€127 million if implemented on the Comprehensive TEN-T Network and €202 million if implemented on the EU-wide transport network).

The Benefit Cost Ratio of the 'Data Focus' option would be 2.3 if it were implemented on the Comprehensive TEN-T Network and 3.6 if it were implemented on the EU-wide transport network.

Table 44 and Table 45 show the distribution of costs associated with the 'Data Focus' option for each of the stakeholder groups. Table 44 shows the costs involved in implementation on the Comprehensive TEN-T Network and Table 45 shows the costs involved in implementation on the EU-wide transport network. On the EU-wide network the costs for transport operators would be substantially higher than on the Comprehensive TEN-T network.

Comparison of Table 38 and Table 39 with Table 37 indicates that the additional costs incurred by MMTIPS providers would be more than offset by cost savings in reduced data discovery and aggregation costs.

³⁴ Note that there are also potential benefits to travellers on local public transport services as a result of better access to real time information before arriving at the transit stop; the sensitivity analysis in Appendix J.2.6 examines the potential impact of this on the overall benefit cost ratio.

Table 38 Distribution of costs between stakeholder groups for Policy Option 2A on the Comprehensive TEN-T network

Cost	Member States	MMTIPS providers	Transport operators	All stakeholders
i. NAPs	€8,043,949			€8,043,949
ii. Data exchange - meeting standards NeTEx and SIRI	€1,270,463		€248,930	€1,519,393
iii-a. Data quality - Mandate basic elements		€226,868		€226,868
iii-b. Data quality - Mandate detailed elements	€120,028,625		€0	€120,028,625

Table 39 Distribution of costs between stakeholder groups for Policy Option 2B on the EU-wide transport network

Cost	Member States	MMTIPS providers	Transport operators	All stakeholders
i. NAPs	€8,043,949			€8,043,949
ii. Data exchange - meeting standards NeTEx and SIRI	€1,270,463		€24,390,803	€25,661,266
iii-a. Data quality - Mandate basic elements		€226,868		€226,868
iii-b. Data quality - Mandate detailed elements	€120,028,625		€0	€120,028,625

J.2.3 Options 3A and 3B - Linking Services

Table 40 shows the monetised benefits and costs for the 'Linking Services' option on both the Comprehensive TEN-T network (3A) and the EU-wide transport network (3B).

Table 40 Benefits and costs for the 'Linking Services' option

	3A	3B
Accrued benefits 2016 - 2030 (EU-28)		
i. Time saving of journey planning (static information)	€281,954,523	€563,909,046
ii. Time saving due to better information on disrupted journeys (dynamic info)	€3,307,448	€6,614,895
iii. Benefits of modal shift to more sustainable modes	€77,336,894	€154,673,787
iv. Cost savings to MMTIPS service providers	€0	€0
Total benefits (EU-28)	€362,598,864	€725,197,729
Accrued costs 2016 - 2030 (EU-28)		
i. NAPs	€8,043,949	€8,043,949
ii. Data exchange - meeting standards NeTEx and SIRI	€0	€0
iii-a. Data quality - Mandate basic elements	€0	€0
iii-b. Data quality - Mandate detailed elements	€0	€0
iv-a. Linking - Demand-based obligation for services to link	€0	€0
iv-b. Linking - Mandatory for all services to link	€71,888,345	€143,776,691
Total costs (EU-28)	€79,932,294	€151,820,639
BCR	4.5	4.8
NPV (total benefits minus total costs)	€282,666,571	€573,377,090

Costs

- The main cost would be borne by MMTIPS service providers for linking all services (see Section 0 for details): €72 million on the Comprehensive TEN-T Network and €144 million on the EU-wide transport network
- This would be in addition to the costs that would be incurred by Member States while setting up the National Access Points - €8 million by end of 2019; this would not vary between the Comprehensive TEN-T Network and the EU-wide transport network.

Benefits

- The types of benefit would be similar to those in the case of Option 1, but they would be significantly greater to reflect the additional improvements due to improved data quality and content
- The largest benefits relate to users' time saved when planning their journeys (€282 million for the Comprehensive TEN-T network); this was assumed to be double for the EU-wide transport network (€564 million)
- The next largest benefits relate to modal shift from taxi and hire car to public transport as a result of improved access to information for the last leg of the outward journey (and first leg of the homeward journey) on cross-border journeys (€77 million for Comprehensive TEN-T Network); this was assumed to be double for the EU-wide transport network (€155 million)

- There would also be relatively small benefits arising from travel time savings as a result of better on-trip dynamic information for some of the rail journeys that were substantially delayed (€3.3 million for the Comprehensive TEN-T Network); this was assumed to be double for the EU-wide transport network (€6.6 million)

The Benefit Cost Ratio of the 'Linking Services' option would be 4.5 if it were implemented on the Comprehensive TEN-T Network and 4.8 if it were implemented on the EU-wide transport network.

Table 41 and Table 42 show the distribution of costs associated with the 'Linking Services Focus' option for each of the stakeholder groups. Table 41 shows the costs involved in implementation on the Comprehensive TEN-T Network and Table 42 shows the costs involved in implementation on the EU-wide transport network. The costs for MMTIPS providers would be higher on the EU-wide transport network than on the Comprehensive TEN-T network. In this case, costs incurred by MMTIPS Providers would not be offset by cost savings.

Table 41 Distribution of costs between stakeholder groups for Policy Option 3A on the Comprehensive TEN-T network

Cost	Member States	MMTIPS providers	Transport operators	All stakeholders
i. NAPs	€8,043,949			€8,043,949
iv-b. Linking - Mandatory for all services to link		€71,888,345		€71,888,345

Table 42 Distribution of costs between stakeholder groups for Policy Option 3B on the EU-wide transport network

Cost	Member States	MMTIPS providers	Transport operators	All stakeholders
i. NAPs	€8,043,949			€8,043,949
iv-b. Linking - Mandatory for all services to link		€143,776,691		€143,776,691

J.2.4 Options 4A and 4B – Comprehensive Approach

Table 43 shows the monetised benefits and costs for the 'Comprehensive Approach' option on both the Comprehensive TEN-T network (4A) and the EU-wide transport network (4B).

Table 43 Benefits and costs for the 'Comprehensive Approach' option

	4A	4B
Accrued benefits 2016 - 2030 (EU-28)		
i. Time saving of journey planning (static information)	€281,954,523	€563,909,046
ii. Time saving due to better information on disrupted journeys (dynamic info)	€6,614,895	€13,229,791
iii. Benefits of modal shift to more sustainable modes	€154,673,787	€309,347,575
iv. Cost savings to MMTIPS service providers	€127,080,541	€201,785,928
Total benefits (EU-28)	€570,323,747	€1,088,272,340
Accrued costs 2016 - 2030 (EU-28)		
i. NAPs	€8,043,949	€8,043,949
ii. Data exchange - meeting standards NeTEx and SIRI	€1,519,393	€25,661,266
iii-a. Data quality - Mandate basic elements	€226,868	€226,868
iii-b. Data quality - Mandate detailed elements	€0	€0
iv-a. Linking - Demand-based obligation for services to link	€35,944,173	€71,888,345
iv-b. Linking - Mandatory for all services to link	€0	€0
Total costs (EU-28)	€45,734,383	€105,820,428
BCR	12.5	10.3
NPV (total benefits minus total costs)	€524,589,364	€982,451,912

The costs of National Access Points, Data exchange and Data Quality would be the same as in the case of Option 2, except that there would be no requirement for a detailed data quality framework. In addition this option would involve costs of linking data.

Costs

- The largest cost item would be the costs for linking some services, although in this case it is a demand-based obligation, in contrast to Option 3, in which it would be mandatory for all services to link
- Thus the costs for this are lower than for Option 3 (€36 million on the Comprehensive TEN-T network, €72 million on the EU-wide transport network); these costs would be borne by the MMTIPS service providers
- The combined cost of meeting data exchange standards would be €1.5 million on the Comprehensive TEN-T network and €25.7 million on the EU-wide network. This is made up of the costs to Member States of developing a national translation schema to conduct data mapping to NeTEx for which the implementation cost would be €1.3 million, plus the cost of converting the real time information data to the SIRI format (€0.2 million on the Comprehensive TEN-T Network and €24.4 million on the EU-wide transport network, which would be borne by transport operators.
- There would also be costs for setting up the National Access Points (€8 million)

- The smallest cost element would be for meeting the data quality requirements; This is €0.2 million for meeting the basic data quality requirements which would be borne by the MMTIPS service providers, and this would not vary between the Comprehensive TEN-T and EU-wide networks

Benefits

- The largest benefits relate to users' time saved when planning their journeys (€282 million for the Comprehensive TEN-T network); this was assumed to be double for the EU-wide transport network (€564 million)
- The next largest benefit relates to modal shift from taxi and hire car to public transport as a result of improved access to information for the last leg of the outward journey (and first leg of the homeward journey) on cross-border journeys (€155 million for Comprehensive TEN-T Network); this was assumed to be double for the EU-wide transport network (€309 million)
- There would be cost savings to MMTIPS service providers, with a one-off cost saving in reduced data discovery costs, as well as an ongoing cost saving in reduced aggregation costs and a reduction in interfaces required (€127 million if implemented on the Comprehensive TEN-T Network and €202 million if implemented on the EU-wide transport network)
- There would also be benefits arising from travel time savings as a result of better on-trip dynamic information for some of the rail journeys that were substantially delayed (€6.6 million for the Comprehensive TEN-T Network); this was assumed to be double for the EU-wide transport network (€13.2 million).

The Benefit Cost Ratio of the 'Comprehensive Approach' option would be 12.5 if it were implemented on the Comprehensive TEN-T Network and 10.3 if it were implemented on the EU-wide transport network.

Table 44 and Table 45 show the distribution of costs associated with the different policy options for each of the stakeholder groups. Table 44 shows the costs involved in implementation on the Comprehensive TEN-T Network and Table 45 shows the costs involved in implementation on the EU-wide transport network. The costs for MMTIPS providers and Transport operators would be higher on the EU-wide network than on the Comprehensive TEN-T network.

Comparison of Table 44 and Table 45 with Table 43 indicates that the additional costs incurred by MMTIPS providers would be more than offset by cost savings in reduced discovery and aggregation costs.

Table 44 Distribution of costs between stakeholder groups for Policy Option 4A on the Comprehensive TEN-T network

Cost	Member States	MMTIPS providers	Transport operators	All stakeholders
i. NAPs	€8,043,949			€8,043,949
ii. Data exchange - meeting standards NeTEx and SIRI	€1,270,463		€248,930	€1,519,393
iii-a. Data quality - Mandate basic elements		€226,868		€226,868
iv-a. Linking - Demand-based obligation for services to link		€35,944,173		€35,944,173

Table 45 Distribution of costs between stakeholder groups for Policy Option 4B on the EU-wide transport network

Cost	Member States	MMTIPS providers	Transport operators	All stakeholders
i. NAPs	€8,043,949			€8,043,949
ii. Data exchange - meeting standards NeTEx and SIRI	€1,270,463		€24,390,803	€25,661,266
iii-a. Data quality - Mandate basic elements		€226,868		€226,868
iv-a. Linking - Demand-based obligation for services to link		€71,888,345		€71,888,345

J.2.5 Data used in the Cost Benefit Analysis Model Assumptions about distribution of costs and benefit and Sensitivity Analysis

This appendix contains the following details about the assessment model:

- Data on costs and grossing up to EU-level
- Assumptions about the distribution of costs and benefits between policy options
- Sensitivity analysis on key assumptions and data elements

J.2.5.1 Data on costs and grossing up to EU level

The following five tables provide a compilation of the data assembled for the impact assessment model, indicating in the final column which elements were used in the model. Table 46 shows data on National Access Points, Table 47 contains the data on data exchange, Table 48 shows data on Data Quality Frameworks, Table 49 shows data on Linking Services and Table 50 shows data used in grossing up the figures to an EU-wide level.

Table 46 – Data collated in relation to National Access Points

Source	Type of costs	Costs borne by	Information	Used
D1, N.1.8	Data registers	MS / Transport authorities	"The costs of developing the recently launched IM Data Index portal (http://imdata.co.uk) which provides access to a range of transport datasets and APIs, (August 2015) were £35,000 in total (approximately equivalent to €49,000), made up of: o £15,000 for development plus website hosting for a year o Construction of the queries and database structure - circa £20,000".	Y
D1, N.1.5	Data warehouses	MS / Transport authorities	"Provision of data warehouses can vary but there is some information in the public domain: o The UK data.gov.uk platform which covers a range of governmental and national UK data sets (broader than just transport) costs approximately €2,000,000 in each of its first two years of operation though it is expected that those costs have reduced significantly for subsequent years (Cabinet Office 2010)."	N
D1, N.1.9	Data warehouses	MS / Transport authorities	"New DELFI services in Germany will not be established before 2016 so there are not yet reliable cost estimates available for data integration for German PT. The initial estimates are in the upper six digits for the first year (e.g. €500,000-€1,000,000)."	N

Source	Type of costs	Costs borne by	Information	Used
D1, N.2.6	Data warehouses	MS / Transport authorities	"In the Netherlands the National Data Warehouse (NDW), collects, processes, stores and distributes traffic data, mainly covering national and regional networks. Whilst basic data is openly available through a free "Bronze" subscription, more valuable data is licensed to third party traffic information service providers through a "Silver" and "Gold" subscription. The connection fee is approximately €6000 per year per provider. This does not cover all the costs of operation."	N
D1, N.1.7	Databases	MS / Transport authorities	"A cost estimate from Trafikverket for the development, building and implementation of the new web Swedish web portal was 200,000 Euros. This consisted 40,000 Euros for the scoping study and 160,000 Euros for the build. No cost information was available on the running costs / maintenance costs."	N
D1, N.2.7	Databases	MS / Transport authorities	"In The Netherlands the NDOV database for PT and rail service information provides both static and real time information nationwide. Data delivery to NDOV by PT and rail operators is a mandatory condition in their licenses. Costs (in 2015) for maintenance and operation (some 100k€/yr) are paid by the public authorities. Service providers can apply for the data for a maximum fee of 1k€/yr. At this point (2015) it is free."	N
D2	Cost savings of data discovery	MMTIPS providers	"An MMTIPS provider explained that they have spent EUR 700 000 in 2013 for generating data for the entire EU. In addition to those costs which were related to generating data by own means, the service provider reported spending 6930 man/hours on sourcing public transport data."	Y
D2	Cost savings of data discovery	MMTIPS providers	"A significant part of the €1M budget of Digitransit has gone to work that would have been eased by an access point with a catalogue of quality-tested data (from Helsinki Region Transport)."	Y
D2	Cost savings of data discovery	MMTIPS providers	"An MMTIPS provider operating a national MMTIPS with RTI who reported spending between EUR 12 000 and EUR 40 000 per year for accessing datasets on air schedules, taxi information as well as a daily feed on rail data and mapping of road restrictions in addition to more than EUR 270 000 per annum for traffic alerts and information on road works."	Y
D2	Cost savings of data discovery	MMTIPS providers	"With respect to collecting data on the fares and actual routing of buses on the road network, a journey planner with a national coverage reported spending EUR 5 000 per month for manually gathering data on the stop coordinates and contacting operators regarding their fares, discounts, etc."	Y
D1, N.2.5	Data access	Benefits of data access	"Transport for London (TfL) has followed an open data policy of making all aspects of its data available to third parties including real-time data. This has resulted in a rich ecology of third party services (for example Google and Citymapper), reducing the load (and hence running costs) on TfL's own services carrying information about the existence of TfL's services to a much greater number of people. TfL has estimated the impact of the accumulated small savings in journey and waiting times that better travel information has created. They have concluded that this leads to a return on investment of around 58:1 for their open data initiative. The Shakespeare Review estimated that these developments have generated a value of £15 to £58 million each year in saved time for users of TfL."	N
D1, N.2.8	Data access	Benefits of data access	"According to the 2011 "Pricing of PSI Study" apps enabled by published transport data "such as Metro Paris have provided a one-off direct revenue of 400K EUR to developers. If a conservative estimate of one hour saved in transport times is allotted per year to each app user (who earns an average wage of 20 EUR per hour), a total savings of 8million EUR can be calculated."	N

Source	Type of costs	Costs borne by	Information	Used
D2	Data access	Benefits of data access	"The network manager of a large European City[3], which reported its current costs of for ensuring availability, mentioned that the adaptation of the IT architecture (systems, software) and human capital to improve availability, accessibility and interoperability (taken together) can be estimated to be of EUR 150 000 per year."	N

Table 47 – Data collated in relation to data exchange

Source	Type of costs	Costs borne by	Information	Used
D1, N.2.1	Costs of converting to machine readable format	MS / Transport authorities	"By enabling access to data for commercial third parties there are potential cost savings compared to the continued provision of MMTIPS by the public sector. Example: UK DfT decided that it no longer needed to provide the Transport Direct national multimodal information service once access to the supporting source data was available to third party service providers and the service provider market for using this had matured. This led to a cost saving of approximately €6m per annum to the UK Government (Transport Direct 2012)."	N
D1, N.2.2	Costs of converting to machine readable format	MS / Transport authorities	"An earlier incarnation of the public transport data management approach in Scotland needed to carry out translations of all timetable and stop data received to ensure a common coding system was in use prior to aggregation and integration. This approach required an additional 3.5 full time personnel. Therefore the approximate cost saving of moving to a regional policy of uniquely coded data was €280,000 per annum."	N
D1, N.2.3	Costs of converting to machine readable format	MS / Transport authorities	"Through the introduction of a web based bureau data management service by Norfolk County Council which enabled bus operators to create and verify their own data online resulted in a staff resource saving of 4 full time personnel. This data is then reused by all downstream systems. This has an approximate staff cost saving of €320,000 per annum."	N
D1, N.1.1	Costs of converting to machine readable format	MS / Transport authorities	"Based on the study team's experience with two major operators with significant market share in the UK, it can be extrapolated that the approximate costs for a UK sized bus market to implement electronic data management compliant with a rich common data standard would be around €25m over a ten year period. This assumes a starting base of a mixed range of bespoke formats or zero electronic data."	N
D1, N.1.2	Costs of converting to machine readable format	MS / Transport authorities	"Based on the study team's experience, costs of weekly data aggregation and integration for a Scotland public transport database can be estimated. This task involves gathering electronic data in a myriad of formats from 20 data suppliers on bus timetables and fares then integrating this data and ensuring sufficient quality for 'door-to-door' journey planning. This requires 2.5 full time personnel with estimated annual costs of approximately €200,000."	N
D1, N.1.3	Costs of converting to machine readable format	MS / Transport authorities	"The field survey resource and equipment costs for gathering geocode and infrastructure attribute data for 45,000 bus stops in the South West of England was approximately €90,000-120,000 (estimate based on project team experience)."	N
D2	Costs of converting to machine readable format	MMTIPS providers	When information is available in a non-electronic format, costs of digitalisation have been reported as being non-negligible: one MMTIPS provider reported spending EUR 360 000 per year to digitalise timetables for ferries for an entire country.	N

Source	Type of costs	Costs borne by	Information	Used
D2	Costs of converting to machine readable format	MMTIPS providers	"One MMTIPS provider reported that, as a result of the fact that certain data elements were not made accessible by the data owner/holder in an electronic and machine-readable format, she had to invest EUR 700 000 to overcome this barrier by collecting the necessary data elements".	N
D2	Costs of converting to machine readable format	MMTIPS providers	"One MMTIPS provider operating at a national level reported investing between EUR six million and EUR twelve million over a ten years' time period for dealing with multiple formats, while another comparable MMTIPS provider claimed that the issue of interoperability entailed total costs of EUR 10 000 in the last two to three years . The discrepancy can be explained by the fact that in the former case a set of new standards was developed: after sinking this initial costs, the annual figure for ensuring interoperability has lowered to approx. EUR 24 000."	N
D2	Costs of converting to machine readable format	MMTIPS providers	"A small-sized service provider operating an MMTIPS with national coverage reported that yearly expenses for gathering the data on public transport stops amount to over EUR 250 000, compiling a database on car parks is estimated to cost EUR 125 000 annually while for the database on inter-urban coach transport, the MMTIPS provider incurs a cost of EUR 44 000."	N
D2	Costs of converting to machine readable format	MMTIPS providers	"In order to digitally integrate the exact routing of urban public buses, the provider reported gathering the data by following the routes in person or via street view on the internet at a cost of around EUR 60 000 per year."	N
Priority Action B	Costs of meeting standards	Transport operators	Assumed one-off implementation cost of 50,000 Euros for meeting a new standard.	Y
D2	Costs of meeting standards	Transport operators	"There will be extra cost for investments in the near future, but for the longer perspective (approx. 5-7 years) ` There is a need for an adjustment period. (from trafikverket)".	Y
Priority Action B	Costs of meeting standards	Transport operators	Messaging middleware annual subscription cost was 16,000 Euros.	N
email from Grand Lyons	Costs of meeting standards	Transport operators	"We have shifted from a proprietary format to NeTEx and GTFS for our PT time tables; This format was nevertheless derived from Transmodel, so no data were added or removed, and the data structure was not really changed. We have used a tool developed by the French ministry 'Chouette" to do the conversion to NEPTUNE then to NETEX. Total Cost for GTFS and NETEX around 25 k€ without tax".	N
D2	Costs of meeting standards	Transport operators	"Some system suppliers are charging a high price for the implementation and maintenance of common standards. (e.g. experience of a SIRI interface costing more than 50,000€ plus an annual maintenance fee for each instance of implementation.)	N

Table 48 – Data collated in relation to data quality frameworks

Source	Type of costs	Costs borne by	Information	Used
D1, N.1.4	Data quality enforcement	MS / Transport authorities	"Enforcement of compliance in UK (during 2003-2010) was carried out by the Data Improvement Group of Transport Direct. This included a team of experts working with public sector and transport providers to improve data, adopt good quality principles, adopt national standards and address identified issues." [MF email 14/01/2016] - Transport Direct data improvement group - "DfT and consultancy staff costs involved were approx. £400k per year. That did not include any funding for local authorities or system suppliers to address actions directly. These costs annually recurred between 2004 and 2011 and sharply declined thereafter (with budget cuts) – by that point the overall quality of data had increased significantly and effectively private sector roles replaced this activity (a one-person data management function at approx. £40k in Traveline Information Ltd).	Y
D1, N.2.4	Reduction in passenger complaints and in turn associated costs	Transport operators	"Reduced costs of handling and providing compensation for complaints due to improved data quality. The benefits of this seems to be small with regional travel information services in the UK reporting a very low number of complaints where compensation needs to be handed out due to clear terms and conditions restricting warranty. The cost saving of eliminating these on a regional level (e.g. south east England) would be fairly negligible and approximately €500 per annum."	N

Table 49 – Data collated in relation to linking services

Source	Type of costs	Costs borne by	Information	Used
Industry information	Linking services	MMTIPS providers	€75k initial cost, €30k annual fee (assumed from a wide range of set-up costs up to €140k depending on the country and the complexity of the service, and €20k- 30k on-going costs, and taking account of the fact that these estimates do not include all of the cost elements involved	Y

Table 50 – Data collated in relation to grossing up

Source	Type of data	Information	Used
D2	Grossing up	"Scale of demand of cross border information. Between Malmö - Copenhagen there are 10 million yearly trips (from Skånetrafiken)."	N
Eurostat 2013	Grossing up	Modal share of EU international cross-border trips by mode of transport from the tourism statistics. However, the statistics refer to trips which would require an overnight stay. Total, 291,515,249 (100%); Air, 154,965,367 (53%); Railways, 14,331,844 (5%); Bus&coach, 17,478,659 (6%); Motor vehicle, 88,298,825 (30%); Waterway, 14,063,430 (5%); Other, 2,377,124 (1%).	Y

1.2.5.2 Assumptions on the distribution of costs and benefits of the policy options

Table 51 shows the assumptions that were made about which policy options involve which cost elements, and Table 52 shows the assumptions about the proportion of each type of benefit that was assumed to be realised under each policy option.

Table 51 Summary of assumptions about which policy options involve which cost elements

Cost	1A	1B	2A	2B	3A	3B	4A	4B
C i. NAPs	✓	✓	✓	✓	✓	✓	✓	✓
C ii-a. Data exchange - machine readable	✓	✓	✓	✓	✓	✓	✓	✓
C ii-b. Data exchange - meeting standards NeTEx and SIRI			✓	✓			✓	✓
C iii-a. Data quality - Mandate basic elements			✓	✓			✓	✓
C iii-b. Data quality - Mandate detailed elements			✓	✓				
C iv-a. Linking - Demand-based obligation for services to link							✓	✓
C iv-b. Linking - Mandatory for all services to link					✓	✓		

Table 52 Summary of assumptions about the proportion of each type of benefit which is realised under each policy option

Benefit	1A	1B	2A	2B	3A	3B	4A	4B
B i. Time saving of journey planning (static information)	2%	4%	20%	40%	50%	100%	50%	100%
B ii. Time saving due to better information on disrupted journeys (dynamic info)	2%	4%	20%	40%	25%	50%	50%	100%
B iii. Benefits of modal shift to more sustainable modes	2%	4%	20%	40%	25%	50%	50%	100%
B iv. Cost savings to MMTIPS service providers	0%	0%	100%	100%	0%	0%	100%	100%

J.2.6 Sensitivity analysis on key assumptions and data elements

The results are particularly sensitive to some of the larger scale assumptions about costs. Some examples are given below:

- The high unit cost of the enforcement of data quality under Option 2 (mandate detailed elements) is the main factor affecting the cost of Data Quality. The analysis showed that this totalled €4.1 million; halving the initial cost of setting up the enforcement system would increase the Benefit Cost Ratio from 2.3 to 4 on the Comprehensive Network and from 3.6 to 5.5 on the EU-wide network
- The cost of linking services are dependent on the unit cost of €75,000 and an annual cost of €30,000, combined with the assumption about the number of services to be linked (200 on the Comprehensive TEN-T network - Option 3A, 400 on the EU-wide network - Option 3B, 100 for the demand based linking under Option 4A and 200 for the demand-based linking under Option 4B). Increasing the number of services mandated to be linked by a third under Policy Option 3 would decrease the Benefit Cost Ratio for Option 3A from 4.5 to 3.5 on the Comprehensive TEN-T network and from 4.8 to 3.6 for Option 3B on the EU-wide network. Increasing the number of demand-based services to be linked by a third would decrease the Benefit Cost Ratio from 12.5 to 9.9 for Option 4A on the Comprehensive TEN-T network and from 10.3 to 8.4 for Option 4B on the EU-wide network.

The sensitivity analysis of some of the larger benefits showed, for example, that:

- If the time saved per trip planned were assumed to be 15 minutes instead of 10, this would increase the Benefit Cost Ratios for all policy options: the BCR for the Minimal Intervention option would increase to 2.9 for the Comprehensive Network and 5.8 for the EU-wide network and for the Linking Services option, the BCR

would increase from 4.8 to 6.6 on the EU-wide network and 4.5 to 6.3 on the Comprehensive TEN-T network

- However if the time saved per trip planned were assumed to be 5 minutes per trip instead of 10, only three of the options would have BCRs over 3 (3.0 for Policy Option 1B, 9.4 for Policy Option 4A and 7.6 for Policy Option 4B)
- Halving the cost savings for MMTIPS service providers would reduce the BCRs for Policy Options 2 and 4 with the BCR for the Data Focus on the EU-wide network option reducing from 3.6 to 3.0 and for the Comprehensive Approach, reducing from 12.5 to 11.1 on the Comprehensive TEN-T network and from 10.3 to 9.3 on the EU-wide network.

However because it was assumed that the modal shift benefits would be realised in a relatively small proportion of journeys, then reducing the distance over which the benefits of shifting to more sustainable modes from 10 km to 8 km for air trips and from 5 km to 4 km for rail trips would result in only a small reduction in the Benefit Cost Ratio of each policy option, and no change in which six policy options have a BCR greater than 3.

The sensitivity analysis also examined the impact of including passenger time savings on disrupted local journeys as a result of real time information being available through other information channels (e.g. smartphones) in addition to real-time information panels at bus stops. These additional benefits were assumed to be realised in Options 2 and 4, i.e. where real-time information was required to be in SIRI format. Furthermore, it was assumed that it would only affect local networks, rather than the Comprehensive TEN-T network and so would only be applicable to Options 2B and 4B.

It was assumed that improved access to real-time passenger information would result in a 5-minute journey time saving for some delayed 'infrequent' bus services (defined here to be those with a headway over 15 minutes). It was assumed that 20% of public transport trips were on infrequent services and that 30% of these were equipped with real-time information (note this 30% was lower than the 75% assumed for all services, because infrequent services are likely to be less technologically advanced compared to frequent services). Data from UITP35 suggested that annually there are 56.8 billion public transport trips in the EU and it was assumed on the basis of data on cancelled bus services in London³⁶ that 3% of these trips are subject to substantial delay. This suggested that there are 102.2 million trips per year in the EU on local infrequent buses with real-time information that are delayed. For such trips, most users were assumed to already benefit from the real-time information due to the availability of real-time information panels at bus stops; however, provision of such information through other channels (such as smartphones) would improve accessibility to a small proportion of users. As such, the 5-minute journey time saving was assumed to be applied to 1% of these trips. These calculations suggested an additional benefit of €444 million over the assessment period for Options 2B and 4B. This had the effect of increasing the BCR from 3.6 to 6.5 in Option 2B and from 10.3 to 14.5 in Option 4B.

³⁵ UITP 2014. Local public transport trends in the European Union, Statistics Brief, June 2014, UITP, Belgium.

³⁶ Transport for London, London Buses Performance Financial Year 2014/15. <http://content.tfl.gov.uk/annual-performance-summary.pdf>

Appendix K Organisational models

As mentioned earlier in the report, it is anticipated that a governance framework would accelerate deployment and market development by bringing together the actors required to agree and coordinate the delivery of services which meet the compatible goals of the actors involved.

One of the key aspects that the stakeholders felt was holding back the deployment of Pan-European MMTIP Services was the lack of a mechanism where various members of the value chain could meet and discuss the scope of the services.

The EC has a number of options open to it to establish an organisational model that is suitable for overseeing the definition and delivery of a suitable governance framework.

A governance framework would likely need to pay attention to the following aspects:

Table 53: Governance framework - points for consideration

Aspect of the governance framework	Possible points for consideration
Framework structure	Should the governance framework take a stance that is: <ul style="list-style-type: none"> • More stand-alone and prescriptive, or • More collaborative and consensus based?
Composition	Which members of the value chain need to be involved to ensure that any decisions are applied, meaningful and sustainable? <ul style="list-style-type: none"> • Road Operators (both inter-urban and local road authorities)? • ITS Service Providers? • Member States? • Users?
Membership of representation requirements	What should the balance be between the representation of: <ul style="list-style-type: none"> • Public and Private sector bodies • Urban and inter-urban road authorities
Decision making powers/level of autonomy	What powers should the governance framework have? How can they be formalised?
Compliance and enforcement powers	Would the governance framework have any powers to enforce the uptake of its recommendations (e.g. under the powers of the ITS Directive?)?
Accountability	Should the framework report to any higher body?
Terms of reference and remit	What is the scope of the frameworks responsibility?
Roles and responsibilities	How are the roles and responsibilities defined?
Ownership requirements	Who owns the outputs from the governance framework (e.g. IPR, specifications etc.)?
Secretariat function	Where are the notified offices for the framework? Where are the outputs stored?

An organisational model would be needed to deliver a governance framework. There are multiple options for the way in which a governance framework could be put in place. This section outlines a number of different organisational models that the Commission could follow to enable a governance framework to be put in place.

At this stage, it could be surmised that there are 4 types of organisational model that could be followed to define and oversee a governance framework:

Table 54 Organisational model options summary

Model number	Organisational model name	Summary
1	Prescribed framework under ITS Directive	Specify a governance framework under the terms of the ITS Directive
2	Collaborative forum	Establish a forum for interested parties to collaboratively define the framework
3	Appointed stakeholder lead	Appoint an existing organisation with a wide stakeholder representation to define and oversee the design and oversight of the governance framework
4	In-house development	The EC could develop and support the governance framework in-house

The remainder of this chapter will explore these above options and identify the pros and cons for each of them.

K.1 Prescribing a governance framework under the ITS Directive

The first organisational model option, would be for the EC to prescribe the governance framework under the terms of the ITS Directive.

The specification would need to take account of the different aspects of a governance framework, such as those described in Table 53.

In particular, the EC would need to identify which members of the value chain they would seek to involve in the definition and oversight of the governance framework and its outputs.

The pros associated with this option would be that the EC would be able to set the pace of the developments and require some action to take place (e.g. for MS representatives to attend a working committee).

The cons associated with this approach would include: a risk of limiting the involvement of the wider stakeholder community and thus alienating key stakeholders that would be needed to implement any targeted services; a lack of buy in due to more prescriptive approach/lack of consensus building; reduces the opportunity to do any informal market testing with key members of the value chain during the development phase.

K.2 Collaborative forum

An alternative to the EC prescribing which governance framework is to be adopted, would be for the EC to support the formation of a collaborative forum.

A collaborative approach would allow interested parties from the value chain to engage in the definition and oversight of the governance framework.

Collaborative forums typically consist of a number of key functions, such as secretariat, administration, working committees, a management committee and technical committees. Some functions lend themselves to being staffed centrally (e.g. secretariat) to ensure that the initial momentum behind an initiative can be realised. While others (e.g. working committees, technical committees, management committees) provide interested parties with the opportunity to involve themselves in the definition of a governance framework.

Collaborative forums have been utilised in a number of initiatives including eCall and the GSM Forum.

The benefit of adopting a community based approach to defining the governance framework and overseeing the delivery of services, is that the whole value chain (and not just a sub-set such as MS representatives or inter-urban road operators) has the opportunity to contribute their views and expertise. This approach helps to reduce the risk of different stakeholders feeling isolated and disconnected from the developments, and subsequently can help to raise the profile of the outputs of the governance framework with the wider community. Additionally, a more consensus led approach allows any proposed outputs to be market tested with members of the stakeholder community during the development phase.

The cons associated with this approach relate to the time that a more consensus led approach could take to delivering results.

K.3 Appointed stakeholder lead

There are a number of membership organisations with a pan-European scope who the EC could appoint to oversee the definition and delivery of a governance framework to accelerate the deployment of the necessary services.

The benefit of the EC appointing such an organisation would be that they would already have membership that covers representatives from the whole value chain, and includes representatives from the MS.

The pros of this approach would be that by selecting an existing organisation with a wide range of stakeholders is that the resulting work to define the services would be collaborative and community focused. The benefits derived from defining a governance framework could also be expected to be delivered relatively swiftly, as there would already be an existing stakeholder network and governance framework in place within the organisation.

The cons associated with this approach are that there is a risk that certain stakeholders who are not already members of the existing organisation may feel alienated. Consequently, it is important for the EC to consider the scope of the organisations membership, e.g. not too focused on only one member of the value chain (such as inter-urban road operators, as this may neglect other stakeholders such as urban nodes, or private sector service providers).

K.4 In-house development

The EC may decide that they are able to put a governance framework in place themselves in-house.

This could be achieved by utilising an existing programme (such as TEN-T) to fund the development of the governance framework, or perhaps by setting up a new division to progress the activity.

The in-house team could define the governance framework and administer any subsequent work themselves, and invite other organisations to contribute as required. This would be a more standalone approach on the EC's part; however, it does enable a wider range of stakeholders to be invited to take part.

The pros of this approach are that the EC would 'own' the timetable for any developments, and so would be responsible for the delivery of any specifications. Additionally, there some of the required administrative functions (e.g. availability of offices, marketing channels and desk officers) would likely already be in place so it would perhaps be viewed as cost-efficient in that regard.

The cons of this approach would be that the stakeholder community may feel excluded from the development of the service definitions, and so buy in may be slower.

Appendix L Management appendix

This appendix presents the contractor's view on the achievements of the study and the execution of the project.

L.1 Achievement of study objectives

The Task Specifications for the study stated the aims of the study to be "providing technical support to the Commission in preparation of a set of specifications for the priority action (a), including the relevant cost-benefit analysis, in line with the policy options for measure that will be advanced to tackle the remaining challenges preventing the emergence of EU-wide multimodal travel information services."

The study team defined specific objectives for the work required to meet these aims. These objectives are listed in Table 55 which summarises the achievements of the study team under each of the objectives and indicates which of the study reports contain the details of each achievement (to supplement the summary of results presented in the main text of this report).

Table 55 Summary of project achievements against objectives

Study objectives	Achievements
Gather evidence to establish an evidence base for analysing the current position for services and national policies	A literature review and information gathering exercise among key practitioners was carried out, identifying Member State and pan-European studies, activities and initiatives. Project deliverable D1 provides a comprehensive account of this baseline situation.
Engage with stakeholders to validate approaches and understand their drivers, constraints, concerns and how they see the costs and benefits of different approaches	One-to-one interviews were carried out with key stakeholders, a workshop was organised with 100 delegates attending from across Europe and a public consultation exercise via the European Commission web site yielded responses from 165 individuals and organisations. These consultations provided information on the drivers, constraints, costs and benefits of different approaches. This information was used in developing the policy options to be assessed and in carrying out the Cost Benefit Analysis. Deliverables D2.1 and D2.2 present the outcomes of the workshop and consultation in detail.
Identify a set of core services that would be useful to have	The expected functional content of services and their supporting data requirements was defined, covering 'minimum' functionality, 'additional desirable' functionality and 'nice to have' functionality. The details are provided in Annex E of D1.
Carry out a high level review of the standards needed to enable such services	A review of standards and protocols for data formats and data exchange was carried out, and the gaps in coverage of standards was analysed. Deliverable D1 presents the results, with details provided in Annex F and Annex G.
Identify policy options and assess their costs, benefits and implications	Policy options were developed in an iterative process during the various stages of the study, taking into account the views of stakeholders and the Member State Expert Group. Cost-benefit analysis of options looked at the costs to different stakeholder groups and benefits in terms of travellers' time savings, congestion reduction and cost savings for service providers. Economic, social and environmental impacts were assessed using a structured, stepwise qualitative assessment method. The detailed results are presented in D3/4.

Study objectives	Achievements
Use the results of the assessment to formulate a set of recommendations for policies to ensure that data is made available by operators to service providers and to define criteria for quality measures associated with the data	The results of the evidence review and stakeholder consultation were used to develop initial recommendations on policy measures. These were then refined in the light of the outcome of the qualitative and quantitative assessment of the policy options. The recommendations include arrangements for providing access to data, terms and conditions of re-use, scope of data standards and data exchange, linking services, and data and information quality.
Recommend monitoring methods and key performance indicators to be used to measure progress once the recommendations have been implemented	A monitoring framework with key performance indicators was defined, covering all of the potential policy options assessed, with recommendations for reporting on the performance monitoring. The precise selection of indicators to be used will depend on which policy options are implemented. The details of the monitoring are included in deliverable D3/4.
Support the European Commission in discussions with key working groups involved in implementing the ITS Action Plan	Members of the study team attended three of the European Commission's Expert Group meetings, including a presentation of the study at the final Expert Group meeting. Presentations were prepared for the European Commission to use at other meetings, to validate the approach being taken during the course of the study.

L.2 Deliverables

The table below provides an overview of the deliverables planned and produced. By agreement with the European Commission, deliverables 3 and 4 were combined into one document.

Table 56 List of deliverables

Number	Title	Finalised
0	Inception Report	30 June 2015
1	Interim Report 1: Review of Evidence	27 November 2015
2.1	Stakeholder workshop and report	8 December 2015
2.2	Report on Stakeholder Consultation	12 February 2016
	Presentation of stakeholder consultation results	11 February 2016
3/ 4	Interim Report 2: Cost benefit analysis, examination and comparison of identified policy options	15 April 2016
	Presentation of study results	18 March 2016
5	Final Report	18 May 2016

L.3 Expected work compared with work carried out, resources

Additional work was carried out on the Inception Report and the first Interim Report. This was largely because the European Commission's view on the scope of the work had changed between writing the terms of reference for the study and the start of work, with the result that it took longer to agree the objectives and scope of the study.

The stakeholder consultation was delayed and also extended in scale and duration. This was because of the need to ensure that the consultation did not coincide with the main summer holiday period and due to the introduction of European Commission requirements to follow EC procedures and publish the consultation on the EC web site; this requirement was introduced after the Inception Report had been finalised. The Gantt Chart for the project was revised at intervals during the project, in discussion with the EC project officer, to take account of these changes.

An amendment to the contract was made, extending the duration by two months to ensure that there was enough time to complete the assessment of policy options and final report after the conclusion of the stakeholder consultation.