Transport Direct

Guide on the use of standards for travel information and retailing

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1 Introduction

1.1 About this document

1.1.1 This document has been prepared under the Transport Direct initiative for the UK's Department for Transport (DfT) by Centaur Consulting Limited, with the assistance of Kizoom.

1.1.2 It presents a review of standards and standard-like initiatives relevant to travel information and retailing, and an analysis of where standards may be adequate to support the successful development of this industry in the UK.

1.1.3 Associated with this Standards Guide are two additional resources:

- It draws on, and should be read alongside the Catalogue CC-PR149-D005-1.0.
- It has been used to inform the Review CC-PR149-D004-1.0.

1.1.4 The authors would like to thank all those that have assisted in the development and validation of information presented herein.

1.2 Intended readership

1.2.1 There are two primary classes of people to whom this Guide (and the associated Catalogue and Review) is addressed:

- The direct audience is those involved in establishing and providing travel information services, or travel retail. The documents cover the standards relevant to these areas, particularly for non-specific services (ie independent of specific transport providers).
- There is an important indirect audience too: those whose role includes the collation and provision of necessary 'back office' data, without which travel information services cannot happen. This includes the provision of network data, operators' fare tables, information on current incidents etc.

1.2.2 Note that this guide does *not* address the full standards needs of this indirect audience. Operational standards are only included where there is a clear impact on "travel information and retailing". There are many standards applicable to transport technologies which relate to network management, logistics, enforcement etc, and which are not included here; the focus of this work is firmly on the interaction with the end user.

1.3 How to use this guide

1.3.1 This guide is presented in three principal sections, together with annexes.

- Section 2 describes standards in the abstract, and outlines some of the benefits (and costs) associated with their use.
- Section 3 applies this to the travel information and retailing context, from the point of view of different positions within the transport value chain.
- Section 4 further refines this to address the current (actual and potential) value of standards in specification application areas.

1.3.2 The Annexes to this Guide takes the form of a set of brief profiles, each describing a possible approach to standards use from a particular generalised perspective. While the main text is intended to assist readers in understanding standards and their potential, the profiles may provide models for individuals to adopt (or vary).

- Annex A is geared to the direct audience of travel information service providers and retailers.
- Annex B is geared to the larger audience of those managing transport operations and infrastructures, who need to provide information to the public either directly and/or through third parties.
- Annex C covers a small number of important additional data sources, not directly related to transport, which is important input to travel information services.

Deciding which standards to use

1.3.3 There is a wide range of standards applicable to travel information and retailing, and the Catalogue skims them briefly. This Guide takes the Standards Catalogue as its input.

1.3.4 Neither the Catalogue nor this Guide is intended to be prescriptive, or indeed exclusive. These are the perspectives of the authors only. However, the intention is that these analyses may give readers an informed head start in developing a standards policy suitable for their own local context.

1.3.5 Criteria for evaluating a standard include both technical considerations – how well does it represent a problem, what technologies does it use, and organisational – how mature is the standard, is it actively supported, how long will it last. We offer a brief checklist of criteria later.

Involvement with standards development groups

1.3.6 Standards are not static and final, but are evolvable tools that can be improved to meet changing business requirements. User organisations are in a position not only to adopt standards to obtain specific advantages, but also to influence and guide the development of current and new standards so that they address its specific ongoing requirements. Participation may be direct or indirect (eg via representative trade bodies).

1.3.7 Involvement has benefits in two directions: participants can both provide leadership to their partners and suppliers that influences and accelerates progress in a way that meets their specific objectives, and through the standards process they can gain access to valuable specialist know-how to evaluate approaches to implementing their requirements.

Maintaining the profiles

1.3.8 This Guide is a snapshot of the state of play as seen by the compilers around the beginning of 2007. To maximise its utility, the Annexes in particular have been developed so that it may be updated by relevant experts as circumstances develop.

1.3.9 First, it is recognised that although every attempt has been made to present an accurate and balanced picture, there may remain errors and omissions. Second, and equally importantly, real-world developments will mean that the picture changes over time: some standards

1.3.10 The intention, therefore, is to make this Guide available online to users; to have a process by which readers can submit changes/additions to the Usage profiles in particular; and potentially also to appoint a number of contributing editors, who can amend the entries as appropriate.

2 What are standards, and why should I consider them?

2.1 The nature of standards

2.1.1 The term "standard" is widely used to cover what is in practice a range of concepts. For the purposes of this guide we have deliberately taken a very broad approach to the term, considering the following:

- *formal* standards developed and ratified by established Standards Development Organisations (SDOs), and *pre-standards* being developed under a formal standards development process;
- *informal* standards, developed and maintained by an organisation other than an SDO;
- *de facto* standards, that is frameworks/specifications/protocols that have achieved widespread acceptance, and to which there is market pressure for developers to conform – some of which are open and some of which are proprietary;
- recommended approaches and 'best practice' guides applicable to a community;
- research and development projects which have as a key aim the production of a specification which might feed into standards etc.

2.1.2 Purists prefer to retain the term "standard" to refer only to publications of SDOs, preferring terms such as "specification" for other items in this list.

2.1.3 ***Formal*** standards are those mandated by formally established bodies such as National (BSI), European (CEN) or World (ISO) standard organisations. They all operate to international conventions and processes for drafting and approving standards, and importantly many of their publications have legal standing. Such processes are generally slow: 2 to 3 years is considered "fast". The reason is that development and consultation with multiple stakeholders internationally is a cumbersome process, and formal standards also involve some bureaucracy. The value of the process lies in exposing any changes to consideration by many different experts, stakeholders and viewpoints, subjecting it to robust review. Effective standards generally have a well developed process for introducing further changes in advance of formal ratification. However, because of the length of this process, formally adopted versions of the standards can trail a long way behind industry use.

2.1.4 ***Informal standards*** (whether ***frameworks***, ***specifications*** or ***best practice guides***) are typically developed by consortia of organisations which represent a wide spectrum of operational interest within a specific sector. While they typically have no legal status, they are valued inasmuch as they represent the consensus position, and the 'distilled wisdom' of industry leaders. Organisations of this kind include both general technology bodies – the World Wide Web Consortium (W3C), European Broadcasting Union (EBU), Object Management Group (OMG), Open GIS Consortium, etc – and also transport specific groups such as the Real Time Information Group (RTIG) and ITSO.

2.1.5 In the relatively fast evolving world of information technology, it often happens that specific products, frameworks or components achieve a critical mass of functionality, users and support from major industry users. This gives rise to a common practice, which is well established, although not (necessarily) universal and without a formal status. These become known as ***de facto*** standards. Examples include both open source frameworks and formats and certain proprietary products (eg Microsoft Windows™). The boundary between informal standards and de facto standards is indistinct: many standards have started out as *de facto* by virtue of wide market uptake and then become more fully supported as an informal standard.

2.1.6 ***Candidates*** for standards in all of the above kinds can emerge from any source. Sometimes a standard will arise within an organisation as a result of specifically identified need; but in other cases it may arise from a deliberate initiative to render an IT problem tractable. External developments that lead to 'standards' are typically research projects; those relevant to this context have generally come either from projects funded either by DfT in the UK, or by the European Commission, or by other national governments; but they could also arise from private projects. A standard in the process of being formalised is sometimes called a 'prestandard', and this is indicated in its reference number (prEN 99999 rather than EN 99999, etc).

2.2 The value of standards

2.2.1 The use of standards is desirable for both business and technical reasons. The principal benefits of standards are:

- protection of investment;
- interoperability;
- improved quality and value.

Protection of investment

2.2.2 Standards based products should be available from a number of suppliers at a lower cost (because investment is shared with many other customers) and have a longer lifetime, hence providing specific advantages:

- **Modularisation & Incremental Deployment:** A standard that introduces a well defined modularisation based on proven separation of concerns not only has technical advantages, but also allows for an incremental approach to adoption that will allow users to spread their investment in standards over an extended period. A basic version can be rolled out with the confidence that additional functionality can be added coherently when needed in the future.

- **Choice of Suppliers:** Systems that use interfaces based on standards can be implemented as discrete pluggable modules which can be chosen from a wide variety of suppliers in a competitive market. The risk of lock-in to a product or supplier is significantly reduced over a monolithic proprietary system from a single supplier.

- **Reuse:** The use of standards can significantly reduce the costs of specifying, tendering and integrating a system, offering cost savings to all parties.

Interoperability

2.2.3 Systems typically use data from a wide variety of external and internal systems. Developing and managing the interfaces with such technically diverse and possibly incompatible systems is expensive and time consuming. It involves the technical and organisational coordination of multiple stakeholders. Specific benefits include:

- **Roadmap for Evolution**: Standards give a clear specification for staged implementation and for further evolution that all parties can work to over time, accompanied by versioning and migration processes. The rationale for the standard is based on clear technical principles.

- **Data management:** Reduced costs for encoding and managing data through the availability of better tools, more automated processing, and the reuse of sharing of data with other stakeholders.

Quality and value

2.2.4 Standards based products represent proven components that have evolved over time. As such they usually have a higher level of generality and abstraction than one-off custom solutions, and have been extensively tested in a wider range of environments.

2.2.5 Key benefits are thus:

- **Risk Reduction:** The use of proven interfaces reduces business and technical implementation risk.

- **Better Abstraction:** Well evolved standards and frameworks generally offer a more comprehensive function than a one-off custom design and are more robust. The introduction of well thought-out abstractions can also show how to make difficult problems simple and tractable.

- **Better Testing:** Well defined interfaces allow the systematic automated testing of each functional module, vital for managing the complexity of the increasingly large and dynamic systems that internetworking leads to.

- **Process & Tool support:** Most standards are accompanied by conformance criteria and in many cases testing tools.

- **Modularisation:** A particular consequence of good abstraction is that it leads to clear decoupling of unrelated function. The use of separate modules with clearly defined interfaces reduces dependencies. Individual functional modules can be replaced or evolved, without unexpected breakages of obscurely dependent function.

- **Reuse:** A key principle of formal standards processes is that where possible standards should build on other standards and reuse existing investment. Many technologies facilitate this; in particular, communications standards frequently adopt the philosophy of “layers” so they can work with each other as flexibly as possible.

2.3 Standards use in travel information and retailing

2.3.1 Travel information and retailing affect:

- all transport modes (walk/cycle, car, bus, coach, rail, air and ferry);

- all stakeholders that participate in the travel experience (network operators, fleet operators, information service providers, retailers of travel services/systems, and travellers themselves); as well as other types of users for whom information about the transport infrastructure is important – e.g. urban planners, policy makers, local business, etc.

- all information delivery mechanisms (PCs, kiosks, mobile devices using SMS (Short Message Service)/WAP (Wireless Application Protocol)/GPRS (General Packet Radio Service)/3G, digital TV, etc).

2.3.2 There is therefore a highly complex network of communications between the different stakeholders, and we have seen that one of the roles of standards is to make such communications easier and more effective.

2.3.3 Equally, an individual organisation will often have a complex set of systems that need to work together, some of which are fairly generic (eg accounting and personnel systems, voice communications) and others of which are quite specific to their industry position (eg scheduling systems or ticketing systems). These systems will be bought in from different suppliers, and again standards can help to ensure their interoperability.

2.3.4 For both of these aspects, the organisational structure of the travel information and retailing industry is a key driver for the use of standards, and this section provides an overview of this. It is necessarily concise and does not preclude new business models arising.

2.3.5 There is no single way of fairly representing all stakeholders. However the 'enterprise map' for travel information and retailing can be reasonably well described using two separate views. These are described in the following sections:

- the value chain view;
- the applications area view.

2.3.6 The annexes to this document provide a number of 'usage profiles' for specific stakeholders.

3 Standards in the transport value chain

3.1 Structure of the value chain

3.1.1 The value chain takes the view of relationships as based on the function of one stakeholder delivering a service to another, usually in return for money.

3.1.2 Many different types of organisation will be involved in the delivery of travel information services. There is no definitive operations model, but Figure 3-1 shows some of the key service roles, in a highly simplified diagram. On the left hand side, a traveller uses a travel service which employs vehicles and networks. On the right hand side are the systems covering data collection, retail and information services, and traveller systems.

3.1.3 Of course, a single organisation might fulfil one or more of the roles identified in the model; thus, a bus company that collects data from buses and provide information to travellers via website or kiosk fulfils all the roles. And of course this diagram hides a wide range of technical factors – for instance, pre-trip planning from a home PC over the internet is very different from in-trip traveller support of real-time information through onboard display systems.

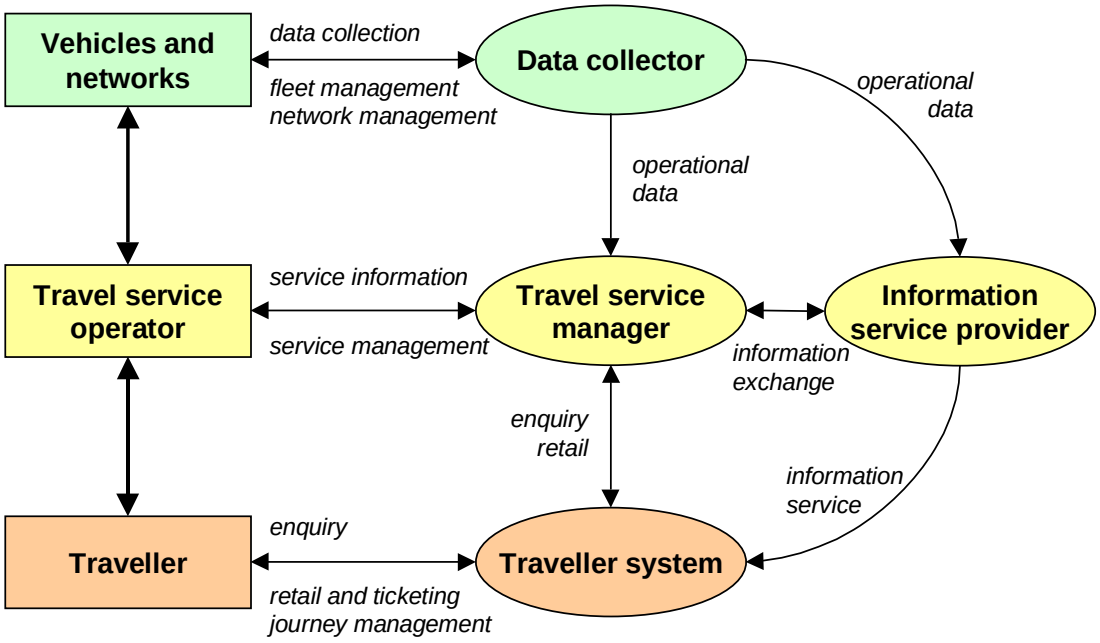

Figure 3-1: A very simple operations model

3.1.4 This leads to a principal value chain of three parties:

- **travellers** need to be able to get their information and access to travel services as quickly, easily and cheaply as possible; they may obtain this information as part of their ticket, or as a separate service;
- **transport operators** need tools that meet their various business needs; they have a requirement to inform staff and customers and to support their brand.
- **information service providers** may act as intermediaries, aggregating and adding value to information obtained from transport operators which they deliver though specialised products such as printed timetables, ticketing services, information web sites or mobile channels. Transport operators may act as their own information service providers,

3.1.5 Other parties are involved in shaping and servicing this principal value chain:

- **policymakers** need to set policy guidelines at national, regional, business, technical and operational level;
- **systems integrators** need to respond to the vision of policymakers and developments by competitors/partners, aiming to position themselves to serve their customers' needs;
- **product suppliers** need to have competitive modern products specialised for the market and to achieve economies of scale through use of standards;
- **systems developers** need to have the specialist technology skills and transport domain expertise to be able to build system.

3.1.6 In this value chain:

- Travellers may acquire and use consumer electronics, but most of these will be generic and not under the travel industry's control (eg mobile phones or internet PCs). The exceptions are travel-specific devices (eg transport smartcards using ITSO) but even with these there is a tendency to make the device as generic as possible (cf the standards for audio trigger keyfobs for the visually impaired), with European or global economies of scale.
- Transport operators are usually corporate entities, sometimes quite large, which use a considerable quantity of assets and personnel to deliver transport services. They invest in technology to help them to manage their operations; some of this involves interacting with their traveller customers, while some is internal to the organisation. Interaction with other transport operators and with public organisations such as the emergency servcies is also often important.
- Systems integrators take the role of identifying needs, developing specifications, acquiring and integrating products, testing, and maintaining systems operation. These may be embedded within a transport operator's organisation or may be external (or a mixture of both).
- Product suppliers may work with transport operators directly but are often engaged though system integrators. They are technical innovators and their aim is usually, as private sector operations, to grow their business by meeting their customer needs profitably; although system integrator capabilities may also exist within a transport operator or public sector organisation (eg Transport for London).
- System developers are the individual technology specialists who may work for any of the organisations involved in the value chain and need to have a current knowledge of relevant standards as part of their professional skill sets.
- Policymakers have a role to ensure that the marketplace works to the overall advantage of their constituency, whether this be national or internal to an organisation. They may set up matters to change operational process, or direct the procurement and implementation of systems. Policy makers may be concerned both to ensure that the transport systems are efficient and sustainable in themselves, and that the access to other resources for example hospitals is optimised for other criteria.

3.2 Standards for different stakeholders

Travellers and transport operators

3.2.1 Travellers do not have an interest in standards *per se*. Their interest is a contract of conveyance, and their overriding need is for this to be achieved well. Where systems can assist they are welcomed. Whether these systems use standards or not, and if so which, is not something they generally care about. (There may be exceptions of 'fashion', as happened with digital mobile based on GSM (Global System for Mobile Communications) and more recently Apple™ iPods™.). Consistency of user interfaces and behaviour are however important for ease of use and uptake. Where technologies are relevant for consumer devices, as for mobile travel services, personal navigation devices, or key fobs for the visually impaired, travellers are concerned that they should be widely supported and durable.

3.2.2 Transport operators are similarly not really interested in standards per se. However they can see direct benefits from their use, primarily as a tool for reducing complexity (and so cost) in the procurement, development and management of systems, and in ensuring a wider choice of suppliers. Because of the expense of data management, certain types of standards are however very strategic to the economic performance of operators systems

Implementers and developers

3.2.3 From the implementer's perspective, standards fall approximately into the following groups:

- ***General technology standards:*** Global 'standards' for IT, internet and telephony are applicable to the majority of travel information and retailing systems. At a higher level, the wide range of formal standards and best practice guides are typically generic to systems and apply across the industry. There are also 'framework standards' – languages, notation systems etc – which are used to formulate specific standards. For standards in these areas, however, there can still be significant choices to be made – for instance, the telecommunications standards suitable for a fleet manager may be very different from those suitable for an internet travel retailer.

- ***Transport operations standards:*** A number of standards are designed to support the exchange of information primarily for operational management purposes – TransXChange, RJIS-CIF (Rail Journey Information System), Transmodel, DATEX, UTMC (Urban Traffic Management and Control), etc.

- ***Traveller service standards:*** A further set of standards support the exchange of information between travellers and other stakeholders. Most relate to devices (DVB (Digital Video Broadcasting), kiosk standards, ITSO, etc) or information presentation (eg RDS-TMC (Radio Data System – Traffic Message Channel) and TPEG (Transport Protocol Experts Group).

3.2.4 There are some transport standards which are applicable across several modes, in principle if not in practice. However even the more general standards and projects have been developed in a specific modal context, and therefore have not been designed for or tested against the requirements of other modes. There is still a degree of inertia or resistance in taking, for instance, TransXChange into the rail domain, or UTMC or DATEX into public transport.

Policymakers

3.2.5 Policymakers are concerned to ensure that an appropriate degree of consensus is reached to achieve benefits, such as rapidity and ease of implementation, without stifling innovation. Typical they will be concerned with the following aspects of standards:

- **Maturity.** Standards typically begin with a candidate solution that is then refined into a more general and robust standard, through a process of consultation and ratification, gaining consensus and uptake along the way. Thereafter there may be further refinements arising from experience. Judgement is needed to decide when a standard has reached a viable degree of capability and support: typically this is well before it is formally ratified. Consideration should also be given as to its remaining life As technology changes the standard will eventually become obsolescent.

- **Openness.** Formal standards are openly published, and industry standards usually are too. *De facto* standards may not be, or may be so only to a limited extent (cf the Windows™ suite of operating systems for PCs). Lack of openness may give competitive advantage to insiders.

3.2.6 Policymakers will generally focus on open standards, as described. However, this may not always provide the best solution for a specific problem. Some standards will not be fully open (for example NTCIP in openly specified but the IPR is retained by the publisher).

3.2.7 From the policymaker's perspective, standards fall approximately into the following (overlapping) groups:

- ***Global context standards:*** Global 'standards' for IT, internet and telephony form a diverse category of emerging and established standards, including both formal and proprietary or partly–open standards. These are areas where a policymaker may have little practical choice in adoption of a standard, being driven by market forces and the availability of suitable 'commodity' equipment, services and skills.

- ***Accepted local standards***. Standards which may be indicated for adoption by policymakers within a particular geographical region include both formal open standards (DVB/DAB, DATEX, etc), standards which have been agreed on a local basis (eg ATCO-CIF or TransXChange), and open frameworks (eGIF, UTMC etc). Any individual policymaker will have a greater or lesser ability to influence the evolution of these, although to an extent these are already 'in the market' and therefore major change may be difficult.

- ***Potential or emerging standards***: Not all standards are fully implemented (eg ITSO, UTMC, SIRI (Service Interface for Realtime Information), TransXChange and some formal standards); and some may still be in the process of development. An increasing number of standards are built in an evolvable structure, and are updated or extended more frequently than is traditional; getting the right balance between fixity and functional coverage can be a difficult path to tread, and the policymaker has an important role here. Ideally a large standard will be designed so that it can be adopted incrementally in modules to meet business requirements. In all cases should be designed so that they can be enhanced and that concurrent versions can exist side by side.

4 Standards in transport operations contexts

4.1 Introduction

4.1.1 As a method for identifying the roles of different travel information standards, a series of model usage profiles have been developed and are listed in the annexes. These are intended as a tool to make an outline functional analysis of which standards are relevant for what purpose, in specific application areas, serving both to map the existing standards base, and to identify gaps.

4.1.2 The discussion in this section provides a kind of overview, giving an indication of the 'bigger picture' in which the individual profiles sit.

4.2 Business and data modelling

4.2.1 Some standards are designed to support the modelling of business data and business process *within* an industry, and its specific problem domain and organisation. The role of a standard here is to save time and to reduce risk in the development of system design by reusing proven design models and specifications and to enable a well-aligned market, as well as to support interoperability between different systems.

4.2.2 The pre-eminent standard here is the European reference data model Transmodel, covering all aspects of public transport. Transmodel has been referred to as a standard for standards-makers, because its data model has been used in specific contexts such as SIRI, Trident and (in the UK) TransXChange. Reference models are especially valuable for harmonising terminology and concepts between similar existing systems as they provide a rigorous context within which to compare slightly different uses for terminology and abstractions.

4.2.3 For road transport and traffic management a comparable function is provided by DATEX, although the update to DATEX II is still fairly immature; within the UK, the UTMC framework covers many aspects of the road network, although it is not specifically oriented to travel information and has been harmonised at a European level.

4.3 Reference data

4.3.1 Certain types of data are essential to describing travel and are used in many different standards.

- Place: Location referencing methods range from individual latitude/longitude points through to point/area of interest catalogues and place name gazetteers which allow location relative to named entities. Ordnance Survey maintains the Integrated Transport Network (ITN) dataset, and other information layers may be located in space both by location and by explicit reference to ITN features. The Digital National Framework is the structure by which different layers of information are coordinated. NaPTAN (National Public Transport Access Node database), the NPTG (National Public Transport Gazetteer) and the emerging IFOPT (Identification of Fixed Objects in Public Transport) are in effect public transport feature layers that model transport specific relationships of place. In-building locations can be modelled in either the mapping or the PT layers or both – a transport view of an interchange includes knowledge of how points such as platforms and boarding position etc relate to transport services as well as the physical infrastructure. It should be remarked that notions of place in travel information services are often remarkably subtle.

- Time: Time is generally simpler to model. Coordinated Universal Time (UTC) prescribes a canonical format for absolute dates and times, with overlays for time zone, summer time etc. Day types are used in public transport systems to characterise day of the week and holidays independently of a specific calendar year and are now fairly well standardised. Some difficulties still arise, eg over how to combine complex availability conditions. There is also a standard W3C data type for duration that allows intervals to be compared and combined.

- Personal identity: In arranging transport, the human is a fundamentally important entity. In order to use some types of information service – for example to make a booking or to set up an alert – a representation of identity is needed. Typically unique internal and external tokens will be needed – for example a system user name, email address, mobile phone number, or an address. Usually they will need to be accompanied by secure mechanisms to ensure privacy, requiring further data such as passwords, PINs (Personal Identification Number) or biometrics. The identity must increasingly be usable between systems. The collection and exchange of personal data is constrained by data protection legislation.

4.4 Presentation of information to travellers

4.4.1 Travellers get their information from a wide range of channels, which may be generic or personalised. The channels which are most likely to be of value depend on where the traveller is in their journey. Generically, we can distinguish seven main channels (in historical order), though there is considerable overlap and convergence in the mobile channels:

- Signs and display panels, in public spaces or on transport systems, which may be pictorial but are more likely to be limited to brief text, and may also have audio information.

- Information provided using broadcast media (radio or TV, Teletext, or perhaps now podcast/streamed media).

- Voice-based enquiry services over the phone interacting with either a human operator (acting as a proxy to access web or other systems), or an automated IVR system.

- Web based services, usually interactive, and capable of engaging maps or other graphics.

- Mobile messaging services that push messages to devices: Pagers, short-message text services provided over customer devices, and email. Typically these have limited bandwidth and require the digesting of message content into a few characters of text.

- Mobile data services using pull services either based on a generic browser (eg using WAP/xHTML) or a smart client.

- Information provided using other dedicated consumer devices with significant onboard computing power and data – satellite navigation systems being the main example.

4.4.2 Signs, panels and audio/PA systems are found in many different generations of technology and sophistication. Presentation is typically driven by the equipment's capabilities, though there are some end-user requirements that are standardised – for example, DfT standards on permissible VMS (Variable Message Sign) messages or RTIG guidelines on accessible public transport information, RNIB (Royal National Institute for the Blind) guidelines on visibility, etc.

4.4.3 The broadcast domain is covered by both broadcast standards such as DAB, as well as specialist transport information standards including RDS-TMC and TPEG.

4.4.4 Web channels have a number of aspects that benefit from standards. Web usability and accessibility guidance are relevant to user interface design, and some de facto conventions are established for effective services, for example journey planning. The existence of web-based data exchange standards for accessing information (eg DATEX II, Journeyweb, SIRI) enormously reduces the cost of building such services.

4.4.5 For limited bandwidth channels like automated voice or SMS text, certain standards relevant to end-users may be useful to simplify service delivery and relate the service to the real-world – for example, nationwide bus stop short codes from NaPTAN, or the use of three letter codes for rail stations.

4.4.6 Satnav and personal navigation devices are proprietary products and the only standards required are probably those regulations related to driver distraction.

4.5 Journey planning

4.5.1 Journey planning is an area where the market development has been dramatic over the past few years, enabled by both broadband communications and cheaper computing. Ten years ago, journey planning largely meant browsing maps and timetables, making phone calls, and consulting professionals (travel agents or travel centres). Five years ago, there were some specific electronic planning services available for most individual modes: rail (qjump, thetrainline), air (travelocity, expedia), and road (AA).

4.5.2 Today, on-line journey planners are widely available and increasingly sophisticated, incorporating real-time and map data. Organisations are able to integrate journey planning capabilities with their other online services and users routinely expect to find on-line journey planners available. While travel agencies still have access to data sources provided by transport operators, similar information is now available publicly; and there is an increasing range of journey planning intermediaries.

4.5.3 JourneyWeb is a framework for distributed journey planning and includes both a collaborative architecture and an XML (Extensible Markup Language) protocol. Nevertheless, much of today's journey planning marketplace seems to work quite well using proprietary mechanisms and protocols.

4.5.4 Base data standards exist to ensure that coherent data is available with which to create multimodal journey plans. Some already exist (such as NaPTAN); other standards and datasets have been identified and are still in development, notably those covering car park data and the IFOPT (Identification of Fixed Objects in Public Transport) standard for describing connectivity within transport interchanges as well as also facilities). As regards base data, the processes to collect and maintain the data are almost always harder than the technical standardisation step.

4.6 Travel retail

4.6.1 Like the other functions described above, travel retail covers a wide range of contexts and service interactions. Products and transactions vary enormously in complexity: the simpler include the sale of individual travel tickets to a transport operator's own member of staff, and unmanned ticket dispensers associated with a transport operator. More complex products

4.6.2 Reservation and booking information standards are developed and maintained internationally by OTA (Open Travel Alliance), specifically with air travel in mind but of wider applicability, and by the UIC for rail. In the UK there are some local standards, such as those developed by ATOC (Association of Train Operating Companies) for rail (RJIS-CIF etc) and by ITSO for smartcard products.

4.6.3 There are no UK standards yet in place for car park payments; currently these operate as single-operator systems. Also, road use charging is not mature – though a lot of architectures have been piloted, and there are relevant published standards (eg CEN (European Committee for Standardisation) EFC standards EN14906/14907 and the DSRC (Dedicated Short Range Communication) standards).

4.7 Communications – connectivity

4.7.1 Generic communications protocols are determined by a global marketplace: telecommunications standards such as DPNSS (Digital Private Network Signalling System), ISDN (Integrated Services Digital Network), GSM/GPRS are established either worldwide through the International Telecommunications Union (ITU) or regionally/nationally. The same applies to the Internet Protocol Suite and associated technologies.

4.7.2 The 'layering' philosophy used to build such standards means that the transport layer is typically transparent to the actual applications: for instance, IP networks can be configured over a complex mishmash of different bearer systems, and higher level protocols can be built over IP without knowledge of its details.

4.7.3 A very few lower-layer communications standards are constructed specifically with a transport environment in mind: DSRC, CALM (Continuous Air interface or Long or Medium range communications), IEEE802.11p, GSM-R, RDS-TMC. Almost all of these are geared to communicating with a mobile unit. TPEG, while not specifically geared to vehicles, does seek to be accessible from vehicles.

4.8 Communications – data exchange

4.8.1 Travel information systems need to exchange data using efficient protocols, especially if they must operate in real-time. Both generic transport protocols (all IP based), such as SMTP (Simple Mail Transfer Protocol), FTP (File Transfer Protocol), HTTP (Hypertext Transfer Protocol), or JMS (Java Message Service) may be appropriate (passing payload as files or strings), or customised protocols that have domain specific messages. The latter will typically be built in a general purpose technology designed for this specific purpose such as such as XML, SOAP (Simple Object Access Protocol) or CORBA (Common Object Request Broker Architecture).

4.8.2 XML provides a framework technology for describing both payload data and control and protocol messages. XML can be used in conjunction with different transport protocols, typically describing the data structures within the file or string that is exchanged by the generic transport protocol.

4.8.3 If a closer process coupling is required, say for speed, this can be achieved through programming languages such as Java, .net, remote SQL (Structured Query Language) etc or through the CORBA framework

4.8.4 Transport Information services often involve large complex data sets and so there is often a need to have specific optimised message sets geared to particular problem domains, for example real time departures, or journey planning.

4.8.5 Currently the following are used:

- Business-to-business services now almost entirely use XML as their framework technology: SIRI (for real time public transport), DATEX II (for traffic management), TIH (Travel Information Highway)/OTAP (Open Travel data Access Protocol) (for travel information), UTMC (also for traffic management), TOPAS/TORIX (for leisure products and bookings), JourneyWeb (journey planning) etc.

- Some messages sets use CORBA either as an alternative to, or in combination with, XML.

- TPEG has an XML representation but can also be used independently of XML.

- Some legacy protocols still define their messages more explicitly and without using the framework of XML (eg VDV (Verband Deutscher Verkehrsunternehmen), RJIS, Unicorn). These can all be adapted via 'packaging' into one or more of the above formats, and in some cases are being so adapted (eg VDV protocols migrating to SIRI).

4.9 Host computer networks

4.9.1 Computer platform standards are determined by a global marketplace, and transport users simply adopt them:

- operating systems typically based on Windows™ or Unix/Linux;

- local networking typically using one of the IEEE802.x standards (Ethernet, WiFi etc), but sometimes with variation (e.g. CANbus for on-vehicle networks);

- database management systems typically using SQL for querying and ODBC (Open Database Connectivity) for data access;

- increasingly, internet-accessible services using control languages and frameworks such as Java, ActiveX and Web Services.

- XML validating and parsing tools used to create WSDL (Web Service Definition Language) and other bindings.

5 Technology layers and system standards

5.1 Introduction

5.1.1 Modern information systems typically involve many different technologies: hardware, software and communications. To manage this complexity, technology is organised into physically separate layers representing different levels of abstraction of, for example, office software works "on top of" operating system software, which works "on top of" PC hardware. In a properly designed software architecture, function is encapsulated in the appropriate layers so that it may be evolved independently of the other layers, and there are standardised interfaces both between layers and between modules within a layer. There may well be corresponding components in different layers – for example a database that corresponds to a data exchange interface, both conforming to a conceptual model. A guiding principle of CEN and ISO work is that where possible standards should be built on existing standards. In analysing standards it is helpful to understand at which level of abstraction the standard applies, and what are its dependencies.

5.1.2 Different aspects of systems are subject to different types of standards – and quite different types of standards are relevant for different aspects of system development. For example data exchange of timetables might be described by a concrete XML schema describing timetable elements and a set of XML messages with which to exchange the timetables (an executable or 'hard' standard); whereas guidelines as to how to display designs for maximum readability for the visually impaired might be described by a 'Soft standard' - a best practice guide.

5.1.3 Typically generic standards are used for lower level layers so as to harness low cost commodity platforms, whereas domain-specific standards are needed for applications that are built in the higher levels.

5.2 System design

5.2.1 The fundamental programming models, frameworks, and design techniques used to build software applications have continued to mature, but have not changed radically since the last version of this catalogue. Most main stream development of software applications uses object-oriented (OO) technology (e.g. JAVA or C#) built with a large set of reusable components frameworks (e.g. .net, or J2EE) whose capabilities channel the way applications are built: typically standard mechanisms will be reused wherever possible. The use of XML as a universal data exchange format has become more widespread, increasingly replacing flat file formats such as csv, mainly because of the richer expressiveness, widespread tool support, and the relatively loose coupling it allows between systems, though ORBS (Object Request Brokers) (e.g. CORBA) are still relevant for high performance networks. XML may be combined with different transports (e.g. http, SOAP, TCP/IP sockets). Relational databases are ubiquitous for persistence stores. The schemas for the content models of the interface protocols and in some cases the associated database schemas can be viewed as the fundamental design artefacts.

5.2.2 The Unified Modelling Language (UML) is well established as the most widely used design notation to specify applications: it allows for a platform neutral description of common architecture, processes and conceptual models. Other potentially more expressive representations (such as "ontologies") are being developed, and indeed explicitly being applied to transport data (as in the NTDF (National Transport Data Framework) project) and may become more significant over the next few years as the tooling and applications that use them are developed.

5.2.3 Protocol design is a common concern for transport standards. Experience of building internet worked applications has advanced design thinking on the most effective patterns of interaction

5.2.4 For passenger information services it is likely that system design will increasingly move towards exposing services as fine grained dynamic web services. Certain de-facto standards, such as the Google Maps API will be significant in this context

5.2.5 Communications between systems for many years used the Open Systems Interconnection (OSI) framework developed by ISO, and this framework – which introduced the concept of "layers" – is still helpful as an abstract tool. A variety of frameworks have developed more concretely around the Internet Protocol Suite. Applications may now typically assume broadband IP connectivity as a commodity capability

5.2.6 In the UK, the e-Government Interoperability Framework (eGIF) is a useful data specification framework for the public sector at large. It includes specific guidelines on the use of XML that are relevant for all XML standards, such as the inclusion of systematic versioning, namespaces, metadata, etc, and a library of reusable schemas.

5.2.7 Architectural frameworks also exist within specific sectors. KAREN provides a pan-European model of transport system requirements and functions (and there are similar frameworks in the US and in Japan). Also European in impact, Transmodel provides a generic logical data model for public transport. More locally, UTMC provides a holistic framework for road traffic management.

5.3 Specific system standards

5.3.1 Systems standards may be 'specific' and relevant only to transport, or to a particular area of transport, or 'generic' in that they apply to IT generally.

5.3.2 Typically, though not universally, generic standards are used for lower level layers so as to harness low cost commodity platforms, whereas domain-specific standards are needed for applications that are built in the higher levels.

Application data presentation

5.3.3 Standards are also relevant for certain immaterial aspects of systems such as user interfaces for the presentation of information, security and access control, accessibility etc. These are often domain specific because the efficiency of presentation is closely tied to the nature of the information. (For example conventions to present train arrivals or departures as late or on time, or how to input to a web journey planner, have different requirements.) Presentation standards are often de facto – for example the interface popularised by Google Maps™.

Application services

5.3.4 Application specific services carry out not just data exchange but application specific functions; for example to make a booking or a payment, or to draw a route on a map. Application services may be delivered either as a low level system to system interface, or as a client and user interface. The former approach is frequently used in modern internet-based e-commerce systems, though the latter ("remote terminal") approach is still widely used within organisations or in closed communities.

5.3.5 Examples of the former approach include TORIX (Tour Operator Reservations in XML); examples of the latter include Unicorn.

Application data exchange

5.3.6 Application data exchange standards describe how information should be exchanged between different systems in a way that can be implemented in software. They prescribe specific protocols for exchanging data in appropriately sized packages at appropriate intervals for the specific application, with appropriate error handling and recovery.

5.3.7 Application data exchange relies on commonality of understanding, so presupposes agreement on a conceptual data model that both producer and consumer system will be adhering to. This means not just the structure of the model but also content to ensure unique reference. Thus, unambiguous descriptions are required of all data types and data reference identifier systems to be used, for:

- data and time formats (typically in UTC);
- entity identifiers: stop identifiers, (eg using NaPTAN codes); operator identifiers etc;
- language codes (using ISO code set);
- etc.

5.3.8 A primary consideration of the protocol is which actor initiates the exchange – some protocols need to be triggered by the producer system, others need to be triggered by a query from a consumer system. The decision as to which pattern or patterns to use must be related to the application requirements and flow of events, and will represent a trade-off to achieve an optimal balance between minimizing latency, versus use of computational resources such as bandwidth, CPU (Central Processing Unit) and memory.

5.3.9 Interoperation between stakeholders typically requires data exchange between heterogeneous systems. The process of achieving this inevitably results in a "lowest common denominator" approach, one which is it viable for all parties to adapt to; the risk, of course, is that information is lost or misunderstood on the way, and standards makers pay great attention to minimising this risk.

5.3.10 Base data and real-time data exchange both require exchange protocols – but they have different constraints. Base data is not time-critical and may be bulky, while real-time data is urgent and so messages may be compact and easy to process. This distinction requires careful engineering of the communication architecture, including consideration of recovery and startup overheads; thus real-time data exchange should be considered as application specific, rather than simply as an instance of a general technology such as FTP or SNMP (Simple Network Management Protocol) or queuing middleware.

Application domain models

5.3.11 Transport and travel constitutes a complex application domain; the data models needed to represent transport operations are also complex, and specific to the sector.

5.3.12 A great deal of work has been carried out in the past 15 years to try and establish general Public Transport (PT) information models, culminating in particular in Transmodel, the CEN model for PT information. Roads data is similarly complex, having a static network layer, historical timing data and real time data layers. Public transport management requires information about roads, and also (potentially) can supply information about road conditions. Nevertheless, the PT and Roads application domain models have historically been quite distinct (though there are a number of initiatives, including DATEX2 on the European scale and nascent work in the Joint Technical Group in the UK, which are trying to address this).

5.3.13 Domain Models may have:

- *Abstract* (conceptual) expression – as an ER (Entity Relationship) model, OWL (Web Ontology Language) & RDF (Resource Description Framework) ontologies, UML diagram, etc; Conceptual models provide a design tool with which to understand the data structures of complex systems, and in particular to compare different implementations and domain standards.

- *Concrete* (codeable) expression – as a relational database schema in SQL (Structured Query Language), an XML schema, or an Object Model in a programming language such as Java or C##. Sometimes there will be an automatic transform from an abstract model to one or more concrete schemas.

An example of the former is Transmodel, of the latter TransXChange.

5.3.14 One general domain subject area – geographic and geospatial data – while not strictly part of Transport Standards, is in particular relevant to and frequently referenced by many types of transport data and its models are closely associated.

5.3.15 Application domain models should include not just representations of the primary universe of discourse, for example stops, incidents, predictions, but also metadata describing relevant quality-of-service (QoS) properties of the data such as whether it is verified, reliability, confidence levels etc.

5.4 General system standards

User interfaces

5.4.1 The usability of Travel Information delivery depends on effective user interface design of both traditional printed fixed signs, and of and internet media. General standards exist for many different aspects of usability. Some of these, such as the best auditory cues to use for blind users to locate door are based on research on the acuity of human senses. Others, e.g. how to use a text message to get data, or how a browser search-box works – or just to read a printed timetable - are more akin to social conventions, albeit also based on ergonomic and cognitive considerations,- and evolve within a continuously changing cultural context.

Software architectures

5.4.2 Modern software applications are often built from pre-existing software components and frameworks which use database and other specialised engines (such as a windowing system) and themselves reside on top of Operating Systems and common middleware. Internetworking provides a universal communications protocol stack.

5.4.3 The widespread use of the internet for data applications has established certain common patterns of design, such as Publish/Subscribe. This is turn has led to standards to enable complex patterns to be undertaken between the systems of a variety of different organisations. For example, the W3C Web Services architecture (W3*) constitutes a standardised architecture for such activity. It breaks the functional constituents for information management and exchange services into a series of Web Service (WS) Components. This provides a toolkit for developers and information users.

Technology design and documentation

5.4.4 These “meta-level” standards include the notations and methodologies used to specify software and real-time application standards, such as UML and XML. The UK GovTalk programme to establish XML exchange formats for all forms of public data has established and codified best practice for the use of XML that are relevant for transport too.

Base technology platforms

5.4.5 These cover the underlying communication and software “platform” technologies used by applications: networking, operating systems, databases and standard “middleware” products such as queuing and messaging software. In general open technologies available as commodity platforms such as IP for communications, SQL as a database language or HTML (Hypertext Markup Language) as a browser mark-up are more robust and easier to maintain. Many application level standards impose dependencies on particular platform standards.

A Model profiles: travel information and retailing services

A.1 Introduction

A.1.1 The following pages provide high level profiles involved in the preparation and presentation of travel information and retailing, grouped mainly under the specific types of organisation encountered in the transport sector. These are intended to identify the role and relevance of different types of standard, and not as an exhaustive tabulation, or specification of transport functions.

A.1.2 These profiles are offered to those involved in transport information and retailing as a tool for analysis: a guide to the functions where standards usage might be helpful, and why. Therefore, they include some potential pointers rather than a complete record of relevant standards – they are certainly not specifications for which standards "should" be used by actors in specific circumstances. **Users are encouraged to complete their own table, using these as a model and referring to the Catalogue (and other courses) as appropriate.**

A.1.3 Note, in particular, that:

- Individual real-world organisations may cover more than one profile. For example, an airline will always fulfil the "airline operation" function but may also fulfil the "ticketing/reservation" function as well; while a travel service may have "journey planner" and "travel website user interface" functions.

- The descriptions of organisations, systems and applicable standards will not cover every case; most relevant organisations will be fairly close to one or more of the profiles, but may not be an exact fit.

- This Guide only covers travel information and retailing. There may well be other standards that are applicable in other aspects of their operation. For example, much of the UTMC suite relates to the control of traffic management devices, which is not described here.

- There may be local requirements to adopt or comply with specific standards arising from regulation. These must of course be adhered to but are not reflected in these profiles.

A.1.4 **Note:** in the tables that follow, standards are given their familiar name, rather than full reference number and title. Pre-standards are indicated by pr (eg prIFOPT). By extension, initiatives that are not yet pre-standards are indicated by pp (eg ppFareXChange) – note however that this nomenclature has no standing or currency and is purely a convention for this report.

A.2 Journey planner

	Function	Consideration	Some relevant standards
Summary	To provide information about point to point journeys over the transport network	To deliver journey planning engines for use by call centre staff and for on-line self-service systems on fixed and mobile internet, kiosk and idtv channels	
Planning	Planning of requirements, capabilities and scaling capacity		
	Investment in data and data exchange standards		
	Sourcing of data		NapTAN. TransXChangge, RJIS CIF, OS-ITN, ATCO CIF
	Planning if handoff to ticketing	To allow users to buy tickets for journeys	
	Enforcement of IPR and use rights	To maintain data ownership	

A.3 Travel website user interface

	Function	Consideration	Some relevant standards
Summary	To provide an easy to use on-line self-service system	To use usable, consistent conventions for the behaviour of on-line journey planners, real-time displays and facilities services. Could also include alert and Travel Angel services	
Planning	Choice of interfaces and delivery channels , web, SMS etc	To ensure consistent usability	[TDP, TfL, NRE Google Transit]
	Choice of text based capabilities	To give transfer of leaning between similar systems	NaPTAN SMS codes
	Linking to and from other sites	Handoff of customers	
	Choice of iconography and terminology		
	Usability for impaired users	To ensure accessibility	Bobby
	Choice of maps & Map interactions		xGDF, ITN [Google maps, MSN Live]
	Design for scaling under abnormal conditions	To ensure that credibility is maintained when data becomes uncertain	“Defcon levels?”
	Location based content services	To integrate relevant content by origin and destination	
Long term management	Procurement of journey planning clients for different delivery channels		
	Specification and Procurement of facilities		
	Procurement of printed output		
	Measurement of usability	To ensure utility of site	
	Measurement of use and site statistics	To plan further capacity and services	
	Measurement of data quality	To ensure information is correct	[Rail retail guidelines]
	Procurement of content management		
Day to day management	Operation of site		SNMP
	Monitoring of patterns of use		
	Content management		

A.4 Travel information broadcaster

	Function	Consideration	Some relevant standards
Summary	Produce travel information over broadcast channels, including radio, TV and DAB and broadcaster websites	To gather and validate information on travel , adding editorial and tailoring for target channels. To disseminate to travel channels	
Planning	To provide electronic feed with content agreements	To set	
	To arrange information sources with different organizations including Road, Rail, PTES, Weather and emergency services		
	To provide DAB output fro in car systems	To allow encoding for transmission to in-car devices	TPEG
	To provide		
Long term management	To procure capture & editing systems, including GIS data,	To ensure systems can exchange data in common incident formats	TPEG, UTMC, NPTG [TrafficLink, TDP, NRE IncidentXML]
	To obtain traffic flow feeds and visualisations		[UTMC]
	Weather	To obtain regional weather forecasts	Various commercial
	To procure external incident feeds from all modes	To provide computer processable content	TPEG [TrafficLink]
	To obtain “jamcam”and video feeds	To provide visual media	
	To procure studio systems	To allow editorial content to be added,	
	To procure DAB distribution systems	To distribute to car systems	
	To set up on-line feeds to other systems	To distribute to other channels and emergency services	[TrafficLink] TPEG
	To procure direct on-line channels including content management systems	To distribute own brand channels on public broadcast sites	As Above, [BBC Travel]
Day to day management	To manage editorial process	To ensure quality and relevance	Best practice
	To monitor feeds and distribution systems	To ensure availability	SNMP
	To handle major events and crises	To work alongside emergency services to provide accurate, up to date and relevant information to travellers affected	
	To update reference data sets	To ensure incident data is tagged correctly.	TPEG, NPTG, XGDF etc

A.5 Ticketing / reservation – operator

	Function	Consideration	Some relevant standards
Summary	Provide information about fare products; reserve, book and pay for a fare product	To sell tickets for available capacity on the operators network, to ensure maximum profitability	
Planning	To agree commercial terms for and selling fare products		General Travel Agent systems GDS, Galileo etc [RSP]
	To agree quotas	To provide information to journey planners that do not have real-time availability checking	
	To plan contentions of sale and carriage		
	To procure reservation and ticketing front and back office systems		ITSO
Long term management	To procure ticket media	To produce ticket in standard forms on different media, electronic and printed	[RJIS ticket formats]
	To procure payment services	To have interoperability and share smart card technology	ITSO
	To Procure ticket control and validation systems	To be able to validate tickets	ITSO [Oyster]
	To train staff in products to retail	To inform passengers and staff	[National Rail Guide NRG]
	To Train staff in products to validate	To apply conditions of travel	[NRG]
	To apportion and share sales revenues	To pay for resold products	
	To provide journey planning to help choose products	See journey planning and on-line handoff	General Travel Agent systems GDS, Galileo etc [RSP]
Day to day management	To provide reservation including checking of availability		General Travel Agent systems GDS, Galileo etc [RSP]
	To provide fulfilment systems for on-line and postal servcies		
	To propagate route, timetable and fare changes		

A.6 Ticketing/reservation – travel agency

	Function	Consideration	Some relevant standards
Summary	Multimodal pre-trip journey planning; reservations and booking; and financial settlement	The travel agency is still a core part of travel retail, particularly for high value and complex journeys. Its role is to assist travellers in obtaining the best journey for their needs, based on purpose, route, and price. It also acts as a financial intermediary. Services may include product bundles including hotels, car rental and travel insurance. This role encompasses both high-street agencies and online travel brokerages.	
Planning	Determine for which travel operations services will be provided; some agencies focus on specific areas (eg air and package holidays only)	Not applicable – commercial decision	
Long term management	Procure data feeds on schedules, seat availability and pricing from airlines – scheduled, no-frills and charter operators	Need to obtain information simply and in comparable form from a variety of providers	GDSs; OTA/TTI protocols including TORIX/TOPAS
	Procure data feeds on schedules, seat availability and pricing from rail and coach operators	As above	NRES; direct feeds???
	Procure data feeds on packaged and bundled services, such as chartered flight bookings, cruises and leisure boating	As above	Unicorn [OTA/TTI]
	Procure links to support services, eg travel insurers and hotel chains	As above	
	Procure travel advisory information – FCO advice, medical information eg vaccinations, etc	As above	
Day to day management	Take and process traveller enquiry; obtain data from variety of providers present possibilities for traveller to select	Need to obtain information simply and in comparable form from a variety of providers	As above
	Take booking and payment; confirm with travel operators and make settlement	Need to provide information simply and in understandable form to the operators; need to comply with international obligations	PNRs
	Cancel booking	Support to previous	ABTA and other guidelines

A.7 In-car systems and services

	Function	Consideration	Some relevant standards
Summary	To provide a safe and usable in-car system interface for drivers that minimises distractions. Devices will have map content and routing	To provide up to the minute traffic and travel information via an in-car unit. Any in-car information system needs to take into account that a driver will be in control of a car when announcements or updates are made. Efforts need to be made to ensure that the driver's concentration is not impeded by updates and that safety is maintained at all times. Need to minimise driver distraction whilst using in-vehicle information systems.	
Planning	Adopt audio and visual technologies that adhere to existing safety standards.	To minimise driver distraction whilst using in-vehicle information systems.	Safety Standards for In-vehicle systems Dialogue Management Standard Auditory Information Standard Visual Behaviour Standard Message Priority (TS) Warning Systems and Warnings Integration (TS) Occlusion Driver Characteristics Lane Change Task (LCT) Calibration Standard
	Adopt interface technologies that allow for ease of use and minimise driver distraction	As above	
	To provide road network and map data for routing and displays	To provide journey planning advice that	X-GDF, ITN etc

	To provide to real-time traffic and travel systems	To provide real-time advice	Highways Agency, TIH, TPEG /DAB, UTC, DATEX2
	To connect to on-line journey planning systems	Gives driver's confidence that they are receiving the correct information and that their journey can be altered accordingly	JourneyWeb
Long term management	To procure on-device content		
	To procure real-time feeds	T provide real-time advice	TIH, UTMC, Datex2
Day to day management	To distribute updates to on-device map and other content		
	Monitoring of travel and journey planning information	To ensure quality of information	
	To operate real-time traffic and travel feeds	To ensure real-time advice is available	

A.8 Personal navigation services

	Function	Consideration	Some relevant standards
Summary	To provide personal navigation data through a portable device, other than a car-fitted device	To provide consumer products to assist users in travelling. Map based interfaces with routing engines. Map have personalisation and mobile internet connectivity	
Planning	To acquire map data	To provide interactive maps	As for journey planners
	To acquire feature content including points of interest, interchange details etc		As for journey planners
	To acquire static timetable content		As for journey planners
	To acquire location out of building	To give a coordinate	GPS
	To acquire location in building	To obtain a location where GPS is not available.	[NFC?]
Long term management	Preparation of map data & changes	To provision devices	
	Preparation of feature changes	To provision devices	
	Set up of real-time feeds	To provide traffic and travel advice	
	Set up discovery processes for real-time feeds	To allow devices to connect to appropriate real-time sources	[NPTG Discovery]
Day to day management	Provisioning updates to map data		
	Provisioning of feature changes		
	Operation of real-time traffic info		As for in car device

A.9 Travel information exchange

	Function	Consideration	Some relevant standards
Summary	Exchange of data between two systems	To provide robust regular exchange of different data at required frequency	
Planning	Development of domain specific conceptual models	To allow for efficient exchange of data, separating transport between systems	TransModel, Datex2
	Choice of domain specific protocols, pull, push etc, including provision of generic frameworks with common services.	To allow for efficient exchange of data,	WS-* prDataex2 SIRI Comms UTMC
	Choice of low level communication transport methods.	To allow for economic transport of data, to allow the interoperation evolution of system s with same payload to be carried by different transport	IP, FTP, SMTP, http, SOAP, IM, etc etc , SOAPA
	Choice of data reference systems	To ensure uniqueness of reference when serialising & deserialising data	DNF, NPTG, NaPTAN
	Version management	To enable staggered evolution in a distributed environment	eGOV versioning
	Resilience and monitoring strategies , heartbeat etc	To ensure continuous operation of complex systems with many points of failure	WS-* prDataex2 SIRI Comms SNMP
	Discovery capabilities	To allow distributed systems to find the appropriate data service instance that covers the transport network area of interest	UDDI, NPTG Discovery
	Indexing	To ensure services can be accurately indexed by search engines	GMS, eGOV
	Planning of communications and security	To prevent compromising systems	General IT
Long term management	Deployment of services		
	Upgrade to new versions of exchange format	To allow robust concurrent operation	EGOV XML versioning
	Access Control	To manage access to specific subsets of data to specific	SIRI Access

		users	
	Capacity planning	To match data volumes and demand	
Day to day management	Monitoring of systems	To ensure that systems are available and secure	SNMP
	Statistics and reporting	To enable capacity planning	

A.10 Real time travel information

	Function	Consideration	Some relevant standards
Summary	Provision of real time monitoring systems.	Delivery of reliable tracking and monitoring of vehicles. Provision of predictions.	
Planning	Installation of AVL monitoring systems on vehicles or at monitoring points	To collect data	
	Provisioning of AVMS systems with schedules and short term changes to schedules	To provide real-time data for displays	TransXChange
	Collection and transmission of AVL monitoring data to AVMS	To exchange data over the air by PMR Radio, GPRS etc	
	Collection and transmission of traffic data to AVMS	To exchange data with UTMC	UTMC, SIRI DATEX2
Long term management	Computation of AVMS predictions	To ensure consistent predictions & interpolation. To ensure useful QoS data	SIRI [RTTI] [AIR?]
	Integration of Situation and Control action data to explain disruptions	To integrate control systems.	
	Dissemination of real-time data to delivery systems at stop, on-board	To drive displays at stop and on-board.	SIRI [RTTI]
	Dissemination of real-time data to external on-line delivery systems web, kiosk, voice, mobile etc	To drive on-line and mobile devices.	SIRI
	Presentation of real-time data in easy to understand standard formats	To ensure consistent interpretation.	
	Special dissemination to disabled users	Inclusion of support for non-visual channels	
Day to day management	Operation of systems against SLA	To ensure systems are available.	
	Management of short term timetable changes	To ensure data is correct.	
	Management of Situations and control actions	To ensure advice is current, especially in crises.	
	Management of historical data	To support other functions.	
	Analysis of historical data for predictions and other purposes	To improve network utilisation and vehicle efficiency	

B Model profiles: transport operations providing information

B.1 Introduction

B.1.1 The following pages provide high level profiles involved in the preparation and presentation of information relating to transport operations – management of networks, of infrastructure and termini, and of travel services themselves.

B.1.2 Each aspect of these operations gives rise to information which is valuable to the traveller. In many cases the provider may already have systems in place to deliver this information, either physically on his assets or electronically via the web (or of course both). Standardising can help this, and in particular can help different actors work together more easily (for example, airlines and airports).

B.1.3 However, the information provided in this way may have additional benefits, to external information services. This annex therefore serves a dual purpose:

- It provides a framework to decide on where information provision within transport operations might benefit from the use of standards.

- It provides a framework for discussion between third-party providers of information/retailing services and transport operations, to agree on how data might be technically made available. (Nothing, of course, is said about the *commercial* aspects of data provision.)

B.2 Rail network operation

	Function	Consideration	Some relevant standards
Summary	Those aspects of the operation of the rail network as a service to train operators that are relevant for travel information. Includes train progress monitoring and engineering management.	The shared infrastructure of network needs to run efficiently as a service to operators. Information on the movement of trains needs to be fed to control room, staff and passenger information systems	
Planning	Planning of services and network utilisation.		RJIS CIF
	Setting of industry standard routes, fare products and fares, the apportioning of revenues	Rail retailing through industry and third parties	RJIS UK Rail retailing Code of Practice
	Setting of conditions of carriage	To ensure passengers are aware of availability rules and other information	
	Setting of processes for ticket validation, excess fares etc	To ensure passengers are aware of contractual rights and obligations.	[UK Rail Conditions of carriage]
	Setting of season ticket rebates		
	Contingency planning for emergencies and major crises, including those caused by other modes	To be able to give passengers and staff use safe advice quickly in different types of emergency	[TPEG, SIRSI SS]
Long term management	Procurement of real-time monitoring systems	To be able to track train progress and make predictions.	dfRTTI (SIRI)
	Procurement of control room incident systems	To share status information that will affect passenger travel with other control systems and delivery systems	
	Procurement of track maintenance services Information about engineering works affecting travel	To inform journey planners in advance of changes To inform users of overruns to engineering works	RJIS-CIF
	Creation of information models of the infrastructure	To support journey planning and alert systems	RJIS RailML?]
	Procurement of ticketing equipment and back office systems	To support ticket fulfilment	RJIS & RSP systems
Day to day management	Use of a real-time systems to gather real-time data and calculation of predictions according to rail-network specific heuristics.	To supply departure boards, in station, on-line and journey planners.	dfRTTI [SIRI]

	Capture of situation reports from multiple sources and exchange with other control rooms	To coordinate operational usage	[dfNexus Alpha]
	Asset management, including accessibility equipment	To provide information about facilities and accessibility to delivery systems	
	Capture of control actions and dissemination as real-time schedule changes and situation reports	To support journey planning and alert systems	
	Dissemination of real-time information	To support journey planning and alert systems	dfRTTI
	Maagement of planned and emergency engineering works and monitoring for completion	To provide advance notice to journey planners , online information systems and alert engines	

B.3 Road network operation

	Function	Consideration	Some relevant standards
Summary	Those aspects of the operation of urban, interurban or mixed road networks as a Highways Authority that are relevant for travel information	Road users need to understand the current network conditions, particularly on the roads they expect to travel on. They need to know that the roads are accessible, and if there is any safety information (eg bad weather) as well as information on likely journey time and (particularly in the future) any costs involved. Operators should be able to provide this information electronically both for prior journey planning and for those currently on the roads. Information needs to be available in good time, which might mean while the road user is on someone else's network.	
Planning	Road use survey, including link load and origin-destination mapping	To enable data to be compared in a coherent fashion from place to place, and from year to year	
	Description of current and possible future road routes, structures and facilities	To assist in traffic modelling for transport planning purposes To provide reference data for asset management systems	[ITN and extensions]
	Establish local requirements for network management	To ensure that all relevant aspects have been considered (via checklist)	KAREN/FRAME
	Establish local policy and strategy on network management. For instance, whether or not to introduce road use charging, decriminalise parking offences, install safety cameras etc	To ensure consistent approach across the UK	TMA2004 Guidelines and equivalents for HA and Scotland/NI
Long term management	Procurement/development of physical assets – pavement, fencing, barriers etc	To ensure minimum quality standards	DMRB
	Procurement/development of electronic assets on the roadway – detection, collection, processing, control strategy, signal control	To ensure that systems can interoperate once purchased; to provide a common design framework for suppliers To ensure that information is available to all parties about traffic moving across Highways Authority domain boundaries	UTMC, DATEX, TIH/OTAP
	Procurement/development of new traffic-related systems for traffic sources/sinks. This includes principally car parks but also potentially private (commercial/residential) developments.	To ensure that information is available to both parties about traffic moving across domains	

Day to day management	Detect current traffic conditions from owned (roadside) facilities	To ensure consistency in the nature and quality of the information provided by detectors To enable efficient integration of multi-supplier detectors into a detection system	UTMC
	Detect current traffic conditions from information provided by other people's systems (specifically including those owned by travellers)	As above	[UTMC may assist]
	Record conditions over short to medium term period for current/historical analysis. This includes ensuring coherent database structures	As above	UTMC, NMCS
	Predict journey times based on current and expected network loading	To provide information to journey planners in comprehensible format; to enable neighbouring highways authorities to advise their road users	
	Identify incidents, their nature, severity and impact; respond to incidents (including working with emergency services); advise travellers of incidents and any appropriate action to take	To enable incident reports to be sent rapidly, and comprehensibly, to all those transport operators and information services that require it To ensure that multiple agencies involved in incident management have accurate and up to date information To ensure relevant information is passed to neighbouring highways authorities	UTMC, DATEX, TIH
	Provide information to road users about road conditions ahead; advise on alternative actions if appropriate	To ensure that systems can interoperate once purchased; to provide a common design framework for suppliers To ensure that information is available to all parties about traffic moving across Highways Authority domain boundaries	UTMC, DATEX, TIH, VMS signage rules
	Manage on street parking	To ensure that systems can interoperate once purchased; to provide a common design framework for suppliers; to assist enforcement organisations	[UTMC may assist]
	Provide priority for specific classes of vehicle (public transport, emergency service etc)	To enable suitably equipped vehicles to be given priority on the network via electronic means	RTIG/UTMC integration
	Detect traffic offences and violations; capture relevant information and take necessary enforcement action (including passing information to the police)	To ensure a coherent approach taken across the UK	[UTMC may assist]

B.4 Footpath/cycleway network operation

	Function	Consideration	Some relevant standards
Summary	Those aspects of the operation of footpath, bridleway and cycleway networks that are relevant for travel information.	Walkers, riders and cyclists need to know the expected and current conditions of their paths. They need to know that the paths are accessible. Operators should be able to provide this information electronically to enable journey planning.	
Planning	Registration of paths and tracks on national databases, , including allowed modes (foot, horse, cycle, wheelchair, mountain bike, motorbike, etc)	Ensure that route and status information can be accurately and consistently presented to users and to journey planners	Ordnance Survey mapping conventions [ITN?]
Long term management	Identification and update of paths, their routes and status	As above	[ITN?]
Day to day management	Identification and management of works required to maintain/develop paths, physical signage etc	As above	

B.5 Waterways operation

	Function	Consideration	Some relevant standards
Summary	Those aspects of the operation of a public inland waterway that are relevant for travel information.	Waterway users need to understand how to get their facility. They need to have information about waterway conditions, particularly if there are access restrictions due to water level or engineering.	
Planning	Plan for development/operation of waterway asset		Planning process
Long term management	Procurement/development of physical assets – moorings, lock gates, towpaths		AINA guidelines
	Procurement/development of electronic assets – water level monitoring (SCADA), water condition monitoring, marina management	To ensure that systems can interoperate once purchased; to provide a common design framework for suppliers	
Day to day management	Manage water and channel conditions, including imposing temporary closures where necessary and making this information publicly accessible	To ensure consistency in the nature and quality of the information provided by detectors, and in the nature and quality of information provided to users (including the public, ferry and leisure operators)	[AINA guidelines]
	Maintain lock and towpath infrastructure, and amenity facilities, and advise on status	As above	[AINA guidelines]
	Inform cycles and other towpath users of closures	As above	

B.6 Airport / port operation

	Function	Consideration	Some relevant standards
Summary	Those aspects of the operation of a port used by public ferry services waterway that are relevant for travel information. This includes check-in information, security checks, baggage handling and information provision.	To allow passengers to arrive at and depart from UK airports efficiently. Passengers and their meeters and greeters need information prior and during their arrival at an airport or port, including flight/sailing information, check-in information, or security information. They may also need information about current access conditions. Information should also be made available for travellers planning their journey to the interchanget – car parking information, security considerations and delays to flights.	
Planning	Plan for the operation of an airport pr port, including all aspects of information, logistics, safety and security.	Modern airports use AODBs running various modules and database software in order to manage huge amounts of data.	
Long term management	Procurement of information/communication systems		
	Procurement/development of physical assets – passenger terminals, car parks, on-site roadways, gating etc		
	Procurement/development of electronic assets – passenger management systems, vehicle management systems	To ensure that systems can interoperate once purchased; to provide a common design framework for suppliers	
	Provide signage and guidance through facility/	To ensure that systems can interoperate once purchased; to provide a common design framework for suppliers	
Day to day management	Provide information to embarking passengers about boarding and departures	To collate information from service operators to provide to passengers both at the port and outside	
	Provide information to disembarking passengers about public transport and road conditions	To collate information from transport networks to provide to passengers at the port	
	Allow passengers to check in, have access to the relevant parts of the airport	Working with airlines to ensure that authorised passengers are in the correct locations	
	Baggage handling	Working with airlines to ensure passengers' baggage is tracked	
	Handle emergencies	Coordinating with relevant emergency services	

B.7 Car park operation

	Function	Consideration	Some relevant standards
Summary	Operation of one or more publicly accessible off-road car parks	Road users need to understand the car parking provision within an area. They need to know which car parks are available, as well as whether there are spaces and what the costs are. Operators should be able to provide this information electronically both for prior journey planning and for those currently on the roads. They need to be able to pay for their car park use, potentially in advance. Operators need to procure equipment to operate car parks.	
Planning	Plan for location, structure and operation of a new car park	To ensure minimum quality standards	Planning process
Long term management	Procurement/development of physical assets – at-grade or multi-storey, including connection with other infrastructure (shopping centre, station etc)	To ensure minimum quality standards	(Buildings Regulations) (Secured Car Parks)
	Procurement/development of electronic assets – vehicle detection, fee collection, ticket issue, cameras, exit barriers	To ensure that systems can interoperate once purchased; to provide a common design framework for suppliers To ensure that information is available to the LA	[UTMC may assist]
Day to day management	Book car parking space	To enable integration with other retailing environments	
	Detect vehicles entering and leaving	To ensure consistency in the nature and quality of the information provided by detectors To enable efficient integration of multi-supplier detectors into a detection system	[UTMC may assist]
	Collect payment	As above	
	Record conditions over short to medium term period for current/historical analysis. This includes ensuring coherent database structures	As above	
	Guide users around the car park to the nearest relevant space, through illuminated signage etc	As above	
	Provide information to drivers outside the car park on current and expected future occupancy levels; advise on alternative actions if appropriate	To ensure information is available to be disseminated via a variety of mechanisms, including journey planners and local road signage (VMS)	UTMC Datex2 TPEG

B.8 Public transport service operation (rail, coach, air, ferry)

	Function	Consideration	Some relevant standards
Summary	Those aspects of the operation of a scheduled public transport service relating to the provision of information for passengers, potential passengers and staff.	Passengers (and potential passengers) need information on planning and using the services including timetables fares and facilities. ee separate sections for ticketing and retailing and for real-time information	
Planning of operations	Planning and registration of routes, and services and the scheduling of timetables.	Many operators need to submit service plans in a common, clear and communicable structure	TransXChange, NaPTAN, NPTG
	Setting of fares, including individual trip fares, zonal fares, and combination fares with other travel products. The specification of appropriate fare products including individual fares, multiple use tickets and season tickets This may involve a consideration of usage, demographics, regulatory issues and available subsidies, competition, and other factors.	Input to direct e-commerce systems; base data for ticketing systems; feed to independent journey planners and retailers. Feed to yield optimisation and planning tools.	TransXChange, NaPTAN, NPTG ITSO
	Setting of performance targets, both operational and financial	Local or regulator monitoring	
	Publication of information on services, routes and fares in both printed and electronic format to both	Electronic supply of data to printers; supply of data to journey planners and public enquirers	ATCO-CIF TransXChange
Long term management of service	Procurement and fitting out of vehicles, including fare collection equipment, on-board travel information displays, CCTV vehicle monitoring, AVL and driver safety equipment	Multiple vendors' products need to be efficiently integrated onto the vehicle platform quickly, cheaply and reliably, in an open product market Need to communicate with various external systems, eg local authority RTI systems	ITSO, SIRI [FareXChange], prCANbus
	Procurement and fitting out of vehicle communication systems including voice and data for both control and passenger information.	As above	SIRI RTIG ??..
	Procurement and fitting out of depots and stations with back office systems	Multiple vendors' products need to be efficiently integrated onto the vehicle platform quickly, cheaply and reliably, in an open product market Need to communicate with various external systems, eg smartcard operators' systems	ITSO

	Procurement of ticketing and payment systems , including credit card, smart card and paper based systems	Multiple vendors' products need to be efficiently integrated onto the vehicle platform quickly, cheaply and reliably, in an open product market Need to communicate with various external systems, eg smartcard operators' systems	ITSO
	Provisioning of on-line information systems including journey planning, departures and travel news (either though own or	See real-time section	Traveline, JourneyWeb, RSP RJIS
	Recruitment, training and management of drivers and staff, including the use of systems and in customer service and safety responsibilities	Staff need to use all vehicles and systems easily – hence common look and feel	Locally defined
	Monitoring of schedule performance against targets	Consistent and comparable management across the operational area	
	Provision of information on facilities to assist disabled travellers	Need to provide information via a variety of channels, including pre-trip	[prIFOPT, RTIG guidelines]
Day to day management of service	Rostering and managements of crews. and scheduling of operational services accommodating planned short term changes such as engineering works,	Efficient design of crew rostering systems; communication to real time systems	[SIRI] [PubTrans/ RailML]
	Control and dispatch of services including information control actions	As above	[SIRI] [TPEG]
	Monitoring of vehicle progress and provision of real-time passenger information. Recording of historic schedule adherence	Consistent and comparable management across the local area and across the UK as a whole	[SIRI]
	Recording of historic schedule adherence	To allow better prediction.. To analyse performance.	
	Ticketing and payment	Use with open schemes such as the national concessionary fares scheme; use with multiple passenger technologies, eg mobiles	ITSO
	Collection and recording of fare sales, passenger occupancy and vehicle utilizations	Efficient design; compatibility of systems across fleet, which may be procured at different times from different suppliers	ITSO
	Communication with passengers at stops		[SIRI]
	Management of congestion levels		

	Collection and maintenance of facility information including impaired access	To inform users about facilities and services on the network	[NRE-StationXML] prSIRI FM
	Monitoring of CCTV and security systems and escalation of situations to emergency services	Efficient communication with police and emergency services. Passenger advice and safety	

B.9 Public transport station operation (rail, coach)

	Function	Consideration	Some relevant standards
Summary	Providing of Travel information and advice for use of a Station or Major Interchange. To operate a transport interchange for one or more operators, providing travel information.		
Planning	Procurement of real-time passenger information displays	To provide multi-modal travel information to passengers waiting on platforms.	
	Procurement and production of static information displays	If electronic means are unavailable, static information is also required.	
	Procurement of audio equipment	Audio information is required to broadcast travel updates and other messages such as platform changes.	
	Procurement of electronic ticket machines for station staff (both static and portable)		
	Provision of station centric printed timetable information		
	Provision and training of staff, including the use of systems and in customer service and safety responsibilities.		Network Rail?
	Provision of information and facilities for disabled travellers	To provide accessible information to all travellers, in both visual and audio form. Any form of audio/visual information should be made available for disabled travellers.	RTIG DDA Guidelines [NreStationXML]
	As for bus service operation but with specific focus on equipment and information service within coach stations and multimodal interchanges	As for bus service operation: to provide data for journey planners, and real-time systems	As for bus service operation
	Planning of access for disabled travellers	To provide information about accessibility	
	Contingency planning for emergencies and major crises, including those caused by other modes	To provide rapid response to inform travellers and staff of appropriate actions	
Long term management	Procurement of signage		
	Procurement of real-time passenger information displays and CIS systems	To provide multi-modal travel information to passengers waiting in station and platforms.	RTIG visual guidelines SIRI
	Procurement of systems for Exchange of real-time data with other systems		

	Procurement of information displays and CIS systems for the sensory impaired		RNIB keyfob
	Provision of Taxi ranks	To manage queues efficiently	[NapTAN]
	Provision of Parking and set down areas		[prIFOPT]
	Planning of engineering works and maintenance	To inform staff and travellers of future planned outages	
Day to day management	Ticket retailing and fare collection		
	Ticket validation	Penalty and enforcement procedures	
	Capture of control actions including bay assignment	To communicate to staff and passengers	prSIRI-SS, TPEG
	Provision of static short-term timetable change information		
	Provision of updates on cancelled trains and alternative travel arrangements		
	Provision of service information to passengers	To provide displays and announcements to passengers	SIRI SD
	Provision on information about platform access including lifts and escalators		SIRI
	Handling of special events and crowd management in confined environments		
	Coordination of engineering works and maintenance	To inform staff and travellers of substitute services	
	Security monitoring with CCTV etc		
	Management of emergencies including security alerts	To communicate with emergency services	[Eltis]
	To feed to advanced real-time systems. To improve planning for capacity and safety		Gap
	Provision of Information Kiosk	To provide passenger assistance	
	Management of major disruptions due to weather, strikes etc	To be able to communicate to staff and passengers in station and approaching	prSIRI-SS, TPEG
	Management of Taxi Ranks	To assist with efficient interchange	NaPTAN
	Management of set-down areas	To ensure efficient interchange to private vehicles	

B.10 On-demand transport: taxi, DRT and PRT

	Function	Consideration	Some relevant standards
Summary	Operation of an on-demand road transport service	Travellers need to know how to contact the service to arrange a trip, and how to access it (if there are particular access points). They need to understand the cost of the trip. They need information on any changes to a pre-booked trip.	
Planning	Registration of service	Many different operators need to submit details of their planned operation in a consistent way, in accordance with regulations	[TransXChange]
	Determination of fare structures	As above	Locally defined
Long term management	Procurement and fitting out of vehicles, including fare collection equipment, on-board travel information displays, CCTV vehicle monitoring, AVL and driver safety equipment	Multiple vendors' products need to be efficiently integrated onto the vehicle platform quickly, cheaply and reliably, in an open product market Need to communicate with various external systems, eg local authority RTI systems	ITSO, SIRI [FareXChange], CANbus
	Procurement and fitting out of vehicle communication systems including voice and data for both control and passenger information	As above	SIRI RTIG??
	Procurement of ticketing and payment systems , including credit card, smart card and paper based systems	Multiple vendors' products need to be efficiently integrated onto the vehicle platform quickly, cheaply and reliably, in an open product market Need to communicate with various external systems, eg smartcard operators' systems	ITSO
	Recruitment, training and management of drivers and staff, including the use of systems and in customer service and safety responsibilities	Staff need to use all vehicles and systems easily – hence common look and feel	Locally defined
	Provision of information on facilities to assist disabled travellers	Need to provide information via a variety of channels, including pre-trip	[prIFOPT]
Day to day management	Management of currently available drivers/vehicles	Efficient design of vehicle management systems; communication to real-time routing systems	[SIRI] [PubTrans/RailML]
	Control and dispatch of services including information control actions	As above	[SIRI] [TPEG]

	Monitoring of vehicle location, and planning for subsequent legs of movement	Efficient design of real-time routing systems; enable open market in systems	
	Provision of information on changes to the trip – especially expected vehicle arrival time	As above	Telecoms industry standards
	Fare collection	Use with open schemes such as the national concessionary fares scheme; use with multiple passenger technologies, eg mobiles	ITSO
	Registration and maintenance of individual passenger details (eg regular users/regular trips, commercial contracts)	Efficient design of client management systems; enable open market in systems	

C Model profiles: other input information

C.1 Introduction

C.1.1 This annex covers information which, while not itself travel related, is nevertheless very important contributory information to travel information services.

C.1.2 As with Annex B, this might assist travel information providers to understand how data might be provided to them.

C.2 Environmental monitoring

	Function	Consideration	Some relevant standards
Summary	To operate road and track-side environmental monitoring in order to manage and maintain the quality of the local environment in urban areas. Monitoring will also allow for the provision of health advice to those who are particularly susceptible to air-born pollutants.	Road-side environmental monitoring stations can provide important environmental information that can be used to monitor levels of air and noise pollution and provide historical evidence of environmental degradation or improvement. It is important that minimum local levels are reached. Monitoring can also provide the traffic manager with real-time information on the state of air and noise pollution in a given area and allow them to adapt traffic flows accordingly. Forecasts providing by modelling software will allow for regional predictions for worst-case scenarios for specific pollutants. Can also provide a benchmark to see if air pollution is getting better or worse. Those with health issues that are susceptible to air born pollutants can also use forecasting to stay indoors during periods of high air pollution.	
Planning	Installation of road-side monitors and key points on urban traffic network	To allow environmental officers and traffic managers to monitor and control environmental pollution.	UK National Air Quality objectives Expert Panel on Air Quality Standards (EPAQS) recommendations UK air quality bands European Community Directives Limit and Guide Values United Nations Economic Commission for Europe critical levels
	Links to traffic management system	To allow for data to be transmitted to traffic management centre	UTMC
	Health impact of pollution levels	To create a conceptual model and pollution types and	[CERC?]

		thresholds.	
	Monitoring of environmental data	To assist in improving the urban environment and being fully aware of pollution 'hotspots'. To provide benchmark reference for future forecasting and traffic control.	National Air Quality Archive
Long term management	Procurement of new monitoring equipment and links to traffic management system.	To ensure minimum quality standards	
	Air Quality Action Zones	To be established by local authorities if local limits are not met	
	Urban traffic management	Development of strategy to keep urban centres flowing, particularly in areas where air pollutants are likely to cause problems.	
	Procurement of weather data	To provide data feed	
	Provision of warnings to public	Making public aware of possible effect of high levels of air pollution on health, especially those who are susceptible.	
	Urban design	Creating spaces where pollutants cannot collect and settle.	
Day to day management	Monitoring of current pollutant levels	To ensure consistency in the nature and quality of the information provided by the monitoring stations	
	Monitoring of short to medium term pollutant levels	As above	
	Monitoring of long term pollutant levels. This includes maintaining coherent database structures.	As above	
	Pollutant forecasting	To provide health authorities and the public with daily pollution forecasts.	
	Managing traffic in susceptible areas, keeping traffic flowing and uncongested	To improve the environmental quality of urban areas.	