Transport Direct

Review of standards for travel information and retailing

CC-PR149-D004-1.0
Cover + 33 pages

28 November 2007

List of contents

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. It draws on, and should be read alongside, the Standards Catalogue CC-PR149-D006-1.0 and the Guide CC-PR149-D005-1.0.

1.1.3 This Review differs qualitatively from the Catalogue and Guide. Those two documents are intended to be objective data collations of available standards, with an outline analysis of those which are applicable to different stakeholders in the transport information and retail industry. They are intended, and constructed, to be readily updateable as circumstances change, in order to provide a long-term resource.

1.1.4 This Review, by contrast, is focussed very specifically on the situation at the beginning of 2007. Its aim is not to *inform* stakeholders of what they *could* do, but to *advise* stakeholders – and particularly Government – on what they *should* do.

1.2 Intended readership

1.2.1 There are two primary classes of people to whom this Review (and the associated Catalogue and Guide) 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 Sources for this document

1.3.1 This review has been developed on the basis of:

- corporate knowledge, understanding and records;
- publicly available information sources;
- advice from a limited number of contacts with whom the catalogue has been discussed;
- feedback from stakeholders contacted as part of the validation exercise;
- review on interim reports.

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

2 Where standards are needed

2.1 Standards benefits

2.1.1 The assessment in the Guide accompanying this Review was that standards have potential value for protection of investment; interoperability; and improved quality/value. Specifically, value arises from:

- **Modularisation & Incremental Deployment:** This value is particularly important in circumstances where functional requirements change due to either business or technology drivers, and/or require a phased investment programme which cannot be foreseen or justified in advance.

- **Choice of Suppliers:** This value is particularly important where there is a supply monopoly (or oligopoly) which is perceived to inflate whole-life costs. *De facto* standards associated with a single supplier may give rise to 'lock-in'; even when they are published, proprietary 'standards' raise commercial issues of intellectual property rights (IPR) etc. Open standards do not suffer this problem.

- **Reuse:** This value is important where systems are complex and risky to specify, procure/select and integrate. A set of procurement specifications built using existing standards will generally be smaller and simpler then one constructed from scratch. The saving is both to manpower, timescales and (through risk-reduction) to potential costs.

- **Roadmap for Evolution**: This value is important where uncertainty is holding up strategic planning. Well articulated standards are designed to allow further change, and also prove a coherent framework for orchestrating the collaboration of suppliers, tool builders and users in a multi-stage development process.

- **Data management:** This value is important where there is considerable sharing of data which changes a lot. Standards will typically include version change and other validation mechanisms to improve quality and allow migration.

- **Risk Reduction:** This value is important where interfaces are complex and could give rise to significant unforeseen costs.

- **Better Abstraction, Testing, Process & Tool support:** This value will be important where functionality requirements are complex and time consuming to capture, to implement, to test and to operate. The broad investment of intellect in a standard can yield services which would not have been identified, or justified, within a single *ad hoc* project.

2.2 Standards costs

2.2.1 The costs of standards are largely generic and can be attributed to four main areas. There are also overarching political implications.

- **Development**: Standards are complex and require considerable expertise to develop, and to validate. This represents a direct cost.

- **Availability**: An organisation constructing its own specification can do so at any time. An organisation using a standard must wait for it to be ready (or undertake work to harmonise any wrong anticipation); and standards can often take a long time to complete and agree. There is a cost to this lost opportunity or extra convergence work.

- **Maintenance**: Once an organisation has adopted a standard, it has to a degree committed itself to keeping pace with the standard. If the standard changes, there may be costs to its users.

- **Procurement**: Procurement to a standard is different from procurement to a home-grown specification. The additional technical and marketplace complexity may impose costs.

- **Adaptation**: A standard is defined to meet generic needs. To be usable within a particularly organisation, either the standard or the organisation may need to be adapted; alternatively it might be necessary to accept some inefficiencies. There is a cost to this.

- **Gold-plating**: Not all organisations will have the same functional needs. Standards often cover the full range of requirements, requiring the adopter to pay for things it doesn't really need.

2.2.2 It should be remarked that standards are more significant for efficient investment in some areas than others. Systems that involve large scale deployment of many communicating nodes, or the compilation and maintenance of large data sets representing complex models, will benefit more than simple, standalone, highly specialist systems. (Note, however, the general tendency for standalone systems to get networked eventually, even when this was not originally planned.)

2.3 Different types of standard

2.3.1 The Guide discussed the nature and relevance of:

- formal standards developed and ratified by standardisation committees, and pre-standards being developed under a formal standards development process;

- *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 output which might feed into standards etc.

Formality

2.3.2 A standard that is intended to enable the technical interoperation of two computer systems inevitably requires a level of precision and formalism, and must be exactly adhered to. Standards governing "softer" aspects, such as conceptual models and user interfaces, may be less precise and formal.

2.3.3 Typically the wider the use of the standard – and so the cost of change – the more formal the process needed to support it. As a rough rule of thumb, the more formal standards are more expensive and time consuming to develop and maintain, and therefore require a high payoff in terms of market certainty, competition, reuse etc. This can to some extent be mitigated by making standards modular.

2.3.4 More 'lightweight' and local approaches have less formality and can be achieved with less investment of time and resource, but may not have as much rigour or credibility.

2.3.5 In the transport information and retail area, success has been achieved by having formal standards predominantly for common data exchange; less formal specifications and guidelines have tended to be used for softer aspects. There is a natural progression, as markets mature and technology becomes economic and pervasive, towards:

- increasing formality at all levels;
- one or a few well specified and well supported solutions.

Openness

2.3.6 A high degree of openness is normally important for effective standards. This is needed to achieve consensus among stakeholders, both during standards development, and afterwards during product development. Specific aspects to this are:

- Early exposure – standards should be circulated in draft to allow suppliers to gain all-round peer review, to allow users to ensure their requirements are addressed and to allow suppliers to plan their development.
- Dissemination – documentation and supporting information should be available on-line, appropriately indexed for search engines. Explanatory materials and model implementations will help people gain confidence and use the standards efficiently.
- Published change process – there should be an agreed process to capture and feed back correction and enhancements.

2.3.7 Formal Standards Delivery Organisations have these functions built into their charters, and community standards often adopt these as core values as well. *De facto* standards, on the other hand, may well begin life as proprietary.

2.4 Assessing the current standards provision

2.4.1 Issues can be categorised by the level, or levels, at which standards are believed to be absent and by the key drivers that led to a perceived gap in standards provision.

2.4.2 Issues may occur at the following levels:

- *Availability of standards*: ie areas where the absence of a standard materially reduces the capability of the industry in respect of a particular application;
- *Adequacy of standards*: ie inadequacy of individual standards or standards suites to serve the applications for which they are intended.
- *Deficiency in implementation*: poor or patchy take-up of existing standards within a segment, or across many segments, of the transport community; or
- *Inadequate coordination and integration*: the incompatibility of closely related applications or standards that prevents adequate interoperability.

2.4.3 However, the absence of a standard relevant to a particular area may not be an indication of a 'gap' worth filling. There is therefore a key distinction to be drawn between:

- areas where no standard exists because one is not needed;
- areas where no standard exists, despite the fact that having one would be of positive benefit.

2.4.4 Evaluation of the current standards provision addresses each of the issue types to each of the application areas discussed in the Guide; then uses the benefit and cost schemes presented in sections 2.1 and 2.2 to determine whether the issue is a real one, ie whether a standard would actually pay its way.

3 Adequacy of current standards

3.1 Introduction

3.1.1 This section evaluates the current provision of “standards” relevant to travel information and retailing based on a system structure view; the following section considers individual business contexts more closely.

3.1.2 This section evaluates the adequacy of *available* standards; it does not comment on the actual deployment in practice, which is inevitably variable and depends on the technology refresh lifecycle in individual contexts.

3.2 Business and data modelling

3.2.1 The development of specific domain models for different aspects of transport systems underpins the development of all Travel Information standards and represents a strategic part of the long term digitalisation of the UK to become an efficient information age economy. Conceptual models provide a unifying framework for understanding the content of different data exchange protocols, and can be used in particular to relate different concrete standards to each other.

3.2.2 Transmodel is a well abstracted conceptual model for many aspects of the public transport domain that is the result of a systematic development program carried out over a number of years. It has proved valuable for harmonising a number of National and European concrete standards and is now a candidate for further development with the International Standards Organisation (ISO). Among the useful aspects of Transmodel is its approach to separating the concerns of public transport (PT) and Geographic Data File (GDF) models.

3.2.3 The new DATEX2 model provides a corresponding model for many aspects of road transport, refining previous DATEX models, and is accompanied by an Extensible Markup Language (XML) schema.

3.2.4 There are a number of areas for travel information not covered by conceptual models. The conceptual model in TPEG (Transport Protocol Experts Group) for “Incidents” allows for automated distribution of incident-related messages, but needs some extending and harmonisation to be able to be combined with operational systems that cover other aspects of incident management as well.

3.2.5 Conceptual models for representing geographical features and networks are highly relevant for travel information systems. These are covered in the ISO19100 series of standards, and are being further developed through X-GDF and other initiatives. Some areas that span modes are included in this framework, allowing (for example) footpaths into and around stations to be modelled. Note, however, that the more recent standards activities which involve location referencing (for example, IFOPT) have not been closely connected with GDF development.

3.2.6 For large data sets assembled by many stakeholders, not only the data content but also the metadata needed to administer the data set are important. The National Public Transport Gazetteer (NPTG) and the National Public Transport Access Nodes (NaPTAN) database have provided valuable models for this. The Ordnance Survey (OS) Digital National Framework (DNF) will include an even wider set of structures, geared to facilitating local overlays to national geographical data in a coherent framework.

3.2.7 The uptake of conceptual models is highly dependent on non-technical factors. In the UK the concept of registered bus services led to a business requirement for TransXChange, which

3.3 Reference data

3.3.1 Most travel information systems rely on key data sets, described by a complex domain model, and representing the fixed 'real-world' context of the system, whose collection and maintenance is fundamental to system operation. It can be distinguished from the transaction and usage data that is created by use of the system. The volatility of the data may vary from years (eg for new rail lines) down to hours or even minutes (eg for environmental conditions or operational timetables), so it may be necessary to exchange 'deltas' in addition to a full baseline in order to keep data current.

3.3.2 Place-based reference data is usually a cause of anguish. While base geographic data is usually relatively uncontroversial, contextual place data is more complex.

- For air and rail, the journey endpoints are relatively few, and data manageable (and indeed harmonised internationally). More information is required to describe details of vehicles or termini, in particular for disabled access and more precise interchange transit times; the IFOPT (Identifications of Fixed Objects in Public Transport) initiative has been set up to deal with this. Work needs to be coordinated with further developments in the GDF world to add additional feature levels for pathways: they represent two conceptually different things that need to be integrated in journey planners and other engines.

- For waterways and footpaths, the situation is patchy. Travel by these modes tends not to be urgent and the absence of reference data has not caused difficulties for many people. However expectations are changing and this probably would benefit from action.

- For roads based transport, the situation is equally patchy but more significant. HA is engaged in a major programme to rationalise England's highway management systems; there is, to our knowledge, no *coordinated* activity on the much larger quantity of local roads, though highways authorities of course all have some kind of network reference system. NaPTAN of course exists for the public transport market, though this only lists access nodes rather than providing full feature catalogues.

- For general descriptions, local systems have tended to adopt their own dictionaries, though the NPTG is beginning to put some uniformity into this.

- NaPTAN now includes standard mechanisms to cross reference stop and station identifiers with different industry reference systems, such as rail station TIPLOC (Timing Point Location), CRS (Computer Reservation System) and NRS (National Reservation System) codes, or coach stop identifiers. This makes it relatively easy to tie together different systems using a single consistent set of mapping tables.

3.3.3 Time reference data, above the concept of UTC (Universal Time Coordinator) and the availability of central synchronisation facilities (including via Global Positioning System (GPS)), is usually subject to local management – eg for timetables.

3.3.4 Person related reference data is held (by law) securely, in places such as the Driver and Vehicle Licence Authority (DVLA) and the Police National Computer (PNC), or in private sector databases – operators/travel agencies, membership organisations (AA, RAC etc) or service

3.4 Presentation of information to travellers

3.4.1 The requirements for presentation are governed by a combination of the channel and the content. There are a large range of relevant generic standards in this area, generally connected with channel opportunities and limitations; mostly these are 'soft' standards, relating to operational practices rather than technical software specifications. As content is added, these need to be regularly revised (cf recent TPEG developments).

3.4.2 Some industries apply formal or informal regulatory rules for the presentation of data – for example UK rail set specific guidelines on the presentation of fares in systems. Regulatory measures may also apply to the types of data that need to be available.

3.4.3 In most cases standards would not further accelerate improvements to presentation. It is sufficient to rely on the efforts of different providers striving for ease of use and accessibility, as can be seen from the convergence in the interfaces of on-line journey planners. Closer coordination would almost certainly be a practical impossibility, given the rate of technological and market development.

3.4.4 One possible area to consider is the provision of more specific guidance on driver alert systems, having both safety and effectiveness in mind.

3.4.5 Support for "carbon consciousness" as an aid to sustainability is partly an issue for presentation. In journey planning, complex multivariable comparison might be easiest to understand if converted into a simple metric such as a carbon footprint per mile (much as say supermarkets show fat and calorie content for different produce). Clear principles would be needed for a credible system that will allow consumers to compare options meaningfully. However, it is not clear to what extent standardisation would add value to this.

3.5 Journey planning

3.5.1 Standards are relevant to journey planning in two quite different ways:

- Outputs: programming interfaces to invoke journey planners (as distinct from user interface standards, discussed above);
- Inputs: the data needed to provision them with reference, schedule and real-time data.

3.5.2 A number of projects have developed standards for interfaces in UK and Europe (eg Delfi, EU-Spirit, JourneyWeb). Standards are therefore in place for assembling the fundamental data sets needed to create journey planners, such as stops, places and timetables for different modes, and for exchanging these in bulk. Work is underway to add parking and interchanges.

3.5.3 The adoption of JourneyWeb as a uniform programming interface was essential to enable country-wide multi-modal planning in the Transport Direct portal. Nevertheless, where requirements are less universal, parts of the market have gone ahead without this (for example, Transport for London (TfL), NRE (National Rail Enquiries) and National Express all use proprietary APIs (Application Planning Interface). It might still be argued that standardising the

3.5.4 Note that the benefits of standardisation at the B2B journey planning level would not be achievable without standardising the data sets that underlie them. The development of the two (functional link protocol and reference data set) must, as in many other places, go hand in hand – cf the benefits that have come from standardising on NaPTAN for stop identifiers.

3.5.5 There are still gaps in the nature and types of real-time data feeds, which will be required to enable high-quality real-time journey planning and alert systems. In particular the incident-related information available from different sources is fragmented and in many cases variable in its detail, coverage and quality. This area would benefit from a coordinated programme of work to develop richer standards.

3.5.6 In order to support statutory requirements on accessibility, including for journey planning, a fuller and more widespread standardisation of accessibility attributes is required. This should allow infrastructure accessibility features and limitations to be related to passenger journey characteristics – for example, whether an end-to-end journey is traversable by wheelchair. The IFOPT project is covering much of the technical standardisation, but there will remain a need for processes and tools to capture and maintain the data.

3.5.7 The FareXChange study revealed gaps in terms for describing fares; in particular complex fare products necessary to describe rail.

3.6 Travel retail

3.6.1 There are well established systems for retailing travel products and an active internet commercial sector that suggests the travel retailing is adequately provided for standards, whether done via a quota reservations mechanism or on-the-fly.

3.6.2 The UK at present makes relatively little use of print-your-own and mobile ticketing, both of which can offer convenience benefits to travellers and cost savings to operators. The obstacles to these appear to be organisational rather than technical but it might be worth asking whether any form of standardisation of a virtual ticket for rail and bus would help overcome these.

3.6.3 Another retail area where technology would allow new efficiencies is for car park and on street parking payments and also for road use charging (in the widest sense). The extent to which the lack of standards is holding up this development is debatable; perhaps the most significant brake on progress is that operators are not confident that they know which payment system to support, and cannot justify adopting one randomly.

3.7 Monitoring and management

3.7.1 As technology becomes more capable and cheaper, and as sustainability becomes a more potent political requirement, the opportunity for improved monitoring and management of the network increases. This will inevitably involve much richer sensor works, of both vehicles and passengers, coupled with better algorithms for collating data and developing control, signalling, and management strategies designed to optimise travel behaviour.

3.7.2 Detection/tracking of vehicles is covered by generic and de facto standards. Detection of passenger flows is not currently undertaken but could be done in a similar manner to road data – subject to data protection constraints. The use of anonymised location data from mobile phone is one potential source of such data, and to harness this economically on a large scale some degree of standardisation and regulatory action is likely to be needed.

3.7.3 Improved prediction, especially in the event of perturbations of the network (eg incidents), will require much more in the way of historical data density and prediction algorithms. The systematic collection of historical data as contextualised time series is fundamental to this activity; it is not clear how far this can be standardised, but standards could help facilitate deployment and integration of sensors, and the exchange of historic data sets.

3.7.4 Environmental pollution levels are a category of data that could be integrated into travel information systems – for example to show hazard levels. A simple conceptual model and exchange protocol (for example as a SIRI (Service Interface for Real Time Information) and/or DATEX2 service) might facilitate this.

3.7.5 A form of data that is not currently collected and used as a feed is the usage of on-line systems themselves – use of on-line systems to make requests can reveal information about two key aspects of transport planning:

- user *intent* or *requirement* to travel at a future point. This could be used to ensure that sufficient capacity is provided, or that frustrated demand is at least understood.

- user's need to *repair* their journey at the present moment. For example, traffic on travel information systems inevitably surges during major disruptions.

There are no current models for exposing real-time usage data back to ITS management systems.

3.8 Safety and security

3.8.1 A number of major incidents in recent years have highlighted the importance of rapid and accurate information dissemination for the safety of travellers, especially in congested circumstance. These have led to improvements in both delivery systems and operational practices.

3.8.2 There is now a range of technology available (including both traveller mobile systems and operational messaging systems), increasing the ability for a proactive to be taken during an incident. It may also be worth considering whether this could be facilitated by some centrally planned capabilities – for example, an organised approach to prior planning on the geographical zones to be used for the dissemination of certain types of emergency information.

3.8.3 However, incident management remains one of the most complex areas of travel information, because of the number of organisations involved and the inherent lack of knowledge of the exact current position. There is a fundamental issue about how an incident is managed to create and provide rapid, accurate and appropriate information to operations staff and travellers alike.

3.8.4 There are standardised approaches which can be employed to make information systems secure in line with the assessed risk. Transport information networks constitute strategic parts

3.9 Communications – connectivity

3.9.1 General purpose communications are continuously innovated on a global scale. As with the security area discussed above, there is a compelling business case for the transport industry to adopt them as robust commodity solutions.

3.9.2 Very occasionally there are requirements that cannot be met directly by mainstream telecoms standards. These are then addressed by the transport community: hence DSRC (Dedicated Short Range Communications), CALM (Communication Air-interface Long and Medium range), IEEE802.11p, GSM-R (Global System for Mobile Communications), RDS-TMC (Radio Data System – Traffic Message Channel).

3.9.3 There is a general question about the extent to which proprietary communications protocols are necessary or desirable in specific contexts. There have been cases in the past where local standards have been developed, to take account of specific aspects of transport (notably mobility but also environmental); however this has been diminishing for some time as a wider range of radio technologies has become available, and we do not believe that there are any further issues here.

3.10 Host computer networks

3.10.1 Computer platform standards are determined by a global marketplace, and transport users simply adopt them. In the main, therefore, standards provision is robust.

3.10.2 There are two caveats to this:

- There may still be a need for guidance on the use of specific standards in particular circumstances, whether for business or technical reasons.
- There may be circumstances where platform construction and networking have specific requirements because of the transport context. This principally applies to areas outside the office environment: in-vehicle and streetside/trackside.

3.10.3 Issues in the first category tend to be addressed in the sector frameworks (eg UTMC (Urban Traffic Management and Control)) referred to above and there are no residual standards issues here. Issues in the second category are more significant, but have also been addressed either by industrial automation standards or by specific transport contexts (notably CANbus and GST (Global System for Telematics)). The use of open source licences to reduce long-term IPR costs is also desirable.

3.11 Communications – data exchange

3.11.1 This area relates to the definition of standard protocols to exchange data from one business system to another, at the syntactic rather than semantic layer (ie the “how” of exchange rather than the “what”).

3.11.2 There are no real issues of absent standards here. A number of mature, current and developing frameworks exist, and are well supported by the wider IT industry; transport systems are adopting these. As ever, there are inevitable practical problems in:

- moving systems using legacy protocols to more modern mechanisms of exchange (eg Unicorn to XML, CANbus to IP (Internet Protocol));
- selecting a single appropriate technical approach, or appropriately controlling multiple approaches (eg the discussion of flat-file versus nested in SIRI);
- finding a technical solution which is going to be robust for an adequate length of time, while not constraining innovation.

However, this is not related to any shortfall in the standards themselves.

3.12 System design

3.12.1 Because the workflows and interactions are complex with a very large number of possible models, in specifying transport standards is usually important to have focused end-to-end use cases (as articulated in the UML (Unified Modelling Language) design methodology by Jacobsen), that give the necessary context to judge the essential requirements of both 'soft' and 'hard' aspects. Conceptual models are typically needed to understand and partition the complex data models found in transport applications. For this, UML class diagrams are a useful ISO standard notation that can be mapped onto both OO (eg Java, C#, XML) and database (SQL (Structured Query Language)) representations.

3.12.2 UML Sequence diagrams are a valuable notation for describing data exchange protocols involving a succession of messages that need to be exchanged between two systems in a particular sequence.

3.12.3 The provision of design documentation in UML notation is important for uptake of complex standards as it makes them more accessible to a wide readership..

3.12.4 XML can be used to express domain models for data exchange and for documentation. Because of self-descriptive capabilities and its explicit attention to name uniqueness, data typing and modularisation issues, XML provides a useful level of abstraction for fully portable specifications and there is widespread tool support. It can be used to describe both the data content and protocol management elements. XML is being used effectively in combination with a wide variety of lower level communication transport mechanisms ranging from simple http (hypertext transfer protocol), FTP (file transfer protocol) to SOAP (Simple Object Access Protocol) or queuing middleware. Other technologies such as CORBA (Common Object Request Broker Architecture) may be more appropriate for some high performance applications but typically require a closer coupling of systems. A key principle followed in both DATEX2 and SIRI is that the concerns of transport should be carefully separated from those of payload content.

3.12.5 The UK eGovernment Schema Guidelines for XML and Metadata standard sets out useful XML encoding principles for using XML.

3.12.6 Some richer modelling technologies including "ontologies" (eg OWL (Web Ontology Language)) or RDF (Resource Description Framework) are now being applied to the transport domain to provide more expressive representations, but have not come into widespread use. They

3 2BAdequacy of current standards

4 Evaluation: potential standards shortfalls

4.1 Introduction

4.1.1 This section evaluates where there are potential shortfalls in standards, taking a system lifecycle and business function view.

4.1.2 Across most or all areas runs the theme of "hierarchy of sophistication" in the availability of data or services, running something like:

- Base data on location, orientation, structure etc: essentially, the "geometry" of transport.
- More complex static structural data: capacity, physical restriction on access or passage, regulatory restrictions (eg speed limits), etc.
- Static operational planning data: timetable, fares/fees, etc.
- Averaged/historical operational data: expected levels of flow, congestion, occupancy etc.
- Real time operational data: actual current flows/speeds, service running, etc.

Each level of sophistication requires sound delivery of the prior levels.

4.1.3 There is a generic challenge to ensure that all of the relevant standards making and maintenance activities are kept aligned, which has not always happened in the past. This includes standards in other transport areas (eg between traffic management and bus operation, or between car parks and rail).

4.1.4 There is a further generic challenge to ensure that extant standards are maintained. Particularly with complex "underpinning" initiatives, such as Transmodel, there is a continual need to refine and advance them in order to sustain the basis on which other standards are built.

4.2 Roads, paths and tracks

Road networks

4.2.1 Road based transport constitutes the great majority of travel in the UK. The cost of implementation, and potential benefit, of improved standards in this area are therefore both large.

4.2.2 Private road transport differs fundamentally from public transport: the "transport operator" in this case the traveller himself/herself. One the one hand, this simplifies the process: provide all information to the traveller, and he/she will be responsible for the control/response strategy on his/her trip. On the other hand, it increases the challenge to present information to millions of (untrained) people in a coherent, accurate, relevant and comprehensible way.

4.2.3 The challenge is to enable road users to make the most effective journey arrangements, pre-trip and in-trip, in relation to a wide spectrum of relevant information about road network, meteorology, incidents, etc. In terms of the sophistication hierarchy:

- The simplest approach is a geometric evaluation of the road network to determine a shortest-distance route. Basic road network data are currently well supported by both standards and products/services.

- A more sophisticated approach takes into account the usability of individual links for the journey in question – because of vehicle characteristics or user preference. Parameterisation of road links with static information – road type, speed limits, accessibility etc – could be used, for instance, to determine the "expected" quickest or cheapest route. Currently, only the most basic information is available in a coherent way: road type, and in the near future perhaps speed limits on the Highways Agency (HA) network. (There is work underway investigating the feasibility of extending this to all roads.) There are challenges for both the data framework and the processes needed to collate and sustain the data, though in principle it should be possible to capture in a NaPTAN-like way: locally entered and edited, nationally available.

- A further refinement is to include temporal data – historic journey time by day type, time of day, etc, while the ultimate is to take into account real time characteristics of the network: actual current flows and projected traffic developments. This enables dynamic (re)routing of journeys to find the best actual route. Historical and real time road speed data by day type and time of day is currently available on the strategic roads network and, in a limited way, in a few local road networks. Information is available from proprietary services, and the general trend to instrumentation of roads and vehicles will generate substantial growth in the data available; but without coordination and standardised datasets, the utility of this data will be limited.

4.2.4 There is little understanding of how much detail is required to provide useful traffic advice in particular cases (for example, for minor rural roads or in a dense urban network).

4.2.5 It is important to recognise that the effective use of data can depend substantially on policy and process issues. An important case that has emerged recently relates to satnav services. Users may be guided along routes which are not optimised for network management purposes, or are inappropriate for their vehicles. Where responsibility lies for providing appropriate advice (perhaps through weightings) is not clear.

4.2.6 Understanding road network conditions requires collecting a great deal of live monitoring information. Where this is under the roads authority's control, extant frameworks (such as UTMC) can largely handle this. However, collection of information from probe vehicle data in open market requires a lot more coordination. Some of this may come through initiatives such as GST but it is not integrated at present with traffic management frameworks.

4.2.7 Journey time prediction is a key aspect of travel planning, and must be based on data collected by road network managers. This information is not collected to any standard or with any quality. However, it would take a lot of resource to do this on every road link in the country, so there must necessarily be a deal of pragmatism in what links are served.

4.2.8 Information on costs applicable to road network elements – Road User Charging (RUC), tolls, etc – is not currently available in a coherent form. If monetarised use of roads is going to become more widespread, it will be crucial to capture and present cost information uniformly, and to allow for its incorporation into journey planners and driver assistance systems. (Car parking, covered below, also affects least-cost calculations.)

4.2.9 Finally, there is a risk that dynamic guidance advice from different systems would be inconsistent. Whether this is a problem or not depends on a number of factors, but it is extremely difficult, in an open marketplace, to prevent inconsistent services from launching.

Car parks

4.2.10 Car parks are a common endpoint and interchange point in many journeys and information on them is therefore key to travel planning. While they have been traditionally served only by printed signage and media, accurate static and real-time occupancy information is now beginning to be made available via local information networks (via on street Visible Message Signs (VMS), and sometimes via the web).

4.2.11 Standards here would benefit not only municipal and independent car park operators, but also those organisations that manage tied car parks – railway stations/ports/airports, retail developments, leisure operators etc. And indeed standards for basic information – capacity and available spaces – are now widely used. Landmark is assembling a database of parking data for Transport Direct; a standard XML format for exchanging this static data with other parties has not yet been formulated but would be useful. DATEX2 defines a new protocol for exchanging real-time occupancy levels but this is not yet in widespread use[1].

4.2.12 As with many other functions, one of the crucial shortfalls in car park information is geographical. It is difficult to obtain accurate information on entry/exit points for car parks, which tend to be localised as a single entity. This could potentially be addressed by extending/paralleling IFOPT and/or NaPTAN. The issue here, of course, is more one of process than of technical definition.

4.2.13 Price and availability (eg time of day) information is at present largely internal to the car park operator, and is not adequately covered by extant car park information standards such as the relevant parts of UTMC. This makes it difficult to include car parks in multimodal journey planning.

4.2.14 In some specific local contexts it is possible to go further, to book a space in advance; for example, this is true at Heathrow Airport. However this is not widespread yet, and is certainly not standardised. Neither is there much implementation of in-car-park guidance systems, and therefore standardisation here is also largely absent.

4.2.15 With increasing pervasiveness of cheap wireless networks, similar considerations will increasingly apply to management of on-street parking, for locating free bays etc. Coordinating this nationally will be important to provide uniform information to users and their devices.

Footpath/cycleway networks

4.2.16 The primary need for footpath/cycleway information is the static (slowly changing) information on the structure of the network and crossings, possibly with accessibility information (eg where kerbed). Real time information on closures may also be of value, both in urban areas (eg to cyclist commuters) and in rural (eg to ramblers).

4.2.17 Network structure information can be covered by the same data structures used for roadways. It is worth noting that z-axis data is much more important to walkers and cyclists than to users of motorised transport; this will be necessary for contour-optimised journey planning.

4.2.18 The key issues here relate to the process of capturing data, and to the IPR issues associated with mapping the data. It may for example be best achieved through community mechanisms,

---

1 We understand that IFOPT also intends to develop a basic car parking model.

in which cyclists contribute cycle routes within their local road network etc. However, it would still be important for information services to be able to 'snap' a cycle lane marked on a road, to the road.

4.2.19 Cyclists also require information relating to interchanges – cycle parks, cycle carriage on public transport etc. This appears to be difficult to provide at present. Security, cost and accessibility are all relevant to this.

4.2.20 Walking and cycle journeys tend to be relatively short and familiar, and the networks are large and diverse. It is therefore possible that best value would be obtained in respect of certain key facility data, such as cycle park locations/details, rather than network data. However the fact that processes are already in place for mapping roads might make it relatively simple to capture the walk/cycle network at the same time.

4.3 Rail travel

4.3.1 ATOC, through its two major subsidiaries RSP (Rail Settlement Plan) and NRE acts to coordinate and set de facto standards for UK Rail Travel Information, and also acts as a conduit into Government and into international rail standards through UIC (Union Internationale des Chemins de fer) and ERA (European Rail Agency). Any progress in rail standards will inevitably be driven by ATOC (Association of Train Operating Companies) in its role as the collective body of the UK rail industry – it will be important, however, to make the rail industry in UK and more widely in Europe fully aware of relevant work elsewhere it can make use of.

4.3.2 RSP has evolved RJIS-CIF (Rail Journey Information System – Common Interchange Format) as the UK rail industry exchange format for rail timetables, fares and ticketing data. This is a long established standard whose content and processes well reflect the requirements of traditional rail retailing. There is now considerable scope for modernisation to support faster modern cycles, electronic distribution and retailing methods. There is also considerable scope for modernising the actual data exchange technology used, for example to move from the use of large batch flat files to XML and a more modular reusable package structure, and a conceptual model based on Transmodel. The use of Transmodel would allow a high degree of harmonisation and sharing of content and technology with other modes such as bus and coach, which would also enable the creation of multimodal fare products such as PlusBus and integrated electronic fare cards. The FareXChange study mapped out the feasibility of doing this.

4.3.3 One of the aspects of UK rail retailing that FareXChange highlighted was the relative complexity of UK rail products and the difficulties this raised for consumers. This needs to be addressed in part through simplification – in a way a standardisation of presentation. Another means is the use of electronic devices and cards which can also simplify the experience of using complex fare products – but richer underlying electronic representations are needed to achieve this – as outlined by FareXChange.

4.3.4 NRE has developed UK nation wide systems for journey planning, real-time data and station facility information, including various rail specific data exchange standards such as RTTI and XML schemas for Station and TOC (Train Operating Company) details as part of its Rail Knowledgebase. Most of these could usefully be converged onto wider standards such NaPTAN and IFOPT (for station accessibility data) and SIRI (for real-time running data), enabling better journey planning that takes into account the use of large interchanges and accessibility restrictions. The Rail TOC schema could form the basis for a general standard for describing information for travellers about transport operators.

4.3.5 A curious omission from the rail data set is an electronic representation of the rail network suitable for visualising the network to passengers (a considerable simplification of the detailed representation used to control the network which does exist). Historically this has not been of interest in its own right because the passengers view has been conveyed through manually-designed route maps (as well as being inherent in the published timetable). Such a representation becomes desirable to support personal devices and also advanced situation and alert systems which need to relate disruptions to particular lines of route.

4.3.6 In a similar way, electronic information does not appear to be available on the ability of trains to carry bicycles. This is harder to achieve as the operational rules of carriage vary; however as a more dynamic data set, there is perhaps a greater need to achieve this.

4.3.7 At a more operational level, there is a need to provide travellers with accurate and up to date information on incidents and disruptions, through as wide a range of media as possible – both prior to travel and while travelling. While there are many in-station CIS (customer information system) systems and much is done via station PA and guard announcements on trains, there is limited coverage available off the network to those who have not yet reached the station or are on a connecting service. The exchange of incident information with other modes – often critical for managing rail disruptions in an urban network – is not done electronically and standards that would assist this, such as the SIRI Situation Monitoring Service, would help.

4.3.8 Rail is, in many parts of the UK, an integral part of local travel, and information needs to connect between rail and other local modes. The current situation in which rail industry uses mode-specific standards can make it difficult to satisfy requirements for journey planning, real time information etc. ERA currently has an initiative entitled “Telematics Application for Passengers – Technical Specification for Interoperability” (TAP-TSI) which aims to deliver a Europe-wide planning standard in early 2009 (draft mid-2008), though modal interconnection is not high on their agenda.

4.4 Local public transport

Timetabled bus/coach/metro services

4.4.1 Much of the standardisation agenda for bus, coach and metro/light rail services is similar to that for heavy rail: there is a need to identify and track vehicles, to project arrival and departure times, to advise the public of prices and service disruptions, and to provide input into journey planning and ticketing systems. As such the same standards already discussed are relevant, – both existing and under development.

4.4.2 The industry structure is, on the whole, more diverse, which complicates matters. Nevertheless, there has been considerable investment in standardisation led by the industry (eg through RTIG (Real Time Information Group) in SIRI and other standards), by UK Government (eg NaPTAN and TransXChange) and internationally (eg Transmodel and SIRI and IFOPT).

4.4.3 The visible gaps largely lie in the same place as for rail: coverage of fares enabling joined-up travel retailing as identified by the FareXChange study, and the generally patchy technical support for the distribution of incident and disruption information. It is worth noting that the latter is as important for the bus and coach operator as it is for the traveller: operators need to be quickly and accurately advised of incidents on the road or in an area, so they can take the appropriate management steps.

4.4.4 Within the potential scope of FareXChange there are some differences in the priorities for the bus industry compared to those for the rail industry. For example a 'FareXChange Lite' covering fare stages and their relationship to stops was of greater potential value to the Bus Industry and its ticketing equipment suppliers, because of the large number of bus stops (rail stations are both fewer in number and more static) and a need to provision fare devices. Conversely individual bus operators have less of a need for the complex product representations found in rail. (Having said that, the huge diversity of bus operators, relative to rail, means that the *totality* of fare product offerings in bus mode is substantial.)

4.4.5 Metro and underground systems have some particular characteristics: during peak hours they are essentially frequency based services, placing a premium on real-time information about service intervals and disruptions, rather than on the timetable. Management of passenger congestion is also safety critical.

4.4.6 One additional area where technology developments may assist is in the automated recording of passenger numbers. This would enable diagnosis of overcrowding, knowledge which could be of value to customers in making decisions. This is primarily of interest in the dense metropolitan networks running at capacity where abnormal passenger levels can mean that travel times are severely degraded. There are straightforward ways that existing journey planning and real-time interface standards could be extended to include congestion information, but it will require some work, as will the capture of 'normal' capacity and congestion levels needed to interpret them in applications. Interfaces into the actual measurement devices are likely to be similar to those used for counting vehicles and can probably be left to the supplier community.

On-demand transport: taxi, DRT and PRT

4.4.7 Taxi and demand responsive transport modes do not appear of themselves to raise further specific standardisation requirements at present. TransXChange already includes a means of registering the availability of flexible services within an area and time bands. The same real-time services used for scheduled services could be used to inform passengers of disruptions

4.4.8 The taxi and private hire car industry has developed sophisticated tracking and dispatching systems without the need for standards, over and above normal technologies for location based road services. These are, naturally, geared to the needs of business operations rather than being customer focused: for instance, they don't allow a customer to locate the nearest available taxi quickly, or to compare private hire prices. As taxi/private hire is competitive and as demand responsive transport (DRT) services tend to be centrally managed within any given context, it is not clear that there is business case for systems to resolve this, or therefore for the associated standards.

Public transport vehicle devices

4.4.9 Increasingly information is being presented to travellers during the course of their trip, rather than simply pre-trip and at stops/stations. While some of this is being achieved through personal technologies (see section 4.7 below), there is also a growing industry which is providing audiovisual technology on onboard public transport vehicles.

4.4.10 The challenges here are very largely economic rather than technical. In terms of information provision, the systems and data structures designed for at-station or web-based usage can also be used onboard – with two provisos:

- There may be a requirement to take a different cut of the data: a vehicle-centric rather than a stop-centric approach. (This is already present in SIRI as a separate service.)
- There may be technical restrictions on data exchange, for example owing to limitations on communications capacity. The usual response to this is to make sure the vehicle carries its timetable, and to make announcements by reference to that.

Standards requirements are therefore dealt with elsewhere and/or in hand.

4.4.11 There is a technical requirement to enable efficient connection of passenger information systems to other relevant systems. CANbus is the standard most directly geared to this, and its proposed IP-oriented update will make this easier.

4.5 Air and water

Airports

4.5.1 Airports are the most complex type of travel interchange to navigate, and information on many different aspects is helpful for their use by travellers; not just about access, facilities and routing through complex buildings, but the times needed for check in and security etc, and the allowances and security procedures. Some of these aspects are adequately covered by general journey planning data standards or simply by web pages provided by each airport (parking information being particularly interesting). Some further aspects should be covered by the IFOPT interchange model which will describe both interchanges and the times needed to travel through them. Processes to populate and exchange interchange data still need to be developed and would support advanced journey planning and personal guidance systems.

4.5.2 Airports are especially vulnerable to major disruptions with traffic backing up rapidly at busy times. Rapid dissemination of real-time data about conditions and access routes is therefore important when this happens. Again this should mostly be covered by general multi-modal real-time information standards, for example SIRI.

4.5.3 In the past couple of years there have been several occasions on which security processes affecting large numbers of travellers have required immediate changes. It might be worth considering whether any specific advisory notice mechanism could be used to make this more efficient.

Airline services

4.5.4 Information on air travel is widely available, not only via travel agencies but now also through publicly available internet sites. Schedules and fares are accessible through a number of specialist websites.

4.5.5 However, there is a certain amount of fragmentation in the industry. Whereas previously the GDSs (Global Distribution Systems) effectively controlled information exchange, and became fairly comprehensive and impartial, there are now many air services (particularly in the no-frills sector) which are not accessible by these means. This is not a matter of the standards not

4.5.6 Real time information (for travellers or non-travellers) is available through airport information services, but we are not aware of any standardisation initiative in this area. An external real time data feed of the SIRI type could be useful for external users, eg to provide real time journey planning/journey updates etc.

4.5.7 Some airlines already operate limited internet and mobile services: companies such as SITA provide systems that reuse IATA bar codes, mailing them over the internet or GPRS (General Packet Radio System) to check in. It is not clear how far there would be value in further standardising this.

Ports and ferry services

4.5.8 The issues for major ports and long distance ferry services parallel those for airports and airline services. Air tends to be higher value and more time critical, so the cost-benefit of any standards development will tend to fall there.

4.5.9 There is another subclass of ferry services which are more like water-borne buses, and these – local, frequent, short – could be integrated into bus information operations.

4.5.10 In either case, there are no specific standardisation requirements in this sector.

Waterways

4.5.11 The primary need for waterway information, like footpaths, is the static information on the structure of the network – including features such as tunnels and locks – and facilities such as moorings. Real time information on closures and restrictions would also be helpful. These are likely to be predominantly of leisure interest.

4.5.12 The structures to represent the waterways network would be adequately covered by GIS transport network structures. Similarly, extant data structures (eg for "roadworks") could be used for real time network issues such as incidents and closures.

4.6 Generic requirements

Travel information broadcasts

4.6.1 Broadcasts of travel information happen in two ways:

- by means of a person interpreting data and providing guidance: on-board announcements from the guard/captain/etc, radio and television "traffic reports", or personalised services provided by companies such as Trafficmaster;
- by means of automated delivery of messages to a traveller's device: generalised information such as that available through RDS-TMC or personalised information provided by companies such as Kizoom.

4.6.2 The first requires appropriate information to be available to the broadcaster on the 'general picture'. This will normally come from a control centre which may have a variety of input data feeds. Some degree of standardisation here can be helpful – which is the purpose of the TPEG suite of standards. (Process alternatives, such as allowing the centre access to relevant operational systems and personnel on a controlled basis, are also possible.)

4.6.3 The second requires the service provider to establish communications directly with the user. General telecommunications standards (eg SMS, WAP) will be relevant here. How much additional standardisation is required depends on how much human intervention is required for the message content: hence, partly the value of business to business communications such as SIRI. (See also section 4.7.)

4.6.4 Ubiquitous wireless technology is changing the landscape for informing users through push services that warn about problems likely to affect road users. These can range from both broadcast services such as DAB providing area focused content, to personalised services focused on individual journey plans.

4.6.5 There is increasing interest in specialist broadcasts for those with disabilities. For instance CEN is developing a new work item on the topic "Traveller Information - Visually Impaired People" (TI-VIP). This may be of interest to UK transport managers, though it is not yet available.

Ticketing/reservation

4.6.6 The use of electronic fare cards to pay for transport is growing very significantly: as well as London's Oyster, there are now requirements for ITSO cards in several rail franchises, and ITSO will be the technical basis for the National Concessionary Bus Pass Scheme. The relevant standards (especially ITSO) are therefore fundamental for improving the ticketing process available to the traveller. This requires a consistent fare and fare product model underlying the card, the ticket validation systems, and the retailing system: both passengers and staff must be able to understand what travel rights have been purchased and how they can be checked.

4.6.7 This involves achieving conceptual coherence across a wide span of different systems. A simplifying common conceptual model such as FareXChange is needed to manage the inherent complexity.

4.6.8 Mobile ticketing (that is, the use of mobile devices to make payments and hold proof of purchase) is also likely to increase – competing over time with smart cards. The same retail systems that support smart cards are relevant for supporting mobile retailing: standards on the device for payment etc, typically driven by wider market requirements.

4.6.9 Technology may also allow changes to business processes for retailing that reduce the need for standards. The ability for operators to undertake direct on-line retailing, without going through agencies – as used for example by low-cost airlines and agencies – means that standardised central systems are less necessary, with a premium on the flexibility to innovate ahead of competitors. Self-service on-line ticketing is an interesting case in point allowing different operators to rapidly introduce their own ticketing regimes if they wish.

4.6.10 The introduction of a national road charging scheme outside of the few current limited areas requires the development of consistent information and payment standards for retailing 'road use' across both planning and fulfilment systems. Indeed this has been recognised at Eruopean level and regulation already exists regarding the European Electronic Tolling System – though the technical framework for this is as yet incomplete. Much of the focus is on back office

Incident information

4.6.11 Incidents are difficult to handle because they are often unpredictable and highly variable in their scope, nature and response. The real-time management of incidents or offences requires rapid, accurate and (usually) secure exchange of information. While the rapidity could potentially be enhanced by having standards-based automation, the operational necessities of incident management will usually require a significant degree of human intervention from, for example, a senior policeman.

4.6.12 This is the subject of a number of current programmes of work, such as the European e-Call initiative in the road sector and UITP work in the rail sector; there is also interest in supporting this at ISO, though the scope of this is still unclear. At this stage it is too early to identify specific areas which are underprovided by current activities.

Environment information

4.6.13 There are two aspects of the environment that are relevant to travel information and retailing:

- Information about the environment on a journey. Examples might be reports/projections of high air pollutant levels (pollen, ozone etc), of adverse weather conditions and their consequences (eg flooding or closures) etc.

- Information about the environmental impact of a journey. With current policies aiming towards emission reduction through modal persuasion, there is a desire to model the environmental consequences of planned journey options, for example in terms of carbon dioxide emitted

4.6.14 The first of these requires the collation and presentation of relevant data from monitoring stations or agencies. There is a considerable amount of this available now. The Met Office and Environment Agency cover the UK with weather and flood information respectively; the position on air quality is less well developed though CERC (Centre for Environmental Research and Conservation) are providing air quality mapping information for central London, for example. Within transport standards, there are frameworks – for example UTMC includes a fairly rich meteorological data object. However there appears to be no standard reference structure to use to import this data.

4.6.15 Environmental conditions can be very important to travellers, both pre-trip and in transit, so although the effect might be on only a small proportion of journeys there would seem to be a good case for working on this. Like congestion, this might be baseline, historic by time of day, or current; the usage and support systems/processes are similar to those required for journey time information, although of course the organisations involved might be different.

4.6.16 For such data to become widely available in journey planners would require:

- a model of monitored elements (eg pollutants);
- presentation conventions based that could be understood by users;
- location-based protocols for data exchange.

4.6.17 The second issue – the environmental impact of a journey – requires reliable modelling and base data about specific vehicle types and loadings etc. Although in principle this would be possible offline, any degree of precision would require a large and evolving data set. It is unclear how much practical benefit (as distinct from political necessity) there would be to standardising this, and how the process of collecting the data might work.

Accessibility information

4.6.18 Travel services are constructed and delivered in a way which facilitates their use by the great majority of authorised users: it is not in the interest of any provider to limit his market by making it hard to use. Nevertheless, a small but significant proportion of users cannot use every publicly available service.

4.6.19 The two key aspects to this are as follows:

- Can my vehicle use this network? The information required here is largely geospatial: tight turns, weight limits, low bridges etc. (Something similar will be required for vehicle-on-vehicle modes, such as vehicle ferries or Le Shuttle.)

- Can I as a person use this service? The information here is more complex because it is at the human scale. It affects both vehicles and premises (stations, airports etc), the access to them and the connection between them.

4.6.20 The need to continue to develop relevant geospatial reference data and projections is dealt with elsewhere. In any case, relatively little of this comes within the scope of travel information and retailing – expect perhaps for the question, can my MPV/minibus use this car park?

4.6.21 The second is also a well-analysed issue. As far as stations etc is concerned, the primary development is IFOPT; the proposed SIRI Facilities Management Service would perform a similar function for vehicle accessibility.

4.7 Private vehicle/personal devices

4.7.1 The dramatic drop in the cost of satnav devices and wireless broadband is creating a market to new types of travel information. These devices are expected to play a major part in the future of travel information and retailing. Some of these will be proprietary and specialised (eg most satnav products), while others will be open and generic (eg mobile phones and PDAs). Some will be vehicle-fitted or even embedded, others will be personal and portable.

4.7.2 Such applications depend on the availability of a number of types of data – notably mapping, routing, and in more advanced systems real-time. To date standards have been largely driven by industry and the international economies of scale needed for mass-market consumer devices.

4.7.3 The use of personal navigation and information device out of the car is also becoming increasingly widespread to provide journey planning and real-time information. The use of near filed communications (NFC) tags and optical bar-coding to simplify the interaction of a user with a mobile device is likely to be significant – for example so that users invoke the right departure board by scanning a printed page or touching a pole or other part of the environment. Mainstream technology standards should for the most part suffice, possible accompanied by presentation conventions.

4.7.4 This is a dynamic marketplace and there is no doubt that a huge amount of industry development will go into this area over the coming years, while suppliers explore the potential of efficient current systems (eg SMS) or creative new systems (eg 3G services) in a wide variety of transport contexts. This will involve integrating products in ways difficult to foresee.

4.7.5 In some ways, these developments – while exciting in themselves – add little to the general marketplace, other than providing yet another channel for disseminating the available information. For example, a small, portable web browser could provide (some of) the functionality of a large, fixed web browser or station screen – it is simply available to the traveller in more places.

4.7.6 Mobile devices can be used for location-based services; however these services – queries such as "where is the nearest X?" or "how do I get to B from here?" – require device tracking. This tracking could be dumb (eg through inbuilt GPS) or could be contextual (eg a system that knows I am now on a specific rail service).

4.7.7 There are a few aspects of mobile devices that might give rise to qualitatively new information requirements. Two in particular are:

- The opportunities of NFC to set up ad hoc local communications. This may be used for a number of functions from smart-ticketing functionality (see paras 4.6.5ff above) to access control.

- The opportunities for personalised services, whether pull (eg "dial 0000 to get information and updates on your current journey plan") or push (eg a pre-booked alert service in case of disruption).

5 Recommended way ahead

5.1 Introduction

5.1.1 The surveys of the past two sections have painted a generally unremarkable picture: while there are numerous issues with travel information and retailing in the UK, only a small fraction of them are a result of inadequate standardisation. Non-standards issues, in no particular order, include the following; the expectation is that time will resolve some, though not all, of these:

- operational difficulties between organisations;
- data protection or ownership;
- lack of a business case;
- difficulty in creating a critical mass;
- immaturity in key technologies or their take up by the marketplace;
- regulatory lack of clarity.

5.1.2 Of the relatively small number of problems with standards, we can identify four general classes:

- **Geographical** base data. At the root of all travel operations there is a geographical context which includes points of interest, transport network elements and interchanges. Effective travel information requires this data to be consistently available. The scale of the dataset, and the uses to which it is put by many organisations, require a standard approach.

- Data relevant to particular **user groups**, especially those with mobility impairments and other disabilities. This is required in order to provide (relevant information on) travel "for all", and specifically in order to comply with recent legislation.

- Data relevant to specific **contexts**, especially where these might affect planning or require replanning (by operators and/or by travellers). This affects transport safety, sustainability and efficiency.

- Standards relevant to the **delivery** of travel information or retailing services to users. The ease, pervasiveness and comprehensibility of this will affect how much of the potential value of such services can be realised.

5.1.3 Most other areas of information management can be left to the marketplace, and to individual service delivery organisations.

5.2 Summary of recommendations

5.2.1 The table overleaf captures the key issues arising from the reviews in sections 3 and 4, covering issues of three kinds:

- Gaps: These are areas where the development of new standards – or the extension of existing standards – could materially improve the value of travel information and the effectiveness/efficiency of travel retailing.

- Coordination failures: The issues raised here are areas where standards activities already exist, but have been undertaken without sufficient coordination to ensure seamless effectiveness. As a result, although standards are available their utility is compromised.

- Upkeep failures: The issues here are where standards already exist and are coordinated, but the lack of ongoing effort to sustain and develop them further means that they become decreasing able to fulfil their intended function.

5.2.2 The table does *not* cover areas where standards do, in fact, exist but have not been widely or adequately implemented in specific local contexts. This is a matter for market mechanisms or regulation, and DfT's position will be developed on a case by case basis. This covers issues such as overseeing the rollout of bus real time information, or the encouragement of smartcards based on ITSO.

5.2.3 The assessment of priority is, broadly, as follows:

- H (High): where the presence of a standard is expected to have a direct and material impact on achieving national policies for safety, accessibility, and/or sustainability.
- M (Medium): where the presence of a standard is expected to have a direct and material benefit to the effectiveness and efficiency of travel.
- L (Low): where the presence of a standard would enable services which would be appreciated by the travelling public.

These assessments are those of the project team, and are necessarily somewhat subjective.

Ref	Description of issue	Priority	Mechanism and DfT role
Standards management			
M1	A number of key "framework" European/international standards – in which the UK has had a major part – require maintenance. Transmodel's data modelling is now close to ten years old. DATEX was subject to a major refresh five years ago, though not within the standards domain.	H	Framework standards such as Transmodel need to be sustained and extended to cover new practices, technical opportunities and functional scope. DfT should ensure that standards-making is (a) supported at a national level where appropriate, and not simply left to voluntary contributions; (b) managed strategically, including through participation in the ITSSG; and (c) not regarded as a one-off activity, but provided with adequate through-life support. This mirrors the positive way that the UK is beginning to manage national frameworks such as UTMC, and at a European level how FRAME is supported.
M2	A number of other widely-used European/ international standards also require maintenance or review, to bring into line with technological developments (specifically pervasive technologies such as IP and XML).	L-H	In the DATEX II project, the old EDIFACT-based communications of DATEX were replaced by technology independence and UML modelling. This kind of update is required elsewhere. Contexts will be assessed on a case-by-case basis but a high priority item is the update of the on-vehicle standard EN13149 (CANbus).
M3	Standards frameworks that rely on location referencing need to be coordinated at the geographical data level, and geographical data standards developed to support framework needs.	H	There is a need to ensure that global frameworks such as ISO14285:2004 (X-GDF) are kept under management. DfT should ensure that it plays its full part in supporting the development of X-GDF. DfT should support the DNF as a concrete mechanism to achieve geographical data alignment within the UK.

Ref	Description of issue	Priority	Mechanism and DfT role
Context related data standards			
C1	Real time and historical information on the environmental conditions of a journey (pollutants, weather, etc) are available only patchily.	M	Gathering this requires both the base data to be available in open formats, and a process by which the data can be pulled, evaluated and presented to users. DfT should engage with the Met Office, Environment Agency and relevant local Government bodies to determine how this can be practically achieved. DEFRA (Department for Environment, Food and Rural Affairs) and/or DCLG (Department of Communities and Local Government) may also be involved, and there may be a role for international activity, especially on the climate change agenda. The aim would be for a coherent input standard for environmental data. Extant research and projects such as CERC's should also be involved in this.
C2	Effective incident management depends on the timely availability of accurate information, to enable individuals and service providers to replan. Such information is not currently available in coherent form.	H	There are a number of extant frameworks that cover this in part, including Transmodel, Datex and TPEG; the emergency services have separate (mainly management) protocols to cover this area. There are also security initiatives in the UITP, CEN and ISO arenas, though these are at varying stages. DfT should coordinate these activities, at least in the UK context. This should begin with a study on the process of managing incident information and the technical aspects (eg data structures) required, and lead to a review of how the existing standards support this process. Addressing the full breadth of this would almost certainly need to be done in cooperation with the Home Office/ACPO (Association of Chief Police Officers). There would be merit, and it would be easier, to establish an approach that at least addressed the management of incidents from the transport operator/user perspective.
Standards related to delivery mechanisms			
D1	Virtual tickets are less widely used in the UK than they might be – partly because customers have difficulty understanding or trusting them	M	This is a major growth area. There are extant standards, such as ITSO and IATA barcodes, that support this functionality for the operator perspective, but the user aspects of how to obtain, review, change, cancel, extend etc are still open. DfT should study traveller requirements in this area, and consult with operators etc on what guidance might be required on the structure of virtual ticketing mechanisms. The focus should be on making virtual ticketing convenient to the user. The work done under ISO24014 on Interoperable Fare Management Systems (IFMS), in CEN under IOPTA and in UK under the ITSO initiative should provide sound technical underpinning for this.

Ref	Description of issue	Priority	Mechanism and DfT role
D2	There is no consistent way of describing fare products. As a result it is difficult to automate the collection and production of complex fare products to retailers/users.	M	DfT should continue the work begun in the FareXChange feasibility study. A schema should be developed to communicate fare data to journey planning engines and retailing systems based on extant fare products, and implementing the relevant parts of Transmodel in a concrete standard.
D3	There is no national general purpose exchange format for transport operator details.	L	Operator codes should be harmonised to establish a unique identifier system. Aligning TransXChange with the rail TOC schema and airline codes may be challenging. DfT should explore the potential of achieving this.
D4	Driver assistance and communications systems are delivered in a multitude of ways	L	Guidance is required on how to achieve this in a way which maximises utility to the driver (in terms, for example, of early warning of changes) while avoiding distraction and potential safety problems. DfT should review available guidance in this area and determine whether it requires updating or putting onto a more rigorous footing. This might have to be taken forward internationally. Requires agreement between mapping and satnav device and road management stakeholders, possibly accompanied by validation and kitemarking measures.
D5	There is no consistent, nationally agreed framework for presenting the environmental impact of a journey, eg in terms of carbon footprint	L	This requires collation of research among current range of ‘carbon calculators’. Various branches of DfT will need to be involved, as will DEFRA and potentially others. Industry stakeholders (eg SMMT (Society of Motor Manufacturers and Traders), MIRA (Motor Industry Research Association), AA/RAC) will have a key role in ensuring that the base data on vehicles is practical to collect and presented fairly and comprehensibly to consumers.
D6	There is no consistent data exchange format to allow users to plan journeys with multiple legs.	M	There are a number of levels to which this might be supported internationally: a common conceptual model (perhaps based on Transmodel?), a common interface standard (likely in XML, as a kind of internationalized JourneyWeb) or a common computation model (ensuring that queries to different systems give the same result). DfT (Department for Transport) should explore the potential for harmonizing at these levels at a national, European and global level.

Ref	Description of issue	Priority	Mechanism and DfT role
Standards for geospatial data			
G1	There is no consistent, nationally agreed framework for projecting road (and other network) features onto maps	M	The OS DNF initiative is geared to ensuring that the UK's geospatial data is constructed to common and coherent principles. Transport is only one part of this, of course. DfT should register NaPTAN and NPTG with DNF to provide a formal geospatial context for PT stop data reference. DfT should take a coordinating role for transport-related aspects of this activity, bringing in relevant national agencies (HA, Network Rail) and local operations (eg LAs/PTEs, BAA) for delivery – in a similar way to NaPTAN.
G2	Car park information is available only patchily and not always in the same format	M	Both local authorities and private car park operators need encouragement to collect this information, and to make it available to business partners and/or the public. The UTMC Car Park Data Object is a good starting point, though this will need to be extended to include cost information. However, the rise of satnav systems puts an international dimension on this and the intentions of IFOPT to develop a car park model are also relevant. DfT will need to engage with both the British Parking Association and local authority groups (eg UTMC Development Group (UDG)) to coordinate this development.
G3	There is no consistent, nationally agreed way of describing the expected journey time along a road/route link, taking into account historical data	M	Various parts of this exist in current frameworks such as UTMC, as well as local databases (eg within the Highways Agency). These need to be harmonised as regards (i) time of day breakdown and (ii) metadata that describes the nature of the estimate – eg based on legal maximum roadspeed, historical analysis, or real time monitoring DfT will need to perform a coordinating function, via industry groups (eg UDG, TfL). There also needs to be a process for making this data available.
G4	There is no consistent, nationally agreed framework for presenting the status of waterway networks to the leisure user.	L	AINA (Association of Inland Navigation Authorities) should be asked to determine the practicality and cost of achieving this. Interchange to and from the waterways is also important, so this cannot be a free standing approach.
Standards required to support specific user groups			
U1	It is difficult to provide advice to people with specific impairments on the suitability of a public transport service for them.	H	The work being conducted under SIRI FMS, under IFOPT and under TI-VIP will help to respond to this need. DfT should continue to champion the UK's involvement in these areas. When relevant standards are available, processes to gather the data will need to be put in place.

Ref	Description of issue	Priority	Mechanism and DfT role
U2	Interchange structures and facilities are not well described; there is no agreed process to capture and present relevant information (particularly accessibility data).	H	IFOPT is the technical means being developed to achieve this. However delivery will require processes to be established. DfT should engage with ATOC/National Rail to cover rail stations; with CPT (Confederation of Passenger Transport) /RTIG and others to cover bus stations; with BAA and others to cover airports; and with ABP and others to cover ports.
U3	There is no ready way of exchanging electronic data about which train services can carry cycles	M	DfT should engage with ATOC to deliver this nationally. There may also be value in an international approach though UIC. SIRI provides some technical basis through its FMS. It would be worth (at lower priority) seeing whether this could be extended to coach services.