DEVELOPMENT OF AN ITS TECHNICAL FRAMEWORK FOR THE UK

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ABSTRACT

The UK Government published an ITS policy framework for the roads sector in November 2005. The document introduced the need for coordination of an ITS Technical Framework at a national level, so that individually procured solutions can interface effectively, sharing data and information in a way that ensures seamless service delivery. The Department for Transport has embarked on the first phase of a programme intended to develop and maintain the ITS Technical Framework for the road sector in the UK.

This paper will present the goals and objectives for the framework, the stakeholders, the approach being used to develop the framework and some results of case studies with different authorities. Following this, the paper outlines the conclusions made during phase 1 of the National Technical Framework for ITS to date, and consequently the recommendations for phase 2. In addition a summary of the progress to date has been included as well as a synopsis of the proposed approach to phase 2.

KEYWORDS

Systems Architecture; National Technical Framework for ITS; UK; Department for Transport; ITS

POLICY BACKGROUND

The Department for Transport (DfT) has published an ITS policy framework for the roads sector (1). In his foreword, Stephen Ladyman, the then Minister of State for Transport, recognised that "*ITS brings economic, environmental and social benefits in many ways".*

The Minister also recognised that there are challenges to be met if we want to extract the full potential of ITS.

The role for DfT in supporting ITS development is set out in the framework and includes:-

- to facilitate, encourage and lead a co-ordinated approach to deploying ITS at policy, technical and organisational levels
- to lead by example, as a major procurer of ITS
- to encourage appropriate standards
- to learn from international experience
- to work in partnership

There are seven major policy themes where ITS is expected to deliver significant benefits. These are:-

1. improving road network management
2. improving road safety
3. better travel and traveller information
4. better public transport
5. a more efficient road freight industry
6. reducing negative environmental impacts
7. security, crime reduction, and emergency planning

In addition, the policy framework recognises the right of an individual to expect a safe, seamless, efficient, comfortable, accessible and reliable journey, irrespective of the number of transport modes or service providers involved.

Currently, the reality in the delivery of ITS cannot be said to match this expectation. Part of the reason is that ITS solutions are developed in isolation and do not work effectively together. If we are to meet the expectations of travellers, we need to ensure that individually procured ITS solutions deliver seamless services by interfacing effectively, sharing data and information where appropriate.
One of the actions identified in (1) was to deliver in partnership with others a national ITS technical framework. This paper sets out DfT's response in taking that action forward.

GOALS AND OBJECTIVES

Goal

The goal of the National Technical Framework for ITS (NTFI) is *to encourage the cost-*effective *deployment of current and future ITS applications, making best use of information and resources.*

Objectives

The specific objectives for the NTFI are:-

- To enable investors in ITS to maximise the available benefits through open interfaces that support data exchange and sharing of resources.

- To enable deployment and operational costs to be reduced by encouraging the use of open, shared platforms, resources and data.
- To reduce the barriers to deployment of ITS by reducing risks associated with lack of open interfaces and lack of seamless interoperability.
- To enable ITS applications and services to work seamlessly across geographic boundaries.
- To enable applications of ITS promoted by the public and private sectors to inter-work and share resources and information as appropriate.
- To promote a strong, competitive market for ITS products.

SCOPE OF THE TECHNICAL FRAMEWORK

The scope of the Technical Framework is expected to:-

- Be relevant to the whole of the UK.
- Cover public sector applications and their interfaces to the market for private sector applications.
- Initially focus on road transport, recognising the need to work across the boundaries with other modes.
- Cover a minimum defined set of ITS applications and services.

INITIAL APPROACH, ANALYSIS AND CONCLUSIONS

The initial approach centred upon the identification and management of the stakeholders; the appointment and management of a contractor who would produce an "end-state" Technical Framework; and the development and deployment of demonstration projects.

However, this approach had a number of issues that quickly became apparent. This initial approach implied a high commitment to ownership of the NTFI by DfT. In addition, despite the significant interest from local authorities and the private sector in the development of the NTFI, it was concluded that there was insufficient confidence in the business case to justify DfT investment in such an end-state Technical Framework. Furthermore, there was a lack of any arrangements for the maintenance and overall governance of the NTFI.

The initial analysis showed that it would not be possible for the DfT to 'own' the NTFI, but rather that the DfT's role should be as champion, with ownership lying with the wider stakeholders.

As a result of this initial analysis, it was decided that phase 1 of the NTFI should take a more pragmatic approach to development and therefore focus on establishing the governance and wider ownership of the NTFI.

THE ALTERNATIVE APPROACH

It was decided that the alternative approach needed to:-

- Acknowledge the reality that there are many ITS stakeholders in the UK
- Allow and encourage devolved ownership of the NTFI
- Acknowledge the need to ensure proper long-term governance
- Acknowledge the role of public sector stakeholders at both national and local level
- Acknowledge the need to accommodate the aspirations of both public and private sectors
- Allow for different level of detail to be incorporated

An approach has been developed to deliver the objectives of the initial phase of the Technical Framework. The approach has been tested by applying it to selected key potential stakeholders. The case studies involve observing and analysing the existing architecture and structural arrangements and the experiences with ITS. The 'trial' case studies will be compared and used to inform the design of the second phase of the plan.

A number of different 'tools' were identified and investigated by the project team, including MEGA (a software tool used in FRAME, ARTISTE and ACTIF). All of the tools investigated refer to the Zachman Framework as a key example of an approach to organising the complexity of thinking before starting to develop an architecture.

The approach uses the Zachman Framework (2). This style of approach is considered to be useful in analysing and developing an enterprise architecture. The Zachman Framework ultimately poses a number of key questions that help to add structure to the analysis. The questions that are needed are what, who, why, where, how and when. These questions can be used at a number of different levels ranging from a high level, low detail contextual level to a low level, high detail level.

REQUIREMENTS OF KEY STAKEHOLDERS

There are many different ITS applications, standards, protocols and commercial products. These involve many different stakeholders.

The Technical Framework is intended to be an enabling mechanism at the functional level for use across different ITS applications and stakeholders. It is intended to support the development of compatible and interoperable ITS applications and services across different ITS domains without requiring adherence by all to a single, prescriptive, overarching physical architecture.

The Technical Framework will not, by itself, ensure that this is achieved. Interoperability will also require clients for ITS applications and services to insist on specific technical requirements being met that are consistent with the Technical Framework.

The term "Key Stakeholders" is used to indicate a stakeholder who is willing to share with DfT in the ownership of the Technical Framework.

To be eligible for Key Stakeholder status, an organisation should ideally:-

- have responsibility for the delivery of ITS applications and/or services, and/or

- have responsibility for the specification/requirements of the ITS applications and/or services, and/or
- be able to approve the use of the Technical Framework within their organisation.

In return Key Stakeholders will be offered the opportunity to:-

- "Own" and manage the relevant part of the NTFI
- Share the ownership and management of interfaces to other parts of the NTFI and external interfaces.
- Develop the commercial/business case for use of their part of the technical framework
- Agree to apply the completed Technical Framework in their ITS deployments.

The benefits of this approach are that it:-

- Acknowledges the ownership of existing investments in ITS applications and services
- Provides a means of balancing the costs associated with development and the benefits arising from the use of the NTFI
- Provides the basis for agreeing the allocation of responsibilities for the NTFI
- Should lead to increased confidence of the supply industry
- Should make the NTFI "self-financing"

It is expected that Key Stakeholders will provide two roles, an "owner" role and a "technical architect" role. The owner will participate in decisions regarding the overall management of the Technical Framework. The technical architect will interface with the technical architects for other stakeholders.

TESTING THE APPROACH

Public sector case studies

To date, four public sector case studies have been undertaken. Each authority involved in the case studies held particular qualities that merit their inclusion as an example stakeholder. The case studies and their reasons for inclusion are listed as follows:

- The Highways Agency as a strategic road authority
- ROMANSE (Hampshire County Council, Portsmouth City Council and Southampton City Council) as an example of local authorities working in partnership
- Kent County Council as an example of urban/interurban management
- The West Midlands as a metropolitan authority.

The conclusions from these public sector case studies have fed into the conclusions below this section.

Private sector case study

In addition, following a workshop with ITS (UK), it was decided that consultation should be sought with the private sector. Subsequently, a case study was organised in

collaboration with innovITS. This case study brought together a number of representatives from major sectors of the ITS industry to discuss the arrangements and possible impact of the NTFI on commercial applications, in particular work carried out surrounding the development and deployment of in-vehicle applications. It is possible that an industry group could work to develop and deliver a framework for in-vehicle applications that could form one of the components of the NTFI. These discussions and those with other members of the private sector have contributed to a set of recommendations which will be outlined later in the paper.

Strategic ITS applications

To date, in phase 1 of the NTFI, the approach used has been applied to strategic ITS applications which play a key role in addressing national transport policy objectives – Electronic Fee Collection, Real Time Passenger Information (RTPI) and Smartcards. The approach was used to test the business case for each of these and to observe the delivery mechanisms in place for each strategic application.

The contexts for Electronic Fee Collection and Smartcard applications were analysed using the project team's expert knowledge with input from DfT internal stakeholders. The approach used to test the business case and governance structure of RTPI was rather different. In this instance, the three local authorities involved in the case studies were asked to describe the delivery, organisation and governance of RTPI in their locality and to consider what impact the NTFI might have on its future delivery. This provided insights into different ways of organising the same service, illustrates some of the variations in method used to achieve similar outcomes and therefore highlights the subsequent barriers for the interoperability between services provided by different organisations. The illustrative results of the findings included below demonstrate the potential barriers to interoperability and the differences in the approach to deployment.

The diagram below illustrates a theoretical context model for RTPI. In the diagram below (Figure 1), the entities within the yellow box are generally considered to be the responsibility of the local authority. Those entities outside of the yellow box (e.g. bus operator; in-vehicle equipment are not the responsibility of the authority.

The basis of Figure 1 is that the bus operator provides the authority with the route and timetable information, whilst at the same time operating their fleet of vehicles (fitted with an on-board unit) and monitoring their progress. The real-time timetable information is then relayed from the bus operator to the RTI control centre, which in turn relays the information to the users.

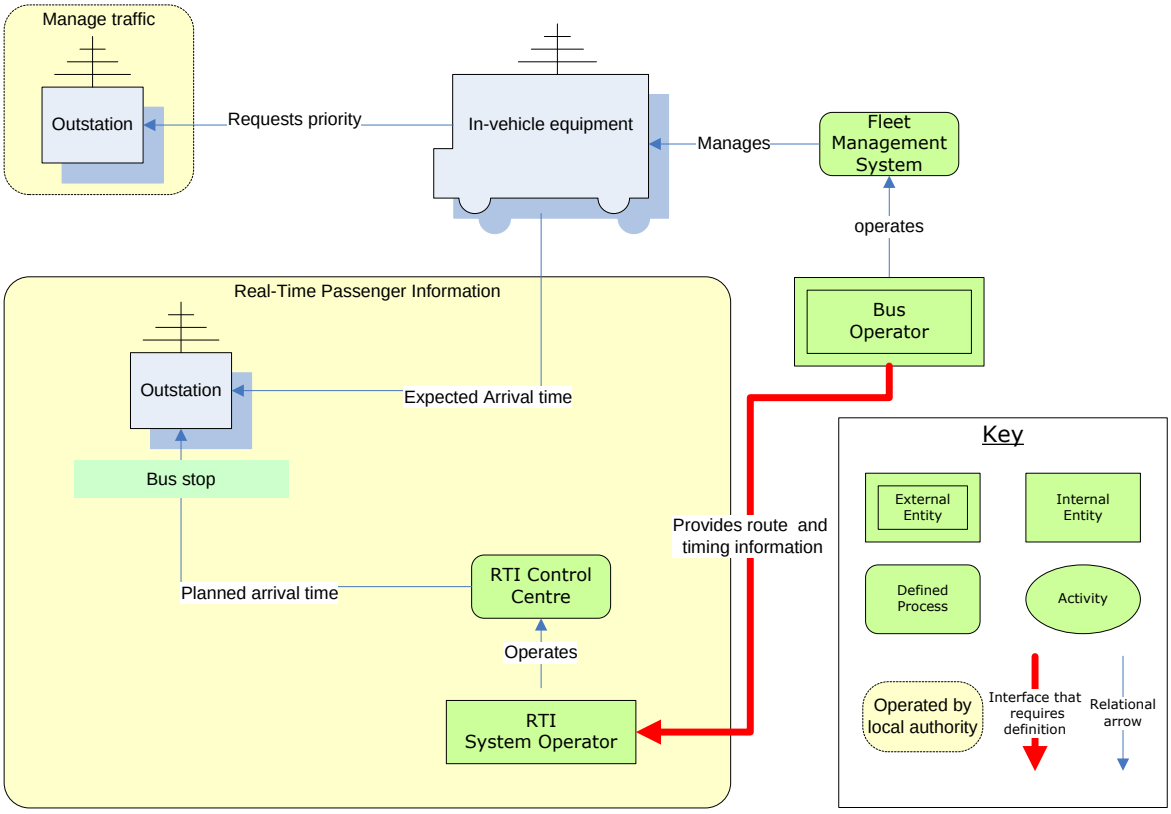

Figure 1: Real-Time Passenger Information theoretical context diagram

As stated earlier, the scenario illustrated by Figure 1 is the theoretical context diagram. The same approach was taken to analysing the approach taken by the local authorities involved in the case studies. Below (Figure 2) is the approach taken by the ROMANSE authorities (Hampshire County Council, Portsmouth City Council and Southampton City Council).

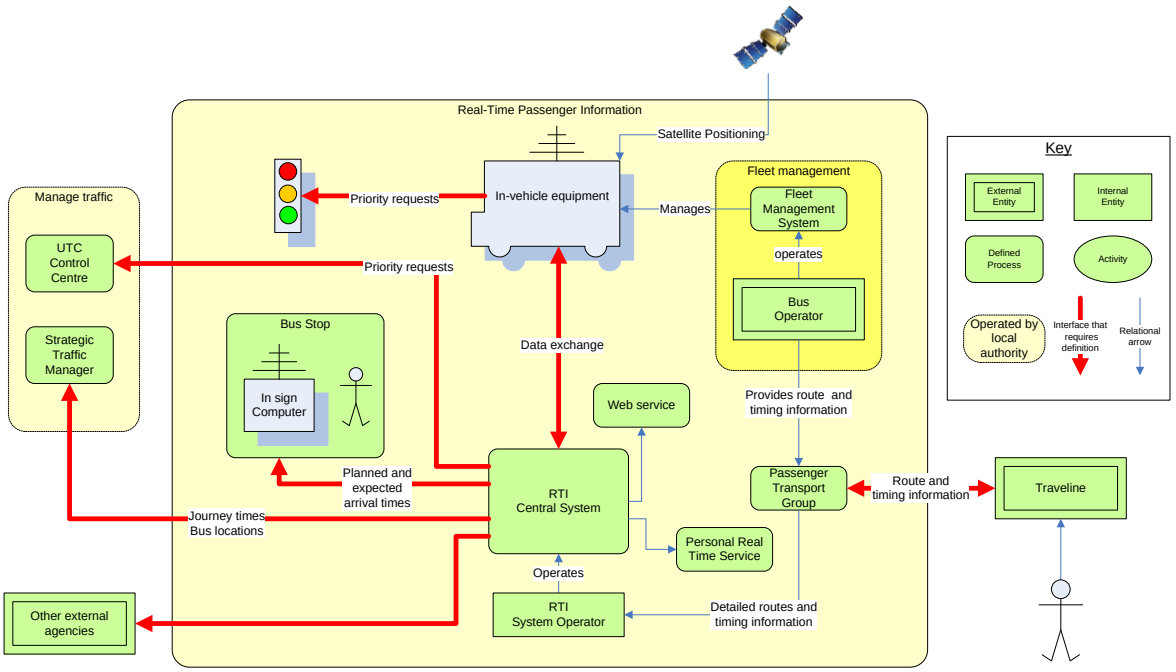

Figure 2: RTPI supply chain in ROMANSE

In the theoretical context model (Figure 1) the local authority has certain entities (e.g. council owned and operated infrastructure and bodies) 'within the box' of their control but then others (e.g. external systems and entities) 'outside the box'. However in the ROMANSE example, the majority of systems and entities are situated within ROMANSE's sphere of influence.

In ROMANSE the on-board units that are fitted to the buses are paid for and fitted by the ROMANSE group rather than the bus operators. This approach blurs the distinction between the public sector and private sector initiatives. It requires ROMANSE to set up complex agreements with the bus operators, over arrangements for the on-board units. In addition there are many interfaces that require definition before they deliver efficient results.

The variations in approach taken to the delivery of RTPI between the ROMANSE authorities and the theoretical context model (as well as that taken by the other case study authorities) is considerable. The results from the analysis of the different approaches (as well as the case studies into Electronic Fee Collection and Smartcards) has fed into the conclusions listed below.

CONCLUSIONS

Following the testing of the approach during the stakeholder engagement process and analysis of the strategic ITS applications, a number of conclusions were drawn. These are as follows:-

Every enterprise needs its own architecture: Each enterprise which was studied needed to have a complete architecture meeting the business goals of the organisation. It is not feasible to join these all together in a single all embracing common ITS architecture

Different enterprises take different approaches: The case studies show that there are significant differences between national and local approaches and between public and private sector approaches. National interest tends to involve rolling out single applications everywhere. In contrast local interest is in integrating all relevant applications to work in an area and in obtaining competitive procurement of system components. Private enterprises focus on delivering 'products' and therefore prefer a generic physical architecture which can be used to provide a variety of ITS services.

Competitive procurement of system components works: Much of the currently available material is in the form of standards and specifications for particular interfaces (e.g. UTMC). This appears to have been effective in enabling local authorities to purchase system components from many different suppliers through competitive procurement.

The resulting systems are not-interoperable: However, despite systems being built using compatible components, this does not, by itself, achieve interoperability. Most of the local implementations are experiencing problems with lack of interoperability with neighbouring authorities.

The key interfaces between applications are not managed or stable: Interfaces between public authorities are, in the main, arranged in an ad hoc manner, and may change over time, sometimes with little commitment by the parties to maintain the interface. There is a need for key interfaces to be identified, managed and maintained.

The Business Case needs to be developed as part of the governance: The ITS market is complex, there are many stakeholders, many potential interfaces, developments in technology and uncertainty in the development of future strategic ITS applications. It is not considered feasible to prepare a business case for a particular set of functions, or interfaces. The Business Case for investment needs to be an integrated part of the process of governing the Framework, such that decisions can be taken as and when all parties are agreed on the case and the deployment plan.

Two further conclusions are relevant to the work to develop the NTFI, rather than to the form it will take.

A long term approach is needed with consistent support for the governance: The process of working with stakeholders, defining the interfaces, generating the business case, developing deployment plans and implementing the Framework is a long term task. The key role of the Department is to provide a secure governance process for at least five years to provide all stakeholders with confidence to commit their resources to making the National Technical Framework for ITS a reality.

The outcome will be decided by process not in advance by DfT: There can be no end-state plan. What is needed is a process which will lead to consensus between relevant parties on strategic requirements (i.e. aspirations), agreement on the implementation plan, management of the deployment and maintenance of the National Technical Framework for ITS as it develops.

RECOMMENDATIONS

Following from these conclusions, recommendations on the guiding principles for the procurement in Phase 2 are outlined below:-

- **The environment**: There is a need to build an environment in which it is possible to develop the business case for each initiative. The way forward is to recognise the various owners and to shape the development around those owners.
- **Ownership**: The owners of the NTFI are: central DfT (Transport Technology and Standards Division), the various owners of the strategic ITS applications, local highway authorities, strategic highway authorities, commercial application providers (through InnovITS) and others. The commercial owners would operate a working group shadowing the management structure of the NTFI.
- **Business case**: At the top level (applications etc.) the owners have to have their own business case. At the lower level, those delivering ITS services also need to have a business case; thus each owner will have to bring a business case for the interaction or interface involving them before they can join.
- **DfT's role** is to provide the environment and a process for enabling the owners to formalise their requirements, develop a business case and then implement it.

- **The process** of developing the NTFI will involve the owners scoping the work that needs to be done, identifying the interfaces, agreeing what they would look like, and then building a common design diagram.

These recommendations are to be used as the basis for developing a proposed plan for the next stage of the work, to develop the National Technical Framework for ITS in the UK.

PROGRESS TO DATE

The main report for phase 1 of the NTFI has been produced and details the work carried out to date. The report includes sections on the aims, objectives and goals of the project; a narrative covering the methodological approach used in the project to date; a summary of each case study and application study carried out to inform the future approach to developing the NTFI; the analysis of other existing approaches to developing an ITS Architecture or Technical Framework; and the relevant conclusions and recommendations for the next phase of the NTFI. This report has subsequently been released for consultation to internal DfT stakeholders, the Chief Scientist, the devolved powers (i.e. Transport Scotland and the Welsh Assembly), the Highways Agency, the Joint Chairs Group, representatives from local highways authorities, and members of the UK ITS industry. Part of the Technical Annex has also been released to the consultees alongside the main report. The documents within the Technical Annex are reference documents for the main report and contain examples of the case study reports that were developed with selected stakeholders. The results of this consultation are due whilst this paper is in production, it is envisaged that the main themes from the consultation process will be released at a later date.

During phase 1 of the NTFI, the possibility of involving industry in the governance process for subsequent phases was explored. This has culminated in discussions with the Technology Strategy Board (TSB - an executive non-departmental public body that is sponsored by the UK Department for Innovation, Universities and Skills) about how they might potentially represent a common voice for the UK supply industry for ITS on a Programme Management Board for the NTFI. The TSB have a number of Innovation Platforms for specific areas of interest - one of which is the Intelligent Transport Systems and Services (ITSS) Innovation Platform (3). Within this there are individual Innovation Platform themes. TSB has developed an Intervention Strategy for ITSS, which takes into account the various inter-dependant ITS themes. The current suggestion is that the TSB would issue interventions and challenges to industry based upon specific or identified themes. This move may enable industry to have advance understanding of the stakeholders requirements in the UK and consequently industry will be able to respond to tenders in a timely and accurate manner. These discussions are ongoing.

PROPOSED APPROACH FOR PHASE 2

Phase 1 of the NTFI sought to achieve an overview of stakeholder aspirations in terms of what they would like the NTFI to be. As a result of this, the DfT has been able to define the requirements of the NTFI. This process has enabled the DfT to decide on the best approach to take to delivering the NTFI in order that it meets these requirements. Phase 2

will develop the environment for the NTFI by way of establishing the governance arrangements that will support and deliver the NTFI.

The proposed approach for phase 2 of the NTFI is expected to be more of a pragmatic approach. It is anticipated that the NTFI will be owned by the stakeholders (provided that the stakeholder meets the criteria outlined in the 'Stakeholder Requirements' section above). The overarching process for the NTFI (including, but not limited to, the approach to defining user requirements, a method of scoping work to be done, an approach to deciding which interfaces need to be defined, and developing the business case for each application/service) is likely to be defined by DfT. It is proposed that the strategic direction for the NTFI will come from a Programme Management Board, directed by DfT. The suggestion is that to facilitate the use of the NTFI, Government may be required to mandate the adoption of certain key components.

The suggested approach for phase 2 supports the continual evolution of the NTFI in terms of stakeholder's policy changes, changes in technology, and alterations to the standards and legislative environments etc. Importantly, the proposed approach acknowledges the role of existing groups and stakeholders with an interest in the field of ITS and it does not disregard the existing work done by these groups but rather embraces it under the umbrella of the NTFI. The existing arrangements are likely to be incorporated into the governance framework for phase 2 in some way.

As outlined earlier in the paper, each stakeholder will be required to have a business case for their area of the NTFI. However, in order to enable the Department to make an informed decision on the prospective progression to phase 2 of the NTFI, a full overall business case is required. The full overall business case is being considered and a decision on phase 2 is expected to be made in the autumn.

REFERENCES

(1) Intelligent Transport Systems (ITS): The policy framework for the roads sector. Department for Transport. November 2005

(2) See the Zachman Institute for Framework Advancement at http://www.zifa.com/

(3) See the Technology Strategy Board's Innovation Platform information at http://www.innovateuk.org/