HOW CAN AN ITS ARCHITECTURE BE CREATED? A EUROPEAN VIEW

Richard A P Bossom
System Design Services, Siemens Traffic Controls, Sopers Lane, Poole, BH17 7ER, UK
Tel: +44 (0)1202 782216, E-mail: richard.bossom@siemens.com
Peter H Jesty
Peter Jesty Consulting Ltd, Warwick Lodge, Towton, Tadcaster, LS24 9PB, UK
Tel: +44 (0)1937 833640, Email: phj@peterjesty.com

SUMMARY

This paper provides an overview of the ITS architecture creation process and how the results can be used in ITS development and deployment. It starts by looking at the Stakeholders and their rôle in the ITS architecture creation process. The results of the process are then described and their use in ITS deployment explained. The use of the two basic types of ITS Architecture is then explained, and the paper finishes with a discussion on how Multi-modal ITS Architectures can be created.

INTRODUCTION

An ITS Architecture is a manifestation of the aspirations, or desires, of the Stakeholders for the future deployment of ITS. It is a tool that can be used to capture which goals the Stakeholders want the ITS deployment to achieve, and the problems that they want it to solve. An ITS Architecture can then be used to define the components and infrastructure that will be needed to implement the services that will achieve these goals and solve these problems. ITS Architecture creation should be one of the initial activities in the ITS development and deployment process, as shown in Figure 1.

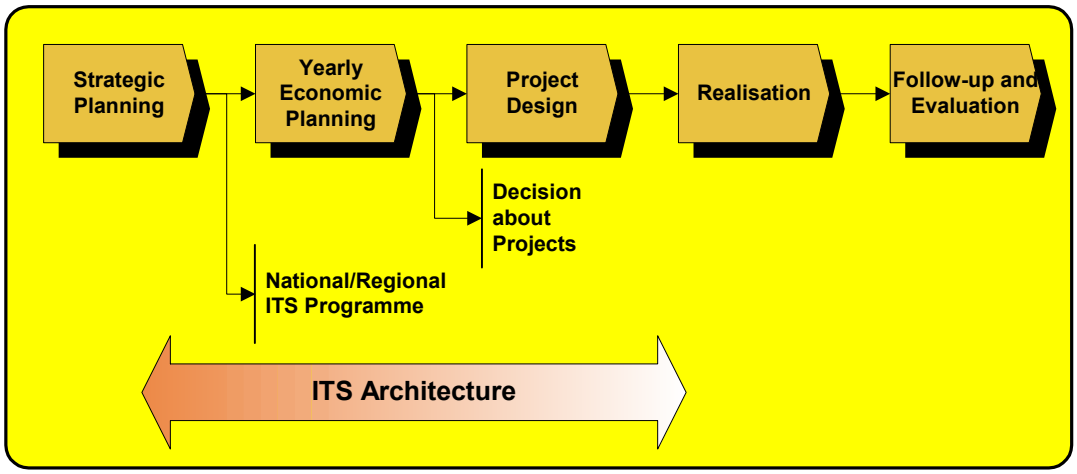

Figure 1 ITS Architecture in the ITS deployment process

THE STAKEHOLDERS' PART IN ITS ARCHITECTURE CREATION

The process of creating an ITS architecture starts with the identification and involvement of the Stakeholders in the ITS deployment. Stakeholders can be divided into the following four categories, some or all of which will be involved in every ITS deployment.

- Want ITS – These Stakeholders want the ITS deployment to solve (or diminish) travel problems, or to provide travel information services to the public. Examples include District, City or Town authorities, Motorway operators, Public Transport operators, freight and fleet operators, Police, etc.
- Make ITS – This category of stakeholder comprises component suppliers, system integrators and telecommunication service providers. The suppliers will deliver hardware and software components for inclusion as part of the ITS deployment. System integrators will combine the components into complete systems and telecommunication operators will make communications services available for the components to use.
- Use ITS – This category of stakeholder has two types: primary and supporting. The primary "Use ITS" stakeholders will benefit directly from the output of the ITS deployment, e.g. travellers, freight shippers and fleet operators. The supporting "Use ITS" stakeholders will control the components and infrastructure included in the ITS deployment and provide its main inputs, e.g. control centre operators.
- Rule ITS – These stakeholders have the responsibility for issuing the regulations governing how to implement and use the components and infrastructure in the ITS deployment. They include local and national authorities (e.g. government ministries), and international authorities (e.g. EC, CEN and ISO) that may also issue regulations, as well as standards and recommendations for international inter-operability.

Service providers will develop and implement services that help those in the "Use ITS" category. They may provide systems that form part of the ITS deployment, or just use information from its constituent systems. Therefore they can fit into the "Make ITS" and/or the "Use ITS" groups.

Figure 2 illustrates where the Stakeholders fit into the ITS architecture creation process. The Stakeholder Aspirations that they help to produce are an expression of the problems or goals for which they need solutions over the next planning period. The Aspirations should be written in the Stakeholders' own words and can only be obtained properly through direct consultation and discussion. This may take a little time as it usually involves meeting with each Stakeholder individually, as well as in groups. The end result must be a set of Aspirations with which all the Stakeholders agree.

CREATING THE ARCHITECTURE

Once the Stakeholders have agreed the Aspirations, the architecture creation process can begin. It starts with the "translation" of the problems and goals in the Aspirations into solutions expressed as Stakeholder Needs. These are formal statements of what the system must do to satisfy the Aspirations. Models may be used to clarify with the Stakeholders some of the processes that need to be included in the services.

The Stakeholder Needs are then used to create a number of different architecture viewpoints. These typically comprise a Functional (or Logical) Viewpoint to show the processes that are required, a Physical Viewpoint to show where the processes are located and a Communications Viewpoint to describe the links between the locations. Sometimes an Overview (or Conceptual Model) is also included to show how everything works, and an Information Viewpoint to describe the contents of (some of) the data flows and data stores.

The European ITS Framework Architecture can be used as the basis for much of this work, although many ITS deployments will only use a sub-set. To this sub-set a small set of "local" User Needs (and consequent functionality) will normally need to be added. The design of the Framework Architecture is such that selecting a sub-set, and making additions is relatively easy to achieve. This work is also supported by aids such as a Selection Tool that simplifies the creation of the Framework Architecture sub-set.

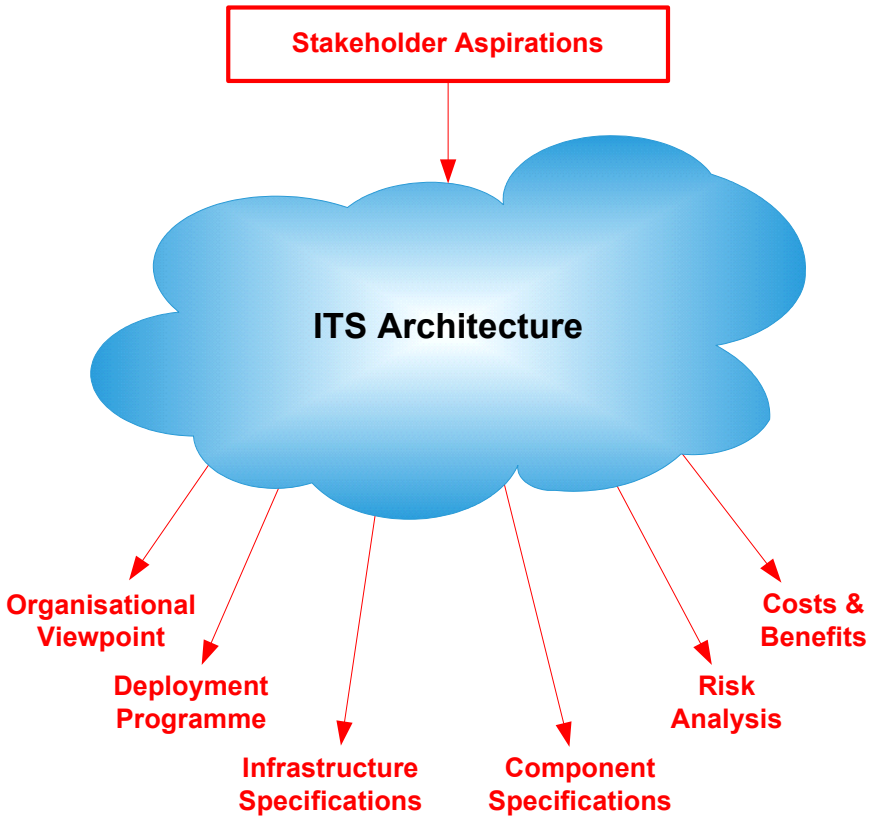

Figure 2 An overview of the ITS architecture creation process

RESULTS OF THE ITS ARCHITECTURE CREATION PROCESS

Once the ITS Architecture has been created, the supporting management documentation shown at the bottom of Figure 2 can be produced. This may comprise some or all of the following.

- Organisational Viewpoint (or Enterprise Model) – this describes how the organisations involved in using, owning, operating or regulating the Components and Communications Infrastructure will relate to each other. It can highlight any

issues that may arise because of incomplete communications, or improperly defined relationships between organisations.

- Deployment Programme – a description of how the Components and Communications Infrastructure will be deployed. It includes such things as actions and dates by which they must be complete, when Components and the Communications Infrastructure must be ready for use, and what is to happen to existing systems and their components.
- Infrastructure Specifications – the descriptions of the Communications Infrastructure that will enable the Components to communicate with each other and with the outside world. They include references to any standards that are to be used for data transfer, and the high-level characteristics of the user interfaces.
- Component Specifications – the descriptions of the Components ("bits and pieces") needed for the system to do what the Stakeholders want. They describe what each "piece" must do, not how it should be done, and include references to constraints such as data protection standards, accessibility, ease of maintenance, etc.
- Risk Analysis – this highlights any risks to the deployment and operation of the Components and Communications Infrastructure. It details the impact of the risks, what can and should be done to mitigate them and who should take these actions.
- Costs & Benefits – this provides details of the projected costs and the benefits to be gained by using the services that will be available when the ITS deployment has been completed.

The contents of each of these outputs will play a vital part in managing the development and deployment of the actual ITS services that deliver solutions to the desires expressed in the Stakeholder Aspirations. The first two outputs show how inter-operability will be achieved, the next two define what needs to be included in the ITS deployment, and the final two enable different solutions to be compared. Stakeholders should be given the opportunity to comment and approve their contents.

TYPES OF ITS ARCHITECTURE

A National, or Regional ITS Architecture can be of two basic types. The first is a "Framework" ITS Architecture that is defined by the Stakeholder Needs and Functional Viewpoint. Users are then left to create the Physical Viewpoints and other outputs for their own specific ITS deployments using guidance and advice provided as part of the Architecture documentation. Alternatively a "Defined" ITS Architecture can be produced. In addition to the User Needs and Functional Viewpoint, a "Defined" ITS Architecture includes the Physical and the Communications Viewpoints, plus many of the other outputs. The users can then select those parts of the Physical Viewpoint (and hence the Communications Viewpoint) that are needed for their particular ITS deployments. Figure 3 illustrates these two types of architecture and the differences between them.

The "Framework" type of ITS Architecture is more flexible but requires more work to be done by its users. Although a "Defined" ITS Architecture is easier to use, it carries a number of assumptions about the services and scope of the ITS deployment. This could cause difficulties when trans-area services are required that cross more than one "Defined" ITS Architectures.

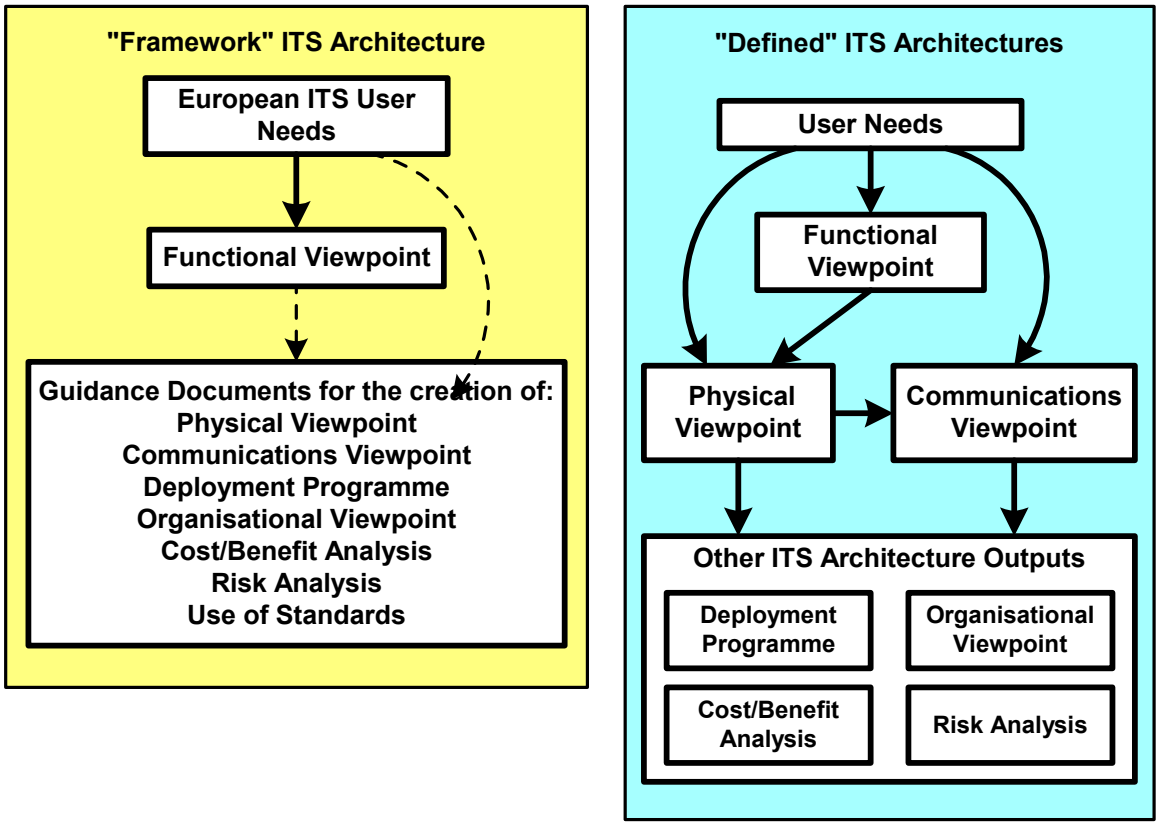

Figure 3 Different types of ITS Architecture

MULTI-MODALITY IN ITS ARCHITECTURES

Whilst there are several ways in which Multi-Modal ITS Architectures can be created, they can be characterised by four possible solutions. These comprise a single universal Multi-Modal ITS Architecture covering all modes, an Architecture that shows only the interfaces to the different modes, an Architecture that includes those parts of each mode that takes part in the inter-modal services, and an extension from one mode to the other modes (see Figure 4).

A single universal Multi-Modal Architecture (see Figure 4(a)) is likely to be very large since it will have to include all the functionality for all the relevant modes. This could make it both difficult to create and to manage properly. It is also likely to take much longer to create because of the large number of Stakeholders that will need to be involved.

An architecture that just shows the functionality and interfaces between the separate modal architectures (see Figure 4(b)) is unlikely to cover all the issues surrounding the exchange of information between them. Getting it to work may also be difficult because there is no "commitment" from the architectures to co-operate.

A Multi-Modal Architecture that "drills" into the relevant parts of each of the individual modal architectures (see Figure 4(c)) is more likely to present all the information required to understand the inter-modal issues. It should also not be too difficult to create and manage, since it will not be much larger than a single mode ITS Architecture, and should not involve too large a number of Stakeholders.

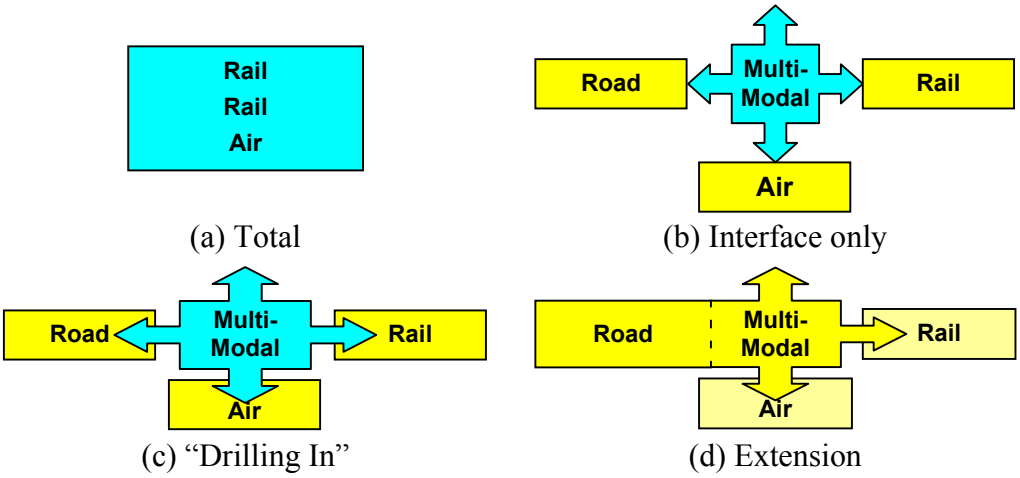

Figure 4 Different types of Multi-Modal Architectures

Currently the most advanced ITS Architectures are those associated with road transport. A road transport Architecture can therefore be extended into the other modes (see Figure 4(d)), picking up the functionality necessary for the inter-modal services. An advantage of this approach is that it is not necessary for the other modal architectures to exist in their entirety. This is the approach that has been taken by Italy in their ARTIST ITS Architecture.

CONCLUSIONS

The process of creating an ITS Architecture is now well understood, and begins with capturing and agreeing the Stakeholders' Aspirations. Various technical viewpoints are then developed, and these form the basis for the various documents that management can use to plan the deployment of ITS services within their area. There are two different types of ITS Architecture, which can be used in different ways.

There appears to be no one-way to develop Multi-modal ITS Architectures. The choice as to which should be used will depend on the range and scope of transport modes that need to be considered as part of the Architecture and the extent to which the functionality that they require has already been defined and/or used.

The process of creating ITS Architectures has been aided by the development of the European ITS Framework Architecture. This provides a ready-made starting point that removes the need for up to 80% of the work required by architecture creation. It can also be used as the starting point for "extended" Multi-Modal ITS Architectures.

ACKNOWLEDGEMENTS

The work described within this paper was funded by the FRAME-S support action of the Information Society Technologies Programme of the fifth Framework Programme of the European Community. The ideas contained therein do not necessarily represent the views of the Commission.