Things to make and do

As a precursor to Thinking Highways' extensive, three-issue feature on the E-FRAME Architecture, PETER JESTY, RICHARD BOSSOM and KEVIN BORRAS offer a joint explanation of what an intelligent transport system architecture actually is and, more importantly, how to go about building one

Like other highly complex systems, integrated ITS applications need a strategic framework as a basis for choices concerning their design and deployment, as well as for investment decisions. Such a framework is generally called a System Architecture, which in the ITS domain is called an ITS Architecture.

An ITS Architecture, clearly, has to cover technical aspects, plus the related organisational, legal and business issues. ITS Architectures can be created at national, regional or city levels, or they can be related to specific sectors or services. They help to ensure that the resulting ITS deployment can be planned logically, does the following things and does them well (and simply):

- Integrates successfully with other systems;
- Meets the desired performance levels;
- Is easy to manage;
- Is easy to maintain;
- Is easy to extend;
- Satisfies the expectations of the users;
- Can be used as a reference source for research projects.

The ability to integrate systems hugely increases their potential. By creating and using ITS Architectures that comply with the European ITS Framework (FRAME) Architecture, not only will components work together, but they can be made interoperable at a European level. Interoperability has never been more important than it is now as we plough headlong into the second decade of the 21st Century. Interoperability encompasses the technical, operational and organisational aspects of ITS and implies the harmonious and complementary functioning of the overall system.

An ITS Architecture is important for a number of reasons which we'll explore briefly. Firstly, it ensures an open market for services and equipment, because there are "standard" interfaces between components, and an open market permits economies of scale in production and distribution, thus reducing the price of products and services.

An ITS Architecture ensures that consistent information is delivered to end-users and encourages investment in ITS because compatibility is ensured – as is, crucially, interoperability between components, even when they are produced by different manufacturers, which is also good for SMEs (Small and


E-FRAME

Medium Sized Enterprises). It also permits an appropriate level of technology independence and allows new technologies to be incorporated easily and provides the basis for a common understanding of the purpose and functions of the ITS, thus avoiding conflicting assumptions.

An ITS Architecture provides a systematic mechanism for capturing the objectives and requirements of all those parties involved, whether they be public authorities, transport operators, ITS OEMs or end users. It facilitates clear discussion between all parties and gives the decision-makers valuable support – support that is not readily available anywhere else.

So why do I need an architecture?

It is possible that initially you will be unaware of any particular disadvantages if an ITS Architecture is not used when planning to deploy an ITS programme or project, especially if there are only a few ITS deployments in your country, city or region. However, the further you get into the deployment process the more evident it will become that without an Architecture your ITS deployment risks being unable to provide the expected services because the components, both publicly and privately owned, are not fully compatible, they are difficult to extend or modify as service requirements change and impossible to adapt when newer technologies emerge.

You will then discover that this will result in high costs for updates and the inclusion of newer technologies, which in turn leads to limitations in service delivery due to lack of interoperability and the failure to develop the ITS deployment to its full potential.

The worst-case scenario is that you discover a serious defect in your overall ITS deployment due to the failure to assess the full implications of component integration. Or you may find you have a deployment that is technically valid, but impossible to operate effectively for organisational reasons. Lack of an ITS Architecture can result in the creation of "technology islands". Over time, when their boundaries meet – as a result of the need to expand or link these islands – incompatibilities, potentially incurable ones at that, will emerge.

Whether you are a national government, public administration or an ITS provider, an ITS Architecture helps you to achieve the best value for your investment and effort in the long term by enabling the impact of these issues to be debated before any procurement starts. This means that changing such things as components, system configuration and communications choices is much less costly than it will be in the design stage and extremely small when compared with the cost of making changes once ITS is in use.

Raising the stakes

The most important starting point for creating an ITS Architecture is the list of Stakeholder Aspirations. These consist of the high-level objectives and requirements of all those involved in the ITS deployment, ie the users, operators, regulators and providers who are usually referred to collectively as the "ITS Stakeholders".

These Aspirations are then converted into simple statements often called the User Needs. In addition, an ITS Architecture normally includes:

- A Functional (or Logical) Architecture (or Viewpoint) – a series of diagrams and descriptions that show the functions or processes needed in order to satisfy the User Needs.
- A Physical Architecture (or Viewpoint) – a series of diagrams and specifications for the physical components and their locations for a particular deployment.
- A Communications Architecture (or Viewpoint) – an analysis of the communications requirements of the links needed between the locations shown in the Physical Architecture.

Other Viewpoints that might be included are an Organisational or Enterprise Viewpoint, which describes the business relationships between organisations and an Information Viewpoint to provide models for key sets of data. It can also be useful to create a Conceptual Model that shows how the whole system works.

Creative writing

Once the ITS Architecture has been created, it can be used to provide a wide variety of benefits:

- A preliminary analysis of Costs and Benefits identifying the sources of likely costs and benefits, eg savings from improved transport efficiency;
- A Risk Analysis examining potential problems, eg reliability of technologies, uncertainty about sources and volume of revenue, potential stakeholder conflicts;
- The starting point for producing the Component Specifications for the elements needed for the ITS deployment;
- A basis for the necessary Communications Specifications, including standards for the communication links between components and also with external interfaces;
- The key milestones in the Deployment Programme in the short, medium and long term, specifying when existing component upgrades are needed and when new components must be available;
- An Organisational Issues document, which highlights aspects affecting the organisation of the ITS deployment, for example relationships between the various stakeholders, revenue distribution, data ownership and procedures to ensure data privacy.

"An Architecture Champion should be an experienced and influential person with exemplary communications skills"

Identity parade

When you have decided that an ITS Architecture is required, the first step is to identify the various people and institutions that you wish to be involved. These should include: the team responsible for creating the ITS Architecture, a review team, and all the ITS stakeholders. It is also helpful to have an Architecture 'Champion'. This should be an experienced and influential person with unquestionably exemplary communication skills.

The next task is to draw up the list of Stakeholder Aspirations, which involves establishing the objectives of each stakeholder - this can be performed by holding a series of individual or group brainstorming sessions. These need to be agreed upon and endorsed by everyone and can then be published. A survey of existing ITS applications may also be done at this stage.

During the ITS Architecture creation process it will be necessary to turn the Stakeholder Aspirations into formal User Needs, created to form the Functional Viewpoint. The process of identifying the User Needs and creating the functionality can

Stakeholder Aspiration – An Example for Public Transport

The delivery of more secure, comfortable and easily usable public transport services through the provision of accurate, reliable and timely service information at stops, stations, all types of interchange points and inside public transport vehicles.

be made easier and quicker if the FRAME Architecture is used as the starting point for individual ITS Architectures..This functionality must be broken down into identifiable components that can be produced and are part of the Physical Viewpoint. Using the FRAME Architecture and creating the Physical Viewpoint is made easier through the use of the FRAME Selection Tool. Like other information about the FRAME Architecture, it can be freely downloaded from the E-FRAME website at: http://www.frame-online.net. The the next step would be to draw up the outline specifications of these components and submit the specifications to a review team. Finally, compare 'where you are' with 'where you want to be' and draw up the all-important deployment plans.

While it goes without saying (almost) that not every solution is applicable to every problem, and that a project that is 100 per cent relevant to City A may be entirely inappropriate for City B. However, take the elements of this "User Manual" that resonate with you and use them wisely.

As a case in point, the following article focuses on how the FRAME Architecture upholds the requirements of the European Commission's ITS Action Plan and ITS Directive. TH

For more information visit www.frame-online.net or email info@frame-online.net

User Needs – Some Examples for Public Transport Travellers

The system shall be able to inform travellers about public transport operations, for example travel times, delays, fares.

The system shall be able to provide information about public transport services to the travellers either on-board the public transport vehicle, or before the journey.

The system shall be able to provide an update of arrival/departure information in real-time and present it to travellers at public transport stops and/or on-board public transport vehicles.

The system shall be able to provide general (dynamic) public transport information, personal safety information, as well as the arrival times of next vehicles, delays, etc. at mode interchanges, for example bus stops, in metro, railway or bus stations.

The system shall be able to provide information that is relevant to travellers with special needs, such as obstacles, manually operated doors, manual payment systems, restrictions for guide dogs and/or pushchairs.