USING THE EUROPEAN ITS FRAMEWORK ARCHITECTURE

Peter H Jesty[1] and Richard A P Bossom[2]
1. Peter Jesty Consulting Ltd, Warwick Lodge, Towton, Tadcaster, LS24 9PB, UK
Tel: +44 (0)1937 833640, Email: phj@peterjesty.com
2. System Design Services, Siemens Traffic Controls, Sopers Lane, Poole, BH17 7ER, UK.
Tel: +44 (0)1202 782216, E-mail: richard.bossom@siemens.com

ABSTRACT

This paper describes a use that has been made of the European ITS Framework Architecture, and the FRAME Browsing and Selection Tools, in a project to create a regional ITS Architecture. It describes the processes that were used, from the definition of the Stakeholder Aspirations to the creation of the descriptions of the physical entities and the links that are needed to fulfil them. Examples of the results are presented, together with an evaluation of them. The evaluation confirmed both the usefulness of the resulting regional ITS Architecture, and the effectiveness of the FRAME methodology to create it.

KEYWORDS: System Architecture, ITS Architecture; ITS Deployment.

INTRODUCTION

When the concept of ITS Architectures was first proposed the fact that they would be useful had to be taken, to a certain degree, as an article of faith. It was a classical "which came first, the chicken or the egg?" situation. It was not possible to demonstrate the efficacy of an ITS Architecture without one being in existence, but in order for one to be created those who were providing the funding had to believe that the result would be useful.

In Europe the debate about the need for, and use of, ITS Architectures started in the 1990's and went on for several years until the launch of the European ITS Framework Architecture in October 2000. This is designed to provide the basis for national and regional ITS Architecture development but it has had to be promoted heavily by the KAREN and FRAME Projects in order to convince decision makers to fund its use. This has been successful and several ITS Architectures are now being developed and used in various parts of Europe.

The first two national ITS Architectures to be based on the Framework Architecture were developed by France and Italy. So far they have been used mainly for Case Studies from which positive reports have been received. However the French ITS Architecture (ACTIF) has recently been used as the basis for the development of a speed limit enforcement project, thereby saving an estimated six months of work, and hence about 50 lives. The Italian ITS Architecture (ARTIST) has started to be used in the National Transport Operative Programme in projects such as ULISSE. It has also been used very successfully during the development of a "freight village" near Bologna, when it enabled the various complex relationships to be clearly understood.

This paper discuses a further use of the European ITS Framework Architecture [1] in a project to develop an ITS Architecture for Kent County Council, which manages a region of England. Most of the involvement with the Council was through their consultants, Jacobs and so, for convenience, both organisations will be referred to as the "Client" in the rest of this paper. The methodology used by the architecture developers, who are called the "Architecture Team" in this paper, was the one being taught in the FRAME Architecture Workshops [2], and the project was thus able to validate the approach. The paper describes the process that was used, the results that were obtained, and the lessons that were learned.

THE OVERALL PROCESS

The process used has two main groups of activities, which are shown in Figure 1. A key feature of these activities is the Reviews that are undertaken by the Client. This is because, in general, whilst the Architecture Team knows what the Client (and its Stakeholders) *might* want, only the Client actually knows what it *does* want. In this case the Client wanted its ITS Architecture to support the ITS deployment foreseen in its latest five-year transport plan (called LPT2 in the UK).

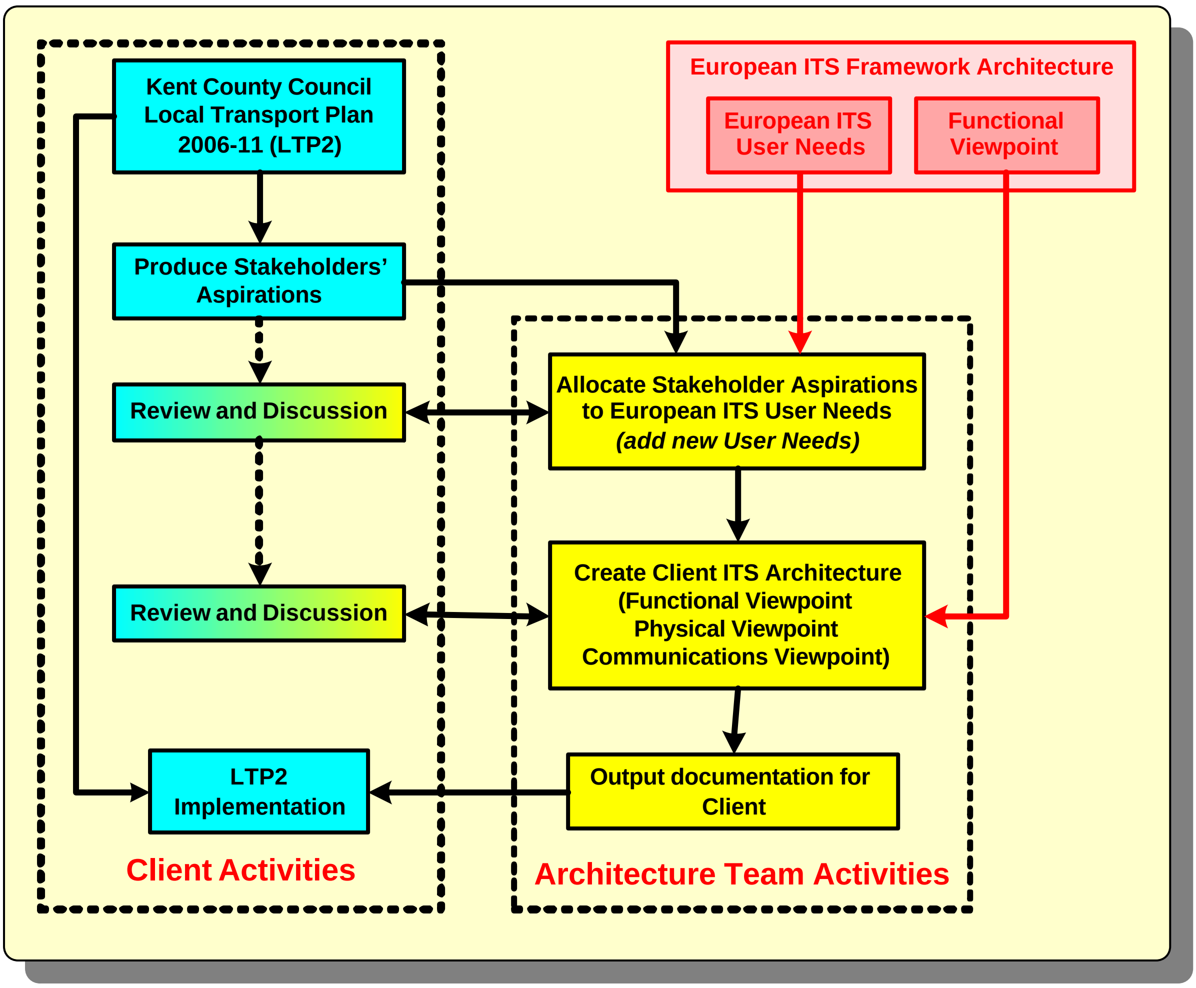

Figure 1 – Overview of Architecture Creation Process

STATEMENT OF THE PROBLEM

Although an ITS Architecture can be used to describe what currently exists, it becomes far more effective when it describes what is wanted in the future, i.e. the aspirations of the Stakeholders for the improvement of road-based transport over the next 3-5 years. The process of capturing the Stakeholders Aspirations, and of creating the resulting User Needs followed the recommended approach [3].

An ITS Deployment will help to satisfy the aspirations of a variety of Stakeholders, and so it is first necessary to identify both who they are and what they want. There are four principal classes of Stakeholder, those who:

- *Want ITS* – to solve transport network problems;
- *Use ITS* – for their own benefit or to manage its operation;
- *Make ITS* – as part of their product portfolio;
- *Rule ITS* – to provide the standards and legislative framework within which ITS operates.

The Client collected the Aspirations from these Stakeholders through a series of meetings over a number of months. This extended timescale was necessary to ensure that they were all able to contribute to the fullest extent.

The resultant Aspirations were provided to the Architecture Team by the Client in a form that reflected the results from the Stakeholder meetings. These were therefore converted into a uniform style and classified under a number of broad headings. Some of the original Aspirations were very brief, and with several possible interpretations. These were therefore expanded by the Architecture Team, and confirmed by the Client as part of their review of the re-written Aspirations.

Once the revised version of the Stakeholder Aspirations had been confirmed and agreed by the Client, the Architecture Team identified the User Needs that represented them from the List of European ITS User Needs. Each Aspiration needed 10-20 User Needs to satisfy it and most of these were found within the existing List, with many repetitions. However, occasionally it was necessary to add a new User Need to satisfy a local Aspiration that had not been identified at the European level. The result of this phase was then also passed to the Client for review and, ultimately, their agreement. The process produced a set of User Needs that are a formal definition of the Stakeholder Aspirations – the "Selected User Needs".

CREATING THE CLIENT'S ITS ARCHITECTURE

Functional and Physical Viewpoints – General Overview

The general process of creating the Functional and Physical Viewpoints of a specific ITS Architecture from the European ITS Framework Architecture can be summarised using Figure 2.

1. With the aid of a cross-reference table, identify the sub-set of Functions that help to satisfy one or more of the Selected User Needs.
2. Select the sub-set Data Flows, Data Stores and Terminator (or Actors) that are connected to these Functions.

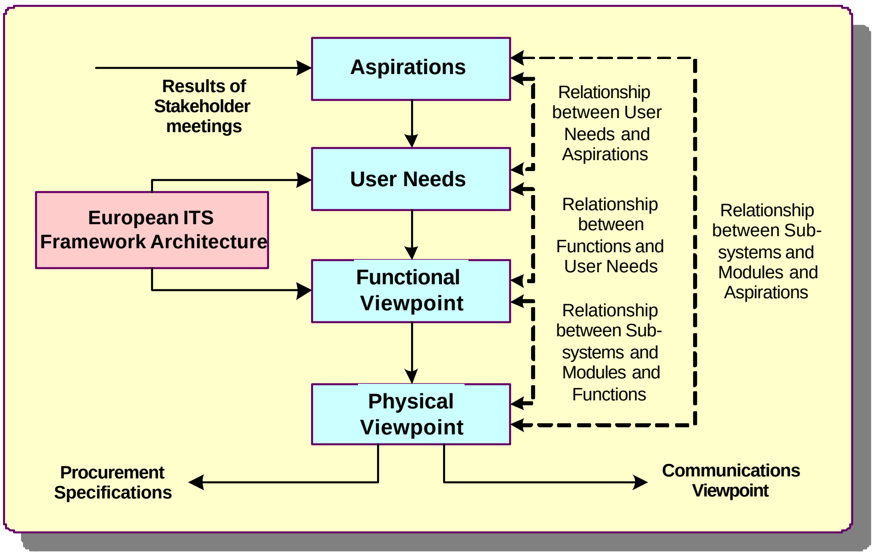

Figure 2 – Creating an ITS Architecture Sub-Set - Overview

3. Check the consistency of the resulting selection and add elements until a consistent Functional Viewpoint has been obtained.

These three stages can be done with the aid of the FRAME Selection and Browsing Tools [1].

The next two stages produces a Physical Viewpoint that shows one way in which the Functional Viewpoint can be deployed, such as in Figure 3.

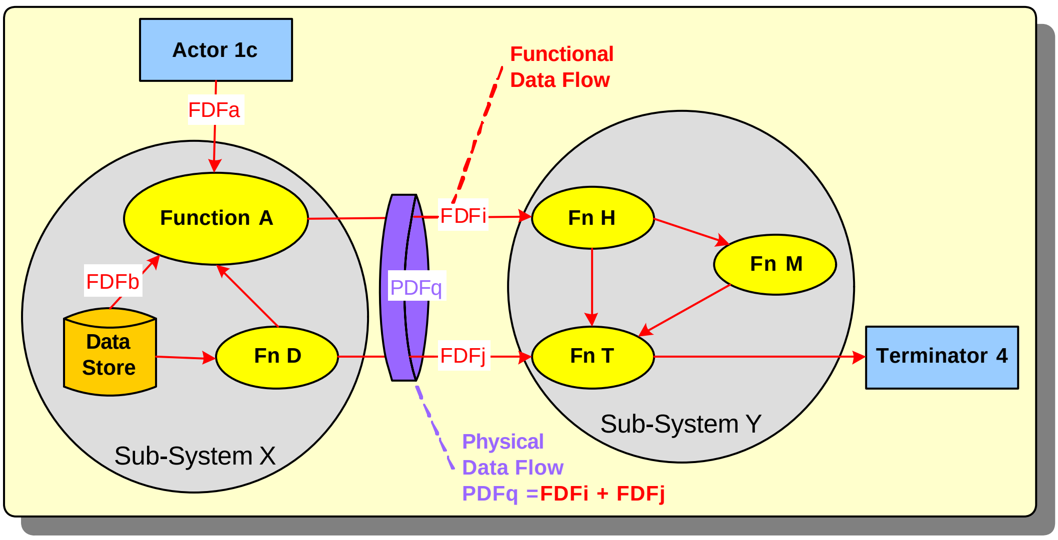

Figure 3 – Example Physical Viewpoint

4. Define a Sub-System for each location and allocate each Function and Data Store to one of them. A Sub-System can be divided into Modules if desired. This can be done with the aid of the Selection Tool.
5. Combine the Functional Data Flows that pass between pairs of Sub-Systems to form Physical Data Flows. This will be done automatically by the Selection Tool.

Functional Viewpoint

Once the Selected User Needs had been agreed by the Client, the Architecture Team then identified those parts of the European ITS Framework Architecture Functional Viewpoint that were needed to satisfy them. Since there were a number of new User Needs, it was also necessary to add a few new Functions and Data Flows to the Selection Tool database in order to satisfy them. The automatic consistency checking facility of the Selection Tool eased the process of producing a coherent and consistent Functional Viewpoint for the Client's ITS Architecture. Since all the details of the Functional Viewpoint were now held within database of the Selection Tool, it was not felt to be necessary to produce diagrams of the Functional Viewpoint. Thus the Functional Viewpoint was provided in the form of a list of Functions together with their definitions, and the set of Data Flows that go to and from them.

Physical Viewpoint

The next step again used the FRAME Selection Tool, but this time to allocate the contents of the Functional Viewpoint to physical entities (Sub-systems and Modules) in several physical locations, thus creating the Physical Viewpoint. The locations were defined after consultation with the Client to represent places such as the Roadside, the Control Centre, etc. The resulting Physical Viewpoint contains the definitions of what each entity will do, which were created from the descriptions of the functionality in each entity. The document also contained a variety of diagrams of the Physical Viewpoint that showed the details of each Sub-System and its relationship to other Sub-Systems and Modules (see Figure 4).

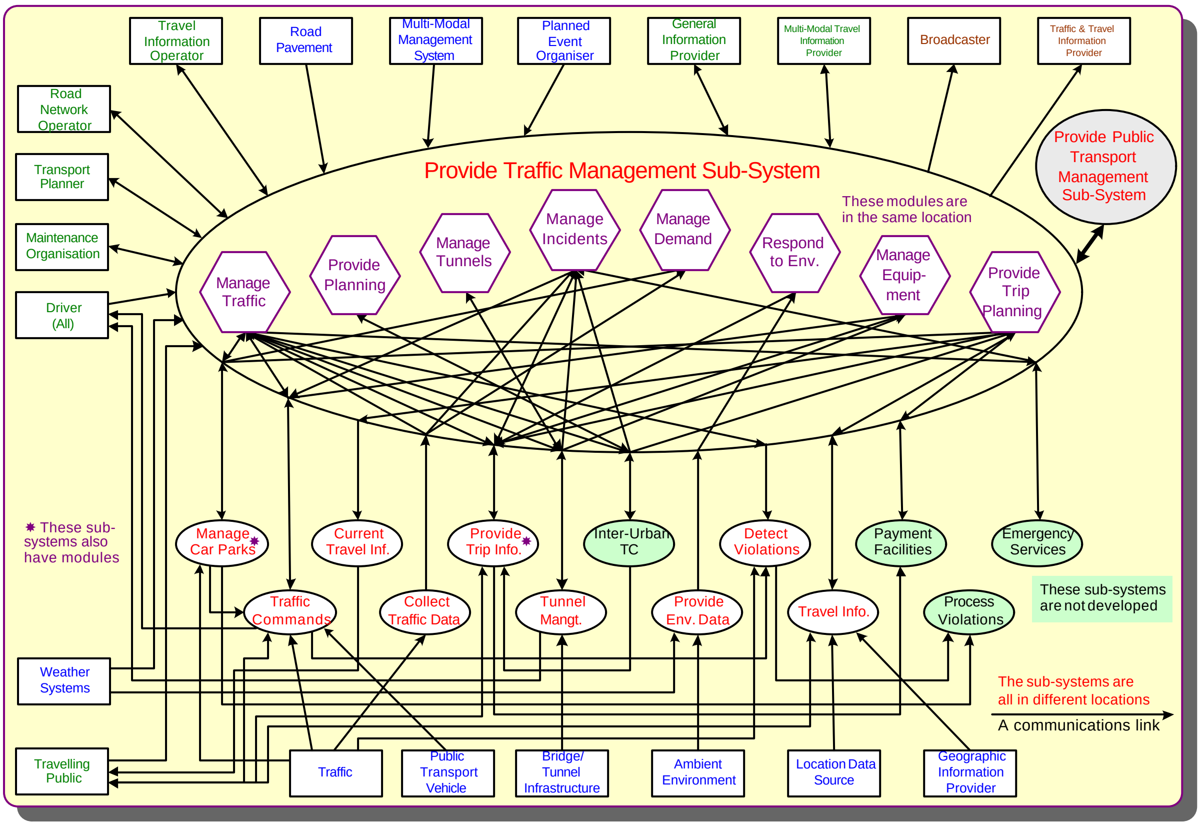

Figure 4 – Example Physical Viewpoint Diagram

Communications Viewpoint

Once the Functional Viewpoint had been allocated to physical entities, the next step was to define the characteristics of the Physical Data Flows that enable data to be exchanged between these physical entities, and also between the entities and the outside world. The results of this work are described in the Communications Viewpoint document and show the required characteristics of each link (see Table 1).

Table 1 – Example Communications Viewpoint

Physical Data Flow	Constituent Functional Data Flows	Data Type	Max Bytes / Message	Max Delay (secs)	Message Interval (secs)	Security Level	Transfer Mode
traffic_cmds	urban_lane_cmds	Raw Data	100	0.5	15	*None*	Wire Line
	urban_tfc_mgt_req	Raw Data	100	1	5	*None*	
Minimum Data Rate for Link		300	**Bytes/Second**			None	
Minimum Inter-Message Gap		5	**Seconds**				

Additional Product

A particular request from the Client was for a document that described of the relationships between the Stakeholder Aspirations and the physical Sub-Systems and Modules (see Table 2). This provided a useful tool with which to study the proposed ITS implementations, and also for use in the "selling" of ITS to the Stakeholders.

Table 2 – Example Relationship Table

Aspiration		**Sub-Systems and Modules**									
No	**Description**	**P1.1.1 Manage Traffic**	**P1.1.2 Provide Planning**	**…**	**P1.1.8 Provide Trip Planning**	**…**	**P1.9 Provide PT Information**	**P1.10.1 Provide On-Trip Information**	**P1.10.2 Provide Pre-Trip Information**	**…**	**P1.13 Provide Traffic Commands**
1.13	There is a need to provide real-time information to traffic, e.g. via VMS, to improve the flow of traffic.	Y			Y			Y	Y		Y
1.15	There is a need to develop a Website for the dissemination of travel and traffic information.	Y	Y				Y				

AN EVALUATION OF THE RESULTS

Some months after the end of the project a follow-up meeting took place at which enquiries were made about what the Client thought of their ITS Architecture and whether they found it useful. The basic message from this meeting was that the ITS Architecture is a success, but that it was not something that they could have produced by themselves. However they did report some difficulties that would need to be addressed in a future project of this type.

The principal products are being used for the purpose for which they were intended. The Physical Viewpoint is providing the starting point for the description of the future ITS deployment, and is being used to support the ITS deployment needed to support the implementation of LPT2. The definitions of the desired ITS functionality in the Functional Viewpoint will be used to create Test Specifications that will be included in the Factory and Site Acceptance Tests for any new equipment. The Communications Viewpoint will be used to help decide how any new communications network can be integrated into the networks that are already available. A particularly useful document has been the one that contains a table showing the relationship between the original Stakeholder Aspirations and the various Sub-Systems and Modules of the Physical Viewpoint.

A real ITS Architecture is, by its nature, likely to comprise a number of fairly long documents, and the one for Kent County Council is no exception. As the Client had not worked with such a product before they did find it a bit daunting initially, and they would have benefited from a short (~4 pages) summary that provided an overview of the contents.

Another problem that appeared is related to the terminology used within the Architecture and is of two forms. The first relates to the terms used by ITS architects to refer to the elements that make up an ITS Architecture. Whilst the term Function is well understood, the terms Terminator and Actor are not. Meanwhile the terms System and Sub-System are extremely overloaded with many possible uses and meanings in an engineering context. It is not clear how to solve this problem because the choice of any other set of terms is likely to lead to a different set of analogous problems.

The second problem in terminology relates to the names of the Functional Data Flows. The European ITS Framework Architecture covers many areas of road transport and it was necessary to devise a naming system that ensured (a) names would not be accidentally duplicated by the various different authors, and (b) it was possible to identify where any Data Flow belonged. Whilst the convention chosen works very well for professional ITS Architects, it does look strange to other engineers when used in a small regional ITS Architecture with limited functionality. Once again it is not clear how to solve this problem for the Functional Viewpoint, but one does have complete freedom to choose names for the Physical Data Flows, and this freedom should be used for the benefit of the Client.

The Client has not yet shown their ITS Architecture to the non-technical Stakeholders, e.g. the politicians. The current documentation is far too large and technical to enable this to be done with any chance of success. Ideally the Client needs a 1-2 page summary that is void of any technical jargon; and which concentrates on how the ITS Architecture achieves the Stakeholder Aspirations.

CONCLUSIONS

A Regional ITS Architecture has been created successfully from the European ITS Framework Architecture, using the methodology and techniques being taught in the FRAME Architecture Workshops. The use of the FRAME Browsing and Selection Tools facilitated the process and thus reduced the development time from that experienced before they became available.

The main results from this project for the Client are the definitions of the physical entities at each location, i.e. the Physical Viewpoint, plus the characteristics of the physical links between them and with the outside world, i.e. the Communications Viewpoint. They provide the starting point for the description of the future ITS deployment, and are being used to support the ITS deployment needed to support the implementation of LPT2.

For the Architecture Team, the main result has been a validation of the methodology for the creation of Regional ITS Architectures that is provided in the FRAME Architecture Workshops. It has also highlighted a number of minor ways in which the methodology plus the FRAME Browsing and Selection Tools can be improved.

ACKNOWLEDGMENTS

The authors would like to thank Kent County Council and Jacobs for their permission to describe their project in this paper.

REFERENCES

[1] FRAME (2004). European ITS Framework Architecture, www.frame-online.net.

[2] Bossom, R. A. P., P H Jesty. Supporting the European ITS Framework Architecture. In Proceedings *9th World Congress on ITS*, Chicago. ITS America.

[3] Jesty, P. H., R. A. P. Bossom. Involving Stakeholders in ITS Architecture Creation. In Proceedings 10th *World Congress on ITS,* Madrid. ERTICO (ITS Europe).