Paper number ITS-TP2083

FRAME NEXT – The new and extended European ITS architecture tool

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Abstract
The increasing connectivity in transport and the rising demand for intelligent transport services, requiring complex Intelligent Transport Systems (ITS) interactions, necessitate a structured implementation approach based on the use of ITS Architecture methodologies. The FRAME NEXT project developed the European ITS Framework Architecture "FRAME" further based on the areas of the ITS Directive, which provided an excellent starting point. The extension of FRAME is based on three pillars: Firstly, the FRAME methodology is being expanded taking up approaches from enterprise architecture frameworks and offering new views. Secondly, the FRAME Architecture is beeing extended and provides reference architectures in the domains of the priority actions and priority areas of the EU ITS Directive 2010/40/EU considering the latest Delegated Regulations and progresses in their implementations, e.g. eCall and the National Access Points to Transport Data. Finally, the FRAME Tool was migrated to a standard software tool based on UML. With these measures, the ITS reference architectures of the FRAME NEXT project contribute to harmonised and integrated ITS implementations in Europe.

Keywords:
ITS Architecture, EU wide ITS Services, System Engineering, eCall, NAP – National Access Point

Introduction

FRAME NEXT is a project that extends the European ITS Framework Architecture, often called the "FRAME Architecture" or in short "FRAME", to include some of the ITS services recently implemented in different EU Member States and additional views to take into account more complex stakeholder cooperation models for ITS service delivery. In addition the FRAME methodology was updated and a new UML model is provided that makes a modern ITS architecture framework attractive and appealing for its users.

The FRAME NEXT project brings together experiences from FRAME and other European ITS architecture examples to combine connected transport aspects and model them in an Architecture methodology. This paper describes the use of the European ITS Framework Architecture, now known as the FRAME Architecture following the principles of the EU ITS Directive.

The project created and documented domain specific sub-set ITS architectures to support

the priority actions of the EU ITS Directive 2010/40/EU. These ITS architectures provide to their users ready-made descriptions of how these ITS services can be delivered in accordance with regulations and standards, which will enable a high level of standardization and inter-operability to be achieved in EU Member states following the approach. At the same time project partners from ten active EU Member States and Norway contribute their current ITS service developments and best practices and share their experiences with other stakeholders from public authorities and industry. Project partners interacted with a wide range of stakeholders at national, regional and city level and with those from various mobility related sectors including freight transport.

The FRAME NEXT project brings together experiences from FRAME and other ITS architectures to combine connected transport aspects. This paper describes how the updated FRAME Architecture export can support the aims of the EU ITS Directive 2010/40[1] and helps to plan connected ITS systems, transport operations and other ITS system aspects.

First developments in EU Member states for the areas NAP – National Access Point and eCall

The EU ITS Directive 2010/40/EU has identified six topics/priority ITS areas in transport to be implemented across the EU. Two of the services for which ITS reference architectures are created from the FRAME NEXT Team are the National Access Point (NAP) to Transport data and the implementation of eCall, including the Public Service Answering Points (PSAP). The ITS architectures for both of these services reflect the way how these services are currently being delivered in several EU Member States. They are also used to validate the new FRAME methodology before it is applied to the remaining four services in the ITS Directive.

Of particular interest from an ITS architecture point of view is the fact that the various NAPs currently in existence at first sight seem to be providing their services using quite different technical solutions. For the FRAME methodology this means that the basic set of functionalities in the NAP, as seen in Figure 1, are mandatory and are present in all implementations, whereas additional functionality is only implemented in single member states and are therefore optional elements of the ITS Service implementations.

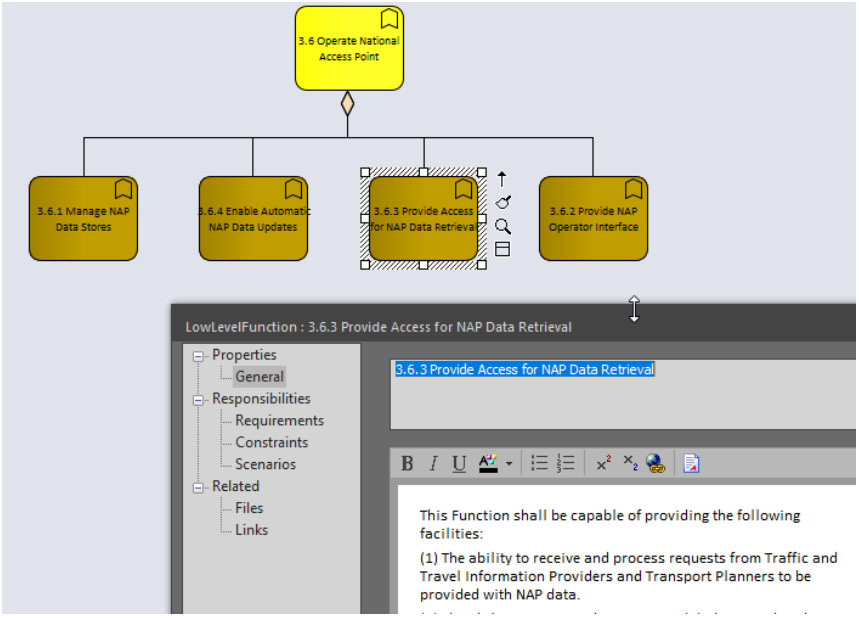

Figure 1 – Functional Tree diagram NAP

For eCall systems in the EU the PSAP´s are being implemented in a broadly similar manner across the Member States. Their representing FRAME NEXT model was developed and is currently published in its first version.

In December 2008 the European Commission (EC) published an ITS Action Plan. The aim of the Action Plan was to foster, accelerate and coordinate the deployment of ITS in road transport, including interfaces with other transport modes. Since the publication of the delegated regulations in the individual EU member states NAPs in very different forms have been developed. They were defined and implemented in various forms e.g. as extension of an existing traffic center (NL), as data broker between stakeholders (DE), as data dictionary to ease the exchange of traffic information and data (AT) or as mixed forms. Each of these characteristics corresponds to the delegated act and can be mapped in the detailed functionalities with the extended frame architecture.
The Commission Delegated Regulation (EU) 305/20131 of Nov. 26th, 2012 is reflecting the need for action at pan-European and national level to implement the harmonised provision for an interoperable EU-wide eCall system in member states. Its ITS architecture created in FRAME will strengthen and of course enhance the introduction of eCall in member states since the implementation became mandatory in 2017 and 2018 for new vehicles. Therefore the setup and operation of national PSAPs – Public Service Answering Points will be more harmonized in the future.
Since the implementation deadline (1.10.2017) four countries (LUX, SLO, CZE, and AUT)

[1] https://eur-lex.europa.eu/legal-content/DE/ALL/?uri=CELEX%3A32013R0305

are "eCall-ready" and can receive and process eCalls in real operating mode in their PSAPs. Starting from two examples the development of the FRAME Architecture methodology will be elaborated in the following section.

4. Extended FRAME Architecture in Europe.

The general process steps of creating a high level ITS Architecture with a framework are shown in Figure 2 below. The single steps and their detailed descriptions and definitions can be found in the references section.

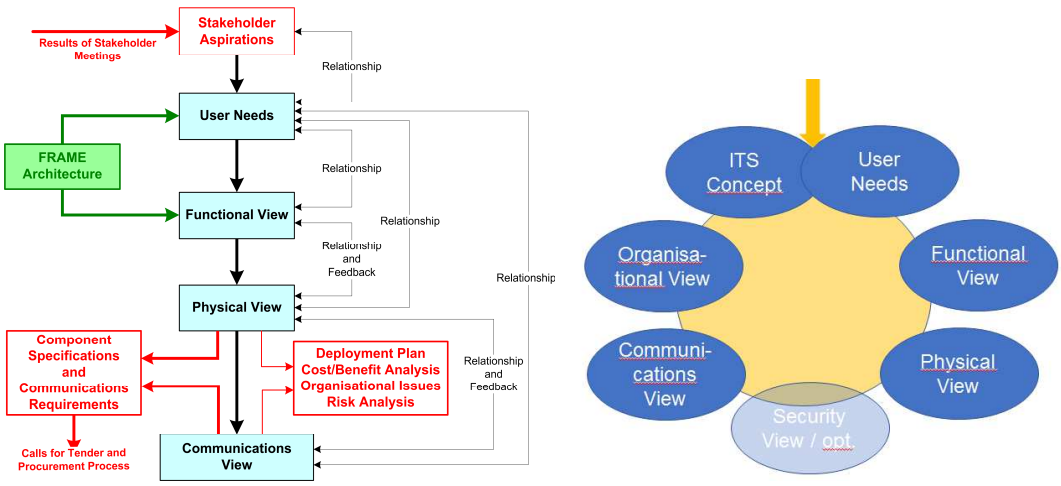

Figure 2 – Overview of the FRAME Extension

Note that the FRAME methodology like other high level architectures uses the term “View” in the names of the parts or single aspects that make up FRAME e.g. the communications aspects in the respective view, and its result all together is defined as an ITS Architecture Framework. In doing this it is follows the recommendations of ISO/IEC/IEEE 42010:2011 [2]. The alternative term of “Architecture” is still used in some publications and projects, but the authors feel that an architecture made up of different views is more comprehensive.

In the FRAME NEXT project, the current understanding of the way in which ITS related services will be specified and implemented across Europe are illustrated in Figure 2. The defined initial elements (ITS Concept and User needs) are the basic inputs, stakeholders provide, whilst the views shown in blue illustrate the existing functional view, but also the future extended Organisational, Communications, Physical and possibly Security view where the definitions what is required to deliver the complete ITS service to users of the architecture elements are provided.

One of the fundamental aspects of using ITS architectures is to elaborate most elements for decision making in complex contexts. Thus the resulting descriptions of what is needed to provide the services does not contain technology constraints. Any reference to

standards in the Communications View need be to known, publicly available and probably domain - specific international standards can be considered as well.

The ITS Concepts provide the "quality" aspects that the service delivery needs to achieve as well as identifying the contributions from partners that are needed to support the use and availability of the service and the goals delivering the ITS service is intended to achieve. These are defined from the stakeholder viewpoint as well as from the end user's point of view. The Organisational View defines the roles and responsibilities of the stakeholders involved in the service delivery.

Many of the links shown between the boxes in Figure 2 are bi-directional so that the initial thoughts in the Overall Concepts may have to be revised once the further elements, in particular the Organisational, or Communications View, has been reflected in an initial Physical View. Thus, it may be that the Physical View will need revision as part of the work to revise the other Views, and so the overall process needs to be iterative and should not be seen as being completed in a single step.

The descriptions resulting from the creation of the Views and the Overall Concepts are intended for use in the next steps to implement and deliver the targeted ITS services. Thus, they are used in requests for tenders to the ITS and communications industries, as well as for the stakeholders to manage their participation in the service delivery.

5. The FRAME Tools and

The results from the FRAME NEXT project is to provide reference architectures for the six priority actions and the basic ITS architecture "meta model in UML" to work on modern ITS systems. For the development of the ITS architecture framework and the future work environment the consortium selected a standard software tool used in the ITS Industry and standardisation organisations [3] as a future proof software development environment. This Software is known in the world of system architectures and definitions of elements and artefacts and therefore offers many exchange formats for the defined results, which will be described later.

Software principles

Based on the EU funded project requirements, it is clear that all software components need to be freely available, platform independent and future proof. The software components, the ITS architecture meta model, the FRAME EA libraries and the predefined reference architectures for the priority areas, will be available at https://frame-online.eu and https://frame-next.eu without a fee and are maintained by a group of project partners. Through the restriction of the project, software environment

the EA library is linked to the operating system compatibility of the software Enterprise Architect. The exported ITS FRAME architecture and the reference models will be available in several formats including an independent UML (Unified Modeling Language) Model, which can be used with many other UML programs and software tools.

Software components – FRAME EA Library

The updated FRAME Architecture extended by FRAME NEXT contains all the components required to create your own versions of the priority actions with own additional characteristics if needed. It covers a lot of high- and low level functional, operational and other needed elements or defined artefacts. All elements are built in the FRAME EA library and can be further used also in the extensions by Users as the predefined stereotypes. As can be seen in figure 3, the elements are well defined, connected and can be linked by the FRAME user.

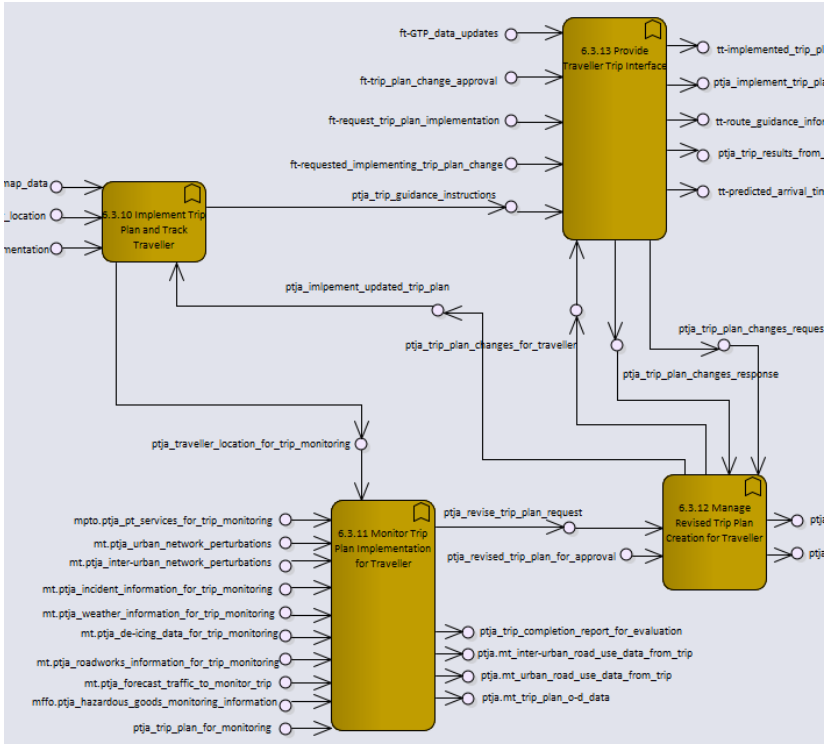

Figure 3 – Connected FRAME components and functions

Software components – FRAME Reference architectures

The shown elements in Figure 1 and 3 are defining elements of the reference architectures. The reference architectures for NAP and eCall and any further reference architectures which are delivered by the FRAME NEXT Team, will consist of specific FRAME EA elements which are connected in a consistent European way. Each of these reference architectures will be available for download separately and in several formats for future extensions and enhancements by users.

Further archievements of FRAME

With the strong development of technologies and platforms in the general economy and in various industry and service sectors in the last ten years also the software development environments have become more similar in functionality between them. The main tools support the needed process steps to create and maintain the respective ITS Architectures and their interfaces to existing systems as well. Secondly, with the selection of a standard tool also the capabilities of a strong development community are available to contribute to the future development of the future ITS Architecture framework. They are actually in use and well known in many industry sectors related to transport.

5. Conclusions

The shift of focus from ITS systems development to service deliveries expands the FRAME Architecture methodology to reflect this situation in the development process. FRAME NEXT adapts the way that the FRAME Architecture is used to help Stakeholders and contributing partners with the creation of complete value chains and service delivery processes in the ITS sector. The FRAME Methodology, and the FRAME Architecture on which it is based, are being modified by the FRAME NEXT project to take account of the regular evolution of ITS. Together they provide a way for stakeholders to have a meaningful participation in the implementation and delivery of ITS related services

While the work in this project is completed till 2021, the FRAME Methodology, Architecture and Tools will be maintained and further developed with intermediate products becoming available as from 2020 onwards.

6. Acknolegdements

The authors acknowledge the financial support provided by the European Commission through the funding of the FRAME NEXT project.

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