Deliverable D4.3.3: Guidelines and proposals for the revision of ITS architecture in Hungary

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Abstract: The current document presents the status of Hungarian National ITS Framework Architecture (HITS), giving an overview about the problems of the maintenance and operation of HITS and providing proposals for its revision.
EXECUTIVE SUMMARY

As a summary of the HITS-history (Hungarian ITS Framework Architecture), it can be claimed that by accepting the pioneering aims of the KAREN/FRAME Programme, in 2002, Hungary has joined one of the most recent developments and researches of our times. Within the CONNECT (TEMPO) Programme, the creation, dissemination and the enforcement of the use of the HITS potentially result in a situation wherein the developments of national intelligent telematic road systems give rise to harmonized, mutually adaptable, compatible and modularly structured systems that are easy to improve.

Application of HITS can – besides more countable and not countable benefits - largely contribute to the speedy spread of the new systems. In addition to the enhanced efficiency, applicability and functionality arising from the ability of cooperation, the development of the systems is foreseen to require a lower level of expenditures, which may be reflected in cost-efficient investments.
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<td>HITS</td>
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<td>FRAME</td>
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<td>CONNECT</td>
<td>Co-ordination and stimulation of innovative ITS activities in Central and Eastern European countries</td>
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1. INTRODUCTION

1.1. Short outline of SEE-ITS project

The Intelligent Transport Systems in South East Europe project has started in October 2012. Aiming for the transport integration of TERN which is a fundamental pre-requisite for South East Europe regional cohesion and development.

SEE-ITS will develop an institutional and technical framework through which SEE organizations and countries can harmonize ITS specifications and define generic collaboration model based on acceptable scenarios. Moreover, the project will execute seven focused pilots to assess the scenarios, perform impact analysis, benefit by the ITS industry participation in the project and deliver a Regional Framework, a User Forum and a long term plan for viable future investments.

The product of the pilot demonstration activity of HTA is planned to be a smart-phone application designed especially for cyclists. The service will take place in the area of the Hungarian section of Eurovelo-6 cycling route.

During the execution of the project the members will participate on meetings and workshops for discussing and sharing the implementation status of their work. Part of the SEE-ITS activities guidelines and proposals for the revision of the existing ITS architectures in SEE countries have to be prepared. By a revision plan the report will be elaborated in order to make sure of the interoperability and the standardization of the systems within the South East Europe countries. The project will be completed in October 2014.

1.2. Aim of the report

The purpose of this document is to present the status of Hungarian National ITS Framework Architecture (HITS), the existing ITS architecture in Hungary. The report also gives an overview about the problems of the maintenance and operation of HITS.

This report describes the level has been reached by first version of Hungarian National ITS Framework Architecture with explanation why it is needed and for what propose to use it. This document also gives picture about the history of the development of HITS, about the methodology which was used during the preparation of the first version and which can be used for the next steps e.g. the revision of it.

Managing all national ITS architecture, as well as HITS, is a process which must be upgraded time to time. The first version of HITS was prepared between 2002 and 2008, and there is a
very strong need for its revision to follow the fast developing trend of FRAME and ITS applications.

1.3. Contents and structure of the document

Contents and structure of this document was determined by the form sent by the international partners of the project. The other elements and background of the HITS Framework Architecture can be analysed on the official website: www.frame-online.hu or downloading the HITS Selection Tools (just in Hungarian language available).
2. OVERVIEW OF HUNGARY’S ITS ARCHITECTURE, THE HITS

2.1. Background

History of the EITSFA, the origin of the HITS
The FRAME Architecture (originally called the European ITS Framework Architecture, EITSFA), as the origin of the HITS, was developed as a result of recommendations from the High Level Group on transport telematics, which were supported by a resolution of the Council of Ministers. It was created by the EC funded project KAREN (1998-2000) and first published in October 2000. The underlying aim of this initiative was to promote the deployment of (mainly road-based) ITS in Europe by producing a framework which would provide a systematic basis for planning ITS implementations, facilitate their integration when multiple systems were to be deployed, and help to ensure inter-operability, including across European borders.

Since the FRAME Architecture is intended for use within the European Union it conforms to the precepts of subsidiarity, and thus does not mandate any physical or organisational structure on a Member State. It comprises a set of User Needs and a Functional Viewpoint only (the User Needs providing a form of requirements for the functionalities contained within the Functional Viewpoint). Most users will only use a sub-set of the FRAME Architecture and a methodology, now supported by computer-based tools, was developed to do this effectively by the EC funded FPV project FRAME-S (2001-04).

After its creation, and in order to enable others to use the FRAME Architecture, it was recognised that a centre of knowledge would be required to which potential users could put questions, from which they could receive training in its use, and which would keep the Architecture up-to-date with the evolution of ITS. This was provided very successfully from 2001 until 2004 by the EC funded projects (FRAME-NET and FRAME-S). The FRAME-NET project provided User Forums and collected and collated the experiences of FRAME Architecture users. The FRAME-S project maintained the FRAME Architecture, produced two tools to assist with its use (Selection Tool and Browsing Tool), and provided many nations and projects with advice. As a result, they (as well as Hungary) were then able to make, or are making, plans to employ the Architecture. Between 2005 and 2008, the start of the E-FRAME project, some limited support for existing and potential users of the FRAME Architecture was provided through the FRAME Forum.

At the time of the KAREN project, the FRAME Architecture had already been adopted as the basis for the French national ITS Architecture (ACTIF), and was subsequently adopted as the

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1 Source: [www.frame-online.net](http://www.frame-online.net), 20. 12. 2014
basis for the Italian national ITS Architecture (ARTIST). Other nations that have used FRAME since then include Austria (TTS-A), the Czech Republic (TEAM), Hungary (HITS) and Romania (NARITS). In addition a number of specific ITS Architectures have been created in the UK including one for Transport for Scotland and another for the County of Kent. More recently, part of Transport for London has been using the FRAME Architecture to plan its future ITS deployments. In a few cases, e.g. VIKING and the COOPERS IP, it has also been used by R&D projects.

History of the HITS
In Hungary, professionals also faced the international tendency that intelligent, computer- and software-aided systems are usually based on unique, often proprietary solutions, and therefore they are difficult to connect, and sometimes even develop and operate. As the case of road ITS (Intelligent Transport Systems), the European ITS Framework Architecture has been designed to tackle the problems of conformity and development potentials, so HITS was signed as the domestic version of EITSFA. The project was founded by CONNECT (TEMPO) program.²

Figure 1: Picture from the public report of the CONNECT and EASYWAY program, named “ITS systems in Hungary”

Hungary has been following the development of KAREN (Keystone Architecture Required for European Networks) and FRAME from the very beginnings. Upon the initiative of MK (Hungarian Roads Company), a pilot project was launched in 2002 wherein the Hungarian applicability of the European ITS Framework Architecture was tested. In the fields of traffic

² Source: www.frame-online.hu, 30. 12. 2014
control, event management and on-the-route information support, the user demands deemed to be indispensable for the traffic control of motorways were selected, and the associated functional structure was examined. Developers contacted some of the actors of transport, and in the light of their responses to related questionnaires the actual Hungarian situation of ITS systems was assessed. The examination clarified the isolated development efforts, which justified the establishment of a Hungarian ITS Framework Architecture to operate within a uniform development framework.

In the following years, the Hungarian version of EITSFA was finalized, and thus the description of user needs, the elaboration of the functional and physical structures became available in the form of the associated documentations. In 2005, all the versions having been prepared so far were processed and integrated, and a national survey was also started to compile a list describing special, domestic demands. That year, in addition to the entire documentation the Hungarian ITS Framework Architecture was given a unique name on the basis of the designation of the European partners: Hungarian ITS Framework Architecture or HITS for short.

In 2007 and 2008 years, the Hungarian parts already collected were updated in the light of the current version of EITSFA, while the Selection Tool software was adopted into the Hungarian environment to facilitate the use of HITS. Another objective was the dissemination of information on the HITS framework architecture by way of leaflets, information sessions and professional forums, publicity days. In 2008 “ITS Hungary Honour of Excellence 2008” has been awarded to HITS – Hungarian ITS Framework Architecture by decision of the ITS Hungary Association Selection Committee, with this justification: “Within the CONNECT Programme, the creation, dissemination and the enforcement of the use of the HITS Framework Architecture potentially result in a situation wherein the developments of intelligent transport systems give rise to harmonized, mutually adaptable, compatible and modularly structured systems that are easy to improve.” The process had been started, but ended shortly due to the lack of financial support.

**Lessons learned**

During the FRAME projects, and from experience with other ITS architecture activities in Europe and in Hungary also, a number of important lessons have been learned, the most important one being:

The **need to keep** an ITS Architecture **up to date**: To keep the its usefulness, an ITS Architecture must be constantly maintained. The aim of the original KAREN project was to define ITS User Needs until at least 2010, but some parts of ITS have evolved more rapidly and radically than had been foreseen.

Although the User Needs were updated during the early part of the FRAME projects (2002/3), the FRAME Architecture contains only a few references to more recent ITS developments, such as those associated with the Intelligent Vehicle or eSafety initiatives. One particular and highly significant area – in which the European Commission has invested very heavily since 2006 – is called “Cooperative Systems” (as they involve vehicle-vehicle and/or
vehicle-to-infrastructure communication), and it was not covered by the original FRAME Architecture. Filling this gap was one of the principal objectives of the E-FRAME project (2008-11). Unfortunately the development of the HITS has been stopped in 2009. The official HITS website (www.frame-online.hu) is updated and operated by TRENECON COWI Ltd., but maintenance and further development has no financial support since the CONNECT project has ended.

Involved stakeholders (in the phase of the development in 2002-2009):
- Ministry of Economy and Transport (GKM)
- Hungarian Roads Company (MK)
- Municipal Public Services Co. Ltd. (FKF)
- State Motorway Management Company (ÁAK)
- COWI Hungary LTD. (COWI Ltd.)

Partners related this report:
- Hungarian Transport Administration (KKK)
- ITS Hungary Association

2.2. **Components of Hungary’s national ITS architecture, the HITS**

The Framework Architecture consists of the following levels:

1. **User Needs (UN)** – A uniform collection of general requirements posed against the systems by the stakeholders of the systems concerned.

2. **Functional Architecture (FA)** – Such functions of the systems that cover the individual groups of needs, and satisfy the associated requirements. Constituents of the FA are:
   - functional areas, groups, functions
   - functional data streams
   - thematic data repositories for the support of any given function

3. **Physical Architecture (PA)** – Repository of exemplary systems as established by real systems to cover and supply the individual function groups. Constituents of the PA are:
   - implemented systems (HITS has only some sub-PA, as systems of ÁAK, FKF, see for details chapter 3)
   - subsystems
   - modules in a uniform structure
   - with the specification of the related physical data streams (as batches of the functional data streams) and databases
4. **Supplementary units** to support the establishment of the systems, as well as the ultimate, physical structuring of EITSFA (HITS has no specific elements in this field):
   - Communication Architecture (CA) – Collection of technologies representing data transmission in between the individual systems
   - Proposed Framework of Required Standards
   - Models of ITS (no specific elements)
   - Cost-Benefit Analysis (CBA guideline was devised in 2008.)

The structure of framework architecture is introduced in the following picture:

![Diagram](image)

**Figure 2**: Structure of the HITS (based on EITSFA)

The detailed description of the structures of the individual HITS levels, as well as of their roles is beyond the compass of this summary, yet the website of the HITS may offer a proper insight into the individual constituents.

2.2.1. **User needs and services**

The creation of HITS, the Hungarian framework architecture is the creation of a mutually accepted and supported transport telematic system architecture that:
   - aims at the developing of ITS products that are conform with each other, are open and modular, as well as cost-efficient,
   - allows any group of users to satisfy its individual requirements,
- supports the open market of ITS products, as well as their compatibility to the European ITS market,
- forms a platform among the community using the ITS, the senior managerial level, as well as the present and future developers of ITS, the old and new systems.

**Figure 3:** HITS bridges the gap between old and new, national and foreign systems (Esztergom-Stúrovo; Photo: György Huszár)

The fundamental task of the structuring of the Hungarian framework architecture has been to prepare an accurate Hungarian translation from the English version of the European EITSFA, adopt all of the User Needs, and examine whether the domestic environment call for the establishment of new user needs, functions and other associated units. Until 2009 new need of any present and planned stakeholder was not detected compared to UN of EITSFA.

In case domestic experts perceive the necessity to establish new demands, elements, on the basis of the instructions supplied by the FRAME team the elements proposed to be modified should be sent to the maintainers of HITS with individual numbering, including the Hungarian and English-language definitions. The developers of the HITS have collected and compared the supplementary units from the various stakeholders, and then presented the same in the planned architectures in a uniform structure as amendments to HITS. Thus, the improvement of the systems can be traced and monitored throughout the development process of the architecture and it helps provide conformity with the EITSFA.

The HITS Selection Tool software was developed towards the promotion, dissemination and easier use of the HITS Architecture Framework, and is offered for downloading from the website www.frame-online.hu with all related documents. As the list of the UN and detailed...
description of the elements are beyond the compass of this summary as mentioned before – some screenshots of the HITS Selection Tool are inserted here. This will allow some insight into the HITS parts.

Selection and browsing among the user needs is available by the HITS Selection Tool. This picture shows the screen of the UN selection in the software (free download of the software: http://www.frame-online.hu/letoltes.html).

![Diagram of UN selection](image)

**Figure 4:** Selection of UN’s in HITS Selection Tool

### 2.2.2. Context Diagram

An ITS Framework Architecture (HITS too) can be defined as a framework being suitable for the description of integrated ITS systems that find its origin in the user needs of the participating organizations, units. It circumscribes the subsystems that are applicable and needed for the satisfaction of such demands, as well as the logical relations, functions and processes among them. It determines the minimum requirements posed against the systems to ensure the cooperation of the independent systems and services. With the full-scale description of the system, it offers an opportunity for the demarcation and separate implementation of the individual components, subsystems, while ensuring compatibility with the other constituents of the system.

The following diagram demonstrates the relations of any ITS (based on HITS) to external actors.
2.2.3. **Logical Architecture (or Functional Viewpoint)**

Since the first step of the HITS-process was to keep and translate every item of the EITSFA, the list of the functions is the same in the two architectures. (The basic of the idea was a total compatibility with the European ITS Framework Architecture to hold the possibility of the expression of it. The sub-selection of HITS gives solution for planning a single systems or local/company sized architectures.)
Following functional areas were defined:

1. Provide Electronic Payment Facilities,
2. Provide Safety And Emergency Facilities,
3. Manage Traffic,
4. Manage Public Transport Operations,
5. Provide Advanced Driver Assistance System,
6. Provide Traveller Journey Assistance,
7. Provide Support For Law Enforcement,
8. Manage Freight And Fleet Operations.

### 2.2.4. Communications Viewpoint

In the HITS framework architecture data flows (FDF, PDF) were defined like in the EITSFA: every connected element and DT has a definition of data. In order to consider the communication viewpoint of the ITS architecture, the following needs to be defined in the future (agreed with the foreign experiences):

- physical principle of data transfer
- safety specifications (protection)
- necessary capacity for the data transfer, which is, regarding such fast development of telecommunications, on the national level almost impossible
as a Hungarian speciality: national PA has to be finished

Regarding the existing functional and physical (and communication) sub-architectures the more often applied communication standard is the XML based DATEX2.

2.2.5. Technical Specification (UME) as a result of HITS

With a view to the international examples of application, two forms of utilization were known:

- in some cases (for example this is the case of EITSFA), it could be used in projects on a voluntary basis
- in other countries the activities of the persons/companies concerned can be assisted by the software solutions as free of charge (in most of European Country) or against payment (mainly in the USA) under the recommendations of the ministries

In the light of the international experience, it was proposed at the end of the development of HITS, that the Hungarian Ministry of Economy and Transport, which can be considered as competent in this issue, should indicate a link to the website at its own website as a recommended application that is anticipated to be subjected to legal regulations.

Following the feasibility studies having been launched within professional circles, the regulatory process were commenced in 2010, and the process resulted in a “pre-Technical Specification” in 2013 that planned to regulate ITS development on motorway and main roads.
3. ARCHITECTURE IMPLEMENTATION

3.1. Case 1: TCC of Budapest and TMC of SMMC

Traffic Control Centre of Budapest (TCC, owner: Municipality of Budapest, operator: Centre for Budapest Transport - BKK) and TMC of Hungarian Motorways (owned and maintained by State Motorway Management Company, SMMC) applied almost the same methodology to prepare the first phase of centre development/improvement. Following the classical FRAME method, the first step was the selection of the user needs, second the creation of the functional viewpoint (sub-selection of functions, databases, dataflows, actors and terminators of HITS) and finally the process ended with the physical architecture plan of the centre.

The HITS sub-architecture of the centres helped to generate the standardised connection between the centres (DATEX2). The systems developed in the CONNECT and EASYWAY phases are in service and properly working now.

The centre of BKK in Budapest controls all of the traffic lights and ITS applications in the capital. The new centre upgraded the old one with new, innovative solutions such as the possibility of internet-based connection and communication between the central and outstations units and other elements.

All Hungarian motorways are operated by a dedicated Engineering Bureau for the given section. Their work is coordinated by the Regional Director of the State Motorway Management Company (SMMC known in Hungary as ÁAK). This practice resulted in isolated systems up to 2010, when the central office had taken the control on the above elements. SMMC Centre now is responsible for the general technical control and the routine central management tasks: finance, accounting, controlling, labour management, human resources, communication, procurements and legal issues, process control and quality management of all motorway section.

3.2. Case 2: Szeged, ITS Master Plan

Just very few city has been recognised until now the need of the ITS Master Plan in Hungary. Szeged first of all decided and created its own ITS Master Plan in 2009. The ITS MP is based on the HITS sub-structure collected from the overall framework architecture. Planning on HITS resulted in some suggestions for the future eg. need of a connection with the TMC of SMMC. The Master Plan had lost its importance when the political regime of the municipality had been changed.
3.3. Problems encountered

“Everything is changing” – the phrase is true mainly for the ITS sector and changes are difficult to be adopted time after time.

In intelligent transport systems, usually inadequate documentation and individual solutions can make any improvement impossible, while the ad-hoc nature of investments (accelerated, ad-hoc investments without any underlying concept) and the lack of regulations prevent the cooperation, compatibility of various systems. In the case of national or cross-border systems providing support for various services, the proper communication of subsystems, the compatibility of the collected data are essential, and similar importance is attributed to the fact that the service-provider is to maintain continuously high standards.

Each of the parties concerned in these systems has an interest in the establishment of “borderless” services. For the travelling driver it is a basic requirement that for the entire duration of the journey continuous information and navigation services on high and steady standards should be supplied. For the operator of roads, an essential demand is that in the entire area of the respective network the same support should be available for the management of the traffic flow and any incident occurring.

Developments so far have tended to generate so-called “technological islands” that can be characterized by isolated and varied solutions.

Authors have identified two main problems. First the lack of the financial support of HITS results a delicate inconvenience in the long term sustainability and availability. Just for example the www.frame-online.hu official HITS website, in spite of the original plans, has been maintained by the developer (TRENÉCON COWI Ltd.) on voluntary basis. Secondly many problems such as the fast depreciation of information (due to the rapid changes of the organisation structure of the administration) and the weakened promotion efforts from governmental level lead to decreasing interest in using the HITS tools.
4. **Conclusions**

4.1. **Actions towards interoperability**

European countries, Hungary also has had to face the challenges posed by “technological islands”, ITS developments as separated blocks. It has been the intention to tackle this problem that gave birth to the national and international framework architectures. However HITS could fulfil its purpose just in case of the preconditions listed below (and in the next chapter):

- national and international financial, technical and/or official support
- fluent updating of the ITS related content
- country-level dissemination of the results and methodology
- integration and cooperation with the national ITS strategy and local ITS MasterPlans

Finally the HITS architecture could help to maintain the network structure of existing TCC and TMC mentioned earlier, and national level applications as for example the KIRA\(^3\) (defined below), and the connection between new and planned systems would be planned in long terms. These elements could be the base of the national Physical Architecture (PA) that is the first and most important step to create interoperability between all ITS of Hungary.

KIRA is a new national database that has fundamental function to solve connection and communication issues between online data collection roadside units and ITS systems developed in Hungary and to provide them with a unified digital transportation network map and reference data. KIRA implements a unified spatial data management and metadata serving in transportation sector according to the EU INSPIRE directive with the power of publishing collected information through the web.

Beside national road and highway management companies the system serves as a platform for Budapest capital and also other large municipalities to publish transportation information. KIRA will consist of 3 modules: Topology server, Connection server and Portal, as the next figure introduce.

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\(^3\) Közlekedési Információs Rendszer és Adatbázis – Information System and Database of Transport
4.2. Final concluding remarks

HITS Framework Architecture is very useful application and tool to solve problems listed above. Continuous upgrade would be necessary to reach wide spread deployment of the architecture and to design it to be more attractive, user-friendly and familiar for decision makers. To reach this purpose there are suggested steps:

1. Upgrade and update of the background databases and elements of HITS;
2. Upgrade of the HITS Selection Tools (e.g. UML diagram making, excel or other form for output);
3. Upgrade of the website with new results and developments;
4. Long term financial support for maintenance and dissemination;
5. Support team for supporting every day users;
6. Methodology-handbook to inform more level of decision makers;
7. Wide dissemination of the HITS results.

Figure 7: Overview of KIRA’s connections, as one possible puzzle of the HITS-PA on national level (from official leaflet of KIRA)
5. **ANNEXES**

Trace Table of the HITS database (with the data flows: FDF, PDF)