
# Ministère de l'Equipement, des Transports et du Logement

## IMPLEMENTATION GUIDE

A study co-financed by the European Commission (DGTREN)

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| **Version** 2.2 | 21/01/2002 |

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# 1 INTRODUCTION

## 1.1 Purpose of the document

This document is the Implementation Guide of **ACTIF** (Framework Architecture for Intelligent Transport in France).

«**Intelligent transport** » refers to new information and communication technologies applied to the field of transport. .

It namely encompasses all the systems enabling to gather, store and distribute the information in connection with freight and passenger transport, e.g. :

- Passenger information systems ;
- Electronic payment systems ;
- Freight management systems ;
- Public transport fleet management systems ;
- Traffic management decision systems;
- Driver assistance systems.

**Intelligent Transport Systems** (ITS) group together all applications and equipment enabling traffic and transport managers to carry out their tasks more easily and users (individuals as well as professionals) to make better use of the passenger and freight transport infrastructure network, including their interfaces with non-land transport modes.

The aim of the **Framework Architecture** is to provide a global approach to the architecture of intelligent transport systems and to favour the interoperability of hardware, applications and services..

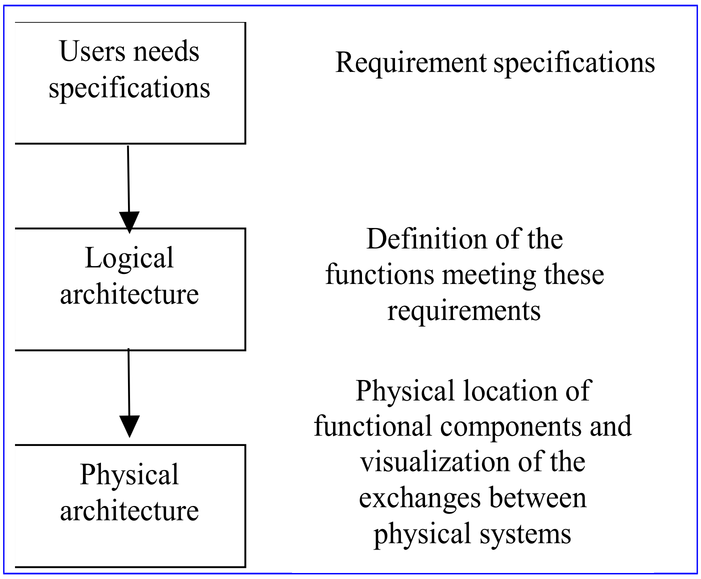
The present document describes the approach used to design the framework architecture as well as its organisation, and provides possible uses of the framework architecture. It presents the modelling principles and data model structure that have been utilized and the traceability procedures implemented. It is a reference manual describing the methodology, concepts and tools implemented for the ACTIF project.

## 1.2 Overview of ACTIF

ACTIF is based on the **users needs** which have been expressed and which the Intelligent Transport Systems are able to satisfy.

The **logical architecture** is composed of the functions implemented by ITS and meeting these needs. It is organised into major functional areas.

The **physical architecture**[1] locates the functions within the architecture, vehicles, passengers or management centers. The interfaces between these levels are also represented.




The logical architecture is thus the basis of the model as it has been defined. Its aim is to build a "future-proof" functional model, independent of technologies and organisations.

The physical architecture provides an easier way to access the framework architecture as the objects dealt with are more closely related to an actual physical perception of ITS. However, it is only a « generic » abstract model, which will be instantiated in IT systems in various ways. A motorway company, for example, can group together traffic management, driver information and even emergency management functions within a single center.

ACTIF can be accessed as follows:

- From a modelling base managed by the MEGA tool which contains an object model of the ITS,
- From an Internet site automatically generated from the MEGA base. This site enables users to navigate within the framework architecture using the links between the model components,
- From a set of Word documents automatically generated by the MEGA base. These documents provide a detailed description of the framework architecture.

## 1.3 Approach adopted for the Framework architecture design

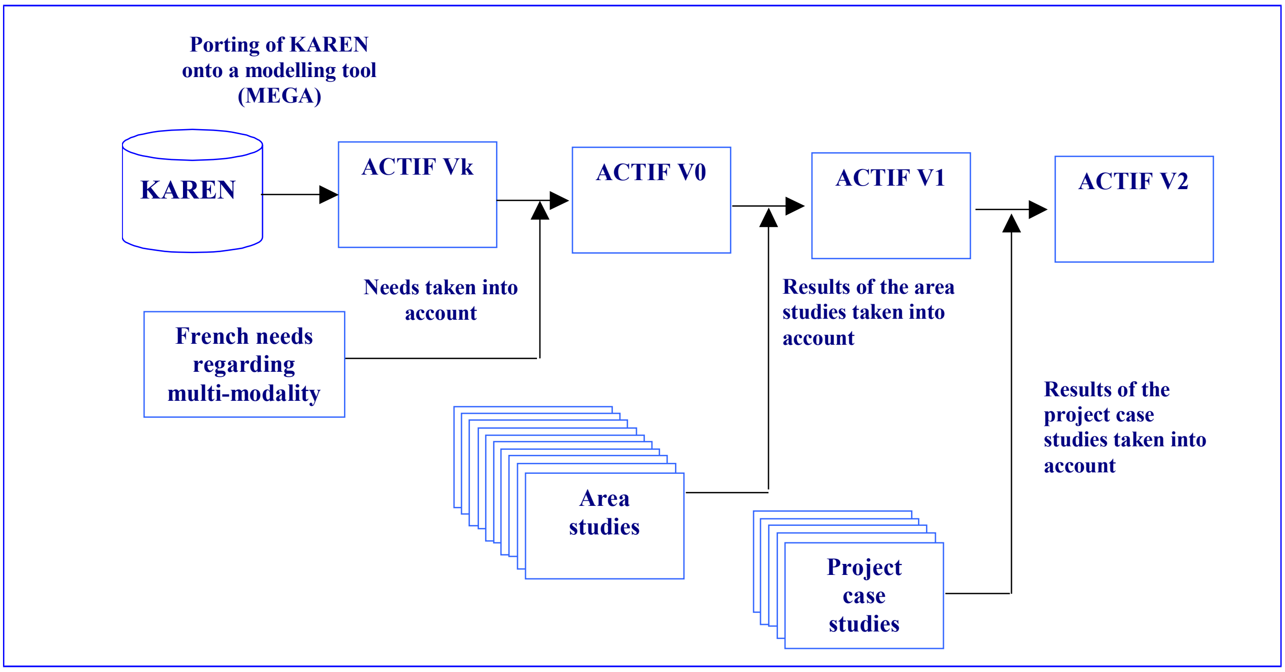
The figure below describes the approach adopted for the ACTIF Framework architecture design.

- The European KAREN architecture (logical architecture) was ported onto a modelling tool. The result was the « Vk »version.
  *This type of tool was used to ensure the consistency of future developments.*

[1] *ACTIF's physical architecture is rather similar to a « system architecture » focusing on interfacing and interoperability. The word « physical architecture » should not be understood here as a description of "frozen" technical systems. The term "physical architecture" has been kept for historical reasons (US, KAREN architectures, etc.).*

- Further needs were then incorporated, taking into account user expectations, notably in terms of intermodality (« French needs »).
- The design of the physical architecture resulted in the « V0 » version of the framework architecture.
- Ten area studies (refer to the table below) have been carried out to test the framework architecture from functional (7 studies) or technological (3 studies) points of view. These studies enabled the framework architecture as well as its descriptive elements to be improved. The « V1 » version of the framework architecture is based on the results of these studies.
- Lastly, 5 project case studies (refer to the table below) allowed the framework architecture to be tested in real cases in which ITS were implemented. This in turn resulted in a further improvement of the framework architecture (« V2 » version).

**Approach adopted for the ACTIF framework architecture design**



**Studies performed within ACTIF :**

| Area studies | Case studies |
|---|---|
| A - Use of ITS operations for transport planning<br>B - Freight management on intermodal platforms<br>C - Co-ordinated urban travel management<br>D - Route optimisation<br>E - Law enforcement<br>F - Emergency call management<br>G - Protection of privacy<br>H - Short range communications services<br>I - Geo-referenced information<br>J - Dynamic positioning | 1- Real-Time Road Information handled by the CIRs<br>2- Centralised Multimodal Travel Management in Grenoble City.<br>3- SILEVIC System (Freight Tracing)<br>4- SITP Project (Public Transport Ticketing and Traveller Information)<br>5- STRIP Project : Traffic Data by Mobile Phone Tracking |

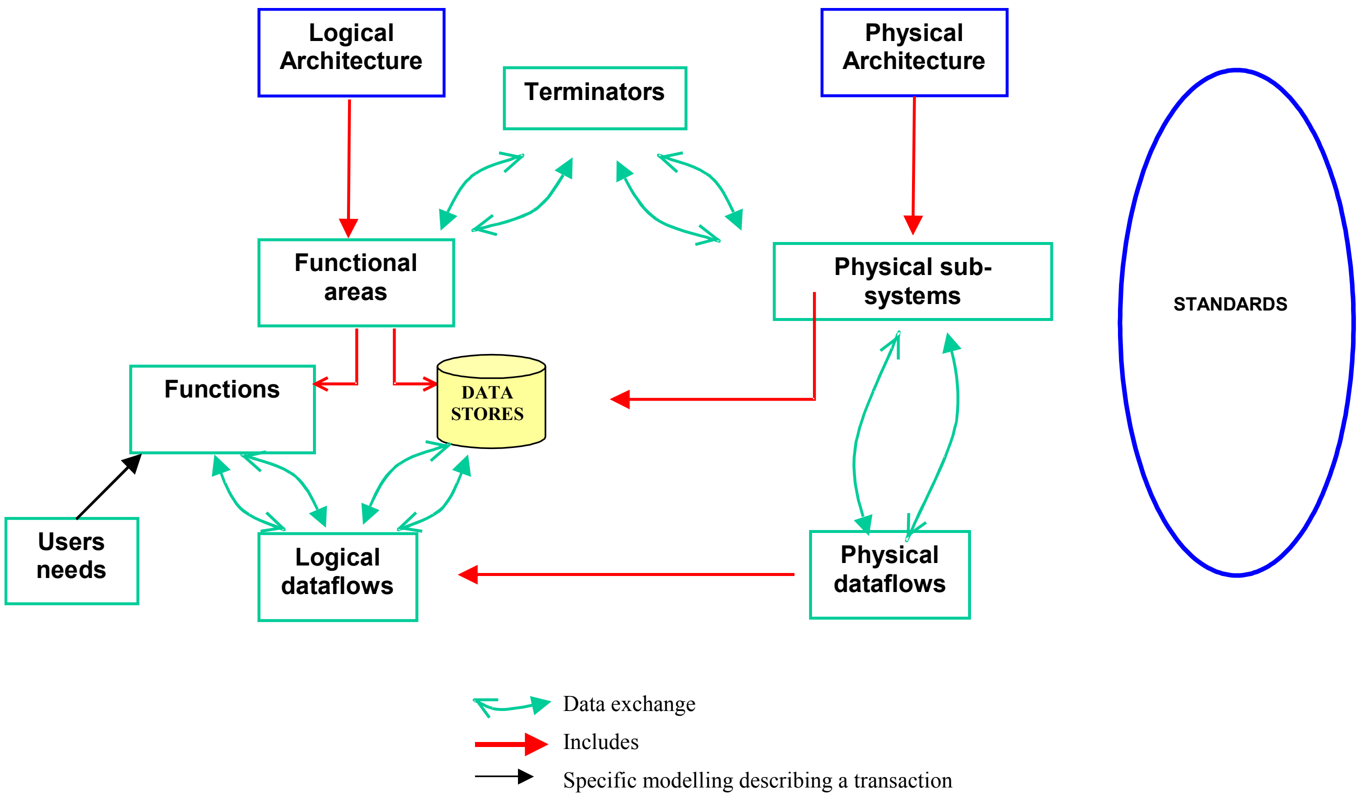
# 2 FRAMEWORK ARCHITECTURE ORGANISATION

## 2.1 Modelling concepts

ACTIF has two modelling levels:

- A logical architecture consisting of functional components interacting via data flow exchanges;
- A physical architecture grouping together functional components within physical sub-systems (vehicle, information center, etc.) by criteria related to the place where the processing is undertaken.

The figure below describes the modelling concepts, the levels they are linked to and their relationships.




The modelling concepts are as follows:

- **Users needs**

They feature the expectations of ITS users and are expressed by the wording: « the system shall enable … ». They are the actual methodological references for the modelling process. The modelling MEGA base stores the link with the functions that take them into account.

- **Terminators**

External elements (human, material, etc.) interacting with the system, which model the system environment. They can be broken down into sub-terminators.
Note: The modelling process identifies the terminators' roles within the system, and not the organisations. Example : depending on his/her role within the system, a same individual can be considered as a pedestrian, a driver, a cyclist, etc.

- **Functional areas**

These group together functional components related to a specific activity sector. The breakdown into functional areas constitutes the first-level breakdown of the system.

- **Functions**

These represent the hierarchical functional breakdown of the functional areas. The users needs totally or partially covered by a function are linked to this function.

- **Functional Dataflows**

Dataflows exchanged by the components of the logical architecture.

- **Data stores**

Elements used for archiving and providing the information processed within the ACTIF system. They are linked to a functional area and can be located at several levels within the area breakdown.

- **Physical Sub-Systems**

These group together the logical architecture components (functions, data stores, and data flows between these components), based on processing locating. This locating only takes the users needs into account : for on-board sub-systems, the functions related to vehicle driving or to the driver's activity will be grouped together.

They are hence of a generic nature, unlike technical IT systems. The comparison between physical sub-systems (ACTIF architecture) and IT systems (technical architecture) is explained in paragraph 3.3.

- **Physical Dataflows**

These represent the dataflow exchanges between physical sub-systems. For their modelling, logical flows exchanged between two physical sub-systems or between a physical sub-system and a terminator are grouped together.

- **Standards**

Standards, common rules or recommendations applying to the framework architecture. They can be linked to functions, logical or physical data, physical sub-systems, data stores and terminators.

## 2.2 Graphical representation

Two types of views feature the graphical representation of the (logical or physical) modelling process, i.e. :

- **Systematic views** :
  - Regarding the logical modelling, they are **hierarchical** functional representations of the ACTIF system, and of the areas and functions composing it.
  - Regarding the physical modelling, they are views representing the exchanges (physical dataflows) between each component (physical sub-system, terminator) and its environment.

  These systematic views aim at providing a graphical representation of all components. For specific work, thematical views shall be designed.

- **Thematic views** feature a transaction or part of a transaction modelled in the ACTIF base. Their aim is threefold :
  - To display a complete process, enabling the data processing rationale to be explained by functions pertaining to various areas and levels, for a specific case ( area studies, for example).
  - To highlight the interfaces between two parts of the model.
  - To Provide a view on the part of the model in which a designer has a special interest.

  These views cover the whole modelled architecture. They can contain components of the physical or logical architecture.

These views provide valuable assistance for :
- The design and specification of systems;
- The identification of the interfaces between the systems;
- The implementation of an area study (taking into account new user needs).

The views produced during the study are available on the Web site.

## 2.3 Components of the framework architecture

The framework architecture is composed of:

1. **The MEGA base**, which is the current reference version and updates the validated versions of the framework architecture. It is directly managed by the technical manager of the project team.
2. **The ACTIF internet site** (or CD-ROM), which everyone can access ; is generated by the tool and parameterised by the project team. It enables a dynamic and flexible consultation of the framework architecture. This site contains the following:
   - A hierarchical overview of the logical architecture
   - A hierarchical overview of the physical architecture;
   - Pages describing the components of the framework architecture : users needs, functional areas, functions, logical dataflows, physical sub-systems, datastores, terminators, standards.
   - Thematic views produced during the ACTIF project.
3. **Documentation** on the framework architecture, generated by the tool and parameterised by the project team. It includes :
   - A main document providing a general description of the framework architecture; which contains the following:
     - The relationship between the system functions and the users needs;
     - A description of the links between the system and its environment;
     - An overview of the logical architecture including the breakdown of the ITS into functional areas and a description of the latter;
     - An overview of the physical architecture including the breakdown of the ITS into physical sub-systems and a description of the latter.
   - A set of appendices providing a detailed description of each type of object within the framework architecture :
     - Appendix 1 – Description of functions ;
     - Appendix 2 – Description of logical views;
     - Appendix 3 – Description of data stores ;
     - Appendix 4 – Description of terminators ;
     - Appendix 5 – Description of physical sub-systems ;
     - Appendix 6 – Description of physical dataflows ;
     - Appendix 7 – Description of standards ;
   - A set of documents produced during the study, namely:
     - The implementation specifications for new or modified users needs;
     - The results of the area studies;
     - The « APPBS » (Actors, Products, Projects, Bibliography, Standards) base, providing a summarized description of the reference objects identified during the area studies and project case studies. This base is an Excel file;
     - "Frequently Asked Questions" (FAQ);
     - Recommendations regarding standardisation.

# 3 UTILIZATION OF THE FRAMEWORK ARCHITECTURE

The framework architecture is an abstract « generic » model that is meant to be independent of technologies or organisations and aims to model all Intelligent Transport Systems.

The utilisation of the framework architecture will lead to the definition of a coherent sub-set of the framework architecture, depending on the problem to be solved, i.e. : a sub-set of user needs, functions and physical sub-systems together with their relative dataflows.

To identify the components to be taken into account, one can use the web site and navigate through the framework architecture. The result can be presented as a Word document constructed using the framework architecture documentation. Depending on the problem to be tackled, it may be necessary to work directly on the modelling MEGA base (which requires a software licence), to build one or several specific thematic views describing the relationships between the identified components, or even to create a modelling base incorporating the identified components.

Four utilization examples are presented in the next 4 sections.

Note:
Due to the nature of the framework architecture, every component must be interpreted using its descriptive attributes (name, description) and in its own specific context. Example :

- The content of a dataflow must be interpreted allowing for its source and target
  (for the logical architecture, low level functions concerned by the dataflow will be preferred)
- The content of a function depends both on the input and output dataflows and the needs covered by the function.

The component names should be as explicit as possible, although there are limits due to the great number of components, the traceability needs related to the European KAREN architecture and the necessity to select short names. The use of acronyms[2] enables users familiar with the ACTIF model to have additional information available as soon as the component name is read.
However, an optimum use of the model requires a minimum knowledge of the sector involved.

## 3.1 Defining a system

The process consists in extracting a sub-set of the framework architecture corresponding to the system to be defined and in taking into account the project's technical and organisational specificities, in order to instance the framework architecture in the project context.

It includes the following steps :

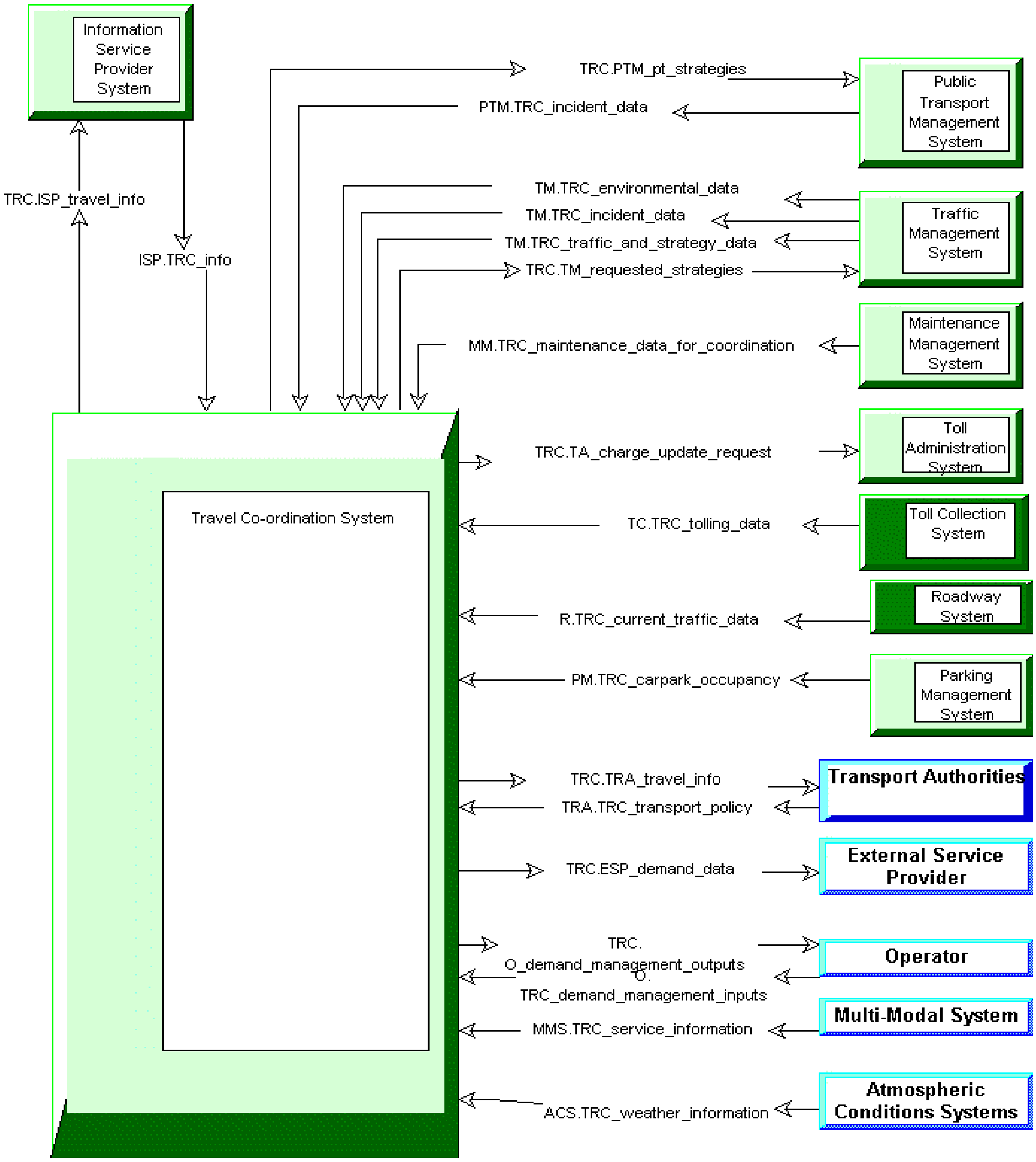
1. Defining the scope of the system, i.e. identifying :
   - the physical sub-systems to be taken into account.
     As a matter of fact, in the physical architecture, a technical system can contain several sub-systems. Examples :
     - the CRICRs (Regional Road Information and Co-ordination Centers) ensure missions involving both trip co-ordination systems and the provision of information services.
     - A public transport enterprise has both transport management and ticketing systems.

[2] *Refer to the rule governing the structure of acronyms under paragraph 5.3.4.*

- the sub-systems and the terminators interacting with the selected sub-systems. This task is carried out using views of the physical architecture.

For example, to design a trip co-ordination center, the starting point is the view of the *Travel Co-ordination* sub-system described below [3].

[3] *This view illustrates a typical approach for the use of ACTIF. It was extracted from the framework architecture as this Guide was drafted. For an in-depth study of trip co-ordination, it is advisable to use the latest version of the framework architecture.*




This view enables the scope of the systems to be identified, using the following questions :

- which traffic management centers and public transport management centers shall be co-ordinated ?
- shall toll road sections, carparks be co-ordinated?
- shall traffic data, weather data or data involving other transport means (air traffic, etc ) be collected ?
- shall traffic information be broadcasted and to whom ?

2. Defining the system

   The process consists in identifying the functions that shall be developed and the data managed. It will be carried out based on the list of functions and databases associated with the sub-systems included in the scope of the system. The logical architecture contains the description of these functions and datastores.

   If we take the example mentioned above, the functions associated with the sub-system *Trip Co-ordination* are as follows:
   3.3.1 Receiving information on trip factors
   3.3.2 Implementing a demand management strategy,
   3.3.3 Defining a demand management strategy,
   3.3.4 Managing the demand data store,
   3.3.5 Providing an operator/demand management interface,

3. Defining exchanges

   The process consists in identifying the internal and external data flows, at both a physical and logical level.

   Internal data flows are the data flows exchanged between the functions identified during the second step. They are shown on the hierarchical views of the logical architecture.

   External data flows are the data flows exchanged between the physical sub-systems identified during the first step, and the other physical sub-systems or the terminators. They are shown on the physical architecture views. They are composed of logical data flows, which are exchanged between the functions identified in the first step on the one hand and other functions of the framework architecture or the terminators, on the other hand.

4. Allowing for recommendations

   The process consists in setting up the list of rules and standards related to the elements taken from the framework architecture during the previous steps.

## 3.2 Analysis of a process

It consists in taking a functional sub-area from the framework architecture, representing a global process, such as the emergency management process or the transport of dangerous goods.

This task first requires that a thematic view be designed, describing the « end-to-end » process, with a possible focus on a specific part of the process (real-time versus deferred time aspects, for example).

This thematic view can then be used as a support for a working group composed of terminators, each specialized in a specific part of the problem.

## 3.3 Analysis of an existing system

The process consists in projecting the framework architecture onto an existing system so as to analyse the gap between this system and the framework architecture, in terms of functions, interfaces, organisation and rules.

Note : to maximize the results of this analysis, the modelling of the existing system available should be precise enough to allow a comparison with the framework architecture.

## 3.4 Domain Analysis

This consists in analysing the standards set for a functional area so as to identify, for example, the points where little progress has been achieved regarding standardization, despite the fact that the team members involved are numerous. The aim of this analysis is to determine prioritary standardisation work to be carried out.

# 4 MODELLING AND REPRESENTATION RULES

## 4.1 Modelling principles

This paragraph describes the modelling principles implemented in the framework architecture.

Regarding the rules that are mandatory and were not observed in the initial model, evolutions will not be systematically implemented, but as and when required.

### 4.1.1 Terminators

Terminators model the interfaces between the intelligent transport system and its environment.

To guarantee the « generic » character of the framework architecture, the terminators model roles, and not organisations. For example, the « archive user » terminator is defined as any type of terminator needing to access the datastores described in ACTIF.

To facilitate familiarisation with the model and the switchover to the technical architecture, the terminator description will include the organisations and bodies that usually fulfil this role. The description of the « archive user » terminator, for example, is as follows :

*This terminator represents any type of terminator needing to access the datastores described in ACTIF. Planning terminators may be:*
*- states and local government bodies, as transport supervisory bodies,*
*- research centers,*
*- public planning departments,*
*- statistics institutes,*
*- infrastructure managers,*
*- planning organisations working for the above mentioned organisations,*
*- private companies,*
*- and naturally, transport operators and traffic managers.*

### 4.1.2 Boundaries of the architecture

In coherence with KAREN choices, mainly due to the willing to keep the model independent from the technical solutions, some STI elements are considered as included in the ACTIF perimeter are, so, modelled as functions. Other elements are considered as out of the ACTIF perimeter and, if necessary, modelled as terminators.

**Included are:**

- Input sources: Detectors, sensors
- Traveller/operator interfaces
- Output devices: signals, VMS

**Excluded are:**

- Vehicle operating systems
- Human beings (*only their **actions** included*)
- Banking
- Telecommunications infrastructure equipment

### 4.1.3 Functional breakdown

The breakdown of a functional area into a set of functions, then into sub-functions respects the following principles:

- At each level, the breakdown must feature independent functions (« the high level function performs this and this »). When the breakdown features a sequence of actions (« the high level function perform this, then, this »), it means that the processing level has been reached; it can no longer be considered as functions.
- The functional breakdown must be « reasonably » independent from the physical architecture and the underlying organisation, which means excluding the break down of a function based on physical architecture criteria, except for the lowest level functions. In that case, they are « derivative » functions. The most usual case is the breakdown of a MMI (man-machine interface) function according to the equipment envisaged (refer to § 4.1.5).
- Intermediary levels are used solely to make the access to the model easier. A trade-off has to be reached between the number of intermediary levels (in depth) and the number of functions at each level (in width).

In practice, the level of detail is similar to that of KAREN architecture (VK version), though modified to allow for French needs, and then completed to allow for the results of the area studies (V1 version) and project case studies (V2 version).

### 4.1.4 Physical breakdown

The breakdown into physical sub-systems relies on the following principles:

- **categories of physical sub-systems** are first identified based on the place where processing is undertaken:
  - « traveller sub-systems » : these sub-systems group together functions geographically related to the traveller (functions that are available in a place that travellers pass through or on a personal device which travellers have with them);
  - « infrastructure sub-systems » : these sub-systems group together functions geographically related to the infrastructure (examples : counting loops, SOS phones, etc.);
  - « vehicle subsystems » : these sub-systems group together functions geographically related to vehicles (cars, trains, coaches, , buses, trucks, containers, etc.) ;
  - « centre subsystems » : these sub-systems group together functions without any geographical constraints[4].

  Note : categories are not a MEGA concept.
- In each category, physical sub-systems are distinguished based on functional criteria such as :

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[4] *Thus, a sub-system « centre » is not necessarily located in a Centralized station. The management system of a freight company may be located, for example, in the corporate manager's truck.*
*This type of variant will result in fully different technical architectures. However, the data flows exchanged between the various components will be similar, on a semantic level.*

- System on-board of a passenger car, an emergency vehicle, a public transport vehicle, etc. for the category « vehicle »;
- Traffic, public transportation, freight, emergency management centers, etc. for the category « centre ».

The list of Physical sub-systems was initially set up based on the Canadian architecture. Then, it was modified based on European and French specificities. The table in the Appendix features the status of these modifications in September 2001.

- The low level functions within the logical architecture are distributed throughout the physical sub-systems previously identified:
  - Each low level function relates to a single physical sub-system. [5]. This distribution is performed as a result of the semantic analysis of the description of the function.
  - The relationship to a physical sub-system depends on the type of function (traffic management, emergency management, etc.) and on the function's geographical link corresponding to the category of the sub-system.
- The distribution of the data stores over the physical sub-systems is similar to that of functions.[6].
- The logical data flows exchanged between all the functions of a physical sub-system and the functions (data stores) of the other physical sub-systems, or with other external elements (Terminators, etc.) are identified.
  Then, they are grouped together to form physical data flows, based on the following criteria: process involved, real-time/deferred time, etc.

### 4.1.5 Recommendations - standards

Recommendations and standards are modelled by means of objects of a « standard » type.

For each recommendation, an object of a « standard » type describing the recommendation is created, then a link between the objects to which the recommendation applies and the « standard » object is created.

### 4.1.6 Man-Machine Interface

For modelling a man-machine dialog, it is recommended to distinguish between processing functions (computation of the requested item of information) and the functions presenting this item.

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[5] This rule has also been utilized in the US architecture. Arbitrations shall be necessary to decide upon the allocation of some functions, even upon the splitting of one function into two different functions, in extreme cases.

[6] *This rule did not raise any problem during the design of the physical architecture using the existing physical sub-systems. In the absolute, a distribution or a duplication of the data stores throughout several physical sub-systems can be considered. In this case, adapted management rules should be available.*

The function « presentation of the information item » can be broken down into sub-functions, depending on the potential interface equipment (information kiosk, office computer, on-board terminal , etc.), to comply with the principle that a low level function cannot be linked to several physical sub-systems.

At the physical architecture level, the functions can then be distributed throughout the various physical sub-systems and any type of client-server multi-terminal solutions can be modelled.

### 4.1.7 Data stores and repository

The data store concept is utilized to model the data used by several functions : the access to a data store will be then modelled, rather than the flow of an item of information from one function to another.

However, ACTIF does not really include data models; a data model results from specification work performed as a standardisation activity or for a specific project.

One considers that the object is identified to its corresponding function. In the data store, read-only and write-only access data flows are represented separately.

Data repositories are modelled as « data stores ».

Two types of data flows shall be modelled, i.e. :
- « off-line » flows preparing the data repository
- the flows for a real-time access to data.

In the V0 version, the flows preparing the repositories are seldom modelled. They will be added as and when the results of the ACTIF area studies are published.

For modelling the transmission of operating data to an archive manager, an operating data transmission standard is defined, which is linked to all the data stores involved.

### 4.1.8 Exchanges between organisations of the same type

The framework architecture models an intelligent transport system and its relationships with its environment, but this environment includes other intelligent transport systems handling other geographical areas or other transport means. It is thus necessary to model the exchanges between the various intelligent transport systems, in the field of traffic management co-ordination, emergency handling or users information, for example.

The modelling relates typically to:
- exchanges between functions of the same type (logical architecture) ;
- exchanges between physical sub-systems of the same type (physical architecture).

Three solutions were considered, i.e. :

1. Incorporating reflexive data flows;
   *This results in a model that is not very legible.*
   *Moreover, it must be pointed out that a « physical reflexive » flow can feature an exchange between two different logical functions, which makes it difficult to differentiate it from an « ordinary » logical flow.*
2. Duplicating the objects involved;
   *This leads to an increase in the number of objects, which involves potential inconsistencies, should the model evolve.*
3. Incorporating a terminator modelling the other intelligent transport systems.
   *This solution enables the system and its environment to be kept apart.*
   *It does not involve any maintenance problem.*
   *The collaboration between two objects of the same type is clearly represented in the model and can be linked to a standard.*

The third solution was selected for ACTIF.

In ACTIF, objects of the same type are modelled by flows between the object considered and a terminator modelling the other intelligent transport systems.

These terminators can be a « Related Road System », or an « emergency system », for example.
*In KAREN, the terminator road related system was used to represent the same type of system, whatever the system considered (Traffic management, Public Transport management). To exclude any ambiguity, ACTIF chose to create a specific terminator for the modelling of this typical exchange. Current and forthcoming changes will thus be carried out with this in view.*

### 4.1.9 Modelling of « generic » data flows

In certain cases, some data flows may not be represented in the model,.

It is always the result of an explicit decision validated by the ACTIF technical committee and usually based on concerns in connection with user-friendliness.

In the current version, this is namely the case for the data flows towards Area 9 « Archive Management ». As a matter of fact, the addition of these « generic » flows (archive supply) would have significantly « overloaded » the functional diagrams without any additional semantic content.

## 4.2 Rules governing the graphical representation

### 4.2.1 Object representation

**Needs** :
They are not graphically represented.

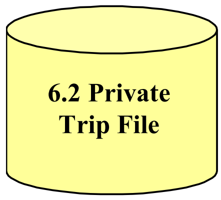
**Terminators** :
The complete name is displayed.
*Sub-terminators are not represented, with few exceptions such as thematic views.*


**Functional areas** :
Their name and number are displayed.

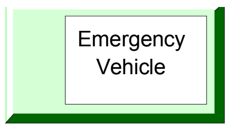

**Functions** :
Their name and number are displayed.
Functions and sub-functions are represented in the same way. The number enables their location in the functional hierarchy to be identified.


**Logical data flows** :
The complete name is displayed.
The prefix within the name specifies the flow source and target.
The English prefix has been kept.

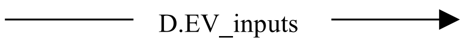

**Data stores** :
Their name and number are displayed.
The first digit specifies the functional area.
The second digit specifies the number corresponding to the order of the data store in the functional area.




**Physical sub-systems** :
The complete name is displayed.
The colour specifies the physical sub-system category.




**Physical data flows** :
The complete name is displayed.
The prefix within the name specifies the flow source and target.
The English prefix has been kept.

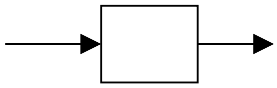



**Standards** :
Standards are not represented.

### 4.2.2 Diagram organisation

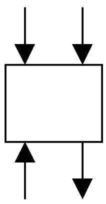
The diagrams present the objects as described previously. Regarding the connection of functions and data flows, the following rules have been used:

- Inputs on the left, outputs on the right, as far as possible.



- Otherwise, inputs and outputs sideways, keeping the data flows apart as far as possible.

- Or downwards or upwards, if the ergonomics justifies it.



### 4.2.3 View content

This paragraph presents the objects displayed in each type of graphical view.

| | |
| --- | --- |
| Context diagram | ITS System<br>Terminators<br>Input and output logical dataflows of the ITS system |
| Functional area diagram (DFD0) | Functional areas<br>Logical dataflows exchanged between functional areas |
| Functional hierarchical view (DFDi) | Functions<br>Data stores<br>Logical dataflows exchanged between those elements |
| Presentation diagram of a physical sub-system | Physical sub-system concerned<br>Other interfacing physical sub-systems<br>Terminators linked to the sub-system<br>Physical dataflows exchanged between those elements |

| | |
| --- | --- |
| Presentation diagram of a terminator | Terminator concerned<br>Physical sub-systems linked to the terminator<br>Physical dataflows exchanged between those elements |
| Thematic view | Any element appearing of interest to the view designer. |

## 4.3 Navigation principles

Sensitive areas enable a dynamic operation of the model.

Positioning the cursor on the generated Internet pages opens a menu featuring :

- The display of the object description, managed in the « comment » field of the object;
- The display of the object description sheet, featuring its characteristics, the access to the diagrams or components and to additional information.

# 5 DATA MODELS

***This paragraph is intended for the user classes 3 and 4; a good knowledge of the MEGA tool is a pre-requisite.***

## 5.1 Terminology

The table below shows the wording used for the objects managed by the MEGA base and for the corresponding ACTIF and KAREN concepts:

| ACTIF Concepts | KAREN corresponding Concepts | MEGA Terminology |
| --- | --- | --- |
| **Functional areas** | Functional Area | Process |
| **Terminators** | Terminators | Terminator |
| **Functions** | High and Low level Functions | « activity »-type operation |
| **Logical data flows** | • Context level terminator data flows<br>• Functional architecture data flows<br>• Interfunctional area data flows<br>• Low level terminator data flows<br>• Medium level data flows<br>• Trigger Flows | « logical »-type message |
| **Data stores** | Data Store | Data store |
| **Physical sub-systems** | - | Application |
| **Physical data flows** | - | « physical » -type message |
| **Hierarchical functional views** | DFD | Logigram |
| **Physical views**<br>• representing a sub-system<br>• representing a terminator | - | Logigram |
| **Thematic views**<br>• Inter-area views<br>• Transactional views | - | Logigram |
| **Users needs** | User Needs | Functionality |
| **Standards** | - | Standard |

## 5.2 Features common to all objects

All the objects managed by MEGA have the following attributes:

**1. Name**

All the objects managed in the MEGA base are identified by a name **or** a number **followed** by a name.

**2. Description**

A textual description explains the name of each object and what it models. This description is located in the « comment » field of the menu corresponding to the object. It can be accessed from the Internet pages generated by positioning the cursor on the sensitive area of the object.

*Note: the description will not refer to other objects of the architecture under their explicit names, as far as possible, which would result in a heavy duty maintenance and a potential consistency loss, should the name of these objects change. This will be allowed for as and when the objects are modified.*

**Comment 2**

This field is located in the « comment » area of the menu corresponding to the object. It is used to trace the successive modifications of the object (see § 6.2.).

**3. Administration (these fields are automatically filled in)**

- Date of creation
- Date of modification
- Name of designer
- Name of the person who made the modification
- The habilitation level is « the technical manager ». This level is specified in the Administration module (Environment/Users)
- Users have a « Read » status and the project team a « Read / Write » status.

**4. Documents**

Object-specific documentation function : this optional attribute is not used within ACTIF.

**5. External references**

Allows an external reference to be associated with the object : this optional attribute is not used within ACTIF.

**6. Comments**

Allows the input of working comments : this optional attribute is not used within ACTIF.

**7. Dictionary**

Creation of key words : this optional attribute is not used within ACTIF.

**8. Impact analysis**

This presentation can be accessed from the MEGA explorer associated with the objects. It provides source-target information in connection with the object for messages, and the hierarchical level for other objects. This analysis is automatically updated if a link is modified – should an object be modified, it is recommended to consult the analysis.

## 5.3 Features specific to each type of object

The tables below feature the data model structure of each ACTIF component. For each object, they provide:

- the list of its attributes
- a summarised description of these attributes
- the identification of the corresponding KAREN information;
- the mandatory or optional feature of the attributes. Compulsory attributes generally relate to the object name, number, description, relationship and comment. Optional attributes concern « complementary » attributes which enable the model to be used in a more sophisticated way
- the implementation of this attribute in MEGA.

### 5.3.1 ACTIF System

| Attributes | Description | KAREN | Mandatory/ optional | MEGA |
| --- | --- | --- | --- | --- |
| **Name** | Name | The system | **M** | Field in ITS system entitled « name » |
| **Description** | A few sentences describing its scope . | Textual information | **M** | Processus field entitled « comment » |
| **Flow** | The information is linked with the flow description. | | | |

### 5.3.2 Functional area

| Attributes | Description | KAREN | Mandatory/ optional | MEGA |
|---|---|---|---|---|
| **Name** | Short name with an action verb. | Name Functional Area | **M** | Process field entitled « name » |
| **Number** | Numbering | Area number | **M** | Process field entitled « name » |
| **Description** | A few sentences describing the purpose of the functional area | Area Description | **M** | Process field entitled « comment » |
| **Transmitted flows** | Identification of input flows | Not available | **O** | Process impact analysislink entitled « transmitted messages » |
| **Received flows** | Identification of output flows | Not available | **O** | Process impact analysis link entitled « received messages » |
| **Standards** | Identification of applicable standards | Not available | **O** | Process impact analysis link entitled « standard ». |

### 5.3.3 Functions

| Attributes | Description | KAREN | Mandatory/ optional | MEGA |
|---|---|---|---|---|
| **Name** | Short name with an action verb. | Function name | **M** | Operation field entitled « name » . |
| **Number** | It represents the hierarchical breakdown | Function number | **M** | Operation field entitled « name » . |
| **Description** | A few sentences describing the realized functionality. | Overview | **M** | Operation field entitled « comment » . |
| **Parent Function** | Identification of the higher level function, with name and number | Linked with the numbering | **M** | Operation impact analysis link, entitled « composed ». |
| **Base Functions** | Identification of lower level functions, with name and number | Linked with the numbering | **O** | Operation description link entitled « Component ». |
| **Constraints** | Short sentence in connection with a requirement which could be a « permanent availablility ». | Not available | **O** | Operation description link entitled « Constraints ». |
| **Objectives** | Summarized description of the function objective | Not available | **O** | Operation description link entitled « Objectives ». |
| **Scheduling of actions** | Step-by-step description of the Functional Requirements | available Functional Requirements | **O** | Operation field entitled « functional requirements ». |
| **Needs** | List of ACTIF and / or KAREN needs fulfilled by the function | Available | **M** | Operation description link entitled « Functionality » |
| **Transmitted flows** | Identification of input flows | Not available | **O** | Process impact analysis link entitled « Result » |
| **Received flows** | Identification of output flows | Not available | **O** | Process impact analysis link entitled « Event ». |
| **Standards** | Identification of applicable standards | Not available | **O** | Operation impact analysis link entitled « standard ». |
| **Physical sub-system** | Name of the physical sub-system to which the function has been allocated (for low level functions only). | Not available | **O** | Operation impact analysis link entitled « Application ». |

### 5.3.4 Data Flows

| Attributes | Description | KAREN | Mandatory/ optional | MEGA |
|---|---|---|---|---|
| **Name** | Name of flow (see naming rules below) | Data Flow Name | **M** | Message field entitled « name » |
| **Description** | A few sentences specifying the message, together with the elements constituting the flow | Available | **M** | Message field entitled « comment » |
| **Parent flow** | Flow identification.<br>Physical flows do not have any parent flow. Logical flows may have two parents, i.e. a logical (functional tree structure) and a physical flow (link logical architecture/physical architecture) | Not available | **M** | Message impact analysis link entitled « composed ». |
| **Base flow** | Flow identification..<br>Physical flows have base flows, i.e. the logical flows constituting them. | Not available | **M** | Message description link entitled « component ». |
| **Source element** | Name and number | Available | **M** | Message impact analysis link entitled « result », « source process », « source messages » or « source terminator ». |
| **Target element** | Name and number | Available | **M** | Link Message impact analysis link entitled « event », « target process », « target data store » or « target terminator ». |
| **Frequency** | Summarized description of the flow transmission frequency : urgent, real-time, off-line: | Not available | **O** | the Message field entitled . « Frequency » |
| **Transmission mode** | Description depending on flows :<br>- local / remote<br>- fixed / wireless | Not available | **O** | Message field entitled « Transmission Mode ». |
| **Type of flows** | This notion is relevant only for the logical flows.<br>The values from KAREN are kept but not maintained | Available: Trigger Yes/No | **O** | Message field entitled « Flow Type ». |
| **Type of message** | Pre-set values: Logical/Physical | Not available | **O** | Message field entitled « Message Type ». |
| **Standards** | Identification of applicable standards | Not available | **O** | Message impact analysis link entitled « standard » |

**Rules governing data flow names:**

Common rule : Whatever the language, French or English, flows have the same acronym.

**Logical flows** : KAREN rules have been kept in ACTIF

1. Acronyms are in small letters.
2. When a data flow resides in a functional area, the flow is identified by the English initial letters of the functional area
   Examples: *ptja* for Provide Traveller Journey Assistance
   *mt* for Manage Traffic

4. When a data flow is sent from the functional area n1 to the functional area n2, the syntax of the flow is as follows *: n1.n2_xxx*(xxx = content of the logical flow)

   Example : *mt.ptja_informations_incidents*

4. When a data flow links a functional area and a terminator, the initial letter of the flow is « f » (for From) if the terminator sends a data flow to a functional area ; and « t » if the functional area sends a data flow to a terminator. The initial letter of the data flow is followed by the acronym of the terminator and by a dash " – " ; the third element represents the initial letters of the considered functional area.
   Example :*ft-ptja_inputs* features a data flow sent from the traveller to the functional area ptja
   *Td-mt_outputs* features a data flow sent from the functional area mt to the terminator driver

5. When a data flow is sent from or to a sub-terminator, the same rule applies, but the source or target functional area is not specified. Actors acronyms are composed of two elements: aaa.sss :

   (aaa = actor's acronym/sss- specifies the actor)

   Example :fo.po-park information features a data flow originating from the parking operator terminator, dependent upon the operator terminator, whose acronym is hence o.po.

6. When a terminator is linked to a single functional area, the data flow starts by To or From, followed by the complete name of the terminator considered.

   Example : De_driver features a data flow originating from the driver Terminator.

**Physical flows**

The acronyms for physical flows start with a capital letter, to distinguish logical and physical flows.

They are constructed as follows : <S>.<C>_ title

- S being the acronym for the data flow source (physical sub-system or terminator)
- C being the acronym for the data flow target (physical sub-system or terminator)
- Title specifies the data flow content

Example : TM.PV_traffic_data models a flow :

- From the Traffic Management terminator
- To the Personal vehicle sub-system
- Containing traffic data

Acronyms thus make it possible to :

- quickly provide a piece of information on the positioning of a flow regarding functional areas or physical sub-systems
- keep the names used in KAREN, hence allowing direct traceability (English acronyms are maintained in the French version)
- ensure homogeneous flow names.

#### 5.3.5 Data stores

| Attributes | Description | KAREN | Mandatory Optional | MEGA |
|---|---|---|---|---|
| **Name** | Short naming with a name | Data Store Name | **M** | Data Store field entitled « name » |
| **Description** | A few sentences explaining the contents of the data store and the extraction possibilities | Description of contents | **M** | Data store field entitled « comment » |
| **Number** | In connection with the functional area number | Available | **M** | Data Store field entitled « name » |
| **Physical Sub- System** | Name of the physical sub-system to which the data store has been allocated. | Not available | **O** | Data store impact analysis link entitled « application » |
| **Standards** | Identification of applicable standards | Not available | **O** | Link of the impact analysis of the data store entitled « standard » |
| **Transmitted flow** | Identification of input flows | Not available | **O** | Data store impact analysis link entitled « transmitted message » |
| **Received flow** | Identification of output flows | Not available | **O** | Data store impact analysis link entitled « received message » |

### 5.3.6 Terminator

| Attributes | Description | KAREN | Mandatory Optional | MEGA |
|---|---|---|---|---|
| **Name** | Short naming with name | Terminator Name | **M** | Terminator field entitled « name » |
| **Acronym** | Letter or short set of lower case letters | Terminator acronym | **M** | Terminator field entitled « key word » |
| **Description** | A few sentences describing the terminator's role | Terminator Description | **M** | Terminator field entitled « comment » |
| **Component** | Identification of actors linked by their names. | Available | **O** | Component link of the terminator's description. |
| **Parent** | Identification of the parent terminator | Available | **O** | Composed link of the impact analysis |
| **Standards** | Identification of applicable standards | Not available | **O** | Terminator impact analysis link entitled « Standard ». |
| **Transmitted flow** | Identification of input flows | Not available | **O** | Terminator impact analysis link entitled « transmitted message ». |
| **Received flow** | Identification of output flows | Not available | **O** | Terminator impact analysis link entitled « Received message ». |

### 5.3.7 Physical sub-system

| Attributes | Description | Mandatory Optional | MEGA |
|---|---|---|---|
| **Name** | Short naming with name | **M** | Application field entitled « name » |
| **Description** | A few sentences describing the contents. | **M** | Application field entitled « comment » |
| **Functions** | List of low level logical functions linked to the sub-system | **M** | Application impact analysis link entitled « operations » |
| **Data stores** | List of data stores linked to the sub-system | **O** | Application impact analysis link entitled « data store » |
| **Standards** | Identification of applicable standards | **O** | of the Application impact analysis link entitled « standards » |
| **Transmitted flow** | Identification of input flows | **O** | Physical sub-system impact analysis link entitled « Transmitted message » |
| **Received flow** | Identification of output flows | **O** | Physical sub-system impact analysis link entitled « received message ». |

### 5.3.8 Standards

| Attributes | Description | Mandatory Optional | MEGA |
|---|---|---|---|
| **Name** | Short naming with name | **M** | Standard field entitled « name » . |
| **Description** | A few sentences describing the contents | **M** | Standard field entitled « comment » |
| **Type of standard** | Value such as standard, corporate standard, de facto standard, regulation, law, ACTIF recommendation, advice | **O** | Standard field entitled « type ». |
| **Object** | Object of standard : data, exchanges, glossary, etc.. | **O** | Standard field entitled « object » . |
| **Organisation** | Organisation responsible for the standard | **O** | Standard field entitled « organisation ». |
| **Date** | Date of the latest update of standard. | **O** | Standard field entitled « Date of the latest update » |
| **Status** | Value such as « on going », « pre-standard » | **O** | Standard field entitled « status ». |
| **Internet site** | Address of an internet site on which the standard is presented. | **O** | Standard field entitled « site ». |
| **Country** | Countries in which the standard is applicable | **O** | Standard field entitled « country ». |
| **Recommended by ACTIF** | Value such as yes/no | **O** | Standard field entitled « recommended by ACTIF » . |
| **Terminators** | List of terminators to which the standard is applicable | **O** | Standard description link entitled « Terminator » . |
| **Sub Systems** | List of sub-systems to which the standard is applicable | **O** | Standard description link entitled « Application » . |
| **Data Store** | List of data stores to which the standard is applicable | **O** | Standard description link entitled « Data store » . |
| **Flow** | List of flows to which the standard is applicable | **O** | Standard description link entitled « Message » . |
| **Functions** | List of functions to which the standard is applicable | **O** | Standard description link entitled « Operation » . |
| **Functional area** | List of functional areas to which the standard is applicable | **O** | Standard description link entitled « Process » . |

# 6 TRACEABILITY

## 6.1 Levels of traceability

Traceability within the ACTIF project is managed according to different levels.

1. Traceability of the work carried out : this makes it possible to keep track of the justifications of the choices made during the various construction phases of the framework architecture.
2. Traceability with Karen : this allows the identification of Karen components in the ACTIF framework architecture.
3. Traceability of the relationship between components: this makes it possible to keep track of the links between the components of the model (needs/functions, functions/physical sub-systems).

## 6.2 General principle

Whatever their origin, object modifications are kept in the field « comments 2 » associated with each object, together with:

- Date of modification;
- Indication of its cause (correction, handling of a need, specific study, etc.)

Comment 1 : correction of obvious faults is not traced.

Comment 2 : the field entitled « comment 2» is not translated. It is to be noted that this field is not documented in the tables above.

The field entitled « comment 2 » is primarily a tool intended for the developers of the framework architecture. It enables the history of modifications to be recorded and different types of comments to be noted. It can therefore be considered as "free"

In addition to the utilisation of the field entitled « comment », the MEGA tool enables a comparison of two versions of a MEGA base. This comparison utilizes a functionality specific to the « administration » module of MEGA tool. This modules enables differences to be detected :

- by links/types of links,
- by objects or activities,
- by creation, modification or deletion operations.

## 6.3 Traceability management procedures

### 6.3.1 Traceability of the work carried out

The traceability of the work carried out is maintained through :

- Methodological paragraphs of the documents describing the framework architecture (« maindoc ») :
  - logical architecture (same text as in Karen architecture) ;
  - physical architecture (specifying the approach used: see note dated 23/01/2001) ;

- Implementation specifications:
  - Each new version is subject to implementation specifications grouped by categories in connection with the modification items
  - A summarized table enables the implementation specifications to be identified, describing each successive version of the model.

- Updating of the modified objects field entitled « comment-2 » :
  - logical architecture V0 : the modified objects field entitled « comment-2 » refers to the corresponding need.
  - physical architecture V0 : the created or modified objects field, entitled « comment-2 », refers to the creation of the physical architecture.
  - Feedback from studies : the modified objects field, entitled « comment-2 », refers to the corresponding study.

A document featuring the comments made throughout the process may be produced. Its format has not yet been specified.

### 6.3.2 Traceability with Karen

Karen objects are maintained with their name and number, unless a faulty name or number has been corrected, in which case it then figures in the field entitled « comment 2 ».

As for new objects, object modifications are recorded in the associated « comment 2 ».

KAREN objects which have not been maintained are deleted from the MEGA base, except for the needs for which only the link with functions has been eliminated.

### 6.3.3 Traceability of the relationship between the model components

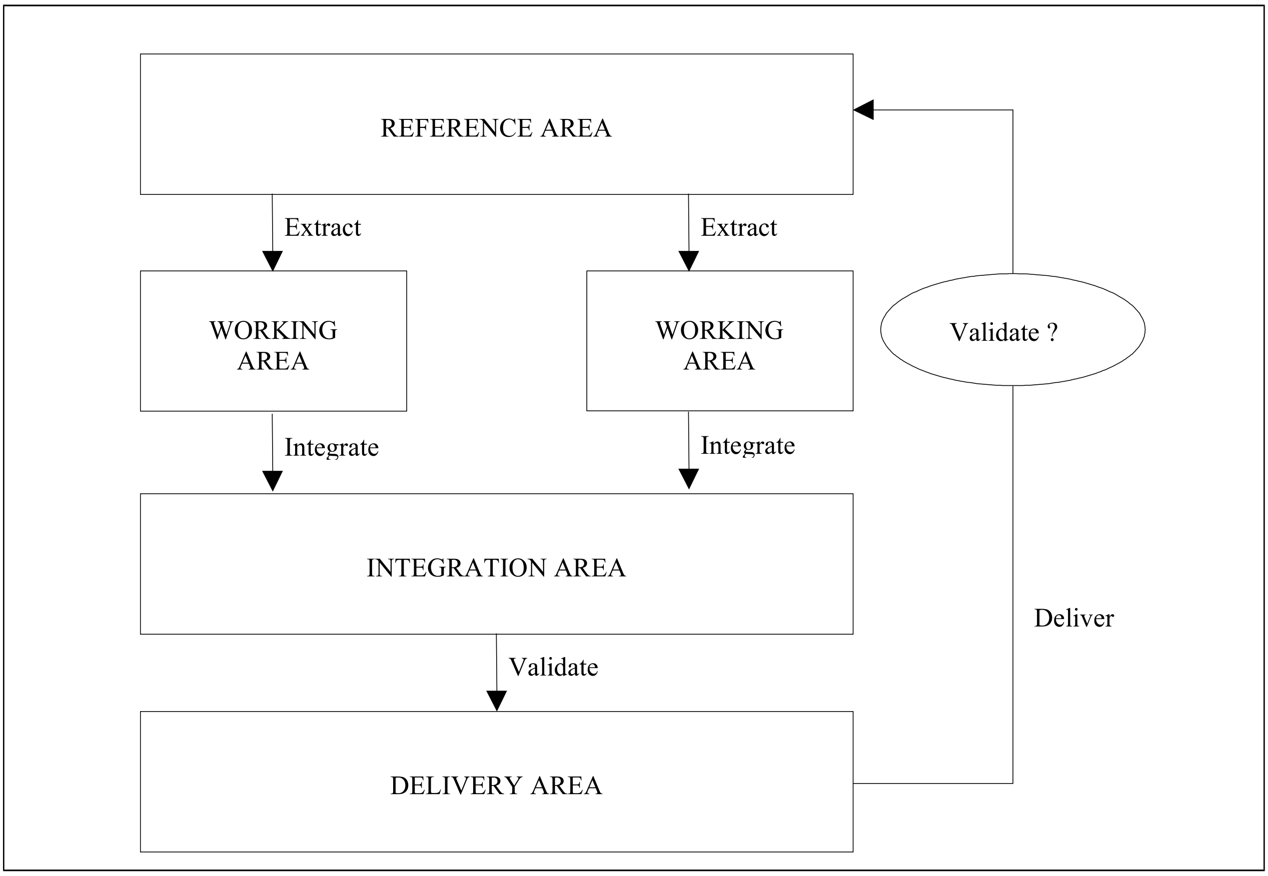
Traceability between user needs and basic functions of the logical architecture is featured in the functions/needs matrix. This matrix can be accessed on the internet site generated from the MEGA base.

Traceability between basic functions of the logical architecture and physical sub-systems is featured in the description of physical sub-systems. This matrix can be accessed on the internet site and in the Word documentation generated from the MEGA base.

Traceability between needs and physical sub-systems is obtained manually, in two stages, from the data above.

# 7 CONFIGURATION MANAGEMENT

## 7.1 Configuration areas




The **reference area** contains the latest delivered version, without any change.
It is located on the administration station.

The **working area** contains the modifications being carried out by the staff in charge of the architecture.

- Extraction from the reference area consists in copying this area into the working directory of the corresponding workstation, from the administration workstation.
- The following operations are performed:
  - change
  - unit validation of the change.
    It shall be ensured that the change of each item is consistent :
    *within the various attributes of the sheet
    * with the figures where the item is represented,
    * with the context, i.e.: all linked items identified on the sheet displayed on the web site (or in MEGA explorer) .

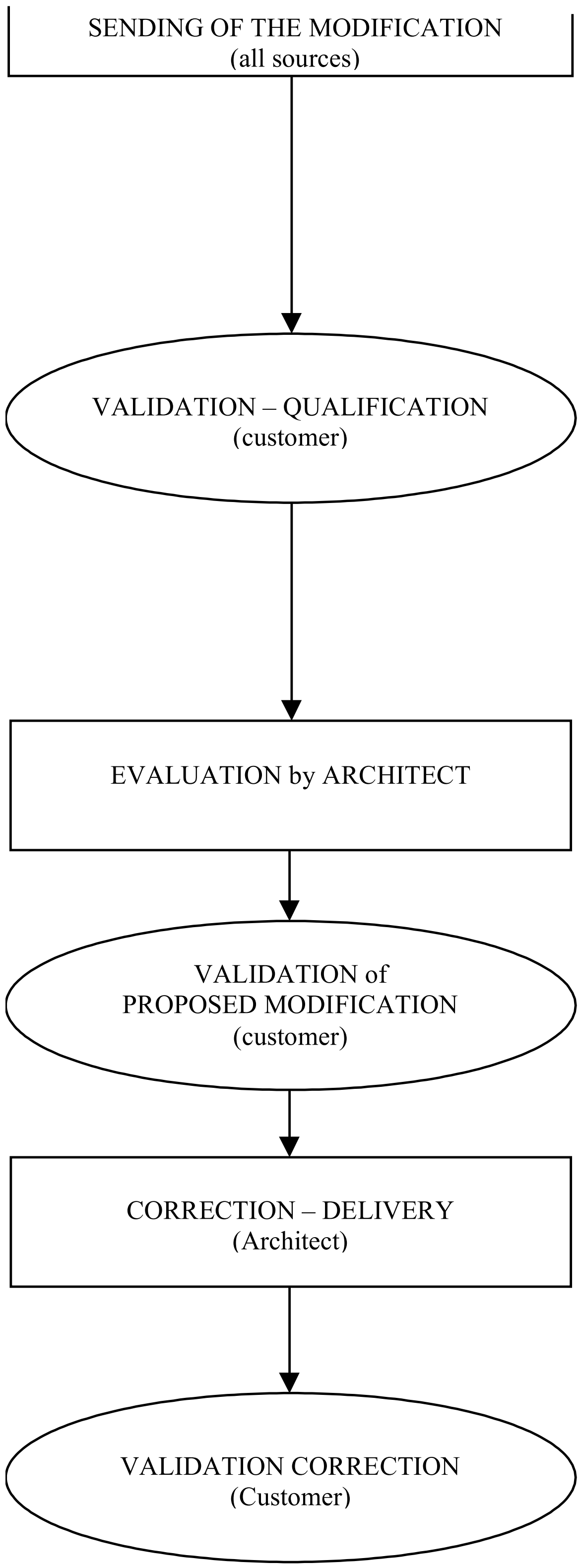
The **integration area** contains the version in the process of development, after integration of the validated modifications (unit validation).

- The changes are incorporated from the change log-book supplied by MEGA. This integration includes:
    - A manual verification of the modified objects, to exclude multiple modifications of a same object;
    - A systematic analysis of the rejected modifications presented by the integration tool.
- Further operations performed within the integration space are the following:
    - generation of sites and documents;
    - spot survey validation of the modifications carried out (additional to unit validations).

The **delivery area** contains the delivered version. It complies with the delivered CD/ROM.

- It is obtained by copying the content of the delivery space, after validation, into a specific directory.
- the operations performed within the delivery space are the following:
    - Preparation of CD/ROM (EXCEL sheet describing the successive deliveries, implementation specifications, sites, documentation, MEGA base containing the model);
    - CD/ROM etching;
    - Editing and printing out of the cover;
    - Drafting of the delivery slip.

## 7.2 Change management procedures




Sending of the problem description
The description shall be « formatted » as far as possible and contain the following information:
- Context: version, date
- Identification of the architecture component concerned (function, flow, etc.)
- Description of the proposed modification
- In case of an anomaly: reproducibility

Validation – qualifying entails:
- Request recording (identification number.),
- Possible grouping with an previously recorded request (avoiding duplicates or contradictory requests)
- verification of the description/additional information
- agreement on the diagnosis (it is obviously an architecture defect)
- deciding to continue the process (avoiding modifications in an area in which a major revision has been decided upon)

The evaluation includes:
- confirmation of the qualification and its status,
- working out of a technical solution
- evaluation of workloads and deadlines

This operation consists in validating the evaluation elements of the previous step.

The correction entails :
- carrying out the modification as specified,
- the verification of the correction by the architect
- the delivery
  (the delivery slip bears the registration number/ the follow-up form of the sheets bears the number of the delivered version)

The presence of the modification complying with its specifications is validated.

# 8 ANNEX – LIST OF PHYSICAL SUBSYSTEMS

The table below draws a parallel between the French architecture and the Canadian architecture used as a basis.

| Canadian Architecture | ACTIF | Comments |
| --- | --- | --- |
| **TRAVELLERS SUBSYSTEMS** | | |
| Remote Traveller Support | Kiosk | No correspondence in ACTIF logical architecture (no low level function identified)[7] |
| Personal Information Access | Personal device | |
| **CENTRE SUBSYSTEMS** | | |
| Traffic Management | Traffic Management | |
| Emission Management | | Suppressed in ACTIF |
| Emergency Management | Emergency Management | |
| Fleet and Freight Management | Fleet Management | Freight and fleet management are separate |
| | Freight Management | |
| Transit Management | Public Transport Management | |
| Maintenance Management | Maintenance Management | |
| Commercial Vehicle Administration | Commercial Vehicle Administration | |
| Toll Administration | Toll Administration | |
| Information Service Provider | Information Service Provider | |
| Archived Data Management | Archived Data Management | |
| | Law Enforcement | Area 7 taken into account |
| | Travel Coordination | |
| | Parking Management | « centre » part of the Canadian Physical Sub-System « Parking management » |
| **VEHICLE SUBSYSTEMS** | | |
| Vehicle | Personal Vehicle | |
| Transit Vehicle | Public Transport Vehicle | |
| Commercial Vehicle | Commercial Vehicle | |
| Emergency Vehicle | Emergency Vehicle | |
| Maintenance Vehicle | Maintenance Vehicle | |
| Intermodal Container | Freight equipment | |
| **ROADSIDE SUBSYSTEMS** | | |
| Roadway | Roadway | |
| Toll Collection | Toll Collection | |
| Parking Management | Parking Facilities | This Physical Sub-system has been divided into a « roadside » part and a « centre » part. |
| Commercial Vehicle Check | Commercial Vehicle Check | |
| Intermodal Terminal | Intermodal terminal | |

[7] *The introduction of functions corresponding to this Physical sub-system shall comply with the principles set in §4.1.5*

--------------TABLE DES PARAMETRES ------------

| Paramètre | Champ |
|---|---|
| Référence | STR-202465/GMO-0005<br>ARCST0005 |
| Version | 2.2 |
| Date | 21/01/2002] |
| Titre | [Guide de mise en œuvre] |
| Projet | ACTIF |
| Client | CETE de Lyon |
| Auteur | Isabelle Thomas |
| TDMmode | 0 |
| TDMde | 1 |
| TDMsur | 1 |
| ClientSIGLE | SIGLE |
| ClientSA | Client |
| ClientLe | le |
| ClientLeM | Le |
| ClientDu | du |
| TypeDocument | Projet |

Ce document a été élaboré avec la version 1.5 de la feuille de style O-98003.

------------TABLE DES PARAMETRES -------------