



Harmonization of EU NAP architectures and first layout of potential NAP federation

Milestone 2.9

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Author(s)	Petr Bureš, RSD CR (CZ); Benjamin Witsch, AustriaTech (AT); Madiha Shahzad, KIOS-UCY (CY); Vladimír Faltus, ČVUT (CZ); Christian von Huth, VD (DK); Holger Drees, BAST (DE); Maria Stavara, CERTH (GR); Sara Linhas, Armis (PT)
Co-author(s)	David Arino Montoya, ITxPT; Jasper Beernaerts, NGL (BE); Chrysostomos Mylonas CERTH (GR), Joao Montenegro ARMIS (PT)
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Abstract

This milestone report (M2.9) outlines the status of the National Access Point (NAP) reference architecture development. The development is based on existing NAP practices, the FRAME methodology, and new requirements that have emerged from the NAPCORE project for the minimum functionality of two types of NAPs: **Metadata Directory** and **Data Platform**.

The purpose of this report is to detail the process of creating the NAP reference architecture (NRA) within the NAPCORE project, to present key inputs to its development, the methodology used, and achievements in the form of a draft NRA. This NRA serves as a technical, organizational, and functional blueprint for creating and harmonizing National Access Point (NAP) activities. It also provides an initial set of recommendations and best practices in the NAP ecosystem¹. The NRA can be applied in three different scenarios:

1. To create a harmonized NAP from scratch by implementing the necessary functional and organizational elements using the architecture.
2. To harmonize existing NAPs by updating already existing NAP functionalities and processes in line with the developed NRA.
3. To establish a basis for comparing NAPs by breaking down complex functionalities and processes. Comparisons can also be conducted using the NLKF tool.

In February 2022, the initial vision for the NRA was established, along with its main goals and requirements. The development of the NRA continued with the collection and selection of relevant materials. The primary inputs to the NRA were descriptions of the main processes of a National Access Point (NAP), developed by NAPCORE WG2.1, and the version of the NRA created by the FRAME-NEXT project concluded in 2019.² The FRAME-NEXT version of NRA was based on the FRAME methodology³ respecting the theoretical requirements from the ITS Directive and supplementing Delegated Regulations (DRs).

To build upon and extend the previous work, the FRAME architecture methodology, was chosen for the development of the NRA. The transformation of the collected material into the NRA began by selecting the elements within architectural views to be covered, creating feedback loops, and aligning with the Working Group (WG). The work on the NRA continued with further development and expansion of the architecture for two types of NAPs and the introduction of a concept of interoperability documents.

Since the work on the NRA began outside of the FRAME tool, only a functional view for both NAP types are fully up to date within the FRAME tool. The update of other NRA views is in progress and will be part of the forthcoming milestone M2.11, which will conclude the work on the NRA within the NAPCORE project.

Abbreviations

Abbreviation	Meaning
DATEX II	DATA EXchange for traffic related data
DR	Delegated Regulation

¹ Please note that even though NAPs could play a significant role in the European Mobility Data Space (EMDS), this role is not further detailed within this document as it is outside of its scope.

² <https://frame-next.eu>

³ A methodology of an ITS system creation and documentation developed by consecutive EU projects over 20+ year long period.



Abbreviation	Meaning
EC	European Commission
FRAME	FRamework Architecture Made for Europe
KPI	Key Performance Indicator
LoS	Level of Service
MS	Member State
NAP	National Access Point
NAPCORE	National Access Point Coordination Organization for Europe
NB	National Body
NLKF	NAP LoS KPI Framework
NRA	NAP Reference Architecture
T	Task
WG	Working Group
ITS	Intelligent Transport System
DCAT-AP	Data Catalogue Application Profile1
Mobility DCAT-AP	Mobility Data Catalogue Application Profile2
RTTI	Real Time Traffic Information
MMTIS	Multimodal Travel Information Services
SRTI	Safety-Related Traffic Information https://op.europa.eu/en/web/eu-vocabulary-ies/dcat-ap
SSTP	Safe and Secure Truck Parking
HTML	Hypertext Markup Language
UML	Unified Modelling Language
XML	eXtensible Markup Language

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1 Introduction

The National Access Point Coordination Organization for Europe (NAPCORE) project was to improve interoperability of the National Access Points as backbone of European mobility data exchange with focus on exchange of static and real time traffic and travel data mandated by the ITS Directive and supplementing Delegated Regulations (DR) to be used by the pan-European driver and/or traveller. Each Member State (MS) had an obligation to establish at least one National Access Point (NAP)⁴ for the data and services described in the DRs with a view to ensure the accessibility, exchange, re-use, and update of data required for the provision of high quality and continuous travel and/or traffic information services to end users across the EU. However, its implementation form, functionalities and organization were left to the Member States. Different implementation strategies resulted in a diverse landscape of NAPs.

To harmonize technical systems in general, a system architecture and description of functionalities and interfaces are required. Such system architecture can define where and how systems should properly interact with each other. Another advantage of building several systems based on a common system architecture is that third parties interested in interacting with these systems do not have to implement different interfaces. Achieving NAP interoperability hinges on defining a reference architecture.

Since many NAPs are in operation, the NAP Reference Architecture (NRA) should take all the models into account and focus on similarities and common core functionalities. The use cases for NRA are described in the conclusion.

1.1 Scope & objectives

The primary outcome of the NAPCORE Working Group (WG) 2, Task (T)2.3, is the NRA.

The scope of the T2.3 is to develop the NRA based on the existing NAP practices, using FRAME⁵ methodology and incorporate new requirements emerging from the NAPCORE project for minimum functionality of two NAP types⁶: **Metadata Directory** and **Data Platform**. The NRA also includes a set of recommendations and best practices for addressing specific aspects of the system.

The T2.3 NRA has several missions, which aim to result in:

- A shared understanding of general NAP-related terms among the member states
- Technical guidance on achieving functionalities
- Enhanced comparability of identical features across different NAPs
- Interfaces for international metadata, data, and service exchange

These four pillars form the foundation for any exchange or harmonization activities and shape the vision of the NRA.

The NAP reference architecture describes the minimum required functionalities, processes, and interfaces to enable a harmonized exchange of information (metadata and data) for an EU-wide reuse of data to create the basis for an EU-wide mobility data space.

⁴ The term NAP evolved within the delegated regulations, but the obligation was there, nevertheless.

⁵ [Frame NEXT - Frame Next \(frame-next.eu\)](https://frame-next.eu)

⁶ NAP typology naming conventions have been developed in this task and are described in detail in chapter 3.4



From this vision, the following main goals and requirements have been defined. The NRA should include:

- Basic NAP functionalities
- Functionalities necessary to enable NAPCORE T2.4 demonstrators
- Artefacts required to serve the functionalities
- Process description of related functionalities
- Description of artefacts harmonized from related NAPCORE WGs as seen in the project landscape
- Interfaces for data and metadata exchange
- Used data standards and specifications
- Definitions of vocabularies

The content of the NRA should be designed in such a way that each NAP within Europe can identify the functionalities and artefacts necessary to enable the seamless data exchange.

The NRA should also be able to be used to create a new technically harmonized NAP. To achieve this vision, we have first to identify all relevant existing sources, results of other WGs in NAPCORE, and identify gaps. The identified items will provide input to the other WGs and will form a solid foundation for a harmonized NRA.

To achieve the above-mentioned objective, this task aims to define the requirements for the NAP architecture (from existing NAPs and data sharing communities) and determine how harmonization shall be approached for the benefit of operators and users. This involves identifying common NAP elements by comparing different approaches across several NAPs, and identifying minimum required functionalities, processes, and interfaces to enable a harmonized exchange of information. It also involves defining how FRAME architecture shall be used and adapted.

The T2.3 has two external milestones: Milestone M2.9 (this report) which contains a draft of the NRA and milestone M2.11 which contains the final NRA.

1.1.1 Document structure

This report addresses Milestone M2.9, “Harmonization of EU NAP architectures and first layout of potential NAP federation.” It outlines the main principles upon which we based the NAP architecture, the structure of work for T2.3, the alignment of this work with other WGs in NAPCORE, the methodology for creating the NRA, and a summary of the FRAME methodology and NRA.

The report is structured to explain the process of creating the NRA, primarily answering the questions of HOW and WHY. The report is comprised of 9 sections.

1. The introduction section with a summary of the scope and objective of T2.3, an explanation of why the ITS Architecture is needed and what it contains.
2. The methodology section details the steps taken to create the NRA.
3. The alignment section discusses the necessity of cooperation among the NAPCORE project participants and selected alignment activities.
4. The architecture development section documents the core functionalities of a NAP based on the minimum requirements. The need for and a list of interoperability documents along with NAP typology are covered in detail.
5. The tooling section describes the concept and analysis support tool, review tool and development tools used in the creation of the NRA and provides a general description of the FRAME architecture.

6. The NAP reference architecture summary section provides an overview of the key achievements of this work. It covers the motivation and user needs as well as the architectural views from functional, physical, organizational, communication and security perspectives.
7. The future support and issue tracking section covers how the NRA will be maintained and the tool to report and manage any potential issues.
8. The conclusion section summarizes the document and outlines the next steps.
9. The annexes section briefly describes the annexes, which contain a description of the NAP reference architecture according to the FRAME methodology.

1.2 NAP Reference Architecture

1.2.1 The architecture definition

A system architecture is a **conceptual model** that defines the structure, behavior, and **more views** of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system.

The architecture could be defined as “**a set of objects and the rules to combine them to make systems**” where these objects could be described on various levels of detail forming a definitive and consistent framework to guide proposal, development, implementation, and maintenance of ITS.

An architecture can be described at various levels, including a framework architecture, a reference architecture, and a specific architecture. In T2.3, our focus is on creating a reference architecture, which consists of:

- **Motivational layer:** This answers the question of WHY and sets up the system.
- **Functional view:** This describes the bounded functionalities of the system, with information exchange (among functionalities, and with other systems). It also describes processes realized by the functionalities.
- **Physical view:** This describes how the functionality could be implemented in separate subsystems and identifies the critical interfaces that need to be harmonized.
- **Communications view:** This describes the interaction and data exchange between the different components of the system.
- **Organizational (enterprise) view:** This describes the relationships between actors in the system.
- **Security view:** This provides a high-level overview that references the security architecture developed by SWG4.1.

Depending on the level of detail in the views, the architecture could be further enriched by outputs such as:

- Common/communication requirements
- Component/interface specification
- Cost-benefit study
- Best practice implementation and guidance material

A reference architecture is based on experiences, previous knowledge, and recommendations. Its goal is to ensure compatibility and synchronization of the systems based on the architecture. In other words, it aims to enable interoperability, provide the same functionality, and maintain a consistent look and feel from the users' perspective.

1.2.2 Use cases and benefits of NAP reference architecture

The NRA, based on the European ITS Framework Architecture (FRAME) methodology, is important for harmonizing the functionalities and procedures of NAPs. Its main use cases include:

- Defining NAP types and specific terms for a mutual understanding
- Harmonizing data type definitions from DRs to aid implementation and set user expectations
- Agreeing on dataset descriptions (metadata, naming and use of keywords) to enhance user search experience
- Specifying technical interfaces to allow service providers (NAP content consumers) to access data from multiple NAPs
- Conducting cost-benefit analysis to plan the implementation of additional NAP features

NRA aims to harmonize NAP activities at the European level and increase their effectiveness. It defines roles, functions, and processes for NAP users and data registration and data/metadata retrieval. It also outlines the minimum functionality for the two basic NAP types at the national level (Metadata directory and Data Platform).

The design principles of the NRA are simplicity, transferability, and understandability. Utilizing the NRA should yield benefits such as:

- Compatibility at the European level with minimum components and detailed system functionality
- Identification of gaps and harmonization and emerging needs in system specification
- Easier inclusion of new systems or components through the technical system description
- Improved usability based on gathered experience and evolving user needs
- Enhanced planning of implementation phases, goal documentation, and result comparison

2 Methodology

This chapter details T2.3's approach to develop the NRA, which is a complex system. As mentioned in the NAPCORE Grant Agreement, this work extends the basic NAP architecture (proposed by the FRAME NEXT project, described in greater detail in section 2.2) based on the requirements gathered as part of T2.1 and gap analysis during workshops and meetings, as illustrated in Figure 1. The intention of this chapter is to familiarize the reader with the main course-of-action adopted by the T2.3 in the subsequent sections.

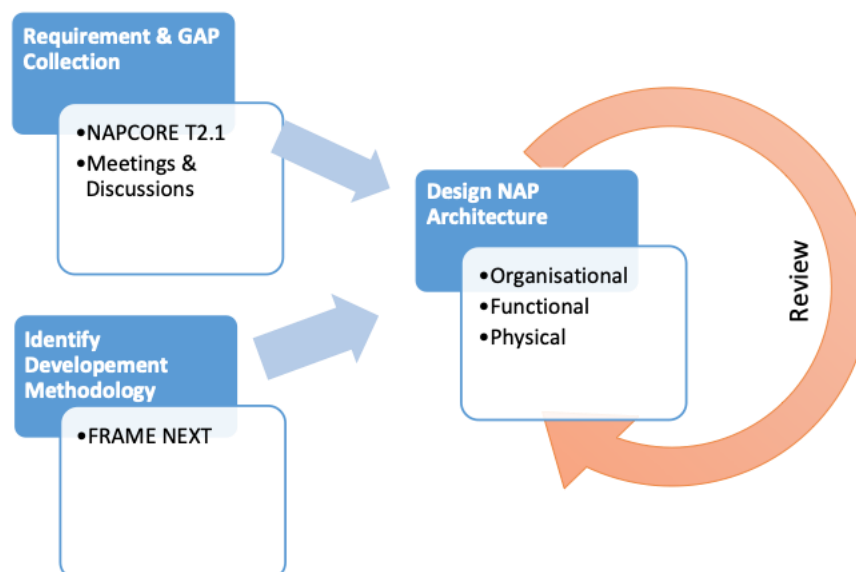


Figure 1 Methodology adopted by T2.3

2.1 General Working Procedure

The work started by collecting and selecting the relevant supporting documents for further development of the NRA. Much of this work had already been performed by the NAPCORE T2.1 which provided descriptions of the main processes of a NAP and in the past under the FRAME-NEXT project which proposed a first version of the NRA. To reuse and extend the work done previously, FRAME architecture methodology was selected for further development of the NRA.

NAP reference architecture (NRA) is not created from a scratch, it is based on already created NRA within the FRAME-NEXT project. This offers the advantage of a head-start and reuse of previous efforts but also has the potential challenges associated with legacy issues (disadvantage).

To continue the development of NRA, it was important to review existing materials (from NAPCORE T2.1 and FRAME-NEXT) and to obtain and process feedback from NAP operators and NAPCORE project participants to validate the task goals and to establish minimum NAP functionality to be described by the NRA.

The feedback was transformed into suggested changes in the organizational, functional, and physical views of the NRA in a series of work meetings. The work meetings were led by a facilitator using the Concept Board tool who created the descriptions of various architecture elements based on an open and interactive discussion with other team members participating in the work meeting. Once this work was completed, the concept board elements and the decisions were processed as changes of the NRA in the Enterprise Architecture software by the maintainers team. They created the descriptions of various architecture elements based on inputs from the concept board. After the different viewpoints, architecture elements and their connections had been completed in a series of work meetings, the early draft version of the NRA was edited to produce the first complete version of the work. This stage included addressing inconsistencies in architecture descriptions, adding missing information to architecture elements, adding missing connections between the different elements of the architecture, and exporting a description of the NRA from the Enterprise Architect software as a Microsoft word file. The refined version was then shared for review to the members of NAPCORE T2.3. Based on their feedback the naming, textual descriptions and functionality of the architecture elements was instituted.

In addition to the work on architectural views, this task focuses on alignment with other tasks. This is achieved during regular or ad-hoc joint meetings covering discussion on interoperability, terminology, and other important harmonization aspects that could be referenced from NRA, such as the interoperability documents.

The development workflow of the NRA, as depicted on Figure 2, can be divided into three primary inputs:

- **Minimum set of functionalities for each type of NAP (Metadata Directory, Data Platform)**
Identification of all necessary functionalities, processes, terms, and definitions to perform minimum function of NAP per its type, this requires cooperation with T2.1 specifying NAP level of service: *Creating NRA*
- **Demonstrator Requirements**
Collecting important lessons learned from other working groups that are dealing with the interfaces and data exchange standards, this requires cooperation with T2.4 specifying NAP level of service, WG2.2 collecting standards and other NAPCORE WGs/tasks: *Identifying and creating interoperability documents*

- **Identify gaps**

While working on the architecture topics, gaps will be identified requiring harmonization effort, such gaps are then discussed with other NAPCORE tasks dealing with the gap to find a solution:
Aligning with other WGs

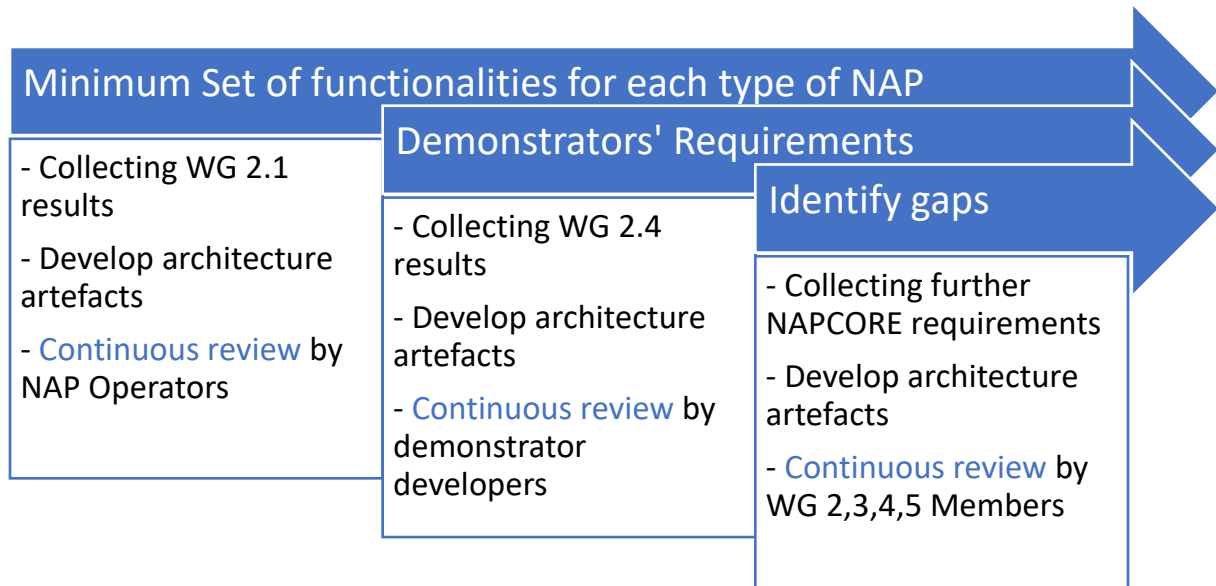


Figure 2 Working process of developing a NAP reference architecture

2.2 Selecting Sources

The NRA development utilized various sources of information, including milestone reports created by NAPCORE WG2. Earlier documents from NAPCORE WG2 provided descriptions of the main NAP processes, key performance indicators, levels of service, and best practices from operational NAPs. NAPCORE deliverables and other inputs include (available as NAPCORE milestones or internal documents):

- M2.1 Typology of NAPs based on the description of levels of service and assessment of associated costs and benefits
- M2.2 Overview of gaps and actions needed
- NAP Levels of Service computation using KPI Framework
- User (NAP operator) perspective on NAP Architecture
- Conceptual Model for mobility DCAT-AP
- Definitions of data categories included in the DRs supplementing the ITS Directive
- M2.7: List of requirements concerning the use of data standards, profiles, and metadata

In addition to the NAPCORE documents stated above, several other relevant sources were identified and used in the development of the NRA. The latest applicable versions of the DRs related to RTTI, SRTI, MMTIS, and SSTP were used as references to understand the requirements for the NAPs. All deliverable reports from the FRAME-NEXT project, including the theory of operations, description of ITS system artifacts, and the FRAME NEXT version of the NRA, also served as important references. FRAME deliverables are available for download at the FRAME-NEXT website, and include:

- D3.1: European Business Framework Architecture for Intelligent Transport Services
- D3.2: Reference Models of the ITS Directive Priority Actions
- D4.2: The FRAME Artifacts
- D4.5: FRAME Architecture - Theory of Operations (Parts 1, 2, and 4)
- FRAME Architecture Tool V5.1.1 (Enterprise Architect file)

The authors of the NRA also organized two workshops with NAP operators to receive relevant feedback for creating the NRA.

2.2.1 FRAME architecture

FRAME, an acronym for the FRamework Architecture Made for Europe, is a minimum stable framework necessary for the deployment of integrated and inter-operable ITS and includes a reference architecture for NAPs, which serves as a starting point for this task. FRAME utilizes a highly flexible visual modelling and design tool called Enterprise Architect by SparxSystems, to encompass all necessary functionalities.

The FRAME architecture is developed as a framework that provides a systematic basis for planning ITS implementations in Europe. It facilitates their integration when deploying multiple systems and helps ensure interoperability, across European countries. A distinctive feature of the FRAME architecture is that it sets out all ITS functionality, from which smaller systems and subsets are created, describing a specific service, or set of services. It offers more than one way of performing a service, allowing users to select the most appropriate set of functionalities for their environment. The development methodology, supported by computer-based tools, assists in creating logically consistent subsets of the FRAME architecture functional view and subsequent physical, communication and organizational views. Thus, the FRAME architecture serves as a framework from which specific models of integrated ITS can be systematically created.

Originally, the FRAME architecture **did not mandate any physical or organizational structure** in European countries. However, the FRAME NEXT⁷ project (2017-2021) extended the reference architectures to address DR No 885/2013 (SSTP), No 886/2013 (SRTI), No 2015/962 (RTTI), and 2017/1926 (MMTIS).

2.3 Analysis of the sources and processing feedback

The work process outlined in Chapter 2.1 involves three work “packages” at each step, which can be supported by various tools to better organize sources and record key findings. For preliminary analysis, we used a Concept Board tool, a simple “digital whiteboard,” to display connections and links between different inputs from relevant NAPCORE working groups and to link the supporting documents of Task 2.3. To illustrate the necessary inputs for the architecture based on the project landscape (discussed in a subsequent section), the inputs and planned outputs are transferred to the concept board, as shown in the figure below.

⁷ <https://frame-next.eu/>

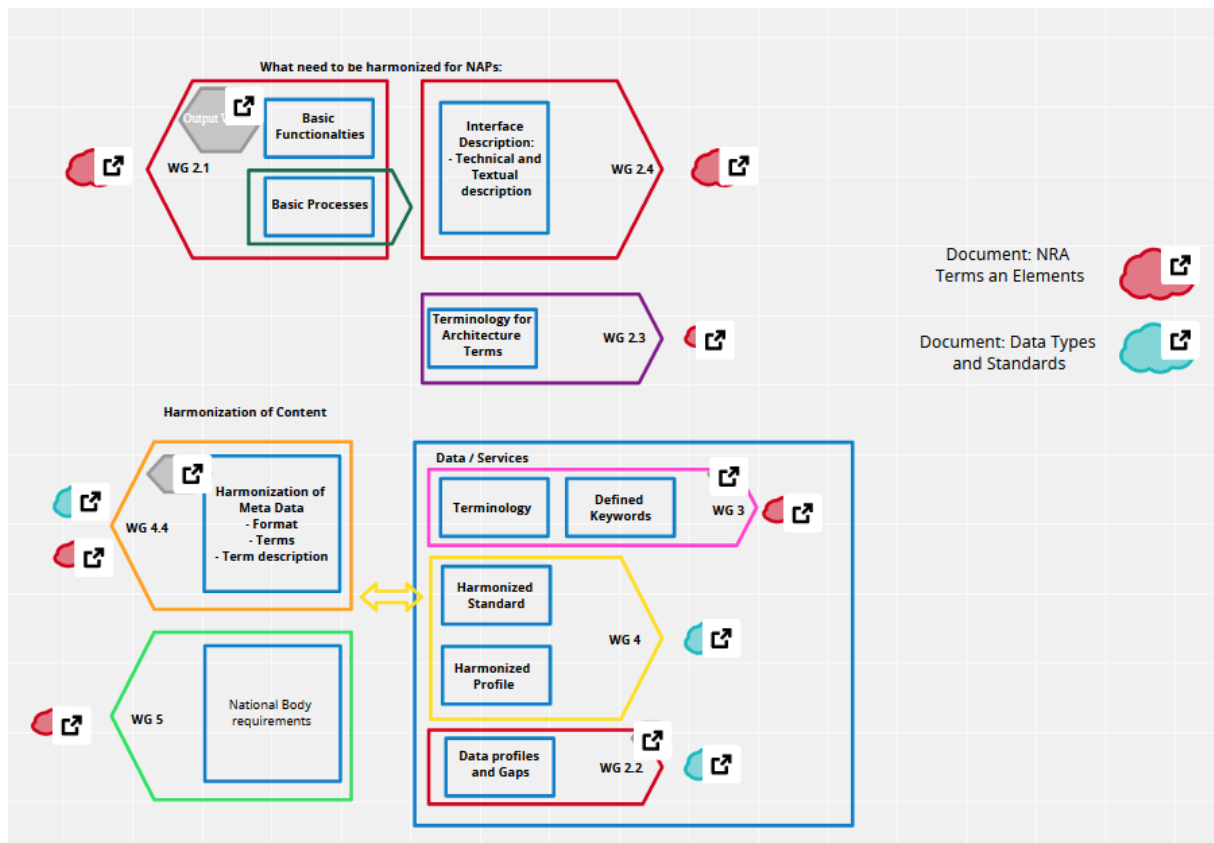


Figure 3 Harmonization landscape to achieve process goals

The arrow boxes⁸ indicate the relevant NAPCORE WGs. Each of these mentioned WGs and subWGs offers pertinent results, inputs, or work topics related to the NRA as shown in respective blue boxes. The final and approved WG report(s) are linked as a grey hexagon.

The results of the architecture work are documented in MS Word files and Enterprise Architect software. The connections between the inputs from the different working groups, including links to the correct Word files, are displayed on the concept board.

The key features of a NAP and the high-level workflow descriptions are described in the milestone reports M2.1 “Typology of NAPs based on the description of levels of service and assessment of associated costs and benefits” and M2.2 “Overview of gaps and actions needed,.” These documents were used to extract NAP functionality.

To verify the key objectives, overall goals and identified NAP functionality, two workshops were organized targeting NAP operators. The feedback thus garnered was crucial in confirming NAP functionality proposals.

Additionally, the NAP Level of Services Evaluation Framework (NLKF) report was analysed in several working sessions to enrich the outlook of anticipated NAP functionalities. The results were incorporated into the NRA and reported back to NLKF authors.

Finally, the documentation from the FRAME-NEXT project was used for comparison of new and existing functionality.

2.4 Transformation of inputs and tools used

The processing of the collected supporting documents into the NRA began by selecting the views to be covered. At the start of the task, a decision was made to update the organizational, functional, and

⁸ The colouring scheme is not relevant for the purpose of this document.

physical views of the NRA created in the FRAME-NEXT project, with other views slated for revision in a later release.

All information elements gathered during the source analysis stage were compared to the FRAME NRA to update existing architectural elements or add new ones. A Concept Board was used to create the first draft set of elements.

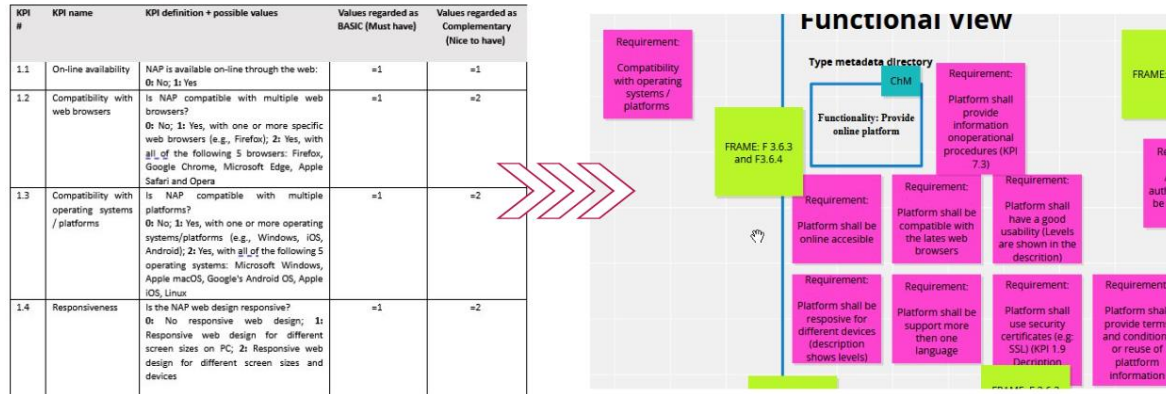


Figure 4 Processing KPI to architecture

The elements were colour-coded based on their nature (update/new functionality) and organized into groups by the view they were applicable for. The sections were created to represent the different architectural views (Functional, Organizational, and Physical Views). Each of these views is divided into sections for the two predefined NAP types.

This process involved extensive discussions and refinement and took several working meetings. Once this task was completed and all identified “issues” were accounted for and recorded within the Concept Board tool, we began to develop the initial content of identified functionalities. Once the initial content was created, we ceased working in the Concept Board and began transferring the findings to the FRAME architecture tool, updating the FRAME NRA in the Enterprise Architect (EA) software tool.

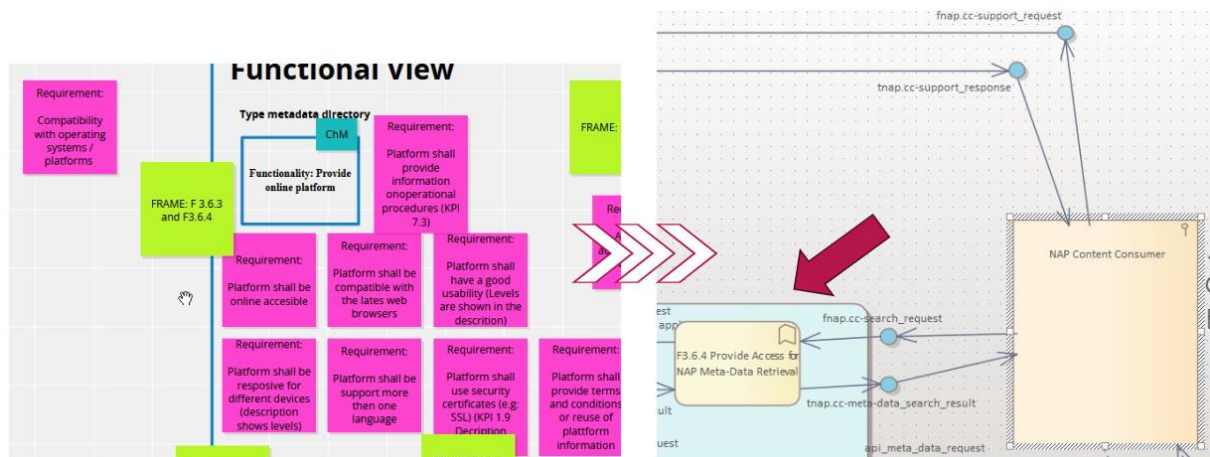


Figure 5 Processing Concept Board labels into Enterprise Architect SW for updating and maintaining FRAME architecture

In this tool, all NRA views were divided to represent two NAP types: the Metadata Directory and the Data Portal. The functional view of the NAP reference was updated, and a printout was created to allow for a more convenient review and commenting on the functionality. The comments were resolved during several working meetings, and the results were transferred back to the EA tool. A new commenting document was created to keep track of the changes made to the architecture by maintaining historical revisions of architecture printouts.

Other views in the FRAME NRA were subsequently checked for consistency and edited only if new elements were needed from the Concept Board or the EA revision process. It is a work in progress and these views will be updated in the final NRA delivery in the M2.11 milestone.

Regarding the security view, a decision was made to include a high-level view regarding the security architecture developed by the SWG4.1 DATEX II.

3 Alignment with other WGs for correlation and validation of the NRA

This section provides a detailed description of the progress made towards the NRA during the NAPCORE project. The collaborative efforts of multiple NAPCORE WGs are instrumental in shaping the NAPCORE project landscape, particularly through their inputs to the pivotal NRA task. This section documents the associations, inputs and impact each WG has, while emphasizing their unified direction and commitment to moving forward as a cohesive whole towards harmonization. One characteristic example is the NLKF framework which is associated with T2.1. The NLKF has contributed to defining the minimum functionalities of the NRA based on the minimum values that have been set for the Level of Service of NAPs (LoS). Therefore, it is evident how important it is to keep these NAPCORE tasks aligned. In addition, this chapter explains how and why some elements of the FRAME architecture have been inherited by the NRA. All the properties of the NRA were set during the online workshop in 2022. Subsequently, during the in-person workshop in Porto that followed, NAP operators provided their feedback on related topics. The continuous alignment among all NAPCORE tasks, as well as the targets of the NRA, which were set and verified in workshops, are provided in more detail in the current chapter.

3.1 Project landscape, requirements collection and cooperation

The NRA is part of the WG2 “Interoperability and LoS of NAPs”. Therefore, the main inputs are from all WG2 tasks. Furthermore, the NRA received inputs from WG3 “NAP content and accessibility” and WG4 “Data exchange standards”. Moreover, the involvement of NAPCORE activities, such as data ambassadors and the harmonization actions of National Bodies, further ensures a holistic and well-rounded input for the development of the NRA.

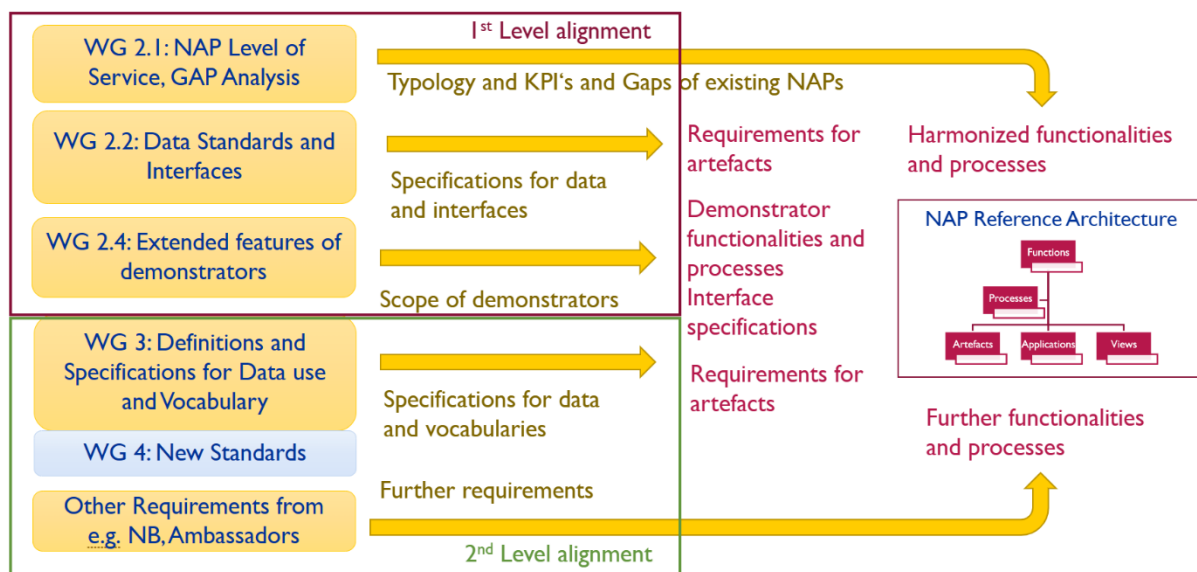


Figure 6 NAPCORE project landscape

The project landscape, as can be seen in Figure 6, has been identified in T2.3.1 as well as the necessity for a bidirectional flow of information between T2.3 (NRA) and other NAPCORE tasks. This interaction

influences deliverables, enabling one task to affect another during development through the exchange of ideas. The key roles towards the identified WGs are highlighted in Table 1.

Table 1 Cooperation roles within the NAPCORE landscape

Role	Description
Collect, harmonize, disseminate	When common concepts are identified among WGs, T2.3 collects the relevant information, consolidates it, proposes, and discusses a consensus solution, as well as communicates this solution to all WGs to be adopted in the deliverables.
Adopt	When an important concept/ idea is recognized as a “best practice” in a WG, then this identified concept is incorporated into the NRA in the form of an interoperability document. This concept is brought to the NRA as an interoperability document.
Propose	T2.3 identifies an important concept that is deemed necessary to be developed by another WG to improve the interoperability of NAPs. Therefore, T2.3 communicates this need to the respective WG leader, urging him/her to generate the required output either from scratch or by modifying the already existing document. This concept is brought to the NRA as an interoperability document.
Collaborate	Collaborating bilaterally on working group outcomes involves a) holding regular alignment meetings, b) closely coordinating efforts on deliverables, c) engaging in collaborative problem-solving and d) ensuring alignment of goals.

3.1.1 Close cooperation/alignment within WG2

Close cooperation, encompassing all roles listed in the table above, is important within WG2. Collaboration and alignment are necessary at the level of project deliverables. WG2 aims at harmonizing the level of service of NAPs considering the currently adopted data standards and NAP architecture while also taking steps towards the maintenance and extension of this architecture. Interoperability demonstrators are also within the scope of WG2 aiming to describe and develop technical solutions enabling increased interoperability and improved NAP level of service. The relevant WG2 tasks with the scope of NRA and important work objectives requiring harmonization include:

- T2.1 “*Level of service of NAPs*”: Focuses on the unified description of NAP level of service, defines relevant terminology, develops key performance indicators, their minimum values, the framework for assessing the level of service, and, from the derived outputs, identifies gaps in NAP implementation = this task requires **collaboration**, so all their deliverables are aligned.
- T2.2 “*Definition of requirements concerning data standards, reference profiles and metadata and support tools*”: Focuses on the improvement of data interoperability by defining common data standards, reference profiles, and metadata (including requirements for them) = this task requires propose/adopt cooperation type since it defines interfaces and recommendations for profiles.
- T2.4 “*NAP service interoperability demonstrators*”: Aims to showcase experiences from and best approaches/practices on real-world use of NRA to support the interoperability and continuity of ITS services = this task requires **propose/adopt** cooperation type since the experiences from implementation shall be reflected in the architecture.

Close cooperation between tasks reflects on the interconnection of the deliverables, Figure 7, depicts how are WG 2 topics developed and how they relate together.

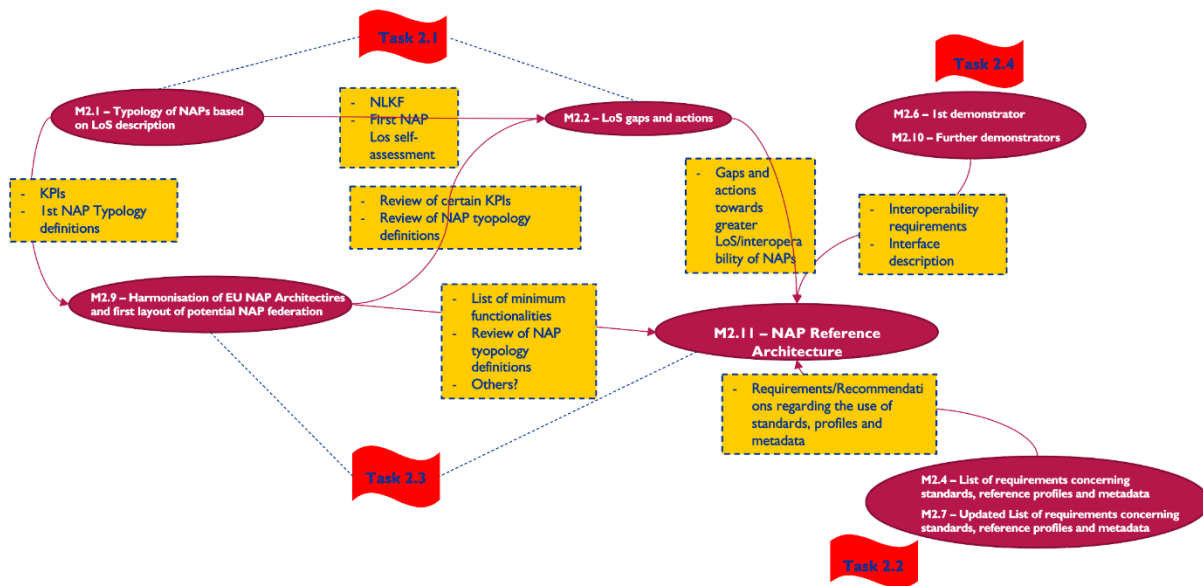


Figure 7 Alignment between WG2 tasks and their deliverables

3.1.2 Cooperation with other NAPCORE WGs

Cooperation within NAPCORE, which mostly covers roles, such as “collect,” “propose”, and “adopt” is needed with other WGs. This collaboration is related to terminology collection and dissemination, sharing ideas on what is needed by the NRA and adopting relevant outputs of other WGs. The relevant working groups with its scope and important work objectives requiring harmonization are:

- WG3 “Data content”: aims to establish a mutual understanding of the current and future content of NAPs by monitoring and assessing the availability of ITS-related data. A robust framework to evaluate data quality as well guidelines to support fair, trusted, and enhanced accessibility of data are part of this WG = this task requires propose/adopt cooperation type since it defines data types and data sharing, and quality requirements shall be reflected in the NRA.
- WG4 “Standardization”: Focuses on the development of standards = this task requires adopt cooperation type since the standards and other relevant findings by the groups shall be reflected in the NRA.
- WG5 “National body”: Focuses on the development of national body processes, self-assessments, conformance assessments and on the creation of NB architecture = this task requires mainly **propose/adopt** cooperation type since NB and NAP must cooperate and due to the exchange of experience when creating the NB / NAP architecture (both are FRAME based).

3.1.3 Specific inputs from NAPCORE WGs

The collaboration with other Working Groups (WGs), as outlined above, contributes to the harmonization of the NAP ecosystem through the bidirectional exchange and promotion of information. To support this, T2.3 has created a document titled ‘NAP Architecture WG alignment.docx.’ This document aims to identify and track developments in other WGs that either influence or are influenced by the development of the NRA. It pinpoints developments of interest, provides descriptions, and suggests actions. These developments serve as inputs to interoperability documents and are summarized in Annex B.

3.2 Selected alignments for validation of the NRA and notes from workshop

This subsection explores principal elements related to the alignment, harmonization, and the path-finding work associated with the NRA.

3.2.1 Continuous alignment between tasks 2.1 and 2.3

A joint workshop in March 2023 was organized by T2.1 and T2.3 to foster collaboration and address common goals. The workshop aimed to facilitate coordination between the two tasks, ensuring alignment in project objectives. This collaborative effort seeks to prevent duplication of work and promote a shared understanding of key concepts.

The workshop identified four key objectives: aligning NAPCORE content through regular meetings and ad-hoc resolutions; utilizing NLKF and NRA for reporting and planning, promoted through workshops and roadmaps; setting up NLKF and NRA for long-term maintenance via governance development and change management processes; and ensuring interoperability documentation is available and implemented by providing guides, manuals, and specifications.

The objectives constitute the action plan we need to follow to reach the goals of WG2.

3.2.2 NAP level of service KPI framework evaluation

The NAP Level of Services KPI Framework (NLKF), a significant output of T2.1, requires alignment with the NRA. Therefore, the content of the NLKF was examined in multiple working sessions and compared with the NRA. The analysis and comparison revealed the need for updates to the NLKF's value descriptions, overall text, values, and minimum levels. To monitor updates, we developed a document for proposing changes, advocating for them, and consolidating resolutions. The structure of the change management document is demonstrated in the following figure.

Category "Communication"

author	KPI	name	type	previous	proposed	justification	decision
	2.1	Support to users to register and add data/metadata	Te		TODO	Refactor (remove downloadable) creates confusion.	
	2.1	Support to users to register and add data/metadata	ML	1	Minimum is B + C.	Specific contact information is a bare minimum	

Figure 8 Sample of NLKF change management document [source [here](#)]

3.2.3 Workshops with NAP operators on Architectural targets

In designing the NRA, it is important to understand the status of NAPs implemented across European Member States (MS), as well as the expectations and requirements of NAP operators. To address this, we organized - in 2022 - an online workshop with NAP operators.

To determine which functionalities are most important to NAP operators and to establish common terminology, T2.3 organized the NRA workshop during the WG2 event in 2023.

During the workshop, the FRAME methodology was presented, followed by a summary of the survey for each topic. An interactive question was prepared for each topic summary to confirm the preferred minimum functionality of the NAP. The results of these workshops were utilized in the development of the reference architecture, see Chapter 4, which outlines, among others, achievements of the workshops.

4 Architecture development

At the beginning of the project, we focused on setting the target for the NAP architecture and aligning it with the expectations of the NAP operators (from the workshops).

4.1 Focusing work on the NAP reference architecture (NRA) task

Based on the 2022 NAPCORE workshop with NAP operators, the NRA shall be promoted as a means to achieve a goal, while it is not a goal itself. The focus shall be put on ensuring that the system functions optimally, is adequately resourced and is designed and works in a coordinated manner with some practical outputs like common baseline, common interface descriptions, common terminology, etc. There is still room for improvement in promoting the architecture, the FRAME created NRA needs to be simplified in its use to fully realize its potential.



Figure 9 Visual interpretation of NAP Operators response to the question “What should not be missed within an ITS Architecture?” from NAP operator workshop in 2022

Also, as many of the NAP operators have some description of the NAP functionality, these descriptions shall be leveraged in T2.3 when creating harmonized descriptions of the NAP functionalities. The use of tools such as Enterprise Architect is not widely spread among the NAP operators, so to have useable architecture we need to focus on browsable HTML as an output from Enterprise Architect modelling.

NAP operators also indicated interoperability as a key feature, as shown in Figure 5, which confirms the importance of the NRA. In sum, the main lessons learned and further steps we shall focus on:

- Provision of standardized components and interfaces.
- Allowing to serve the same purpose in different ITS Services.
- Avoiding the creation of “technology islands” that are impossible to link together due to incompatibilities.

Based on the analysis of the sources, review of the work done by other NAPCORE WGs, alignment with other WGs, and input from T2.3 members, the requirements of **the NAP architecture** are:

- It **shall specify all the actors** involved in the ecosystem of a NAP.
- It **shall specify all the main functionalities** of the NAP.
- It **shall specify** the entirety of the **main technological components** of a NAP (e.g., user interfaces, databases) and their high-level interactions.
- It **shall indicate the responsibilities** of involved actors considering the main components of a NAP (e.g., who is responsible for the maintenance of the user interface, who is responsible

for providing and checking the completeness of metadata, who is responsible for maintaining any existing servers).

- It **shall include multiple viewpoints** (*context/enterprise/organizational view* = system identity, who is responsible for what and actors' relationships/interaction, *functional view* = system functions and information exchange at their interfaces, *physical/communications view* = physical objects, interfaces enabling data flow between the objects and data exchange itself).
- It **shall consider at least two main NAP types** (metadata directories and data platforms).
- It **shall have varying granularity** and consider varying maturity levels (i.e., it is not useful to provide a complex UML diagram to an operator of a NAP that is under implementation = he/she will get lost).
- A NAP architecture shall assist in the identification of the **minimum** components and their interactions, seen from both functional and physical viewpoints (i.e., this will be useful to ensure that NAPs will share a common basis).

It shall also provide harmonized outputs as interoperability documents:

- **Terminology + definitions** (e.g., NAP types)
- **Data type** definitions for DRs (input from WG3)
- **Reference architecture** definition (for 2 NAP types, based on T2.1)
 - **Components and interface definitions**
- **Cost and benefit analysis** (task 2.1 + 2.3 under 2.3 lead)
- **Naming and keywords** of published data on NAPs (minimal requirements, WG4.4)

The identified outputs are the basis for the identification of interoperability documents, they are being developed already by other WGs, while T2.3 needs to monitor and adopt the development.

4.2 Functionality development

The NAP level of services KPI framework (NLKF) as an output of T2.1 is a key input to the NRA creation process. The first functionality proposals for comparison with FRAME NRA were developed based on the various features included in the NLKF. Findings from the analysis were compared with the already identified functionality and transformed into NRA; see the process depiction in the Figure 10.

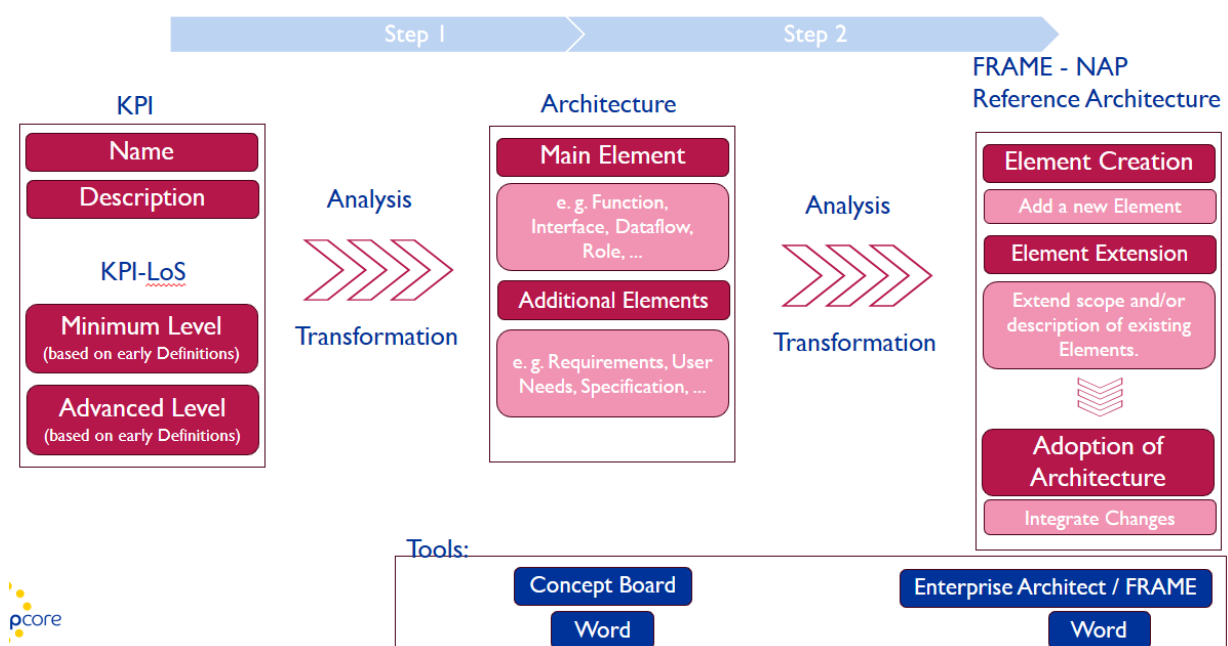


Figure 10 Process KPI to architecture transformation

Based on the NLKF and findings from other NAPCORE WGs, the decision was made to create NRA for 2 NAP types (metadata directory and data platform). Further on to decide what functionalities are important to NAP operators T2.3 participated in the WG2 workshops (see Chapter 3.2.3).

To assess the importance of NAP functionalities, an interactive session took place. The session used a survey to verify whether each functionality was currently in use in the existing NAPs. The functionalities were divided into two main groups:

1. Functionalities related to NAP operation and management (see chapter 4.2.1.1).
2. Functionalities related to data, service and metadata provision, export and receiving (see chapter 4.2.1.2).

The survey aimed to harmonize functionality description and understanding, with the view to get minimum functionality ideas. All questions related to the functionalities had three answers: YES/NO/PARTIALLY + commenting box. We have received responses from 19 NAP operators.

Meta data structure & content

<https://SLIDO.com/#1858704>

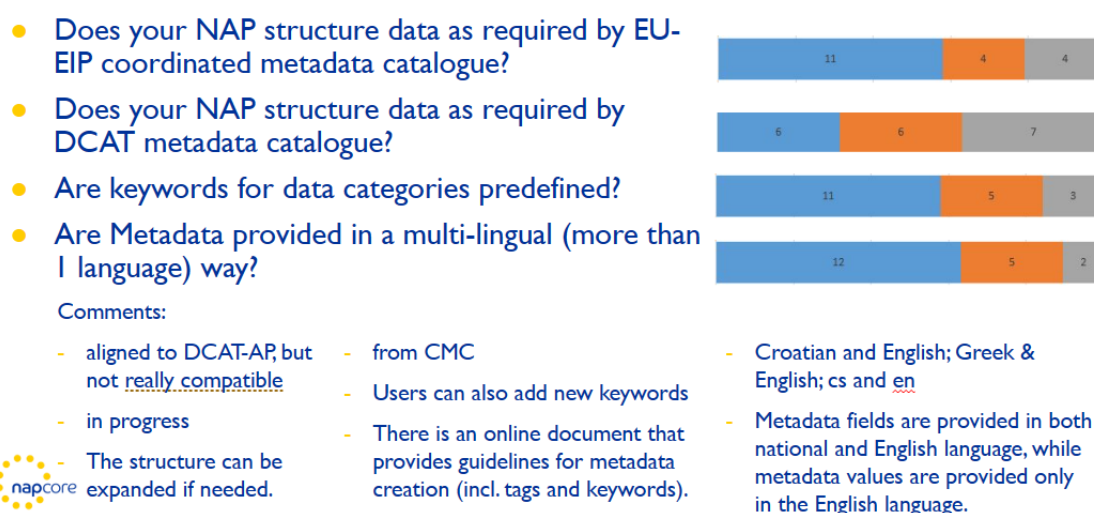


Figure 11 NAP Operators response to "Metadata structure and content" question from NAP operator survey in 2023

The information received by the survey was used to focus the NRA creation and to initially set up expected minimum functionality. The results were also presented to the NAP operators during the Workshop, along with a brief conclusion.

To further focus work on the NRA, we needed to identify the minimum set of functionalities, we reached this goal during an interactive session at Porto NAP operator's workshop. Each functionality topic identified earlier was presented and minimum functionality was selected.

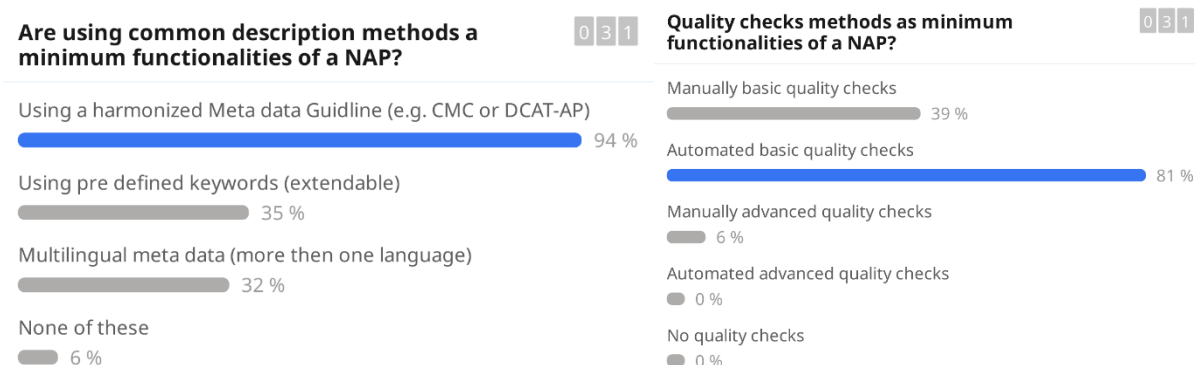


Figure 12 NAP Operators' response to "minimum NAP functionality" question from NAP operator workshop in 2023

The interactive survey received responses from 28 to 31 participants, the question-response details are provided in **Annex C**. Each response was directly discussed with the participants before moving on to the next question. The results of the two questions are depicted in the figure above. If more than 50% of the respondents voted "Yes", the functionality was considered a "strong candidate" for being classified as a minimum requirement. However, further debates and discussions were held during subsequent T2.3 meetings (and other events/meetings) to finalize a functionality as a minimum requirement.

For instance, the responses shown in the figure above confirmed that the minimum NRA should utilize a harmonized metadata catalogue and provide automated basic quality checks.

4.2.1 Functionalities for the NRA

The following functions represent an input to update the functionality of the NRA from NLKF analysis. In each functionality topic, a **minimum** was identified from the possible choices. See the Annex C.

4.2.1.1 Functionalities for NAP operation and management

NAP User Support FAQ, Questions & Answers

There is a need for broad support for several types of NAP users by email, contact form and FAQs.

Metadata Storage

The storage of information and data is a crucial part for data platform NAP type. Minimum requirement is to store metadata. The storage of information and data are strongly related to the functionalities of the NAP.

Publisher Management

Dataset / service publisher provides information about (including the dataset) the dataset / service through NAP to the subscribers.

Platform User Management

Platform Users, i.e. subscribers, are the focus group of any information provider. In general, there is no need to know the data user as a NAP, but it makes sense in some use cases (data could be retrieved via NAP, or for newsletter only).

Provide (User) Interface

Information at NAP can be accessed by user or by machine, furthermore information could be entered to the NAP by user, via GUI (Graphical User Interface), or by a machine, e.g., APIs (Application Programming Interfaces).

4.2.1.2 Functionalities for metadata, data, and service

Metadata structure and content

Metadata are essential to find relevant data and assess its usefulness before using it. There are several sets of specifications for structuring metadata, e.g., DCAT and coordinated metadata catalogue (developed within an EU-EIP project).

Metadata quality checks

Metadata are essential to find and evaluate data before using it. Therefore, Metadata should be complete and provided with high quality. If a standardised format for description is used, a basic quality check can be done automatically.

Metadata provision to user

The Metadata accessibility and searchability is a crucial part of the usability of the NAP.

Static data provision to user

Providing static data via NAP as links (to its store) is minimum functionality.

Dynamic data provision to user

Providing dynamic data via NAP as links (to its store) is minimum functionality.

Provide data interface between producer and subscriber

If a data exchange happens between a publisher and a data user there are several possibilities how a NAP could be involved or not. Minimum functionality is not to be involved.

Metadata processing (at input)

Automatic metadata processing at input is a useful for enhancing visibility of data and speeding their delivery to the user.

Static traffic and travel data processing (at input)

Usually, NAPs do not need to process static data. Minimum functionality is just to link them.

Dynamic traffic and travel data processing (at input)

Usually, NAPs do not need to process dynamic data. Minimum functionality is just to link them. .

Data Processing

The processing (e.g., data aggregation, data merge) of the raw input data is very unlikely for the NAP. Minimum functionality is just to link them.

4.3 Interoperability documents and their role in NAP Reference Architecture

Most interoperability issues can be resolved by utilizing the NRA. However, there are aspects of NAP implementation and usage that could be shared among NAPs to further enhance interoperability. This can be achieved by enforcing the following key features:

- **Common Terminology:** Ensuring everyone speaks the same language is crucial.
- **Standardization:** Adopting the same standards for data exchange, structure, and content.
- **Best Practices:** Following proven examples for look, feel, and recommendations.

These aspects could be disseminated in the form of guidelines or best practices, leading to the creation of interoperability documents.

In Task 2.3, our focus is on identifying such documents, not necessarily creating them. The purpose of these interoperability documents varies depending on the primary user, which could include:



- **Decision makers:** To identify key concepts using a common terminology.
- **Developers:** To implement recommended features that ensure interoperability.
- **Operators:** To run the system as recommended, adhering to metadata and naming conventions.
- **Subscribers:** To follow the example set by the first subscription.

The identification of these documents aims to bridge the gap between what is described in the NRA and what is needed to achieve a common look and feel. We begin with typical NAP usage scenarios and identify potential candidates. These scenarios include:

- Registering and/or uploading data to one or several NAPs as an international data owner.
- Searching, discovering, or subscribing to data published by one or several NAPs.

Our goal is to make these scenarios as seamless as possible. Currently, the situation varies, ranging from “one-click” subscriptions to months of administrative and technical hurdles. Considering these scenarios, to enhance user experience, the NAR should incorporate guidelines on best practices for the following aspects (but not necessarily limited to those):

- NAP user registration process.
- NAP data/services registration process.
- NAP data search and metadata retrieval process.
- NAP metadata/data in-house quality assessment.

4.3.1 Process of identification of interoperability documents

The concept of an interoperability document can originate from various sources and have diverse reasoning behind it. However, not every idea is worthy of being transformed into a formal guidance document. Consequently, we need to devise a method for formulating these ideas to determine if there is a clear benefit that Task 2.3 could agree upon, and if there is an entity already responsible for working on such a recommendation. Each identified idea must be initially described as follows:

- **Author:** The originator of the idea.
- **Title:** A concise and precise name of the expected guideline.
- **Why and for whom (who benefits):** A brief textual explanation of the rationale behind the idea and the subsequent creation of the guideline, including who benefits and how.
- **Who is responsible (they might exist already):** The task within NAPCORE is responsible for developing the guidelines due to its current responsibilities.
- **Minimum or Recommended:** There are requirements essential for achieving interoperability, such as the same data description method, and there are desirable interoperability aspects, such as the type of linking data sets.
- **Description (what):** A paragraph describing the planned content of the measures to achieve interoperability.

4.3.2 List of identified interoperability documents

In Task 2.3, we are focusing on the development of one interoperability document, the **terminology**, which also encompasses work on the NAP typology as they are integral parts of the terminology. Terminology is addressed as a separate document.

Other interoperability documents, once identified, are the result of the work or work plan of other NAPCORE Working Groups (WGs).

DISCLAIMER: Task 2.3 is not tasked with the development of the following interoperability documents. Its responsibility lies in identifying, collecting, and referencing these documents in a unified manner.

While the identification of interoperability documents is an ongoing process, with potential candidates listed in Annex B, we have already pinpointed several key interoperability topics:

1. **Data Provider Registration:** This shall outline best practices in the registration of NAP Content Provider at NAP, while there is metadata specification covering necessary information elements, there are still implementation questions to be resolved e.g. what documentation shall be provided and how, what is the process of provider verification, how is compliance assessment provision resolved, what are typical contracts / legal documents between NAP and Content Provider, how is registered used structured into sub-accounts of users and machines, etc. (licenses?, quality framework used?...), is it open for registration of any content provider, possibility of active search for providers by NAP. Having these documents aids in managing international data and service providers, correctly identifying organizations and related individuals, and establishing a trust layer for data and service consumers.
2. **Data/Service Registration:** This shall encompass all harmonization activities proposed by NAPCORE for data and service description, such as the new mobilityDCAT-AP, a metadata profile developed by WG4.4. It describes a minimum and a complete set of information description fields to describe data and services on mobility data platforms. It would also detail the necessary information to be filled in, additional documents for a better understanding of the data, languages used in the description, naming conventions, and harmonized vocabularies for easy search. These are all crucial elements for harmonizing data description. Ideally, keywords, which are essential for efficient and easy information search, should be defined identically at each NAP to yield comparable search results. In addition to using the new mobilityDCAT-AP, there are also best practices on how to arrange and connect input fields or solutions to complex problems. For example, the connection of affected data and service description with the underlying delegated regulation should be clearly covered. Also, the process of data registration and NAP interaction shall be covered, e.g. what data could be registered at NAP, adherence to the (meta)data quality measurements mentioned in the DRs, and revocation of off-topic datasets.
3. **Data and Service Presentation at NAP:** This involves where to find it, how to search for it, how to display it, adding community features, etc. This collection of solutions can enhance the usability of NAPs and improve user experience. The introduction of new functionality should be evaluated against its costs.
4. **NAP Operation:** This document should indicate all implications of using the NRA as the main tool for harmonization. In addition to the architecture, best practices of operation can be stated. Such best practices could include specific terms used in the NAP context for unified understanding, properly named and defined NAP interfaces, which language to use, and many more.

The identified topics above are not yet structured as recommended in the previous chapter. We will continue with structuring them and identifying and promoting the development of interoperability documents based on specific inputs from NAPCORE WGs as described in Annex C.

4.4 Harmonized NAP Typology

The first concern of interoperability is the terminology. Having the same terminology enhances the possibility of achieving an understanding and agreement between system actors. The NAP Architecture therefore first needs to define what a NAP is and what its types are.

This subchapter therefore summarizes the NAP typology as it has been researched, proposed, and promoted by the NAP Architecture task.

To propose the correct candidates for naming NAP following resources were analysed:

- Delegated regulations and the ITS Directive review => what is the NAP as per DRs?



- NAP implementation among member states together with a functionality and “assigned name by the operator”.
- Information on NAP from WG1 and WG2.

References to the NAPs in delegated regulations and the Directive

NAP references in the 2010/40/EU, COM/2021/813 final, 885/2013, 886/2013, 2022/670, 2015/962, 2017/1926. In general, the documents state that:

- data shall be provided/accessible **via/through** NAP (this does not imply if data needs to be hosted or not),
- metadata shall be provided to NAP so it can provide discovery services to users (implying that just metadata is enough),
- NAP shall constitute a single point of access,
- Handover points should be **listed** in the national access point,
- NAP can be in the form of **repository or database/data warehouse**,
- NAP regroups the individual access points of service providers/data owners,
- NAPs organize the access to and reuse of transport-related data.

Mandatory for a NAP is **only** to collect and provide metadata of all data sets from all APIs, to provide a single point of access. Therefore, a NAP could be:

- A metadata directory allowing data to be described with links to data itself and any file content (documentation, samples, ...) elsewhere,
- A data portal having the function as above and taking over the data distribution and creating a technological layer between provider and subscriber,
- Or anything in between.

Further implementations are possible; HOWEVER, the data accessibility and findability requirements imply that the NAP shall be open for **all** providers/data owners to register data at the NAP and provide data through/via the NAP.

NAP implementation among Member States

In the **WG2** survey⁹ among the member states, in 2022, there have not been a direct question about NAP type. **Data platform, data directory, database, and data broker**, are mentioned in the text and answers without clear distinction in between. In the **WG3** survey¹⁰ among the NAPs with regards to data availability, there is the following question: “*What type of NAP do you operate for each Delegated Regulation?*”; the following options were provided: database; Web-link repository; Not applicable.

Some NAPs are providing data directly for download from the NAP address, some are linking to data sources outside of the NAP and others are handling the data exchange.

From the answers it seems that most of the NAPs are implemented as metadata data portals, so providing full metadata description with links to the data stored elsewhere (AT, SE, CZ) [type1]. Some of the NAPs allow limited storage functionality of static or semi static data together with full metadata description and links to data stored elsewhere (FR, GR) [type2]. Very few NAPs provide full brokering functionalities, meaning that the data are retrieved by the NAP and made available to a subscriber through the NAP interface (DE) [type3]. There is also an option to extend the functionality

⁹ Online survey conducted in 2022 by task 2.1 in work item 2.1.1. NAP state of practices, ambitions, and needs

¹⁰ Online survey documented in [NAP data availability monitoring questionnaire 2nd iteration v2.0 final.docx \(sharepoint.com\)](#)

of the national road databanks to include NAP functionality, in such case the NAP is the National Traffic Information Centre [type4].

4.4.1 NAP Typology preparation and workshop

The preparatory analysis, carried out in 2022, resulted in **13 different NAP labels**, often conflicting definitions for the same NAP type, creating confusion between partners and hindering harmonization.

Following the identification task, the labels were analysed for the meaning and respected IT definitions of the term creating a set of candidates to be used preferably by NAPCORE.

To select the best candidate the NAP Type labels were grouped into categories “**metadata portals**” and “**data portals**” with the intention to eliminate all but one term in each category based on the NAP operators’ feedback during the WG2 workshop in Porto on March 31, 2023.

- **Metadata portals** – functionality: metadata and discovery services, labels: data directory, web-link repository, data registry, data repository.
- **Data portals** – functionality: metadata and discovery services, data hosting, advanced features (data processing, brokering, enhancing, visualization). Labels: data directory, web-link repository, data registry, data repository.

For each label, we prepared a summary with online definitions, comments, and key features. After each group presentation, we provided an audience with statements and asked for their approval.

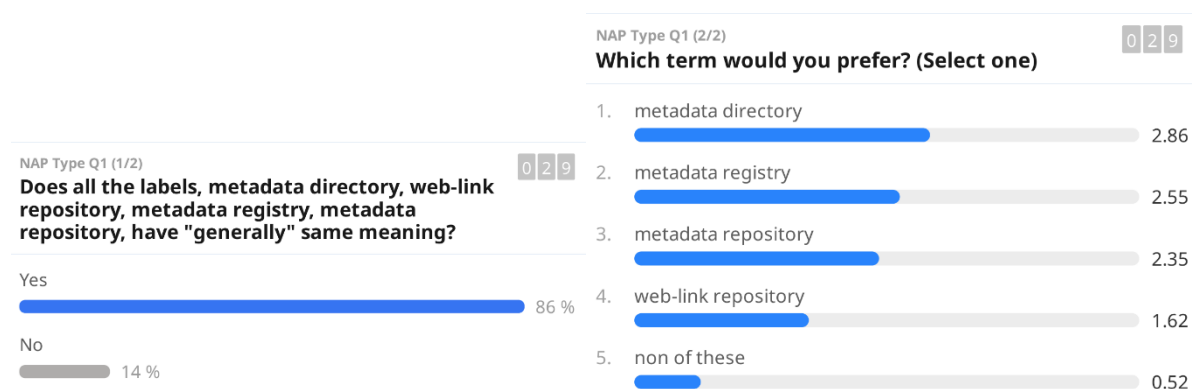


Figure 13 NAP Operators response to preference “metadata directory label” from NAP operator workshop in 2023

The conclusions of the workshop were critical for our work of functionality preferred by most of the NAP operators and to select 2 preferred NAP type labels (metadata directory and data platform) when referring to basic NAP functionality. The workshop slides, together with collected answers, are provided in **Annex C**.

NOTE: The “data platform” NAP type integrates NAP labels such as “warehouse”, “broker”, “clearing-house”, and “platform”. Its scope spans from a NAP with just few static data stored directly at the NAP while other data is just referenced to other distribution interfaces to a data portal enabling storing and retrieving of data from various data producers and providing a technological distribution interface as well as clearing interface between parties.

4.4.2 NAP type definitions

T2.3 recommends the following NAP type labels when referring to NAP within NAPCORE Working Groups to eliminate potential ambiguity.

- **Metadata directory:** The metadata directory contains **descriptions** of the data and services important for their identification, assessment, and subscription by consumer, i.e., metadata. It provides facilities to authenticate data provider and functionality to insert a metadata records. The NAP provides search and discovery services of the hosted records to end users and via machine readable content to other portals. The NAP is not directly involved in the data exchange between data providers and data consumers.

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Key features: Storage & provision of metadata records of data, services, and providers; search/discovery functionality; data provider authentication.

- **Data platform:** The data platform contains **descriptions** of the data and services important for their identification, assessment, and subscription by consumer, i.e., metadata, together with the data and/or services themselves. It provides facilities to authenticate data provider, and optionally, data consumer and functionality to insert a data and metadata records to NAP internal database. The NAP provides search and discovery services of the hosted records to end users and via machine readable content to other portals and distribution interfaces for data dissemination. The NAP is an intermediary between data provider and consumer, the data however remain in the ownership of the data provider.

Key features: Storage & provision of metadata records of data, services and providers, storage & provision of data and services; search/discovery functionality; data provider and data user authentication.

4.5 NAP Terminology

In the context of NAPCORE, a commonly agreed terminology is crucial for several reasons:

1. **Clarity:** It ensures clear communication among team members, stakeholders, and other parties involved. Misunderstandings can lead to incorrect assumptions and errors.
2. **Consistency:** It allows for consistent use of terms across different projects and implementations, making it easier to compare findings.
3. **Efficiency:** It saves time and effort as everyone understands the terms being used, reducing the need for lengthy explanations.
4. **Collaboration:** It facilitates collaboration between different members of tasks, working groups and external stakeholders, represented by EC or MS experts, as everyone speaks the same 'language'.
5. **Standardization:** It aids in creating standardized processes and methodologies, which are key for the reproducibility of results.

A commonly agreed terminology is a fundamental aspect of effective data science practice. It fosters clear communication, promotes consistency and efficiency, and enables effective collaboration and standardization of processes. It ensures that everyone involved in the project, regardless of their role or department, can communicate effectively and work towards the same goals. Without this shared language, the risk of miscommunication and inefficiencies increases, potentially impacting the success of the project.

We have focused on the collection of terminology from NAPCORE working groups and ITS relevant sources (e.g. the ITS Directive 2010/40/EU and its Delegated Regulations and ISO TC204 terminology).



We identified important and commonly used terms and proposed their definition, selecting between the terms the one that should be used within the project to address the issue of concern and promote their usage.

It is however important to promote the term with the right explanation of their context and sources, therefore we also focused on the structuring term definition.

Table 2 Terms definition

Term	
Acronym	
Definition	<i>As defined in the specific source</i>
Source(s)	<i>Generic source name (like the SRTI DR or a standard number)</i>
Keywords	<i>Related keywords, topics</i>
Usage Context	<i>This is an example of how this term is used</i>
Additional Notes	<i>Any additional observation or comment</i>

For collecting, sorting and bulk editing of terms, we used MS Excel. For the purposes of commenting, change proposals and distribution, we used MS Word, auto generated from Excel. This approach allows us to defer discussion about the ordering of the terms and their visual representation to later time in the project and focus the definitions.

The terminology is a living document, work in the progress is documented in the **Annex B**.

5 Tooling

Text with regards to the FRAME methodology (chapters 5.3-5.5) is compiled using FRAME NEXT project deliverables. Methodology: [FRAME D4.2], FRAME objects and views: [FRAME D4.2, FRAME D3.1, D4.5 part 01]¹¹.

5.1 Concept and analysis support tools

The Concept board tool is used as a simple “digital whiteboard” for mapping inputs to, and to work out minimum requirements on the NRA¹².

¹¹ <https://frame-next.eu/downloads-and-documents/>

¹² <https://app.conceptboard.com/board/m2a4-3ztg-sc22-hdx3-ay5m>.





5.2 Review tools

5.3 FRAME development tools

FRAME Architecture consists of three elements: architecture, methodology and tools.

- The FRAME Architecture Tool v.5.1.1, based on an Enterprise Architect file (*.eapx), shall be used for the creation of the ITS Architecture. This Tool:

- 

- Allows for graphical modelling.
- Uses UML basic modelling language.
- Can produce standardized output documents i.e. XML.
- Is widely used by the ITS community.

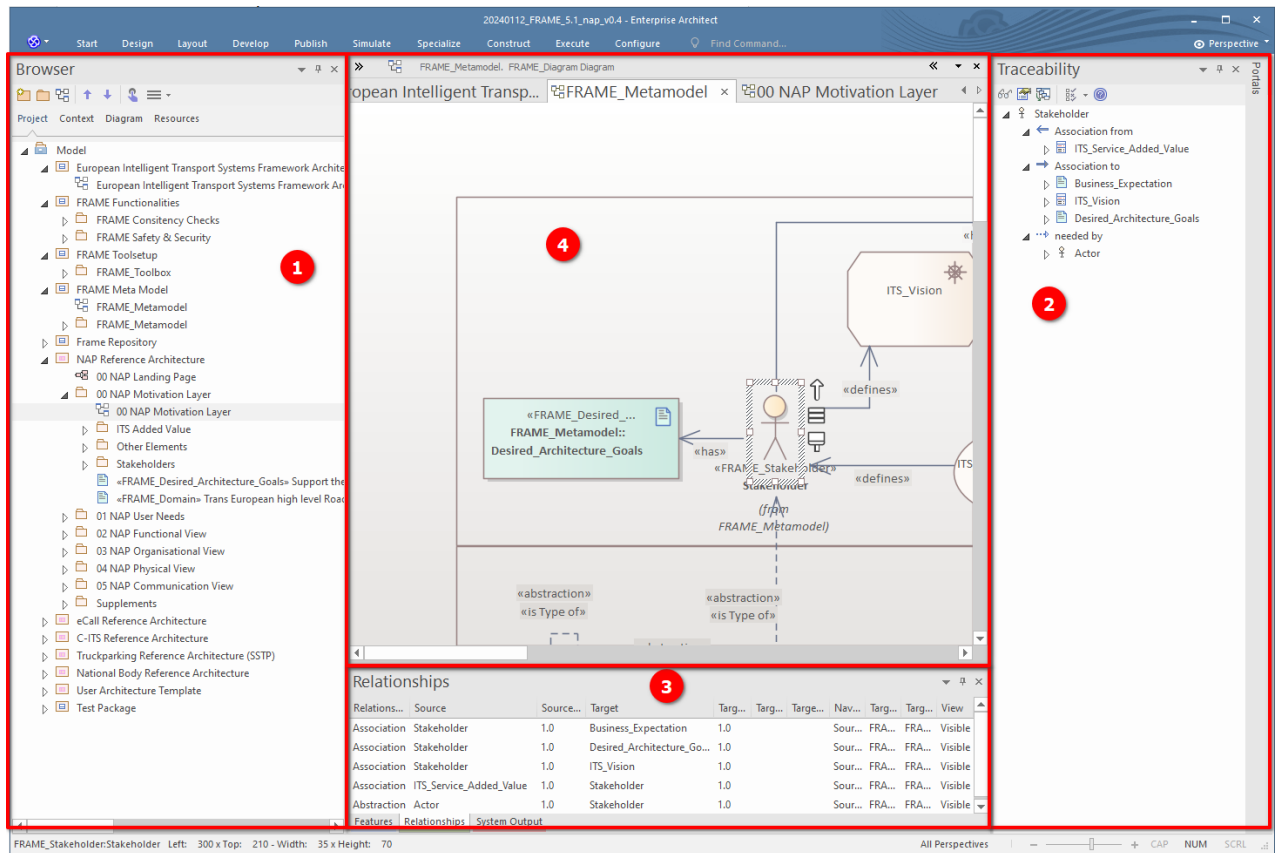


Figure 15 Enterprise Architect SW used for FRAME

The FRAME architecture Tool contains the following packages: FRAME Metamodel, FRAME Repository and reference architecture models which have already created been (e.g., eCall reference architecture, C-ITS reference architecture, etc.) or are to be developed in future (e.g., NRA, National body reference architecture, etc.).

The tool is organized to provide extensive control over the model. The models were organized into folders so they could be easily worked with in the project browser (1). Selected parts of the model could be visualized in the diagram area (4) and all connections between objects in the model could be visualized in Traceability (2) and Relationships (3) docks. By iterating over the objects displayed in docs (2 and 3), one can explore the whole architecture.

In the following peer chapters, more information about FRAME is provided, namely on the methodology of FRAME when creating an ITS architecture and the views and objects used by the modelling tool while creating the architecture.

5.4 FRAME methodology

In its original form, the FRAME Architecture consisted of a Functional View, the content of which was linked to a set of User Needs. FRAME Architecture users could create their own sub-set Functional View to support the ITS Services they wished to deploy by identifying the User Needs that matched the content and requirements of the Services they wished to implement. Starting from the User Needs they could then create the sub-set Functional View that only included the functionality that

their chosen Services required. This was achieved using the FRAME Selection Tool, which also enabled the users to further produce Physical and Organizational Views based on the Functional View they had created. They could also manually produce a Communications View based on the content of the Physical View.

The way of identifying the User Needs that supported the ITS Services the FRAME users wished to deploy was also a manual process. The users were expected to produce descriptions of the ITS Services they needed and were encouraged to get these agreed upon with all their stakeholders. As a result, these descriptions were called Stakeholder Aspirations, and they could then be mapped to the User Needs.

The FRAME NEXT project integrates FRAME and TOGAF (The Open Group Architecture Framework, see <https://www.opengroup.org/>) methodologies and produces an extended methodology based on the use of the Enterprise Architect tool. The result is that the FRAME Architecture has been expanded to include the Physical, Organizational and Communications Views, together with the Overall Concepts (a more formal version of the Stakeholder Aspirations) plus the Safety and Security Views. In addition, the User Needs have been included as part of the Functional View.

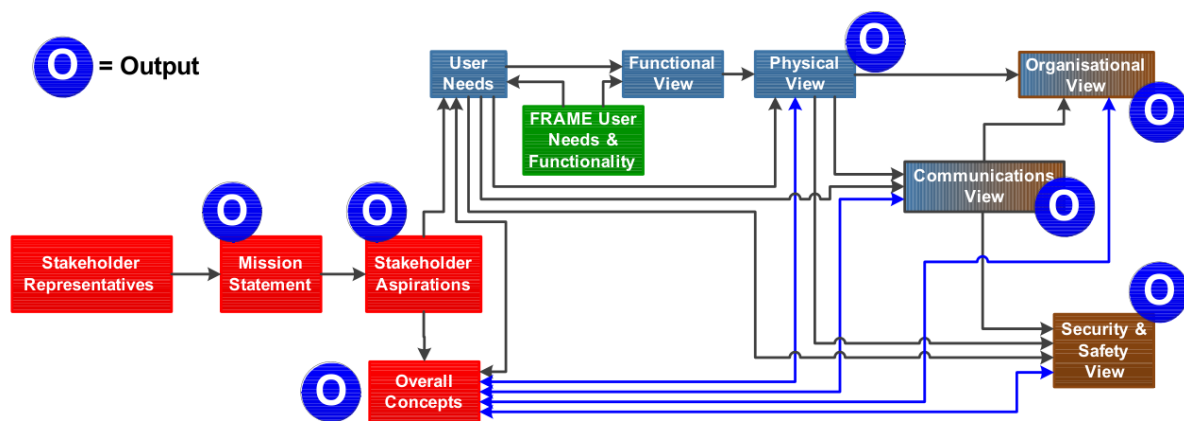


Figure 16 FRAME methodology for the creation of sub-set ITS architecture from the FRAME Architecture [source FRAME]

The FRAME methodology formalizes the creation of ITS Vision and Mission statements. It also includes other factors, such as:

1. The roles of stakeholders in the deployment of the ITS services.
2. The creation of the Stakeholder Aspirations in which the stakeholders describe, in their own words, the services that the ITS deployment is to provide.
3. The identification of the actors to be involved in the specification and creation of all the things (software, hardware, communications, documentation, etc.) that form part of the ITS deployment.
4. An assessment of the benefits the ITS Services will provide.
5. More formal ways to define the Communication View, including the use of standards.
6. An expanded Organizational View.
7. A Safety and Security View.

5.5 FRAME objects and views

5.5.1 FRAME metamodel

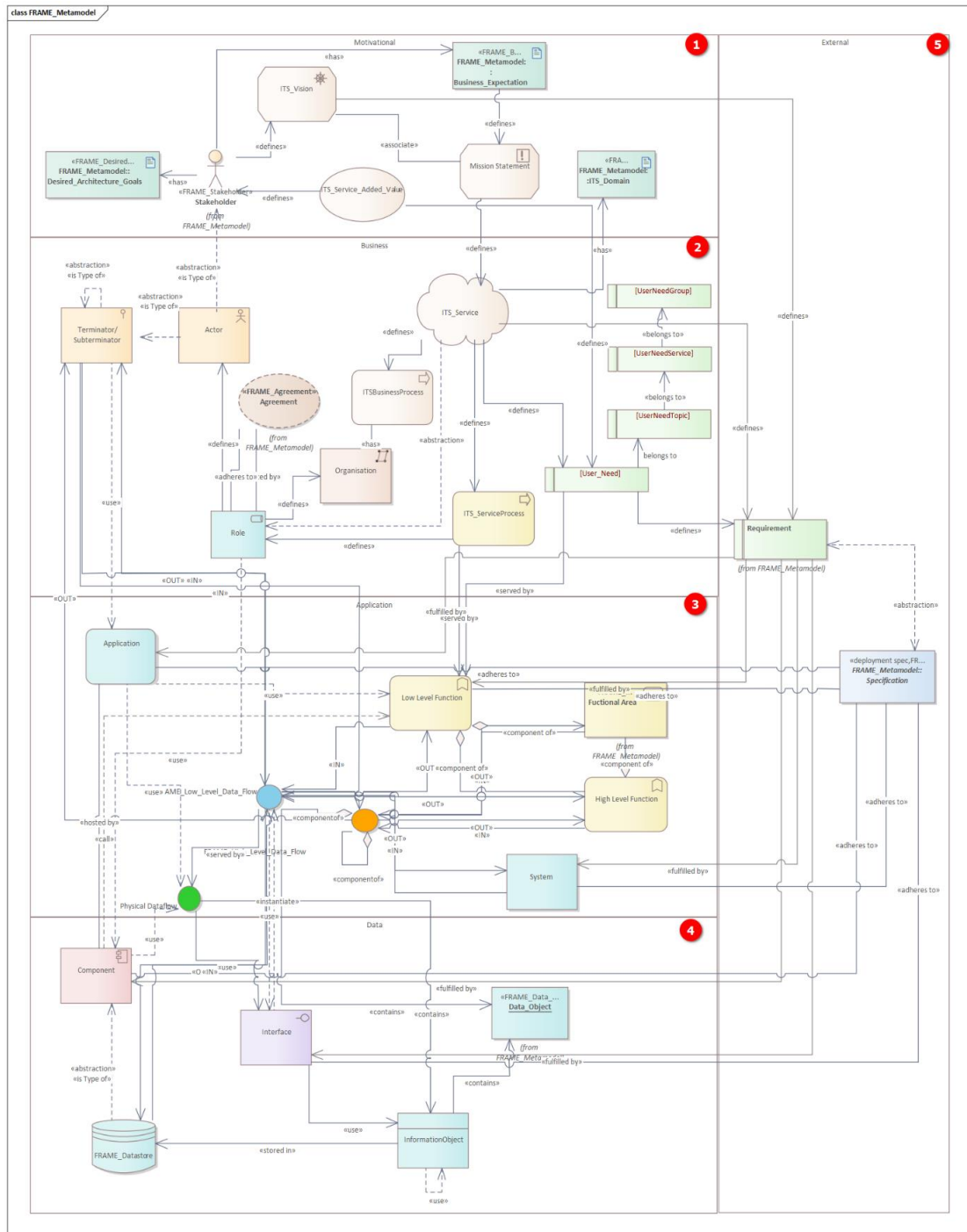


Figure 17 FRAME metamodel [source FRAME Architecture Tool]

The figure above defines objects used by updated FRAME architecture and depicts so-called metamodel. The metamodel has a different structuring than the final views of the architecture, it structures the FRAME artefacts into five sections. The first four sections develop from a high-level perspective down to more technical details of the service. The last layer contains artefacts, which are relevant for all sections. The sections are:

1. **Motivational Layer:** In this section, the reasons for the current effort to create the service as well as the goals, relevant stakeholders and the scope of the service are documented. The

intention of this section is to formulate an idea of the service, to get an impression of the intended result of its use and to identify the conditions under which it will be used. Naturally, each stakeholder has some aspirations regarding participation in the value creation. These will be noted in the building block "Desired business results" of the ITS service. Stakeholders might also have specific requirements regarding the architecture of the service which are collected in the "Desired architecture goals".

2. **Business Layer:** In this section, the organizational structure of the service and the detailed description of the features and processes are documented. Particularly, the distinct roles, which are necessary for the service and will be taken by suitable actors, and their involvement in the processes. The roles are characterised by their responsibilities and required capabilities. The roles are the executing parties in the processes that operationalize the service. The governance of the service is documented by using agreements between the roles. Part of the Business Layer is also the list of relevant User Needs. These form the functional requirements of the service. The artefact "ITS Service" contains the main facts about the service.
3. **Application Layer:** In this section, the functionalities of the service and the respective applications are documented. The applications use low-level functions and are hosted by components (Data Layer). The structure of the FRAME functions was preserved as it was in the selection tool. This helps to organize and browse the functions.
4. **Data Layer:** In this section, the communication parts of the service, namely information objects, data stores, components and used interfaces are documented.
5. **External:** This section contains cross-section artefacts like requirements and specifications. Requirements emerge on all levels and therefore, the artefact is linked to elements in all sections. The same applies to specifications.

5.5.2 FRAME artefacts

In this chapter we present artefacts present in the metamodel (Chapter 5.5.1) that are used to build FRAME Views, these descriptions were compiled from FRAME NEXT deliverables D4.2 and D3.1 and will need revision to fit the expectations of those artefacts in the project NAPCORE.

ITS Stakeholders are entities or individuals who have an interest in the deployment, operation, and outcomes of ITS systems. They can be directly or indirectly affected by the decisions made during the system's lifecycle. They are usually non-IT decision-makers, e.g., politicians, land-use planners, high-level managers, and others.

The **ITS Vision** statement is the long-term objective, the aspirational goal, of the stakeholder. It is a long-term view and concentrates on the future. It is a source of inspiration and provides clear decision-making criteria.

The **ITS Mission** statement is what the stakeholder needs to do in the present to achieve their vision. It outlines the purpose of the stakeholder's existence and guides their actions. It formulates a clearly structured, overarching, long-term policy objective and the benefits of the defined ITS service deployment, considering the interests of stakeholders and end-users. It represents a long-term framework for strengthening the security of action and investment for the involved actors and involves all modes and means of transport.

The **ITS Service** describes a value-added service provided by ITS actors in the field of transport, traffic, and mobility for end-users. The added value is created by combining technologies, organizations, processes, and people. The service can be delivered by a single actor or in cooperation with others, and it creates added value that may consist of individual benefits for mobile travellers, collective benefits for end-user groups or society, or a mixture of both. It describes the idea and functional elements of the ITS service as well as framework conditions.



The **ITS Domain** is a concept that categorizes the diverse applications of ITS into specific fields of application. It applies sector-specific knowledge and additional architectural knowledge to ITS. The domain also defines the boundaries of the ITS system or service at the start of an ITS architecture project, distinguishing it from similar or adjacent systems or services.

The **ITS Service added value** is created when end-users are given access to ITS information within application processes via easily accessible service access points, enabling them to make their own ITS decisions safely, reliably, quickly, and effectively. It presents the benefits of the ITS service.

The **ITS Actor** is part of an ITS value-added chain/network and is directly involved in value creation. It contributes to the added value of ITS benefits by using its ITS capabilities as part of its activities. It usually also represents the interests of ITS stakeholders who are not directly involved in the ITS value chain but have strong associated interests. The ITS end-user is also considered a special ITS actor.

The **ITS Role** defines and describes responsibilities, tasks, and capabilities that are typical and necessary for the value creation of ITS services. Is taken by ITS actors and stakeholders depending on the requirements of the ITS service to be implemented. A single ITS actor or stakeholder can occupy one or more ITS roles.

Business expectations of an actor involved in the ITS Service formulates the economic added value for an institution/company associated with an ITS service as a goal.

The **ITS Business process** links the main activities of ITS roles that implement an ITS service in total. It uses ITS information objects to exchange information between the functions or activities of ITS roles and ITS applications based on standardised interfaces.

An **ITS Information object** describes the semantic meaning of information related to content. It is used as input or output in ITS business processes and is described and used in ITS data models.

An **ITS Application (or module)** consists of a computer program or system of computer programs that automate or implement useful functions. It uses ITS interfaces for communication with other ITS applications and realizes technical activities in an ITS business process. These are parts of Sub-systems in the Physical View of ITS. They contribute to the functionality of the Sub-systems and can be duplicated in total or partially across several locations. Modules communicate with each other and with Terminators/Actors through Physical Data Flows.

The **ITS Data object** contains ITS information objects and uses ITS references to describe locations. It is used in ITS interfaces.

An **ITS Interface** serves the exchange of information between systems. It corresponds to an interface specification consisting of the definition of a protocol and a data model and is used and implemented by ITS applications.

A **Function**, also known as a “process”, is an action that involves receiving or processing input data. This data is then either passed on to another function or sent out as information or control instructions to an external entity. Functions are categorized into various levels: High-Level Functions (HLF) and Low-Level Functions (LLF). HLFs contain a group of functions concerned with a specific part of data processing and always have component LLFs. LLFs, on the other hand, perform a specific part of the data input, process, or information output process and have no component functions. User needs are allocated to LLFs, which are the only functions used in the FRAME Methodology.

Data Stores are repositories of data. Many of them are managed by their own dedicated Low-Level Functions. They store data from, and provide data to, (usually) more than one other Low-Level Function. Thus, Data Stores will always be part of Functional Areas or High-Level Functions.

Data Flows are the movements of data between different components of the system. There are three types of data flows. The first type is data flows between Low-Level Functions. The second type

is data flows between Low-Level Functions and Data Stores. The third type is data flows between Low-Level Functions and Terminators/Actors.

Terminators/Actors define the world outside the FRAME Architecture, i.e. artefacts that are not modelled within it. Actors are used to identify variants of a Terminator, e.g. several types of vehicles and drivers, or the separate roles that a traveller may take during a trip.

Components (or **Sub-systems**) are at the highest level and may consist of one or more Modules. The number of Modules in a Sub-system is optional, and a Sub-system does not need to have any Modules if it lacks complexity. Sub-systems only exist in one geographic location, meaning that if the ITS deployment is being made across several locations, each location will have its own Sub-system. Sub-systems and Modules may be duplicated in total, or in part, in several locations.

Physical Data Flows are the means of communication between Sub-systems, Modules, and Terminators/Actors in the Physical View of ITS. There are two types of Physical Data Flows: Internal, which links Sub-systems and Modules together; and External, which link Sub-systems and Modules to Terminators/Actors. The creation of a Physical View is always based on a particular Functional View, which must have passed the logical consistency checks before it can be used.

5.5.3 FRAME views

The **Motivational Layer** shows the initial position of the system development, the involved stakeholders and the expected added values and desired business goals. This results in key elements like the ITS Vision of the desired system and the ITS Service description itself.

The **Functional View** is a perspective that focuses on the functional aspects of a system. It defines the architectural elements that deliver the system's functionality, documenting the system's functional structure, including the key functional elements, their responsibilities, the interfaces they expose, and the interactions between them. This view is often the cornerstone of most architecture descriptions and is usually the first part of the description that stakeholders try to read.

Creating the Functional View involves using the User Needs identified as representing the Stakeholder Aspirations to enable the functionality needed to provide the Service(s) to be identified. The functionality to be included in a Functional View will be a sub-set of what is in the complete FRAME Architecture and, usually, does not need to be added to by the FRAME End User. The exception is when an extra new functionality needs to be added by the FRAME End User to provide Service(s) that are currently not included in the FRAME Architecture. The Functional View consists of the functions, dataflows, datastores and terminators.

The **Physical View** is a perspective that depicts the system from a system engineer's point of view. It is concerned with the topology of software components on the physical layer as well as the physical connections between these components. This view is used to describe the arrangement of physical elements, such as system elements and physical interfaces, that provide the solution for a product, service, or enterprise. It is intended to satisfy logical architecture elements and system requirements. The Physical View also includes the exchange of information between systems, which corresponds to an interface specification consisting of the definition of a protocol and a data model. The Physical View is always based on a particular Functional View, which must have passed the logical consistency checks before it can be used. The Physical View consists of Sub-systems and, optionally, Modules and Physical Data Flows.

The **Communications View** is a perspective that focuses on the interaction and data exchange between different components of the system. It outlines the communication protocols, data formats, and interfaces used for data transmission between different system elements. This view is crucial for understanding how information flows within the system, how components interact with each other, and how external systems interface with the system. It helps in designing efficient communication

strategies, ensuring seamless data exchange, and improving the overall performance and reliability of the system.

The **Organizational View** provides information about the roles and responsibilities, plus other data such as capability, actor definitions, desired business results and business processes for the ITS deployment which are related to the sub-set ITS architecture that is being created from the FRAME Architecture. In addition, the Organizational View also includes what is expected from the creation of the sub-set ITS architectures. The Organizational View consists of ITS Actors, their Roles, Agreements between the Roles, and relations to the Components (sub-systems) and Modules (Applications).

As for the **Safety and Security View**, 'Safety' relates to freedom from hazards that can result in physical harm and 'Security' to freedom from threat agents and abuse, which may be actual or perceived. The abuse commonly includes, but is not limited to, unauthorised disclosure (loss of confidentiality), unauthorised modification (loss of integrity), and unauthorised deprivation of access to the asset (loss of availability).

6 NAP reference architecture summary

The development of the National Access Point (NAP) reference architecture is based on the revision and update of the FRAME NRA, incorporating findings from the NAPCORE project. As our focus has been primarily on working outside of the FRAME tools on NAP functionality, we have not been able to incorporate all changes into the FRAME model. This chapter provides a summary that describes the status of the NRA update in the FRAME tool.

During the NAPCORE project, we decided to extend the functionality described in the FRAME NRA to cover data distribution by the NAP. This decision led to the creation of two reference architectures (presented as views) within the FRAME tool: one for the Metadata Directory and another for the Data Platform (definitions provided in the previous chapter).

In the following chapters, for simplicity, all architectural views will primarily be described from the perspective of the Metadata Directory. Elements of the Data Platform are indicated and highlighted to distinguish the functionalities of both types of NAPs. We chose this approach because the Data Platform reference architecture fully encompasses the Metadata Platform reference architecture and adds extra elements. Therefore, it is not necessary to describe both NRAs separately."

In each chapter, we first state the status of the update, followed by a diagram (if practical), which describes what is **currently** described in the FRAME tool, and then the planned updates for the view.

6.1 The Motivation Layer

Status: update ongoing, not yet transferred to the FRAME tool (text below describes the actual status within the FRAME tool); we plan to present the update in milestone M2.11.

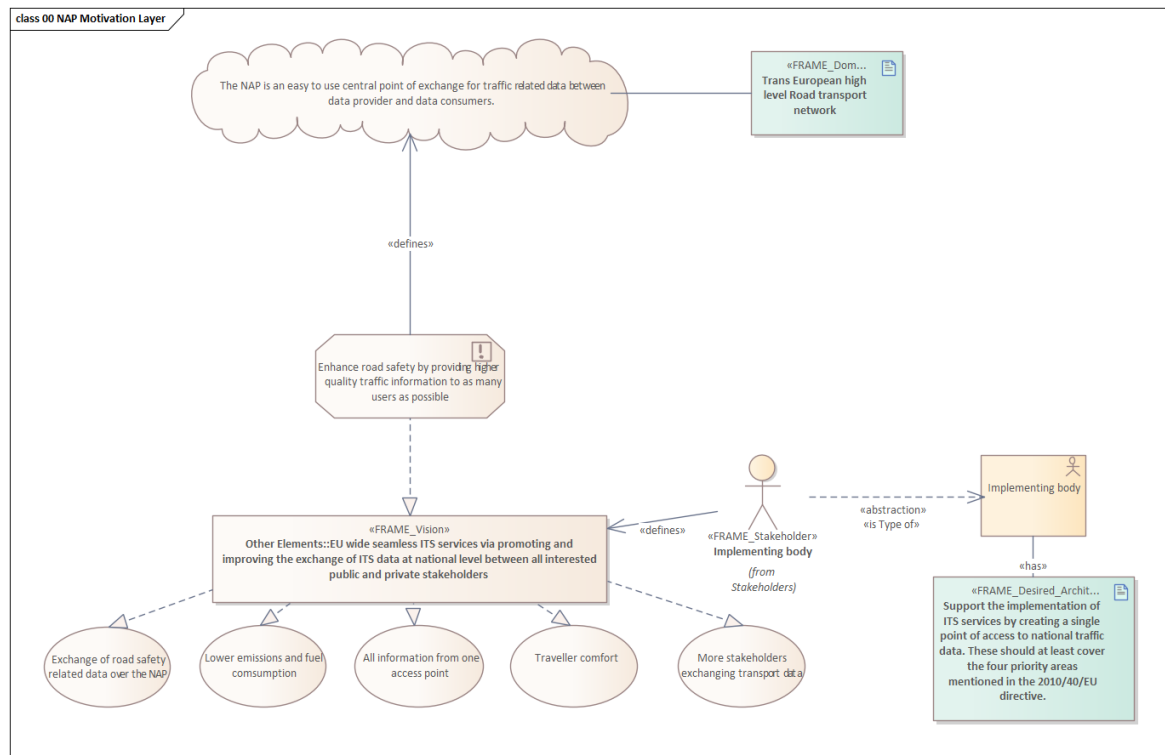


Figure 18 NAP Motivational Layer [source FRAME Architecture Tool]

The Stakeholders' *Vision* is related to their intention to implement a NAP and is defined as follows: *"EU wide seamless ITS services via promoting and improving the exchange of ITS data at national level between all interested public and private stakeholders"*. The *Vision* must fulfil stakeholders' and end-users' *Mission Statement* defined as: *"Enhance road safety by providing higher quality traffic information to as many users as possible"*. As a result, the *Mission Statement* is achieved when the *Vision* is realized through the implementation of a NAP that makes ITS Services accessible to end-users, delivering additional benefits (Added Values) to them as defined below.:

- Exchange of road safety related data over the NAP,
- Lower emissions and fuel consumption,
- All information from one access point,
- Traveller comfort and
- More stakeholders exchanging transport data.

The description of ITS services explains the preferred attributes of a NAP: *"The NAP is an easy-to-use central point of exchange for traffic related data between data provider and data consumers."* To accomplish this, the NAP must have established a clear definition of the ITS domain, which will help set boundaries across various parameters (Transport Network, ITS Service, ITS Service Type, Level of detail, Perspective, Focus).

The interests of stakeholders are embodied in the ITS actor, referred to as the Implementing Body. This Implementing Body has outlined Desired Architecture Goals, specifying what the architecture goals should achieve, ensure, and enhance. These goals are also in line with the Mission Statement, Vision, and Added Value. The primary goal is defined as follows: *"Support the implementation of ITS services by creating a single point of access to national traffic data. These should at least cover the four priority areas mentioned in the 2010/40/EU directive."* and complementary goals are defined as: *"Availability and accessibility of EU wide mobility data"* and *"Easy generation of ITS Services"*.

In the upcoming update of the Motivation layer, we will focus on the revision of all elements, a better description of the service, introduction of more stakeholders and their visions and expectations and linking them with service added value. Aligning with NB reference architecture. A decision will be made on whether to create diagrams, one per each NAP type.

6.2 User Needs

Status: not yet updated; not yet transferred to the FRAME tool (text below describes the actual status within the FRAME tool); we plan to present the update in milestone M2.11

This part of the NRA describes User needs matching the content and requirements on a NAP to be implemented (or upgraded, extended) and is comprised of 8 User Needs defined as follows:

1. The system shall make sources of static and dynamic urban and inter-urban road and traffic information accessible to authorized users, such as Information Service Providers (ISPs) and Broadcasters, who can then distribute it to their end-users.
2. The system shall provide a discovery service of static and dynamic urban and inter-urban road and traffic information for authorized users, such as Information Service Providers (ISPs) and Broadcasters.
3. The system shall provide all the information available from it in the form of metadata, with pointers (links) to where the actual data can be found.
4. The system shall be able to validate the identity of a data provider for a National Access Point (NAP).
5. The system shall be able to permit a validated data provider to update its metadata links directly.
6. The system shall provide a search interface in the native language(s) of the area covered and, at least, English.
7. The system shall provide Information Management tools for the operator.
8. The system shall provide information using "open" standard communication protocols.

The User Needs serves as an entry to create ITS Architecture from all ITS areas and allows to select the right functionality to achieve stakeholders' aspirations. The reference architecture provides feedback on the purpose of the system.

In the oncoming update of User Needs, we will focus on their revision and/or adding new User needs to cover the extension of the NRA by multimodal data and by hosting data and services on NAP. Resolving authorized vs. Unrestricted access to data stored at NAP.

6.3 Functional View

Status: updated according to NAPCORE findings; **export documenting all features of the functional view is part of Annex A;** we plan further update in milestone M2.11

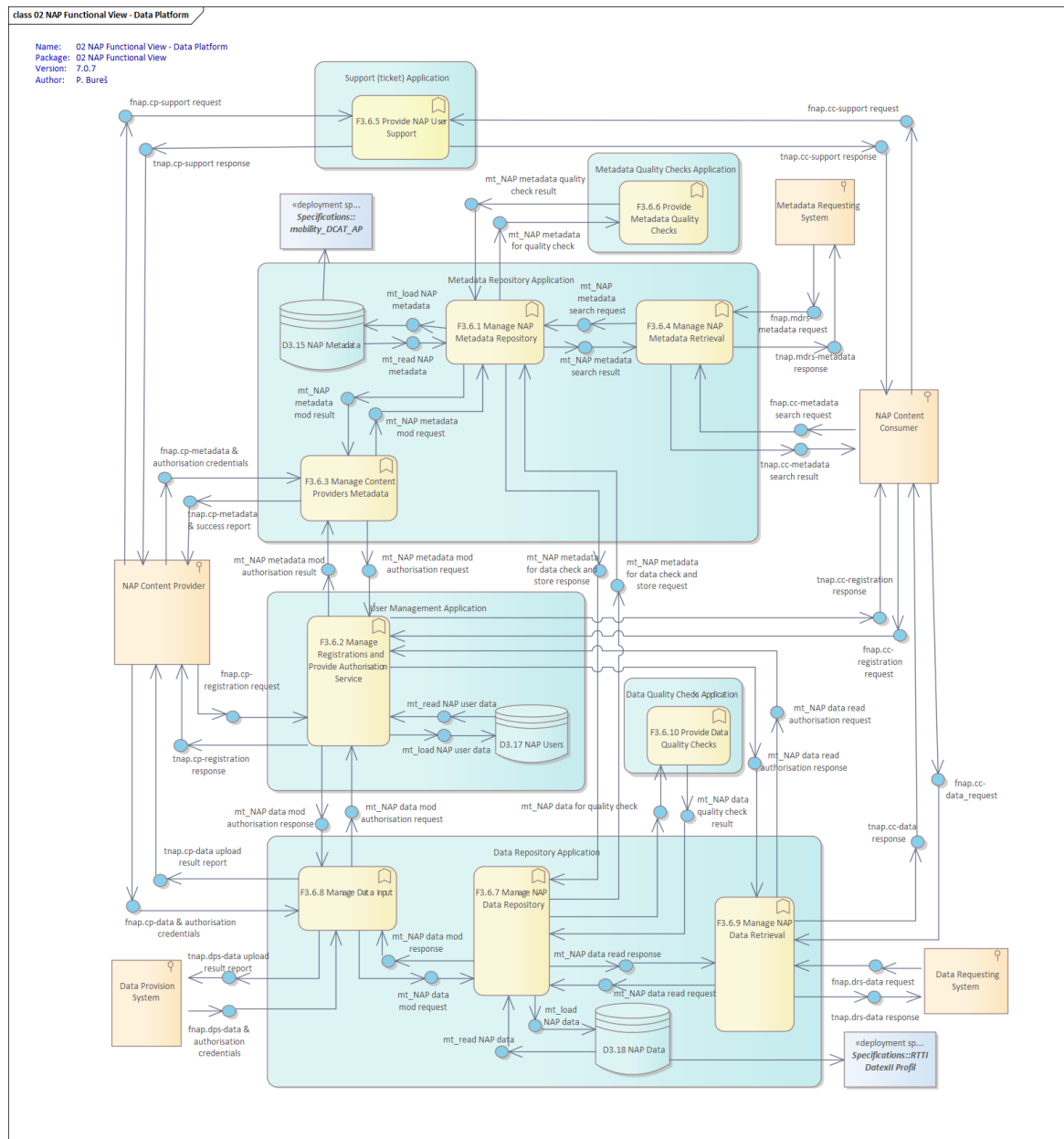


Figure 19 NAP Functional View [source FRAME Architecture Tool]

The NAP Content Provider (real person or organization) sends metadata and, in the case of Data Platforms, also traffic and travel data to a NAP. The NAP Content Consumer (a real person or organization) retrieves metadata and, in the case of Data Platforms, also travel and traffic data from NAP. Metadata Requesting System (a machine) retrieves metadata from NAP via a dedicated API.

The Data Requesting System (machine) and Data Provision System (machine) represent an addition to Data Platform NAP for machine-to-machine exchange of traffic and travel data with NAP

NAP users can register at a NAP, manage registration, add personal and machine accounts including their credentials and store them in D3.17 NAP Users data store via Function F3.6.2 Manage Registrations and Provide Authorization Service. This function also provides authorization to end-users and machines uploading or retrieving NAP metadata or NAP data (in the case of Data Platforms) indirectly via other NAP functions. This function is critical for all other processes described below. Management of metadata is ensured by the functions F3.6.1, F3.6.2, F3.6.3, F3.6.6 and D3.15 NAP Metadata store. NAP Content Provider to request retrieval, creation, update, or deletion of metadata and checks basic consistency and completeness of the provided metadata via function F3.6.3. To authorise the

request the F3.6.3 function sends authorization credentials to the function F3.6.2. In case of successful authorization, the function F3.6.1 performs the request on D3.15 NAP Metadata store then calls F3.6.6 function to execute metadata quality check and stores its result in the data store alongside the metadata provided by the user. The result of the operation is propagated back to its originator. It is important to note that via this functionality chain, the NAP Content Provider could access and retrieve only its metadata. For retrieving and searching for metadata of other providers, the entity accesses the system as a NAP Content Consumer.

Retrieval of metadata is ensured by the functions F3.6.4, F3.6.1 and D3.15 NAP Metadata store. NAP Content Consumer or Metadata Requesting System sends a search request to the function F3.6.4 Manage NAP Metadata Retrieval which provides a search engine for the metadata. The F3.6.4 passes the search request for metadata to function F3.6.1 which retrieves requested data from D3.15 and sends a result back to the function F3.6.4 which then in turn distributes requested metadata to the NAP Content Consumer or Metadata Requesting System. Requested metadata also includes information about quality of metadata (quality records), quality of metadata is provisioned by the function F3.6.6 Provide Metadata Quality Checks.

The Data Platform functional view adds management and retrieval of traffic and travel data.

Management of data is ensured by the functions F3.6.7, F3.6.8, F3.6.9, F3.6.10 and D3.18 NAP Data store. The data platform functionality interfaces with F3.6.2 and F3.6.1 functions from Metadata directory functionality.

NAP Content Provider or Data provision system request retrieval, creation, update or deletion of data and Content Consumer data access authorization information via function F3.6.8. To authorize the request the F3.6.8 function sends authorization credentials to the function F3.6.2. In case of successful authorization, the function F3.6.7 performs the request on D3.18 NAP Data store then calls F3.6.1 to connect metadata with data and to pass relevant metadata to function F3.10 to execute metadata quality check and stores its result the data store alongside the data provided by the user. The function F3.6.7 also logs events related to access to the stored data into database. The result of the operation is propagated back to its originator. It is important to note that via this functionality chain the NAP Content Provider could only access and retrieve its data information. For accessing data of other providers, the entity accesses the system as NAP Content Consumer.

Retrieval of data is ensured by the functions F3.6.9, F3.6.7 and D3.18 NAP Data store. The data platform functionality interfaces with F3.6.2 and F3.6.1 functions from Metadata directory functionality.

NAP Content Consumer or Data Requesting System sends a data request to the function F3.6.9 Manage NAP Data Retrieval. To authorise the request the F3.6.9 function sends authorization credentials to the function F3.6.2. In case of successful authorization, the function F3.6.7 performs the request on D3.18 NAP Data store then calls F3.6.1 to connect relevant metadata and sends requested data with relevant metadata back to the function F3.6.9 which then in turn distributes requested metadata to the NAP Content Consumer or Data Requesting System. Requested data also includes information about quality of data (quality records), and last update time information.

It is important to note that some NAPs do not require authentication to access stored data in this case the credentials and content consumer access authorization information are empty. To support end-users before, during or after execution of the processes described above the function F3.6.5 Provide NAP Users Support provide facilities to process request for support sent to this function by end-users.

In the oncoming update of Functional View, we will focus on clarifying the functionality, based on comments we will receive from external review (via M2.9) and possible introduction of high-level function in User Management application to reduce visual diagram complexity, and replacing NAP



Support functionality terminators NAP Content Provider and NAP Content Consumer by their higher-level abstraction NAP User to reduce the number of dataflows with the same content.

6.4 Physical View

Status: partly updated; text below describes the actual status within the FRAME tool; we plan to present the update in milestone M2.11

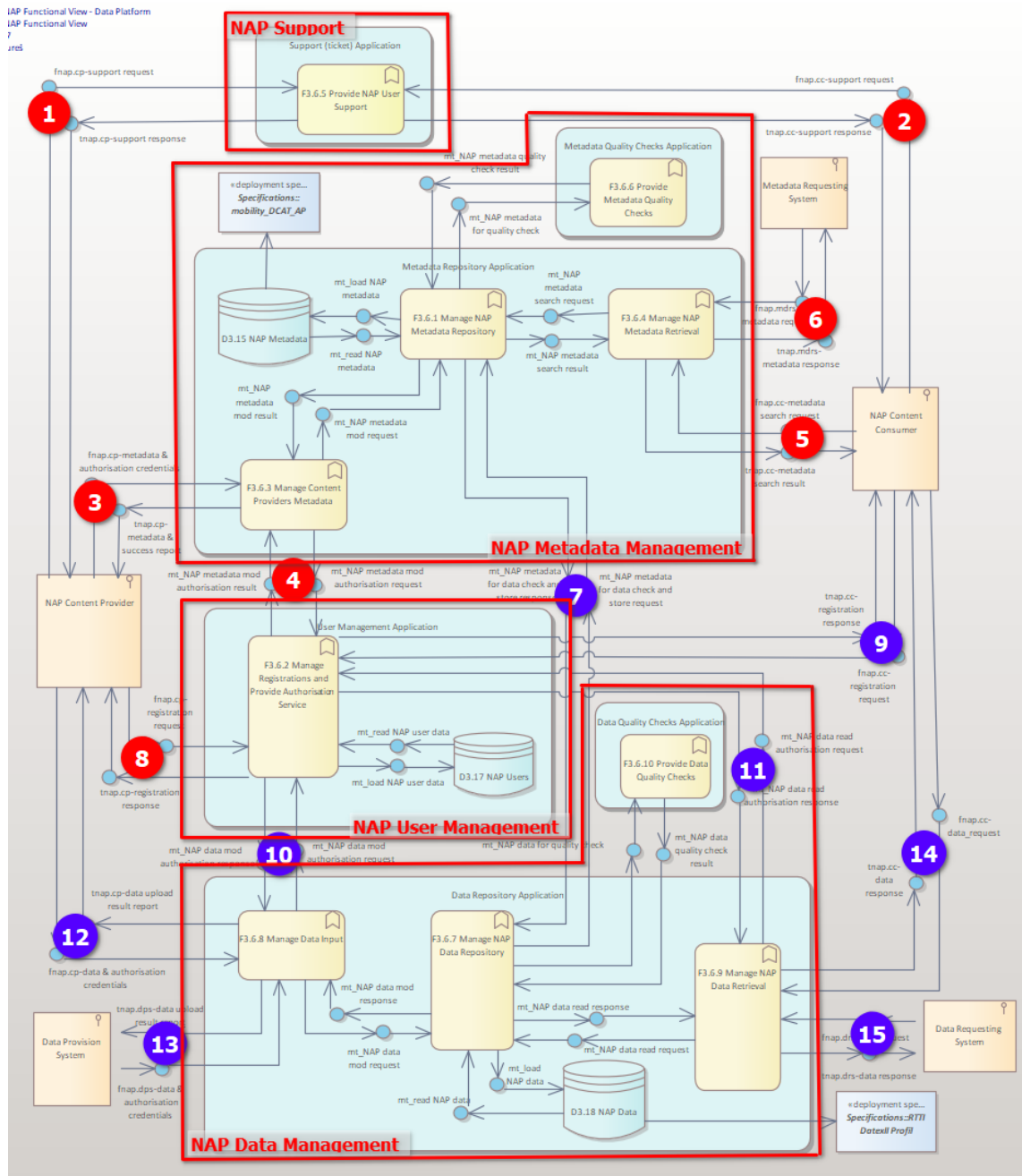


Figure 20 A mock-up of the NAP Physical View based on the Functional view [source FRAME Architecture Tool]

The physical view of the NRA (derived from the functional view) comprises 4 components (subsystems): NAP Support, NAP Metadata Management, NAP User Management, NAP Data Management. Each component (subsystem) contains application(s) (modules) which in turn contain functions from the Functional View. The Data Platform physical view differs from Metadata directory physical view by including NAP Data Management component with its physical data flows.

All the components represent the NAP as a system (from a Physical View perspective) to be implemented having internal physical data flows [IPDF] (between applications assigned to the same component) and external physical data flows [EPDF] between components (applications) and terminators. All EPDFs must have at least one Interface and one Interface specification defined.

NAP Support component hosts *Support (ticket) Application*. This component handles tickets from NAP users and provides back support to NAP users. *NAP Support component* has two external physical data flows (EPDF) with the *NAP Content Provider* (1) and the *NAP Content Consumer* (2) with interfaces through which these NAP Users send their support requests and receive feedback from the *NAP User Support component*.

NAP Metadata Management component hosts *Metadata Quality Checks* application and *Metadata Repository* application. The component handles the management of the metadata, its access and retrieval, authorization of *NAP Content Providers* (in cooperation with *NAP User Management* component) and metadata quality checks. This component has one internal and six external physical data flows to components/terminators. The internal physical data flow connects *Metadata Quality Checks* application and *Metadata Repository* application providing information objects concerning performed metadata quality checks. EPDF to *NAP Content Providers* (3) facilitates requests to upload or update metadata and their authorization to do so. Authorization proceeds via the EPDF to the *NAP User Management* (4) component. EPDF to *NAP Content Consumer* (5) facilitates the search requests sent by the *NAP Content Consumer* to the *NAP Metadata repository* application as well as the search results being sent to the *NAP Content Consumers*. Interface *Content Consumer - Metadata component* of this physical data flow provides search engine and is implemented according to the *specification of interface to Content Consumer*. EPDF to *Metadata Requesting System* (6) facilitates metadata distribution via NAP API implemented according to respective specification. Last EPDF to *Data Repository* component (7) belongs to Data Platform physical view and facilitates request to retrieve metadata related to data being processed by the *Data Repository* component.

NAP User Management component handles user registrations, logins and authorizations using the hosted *User Management* application. This component has five external physical data flows to components/terminators. First EPDF with the *NAP Content Provider* (8) terminator facilitates provision of registration data and authorization credentials. EPDF to the *NAP Metadata Management* component (4). Next 3 EPDFs are part of the Data Platform physical view. EPDF with the *NAP Content Consumer* terminator (9) carries *NAP Content Consumer* registration data and authorization credentials. Two EPDFs with *NAP Data Management* component for user authorization performed at the point when the Function Manage Data Input request authorization of *NAP Content Provider* or *Data Provisioning System* for traffic and travel data upload or update (10) or at the point when function Manage NAP Data Retrieval requests authorization of *NAP Content Consumer* or *Data Requesting System* for traffic or travel data retrieval (11). It is important to note that in case no registration is required for *NAP Content Consumer* or *Data Requesting System* the physical data flows (9) and (11) are empty.

Data Platform physical view includes **NAP Data Management** component enabling the exchange of traffic and travel data with using the hosted *Data Repository* application. This component has one internal and seven external physical data flows. Internal PDF connect *Data Quality Checks* application and *Data Repository* application providing information objects concerning performed metadata quality checks. Two EPDFs provides *data interfaces* through which *NAP Content Provider* (12) or *Data Provisioning System* (13) requests for traffic and travel data are stored in the *Data Repository* application. This interface is implemented according to the *specification of content provider data provision interface*, e. g. SFTP (SSH File Transfer Protocol). Two EPDFs provides *data interfaces* through which *NAP Content Consumer* (14) or *Data Requesting System* (15) requests for traffic and travel data retrieval or

machine-to-machine data distribution. Three other EPDFs (7), (10) and (11) have been already mentioned above.

In the oncoming update of Physical View, we will focus on aligning the view with the functional view, better description of applications (modules) and components (subsystems), decision on deleting component from within the terminators, decision on merging existing components, addition of currently missing physical dataflows (distinguishing internal and external), adding new and reviewing (adding content) current interfaces and specifications.

6.5 Organizational View

Status: update ongoing, not yet transferred to the FRAME tool (text below describes the actual status within the FRAME tool); the organizational view for Data Platform is not defined, it will be created in later architecture upgrade; we plan to present the update in milestone M2.11

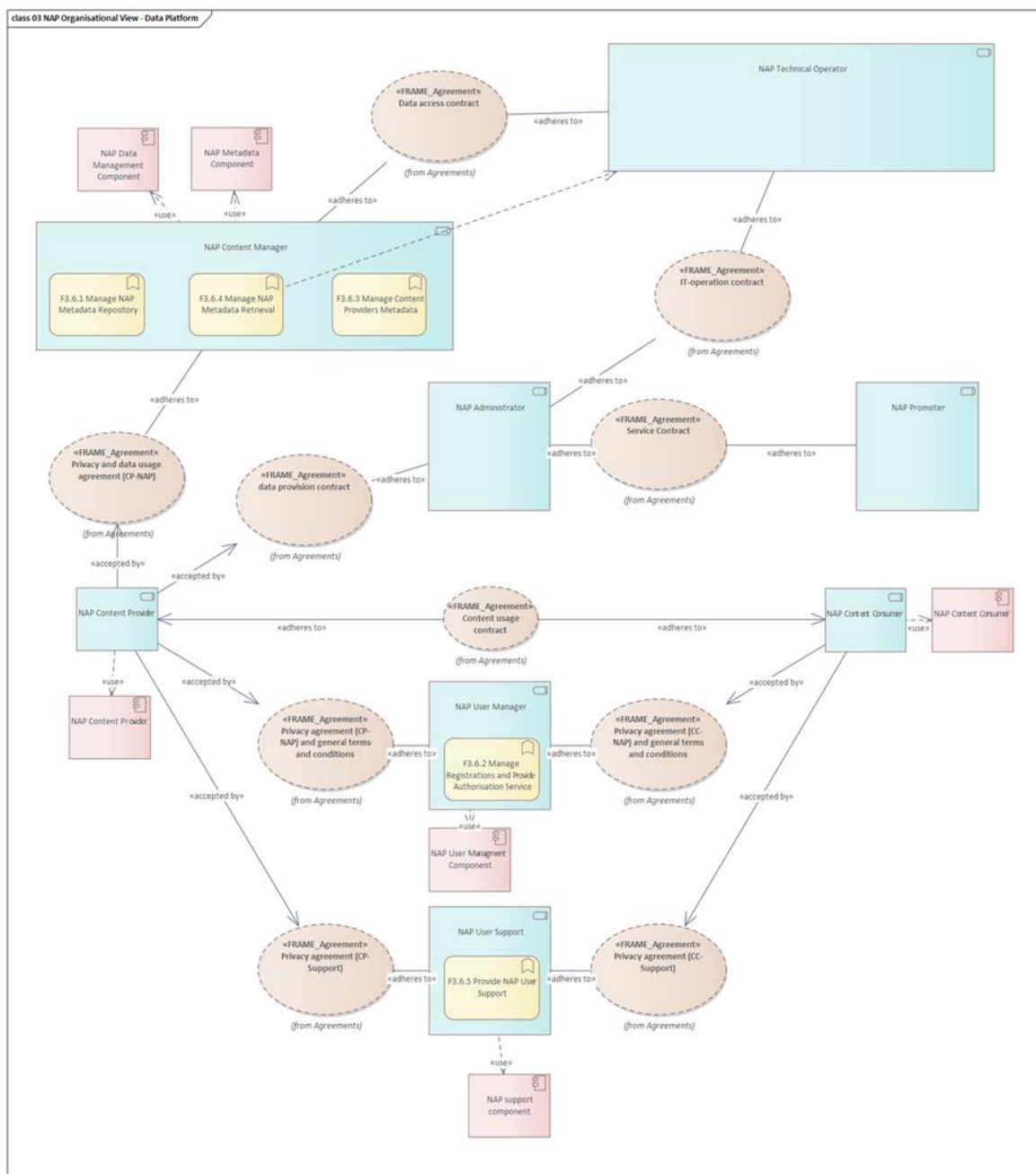


Figure 21 NAP Organizational View [source FRAME Architecture Tool]

The organizational structure comprises eight roles: NAP Content Provider, NAP Content Consumer (associated with NAP Content Provider and NAP Content Consumer terminators), and NAP internal roles (associated with the NAP Service Operator actor) – NAP Technical Operator, NAP Content Manager, NAP Administrator, NAP Promoter, NAP User Manager, and NAP User Support.

A single actor, representing one organization, can assume multiple roles. It is also possible for one individual to be responsible for several roles. However, the distinction between roles allows for the possibility of different actors fulfilling them if needed.

The **NAP Content Provider** is responsible for collecting, providing, and updating traffic and travel data and metadata (collectively referred to as content), in accordance with the terms set in contracts with the NAP internal roles and NAP Content Consumers. The NAP Content Provider must comply with the terms set out in various agreements, including the Privacy and Data Usage Agreement, Content Usage Contract, Data Provision Contract, and Privacy Agreement.

The **NAP Content Consumer** is responsible for compliance with the Content Usage Contract concluded with the NAP Content Provider. The NAP Content Consumer uses the NAP Content Consumer Component, which hosts the Content Consumer applications to access, retrieve, and process metadata and data (content). The NAP Content Consumer must also comply with the terms set out in the Privacy Agreement.

The **NAP Content Manager** ensures that the quality guidelines/criteria of content (data and metadata) are met, data formats are correct, and content is processed in compliance with the Service Level Agreement contracted with the NAP Technical Operator. To fulfil these responsibilities, the NAP Content Manager facilitates functions such as managing the NAP Metadata Repository, managing NAP Metadata Retrieval, and managing Content Providers Metadata, and uses the NAP Data Management Component and NAP Metadata Component. The NAP Content Manager must comply with the terms set out in the Data Access Contract concluded with NAP Administrator.

The **NAP Technical Operator** provides technical resources for the NAP Content Manager, including interfaces to other relevant roles and technical support for the NAP Service Operator, second-level support for technical issues, etc. The NAP Technical Operator must comply with the terms set out in the IT-Operation Contract concluded with the NAP Administrator.

The **NAP Administrator** is responsible for service creation, subscribing new NAP Content Providers to the NAP, maintaining the service value chain, and acting as an authority over other NAP internal roles. The NAP Administrator must adhere to the terms set out in the IT-Operation Contract, Data Provision Contract, and Service Contract with the NAP Promoter, which outlines the conditions for the services of the NAP Promoter, strategic guidelines from the NAP Administrator, and billing agreements.

The **NAP Promoter** is responsible for public relations activities, such as managing the website, publications, events, and social media, and must comply with the Service Contract.

The **NAP User Manager** is responsible for providing verification and authorization services for NAP Content Providers and NAP Content Consumers, issuing authorization credentials, and monitoring NAP users' activity. To fulfil these responsibilities, the NAP User Manager facilitates the function "Manage Registrations and Provide Authorization Service" using the NAP User Management Component. The NAP User Manager must comply with the terms set out in the Privacy Agreement and the general terms and conditions.

The **NAP User Support** is responsible for providing first-level support for NAP users and collecting feedback from content consumers on issues with services, data, and metadata (e.g., accuracy, timeliness, etc.). To fulfil these responsibilities, the NAP User Manager facilitates the function "Provide NAP

User Support" and uses the NAP User Support component, which hosts an application to handle support tickets and provide support to all NAP users. NAP User Support must comply with the terms set out in the Privacy Agreement.

In the forthcoming update of the Organizational View, our focus will be on several key areas. We aim to align this view with the physical view and the NB architecture and create an organizational view for the Data Platform NAP. We will also review the actors, introduce high-level actors, and reassess the responsibilities of NAP internal roles. Given the complexity of the current view, it is unlikely that, for instance, a Content Provider will interact with four different contacts, each representing a different role, and sign four separate contracts. Therefore, we plan to review and streamline the agreements between the roles. In the contractual relationship view, only the key roles will be represented.

6.6 Communication View

Status: update ongoing, not yet transferred to the FRAME tool (text below describes the actual status within the FRAME tool); we plan to present the update in milestone M2.11

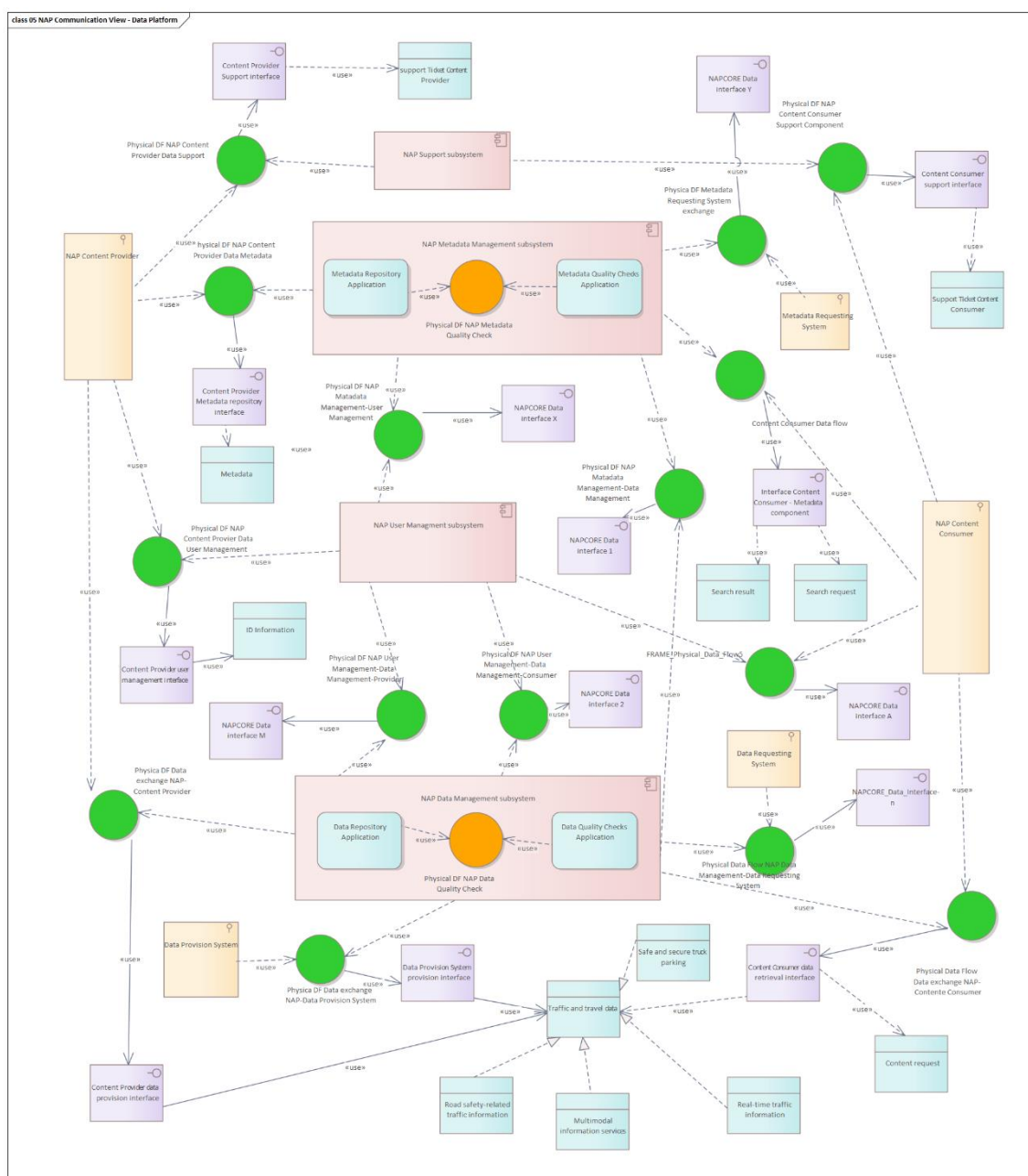


Figure 22 NAP Communications View [source FRAME Architecture Tool]

The Communication View focuses on information objects passing through interfaces defined on external physical dataflows, on requirements of interfaces and process description. In the current version not all Information objects are covered, and the requirements are completely missing.

There are 15 external physical dataflows with interfaces. For example:

Physical DF NAP Content Provider Data Metadata between the NAP Content Provider terminator and the NAP Metadata Management component is characterized by information object Metadata which is provided along with other related information by the NAP Content Provider.

Content Consumer Data flow between the NAP Content Consumer terminator and the NAP Metadata Component is characterized by information object Search request (request of NAP Content Consumer for search of metadata) and Search Result (result provided by the NAP Metadata Component based on the Search Request).

Physical DF NAP Content Provider Data User Management between the NAP Content Provider terminator and the NAP User Management Component is characterized by information object ID containing registration data (identity data) and authorization credentials.

Physical DF Data exchange NAP-Content Consumer between the NAP Content Consumer terminator and the NAP Data Management Component is characterized by two information objects. Content Request and Traffic and Travel Data information objects containing data (Road safety-related traffic information, Safe and secure truck parking information, Real-time traffic information, Multimodal travel information) requested by the NAP Content Consumer.

Physical DF Data exchange NAP-Content Provider between the NAP Content Provider terminator and the NAP Data Management Component is characterized by the information object Traffic and Travel Data provided by the NAP Content Provider (described above).

In the forthcoming update of the Communications View, our focus will be on several key areas. We aim to align this view with the physical view and the NB architecture. We will also cover data flows, interfaces, and connected information objects. The revision will be complex since there was not any content update yet and we need to make decision how to reflect current FRAME methodology requirement into this View.

6.7 Security View

Status: discussing update with WG4.1; we plan to present the update in milestone M2.11.

With regards to the security view the decision was made to include it on high level so it could reference security architecture developed by WG4.1 DATEX working group. The security requirements for the (meta)data upload / retrieval, user registration and interaction are partly common across all EU countries such as metadata integrity and partly specific to Member State such as data storing and retrieval processes. In some Member States, data is available with only basic security while in others access via user credentials is required. The implementation of security mechanisms is also dependent on the physical entities involved and the systems the Member States use for receiving, processing, and distributing (meta)data.

In the forthcoming update of the Security View, a diagram shall be created for referencing security architecture developed by WG4.1 DATEX II.

7 Future support and Issue Tracking tools

The work on the NRA according to FRAME methodology began in the project FRAME-NEXT, in 2019. Project FRAME also proposed how to support the architecture and its new versions by using tracking tools. In the NAPCORE project, the work on the NRA continued, further developing, and expanding the architecture for two NAP types and introducing a concept of interoperability documents that also needs to be maintained. In this chapter, we address how the NRA will be maintained after the project NAPCORE.

7.1 Setting up a maintenance website and communication channels

The preferred maintenance website is GitHub, which will host:

- Versions (or references to versions stored elsewhere) of NRA as a binary Enterprise architect output. Hosting will need to be decided since the binary file is quite large and cannot be tracked by GitHub
- Textual printouts from the architecture for tracking purposes
- Texts of the interoperability documents
- Wiki describing the architecture, its use and maintenance procedures



- Issues with their tracking and assignment to releases of architecture

The maintenance website will also need a group of maintainers able to address raised issues and release new versions of the architecture.

A complete description of the maintenance website, together with a working example will be delivered with the milestone M2.11 at the end of the project.

7.2 Updating and maintaining NRA after NAPCORE project

Upon the completion of the NAPCORE project in 2024, the NRA will be accessible as a fixed version within the M2.11 report on the NAPCORE website. For developmental purposes, the NRA will be available on GitHub under an open license (type to be determined), and issues raised by maintainers or other parties will be addressed during regular releases.

The NRA is a component of the FRAME architecture, requiring versioning maintenance for both the core FRAME functionality and the NRA.

The governance structure and maintenance processes for the NRA and the process for updating the core FRAME functionality based on NAPCORE developments are yet to be determined. However, we plan to base them on the maintenance processes for mobilityDCAT-AP, as defined within WG4.4.

8 Conclusions and next steps at this stage

The NRA serves as a technical, organizational, and functional blueprint for creating and harmonizing National Access Point (NAP) activities. This is in accordance with the Delegated Regulations, stakeholder implementations, and best practices, as evaluated through several reviews by various NAPCORE working groups.

Milestone 2.9, titled "Harmonization of EU NAP architectures and first layout of potential NAP federation," outlines the harmonization activities, technical procedures, and developmental steps taken to achieve a NAP reference architecture. This NRA consolidates all NAPCORE National Access Point harmonization activities. While this document does not describe the final architecture due to ongoing developments in NAP harmonization, it does include and represent all achievements and results currently available within NAPCORE. Future results and further harmonizations from ongoing NAPCORE developments will be continuously integrated into the architecture, as outlined in the maintenance procedure.

By utilizing the well-known software, Enterprise Architect, and the most suitable toolkit, FRAME, we ensure that the architecture is both understandable and future-proof.

The NRA can be applied in three different scenarios:

4. To create a harmonized NAP from scratch by implementing the necessary functional and organizational elements using the architecture.
5. To harmonize existing NAPs by updating already existing NAP functionalities and processes in line with the developed NRA.
6. To establish a basis for comparing NAPs by breaking down complex functionalities and processes. Comparisons can also be conducted using the NLKF tool.

The further update of the NRA is an iterative process that begins with the submission of the M2.9 milestone report for review. It includes planned work on the Motivational layer, Physical, Organizational, and Communications view as identified in Chapter 6 NRA summary. It also involves work on identifying interoperability documents and maintaining the NRA.

We plan to incorporate external comments from M2.9 reviewers and input from NAP Operators during a planned workshop in mid-2024. We will also incorporate internal comments from NAPCORE



WGs, input from WG2 tasks (level of service, standardization, and demonstrators), as well as input from other WGs (see Chapter 3 Alignment with other WGs).

We aim to provide feedback to the FRAME forum with proposals to update the FRAME architecture methodology and content based on NAPCORE findings. We will also provide findings to NAPCORE WGs regarding identified interoperability documents, receive the results, and incorporate them.

To achieve this, we plan regular biweekly Task 2.3 working meetings to incorporate feedback, ad-hoc NRA development meetings, regular WG2 interoperability meetings between groups, and NRA feedback collection and promotion workshops providing guidance on how to utilize the NRA effectively.

The work on the NRA within the NAPCORE project will conclude with the publication (and acceptance) of milestone M2.11. The NRA will be published on the NAPCORE web page and GitHub, and we will continue to collect further feedback via GitHub and email.

9 Annexes

9.1 Annex A NAP reference architecture

This annex contains the introduction, target group usage hints and NAP reference architecture export from the FRAME tool for Functional views of metadata directory and data platform.

Other views, Motivation layer, Physical, Organizational, Communication and Security views are still being worked on and will be reported in milestone M2.11 at the end of 2024.

9.2 Annex B Interoperability documents

This Annex contains specific inputs from NAPCORE WGs as information pool for identification of interoperability documents and description and link to standalone terminology documents, Data definitions documents and metadata catalogue website.

We aim to further improve this Annex, incorporating information about all identified interoperability documents and either directly host them within the annex or linking them.

These documents are NOT created by WG2; they already exist in other NAPCORE groups. The WG2, therefore, encourages its use as a recommended resource.

9.3 Annex C Porto workshop on NAP Reference Architecture

Corresponds the presentation to the NAP operators, from the Porto WG2 Workshop, on March 31, 2023. The presentation contains explanations of minimum functionality and NAP typology, as well as results of online voting by the audience.