

Roadmap for the implementation process

DELIVERABLE

Version: Final

Project Acronym :	24-EU-TG-TISGRADE
Project ID:	101232828
Deliverable number:	D4.1
Deliverable name:	Roadmap for the implementation process
Work package number:	WP4
Due date:	May 2026
Delivery date:	10 June 2026
Lead beneficiary:	HU_KOZUT
Main Author:	Aletta Büki András Selmeczy
Contributing Authors:	Petr Bureš Sara Linhas Peter Lubrich

Table of contents

1	Executive summary	3
1.1	Purpose of the document	3
2	Introduction	4
2.1	TISGRADE project	4
2.1.1	General	4
2.1.2	WP4 in specific	5
2.2	NAPCORE project	6
2.3	Other relevant projects	7
2.3.1	VERKKO	8
2.3.2	C-Roads Platform	8
2.3.3	X4ITS	8
2.3.4	MERIDIAN	8
2.4	Legal background	9
3	Current situation	11
3.1	Overview of the current situation	11
3.1.1	Map of IT infrastructure and architecture	11
3.1.2	Dataset domains	12
3.2	Identified Gaps and Challenges	13
4	Planned improvements	15
4.1	Major upgrades planned	16
4.2	Minor upgrades planned	18
4.3	No upgrade planned	19
5	Implementation Roadmap and Timeline	20
5.1	Implementation phases of NAP upgrades	20
5.1.1	Joint technical discussions and detailing of scope and support.	20
5.1.2	Individual procurements and preparation of implementation	20
5.1.3	Parallel implementation and follow-up, feedback loop and fine tuning	20
5.2	Detailed descriptions of WP4 Tasks	21

5.2.1	Task 4.1 Coordination and mapping of IT infrastructure and architecture of NAPs	21
5.2.2	Task 4.2 Implementation of mobilityDCAT-AP	21
5.2.3	Task 4.3 Improvements of digital transport infrastructure, data standards, DR compliance and cybersecurity	22
5.2.4	Task 4.4 User experience enhancement	24
5.2.5	Task 4.5 Description of best practices, sample architecture, future improvements need identified	26
5.3	Expected outcomes.	27
6	Next steps, follow up	29
7	Conclusion	30
8	References	31
8.1	Figures and tables	31

1 Executive summary

1.1 Purpose of the document

This document presents a comprehensive roadmap for the implementation within the framework of TISGRADE Work Package 4 (WP4). It provides a clear basis for coordinated implementation and monitoring of processes. It outlines the current situation, identified gaps, planned upgrades and the implementation timeline leading to the final project completion by December 2028.

As an introduction, the document provides an overview of the TISGRADE project, with a specific focus on WP4 and its role in supporting the implementation and improvements of National Access Points (NAPs). It presents the relevant project background, including connection to NAPCORE and other external initiatives such as VERKKO, C-Roads Platform, as well as the related legal framework.

The deliverable describes the current situation of Member States' IT infrastructure and architecture, including the currently used APIs and identifies the main gaps and challenges affecting NAP upgrades. Based on this assessment, it outlines the planned improvements, distinguishing between major upgrades, minor upgrades, and cases where no upgrade in scope.

The implementation roadmap sets out the WP4 tasks, including coordination and mapping of IT infrastructure, implementation of mobilityDCAT-AP, improvements of digital transport infrastructure, data standards, Delegated Regulation (DR) compliance and cybersecurity, user experience enhancement and the collection of best practices and future improvement needs.

The document highlights the planned implementation phases for NAP upgrades, including joint technical discussions, preparation for implementations, parallel implementation, and follow-up activities. The expected outcome is a coordinated roadmap that supports Member States in improving their NAPs and contributes to better interoperability, data quality especially on RTTI and compliance across Europe.

2 Introduction

2.1 TISGRADE project

2.1.1 General

TISGRADE project is a European-wide initiative that improves the availability and quality of Real-Time Traffic Information (RTTI) data, making it more easily accessible via National Access Points (NAPs) for use by service providers.

Each of the partners within TISGRADE will implement the revised RTTI Delegated Regulation and the RTTI related aspects of the revised ITS Directive, in line with the alignment done within both NAPCORE as well as the Member States RTTI taskforce. TISGRADE focuses on the actual deployment of these recommendations to further enhance the crucial RTTI data availability, quality, findability, accessibility, and interoperability in EU harmonized way. This will promote the EU-wide availability and continuity of high-quality traffic information services, since service providers will have a European wide business perspective.

TISGRADE covers the whole data value chain for RTTI data, with WPs 2, 3, 4 and 5 addressing four essential elements of the data value chain:

- Data collection and digitization tooling (WP2)
- Quality validation of static and dynamic datasets (WP3)
- Upgrade of National Access Points (WP4)
- Public private feedback loop (WP5).

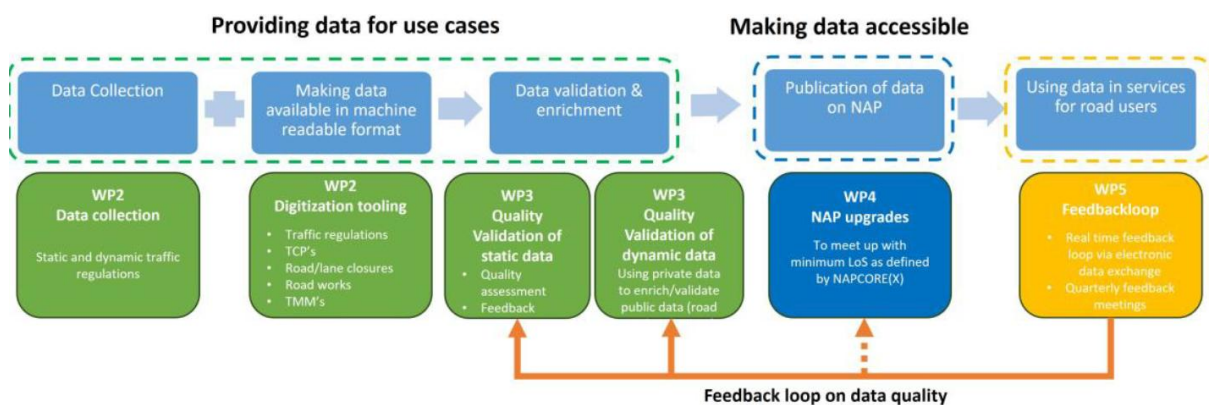


Figure 1. TISGRADE RTTI data value chain

For all involved public and private stakeholders to maximize potential of the revised RTTI Delegated Regulation (2022/670/EU) and the revision of the ITS Directive (2023/2661/EU), it is important that:

- European road authorities make RTTI data EU-wide available in an EU harmonized standards (e.g. DATEX II/TN-ITS) and with a public-privately agreed quality, so that service providers can have a viable business model.
- This data is made easily accessible and findable on NAPs that have (at least) the minimum Level of Service as defined by NAPCORE;
- This data can be processed by service providers in their navigation services towards road users.
- The feedback loop on data quality is operationalized and deployed EU-wide in such a way that service providers (or road authorities) can signal any inaccuracies related to the data without delay to the data holder from which the data originates, and that the data holders in a timely manner correct these signaled inaccuracies.

2.1.2 WP4 in specific

The primary objective of WP4 is to upgrade National Access Points (NAPs) to the minimum LoS (Level of Service), defined by NAPCORE project, to improve interoperability and accessibility of metadata for the RTTI data sets. The LoS Framework aids NAP operators by identifying the current state, gaps and opportunities for improvement. It serves as a roadmap for enhancing NAP features and performance to achieve desired service levels, fostering better harmonization and functionality across EU. In WP4, with the implementation support of TISGRADE, those Member States who scored lower on the scale of LoS KPI assessment have the possibility to increase their level of services.

WP4 enforces and supports the realization of the results and recommendations of NAPCORE project. The upgrades will be done in a harmonized manner to gain a homogeneous performance level throughout Europe, making cross-border data sharing fully accessible for each Member State. Theoretical harmonization will be transformed to practical deployment which will focus on the following practical implementations: IT infrastructure/architecture, metadata standards (mobilityDCAT-AP), cybersecurity, and user experience (UX). The implementation's core objectives consist of bridging the deployment gap and applying technical upgrades. The following main actions will be conducted in WP4:

- Implementation of upgrades of the NAP's in line with the minimum Level of Service of NAPCORE/NAPCORE X, with input of the RTTI taskforce.
- Increase the resilience, reliability, and performance of NAPs (reduce downtime, reduce performance issues, and data latency, optimize data storage architectures).
- Provide technical support on IT development related issues and highlight best practices.

- Support the implementation of interoperability functionalities.
- Enhance the service level of NAPs through individual infrastructure development.
- Develop bulk notification functionality to improve service levels.
- Create a homogeneous version of data exchange versions to reduce data loss between conversion.
- Cybersecurity developments / improvements.
- Extend metadata and implementation of the mobilityDCAT-AP.
- User experience enhancements (visual appearance, homepage improvements, optimizing user journeys).
- Apply data visualization solutions, (e.g. data visualization on a map).
- Implement automatic reporting functions.
- Renew queries and reports functionality for business monitoring of NAP operations.

WP4 covers 5 Tasks, which will be presented in more detail in Chapter 5 “Implementation Roadmap and Timeline”:

- T4.1 – Coordination & Mapping of IT infrastructure and architectures of NAPs
- T4.2 – Implementation of mobilityDCAT-AP
- T4.3 – Improvements of digital transport infrastructure, data standards, DR compliance & cybersecurity
- T4.4 – User experience enhancement
- T4.5 – Description of best IT practices, sample architecture, future improvement needs.

In TISGRADE project, WP4 is linked to WP2 and WP3, as it depends on the availability of structured and validated RTTI data. While it also supports WP5 by making datasets accessible for services used by road users.

In parallel with this document, Deliverable D4.4 is being prepared which provides a structured, implementation-oriented upgrade plan for the digital transport infrastructure supporting NAPs. Its purpose is to consolidate, in a common and practical ways, the main technical needs, legal and compliance aspects, standard-related improvements and cybersecurity and resilience considerations identified across the participating partners, to support future NAP upgrade actions and provide a shared reference point for the task.

2.2 NAPCORE project

NAPCORE (National Access Point Coordination Organization for Europe) project has a significant role in increasing the accessibility, findability and interoperability of mobility data on the NAPs by aligning with all the NAPs in Europe.

NAPCORE project introduced the concept of Level of Service (LoS) of NAPs “to enhance the compatibility and interoperability of National Access Points (NAPs) across Europe”. LoS defines minimum and desired conditions for NAPs and is assessed using a KPI framework developed by NAPCORE. This framework is based on common features observed in existing NAPs and categorizes the features into seven groups:

1. **NAP Access Conditions and Features:** registration processes, user experience, navigability, and visualization.
2. **Communication and Support:** promotion, communication, and user support mechanisms.
3. **Data Discovery:** tools and functionalities for searching and locating datasets.
4. **Maintenance and Updates:** monitoring and managing the updates of datasets.
5. **Dataset Information:** Uniform descriptions of datasets and services.
6. **Interoperability:** use of Metadata catalogues to ensure compatibility.
7. **Data Exchange and Operational Policy:** guidelines for data exchange and operational standards.

In TISGRADE WP4, the LoS KPI framework provides a basis for defining the necessary improvements that must be done to create the public private feedback loop on data quality on the RTTI datasets, including what the role of the NAPs should be in this feedback loop.

NAPCORE also provides best practices and guidelines on data quality, where Data Dictionaries for RTTI - DR (EU) 2022/670¹ and several quality frameworks² can be found, as well as the mobilityDCAT-AP specification to be implemented within the TISGRADE project.

As a final phase of TISGRADE, all best practices and lessons learned from WP4 will be scaled up through NAPCORE, enabling EU-wide adoption and broader impact.

2.3 Other relevant projects

TISGRADE project has a facilitating role for RTTI related (C-)ITS projects, since it will increase the availability and quality of crucial RTTI data, to be used in the (C-)ITS services developed in these projects. In the following subchapters, some related projects are described briefly.

¹ NAPCORE: specific RTTI Data Dictionary: https://napcore.eu/wp-content/uploads/2025/05/DD_2022_670.pdf

² NAPCORE: Quality Online Repository: <https://napcore.eu/quality/>

2.3.1 VERKKO

VERKKO is the European initiative for efficient and sustainable digital traffic management. It brings together 40 partners from 12 European countries to build a unique network of ITS and Cooperative-ITS (C-ITS) implementations and digital infrastructure. The overall objective is to modernize and harmonize transport infrastructure on the Core, Extended Core, Comprehensive TEN-T network, and Urban nodes.

It is important for VERKKO to both cooperate with and take other European initiatives into account. The increased data availability and quality of RTTI data as result of the TISGRADE project, can promote the (C)ITS services developed in VERKKO.

2.3.2 C-Roads Platform

The European C-Roads Platform is a joint initiative of European States, which can be both EU and non-EU Member States, and road operators deploying and operating secured and trusted Cooperative Intelligent Transport Systems (C-ITS) services across Europe to significantly improve the exchange of information between vehicles and road infrastructure.

TISGRADE will align with C-Roads Platform, since the quality needs for RTTI data for ITS and C-ITS services are highly related. Working closely with the C-Roads Platform will ensure the interoperability and harmonization of ITS and C-ITS services.

2.3.3 X4ITS

X4ITS is a European project to develop a connected ITS road network along the Central and Eastern corridors of the Trans-European Transport Network (TEN-T). The project brings together public authorities, cities, public transport operators, rail suppliers, road administrations, and traffic information service providers. The project builds on years of work, starting with the Corridor Project, followed by Crocodile 2 and Crocodile 3, alongside other Crocodile projects in Croatia and Hungary.

The partners are working together on harmonized and synchronized cross-border Intelligent Transport Systems for a better connectivity in Europe which TISGRADE project can support with the increased data availability and quality of RTTI data.

2.3.4 MERIDIAN

MERIDIAN is a CEF-funded project fostering the digitalization of mobility systems focusing on the CEF Core Network Corridors Scandinavian-Mediterranean and North Sea-Baltic. The project focuses on the deployment of digital systems and services, including expansion of digital infrastructure, roll-out of C-ITS, implementation of ITS for bottlenecks on open road and tunnels, digital corridor management and

multimodal services. Its activities contribute to safer, more efficient, and more sustainable traffic management.

The synergies between MERIDIAN and TISGRADE can support better data quality, harmonized data exchange, cross-border traffic information services, and more reliable digital mobility services across the TEN-T network.

2.4 Legal background

This subchapter provides an overview of the most relevant regulations in connection with National Access Points (NAPs) which must be considered during the upgrades of NAPs in WP4.

The ITS Directive 2010/40/EU sets out the conditions for the deployment of interoperable Intelligent Transport Systems (ITS) services across the EU. Its amendment by Directive 2023/2661 strengthens and formalizes the role of National Access Points (NAPs). National Access Point is defined as a digital interface set up by a Member State that constitutes a single point of access to data. NAPs are set up to facilitate access, easy exchange, and reuse of transport related data in Europe, in order to help support the provision of EU-wide interoperable travel and traffic services to end users.

The most relevant act for TISGRADE project under the ITS Directive is the Delegated Regulation 2022/670 (EU) which supplements Directive 2010/40/EU regarding the provision of EU-wide real-time traffic information (RTTI) services. The Regulation establishes the specifications necessary to ensure the accessibility, exchange, re-use and update of data-by-data holders and data users for the provision of EU-wide RTTI services and to ensure that these services are accurate and available across borders to end-users.

In TISGRADE WP4, improvements are supported on all the datasets, not just on RTTI datasets, so the following regulations must also be considered during the implementations:

- Delegated Regulation (EU) 2017/1926 supplementing Directive 2010/40/EU regarding the provision of EU-wide multimodal travel information services (MMTIS). This Regulation was amended through Delegated Regulation 2024/490 regarding the provision of EU-wide MMTIS.
- Delegated Regulation (EU) No 886/2013 supplementing Directive 2010/40/EU regarding data and procedures for the provision, where possible, of road-safety related minimum universal traffic information (SRTI) free of charge to users.

- Delegated Regulation (EU) No 885/2013 supplementing Directive 2010/40/EU regarding the provision of information services for safe and secure parking places for trucks and commercial vehicles (SSTP).

Besides the ITS Directive and its delegated acts, the Regulation (EU) 2023/1804 on the deployment of Alternative Fuels Infrastructure (AFIR) also important, since by 31 December 2024, Member States must ensure that relevant Alternative Fuels data is made accessible on an open and non-discriminatory basis to all data users through their National Access Points (NAPs). The European Commission adopted several delegated and implementing regulations in April 2025 to further develop and harmonize the framework established under AFIR:

- Delegated Regulation (EU) 2025/645 supplements Regulation (EU) 2023/1804 of the European Parliament and of the Council as regards common technical requirements for a common application program interface to enable an automated and uniform data exchange between operators of publicly accessible recharging and refueling points for alternative fuels and data users. The operators may set up the API themselves or use a protocol solution for the API developed by relevant market actors, including third party services. This regulation aims to ensure data interoperability and facilitate real-time data sharing across EU.
- Implementing Regulation (EU) 2025/655 establishes rules for the application of Regulation (EU) 2023/1804 as regards specifications and procedures relating to the availability and accessibility of data on AFI.
- Delegated Regulation (EU) 2025/656 amends Regulation (EU) 2023/1804 by listing applicable standards for wireless recharging, electric road system, vehicle-to-grid communication, and hydrogen supply for road transport vehicles, ensuring that technical innovations are accompanied by compatible data and communication protocols.
- Delegated Regulation (EU) 2025/671 amends Regulation (EU) 2023/1804 by defining further specifications for static and dynamic data for publicly accessible AFI, focusing on hydrogen, liquified methane and charging points.

In addition, there are other specific regulations related to open data, cybersecurity (such as Open Data Directive 2019/1024, NIS2 Directive 2022/2555) which are detailed in Deliverable D4.4.

3 Current situation

This Chapter describes the current situation based on the results of the survey that was sent out to Member States participating in WP4. The questionnaire was developed and distributed jointly with Task 4.3 “Improvements of digital transport infrastructure, data standards, DR compliance and cybersecurity”. The purpose of the questionnaire was to gather information on each partner’s NAP regarding the following aspects:

- its current situation and known challenges.
- relevant infrastructure, architecture, and data exchange practices.
- data discovery and notifications.
- main points related to standards, regulatory compliance, and cybersecurity.
- ongoing or planned improvement initiatives.

Regarding Task 4.1, the key aspects were the current IT infrastructure and architecture of NAPs across Member States to obtain a consistent and comparable overview at EU level. The survey can be found in the Annex.

12 of 15 Member States completed the joint questionnaire who will implement NAP upgrades in TISGRADE WP4. For those who did not complete the questionnaire, data was harvested manually, and the GA statements were assumed to be still valid.

3.1 Overview of the current situation

The following subsections provide an overview of the current IT infrastructure and architecture. Moreover, it summarizes the results of the assessment related to the currently used APIs.

3.1.1 Map of IT infrastructure and architecture

The assessment showed that most National Access Points are built around centralized management of metadata and datasets, supported by API-based data exchange mechanisms and dedicated collection or submission tool for data providers. The level of validation, monitoring and reporting functionalities varies in Member States. Many NAPs use manual uploads and publication processes, indicating that automation remains one of the key areas for further developments. The integration with national registries and open data portals is widespread, enabling alignment with broader national digital ecosystems and facilitating data sharing.

Regarding the architecture models, the most common approach is centralized platform architecture, which is used by 42% of the responding Member States. While distributed architectures account for 25% of the responses, reflecting the need to manage data across multiple systems, organizations, or regions. Hybrid architecture,

which combines centralized and distributed elements, represents the same percentage, while federated architectures are used by below 10%.

Most NAPs operate on cloud-based infrastructures which provide scalability, flexibility and high availability, while on-premises infrastructures are also common. Some Member States also reported the use of modular architecture, caching mechanisms, redundancy mechanisms and continuous performance monitoring to further enhance operational resilience and service continuity. Backup and disaster recovery mechanisms are also implemented in some Member States.

Regarding interoperability, a broad range of European and national standards are currently applied. DATEX II is the most widely adopted standard, followed by mobilityDCAT-AP, TN-ITS, NetEX/SIRI and GTFS/GTFS-RT. In most cases, the data providers connect to the NAP manually or with direct upload interface, while nearly half of responding Member States stated that they use API-based integration. The most common APIs that are implemented in NAPs are REST and SOAP. Regarding the authentication mechanisms, several NAPs use API keys, OAuth/token, but in some cases registration with username and password is needed for the authentication.

The assessment also showed that data discovery functionalities are established across the surveyed NAPs. Search and filtering capabilities are available in nearly 90% of NAPs. However, user notification services are less mature and less consistently implemented. Half of the responding Member States do not provide any user notification functionalities, while in 3 Member States automated notification services are available, and 3 Member States use manual notification processes. Regarding the notification mechanisms, e-mails are the most common way, but some NAPs use portal-based notifications to inform users about dataset updates, changes in availability or newly published content.

3.1.2 Dataset domains

Based on the assessment, the number of available datasets in Member States' National Access Points for RTTI, SRTI, MMTIS, STTP and AFIR varies significantly.

Real-time Traffic Information (RTTI) datasets show a wide range from only 1 dataset in some Member States to 100-150 datasets in others. Most countries have between 3 and 40 RTTI datasets, indicating various levels of maturity and data coverage.

The number of Safety-Related (minimum universal) Traffic Information (SRTI) dataset is lower and more consistent, typically ranging from 1 to 14 datasets. While Multimodal Travel Information Services (MMTIS) datasets show the greatest discrepancy. Several Member States provide 1-20 datasets, while one Member State reports 250 MMTIS datasets.

Regarding Safe and Secure Truck Parking (SSTP) datasets, the availability in the NAPs is the lowest. Most Member States report between 0 and 5 datasets, indicating either limited deployment of STTP services or a more centralized approach to the publication of this information.

Alternative Fuels Infrastructure Regulation (AFIR) datasets range from 0 to 50 datasets. Most countries provide only a few data sets, while one Member State stands out with significantly broader AFIR coverage. However, when it comes to AFIR data, it is also possible that a single dataset may contain data from multiple charging point operators or mobility service providers.

In conclusion, the results demonstrate considerable differences in dataset availability among Member States. The results suggest that the maturity level of NAPs, the number of contributing data providers and national implementation approaches significantly influence the volume of datasets made available under each delegated regulation.

3.2 Identified Gaps and Challenges

The assessment of the current situation across participating Member States shows that most NAPs support multiple delegated regulations or data domains. Most NAPs still function primarily as metadata directory, and only a limited number of NAPs offers advanced functionalities such as automated validation, monitoring, reporting, or integrated data storage. Although some NAPs are tightly integrated with national systems/registries, the overall level of development remains uneven across countries.

The main challenges are data availability and coverage, particularly regarding traffic data and completeness of datasets made available through NAPs. Many Member States reported difficulties in estimating maturity, coverage, or readiness. Regarding operational challenges, in many NAPs the back-office capabilities, automation and reporting are limited. In addition, resource and budget constraints further hinder the development of more advanced functionalities and the modernization of underlying technical infrastructures.

Several Member States faced challenges related to interoperability and integration. The integration with other national systems and the alignment with European initiatives are limited. In some countries, fragmented architecture creates additional complexity as well. Some governance-related issues were also highlighted, including unclear ownership structures and insufficient stakeholder engagement. In addition, several Member States have raised concerns regarding cybersecurity and operational resilience, which will be one of the project's key areas for improvement.

Overall, the baseline assessment demonstrated that further developments are required to improve data availability, increase automation, strengthen validation and monitoring capabilities, enhance interoperability, improve cybersecurity, and establish more sustainable operational models.

4 Planned improvements

The planned improvements for each Member State were initially defined and submitted as part of the Grant Agreement. These planned activities have been reviewed and grouped into - based on the scope and expected impact of their planned NAP upgrades- two main categories: major and minor upgrades. The distinction between major and minor upgrades is based on several key aspects, such as knowledge, technical understanding, and feasibility (e.g. required resources, timelines, etc.). In WP4, there are also some participating Member States who will not implement; however, they will support the others with their expertise.

The planned upgrades in each Member State, as presented below, follow the categorization and include updates provided by the Member States since the start of the project. However, as technical discussions are still ongoing, changes may occur in the planned developments.

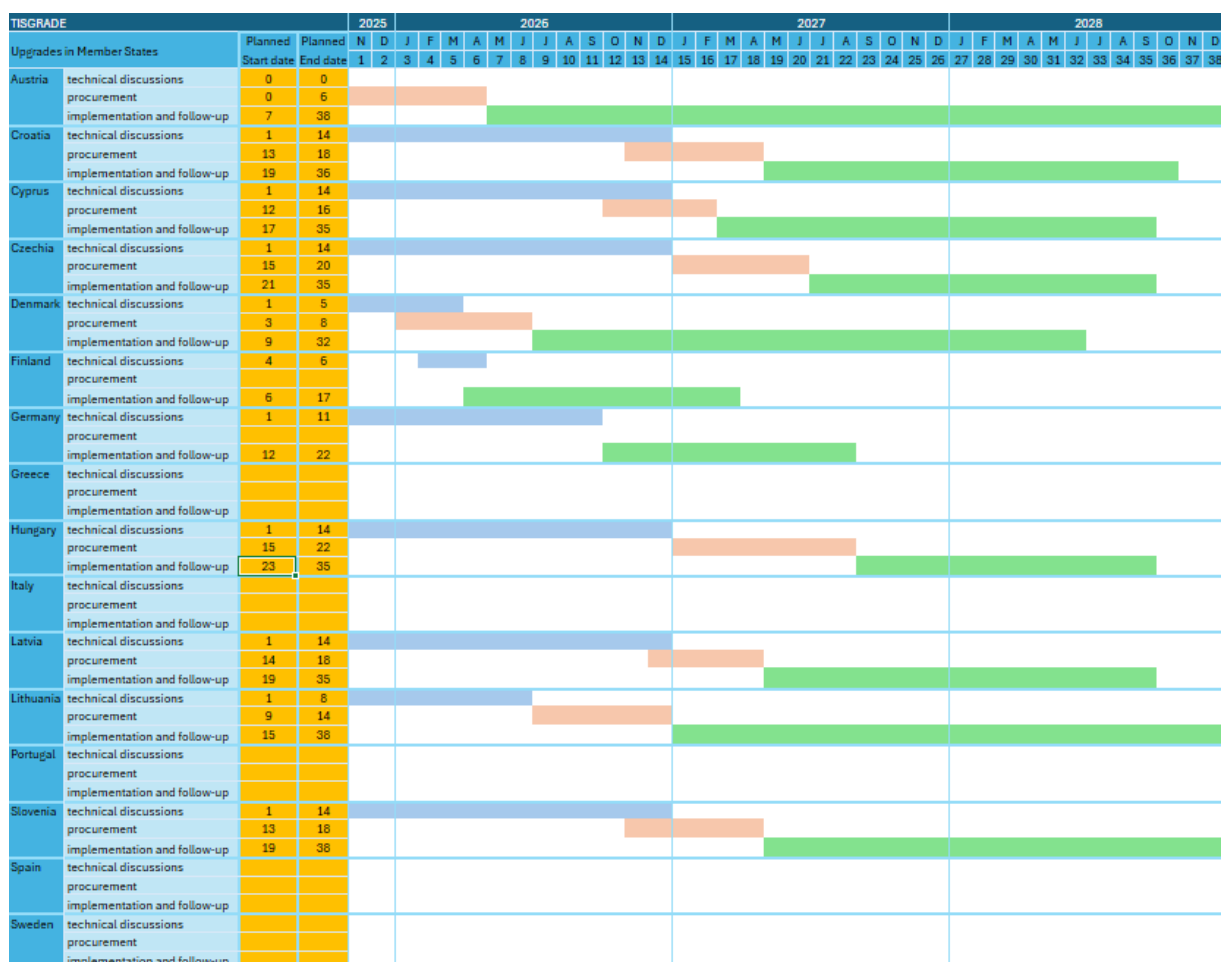


Figure 2., Timeplan of the individual improvements as of 2026.Q2

4.1 Major upgrades planned

Major upgrades typically involve significant changes to the NAP, such as the introduction of new features, major architectural changes, or the integration of new data domains. These updates require a higher level of technical effort, coordination, and investment.

This table shows the major upgrades that Member States plan to implement in the project.

Member State	Planned upgrades
Austria	• Implementation of MobilityDCAT-AP V3.0 • Implementation of EUID(eIDAS) • Usability upgrade for data publisher and data consumer • New data consumer features • Adoption to new KPI framework of NAPCORE • Cooperation with Austrian Mobility Dataspace • Harvesting of other NAPs • Support functionalities of Austrian National Body
Croatia	• Improve the usability, accessibility, and navigation of the Croatian NAP through a better user interface and updated metadata workflows. • Use artificial intelligence to automate ITS Directive reporting and improve data quality, compliance, and interoperability. • Develop AI-based support services for users, end users, and data providers. • Develop a national stop point registry for the Croatian NAP to support harmonized public transport data exchange in line with MMTIS requirements. • Develop a national system for collecting, validating, and publishing alternative fuels infrastructure data for the Croatian NAP in line with AFIR and ITS requirements.
Cyprus	• Mapping of metadata elements and vocabularies: aligning metadata elements and vocabularies from national non-conformant or proprietary systems with mobilityDCAT-AP and converting metadata entries to better align the national needs • Handling of "mandatory", "recommended" and "optional" elements: ensuring correct categorization and handling of these elements. • Automation and support: facilitating compliant metadata entry by implementing a mobilityDCAT-AP RDF model, with features for machine-readable metadata import/export and compliance validations using (probably) SHACL
Czechia	A large-scale NAP upgrade including: • MobilityDCAT-AP integration, implementing catalogue harvesting and exposure functionalities, and creating tools for validity checks and automatic conversions from non-mobilityDCAT-AP sources. • Full implementation of NAP back-office systems, focusing on enhancing user and data management capabilities. On-the-fly and scheduled testing capabilities of the user entered information. Infrastructure improvements to enhance resilience and cybersecurity. Implementation of organizational and technical enhancements to

Member State	Planned upgrades
	improve interactions with state registry for user verification and Czech Open Data Portal Implementation of the data provider interface, and of the data consumer interface to align with mobilityDCAT-AP standards, enhancing search, display results, and communication with data providers. Implementation of metadata validation visualization, incorporating user and validation feedback into catalogue entries. Provision of a user forum for feedback. Dissemination, and tracking data usage in projects. NAP visualization enhancements with statistics and graphs and creation of generic NAP content, texts and methodologies, along with promoting new data and projects
Denmark	- Implement/update mobilityDCAT-AP and catalogue harvesting. - Implement new user login using eID - Increase usability (defining user groups and using insights from user tests) - Supporting the role of the NAP operators - Supporting the role of the National Body - Better look and feel for the users searching for datasets. - Better look and feel when providing or updating metadata (better workflow)
Finland	- Build single NAP IT infrastructure for RTTI, SRTI, MMTIS and AFIR based on NAP Level of Service (LoS) Key Performance: Indicator Framework (NLKF) and NAP Reference Architecture (NRA) - Implement/update mobilityDCAT-AP and catalogue harvesting. - Implement secure user management for data providers and data consumers. - Enhance data/metadata input workflows and tools. - Integrate data validation tools to NAP
Germany	Two upgrades are prioritized and are planned to be realized within TISGRADE runtime: (1) Automated quality checks for metadata: The NAP system checks the metadata entries, as entered by data providers via the system's GUI, against defined validation criteria e.g. "Is a standard license available? If so, is a recommended standard license being used?". Depending on the validation results, various actions may be triggered: - user interactions (e.g. warnings in case of missing metadata) - additional GUI labels per dataset (e.g. quality metrics or a "quality certificate") - administrative reporting (e.g. consolidated statistics on validations of all datasets) (2) AI Chatbot: The chatbot will allow for searching datasets, asking questions, and seeking help about the NAP usage. The goal is to enhance the user friendliness and efficiency when using the NAP system. It will also ease discovery of datasets, considering the many datasets on the system, and the restricted search capabilities on the GUI. This feature will complement existing data-search and user-help functions (i.e. dataset filter mechanism, user guideline, FAQ)
Hungary	Enforce NAPCORE results and recommendations such as:

Member State	Planned upgrades
	- o ensuring interoperability and automatic collection of metadata - o develop bulk notification functionality to improve service levels. - o extend metadata. - o user experience enhancements - o apply data visualization solutions. • Renew queries and reports functionality for business monitoring of NAP operations. • Implement the mobilityDCAT-AP
Latvia	• Alignment of the NAP with the minimum NAPCORE Level of Service (LoS), to the extent possible • Development and performance improvement of the NAP infrastructure • Strengthening cybersecurity and system security • Improvement of data governance and standards • Enhancement of data exchange and interoperability • Development of user experience and access solutions • Quality assurance, including audits, testing and evaluation
Netherlands	• Upgrade to mobilityDCAT-AP v3.0 x • Implementing an AI-chatbot to help users of the NAP by searching datasets and their context • Automated import of existing datasets from other Dutch DCAT-portals • AI-assisted automatic generation of ITS compliance reports, derived from metadata available in the NAP.
Slovenia	• Upgrade of nap.si website accessibility in compliance with Directive (EU) 2016/2102 • Implementation of the NAP.si metadata according to the mobilityDCAT-AP, at the same time aligning the digital procedure for data compliance assessment with the catalogue • TN-ITS data validation procedure to assure good quality for service providers. • Improve the NAP.si interface, improve searchability of the data and align the NAP.si architecture according to the NAPCORE

Table 1. Major upgrades planned in Member States

4.2 Minor upgrades planned

Minor upgrades, on the other hand, involve enhancements to existing systems. These may include the optimization of current features, minor extensions or adjustments that do not fundamentally alter the system's architecture or operation.

This table shows the minor upgrades that Member States plan to implement in the project.

Member State	Planned upgrades
Greece	Minor IT developments on the NAP according to the recommendations of NAPCORE
Lithuania	Minor IT developments on the NAP according to the recommendations of NAPCORE
Spain	The development of NAP is planned, but not funded from TISGRADE budget
Sweden	- Minor IT developments on the NAP according to the recommendations of NAPCORE - Upgrade the mobilityDCAT-AP to version 3.0 - Replace CKAN with another solution

Table 2. Minor upgrades planned in Member States

4.3 No upgrade planned

In WP4, there are some project partners who have not planned any implementations. In general, during the project timeline they will support the other Member States implementing their own upgrades with knowledge sharing. In case of Italy, a new partner is currently entering the project, and until the submission of this deliverable they could not take any official position on the WP4 related technical activities.

Member State	Planned upgrades
BE_MOBILE	No Implementation
BE_CEDR	No Implementation
BE_ERTICO	No Implementation
BE_NGI	No Implementation
DE_BMDV	No Implementation
HR_MTC	No Implementation
HU_MINISTRY	No Implementation
IE_GOOGLEMAPS	No Implementation
IT_SPE	No Implementation
IT_EXYOND	No Implementation
NL_HERE	No Implementation
NL_TOMTOM	No Implementation
SE_GBG	No Implementation

Table 3. No upgrades planned in these entities

5 Implementation Roadmap and Timeline

In WP4, the implementations mentioned in the previous chapter will be conducted in 3 main tasks and 2 supporting tasks. This Chapter gives an overview of the implementation phases of NAP upgrades and provides a comprehensive timeline for all the implementations planned by Member States.

5.1 Implementation phases of NAP upgrades

The implementations will be conducted through three main phases. However, as project partners operate independent IT systems, implementation activities will be conducted in parallel according to partner-specific timelines while remaining aligned with the overall project milestones. The overview of each Member States' upgrade timeline is available in the Annexes.

5.1.1 Joint technical discussions and detailing of scope and support.

The first phase focuses on coordination, technical alignment, and the detailed specification of improvements. During this period, partners will jointly discuss the scope of the developments, clarify technical requirements, define support needs, and outline the relevant architectural and methodological considerations. The main objective of this phase is to establish a collective understanding of the planned upgrades and to create the necessary working structures for the effective cooperation among the partners.

5.1.2 Individual procurements and preparation of implementation

The second phase will cover the partner-specific procurement and preparation activities required before the actual implementation can start. This may include the preparation of technical documentation, approval processes, the launch and publication of procurement procedures, supplier selection, contracting and the preparation of development environments. The exact timing may vary between partners, since these processes depend on national, partner-specific requirements.

Throughout this phase, WP4-level coordination will continue to ensure that preparation processes remain aligned with the overall objectives of the WP4. Technical support and regular exchanges will be provided in each Task.

5.1.3 Parallel implementation and follow-up, feedback loop and fine tuning

This third phase will focus on the parallel implementation of the planned developments by the partners, followed by testing, validation, feedback collection, and fine-tuning. The WP4 partners will conduct their individual implementations which will be monitored at regular intervals with the monitoring tool developed by

Task 4.1. The partners will also share their implementation experiences within the WP, highlighting main challenges and lessons learned.

5.2 Detailed descriptions of WP4 Tasks

5.2.1 Task 4.1 Coordination and mapping of IT infrastructure and architecture of NAPs

The main goal of Task 4.1 is to coordinate the implementations within other WPs between tasks and external projects in a harmonized manner. Task 4.1 serves as an umbrella task for all the other Tasks in WP4, and it does not carry out developments or harmonization work, except what is necessary for coordination. The Task supports the implementing countries by providing background guidance, facilitating coordination, and ensuring that the implementation activities are aligned with the objectives of WP4.

The Task includes the assessment of Member States' current IT infrastructure, architecture and currently used APIs for different datasets. Task 4.1 contributes to defining how to meet the minimum Level of Service (LoS) defined by NAPCORE as well as the necessary improvements that have to be done to create the public private feedback loop on data quality on the RTTI datasets (WP5), including what the role of the NAPs should be in this feedback loop.

As a key activity, T4.1 will regularly monitor the processes of the NAP upgrades of each participating Member States. The monitoring tool is already prepared, and this tool will be updated every 3 months to gather the actual status of each NAP upgrade. Each Member State will be asked to present the implemented upgrades as well when the implementations are done. The presentations can help other partners and provide input for Task 4.5. Besides these activities, this task also provides feedback on the implementation carried out to other WPs and projects.

5.2.2 Task 4.2 Implementation of mobilityDCAT-AP

The objective of Task 4.2 is to support and facilitate the adoption of mobilityDCAT-AP by interested Member States and National Access Point operators. By promoting a common Metadata approach, the task may contribute to improved metadata interoperability, machine-readable information exchange, and enhanced discoverability of mobility datasets across Europe. The task could also help reduce implementation effort through the sharing of experiences, reusable components, and common practices.

5.2.2.1 Stage 1 – Prepare and Align

The initial stage may focus on establishing the organizational, technical, and governance foundations necessary for mobilityDCAT-AP adoption. This could involve

identifying interested NAP operators, assessing implementation readiness, and reviewing existing metadata structures and technical environments. A support framework, such as a helpdesk or expert network, may be established to facilitate knowledge sharing and provide guidance during planning and design activities. Existing metadata models, vocabularies, and extensions could be analyzed and mapped against the mobilityDCAT-AP information model, potentially resulting in implementation guidance, migration considerations, and recommendations that may support future deployment activities.

5.2.2.2 Stage 2 – Implement and Validate

The second stage may focus on supporting practical implementation activities within individual NAP systems. Depending on national priorities and available resources, metadata repositories could be aligned with the mobilityDCAT-AP information model, while metadata management processes and user interfaces may be adapted to facilitate compliant metadata creation and maintenance. Quality assurance mechanisms, such as completeness checks, validation procedures, controlled vocabularies, and plausibility checks, could also be considered. Furthermore, metadata exchange capabilities may be enhanced through import/export services, harvesting mechanisms, and interoperable interfaces. Testing and validation activities could help assess technical and semantic compliance and identify opportunities for improvement.

5.2.2.3 Stage 3 – Reuse, Scale and Sustain

The final stage focuses on capturing implementation experiences and encouraging the reuse of solutions across the European NAP ecosystem. Outputs from individual deployments, including mapping approaches, validation rules, software extensions, API specifications, and user interface concepts, will be documented and shared through common repositories where appropriate. Such artefacts may serve as examples or reference implementations for future adopters. The support framework established during earlier stages could continue to evolve as additional implementation experience becomes available. Over time, these activities may contribute to a more interoperable and sustainable ecosystem for mobility metadata exchange while supporting further harmonization between Member States.

5.2.3 Task 4.3 Improvements of digital transport infrastructure, data standards, DR compliance and cybersecurity

The objective is to support the planning, coordination and follow-up of improvements to the operational capabilities, standards compliance, and cybersecurity posture of European National Access Points (NAPs). Through structured upgrade planning, implementation support and exchange of good practices, the task contributes to making NAP more robust, reliable, interoperable, and secure, while recognizing that

implementation choices, technical architectures, procurement processes and timelines remain specific to each Member State / NAP operator. Task 4.3 focuses on digital transport infrastructure, data standards, Delegated Regulation compliance and cybersecurity-related needs. It supports upgrades related to NAP back-office systems, data and user management, validation and quality support, monitoring and reporting, standards versioning, secure data exchange, and operational resilience. It does not prescribe one common technical solution for all NAPs but provides a harmonized planning framework to support nationally adaptable implementations.

5.2.3.1 Stage 1 – Assess, Plan and Harmonize

The first stage focuses on preparing the ground for NAP operators for the upcoming upgrades by assessing existing technical capabilities, identifying compliance gaps, and aligning implementation plans with NAPCORE recommendations. Particular attention is given to the adoption of common standards such as DATEX II and TN-ITS, the requirements stemming from the ITS Delegated Regulations (RTTI, SRTI, SSTP and MMTIS), and emerging obligations related to cybersecurity and digital resilience. The aim is to support harmonized directions and comparable planning, rather than to impose identical deployment paths across Member States. This stage is linked to T4.1, which provides the broader mapping and coordination of NAP infrastructure and architecture, and to D4.4, which consolidates the initial Digital Transport Infrastructure Upgrade Plan.

5.2.3.2 Stage 2 – Deploy and Upgrade

The second stage focuses on supporting the implementation and follow-up of planned upgrades in the practical implementation of the required enhancements within individual NAP systems. The concrete implementation work is conducted by the respective Member States / NAP operators, according to their national context, technical setup, funding, procurement rules and internal priorities. Depending on the needs identified by each NAP, the upgrades may include improvements to digital transport infrastructure and back-office systems, user and data management processes, metadata and data exchange mechanisms, validation and quality support, monitoring and reporting capabilities, and alignment with relevant NAPCORE recommendations. Where applicable, this may also include the integration of specialized tools or components, such as the Urban Vehicle Access Regulation (UVAR) toolbox and other relevant NAPCORE solutions and improving user and data management processes. The deploy and upgrade phase may include migration to newer standards versions, improved support for DATEX II, TN-ITS or other relevant formats, and stronger alignment between technical implementation and Delegated Regulation compliance needs. . In parallel, cybersecurity measures are addressed or

strengthened considering NIS2 requirements, national obligations, and NAPCORE best practices, improving the resilience and security of NAP operations.

5.2.3.3 Stage 3 – Validate, Operate and Scale

The final stage focuses on monitoring progress, consolidating lessons learned and supporting the sustainable operation of the implemented upgrades. Validation in this context should be understood as the review and follow-up of implemented improvements against the planned objectives, relevant standards, operational needs and available KPI-based references, although formal compliance verification, certification or technical auditing remains outside the scope of this task. Compliance with relevant standards, Delegated Regulations requirements, and cybersecurity requirements may be supported through reporting, quality assurance procedures, and operational monitoring, where these are applicable and available within each NAP. Lessons learned, implementation artefacts, and best practices are collected and shared across the NAP community to support future deployments and continuous improvement. Through ongoing cooperation and knowledge exchange, NAP operators can further enhance interoperability, maintain regulatory compliance, and ensure that their systems continue to evolve alongside emerging European mobility data requirements.

5.2.4 Task 4.4 User experience enhancement

Task 4.4 focuses on the systematic enhancement of the user experience (UX) and user interface (UI) of National Access Points (NAPs). The objective is to upgrade front-end components and, where required, associated back-end services to improve usability, reachability, searchability, and data reuse for both data providers and data consumers.

The task covers the full interaction layer of NAPs, including metadata entry workflows, dataset publication, catalogue search and filtering, subscription mechanisms, visualization components, user guidance, and operator back-office tools. It also includes UX-related content updates, user feedback mechanisms, and usability testing.

All developments must align with the NAP Level of Service KPI Framework (NLKF), the NAP Reference Architecture (NRA), and the technical outputs of other WP4 tasks. The overarching goal is to support Member States in deploying coherent, technically sound UX improvements while ensuring cross-task harmonization and avoiding duplicated reporting.

Task 4.4 is structured into two technical subtasks T4.4.1 – Implementation and T4.4.2 – Implementation Support.

5.2.4.1 *Implementation*

This subtask covers the design, development, deployment, and documentation of UX/UI enhancements by individual partners. Activities include:

- implementation of frontend and related back-end changes,
- integration of mobilityDCAT-AP-aligned metadata structures into UI components,
- deployment of improved search, filtering, visualization, and guidance features,
- reporting of progress, deviations, and technical issues through WP4 channels.

5.2.4.2 *Implementation Support*

This subtask provides the coordination and harmonization layer for UX activities. It includes:

- exchange of UX patterns, mockups, screenshots, and implementation artefacts,
- alignment with T4.1 (architecture) and T4.5 (best practices),
- identification of reusable components and common design approaches,
- consolidation of materials into a shared UX blueprint.

5.2.4.3 *Planned activities within the task:*

2026 – Baseline and alignment

- Establishment of the working structure and shared repository
- Collection of partner plans and existing UX artefacts
- Initial definition of UX KPIs and classification of UX-relevant activities
- **Workshop 1:** presentation of planned enhancements and initial harmonization

2027 – Development and technical exchange

- Continuous implementation under T4.4.1
- Regular technical exchanges during WP4 meetings
- **Workshop 2:** mid-term review of implementations, cross-task alignment, and identification of reusable components
- Ongoing consolidation of UX materials for the blueprint

2028 – Finalization and consolidation

- Completion of UX/UI deployments
- **Workshop 3:** final presentation of results and lessons learned.
- Integration of outputs into the T4.4 final report and contribution to T4.5 best practices

Throughout the project, Task 4.4 remains nonrestrictive, and implementation driven, enabling partners to develop UX improvements autonomously while ensuring technical coherence and shared learning across the consortium.

5.2.5 Task 4.5 Description of best practices, sample architecture, future improvements need identified

The objective is to consolidate the knowledge, lessons learned, implementation experiences, and technical results generated throughout the project into a common framework for future National Access Point (NAP) developments. By capturing best practices, defining reference architecture, and identifying future improvement needs, the roadmap aims to support Member States in planning and implementing harmonized NAP upgrades, achieving a consistent level of service across Europe, and preparing future investment and funding initiatives.

5.2.5.1 Stage 1 – Consolidate Knowledge and Establish a Common Vision

The first stage focuses on collecting and analyzing the findings generated throughout WP4 and other relevant work packages. Technical experiences, implementation outcomes, lessons learned, and operational feedback are reviewed to identify successful approaches and usual challenges. Building on this knowledge, a reference architecture for National Access Points is developed, describing the recommended technical building blocks, data exchange mechanisms, interoperability interfaces, governance principles, and operational capabilities required for modern NAP systems. The resulting recommendations are aligned with NAPCORE objectives and provide feedback to the NAPCORE Level of Service KPI Framework (NLKF), helping to establish a common vision for future NAP developments across Member States.

5.2.5.2 Stage 2 – Define Best Practices and Harmonized Upgrade Approaches

The second stage focuses on transforming implementation experiences into practical guidance that can be reused by all Member States. Best practices are documented for metadata management, data harvesting, data exchange, storage, integration, quality assurance, standards compliance, and interoperability with external data portals. Particular attention is given to emerging regulatory requirements, including the Multimodal Mobility Services Regulation (MMTS), and to solutions supporting seamless data exchange between NAPs and other European data ecosystems. Recommendations are also developed for reusable tools, modules, and architectural components that can accelerate future deployments and support harmonized upgrades while allowing flexibility for national requirements.

5.2.5.3 Stage 3 – Plan Future Evolution and Sustainable Growth

The final stage focuses on identifying future improvement needs and supporting the long-term evolution of National Access Points. Existing bottlenecks, technical limitations, organizational challenges, and emerging requirements are analyzed to define priority areas for future development. Based on these findings, recommendations are prepared for dynamic and flexible upgrade roadmaps that can be adapted to the specific needs of individual Member States while maintaining

overall European harmonization. The resulting guidance also serves as a foundation for future funding initiatives, including CEF proposals and national investment plans, ensuring that NAP development remains aligned with evolving European policies, standards, and operational requirements.

5.3 Expected outcomes.

The expected outcomes of WP4 and its tasks by the end of the project are as follows:

- **Coordinated NAP upgrades (T4.1)** in accordance with the Grant Agreement, mapped, coordinated and harmonized implementations will be carried out in all the tasks and subtasks. The outcome is a coordinated roadmap that supports Member States in improving their NAPs and contributes to better interoperability, data quality especially on RTTI and compliance across Europe.
- **Mobility DCAT-AP (T4.2):** The successful execution will lead to a significant increase in the adoption of mobilityDCAT-AP across Europe, resulting in higher metadata quality, greater interoperability between National Access Points, and more efficient metadata exchange mechanisms. By providing reusable implementation components and a coordinated support framework, the roadmap will reduce deployment effort for individual Member States while fostering a harmonized European approach to mobility metadata management. Ultimately, this will improve the discoverability, accessibility, and reuse of mobility datasets and strengthen the digital foundations of the European mobility data ecosystem.
- **Improvements of digital transport infrastructure (T4.3):** This will result in upgraded and future-proof National Access Points that provide improved digital transport infrastructure, stronger compliance with European data standards and delegated regulations, enhanced metadata and data quality, more efficient reporting capabilities, and a significantly improved cybersecurity posture. By harmonizing deployments and promoting the reuse of best practices, the roadmap will contribute to a more interoperable, secure, and resilient European mobility data ecosystem. The Deliverable D4.4 Digital Transport Infrastructure Upgrade Plan is already developed which provides a structured, implementation-oriented upgrade plan for the digital transport infrastructure supporting NAPs.
- **User experience enhancement (T4.4):** The completion of this task will result in implemented UX enhancements and a technical implementation report per partner and in a collected UX documentation, examples, and a consolidated final report summarizing UX enhancements across the consortium
- **Best practices and sample architectures (T4.5):** This will deliver a comprehensive and openly accessible reference document describing best IT

practices, recommended NAP architectures, interoperable data exchange solutions, and future development priorities. It will provide Member States with practical guidance for planning and implementing both individual and harmonized NAP upgrades, support the achievement of a consistent NAP Level of Service across Europe, and contribute to the creation of a more interoperable, resilient, and future-proof European mobility data ecosystem.

6 Next steps, follow up

This roadmap provides a strategic direction for the evolution of National Access Points but does not define the detailed technical, organizational, or financial measures required for implementation. As a next step, the roadmap will be translated during the continuation of the project work, into concrete action plans at both European and national levels, including detailed requirements, implementation schedules, governance arrangements, resource planning, and success indicators. Regular reviews will be conducted to assess progress, capture lessons learned, and adapt priorities to emerging regulatory, technological, and operational developments.

The results of the Work package and achievements will be summed up in D4.2. which is due in 2028 Q4, when the project is also coming closer to its end. Besides D4.2, the following deliverables will be developed by 2028 Q4:

- **D4.3 Final report on mobilityDCAT-AP implementations**, addressing also issues and future improvement needs by Task 4.2
- **D4.5 Final report and recommendations on NAP upgrades with cybersecurity improvements** by Task 4.3
- **D4.6 Final report on UX upgrades** and enhancements by Task 4.4
- **D4.7 Description of best IT practices and future NAP improvement needs** by Task 4.5. This document will serve as a reference for Member States to enhance their NAP infrastructure, align with EU-wide standards, and suggestions for yearly NAP upgrade plans and potential solutions for data exchange and harvesting. This will be an open document, shared with all the Member States, providing the possibility for individual or harmonized upgrades to reach homogenous NAP Level of Service across the European Union.

7 Conclusion

The proposed roadmap establishes a coherent and progressive framework for strengthening National Access Points (NAPs) across Europe through three complementary streams of activity: the adoption of mobilityDCAT-AP, UX upgrades, the enhancement of digital transport infrastructure and cybersecurity, and the consolidation of best practices and future development recommendations, **contributing to the creation of a harmonized, interoperable, secure, and future-proof European mobility data ecosystem.**

- The first pillar focuses on the implementation of mobilityDCAT-AP as the common metadata framework for NAPs. Through expert support, metadata harmonization, technical implementation, validation, and knowledge sharing, Member States will be able to adopt a common semantic model that improves metadata quality, machine-readability, discoverability, and interoperability. This will significantly facilitate cross-border data exchange and reduce implementation effort through the reuse of common solutions and best practices.
- The second pillar addresses the evolution of NAPs as critical components of Europe's Digital Transport Infrastructure. By upgrading back-office systems, integrating specialized tools and services, strengthening standards compliance, and implementing advanced cybersecurity measures, NAPs will become more resilient, reliable, and capable of supporting future regulatory and operational requirements. The roadmap ensures alignment with evolving ITS standards, delegated regulations, data exchange mechanisms, and cybersecurity obligations, thereby increasing the overall level of service delivered by NAPs.
- The third pillar captures and consolidates the knowledge generated throughout the implementation process. Lessons learned, reference architecture, technical recommendations, reusable components, and identified improvement needs are transformed into a common framework that can guide future NAP developments. This enables Member States to benefit from proven implementation approaches while maintaining sufficient flexibility to address national requirements and priorities.

Taking together, these roadmap activities establish a continuous improvement cycle consisting of harmonization, implementation, validation, knowledge sharing, and future planning. The expected result is a European network of National Access Points that operate according to common standards, provide high-quality and interoperable mobility data services, maintain a strong cybersecurity posture, and continuously evolve in response to emerging technologies, policies, and user needs. The roadmap therefore not only supports the achievement of current NAPCORE objectives but also

provides a strategic foundation for future investments, coordinated upgrades, and the long-term sustainability of the European mobility data ecosystem.

8 References

8.1 Figures and tables

Figures

Figure 1. TISGRADE RTTI data value chain	4
Figure 2. Timeplan of the individual improvements as of 2026.Q2.....	15

Tables

Table 1. Major upgrades planned in Member States	18
Table 2. Minor upgrades planned in Member States	19
Table 3. No upgrades planned in these entities	19