OJP4DANUBE

DEPLOYMENT STRATEGY AND OJP PROFILE

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INTRODUCTION

Today, thanks to Intelligent Transport Systems (ITS), EU citizens can access a broad range of travel information about transport services that lead to a safer, more coordinated, and more efficient use of the overall transport system. However, in order to meet demands for seamless door-to-door travel within the EU, there is a growing need for the application of ITS technologies to further enable the rollout of cross-border multimodal travel information services in an integrated and interoperable way. In other words, to effectively address the diversification of citizens' mobility needs, there is a need to bring travel information from existing local and national journey planning services to a single transnational system.

In practice, technical interoperability and organizational differences were identified as the main obstacles to integrating transnational travel information services. In particular, the interoperability of local journey planner systems needs to be ensured based on unified standards. To achieve this, EU travel information service providers (TISPs) have been asked to implement the Open Journey Planner (OJP) standard in order to enable accurate and timely cross-border, door-to-door, and multimodal information exchange about public transport services together with other active, shared and micromobility transport solutions.

To support the resolution of these interoperability issues, a key requirement concerning EU strategic policies is the need for policymakers to ensure EU local journey planners adhere to the OJP standard and implement the needed data structures of the OJP profile.

In order to transfer this knowledge to the policy level and to future adopters, the OJP4Danube brochure presents an innovative implementation of the OJP API in pilots to take place in existing journey planners of six countries along the Danube (AT, CZ, HU, SK, SL, RO). This document reports features of required digital infrastructure, tools, and services as well as the OJP4Danube strategic action plan to develop a long-term organizational structure of multimodal cross-border travel information networks.

ABOUT OJP4DANUBE

The Danube Region is lacking an integrated multimodal journey planner across public transport motorized modes (road, rail, water transport) together with emerging micromobility modes. To address this gap, the OJP4Danube project introduces mechanisms to better coordinate transport operators and travel information service providers to integrate their journey planning services.

The core focus of the OJP4Danube project is to connect railway corridors to cycling routes and to provide travel information relevant for travellers willing to combine rail with cycling in the planning of cross-border trips.

A linked network of transport services within the Danube region enables multimodal local trips as well as long-distance journeys with environmentally-friendly modes, including cycling and inland waterways. The innovative approach of Linking of Services was initially applied in the LinkingDanube project (2017-2019), where the feasibility of harmonized cross-border information exchange based on the OJP API was investigated. As a follow-up project, OJP4Danube provides an operational multimodal, OJP-based travel information service through the integration of bicycle routing as well as the linking of rail and cycling services (e.g. taking a bicycle onboard) in the Danube region.

In accordance with the project objectives, 14 partners from 8 Danube region countries are working together within the OJP4Danube consortium to tackle the common challenge of unconnected travel information service networks as well as the interoperability issue of the systems and to simplify journey planning for end users within the Danube region.

Figure 1: The concept of linking services, simplify journey planning for end users (Source: LINKINGDANUBE project)


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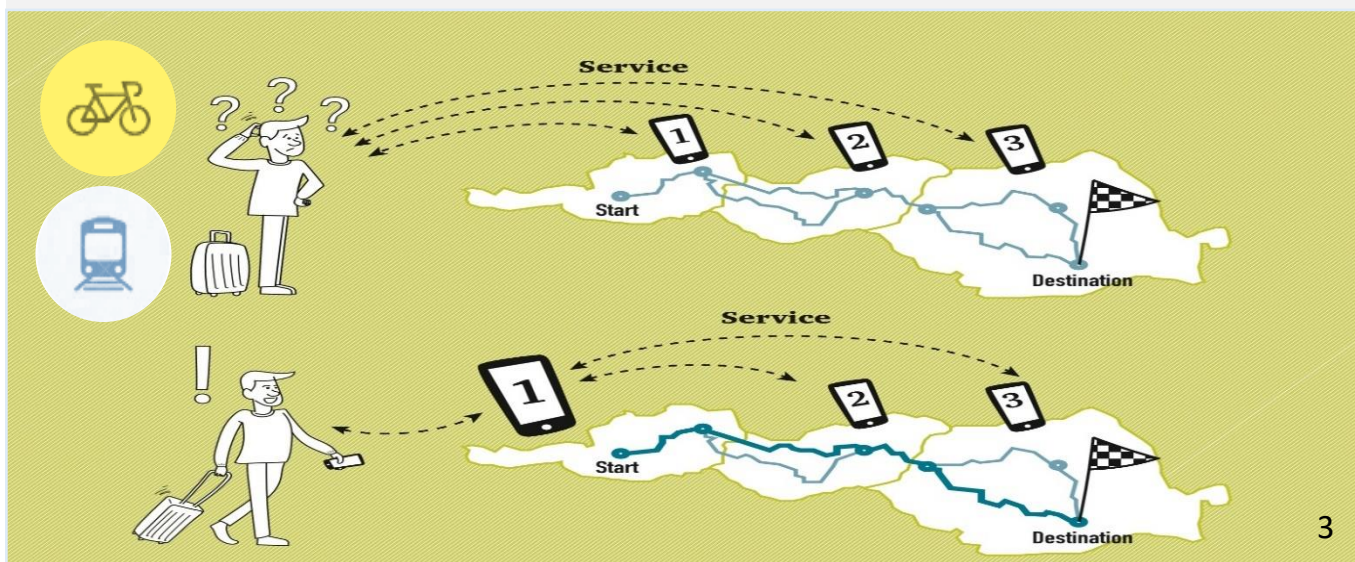
PART I. OJP4DANUBE DEPLOYMENT STRATEGY

The strategy of OJP4Danube intends to ensure a harmonised deployment of OJP (Open Journey Planning) in the involved countries and will set out the organisational and technical framework for a long-term operation of cross-border information exchange between the key actors in multimodal travel information (VAO, ZSSK, LUR, GYS, GLI, ELS, PUT, and KOR).

The strategy map (see figure 2) describes the OJP4Danube deployment strategy and the interrelationships of its individual components. Based on the legal framework defined by the EU and the technical standards developed from EU specifications, stakeholders and future adopters can derive policy and IT requirements that they must fulfil to become part of the OJP network. To perform distributed journey planning, the technical standard requires to select between a decentralised (centrally distributed) or fully distributed system architecture. Based on the selected architecture, an appropriate governance structure (e.g. network, platform, or association) is needed to enable the collaboration and operation of the OJP service (the collaboration structure). Together, the governance and collaboration structures enable the definition of organisational processes. These processes regulate concrete operational processes and lead to the full description of stakeholder roles, responsibilities and tasks in an OJP network.

Figure 2: OJP4Danube strategy map (Source: AustriaTech).

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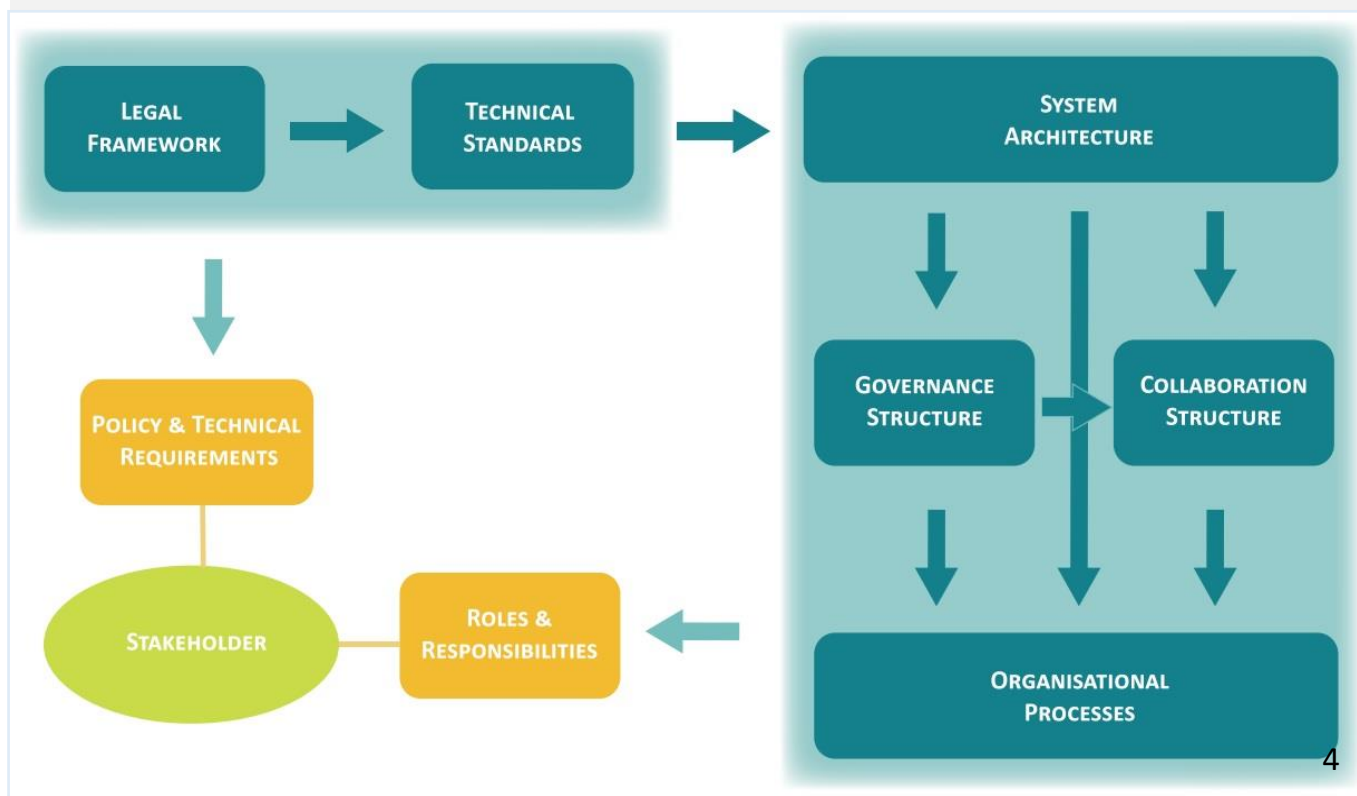
LEGAL FRAMEWORK AND TECHNICAL STANDARDS

Currently, European traveller information services provide only very limited routing information for cross-border travelling, which does not sufficiently meet the high cross-border travel demands by both tourists and cross-border commuters. To extend the geographical coverage of full door-to-door travel information services and to unlock the full potential of multimodal and integrated rail mobility solutions, the European Union has established a legal framework, called the **ITS Directive Delegated Regulation**. This framework provides standards and specifications that define the detailed provisions and procedures to implement EU-wide multimodal travel information services, including access to travel data.

The Delegated Regulation also recommends measures supporting the linking of local, regional and national travel information service providers (TISPs) through a standardised interface. This interface is based on the **CEN/TS 17118:2017 standard "Open API for distributed journey planning (OJP)"** [1] and it also defines **National Access Points (NAPs)** to make scheduled travel data and other key transport data available at national level in every country in the EU. Based on this recommendation, to fully use the potential of a NAP and enable the linking of services, TISPs should make data available in standard formats like NeTEx, SIRI or DATEX II or other compatible formats. These standards are issued by European standardisation bodies and the European Commission to guarantee the interoperability of passenger information.

In line with this legal framework and technical standards, OJP4Danube aims for an operational OJP service in the Danube Region and focuses on the implementation and piloting of basic requirements for the integration of bicycle routing as well as the linking of rail and cycling services as part of a multimodal, OJP-based travel information service.

The OJP4Danube system, henceforth called OJP4Danube Journey Planner (OJP4D), aims at becoming a link between the services provided by existing national journey planners to offer extended trip planning solutions going beyond the coverage of any single local journey planner. The OJP4D is connected to a web service via an OpenAPI interface, which allows sending back the combined routing results to the linked local systems. The common OpenAPI interface will also need to be integrated into each one of the local journey planners to ensure requests from the OJP4D can be answered in a standard format and in a timely way.

[1] http://www.normes-donnees-tc.org/wp-content/uploads/2017/01/TC_278_WI_00278420_E-RS-170118-final3.pdf

SYSTEM ARCHITECTURE

The system architecture to be applied in OJP4Danube closely relates to the concept of a centrally distributed journey planner and it is based on existing local, regional or national JPs that will collaborate exchanging travel and routing information using OJP standardised interfaces. Figure 3 depicts the system architecture of the OJP4Danube service, including the following main components, as one of the key outputs of project.

- **Home system (passive system):** an existing LJP that will be part of the decentralised network of JPs established through OJP interfaces.

- **Active systems (central OJP router):** a travel information service that can perform the distributing routing task and provider of the information to the end users.

- **Complete systems**: JPs that will have both functionalities as passive system and active systems.

- **Danube Region Journey Planner app**: a web portal/mobile app to provide the distributed journey services to the End-Users.
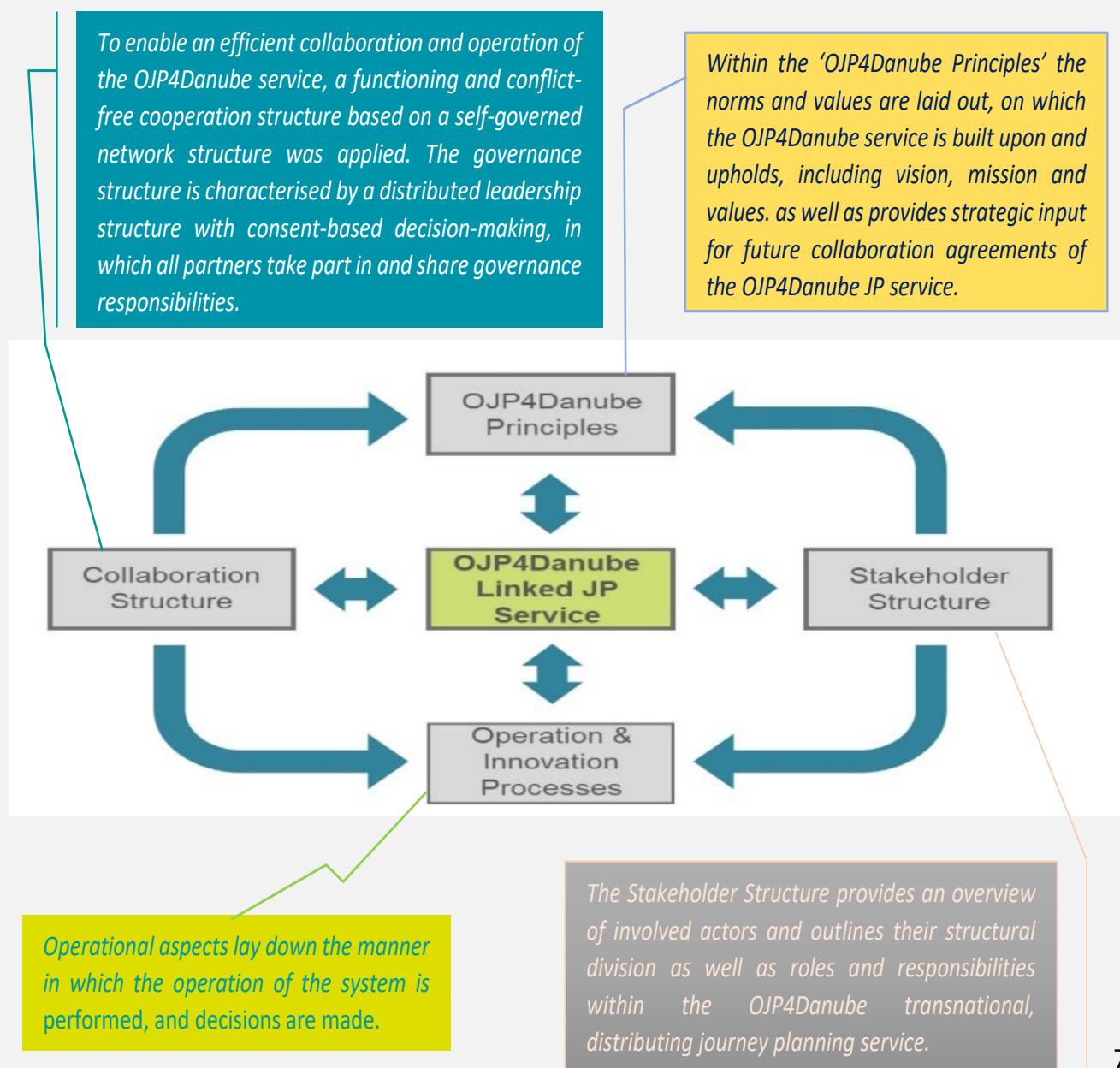
Figure 3: System architecture for OJP4D (Source: AustriaTech).
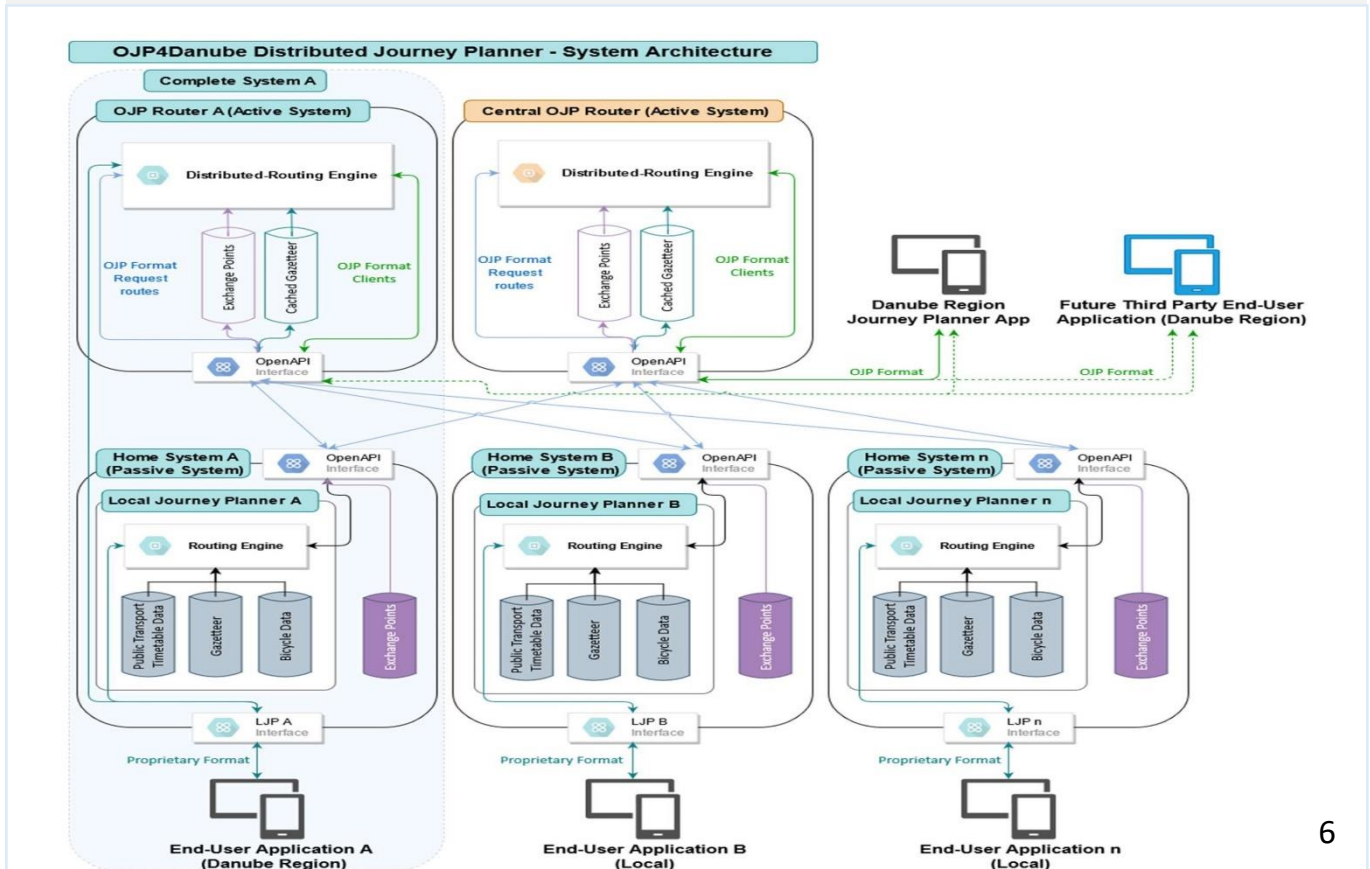
ORGANISATIONAL ARCHITECTURE

The organisational architecture as a cohesive framework complements the technical architecture and provides an essential element to ensure a durable and resilient operation of the OJP4Danube service also beyond the project duration. Figure 4 shows a conceptual approach that provides a starting point for the elaboration of the OJP4Danube organisational architecture and outlines the conceptual key elements necessary to establish a comprehensive organisational architecture for a self-governed and decentralised journey planning service.

Figure 4: Conceptual approach (Source: AustriaTech).

To enable an efficient collaboration and operation of the OJP4Danube service, a functioning and conflict-free cooperation structure based on a self-governed network structure was applied. The governance structure is characterised by a distributed leadership structure with consent-based decision-making, in which all partners take part in and share governance responsibilities.

Within the 'OJP4Danube Principles' the norms and values are laid out, on which the OJP4Danube service is built upon and upholds, including vision, mission and values. as well as provides strategic input for future collaboration agreements of the OJP4Danube JP service.

Operational aspects lay down the manner in which the operation of the system is performed, and decisions are made.

The Stakeholder Structure provides an overview of involved actors and outlines their structural division as well as roles and responsibilities within the OJP4Danube transnational, distributing journey planning service.
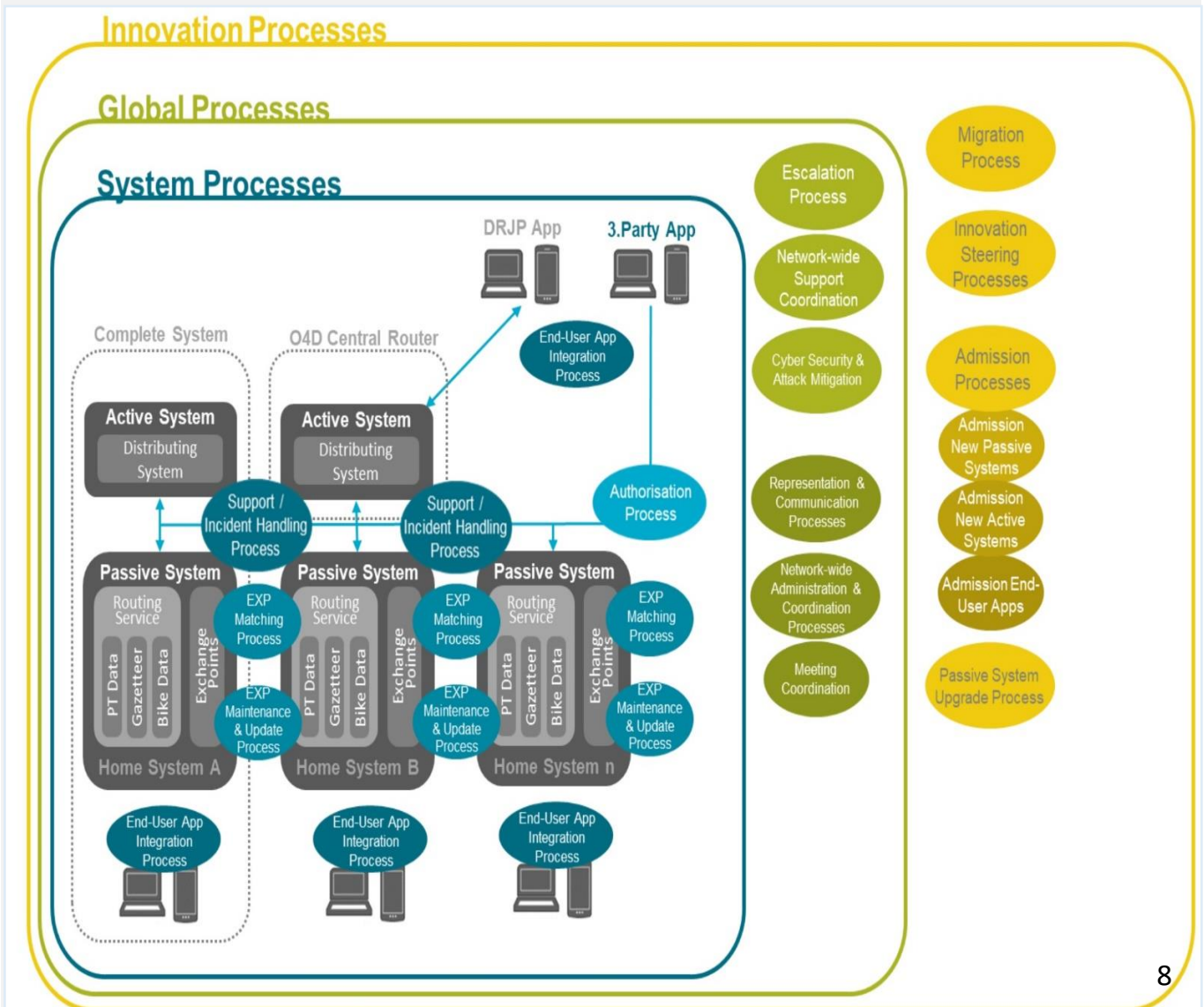
ORGANISATIONAL PROCESS ARCHITECTURE

The technical architecture is used as a base and is complemented with an organisational process layer, to illustrate the systemic relevance of the individual processes on multiple levels. Data and insights generated during technical discussion within the OJP4Danube project as well as from other OJP projects (e.g. LinkingAlps) showed that essential organisational processes to operate the OJP4Danube service take place on the systems level and the global/network-wide level (see Figure 5). The systems level refers to processes, which are relevant for the individual participating systems or for the direct collaboration between systems, while the global or network-wide level covers operational as well as innovation processes concerning all participating systems and stakeholders.

Figure 5: Organisation processes architecture (Source: AustriaTech).

For the analysis of the organisational structure of the OJP4Danube service, a user-centric perspective was applied. Within the organisational structure, the involved stakeholders and their roles and responsibilities are major elements. In the stakeholder structure (see Figure 6) categories were built, to create a generalised stakeholder model. The model shows that the OJP system is constituted at the moment of one active system (ELS), however, the Slovenian project partners proposed to also adapt their local journey planner to an active system, with the aim of becoming a complete system.

ELS operates on the back end, as well as the front end, which means that ELS has the role of OJP Implementer as well as OJP User. KORDIS, VAO, ZSSK, GYS hold the role as OJP Implementer, but as passive system on the back end of the service. A diverse range of supporting actors are involved in the development of the OJP4Danube service but are also necessary for the after-project operation and innovation of the service.

Figure 6: OJP4Danube stakeholder structure (Source: AustriaTech).
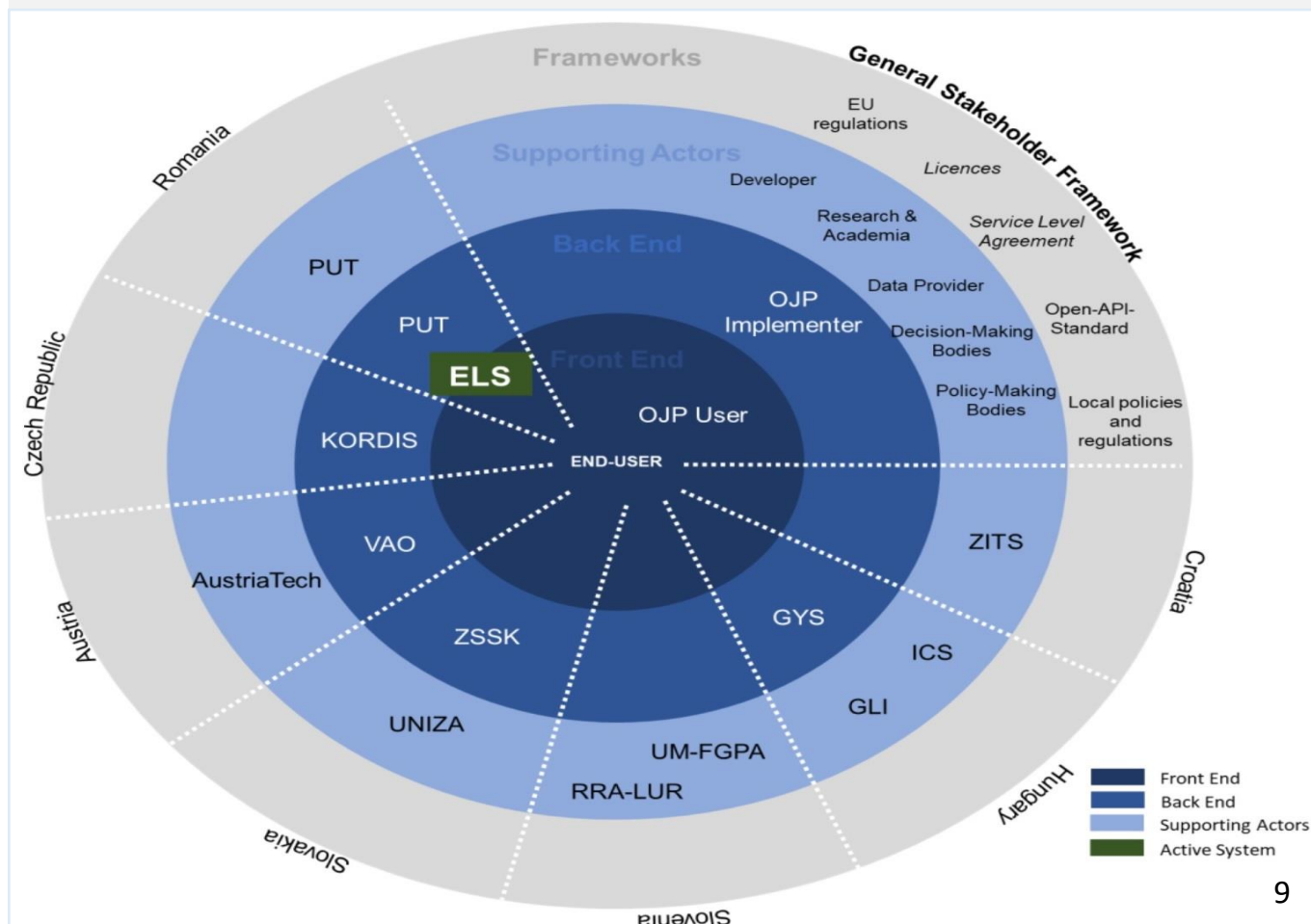
PART II. OJP PROFILE

When applying EU standards for data exchange, there is always a need to define a particular structure and syntax of exchanged information. **This concretisation of a broad standard to a specific exchange application is referred to as "profile".** For instance, profiles are also applied in exchange frameworks like DATEX II, NETEX and SIRI.

In connection with the OJP4Danube deployment strategy, the development of an **OJP profile** is a key element to allow cross-border information exchange, including the exchange of active mobility options (e.g. cycling routes and services) as an innovative application of OJP which is not yet well supported in Europe. Providing a tested and viable OJP profile supports not only the implementation of pilots, but will serve as a basis for further OJP implementation across Europe. The consortium develops the OJP4Danube OJP Profile which aims to define a specific subset of (XML) data elements following a clearly arranged structure in accordance with the OJP standard (CEN/TS 17118:2017) and defined using XML schemas. The schemas include all functionalities required for an OJP interface in order to enable communication with the OJP4Danube distributed journey planning system. Additionally to the provided XML schema of the OJP standard and its provided annexes, the OJP4Danube OJP Profile also consists of a minimum content specification and a documentation of how the standard is applied. The profile provides information on how the exchanged requests and responses (and contents) of the API are to be applied in the implementation for the specific use cases defined for OJP4Danube, particularly in terms of combining rail and cycling transport services. In this sense the OJP4Danube OJP Profile defines the content and the structure of the information content as well as the physical exchange format.

The specifications of the OJP4Danube OJP Profile are the result of discussions and developments in the OJP4Danube project, building upon existing and relevant standards and specifications to apply for building OJP services. The main references considered are as follows:

- **CEN/TS 17118:2017:** public Transport - Open API for distributed journey planning and related schema files (xsd-files). Additionally, also technical discussion and information on the standard that can be found in the related forum of VDV and the GitHub.
- **Network and Timetable Exchange (NeTEx):** passenger Information European Profile (prTS 16614:PI Profile - TC WI 00278457)
- **LinkingDanube Specification:** relevant LinkingDanube documentation and deliverables (OJP4Danube D.T1.1.1 Ex ante report)
- **LinkingAlps Specification:** linkingAlps_D.T1.5.1_(OJPProfile)_V2-00.pdf   (incl. Annex); D.T1.3_4_RequirementsDocument_CLEAN.pdf

OJP4DANUBE OJP PROFILE SPECIFICATION

The ongoing OJP specification activity intends to provide an aligned OJP profile enabling harmonised deployment of OJP in the involved countries, with the potential for further exploitation by other Member States and organisations. This task is split into two parts: the first part is devoted to the development of an aligned OJP profile (completed at the time of writing this brochure), and the second part is the update of the OJP profile that will be performed after implementation and testing of the OJP services in the pilots (2022).

In connection with the development of the profile, the LinkingDanube OJP profile has been used as a basis. It is worth noting that this profile needs to be extended with regard to the data and quality requirements coming from the use cases defined within the OJP4Danube project. In other words, OJP4Danube OJP profile must be characterized in accordance with extended information exchange including new modes (e.g. train, cycling, e-scooters etc.) and other related travel services information (e.g. whether taking a bicycle onboard a train is possible, whether bicycle parking is available at stations etc.).

Based on a mapping of the information content (schemas) with the local system's data and information as well as inputs provided by OJP implementers, the consortium implemented required specifications in the OJP profile through applying the following restrictions:

- Restricted data (IDs, dates, geolocations, locale codes, error codes) formats

- Unified location name formats

- Restricted message structures

- Minimum content specification

The first part of the profile specification activity resulted in deliverable D.T2.3.1 OJP Profile, which will be the basis for the implementation in the 6 OJP pilots. In addition, DT2.3.1 OJP Profile - Annex I and DT2.3.1 OJP Profile - Annex II describe the OJP profile message structure and minimum content specification, respectively.

After implementation of OJP in pilots, the consortium will update the profile and publish the final profile that can be used as a European Minimum Profile. It will also be made available over the OJP4Danube E-learning web tool and other learning interactions.

OJP SUPPORTED
SERVICES IN OJP4DANUBE

Out of the seven services defined by the OJP standard, four services (LocationInformation, ExchangePoints, Trip, MultiPointTrip) will be implemented and three services (StopEvent, Fare and TripInfo) will not be used within the scope of OJP4Danube. However, it should be noted that this service is likely to be included at some point in the future. For the sake of complete documentation, the names of the related OJP schema files and a short description for each service are given as well.

Table 1: OJP services and OJP schema references.

Service name	Service in OJP CEN/TS 17118:2017	XML Schema file	Supported OJP4D in
OJPLocationInformation	Location information	OJP_Locations.xsd	Yes
OJPExchangePoints	Exchange points	OJP_Locations.xsd	Yes
OJPTrip	Trip request	OJP_Trips.xsd	Yes
OJPMultiPointTrip	Distributed journey planning	OJP_Trips.xsd	Yes
OJPTripInfo	Trip/Vehicle information	OJP_TripInfo.xsd	No
OJPStopEvent	Departure board	OJP_StopEvents.xsd	No
OJPFare	Ticket price calculation	OJP_Fare.xsd	No

These are the result of the mapping of the LJP with the OpenAPI Technical Specification. It represents an excerpt of available data collected from project partners for each of the relevant (LJP) in order to determine the available information for the OJP4D System. The original list of UI features relevant for combining rail with active mobility which are already supported by some or all of the OJP4Danube project TISPs is provided in the deliverable D.T1.1.1 Ex-ante report. The UI features supported in the OJP4Danube OJP Profile are listed in D.T2.3.1.

OJP4DANUBE OJP PROFILE VALIDATION

Due to the implementation of the OJP profile within operative environments, applying validation tools is a key factor to facilitate the harmonised development of OJP4Danube services in the involved countries and aid future OJP4Danube implementors. Therefore, the project contributes to evaluating the developed OJP profile by assigning the following three validation tools:

- **Online documentation tool** provides the combined documentation information about both the standard OJP XML schema, as well as formats and restrictions specific to the OJP4Danube Profile (D.T2.3.1) on a unified user interface.

- **Mock-up API** provides developers with a tool where they can review what systems take part in the journey planning process, what endpoints these systems must implement and what messages traverse through these endpoints, both as request and response messages.

- **Automated Validation tool** allows for developers to interactively test their interfaces, with test cases covering multiple endpoints and scenarios including but not limited to schema and profile validation, custom type validation, latency, and performance testing.

These three components differ in function, but they form a fully integrated online tool [2] that supports the OJP developers within six remote development teams working on the OJP service implementation in the countries. Table 2 presents an overview of features implemented in LinkingDanube and OJP4Danube validation tools.

Table 2: The LinkingDanube and OJP4Danube validation tool features.

Feature	LinkingDanube	OJP4Danube
Sample XML messages	✔	✔
Self-documenting sample XML messages		✔
OJP Profile documentation tool		✔
Custom data format documentation		✔
Mock API	✔	✔
OJP schema validation	✔	✔
OJP Profile validation		✔
Custom data format validation		✔

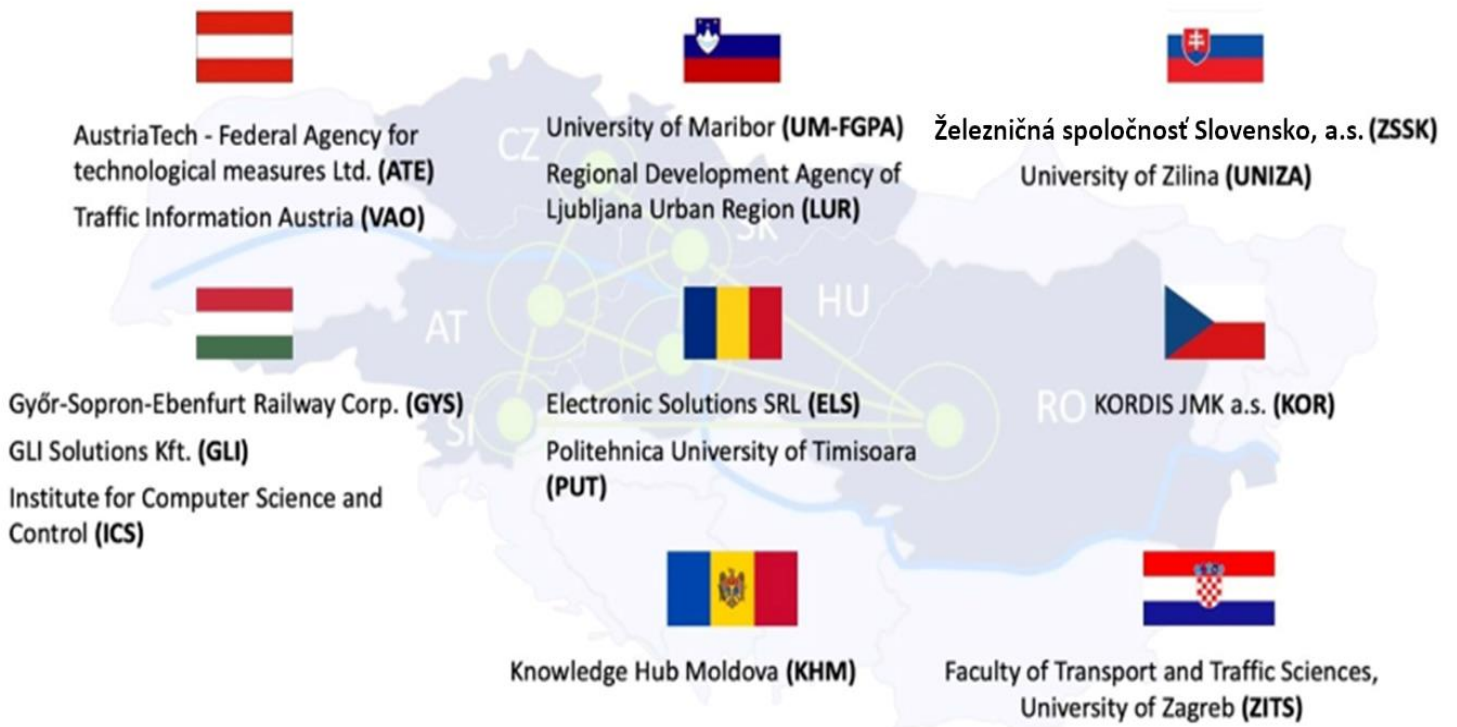[2] https://ojp4danube.hbit.sztaki.hu

CONCLUSION

The OJP4Danube deployment strategy is compliant with the overall EU legislative framework in terms of policy, standards, system architecture, governance, collaboration and process. It will help decision makers and OJP (Open Journey Planning) API implementers to learn and share knowledge about standard solutions for exchanging information and ensuring interoperability between transnational journey planning services already implementing OJP. Each step of the strategy is shortly summarized below.

1. *Policy: the EU formulates its declaration of intent of "linking services" in its directives and documents. The implementation of these legal requirements and the set up of a responsible authority in the participating countries is mandatory.*

2. *Standards: the Delegated Regulation recommends linking local, regional, and national travel information service providers (TISPs) including the provision of interfaces to exchange routing requests and results. Based on this recommendation, TISPs will use the Open API standard for distributed journey planning.*

3. *System architecture: the chosen "centrally distributed" system architecture influences all further processes and collaboration. Therefore, the decision about the desired system architecture must be well thought out and agreed upon by all partners.*

4. *Governance: a governance structure is necessary to enable the collaboration and operation of the transnational Journey Planner services. To ensure the configuration of the service after the end of the project, a suitable governance structure must be enabled.*

5. *Collaboration: a functioning and conflict-free cooperation is based on basic rules and guidelines. Based on the selected governance structure, a collaboration structure must be established where feasible cooperation frameworks are set.*

6. *Process: organizational processes can be considered the connecting link between the technical architecture and the cooperation structure. Providing specific processes ensures a functioning collaboration between all partners and clear distribution of roles.*

Considering the very important role of exchanging information between implementers enabling cross-border information exchange, **the OJP4Danube OJP profile** was jointly developed by the OJP implementers and partners of the project. In the course of the development of the OJP profile, regarding the linking of rail and bicycle as well as the stronger integration of bicycle routing, OJP4Danube builds on existing standards, specifications and profiles in order to promote a harmonised, Europe-wide implementation. Organisational action plans within OJP4Danube defines measures on how the strategy can be implemented on an operational and institutional level on a wider scale in order to pursue further integration of journey planners across Europe.

This deployment strategy developed by OJP4Danube provides a basis for cooperation in a transnational, distributed journey planning network as well as an overview of the main requirements necessary for future adopters to be a part of this network.

Project partners

AustriaTech - Federal Agency for technological measures Ltd. **(ATE)**

Traffic Information Austria **(VAO)**

University of Maribor **(UM-FGPA)**

Regional Development Agency of Ljubljana Urban Region **(LUR)**

Železničná spoločnosť Slovensko, a.s. **(ZSSK)**

University of Zilina **(UNIZA)**

Győr-Sopron-Ebenfurt Railway Corp. **(GYS)**

GLI Solutions Kft. **(GLI)**

Institute for Computer Science and Control **(ICS)**

Electronic Solutions SRL **(ELS)**

Politehnica University of Timisoara **(PUT)**

KORDIS JMK a.s. **(KOR)**

Knowledge Hub Moldova **(KHM)**

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