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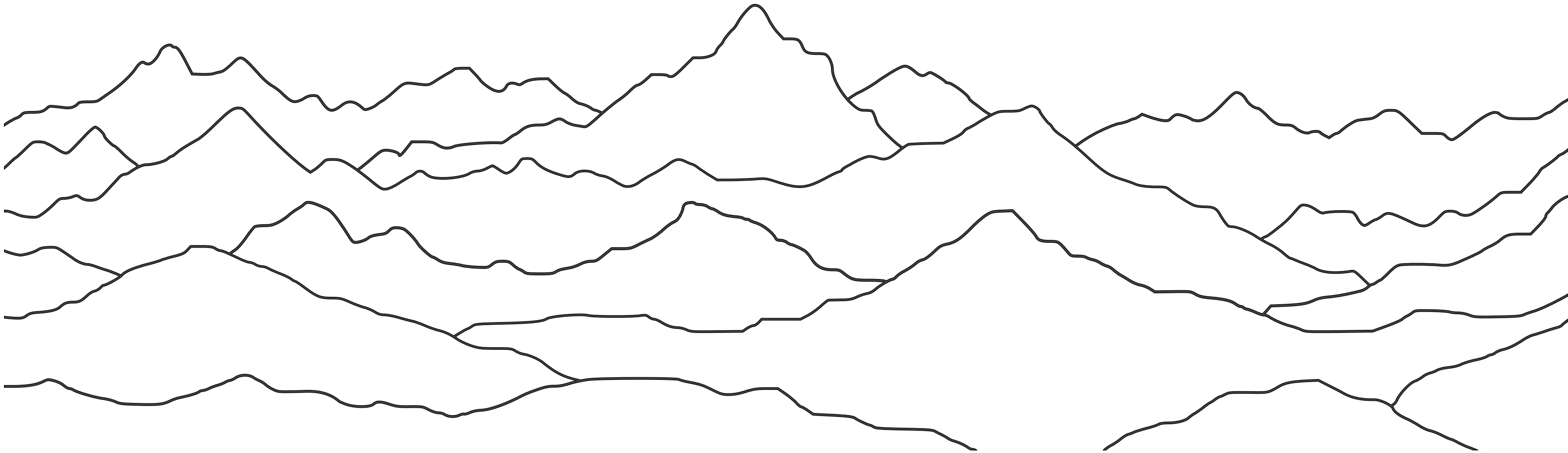

LinkingAlps
Decision Support Handbook for Future Adopters

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LINKINGALPS - DECISION SUPPORT HANDBOOK FOR FUTURE ADOPTERS

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FOREWORD

Low carbon mobility options are part of the solution for minimizing the negative impacts associated with transportation. Promoting and enabling access to information that can assist travellers to privilege and use sustainable modes of transport is at the core of our project, LinkingAlps. LinkingAlps - Innovative Tools and Strategies for Linking Mobility Services for a Decarbonised Alpine Space is a project that belongs to the Interreg Alpine Space programme. Additional information can be found at: https://www.alpine-space.eu.

Information on routes, available modes of transport, timings and connections often is available to travellers (tourists and commuters) from different sources - travel information service providers. The difficulty of combining different options in a travel plan in a unique, reliable, and streamlined service (particularly in cross-border journeys) often demotivates passengers to search for more sustainable ways to travel.

The development of a standardised exchange service of travel information between the individual travel information service providers is one of the main goals of the LinkingAlps project. This way, information can be exchanged between individual information systems and compiled into a continuous travel chain. Travelers can, as a result, view the entire trip from start to destination on a single service, and the shift from individual motorized transport modes to low carbon mobility options is better supported. Using innovative tools and transnationally aligned strategies linking information mobility services, the options for low carbon mobility will increase. The project approach includes pilot activities and testing for a decentralised, transnational journey planning system.

The LinkingAlps Decision Support Handbook should be viewed as an implementation guide for the "linking of services" approach and a strategic decision support tool for operators. Technical and organisational decisions are explained, and implementation aspects are detailed.

The Handbook is conceived and designed to assist of the LinkingAlps services, namely travel information service providers, and data owners and suppliers. Professionals, operators, technicians, associations, public or private organizations and the general interested public can find in this document know-how to enhance their workflows and practices, expanding their knowledge on the thematic of multimodal transportation and related services.

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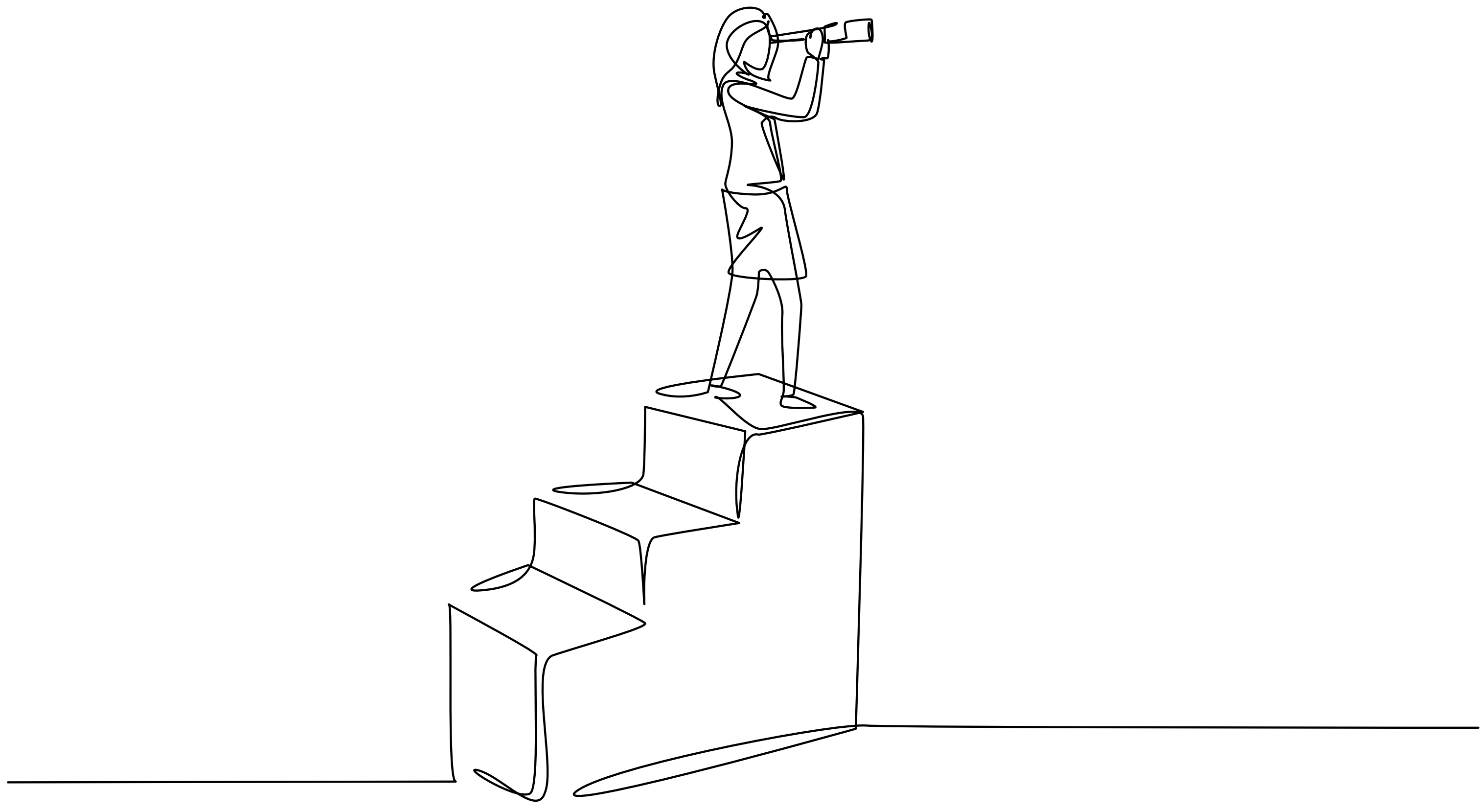


1. Introduction

One significant difficulty when planning a journey across borders is finding the transport options available in each country and region, travellers often face the problem that travel information is not visible for the entire route.

LinkingAlps created an Alpine-wide standardised exchange service of travel information to tackle this issue. Thanks to this service, it is now possible to compile the information provided by the individual information systems into a continuous travel chain, allowing people to access all travel information through their usual transport information portal.

This exchange service will be based on the Open Journey Planning (OJP) approach, which is fully compliant with the provision of the Delegated Regulation 2017/1926 on the provision of EU-wide multimodal travel information services, that is supplementing the European ITS Directive (2010/40).

LinkingAlps encourages the shift from individual cars towards low carbon mobility options like public and on-demand transport by easing the information search.

The LinkingAlps project

LinkingAlps – Innovative tools and strategies for linking mobility information services in a decarbonised Alpine Space

Based on the Open Journey Planning API tested in the LinkingDanube project and its general findings, the LinkingAlps project kicked off in November 2019, bringing together 14 partners from six Alpine Space countries (Figure 1):

- AustriaTech – Federal Agency for technological measures ltd. (Lead partner) – (AT)
- Traffic Information Austria – (AT)
- Transport Association of Tyrol Ltd. – (AT)
- STA – South Tyrolean Transport Structures – (IT)
- LINKS Foundation - Leading Innovation & Knowledge for Society – (IT)
- Regional Agency for Innovation and Purchasing Ltd – (IT)
- Metropolitan City of Turin – (IT)
- Regional Development Agency of the Ljubljana Urban Region – (SI)
- University of Maribor, Faculty of Civil Engineering, Transportation Engineering and Architecture – (SI)
- SBB Swiss Federal Railways – (CH)
- Federal Office of Transport – (CH)
- Transport and Energy agency Canton Grison – (CH)
- Cerema - Centre for Studies and Expertise on Risks, Environment, Mobility, and Urban and Country planning – (FR)
- Consulting company for control, information and computer technology GmbH – (DE)

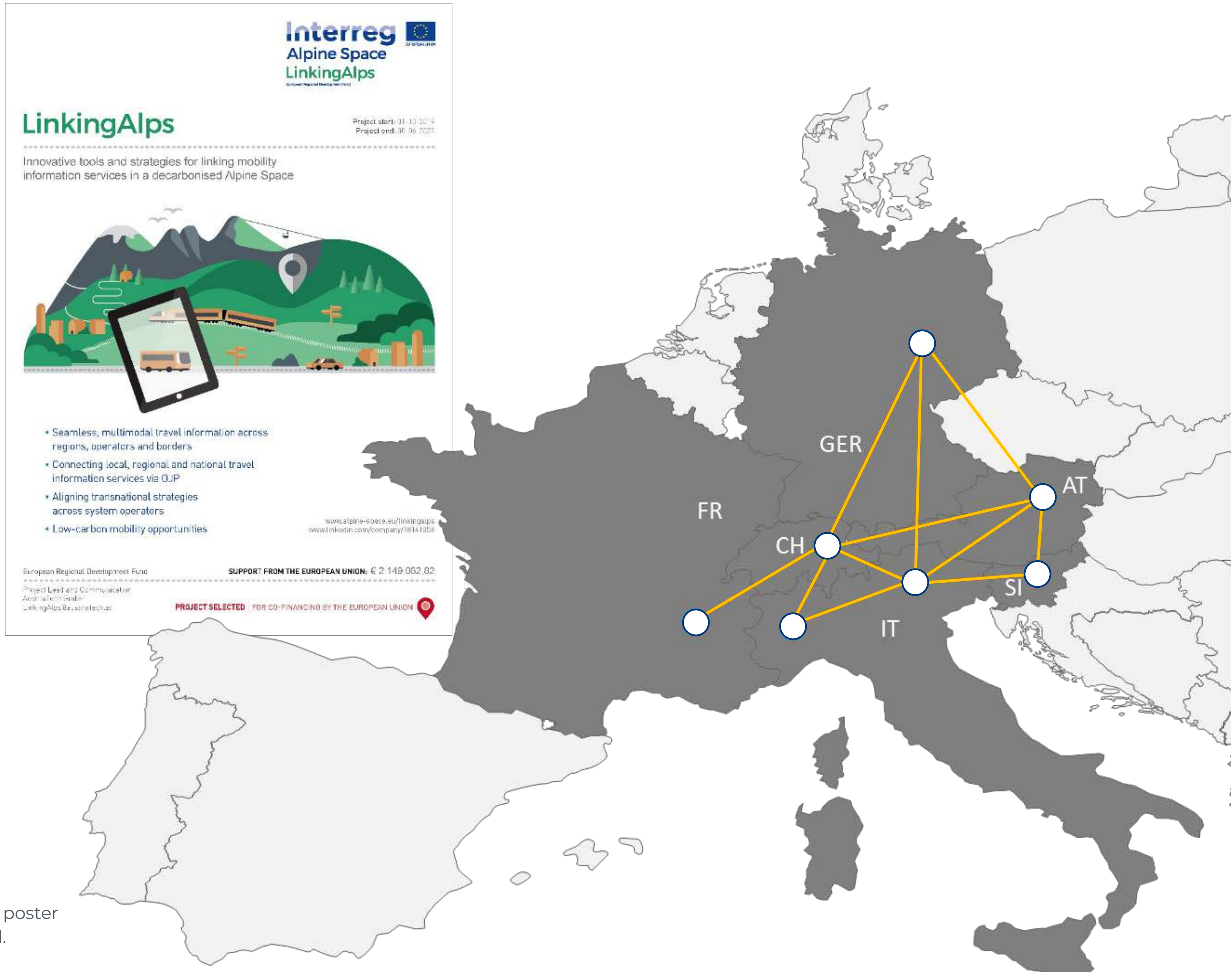


Figure 1. LinkingAlps project poster and countries involved.

The LinkingAlps Distributed Journey Planning System is a network of existing travel information service providers. The participating travel information services in the project are listed in Table 1, meaning that in the beginning of operations the total LinkingAlps DRJP coverage equals the sum of the coverage of the participating services.

Table 1. Participating travel information services.

Project Partner	Travel information service
VAO (AT)	Traffic Information Austria
SBB-SKI (CH)	Open Data Platform Swiss Public Transport
STA (IT)	South Tyrolian Journey Planner
ARIA (IT)	Muoversi Lombardia (Lombardy trip planner)
CMTo/5T (IT)	Muoversi Piemonte (Piemonte trip planner)
RRA-LUR/UM-FGPA (SI)	AtoB Slovenia

The extension of the Open Journey Planning approach to the Alpine region (new service providers) and the full operationalisation of the service (technological readiness) were main aims of the project.

A decentralised, transnational journey planning system for low carbon mobility options (end-user service) is the main technological result, from here forward referred in the handbook as the Linking Alps Distributed Journey Planning Service (DRJP).

The project developed a framework strategy for the harmonized implementation of OJP in Europe framed in the OJP (EU) profile, opening the results of the project to future adoptions from other countries.

Figure 2 gives an overview on the project partners which are responsible for the development of the service.

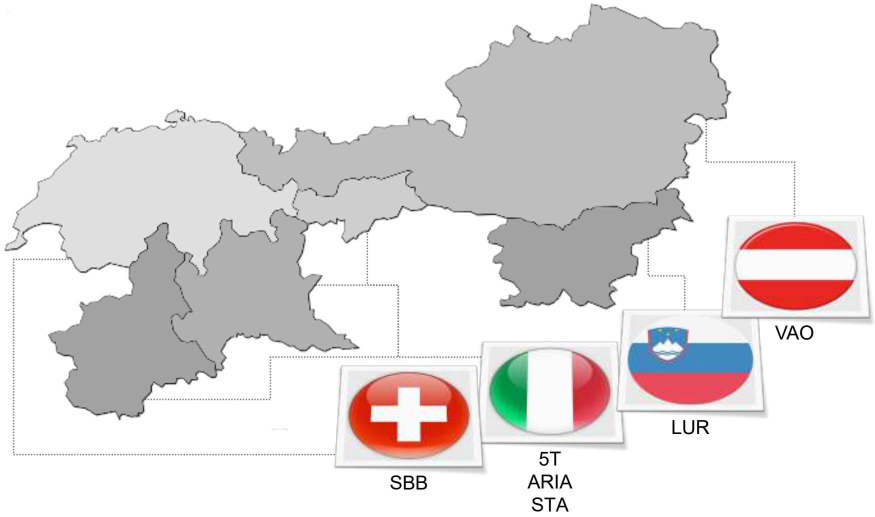


Figure 2. LinkingAlps covered regions and JP developers.

Intended to give the end user easier and better access to travel information, the LinkingAlps cross-border journey planning system promotes low-carbon mobility, providing an easier and comfortable access to travel information, cross-border trip planning and aligned multimodal mobility services.

For Service Providers, the LinkingAlps approach enables:

- Sovereignty over data,
- The extension of the range of their own system adding the coverage of all affiliated systems,
- The improvement of the functionalities and quality of information provision for customers,
- Strengthening the market position of the local/regional/national service provider.

For Mobility Systems, the LinkingAlps approach allows:

- The support of sustainable mobility behaviour of travellers,
- The strengthening of the market position of small-scale providers and regions vs. international platforms.
- Improving accessibility and connectivity of rural areas,
- Solution for the last/first mile issue.

The present handbook intends to serve as a facilitator guide for future adopters of the LinkingAlps Distributed Journey Planner.

Structure of the decision support handbook

The handbook content structure (Figure 3) was designed to allow readers to get an overview of the base concepts of Open Distributed Journey Planning, its principles, and a more insightful view on the legal, technical, and organisational frameworks that served as foundations for the development of the LinkingAlps DRJP – Section 2.

Section 3 lists the main regulations, directives and standards which assure that the developed multimodal travel information service is accurate, reliable and easily adopted.

The LinkingAlps Organisational framework built to improve the collaboration for the strategic optimal long run of the LinkingAlps DRPS, between all stakeholders is detailed in Section 4 In this section, a comprehensive view on the stakeholder structure, as well as the roles and responsibilities of the LinkingAlps participants is presented.

Section 5 – LinkingAlps Distributed Journey Planner for the Alpine Region presents the core of the developed system with detailed descriptions of its architecture and technical implementation aspects.

With the purpose of facilitating and guiding future adopters, whether from the operative or policy level, decision support for the implementation of OJP is presented in Section 6, facilitating a streamlined vision on the requirements of the LinkingAlps DRJP and the steps needed for the uptake of the service.

In Section 7 – Use case, an example is detailed on how LinkingAlps was embraced as a National service in Slovenia.

The appendixes compile the knowledge obtained during the project span, in the form of questions and answers (Appendix A. Frequently Asked Questions) and of a list of the main terms used throughout the handbook (Appendix B. Glossary).

We intend that the document also sparks interest in the primary beneficiaries of the project results, the travellers. They can now enjoy a consistent cross-border journey planning system that provides easy access to the relevant and desired information.

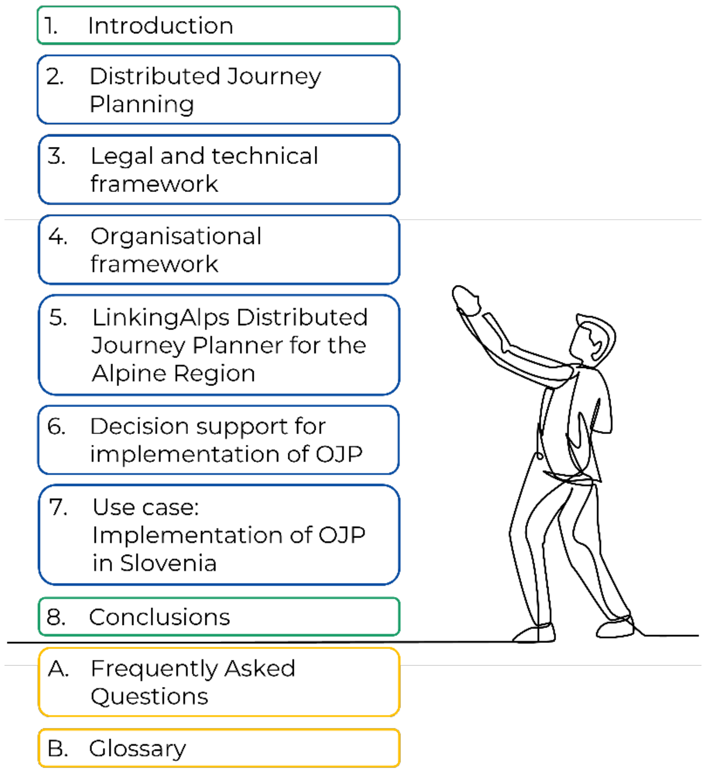


Figure 3. Decision support handbook for future adopters' structure.

2. Distributed Journey Planning

Transit users traveling across borders often face the problem that travel information for the entire route is not visible immediately. In most cases, travellers must switch between the information systems of different operators, regions, or countries to plan their entire journey.

The LinkingAlps project addresses this problem in the Alpine Space, developing a standardized exchange service of travel information between the individual travel information service providers.

This way, information can be exchanged between different systems and compiled into a continuous travel chain. Travelers can thus view the entire trip from origin to destination on a single service.

Distributed Journey Planning (DRJP) requires that the system responding to an end user's enquiry can communicate with other information systems and merge the responses with data from its repositories, creating one or more seamless journey plans for the enquirer.

There are different possible "architectures" for distributed journey planning; however, the environment is generally as conceptualized in Figure 4, following the **CEN/TS 17118:2018 Intelligent transport systems – Public transport – Open API for distributed journey planning**.

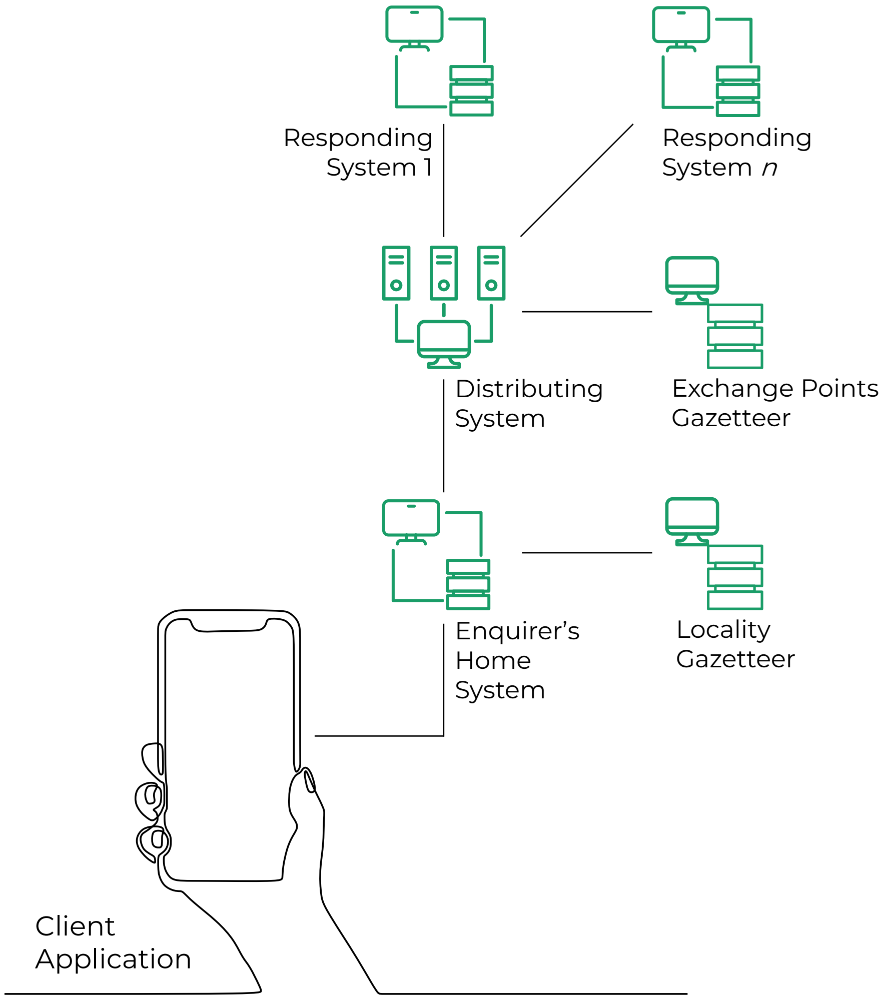


Figure 4. Distributed journey planning environment.

In the Distributed Journey Planning Environment, we identify the following "components":

1. The Home System, journey planning system to which the enquirer is connected.
2. A Distributing System, system that distributes the enquiries to other systems (may be integrated with the home system or physically separate).
3. The Responding System(s), that reply to questions from the distributing system.
4. Gazetteer(s), directory(ies) of common objects that enables to find geolocations defined as stop points, stop stations, points of interest, addresses, etc.

The Distributed Journey Planning environment that can be described through a simple example:

A traveller (enquirer) reaches out to a journey planning Application, intending to plan a short trip (regional transport) to a defined location.

As input, the traveller minimally must provide information to specify the request, such as the starting point, desired destination, and intended mode(s) of transport.

The request is now in the hands of the Enquirer's Home System, which analyses if it can, on its own, return the journey plan ("consulting" its local database). It may happen that the destination is not within the Enquirer's Home System region but in a neighbouring region, outside of its service area.

In this case, the request passes to the **Distributing System** that communicates it to the responding systems for the component of the trip in the responding system's territory.

After receiving the replies, it creates the trip composition and returns it to the traveller.

The designated "Use case 1: short distance" (Figure 5), depicts an example of how a multimodal journey can be handled when two neighbouring regions are covered i.e., linking two different journey planners).

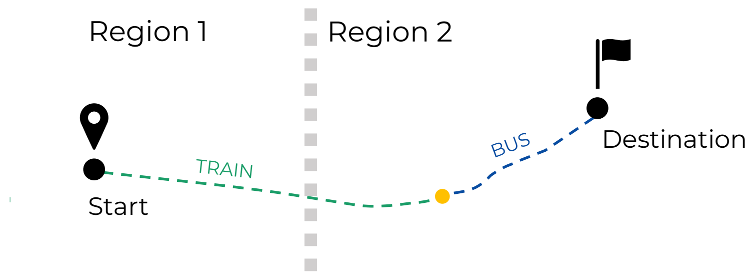


Figure 5. Use case 1: short distance - regional transport.

Use case 1 presents one transfer, so two **trip legs** are defined. A **trip leg** corresponds to a single stage of a trip that is made without change of transport mode.

It can also happen, especially in the case of journeys to regions abroad, that a request is made by the traveller implying the use of long-distance transport, "Use case 2: long distance" (Figure 6).

The distribution principle maintains its relevance and functionality as before.

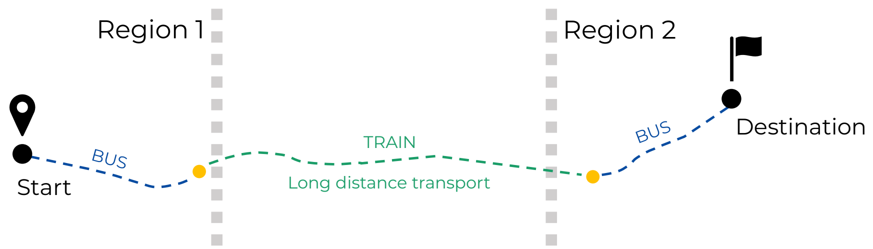


Figure 6. Use case 2: long distance – long distance transport.

The long-distance transport connection(s) that interlink different Journey planning systems are called **trunk leg**(s).

The distributing system recognises the relevant responding systems for the request, analysing the area covered in the trip and understanding the **exchange points** (and their identifiers) that will link the parts of the full trip.

Exchange points, according to the CEN/TS 17118:2018 are "the boundary points where the trip calculation is handed over to the next journey planning system", therefore fundamental for the journey calculation. This includes regional stops which match with stops for long distance or regional stops from adjacent regions. Exchange points are mainly but not exclusively located at borders and in bigger cities.

Exchange points can be of the following types:

- **Stops**: **Stop places** or **stop points**: Stop places comprise one or more locations where vehicles may stop and passengers board or leave vehicles. Stop points are locations where passengers board or alight from vehicles,

- Addresses,
- **Points of Interest**, places where passengers are likely to travel by public transport,
- Coordinates,
- **Topographic places**, e.g., city, suburb, town, village.

Therefore, the Distributing System sends an online request to each responding system or builds up an exchange point knowledge base, for example, obtained through a **static collection process** as illustrated in Figure 7. For the identification of exchange points, GPS coordinate, IDs and modes information is exchanged between systems. In this static approach, all exchange points of a responding system are requested. Exchange points can also be retrieved using a **dynamic approach**, meaning that a specific origin-destination-relation must be provided.

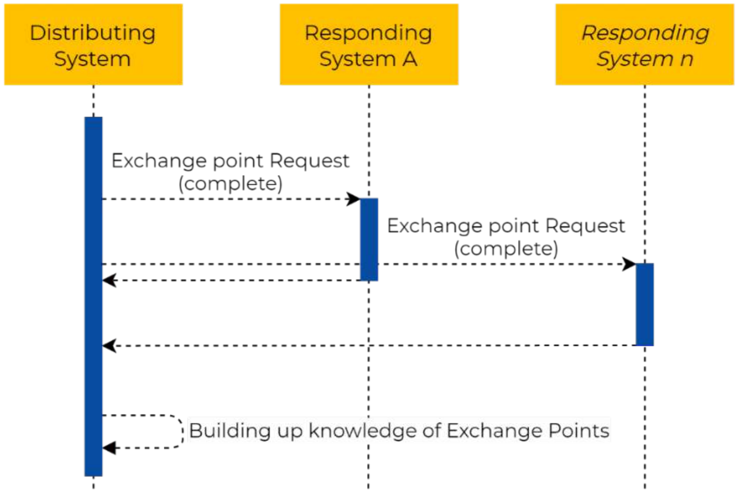


Figure 7. Static exchange point knowledge connection.

The LinkingAlps system considers as exchange points public transport stations with a direct connection to another local journey planning region.

Ultimately the principle behind Distributed Journey Planning is dividing a trip that exceeds the boundaries of one journey planner into smaller tasks that can be handled by other Journey Planners, compose the full trip and present to the user the routing result(s).

For the traveller this means (Figure 8):

- Simplified access to sustainable multimodal, seamless traveller information – across border and operators,
- Increased acceptance of public transport and alternative mobility,
- Usage of the well-known JP App of their home service in their language, with extended geographical coverage,
- Information of the highest quality and accuracy,
- Inclusion of local transport/on-demand transport (if available in the existing traveller information service).

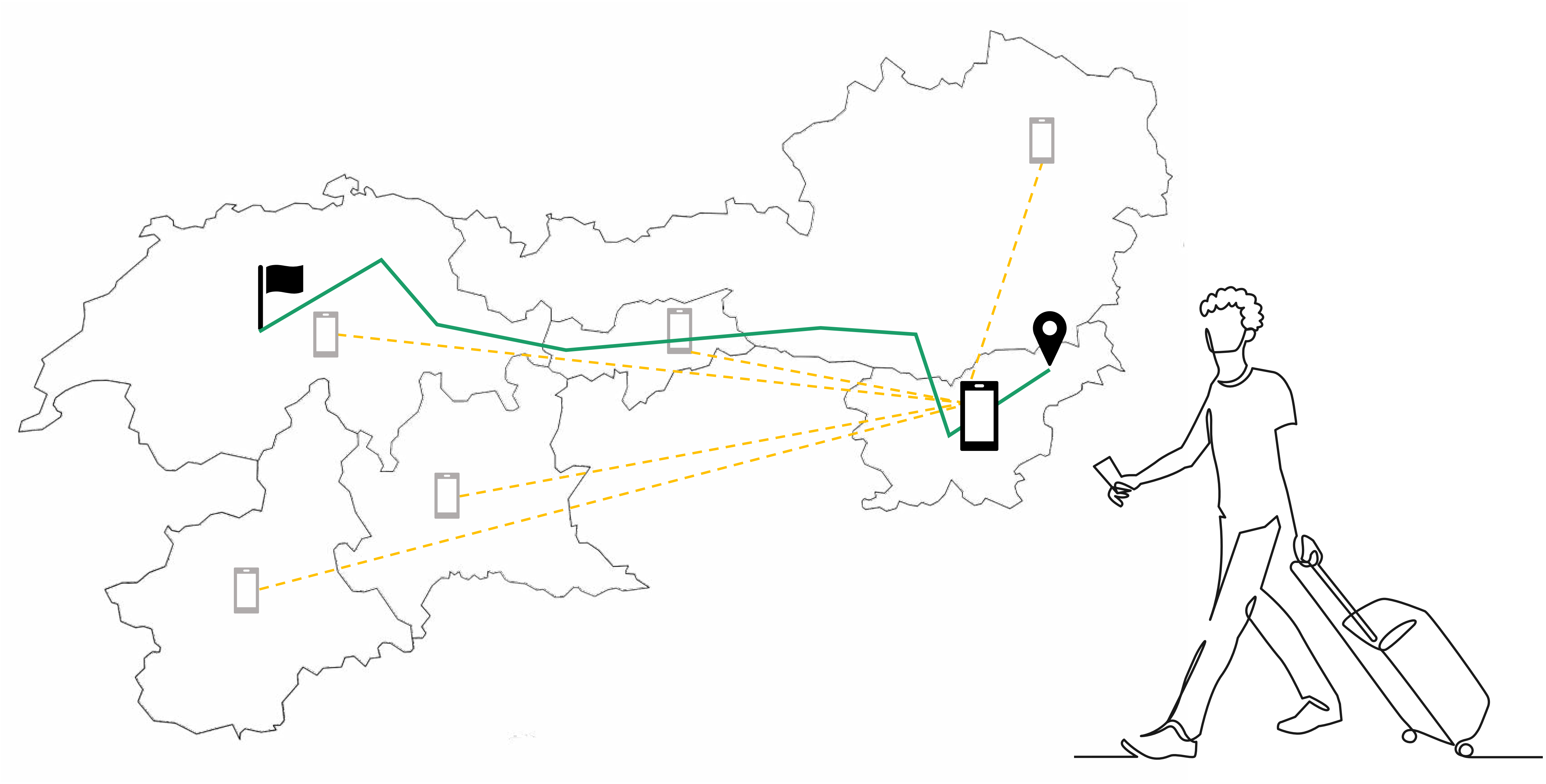


Figure 8. The “Linking of services” at the service of the travellers.

3. Legal and technical framework

The objective of the European Commission regarding the provision of multimodal travel information services are major premises for LinkingAlps. The compliance with the Del. Reg. 2017/1926 supplementing the EU ITS Directive is a key pre-condition. The network of journey planners will exchange information via OJP interface fully compliant in line with the Technical Specification CEN/TS 17118:2018 for "Open API for Distributed Journey Planning". The Delegated Regulation 2017/1926 of the ITS Directive envisaged the linking of services through that CEN/TS 17118:2018. The compliance with the Delegated Regulation and its provisions on European standards and technical specifications is a precondition. The key task of the system is to enable linking of services through the given provisions of the Delegated Regulation.

To ensure that the project results are compliant with the current legislative framework, safeguarding that the developed multimodal travel information service is accurate and reliable, the following regulations, directives and standards were analysed and served as base and input:

- SIST-TS CEN/TS 17118:2018 - Intelligent transport systems - Public transport - Open API for distributed journey planning.

  This technical Specification defines a schema for establishing an Open API for Distributed Journey Planning that can be implemented by any local, regional or national journey planning system in order to exchange journey planning information with any other participating local, regional or national journey planning system.

- Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport.

  The Directive establishes a framework which supports the coordinated and coherent deployment and use of Intelligent Transport Systems (ITS) setting out the general conditions necessary for that purpose. It also provides for the development of specifications for actions within certain priority areas: Optimal use of road, traffic and travel data; Continuity of traffic and freight management ITS services; ITS road safety and security applications; Linking the vehicle with the transport infrastructure, as well as for the development of necessary standards. ITS applications and services in the field of road transport and to their interfaces with other modes of transport are the main beneficiaries of the Directive.

- Commission Delegated Regulation (EU) 2017/1926 of 31 May 2017 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU-wide multimodal travel information services.

  Establishes the necessary specifications to ensure that EU-wide multimodal travel information services are accurate and available across borders to ITS users.

- EN 12896:2006, Public transport – Reference data model (Transmodel v5.1).

  Transmodel provides an abstract model of common public transport concepts and data structures that can be used to build many kinds of public transport information system, including timetabling, fares, operational management, real time data, journey planning etc., [https://www.transmodel-cen.eu/].

- EN 12896-1:2016, Public transport - Reference data model – Part 1: Common concepts (Transmodel v6).

  Part 1 Common Concepts comprise models used in all other parts including:

  - Versions and validity: with versions of data and validity conditions, responsibility over data;
  - Generic framework: • Generic network elements: points and links, link sequences; zones; layers and projections, places; groupings accessibility;
  - Reusable components: Generic models for: transport modes, calendars, addresses & topographic places, generic equipment & facilities, vehicle types & trains, transport organisations.

- EN 12896-2:2016, Public transport - Reference data model - Part 2: Network topology (Transmodel v6).

  Part 2 Network topology presents the public transport reference data model based on Transmodel v5.1, the model for the Identification of Fixed Objects for Public transport (IFOPT), published 2009 as EN 28701, SIRI an NeTEx. Includes among others, the description of working paths of vehicles, itinerary, connection, network restrictions and constraints

- EN 12896-3:2016, Public transport - Reference data model – Part 3: Timing information and vehicle scheduling (Transmodel v6).

  Part 3 Timing information describes time-related aspects, well separated from the space-related ones.

- CEN/TS 16614-1, Public transport - Network and Timetable Exchange (NeTEx) - Part 1: Public transport network topology exchange format.

NeTEx [https://www.netex-cen.eu/] is dedicated to the exchange of scheduled data (network, timetable and fare information). It is based on Transmodel V6 (EN 12896 series) and SIRI (CEN/TS 15531-4/-5 and EN 15531-1/-2/-3) and supports the exchange of information of relevance for passenger information about public transport services and for running Automated Vehicle Monitoring Systems (AVMS).

NeTEx Part 1 is the description of the public transport network topology exchange format. This covers routes, lines, route points, stop places and their components, stop points, navigation paths and other places linked to the PT network and relevant for passenger information, stop place equipment and services, network version, administrative information, etc.

- CEN/TS 16614-2, Public transport - Network and Timetable Exchange (NeTEx) - Part 2: Public transport scheduled timetables exchange format.

  NeTEx Part 2 is the description of the scheduled timetables exchange format.

- EN 15531-1:2015, Public transport - Service interface for real-time information relating to public transport operations - Part 1: Context and framework (SIRI).

  SIRI (Service interface for real-time information relating to public transport operations) has been developed under the aegis of CEN (European Committee for Standardization) and is the reference interface for data communication in public transportation systems.

  Part 1: Context and framework includes background, scope and role, normative references, terms and definitions, symbols and abbreviations, business context and use cases.

- EN 15531-2:2015, Public transport - Service interface for real-time information relating to public transport operations - Part 2: Communications (SIRI).

  Part 2: Communications includes mechanisms to be adopted for data exchange communications links.

- EN 15531-3:2015, Public transport - Service interface for real-time information relating to public transport operations - Part 3: Functional service interfaces (SIRI).

  Part 3: Functional service interfaces includes data structures for a series of individual application interface modules Production Timetable (PT), Estimated Timetable (ET), Stop Timetable (ST), Stop Monitoring (SM), Vehicle Monitoring (VM), Connection Timetable (CT), Connection Monitoring (CM), General Message (GM).

- CEN/TS 15531-4:2011, Public transport - Service interface for real-time information relating to public transport operations - Part 4: Functional service interfaces: Facility Monitoring (SIRI).

  Part 4: Functional service interfaces is devoted to facility monitoring. This Technical Specification specifies an additional SIRI functional service to exchange information about changes to availability of Public Transport facilities between monitoring systems and servers containing real-time public transport vehicle or journey time data. These include the control centres of transport operators, as well as information systems that deliver passenger travel information services.

- CEN/TS 15531-5:2016, Public transport - Service interface for real-time information relating to public transport operations – Part 5: Functional service interfaces: Situation Exchange (SIRI).

  Part 5: Functional service interfaces is devoted to situation exchange (SX). The scope of this WI is to update CEN/TS 15531-5:2011 which describes structured incident model for disruptions to services, in terms that relate directly to the entities of other SIRI services. Incidents can then be directly linked to stops, lines, journeys, etc in two ways: as the cause of disruption or as the result of service problems.

4. Organisational framework

Serving as a conceptual foundation of the LinkingAlps DRJP for elaborating the operational and regulative frameworks of the service, this section elaborates on the LinkingAlps Organisational framework. The framework was built to improve the collaboration for the strategic optimal long run of the LinkingAlps DRPS, between all stakeholders (Figure 9). Always present and serving as a base, the mission and vision drove the project and established the path for successfully implementing the service.

- Mission: Provide low-carbon mobility solutions and foster mobility shifts towards more sustainable transport mode.
- Vision: Provide a durable, distributed solution to enable seamless, transnational, cross-provider, and multimodal journey planning service, continuously innovated and expanded. Embrace the (fully) distributed service avoiding the necessity for international data pools.

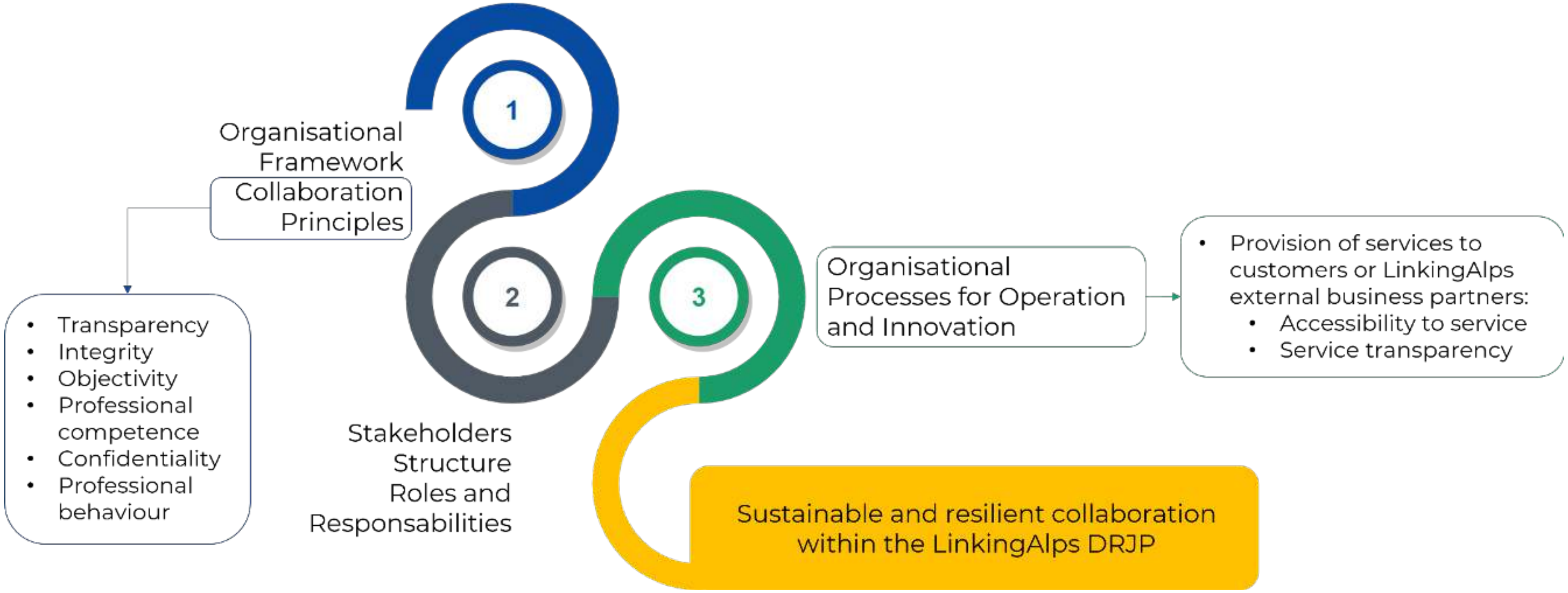


Figure 9. Organisational principles, processes, and goal.

LinkingAlps presents a stakeholder structure which highlights the complexity but also the partly overlapping character of roles and responsibilities of actors within the LinkingAlps system:

OJP Users in the LinkingAlps DRJP system, are located on the local front-end of the system and enable the end-user to enquire trip plans via an end-user application (GUI). The OJP User can either be a third party, which is connected via an OJP interface to a participating, active system of the distributed system, or a service provider who is an integrated participant (active or passive system) of the OJP system. In case an end-user application is provided by a passive system, the end user application must connect to an active system and generate the combined routing results from this active system.

OJP Users act as clients of the home system (for local trip requests) and of the distributing system (for distributed trip requests), which are providing the route results for end-user requests.

The OJP User is not directly involved in the distributed journey planning process but can be considered the link between the end-user and the LinkingAlps service. Overall, its key role comprises the request submission from the end-user to the distributed system and vice versa, the submission of the routing result from the distributed system to the end-user. Within the LinkingAlps DRJP system, STA will act as OJP User as well as OJP Implementer and provide access to the LinkingAlps service over their End-User application.

The **Active system** is one form of participating system in the stakeholder structure. It is an organisation operating a travel information service, in particular a journey planner which contains a distributing system that has the distribution logic to gather the needed information (also from other systems) to which the end user is connected to, that means it is the enquirer's home system.

In the technical architecture the active system is also called OJP router, which indicates that it comprises an OJP interface, a distributing system and OJP routing capabilities. Active systems can be considered the enabler for the distributed journey planning service, holding an essential role for the operation of the service as well as steering of the innovation developments. In the LinkingAlpsDRJP the active systems are SBB and STA.

A **Passive system** is a travel information service provider, in particular a (local) journey planner, that operates an OJP interface that is responding to request from active systems, thus also called OJP responders in the technical architecture.

Passive systems have no distributing system and do not provide an OJP routing. However, passive systems provide route information on their coverage area to the active system, and thus, increase the coverage of the LinkingAlps service.

A Passive system can be upgraded to Active system.

Passive systems are an integral part of the distributed systems. The performance and service quality of each passive system, directly affects the overall system performance and service quality, as they deliver parts of the routing results to an active system, which combines different routing results and provides the combined routing to the end user of the LinkingAlps system.

In the LinkingAlps service the passive systems are VAO, ARIA, 5T and LUR.

Supporting Actors played an essential role in the development of the LinkingAlps DRJP. The project benefited from support from: Suppliers, Developers, Research and Academia, Traffic Data Providers and Policy-making Bodies. After the project closure, one supporting role, the Network Coordinator, will be essential. Acting on a network-wide or global level, it oversees the coordination of administrative and collaborative activities and tasks to enable the cooperation as well as the innovation of the LinkingAlps service.

Furthermore, it is proposed that the Network Coordinator should be the first contact point for interested, new active or passive systems as well as for interested OJP Users and end-user application providers.

As project coordinator, AustriaTech took over this role during the project span, and will remain Network Coordinator after project closure.

5. LinkingAlps: Distributed Journey Planner for the Alpine Region

The LinkingAlps distributed journey planning system is a network of existing travel information service providers. The LinkingAlps journey planner as end-user service is based on a novel linked decentralised (distributed) system of active and passive systems (Figure 10).

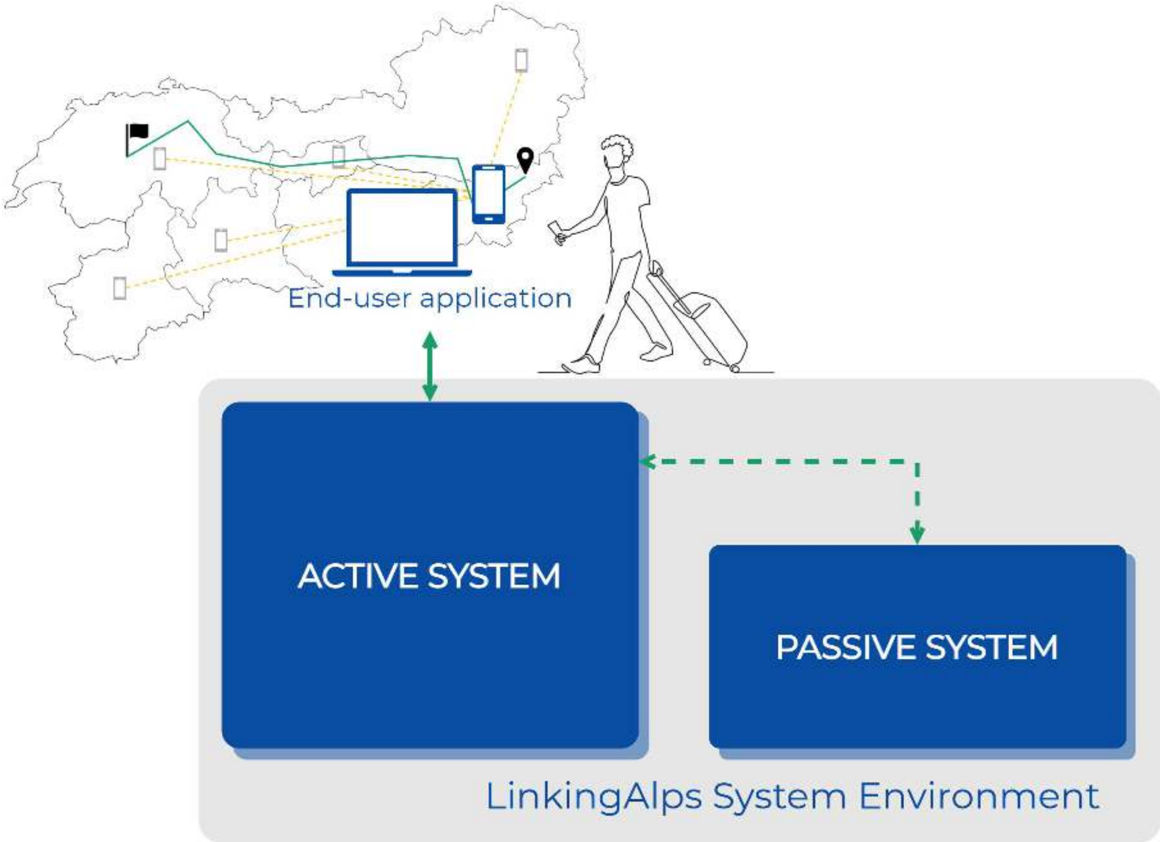


Figure 10. The LinkingAlps system environment enabling the linking of services.

Passive systems

Local journey planners are the base of the LinkingAlps System. With a routing engine and access to multimodal data within a particular local, regional or national coverage.

Local journey planners have no transregional (or distributed) OJP routing capabilities. Within the LinkingAlps distributed journey planning environment, a Local Journey Planning System that is participating as a **Passive system**, also known as **OJP Responder**, serves as an information source for journeys that require information from within its coverage area to be calculated (Figure 11). Passive systems contain a routing engine, multimodal public transportation travel data (PT timetables), a gazetteer (directory of common objects across the local journey planning system for all geo locations) and a list of exchange points related to their coverage.

Each OJP responder is responsible for the implementation of the gazetteer repository. Exchange points are handover points between different local journey planners. In LinkingAlps, exchange points are defined as public transport stations with a direct connection to another local journey planning region.

To enable the distributing routing based on the Technical Specification CEN/TS 17118:2018 for "Open API for Distributed Journey Planning", passive systems must:

Contain information which allows the calculation of trunk legs (i.e., long-distance transport connection(s) that interlink

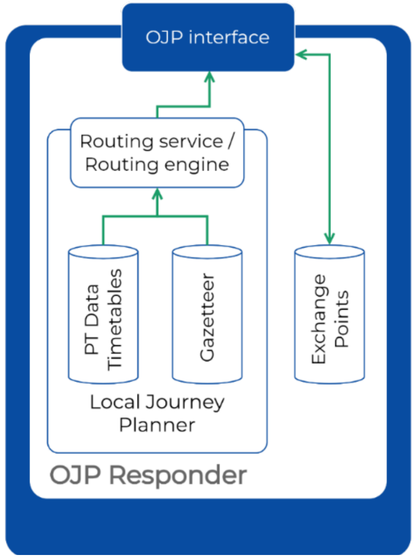


Figure 11. Passive system (OJP Responder).

different journey planning systems), mostly connected to the identification of exchange points (public transport stations with a direct connection to another local journey planning region); Support both the static and dynamic approaches of retrieving exchange points.; Integrate real-time data if available for its area.

Passive systems do not have a distributing system, but they are providers of information to create itineraries that can be combined with others in the distributing system.

For this to happen, the passive system has an exchange service (openAPI web service) designated OJP Interface.

Active systems

The active system, also known as responding system consists of the OJP router and the OJP responder (Figure 12).

The OJP router provides the OJP servers to an end user application. It consists of two interfaces (end-user interface and OJP interface) and a distributing system.

The **distributing system** is part of the OJP router and is able to split up a trip request into sub trips and send them to the relevant OJP responders as well as reassemble the partial trip leg routes and send the combined response to the end user application via the end user interface. The OJP router communicates with the OJP responder by an OJP interface. It actively requests information from other services via the distributing system.

The OJP responder has the role of an information source and provides the responses to the requests from the OJP router. It provides access to multi-modal travel data information about its coverage area as well as a list of exchange points and a gazetteer containing mainly local geo locations like for example addresses related to the local journey planner.

At least one system wide OJP router is needed within the system, initially the LinkingAlps system counts with two OJP routers.

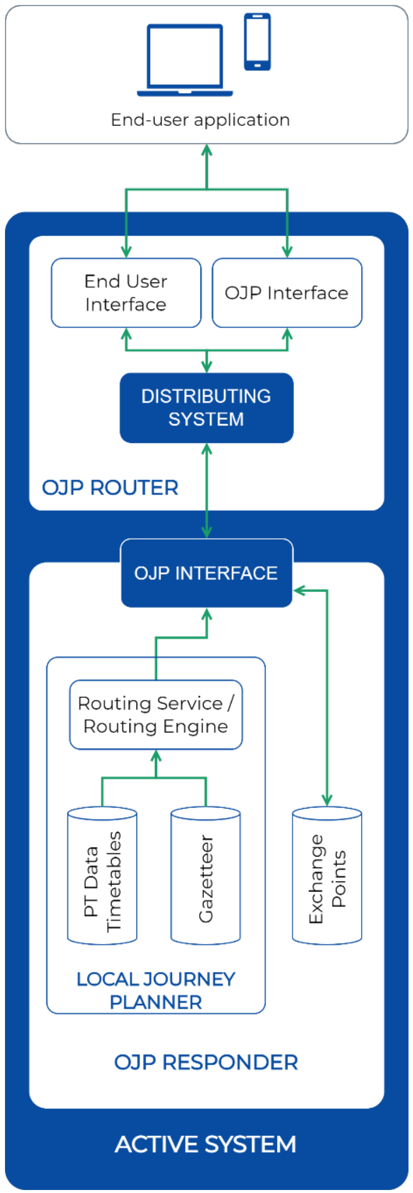
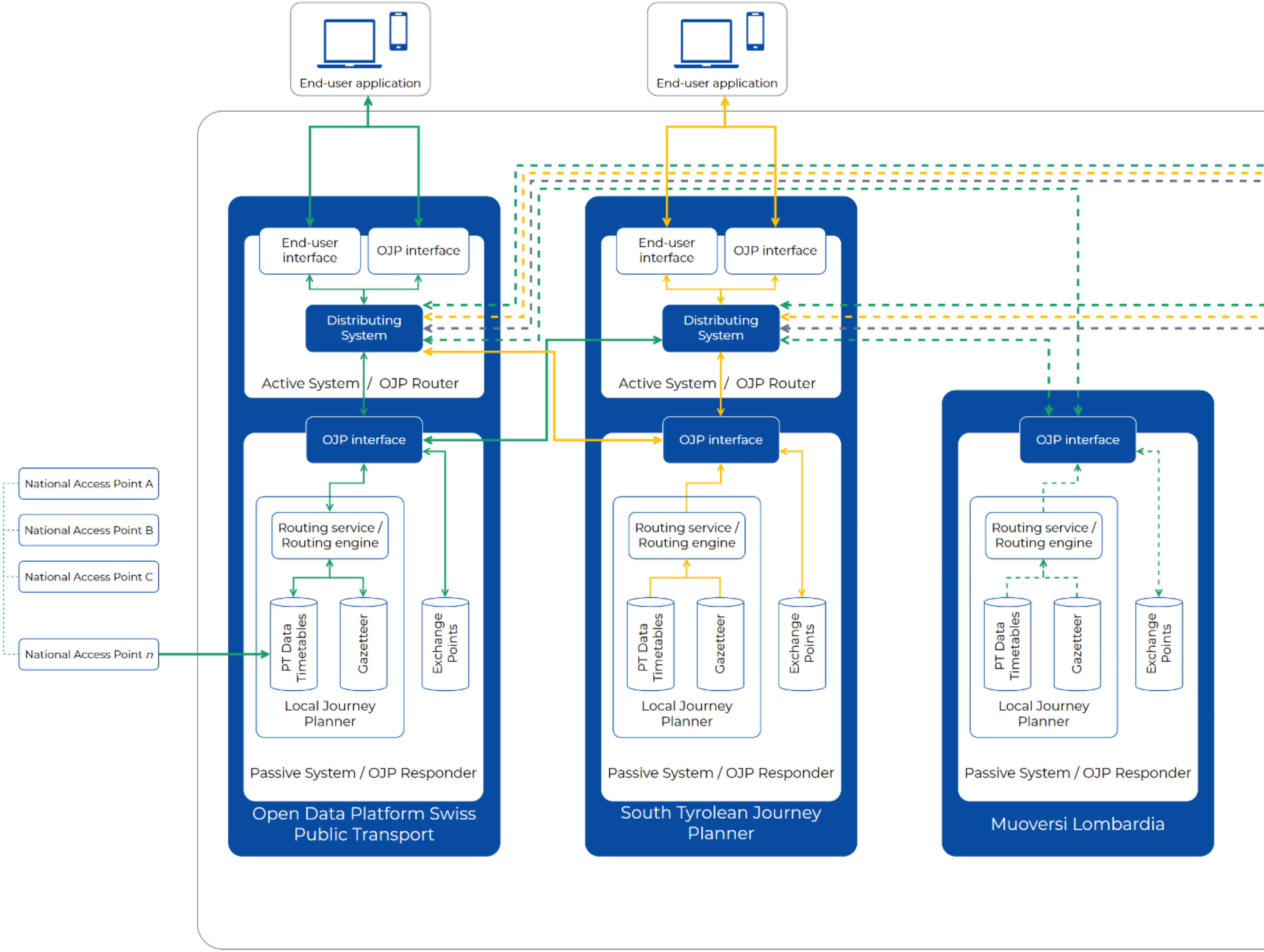


Figure 12. Active system (OJP Router and OJP Responder).

The LinkingAlps system

Some characteristics of the LinkingAlps system (Figure 13), which summarise and detail its architecture, can be listed as follows:

- The system complies with the **Delegated Regulation 2017/1926**, which supplements the EU ITS Directive.
- The network of journey planners will exchange information via an OJP interface compliant with the **Technical Specification CEN/TS 17118:2018 for "Open API for Distributed Journey Planning"**.
- LinkingAlps is a decentralised and distributed journey planning system.
- It enables that a network of journey planners collaborates to handle journeys over an area beyond their individual coverage and information exchange between the participating services.
- This decentralized approach allows the journey planners to keep the sovereignty over their data and the interpretation of the data in their routing.
- Yet, some parts in the system are managed and handled system wide, to maintain the high performance of the service, for example the exchange and integration of supporting data (e.g., exchange points. gazetteers, long-distance transport).
- The **architecture** of the system follows a federated approach. The system provides access to various autonomous information sources without copying their data. It also integrates multiple data sources, but they remain unchanged. The system facilitates the combination of individual systems that maintain their autonomy and sovereignty, participating travel information services keep the authority over their data and the interpretation of the data in their routing.
- The LinkingAlps system allows future extensions and the possibility of the inclusion of further OJP services.


End-user application
End-user application
End-user interface
OJP interface
Distributing System
Active System / OJP Router
OJP interface
Routing service / Routing engine
PT Data Timetables
Gazetteer
Exchange Points
Local Journey Planner
Passive System / OJP Responder
Open Data Platform Swiss Public Transport
End-user interface
OJP interface
Distributing System
Active System / OJP Router
OJP interface
Routing service / Routing engine
PT Data Timetables
Gazetteer
Exchange Points
Local Journey Planner
Passive System / OJP Responder
South Tyrolean Journey Planner
OJP interface
Routing service / Routing engine
PT Data Timetables
Gazetteer
Exchange Points
Local Journey Planner
Passive System / OJP Responder
Muoversi Lombardia
National Access Point A
National Access Point B
National Access Point C
National Access Point n

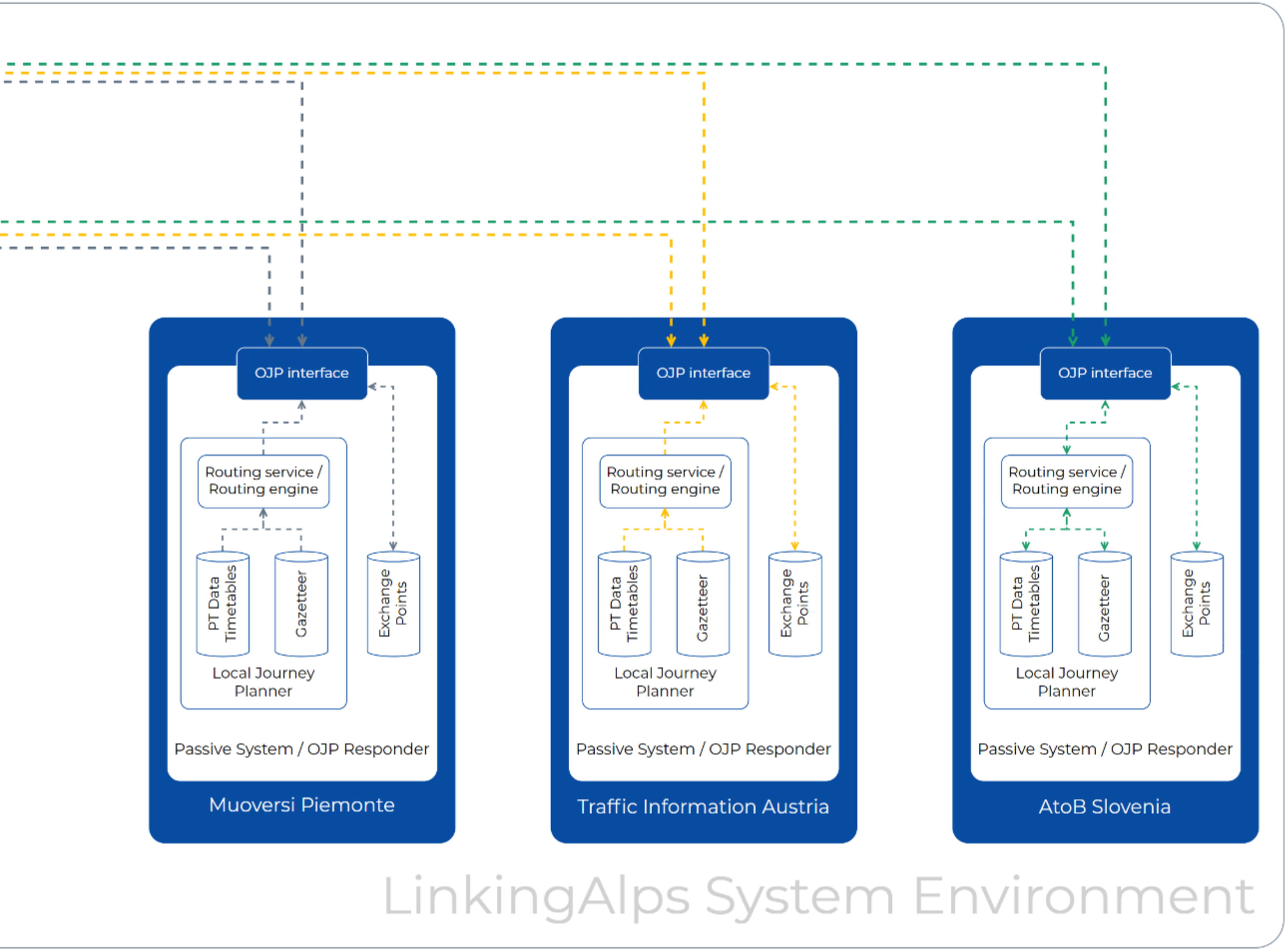


Figure 13. LinkingAlps System Environment.

LinkingAlps OJP services

The Technical Specification CEN/TS 17118:2018 for "Open API for Distributed Journey Planning" describes in detail seven OJP Services. LinkingAlps enables six of them, being that the inclusion of the ticket price calculation is expected to be included in the future. Table 2 summarises the mentioned services:

Table 2. LinkingAlps supported OJP services.

Service name	Service in CEN/TS 17118:2018	Supported in LinkingAlps
OJPLocationInformation	Location Information	✓
OJPTrip	Trip request	✓
OJPStopEvent	Departure board	✓
OJPTripInfo	Trip/Vehicle information	✓
OJPExchangePoint	Exchange points	✓
OJPMultiPointTrip	Distributed journey planning	✓
OJPFare	Ticket price calculation	Not yet

The **OJPLocationInformation** service provides different methods to respond with the location to a given (user) request. It uses text matching or GPS coordinates as user input in order fulfil this task. This service also can be used for more complex applications like “finding the nearest stops/stations for a given coordinate” and “matching text input against the names of locations near a given coordinate” [1]. The normal use-case of this service is to process a user query into a list possibly meant locations, which can then be used for feeding other services such as OJPTrip, OJPStopEvent or OJPMultiPointTrip.

The **OJPTrip** service provides intermodal trip information from an origin location to a destination taking user preferences (e.g., the fastest connection and fewest transfers) into account. In distributed environments, the complete trip is not calculated within one single system, instead the planning task is split and distributed to several planning engines. This service calculates the trips based on locations which result from the OJPLocationInformation service.

The OJPStopEvent service provides information on arrivals and/or departures of public transport services from stops for a requested time or period of time.

The OJPTripInfo service "provides intermodal trip information from an origin location to a destination taking various user preferences into account". This service deals with information previously defined from the OJPLocationInformation and OJPTrip services.

The OJPExchangePoint service provides exchange points which allow the definition of the complete journey. As several journey planning systems "plan" different parts of the whole trip, each of the planners gets a sub-query to plan.

OJPMultiPointTrip is the service that provides the intermodal trip information from multiple origin locations to multiple destinations taking various user preferences into account.

6. Decision support for implementation of OJP

The systems participating in the LinkingAlps systems environment provide national or regional travel data service for the distributed travel journey planning.

The travel data service usually is part of a more encompassing digital platform for traffic and mobility data, like the Traffic Information System (Austria), Open Data Platform for Public Transport (Switzerland), National Traffic Management Data (Slovenia), but can also be solely regional journey planner (Italy).

To understand technical and organisational decisions related to the implementation of the "linking of services" based travel journey planning approach as implemented by LinkingAlps, Figure 14 presents an idealized general system environment for traffic and mobility data containing aspects of data owners, data suppliers, data aggregators, travel data or service providers, travel data publishers and travel information service providers.

Table 3 presents the roles in the system architecture for traffic and mobility data and their brief description.

Table 3. Roles and responsibilities of traffic and mobility data actors.

	ROLES	Description	
	Data owners	Entities which create the data, as transportation fleet data, transportation modes, timetables, infrastructure and facility data.	PT companies (Public/Private)
	Data suppliers	Entities which collect and transform data from data owners.	PT companies (Public/Private), IT companies (contracted)
	Data aggregators	Entities that collect, validate, organise and store data.	Public PT authorities
	• Travel data providers	Entities that provide standardised data (e.g., timetables in NeTEx).	
	• Travel data publishers	Entities that make available PT datasets (e.g., weather data, delays, timetables).	
Service Providers / Mobility Systems	**Travel information service providers**	Entities which develop and make available the end-user service.	Journey Planners

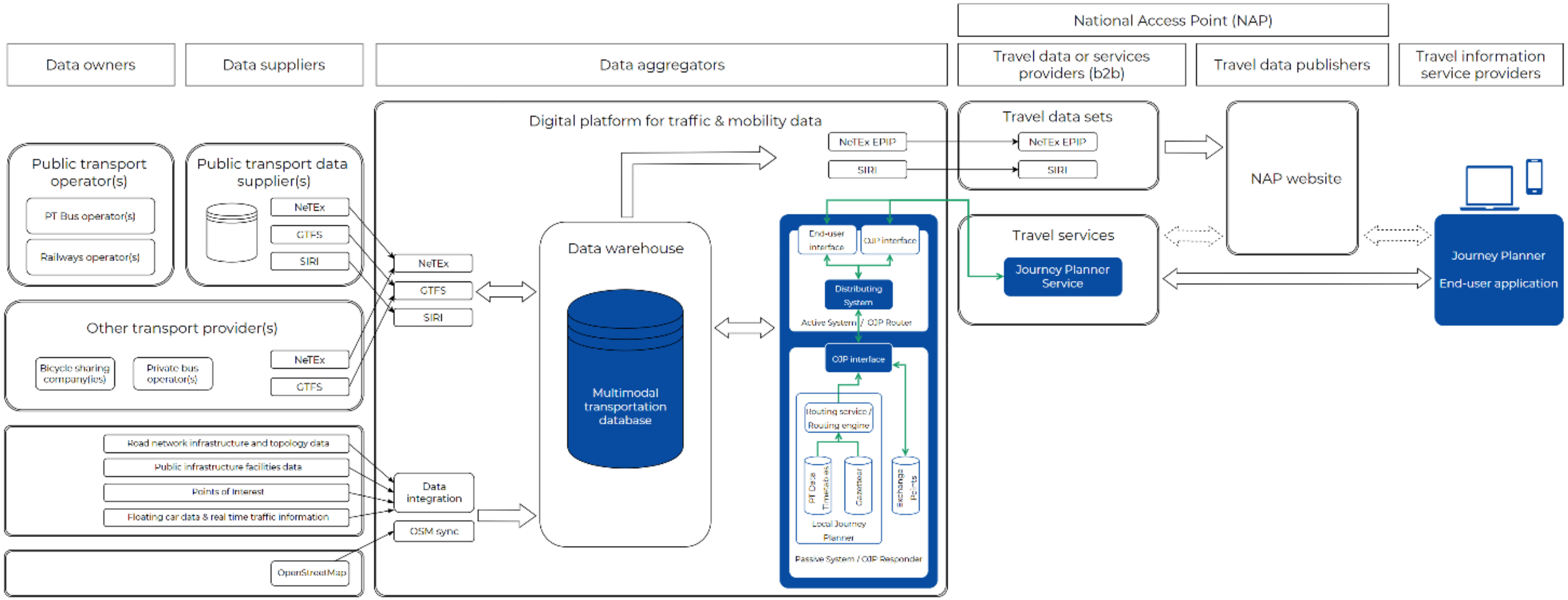


Figure 14. General system environment for traffic and mobility data.

The system environment includes the aspect of National Access Point (NAP) as an intermediary layer that facilitates discoverability of traffic and mobility data.

The system environment architecture shows how the OJP compliant component, in this case the LinkingAlps component, is integrated and exposed to NAP as journey planner service consumed by journey planning end-user applications (i.e., as dedicated mobile applications, desktop applications or websites). Thru the NAP the OJP component is externally linked to other LinkingAlps components. The journey planner service is implemented as REST application programming interface for OJP API requests and responses. The OJP API provides OJP interface functionality extension to the end-user interface of a local journey planner. Theoretically, it is possible to provide only OJP interface for newly developed end-user journey planner applications, though it is more common to extend interfaces of already available journey planners.

Internally, the OJP component sources data from the so-called multimodal transportation database. The database is a central data warehouse for all traffic and mobility data region- or country-wide. For the OJP component to have all the necessary and sufficient data for journey planning service the multimodal transportation database must contain public transport data, namely road and rail network data, transport infrastructure data (stop places), points of interest, timetables and real time traffic information data. For better efficiency and near real-time response the OJP component can cache crucial data from the multimodal transportation database, especially public transport timetables, stop places and their geo-locations (gazetteer). The time crucial data are needed as input for the routing algorithm to calculate trip segments and respond the results to the enquiry system from which the routing request came from.

The presented general system environment for traffic and mobility data can serve as possible goal for organisational and technical decisions that eventually leads to better travel information services.

For example, a French region Provence-Alpes-Côte d'Azur wants to provide better travel information service for the south-eastern part of France. Their association *La Métropole Mobilité*, the largest of its kind in France, integrates 14 transport networks to facilitate the use of public transport and to offer a consistent service throughout the region. Among them are networks for bus, tram, metro, maritime and bicycles sharing transport. Known as one of the most touristic regions in France it is important to promote and improve accessibility and connectivity of their travel information service to existing travel information platforms like the LinkingAlps cross-border journey planning system.

The interest for linking services is mutual as technically for the LinkingAlps system this means a scalable growth but also geographical enlargement by joining a geographical region adjacent Italian north-western region Piedmont, which is covered by the LinkingAlps subsystem Muoversi Piemonte. The travel information service for end users exists and is enabled using the mobile application called "*La Métropole Mobilité*". The app has functionality for multimodal journey planning in the region.

A high-level decision could be to integrate the app in the LinkingAlps system. In the next section a decision support diagram is described for this technical and organisational challenge.

Integrating a multimodal journey planning app in the LinkingAlps system

The first case assumes an existing multimodal journey planner application that provides the travel information service for a region (or multiple regions) which wants to be integrated in the LinkingAlps system. Such an example is the *"La Métropole Mobilité"* app (Figure 15), which provides multimodal travel information for the French region Provence-Alpes-Côte d'Azur. A possible decision to join the LinkingAlps system results in organisational and technical tasks that can all stem from a simple request to use the app for planning journeys to neighbouring regions across borders (e.g., Italy, Switzerland). The request might come as a "simple" feature request by the app users; the request might also come from a well-informed travel information service provider or developer of the app aware of the OJP API standard potentials and of the LinkingAlps system.

Figure 15. Marseille, France, "La Métropole Mobilité" app", (https://ampmetropole.fr/mes-demarches/).

It is also highly possible that the request comes from private or public transport operators in the region that want to extend their long-distance travel service operations to those neighbouring regions. Data aggregator usually is an entity governing the core traffic and mobility data and its utilization (thru the multimodal transportation database) inside the digital platform for traffic and travel data. Their role is to follow international initiatives (like LinkingAlps), be familiar with standardized technical specifications and best practices and they can also identify the possibility for mutual exposure of their travel data to distributed journey planning systems. In the use case it is assumed that the request comes from the travel information service provider. Travel information service provider submits request for the new feature "Cross-border journey planning". The feature request minimal integration of the journey planning travel information service. The workflow with necessary considerations and decisions is shown in the BPMN (Business Process Modelling Notation) diagram (Figure 16).

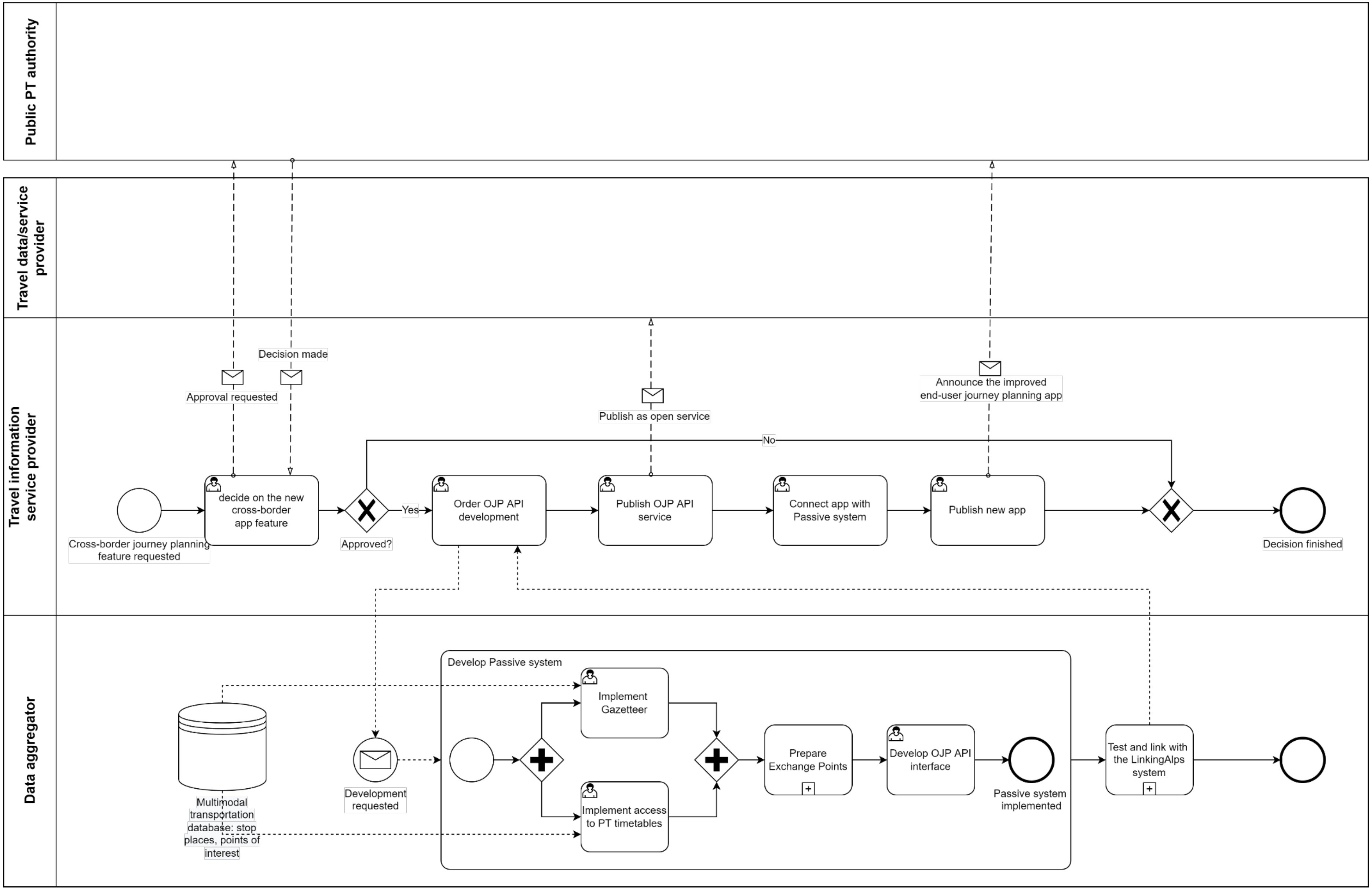


Figure 16. Decision support diagram for integration of JP app in the LinkingAlps system.

7. Use case: implementation of OJP in Slovenia

The Slovenian LJP AtoB (AtoB.si, user web interface on Figure 17, technical architecture on Figure 18) is integrated in the traffic and mobility platform of the National Traffic Management Centre (NCUP.si), which is organized within the Ministry of Infrastructure (Republic of Slovenia).

The NCUP aggregates traffic and mobility data and stores them to a multimodal transportation database, which is then used to feed the AtoB. The AtoB's passive system was developed in frame of the LinkingAlps project (initial version – Alpine region) and upgraded in the OJP4Danube project (upgraded - Danube region).

Start for the development of the active system is planned for December 2022 and is financed by the Ministry of Infrastructure. The gazetteer as part of the AtoB is populated from the multimodal transportation database providing national address data (source is the GURS - Surveying and Mapping Authority of the Republic of Slovenia) and POI data (from the OpenStreetMap). The link to the AtoB is published inside the national access point (NAP.si). The AtoB supports the standard OpenAPI interface compliant with the requirements of the LinkingDanube, LinkingAlps and OJP4Danube projects. For the time being these are the three separated interface because of the different geographical coverage and slightly different requirements as defined by the three projects but all support OpenAPI interfaces version 1.0:

```
<OJP xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns="http://www.siri.org.uk/siri"
version="1.0" xmlns:ojp="http://www.vdv.de/ojp" xsi:schemaLocation="http://www.siri.org.uk/siri ../ojp-xsd-v1.0/OJP.xsd">
```

Despite the differences in the OpenAPI interface the backend components of the LJP AtoB, namely routing engine, gazetteer and timetables are shared.

With the alignment of the three OpenAPI interfaces and union of the three geographical coverages this will provide for a single national LJP AtoB.

Besides the stable OpenAPI interface implementation, data quality is crucial for usefulness and user-friendly operation of LJP.

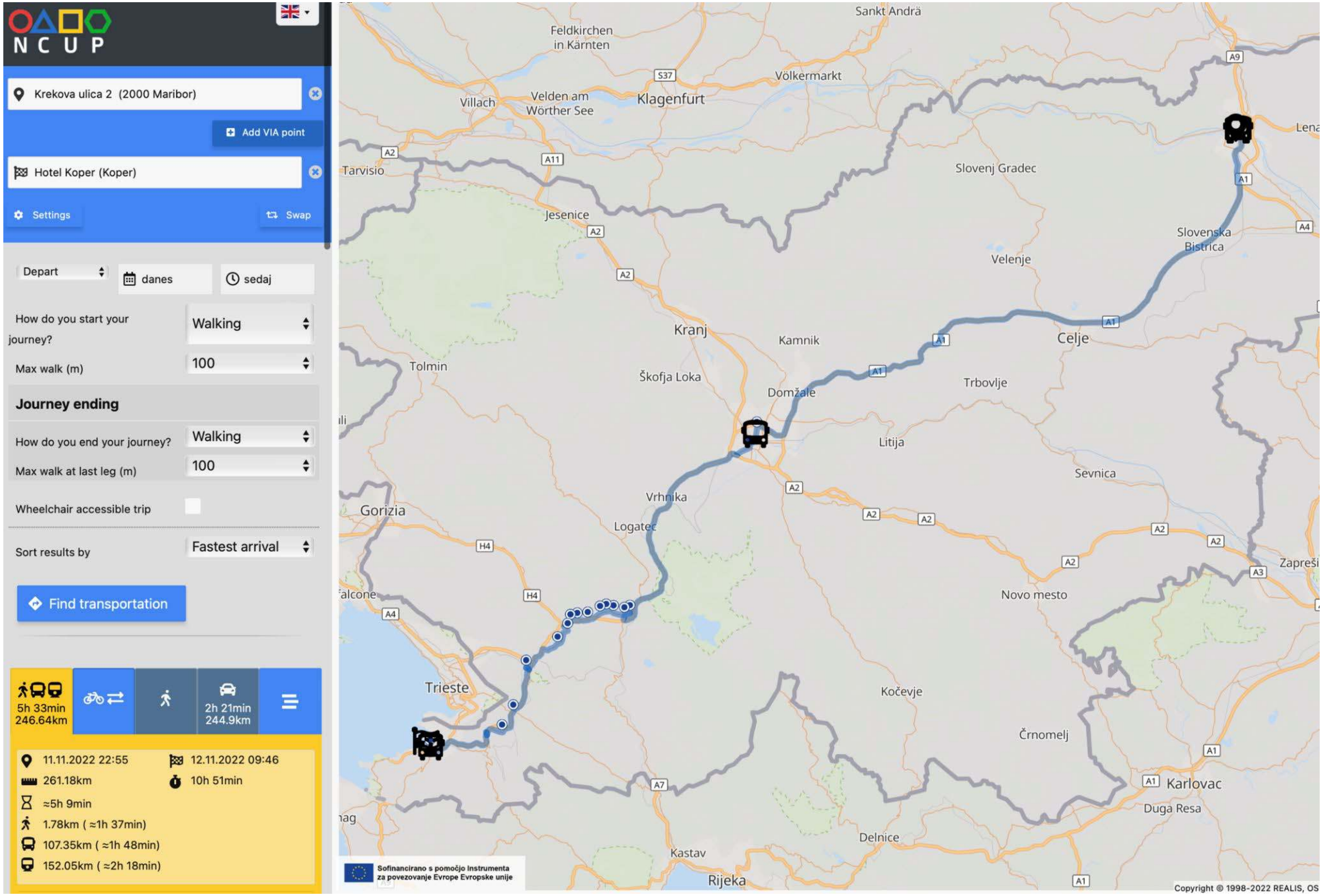


Figure 17. Slovenian local journey planner compliant with the OpenAPI interface.

To ensure the appropriate quality and up-to-date input data, a special Extract-Transform-Load (ETL) workflow has been implemented to prepare data for the LJP.

The workflow collects new data daily from data sources (IJPP, LPP – Ljubljana public transport, FlixBus, gtfs.de – long distance rail data for IC and ICE trains, and OpenStreetMap).

After extraction the new data is filtered for relevance based on different criteria, for example only international lines with at least one scheduled stop point in Slovenia are relevant. The collected data is then checked against duplicated stop places and possible geometrical misalignments are corrected. One undesirable side effect are missing travel route projections, which results in straight lines between the start and destination locations displayed in the end-user application. At the end of the ETL workflow a graph is constructed, which is then used for computation by the routing engine.

Data from the bicycle-sharing system BicikeLJ (https://www.bicikelj.si/en) across the wider Ljubljana city area is also integrated in the LJP AtoB. For the data source a specific ETL workflow was created, which first transforms data to the General Bikeshare Feed Specification (GBFS) format to be consumed by the LJP AtoB. The data from the BicikeLJ is sourced in 3 minutes time intervals.

Challenges for the future operational and user-friendly Slovenian LJP AtoB are:

- To guarantee reliable sources and preparation of quality network and timetable data for international public transport lines that crosses Slovenia, which will have to be obtained from the national authority (Ministry of Infrastructure) that registers them.
- Currently the data validity of the rail data (gbfs.de) is of 7 days, it would be desirable to have data valid for at least 6 months to enable short-term journey planning.

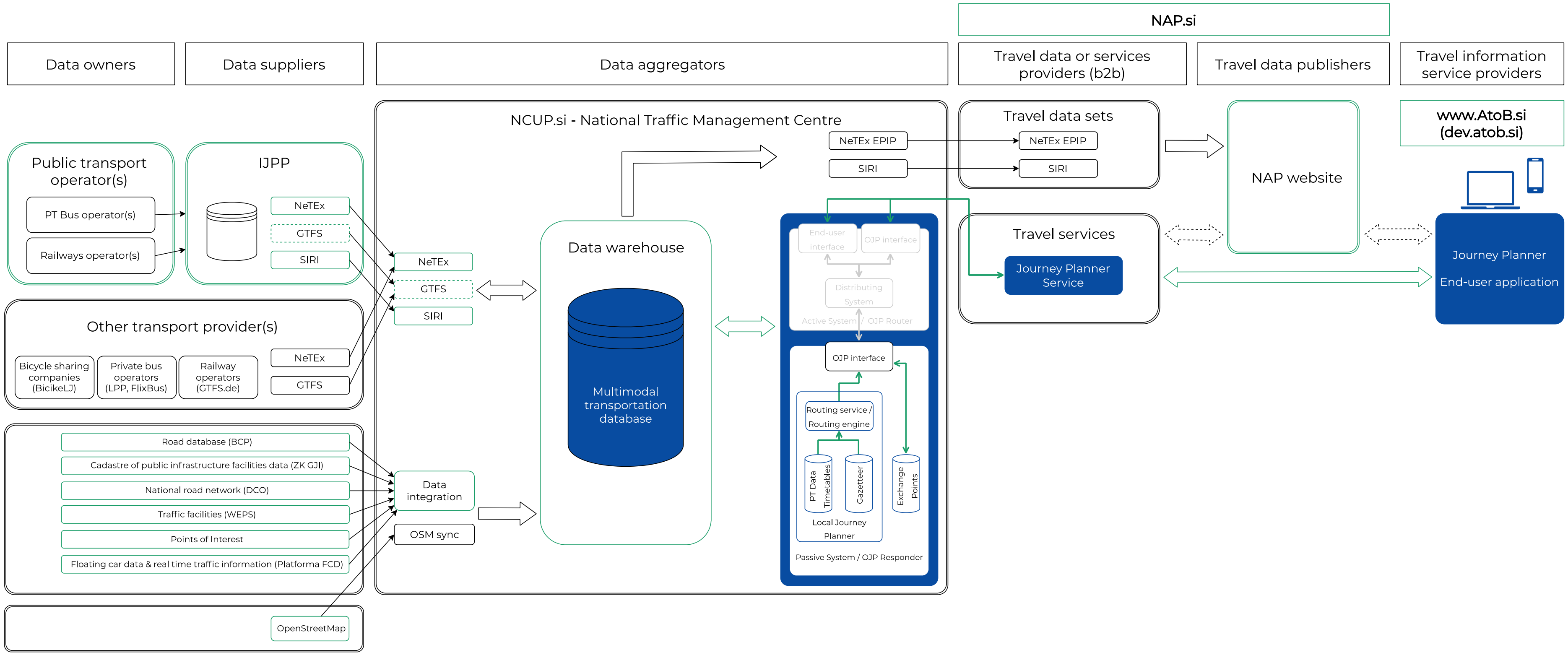


Figure 18. Slovenian national journey planner as part of national mobility and traffic data platform.

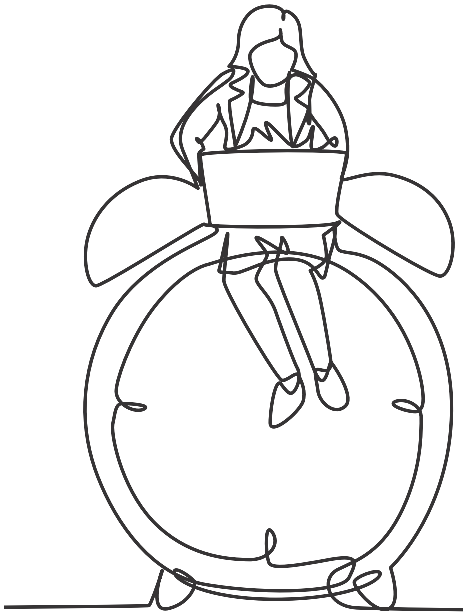
8. Conclusions

The LinkingAlps approach for distributed journey planning (LinkingAlps DRPS - Linking Alps Distributed Journey Planning Service) has multiple benefits for the traveller. Besides the simplified access to sustainable, multimodal traveller information, they can continue to use their well-known JP app of their home service in their native language. There are also several advantages for service providers. They can keep sovereignty over their data as well as extend the range of their system. Thus, it could lead to a strengthening of their market position.

For the mobility system, the LinkingAlps approach supports a sustainable mobility behaviour of travellers. It also offers a chance to small-scale and regional providers to strengthen their market position. Other benefits for the mobility system are better accessibility and connectivity of rural areas and solutions for the first/last mile issue.

Future implementers should use “Requirements document”, the “LinkingAlps OJP Profile” and the “Overall Organisational Architecture” for further technical details for an appropriate implementation.

Compliance with the standard OJP API interface makes LinkingAlps DRPS compatible and linkable to other OJP implementations, like OJP4Danube and EU-Spirit. That could eventually lead to linking of OJP based journey planners Europe wide.



In your local journey planner specify the start and end points of your trip, preferred time and date for your departure and arrival.

→

The local planning system matches the locations you selected with locations understood by the relevant journey planning systems.

→

The local planning system establishes how your journey can be planned when one end or both ends are outside its direct scope.

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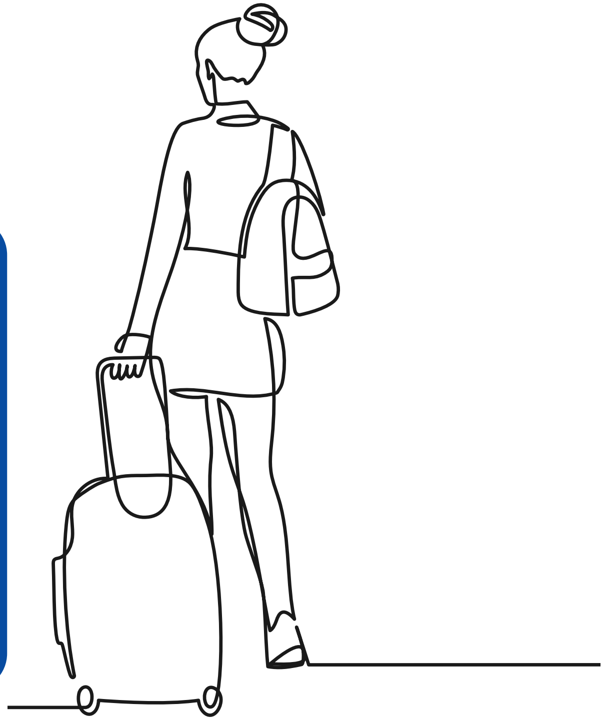
If it is outside of its covered area, its distribution system sends elements of the trip to relevant "distant" journey planners and receives a response from each of those planners with possible matches.

The local planning system then integrates those responses with its own generated information and creates a seamless trip plan to meet your requirements.

Your results are then back to your familiar journey planner and you are ready to go!



Appendix A. Frequently Asked Questions

- What is a journey planner?

A journey planner is a search engine that creates information for an optimal means of travelling between two or more locations, using one or more transport modes, often based on user defined criteria, for example, fastest trip, most economic and fewest mode changes.

- What types of journey planning systems exist?

Journey planning systems are usually distinguished as centralised or decentralised. The difference remains where the supporting data for the journey planning is held. If the planning systems share a central repository the system can be considered centralised. When each participating system holds data on all participant systems' areas (not only the gazetteers but also long-distance timetable data), the enquiry process can work on a peer-to-peer decentralised basis, and the journey planner is considered decentralised.

- What is a Distributed Journey Planner?

Being a distributed journey planner implies that data is collated from multiple systems exchange information, improving the quality and accuracy of the planning process and final journey plan presented to the traveller.

- What is an Open Journey Planner (OJP)?

An open journey planner is a journey planner which follows the Standard for communication for distributed journey planning CEN/TS 17118:2017 (Open API for Distributed Journey Planning).

- Who are the users of OJPs?

Users of an open journey planning information service are end users (for example, tourists, daily commuters) needing information for travel. The service is enabled by orchestration of data and systems provided by OJP stakeholders.

- Who are the stakeholders involved in OJPs?

Besides its end users the OJP information service requires participation of data owners / data suppliers, data aggregators, travel data and service providers, travel data publishers, and travel information service providers.

- What are the requirements for the implementation of OJP?

Organizational, technical and data requirements are primary for implementation of OJP. Organizational requirements involve organizing stakeholders so that they can fulfil technical requirements such as implementation of a local IT environment for traffic and mobility data that can then be linked to a distributed journey planning system (for example, Linking Alps Distributed Journey Planning Service). Basic data requirements for a local implementation of an open journey planner are accurate geographical (gazetteers, exchange points, route projections) and temporal public transport data (timetables, fares).

- What is a gazetteer?

A gazetteer is a directory of geolocations (stops, stations, POIs and addresses).

- What is an exchange point?

An exchange point defines a location where the trip leg of one system is connected to the trunk leg of another system. This includes regional stops which match with stops for long distance or regional stops from adjacent regions. Exchange points are mainly but not exclusively located at borders and in bigger cities.

- Where does the OJP's data come from?

Data that feeds the journey planner come from the data aggregator's database, usually a multimodal transportation database. Data aggregator collects mobility data from data owners and/or data suppliers in an agreed data format, most common is NeTEx (and GTFS).

- What is a national repository of public transportation data?

National repository of public transportation data is a multimodal transportation database, a data warehouse, which is a result of extraction, transform and load (ETL) procedures inside data aggregation process that combines public transportation data from different sources (data owners / suppliers) and from which data is delivered to travel data / service providers.

- What is a NAP and is it essential for the OJP?

A National Access Point (NAP) facilitates the access, exchange and reuse of transport related data, a platform where transport-related data from various data providers are made accessible to the public (mostly travel information service providers). Technically, an open journey planner service can be exposed thru a NAP website.

- What is an active/passive system?

An active system and/or passive system are parts of the local IT environment for traffic and mobility data. An active system is a travel information service that can perform distributed routing and provide that information to the end users. It includes an Open API interface (OJP interface) and actively requests the information from other Passive systems. A Passive system is a local journey planner that operates on OJP interface with the ability to respond to requests from Active systems. A local IT environment for traffic and mobility data with only a Passive system represents a minimally sufficient OJP implementation, when complemented with an Active Systems it represents a full OJP implementation.

- How do users benefit from the OJP?

Users of the Linking Alps Distributed Journey Planning Service will have improved access to sustainable multimodal information through their familiar Journey Planning Application with extended geographical coverage, high quality and accurate information, enabling multimodal cross border travel planning.

- How do users access the system? (Local JP integrated in the LinkingAlps)

Users can access the system through their familiar journey planner.

- How to develop an OJP compliant journey planner?

Besides typical software components (PT data, Gazetteer, routing engine) a journey planner needs to be upgraded with an OJP interface and an exchange point list, which qualifies it as a Passive system. The journey planner with a Passive system can be further upgraded with an Active system, which must contain a distributing system.

- What standard data formats are used for implementation of OJP?

An open journey planner does not require any specific standard data format but depends on the standard technical specification CEN/TS 17118:2017 (Open API for Distributed Journey Planning). However, it is advisable that data owners/providers make their data available to the multimodal transportation database in the standard NeTEx format for static PT data sets and standard SIRI for dynamic PT data sets.

- Can my OJP implementation be based on open-source software?

Parts of the OJP implementation can be based on open-source software solutions. For example, the OpenTripPlanner (OTP, http://www.opentripplanner.org) is an open-source multi-modal trip planner focusing on travel by scheduled public transportation in combination with bicycling, walking, and mobility services including bike share. The OTP2 doesn't support OJP

API but it can be upgraded to support it. Besides it includes a routing engine and interestingly also supports loading NeTEx in the version 2 (OTP2, https://docs.opentripplanner.org/en/latest/).

- What is the performance level of my route planner in terms of response time?

The prototype system Linking Alps Distributed Journey Planning Service reported response times of less than 10s. The response time can be improved with the improvement of response times of participating systems.

- Am I encouraged to use open standards?

Yes! Open standards are developed to improve functionality and interoperability. In the LinkingAlps case, the Open API for distributed journey planning, Transmodel, NeTEx and SIRI are examples of open standards that led to an improved final service.

- What kind of return can I expect by choosing to invest in OJP?

Investment in developing of an OJP API compliant journey planner with the objective of linking it into the Linking Alps Distributed Journey Planning Service not only offers local public transport schedules (timetables) to regional travellers but also to cross-border travellers. For this to happen local/regional multimodal transport providers are motivated to supply their data to a regional/national multimodal transportation database, which systematically increases visibility of their travel products to other participating regions.

Appendix B. Glossary

Active system	The active system integrates the routing information from several local journey planners to a combined seamless route. It is composed of a Passive system and a Distributing system. It communicates through an OJP interface. It is a journey planning engine with OJP capabilities. Via the distributing system it can detect journeys through adjacent or remote regions and able to create OJP Trip Compositions.
Adjacent region	Region which is adjacent to the local region and has its own "local" journey planning systems.
Adjacent system	Alias for neighbouring system. Participating system of an adjacent region.
Distributing system	System that distributes journey planning enquiries to other systems. It sends the request for journey-parts through areas to the corresponding passive servers, receives the responses and can create OJP Trip Compositions. It has the knowledge about gazetteers and can collect information about exchange points for the whole system.
End user	User of an "end user application". Person asking for journey planning information by using an end user application. Enquirer of a journey plan with a start, an end point, and some travel preferences.
End user application	Application used by the end user to have access to JP information generated by the Distributed Journey Planning Service (DRJP). It can be a third-party application connecting by OJP interface to a Participating system or the User Interface Participating system. The providers of the end user applications are named "OJP users" in the LinkingAlps project.
Enquirer	End user asking for information.

Enquirer system	Alias for Home system.
Estimated data	Predicted arrival or departure time of a particular means of transport at a particular stop. In the case of real time data, it can change several times during the journey.
Exchange point	Stop point or stop place, where the trip leg of one system is connected to the trunk leg of another system. This includes regional stops which match with stops for long distance or regional stops from adjacent regions. Exchange points are mainly but not exclusively located at borders and in bigger cities.
Exchange point database	Repository/view on a database or a service that can list the relevant exchange points of the distributed service. It can be a static system-wide database or be generated dynamically with requests for exchange points to the responding services.
Gazetteer	Directory of common objects across the local journey planner systems and its system borders. It enables the active system to find the passive system for all geolocations (stops, stations, POIs, addresses, etc.). The gazetteer acts system wide.
Home system	Participating system called by the end user application. It is the system that takes care of the end user travel information request and provides an answer.
Journey	The movement of a traveller from a start point to an end point by using one or more transport modes.
Journey Planner (JP)	System that calculates the journey for a given request. It can accept requests directly from end-user services. It is a generalization of OJP Router and OJP responder.

Journey Planning System (JPS)	Alias for Journey Planner.
Local Journey Planner (LJP)	System with a routing engine and access to multimodal data with a particular local, regional or national coverage; "local" underlines its focus on a specific coverage that is limited. LJPs have no transregional (or distributed) OJP routing capabilities.
Local region	Territory covered by a journey planner / home-system, which can plan trips by itself without information from other systems.
Location database	Database with all locations relevant for the whole system. The location database is part of the gazetteer.
Long distance schedule data	Schedule data of long-distance traffic.
Long distance traffic	Traffic moving over extended areas, great distances and usually not subject to frequent stops.
Long distance transport connection	Trunk legs of the routes that connect at least two OJP systems. They are used to connect two neighbouring or remote systems. Exchange points are defined along the trunk leg which defines all the neighbouring systems.
Neighbouring system	Alias for Adjacent system.

OJP Implementer	Travel information service provider that is implementing an OJP service exchange (in most cases on the back-end system of an end user service).
OJP Interface	Application Programming Interface (API) based on CEN/TS 17118:2017 - Intelligent transport systems - Public transport - Open API for distributed journey planning
OJP Responder	Alias for Passive system.
OJP Router	Alias for Active System.
OJP Trip Composition	Process of combining the different trip legs coming from different OJP Responders. It is transmitted via OJP Interface.
OJP User	End-user service provider that uses OJP services from local JPs to provide an end-user service.
Open Journey Planning (OJP)	Standard for communication for distributed journey planning (CEN/TS 17118:2017).
Participating system	Local journey planner, part of the OJP system architecture and the appropriate OJP service.

Passive system	Local journey planner with an OJP interface (API) being able to respond to requests from distributing systems. It is an information source within the system without distributed journey planning capabilities. It communicates through an OJP interface as a responding system. Alias OJP responder, responding system.
Public transport services	Service that allows people to travel. The service is for public usage.
Real time data	The real time of a particular means of transport at a particular stop; only sent after the arrival/departure of the vehicle at a particular stop.
Remote region	Region not adjacent to the local region. A remote region is covered by a local LJP.
Remote system	Participating system of a remote region.
Responding system	The generalized term for a system that responds to questions from the distributing system.
Schedule data	Planned data for public transport services.
Server	In this context a program (software) that provides special services to be used by other programs.

Service	Technical, self-sufficient unit that bundles related functionalities into a complex of topics and makes them available via a clearly defined interface.
System	Delimitable "structure" consisting of various components which can be regarded as a common whole due to certain ordered relationships between them.
Travel information application	Allows the end user to get information about their journey and other relevant information for travelling.
Trip	Alias for Journey.
Trip leg	Local part of a trip which is calculated by a single Local Journey planning system.
Trunk leg	The "trunk" legs are long-distance transport connections that interlink Journey planning systems.
LinkingAlps Distributed Journey Planning Service (DRJP)	Is a network of existing local, regional, or national travel information services (routing platforms) that collaborate on the basis of CEN OJP exchange interface (CEN/TS 2017: openAPI for distributed journey planning) in order to exchange travel information and routing results. A web-based communication network between the participating systems needs to be established as the systems are physically remote. A universal common interface for exchanging requests between the participating services needs to be specified and implemented at all participating systems.

OJP Profile	The LinkingAlps OJP Profile 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 to enable communication with the LinkingAlps distributed journey planning system. In this sense the LinkingAlps OJP Profile defines the content and the structure of the information content as well as the physical exchange format.
Routing result	Result of a routing request by the end user.
Steward (exchange point steward)	In the system-wide exchange point list, the 'steward' system is considered the system, which has the most complete information on stop points or stop places (including timetables) of all systems. The 'steward' acts as the prime system, which is managing and maintaining the stop point or stop place information. The 'steward' is responsible for the stop point or stop place. A single exchange point can only have a single 'steward'.
Stop place	Place with one or more locations where vehicles may stop and where passengers may board or leave vehicles or prepare their trip.
Stop point	Point where passengers can board or alight from vehicles.