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LinkingAlps Organisational Framework Strategy

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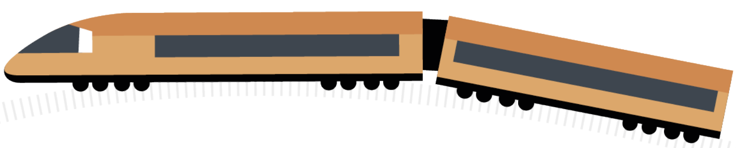

1 Introduction

Today, transport emissions represent around 25% of the EU's total greenhouse gas emissions, and these emissions have increased over recent years. The goal of being the first climate-neutral continent by 2050 requires ambitious changes in transport. A clear path is needed to achieve a 90% reduction in transport-related greenhouse gas emissions by 2050.[1]

One way to foster the shift from motorized individual transport towards low carbon mobility options such as public transport, railways and alternative modes of transport like on-demand transport is to facilitate seamless door-to-door mobility options across borders, operators and modes. However, cross-border travellers often face the problem that travel information for the entire route is not visible at a glance in an integrated service. In most cases, travellers have to switch between the information systems of different operators, regions or countries in order to plan their entire journey. This creates a barrier to the use of public transport services. Since journey planners normally emerge from a local (city) or regional scope, they lack cross-border and cross-operator information. Therefore, there is a need for seamless journey planners that go beyond local or regional system boundaries.

In addition, the Mobility-as-a-Service concept is changing the market and roles. Cross-operator cooperation is emerging to provide new multimodal mobility offers. Operators are opening up their back-end systems to third parties (e.g. for shared ticketing) via application programming interfaces (APIs), enabling the integration of different offers into a single travel information service.

The recently completed LinkingDanube project has demonstrated the feasibility of a unified information exchange in the form of the Open Journey Planner (OJP) developed in the project. Now LinkingAlps takes OJP to the next level by preparing the ground for an operational service in the Alpine Space after the end of the project. The Alps are one of the most popular holiday destinations in Europe and therefore have a high volume of tourists. More importantly, however, we are dealing with a highly interconnected area where a large number of cross-border commuters and residents travel across borders for their daily errands and recreational activities. Moreover, the Alpine transit routes are important transit lines through several countries and regions, such as the Brenner route. For this reason, there is a need for seamless and high-quality travel information for travellers. The LinkingAlps project addresses this problem in the Alpine region.

1 Transport and the Green Deal | European Commission (europa.eu)
https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/transport-and-green-deal_en

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LinkingAlps project overview

The main objective of LinkingAlps is to foster the shift from motorized individual transport towards low carbon mobility options such as public transport, railways and alternative modes of transport like on-demand transport. By using innovative tools and transnationally aligned strategies for linking mobility information services, the options for low carbon mobility will be increased by offering seamless door-to-door mobility chains for transnational travellers. Mobility information services and travel information across borders, operators and modes are shared within the project partners to offer the best option for the end user (traveller). It is also aimed at reaching out to the end users in order to raise awareness of new tools.

The project brings together 14 partners from six Alpine Space countries that tackle the common challenge of "linking of services". The following partners are part of the LinkingAlps Consortium:

Travel information service providers

- Traffic Information Austria (VAO)
- Swiss Federal Railways (SBB)
- Regional Development Agency of the Ljubljana Urban Region (RRA LUR)
- ARIA Lombardia S.p.A. (Regional Agency for Innovation and Purchasing Ltd)
- South Tyrolean Transport Structures (STA)
- Metropolitan City of Turin (CMTo)

Regional transport authorities

- Transport Association of Tyrol Ltd. (VVT)
- Transport and Energy agency Canton Grison (AEV)

National transport authorities / agencies

- AustriaTech – Federal Agency for technological measures ltd. (ATE) – lead partner
- Federal Office of Transport (FoT)

Research organisations & consultants

- LINKS Foundation – Leading Innovation & Knowledge for Society
- Centre for Studies and Expertise on Risks, Environment, Mobility, and Urban and Country planning (Cerema)
- University of Maribor (UM-FGPA)
- Consulting company for control, information and computer technology GmbH (BLIC)

With these partners from Austria, Germany, Italy, Slovenia, Switzerland and France the project aims to establish an open, standardised exchange service for travel information so that the information can be integrated into one single service providing seamless travel information. It is envisaged to provide a durable, distributed solution to enable a transnational, cross-provider and multimodal journey planning service, which will be continuously innovated as well as expanded. The vision is to reach a high distribution degree in the service to avoid the necessity for international data pools. To achieve a sustainable service, a viable organisational and operational architecture for linking services is implemented. By means of a scalable approach and implementation support, the project aims to reach future adopters and create a network of multipliers to leverage an alpine-wide application.

Components of the LinkingAlps framework strategy

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Legal framework for "linking of services"

In 2017 the European Union published the Delegated Regulation 2017/1926. This Directive deals with EU wide multimodel travel information services and supplements the Directive 2010/40/EU. As a part of this directive the „linking of services“ concept deals with further cooperation between different service providers.

3.1 Starting point for "linking of services" in general

Traveller information services are in the scope of various European ITS (Intelligent Transport Systems) projects. With the Delegated Regulation (EU) 2017/1926 on the provision of EU-wide multimodal travel information services (MMTIS) supplementing Directive 2010/40/EU, the European Union has established a legal framework, which consists of both non-binding and binding acts. The Delegated Regulation contains measures to support the interconnection of local, regional and national travel information services aimed at improving the geographical coverage of the entire door-to-door network in order to meet the travel needs of end users across the Union and to exploit the full potential of multimodal travel information.

For a wide range of stakeholders, the Delegated Regulation is a key motivator to engage in R&D activities and to seek collaboration to both comply with the Delegated Regulation and develop state-of-the-art transnational journey planning services. These motivators trigger the need for technical innovation and implementation work as well as an appropriate organisational framework in order to ensure aligned approaches and coordinated implementation.

The Delegated Regulation on MMTIS comprises a list of specifications necessary for provision, exchange and update of standardised travel and traffic data. The Delegated Regulation lines out, that these specifications should

not oblige transport authorities, operators, service providers and infrastructure managers to start collecting any data that is not already available in machine-readable format. Yet if these data are available, the specific requirements regarding the static and dynamic data of different transport modes should apply.

Particular standards like NeTEx or the technical specification on Open API for distributed journey planning[2] (the OJP standard) are set out in the Delegated Regulation. In addition, there are several standards in the domain of public transport (Transmodel, SIRI) and technical specifications in the railway domain, like the TAP-TSI. These standards are issued by European standardisation bodies and the European Commission in order to guarantee interoperability in passenger information.

The Delegated Regulation defines single points of access (National Access Points, NAP) to make the specific data of different transport modes, including data updates, as set out in the Annex of the Regulation (timetable data, real-time information, stations, etc.), publicly accessible. Thus, this Regulation directly affects transport operators and sets clear obligations for them with regard to data provision, re-use and accessibility of data. So far, only the provision of the static data listed in the Annex of the Regulation is mandatory across all modes. However, a revision of the Regulation is currently in progress where it is discussed to extend the obligation to dynamic data and to include data quality requirements. This is essential to guarantee accurate, real-time travel information for travellers.

3.2 Linking of Service concept and the link to the "OJP standard"

While previous research initiatives focused on data exchange, the concept of "linking of services" was first introduced and defined in Delegated Regulation 2017/1926 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 (as described before).

2 Universal interface for service exchange that allows to set up distributed services with decentralized data sources.

The concept of "linking of services" is addressed in number (19) of the Delegated Regulation and subsequently in Articles 7 and 8:

> (19) At present, there are a substantial number of multimodal travel information services in Europe but those services that offer a full door-to-door routing result are mainly limited to the territory within a Member State. A key solution to enhance the geographical coverage of travel information services and to support Union-wide multimodal travel information is by linking local, regional and national travel information services. This involves the use of technological tools including interfaces to link existing information systems to exchange routing results. It is recommended that travel information services should use the European Technical Specification entitled 'Intelligent Transport Systems — Public Transport — Open API for distributed journey planning 00278420' currently under finalisation when performing distributed journey planning. When service providers establish handover points for distributed journey planning, such handover points should be listed in the national access point.

Article 7

Linking travel information services

> 1. Upon request, travel information service providers shall provide to another information service provider routing results based on static, and where possible, dynamic information.
> 2. Routing results shall be based on:
>   (a) the enquirers start and end points of a journey along with the specific time and date of departure or arrival, or both;
>   (b) possible travel options along with the specific time and date of departure or arrival, or both, including any possible connections;
>   (c) the handover point between travel information services;
>   (d) in case of disturbances, alternative possible travel options along with the specific time and date of departure or arrival, or both, and any connections, where available.

Article 8

Requirements for service provisions reuse of travel and traffic data and linking of travel information services

> 5. Terms and conditions of linking travel information services shall be defined in contractual agreements between the travel information service providers. Any financial compensation of the expenses of linking travel information services incurred shall be reasonable and proportionate.

The basic idea of this concept is to exchange information by providing routing results for combined transnational/cross-operator journey planning without the need to exchange and maintain the corresponding data in a central database. The principle is only very roughly drafted in the Delegated regulation. As it is referred to in the Delegated Regulation, the "Public Transport – Open API for Distributed Journey Planning" (CEN/TC 278 (2017) standard is the very basis for understanding and implementing the "linking of services" concept. The definitions used in this standard, referred to as the "OJP standard", include the basic concept already mentioned before that the use of a common, open application programming interface (Open API) enables services to communicate with each other and exchange routing results without integrating the other services' data. Due to this interrelation, the term "OJP" – Open Journey Planning – is commonly used when talking about the implementation of the "linking of services" approach.

The system architecture followed in LinkingAlps project closely relates to the concept of a centralised distributed journey planner described in the final draft version of the Technical Specification "Public Transport – Open API for Distributed Journey Planning" prepared by the Technical Committee CEN/TC 278 (2017).

FIRST FRAMEWORK COMPONENT: LEGAL FRAMEWORK

Key findings:

The EU formulates the intention of "linking of services" in the Delegated Regulation (EU) 2017/1926 and thus provides the basis for the establishment of a transnational journey planning system. The implementation of these legal requirements and the establishment of a responsible authority in the participating countries is mandatory.

Challenges:

Based on the Delegated Regulation, each country is obligated to set up their National Access Point and its responsible authority. However, each country sets them up differently which leads to disparate implementations of the Delegated Regulation in regards to transnational routing. Therefore, time and effort is needed for aligning all these different approaches to form the basis for an operating transnational routing service.

Possible solutions / required activities:

The EU Directives must ensure a minimum level of data quality. In addition to static data, dynamic data must also be mandatory. Both data provision and minimum data quality must be enforced. In accordance with the EU Directive, all relevant data must be made available in an appropriate manner.

SECOND FRAMEWORK COMPONENT: POLICY FRAMEWORK AND IMPACT ON SERVICE PROVISION

Key findings:

When it comes to the provision of data and information, different policy related framework conditions apply to the project partners. Some of the partners want to offer the service as an open service, providing free access to the API (request limits at marginal cost excluded), thus ensuring a high distribution of the LinkingAlps approach. Other partners have business models that do not allow them to offer the service for free to third parties outside the consortium. In addition, some partners provide all relevant data as open data, while in other partner countries the framework conditions do not allow the partners to provide the basic and supporting data on an open data basis, even though the provision of that data is mandatory according to the Delegated Regulation (EU) 2017/1926.

Challenges:

Contradicting framework conditions on the topic of open data and free access make it difficult to reach agreement on licenses

Possible solutions / required activities:

In line with EU Directives (in particular Directives (EU) 2010/40 and (EU) 2019/1024), the relevant data and services must be open and the respective countries and regions must implement the relevant EU regulations.

4

OJP standard

In order to draw conclusions about the project and to present them in a comprehensible way and put them in the right context, we will explain some basic technical principles in addition to the organizational ones that will follow in the subsequent chapters.

In many domains like social media and e-commerce, APIs are well known and operated on a daily basis. Also in travel information domain, APIs are already used for information gathering.

The OJP standard ("Public Transport – Open API for Distributed Journey Planning" (CEN/TC 278 (2017)) enables the exchange of journey planning information between any participating local, regional or national journey planning systems and serves as a basis for the realisation of the distributed journey planning approach. The main principle of distributed journey planning includes splitting a big task – a trip request that exceeds the boundaries of one journey planner – into a set of smaller tasks that can each be processed by several local journey planners and afterwards, be reassembled and presented as one single routing result.

A simple process of making an enquiry in a distributed journey planning looks as follows[3]:

1. An enquirer goes to his home system and composes an enquiry expressing the location of the start and end points in their own terms or as permitted by the end user.

2. The enquirer's home system seeks to match the enquirer's locations to locations understood by the journey planner, and then converting them into terms (perhaps geographic coordinates) that can be understood by the home and other distributed journey planning engines.

3. The home system establishes what questions it needs to ask and from what journey planning systems (both its own and those of one or more distributed partners) it needs to ask for information that it does not already have in its own database.

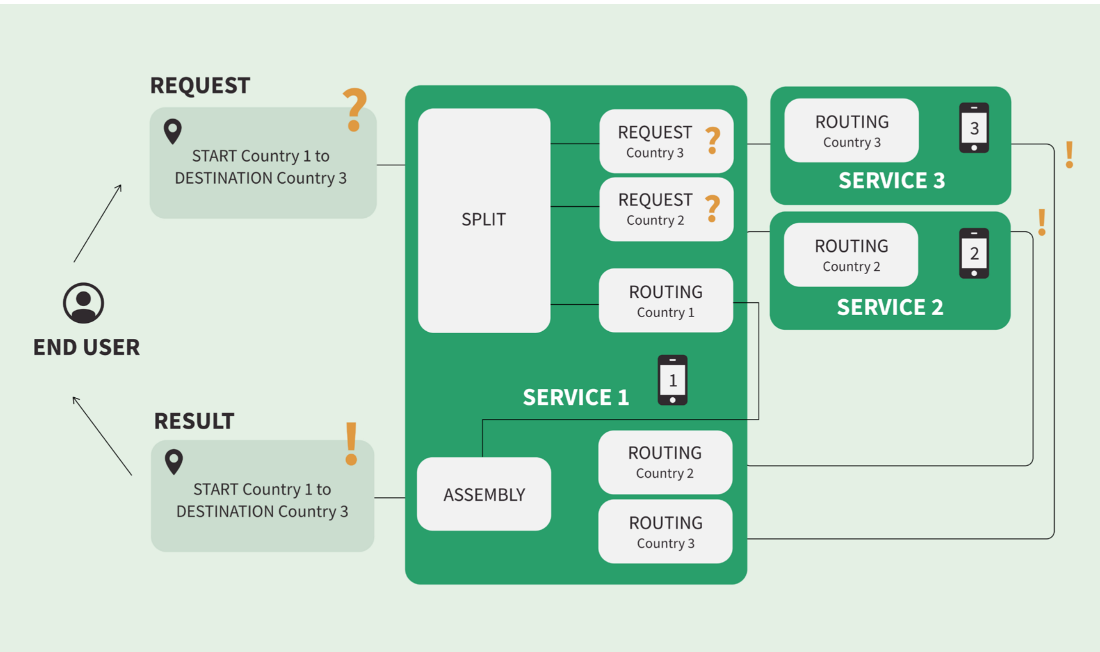


Figure 1: Concept of request flow within distributed journey planning (Source: LinkingDanube project, LinkingDanube consortium, 2018)

3 CEN/TC 17118:2017 for „Open API for Distributed Journey Plannings

4. The home systems then collates the information received in response to the questions asked of the different systems to create a seamless and efficient journey plan which it can then deliver to the enquirer.

Based on this process a network of journey planners will exchange information via OJP interface fully compliant with the specifications outlined in the Technical Specification CEN/TC 17118:2018 for "Open API for Distributed Journey Planning".

4.1 Standard development motivation

The overall aim of "linking of services" is to enable a distributed routing without a central service, while at the same time allowing travellers in the European Union to plan their journeys more easily and seamlessly. When looking at the basic approach there are some main drivers that vary for the different stakeholder groups.

For OJP implementers (= OJP service providers) the main motivators are to:

- Extend the coverage of the existing travel information services by integrating travel information from other sources dynamically by using APIs
- provide seamless travel information to the passengers while minimizing comprehensive data exchange processes
- ensure the actuality of the information according to the source system
- avoid misinterpretations when the route calculation is carried out by the actual source system and is therefore only in the hands of the routing provider.

For OJP users (= end user application providers) motivators can be to:

- use trusted and reliable information to build up special end user services
- focus on the end user application side in the development and do not need expert knowledge in the whole travel information production chain.

For end users (= travellers) the full implementation of the OJP should mean:

- improved accessibility to travel information for the passengers and increased acceptance of public transport and alternative mobility
- extended geographical coverage of the well-known end user application

For sure, it is a step-by-step approach to fully unfold the benefits. Nevertheless, every step on the way towards implementation is reaching out to the goal of seamless journey planning in the European Union.

THIRD FRAMEWORK COMPONENT: OJP STANDARD AND OJP EU PROFILE

Key findings:

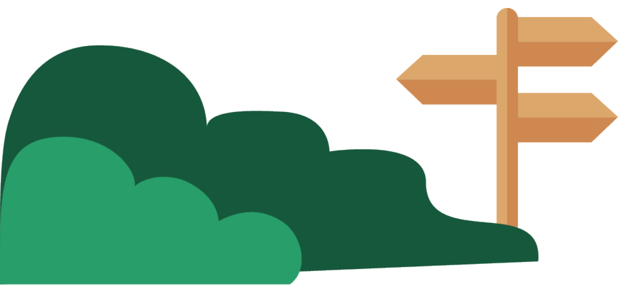
Based on the Directive 2010/40/EU, the EU provides technical standards for the exchange of various data. The participating countries and supporting stakeholders must implement these technical standards and requirements in their systems. The Delegated Regulation (EU) 2017/1926 defines the OJP standard (Open API for Distributed Journey Planning) which enables the exchange of journey planning information between any participating local, regional or national journey planning systems and serves as a basis for the realisation of the distributed journey planning approach. However, when it comes to standardisation, there is a need for concrete technical specifications and data profiles that specify how the standard is actually implemented. Within LinkingAlps, the LinkingAlps OJP profile has been specified and implemented.

Challenges:

Although various initiatives exchange regularly, different interpretations of the standard are possible and so far, there is no commonly agreed profile. The specification of the profile needs to be made tighter to minimise the scope for interpretation.

Possible solutions / required activities:

A clear, interpretation-free OJP profile needs to be defined (OJP EU profile). Europe-wide harmonization must be driven in OJP standardization groups, but parallel initiatives (like OJP4Europe) also have to be supported in order to enable the exchange of the OJP network and to provide a framework for further harmonisation of the technical profile. Quality control, mandatory test sets for implementation and perhaps even certification could be introduced.



5

Distributed solution approach – an overview

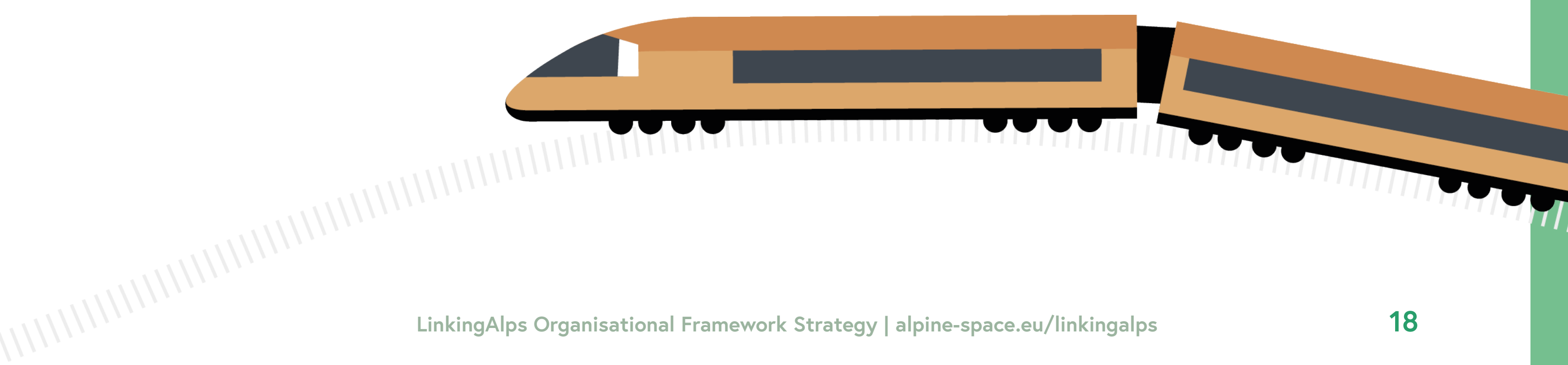
In order to develop sustainable solutions as basis for an operational cross-border framework of services, the technical approaches need to comply with the EU Strategies for multimodal travel information. The objective of the European Commission regarding the provision of multimodal travel information services are major premises for LinkingAlps. The compliance with the Delegated Regulation 2017/1926 supplementing the EU ITS Directive is a key pre condition.

5.1 Decentralised architecture

Past initiatives to establish EU-wide travel information services using an architecture with only one central system that includes all data related to the journey planner network were facing massive challenges. A centralised pool for travel data means to have a neutral pool operator that is interpreting the data. Because of missing trust on the neutrality on the central service provider and conflicting interests of data providers (source systems) and pool operator, as well as missing viable organisational models for a central European travel information service, the decentralisation of information got more into the focus of the related stakeholders. Considering the past, the EC is regarding „linking of services" with a decentralised organisation of information provision as an enabler for seamless travel information.

In the LinkingAlps approach that is described below, a decentralised and distributed journey planning system has been implemented, meaning that a network of journey planners (participating systems) collaborate to compute journeys over a wide area beyond the domestic coverage of each planner. Participating systems are considered as either regional or national journey planning systems taking part in the decentralised, distributed system. The key task of the system is to enable information exchange between the participating services vice-versa. A standardized interface was developed that allows the peer-to-peer exchange through APIs. This decentralized approach allows the journey planners to keep the sovereignty over their data and the interpretation of the data in their routing. Nevertheless, this decentralised and distributed journey planning system needs some parts in the architecture, which are managed and handled system wide. This makes exchange of supporting data necessary. Therefore, the performance of the services has to be considered when setting up the relevant approach.

Considering the given framework conditions from organisational and technical point of view the architecture as presented for the LinkingAlps approach is as distributed as possible, but with consideration of an operational, performant service. That means that the OJP interface was finally implemented in a way that it supports a high level of distribution, but exchange and integration of supporting data (like exchange points, gazetteers, long-distance transport) is not regarded as contradiction to distributed journey planning approach.



5.2 GENERAL IMPLEMENTATION PRINCIPLES FOR THE LINKINGALPS APPROACH

The LinkingAlps Distributed Journey Planning Service is a network of existing local, regional and national travel information services that collaborate based on the OJP standard as described before. For describing the system architecture, the following terms are used:

- A participating system is part of a decentralised network of journey planners (JPs) established through OJP interfaces. Participating systems can be active or passive role in the architecture, depending on their tasks. Participating services are distinguished according to the functionality and scope to active and passive systems.

- A Local Journey Planner is a 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. A LJP itself has no transnational (or distributed) OJP routing capability.

- An active system is a travel information service, in particular a journey planner, to which the end user is connected to (that means it is the enquirer‘s home system). It is providing an openAPI service (exchange service), the OJP interface, and is actively requesting the information from other services by using a distributing system. Hence the active system contains a distributing system that has the distribution logic in order to gather the needed information. The active system further integrates the routing information from several local journey planners (active or passive systems) to a combined (seamless) route. Doing so, it has an OJP routing algorithm facilitation the trip composition. In order to gather the required trip information in some cases the active system is also responding to requests from other systems through the OJP interface and consequently takes over the tasks of an OJP responder. In the system architecture description, it is called the OJP router indicating that it comprises an OJP interface, a distributing system and OJP routing. An active system can, but must not contain the end user service as well.

- A passive system is a travel information service, in particular a local journey planner, that is providing an OpenAPI web service (exchange service) (OJP interface) so that other clients can access information from the server. Passive systems are so called OJP responders and deliver responses to request over OJP interface coming from active systems. Passive systems have no distributing system and do not provide an OJP routing. Both, active and passive systems can be in the role of a responding system as the communication in the network is on a peer-to-peer basis. Therefore, the term „active and passive“ systems are not used in the system architecture component description.

- Besides active and passive systems, there are further system components, like the end user application. The end user application provides the GUI to the end user and is able to provide a seamless routing.

- Processes and tools/services to exchange supporting data for the service need to be defined and agreed between the active parts of the service in order to provide a functional distributed journey planning service.

The overview of the system architecture as included below is not the "server-centered" view, but describes the LinkingAlps ecosystem and the interconnection between the different components of the network, also from a process point of view.

The main components of the system architecture are:

- End user application
- OJP responder (alias passive system)
- OJP router (alias active system)
- Gazetteers
- Exchange point lists/service
- Distributing system
- OJP interface (OJP API based on a LinkingAlps OJP profile)

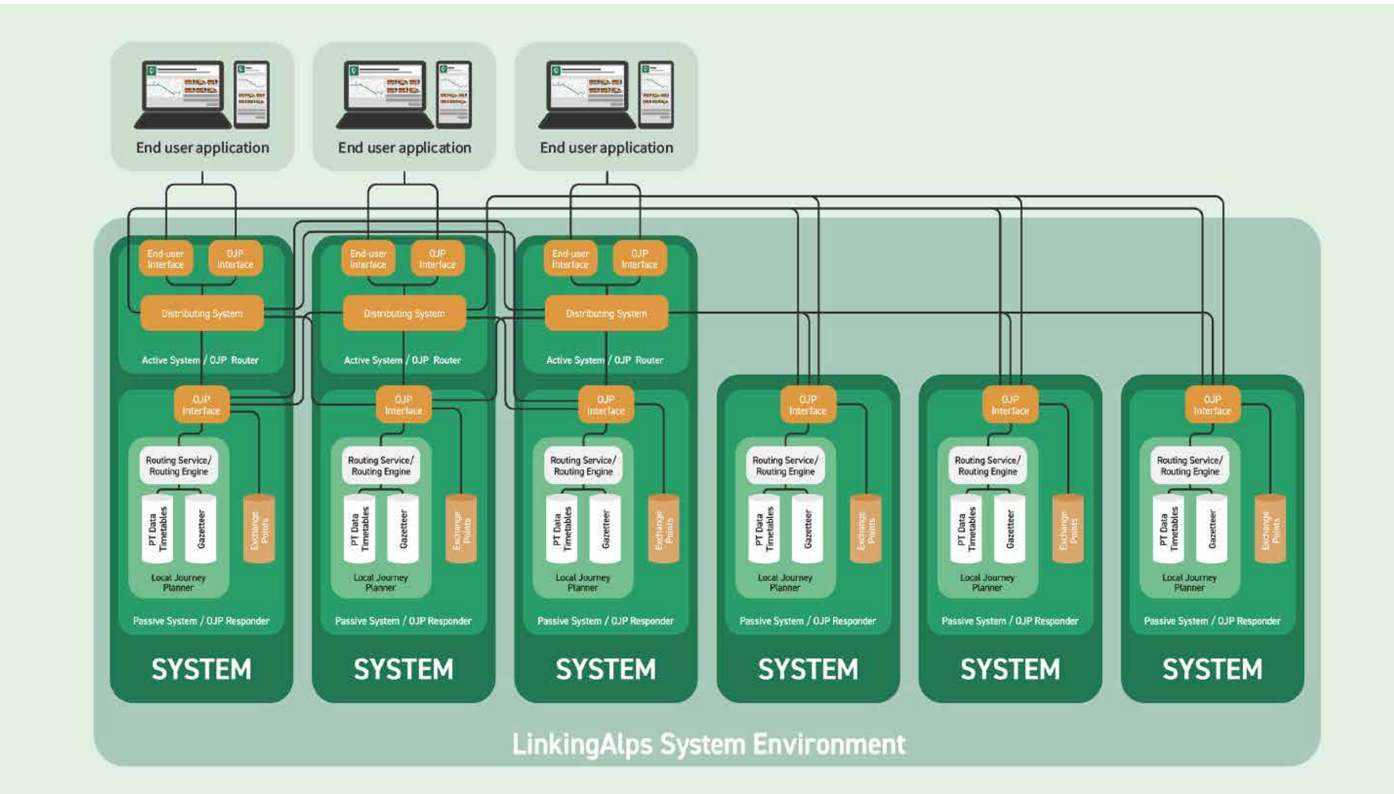


Figure 2: LinkingAlps system environment (Source: ATE/Gabler, 2022)

The end user is a public person with a request for a trip plan. The end user application is the travel information system that the enquirer is using. The provider of the application is called the OJP user and is the client of the home system for local trip requests and of the distributing system for distributed trips, depending on which system is providing the response for the trip request.

The OJP responder or passive system has the role of an information source and provides the responses to the requests of the active system. They provide access to multimodal travel data, information about their coverage area as well as a list of exchange points and a gazetteer, containing mainly local geolocations related to the Local Journey Planner.

The OJP router or active system is providing the OJP service to an end user application. It consists of a passive system and a distributing system. The OJP router can communicate with the passive system and the end user application via an OJP interface. It actively requests information from other services through the distributing system.

A gazetteer is a directory of common objects across the local journey planning system for all geolocations and acts system-wide. Therefore, the harmonisation of the localisation identification is important. Each active and passive system is responsible for the implementation of the gazetteer repository.

FOURTH FRAMEWORK COMPONENT: DISTRIBUTED SOLUTION APPROACH

Key findings:

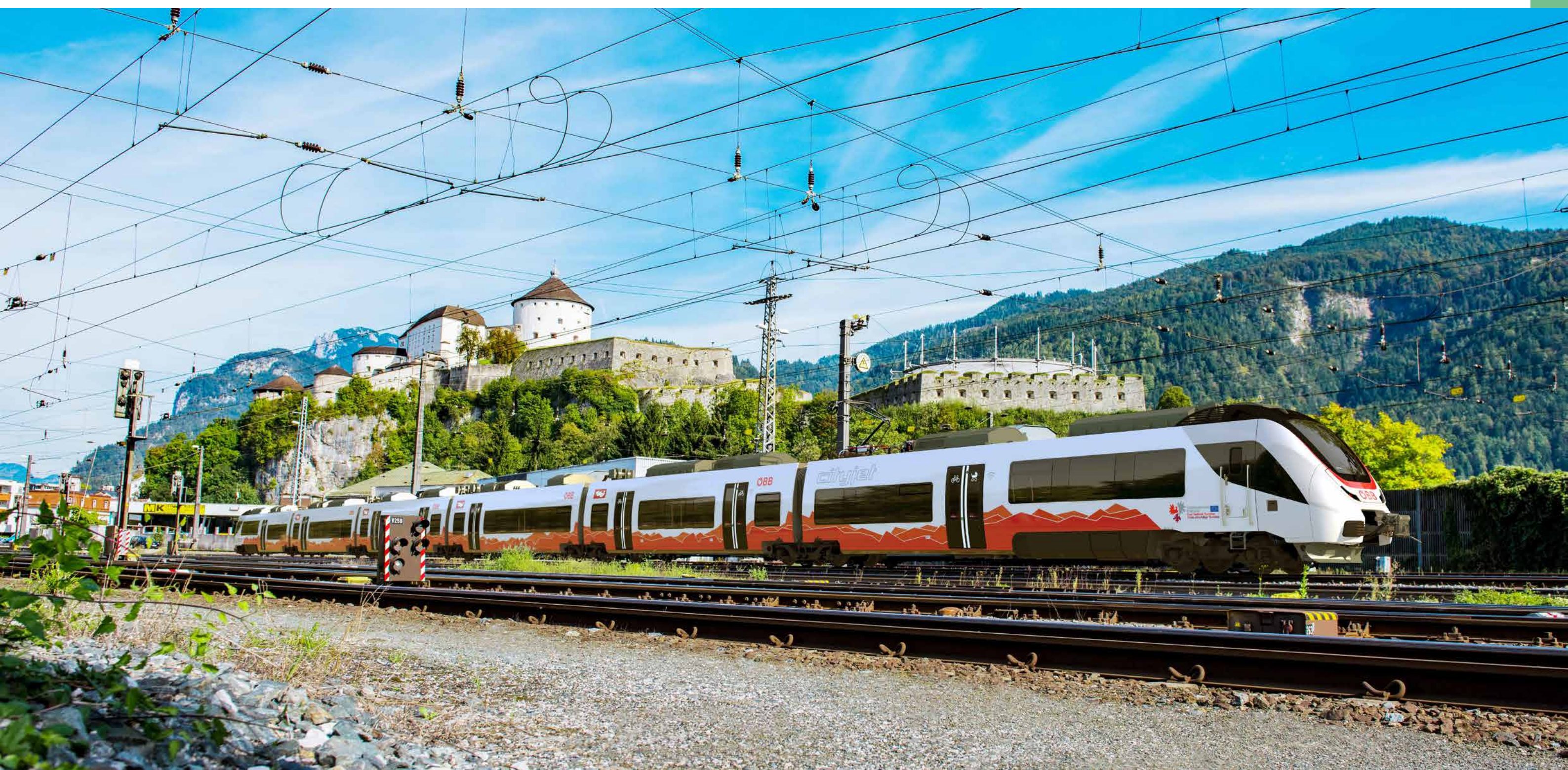
Considering the given framework conditions from an organisational and technical point of view, the architecture as presented for the LinkingAlps approach is as decentralised as possible, while ensuring an operational service. This means that the OJP interface was implemented in such a way that it supports a high degree of distribution, but also includes the exchange and central integration of the necessary supporting data (such as exchange points, gazetteers, long-distance transport). As a novelty, not just one but two OJP routers were implemented and OJP responders were connected to both OJP routers. In addition, OJP routers and responders from different suppliers have been connected.

Challenges:

Due to the high complexity, not all aspects of the fully distributed approach could be implemented during the project. The suppliers' systems still need to be further developed and brought to production maturity. However, a technical concept for the fully distributed approach has been created and evaluated. Another challenge is data management, which involves a lot of work because basic information (e.g. the use of IDs) is neither regulated nor standardised globally.

Possible solutions / required activities:

The technical concept for the fully distributed approach is currently being validated. Furthermore, the integration of the required supporting data must be globally specified, harmonised and automated, and the data quality must be controlled at the source of the raw data. Other aspects of the fully distributed approach can be implemented and tested as part of proof-of-concepts or student projects. In addition, the performance and data management of the service needs to be improved.



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Data availability and service quality

Although the “linking of services” approach is as distributed as possible and the main objective is to exchange routing results, the aspect of data and its availability has a major impact on the quality of the end user service and the quality of the distributed routes. There are two main aspects related to this component that need to be tackled in the context of distributed journey planning:

FIFTH FRAMEWORK COMPONENT: AVAILABILITY OF (BASIC AND SUPPORTING) DATA

A. LONG-DISTANCE DATA:

Key findings:

The technical solution as currently developed within the LinkingAlps approach has some limitations in terms of the number of journey planning services (regions) that can be covered in one request. Due to these limitations, as well as due to performance considerations, there is a need for a long-distance service when so-called remote regions are connected. In addition, a concept for an algorithm with a fully distributed approach or the so-called "system hopping"-approach has been developed in the LinkingAlps project. In principle, this approach is possible without a specific long-distance service. However, without the availability of a centralised long-distance routing the complexity and the computational load are too high to provide a service in an operational environment that meets the performance requirements of users. Therefore, in this respect, more research is needed to develop the approach further, or long-distance data needs to become available.

Challenges:

Long-distance data for rail are currently only available to UIC members and therefore to railway companies. Other databases, such as the MERITS database, are a possible solution. However, in addition to the costs of data use via the MERITS database, the use of the MERITS data is also restricted depending on the framework conditions of the service provider (e.g. no open data usage). Based on the experience from the LinkingAlps project partners, the MERITS database might therefore not be the appropriate basis for the implementation of a fully distributed ("system hopping") approach. It must be stated that also, long-distance data are unavailable for the majority of the participating countries in a machine-readable format at the National Access Points.

Possible solutions / required activities:

The provision of long-distance rail data is crucial for the further development of high-quality services in the field of OJP. A Europe-wide commitment to provide this data and the correct implementation of Delegated Regulation (EU) 2017/1926 must be considered in this context.

B. AVAILABILITY OF DATA WITHIN LINKED SERVICES (STARTING POINT OF NETWORK PARTNERS):

Key findings:

The basic approach of OJP is to link services. All services in the network have a different initial situation. Depending on the coverage of the service, the national or regional framework conditions, the goals of the service providers themselves and the availability of the data varies greatly. Even if the aim is to connect services, it must be taken into account that the availability of data within the services is a crucial prerequisite for the functioning and quality of the service. The LinkingAlps project has shown that the quality of journey planner services can vary widely. Some services include static timetable data as well as real-time data, for other services, only static data is available. For some services, the time horizon covered for the data is one year, for others only half a year. For all these differences in the service, solutions have to be found in order to provide a consistent set of information to the end user while remaining a similar service quality for especially end users who are accustomed to high quality services.

Challenges:

Differences between partners must be addressed and resolved. The solutions can look very different depending on the nature of the differences between the partners.

Possible solutions / required activities:

These differences (e.g. the availability of real-time data) need to be addressed on a political, organisational and technical level. One solution for the end user service (front end) could be to provide additional information if only static information is available for some parts of the route. In the long term, the availability of real-time data is a must.

C: SERVICE QUALITY OF THE LINKED SERVICES:

Key findings:

The OJP interface links together the existing journey planning services, which are already running and in the different regions. Obviously, these services have different standards for data quality and the quality of the routing and information they provide to their users. As the quality differs between the different systems with some services providing much more information than others do, the overall quality of the linked service is also affected. The main issue with this is that the system can only provide information as good as the lowest quality service, as it does not make sense to provide information only for one part of a route and for the other not.

Challenges:

The connected services need to be aligned and certain standards as well as requirements regarding data quality and service quality need to be defined and implemented. As each service provider has to do this by himself and depends on the specific situation, this could be a time consuming and also costly activity.

Possible solutions / required activities:

A minimum quality of the service need to be defined between the partners to harmonise the different services. A level needs to be found which users accustomed to high-quality services would still use while also not demanding too many changes for services with lower quality or making it impossible for lower quality services to be part of the system. Furthermore, the lower quality services, which do not meet the defined minimum quality, have to get to such a level where they can provide a service with at least this minimum quality.

7

LinkingAlps
Organisational architecture

In addition to a resilient technical architecture, an organisational architecture consisting of stakeholder structure, organisational processes, governance and collaboration structure were developed to complement the technical components and to ensure a sustainable and smooth operation of the LinkingAlps service beyond the project period.

7.1 STAKEHOLDER STRUCTURE

Figure 3 provides an overview of all stakeholders involved at the national level during the project period and presents the stakeholder categories for a general stakeholder model. Based on the user-centered approach, stakeholders of the LinkingAlps system were categorised by their role in information provision as “front end”, including end user applications and OJP users, and “back end”, including OJP implementers.

In addition, supporting actors were identified who facilitate the initial development of the fully distributed system during the project-phase, on the one hand, and are involved in the continuous maintenance and innovation of the LinkingAlps service also after the project end (incl. suppliers, R&D), on the other hand. Furthermore, decision-making bodies and authorities are considered as supporting actors that play a crucial strategic and enabling role within the stakeholder structure.

Because of their importance in facilitation, they enable and drive the implementation of the novel LinkingAlps solution and pursue continuous development of the conceptual, regulative and policy foundations to sustain and innovate the LinkingAlps service, but also to use the insights and learnings from the fully distributed LinkingAlps solution to advance the “linking of services” approach.

The model shows that the LinkingAlps system consists of two active systems (SBB and STA) located at the back end of the service, while so far only STA also has a role as an OJP user at the front end of the LinkingAlps service. VAO, 5T, ARIA, and LUR provide passive systems at the back end of the service. A variety of supporting stakeholders are involved in the development of the LinkingAlps service and are also necessary for the operation and innovation of the service after the project.

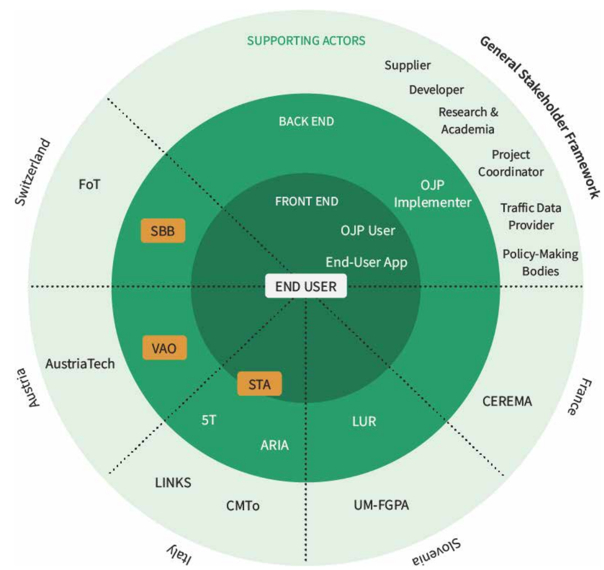

Figure 3: LinkingAlps stakeholder structure (Source: ATE)

The stakeholder structure illustrates the complexity, but also the partially overlapping character of the roles and responsibilities of the actors within the LinkingAlps system. Thus, it is essential to add an organisational layer to the definition of roles and responsibilities of the involved actors as stipulated in the technical architecture. Table 1 provides an overview of the roles and responsibilities of the implementing actors and shows that both active and passive systems can have multiple roles.

Role	System Level	System Component	Responsibility
End user app	Front end	External actor or participating system	Provision of end user app (GUI)*
OJP user	Front end	Active system	Provision of end user app (GUI)*
	Front end	Passive system	End user application* (App needs to be connected to an active system)
OJP implementer	Back end	Active system	• OJP responder • OJP router • Distributing system
	Back end	Passive system	OJP responder

* Solution possible within the system design but not implemented in the current version of the LinkingAlps system

Table 1: Roles and responsibilities of implementing stakeholders

7.2 ORGANISATIONAL PROCESSES WITHIN THE DISTRIBUTED JOURNEY PLANNING NETWORK

The project developed a set of detailed organisational processes that are essential tools to structure and coordinate stakeholder collaboration for a durable and resilient operation of the LinkingAlps service.

In Figure 4, technical architecture of LinkingAlps is used as a basis and is complemented by an organisational process layer to illustrate to systemic relevance of the individual processes on multiple levels. The developed processes not only relate to the operation of the LinkingAlps service, but also cover innovation and expansion activities. Organisational processes include coordinative activities that support technical processes and thus enable the operation of the LinkingAlps service, as well as administrative processes related to the steering and management of the LinkingAlps service.

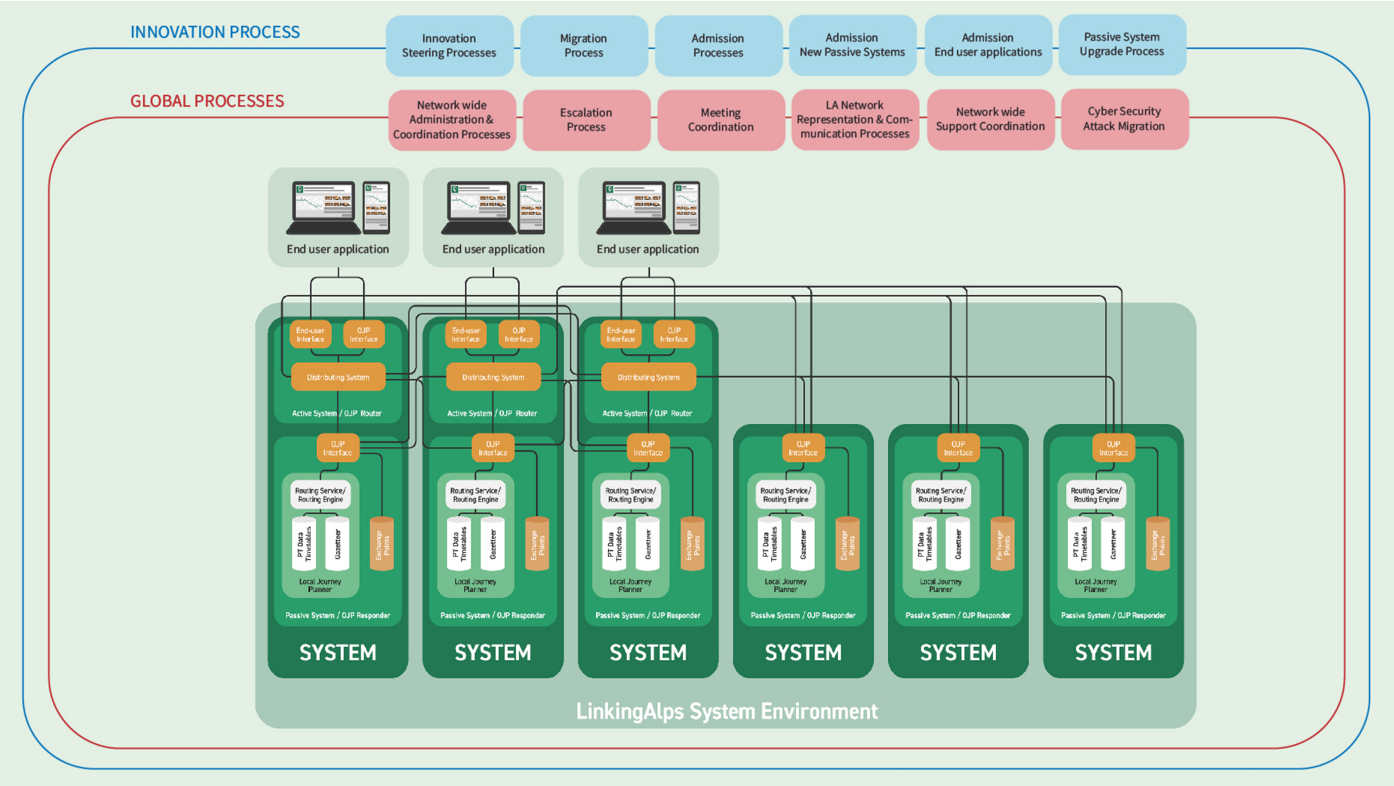

Figure 4: Organisational process architecture (Source: AustriaTech)

7.3 COLLABORATION STRUCTURE FOR DURABLE OJP SERVICES

The collaboration structure can look very different depending on the related network and depends on the starting point of the network and the relevant framework conditions. In the LinkingAlps project, the partner network has decided to smoothly transfer the pilot, which is the outcome of the R&D project funded under the INTERREG Alpine Space programme, into an operational service once the project is completed. The transition of the pilot activities into an operational service needs to be a gradual process, so that the technical and organisational processes can be transferred into a fully operational environment. In the case of LinkingAlps, the partners decided for the common procedure of a beta-phase. The details of the beta phase will be defined prior to the end of the pilot phase.

SIXTH FRAMEWORK COMPONENT: ORGANISATIONAL ARCHITECTURE

Key findings:

The main goal of the pilot and the phase after the LinkingAlps project is to develop a stable, operational service. For the operational service, a commitment is required from the participating systems to keep the service running and to jointly drive technical and organisational aspects of the service. This ensures investment security for users, which can build on a service available in the long term. Collecting user feedback is important for adapting and improving the service.

Challenges:

In order for a journey planning system to participate in the productive service, it must meet the requirements defined in the Terms of Reference (ToR) adopted prior to the beta-phase. The ToR contain a service level agreement that includes the content of the service, data quality, support, time of operation, response time, actualisation intervals and bug fixing parameters. In addition, the following content must be part of the ToR: profile, profile development and rollout as well as the necessary open data basis to be provided by the partners. The active server must use the passive systems in the way stated in the ToR.

Possible solutions / required activities:

Some of the project partners propose an approach where any partner willing to provide a functional passive system can enact the ToR itself. In this way, no central coordination is required and the LinkingAlps service can connect to EU Spirit and other passive systems that support enough content. This requires a detailed ToR document. At the time of writing this Output, the formulation of the document was still in progress.

8

OJP in the Alpine Space and across Europe – Conclusions and next steps

This output provides an overview of the required components of an organisational framework strategy for the harmonized deployment of a seamless and open transnational journey planning service and combines findings of previous deliverables and activities.

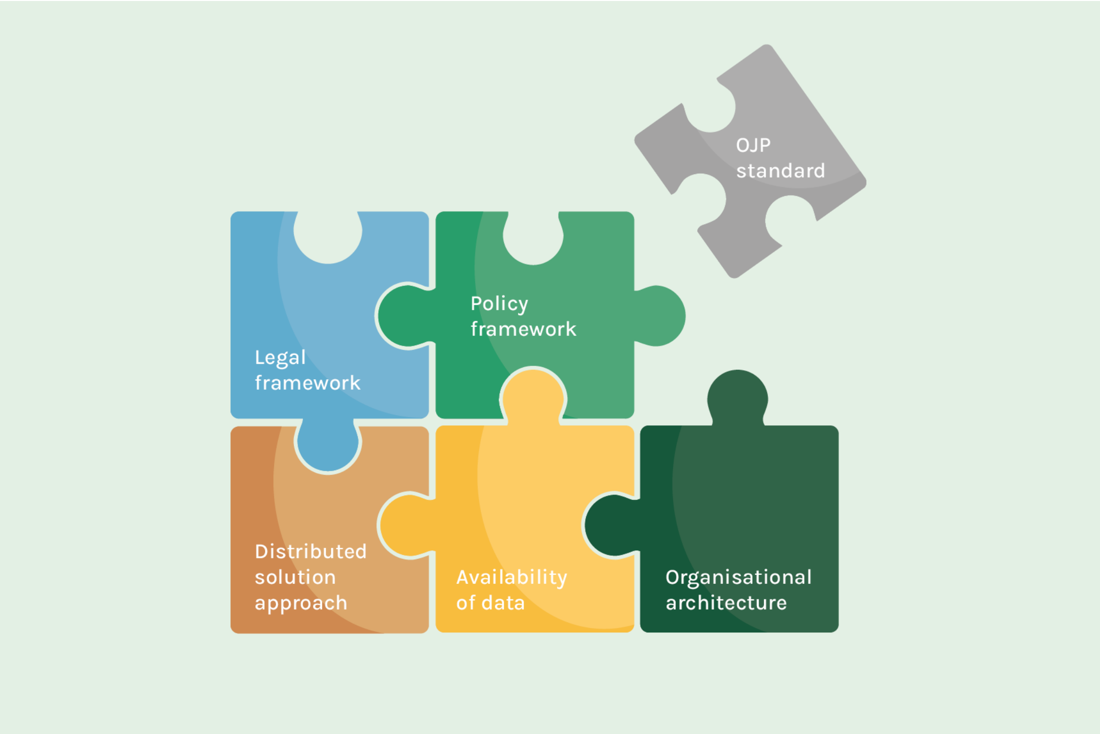

Figure 5: Framework strategy components

Summarizing the last chapters, the project facilitated a learning process regarding the OJP implementation. During the project, the possibilities but also the challenges of the OJP standard became much clearer. With the development of the "system hopping"-approach, it was possible to evaluate where the potential limits of the given framework conditions currently lie. The issue of availability of basic and supporting data, especially in the area of long-distance data, was also addressed in the project. The next steps for the LinkingAlps network have already been defined to move step by step from the pilot activities to an operational service.

Furthermore, some necessary actions at European level have been identified, especially with regard to the availability of long-distance data, which are crucial for the further development of OJP. As far as further developments are concerned, it must be noted that in the future it will be necessary to merge the different activities. As mentioned before, initiatives such as OJP4Europe will be needed to ensure a harmonised, compatible OJP development in Europe.

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