Interreg
Alpine Space
LinkingAlps
European Regional Development Fund

EUROPEAN UNION

Output O.T2.1

Transnational mobility information services

Version: v1.0

Dissemination level: Public

WP: WP T2 Development, demonstration and evaluation of a pilot service

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Date: 30.09.2022

Preface

Acronym:	LinkingAlps
Title:	Innovative tools and strategies for linking mobility information services in a decarbonised Alpine Space
Project number:	740
Start Date:	01-10-2019
End Date:	30-09-2022
Call number:	4th call
Priority:	Priority 2 - Low Carbon Alpine Space
Specific objective:	SO2.2 - Increase options for low carbon mobility and transport

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1 Introduction

LinkingAlps is an INTERREG Alpine Space project with 14 partners from Austria, Germany, Italy, Slovenia, Switzerland and France. It started on October 1st, 2019 and will run until September 30th, 2022. LinkingAlps aims to establish a standardised exchange service for travel information so that the information can be integrated to a single service providing seamless travel information across operators and borders. 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).

2 LinkingAlps project and goals

In order to travel across the border, travellers often face the problem that travel information is not visible for the entire route. Therefore, they are forced to switch between the different information systems of the respected operators, regions or countries in order to plan their entire journey. The LinkingAlps project addresses these problems covering the Alpine Space. The goal of the project is to create a standardised exchange service of travel information between the individual service providers. Thus, travellers will be able to view their entire trip in a single service and have access to high-quality travel information.

One of the main scopes of the project is the Linking of Services by developing a network of travel information services. To create this network existing regional and national journey planner services with focus on multimodal transport will be interlinked through a standardised exchange service. Another goal is the shift towards low carbon mobility options such as public transport, railways as well as on-demand transport and other alternative modes of transport. LinkingAlps builds on the results of the LinkingDanube project by providing an operational service in the Alpine Space.

The LinkingAlps approach 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 are able to 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 as a whole, 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.

3 System architecture

The LinkingAlps Distributed Journey Planning Service is a network of existing local, regional or national travel information services, which collaborate via Open API (CEN OJP exchange interface). One of the main components are the **participating systems**. These can be either active or passive systems, depending on their functionality and scope. A **Local Journey Planner** is a system with a routing engine and access to multimodal data with a particular local, regional or national coverage. It does not have transnational or distributed OJP routing capabilities.

An **active system or OJP router** is a participating system that the end-user or traveller is connected to. It provides an openAPI service (exchange service) and the OJP interface. The active system contains a distributing logic in order to gather the needed information by actively requesting it from other services. The active system then combines the routing information from several local journey planners to a route. The OJP router therefore consists of an OJP interface, a distributing system and OJP routing. It can also contain the end user service as well.

A **passive system** or OJP responder is a travel information service that is providing an openAPI web service (exchange service or OJP interface). The OJP Responder acts as the information source and responds to the trip request of the OJP Router via OJP interface. It provides access to multimodal travel data, information about its coverage area and a list of exchange points as well as a gazetteer, containing mainly local geolocations. Contrary to active systems, passive systems have no distributing system and do not provide OJP routing.

The **Distributing System** is part of the OJP Router and is able to split up a trip request into sub trips, which are then sent to the relevant OJP Responders. The Distributing System reassembles the partial trip leg routes and sends them back to the OJP Router via the OJP Interface. The OJP Interface links the existing information systems to exchange routing results.

Another component is the **end user application**, which is the travel information application that the end user has access to. The providers of the end user application are called OJP users. It is the client of the home system (for local trip requests) and of the distributing system (for distributed trip requests) that are providing the results of the distributed journey planning enquiry to the end user through a GUI.

A **gazetteer** is a 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, points of interest (POIs), addresses, etc.). The gazetteer acts system-wide. Location identifications must be harmonised across the systems so that they can be looked up by all distributing services. It is a repository, which is held decentrally within the Journey Planners or in a central database and enables an identification of all geolocations (Stop point, Stop place, Topographic Place, POIs, Address) across the local journey planner systems and its system borders.

Exchange points are hand-over points between different local journey planners. Exchange points in LinkingAlps are defined as stops/stations with direct connections in the neighbouring regions/countries and the possibility to change the transport option (mode, vehicle). Generally, exchange points are defined as stops or stations where the trip leg of one participating system is connected to the trunk leg of another participating system.

The communication between the OJP router, distributing system and OJP responder as well as end user application is done via an **API** based on a common LinkingAlps profile. This API is a standardised interface allowing communication between all distributed system parts. It is based on "Open API for distributed journey planning "developed by Technical Committee CEN /TC 278 (2017). The OJP service is implemented on OJP routers (active systems), distributing systems, OJP responders (passive systems) according to an agreed and aligned LinkingAlps OJP Profile.

4 Description of the service

The LinkingAlps OJP profile covers regions in Italy, Switzerland, Austria and Slovenia. Figure 1 illustrates the regions that are currently covered and where routing is possible.

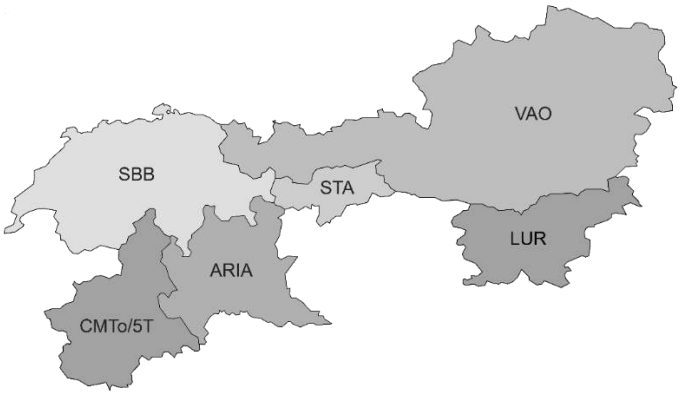

Figure 1: LinkingAlps coverages area, Source: LinkingAlps, 2020.

As part of the LinkingAlps project many partners are involved as participating systems. In total, there are six existing travel information services/journey planners. STA and SBB each developed an active system, while ARIA, VAO, CMTo/5T and LUR are participating as passive systems.

The end-user sends a routing request via the OJP interface to the active system. With distributing logic, it splits a request up and sends it to the corresponding journey planners. It then combines the trip legs to a seamless route and sends the result back to the end-user.

Figure 2 shows the Interface of the LinkingAlps Journey Planner (Link: https://linkingalps.suedtirolmobil.info/de/). By entering the point of departure as well as the destination, the traveller receives the result as one. Figure 3 and Figure 4 show, that this is not only possible for domestic journeys, but also between countries, for example between South Tyrol and Switzerland.

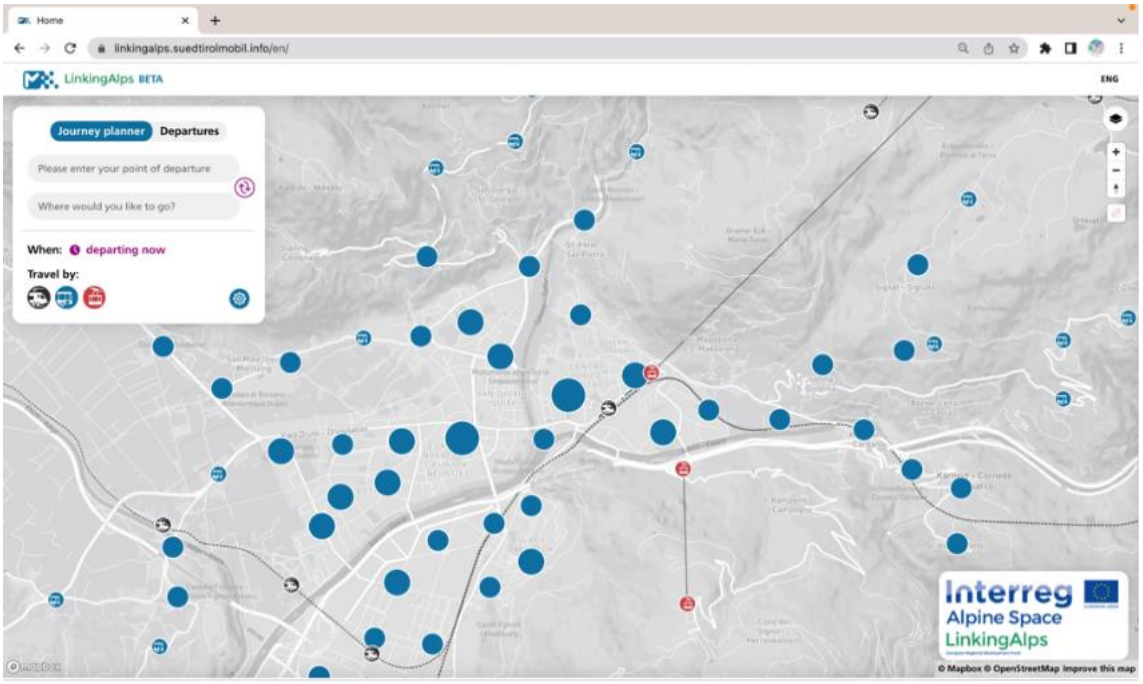

Figure 2: Interface of Journey Planner, Source: STA, 2022.

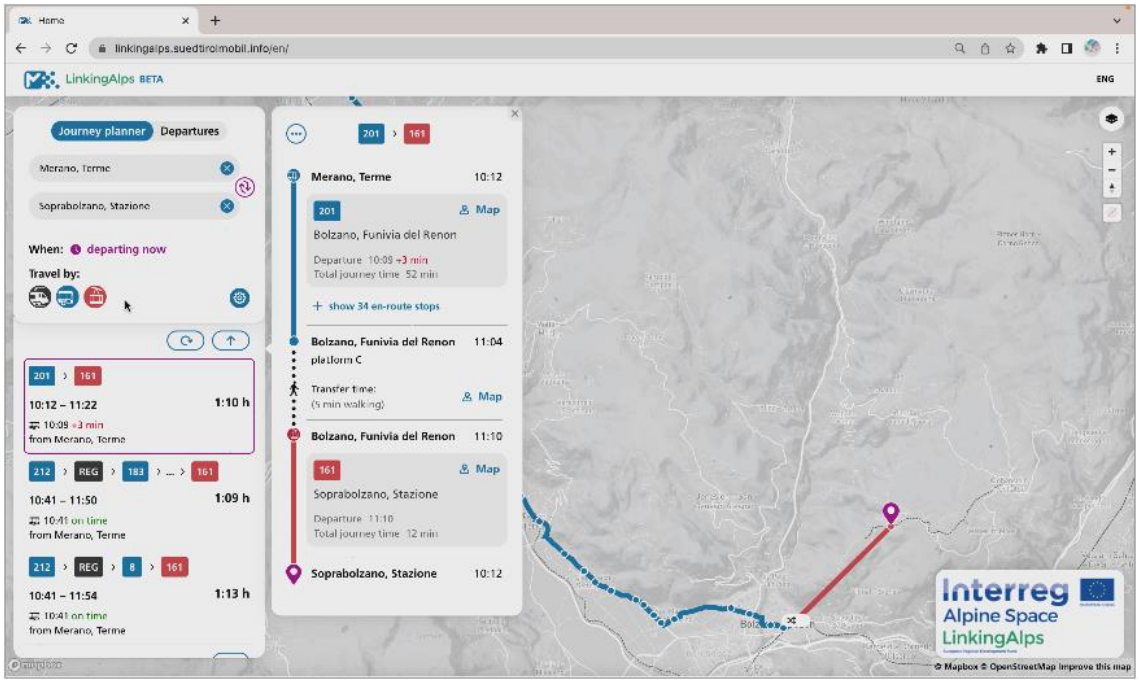

Figure 3: Travel information within South Tyrol, Source: STA, 2022.

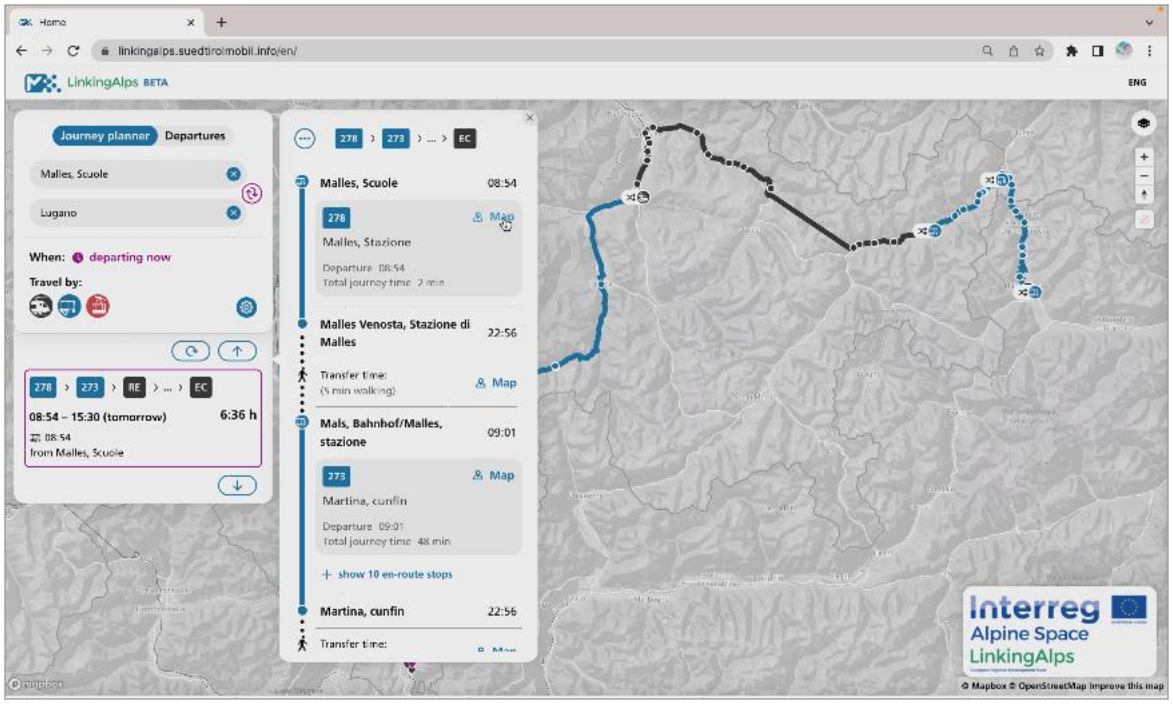

Figure 4: Travel information between South Tyrol and Switzerland, Source: STA, 2022.

5 Service functionalities and conclusions

To determine what is working and what is not, this section refers to deliverables and activities that have investigate how well the system is working and responding to requests. In particular, D.T2.5.1 as well as A.T2.4 provided an evaluation and report on the functionality.

Regarding the active systems, they fulfil the requirements to 81 %. One of the reasons is that the requirements were differently implemented or deemed unnecessary for the system. The active systems also face a problem with performance, as it still needs to improve to provide the same performance as the currently operational systems. The passive systems' current fulfilment is a little lower with 72,5 %. One of the main problems for the passive systems is that the requirements cannot be fulfilled by all systems, due to the lack of data quality provided to them. Also, performance issues lower the fulfilment as some requests take several seconds to be processed. This also lowers the overall performance of the system.

Various tests of the OJP services were performed, namely LocationInformation, Trip, StopEvent, TripInfo, ExchangePoint and MultiPointTrip tests. LocationInformation offers information regarding places, e.g. stops, addresses, POIs, etc. Trip allows the planning of trips from "A" to "B". MultiPointTrip allows the planning of trips with multiple origin and/or destination places given. TripInfo allows the retrieval of detailed information on a specific service, e.g. the complete list of calls. The service ExchangePoints makes it possible to retrieve exchange points between operators/networks. StopEvent allows the retrieval of stop events, e.g. for departure or arrival boards. The testing categories and criteria can be found in Figure 5.

Category	Criteria	Definition
General	Coverage	Geographical area covered by implemented system. For Linking Alps this area should encompass Austria, Italy (partially), Slovenia and Switzerland.
	Availability	Availability of the Journey Planning System in terms of: • System availability • Information availability
Quality	Correctness	The ability to accurately return results according to the search parameters.
	Completeness	All (user) set parameters / constraints of the enquiry are considered.
	Timeliness	Time needed for the system to return enquiries.
	Repeatability	The same test yields the same result.

Figure 5: Criteria Categories and their Definitions, Source: Jan Grüner, BLIC, 2022

Figure 6 shows the results of these tests. At the time tests were conducted, the data from SBB was already there but still needed to be transformed into a more useable data format, so their active system is not included in the tests. The availability of LocationInformation is high in all systems. CMTo needs improvement in the sections Completeness and Correctness, STA in Correctness. An issue that each of the systems must work on is the time it takes for the systems to respond to a request. It needs to be lowered significantly. All systems delivered good results in the Trip tests. Again, CMTo needs to work on Completeness and STA in particular needs to reduce the response time significantly.

LIR

	Avail-ability	Complete-ness	Correct-ness	Timeli-ness
ARIA	100%	100%	100%	5357,25ms
CMTO	100%	67%	67%	314,17ms
LUR	100%	100%	100%	n/a
STA	100%	100%	52%	3931ms
SBB	n/a	n/a	n/a	n/a
VAO	94%	100%	100%	225,59ms

TR

	Avail-ability	Complete-ness	Correct-ness	Timeli-ness
ARIA	100%	100%	100%	382,38ms
CMTO	100%	70%	100%	1119,40ms
LUR	100%	100%	100%	n/a
STA	100%	100%	100%	11242,89ms
SBB	n/a	n/a	n/a	n/a
VAO	100%	100%	100%	644,50ms

Figure 6: Test results of LocationInformation and Trip, Source: Jan Grüner, BLIC, 2022.

In conclusion, distributed journey planning is working, although there are still challenges, which need to be solved. First and foremost the data quality and system performance need to be enhanced, as all the journey planners involved need to reach a comparable level as otherwise users used to a certain standard of routing results (in terms of available information, selection of suggested routes or time of response) will likely not use the service. Furthermore, the OJP standard itself needs to be developed further to provide all the information current journey planners in Europe already use. Although the implementation for the LinkingAlps service is not yet at an operational level, the participating journey planners see the benefits of using OJP and commit to further work on the current issues within the next months to provide a distributed operational routing service covering Austria, Switzerland, Southtyrol, Lombardia and the Metropolitan area of Torino.