Technical Architecture of LinkingAlps

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CEN/TS 17118:2017
Open API for distributed journey planning

- Aim of the document is the definition of a schema to exchange journey planning information
- **Technical architecture beyond the scope of the OJP standard**
- Some principles are stated that are valid for all approaches concerning the architecture
- Architectural concepts can be categorized in **distributed and centralized approaches**

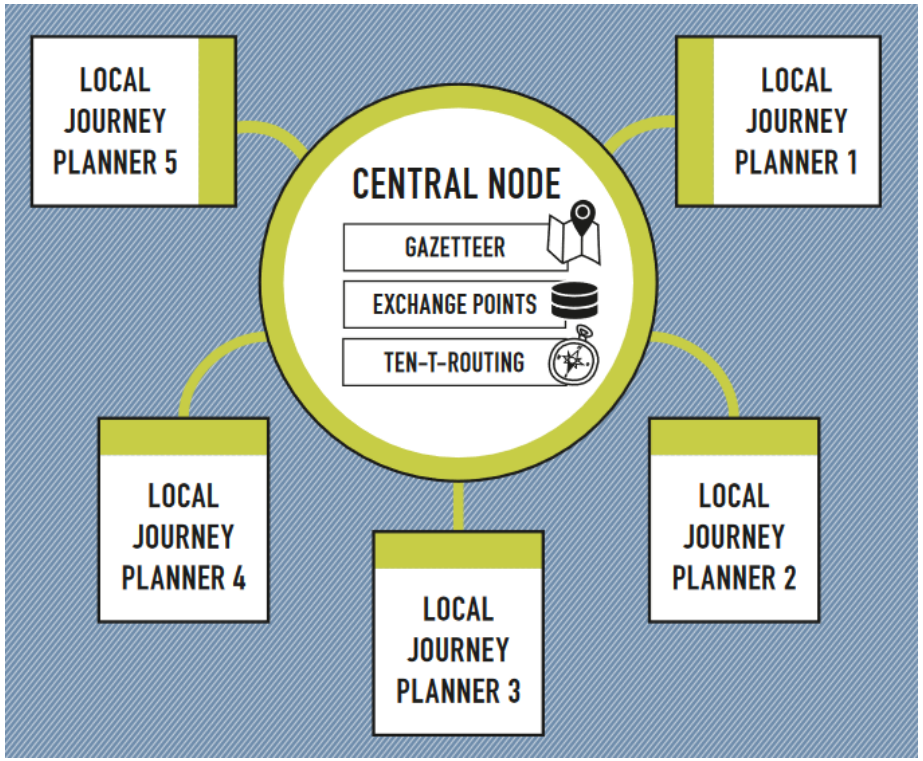
CEN/TS 17118:2017
Open API for distributed journey planning

- **Overall principles of distributed journey planning approach**
  - Enquirer goes to his **home system** for a routing information from location A to location B
  - The home system has the task to **match the enquirer's locations** to locations understood by the involved journey planners
  - The **home system determines what journey planning systems are needed** to get the requested and overall routing information and triggers corresponding requests
  - The **home system** creates a seamless and efficient journey plan out of the received responses which can be delivered to the enquirer.

- Key consideration related to these principles:
  - **What supporting data (metadata) is required and where it is stored → centralized or distributed**

Components for distributed journey planning

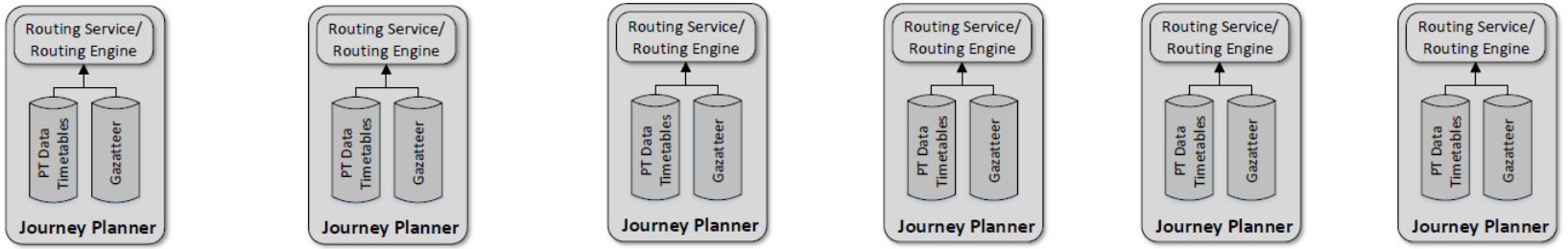
- **Local journey planner** – system with a specific limited coverage
- **Passive system** – local journey planner that provides routing information via an OJP interface
- **Exchange point DB/service** – knowledge about handover points from one local journey planner to another
- **Gazetteer** – directory of available locations in a system that can be used for routing
- **Active system** – connected to several passive systems for the overall trip calculation
- **Distributing system** – part of an active system and responsible for the distribution logic to gather the needed information
- **End user application** – connected to an active system to provide the overall routing information to the enquirer



Scheme of a central-distributed journey planning architecture
Source: The LinkingDanube Concept (interreg-danube.eu), 2018

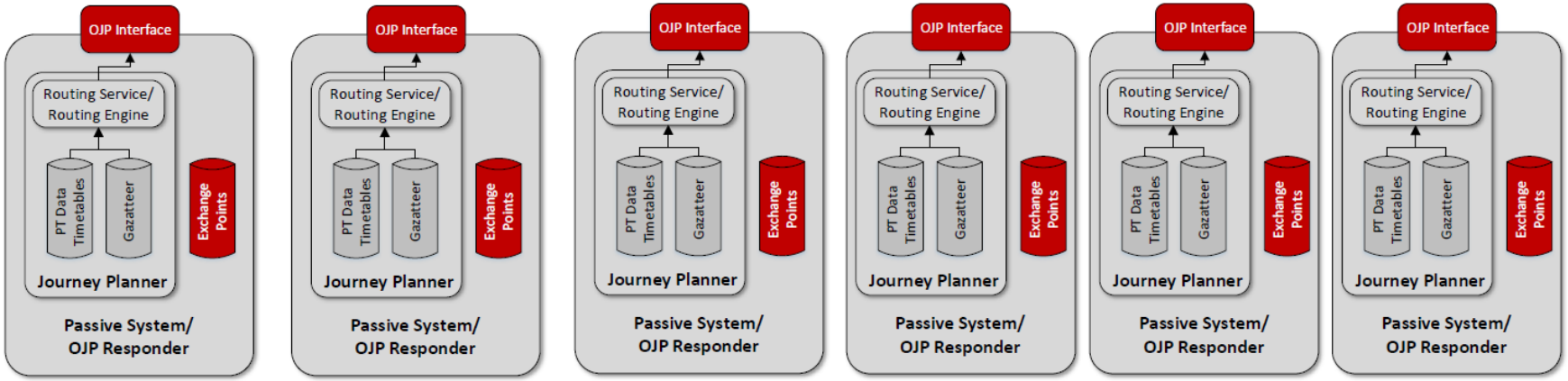
Components for distributed journey planning

- **Local journey planners**



Components for distributed journey planning

- **Passive nodes**

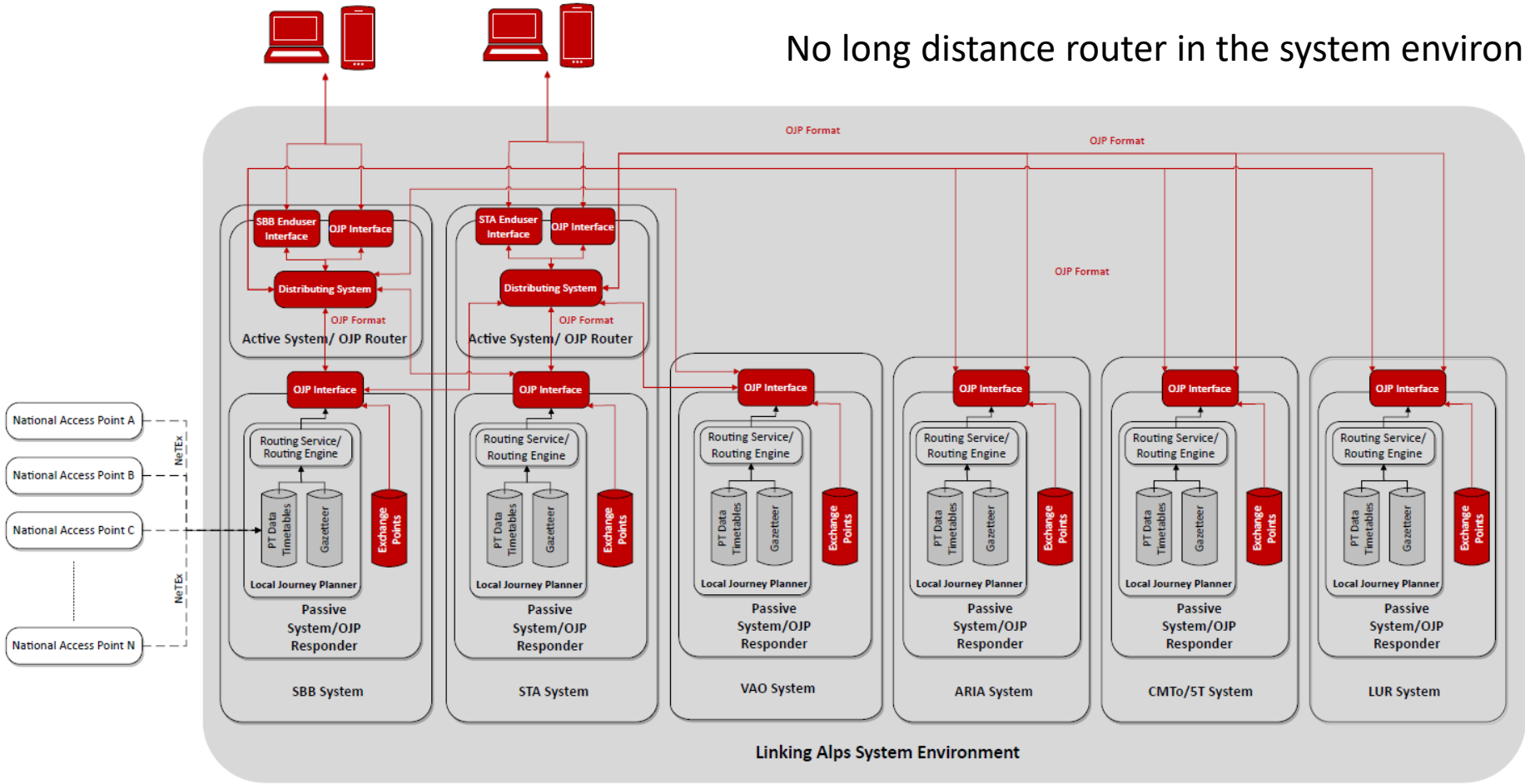


Design principles of LA architecture

- The architecture shall be **as distributed as possible**
- The architecture shall consider the aim of an **operational, performant service**
- The architecture and LA OJP profile shall support **flexibility with respect to routing algorithms and concepts**
- The architecture shall be **scalable**
- The architecture shall support **interoperability with other OJP environments like EU Spirit**

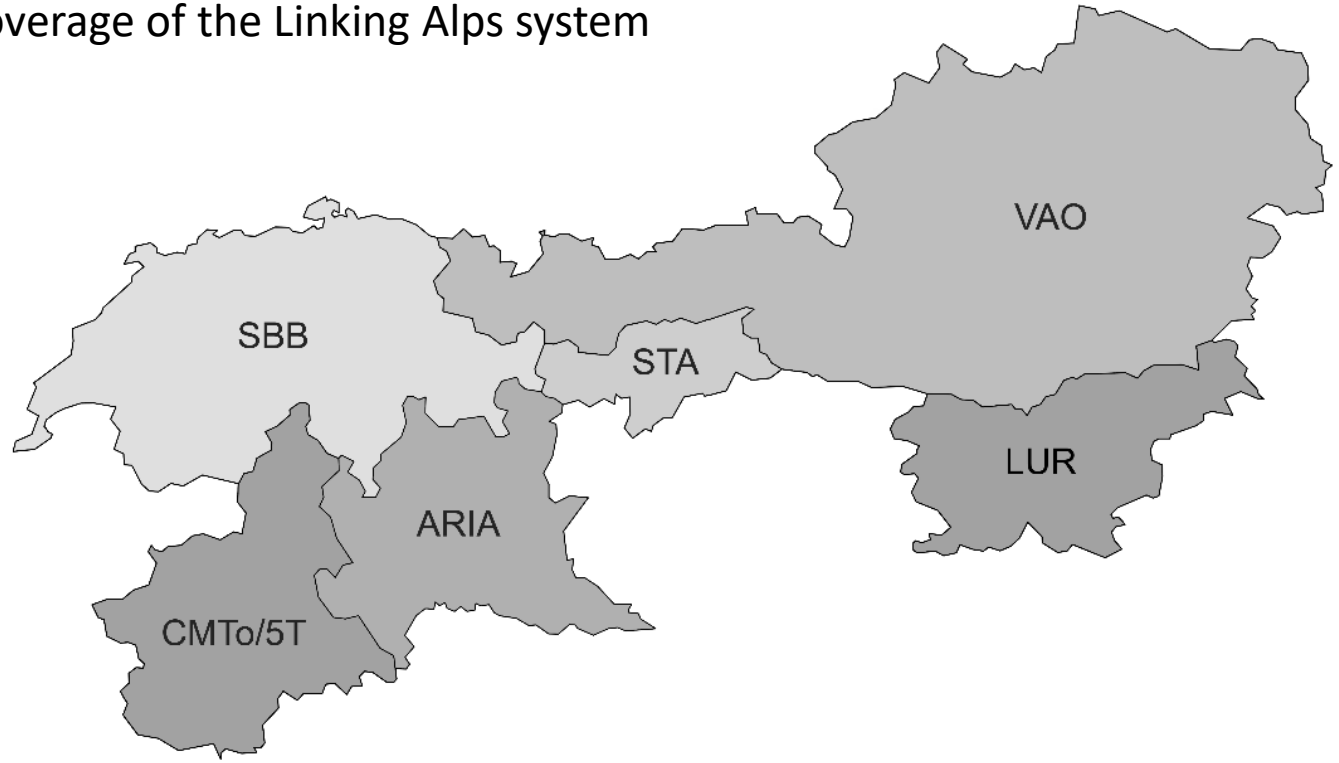
Linking Alps system architecture

No long distance router in the system environment



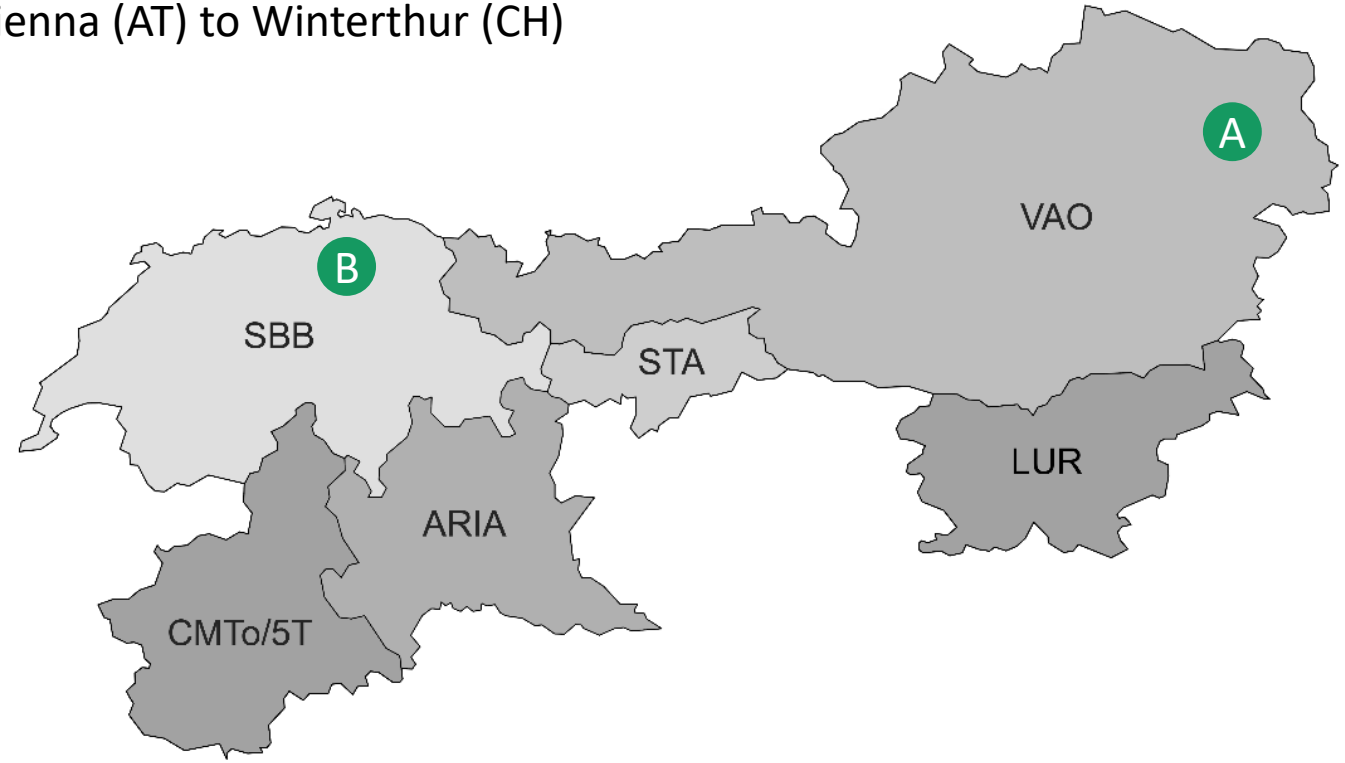
Routing algorithm

- Geographical coverage of the Linking Alps system



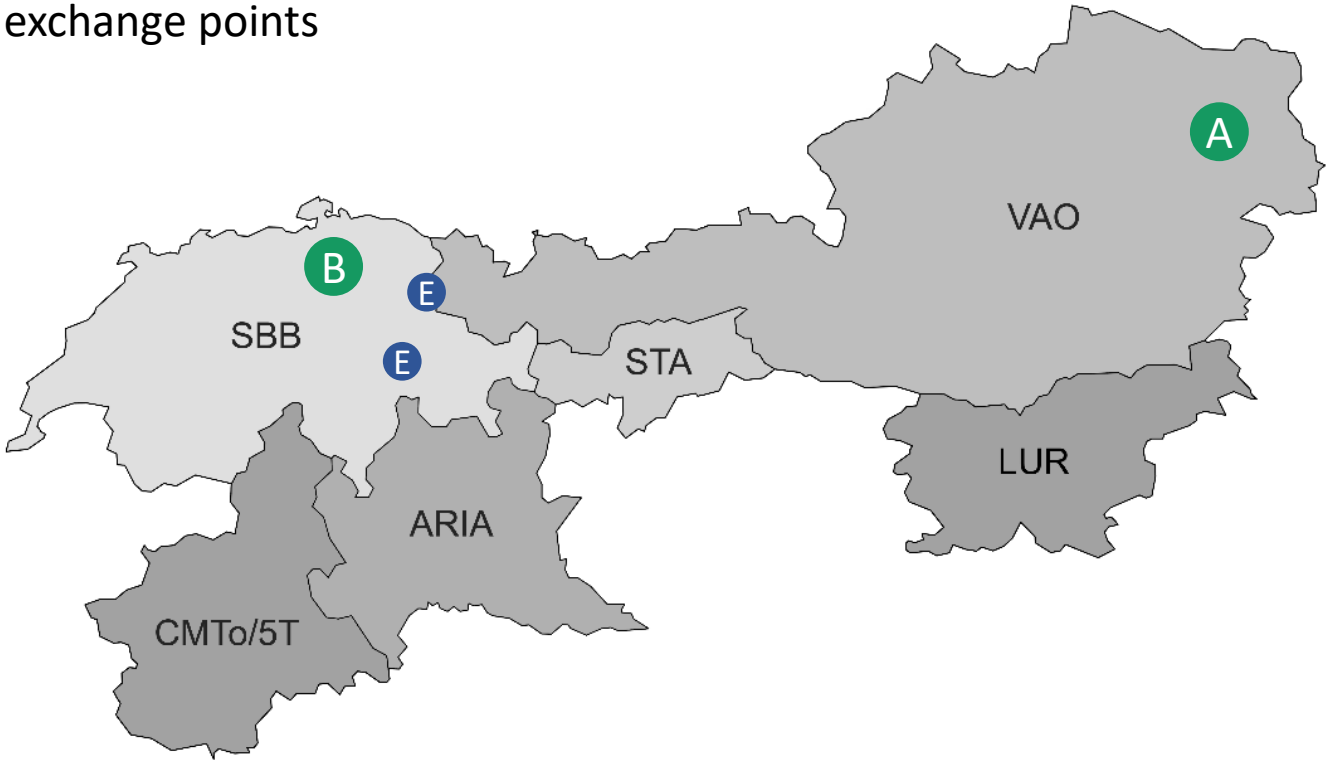
Routing algorithm

- Routing from Vienna (AT) to Winterthur (CH)



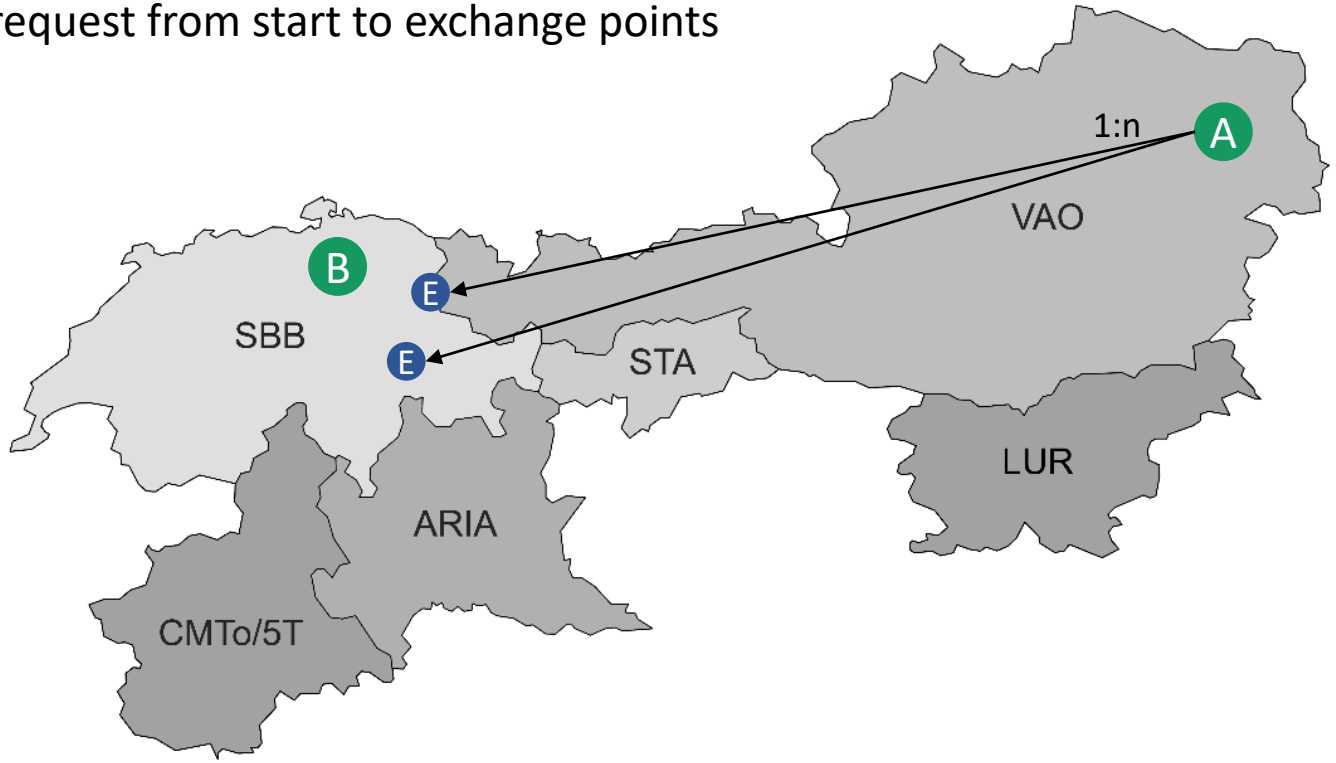
Routing algorithm

- Finding suitable exchange points



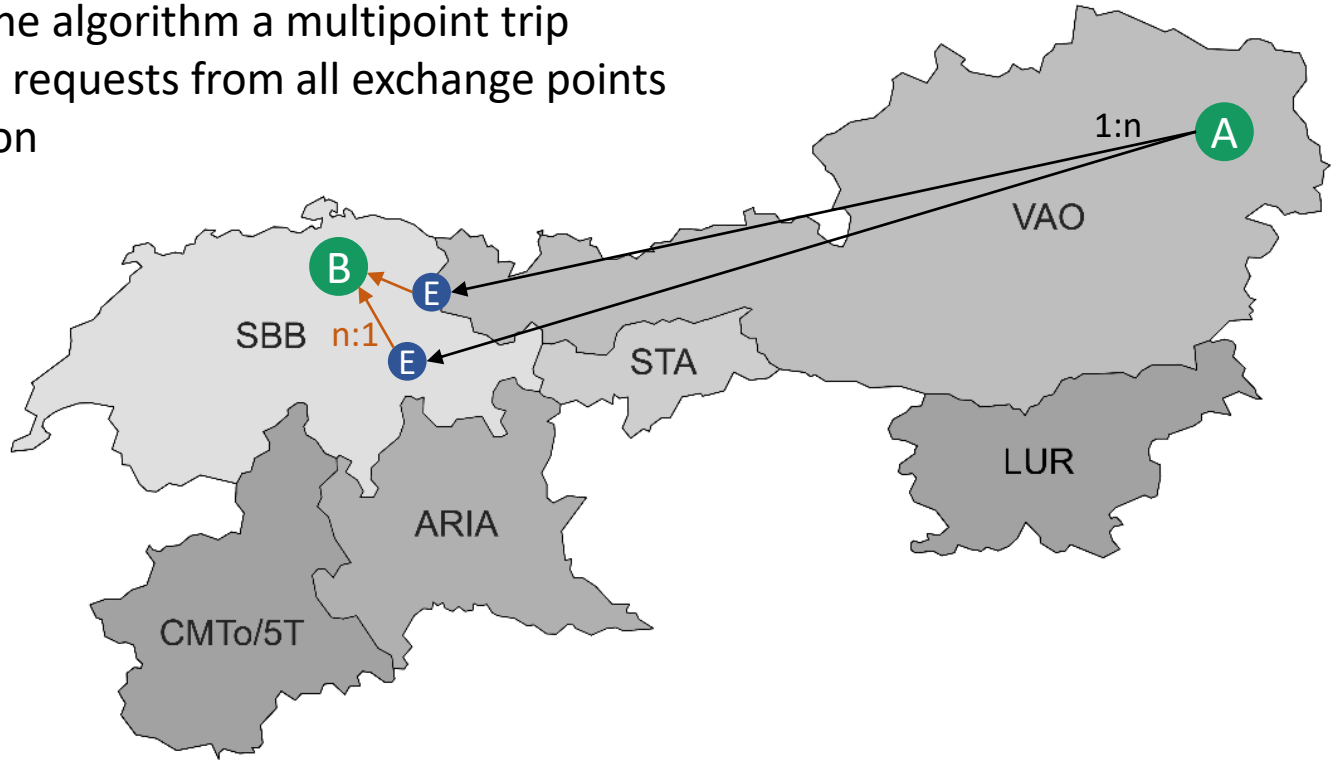
Routing algorithm

- Multipoint trip request from start to exchange points

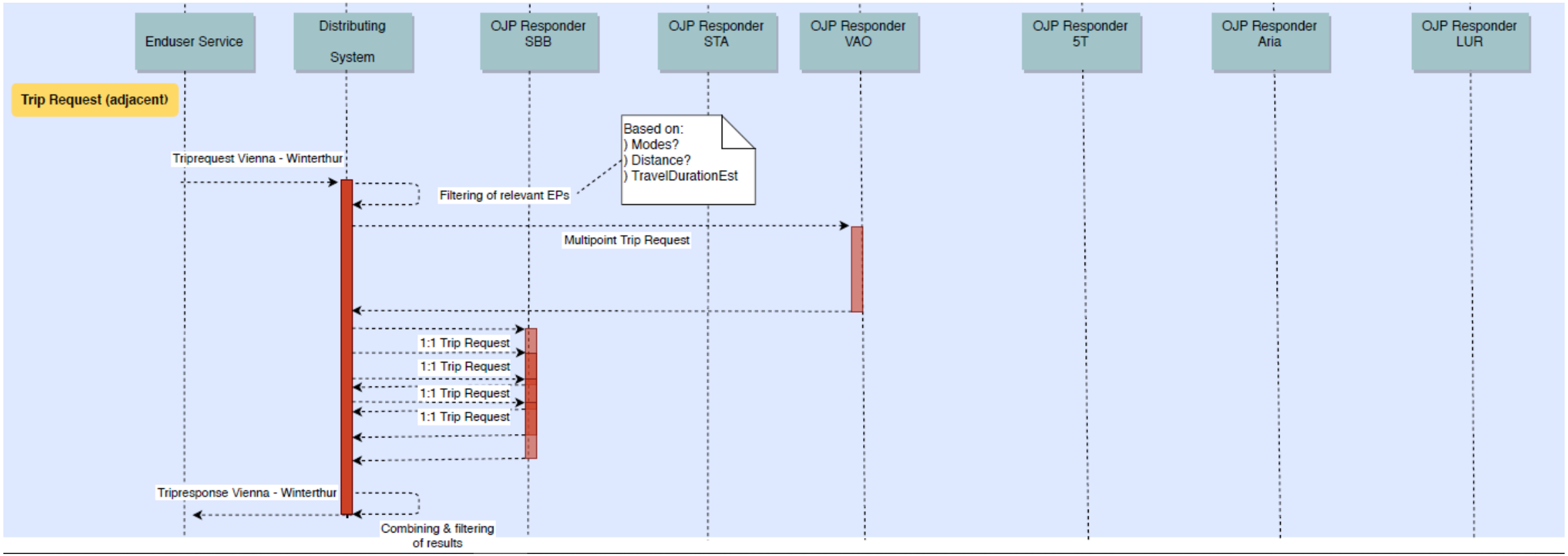


Routing algorithm

- Depending on the algorithm a multipoint trip request or n 1:1 requests from all exchange points to the destination



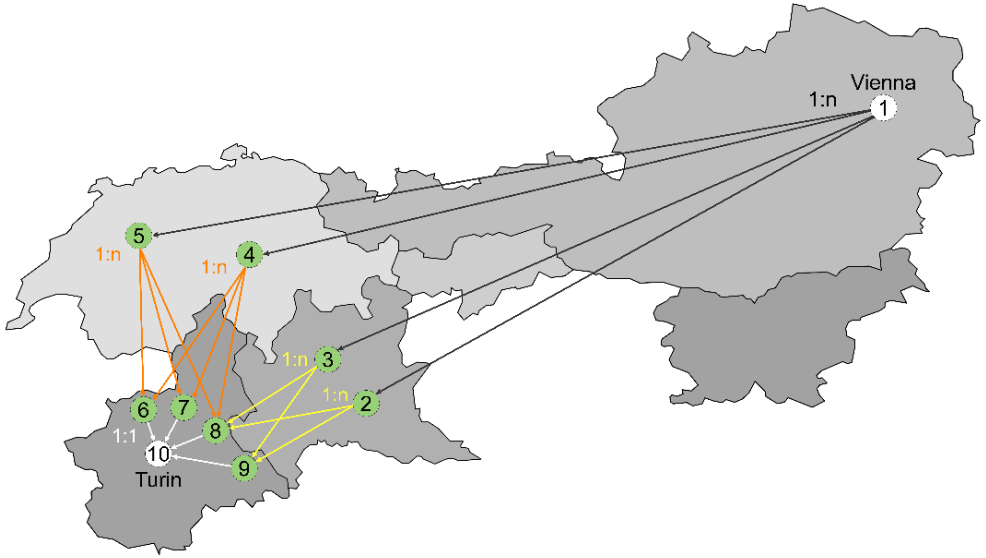
Request flow for adjacent use case



Concept for the fully distributed approach

- Remote use case: No trunk leg from Vienna (AT) to Torino (IT)

- **Concept without importing long distance connection into passive systems:**
  - Building up a meta network
  - Prerequisite: Knowledge of all exchange points
  - Route calculation by hopping over one or more passive systems
  - Distributing system responsible for minimizing hops



- From current point of view **reservations related to performances with respect to an operational service**
- **Interesting** in future **for lab environments**

Active system & distributing system

- **Tasks of a distributing system as core component of an active system**
  - Identification of relevant passive nodes for a specific request
  - Translation of user input for start/destination points into well known locations by usage of gazetteers
  - Requesting or collecting exchange points in order to enable distributed route calculation
  - Providing search and filter strategies to find suitable exchange points for a specific relation
  - Orchestration of the requests according the implemented routing algorithm
  - Merging results of passive nodes to overall trips
  - Filtering of relevant overall trips according to user's preference

Relevant processes for the active system

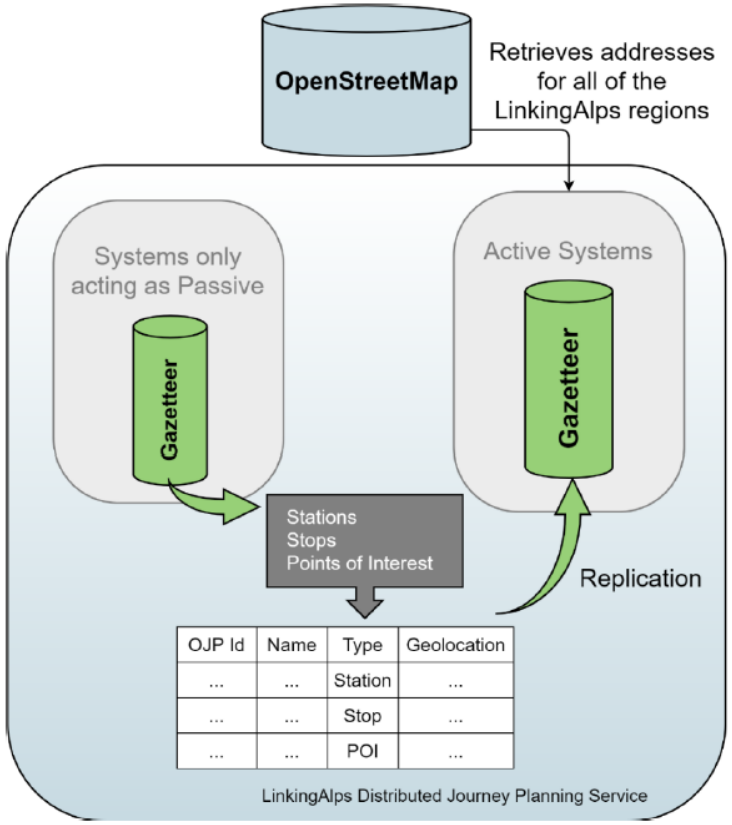
- Developed processes to ensure flexibility with respect to algorithms and concepts

- Static and dynamic approach with respect to the gazetteer
  - The OJP standard contains the Location Information Request to request locations according to user input
  - Usable for requesting locations during runtime → dynamic approach

  - Definition of an OJP Location Information request structure to get locations of a passive system without user input
  - Possibility of collecting locations for caching on active system side → static approach

Static approach for gazetteer

- Content of gazetteers on passive node level
  - Stop points and stop places
  - Points of interests
  - Topographic places
  - Addresses based on OSM
- Caching of locations on active node level
  - Specific Location Information Request according to the OJP standard to collect all stop points, stop places, POIs and topographic places
  - Address data not included in the process because of huge amount of data that can be accessed easily direct via OSM



Relevant processes for the active system

- Developed processes to ensure flexibility with respect to algorithms and concepts

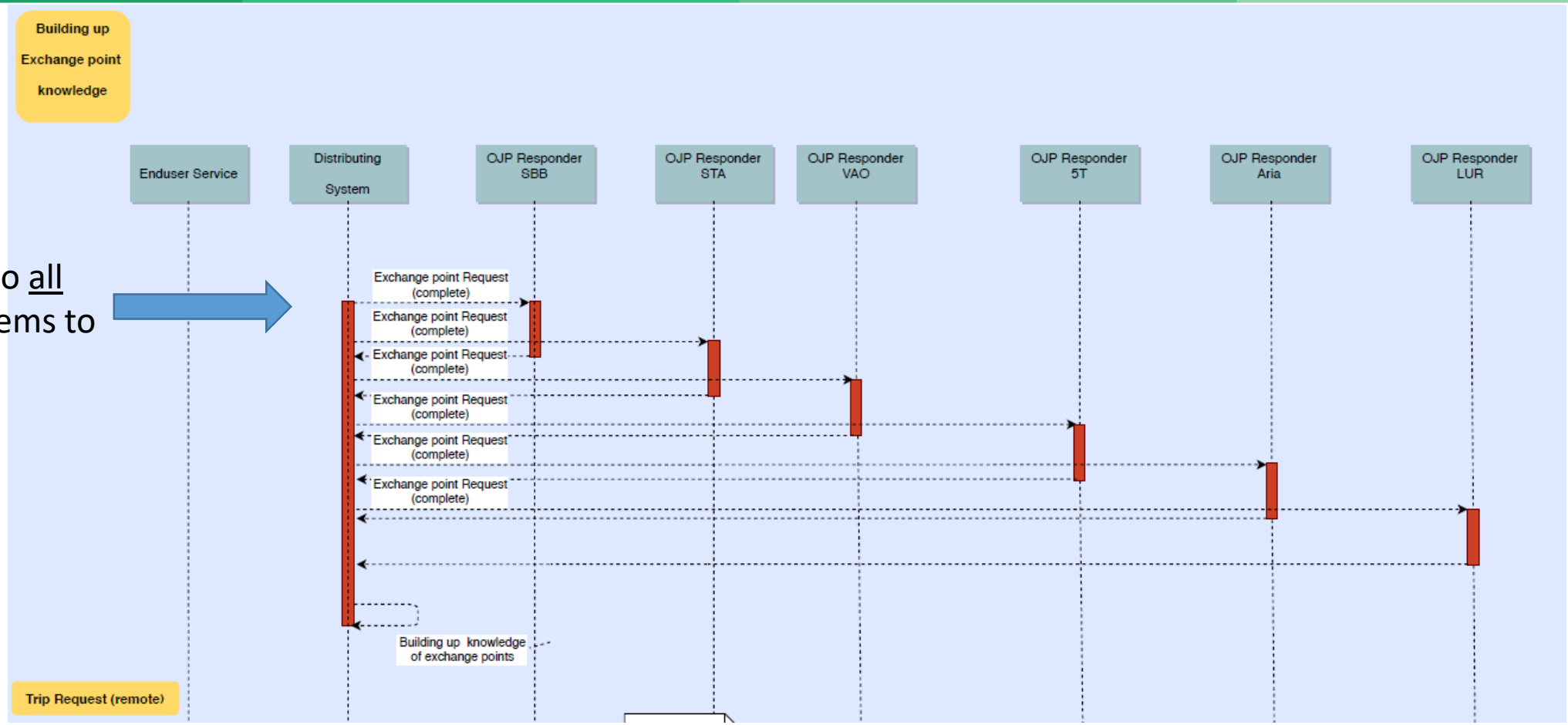
- Static and dynamic approach with respect to the exchange points
  - The OJP standard contains the Exchange Point Request to request Exchange Points for a specific relation from a starting point to a destination system
  - Passive nodes provide relevant exchange points with travel duration estimates from the starting point to the EPs
  - Travel duration estimates needed as heuristic for an overall route calculation
  - Usable for requesting locations during runtime → dynamic approach

  - Definition of an OJP Exchange Point request structure to get all EPs of a passive system
  - Possibility of collecting all EPs for caching on active system side → static approach
  - Active system responsible for travel duration estimates since heuristic for overall route calculation is still needed

Static approach for exchange points

EP request to all passive systems to get all EP

Trip requests



Summary

- The Linking Alps system architecture is designed **as distributed as possible with focus on flexibility of possible routing algorithms and concepts**
- Processes to support this **flexibility also with respect to the gazetteer- and exchange point handling** were defined within the “OJP framework”
- **No long distance router in the LA system environment** leads to the necessity of importing long distance traffic on passive node level to address the remote use case
- Concept to address the remote use case without importing long distance traffic was designed with a hopping algorithm
- Currently not suitable for an operative system but relevant for further investigations
- **Interoperability with other OJP environments** like EU Spirit based on OJP profile

Thank you for your attention

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