Route Planning on the Web

Data access for the Mobility as a Service ecosystem

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What is Mobility as a Service (MaaS)?

“MaaS is an on-demand, real-time platform that can include any combination of transport methods such as car and bike sharing, taxis and car rentals/leases, and provide everything for the consumer from travel planning to payments”

GEOTAB - https://www.geotab.com/blog/what-is-mobility-as-a-service/
Let’s build a MaaS route planner!

This is what we need:

- Road networks
- Public transport schedules
- Shared mobility data
- Transfer footpaths

Algorithm
What challenges are we going to face:

● How do we **access** the data?

● Can these datasets **interoperate**?

● How do we **model** the data?
How can we access the data?
Traditionally data is published in the Web in two ways:

- **Data dump**
  - High flexibility
  - High storage costs
  - High integration costs

- **Route planning service**
  - Low client load
  - No flexibility
  - Low scalability
Divide & Conquer

If we “tile” or “fragment” data dumps we can get the best of both worlds

See the Linked Data Fragments concept - [https://linkeddatafragments.org/](https://linkeddatafragments.org/)
How do we handle interoperability?
Linked Data introduces two key aspects for data interoperability

1. Describes how to handle different data serializations: RDF $\rightarrow$ XML/RDF, JSON-LD, CSVW, …

2. Introduces global identifiers for domain models and their instances: HTTP URIs
Linked Data alone does not solve interoperability

Train station → <http://vocab.gtfs.org/terms#Station>

But also…

- <http://www.wikidata.org/entity/Q55488> (Railway station)
- <https://schema.org/TrainStation>
- <http://linkedgeoadata.org/ontology/RailwayStation>
- <http://w3id.org/transmodel/terms#ScheduledStopPoint>
- ...
Linked Data creates a framework to solve interoperability
How to model the data?
The data model *strongly depends* on the route planning algorithm(s)

**Dijkstra-based**
- Set of nodes (stop/road node)
- Set of edges (connection/transfer/way)

**RAPTOR**
- Ordered set of Routes
- Ordered set of Trips
- Ordered set of StopTimes
- Ordered index of routes per stop
- Ordered set of Transfers

**CSA**
- Set of stops
- Set of Transfers
- Ordered set of connections

**Transfer Patterns**
- Set of stops
- Set of optimal transfer patterns
Our proposed solution
For public transport: **Linked Connections**

**Linked Connections** describes a hypermedia-based Web interface designed for the **CSA**. It uses the **Linked-GTFS**, **LinkedConnections** and **Hydra** ontologies.

https://graph.irail.be/sncb/connections?departureTime={ISODate}
For road networks: **Routable Tiles**

Vector tiles-based specification for publishing OSM road network as Linked Data. It uses the [OSM ontology](https://tiles.openplanner.team/planet/{z}/{x}/{y}/).

```json
{
  "@id": "http://www.openstreetmap.org/way/35996266",
  "@type": "osm:Way",
  "osm:name": "Amerstraat",
  "osm:highway": "osm:Tertiary",
  "osm:cycleway": "osm:Track",
  "osm:maxspeed": "50",
  "osm:hasTag": [ ]
}
```

* [http://pieter.pm/demo-paper-routable-tiles/](http://pieter.pm/demo-paper-routable-tiles/)
For transfer footpaths: **Delaunay triangulation**

We use the **Delaunay triangulation** to create an approximation of the full footpath graph within and among transport networks which enables **unrestricted walking**.

* [https://hdelva.be/articles/decentralized-footpaths/](https://hdelva.be/articles/decentralized-footpaths/)
Putting it all together: Planner.js*

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Wrapping up...

- Data accessibility is key to determine the feasibility of MaaS applications. → **Smart data fragmentations** allow cost-efficient data sharing for both data producers and reusers.

- Standard semantics are needed to ensure interoperability. → Definition of **mappings** to existing domain models and **data translation tools** are key to increase adoption.

- Route planning data models are heavy dependant on algorithm-specific data structures. → Should popular **algorithm-specific data models** (e.g. Linked Connections) be considered for standardization?
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Thank you!

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