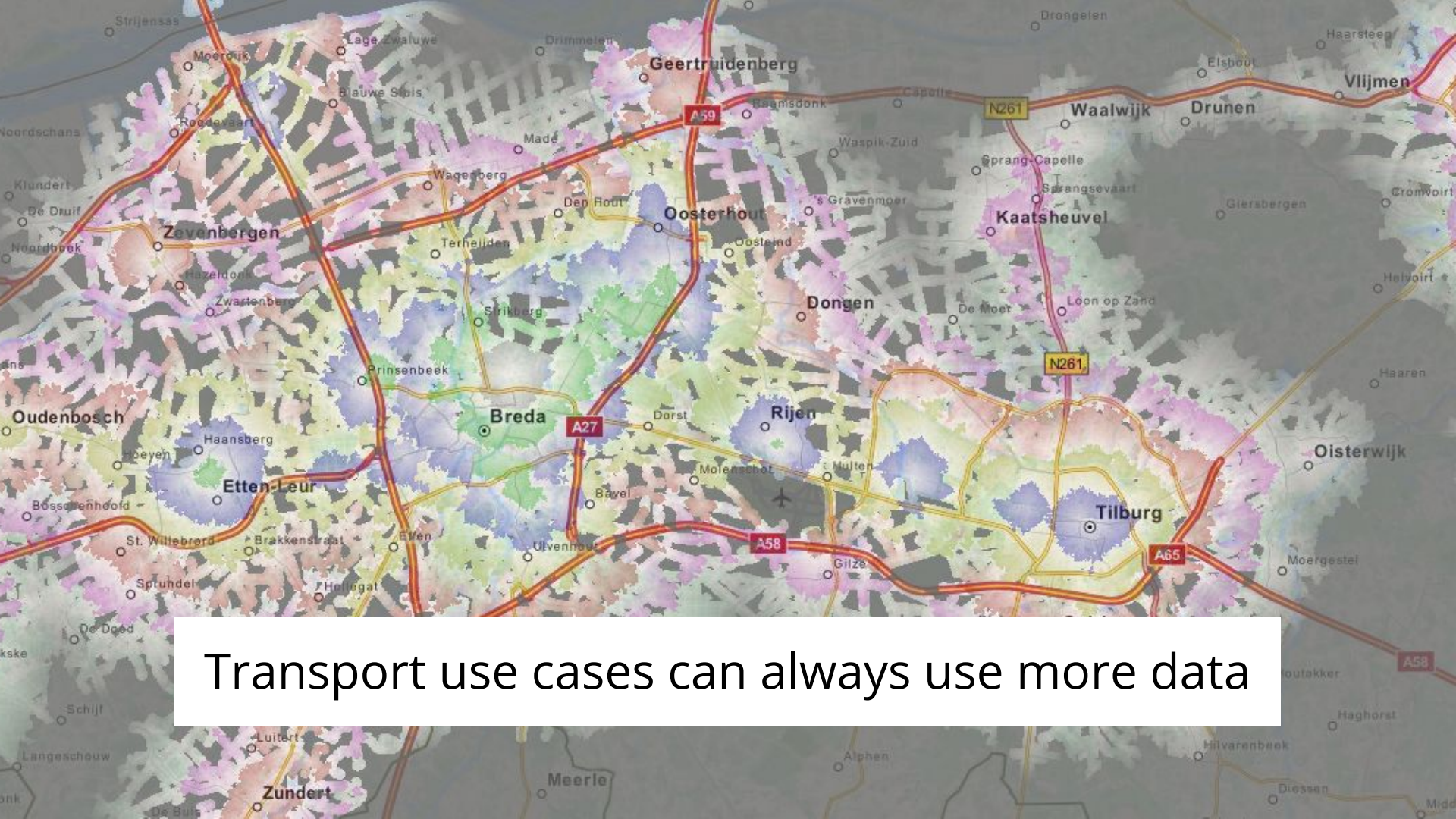
Knowledge Science in action: transport and mobility

Pieter Colpaert
https://pietercolpaert.be

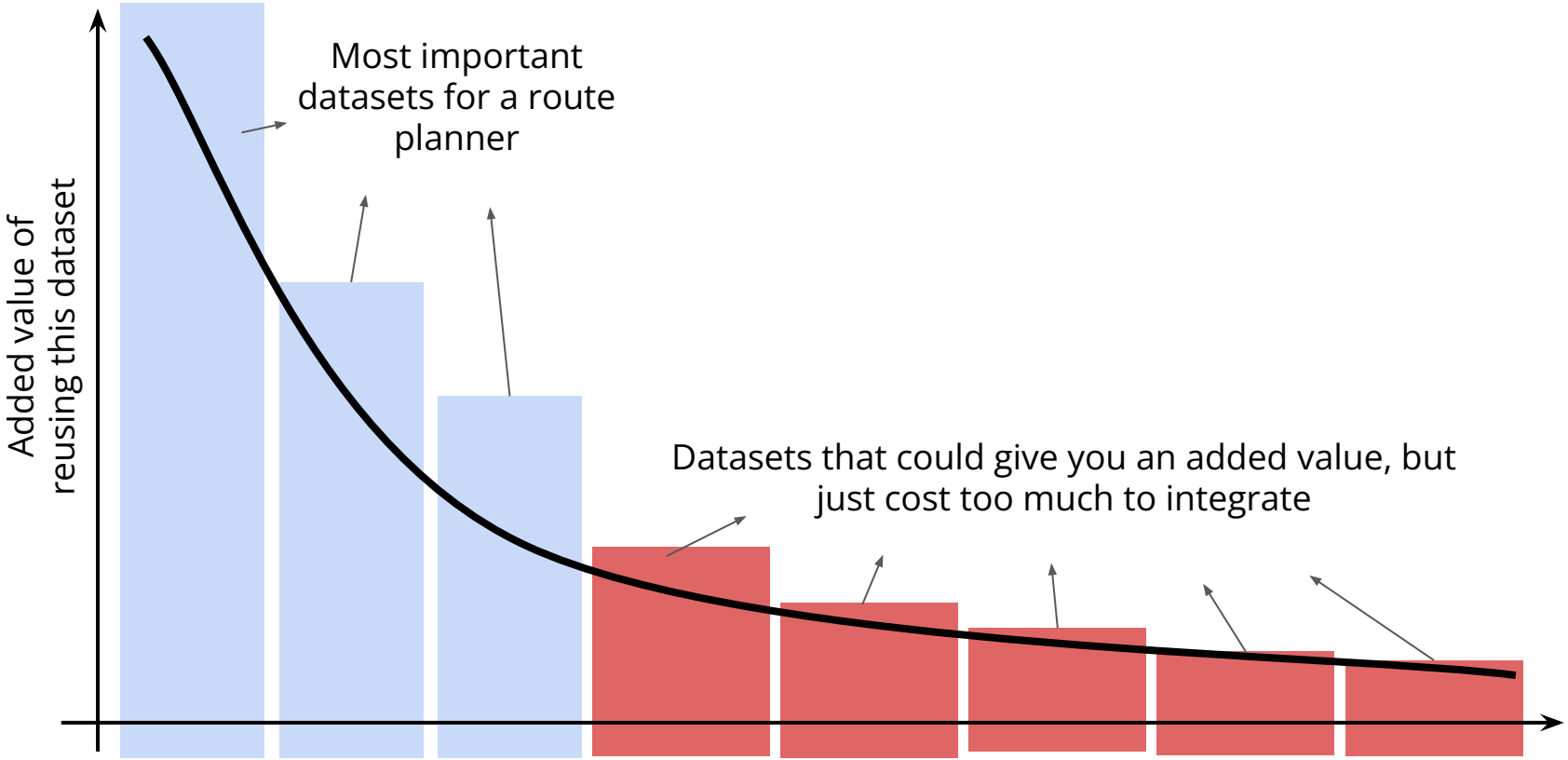
How far do you live from work?

Who answered
a distance in time using one or more modes of transport?



Transport use cases can always use more data

The long tail of data adoption in route planners



How do we lower integration costs then?

Steps to publishing your data for automated reuse

A very surprising slide for this audience probably

1. **Vocabulary**

   Choose and document your domain model (`rdfs` is fine, really)

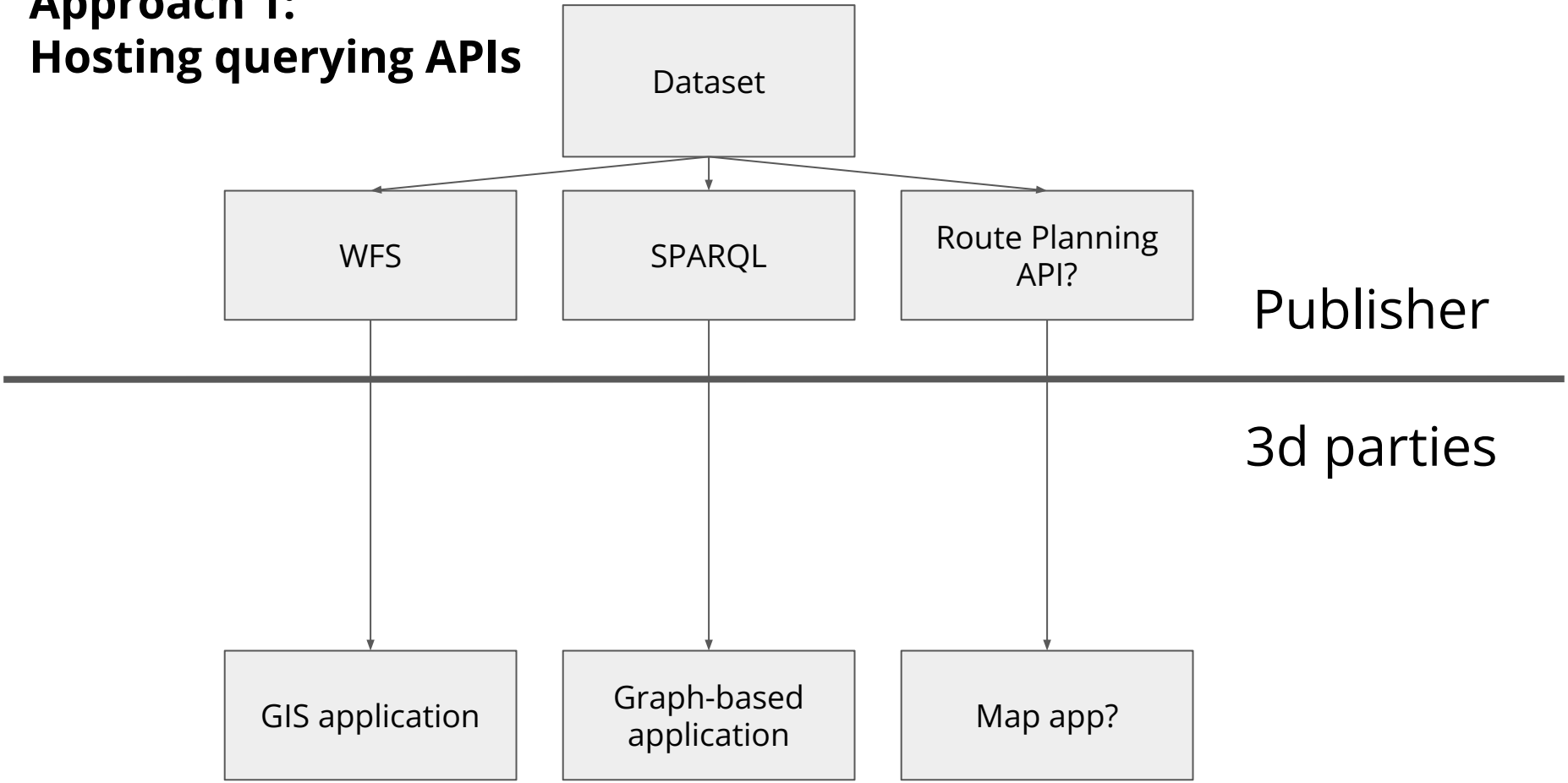
2. **Application Profile**

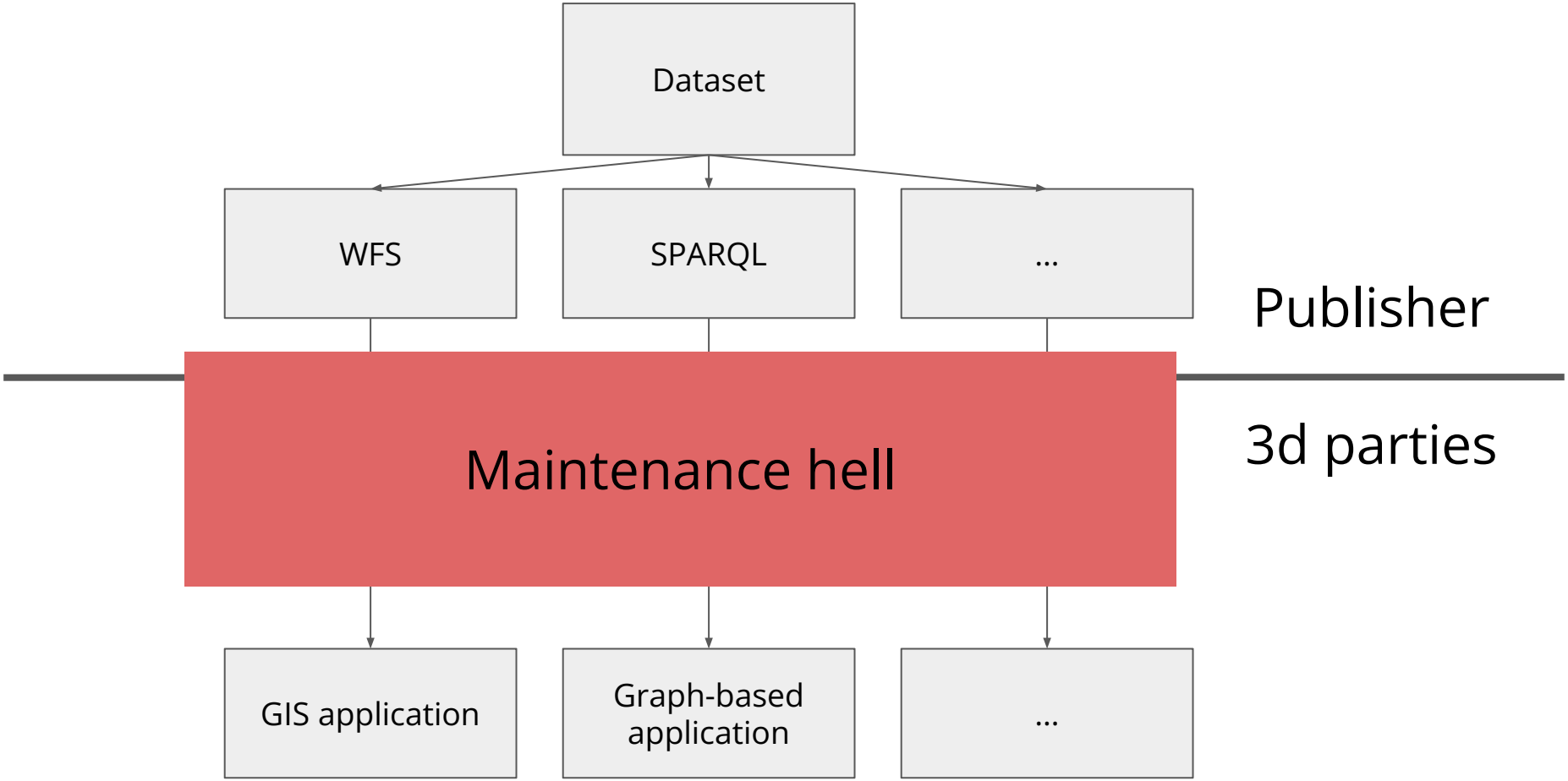
   Describe your things by documenting what fields you keep in your dataset using SHACL or ShEx, and where you refer to other databases

3. **Self-describing Linked Data API**

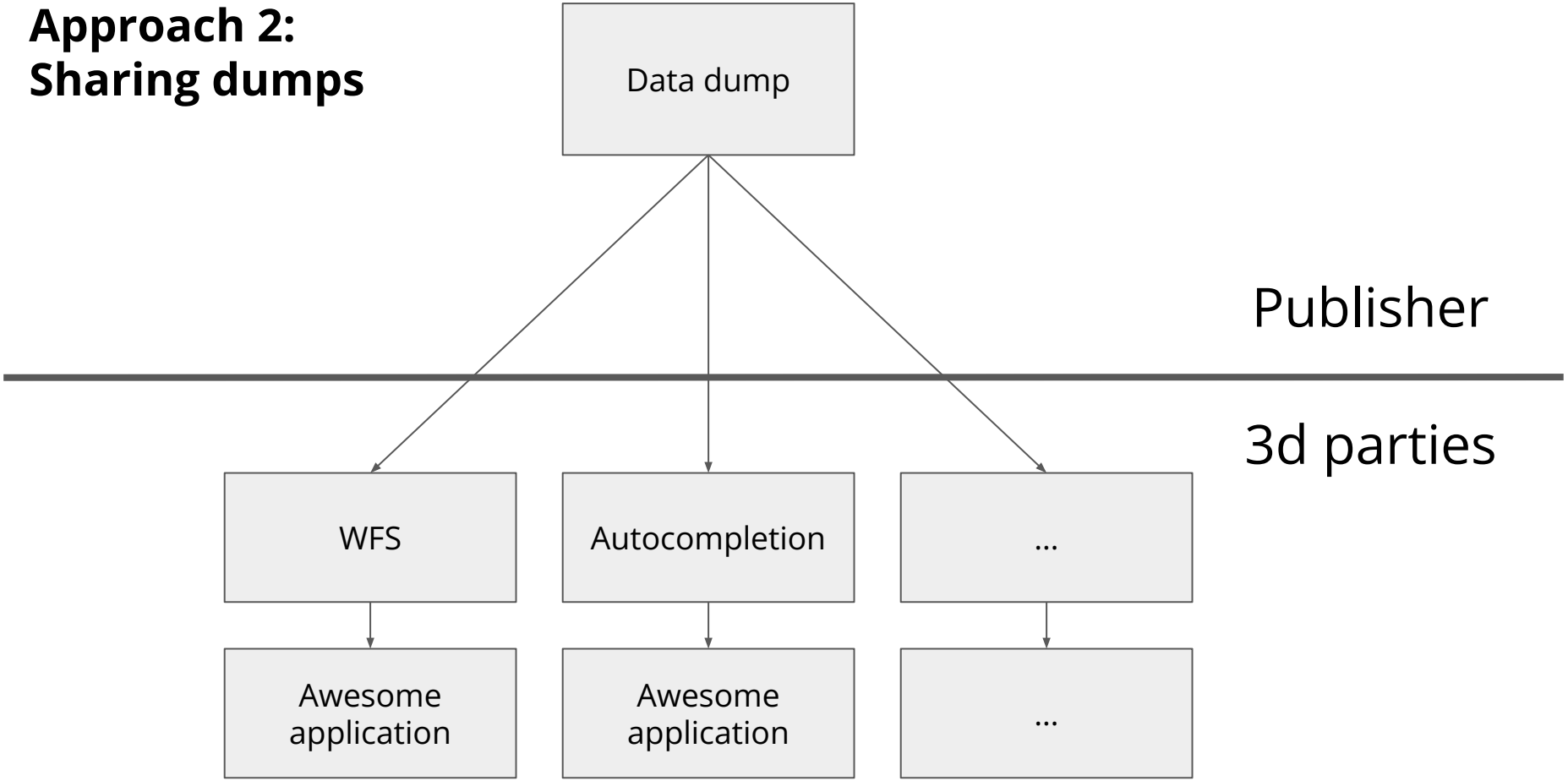
   Now publish the actual data… But what API should you use?

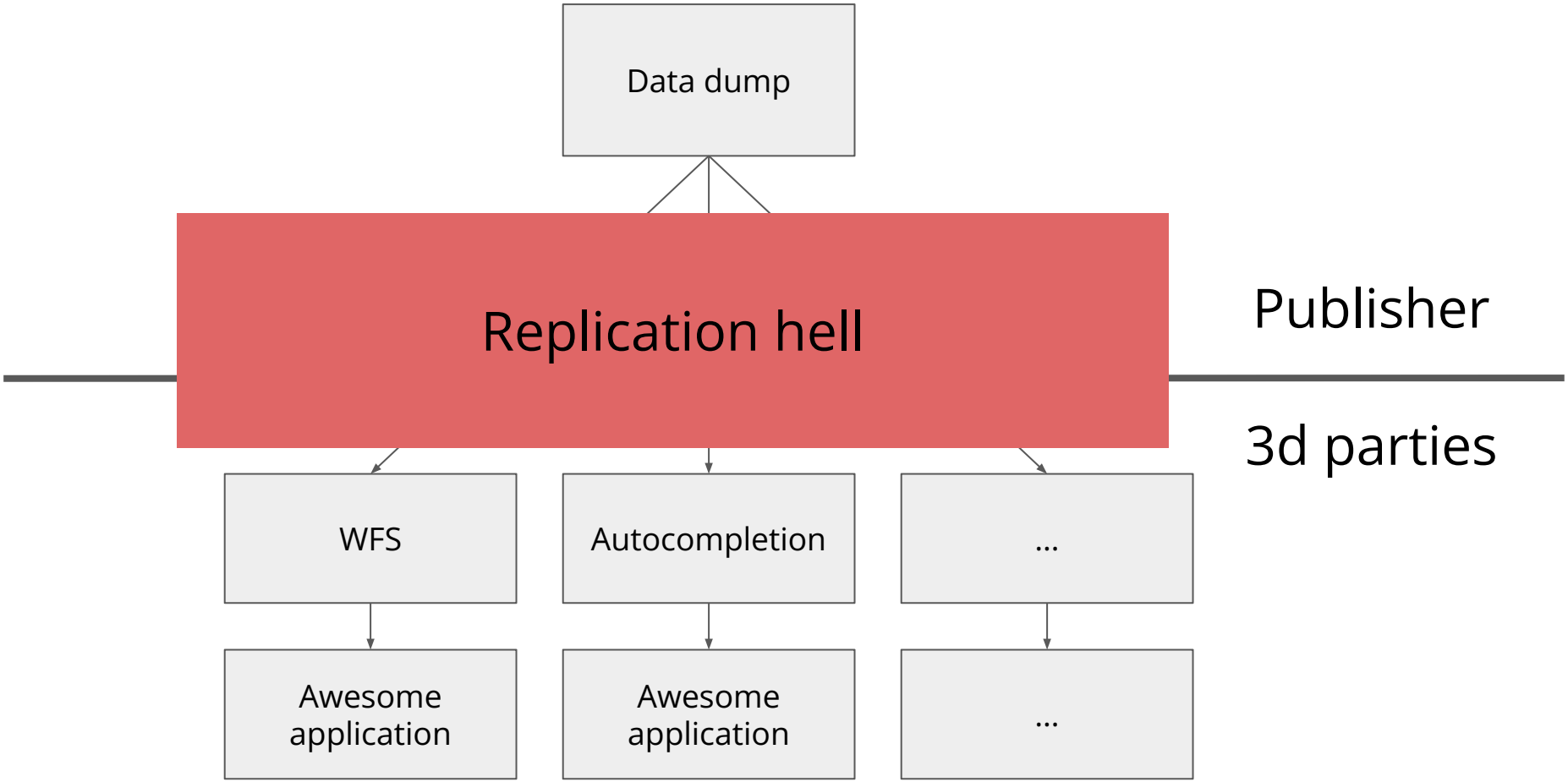
Approach 1:
Hosting querying APIs



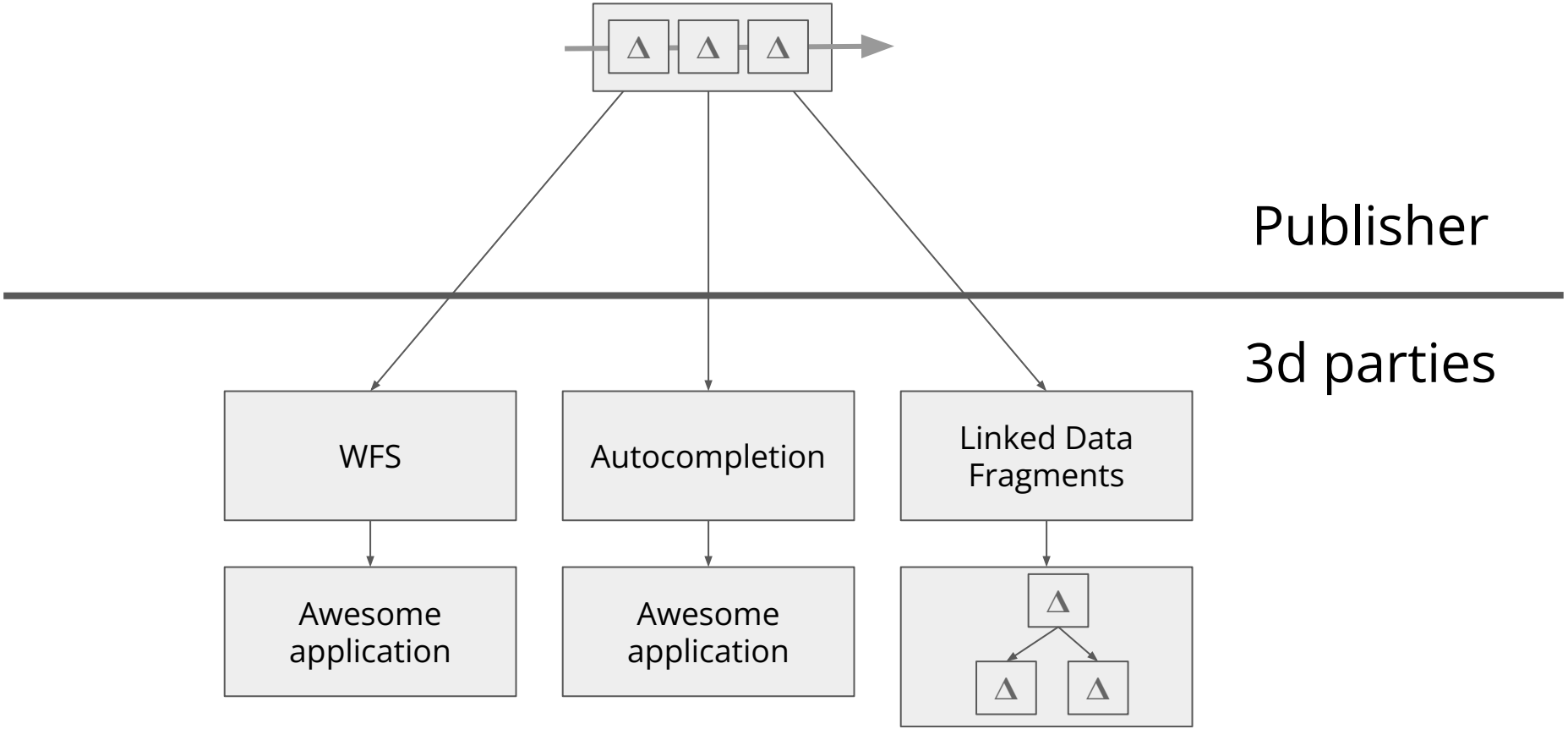

Dataset
WFS
SPARQL
...
Publisher
Maintenance hell
3d parties
GIS application
Graph-based application
...

Approach 2: Sharing dumps

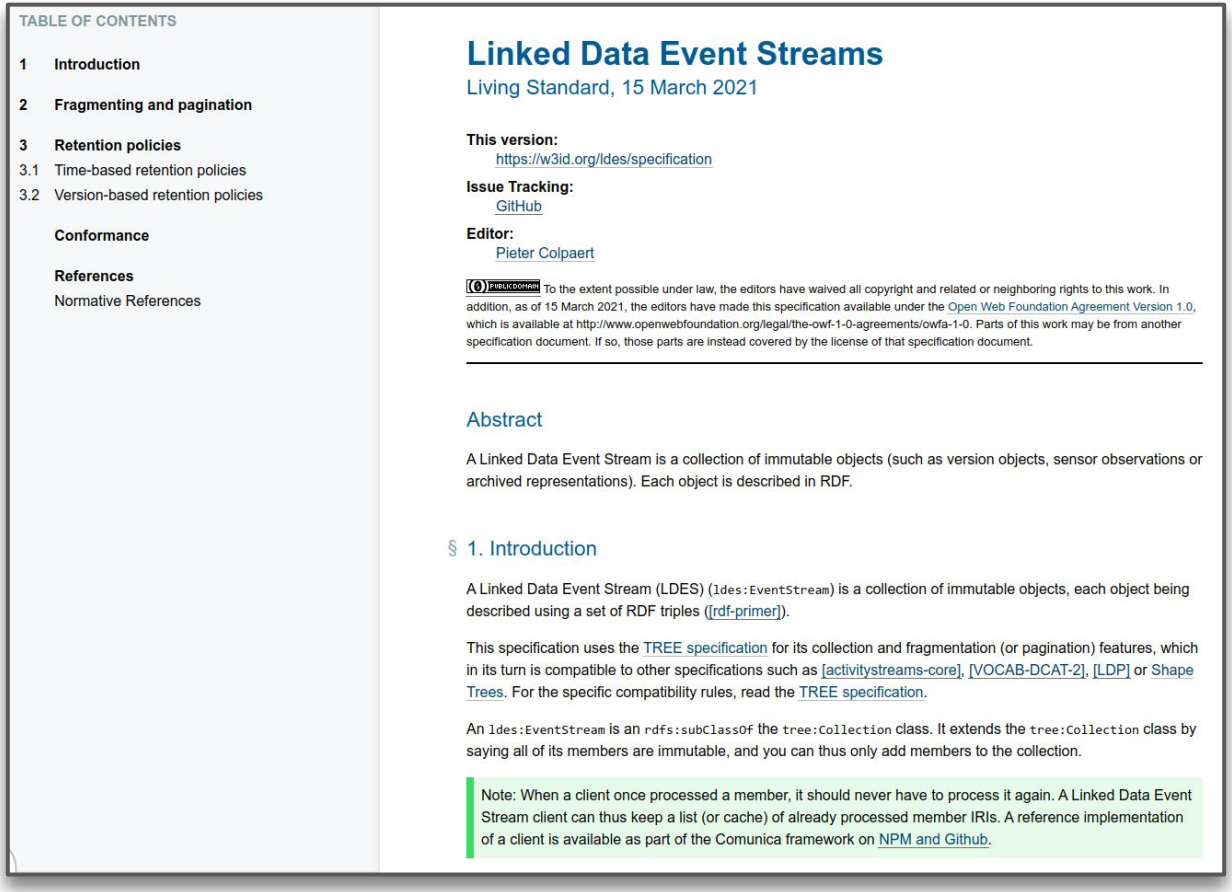



Data dump
Replication hell
Publisher
3d parties
WFS
Autocompletion
...
Awesome application
Awesome application
...

Event streams focus on live replication



The SEMIC EU specification on Linked Data Event Streams (LDES) – https://w3id.org/ldes/specification



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Linked Data Event Streams

Living Standard, 15 March 2021

This version:
https://w3id.org/ldes/specification

Issue Tracking:
GitHub

Editor:
Pieter Colpaert

Abstract

A Linked Data Event Stream is a collection of immutable objects (such as version objects, sensor observations or archived representations). Each object is described in RDF.

§ 1. Introduction

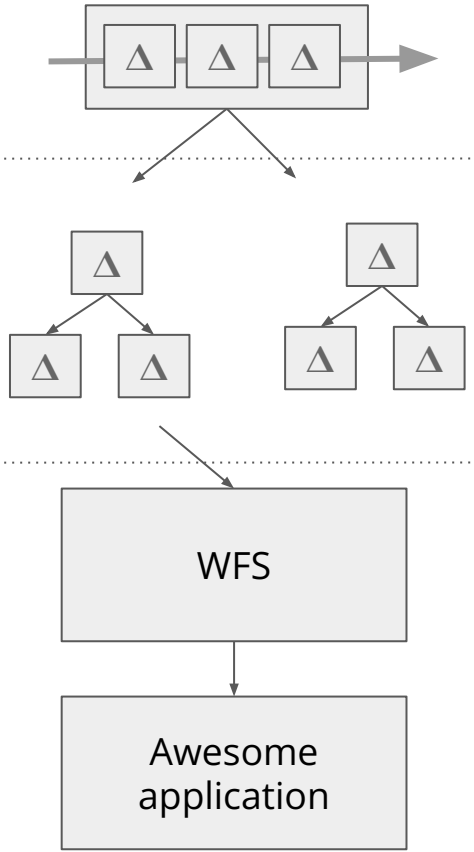
A Linked Data Event Stream (LDES) (`ldes:EventStream`) is a collection of immutable objects, each object being described using a set of RDF triples ([rdf-primer]).

This specification uses the TREE specification for its collection and fragmentation (or pagination) features, which in its turn is compatible to other specifications such as [activitystreams-core], [VOCAB-DCAT-2], [LDP] or Shape Trees. For the specific compatibility rules, read the TREE specification.

An `ldes:EventStream` is an `rdfs:subClassOf` the `tree:Collection` class. It extends the `tree:Collection` class by saying all of its members are immutable, and you can thus only add members to the collection.

> Note: When a client once processed a member, it should never have to process it again. A Linked Data Event Stream client can thus keep a list (or cache) of already processed member IRIs. A reference implementation of a client is available as part of the Comunica framework on NPM and Github.

LDES published through multiple Linked Data Fragments interfaces



Linked Data Event Stream
?page=1

Publisher

E.g., geospatial data tiles
/x/y/z?page=1

Geospatial API
?bbox=...&q=...

3d parties

5 minutes,
5 demos,
here we go

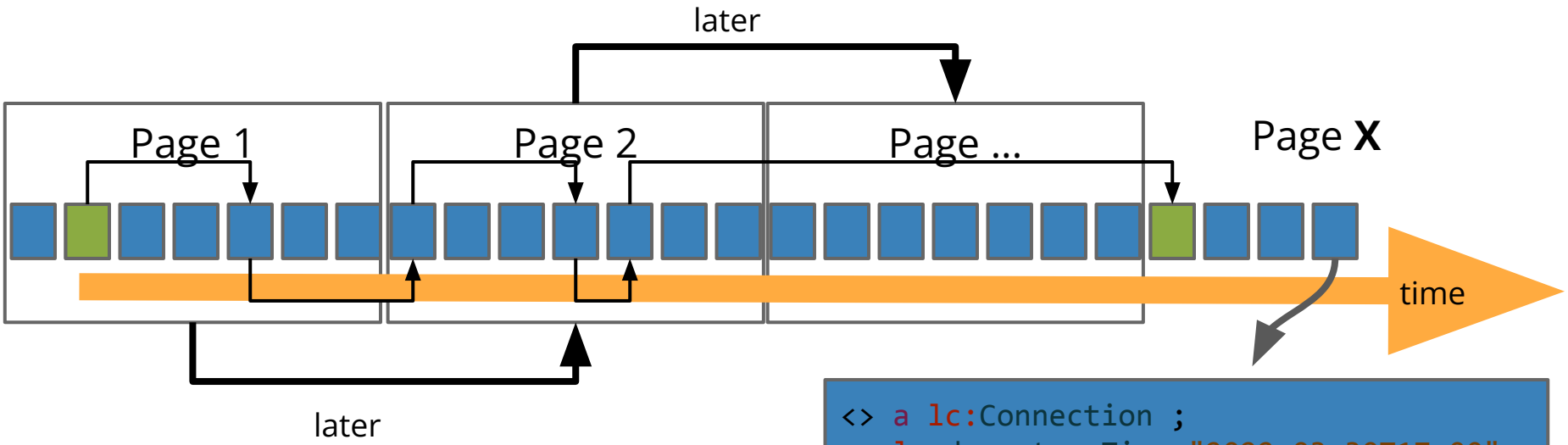
1. Parking availabilities
2. Public Transit time schedules
3. Route Planning on OSM
4. Railway Infrastructure (RINF)
5. Autocompletion of street names

Decentralized parking availabilities

1. Retrieve DCAT **catalog**
2. Javascript **filters** parking dataset and **populates** dropdown
3. **Fetch LDES view** for a parking site
4. Show **real-time** and **historic info in sparkline**

Old but still functional code example at https://smart.flanders.be/kennis-en-instrumenten/data-piloten/parkeren/

Time-based fragmentation of public transit time schedules with Linked Connections



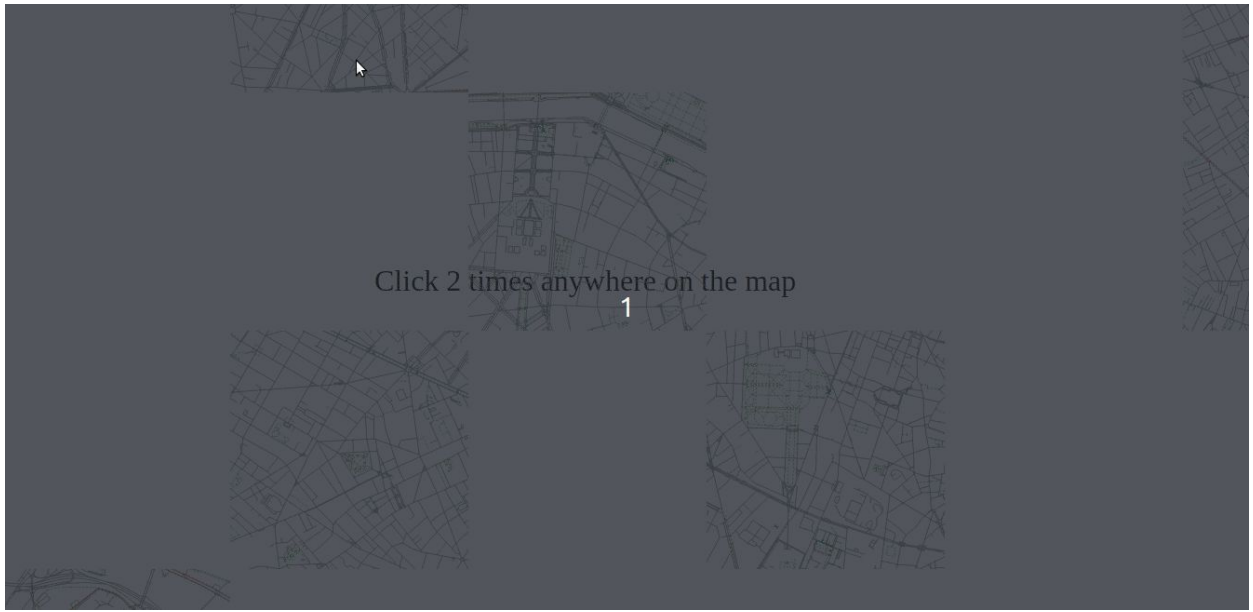

```
<> a lc:Connection ;
   lc:departureTime "2022-03-30T17:00";
   lc:arrivalTime "2022-03-30T17:10";
   lc:arrivalStop <S1> ;
   lc:departureStop <S2> .
```

Plan routes from your browser

https://linkedconnections.org

Pieter Colpaert, Ruben Verborgh, and Erik Mannens. "Public Transit Route Planning Through Lightweight Linked Data Interfaces". International Conference on Web Engineering. 2017.

Same idea, but geospatial tiling of roads



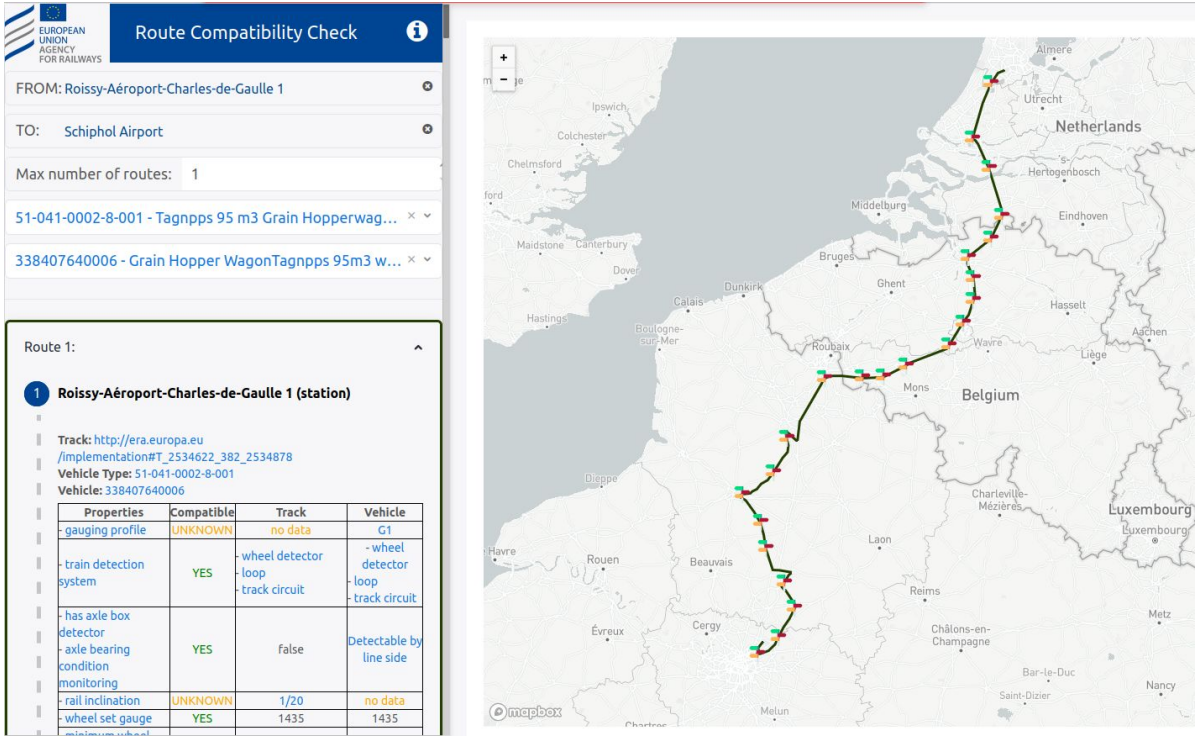
Routable Tiles: fragmenting OSM in LD tiles

P. Colpaert, B. Abelshausen, J. Rojas, H. Delva, and R. Verborgh, “**Republishing Open Street Map’s roads as Linked Routable Tiles**”, in *Proceedings of the 16th ESWC: Posters and Demos*, 2019.

Extra summary index speeds it up

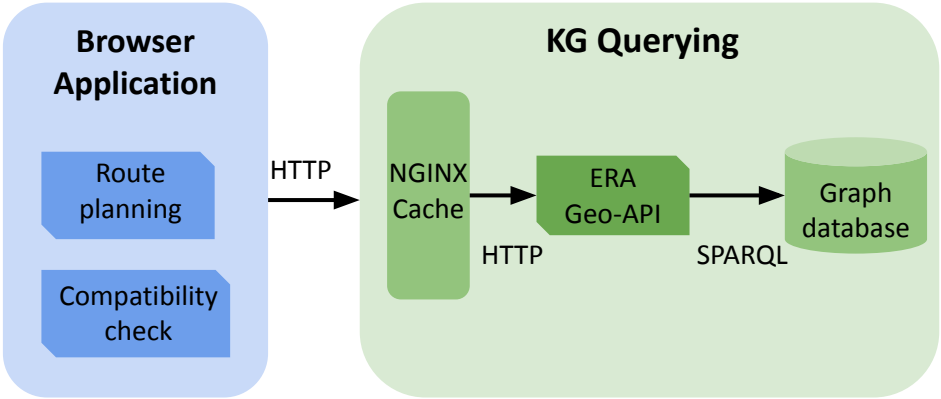
[Client-side route planning: preprocessing the OpenStreetMap road network for Routable Tiles]
Harm Delva, Julián Rojas, Ben Abelshausen, Pieter Colpaert, Ruben Verborgh *Academic Track, State of the Map 2019*

Railway compatibility in Europe



Online app at http://data-interop.era.europa.eu/

Railway compatibility in Europa



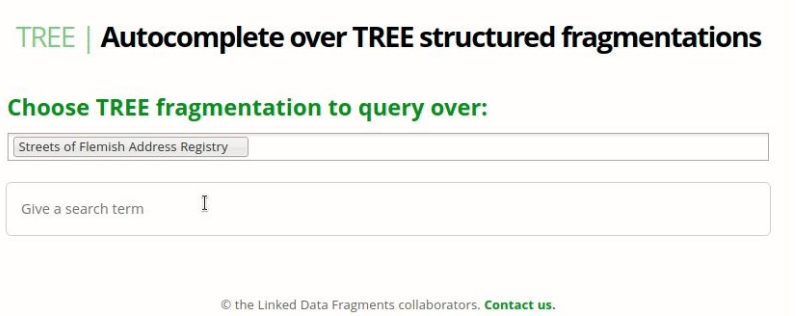
In-use architecture shields a SPARQL endpoint with a geospatial fragmentation

Vocabulary at https://data-interop.era.europa.eu/era-vocabulary/

API at https://data-interop.era.europa.eu/ldf/sparql-tiles/implementation/10/522/343

In-use paper at ISWC: "Leveraging semantic technologies for digital interoperability in the European Railway domain"
by J. Rojas, M. Aguado, P. Vasilopoulou, I. Velitchkov, D. Van Assche, P. Colpaert & R. Verborgh

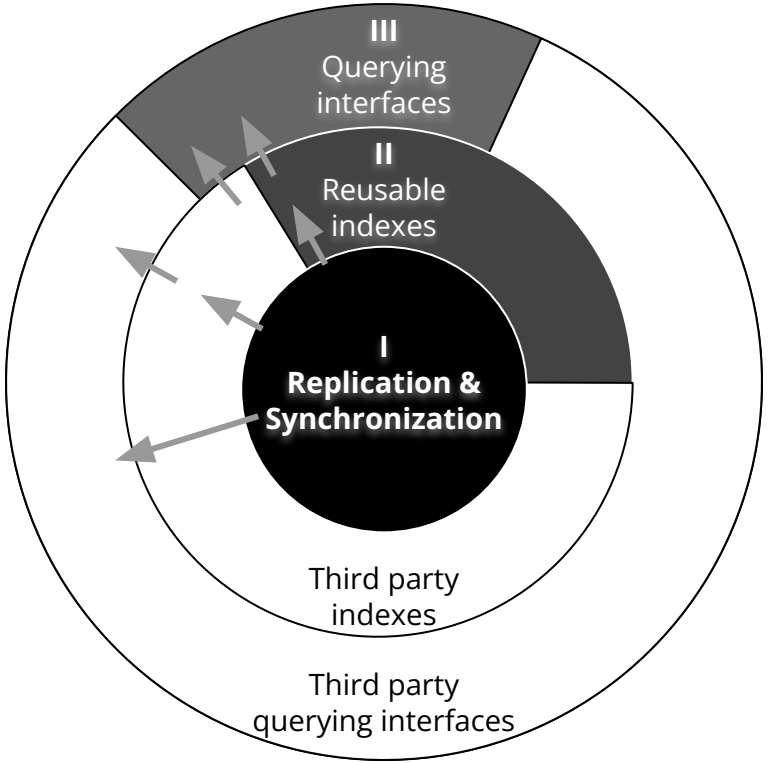
Substring fragmentations for autocompletion



Live demo at tree.linkeddatafragments.org

Ruben, D., Delva, H., Colpaert, P., & Verborgh, R. (2021, May). "A File-Based Linked Data Fragments Approach to Prefix Search". Proceedings of the 21th International Conference on Web Engineering.

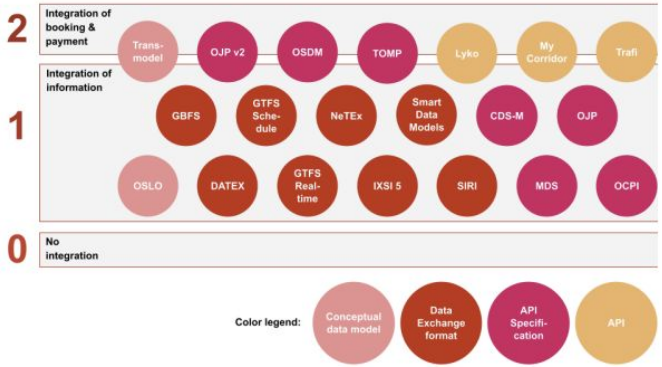
But everything API starts from the Linked Data Event Stream



Dwight Van Lancker, Pieter Colpaert, et al. 2021. Publishing base registries as Linked Data Event Streams. In *Proceedings of the 21th International Conference on Web Engineering*.

Current status of Linked Data in mobility

1. Interesting prototypes, vocabularies and architectures are sprouting
2. The MaaS alliance doesn't list Linked Data as a useful exchange model, but only sees it as a way to create conceptual data models



https://maas-alliance.eu/wp-content/uploads/2021/11/20211120-Def-Version-Interoperaability-for-Mobility.-Data-Models-and-API-_-FINAL.pdf

3. I believe the idea of Linked Data Event Streams and the ecosystem around it will bridge that gap

Want to help? Next up: the Sem4Tra Workshop

In September at SEMANTiCS! Prepare your submissions!

Join our Slack:
https://join.slack.com/t/sem4tra/shared_invite/zt-16c579hlg-sXwAgJPKmreRyd2Dje08oQ

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