
European Commission
17 January 2023
Webinar on LDES and Base registries
We will start at 13:05pm CET
DIGIT.D2 - Interoperability.
interoperable europe

Objective of this webinar

- Familiarise with Linked Data Event Streams
- Demonstrate the business value Linked Data Event Streams can bring for base registries
- Show Linked Data Event Streams in practice

Agenda

1. **Welcome & introduction**
2. **What is a Linked Data Event Stream (LDES)?**
3. **LDES and Access to Base Registries (ABR)**
4. **LDES as a solution - uses cases**
5. **LDES implementations – success stories**
6. **Wrap up and next steps**

Workshop practicalities

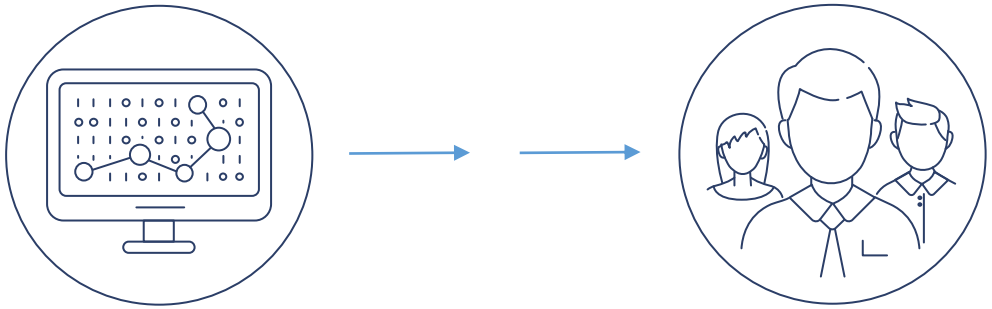
Please mute your microphones

You can also share your questions for the Q&A session via the chat

The workshop will be recorded

Meeting flow

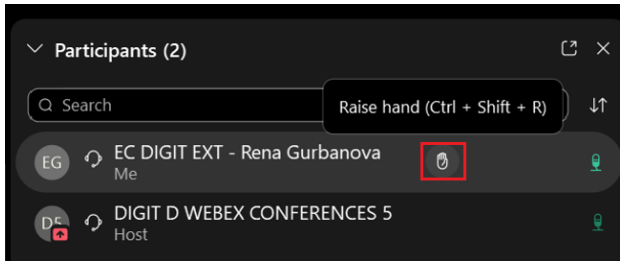
Presentations of the meeting will be followed by Q&A sessions



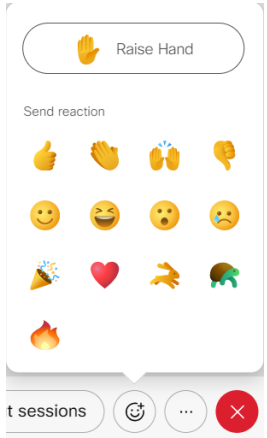
Presentation **Q&A session**

How to raise your hand?

1. Click ‘Participants’ and then click ‘Raise hand’ next to your name.



2. You can also raise and lower your hand from the Reactions menu.



The SEMIC action

The objectives of the SEMIC action is to foster Semantic Interoperability amongst the EU Member States by:

- Fostering, share and reuse of semantic assets, experience and tools and facilitating agreements in key areas.
- Identifying opportunities for alignment on semantic definitions, metadata and reference data sources with special focus on identification and definitions of Core Concepts / Vocabularies.
- Raising awareness on the importance of data and metadata management.

What is a Linked Data Event Stream (LDES)?

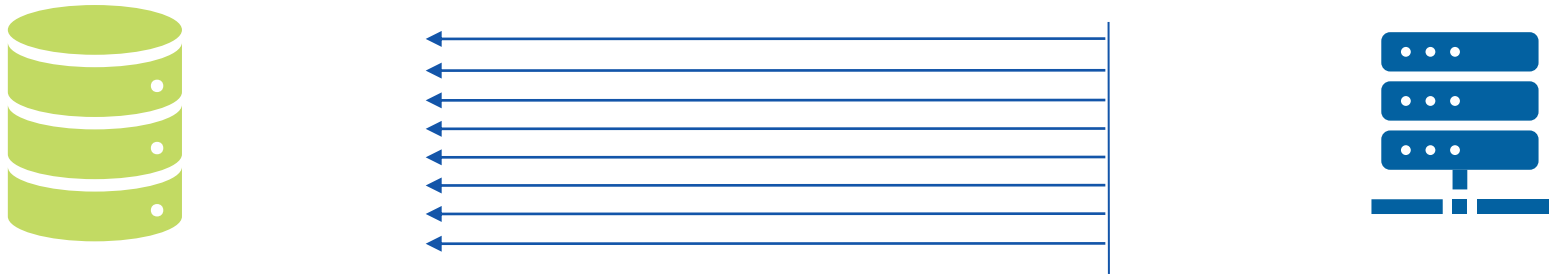
Arne Van Der Stuyft | SEMIC team

Current data sharing strategies

Data owner/publisher

Data users

1. Use of API's



2. Data dumps

Use of API's – Pros and cons

Data owner/publisher

- x Maintenance and the evolution of functionalities
- x Load of the database
- x Costs for exploitation and support

Data users

- ✓ Use of tailored API
- ✓ Limited operational costs
- x Higher costs to guarantee availability and reliability
- x New functionalities depends on the data owner
- x (Often) No history of data

Ideal situation for a '**Maintenance hell**'

Data dumps – Pros and cons

Data owner/publisher

- ✓ Limited load on the database through caching
- ✓ None or limited features to maintain
- ✓ Low cost of support and exploitation

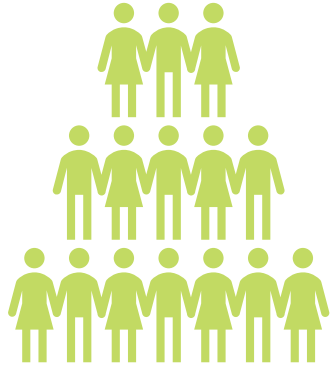
Data users

- ✓ The required data is available locally
- ✓ Responsive
- x Data will be replicated locally
- x User gets outdated data
- x (Often) No history of data

Ideal situation for a '**replication hell**'

A Linked Data Event Stream

A publication technology to share information with multiple parties



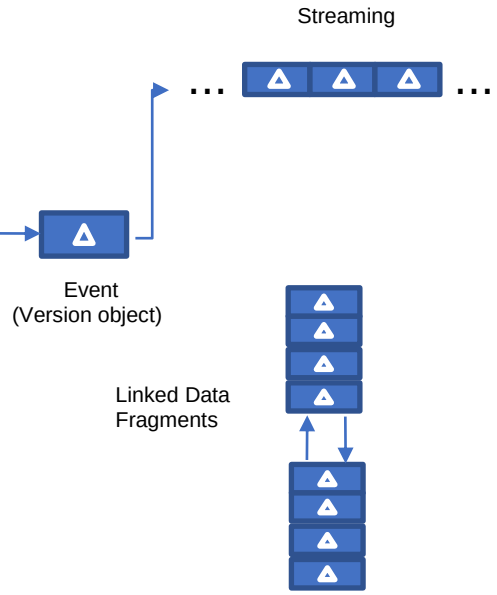
Allowing everyone to replicate and stay up-to-date regarding the unique source of truth

Linked Data Event Streams

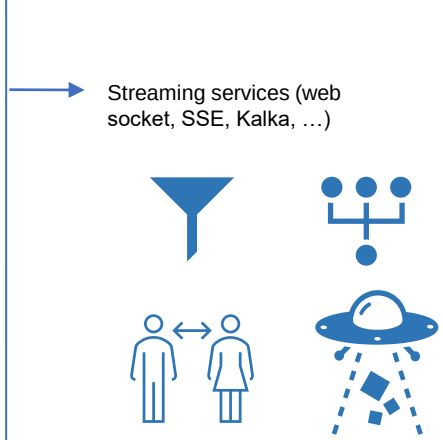
Data owner

Fast- and slow-moving data: IoT, transactions, contextual data, user data

Data publisher



Data intermediary

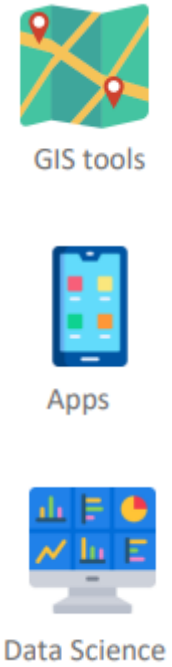


Building blocks – Combine, aggregate, filter, refragmentate

Data service providers

LDES 2 Service – Services decoupled from the source

Data users



Changeable datasets | **Minimal API** | **Transform, republish** | **Stay up-to-date** | **Scalable applications**

Linked Data Event Streams

- SEMIC: The Linked Data Event Streams specification (https://w3id.org/ldes/specification)

- Based on TREE (https://w3id.org/tree/specification)
    - Linked Data Event Streams are Linked Data Event Members published conform TREE

- The Smart Data Specification for Semantically Describing Streams (https://w3id.org/sds/specification)

LDES and Access to Base Registries (ABR)

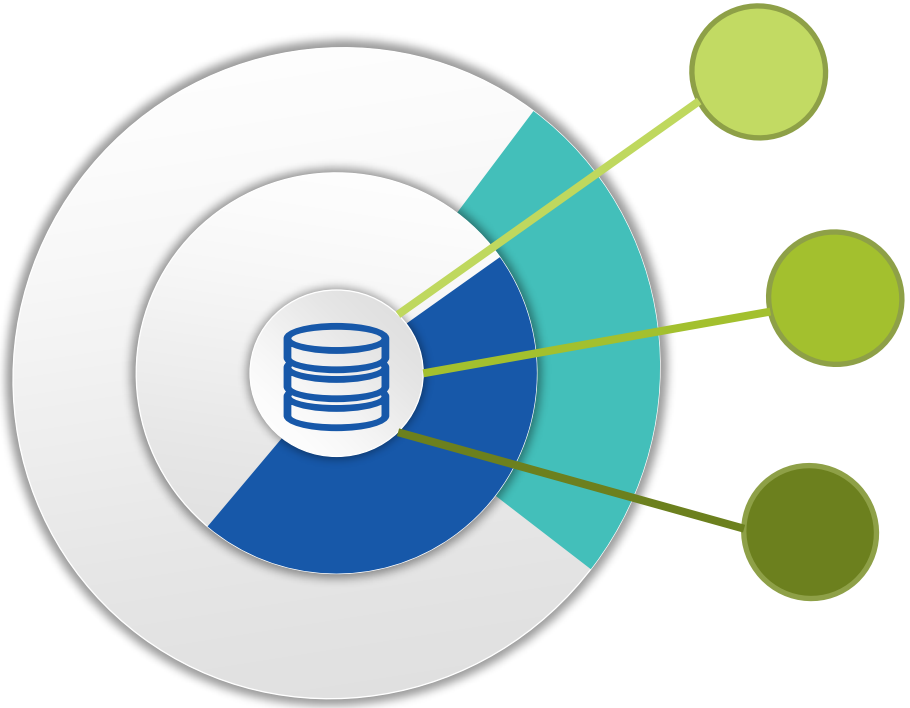
Bert Van Nuffelen | SEMIC team

Base Registry

A **Base Registry** is a digital system that is the single source of truth for data that is considered **core** to the operations by a public government.

Base Registry is interconnected

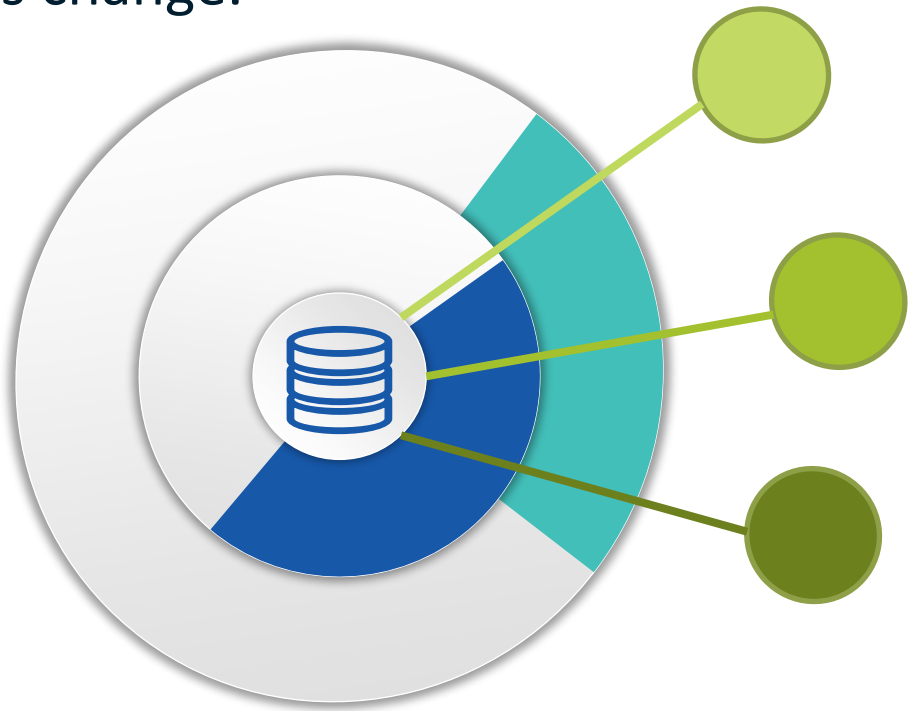
A Base Registry is highly/tightly **connected** with other systems in the public government **crossing bounderies** of agencies, departments,… but also jurisdictions (regional -> federal -> EU)



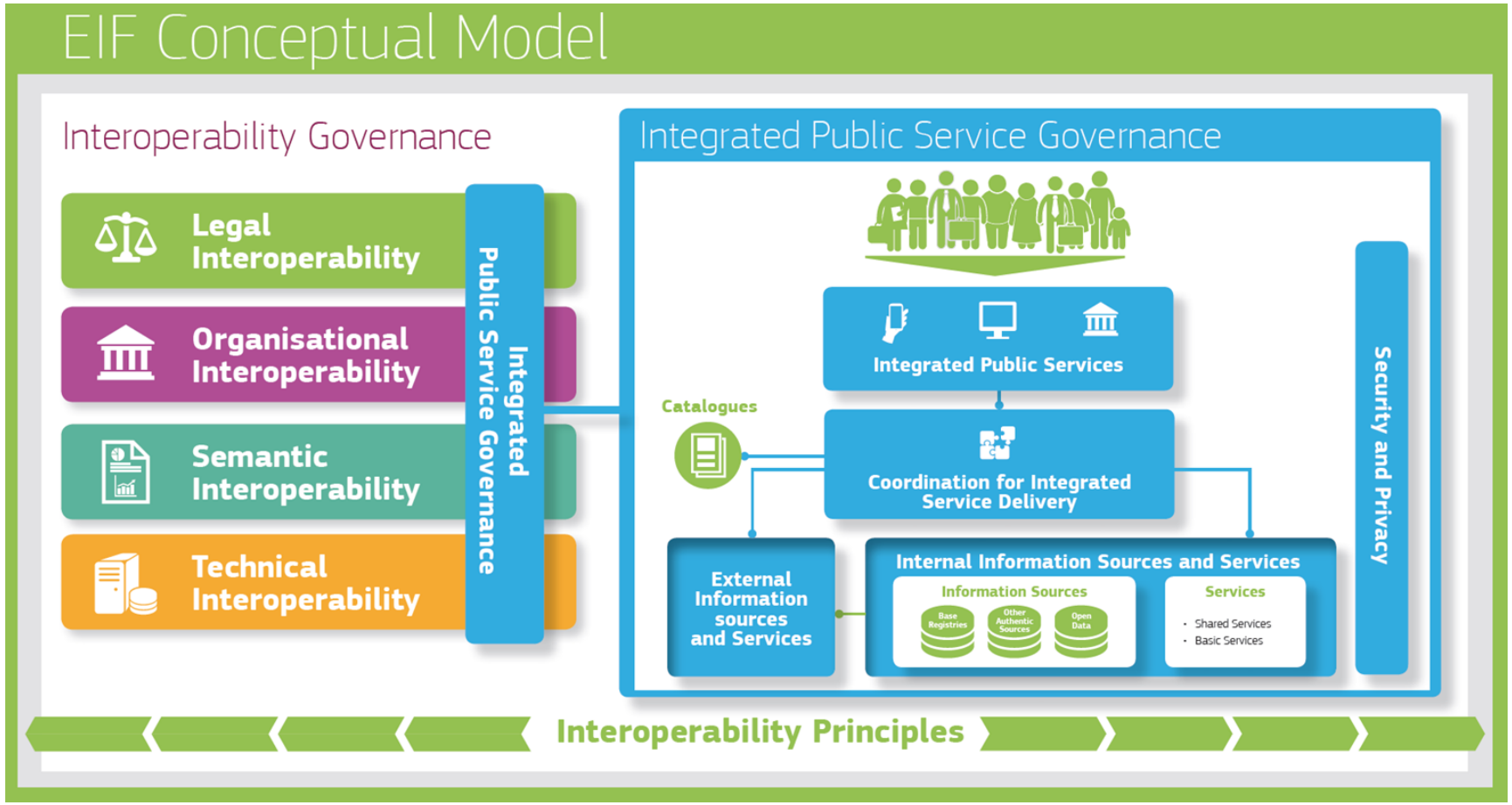
Base Registry evolves

A Base Registry evolves

- The data is in constant flux, but history has to be maintained.
- The information models change.



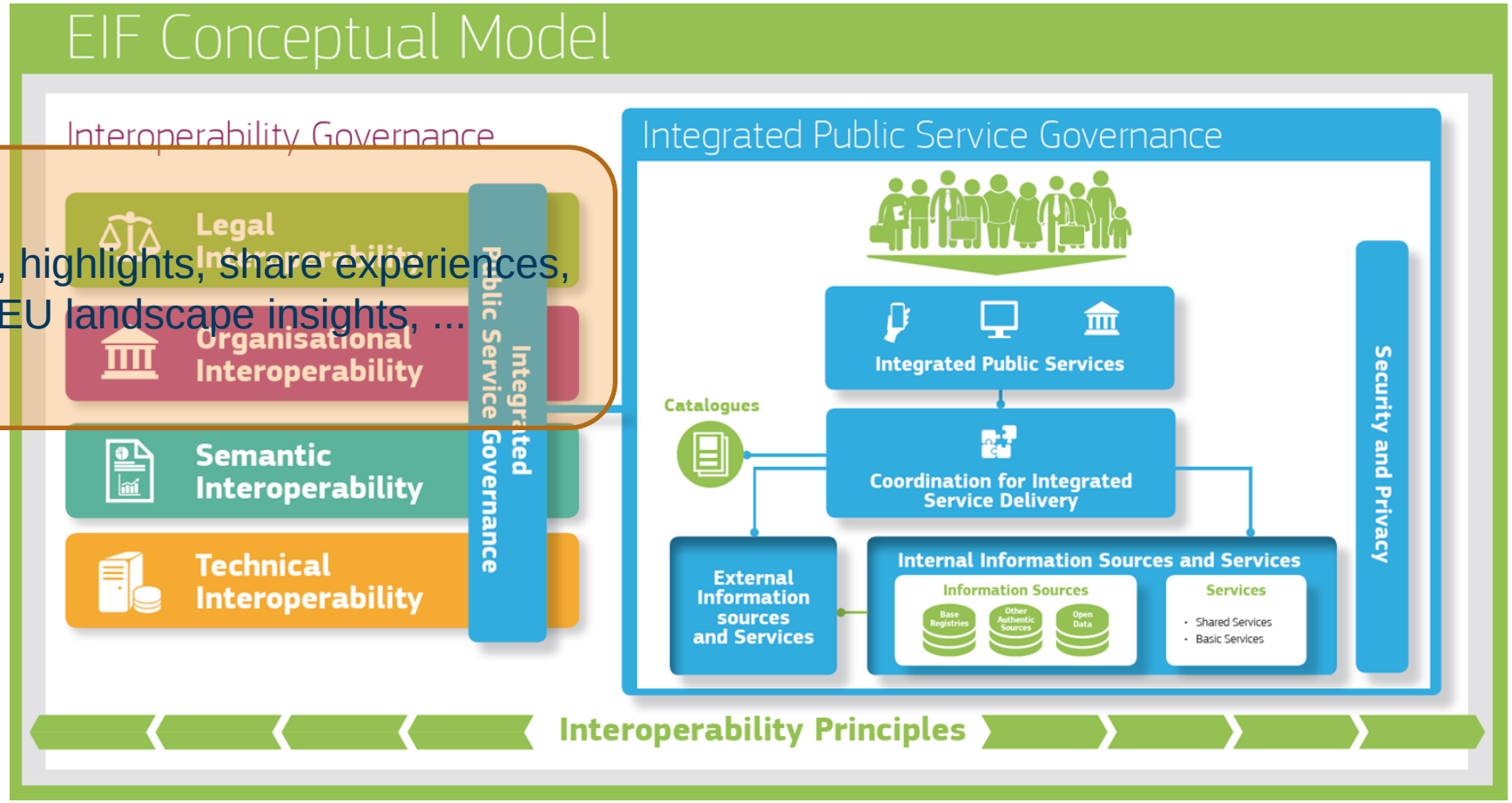
Interoperability is key challenge for Base Registries



* European Interoperability Framework

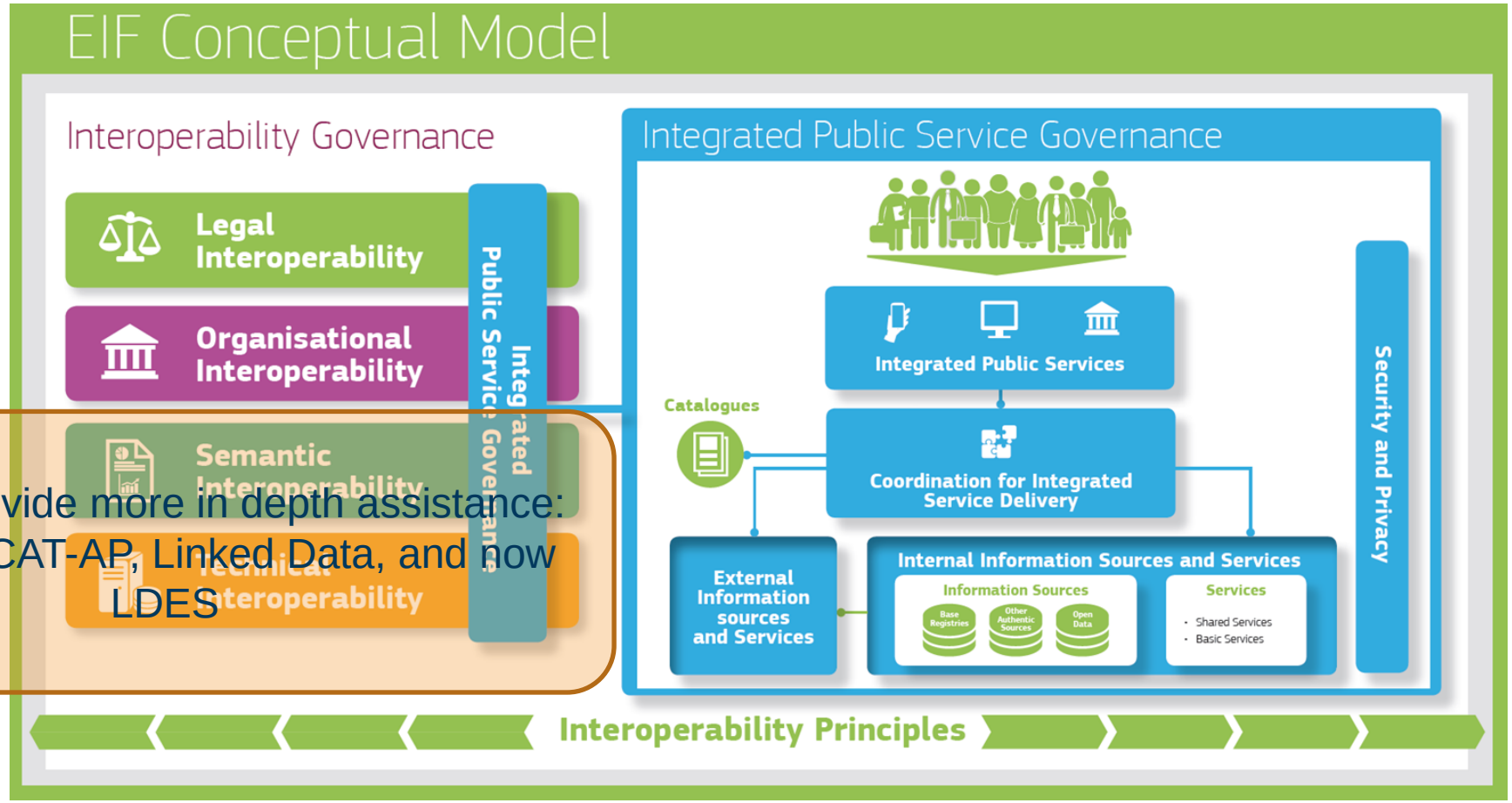
Interoperability is key challenge for Base Registries

ABR informs, highlights, share experiences, collect EU landscape insights, ...



* European Interoperability Framework

Interoperability is key challenge for Base Registries

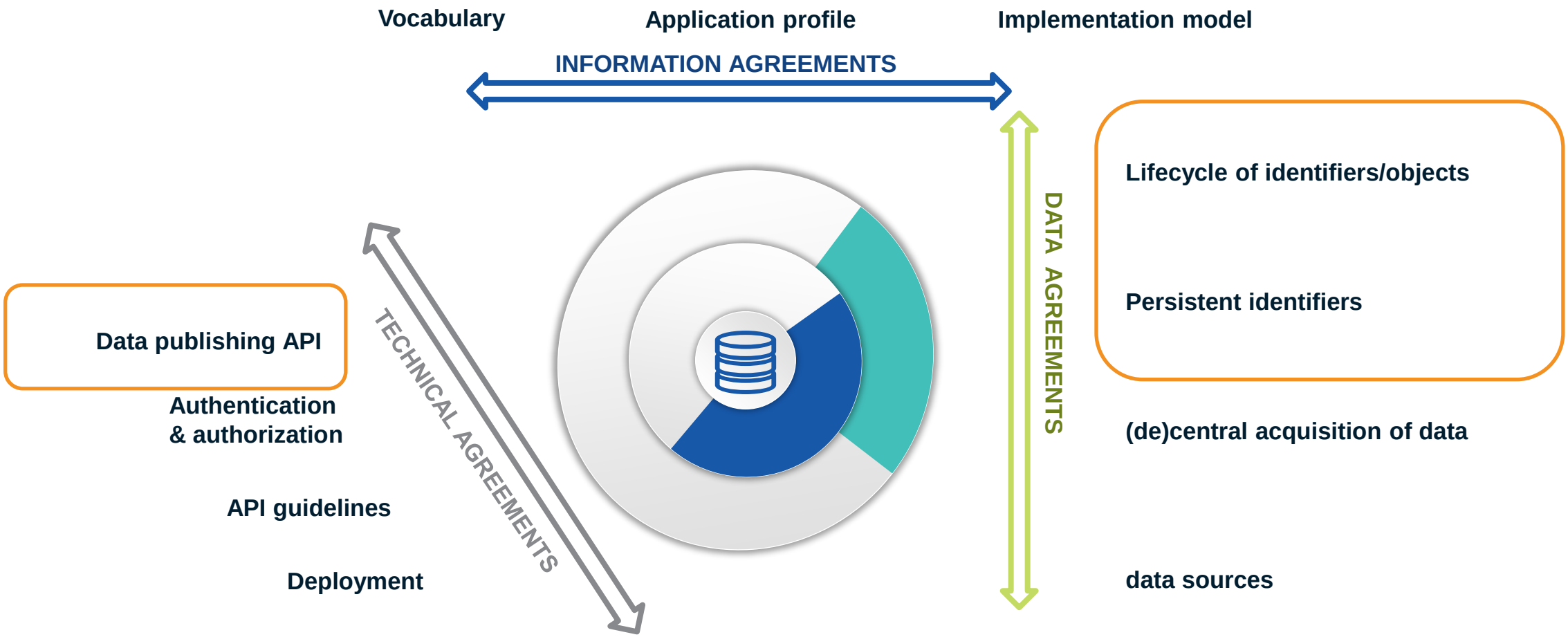


ABR can provide more in depth assistance: e.g. Breg DCAT-AP, Linked Data, and now LDES

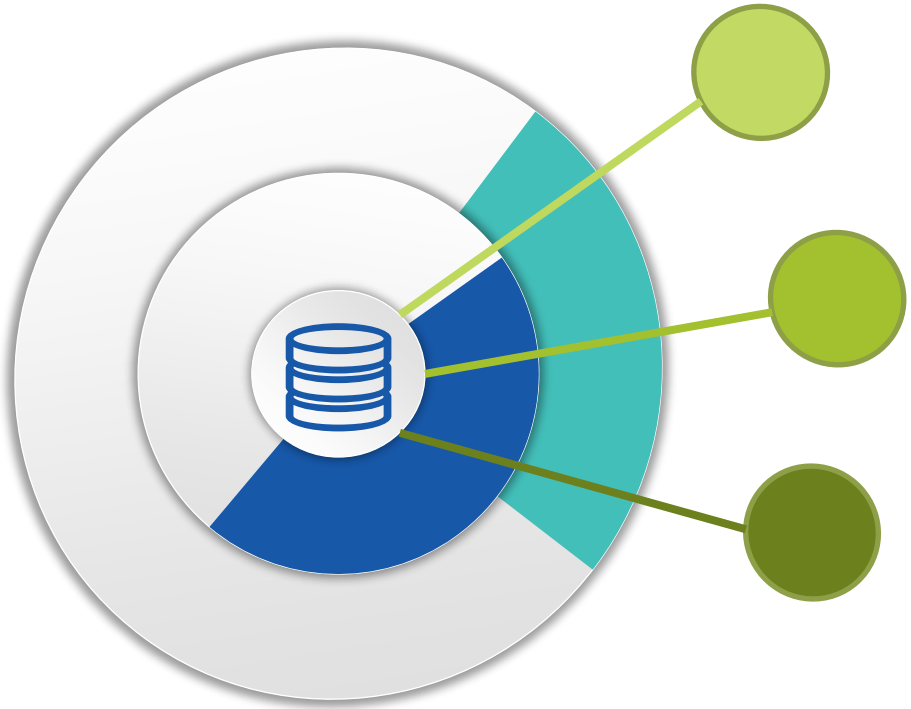
* European Interoperability Framework

European Commission

Data interplay-axes in Base Registry

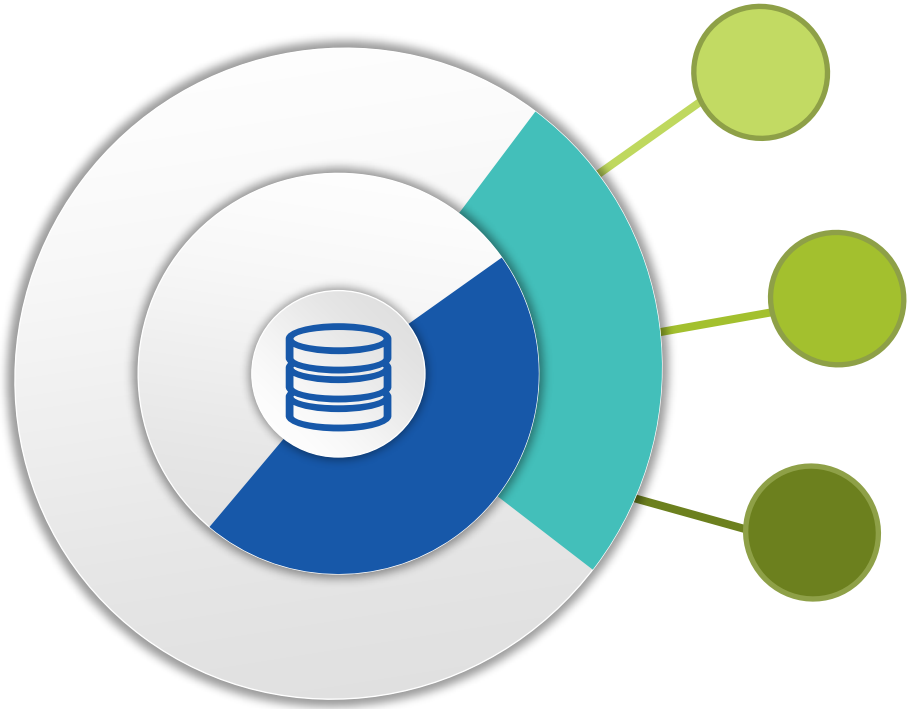


LDES as core element for base registry



- LDES provides an incremental path towards a broad offering of API/Query interfaces for a base registry

LDES as core element for base registry



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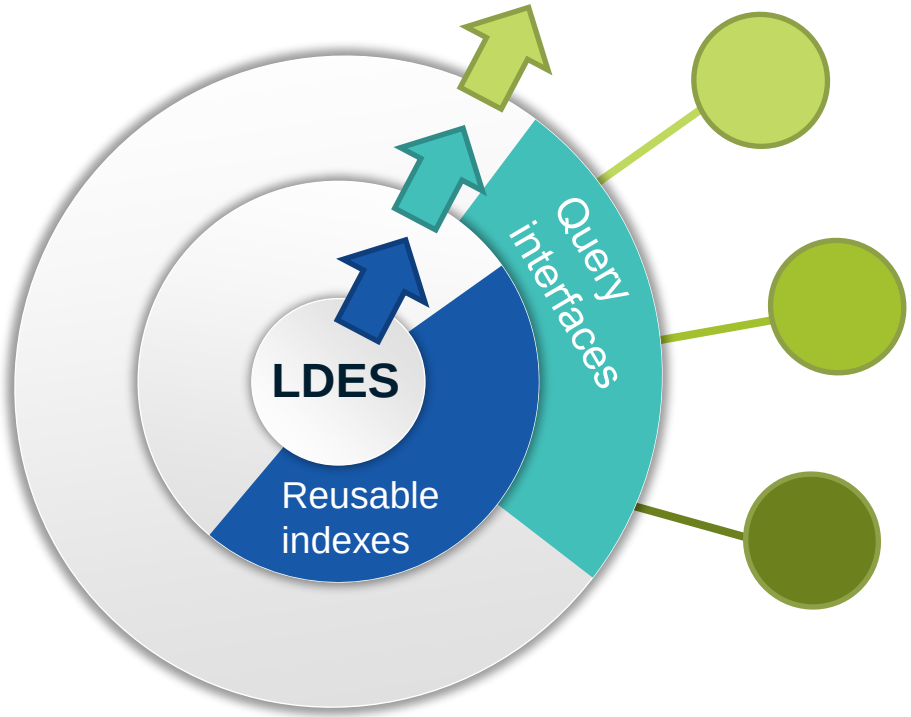
LDES as core element for base registry



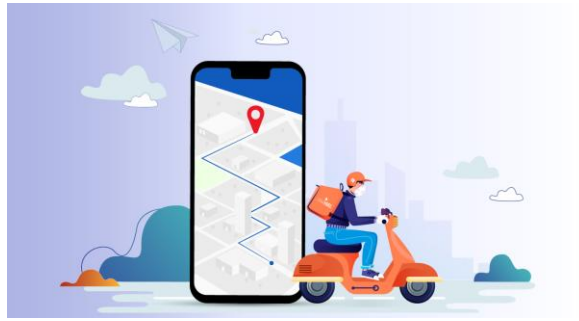
LDES as a solution:
Use case on Address Base Registries

Julian Melendez | imec

Address data is crucial for many business cases

POSTAL SERVICES

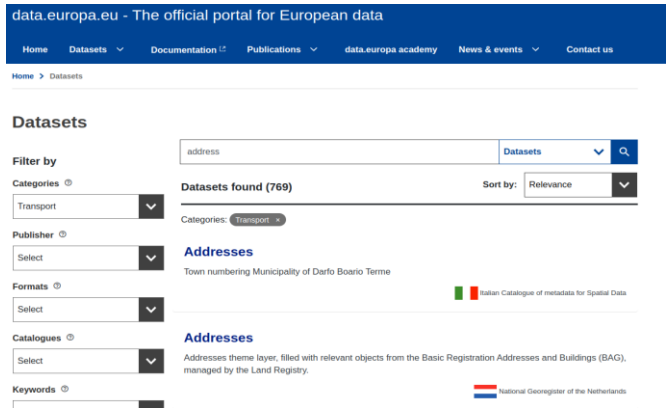
FOOD DELIVERY



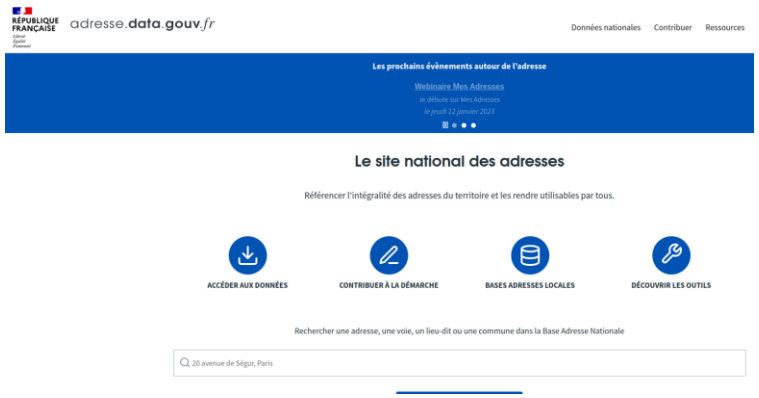
SHARED MOBILITY

ONLINE SHOPPING

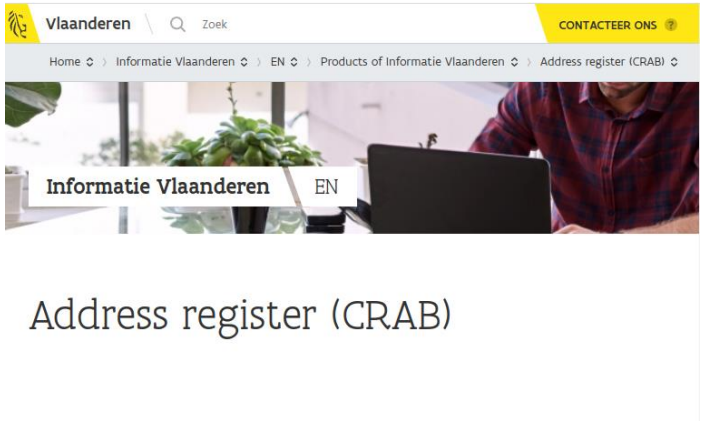
Official data is **scattered** across open data portals and usually **outdated**



EU data portal



National data portals



Regional data portals

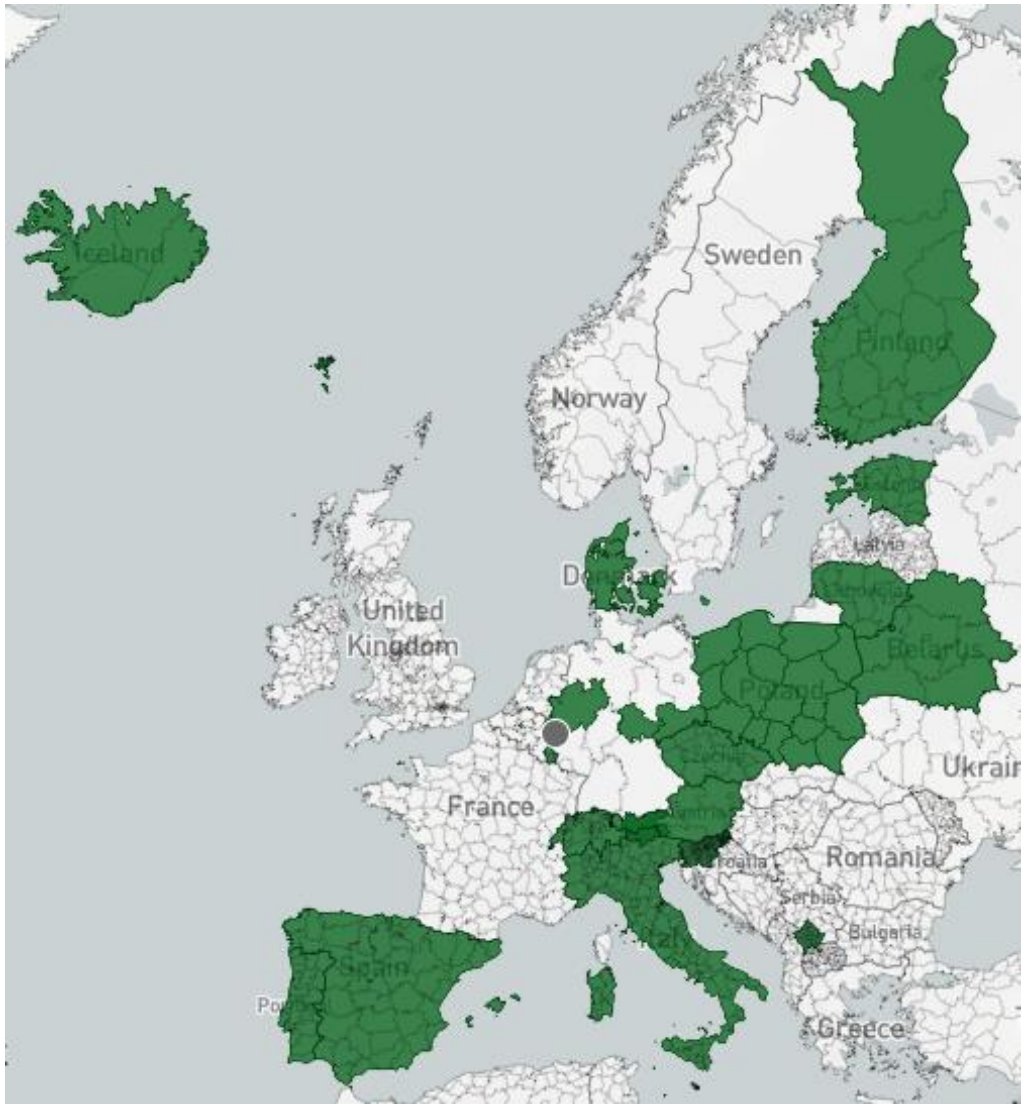
European Commission

Non-official open data alternatives cannot guarantee **reliability** nor **completeness**

Openaddresses.io

OpenStreetMap - Nominatim

Openaddresses.io incomplete coverage in Europe*



* screenshot taken on 12/01/23

OSM-Nominatim usage restrictions

Nominatim Usage Policy (aka Geocoding Policy)

This is an Acceptable Use Policy for the server running at nominatim.openstreetmap.org and does not apply to nominatim services run by yourself or other organisations

OSM's Nominatim service is mainly there to power the search bar on openstreetmap.org. We are in principle happy for the public API to be used by external users for creative and unexpected uses. However, be aware that the service runs on donated servers and has a very limited capacity. We therefore ask you to limit your use and adhere to this usage policy.

Use of any OSMF provided service is further governed by the OSMF Terms of Use .

Requirements

- No heavy uses (an absolute **maximum of 1 request per second**).
- Provide a valid **HTTP Referer** or **User-Agent** identifying the application (stock User-Agents as set by http libraries will not do).
- Clearly display attribution as suitable for your medium.
- Data is provided under the ODbL license which requires to share alike (although small extractions are likely to be covered by fair usage / fair dealing).

Unacceptable Use

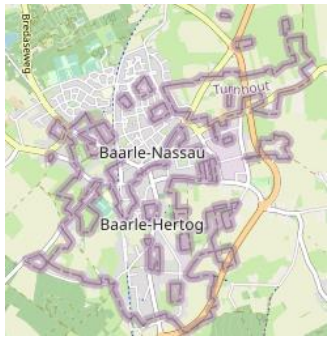
The following uses are strictly forbidden and will get you banned:

- **Auto-complete search** This is not yet supported by Nominatim and you must not implement such a service on the client side using the API.
- **Systematic queries** This includes reverse queries in a grid, searching for complete lists of postcodes, towns etc. and downloading all POIs in an area. If you need complete sets of data, get it from the OSM planet or an extract.
- **Scraping of details** The details page is there for debugging only and may not be downloaded automatically.

Reliable access to address data is **more challenging** for business located in cities in between international borders

Baarle-Hertog / Baarle-Nassau

Belgium and The Netherlands



Konstanz / Kreuzlingen

Germany & Switzerland

Tourcoing / Mouscron

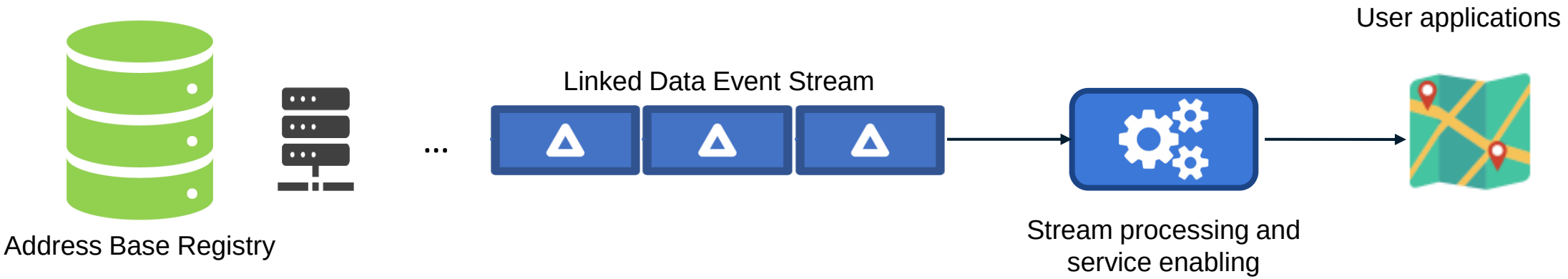
France and Belgium

Irun / Hendaye

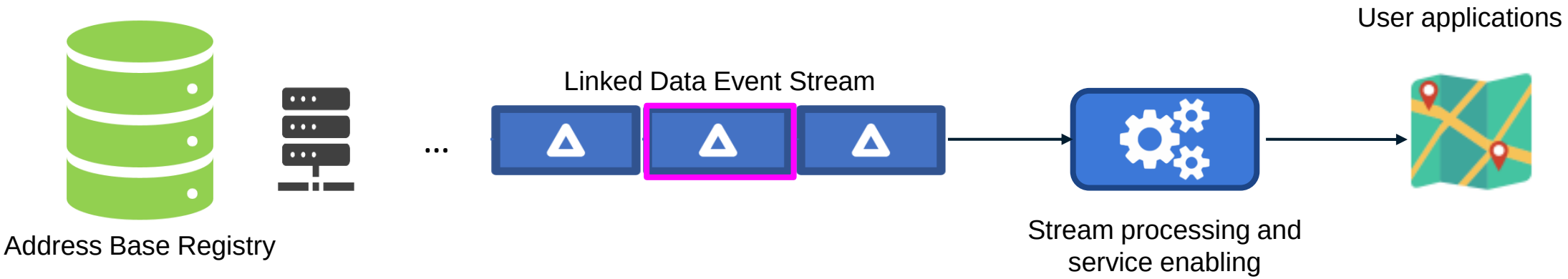
Spain and France

European Commission

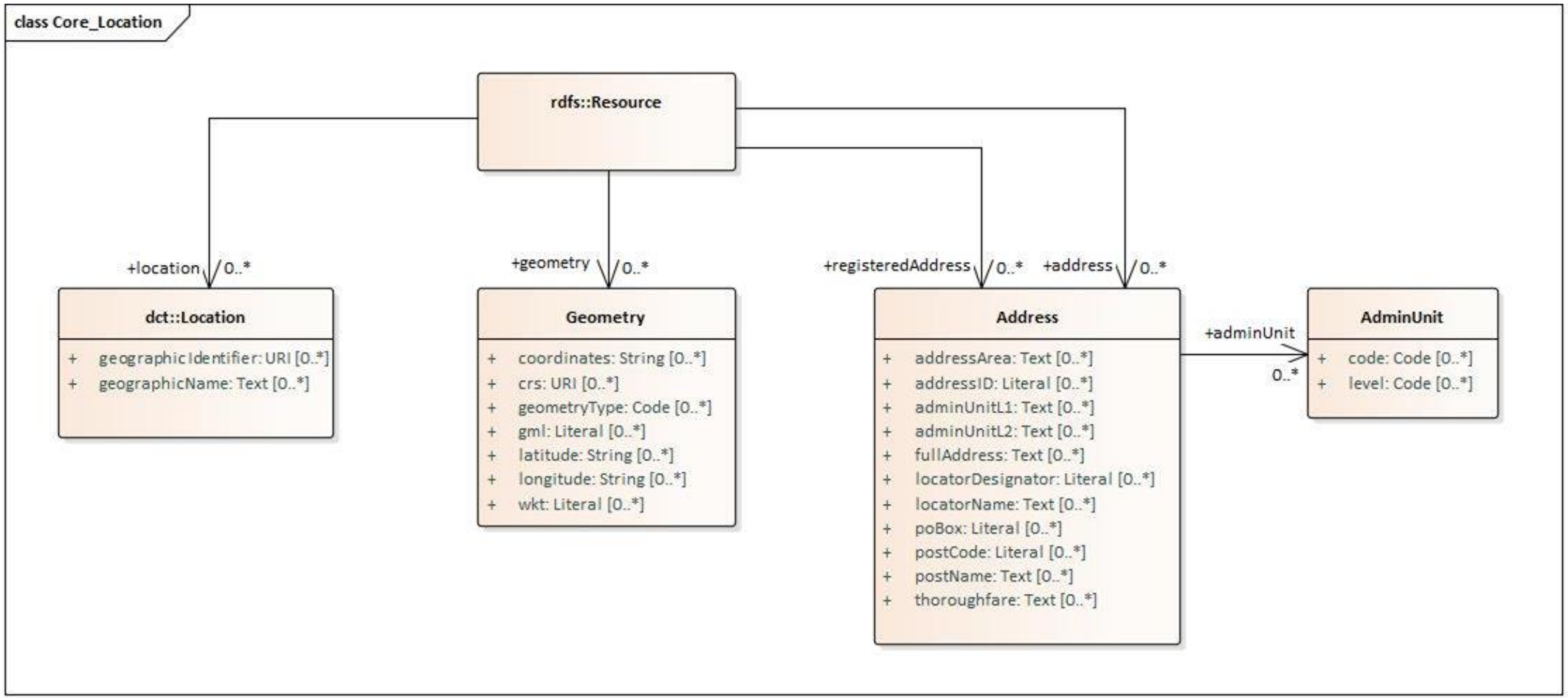
Publishing address base registry data as an LDES to enable reliable address lookup services



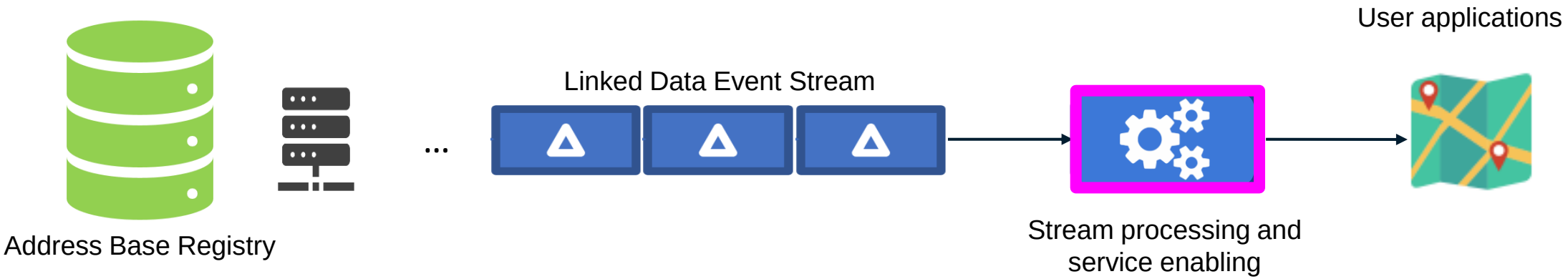
Publishing address base registry data as an LDES to enable reliable address lookup services



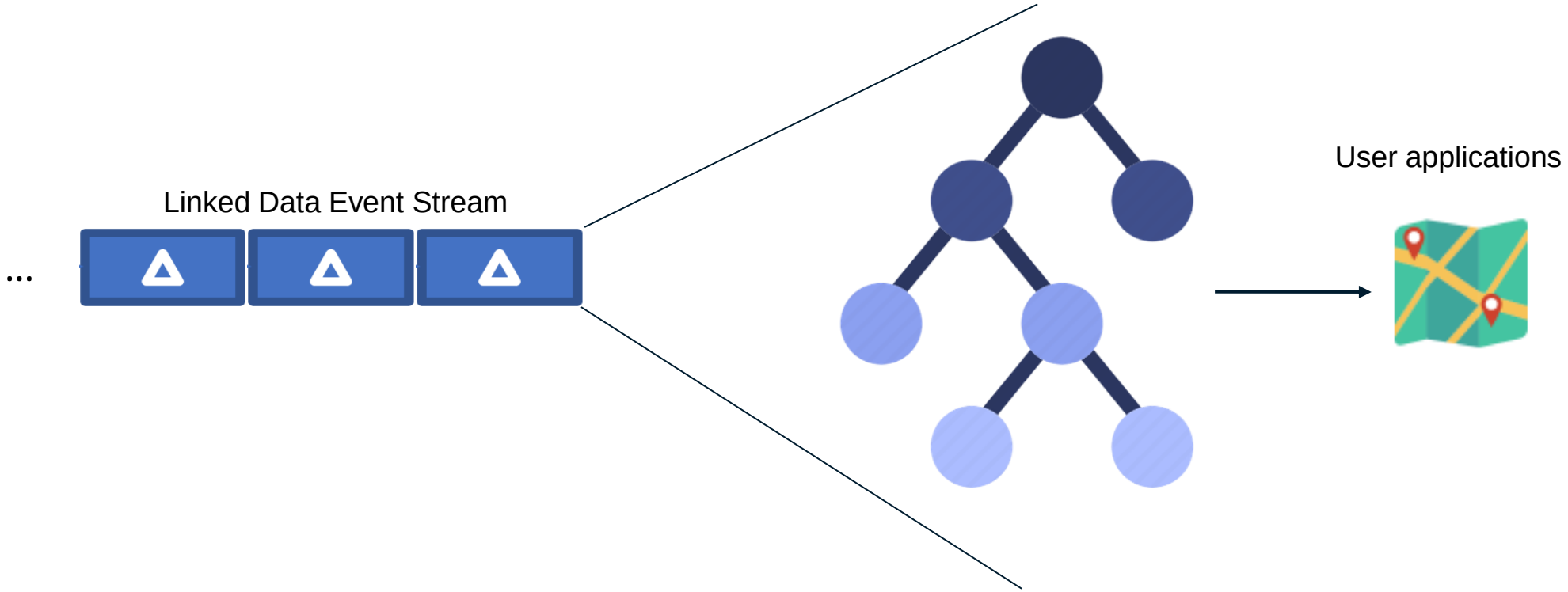
The EU Core Location vocabulary as a standardized data modelling approach



Publishing address base registry data as an LDES to enable reliable address lookup services



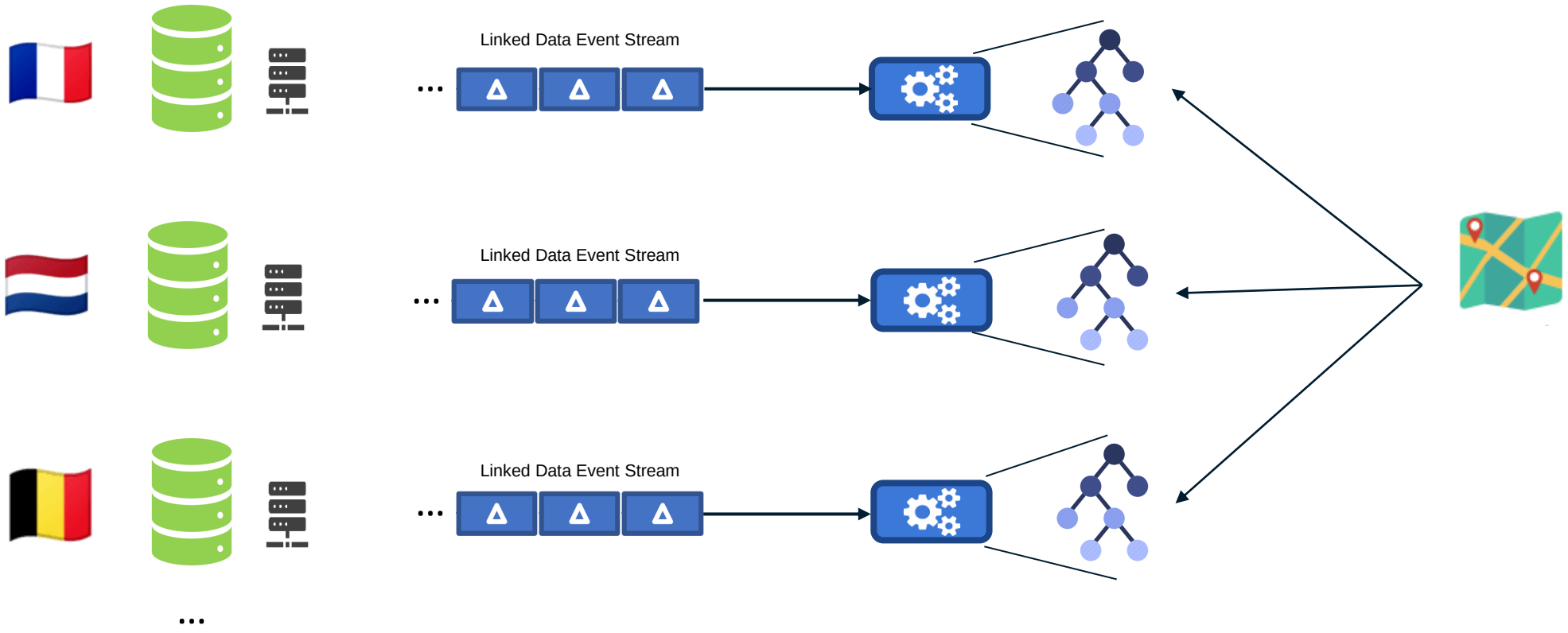
Creating a data projection (view) from the LDES to serve full text search services



Pilot implementation over data dumps from official address base registries

Member State	Address Base Registry	Access URL
France	Base Adresse Nationale	https://adresse.data.gouv.fr/
The Netherlands	Basisregistratie Adressen en Gebouwen	https://www.kadaster.nl/zakelijk/registraties/basisregistraties/bag
Belgium	BeSt Address	https://www.geo.be/catalog/details/ca0fd5c0-8146-11e9-9012-482ae30f98d9?l=en

Pilot implementation over data dumps from official address base registries



LDES-based ecosystem for address base registries

Data owner

Data publisher

Linked Data Event Stream

Linked Data Event Stream

Linked Data Event Stream

Data intermediary

Data service providers

WFS

PostGIS

Graph DB

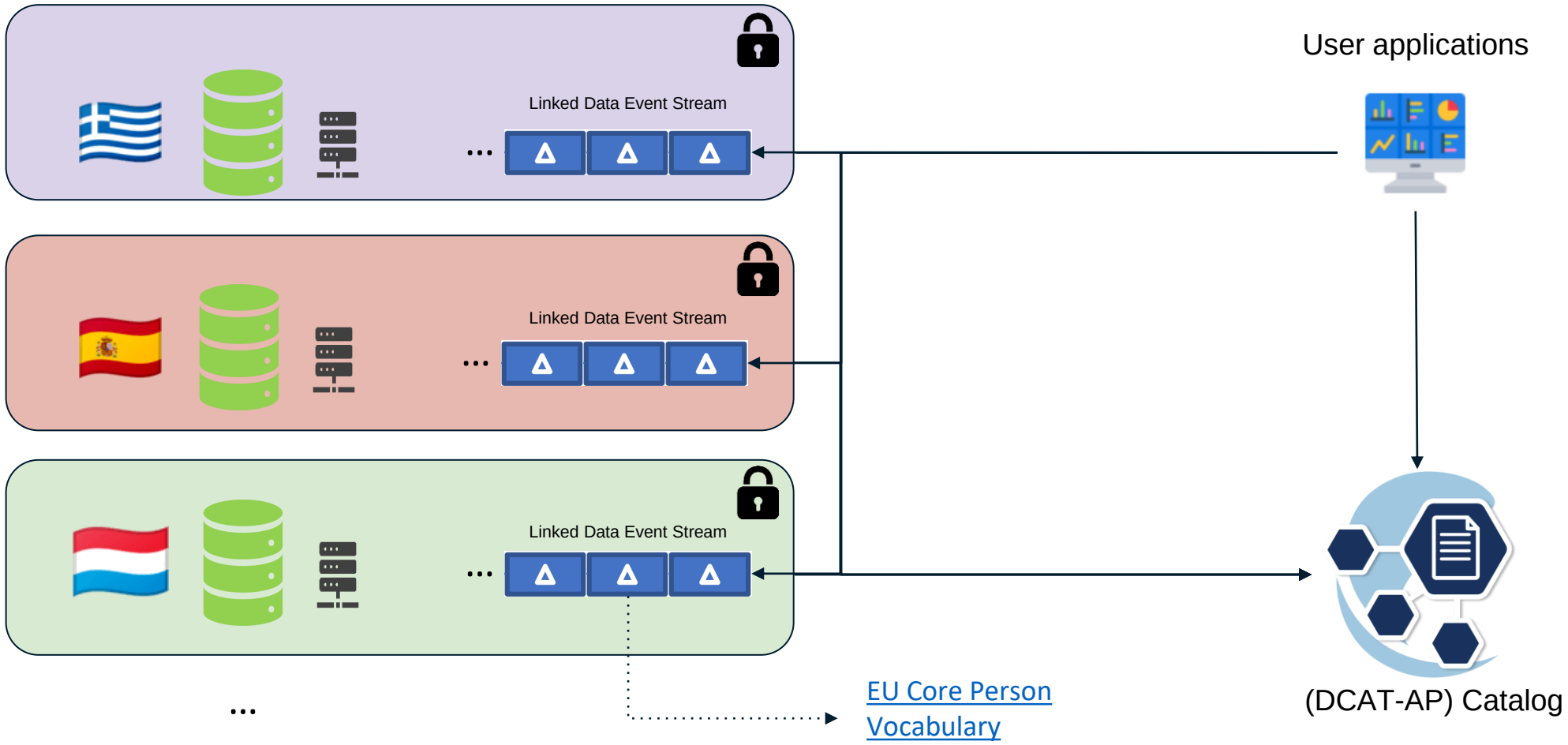
IoT Context Broker

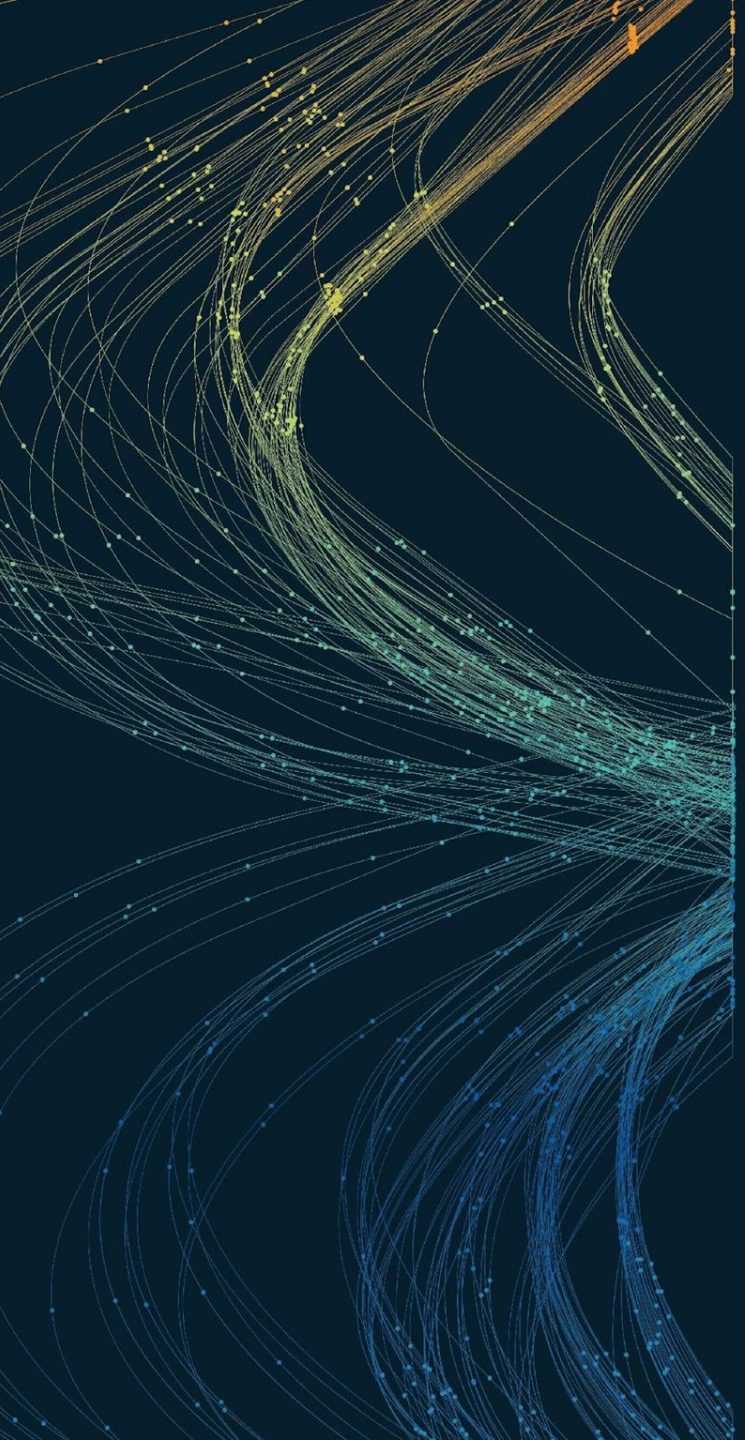
LDES 2 Service – Services decoupled from the source

Data users

Live demo

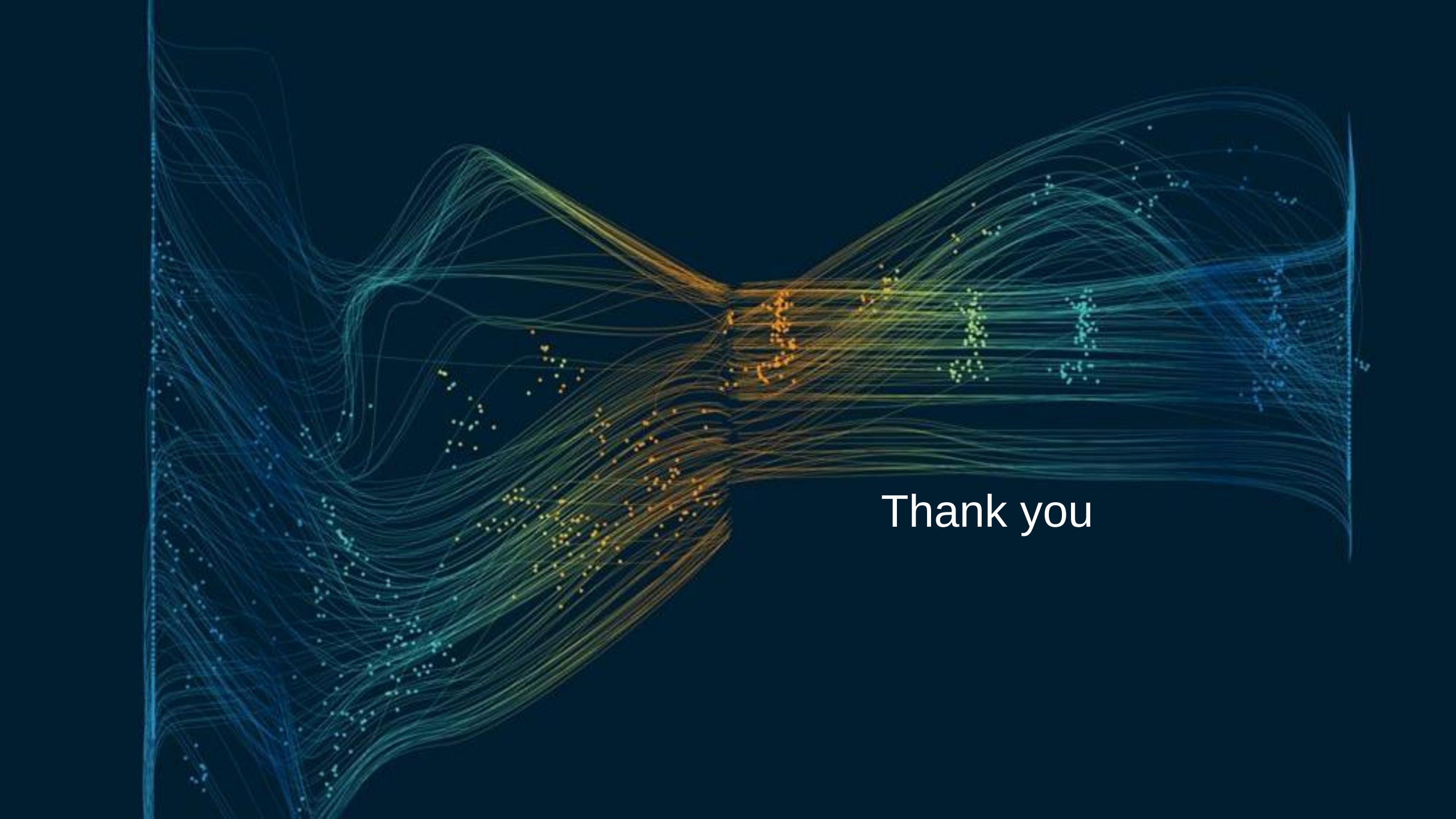
A pilot on privacy-aware Citizen Base Registries data sharing across EU member states (WIP)





Takeaways

- LDES-based publishing approaches can become a core API strategy for publishing Base Registry data.
- Reuse, synchronization and interoperability are core considerations of LDES
- LDES is compatible with Data Space architectures enabling interoperable, cost-efficient and secure data sharing capabilities


Thank you

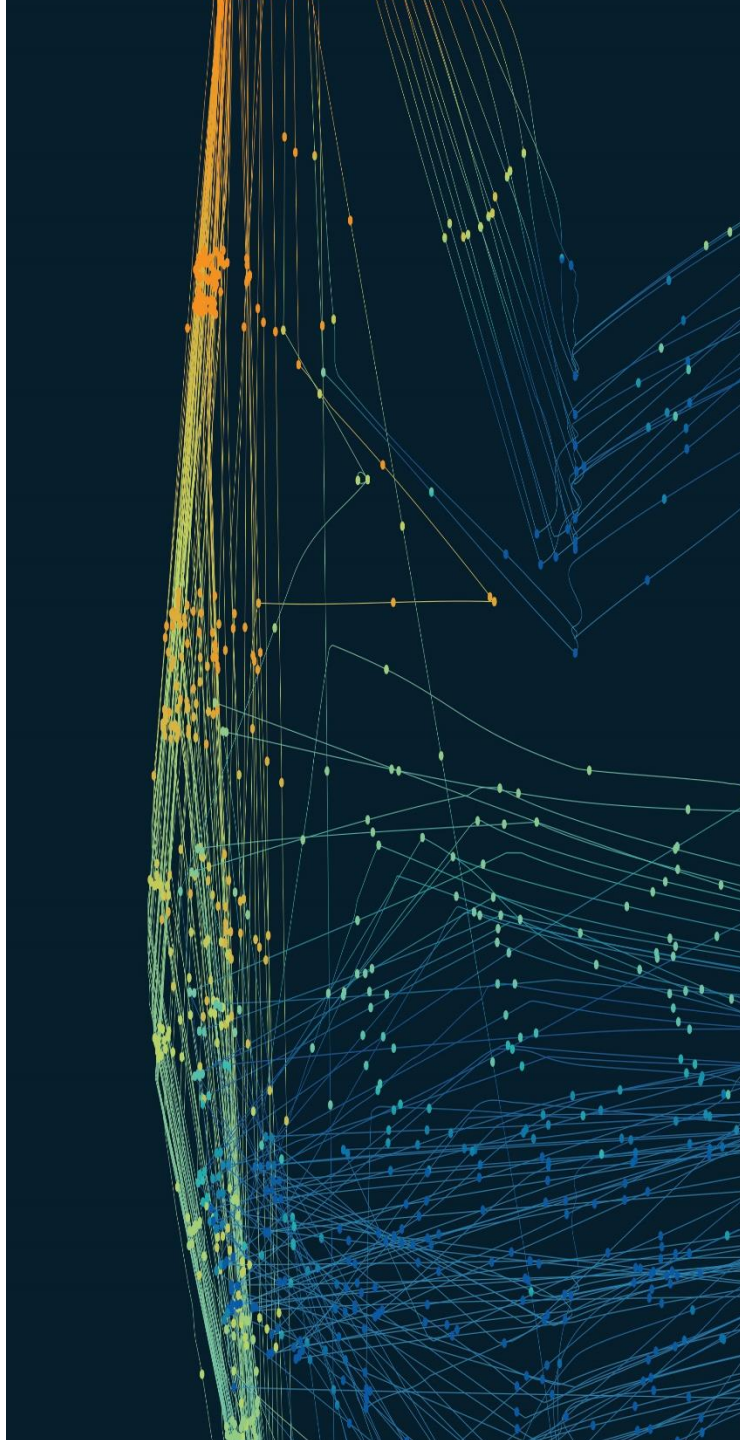
The European Base Register of Railway Infrastructure:

LDES for a liquid and data centric SERA -Single European Railway Area

Marina Aguado | European Railway Agency

1

SERA and the European Union Agency for Railways



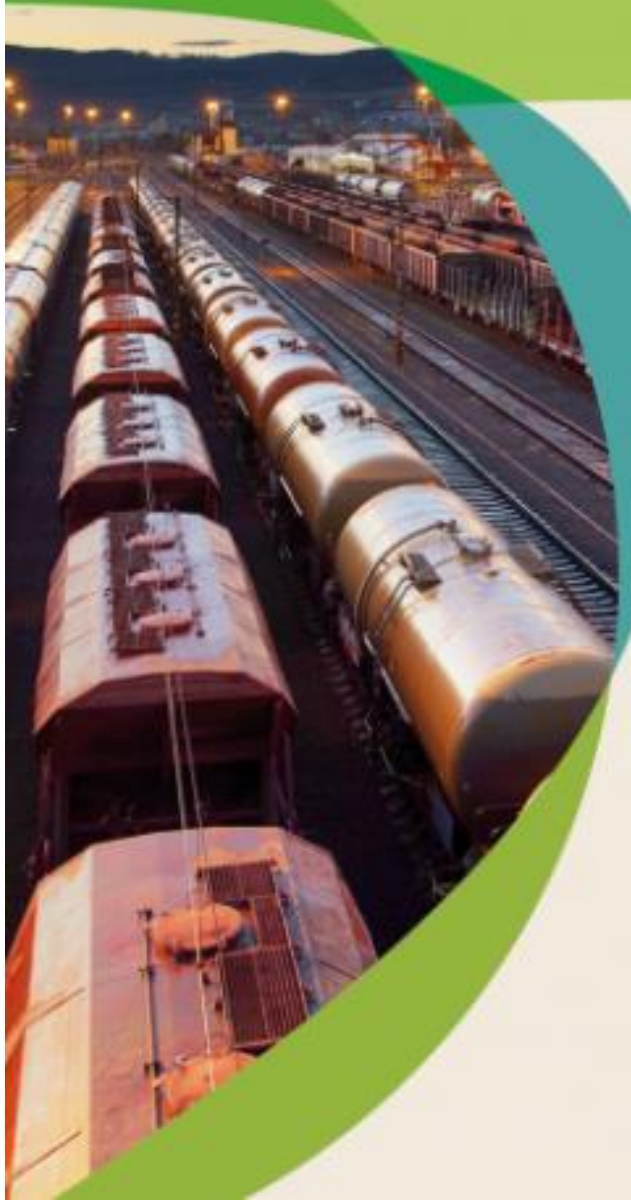
European Commission

Making railways work better for a digital society

European Commission

BOOSTING EUROPEAN RAIL TRANSPORT

through new harmonised procedures across the EU



Manufacturer

Railway undertaking

Contractor of ERTMS infrastructure

Operations in MORE THAN ONE Member State

BEFORE
31 OCTOBER 2020

Different national rules & requirements
multiple authorisations and certificates
from 25 different national safety authorities

SINCE
31 OCTOBER 2020

EU Agency for Railways
as single authority

- Vehicle authorisation
- Safety certification
- ERTMS trackside approval

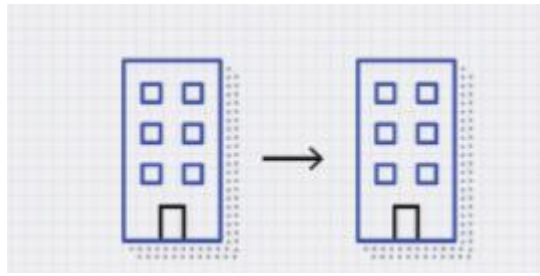
The Agency´s data ecosystem

Railway Sector

Business to Government Data Exchange B2G

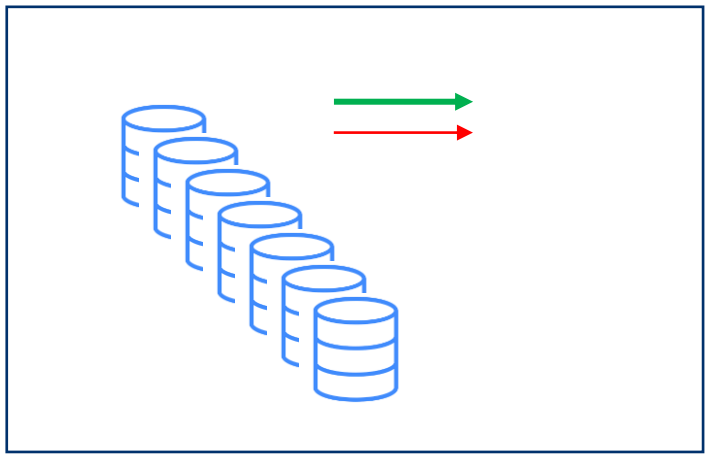
EUROPEAN UNION AGENCY FOR RAILWAYS

Railway Business to Business Data Exchange B2B



- TAF/TAP (IM, RU exchange)
- ERTMS (Supplier IM, RU)

BASE Registers



1st Meta Data – Common Ontology – Data Catalogue - Reference Data

2nd Data Access

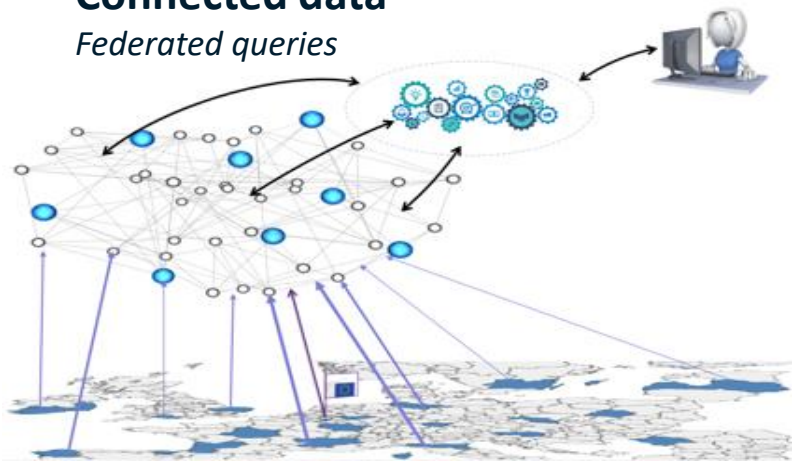
European Commission

Agency´s digital roadmap:

from siloed to connected data “Fairification” of our railway datasets

Connected data

Federated queries



High Value datasets for mobility

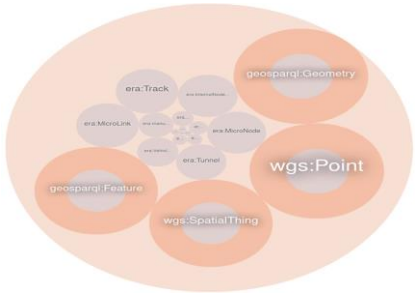
Common European Mobility Data Space

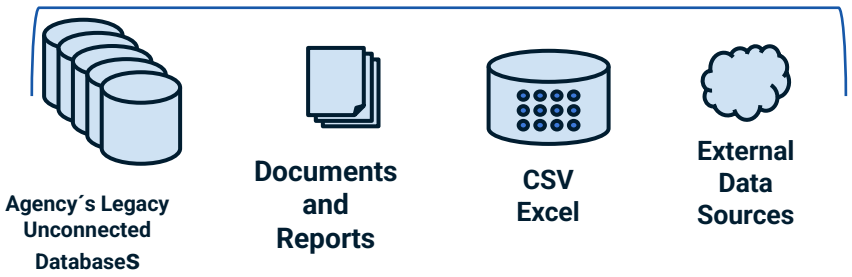
DTLF	ITS NAPS	Vehicle data	Aviation	Road Safety

ERA in house data

[ERA Knowledge Graph + SPARQL endpoint]

A total of ~30 million data statements (aka triples)
+270k Track segments described
+50k stations (aka Operational Points) described
+50k geo-referenced objects (lat/lon)
+2k Vehicle Types described
27 countries covered





European Commission

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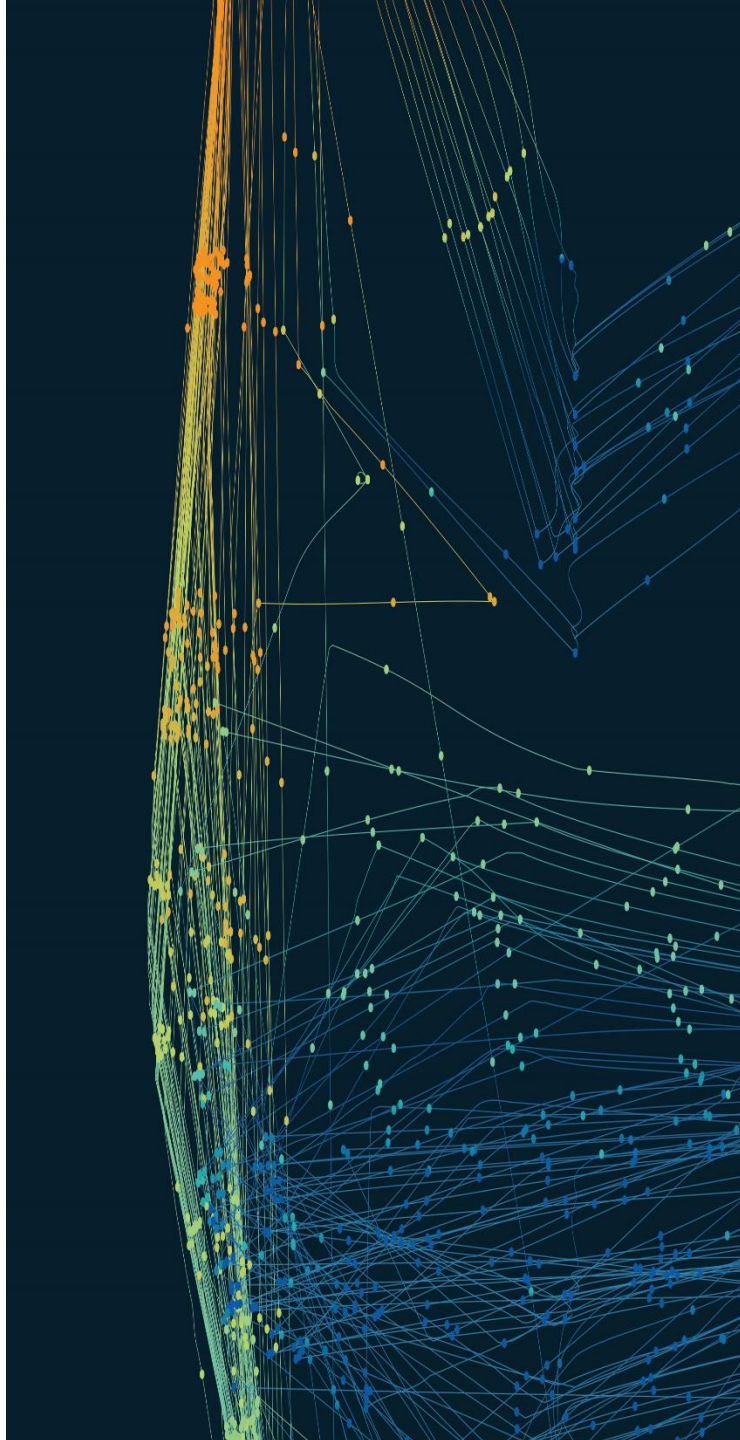
The European Base Register of Railway Infrastructure



European Commission

European Railway Register

Subject Matter Experts
Laws, regulations,
concept models, requirements

Data Architects
Logical Models

Developer
Physical Models

Legal interoperability

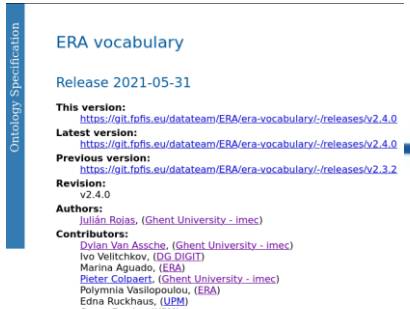
Organizational interoperability

Semantic interoperability

Technical interoperability

Fourth Railway Package
technical pillar

The Agency collects railway infrastructure data from all EU member states



The Agency publishes a Knowledge Graph

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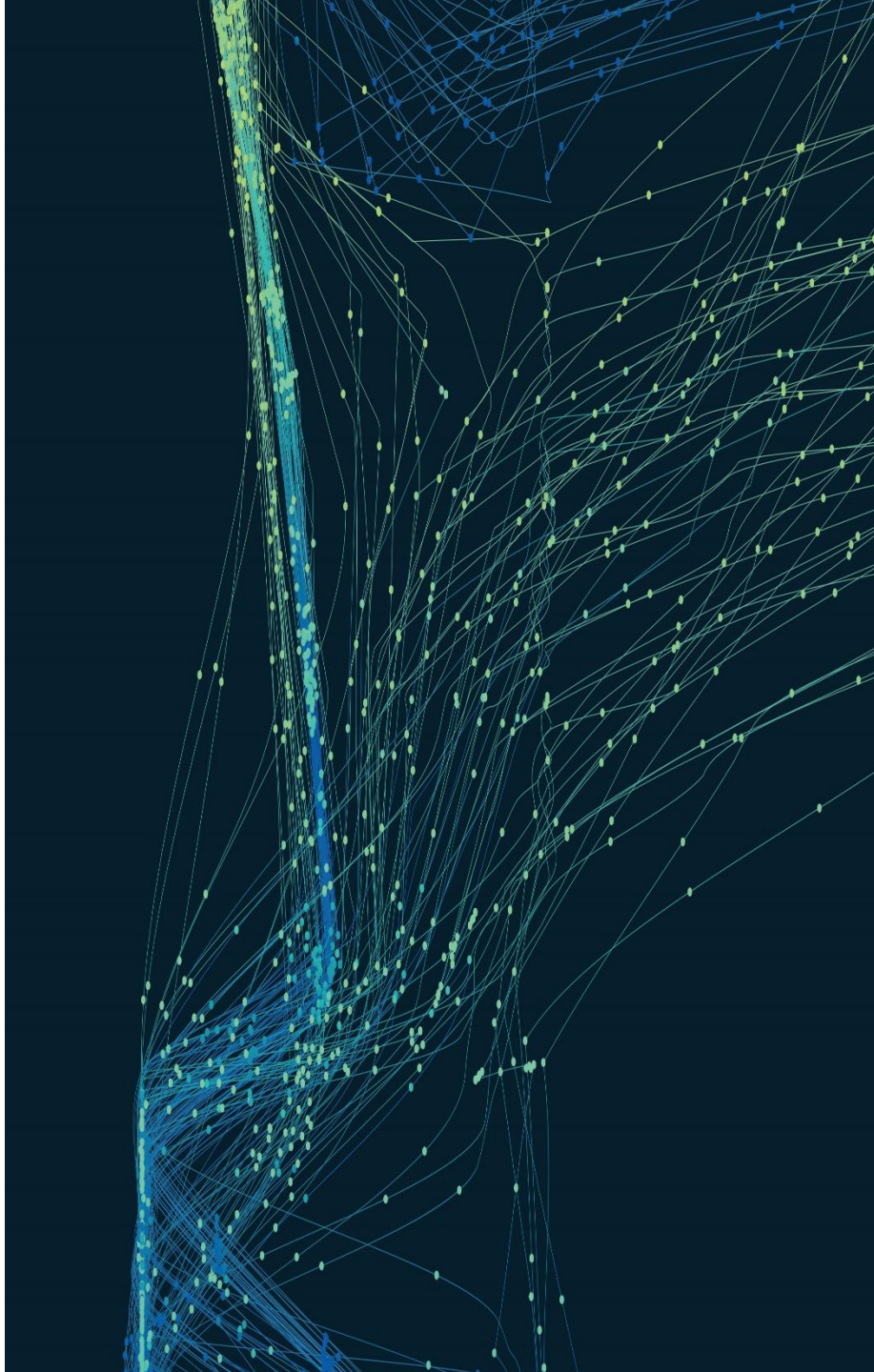
3

Interoperability Challenges



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Towards real time …Infrastructure change alert

Article 6.d of the EU regulation 2019/777

COMMISSION IMPLEMENTING REGULATION (EU) 2019/777

of 16 May 2019

on the common specifications for the register of railway infrastructure and repealing Implementing Decision 2014/880/EU

(Text with EEA relevance)

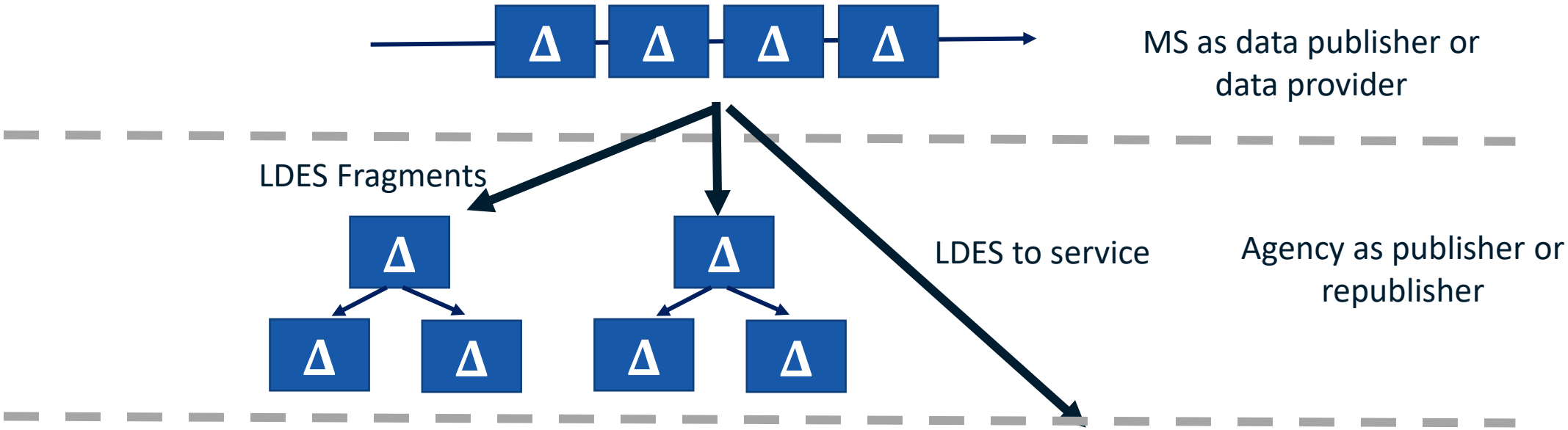
Article 6

Further developments

(d) provide means for alerting railway undertakings regarding changes in the RINF Application relevant to them.

Source: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0777&from=ENt

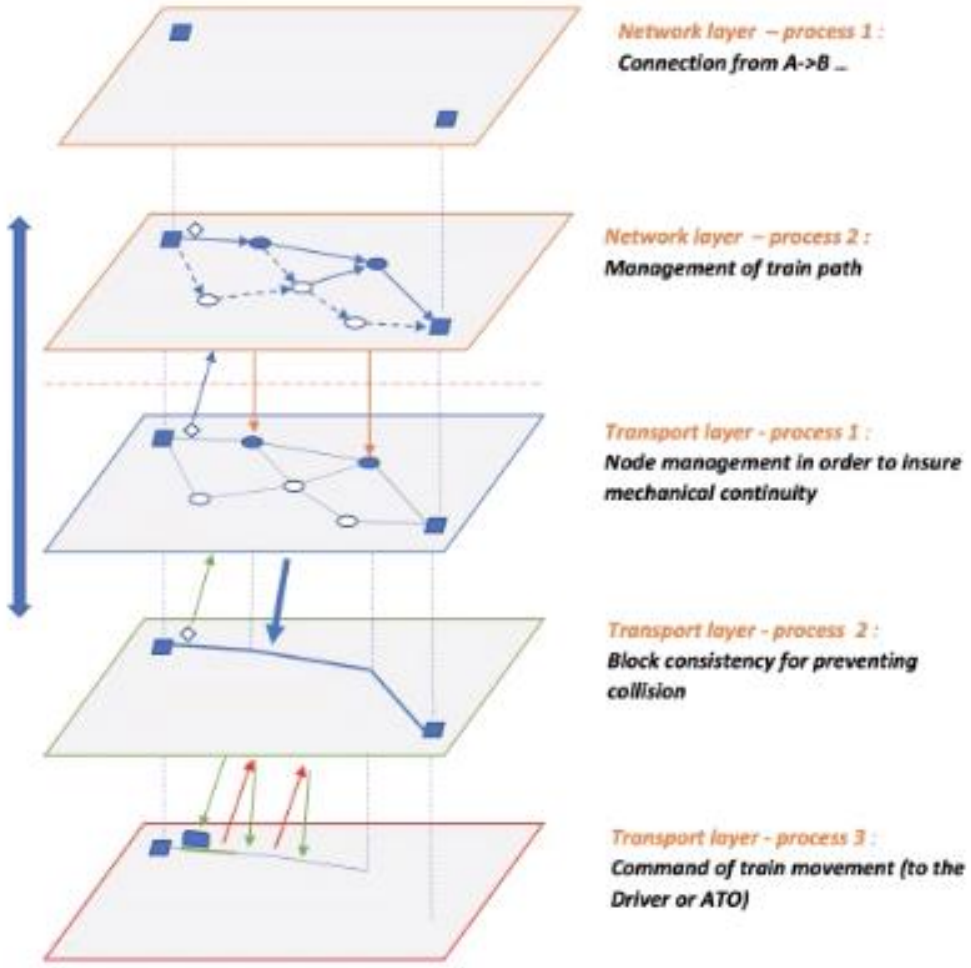
An event sourcing architecture

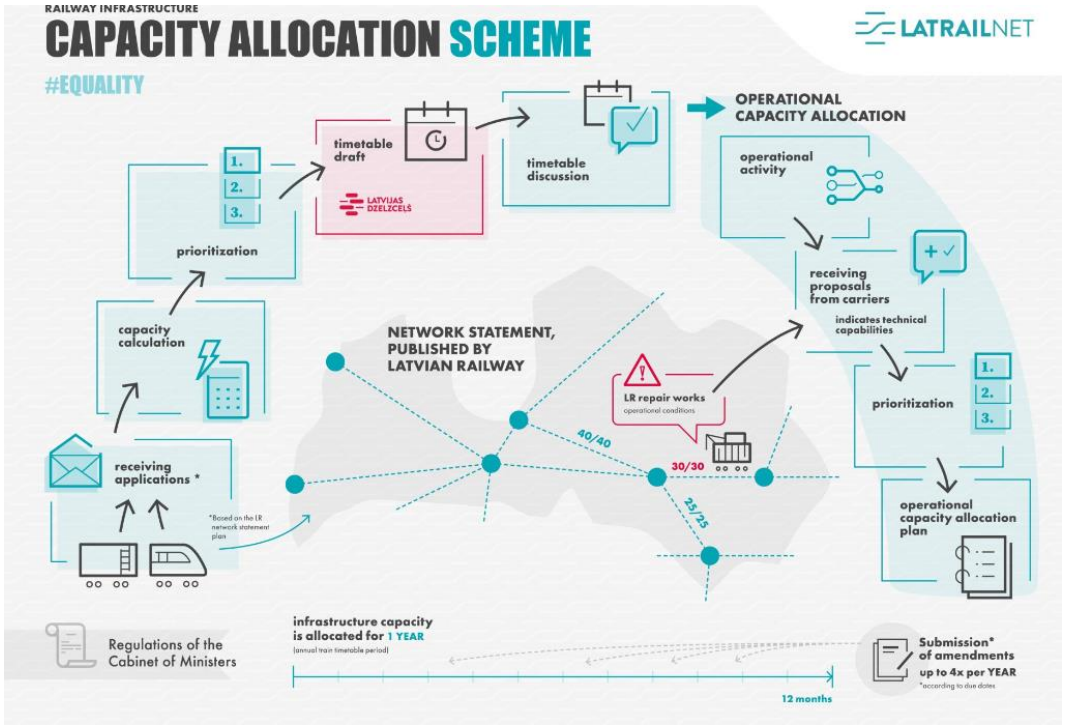


SPARQL on the client-side

Plenty of railway actors as data consumers

We need to capture and publish data updates as they happen at the source

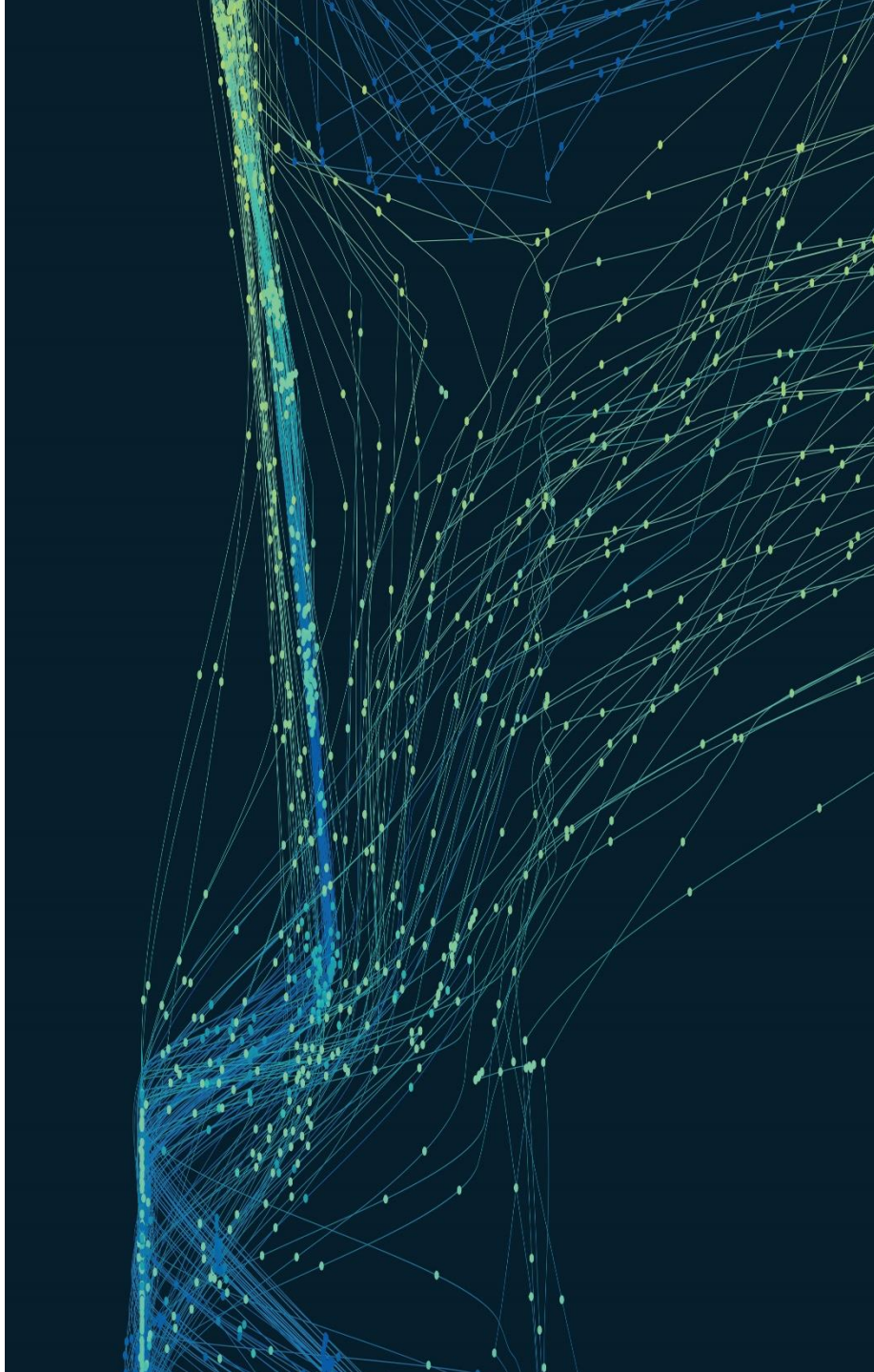




4

The LDES opportunity : Pilot Phase

There are many variations of passages of Lorem Ipsum available, but the majority have suffered alteration.



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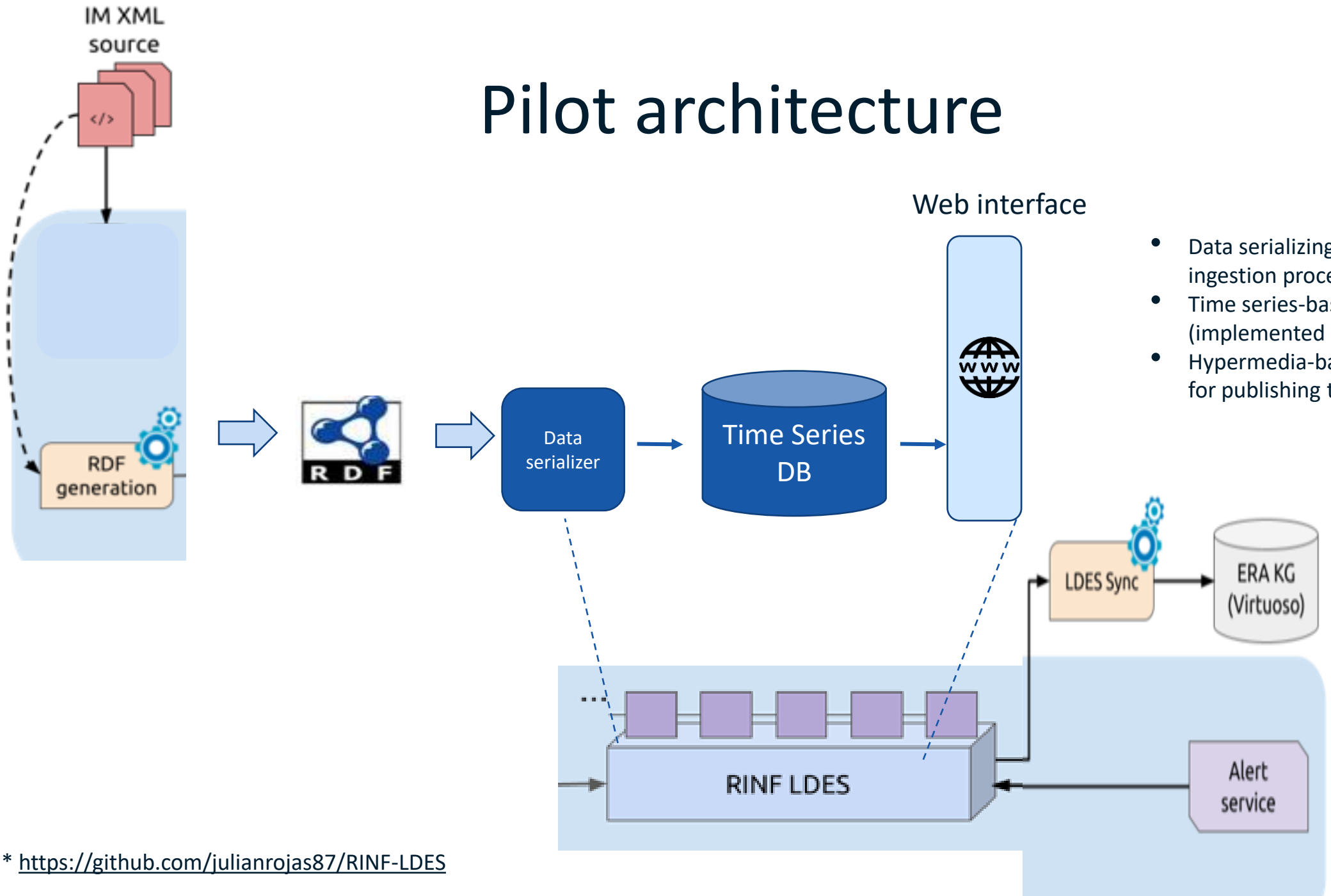
LDES opportunity for ERA

- LDES (Linked Data Event Streams) as a Time-stamped Linked Data.
- **Historic data** remains accessible for reuse
- Removes the need to handle manual data back-ups
- An alert system based on event tracking – requested functionality in our legal basis
- Smarter and more performant data provision
- Opens the door to more flexibility to the Infrastructure Managers. Only need to update data when linked to recent changes.
- Enriched validation process.
- Able to restore latest data provision Example: error when uploading data

Pilot architecture



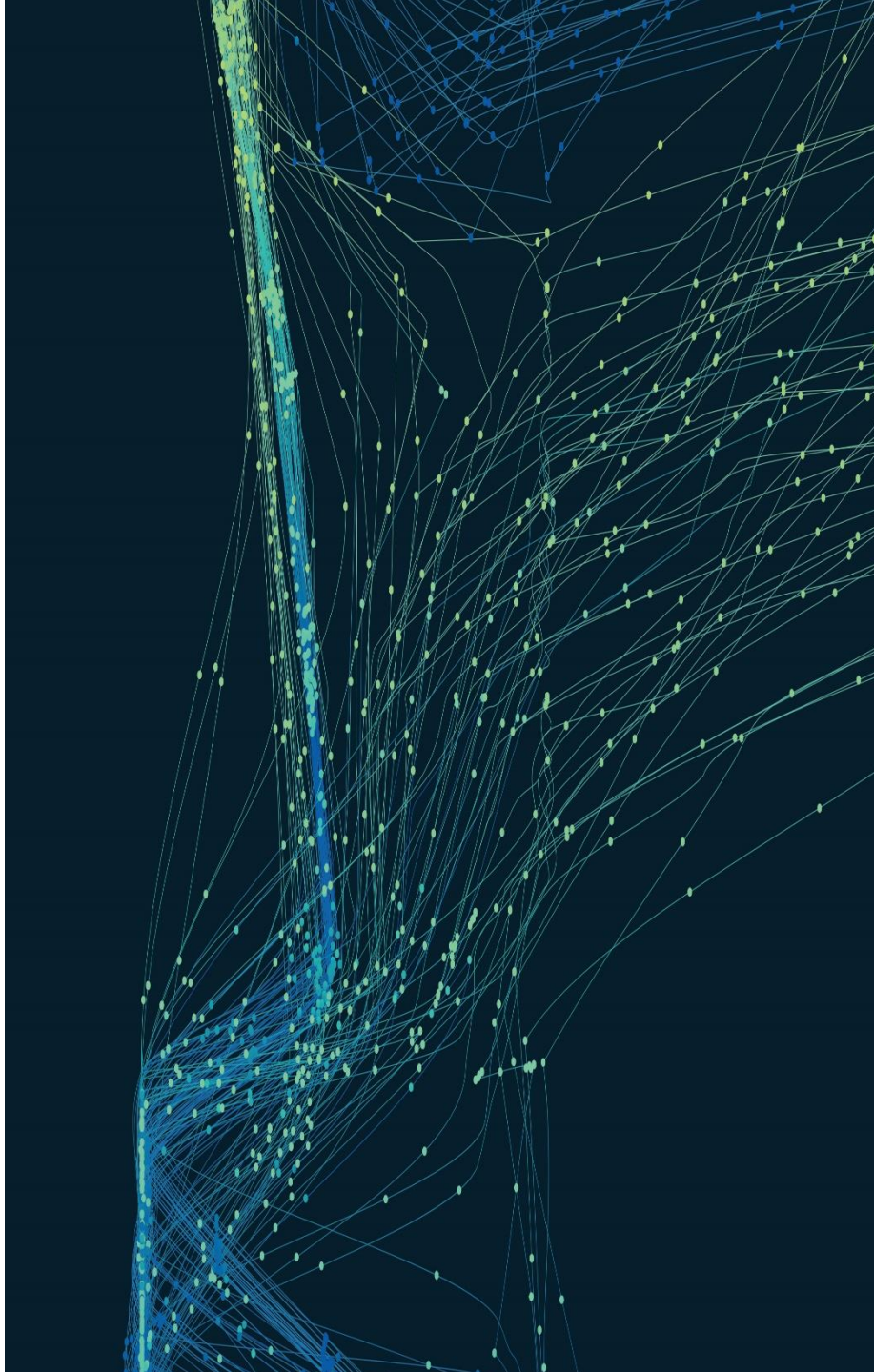
- Data serializing module to manage ingestion processes
- Time series-based persistence (implemented in a MongoDB)
- Hypermedia-based Web interface for publishing the LDES

* https://github.com/julianrojas87/RINF-LDES

5

Next Steps

LDES in production: a 12 months effort



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Goal

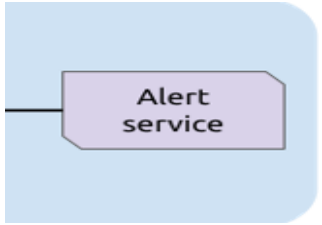
Enrich data elements with metadata dct /prov and the historic changes
Enable differential and more performant data provision

- at the source (data providers)
- at RML transformation level

LDES in production: a 12 months effort

Use cases:

- Complete the Infrastructure Alert service for allowing users to subscribe and receive proactive notifications.



  - Web interface to visualize the latest infrastructure changes.
  - Time-travelling capabilities over LDES data.

- Restore functionality – “ time machine “ or data time travelling functionality

- Route Compatibility Check export with timestamp and alert of changes in the outcome when infrastructure data or business rules for RCC changes

Outcomes

- LDES stands as a complementary alternative for publishing and capturing the stream of data source changes.
- Use LDES as input for quality check: Intermediary quality assessments processes can be applied on the LDES before final publishing and allowing early detection of data quality issues.

LDES @ Event Sourced Base Registry

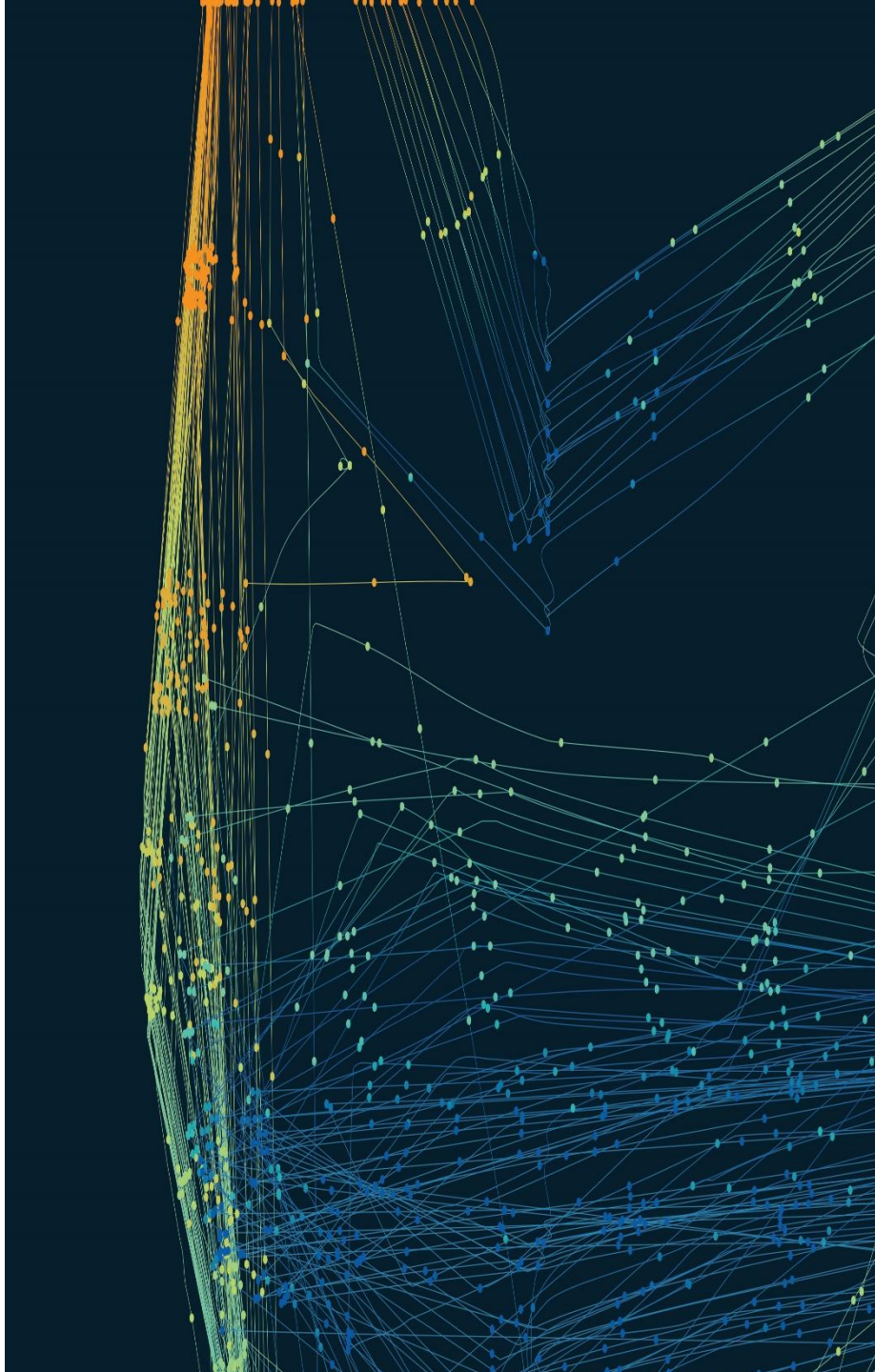
Marc van Andel | Kadaster.nl

1

LDES @ Base Registry

Presented in previous webinar:

LDES endpoint @ Base Registry of Topographical Objects



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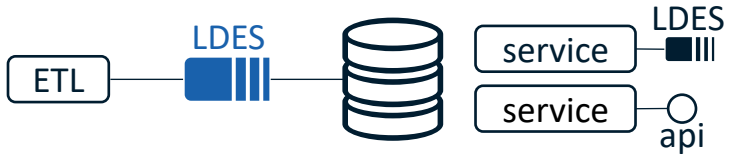
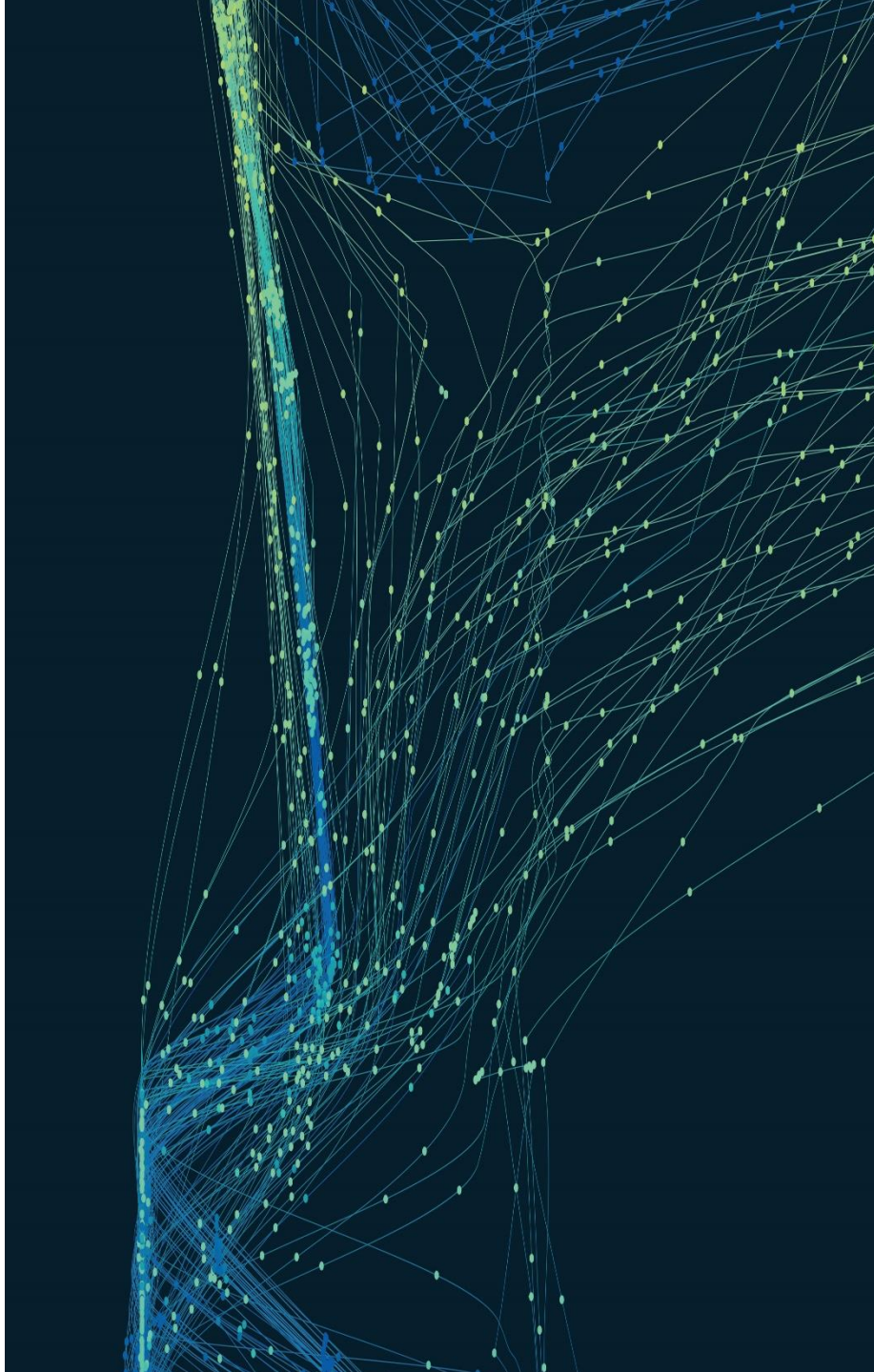
2

LDES for Updates

In previous webinar the idea was to apply LDES for updates of each base registry from sources.





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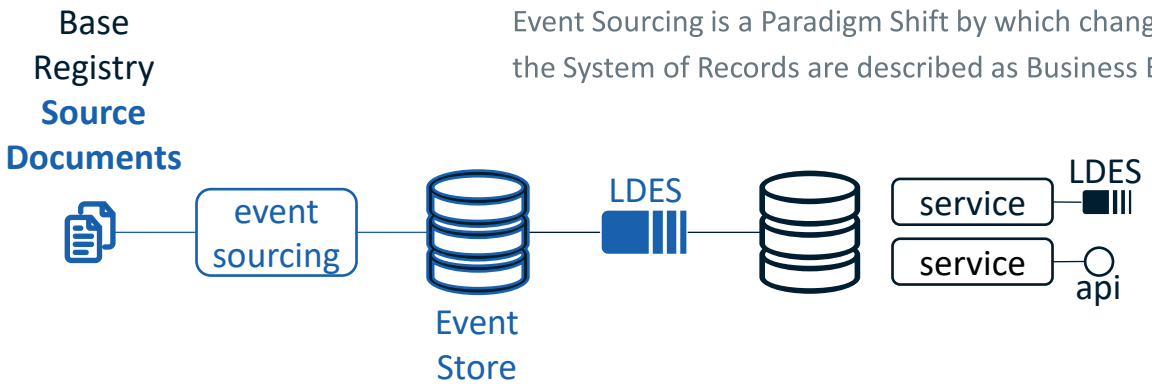
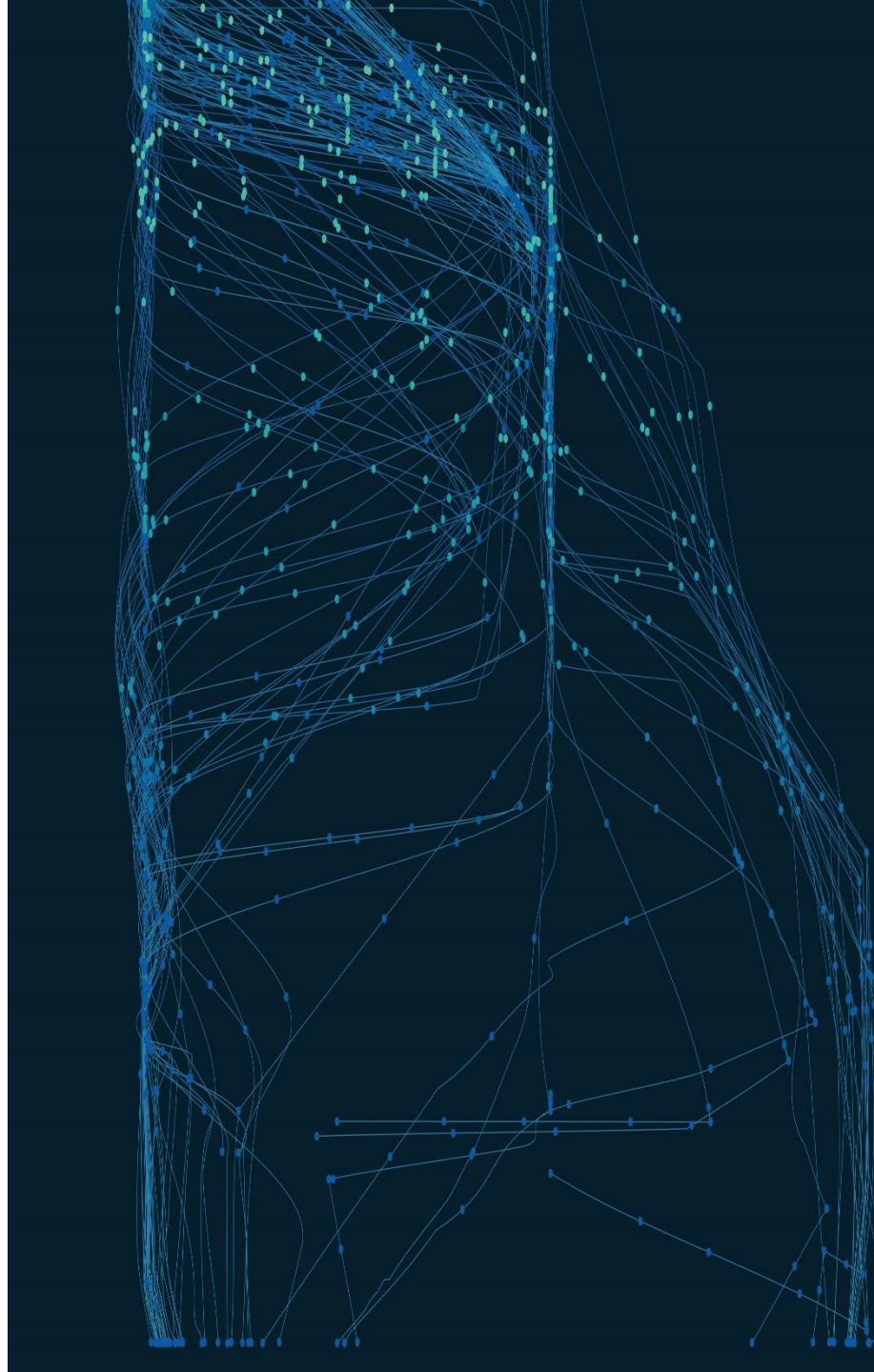
3

LDES for Updates from Event Sourced System

In this Proof of Concept, we've applied LDES to publish the Events from an Event Sourced System.

Event Sourcing is a Paradigm Shift by which changes in the System of Records are described as Business Events.





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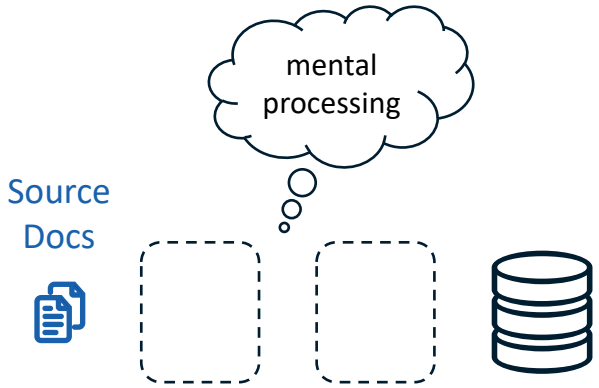
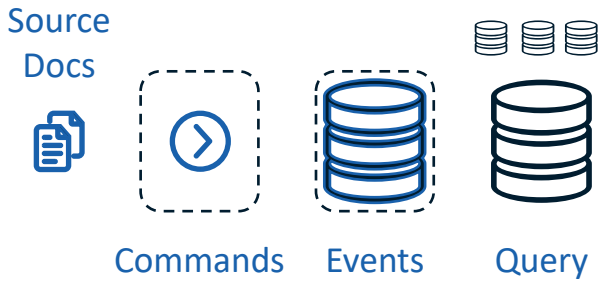


Regular

Digital form of ‘The Paper Way’

In times where memory is expensive and processing power is limited the ‘paper way of working’ has been ‘digitalized’ but the processes have not been updated to the digital era.



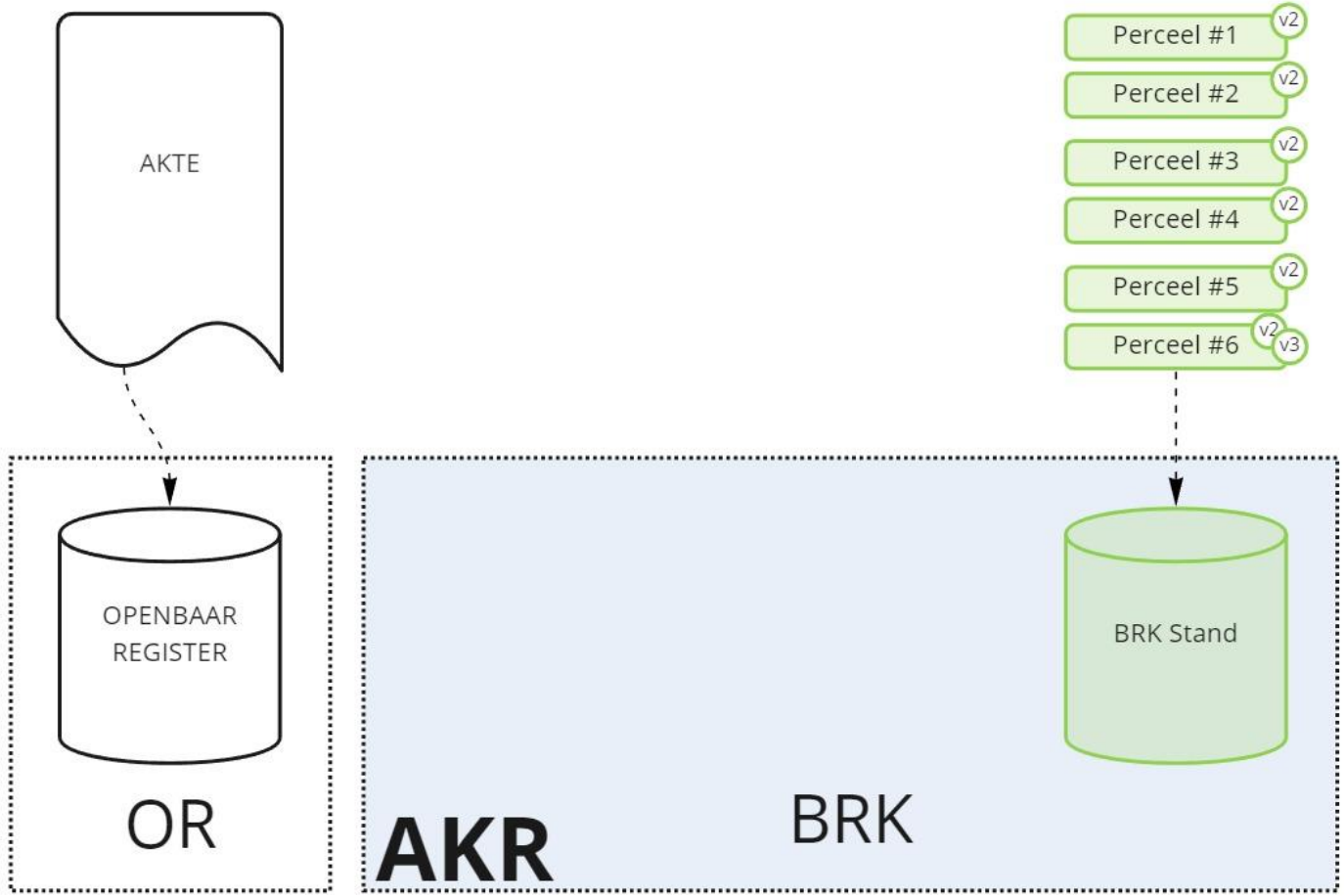
Event Sourcing

Domain Driven Design

With unlimited resources on memory, storage and processing power processes need to be redesigned in the digital era. Source documents are to be modelled into Commands, triggers to update the system. Events describe the changes of the System of Records held by the system. And multiple Query Stores (or Views) can be produced and used.

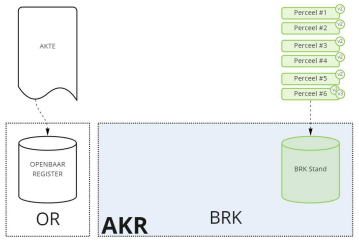
Proof of Concept | LDES for Updates from Event Sourced System

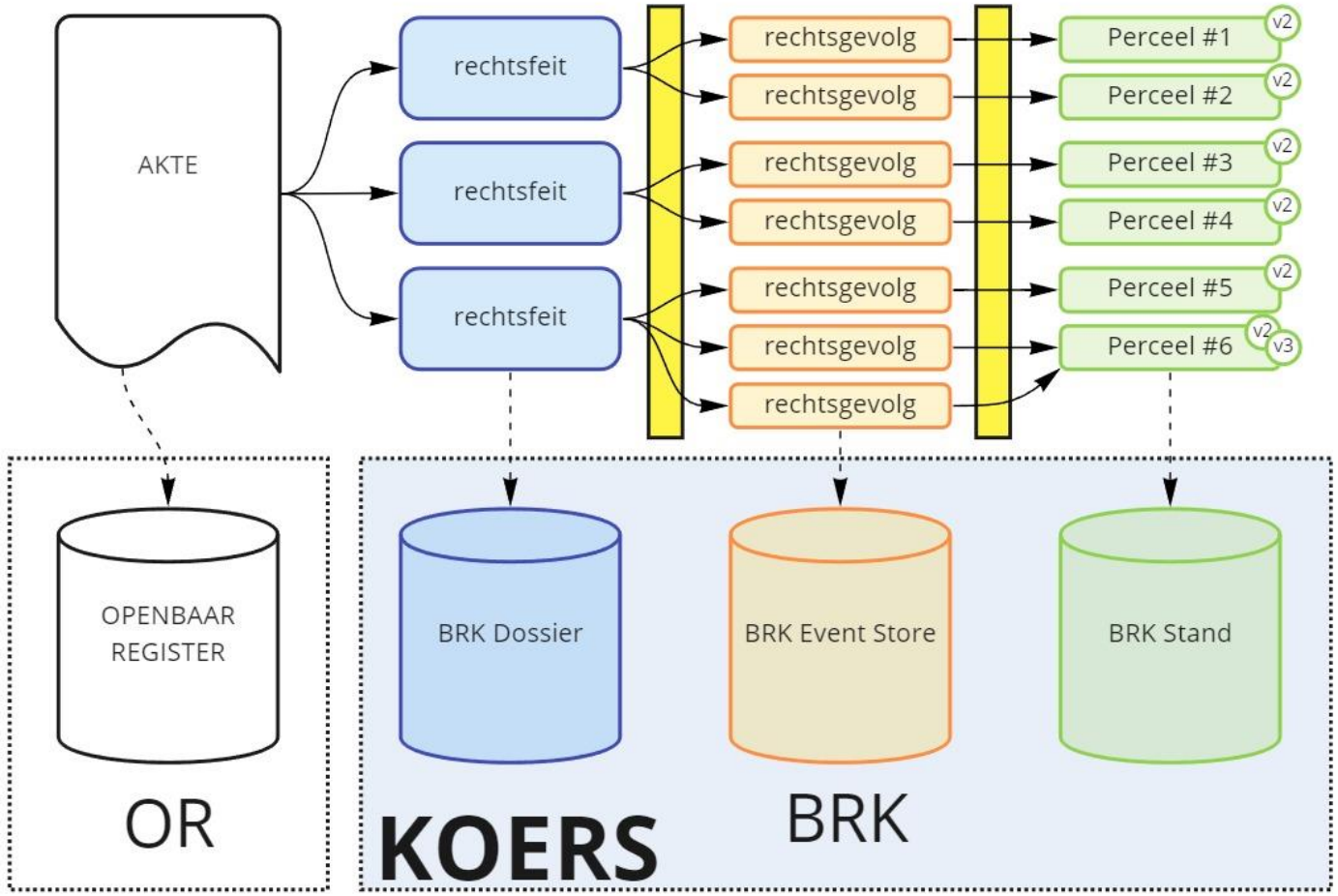
01



Proof of Concept | LDES for Updates from Event Sourced System

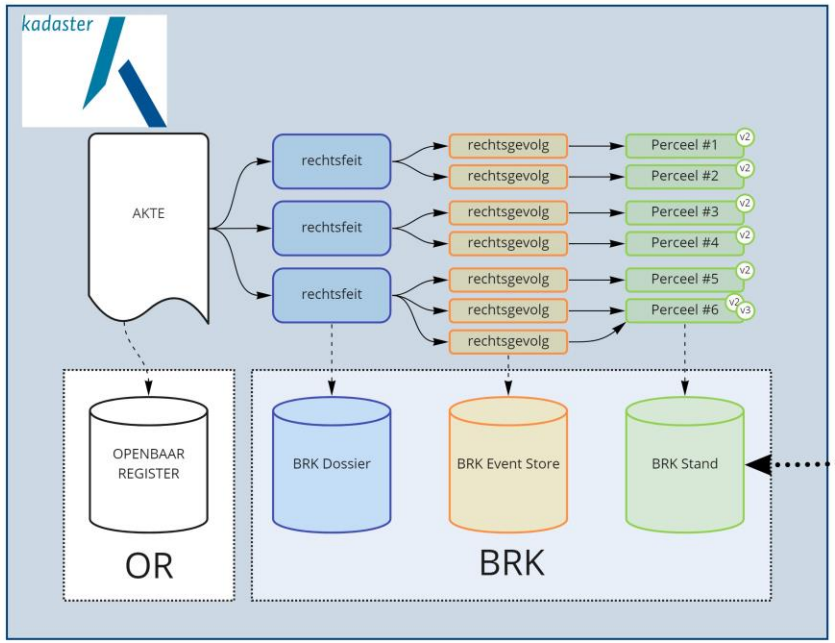
01





Proof of Concept | LDES for Updates from Event Sourced System

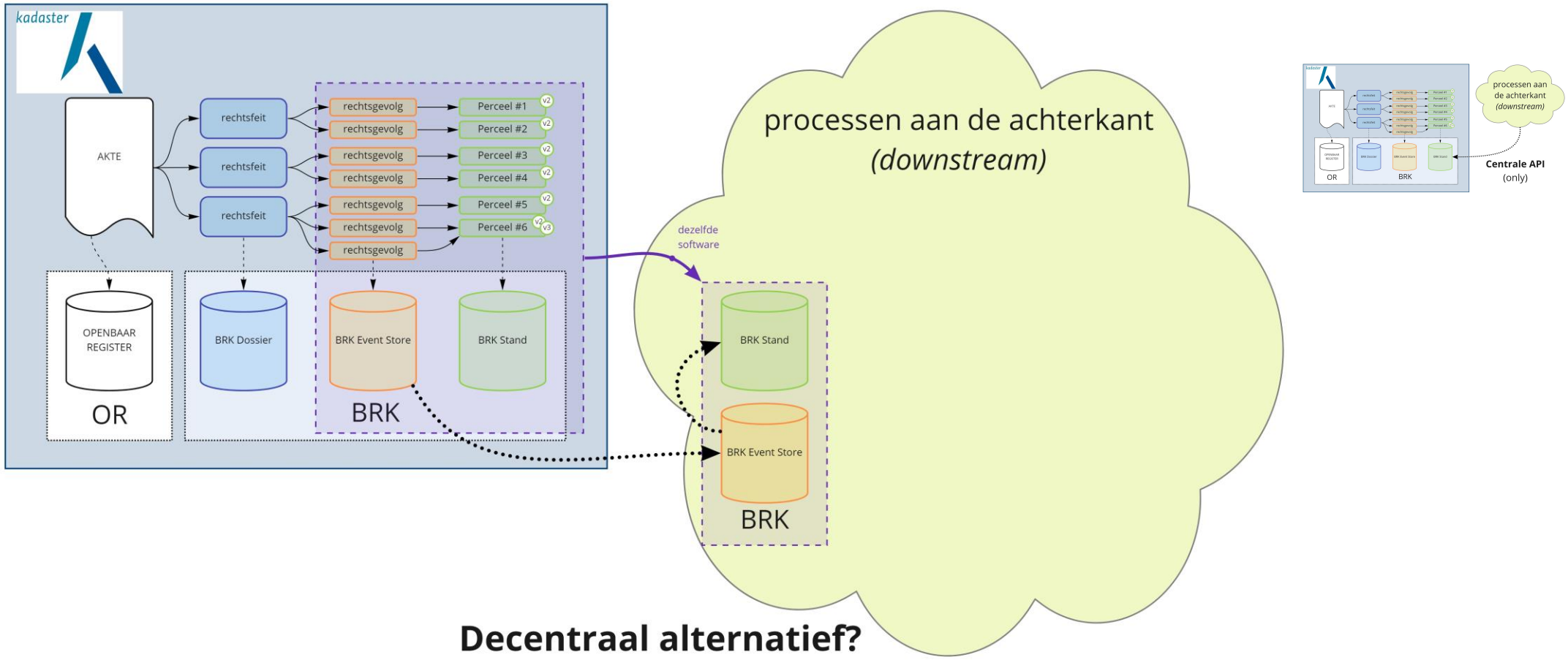
processen aan de voorkant *(upstream)*



processen aan de achterkant *(downstream)*

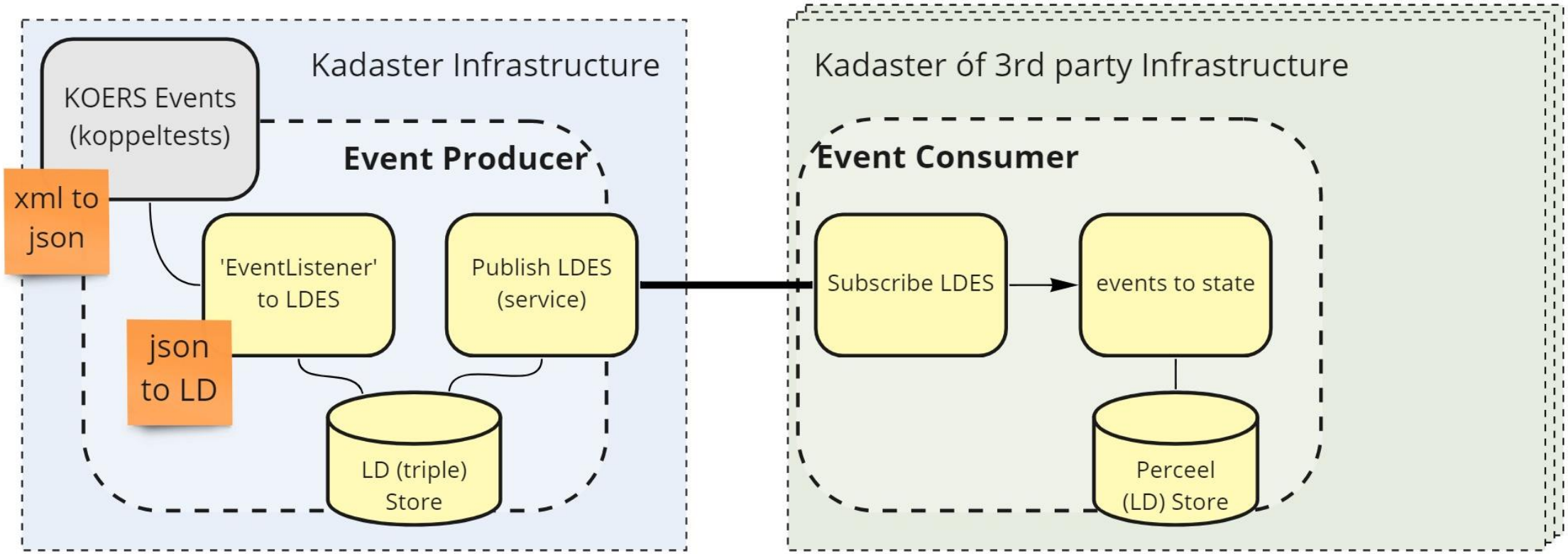
Centrale API (only)

Proof of Concept | LDES for Updates from Event Sourced System



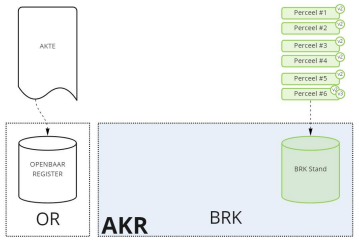
Decentraal alternatief?

Proof of Concept | LDES for Updates from Event Sourced System



Proof of Concept | LDES for Updates from Event Sourced System

01



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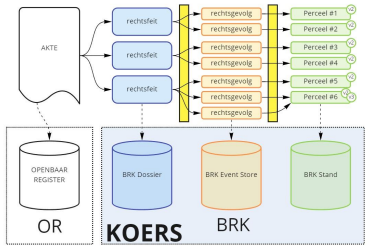

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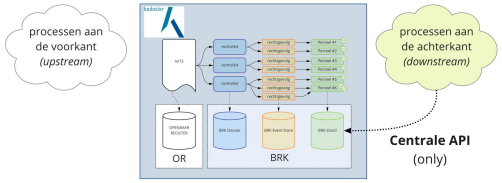

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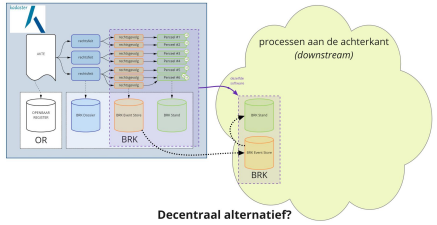

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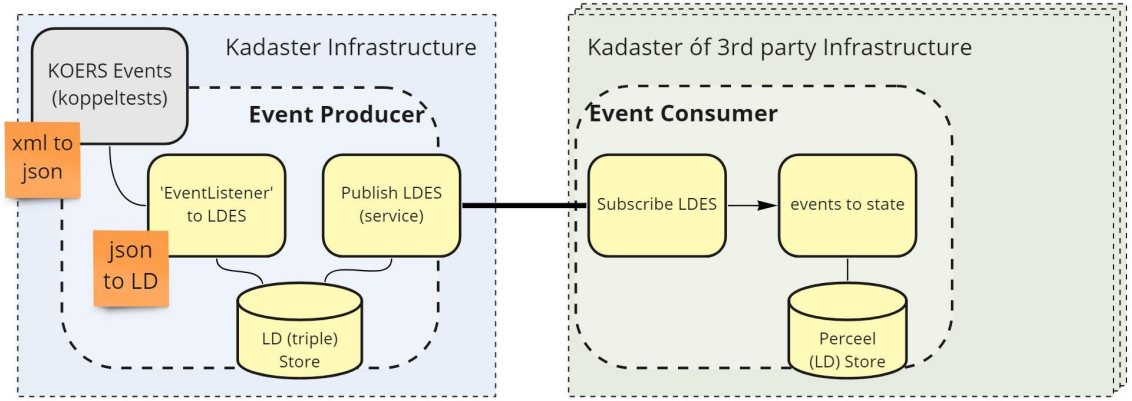

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Proof of Concept | LDES for Updates from Event Sourced System

marc@LT0247323: ~/projects/


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      "aandelen": [
        {
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          "noemer": "1",
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        }
      ]
    }
  ]
}]
working on aggregate [https://kadaster.nl/id/NL.IMKAD.KadastraalObject.119]
current aggregate: [{
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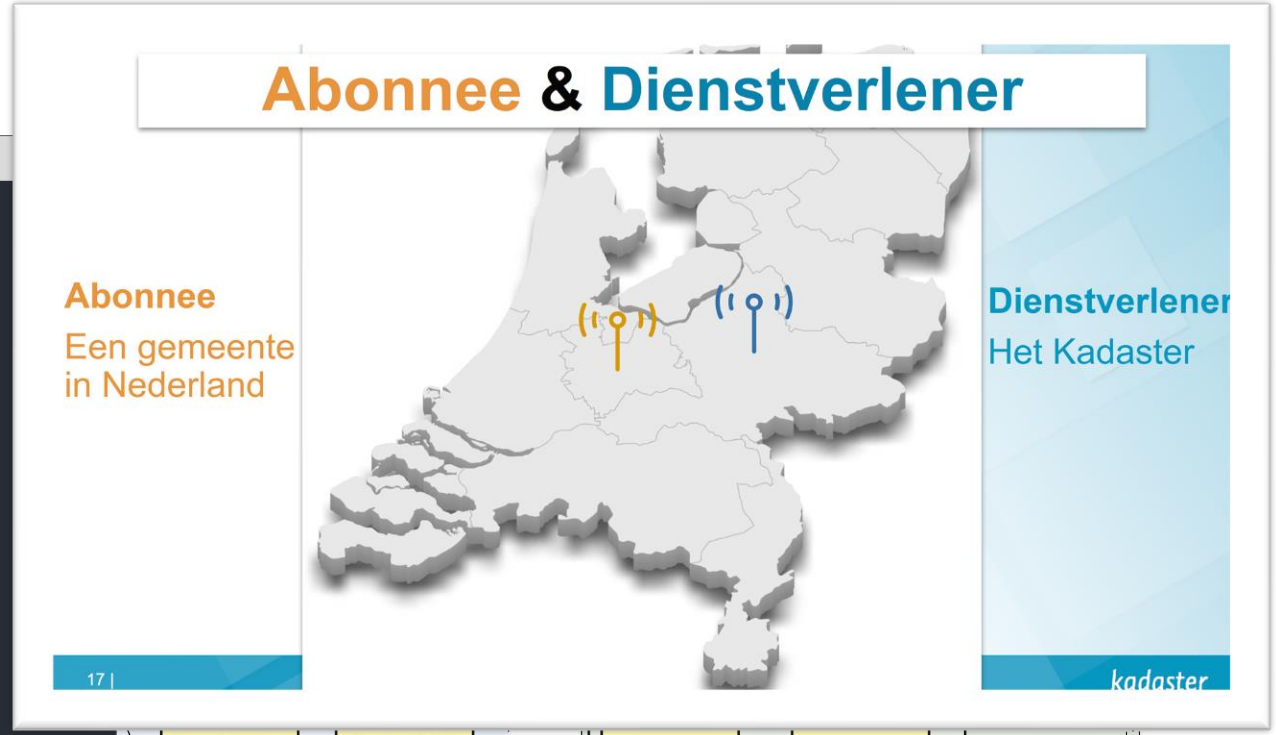
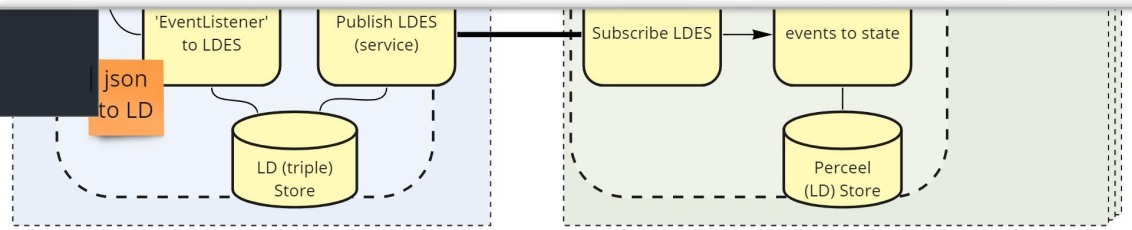
    }
```



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Proof of Concept Conclusion

01

LDES for Updates from Event Sourced System works!

We proved publishing of Base Registry Events as LDES
and subscribing to the LDES for further processing is possible

02

The LDES spec is NOT designed for Event Sourcing (yet)

The LDES spec is designed for publishing versions of Base Registry
Objects and is currently not optimized for Event Sourcing patterns

03

Rich filtering on LDES is missing

The LDES spec is designed for timestamp navigation but for rich
subscription models other filtering methods need to be possible as well

04

What's next?

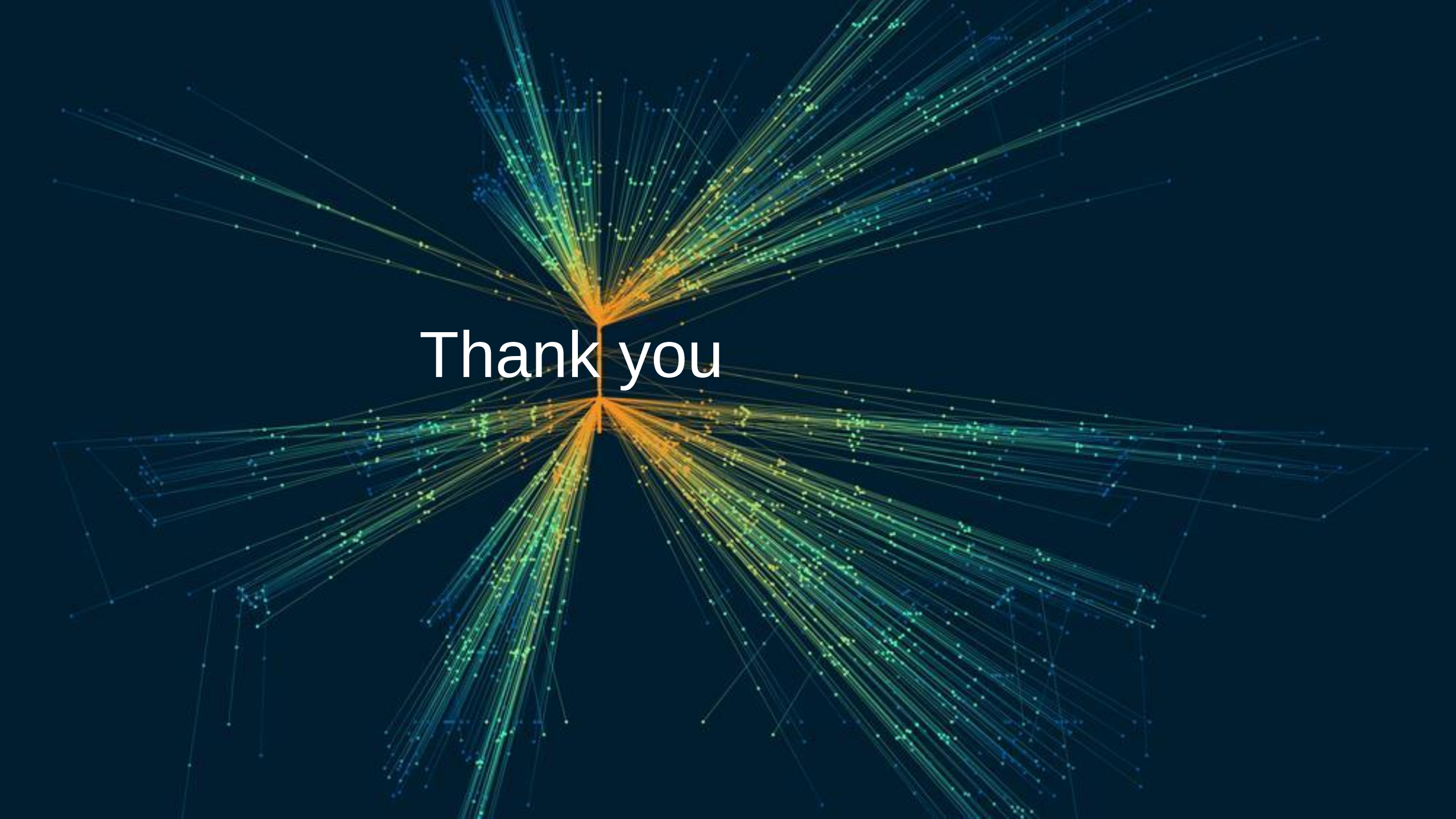
So … it is possible. Are we bringing this into production?
More work is needed …

Wrap-up and next steps

Some exciting pilots coming up!

- Second webinar in ABR: **'Webinar dedicated to the review of Data Catalogue Application Profile for Base registries (BregDCAT-AP)'**
- Further implementation of the ERA pilot
- Pilots being developed in the LDES community:
  - Pilot on Marine data in Europe
  - Internet of Water (IoW) in Flanders
- Complete the EU Survey (see link in the chat)

Interested in developing a pilot in your Member State or organisation? See how SEMIC can help you with it via this page or by contacting arne.van.der.stuyft@pwc.com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