

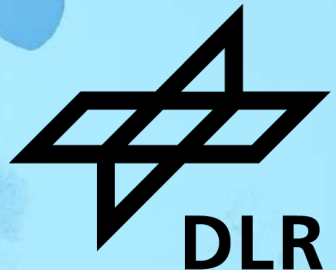
# GEODATA INFRASTRUCTURE FOR THE MANAGEMENT OF RESEARCH DATA IN RAILWAY DOMAIN

NFDI4Ing Conference 2023, 27-28 September 2023

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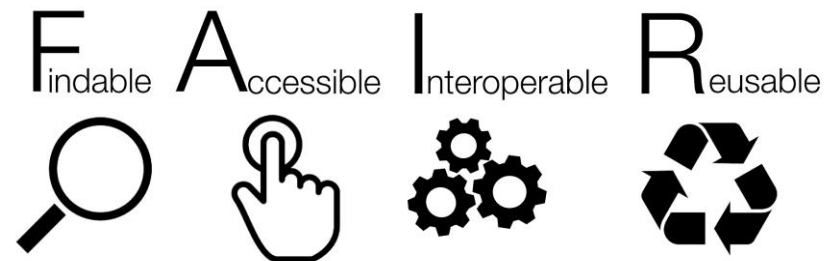
Julia Heinbockel <sup>id</sup>, Angela Uschok <sup>id</sup>, Lucas Andreas Schubert <sup>id</sup>

Institute of Transportation Systems, German Aerospace Center (DLR), Germany



# Which problem do we address?

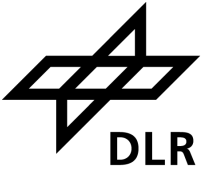
- Requirement for FAIR management of datasets within our department
- One-stop storage solution for all research datasets in the department
- Easy retrieval of datasets and their metadata from various applications



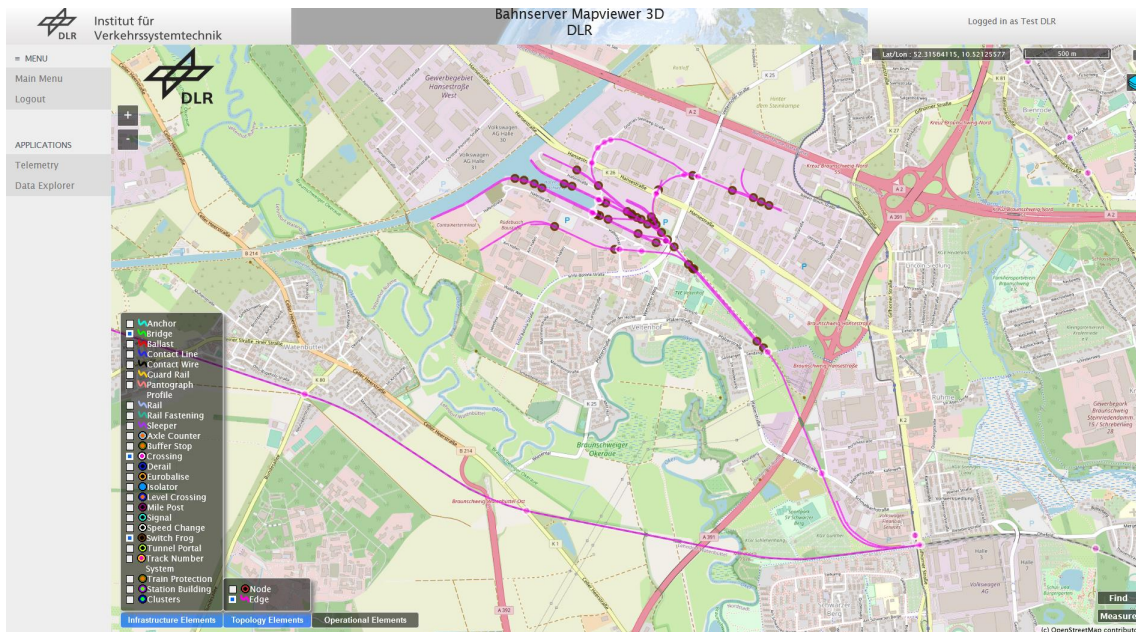
Source: [https://en.wikipedia.org/wiki/FAIR\\_data#/media/File:FAIR\\_data\\_principles.jpg](https://en.wikipedia.org/wiki/FAIR_data#/media/File:FAIR_data_principles.jpg)



# Which datasets do we deal with?



- Railway topology and infrastructure
- Railway condition data



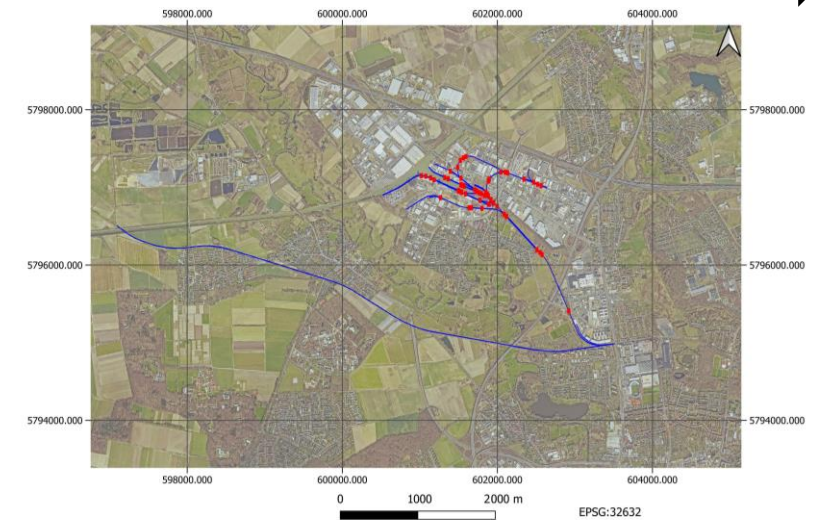
Braunschweig railway network. Source: DLR-TS; Base map: OpenStreetMap (OSM); CC BY-NC-ND 3.0



Problems identified in Braunschweig railway network in 2019. Source: DLR-TS; Base map: OpenStreetMap (OSM); CC BY-NC-ND 3.0

# Which datasets do we deal with?

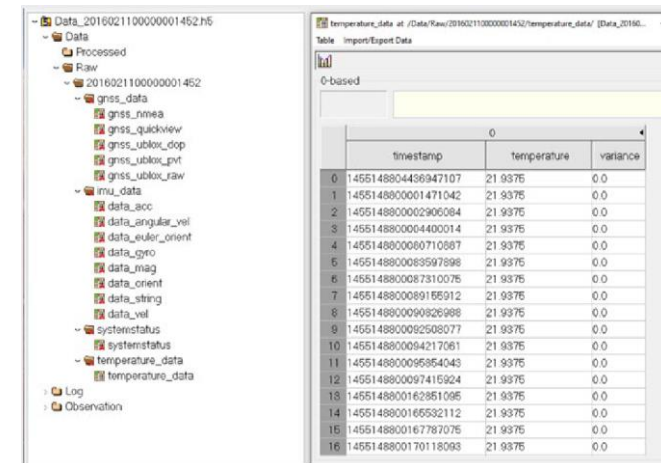
- Multi-sensor measurement data from multiple units in the field for more than five years
- Sensors: GNSS receivers, IMU, accelerometers, weather sensors, cameras, barometers, laser scanner, odometer, etc.
- Current size of data: ~60 TB



Braunschweig railway network. Blue lines represent the tracks and red points represent the infrastructure elements. Source: DLR-TS, CC BY-NC-ND 3.0; Base map: Aerial image 2020, Transparency 20%; Stadtplan (c) Stadt Braunschweig.



RailDrive, one of the measurement vehicles. Source: DLR-TS; CC BY 3.0



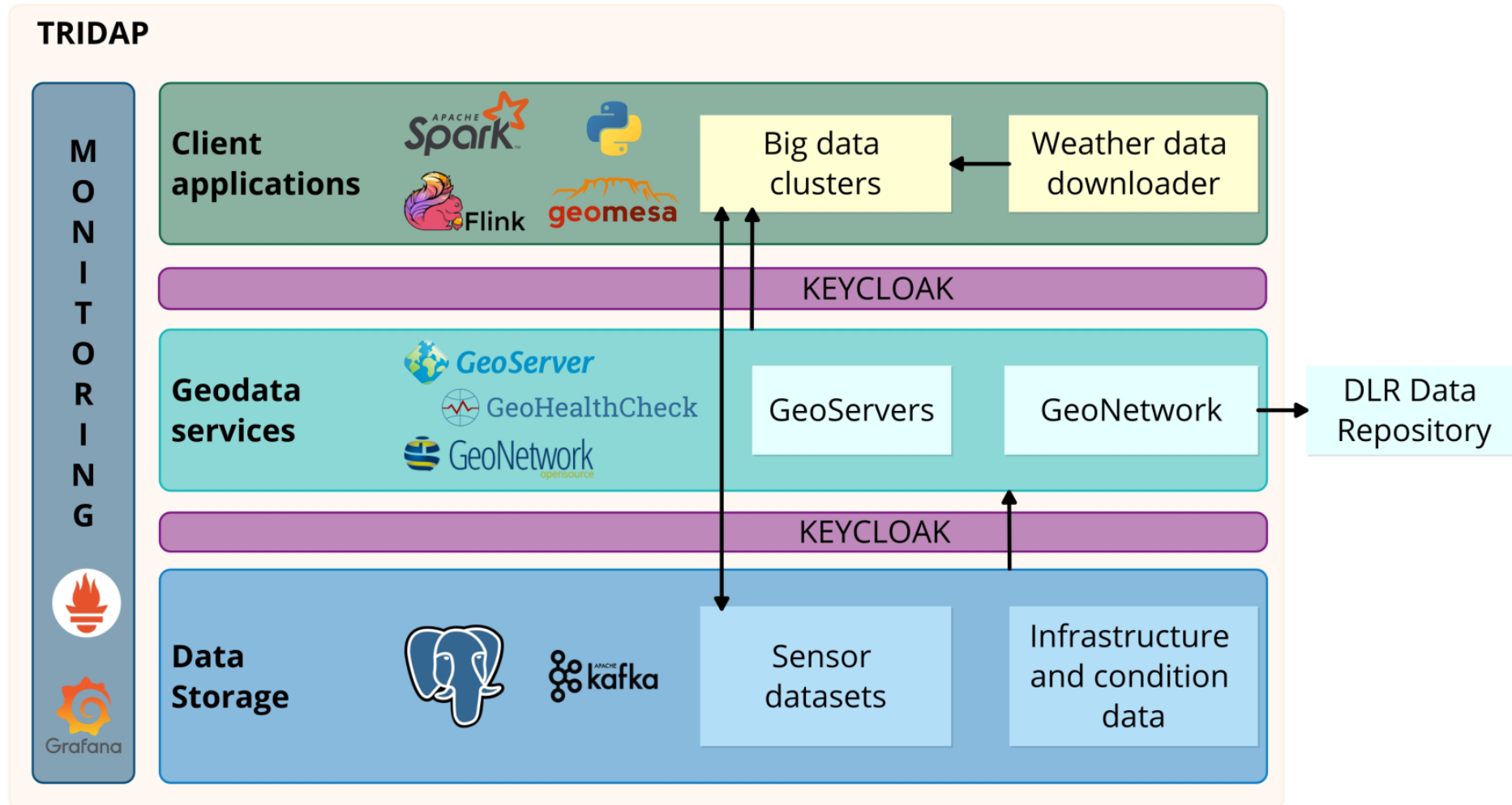
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1 1455148800001471042	21.9375	0.0
2 145514880002906084	21.9375	0.0
3 145514880004400014	21.9375	0.0
4 145514880060710587	21.9375	0.0
5 1455148800083597898	21.9375	0.0
6 145514880087310075	21.9375	0.0
7 1455148800089155912	21.9375	0.0
8 1455148800090826988	21.9375	0.0
9 1455148800082508077	21.9375	0.0
10 1455148800064217061	21.9375	0.0
11 1455148800095954043	21.9375	0.0
12 1455148800097415924	21.9375	0.0
13 1455148800162951095	21.9375	0.0
14 1455148800165532112	21.9375	0.0
15 1455148800167787075	21.9375	0.0
16 1455148800170118093	21.9375	0.0

A sample measurement dataset. CC BY-NC-ND 3.0 Source: Shankar, Sangeetha and Heusel, Judith and Böttcher, Oliver and Patil, Akhil Jayant and Baasch, Benjamin (2022) Management von großen Sensordatenmengen für die Digitalisierung und Automatisierung im Bahnbereich. ETR - Eisenbahntechnische Rundschau (12), pp. 45-49. DVV Media Group. ISSN 0013-2845. URL: <https://elib.dlr.de/188041/>

- Development of “Transportation Infrastructure Data Platform” (TRIDAP) to ..
  - .. manage datasets generated in the research department in a FAIR-compliant way
  - .. analyze datasets on railway assets and their condition as well as multi-sensor data
  - .. share raw and processed data in standardized data formats through the use of standardized interfaces
  
- Use open-source software to setup the platform
  - PostgreSQL database, Keycloak, Apache Kafka, Apache Flink, Apache Spark, GeoServer, GeoNetwork, GeoHealthCheck, GeoMesa, Prometheus and Grafana
  
- Reuse existing infrastructure offered by the institute
  - NetApp storage, Grafana

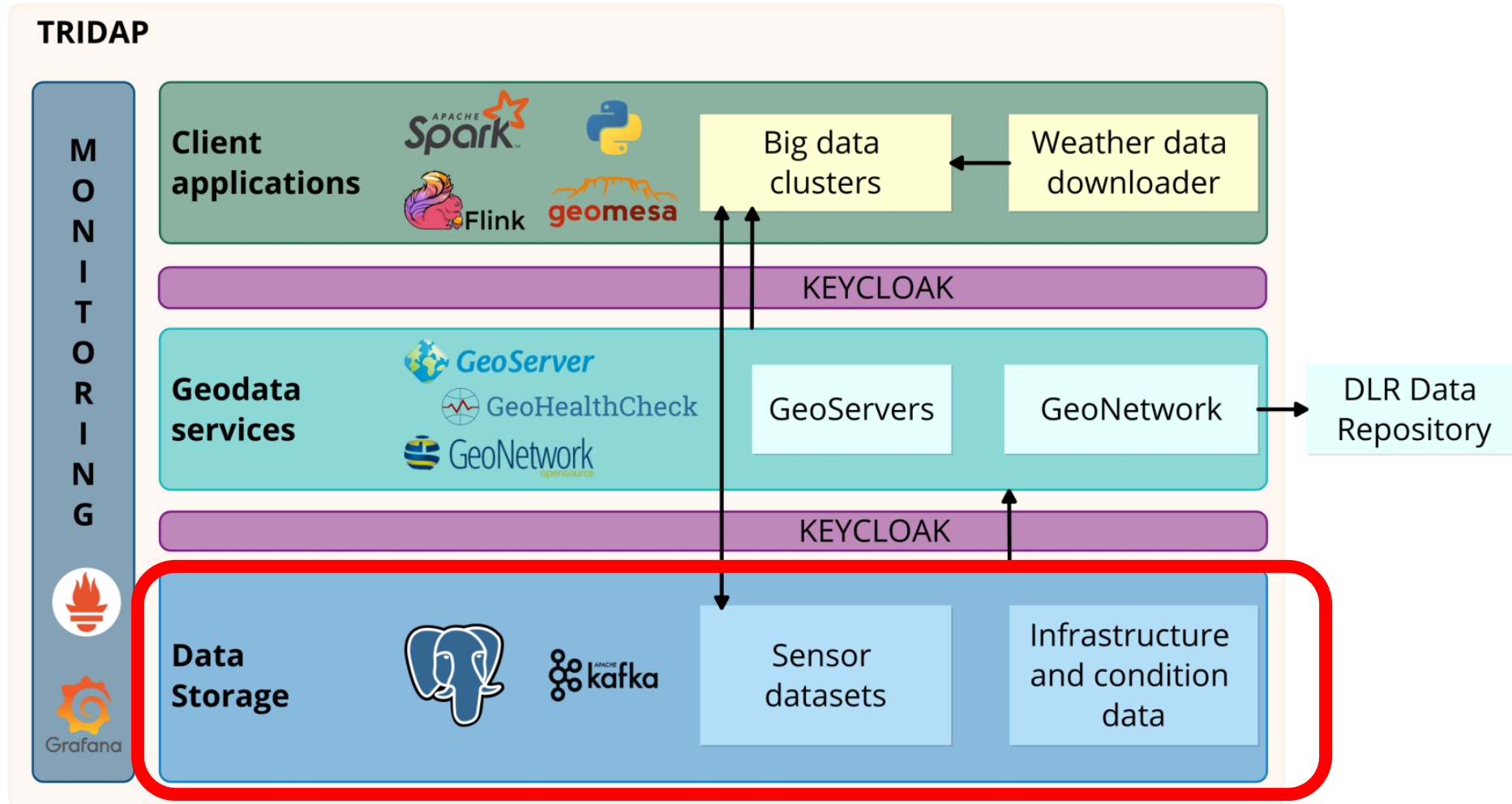


# Architecture



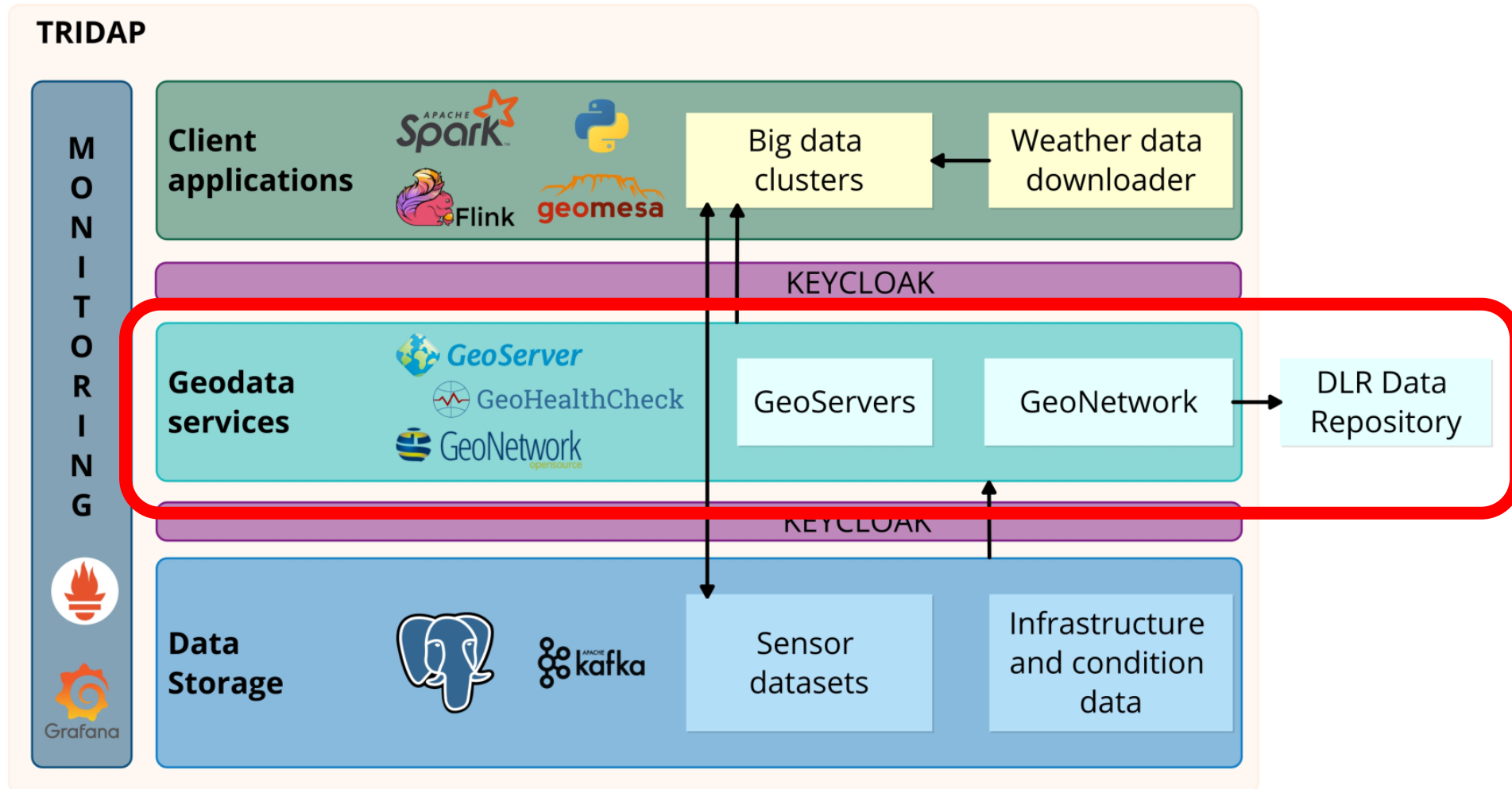
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# Architecture



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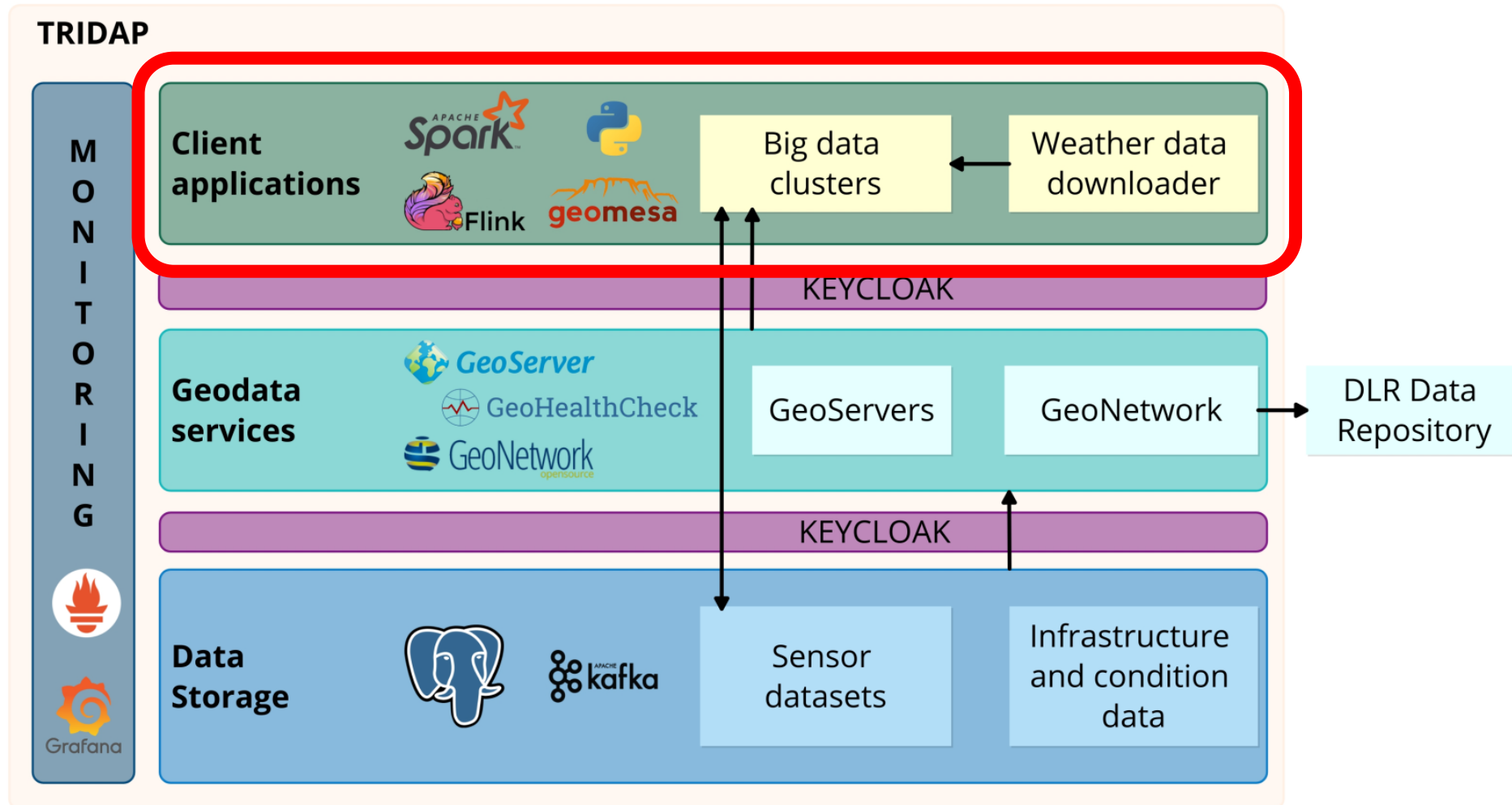
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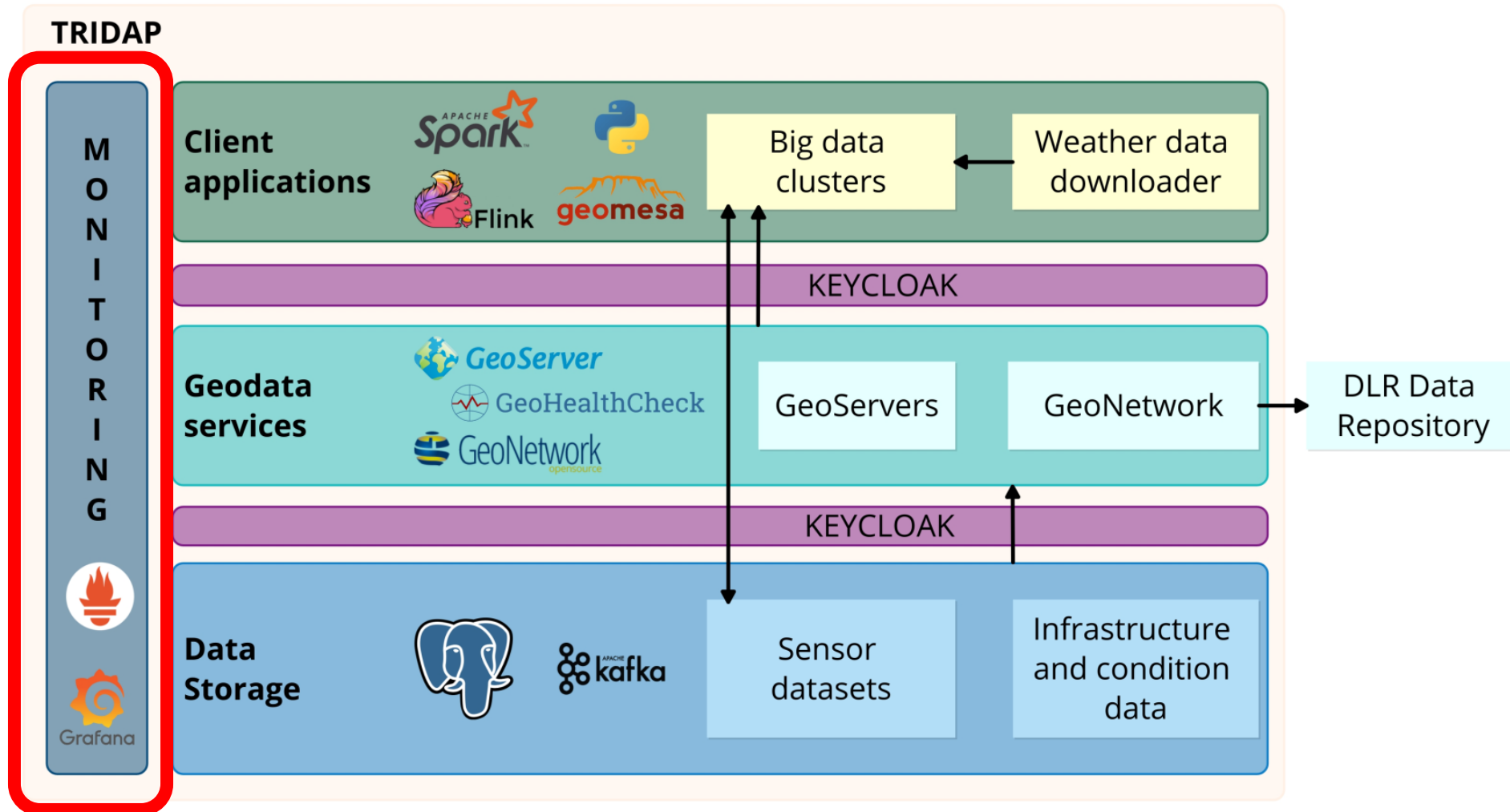


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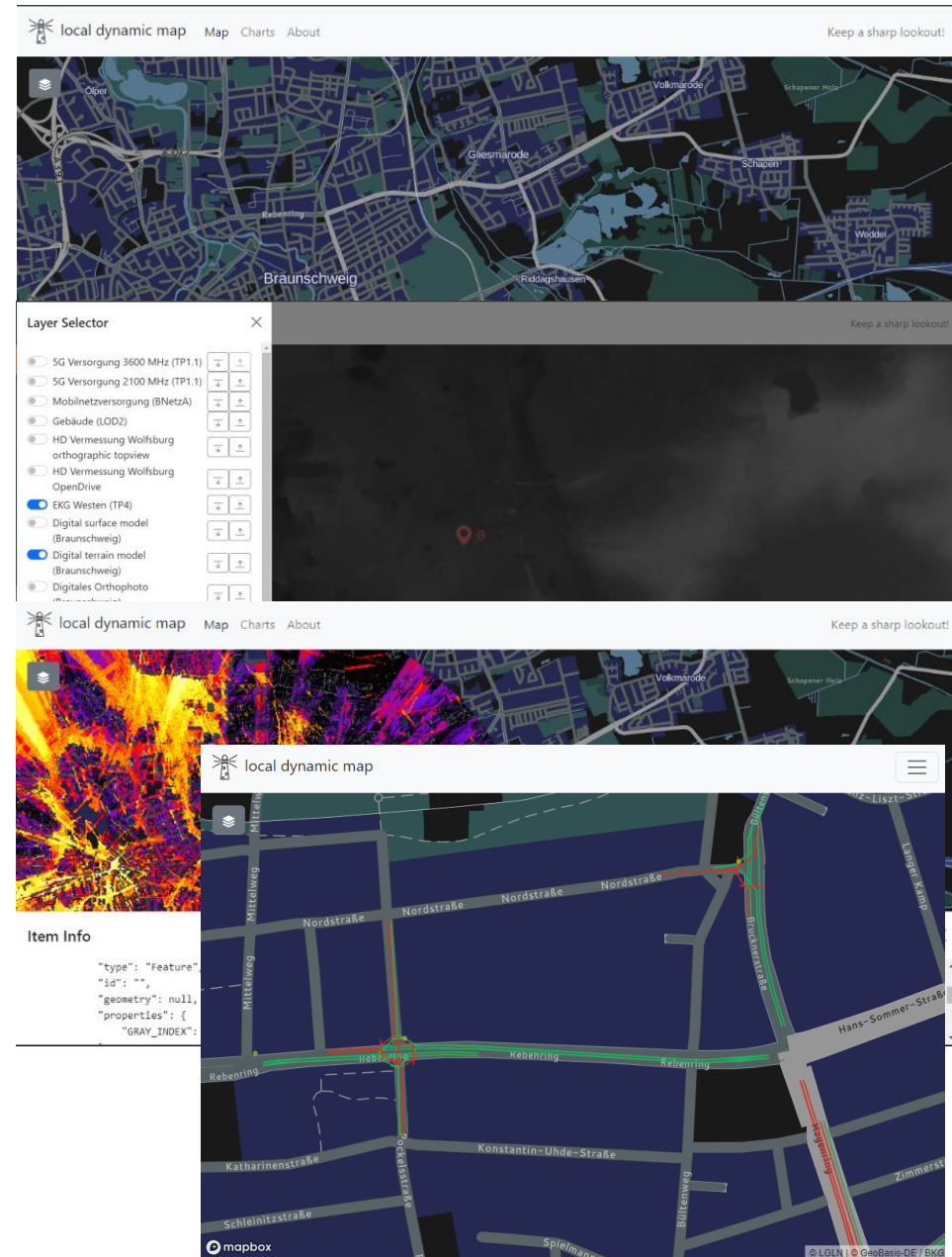
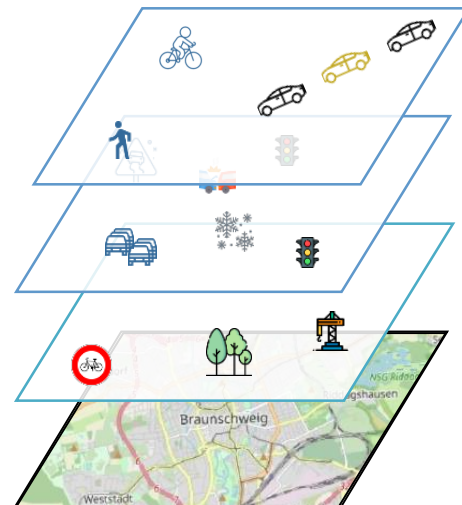


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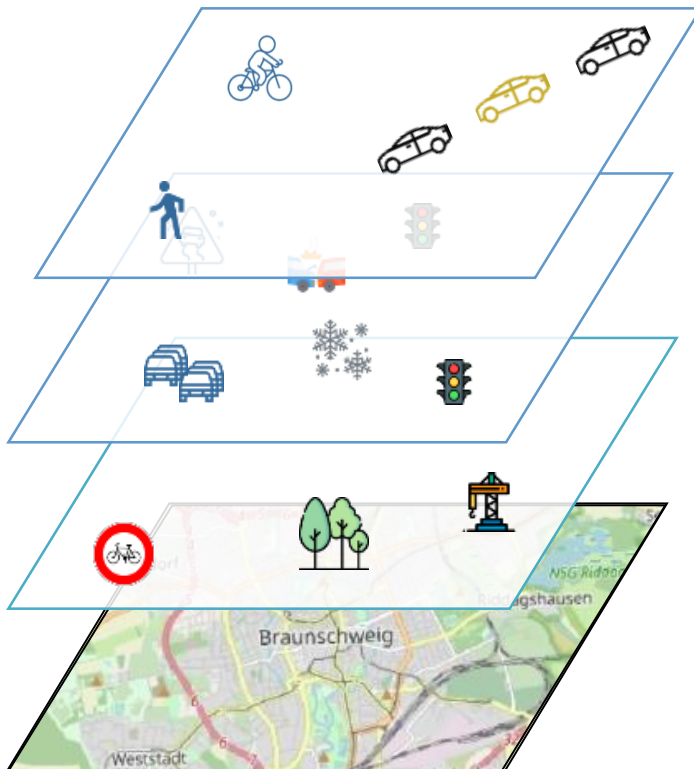
# Local Dynamic Map (LDM)

- Dynamic Map (LDM) as a database and data hub for georeferenced data with static and dynamic layers
- Merging the data sets using a multilayer approach
- Use of standardized interfaces (e.g. Fiware, OGC)
- Provision as API and as WebApp/Frontend

Dynamische Daten  
Quasidynamische Daten  
Quasistatische Daten  
Statische Daten



# Local Dynamic Map (LDM)

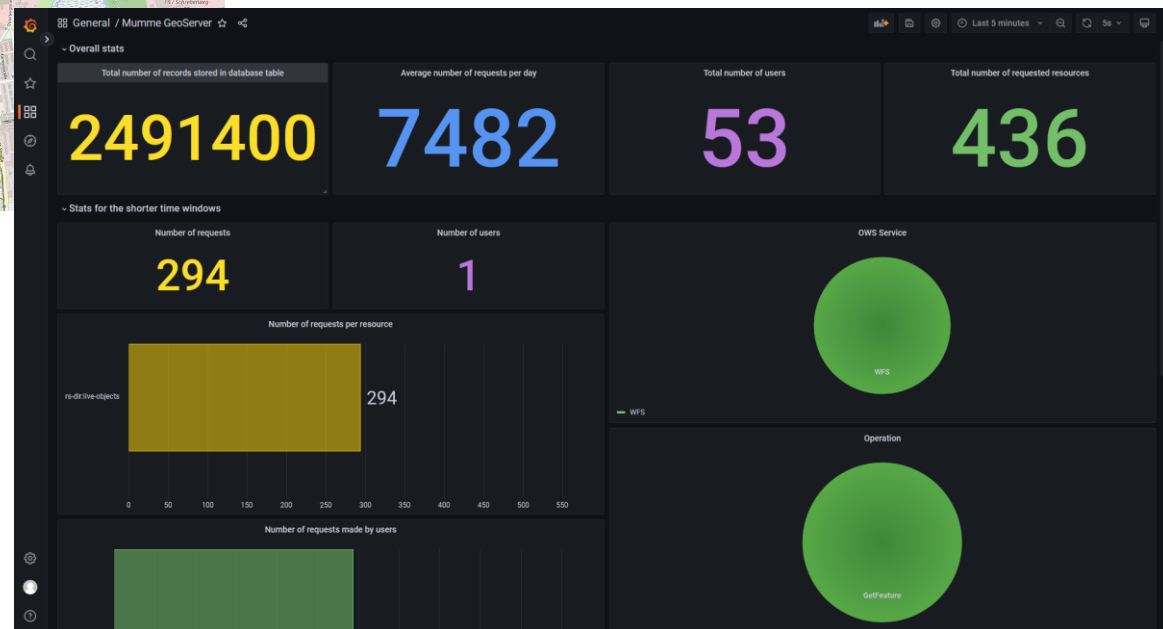
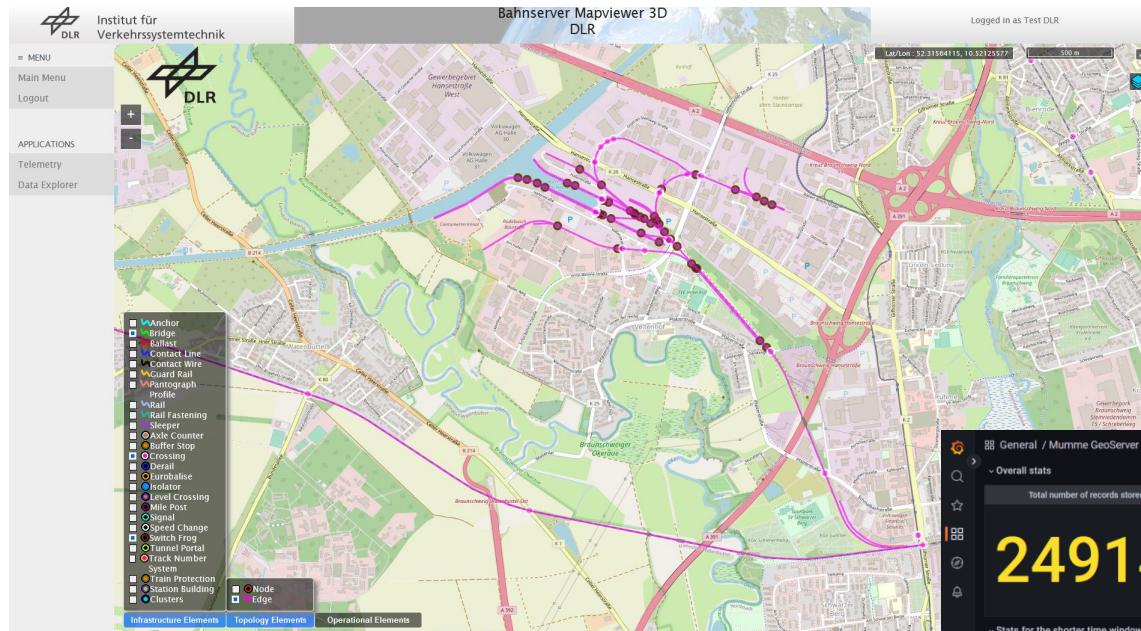
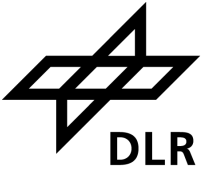


Layer	Example
Dynamic Data	Positions of vehicles, pedestrians, cyclists
Quasi-dynamic Data	Weather data, signal phase, road blocking, traffic congestion
Quasi-static Data	Buildings, vegetation, traffic signs, road construction
Static Data	Elevation and terrain profiles, aerial photos

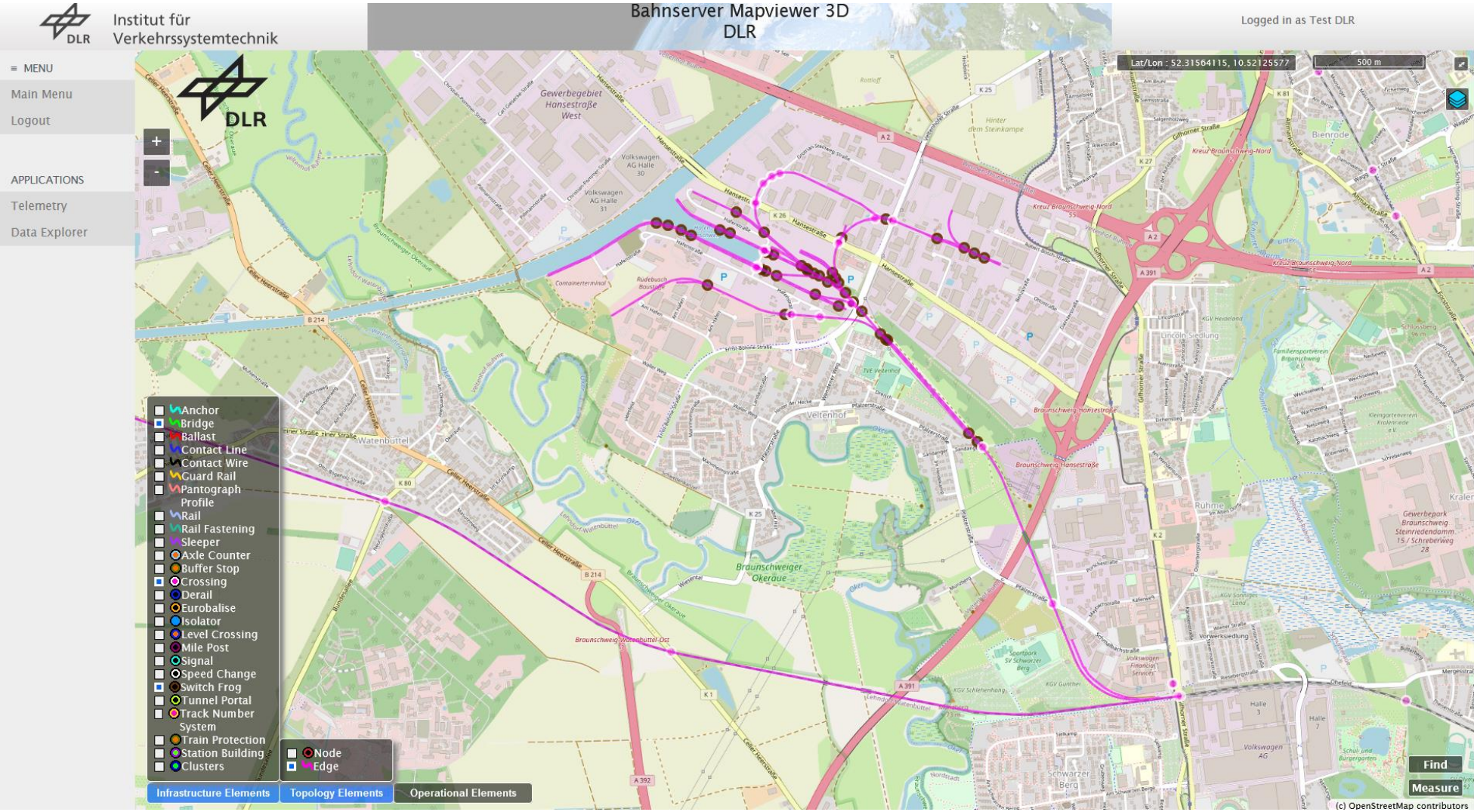
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# Demo



# Sample dataset – Railway Infrastructure of Braunschweig Harbor





# Sample dataset – Data storage in PostgreSQL database

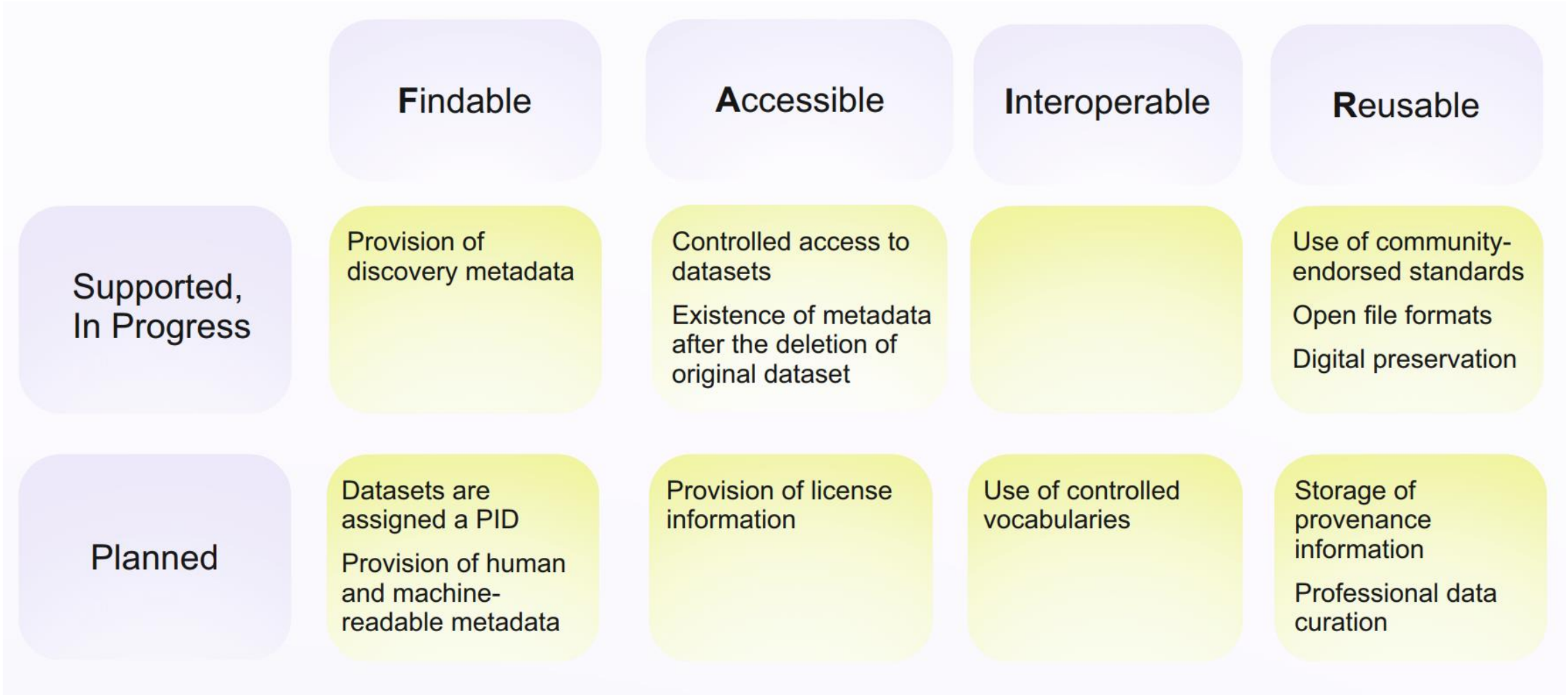
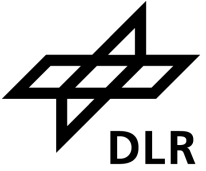


- Database to store detailed information on railway networks
- Supports metadata storage
  - creator of the dataset
  - data collection procedure
  - organisations involved in operating and maintaining the network,
  - date of creation,
  - ...
- Change tracking has been integrated

Database schema developed based on railML Format: <https://www.railml.org/en/>

# Towards FAIRness

Based on [FAIR-Aware Questionnaire](#)



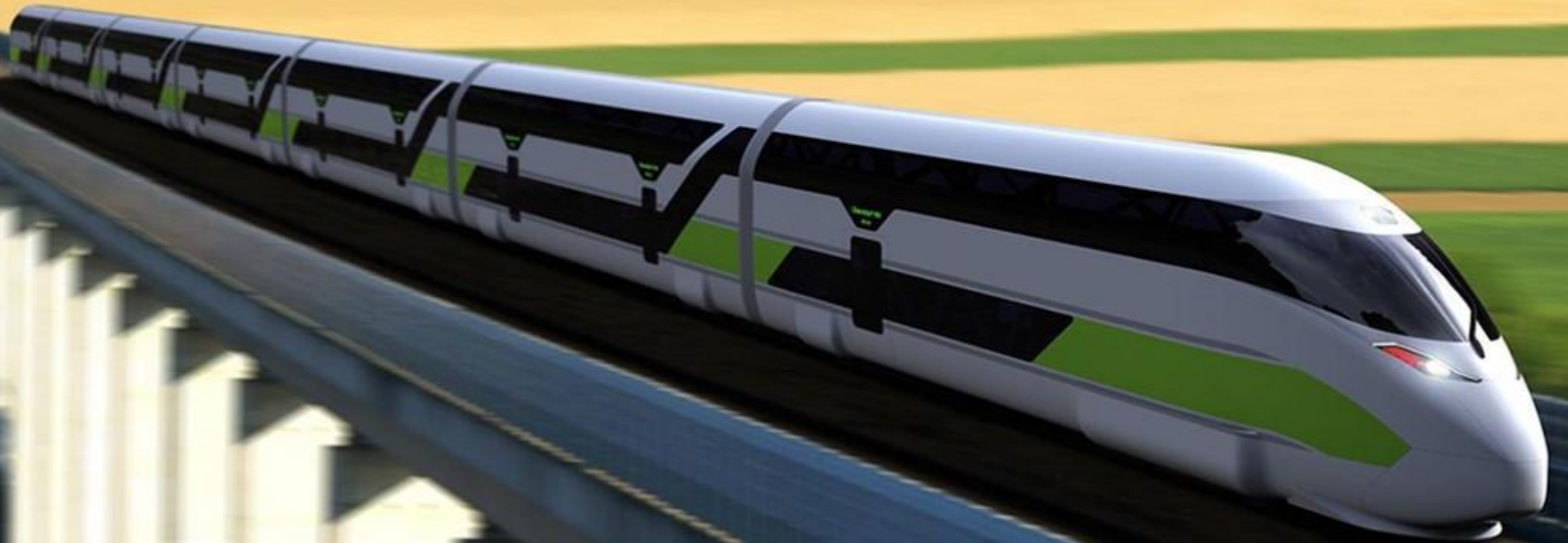
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- Summary
  - Open-source software based solution for research data management
  - Centralized storage of railway infrastructure and multi-sensor data
  - Sharing of (meta)data through the use of GeoServer and GeoNetwork
  - Monitoring of all components to ensure continuous service to the users
  
- Coming soon
  - Publication of GeoServer Monitoring PostgreSQL Plugin as open source software (Q1 2024)
  
- The work presented here is being financed by the cross-domain DLR project Digitaler Atlas 2.0 (January 2022 - December 2025)
  - Project page: <https://verkehrsforschung.dlr.de/de/projekte/digitaler-atlas-20-domaenuebergreifende-softwareanwendungen-und-geodateninfrastrukturen>

**Thank you for your attention!**

**Questions?**



# Imprint



Theme: Geodata Infrastructure for the Management of Research Data in Railway Domain

Date: 2023-09-28

Authors: Sangeetha Shankar, Laura Maria Fischer Prestes, Akhil Jayant Patil

Institute: DLR Institute of Transportation Systems

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