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MOBILITY DATA SPACE

SECURE DATA SPACE FOR THE SOVEREIGN AND CROSS-PLATFORM UTILIZATION OF MOBILITY DATA

IN COOPERATION WITH

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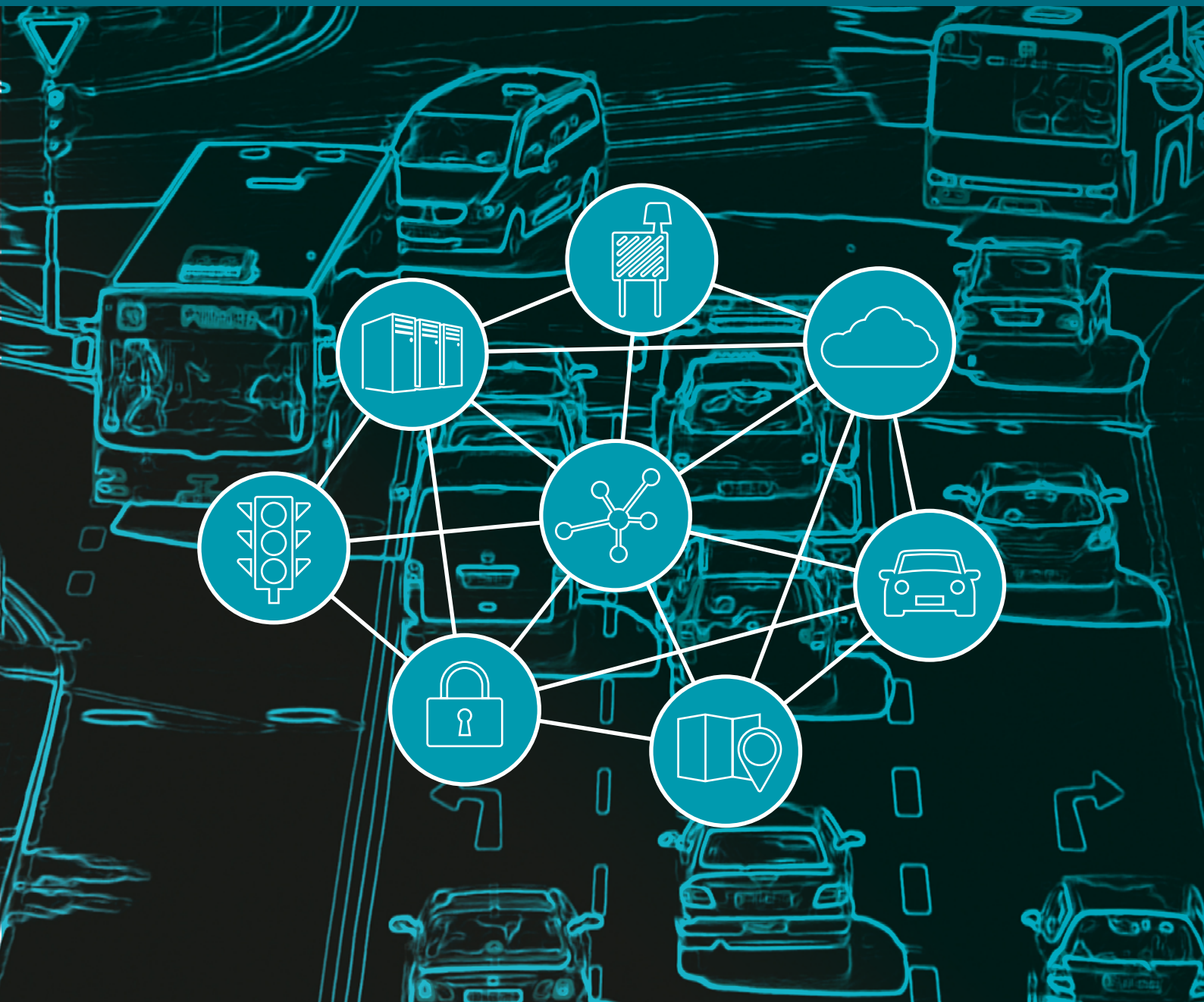
Bundesanstalt für Straßenwesen



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1 SUMMARY

Intelligent transport and mobility systems require large amounts of data, for example, to successfully support decision making or even automatically make decisions of their own. Although multitudes of mobility data are already being collected today, the comprehensive processing and exploitation of this data has often been impossible due to technical, legal or economic reasons. With **Mobility Data Space**, an open data space is now being created which offers access to real-time traffic data and sensitive mobility data beyond their secure exchange, and which links existing data platforms to each other. In the future, it will thus be possible to provide comprehensive mobility data on a national level.

Based on a decentralized system architecture developed by the International Data Spaces Association e. V., the Mobility Data Space offers an ecosystem in which data providers can specify and control the conditions under which their data can be used by third parties. This approach creates data sovereignty as well as trust, and data users can be sure about data origin and quality. By integrating data from the public and private sector via regional and national platforms, the Mobility Data Space will become a digital distribution channel for data-driven business models, providing entirely new options of data acquisition, linking and exploitation.

Whether data provider, user, developer or end user – the Mobility Data Space takes all acting parties into consideration and offers:

- Data sovereignty and security along the value chain,
- Standardized access to data from both public and private sources,
- Space for the emergence of new business models, distribution channels and services, as well as
- A larger selection of innovative mobility services and applications.

International Data Space

The International Data Space[1] (IDS, until 2019 known as »Industrial Data Space«) was designed by the Fraunhofer-Gesellschaft in 2015 with the aim of creating a safe data space for the sovereign management of data assets by enterprises from different fields. Due to the overwhelming feedback to the industry initiative, the International Data Spaces Association e. V.[2] was founded in 2016. It is continuing the development of the International Data Spaces reference architecture and supports the industry in its introduction and implementation.

Fraunhofer coordinates the adaptation of the IDS reference architecture to sector-specific needs through IDS verticalization. The Fraunhofer IVI leads the Mobility Data Space verticalization initiative, supporting the transportation and mobility sector in creating new mobility services using data-based business models in sovereign data ecosystems.

1 https://www.fraunhofer.de/en/research/lighthouse-projects-fraunhofer-initiatives/international-data-spaces.html
2 https://www.internationaldataspaces.org/

2 MOBILITY DATA – THE STATUS QUO

Collecting mobility data is increasingly gaining in importance. It is the only way in which intelligent systems can provide traffic participants and decision makers with sufficient information to optimize traffic flows, increase safety and protect the environment.

The interaction of several different traffic participants, providers and operators requires a **trustworthy exchange of data and their interoperability**.

In the field of mobility, quite a large amount of data requires protection. Among these are data on traffic infrastructure and real-time data on the current traffic situation. Data from different sources need to be merged either physically or virtually at the point of decision.

Data acquired by the German Federal Government and the Federal States are already being provided to users in a standardized format in the Mobilitäts Daten Marktplatz (MDM, Mobility Data Marketplace) of the Federal Ministry of Transport and Digital Infrastructure (BMVI).

On a regional level, this data is partly available via corresponding platforms. The fact that the data is rarely ever provided in a national context complicates its multi-regional exploitation.

Public transport providers, car sharing providers and charging station operators are usually **reluctant to provide further mobility data to third parties.** Reasons for this include the lack of infrastructure (i. e. a National Access Point for data exchange) and the lack of established data formats and interfaces, which as of yet do not apply in certain sectors (car sharing, bike sharing, e-mobility).

Sensitive data, such as passenger flows, which is generated by vehicles or privately owned mobile devices, is being collected and processed by public transport providers, navigation service providers, fleet operators and mobile communications providers. However, there is virtually no cross-company utilization, processing and linking of this data due to its sensitivity in terms of data protection, informational autonomy and protection of trade secrets.

Security and sovereignty for new exploitation options

The Mobility Data Space offers a solution: an **open mobility data ecosystem** in which data providers can specify and control the conditions under which their data may be used and exploited by third parties. This approach creates **data sovereignty** and a trusting environment for data providers and it gives data users **assurance** about data origin and quality.

Through the assurance of data sovereignty, data that had previously not been usable due to its sensitive nature can now be exploited. The mobility data space will become a digital distribution channel for data-driven business models. The linking of public and private data via regional and national data platforms through a decentralized **data space concept** provides completely new options for data acquisition, linking and utilization.

Within the scope of a collaboration between the Fraunhofer-Gesellschaft and ca. 100 enterprises, the International Data Space (IDS) was created as a basis for **decentralized data value chains**. Ever since its inception, the IDS has been continuously improved by the International Data Spaces Association e. V. For a better combination of resources, the future will see the integration of cloud infrastructures into data spaces and their interlinking through projects such as Gaia-X.

3 THE MOBILITY DATA SPACE: ARCHITECTURE AND COMPONENTS

Beyond the IDS' technical functionalities in the area of secure and sovereign data exchange, the Mobility Data Space aims at making accessible real-time traffic data (e. g., sensor data, traffic light sequences) and sensitive mobility data (e. g., vehicle-generated and smartphone-generated data, movement patterns) as well as connecting local, regional and national data platforms in order to facilitate the provision of comprehensive mobility data on a national level. Services and applications for data enhancement and exploitation form the basis for a broad mobility data ecosystem.

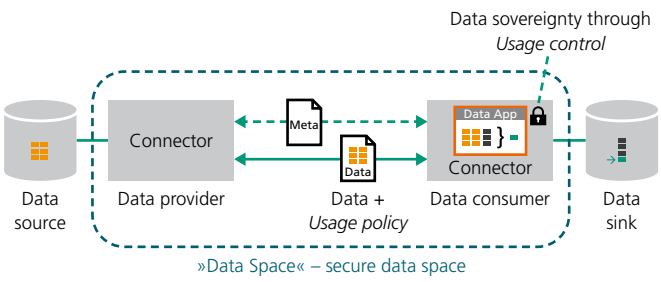
The **Mobility Data Space**

- is based on the open, decentralized system architecture developed by the International Data Spaces Association e. V.,
- guarantees data providers sovereignty over their own data and security along the processing and value chains in the sense of a digital rights management system,
- allows the provision and distribution of sensitive data, as well as the traceability of their use for purposes of billing/payment,
- provides data users (e. g., travel information services) with standardized access to an ecosystem that pools data from public and private sources and services through the connecting of local, regional and national platforms,
- opens up new business opportunities
  - for developers: data apps for mobility services and applications, including distribution via a data app store
  - for IT service providers: hosting of components and data apps in cloud environments as well as corresponding consulting services,
- offers advantages for end users by fostering the development of novel mobility applications and services through the availability of mobility data sources.

3.1 Data Sovereignty through Usage Control

Participation in a secure data space is possible via a technical connector component that data providers and data users either host themselves or have hosted for them. The data space is established across the networked connectors, meaning that it is not a centralized platform but rather an **expandable network of decentralized players** (minimum of two). Before being transferred to the target connector, the data to be provided is extended by a set of rules, the so-called »usage policy«. The data remains in the target connector and is secure against direct access by the data user. If data users want to work with the data, e. g., for purposes of data analysis or fusion, they must access it within the connector via so-called »data apps«.

These apps are capable of integrating further data, e. g., from user databases that are run outside of the connector. A usage control layer within the connector guarantees compliance of the data app with the specified rules, with the effect that only aggregated results will leave the connector. All steps taken during data use and processing within the data space can be recorded. This way, data providers have complete knowledge of all activities relating to their data.



1 *Functional principle of data sovereignty through mechanisms.*

3.2 The Mobility Data Space as a Distributed System

Beyond the minimum example, a data space can consist of dozens or even hundreds of participants. This kind of decentralized, distributed system requires a central directory in which data sources and services are published and which can be searched either manually or automatically by data users. Therefore, existing regional and national mobility data platforms play a special part within the Mobility Data Space. With different operator and business models, one or more central components for the data space can be offered:

- A **data marketplace** (technically, a metadata directory), for the publication and displaying of data sources and their terms of use. Metadata needs to be provided in a machine-readable format so that devices such as automated vehicles, smartphones and IoT devices will be able to find and use them autonomously.
- A **vocabulary provider** that provides the necessary domain knowledge about traffic and mobility data formats (e. g., DATEX II, NeTEx) as well as APIs (e. g., SIRI, TRIAS) in the form of vocabularies and ontologies, thus ensuring the machine-readability and interoperability of data.
- An **identity provider** as a single point of contact that evaluates the trustworthiness of data providers, data users as well as data and data apps, and that also allows secure communication based on the aforementioned evaluations.
- A **data app store** for the easy registering and marketing of data apps (for the processing of data relating to mobility).
- A **clearing house**, the system's central logging component, that records transactions made within the distributed system in order to make them available to the relevant parties for purposes of billing and quality analysis at a later point in time.

The connector also allows the exchange of data between data providers and users via the platform. This facilitates the **brokering of data** through which data users can subscribe to data publications and receive the data provided by the respective data providers in real time. In addition to this brokering task, the connector can execute data apps, for example, to compile the data provided to the platform into new virtual data sources. This way, existing data platforms can be extended to receive sensitive data worth protecting as well as mobility data from data providers and other data platforms, and to transfer them in compliance with the usage policy to data apps for enhancement and exploitation.

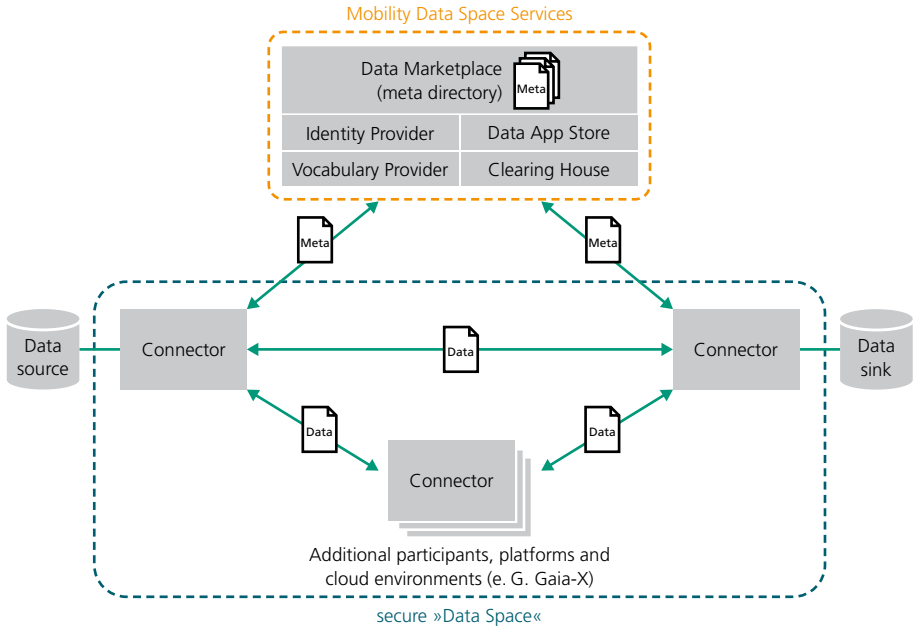
3.3 Design and Operation of Central Components

Due to the important role of the central components in the Mobility Data Space, additional organizational issues must be considered:

- The **neutrality of the central components operator** is an important prerequisite for a guaranteed disrimination-free exchange of mobility data. This neutrality may be ensured, for example, by a public authority or an association.
- The funding of the central components operation must be stable – not least for creating trust in the concepts of the Mobility Data Space. If operators have to raise user fees in order to cover their costs, the attractiveness of participating in the Mobility Data Space will decrease for all parties. In addition, funding models such as the promotion of data services might impair neutrality.

3 THE MOBILITY DATA SPACE: ARCHITECTURE AND COMPONENTS

- There has to be a continuous **harmonization** of the data formats and models provided by the vocabulary provider. Communication and coordination with the relevant stakeholders is important to identify changing requirements of the data formats and models and to find solutions. Predefined processes can be a way to better include the stakeholders.
- Because licence and usage policies are new for many parties acting in the field of mobility, examples and patterns should be offered.
- Although marketing does not play a key role in data exchange itself, it is an important element in broadening the implementation and knowledge about the Mobility Data Space. Because utilization of the central components lies in the interest of the central components operators, appropriate marketing is necessary.



2 *Secure data space.*

4 THE MOBILITY DATA MARKETPLACE (MDM) AS CENTRAL PLATFORM WITHIN THE MOBILITY DATA SPACE

The Mobility Data Marketplace (MDM) is currently a platform that already covers some of the concepts of the Mobility Data Space. The MDM is known as the central point of contact for road traffic data in Germany. Because it is operated by the Federal Highway Research Institute (BASt), it has a neutral position. This way, data providers can rely on a neutral IT infrastructure that is not influenced by the interests of private economy.

Currently, the most important providers of road traffic data are authorities on all levels of public administration, ranging from ministries to small municipalities. With the help of this data and the results of their processing by service providers, traffic participants will receive better information and both the safety and efficiency on roads will increase.

The MDM offers two core functionalities:

- The MDM has a **metadata directory** for searching relevant data publications. The directory's entries can be filtered according to various criteria.
- Due to its brokering functionality, the MDM is a **data distributor**: Through 1:n distribution, data provision is made easier for both data providers and data users. Data providers offer their data publications, and interested data users can then subscribe to them. This means that the MDM is not focused on end users (travelers, users of a mobility app, etc.), but on establishing data exchange in the B2B sector (e. g., infrastructure operators and service providers).

For data exchange via the data distributor, the MDM primarily uses the DATEX II data model. This European standard is commonly used in traffic control centers and is required by law as a basis for the exchange of traffic data.

The MDM website provides DATEX II profiles for several data types. With the help of these profiles, data providers can identify the requirements for the individual elements of their data publications, and data users know what to expect from the publications so that they are able to integrate them into their systems.

Some of the MDM's functionalities correspond with the core components of the Mobility Data Space:

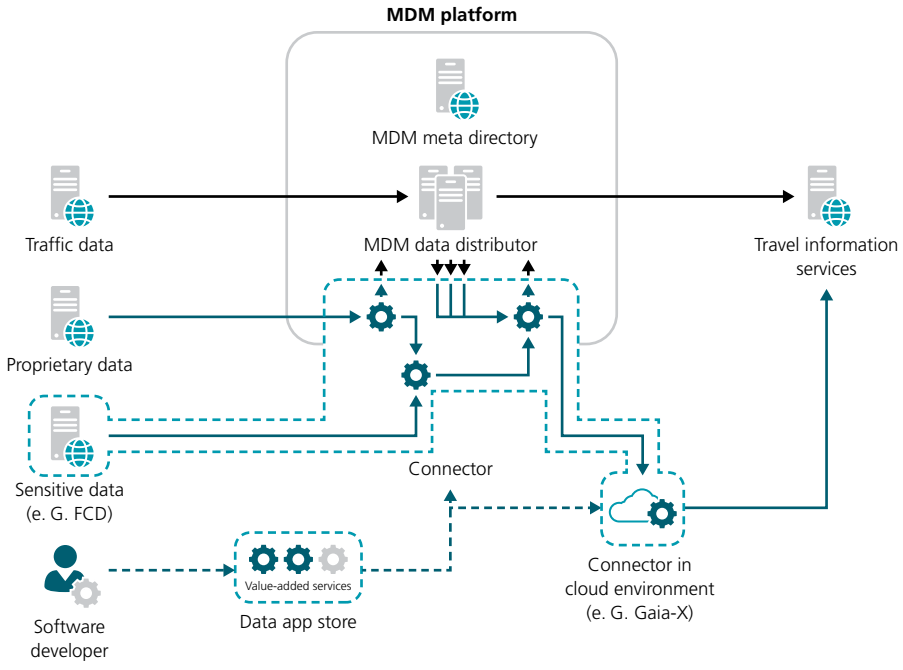
- The **data marketplace is the core functionality** of the MDM. Metadata is searchable via a web-based user interface, but it is not machine-searchable. Also, it is possible to distribute usage and content data in addition to metadata via the data distributor. Through this type of 1:n distribution system, a large number of subscribers to a certain offer can receive real-time data while the data provider only has to manage one interface. This way, only the most recent data content is available in the MDM, and the historicization of data does not take place.
- The **vocabulary provider functionality** is already partly supported by the MDM through the provision of DATEX II profiles.
- While access to the metadata search is free, data providers and data users have to **register as users for the MDM**. The range of certificates is comparable to that of the identity provider functionality.
- In analogy to the clearing house, **transactions are also logged** in the MDM. However, a standardized procedure following the IDS concept is not implemented in the MDM.

The MDM is **currently not implemented in an IDS-compliant way**. The metadata directory is not machine-readable, data distribution is not carried out via a connector, and the mobility vocabulary provider, identity provider and clearing house components were not created according to the concepts of the Mobility Data Space. Also, a data app store is missing.

The Mobility Data Space concepts can **enhance the MDM's functionalities**, thus increasing its attractiveness. Figure 3 shows how the MDM, as complemented by an IDS connector, will become a part of the Mobility Data Space, run data apps and broaden its spectrum of services through data processed by those apps. Looking at the necessary organizational aspects of a central platform within the Mobility Data Space, the MDM already considers various aspects relating to the operation of central components in a similar way:

- As a **neutral operator**, the MDM is trustworthy. Therefore, additional key roles, such as the identity provider, the app store provider and the vocabulary provider, can also be taken on by the MDM.
- Commercial services and advertising are currently not pursued in the MDM as ways to raise funds, as such practices might impair neutrality. However, should the hosting of data apps that explicitly create added value require extensive resources, **fees might be considered**.
- The limitation to DATEX II as the only model on the platform could be lifted. In particular, the increased inclusion of mobility data beyond road traffic calls for the **adoption of additional data standards**. In the future ecosystem, additional standards will be recommended and developed, and conversions between them will be supported. Therefore, it is imperative to harmonize the use of data standards.
- **Machine-processible standard licences** offered by the MDM for some frequently occurring cases are conceivable.
- Marketing activities conducted by the MDM are realistic in the future. The MDM does not only wish to be a part of the mobility data ecosystem, but it also wishes to contribute to the **onboarding of additional stakeholders**. For maximum efficiency in terms of marketing, several important partners within the mobility data ecosystem should undertake joint steps.

In 2020, the BMVI has decided to substitute the current MDM with a new platform, the MDP – Mobility Data Platform. The MDP will incorporate the abovementioned functionalities based on presented IDS-concepts. The new platform is currently in development and is expected to go into operation by 2022. The connection of several platforms will result in comprehensive visibility and availability of data sources for data users. Mobility data in particular are generated and used on a regional level, either by communities or by fleet operators in private economy.



3 *The MDM, expanded by an IDS connector, as part of the Mobility Data Space.*

5 DATENRAUM MOBILITÄT (DRM) – A NATIONAL IMPLEMENTATION IN GERMANY

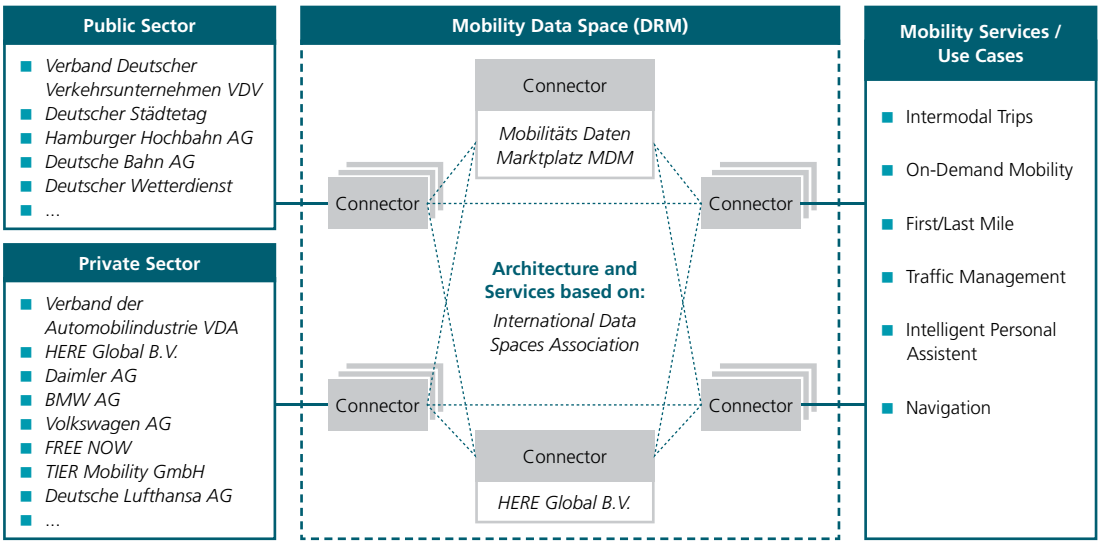
In 2020, the German Federal Government has decided to implement and to promote the operation of a federated national Mobility Data Space »Datenraum Mobilität« (DRM), following the decentral architecture principles of the here presented Mobility Data Space concepts. A large-scale stakeholder and governance process, led by acatech[3] (German Academy of Science and Engineering), has resulted in an extensive stakeholder engagement, supporting DRM by the provision of mobility data and the implementation of DRM based use cases.

DRM will address the private and public sector equally in order to establish and promote a comprehensive mobility data ecosystem. A very important role will be played by existing data platforms (such as MDM, HERE), since they provide access to already connected participants and their data offers (Fig. 4).

On behalf of the Federal Ministry of Transport and Digital Infrastructure (BMVI), acatech founded[4] the non-profit organisation »DRM Datenraum Mobilität GmbH« in May 2021, together with further supporting public and private shareholders. This entity will bring the DRM in operation and will be responsible for legal and governance aspects.
The DRM will provide the central services that are necessary for the operation of a data space according to IDSA: a data marketplace (technically, a metadata directory), a vocabulary provider, an identity provider, a data app store and a clearing house (see also chapter 3.2). The data exchange is established directly between the participants themselves in a distributed manner by using IDSA-compliant connectors. The DRM operator has no touching point with the exchanged data itself as proposed in chapter 3, resulting in an opposite architecture then a data platform/data lake.

The DRM services are based on reference implementations by Fraunhofer, following the IDSA specifications. The interim operation of DRM is provided by Fraunhofer IVI, until a professional operator takes over in 2022.

3 https://www.acatech.de/projekt/datenraum-mobilitaet/
4 https://www.acatech.de/allgemein/vernetzter-verkehr-acatech-gruendet-traegergesellschaft-drm-datenraum-mobilitaet-gmbh-als-non-profit-organisation/



4 *Connected participants and their data offers.*

6 CONNECTION OF DATA PLATFORMS

Currently, mobility data platforms are created on a regional level, e. g., by smart city initiatives, in order to pool the local services. Through the integration of these platforms and the data space concept, as well as through the resulting network, the MDM helps to make **regional mobility data visible on a national level**.

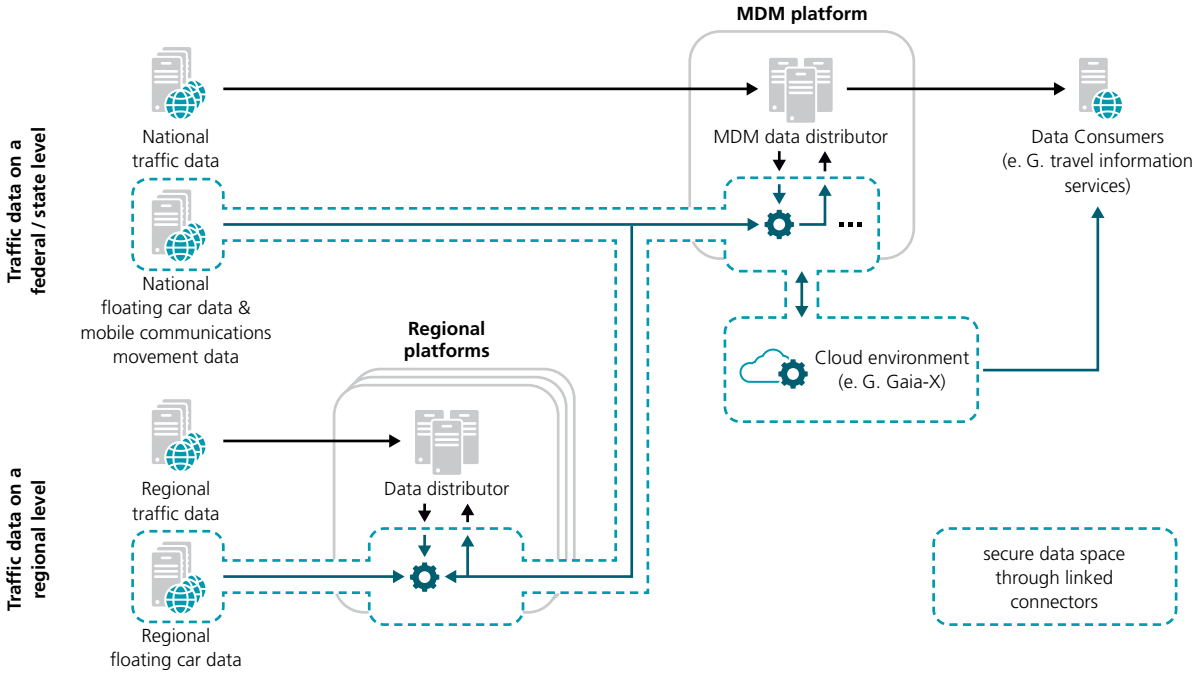
Further national data platforms with different focus topics, such as open data in mCLOUD, and commercial data services, such as geodata, vehicle data or navigation services, can also be combined into an ecosystem with the help of data space concepts.

Cloud services provide a further level of networking. With the help of their resources, cloud services create scalability for business models in the field of data exploitation and management.

It is thus possible to offer customized CPU-intensive prediction models, AI applications and high-volume data analyses, which would be impossible for just one conventional platform.

The use of resources and the resulting costs for cloud computing can be tied to customer demand, which means that they can be planned and calculated. Hosting an IDS connector in a cloud environment is just as secure as hosting it on a platform, the only difference being that a cloud-hosted connector is scalable according to the demand.

In addition to that, cloud environments, just as single platforms, are also often **data and service ecosystems**. Thus, the data offered by a connector is made available for additional interested parties within the cloud ecosystem.



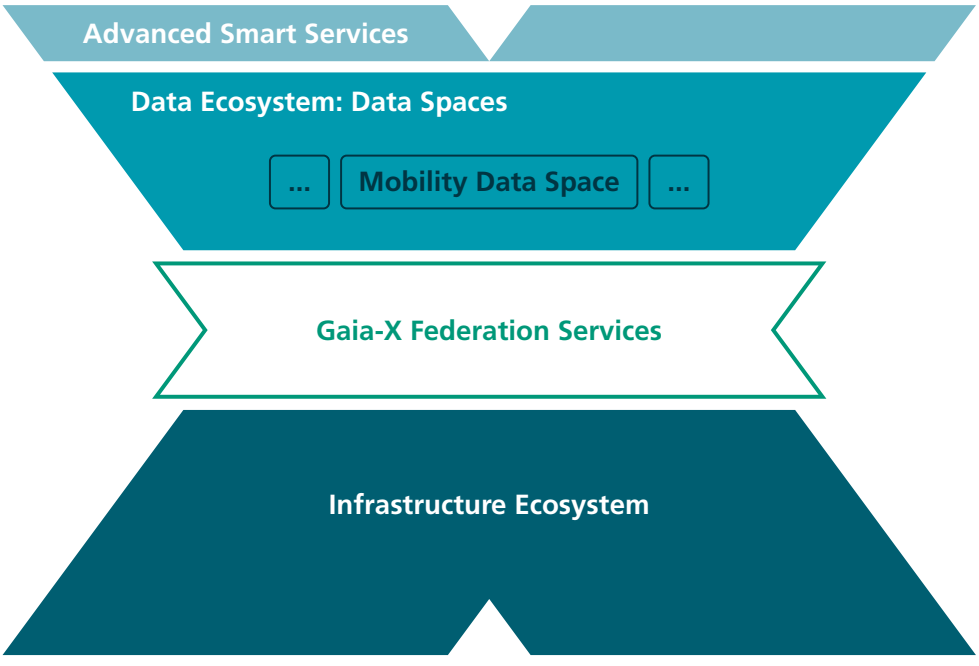
5 *Connecting regional data platforms with MDM and cloud environments.*

6.1 Mobility Data Space and Gaia-X

The **Gaia-X initiative**, which is currently being promoted by the German federal government, gives an outlook on the prospective network of cloud ecosystems. The technological core of the initiative aims at connecting several European cloud environments with the help of data space concepts to form a connected infrastructure.

Like the IDS, Gaia-X respects European data sovereignty values. In fact, IDS technology provides a key foundation for sovereign data exchange in Gaia-X. With its broader scope, Gaia-X will provide a specification for the whole data and service stack: from raw IoT data, provisioned by an infrastructure ecosystem, to providing and offering this data via a **data space ecosystem**.

In the mobility domain, the **Mobility Data Space will constitute the Data Ecosystem layer** within the Gaia-X architecture and will also comprise **Advanced Smart Services**, e.g., employing artificial intelligence fueled by the data, thus providing the foundation for new disruptive applications. Further, the Mobility Data Space Services will be made interoperable with the Gaia-X Federation Services, for example, the metadata directory (see. 3.2) is planned to be compliant to the Gaia-X Federated Catalogue specification. The first open source reference implementations of the Gaia-X Federation Services are expected for spring 2022 and planned to be adapted for the Mobility Data Space soon after.



6 *Mobility Data Space within the Gaia-X architecture.*

7 APPLICATION EXAMPLES AND USE CASES

7.1 Application Example: »Mobility Service Provider«

The following example illustrates the potential of a mobility data ecosystem as pictured above including the MDM and additional decentralized stakeholders: A mobility service provider wants to offer short trips on dynamic routes. Their business model only works if they can serve **a large number of customers per trip and direction**.

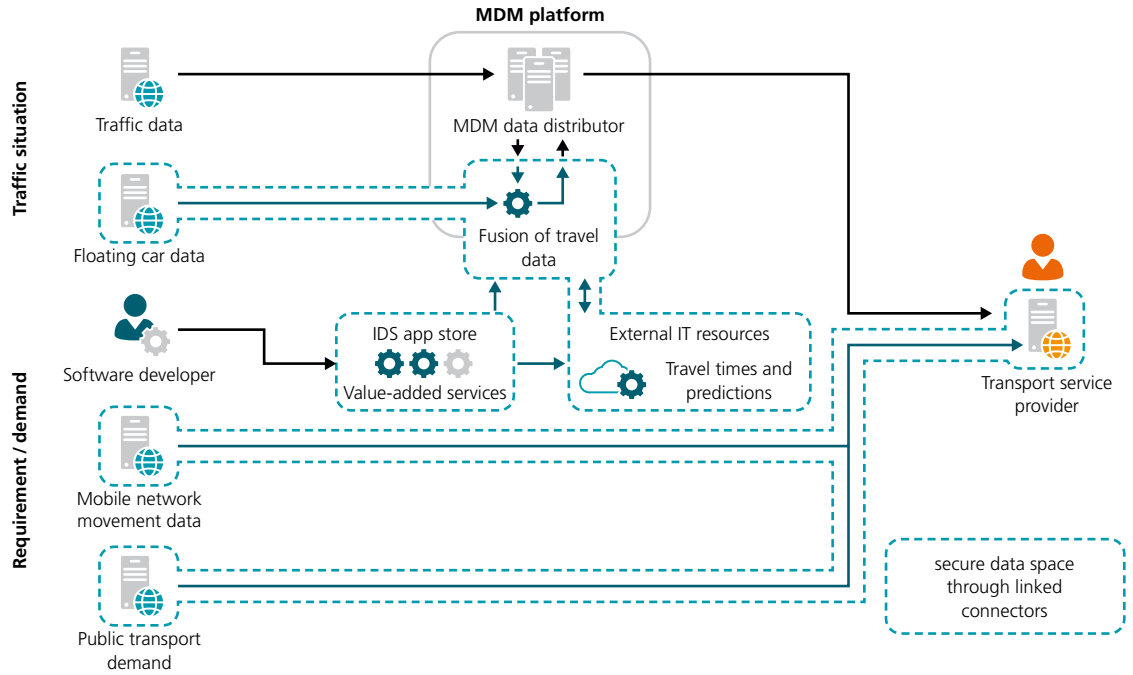
For routing and achieving optimal travel times, they need **traffic state** information. This information is gathered by road operators, road administration offices and environmental agencies through traffic monitoring, and provided via the MDM. This is already a daily practice.

In order to achieve the highest possible occupancy rate of their vehicles, the service providers also need **mobility data, movement data and demand data**.

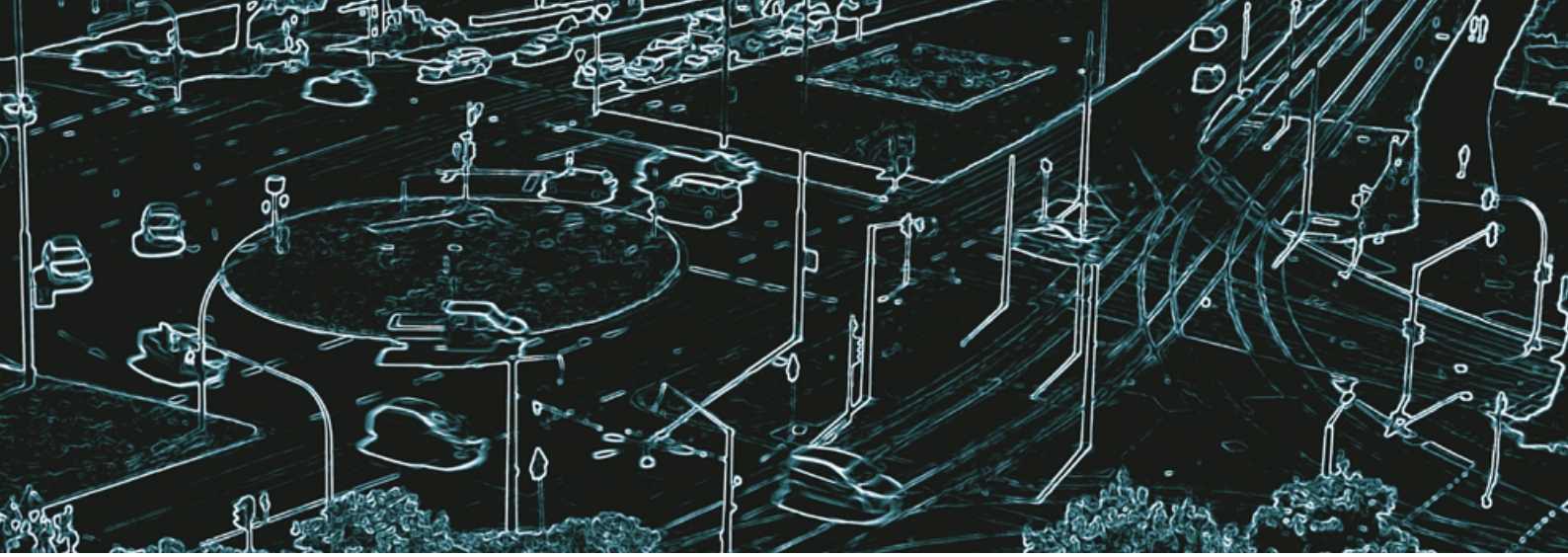
Fleet operators (taxis, logistics, public transport) as well as providers of navigation services are already gathering **floating car data** (FCD) representing individual traveling speeds. This type of data is highly sensitive because it contains personal driving profiles. For this reason, the transfer of raw floating car data to third parties has been impossible so far.

In the depicted scenario, both the data provider and the MDM have an IDS interface (**IDS connector**). In this data space, the data provider can control how their sensitive floating car data may be processed by the MDM and in what shape they may be transferred from the data space to the data user after processing.

In doing so, data providers can **offer their sensitive data for external business processes** without the fear of unauthorized data exploitation for other purposes than originally intended.



7 *Secure provision of mobility data for external business processes.*



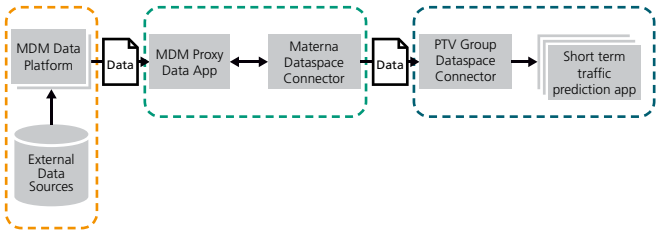
It is also possible to transfer data directly to users without a central platform, such as the sensitive movement profiles gathered by telecommunications and transportation providers referred to in this example. In this case, the data is processed within the data users IDS connector for utilization in their business processes and in compliance with the data providers' specifications.

Data processing (traffic data fusion) is realized by a **data app** whose compliance with the data providers' requirements has been verified by a certification agency. The app is run within the MDM's IDS connector. This app and other data apps may be developed by an independent software developer and offered in an app store. App development may be commissioned by data providers/data users, but it is also possible for stakeholders to develop apps on their own initiative with the aim of implementing a business model.

Data that has been enriched by an app is a **potential new data source** available to MDM users. This way, data apps can become the **basis for a novel mobility data ecosystem**. The IDS's decentralized architecture allows the integration of further IT resources. In the above example (see Fig. 5), the architecture is extended by an external cloud environment that runs a more complex data app for the calculation of travel times and predictions.

7.2 Providing real-time data for short-term traffic flow predictions

Traffic forecasts are often still not using real-time data.



8 *Architecture of the Materna and PTV use case.*

A machine learning based approach, developed by PTV Group aims to combine historic data and real-time traffic flow and velocity data, provided by Strassen. NRW via the MDM data platform, to provide reliable short-term traffic forecasts in North Rine-Westphalia. For this and other use cases in the Mobility Data Space, Materna (as developer and operator of the current MDM) developed a data app to forward any MDM data publication via their own IDS-Connector.

7.3 Real-time Commuter Travel Assistance

A key use case for the Mobility Data Space is to provide real-time information about traffic conditions and travel times for daily commutes. Extensive real-time data sources from public transport operators, road authorities, traffic management systems, movement data from private fleets and information from mobile network operators are incorporated via the Mobility Data Space to detect affecting disruptions, as well as derive and predict current future travel times. The commuter is notified instantly on occurrence and gets a new alternative route provided.

The use case is implemented by ivm GmbH, Trafficon – Traffic Consultants GmbH and Fraunhofer IVI into the www.vielmobil.info portal.

7.4 Mobility service providers in NPM RealLAb Hamburg

RealLab Hamburg has been initiated by NPM to explore, probe, test new mobility solutions in a controlled but real-life setting. Some projects explicitly involve mobility service providers, traditional public transport agencies as well as new micromobility providers. To this end, Telekom is working with the Telekom Data Intelligence Hub (DIH) team and the Urban Software Institute to build a fully functional demonstrator that will be presented with RealLabHH at the 2021 ITS World Congress. Since IDS is a core technology of the European GAIA-X

7 APPLICATION EXAMPLES AND USE CASES

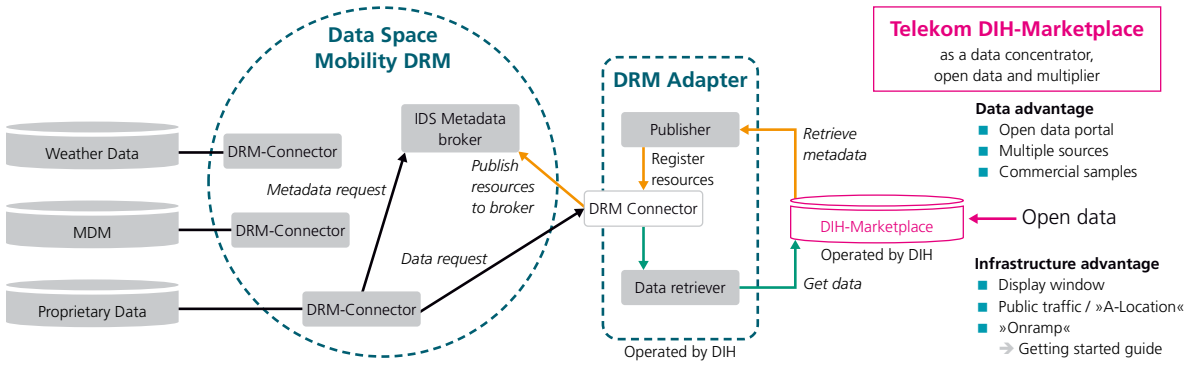
distributed data infrastructure, this will effectively be a first mini-Gaia-X mobility data space demonstrator with real companies involved, such as Hamburger Hochbahn (»Startschuss für das Reallabor Digitale Mobilität Hamburg – mit Bundesminister Scheuer«). More details on this project in our DIH story „DT and NPM“ and „Mobility with IDS“. The goal is to show how a federated data structure with sovereignty controls based on IDS can create benefits for all stakeholders: faster and better travel options for citizens, such as intermodal travel; new business opportunities for both established public transport companies (e.g., convenience offers combining rail and on-demand shuttles) and new micromobility providers. (e.g., connecting e-scooters to public transit). Specifically, a planning app for a door-to-door service between Hamburg and Berlin is to be implemented as a demonstrator. With the initial IDS components, such as connectors, a broker, and identity management up and running, the project is already fine-tuning and experimenting with data usage policies and enforcement options to facilitate automated machine-to-machine interaction that can ensure data sovereignty for all stakeholders.

5 https://dih.telekom.net/
6 https://www.bmvi.de/SharedDocs/DE/Video/Youtube/livestream-digitale-mobilitaet-hamburg.html

7.5 Telekom Data Space Adapter and Data Intelligence Hub open data marketplace

The Telekom Data Intelligence Hub (DIH) team is creating a data space adapter to connect the DIH open data marketplace with the Mobility Data Space (MDS). On the one hand this adapter ensures that data offers can be called up via an IDS dataspace connector and, on the other hand, they can also be published in the IDS metadata broker of the MDS. Advantages are numerous: First, the data space adapter extends data space connectors to enable connecting existing data hubs, such as DIH, into the new MDS. Secondly, the DIH open data marketplace instantly adds a rich and curated catalog of open-source data offers in MDS with an easy-to-use graphical user interface. Thirdly, it provides an on-ramp to MDS with infrastructure that can enable other data providers to easily offer their datasets in MDS.

Figure 9 provides a high-level overview of this MDS extension. The data space adapter provides open data offers according to an IDS compatible data directory. Data consumers can search through all open data offers of the DIH marketplace via the IDS Metadata Broker in the data room mobility and access them via the Dataspace Connector. Data providers from various organizations in the mobility sector can access the DIH portal (interface) via an access control (IAM) and provide their own data there.



9 *Architecture of the Telekom Data Space Adapter (© DT IoT GmbH).*

8 A COMMON MOBILITY DATA SPACE – OUTLOOK ON A EUROPEAN LEVEL

The European Commission has requested the establishment of **National Access Points** (NAPs) that are a prerequisite for the uniform handling of mobility data across Europe. The legal basis for this can be found in the ITS Directive no. 2010/40/EU. According to the directive, all member states are obligated to offer a platform on which at least the respective states' **mobility data metadata description** can be published. In addition to the ITS directive, several delegated regulations specify the data providers' obligations to publish mobility data via the NAP:

Safety-Relevant Traffic Information

According to the delegated regulation no. 2013/886, end users are to be granted free access to general **safety-relevant traffic information** (SRTI). This means that road operators in particular are obligated to provide existing data, e. g., on road works or exceptional weather conditions. This data is often used by service providers and forwarded to their clients.

Through increasingly connected vehicles, more and more private parties are in possession of safety-relevant information that can help, for example, to detect temporarily slippery roads. Because this data has the potential for commercial exploitation, there are reservations concerning its disclosure. The sharing of data in a secure data space can be a way to reduce these reservations.

Real-Time Traffic Information

The same applies to the provision of **real-time traffic information** (RTTI) across Europe in compliance with the delegated regulation no. 2015/962.

This regulation calls for the publishing of data on traffic volume and traffic jams, as well as dynamic speed limits and road closures via the NAP. In addition to road operators, this regulation also increasingly affects private parties with access to vehicle data.

Multimodal Travel Information Services

The delegated regulation no. 2017/1926 on the provision of **multimodal travel information services** (MMTIS) across the EU demands that both static and dynamic, as well as historical travel and traffic data are to be published via the NAP by traffic authorities, transport providers, infrastructure operators and providers of demand-based transportation services.

These multimodal travel planning and information services need to be linkable. This way, **Europe-wide services** can be created for end users.

Although the aforementioned legislative initiatives obligate private companies to provide data in high volumes, enterprises often fear the disclosure of business secrets and customer data. The **sharing of sensitive data in a secure data space** such as the Mobility Data Space will help alleviate these fears. Data providers can trust that their data will only be exploited according to the terms and conditions of use and licensing specified by them, and that they will be able to control and monitor the usage.

Another obstacle for the utilization of European NAPs for internationally acting enterprises, such as vehicle manufacturers and navigation service providers, is the fact that there still is a **large number of platforms in Europe**. Ca. 30 NAPs, some of which differ significantly in the way they are implemented, need to be supplied in order to offer services internationally. The further harmonization – or, even better, the connection of European NAPs through the concepts of the Mobility Data Space – would certainly be widely welcomed.

This can be the first step towards a **common European mobility data space** as envisioned within the Commission's COM 2020/66 data strategy. On the whole, the Mobility Data Space includes all concepts necessary to »facilitate access, pooling and sharing of data from existing and future transport and mobility databases«.

A European data strategy

On February 19, 2020, the European Commission published the Communication 2020/66, introducing a European data strategy. This strategy explicitly promotes the creation of Europe-wide data spaces in different sectors including the mobility sector:

» [...] a Common European mobility data space, to position Europe at the forefront of the development of an intelligent transport system, including connected cars as well as other modes of transport. Such data space will facilitate access, pooling and sharing of data from existing and future transport and mobility databases. [...] «[7]

Currently, it seems likely that this document will influence European legislation regarding the provision of data at National Access Points as well as different funding instruments.

7 https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:52020DC0066

9 IMPLEMENTATION WITHIN mFUND RESEARCH PROJECTS

The foundations for the development of the Mobility Data Space were laid in two mFUND projects funded by the Federal Ministry of Transport and Digital Infrastructure (BMVI): »Vorstudie-MDM-MDS« (12/2017 to 05/2018) and »MobilityDataSpace« (06/2019 to 05/2022).

Within the **»Preliminary Study on Connecting the MDM to the Intended Mobility Data Space«** (Vorstudie-MDM-MDS)[8] project, BASt, Fraunhofer IVI and Fraunhofer IAIS developed potential improvements to the MDM through an integration concept for MDM and IDS components. The concept investigates different multimodal and intermodal mobility scenarios, considers the integration of open data from the mCLOUD and illustrates potential contributions from the MDM/MDS that can help establish the future National Access Point for multimodal travel information.

This preliminary study is the basis for the implementation of the intended Mobility Space within the scope of a follow-up research and development project. It answers organizational, functional and technical questions regarding the development, operation and use of the Mobility Data Space.

In order to motivate relevant stakeholders to participate in the Mobility Data Space, the study's scientific results were presented at several relevant expert conferences such as the 2018 ITS World Congress, the MDM Conference and the mFUND Conference, as well as a number of industry symposia.

The preliminary study resulted in a **technical and temporal roadmap for the Mobility Data Space** that will be updated and implemented within the mFUND »MobilityDataSpace« project.

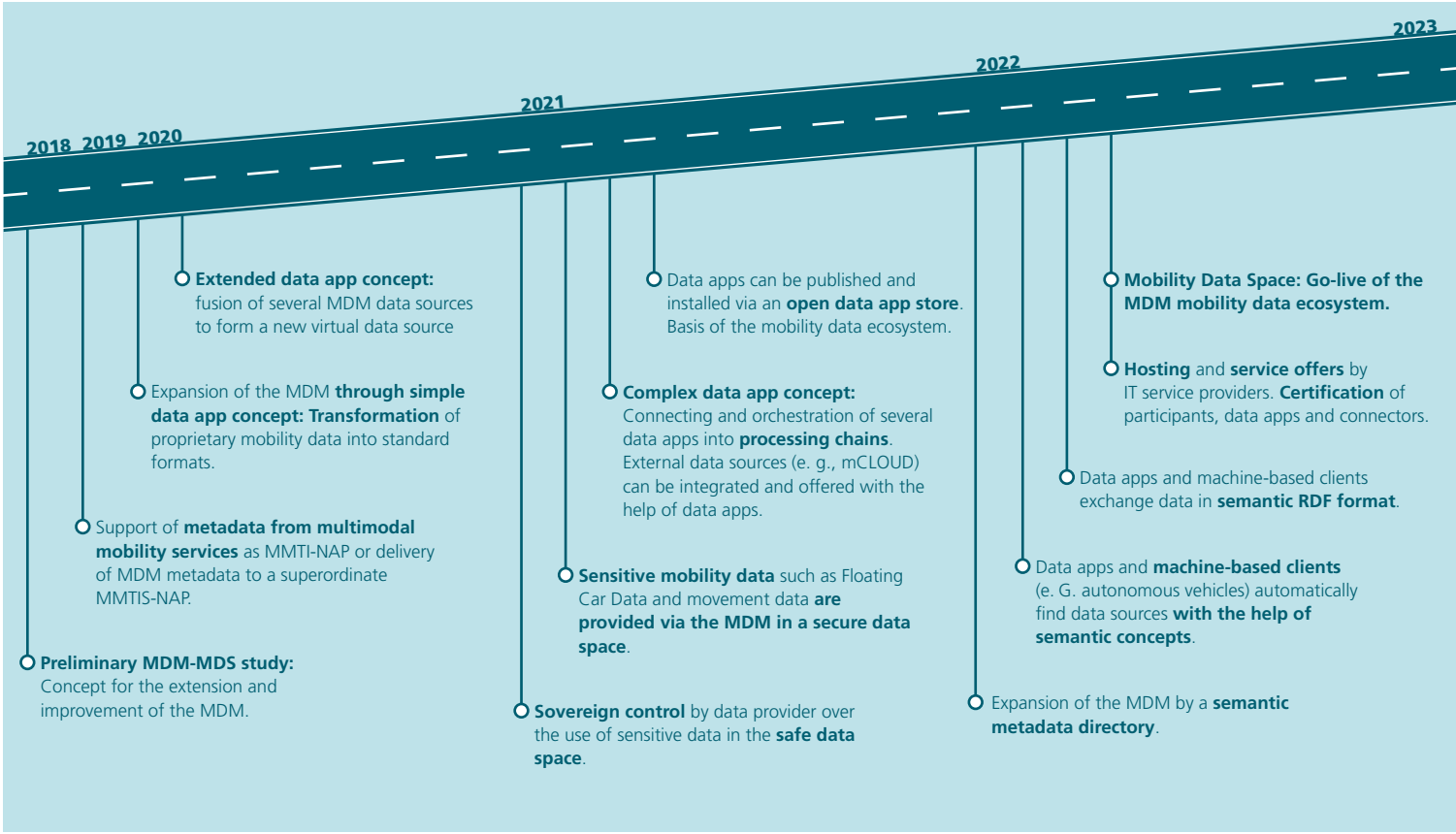
The project **»MobilityDataSpace: Connecting local, regional and national data platforms through data space concepts, as well as enrichment and exploitation as a mobility data ecosystem«**[9] aims to initiate the development of the Mobility Data Space, which will establish itself as a mobility data ecosystem by including the Mobility Data Marketplace by BASt as well as additional regional traffic data platforms.

New local traffic data and nation-wide mobility data will be acquired and provided for secure and sovereign processing on platforms extended by data space concepts. By connecting regional platforms with the MDM, it will be possible to **provide and exploit regional data on a national level**.

Within the project, the MDM and further local platforms will be improved for the support of data-driven services. To achieve this, they will be expanded by a **secure and protected execution environment** for services and data apps in which mobility data can be provided and processed under guarantee of data sovereignty. This way, sensitive mobility data such as floating car data (FCD) will be exploitable for the first time.

By connecting the MDM with local platforms into a decentralized data space, a **federal mobility data ecosystem** will be created. With this ecosystem as a basis, complex real-time use cases can help lower environmental impact, optimize traffic flows and improve multi-modal commuter information services.

8 https://www.bmvi.de/SharedDocs/DE/Artikel/DG/mfund-projekte/vorstudie-verknuepfung-des-mdm-mit-mds-mdmd-mds.html
9 https://www.bmvi.de/SharedDocs/DE/Artikel/DG/mfund-projekte/mobility-data-space.html



10 *Development roadmap for the Mobility Data Space.*

PROJECT PROFILE

Project Title
»MobilityDataSpace: Verknüpfung kommunaler, regionaler und nationaler Datenplattformen durch Data-Space-Konzepte sowie Veredelung und Verwertung als Mobilitätsdaten-Ökosystem«

(»MobilityDataSpace: Connecting local, regional and national data platforms through data space concepts, as well as enrichment and exploitation as a mobility data ecosystem«

Coordinator
Fraunhofer Institute for Transportation and Infrastructure Systems IVI, Dresden

Partners
- Deutsche Telekom IoT GmbH
- Die Autobahn GmbH des Bundes
- Federal Highway Research Institute (BASt)
- Fraunhofer FIT
- Fraunhofer IAIS
- Fraunhofer IML
- Fraunhofer ISST
- ivm GmbH – Integrated transportation and mobility management in the Frankfurt RheinMain region
- Materna Information & Communications SE
- Urban Software Institute GmbH

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