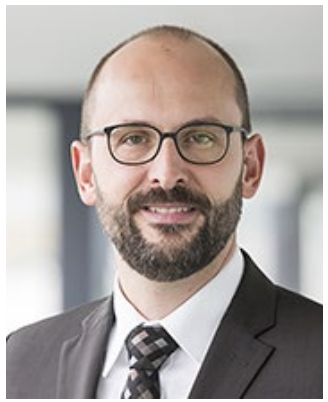
DATA MANAGEMENT IN THE ERA OF DIGITAL ECOSYSTEMS: - CHALLENGES WITH DATA SPACES IN DIGITAL FARMING

Prof. Dr. Joerg Doerr, TU Kaiserslautern and Fraunhofer IESE

Fraunhofer IESE
DIGITAL FARMING
TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

Presentation of the chair

- Research interests: **Software and Systems Engineering** in the field of Digital Farming
  - **Requirements analysis** for different actors in the agricultural ecosystem
  - Improving **interoperability and networking** between actors and systems
  - Improving the **user acceptance of** digital farming solutions (e.g. FMIS, decision support systems, agricultural machinery)
  - **Data management** for innovative solutions in the food chain

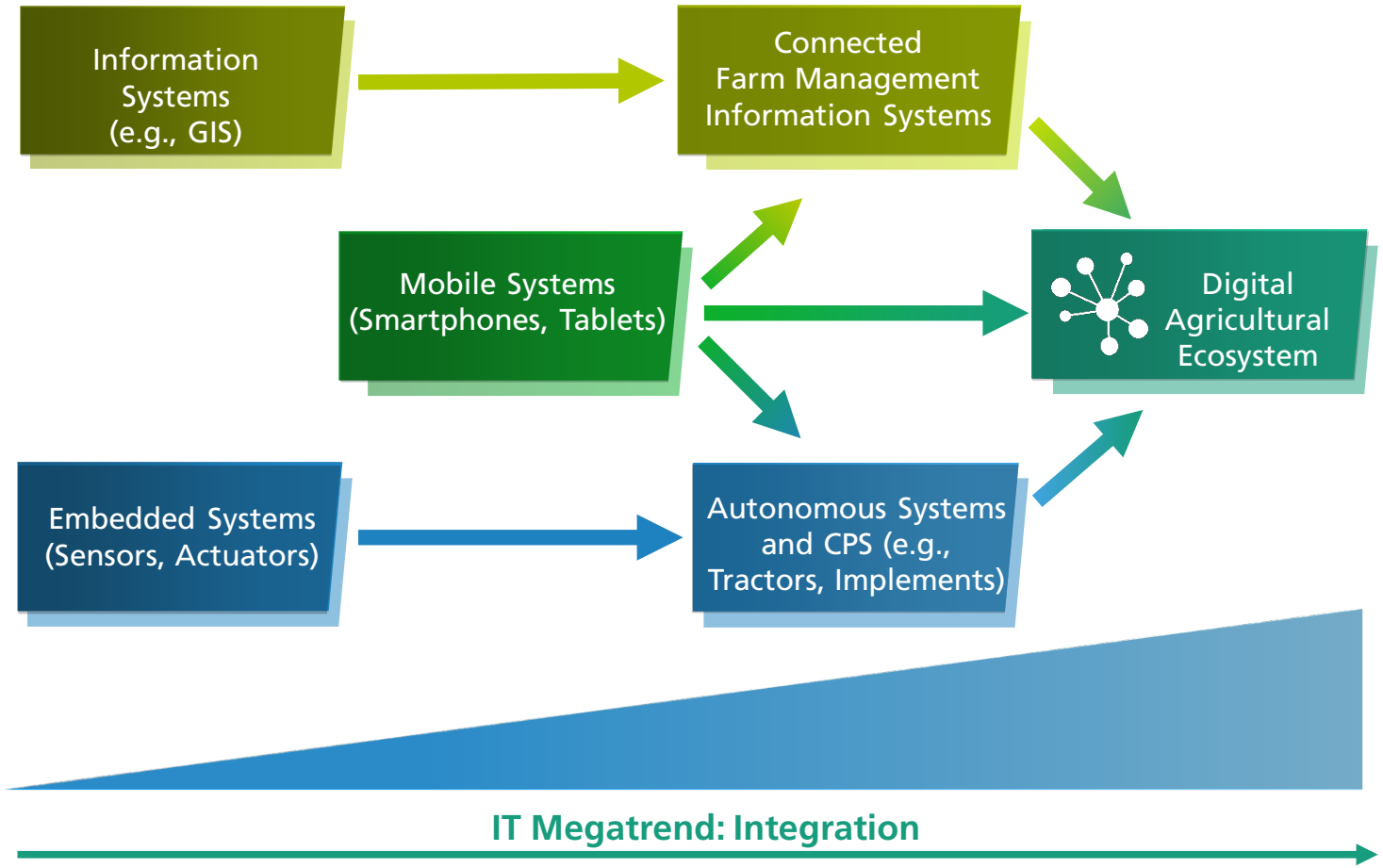






Fraunhofer IESE DIGITAL FARMING TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

Digital Farming – Digital Transformation in Agriculture



Definition of Digital Farming:

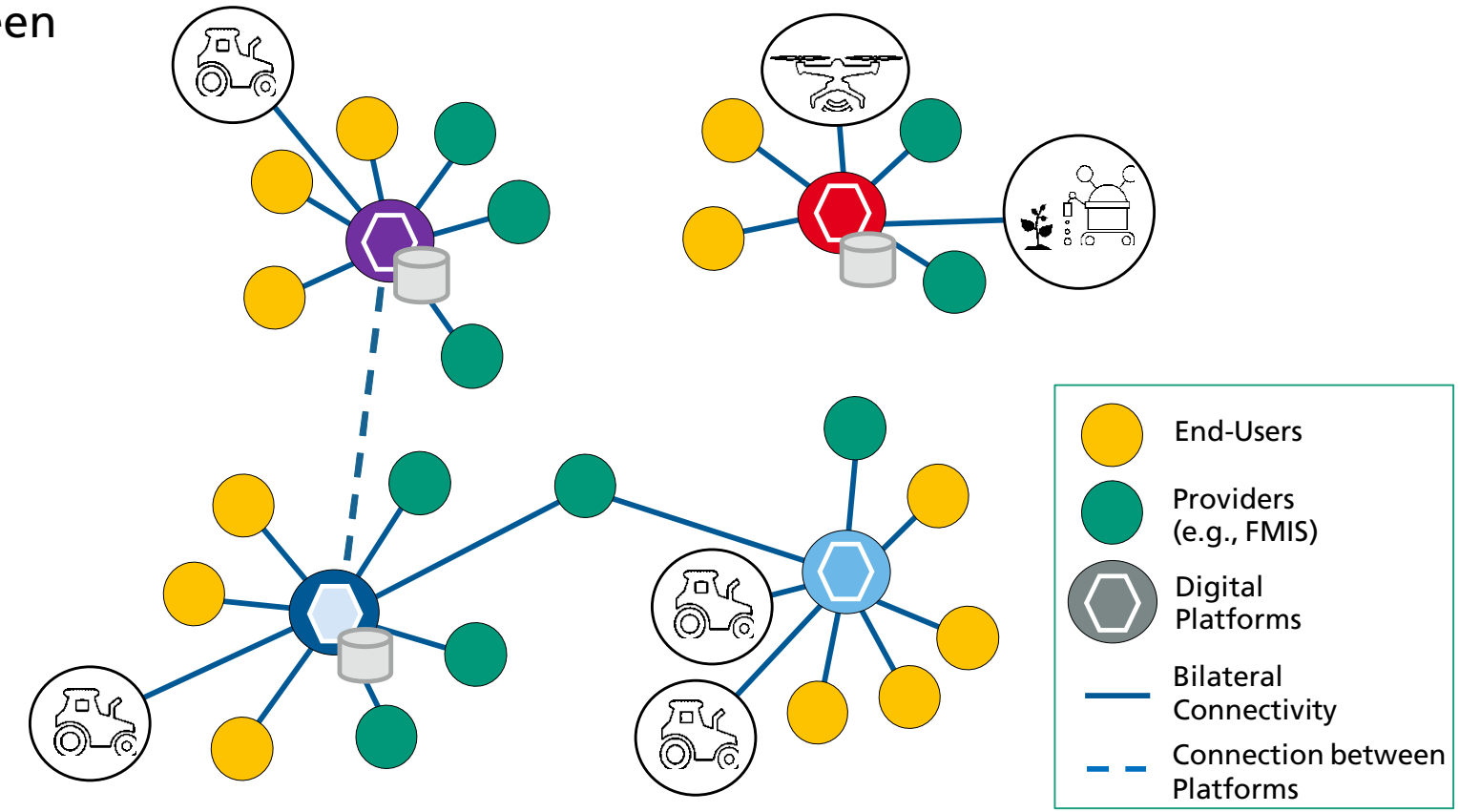
- Software-supported optimization and automation of agricultural work and business processes as well as innovative business models.

- Data plays an increasingly important role in Digital Farming
- **Data Spaces** have a huge innovation potential
- **Data Management** gets more and more important as enabler for AI

Fraunhofer IESE DIGITAL FARMING TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

Challenges in the Digital Agricultural Ecosystem

- Status quo in practice and research
  - **Segmentation** of the domain ecosystem into a wide variety of different digital ecosystems
  - **Bilateral connectivity** between systems
  - Competing ecosystems
  - Research approaches also not very integrative



Observed Challenges in the Context of Data Spaces

- It is **hard to interconnect entities from different digital ecosystems** in specific agricultural production processes, e.g., cooperative work of machinery from different vendors
- Data from specific assets like fields, animals, farms, or machinery is **often stored and distributed across multiple software solutions and digital ecosystems** as there is no single system that combines all the data
- Data is often stored in a **proprietary manner**, and **interfaces for data access are not available** or insufficiently described
- **Data sovereignty** across ecosystems, even though a key requirement in digital farming, is **rarely addressed** or if it is, then mostly within ecosystem boundaries
- The **complexity of agricultural processes**, the digital ecosystem architecture, as well as the **multitude of entities and actors** are overwhelming challenges for farmers as well as providers of digital products and services

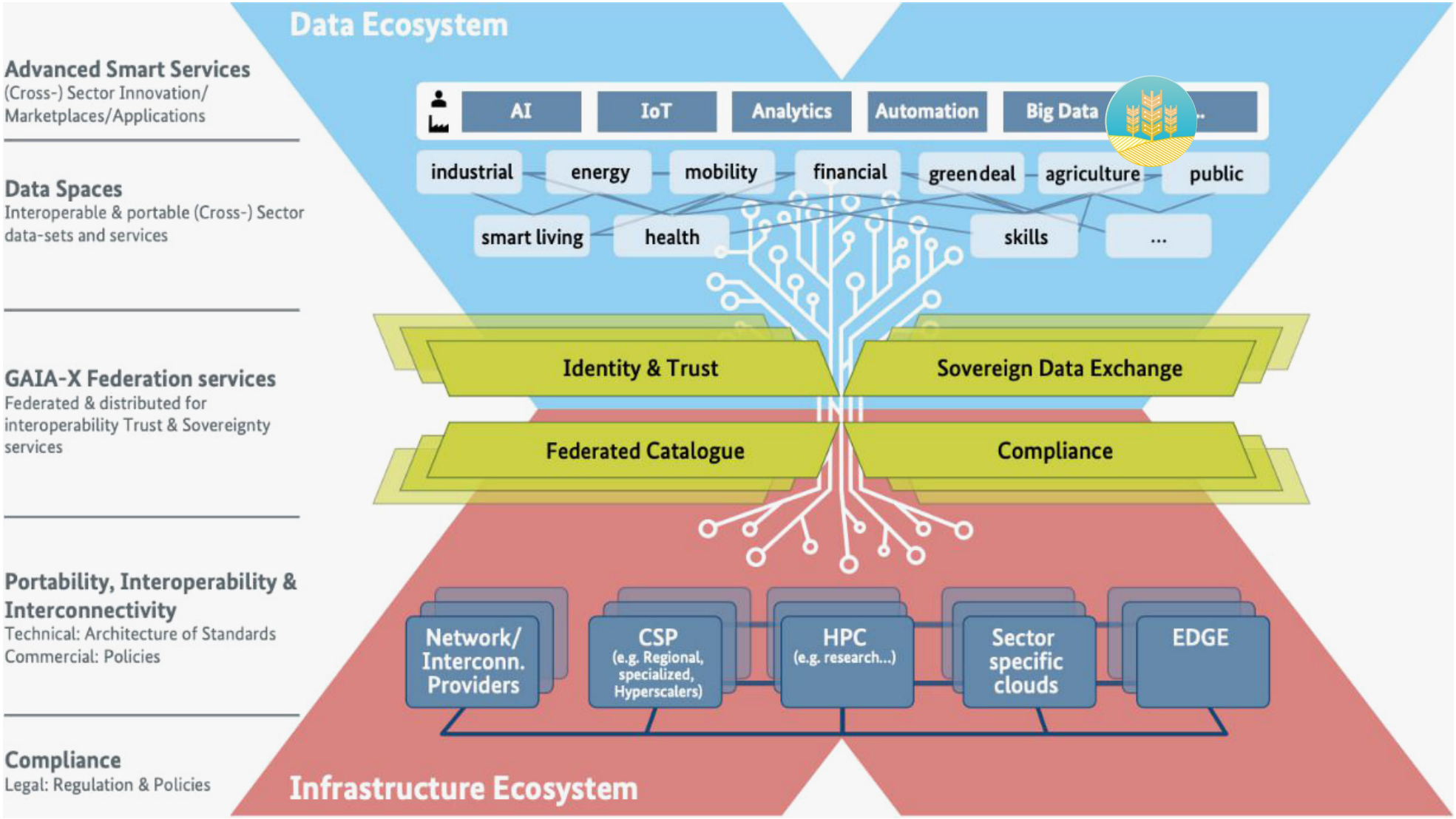
Source: Doerr, J.; Kalmar, R; Rauch, B; Stiene, S. (2022): Data Spaces in Agriculture, VDI International Conference on Agricultural Engineering, 2022

Different Approaches to Working with Data

- a) fully **decentralized data spaces (distributed data)** with direct connections **(individually negotiated or enabled by a framework)** between entities or
- data spaces that are enabled by
  - b) **data routers (offer: transport data from party A to party B)** or
  - c) **data hubs (store data and provide interface for third parties)**
- While a data router only transports data from producer to consumer, a data hub stores the producers' data and makes it reusable for third-party actors.
- In a digital domain ecosystem, combinations of paradigms can exist

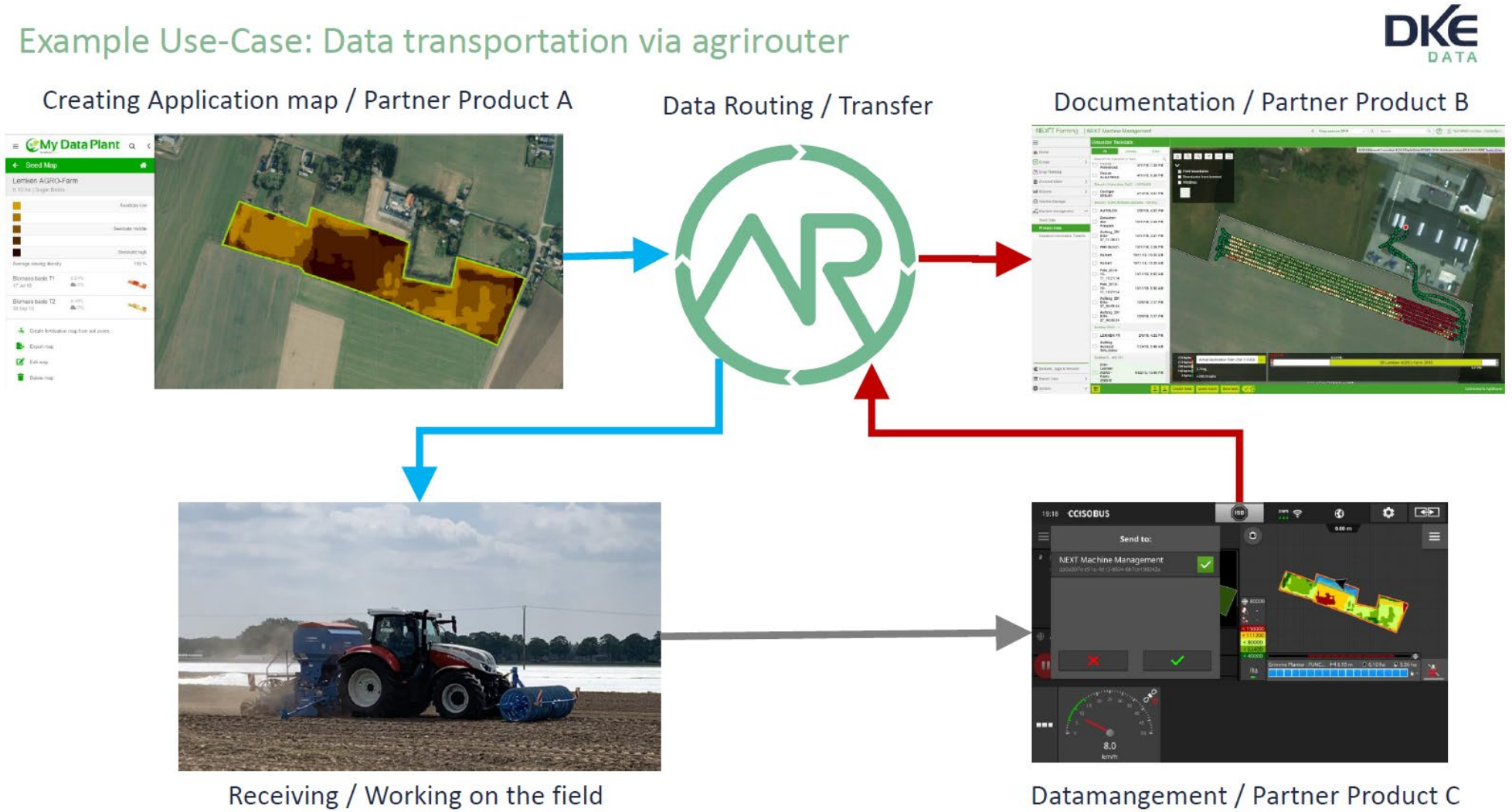
Source: Doerr, J.; Kalmar, R; Rauch, B; Stiene, S. (2022): Data Spaces in Agriculture, VDI International Conference on Agricultural Engineering, 2022

Project Example GAIA-X – used in the Project NaLamKI



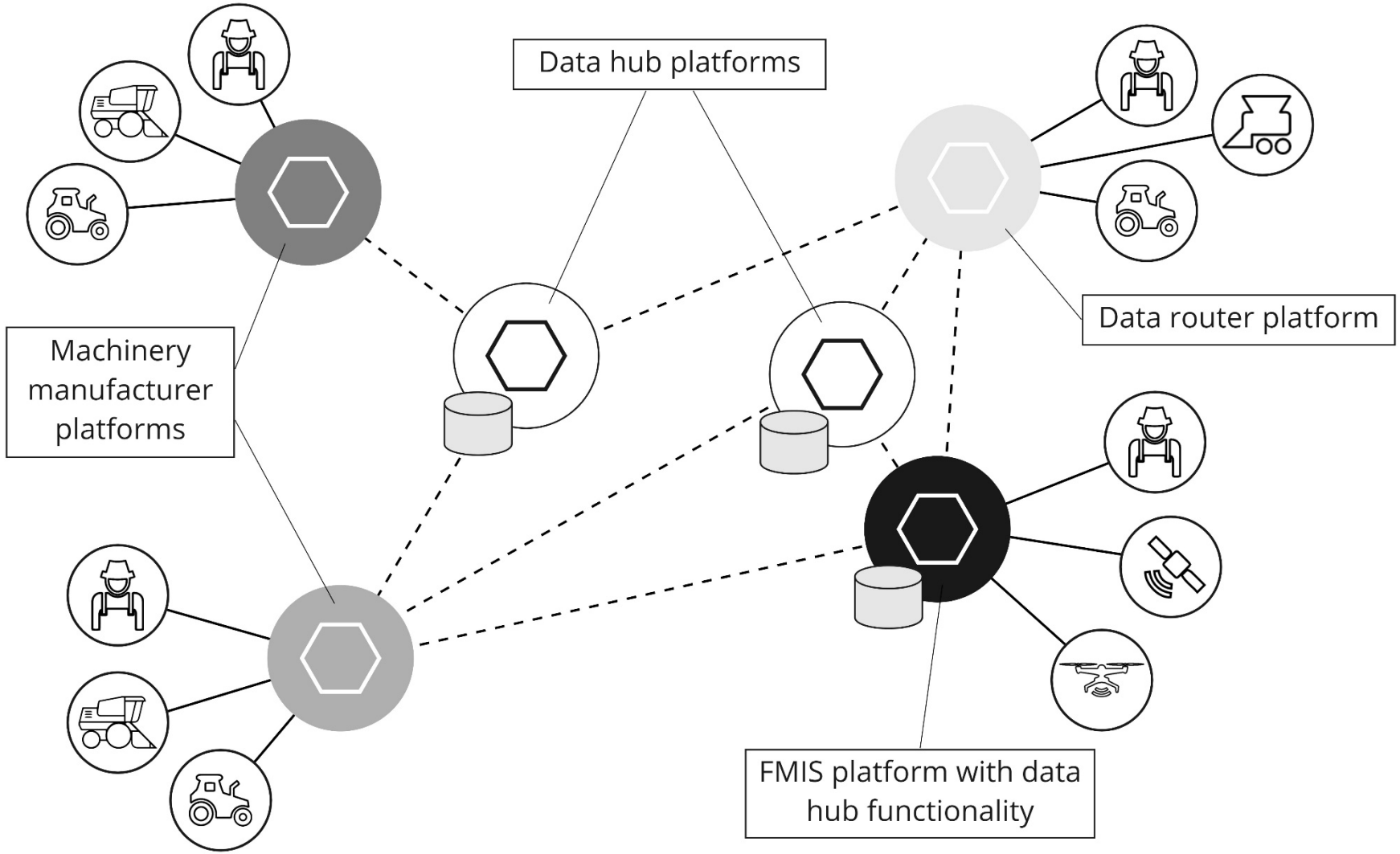
Source: BMWK

Project Example: Agrirouter



Source: DKE Data

Project Example: Data Hubs in the Cognitive Agriculture (COGNAC) Project



Source: Doerr, J.; Kalmar, R; Rauch, B; Stiene, S. (2022): Data Spaces in Agriculture, VDI International Conference on Agricultural Engineering, 2022

Digital Twins as Technological Enabler for Centralized Access to Decentralized Data (1/2)

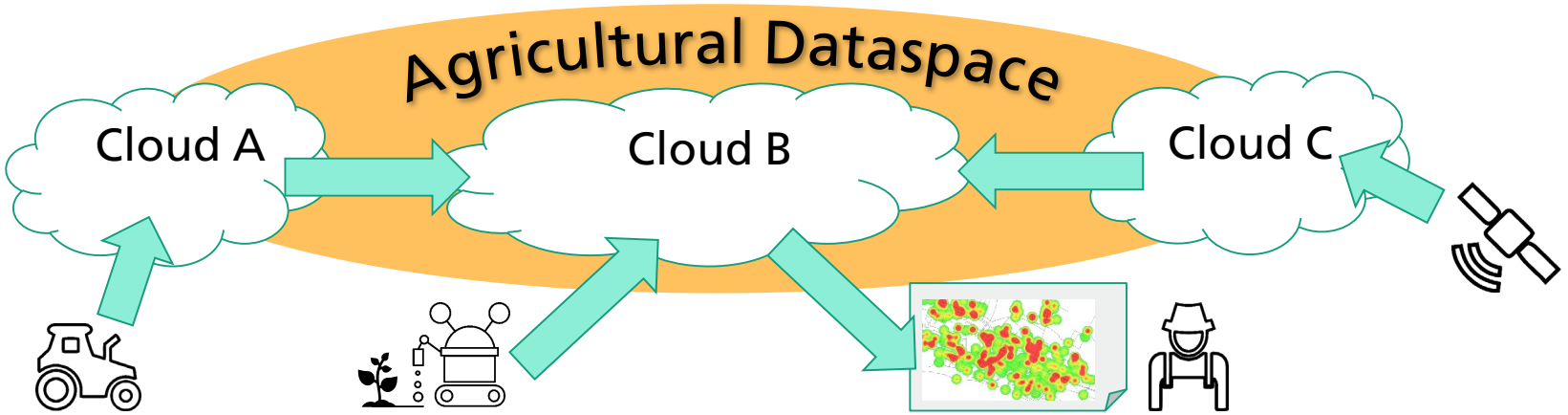
- We expect the digital domain ecosystem of agriculture to **remain decentralized with multiple digital ecosystems**
- **Diversity and numbers will increase** as it expands across the agricultural value network to interconnect the whole food sector → **increase the current complexity** in the agricultural domain when it comes to **data volume, data sources, heterogeneity, and maintaining control**
- How to handle this complexity?
  - centralize the data itself
  - **manage the access to the data** according to its "conceptual belonging" rather than the originating system (e.g., the field, the animal and not system XYZ)
- AI can access the data from there, IoT can provide the data to the twin

Digital Twins as Technological Enabler for Centralized Access to Decentralized Data (2/2)

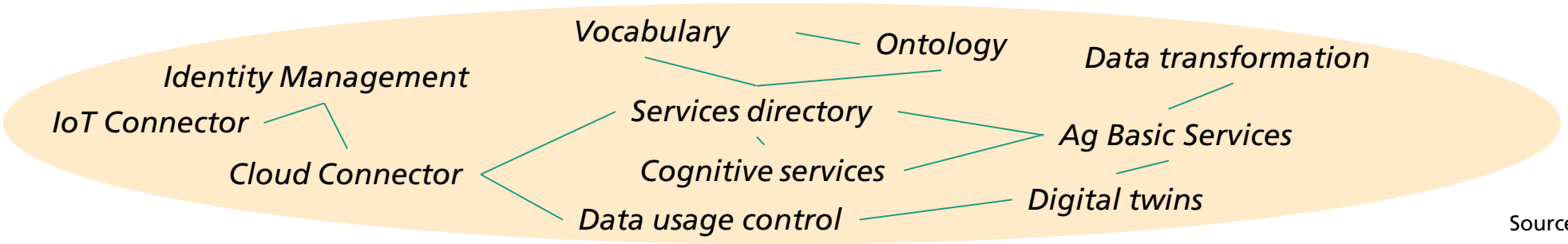
- **Access to all of an asset's data in one place**
  - the information needed for agricultural processes will become **easily reusable** for existing and new use cases
  - Asset owners will have **easier data sovereignty** and benefit from easier administration
- Realization by **utilizing digital twins** containing an asset's information
- For the concept of digital twins, we can distinguish two cases:
  - Actual data is physically stored in one place, or
  - **data is distributed**, but **access to it is offered via one single interface**

Agricultural Dataspaces: Standardization is Needed to Realize the Necessary Key Concepts

- The Agricultural Dataspace is created between cloud solutions, among which the farmer can choose flexibly:



- The interaction between solutions of different manufacturers requires **novel and standardized approaches** for basic services of digital cooperation of individual platforms:



Source: Fraunhofer IESE

Source: Fraunhofer IESE