EU-JAPAN DIGITAL WEEK 2025

31 MARCH - 7 APRIL, 2025

TOKYO, JAPAN

THE EU-JAPAN DIGITAL WEEK IS ORGANISED AS PART OF THE EU-JAPAN DIGITAL PARTNERSHIP

Experience from implementing an EU-Japan cross-data space case study

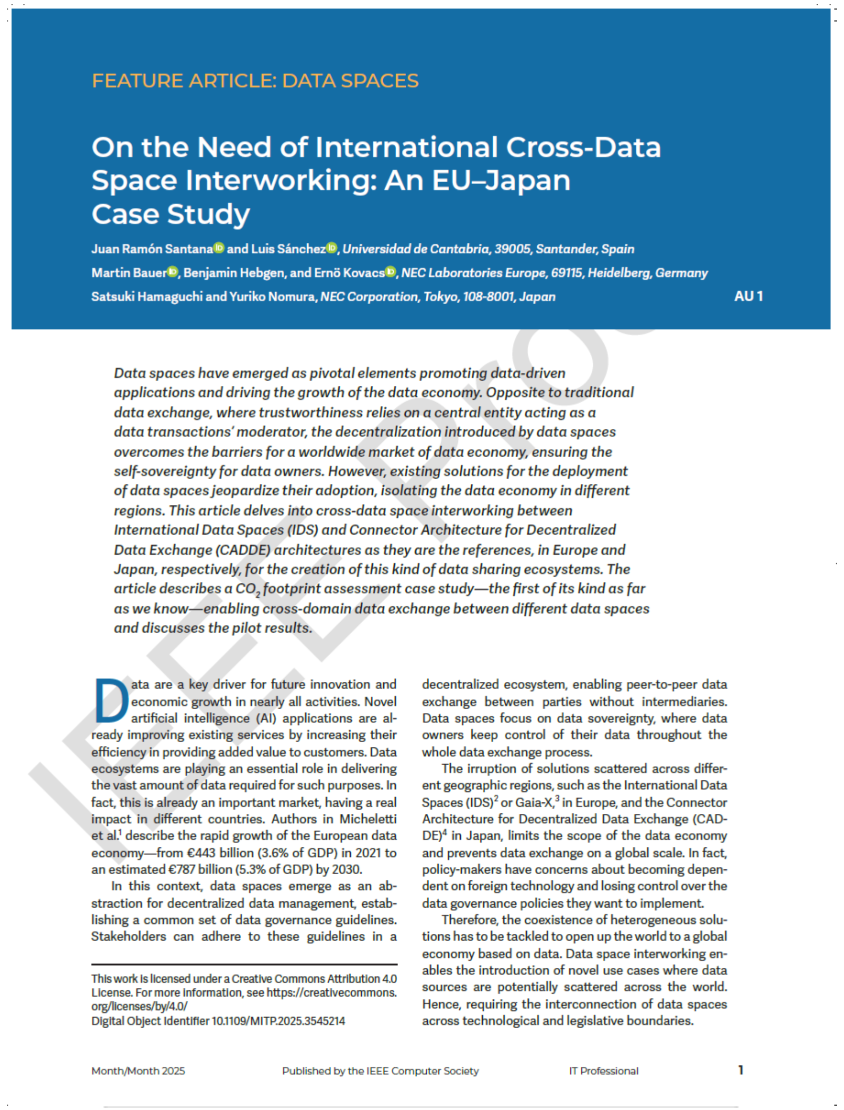
Martin Bauer
Principal Standardization Engineer
NEC Laboratories Europe

INPACE
Indo-Pacific-European Hub for Digital Partnerships

O-CEI

NEC

Overview



FEATURE ARTICLE: DATA SPACES

On the Need of International Cross-Data Space Interworking: An EU–Japan Case Study

Juan Ramón Santana and Luis Sánchez, *Universidad de Cantabria, 39005, Santander, Spain*
Martin Bauer, Benjamin Hebgen, and Ernö Kovacs, *NEC Laboratories Europe, 69115, Heidelberg, Germany*
Satsuki Hamaguchi and Yuriko Nomura, *NEC Corporation, Tokyo, 108-8001, Japan* AU 1

Data spaces have emerged as pivotal elements promoting data-driven applications and driving the growth of the data economy. Opposite to traditional data exchange, where trustworthiness relies on a central entity acting as a data transactions' moderator, the decentralization introduced by data spaces overcomes the barriers for a worldwide market of data economy, ensuring the self-sovereignty for data owners. However, existing solutions for the deployment of data spaces jeopardize their adoption, isolating the data economy in different regions. This article delves into cross-data space interworking between International Data Spaces (IDS) and Connector Architecture for Decentralized Data Exchange (CADDE) architectures as they are the references, in Europe and Japan, respectively, for the creation of this kind of data sharing ecosystems. The article describes a CO_2 footprint assessment case study—the first of its kind as far as we know—enabling cross-domain data exchange between different data spaces and discusses the pilot results.

Data are a key driver for future innovation and economic growth in nearly all activities. Novel artificial intelligence (AI) applications are already improving existing services by increasing their efficiency in providing added value to customers. Data ecosystems are playing an essential role in delivering the vast amount of data required for such purposes. In fact, this is already an important market, having a real impact in different countries. Authors in Micheletti et al.[1] describe the rapid growth of the European data economy—from €443 billion (3.6% of GDP) in 2021 to an estimated €787 billion (5.3% of GDP) by 2030.

In this context, data spaces emerge as an abstraction for decentralized data management, establishing a common set of data governance guidelines. Stakeholders can adhere to these guidelines in a decentralized ecosystem, enabling peer-to-peer data exchange between parties without intermediaries. Data spaces focus on data sovereignty, where data owners keep control of their data throughout the whole data exchange process.

The irruption of solutions scattered across different geographic regions, such as the International Data Spaces (IDS)[2] or Gaia-X,[3] in Europe, and the Connector Architecture for Decentralized Data Exchange (CADDE)[4] in Japan, limits the scope of the data economy and prevents data exchange on a global scale. In fact, policy-makers have concerns about becoming dependent on foreign technology and losing control over the data governance policies they want to implement.

Therefore, the coexistence of heterogeneous solutions has to be tackled to open up the world to a global economy based on data. Data space interworking enables the introduction of novel use cases where data sources are potentially scattered across the world. Hence, requiring the interconnection of data spaces across technological and legislative boundaries.

Digital Object Identifier 10.1109/MITP.2025.3545214

1. Motivation
2. EU and Japan Data Space Ecosystem
3. Data Space Interworking: Proof-of-Concept Architecture
4. Application: CO_2 Footprint Monitor
5. Experiences and Conclusion
6. Vision: AI Agent Framework

Juan Ramón Santana, Luis Sánchez, **Martin Bauer** , Benjamin Hebgen, Ernö Kovacs, Satsuki Hamaguchi and Yuriko Nomura,
On the Need of International Cross-Data Space Interworking: An EU–Japan Case Study, IEEE IT Professional
<to be published soon>

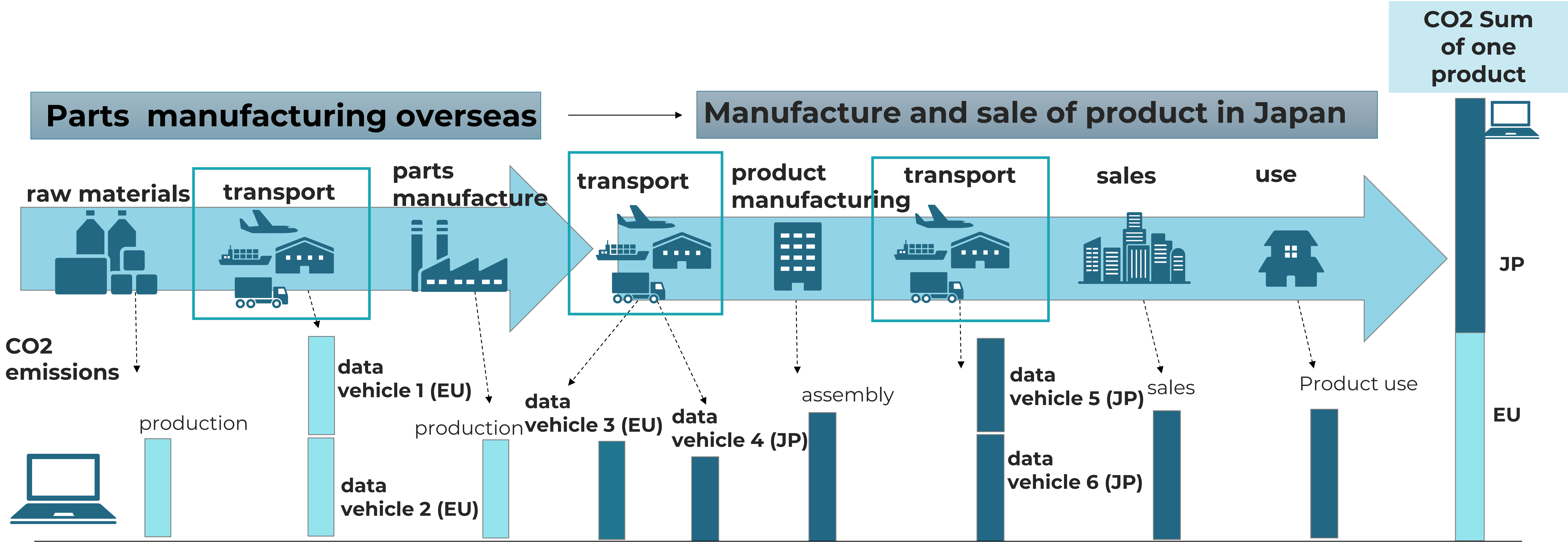
Motivation

- There are many use cases where trusted international data exchange is needed
- Example: "Digital Product Passport" requires capturing the environmental footprint

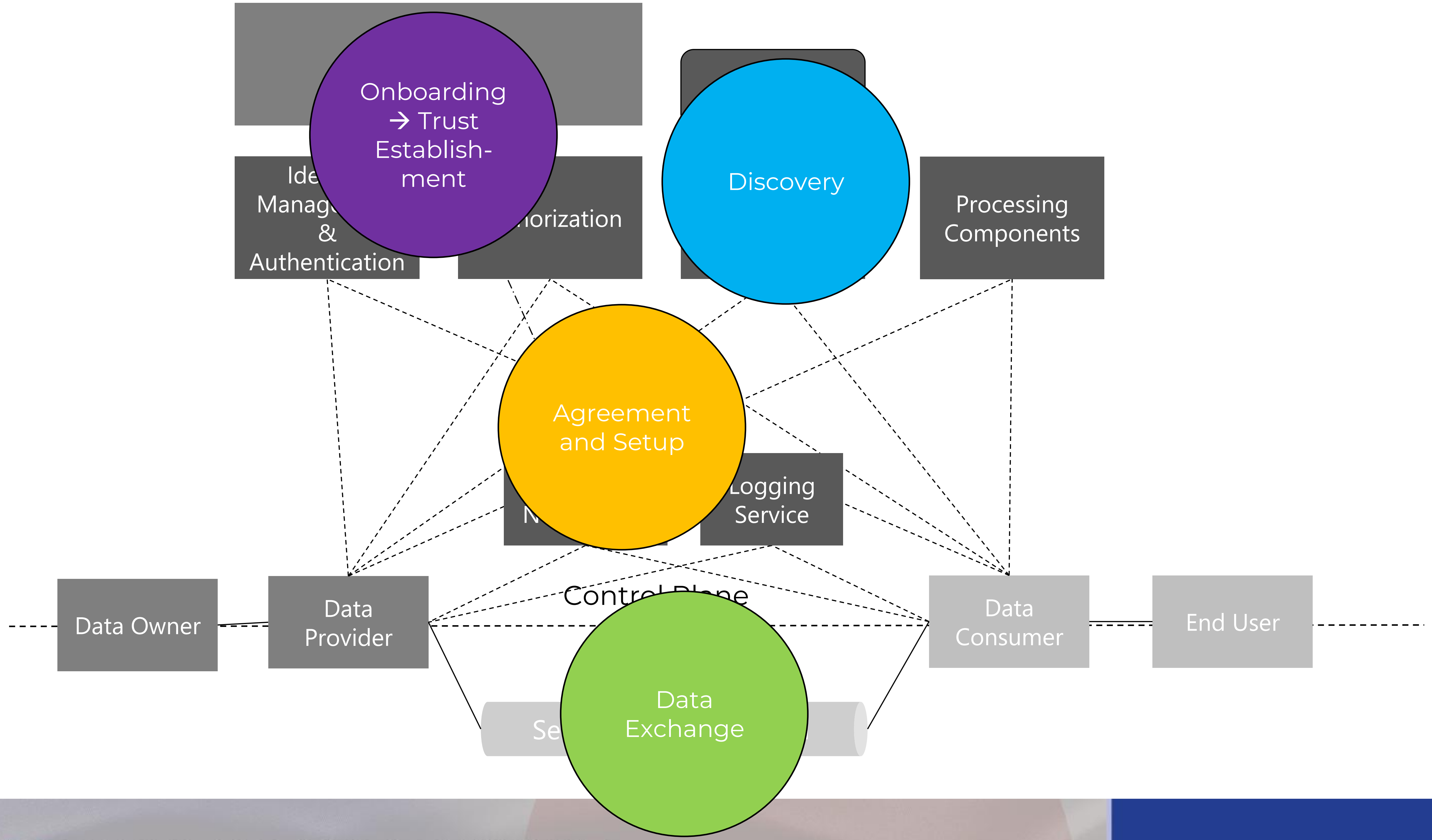
    - International supply chains need to be incorporated into the CO_2 calculations

    → Connect International Data Spaces across technology and legislative boundaries

Motivation: Carbon Management in an International Supply Chain

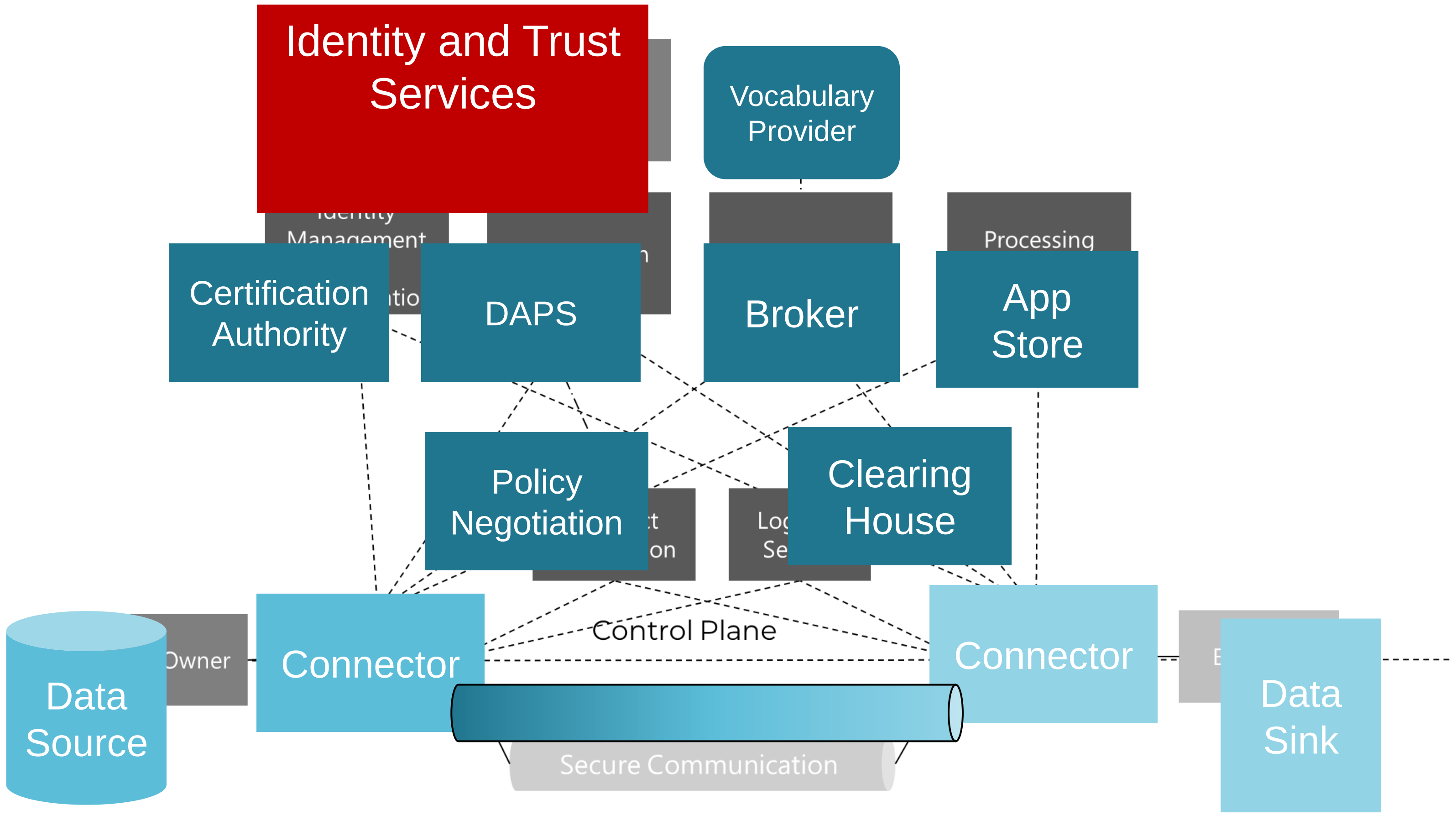


Abstract Data Space Architecture



EU Data Space Ecosystem (2022/23)

- **IDS**
- IDS architecture provides a reference framework for decentralized data exchange
- Central concept: connector, establishes secure communication between participants.
- Connectors are supported by a set of centralized components provided by a data space facilitator.
- Before data exchange takes place, participants' connectors agree on a mutually binding contract establishing the conditions under which data can be accessed and used.
- IDS requires any component interacting in a data space to be certified to guarantee conformance to the processes defined in the architecture, so that agreements can be technically enforced.
- **Gaia-X**
- Gaia-X specifies a framework for creating a federated and secure data infrastructure based on a common trust framework.
- [not yet available in the timeframe 2022/23]

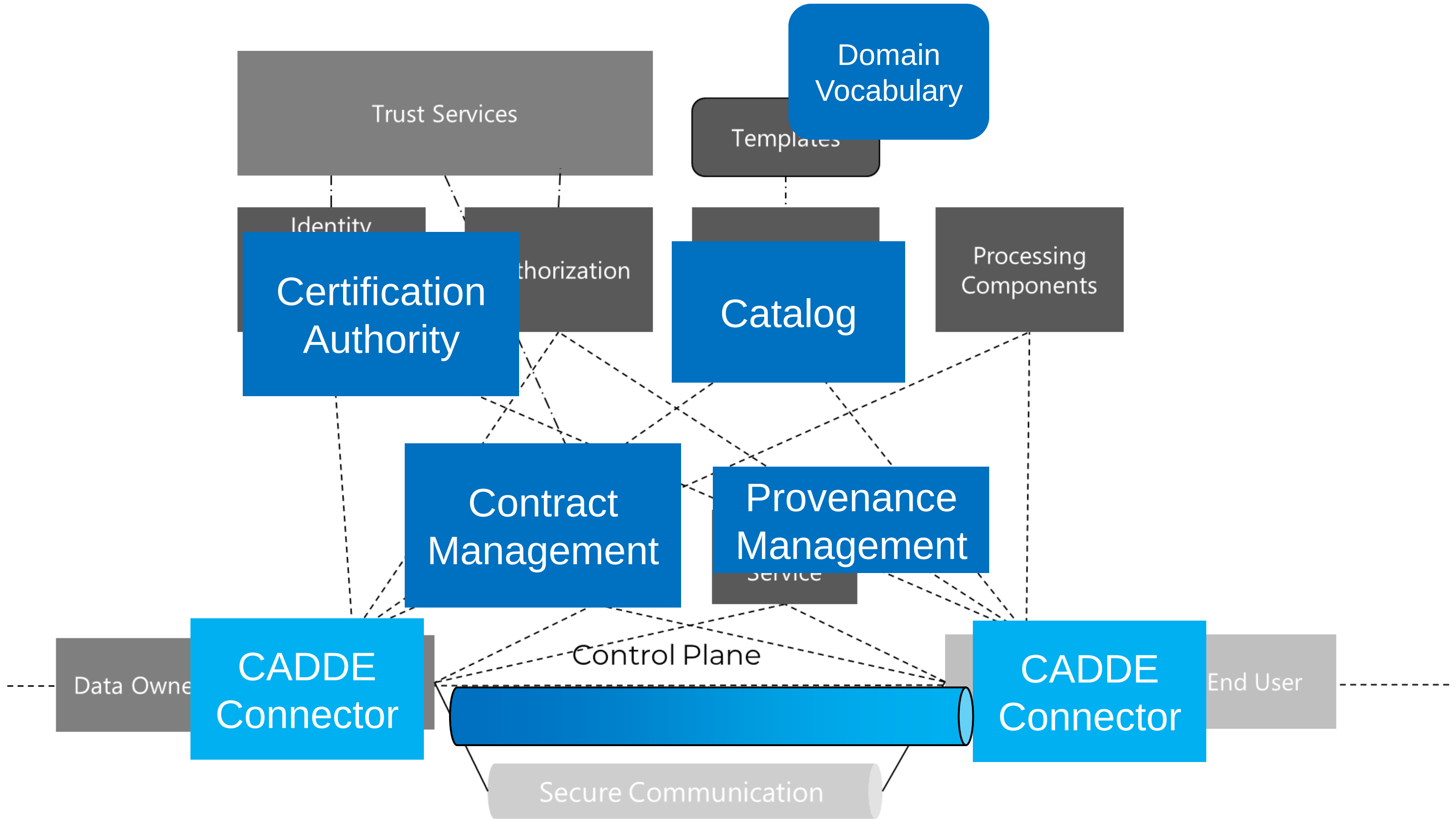


Japanese Data Space Ecosystem (2022/23)

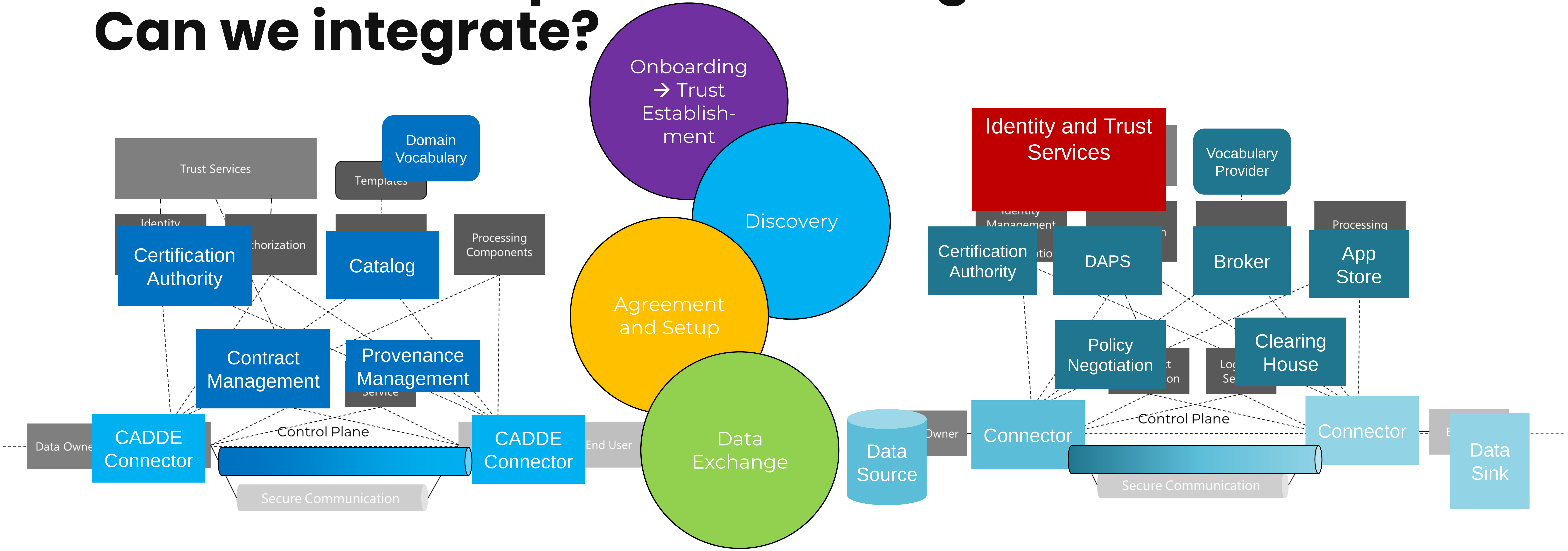
CADDE Architecture to be verified

DATA-EX / CADDE

- CADDE is a cross-domain data exchange platform for discovery and cross-domain data sharing.
- The core element is a network of connector modules enabling data providers and consumers to participate in a CADDE data space.
- CADDE is planned to be used by the Japanese nation-wide cross-domain data exchange platform DATA-EX.
- With the support of CADDE, DATA-EX provides the following:
  - unique identification of data items
  - secure access to the data space only to authorized members
  - connectors enabling publishing, discovery, and using data under access control policies
  - data catalogues managing metadata descriptions and data access details
  - history management controlling relationships between data items, logging all data exchanges.



Different Data Space Technologies – Can we integrate?

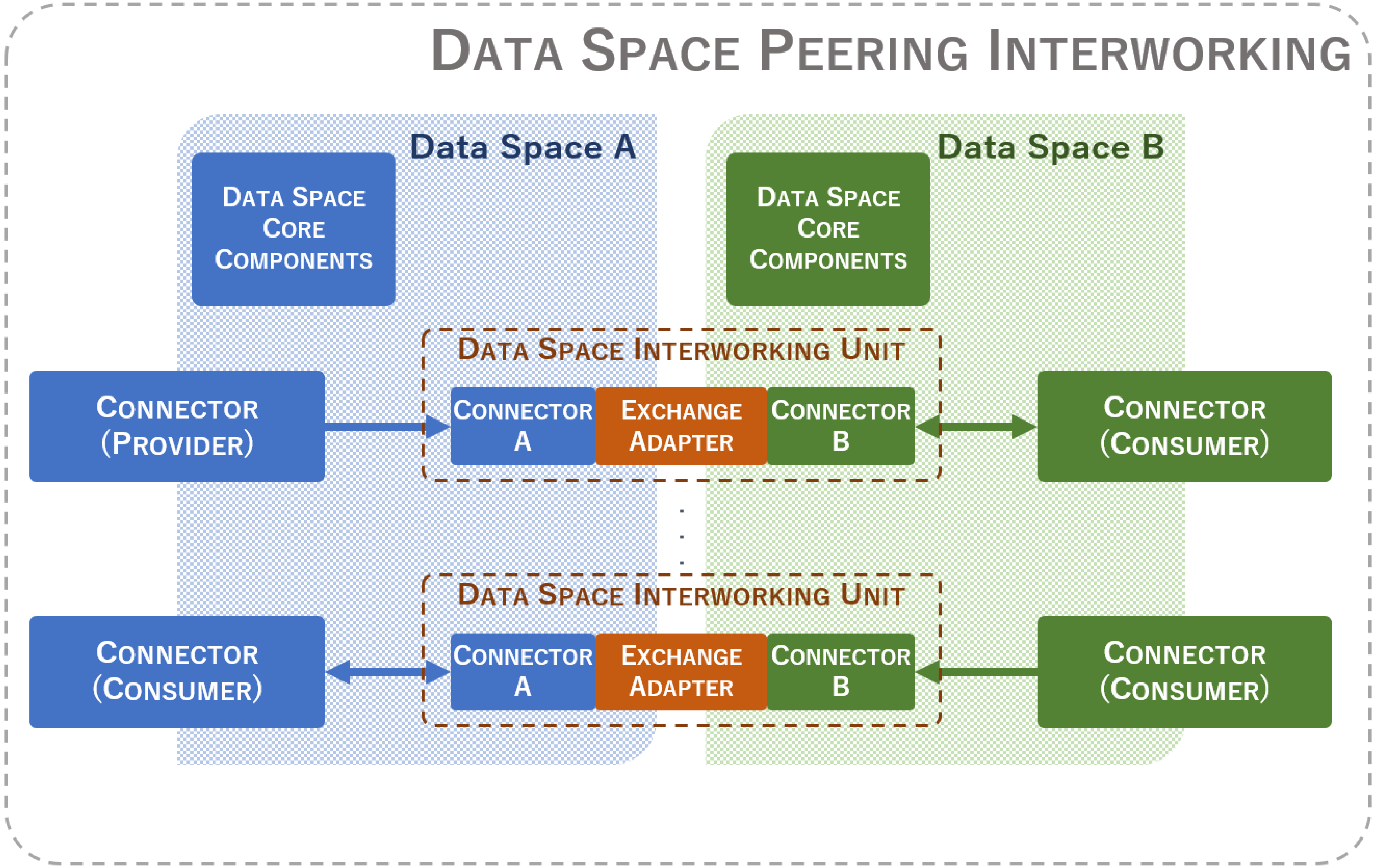


Data Space Peering Architecture

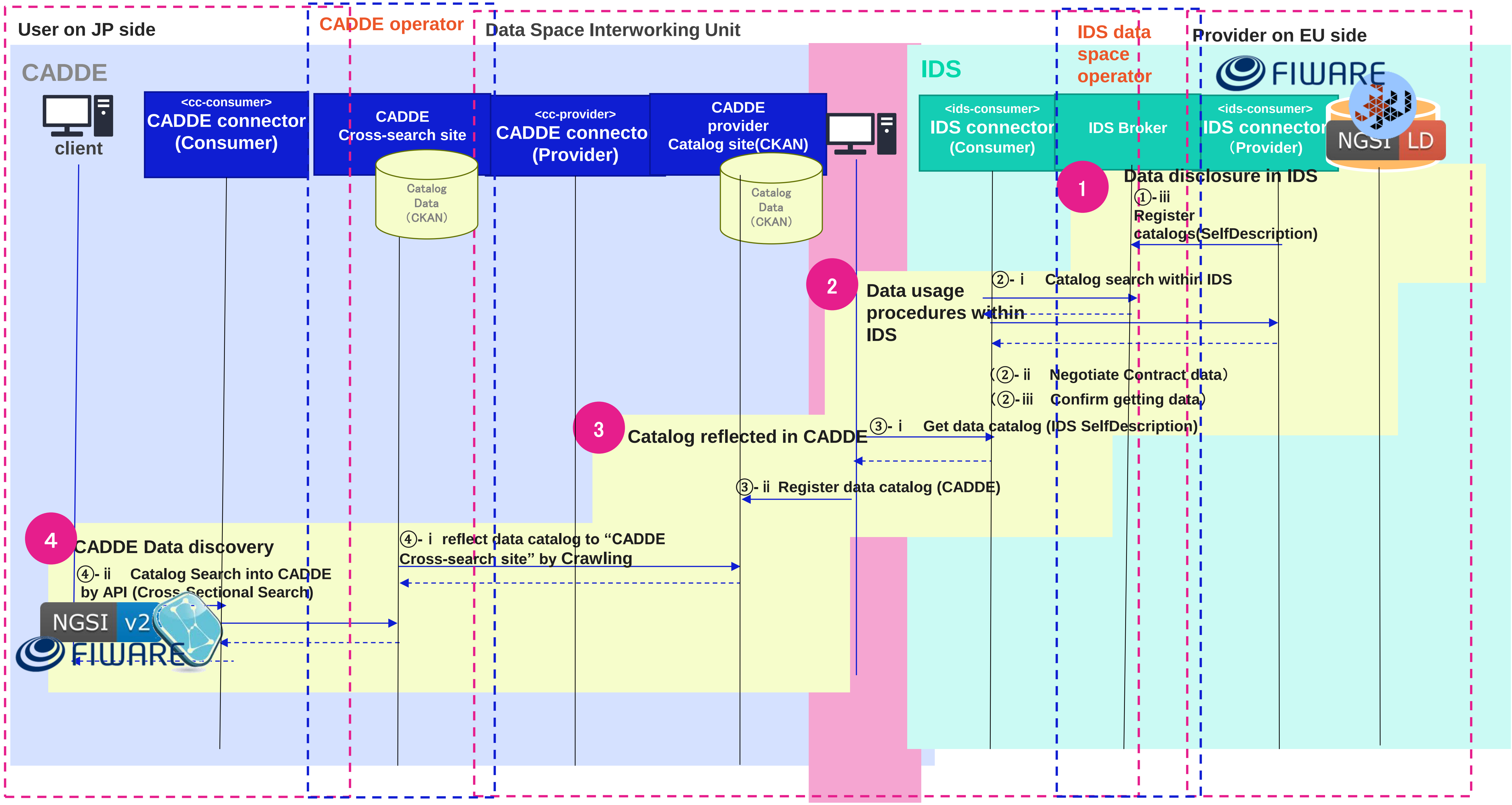
Data Space Peering Interworking

- Data Space Interworking Unit: Connector A (e.g. CADDE), Connector B (e.g. DSC(IDS)) + Exchange Adapter

- Data Space Interworking Unit in each Data Space represents respective other Data Space

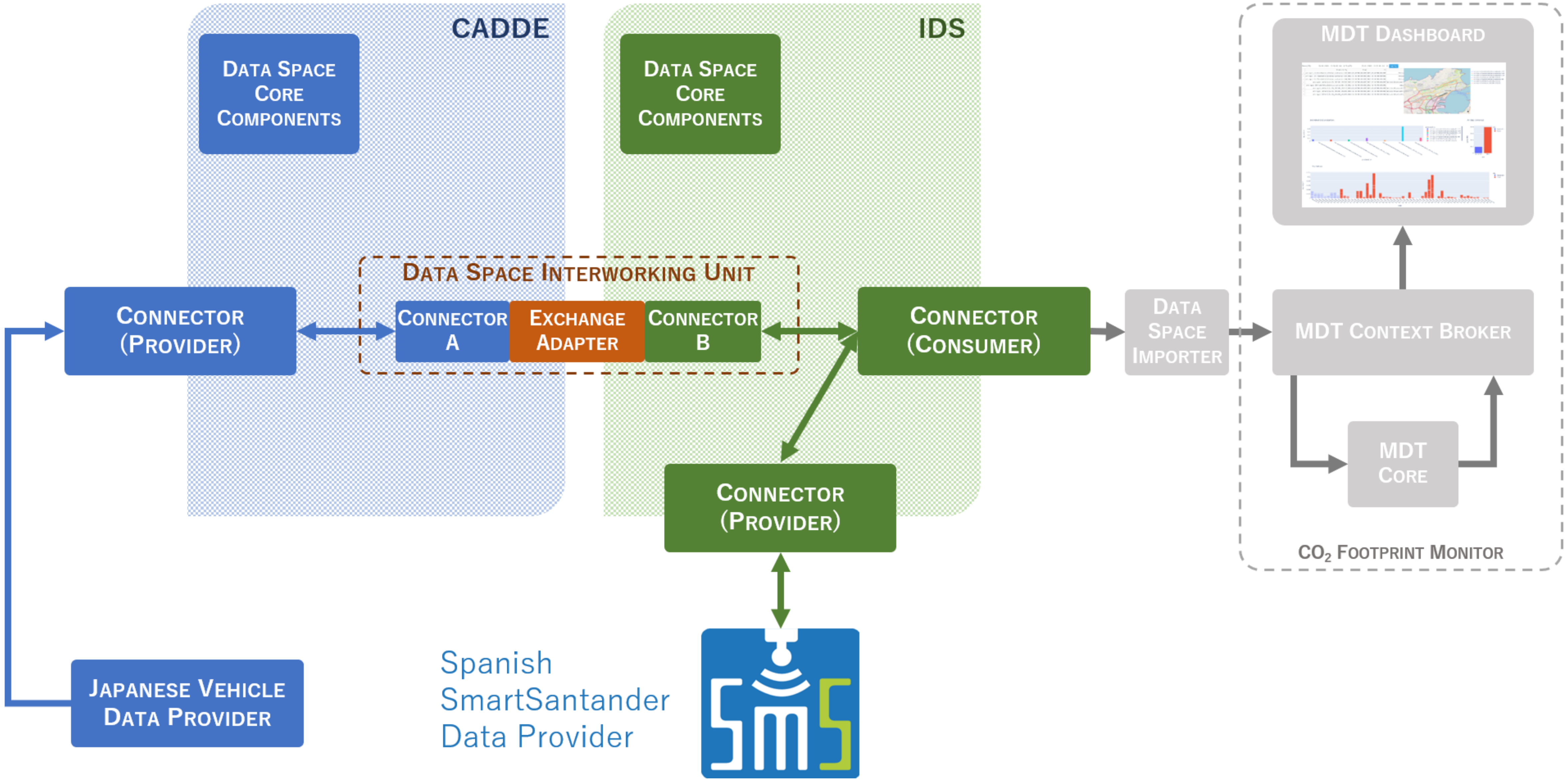


Example: Data Discovery Japan → Europe



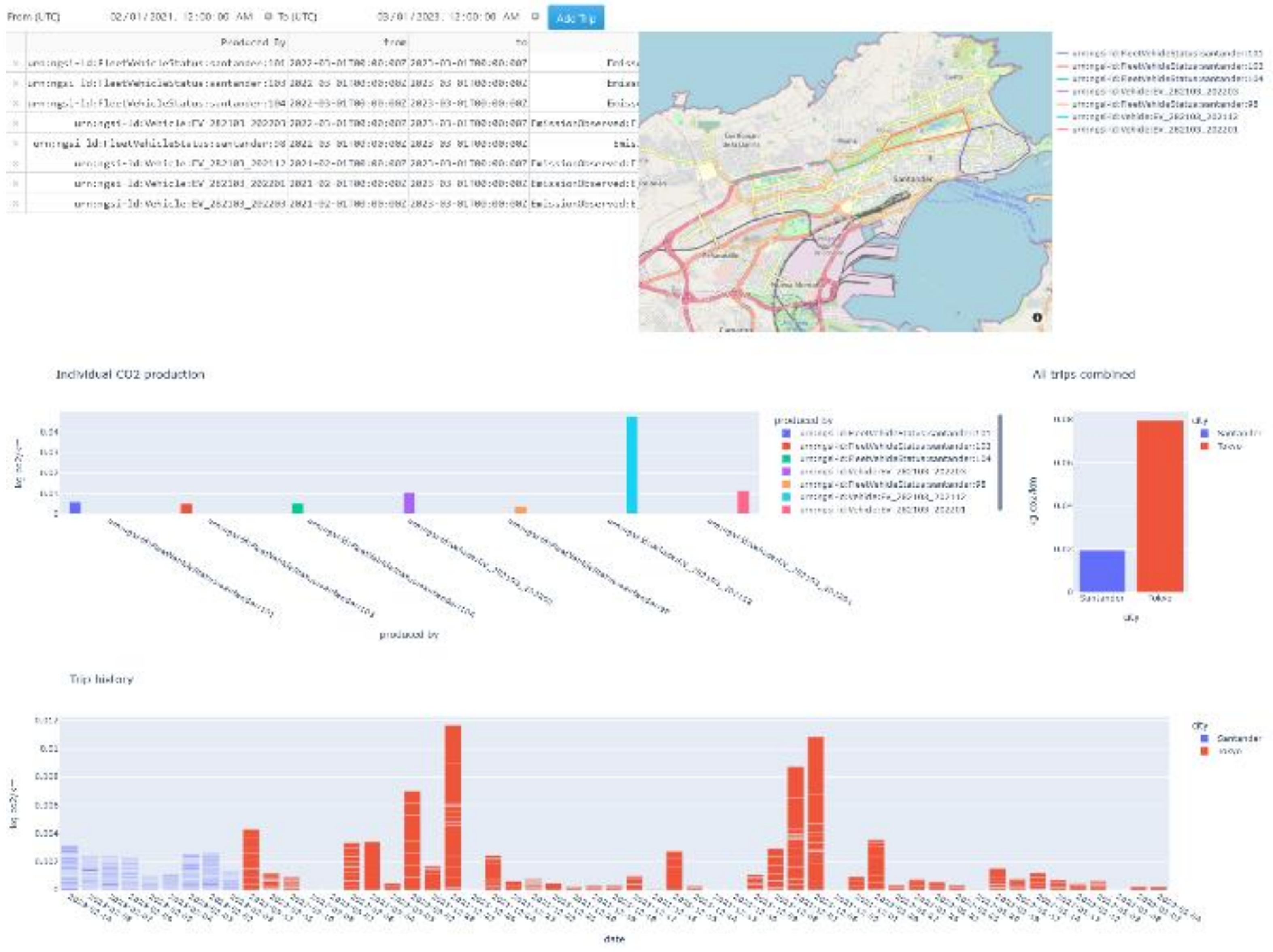
Resulting CO_2 Footprint Monitoring System

- On the European side, an IDS-based data space was established within the framework of SmartSantander
- The connector selected was the IDS-certified data space connector (DSC).
- On the Japanese side, a CADDE-based data space was used.



Application: CO_2 Footprint Monitor

- CO_2 Footprint Monitor consumes different kinds of mobility-related data to **estimate vehicles' CO_2 emissions**
- It is based on the ODALA Mobility Data Toolkit (MDT), a tool to track emissions **based on vehicle metrics**.
- On the European side, the system was populated with heterogeneous open and private datasets, including **buses' position, routes and speed, updated in real-time**.
- On the Japanese side, **information on vehicles' position, engine type, and vehicle consumption metrics**, framed within the Strategic Innovation Program (SIP) was used.
- All these mobility-related data have been **processed continuously, estimating the CO_2 emissions per vehicle and passenger**, enriching the information obtained from both data spaces.
- Everything is **shown on a dashboard as a multigraph visualization of vehicles CO2 emissions**.



Experiences

✓ **Agreement and Setup**
Data Space Interworking Unit is part of both data spaces and thus enables agreement and setup.

✓ **Discovery**
Different discovery protocols and data models are used.
Data Space Interworking Unit can handle both and supports translation between them.

✓ **Data Exchange**
Information is represented using different but similar representations and underlying models (NGSIv2 vs. NGSI-LD).
Data Space Interworking Unit can handle both and supports translation between them.

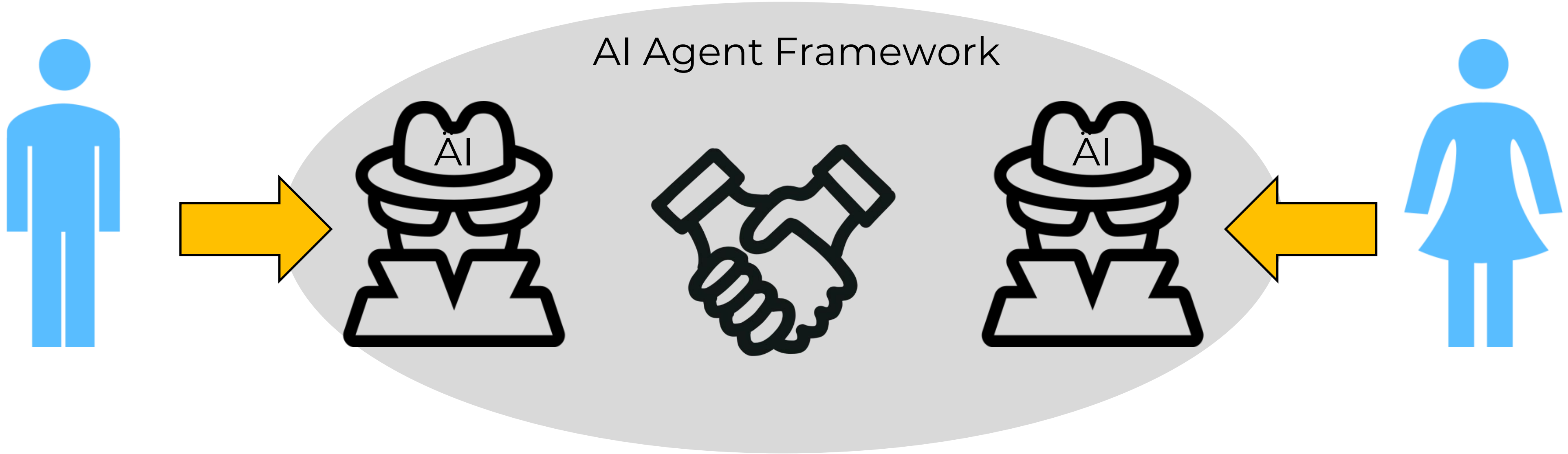
✗ **Trust**
Assumption here is that Data Space Interworking Unit is trusted in both Data Spaces and respectively represents the other Data Space. This generally does not hold and breaks end-to-end trust typically assumed and required in Data Spaces!

Conclusion

- Currently there are **different data space technologies**.
  In Europe, there is ongoing work in aligning approaches, e.g. in Data Spaces Business Alliance (DSBA) and Data Spaces Support Centre (DSSC)
- Building an **integrated data space is technically possible**, protocol and data conversions are generally feasible.
- However, trust establishment requires further alignment, i.e. a **compatible trust architecture**.
- Example: *agree on a common trust technology and common policy language as a basis* that would enable end-to-end trust between participants
  [actual trust anchors and policies could then be agreed on case-by-case basis]

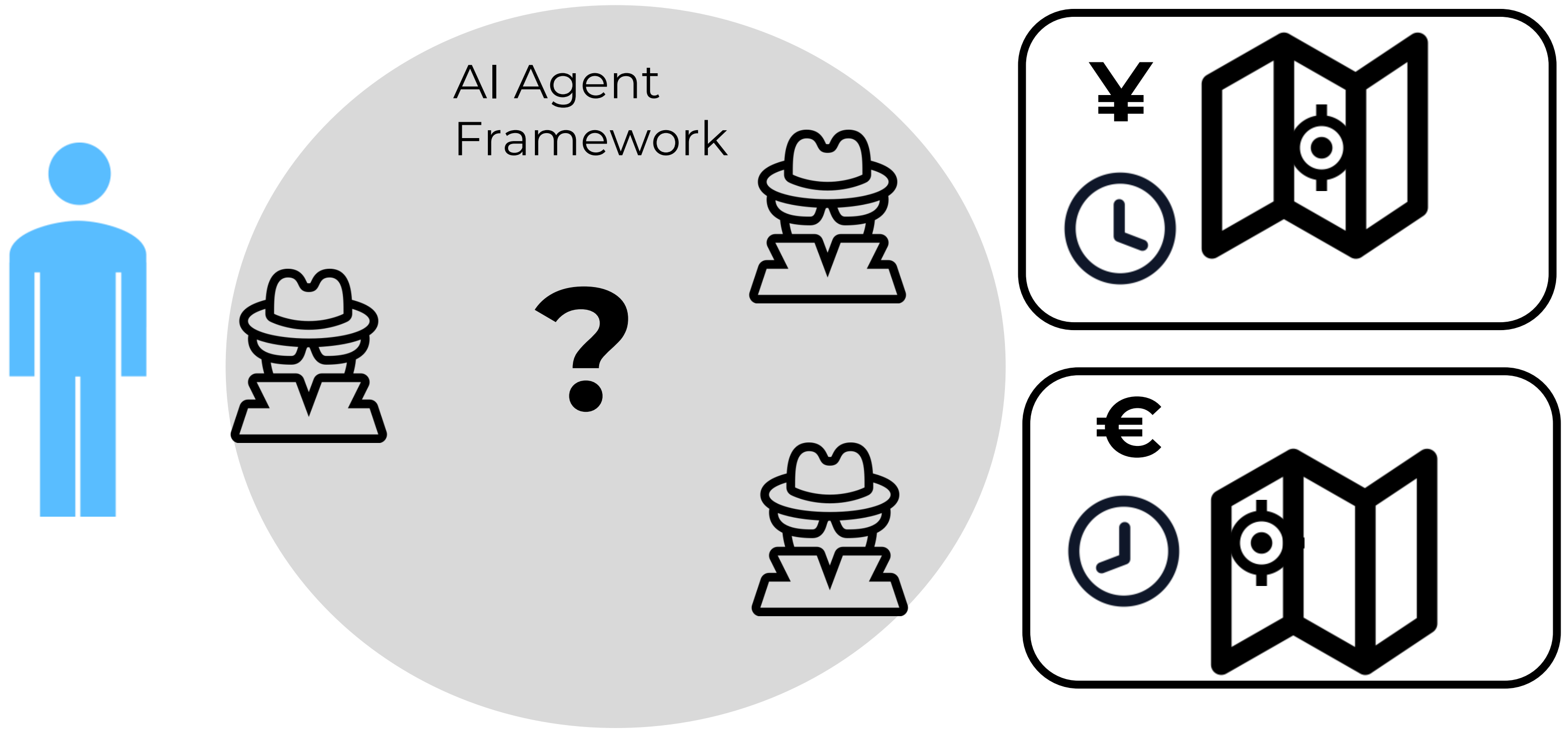
Vision: AI Agent Framework

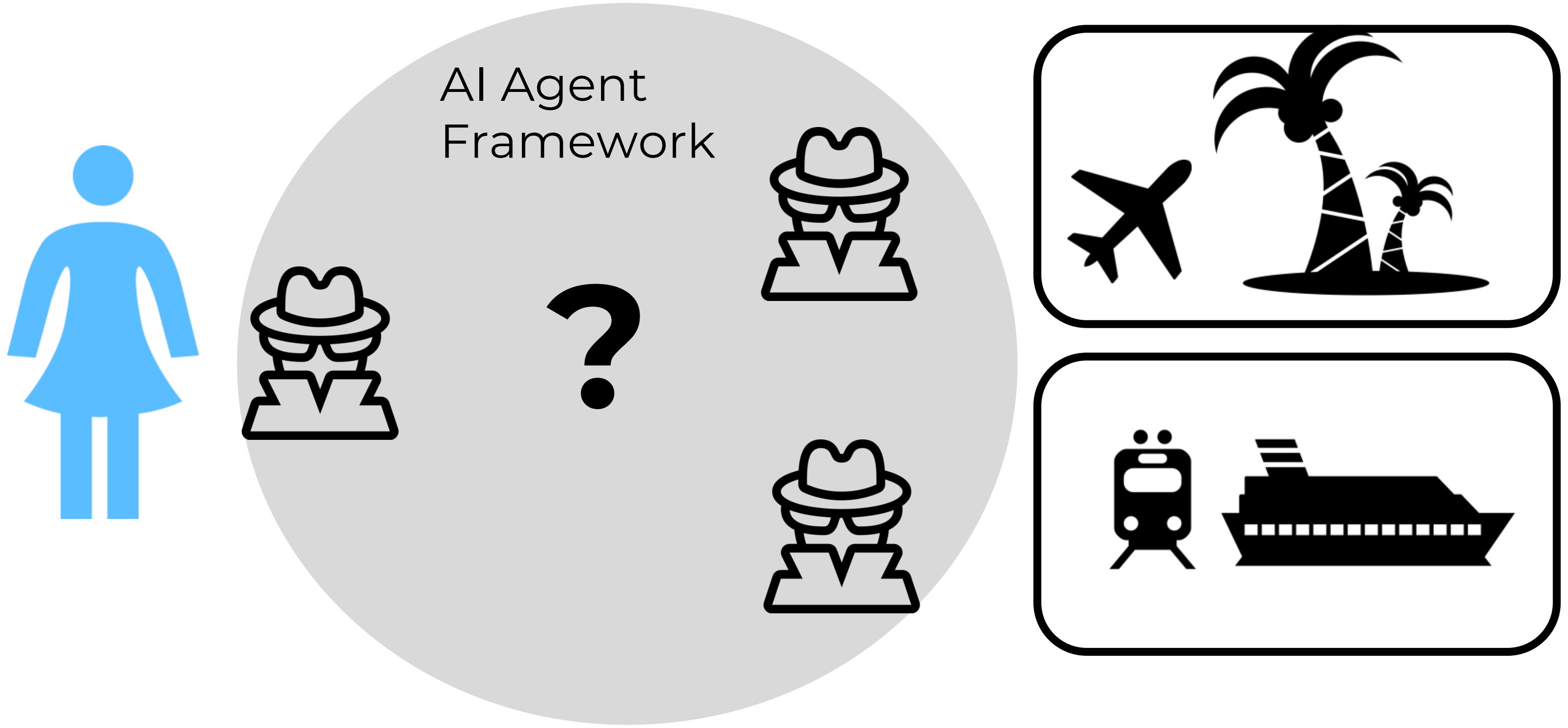
- Data spaces provide a great basis for making data available in a trustworthy manner.
- However, how can the data be found and utilized best?
- AI agents can discover, negotiate, exchange and utilize data on behalf of human users.



Vision: AI Agents – Use Case Examples

- Buying and selling goods, taking into account location, timing etc.
- Tourism: enable the consumer to find the best package by choosing and combing offers from different providers.





THANK YOU FOR YOUR ATTENTION!

The EU-Japan Digital Week is an initiative under the EU-Japan Digital Partnership and is supported by the following projects and organisations