Architectural Concept for Global Trusted Dataspaces:

Realizing trusted data distribution across organizations and industries

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NTT Communications Corporation
NTT DATA Corporation
Nippon Telegraph and Telephone Corporation

Overview

Purpose of this document

This White Paper introduces an architectural concept for global trusted dataspaces to provide trusted data distribution across organizations and industries. The project is an initiative by NTT Communications Corporation (NTT Com) and NTT DATA Corporation (NTT DATA), based on the technologies and knowledge provided by Nippon Telegraph and Telephone Corporation (NTT).

The White Paper presents the efforts and achievements up to now made toward realizing a global data linkage platform, as well as plans for future verification testing and technological development. Going forward, NTT Group plans to recruit demonstration partners from various industries.

Target readers of this document

Companies and organizations struggling with data integration globally, or those considering initiatives to address integration issues.

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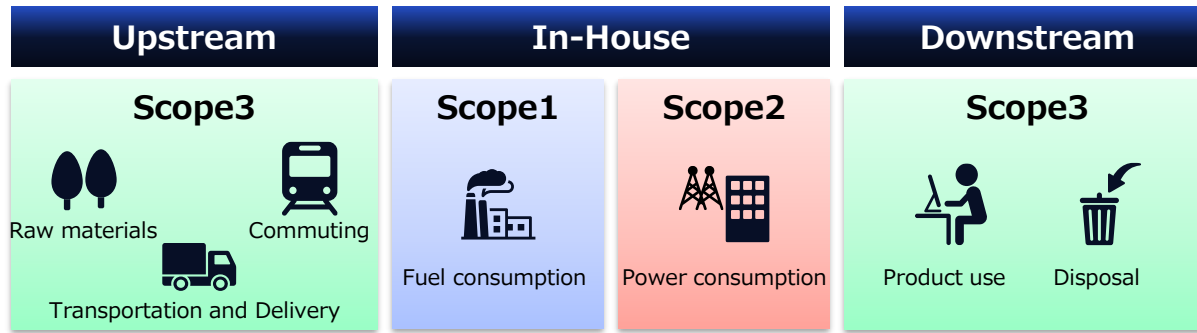
NTT Communications Corporation

NTT DATA Corporation

Nippon Telegraph and Telephone Corporation

Changes in the Social Environment:
Data sharing is necessary among companies that comprise the global value chain

From the perspective of ESG and SDGs, sharing data globally is necessary for organizations and companies in a range of industries, such as automobiles, aviation, and energy.

Disclosure Scope

Throughout product life cycles, the **following items must be disclosed based on aggregation by product** -- the types of materials used, amount of CO_2 emissions and resources wasted throughout the entire manufacturing process, **not only in-house data**.

Upstream	In-House		Downstream
Scope3	**Scope1**	**Scope2**	**Scope3**
Raw materials Commuting Transportation and Delivery	Fuel consumption	Power consumption	Product use Disposal

Disclosure →
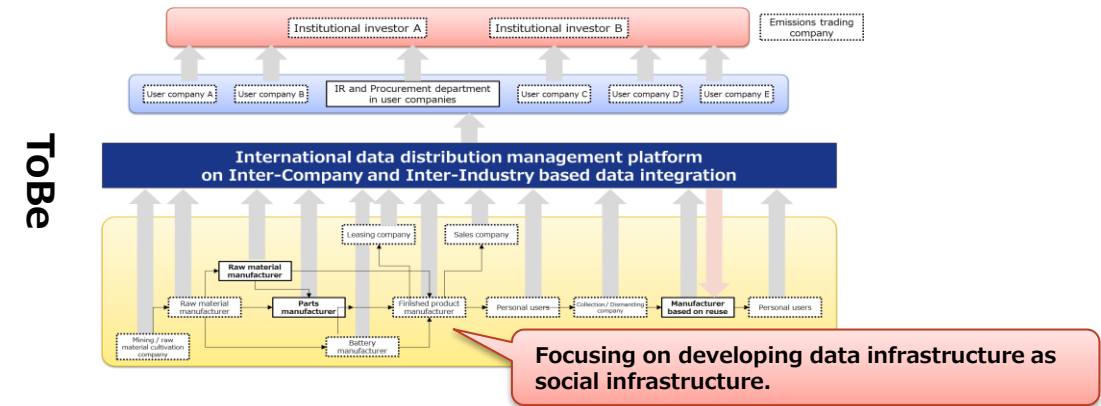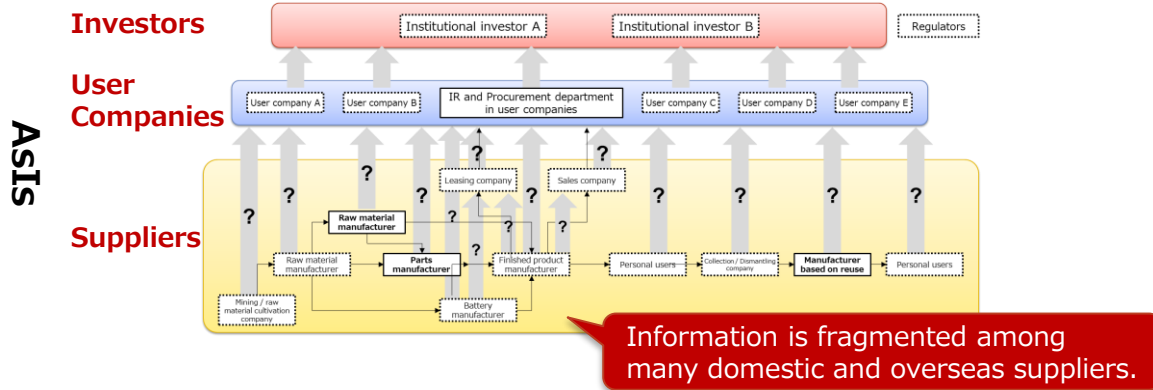
- Institutional investors
- Shareholders
- Business Partners
- Consumers
- Regulators

Data to be shared across organizations, companies globally for **"Society 5.0"**.

Information Collection Issues

It is necessary to efficiently collect accurate data from producers and manufacturers, distributors, sellers, users, collectors and **all around stakeholders making up entire value chain**.

AsIs

Investors
User Companies
Suppliers

Information is fragmented among many domestic and overseas suppliers.

ToBe

International data distribution management platform on Inter-Company and Inter-Industry based data integration

Focusing on developing data infrastructure as social infrastructure.

Security measures are essential to prevent data diversion, leakage, falsification, etc., particularly as regards confidential information such as trade secrets, state secrets, and personal data.
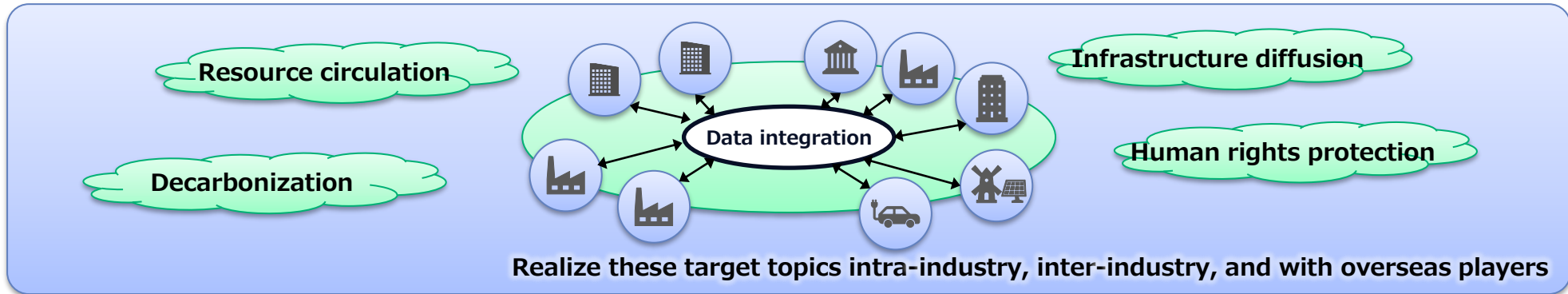
In Europe, efforts for common platforms such as Gaia-X[1] have been launched with the aim of data integration that transcends organizations and industries. In Japan, such a structure is being planned and developed.

Target

Promote data integration on a global scale to solve social issues such as SDGs and Society 5.0[2]

Resource circulation

Decarbonization

Data integration

Infrastructure diffusion

Human rights protection

Realize these target topics intra-industry, inter-industry, and with overseas players

Requirements

Issue 1 : **Trusted data distribution among companies and organizations**

- Maintain confidentiality by **limiting data disclosure by recipient, purpose, and period**

- Information such as tracking, inquiry, sending, receiving, and aggregation **can be handled based on common method**

- **Reduction of the cost burden** for system construction and operation

Issue 2 : **Compliant with policies and regulations of overseas**

- **Cooperating with infrastructure such as Gaia-X in EU and Catena-X[3]**
  Ensuring interoperability with standards such as IDS, FIWARE, RAMI 4.0

- Compliance with national and regional **data protection regulations and security laws**

- Building fair and trusted global data distribution **based on laws and treaties**

NOTE 1: Gaia-X is a data infrastructure concept adopted by the German and French governments in October 2019 for data distribution on protecting security and data sovereignty.
NOTE 2: Society 5.0 means a human-centered society that achieves both economic development and solution of social issues based on integrating cyber space and physical space.
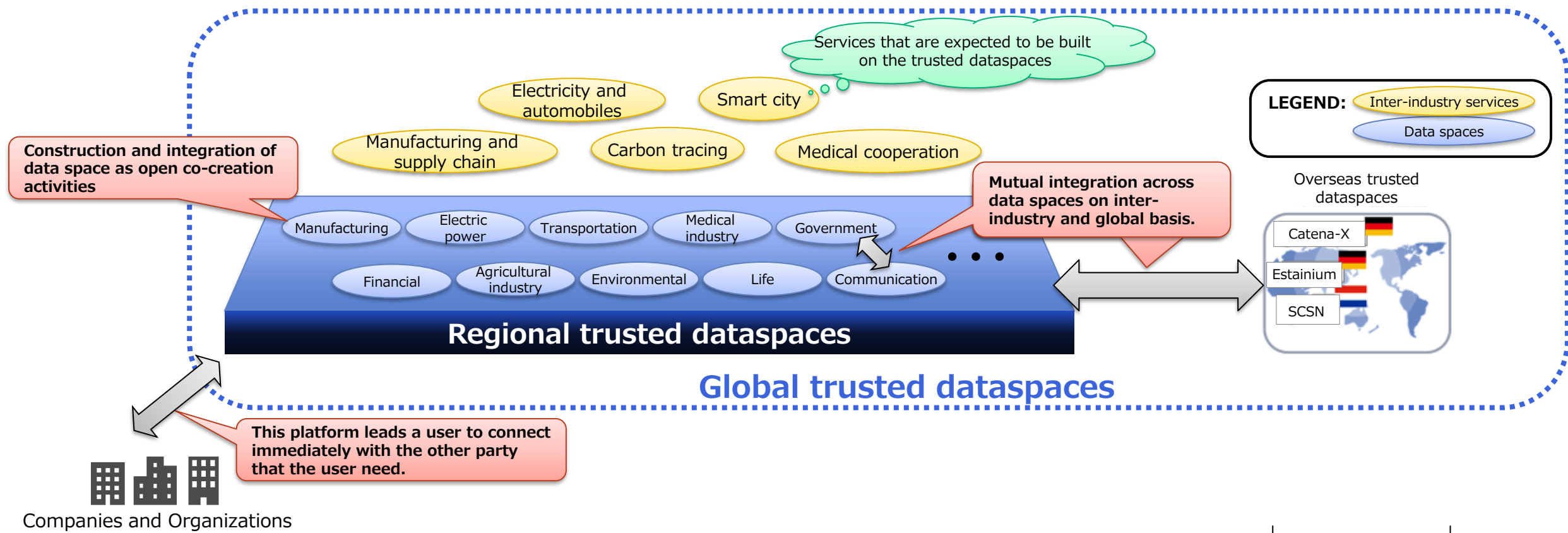NOTE 3: Catena-X is an alliance established by the BMW Group and Mercedes-Benz to share data throughout the automobile value chain with the aim of strengthening competitiveness and reducing CO_2.

Target:
Realization of global trusted dataspaces based on the concept of "Safe, Secure, and Global"

Focus on secure connections, and support for organizations and industries that want to connect globally.

The value that can be provided by realizing global trusted dataspaces:

Building services between data spaces in each industry and across industries on global trusted dataspaces makes it possible **to protect the data sovereignty of companies and organizations** and **support global value creation in various companies and industries**.

Services that are expected to be built on the trusted dataspaces

Electricity and automobiles

Smart city

Manufacturing and supply chain

Carbon tracing

Medical cooperation

LEGEND: Inter-industry services

Data spaces

Construction and integration of data space as open co-creation activities

Mutual integration across data spaces on inter-industry and global basis.

Overseas trusted dataspaces

| Manufacturing | Electric power | Transportation | Medical industry | Government |

| Financial | Agricultural industry | Environmental | Life | Communication |

Regional trusted dataspaces

Catena-X

Estainium

SCSN

Global trusted dataspaces

This platform leads a user to connect immediately with the other party that the user need.
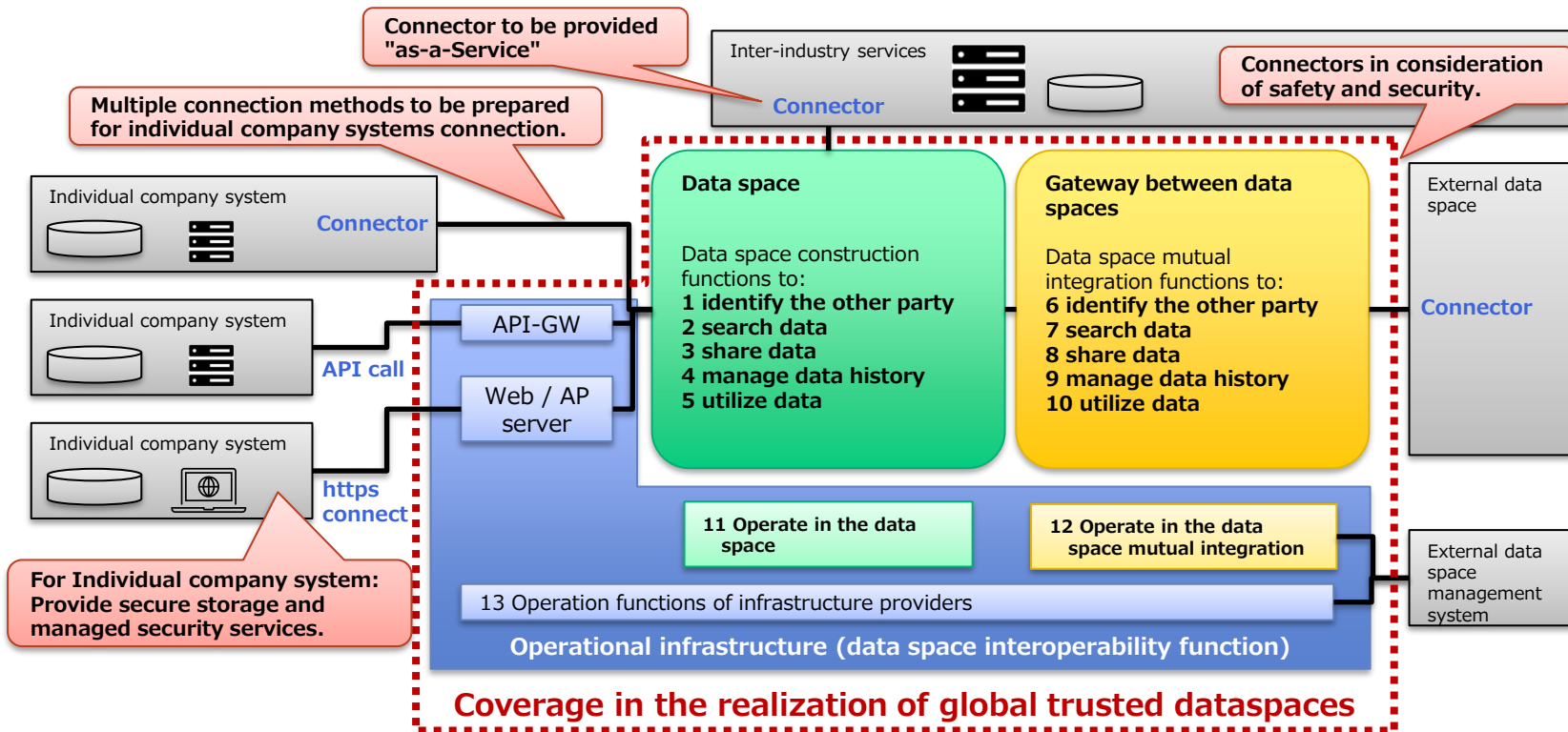
Companies and Organizations

NTT Group Action:
Define function groups and formulate architecture for global trusted dataspaces

Focus on interoperability, security, data sovereignty protection, and usability, and separate into mutual integration and interoperability functions of data space.

Key requirements for the architecture:

"**Connect to various existing and new systems**", "**Connections that are easy, secure and safe for everyone**", "**Protect the data sovereignty of data owners**" and "**Realize the flexibility of development based on safe and secure**"

Data integration infrastructure architecture

Connector to be provided "as-a-Service"

Multiple connection methods to be prepared for individual company systems connection.

Inter-industry services

Connector

Connectors in consideration of safety and security.

External data space

Connector

Individual company system

Connector

Individual company system

API call

API-GW

Web / AP server

Individual company system

https connect

Data space

Data space construction functions to:
1 identify the other party
2 search data
3 share data
4 manage data history
5 utilize data

Gateway between data spaces

Data space mutual integration functions to:
6 identify the other party
7 search data
8 share data
9 manage data history
10 utilize data

For Individual company system: Provide secure storage and managed security services.

11 Operate in the data space

12 Operate in the data space mutual integration

13 Operation functions of infrastructure providers

Operational infrastructure (data space interoperability function)

External data space management system

Coverage in the realization of global trusted dataspaces

Function Groups

#	Functions		Classification	
1	confirming the identity of the connection destination and specifying the connection destination	Construction	Data space construction
2	finding the data you want		
3	sharing data only with the person you want to share data with		
4	securely maintaining and using data transaction history and history		
5	processing data		
6	confirming the identity of the connection destination and specifying the connection destination across the data space		Data space mutual integration
7	finding the data you want across the data space		
8	sharing data only with the person you want to share data with across data spaces		
9	securely holding and using data transaction history and history across data spaces		
10	processing data across data spaces		
11	the operation of the data space operator	Operation	Data space interoperability
12	the operators of data space interconnection		
13	infrastructure providers		

NTT Group Action:
Examine and demonstrate methods for international interconnection of different data spaces

Implement a method for international interconnection of different data spaces, and establish connections. Lead the world in testing.

As the international interconnection method, utilize IDS Connector, an essential function of the IDS[4] compliant data space, and the IDS connector authentication system Dynamic Attribute Provisioning Service (DAPS).
In addition, **an international interconnection test was conducted with SCSN[5], which has the same function**.
This is the world's first instance of international interconnection for practical use to manage connections and protect data sovereignty based on the policies of each country.

Efforts for data space mutual interconnection functions
Implementation and connection test for method of internationally interconnecting different data spaces
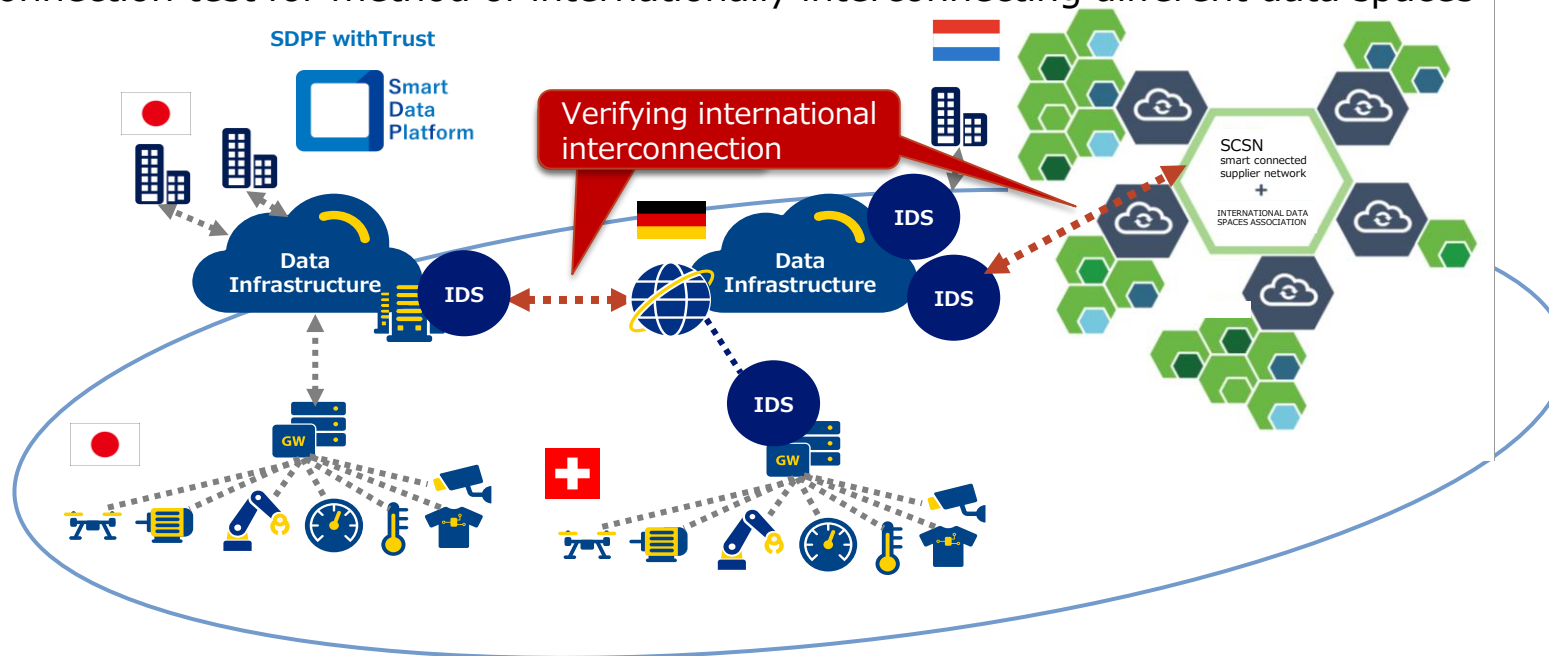
NOTE 4 : A system of technical specifications for international data spaces established by the International Data Spaces Association (IDSA).
NOTE 5 : A network for exchanging supply chain information in the manufacturing industry provided in the Netherlands.

Inter-organizational Data Integration Issues (1): Confidentiality to protect data sovereignty, and linking data safely and securely

The challenge is to reconcile the conflicting demands of the need for raw data, and reluctance for disclosure.

Issue — Currently, there is a risk that confidential data will be leaked to third parties, including competitors.

Example : Calculation and publishing of the deterioration state of batteries by combining in-house and other companies' data

In-house
- ·Material information
- ·Temperature information

Data

Apps

Statistical calculation app

Other Company A

Data

Battery usage

Regional trusted dataspaces

Data originally intended to be published

Data

Apps

Calculation result

Battery deterioration

In the case of a non-confidential platform, the platform administrator etc. could view confidential data.
-> Risk of confidential data leak

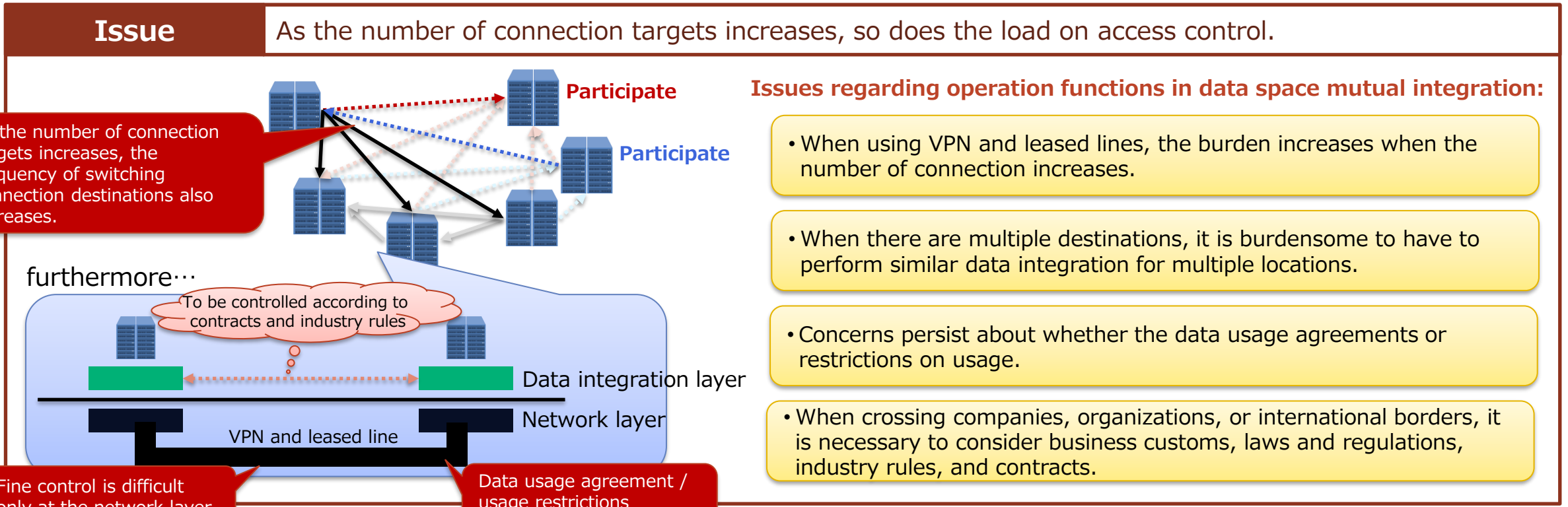**Issues regarding operation functions in data utilization:**

- Currently, there is no foundation for safe and trusted data integration.

- Companies do not want to disclose confidential business information such as product types and volumes, or customers.

- Companies do not want data to be use for anything other than the intended purpose.

- Because raw data is not disclosed, necessary information cannot be collected.

Solutions on operation functions in data utilization:

Adopt and develop concealment technology so that calculation results can be acquired without disclosing confidential data to a third party
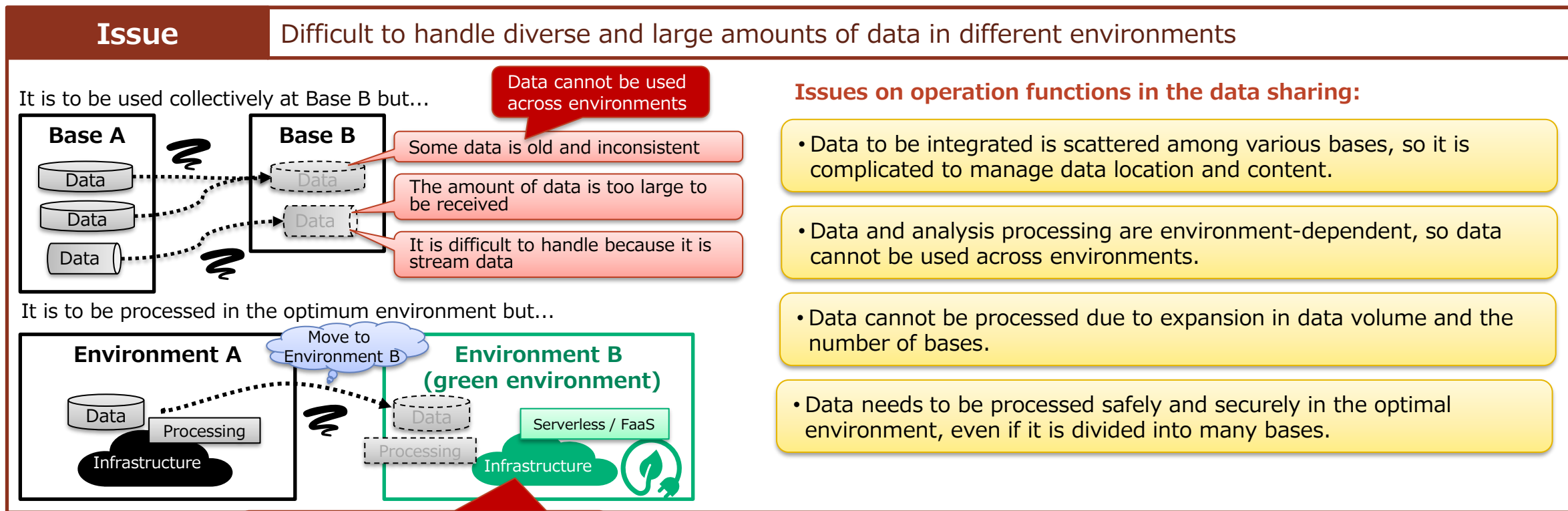
Inter-organizational Data Integration Issues (2): Connectivity for secure and easy connections among multiple companies and globally

The challenge is to create a structure to efficiently integrate data with reliable partners for numerous connection partners.

Issue
As the number of connection targets increases, so does the load on access control.

Participate

Participate

As the number of connection targets increases, the frequency of switching connection destinations also increases.

furthermore…

To be controlled according to contracts and industry rules

Data integration layer

Network layer

VPN and leased line

Fine control is difficult only at the network layer

Data usage agreement / usage restrictions required

Issues regarding operation functions in data space mutual integration:

- When using VPN and leased lines, the burden increases when the number of connection increases.

- When there are multiple destinations, it is burdensome to have to perform similar data integration for multiple locations.

- Concerns persist about whether the data usage agreements or restrictions on usage.

- When crossing companies, organizations, or international borders, it is necessary to consider business customs, laws and regulations, industry rules, and contracts.

Solutions for operation functions in data utilization:

Development of a platform that can flexibly control access even with many-to-many connections.

Inter-organizational Data Integration Issues (3): Structure for processing data from different locations in the optimal environment

Consolidation of the data from many bases in one place is unrealistic. Further, the optimal environment varies. The issue is to realize a structure for processing data from different locations in the optimal environment.

Issue — Difficult to handle diverse and large amounts of data in different environments

It is to be used collectively at Base B but...

Base A
- Data
- Data
- Data

Base B
- Data
- Data

Data cannot be used across environments

- Some data is old and inconsistent
- The amount of data is too large to be received
- It is difficult to handle because it is stream data

It is to be processed in the optimum environment but...

Environment A
- Data
- Processing
- Infrastructure

Move to Environment B

Environment B (green environment)
- Data
- Processing
- Serverless / FaaS
- Infrastructure

Vendor and data center environment are different and does not work

Issues on operation functions in the data sharing:

- Data to be integrated is scattered among various bases, so it is complicated to manage data location and content.
- Data and analysis processing are environment-dependent, so data cannot be used across environments.
- Data cannot be processed due to expansion in data volume and the number of bases.
- Data needs to be processed safely and securely in the optimal environment, even if it is divided into many bases.

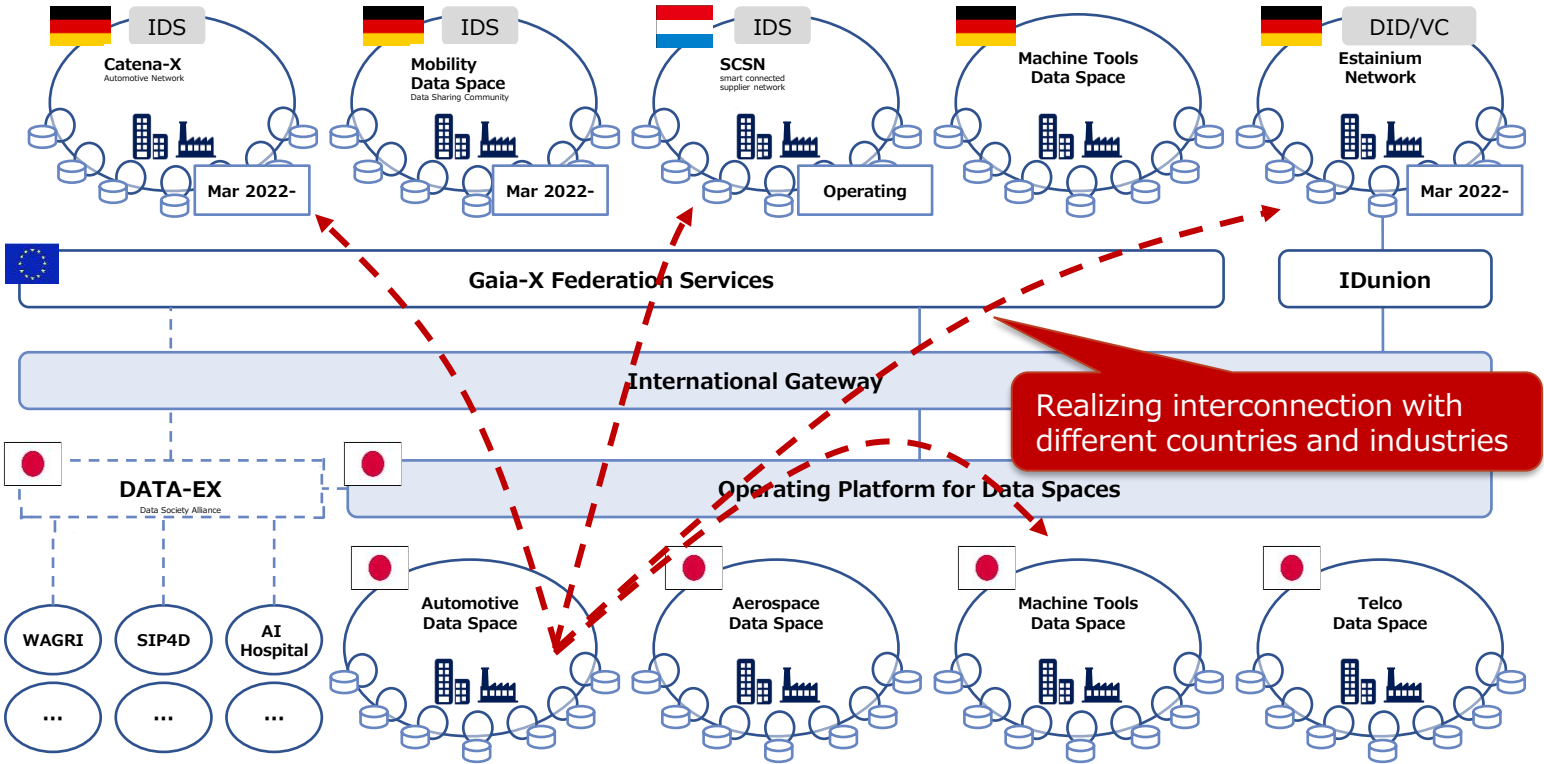## Solutions on operation functions in the data utilization:

Realize a structure for processing data from different locations in the optimal environment.

NTT Group is planning a demonstration experiment to connect SCSN and Catena-X with the Japanese data space.

Efforts for mutual integration of operational functions in data spaces

In cooperation with IDSA[6], Fraunhofer[7], and TNO[8], NTT Group will further enhance its knowledge of international interconnections and data exchange.
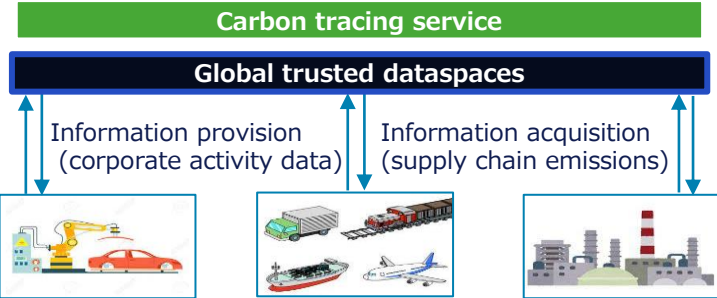

https://mobility-dataspace.eu/
https://catena-x.net/
http://smart-connected.nl/
https://www.gaia-x.eu/
https://data-society-alliance.org/

NOTE 6: International Data Spaces Association(IDSA)
NOTE 7: German Fraunhofer Research Organization(Fraunhofer-Gesellschaft)
NOTE 8: Netherlands Organisation for Applied Scientific Research (TNO)

NTT Group Future Efforts:
Promotion of co-creation activities

NTT Group will invite participation of companies and organizations in such industries as automobiles, aviation and energy, aiming to realize global trusted dataspaces through open co-creation.

Data integration service led by NTT Group

- NTT Group-led initiative to realize a global trusted dataspaces to promote data utilization across domestic companies.
- Aiming to realize high-end services such as carbon tracing and storage battery life cycle management.
- Also aiming to be used over a wide area as a system that supports Japan's economic security and resource recycling management.

Carbon tracing service

Global trusted dataspaces

Information provision (corporate activity data)　　Information acquisition (supply chain emissions)

PF construction that enables quick and highly accurate visualization

We are looking for companies and organizations that can participate in co-creation activities.

NTT Group technology development and multiply collaboration with each industry and company globally

As an advancement of "Connecting Power" to provide a structure to connect Horizontal × Industry
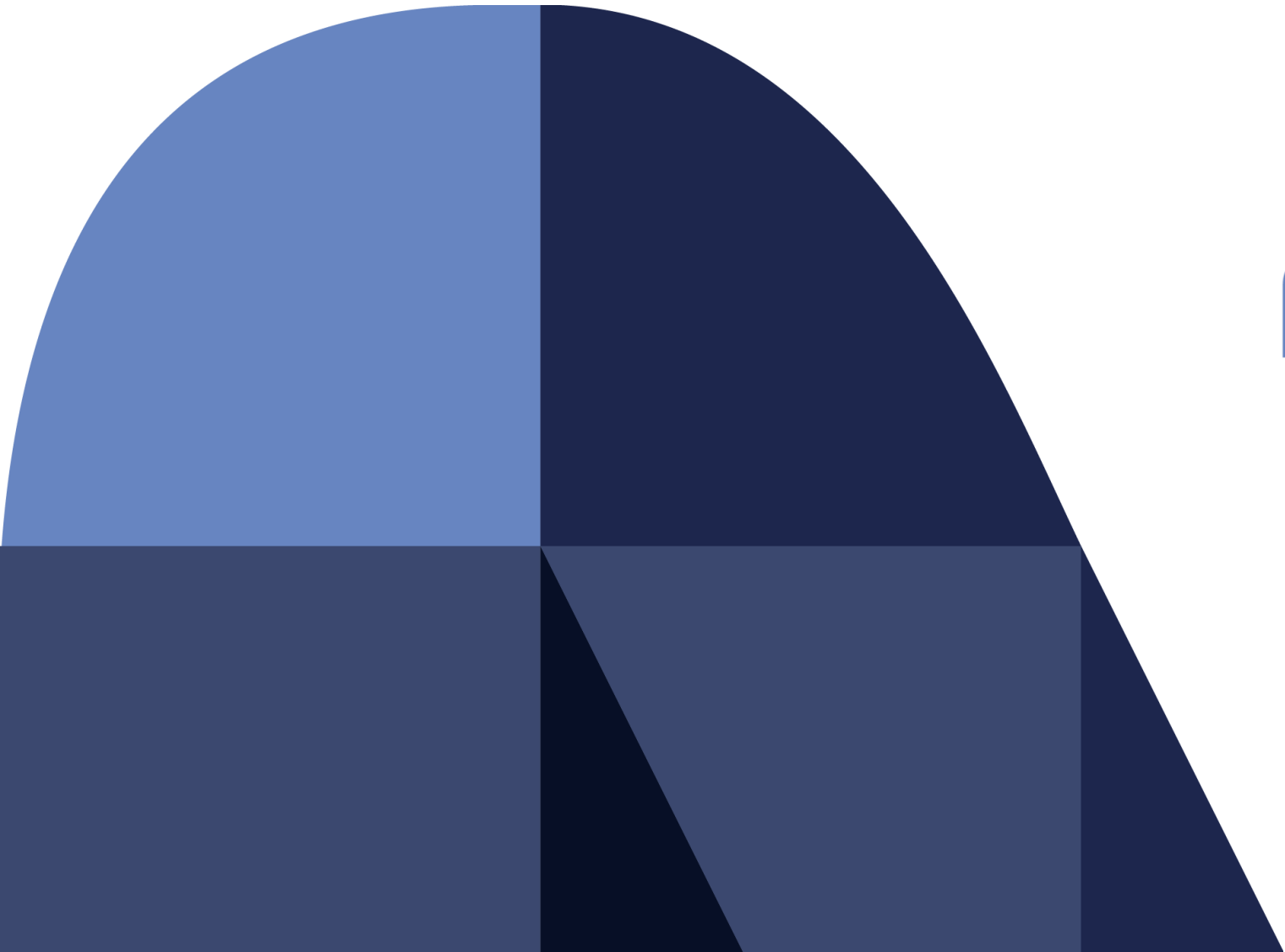
Demonstration and implementation for interconnection of overseas data integration infrastructure

In collaboration with organizations such as the Netherlands Organisation for Applied Scientific Research, the German Fraunhofer Research Organization, and IDSA, we will develop a data distribution platform that can securely interconnect European and Japanese data spaces such as Catena-X. We will invite participation from companies in various industries to promote global demonstration and implementation.

NTT Group Technology Development

NTT Group will proceed with demonstration and implementation realizing global trusted dataspaces based on the following technologies:
"Concealment technology that can process data and algorithms while they are encrypted", "Connectivity such as access control that connects many companies easily and safely" and "Structure for processing data from different locations in an optimal environment"

This concept is announced at the following URL.
https://www.nttdata.com/global/en/media/press-release/2022/may/ntt-com-and-ntt-data-to-develop-data-sharing-eco-system
NTT DATA Corporation

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