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Boris Otto, Kai Garrels, Michael Jochem, Tom Meyer · December 2024

Manufacturing-X Manifest: What does exist and on what should we focus?

Overview

This presentation illustrates how data spaces within Manufacturing-X can currently built and which directions should be taken to enable interoperability between the Manufacturing-X data spaces.

1. **User Journey**
   Example of an Early Warning between an OEM and Tier 1
2. **Currently Available Protocols and Components**
   What is possible to run today (fast track)?
3. **Manufacturing-X Manifest**
   Requirements and Ecosystem Principles enabling data space interoperability.
4. **Running: Now & Future**
   What is possible to run today (fast track)? How should the future look like?
5. **Appendix**
   More detailed flow of information between components using the existing components.

User Journey: Quality Management

Description

In the following user journey, a car manufacturer collaborate with his component supplier to solve quality issues.

Business Process & Description

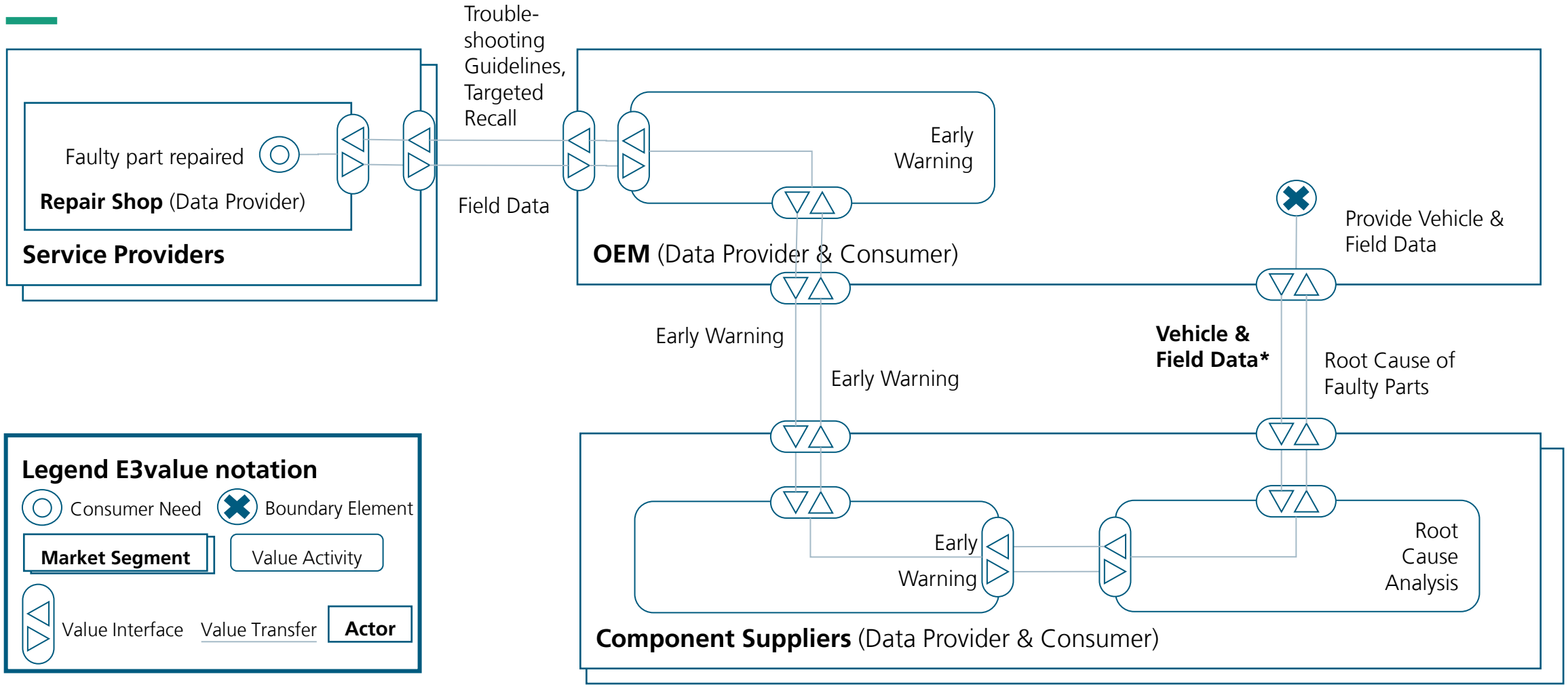
A car original equipment manufacturer (OEM) has been informed by his repair shops that a lot of customer face problems with a specific part in a specific car model. After checking these cars and the parts, the system failure is based on a problem with the control unit component that needs to be exchanged. As the component supplier (Tier 1) supplies these parts to the OEM, the OEM starts a “early warning” by sending a notification message over his IT systems to the component supplier. This early warning references quality relevant data and information about the problematic control unit. To perform the root cause analysis, the component supplier requests field data from the OEM. The component supplier finds and resolves the problem of the control unit. He then provides a fixed version to the OEM. Thus, the OEM informs the repair shops and performs software updates during the next repair shop appointment instead of recalling all parts affected.

Technical Process & Description

Since the OEM and the component supplier are both part of an ecosystem, such as the Catena-X data space, they collaborate. During the production of the car model, digital twins are used to create a technical relationship between the parts. Thus, the IT systems know that a specific control unit is built inside a specific car model. During the problem in the field as described above, the OEM uses the already build up chain of digital twins to identify the correct digital twin. The API for early warnings is used to send a notification in a standardized format under specific conditions. Further information from the field can be provided via the digital twins.

Ecosystem for Quality Management

Quality Case



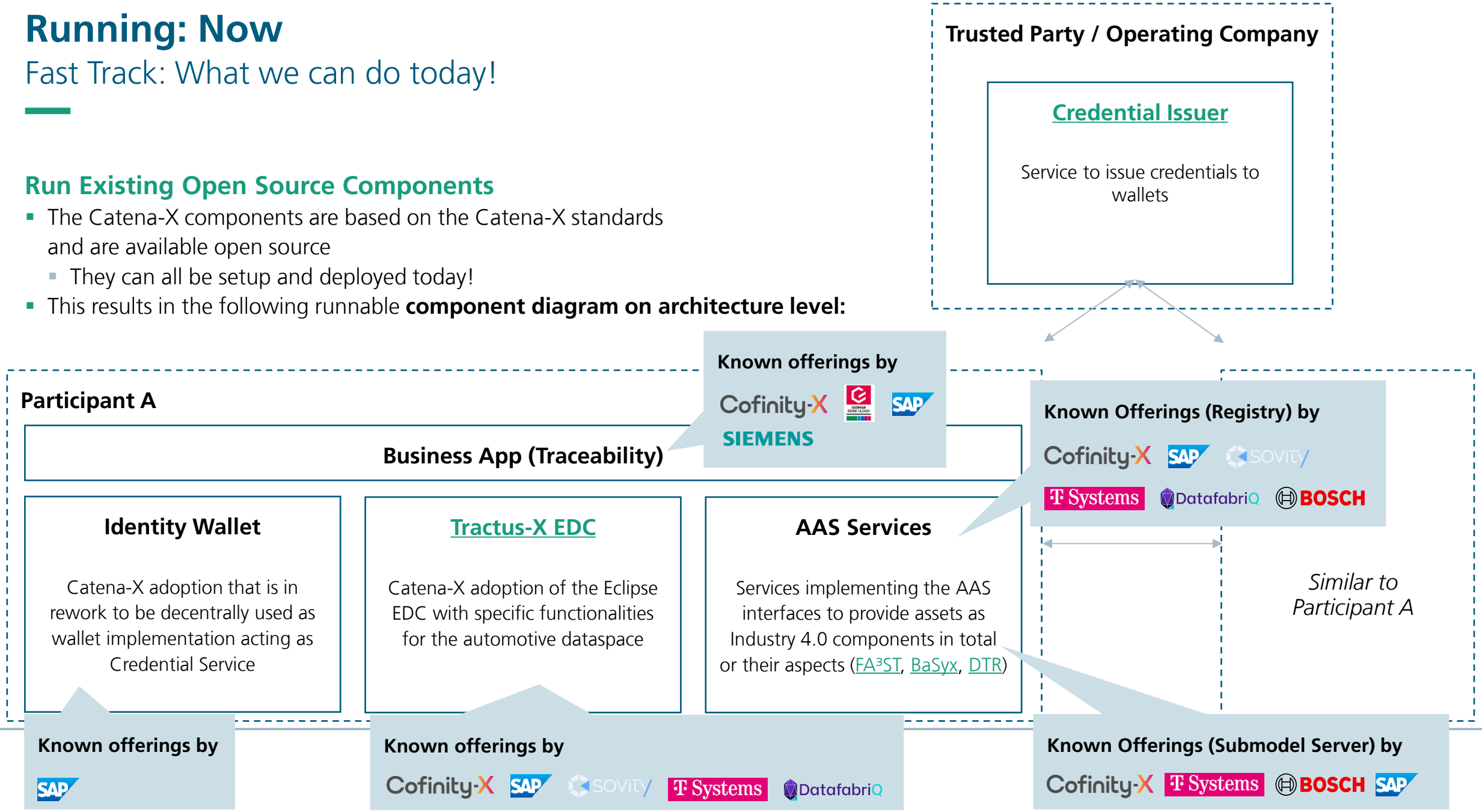
***** See **Vehicle & Field Data Transfer** as sequence diagram on the following slides

Running: Now

Fast Track: What we can do today!

Run Existing Open Source Components

- The Catena-X components are based on the Catena-X standards and are available open source
  - They can all be setup and deployed today!
- This results in the following runnable **component diagram on architecture level:**



Ecosystem Basics

Involved Protocols

Specification / Protocol	Purpose	Ref. Impl.
Data Space Protocol (DSP)	It defines the process from data offering via negotiation to access of data while preserving usage control.	Eclipse Dataspace Components Connector (EDC)
Decentralized Claims Protocol (DCP)	Overlays the DSP with organizational identities and verifiable claims in a decentralized network.	Eclipse Dataspace Components Connector (EDC)
Asset Administration Shell (AAS)	Provide interoperable data provisioning between companies using aspects of digital twins.	BaSyx, FA3ST
OPC UA	Provide operational data of manufacturing processes for AAS.	
IEC 61850	Provide operational data of Energy Network and Utilities for AAS.	

Components

Overview of what already exists (partly based on Catena-X)

Eclipse Dataspace Components (EDC)

High-level framework for data sharing. Open-Source project

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Dataspace Protocol (DSP)

A standardized protocol to facilitate interoperable data sharing

INTERNATIONAL DATA SPACES ASSOCIATION

Identity Wallet

Serivce providing verifiable information to authorized applications (e.g. contracts)

Tractus-X EDC

Catena-X adoption of the Eclipse EDC with specific functionalities for the automotive dataspace

Catena-X Automotive Network

Decentralized Claims Protocol

Eclipse Working Group outcome of an SSI implementation based on decentralized identity documents (DID) and verifiable credentials (VC) using verifiable presentations (VP)

Managed Identity Wallet

Catena-X adoption that is in rework to be decentrally used as wallet implementation acting as Credential Service

Deprecated

Identity Hub is in discussion.

Manufacturing-X Manifest

The transition to increasing interoperability between data spaces.

Overall Requirements

All data spaces in the domain of Manufacturing-X must be interoperable to each other.

- Participants must be identified dynamically (e.g., using the Decentralized Claims Protocol (DCP)). Participants may vary
  - from Business Partners
  - to Industry 4.0 components.
- Cross-company data flow must be governed by a standardized communication (using the Data Space Protocol (DSP)).
- Data must be exchanged in an unambiguous way: Asset Administration Shell (AAS)
- If AAS needs operational data, AAS must be populated using standardized protocols, such as
  - Industrial Manufacturing Processes: OPC UA
  - Utilities: IEC 61850

Ecosystem Principles

- Credential formats and presentation protocols need to be harmonized. Decentralized Claims Protocol (DCP), Open ID 4 Verifiable Credentials (OID4VC) / Open ID 4 Verifiable Presentations (OID4VP) and eIDAS 2.0.
- To increase ease of scalability of AAS, AAS should natively support DSP.
- Type 2 and Type 3 AAS are enabled to act as participants within the data space.
- DSP communication needs to be applicable from level entity till industry 4.0 component level.

Components

Overview of gaps based on the manifest

Connector

High-level framework for data sharing. Open-Source project.

ECLIPSE FOUNDATION

Dataspace Protocol (DSP)

A standardized protocol to facilitate interoperable data sharing

INTERNATIONAL DATA SPACES ASSOCIATION

Identity Wallet

Service providing verifiable information to authorized applications (e.g. contracts). Wallets rely on eIDAS 2.0 and OID4VC/VP to improve scalability.

Tractus-X EDC

Catena-X adoption of the Eclipse EDC with specific functionalities for the automotive dataspace

Catena-X Automotive Network

Asset Administration Shell

AAS that uses the data space protocol (DSP).

Managed Identity Wallet

The existing wallet implementation supports eIDAS 2.0 and OID4VC/VP.

Deprecated

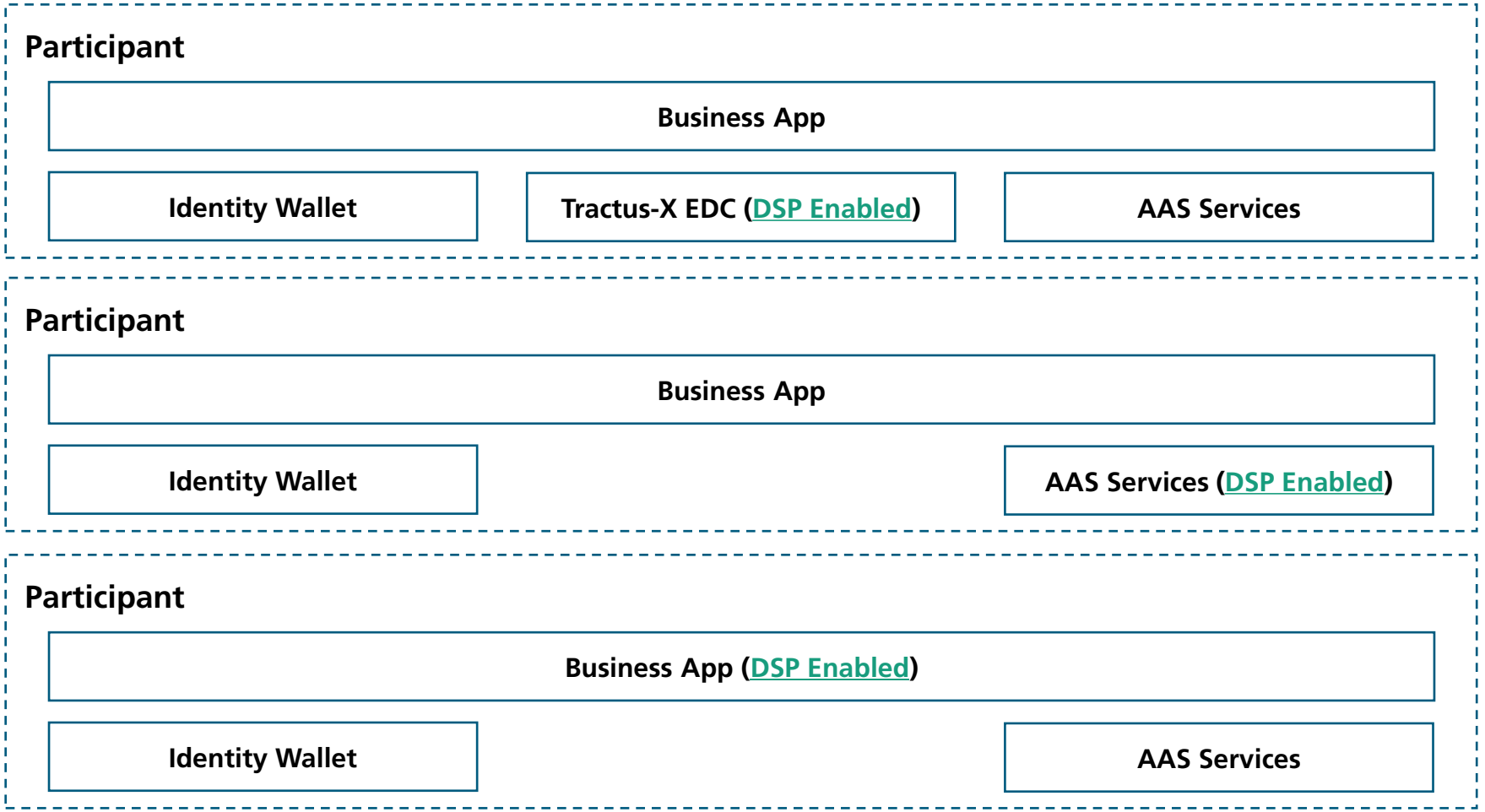
Identity Hub is in discussion.

Legend	Unchanged	gap

Running: Future

Future Vision Track: What would be the ideal long-term solution?

Disclaimer: Machine communication has not yet been considered as direct data source. Most likely Option A or B are best feasible for that case.



Option A
Same as today. Microservice stack based on Catena-X

Option B
Integrate the DSP directly in the AAS Service to substitute the EDC

Option C
Integrate the DSP directly in the Business App to substitute the EDC

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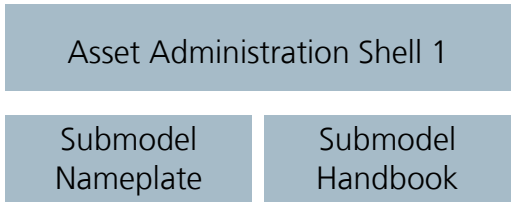
Asset Bundling

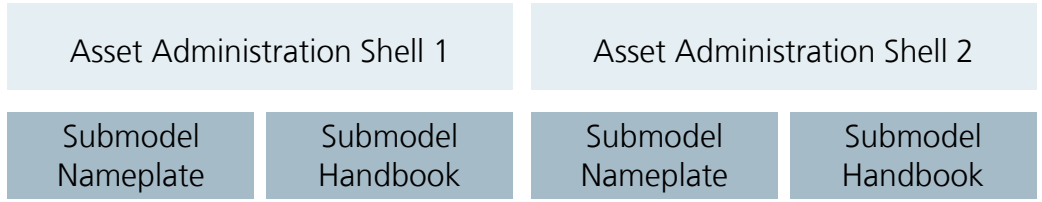
What's already possible using the Digital Twin KIT of Catena-X

Following approaches are possible

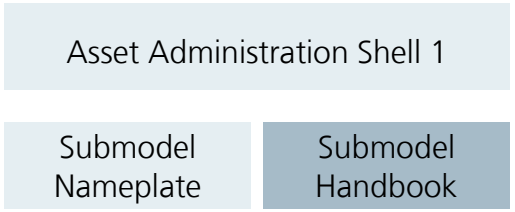
Case A: Grant access to the **whole AAS**



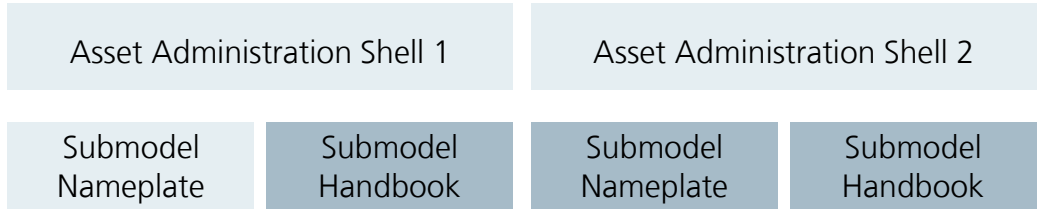
Case C: Grant access to **multiple Submodels of multiple AAS**
(requires further backend / AAS server security evaluation)

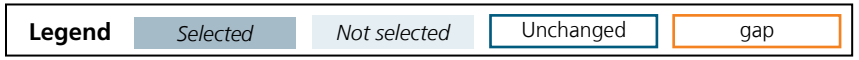


Case B: Grant access to **specific Submodels**



Case D: Grant access to **specific Submodels of multiple AAS**
(requires further backend / AAS server security evaluation)





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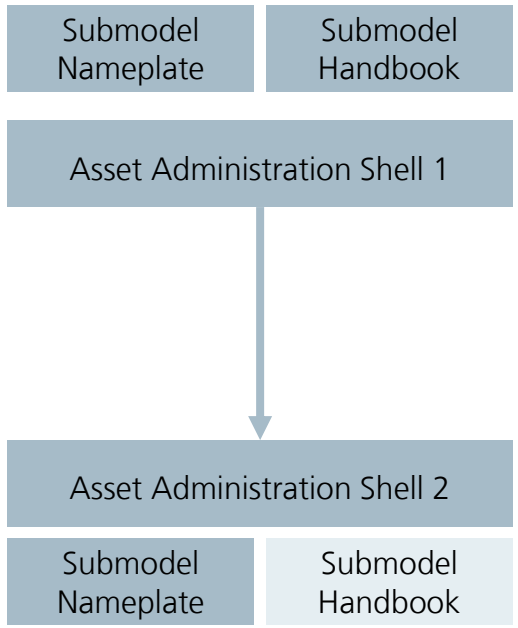
Asset Bundling

What's already possible using the Digital Twin KIT of Catena-X

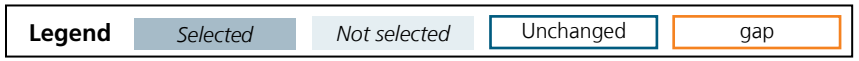
Following approaches are possible

Case E: Grant access to **containing AAS and their Submodels**
(requires transitive evaluations)



Case E

Within industry 4.0 components the parent component needs access to Submodels of its child components.



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Appendix

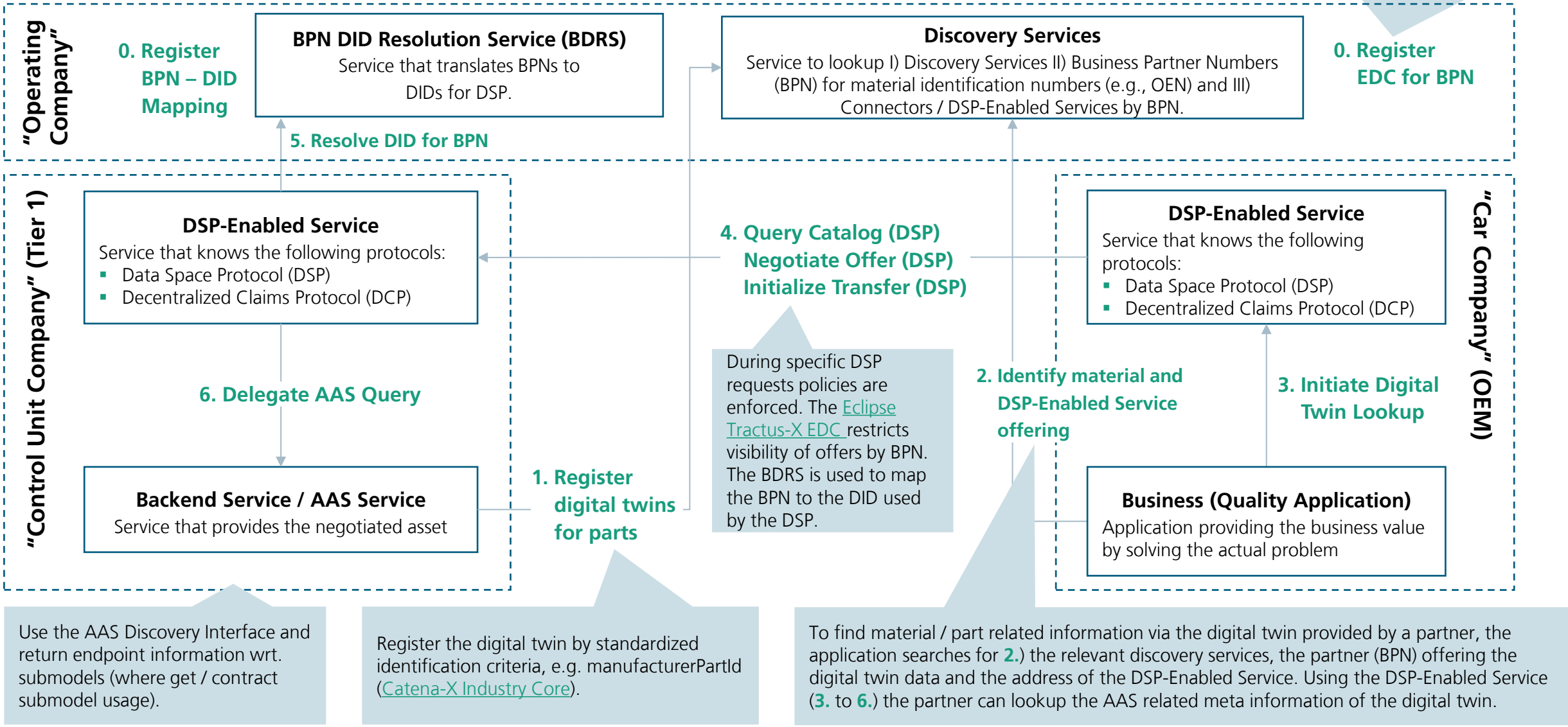
Detailed Component Interaction Based on Currently Available Protocols

Disclaimer: Partners incl. their BPN in Catena-X can be looked up via Business Partner Data Management (BPDM). These steps have been omitted for readability reasons.

User Journey: Early Warning

Detailed View on Material and Partner Identification within Network

During onboarding the BPN and DID have been generated and mapped to each other.
During technical onboarding a participants registers his / her connector which then can be looked up.



Use the AAS Discovery Interface and return endpoint information wrt. submodels (where get / contract submodel usage).

Register the digital twin by standardized identification criteria, e.g. manufacturerPartId (Catena-X Industry Core).

To find material / part related information via the digital twin provided by a partner, the application searches for **2.**) the relevant discovery services, the partner (BPN) offering the digital twin data and the address of the DSP-Enabled Service. Using the DSP-Enabled Service (**3.** to **6.**) the partner can lookup the AAS related meta information of the digital twin.

User Journey: Early Warning

Detailed View on Flow of Negotiation

During negotiation, the conditions of the data offer are validated based on the signed documents

This step ensures verification for the OEM, like checking if Tier 1 is part of the Catena-X data space and have signed documents

0. Issue Verifiable Credential (VC)

"Control Unit Company" (Tier 1)

3. Obtain Credential Return: JWT with Verifiable Presentation (VP) Decide on usage

Prior to data or API usage, one looks up the needed service offering and negotiates them

DSP-Enabled Service

Service that knows the following protocols:

- Data Space Protocol (DSP)
- Decentralized Claims Protocol (DCP)

2. Query Catalog (DSP) Negotiate Offer (DSP)

4. Use Asset

Delegates the early warning and the Digital Twin (AAS) requests to the respective Service

5. Delegate Request

After both parties agreed to the usage by a technical contract, usage may take place multiple times based on the contract as defined by the contract

Backend Service / AAS Service

Service that provides the negotiated asset

"Car Manufacturing Company" (OEM)

Credential Service

Service that knows the following protocols:

- Decentralized Claims Protocol (DCP)

DSP-Enabled Service

Service that knows the following protocols:

- Data Space Protocol (DSP)
- Decentralized Claims Protocol (DCP)

1. Contract digital twin and API usage

Business (Quality Application)

Application providing the business value by solving the actual problem

"Trusted Party"

Credential Issuing Service

Service that knows the following protocols:

- Decentralized Claims Protocol (DCP)

Getting Digital Twin data from and sending early warnings to the Tier 1's API endpoints also walks through the DSP-Enabled Service

About the Authors

Boris Otto
Fraunhofer ISST,
Board Member, Catena-X

Kai Garrels
ABB Stotz-Kontakt GmbH,
Lead Working Group "Reference Architectures and Standards",
Platform Industry 4.0

Michael Jochem
Robert Bosch GmbH,
Lead Working Group "Security of Networked Systems",
Platform Industry 4.0

Tom Meyer
Fraunhofer ISST,
Co-Lead Expert Group "PURIS", Catena-X