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1. OVERVIEW

1.1 Introduction
With Catena-X, the automotive industry of the future uses a trustworthy, collaborative, open, and secure data space to enable a data-driven value chain for their relevant business processes. All players are connected in end-to-end value chains, where all partners operate on an equal playing field, have sovereign control over their data and no lock-in effects occur. Thereby value chains, especially those of small and medium-sized companies, can be digitalized sustainably. Further it secures that market participants and competitors collaborate compliantly.

1.2 Objectives
This document defines the operating model and processes required in the Catena-X ecosystem to participate in or run this data space. The operating model is based on the concepts and values of Gaia-X and the International Data Space Association (IDSA) to create the first open and collaborative data ecosystem for the automotive value chain. Thereby, Catena-X applies these concepts and extends them by integrating automotive-specific requirements for compliance, interoperability, and security. The operating model lays the foundation and is the prerequisite for further standardization, certification, implementation, and operations of software components and partners in the Catena-X data space. The operating model is continuously updated to reflect the evolution of business and regulatory requirements, as well as emerging technologies.

1.3 Scope
The Catena-X operating model describes the entire Catena-X ecosystem, focusing on the operating environment and its roles, processes, and services, and how they interact. It also describes the scope and requirements of the various software components, including an initial list of reference implementations for the first market release. Since Catena-X is under continuous development, the document refers, where appropriate, to dynamic content that can be found on the website of the Catena-X association.
2. CATENA-X ECOSYSTEM

The Catena-X ecosystem consists of three areas: (1) the Catena-X Automotive Network e.V., (2) the development environment, and (3) the operating environment.

![Diagram of the Catena-X ecosystem]

**Figure 1: Catena-X Ecosystem**

The Catena-X Automotive Network e.V. (from here on referred to as ‘association’) is responsible for standardization, certifications, and governance of the Catena-X ecosystem. The association embraces the following industry partners: Direct partners (e.g., OEMs, suppliers, recycler), indirect partners (e.g., business application and service provider), and consulting partners (e.g., research institutes, transfer centers). Members can participate in working groups to actively shape the Catena-X ecosystem.

The association is complemented by the development environment. On the one hand, the focus of the development environment lies on the creation of standardization candidates that can be submitted into the standardization process of the association. On the other hand, it focuses on the development of open-source reference implementations and other implementations for the dataspace.

In the operating environment, the various open source and commercial services and business applications are run by different providers. A detailed description of the provider roles and the associated software components can be found in Chapter 3 and Chapter 4.

The Catena-X association publishes standards, thereby aiming at enabling interoperability, data-sovereignty, and security for all participants in the data space. The ecosystem participants must comply to the standards published by the Catena-X association in order to work with the data space. Catena-X standards are based on Gaia-X / International Data Space Association (IDSA) concepts and principles, industry standards, and best practices, among others, and extend these by incorporating automotive domain and use case specific requirements. By certifying ecosystem participants and software components the Catena-X Association ensures transparency and creates trust in the ecosystem. A certification testifies, for example, that a software component is interoperable, data sovereign and safe to use in the Catena-X data space.
3. SCOPE OF OPERATIONS

This chapter describes and categorizes the reference implementations available in the Eclipse Tractus-X project based on the scope of the market release 2 (milestone MS02) using the ecosystem roles defined in Chapter 4. Each reference implementation follows the corresponding Catena-X Association standards, which can be found on the Catena-X website. Reference implementations are offered by the development environment and can be taken advantage of by potential providers. However, any other implementation that meets the Catena-X standards can be used. The scope of future releases can be found in the Eclipse Tractus-X project.

The architecture of the Catena-X data space consists of three main areas: Core Services, Enablement Services and Business Applications as shown in Figure 2.

Core Services enable the basic functions of the Catena-X ecosystem such as identity or data discovery on a data space level.

Enablement Services can be deployed either self-managed by each participant or managed by an Enablement Service provider to provide or consume data within the Catena-X data space. The basis is the Eclipse Dataspase Connector (EDC). Depending on the use case and the legacy system, it is possible to integrate several EDC extensions or backend data services.

Business applications solve a specific business problem such as demand and capacity management, circular economy. Business applications can range from large enterprise solutions to specialized solutions for small and medium sized enterprises.

Figure 2: Overview of Catena-X Reference Implementation (Version 1.0)

3.1 Core Services

The architecture of the Catena-X core services is derived from the reference architectures of industrial data space association (IDSA) and Gaia-X. In the following, the different reference implementations that can be operated by a core service provider are described in more detail:

- Section A lists core services that can be operated n times in the Catena-X data space.
Section B lists core services that can only be operated once in the Catena-X data space due to business reasons or technical limitations and are therefore tendered via the nomination process of the association.

3.1.1 Section A:
In the following, the core services are listed that can be operated n times in the Catena-X data space.

### Catena-X Portal Frame

The Catena-X portal frame is a single management interface for customers. Customers can, for example, register their organizations, manage their organization and user data, manage their technical integration (e.g., IdP or Connector) or get notifications. Furthermore, the Catena-X portal frame can integrate other services in its navigation such as the marketplace, digital twin registry or semantic hub service. The portal frame also includes the ability to store and provide various self-descriptions. Self-descriptions provide metadata to describe participants and their service endpoints.

**Federated Service:** n/a

### Identity Provider

The Identity Provider (IdP) is a service that stores and verifies the identity of users. The IdP implementation is based on OpenID Connect and OAuth. It provides a concept for rights and roles at the Catena-X data space level. In addition, data provider and consumers or other business networks can integrate their user base with the Catena-X data space so that their users have a seamless user experience.

**Federated Service:** Yes, federated identity management between different providers based on OpenID Connect and OAuth supported.

### Semantic Hub

The semantic hub visualizes the standardized semantic models managed in Eclipse Tractus-X. Semantic models describe the meaning of the data in a machine-readable, standardized way. From this, various documents, and formats (e.g., JSON) are derived. The human readable documentation including the graphical representation of the generated semantic model. The semantic hub can be provided by multiple providers for their customers.

**Federated Service:** No.

### Catena-X Marketplace

The Catena-X marketplace lists certified business applications, enablement services and consulting services. Catena-X customers can search and filter the marketplace offerings e.g., by use cases. In addition, the marketplace provides functionalities for providers as well as the marketplace providers for the management and submission of business applications and enablement services.
Federated Service: No synchronization between different CX marketplace instance supported for market release 2. Each provider can provide their own CX marketplace. Users can switch between different CX marketplaces using the IdP federation.

Self-Description Factory

The self-description (SD) factory creates self-descriptions for providers, their service offerings, and resources. Each self-description provides metadata, such as location or technical endpoints, in a verifiable manner to enable interoperability and adhere to the Gaia-X Trust Framework. Self-descriptions are stored and published in the Catena-X Portal Frame.

Federated Service: n/a

Catena-X Managed Identity Wallet

To align the identity, authentication and data exchange of Catena-X participants with the open and decentralized concepts within GAIA-X, especially self-sovereign identities, every legal entity associated to a Business Partner Number should have the possibility to also get a W3C compliant DID (Decentralized Identifier). The Managed Identity Wallets service implements the Self-Sovereign-Identity (SSI) readiness by providing a wallet hosting platform including a DID resolver, service endpoints and the company wallets itself.

Federated Service: n/a

3.1.2 Section B:

The core services that are run by only one provider in the data space due to business reasons or technical constraints are listed below. Therefore, the core services of Section B are tendered via the nomination process. Synchronization between core services is initially limited to business partner and user identities.

Dynamic Attribute Provisioning Service (DAPS)

The connector (e.g., Eclipse Dataspase Connector) relies on a DAPS instance for acquiring and validating Dynamic Attribute Tokens. In doing so, it implements an RFC7523 JWT bearer client authentication for OAuth2. This protocol allows connectors to authenticate to the DAPS with their X509v3 certificate and in return obtain an Access Token that they can use to access other connectors. In other words, the DAPS checks if connectors A and B are valid data space services and only then, data is exchanged.

Reason for nomination: Deployed only once due to technical architecture. The objective is to create one standardized and interconnected Catena-X data space. It is planned to replace the DAPS with a self-sovereign identity (SSI) solution.

Business Partner Data Management - Golden Record

The business partner data management (BPDM) golden record service provides a high-quality data record of business partners including a unique identifier (business partner number). The golden record service removes duplicate data, adds missing information, and improves data
quality about business partners, on sites, and about addresses from different data sources, so-called sharing partners.

Reason for nomination: Deployed only once to reduce complexity and realize consistent business partner records in the Catena-X data space. Harmonized business partner data are mandatory for effective working services within Catena-X data space.

### Business Partner Number Issuer

The business partner number (BPN) issuer assigns the different BPNs (i.e., legal, site, address) in the Catena-X data space. The BPNs are used to create a unique identifier for business partners. The BPN is added after the creation of the golden record of the business partners and their different levels.

Reason for nomination: Deployed only once to reduce complexity and realize consistent business partner records in the Catena-X data space.

### Dataspace Discovery Service

The Dataspace Discovery Service is an API endpoint and is part of the CX portal frame. All connector endpoints within the dataspace can be found via this API endpoint. This is currently only used for notifications. Not for general Contract Offer discovery.

Reason for nomination: Deployed only once due to technical limitations. In a later version there could be multiple endpoints providing the information.

### Digital Twin Registry

The Digital Twin Registry is used to manage and discover Digital Twin meta-data. Each participant must register its Digital Twin and relevant sub-models in the Digital Twin Registry to expose its data offering to other participants at the metadata level. Data offerings follow the semantic models stored in the Semantic Hub.

Reason for nomination: Deployed only once due to technical limitations of the Digital Twin Registry and the Eclipse Dataspace Connector (EDC). It is planned to replace the Digital Twin Registry by a decentralized digital twin registry solution in the future.

For information on core service certification, visit the Catena-X Association Website.

### 3.2 Enablement Services

Enablement services must be deployed and run by each data space participant in a decentralized manner. The basis for this is the Eclipse Dataspace Connector (EDC). The EDC is a reference implementation and a mandatory service of the Catena-X operating model to ensure data sovereignty and interoperability until standards (e.g., API specification) are available. In addition, it is possible to integrate several EDC extensions (e.g., API Wrapper) or backend data services (e.g., Item Relationship Service). EDC extensions and backend data services vary depending on the use case and the legacy system. These services are not synchronized with each other.
**Eclipse Dataspace Connector**

The Eclipse Dataspace Connector (EDC) provides a connector framework for sovereign, inter-organizational data exchange. The framework contains modules for performing data query, data exchange, policy enforcement, monitoring, and auditing. Specifically, it can be integrated with existing identity, data catalogue, and transfer technologies to provide compliance, policy, and control capabilities across the network. Network participants can either deploy the EDC themselves or commission enablement service provider that provide the EDC as a managed service.

*Mandatory service to enable inter-organizational data exchange.*

**API Wrapper**

The API wrapper is a generic concept that simplifies the retrieval of data assets. It includes e.g., a proxy for the Asset Administration Shell (AAS) as well as a service for interacting with federated and semantically annotated data components in a convenient way. It makes use of the Asset Administration Shell Specification for discovering and accessing data assets and services associated with Digital Twins such as vehicles or serialized and non-serialized components. The API Wrapper is a recommendation for backend data service using the Eclipse Dataspace Connector.

*Optional service, depending on the use case requirements.*

**Sub-Model Registration Agent**

Data provider can use the Sub-Model Registration Agent to register new Digital Twins and their sub-models in the Digital Twin Registry by sending specific requests to the Digital Twin Registry API.

*Optional service, depending on the requirements of the use case.*

**Item Relationship Service**

The Item Relationship Service (IRS) builds data chains and provides custom business logic (e.g., aggregation of certificates) for business apps and other services. The IRS connects Digital Twins, builds and connects different data chain types (e.g., batches, serialized parts), and supports different lifecycle phases (e.g., BOM as Built).

*Optional service, depending on the requirements of the use case.*

**Simple Data Exchanger**

The Simple Data Exchanger (SDE) particularly enables small and medium-sized to provide data, manage contracts and usage policies in the Catena-X data space via an EDC. Data provider and consumer can upload data via e.g., CSV-files or manual entry. The SDE registers relevant meta-data in the Digital Twin Registry and makes it accessible via an EDC. The SDE service depends on the EDC and the Digital Twin Registry.

*Optional service, depending on the needs of a data provider / consumer.*
For information on data provider / consumer service certification, visit the Catena-X Association Website.

3.3 Certified Business Applications

Business applications (e.g., traceability applications) are either run by a business application provider or by data providers / consumers themselves. All business applications communicate via the connector (e.g., using EDC). In addition to commercial off-the-shelf (COTS) business application, there will be reference implementations of open-source business applications. Open-source business applications are initially provided by the development area in the Eclipse Tractus-X project. As with Core and Enabling Services, reference implementations are an offer that can be used by any participant in the data space (please refer to the Reference Implementation Guidelines in Chapter 5). Business applications receive the “Catena-X Certified Solution” label as soon as they comply with the Catena-X business domain standards and can then be listed on to Catena-X marketplaces. A list of the Catena-X business standards can be found on the Catena-X Association Website.
4. ROLES IN THE OPERATING ENVIRONMENT

The operating environment is based on the idea that there are multiple but distinct roles that aim at providing an attractive and fully functional ecosystem. Each provider can take on one or more of the following roles in any combination:


Figure 3: High-Level Overview of Operating Environments

<table>
<thead>
<tr>
<th>Role</th>
<th>(1) Core Service Provider</th>
<th>(2) Enablement Service Provider</th>
<th>(3) Business Application Provider</th>
<th>(4) On-Boarding Service Provider</th>
<th>(5) Consulting Provider</th>
<th>(6) Data Provider and Consumer</th>
<th>(7) Conformity Assessment Bodies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective &amp; Tasks</td>
<td>Runs core services enabling basic functionalities of the Catena-X ecosystem.</td>
<td>Runs enabling services for data provider and consumer.</td>
<td>Runs business apps solving a specific business problem.</td>
<td>Provides access of their customer base to the Catena-X ecosystem and optionally vice versa.</td>
<td>Offers consulting services.</td>
<td>Provides &amp; consumes data within the Catena-X ecosystem.</td>
<td>Performs the conformity assessment for certification objects.</td>
</tr>
<tr>
<td>Catena-X Label Company-Level</td>
<td>Certified Operating Company / Partner</td>
<td>Certified Provider</td>
<td>Certified Provider</td>
<td>Certified Provider</td>
<td>Certified Provider</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Catena-X Label Solution-Level®</td>
<td>Certified Solution</td>
<td>Certified Solution</td>
<td>Certified Solution</td>
<td>Certified Solution</td>
<td>Certified Solution</td>
<td>Certified Solution</td>
<td>-</td>
</tr>
<tr>
<td>Nomination by Association</td>
<td>Mandatory*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Mandatory*</td>
</tr>
<tr>
<td>Association Membership</td>
<td>Mandatory</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
</tr>
</tbody>
</table>
Core Service Provider

Core Service Providers run core services that enable the basic functionality of the Catena-X data space (e.g., identity provider, marketplace). The Core Service Provider is responsible for the commercial provision, service operation and maintenance, and the release support of the core services in the data space. It actively markets the core services and is the contractual partner for partners such as application provider and data provider / consumer.

As a Core Service Provider, it is mandatory to certify your company as a Catena-X Operating Company or Partner and list your services as Catena-X Solutions. Core services provided by this role must comply with relevant standards to ensure data sovereignty and interoperability between different core service providers. Core service provider must ensure the synchronization of organization and user identities. In the future, synchronization could be extended to other information such as marketplace entries. For core services that can only be operated by one provider in the Catena-X data space due to business reasons or technical limitations, a provider has to be nominated by the association. Section B Core Services as described in Chapter 3 are therefore tendered to ensure high data security standards and availability. Furthermore, it is mandatory to become a member in the association. This ensures compliance with the values and rules of the association.

Enablement Service Provider

Enablement Service Providers equip data space participants with solutions to provide or consume data within the Catena-X data space and operate data services e.g., Connector as managed services, that must be used by each data space participant depending on the use case. Enablement Service Providers must comply with relevant standards to ensure interoperability and data sovereignty between data space participants and business applications on a use case level. As Enablement Service Provider, it is mandatory to certify your managed services as a Catena-X solution. Enablement Services don’t require synchronization.

Business Application Provider

Business Application Providers run business applications that solve a specific business problem (e.g., traceability, demand and capacity management, circular economy). Business applications can range from enterprise solutions to specialized solutions for small and medium sized enterprises (SMEs). Business applications must comply with use case standards (e.g., product carbon footprint rule book) and must be certified according to software certification criteria to get listed in the Catena-X marketplace or to be a part of an interoperable value chain process. As Business applications providers it is mandatory to certify your Business Applications as a Catena-X solution.

Business Applications don’t require synchronization.

On-Boarding Service Provider

On-Boarding Service Providers enable Data Provider / Consumer to be integrated into the Catena-X network. This includes organizational and technical onboarding. Since, for example, a BPN is required for the technical onboarding, bilateral coordination must take place with the company that provides the services in order to use them if it is not the company that operates the services.

The onboarding process of a new Data Provider / Consumer into the Catena-X network must comply with the Catena-X standards. Potential participants can thus be completely integrated into the Catena-X network by an On-Boarding Service Provider. An On-Boarding Service Provider can enable the connection of their established customer base to the Catena-X data space (network to network interoperability). The focus is on the synchronization of organization and user identities as well as enabling single-sign on (SSO) and not on the synchronization of services, business applications, or data (for this see roles (2), (3), (5)). The goal...
is to provide their customers with a standardized access to the Catena-X data space as well as to the marketplace offerings in the Catena-X data space. This network-to-network interoperability needs to be certified by Catena-X standards. Optionally, the On-Boarding Service Provider can allow the access from the Catena-X to the network of the On-Boarding Service Provider. Thereby the network does not have to comply with the Catena-X standards.

For information on relevant standards, visit the Catena-X Association Website.

### Consulting Provider
Consulting Providers offer consulting services, such as assistance on how to use the Catena-X data space or business development consulting for data space participants. Consulting Services must comply to relevant standards. For information on relevant standards, visit the Catena-X Association Website.

### Data Provider and Consumer
Data Providers and Consumers (with and without a legacy system) provide, consume, and manipulate data to collaborate with other data space participants by means of core and data services as well as business apps. They run a DataSpace Connector within their own responsibility and must comply to role-specific standards to ensure interoperability and data sovereignty between data space participants and business applications. Besides this, this the role doesn’t require specific certifications. In addition, data providers and consumers can use data sources (e.g., from other enterprise networks) in mutual agreement with the Catena-X data space via EDC's. For information on relevant standards, visit the Catena-X Association Website.

### Conformity assessment Body (CAB)
Conformity assessment bodies carry out the conformity assessment as part of the certification process. The conformity assessment demonstrates whether a certification object such as a solution meets the relevant requirements. Such requirements are stated in the standards, regulations, contracts, or other normative documents such as the operating model whitepaper. Conformity assessments ensure and testify that interoperability, data sovereignty, and security standards are met by any data space participants, thereby creating trust. A CAB is nominated by the association and its company is certified as a trusted partner. For information on relevant standards, visit the Catena-X Association Website.

#### 4.1.1 Catena-X Labels
The association issues four different labels to help customers find the suitable providers for their needs. Labels are associated with the offered services of the provider.

- **Certified Operating Company (Core Services)**
- **Certified Partner (Core Services)**
- **Certified Provider (e.g., Business App Provider)**
- **Certified Solution (e.g., Business App)**

<table>
<thead>
<tr>
<th>The distinguishing factors between a Certified Operating Company and a Certified Partner are described as follows:</th>
<th>Service Portfolio</th>
<th>Marketplace Offering</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Certified Operating Company</strong></td>
<td>Operation of at least the following core services: • CX Portal Frame • Identity Provider • CX Marketplace • Semantic Hub</td>
<td>The CX Marketplace provides a neutral listing of multiple certified solutions (e.g., business applications and services) from different certified providers in the CX data space.</td>
</tr>
<tr>
<td><strong>Certified Partner</strong></td>
<td>Operation of selected core services (e.g., identity provider).</td>
<td>Partners can operate their marketplace and offer their own certified solutions in the CX data space.</td>
</tr>
</tbody>
</table>
5. PROCESSES FOR STANDARDIZATION, NOMINATION AND CERTIFICATION

This chapter describes the overarching process steps a provider must follow to become a certified provider of business applications or services in the Catena-X data space (see Figure 5). The process flow includes the processes for nomination, standardization, and certification as well as their interaction. There are two entry points:

Start event 1: A provider selects a software component that can be run multiple times.

Start event 2: A provider is selected through the nomination process to provide, for example, selected core services of section B or conformity assessment services.

Figure 4: Overarching Processes
The process steps of the overarching process are described in detail below.

Table 1: Overarching Processes

<table>
<thead>
<tr>
<th>Process Step</th>
<th>Description</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select Software Component(s)</td>
<td>A provider selects one or more software components for development and operations.</td>
<td>Overview of software components</td>
<td></td>
</tr>
<tr>
<td>Look up Catena-X Standards</td>
<td>A provider researches the required CX standards for the selected component(s).</td>
<td>CX standards</td>
<td></td>
</tr>
<tr>
<td>Selected as Core Service Provider</td>
<td>In addition, a provider may participate in the nomination sub-process for selected core services. If a provider is selected for the operations of a core service, he must complete the subsequent process steps.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous development and deployment</td>
<td>A provider must develop and deploy software components in accordance with the corresponding CX standards.</td>
<td>CX standards, CX reference implementations</td>
<td>Software Component</td>
</tr>
<tr>
<td>Select Certification Object and Create Certification Request</td>
<td>Before a provider can release a software component in the CX ecosystem, the provider must demonstrate that the certification object (e.g., a software solution) meets the required certification criteria. An overview and further information about the certification objects can be found in Table 4.</td>
<td>Certification criteria and templates for each certification object: Software Solution Provider</td>
<td></td>
</tr>
<tr>
<td>Send Certification Request(s)</td>
<td>For each certification object, a provider must send a certification request to the Catena-X association for evaluation.</td>
<td></td>
<td>Certification Request</td>
</tr>
<tr>
<td>Receive Certification Result</td>
<td>After review of the certification request(s), a provider will receive the certification results from the CX Association.</td>
<td></td>
<td>Certification Result</td>
</tr>
</tbody>
</table>

5.1 Standardization

This section describes the standardization subprocess including the option to propose new standardization candidates. The Catena-X Association publishes standards for generic core and enabling services as well as for business applications based on a specific business domain. These standards form the association for the development and operation of software components in the Catena-X network to ensure interoperability and data sovereignty between different software components and providers.
Figure 5: Standardization Process

The process steps of the standardization process are described in detail below.

Table 2: Standardization Process Steps

<table>
<thead>
<tr>
<th>Process Step</th>
<th>Description</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create and Send Standardization Proposal</td>
<td>Anyone can create and submit a standardization proposals to the CX association. It is recommended to submit standards together with a forum coach from the association.</td>
<td>▪ Standardization Template</td>
<td>▪ Standardization Proposal</td>
</tr>
<tr>
<td>Check of Proposal for Relevance</td>
<td>The technical committee for standardization checks the proposal considering relevance for the CX ecosystem. If not relevant, the technical committee for standardization sends feedback to the submitter.</td>
<td></td>
<td>▪ Standardization Proposal</td>
</tr>
<tr>
<td>Formal Check of Proposal</td>
<td>The back-office checks whether the proposal meets all the formal criteria. In addition, the back-office checks whether a similar proposal already exists. If the formal criteria are not met or a similar proposal has already been submitted, the back office sends feedback to the submitter.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review of Proposal</td>
<td>The technical committee reviews the standardization proposal considering the adherence to CX and Gaia-X values / principles, if the involvement of external expertise is necessary, the use or enhancement of existing CX standards, conflicts with other standards (e.g., license rights). If there is a conflict that can be corrected, the submitter receives feedback. If the conflict cannot be corrected, the standardization proposal is rejected.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create Standardization Draft</td>
<td>The expert group standardization creates the standardization draft.</td>
<td>▪ Standardization Proposal</td>
<td>▪ Standardization Draft</td>
</tr>
</tbody>
</table>
Provide Opt-Out | Members of the Catena-X association may provide approval/disapproval within 45 days that the intellectual property in the proposed standard, for example, is owned by another third party already.
| Standardization Draft | Opt-Out

Evaluation of Opt-Out | At the end of the 45-day opt-out phase, the standardization expert group evaluates the response.
| Opt-Out | Recommendation

Board Approves Standard | The board decides on the publication of the standard.
| Standardization Draft

Publish / Update Standard | The publications committee formulates the final publication of the standard and then publishes the standard and updates the repository with CX standards.
| Standardization Draft | Final standard document

5.2 Nomination
The Catena-X association is responsible for the execution of the nomination process including the selection of a partner. The nomination process is intended to ensure neutrality and trustworthy execution of selected roles and tasks within the Catena-X ecosystem. The various rights and obligations of the operator are described in the Request for Tender (RFT). This is, for example, the license for operation, which can also be withdrawn in case of unfair behavior. This ensures a fair award and safe operation of the various components. Tasks include, for example, the operation of Core Services - Section B by Core Service Providers or the certification of providers and solutions by CABs.

Figure 6: Nomination Process
The process steps of the nomination process are described in detail below.

Table 3: Nomination Process Steps

<table>
<thead>
<tr>
<th>Process Step</th>
<th>Description</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create Request for Tender (RfT)</td>
<td>The Catena-X association is responsible for the creation of the Request for Tender (RfT) document (e.g., for core services - section B)</td>
<td>RfT Document(s)</td>
<td>RfT Document(s)</td>
</tr>
<tr>
<td>Publish RfT on Website</td>
<td>The Catena-X association is responsible for the publication and distribution of the RfT Document on the website. (link)</td>
<td>RfT Document(s)</td>
<td>RfT Document(s) RfT Event incl. Timeline RfT Template</td>
</tr>
<tr>
<td>Create and Submit Tender for selected Core Service(s)</td>
<td>A provider can create and submit a tender for the published RfT.</td>
<td>RfT Document RfT Event RfT Template</td>
<td>Tender</td>
</tr>
<tr>
<td>Receive and Review Submissions</td>
<td>The CX association compares the tender(s), regarding the fulfillment of the nomination criteria and creates a shortlist of candidates for the board.</td>
<td>Tender(s)</td>
<td>Short List of Provider Candidates</td>
</tr>
<tr>
<td>Select Provider</td>
<td>The board of the association elects a provider with an absolute majority vote.</td>
<td>Short List of Provider Candidates</td>
<td>Nomination of Provider</td>
</tr>
<tr>
<td>Inform Providers</td>
<td>The CX association informs all provider(s) about the result of the nomination process.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.3 Continuous Implementation and Deployment

The continuous implementation and deployment chapter describes the possibilities of a provider to develop and deploy a software component in the Catena-X data space. To do this, a provider can either use and extend Catena-X reference implementations, other free and open-source products, or use commercial off-the-shelf products. A potential financial participation of the association, which supports the further development of components, is currently being evaluated. However, all software components must comply with the corresponding standards published by the Catena-X Association.

5.3.1 Catena-X Reference Implementations

Catena-X Reference Implementations are free and open-source software (FOSS) components, which are managed by the associated open-source project. All information about the Catena-X reference implementations (e.g., project structure, development, and release processes) can soon be found on the Eclipse Tractus-X project website and will follow the Eclipse Foundation Development Process. The repositories of Eclipse Tractus-X contain, among other things, source code, documentation, and deployment instructions. Other reference implementations (e.g., DAPS) used by the Catena-X data space but developed by other projects such as Gaia-X or IDSA can also be found in the Eclipse Tractus-X project. For a complete list of reference implementations used, see the Catena-X Association website and Tractus X repositories.
5.3.2 Usage of Catena-X Reference Implementations

Catena-X Reference Implementations are released under the Apache 2.0 license. According to the Apache 2.0 license, anyone can freely use, modify, and distribute the reference implementations in any environment. Reference implementations are usually not market-ready solutions and require a certain industrialization effort, which can vary depending on the software component. As part of the developing environment, the Catena-X consortium provides the first open-source Catena-X reference implementations for core and enabling services.

5.3.3 Extension of Catena-X Reference Implementations

Providers can add their own proprietary features to the given reference implementations to create a differentiated service offering. This can include e.g., additional features, a better usability or extended customer support.

5.3.4 Contribute and Report Bugs to Catena-X Reference Implementations

Any provider can become a contributor or committer of the Eclipse Tractus project as part of the Eclipse development process in case an operator is using a reference implementation. To realize an active open-source community, these providers need to report bugs and contribute patches.

5.4 Conformity Assessment

The process of conformity assessment demonstrates whether a certification object complies with the Catena-X requirements. Such requirements are stated in Catena-X standards and rules, international standards, or other normative documents. The result of the conformity assessment process is a Catena-X certificate, which signals that the certification object is aligned with the Catena-X values such as data sovereignty and interoperability. Currently there are two certification objects, namely Provider and Solution (see Table 4). Depending on the role and business domain in the Catena-X data space, certification objects must comply with the relevant Catena-X requirements, which correspond to different standards and standardization types (e.g., processes, application programming interface specifications). For example, a traceability business application must meet all requirements for the business application provider role in the traceability business domain.

Table 4: Overview Certification Objects

<table>
<thead>
<tr>
<th>Certification Object</th>
<th>Requirements</th>
<th>Certification Validity</th>
<th>Certification Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provider</td>
<td>The certification object “Provider” is defined by standards for the general participation in the data space depending on their role. The standards include but are not limited to the following standard types: International Standards (e.g., ISO 27001) Catena-X Standards and Rules Service-Level Agreements See provider criteria on website.</td>
<td>Recertification is required after 3 years or whenever there is a major change in any of the standards included. Revocation if misconduct.</td>
<td>Building trust in ▪ Availability ▪ Data Security ▪ Trustful Provisioning</td>
</tr>
<tr>
<td>Solution</td>
<td>The certification object “Solution” is defined by standards that focus on executable software based on business domain or platform capabilities and includes but is not limited to: Application Logic.</td>
<td>Recertification is required after 3 years or whenever there is a major change in any of the standards included.</td>
<td>Building trust in ▪ Data Quality ▪ Security ▪ Interoperability ▪ Transparency</td>
</tr>
</tbody>
</table>
If a Catena-X use case such as traceability or sustainability requires specific certificates for participation, these can be requested bilaterally between the different participants according to policies for the connector. There will be standardized policies in the Eclipse Tractus-X project that can be used in the use cases. In addition, custom policies can be added by the data provider / consumer, which can also be standardized if required. Policies can also be used to show, that a connector implementation of a data provider / consumer is certified by a conformity assessment body.

5.4.1 Conformity Assessment Process
Overall, the Catena-X association is responsible for the standardization and certification within the Catena-X data space. However, the Catena-X association does not carry out the conformity assessment process itself, but delegates it to selected conformity assessment bodies using the nomination process. The conformity assessment process can be applied to all certification objects. Only the certification criteria and the certification validity change.
The process steps of the certification process are described in detail below.

### Table 5: Certification Process Steps

<table>
<thead>
<tr>
<th>Process Step</th>
<th>Description</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create and Submit (Re-) Certification Request</td>
<td>A participant can request the certification of its software component.</td>
<td>CX Standards Conformity Assessment Template</td>
<td>Certification Submission</td>
</tr>
<tr>
<td>Review of (Re-) Certification Request</td>
<td>The conformity assessment body reviews the certification submission, regarding the fulfillment of the CX requirements.</td>
<td>Certification Submission</td>
<td></td>
</tr>
<tr>
<td>Provide Assistance for Certification</td>
<td>The certification object does not meet the certification criteria, but the request can be corrected. The conformity assessment body provides assistance in resolving shortcomings that can be corrected.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create Certification</td>
<td>The certification object complies with all certification criteria.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanctioning / Exclusion</td>
<td>The certification object does not meet the certification criteria and the certification request cannot be corrected.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comment on Findings and Present Solution</td>
<td>In case of findings that it can be corrected, the requestor has the opportunity to revise his application together with the conformity assessment body.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Send Certification</td>
<td>If all certification criteria are met, the conformity assessment body awards and sends the certification.</td>
<td></td>
<td>Catena-X Certification</td>
</tr>
</tbody>
</table>

### 5.4.2 Conformity Assessment Methods & Toolbox

The conformity assessment process defines different levels of trust in combination with assessment methods. An assessment method can start with a self-declaration via form or with automated self-descriptions (i.e., Gaia-x compliant self-descriptions in the SD Hub.). The goal of Catena-X is an automated assessment (i.e., test bed based on automated test cases). In addition, the Catena-X Association will provide a standardized toolbox (e.g., templates, test-cases, process descriptions to conduct assessments). Conformity Assessment Bodies (CAB) use this toolbox to carry out the assessment.

### 5.4.3 Conditions

Building trust may cause a conflict with other goals of the Catena-X ecosystem. Therefore, the conformity assessment process was designed and is based on the following conditions:

- Economic efficiency, effectiveness, and re-certification: The economic value of a certificate must be positive for a provider.
Innovation and continuous delivery: Software changes continuously. A certification process must embrace continuous change and must not slow down the innovation process.

Anti-Trust Law: A certificate must always be compliant with anti-trust law.

Free and Open-Source Software (FOSS) innovation process: The open-source community builds trust by ensuring transparency. A certificate must embrace open-source values and principles.

6. OUTLOOK

The operating model represents an initial, practical guide for participants in the Catena-X data space. It reflects the current state intends to provide an overview of the available reference implementations, the roles in the ecosystem and the relevant processes. Catena-X is a journey - Services and processes are constantly changing and evolving to enable broad adoption and are intended to be sustainable and scalable.

6.1 Legal Framework

One of the next steps to be elaborated is the legal framework. This will describe how the different parties within the data space interact from a legal perspective. The goal is to create a secure framework for Catena-X in which the different parties can interact.

6.2 Decentralization

The Catena-X operating model addresses the risk of a monopolistic structure in the operating environment. It fosters competition between providers to empower innovation and to allow business opportunities for all participants. It helps to gain acceptance among different stakeholders across the automotive value chain. The long term objective is to replace interim central services with decentral or federated operation concepts. This is to enable multiple core service providers in the operating environment where participants can choose their preferred core service provider. Therefore, we are investigating the extend to which the following capabilities can be federated or decentralized.

- IDS Identity Provider (DAPS)
- Discovery (Federated Catalogue)
- Digital Twin Registry
- Business Partner Number Issuing

6.3 Operating Environment Synchronization Service

In the future a federated registry is required to have a common state of overarching information in the operating environment. It serves as the backbone of the data space governance which stores information, similarly to the Official Journal of the European Union. It may be used for synchronization of marketplace entries of different providers. The service is not restricted to this application but can basically be used for all applications within the data space were actions of providers need to be announced and audited by other participants or the association. Depending on the required transparency and legal requirements it can be implemented with different features for audit-trails and run either in a federated way by using a standardized consensus protocol (e.g. distributed ledger technology) or by a 3rd party trustee.
For this service, a Catena-X standard will soon be published.

6.4 Interoperability to other Data Spaces

CX will further evaluate how it enables interoperability to other data space initiatives. The Data Space Support Centre will facilitate common data spaces in different sectors that collectively create an interoperable data sharing environment.

The support center explores the needs of data space initiatives, will propose guidelines for common European data spaces, such as cross-sectoral data sharing standards, requirements for security and access procedures.
7. APPENDIX

7.1 Catena-X Operating Model Overview

Figure 8: Catena-X Operating Model Overview
7.2 Glossary

<table>
<thead>
<tr>
<th>Term and Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Application Software</td>
<td>Business apps are operated by Business App Providers to solve a specific business problem within the Catena-X ecosystem. Business Applications can be enterprise solutions or specialized solutions for SME.</td>
</tr>
<tr>
<td>Catena-X board of directors</td>
<td>The board of directors of Catena-X Automotive Ecosystem e.V. consists of nine members. It manages the business of the association in joint responsibility.</td>
</tr>
<tr>
<td>Catena-X (CX)</td>
<td>Catena-X is the first integrated, collaborative, open data ecosystem for the future automotive industry. It connects all players to end-to-end value chains - easier, more secure, and more independent than ever before.</td>
</tr>
<tr>
<td>Certification Object</td>
<td>There are several objects in Catena-X to be certified by the association.</td>
</tr>
<tr>
<td>“Commercial off-the-shelf” (COTS) Products</td>
<td>Software and/or hardware product that is commercially ready-made and available for sale, lease, or license to the general public.</td>
</tr>
<tr>
<td>Conformity Assessment Body (CAB)</td>
<td>A Conformity Assessment Body is the legal entity that performs the conformity assessment process for the certification objects in the Catena-X data space.</td>
</tr>
<tr>
<td>Data Space</td>
<td>The term ‘data space’ refers to a type of data relationship between trusted partners who adhere to the same high-level standards and guidelines in relation to data storage and sharing within one or many. It is the “Run-Time” of all software components and services.</td>
</tr>
<tr>
<td>Dynamic Attribute Provisioning System (DAPS)</td>
<td>DAPS (Dynamic Attribute Provisioning Service) is an attribute service that acts as an identity provider for EDC by providing attributes for entities, such as organizations, people, and products.</td>
</tr>
<tr>
<td>Development Environment</td>
<td>The body in the Catena-X Ecosystem in which the actual development is carried out by different development groups (e.g., Consortia in the Eclipse Foundation).</td>
</tr>
<tr>
<td>Development Group</td>
<td>Development groups can develop, e.g., core services, data Provider and Consumer services and business applications. A development group is organized by a consortia contract or an open-source community activity within e.g. the eclipse foundation.</td>
</tr>
<tr>
<td>Ecosystem</td>
<td>An Ecosystem is an organizing principle describing the interaction of different actors and their environment as an integrated whole, like in a biological ecosystem. In a technical context, it refers to a set of loosely coupled actors who jointly create an economic community and its associated benefits. There is one Gaia-X Ecosystem federating independent autonomous existing and future ecosystems like the Catena-X ecosystem.</td>
</tr>
<tr>
<td>Free and Open-Source Software (FOSS) Products</td>
<td>Describes any software that is licensed or distributed (i) as “free software” (as defined by the Free Software Foundation), (ii) as “open-source software” or pursuant to any license identified as an “open-source license” by the Open Source Initiative (<a href="http://www.opensource.org/licenses">www.opensource.org/licenses</a>) or other license that substantially conforms to the “Open Source Definition” or (iii) under any similar licensing or distribution model that enables free access to the software in source code and under license terms that, in principle, allow for free use of the software by any user without payment of license fees.</td>
</tr>
<tr>
<td>Operating Environment</td>
<td>The body where core services, enablement services and business applications are operated by different providers.</td>
</tr>
<tr>
<td>Provider</td>
<td>Providers are ecosystem participants who offer infrastructure, operation and their own services and applications in competition with each other. Providers can take on specific roles in the ecosystem.</td>
</tr>
<tr>
<td>Orchestrator</td>
<td>The group of partners initiating and setting operational guidelines for the Catena-X ecosystem, responsible for building and managing/governing the ecosystem and ensuring that ecosystem services are available. (Catena-X e.V.)</td>
</tr>
<tr>
<td>Standardization</td>
<td>Standardization is the process of developing and implementing technical standards based on the consensus of different parties that include associations, and users.</td>
</tr>
<tr>
<td>Nomination</td>
<td>Nomination is part of the process of selecting a provider for unique critical services or Conformity Assessment Bodies.</td>
</tr>
<tr>
<td>Nomination Candidate</td>
<td>A company that has applied to become a core service provider for a service that only exists one time in the entire ecosystem. The candidate is awarded by the board.</td>
</tr>
<tr>
<td>Software component</td>
<td>An executable software implementation.</td>
</tr>
<tr>
<td>Services</td>
<td>Services can be provided in conjunction with or without software and are offered by a provider.</td>
</tr>
<tr>
<td>Standardization Candidate (SC)</td>
<td>A standardization item (e.g., protocol, API specification, semantic model) that has applied or is being considered as a Catena-X standard. The candidate is awarded by the technical committee.</td>
</tr>
<tr>
<td>Request for Tender (RFT)</td>
<td>Tender documentation and criteria to get nominated as a trusted operating company.</td>
</tr>
<tr>
<td>Eclipse Dataspace Connector (EDC)</td>
<td>The Eclipse Dataspace Connector (EDC) provides a framework for sovereign, interorganizational data exchange. It will implement the International Data Spaces (IDS) standard as well as relevant protocols associated with GAIA-X. The connector is designed in an extensible way to support alternative protocols and integrate in various ecosystems.</td>
</tr>
</tbody>
</table>