SECOND ECLIPSE TRACTUS-X COMMUNITY DAYS

16. – 17.05.2024
STUTTGART

SUPPORTED BY:

Tractus-X
Catena-X
ARENA 2036
ECLIPSE FOUNDATION

Cofinity-X  polygran  smartSense Consulting Solutions Pvt. Ltd  IDTA
SECOND ECLIPSE TRACTUS-X COMMUNITY DAYS

May 16th & 17th 2024

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Agenda

1. Asset Administration Shells from IDTA

2. Use of Asset Administration Shells in Catena-X
1. Asset Administration Shells from IDTA
Challenges in Data Lakes without Digital Twins

Heterogeneous Data Landscape

Data Consumer

2013
What is a Digital Twin?

https://www.youtube.com/watch?v=w_yvE7Dq-F0

Source: https://industrialdigitaltwin.org
What is a Submodel?

**Propety**
MaxRotationSpeed

- semantic ID = 0173-1#02-BAA120#008
- value = 2000

2000 = year?
2000 = Euro?
2000 = steps
2000 = ...?

**Property**
0173-1#02-BAA120#008
Max. rotation speed

<table>
<thead>
<tr>
<th>Data type</th>
<th>INTEGER_MEASURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit of measure</td>
<td>1/min</td>
</tr>
<tr>
<td>Definition</td>
<td>Greatest possible rotation speed with which the motor or feeding unit may be operated</td>
</tr>
</tbody>
</table>

2000 = MAX. ROTATION SPEED (1/MIN)

Source: https://industrialdigitaltwin.org
## Digital Twins: Asset Administration Shell

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>Start of Industry 4.0</td>
</tr>
<tr>
<td>2015</td>
<td>Concepts and Specifications</td>
</tr>
<tr>
<td>2019</td>
<td>Alliance Industrie du Futur et al.</td>
</tr>
<tr>
<td>2020</td>
<td>Founding of IDTA with 23 Organisations</td>
</tr>
<tr>
<td>2021</td>
<td>Founding of Catena-X with 17 Organisations</td>
</tr>
</tbody>
</table>

**Asset Administration Shell**

- **Internationalization**
- **Technology Spin-off**

**Dataspace**

**IDTA**
- Industrial Digital Twin Association

**Institute for the Future**
Digital Twins: Act!

Digital twins are becoming omnipresent within the automotive industry. They are used not just for production but also for available products. Hence, digital twins mirror products, objects, systems, and processes as a virtual representation. The basic idea of a digital twin is to cover all stages along the life cycle, from the initial concept over the development until use, disposal, and recycling. By doing so, the technology helps to recognize hardware failures in advance and predict maintenance needs before wear and tear lead to critical breakdowns.

**CAPABILITIES**
- Optimized plant utilization
- Increase of process quality and efficiency
- Prediction of failures and breakdowns
- Enabler of circular economy (transparency and traceability of components along their lifetime)

**Digital Twin @ BMW**
- Digital Factory Planning: Miraal Omniverse helps the BMW Group reduce planning time, improve flexibility and precision.
- Digital Twin: Planes in Stuttgart, Munich and Regensburg use the technology to mirror production processes.
- Digitalization of Plants: By early 2023, all BMW Group automotive plants are digitalised using 3D laser scanning.
- LLORA: It’s the first physical factory born in the virtual world.

**RELATED TECHNOLOGIES**
- Metaverse
- Industry 4.0
- Artificial intelligence
- Big Data
- Predictive Analytics

Source: https://www.bmwgroup.com/de/innovation/unternehmen/technology-trend-radar.html
Semantic Models and Standards

Definition of Semantic Aspect Meta Model
Eclipse Semantic Modeling Framework

Definition of use case specific Aspect Models
Eclipse Tractus-X

Standardization
Catena-X e.V.

Certified Submodel Server Implementation
e.g. Admin Shell IO by IDTA
Digital Twins: Benefits by Use

**Benefits**

- homogenization of data landscape
- enhanced data quality
- increased data availability
- strengthened interoperability
- automated processing on supply chain data
- enabled product lifecycle management
2. Use of Asset Administration Shells in Catena-X
Digital Twins: Catena-X Standard CX-0002

Digital Twin Registry

Data Providing Submodel Server

Eclipse Dataspase Components

Data Usage Policy allows data consumer to consume + terms and conditions for usage

Data Provider

Portal

Semantic Hub

Discovery Finder

BPN Discovery

EDC Discovery

Operator

Data Consuming Application

Eclipse Dataspase Components

Data Consumer

Data Model Definition

Twin / Aspect Registration

Data Discovery

Data Share

Internal of Enterprise
Discovery Flow

1. Discovery Finder → BPN / EDC Discovery
2. BPN Discovery: identifier → BPN
3. EDC Discovery: BPN → EDC-endpoint
4. Eclipse Dataspace Components: data catalogue → Digital Twin Registry endpoint
5. Digital Twin Registry: specificAssetId → Digital Twin(s) → Submodel(s)/Aspect(s)
6. Submodel Server: Aspect → Data Endpoint
Asset Administration Shell API v3

5.1. Discovery Service Specification - v3 SSP-001

5.2. AAS Registry Service Specification - v3 SSP-003

6. Submodel Server Specification - v3 SSP-003
Create an Asset Administration Shell

- **Data Usage Policy** allows data consumer to consume + terms and conditions for usage
- **Digital Twin Registry**
- **Data Providing Submodel Server**
- **Eclipse Dataspace Components**
- **Data Consumer**
- **Data Provider**
- **Portal**
  - **Semantic Hub**
  - **Discovery Finder**
  - **BPN Discovery**
  - **EDC Discovery**
- **Operator**
  - **Data Consuming Application**
  - **Eclipse Dataspace Components**

- **Data Model Definition**
- **AAS / Aspect Registration**
- **Data Discovery**
- **Data Share**
- **Internal of Enterprise**
Create an Asset Administration Shell
Publish in BPN Discovery

Digital Twin Registry

Data Providing Submodel Server

Data Usage Policy allows data consumer to consume + terms and conditions for usage

Data Provider

Eclipse Dataspace Components

Operator

Portal
Semantic Hub

Discovery Finder

BPN Discovery

EDC Discovery

Data Consumer

Data Consuming Application

Eclipse Dataspace Components

Data Model Definition

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Data Discovery

Data Share

Internal of Enterprise
Publish in BPN Discovery
1. Discovery of Services on BPN, \textit{manufacturerPartId}

- **Data Usage Policy**: allows data consumer to consume + terms and conditions for usage

- **Operator**:
  - Portal
    - Semantic Hub
  - 1. Discovery Finder
  - 2. BPN Discovery
  - 3. EDC Discovery

- **Data Consumer**: Eclipse Dataspace Components

- **Data Provider**: Eclipse Dataspace Components

- **Internal of Enterprise**:
  - Data Model Definition
  - AAS / Aspect Registration
  - Data Discovery
  - Data Share

Additional Components:
- 5. Digital Twin Registry
- 6. Data Providing Submodel Server

- **Data Sharing Flows**:
  - Internal of Enterprise
  - Data Discovery
  - Data Share
1. Discovery of Services on BPN, \textit{manufacturerPartId}
2. Discovery of BPN by manufacturerPartId

- 1. Discovery Finder
- 2. BPN Discovery
- 3. EDC Discovery
- 4. Eclipse Dataspace Components
- 5. Digital Twin Registry
- 6. Data Providing Submodel Server

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Data Usage Policy allows data consumer to consume + terms and conditions for usage

Data Model Definition
AAS / Aspect Registration
Data Discovery
Data Share
Internal of Enterprise
2. Discovery of BPN by manufacturerPartId
3. Discovery of EDC endpoint by BPN

- **Data Usage Policy** allows data consumer to consume + terms and conditions for usage
- **Data Provider**
- **Data Consumer**
- **Semantic Hub**
- **1. Discovery Finder**
- **2. BPN Discovery**
- **3. EDC Discovery**
- **Portal**
- **Operator**
- **Data Model Definition**
- **AAS / Aspect Registration**
- **Data Discovery**
- **Data Share**
- **Internal of Enterprise**

Eclipse Dataspace Components
3. Discovery of EDC endpoint by BPN
5. Discovery and Read-out of AAS

Data Usage Policy allows data consumer to consume + terms and conditions for usage

Data Model Definition
- AAS / Aspect Registration
- Data Discovery
- Data Share
- Internal of Enterprise
5. Discovery and Read-out of AAS
6. Share of Aspect Data by Submodel Server

Data Usage Policy allows data consumer to consume + terms and conditions for usage

Data Model Definition
AAS / Aspect Registration
Data Discovery
Data Share
Internal of Enterprise
6. Share of Aspect Data by Submodel Server

Enter the URL and click Send to get a response.
Available Catena-X Solutions

Bosch Semantic Stack
Digital Twin Registry

Eclipse Tractus-X
Digital Twin Registry
Thank You!

Visit us:

www.catena-x.net

LinkedIn
Backup

1. Discovery Finder
2. BPN Discovery
3. EDC Discovery
4. Eclipse Dataspase Connector
1. Discovery Finder

Swagger UI from CX-0053

**POST** Define endpoints to „BPN / EDC Discovery“

**DELETE** Delete endpoints to „BPN / EDC Discovery“

**POST** Find endpoints from „BPN / EDC Discovery“
1. Discovery Finder

**POST** /api/administration/discovery/search

**REQUEST**

```json
{
  "types": [
    "wmi"
  ]
}
```

**RESPONSE**

```json
{
  "endpoints": [
    {
      "type": "wmi",
      "description": "world manufacturing index",
      "endpointAddress": "api/administration/bpnDiscovery/wmi/search",
      "documentation": "The world manufacturing index is the first 3 characters of the vehicle information number",
      "resourceId": "f20e1ce4-56a5-47a0-9443-4672c7f373f1"
    }
  ]
}
```
2. BPN Discovery

Swagger UI from CX-0053

- POST Create *number*-BPN matching(s)
- DELETE Delete *number*-BPN matching
- POST Find *number*-BPN matching(s)
2. BPN Discovery

POST /api/administration/bpnDiscovery/wmi/search

**REQUEST**

```
{
  "searchFilter": [
    {
      "type": "wmi",
      "keys": [
        "WBA"
      ]
    }
  ]
}
```

**RESPONSE**

```
{
  "bpns": [
    {
      "type": "wmi",
      "key": "WBA",
      "value": "BPNL000000000SFw",
      "resourceId": "f20e1ce4-56a5-47a0-9443-4672c7f373f1"
    }
  ]
}
```
3. EDC Discovery

Swagger UI from CX-0001

POST find EDC-endpoint(s) linked to BPN(s)
3. EDC Discovery

POST /api/administration/bpnDiscovery/wmi/search

```
REQUEST
{
   "searchFilter": [
      {
         "type": "wmi",
         "keys": [
            "WBA"
         ]
      }
   ]
}
```

```
RESPONSE
{
   "bpns": [
      {
         "type": "wmi",
         "key": "WBA",
         "value": "BPNL00000000SFW",
         "resourceId": "f20e1ce4-56a5-47a0-9443-4672c7f373f1"
      }
   ]
}
```
4. Eclipse Dataspace Connector

- **POST**: create data asset on DTR & Submodel Server(s)
- **DELETE**: delete data asset on DTR & Submodel Server(s)
- **POST**: find data asset on DTR & Submodel Server(s)
4. Eclipse Dataspace Connector

**POST**

```
https://edc.control.plane/catalog/request
"asset:prop:type": "data.core.digitalTwinRegistry"
```

**RESPONSE**

```
{
    "@id": "6e1cf597-7694-4153-a082-ac8f683e28f2",
    "@type": "dcat:Catalog",
    "dcat:dataset": [
        {
            "@id": "1",
            "@type": "dcat:Dataset",
            "odrl:hasPolicy": {
                ...
            },
            "dcat:distribution": [
                ...
            ],
            "edc:participantId": "BPNL00000003B5MJ",
            "@context": {
                "edc:type": "data.core.digitalTwinRegistry",
                "edc:description": "Product EDC Demo Asset",
                "edc:id": "1"
            }
        }
    ],
    "dcat:service": {
        ...
    }
}
```
5.1. Digital Twin Registry (Discovery Service)

Swagger UI from CX-0002

- **GET** find AAS identifiers linked to specific asset identifiers
- **GET** find specific asset identifiers based on an AAS identifier
- **GET** returns the self-describing information of a network resource
5.1. Digital Twin Registry (Discovery Service)

GET /lookup/shells?assetIds=xyz

RESPONSE

[
  "d17f8c54-1950-434d-9bb9-c2e3ceefd868",
  "71d968f4-021a-48a4-96f8-7e2f8ea281ad",
  "94d2ef9a-b234-45ae-9176-b08c65645184"
]
5.2. Digital Twin Registry (AAS Registry)

Swagger UI from CX-0002

- **GET** read all Asset Administration Shell descriptors
- **GET** read all Asset Administration Shell Submodel descriptors
- **GET** read a specific Asset Administration Shell descriptor
- **GET** read a specific Asset Administration Shell Submodel descriptor
5.2. Digital Twin Registry (AAS Registry)

GET /shell-descriptors/:aasIdentifier

RESPONSE

```
{  
  "idShort":"idShortExample",
  "id":"94d2ef9a-b234-45ae-9176-b08c65645184",
  "description":{
  
    "language":"en",
    "text":"Example of human readable description of digital twin."
  },
  
  "specificAssetIds":{
    
    "name":"partInstanceID",
    "value":"SN12345678",
  }
}

"submodelDescriptors":[
  
    {  
      "idShort":"serialPart",
      "id":"cd47615b-daf3-4036-8670-d2f89349d388-2",
      "semanticId":{
        "type":"ExternalReference",
        "keys":{
          "type":"GlobalReference",
          "value":"urn:bamm:io.catenax.serial_part:1.0.1#serialPart"
        }
      }
    }
]
```
6. Submodel Server

Swagger UI

GET
read self-describing information of a network resource

GET
read Submodel in the ValueOnly representation
6. Submodel Server

GET /submodel/$value

```
RESPONSE
{
    "localIdentifiers": [
        {
            "value": "SN12345678",
            "key": "partInstanceID"
        }
    ],
    "manufacturingInformation": {
        "date": "2022-02-04T14:48:54",
        "country": "HUR"
    }
}
```

```
"catenaXId": "urn:uuid:580d3adef-1981-44a0-a214-13d6ceed9379",
"partTypeInformation": {
    "manufacturerPartId": "123-0.740-3434-A",
    "customerPartId": "PRT-12345",
    "classification": "product",
    "nameAtManufacturer": "Mirror left",
    "nameAtCustomer": "side element A"
}
```
Conclusion: Discovery of Data

Data Model Definition

Twin / Aspect Registration

Data Discovery

Data Share

Internal of Enterprise