Gaia-X Federated Catalogue
Enabling consumers to find best-matching offerings and to monitor for relevant changes

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Gaia-X Federated Catalogue
Part of the Federation Services

- The Federation Services enable a Federation of infrastructure and data. They are provided with an open-source reference implementation.

- The [Federated Catalogue] constitutes the central repository for Gaia-X Self-Descriptions enabling the discovery and selection of Providers and their Service Offerings.
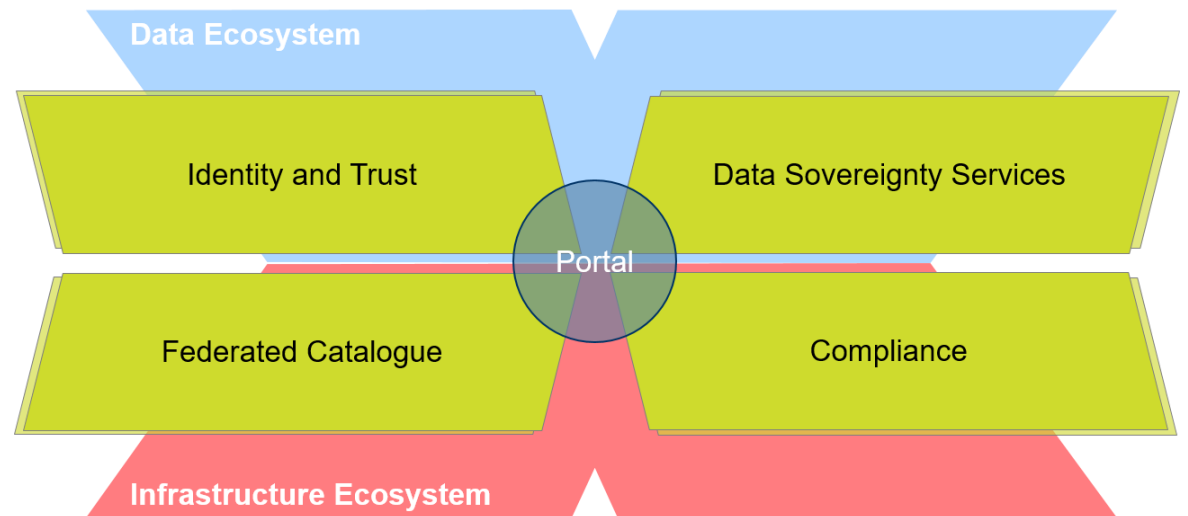
Gaia-X Federation Services and Portal as covered in the Architecture Document. The image is taken from [1]

[1] https://docs.gaia-x.eu/technical-committee/architecture-document/21.03/federation_service/

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The goal of the project, what can you do with the catalogue?

- **Implement a micro-services-based portal API with the minimal viable Gaia-X Federated Catalogue functionality**

- **The main micro-service API, along with the UI component, allows you to:**
  - Add, remove, update, and get **Participants,** i.e., Provider and Consumer
  - Add, remove, update, and get **Self-Description**, e.g., **Offerings**
  - **Query** Participants and Offerings with **openCypher**, a graph query language
  - Add, remove, update, verify, and get **Schemas**, e.g., Ontologies
  - For standalone deployment, i.e., without an existing IAM system:
    - Add, remove, update, and get **Users**
    - Assign, and revoke **Roles**
  - A **demo portal** is also included

The image was taken from https://www.gxfs.eu/

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Glossary

Term	Definition
Self-Description (SD)	A Self-Description expresses characteristics of a Resource, Service Offering or Participant and describes properties and Claims which are linked to the Identifier. *It is a Verifiable Presentation.*
Verifiable Presentation (VP) cf. W3C Verifiable Credential Data Model	*Presentation of one or more Verifiable Claims for sharing with a specific verifier. Tamper-evident, with trustable authorship, thanks to cryptography. An RDF graph is usually serialized in JSON-LD.*
Verifiable Credential (VC)	*A set of one or more Claims, cryptographically signed by an Issuer. In Gaia-X: about one subject*
Claim	A statement (assertion) made about a subject within Gaia-X.
Schema	*Package of: Ontology = term definitions; SHACL validation shapes, and •controlled vocabulary.*

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This project is conducted early in the Gaia-X development, with little experience of how Self-Descriptions will look in practice.

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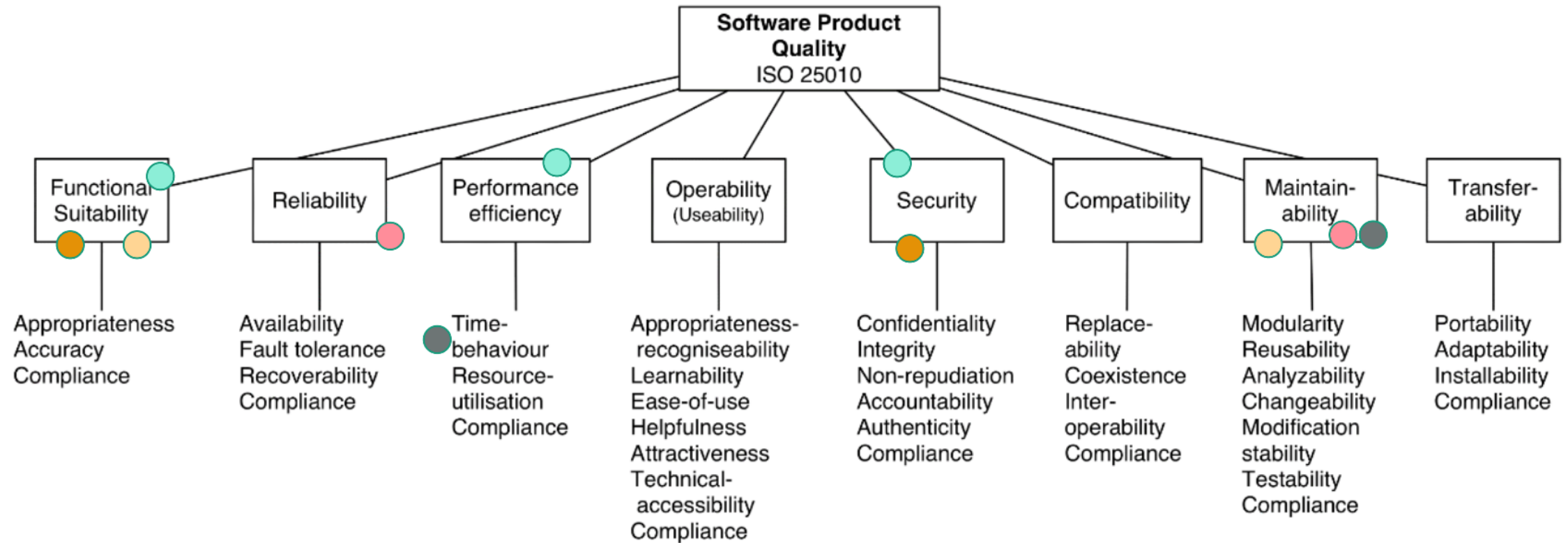
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Assumptions

Therefore, several assumptions regarding the characteristics of Self-Descriptions have to be made:

- Set descriptions usually contain 20 to 50 claims. Bigger Self-Descriptions rarely exist.

- The provider/participant itself provides most claims affecting a service offering or a participant.

- Most claims are flat triples containing the service or the participant as the subject.

- The claims are based on the central Gaia-X ontology, which defines approximately 15 key classes used frequently.

- The Self-Description of a service or participant is likely to be updated daily or every few months.

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Quality requirements

Software Product Quality ISO 25010 hierarchy diagram:

Software Product Quality ISO 25010

Functional Suitability
- Appropriateness
- Accuracy
- Compliance

Reliability
- Availability
- Fault tolerance
- Recoverability
- Compliance

Performance efficiency
- Time-behaviour
- Resource-utilisation
- Compliance

Operability (Useability)
- Appropriateness-recogniseability
- Learnability
- Ease-of-use
- Helpfulness
- Attractiveness
- Technical-accessibility
- Compliance

Security
- Confidentiality
- Integrity
- Non-repudiation
- Accountability
- Authenticity
- Compliance

Compatibility
- Replace-ability
- Coexistence
- Inter-operability
- Compliance

Maintain-ability
- Modularity
- Reusability
- Analyzability
- Changeability
- Modification
- stability
- Testability
- Compliance

Transfer-ability
- Portability
- Adaptability
- Installability
- Compliance

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Gaia-X Federated Catalogue
Architecture

High-Level Architecture of the Gaia-X Catalogue. Modules in blue provide internal functionality. Red modules indicate an external interface for the Catalogue. Green modules denote (potential) users of the external interfaces.

Source code: https://gitlab.com/gaia-x/data-infrastructure-federation-services/cat/fc-service

Gaia-X Federated Catalogue
Architecture – The Authentication Component

- It is responsible for authenticating users

- This is not a central component of the catalog, as it may be replaced by the Lot 1 "Authentication & Authorization" implementation

- The responsibilities of the authentication components are:

  - Storage of Users

  - Storage of user roles for a Participant

- We used **Keycloak** to implement this component

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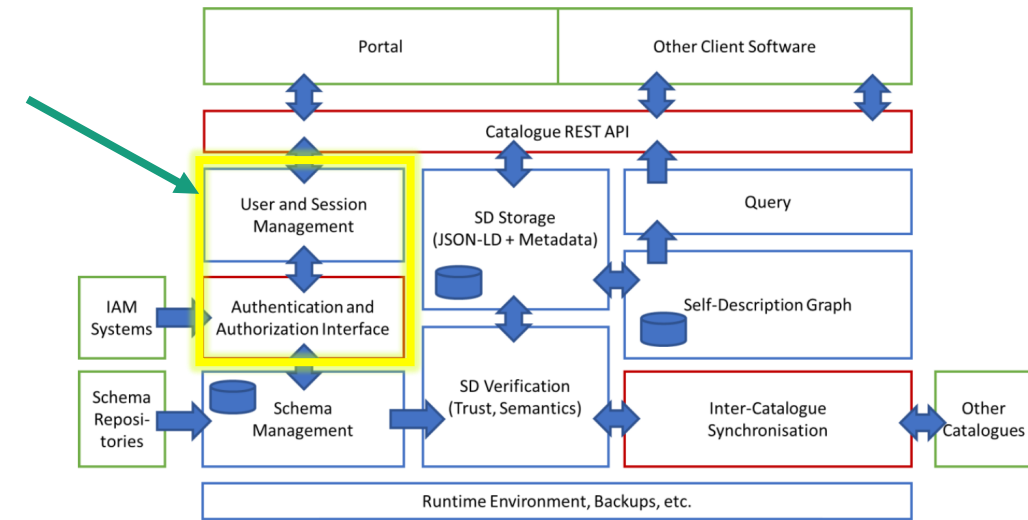
Gaia-X Federated Catalogue
Architecture – The Query and Graph-DB Component

- Graph database, holding all claims contained in active Self-Descriptions.

- The Graph database is responsible for executing semantic search queries.

- The responsibilities of the authentication components are:

  - Processing Queries

  - Updating the graph on SD changes

  - Mapping of Claims to a graph representation

  - Managing the graph lifecycle

- We used **Neo4J** to implement this component

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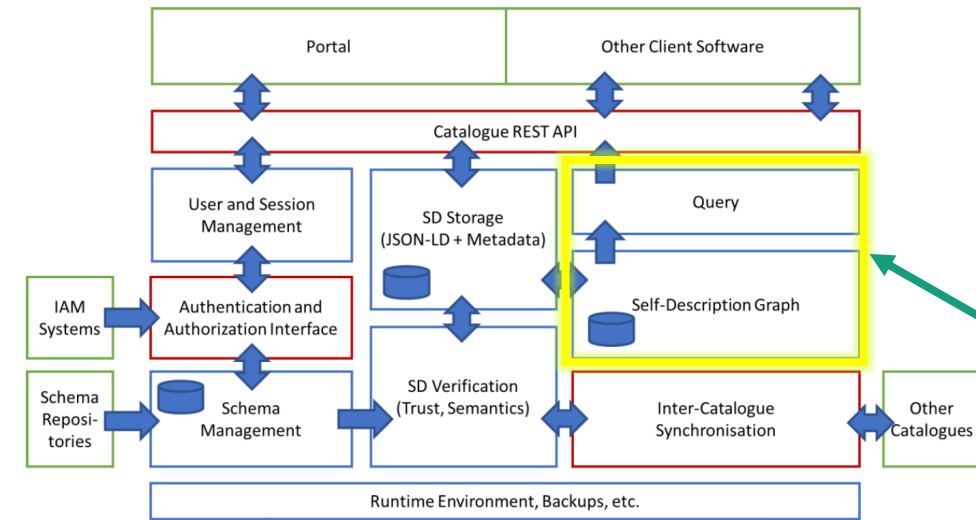
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Architecture – The SD Store Component

- It is a blob storage holding the Self Descriptions, and Metadata files

- This includes historical versions of the Self-Descriptions and Metadata

- The responsibilities of the authentication components are:

  - Storing SDs, i.e., JSON-LD files

  - Administrative Metadata

  - Query interface for SD Metadata

- For the sake of simplicity, a folder in the file system is used to store SDs files, and PostgreSQL is used to store metadata.

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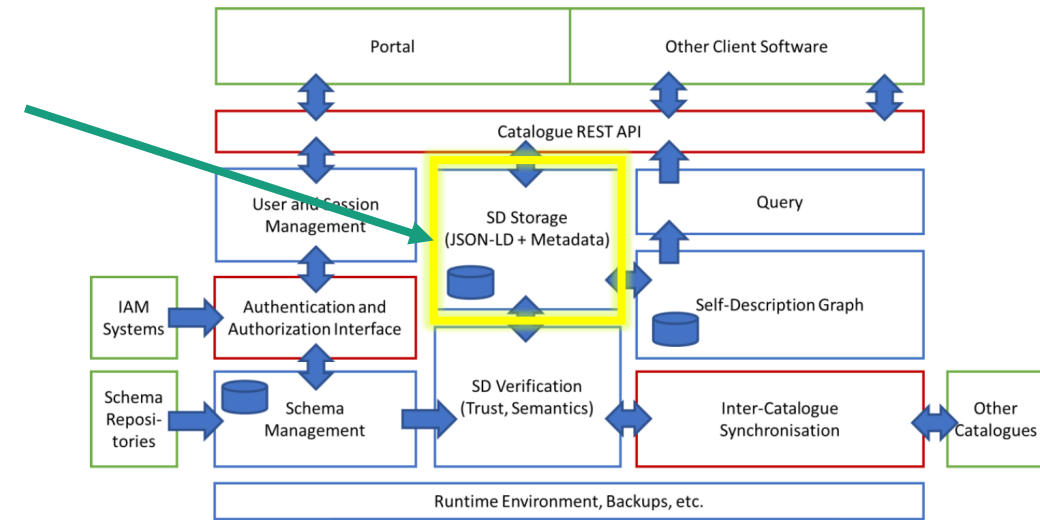
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Architecture – The Schema Management Component

- Responsible for storing the schema files

- This includes historical versions of the schema files

- The responsibilities of the authentication components are:

    - Creating the unified schema graph

    - Handling the relationship between Terms and Schemas

    - Handling the lifecycle and versioning of Schemas (persisted in the Metadata Store)

- Same interfaces as SD Store were used
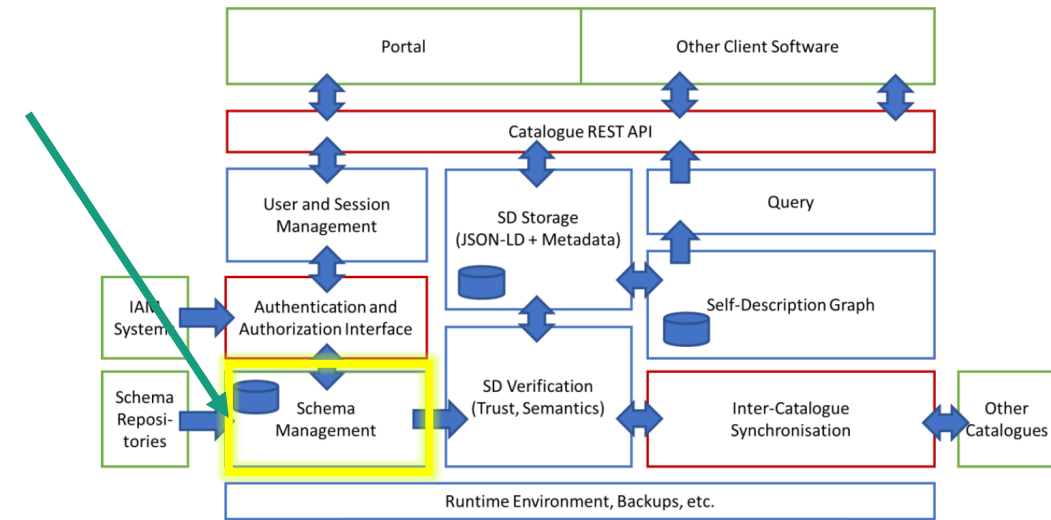
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Architecture – The SD Verification Component

- Responsible for applying the defined verification rules on the Self-Descriptions

- It also extracts the claims from the Verifiable Presentation (Claim Extractor)

- It also contains a component to revalidate submitted Self-Descriptions

  (Revalidation Service) periodically

- The responsibilities of the authentication components are:

  - Semantic verification of SDs against Schema

  - Syntactic validation of SDs

  - Cryptographic validation of SDs

  - Claims extraction

- SHACL shapes + JAVA Library
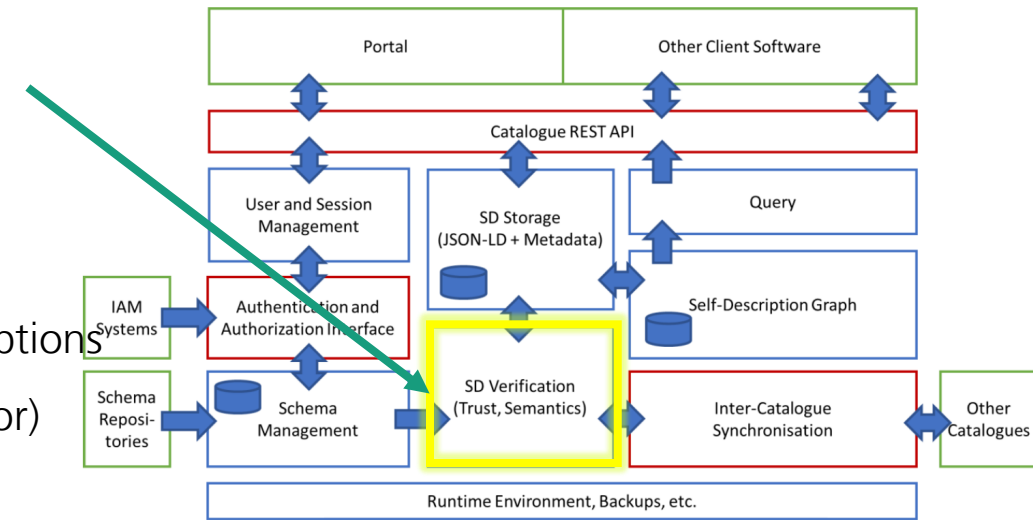
Gaia-X Federated Catalogue
Architecture – The Catalogue REST API Component

- The REST API is the main external interface for users to interact with the Catalogue

- The responsibilities of the authentication components are:

  - REST-API

  - For write access

  - Delegating Authentication

  - Using Core-Service

  - Provides Metrics

- Implemented with a Java-Controller in Spring-Boot
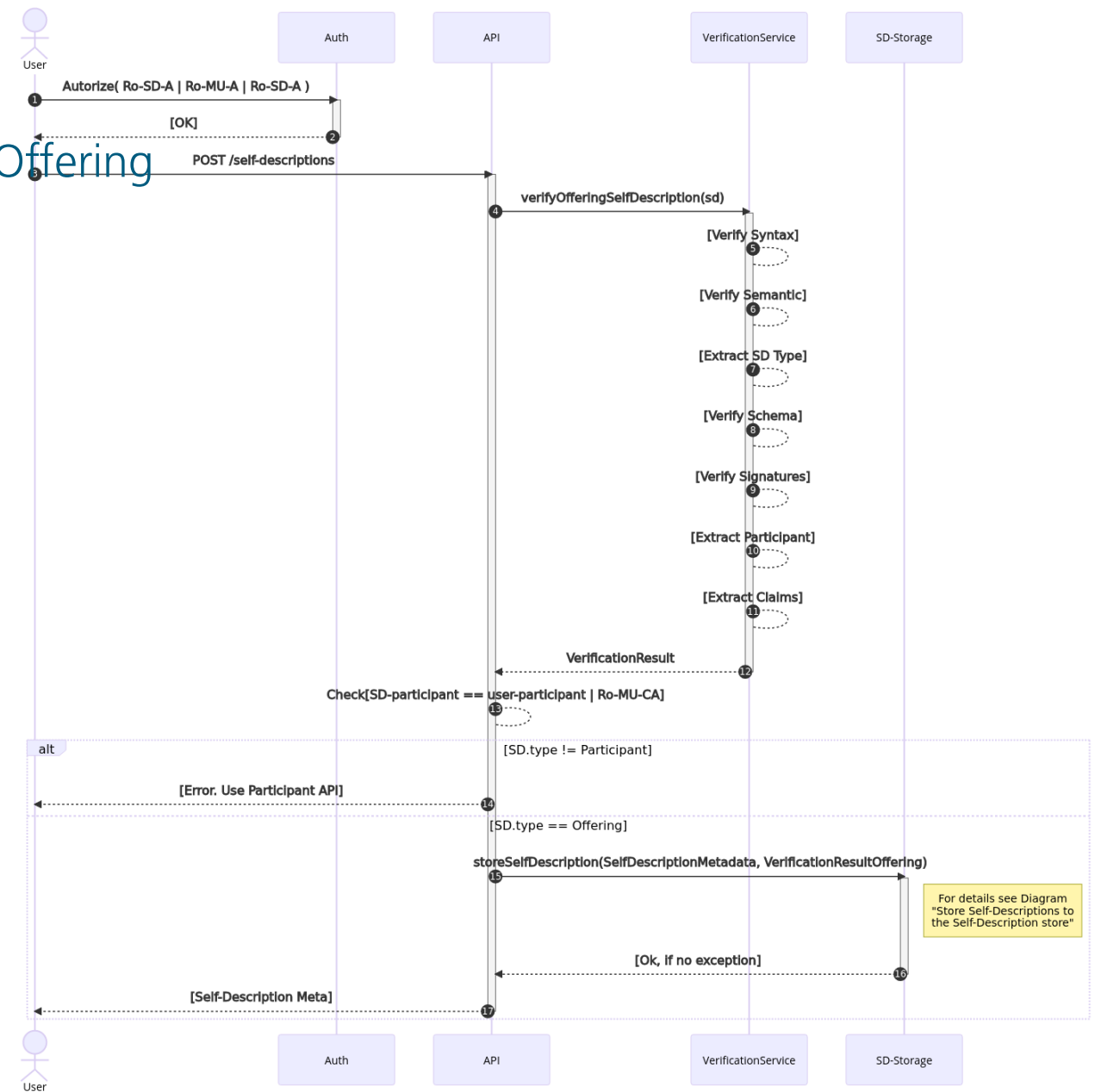
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Runtime View, Adding a Self-Description for an Offering

Gaia-X Federated Catalogue

Runtime View, Adding a Self-Description for an Offering

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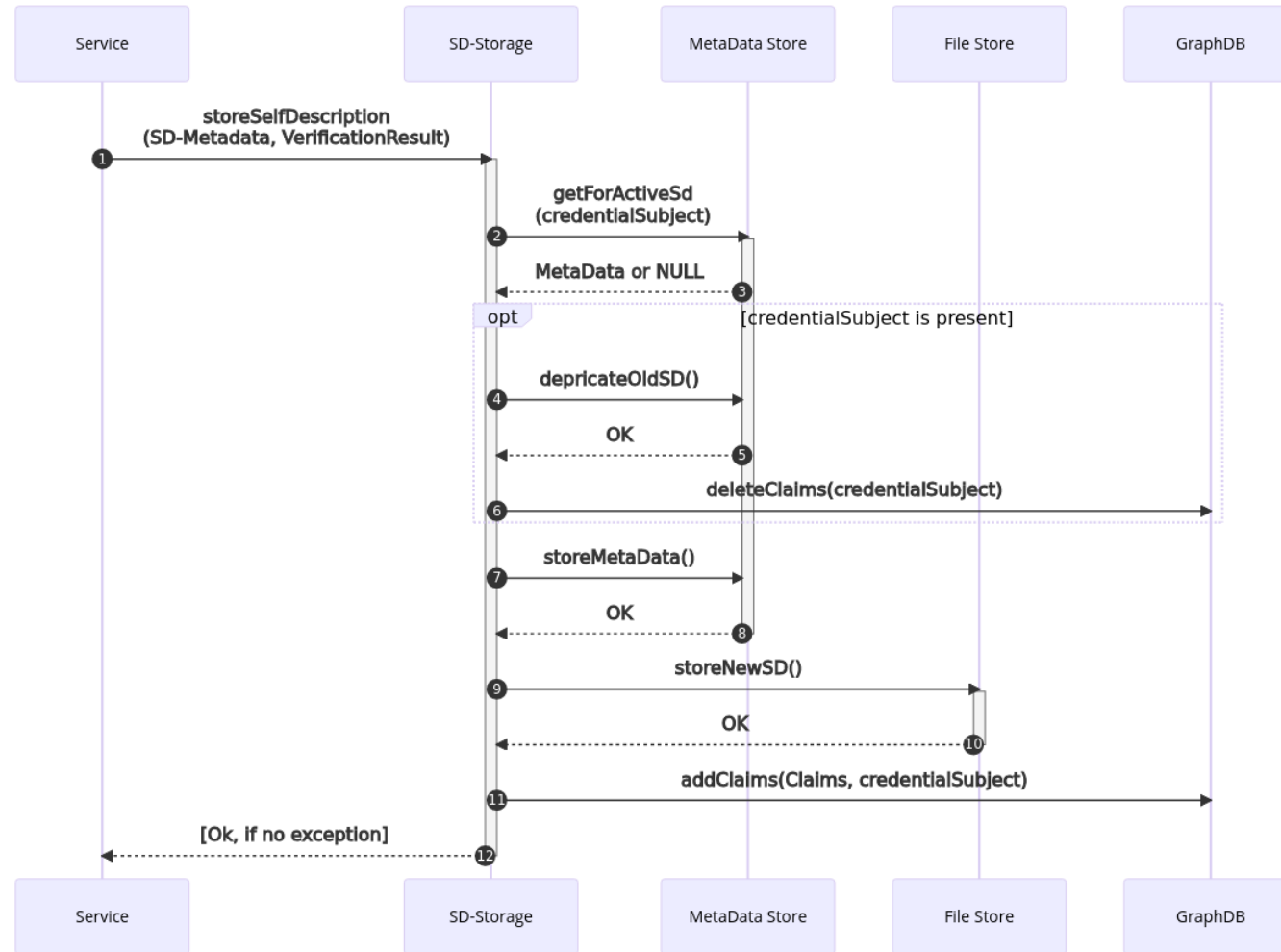
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How to use it? Typical Use Case (Based on discussion with Sebastian Lorenz from Fraunhofer IVI)

- What I would like to do, in general, is:

  - Create two participants in GX, a Provides and a Consumer

  - Let one participant offer some files

  - Let the second participant consume the files

- The consumer should find the provider via the catalog

  - Step 1: Create an SD with the SD Wizard

  - Step 2: Upload the exported SD into the catalog

  - Step 3: Query the catalog with openCypher to find a certain

    kind of resource

https://sd-creation-wizard.gxfs.dev

https://gaia-x.fit.fraunhofer.de/
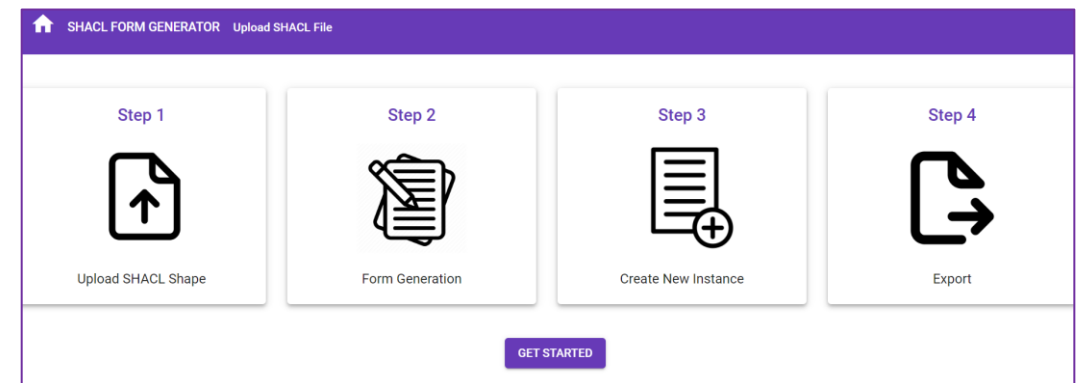
Gaia-X Federated Catalogue
Screenshot of a portal using the GXFS-Catalogue Federated Service

- Informationsklassifizierung -

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Conclusions

- The good

  - Strong Software Engineering process

  - Quality criteria guide our decision during the design

  - Open-source component available to be used (very soon)

  - Graph layer to run interesting/relevant queries and analytics

- The bad

  - It was complex to develop under too many assumptions

  - Lack of real examples of Self-Description files for testing purposes

  - Many new GAIA-X terms and concepts to be learned before starting to implement

Special thanks to all the people working on the implementation of this service

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Thank you!
Danke!
Gracias!
Merci!