gaia-x

Gaia-X Federation Services (GXFS)

Gaia-X Ecosystem Kickstarter

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Abstract

This White Paper seeks to explain the concept of Gaia-X Federation Services as part of the broader Gaia-X ecosystem. Ultimately, it aims to introduce and engage the reader to the Gaia-X project overall, explaining why Federation Services are a key part of delivering on Gaia-X's ambitions and giving an overview of different Federation Services for a non-technical audience.

Content

1. What Gaia-X is and why it matters

Gaia-X is a European project that promotes innovation through data sharing. The latest factsheet on Gaia-X is available here. Additional information on Gaia-X may be consulted here.

Currently, vast amounts of data remain unused. The potential of linking up different industries remain untouched. Industry experts have identified a lack of trust in the current landscape of storing, sharing, and handling data as the key problem. The fear of cloud service clients losing control over their data or becoming stuck with one service provider upon uploading their confidential information to the cloud (vendor lock-in) persists.

Meanwhile, the necessary technical mechanisms to exchange data are complex and require that implementation efforts and investments are put at risk in the absence of a widely adopted set of standard rules. Gaia-X mitigates these concerns by developing a framework, whereby actors agree on a single set of guidelines, aiming to a common set of values; to create trust among all necessary actors, providers of technology, and users of technology.

Data sovereignty, privacy and confidentiality, security, technology neutrality and interoperability are amongst the core values that Gaia-X promotes through its framework developed by a community-driven process. Business Companies, Startups, Research Institutions, and any other actors can join Gaia-X to drive the project considering their needs, expectations and sharing their knowledge and assets.

In this way, participants will share with the community all about their products and services, gain certification, exchange data with others and develop new services together.

2. Gaia-X Federation Services – Orchestration concept

The goal of Gaia-X is to foster innovation and data sovereignty. This is achieved by establishing a digital ecosystem, where data is made available, collated, and exchanged in a trustworthy environment, with data owners retaining full sovereignty over their data.

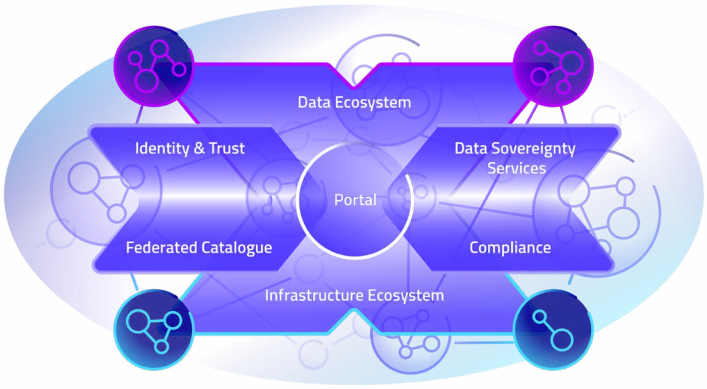
Gaia-X enables and promotes the creation of the so-called Gaia-X Federations in the market. The Federations are self-determined ecosystems, where individual Participants join together to offer services to be consumed within the Federation, to provide value to its participants, and or also outside the Federation, to create further value to the participants offering new value to the market.

Gaia-X does not operate itself on the market to compete with market incumbents. Gaia-X does not develop a company like a stand-alone cloud provider, neither does it implement data spaces collecting the data from its members. Instead, Gaia-X develops the software components necessary to set up a federated system that inter-connects several participants with each other, aiming to develop new services and innovative products.

Such ecosystems consist of joined interconnected data and infrastructure ecosystems, aggregated as ‘Federators’ by the concept of a Gaia-X Federation, and individually orchestrated and operated by a set of ‘Federation Services’.

The data ecosystem fosters data spaces based on data exchange with agreed rules.

Data and service offerings can be transparently shared across different industry players in different sectors. These so-called Federations promote the creation of new advanced services thanks to the increased amount of data and information that a Federation provides with regard to any individual Participant.



In the infrastructure ecosystem, the offerings from different providers are interoperable, interconnected, and compliant to certain rules. Providers can collaborate linking with each other, to further develop and expand their offerings in terms of catalogues, performances, regions, and critical mass. This is how new infrastructure services providing value to all participants will be created.

In the data ecosystem, the data from different users (data owners), becomes interoperable through the adoption of a Gaia-X infrastructure ecosystem. Users can collaborate linking with each other, to exchange data that, coming altogether, provide better insight into their specific supply chain or product/service value chain. This is how new data services providing value to all participants will be created.

Gaia-X aims to produce a data-infrastructure ecosystem, where infrastructures and data come together, joining users and providers in a joint effort that combine the needs for trustworthy platforms to enable and boost the creation of common data spaces.

3. Defining Federations

To achieve the goals mentioned above, Gaia-X plans to organise Participants into the so-called Federations. A Federation is a group of Participants that work together and collaborate on equal and horizontal lines. The Federation is not owned by anyone. Instead, the Participants cooperate based on joint rules that produce value for all. A participant of the Federation or an external service supplier is appointed to become the so-called Federator, aiming to facilitate the group coordination and to provide for the necessary Federation Services implementation, required to operationalise the Federation. Gaia-X Federations can be across participants from the same industry or from different industries, thus implementing both vertical ecosystems ad well as horizontal (or meshed) ecosystems of data and infrastructures.

Self-Descriptions are the basis for the Federations to function. In simple terms, they are descriptions, according to a common format, of the user profile of each Participant and, where applicable, of each of their service offerings. Participants are asked to share information about their business, their data and their service offering in their Self-Descriptions that can be verified by others within the Federation. Each Federation can create and manage its own Service' Catalogues – a collection of the services offered within this Federation. The access rights are set by the Federation based on core governance rules and can be linked with Service Catalogues for generic public service offerings.

4. The role of Federation Services

The Federation Services SW provided by Gaia-X AISBL, is to be seen as the implementation of a toolbox – providing for the minimum technical requirements to empower a Federations to become operational. The Federation Services toolbox define a range of services necessary to fulfil the Gaia-X's objective of building trust and interoperability, and ensuring Participants retain sovereignty over their data. Concretely, the first set of services that will be delivered are:

- Identity and Trust Services: To bridge today's trust gap, Participants will use Gaia-X Federation Services to build up tailored services that authenticate and authorise Participants in a Federation, for example via credential validation.

- Federated Catalogue: The Federated Catalogue will be the repository of one Federation, enabling participants to find other Participants' information and service offerings in the shape of the Self-Descriptions mentioned earlier. Gaia-X Federation Services will provide the basic code for each Federation to build their own Federated Catalogue.

- Data Sovereignty Services: Gaia-X Federation Services will help Participants in a Federation retain sovereignty over their data by offering services that can create transparency and enable data usage control. These will include services that can facilitate contract negotiations and keep track of data transactions within Federations. These will empower Participants to determine and keep track of how their data usage through different transactions.

- Compliance: Gaia-X Federation Services will enable verification of compliance for the services being shared, to help assess if Participants and services adhere to Gaia-X principles, for example in the fields of cybersecurity or data protection. Compliance checks verify during the onboarding phase of a new Participant and will allow for continuous monitoring of services on the run. Additionally, these services will interact with a set of Decentralised Services (part of the Gaia-X framework) that will provide for notarisation and governance and control mechanisms to further support trustworthy transactions between Participants and automation of the several credentials verification (these Decentralised Services are out of the scope of the Federation Services toolbox, and provide for a common layer of governance and control for any Gaia-X federation in a decentralised, sovereign and non-alterable or corruptible way).

In addition to the four key areas, the Gaia-X Portal serves as a sample integration layer showcasing the Federation Services and providing a user-friendly access to these services. It will support the Onboarding and Accreditation of Participants, showcase service discovery and sample service orchestration and provisioning.

5. How Federation Services will work in practice

It is important to understand that the services will not be provided by a central authority, but that each Federation will be able to use the reference open-source code of the Gaia-X Federation Services toolbox to then build apps and services that match the requirements in their respective Federation. In any case, the GXFS source code should be seen as reference implementation point to achieve inter ecosystem interoperability. The functional implementation can also be achieved with other implementations that conform with the Gaia-X technical and functional specifications. The final compliance of a Gaia-X service will anyway be verified through the aforementioned Decentralised Services, thus not allowing any possibility to modify the Federation Services open-source Code to obtain a competitive advantage.

The Federator of a Federation will be tasked with providing these services. This is because requirements towards the specific tools may diverge depending on the industry in question. For instance, an automotive Federation might have very different requirements than an insurance Federation. Through the development of open-source code, the Participants of a Federation are enabled to develop certified, Gaia-X compliant services, and can flexibly design the user interface in a way that's best suited to serve a Federation's needs.

The Gaia-X association maintains a repository of the Federation Services. Interested parties can gain access and build services based on the GXFS open-source code. Through this open-source implementation, all Participants and interested Gaia-X supporters can improve and continuously adapt the services developed under the GXFS umbrella to meet the Federations' needs.

6. Which Federation Services are currently being developed

The following section provides additional insights into the functionalities and benefits of each Federation Service and presents how such services could be of benefit to Gaia-X users.

6.1 Identity & Trust

Identity and Trust based on a Self-Sovereign Identity (SSI) concept enables to handle decentralised identities and digital trust establishments for identities and assets. The decentralised identity management based on w3C Verifiable Credentials and Distributed Identifier (DID) enables Gaia-X Participants to keep control over their digital identities. The following services are specified as part of the Federation Services for Identity & Trust:

6.1.1 Authentication/Authorisation (AAU)

Service functions enable Gaia-X Participants to authenticate users and systems in a trustworthy and decentralised self-sovereign manner.

6.1.2 Organisation Credential Manager (OCM)

The OCM establishes trust between the different Participants within the Gaia-X ecosystem by offering credentials to company Participants and managing credentials of the organisation.

6.1.3 Personal Credential Manager (PCM)

PCM acts as a user representative, securely holding the acquired distributed identity credentials and identity attributes, providing the technical means to selectively disclose the attributes for authentication and service consumption. The PCM as a Gaia-X component is used by a natural person – typically in the form of a personal wallet for a user. The PCM enables users to interact with the SSI-based ecosystem through VC'S and DID's in a privacy-preserving way. The PCM form factors are smartphone-based applications and browser-based applications/add-ons for stationary PCs and notebooks.

6.1.4 Trust Services (TRU)

The Trust Services are the technical implementation to enforce policies for the usage of the decentralised and self-sovereign components of Gaia-X. The Trust Services work through cryptographic validation of the provided credentials. The Trust Services' scope covers the technology functionalities to ensure a consistent level of trust between all Participants in Gaia-X. Further features are verification by applying standards like LD Proof Chains/Sets, establishing policy-driven trust, providing the required trust anchors, and ensuring trust chains between multiple Participants.

6.2 Federated Catalogue

The Federated Catalogue constitutes an indexed repository of Gaia-X Self-Descriptions to enable the discovery and selection of Providers and their service offerings. The Self-Descriptions are the information given by Participants about themselves and about their services in the form of properties and claims.

6.2.1 Catalogue (CAT)

A Catalogue stores Self-Descriptions both as stand-alone and as aggregated in a graph data structure. The Self-Description Storage contains the raw published Self-Description files in the JSON-LD (JavaScript Object Notation for Linked Data) format, together with additional lifecycle metadata.

The exchange format for Self-Descriptions is JSON-LD. JSON-LD uses JSON encoding to represent subject-predicate-object triples according to the W3C Resource Description Framework (RDF). The Self-Description Graph imports the Self-Descriptions from the Self-Description Storage into an aggregate data structure. This constitutes the basis for advanced query mechanisms that consider the references between and among Self-Descriptions.

Since Self-Descriptions are protected by cryptographic signatures, they are immutable and cannot be changed once published. This implies that, after any changes to a Self-Description, the Participant as the Self-Description issuer, must once again sign the Self-Description and release it as a new version.

6.2.2 Self-Descriptions

Gaia-X Self-Descriptions express characteristics of Resources, Service Offerings and Participants that are linked to their respective Identifiers. Providers are responsible for the creation of Self-Descriptions of their Resources. In addition to self-declared Claims made by Participants about themselves or about the Service Offerings provided by them, a Self-Description may comprise verifiable credentials issued and signed by trusted parties. Such Credentials include Claims about the Provider or Resources claimed by the issuer.

Self-Descriptions in combination with trustworthy verification mechanisms empower Participants in their decision-making processes.

Specifically, Self-Descriptions can be used for:

- Discovery and composition of Service Offerings in a Catalogue
- Tool-assisted evaluation, selection, integration and orchestration of Service Instances and Resources
- Enforcement, continuous validation, and trust monitoring together with Usage Policies
- Negotiation of contractual terms concerning Resources of a Service Offering and Participants
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Gaia-X Self-Descriptions are characterised by the following properties:

- Machine-readable and machine-interpretable
- Technology-agnostic
- Adhering to a generalised schema with expressive semantics and validation rules
- Interoperable, following standards in terms of format, structure and included expressions (semantics)
- Flexible, extendible and future-proof, in that new properties can be easily added
- Navigable and referenceable from anywhere in a unique, decentralised fashion
- Accompanied by statements of proof (e.g., certificates and signatures), making them trustworthy by providing cryptographically secure verifiable information.

6.3 Data Sovereignty Services

Data Sovereignty Services give Participants the capability to have full self-determination of their data exchange and sharing. Informational self-determination for all Participants includes two aspects within the data ecosystem: (1) Transparency, and (2) Control of data usage. Enabling data sovereignty when exchanging, sharing, and using data relies on fundamental functions and capabilities that are provided by Federation Services in conjunction with other mechanisms, concepts, and standards. The Data Sovereignty Services build on existing concepts of usage control that are more than traditional access control. Traditional access control typically focuses on the data access dimension but leaves aside the data processing angle. Gaia-X Data Sovereignty Services seek to expand this concept and fill existing gaps. As such, usage control is concerned with requirements that pertain to future data usage patterns (i.e., obligations), rather than data access (provisions).

6.3.1 Data Contract Transaction (DCT)

The Data Contract Transaction constitutes the formal data transaction initiation handshake between the data provider and the data consumer. The DCT validates the entire contract and, if the content is valid and the Participants have both successfully confirmed the contract, the Data Contract Service (DCS) adds its signature and distributes the finalised Data Contract to all involved parties. The service allows for negotiation of contracts.

6.3.2 Data Exchange Logging (DEL)

Data Exchange Logging provides evidence that data has been submitted and received, that rules and obligations (Data Usage Policies) were enforced, and on whether these have been complied with or violated. This supports the clearing of operational issues, but also eventually the clearing of fraudulent transactions. The parties involved in the data exchange are the data provider and the consumer of the data; they both receive notifications about the transaction. Some use cases may also require access to the notifications by an eligible third party that has been agreed upon in the Data Contract.

6.4 Compliance

Gaia-X defines a compliance framework that manifests itself in the form of a Code of Conduct, third party certifications/attestations, or through signing of Terms and Conditions. The compliance framework is made up of rules (e.g., for encryption, data protection standards, and interoperability etc.) that Participants need to adhere to. These rules are the combination of those defined in the Policy Rules' Document of Gaia-X, and other rules defined by the Labelling & Compliance Working Group (that collects needs from the three key committees of the Association: DSBC- Data Space Business Committee, TC- Technical Committee and PRC- Policy Rules Committee). The main objective of the Compliance Federation Service is to provide Gaia-X users with verification of Compliance to the stated characteristics for each of the specific Service Offerings. Federation Services in the field of Compliance consist of three components:

6.4.1 Onboarding and Accreditation Workflow (OAW)

Ensures that all Participants, Resources and Service Offerings undergo a validation process before being added to a Catalogue. One goal of the OAW is to document the validation process and the generation of an audit trail to guarantee adherence to generally accepted practices in Conformity Assessments.

- Registration of the Gaia-X Participant: Upon successful validation, a verifiable credential (VC) for the entity will be issued to underpin the status as a registered Participant in Gaia-X. Subsequently, principals of those registered providers can register the service offerings for Gaia-X.
- Self-Description and additional evidence: to support adherence to the Gaia-X policy rules (e.g., by Codes of Conduct, third-party certifications/attestations, acceptance of Terms and Conditions) have to be provided.
- Documentation of the validation process and the generation of an audit trail to guarantee adherence to generally accepted practices in conformity assessment.

In addition to the general onboarding workflow, special functions must include:

- Monitoring of the relevant bases for Compliance
- Monitoring of updates to Service Offerings that could trigger revisions / recertifications for Compliance
- Suspension of Service Offerings
- Revocation of Service Offerings

6.4.2 Continuous Automated Monitoring (CAM)

Enables compliance monitoring based on Self-Descriptions mentioned above in the context of the Federated Catalogue. CAM is achieved by automatically interacting with the service-under-test, using standardised protocols and interfaces to retrieve technical evidence.

6.4.3 Notarisation Service (NOT)

The Notarisation Service is designed to manage notarisation requests and issue digital, legally-binding and trustworthy credentials. To issue such notarised credentials (including eIDAS signatures and public keys in the verifiable credentials format), participants need to provide relevant legal and accreditation documents as defined in the Gaia-X Policy & Rules Compliance Framework.

7. About

About the Gaia-X Association

The international non-profit association Gaia-X, European Association for Data and Cloud, AISBL (French: association internationale sans but lucrative) is the solid and future growth of the project. It is intended to consolidate and facilitate work and collaboration within the Gaia-X community. The Gaia-X association will develop technical solutions and regulatory frameworks and ensure the necessary central facilities and core services can guarantee the envisaged data infrastructure are made available. The association has no business interest of its own.

About GXFS-DE

GXFS-DE is the project name of an initiative funded by the German Ministry of Economics and Energy, based on a decision by the German Parliament. It has been established to kickstart the development of Gaia-X Federation Services as specified in a joint community process. The resulting specifications and open-source code out of this funded project are in ownership of the Gaia-X European Association for Data and Cloud AISBL – Brussels, Belgium. The eco Association of the Internet Industry, with its Head Office in Cologne, Germany, acts as a procurer to coordinate the specification work and to award the contractors for the implementation, based on an open EU-wide tender process.

8. Further information & references

Gaia-X European Association for Data and Cloud AISBL – www.gaia-x.eu
GXFS Gaia-X Federation Services Project-procured by eco – www.gxfs.de
Gaia-X Publications: https://www.gaia-x.eu/publications
Gaia-X Code Repository: https://gitlab.com/gaia-x

9. Glossary

For a full overview of terminology and relevant definitions, please refer to the glossary in the Architecture Document.

10. Media Contact

Company Name: Gaia-X European Association for Data and Cloud AISBL
Contact Person: Dr. Vassilia Orfanou, CMO
Phone: +306974825327
Email: vassilia.orfanou@gaia-x.eu
Address: Avenue des Arts 6-9, 1210 Brussels, Belgium
Website: www.gaia-x.eu

Company Name: eco – Association of the Internet Industry
Contact Person: Mareike Zeisig, Marketing Manager
Phone: +49 (0) 221- 70 00 48- 107
Email: mareike.zeisig@eco.de
Address: Lichtstr. 43h, 50825 Köln, Germany
Website: www.gxfs.de