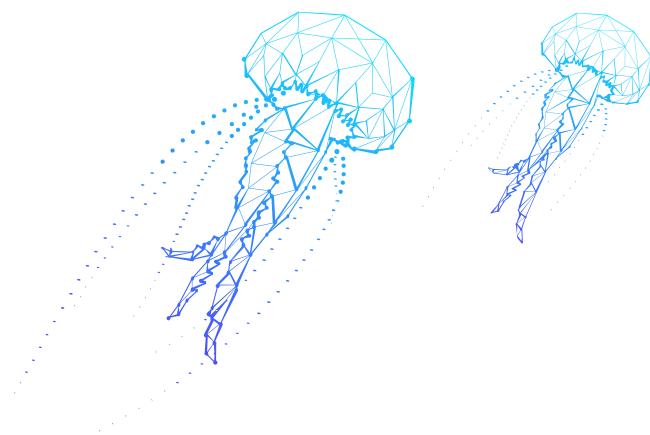


## Ocean Protocol Use Case

# Gaia-X, A Federated European Data Infrastructure

### Abstract

Ocean Protocol already supports a wide range of functionalities the Gaia-X federated services aim to provide. Ocean Protocol might allow the Gaia-X community and emerging European data economy to save years of development and integration time. By applying open-source distributed ledger technology and smart contracts, Europe can accelerate the development of Gaia-X for all European citizens, businesses, scientists, and governments.



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## Goal

Gaia-X aims to be a decentralized, secure, transparent digital ecosystem for the European data economy. Digital services and data can be shared easily and securely by any public or private institution without sacrificing data protection, privacy, and European values. As data has the potential to become the single most valuable good of our time, Gaia-X will significantly contribute to the economic welfare of all Europeans in the coming decades.



*Image: mixmagic/shutterstock.com*

## The Federated Services

All of this is achieved through a multitude of interoperable platforms that all follow minimum technical requirements and services known as the Gaia-X federated services. (Sources: <https://www.gaia-x.eu/>). For a complete overview of the specifications of the Gaia-X federated services, please see <https://www.gxfs.de/federation-services/overview-specification-documents/>.

Ocean Protocol already supports a wide range of functionalities the Gaia-X federated services (GXFS) aim to provide. It also works well with Self-Sovereign Identities (SSI) and Verifiable Credentials (VC). Ocean Protocol might allow the Gaia-X community and emerging European data economy to save years of development and integration time. This time and resources could be used following an iterative and agile approach of continuous improvement.

## Mission

Europe needs an operating, open and secure data economy to remain innovative and internationally competitive. Ocean Protocol can be the steppingstone, as it provides many of the functionalities the Gaia-X federated services aim to provide already. It offers a functional, fully open-sourced foundation to develop a Minimal Viable Gaia-X towards a fully-fledged data economy in accordance with European values. Every contributor of the Gaia-X community can integrate existing solutions, add new components, and implement new use cases for the future European data economy, today.

Ocean Protocol supports the following federated services:

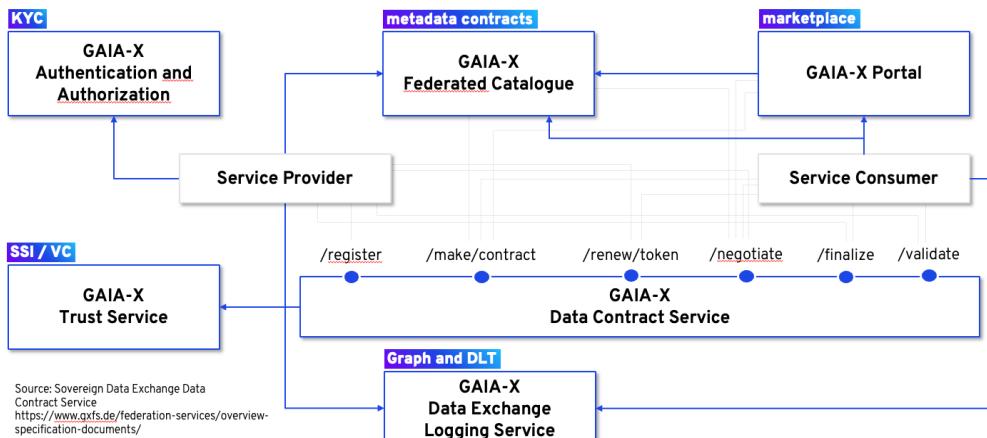


Illustration 1: Gaia-X Federated Services and Ocean Protocol

Image: Licensed under a [CC BY 4.0 license](#), [Gaia-X, European Association for Data and Cloud, AISBL](#). Remixed by deltaDAO AG for illustration purposes regarding the [Gaia-X architecture document 21.06](#). Source: Sovereign Data Exchange Data Contract Service, <https://www.gxfs.de/federation-services/overview-specification-documents/>

1. Identity & Trust. As most DLT solutions, Ocean Protocol relies on Self-Sovereign Identities (SSI) and works well with verifiable credentials (VC). This allows users to always retain control of their identity and adds a new level of trust and security.
2. Federated Catalogue. Ocean Protocol metadata smart contracts provide a decentralized database and “ground truth” for all data asset self-descriptions. This includes a fully operational federated catalogue (FC) and inter-catalogue synchronization on the application layer.
3. Sovereign Data Exchange. Ocean Protocol enables Data Contract Services (DCS) based on Smart Contracts. These allow providers and consumers to offer, negotiate and stipulate data contracts and execute data access rights in a transparent and secure manner. Compute-to-Data (CtD), as part of the Ocean Protocol core features, allows data service providers to always stay in control of their data. CtD enables data owners to grant only compute access to their data. The data itself remains with the data owner in a secured environment.
4. Data Exchange Logging. Using DLT, all transactions are verified, stored, and audited in an ordered, transparent, and trustless way, thus enabled the Data Exchange Logging Service (DELS).
5. Portal & Integration. Only a user-friendly tool for discovery and interaction with data assets will allow for widespread adoption and acceptance of Gaia-X services. Ocean Protocol delivers an open-source, customizable web frontend and APIs to interact with. Users can start publishing and consuming data services with not much more than a standard browser at their disposal.
6. Security & Privacy by Design. As a DLT application and protocol, based on a trustless environment and SSI, Ocean Protocol features security and privacy by design. It does not collect any more information about the participants than is needed to facilitate its services.

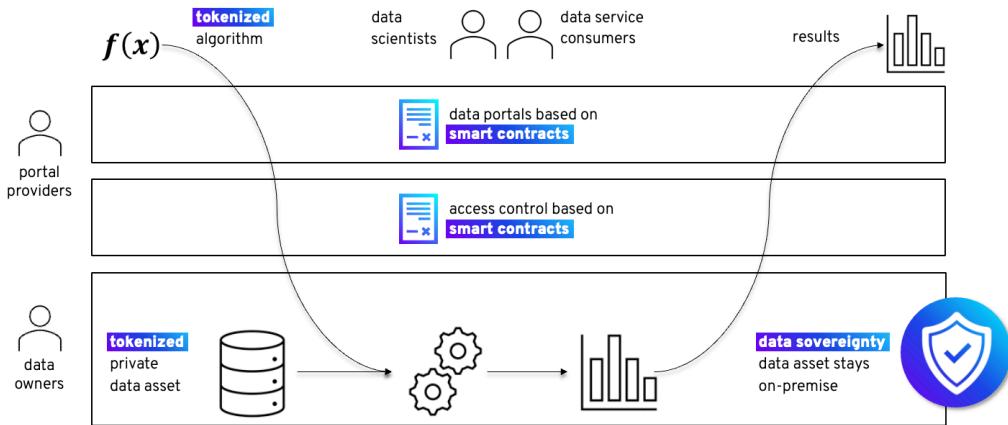


Illustration 2: Compute-to-Data (CtD) Description

## An Infrastructure for all Europeans

Gaia-X is built for all European citizens, businesses, scientists, and governments. Gaia-X offers private and public institutions, such as research institutions, associations, companies, administrations, and politics, the foundation to innovate and co-create in an unprecedented effort to create the infrastructure of a modern knowledge society.

How does Ocean Protocol, as an open-source data exchange solution based on DLT, and smart contracts support this?

## Dimensions of Utility

The utility of Ocean Protocol can be (briefly) summarized across the following dimensions.

1. Transparency
2. Privacy Protection
3. Security and Integrity
4. Governance and democratization of data
5. GDPR-compliance and data sovereignty
6. Monetization and Incentives

### 1. Transparency

Transparency is among the most prominent features Ocean Protocol and other DLT applications can offer the European data economy. DLT has the potential to transform a “shadow economy” in a transparent economy for SMEs and citizens. Each transaction is orderly stored in a distributed public database that all participants can query. Data auditability will emerge as a new basis of trust because each participant can verify transactions and rely on the same ground truth.

Storing all transactions in a public database will significantly aid in observing the flow of data in real-time. In an evolving data economy, this will be of tremendous value for the co-creation of a democratic data economy. Participants, policymakers, and regulators can derive evidence-based decisions and, at the same time, a new dimension of micro- and macroeconomic research on the data economy becomes possible.

The knowledge and data, which has been available to a small, selected group of gatekeepers in the past, now becomes available to everybody.

## 2. Privacy Protection

Privacy protection is ensured as actors are only identified by their self-sovereign identity (SSI) and, where needed, added verifiable credentials (VCs) that attest a specific level of trust or other required attributes. Users stay in control of their personal information and decide on a case-by-case basis with whom they share data and what data they want to share. Data minimization is built at the core of the solution. This helps us to move away from a system where participants must share vast amounts of private information to perform basic economic everyday transactions.

## 3. Security and Integrity

Security and Integrity is another core feature of Ocean Protocol and other DLT solutions. In a decentralized database, relying on strong cryptography and blockchain, a single point of failure does not exist. As each transaction must be signed by a verified and cryptographically proven identity, a strong layer of security is added. The integrity of the ground truth can be ensured through smart contracts and can be controlled by the community it serves. Even if parts of the system are lost, the missing parts can be replicated from the decentralized ledger. A decentralized system is far more resilient against attacks, downtimes, or other events than any centralized solution. This advantage is very inviting for use cases demanding the highest levels of security, availability, and compliance. Furthermore any truly decentralized system has to tackle the Byzantine Generals Problem or Byzantine Faults. DLT consensus models offer promising results in this regards with Bitcoin being a prominent example in this regards although it relies on energy intensive Proof of Work (PoW) which is not always a preferred solution.

## 4. Common Governance (DAO) and the Democratization of Data

Common governance and democratization of data are core value propositions of Gaia-X. A decentralized solution significantly contributes to openness and unrestricted market access. As every participant can easily offer data services and the infrastructure becomes increasingly decentralized, economic entry barriers will be removed, and the European data economy will become more democratic, efficient, and competitive (far less controlled by dominant gatekeepers).

Smart contracts also allow collecting fees on network revenue, which can be reinvested in the infrastructure and shared among the community. The democratic voting of all participants can determine the allocation of collected fees. This budget can then be used to fund essential contributions and activities for the common good that usually get underfunded (problem of the commons). This represents the very core and operational model of a decentralized organization (DAO) and reflects European values. All contributors that run and maintain the economy have a say in the further development and maintenance of the system.

## 5. GDPR-compliance and data sovereignty

GDPR-compliance and data sovereignty benefit from Compute-to-Data (CtD) and data minimization. Ocean Provides a data access mechanism that enables data owners to grant only compute access to their data. The data itself remains with the data owner in a secured environment. Furthermore, the distributed ledger automatically creates audit trails and data collection plans that contribute to compliance and allow provenance of all data assets.

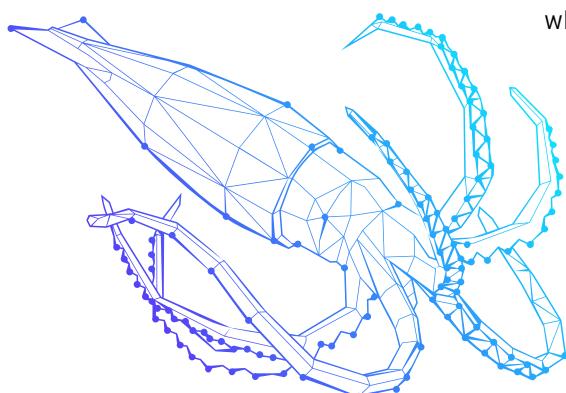
## 6. Monetization and Incentives

With Ocean Protocol, data service providers themselves can settle payments for data services as prepaid services on-chain, without the need for any intermediary. Data monetization will become increasingly decentralized as every participant can conveniently offer data services. With increasing competition and lower entry barriers, the dominance of large gatekeepers will be decreased, which benefits all consumers.

Royalties can be transparently embedded on the smart contract level to be settled immediately after a data service has been consumed. This is of particular importance when data is being pooled by multiple actors, i.e., in a joint research project or business consortia.

Ocean Protocol smart contracts can automatically collect a community fee and portal provider fees. This aligns incentives within the ecosystem as all participants benefit from a continuously growing ecosystem. Portal providers contribute through their service to decentralization and diversification and are rewarded with fractional transaction fees. Publishers earn, based on the consumption of their services, and will compete for the best products. Consumers benefit from lower prices and low entry barriers. The community and overall ecosystem benefits from diversity and community fees that can be used to improve the system for all participants. This together gives the community strong incentives to cooperate on a neutral platform and drives competition on a product level and excellence in research.

Real-time, final, and verifiable settlement of payments make a lot of sense because once a data asset has been consumed, the delivered product (a digital report) cannot be returned as a physical product. However, publishers can also just use the settlement with data tokens for data exchange contract logging and rely on off-chain payment solutions as well. In this case they just grant access by sending out data tokens as access vouchers after a payment has been confirmed or they offer the service before a payment has been received. In any case the underlying mechanism allows for a high degree of flexibility and automatization, which is very much desired by Gaia-X.



## Benefits for Companies

Topic	Benefit
Business Development	<ul style="list-style-type: none"> <li>• New opportunities for product placement and product development.</li> <li>• Access to previously unavailable data and data services.</li> <li>• Ability to combine data and algorithms from a free and open market (data lego).</li> <li>• Lower market entry barriers.</li> <li>• New opportunities for collaboration (with competitors or in a consortia) on a neutral platform.</li> <li>• IoT compatible market for the economy of things.</li> <li>• Reduced market fragmentation.</li> <li>• Cross-listing allows to offer the same data service product across a digital single market and hundreds of decentralized data portals at the same time.</li> </ul>
Monetization	<ul style="list-style-type: none"> <li>• Payment Options (Prepaid, Post-paid, Free).</li> <li>• New business opportunities.</li> <li>• Monetization of personal data in compliance with data protection and privacy protection.</li> <li>• Flexible Pricing (Fixed, Variable, Free).</li> <li>• Price Discovery.</li> </ul>
Cost Efficiency	<ul style="list-style-type: none"> <li>• Software is offered open source and for free. No license costs associated with the open-source components.</li> <li>• Reduced transaction costs.</li> <li>• No lock-in into a specific proprietary platform.</li> <li>• Potential for high degrees of automatic processing.</li> <li>• IT-Centers can be turned into profit center.</li> </ul>
Security and Compliance	<ul style="list-style-type: none"> <li>• Automatic audit trail for provenance of data, compliance and record keeping.</li> <li>• Compliance with privacy and data protection regulation much easier.</li> <li>• Data sovereignty and prevention of data leakage.</li> <li>• Security enforced through cryptographic signing and verifiable credentials.</li> <li>• Reduced third party risks.</li> <li>• Access rights distribution can be easily monitored.</li> <li>• Ability to switch seamlessly between private and public networks.</li> <li>• As all participants are working together in a common network there is a high incentive to collaborate on platform security.</li> <li>• Different jurisdictions might require various kinds of computation and algorithms which can be combined with the same underlying data, always under full control of the publisher.</li> </ul>
Transparency	<ul style="list-style-type: none"> <li>• Transparency adds verifiable reputation.</li> <li>• New opportunities for business analytics and trend discovery as market dynamics can be observed in real time.</li> <li>• Competition is likely to increase, and dominance of gatekeepers is likely to decrease.</li> <li>• Trust and transparency foster investments.</li> </ul>
Availability	<ul style="list-style-type: none"> <li>• High availability due to decentralization.</li> <li>• Portals are available 365/24/7.</li> <li>• Portals are open to other data spaces and for international collaboration and shared value creation.</li> </ul>

## Benefits for Society



*Image: KanawatTH / shutterstock.com*

Topic	Benefit
Openness and Transparency	<ul style="list-style-type: none"> <li>• Less information asymmetry between market participants</li> <li>• Better foundation for decision making processes based on empirical evidence</li> <li>• Better oversight by regulators to ensure fair competition</li> <li>• Undistorted competition</li> </ul>
Monetization	<ul style="list-style-type: none"> <li>• Enables a universal data income for citizens and reveals the value of personal information and data</li> <li>• New business and employment opportunities</li> <li>• Potential driver of economic growth and welfare in the European Union</li> <li>• Higher competition usually leads to better products and lower prices as the market dominance of gatekeepers is being reduced</li> </ul>
Security and Data Protection	<ul style="list-style-type: none"> <li>• Data sovereignty helps users to stay in control of their data</li> <li>• Reduced risks of data leakage</li> <li>• Data minimization by design and self-sovereign identity (SSI)</li> </ul>
Efficiency	<ul style="list-style-type: none"> <li>• Sustainable business models for public infrastructure help to reduce the need for subsidies</li> </ul>

## Benefits for Research Institutions

Topic	Benefit
<b>Openness and Transparency</b>	<ul style="list-style-type: none"> <li>Access to previously unavailable data and data services</li> <li>Private and public actors will be able to share data for research purposes without losing control over the data</li> <li>Transparency adds verifiable reputation</li> <li>Transparency and incentives for competition will lead to excellence in research as results can be easily verified</li> </ul>
<b>Research opportunities</b>	<ul style="list-style-type: none"> <li>Data will be available for reuse and peer review of data driven research</li> <li>Gaia-X is likely to foster open access, open data, and FAIR principles</li> <li>Ability to combine data and algorithms from a free and open market (data lego)</li> <li>New opportunities for micro and macroeconomic research in an evolving data economy as it unfolds</li> <li>New opportunities of collaboration between private and public actors</li> </ul>
<b>Funding</b>	<ul style="list-style-type: none"> <li>Data curators can be directly incentivized for their services adding to new high-quality sources of data in Europe and around the world</li> <li>Enables new ways to fund research projects through the monetization of research data and through the opportunity to drive business applications directly from research data</li> <li>High availability of research data might contribute to investments into research projects as it adds verifiable trust, early product development opportunities and transparency</li> <li>Potential driver of economic growth and welfare in the European Union</li> <li>Collaborators of a data driven research project can be incentivized as they will be rewarded in direct relation to their contribution in terms of algorithms and/or data</li> </ul>
<b>Security and Compliance</b>	<ul style="list-style-type: none"> <li>Automatic audit trail for provenance of data, compliance and record keeping</li> <li>Compliance with privacy and data protection regulation much easier</li> <li>Data sovereignty and prevention of data leakage</li> <li>Access rights distribution can be easily monitored</li> <li>Ability to switch seamlessly between private and public research networks</li> <li>As all participants are working together in a common network there is a high incentive to collaborate on platform security</li> <li>Different jurisdictions might require various kinds of computation and algorithms which can be combined with the same underlying data, always under full control of the publisher</li> </ul>
<b>Availability</b>	<ul style="list-style-type: none"> <li>High availability due to decentralization</li> <li>Portals are available 365/24/7</li> <li>Portals are open to other data spaces and for international collaboration, enabling a new impulse for decentralized science and shared value creation</li> </ul>

## Benefits for Governments and the Public Sector

Topic	Benefit
<b>Openness and Transparency</b>	<ul style="list-style-type: none"> <li>Access to previously unavailable data and data services.</li> <li>Private and public actors will be able to share data for research purposes without losing control over the data.</li> <li>Better foundation for decision making processes based on empirical evidence.</li> <li>Better oversight by regulators to ensure fair competition.</li> </ul>
<b>Neutrality and Availability</b>	<ul style="list-style-type: none"> <li>As the network is operated by all participating member states it acts as a neutral space to collaborate in. Disputes about leadership in infrastructures can be avoided to a considerable extent as there is no single party in control of the network.</li> <li>High availability due to decentralization.</li> <li>Portals are open to other data spaces, international collaboration and shared value creation.</li> </ul>
<b>Security and Compliance</b>	<ul style="list-style-type: none"> <li>Automatic audit trail for provenance of data, compliance and record keeping.</li> <li>Compliance with privacy and data protection regulation much easier.</li> <li>Data sovereignty and prevention of data leakage.</li> <li>Access rights distribution can be easily monitored.</li> <li>Ability to switch seamlessly between private and public research networks.</li> <li>As all participants are working together in a common network there is a high incentive to collaborate on platform security.</li> <li>Different jurisdictions might require various kinds of computation and algorithms which can be combined with the same underlying data, always under full control of the publisher.</li> </ul>
<b>Efficiency</b>	<ul style="list-style-type: none"> <li>Sustainable business models for public infrastructure help to reduce the need for subsidies.</li> <li>Investments and regulation in a transparent data economy becomes much easier and more efficient as the results can be immediately observed and measured.</li> <li>Lower transactions costs make services much more available and foster economic growth and welfare.</li> </ul>

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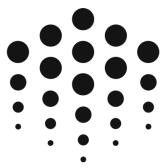
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