

X-Road®

Nordic Institute for Interoperability Solutions
(NIIS)

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1. Introduction

a. *Brief overview of organisation and Industry*

The Nordic Institute for Interoperability Solutions (NIIS) ensures the development and strategic management of digital government solutions that allow NIIS members: Estonia, Finland and Iceland to provide excellent digital public services.

b. *Main stakeholders and the roles they play in designing the use-case*

X-Road® is open-source software that provides unified and secure data exchange between organisations in a collaborative ecosystem. It streamlines data exchange processes, enhances security, and facilitates interoperability, enabling organisations to derive greater value from their data assets. X-Road is fully data type and use case agnostic, and it can be used by different business domains and data ecosystems. X-Road hasn't been designed for a specific business domain or use case, so it can be used in a broad variety of use cases to establish a single data ecosystem.

NIIS is responsible for developing the X-Road software used by NIIS member countries and other countries to implement national data ecosystems. Typically, the national ecosystems are open to both public and private sector organisations. However, the organisations implementing X-Road are usually public authorities, and they are responsible for managing the ecosystems and defining their rules and policies.

2. Context & Challenge

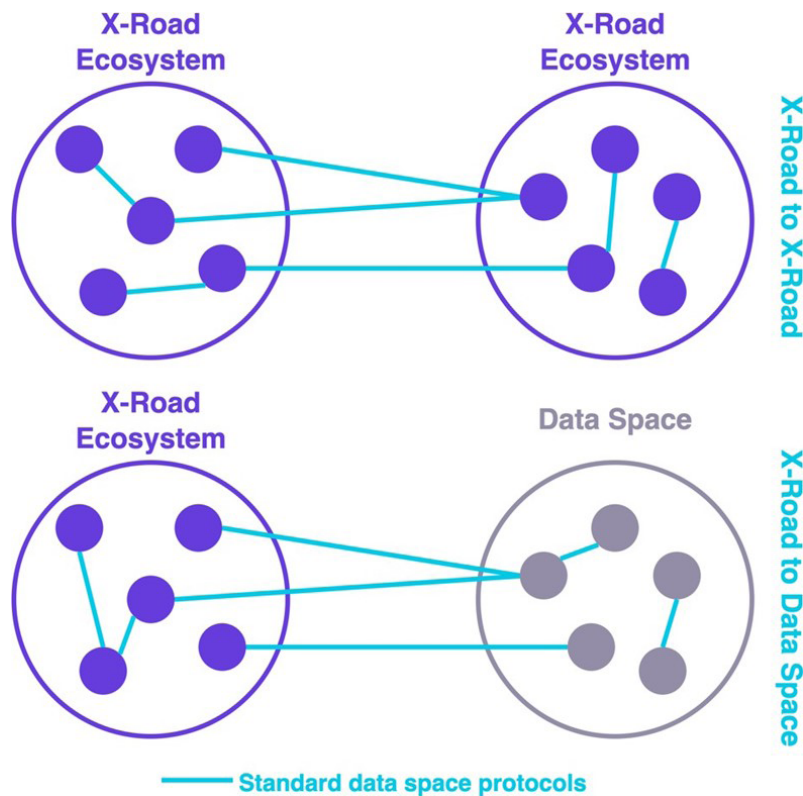
a. *Brief description of the problem that the use-case addresses*

Currently, X-Road is based on a custom X-Road-specific protocol stack that is not interoperable with other data exchange technologies. Without using international standards and common specifications, achieving cross-ecosystem interoperability is challenging. Therefore, NIIS aims to replace X-Road's custom protocol stack with a data space protocol stack and align X-Road's trust framework with the Gaia-X trust framework. In this way, X-Road will support ecosystem-level federations with data spaces and other data ecosystems based on the same set of data space standards and specifications.

3. Solution description

a. Solution implemented to address the identified challenges

The X-Road 8 “Spaceship” nurtures the proven ecosystem model and security while it takes X-Road to the next level by providing a solid data space infrastructure.



X-Road 8 provides a generic and data-agnostic solution to build data spaces for different business domains. X-Road 8 will be technically compatible and interoperable with the Gaia-X trust framework, enabling X-Road user organisations and services to meet the requirements of the Gaia-X Compliance rules. The Gaia-X trust framework provides a unified way to establish trust between different entities and share metadata about them. This enables better interoperability with other data exchange ecosystems and data spaces that are conformant to the Gaia-X specifications.

The data space concept is gaining much traction not only in Europe, but also globally. Multiple organisations and initiatives are developing specifications and standards for data spaces. Instead of maintaining and developing custom X-Road-specific specifications, joining the international data spaces community offers greater benefits by utilising collaborative efforts across different initiatives and integrating their deliverables into X-Road. To that end, using common standards provided by Gaia-X further increases the technical interoperability with other data spaces, and therefore promotes seamless collaboration and alignment.

b. Role of technology in the development and deployment of the solution

Increasing interoperability between ecosystems can rely on several layers as described by the European Interoperability Framework. In X-Road's case, the technical layer is playing the key role without forgetting the semantic interoperability layer.

Indeed, using the Gaia-X ontology is a way to use the same vocabulary as other ecosystems or data spaces and thus help ease the connection.

What's more, using the same technologies is also a way to increase interoperability. The aim when building X-Road 8 is to use existing open-source components and building blocks. For example, the Eclipse Dataspace Components (EDC), is used as a basis for the implementation, even if it would require specific developments to set up all the Gaia-X Concepts.

Utilising existing open-source solutions and contributing to their development can significantly speed up the development of X-Road 8. It also reduces the amount of technical maintenance work since a larger number of organisations are participating and therefore, more resources can be spent on developing new business features.

4. Implementation

a. How the solution was integrated into the use-case organisation's existing systems or processes

As X-Road is a framework used by many organisations, it has to rely on smooth integration into existing organisation's systems and processes.

Indeed, the project tries to ensure seamless integration with previous X-Road versions for backward compatibility. It also estimates the necessary changes required for information systems transitioning to X-Road 8, and assesses potential updates to existing X-Road components. This is necessary because X-Road is currently implemented in 25 countries, and the number is further increasing. Over 542 million people depend on an X-Road infrastructure as the backbone for digital services provided by public administration and companies. This means the X-Road 8 ecosystems in the future will potentially constitute some of the largest data spaces worldwide.

b. Significant milestones or challenges during the implementation phase

Apart from technologically migrating from the X-Road specific stack to the data space protocol stack, including the use of Gaia-X concepts and technologies, the biggest challenge is maintaining backward compatibility and minimising the variations the X-Road user organisations must implement when migrating to X-Road 8. The aim is to ensure that connected information systems and services require no modifications when migrating to X-Road 8. At the same time, new X-Road ecosystems established with X-Road 8 should not need to manage details related to the previous versions.

A significant milestone in transforming X-Road 8 into a data space solution was integrating support for the Gaia-X Trust Framework, a process that began during the development of X-Road 7.

5. Benefits & Impact

a. Measurable use-case implementers' benefits observed since implementation

The implementation of data space standards and components is still in the proof-of-concept stage, so it's too early to measure the concrete benefits. One expected benefit is that X-Road user organisations will be able to use X-Road to exchange data with organisations that are members of other data exchange ecosystems. Instead of deploying multiple technical solutions, it's sufficient to only have X-Road.

Furthermore, in the future, X-Road could be used as a core technology when establishing new domain-specific or cross-domain data spaces, even outside of X-Road's original scope, which is to form a national data-sharing ecosystem.

b. Benefits for the end-users

Transforming X-Road into a comprehensive data space solution creates value through additional features, reduces the need for custom development, increases interoperability and provides new opportunities for X-Road users in Europe and worldwide. Combining the strengths of X-Road and data spaces will make X-Road 8 "Spaceship" an outstanding solution.

6. Added Value through Gaia-X

a. Alignment with the [Gaia-X vision](#)

X-Road 8 will provide the technical means to become a Gaia-X participant when an organisation meets the requirements of the Gaia-X Compliance rules. Both X-Road and Gaia-X are aligned on the need to enhance interoperability between data spaces. Sharing a common framework for trust and common technologies are two pillars of the Gaia-X Vision that X-Road is also aiming to support.

b. Alignment of current architecture and technology stack with the Gaia-X technology model, and any convergence needs

Technical compatibility and interoperability with the Gaia-X trust framework offer clear requirements and a foundation for the X-Road's trust framework. Instead of designing a new trust framework, X-Road is able to extend the Gaia-X trust framework. The Eclipse Dataspace Components (EDC - which is not an out of the box solution) are used as a basis for the implementation, but extra work will be required to set up interactions using Gaia-X concepts, especially to use, verify or share Gaia-X verifiable credentials.

Currently, X-Road's trust framework is technically based on X509 certificates, while the Gaia-X trust framework is based on W3C Verified Credentials (VCs). Therefore, X-Road's technology stack must be aligned with the requirements outlined in the Gaia-X specifications. However, at least initially, X-Road 8 must support both technologies to enable smooth migration for the user organisations.

7. Use-case scaling

a. Requirements and steps for a new member (user, provider, or service providers) to join use-case

X-Road is an open-source solution licensed under the MIT open-source license which allows anyone to use X-Road free of charge. Therefore, anyone can implement X-Road and contribute to the development of X-Road 8. Contributing to the expansion requires signing the NIIS Contributor License Agreement (CLA) and aligning the development work with the X-Road roadmap and backlog. However, other source-code contributions don't require signing the CLA document.

b. Other sectors that could benefit by making use of the resources in this usecase

X-Road is a sector and domain-agnostic, generic data exchange solution between information systems. Additionally, the learnings from transforming existing data exchange ecosystems into data spaces can be applied across sectors. For example, in the NIIS member countries, X-Road is used as a platform for data exchange within the public sector, between the public and private sectors, and within the private sector. The private sector includes multiple business domains, such as, transport, healthcare and finance. X-Road provides a unified way to access data and services provided by different organisations and sectors.

8. Next steps

a. What are the next steps of your project functionally-speaking?

The next steps include refactoring the X-Road architecture to make it more modular, integrate the EDC into the X-Road architecture, refine the X-Road trust framework, and implement the relevant protocols from the data space protocol stack, e.g., the Dataspace Protocol (DSP) and Dataspace Decentralized Claims Protocol (DCP).

X-Road 8 will be technically compatible and interoperable with the Gaia-X trust framework, enabling X-Road ecosystems and user organisations services to become Gaia-X compliant. Instead of designing a new trust framework, X-Road can extend the Gaia-X trust framework.

b. What are the next steps of your project in relation to the current (and near-future) versions of the Gaia-X architecture, and/or Policy Rules Compliance Document, and/or GXDCH release?

We are closely following the development of various Gaia-X deliverables, and our aim is to keep the X-Road 8 design technically interoperable with them. Over time, different X-Road 8 minor versions will support different versions of the Gaia-X specifications. In this context, ensuring backward compatibility between different X-Road versions - and indirectly between different Gaia-X specification versions - remains a top priority. In the X-Road architecture, refine the X-Road trust framework, and implement the relevant protocols from the data space protocol stack, e.g., the Dataspace Protocol (DSP) and Dataspace Decentralized Claims Protocol (DCP).

X-Road 8 will be technically compatible and interoperable with the Gaia-X trust framework, enabling X-Road ecosystems and user organisations services to become Gaia-X compliant. Instead of designing a new trust framework, X-Road can extend the Gaia-X trust framework.

Gaia-X

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