

Comparison of X-Road and Cybernetica UXP[®]

White Paper

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1. Introduction

This document compares X-Road software with its commercial counterpart Cybernetica UXP® (Unified eXchange Platform). These two platforms have similar architecture and have partial protocol-level compatibility. In practice, UXP components such as the security server and the registry server can be substituted for the corresponding X-Road components when compatible configuration parameters are selected. However, the two systems are developed based on different development models and UXP offers many features that make it more suitable for implementation outside Estonia. In addition, Cybernetica offers full support for the UXP product, including version updates, training, installation and integration support.

In Section 2 we detail the interoperability between X-Road and UXP. In Section 3 we compare the two platforms with regards to their development approach, features and support.

2. Interoperability of X-Road and UXP

The X-Road/UXP architecture is built on separate components that communicate with each other using clearly defined protocols. The protocols are based on established standards, such as TLS, HTTP, MIME, OCSP and TSP.

UXP has partial protocol-level compatibility with X-Road. A UXP security server can be substituted for an X-Road security server. That is, it can inter-operate with X-Road security servers and an X-Road central server. However, there are two main restrictions.

- The UXP security server must be downgraded to use insecure cryptographic algorithms to work with X-Road.
- The interoperability is limited to SOAP protocol. X-Road and UXP use different implementations for REST protocol that do not work together.

The UXP security servers support a wider range of SOAP services. With UXP, existing SOAP services can immediately be connected to the system, there is no need to add support for X-Road specific SOAP headers (as is the case with X-Road).

UXP and X-Road installations can be connected using the federation. The security servers from one installation can call the security servers from the other installation. The two previously listed restrictions apply.

UXP and X-Road use PKI protocols (OCSP and TSP) in the same manner. Certificates issued for UXP work with X-Road and vice versa.

3. Comparison of X-Road and UXP

3.1. Development Approach

X-Road code is maintained by Nordic Institute for Interoperability Solutions (NIIS) under the cooperation agreement of the governments of Estonia and Finland.

UXP is a product developed by Cybernetica, the original developer and maintainer of the X-Road software since the first version was released in 2001. Cybernetica has extensive

experience in developing and deploying mission-critical e-government systems to countries around the world. We perform world-class research in cybersecurity and cryptography in cooperation with the DARPA, the EU and the ESA. The following are the main differentiating factors of the UXP development.

- Very strong development team employing people who created the first version 20 years ago and continued the development over time. We have a thorough knowledge of the domain and ensure that installed system will be a good fit for the customer.
- Strong emphasis on stability and security. We know that UXP is the foundation of a strong digital government and as such, it must work without any issues. From the internal quality point of view, we implement very strict code quality control and comprehensive automated test suites.
- Regular security testing; both internal and external penetration testing is used.
- Strong focus on usability. We work continuously to make installation, usage and application development easier. UXP is designed to support existing applications and development tools — existing services can simply be connected to UXP.
- Emphasis on offering the complete solution. We know the value of using tried and true components as a base, but we also know that only the components do not form a complete solution. Both technical and non-technical gaps need to be filled. We work with our customers to build a working system, from helping to set up an organizational framework to developing any components needed for working e-government.
- A clear development road map that reflects the needs of our clients as well as global trends in digital governance and our research.
- Development of client specific functionality — it is possible to modify the product or develop custom add-ons according to the requirements of a particular deployment.
- UXP is a closed-source product, but the source code can be made available for audit and escrow (the source code is stored by a third party and is released under certain conditions, for example, if Cybernetica discontinues the product).

3.2. Product Features

UXP implements the basic protocols of the X-Road system and can fulfill the same basic functionality as X-Road. However, UXP contains several enhancements and additions compared to the base X-Road. The additional components make the UXP a complete e-government solution that does not depend on existing Estonian infrastructure and can be quickly deployed. The following is an (incomplete) list of UXP product features not supported by X-Road.

- Numerous security, performance and stability improvements. UXP supports long key lengths (according to NIST SP 800 recommendations) and additional cryptographic algorithms for better performance and security.
- X-Road requires the service developers to modify the services and WSDLs to comply with X-Road SOAP profile. It also restricts the SOAP encoding style that can be used. UXP natively supports all existing SOAP 1.1 and SOAP 1.2 services. It also does not restrict the encoding style as the X-Road does. This means quicker integration as existing web services can immediately connect to the UXP framework without any additional work.
- Both UXP and X-Road have native support for REST web services and JSON protocol.

- UXP has good support for localization. Localized versions of user interfaces can be maintained and installed as additional packages. Several of our clients already use a localized version of the software.
- UXP supports plugins for adding additional cryptographic algorithms. This allows, for example, experimental support for post-quantum cryptography and distributed blockchain.
- UXP has native support for cloud deployments, making it easy to implement either parts or the whole infrastructure on cloud platforms.
- UXP supports deployment in configurations that employ several unconnected networks (such as the public Internet and a separate government network).

In addition to changes to the basic components, UXP contains additional components not present in X-Road that simplify setting up a complete working e-government backbone.

UXP Monitoring collects system status (health) data and transaction statistics (analytics) from the security servers. This information is presented in a dashboard that provides a quick overview of the overall status of the system. The monitoring system can send configurable alerts when some conditions have been reached. UXP Monitoring contains default dashboards and graphs for viewing the transaction statistics. Performing additional analytics is possible using an external tool.

UXP Directory collects and presents information about the organizations and services that are connected to UXP. The automatically collected information can be complemented by manually entered data, such as contact data of organizations and human-readable documentation for the services. UXP Directory integrates with the monitoring system and displays basic statistics about the organizations and services. UXP Directory also contains basic analytics functionality by visualizing the communication channels between the organizations and by offering to download the detailed analytics data as open data.

UXP Data Privacy contains two main functions: consent management and access tracking. The consent management module allows the data subject (citizen) to control who has access to their data and for what purpose. The access tracking module records access to the personal data and provides the data subject an overview of who has accessed their data. The data subject can then request an inquiry why a certain request was made. The access tracking functionality can be deployed both with and without consent management.

UXP SQL Connector can be used to quickly create a web service that is backed by an SQL database. This can be done without writing any code by using a web user interface. In addition to simple SQL statements, such as SELECT, INSERT and UPDATE, the Connector also supports calling of stored procedures. This allows exposing complicated business logic that is implemented in the database.

UXP Verifier provides a graphical user interface for examining the secure transaction log. It is possible to search for a particular transaction from the log and to verify the integrity of the transaction using a digital signature.

UXP Trust Services speed up the implementation of UXP by providing components for building the necessary PKI infrastructure. It contains Certification Authority, Registration Authority, OCSP Service, Timestamping Service.

3.3. Support

X-Road software can be downloaded from Github and used under an MIT-style license. However, for quick and reliable deployment and maintenance this is often not enough.

- Support is only available to organizations connected to the Finnish and Estonian X-Road installations. Support response time in such situations is not defined.
- There is no warranty associated with the publicly available software.
- There is no clear consultancy partner for implementation, customization and integration.
- Training is not available.

UXP is supported by Cybernetica directly and through cooperation with local partners.

- Cybernetica offers support agreements with predefined response times. Both first and second level support is available.
- Cybernetica provides a warranty for the product.
- Cybernetica offers consultation (including legal consultation) and customization services.
- Cybernetica offers installation support and installation services. Leveraging our experience dramatically decreases the time needed for setting up the system and also provides a predictable cost structure.
- Cybernetica offers on-site training for end users, systems administrators and developers as part of the implementation plan.