The Estonian IT Interoperability Framework

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The Estonian IT interoperability framework generalises and provides a systematic overview of positive developments in state information systems. The main objective of the framework is to ensure that state information systems are citizen-focused and service-based. Information systems must be integrated into a single logical whole, one which serves the population and various organisations. To this end, it is necessary to reach agreement at the state level on clear rules and agreements. Common middleware must be used.

INTRODUCTION

Over the last several years, a public key infrastructure (PKI) has been established, and several user-oriented portals such as www.riik.ee, www.eesti.ee, and https://www.eesti.ee have been developed in Estonia. In addition, a data exchange layer known as "X-Road" has been created. The existing framework generalises and provides a systematic overview of positive developments in state information systems.

In order to implement the interoperability framework, the state must be citizen-centred, and its information systems must be service-based. As a member state of the European Union, Estonia must ensure the interoperability of its information systems and those of other member states. Although the functions of state information systems are aimed at achieving the same level of rationality as is applied to private sector systems, there are major differences between the state and the private sector. It is not the state's aim to sell services, but rather to ensure their expediency. It is assumed that in the nearest future, information systems will be able to handle several operations at one and the same location, e.g., service users will no longer have to visit offices or search for Web sites. The efficiency of public sector information systems cannot be measured by the same indicator (return on investment) that is applied to private sector systems. In terms of integrated service provision, public sector information systems must be pathfinders for private sector information systems. Participation in the development of state information systems through public procurement and satisfying the needs of the state as a whole – this poses a considerable challenge for the Estonian IT sector.

Institutions are autonomous when it comes to the IT architecture and interoperability principles of their internal information systems, but when central and local governmental institutions launch new IT projects, they must observe the principles of the interoperability framework. See http://www.riso.ee/en/information-policy/interoperability for more information about this.

DEFINITIONS AND OBJECTIVES

Interoperability denotes the ability of information systems and their supported business processes to exchange data and to share information and knowledge.

The Estonian IT interoperability framework is a set of standards and guidelines aimed at ensuring the provision of services for public administration institutions, enterprises and citizens, both in the national and in the European context.

The framework serves as:

- A guide for those who are drafting concepts for nationwide information systems;
- A guide for IT project managers in the field of public administration when they wish to draft concepts for the information systems of their institutions;
- A form of assistance in organising public procurements.

The aim of the IT interoperability framework is to improve public sector efficiency in Estonia by improving the quality of services that are provided to local residents and enterprises, both at the national and at the EU level. The specific objectives of the framework are the following:

- To facilitate and implement the transformation of institutionally based public administration institutions into service-centred ones, allowing all citizens to communicate with the state without knowing anything about its hierarchical structure and separation of roles;
- To reduce public sector IT spending through the extensive use of centrally developed solutions;
- To improve the interoperability of new IT projects through the co-ordinated use of a centrally developed infrastructure, middleware (the PKI), the X-Road data exchange layer, the environment of local residents, etc.), and open standards;
- To improve the co-ordination and management of national information systems and to accelerate the development of IT solutions;
- To contribute toward the co-development of the state's information systems;
- To allow for the autonomous development of all systems under the principles of organisational, semantic and technical interoperability;
- To ensure free competition in public procurement.

The document examines the state's IT interoperability framework from three perspectives – organisational, technical and semantic interoperability.

The framework does not attempt to offer clear solutions to all IT-related problems in Estonia. Transforming the institutionally based

world into one that is service-centred and citizen-oriented – that is a lengthy process, one which requires amendments to legislation and changes in the way in which public administration activities are organised. Activities which do not require creative and intellectual work by human beings should be detached from the typical activities of the public sector. The current version of the framework does not describe new forms of governance which accompany the development of the Information Society, but it does set out rules, trends and principles which are necessary for the development of the Information Society from the viewpoint of information systems.

The first version of the framework was published in 2004, and the present version is its follow-up.

PRINCIPLES OF INTEROPERABILITY

The key principles of Estonian IT interoperability include the following:

- The institutionally based approach should be replaced with a service-centred one;
- Public services (including nested ones) are provided free of charge for public sector institutions;
- The development of information systems is based on an Internet-centred approach;
- XML-based technologies are used to integrate information systems and to present data;
- There is a move toward the more extensive use of open standards;
- In developing information systems, open source solutions are considered alongside proprietary ones;
- Access to public services should be ensured via a Web browser and by various channels and devices;
- All services requiring user authentication and authorisation must exploit the secure X-Road middleware for data transport;
- The authentication and authorisation procedures for civil servants are based on their use of the Estonian ID card;
- As a temporary alternative, authentication mechanisms used by Internet banks can be used for authentication of individuals;
- Central and local government agencies must co-operate in order to ensure the provision of information and services to local residents, officials and businesspeople at a single place and without the need to know anything about the subordinating system of the executive power or the division of roles therein.

Interoperability is analysed from three different angles:

- Organisational interoperability refers to the ability of organisations to use information systems so as to offer services to other organisations or to their clients. Organisational interoperability is associated with the activities of organisations, and with agreements among them. Organisational interoperability is ensured by legislation and general agreements;
- Semantic interoperability refers to the ability of different organisations to understand exchanged data in a similar way. This presumes the creation of a mechanism which makes possible the presentation of service data and data definitions;
- Technical interoperability speaks to the interoperability of infrastructure and software. Infrastructure interoperability is the ability of hardware acquired by different organisations to work in a connected way. This is ensured via the Internet and the PKI infrastructure. Software interoperability refers to the ability of software used by different organisations to exchange data. Achieving software interoperability requires the establishment of common data exchange protocols, the development of software that is needed for the management of data connections, and the creation of user interfaces so as to enable communications among different organisations.

When it comes to the architecture of interconnected systems, it must be said that systems can be connected on the basis of two principles of architecture – bilateral agreements or multilateral agreements (Figure 1).

There has been a trend toward moving from bilateral to multilateral agreements, which considerably reduces the number of connections that are necessary for communications among information systems. This, consequently, facilitates the management of connections. The responsibility for ensuring general compliance with rules related to organisational, semantic and technical interoperability rests with the relevant organisations.

PUBLIC SERVICES AND NESTED SERVICES

A public service is a service which is provided by an organisation to local residents, agencies, enterprises and organisations. A public Internet-based service is characterised by the following factors:

- It is directed at personalised users (individuals);
- It is provided online;
- Central and local government agencies provide services which are dictated by law;
- For private companies and other organisations, the provision of

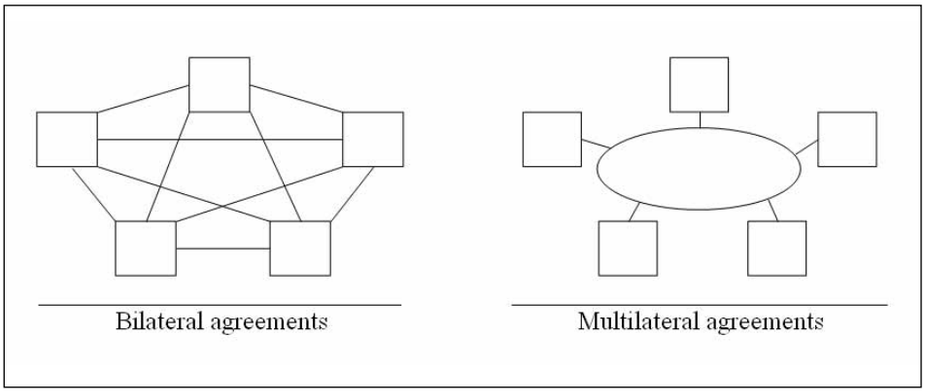

Figure 1. Types of agreements

such services is regulated by legislation, or by contracts concluded with central or local government agencies.

In the electronic environment, a public service must be accessible to its target audience, and the following requirements must be observed:

- The services are provided to the users at as close a level as possible;
- The services can be used with minimal training;
- Minimal information is required from the user;
- The service is secure in its use by anyone.

An interconnection service is an operation which is performed by one organisation and constitutes a necessary component in an operation that is performed by another organisation, but it is not necessarily of meaning in the first organisation. An interconnection service is used by an information system (programme). It is not the independent service of the organisation which provides it. Instead, it can be a part of a public service operation that is provided by another organisation, or part of an internal working process at another sub-organisation.

DESCRIPTIONS AND QUALITY OF SERVICES

Service descriptions are compiled by service providers and should contain the following information:

- The syntax and protocol of the service (in the case of X-Road services, for instance, these are produced in the WSDL format);
- A service provision policy (the principles as to who receives the services and the purpose of the provided services);
- Quality indicators (functionality, reliability, efficiency).

Service descriptions are published in the administrative system for state information systems (RIHA). A taxonomy has been created in the RIHA UDDI to present the characteristics and indicators of a service. The free text of the service description is published as a separate file on the public Web (either in RIHA, by the service provider or elsewhere). A link has been created to that text from service data that are maintained in RIHA (e.g., the UDDI model).

It is the task of the service provider to describe a service in RIHA. The easiest way is to describe the services (including non-X-Road services) in a WSDL file which RIHA automatically reads and which completes data fields in RIHA. The universal part of the description (presentation of protocol, policy, etc.) which applies to several services or databases should be stored in a separate file, one to which there is a link from the WSDL file.

Describing quality indicators is necessary so that the quality of services can be evaluated and ensured. The quality of a data service refers to the degree to which service indicators correspond to requirements. Service requirements are quality indicators which are defined in service descriptions. Quality indicators characterise the functionality, reliability and efficiency of a service.

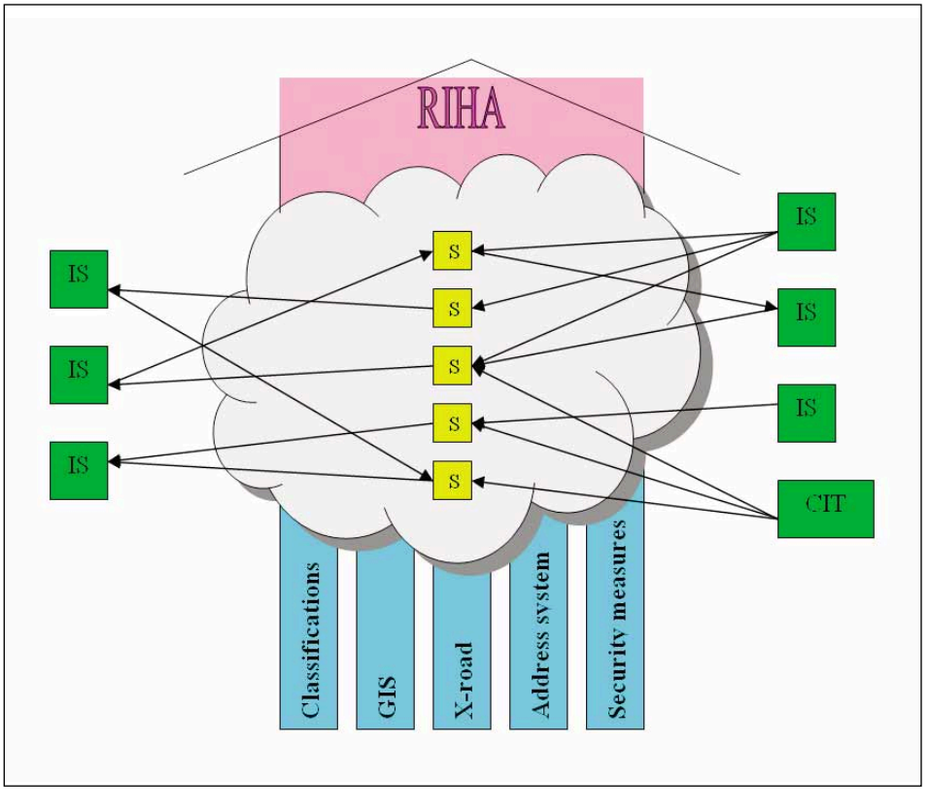

Figure 2. The state information system can be regarded as a service space which is based on support systems and is administered through RIHA. Information systems communicate with each other via services (S – a service, IS – an information system, CIT – the citizen portal as a special guide to the information system).

THE GENERAL STRUCTURE OF THE STATE INFORMATION SYSTEM

The state information system (Figure 2) is a service-centred organisation, which means that operations performed by civil servants, entrepreneurs, local residents and software are considered services. End users access the services in a common service space. They are interested in the service, and not in the organisation which is providing it.

Central and local government agencies, private companies and third-sector organisations all provide services. These are used by central and local government agencies, private companies, third-sector organisations and individuals. The common service space allows individuals to represent themselves and their place of employment when using public services. The services may or may not require authentication.

These are the logistical components of the state information system:

- Information systems (both as service providers and service users);
- The administrative system for the state information systems (RIHA), along with its catalogue of services;
- The state-administered citizen IT environment;
- Support systems and rules.

The support systems and rules for the maintenance of the state information system are the following:

- The classification system;
- The system of address details;
- The data exchange layer for information systems (X-Road);
- The geodetic system;
- The system of security measures for information systems.

PRINCIPLES FOR USING OPEN SOURCE SOFTWARE

Central and local government agencies must observe a series of principles when it comes to the OSS:

- OSS-based solutions must be considered along with proprietary ones in the development of information systems and in tender notifications. Decisions may be taken in favour of OSS, commercial software, or a combination of the two, but when it comes to equality in other requirements, open source software is to be given priority. Decisions should be made on a case-by-case basis.
- When solutions ensure mutual communications among information systems in joint projects, in commonly used information systems, or in new or modernised information systems, only those products which support the use of open standards and specifications should be used;
- Adhering to company-specific products and services and developing dependency on them must be avoided;
- When purchasing IT solutions, there should also be procurement of the code of the acquired software or, in the case of a commercial product, its adaptations, as well;
- If possible, a specific principle must be applied to software that is procured by central or local government agencies – it and its adaptations can be used without restriction by other public administration institutions (this principle cannot be applied to standard software which is owned by its producer). If several agencies have similar needs, joint software acquisitions should be considered.

SOFTWARE IN THE ESTONIAN LANGUAGE

Estonia promotes the localisation and adaptation of software so as to bring it into accordance with the requirements of the Estonian language and culture. There are requirements in the standard "EVS 8:2000, Requirements on information technology in the Estonian language and cultural environment". In addition, the use of Estonian spellers in text-based applications, along with an assistant module for text-indexing might be expedient.

ORGANISATIONAL INTEROPERABILITY

When it comes to information systems, organisational interoperability refers to the ability of organisations to use information systems so as to provide services to each other and to the general public. Organisational interoperability is based on the following principles:

- All interoperable institutions are autonomous organisations with a specific technological architecture;
- All connections among institutions are based on multilateral agreements, avoiding bilateral agreements wherever possible;
- Private sector and non-governmental organisations which take part in the state's interoperability network own the information and/or data which they create or obtain. Data in the state information system are owned by the state. Responsibility for the structure and content of data rests with the organisation which administers the relevant data, either as the chief processor or an authorised processor of data;
- In data exchange, legal restrictions and organisational capacities must be taken into account;
- Interoperable institutions exchange information after user authorisation;
- Each institution determine access restrictions within its own information system. The use of nested services is agreed among institutions.

STATE-LEVEL CO-ORDINATION OF INFORMATION SYSTEMS

Estonia's non-hierarchical co-ordination system ensures that necessary decisions can be taken as close to the level where they occur as possible. The Act on the Government of the Republic says that co-ordination of information systems and the implementation of economic policy in the area of informatics are the duties of the Ministry of Economic Affairs and Communications. Implementation of the information policy is based on annual information policy action plans, which define the responsible authorities, the quantifiable performance indicators, and the way in which finances are to be evaluated.

Responsibility for the implementation of information policy rests with the Department of State Information Systems (RISO) of the Ministry of Economic Affairs and Communications, working together with the Estonian Informatics Centre (RIA), which is under its jurisdiction.

SECTORAL INFORMATION SYSTEMS

The principle of subsidiarity says that sectoral information systems are developed and administered independently by ministries and agencies in their areas of activity. Responsibility for different areas of activity is divided up amongst various government institutions:

- Education, research and development (Ministry of Education and Research);
- Enterprise, development (Ministry of Economic Affairs and Communications);
- Culture (Ministry of Culture, State Chancery);
- Health care (Ministry of Social Affairs);

• Environmental and spatial data (Ministry of the Environment);
• State and local government administration (State Chancery, Ministry of the Interior, Ministry of Finance, Ministry of Foreign Affairs).

SEMANTIC INTEROPERABILITY

Semantic interoperability refers to the capability of information systems to make adequate use of data received from other information systems. Semantic interoperability is complicated by virtue of the fact that the use, objectives and contexts of using software systems can differ, which means that there are differences in forms of presentation, codes, and shades of meaning.

Semantic interoperability cannot be achieved by establishing similar requirements and standards for all software systems, as this would be neither realistic nor reasonable. Achieving semantic interoperability is a means for facilitating the work of software engineers and developers who have to build interfaces with other software systems.

Achieving semantic interoperability is, to a great extent, a matter of an organisational, social and educational nature. Support is needed for system specialists so that they might better understand each other's field of activity. Sound documentation must be prepared with respect to data structures and protocols so that the search for such documentation can be made easier.

In order to public data which are stored in information systems, the systems use various tools, beginning with languages, dictionaries, classifications and rules and ending with complex ontologies. We can also speak of the semantic assets of the software and hardware of an information system.

SEMANTIC INTEROPERABILITY ASSETS

Semantic interoperability assets are divided up between syntactic and semantic ones. In order to ensure semantic interoperability between two information systems, a semantic gateway must be established between them. This gateway has to ensure semantic alterations, thus leading to the adequate and mutual use of data in two information systems. The semantic gateway for a state information system is a set of multilateral agreements and rules which facilitate the mutual linkage of systems at the semantic level.

Syntactic interoperability assets include XML schemas, metadata schemas and core components. Principles need to be defined at the national level with respect to the publication of data schemas and to the definition of metadata. The syntactic level of interoperability is the first stage is achieving semantic interoperability, and it can be achieved by creating repositories for XML schemas.

Semantic assets of semantic interoperability speak to information resources which have been created so as to ensure the interoperability of information systems. These include:

• Dictionaries;
• Thesauruses;
• Nomenclatures;
• Taxonomies;
• Mapping tables;
• Ontologies;
• Service registers.

ARCHITECTURAL REQUIREMENTS FOR SEMANTIC INTEROPERABILITY

In planning system architecture, the following guidelines should be taken into account so as to facilitate semantic interoperability:

• The XML format is used over the http or https protocol for data exchange;
• The XML format should be easy to understand and should not contain excessive "noise" (tags and details);
• The XML format must be documented in a manner which developers can easily understand;
• The presentation layer should be a separate application, one which communicates with the main application via XML texts and generates the HTML that is necessary for the user, or else implements the interface in some other way (WAP, SMS, desktop applications, etc.);
• Direct generation of an HTML text which does not support adaptable semantics from the main application must be avoided.

TECHNICAL INTEROPERABILITY

The state's IT architecture must satisfy the following requirements:

• Preservation of data in one place: Data are preserved only in a database, in which they serve as basic data. Availability requirements may lead to the copying of data, but in that case it must be remembered that data may be outdated;
• Linking business processes via nested services: Information systems communicate with each other via nested services. If an agency needs data from another so as to perform a business process, or if the workflow has to be carried out in another agency, nested services can be used. Agencies must ensure that the data and services which they offer can be nested. For instance, one must avoid a situation in which a document is printed out in one agency, mailed to another, and then scanned again into a computer;
• Ensuring the availability of nested services: Where a service user's requirements in terms of the availability of a service are stricter than those of the service provider, the latter should increase service availability. If this is impossible, other solutions can be considered, while taking legal aspects into account;
• Avoiding a "single point of failure": If the solution is one where the collapse of one part of the system can disrupt the functioning of the entire system, then the solution must be avoided;
• Security: Solutions that are used in the state's information system must be secure, ensuring confidentiality, authenticity, availability and provability of data;
• Open standards: Open standards must be preferred when choosing IT solutions;
• Personal rights to access data about oneself: Each person has the right to access data that has been collected about him or her in information systems. Everyone should be entitled to obtain information about in-

quiries made about them by others, unless this has been restricted by law;

• Single-point entry to services: Central and local government agencies work together to make sure that citizens, officials and businesspeople can obtain all of the information and services that they need from several central portals – www.riik.ee, www.eesti.ee, and https://www.eesti.ee.

INFRASTRUCTURE REQUIREMENTS FOR INTEROPERABILITY

Infrastructure refers to the hardware, software and network resources which support communications among people and organisations, access to information systems, and use of services. These are the basic principles for the development and maintenance of infrastructure:

• Primary responsibility for the development, application and maintenance of the state's information infrastructure rests with the private sector;

• In maintaining its infrastructure, the public sector proceeds from the principle of subsidiarity, according to which all state agencies are responsible for the development of the infrastructure of their own information systems, while also keeping in mind the general principles of the state's IT interoperability framework;

• The public sector encourages the private sector to invest and participate in the development and maintenance of the state infrastructure;

• The state fosters and protects free competition in the provision of infrastructure services;

• The state ensures free access to its infrastructure for service providers and users alike;

• The state's information infrastructure is a component in the global information infrastructure.

CENTRALLY DEVELOPED INFRASTRUCTURE

In order to ensure the interoperability of public sector information systems, the public sector must assume responsibility for the development and maintenance of several infrastructure components. Responsibility for the co-ordination of these components is assigned to the ministry which is responsible for the co-ordination of state information systems, while infrastructure development is, as a general rule, outsourced to the private sector. The functions of central infrastructure systems are ensured either by state agencies or by the outsourcing of services to the private sector. The use of the following central components is mandatory for public sector agencies:

• The X-Road data exchange layer;

• The interoperability layer of geo-information systems;

• The interoperability layer of document management systems;

• The infrastructure which ensures the interoperability of Web sites which are maintained by public sector agencies, the state portal www.riik.ee, as well as the domain riik.ee;

• The infrastructure which ensures the interoperability of thematic portals, as well as the information portal www.eesti.ee;

• The layer of interoperable personalised portals (citizen portals, business portals, the portals of civil servants);

• The system of classifications;

• The system of address details;

• The administrative system of the state information system;

• The security system;

• The geodetic system.

CENTRAL CONSOLIDATION

In developing their infrastructure, public sector agencies must work together with one another. Use of the infrastructure components which are acquired through centralised consolidation is not mandatory. Partial central support is given for the following activities:

• Joint procurement of software licences;

• Consolidated purchase of external Internet connections and the development of a backbone network for state agencies (also usable, in part, by local governments);

• Limited Web hosting of the domains riik.ee, gov.ee, eesti.ee and estonia.ee.

INFRASTRUCTURE OUTSOURCED TO THE PRIVATE SECTOR

When acquiring infrastructure, public sector agencies must co-operate with one another. Assistance in the development of infrastructure can be obtained from the Estonian Informatics Centre, which is administered by the Ministry of Economic Affairs. Private sector services are used for the following components of infrastructure:

• Acquisition of software – state agencies are encouraged to co-operate in this area;

• Acquisition of system software – ditto;

• Development of services related to the public key infrastructure;

• Establishment of development environments – public sector agencies should not develop their own development tools or environments, they are instead encouraged to work with each other in order to ensure their interoperability;

• Hosting services – public sector agencies are encouraged to co-operate in the outsourcing of hosting services to the private sector;

• Back-up services – ditto.

ROLES IN THE DEVELOPMENT OF INFRASTRUCTURE

This is how roles are divided up in this area:

• The state plans the general development of IT systems, sets out requirements related to the IT systems of state agencies, co-ordinates co-operation among state agencies in the field of IT systems, and serves as the supervisor of these processes;

• Private companies design specific objects and IT systems and provide consultations to state IT specialists;

• Private companies carry out the state's orders in developing and maintaining the state infrastructure, as the state does not own the technologies that are necessary for the functioning of the components of its infrastructure. ❑