

ICA Country Report 2006
ESTONIA

Table of Contents

1	GOVERNMENT STRUCTURE AND IT COORDINATION	3
2	STRATEGIC APPROACH TOWARD e-GOVERNMENT	4
	2.1. Strategic plans and implementation framework	4
	2.2. The role of the CIO	5
3	ORGANISATIONAL ISSUES	6
	3.1 Integrated service delivery and interoperability	6
	3.2 Initiatives in training and funding	8
4	OPERATIONAL ISSUES	9
	4.1. Governance structures (e.g. government-wide councils) to improve service transformation	9
	4.2. Methods of providing information and services to the citizens	9
	4.3. Use of innovative technologies to serve citizens	11
	4.3.1. e-Voting	11
	4.3.2. Reorganisation of GIS	13
	4.3.3. ePolice	14
	4.3.4. Motor Vehicle Registration Centre (ARK)	14
	4.3.5. Mobile Services in Tartu City	15

1 GOVERNMENT STRUCTURE AND IT COORDINATION

Following the “Government of the Republic Act”, the Estonian Government is organised in 11 Ministries, 25 Boards and Administrations and 10 Inspections. Also, 15 County Governments are comprised in the Central Government structure. Next to that there are 227 Local Governments in Estonia, which are, by Constitution, independent from the central government.

1. Ministry of Education and Research - www.hm.ee
2. Ministry of Justice – www.just.ee
3. Ministry of Defence – www.mod.gov.ee
4. Ministry of Environment – www.envir.ee
5. Ministry of Culture – www.kul.ee
6. Ministry of Economic Affairs and Communications – www.mkm.ee
7. Ministry of Agriculture – www.agri.ee
8. Ministry of Finance – www.fin.ee
9. Ministry of Internal Affairs – www.sisemin.gov.ee
10. Ministry of Social Affairs – www.sm.ee
11. Ministry of Foreign Affairs – www.mfa.ee

The competencies and policy areas of the ministries are fixed in the “Government of Republic Act”. All ministries are relatively independent. This administrative organisation defines the environment for co-ordination of IT-developments – in Estonia, we see what can be called decentralized co-ordination, as opposed to strong central management of IT development.

Pursuant to the “Government of the Republic Act”, the co-ordination of state information systems as well as the elaboration and implementation of policies in the field of information society are assigned to the Ministry of Economic Affairs and Communications (MEAC), in particular to the Department of State Information Systems (RISO) (see www.riso.ee/en). The tasks of the department include the coordination of state ICT-policy activities and development plans in the field of state administrative information systems (IS): state ICT budgets, ICT legislation, coordination of ICT projects, ICT audits, standardisation, ICT procurement procedures and international cooperation in the field.

Also under the jurisdiction of the MEAC is the Estonian Informatics Centre (EIC), an implementing body responsible for the development of computer networks, arrangement of data communication in public administration, accomplishment of ICT public procurement, as well as administration and development of bigger nationwide ICT projects (see - www.ria.ee).

All ministries and boards have persons (IT-managers or CIO-s) responsible for co-ordinating the IT developments of the competency and policy area of the ministry. Contact data for IT managers of the ministries, boards and inspections is available from www.riso.ee/en/pub/yearbook_2005.pdf.

At regional level, ICT development is coordinated by IT councils established at county governors’ offices. IT councils organize the elaboration of counties’ IT strategies and plan measures of implementation.

In order to ensure horizontal co-ordination between the public, private and the third sector, a government committee – the Estonian Informatics Council – has been established. The task of the Informatics Council, chaired by a minister responsible for the state information systems, is to advise the Government of the Republic on topics related to the development of information society.

The institutional structure and the mandate of coordination of IT-development has been the subject of continuous discussion on the political level. This task was originally assigned to the State Chancellery in 1993 and later transferred on to the Ministry of Transport and Communication and then to the Ministry of Economic Affairs and Communications. One of the basic arguments in the discussions has been the need to join public administration reforms and IT development – which relates to the well-known argument that the precondition to the real changes in using IT in public administration is to change processes inside the government. Recently the discussions to fulfil these needs were started again by State Audit Office with the idea to find the best frameworks for co-ordination.

2 STRATEGIC APPROACH TOWARD e-GOVERNMENT

2.1. Strategic plans and implementation framework

In 2005-2006 the main strategic developments were guided by “Principles of the Estonian Information Policy 2004-2006” (see <http://www.riso.ee/en/information-policy/policy-document>). According to this strategy, annual Information Policy action plans were approved by the Government. The approved action plans for 2006 are available in www.riso.ee. They contain 16 action lines, describing priority fields, predicted results and impact, responsible institution, content and predicted time and finance resources. The priority fields of the information policy action plan for 2006 are:

1. Geographical information systems
2. Document management and digital archiving
3. Reorganisation of the population information system
4. Remodelling of state information systems
5. Social welfare information systems
6. ICT in education and research
7. eInclusion and broadband strategy
8. ePublic Procurement
9. Development of e-services presentation layer
10. eSecurity
11. eBorder
12. Co-ordination of the state IT policy and respective action plans
13. eJustice
14. Digital cultural heritage
15. eHealth
16. Environmental register

A new policy document, entitled “Information Society Development Plan 2013” is currently under elaboration and open for public discussion. The Government is expected to approve the

document this autumn. The strategy focuses on three major dimensions (social, economic and institutional) with three main goals:

- Every member of the society will have the possibility to use all benefits of the Information Society;
- Wide use of ICT is the engine of economic growth of Estonia;
- Public sector is citizen-centric, transparent and effectively functionin.

One of the main objectives of the Estonian information and communication technology (ICT) policy in the coming years is to make state information systems more citizen-oriented and service-based. Information systems have to be integrated into a single logical whole serving the population and different organisations. To this end, it is necessary to agree – on the state level – upon clear rules and agreements, and to use common middleware. “The Estonian Interoperability Framework” (http://www.riso.ee/en/files/framework_2005.pdf) sets out commonly agreed principles for the development of state information system in Estonia.

To reach this ‘citizen centricity’, the strategic direction over the last years has been to look at the information society development processes from the viewpoint of users – ordinary citizens. There have been several steps to guarantee for everyone the possibilities of e-participation in the decision making process, the availability of e-services, free access to information, etc. In practice it means that today everyone has the possibility to access the Internet, can use electronic identification methods for access to e-services (smart-card type ID-cards, use of Internet bank authentication systems, etc.), can use a wide range of e-services offered both by public and private sector and, with the use of e-tools, can participate in decision making processes.

In addition to the general strategy document two other policy documents have been in focus – the “Estonian Broadband Strategy 2005-2007” (approved by the Government and available at www.riso.ee) and the “Estonian Information Security Strategy” (currently under development, available at: <http://www.riso.ee/en/information-policy/security>)

2.2. The role of the CIO

The role of the CIO’s of the ministries has been the same for the last ten years. Their basic responsibilities are:

- creating and implementing an ICT action plan on the level of ministry;
- planning and preparing the annual ICT budget, in line with both the ministerial and the general government ICT action plans;
- implementing projects, including procurement, the organization of supervision and answering to the ministerial training needs;
- maintenance of the ICT architecture and user support;
- participation in an ICT task group of ministries, to be lead by the head of department of State Information Systems (Ministry of Economic Affairs and Communications)

The role and duties of national CIO’s are defined by the head of the Department of State Information Systems. As the management of development of eGovernment has been widely decentralized in Estonia, the role of national CIO’s has historically enveloped co-ordination and co-operation building, and not direct management.

3 ORGANISATIONAL ISSUES

3.1 Integrated service delivery and interoperability

Interoperability denotes the ability of information systems and of business processes they support to exchange data and 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 the European context.

The ICT interoperability framework was approved by the main target groups at the end of last year (2005) and is a follow-up to the similar document of 2004. The Current 2005 document (see <http://www.riso.ee/en/information-policy/interoperability>) describes the phenomenon of IT interoperability in Estonia from three different aspects: organizational, technical and semantic.

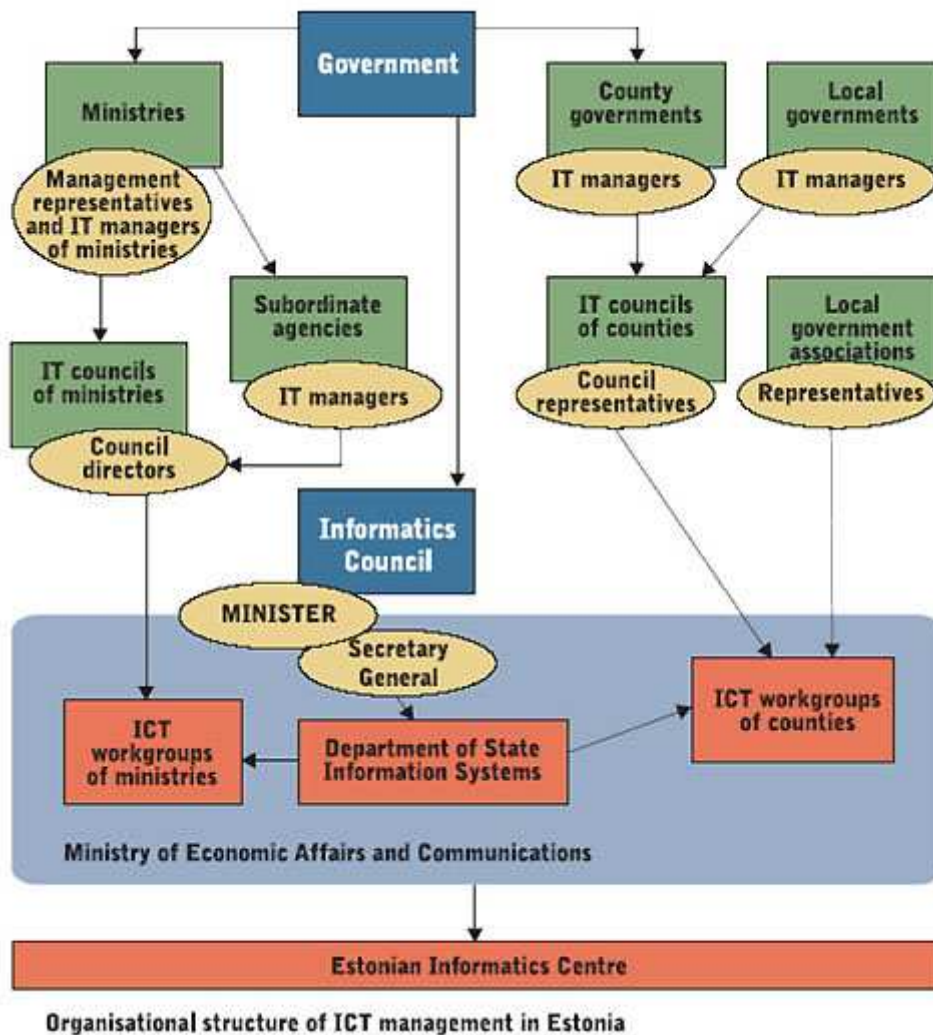
In the context of information systems, organisational interoperability is very important.

Organisational interoperability is based on the following principles:

- All interoperable institutions are autonomous organisations with a specific technological architecture.
- All connections between institutions are based on multilateral agreements; if possible, bilateral agreements are avoided.
- Private sector bodies and non-governmental organisations participating in the state interoperability framework own the information and/or data they create or obtain. Data in the state information system is owned by the state. Responsibility for the structure and content of data lies with an organisation administrating the respective data either as a chief or an authorised processor of data.
- In data exchange, legal restrictions as well as organisational capacities are taken into account.
- Interoperable institutions exchange information by user authorisation.
- Each institution determines access restrictions within its own information system. The use of nested services is agreed on between institutions.

The non-hierarchic co-ordination system in Estonia ensures that necessary decisions can be made as close as possible to the level where they apply to.

Organisational structure of ICT coordination in Estonia



Sectoral Information Systems

In accordance with the principle of subsidiarity, sectoral information systems are developed and administered independently by ministries and agencies in their field of administration.

Responsibility for different fields of actions is divided between various state institutions:

1. **Education, research and development (Ministry of Education and Research, Ministry of Economic Affairs and Communications):** extensive training for the population will be increased so as to ensure their coping in the information society and guarantee readiness for making use of IT solutions.
2. **Enterprise development (Ministry of Economic Affairs and Communications):** promotion of pre-conditions necessary for the development of eBusiness.
3. **Culture (Ministry of Culture, State Chancellery):** development of a national database (eCulture) that would allow the integration of national information resources and the development of information services; development of digital archives; collecting digital information of archival value; digitisation of records as cultural heritage.

4. **Health care (Ministry of Social Affairs):** development of the eHealth project; modernisation of the health care system by implementing modern IT solutions.
5. **Environment and spatial data (Ministry of Environment):** aggregation of environmental data into a general national register; processing information related to land and geographic location, issuing guidance for the performance of public sector activities in the field of geo-informatics

3.2 Initiatives in training and funding

Several workgroups are active involving ICT managers of ministries, ICT managers of counties, etc. Usually these workgroups gather once in every three months to discuss matters concerning developments in their fields and to pass on good experience to one another.

Twice a year, a seminar for all public sectors ICT managers is held. This is mainly to inform all ICT managers about changes in ICT field and to give them additional opportunity to communicate with each other.

A new project called “Computer protection 2009” was launched in May 2006. The initiative, carried out by the Look@World Foundation, aims at making Estonia the most secure information society in the region by 2009. To this end, a number of sub-projects will be launched, one of the priority fields being the promotion of ID card based authentication in the use of e-services. As a first step, a gateway to PC protection related information and discussions at www.arvutikaitse.ee (currently only in Estonian) has been launched. The web site provides information on how to protect one’s computer from cyber criminals and gives advice on how to be safe when shopping online and not to fall victim to fraud. The main initiators of this project were from the private sector – banks, telecoms, IT companies.

Another initiative to offer special information society development training for officials of local government is under development. The leading institution here is the e-Governance Academy (Non-Government, not-for-profit Foundation). The main objective of the academy is to provide training in ICT co-ordination and use of IT for high-level officials, specialists, and representatives of the third sector. The training project offers practical information and experience, know-how of EU experts, and the exchange of experience between participants in training. To read more about e-Governance Academy: <http://www.ega.ee/>

Estonia’s accession to the European Union (EU) has opened up access to new funds, aiming to diminish social and economic disparities between various regions of the EU. Estonia can apply for support from four of these so-called *Structural Funds*, where one of the financial measures is focused on the development of information society.

In the framework of structural funds, there are 19 major projects currently in the stage of development. Some additional information is available from: www.riso.ee/en

4 OPERATIONAL ISSUES

4.1. Governance structures (e.g. government-wide councils) to improve service transformation

In ministries, the development of information systems is co-ordinated by ministries' IT councils, which make proposals to their IT development strategies and, proceeding from the information policy and respective action plans, drafts measures for their implementation. IT councils are established by directives of ministers, while the council's work format (its members, frequency of its meetings etc.) are left to its own discretion.

At regional level, ICT development is co-ordinated by IT councils established at county governors' offices. County IT councils organise the elaboration of county IT strategies and, proceeding from the information policy and respective action plans, draft measures for their implementation.

4.2. Methods of providing information and services to the citizens

As mentioned in the ICA report of last year, there are several building blocks in IT architecture that guarantee the interoperability of different information systems of different state institutions. They are infrastructure components (ID-cards with eID, PKI, Internet bank systems), middle-wear (x-road) and front-end portals.

The X-Road was launched four years ago. At the beginning, it was developed as an environment that would facilitate making queries to different databases. By now, a number of standard tools have been implemented for the creation of eServices capable of simultaneously using the data of different databases. These services enable to read and write data, develop business logic based on data etc.

The X-Road enables to do any common data processing operation. Proceeding from this principle, several extensions have been developed for the X-Road: writing operations to databases, transmission of huge data sets between information systems, successive search operations of data in different data sheets, possibility to provide services via web portals, etc.

The x-road project was one of the best-practice examples not only in our region but also on an international forum. Estonia is one of the first countries where such interoperability framework has been operational in the national level, already for several years. Today it takes only several days (in some cases only several hours) and limited budgets (from 1000 to 10000 USD average) to develop new e-service in this environment.

By August 2006, the X-Road had:

- ~ 64 databases providing services;
- ~ 363 institutions and companies using the services;
- ~ 921 different services.

The project was initially launched in order to link Estonian state databases to the common data resource accessible over the Internet. After the successful start of sending database queries and answers over the Internet, the X-Road environment was expanded to send all kinds of electronic documents in XML-format securely over the Internet. Furthermore, X-Road became the skeleton for all eGovernment services. The main backbone of the eGovernment environment is

the X-Road network of distributed and central servers. The eGovernment project itself started in parallel to the X-Road infrastructure project and the ID card and PKI projects were launched in parallel to the development of some back-office information systems. Of course, there was a set of information systems already developed before.

The essence of e-Government in Estonia is that different information systems communicate with each other via security servers (SS), which are built up as special firewalls storing all the messages (queries, services) in logs. This means that after a long period of time it would still be possible to restore past situations, e.g. who has used the service and when, as well as what kind of decisions have been made in a particular context.

In the e-Government environment, information systems provide and also consume services. Estonian commercial banks (more precisely Hansapank, SEB Eesti Ühispank, Sampo Pank, Krediidipank and Nordea Pank) are playing three different roles in the eGovernment schema.

First, they provide portals (connected to the eGovernment environment) with authentication service for citizens. This is because not all Estonian citizens possess the electronic ID card yet, but more than half of the population already has contracts with commercial banks for using Internet bank facilities. The authentication mechanism provided by banks is considered equally trustworthy as that based on the ID card and valid for using eGovernment services.

Second, some of the services are charged for and, therefore, easy solutions have been developed to pay these charges. At first, the citizen transfers money to the bank and right after the transfer the e-service will start automatically.

Third, the banks themselves are users of data and e-services and they are using this environment just like any other information system.

The X-Road centre is actually the heart of the e-Government environment as all central servers (central monitoring server, certification server, etc.) of the whole network are connected and located in that centre. The centre employs special staff for managing e-Government hardware, software, Internet connections, agreements, etc. A new central register of databases was added to the X-Road centre at the beginning of 2005. On one hand, this register includes the description of all Estonian public sector registers and databases. On the other hand, the register gathers all descriptions of e-services in WSDL (Web Service Description Language) format, which enables to develop different automatic tools by using the library of e-services for automatic generation of new services on the basis of these descriptions. This provides a new opportunity for doing research and development projects in the near future.

The Estonian Certification Agency (CA) is responsible for the developments related to the ID card, digital signature, and other PKI infrastructure elements in Estonia.

Direct communication between citizens and the eGovernment environment makes use of a set of communication portals: the Citizen Portal, the Entrepreneur Portal, and the Civil Servant Portal.

4.3. Use of innovative technologies to serve citizens

4.3.1. e-Voting

Though small-scale pilot projects on Internet-based voting have been carried out in several countries, the number of those having been able to confirm the Internet-based votes valid is still small. In Estonia, Internet-based voting was used during the local government elections in October 2005. For the first time, the new kind of voting was applied countrywide.

The development of the Estonian e-Voting system was started in 2003 with an objective to provide voters with an additional opportunity to cast their votes, raising thereby voting activity and voting convenience. e-Voting does not replace the traditional methods of voting: each voter can decide himself, whether he votes electronically or in a traditional way.

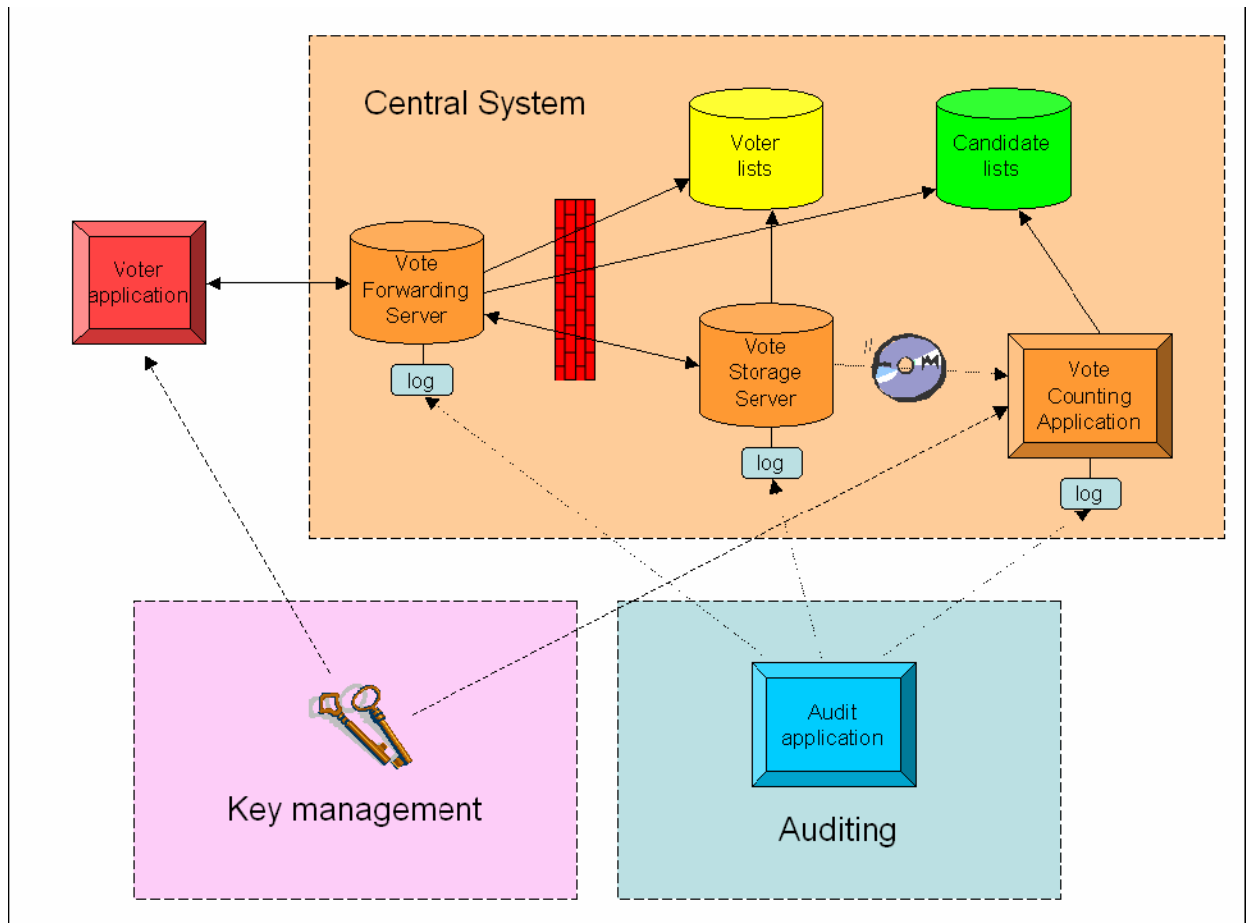
The legislative framework for e-Voting was put in place in 2002, after which the National Electoral Committee decided to launch a project targeted at the development of an e-Voting system. The objective of the project was to enable e-Voting during the local government elections of 2005.

By the end of 2001, ID card enabling secure personal authentication and digital signing as well as the necessary public key infrastructure (PKI) was legally provided for in Estonia. ID cards have been issued since January 2002, and by October 2005, the number of issued cards reached about 850.000. Thus, more than 80% of eligible voters (1.06 million) had the national ID card and were able to vote via Internet.

e-Voting took place during advance polls and ID cards were used for voter authentication. Only authenticated people with the right to vote were able to cast their vote, meaning that a database of citizens with the right to vote was developed prior to elections.

The e-Voting system follows all principles characteristic of traditional voting. In order to avoid the influencing of voters there was a possibility of electronic re-vote – an e-voter could cast his/her vote again electronically; only the last vote was counted. Additionally priority was given to traditional means of voting (with paper ballot) – if the voter went to polling station during advance polls and cast a vote, his or her e-vote was deleted.

General architecture of eVoting system



In the 2005 elections the number of valid e-voters made about 2% of all votes casted. It should be noted that, in absolute numbers, 9.317 people voted over the Internet, compared to a potential of about 10 000 citizens who have used both the necessary certificates before. Taking into account these figures, it is clear that citizens who are used to utilising the ID-card for making digital signatures, have easily adopted the e-voting system. The eagerness with which the Estonians apply new IT solutions clearly points to a high level of e-readiness of the people. It assures the expectations that after some time Internet voting will be as natural as the one with paper ballot.

More information about the principles of the Estonia's e-Voting system as well as its technological solutions can be found at the web site of the National Electoral Committee: <http://www.vvk.ee/engindex.html>.

4.3.2. Reorganisation of GIS

For the reorganisation of the public sector geo-information systems (GIS), the Public Sector Infrastructure for Spatial Information based on OpenGIS standards is under elaboration. This comprises the network of related spatial data servers and provides the technological (software) base for integrating various spatial data into a whole. This way, the public sector geo-information resources will be created, which will utilise an interoperable datasets' network and ensuing synergy. It will facilitate co-operation between state agencies and enable to enhance the quality of citizen-oriented public sector services. For citizens, it will take very little effort and time to get answers to their queries or communicate with state agencies. Civil servants processing spatial data also spend considerable amount of time on preparing, gathering, approving, controlling and entering information and drafting responses. Automated data processing tools would simplify the work of civil servants, e.g. perform complex queries to different databases; compare data and check upon their quality; ensure compliance with data security requirements (confidentiality, integrity, availability, time-criticality); draft data exchange documents, etc. This way a lot of workforce could be saved and the quality of public and online services provided by the public sector agencies would increase.

Various procedures (e.g. public disclosure and adoption of plans, registering of cadastral units, issuing building permits, identifying environmental pollution, formation of new address units, etc.) produce a lot of (spatial) data about the same geographical location. The availability of such location-based information allows for better understanding and assessment of the region's value and thus enables to make respective public processes more transparent, i.e. civil servants can better administer and citizens and entrepreneurs can better monitor these processes and this way also participate in the administration process. One and the same region might often be involved in various plans. The question is how these different plans take account of each other and whether the outcomes are mutually consistent? Therefore, it is important that data (incl. the status of other registers) necessary for decision-making is always available and after the registration new data is accessible for other user groups. Consequently, when the amount of spatial data grows, the use and administration of such data becomes more complicated. Spatial data processing (incl. analysis, control, and updating) entails the simultaneous and immediate use of data from different data sources (different institutions and various servers). That is why spatial data have to be interoperable, semantically comprehensible and highly available. A large amount of data resulting from procedures or observations is entered in registers on a daily basis. This includes location data on the event or object(s). Generally, the normal user cannot control such data acquisition, i.e. the user is not aware of whether and what kind of information has been gathered. Therefore, it is ever more complicated to obtain an overview of the availability, quality, status, sources and conditions of use of (spatial) data. The solution is to make metadata (data about data) accessible for users. All in all, the implementation of rules for co-operation between spatial data administrators and the use of automation equipment ensuring the interoperability of databases is inevitable. The reorganisation of public sector geoinformation systems and the development of the Land Board's data services provide a solution for the above-mentioned problems. Other registers and state information systems should take advantage of the new spatial data infrastructure as well by taking into use available services and also by providing their own services. The OpenGIS project is still under development but already today e-GIS have been evolved into system including special data from more than 10 state registers and databases, satisfying more than 1 billion queries per working day from thousands of users.

Using x-road infrastructure providing efficient and secure special data dissemination and developing OGIS standards based services, e-GIS is continuously evolving into interoperable nation-wide geo-information system.

4.3.3. ePolice

The objectives of the Police Board's project „Re-organisation of the general information system of the Estonian police and development of e-services” were the following:

- To develop new services for citizens and organisations in order to facilitate the communication with the Estonian police (submitting applications, making enquiries, etc.);
- to increase the efficiency of police officers' work;
- to ensure better integration of the general information system with other information systems of the police;
- To improve the quality of data in police information systems.

The project is divided into six themes:

- development of e-services for individuals and organisations;
- development of the operational management information system;
- development of the information system for offence proceedings;
- development of the map server;
- development of the punishment register;
- Development of a new architecture for the POLIS information system.

The project supplies the police vehicles with a mobile workstation that allows making integrated queries in the databases of the police and its partners (the Citizenship and Migration Board, the Estonian Motor Vehicle Registration Centre, the Estonian Traffic Insurance Fund). In addition to this, police vehicles are also equipped with the positioning device, giving the control centre constant information about the patrol cars.

The e-police solution was implemented in actual operations in 2005. Today the devices have been installed in 232 police vehicles. The active usage of the e-police opportunities is proven by the fact that about 11 000 vehicles and person queries are made every day.

4.3.4. Motor Vehicle Registration Centre (ARK)

The Estonian Motor Vehicle Registration Centre has launched several projects that aim to make the agency more customer-oriented and convenient both in the virtual and the physical world. Increasing the efficiency of ARK's internal processes is also of great significance in order to reduce irrelevant bureaucracy and leave more time for the performance of the organisation's core activities.

Information system for the verification of state fee payments - TASU

The project, which aim was to ensure better handling of information about state fee payments, was completed by the end of 2005. Before, clients were required to present their payment orders on paper in ARK bureaus, after which the orders have been entered in a database. Such a system is time-consuming both for the front-line staff entering tax-related information in databases and for customers themselves, who must ensure that they have paper-based payment orders on them.

Paperless ARK

The objective of the „Paperless ARK” project is to digitalise a number of time-consuming and paper-based processes between ARK and its co-operation partners. For instance, the agency intends to allow scrap yards to digitally notify ARK about the classification of a vehicle as dismantled. Moreover, the agency plans to make it easier for driving schools to send their student lists to ARK.

4.3.5. Mobile Services in Tartu City

Tartu is the second largest city of Estonia. Being frontrunner in use of e-services lot of development was focused on the m-services last few years. There were basically two reasons:

1. at the end of 2005, mobile penetration in Estonia was 100 per cent;
2. because people carry their mobile phones with them all the time, while most computers are connected to a specific location, public services that are offered via mobile phone are accessible everywhere and at all times.

At the end of 2005, following mobile services were launched:

Mobile parking - clients of all Estonian mobile operators can pay for parking via their mobile phone

Mobile bus ticket – there is an ID-card based ticketing system in Tartu, which also includes paying for bus tickets via mobile phone

T-number – allows one to receive information on Tartu’s sightseeing via mobile phone: there are 90 audio-clips for different tourist attractions. It is also possible to send an SMS to a short code 17120 and a mobile positioning device provides the sender with the codes of the closest objects

Mobile payments – possible to use a mobile phone for paying for products and services – in some taxis, shops and restaurants

Tartu City Short Code – short code 1789 is currently used as a way for citizens to provide the city with information about broken traffic lights of street lamps, damaged traffic signs, stolen park-benches etc.

M-teacher – provides teachers with the interface to send text messages to the parents with important information needs to be forwarded

M-neighborhoodwatch – taxi, and bus drivers, security companies and other active people can participate in making Tartu safer by receiving SMS-notifications on issues (missing persons, stolen cars etc.) that require watchful eyes. Messages are sent by police control center and all Tartu taxi, bus, and security companies are included in this project.

M-library – if person wants to borrow book, movie or audiotape which is currently not available, she can register and receive SMS when it becomes available

Additional information about m-Tartu project is available from:

[http://www.tartu.ee/?page_id=58&lang_id=1&menu_id=6&lotus_url=/uurimused.nsf/Web/tee
mad/5C3CF5BE6E7B3689C22570E5004DF9E9](http://www.tartu.ee/?page_id=58&lang_id=1&menu_id=6&lotus_url=/uurimused.nsf/Web/tee%20mad/5C3CF5BE6E7B3689C22570E5004DF9E9)