Proposal of Interoperability Framework of the Czech Republic in Environmental Information Exchange

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Abstract

The paper presents new results of the national ComFrame research project (Analysis and Design of Communication Framework within International Environmental Information Systems) funded by the Ministry for Environment of the Czech Republic. Working on the ComFrame project since 2005, the Masaryk University has collaborated with the Czech Environmental Information Agency. The basics for the findings were provided by monitoring of environmental communication activities and current interoperability within interested parties (administration bodies, businesses, citizens and academicians) of the Czech Republic. The information exchange within national and pan-European environmental information systems was analysed. Selected government services in environmental sector, i.e. interoperability and communication framework for national and international environmental information exchange were studied and proposed to meet European Union legislation, taking into account as the requirement of public access to environmental information and the re-use of public sector information as well as objectives of interoperability of Program IDABC for pan-European eGovernment Services.

1. Introduction

The Communication Framework (ComFrame) Project:

No. SM 10/99/05 Analysis and Design of Communication Framework with International Environmental Information Systems (http://www.cba.muni.cz/mkr) funded by the Ministry of Environment (MoE) has been solved by the Masaryk University (MU) since 2005 (Hřebíček 2005, 2006), (Ráček/Hřebíček, 2006). The research team has set the collaboration with the research team of the DEMO-net project The Democracy Network (http://www.demono-net.org) funded by the European Commission (EC), which is leaded in the Czech Republic by the European Projects & Management Agency (EPMA) since January 1st, 2006, (Hřebíček/Zálišová 2006). The paper presents main results of the ComFrame project in the area of the public access to environmental information and the re-use of public sector information with respect to eParticipation in environmental information exchange and the objectives of interoperability for pan-European eGovernment Services.

The research work of the ComFrame project has started with the analysis of the European Union (EU) Program Interoperable Delivery of European eGovernment Services to public Administrations, Businesses and Citizens (Program IDABC, http://ec.europa.eu/idabc/) and its European Interoperability Framework (EIF, 2004) and related eEurope initiatives and legislation (Hřebíček, 2005, 2006). It followed the outlines of the eEurope Action Plan, the IDABC decision (Decision 2004/387/EC) to be based on a framework of common principles and rules, as well as, on the agreement on open standards and interfaces for the implementation of interoperability between systems, applications, business processes and actors producing or using eGovernment services. European Union fundamental legislative acts for environmental information management are the Directive 2003/4/EC, Aarhus convention², and the Directive 2003/98/EC. According to the Directive 2003/4/EC on public access to environmental information, the Czech Republic has to ensure that environmental information at public administrative bodies are available

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² UN/ECE Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (“the Aarhus Convention”)
to the public (citizens, businesses, academicians, etc.) on request. The development of interoperability standards for data and information management with respect to public access to environmental information (Directive 2003/4/EC and Aarhus convention) was undertaken for eGovernment services in cooperation with the MoE and the Ministry of Interior (MoI) of the Czech Republic. The new important tasks have arisen also from the Directive 2003/98/EC, on the Re-use of Public Sector Information, which in the whole environmental sector is under control of the MoE. This directive is applied in the Czech Republic since March 2006 and guaranteed to public (citizens and businesses), that environmental data, information, indicators, and reports they hold are accurate enough to ensure required responses.

The Interoperability (Communication) Framework of eGovernment services for environment protection is defined in the ComFrame project as the overarching set of policies, standards and guidelines which describe the way in which interested parties (administrations - A, businesses - B, citizens - C) have agreed, or should agree, to communicate with each other. Administration bodies that provide electronic services (eServices) are faced with the same situation, they need to elaborate a set of agreements on a large number of issues, considering organisational, semantic and technical aspects. The European Interoperability Framework addresses these issues in order to facilitate the interoperability of eGovernment Services at pan-European level (EIF 2004).

The European Environment Agency (EEA) (http://www.eea.eu.int) through its projects Reportnet (http://www.eionet.europa.eu/rn) and proposed Shared Environmental Information Systems (SEIS) is going to develop the system that enables the transparent flow of harmonised environmental data, derived from the national administrations in order to increase the efficiency of the reporting exercise and improve the effectiveness of the environmental policies. This could have a principal role in the process of pan-European interoperability of environmental information and communication management. The EEA manages this information and communication process through the European Environmental Information and Observation Network (EIONET) (http://www.eionet.eu.int). In the ICT related part, the Reportnet project has developed "open source" tools and enhanced those built previously to meet the needs of the expanding EIONET system and SEIS. The Czech Republic has been included in the EEA and EIONET information management, and it has established its National Focal Points (NFP) at the Czech Environmental Information Agency - CENIA (http://www.cenia.cz). These solutions offer EEA in-house developed tools to support common data modelling, integration with socio-economic and spatial data, applications for automatic data exchange, and visualisation tools. The EEA interoperability solutions will be transferred to the Czech interoperability standards of MoI through the CENIA and MoE with using the ComFrame project results.

2. Objectives of ComFrame project

The European Interoperability Framework for pan-European eGovernment Services provides the general outline and principles for the implementation of pan-European interoperability and differentiates organizational, technical and semantic interoperability as follows (EIF, 2004):

- **organizational interoperability** is obtained when actors (administrations - A, businesses - B, citizens - C) agree on the why and the when they should exchange information, and on some common rules to make it happen safely, with minimal overhead, as a regular process;
- **technical interoperability** is obtained when actors agree on the structure and the format of messages that they exchange, and on the media and channels that they will use for these exchanges. When applied to the Corporate Environmental Information System (CEIS) of the MoE, technical interoperability leads to the concept of open information system with Service Oriented Architecture (SOA) and Service Oriented Software Systems (SOSS), in which the heterogeneity of components is no longer an obstacle to "seamless" data exchange;
- **semantic interoperability** is thus obtained when actors are able to share meaning, which is to understand each other. This implies sharing some context (e.g. the definition of terms, examples and
counter examples, translations, etc.), which enables the common interpretation of the environmental data/information that are exchanged. It also implies that actors have some joint objectives, which justify the data exchange, hence contributing to give it some additional contextual meaning.

Therefore, the ComFrame project was focused on the solving of following main objectives (Hřebíček 2005, 2006):

- to develop a proposal of communication (interoperability) framework with respect to organizational, technical and semantic interoperability for eGovernment services in environmental protection processes and sustainable development of the Czech Republic;
- to keep a proposal of communication (interoperability) framework in compliance with European Interoperability Framework and the Shared Environmental Information System developing by the EEA (i.e. with respect to requests of DG Environment, Eurostat, JRC, Program IDABC, Reportnet, etc.).

The implementation time table of the ComFrame project was divided into three phases: the analysis of target groups (actors); the analysis of communication/interoperability frameworks; the proposal of a communication/interoperability framework of the Czech Republic.

2.1 The Analysis of Target Groups (Actors)

The objective of this phase was the identification of informational needs of actors (national, regional and local public administration bodies, businesses, citizens and non-governmental organizations, academicians) of environmental information exchange with regard to communication with relevant information systems of the CEIS in the Czech Republic and the SEIS in abroad. The special questionnaires were developed and addressed more than six thousand informants via Internet and three hundred citizens personally. 2008 informants fulfilled questionnaires. The special web portal (http://www.cba.muni.cz/mkr) of the ComFrame project was developed, where you can find more information. It was also used for the collection of special questionnaires from respondents/informants of interested parties.

The most important results were presented at the conferences EnviroInfo 2006 (Ráček/Hřebíček, 2006) and Enviro-i-forum (Hřebíček/Némethová/Ráček, 2006) and we will not repeat these here.

2.2 The Analysis of Communication/Interoperability Frameworks

The objectives of this phase of the ComFrame project were focused on the analysis of interoperability requests (communication with relevant information systems) identified in the phase 1. This phase was solved since March 2006 and covered the examination of interoperability of the CEIS with the SEIS of the EEA, Reportnet (i.e. with respect to the use of ICT, further legislation, organization framework and technology and also communication standards). The interoperability framework of the Czech Republic for environment protection should pay attention to the cross-border exchange of environmental information. eGovernment services which are primarily aimed at citizens and businesses (enterprises) of other countries may be more and more demanded. These services may require different information channels (SEIS, EIONET, Reportnet) to provide them and they may need to be offered in different languages.

The results of the phase 1 provide information on the obstacles that have to be overcome and challenged that may be undertaken in implementation of communication/interoperability framework for eGovernment services in environmental protection (Hřebíček, 2006):

- Effectiveness: eGovernment services may not be limited to the provision of traditional administration services by electronic means; but suppose the delivery of entirely new services.
Efficiency: Improved access to environmental information and cost reduction by integration processes in local, regional and national (the MoE and the Czech Environmental Inspection) administrations.

Flexibility: Multi-channel (Internet, mobile phones, etc.) access to environmental information and eGovernment services for every actor, 24 hours a day, 7 days a week.

Transparency: Ease of finding and using of eGovernment services for environment protection, thus allowing actors better access to and participation in administrative matters and political issues.

2.3 The Proposal of Communication/Interoperability Framework of the Czech Republic

The objectives of the last phase of ComFrame project are focused to the optimal design of structure, formats, attributes, appropriate ICT and effective methods of communication of the information subsystems of the CEIS within the European Interoperability Framework and the SEIS, which was identified and analyzed in previous phases and the specification long-term framework of the relevant co-operations.

At first, we defined the theoretical model of the Single Information Space for the Environment in Europe which enables to implement the vision for developing the Shared Environmental Information System (Hřebiček/Räček, 2007), where we considered an Information Space generally, as a network of constituents (elements) which comprise information. All its constituents (elements) can be sorted into four basic classes respecting environmental data and information management processes:

- **Attributes**: the class which represents indivisible fundamental environmental data. Typical attributes are numbers or strings (e.g. temperature, concentration, weight or name of species, etc.), but there can be also large indivisible data as pictures, animations, sounds and videos.

- **Objects**: the class representing a logical cluster of attributes which are in coherence and should be presented together (e.g. temperature at some place in specified time, etc.).

- **Methods**: the class representing operations over objects using some form of object aggregation (e.g. average temperature in some place and time period, etc).

- **Information**: the highest class in the aggregation hierarchy. It is the class formed from methods using “reporting” functions and tools and it also represents output information in the form requested by system user.

Every class of attributes, objects, methods and information includes also *meta-data description*. All four sets (attributes, objects, methods and information) have a *tree structure* where nodes (classes) in lower tree layers inherit their structure (including also meta-data) from nodes in upper layers.

For the formalization of above specifications we considered four principal sets $I$, $M$, $O$ and $A$ which represent *universum* of classes of information, methods, objects and attributes. Therefore, sets $I$, $M$, $O$ and $A$ are defined as domains of information, methods, objects and attributes. It means that: $I \subseteq I$, $M \subseteq M$, $O \subseteq O$, and $A \subseteq A$.

**Assumptions**: a) Roots of trees represent abstract classes and the nodes in the lowest layer personate concrete environmental magnitudes; b) The inheritance is hidden in the condition that sets $I$, $M$, $O$ and $A$ must be tree ordered; c) The constituent aggregation is hidden in next mandatory rules:

- for every $i \in I$ exist set $M'$ and relation $r$ where $M' \subseteq M$ and $r(i, M')$ is valid;
- for every $m \in M$ exist set $O'$ and relation $r$ where $O' \subseteq O$ and $r(m, O')$ is valid;
- for every $o \in O$ exist set $A'$ and relation $r$ where $A' \subseteq A$ and $r(o, A')$ is valid.

**Definition**: The Environmental Information Space $S$ is defined as a quintuple $S = [I, M, O, A, R]$ where $I$, $M$, $O$ and $A$ are domains of classes and $R$ is a set of constituent inheritance and constituent aggregation relations.
All classes I, M, O and A are derived from the basic abstract class C (Constituent), which contains basic structure of all constituents. In practice relations R are implemented by ontologies (Chandrasekaran, Josephson, Benjamins 1999), (Sowa 1999).

The Environmental Information Space S will help us to fulfil the objectives of the ComFrame project and simplify the development of the proposal of an interoperability framework of the Czech Republic for environmental information exchange with the SEIS (i.e. international environmental information systems) and eGovernment services for environment protection.

We proposed the concept of the interoperable middleware architecture providing eGovernment services based on several technological approaches and principles (Štefaník/Ráček/Hřebíček 2007). Accessible services for environmental information exchange may be used and disseminated by the following means:

- Information concerning data formats and conditions for the usage of services offered by environmental systems may be at the lowest level accessible in a form of the simple text description and published due to web based portal to all potential interested persons. The information about accessible services would be gathered by a background application or a system (automated or manual) and this application would publish them in the way mentioned above. As an example: short description of service, its provider, a place where it may be found and further eventual conditions.

- The second possible way is not to provide a mere description of the service but to encapsulate the original service provided by other system and offer its encapsulated version via a local portal. In this case it would be necessary to use middleware as a mediator between users and services. This middleware would act as a local service and a portal administrator would constitute a certain form of guarantee and quality of concrete service which is provided thorough a local portal.

- A further possibility is to use original service and specialize and extend its initial functionality for local needs. Typical examples are translations. With regard to a number of official languages which are used in EU is the usage of this approach effective and thus enables access of these services to a broader group of users.

- The last possibility is to aggregate a few offered services and thus create a new unique service which would use information from variety of sources even quite different ones. This aggregation enables an extension of usability of environmental data and information which would not be otherwise usable in wider scale.

![Figure 1: The schema of middleware functionality](source: Štefaník/Ráček/Hřebíček 2007)
An example of first type may be various dictionary services offering simple searches in a concrete domain: searching in documents, document validation, document translation, a conversion into different formats. In this case the service is so simple that is sufficient a short characteristics and a reference to its original provider. But there are no obstacles for its implementation through a local portal.

An application of the second approach is convenient for services which are accessible by quite complicated ways (technical or administrative). Another complication may constitute licence policies concerning with concrete service. In this case the middleware which mediates this service serves as a multiplier and thus facilitates the access to services which would be unreachable for the most part of users. In the case of licensed services it would be possible to access only some parts of a service.

The third mean (see note below) finds a use in cases when a service in its original form is not suitable for local requirements at all or only partially. As an example may be taken a hypothetical service which does not communicate with the user in a language he understands. During the communication the middleware performs a mapping from one language to another and thus facilitates the usage to the local user. Users will understand the “new” service and this will cause increasing in awareness of users about this service and subsequently its usage.

A further possibility is to use the original service as a basis and build a completely new service on it. The new service may exploit the original service only as a minor source of information or may be completely dependent on its functionality. In this way it is theoretically possible to derive an unbounded amount of services and to react flexibly to actual requests coming from users. (There is no necessity to change anything in the original function because the results from it are not directly passed to the user).

The last possibility is to integrate a bigger number of services from different sources and to create a space for effective exploitation of approachable services. Examples of usage of these aggregated services are risk management or decision support systems.

The above development is coordinated by the MoE and the MoI, which brought new methodology since April 2007. The implementation of this phase will be finished at the end of the year 2007.

3. Conclusions

The ComFrame project solved at Masaryk University since 2005 creates a good basis for integration of research of interoperability in a field of eParticipation and for strengthening of eParticipation in environment protection of the Czech Republic. Its solution (for local, regional, national and pan-European level) will fulfill its above presented objectives and bring a better development of the communication/interoperability framework for eGovernment services for environment protection of of the Czech Republic. Generally, it will improve eParticipation in public participation on environmental impact assessment of new technologies and environmental information management to fulfil requirements imposed by the novel European environmental legislation and international standards.

Standardisation in technical interoperability and harmonisation in legislation of the Czech Republic are main ways to achieve objectives of the ComFrame project. We recommended to the MoE and the MoI to use following techniques and methods:

- **Effective standardisation**: Use open standards; incorporate existing standards in a larger context; stimulate re-use of proven standards.
- **Efficient administrations**: Redesign administrative processes of administrative bodies in the public access to environmental information (Directive 2003/4/EC and Aarhus convention) and the re-use of public sector information (Directive 2003/98/EC) and make the best use of the available technology. This is also an opportunity to make services more user-centred; keep administrative systems independent of proprietary technology; coordinate and manage the eGovernment initiative of the MoI. Keep track of developments in the wider community. E.g., changes in privacy legislation may impose requirements to the provision of some eServices.
• **Appropriate ICT tools:** Centrally agreed XML schemas may be provided free of charge throughout the public sector. This form of re-use reduces cost and the need to develop separate mechanisms for data exchange. It also enable wide access and inclusiveness by design (user-friendly interfaces, access for the disabled, foreign language support, etc.).

• **Effective data and information management:** The simple definition of the Environmental Information Space will enable the MoE and regional administration bodies to reduce the amount of data to be collected by using well-defined data dictionaries and data structures. Ensure information security by preventing unauthorised access to systems and, in the case of highly confidential information, securing each record (or even each component) individually.

We see the promising role of eGovernment services for environment protection and sustainable development of the Czech Republic, if used the idea of Environmental Information Space for environmental information exchange with the SEIS and the relevant model of eParticipation according to the level of maturity of information society.

In order to reach the excellence in environmental information exchange with the SEIS and in the area of eParticipation research in environment protection, we need to seek for the best results of the implementation of new ICT in the process of transformation eGovernment services and the whole society, which requires the integration of effort of different scientific researches, particularly to ICT research in the 7th Framework Programme (Objective ICT-2007.6.3) of the European Community for research, technological development and demonstration activities and cooperation in the field of ICT. The Call FP7-ICT-2007-2 was launched in May 2007 to address several challenges and objectives including ICT applications in the field environmental information management and energy efficiency.

Such collaborative work of different kind of communities (national, regional and local public administration bodies, businesses, citizens and non-governmental organizations, academicians), including research communities, could enrich dialog about European sustainable development and democratic values in order to reach European targets: open administration, freedom of information, inclusive government, etc.

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### Bibliography


