

Interoperability Registries in eGovernment: Developing a Semantically Rich Repository for Electronic Services and Documents of the new Public Administration

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Abstract

As electronic Government is increasing its momentum internationally, there is a growing need for the systematic management of the newly defined and constantly transforming services. eGovernment Interoperability Frameworks usually cater for the technical standards of eGovernment systems interconnection, but do not address service composition and use by citizens, businesses or other administrations.

An Interoperability Registry is a system devoted to the formal description, composition and publishing of traditional or electronic services, together with the relevant document and process descriptions in an integrated schema. Through such a repository, the discovery of services by users or systems can be automated, resulting in an important tool for managing eGovernment transformation towards achieving interoperability.

The paper goes beyond the methodology and tools used for developing such a system for the Greek Government, to population with services and documents, application and extraction of useful conclusions for electronic Government transformation at global level.

1. Introduction

In the dawn of 21st century, where system complexity, multiplicity and diversity in the public sector is posing extreme challenges to common interoperability standards, eGovernment Interoperability Frameworks (eGIF's) pose as a cornerstone for the provision of one-stop, fully electronic services to businesses and citizens [16]. Such interoperability frameworks aim at

outlining the essential prerequisites for joined-up and web-enabled Pan-European e-Government Services (PEGS), covering their definition and deployment over thousands of front-office and back-office systems in an ever extending set of public administration organizations.

Embracing central, local and municipal government, eGovernment Interoperability assists Public Sector modernization at business, semantic and technology layers. As more and more complex information systems are put into operation everyday, the lack of interoperability appears as the most long lasting and challenging problem for governmental organizations which emerged from proprietary development of applications, unavailability of standards, or heterogeneous hardware and software platforms.

2. Background and Scope of the paper

In order to effectively tackle the transformation of Public Administration, European Union has set key relevant priorities in its "i2010 eGovernment Action Plan" [15]. At national level, most European Union Member States have produced their own National Digital Strategies (e.g. the Greek Digital Strategy 2006-2013 [25], or the Estonian Digital Strategy [11]) which include

measures and strategic priorities aimed at developing eGovernment.

Whithin this context, most countries have tried to face the interoperability challenge with the adoption of national e-GIF's covering areas such as data integration, metadata, security, confidentiality and delivery channels, which fall into the technical interoperability layer. Such frameworks have issued "sets of documents" guiding system design but have not developed to date appropriate infrastructures, such as repositories of XML schemas for the exchange of specific-context information throughout the public sector – observed only partially in United Kingdom's e-GIF Registry [6] and the Danish InfoStructureBase [8]. Furthermore, as shown in recent eGovernment Framework reviews [7, 14], there exists no infrastructure proposal for constructing, publishing, locating, understanding and using electronic services by systems or individual users.

In order to take full advantage of the opportunities promised by e-Government, a second generation interoperability frameworks era, launching "systems talking about systems" and addressing issues related to unified governmental service and data models, needs to commence. As presented in the next sections of this paper, such an Interoperability Registry infrastructure, should consist of:

- An eGovernment Ontology, able to capture the core elements and their relations, thus representing services, documents, providing organizations, service users, systems, web services and so on.
- A metadata schema, extending the eGovernment Ontology and providing various categorization facets for the core elements, so as to cover for

information insertion, structuring and retrieval.

- Formal means for describing the flow of processes, either still manual or electronic, and the structure and semantics of various electronic documents exchanged among public administrations, citizens and businesses.
- An overall platform integrating data storage, ontology management, enterprise modelling and XML authoring, data input and querying mechanisms as well as access control and presentation means.
- The population of the eGovernment Ontology database, with information about administrations, their systems, services and documents is an important step. Since this task usually involves gathering huge amounts of information, an initial set of data should be considered first: this way, population achieves a critical mass, while automatic knowledge acquisition tools are being developed.

3. Defining the eGovernment ontology

The representation means of the proposed system should first capture the core elements of the domain, together with their main relationships. Most existing approaches for eGovernment ontologies cover neighboring domains, such as Public Administration Knowledge [12,28], Argumentation in Service Provision [22], eGovernment projects [23], or types and actors in national governments [24].

As depicted in Figure 1, the proposed eGovernment Ontology provides for the representation of the following core elements:

- *Services*, of various types, provided by Administrations towards citizens, businesses or other administrations.
- *Documents*, in electronic or paper forms, acting as inputs or outputs to services.
- *Information Systems*, being back-office, front-office or web portals providing the electronic services.

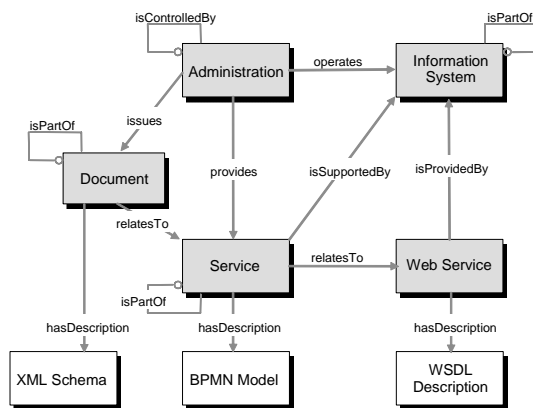


Figure 1. Core Elements of the Ontology

- *Administrations*, nested at infinite hierarchical levels, being ministries, regions, municipalities, organizations or their divisions and departments.
- *Web Services*, being electronically provided services, either final or intermediate ones (contributing to the provision of final services).
- *XML (eXtensible Markup Language) Schema Definitions*, for linking the formal representation of data elements and documents.
- *BPMN (Business Process Modelling Notation) Models*, for linking services with their workflow models.
- *WSDL (Web Services Definition Language) Descriptions*, linking Web Services with the respective systematic, machine readable description of their behaviour.

Additional objects complementing the core ontology elements are *Citizens* (as various types of citizens requesting services), *Enterprises* (both as service recipients but also as contractors for government projects), *Legal Framework Elements* (that guide services provision), *Life Events* and *Business Episodes* that may trigger a service request, or *Technical Standards* affecting the provision of electronic services.

3.1. Metadata standards for multi-faceted classification

The eGovernment Ontology is supported by numerous categorization facets and standardized lists of values for systematically structuring database contents during the population phase, including types of services and documents (according with the Government Category List – GCL categorization),

All the core elements of the eGovernment ontology have predefined metadata, so that their description, search and retrieval can be assisted. The implemented metadata structure is based and extends on a number of existing metadata structures in literature and practice, namely:

- The Dublin Core metadata standard [10] which provides a generic set of attributes for any government resource, be it document or system, including various extensions [20].
- The European Interoperability Framework – EIF (Version 1.0) [16] published by the IDABC Programme.
- The United Kingdom e-Government Interoperability Framework [3] and its relevant specifications (e.g. the e-Government Metadata Standard [4], the e-Government Strategy Framework Policy and Guidelines

[5], and the relevant Schema Library [6]).

- The German Standards and Architectures for e-Government Applications (SAGA) Version 3.0 (October 2006) [17], which identifies the necessary standards, formats and specifications, sets forth conformity rules and updates them in line with technological progress.
- The Danish Interoperability Framework (Version 1.2.14) [9] released in 2006, which includes recommendations and status assessments for selected standards, specifications and technologies used in e-government solutions while the collaboration tool InfoStructureBase [8] includes an international standards repository containing business process descriptions, data model descriptions, interface descriptions, complex XML schemas and schema fragments.
- The Belgian Interoperability Framework (BELGIF) [2] that is built on a wiki collaborative environment and has released recommendations on web accessibility and on the realization of XML Schemas, apart from a list of approved standards.

The resulting metadata definitions cover all the important facets for classifying and querying the elements of the ontology, so as to provide answers to important questions around the status of electronic provision of services, existence and structure of documents, relation of services with public administrations, characteristics of the various governmental information systems and so on. Table 1 shows the metadata definitions for the *Service* element, indicating which of them are represented as strings, numbers, list of

values or structured elements themselves.

Table 1. Services Metadata

Field	Description, Type
Code	The Service Code, Unique, String
Title	The Service Title, Unique, String
Providing Administration	The Administration (organization, department or office providing the service), Element
Engaged Administration	Other Administrations, taking part in the service provision, Multi-Element
Final Service	Yes/No, if it is a final service, giving output to the citizens or businesses, List
Beneficiary	Citizens or Businesses or subtypes of them, Element
Type	The Service Type, (e.g. Registration, Benefit, Application, Payment, etc), List
Category	Service Category, according to GCL (e.g. social service, taxation, education), Element
Life Event	The associated Life Event, Element
Business Event	The associated Business Event, Multi-Element
Legal Framework	The applying legal framework for the service, Multi-Element
Ways of Provision	Manual, Internet, SMS, I-TV, etc., Multi-List
Electronic Provision Level	Level of electronic provision (1 to 4), according with the EC standardization
Multilingual Content	Languages in which the content for the service exists, Multi-List
Manual Authentication Type	Type of Authentication needed when the service is provided in a manual way (e.g. presence in person, id-card, proxy), List
Electronic Authentication Type	Type of Authentication needed when the service is provided electronically (e.g. username/passwd, token, digital signature), List
Frequency	Frequency the service is requested, by means of High-Medium-Low, List
Web Site	The URL of the portal providing the service, String
International Policy	Yes / No, if the service is included in the i2010 20 core-services set, List
National Policy	Yes / No, if the service is included in the National Digital Strategy core-services set, List
Information Source	The source(s) of information for the service, String
Date of last Update	The date of last sampling, Date

Relevant, extensive metadata description fields exist for *Documents*, *Administrations*, *Information Systems* and *WebServices*, providing an indication of the descriptive power of the Ontology.

Non-core elements (e.g. Legal Framework Elements, Generic Governmental Resources) may have simpler metadata fields, as shown in Table 2.

Table 2. Legal Framework Metadata

Field	Description, Type
Code	The Legal Framework Code, String
Title	The Legal Framework Title, Unique, String
Type	The type of the Legal Framework (law, decree, directive, etc), List
Legal Framework	The superceding legal framework, Element
Administration	The primary Administration maintaining the Legal Framework
Date of last Update	The date of last sampling, Date

4. Combining processes and data

The description of Services and Documents cannot be complete without formal representation of the services flow and of the documents internal structure. The importance of formal, combined description of services and document schemas has been properly identified in current literature [22,13].

Business modeling and analysis of the processes and the public documents that take part in their execution, is done using the BPMN notation [18] and the ADONIS modeling tool, provided by BoC International [21]. On top of the ADONIS tool, integration with the eGovernment Ontology (*Services*, *Documents*, *Administrations*) has been implemented, ensuring a complete, interoperable data schema.

As shown in Figure 2, eGovernment Processes are modeled using BPMN

Notation, resulting in easy identification of documents to be exchanged, decisions taken during the service flow by citizens/businesses or administrations and specific activities or information systems that take part in the overall process execution – in this case the electronic VAT declaration from an enterprise towards the TAX Authority.

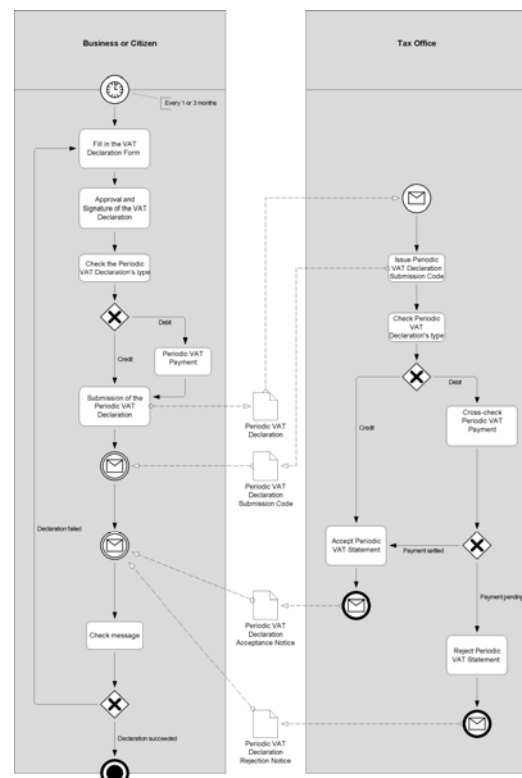


Figure 2. VAT Declaration Model

Design of data schemas involved in the execution of the processes under consideration, has been performed with the use of the UN/CEFACT CCTS methodology [27], for the creation of common components among the various governmental documents that have been identified through process modeling. Then, following modeling and homogenization of data components, Altova XML authoring tools [1] have been used for defining the final XSD

descriptions representing business documents of all types.

Final XSD files have been linked with the respective governmental documents of the ontology, resulting in a comprehensive and easy to navigate semantic network structure.

5. The Interoperability Registry Platform

The architecture that implements the Interoperability Registry comprises three layers: (a) the Web-based and UDDI (Universal Description, Discovery and Integration) interfaces for various groups of users, (b) the tools layer including ontology management, process and data modeling and (c) the information repository for interconnected data elements, process models, XML schemas and Web Services descriptions. These three layers, as shown in Figure 3, are integrated through a Relational Database Management System and the Common Access Control and Application Engine.

The front-end platform components are the following:

- The Registry Web Site found within the Greek eGIF Web Site [26], which publishes the various documents of the eGovernment Framework but also gives access to citizens and businesses for publicly available data.
- The Registry Intranet, accessible to pre-selected public administrations and portal builders that gives access to the Registry Tools (processes, ontology, XML).
- The Registry UDDI interface, where administrations publish their Web Services or find existing, available Web services to use through their information systems, constructing truly interoperable, one-stop services.

The Tools layer consists of the process modelling facilities, based on ADONIS engine, the XML Management facilities, based on ALTOVA XML platform, and the custom-developed ontology management, data entry and reporting tools that integrate all representations and models. A view of the system is given in Figure 4.

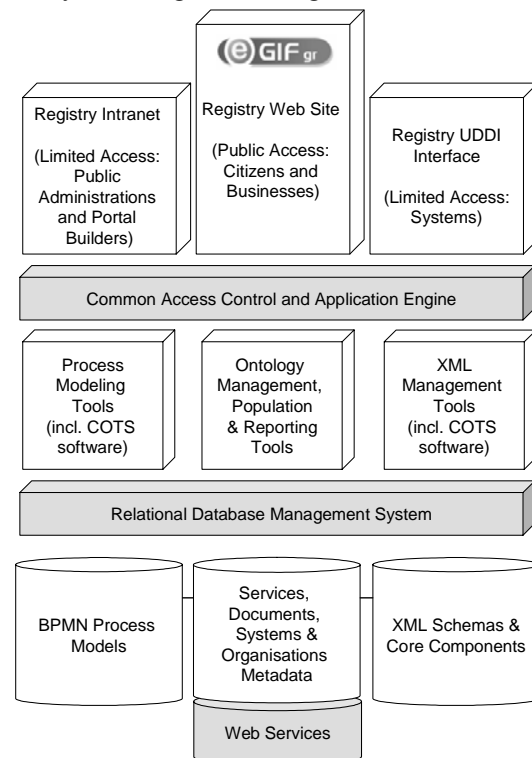


Figure 3. Platform Architecture

Finally, the Data Storage layer, incorporates connected database schemas for the ontology instances, the Web Service descriptions in WSDL, the process models and the XML schemas and Core Components.

The development and integration of the whole platform has been performed with the use of Microsoft Visual Studio .net suite, using the ASP 2.0/AJAX development paradigm. A parallel installation has also been performed using Java/J2EE/MySQL components.

Services Management

GENERAL INFORMATION

Service Title:	Citizen Criminal Record Issuing
Service Code:	02_042
Providing Administration:	Ministry of Justice, Department of CR
Legal Framework:	Law 1805/1988 – GGA 199 A' / 1998

CATEGORISATION

Service Type:	Certificate
Government Category:	Security and Justice, Criminal Record
Associated Life Events:	Find a job Start a new enterprise
Associated Business Episodes:	
Is Template Service:	<input checked="" type="radio"/> YES <input type="radio"/> NO
Based on Template Service:	Citizen Criminal Record Issuing

Figure 4: Interoperability Registry – Part of the Services Management Form

6. Population of the Repository

Initial Population of the Interoperability Registry Repository was greatly assisted by the existence of data in electronic form, through the Greek Ministry of Public Administration. As shown in Table 1, even for a country close to the average European Union Member State population (11,000,000 citizens), the size of the domain is significant, involving thousands of governmental points, services and document types.

Furthermore, a plethora of information systems are currently under development, during the new Greek Digital Strategy plan, aiming to achieve full electronic operation of the State by 2013.

Table 3. Size of the Domain in Greece

Organisational Aspect
18 ministries, 13 prefectures, 52 districts, 1,024 municipalities, 690 public sector organizations
2,500 Governmental "Points of Service"
Services and Data Aspect
3,000 non-interoperable Service Types (Government to Citizens and Businesses)
4,500 Document Types exchanged between Administrations
Systems Aspect
300 Central Government Internet Portals
1,000 Municipal Government Internet Portals
2,500 Public Administration Back Office Systems
Users Aspect
750,000 Enterprises (small, medium and large)
11,000,000 Citizens
18,000,000 Tourists per year
1,000 IT products and services companies

Population of the repository was achieved through the following automated and semi-automated activities:

- Automated import of more than 1,797 administrations including ministries, prefectures, districts, municipalities and public sector organisations.
- Automated import of 1,009 public services definitions, with core metadata descriptions and frequency indications, stemming out of 3,000,000 service requests by citizens and businesses during the last year.
- Modelling of the core-100 governmental services (including all i2010 services and the services amounting to 85% of the yearly service requests),
- Modelling of the core XML schemas and WSDL for Web Services to be developed – an activity that is still going on.

The resulting platform is now being maintained and further populated with the assistance of engaged public administrations. Already, crucial questions of administrations can be answered, like:

- What is the formal description of the Birth Certificate Issuing service ?
- Which services are depending on identity card provision ?
- What are the most needed services by other services (interoperability request) ?
- What are the needed documents and their XML definitions for issuing a residence permit ?
- Which services pertaining to civil registries are already electronic at level 2 or 3 ?

- What are the existing Web Services from the Tax Authorities – Ministry of Finance ?

The acceptance of the Interoperability Registry by the Public Administration is following a three-stage approach: (a) the core team, including the Ministry of Public Administration and the National eGIF team, (b) the main Public Sector stakeholders, including key ministries, organisations and local administrations and (c) eGovernment project managers and implementation teams, from the public and private sector. Currently, registry users, with various levels of access, exceed 100.

7. Conclusions

The new Greek Interoperability Registry presented in this paper introduces a new system (not a paper-based specification) that will interact with e-Government portals and back-office applications, administration stakeholders, businesses and citizens, guiding eGovernment transformation and ensuring interoperability by design, rework or change.

The implementation addresses a number of key issues, such as:

- Definition of an eGovernment Ontology and Metadata Definitions for all core elements in the eGovernment domain.
- Formal description of governmental services with the use of BPMN models and tools.
- Development of unified governmental data models (in the direction of UN/CEFACT Core Components), with the use of XML authoring platforms [7].
- Integration of models, tools and repositories in a comprehensive platform, made available to public

administrations, businesses and citizens.

- Specification of truly interoperable, one-stop governmental services.

The initial application of the system, as well as the relevant evolutions from other European eGIF's, are indicating that new perspectives should be taken into consideration in eGovernment Frameworks from now on, analysed as following:

- Importance and adequate effort should be put in defining standard, formally described electronic services for businesses and citizens, thus providing clear examples to administrations and service portal developers.
- The paper-based specification should give way to system-based presentation of the framework, incorporating service descriptions, data definitions, unified domain representation ontologies and metadata in a common repository.
- Organisational interoperability issues should be supported by a more concrete methodology of how to transform traditional services to electronic flows, with the use of decision-making tools. In this direction, the Interoperability Registry infrastructure presented can be of great assistance as it contains all the necessary information in a comprehensive, well-defined and connected semantic network.
- The collaboration among European e-Government Interoperability Frameworks is particularly beneficial for the ongoing efforts of individual countries, since it ensures that lessons from the pioneers' experience are learnt and that the same mistakes will not be repeated.

Future work along the Greek eGIF and the Interoperability Registry includes both organisational and technical tasks, since the proper maintenance and usage of the registry is now the crucial issue. So, efforts will be targeting the following objectives:

- Binding with the Central Governmental Portal for citizens and businesses, so that the registry can be used for locating and enrolling to electronic services.
- Completion and publication of additional XML Schemas based on Core Components methodology.
- Initial training of key staff within administrations for using and extending the registry.

Finally, it has been identified that no system can work without the engagement of the public servants: more effort is to be put towards encouraging stakeholders to interact with the registry and among themselves, building synergies across the public sector authorities in a truly interdisciplinary way – hopefully extending the eParticipation features of the registry.

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