ACCESS TO E-GOVERNMENT SERVICES EMPLOYING SEMANTIC TECHNOLOGIES

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Abstract

The paper describes Access-eGov (Access to e-Government Services Employing Semantic Technologies), an IST project partially funded under the IST Programme of FP6 (e-Government research). A project consortium consists of eleven partners from five countries (Slovakia, Poland, Germany, Greece, and Egypt) led by the Technical University of Kosice. It will last from January 2006 till December 2008.

Keywords: ontology, knowledge management, semantic technologies, web services, e-Government

1 INTRODUCTION

By employing semantic technologies the Access-eGov project will support semantic interoperability among e-Government services across organisational, regional and linguistic borders. For service providers (on all levels of public administration – local, regional, national, and European) Access-eGov will enable introduction of a (new) e-service to the world of e-Government interoperability in an easy way. For citizens and business users the Access-eGov will provide a meta-service, enabling users to find e-Government services relevant to the given life event or business episode. Once the relevant services are found, Access-eGov will generate a scenario consisting of elementary government services. At the realisation of the scenario the user will be guided by a virtual personal assistant. Access-eGov is proposed to be built on peer-to-peer and service oriented architecture, addressing the semantic issues through ontology-guided mark-up of local e-Government service interfaces.

2 PROBLEM STATEMENT

The action plan eEurope formulated specific aims in the area of e-Government with the aim to make public administration open, transparent, inclusive and productive. eEurope+ for the then candidate countries built on eEurope emphasising that "*e-Government can improve public services, making them faster, as well as more accessible and responsive*" and noting also importance of existing good practices "*Candidate countries lend great importance to the exchange of good practices with EU member states*". This is the starting point of Access-eGov project – to build on existing good practice in EU15, enhance and upgrade it using advanced ICT to make government services more accessible and efficient – for the benefit of "old" as well as new EU member states.

In "real life" situations citizens as well as businesses usually do not need an atomic (singular) government service, but a (often non-linear) sequence (including if-then-else branches) – it means "scenario" of atomic services. And since we are still far away from the situation that

all needed government services for the given life event are available on-line, it means that users usually have to deal with a "hybrid scenario" – a combination of traditional services and e-services. Carrying out a sequence of mutually dependent e-services needs back-office integration, which is missing in the present-day reality.

To be more specific, users (citizens as well as businesses) are often facing a problem to find which public administration institutions are providing the service(s) needed in the given situation (context), whether they are provided it in an electronic or only in a "traditional" way, what inputs are required to this service, etc. A simple solution of that is a central e-Government portal. But then is there a problem, especially for a centralised provider, if the portal should contain information on all existing traditional or e-services on the local, regional, national, European level. Where to get information about all new e-services and how to keep all this information up-to-date? An alternative solution would be to create a distributed system and to delegate the responsibility for registering a new e-service into the decentralised (Access-eGov) system and updating information on existing services to local providers (PA institutions). And here the Access-eGov comes into play …

3 OBJECTIVES

Access-eGov aims at increasing the accessibility of public administration services for citizens and business users by supporting the interoperability among existing electronic and "traditional" government services. For citizens and business users, Access-eGov will provide two basic categories of services. Firstly, Access-eGov will identify – depending on the needs and context situation (location, etc.) of the user – traditional and/or e-Government services (if available) relevant to the given life event (of the given citizen) or business episode (in case of businesses). Secondly, once the relevant services have been identified, Access-eGov will generate a "scenario" consisting of elementary government services. In most cases these scenarios will be probably of a "hybrid" nature – i.e. a combination of elementary traditional and e-services – which will lead to a requested outcome (e.g. to get a building permit, register a new company, etc.). Access-eGov will also provide a *virtual personal assistant*, who will guide the user through the scenario (reminding him/her of deadlines, providing support information, initiating e-services, etc.).

Special attention will be paid to the e-Inclusion criteria to guarantee that Access-eGov will be accessible also to disadvantaged groups of users, for which the system can be considerably beneficial. Project partner e-ISOTIS (Greece), organisational mission of which is closely related to e-Inclusion, will guarantee that the e-Inclusion criteria will be fully incorporated into the user requirements and subsequently will test the developed solution against these requirements.

Access-eGov will also provide services for the public administration, i.e. service providers, and this on all levels: local, regional, national, and European. As such it will enable the easy introduction of a (new) e-service to the world of e-government interoperability. Design of software components is focused on end user with respect to ensure user-friendly environment. Therefore no special e-skills will be required to use the Access-eGov system. User friendly user interface (including a virtual personal assistant) and implementation of WAI criteria will also support e-Inclusion.

The project's objectives can be defined on two levels as a) Organisational objectives; which are implying b) Software and Technical (S&T) and c) methodological objectives.

Concerning the **organisational objectives**, the Access-eGov project will be focused on the improvement of accessibility and connectivity of governmental services for citizens and businesses. This implies a simplification of the use of government services for users – by

means of creating integrated hybrid scenarios and providing guidance to users while following this scenario.

While following these objectives, the existing good e-Government practices will be taken into account (e.g. the Responsibility Finder – "*Zustaendigkeitsfinder*" in Schleswig-Holstein, project partner from Germany).

These organisational objectives will be achieved through achievement of **S&T objectives**, focused on the design, development, implementation, integration, and validation of following software components:

- A server providing *reference ontology* covering basic domain knowledge & processes for locating and contracting e-government services (in the scope required to cover pilot projects) despite possible semantic differences in natural languages, vocabularies, business objects, applications, and data structures;
- Rule-based editorial component as plug-in or add-on for web sites and web applications to insert semantic mark-up to e-Gov applications by public administrations;
- Tools (agents) for finding and brokering information according to semantic requirements through which services will be accessible to users and/or other e-Gov applications;
- A platform for composition of services into complex process definitions (covering life events/business episodes) enabling semantic interoperability of particular e-Gov services;
- A distributed security infrastructure providing multiple security services for authenticating users and protection of data and enabling easy administration of complex security policies.

To increase the project impact and facilitate the employment process, these technical objectives will be complemented by a **methodological objectiv**e:

- Development of methodological guidelines how to make best use of the above components, i.e. how to integrate them into a given IT infrastructure and how guide required organisational adaptations.

And also by an objective aimed at international, "trans-EU border" cooperation and usability of the system (building on the third country participation in the project – in this case, project partner German University of Cairo, Egypt):

- Non-trivial validation to systematically challenge the technology and applications for technical feasibility, service quality, and user acceptance from not only EU insider perspective, but from outside EU view as well (cutting across intercultural and language barriers).

Functionality and benefits of the Access-eGov platform can be summarised in the following points:

- For e-Government service providers on all levels: Easy registration of e-services to the Access-eGov platform;
- For users (citizens and businesses):
  - Improved accessibility of government services, identification of government services (whether online or traditional) relevant to the user's need (life event / business episode) and the context (location etc.);
  - Providing them with a user-tailored (personalised) scenario consisting of available elementary government services (the scenario is either purely "digital" in case if all

necessary government services are available online or "hybrid" – if it is a combination of traditional and online services);

- Guidance through the designed scenario;

- Utilising leading edge technologies in semantic web, knowledge modelling, peer-to-peer and service-oriented architecture, security and authentication and thus supporting: semantic interoperability across organisational/regional borders and languages (multi-lingual solution) while guaranteeing appropriate level of security for all involved parties.

In addition to the SW components, methodological guidelines will be developed (aimed at maximising impact of the Access-eGov implementation, covering also issues related to its integration with a legacy IT infrastructure and reengineering of organizational processes).

4 PROPOSED ARCHITECTURE AND FUNCTIONALITY

Access-eGov system is proposed to be built on peer-to-peer and service oriented architecture, addressing the semantic issues through ontology-guided mark-up of local e-Government service interfaces.

Service oriented architecture (SOA) is essentially a collection of services, which represent reusable functionality and which are able to communicate with each other passing data and co-ordinating some activity. Services can be composed to new services on higher levels of abstraction.

The SOA mainly consists of service suppliers, their service requestors and a registry that is used to publish the service and hold information for search purposes. In the area of SOAs there is used mainly a set of modern techniques based on XML called *Web Services*. They comprise different protocols: SOAP (www.w3.org/TR/soap), XML-RPC (www.xmlrpc.com/spec), Jabber (www.jabber.org), that are layered over different transport protocols and a more or less competing set of standards for the description: WSDL (www.w3.org/TR/wsdl); DAMLS (daml.semanticweb.org) and registration of services: UDDI (www.uddi.org), WS Inspection, ebXML Registry, JXTA Search. All these description and registration standards have their special purposes and weaknesses, but they have in common, that they are used in a more or less stable setting, where functionality of services does not alter frequently and is predominantly organised in registries. A further aspect is, that services are available over time and do seldom change their location.

The core **Web Service** technology (WSDL, UDDI) defines formal interface contracts, describing the message syntax, but does not address the semantic of those interfaces. This means, that the meaning of the exchanged data is not formally described. Since the emerging *Semantic Web* and Web Services have a similar target audience, namely application clients, they are made for automated processing and share a common base technology (XML), it is obvious to apply semantic web techniques to web services. The Resource Description Framework (RDF) is particularly intended for representing metadata about web resources in general and web services in special and represents a notation to express structured metadata which has also a XML-based format representation (RDF/XML[1]). On higher level of abstractions there are several web ontology languages (see Ontologies part below in this section).

Peer-to-peer (P2P) is a communication model in which each party has the same capabilities and in opposite to the Client/Server model either party can initiate a communication session.

[1] http://www.w3.org/TR/rdf-syntax-grammar/

In recent usage, peer-to-peer has become to describe a type of transient Internet network that allows a group of networking programs to connect with each other and mainly access and exchange files from one another's hard drives. Napster and Gnutella are just well known examples of this kind of peer-to-peer software, a more modern and establishing example is Bittorent (www.bittorrent.com). There are free frameworks, like JXTA (www.jxta.org) or JABBER, which contain a set of streaming XML-based protocols where also integration of the SOAP protocol can be found. So, basic web service technologies can be used in conjunction with peer-to-peer frameworks. Interoperability between SOA-based and peer to peer technologies is sometimes required but even yet emerging.

The e-Government services can be offered by public organisations as well as private players. Public organisations exhibit characteristics that require a classical SOA, while a lot of private stakeholders better fit to a peer to peer network. If there is a lack of a centralised co-ordination while a huge amount of uncoordinated municipals drives their own registries, some kind of decentralised co-ordination mechanism loan from the peer to peer domain are well applied.

The **Semantic Web** is an opportunity for providing, finding and processing information via Internet with the help of machines which are capable of dealing with the semantics of the information (see in [2] for overview). Information is something meaningful to social actors who seek to enhance their knowledge in order to satisfy a specific concern or accomplish a specific task related to their particular context. The information in focus is considered to be heterogeneous in terms of syntax, structure, and semantics. It may be of different form and function. In the area of e-Government [4] it comprises at least full text documents (e.g. laws), image-based documents (e.g. personal certificates, off-line forms), electronic forms (e.g. for case-based applications such as renewal of drivers license), structured data (e.g. office opening hours), case discriminations (e.g. check of marital status), static and/or dynamic text or multimedia content embedded in web pages (e.g. news, alerts, instructions, comments, etc.), links to other web resources (e.g. city map), front/end to services processed by web servers and/or backend applications (e.g. user authentication, transactions such as renewal of drivers license), user related objects (e.g. user profiles within life events), etc. Ongoing research in Semantic Web area [1] is mainly focusing on how to build adequate *ontologies*, how to build agents making intelligent use of the metadata, how to design and how to solve semantic interoperability problems.

Ontologies can describe structurally heterogeneous and distributed information sources. By defining shared and common domain theories and vocabularies, they help both people and machines to communicate concisely, supporting the exchange of semantics. Over the last few years, ontology engineering has become a major research subject. Development of ontologies by different research groups resulted in using various approaches, creating and adopting various techniques, methods, and dedicated languages. Extended information regarding ontological engineering can be found e.g. in [7].

Despite the existence of large amount of various ontology editors, manual building of ontologies suffers from knowledge acquisition bottleneck. It is thus not surprising that many attempts to develop ontologies without, or with minimal human supervision have arisen [3]. Several major approaches can be distinguished, such as learning from unstructured texts, acquisition from semi-structured data, and acquisition from structured schemata.

A number of possible languages can be used to represent ontologies, including general logic programming languages like Prolog. More common, however, are languages that have evolved specifically to support ontology construction. The Open Knowledge Base Connectivity (OKBC) model and languages like KIF (and its emerging successor CL, cl.tamu.edu) are examples that have become the bases of other ontology languages. Several

languages use frame logic, which is basically an OO approach defining frames (classes) and attributes (properties). There are also several languages based on description logic thought to be especially computable. These include Loom and DAML+OIL (www.daml.org).

In recent years, standardisation efforts were made in the direction of ontology language standards. Ontology languages increasingly rely on W3C technologies like RDF Schema as a language layer, XML Schema for data typing, and RDF to assert data. Web Ontology Language (OWL, www.w3.org/2001/sw/WebOnt) standard evolved from DAML+OIL as a W3C recommendation.

Workflow is the automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant (human or machine) to another for action, according to a set of procedural rules. *Workflow management systems* (WFMS) have been introduced to support this. WFMS may be characterised by providing support in three functional areas (1) modelling functions, (2) run-time control functions, and (3) run-time interactions with human users and IT application tools.

Current research activities are focused on adjusting workflow into Services Oriented Architecture on the basis of Web Services. It results in development of standards and specification used in advanced and innovative Workflow Management Systems. From the Access-eGov perspective, an important specification is ASAP (Asynchronous Service Access Protocol), which is currently a Working Draft specification being developed by an OASIS Technical Committee (www.oasis-open.org). ASAP is a web services protocol that can be used to access a generic service that might take a long time to complete. The service being invoked might be fully automated, a manual task that a person performs, or any mixture of the two.

By means of WFMS, various linear and non-linear sequences of e-Government services can be described, inckluding e.g. conditional if-then-else statements, loops, etc. Proposal is to use workflows in the Access-eGov system as a technique for modelling complex services and its behaviour in a time period.

Security is an integral part of an e-Government system to prevent misuse of resources and to assure protection of data. The basic goals that must be ensured by any security system are integrity and availability of data and communication and availability of services. Also, the Access-eGov approach poses further requirements: users should be able to perform a Single Sign-On (SSO) in order to use different services with only one authentication procedure, but allowing the user to apply more than one scheme of authentication (e.g. username/password or emerging signature cards like the german health card[2]). Furthermore, there is a large number of potential users that can interact with the system. Thus, the security system should also follow a distributed approach to enable load balancing and fault tolerance.

Those aforementioned requirements can mostly be fulfilled by Authentication and Authorisation Infrastructures (AAIs) [5]; there exist some first approaches that are freely available. The most relevant ones are Kerberos, Shibboleth, and Project Liberty. However, they all lack support for advanced authorisation models (if they are existent at all, e.g. Shibboleth has no access control concept, this is left to an external application), as they mainly focus on issues of authentication and federated identity management. Further information on this can be found in [5]. This is especially important in the context of a large number of heterogeneous users that is bringing traditional access control models like Role based Access Control (RBAC) to their limits. As a consequence, there are ongoing research efforts to develop models based on subject and object attributes that are more suitable for this

[2] http://www.bmgs.bund.de/deu/gra/themen/gesundheit/geskarte/index.cfm

situation; this still needs more exploration, however, especially in the field of policy administration, as this is a very complex task when dealing with a large number of users and resources [6].

For secure communication between nodes in an environment like the Internet some open standards have arisen and are still under development. Using XML as a technological basis, they cover problems like exchanging assertions about users and their security properties (SAML[3]), encrypting and signing XML messages (XML Signature, www.w3.org/Signature/, and XML Encryption, www.w3.org/Encryption/2001/) and handling of security policies (XACML, www.oasis-open.org/committees/xacml). However, not all of these standards are widely deployed yet.

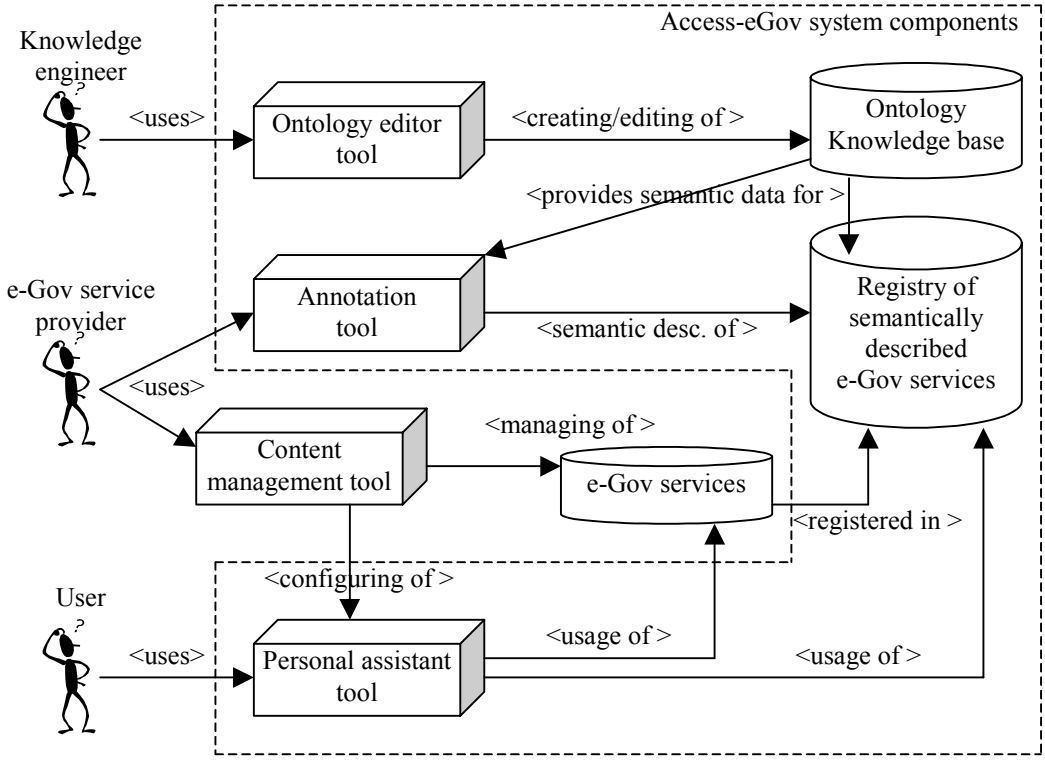

Figure 1: Overall functional schema of components in the Access-eGov system.

A **general schema** with main functional components of the proposed Access-eGov system is depicted on the Figure 1. Firstly, the knowledge engeneer uses the Ontology editor tool for creating the ontology – a core semantic description of particular e-Government domain. In the second step, the provider (an employee of a governmental institution) describes the e-Government services by the Annotation tool. During this process, the services are semantically enhanced by objects (concepts and relations) from the ontology, services can be organized into a complex sequences (using workflow modelling). Finally, semantically described services are stored in the Registry – a central repository of Access-eGov services. Such registered services can be retrieved and used by a citizen or business user, by means of Personal assistant tool. Of course, all the communication between modules is secure, authentified, and authorized – by means of distributed security system.

[3] http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=security

5 PILOT APPLICATIONS

Three distinct pilots of the Access-eGov system will be implemented and evaluated in three EU countries.

The **Slovakian pilot** will be specified and implemented by the Kosice Self-Government Region and municipality of Michalovce City. This pilot will be focussed on the land-use and -planning and building permit, and aims at making this rather complicated process more transparent, efficient and easier to understand, hence saving time (and thus also money) for citizens and businesses.

The **Polish pilot** will be implemented in the Silesia Region in cooperation between the Cities on Internet and City Hall of Gliwice. This pilot will focus on the registration processes of a company.

The **German pilot** will be implemented by the State Government of Schleswig-Holstein, which will implement an upgrade and field test based on the existing good practice, the so-called "*Zustaendigkeitsfinder*" ("Responsibility Finder"), by introducing a semantic layer (securing semantic interoperability between national and local governments). As a result of this, the quality of services to citizens and businesses looking for a government service provided by national and/or local governments will be improved and maintenance of the system (updating information on these services) will be made easier and more efficient.

In addition, the German University in **Cairo**, thanks to its location in Egypt, will arrange a challenging test case – for example, a person with an Egyptian citizenship searching for e-Government services provided by EU ountry or wanting to obtain a work permit in an EU country. It will include all tasks of an intra-European scenario plus additional challenges of language and cultural differences.

6 BASIC FACTS OF THE PROJECT

Access-eGov FP6-2004-27020 was selected to be funded by the European Comission within the Information Society Technologies (IST), Sixth Framework Programme. This project addresses the strategic objective SO 2.4.13 Strengthening the integration of the ICT research effort in an enlarged Europe. The total budget of the project is E 2,3 million with the contribution of the EC of E 1,98 million. The project has an expected duration of 36 months, starting on the 1st of January 2006 and ending at the 31st of December 2008. Further information can be found on the project's web site at www.access-egov.org.

The Access-eGov consortium consists of eleven partners from five countries (Slovakia, Poland, Germany, Greece, and Egypt), led by the Technical University of Kosice, Slovakia.

7 SUMMARY, CONCLUSIONS

The Access-eGov project for supporting semantic operability among e-Government services was described in the paper. Various semantic technologies and approaches being used in the project were presented, including SOA and Web Services, Peer-to-peer networks, ontologies and knowledge modelling, workflow systems, and semantic web principles.

Of course, there are still a lot of open questions to be solved in future, some of them are consistency check after modification of ontology / service / its semantic description, interfaces between components, issues on the proper knowledge modelling of e-Government services, quality assurance of semantic description of the services.

Currently, the Access-eGov project is still in its initial phase, where user requirements for pilot applications are collected and evaluated. However, clearly defined scope and objectives,

innovative and powerful technologies, as well as quality of project consortium, should assure a success of the Access-eGov project in future.

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