

Ontology for E-Government Public Services

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INTRODUCTION

In the past few years, information and communication technologies are increasingly used for provision of public services, improvement of managerial effectiveness and promotion of democracy, a development that is commonly termed as e-government (Gil-Garcia, 2004). Transactional services are an indispensable tool for delivering public services and can additionally be used for democracy promotion (e.g., via questionnaires and polls), thus, playing a central role in e-government. Transactional services development and promotion has also been in the focus of specific projects and initiatives (e.g., European Commission, 2004) or supporting frameworks (e.g., UK online, <http://www.govtalk.gov.uk/schemasstandards/egif.asp>).

E-government services have now been developed to cover the basic services that should be delivered to citizens and enterprises (Cap Gemini Ernst & Young, 2004). Administrations realise however, that besides making new e-services available or enhancing existing ones, a number of issues regarding e-services has to be addressed, including:

1. **E-Service Composition:** In many cases, different public services need to be combined to fully service the needs of a service consumer (citizen or enterprise) in a particular point in time. This issue is often termed “handling of life events” (Wimmer & Tambouris, 2002).
2. **E-Service Cataloguing:** Mechanisms enabling service consumers to locate the available e-services should be provided (Gant & Gant, 2002). These mechanisms should cater for the needs of all service consumers, such as incorporation of multiple taxonomies for e-services (e.g., by delivering organisation, life events, by service category, etc.), provision of search facilities, retrieval of relevant legislative information, etc.
3. **Change Management:** Legislation regarding governmental services is often revised, necessitating changes to the content or procedures of services (Vassilakis, 2003). E-services are more prone to changes since the regulatory framework of e-ser-

vice provision can also be subject to modifications (e.g., stronger encryption or stricter authentication requirements). Whenever changes occur, the affected services (or service portions) must be located and undergo maintenance activities. *Cascading effects* may also appear, (e.g., if service A depends on service B and service B is modified, harmonisation actions may be needed for service A).

4. **Administrative Responsibility:** The administrative responsibility must be clearly reflected in all phases of e-services lifecycle (Cassese & Savino, 2005), since it determines both the authoritative source to define (or revise) requirements and procedures and the canonical bureau for operating the e-service, resolving issues, etc. In some cases, operation of services can be delegated by the administratively responsible authority to other agencies, (e.g., the ministry of internal affairs is administratively responsible for the service “issuance of birth certificates”, but municipalities or citizen service centres can be endorsed to also deliver this service.

The issues previously identified reveal the need for *semantically rich* means for representing the various aspects of e-services. Indeed, through these descriptions a number of *concepts* (i.e., types of entities such as service, document, service consumer, legislation, etc.) are identified, which are connected through various *relationships* (e.g., a service “issues” a document, a regulation “governs” a service and so forth). Such a representation, together with the appropriate tools, would facilitate the task of locating specific concepts, and then exploit the relationships to trace other concepts linked to them. For instance, if a piece of legislation is linked to a number of e-services through links of type “governs”, these links can be used to pinpoint the services that should undergo maintenance activities when this piece of legislation is modified.

In this article, the usage of ontologies for meeting the requirements previously listed is examined. An ontology for e-government services is presented, covering various aspects of services, including administrative responsibil-

ity, meta-data, involved documents, and legislation. Both the development and usage phase of the ontology are covered and directions for further exploitation of the potential offered by the ontological representation are given.

BACKGROUND

According to W3C, “an ontology defines the terms used to describe and represent an area of knowledge” (W3C, 2004), defining *classes* (or *concepts*), which are general things in the domain of interest, *relationships* that may exist among things and *properties* (or *attributes*) those things may have. Ontologies can also be viewed as descriptions (like a formal specification of a program) of the concepts and relationships that can exist for an agent or a community of agents (Gruber, 1993).

The representational capabilities of ontologies can be complemented with reasoning capabilities through specific rule languages and rule evaluation engines, (e.g., SWRL [Horrocks, et al. 2004], the KAON2 reasoning engine [Motik, Sattler, & Studer, 2004]), providing thus a framework that completely supports the requirements presented above. Reasoning aims at extracting information not directly represented, mainly through the application of rules on the given facts. For example, the organisations through which a document is issued can be determined by first identifying the services that produce the specific document and then retrieving the organisations that offer these services. This can be represented as a rule of the form “if (offers (Organisation, Service) AND issues (Service, Document) THEN issues (Organisation, Document))”. Such a rule is evaluated by a reasoning engine against the existing ontology to produce the list of organisations issuing a specific document. Finally, the use of ontologies enables direct integration of public services into the semantic Web (Berners-Lee, Hendler, & Lassila, 2001), multiplying the benefits of this approach. For this purpose, special languages have been designed, including DAML and OIL, whereas RDF can be also used for defining assertions (Davies, Fensel, & Harmelen, 2003).

The issue of service composition is typically tackled using pre-determined execution scenarios, where human experts model the execution order, flow control, and data dependencies of constituent services (Bunting, et al., 2003; Wimmer & Tambouris, 2002). More flexible frameworks allow the dynamic modification of certain model elements (Casati, et al., 2000), while commercial systems enable the graphical modelling of composite services and provide engines for their execution (Iona, 2005; Oracle, 2004).

In the area of e-service cataloguing, the predominant approach is the use of portals, (e.g., FirstGov of US (<http://www.firstgov.gov>) and DirectGov of UK (<http://www.direct.gov.uk/>)). Portal maintenance is however a costly task, since the need for flexibility and support of multiple views in a change-prone environment, necessitates frequent updates and extensive consistency checks.

The relationship between e-services and legal documents or administrative information is usually handled in an ad-hoc manner. In the best case, legislation databases will be used for maintaining the “point-in-time” versions of the legislation (Teratext Solutions, 2004), but no direct linkage to relevant e-services is established. Similarly, administrative information for e-services is stored in an unstructured form within the legislation and/or the public authorities’ regulatory framework.

Recently, the usage of ontologies for modelling e-services has been examined. In Bougouettaya, et al., (2001) ontologies are used as a basic model for organising and discovering e-services. An important aspect of this work is the *ontology distribution*, which facilitates a semi-autonomous maintenance of the ontology data, with each administration maintaining a specific ontology portion. In (Tambouris et al., 2004), the usage of ontologies in application development is examined. Finally, in Adams et al., (2002) an ontology is formulated to promote knowledge management in the context of e-service development.

PUBLIC SERVICE ONTOLOGY: KEY REQUIREMENTS, MODELLING, AND USE

For a public services ontology to be useful, a number of requirements have to be met. Firstly, the ontology should be *complete*, (i.e., it should cover all relevant aspects of services). Secondly, it should facilitate *incremental development* by incorporating certain concepts and relationships at an initial phase and then defining new ones, or creating instances as needed. Due to the decentralised responsibility scheme for public services, it is desirable to build an ontology scheme that can be jointly developed by multiple authoritative sources. Each source would maintain its own portion of the ontology, and the combination of all portions would form the global perspective. The ontology should allow the extraction of different *views* or *taxonomies* (Adams et al., 2002) enabling public service stakeholders to navigate within the ontology concepts as best suited to their interests, or the task at hand. The *semantics* of the concepts and relationships within the ontology should be clearly defined; semantic ambiguity and ad-hoc concept and relationship types

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