A SOA Based Government Interoperability

EL BENANY Mohamed Mahmoud
LIIAN laboratory
Sidi Mohamed Ben Abdellah University
Faculty of Science D.M
U.S.M.B.A FES
Fez, Morocco
medmhdbenmannu@gmail.com

EL BEQQALI Omar
LIIAN laboratory
Sidi Mohamed Ben Abdellah University
Faculty of Science D.M
U.S.M.B.A FES
Fez, Morocco
Omar.el-beqqali@gmail.com

Abstract
One of the ways to get the interoperability in e-Government interoperability is to uphold an Enterprise Architecture paradigm across the country. Many of the global tiger countries have successfully used enterprise architecture frameworks for their e-Gov interoperability. The main factor of G2G concerning interoperability between central and local governments is the heterogeneity in developing E-Gov applications. One of E-Government implementations is to do a form of relationship named Government to Government (G2G). The interoperability that has occurred are done by creating a brand new architecture that has a function to allow existing E-Gov applications to be able to communicate with each other. This paper focuses on creating an Enterprise Architecture Framework (EAF) for interoperability and data integration on eGov applications. This architecture combines the approach of Service Oriented Architecture (SOA) and Event Driven Architecture (EDA) to do an Enterprise Architecture Framework work that is real-time, the relationship between the one-to-many services, and the message transmission models that are asynchronous. The services provided and the events are defined by using Web Service Definition Language (WSDL), while the orchestration mechanism that occurs between services is defined by using the Business Process Execution Language (BPEL4Sw). BPEL is conducted by the Government Service Bus (eGSB).

Keywords — E-government, interoperability, BPEL, SOA, Enterprise Architecture.

1. INTRODUCTION
The current trend in e-government applications calls for joined-up services that are effective, simple to use, shaped around and responding to the needs of the citizen, and not merely arranged for the provider’s convenience.

E-Governance initiatives are similar across the world, but in some countries it will be more complex than in other due to the multi-tier administrative structure, diversity of culture, and different process management methods in various government departments. Globally most of the Governments are taking efforts for their interoperable e-Government system to provide one-stop service to its stakeholders [1]. The solution is e-government interoperability among the administrative structure of a country. One of the ways to get the interoperability in e-Governance systems is to uphold an Enterprise Architecture paradigm across the country. Many of the global tigers have successfully used enterprise architecture frameworks for their e-Gov interoperability. E-Government continues to be recognized as a key strategy for improving government services and the effectiveness of public policies and programs. A key component of e-government initiative is the ability of multiple government and nongovernment organizations to share and integrate data and information across their traditional organizational boundaries. E-Government interoperability represents a set of multidimensional, complementary, and dynamic capabilities needed among these networks of organizations in order to achieve successful information sharing. However, this view is complex and provides both researchers and practitioners with the challenge of understanding and developing many and very diverse interoperability capabilities [2].

The rest of this paper consists of the following sections: Section 2 presents the related work and some background of this topic, section 3 describes the E-Government context. Section 4 exposes the interoperability problem. Section 5 explains our proposed SOA-based framework for E-Government Interoperability and finally Section 6 will present the conclusion and the future work.

2. RELATED WORK/BACKGROUND
Public administrations have been very much concerned about the need of avoiding vendor lock-in when procuring IT infrastructure. This concern met a response in the 1980s by means of the standardization. Standardization was a typical response in the 1980s to the concerns related to interoperability and proprietary systems [3]. Many e-government projects are being developed and various approaches have been proposed for the design and development of an architecture to deliver e-government services to citizens with several approaches (e.g., standards, reference models, architectures, frameworks, industry-neutral and industry-specific initiatives) have been developed. However, their focus is mainly on technical aspects related to inter-organizational communication.

Relevant European initiatives, frameworks and roadmaps to develop interoperability of enterprise applications and software are presented in [4], e.g., ATHENA (www.athena-ip.org), IDEAS (www.ideas-roadmap.net), INTEROP NOE (http://interop-noe.org) EU-funded projects. The authors advance three main research domains: enterprise modeling, architectures and platforms, and ontologies. However, the authors do not tackle business/economic interoperability aspects.

One European project, ECOLEAD, (www.ecolead.org) has directly addressed issues on CN performance. Preliminary results have been presented (e.g. [5]), with focus on social networks and the metrics proposed refer to “task level”. An agent-based approach to systems interoperability is described in [6]. Experiences in designing and integrating collaborative engineering environments supported by tools that enable cooperative work and intellectual capital sharing, based on an action research approach are introduced in [7]. An approach for an interoperable industrial networking architecture consisting of two field bus segments is proposed in [8]. A modeling framework for agile and
interoperable virtual enterprises is presented in [9]. However, semantic and business/economic aspects are not addressed.

A number of areas that need further research in the context of a networked environment have been identified by researchers (e.g., [13,10]), including: the definition of reference models for CNs, the development of new applications, architectures and infrastructures to support CNs; knowledge oriented collaboration; theoretical models. The issue of adopting a holistic approach on interoperability is of utmost importance to designers and managers (e.g., [11,12]).

The eGov project [14] proposes an architecture to enable ‘one-stop government’. In order to describe services a markup language (GovML) has been developed [15]. GovML defines a set of metadata to describe public administration services and life events. The FASME project [16] focuses on supporting citizen mobility across European countries by the integration of administrative process. In order to satisfy this objective a smart card is provided to citizens for the storage of all personal information and documents. Services are delivered through dedicated kiosks. The EU-PUBLIcom project [17] defines a Unitary European Network Architecture. It proposes a middleware solution to connect heterogeneous systems of different public administration and to enable a service-based cooperation between public administrations.

The eGovSM project [18] supports the automation of administrative process involving several administrations and allowing the reuse of data. The eGovSM is formalized using a set of XML Schema models in order to support the realization of an interoperable system. So, this article aims at addressing these challenges.

3. THE E-GOVERNMENT CONTEXT

The term e-government is broadly defined as the use of information and communication technologies to support the business of government, such as providing or enhancing public services or managing internal government operations. Its benefits include improved efficiency, transparency, accountability, and access as well as coordination of services at lower costs. However, the task of delivering these benefits is not only difficult but also poorly understood. Our research suggests that interoperability is a fundamental barrier to achieving the benefits of e-government. We believe that a better understanding of the context and relevant issues will help resolve the difficulties many governments have in achieving these benefits. While many governments have addressed interoperability as primarily a technical issue, the full range of the interoperability problem has other facets and is influenced by a variety of sources, especially in the public service context. To address the entirety of the interoperability challenge, we need to consider technical factors such as data semantics and process standardization as well as nontechnical factors such as legal, political, and social issues.

Three definitions of E-Gov will we give in this context; 1) The use of information and communication technologies (ICTs) to improve the activities of public sector organizations [19]; 2) The use of information technology to free movement of information to overcome the physical bounds of traditional paper and physical based systems [20]; 3) The use of technology to enhance the access to and delivery of government services to benefit citizens, business partners and employees [21][22].

4. THE INTEROPERABILITY PROBLEM

Interoperability is a complex problem. To enable interoperability in an e-government context, we must examine all its elements. So What Is Interoperability?

Interoperability is another term that has many definitions. Ford and colleagues provide a list of 34 different definitions [23] that cover a wide range of possible meanings: from the very general—“the ability of systems to work together” [24], to the very specific—“the ability of a set of communicating entities to (1) exchange specified state data and (2) operate on that state data according to specified, agreed-upon, operational semantics” [24], to the very targeted “two-way radio: compatible communications paths (compatible frequencies, equipment and signaling), radio system coverage or adequate signal strength, and scalable capacity” [25].

Significant research has provided new ways to understand interoperability for many important stakeholders such as the computing community (significantly, the Institute of Electrical and Electronics Engineers), the health care industry, the U.S. Department of Defense, and software research institutions [26] [27] [23] [28] [29] [30]. This wealth of research implies that although there is significant interest in interoperability, there is little agreement on what it is. A potential reason for the many definitions and interpretations is that interoperability is situation dependent; its meaning can vary from technical to nontechnical, depending on the context [23]. We believe that consensus about a definition can be reached only at a high level.

4.1. MODELS FOR INTEROPERABILITY

There are multiple models for interoperability. The models break down the interoperability problem into different types, levels, and/or dimensions. The Levels of Information Systems Interoperability (LISI) model breaks down interoperability into different levels of connectivity between systems [CHSR Architectures Working Group 1998]. The Organizational Interoperability Maturity Model (OIMM) and the Levels of Conceptual Interoperability Model (LCIM) build on the LISI model in different ways—the OIMM model through abstraction to command-and-control support and the LCIM model through data management—to bridge technical design and conceptual design [31][32].

Figure 1: Conceptual Interoperability Model (LCIM){33}

<table>
<thead>
<tr>
<th>Levels</th>
<th>Description of interoperability at this level</th>
</tr>
</thead>
<tbody>
<tr>
<td>L6(Conceptual)</td>
<td>Interoperating systems at this level are completely aware of each others information, processes, contexts, and modeling assumptions</td>
</tr>
<tr>
<td>L5(Dynamic)</td>
<td>Interoperating systems are able to reorient information production and consumption based on understood changes to meaning, due to changing context as time increases.</td>
</tr>
<tr>
<td>L4(Pragmatic)</td>
<td>Interoperating systems will be aware of the context (system states and processes) and meaning of information being exchanged.</td>
</tr>
<tr>
<td>L3(Semantic)</td>
<td>Interoperating systems are exchanging a set of</td>
</tr>
</tbody>
</table>
There are three primary goals associated with achieving interoperability in any system (computer or otherwise): data exchange, meaning exchange, and process agreement [32].

1) Data Exchange: The first goal with respect to interoperability is basic data exchange i.e. whether data can be exchanged at all. May be data exchange range from phone connections, email, and document exchanges to web pages and the automated exchange of data in computer-readable format. A computer system example would be the exchange of data between two computer systems in which there is an agreement on the types and size of the data exchanged, and data can go back and forth without the participants having any knowledge of the meaning of the data.

2) Meaning Exchange: The second goal with respect to interoperability is the exchange of meaning (i.e., all participants in a given communication assign the same meaning to the information that is exchanged). Meaning exchange is fundamentally different from data exchange because of the aspect of misinterpretation. Data exchange either occurs or does not occur. Meaning exchange, however, is much more difficult because there is no implicit guarantee that all participants will interpret the meaning of the data in the same way. Even when two participants agree on a particular piece of data as a unit of distance, if both sides do not understand the specific type of unit in exactly the same way, there is potential for failure or even disaster.

3) Process Agreement: The third goal with respect to interoperability is agreement on how to act on information that has been exchanged (i.e., whether all participants in a given communication have the same understanding of how to act once they have exchanged information). Process agreement is a fundamentally different type of interoperability goal from data exchange and meaning exchange because its focus shifts from the information exchanged to the actions taken by the participants once the information exchange has occurred. Here, all participants must agree in advance about what to do with the data they receive in the exchange. Process agreements are often complex and represent many of the problems that e-government efforts attempt to address. Lack of process agreement often manifests as a need for the consumer to provide the same information to multiple government services in response to a single event.

3.3. Interoperability Levels

The interoperability levels explain how interoperability goals can be built on each other to achieve various goals.

- Data Exchange: The basic level of interoperability is the exchange of data. This is necessary to have already been successful at information exchange.
- Meaning Exchange: Semantic interoperability maps to the goal of data exchange. Here, technical interoperability is placed at the base level because the exchange of data is at the root of all communication. In some of the more technically based interoperability models, this level is divided into sublevels that map to specific modes of communication and separate the data from the communication channel [29]. The approach taken in existing e-government interoperability models is to abstract the details of the communication and have a single level.
- Process Agreement: The goal of process agreement is to abstract the details of the communication and have a single level. This is consistent with many of the existing interoperability models [31].

3) Organizational Interoperability: Organizational interoperability maps to the goal of process agreement. We place it at the top level because process agreement cannot occur without both information exchange and meaning exchange supporting the communication to establish the process and the communication that contains the information for the recipient to act on. Although the term process interoperability describes the interoperability goal of process agreement more directly, organizational interoperability is a better term for the e-government context because it captures the scope of inter- and intra-organizational process alignment that is necessary to meet this interoperability goal [32].

5. The Proposed SOA-Based E-Government Interoperability Framework

This paper is focused on creating an architectural framework for interoperability and data integration using a combination of SOA and EDA-based approach. This SOA approach that was used is based on the concept of making the communication architecture. This architecture can perform a wide range of heterogeneous platforms of existing e-Gov applications. The communication is represented among open standard services. The EDA approach that was used is based on the concept for provision of dynamic services. The combination of SOA and EDA approach aims to provide services that can be real time for business processes, because the services are available in a combination with the event as a trigger for asynchronous message sending.

5.1. Service Oriented Architecture

SOA is a form of an architectural model that refers to the principle of technology-oriented service [34]. Figure 3 describes the scope of the service in SOA which consists of functions, procedures or a process that gives response if requested by a client or it can also be viewed as a logical encapsulation from an individual or a group of specific activities as the implementation of business processes. The concept of service-oriented allows to be approached by dividing the problem into a set of small service, and the solutions to these problems must be solved by allowing all to participate in a service orchestration. SOA is not associated with a particular technology, but more toward a modular approach.

To implement application with service-oriented approach to SOA, the implementation is in a layer that lies between business process layer and application layer. This layer is a part of the enterprise logic called the service interface layer, Service interface layer has a function...
Web services are technology that is used to exchange information based on XML. It allows interoperability between multiple applications and platforms that are developed with different programming languages. SOA approach enables applications to communicate with other applications by requesting relevant service of respected application regardless of the platform and the programming language. Applications can adapt to the functions and services to suit the different processes in a flexible business processes [36].

5.4. BUSINESS PROCESS EXECUTION LANGUAGE

BPEL is an XML-based language used to define business processes with web services. The main goal of BPEL is to standardize the business process flow that is defined to work with using the web services [38]. BPEL extends the interaction with web services model and enables to support the transaction. BPEL is based on web services, so it is assumed that each of the business processes involved is implemented by using web services, so that BPEL can regulate the interaction between web services using XML documents [39]. BPEL is used to describe a business process in two different ways, i.e. executable and abstract processes. The executable processes specification is to define the order of execution in a number of activities; the partners that are involved, exchanging messages between partners, and exception handling mechanisms. The abstract process specification is the behavior of exchanging messages with different parties without providing information about the internal behavior from the parties. The elements contained in the general structure of BPEL are composed of: tag: Process, PartnerLinks, Variables, and Sequence [40]. Process is a main key element of the BPEL. The process name is defined on the tag having attribute name. In addition, the tag is also used to include information related to the process definition. PartnerLinks is an element to define the type of port from another service that participates in the execution of business processes. Variables are elements used to store the status that is used for workflow logic. Sequence is an element to organize a set of activities that can be executed consecutively. The elements that BPEL supports for sequence include receive, assign, invoke and reply.

INTEROPERABILITY ARCHITECTURE CONCEPTUAL

In this section is given a conceptual model of framework interoperability of E-Gov in Country which can be used for interoperability of local governments to the central government or in the other way around.

5.5. DEVELOPED E-GOV INTEROPERABILITY ARCHITECTURE

Interoperability architecture will developed by using SOA approach to create services for business process, so interoperability can be performed by accessing these services. To create interoperability architecture that operates in real time, SOA approach needs to be combined with the EDA approach. The aim for this combination is to enable the service works with the event as a trigger, where the events in the services are defined using WSDL. To set the service orchestration which has occurred, a bus service called the Government Service Bus (GSB) is defined using BPEL. The development of interoperability architecture consists of the components shown in Figure 4. Interoperability scenarios are developed using an approach where each district/city, province, and national levels are assumed as elements involved in the mechanism of interoperability. Each element can act as a service provider as well as a service consumer. Architecture interoperability scenarios were developed using the model given in Figure 4 as follows:

1) National and province governments: National and province governments as a service provider for the functions of adding,
deleting, and updating that will be used by the consumer service in districts/cities. This scenario is used to create a distributed database contained in each district/city, province, and national levels.

2) District/city: District/city as a service provider for the function of read data (data on population, birth data, mortality data, recap of the population, recap of the number of births, and recap the number of deaths) that will be used by the service consumer, i.e. province and national level in accordance with the hierarchical structure.

3) Each province and nationally: Each province and nationally has GSB that is equipped with BPEL to set orchestration between the services that have occurred. GSB is also defined as an event (the read data) that is used to trigger between the services performed by the BPEL orchestration.

4) Service Orchestration: This component is responsible for managing composite services. The composite service is invoked by a client and in turn it invokes and orchestrates different services to achieve the require-ment of the composite service.

5) Service Registry: Is used to provide a search point of access to services and database definitions and metadata for all services provided by the Central Database model. The registry is based on Universal Description Discovery and Integration (UDDI).

6. CONCLUSION ET FUTURE WORK

The proposed Enterprise Architecture framework for E-Government interoperability was based on SOA and was realized by using an ESB called in our case eGSB and SOA. The framework provides the main functionalities which are the interoperability between central and local government to be able to access to the integrated data, and the replication between the diverse database types. The main components of the framework are: ESB, Web Services, UDDI, databases, e-Government portals, governmental business Applications, and front-end applications, BPEL and finally EDA to produce a system that is a real-time.

In order to evaluation this work, we need to have a use case at a real data that will constitute our future work.

REFERENCES

[3] Luis Guijarro, Interoperability frameworks and enterprise architectures in e-government initiatives in Europe and the United States Communications Department, Technical University of Valencia, Camino de Vera, s/n. 46022 Valencia, Spain Available online 7 July 2006