

Multi-Agents Coordination Model in Inter-Organizational Workflow: Applying in E-government

E. Karoui Chaabane, S. Hadouaj, and K. Ghedira

Abstract—Inter-organizational Workflow (IOW) is commonly used to support the collaboration between heterogeneous and distributed business processes of different autonomous organizations in order to achieve a common goal. E-government is considered as an application field of IOW. The coordination of the different organizations is the fundamental problem in IOW and remains the major cause of failure in e-government projects. In this paper, we introduce a new coordination model for IOW that improves the collaboration between government administrations and that respects IOW requirements applied to e-government. For this purpose, we adopt a Multi-Agent approach, which deals more easily with inter-organizational digital government characteristics: distribution, heterogeneity and autonomy. Our model integrates also different technologies to deal with the semantic and technologic interoperability. Moreover, it conserves the existing systems of government administrations by offering a distributed coordination based on interfaces communication. This is especially applied in developing countries, where administrations are not necessary equipped with workflow systems. The use of our coordination techniques allows an easier migration for an e-government solution and with a lower cost. To illustrate the applicability of the proposed model, we present a case study of an identity card creation in Tunisia.

Keywords—E-government, Inter-organizational workflow, Multi-agent systems, Semantic web services.

I. INTRODUCTION

IN order to achieve a common goal, many organizations need to cooperate. The process of the cooperative works can be modeled as an inter-organizational workflow [1].

In e-government environment, organizations are presented by government agencies that collaborate to deliver citizens services. The application of IOW on e-government induces specific problems for this domain. A fundamental problem for IOW is the coordination of the different business processes involved in it [2] and it's also one of the reasons of failure of e-government projects. Based on a study done by [3], 35 percent of e-government projects are total failures, 50 percent are partial failures, and only 15 percent are success. In IOW, there is a conflict requirement: how to coordinate the partners involved in the execution of a service and at the same time

respecting their autonomy and privacy. To create an IOW coordination model, different requirements should be respected.

IOW models are generally applied in e-business domain [1]-[9]. The nature of a firm and a local government is different. So they can't be approached the same way [10]. Rabaiah [10] summarizes the major differences between business and government. In private firm, business interest of the participating firms ensures that all the partners cooperate and coordinate to make workflow successful. But these common interest and goals are not the same ones in government department [11]. He also mentioned that it's difficult to apply e-business workflows models in e-government so that a new approach is required.

Many efforts are taken to create new models for e-government [11]-[18]. Most of them are based on a centralized architecture. All transactions between government agencies are managed by a middleware that coordinates them. This implies an increase of the transaction time and the communication cost [19]. For this reason, different distributed models are proposed [12], [5]. However, the coordination between organizations is based on workflow systems. The problem of this solution is first independent of the nature of country; in our context (developing countries) many organizations are not equipped with workflows systems, the e-government project will be so costly because the rebuilding of the entails IT infrastructure will be needed.

Besides, many others problems related to e-government exist such as technical interoperability, semantic interoperability and the dynamic environment. Software applications working in e-government environments face two major problems [8]: data heterogeneity and technological interoperability. Service Oriented Architecture (SOA) in an e-governance domain ensures better reusability, maintain-ability and flexibility [17]. Web service (WS) technologies can provide interoperability and integrity but at a certain level of heterogeneity and for a limited rigid set of services and it is not the case in e-government. Moreover, Web services lack of automatic service discovery, selection, composition, publication etc [18], [17]. To resolve this problem, Semantic Web (SW) technologies [20] are combined with Web service. SW provides a common framework that enables data integration, sharing and reuse from multiple resources [18]. Combining SW with WS forms a new paradigm called Semantic web Service (SWS). "A Semantic Web Service (SWS) is the combination of semantic web technology and

F. E. Karoui Chaabane is with the High Institute of Management of Tunis, 41, Freedom street, Bouchoucha 2000 city Bardo, Tunis, Tunisia (e-mail: emnkaroui@yahoo.fr).

S. S. Hadouaj is with Computer Science Department, University of Economic and Management Sciences, Nabeul (e-mail: hadouaj@yahoo.fr).

T. K. Ghedira was with the Computer Science Department, University of Tunis, High Institute of Management of Tunis, Tunisia. He is now the City Science director, Tunis, Tunisia (e-mail: khaled.ghedira@isg.rnu.tn).

web services. Semantic Web Services (SWS) technology provides an infrastructure in which new services can be added, discovered and composed continually, and the organization processes automatically updated to reflect new forms of cooperation" [17]. However, SWS have insufficient degree of autonomy or dynamic adaptation for situation's change. 'Intelligent Agent can contribute to make SWS frameworks more autonomous and dynamic, thus maximizing their perceived usefulness' [18]. Since an agent has special properties such as autonomy, reactivity, pro-activity, flexibility and social ability; agents can autonomously discover, compose, invoke and monitor services without human intervention. Besides, agents are able to adapt to changing situations and to handle the dynamism of SWS environments [18]. Far from SWS, Multi agent systems form one of the coordination models applied in IOW. There are common properties between IOW and MAS such as autonomy, distribution, inter-operability and coordination. IOWs (inter-organizational workflows), for their very nature, seemingly represent some of the most natural applications for agent-based models and technologies [21].

Our work is a part of a government project in Tunisia named S2EG Secure System for E-Government. The aim of the project is to secure inter-organizational interactions in e-government through the developing of secure applications based on reuse and coordination of administrations services using an IOW coordination model.

In this paper, we present a distributed coordination model that:

- Respects the requirement of IOW applied in e-government such as interoperability, flexibility, autonomy, privacy, distribution and workflow preservation
- Is based on the interfacing idea where government entities are not equipped with workflows systems
- Relies on the combination of SWS and Agent.

The paper is organized as follows: Section 2 identifies the requirements of IOW applied in e-government. Section 3 sets out the challenges e-government domain presents. Section 4 presents the existing IOW models applied in e-government. Section 5 describes our new model. Section 6 is devoted to experimentations and results achieved in a case study of an identity card creation in Tunisia. Finally, section 7 provides conclusions and future work.

II. REQUIREMENTS FOR INTER-ORGANIZATIONAL WORKFLOWS APPLIED IN E-GOVERNMENT

Reference [6] and [22] presented five requirements: interoperability, autonomy, flexibility, distribution and technological environment. However [5] emphasizes on flexibility, privacy and workflow preservation requirements. For [1], two requirements are similar to [5] (flexibility and privacy) but he used workflow reuse instead of workflow preservation.

From the literature, autonomy, interoperability, flexibility and distribution requirements are taken into account by the most IOW coordination models. Applied in e-government, we

suggest these requirements: autonomy, interoperability, flexibility, distribution, privacy, workflow preservation and security.

III. E-GOVERNMENT CHALLENGES

In e-government environment, Interoperability is a key issue in the development of e-government services [32]. We address two aspects of interoperability: technical interoperability and semantic interoperability.

A. Technical Interoperability

In e-government, Government administrations are heterogeneous entities since they use disparate technological solutions. This heterogeneity creates a barrier for them to communicate and interact effectively [18]. In the case of undeveloped countries, most of them are not equipped with technological solution what's make the coordination between them a difficult task. To overcome this problem, web service technology is well suited for e-government.

Web Services is considered as an important element for application interoperability and integration [23]. But the major drawbacks of the web services technologies are their inability to allow automatic discovery, composition, and selection of web services [17]. The same problem is presented by [18] and others. To solve this problem, we use semantic technologies.

B. Semantic Interoperability

In e-government, data heterogeneity (and the semantic interoperability arising from such heterogeneity) is serious problem and remains a key issue as different naming conventions are used to represent data labels. This creates a barrier for inter-organizational services between public agencies of different domains outside that boundary [24]. Semantic Web is defined by [20] as "An extension of the current one (web), in which information is given well defined meaning, better enabling computers and people to work in cooperation". Currently, research is under way exploring the potentials of semantic technologies for e-government (see e.g. EU projects such as SemanticGov, TerreGov, OntoGov, and SmartGov).

The combination between Web services and Semantic web technology forms a new paradigm called Semantic Web Service (SWS) [25]. Nowadays, several approaches are presented by W3C such as OWL-S, WSMO, SWSF WSDL-S and SAWSDL. Some of these approaches (WSDLS and SAWSDL) add attributes extension to WSDL and XMLschema in order to support the semantic description of WSDL components. Others propose ontology for semantically describing all relevant aspects of WS [18]. New frameworks have been created to bring together the major functionalities of SWS such as WSMX [26] and the Internet reasoning service (IRS) project, a SWS framework that allows applications to describe and execute WS semantically [27]. These frameworks offer a high degree of interoperability however they do not possess enough degree of autonomy or the ability to adapt automatically to changing situations. Intelligent agents can make those frameworks more autonomous and

dynamic [18].

C. The Dynamism of E-government Environment

By using SWS, Technological and semantic interoperability problems are resolved. However we remain facing another problem: the dynamism of e-government environments. Explained by [18], new information and services can be made available at any time, whereas existing ones may disappear. Intelligent Agent has been a key technology as computing systems become evermore distributed, inter-connected and open [28]. In current web environments, the ability of agents to autonomously understand, to cooperate, coordinate, and negotiate with others, and to respond flexibly and intelligently to dynamic and unpredictable situations will lead to more convenience for users [15]. So IA's proper-ties such as autonomy, reactivity, pro-activeness are able to make SWS frameworks more autonomous and dynamic.

IV. RELATED WORKS

A. IOW

A Workflow is concerned with the automation of procedures where documents, in-formation or tasks are passed between participants according to a defined set of rules to achieve, or contribute to, an overall business goal [32]. With the rise of virtual organizations, electronic commerce and international companies, business process involve more than one organization [30] so the notion of inter-organizational workflow appears.

Inter-organizational workflow is defined by [31] as the cooperation of distributed and heterogeneous business processes running in different enterprises/organizations. In [5], virtual organization is a set of partners (real organizations) distributed in time and in space sharing resources and competencies (similar or dissimilar) and cooperating to reach some shared objectives using information technologies. A fundamental problem for IOW is the coordination of the different business processes involved in it. By coordination, we mean all the work needed to put all these processes together in order to provide the global common goal in an efficient manner [2].

E-government is one of the IOW application fields. Government entities cannot work independently but need to cooperate in order to offer citizens services. Many models are presented in the literatures that deal with IOW but these models cannot be applied in e-government for different reasons: (1) the poor coordination between government organizations caused by the nature of government environment compared to private sector (enterprise). Explained by [11], In government sector, hierarchical processes, autonomy of different participants, no common shared standard of performance, no shared benefits, absence of contract, etc, causes the Inter-organizational process to fail resulting in the failure of the e Government application. (2) The differences existing in the following criterion: aim, driver, processes Client's relationship, Operation and Emphasis. A table is presented by [10], comparing e-government to e-

business basing on the mentioned criterion. He also adds that a new approach for e-government is needed. (3) Legal restrictions in data access and the cooperation of authorities in non-hierarchical networks require a different approach for e-government [13].

B. Agent-based IOW Applied in E-government

Different IOW models applied to e-government are proposed such as [11] and [13]. Punia [11] presents a number of approaches to model e-government inter-organizational process and creates a new model called "public private process model". The interaction between two or more organizations is established through a third party intermediary which coordinates, manages and controls the Inter-organizational processes. Each organization is responsible for its own private internal processes and third party intermediary is the owner and responsible for common public processes. This idea is similar to the existing IOW models applied in e-business such as Process View [4] and view based approach [5]. The model presented by Punia [11] is centralized compared to the distributed model of Chebbi [5] where each organization has its own public processes. The model of [11] is a feasible solution that respects the characteristics of government administrations such as autonomy and independence. However, it's difficult to derive a public process from a private one and it doesn't respect the distribution requirement of IOW. Reference [13] designs a distributed workflow system for e-government explaining the need for a new model by "Legal restrictions in data access as well as the cooperation of authorities in non-hierarchical networks, however, require a different approach to this subject". Moreover he adds that government workflows are different from e-business workflows due to its institutional-links. The new approach is based on the Workflow Reference Model defined by the Workflow Management Coalition (WfMC) (Hollingsworth, 95). Each public authority has its workflow and the interaction between them is specified by the WfMC. The power of this solution is to adopting a distributed system "Distributed execution of workflows represents an important step towards efficient realization of cross-institutional decision making processes" [13]. However this model imposes that each public administration has its workflow system, which is not the case of all developing countries' administrations.

Other models are based on agent technology. The choice of this technology is explained by several reasons; First, MAS have similarities with IOW such as autonomy, distribution and flexibility. Second, Agent approach offers natural abstractions, languages (KQML, FIPA-ACL) and protocols (FIPA-request, FIPA-contractnet, etc.) to design and model IOW. Therefore, different approaches adopt this technology such as [12] who presented a hybrid intermediation portal. The pro-posed operational and technical architecture define the combination of a workflow engine and a software agent platform for the appropriate management of inter-organizational workflow processes. It exploits and combines the advantages of strict centralized topologies with totally distributed systems that use agent technologies. The model proposed is based on the

Workflow Management System (WFMS) [29]. So, a workflow system has to be presented in each administration to make the coordination between them.

C. Agents and SWS Based IOW Applied in E-government

Different research projects have explored how to support the coordination of e-government administration using agent technology. Some of them mentioned that their solutions are lacking semantic interoperability and it will be added as a future work by using ontologies "The usage of a general ontology for describing inter-organizational workflows would be a good step for reducing organizational costs, as the employment of specialists who understand and can describe the business models for each case will no longer be necessary" [12]. There are e-government projects where the semantic technologies are involved (OntoGOV, Smart-Gov, SemanticGOV, etc.). These projects have demonstrated the feasibility of semantic technologies in e-government, but they did not explore the possibility of using a Semantic Web Services infrastructure for the interoperability and integration of different public administration services [16]. Web Service (WS) provides a set of standards SOAP, WSDL and UDDI to deal with technical heterogeneity. Using web service, we can reduce the cost and time of integrating applications and integrating distributed information [15]. However Web Service descriptions are usually syntactic instead of semantic content, which leads to necessity of much man-intervention when to decide whether it offers the desired functionality [15]. The efficiency of WS can be attained if it's combined with Semantic Web Technology. By combining the two technologies, we obtain a new standard The Semantic Web Services (SWS). Moreover, new researches in e-government show the necessity not only to combine web service with Semantic web using SWS but also adding agent technology [14]-[18]. In fact, SWS have insufficient degree of autonomy or dynamic adaptation for environment's change. Intelligent Agents (IA) [28] are the software entities best suited to deal with SWS [18]. References [14]-[16], [18] presented different architectures but common divisions: we find that there is three layers/ divisions (The user one, the middleware and the web service layer). This makes of them centralized architectures based on a middleware. In fact, coordination between the different government administrations is established through the middleware. For example, in the work of [14], he presented an architecture that augments web services with multi-agent technology and uses OWL-S (Web Ontology Language for Services) for semantic description. Moreover, he identified reasons behind slow adoption of semantic web services and proposed a solution based on simplicity by extending WSDL to represent semantic information. The architecture proposed by [14] is based on the Service Oriented Architecture. The architecture is divided on three layers: user layer, agent layer presenting the middleware and service layer.

D. Recapitulation and Discussion

Differences between e-business and e-government also problems specific to e-government such as the dynamism of

the environment and the technical and semantic interoperability led the researchers to create new models for e-government. These models differ according to the used technologies and in which point they respect the requirements of the WIO applied to the e-government. Indeed, the similarity between the SMA and the WIO and the capacity of an agent to adapt with an autonomous and dynamic way to the changes of the environment allowed to create agent based models. However these models lack semantic interoperability. So, new projects are developed to explore semantic technologies feasibility.

To facilitate applications integration and distributed information and to manage technique interoperability, web service technology was used by several projects. However, Web Service technology misses semantic description of the Web services. This requires a human intervention. The combination of Web service with semantic Web has created a new standard Semantic Web Service which allows exploiting the benefits of every technology.

So there are several works which combine Semantic Web Service and agent technology. This what allows on one hand to manage the technical and semantic interoperability and on the other hand it allows a dynamic and autonomous adaptation to the changes of the environment.

However, these works is that they do not include all these necessary elements to create a good coordination in the WIO applied to the e-government:

Distribution to reduce the transaction time and the communication cost.

Communication based on the interfaces to respect the autonomy and protect the private life of the governmental administrations and also to reduce the cost of the construction of a whole infrastructure or to replace the existing one.

For that purpose, we propose a new model of WIO applied to the e-government. Then we apply our model to a case study which is the creation of the electronic identity card in Tunisia.

V. THE PROPOSED IOW MODEL FOR E-GOVERNMENT

In this section, we introduce our semantic agent based IOW model. First we present the necessity of applying IOW on e-government respecting different exigencies and how to move from the common centralized architecture based on a middleware to a distributed architecture. Then, we describe our model.

The model that we present is based on the application of IOW in e-government. It profits from the combination of the two technologies SWS and Intelligent agent. An agent represents a government administration interface. So, the coordination between government administrations is established through agents coordination.

A. From a Middleware to a Distributed IOW

E-government projects are costly ones. To reduce this cost especially in developing countries, government administrations are perceived as autonomous entities. There is no real need to replace incompatibles systems [10]. This idea is based on the generic distributed model presented in [10]

(See Fig. 1). Our model is concerned with only inputs and outputs of each government entities systems. It is not concerned with the detailed workflow or processes within each government entity but instead is concerned with the “interfacing” among objects (local governments). This makes the whole system platform modeling simpler, cheaper and easier to implement [10]. Moreover, the model suits developing countries where the most of government administrations are not equipped with a workflow system.

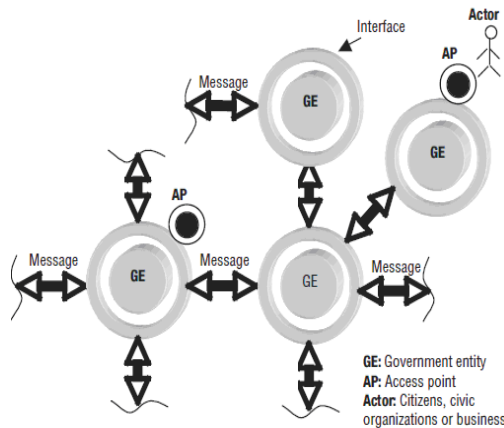


Fig. 1 Relationship that exist among Government Entities through Interfaces [10]

As presented in the previous section, government architectures that used SWS and agent technologies in e-government are centralized ones based on middleware. We profit from the power of the combination of these technologies but with a distributed solution. The distributed solution compared to a centralized one reduces transaction time and communication cost [19].

Each government entity has an interface that allows it to coordinate with others entities. The coordination between entities, in order to provide a service demanded by a citizen, is based on the interaction between the interfaces. We define an interface by a number of agents. One of them is responsible of the communication with others agents in others entities. A detailed description of the model and its components is presented in the next section.

B. Description of the Model

From the study of the requirements of IOW applied in e-government, we found that the model has to respect these requirements: Interoperability, flexibility, autonomy, distribution, workflow preservation, security and privacy. In the following we show how these requirements are respected by our model. First, SWS provide a high degree of interoperability between government administration systems. Second, the use of agent technology provides natural abstractions to deal with autonomy, distribution, and flexibility which are inherent to IOW. Third, the use of the interfacing technique where each government administration has an interface that it is responsible for the communication

with each other can protect their private information. Finally, if some public administrations are equipped with workflow system, the proposed model preserves their workflow systems.

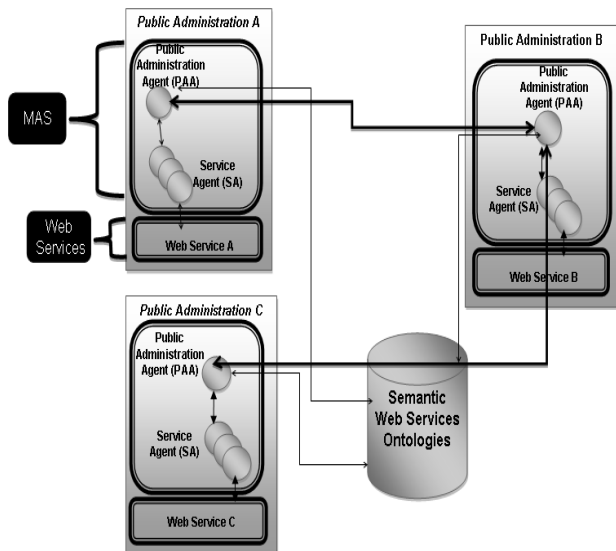


Fig. 2 IOW coordination model

Our model (See Fig. 2) is composed from different services providers responsible for the execution of a service requested by the user and a knowledge base (Semantic Web Services Ontology). Each service provider is a government administration which is composed of two parts: Interface and Web Service.

- **Interface:** a set of Intelligent Agents that constitute a Multi-Agent System (MAS)

The MAS in each government administration (public administration) is composed of two types of agents: (1) Public Administration Agent (PAA) and (2) Service Agent (SA).

- 1) **Public Administration Agent (PAA):** it presents the administration and has the role of ensuring the communication with other administrations. It has also the role of service discovering using ontology.

To fulfill its assigned task successfully, PAA has access to the Semantic Web Services Ontology. This one contains the semantically enhanced description of WS.

- 2) **Service Agent (SA):** It's responsible for interfacing between a WS and the agents. It has the role of invocation of the correspondent web service.

- **Web services (WS)** representing services offered by the government administration. Public administrations are service providers that develop and modify their services. In general, it is the service providers who are responsible for implementing the services they aim to offer.

Detailed Description

To describe the functionalities of the model, we used a general case where the execution of a demanded service by a citizen needs the coordination of just two Public Administrations: Public Administration 1 (PA1) and Public Administration 2 (PA2). We also suppose that each public

administration provides only two web services (See Fig. 3). We mention that the model is not concerned by the user interface.

The first PA (PA1) responsible for the execution of the service is acting as below:

PAA1 discovers the service in the ontology. Two scenarios can occur:

- **Scenario 1:** The agent PAA1 finds the service; it will be executed by the administration. PAA1 sends the service to the corresponded SA responsible for the invocation of the service.

- **Scenario 2:** The agent PAA1 can't find the service in the ontology. This implies that no single, atomic service exists. So, it is a composed service that needs a composition stage.

After composition of the service, PAA1 searches the sub-services in the ontology. Then, the system sequentially executes them and collects the results in this manner: (We suppose that the sub-services founded are (S11 and S22))

1) PAA1 sends the sub-service (S11) concerned with the administration 1 to the SA responsible for its execution (SA11). The SA11 invokes its corresponded Web service (WS11) and returns the result to the PAA1.

2) PAA1 sends the rest of the sub-services (S22) to others administrations (PA2) concerned with their execution. In the example, PAA1 sends the requested sub-service to PAA2. This one repeated the discovering service stage. It found the sub-service S22 in the ontology and sends it to the correspondent Service Agent SA22. Finally, SA22 invokes its correspondent WS22.

In a more complex example, the sub-service sent to PA2 can be a composite one. In this case, the execution of the service requires the interaction with others PAs as shown in Fig. 3.

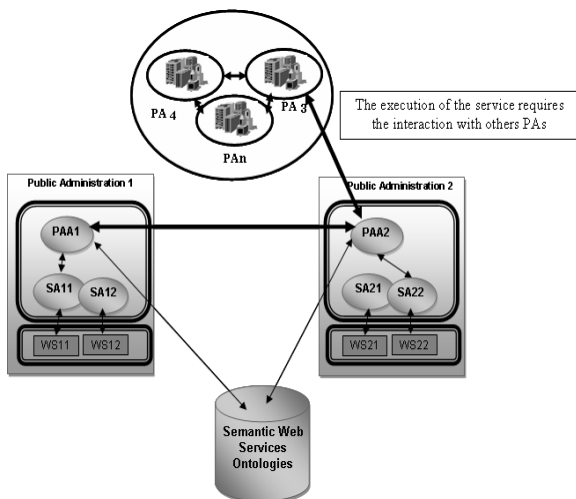


Fig. 3 IOW coordination model Example

VI. CASE STUDY AND FIRST EXPERIMENTAL RESULTS

The case study we used concerns the process of creating an electronic identity card in Tunisia. It's a part of a Tunisian

government project S2EG (Secure System for E-Government). The aim of the project is to develop a secure government architecture that includes authentication, certification, access control, privacy and development of secure applications based on application reuse and coordination of administrations services by the use of an IOW coordination model (this is the part of our work).

The process of creating an electronic identity card is an inter-organizational process involving four government administrations: Municipality, Police Station, Court and Work (or school). We mention that the demand of the electronic card service including the interaction between the citizen and the system is not our concern.

To create an identity card, the citizen has to offer different documents to the police station: Birth certificate from the municipality, address certificate from police station, nationality certificate from court, working certificate from the work if he is a worker or presence certificate from the school if he is a student.

For this purpose, we develop five services. Each of them represents government administration:

- Birth certificate Service for municipality
- Address certificate Service for police station
- Nationality certificate Service for court
- Working certificate Service for work (if the citizen is a worker) or presence certificate for school (if the citizen is a student)
- Blood group service for health ministry

We represent government administrations involved in this process by a set of agents. Each agent (Public administration Agent) represents the interface of communication with other administration. So, we develop the interaction of inter-organizational agents.

To create an identity card (see Fig. 3), the ministry agent (after receiving the demand of the identity card creation from the citizen) sends requests including the identifier of the citizen to the different PAAs of the public administrations concerned with the process: municipality, police station, court, work or school and health ministry. Since we have just one service for each public administration, we assign the role of the SA to the PAA. In fact, the PAA of each public Administration invokes the corresponded Web service. Then, each PAA sends the result (object) to the ministry agent. After receiving all the objects (birth object, Address object, Nationality object, working object and Blood group object), the ministry agent creates the identity card.

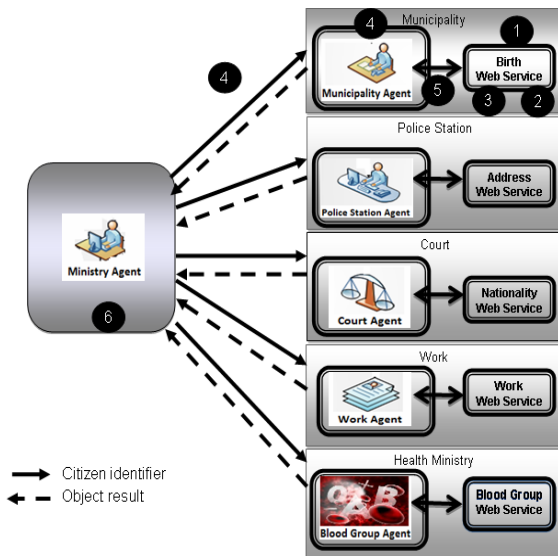


Fig. 4 Electronic identity card creation scenario

Our IOW coordination model is implemented using Eclipse IDE 3.2 for creation of java applications. It is Considered to be the best Java development tool available and we use J2EE (platform of java applications development) for the development of the five services using the plug-in Spring Web services.

The implementation steps are presented in Fig. 4:

1. Services implementation using the plug-in Spring of J2EE
2. Exposition of Web Services using Spring Web Service and generate of WSDL
3. Create the client part to be used for the invocation of web services
4. Creation of agents and communication between agents (FIPA-ACL messages)
5. Invocation of web services by PAAs through client services
6. Identity card creation

What we have developed is a part of the whole implementation. We have to complete the semantic description of services, creation of the ontology, publication of these services in the ontology and discovering services by PAA.

The scenario presented shows promising benefits of the proposed IOW coordination model for e-government field. It's easier, cheaper, and simple. It also represents the real distributed Inter-organizational system.

VII. CONCLUSIONS AND FUTURE WORKS

In this paper, we proposed a new Inter-Organizational Workflow model applied in e-government field. This model enabled us to create a framework for e-government processes that respects the distribution criterion of government administrations. Therefore, to execute a government process, the collaboration between government administrations is based on interfaces communication. So, it's not necessary to pass through a middleware. Moreover, the proposed model

enhanced the coordination between these administrations with respecting their autonomy, privacy, distribution and flexibility. For this purpose, Multi-Agent approach was adopted to deal more easily with e-government IO characteristics. As a key issue in the development of current e-government services, interoperability was taken into account as technical and semantic issue. The Web Services (WS) and Semantic Web Services (SWS) were technological solutions adopted for interoperability. In fact, the model has the potential benefit of the use of main ingredients: ontology, WS and IA technologies.

Government projects are costly ones especially applied in developing countries where government entities are not equipped with workflow systems. The use of our approach can facilitate the migration for an e-government solution with lower cost (cost of rebuilding entail government administrations IT infrastructure).

The presented case study is a simple one. It doesn't take care of all the model's functionalities. First and for the same case study, we emphasize to add semantic descriptions to services and create the semantic Web Services ontology using OWL-S. Second, we publish these services through the created ontology. Then we develop service discovering by agents and services composition when an administration agent discovers a composite service. This case is presented in another case study more complex (Fig. 3).

Finally, our model can deal with the constraints of the dynamic environment in which the inter-organizational collaborations evolve in e-government. This is not shown in the presented case study what takes us to highlight the role of the agents to adapt itself further to a change of environment.

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REFERENCES

- [1] D. Lin, H. Sheng, T. Ishida, "Interorganizational Workflow Execution Based on Process Agents and ECA Rules," IEICE Transactions 90-D (9), pp.1335-1342, 2007.
- [2] L. Bouzguenda, E. Andonoff, C. Hanachi, W. Bouaziz, "An Agent-Based Model for Autonomic Coordination of Inter-Organizational Business Processes," Informatica, Lith. Acad. Sci. 20(3), pp.323-342, 2009.
- [3] R. Heeks "eGovernment for development: Success and failure rates of eGovernment in developing/ transitional countries," Overview. IDBM University of manchester, UK, 2003.
- [4] M. Shen, D. Liu, "Coordinating Interorganizational Workflows Based on Process-Views," DEXA, pp. 274-283 (2001).
- [5] I. Chebbi, C. Dustdar, S. Tata, "The view-based approach to dynamic inter-organizational workflow cooperation," Data and Knowledge Engineering, 56(2), pp.139-173, 2006.
- [6] M. Divitini, C. Hanachi, C. Sibertin-Blanc, A. Omicini, F. Zambonelli, M. Klusch, R. Tolksdorf (Eds.), Inter-Organizational Workflow for Enterprise Coordination, Coordination of Internet Agents, Models, Technologies and Applications. Coordination of Internet Agents, Springer-Verlag, pp. 46-77, 2001.
- [7] P. Grefen, K. Aberer, H. Ludwig, Y. Hoffner, "CrossFlow: Cross-Organizational Workflow Management for Service Outsourcing in Dynamic Virtual Enterprises," Data Engineering Bulletin, Vol. 24, No. 1, IEEE, pp. 52-57, 2001.
- [8] P. Rittgen, "Negotiating and Enacting Contracts for Business Networks," Journal of the Brazilian Computer Society, pp. 7-26, ISSN, 0104-6500, 2007.

- [9] H. Lopes Cardoso, P. Leitão, E. Oliveira, "An approach to inter-organizational workflow management in an electronic institution," 11th IFAC Symposium conference on Information Control Problems in Manufacturing - INCOM 2004, pp. 429-434, 2006.
- [10] A. Rabaiah, E. Vandijk, "Federation of E-government: A Model and Framework," Information Systems Control Journal, Vol.4, 2007.
- [11] D.K. Punia, K.B.C. Saxena, "Managing inter-organisational Workflows In eGovernment services," In: Proc. 6th Int. Conf. on Electronic Commerce. ACM Press, pp.500-505, 2004.
- [12] Y. Verginadis, G. Mentzas, "Agents and workflow engines for inter-organizational workflows in e-government cases," Business Process Management Journal, Vol. 14, No. 2, pp.188-203, 2008.
- [13] D. Beer, , S. Höhne, , H. Petersohn, , T. Pöhnitzsch, , G. Rünger, , M. Voigt "Designing a Distributed Workflow System for E-Government," In: Hamza, M. H. (Hrsg.): Proc. of the 24th IASTED International Conference on Modelling, Identification, and Control (CD-ROM), S. 583-588. ACTA Press – ISBN 0-88986-474-8. Innsbruck, Austria 2005.
- [14] M. Ansari, M.A. Usman, M.Z.A. Nadeem, S. Raza, "Multi-agent Based Semantic E-government Web Service Architecture Using Extended WSDL," IAT Workshops, pp. 599-604, 2006.
- [15] H. Zhu, F. Su, "An Integrated Model in E-Government Based on Semantic Web, Web Service and Intelligent Agent," IEEE (2), pp.96-10, 2007.
- [16] A. Gugliotta, L. Cabral, J. Domingue, V. Roberto, "A semantic web service-based architecture for the interoperability of e-Government services," Proceeding of the International Workshop on Web Information Systems Modeling, Sydney, Australia, 2005.
- [17] U. Marjit, A. Sarkar, S. Santra, U. Biswas, "A Semantic Approach to Web Services for Interoperability and Integration of E-Services in Service-Oriented Architecture based E-Governance System," ISCET, 2010.
- [18] F.G. Sánchez, L.A. Sabucedo, R. Martínez-Béjar, L.A. Rifón, R.V. Gacia, J. M. Gómez, "Applying intelligent agents and semantic web services in eGovernment environments," Expert Systems 28(5), pp.416-436, 2011.
- [19] A. Berrais, "Modèles de coordination multi-agents pour le workflow interorganisationnel: Application à l'e-gouvernement," Master thesis, 2008.
- [20] T. Berners-Lee, J. Hendler, O. Lassila, "The semantic web," Scientific American, vol. 2, pp.34-43, 2001.
- [21] A. Omicini, A. Ricci, N. Zaghini, "Linkable Coordination Artifacts for Inter-Organisational Workflow," 1st International Workshop on Coordination of Inter-Organizational Workflow: Agent and Semantic Web based Models, CIOW, 2006.
- [22] L. Bouzguenda, Andonoff, E. C. Hanachi, C. Sibertin-Blanc, "Une Architecture et un Modèle Organisationnel Orientés Agent pour le Workflow Inter-Organisationnel Lâche," XX IIème Congrès INFORSID 04, Biarritz-France, 26/05/04-28/05/04, Inforsid, Les Bastidonne-13122 Ventabren, pp. 461-479, 2004.
- [23] P. Fremantle, S. Weerawarana, R. Khalaf, "Enterprise services," Commun, ACM 45(10), pp.77 82, 2002.
- [24] S. Muthaiyah, L. Kerschberg, "Achieving interoperability in e-government services with two modes of semantic bridging: SRS and SWRL," Journal of Theoretical and Applied Electronic Commerce Research, vol 3, pp.52-63, 2008.
- [25] S. McIlraith, T.C. Son, H. Zeng, "Semantic web services. IEEE Intelligent Systems," Vol 16, pp.46-53, 2001.
- [26] O. Shafiq, M. Moran, E. Cimpian, A. Mocan, M. Zaremba, D. Fensel, "Investigating semantic web service execution environments: a comparison between WSMX and OWL-S tools," In: Proceedings of the 2nd International Conference on Internet and Web Applications and Services (ICIW), Morne, Mauritius, p. 31, 2007.
- [27] J. Domingue, L. Cabral, S. Galizia, V. Tanasescu, A. Gugliotta, B. Norton, C. Pedrinaci, " IRS-III: a broker-based approach to semantic web services," Journal of Web Semantics, Vol 6, pp.109-132, 2008.
- [28] M. Wooldridge, N.R. Jennings, "Intelligent agents: theory and practice," The Knowledge Engineering Review, vol.10, pp.115-152, 1995.
- [29] WfMC: Workflow Management Coalition, Terminology & Glossary. www.wfmc.org, Document Number WfMC-TC-1011, Document Status - Issue 3.0, 1999.
- [30] O.A. Prisecaru, "A Petri Net based Approach to Modelling Resource Constrained Interorganizational Workflows," MSVVEIS, pp.29-38, 2008.
- [31] W.M.P. Van Der Aalst, "Process-oriented architectures for electronic commerce and interorganizational workflow," Information systems, Vol.24 (9), pp. 639-671, 1999.
- [32] D. Hollingsworth, "Workflow Management Coalition- The Workflow Reference Model", 1995.