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Semantic Web Technologies in e - Government

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***Abstract*—**e-Government is already in its second decade. Prerequisite for further development and adaptation to new realities is the optimal management of administrative information and knowledge production by those involved, i.e. the public sector, citizens and businesses. Nowadays, the amount of information displayed or distributed on the Internet has reached enormous dimensions, resulting in serious difficulties when extracting and managing knowledge. The semantic web is expected to play an important role in solving this problem and the technologies that support it. In this article, we address some relevant issues.

***Keywords*—** e-Government, semantic web, ontologies

I. Introduction

THE progress made in recent years in e-Government is significant, even though an initial stage passed during which the e-Government was regarded as equivalent to building infrastructure and networking for the public sector. Afterwards, specific strategic documents, international initiatives and projects, either completed or are still "running" in countries with corresponding policies, aim at making public administration more efficient and more competitive. As a result of the above, nowadays, the huge amount of electronic public services and information produced are difficult to exploit because of their inconsistent development. Coping with this problem requires an emphasis on innovation, advanced technology and knowledge management systems. In this context, the authors of this paper research the possibilities of the Semantic Web and the technologies that support it, as an extension of the existing Internet. The Semantic Web is expected to provide effective solutions concerning a better exploitation of the information offered as well as producing and managing knowledge in the field of e-Government.

The paper is organized as follows: In Section II, we review previous related works on the problem of seeking information in the e-government domain. In the Section III, the Semantic Web, while the technologies that support it are outlined in Section IV. In Section V, we introduce an ontology for e-government within the Greek Public Administration. Finally, conclusions are drawn and future work is proposed in Section VI.

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II. Previous Related Work

In [1], the authors discuss issues concerning the semantic web as a solution for the local e-government and the design of ontologies for e-Government in Protégé as well the development of semantic search algorithm. In [2], the author proposes a novel ontology development methodology for the construction of light-weight e-Government domain ontologies by bringing ontology modeling closer to domain experts. The authors in [3] introduce an activity-based approach for the development and use of e-Government service ontologies. In [4], the authors present a Slight Ontology Framework in order to solve the problem of change management that requires the development of e-Government. A case study of an ontology in the e-government domain is included in [5] and a review of the state of the art as well as the terminology for e-Government ontologies can be found in [6] and [7]. The capture of the workflow knowledge in e-Government domain within an ontology knowledge framework is shown in [11]. All the previous are also related to knowledge which can be produced from the data available to government agencies and knowledge-based systems according to [12].

An overview of the Semantic Web and the technologies that support it is presented in report [13], and, in addition, its potential in e-Government is outlined in [14], [15] and [16].

Nowadays, the comparative advantage an organization or a business can have is the production or acquisition of knowledge through the enormous amount of information kept or managed. As mentioned, the internet through the basic operation of the free movement of information has proved to be a key tool in search and expansion of information in all fields: scientific, business, government, etc. The huge amount of information handled daily is supported by several advanced software applications that search, collect, store, and, finally, process knowledge.

Unlike information, knowledge production has not yet been automated so as to be fully supported by machines (computer systems) and rely on human intellect and effort. Existing technologies, support the user in searching for information via the Internet with specific tools such as search engines, but then this is the determining factor in its further processing. Search engines, which appear as the most frequently chosen means to find information online, operate on a keyword or phrase, showing links to any records that meet the standards set by the user. However, search engines offer no semantic control of the subject. Most of the times, millions of links are returned, but obviously their majority are not desired by the user. This process has proved to be inefficient, since the information that the user has to process is extensive in size and variety. The time and energy required by the user make the production of knowledge through the Internet a difficult task.

Efforts in recent years have focused on the automated production of knowledge concerning the so-called "metadata". The metadata, which practically is "information about information," aimed at supporting an intelligent way of searching for information online.

In particular, the situation concerning the procedure of searching information on the Internet, is currently described as follows:

- Little or no results. When a user searches for specific information based on a specific keyword or phrase in a strictly specified field or looking for media files or a specific piece of text within a text, then the phenomenon is observed of minimum and, in many cases, no results. Many machines are complementary, giving results that may fit the needs of the user. But such cases, make the whole search more difficult, returning mostly useless information.
- Many or excessive results. In most cases, the returned, hypothetically "relevant" links include thousands or millions of references, making their effective control practically impossible.
- Conceptual approach to search. Until now, search engines perform simple lexical analysis based on search strings and produce result lists that require their human users to draw conclusions on the suitability of the data for the subject area being investigated. Thus, a logical analysis is needed by the user to select the relevant findings. Often, Web page manufacturers, using the logic of the lexical analysis, introduce common words in the "metadata" sector so that their sites occupy high positions in the list returned by search engines. This, however, often leads to conceptual confusion, since many words have ambiguous meaning and are being used several times incorrectly. This leads to inappropriate website recall from search engines. The best example is the word "sex" which, apart from identification of "sexual act" is used to determine the "sex" to "male" or "female." The search engines use the key "sex" recall a few hundred million pages of content on the first version and a minimum content of the second. This is because the sites do not contain enough information about the semantics of their contents and the user's software cannot draw conclusions from the content page.
- Poor results. Sometimes, the results of keyword search are insufficient to meet the user needs and, thus, the user has to make additional searches under different conditions/restrictions and then combine the results with those collected earlier on.

From the previous, it is clear that although the search for information is adequately supported by existing information technology solutions, the process may be problematic when searching for information aiming at knowledge production and acquisition of comparative advantage. All involved in this process, are waiting for developments propelled by the so-called "Semantic Web" which is presented not as a replacement for the existing internet, but rather as its extension.

III. Semantic Web

The Semantic Web is an initiative that aims at creating a universal medium for exchanging information based on sense-meaning (or semantics) of the contents of documents on the Web, in a manner understandable by the computers. The goal is to enable the automated production of knowledge by the existing information [3]. Under the guidance of Tim Berners-Lee of the World Wide Web Consortium (W3C), the Semantic Web extends the capabilities of the World Wide Web through the use of standards, mark-up language and related processing tools. Specifically in 2001, Tim Berners-Lee stated that "The Semantic Web is an extension of the current Web, which is a well-defined meaning to information, enabling computers and people to cooperate better" [21].

The Semantic Web provides a common framework that allows data to be shared and reused across the boundaries of an application, an enterprise or a community, with particular interest in both businesses and national administrations. It is a collaborative effort led by the W3C1 with participation of a large number of researchers and industrial partners. The Semantic Web is based on the Resource Description Framework (RDF), which incorporates a variety of applications using XML for syntax and URIs for naming [22].

The current design of the Internet is anthropocentric, meaning that the bulk of Web content today is designed to be read by humans. It is based on documents written mainly in the environment of HTML, which is used to describe a structured text with emphasis on the visual display while showing limited abilities regarding the classification of blocks of text on a page. So far, computers can, efficiently analyze web pages for the occurrence and routines, but they generally do not have a reliable way to process semantics of their contents.

The semantic web is expected to contribute to the smart access and manage information moving online through new technologies and develop corresponding new applications. The overall vision seeks to make the transition from the existing web of static pages into a dynamic network of providers of services (Web services) which automatically discover information, trade for goods that the user intends to purchase or gather information from different sources and unite them in homogeneous forms with the ultimate goal of sharing and interaction with other systems based on a "common language".

Semantic integration of the net is expected to give another quality boost to the existing infrastructure in various sectors such as e-governance, e-commerce, distance e-learning etc. with substantial support communication between different systems (interoperability) as well as saving time and energy to finding, sorting and processing of information.

In particular, as far as e-governance is concerned, the development of the semantic web is expected to lead to improvements in both parts of the entire system, the so-called "front-office" and "back-office":

- Regarding the citizens' service, the search of services will be greatly facilitated through both electronic government portals (developing semantic portals) and the physical presence at point of service (within functioning of one-stop shops). The search for the appropriate service from the same institution can be more effective and efficient.
- Regarding the back-office, seeking stakeholders and sharing information on common terminology and semantics will improve both the time of internal delivery of items and the overall performance of the state service, as when all government systems "speak" the same language any sharing problems can be solved more easily.

Regarding the online learning infrastructure, improvements are being expected in the functioning of two main pillars of e-learning [25]:

- Web-based education: by the creation of appropriate ontologies that will be accessible, scalable and exportable by all the participants (universities, students, etc.). The representation of knowledge with this philosophy can consolidate educational resources and form the basis of a content repository where the educational material will be presented to the learner through a suitable electronic educational system .
- Managing the educational data itself: management information systems in education record data concerning students and teachers, basing knowledge representation, each on its own philosophy. The XML as intermediate language, as many commercial database management systems support it, can be exploited to receive data from all individual information systems and merge them so that management information systems in education with information about those involved in educational process could cooperate with electronic educational system, which makes it possible to personalize educational teaching [25].

A. The levels of the Semantic Web

According to the inspirer of the Semantic Web Tim Berners-Lee, the semantic web comprises a series of levels, in terms of technological levels of functionality. The stratification of the necessary technology to support the semantic web according to W3C is broken down into 7 levels:

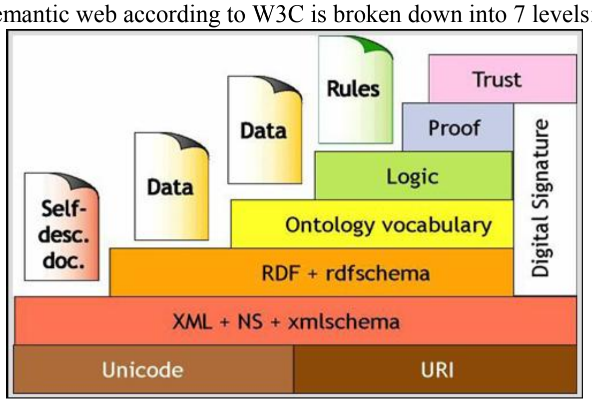

Fig. 1 Stratification of Semantic Web technologies

1st level: The HTTP protocol used in the existing network is the foundation to transfer the data for the semantic web as well, while URIs (Universal Resource Indicators) support the classification, and Unicode coding universal access.

2nd level: At the next fundamental level XML language (Extensible Markup Language) has an important role which allows writing structured documents with the vocabulary defined by the user.

3rd level: The third level is based on the model of RDF. This model is based on XML and through the RDF Schema (which is based on RDF) design principles are offered for the classification of the web objects into hierarchies . Basic concepts used are classes, properties, relations between subclasses and subproperties and limitations of the areas and lines.

4th level: At this level a common representation of ontologies is needed , so that the terms used in the data level will be defined and related to each other (RDFS, DAML+OIL,OWL).

5th level : At this level, automated reasoning and conclusion are supported through logic, based on the information structured in an ontology. It also becomes possible and powerful by using standard rules of the "pseudo" intelligent decision-making process of calculating machines.

6th level: At the level of proof, the results inferred from data in the semantic web, can lead back to the initial case . For example if someone sends to a page named A the evidence that he can use it, then the page should be able to check and verify the existence of this evidence.

7th level: At the level of confidence in conjunction with the technology of digital signatures (already being materialized) the extent to which the information is handled, processed and inferred the semantic web is reliable, is ensured by an automated manner.

IV. The Technologies Used In The Semantic Web

A prerequisite for the functioning of the Semantic Web, is the access of computer systems in structured collections of information and sets of logical rules that can be used to conduct automated conclusions. So we talk about the "representation of knowledge", a thematic concern in recent years in the field of Artificial Intelligence.

Among the technologies used by the Semantic Web are the following:

- the URIs (Universal Resource Identifier): strings that uniquely identify an entity (a Web site, a property, a man, a thing, etc.)
- mark-up language XML (Extended Markup Language): allowing users to add arbitrary structure to their documents, without specifying the semantics of this structure
- Technology RDF (Resource Description Framework): used for data representation and exchange knowledge online
- Technology OWL: used for creating and distributing ontologies, supporting advanced Web search, software

agents and knowledge management.

Each of these technologies is based on those mentioned before. For example RDF is based on XML and uses URIs. These technologies combine to provide descriptions that supplement or replace the contents of documents on the Web, as will be seen below. These are recognized by the machine descriptions, allowing the addition of meaningful content, thereby facilitating the automatic search of information from computers. The meaning of the content expressed by RDF, which encodes sets of triples , which represent "the subject, verb and object of a sentence". These triples can be written in XML. An RDF document states that some entities (web pages, people or things) have some properties with specific values (eg X factor is necessary for the document Y). This mode of representation can express most of the data that computers understand. The subject, verb and object are identified by a URI, just like at websites. So everyone can add a new entity or a new property.

A fundamental component of the Semantic Web are the ontologies. Ontologies define concepts and relationships of concepts to a field in a formal way. They contain definitions of classes of objects and relations between classes and export rules of logical conclusions. Through ontologies it is possible to combine data from different sources, which share the same ontology. Yet solved problems of terminology and the meaning of the terms that appear on a page can be defined by pointers to the ontology. Ontologies can enhance the functioning of the Web by increasing the accuracy of information searches, since the information referred only to a specific concept rather than a keyword is being asked. They can also be used to link an information site with corresponding structures of knowledge and logical rules. Shared ontologies help to exchange data between different meanings and web-based services.

There are many automated web-based services that do not use semantics, but other programs (such as software agents) can not identify such a service for a specific function by themselves . This can only happen when there is a common language for describing services provided in a network so that different agents can advertise their services in a yellow pages service.

Having identified the desired agent, the two communicating software agents can understand each other by exchanging ontologies. The Semantic Web provides this flexibility. Discovering new ontologies are software agents obtain new opportunities for the extraction of logical conclusions.

The unifying logical language of the Semantic Web makes it possible to unite the concepts that anyone may designate (through a URI) to a universal Web. Thus, software agents will be able to analyze semantic knowledge of people by providing a new form of useful tools.

A. Metadata

Metadata so-called data about data (or information about information for many) are a fundamental concept in creating the semantic web. Metadata is information describing a data set and an effective solution to the growing increase in the volume of information moving online.

Metadata serve the user in two ways [24]. First are the means through which to determine a specific set of data and also to record the content, quality and characteristics of a dataset to allow the validation of the user without the need for access to the same data.

However, the increase of given information and their diversity leads to an increase of metadata to describe them. This dictates the need for evolution and the specific format of the metadata. So the W3C has proposed the division of metadata in three areas:

- The first zone includes the relatively unstructured data, which practically are posted automatically from the data sources. These data, show low clarification semantics, do not support research by field and do not allow the user to have an objective assessment before recovering the information.
- The second zone includes data containing a level of description such that the user is able to evaluate the usefulness of the information source without requiring connection to the source.
- The third zone includes descriptive higher-level formatting, which can be used for positioning and finding, but having a role in the description of objects.

Three key elements are necessary for the effective use of metadata:

- Semantic elements: means a set of perceived common terms to describe the content of information sources
- Syntactic elements: a common means recognized standard syntax for connecting to terms with meaningful proposals metadata
- Interoperable elements: means a framework that allows the exchange and recombination of proposals metadata between different applications and objects.

B. Agents

The concept of agents, means programs that autonomously perform some function, often without the direct supervision of the user, and shall become effective after such operations. These programs typically perform web browsing, process the information they find and are already used for functions of finding, sorting and selecting data.

The main features are recorded as follows:

- Autonomy. Their behavior is based on the objectives, not necessarily on the external to the system events that cause it.
- Collaborative behavior. An agent can cooperate with another to achieve the common goal.
- Reactivity. An agent can perceive events in its environment and react accordingly.
- Communication based on knowledge. An agent can communicate with others using a language of communication and not using common protocols or standards.

- Ability to draw conclusions. Mention the possibility of energy operator with the abstract description of a data problem.
- Mobility. An agent can act independently of the platform.
- Personality. An agent has the characteristics of human nature.
- Adaptability. Increasing experience of the agent leads to learning and improving its capabilities.

Relevant to the agent program capabilities there are also mentioned the "intelligent agents". This means programs that exhibit some form of artificial intelligence and having the capability of learning based on experience and data they can make decisions. The Semantic Web technologies will lead to increasing both the number and capabilities of agents and intelligent agents will change the way of navigation and collection of data with the help of ontologies.

C. Web Services

According to the definition formulated by the research team of the W3C Web Services, Web-based services are defined as a resource - not necessarily through the web, but also in the local intranet of an organization. It is particularly mentioned : "A web service is a software application, which is identified by a URI, whose interfaces and connections can be established to describe and identify the basis of XML, and supports direct interaction with other software applications using messages based on XML, through web-based protocols.

The basic principle of online services is their materialization by focusing on interfaces, the contact point between the service itself and the software asks. The innovative element of these services to the existence of many independent entities that communicate with others based on open standards and not strictly linked.

The functions that can be obtained from the web services are:

- Automatic service discovery. Obviously the automatic identification of services that cover the limitations set by the user.
- Automatic web services call. Until now, most services require human intervention during their execution, where the user makes various choises for the desired result. In the case of automatic execution of a web service, the user will formulate the question - a request and the smart agent will activate all the necessary procedures automatically. For example, it will send tax number and bank account number in order to complete the process of tax settlement using information deriving from the user’s smart card.
- Automatic service composition. By introducing a set of services a new service can be created to achieve a goal, not covered by the original services. This can happen if the requirements and results of each service with a specific methodology have been described. For example in the case of the automatic debit , sub-services appear such as "check account balance", "charged amount", "inform".
- Automatic services implementation observation. In the case where services are 'run' for a long time, it is useful to provide information on the stage of service at any time.

The online services, find application in addition to scientific applications in e-governance and e-commerce. The architecture is based on:

- exchanging messages using the protocol SOAP, which leads to the construction of structured packages of data exchanged via applications
- the description of web services with WSDL, (an extension of XML) which provides a description of the protocol, services and structure of messages exchanged. Also contains all the necessary information for using the service.

Publication of descriptions about their discovery and use. The storage of information in UDDI registers, leads to the creation of online catalog information, giving the user the opportunity to discover a service and to communicate with it through a SOAP message.

The next step in these services is the "Semantic Web Services" which will also contain semantic information in order to fully describe their harmonious integration into the semantic web. In this way the search for such services will become more efficient and what automated.

D. Ontologies

The word "ontology" comes from philosophy, of which it consists a sector , which deals with the nature and organization of reality. In computer science, ontologies aim to capture the knowledge of a field of interest in a basic way and provide a commonly accepted perception of the field, which can be reused and shared between applications and groups. Ontologies provide a common vocabulary and set a field with different levels of quality, the meaning of terms and relations between them [26].

Ontologies can also be defined as descriptions of concepts and relationships that may exist for an agent or a community of agents. Ontologies can also be regarded as an essential technology for supporting intelligent search, since both allow computers to understand as they involve formal semantics and the other is simultaneously perceived by humans. According to W3C, the ontology describing the terms used to describe and represent a knowledge base defining :

- Classes that are general concepts of the field of interest
- Relationships that may exist between classes and
- Qualities or characteristics that may be.

Ontologies are a dynamic field, which initially was investigated by scientists in artificial intelligence since the early 90s, engineering knowledge, natural language processing and representation of knowledge. More recently the concept of ontology is spread in areas such as intelligent information integration, cooperative information systems, information retrieval, electronic commerce and knowledge management. The reason they are so popular is because they promise a "Shared and common understanding of a field that can commune between people and applications. Because they aim at a consensual knowledge of the field development is a cooperative process of different people from different background and location.

As already mentioned, ontologies were associated with the development of semantic web and have proven particularly useful in further development. This happened without the necessary infrastructure already existing, in terms of methodology, by the field of knowledge representation. These structured depictions or models of known and accepted facts are structured today to make a number of applications more capable of managing complex disparate information. They become more effective when the semantic distinctions that humans take for granted, is critical for the purposes of the application. This may mean management of common sense lurking in extracts of natural language, or experience that was deposited in specific languages and work deposits [26].

The examples of ontologies usage include various areas such as: research in the semantic network, creating medical directives for health patients, mapping the names of animals and plants, search for specific sources of public information, collaborative planning organization, in-depth safety analysis and automatic exchange of electronic information between trading partners. The ontologies on the Web (World Wide Web) are used by websites to classify sites like Yahoo and Google, and for different classifications of products for sale, according to their characteristics at various online stores like Amazon. com, etc.

The development of ontologies for concepts relating to government agencies and in the further development of e-Government, offers significant advantages. First in-house gives a formalism to represent information and knowledge about the structure and distribution and secondly enables external applications to reuse the data kept in achieving maximum interoperability, thus offering high quality services to citizens and other organizations.

1. Types Of Ontologies – Classification

At times there has been a development of different classification systems for ontologies. A classification system based on the issue of arrest has been proposed by Guarino in 1998 [7]. Guarino proposes the development of different types of ontologies according to their level of generality as shown below.

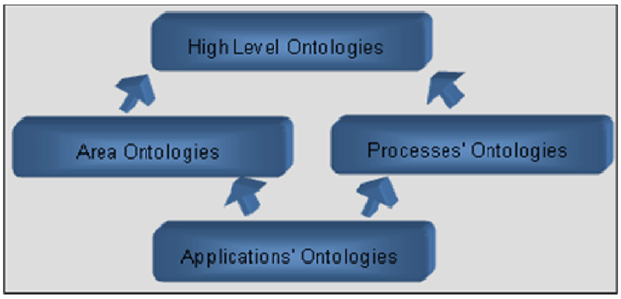

Fig. 2 Ontology categories

- The high-level ontologies are used to describe very general concepts such as space, time or an event which are independent of a particular problem or domain.
- Area Ontologies describe the vocabulary of a specific area each time specifying the terms of the ontology of the previous level.
- Processes' ontologies are used to describe the vocabulary related to a specific elementary task or activity also specifying the concepts of high-level ontologies.
- Applications' ontologies are the most specific ontologies. The concepts described correspond to the roles played by entities sectors performing a certain activity.

According to Gomez-Perez and Benjamins (1999) Ontologies are classified as follows [27] :

- Knowledge representation ontologies: entities provide representation without specifying what these represent.
- General or common ontologies : intended to capture general knowledge around the world, providing basic concepts such as time, space, events, etc.
- Top-level ontologies: provide general concepts under which correlate all the terms in existing ontologies
- Metadata ontologies: provide a vocabulary for describing the content information, which is available electronically.
- Domain ontologies : representing knowledge about a particular field, eg medicine etc.
- Method or task ontologies: provide terms referring to specific tasks, eg diagnosis, etc.

An ontology, according to the degree of formality of its representation, can be :

- Highly informal, that is expressed in a natural language.
- Semi-informal, for example, expressed in a limited and structured subset of natural languages.
- Semi-formal , formulated in an artificial and strictly defined language.
- Rigorously formal: definitions of terms in strict semantics, theorems and proofs of claims.

2. Ontology Representation Languages

Ontologies are usually expressed in a language based on logic (logic-based language), so there can be detailed, accurate, consistent, fair, and expressive distinctions between classes, properties, and relationships. Some ontology tools can automatically perform reasoning using ontologies, and thus provide advanced services to intelligent applications such as: conceptual / semantic search and recovery engines , software agents, decision support engines , speech and natural language understanding engines, knowledge management engines, intelligent databases, and e-commerce engines.

The use of ontologies is the emerging Semantic Web in a way to represent the semantics of documents to be used by web applications and intelligent agents. The architecture of the Semantic Web consists of the following three levels [2]:
1. The metadata layer : The data model at this level must include the concepts of resources and properties. The language of RDF (Resource Description Framework) is the predominant data model for this level.
2. The schema layer : In this level ontology languages that provide hierarchical descriptions of concepts and properties are introduced to the web. The RDFS (Resource Description Framework Schema) is the preferred candidate schema for this

level.
3. The logical layer : Consisting of more powerful ontologies languages. These languages offer a greater set of configuration files that can be mapped to known expressive description logic. Here OIL (Ontology Inference Layer, 2000) and DAML-OIL (Darpa Agent Markup Language-Ontology Inference Layer, 2001) were the two prevalent languages. Now the W3C proposes OWL Web Ontology Language as the official ontologies language.

General Ontology representation languages could be divided into three categories [7]:
1. Traditional languages. Predicate logic first order (cf. Prolog), Logical frameworks (Frame-based logic), Descriptive logic (Description logic)
2. Web-based languages. Their syntax is based on XML
3. Languages were developed to represent specific ontologies and use in specific applications. Examples: CycL, GRAIL, NKRL

The most common ontologies representation languages are Web-based languages and some of them are, Simple HTML ontology extensions (SHOE), Ontology exchange language (XOL), Ontology markup language (OML and KML), Resource description Framework schema language (RDFS), DARPA agent markup language (DAML), Ontology interchange language (OIL), Ontology Web Language (OWL) The differentiation and separation of ontology representation languages are based primarily (a) syntax, (b) terminology (eg, Class or concept, Instance or object, Slot or property), (c) the expression, ie something that can be expressed in a language can not be expressed in another, and (d) semantics as the same statement can mean different things in different languages.

Furthermore, an ontology representation language is determined by some design goals that describe the general motives and which result from the study of various actual cases of use. Here are eight design goals for a ontologies language appropriate for the Semantic Web.

1. Reusability of standard ontologies: Ontologies should be publicly available and different data sources must be able to refer to the same ontology.
2. Ability to change the established ontology: An ontology may change during its life. A data source should specify the version (version) of the ontology to which it refers.
3. Ability to correlate established ontologies: Different ontologies can be modeling the same concepts in different ways. The language should provide ways to relate the different representations, allowing the conversion of data to different ontologies, creating an "ontology web".
4. Ability to detect inconsistencies in ontologies and entities (instances) used: Different ontologies or data sources can be contradictory.
5. Balancing expressiveness and capacity to escalate when creating ontologies: the language must be able to express a wide range of knowledge, but also provides efficient tools for logic processing.
6. Avoiding unnecessary complexity which may discourage the widespread adoption of language: The language should be easy to learn and contain clear concepts and meaning.
7. Maintaining compatibility with other standards: The language must be compatible with other standards commonly used in the Web and meet the industry standards.
8. Support for internationalization: The language should support the development of multilingual ontologies, and potentially provide different views of ontologies that are appropriate for different cultures.

V. Ontologies For Public Administration

The figure below shows the hierarchy of the concepts of public administration by using diagrams of the Owl DL. The classes of the first level are subclasses of the original owl: thing, and are as follows:

- Public administration
- Transaction
- Individual

Each of these is a superclass for classes of the next level that are discussed below. The first level classes are abstract concepts quite deductive, since both the administration and the transaction include a lot of other concepts which have to be specialized and analyzed accordingly. Also an individual can be a citizen, or a company through its representative or an employee of the government.

The second level classes are used for an effective presentation of key concepts relating to transactions with the public sector. So this lists the subclasses concerning :

- Public organizations. This means according to their current practice:
  - Ministries
  - Regions
  - Prefectures
  - municipalities
  - the Public Entity supervised by the Ministries
  - Legal Entities of Private Law, supervised by the State
  - Customer Service Centres – One stop shops
- Trade. A transaction takes place in a certain way, concrete elements are required and numerous categories are included.
- Individuals who transact, and have personal data and specific properties.

Examples of third-level headings mention those related to :

- Ministries. By this meaning, a ministry may mean the services that organically belong to it,such as the headquarters, the general secretariats and the various branches or agencies of it.
- Transaction Categories. A transaction with the public can relate to many services desired by citizens such as issuing certificates or business licences or undesired such as penalties from violations or convictions, etc.
- Transaction mode. A citizen or an enterprise, has several opportunities to communicate with the public sector, for example by the physical presence in the building of the public organization or via the Internet (online services

provided), or by fax or by traditional mail, combined with the development level of e-govenrment.

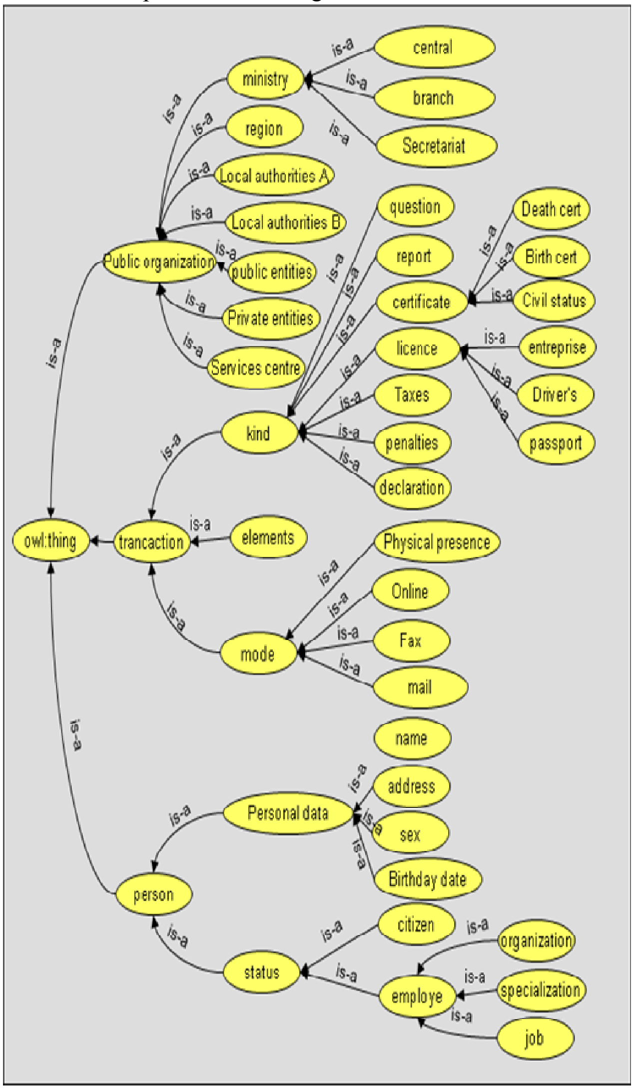

Fig. 3 The ontology of the transaction with the public administration

VI. Conclusions

The Semantic Web undoubtedly is a powerful tool for achieving intelligent use of existing information on the Internet. The application faces problems, associated with the design of websites, the lack of experience on supporting technologies that characterizes users. Also, semantic annotation of information does not particularly seem to concern the manufacturers and owners of commercial or private sites. On the other hand, public sector that has much to gain from its use, has to reform and adopt relevant policies in order to take advantage of the semantic web. In the future we are going to study the ontologies describing the concepts, procedures and work flow in the public sector and also on their implementation in a specific ontology language and their usage on the next level of the semantic web's development.

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