

# The Use of Semantic Technologies in Legal Applications: The IURISERVICE, NEURONA, and ONTOMEDIA Projects

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**Abstract.** This paper describes relevant projects of the Institute of Law and Technology (IDT-UAB) on the area of legal semantic applications based on legal ontologies. It focuses on the description of the IURISERVICE (on-call judicial problems), NEURONA (data protection), and ONTOMEDIA (mediation) projects.

**Keywords:** legal ontologies, NEURONA project, Mediation Core Ontology, OPJK, semantic applications

## 1 Introduction

The increasing need for legal information and content management caused by the growing amount of unstructured (or poorly structured) legal data managed by legal publishing companies, law firms and public administrations or the increasing amount of legal information directly available on the World Wide Web (WWW or Web), there is an urgent need to construct conceptual structures for knowledge representation to share and manage intelligently all this information, whilst making human-machine communication and understanding possible.

The use of semantically-enabled technologies for legal knowledge management could provide legal professionals and citizens with better access to legal information (acts and regulations, judgments, information from other legal bodies, etc.), and improve the conditions in which citizens may participate in public affairs.

Legal ontologies may be the key to implement these new technological advances and to facilitate legal knowledge search, reasoning, and intercommunication.

In this paper, we describe several legal ontologies and semantic-enhanced applications that the Institute of Law and Technology is currently developing.

## **2 The IURISERVICE, NEURONA, and ONTOMEDIA projects**

In this section we will briefly describe the IURISERVICE, NEURONA and, ONTOMEDIA projects, their consortium, objectives, ontologies, and other relevant details.

### **2.1 IURISERVICE: a practical judicial knowledge management application**

The IURISERVICE application was designed to provide Spanish judges in their first appointment with on-line access to an Frequently Asked Questions system, with a repository of practical questions (problems) with their corresponding answers. The aim of the system was to discover the best semantic match between the user's input question in natural language and a stored question. Time and accuracy were critical issues and, to that end, the main research was based on the possibility of modelling the legal knowledge contained in the repository of questions through the use of ontologies. Therefore, the search engine was enhanced with an ontology: the Ontology of Professional Judicial Knowledge (OPJK) and semantic distance calculation. This OPJK ontology has been developed by the Institute of Law and Technology [1,2] and the web-based application was developed by the company iSOCO, both in collaboration with the Judicial Spanish School and the General Council of the Spanish Judiciary (CGPJ).

The need for the IURISERVICE system and its initial design was established as a result of several fieldwork investigations that involved surveys and interviews with judges in their first appointments.<sup>2</sup> During these interviews the judges expressed several problems regarding on-call situations at late hours, which were difficult to consult or comment with others. Therefore, access to a Frequently-Asked Questions (FAQ) repository containing this type of material could be of use, especially during the first months of appointment.

On the one hand, the lists of questions gathered from the interviews provided the input list of questions for the system and, together with the answers by senior judges of the Spanish School of the Judiciary, conformed the repository of the system. On the other, this list of questions provided the input knowledge for the OPJK ontology, which ought to represent the relevant concepts related to the problems that take place during the on-call period, the knowledge contained in the list of questions.

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<sup>2</sup> Detailed information regarding this survey can be found at [3, 4]. Also [5] includes some references to the data. The most up-to-date analysis of the data is contained in [6], although more information regarding the data and the results may be found in [5, 6].

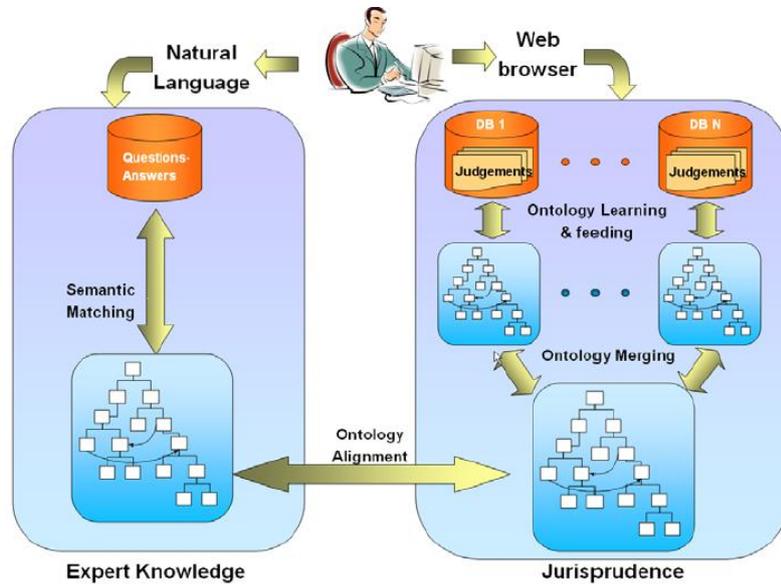


Fig. 1. A screenshot of the IURISERVICE architecture.

Therefore, the conceptualization process of the Ontology of Professional Judicial Knowledge was based on this previous and careful knowledge acquisition stage, which comprehended the acquisition of the list of questions and the treatment of this corpus in order to obtain the relevant terminology related to practical problems faced by judges in their first appointment, through term extraction from the corpus of questions---problems---faced by judges. Detailed information regarding this process may be found at [2]. The methodological steps recommended by most ontology development methodologies and knowledge acquisition techniques were followed and accounted for: 1) preparatory phase (specification of ontology requirements), 2) development phase (knowledge acquisition---experts, documents, reuse---, conceptualization---classes, relations, properties, instances---, validation and formalization), and 3) evaluation phase.

OPJK version 1.0 includes 74 classes, 73 `rdfs:subClassOf` relations and 912 instances, together with a total of 31 `owl:ObjectProperty` axioms (14 `owl:subPropertyOf` and 15 `owl:inverseOf`), 1 transitive and 1 functional `owl:ObjectProperty`. OPJK version 2.0 includes, as well, 1 `owl:equivalentClass` and 75 `owl:disjointWith` axioms, around 100 multiple class instantiation constructs, and, finally, 53 `owl:sameAs` axioms.

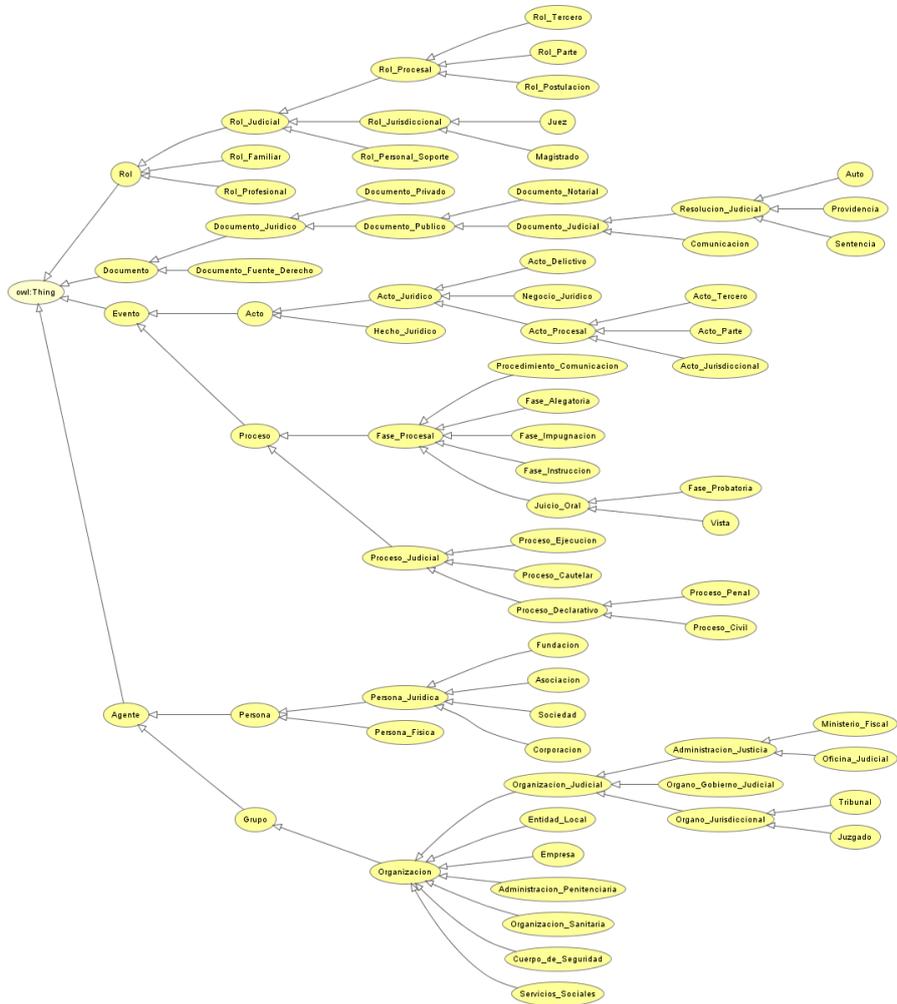


Fig. 2. OPJK ontology for the IURISERVICE system.

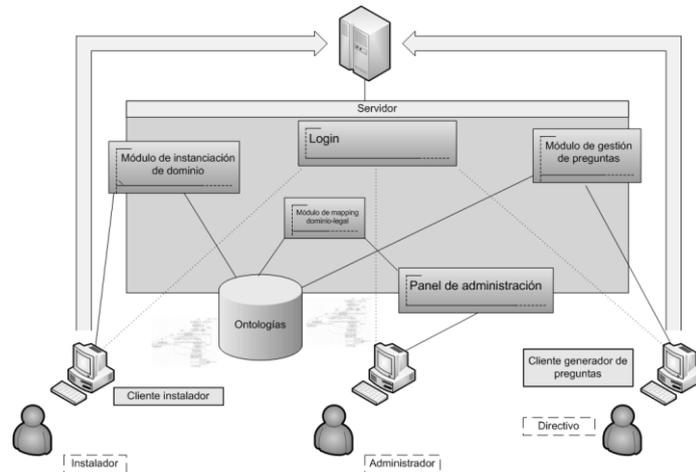
## 2.2 NEURONA: New Technologies for Corporate Security

The NEURONA project is financed by the Spanish Ministry of Industry, Tourism and Commerce and developed by S21sec (coordinator) and the Institute of Law and Technology. The project's primary goal is the development of techniques and systems in order to incorporate *intelligence* in the three main areas of corporate security: legal, organizational and technological. Integration of these elements may represent the next step in corporate security and IT asset management.

In order to constrain this global objective into something feasible and useful, IDT-UAB and S21sec have split the work into several tasks and assigned each to a working team. A first team is set up by legal experts, and their main task is to select, study, analyze and organize relevant regulations for the project's scope, related to corporative security issues. Nevertheless, the main interest is on the study and analysis of Spanish personal data protection regulations.<sup>3</sup>

The second team is set up by both legal experts and engineers, and their goal is to model the regulations analyzed by the first team. Nevertheless, this team has also to provide techniques which may accomplish the main project's goal in providing intelligence on corporative security tools. Concerning this issue, the development of an ontology which consists of a formal specification of Spanish personal data protection regulations is still in progress. This ontology is being modeled with OWL-DL and Protégé.<sup>4</sup>

The third and last team is set up by engineers only, and their goal is to implement a distributed tool which runs the ontology developed by the second team, mainly through the OWL API. In addition, this tool is actually allowing that the three different kinds of final company users execute a number of use cases. These cases are in fact the ones to run the ontology. As part of the development process, the system's behavior is being implemented first as a local framework, and afterwards, client and server sides will be separated.



**Fig. 3.** A screenshot of the NEURONA architecture. Three different user roles (drawn at the bottom) may log into the system and perform typical tasks.

The main intelligent behavior at this point is expected to be a report about the syntactical correctness of personal data files provided, the abnormal or harmful state

<sup>3</sup> Ley Orgánica 15/1999, de 13 de diciembre, de Protección de Datos de Carácter Personal (LOPD), you may find the English version of the act at: [https://www.agpd.es/portalweb/canaldocumentacion/legislacion/estatal/common/pdfs\\_ingles/Ley\\_Orgnica\\_15-99\\_ingles.pdf](https://www.agpd.es/portalweb/canaldocumentacion/legislacion/estatal/common/pdfs_ingles/Ley_Orgnica_15-99_ingles.pdf) (July 12th, 2009).

<sup>4</sup> <http://protege.stanford.edu>

of these data files —with some restrictions—, or the lack of information demanded by the regulations formalized in the active ontology to infer something. That is, in fact, a first version of an automated process which could determine whether some aspects of the current state of a company's personal data files might do not comply with the established set of regulations. These research issues are still in progress.

### **2.3 ONTOMEDIA: Ontologies and Web Service Platform for On-line Mediation**

The aim of the ONTOMEDIA project is to develop an online platform with a wide range of tools and capabilities to support mediators during mediation processes and to offer citizens the opportunity to access on-line mediation services and locate appropriate mediators for their dispute.

Different groups participate in the project in order to develop this wide range of tools. XimetriX Network Thoughts is the coordinator of the project and it will provide the technical knowledge in semantic technologies and applications for the development of the mediation platform. The vast experience of the Institute of Law and Technology in legal knowledge acquisition and legal ontology development is central to acquire all the necessary knowledge regarding the mediation domain in order to conceptualize and formalize the ontologies used by the system. The Laboratory for Hardware-Software Prototypes & Solutions (CEPHIS UAB) focuses on the research and development of new hardware and software design methodologies, based on the use of virtual components (IP cores) to increment the productivity of the custom-designed electronic systems. Finally, the Digital Video Understanding (DVU-UPF) is devoted to the automatic extraction of information in audiovisual support to allow the categorization, interaction, navigation and presentation of the video through the extraction and the intelligent organization of the necessary information regarding the mediation process.

Therefore, the ONTOMEDIA project wants will develop a Web Portal to enable online mediation process and a Web Service platform with the tools such video conference, transcription, notation, voice recognition, and semantic classification. Figure 2 shows the general design of the project.

As mentioned in the above description of the partners, the IDT group is in charge of the development of the legal ontologies for the mediation platform. At the moment, the team of legal experts has acquired significant knowledge regarding the mediation process and after a conceptualization process involving legal experts the Mediation Core Ontology (MCO) has been formalized. With this ontology we tried to model the process of mediation, to locate all the documentation needed during the process or all the documentation created in the process, and to establish the roles of the participants in the mediation process. The knowledge of the experts in mediation domain was key to acquire the main concepts of the MCO and the relations between them. Moreover, the initial stages of the ONTOMEDIA project have run in parallel with the elaboration of the White Book on Mediation in Catalonia, a project coordinated by the UAB Institute of Law and Technology [8].

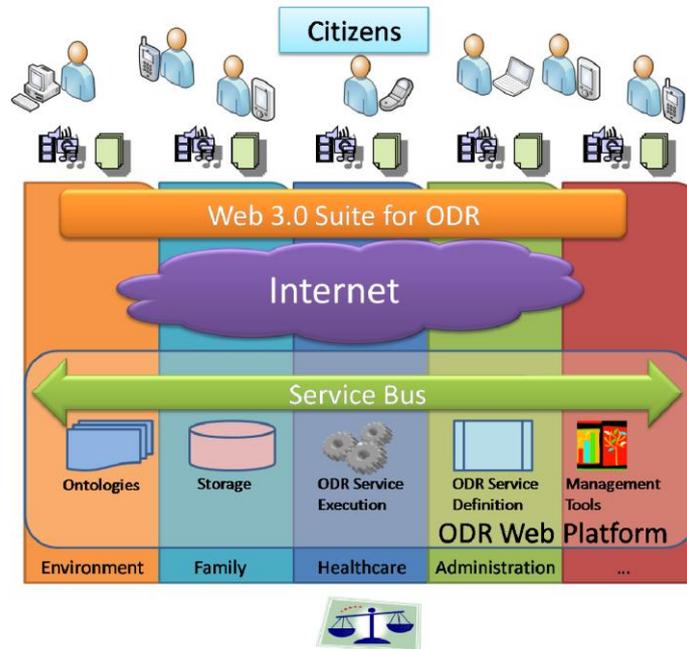


Fig. 4. General architecture of the ONTOMEDIA mediation platform.

The main purpose of the White Book is to provide Catalan lawmakers with in-depth research on the state-of-the-art mediation theories and practices as the basis for future legislation and policies. The White Book project has provided a unique opportunity to gather national and international leading experts and practitioners in a number of work sessions and workshops on concepts, methods, techniques and protocols of mediation.

The expert knowledge and support offered by the participants and the outcomes of the White Book project have been integrated in the methodological process for the development of MCO. These different methodological steps have followed already established ontology development methodologies, such as METHONTOLOGY [9], On-To-Knowledge (OTK) [10], HCOME [11] or UPON [12], which describe a preparatory step (establishment of requirements), a development step (knowledge acquisition, conceptualization and formalization), an evaluation stage and a (if required) implementation step.<sup>5</sup> More detailed information regarding the development process may be found in [13].

The MCO ontology will be used to establish an initial set of requirements for the platform, and to support the acquisition of further knowledge. It will enable the modularization of further subdomain mediation ontologies to enable semantic

<sup>5</sup> The methodology followed was established during the development of the OPJK ontology and is described in [2].

reasoning and classification, for example, to offer selected mediators more suitable for a specific dispute or to manage documentation.

The ONTOMEDIA project is funded by the Ministerio de Ciencia e Innovación and has duration of three years until 2011.

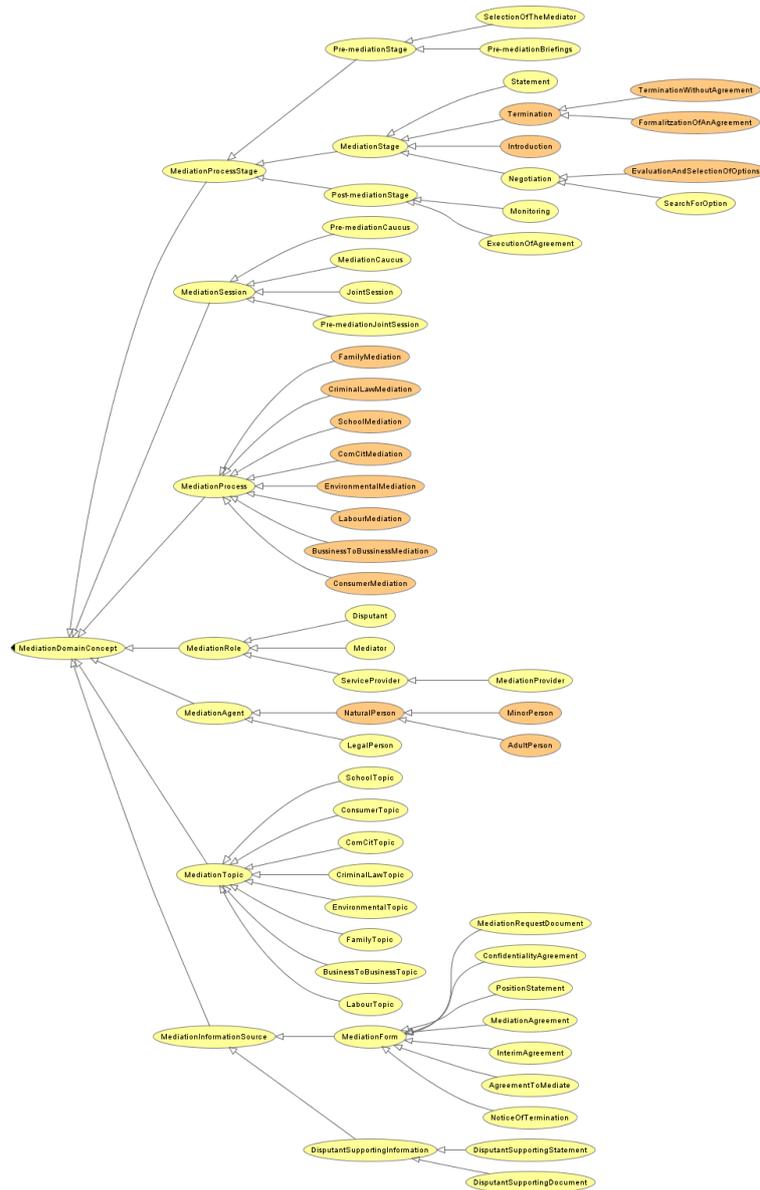


Fig. 5. The Mediation Core Ontology.

### 3 Conclusions

In this paper we have presented several ongoing or recently finished research projects which aim at the development of semantically enhanced applications for the legal domain. The IURISERVICE project was aimed at the development of a web-based application for the management of practical knowledge in the judicial profession, the objective of NEURONA is to manage personal data compliance, and, finally, ONTOMEDIA is directed at the development of an online mediation platform.

These different projects make use of semantic technologies in the form of legal ontologies, developed by the Institute of Law and Technology. OPJK (the Ontology of Professional Judicial Knowledge) was developed for the prototype IURISERVICE, the Mediation Core Ontology has been developed to preliminary assess the needs and requirements of the ONTOMEDIA platform, and the ontology for personal data protection compliance is under development for the NEURONA system.

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