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TOWARDS THE NEXT-GEN TECHNOLOGIES FOR WORLD WIDE WEB: THE SEMANTIC WEB

BY

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Abstract. This article represents a study that we conducted in the domain of new technologies that have been developed for the most important service that runs on the Internet, which is the World Wide Web. This new generation is called the *Semantic Web.* We will present this domain theoretically, describe their architectures with the stack of new technologies, computing paradigms, service standards that have been created in order to sustain their operability. We will make comparisons of these with the old, traditional technologies correspondent from the classic Web and show what are their advantages and improvements, how they are expected to change our lives in better, what are the social and economic impacts. The results of researches are presented in tabular forms, with tables containing various data that we culled from the resources read from literature, we analyse, combine and process them in order to present the reader with a rich set of information about the domain considered. We then make a series of discussions and analyses around these results in order to present their significations, explain the repercussions they have and what are the advantages and benefits that will bring in this field of interest.

Keywords: Semantic Web; Artificial Intelligence; process automation; ontology; logical representation formalism; OWL.

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1. World Wide Web

The World Wide Web (abbrev. WWW, or simply Web) was invented at the beginning of 90s by the British savant Tim Berners-Lee, which proposed the idea of using hypertext to access and link the information on the Internet. It is a system of interconnected hypertext documents called *web pages* consisted of multimedia content (text, images, audio, video) that can be accesses and used by means of a *browser*. It operates based on a client-server type architecture, where documents are stored on a *web server* and accessed and rendered by a web browser by means of their unique names identifiers, called URIs, URLs or URNs. This scenario is drawn in Fig. 1.

The day of 6 August 1991 is considered the birth of Web as a publicly available service on the Internet. It was executed on a NeXT machine at the European Center for Nuclear Research (CERN), at Geneva, Switzerland. On 30 April 1993 it has been announced by CERN that the Web is a freely available service for everyone.

The three milestones that lay at the foundation of Web are:

i) a unique global identifiers system for resources: Uniform Resource Identifiers (URI), Uniform Resource Locator (URL), Uniform Resource Name (URN);

ii) Hypertext Markup Language (HTML) publishing language;

iii) Hypertext Transfer Protocol communication protocol.

In the space of Internet and Web exists two main actors: clients and servers.

A *web client* is represented in general by a browser (*e.g*. Internet Explorer, Mozilla Firefox, Safari, Opera). A web server is an application that receives and serves the clients' requests using the HTTP protocol (generally web pages). The logical connection between them is made through URIs. The application level ISO/OSI protocol on top of which applications are developed is HTTP, and also its secure version, HTTPS (Berners-Lee & Fischetti, 2000).

The essential property of the World Wide Web is its universality. A hypertext link is capable to link anything to anything. Web technologies do not discriminate between scribbled draft and refined performance, commercial and academic information, between diverse cultures, languages and media. Information varies in many ways, such is that made for human consumption and for machines. In the first category enters the TV movies, printed books, magazines, while in the latter are software programs, databases, sensors outputs. Until now the Web was developed as a medium of documents for people, and very little for information that can be processed automatically. The next generation, namely Web3.0. known also under the name 'Semantic Web' have been proposed especially for this (Fensel & Berners-Lee, 2003).

Since its inception and until present day, the World Wide Web has passed through three generations of evolution. The first implementation was Web1.0, which was characterized by static pages and content delivery only, there was very little about user interaction and content distribution. The second generation, Web2.0. was focused on the possibility that people can collaborate and share information online. Unlike Web1.0, the second generation was dynamic in sense that it serves applications to clients and offers an open communication focusing on the online communities and social interaction. Web3.0, also known as the “Semantic Web”, is the current generation that is in use, and we will offer a large description of it in subsequent sections. To find more information about the evolution and generations reader is referred to see (Choudhury, 2014). There is also talked about a 4th generation, that hasn't yet occurred, which is considered an ultra-intelligent, electronic agents, symbiotic and ubiquitous Web.

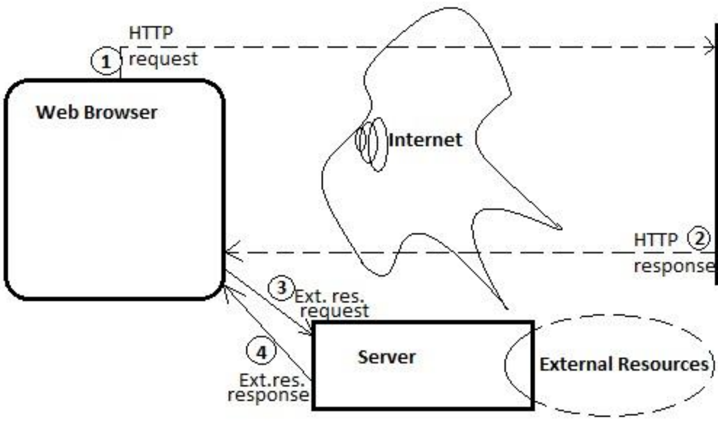

Fig. 1 – The client-server architecture of the WWW.

2. Semantic Web

2.1. Overview

The Semantic Web is a term coined at the beginning of 2000s by none other than the inventor of the classic Web and founder of consortium that deals with the development of its technologies, W3C, sir Tim Berners-Lee. Its main objective is to bring automation to the processes on the current Web, enabling machines to execute tasks that currently can be done only by humans, such are those of finding, interpreting, processing, combining the information. The Semantic Web is not a separate entity of the classic Web but an extension to it that adds new data and metadata to documents, extending them to data that have a semantic structure. This way of extending unstructured and semi-structured documents to data allows the Web to be automatically processed by machines. The name 'Semantic Web' is used interchangeably with the third generation of WWW, the Web 3.0. (Domingue *et al*., 2011).

The Semantic Web will bring structure to the meaningful content of Web pages to create an environment where software agents roam from page to page in order to carry out sophisticated tasks for users. Humans use the Web for tasks such as translating a word from a foreign language, buy an online book, find the smallest price of a DVD. Computers cannot perform these tasks without a human guidance because Web pages are created to be read by humans, not by machines. Computers can parse Web pages for processing layouts and routines, but have no reliable way to process the semantics, such as ‘this is the home page of London College’, ‘this link goes to prof. Cherry’s CV, and others like that.

Berners-Lee, in his 2001 feature article from Scientific American in which he presented the conceptual ideas behind the project, he used examples to illustrate the expected capabilities of the new technologies. This is an environment in which tasks made by humans are handled by agents in an intelligent manner, similar to the process of human thinking. For example, a patient’s agent retrieves information about his prescribed treatment from the doctor’s agent before the doctor even gives him the prescription, searches the Web to create a list of providers for those medecins and keeps only ones that are in-plan with patient’s insurance that are located within a 20 miles radius of home and that have a rating of at least‘very good’ on trusted services sites. The agent then began to find matches between available appointment times from agents of the providers and the patient’s working schedule and presented the patient with the plan. As it can be seen, there is a strong connection between Semantic Web and Artificial Intelligence, and this is discussed in more detail in (Hendler & Berners-Lee, 2010; Halpin, 2005).

2.2. Architecture

Fig. 2 presents the architecture of Semantic Web, with the stack of technologies and languages that have been created for each layer. As it can be observed, there are standards created for each layer.

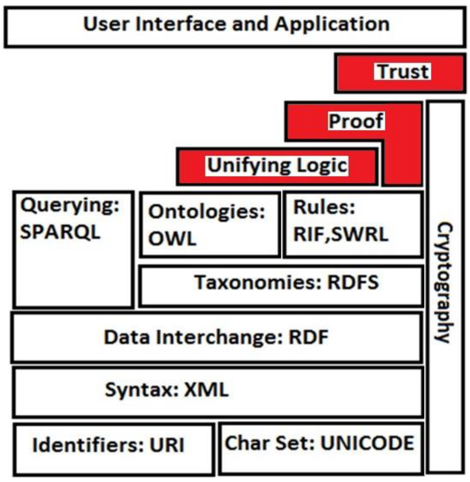

Fig. 2 – Technologies stack of the Semantic Web.

The three milestones that lay at the foundation of Semantic Web are (Fensel & Berners-Lee, 2003):

– RDF (Resource Description Framework): the universal format for publishing the data on the Semantic Web;

– OWL (Web Ontology Language): language for representing of ontologies;

– SPARQL (Simple Protocol for Access RDF Query Language): the standard language for data interogation.

Other standards that have been created for the layers of the stack are:

– Notation3, N-triples, Turtle: formats of different serialization of RDF data;

– RDF Schema: a language for describing the structure of RDF vocabularies (similar to Schema for XML documents);

– Rule Interchange Format (RIF), Semantic Web Rule Language (SWRL): languages for expressing Web rules that are executed by computers;

– Simple Knowledge Organization System (SKOS): a standard designed for representation of structured vocabularies (classification schemes, taxonomies, ontologies).

The Semantic Web takes the solution further, it involves publishing in languages specially designed for data, like the ones stated in the above list. By contrast to the HTML language, which describes documents and the links between them, the Semantic Web languages can describe a variety of arbitrary things (people, places on earth, events etc.). These technologies provide descriptions that supplement the content of Web documents. Content may be descriptive data stored in Web accessible databases or as markup inside documents. These machine-readable descriptions enable adding semantics (meanings) to the contents, *i.e*. describe the structure of knowledge of that content. In this way a machine can process knowledge relying on processes such as deductive reasoning and inference to obtain more meaningful results and automating some tasks such as information search, share, analyze, processing (Antoniou *et al*., 2012).

Not everything has been standardized though. Those are the top 3 layers of the architecture, which are colored in red in Fig. 2, namely: Logic, Trust, Proof (and Cryptography, as some have affirmed). These contain technologies that have not yet been created, or just prototype ideas that will be implemented.

Trust: trust of the derived statements will be done by verifying that premises come from trusted sources and the derivation of information relies on a type of formal logic

Criptography: has the role to verify that semantic statements come from trusted sources. This is achieved using digital signatures for RDF statements.

Digital signature: is a technology that uses notions from mathematics and cryptography and has the role to prove that some person wrote or agrees with a statement or document. Thus, every RDF statement must be digitally signed in order to guarantee its authenticity. The multitude of trustings led to the occurrence of "Web of Trusts", which represents the propagation of trust relations from one peson to another, i.e. if X trusts Y then all its trust relations will be also of Y, and vice-versa (Berners-Lee & Swick, 2006).

The non-realization of these technologies is due to the existing problems that we deal with and sits under the umbrella of these areas. Some of the most important problems are: vastness, imprecision, uncertainty, inconsistency and deceit, as it was affirmed by (Gandon, 2017, 2018), (Balandina, 2016). They also affirmed that today there are no public and available ways for viewing and directly using the information from the sites of Semantic Web.

2.3. State of Development of Tools

With the languages and technologies set up, the Semantic Web tools and applications development started to emerge. In what follow will be presented a list with the most important categories:

a) development environments: Apache Jena, Sesame, Joseki, Protégé, OntoEdit, TopBraid Suite, RDF Suite;

b) RDF triple store systems: AllegroGraph, OpenLink Virtuoso, Mulgara, OWLIM, Kowari, RDFStore, SDB;

c) Inference engines/reasoners: FaCT, FaCT++, HermiT, Pellet, Racer, RacerPro, KAON2, SHER;

d) data processors/transformers: CWM (Closed World Machine), D2RQ and D2R server, GRDDL, D2R Map and D2R Server, SquirrelRDF, R2RML, P2R, Relational OWL, METAmorphose, Virtuoso Universal Server;

e) browsers: OpenLink Data Explorer, Marbles, ObjectViewer, SIOC, Disco;

f) RDF/OWL browsers: BrowseRDF, jOWL, Knoodle, Lena, Ontology Browser, OWLSight, Virtuoso Faceted Browser, TopBraid Ensemble;

g) search engines: Swoogle, SWSE, Falcon, Watson, Sindice.

For these and other tools that have been created by now to support the development of Semantic Web applications readers are invited to see the works of (Yu, 2014; Herman, 2012; Horwitt, 2011; Shivalingaiah, 2009) and also the resources from Wikipedia and (AI3, 2006), which are also good and correct sources of information dissemination.

Tables 1 and 2 summarize the new capabilities and benefits that Semantic Web technologies will bring, as it was discussed during this section, and compares them with the classic Web.

Table 1
New Features of Semantic Web Technologies Compared to Classical Web

Characteristic	Semantic Web	Classic Web
Universal data representation	RDF	–
Reusable data models	RDF, OWL	–
Intrinsic distributed data models	RDF, OWL	–
Standard W3C query languages	SPARQL	–
Validation, classification and processing of information	inference engines, reasoners, classifiers	–
Provide descriptions of the structure of contents in form of semantics	metadata	–
Automation of tasks relying on machine-readable semantics	deductive inference, reasoning	–
Application domains in the industry	many	little

Table 2
Classic vs. Semantic Web Models Characteristics

Charact.	Model	Databases	XML	RDF	OWL
Expressivity		Medium	Small	Medium	Large
Accessibility		Small	Medium	Large	Large
Flexibility		Small	Medium	Medium	Large
Inference		Small	Small	Medium	Large

2.3. Languages for Ontologies Representation

Ontology is the fundamental technology of the Semantic Web in which resources descriptions that are processed by machines are created. It's a term borrowed from phylosophy, where it means the science that deals with describing the types of entities from the real world and the way they are related. In Computer Science an ontology is an explicit specification of the conceptualization of a domain from the real world having the main goal to provide a shared vocabulary that defines the most important concepts, properties and their restrictions. This vocabulary can be shared, reused, exchanged in different heterogeneous systems by humans and/or agents.

Ontology reprezentation languages are ones that had the biggest evolution among all other languages of the Semantic Web, and many were created since its inception to surpass the limitations of the previous. In this section we will present the principal ontology languages that have been created until now for the Semantic Web.

i) DAML+OIL

This language resulted from a combination of efforts between an American corporation (DARPA) and an European group of researchers from Vrije University, Amsterdam, each group creating its own ontology language. The result of the combination was DAML+OIL.The development of the language was taken by a committee made of members of the 2 teams and Joint US-EU adhoc Agent Markup Language. The resulting language has formal semantics given by its own model theoretics in the Description Logic (DL) style, instead of a direct translation into them (Krotzsch & Horrocks, 2012). The DL derived constructors of OIL language have been inherited also in DAML+OIL but the Frames structure was left behind for the DL axioms. Offered a meaning for those parts of RDF that were consistent with its syntax and with model theory from DL. This didn't seem like a big issue knowing that RDF didn't had at that time a pure formal meaning and encountered some serious problems when DAML+OIL was used as foundation at the development of OWL (Fensel *et al*., 2003).

ii) OWL

OWL is the standard ontology language of the Semantic Web created by W3C. The main objective in its design was to have semantics that could be defined using a translation to an expressive DL. The aim of this association is to allow OWL to benefit from the results of research in DL during the past decade, such it would be the decidability and complexity of key inference problems, the existing DL reasoners and inference engines(e.g. FaCT++, Pellet, Racer, HermiT, KAON2) to provide reasoning services for OWL applications. An ontology specified in OWL is considered as a TBox (terminological) of a DL supplemented with a role hierarchy that describes the domain in terms of classes (concepts) and roles (proprieties). An ontology is constituted from a set of axioms that assert its structure, such as subsumption relations of classes and properties. Similar as in a standard DL, classes in OWL can be names or expressions made of atomic ones using the set of concept constructors.

The numerous influiences that exercised on the language led to a number of problems, such as the ones related tosyntax, semantics, expressivity, computations. The solution found by the creators was to create three different languages (versions) each focused on specific issues (Horrocks et al., 2003):

– OWL Lite: offers a simple syntax, low power of expressivity and an easily decidable inference;

– OWL DL: offers a friendly syntax, medium expressivity and decidable inference;

– OWL Full: it is completely expressive, but so the inference is undecidable; is completely compatible with RDF and RDFS.

iii) OWL2

Although very successful, the OWL language was not able to satisfy all requirements. After intensive discussions between users, theorists and developers have been decided to address these requirements by an incremental revision of the language, called OWL1.1. The initial goal of this new version was to exploit recent researches in DL in order to address certain expressivity problems that occurred in DL. As things went on it was decided to address also the requirements for performance by exploiting the researches from smaller DLs with suitable computational proprieties. The group decided to call the new language OWL2 to indicate a step in its evolution (Horrocks *et al*., 2011).

OWL2 has at the basis the SROIQ(D) DL language, thus it extends OWL with qualified cardinality restrictions, a bigger expressivity of proprieties such as the ability to assert that properties are reflexive, irreflexive, disjoint, assimetric, and with the capability to link them into chains of properties. It also weakens the constraints of names separations from OWL, in OWL2 the same name can be used for a class, propriety or individual, a characteristic that is called 'calambur'. In addition, OWL2 provides a much extended support for datatypes, including namy of the datatypes and facets from XML Schema, and for annotations, including capabilities to annotate axioms and entities. Finally, it also offers a limited form of keys in the style of databases.

Besides growing the expressivity power of the language, OWL2 defines three profiles, that are language fragments with desired computational properties and low worst-case complexities for the key inference problems (knowledge base consistency, satisfiability and subsumption of class expressions, instance checking). These profiles are (Horrocks et al., 2011):

– OWL2 EL: based on the εL^{++}, aDL language in which the standard reasoning problems have polinomial complexity

– OWL2 QL: based on DL Lite, a DL language in which the standard reasoning problems can be reduced to SQL queries answering

– OWL2 RL: based on DLP, a DL language for which query answering can be implemented using rule-based techniques that have been proved to be well scalable

In Table 3 we made a summary with the main ontology languages presented in this section and stated what is the corresponding DL that sits at foundation of each one.

In addition to the features described above, OWL2 also adds some convenience characteristics, such as a better specification in both BNF and UML formats, an XML syntax that is completely validated, and use of the Manchester syntax as a textual one and that is more user-friendly. For these and many more information about the standard Semantic Web ontology languages the best sources are the their respective guides from W3C's website: https://www.w3.org/TR/?title=owl.

Table 3

Semantic Web Ontology Languages and Underlying DL Formalisms

Ontology language		DL language
OIL		Semantics transl. to DL SHIQ Frames paradigm
DAML+OIL		SHIQ(D)
OWL	OWL Lite	SHIF(D)
	OWL DL	SHOIN(D)
	OWL Full	- (undecidable)
OWL2	OWL2 EL	εL^{++}
	OWL2 QL	DL Lite
	OWL2 RL	DLP

2.5. State of the Art in Researches

In what follows we will present some of the most important works in the domain of Semantic Web that had been read by authors in conducting this research. For others will provide the reader with references.

One of the most important is the phd thesis of (Pan, 2004), intuitively called *"Description Logics: Applications on the Semantic Web"*. This is a broad study in the domains of logical knowledge representation formalisms, ontology languages and Semantic Web. He observed the existing limitations in W3C's ontology languages, such as incompatibility between semantics of OWL and RDF for ontologies development, lack of support for customized datatypes and predicates in OWL. Its contributions in these domains are multiple. First it proposes a modification of RDFS language as a semantic foundation for the latest ontology languages that are based on DLs. Second, it created two decidable extensions to OWL in order to support customized datatypes and predicates. Lastly, it propose a framework for reasoning in DL to support a wide range of decidable languages with customized datatypes and predicates. This framework provides decision procedures for a wide range of decidable DLs that support datatype expressions, such those closely related to OWL and the two extensions proposed. The hybrid reasoner is highly extensible and supports new datatypes and predicates, new forms of expressions of them, and new decidable DLs.

One important category of tools that have been created are converters between traditional and Semantic Web data models, such as relational to RDF, XML to RDF etc. Relational database conversion to RDF so that it can be queried using SPARQL language is referred as RDB-to-RDF. Next we will present some works done in this area, which is an active domain of research.

In september 2012 W3C published the R2RML recommendation, a standard languagefor describing the mappings between RDB and RDF representations, which marked a new step towards the actualization of the Semantic Web. R2RML encourages RDB-to-RDF tools developers to comply with a standard mapping language. The above mentioned tools are categorized as R2RML and non-R2RML tools. For a complete documentation to be seen the offcial guide from W3C's website: https://www.w3.org/TR/r2rml/.

One of the preliminary works done in this field was (Teswanich, 2007), which proposed a tool for transforming RDF documents and schemas to relational databases. They said that this bridging is necessary in order to avoid learning curves associated with the new tools and to leverage the advantages of traditional (relational) tools without losing the benefits of the new Web technologies and standards. The tool, called RDF2RDB, involves data replication, the data of triples are dumped into a relational schema, and requires information about schema definitions that is stored in ontologies. The problems with their solution are related to the big space consumed by the duplication of the RDF store and the need for syncronization of changes between the two stores. These problems are addressed by the next tools developed in the field, such are the ones below.

D2RQ is a platform for accessing data from relational databases as virtual, read-only RDF graphs without having to replicate them into an RDF store (Bizer, 2004). The platform is constituted of 3 major components:

– D2RQ Mapping Language: a declarative language for describing the relations between ontological and relational data model;

– D2RQ Engine: a plugin for Jena and Sesame Semantic Web toolkits that uses the mappings to rewrite API calls to SQL queries on the relational model and passes the query results to upper layers;

– D2R Server: an HTTP server that is used to provide a LinkedData view, HTML view for debugging and a SPARQL endpoint over the database.

Using D2RQ platform you can: query a non-RDF database using SPARQL, access info in a non-RDF database using Jena or Sesame API, access contents of the database as linked data over the Web and make SPARQL queries over the SPARQL protocol against the database. Supported databases include: Oracle, SQL Server, MySQL, PostgreSQL, HSQLDB, Interbase/ Firebird.

A similar tool is R2D (RDF to Database) that was proposed by (Ramanujam *et al*., 2009). This tool has the goal to transform RDF data at runtime into an equivalent normalized relational schema, acting thus as a bridge between the 2 data models and making available the existing relational tools also for RDF stores. Compared to other existing tools which have the same purpose, this tool also has the capability to process blank nodes and RDF container objects. Blank nodes are ones that neither URI references or literals but used to associate a resource with a set of properties that represent some complex data. They are a main component of RDF graphs and the focus of the R2D tool was put on their relationalization. Also enhanced are the SQL to SPARQL transformations that now contain pattern matching and aggregation of RDF data.

Other examples of tools from the category of bridging data models are: OpenLink Virtuoso (Erling & Mikhailov, 2007), RDF123 (Han *et al*., 2008), Triplify (Auer *et al*., 2009).

Another major domain of the Semantic Web of an impacting importance are the inference engines and reasoners. Based on their underlying algorithms for reasoning they fall in two categories: Tableaux-based and Non-tableaux. In the first category lays the majority of reasoners created by now, such as: FaCT, FaCT++, Pellet, Racer, HermiT, F-OWL.

From the second the main reasoning techniques are: First Order Theorem Prover and First Order Resolution Calculus. Concrete systems that use these techniques are: Hoolet and KAON2, respectively. More information about inference engines created by now on the Semantic Web, techniques used by these, main reasoning tasks performed on DL knowledge bases, and comparisons between them are presented in (Dalwadi *et al*., 2012).

From the more recent works in Semantic Web we will mention those of (Aebeloe *et al*., 2019) who created a decentralized architecture for sharing and querying semantic data that does not rely on servers to provide access to those data, thus avoiding frequent unavailability due to numerous servers failures. (Hartig, 2019) presents an extension to standard Semantic Web query language, tSPARQL, as a way to assess and query the trustworthiness of RDF data. It allows users to add trust information to RDF applications in an easy manner.

2.6. Impact on Society and Life

The most important domains where the Semantic Web technologies will improve our life and experience are presented below.

Business processes are collections of related services that work collectively to fulfill an final goal. The application of Semantic Web technologies in business process management plays a significant role in information exchange among business groups for corporate purposes. It has been found a prominent role in searching of relevant data, information sharing among agents, filtering of data used for finding web sites, market trends analysis, compozition and integration of services, exchange of machine dialogue over different domains, virtual community, flexibility and standardization of vocabularies (Feldmann *et al*., 2016).

Electronic commerce is an area with huge economic impact, and the Internet provides a much higher way for flexibility and openness that will help to optimization of business relations. The peer-to-peer type architecture of e-commerce encounters many obstacles until becoming real thing. The Semantic Web has technologies and services that have the potential to solve the problems from e-commerce.

E-science is the use of electronic resources by scientists that work in teams for big distributed projects. Large scale science, as it was affirmed by Human Genome Project, will be ascendingly done by globally distributed collaborations enabled by the Internet that will require accesses to large data collections, large scale computing resources, and high performance vizualization tools. One example of such collaborations are the ones from Biology, that experiment with DNA and genomic data.

Social networks have become an important part of the modern society that put a major impact on the personal, social educational, professional and business. Connects people from all over the world through the web sites, like Facebook, MySpace, LinkedIn, Orkut etc. General interes search engines have a growing trend to assimilate technologies of Semantic Web, such are Tumbup, Wolfram Alpha, True Know and Zoom. Facebook introduced a Semantic Web technology, called Open Graph Protocol that allows third-party sites to interact with ones of social networks. The Semantic Web has been used by many researchers and many projects have won momentum in recent period, some honorable mentions are: Friend-of-a-Friend (FOAF), Semantically Interlinked Online Communities (SIOC).

More information about application domains can be found in works of (Mehra & Kumar, 2011; Feldmann *et al*., 2016); for those about oil and gas industry to be seen the articles of W3C CEOs (Bratt, 2008; Herman, 2012).

3. Conclusions

As it was stated from the begining, the current work was intended as a review in the domain of new inovations brought to the technologies of Internet and World Wide Web in the last two decades, starting with the domain's inception. The article began with a section in which it was briefly presented the definitions and roles of Internet and World Wide Web, then we moved on to discuss the new generation technologies that had been created for them. The Semantic Web represents the third generation of WWW (also known as Web 3.0) and has as main purpose to transform it into a Web of structured data that can be processed automatically by machines the same way as humans do. We made a series of comparisons between the next-gen technologies and the classic ones, and presented the results in tabular forms. A state of art was done regarding the most important languages and tools that had been created in the last decade to support its evolution, we chose a few of the most important categories, such as data model converters, inference engines and reasoners. Since the foundation of Semantic Web represents the ontologies, we chose to present in a different section the main languages for ontologies representation that had been created by now, and state their connection with logical representation formalisms. We concluded with the main domains where the technologies of Semantic Web find most applications.

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ÎNSPRE URMĂTOAREA GENERAŢIE DE TEHNOLOGII PENTRU WORLD WIDE WEB: WEB-UL SEMANTIC

(Rezumat)

Lucrarea de faţă îşi propune să facă un studiu în domeniul noii generaţii de tehnologii care au fost create pentru cel mai important serviciu care rulează pe Internet, şi anume World Wide Web. Acestei generaţii noi i-a fost atribuit numele de Web Semantic datorită faptului că se bazează pe descrieri ale resurselor pentru a fi inţelese şi prelucrabile de către programme software (agenţi). Vom oferi o prezentare teoretică a acestui domeniu, descrie arhitectura sa formată din stiva de tehnologii, paradigme de calcul şi standard pentru servicii, toate fiind dezvoltate pentru a susţine interoperabilitatea proiectului. Vom realiza aici o serie de comparaţii ale lor cu cele tradiţionale, găsite în Web-ului classic, şi vom pune in vedere avantajele şi îmbunătățirile pe care le aduc, cum este aşteptat să schimbe vieţile noastre în bine, care sunt impacturile sociale şi economice. Rezultatele cercetării sunt prezentate sub formă de tabele, în care se găsesc date culese de autor din literatură şi prelucrate, combinate pentru a oferi cititorului o imagine cât mai bogată şi clară despre domeniul în cauză. Apoi vom realiza o serie de discuţii şi analize în jurul acestor rezultate pentru a explica semnificaţiile lor, repercusiunile şi care sunt avantajele aşteptate să le aducă în aria de interes.