Cloud Computing Services: Benefits, Risks and Intellectual Property Issues*

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Abstract

Major software players of the global market, such as Google, Amazon and Microsoft are developing cloud computing solutions, providing cloud services on demand: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a service (SaaS). In software industry and also in ICT services market, cloud computing is playing an increasingly important role. Moreover, the expansion of cloud services indirectly contributed to the development and improvement of other types of services on the market – financial and accounting services, human resources services, educational services etc. – in terms of quality and affordability. Given the fact that cloud computing applications proved to be more affordable for small and medium enterprises (SME), an increasing number of companies in almost all the fields of activity have chosen cloud based solutions, such as Enterprise Resource Management (ERP) software and Customer Relationship Management (CRM) software. However, cloud computing services involve also some risks concerning privacy, security of data and lack of interoperability between cloud platforms. Patent strategy of certain proprietary software companies leaded to a veritable "patent war" and "patent arm race" endangering the process of standardization in software industry, especially in cloud computing. Intellectual property (IP) legislation and court ruling in patent litigations is likely to have a significant impact on the development of cloud computing industry and cloud services.

Keywords: *cloud computing services, Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a service (SaaS), standardization and interoperability, software patents.*

JEL Classification: *L-86, O-30, O-39.*

1. Introduction

The present article proposes an analysis of cloud computing services and an assessment of their main benefits and risks, given the essential features and characteristics of cloud computing and the particularities of services in this field. The first objective is to carry out a concise literature review on this topic in order to briefly summarize the main definitions and theoretical perspectives on cloud computing and also the main benefits and risks of cloud computing services; the second objective is to realize a more elaborate and particularized analysis concerning one central issue related to cloud computing services: the impact of intellectual property legislation – especially court ruling in patent and copyright cases – on standardization and interoperability in cloud computing services. A more detailed summary of the article is the following: (a) define the concept of cloud computing, pointing

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the main features; define and exemplify the principal types of cloud computing services: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS); (b) analyse the main benefits of cloud computing services; (c) and the potential risks and challenges: security and privacy of data, vendor lock-in, lack of standards and interoperability, intellectual property issues; (d) Assess the impact of intellectual property legislation and court ruling in patent litigation in the field of cloud services.

2. Cloud Computing Definitions and Characteristics

2.1. Cloud Computing Definitions

The name "cloud computing" is essentially a metaphor. In order to properly define cloud computing it is necessary to explain what is really behind this metaphor. "The cloud" is a familiar cliché designating the Internet and often a cloud shape is used to represent Internet in a network diagram, abstracting underlying infrastructure, hardware and software. In very broad terms, according to Barry Sosinski, cloud computing refers to applications and services that run on a distributed network using virtualized computing resources based on pooled physical resources, partitioned as needed and accessed by common Internet protocols and networking standards (Sosinski 2011, 3-5).

There is no formal definition of cloud computing universally agreed by all IT specialists and academics, but nevertheless there are two main definitions that are being used by Cloud Community and also there are some key (defining) characteristics of cloud computing that are often emphasized by IT scientists.

First definition is provided by Ian Foster: cloud computing is a "large-scale distribution computing paradigm that it is driven by economies of scale, in which a pool of abstracted, virtualized, dynamically-scalable, managed computing power, storage, platforms and services are delivered on demand to external customers over the Internet" (Foster, Zhao, Raicu & Lu, 2008). The second definition is provided by Jeff Kaplan: cloud computing is a "broad array of web-based services aimed at allowing users to obtain a wide range of functional capabilities on "pay-as-you-go" basis that previously required huge hardware-software investments and professional skills to acquire. Cloud computing is the realization of the earlier ideals of utility computing without the technical complexities or complicated deployment worries" (Geelan, 2009).

Another more comprehensive definition of cloud computing is suggested by Mohan T.: cloud computing is "a techno-business disruptive model of using distributed large-scale data centers either private or public or hybrid offering customers scalable virtualized infrastructure or an abstracted set of services qualified by service level agreements (SLAs) and charged only by the abstracted IT resources consumed." (Buyya, Broberg & Goscinski 2011, 44)

2.2 Cloud Computing Nature and Characteristics

Given cloud computing definitions mentioned above, we may infer some of the essential features of cloud computing and also the special character of cloud computing services.

In the Cloud Computing Bible, Barrie Sosinsky clarifies that the use of term "cloud" makes reference to two essential features: abstraction and virtualization. Thus, Sosinski explains that "cloud computing abstracts the details of system implementation from users and developers" and that "applications run on physical systems that aren't specified, data is stored in locations that are unknown, administration of systems is outsourced to others, and access by users is ubiquitous." Also, regarding virtualization he explains that "cloud computing virtualizes systems by pooling and sharing resources" and that "systems and storage can be provisioned as needed from a centralized infrastructure, costs are assessed on a metered basis, multi-tenancy is enabled, and resources are scalable with agility" (Sosinski 2011, 4).

There are also important characteristics of an ideal cloud computing model (Sosinski 2011, 24-25):

- scalability: access to unlimited computing resources as needed;
- elasticity: ability to right-size resources as you needed;
- low barrier to entry: access to systems for a small investment;
- utility: pay as you go model that matches resources to need on an ongoing basis.

The nature and characteristics of cloud computing are sometimes explained using the electricity analogy, although the comparison with electricity model has some limits. According to Voorsluys, Broberg and Buyya, the computing resources are virtualized much in the same way that electricity is virtualized. Electricity is readily available from a wall socket and beneficiaries of electric power do not necessarily need to know or care how electric power is generated or how it gets to that outlet. Electricity is delivered as a utility and behind this service there are power generation stations and huge distribution grids. Similarly, cloud computing model aims to deliver computing resources as a utility, aggregating computing resources in one system and distributing computing services in a standardized manner (Buyya, Broberg & Goscinski 2011, 3). James Urquhart (Uruquart 2009) and Krishnan Subramanian (Subramanian 2010) explain that although analogy between cloud computing model and electricity model is useful in depicting some important features of cloud computing, the cloud computing model and electricity model are nevertheless different, mainly because cloud computing involves computing and storing data. From this perspective in the cloud computing model there are additional problems – security of information, legal and contractual issues – that are not encountered in the electricity model.

2.3. Cloud Computing Services

Voorsluys, Broberg & Buyya emphasize that the main principle behind cloud computing is the possibility of providing computing, storage and software as a service (Voorsluys, Broberg & Buyya 2011, 3). Services provided through a cloud system are frequently classified as: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS) (Furht & Escalante, 2010, 339). IaaS, PaaS and SaaS are known as SPI model of cloud computing (Sosinski 2011, 3).

IaaS provides virtual machines, virtual storage, virtual infrastructure and other virtualized computing resources. IaaS service provider manages the entire infrastructure, while the client is responsible for all other aspects of deployment that can include the operating system and applications. Examples of IaaS service providers are: Amazon Elastic Compute Cloud (EC2), Eucalyptus, GoGrid etc. For instance, on Amazon EC2 a client could have a virtual machine (which imply hardware virtualization) and can install an operating system (OS) on that virtual system. Amazon has also a number of operating systems and enterprise applications but clients can install whatever software they want to run (Sosinski 2011, 11). Sometimes IaaS providers are also PaaS and SaaS providers. Most of the large cloud computing services providers (especially IaaS providers) have multiple data centers located all over the world. For example, according to Sosinski estimation, in 2010-2011, Amazon had about 20 data centers, while Google 35 data centers (Sosinski 2011, 14).

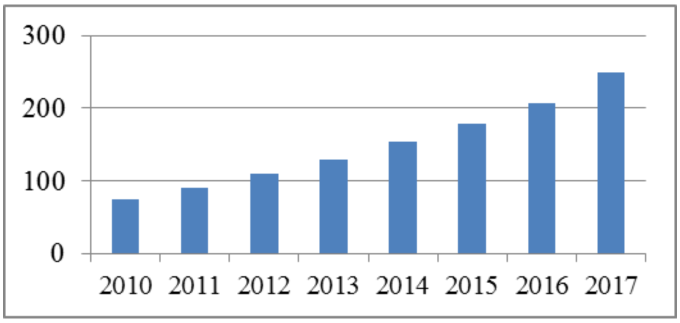
PaaS provides virtual machines, operating systems, applications, services, development frameworks, transactions and control structures. The client can deploy applications in the cloud infrastructure or use applications developed using programming languages and tools supported by PaaS provider. The provider manages cloud infrastructure, the operating systems and provided software and the client is responsible for installing and managing deployed applications (Sosinski 2011). Examples of PaaS services are: Google AppEngine, GoGrid CloudCenter, Force.com, Windows Azure Platform, Zoho Creator.

SaaS is a complete operating environment with applications, management and user interface. In SaaS model everything from the application down to infrastructure is the vendor responsibility, the client is simply using the application: entering, managing data etc. (Sosinski 2011). Examples of SaaS services are: Google Apps, Oracle on Demand, Zoho CRM, SalesForce.com, SQL Azure.

All these types of cloud computing services could be classified as high tech knowledge intensive services, but in addition they revolutionized other type of services (financial and accounting services, human resources services, educational services, etc.) because cloud computing solutions and applications proved more affordable and less expensive for small and medium enterprises (SMEs). For example, companies can use ERP (Enterprise Resource Planning) or CRM (Customer Relationship Management) applications in the cloud, without having to buy or rent data centers and without having to maintain IT departments. Acumatica ERP and Zoho CRM represent two of the multiple cloud based solutions, especially for SMEs.

Interest in cloud computing is growing as companies look to reduce their costs and shift their services online. Gartner analysts estimate that worldwide spending on public cloud services increased from 109 billion dollars in 2012 to 132 billion dollars in 2013 and predict that in 2017 global public cloud services spending will reach 250 billion dollars (Graphic 1).

Graphic 1 – Worldwide Public Cloud Services Market Size, 2010-2017 (billion dollars)



Source: Gartner (2013)

*2013-2017 forecasts

3. Cloud Computing: Benefits, Challenges and Risks

3.1. Benefits of Cloud Computing Services

The main benefits of cloud computing services are closed related with its essential characteristic (abstraction, virtualization, scalability, computing as a utility, etc.). Barrie Sosinski (Sosinski 2011, 16-18) enumerated five essential advantages of cloud computing services:

- on demand services – the client can access the services without interaction with cloud service provider personnel
- broad network access – access to resources in the cloud is available over the network using standard methods in a manner that provides platform independent access to clients of all types
- resource pooling – resources are pooled in a system that support multi-tenant usage.
- rapid elasticity – resources can be rapidly and elastically provided.
- measured service – clients are charged based on a known metrics such as amount of storage, number of transactions, bandwidth etc.

Other benefits of cloud computing and cloud services may include: access to a huge range of applications without having to download or install anything, lower costs, ease of utilization, quality of the service (QoS) agreed under the contract, outsourced IT management, simplified maintenance and upgrade, access to the application from any computer via Internet, scalability via on demand resources, pay-as-you-go pricing model.

3.2. Cloud Computing Services: Challenges and Risks

Privacy and Security of Data

Cloud computing analysts often emphasized that the most important area of concern and risk regarding cloud computing services is privacy and security of data. Since cloud computing involves massive use of third-party services and infrastructure, the problem of security and privacy of sensitive data transferred in cloud applications cannot be avoided – cloud computing environment may not be as secure as in-house IT systems. In this case, trust toward providers of cloud services is important. Moreover, security procedures such as data encryption, access protocols, methods of data aggregation, and methods of erasing information at the end of the service relationship are key techniques of ensuring security of data (Buyya, Broberg & Goscinski 2011, 35).

However, as a rule, consumers cannot rely thoroughly on cloud providers to keep their data private against government control and political surveillance. Security of data and communication is not only a technological problem but also a political problem. For instance, in 2010 Google considered that Chinese dissidents were at risk because Chinese government used company's technology for political surveillance, and after these incidents, Google decided to move their servers from China in Hong Kong (Sosinski 2011, 18-19) (Branigan 2010). Another example is the case of the US Intelligence organization, National Security Agency (NSA), which is presumed to have paid “hundreds of millions of dollars a year to U.S. companies for clandestine access to their communications networks, filtering vast traffic flows for foreign targets in a process that also sweeps in large volumes of American telephone calls, e-mails and instant messages” (Timberg & Gellman 2013). NSA documents leaked by Edward Snowden (a former NSA contractor) reveal that voluntary cooperation between NSA and providers of global communication date back to 1970s (Timberg & Gellman 2013). If disclosed to the public, such deals between intelligence agencies and global communication companies could cost tech giants and cloud companies suspected to be involved (like Google, Microsoft, IBM, Yahoo, Twitter, Facebook etc.) billions of dollars. This fact could limit the incentive of global communication providers to violate the privacy of data. The Information Technology & Innovation Foundation (ITIF), a D.C. based think tank, published a report asserting that U.S. cloud computing providers could lose up to $35 billion by 2016 because of the leaks revealing collaboration with intelligence agencies (Gustin 2014) (Castro 2013).

Standardization, Interoperability and the Risk of Vendor Lock-in

A major concern for cloud services customers is the risk of vendor lock-in (customer became dependent on a certain vendor, being unable to change the vendor without incurring substantial losses or without substantial switching costs). For example, customers may decide to change their cloud services provider and for this reason they will need to move their data or/and applications on other platforms. Therefore, an important question and at the same time a major challenge for cloud services providers is are the problems of standardization and interoperability between cloud platforms. Richard Stallman a renowned American software freedom activist and computer programmer (the president of Free Software Foundation and the founder of GNU operating system project) considers that the risk of data and application lock-in by a certain provider in the case of web based applications is very high. For this reason he warned that cloud computing may be “a trap aimed at forcing more people to buy into locked, proprietary systems that would cost them more and more over time” (Johnson 2008).

Patents and Copyrights in Software Industry and Cloud Services: their Impact on Standards and Interoperability

There are two important orientations concerning software licensing that may be identified in software industry: (a) free software and open source, on the one side and (b) proprietary software, on the other side.

Currently, free software movement is leaded by Free Software Foundation that works for adoption of free software and free media formats, and organizes activist campaigns against threats to user freedom[2]. According to Free Software Foundation, a program is free software if the program's users have the four essential freedoms[3]:

The freedom to run the program, for any purpose (freedom 0).

The freedom to study how the program works and change it so it does computing as anybody wish (freedom 1). Access to the source code is a precondition for this.

The freedom to redistribute copies (freedom 2).

The freedom to distribute copies of modified versions to others (freedom 3). By doing this anybody can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this.

Free Software Foundation actively campaigned for convincing people to use free software, pointing out some hidden threats for users from the part of proprietary software companies (Microsoft, Apple): invading privacy, vendor lock-in, abuse standards etc. Also Free Software Foundation actively campaigned against software patents.

Open Source Initiative is in some respects similar with free software movement. An open source program needs to meet the following criteria[4]:

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[2] The complete program and philosophy of Free Software Foundation are exposed on their website: www.fsf.org

[3] The definition of free software presented here is authored by Free Software Foundation as fundamental principle of its project to develop a Unix-like operating system – GNU operation system – which was launched in 1984 (www.gnu.org).

[4] This is an abridged definition of open source software. The complete definition may be found on the Open Source Initiative Website: opensource.org

Free redistribution of program;

The program must include source code, and must allow distribution in source code as well as compiled form;

The license must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software;

Integrity of The Author's Source Code;

No discrimination against persons or groups;

No discrimination against fields of endeavor;

The rights attached to the program must apply to all to whom the program is redistributed without the need for execution of an additional license by those parties;

License must not be specific to a product;

The license must not place restrictions on other software that is distributed along with the licensed software. For example, the license must not insist that all other programs distributed on the same medium must be open-source software;

License must be technology-neutral.

Open Source Initiative devised also the open standards requirements for software: no intentional secrets, availability, no patents that hinder interoperability, the implementation of standards must not be the object of license agreements and must not require technologies that do not meet the open standards criteria.

The main difference between Open Source Initiative and Free Software Movement is that the advocates of open source do not actively campaign against proprietary software. They simply promote by their activity other types of software than proprietary software. According to their statements, they also do not oppose software patents if these do not hinder standardisation and interoperability.

Proprietary software[5] companies develop computer software licensed under the exclusive right of copyright holder. According to this type of license the user has the right to use the software complying with some restrictions, such as number of computers on which software can be used, further distribution and reverse engineering (e.g. inspection and modification of source code). Typically, vendors of proprietary software do not offer the human-readable version of software but only the compiled form of software – the machine language "understood" by the central processing unit of computer.

The licensing strategy of proprietary software companies played an important role in the "fight" against open source and free software competitors. Internal Microsoft memoranda leaked in the 90's[6] reveals that Microsoft used FUD tactics (spreading fear, uncertainty and doubt) and EEE tactics (embrace, extend and extinguish) to disrupt its competitors which develop open source software. By

[5] It is important to note that proprietary software is not synonymous with commercial software. Proprietary software may be distributed without charge or for a fee. Similarly free software or open source software may be distributed with no charge or for a fee.

[6] The documents leaked are often referred as Halloween documents, mainly because many of them were originally leaked close to 31 October in different years. The documents are currently published on www.catb.org

EEE tactic, Microsoft "embraced" certain open standard or open source software, "extended" it with some extra features and finally "extinguished" it breaking compatibility with other open source software and imposing a non-disclosure license agreement for the new released software. According to Microsoft's critics, what happened with Kerberos, the computer network authentication protocol developed by Massachusetts Institute of Technology (MIT), illustrates perfectly Microsoft EEE tactic. Kerberos gained pre-eminence on the market because its developers from MIT released the source code and this fact allowed security experts around the world to review and to refine the program, line by line (The Economist, 2000). Microsoft included Kerberos in its Windows 2000 operating system and slightly modified it, adding proprietary extensions, so that Microsoft version was no longer fully interoperable with widely used standard version of Kerberos. Further, Microsoft denied the access to a Windows 2000 Server using the modified Kerberos to all products, except those made by Microsoft. Critics say that Microsoft extinguished an open standard in order to help Windows become a dominant operating system on servers (Dominic 2000).

Another often cited instance of Microsoft EEE tactic is the case of AOL's IM protocol which everyone was using in the 90s. Microsoft extended the standard with proprietary add-ons which supplied new features but broke compatibility with AOL's software. Microsoft extended the standard and gained dominance providing the MS Messenger for free, but AOL was not allowed to use Microsoft protocol (Hu 2001).

Although Microsoft was repeatedly sued for monopoly abuse, the real "sin" of Microsoft was its licensing strategy. IP legislation and court ruling in patent litigation played an important role in this. While benefiting of standards and software previously developed under free software or open source license agreements, Microsoft systematically broke compatibility with free software or open source products by its corporate licensing strategy. Notwithstanding, open source and free software companies proved to be increasingly competitive and continued to flourish improving also the quality of their products. During economic recession of 2009 a growing number of entrepreneurs searched for ways to reduce IT costs and open source software proved to be a great way to cut costs (Randall 2009). Consequently, open source software companies not only survived recession but they increased their sales. For example, in 2009, Red Hat, the world's biggest independent open-source firm revealed an increase of 25 percent of annual revenue over the previous year.

Open source and free software companies' progress is mainly due to their development model, especially to the fact that they praised and cultivated open source and open standards. Even Microsoft joined the new trend and started to cooperate with open source software companies. Although Microsoft did not abandoned its licensing policy, it had to refrain in some cases because the cooperation with companies developing open source software under GNU General Public License[7] required sharing the source code of applications developed using other open source software. For example, in 2009, Microsoft contributed approximately 20.000 lines of source code to the Linux kernel with the aim of improving support for running the Linux operating system in virtualized environments on Windows servers. Microsoft used Linux code in order to develop the Linux Hyper-V driver, and consequently they had to release the resulting code under the GPL in order to comply with the licensing requirements of open source software partners (Paul 2009).

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Standards and interoperability are key conditions if cloud computing services are to be widely adopted by customers. According to the specialists from the Institute of Electrical and Electronics

[7] GNU General Public License may be read on the GNU project website: http://www.gnu.org/copyleft/gpl.html

Engineers (IEEE), standardization and interoperability represent a bigger issue than privacy and security of data for cloud computing services. Patent and copyright strategy of companies developing proprietary software could seriously hinder the establishment of open standards and interoperability between cloud services providers. The easy switching between two providers of cloud computing services is possible if both providers are either running the same operating system or are conforming to an open standard. But if operating systems and standards should conform to licensing rules and royalties, every standard could contain individually licensed components with intellectual property owners taking advantages from everyone implementing the standard (Upbin 2012). In this case, a wide agreement on using standards will be hardly reached.

Software companies often claimed copyright on the very interfaces that let one piece of software interoperate to another (APIs - Application Programming Interfaces). APIs are ubiquitous and fundamental to all kinds of program development. Granting copyright protection to functional APIs would allow some companies to hold up important interoperability functionality that developers and users rely on every day. This would have important consequences for cloud computing services cancelling almost all their advantages both for developers and customers. Two recent cases perfectly illustrate this kind of problems. In the Oracle vs. Google, Oracle attempted to persuade US Federal Court that the very interfaces of programming services (Application Programming Interfaces - APIs) can be copyrighted and claimed copyright on Java's APIs. In 2010, Oracle bought Sun Microsystems, which was a company that developed and supported open source software, including Java. The Federal court rejected in 2012 Oracle request (Vaughan-Nichols 2012). In 2013 Oracle appealed the case and some of the panel judges may side with Oracle (Levine 2013).

In a similar case concerning the popular statistical package SAS, European Court decided that APIs can't be copyrighted because this would imply a monopoly on ideas:

"A firm called World Programming created a clone designed to run SAS scripts without modification. In order to do this, they bought a copy of SAS and studied its manual and the operation of the software itself. They reportedly did not have access to the source code, nor did they de-compile the software's object code. SAS sued, arguing that its copyright covered the design of the SAS scripting language, and that World Programming had violated the SAS licensing agreement in the process of cloning the software. The EU's highest court rejected these arguments. Computer code itself can be copyrighted, but functional characteristics—such as data formats and function names—cannot be. "To accept that the functionality of a computer program can be protected by copyright would amount to making it possible to monopolize ideas, to the detriment of technological progress and industrial development," the court stated." (Lee 2012)

Therefore, many proprietary software companies try to acquire a special position on the market by their licensing and patent strategy. In many cases, they used royalty free available software and technologies, added some new features and finally claimed copyright on the new released software. According to Free Software Foundation, virtually all of the technologies used now in software industry were developed before software was widely viewed as patentable. "The Web, email, your word processor and spreadsheet program, instant messaging, or even more technical features like the psychoacoustic encoding and Huffman compression underlying the MP3 standard—all of it was originally developed by enthusiastic programmers, many of whom have formed successful business around such software, none of whom asked the government for a monopoly." (End Software Patent, 2013)[8]

Major software companies are increasingly involved in a veritable "patent war". They are increasingly interested in building their patent portfolio mainly in order to secure defense against patent litigation (Prentice 2010) but also in order to pull out of the race their competitors. Moreover, gains from selling patent portfolios became an important source of profits for tech and software companies. The case of Microsoft and Salesforce that sued each other in 2010 for alleged patent infringement illustrate this trend. Microsoft and Salesforce compete head-to-head in the market for customer relationship management (CRM) software. They also compete in the market for the underlying platform to host online software, with Salesforce's Force.com and Microsoft's Windows Azure. Gartner researcher and analyst, Brian Prentice, considers that "patent arms race" in software industry will not ends very soon.

Currently, it is almost impossible for a software developer to avoid the accidental infringement of previously copyrighted software. It is also difficult to follow what new software patents are registered (Timothy B. Lee and Christina Mulligan, 2012). How the software industry and cloud computing services would look like if the current trend of "patent arms race" will continue? If the consolidation of patents portfolio will continue to be the main objective of software companies, the offensive or defensive patent war will be pervasive and more and more resources will be diverted to resolve legal disputes.

Stephan Kinsella, an American intellectual property lawyer and economist questions the legitimacy and justification of certain types of intellectual property, especially copyrights and patents, on the ground that they unjustly trespass against the tangible property of owners, transferring it to authors and inventors. According to S. Kinsella, patents and copyrights are veritable monopoly privileges granted by courts, creating artificial scarcity where there was none before (Kinsella 2008). In the case of software patents, private and tangible owned resources of customers and developers from everywhere are placed under the control of software companies that obtained some key software patents which indeed are very akin to any others legally granted monopoly privilege.

It is usually asserted that the system of patents encourage innovations, providing incentives for inventors to engage in innovative activities. But in industries where progress is achieved by sequential and complementary innovation – such as software and especially cloud computing industry – open and royalty-free standards could be more important. Royalty-free standards do not mean that a company cannot charge customers for programs or services they provide. The main role of open, royalty-free standards is to ensure universality, which is a key principle underlying Web and development and growth (Berners-Lee, 2011). In software industry, as in many fields of research, innovation and progress have an incremental character and for this reason it is facilitated both by the wide access of developers and people to previously developed technologies and software, and by the reliance on common or universal standards.

Moreover, most of the software engineers are becoming more and more burdened with legal and administrative tasks, which means that, in terms of costs and benefits, in every software company less time and resources are engaged in genuine software engineering tasks, while more and more resources are diverted to an offensive or defensive patent war.

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[8] The entire pleading against software patents may be found on the following web address: http://endsoftpatents.org/

The development of cloud computing industry and of cloud services depends on the existence of open standards. There are initiatives for creating open source cloud platforms that will compete with proprietary platforms, such as Microsoft (Azure Platform) and VMware (vSphere). For example, Rackspace.com – a large IaaS cloud service provider – initiated an open-source project, called Openstack, providing open source software for building public and private clouds. Also, Eucalyptus is a Linux based software platform for creating cloud computing IaaS systems. The project have an interface that can connect to Amazon's cloud systems (EC2, S3) and it offers also the possibility for developers to work in a private cloud on Eucalyptus platform with different technologies for system virtualization, including VMware, Xen and KVM (Sosinski 2011, 201-21).

Resuming this last section of the paper on intellectual property issues it follows that: (a) the setting of open standards and the interoperability between cloud services are hindered by licensing rules and patents; (b) the legitimacy of software patents and software copyrights is questionable given the fact that they are veritable monopoly privileges granted by courts via government legislation (c) in the field of cloud computing patents limits innovation (Berners-Lee, 2011) and shift resources used for developing cloud solution to the "patent arms race" and "patent war".

4. Concluding Remarks

Cloud computing services play an increasingly important role in software industry and services market. Given their undeniable advantages – affordability, easy access to information, outsourced IT management, lower costs etc. – many companies in almost all the fields of activity have chosen cloud based solutions for their businesses.

But in spite of its many benefits, cloud computing services have their disadvantages – e.g. risks concerning the privacy and the security of data in the cloud and lack of interoperability between cloud platforms. In the context of patent war between major software companies, the problem of standardization and interoperability represents an important challenge for cloud services. Intellectual property legislation and court ruling in patent litigations could impact negatively the process of standardization in cloud computing. Very often proprietary software companies try to patent key software features that make interoperability possible, precisely because they estimate important gains from such operations. Moreover, the patent arm race that escalated software and tech industry is impacting on cloud services, hindering innovation, increasing costs for start-up projects and diverting resources from genuine software engineering tasks to an offensive or defensive patent war.

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