"OPEN SOURCE" TECHNOLOGIES USED IN CLOUD COMPUTING IMPLEMENTATIONS

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Abstract: *History has revealed that open source standards are extremely beneficial for end users and is a catalyst for innovation. Similar to how open source technology has revolutionized the Web and made possible the Linux operating system, it will also have a tremendous impact on cloud computing. With regard to open standards and open source technologies top companies will achieve this for cloud computing. This time also, the winner will be the customer who will not be constrained by a single provider and will be free to choose the best platform based on an optimal set of capabilities that meet his needs [1]. This paper aims to present the important issues in cloud computing implementations using open source technologies and developments.*

Keywords: open source, cloud computing, open cloud, business analytics, cloud enterprise, cloud governmental

1. INTRODUCTION

Recently, IBM announced that all cloud services and software products will be based on open source architecture ("*open cloud*"). This will ensure the continuity of innovation in cloud technology, unreliable and difficult to manage offers being eliminated. Without open standards in the cloud industry, businesses will not be able to take the advantage of opportunities associated to interconnected data, such as the mobile computing technology and "*business analytics*."

As a first step, the company announced a new private cloud offer based on *OpenStack* open source platform. This significantly speeds up and simplifies "*enterprise cloud*" management system. For the first time, businesses can benefits of the availability of an open source technologies set for building enterprise cloud services that can be ported to hybrid cloud environments.

Being developed on basic customer needs, new cloud computing software provides flexibility by eliminating the need to develop specific interfaces for various cloud services [1-3]. With the new software, companies can combine different services and quickly deploy cloud infrastructure, aligning the components of processing, storage and networking via a user friendly graphical interface. The new software allows users to:

- Build new cloud services by combining the power of models based on cloud systems via a simple graphical interface for automation of cloud composition [2].
- Reduce operational costs with a system that can automate application deployment and cloud systems lifecycle management: computing, storage and network configuration, automate human tasks, "*third party*" integration tools, all being provided through a single platform cloud.
- Simplify end user cloud services consumption, using a "*self-service*" portal, including the ability to measure the cloud computing cost with counting and charging capabilities [1].

There were announced new versions of open standard software for helping companies to effectively monitor and control the enterprise cloud technology deployments. For example, there is software allowing companies to monitor real-time performance and availability of applications hosted in cloud and delivered through the Internet and public cloud hosted platforms. Two new programs, using analytics capabilities to anticipate scale of changes and use, are now available [4].

In addition, the new integration automates and extends the ability to control the cloud services on compliance, regulation and "*end point*" security or mobile devices, medical and automotive engines. The integration of these two products is possible due to the open standards OSLC (*Open Services for Lifecycle Collaboration*).

1.1. Open Standards

The elaboration of open standards has proved to be an important aspect in the success of technologies such as the Internet and operating systems. For the similar cloud development to its predecessors, manufacturing firms must produce only compatible cloud services.

A recent study of *Booz & Company* warns that without a concentrated effort for establishing standards and the leadership of large companies, the promises with regard to the cloud computing can't be achieved [5]. To learn more about the importance of open source in cloud computing and how to adopt - similar to Web innovation, we must exhaustively treat the subject.

A company applies open standards support and validation of Linux, Eclipse and Apache experiences to cloud computing technology. Working with the IT community, helps companies develop open cloud technology by:

- Creating a "*Cloud Standards Customer*" Board formed of 400 members (which originally included 50 members);
- Supporting OpenStack Foundation as founding members and top developers on planning and OpenStack project design;
- Supporting cloud computing standards such as *Open Services for Lifecycle Collaboration, Linked Data* in W3C and TOSCA in OASIS for developing cloud application portability;
- Over 500 open cloud project developers belonging to large companies;
- Close cooperation with the OpenStack Foundation, which already has over 8200 members from 109 countries and 1,000 organizations.

1.2. IBM and open cloud

IBM is one of the largest providers of private cloud with a big number of customers, a number that has increased by over 100% each year. IBM portfolio of cloud solutions [4], called *SmartCloud* is based on a common interoperability code, allowing corporate customers to move between private, public and hybrid cloud services.

IBM Orchestrator will be available this year. *IBM SmartCloud Monitoring Application* availability is scheduled for the second quarter. Analytic programs were available at the end of March 2013 [6].

IBM has helped thousands of clients for adopting cloud models and manages millions of cloud environment transactions every day. It helps clients in diverse sectors as banking, communications, healthcare and government to build their own cloud environments or to connect securely to infrastructure services and cloud-based business. It is unique in combining important cloud technologies, knowledge about processes, has a broad portfolio of cloud solutions and a network of global delivery centers.

OpenStack is an operating system that controls big computing systems, storage and storage resources through a data center, all being managed by a control panel that offer administrators the control, respectively the users with the access to the resources via a web interface [7].

2. EUROPEAN REGULATIONS BY THE EUROPEAN COMMISSION

Data protection and cloud security is an under construction building site in the European Union (EU). Personal data protection and security in the cloud continues to be one of the most discussed topics at the legislative level in the EU. European Commission (EC) supports the application of European regulations for protecting the personal data stored in the cloud [8].

European Commission Directorate responsible for the Digital Agenda has addressed the issue of protection of personal data with regard the U.S. authority's access to data stored on U.S. companies cloud sites located in Europe. It stressed that the European Commission will continue to support the application of European rules to protect personal data and that this topic is part of an ongoing dialogue with the U.S.

European Commission Report *on Cloud computing* published in 2012, contains several recommendations with regard to the international data transfers and aims to review the standard contractual clauses for the data transfer hosted in the cloud to countries outside the European Union.

ENISA has recently published a cloud computing report from the perspective of *Critical Infrastructure Protection*. The report contains a number of scenarios and threats that may arise by monitoring public sources of information. Taking into account the perspective that in the future, most organizations will rely on cloud computing services [8, 9], "*cloud services protection*" becomes a key factor for establishing trust in cloud computing

The report highlights the need to "*secure cloud services*" against attacks that could cause data losses, especially in IaaS and PaaS services serving cloud service (SaaS) vendors, which in turn provides cloud services for millions of users and organizations. Last but not least, the report highlights the legal and administrative disputes that may arise in the context of a fragmented regulatory framework for cloud computing services.

The main recommendations are related to the establishment of a "*cloud services security governance framework*" for including a detailed assessment of security risks and measures taken by the provider and a plan for incidents reporting and analysis.

Another issue concerns "*the practical application of the right to be forgotten*" and that should be the authorities that should ensure complete deletion of data in the context of their storage on cloud services. It must be emphasized that the principles underlying the right to be forgotten, is present in the European legislation ever since 1995.
Once the data is no longer needed for the purpose for which it was collected, they must be removed. The data protection regulations recently proposed by the European Commission, "*the right to be forgotten*" would require data processors "*deletion obligation*" for avoiding data collection and dissemination. Responsible controllers for data protection in the European countries will not have the responsibility to delete the data, but to take all necessary, including technical, measures, to inform data processors that the data subject requests the deletion, including the links that lead to the data, and avoid copying it to other media.

Standardization and interoperability are among the most important challenges of cloud computing. In general, the client wants to be able to use applications provided by many cloud providers; moreover, after a period of time even without any issues with the service, wants to be able to move to another provider. EuroCloud realized the need for regulatory consistency, transparency and standardization. Thus, were laid the foundations of a certification program, EuroCloud Star Audit, and a European working group on interoperability.

At the European level , was declared the *European Cloud Partnership* as one of the main directions of the Commission and its efforts to launch implementation plans leading up to the process of developing European standards for data protection and information security in cloud computing [9].

Among others, the European Telecommunications Standards Institute role is to propose and implement a set of technical standards in the field. This is a very important pillar of the strategy, along with the legal and international dialogue. Moreover, it was formally recognized the purpose and the development in the recent years of EuroCloud association.

2.1. Crypton open source project

Crypton is an open source software project that try to offer software developers an easy way to encrypting their applications in an attempt to countercount online surveillance efforts. The project was launched by SpiderOak, a company known for its online storage and synchronization service like Dropbox. The company differentiates itself by encrypting data in such a way that none of its employees can access it, unlike Dropbox, in which some employees have limited access to certain data types.

Crypton started as an internal tool that the company needed for some of its other software projects. The company wanted a secure way to encrypt data without users having to download a separate program. *SpiderOak* wanted also to create an easy way to use encryption for application developers.

Crypton is basically a framework that allows applications to encrypt data in a web browser before being sent to a remote server. Web browsers evolution in the recent years made possible the creation of Crypton. Web browsers JavaScript engines are more powerful and can perform encryption intensive tasks such as key generation needed to lock and unlock the encrypted data.

2.2. Convergent Infrastructures

A new marketing research conducted on behalf of HP, supports the need for solutions that cover both traditional media and the public cloud, externalized and private. Respondents indicated that 75% of business and operational managers plan to implement a hybrid delivery model. Meanwhile, 65% of them are worried about the limitations imposed by unique vendors, and 72% said that workload portability between cloud models is important for cloud implementations [10].

To ensure that cloud environments are affordable and easy to implement, companies have improved the functionality of existing solutions. The new improvements are built on converged infrastructure and *Cloud Service Automation* software that enables customers:

- To manage the requirements of cost, security and availability of cloud environments with open and extensible architecture for heterogeneous computing environments, including support for virtual machines based on Kernel and virtualization technologies from HP, Microsoft and VMware and physical provisioning server blade.
- To get instant access to additional capacity and manage requirements for services settlement incidents as required by the new performance of the solutions.
- To reduce the time required for administration and to accelerate the development of new services through an extensive portfolio that includes 50 new preinstalled applications templates.

The portfolio includes now over 200 templates enabling the customers to create custom catalogs with services for ready application immediate implementation.

3. MANAGING CAPACITY IN THE CLOUD

Capacity management is the most underestimated problem of cloud computing. One of the main reasons for using cloud computing services is the efficiency and the economy of costs. The maximum IT efficiency in the cloud originates from the capacity planning and good management. Unfortunately they are the most neglected aspects of cloud computing [9].

Many companies adopt cloud computing without preparing a detailed capacity management strategy as cloud platform is seen as infinitely elastic, and the capacity can be purchased when needed. Any sudden buying of cloud resources can be a costly action, and companies can mitigate costs by previous planning capacity and avoid over or under provisioning.

When cloud is used for high-level disparate and critical applications, it is important to think about storage requirements [10]. In our opinion, the cloud must be used to run intensive and critical applications and workloads, rather than just HR and email systems for providing its full benefits.

The problem is, however, that there are very few tools to identify the amount of resources in the cloud or the cloud's capacity. In the internal data centers have always been tools to determine capacity, being able to act accordingly, but this is not possible in the cloud, probably because it is not in the interest of cloud providers to advise consumers to buy less but often to buy in advance.

According to analysts, only when a third of cloud management providers will develop tools for this purpose, the capacity management shall become easier in the cloud. The new trend in cloud computing is to develop a strategy for "*virtual private cloud*". It essentially turns "*multi-tenant*" architecture in a "*single-tenant*" architecture. It is important to have a clear vision of what can or cannot penetrate the cloud.

The bad news is that there are very few proprietary applications of those that meet the criteria, but the good news is that all these applications are large in size and valuable, being able to generate efficiencies and cost savings [11].

3.1. The Security in the virtual media

Data security in virtual environments is often neglected, a study revealing that 48% of IT organizations reported or suspected unauthorized access to files on virtual servers. For this study, the firm *Varonis* interviewed 100 IT professionals. The results show that there is limited awareness in terms of security when it comes to virtual servers, but at the same time, 87% of respondents said their applications servers were virtualized [10].

The main reason of virtualization refers to the rapid deployment of operations (76%) and disaster recovery (74%). The study also revealed that the main area neglected in companies is the security of the files. While nearly 60% of the respondents said they show increased attention on setting and controlling subsequent updates, 70% of these have implemented small extend or no audit, this percentage including and 20% of large companies.

The survey results suggest that although virtualization allows IT to isolate applications and services via several clicks [12], this does not help the management of permissions and auditing. Data protection requires the same level of vigilance in a virtual environment - given the complexity of multiple operating systems - as a single device.

4. CONCLUSIONS

The concept of "*open source*" has produced a revolution in the distribution of applications with immediate effect on the quality of delivered applications. Many times, developers (other than those who wrote the original program) have detected errors in application source code, errors that were corrected and communicated to the manufacturer or contributed to the expansion of applications by writing additional modules helping to obtain a superior product quality.

"*Open source*" systems had an unprecedented development in the recent years, which allowed their penetration in the commercial sector for performance reasons and operating costs. Therewith, in the last period appeared increasingly often about the concern of states for introduction of "*open source*" technologies in the government cloud [3, 8] and in public administration.

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