

A Hybrid Cloud Computing Model for Higher Education Institutions in Saudi Arabia

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Abstract. Cloud computing is a new technology that has an increasing popularity among business enterprises especially small to medium enterprises. In educational institutions where information technology is backbone for conducting research and academic activities limited budget does not allow to acquire latest technology or upgrade the existing technology. Universities produce two different types of data i.e. intellectual data that needs to be shared among other institutions in order to keep updated each other and operational data that is used within a university for daily routine work. In this study a proposed hybrid cloud model is proposed for higher education institutions in Saudi Arabia in order to share intellectual data. The proposed hybrid model is viable under ministry of higher education in Saudi Arabia. Different aspects of the model have been discussed and efficacy of the model.

Keywords: Cloud computing · Cloud model · Cloud computing in Saudi Arabia

1 Introduction

Cloud computing is a new technology that has an increasing popularity among business enterprises especially small to medium enterprises. Since cloud computing is an evolving technology different people interpret cloud computing term in different ways and sometime they misinterpret the term in order to market their products. Cloud computing definitions have been reviewed by [1] and three main components were identified i.e. virtualization, scalability and pay-per-use service model that are the basics of cloud computing definition. In cloud computing framework computing resources are formed in a pool of resources on network and it allocates the required services dynamically to various applications based on user requirements. In cloud computing model users do not need to purchase any expensive hardware and just by paying the rental cost to the cloud provider all services can be availed. Since this model reduces cost and operational cost it is lucrative to organizations especially to small-scale enterprises [2]. Cloud computing model is comprised of two layers namely resource layer and service layer. Figure 1 shows the basic cloud model [4-6].

In the lowest layer of the service layer i.e. Infrastructure as a Service (IaaS) computing resources (memory allocation, processing time, disk based storage etc.) are provided to users. Users can run software of their choice using the resources and they

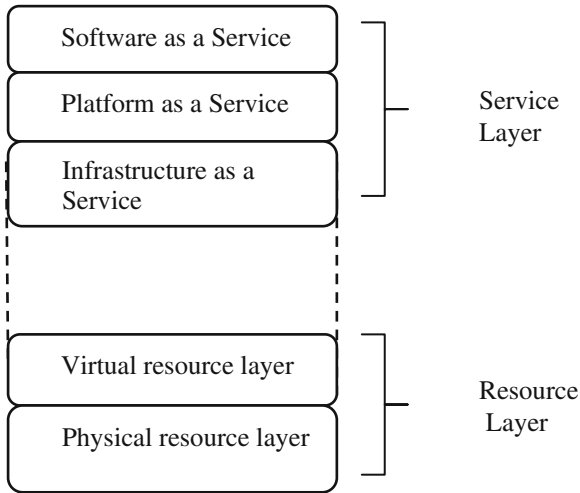


Fig. 1. A cloud computing layered model

are billed by their selection of choice [3]. The middle layer i.e. Platform as a Service (PaaS) provides personalized services in terms of software and hardware that enhance better performance. It provides to users a platform on which a user can develop and host their applications. This layer consists of an operating system and application development tools which are used to develop applications. The top layer of the service layer is Software as a Service (SaaS) that provides to users application environment such as email hosting where users have no control on the infrastructure.

The service layers are used by different users depending on their requirements; for example, IaaS service layer is used by large organizations that have resources to support applications and underlying platforms supplied by cloud service provider in order to save cost. The cloud computing framework can be used in educational environment in order to manage resources and keep updated with other institutions in the industry. Since private and public educational institutions work under financial constraints it is difficult to update with the latest information technology. It is almost impossible for organizations to be aligned with growing information technology. In order to have accessibility to latest IT tools and services and sharing research activities it is necessary to investigate cloud computing model and in the present study author strives to propose a cloud computing framework for educational institutions in Saudi Arabia.

2 Cloud Computing Model for Institutions

In many organizations cloud computing technology is being used due to its availability of virtualized resources [7]. Ministry of Higher Education (MOHE) in Saudi Arabia is responsible to dealing with higher education, creating higher education institutions, coordinating and supervising the post-secondary institutions. In Saudi Arabia there are 45 degree awarding universities/colleges (both public and private). Table 1 presents the details of the universities functioning in different regions of the Kingdom.

Table 1. Number of universities in Saudi Arabia

Province	Number of universities	
	Public	Private
Riyadh	7	8
Makkah	4	3
Madinah	4	1
Eastern Province	4	4
Asir	1	0
Hail	1	0
Najran	1	0
Tabuk	1	1
Al Jouf	1	0
Al Qassim	1	0
Al Baha	1	0
Northern Borders	1	0
Jazan	1	0

Universities produce intellectual capital data and the data that facilitate daily routine work. All educational material that includes course specifications, course reports, course material, curriculum, student's projects, assignments etc. are considered intellectual capital for an institute. When this capital is shared with other educational institutes a large number of people (teachers and students) would benefit them and cause reduction in duplication of efforts. If this capital is available to all universities under some authority and control then universities would extend their focus to innovative and creative ideas rather than re-inventing the wheel.

In addition to intellectual capital universities have their own data that they use internally to run business on daily routine basis. This data however cannot be shared with other universities and it is called as operational data.

Now the authors suggest a cloud computing model based on the above two types of data i.e. intellectual capital data and operational data. The proposed model can be called as a hybrid model that consists of two clouds i.e. public cloud (intellectual capital data) and private cloud (operational data).

In the proposed model it is suggested that a hybrid computing model would facilitate universities in Saudi Arabia to share knowledge and research activities. Since MOHE is responsible to coordinate and supervise higher education institutions in Saudi Arabia public cloud that consists of intellectual capital data generated by universities is owned by the ministry and it can be called as MOHE cloud. The operational data that is purely generated by the universities in order to running daily routine activities are placed in a private cloud and can be called as university cloud. Figure 2 shows the hybrid cloud model.

In the hybrid cloud model MOHE cloud is a public cloud that owns all the intellectual capital data generated by universities such as assessments, course specifications, course reports, course material, etc. that would be shared by any universities approved

by the MOHE. However, MOHE would be responsible to place security and monitoring controls in order to prevent data from plagiarism. Universities which contribute in this cloud by supplying data are considered as source of information and those who receive data from the cloud are considered as sinks. A university can be considered a source and sink of the cloud at the same time.

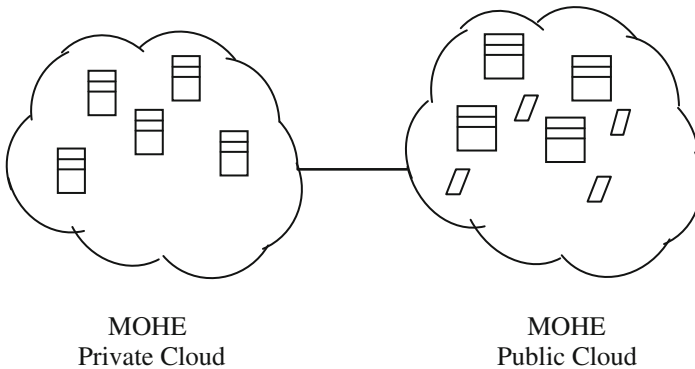


Fig. 2. A hybrid cloud model

University cloud is a private cloud where operational data of an individual university is placed. The data is sole propriety of the university and is inaccessible to other universities. Universities may grant access to the data to different users depending on their requirements. Students of a university may access their exams schedule or exam results without visiting university personally. However, security controls need to be more effectively implemented in the cloud as any breach of security may cause disastrous results.

3 Efficacy of Model

The hybrid cloud model will have great effects on educational institutions as well as on Saudi ministry of higher education which may develop and maintain a pool of knowledge and research material. This cloud however has great advantages such as a treasure of knowledge at one place and encouragement to other institutions to participate in increasing knowledge and research by using existing data and applying innovative ideas of their own. Another benefit of the cloud is to provide support in terms of assessment, projects and course material in order to improve effectiveness and quality of teaching. Since the MOHE owns the cloud a constant monitoring would help the ministry to identify and provide guidelines to improve quality of teaching at some universities that are found below the set criteria of quality.

The model will save huge budget of IT infrastructure spent in universities in order to provide and maintain IT services within universities. Universities are required to pay a usage fee to service provider since all IT infrastructure is maintained by the service provider. Hence, universities can utilize the latest technology without investing in

acquisition of technology. The model provides information accessibility to its users with convenience and comfort any time and day they wish to access. Students may have access to a number of academic resources that may help them develop their knowledge and skills [8]. The private pool of universities facilitates students to access their exams schedule and results immediately they are announced without visiting universities. MOHE of Saudi Arabia would be in a position to monitor and align all higher education institutions to the required standards and guidelines provided by the ministry. This model will save heavy government investment that is required to purchasing hardware, software, networking and communication devices for research and higher education institutions.

4 Conclusion and Future Work

Cloud computing technology has helped business organizations especially small to medium business enterprises to benefit from the latest technology in order to manage their information. In the present study we have presented a hybrid cloud model that would facilitate business organizations to share and contribute knowledge and research in higher education in Saudi Arabia. The implementation of this model will save heavy investments in technology infrastructure in higher education and provide opportunities to sharing knowledge and research among universities. We intend to validate this framework in future and since strict security measures and controls are needed to implement the model; there is a need to investigate different security models and propose a viable security model that can be implemented in a hybrid cloud model for higher education.

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