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Cloud Computing Approaches, Characteristics and Cloud Computing Status in the Arab World

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Abstract

Many technological terms have arisen with the Internet evolution, among these is Cloud Computing. Cloud services have gained a solid position in the field of Information Technology (IT). Cloud computing offers scalable and virtualized resources as services over the Internet. Cloud computing is an innovative computing improvement that provides computing services free of physical boundaries and minimum equipment requirements. Cloud Computing offers new methods to provide valuable services at affordable costs, that is what made it a target service in the developed and developing countries including Arabic states. Many of the developing Arab Countries have made advances in utilizing cloud computing services in different fields such as Saudi Arabia, United Arab Emirates, Qatar and trying to overcome many challenges to widen the services applications while others are still in their early steps.

This paper aims to view all the data that explain cloud computing, its approaches, services, the advantages and concerns that surround it, features and uses and also this paper views brief history for the development of cloud computing technology.

Few studies have shed the light over cloud computing technology in the Arab Countries. In this geographical area the available data of all fields of application is not gathered and discussed in previous articles. Thus, this paper presents facts and documented numbers related to Arab countries position in the field of IT industry, in addition to viewing some recommendations regarding the challenges these countries face like the lack of skilled manpower, security issues, and network connectivity issues.

Key words: Cloud Computing, Cloud Services, Arab Countries, Cloud Computing Characteristics.



أساليب الحوسبة السحابية وخصائصها وحالة الحوسبة السحابية في العالم العربي

الملخص

نشأت العديد من المصطلحات التكنولوجية مع تطور الإنترنت ، من بينها الحوسبة السحابية. اكتسبت الخدمات السحابية مكانة قوية في مجال تكنولوجيا المعلومات حيث توفر الحوسبة السحابية موارد قابلة للتطوير من خدمات عبر الإنترنت. الحوسبة السحابية هي تحسين مبتكر للحوسبة حيث توفر خدمات الحوسبة خالية من الحدود المادية والحد الأدنى من متطلبات المعدات. توفر الحوسبة السحابية أساليب جديدة لتوفير خدمات قيمة بتكلفة معقولة ، وهذا ما جعلها خدمة مستهدفة في البلدان المتقدمة والنامية بما في ذلك الدول العربية. حققت العديد من الدول العربية النامية تقدماً في استخدام خدمات الحوسبة السحابية في مجالات مختلفة مثل المملكة العربية السعودية والإمارات العربية المتحدة وقطر وتحاول التغلب على العديد من التحديات لتوسيع تطبيقات الخدمات بينما لا يزال البعض الآخر من البلاد العربية في خطواتها المبكرة في استخدام هذه التقنية.

تهدف هذه الورقة البحثية الوصفية إلى عرض جميع البيانات التي تشرح الحوسبة السحابية ، ونهجها ، وخدماتها ، والمزايا والاهتمامات التي تحيط بها ، والميزات والاستخدامات ، كما تعرض هذه الورقة تاريخاً موجزاً لتطوير تكنولوجيا الحوسبة السحابية.

القليل من الدراسات ألفت الضوء على تكنولوجيا الحوسبة السحابية في الدول العربية ، كما في هذه المنطقة الجغرافية ، لم يتم جمع البيانات المتوفرة لجميع مجالات التطبيق ومناقشتها في مقالات سابقة. وبالتالي ، تعرض هذه الورقة حقائق وأرقام موثقة متعلقة بمكانة الدول العربية في مجال صناعة تكنولوجيا المعلومات ، بالإضافة إلى عرض بعض التوصيات المتعلقة بالتحديات التي تواجهها هذه البلدان مثل نقص القوى العاملة الماهرة ، وقضايا الأمن ، وقضايا الاتصال.

الكلمات المفتاحية: الحوسبة السحابية ، الخدمات السحابية ، الدول العربية ، خصائص الحوسبة السحابية.



1. Introduction

The word (Cloud) in Information Technology (IT) field states a Network or Internet. The phrase suggests the availability of something in an inaccessible area (Malik, Wani & Rashid, 2018). Rittinghouse & Ransome (p.24, 2009) described the term cloud as a “metaphor used to represent the transport of data across carrier backbones - which owned the cloud - to an endpoint location on the other side of the cloud”. Ashraf, A., et al. (2013) explain that clouds could be considered as a wide range of usable virtualized bases and references and can be vigorously reconstructed to different scales permitting ideal operation. Cloud could be considered beneficial over framework or web, i.e., on open frameworks or on private frameworks. Different services such as, e-mail, online meetings and other services all continue running in the cloud (Malik, Wani & Rashid, 2018). However, cloud computing term had been widely defined in literature by the perspective of the author. For example Zhang et al. (2010) defined cloud computing as an extended branch to three key computing technologies, which are grid computing, cluster computing and parallel computing and the technology was described as user-friendly version of grid computing by Trevor Doerksen as mentioned in Geelan (2009) article where the author viewed several definitions for Cloud Computing, some of which described it as various Internet-based services that work by the 'pay as-you-go' basis with minimal technological complexity and minimal complicated deployment worries. Cloud computing is created to provide various IT technologies regardless of the time and place, for example, mobile platforms that imitate the potential of regular computing in improved ways allowing updates and changes in an advanced smart way unlike traditional computing (Varnika, 2018).

When tracking the history of cloud computing, we find that it is rooted since 1960s by John McCarthy (Varnika, 2018). During the 1960's and 1970's “time-sharing” services were provided by major banks to local and far-off users. During 90's and early 90's, major data centers became regular requirements in big companies.



The later advancement was the ease of access and availability of the Internet which allowed the enrollment of Amazon Web Services (AWS) in 2002 which afforded several cloud services like storage and computing, later on Amazon continued developing the services and enabled companies and individuals to rent their services to make specific needed computations through compute cloud, widely known as Elastic Compute Cloud EC2 clusters (Alzaharani, 2016). Google followed amazon in using cloud computing services in 2009 when it announced “google apps” adds-on which allowed developers to create products and host it on Google servers as web application (Sanderson, D., 2009). After that, Apple launched iCloud and Microsoft launched OneDrive they both represent cloud storage products. Microsoft Azure was also launch which extends its services to vary between online storage, Application Programming Interfaces APIs, web applications and others (azure.microsoft.com). To be more specific, Cloud providers cater various types of cloud services: Infrastructure as a Service (IaaS); Platform as a Service (PaaS); Software as a Service (SaaS) and these will be discussed later in this paper.

As time passes, the number of competitors in this area increase and experts expect that cloud computing technology will get cheaper and more affordable and reachable for users, particularly for tech-startups and entrepreneurs. The world is moving very quickly in computing technologies, The United States, China, India, Vietnam, Brazil, and South Korea encompass the biggest computing services market (A.A. Ellatif, 2016) while Cloud computing is in its peak in developed countries it still in its early stages in developing countries due to the ignorance of the potentials of Information and Communication Technologies (ICTs), thus The international IT market, aided by developing countries’ governments, paid much consideration to hosting and encouraging the use of cloud computing. (Kshetri, 2010; A.A. Ellatif, 2016).

This paper aims to review the types, characteristics, advantages and disadvantages of cloud computing. The paper also aims to present a detailed review for the cloud computing development status and uses in the Arab countries as most of these countries lie under “developing countries” description which are witnessing variable interest and usage for the cloud computing technology,



some research studies had investigated the technological status specially in cloud computing in the Arab States but have not been gathered and discussed in previous review articles.

2. Cloud Computing Models and Characteristics

2.1 Cloud Computing Models and Services

Several types of services and models lie behind the expediency of cloud computing technology that makes it an open service to end clients. Two major types of working models are the driving force of cloud computing: Deployment Models and Service Models.

A. Deployment models: These models differentiate the type of approachability to the cloud environment, and these are classified into four types as follows:

- 1) Public cloud: This cloud is reachable to all the exterior customers via the web where only a registration with cloud is needed to utilize cloud resources on a pay-per-use model. This cloud model is open for users which makes it less secure than the private cloud. The cloud setup is controlled and achieved by a large Cloud Service Provider (CSP). The public cloud is oriented for organizations that rely on sharing their resources, software and platforms openly with the users. Examples of public cloud service providers: Google, HP, DELL, and Amazon (Mas'adeh, 2016; Malik, Wani& Rashid, 2018).
- 2) Private cloud: This cloud is systemized mainly for the organizations that have their own data base. These control the cloud services that are only owned by them. This cloud model provides enhanced security system in comparison with other cloud models. Private cloud resources are less costly than public cloud, however, it provides better outcomes. Private cloud is commonly known as inward or corporate cloud as it can be present inside or outside the organization's border. Examples of private cloud providers are: Cloud stack, Rackspace and Red Hat cloud (Mas'adeh, 2016; Malik, Wani & Rashid, 2018).



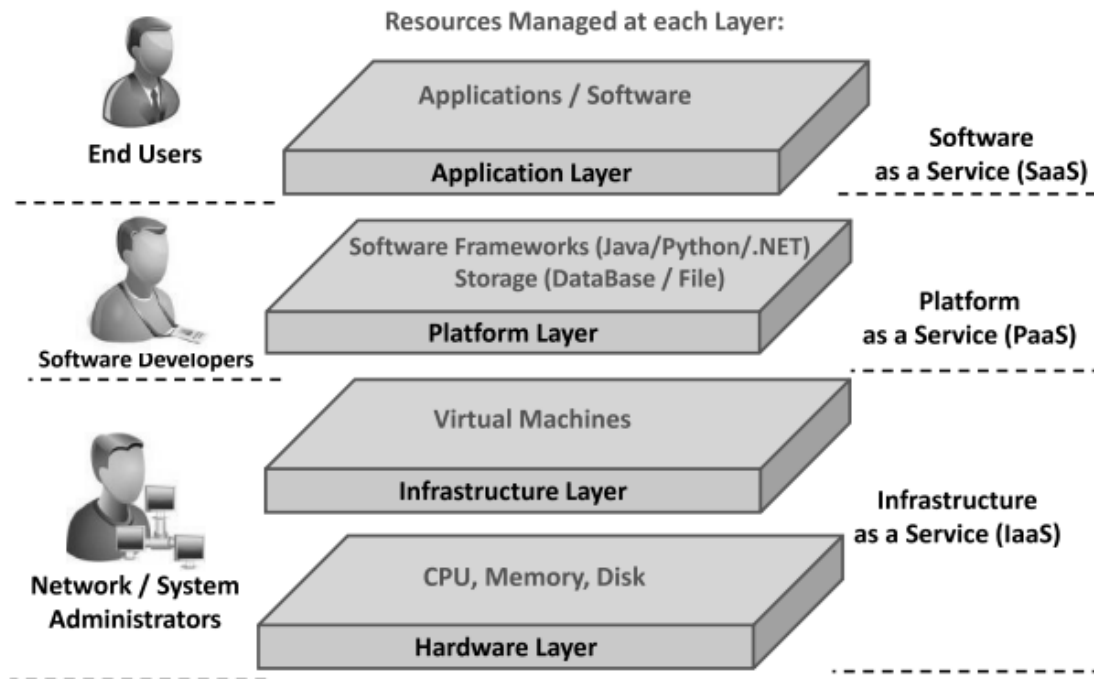
- 3) Community cloud: This cloud is designed when few organizations build and provide the same cloud infrastructure, strategies, constraints, standards and concerns. The cloud infrastructure is vulnerable to be enabled by a third-party vendor or an internal one of the shared organizations, this cloud is considered a subclass of the public cloud, but provides better security. Examples of community cloud providers are Cisco systems and Intel corporation (Mas'adeh, 2016; Malik, Wani& Rashid, 2018).
- 4) Hybrid cloud: As the name implies, this cloud is made up of all the previously mentioned models, also known as half and half cloud. A hybrid cloud is defined by Hurwitz, Kirsch & Kaufman (p.4, 2015) as “an environment that integrates traditional IT with a combination of public, private, or managed cloud services”. The essential activity is accomplished by private cloud whereas the non-critical activity is done by public cloud. The hybrid cloud models rely mainly on interior IT infrastructure, that is why it is crucial to maintain excess crosswise over data centers (Malik, Wani & Rashid, 2018).

B. Service models: A cloud can connect with a customer (client or application) in a variety of routes by abilities called services. Services Models are the efficient, practical models where the cloud computing works. Through the Internet three main types of services have developed:

- Software as a Service (SaaS): One of the known examples is the use of Google Apps. SaaS is a model of software placement where an application is introduced as a service available to customers through the Internet. SaaS is considered to be a business software rather than being a buyer software (Kulkarni, Gambhir & Palwe, 2012).
- Platform as a Service (PaaS): Employing cloud services as a platform to store data and to preserve large databases on cybernetic servers from where data can be retrieved in reality, through application programming interfaces and some other form of graphical or command-line interface. Windows Azure by Microsoft is an ideal example (Ahmad & Waheed, 2015).
- Infrastructure as a Service (IaaS): IaaS providers like Amazon manage to provide the flexibility to install and run any software environment efficiently using cloud computing infrastructure which includes using hardware components, networking operations,

and programming tasks (Goyal, S., 2013; Ahmad & Waheed, 2015). Figure (1) presents Cloud Computing Architecture, controllers of each service provided by cloud computing.

Figure (1): Cloud Computing Architecture (Givvehchi, et al., 2013)



2.2 Cloud Computing Characteristics

Grobauer, Walloschek & Stocker (2011) defined important and basic features of cloud based on the US National Institute of Standards and Technology (NIST) description as:

well what it means to provide IT services from the conveyor belt using economies of scale:

- **On-demand self-service:** This feature eliminates the need for human interaction as users can control services solely using a ‘pay-and-go’ method delivering and receiving services and related resources are automatically achieved at the provider.



- Ubiquitous (Broad) network access: Cloud services are reachable through the network, these services using standard mechanisms and protocols. The expressions of “easy-to-access standardized mechanisms” and “global reach capability” are also used to describe this characteristic (Jula, Sundararajan & Othman, 2014).
- Resource pooling: Providing different resources in the cloud actively using a homogeneous infrastructure that is common among all service users.
- Rapid elasticity: It can also be named as scalability where the resources can scale up or down whenever needed.
- Measured service: Service usage is continually computed, supporting optimization of resource usage, informing the customer with the usage.
- Multi-Tenacity: This concept is proposed by Cloud Security Alliance, it implies that it is crucial to own models for policy-driven application, division, segregation, and service quality for different consumer groups (Espadas et al., 2013).

2.3 *Cloud Computing Advantages and Disadvantages*

Just like every rising and speedily developing technology, cloud computing services are priviledged with many advantages and criticized by some disadvantages or to be more specific there are some concerns about it. In the following are the most important of both advantages and disadvantages of cloud computing.

2.3.1 *Cloud Computing Advantages:*

- Cost efficiency: This technology is considered as the most cost efficient service to use preserve and update in comparison with the conventional computer software which costs companies a lot financially, cloud also provides multiple payment options, one-time-payment, pay-as-you-go and other scalable options available (Apostu, et al. 2013).



Also, the man power needed for cloud computing systems is not required. Even simple applications like email stems vis applications like Google Apps (Varnika, 2018).

- Easy management: Hardware and software maintenance of the infrastructure is easy and does not require highly skilled IT team. The requirements at the user level are not complicated, only a web browser connect to the internet is what it takes to run the service (Varnika, 2018).
- Uninterrupted Services: Cloud computing services do not suffer of outages, so stable uninterrupted continuous – rarely failed - services are provided to users. As well, cloud provides an offsite backup which is crucial in storing and backing up data in cases of disasters and even systemized for disaster recovery (Apostu, et al. 2013; Kaur, 2015; Varnika, 2018).
- Green Computing: Heavy use of systems in institutions leads to the production of enormous amounts of electronic waste which is one of the factors that lead to the “green effect”, using cloud computing services reduces these waste products to a certain limit preserving the environment (Varnika, 2018).
- Quick Deployment: Finally, and importantly, Cloud computing services is characterized with quick deployment feature.

Of course, advantages do not stop there, the obtainability of high-capacity networks, the prevalent adoption of hardware virtualization, service-focused infrastructure, autonomic and efficacy computing lead to a continuous growing in cloud computing (A. Ellatif, (2016); Varnika, 2018).

2.3.2 Cloud Computing Disadvantages

On the other hand of all the previously mentioned advantages, some concerns accompany this service such as:



- Data security: Storing large amounts of data that is oriented around user privacy, identity, and application-specific preferences in centralized locations raises many concerns about data protection. (Rittinghouse and Ransome, 2009).
- Highspeed access to the Internet and service continuity: Cloud computing is weak if not supported with high speed internet (Rittinghouse and Ransome, 2009). The continuity of service might seriously be affected by the speed of the network, the power status (any power cut-off would stop the service), and system bugs might affect the quality of the service as well (Qian, et al. 2009).
- Standardization: Technical standards utilized in the different services provided by cloud computing are not fully defined, publicly assessed and endorsed by a managing organization. (Rittinghouse and Ransome, 2009).

3. Cloud Computing in the Arab World

Reaching the ideal potential of cloud-based technologies in developing countries is a real challenge specially to their governments. Based on (UN Human Development Data, 2019), most of the Arab countries belong to the developing countries. Several challenges face the Arab States in applying cloud computing including the following as indicated by A.A. Ellatif (2016).:

- ICT infrastructure holdups: Many Arab countries lack the required bases to cloud computing services as modern equipment and techniques.
- Performance: some applications are oriented to transactions, businesses and other rigorous data applications, whereas, Cloud Computing may suffer with appropriate performance as cloud providers may face delays and low speed working, this is due to low-skilled personnel.
- Security and Privacy: companies in the Arab states still worry about security when using Cloud Computing no matter how assurances are given. Customers are also concerned about experiencing attacks when the significant sources and IT information are existing outside the Fire wall.



- The cost of data transfer rate: Money saved with cloud computing from the hardware and software costs is spent on the high data transfer rate cost for the web as the low-cost data transfer rate could be used only for the services that is not data-intensive only.

In developing countries, cloud activities are focused on the large economies like China and India. However, in the Arab countries, Gulf Arab countries are taking quick steps toward cloud computing. Arab countries also are getting much attention from leading companies in cloud computing as DELL company announced offering cloud services to companies in the Middle East and Saudi Arabia (Karim & Rampersad, 2017).

According to the Information Society Report – ITU (2015), and based on the ITU ICT Development Index “*The ICT Development Index (IDI) is a composite index that combines 11 indicators into one benchmark measure that can be used to monitor and compare developments in information and communication technology (ICT) between countries and over time.*” The sixteen Arab countries included are ranked from 27 to 150 out of 162 classified countries as shown in Figure (2). A noticeable change is recorder in 2015 in comparison to 2010.



Figure (2): IDI rankings, Arab States region in 2015, (Information Society Report – ITU, 2015)

| Economy | Regional rank 2015 | Global rank 2015 | IDI 2015 | Global rank 2010 | IDI 2010 | Global rank change 2015-2010 |
|----------------------|-----------------------|---------------------|-------------|---------------------|-------------|------------------------------------|
| Bahrain | 1 | 27 | 7.63 | 48 | 5.42 | 21 |
| Qatar | 2 | 31 | 7.44 | 37 | 6.10 | 6 |
| United Arab Emirates | 3 | 32 | 7.32 | 49 | 5.38 | 17 |
| Saudi Arabia | 4 | 41 | 7.05 | 56 | 4.96 | 15 |
| Kuwait | 5 | 46 | 6.83 | 45 | 5.64 | -1 |
| Oman | 6 | 54 | 6.33 | 68 | 4.41 | 14 |
| Lebanon | 7 | 56 | 6.29 | 77 | 4.18 | 21 |
| Jordan | 8 | 92 | 4.75 | 84 | 3.82 | -8 |
| Tunisia | 9 | 93 | 4.73 | 93 | 3.62 | 0 |
| Morocco | 10 | 99 | 4.47 | 96 | 3.55 | -3 |
| Egypt | 11 | 100 | 4.40 | 98 | 3.48 | -2 |
| Algeria | 12 | 113 | 3.71 | 114 | 2.99 | 1 |
| Syria | 13 | 117 | 3.48 | 106 | 3.14 | -11 |
| Sudan | 14 | 126 | 2.93 | 127 | 2.05 | 1 |
| Djibouti | 15 | 148 | 2.19 | 143 | 1.69 | -5 |
| Mauritania | 16 | 150 | 2.07 | 146 | 1.63 | -4 |
| Average | | | 5.10 | | 3.88 | |

In 2017 a project by MENA Cloud Alliance developed a Cloud Competitiveness Index 2017 (CCI2017) view of the cloud status, now and for a continuous basis. This measure evaluates the affordability of the cloud computing ecosystem for the six Gulf Cooperation Council countries: UAE, Qatar, Bahrain, Kuwait, Oman & KSA. The report has indicated that the most cloud-competitive economies were (UAE and Qatar) respectively, however, their score in ‘Affordability’ pillar of the ‘Connectivity’ domain was considered low. Doha, Dubai & Kuwait City are rated within top 50 most talent -competitive cities in the world (32nd, 36th, and 43rd respectively). Regarding to Saudi Arabia, it is mentioned in the report that Saudi Arabia’s Communications and information technology Commission (“CITC”) has recently invited public suggestions coming back to its proposed guideline of cloud computing.



Vision 2030 objectives stress on developing a strong cloud services industry in Saudi Arabia as a key to create a developed digital infrastructure, which is essential to the current advanced industrial activities.

Moreover, in Saudi Arabia the government has used cloud computing technology in developing e-government applications to improve services provided by the public sector through e-government program (YESSER). It is observed the ability and will of Saudi Arabia to have a public cloud locally and under their power, However, shortage of infrastructure and skills, are two major challenges that (Karim & Rampersad, 2017). Currently two telecommunication companies have taken the chance to provide cloud services in Saudi Arabia (Alsanea, 2015). United Arab Emirates (UAE) also has boarded on a number of e-applications to improve and speed up government activities, Qatar is also following the same steps (N. ALMutairi & Fahad Thuwaini, 2015).

In a wider research that included more Arabic countries Mas'adeh, R. (2016) collected data from firms in Jordan, Saudi Arabia and United Arab Emirates via a questionnaire. The research was one of the few if not the only to test the underlying series of technological, organizational, and environmental variables on cloud computing adoption utilizing combination of Technology Acceptance Model (TAM) model and Technology-Organizational-Environmental (TOE) framework. The study concluded relative advantage, compatibility, complexity, organizational readiness, top management commitment, and training and education as important variables for impacting cloud computing implementation in these countries.

In the educational and research field in Arab countries, Kamoun, F. et al. (2016) collected related data based on an online questionnaire which aimed government departments, engineering schools, faculties and research centers, and educational data centers. Forty replies provided by organizations from 10 Arab countries were usable and the study revealed that 52% of surveyed institutions are either in the production, implementation or test phase which is a fair result.



Working group of studied using accessible documents and material published on the net generally by the major cloud providers to find Arab educational organizations that have adopted the cloud and it revealed that:

- Morocco is leader in Africa in cloud computing adoption.
- In Tunisia, four higher education organizations implemented public clouds.
- In Jordan and Saudi Arabia two universities in each country have implemented the cloud, while a few organizations in Qatar and Sudan implemented the cloud.

4. Conclusion

In conclusion, cloud computing technology is an ideal one to keep up with the speedily moving technology, and despite its challenges, it still the most widely used technological service due to its encouraging features. In the developing Arab countries, Cloud computing has already taken a major part in daily life using a wide range of cloud provided applications such as Google Maps, Facebook, Microsoft Hotmail, and so on.

Arab countries have taken solid steps especially Arab Gulf Countries in adopting cloud computing in the governmental services, however, other majors and aspects worth adopting this technology such as education, health, research, and this would be applicable by getting over the major challenges that Arab countries face of connectivity, skilled manpower, security issues and others.



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