Cloud Computing Topology: Towards Enhancing the Performance

Tariq Alwadan
The World Islamic Science and Education University

Cloud Computing Topology: Towards Enhancing the Performance

Tariq Alwada'n
Faculty of Information Technology
The World Islamic Science and Education University
Amman, Jordan
Tariq.alwadan@wise.edu.jo

***Abstract*— the fascinating world of Cloud computing has definitely changed the way of using computers and the Internet. The impact it has left so far on how IT and business services are delivered and managed is undeniable. Cloud computing is intended to permit access to huge quantity of computing power by combining resources and providing a solo system interface. A significant goal of this computing technology is to provide an information technology service model in which service provider creates computing resources and delivers them on demand. The cloud broker is the core of the cloud system as it behaves as a conciliator among two or more parties. I have introduced a new topology where the cloud broker has the ability to store the results of the cloud user requests for a specific period before sending them back to the cloud consumer or users. The aim of this topology is to save time and money when the cloud users decide to run the process all over again.**

Keywords—cloud computing; grid computing; cloud broker; private cloud; public cloud; hybrid cloud.

I. Introduction

As a result of the technological advancements in communication and networking, a global grid as an outcome product of a mixture of a range of computer system networks to obtain a diverse array of uniform and diverse systems deployed to provide solutions to several technical and industrial issues including cost, speed, encryption, etc. [1]

A structure which has the capability to organize resources, including management and processing, is called a Cloud. For instance, hard drive, software applications, random access memory and central processing unit of a computer, which are not restricted by a primary domain, set up interfaces and protocols to deliver elevated service quality. Therefore, the important advantage of employing cloud environment is its potential to arrange and distribute resources [2]. Various concerns such as searching proper resources and reducing the amount of delayed jobs must be resolved for the growth of cloud environment.

A. Roots of Cloud Computing

The comprehensive idea of conveying computing resources with the help of a worldwide network was entrenched in the 1960's [4]. The cloud computing roots can be tracked by analyzing the development of various technologies, particularly hardware, software, and Internet technologies. According to Broberg , Joseph Licklider gave the concept of "intergalactic computer network." He also presented the idea of allowing expansion of Advanced Research Projects Agency Network (ARPAN) in late sixties. "His vision was for everyone on the globe to be interconnected and accessing programs and data at any site from anywhere"[4]. Figure 1 given below demonstrates the congregation of technology departments that considerably developed and contributed to the introduction of cloud computing.

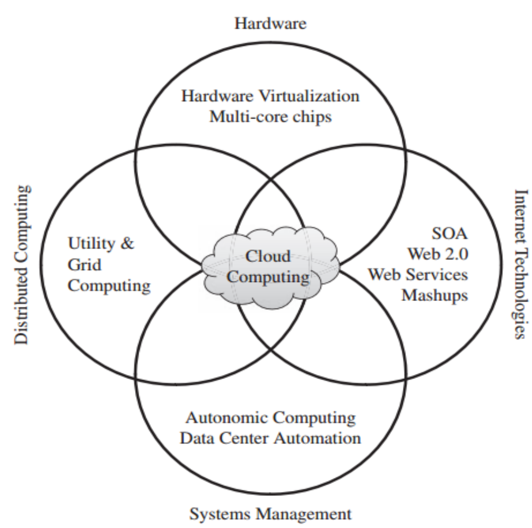


Fig. 1. Technology departments in Cloud [4]

B. Mainframes to Clouds

Mainframe cloud provides an advantage to providers, clients, and users of service. Clients can get economical prices and cost-efficiency by selecting economical services from outdoor providers [5]. The clients can achieve IT services according to their computing and usage needs through pay-per-use "on-demand" feature of this model. On the other hand, providers can attain enhanced functional costs. Mainframe cloud infrastructures are developed to offer to cater multiple users through compound solutions, hence the effectiveness and competency.

The mainframe provides several benefits for Cloud computing. Some of the benefits are: [5]

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

- Vitality: The latest mainframe provides an extremely vital platform with the highest level of accessibility, dependability, redundancy, protection, reliability, and performance.
- Protection: The modern Mainframe Cloud execution ensures improved system with a great level of protection intelligibility offering an outlook around the organization. Organizations can computerize the analysis supervision of possible inside and outside threats. They can also reduce the safety threats intrinsic on public Clouds.
- Transfer: Simple transfer of scattered workloads to the mainframe virtualized environment lessens the number of distributed systems that require being administered.

C. Grid Computing

Grid computing is the gathering of resources of many computers from different locations in order to solve a single problem at a time. The problem can be scientific or procedural which requires multiple computers to access large amount of data [6]. The grid can be assumed as a circulated system with unconnected workloads to absorb huge number of files. A doctor analyzes patient record on a server and uses the whole network of computers to examine data [7].

A major feature of grid vision is developing Internet-based protocols which enable circulated resources to be “discovered, accessed, allocated, monitored, accounted for, and billed for and in general managed as a single virtual system” [8]. The following benefits provided by grid computing make grid computing a potential trend. The benefits can be summarized as: cost-efficient implementation of resources, performance efficiency by combining multiple computer resources and resources of multiple computers tie up cooperatively and administered as an association towards single goal [7].

Clouds mainly consist of data centers which are owned by the same institute. The homogeneity within each data center in the infrastructure is the main feature for the cloud computing compared to grid computing. In this case, any conflict between a heterogeneous data centre and/or different administration domains can become a serious issue for cloud interoperability. It can be seen that the stages of anonymity and privacy provided by cloud to the external users will be less than the user of desktop in numerous situations. On the other side, grids was originally established on the idea that resources infrastructure are dynamic and heterogeneous in their nature. This means different organization with different administrative domains. This also means that security was taken into account from the beginning when the grid system was originally built.

This paper is organized as follows. Section II gives an overview of the Cloud Computing Deployment Models. In Section III presents the cloud architecture. Section IV gives a brief description on how the cloud computing works. The details of proposed topology are described in section V. Section VI discusses the results of simulation. The paper ends with the conclusion in section VII.

II. Cloud Computing Deployment Models

These models are concerned with the purpose and the nature of the cloud in order to know which deployment model is suitable for the work requirements. This novel concept of model consists of three popular models among others, namely public, privet and hybrid [9] [10].

- **Public Cloud**: it is classified as cloud hosting where the cloud services are carried over a network which is open for public usage. In this model the service provider gives services and infrastructure to a number of clients. The clients do not have any control and ability over the location of the infrastructure. From the technical opinion, there may be minor difference between private and public clouds’ structural model except in the stage of security.
- **Private Cloud**: is also famous as internal cloud; the design for cloud computing is applied on a cloud-based secure environment, that is protected by a firewall. This model should be under the control of the IT office that belongs to the specific organization. Private cloud as it lets only the authorized users, grants the organization superior and exact control over their data.
- **Hybrid Cloud:** In a hybrid cloud, the resources are run and supplied either in-house or by external providers. It is a mixed between two platforms in which the workload exchanges among the private cloud and the public cloud as client the need and requires. Resources that are non-sensitive can be stored in the public cloud that belongs to a third party provider. While the sensitive Information that is critical or sensitive must be stored internally.

III. Cloud Architecture

The designs of software applications, which utilize on-demand services that are accessible through Internet, are called cloud Architectures. These applications utilize the underlying computational infrastructure only when (1) it is desirable (for instance to perform a client’s job), (2) required resources are acquired on demand, (3) a particular job is performed followed by surrender of the unnecessary resources, and (4) often self-disposal is also performed after the job is finished. A generic model of Cloud architecture is depicted in Figure 2 [11].

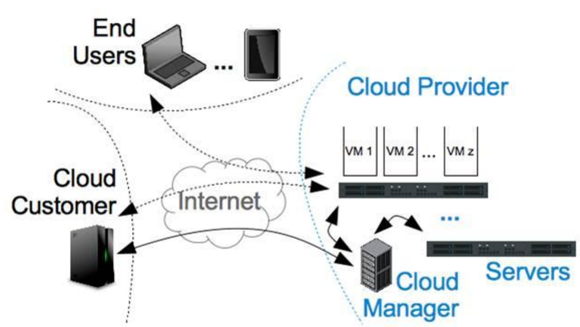


Fig.2. General Cloud Architecture [11]

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

A. Cloud Architecture Layers

Figure 3 below shows the relation among Cloud architecture layers, which are IaaS, PaaS, and SaaS.

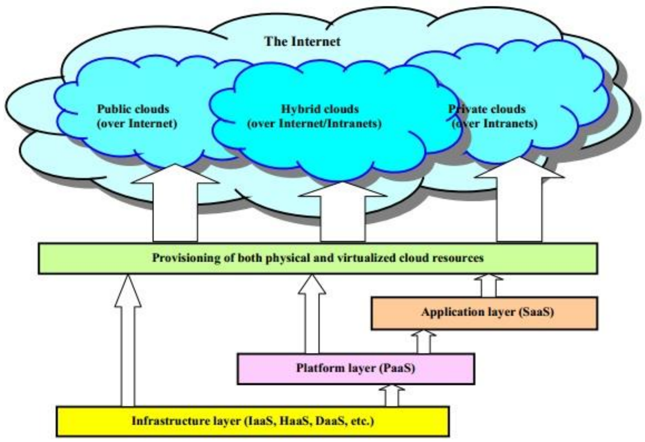


Fig.3. Cloud layer [12]

- Infrastructure as a Service (IaaS): is a service provision/business model which offers virtualization of resources on-demand [13]. In this model, the organization externalizes the use of tools which are used to perform operations. The provider is the owner of the tools and is responsible for hosting, managing, and executing the infrastructure. The customer is used to pays on pay-per-use criteria on-demand. [14] By using web based - graphical user interface that performs as an operation management console, customers can perform self-provision when using this service. By using this service, the user is also offered Application Program Interface (API) access to the infrastructure [15].
- Software as a Service (SaaS): is a storage and delivery model where the client gets the storage space from the provider on rent [16]. The data is put on stack form on the Internet, and the service providers provide their software to the client through which they can access their data. The software is known as "on-demand software" [17]. The users can access SaaS through the web browser. The software provided by the provider is used to perform storage related tasks such as backup and transfer of data. SaaS is gradually becoming extra prevailing storage model as primary technologies that support web services. As there are no initial costs involved, this service is popular with Server Message Block (SMB) [18]. SaaS has been included in the policy of all significant software enterprises. Facebook, Google, and Twitter use the web service SaaS model which offers customer relationship management that relies entirely on servers of the provider and allow clients to access and customize on-demand [19].
- Platform as a Service (PaaS): is the model for running applications over the Internet by renting hardware and software infrastructures [20]. This model provides the clients with an opportunity to get virtualized servers and software services on rent for maintaining and executing current applications and developing new ones. It is the class of computing service that as a service offers a solution stack and computing platform. The client develops an application by using the tools provided by the provider. The client also handles software operation and design settings [21]. All major organizations are using PaaS service for agility, elasticity, and reliability. The applications provided by PaaS have the latest specifications. PaaS is a modification of SaaS (software delivery model in which software applications are made accessible to clients over the web). PaaS provides quite a few benefits for developers. When using PaaS, users can modify and upgrade features of OS anytime. An example of PaaS is Google App Engine which provides elastic environment for development, management, and hosting of Web-based applications [22].

B. Cloud Service Broker (Cloud Broker)

A second party entity is a cloud broker, and it means that the broker works as a private cloud service or business. It also means that the broker works as public cloud service which works as a liaison agent between the costumer of a cloud computing service and the vendor of cloud computing [23].

Generally, a computer or software which behaves as a conciliator among two or more parties during consultations is called as a broker. Finding out and deciding about the appropriate resources for tasks by transmitting input files of jobs to the resources, observing jobs, and returning the outputs of the job to the clients are the main functions of a broker [24].

IV. How Cloud works

In general, Figure 4 shows the basic operations that explain how the cloud works.

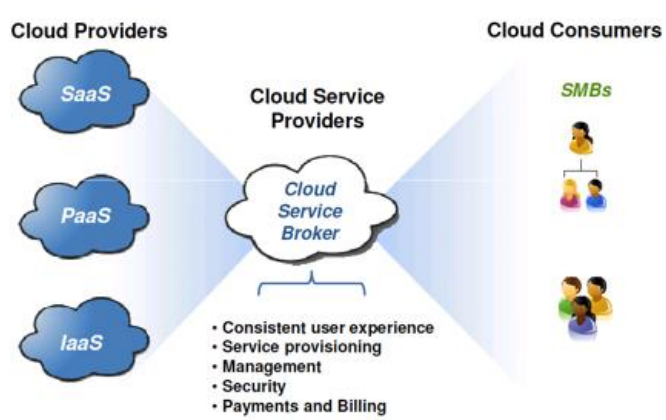


Fig.4. Cloud Computing Services [26]

In the cloud system, cloud users can throughout a Cloud Broker (CB) get access to the cloud computing resources and services of cloud service providers [26]. A cloud broker is a third party, personal or commerce, that works as a mediator

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

between the customer (cloud user) and the providers of that service during negotiations [25].

When a cloud broker gets a user request(s), it will choose the suitable cloud services and resources provided by the cloud service providers. Then the broker performs the cloud process like proxy, intermediation, monitoring, governance, security, provisioning, substitution, etc. After that the cloud broker returns feedback results to the cloud user [26].

A cloud broker may possibly be got the privileges to negotiate agreements with cloud service providers on behalf of the cloud users. In this case, the broker is given the authority to divide services among several service providers so as to reduce the cost as possible, although the negotiations with multiple providers could add more complexity to the system. The cloud broker may possibly supply the cloud users with user interface (UI) and an Application Program Interface that hides some complexity and permits the users to work with their cloud services like if they were being bought from a single provider. This kind of broker is called a cloud aggregator [25].

V. PROPOSED TOPOLOGY

In my topology I have introduced a cloud topology where the cloud broker has the capability to store the processing results of the cloud user jobs for a specific period before sending them back to the cloud users. The goal of this topology is to save time and/or money when the cloud users choose to run the process all again.

Let us suppose that the cloud users want to process some data, the users send their data to the cloud broker throughout the API. Then the broker looks for the best available cloud services or resources to process the user's data. The users request job might be divided into sub-jobs and distributed among several cloud resources in order to save some cost and/or time. After the data is processed by the cloud resources, the broker re-assembles those sub-jobs into one processed job and prepares the processed job to be sent back to the cloud users. At this point, in my topology, the broker marks the finished job with a unique Identification Number (ID) and sends the resulted job with the ID to the cloud users.

In the next stage, the broker store the resulted processed data marked with the unique ID in one of the broker data centers. Later, if the cloud users decided to retrieve a copy of the processed data or decided to resume the processing with new data, all what is need to be done is sent the ID of the job and the broker will retrieve the store processed data from the broker data centers. Figure 5 explains the topology in graphs.

VI. SIMULATION

The Jade platform has been chosen to execute my topology. Jade platform has the ability to provide a smooth understanding of job requests and broker responses in the case of cloud environments. Different scenarios have been conducted using this platform.

In my simulation I used two scenarios. In the first one 10 jobs have been sent to the cloud for the first time. Those jobs were sent from 10 different cloud users to the cloud broker. The broker found the suitable service providers for them and the processed jobs were sent back again to the users with their unique ID. In the second scenario, another 10 jobs from the same cloud users were sent again to the broker but 4 of those jobs were processed before. In this case, the new jobs took their process cycles as usual, while the cloud broker looked to old jobs' IDs in the broker data center and re-submitted their results again to the cloud users without going in to cloud service providers all over again. Figure 6 shows part of the two scenarios.

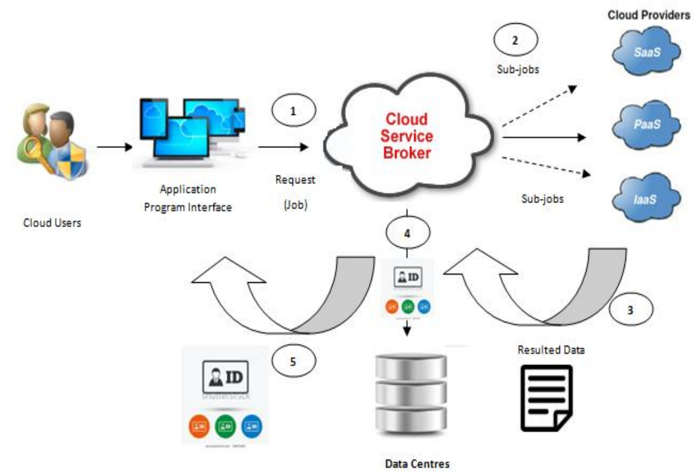


Fig.5. Proposed Topology

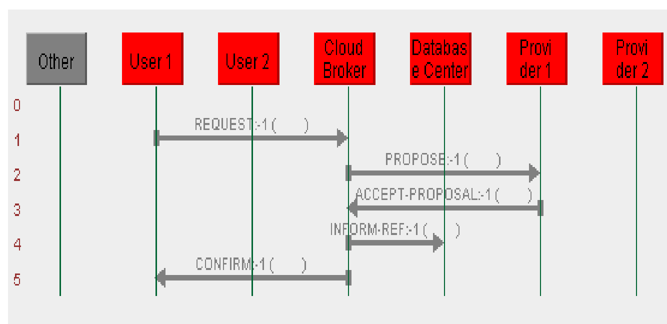
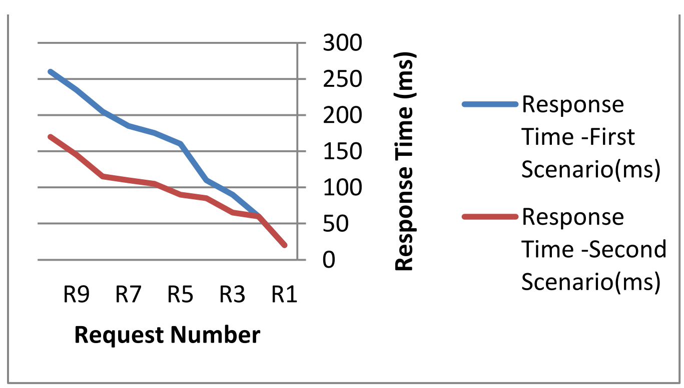


Fig.6. Jade Execution for Job Request

The results of the simulation are explained in the next two charts. In the first chart, Figure 7, the response time of the system has been measured in both scenarios mentioned above.



https://sites.google.com/site/ijcsis/
ISSN 1947-5500

Fig.7. Response Time for the 10 Requests in both Scenarios

It can be noticed from Figure 7 that the time required to fulfill the 10 request by using my topology (Second Scenario) is less than the one in the old topology, as 4 of the 10 requests had been processed before. Therefore, those 4 requests took less time than the original stages, as the broker only need to retrieve the results of the 4 requests from the broker data centers instead of looking for suitable provider to process them again.

The second criterion that has been measured is the complexity of the system. The two scenarios have processed to see the number of massages that have been used in the system during the 10 requests process in both cases. Figure 8 shows the results of the complexity of the system criterion.

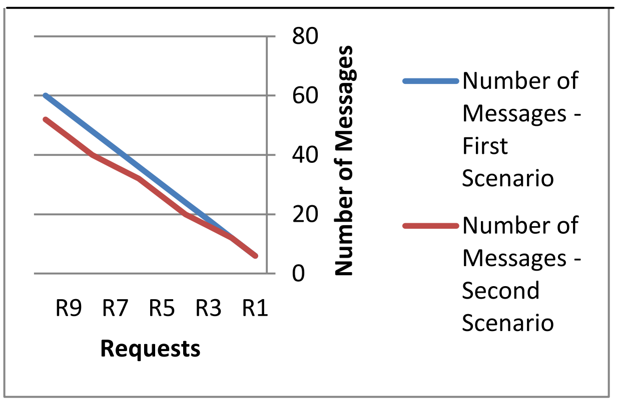


Fig.8. System Complexity for Both Scenarios

Figure 8 shows that the number of messages in my topology (Second Scenario) is less than the old one, as the broker only need to communicate with the broker database instead of communicating with all the cloud elements.

VII. CONCLUSIONS

Cloud computing is intended to permit access to huge quantity of computing power by combining resources and providing a solo system interface. In this paper, I have introduced a new topology where the cloud broker has the ability to save the processing results of the cloud user requests before transferring them back to the cloud users. The purpose of this topology is to save time and money when the cloud users make a decision to go with the process again.

REFERENCES

[1] C. Y. R Buyya. Vision, hype and reality for delivering computing as 5th utility . In Cloud computing and emerging IT platforms. 2009.

[2] M. Rouse. What is public cloud. Retrieved from Whatis.com. (2014, October 12).

[3] Shakow, David J., The Taxation of Cloud Computing and Digital Content. Tax Notes, Vol. 140, No. 4, July, 22, 2013; Tax Notes International, Vol. 71, No. 4, July, 22, 2013; State Tax Notes, Vol. 69, No. 4, July 22, 2013; U of Penn, Inst for Law & Econ Research Paper No. 13-26. 2013.

[4] J. A. M. Broberg. Cloud Computing:Principles and Paradigms . John Wiley & Sons. Jeremy Long - jeremy.long(at) Retrieved from owasp.org. 2011.

[5] K. Ben. Revolution not evolution How Cloud Computing Differs from traditional it and Why it Matters. United States: San Antonio.pp7.2010.

[6] T.Alwada'n. Security for Mobile Grid Systems. PhD Thesis. School of Computing, De Montfort. (pp. 26-28). 2012.

[7] T.Alwada'n. Security for Mobile Grid Systems. PhD Thesis. School of Computing, De Montfort. (pp. 35-36). 2012

[8] I. F. Keahey. Achieving quality of service and quality of life in the grid, Scientific Programming. In Virtual workspaces (pp. 265-275).2005.

[9] De Chaves, et al. Towards a design for analyzing enterprise Clouds. IEEE CommunicaLons Magazine. 2011.

[10] IBMdeveloperworkers. 4 Types of Cloud Computing Deployment Model You Need to Know. https://www.ibm.com /developerworks /community/blogs/722f6200-f4ca-4eb3-9d648d2b58b2d4e8/ entry/ 4_ Types_of_Cloud_Computing_Deployment_Model_You_Need_to_Kno w1?lang=en

[11] J. Strickland. How cloud computing works. Retrieved from http://computer.howstuffworks.com/cloud-computing/cloudcomputing4. April, 2008.

[12] Galleryhip.com. Cloud Architecture Layers. Retrieved from http://galleryhip.com/cloud-architecture-layers.html. 2014.

[13] B. et al. Sotomayor. Virtual infrastructure management in private and hybrid clouds. IEEE Internet Computing 13 , (pp. 14-22). 2009.

[14] Cisco Systems. Managing the Real Cost of On-Demand Enterprise Cloud Services with Chargeback Models. White Paper.(pp. 10). 2010

[15] D., R. W. Nurmi. The Eucalyptus open-source cloud-computing system. Proceedings of IEEE/ACM International Symposium on Cluster Computing and the Grid, (pp. 124-131). Shinghai, China. 2009.

[16] Quattra Inc. Quattra cloud vision and frame work value. (pp 1-5). 2012.

[17] Salesforce.com, inc. The 7 Secrets of SaaS Startup Success. (pp 5-12). 2008.

[18] V.Beal. Cloud computing (the cloud). Retrieved November 2014, from http://www.webopedia.com/TERM/C/cloud_computing.html Bill Sempf - bill.sempf(at)owasp.org. 2014.

[19] L, M. B. Youseff. Toward a unified ontology of cloud computing. Proceedings of the 2008 Grid Computing Environments Workshop, (pp. 1-10). 2008.

[20] M. Margaret. Platform as a Service (PaaS). Retrieved from http://searchcloudcomputing.techtarget.com/definition/Platform-as-a-Service-PaaS. 2012.

[21] J. Sen. Security and Security andPrivacy Privacy Privacy Issues in Cloud Computing Computing. 2013.

[22] L. Ramkumar and M. Raju.Cloud Computing Benefits for Educational Institutions RFC-2404: The Use of HMAC-SHA-1-96 within ESP and AH. C. Madson, R. Glenn. November 1998. Retrieved From:http://www.ietf.org/rfc/rfc2404.txt. 2013.

[23] H. Michael et al. NIST Cloud Computing Standards Roadmap.2011.

[24] The Nimrod-G Grid Resource Broker and Economic, 2012.

[25] Margaret Rouse. Cloud Broker. September 2013. Web: 5th of October 2016. http://searchcloudprovider.techtarget.com/definition/cloud-broker.

[26] Jack E. Brown. Cloud Service Broker. August 4, 2011. Web: 5th of October2016. https://machine2 twomachine .wordpress.com /2011/08/04 /hello-world/

https://sites.google.com/site/ijcsis/
ISSN 1947-5500