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Generalized Framework For Memory Utilization In Cloud Storage Services

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Abstract-Cloud storage is a mechanism according to which the data can be stored from the cloud or the internet on remote servers. It is operated, managed and maintained on the storage servers by a cloud storage service provide build on virtualization techniques. The main advantage of storing data on cloud is that guarantee affordability. The aim of this research is to develop a framework with extensible and generalized application that facilitates flawless simulation, modelling and emerging cloud services implementation. The simulation has been performed on CLOUDSIM platform. QoS parameters, such as, Total memory Utilized in MB and Total Fluctuation in Bandwidth Utilization are considered to compute the experiments.

Keywords- Cloud computing, cloud storage, Memory utilization, Bandwidth utilization, CLOUDSIM

1. INTRODUCTION

Cloud computing is known as a comparatively novel business model in the world of computing. As per the NIST standard definition, “Cloud computing is defined as the model for permitting suitable, ubiquitous, on-demand network access towards sharing pool of configurable computing resources like servers, networks, storage, services and applications) that could be quickly provisioned and released with least management effort or service provider interaction.” [1]. The architecture of cloud computing is shown in Figure 1. Basically, cloud computing is the transferring of services of computing like storage, servers, databases, networking, analytics, software, and more on the Internet or to the cloud. The organisations that provided the above mentioned services is known as cloud provider and usually charge for cloud computing services on the basis of usage [2].

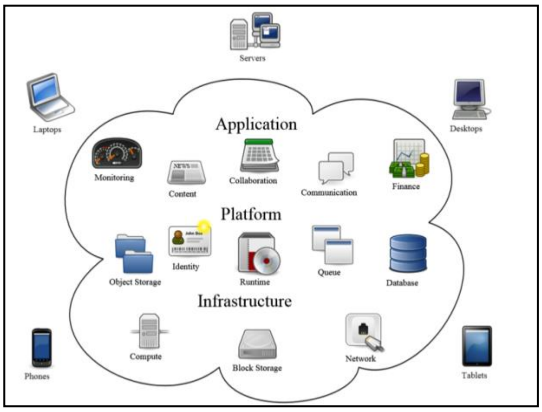

Fig 1. Cloud Computing

2. BACKGROUND

2.1 *Essential Characteristics of Cloud Computing*

This section describes the significant characteristics related to cloud computing [3]:

On-demand Self-service: Cloud service provider delivers on demand services to their users e.g. network storage at anytime, anywhere as per the user requirement with no human interaction.

Broad Network Access: It is described as the hosted application, which should be accessible via nearly some network based application. These can include, thin or thick client platforms but are not limited to, the following:

- Laptops
- Desktop
- Mobile phones
- Tablets
- Workstations

Extensive network access is usually achieved by using a built-in Web browser for the device, as it is one of the most prevalent clients [4].

***Resource Pools*:** A resource pool is a concept in which multiple organizations can share an underlying physical cloud infrastructure. Re-allocation of virtual resources is based on consumer demand. Consumers typically do not know the exact location of a given resource, but might be able to specify a location at an enhanced level of abstraction (eg, "country, state, or data center"). Some examples of resources are: processing, storage, and memory with network bandwidth [2].

***Fast Flexibility*:** Fast flexibility is the facility to provide scalable services. It allows users to automatically request other spaces or other types of services in the cloud. Fast recovery is the ability of a system to adapt resources to workload levels by providing resources in an independent manner so that the resources provided at each point in time are as close as possible to the current requirements. For consumers, the features available for supply often seem unrestricted and can be distributed at any time. Flexibility allows cloud provider customers to achieve cost savings, which is often the core reason for cloud services.

***Measured Service*:** The cloud system automatically controls the resource usage of users, by determining the measuring ability of the system. Measurement services are a reference for services that are measured or monitored by cloud providers and control services such as billing, efficient use of resources, and overall forecasting plans [5].

2.2. *Cloud Computing Services*

The cloud computing services are mainly fall into three categories named as IaaS (Infrastructure as a Service), PaaS (Platform as a Service), and SaaS (Software as a Service) [6]. These are sometimes referred to as cloud computing stacks because they are built on top of each other. The detail description of these services is provided below.

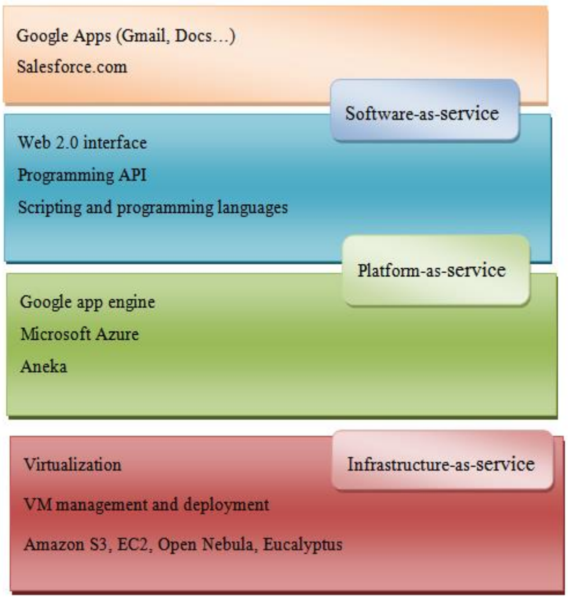

Fig 2. Cloud computing services

(Source: https://en.wikipedia.org/wiki/Cloud_computing)

i. *Infrastructure as a Service (IaaS)*

It is a way to provide cloud infrastructure such as storage, servers, networks and operating systems. Customers can access the service as a pay-per-use model instead of purchasing servers, software, and network devices. Rackspace Hosting and Go-daddy Hosting are considered examples of IaaS [7]

ii. *Platform as a Service (PaaS)*

It is a cloud computing model in which service providers offers hardware and software tools as a service. It gives developers the opportunity to build their own applications on the Internet. It provides a platform and environment for developing applications such as operating systems, network access, design and development tools. Force.com and Microsoft azure are some examples of PaaS.

iii. *Software as a Service (SaaS)*

SaaS is a software delivery model in which software is purchased on a subscription basis. This is a “pay as you go” structure that was initially used extensively for sales force automation and customer relationship management (CRM). It benefits both the consumer and the user provider. Google, Twitter, Facebook and Flicker are few examples of SaaS [8].

Cloud computing is an innovative technology that leverages the Internet and centralized remote servers to maintain data and applications. With the advent of this technology, the cost of computing, application hosting, content and storage of the correct storage has been greatly reduced. The concept of cloud computing is based on the basic tenets of ‘reusability of information technology capabilities.’ Compared to the traditional concepts of Grid Computing, Utility Computing, Autonomic Computing, or Distributed Computing, the difference between cloud computing is to broaden horizons across organizational boundaries. The idea of the cloud is to allow organizations to focus on their business workflows rather than the basic IT frameworks they need to run them [9]. Cloud computing is a practical way to experience direct price adv.Artificial ages, and it has the prospect of transforming the data centre from a capital-intensive setting to a variable-price environment. Virtualization technology has affected the modern data centres. As all the applications and operating systems are established as virtual machine images, and are executed by physical servers running on VMM (Virtual machine monitor) or hypervisor computer software that creates and run virtual machine) [9].

Cloud computing allows several organizations and customers to use a variety of applications without installing and accessing their personal records on any portable computer with web access [10]. The technology also allows greater proficiency in computing by using centralized data storage, bandwidth, and processing. Cloud computing has become a popular explanation, making cheap and easy access to external information technology an import artificial source. It helps the scientists with a new model for utilizing the computing infrastructure. More and more enterprises (for example, businesses, research centers, etc.) got benefits from cloud computing in the direction of hosting their applications [11]. With virtualization, cloud computing can address the vast client base of heterogeneous computing need with the same type of physical infrastructure. Resources of computer, storage resources and the different applications can dynamically provide charge as per use and later can be released if not needed. Such services are offered with an agreement i.e. SLA, which gives the user the desired Quality of service (QoS). Some enterprises harness the ability of cloud resources with private and public clouds by giving full QoS to users. Cloud computing is flexible and service based infrastructure with the support of multiple programming patterns [12]. In contrast to previous approaches such as clustering and grid computing, cloud computing is not application-oriented, but service-oriented; it also provides on-demand virtualization type resources as a measureable and billing convenience. As shown by Amazon's estimates, data centre energy-related costs accounted for 42% of total work costs. Therefore, it increases the energy proficiency of the Map Reduce standard and attempts to reduce the energy efficiency of the cloud data centre. Open resource framework called Eucalyptus has been released, which provide service to users for creating private cloud computing grids compatible with API and are according to existing Amazon standards.

In order to fully understand the capabilities of cloud computing, cloud providers need to ensure that they can adapt to their virtual machine (VM) transport to meet different buyer prerequisites while keeping customers away from the basic data center [13]. Virtualization applications dispense many comforts, including consolidation, migration. In this workspace, data centre has becomes a main hub of interchangeable computer resources which are leveraged to run the virtual machine images as needed. A general technique for enhancing data centre energy proficiency is to place VMs by co-ordinating the number of dynamic servers to meet the current needs of VMs and using SLA violations to place the remaining servers in low-control standby mode [14].

Cloud allows multiple services to be hosted on globally shared resource pools, where resources are allocated to on-demand services. It uses a virtualized environment to run the service, because there is no virtualized computing being inefficient and inflexible. But, it has some service performance degradation, and energy costs and a lot of power consumption. In the past, many researchers have worked on energy-saving algorithms to reduce energy consumption. Many algorithms have been implemented to conserve data center power by shutting down or placing idle servers in the server's sleep mode [15]. However, these technologies are not as effective as service performance degradation and inappropriate resource utilization. Some of the previous work includes the idea of developing energy-efficient algorithms for data centers and put forward a virtual machine placement algorithm for minimizing the migration (MM) by using host CPU utilization. The algorithm outperforms other placement algorithms, but they do not take SLA parameters into account when selecting virtual machines for migration, which may be achieved by real-time migration. Most violations occur during real-time migration of virtual machines that affects SLA parameters such as availability, response time, throughput, network bandwidth, and so on. Therefore, it is necessary to develop a new method for SLA-aware energy-efficient algorithms for resource allocation in the data center [16].

2.3 *Deployment Models*

The deployments model of cloud computing represents an unambiguous type of cloud environment, mainly distinguished by ownership, dimension, and access. There are four general cloud deployment models namely; Public Clouds, private model, hybrid model and community model. The description of these models is provided below:

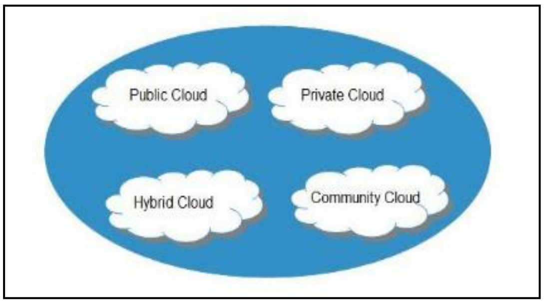

Fig 1. Deployment model

(Source: https://www.linkedin.com/pulse/3-service-4-deployment-models-cloud-computing-sankar-somepalle)

2.3.1 *Public model*

It allows users to access the cloud through the use of the web interface. Users must pay as per the duration of their service uses. It can be compared to the electricity billing system we use at home, that is, paid for its use [17]. It helps to minimize the operating costs of IT organization. Public clouds are insecure as compared to other clouds because they can be affected by a variety of malicious attacks, as public clouds are typically run by a single service provider. Many customers use resources provided by a service provider and customers do not know the location of the cloud infrastructure. Computing resources are shared among many clients. Therefore, they are vulnerable to various malicious attacks. In order to avoid malicious attacks, cloud providers and users will perform security checks. Suppliers and cloud users should understand their responsibilities [18].

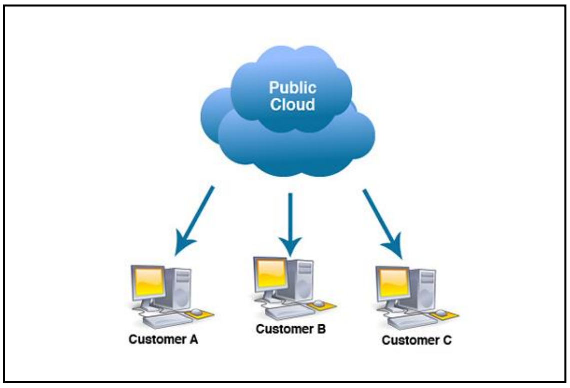

Fig 1 .Public cloud

(Source: https://cloudxchange.io/cloud-managed-services-for-public-clouds/)

2.3.2 *Private cloud*

Private clouds are typically owned or operated within the organization's internal data centre. Infrastructure is not shared with other organizations, so managing its security is easier than public clouds as it is under the control of the enterprise. Now, in a private cloud, resources are managed by some organizations themselves, thus security as well as the QoS is increased. In public cloud, all applications and resources are managed by the service provider, while in the private model; the organization itself can provide all services to its users [19].

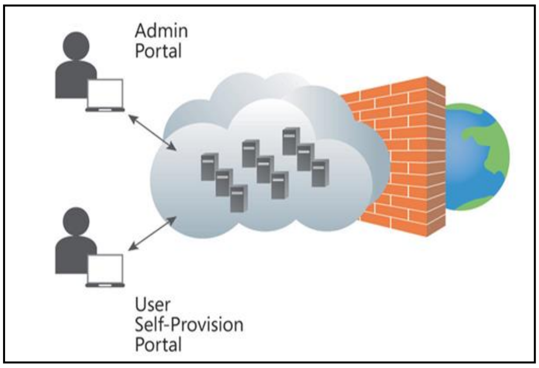

Fig 1 .Private cloud

(Source: https://blogs.technet.microsoft.com/yungchou/2011/03/21/what-is-private-cloud/)

2.3.3 *Hybrid Cloud*

It is a typical combination between a public and private cloud offering the benefits of multiple deployment models. It also means the ability to connect collocation and manage the services with cloud resources work of hybrid cloud to enable the enterprise to perform state-ready workload in the private cloud and asking the public cloud for intensive computing resources when peak workload occurs, after that return if no longer required [20].

Table 0-1Comparison of Cloud Computing Deployment models [44]

Deployment Model	**Scope of services**	**Managed by**	**Security level**
Public model	General public and large industry groups	Cloud service provider	Low
Private model	Single organization	Single organization	High
Community model	Organization those share the same policy, mission and same security aspects	Several organization or Cloud service providers	High
Hybrid	Organizatio	Organizatio	Mediu

model	n and public	n and public	m

2.3.4 ***Popular cloud computing platforms***

i. Abi-Cloud

It is a cloud computing platform used for building, managing public as well as private cloud in the same environments. Using Abi-Cloud, user in ease can deploy and manage the server, storage system, network, virtual devices and applications. It is a powerful web-based management function, using this user can deploy a new service by just dragging a virtual machine with mouse. Hence, it is much easier and flexible than other cloud computing platforms that deploy new service through command lines. It can be used to deploy and implement private cloud as well as hybrid cloud according to the cloud providers' request and configuration. It also manages theEC2 according to the rules of protocol. Besides, a whole cloud platform based on Abi-Cloud can be packed and redeployed at any other Abi-Cloud platform. This is much helpful for the transformation of the working environment and will make the cloud deployment process much easier and flexible [21].

ii. Eucalyptus

Eucalyptus (Elastic Utility Computing Architecture for Linking Your Programs to Useful Systems) can build open-source private cloud platform. Eucalyptus is an elastic computing structure that can be used to connect the users' programs to the useful systems. It is an open-source infrastructure using workstation. Currently, Eucalyptus is compatible with EC2 from Amazon, and may support more other kinds of clients with minimum modification and extension.

iii. Nimbus

Nimbus is an open tool set and also a cloud computing solution providing IaaS. It helps to build the required computing environment with the deployment of virtual machines and permits users lease remote resources. In this, functional components can be classified as three kinds. One is client- supported modules which are used to support all kinds of cloud clients that are Context client module, cloud client module, reference client module and EC2 client module are all belonging to this kind of component. The second kind of component is service-supported modules of cloud platform giving all types of cloud services. The third kind of component is the background resource management modules which are mainly used to manage all kinds of physical resources on the cloud computing platform, including work service management module, IaaS gateway module, EC2 and other cloud platform support module, workspace pilot module, workspace resource management module and workspace controller.

iv. Open Nebula

Open Nebula [22] is also an open source cloud service framework. It helps user to deploy virtual machines on physical resources. It can set user's data centres to flexible virtual infrastructure that can automatically adapt the change of the service load. Nimbus implements remote interface based on EC2 or WSRF through which user can process all security related issues, while Open Nebula does not. Open Nebula is also an open and flexible virtual infrastructure management tool, which can be used to synchronize the storage, network and virtual techniques and let users dynamically deploy services on the distributed infrastructure according to the allocation strategies for data centre and remote cloud resources. Users can easily deploy any types of clouds with the interior interfaces and Open Nebula data centre environments.

Fig 6. Cloud computing platforms

2.3.5 Applications

There are various applications of cloud computing in this modern world. Different search engines and social websites are taking the approach of cloud computing like, Amazon, Hotmail, LinkedIn, The Features of cloud computing in relation to scalability reduces the risk, low cost testing, ability to segment the customer base and auto-scaling based on application load [23].

i. Cloud computing provides dependable and secure data storage centre.
ii. Cloud computing can process data sharing between different equipment.
iii. The cloud provides infinite possibility for consumers to use the services of internet.
iv. In Cloud computing, user does not need to have high quality equipment and it is easy to use.

3. TOOL UTILIZED FOR THE CLOUD STORAGE

Recently, cloud computing emerged as the leading technology for delivering reliable, secure, fault-tolerant, sustainable, and scalable computational services, which are presented as Software, Infrastructure, or Platform as services (SaaS, IaaS, PaaS). Moreover, these services may be offered in private data centers (private clouds), may be commercially offered for clients (public clouds), or yet it is possible that both public and private clouds are combined in hybrid clouds.

These already wide ecosystem of cloud architectures, along with the increasing demand for energy-efficient IT technologies, demand timely, repeatable, and controllable methodologies for evaluation of algorithms, applications, and policies before actual development of cloud products. Because utilization of real testbeds limits the experiments to the scale of the test bed and makes the reproduction of results an extremely difficult undertaking, alternative approaches for testing and experimentation leverage development of new Cloud technologies.

A suitable alternative is the utilization of simulations tools, which open the possibility of evaluating the hypothesis prior to software development in an environment where one can reproduce tests. Specifically in the case of Cloud computing, where access to the infrastructure incurs payments in real currency, simulation-based approaches offer significant benefits, as it allows Cloud customers to test their services in repeatable and controllable environment free of cost, and to tune the performance bottlenecks before deploying on real Clouds. At the provider side, simulation environments allow evaluation of different kinds of resource leasing scenarios under varying load and pricing distributions. Such studies could aid the providers in optimizing the resource access cost with focus on improving profits. In the absence of such simulation platforms, Cloud customers and providers have to rely either on theoretical and imprecise evaluations, or on try-and-error approaches that lead to inefficient service performance and revenue generation.

The primary objective of this project is to provide a generalized and extensible simulation framework that enables seamless modelling, simulation, and experimentation of emerging Cloud computing infrastructures and application services. By using CLOUDSIM, researchers and industry-based developers can focus on specific system design issues that they want to investigate, without getting concerned about the low level details related to Cloud-based infrastructures and services.

Utilization model of CLOUDSIM

1. Directory structure of the CLOUDSIM Toolkit
----

cloudsim/ -- top level CLOUDSIM directory
docs/ -- CloudSim API Documentation
examples/ -- CloudSim examples
jars/ -- CloudSim jar archives
sources/ -- CloudSim source code
tests/ -- CloudSim unit tests

3 Software requirements: Java version 8 or newer

CloudSim has been tested and ran on Sun's Java version 8 or newer.

Older versions of Java are not compatible.

If you have non-Sun Java version, such as gcj or J++, they may not be compatible.

You also need to install Ant to compile CloudSim (explained in more details later).

4 Installation and running the CloudSim Toolkit

You just need to unpack the CloudSim file to install.

If you want to remove CloudSim, then remove the whole cloudsim directory.

You do not need to compile CloudSim source code. The JAR files are

provided to compile and to run CloudSim applications:

* *jars/cloudsim-<VERSION>.jar -- contains the CloudSim class files*

* *jars/cloudsim-<VERSION>-sources.jar -- contains the CloudSim source code files*

* *jars/cloudsim-examples-<VERSION>.jar -- contains the CloudSim examples class files*

* *jars/cloudsim-examples-<VERSION>-sources.jar -- contains the CloudSim examples source code files*

4. RESULTS ANALYZED

The performance evaluation of the simulation is calculated using the following parameters

a) Total memory Utilized in MB
b) Total Fluctuation in Bandwidth Utilization

The total memory used is the total memory consumption in order to process the data files which are to be stored on cloud network. The CLOUDSIM tool is installed in Windows platform.

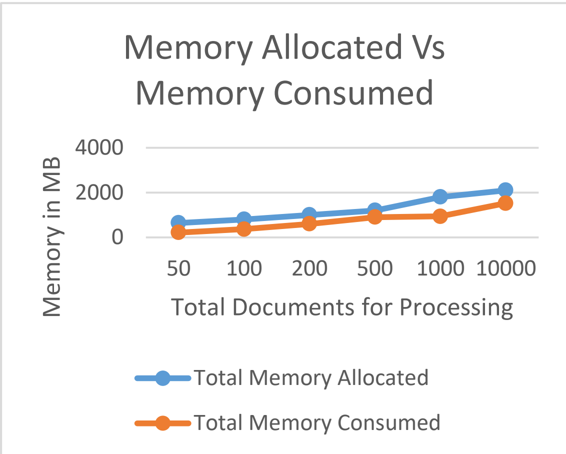

Fig 7. Memory Allocated Vs Memory Consumed

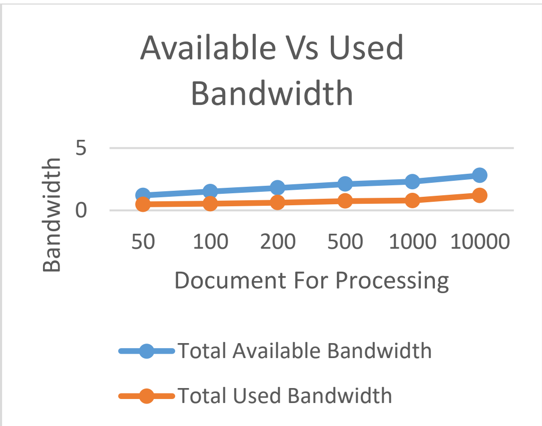

Fig 8. Available Vs Used Bandwidth

The memory utilization increases with the increase in the documents to process. A total of 10,000 documents are used for the processing and approximately 2100 MB ~2GB space is utilized on hard disk. In the similar fashion, the bandwidth utilized of the system also increases with the increase in the document processing. The maximum bandwidth utilization is ~2.7 GZs for 10000 documents.

5. CONCLUSION

Cloud computing is known as on-demand computing model based on a fixed Internet connection to share and access the information on many devices. If we step back to observe a larger image, cloud computing allows users to access all the data stored in the third-party data center which can be attained by less resources. This research has dealt with providing a comprehensive framework by using emerging cloud services with ideal modelling and simulation. The simulation has been carried out by evaluating Total memory Utilized and Total Fluctuation in Bandwidth Utilization. It is being concluded that the memory usage enhances with an enhancement in document to execute. 10,000 documents are considered for the execution and around 2100 Mb~2GB memory is used on hard disk. The bandwidth usage is also enhancing with the enhancement in the document execution. For 10,000 documents, maximum bandwidth used is ~2.7 GZs.

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