APPROACHES TO IMPROVE CLOUD COMPUTING PERFORMANCE

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Abstract— Cloud Computing is the delivery of computing services over the Internet. Cloud computing at present generation aims to provide the data centers and enables application service providers to lease data center capabilities for deploying applications, depending on user Quality of Service (QOS) requirements. Cloud applications have different configurations, compositions and deployment requirements. Measuring the performance of resource allocation policies and application scheduling algorithms at finer details in Cloud computing environments is one of the challenging problems to tackle. In this paper the CloudSim architecture, CloudSim life cycle is explained and also the scheduling methods like Time-Space shared scheduling method and FIFO based scheduling method are proposed and evaluated. This analysis helps in virtual to real deployment and would be easier and accurate.

Index Terms—CloudSim, Cloud Computing, Cloud Applications, Application Scheduling.

I. INTRODUCTION

Cloud Computing is one of the technologies which provides secured and efficient services over the internet. Cloud computing at present generation aims to provide the data centers and it enables the application service providers to lease data center capabilities for deploying applications depending on users QOS requirements. Cloud services which are now available allow businesses and individuals to use software and hardware which are managed by third parties somewhere located at remote locations. Cloud Computing is mainly used for providing a service to the consumer, it is “pay as per use” service. Cloud Computing provides services such as Software as a Service (SaaS), Platform as a service (PaaS) and Infrastructure as a service (IaaS). Now a day’s the internet is fast growing, the individuals and big organizations are finding new ways to reduce the cost of implementation, storage or communication.

Cloud Computing has basically two parts, the First part is of Client Side and the second part is of Server Side. The Client Side requests to the Servers and the Server responds to the Clients. The request from the client firstly goes to the Master Processor of the Server Side. The Master Processor have many Slave Processors, the master processor sends that request to any one of the Slave Processor which is free at that time. All Processors are busy in their assigned job and none of the Processor gets Idle.

In Cloud Computing Job Scheduling is a very difficult due to its parallel and distributed environment. The order in which work is performed in the computer system is called Scheduling. Job may be distributed among more than one virtual machine, so it is difficult to determine the job completion time.

To host an application in cloud environment requires complex deployment and composition, and to evaluate the implemented model in repeated manner is very tedious and costly process. So simulation tools like

CloudSim are used to model Cloud Computing systems and application environment. The CloudSim is an extensible simulation toolkit that enables simulation and modeling of Cloud Computing environments. The CloudSim toolkit supports for modeling and creation of one or more virtual machines (VMs) on a simulated node of a Data Center, jobs, and their mapping to suitable VMs. It also allows simulation of multiple Data Centers to enable a study on federation and associated policies for migration of VMs for reliability and automatic scaling of applications.

CloudSim provides lots of benefits to IT companies or an individual who wants to deploy his services through cloud. CloudSim has the following important properties [09]:

- CloudSim helps to simulate and model the data center, Cloud Computing environments.
- CloudSim provides a self-contained platform for modelling clouds, provisioning, service brokers and allocation policies.
- CloudSim provides support for simulation of network connections among the simulated system resources.
- CloudSim provides facility for simulation of federated cloud environment that inter-networks resources.

These features show that CloudSim aids in developing the cloud environments and it uses sequential algorithms [10] like FCFS to allocate the resources. This sequential way may not match with the real world requirements because there are different types of requirement in the real world that must be categorized and allocation should be done based on different categories. So there is need to refine the algorithm and architecture of CloudSim so that every experiment using this simulator can be compared directly to the physical set up of cloud environment. By doing this the cost and time of cloud implementation can be reduced.

CloudSim Simulation Environment: CloudSim frame work does the following things, firstly entity will be created which is named as CIS (Cloud Information Service), and this is the kind of registry that contains the resources that are available on the cloud. So CIS takes care of registry of the data center. Now data center is required to be registered and this registration process will be done with the CIS. Data center will be having some characteristics. Characteristics are basically for the hosts, each host will have some hardware configurations like number of processing elements, RAM, Bandwidth etc.

The cloud environment basically works on virtualization which differs from other technologies like parallel computing, grid computing etc. So virtualization says that the host will be virtualized into the number of machines, so each virtual machine will have the parameter.

It requires registering the datacenter with the CIS, as per the CloudSim frame work. Once above all process is done it is required to have the broker which will submit tasks to the data centers. Broker is basically an entity which at the initial stage talks to CIS and retrieves the resource information which is registered with the CIS about data centers, so the information so passed is called data center characteristics, now the broker will be having all the characteristics of the data centers. Refer to the **Figure 01** below:

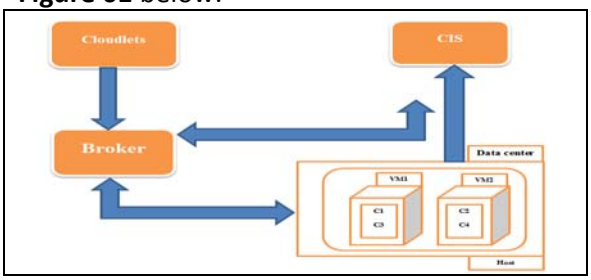

Figure 01: CloudSim Simulation Environment

Broker will have some tasks which are named as **Cloudlet(s)**, so set of cloudlets will be submitted to the broker. The broker directly interacts with the data center and assigns the cloudlet to some of the virtual machines which are running on the host. This is the basic framework or basic model which the CloudSim simulation tool which provide us. CloudSim simulation tool takes care of lot of behavior's which are connected to all of the components, so the components are basically called as entities.

The above model works on various kinds of policies. We can submit more than one task to the virtual machines but overall processing is to be done is on the physical machine because the virtual machines share the resource of the physical machine. All the resources will be provided to the virtual machines on the basis of the policies i.e. virtual machine scheduler policies. So there are three different kinds of policies.

1. VM allocation policy.
2. VM scheduler policy.
3. Cloudlet scheduler policy.

So all the policies are either time shared or space shared.

II. RELATED WORK

Harjit Singh has discussed about the evolution process of cloud computing, characteristics of Cloud, current technologies adopted in cloud computing and they also presented a comparative study of cloud computing platforms (Amazon, Google and Microsoft), and its challenges. Cloud computing is the delivery of computing services over the Internet [01].

Qi Zhang has presented a survey of cloud computing, highlighting its key concepts, architectural principles and state-of-the-art implementation as well as research challenges. The aim of the paper is to provide a better understanding of the design challenges of cloud computing and identify important research directions in this increasingly important area [02].

Monica Gahlawat, Priyanka Sharma have described about the basic information about the Cloud Computing and its various services and models like SaaS, IaaS and PaaS. They also described about the deploying models of Cloud Computing and Virtualization services [03].

Rodrigo N. Calheiros, Rajiv Ranja, Anton Beloglazov, Rajkumar Buyya, A. F. De Rose have described about the various web based application related to Cloud Computing [04].

Anthony Sulistio, Rajkumar Buyya have described about the Scheduling. They said Scheduling is a process of finding the efficient mapping of tasks to the suitable resources so that execution can be completed such as minimization of execution time as specified by customers. They described various types of Scheduling like Static, Dynamic, Centralized, Hierarchical, Distributed, Cooperative, Non-Cooperative Scheduling. They also described Scheduling problem in Cloud and the types of users like CCU (Cloud Computing Customers) and CCSP (Cloud Computing Service Providers) [05].

Catalin L. Dumitrescu, Ian Foster have described about the Simulation techniques and the CloudSim. They described the various features of CloudSim like it supports for modeling and simulation for large scale of cloud computing infrastructure including data centers on a single physical computing node [06].

Henri Casanova, Arnaud Legrand have described about the optimization criterion that is used when making scheduling decision and represents the goals of the scheduling process. The criterion is expressed by the value of objective function which allows us to measure the quality of computed solution and compare it with different solution [07].

Saul Berman, Lynn Kesterson-Townes, Anthony Marshall and Rohini Srivathsa have described about the Quality of Service that is the ability to provide different jobs and users, or to guarantee a certain level of performance to a job. If the QoS mechanism is supported it allows the user to specify desired performance for their jobs. In system with limited resources the QoS support results in additional cost which is related to the complexity of QoS requests and the efficiency of the scheduler when dealing with them [08].

III. SIMULATION WORK

Here it is explained about how actually the simulation works and for each module the code is included. Initially it is required to set the number of users; this will directly correlates with the broker count.

1. Requires the initialization of common variables.
   CloudSim.*init*(num_user, calendar, trace_flag);
2. Data center must be created, this in turn will lead to the creation of host,

characteristics (Parameters: Processing Elements, RAM, BW etc.)
Datacenter datacenter0 = *createDatacenter*("Datacenter_0");

3. Datacenter broker instance is required to be created.
   DatacenterBroker broker = *createBroker*();
   int brokerId = broker.getId();
4. Virtual machines (Parameters: Processing Elements, RAM, BW etc.) instances is required to be created.
   Vm vm1 = **new** Vm(vmid, brokerId, mips, pesNumber, ram, bw, size, vmm, **new** CloudletSchedulerSpaceShared());
5. Virtual machines which are created are submitted to the broker.
   broker.submitVmList(*vmlist*);
6. Requires specifying the cloudlet(s) which are created with the certain parameters.
   Cloudlet cloudlet = **new** Cloudlet(id, length, pesNumber, fileSize, outputSize, utilizationModel, utilizationModel, utilizationModel);
7. Cloudlets which are created are submitted to the broker. So now broker has both Cloudlets and Virtual machines. Cloudlets will be mapped to the virtual machines through broker.
   broker.submitCloudletList(*cloudletList*);
   broker.bindCloudletToVm(cloudlet.getCloudletId(),vm.getId());
8. Start Simulation function is called.
9. Stop Simulation function is called.
10. Prints the status of the simulation.

Data Center consists of different Hosts and the Host manages the VM Scheduler and VMs. Cloudlet Scheduler determines how the available CPU resources of virtual machine are divided among Cloudlets. There are two types of policies:

1**] Space-Shared** (Cloudlet Scheduler Space Shared): This is used for assigning specific CPU cores to specific VMs.

2] **Time-Shared** (Cloudlet Scheduler Time Shared): This is used to dynamically distribute the capacity of a core among VMs.

Whenever the cloudlets are deployed on VMs, both the Time shared and Space Shared is incorporated.

IV. PROPOSED FRAMEWORK

Cloud computing is a “pay as you go” service. It is not easy to deploy the simulated work directly to the real world because cloud services are layered services and it takes additional scenarios also into consideration. For example when we are providing a service as cloud, we have several tasks that have higher priorities and needed to be finished first and there will be some other tasks which are defined earlier and needed to be performed according to the scheduled time. In the CloudSim simulation toolkit, the VMs are created and are allocated based on the requirement of the hosts. An application is developed which simulates the cloud and performs Tasks Allocation to the VMs on the basis of FCFS (First-Come-First-Served) Scheduling Policy, in the Cloud.

The proposed architecture is given as **Figure 02**:

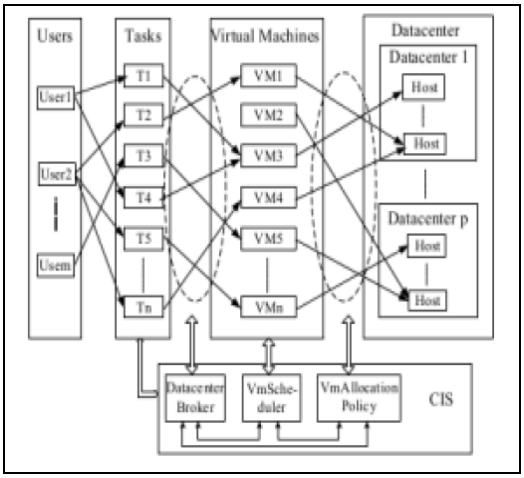

Figure 02: FCFS task allocation in CloudSim

Our FCFS scheduling will be having a Datacenter Broker that implements the FCFS Task Scheduling Policy. The different Entities in our application are:

- FCFS
- FCFS Broker
- Datacenter Creator
- VMs Creator
- Tasks or Cloudlet Creator

FCFS: This entity creates the Datacenter and creates the VMs and creates the Cloudlets or

Tasks by calling respective other entities. Once all of them are created, VMs and Tasks are submitted to the FCFS Broker.

FCFS Broker: This is a Datacenter Broker and it schedules the tasks to the VMs on the basis of FCFS policy. The tasks are got from the FCFS Entity.

Datacenter Creator: This entity is used to create Datacenter(s).

VMs Creator: This entity creates the specified number of VMs given by the user.

Cloudlet Creator: This entity creates the specified number of tasks.

Thus, we can perform task allocation to the VMs on the basis of FCFS (First-Come-First Served) Scheduling Policy in the Cloud.

V. RESULTS AND ANALYSIS

The type of scheduling policy used here is Time shared /Space Shared allocation policy. The simulation gives the timing performance as shown in the **Table 01,** referring to this table and considering the cloudlet performance of 3200sec, compared to the one without multiple cloudlets sharing the work, we get a speed up of 2. The speed up is given by the ratio of timing measurement without using multiple cloudlets sharing the work, over the timing with sharing.

Therefore Speedup = 800*8/3200
= 6400/3200
= 2

Total No. of Cloudlets	Timing Performance (Sec)
1	**800**
2	**1600**
8	**3200**

Table 01: Timing performance of different number of cloudlets

Speed up obtained is low compared to the ideal speed up. Therefore alternate mechanisms for improving performance such as FCFS method is experimented in CloudSim.

The FCFS scheduling is implemented and comparison of which is made with the performance of Time-Space shared scheduling of 8 cloudlets is given in **Table 02.** These simulation runs are carried out for 8 cloudlets and 2 VMs.

Scheduling Policy	Timing(Sec)
Time-Shared Scheduling	3200
FCFS	20.1

Table 02: Time taken to execute the cloudlets based on the scheduling policy.

The FCFS Scheduling takes 20.1sec for executing all 8 cloudlets. Further we can improve the execution time by using different scheduling policies like priority based scheduling policy.

Screen Shots for the Simulation runs corresponding to the results shown in **Table 02** are given below in **Figure 03** and **Figure 04**:

The simulation output displays the following information. The CloudSim toolkit is initialized and then datacenters are started, broker will be starting, Entities are started. Broker creates the VMs in the Datacenter and is created in the particular Host. Broker sends the cloudlets to the VMs. Cloudlets get executed and time at which the cloudlets got executed is sent back to broker. After when all cloudlets are executed all VMs are destroyed. Broker shuts down. Cloud Information Service (CIS) notifies to all entities to shut down. Simulation gets completed and status about the simulation is displayed.

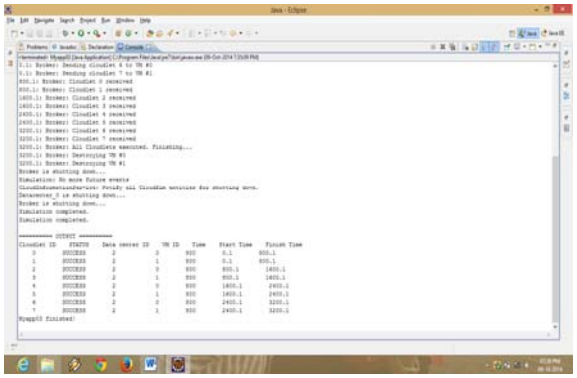

Figure 03: Time-Space Shared Scheduling

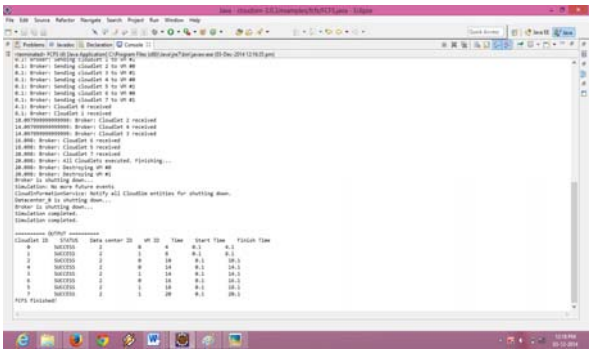

Figure 04: FCFS Scheduling

VI. CONCLUSION

Recently many efforts have been done in cloud technology to develop various techniques and have been presented to make it more efficient. CloudSim has been developed to help the organization and researcher to evaluate their experimental model before deployment in the real world. If the deployment is different from what we hypothyse then it causes heavy implementation and cost time. So in this paper simulation strategy is defined in real world manner so that the experiment what is being executed using CloudSim can be deployed directly in the cloud environment. Approaches to improve the performance of applications in Cloud Computing are discussed in this paper. An evaluation of the Scheduling mechanisms such as FCFS and Time-Space Scheduling are done in CloudSim environment. The results obtained indicate the scope for further improvement of the performance.

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