Cloud Simulation Environment and Application Load Monitoring

Sandya Koushal
USICT
GGSIP University
New Delhi, India
skaushal0107@gmail.com

Rahul Johri
USICT
GGSIP University
New Delhi, India
rahuljohari@hotmail.com

***Abstract*— Cloud computing is now across all the enterprises and they are being benefitted by the low cost and highly available environment. Cloud computing has changed the way industries used to work with all by their own concept. Sharing of resources and availability of on demand computational power has made the work easier for the smaller and large enterprises both. But the initial estimation for the requirement of the resources and to measure the peak time load or load at non peak hour so that enterprise or a proof of concept can use the cloud optimally was still the problem. Cloud Computing is a service based model and a well defined resource requirement leads to a optimal utilization of the resources. Cloud Simulation is a powerful tool to simulate the exact environment, visualizing the usage patterns and to monitor the load. CloudSim is Cloud Simulation framework that provides all these capabilities and can be used monitor the usage patterns. In this paper we are using CloudSim API [3] to monitor the load patterns of the various users of a web application.**

***Index Terms* — CloudSim, Simulation Tool, Cloud Computing.**

I. INTRODUCTION

In this fast changing technological era a great change is the evolution and use of Cloud services which are based on technologies like Web 2.0, Service [7] Oriented Architecture (SOA). A significant change is observed in the way services are provided on the fly with just the requirement specification. A ready to go environment for the design, development or proof of concept can be prepared in just hours or less. Service providers like Amazon EC2 [7], IBM Smart Cloud, Google App Engine, and Aneka [10] are providing Hardware, Platform or Software as a service in the very efficient medium economically [6].

Cloud Computing is a computational environment exposed as a service over the network. Cloud computing delivers infrastructure, platform, and software that are made available as subscription-based services in a pay-as-you-go model to consumers.

One implication of Cloud platforms is the capability to dynamically adapt (scale-up or scale-down) the amount of resources allocated to an application in order to attend variations in demand that are either known, and occur due to access patterns observed during the day and during the night; or unexpected, and occurring due to a huge increase in the popularity of the application service. Hence, the development of dynamic provisioning techniques to ensure that these applications achieve quality of service under transient conditions is required. Some time resource requirement of a service may go beyond the limit of the maximum allowed resources. Therefore, in those cases where the number of requests overshoots the cloud's capacity, application hosted in a cloud can compromise on overall quality of service delivered to its users.

Writing the software and developing application provisioning techniques for any of the Cloud models – public, private, hybrid, or federated – is a complex undertaking. CloudSim eases these challenges by supplying a platform in which strategies for each element can be tested in a controlled and reproducible manner. CloudSim [1] is a simulation framework which allows evaluation of the performance of resource provisioning and application scheduling techniques under different usage and infrastructure availability scenarios. CloudSim uses Event simulation engine [11] to provide simulation techniques.

II. CLOUDSIM ARCHITECTURE

Figure 1 shows the multi-stacked design of the CloudSim software framework and its structural components. Before this various Grid Simulation [9] techniques were available to simulate the environment but lesser capable than CloudSim.

Simulation with CloudSim provides support for simulation and modeling of virtualized Cloud-based data center environments including dedicated management interfaces for virtual machines (VMs), memory, storage, and bandwidth.

A. User Code Layer

CloudSim stack is the User Code that exposes basic entities for hosts (number of machines, their specification and so on), applications (number of tasks and their requirements), VMs, number of users and their application types, and broker scheduling policies. By extending the basic entities given at this layer, a Cloud application developer can perform following activities:

1) Generate a mix of workload request distributions, application configurations;

2) Model Cloud availability scenarios and perform robust tests based on the custom configurations; and

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3) Implement custom application provisioning techniques for clouds [9] and their federation.

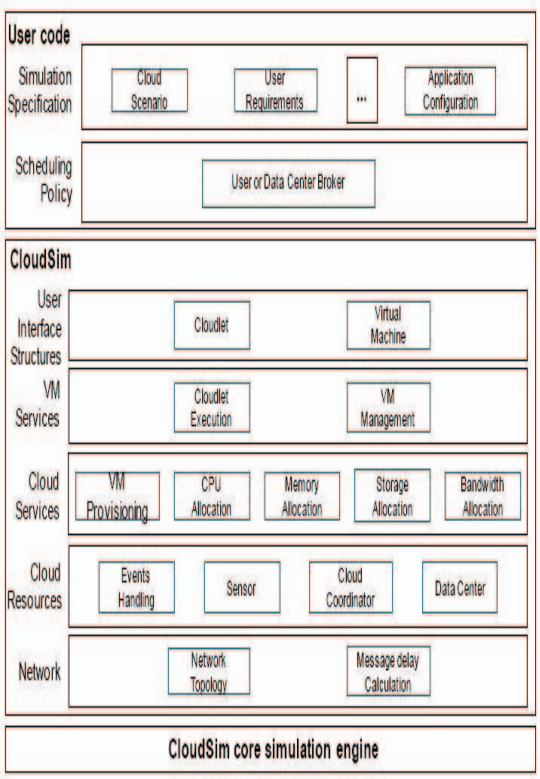

Figure 1: CloudSim Architecture [2]

B. CloudSim

This layer provides various functionalities stated as below.

1) To study the efficiency of different policies in allocating its hosts to VMs (VM provisioning).

2) Cloud host can be concurrently allocated to a set of VMs that execute applications based on Software as a Service (SaaS) provider's defined QoS levels.

3) Managing application execution, and monitoring dynamic system state.

4) Support for dedicated management interfaces for virtual machines (VMs), memory, storage, and bandwidth.

III. Cloud Modeling

Modeling the cloud was never that easy before the introduction of the CloudSim API [4]. A vast set of libraries are provided and can be used to model the cloud environment and can be used for various initial estimation and to check load bearing capacity of an available hardware or service configuration.

Figure 2 shows the various steps involved in a cloud environment simulation.

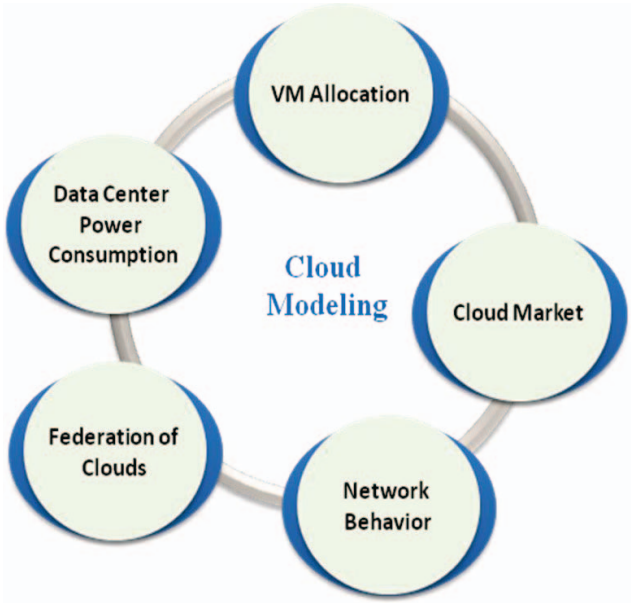

Figure 2: Cloud Modeling

A. VM Allocation

Virtualization layer that acts as an execution, management, and hosting environment for application services.

B. Cloud Market

It is necessary for regulating Cloud resource trading and on-line negotiations in public Cloud computing model, where services are offered in a pay-as-you-go model.

C. Network Behavior

Network topologies [8] to connect simulated Cloud computing entities (hosts, storage, end-users).

D. Federation of Clouds

Entity is responsible for communicating with other data centres and end-users in the simulation environment, also for monitoring and managing the internal state of a data centre entity.

E. Data Centre Power Consumption

Development of efficient and energy conscious provisioning policies at resources, VMs, and application level.

IV. Application Load Monitoring

Application load is monitored by deploying an application on the cloud and check the usage behavior of various users in the cloud. Cloud Reports [3] is used to create the reports on the fly. Cloud Report uses the CloudSim API [4] to create a virtualized cloud environment that has various policies and more can be built and applied at the time of resource allocation.

A web application "**ebookshop**" is hosted on this environment. Ebookshop is an online book selling site

where user can buy new books and create their own wish list. Login to the site is required before user access to the books catalog. Administrative user has access to the various reports like monthly sales report, weekly sales report, and reports for system availability and load at different times.

Whenever a new user creates a new profile an automatic update is inserted in customer registry for Cloud Reports. User behavior in accessing the site is monitored like duration of access, time of access, number of hits etc and based on the statics collected a report is generated that shows the system availability and usage at the time of accessing the data.

Reports for the system on cloud are created in HTML format and created at the host system. A shared MySQL Data base is used to keep the data for Cloud Reports as well as the web application. Once multiple users are entered into the system a simulation runs that generate the reports for the system usage based on the different customer usage pattern.

Figure 3 shows the Resource Utilization Graph for multiple users.

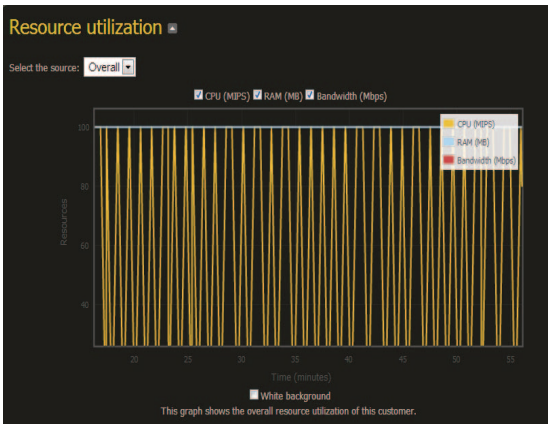

Figure 3: Resource Utilization Graph

Above graph shows the Resource - Time [5] graph and availability of CPU, RAM and Bandwidth at any point of time.

V. SYSTEM FLOW

Load monitoring system comprises various components as described in the diagram below.

There are two types of user one is new system user and other is existing set of users. A new user needs to register on the 'ebookshop' application in order to perform activities on the application. Both type of users need to login for the activities they will execute on the system. Flow of the application is as described in the below steps

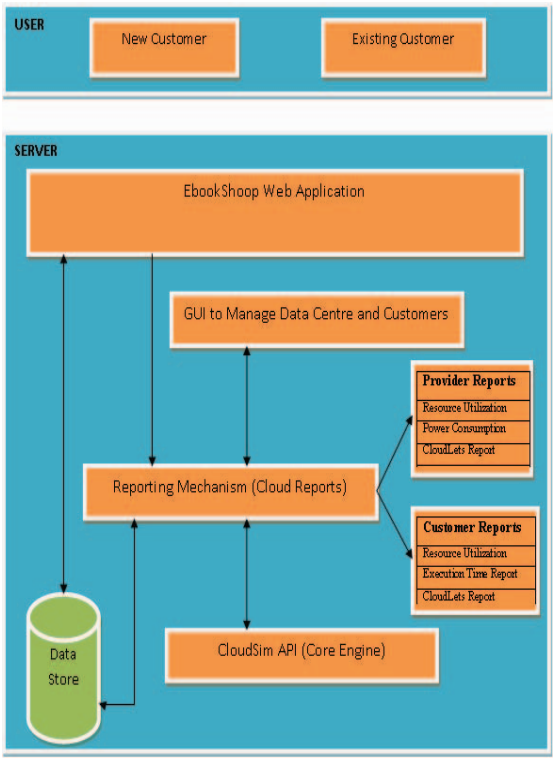

Figure 4: Resource Utilization Graph

Figure 4 provides a deep insight about the system components.

A. User Component

This block comprises the user related activities like login into the system, signup etc.

1) New Customer is the user of the system who want to access the site but does not have any account already existing with the system. New customer will create his user id first and then only will be able to access the application.

2) Existing customer is the user which has created his account in the past and now want to buy some books to enter the site he just need to enter his login credentials at first screen of the application.

B. Server Block

This block comprises various server API and Engines to build simulation and generate reports.

1) EBookShop Web Application: This is a web application than comprises various functionalities like create new customer, purchase book, create wish list, traverse through catalog etc. As a new customer comes this application sends this information to cloud reporting module where it get analyzed and processed.

2) GUI to mange Customers and Data centers: This is a tool that provides administrator, access to the existing data centers in cloud and can manage them according to the need based on various parameters like traffic conjunction, Load bottleneck etc

3) Reporting Mechanism (Cloud Reports): This is the capability using which an administer can analyze the various entities on the cloud like Resource Utilization by each customer, Data center Power Consumption, Total cost of using application in cloud etc.

4) Provider Report: These are the reports which provides the graphical representation of factors like Data center resource utilization, data center power consumption, cloudlets report, virtual machine utilization etc.

5) Customer Reports: An administrator can generate the customer usage statistics of the network and resources various reports are generated under this head and is beneficial for the understanding of resource consumption.

6) CloudSim API (Core Engine): This is the core application programming interface that provides functions to create Data center, manage customers, policy creation, resource allocation etc.

7) Data Store: This is the central repository that is being used by both the Web Application and the Cloud Reports tool to store the customer data and the data generated after analyzing the reports.

VI. SYSTEM FLOW

A. New user opens the application home page and Sign up to create user id and password to login.

B. User fills basic details required for registration and provides user id. If any user with same id already exists than user gets an error to choose different user id.

C. As user is created in application one entry for the same user goes to analytics database that admin uses for analyze the load and resource consumption in cloud environment.

D. As this is a virtual cloud, CloudSim API is used to simulate a virtual cloud environment.

E. After filling at least mandatory details user is able to login into the application and perform activities like buy a book, traverse books list, feedback on books and many more available options.

F. As user performs any activity than resources consumed by all the users are monitored.

G. Administrator runs the simulation tool to create the Simulation environment in order to generate the usage statics reports for the various users in cloud. Reporting mechanism is used to perform these activities.

H. Along with generating the reports a User Interface is provided in order to manage the customers and cloud providers.

I. Reports provide utilization of CPU, RAM at a particular time by a particular user.

VII. FUTURE WORK

As load monitoring is an area where load on the networks, performance bottle necks should also be reported so team is working to extend this with more reports related to network topologies, performance issues, and Cloud availability.

Future work needs more study of public and federated cloud this will enhance the existing report generation mechanism by adding 3 D graphs so that better visualization could be possible.

VIII. CONCLUSION

To test these newly developed methods and policies, people need framework or tools that allow them to evaluate the concept prior to a real deployment in commercial a cloud environment, where tests can be reproduced. Simulation-based approaches in evaluating Cloud computing systems and application behaviors offer significant benefits, as they allow Cloud developers:

1) To test performance of their provisioning and service delivery policies in a repeatable and controllable environment free of cost; and

2) Performance bottlenecks tuning before real-world deployment on clouds.

3) To generates reports in virtual environment for butter understanding of resource utilization.

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