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RESEARCH ARTICLE

Study of Cloud Simulation Tools based on Cloud Sim

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Abstract— As the concept of cloud computing evolving day by day and everyone from individuals to different organizations want to connect with cloud through datacenter which may generates many problems for cloud service providers. The cloud simulation tool provides a platform to implement solutions for it which is very similar to the real datacenter. In this paper, we will study three simulation tools. These tools are variants of cloud Sim and one of them is the successor of NS2. Also, we will analyze their behavior individually and identify which one is best suited for power consumption as main feature.

Keywords— Cloud computing, datacenter, cloud sim, cloud analyst, cloud report, and green cloud.

I. INTRODUCTION

Cloud computing is a type of computing that relies on sharing computing resources rather than having local servers or personal devices to handle applications. In cloud computing, the word cloud is used as a metaphor for "the Internet," so the phrase cloud computing means "a type of Internet-based computing," where different services such as, storage on servers and applications are delivered to an organization's computers and devices through the Internet [1]. The concept of cloud computing involves a data center somewhere in the world, or even multiple data centers scattered around the world. These datacenters are hosting the applications on their servers and the clients use them to operate their business. This structure reduces capital expenditures, since by renting from a third-party provider to provide the services on a peruse fee, the business only pays for the resources used. Some Cloud providers employ a utility computing model, meaning they bill clients like a utility such as an electrical company. Others bill on a subscription basis. Many resources available in a datacenter and in the cloud, a client can purchase or rent, such as processing time, network bandwidth, disk storage, and memory. The users of the cloud do not need to know where the datacenter is, or have any expertise on how to operate or maintain the resources in the cloud. Clients only need to know how to connect to the resources and how to use the applications needed to perform their jobs. With cloud-based computing, the applications run on servers in the data center, not the local laptop or desktop computer the user is operating. This procedure may reduce the need for big processing power and memory on the end user's computer, but it may increases the power consumption of complete datacenter if the demand of resources rises simultaneously. Similarly many other problems may arise with the use of cloud computing such as security and privacy is the another one. To handle these issues or to implement new schemes the concept of cloud simulation tool comes. These tools help in terms of time, money, as well as provide a complete model for its infrastructure. Many simulation tools have been developed by the researchers previously which provide a complete environment of cloud computing from

customers to datacenter. The rest of the paper organized as follows, the section II presents the introduction about the cloud simulation tools. Section III covers the detail working of cloud simulation tools (i.e. cloud analyst, cloud report, and green cloud). And in the end, Section IV provides the conclusion of complete discussion.

II. CLOUD SIMULATION TOOL

Cloud is a model to enable a convenient and on-demand network access. Now, most of the organizations focus on adopting cloud computing model so that they can cut capital expenditure, efforts and control operating costs. But the problem occurs when we want to test the performance of scheduling and allocation policies in a real Cloud environment for different application models. The use of real infrastructures for benchmarking the application performance under variable conditions is often constrained by the rigidity of the infrastructure. Thus, it is not possible to perform benchmarking experiments in repeatable, dependable, and scalable environments using real world Cloud environments. So a viable alternative is the use of cloud simulation tools [2]. These tools are available to design and develop customized cloud computing models. Simulation tools are mostly used by developers, students and researchers [3]. These tools open up the possibility of evaluating the hypothesis in a controlled environment where one can easily reproduce results [2]. Various tasks performed by the cloud simulators are:

- Modeling and simulation of large scale cloud computing datacenters
- Modeling and simulation of virtualized server hosts, with customizable policies for provisioning host resources to VMs.
- Modeling and simulation of energy aware computational resources.
- Modeling and simulation of datacenter network topologies and message passing applications.
- Modeling and simulation of federated clouds.
- Dynamic insertion of simulation elements, stopping and resuming simulation.
- User defined policies for allocation of hosts to VMs, and policies for allotting host resources to VMs.

III.CLOUD SIM SIMULATOR

CloudSim is a widely used simulator for cloud parameters developed in the CLOUDS Laboratory, at the Computer Science and Software Engineering Department of the University of Melbourne. The CloudSim library is used for the following operations [4]:

- Large scale cloud computing at datacenters.
- Virtualized server hosts with customizable policies.
- Support for modelling and simulation of large scale cloud computing datacenters.
- Support for modelling and simulation of virtualized server hosts, with customizable policies for provisioning host resources to VMs.
- Support for modelling and simulation of energy aware computational resources.
- Support for modelling and simulation of datacenter network topologies and message passing applications.
- Support for modelling and simulation of federated clouds.
- Support for dynamic insertion of simulation elements, as well as stopping and resuming simulation.
- Support for user defined policies to allot hosts to VMs, and policies for allotting host resources to VMs.
- User defined policies for allocation of hosts to virtual machines.

As the CloudSim has major limitation of lack of Graphical User Interface, so several variants has been developed such as CloudAnalyst, CloudReport, Green Cloud, etc. In rest of the chapter we will discuss all these three variants of CloudSim, and also describe why we choose the Green Cloud Simulator tool for our simulation work.

A. CloudAnalyst

CloudAnalyst was derived from CloudSim and extends some of its capabilities and features proposed. It separates the simulation experimentation exercise from a programming exercise and also enables a modeller to repeatedly perform simulations and to conduct a series of simulation experiments with slight parameters variations in a quick and easy manner. CloudAnalyst can be applied to examining behavior of large scaled Internet application in a cloud environment [2]. The main feature provided by this tool is load balancing.

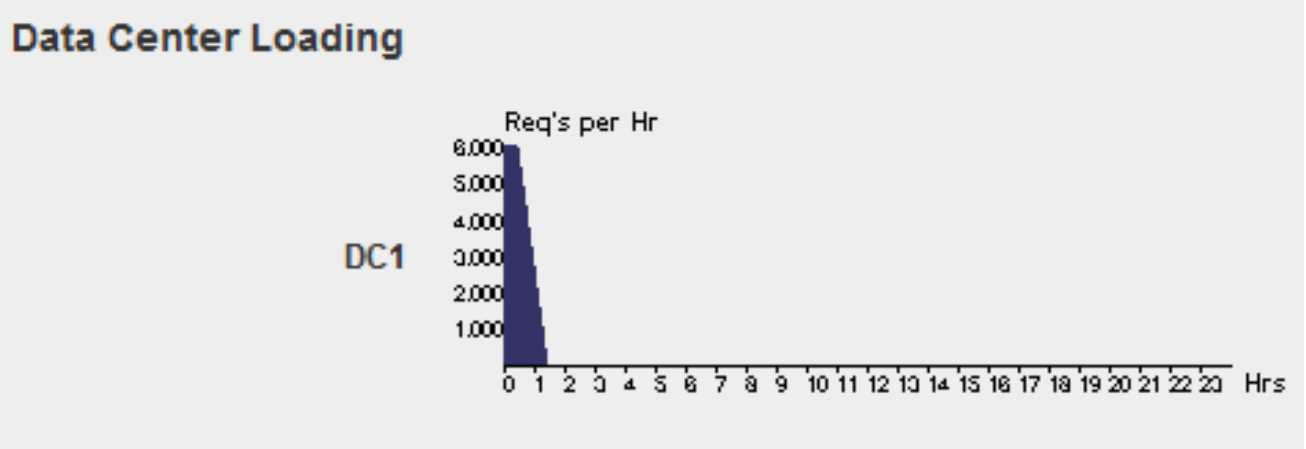

Figure 1.1: Datacenter load.

The result of CloudAnalyst in the form of graph is shown in Figure 1.1. Here this graph shows that the number of requests which can be handled by datacenter is 6,000 in an hour. We can run number of simulations by taking different parameters to examine the datacenter load and accordingly can change some parameters to balance it. But our main motive was to examine the power consumption of datacenter, and this tool was unable to provide this information.

B. CloudReport

CloudReport is a graphic tool that simulates distributed computing environments based on the Cloud Computing paradigm. It uses CloudSim as its simulation engine and provides an easy to use user interface, report generation features and creation of extensions in a plugin fashion. The application simulates an Infrastructure as a Service (IaaS) provider with an arbitrary number of datacenters. Each datacenter is entirely customizable. The user can easily set the amount of computational nodes (hosts) and their resource configuration, which includes processing capacity, amount of RAM, available bandwidth, power consumption and scheduling algorithms. The customers of the IaaS provider are also simulated and entirely customizable. The user can set the number of virtual machines each customer owns, a broker responsible for allocating these virtual machines and resource consumption algorithms. Each virtual machine has its own configuration that consists of its hypervisor, image size, scheduling algorithms for tasks (here known as cloudlets) and required processing capacity, RAM and bandwidth. It generates the simulation result in the form of HTML files [5]. The number of supported extensions by this tool is:

- Virtual machines allocation policies.
- Broker policies.
- Processing elements provisioners.
- RAM provisioners.
- Bandwidth provisioners.
- Cloudlets schedulers.
- Power consumption models.
- Resource utilization models.
- Virtual machines schedulers.

The main features provided by this tool in the form of graph, firstly w.r.t datacenter provider are: resource utilization by different hosts, overall power consumption by hosts, number of migration between the hosts or virtual machines, number of virtual machine successfully allocated on datacenter by each customer, number of cloudlets (tasks) successfully executed on datacenter by each customer, and cost generated for each customer on the basis of resource utilization. Secondly, w.r.t each customer is: resource utilization by customer in each virtual machine, number of cloudlets has been successfully executed by customer on each datacenter, and the amount of time each customer's cloudlets took to be executed.

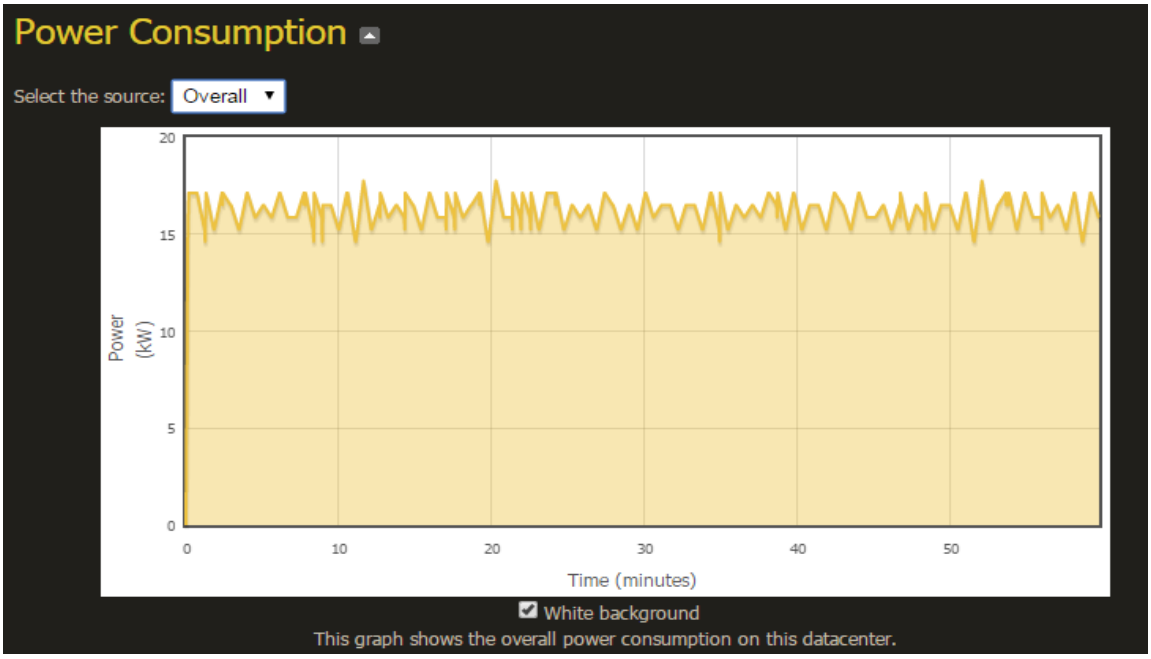

Figure 1.2: Overall power consumption by host.

As it is shown in Figure 1.2, this tool provides enough information related to the power utilization by all hosts, but it is also important to know power consumption of complete datacenter. And this tool was not able to provide this information as well as power consumption by switches.

C. GreenCloud

GreenCloud is a sophisticated packet-level simulator for energy-aware cloud computing datacenters with a focus on cloud communications. It offers a detailed fine-grained modelling of the energy consumed by the datacenter IT equipment, such as computing servers, network switches, and communication links. GreenCloud can be used to develop novel solutions in monitoring, resource allocation, workload scheduling as well as optimization of communication protocols and network infrastructures. It is released under the General Public License Agreement and is an extension of the well-known NS2 network simulator. About 80 per cent of GreenCloud code is implemented in C++, while the remaining 20 per cent is in the form of Tool Command Language (TCL) scripts. The main motivation behind development of GreenCloud is lack of detailed simulators in the market. It allows simulating environment for energy aware cloud computing datacenters. It focuses on communication within a cloud that is all communication processes are simulated on packet level [3].

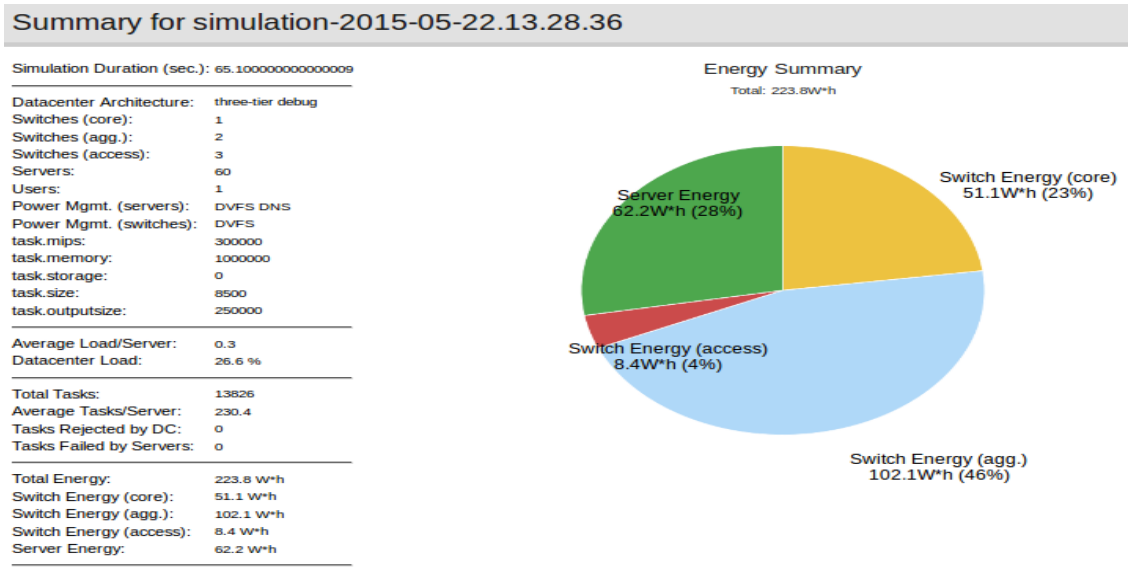

Figure 1.3: Result in the form of log and pie chart.

The figure 1.3 presents the result of three-tier debug architecture, the average Load/Server is 0.3 i.e. lightly loaded, and Datacenter Load is 26.6%. It presents all information regarding the Total Tasks, Average Tasks/Server, Rejected task, failed task by server and so on. The Pie chart shows the energy consumption of each component in percentage such as Server, Core switch, aggregation switch, and Access switch.

The main features provided by GreenCloud simulation tool are:

- Completely focused on cloud networking and energy awareness.
- Simulation of CPU, memory, storage and networking resources.
- Independent energy models for each type of resource.
- Provide support of virtualization and VM migration.
- Network-aware resource allocation.
- Completely based upon TCP/IP implementation.
- Open Source software.
- The script used is C++/OTcl.

With these useful features this tool has also some drawbacks which cannot be neglected.

- High Simulation time, generally Tens of minutes.
- Limited graphical support.
- High memory requirements.

IV. CONCLUSIONS

After running the multiple simulations, it is clear that each tool is efficient at particular circumstances. This paper provides the analysis of these tools w.r.t the power utilization. The observations of this study are (i.)The first simulation tool (i.e. cloud analyst) just provides the detail regarding load over datacenter by varying the User Base (UB) and Datacenter (DC) parameters. But this tool was unable to provide the information regarding power consumption of datacenter. (ii.) The 2nd tool (i.e. cloud report) provides the information regarding the power utilization of datacenter, but the power consumption by individual component was missing. (iii.) The last tool (i.e. Green cloud) provides all the information that is missing in both the previous tools with some its own limitation. So, according to our study the green cloud tool provides the best result regarding power utilization of datacenter. The Table 1 presents the overview of these tools in terms of different parameters.

Parameters	CloudAnalyst	CloudReport	GreenCloud
Platform	SimJava	SimJava	NS2
Programming Language	Java	Java	C++/OTcls
Operating System Support	Windows (all version)	Windows (all version)	Linux (ubuntu)
Networking	Limited	Limited	Full
Simulator Type	Event Based	Event Based	Packet Based
Simulation Time	Second	Second	Tens of Minutes
GUI Support	Full	Full	Limited
TCP/IP Support	None	None	Full
Power saving modes	None	None	DVFS, DNS or both
Availability	Open Source	Open Source	Open Source

Table 1: Comparative analysis of cloud simulation tools.

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