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Cloud Computing Tools: Inside Views and Analysis

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Abstract

Cloud computing tools can be segregated into various categories as indicated by their highlights. In this area, we have made an extensive investigation with various classes on the basis of the following parameters such as broadening, correlation and classification. In this paper, we have taken some of the important open-source Cloud tools for comparative study for their better utility. It is very much useful if we can optimize codes in subtleties, growing new calculations for all the users involved in various processes and its design. The five open-source Cloud computing tools, more specifically CloudSim, Cloud Analyst, Cloud Reports, Cloudsched and Green Cloud are illustrative of many related test systems differ from each other on the parameters like architecture design, modeling elements, simulation process, performance metrics and scalability. These tools have regular highlights by their commercial vendors, particularly in design, displaying components, and reproduction process. These are some of the important characteristics, which can be utilized to study the utilities of these tools, for example: concentrating on different layers and with several execution measurements.

Keywords: CloudSim; Cloud Analyst; Cloud Reports; Cloudsched; Green Cloud.

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1. Introduction

As per different industry gauges, the server farm redistributing market in India, at present pegged at near $2 billion, is anticipated to develop at a CAGR of 25% to reach $5 billion by budgetary year 2023-24 [1]. Therefore the buzzword Cloud Computing technique is the need of the hour. There are many open source Cloud computing tools are present but there are few popular tools among them are there like: CloudSim, Cloud Analyst, Cloud Reports, Cloudsched, Green Cloud. The objective of our research is to extensively study the architectural design of each and every tool, platform, programming model, availability, graphic support, physical model, energy consumption, simulation time and memory space required etc. Broad research on all issues in genuine condition is very difficult in light of the fact that it expects designers to consider arranged foundation on the earth, which might be outside the ability to control. Also the conditions of system can't be controlled or anticipated. Assessments of the execution of remaining task at hand models and Cloud provisioning figuring in a repeatable way are irksome. In this manner Cloud based simulators are made to acknowledge and apply progressing top tier Cloud handling tools. For this reason here we have highlighted five open source Cloud computing simulation tools.

2. Research Challenges

The key research challenges can be outlined as: extensive study of each and every Cloud based simulator, their architectural design and simulation process, performance metrics and scalability, and finally simulation outputs and result analysis. We have written this research paper as given as follows. Section 3 highlights the related research works. A tabular representation of Cloud based simulators and their comparisons have been narrated in Section-IV. Section-5 narrates architecture of different Cloud-based simulators and the results have been shown in section-6. At last but not the list, in Section-7 we have given the conclusion with advances in future research related to Cloud based simulators.

3. Related Work

Our early works are mostly related to minimization of response time [2] [4] over Cloud to serve the end user in better way. Besides, how to improve the different quality parameters of Cloud environment have been discussed in [3]. Then, we have investigated some energy efficient power models using Cloud Reports [5] [7] and energy efficient task schedulers using Green Cloud [6]. Apart from that we have also devoted our time towards Edge Cloud framework [8]. In [9] authors have developed a Grid computing tool called Gridsim which is basically used for resource allocation problems in Grid. In [10] authors have developed a Cloudsim toolkit for resource provisioning algorithms in Cloud based infrastructure. In [11] the author invented a tool known as Cloud Analyst for large scale Cloud computing environment. In [12] Thaigo Teixeira Sa et al. have developed a Cloud GUI based simulation tool known as Cloud Reports for energy-aware Cloud environment. Minxian Xu et al. [13] have developed a tool known as FlexCloud.

4. Comparison of Different Cloud Based Simulators

In this section, we compare five different simulators i.e. CloudSim, Cloud Analyst, Cloud Reports, Cloudsched and Green Cloud based on different parameters like platforms, programming language, availability, graphical support, application model, communication model, support of TCP/IP, parallel experiments, energy models, energy consumption, power saving models, memory space and simulation time.

Table 1: Comparison of Different Cloud Based Simulators

Comparison Items	CloudSim	Cloud Analyst	Cloud Reports	Cloudsched	Green Cloud
Platform	Any	Any	Any	Any	NS2
Programming Language	Java	Java	Java	Java	C++
Availability	Open Source	Open Source	Open Source	Open Source	Open Source

Graphical Support	Limited	Yes	Yes	Yes	Limited
Application Model	Computation, Data transfer	Computation, Execution time	Computation, Data transfer, and Execution time	Computation, Execution time	Computation, Data transfer, and Execution deadline
Communication Model	Limited	Full	Full	Full	Full
Support of TCP/IP	No	No	No	No	Full
Parallel Experiments	No	No	No	No	No
Energy Models	No	No	Yes	No	Yes (Servers+Network)
Energy Consumption	Yes	No	Yes	Yes	Yes
Power Saving Models	No	No	No	No	DVFS, DNS, and both
Memory Space	Small	Small	Small	Small	Large
Simulation Time	Sec	Sec	Sec	Sec	Min

5. Architecture of Different Simulators

5.1 Architecture of CloudSim

The multi-layered structure architecture of CloudSim [9] is demonstrated in Fig. 1. The user code layer target the uses are to have VMs and its conditions of dynamic structure are given. By expanding the middle VM to give convenience, the Cloud provider can similarly think about the viability of different methodology at this layer. In context on the top layer, the User Code tends to the central substances for has, and through broadening parts at this layer. Architects can connect with the application to make demands in an assortment of philosophy, set-up, and conditions of cloud model, acknowledge custom applications, etc.

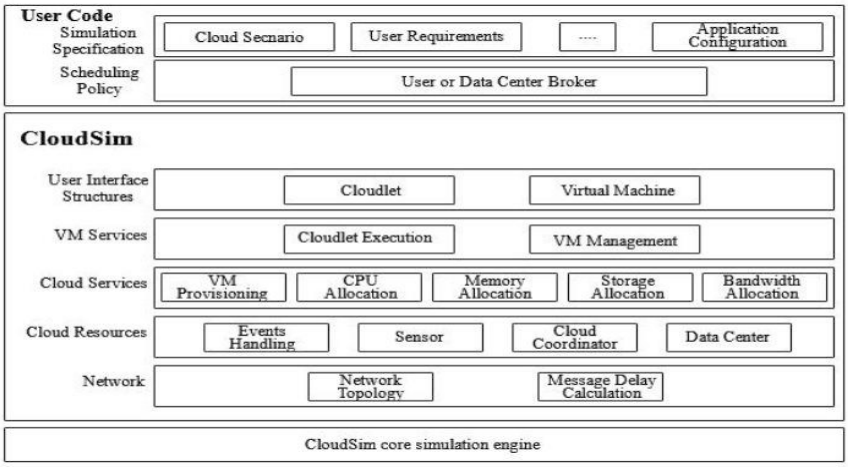

Fig. 1 Architecture of CloudSim

The architecture of the CloudSim is divided into three layers: User code, CloudSim layer and CloudSim simulation engine layer.

5.2 Architecture of Cloud Analyst

The architectural design of Cloud Analyst [11] is demonstrated in Fig. 2 which expands over CloudSim toolbox.

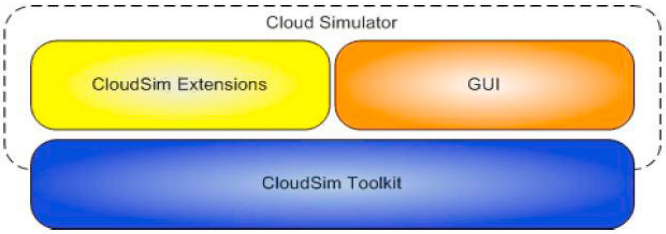

Fig. 2 Architecture of Cloud Analyst

Fig. 3 demonstrates the principle parts and area substances of Cloud Analyst.

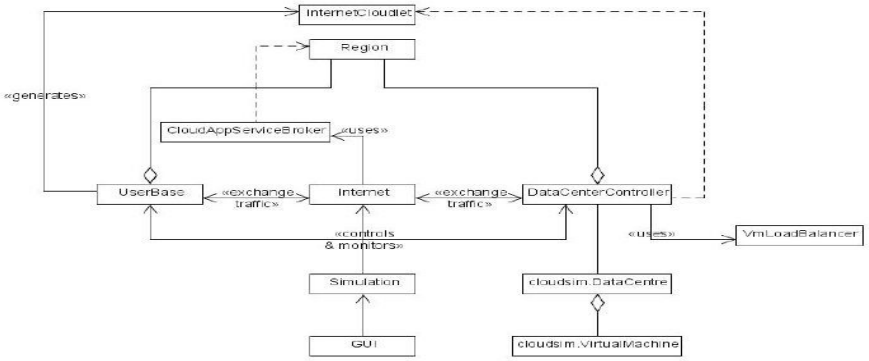

Fig. 3 Main Components of Cloud Analyst

The fundamental classes and their obligations are as per the following:

- **GUI Main** – This is a graphical user interface which acts as front end controller.
- **Simulation** – It simulates the user parameters given.
- **User Base** – It is nothing but a collection of customers/users at a single place.
- **Cloud Data Centre Controller** – It controls the data centre.
- **Internet** – Internet defines the traffic guiding behaviour.
- **Internet Characteristics** – Different internet characteristics include execution time between Cloud server and client.
- **Service Broker and its executions** – It defines the different administration representatives.
- **VMLoadBalancer and its utilization** – It balances the load by modifying procedures utilized by data centre to dole out VM demand.
- **User Base Element** – This component keeps information about customer bases,
- **Data centre Base Element**- This component tells about data centres and machines for the User Interface
- **Machine Element**- This helps machines for user interface.

5.3 Architecture of Cloud Reports

The design of Cloud Reports [12] is given in Fig.4. The Cloud Reports programming building seeks after a measured plan as given in Fig.5. It at present contains five required modules and a discretionary extensions module. The persistent layer consists of graphical user interface (GUI), report manager, simulation manager, different extensions and core entities. However the Cloud Reports tool is being prepared on top of CloudSim simulation engine and java virtual machine (JVM). The SQLite database is being used by Cloud Reports.

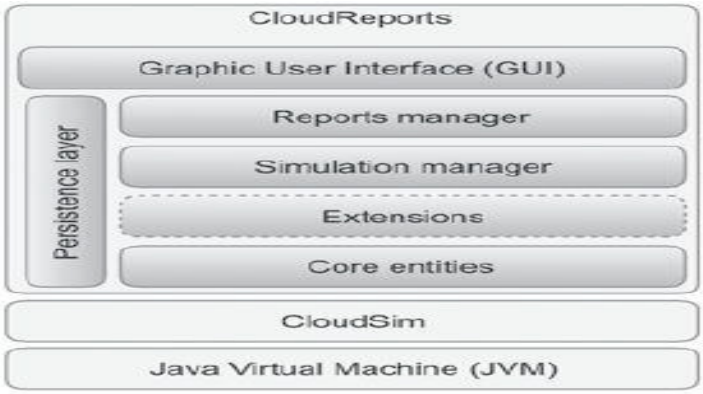

Fig. 4 Architecture of Cloud Reports

The reports manager gathers, sorts out, and forms re-enactment information from database documents and creates recreation reports. The reports are made out of HTML and crude information documents. The HTML records contain information about general data for Cloud data centres and clients, which incorporate by and large and per host control utilization. The report executive uses all entertainment data to deliver charts thusly and join them in the HTML report records. Crude information records contain a collection of multiplication data in a single book archive that is fit to be imported by different applications, for instance, MATLAB and Octave. The detailed structure of Cloud Reports simulation environment is given in Fig.5.

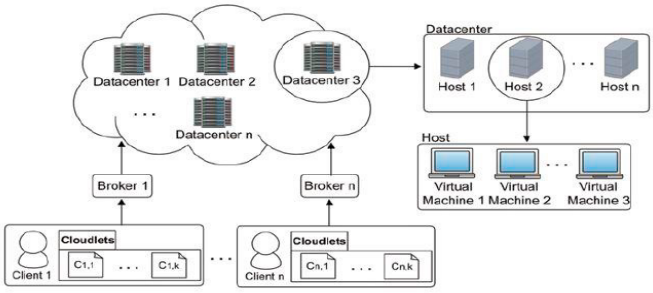

Fig. 5 Simulation environment of Cloud Reports

5.4 Architecture of Green Cloud

Fundamentally Green Cloud design [6][14] comprises of three tier data centre architecture which are normal now-a-days. They incorporate three system networks: (a) Access network, (b) Aggregation network and (c) Core network. The access network consists of pool of processing servers (or hosts) whereas core network at the base of the tree and the aggregation network are answerable for routing.

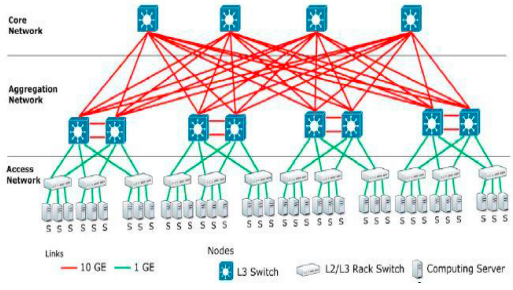

Fig. 6 Architecture of 3-Tier Data Centre

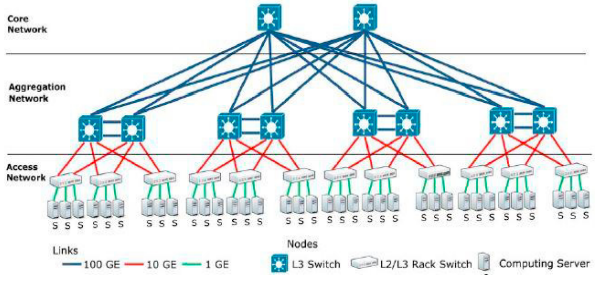

Fig. 7 Architecture of 3-Tier High Speed Data Centre

There is another data centre architecture exists which is called 3-tier high-speed data centre architectures as shown in Fig. 7. This is intended to advance the quantity of hubs, capacity of core, and aggregation networks that are as of

now a bottleneck, which farthest point the most extreme number of hubs in a server farm or a for each hub transmission capacity.

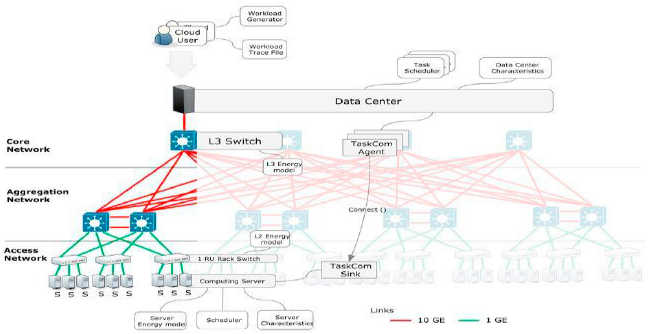

Fig. 8 Architecture of Green Cloud

5.5 Architecture of Cloudsched

The simplified layered architecture of Cloudsched is given in following Fig. 9.

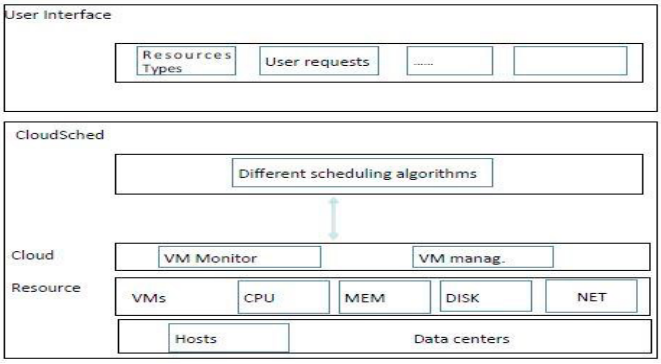

Fig.9 Cloudsched layered Architecture

The different components shown in Fig.9 of Cloudsched can be described as follows:

- **User Interface:** This is the top layer which pick resources and send requests to the customers/users, in a general sense a couple of sorts of virtual machines are pre-intended for a customer to pick.
- **Core Layer of Scheduling:** During the client deals core layer scheduling is dependable to pick fitting server ranch and physical machines further subject to client demands. Cloudsched gives support for appearing and reproducing of Cloud server develops particularly doling out virtual machines (containing central processing unit, storage, memory, and information move limit, and so on.) to appropriate physical machines. This layer can manage a gigantic size of Cloud data centre after involving a large number of physical machines. Special computations can be applied in different server cultivates in perspective on customers and their virtues.
- **Cloud Resource:** At this most lessened layer, there are Cloud assets which combine physical machines and virtual machines; by then two containing certain extent of CPU, memory, limit and information move limit, and so on.

6. Simulation Process and Output

6.1 CloudSim Simulation Process and Output

The user interface of CloudSim is shown in Fig.10 and the output is given in Fig. 11.

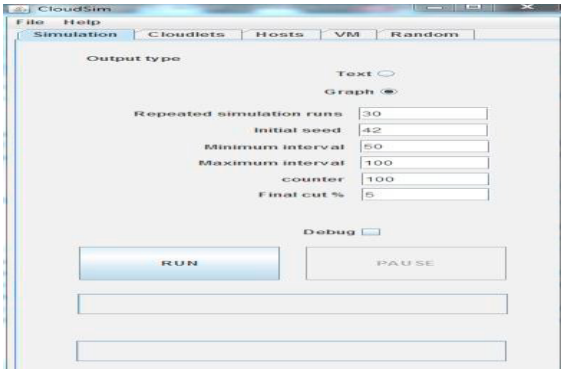

Fig.10 CloudSim GUI Interface

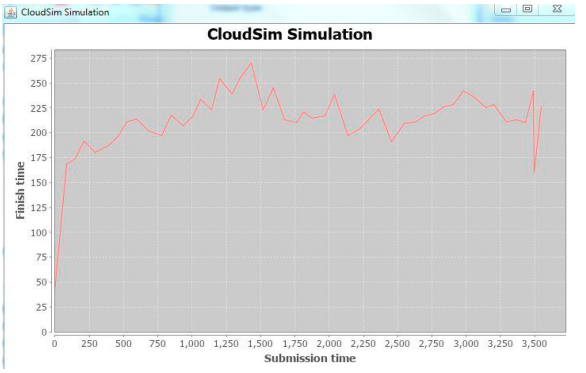

Fig. 11 CloudSim Output

6.2 Cloud Analyst Simulation Process and Output

The Graphical User Interface of Cloud Analyst is given as shown in Fig.12.

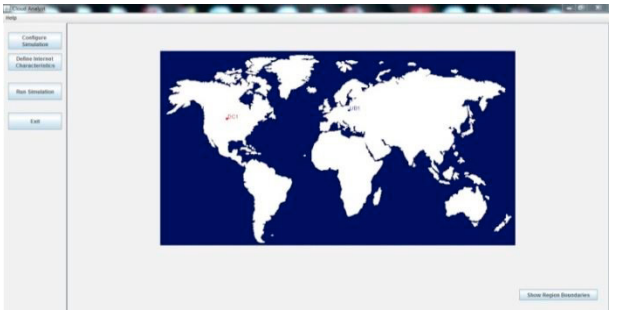

Fig. 12 GUI Screen of Cloud Analyst

We have played out a few investigations for discovering in general overall response time, by and large Cloud data centre handling time under different conditions [2] as appeared in Fig.13 and Fig.14 separately. We found that AMLB (Active Monitoring Load Balancing) is the effective one as it devours less by and large response time and less data centre handling time in contrast with the other two algorithms.

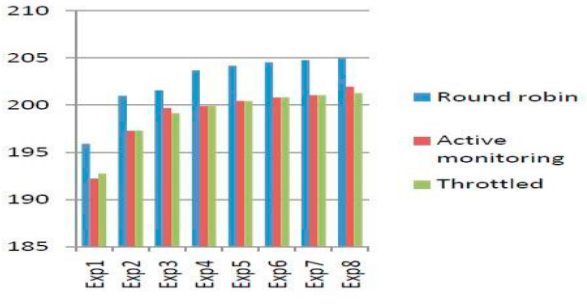

Fig. 13 Response time comparison

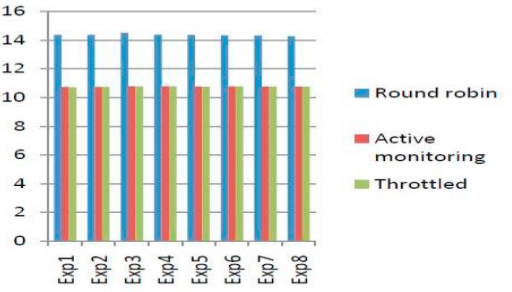

Fig. 14 Overall data centre processing time comparison

6.3 Cloud Reports Simulation Process and Output

The GUI of Cloud Reports is shown in Fig.15.

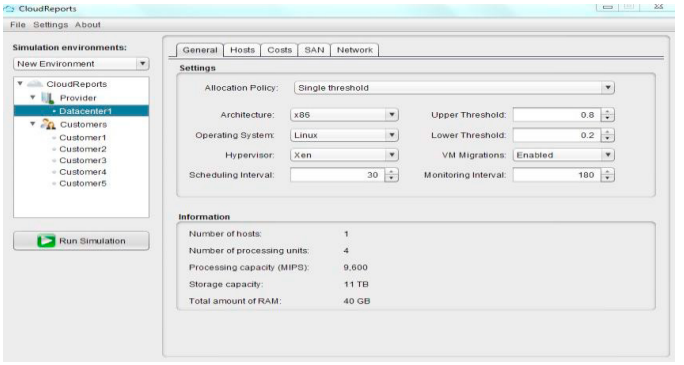

Fig. 15 Cloud Reports GUI

Using this tool we have addressed the following key issues [5]:

- Virtual machine scheduling algorithms
- Overall CPU utilization in each power model
- Overall control utilization for each situation by empowering VM migration
- Relationships between CPU usage and in general power utilization in each model as appeared in Fig. 16
- Finally we make sense of which power model is the best one
- Overall power utilization (in KW) for each situation by empowering virtual machine (VM) relocation
- Overall resource utilization
- Cloudlets utilized per each VM
- Execution time etc.

Table 2: Four Different Power Models Comparison

Power Models	Overall Power Consumption (Kwh)	Mean Square Error (MSE)	R-Square
Cubic Power Model	33.85	0.0881	0.309
Linear Power Model	40.10	0.0973	0.41
Square Power Model	40.93	0.0419	0.68
Square Root Power Model	50.29	0.1891	0.64

From the above comparison we find that Cubic power model performs better than the other power models.

6.4 Cloudsched Simulation Process and Output

Cloudsched is a lightweight Cloud assets planning simulator [15]. Its significant highlights and structure and execution subtleties are exhibited. Reproduction results are talked about for burden parity and vitality productive calculations. Cloudsched can assist engineers with identifying and investigate proper arrangements thinking about various asset planning approaches and calculations.

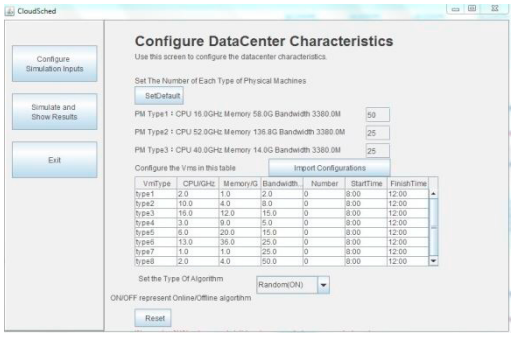

Fig. 16 GUI of Cloudsched

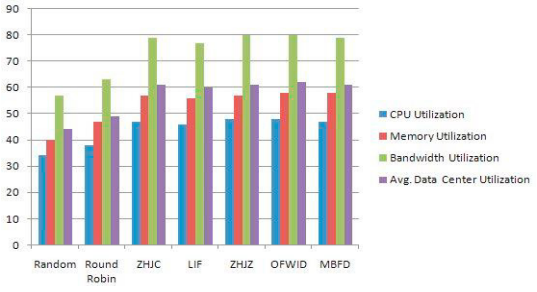

Fig. 17 Comparison of Different Scheduling Algorithms

There are various types of algorithms present for scheduling purpose [15]. They are: (a) Random, (b) Round Robin, (c) ZHCJ, (d) LIF (Least Imbalance Level First) (e) ZHJZ (g) OFWIDE (Offline without Delay) and MBFD (Modified Best Fit Decreasing). Fig.17 shows the comparative study for the above scheduling algorithms.

6.5 Green Cloud Simulation Process and Output

Green Cloud simulator is a popular simulator which is build on top of NS2. Here we have simulated 6 heterogeneous energy-efficient algorithms into considerations [6][17]. They are: Round Robin (RR), Green, Random, HEROS, RandDENS and BestDENS.

Table 3: Inputs for Three-Tier Data center Architecture

Network Configuration	3-Tier	3-Tier High Speed
Core Switches	8	2
Aggregation Switches	16	4
Access Switches per Pod	64	256
Servers per Rack	3	3
Total server	1536	1536
Simulation Time	65.5 sec	
Target System Load	30%	

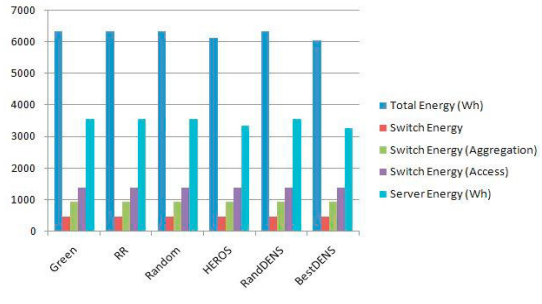

Fig. 18 Energy Consumption in 3-Tier Architecture

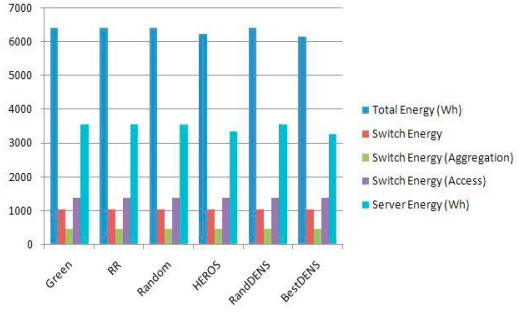

Fig. 19 Energy Consumption in 3-Tier High-speed

Here BestDENS scheduler exploits heterogeneity and consumes less energy followed by HEROS scheduler. Therefore the most energy efficient algorithm in this case is BestDENS followed by HEROS.

7. Future Advances and Conclusion

This research work describes the basic differences among Cloud based simulators namely: CloudSim, Cloud Analyst, Cloud Reports, Cloudsched and Green Cloud. These test systems can reenact the situations of cloud server farm from different layers in the distributed computing design. We give itemized correlations about these test systems based upon their structures, components displaying, recreation process, execution measurements and yields. Simulators are the critical tools for research and to analyze the complexity of the system and the system traffics. We can see that none of them is perfect for all perspectives and arrangements since, still there are a great deal of work to ad lib in the field of demonstrating diverse Cloud layers, high extensibility which can enable new modules to be sent effectively in the devices, simple to utilize lastly think about the client need.

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