Comparative Study of Simulation Tools in Cloud Computing Environment

Ranu pandey, Sandeep Gonnade

Abstract— Cloud computing includes delivery of dependable, secure, fault-tolerant tolerant, maintainable, and scalable infrastructures for facilitating web based application services. These applications have diverse composition, setup, and deployment requirements. As the adoption and deployment of cloud computing increases, it is discriminating to assess the performance of cloud computing environments. Modeling and simulation are suitable for assessing performance and security issues. Cloud simulators are needed for cloud framework testing to abatement the intricacy and separate out quality concerns. A few cloud simulators have been particularly created for performance testing of cloud computing environments. In this paper we study diverse sort of cloud simulators .Thereafter, we rundown the examinations of distinctive tools by some criteria.

Index Terms—. Cloud Computing, Cloud Simulation tool, CloudSim, CloudAnalyst, EMUSIM, GreenCloud, MDCSim, NetworkCloud, ican cloud.

Abbreviations—Automatic Emulation Framework (AEF); Data Center (DC); Network Simulator 2 (NS2); Virtual Machine (VM).

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1 INTRODUCTION

Cloud computing is a region that is encountering a quick development both in the academia and industry. This technology, which points at offering appropriated, virtualized, and adaptable assets as utilities to end clients, can possibly support full acknowledgment of "computing as a utility" .Along with the development of the cloud technology, new conceivable outcomes for internet-based application development are rising. These new application models could be grouped into two catagories: on one side, there are the cloud service providers that are eager to give substantial scale computing infrastructure at a cost based fundamentally with respect to use designs. It eliminates the beginning high-take for application developers of environment set up application deployment. On the other side there are large scale programming frameworks suppliers, which create applications, for example, social networking and e-commerce, which are picking up fame on the Internet. These applications can profit enormously from cloud infrastructure administrations to minimize expenses and enhance administration quality to end clients.

Previously, development of such applications required obtaining of servers with a fixed capacity fit to handle the normal application peak demand, establishment of the entire programming framework of the stage supporting the application, and design of the application itself.

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Anyhow the servers were underutilized more often than not on account of crest movement happens just at particular brief time periods. With the coming of the Cloud, organization and facilitating got to be less expensive and simpler with the utilization of pay-for every use, adaptable elastic framework services provided by cloud suppliers.

When these two ends are united, a few elements that effect the net profit of cloud might be watched. Some of these elements incorporate geographic distribution of client bases, capabilities of the internet infrastructure within those geographic areas, dynamic nature of usage patterns of the user bases, and capabilities of cloud services in terms of adaptation or dynamic reconfiguration, among others.

A comprehensive study of the whole problem in the real Internet platform is extremely difficult, because it requires interaction with several computing and network elements that cannot be controlled or managed by application developers. Furthermore, network conditions cannot be predicted nor controlled, and it also impacts quality of strategy evaluation.

A more viable alternative is the use of cloud simulation tools. Cloud simulators are required for cloud environment testing to decrease the complexity and separate out quality concerns. They enable performance analysts to examine system behavior by focusing on quality issues of specific component under different scenarios [Xiaoying Bai et al., 2011]. These tools open up the possibility of evaluating the hypothesis in a controlled environment where one can easily reproduce results. Simulation-based approaches offer significant benefits to IT companies by allowing them to test their services in repeatable and controllable environment and experiment with different workload mix and resource performance scenarios on

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simulated infrastructures for developing and testing adaptive application provisioning techniques [Calheiros et al., 2011].

None of the current cloud system simulators offer the environment that can be directly used for modeling Cloud computing environments. But Cloud Simulators which are generalized and extensible simulation frameworks that allow seamless modeling, simulation, and experimentation of emerging Cloud computing infrastructures and application services. By using cloud simulators, researchers and developers can test the performance of a newly developed application service in a controlled and easy to set-up environment. The vast features of cloud simulators would speed up the development of new application provisioning algorithms for cloud computing. This paper first gives background about various simulators available. Section 3 defines cloud simulators that are available such as CloudAnalyst, GreenCloud, NetworkCloud, EMUSIM and MDCSim. ,iCancloud,virtual cloud.In the section 4, it Compares all Cloud Simulators with respect to different criteria.

2 Related Work

In the previous decade, Grids [foster & Kesselman, 1999] have developed as the infrastructure for delivering high-performace service for compute and data-intensive scientific applications. To support research, development and testing of new grid segments, policies and middleware, a few grid simulators, for example, Gridsim, Simgrid, Optor-Sim and Gangsim have been proposed. Simgrid is a generic framework for simulation of distributed applications in grid platforms. Gangsim is a grid simulation toolkit that provides help for modeling of grid-based virtual organizations and assets. Then again, Gridsim is an event driven simulation tool stash for heterogeneous grid assets. It backs modeling of grid elements, clients, machines, and network including network traffic yet none of these can support the infrastructure and application level requirements emerging from cloud processing ideal model. In particular, there is no support in existing grid simulation toolkits for modeling of on-demand virtualization enabled resource and application administration. Further, cloud infrastructure modeling and simulation toolkits must give backing to economic entities, for example, cloud brokers and cloud exchange for enabling ongoing exchanging of services. Among the currently available simulator talked about, just Gridsim offers support for investment driven resource management and application scheduling simulation.

3 Cloud Simulators

Simulation these days assumes an expanding part in the assessment of conceivable results and circumstance analysis. It is the limitation of the operation of a real world methodology or system (Banks 1998). Simulation modeling and analysis is the procedure of creating and exploring different avenues regarding a computerized mathematical model of a physical framework (Chang 2004). Simulation is the route how to research the model.

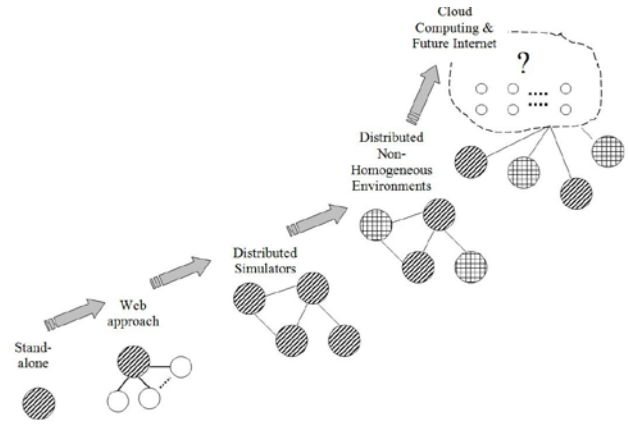

Figure 1: Development of simulation tools architecture

Cloud simulators give a summed up and extensible simulation framework that enables modeling, simulation, and experimentation of emerging cloud computing infrastructures and application .These are the following simulators that support the cloud environment:

3.1 Cloudsim

CloudSim is a simulation application which enables seamless modeling, simulation, and experimentation of cloud computing and application services [Calheiros et al., 2009; 2011; Buyya et al., 2009] due to the problem that existing distributed system simulators were not applicable to the cloud computing environment. Evaluating the performance of cloud provisioning policies, services, application workload, models and resources performance models under varying system, user configurations and requirements is difficult to achieve. To overcome this challenge, CloudSim can be used. CloudSim is new, generalized and extensible simulation toolkit that enables seamless modeling, simulation and experimentation of emerging cloud computing system, infrastructures and application environments for single and internetworked clouds. In simple words, CloudSim [Rahul Malhotra & Prince Jain, 2013] is a development toolkit for simulation of Cloud scenarios. CloudSim is not a framework as it does not provide a ready to use environment for execution of a complete scenario with a specific input. Instead, users of CloudSim have to develop the cloud scenario it wishes to evaluate, define the required output, and provide the input parameters [Dr. Rahul Malhotra & Prince Jain, 2013].

CloudSim is invented and developed as CloudBus Project at the University of Melbourne, Australia. The CloudSim toolkit supports system and behavior modeling of cloud system components such as data centers, virtual machines (VMs) and resource provisioning policies. It implements generic applica-

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tion provisioning techniques that can be extended with ease and limited efforts. CloudSim helps the researchers and developers to focus on specific system design issues without getting concerned about the low level details related to cloud-based infrastructures and services [Wickremasinghe, 2009]. CloudSim is an open source web application that launches preconfigured machines designed to run common open source robotic tools, robotics simulator Gazebo.

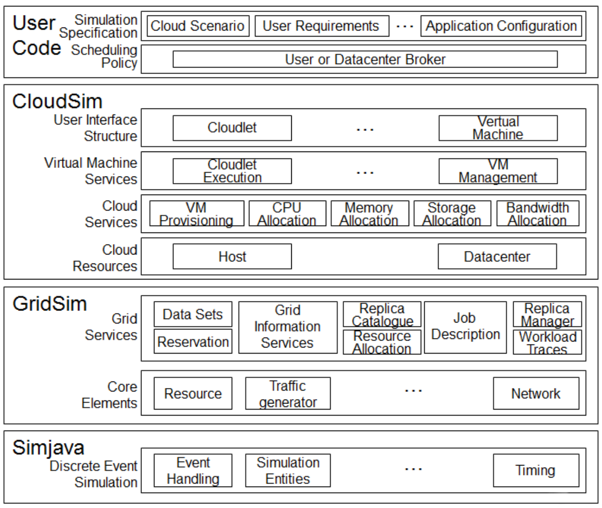
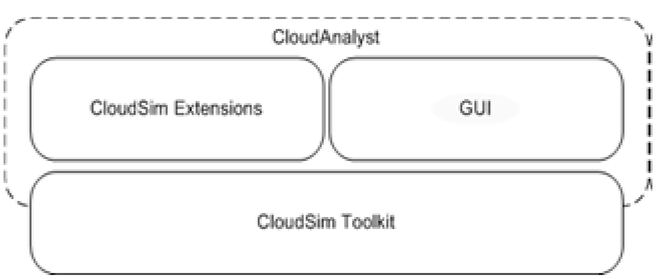


Fig. 2 The CloudSim architecture

The users could analyze specific system problems through CloudSim, without considering the low level details related to Cloud based Infrastructures and services [Wei Zhao et al., 2012].

3.1.2. CloudAnalyst

CloudAnalyst was derived from CloudSim and extends some of its capabilities and features proposed [Wickremasinghe, 2009; Wickremasinghe & Calheiros, 2010]. CloudAnalyst separates the simulation experimentation exercise from a programming exercise. It also enables a modeler 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.



. Figure 3. CloudAnalyst architecture

The main features of CloudAnalyst are the following.:

1. Easy to use Graphical User Interface (GUI). Cloudanalyst is outfitted with a easy to use graphical user interface (see Figure 4) that empowers clients to set up experiments rapidly and effectively.

2. Ability to define a simulation with a high degree of configurability and flexibility. Simulation of complex frameworks, for example, Internet applications relies on numerous parameters. Commonly, values for those parameters need to be arbitrarily assumed or decided through a procedure of experimentation. Cloudanalyst gives modelers a high level of control over the experiment, by displaying elements and configuration options, for example, Data Center, whose hardware configuration is characterized regarding physical machines made out of processors, storage devices, memory and internal band-width; Data Center virtual machine determination as far as memory, storage and bandwidth quota; Resource assignment policies for Data Centers (e.g., time-shared vs. space-shared); Users of the application as groups and their distribution both geologically and transiently; Internet progress with configuration options for network delays and available bandwidth; Service Broker Policies that control which segment of aggregate client base is services by which data center at a given time; and simulation span in minutes, hours or days.

3. Repeatability of experiments.

Cloudanalyst permits modelers to save simulation experiments input parameters and brings about the manifestation of XML records so the examinations might be repeated. The underlying Cloudsim simulation framework ensures that repeated experiments yield indistinguishable effects.

4. Graphical output

. Cloudanalyst is capable of creating graphical yield of the simulation results in the form of tables and graphs, which is desirable to viably outline the substantial measure of facts that is gathered throughout the simulation. Such a viable presentation helps in distinguishing the important examples of the yield parameters and aides in comparisons between related parameters. In the current version of Cloudanalyst, the accompanying factual measurements are professional produced as yield of the reproduction: Response time of the reenacted provision; general normal, least and maximum reaction time of all client solicitations reproduced; response time organized by client gatherings, spotted inside geographical locales; reaction time masterminded by time, demonstrating the example of progressions in requisition use throughout the day; use examples of the provision; number of clients orchestrated by time or areas of the world, and the general impact of that use on the server farms facilitating the requisition; time taken by server farms to administration a client demand; general ask for genius cessing time for the whole recreation; normal, least and greatest appeal preparing time by every server farm; reaction time variety example throughout the day as the heap changes; and points of interest of expenses of the operation.

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Figure 4. Cloud Analyst GUI

5. Use of consolidated technology and ease of extension. CloudAnalyst is based on a modular design that can be easily extended. It is developed using the following technologies: Java (the simulator is developed 100% on Java platform, using Java SE 1.6); Java Swing (the GUI component is built using Swing components); CloudSim (CloudSim features for modeling data centers is used in CloudAnalyst); and SimJava [6] (some features of this tool are used directly in CloudAnalyst

3.1.3. NetworkCloudSim

Network CloudSim is an extension of CloudSim as a simulation framework which supports generalized applications such as high performance computing applications, workflows and e-commerce [Buyya et al., 2009]. Network CloudSim uses Network Topology class which implements network layer in CloudSim, reads a BRITE file and generates a topological network. In network CloudSim, the topology file contains nodes, number of entities in the simulation which allows users to increase scale of simulation without changing the topology file. Each CloudSim entity must be mapped to one BRITE node to allow proper work of the network simulation. Each BRITE node can be mapped to only one entity at a time. Network CloudSim allows for modeling of Cloud data centers utilizing bandwidth sharing and latencies to enable scalable and fast simulations. Network CloudSim structure supports designing of the real Cloud data centers and mapping different strategies. Information of network CloudSim is used to simulate latency in network traffic of CloudSim. This simulation framework which supports the modelling of essential data center resources such as network and computational resources, and wide variety of application models such as parallel application, workflow and parametric sweep.

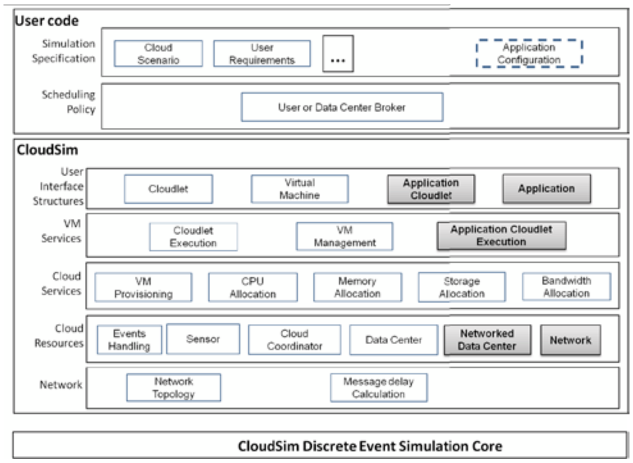

Figure 5: The CloudSim Architecture with NetworkCloudSim elements

3.1.4. EMUSIM

EMUSIM is an integrated architecture [Calheiros et al., 2012] to anticipate service's behavior on cloud platforms to a higher standard [Calheiros et al., 2011; Wei Zhao et al., 2012]. EMUSIM combines emulation and simulation to extract information automatically from the application behavior via emulation and uses this information to generate the corresponding simulation model. Such a simulation model isthen used to build a simulated scenario that is closer to the actual target production environment in application computing resources and request patterns. Information that is typically not disclosed by platform owners, such as location of virtual machines and number of virtual machines per host in a given time, is not required by EMUSIM. EMUSIM is built on top of two software systems: Automated Emulation Framework (AEF) for emulation and CloudSim for simulation.

3.1.5. MDCSIM

MDCSim is a commercial discrete event simulator developed at the Pennsylvania State University. It helps the analyzer to model unique hardware characteristics of different components of a data center such as servers, communication links and switches which are collected from different dealers
and allows estimation of power consumption. MDCSim is the most prominent tool to be used as it has low simulation overhead and moreover its network package maintains a data center topology in the form of directed graph [Dr. Pawan Kumar & Gaganjot Kaur].

3.2 Green cloud

GreenCloud is a Cloud Simulator that have green cloud computing approach with confidently, painlessly, and successfully. In other words, GreenCloud is developed as an advanced packet level cloud network simulator with concentration on cloud communication [Kliazovich et al., 2010]. GreenCloud extracts, aggregates and makes fine grained information about the energy consumed by computing and communication elements of the data center equipment such as computing servers, network switches and communication links [Wei Zhao et al., 2012; http://www.isi.edu/nsnam/ns/] available in an unprecedented fashion. Moreover, GreenCloud offers a thorough investigation of workload distributions. In particular, a special focus is devoted to accurately capture communication patterns of currently deployed and future data center architectures. GreenCloud can act as Cloud Bridge [http://gogreencloud.com]. In simple words, GreenCloud is the practice of designing, manufacturing, using and disposing computing resources with minimal environmental damage. The Green Cloud is a supercomputing project under active development at the University of Notre Dame. Green Cloud provides a virtual computing platform by using grid heating which reduces cluster upkeep costs.

Figure 6: A User View of Green Cloud

GreenCloud Simulator is an extension of Network Simulator (NS2) simulator [Wei Zhao et al., 2012; http://www.isi.edu/nsnam/ns/]. GreenCloud simulator implements a full TCP/IP protocol reference model which allows integration of different communication protocols with the simulation. The only drawback of Green Cloud Simulator is that it confines its scalability to only small data centers due to very large simulation time and high memory requirements

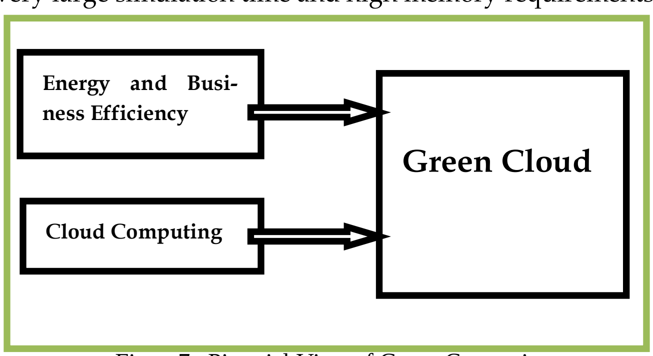

Figure7 : Pictorial View of Green Computing

GreenCloud Aim

1. To create high-end computing systems, for example, Clusters, Data Centers, and Clouds that distribute assets to applications facilitating Internet services to meet clients' quality of service requirements.
2. To minimize utilization of electric power by enhancing power management, dynamically managing and configuring power aware capability of system devices [http://www.cloudbus.org/greencloud/].
3. To Provide detailed simulators.
4. To investigate energy efficiency and measure cloud performance.

Greencloud can lessen Data Center Power Consumption by:

1. Workload consolidation through DC virtualization.
2. By statistical multiplexing incentives prompting aggressively bringing down Opex.
3. By enhancing manageability by decreasing host count..

3.3 iCan cloud

iCancloud is a simulation platform that is created by a research group(ARCOS) at Universidad carlos iii de madrin spain that meant to model and recreate cloud computing frameworks, which is focused to those clients who deal with those sorts of frameworks. The fundamental goal of iCancloud is to foresee the exchange offs between expense and performance of a given set of applications executed in a particular hardware, and after that give to clients helpful data about such costs. Nonetheless, iCancloud could be utilized by an extensive variety of clients, from fundamental dynamic clients to developers of large distributed applications. It gives flexible cloud hypervisor module and an amicable client GUI to simplify the generation and customization of huge distribut models.

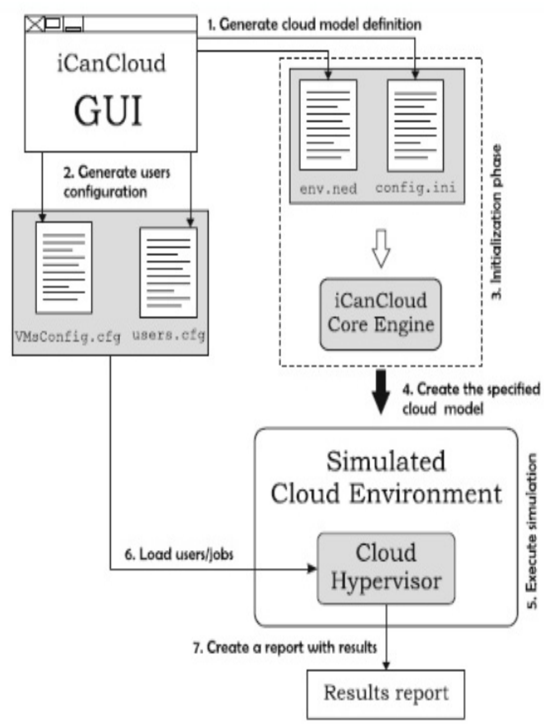

Figure8: Configuration of ican cloud process

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4 Comparison of Various Cloud Stimulator

The number of simulation environments for cloud computing data centers accessible for open utilization is constrained. The Cloudsim simulator is most likely the most modern around the simulators over-viewed. The Mdcsim simulator is a moderately new data center simulator created at the Pennsylvania State University. It is supplied with specific hardware chracteristics of data server parts, for example, servers, communication links and changes from diverse vendor. Table 1 looks at different Cloudsim simulators through correlation of their qualities, for example, platform, language, networking, simulator type and availability [dzmitry Kliazovich et al., 2010]. The proposed Greencloud simulator is created as an extension of the Ns2 network simulator which is coded in C++ with a layer of Otcl libraries implemented on top of it. It is a packet level simulator. On the contrary, Cloudsim and Mdcsim are event based simulators which avoid building and processing small objects exclusively. Such a strategy decreases simulation time considerably, improves scalability, however lacks in the simulation exactness. Both Greencloud and Cloudsim simulators are discharged under open source GPL license. The Mdcsim simulator is presently not available for open download which is a commercial product [dzmitry Kliazovich et al., 2010]. Condensing, short simulation times are provided by Cloudsim and Mdcsim actually for large data centers because of their event based nature, while Greencloud offers a change in the simulation precision keeping the simulation time at the reasonable level. None of the tools offer user-friendly graphical interface. The GreenCloud supports cloud computing workloads with deadlines, but only simple scheduling policies for single core servers are implemented. The ican cloud simulator provides flexiblecloud hypervisor module and a friendly user GUI to ease the generation and customization of large distributed models The MDCSim workloads are described with the computational requirements only and require no data to be transferred. Communication details and the level of energy models support are the key strengths of the GreenCloud which are provided via full support TCP/IP protocol reference model and packet level energy models implemented for all data center components [Dzmitry Kliazovich et al., 2010

Table1. Comparision of various cloudsim

Parameter	Cloud analyst	Network cloudsm	MDCSIM	EMUSIM
Platforrn	Cloudsim	CLOUDSIM	CSIM	AEF
Programming language	Java	Java	C++/ Java	JAVA
Networking	Limited	Full	Limited	Limited
Simulator Type	Event Based	Packet Level	Event Based	Event Based
Availability	Open Source	Open Source	Commercial	Open Source
Simulation time	Seconds	Seconds	Seconds	Seconds
Graphical support	Full	Limited	None	Limited
Application model	Computation ,datatransfer	Computation,data transfer	Computation	Computation ,data transfer

Table2. Comparision of various cloud simulators

Parameters	Cloudsim	GREEN cloud	iCan cloud
Platforrn	-	Ns2	OMNET.MPI
Programming language	JAVA	C++/OTcl	C++
Communication model	Limited	Full	Full
Physical models	None	Available using plugin	FULL
Availability	Open source	Open source	Open source
Support for parallel equipments	No	No	Wip
Graphical support	Limited Through cloud analyst	Limited Through Nam	FULL
Support for power consumption modeling	Limited	Yes	Wip

5 Conclusion

Cloud computing has been one of the quickest developing parts in IT industry. Simulation based methodologies get to be popular in industry and the educated community to assess cloud computing frameworks, applications behaviors and their security. A few simulators have been particularly developed for performance analysis of cloud computing environments including Cloudsim, Greencloud, Networkcloudsim, Cloudanalyst, EMUSIM and Mdcsim yet the number of simulation environments for cloud computing data centers available for public use is restricted. The Cloudsim simulator is presumably the most refined among the simulators reviewed. The Mdcsim simulator is a relatively fresh data center simulator.

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Finally we provide the overview on the current development status of cloud simulators in cloud environment.

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