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Green Computing with Simulators [Compatibility Mode]

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Abstract: ***There is required temperament to protect our natural world from environmental problems for existing and forthcoming generations. Green Computing is a innovatory way related with environment protection and sustainability of Information and Communication Technology (ICT). It mainly focuses on accomplishing corporate social responsibility by cutting down carbon footprints, e-waste and by conserving energy. This paper examines the consistency of Green computing in education and finds captious success factors for the same through simulators. This paper represents the national mission for Green India.***

I. INTRODUCTION

Green computing is the study and pattern of environmentally sustainable computing or Information Technology. Green computing also covers designing, manufacturing, using and disposing computers and peripheral devices efficiently and effectively with minimal or no effect on the environment.

The targets of green computing are alike green-chemistry, reduce the usage of insecure materials, increase energy expeditiously, shine-up the product's lifetime and promote recyclability or biodegradability of obsolete devices and waste. Green computing is essential for all classes of systems. Various corporate IT departments have initiated green computing initiatives to reduce the environmental effect of their IT operations.

II. NEED OF GREEN COMPUTING IN EDUCATION

Green computing is about cutting down the environmental footprints of computer or ICT in general. This is generally achieved by the following processes:

- Making data centers and computing devices more energy efficient.
- Usage of more renewable energy sources.
- Less usage of insecure materials in computer devices.
- Increasing device's lifetime.
- Making devices recyclable.

This means that the main advantage of green computing are:

- Decreased environmental impacts.
- Lower energy expenditure.
- Long lasting computing devices.
- Decreased health risk for computing devices.
- Decreased health risk for computer workers and recyclers.

We need to utilize Green computing because of the below given reasons:

- **Tons of Electronic Waste:**

Dozens and millions of dump get collected daily around the globe in junkyards from educational institutes, since the machinery came in. We should move towards green technology and make use of environment-friendly products.

- **Narrowed Resources:**

Resources are getting narrowed and should be used efficiently in process to save environment. Green ideas that lead to decrease the utilization of these resources should be used as much as possible. Cloud computing is an applicable example of it.

- **Energy Cost:**

The utilization and demand for energy consumption has lead to crisis situation in many countries. The trouble can only be resolved by moving to other clean and green alternatives. Solar energy, bio gas and wind energy are best fit examples towards that.

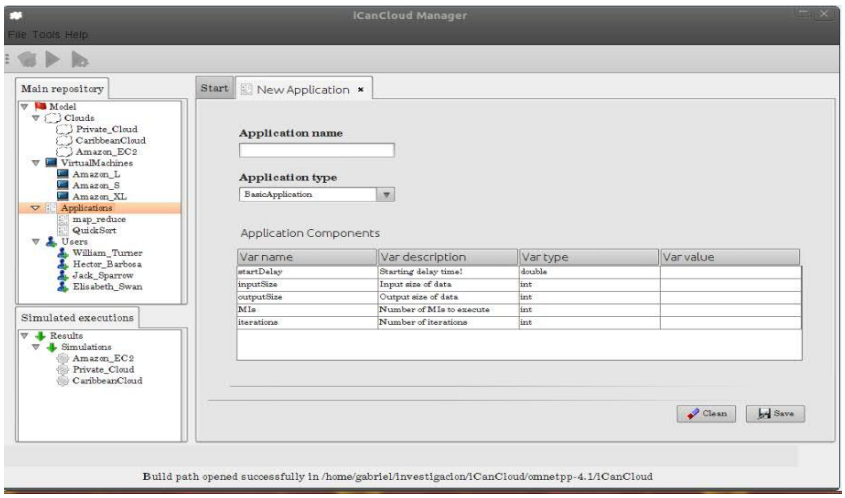
Green computing focuses on reducing the negative environmental impacts through the appropriate utilization of electronics with the development of energy-efficient designs through implementation of recycling programs that can re-use existing computers and through the design of manufacturing processes that cut down waste.

IT industry is developing day by day and there is more demand for computing and communication as it proceeds to advance. Servers, networks and data centers will consume much energy. The computers emits carbon dioxide and other deadly gases that can harm human health. The energy consumption by various computing devices also play a major role towards our harmful educational environment. The data center of some educational institutes as of 2015 were said to have 1.5 percent of total energy consumed and at a cost of $4.5 billion.

For bringing down the high usage of electricity, dispersion of harmful gases in educational institutes, a detailed study on commonly used green computing simulation tools is done for the purpose of green environment. The details of simulations are described below:

1. iCanCloud:

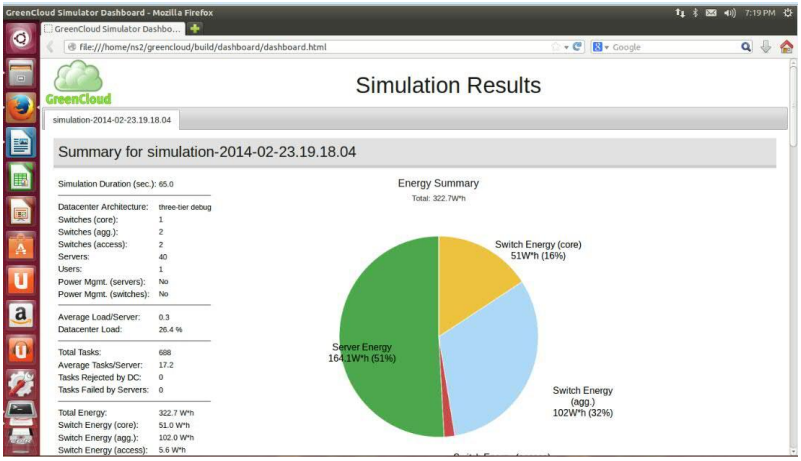
iCanCloud simulator is used to design and simulate a cloud computing system with a wide range of users. The user ranges from basic users to developers of large distributed applications. iCanCloud can foretell trade-offs between the cost and performance of a given application that executes in circumstantial hardware. This simulator is designed on an open source communication network simulation package for extensible, modular, component-based C++ library and framework which are being utilized for developing network simulators.



(Fig. iCanCloud Simulator)

2. GreenCloud:

The GreenCloud simulator is developed to regain the details of the energy consumed by educational centers, as well as packet level communication patterns between them. It represents the energy-aware studies of cloud computing data centers in a realistic setup. GreenCloud is designed on top of NS2 (a packet level network simulator) to extract aggregates and acquire information about the energy consumed by computing and communication elements in educational centers. It is an open source tool, with a limited graphical user interface (GUI).



(Fig. GreenCloud Simulator)

3. CloudSim

CloudSim offers classes representing data centers, physical hosts, virtual machines, services to be executed in the data centers, users of cloud services, internal data center networks, and consumption of energy of physical hosts and data center's elements. On the other side, CloudSim supports dynamic insertion of simulation elements and provides message-passing application and data center network topology. Moreover CloudSim is capable of instantiating 100,000 machines in less than 5 min. It further enables studying on allocating policies and migrations of virtual machines (VMs) rendering its very useful in the research field for many researchers in educational centers.

(Fig. CloudSim Simulator)

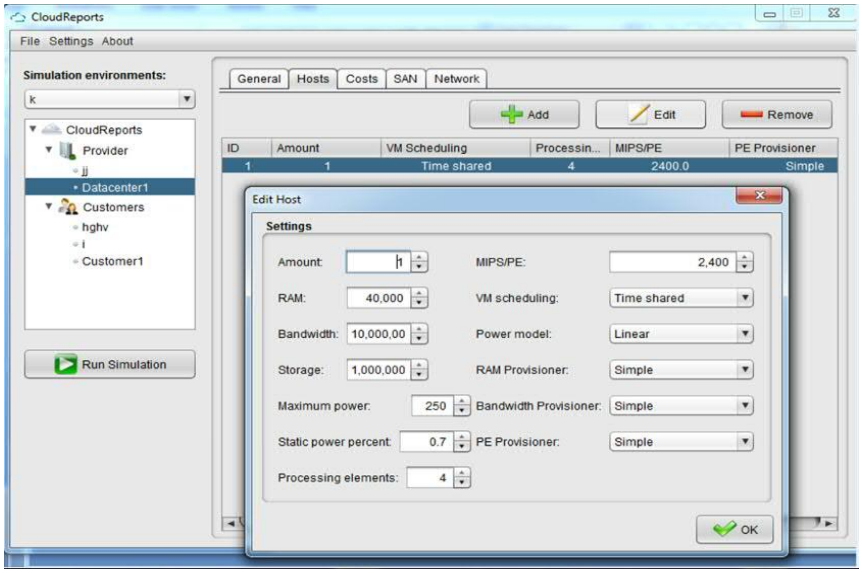
CloudAnalyst

CloudAnalyst is advantageous where the primary objective is to simulate distributed applications among several data centers and user groups. It acquires the original characteristic of CloudSim framework, extending it to simulate large-scale Internet applications and analyze their behaviors in cloud environments. Moreover, it assists the evaluation of social network tools, based on the geographical distribution of users and data centers.

(Fig. CloudAnalyst Simulator)

CloudReport

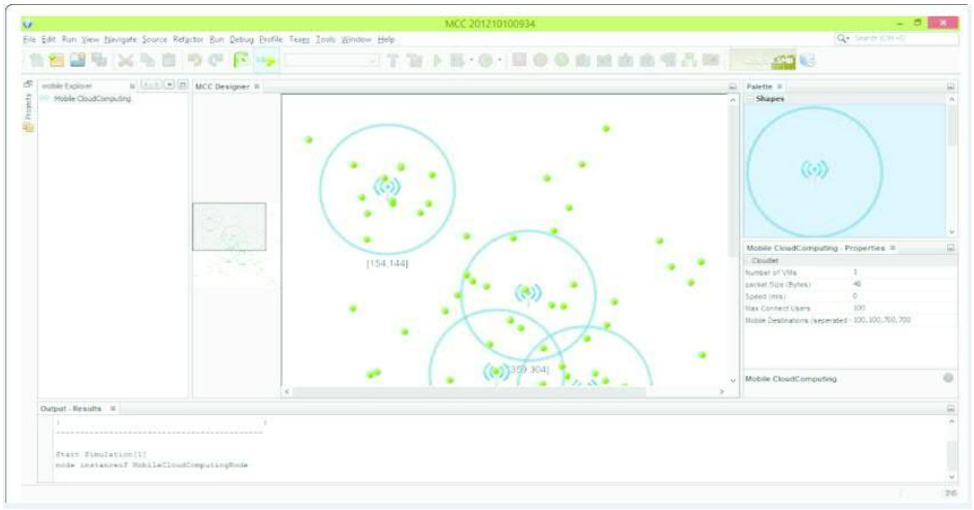
CloudReport is another tool which is developed on CloudSim's framework. Withal, CloudReport enhances numerous characteristics of CloudSim such as a user-friendly graphical user interface, running multiple simulations concurrently, and increased simulation results. In add-on, CloudReport benefits from the usage of Application Programmable Interface (API) for developing specific extensions to simulate specific algorithms. When simulation completes, CloudReport results are shown in tables and charts with execution time and resource usage costs like information. It also provides information about Virtual Machine allocation, energy consumption, and other user-defined characteristics.



(Fig. CloudReport Simulator)

CloudExp Simulator

CloudExp is a designing and simulation environment which presented a specialized mobile cloud computing experimental framework. It is developed on "CloudExp" framework with new features. It provides user-friendly GUI to enhance the user's experience in developing their own infrastructure. This simulator let researchers to analyze the communication cost between users and clouds. In CloudExp, cloudlets are developed using a simple drag and drop facility. In addition, CloudExp conducts different mobility scenarios for mobile devices.



(Fig. CloudExp Simulator)

A Comparison between Green Computing Simulators:

Parameter	CloudSim	CloudAnalyst	CloudReport	Cloud Exp	Green Cloud	iCanCloud
Platform	SimJava (GridSim)	Java SE 1.6, Swing, SimJava (CloudSim)	Ant, Maven, Java Development Kit (CloudSim)	CloudSim	NS2	OMNET, MPI
Availability	Open source	Open source	Open Source	No	Open source	Open source
Language/ Script	Java	Java	Java	Java	C++/OTcl	C++
Graphical support	Limited by using CloudAnalyst and CloudReport	Full	Full	Full	Limited by using Nam	Full
Communi-cation Models	Limited	Limited	Limited	Full	Full	Full
Power consumption modeling support	Limited	Limited	Limited	Yes	Yes	Work in progress
Run on windows environment	Yes	Yes	Yes	Yes	No	Yes

III. Conclusion

The acceleration popularity and complexity of computing systems makes simulation software an crucial option for designing, configuring, managing, and analyzing the performance of a system. Green computing simulators have found use in measuring trade-offs between cost and performance in pay-as-you-go (PAYG) environments. A variety of tools, including CloudSim, CloudAnalyst, and CloudReport, CloudExp, iCanCloud, and GreenCloud, are discussed here in this paper. By comparing different simulators, it is concluded that iCanCloud is a superior platform as it provides full GUI support to the user and runs on Java Virtual Machine (JVM).

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