

# A Study on the Cloud Simulation with a Network Topology Generator

Jun-Kwon Jung, Sung-Min Jung, Tae-Kyung Kim, and Tai-Myoung Chung

**Abstract**—CloudSim is a useful tool to simulate the cloud environment. It shows the service availability, the power consumption, and the network traffic of services on the cloud environment. Moreover, it supports to calculate a network communication delay through a network topology data easily. CloudSim allows inputting a file of topology data, but it does not provide any generating process. Thus, it needs the file of topology data generated from some other tools. The BRITE is typical network topology generator. Also, it supports various type of topology generating algorithms. If CloudSim can include the BRITE, network simulation for clouds is easier than existing version. This paper shows the potential of connection between BRITE and CloudSim. Also, it proposes the direction to link between them.

**Keywords**—Cloud, simulation, topology, BRITE, network.

## I. INTRODUCTION

CLOUD computing will be a major technology in the development of the future Internet services, supporting on-demand provisioning of applications, platforms, and computing infrastructures. Customers can accept the cloud system everywhere and receive sufficient and powerful computing resources. Therefore, if the cloud user pays appropriate costs, it is able to create a computing environment which is nearly infinite. Also, cloud computing has features of the distributed computing environment such as grid computing system. Because cloud datacenters are distributed, although one datacenter is corrupted, cloud system and user data are available still. These cloud services are divided into IaaS (Infrastructure-as-a-Service), PaaS(Platform-as-a-service) and SaaS(Software-as-a-Service).

Cloud provider wants to predict the usage of cloud services because the cloud computing environment normally needs expensive cost. Cloud computing provides the services with connecting a number of clouds. Thus, predicting a delay of services on separated datacenter is needed for stable cloud services. CloudSim is the simulation tool for this purpose[1]. It notifies a time of processing service on cloud computing.

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Additionally, it shows the transmission delay time between each datacenter on a network topology.

However, CloudSim cannot make the information of network topology independently. Thus, some tools need to make network topology for sending the information to CloudSim. BRITE is the typical tool to create topology information [2]. BRITE can provide CloudSim with on-demand topology data. Moreover, if CloudSim can be linked to the user interface of topology generator on BRITE, it will be more convenient simulation tool. This paper shows the way to link between CloudSim and BRITE, and simply implemented results. The remainder of this paper as follows.

Chapter 2 shows the information about CloudSim and BRITE generator. Chapter 3 discusses the necessary factors to link them and the way to link each tool. Chapter 4 shows future works and concludes this paper.

## II. RELATED WORK

In this chapter, we discuss the concept of CloudSim and Brite.

### A. CloudSim

CloudSim is a simulation program for cloud computing from Clouds lab in the University of Melbourne [2]. It is developed in java platform including the pre-developed simulation modules such as SimJava and GridSim. Figure 1 shows the architecture of CloudSim[1].

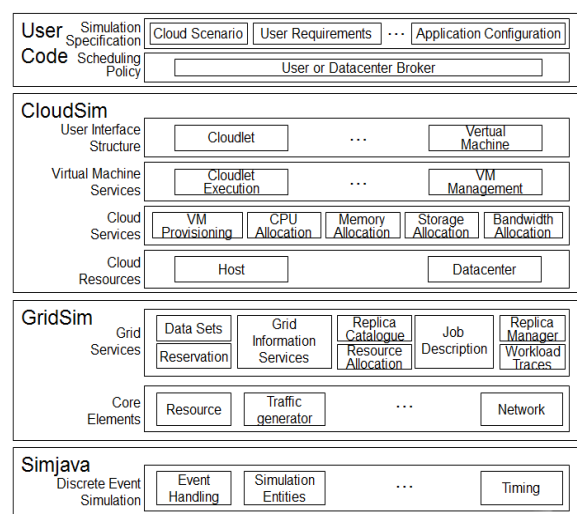


Fig. 1 The CloudSim architecture

The main components of CloudSim are datacenter, Virtual Machine (VM) and cloudlet. Datacenter has one or many VMs. Each VM deals with many cloudlets which are the units of cloud service. VM is assigned several cloudlets and processes them using scheduling a policy such as time-sharing and space-sharing. CloudSim shows us the results of processes such as a time consumption of each cloudlet. A cloudlet has a set of the information of resource consumption to provide users with a cloud service. This information consists of a program instruction length, program size, output data size, and etc.

CloudSim is a useful tool for the cloud service provider to predict user needs. If the provider does not predict the needs, it may pay unnecessary cost. For instance, if the company constructs the cloud environment too small than user needs, they will pay more expensive cost to build the additional datacenters. It is important that the cloud service providers construct the appropriate cloud environment to provide services for various customers. Thus, the prediction of cloud service availability to meet user needs is also important. CloudSim helps a cloud service provider to determine the cloud service's quality and quantity. Although there are such advantages of its system, it is not suitable for supporting various diverse cloud environments. Since CloudSim is a less-developed program, it is not able to support priority of cloud services. Additionally, it can receive only the precomputed information of a datacenter topology to apply its network delay. Therefore, CloudSim is not suitable to support various cloud environments.

### B. Brite

Internet consists of a number of networks. Commonly, researchers assume topologies for study about the internet technology. They need to satisfy below requirements for high-level studies.

- Representativeness
- Inclusiveness
- Flexibility
- Efficiency
- Extensibility
- User-friendliness
- Interoperability
- Robustness

BRITE is the topology generating tool for fitting these requirements [3]. The architecture of BRITE is proposed by Boston University. Figure 2 is a model to view its components.

BRITE reads configuration data (1) through its graphic user interface. Also, it can import another topology generator output like (2). It makes text output of topology generating through (1) and (2). It is able to create another output formats of NS (Network Simulator) [4] or SSF(Scalable Simulation Framework)[5] for each processing.

BRITE has three classes of topologies. The model class is an abstract base class from which multiple specific generation models. Figure 3 shows its topology classes.

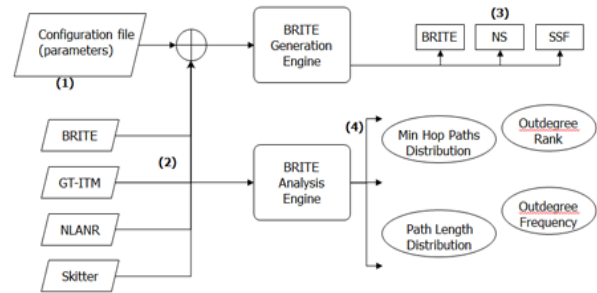


Fig. 2 The Topology of BRITE

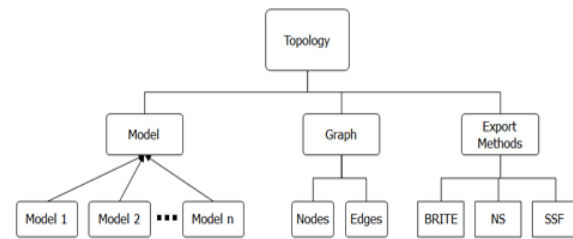


Fig. 3 A Topology classes

BRITE has four type of generating topology - AS only, Router, Top Down and Bottom Up. Thus, its user interface has four tabs. Additionally, it supports import function of other generating algorithms. Figure 4 shows the view of BRITE user interface.

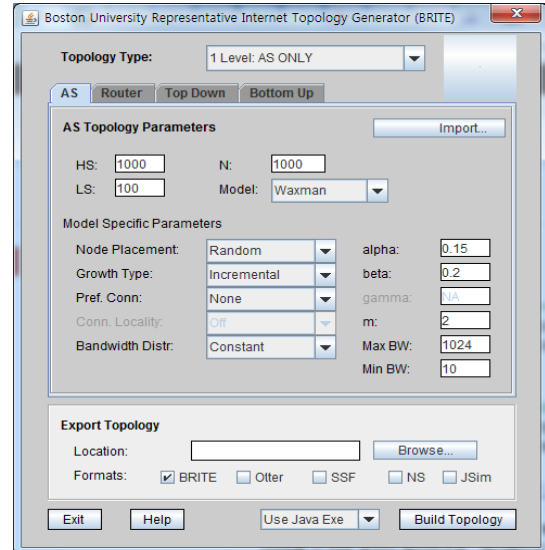


Fig. 4 The BRITE GUI

### III. LINKAGE BETWEEN CLOUDSIM AND BRITE

CloudSim needs the topology information to calculate the delay of communication between each datacenter. CloudSim can use the topology data reading txt file. CloudSim supports BRITE topology format. BRITE is developed by java including a graphic user interface (GUI). Thus, the topology information generated by BRITE can be processed by CloudSim automatically.

If above two tools are connected each other, there are several merits to simulate cloud system. First, CloudSim can get the useful user interface which is able to input common user's control. Because CloudSim has only processing module without the I/O interface, it is difficult to test cloud simulation for untrained users. A tester must create an example source code with parameters directly to simulate cloud service on existing CloudSim. If CloudSim has a GUI, a tester can use the simulator without the inconvenience of development or debugging.

Second, the tester can get more detailed result of simulation. CloudSim must have the topology information to calculate network delays. In addition, it cannot tell that is a cloud service, if the datacenters are not distributed. Thus, CloudSim needs the topology information to work more detailed simulation. Connected BRITE can send detailed topology data to CloudSim. Therefore, this connected tool can provide more clear simulation result.

Third, improved CloudSim is able to support various topology. BRITE supports various formats about GT-ITM[6], NLANR[7], and etc as well as its own generating algorithm. Thus, the user can run CloudSim with a number of topology types.

To get these merits fully in CloudSim, the developer has to consider several problems. The source codes of BRITE include java awt package to provide GUI. However, a design of this package is crude and it is inconvenience to adjust it for upgrading. It needs to replace awt package with swing package. Because swing is improved package to support GUI and the development tool named eclipse has a plugin of visual editing with swing. Therefore, it will be suitable to provide interface of topology generator in CloudSim with BRITE. In addition, the information generated from proposed tool is made into txt file now. However, if each tool is connected to each other, they do not need txt file to provide topology data. Therefore, arranged BRITE will provide the topology data to CloudSim without txt file format.

Developers will run some steps to apply these considerations. First, some contents in BRITE user interface are removed. CloudSim may ignore these contents due to needlessness for received topology data. Contents of CloudSim are the number of datacenter node, its placement, each bandwidth and etc. The other components are removed from user interface. In removed area in user interface, the information of testing on CloudSim is set. This improved user interface has the fields of performance information to set required simulating information. The added fields consist of the performance information of each cloud component. If its information cannot be received from user interface, the user may be able to select one rule of many rule sets about cloud simulation.

In the cloud environment, it assumes the simulator need only datacenter nodes. In other words, the other components, for instance, router, switch, and etc are not considered. Improved BRITE user interface are not required various options for CloudSim. The basic elements which are required for CloudSim are shown below.

- A count of datacenters
- Max and min network bandwidth
- Node's placement

• Topology model

For the efficiency of processing, unnecessary components of BRITE to link CloudSim are removed. The others are visible or fixed. Because the user interface source code is located in Brite.java, it is modified firstly. The information of CloudSim processing can be placed in the bottom area of GUI. The result of simulating is text data type. This component can be located in topology output area. Expected user interface's view is Figure 5. Figure 6 show expected text output of cloud simulation.

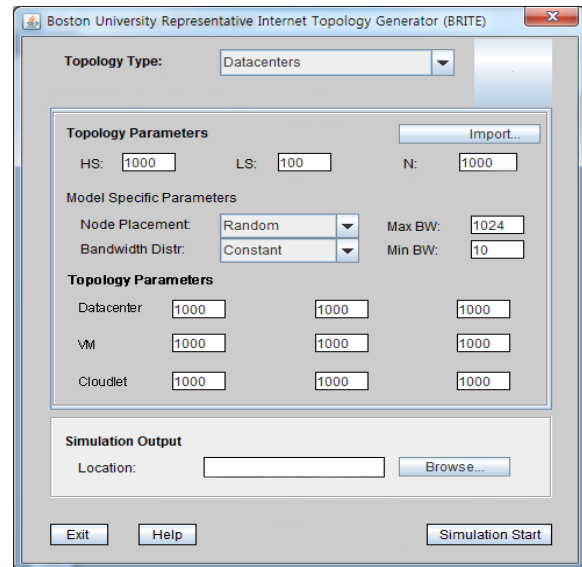


Fig. 5 The user interface of linkage between BRITE and CloudSim

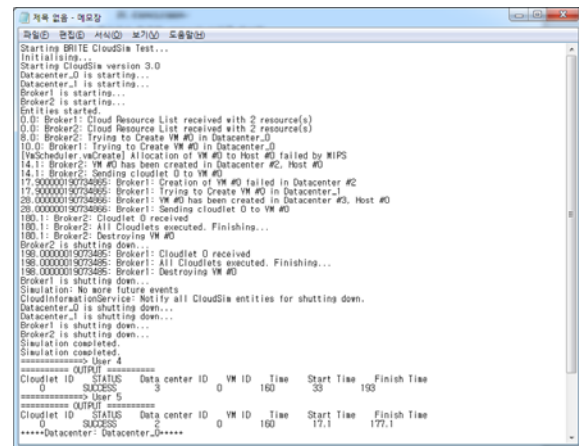


Fig. 6 The BRITE-CloudSim output text file

IV. CONCLUSION

CloudSim is a tool for the simulation of cloud computing services. It is able to calculate time consumption and power consumption. Additionally, it can show the service delay time using network topology information. CloudSim can read the file of topology information. To be more useful tool, CloudSim needs to create topology data itself. BRITE can make this topology using own parameters from its GUI. Thus, this paper

shows the potential of the linkage between two tools and virtual implementation way. By the linkage with BRITE, CloudSim will have various merits about cloud simulating. Moreover, CloudSim will have a GUI. Thus, CloudSim is more convenience before no-user interface. However, BRITE's user interface is old type. Thus, it seems rough. Additionally, CloudSim needs more convenient user interface for operating easily.

CloudSim needs improvements and studies for upgrading. CloudSim needs more sophisticated user interface. Also, it needs more various functions. If the user interface is improved that offer more various environment parameters, the integrated tool is more useful. We will study about the implementation this proposed possibility. Additionally, cloud services will be studied to more functionally.

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