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IMPLEMENTATION & ANALYSIS OF PUREEDGESIM

Shivani Deshmukh
School of Computer Science and Engineering
Vellore Institute of Technology
Chennai, Tamil Nadu, India.

Lakshay Grover
School of Computer Science and Engineering
Vellore Institute of Technology,
Chennai, Tamil Nadu, India.

Abstract— **Cloud computing is a classical technology, known for provisioning many resources and make easy availability of the data at the user end point request. Cloud computing can be definitive as well as expandable where the services are defined at best level. In recent years, cloud computing had faced various obstacles like overloading, Deadlock in resources allocation and many more and to overcome this, cloud simulation is utilized for evaluating new methods as well as paradigms. This work presents utilization of edge with fog computing using PureEdgeSim, an open accessible simulation structure deployed from CloudSim Plus. PureEdgeSim will make enable user to work on particular details which are low level. The methods proposed in the paper can be used for IOT connecting devices.**

Keywords— **cloud computing, edge computing, fog computing, Edge Application.**

I. INTRODUCTION

In the recent few years, cloud computing is known to be a famed area. It is for anything that can be compère for the omnipresent through the internet such as data, network, services and many more which are accessible whenever required [1][2]. There are many features in cloud computing such as elasticity, on-demand service delivery, all-over access, etc. Moreover, it has been studied from the research, exploiting the computer simulation in such a way that it will diminish the expense for performing the experiments. To run an experiment, cloud simulation will yield the quicker way (i.e. in a second) in real infrastructure instead of taking more and more time. Additionally, the extensive experiments are executed within a fraction of a second by utilizing the cloud simulation. For cloud computing, the Educational institute has created some of the simulation tools. CloudSim is one of the widely utilized cloud simulations. Having attributes like open accessibility and excellent flexibility, created in the most utilized programming language Java, CloudSim has several drawbacks. These drawbacks have been overcome by CloudSim plus which has sufficient structure of a class, well-mannered package structure and sufficient design patterns to get better metrics of object-oriented design. Concentrating on the advantages of CloudSim Plus the PureEdgeSim has devised. PureEdgeSim (i.e. Pure Edge Computing Simulator) is the simulation structure which is based on the CloudSim Plus.

It is the framework from which the user is permitted to examine the particular design issues of the system as soon as possible on the provision of the details that are low level. PureEdgeSim is an object-oriented framework, it has better code in together with the developed class hierarchy so that it is not burdensome to understand, enhanced the utilization of reusability concept. The PureEdgeSim is the publicly accessible project. The purpose of this paper is to present the PureEdgeSim, its new attributes, architecture, utilization and benefits as well.

II. RELATED WORK

Various cloud simulators observed in studies have proposed in this section. CloudSim is one of the widely utilized cloud simulations. CloudSim aids comprehensive data centers of cloud computing as well as modelling. It is the most appropriate tool for cloud simulation. But it has several drawbacks such as insufficient design patterns, insufficient documentation, the phenomenon of dereliction gets neglected and so on.

CloudNetSim++ is an openly accessible simulator, aids physical network features' simulation as well as modeling. Applications, protocols are consolidated by the researchers to examine rational data centers in together with traffic patterns of the network with the help of CloudNetSim++.

CloudSimPlus is a tool devised based on the CloudSim. The notions of Green IT estimation can be aided by CloudSim Plus. It can estimate the organization of strategies. There are many advantages of CloudSim Plus as presented in the above section.

III. PUREEDGESIM OVERVIEW

PureEdgeSim is devised in mostly utilized programming language Java. It is the framework from which the user is permitted to examine the particular design issues of the system as soon as possible on the provision of the details that are low level. Cloud provider have different organizations along with their features so these features can be defined by the developers with the help of PureEdgeSim much like: (i) applications, SANs (Storage Area Network) and many more

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which are consists in logical resources; (ii) applications' prerequisites in together with the utilization, workloads; (iii) tangible resources including actual machines as for instance servers, hosts and datacenters; (iv) the components sort of VMs (Virtual Machines) are endowed by the virtualization layer in order to facilitate virtualizing logical along with physical resources. Adaptable framework is endowed by the PureEdgeSim. PureEdgeSim consists new concepts namely: Fog computing, Edge computing as well.

A. Fog/Edge Computing

limited resources are provisioned in order to run time-served operating system by the commercial devices, which are gradually escalating due to the growth in embedded system-on-a-chip. That's why the IoT (Internet of Things) has likely increased. There are enormous IoT devices, only saves as well as deliver the data for evaluation. Although, the computations that are complicated are executed on-site due to the increasing ability of computing of current devices. As a result of edge computing, it sustains applications together with advanced services as the ability of cloud computing is improved as well as increased due to the edge computing that takes resources near to the network's edge. Progressively, in optimizing data the IoT is becoming more and more traditional on the network's edge. Hence, Edge computing is well liked. Notably, edge devices are utilized by the fog computing in order to locally accomplish the tasks regarding to storage, compute and connection as well. Likewise, devices range from Internet of Things (IoT). There is having significant responsibilities likewise without any failure the concatenation of mobile applications as well as cloud computing as for the improvement and management of data, centralized storage the development of cloud computing is becoming a widespread approach. In order to complete such tasks, fog computing has devised by the Cisco. Basically, fog computing is planned to locally process on foggy devices as these carries several tasks. The fog layer is made up of servers that are geo-allocated and located on the edge of the network. Each and every fog server has the capability of transmit in together with compute wirelessly and is provided along with an extensive data warehouse. Fog server is a slight form of the cloud server.

IV. LAYERED ARCHITECTURE

In this architecture (Figure 1), simulation structure consists of data centers as well as hosts, they organize along with delivering events for communicating throughout the runtime of the simulation.

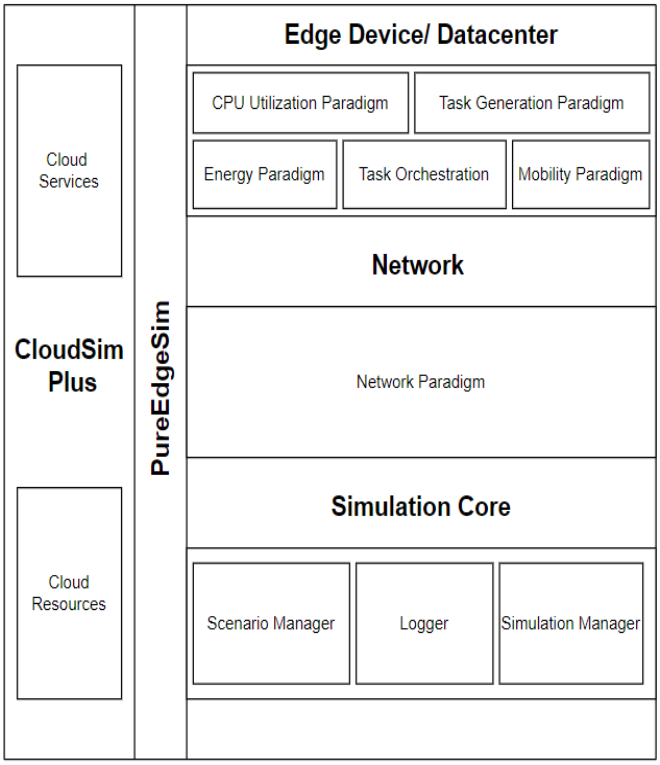

Figure 1. PureEdgeSim Architecture

Prior to classification/categorization, the scheduling (i.e. resources management) which is acquired, conceded by the environment of edge computing together with fog computing simulation. Furthermore, in NS-3 / Omnet++, the tasks have to face many obstructions due to the structure's heterogeneity, because each and every characteristic of the simulation is to be determined by the user from the requirements of power, mobility, resources and so on, it requisites more and more efforts along with the time.

PureEdgeSim extracts the benefits of attributes of the CloudSim Plus together with the innate aid for the simulation of the discrete events and is utilized amidst of components at the time of the transmission. The advantage of its library which is exquisite, as well as all the aspects, are covered from resources (such as hosts, data centers and so on) to services (CPU schedulers, policies of VM allocation) of the cloud computing is taken by the PureEdgeSim. Accordingly, for modelling the Pure Edge along with the fog computing environments in which several classes are included.

V. ARCHITECTURE

To comprehend the code easily and enhance the legibility of the code together with reusability. PureEdgeSim is made up of various modules, demonstrated in Figure 2. It consists of seven modules. In this section, we have proposed these seven modules, their responsibilities along with main classes.

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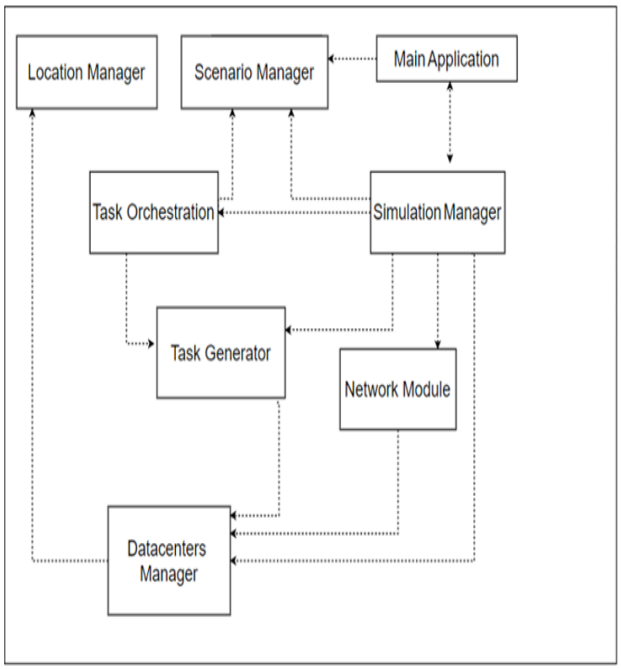

Figure 2. PureEdgeSim Module

Seven modules are given in detail:

Simulation Manager:
This module produces the files which contain output. some of the main functions of this module include actuating as well as managing the scheduling events, simulation environment and so on. This module has two salient categorizations: (1) Simulation Manager (2) Simulation Logger. The simulation Manager plans the start as well as the end of the simulation. It actuates the environment of the simulation, also sets up output printing and task generation too. the Simulation Logger computes the outcomes, demonstrates the outcome when each process will be finished and for utilizing it, the outcome will be saved in CSV format. The simulation result is produced in which the simulation logger is responsible.

Datacenter Manager:
This module is for the creation of edge devices as well as data centers. It has three classes:

- Edge Datacenter: to represent the multeity of edge devices the CloudSim Plus has the datacenter simple class which is expanded by the Edge Datacenter class.
- Server Manager: under input files, edge devices together with data centers prompted by the server manager.
- Energy Paradigm: it improves their utilization of energy

Tasks Generator:
Task Generator produces the tasks. Application (smart-home, cloud gaming, e-health) with certain features such as latency, size of a file, CPU usage, etc. allocated to the edge devices by the task generator. Afterward, the tasks of each device will get spawned by the task generator. This module has two salient classifications:

- Task class: it is devised from CloudSim Plus which consists of Cloudlet Simple class.
- Task Generator: at the time of the simulation the tasks are performed and these tasks are produced by the Task generator. Although, this class will be expanded by the PureEdgeSim user to produce own generator as per their necessity.

Location Manager:
Because of the geographical distribution of edge as well as fog computing, at the time of transportability, they may keep up serving mobile devices when the lowest latency is provisioned. Every device gets allocated its primary location due to the location manager. This module manages the transportability of devices. This module consists of two major classes. first is Location Class, which illustrates the (x, y) coordinate of the device. Another is Mobility Class, for every mobile device, it will create an upcoming location. PureEdgeSim users may execute their mobility paradigm by enhancing the mobility class

Task Orchestration:
The evaluation, encapsulation, and generation of data will be in heterogeneity, large volume as compared to the previous. Successful performance of the infrastructure requires some major decisions: typically, how the data can be composed in together with how it can be handled (Cloud, Edge, Fog). There are several competing pressures such as characteristics of the service, infrastructure usage (end-user requirement) by which these decisions get affected. Consequently, to get better applicability the performance of the resource management methods has to get enabled by the simulators. And this is provisioned by the PureEdgeSim along with the Task Orchestration Module, which includes the orchestration by which the decision-maker has illustrated. it determines that if implement the task or offload it locally as well as where the task will be offloaded, it is based on the policy which is utilized. If the orchestrator class gets enhanced by which the PureEdgeSim with its ultimate extensibility as well as scalability will get reflected then Orchestration policies such as (utilized task orchestration method, computing models) can be performed by the users without any obstruction.

The Network Module :
Generally, it comprises of the network paradigm. Different from CloudSim and CloudSim Plus as well, in which every VM (virtual machine) gets assigned the bandwidth which endures static, at each moment of simulation, the network load will be calculated by the network paradigm. During data transmission, at each transferring moment such as (from the initial point of the transferring till its endpoint), depending on the network load, its issued bandwidth will fluctuate at the

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specific instant. Because of the obstruction of the WLAN / WAN this network paradigm calculates the limits of the bandwidth. Bandwidth is assigned to every device that will be lessened if numerous devices are associated with the same access point i.e. WLAN. If the WAN is greater than that of the allocated bandwidth, The WLAN's short bandwidth will provide the sufficient speed of transmitting the data from (or to) the cloud.

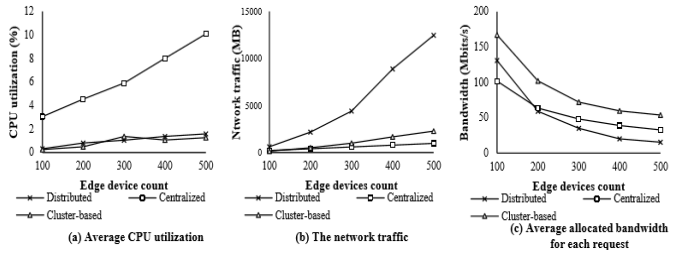
The Scenario Manager Module :

Multiple combinations of devices are necessitated by every use case (such as connected vehicles, smart homes, smart logistics, Healthcare, smart grid). The heterogeneity can be consisting of an ability to compute, mobility of the devices, energy source. Consequently, a simulation framework can be capable to assist the multeity of models of devices together with their various necessities of quality of services such as latency. Moreover, without reducing (or changing) the internal part of the simulators (i.e. fog and edge computing), simulators can be enhanced along with the multiple devices as well as applications without any obstruction.

The user scenario, as well as the variables of simulation, can be loaded from the file of input which is guaranteed by the scenario manager. Scenario manager module has two salient categorizations: Files Parser: scenario of the user will be loaded by the File parser.

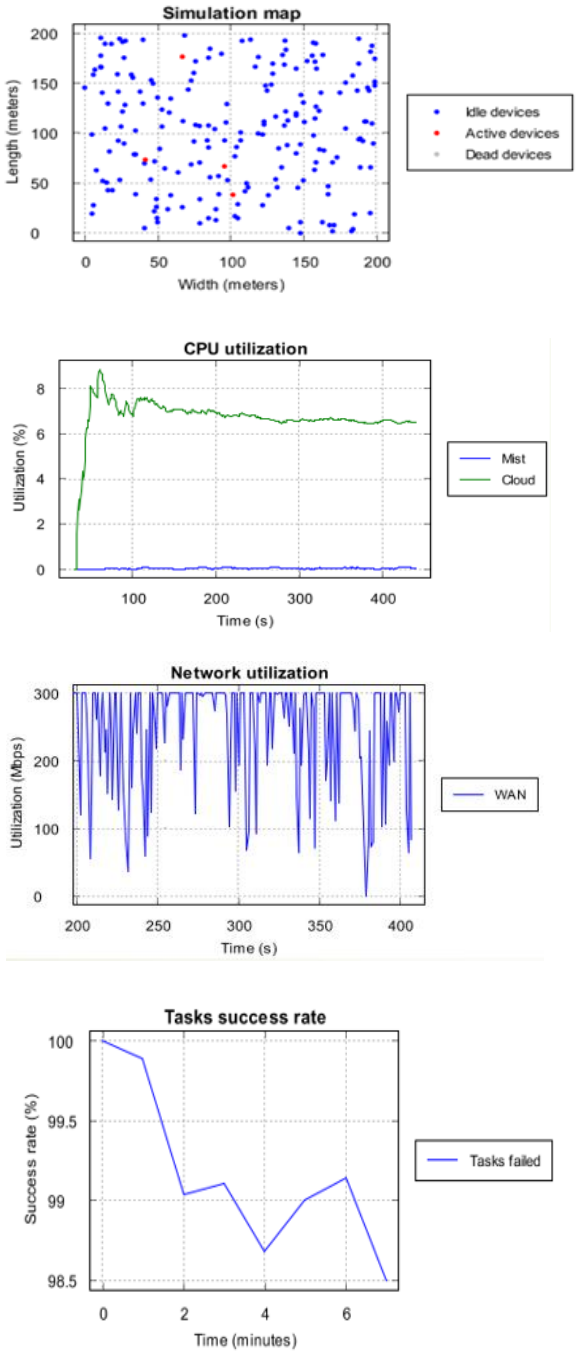
Simulation parameter class: for the multiple variables the simulation parameter will react as a placeholder.

VI. RESULT



(a) Average CPU utilization (b) The network traffic (c) Average allocated bandwidth for each request

VII. OUTPUT



VIII. CONCLUSION

Nowadays the embedded devices are taken to the next level which is known as edge devices where the IoT application executes the data in its locally designed server. The edge devices usually execute locally for the faster rate of the task execution. In applying any edge devices for a task, the CPU utilization, network bandwidth must be monitored for the

betterment of the task execution as the data are processed locally the task resources are limited to that edge computing devices.

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