An Effort for Energy Saving of Data Center Resources by Green Cloud Computing

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Abstract: **The increasing availability of ultra-fast internet provides us the capability to access the eBooks, multimedia, news, and thousands of concurrent e-commerce transactions and millions of Web sites in just a part of seconds. Now a day's every business and social activity is being performed with the help of internet based application. To perform any information technology application we require the computation resources, storage capacity, software, etc. This tends to increase the pressure to reduce the costs for optimally utilizing the entire Information Technology infrastructure. One solution to this requirement is cloud computing. Cloud computing is Internet-based computing environment which provide the application, Platform, software and network as per the demand of the user. It is fact that all resources are limited in the world and this rule is also applicable for the information technology world. The Energy utilization is a major resource for information computing and data communication. As the requirements of more resources are growing electricity utilization is also increasing exponentially. Every computing device consumes energy in transportation and switching of data from more than location to another in cloud computing. When data is transmitted from one computing device to one or more servers or data centers then it consume the energy. More energy consumption leads emissions of gases which affect the environment which causes harmful effects to our planet. Making the world green is the responsibility of all internet and computer users, developers and all stake holders. The resolution to this problem is Green computing, it develop for the environment friendly utilize of computers resources. The green cloud computing uses the advantage of both cloud and green computing to decrease the power utilization in cloud computing.**

Keyword: Data Center, Cloud Computing, Green computing, Green Cloud Computing, Green Cloud Simulator.

I. INTRODUCTION

Now a days as users of internet is going to increase very fast the need of cloud computing came into existence. This overcomes the limitation of the quantity of information present on a single server by allowing the user to link to any remote server for information. It is the base for need of cloud computing. But this creates a need for more number of resources which leads to an abrupt level of power consumption and increasing the quantity of harmful gases in environment which is released by most of the devices related to cloud computing environment. This causes pollution which causes harmful impact on environment as well as to people. So a green solution is desired towards this problem. Now the green cloud computing comes into existence which provides a Simulating environment to visualize the total power consumption by each of the device included in cloud computing by performing some calculations using the statistically derived formulas and then making changes as required to decrease the level of power consumption thereby reducing the pollution. In today's world the increase demand for data through internet has made cloud computing a center of attraction. Cloud computing is not only services based utility but also present the commercial model by provide the way to business through internet. However, the data centers which is using cloud computing based software and program usehigh electricity consumption which is the cause emission of gages which affect the green house and increase the overall cost of functioning such systems. With enhancement of data center, the power consumption is increasing at such a rate that it has become a key concern these days because it is ultimately leading to energy shortcomings and global climatic change. Therefore, a solutions is required for this problem; that solution is green cloud computing.

II. CLOUD COMPUTING

The most of the companies for information technology has observed the cloud computing importance and keep increasing their data distribution facilities and computational ability. The data centers which require huge amount of electricity that raise the total costs and electricity utilization for cloud data centers. Cloud computing is not a new

invention in computer science technology rather it is an evolution of existing computing science technology of network, grid and cluster computing. That why there is no single definition of cloud computing, using the cloud computing means **we** are using the software, infrastructure, storage and platform as a service by using the Web-based applications and accessing them through an online connection. A cloud can be define as the extension of the distributed computing system where number of computers are interconnected with each other and provide the services of application, recourses and platform as required by the users over internet.

2.1 Types of Cloud Computing

Basically the cloud computing can be divide in the three popular categories of Saas, Paas and Iaas.

(i) Software as a Service (SaaS):

- This is the higest layer of cloud computing layer architecture, this layer describe about the software which will be provide whena applicationdemands to access.

(ii) Platform as a service (PaaS):

- PaaS provide the facility for deployment of application without paying for the hardware and software .
- It may also include platform for design, development, testing and deployment of the application.

(iii) Infrastructure as a Service (IaaS):

- IaaS providers presents computers as virtual machines and offers additional resources such as firewalls, load balancers and IP addresses.
- IaaS cloud supply these resources on demand from data centers.

2.2 Deployment Models of Cloud Computing:-

(i) Public cloud:

- Public cloud applications are developed for public by the service provider.
- These services are may be unchangeable orchangeableas per a pay per use model.

(ii) Private cloud:

- Private cloud is operated solely from a single organization.
- They are managed internally or a by a third party and are hosted internally.
- Private cloud project requires a significant level of engagement to virtualize the business environment.

(iii) Community cloud:

- Community cloud shares the infrastructure between several organizations and forms a specific community with common concerns (i.e. security, compliance, jurisdiction, etc.)

(iv) Hybrid cloud:

- Hybrid cloud is the combination of two or more type of clouds that work as single could.

III. GREEN COMPUTING

The word green represents the nature and when we add computing with the green means we are substantially adding computation to the nature. It is very necessary to make computing environmentally sustainable to decrease the emissions of greenhouse gases. The goal of green computing is reduce the overall power consumption. This can be achieve by redesigning the infrastructure of network by reducing the quantity of servers, switches and cables or by applying the different power consumption schemes and patterns.

IV. EXPERIMENTAL/THEORETICAL REQUIREMENTS

The requirement of Green Cloud Computing has come after the addition of the advantage of green computing with the cloud computing. As per the Search Statistics provided by the Google Company,Average number of searches per Day in year 2012 is 5,134,000,000 and Google Searches in 2012 is1,873,910,000,000 as per the official web blog of Google. Searching of one content Google releases about 0.2 grams of CO2. It means 1026 tones greenhouse gas emissions per day by Google only, and then just imagines what will be the figure if we include the other search engines and web sites.

Therefore the main concern is to decrease the carbon emission in cloud computing to reduce the operational cost and to protect our environment from pollution. The solution to the success of energy efficient clouds is "Virtualization". Virtualization is the process of presenting a logical grouping of computer resources in this way that their simulated result gives the same visual effect as the original configuration. This gives result in higher savings in the way of space, management and energy.

This paper presents an analysis of datacenter on cloud computing simulation environment. Green cloud simulator is explore the data forenergy consumed by the data center components and to find the packet level communication between these components. The simulation results provide with the help of simulator demonstrates the energy utilized in different components ofdata center like server energy and switch energy at all the three levels (core, aggregation and access level) according to use of switches and servers used in the architecture.

V. SIMULATOR INPUT

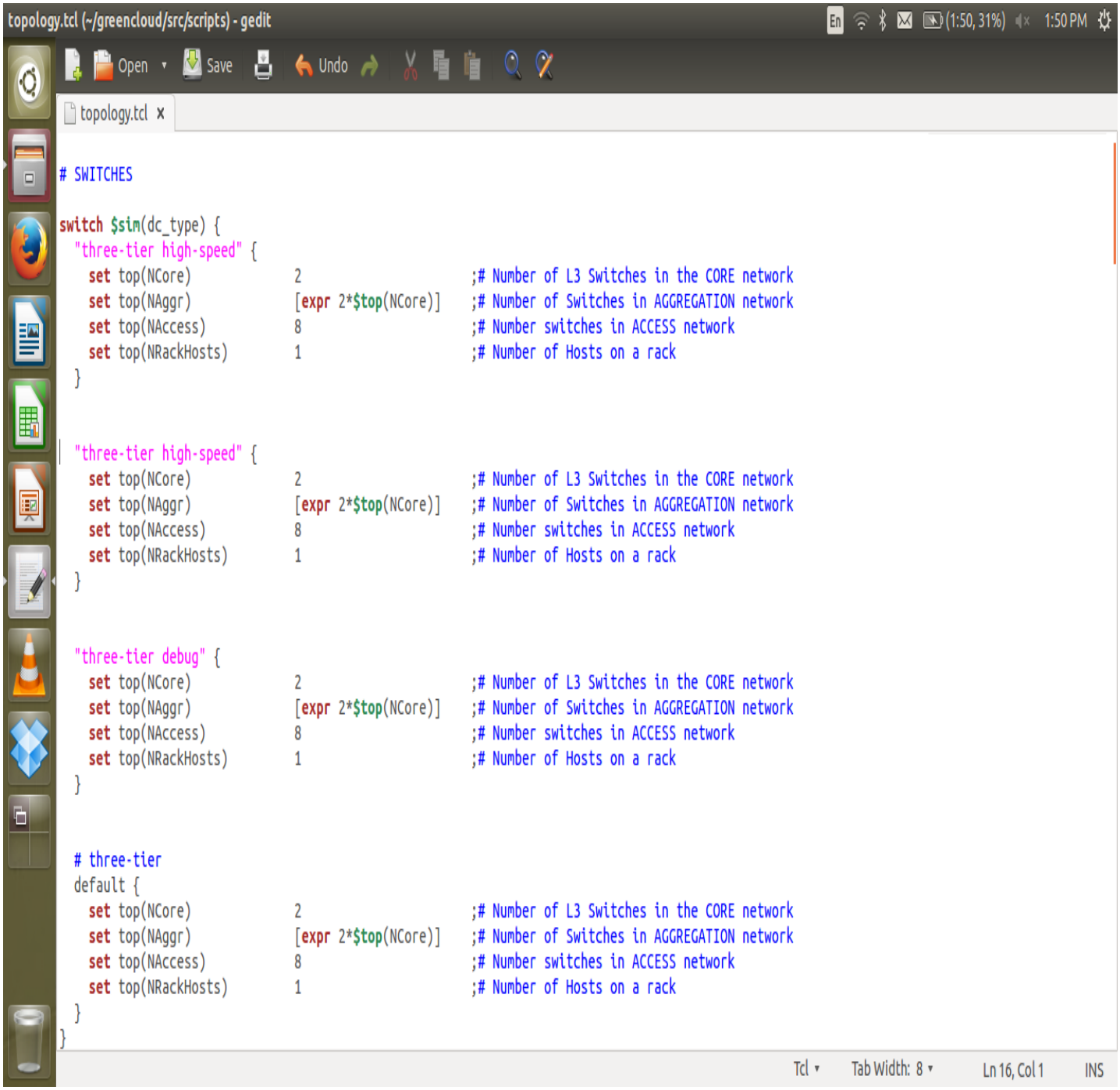


Figure 5.1: Screen shot-1 of input

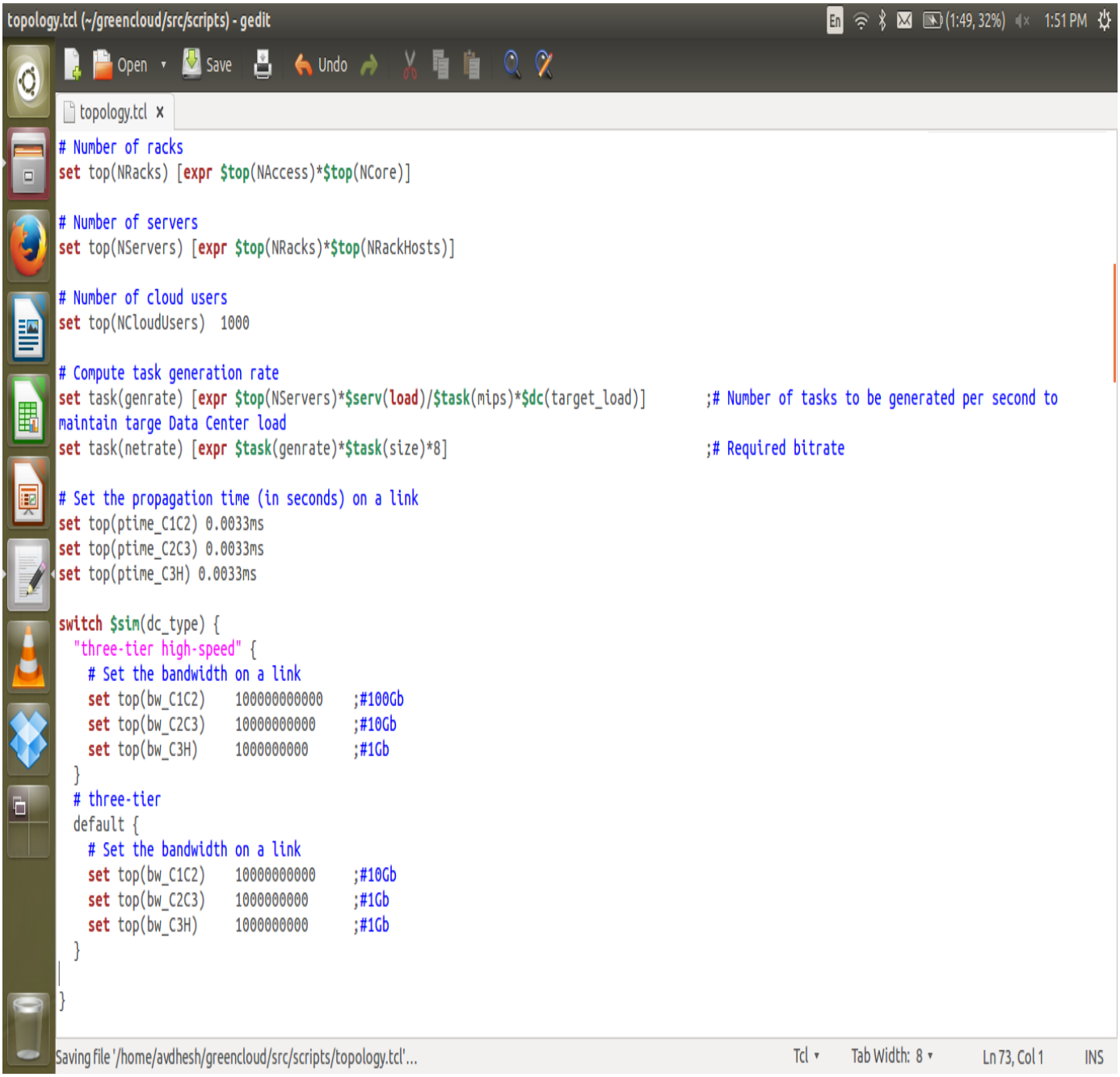


Figure 5.2: Screen shot-2 of input

The data center infrastructure consist basically consist of three layers namely core layer, aggregation layer and access layer. For the study of e-governance data center we have taken two L-3 switches in the core layer which provides loop free multipath routing. The core layer switches are linked with aggregation layer L-2 switches which are less costly than L-3 switches and the switches are always double in number than core layer switches. Aggregation layer switches are used to connect thousands of servers together.
The servers are arranged in different racks where all servers in a rack are connected to the top most servers called Top of Rack. This top of rack is used to dynamically switch on the

server which contains the information related to the particular request. This saves the amount of energy consumed by different servers even when they are in ideal state. There can be many number of Top of Racks but for our data center only one is sufficient as the numbers of servers are less in number.

The number of switches in core layer and access layer defines the number of racks. The efficiency of a data center depends on the number of users it can respond to in minimum amount of time. We have considered 1000 users for our study.

VI. FINAL RESULT & RECOMMENDATION

Simulation Duration (sec.): 60.0

Datacenter Architecture:	three-tier debug
Switches (core):	2
Switches (agg.):	4
Switches (access):	8
Servers:	16
Users:	1000
Power Mgmt. (servers):	No
Power Mgmt. (switches):	No
Datacenter Load:	99.5 %
Average Load/Server:	1.0 %
Total Tasks:	273316
Average Tasks/Server:	17082.2
Total Energy:	407.2 W*h
Switch Energy (core):	95.9 W*h
Switch Energy (agg.):	191.9 W*h
Switch Energy (access):	39.2 W*h
Server Energy:	80.2 W*h

Figure 6.1: Screen Shot-1 of Simulator Result

The simulation results show the energy consumed by different data center components like switches in core layer, aggregation layer and access. The highest amount of energy is consumed by aggregation layer switches as it provides multipath routing to a number of servers. The average power consumed by a server in processing a request is 1%. The total data center load is 99.5%. Total tasks performed in a second are approx. 2 MIPS.

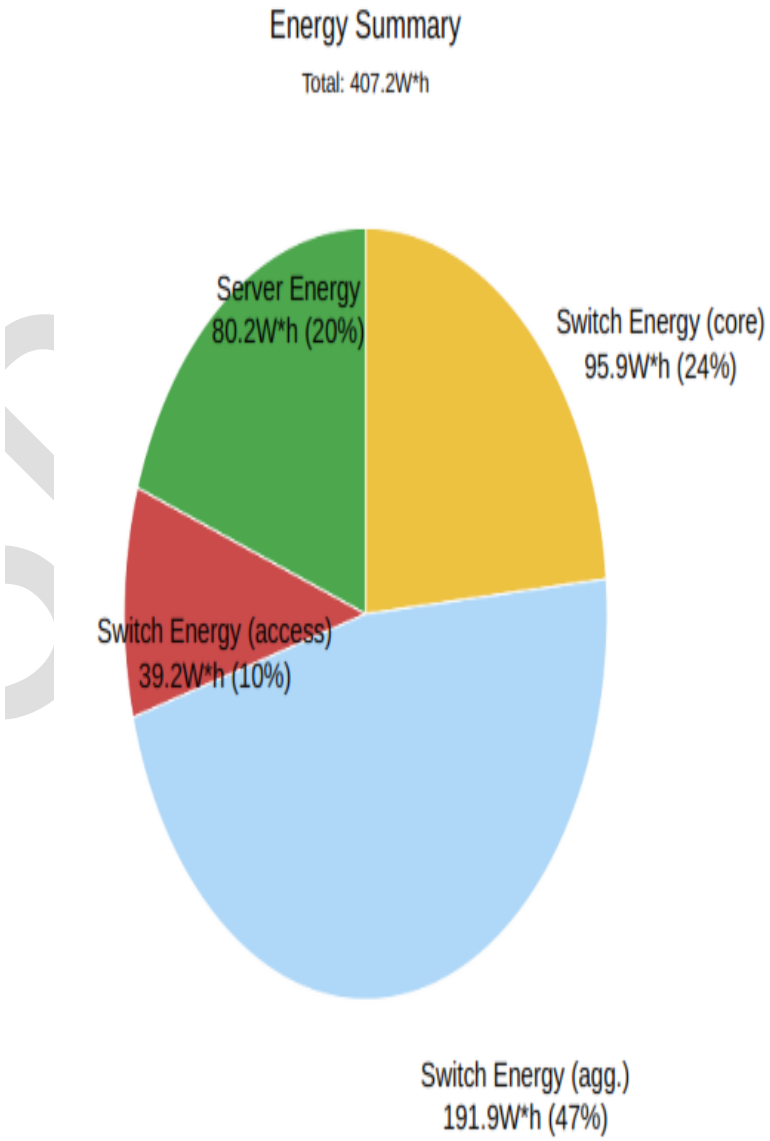
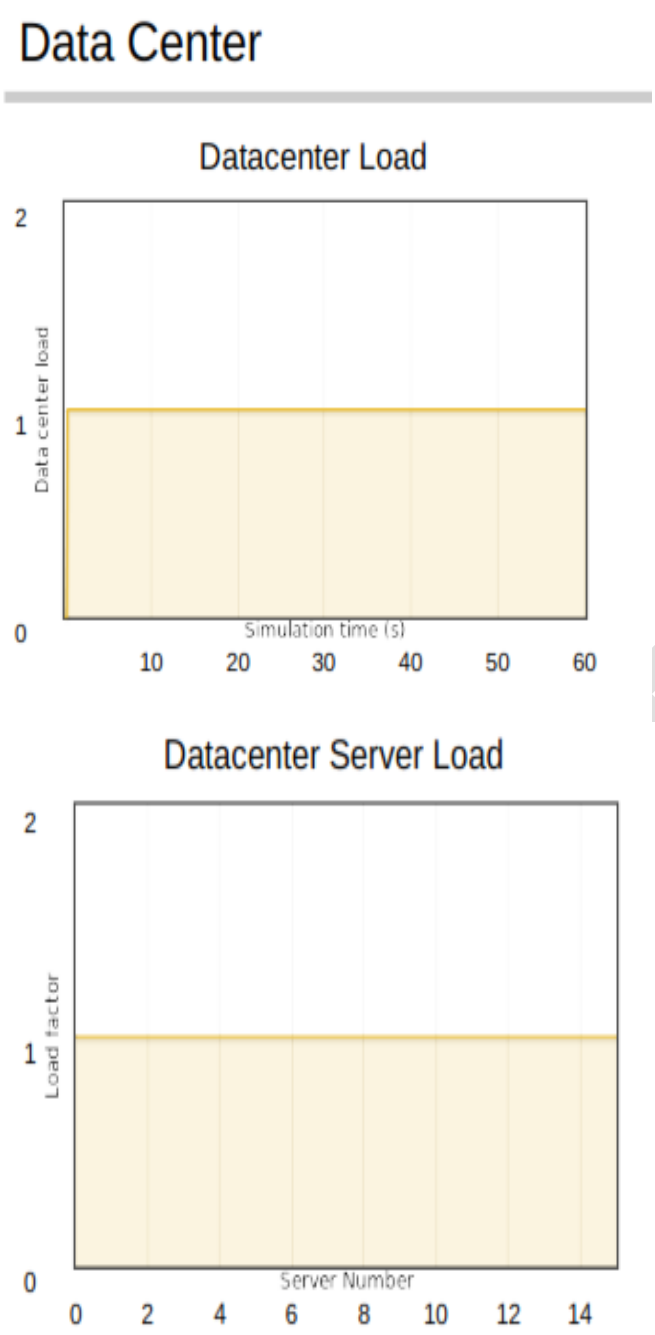
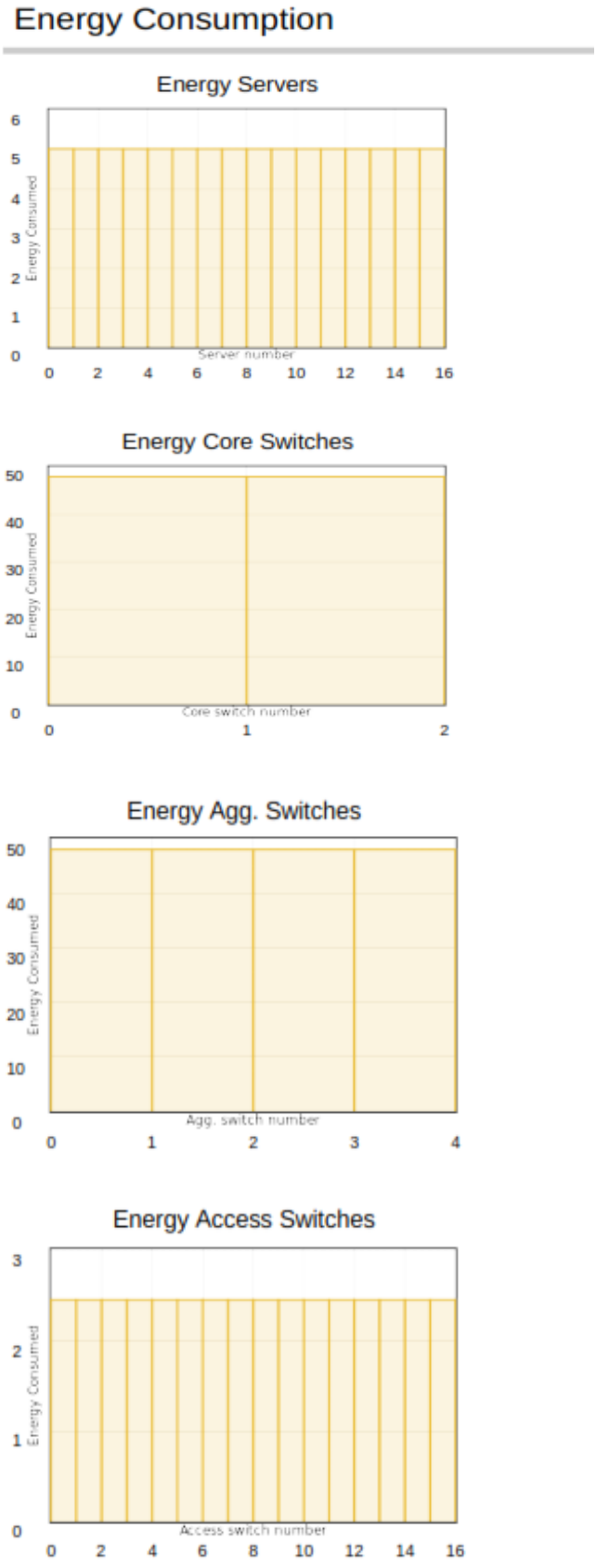


Figure 6.2: Pie chart describing percentage of energy consumption by different modules





The two graphs generated corresponding to the data center depicts the relationship between load and simulation time or load and number of servers. The first graph shows that for complete simulation time the load on the data center is constant i.e. 1% per second. The second graph describes that there are total of 16 servers and all are operated at constant load.

a.) The first graph shows the amount of energy consumed by each server. As the simulation result shows that the total energy consumption of server was 80.2W*h therefore the power consumed by each server is approximately 5W*h.

b.) There are total 4 switches in aggregation layer and consumed by access layer switches. There are total 16 switches in access layer and the power consumed by each switch is 2.45W*h.

VII. FUTURE SCOPE & CONCLUSION

While green cloud structure embeds several provisions to make cloud computing more green but we require more effort to implement it in real life. The scope can be further extended by considering the following elucidations:

- For enabling green cloud data centers, we will understand and analyze the existing data center electricity consumption and way to cooling the equipment, electricity consumption by the servers and their cooling requirements to achieve maximum efficiency.
- We will also require modeling tools to analysis the power usage of all the components and services of cloud.
- For designing the holistic solutions we will consider such as number of servers, each type of switches, users and total links to a data center to minimize the overall power usage of a data center.
- Our main aim will be improving the effectiveness of the equipment used in the cloud computing.

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