Comparison of Three-tier and Fat tree DCN Architectures with regard to Energy Consumption.

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***Abstract*—In this modern era, internetworking has become a commodity. This requires repositories of billions of gigabytes of information i.e. datacenters. On the other hand, running out of energy resources is a burning issue. The performance bottleneck now is not a processing power but is energy consumption of datacenters. Energy resources should be optimized by achieving considerable energy consumption in the datacenter and design architecture with suitable parameters. Fat tree architecture and three tier architecture are two models for designing Data center network. By comparing both of the architectures in energy consumption we can understand which architecture is better to use when energy consumption is considered.**

Keywords— Data centers;Energy consumption;Fat-tree DCN Architecture;Green cloud simulator;Three-tier DCN architecture;.

I. Introduction

Datacenter is a pool of resources (computational, storage, network) interconnected using a communication network. Datacenter Network (DCN) holds a pivotal role in a data center, as it interconnects all of the data center resources together. Datacenter networks are the backbone of the modern economy.

We have many DCN architectures like Dcell, elastic tree, 2 tier but of which we took three tier and fat tree architectures for comparison as these architectures are most effectively used for designing data centers and three-tier is used due to efficient routing and fat tree architecture has less cabling and cheaper when compared to three tier architecture.

In this paper, we analyze the performances of Fat-tree architecture and three-tier architectures in a Datacenter Network. Performance of these architectures is evaluated for Datacenter's when energy consumption is considered. We deter mine the energy consumption on basis of server switching and wiring aspects.

II. Survey of Related Works

The Datacenter network architecture has various performance metrics like scalability, agility, fault tolerance bandwidth, cost etc. with increase in architectures we need to ensure better architecture with good Quality of services (QOS) and efficient energy consumption are used [1] A comparative study on these architecture can be effective and is highly essential for better performance.

On the basis of suitable conditions and environment, an architecture can be designed to satisfy the needs and also to save the power consumed by the hardware and these architecture designs help to reduce energy [2].

Green cloud simulator is an extension of ns-2 simulator tool this is used to help in modeling a green cloud center and it is used to determine the energy consumed by the data centers in different aspects like cabling, servers, switches [3].

III. Problem Statement and Main Contribution

From the review of related works one can say that the energy consumed by the two DCN architectures namely three tier and Fat tree architecture is not determined and they are not compared based on energy consumption. So, our research is modeling these architectures and comparing the energy consumed by these architectures and analyzing the energy consumed at different levels (servers, switching, etc.).

The main contributions are modeling of three-tier high-speed architecture and fat tree architecture and determine the energy consumed by these architectures and how the energy consumption varies at different levels.

IV. Problem Solution

The solution to the problem is to implement these DCN architectures in green cloud computing and allocating the servers to the architecture and checking the energy Consumed by these architectures.

A. Modeling

The three-tier architecture consists of three layers namely access layer, aggregation layer and core layer. In a three-tier architecture, the aggregation layer facilitates the increase of server nodes (up to 10,000) servers. In a three-tier architecture, we use map reduce algorithm. A typical three tier architecture consists of maximum 8 core switches. Major problems faced by three-tier architecture includes scalability, fault tolerance, cross-sectional bandwidth and energy efficiency.

Fat tree architecture is contrast to that of three-tier architecture, it uses to that of a commercial Ethernet architecture. Similar kind of switches can be used in the fat tree architecture. So, we have low costing in a fat tree Architecture switch to switch cabling is used through which we can reduce the number of cabling. Fat tree has the full bisectional bandwidth. Fat tree topology offers 1:1 oversubscription ratio. This architecture is composed of k pods. Where each pod contains K/2 access layer switches, same number (K/2) of aggregate layer switches and the same topology. Many data centers are built using a Fat tree network topology because of its high bisectional bandwidth. We can further reduce the energy consumption by merging networks.

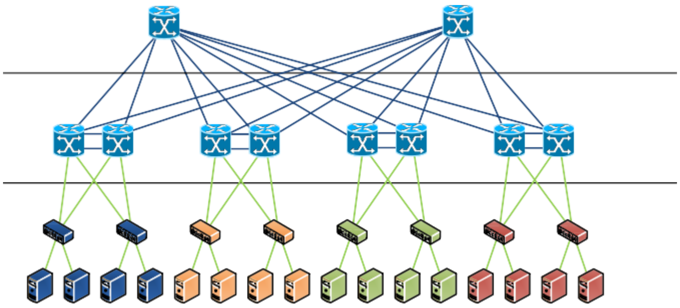

Fig. 1. Block-diagram of three-tier

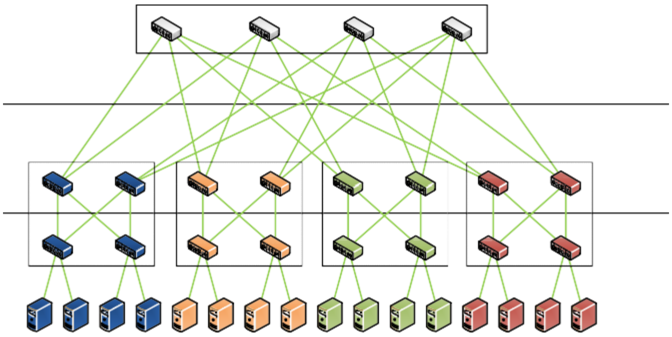

Fig. 2. Block-diagram of Fat tree Architecture

B. *Implementation*

The two DCN architectures are implemented in green cloud simulator. In this simulator we model the three-tier and fat tree architectures and these models are given in the appendix section through this simulator, we provide the number of servers and note the energy consumed by these architectures.

C. *Verification*

Here, the reader can read about the validation scenario. In here we design a topology with the core, access and aggregation switching and assign an equal number of servers to both the topologies. We can observe that the servers occupy the most part of the power consumption and next highest power consumption is performed by the aggregation switches remove full stop in the fat tree architecture. In fat tree there are a high number of aggregation switches as there are remove more number of interconnecting between them the verification process is performed by the green cloud simulator and the results are taken from the green cloud dashboard connected to website.

From the fig 3 we observed that server energy consumes 238.6 W*h and switches consumes 63.6W*h including core layer, access layer aggregation layer. Total energy consumed by fat tree is 302.2W*h and from the fig 4 we observed the server energy consumes 270.1W*h and switches consumes 48.4W*h. Total energy consumed by three-tier is 318.4W*h. Hence fat tree consumes less energy when compared to three-tier DCN architecture.

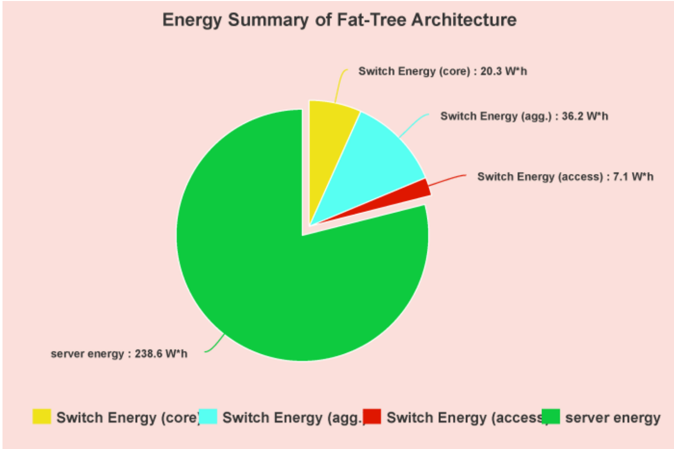

Fig. 3. Pie-diagram of Fat tree Architecture

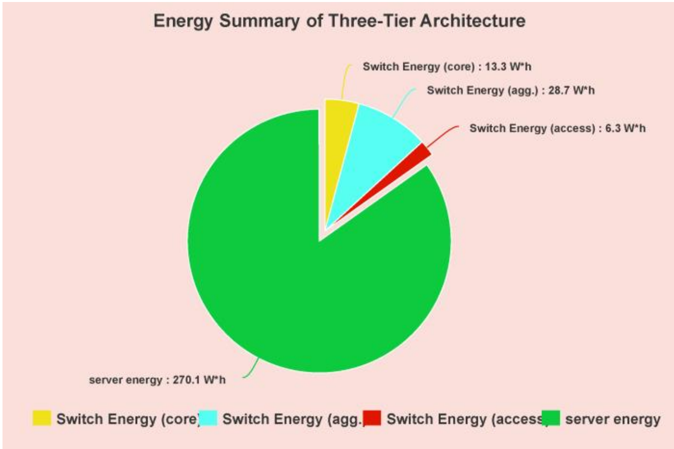

Fig. 4. Pie-diagram of three-tier

V. Conclusion

From the results obtained by the simulator, we can compare the power consumed by these architectures and we can notify that Fat tree architecture is better when compared to three-tier architecture. Fat tree architecture is low cost when compared to three-tier architecture. Future wok there are many other architectures we can model a hybrid architecture and determine the energy consumed by these models. Various parameters like throughput and latency can be taken into account.

References

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APPENDIX

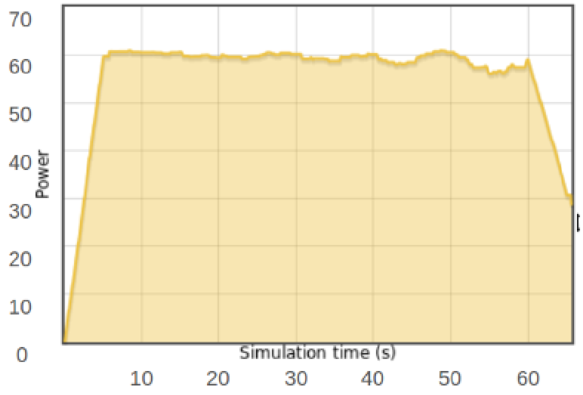

Fig. 5. Power Consumed by Servers by fat tree architecture

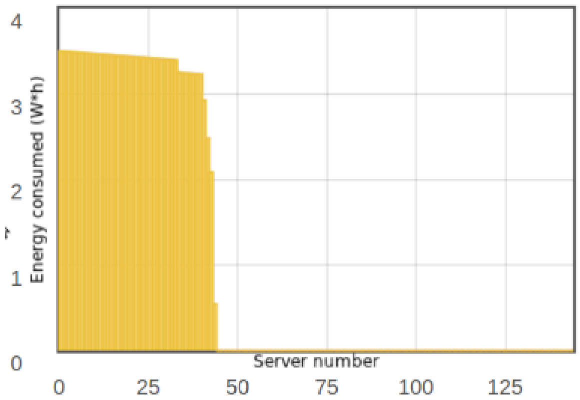

Fig. 6. Energy Servers

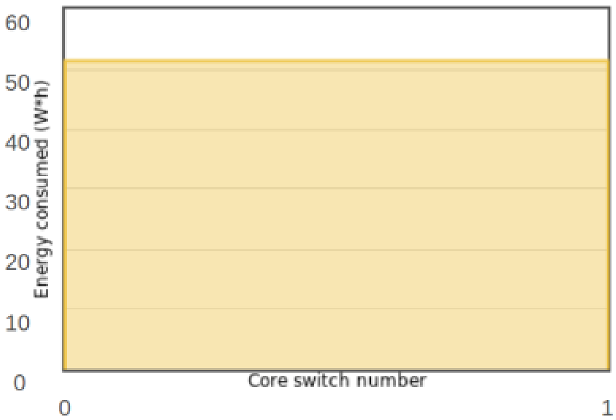

Fig. 7. Energy Core Switches