Comparative Study of Green Computing On University Campus

Pankaj[1], Pawan Prakash Singh[2]

[1, 2] Department of Computer Science, Suresh Gyan Vihar University, Jaipur, India

Abstract : ***"Green computing achieve not only more efficient processing and utilisation of computing infrastructure for operational, but also minimize energy consumption and save power waste. Green computing is ensured that the future growth of computing is sustainable and more reliable. Otherwise, Green computing with increasingly then front-end client devices interacting with back-end data centres will cause an enormous escalation of energy usage and more wastage of energy. The power consumption of network and internet is up to 10% of global total power consumption. The purpose of this study is to identify ways in which Green IT practices and solutions can impact of power and demand of power in University campus, while simultaneously supporting green benefits, including energy efficiency, and demand of power in network and reduce power wastage. Therefore, the main objective of this thesis is to illustrate how Green IT paradigms and its inherent benefits can affect on power of network equipment and how can save environment. The main focus of study falls in following area: (a) Find out the energy of private network equipment like switch, router and storage device ,server etc. (b) Green IT initiatives (c) Simulation graph of demand of power in University campus network."***

Keyword: Demand of Power, Green IT, Network energy, Network Design, Network connectivity

1. Introduction

With the growth of high speed networks over the world, there comprised of thousands of concurrent e-commerce transactions and millions of Web queries a day. And transfer of data within the network also increasing time to time. So, Increasing demand is work through a large-scale of data centres, which performed action by hundreds and thousands of servers with other infrastructure such as network systems and cooling, storage. Demand of power is a factor to measurement the power of network. Demand of power is based need of data by user. It is directly proportional to the user and supply of power. For using service, Users Request to server to access the service. According to request server provide the service. So, transfer of data between data centre and user through internet. In this process of transfer needs to many equipment of network used. So, Demand of power is based power consumption of network equipment. This goal of reducing (GHG) emissions arising from information and communication technology (ICT) services.[3] Green Computing perform action on the process and reduce the power consumption and save the energy which are occurring of power wastage or idle time of equipment.

2. Network connectivity of University Campus

According to scenario LAN AND WAN is connecting with NETDEFEND UTM Firewall .UTM firewall blocked all unauthorised IP. And gives the permission only valid IP. UTM is connected with three tier switches via cable .And three tier switches have 24 port. But at this time, According to campus, they use 6 ports in distributed line to per department. Here, also trying to understand that data transferring between server sides to user side which number are port are using and IP number and gateways number and subnet number which are using data transferring between server sides to department.

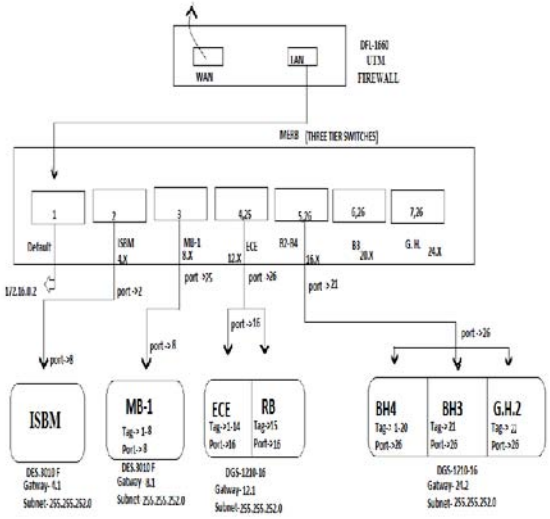


Figure 1: Network of Suresh Gyan Vihar University, Jaipur

Above given figure no (1) is a network of SURESH GYAN VIHAR UNIVERSITY. It describes a scenario view of transferring data from a department to another department. It does also specify the port number. According to port number data connectivity is a department to another department via Ethernet switches.

In three tier switch, port number 1 is connected with default department which are its own server room network Default network use 172.16.02 IP number. and port 2 of switch is going to department of ISBM where through cable and after that they are connected with port 8 and there using layer two switches to connected with router. In ISBM block using gateway 4.1 and subnet 255.255.252.0 .This type port 25 is connected to main building router .which provide the internet network for user and main building network work on gateways 8.1 and subnet 255.255.252.0. And port 26 is connecting to small Ethernet switch port 16 and there network use 12.1 and subnet 255.255.252.0. Port 16 is giving connectivity in two departments ECE and RB. Port 21 is giving

connecting to BH4, BH3, GH2 hostel for internet network .There are using gateways 24.2 and subnet 255.255.02

3. Methodology

After the over view of connectivity of Gyan Vihar University now next step is focus on main calculate the power consumption and capacity of devices. And using mathematically calculation and equation calculate power of demand and observation of both standard and observed and also plot graph of power of demand (kW) respect to time (min.).Using comparative study observed data of campus power of demand in every 15 min. Segment and using dynamic IP assign algorithm save power consumption in network. Simulation work is shows that power of demand of campus.

Using [1] mathematically formula of calculating power. This formula calculate on total power consumption reading based on a bit transfer from server to network and network to user .In which use equipment and reading of devices power and capacity of device .These Table of standard data devices and power consumption and capacity of devices . The corporate and Internet IP networks in greater detail and outline the functionality of the equipment in those networks. Table {1} and {2} lists equipment used in our calculations of energy consumption in the corporate network and the Internet IP network as well as the capacity and power consumption of this equipment.

Table 1: Standard data of Capacity and Power Consumption of device

	Equipment	*Capacity*	*Power Consumption*
Storage	HP 8100 EVA	604.8 Tb	4.9 kW [5]
Computation Server	HP DL380 G5	800 Mb/s	355 W [6]
LAN	HP DL380 G5	320 Gb/s	3.8 kW [6]
Gateway Router	Juniper MX-960	660 Gb/s	5.1 kW [7]
Ethernet Switch(small)	Cisco 4503	64 Gb/s	474 W [6]
BNG	Juniper E320	60 Gb/s	3.3 kW [7]
Provider Edge	Cisco 12816	160 Gb/s	4.21 kW [6]
Core Router	Cisco CRS-1	640 Gb/s	10.9 kW [6]
WDM(800 km)	Fujitsu 7700	40 Gb/s	136 W/channel [9]

3.1 Consumption of Energy in Campus

In Campus, after creating a network overview scenario .This data is taken from Suresh Gyan vihar campus. This devices are used in Gyan vihar network and here table is generated which describe the Equipment of network and Capacity of network Equipment and Power Consumption by Equipment to transport data from data centre to user.

Table 2: Observed data of Equipment (Suresh Gyan Vihar University)

	Equipment	*Capacity*	*Power Consumption*
Storage	IBM PC	1000 Gb	3.5kW
Computation Server	Juniper NIC T33678	1Gb/s	200 W
LAN	Ethernet D-link 801	100 mb/s	2.5 kW
Gateway Router	Juniper mi10	5 Gb/s	4.3kW
Ethernet Switch(small)	DES-3010F	32 Mb/s	420 W
Ethernet Switch	D-Link's DES-3828	110 Mb/s	2.8 kW
BNG	Cisco ASR 6000	60 Gb/s	3.2 kW
Provider Edge	Juniper E320	120 Gb/s	4.12 kW
Core Router	Linksys 510 WAP549	625 Gb/s	9.1 kW
WDM (200 M.)	Lanmark-of OM4	10 Gb/s	60 W/channel

By using the formula, the energy EI required to transport one MB from a data center to a user through the Internet is

$$Ei = 6\left(\frac{3Pes}{Ces} + \frac{Pbg}{Cbg} + \frac{Pg}{Cg} + \frac{2pe}{Cpe} + \frac{2*9Pc}{Cc} + \frac{8Pw}{2Cw}\right)$$ [1]

Where Pg, Ppe, Pc, Pbg and Pw ,Pes are the powers consumed by data center gateway routers, provider edge routers, broadband gateway routers, , core routers, WDM transport equipment, and the Ethernet switches respectively.

Ces, Cbg , Cg , Cpe, Cc, and Cw are the capacities of the corresponding equipment in bits per second. The power consumption and capacities of this equipment is given in Table 4. The factor of six accounts for the power requirements for redundancy (factor of 2), cooling and other overheads (factor of 1.5), and the fact that today's network typically operate at under 50% utilization [8] while still consuming almost 100% of maximum power [5] (factor of 2). The factor of three for Ethernet switches is to include the Ethernet switches in the metro network as well as the Ethernet switches in the LAN inside the data center. The factor of two for provider edge routers is to include the edge router in the edge network and the gateway router in the data center. The factor of two for core routers allows for the fact that core routers are usually provisioned for future growth of double the current demand [4].Using Data of tables and apply mathematical formulation In Standard data, The energy EI required for all equipment to transport one MB from a data center to a user through the Internet is 385.426 joule. And For Observed, energy EI required to transport one MB from a data center to a user through the Internet is 465.701 joule.

3.2 Demand of power

Power Demand is defined as the integral between zero and a certain time (called integration period) of the power curve of the facility divided by the integration period. In

short, it is the average installation's power at the integration period:
Formula Power of Demand

$$DP = \frac{\int_0^{ti} P.dt}{ti} \text{ [kW] [2]}$$

DP: Power Demand [kW]
P : Instant facility Power [kW]
ti: Integration period [h]

Using this formulation, demand of power (kW) is measure and its describe demand of power in a particular time period. So, here using 15 minutes Instant time for Integral. Below table is measure power in kW. To record demand profiles is simple, cheap and useful. Provided the data is available, each system and the total installation can be modelled so that, once obtained the model, it can be compared with the real performance.

(a) Demand of Power for Standard Network

Using the energy of standard work, apply the formula of power of demand result in given instant time. It describe the demand of power respect to time is increase.

Table 3: Standard data of Demand of Power

Date and Time	*Demand of Power (Kw)*
2/4/2009 11:00	5.7789
02/04/2009 11:15am	11.5578
02/04/2009 11:30am	17.3367
02/04/2009 11:45am	23.1156
2/4/2009 0:00	28.8945

(b) Demand of Power for Observed Network

In campus network, energy is consume by network is very high compare to energy of standard energy. As before calculate the energy of network Ei, using this Ei terms use in calculated the Power of demand of network. This power of demand is measured on 12/05/2013 in Suresh Gyan Vihar University; time 12:00 pm to 1:0 0pm. below table is giving a measurement of power of demand in "peak hours". When data transfer in network from data centre to user is increasing and accordingly power of demand also increasing .We can say increasing utilization of network or data transfer also increase power of demand respectively. This data is measure on every 15 min. Power of demand of demand in Gyan vihar university is:

Table 4: Campus data of Demand of Power

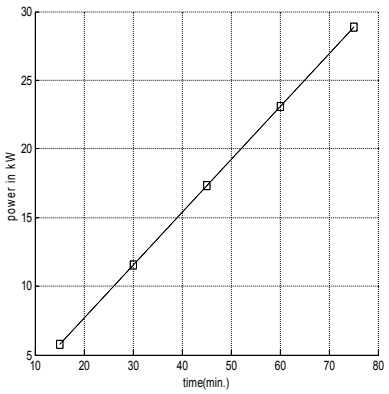
Date and Time	*Demand of Power (Kw)*
12/5/2013 12.00	6.982
12/5/2013 12.15	13.9641
12/5/2013 12.30	20.9461
12/5/2013 12.45	27.9282
12/5/2013 1:00	34.9102

As the data, can say that Power of demand of demand of network is going very high in "peak hour". This can be a Big issue in future and can b a reason for system crash. Using this data, a graph can be plotted between graph individual powers of demand with respect to time. And also plot a comparative graph between standard and observed .This graph are plot using MATLAB.

4. Result

4.1 Standard Graph

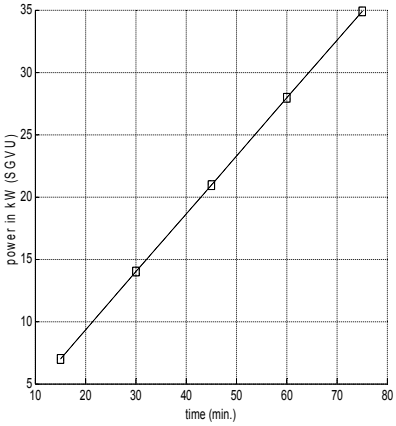
This graph is plot between power of demand and time. Here power of demand is measure in kW and time in min.



As shown of graph, Power of demand is increasing proportional to time. Means "In peak hour" the power of demand level is high. And data transfer between user and data centre increasing according to power of demand. In this graph, every 15 min. Calculated Power of demand reading is taken in time slot.

4.2 Observed Graph Power of Demand of Campus

Using measurement of power consumption by equipment and capacity of equipment calculate the energy of network which are using to transport one bit data transfer data centre to user through internet. In campus university, using this energy calculate the reading of power of demand respect to a time. This given below graph is x axis describe the time and vertical y axis describe Demand of power in kW.

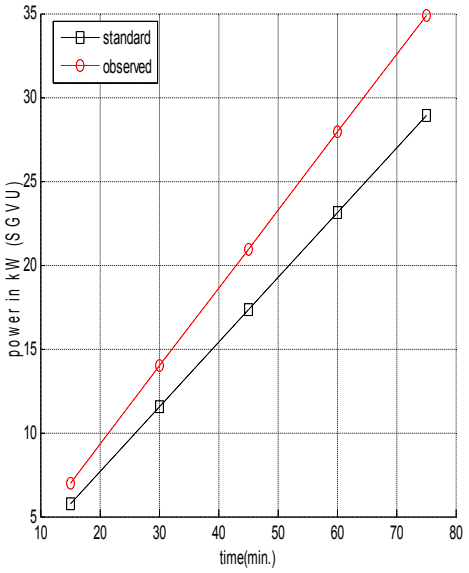


Has seen from the above graph, in Campus University in peak hour when utilization of network is high then we measure the power of demand in instant time. .In this graph, Power of demand reading is taken on every 15 min. time slot.

4.3 Comparative analysis of Standard graph and Observed Graph

The below graph presents standard power rating in kW represent in black line And Observed power rating also in

kW and its represent in red line with reference to time(min.)



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As from the observation of above graph there is difference between the Observed line and Standard line .This difference states regarding to use of green computing in the network. The standard line represents use of green computing in network where as the observed line represents usage of equipment other than green computing this regards more power consumption in ordinary equipment as compare to green computing.

5. Conclusion

In this Paper, have seen demand of power of campus is increasing simultaneously respect to time in "peak hours", and did comparative study between Standard and Observed. And power of demand is increasing time to time So in campus, future work of this Paper regarding to usage of green computing in university campus .The green computing is to be done by the application of solar energy and use of dynamic IP assign through dynamic router in the campus [10]. And can be help in control demand of power and which tends to more power saving and operating cost of the equipment. Using solar energy can save power waste and reduce the electricity bill of campus.

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Author Profile

Pankaj was born November 11, 1990 in Hanumangarh Town, Rajasthan, India. He received Bachelor of degree Information Technology in Engineering from Suresh Gyan Vihar University, Jaipur, Rajasthan in 2012. He is pursuing Master of Technology in Computer Science Department from the same collage. He has submitted dissertation on "Comparative Study of Green Computing on University Campus" and area of interest regarding this technology. Presently he is at Suresh Gyan Vihar University, Jaipur.