NOVATEUR PUBLICATIONS
JournalNX- A Multidisciplinary Peer Reviewed Journal
ISSN No: 2581 - 4230
VOLUME 6, ISSUE 10, Oct. -2020

REVIEW ON IMPROVING ENERGY EFFICIENCY OF INTERNET ROUTERS

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ABSTRACT:

In the recent past, the use of internet has become an integral part of economic development in every country, both the developed and the undeveloped. As a result, there has been an increase in the size of internet networks to ensure that the demands of the consumers are met. However, the amount of power consumed increases as the size of the network increases (Szymanski, 2016). There is an increase in the demand for power as urbanization also increases and since internet is becoming the major power consumer with time, it is important to establish a more efficient system. As the number of internet users increases, it is expected that the power usage will increase to higher levels. There is the need to create the strategies that can help improve the efficiency of the use of internet (An & Luo, 2018). It is expected that if the efficiency of the system is not improved, the amount will increase to levels that surpasses the global power output. Improving the efficiency of these systems is an approach that is expected to reduce the cost of the use of electricity. The thesis outlines the various approaches that can be used to ensure an improved efficiency of the internet networks in terms of power consumption.

Modelling Internet Power Consumption

KEYWORDS: Energy, modeling, network, routers

INTRODUCTION:

Maintaining equipment inventory is the best approach for modelling the internets power consumption and its related information and communications technology. The use of the historical sales data on telecommunications equipment is an important insight towards the estimation of equipment quality in an internet network. This is considered to be a perfect means of estimating the magnitude of energy consumption when considering the information regarding the energy consumption of such equipment. However, the approach doesn't give the interplay between the growth of demand and the consequential consumption of power that can be very important in understanding future energy growth. The future trends for growth can influence the consumption patterns of power as most of the internet-based services are in use (Yang et al., 2016). A complementary approach tends to use a model based on the principles of telecommunications network design. The approach involves the segmentation of the internet into several parts. The energy consumption rate of the parts can then be calculated with the use of a paper design for the network, alongside the data provided by the manufacturers on the equipment power consumption.

The access network is key in connecting the individual homes and their businesses to the various local exchanges. Currently, there are a wide range of technologies that have been identified for modifying power consumption some already in use while others still undergoing development. It is now possible to use the fixed line telephone services with the help of a digital subscriber loop that makes the use of the copper pairs. Currently, a higher frequency of the fixed line telephone service is in use as it is more efficient (Chen et al., 2017). When the copper pairs are in a perfect condition, a fiber to the node technology is often used. In this technology, a dedicated fiber is used and it extends from the local exchange to link to the DSL access multiplier. The main network is often made up of a smaller number of the large routers within the main population centers. The core routers are always in charge of all the necessary routing activities and are also the gateways for the neighboring core nodes (Yang et al., 2016). The core routers in a single network are always highly meshed but only have limited links for networks from the other providers.

Estimating Power Consumption:

An access bit rate is often selected in estimating the consumption of power within a network infrastructure. With the knowledge of the network design, access technology, and the access rate, it is possible to calculate the capacity of a telecommunications equipment within the access, core networks and metro. The central office often harbors a number of OLT card often connected to an ethernet switch within the metro networks. The switch is likely to have a particular number of OLT cards and a maximum capacity it can accommodate (Ma et al., 2018). This often determine the number of switches required in handling this capacity. Despite the plots being smooth, there is a level of artifacts necessary for making a tractable analysis. The approach is based on an evaluation of the equipment with the right capacity to meet the total efficiency needs. However, a number of the network have a considerably flat load and power profile (An & Luo, 2018). Therefore, deploying the next equipment set for coping up with the traffic increase results into an increase in the total power consumption.

Major Contributors to Internet Power Consumption:

There are often a wide range of factors that influence the rate of power consumption in internet transmission. The factors are varied and tend to influence the efficiency of the system.

Network Equipment:

The physical equipment used in the network system is one of the main contributors in the consumption of power. It often entails the equipment used in the access, metro and core network. Three main technologies often dominate the access network and often includes the copper, fiber, and a hybrid fiber coax and wireless. The metro network often acts as a gateway to the core and metro networks. A local traffic requires the routing within the suburban and city central areas (Ma et al., 2018). The rest is often routed into the core networks. The core network is often made up of intercity network systems and a core router and the two transport internet network services between different routers. Most of the internet services provided to the end users requires the exchange of information between the end users and the service provider’s internet’s point of connection. The data transport system is often backhaul and tend to use an ethernet or a wireless transport. There is always the need to power and cool the network equipment (Szymanski, 2016). This often entails providing a DC power system to the racks and tend to house the equipment and provide power supply to ensure power continuity to the equipment in the network.

Capacity Planning:

There is the need for the owners of the telecommunication network to create room for future growth, traffic peaks and the restoration and protection of services. The approach generally requires some level of overbuilding the network that eventually increases its power consumption. Some sections of the core network or metro edge can always be 100 percent overbuilt based on the owner's network policies.

Cloud Facility:

A significant amount of traffic in the internet emerges from the various services that are web-based and the available resources for ending the users through the internet. Examples include the content delivery, cloud services, and the storage as a service. The data centers offering these kinds of services requires a considerable level of equipment and the power to function. Content services requires the servers that store the content or data and regulate the its access. Other services require the hosting, processing and the search for data by the servers. The machine offering these kinds of services are always linked through a local or a wide area network (Szymanski, 2016). The networks also consume a lot of energy.

Demographics:

It is common that the internet is always an intra and international network. The physical distance that exists between the various populations directly impacts the network's total power consumption. The density of the premises within the population location centers is also another critical factor. The widely spread entities often requires a lot of power for connection to the local exchange system.

Service Scenarios:

Normally, the consumption of power is largely influenced by the service being offered that are always varied. There are always the shared services that may include the quasi real time and the non-real time services as the web browsing, email, and audio or video download and in such cases, short delays are always acceptable. The services are more often oversubscribed with realizing any speed degradation (Szymanski, 2016). The dedicated capacity for each of the service is always offered through the backhaul and access networks to the server offering the service or the contents. It is not likely that the dedicated capacity services can be oversubscribed. There are also the real time services often delivered to the multiple users through the multicast. Such kind of services may include the internet radio, video on demand services, and the broadcast video (Hao et al., 2020). A copy of the requested service is aligned to a switch next to the customer requesting. This is then replicated to all the requesting customers connected to the switch.

Service Managed:

It is important to monitor the operations of all the networks and their services to be confident that their services meet the expected standards. The functions tend to add up to the total power consumption of the network since they need specialized equipment and systems to be incorporated into the network. It is clear that these are some of the factors that tend to influence the consumption of power by the internet infrastructure. Most of the factors that influence energy consumption tend to interplay with each other. There is however other alternative that still can have an impact on the total power consumption of the system (Zhong et al., 2016).

Improving the Internet's Energy Efficiency:

It is evident that the two main areas that needs a close attention when seeking to improve the efficiency of any internet network are the core network routers and the access to network. The European Union has addressed the challenge arising from the address of the home terminal equipment and have as a result published the equipment's guidelines for power consumption. The voluntary code of conduct is meant to improve the energy efficiency of the various brands of equipment sold across Europe. It is part of the strategies for the improvement of energy efficiency of the internet equipment (Szymanski, 2016). The standards set by the Union requires that the equipment should able to reduce the power consumption when not being used. The low power state is very significant in saving the total energy consumption of these equipment. The second approach entails the reduction of a device's processing rate at the time when the workload is low. Most of the devices tend to operate in a range of bit rates. Power consumption is often low when the equipment operates at a lower speed. Making the internet routers more energy efficiency is the most common approach that has been set to save on the power consumption. This often entails changes either on the router function or the signal processing technology of the router (Zhong et al., 2016). Lastly, it is recommended to adopt the network access technologies that are energy efficient.

Power Aware Routing Control:

The control of internet routing can be used as a perfect approach towards reducing an internets total energy consumption. However, there are often the challenges of being aware of the network performance and the QoS considerations. It is possible to use a queueing theoretical analysis and an optimization technique to for traffic distribution to help reduce the cost function and is made of both the QoS and energy. The separation of nodes into the set of links and the set of routers has the nodes that tend to connect the nodes. This representation allows for a separately model the impacts of the links and the routers on QoS and the consumption of power. Basically, the control of the routing process is meant to make the entire process easier to operate and more efficient in terms of energy consumption (Hao et al., 2020). The approaches used in the process of improving efficiency need to be in line with the current demands for development.

The amount of power that a router consumes is a critical factor when choosing the router to be used for internet supply. The good news is that currently there are several routers that use small amounts of power to operate ranging between 2 to 20n watts. This is like leaving a single CFL bulb turned on at all times. However, the amount of power consumed by these devices still vary based on the model. For instance, the models that have multiple antennas tend ton consume more electricity as compared to the models that uses single antennas. It is also likely t6hat the consumption rate of the energy will vary based on the settings and therefore, it is important to refer to the user manual to consider the most effective setting for energy consumption (Szymanski, 2016). The cost of one's electricity will also influence the exact cost of operating the router. The collective cost of running then routers in every household is therefore a huge amount of money. If not managed, the amount can exceed the global power supply.

Energy Efficiency Standards for Routers:

Routers have a number of features that are key in saving energy. The lower power mode enables the device to go into a standby or sleep mode when the device is not in use. An energy efficient ethernet is important in scaling down the consumption of power based on the use. The future is capable of reducing the total power consumption by up to 50 percent or more when it is enabled. The disadvantages of such devices are not easy to find even upon an exhaustive search within the internet. The increase in the marketing and distribution of the energy efficient routers would be key in empowering the customers to choose the alternatives with high efficiency. The chosen product must meet certain efficiency standards for it to be considered appropriate. At the moment, there are just a few US environmental protection agency routers in the market and consumes about 5 and 13 watts of power. When buying the smaller internet equipment, it is important to consider the energy star logo that implies that the model uses 20 percent less compared to a conventional unit. Ideally, it is important to consider the devices that are both energy star certified and EEE enabled when possible. Unfortunately, such models don't seem to be on the market currently (Shukla & Kumar, 2018). The most sustainable choice in this category is the TREND net TEW-651 BR, which is an inexpensive router using just 2 watts of power.

Network Energy Wastes:

There are a number of organizations that have reported the data on the energy consumption and the relating carbon footprint that has indicated a growing and alarming trend. A larger percentage of the total energy consumption arises from the network infrastructure that contributes to up to 70% of the total power requirements. Data centers often takes about 10 percent of the energy with the remaining 20 percent going to the spurious sources (Ma et al., 2018). The global initiative for energy sustainability has also reported same estimation and considered the carbon footprint of the networks to be at an alarming rate. According to the 2020 estimates, the networks mobile estimation is expected to reach up to 50 percent of the total carbon dioxide emission. The devices will result into an ever growing and a non-negligible contribution to the environmental degradation (Bhalla et al., 2016). Based on the previous research, the total power consumption by the telecommunication equipment estimates at approximately 19 to 24 Twh per year. This is about 0.9 percent of the US total power consumption. The level is expected to rise in the near future.

Internal Source of Energy Wastes:

To face the challenges of energy efficiency in the use of equipment, it is important to analyze and understand the exact causes of power wastage in an equipment. The network devices operating at various zones plays a key role due to the fact that their total energy requirements arise from their density and operational energy requirements. The specific functionalities of the network influence its operational energy requirements. The data plane is the representation of the energy starving and key elements in the larger part of the entire network architecture. This is mainly because it is often made up of elements serving special purpose. A part from the routers, the internal contributors of power wastage in a network system cannot be generally maintained at a fair level (Szymanski, 2016). The complex traffic engines tend to play a significant part in the total energy consumption.

CONCLUSION:

In conclusion, as the number of internet users increases, it is expected that the power usage will increase to higher levels. There is the need to create the strategies that can help improve the efficiency of the use of internet. The use of the historical sales data on telecommunications equipment is an important insight towards the estimation of equipment quality in an internet network. Ideally, it is important to consider the devices that are both energy star certified and EEE enabled when possible. Unfortunately, such models don't seem to be on the market currently. A significant amount of traffic in the internet emerges from the various services that are web-based and the available resources for ending the users through the internet. Most of the internet services provided to the end users requires the exchange of information between the end users and the service provider's internet's point of connection.

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