

Significance of Green Networking and its approaches in the age of Globalization

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ABSTRACT

Internet is playing a significant role in our lives and in modern economy. Internet is a heterogeneous network which includes various components. Each component needs power to function and it is observed that lot of energy is consumed during the digital communication. This paper presents a study of green network and various ways adopted for green networking.

Keywords

Network, Green Computing, Green networking, Green Internet, Data Centers, Data Compression, Server Consolidation, Virtualization.

1. INTRODUCTION

”Globalization” refers to the emerging of an international network, belonging to an economical and social system [9]. Because of globalization a business is now moved beyond the boundaries of state and nation. Various organizations which are miles apart can communicate with each other. Technology has played a vital role in Globalization specifically an Internet and Internet services.

In this age of ICT it is becoming very essential to understand the energy consumption during digital communication. Reducing the energy consumption is Energy conservation.

2. WHY GO GREEN?

The world is facing energy challenges like global warming, resource consumption, climate change etc. Therefore it is required to take into account impact of globalization and internet on energy demand.

Each PC which is in use generates a ton of Carbon Dioxide every year in addition to this all electronic components on the internet also consume power. Data center which are used to store data globally also consumes a lot of energy. The recent examination revealed that US data centers consumed about 70 billion kilowatt-hours of electricity in 2014. This consumption is 2 percent of the country’s total energy consumption, according to the study [2]. Consumption of energy leads to carbon dioxide (CO₂) emission.

Raghavan and Ma estimated that the Internet uses 84 to 143 gigawatts of electricity every year, which amounts to between 3.6 and 6.2 percent of all electricity worldwide. Taking other energy consumption into account, the total comes up to 170 to 307 gigawatts. This energy consumption is around two percent of worldwide [3].

Smart phones and various other devices make internet accessing very easy for users which leads to increase in the Internet traffic. Although Internet traffic volume doubles every 3 years, the increase in usage has not been matched by a similar increase in network energy efficiency. By the end of 2016, global IP traffic will reach 1.1 ZB per year, or 88.7 EB per month, and by 2020 global IP traffic will reach 2.3 ZB per year, or 194 EB per month [4].

Going green means sustainable use of natural resources through environment friendly practices. Energy efficient networking is referred Green Networking and Green Internet is moving towards energy efficient Internet to meet the upcoming demands. First efforts towards green networking can be traced back to the papers by Gupta and Singh [12] and Christensen et al. [13]

3. TERMINOLOGIES

3.1 NETWORK

A network can be defined as a group of computers and other devices connected to each other so as they are able to exchange data. Components of a network are personal computers, peripherals, switches, routers and communication media. There are various networks now-a-days present in this world and each one has different hardware and software configuration. When a person from one network wants to communicate with a person from another network, it is essential to connect these different, incompatible networks.

Network can be classified into two types:

1. **Wired Networks:** These networks are also called as Ethernet networks. In this various devices such as PCs, printers etc. are physically connected via Ethernet cables. Wired Networks are reliable, easy to control, more secure and fast but they are difficult to maintain.
2. **Wireless Networks:** In these networks there is no physical connection between the nodes. These networks use high frequency radio waves for communication. Wireless Networks provide portable accessing and ease of maintenance but faces the security challenges.

3.2 INTERNET AND INTERNET OF THINGS (IoT)

Internet has tremendously changed the way of sharing information. It provides fastest and cheapest way of communication. The Internet today is a widespread information infrastructure [15]. A collection of interconnected networks is called an internetwork or internet [1]. Computers which are connected to internet can communicate with each other. No single person or organization controls or owns the Internet.

The Internet of Things (IoT) is a term coined by Kevin Ashton. IoT is network of interconnected things/ devices which are embedded with Hardware, Software, network connectivity that enables the communication. The three key components of IoT are Things, Internet and connectivity.

3.3 GREEN COMPUTING

Green Computing is also referred as Green Technology. It mainly aims to use of computers and other electronic devices in an environment friendly manner. It spans over the entire life cycle of a digital device starting from design, manufacturing/engineering, usage and disposal/ recycling and tries to reduce the environmental impact during each stage. The goal of green computing is to lower down the use of hazardous materials, maximize energy [9]. Green computing includes the implementation of best practices, such as energy efficiency central processing units, peripherals and servers [10].

3.4 GREEN NETWORK

Green networking is working towards reducing the energy consumption by all network devices. Green networking is the practice of selecting energy-efficient networking technologies and products, and minimizing resource use whenever possible with bandwidth conservation.

The goals of Green Networking are as follows: [5]

1. Reduction of energy consumption,
2. Improvement of energy efficiency,
3. Consideration of the environmental impact of network components from design to end of use,
4. Integration of network infrastructure and network services; this integration consolidates traditional different networks into one network,
5. Making the network more intelligent; the intelligent network will be more responsive, requiring less power to operate,
6. Compliance with regulatory reporting requirements; for example, the National Greenhouse and Energy Reporting System (NGERS) and the proposed Carbon Pollution Reduction Scheme (CRPS),
7. Promotion of a cultural shift in thinking about how we can reduce carbon emissions.

3.4 DATA CENTER

Internet relies on Data Centers. A large group of networked computer servers used for the remote storage, processing, or distribution of large amounts of data are called Data Centers. Data centers are commonly run by large companies or government agencies. These data centers consume a very large amount of electricity as they have to provide services 24/7, which essentially needs external cooling system.

3.5 ENERGY CONSUMPTION BY VARIOUS ICT DEVICES:

Before understanding how to save or reduce energy usage, it is necessary to understand how much energy is consumed by various ICT (Information and Communication Technology) devices. Fig. 1 provides this information.

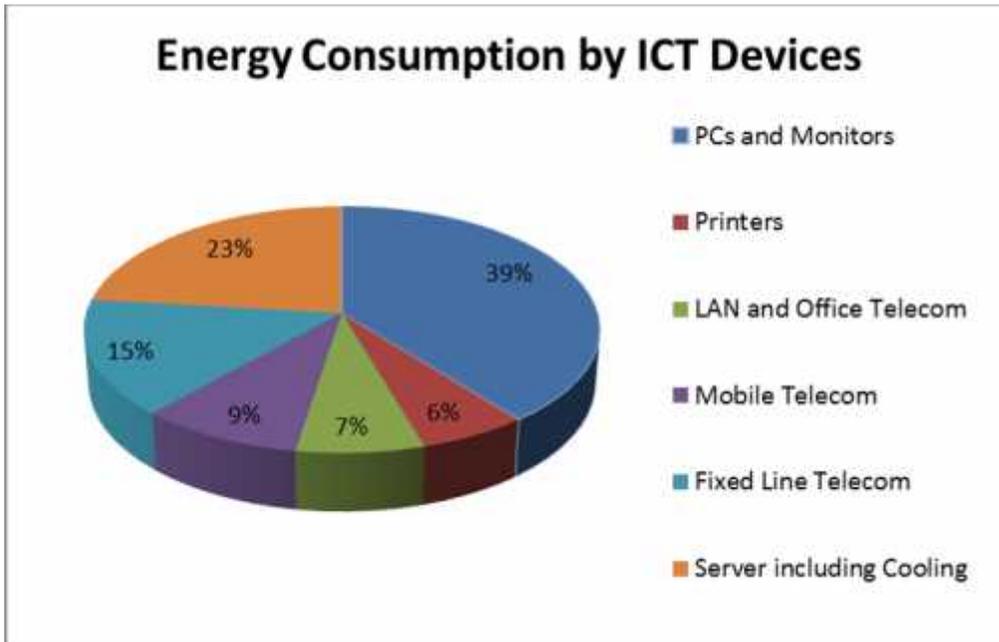


Fig.1 Power Usage of ICT devices [5]

4. APPROACHES FOR GREEN NETWORKING

4.1 DATA COMPRESSION

Wireless transmission of a bit can require over 1000 times more energy than a single 32-bit computation [7]. So to save the energy it is essential to reduce the number of bits which we are transferring on the Internet. Data compression is a technique which allows devices to transfer or store large amount of data but in less number of bits. This technique is also known as data compaction. The data can be textual documents such as emails, messages etc., images such as drawings; photographs etc. or it can be temporal media such as audio, video. The advantages of data compression are:

1. Large data can be stored in less space.
2. Data can be transferred in less time.
3. Less Bandwidth required for data transfer.
4. Improves coding efficiency.

It is required to compress the data at the sender's side and at the receiver's end it is required to decompress the received data. There are generally two types of data compression algorithms,

1. Lossless data compression: Here the data is compressed in such a manner that after decompression exactly same data is generated as the original one. Thus there is no data loss.
2. Lossy data compression: In this technique the data generated after the decompression is not exactly same as the original data.

4.2 VIRTUALIZATION

Virtual means, being in effect but not in actual or fact. Virtualization gives an illusion that unlimited resources are available for the processing. There are various branches of virtualization and Network Virtualization is becoming a one of the youngest among them.

Network virtualization is the technology that enables the creation of logically isolated network partitions over shared physical network infrastructures so that multiple heterogeneous virtual networks can simultaneously coexist over the shared infrastructures. [11]. Advantage of network virtualization to enable a smart energy aware network [14].

Network virtualization consists of Internal and External Virtualization.

1. Internal Virtualization: This technique is applied with virtual servers. Internal virtualization is implemented using the software which provides the connectivity within the server and exchange of data.
2. External Virtualization: It is virtual networking that is outside the virtual server. It involves physical devices such as switches, Ethernet, network adapters etc.

4.3 SERVER CONSOLIDATION

Energy consumption is very high at Data centers so it is required to go for Green Data Centers. Server consolidation is one approach to Green Data Centers.

Consolidation is merging or integration of many items into a single one. Server consolidation tries to reduce number of servers or server locations. It helps in using the server resources efficiently. Server consolidation describes a variety of ways of reducing capital and operating expenses associated with running servers [6]. It is developed as a solution to server sprawl. Server Consolidation helps in using server resources in an efficient manner. According to Tony Iams, Senior Analyst at D.H. Brown Associates Inc. in Port Chester, NY, servers typically run at 15-20% of their capacity, but they take up more space and electricity as compared to their workload. This underutilization of server capacity is called 'Server Sprawl'.

Virtualization is also used as one approach for server consolidation.

5. CONCLUSION

For an organization whether it is big or small, information is a very important asset. Information has to be processed, stored and distributed. The necessity to access information anytime and from anywhere is the base for technology evolution resulting into the digital communication. The enormous growth of digital communication has increased the demand of energy which ultimately leads to increase in CO₂ emissions. This paper tries to address the concept of green networking and gives the overview of various approaches towards green networking.

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