Green Telecommunications: Data Optimization and Aggregation in the Wireless Network

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Abstract – The green telecommunication is the branch of telecommunication based on the energy efficient mechanisms to reduce the power consumption on the network nodes, which finally impact the release of carbon dioxide in the environment. The carbon footprints are the term to find the release of the carbon in the environment. To keep the environment green and healthy, the carbon fuel usage reduction on the sources of electricity production like thermal units or similar other power generation sources is very important factor. The above target can be achieved only after lower the total power consumption. The networks with base stations are usually consisted of several nodes in the communication clusters. The power consumption of these nodes can be reduced by optimizing the packet size, data aggregation, optimized data forwarding techniques, etc. The energy efficient data aggregation on the base station and the packet data optimization on the other nodes is the major objective of this research. This research will lower the energy consumption of the entire network by using an effective data optimization algorithm on the source nodes. The proposal also includes the data aggregation in the manner to reduce the power consumption on the intermediate nodes between the BTS and the destination server. The performance evaluation would be done on the basis of residual energy, percentage of energy consumption, load, throughput, etc.

Index Terms – Green telecommunication, Data aggregation, Packet data optimization, Energy consumption, owner consumption.

1. INTRODUCTION

Nowadays, climate change has become the important challenge for all of the countries across the globe. The rise in the global warming is hitting the world harder, which is causing the rise in the temperature every year. The rise in temperature affects the various factors across the globe. The major affect comes to the health and agriculture areas. The rising content of the greenhouse gases (GHG) in the environment is also hitting the ozone layer, which is the cause of the increasing radiation amount on the earth. The carbon dioxide (CO_2) is the major part of the GHG. CO_2 is the most responsible gas out of the GHG pool which affects the rise in temperature at the most. The natural disasters like hurricanes, floods, etc. are also rising due the GHG effect. The GHG effect is responsible for heavy melting of the snow from the various parts of earth, which results in the rise of sea levels. An estimation study have told that the CO_2 emission have climbed by up 30%. The Kyoto protocol was the key step taken by almost 160 countries across the world to take on the rising pollution. Many countries have started the efforts to reduce the energy consumption and the carbon emission.

The information and communication technology sector is along responsible for the 2% emission. The 2% emission equals almost 860 million tons of the greenhouse gases emissions in the whole world. The energy consumption in the ICT sector is higher because a number of computers, monitors, network devices, data centers, switching setups, etc. consume heavier amounts of power. The PC and monitors contributed 40% of total power consumption and mobile telecom comes at 24% and 23% by the data centers across the globe. Controlling the power consumption in the telecom sector can affect the total carbon emission around 0.5% of total carbon emission, which account for a good amount of carbon release prevention. At least, the target for the telecommunication industry is to not to let it go beyond the limit of total 2% GHG emission.

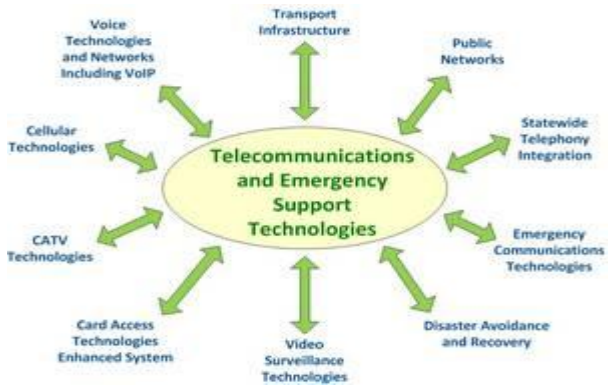

Figure 1: The factor of energy consumption in the telecommunication industry

The power consumption charges are the largest parts of the total expenses for the telecom companies in the world. The telecom networks contribute a high amount of GHG, which can be controlled by using various mechanisms using the effective data exchange, aggregation and data propagation techniques.

The number of people connected with telecom networks is rising in the world every year. The rising number of users directly affects the energy consumption of the telecom operators. Most of the users connecting to the telecom network are the mobile users. The mobile technology contributes the largest amount of total carbon release across the world. There must be the energy consumption check in the wireless networking equipment's, the customer connectivity and the data processing mechanisms. Even if the telecom networks are comparatively energy-lean, the energy consumption mechanisms can still lower the power consumption, which will directly affect the fossil fuel energy. The coal is the major source for electricity production, and used in the thermal units for power generation. The thermal power generators release the largest amount of the GHG in comparison with all other power generation sources and are the second most popular medium of power generation.

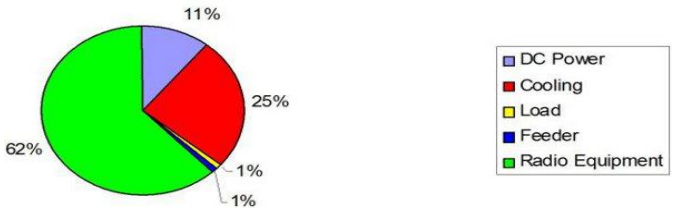

Figure 2: Percentage of the energy consumption of various functions on wireless BTS

Reducing the power consumption is not only done for the purpose of reducing the operating cost of the organizations, but it is also a corporate social responsibility. The reduction in the carbon emission will directly affect the climate and public health across the globe. The power consumption can be controlled using several methods. The energy efficient devices can be used for lower power consumption. Also the use of eco-friendly and renewable power generation sources can cut down the CO_2 release in the environment. Efficient power management, infrastructure sharing, use of eco-friendly renewable energy sources and cutting down carbon emission over the complete duration of the product lifecycle have been under intense consideration by telecom industry all over the world.

Even if ICT is the part of the carbon emission problem, it can also become the part of the power consumption controlling solution. There can be significant decrease in the GHG emission and the operating cost of the telecom industry by using the energy efficient techniques. This can also revive the telecom sector economy by raising the profits of such organizations. The machine to machine communication optimization, software process control, multimedia data dissemination, data center process optimization or several other techniques can be used to reduce the power consumption in the telecom industry to reduce the overall power consumption.

2. LITERATURE SURVEY

Kumar, Amit et. al. has worked on Life Cycle Assessment of Wireless BTS to reduce Carbon Footprints. Author analyzes how this impact on environment and how to reduce this impact by using Life cycle assessment (LCA). Carbon Credits give mechanism to reduce the carbon emissions. Rambabu A. Vatti et. al. has worked on throughput Improvement of Randomly Deployed Wireless Personal Area Networks. In this paper, the authors have proposed a solution to solve the problem of packet loss is due to over usage of the intermediate nodes. The authors have proposed a routing algorithm based on the remaining energy at the intermediate nodes. Remaining energy based adaptive multi-hop Algorithm (RAMA), which takes routing decisions based on the remaining energy at each of the neighboring nodes and adopts short distance multi hop communication to relay the data from source to sink node. S. S. Krishnan et. al. has proposed the energy consumption model in the Indian mobile communication sector. The authors have taken on the reduction of the carbon emission, specifically CO_2 emission reduction, by using the energy efficient mechanisms. The authors have segregated the telecom sector into various small segments, based on the network equipment lifecycle. The telecom sector has been also detailed for each segment's energy consumption and the carbon emission amount. This paper also evaluates the four scenario to examine the effect of the power consumption reduction techniques for their effectiveness and amount of CO_2 emissions. Amanna, Ashwin et. al. has worked on green communications. The developing countries have turned towards the wireless telecom to create the maximum network reach. The wired network costs are higher, which hinders the developing countries from implementing the wired telecom structure. Simultaneously, the industrialized world has developed an insatiable demand for broadband data delivered through their cellular handset. This meteoric rise in users and data demand alone does not create a crisis; however when one evaluates the communications ecosystem from a carbon footprint and energy cost perspective, the results are startling. Charaan, R. M. et. al. has worked on effective analysis on r-leach protocol for wireless sensor networks. To extend the lifetime of WSN the LEACH protocol is implemented by forming clusters for routing in a large scale network. LEACH protocol utilizes the technique of selecting the cluster head through random rotations of a local cluster to distribute evenly the energy load among the wireless -sensor network. In cluster communication distributed nodes transmit data packets to its cluster head through intermediate nodes.

3. PROBLEM FORMULATION

Green Telecommunication is the major factor in the telecom world in the current scenario. The carbon emission is rising every year, which is hurting the environmental structure by the release of the greenhouse gases and pollutant in the atmosphere which is rising the overall temperature around the world. This all leads towards the worst days ahead if not controlled at this stage. The major goal of the current pollution control policies

is measured by carbon footprints. The carbon footprints have to be lowered in order to lower the content of pollutants. In the proposed model, we are going to implement the proposed model of energy efficiency in the wireless networks in the Network Simulator – 2 (NS-2).

4. METHODOLOGY

At first stage, a detailed literature study would be conducted on the green telecommunications and life cycle assessment methods or architectures. In addition, the energy consumption problems and requirement analysis of green telecommunications in wireless networks would be thoroughly studied and developed. Literature study will lead us towards refining the structure of the proposed security solution design. Afterwards, the proposed solution will be implemented in NS-2 simulator and a thorough performance analysis would be performed. Obtained results would be analyzed and compared with the existing techniques.

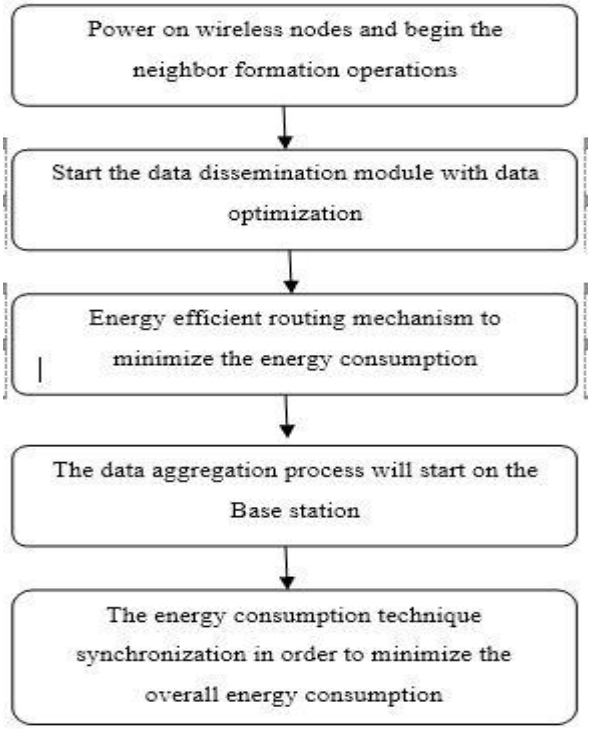

Figure 3 Flow chart

The process will start with the data optimization on the wireless nodes on the edge. These wireless nodes will ensure the minimum energy consumption by reducing the power consumption on the transmission and receive processes. The data optimization will also affect the routing process as the intermediate nodes will also need to put the lesser effort than the effort made to route the data without optimization. Hence, it can be said that the data optimization reduces the routing effort on all of the intermediate nodes in a wireless network. The BTS will start an energy efficient data aggregation process. The data aggregation process may include the encoding techniques which will work as a second layer of data optimization. The Figure 3 explains the workflow of the energy efficient wireless network.

5. CONCLUSION

The proposed work will be implemented in the NS-2 simulator using a standard topology. The proposed work will be entirely based upon the design of the data aggregation and packet optimization algorithms. The combination of latter two techniques would be used to reduce the power consumption at the source and intermediate nodes. The performance of the proposed model will be evaluated on the basis of various network performance and energy based parameters. The proposed work will be also evaluated in the terms of carbon footprints and release of the carbon amount in the environment.

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