A Review on Green Communications

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***Abstract*— Green communication aims at addressing the exploration of sustainability regarding environmental condition, energy efficiency and the communication purpose mainly on the mobile devices. Green communications is a duty to strengthen corporate responsibility towards the environment and motivate an ecological generation of network equipments and systems. The paper attempts to present latest research in green communications and networking for next-generation wired and direct and indirect impacts on the environment. Recent ideas of mobile technology involve the growth in number of equipment exploited every year which has initiated the need to innovate in the field of energy efficient communications.**

The paper presents literature survey on the protocols to improve energy efficiency in green communication networks. It elaborates the various aspects of analysis, design, distribution, and expansion of protocols, and architectures of green communications and networking.

Keywords- Green communication, CO2 emission, Mobile Devices.

I. INTRODUCTION

Today, the world of telecommunications and information communities is facing a big challenge, namely, the transmitted multimedia-rich data are exploding at an confound speed and secondly the total energy consumption by the communication and networking devices and the global CO2 emission is rapidly increasing.

It has been noted that ―presently 4% of the world-wide energy is consumed by the ICT (Information & Communications Technology) infrastructure that causes about 3% of the world-wide CO2 emissions, which when compared to the world-wide CO2 emissions by airplanes or one quarter of the world-wide CO2 emissions by other vehicles.

According to the recent research, more than half the global population is mobile subscribers. Assumption made by telecommunication market is that, for the next generation there will be an increase in subscribers, per subscriber's data rate, and the roll out of additional base stations in case of mobile networks . The roll of mobile networks is mainly focused on reducing the energy consumption of terminals, whose battery power imposes requirements in the same regard.

As a fact, recent ideas of mobile technology include the growth in number of equipment exploited every year which has initiated the need to innovate in the field of energy efficient communications.

To meet the requirements of subscribers, the number of base stations has been increased which led to the increase in data traffic.

This paper discusses the issue of energy efficiency and consumption in communications networks. The recent research of Ericsson, the report says that, the half of a mobile operator's operating expenses is equivalent to the costs of the energy. Therefore, telecommunications applications can have a direct, sustainable impact on lowering greenhouse gas emissions, power consumption, and energy-efficient wireless transmission techniques.

II WHAT IS GREEN COMMUNICATION?

Green communication is the practice of selecting energy efficient communications and networking technologies and products, minimizing resource used whenever possible in all branches of communication.

Information and communication technology (ICT) sector has experienced a prodigious growth in the number of mobile subscriptions over the last decade. Recent studies have shown that the number of global mobile subscriptions has increased exponentially from 500 million subscriptions in 2000 to 5 billion subscriptions in 2012. And tend to reach global penetration of 100% after 2020.

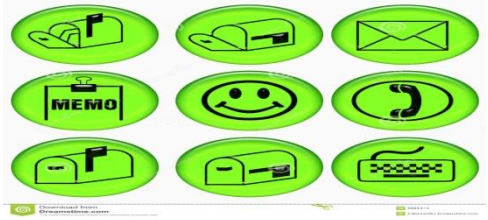

Fig. 1. Green Communication

A. Types of Environmental Impacts

A lot of terms are been used while discussing green technologies and are often used and misused. The carbon emissions currently receive most attention due to the problem of global warming and the change in climate. When considering the environmental friendly solution, air pollution, water pollution and soil quality, protection of the ozone layer, use of natural resources, waste reduction etc. have to be considered as main impact.

Telecommunications equipment typically contains a considerable amount of scarce materials and heavy metals. The biggest challenge is to extract these materials through mining and treatment of the waste is the main challenge on environment. From this method the amount of waste produced with and without material can be derived.

We observe that the recycling is 93kg while without recycling 12 kg of useful material for the computer results in 500 kg of mining waste. In order to have a complete view of the environmental impact of a product, all five stages should be considered, mainly material extraction, production, use, transport and end-of-life.

The subject of energy consumption, the material used in information and communication technology which relates to the carbon emissions need to be considered as well. While discussing about the same, we have to consider greenhouse gas emission which includes the Kyoto protocol such as methane (CH4), nitrous oxide (N2O), carbon dioxide (CO2), PFCs, HFCs and sulfur hexafluoride (SF6).These Green house gases have a different global warming potential (GWP) considered for a hundred years horizon. These GWPs are mainly relevant to the GWP of carbon dioxide in CO2 equivalent.

CO2 emissions are mainly associated with off-grid sites that provide coverage for remote areas. Most such sites are powered by diesel-power generators. The greenhouse gas emissions for nuclear power are very low and nuclear power has other impacts on environment such as the treatment of nuclear waste.

B. Direct and Indirect Impacts:

When analyzing the direct and indirect impacts environmental friendly solutions are to be considered. For example, implementing a solution which reduces the energy consumption of a service results in a direct impact. Indirect impacts of solutions are related to the wider concepts of the adoption of the solution. The existence of the email replaced letter writing, issues of transport, paper usage etc. Indirect impact reduction typically limits the environmental issues. Since the variations in the political, financial, informational factors are dependent on these, those reductions are typically harder to predict. Increasing efficiency is the main strategy in limiting environmental impacts. If we consider the adoption of email, one could state that by replacing every letter sent by an email we are largely reducing the impact of those letters. This case demonstrates that initializing the indirect environmental impacts of solutions is a difficult task which has to be carried out with great care. [1]

C. Mobile Devices

Presently various mobile communication devices, such as smart phones, smart watches, personal wearable communication devices, health care devices and smart glasses have taken us toward the era of smart society. With the rapid development of wireless communication technology, the lack of co-operation among mobile nodes not only affects the quality of communication, but also results in the unbalance of resource utilization, which increases the unnecessary energy consumption of mobile devices.

The categories of accessing the networks can be broadly divided into 3 types mainly, regular mobile phones, laptops and smart phones. Recent research states that the operation is estimated to 1.5 kWh per year based on charging every 50th hour equal to 30 percent of battery capacity every day and a standby scenario of 40 percent of the remaining time. Green communication among mobile and networks such as information sharing, spectrum of energy awareness, routing adaptation and data caching enables providing potential benefits for optimizing and balancing the resource usage and saves the energy of entirely mobile and wireless networks, therefore green communication becomes the utmost important and promising research topic for future mobile networks. The aim of the special issue is to motivate researches to publish their latest research up-to-date issues and challenges in the field of green communication for mobile devices. [1][2]

D. Carbon Footprint Models and Assumptions:

Taking into account of mobile networks which includes equipments of user, using networks, programs of business of subscribers operating the networks and the implementation of sustainable networks which is as the result of data traffic implemented by the mobile subscribers.

The carbon footprint model which is used for mobile communications can be divided into five kinds:

1) Production of mobiles which is equivalent to the production including low-cost mobiles, Smartphone's, and systems, on prompt sales in the year and covering all operators newly initiated that year.
2) Mobile devices operation is to charge the batteries and standby efficiency of charges left plugged in for all mobile phones and systems. In this case grid operation for systems, extra monitors and other operators are included.
3) RAN sites operation which includes the efficiency in case of electricity of base station sites, control sites and core sites.
4) Operator activities include office operations, stores activities, operations in vehicle fleet, and business travel operation related to all users business activities.
5) Mobile network users generate the data centers and transport. That is mobile network users generate the allocation of other networks. [2]

E. Radio Access Networks:

The structures of the carbon footprint of site manufacturing and construction for the radio access network (RAN) are depend on a complete Life cycle analysis of network equipments. The amount of RAN electricity consumption in 2007 was about 20kwh. Recent research gives us the idea about construction of new sites and removal of old site equipment. From the survey it is noted that on an average there is ten percent decrease of new base station when compared to previous year. Base station model could be seen as the mix of product which is installed. We predict that until 2020, the trend continues as eight percent per year over the period of study and referred as continuous progress. Under the assumption and taking into consideration installation of new and removal of old equipment each year, the global average of base station site power amounts to about 1.8 kW in the year 2007 and reduces to about 1.2 kW in 2020. The study assumes a roll-out model assuming between 600,000 and 675,000 sites newly deployed and up to 300,000 sites taken out of service each year. [1]

F. Energy Efficiency Metrics

Energy efficiency metrics provide information that can be used to assess and compare the energy consumption of various components of a cellular network and of the network as a whole. These metrics also help us to set long-term research goals for reducing energy consumption. With the increase in research activities pertaining to green

communication and due to the intrinsic differences and relevance of various communication systems and performance measures, it is difficult for one single metric to suffice.

While the definitions of energy efficiency metrics at the component and equipment levels are fairly straightforward, it is more challenging to define energy efficiency metrics at the system or network level. Network level metrics assess energy efficiency at the network level by considering the features and properties of the capacity and coverage of the network.

The goals associated with green cellular networks:

- Improvement of energy efficiency.
- Improvement of the intelligence of the network through tradeoffs between energy consumption and external conditions, that is, traffic loads.
- Integration of the network infrastructure and network services to enable the network to be more responsive and to require less power to operate.
- Reduced carbon emissions.[2][3]

III. CONCLUSION

This paper presents an overview of energy consumption problems in green communication networks and describes network energy saving techniques. It is identified that the common energy consumption problem green communication networks and describes the techniques that have been used to improve the energy efficiency of these network. This problem can be solved solutions from the time and frequency domains. The energy saving problem cross multiple systems or networks is less understood. More efforts are needed from the modeling to particular solutions. Radio access networks are also included in this paper. Other important issues include the variation of mobile operator coverage and the types of services from one area to another.

As communication networks experience exponential growth worldwide, it is important to make high priority in the design and development of wireless access networks.

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