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Review Article

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The Carbon Footprint of a Telecom Network Measured using Nuclear Energy Science Framework

S Parthasarathy [1*], Abolfazl Mehbodniya[2], C Bazil Wilfred[3] S Suprakash [4], D Vijendra Babu [5] and K Kousalya [6]

[1]Department of Computer Science and Engineering, SRM Valliammai Engineering College, SRM Nagar, Kattankulathur, Tamil Nadu, India

[2]Department of Electronics and Communications Engineering, Kuwait College of Science and Technology (KCST), Doha Area, Kuwait, Middle East

[3] Department of Mathematics, Karunya Institute of Technology and Sciences, Coimbatore, Tamil Nadu, India

[4] Department of Information Technology, Kalaslingam Academy of Research and and Education, Anand Nagar, Krishnakoli , India

[5] Department of Electronics and Communcations Engineering, Aarupadai Veedu Inistitute of Technology, Paiyanoor, Tamil Nadu, India

[6] Department of Computer Science and Engineering, Kongu Engineering College, Perundurai, Tamil Nadu, India

[*]**Corresponding author:** Parthasarathy S, Assistant Professor, Department of Computer Science and Engineering, SRM Valliammai Engineering College, SRM Nagar, Kattankulathur, Tamil Nadu,India E-mail: parthasarathys0667@gmail.com

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Abstract

The article describes the development of the sustainable telecoms network and provides data on the environmental impact of the system. An article is devoted to discussing the approach of utilizing the green telecommunications layer foundation to estimate the ecological footprint of telecommunications infrastructure. The approach helps to bridge the gap among greenhouse gas management and mitigation (GHG). The goal is to construct readers to the current green telex and highlight the need for communication and information technology for quality and integrity. This article gives an extensive reference to a rising pool of academics who might work quickly on the nuclear energy of network infrastructures.

Keywords: Telecommunication; Environmental impact; Structured framework; Nuclear energy

Introduction

Early, the increase in global average temperature has now become a worldwide issue but is today regarded as among the key issues facing mankind. The globe has become a significant issue for the deterioration of mineral wealth, ecology, and climatic changes [1]. The global temperature has increased from 2 to C and will grow to 6 to C, with CO2 levels doubling over a 40-100 year period at IPCC [2] as technological advancement raises the world's need for energy-oriented solutions, and as affordable alternatives to fossil energy fuels remain unavailable. It is said to get an environmentally sustainable or greener image with the vast and wide adoption of ICT in many areas of society. This is because contemporary telecommunications alter our societies by replacing travel and transit. For example teleconferencing, teleconference, etc., online distribution, and other channels to mitigate human-environmental consequences. Virtual events that incorporate trip audio and video conferences might cut CO2 emissions by approximately 24 thousand tonnes annually [3].

The use of ICT has expanded worldwide at a nearly exponential rate [4]. By 2015, cell phone traffic is projected to increase by more than eight times from 56 MB/month to 455 MB/month [5]. By 2020, about 80% of families will have internet connections with their mobile phones by Singh [6] and one in 20 houses will be owned.

The continuously growing needs for communications services have not only greatly increased power consumption and are environmentally friendly in the latest days. The problem of the telecommunications industry's increased environmental impact is but also forcing phone companies and suppliers to spend less on electricity and squeeze more performance from their systems. As a result, telecommunications suppliers will need to decide subtly to invest billions in clean energy optimizing technology and to provide them with just enough innovation to please their consumers as well as their bases [7].

The telecommunications business may not be the most major energy industry in terms of global provides access to the charcoal, steel, and iron non-ferrous metal industries [1]. Although the telecoms sector is fairly power light, the communication protocols continue mostly to be driven by fossilized fuels, which is why energy prices constitute a considerable part of opex. Energy expenditures contribute to as much as 50% of the operational costs of a phone company in certain telecommunications areas [8].

As of today, technical advances in the telecommunications sector have mainly met the service quality (QOS) and consumer capability requirements. About 12,000 new base stations serve about 400 million new mobile users worldwide each year [9]. This rising economy needs a growing quantity of electricity that raises the telecom industry's power consumption basis. The energy usage of telecommunications networks is therefore questionable and an electricity telecom solution is essential to create in Figure 1.

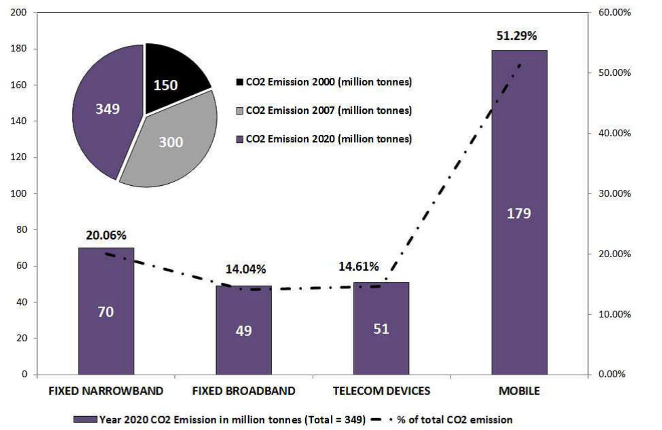

Figure 1: Carbon footprint (2000) and expected CO (2020).

The remaining paper is arranged accordingly. The environmental emission and electricity generation trends in ICT are shown in section II. The green-purpose layout framework to discover the carbon footprint of communication systems is provided in section III in detail. The final portion ends with a paper describing future themes in the study.

CO and Energy Utilization

ICT may play both good and harmful roles with new emerging technologies and techniques. So it is multidimensional for the interaction between ICT and the environment [10]. Since the first computer was sold [11], time, space, energy consumption for ICT services have been reduced by three orders. Nevertheless, a large number of telecommunication services, both in the network infrastructure and the network architecture, will need to expand to address the rapid rise in information and telecommunication use. Continuing effective energy technological advances are thought to minimize energy usage and offer a strategic advantage [12]. However, the environmental cost for the telecommunications sector has considerably increased as a result of the increased inventory of ICT equipment and communications infrastructure to deliver intermittent 24*7 services and will grow due to the development of efficient energy technology [13].

It is estimated that about 1% of the carbon dioxide emissions are accountable to the ICT industry worldwide [14]. Global emission increases in telecommunications have grown from 150 million tonnes of CO2 equivalents in 2002 to 25 million tons in 2007 and are anticipated to rise 348 million metric tonnes, as illustrated. This includes computers, computers, air cooling, static and wireless phone equipment, and networking, LAN, and workplace connections. The above elements of ICT and associated environmental impact contribution in the ICT industry are illustrated in Figure 2. By 2020, about 2% of global carbon emissions are projected by ICT. The amount of fiber connection, accounts is forecast to stay fairly stable, while both the internet accounts are forecast to almost double the throughout that timeframe, according to the current trends in emerging concepts and devices [15]. The telecoms network includes the Radio Access Network (RAN), improve the process, network infrastructure, the aggregation, electricity grid and fiber to the channel, etc., as well as components that contribute to the carbon footprint. The power usage ratio is illustrated throughout the communication protocols. The is a base sector uses around 59% of the power on the net among the mobile network parts, whereas the cable modem center accounts for about 21% and the central transmitter for some 19% (Figure 2).

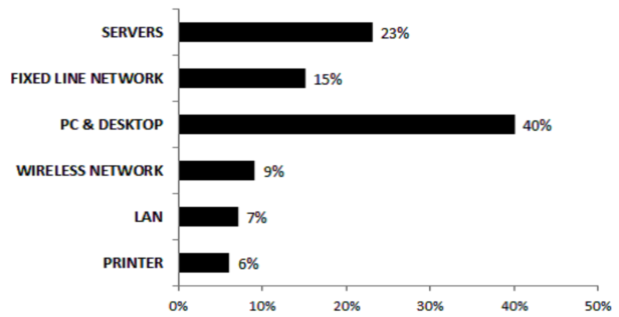

Figure 2: ICT on carbon emission.

RAN: BTS utilizes about 59% of its capacity alone, while in core around 21% of its capacity is used by MSC, while the main transmission consumes approximately 18%. The main reason for the expansion of telecommunications infrastructure's carbon footprint is due to a growth in BTS and MSC numbers. The expansion of telecom and spread of mobile phones, as well as new apps, such as live streaming, games, and other peer-to-peer material sharing [5], is also the reason why these projects have expanded as shown in Figure 3. When people are appointed to a huge mobile global market, fewer basic stations are used and maintained by the provider [10].

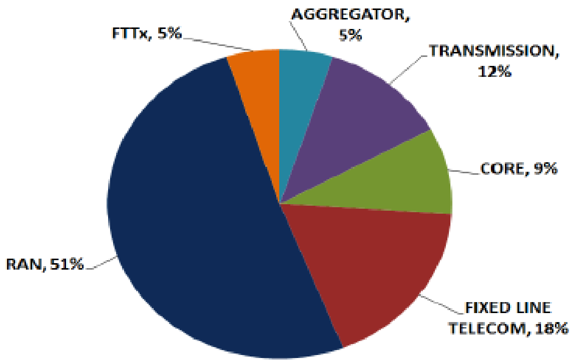

Figure 3: Power distribution of consumption at various components of telecommunication system.

Calculation of Carbon in Telecommunication

Green telecom is a much-debated subject in and beyond the telecommunications sector. However, there are nonetheless not enough standards which have also made it hard to assess its efficiency or scope. From time to time, optimized power consumption might enhance energy consumption in one section of a system and impair efficiency in another portion of that network [16]. Order to effectively manage a system and using it greenly is a hard undertaking. The telecommunications sector has therefore understood that the next stage of its growth depends on green technology innovativeness and that the connection of efficiency gains to money is quite near. The confluence of the increased energy prices and our strong connection and data propensity will have a huge impact on the environment unless a coordinated strategy [17] addresses them. That is why service providers and businesses pay increasing emphasis to and ultimately seek to reduce their energy use.

An overview of the telecom's network infrastructure is given by a green telecom layered framework. The network element, thermo acoustic and data centers, as seen in Figure 4, are split into three layers. The network component is the initial level. The network control and the access network may be largely split into two structural capitals. A core network delivers a range of services to consumers and ends users as the key elements of a telecommunications network. The network architecture refers primarily to the core network of the telephone system, particularly connects bigger towns and stretches throughout the country and across the continent [18].

Usually, the central system was based on data transmission and has an enormous volume of traffic. A telecoms system enables users to their proximate suppliers of services and the main network. The access point is the "last mile" of a telecommunications device that supports the regional telecoms office (CO) to end-users. It includes the bulk of the telecommunications network. It is also a large energy user since a large number of available components are present [19, 20]. Critical infrastructure is the second stage. The fundamental basic infrastructure is utilized extensively with communication systems at the center including with network infrastructure [21] (Figure 4).

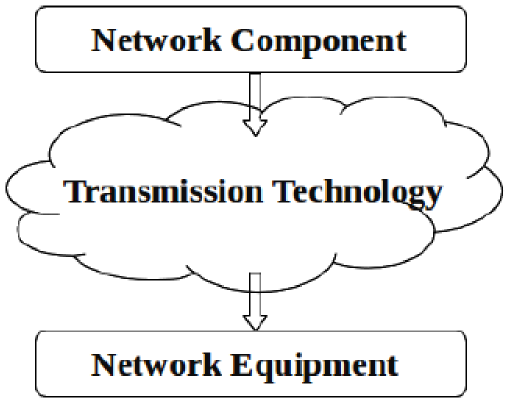

Figure 4: Environmental sustainability three-layer architecture.

The ultimate level is indicated by the phrase networking gear. The sustainable telecommunication layer architecture. The network level (equipment level) is composed of equipment/software parts as well as of the telecommunication system level, the major level where the energy consumption is examined.

As an example in Figure 5, seriously remember an IP *via* WDM. The WDM is the transportation system that multiplies optical transmission signals on one optical cable. For mixing several optical message signals in a particular screen, a WDM transport system employs a multiplex at the transmission side, as well as the de-multiplexer only at the receiving end to separate them. The preamplifier, as well as the voltage amplifier, are being used to enhance the strength of the electronic fiber to improve the receptor sensitivity and adjust correspondingly for the voltage drop.

In switch stages as well as in networked devices, the energy demand of WDM transit system elements may be identified. Digital Cross Connect (DXC), routers or switches and optic pass are key energy-saving elements at the switch stage (OXC). The broadcast phase comprises multiplex, demodulator, transponder, post, and voltage amplifier elements that are the most important power using components [18].

The single step that connects a gap across reduction and preparedness is assessment. But in many situations, the right way to calculate carbon emissions from the telephone system is not the issue. Although organizations' carbon emissions and energy consumption are unable to measure their telecom directly, they frequently know that the energy consumption is too high, and if feasible, should be lowered [22]. Consequently, it is crucial for green telecoms operations early to choose the proper approach to evaluate the environmental impact of the communication system. The networking device's carbon footprint, named "mobile communications infra" is dependent both on the fault injection layer and the transmitting technique level electricity consumption. The computation of the carbon footprint may be separated into two components, dependent on the functioning of the telecommunications network equipment.

PTE is the networking entity's total power usage and includes the infrastructure needed for ventilators as well as other air cooling, etc. (in KW). The PCO was its thermal power required for the current implementation (KW) of the network gear and the PNE is the routing problems (KW) operating energy of formula [23].

PTE =PNE+PCO

PAVG has the power output and PSLEEP has the highest power of both the machinery (in KW), while in a sleep state. PAVG is the highest power (in KW). The ICT devices are operated at ambient temperature.

The emissions of carbon EG during network operating utilizing grid electricity must be indicated by

Eg =0.3*PTE*ECO*HC (1)

Where ECO: carbon emission factor and HG: Mean grid power/day (Figure 5).

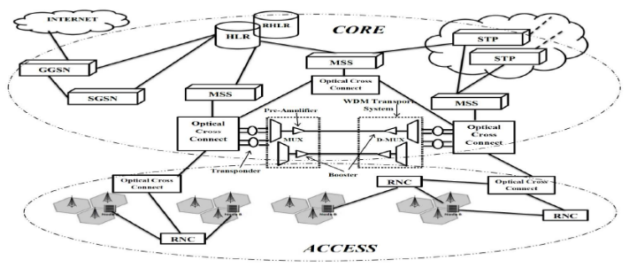

Figure 5: Telecom network hierarchy.

In rural locations that have just a few hours of available power production a day, vendors usually rely on ineffective power plants that increase the carbon footprint in the communications industry substantially. This indicates a power supply of 11 kilowatt hours per liter of diesel. The fuel electricity is 46 mega joules per kilogram or 39 mega joules per liter [24]. One liter of diesel is generating 2.7 kg of carbon dioxide and 0.3 kg of CO2 is consequently created in one liter per kilowatt.

May PDG be the capability of a DG set (kilovolt ampere), which is powered by a DG set every day for the HDG average amount of an hourly system component. Mostly during the functioning of the network element, total carbon emissions EDG (in tonnes per year) *via* DG sets

EDG = (-.09*PDG*N*HDC) (2)

Where N:quantity of diesel (in ltrs) for 1 hour; η:efficiency of DG.

Machinery for the telecommunications network may be estimated using the carbon pollution ET in tonnes annually, plus (1) and (2). Table 1 and Table 2 illustrate the computation of carbon emissions for private and public main networks, using the aforesaid technique.

ET=EG+EDG

Rural				
Carbon emission calculation (GRID power)				Total Carbon Emission (in tonnes)
Average power consumption of network	Average grid power supply (hours)	Carbon emission factor (Kg/KWH)	Emission (in tonnes)	

element (KW)				
1.76	13	0.523	4.3677	
Carbon emission calculation (DG Set Power)				
DG set capacity (KVA)	Average DG set power supply (hours)	Liters of diesel consumed (per hour)	Emission (in tonnes)	
15	11	2.5	29.634	34.0017

Table 1: Carbon emission calculation for rural regions.

Urban				
Carbon emission calculation (GRID power)				Total carbon emission (in tonnes)
Average power consumption of network element (KW)	Average grid power supply (hours)	Carbon emission factor (Kg/ KWH)	Emission (in tonnes)	
3.125	21	0.84	20.12	
Carbon emission calculation (DG Set Power)				
DG set capacity (KVA)	Average DG set power supply (hours)	Liters Of diesel consumed (per hour)	Emission (in tonnes)	
15	3	2.5	8.082	28.202

Table 2: Carbon emission for urban regions.

Conclusion

The modern situation is extremely complex and hard; the globally growing need for computing, data communication technologies drives the rapid expansion of telecommunications and increases emissions from enhanced technology. As phone companies and suppliers try their utmost to reach power networks, companies must discover alternative options of non-nuclear power, like gasoline, that the communications system is extensively utilized today. But it appears impossible to translate that achievement into the advancement of ecological sustainability owing to the unavailability of adequate concepts. To calculate carbon footprint emissions dependent on energy usage at the base of a telecommunications infrastructure, the green communication layer model defines visibility into multiple levels of telecom networks. Effective measurement of the environmental impact ought to be the responsibility of corporations that opens the way for network management by decreasing the amount of power required to operate the network while sacrificing capacity. The proposed nuclear power generation is for reducing the efficiency of the system impact.

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