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Power Consumption and Optimization of Energy Consumption for Telecom Towers in India

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Abstract

In this paper, the work consists of categorizing telecommunication Base Stations (BTS) for INDIA and their power consumption. It also proposes some parameters for saving of energy. Telecom sector is the second largest consumer of energy after transportation and base stations are responsible for the large amount of energy consumed in cellular networks. According to the data provided by Minister of State for Communications and IT Milind Deora, India has total 7,36,654 base transceiver stations (BTS -2G GSM and CDMA & 3G Mobile Towers) while out of that only 96,212 BTSs have been installed to provide 3G mobile and data services[1]. These telecom towers that require about 12-14 billion units of electrical energy [2] and energy consumption per tower will further increase with green field tower roll outs and increase in BTS tenancies. On average, 70% of the new towers to be constructed every year would be in the rural areas where grid power is not the primary source of energy. Further, over 300,000 new BTS will be required in the rural market over next 4-5 years.

Keywords

BTS (Base Transceiver Station), GSM(), CDMA (), Wi-Fi(), Li-Fi, UE(user equipment),Transceiver (TRX), Power amplifier (PA), Baseband receiver unit (BBxx):

I. Introduction

A base Transceiver Station (BTS) is a piece of equipment that facilitates wireless communication between user equipment (UE) and a network. UEs are devices like mobile networks (handsets), wireless local loop phones, computers with wireless connectivity. The network can be that of any of the wireless communication technologies like GSM, CDMA, Wireless local loop, Wi-Fi, Li-Fi or other WAN technology.

II. Installation of BTS

In order to cope with the development of the world, the requirements in telecommunication will continuously increase. In order to allow a vast and rapid communication (i.e., to maximize the range of signals and the extent of the telephone and broadcast coverage), telecommunication and broadcast companies (namely, Airtel, Idea, Reliance Communications, Tata communications, MTNL, TTML, BSNL, Vodafone India with its transmitters, and other broadcast channels) proceeded with the installation of pieces of equipment of telecommunications in several rural and urban areas in India, on the mountains and the buildings. These installations require a reliable electric power supply being without interruption.

But Unreliable electrical grid supply and as many areas are electrically isolated because they are not supplied by the interconnected electrical networks is one of the biggest challenges faced by the rapidly growing telecom tower industry in India. Today, on average, 70 percent of the approximately 400,000 mobile towers in India face electrical grid outages in excess of 8 hours a day. Telecom tower operators currently use diesel generators, batteries, and a variety of power management equipment to address the demand-supply gap. The resulting energy costs alone account for 25 percent of the total network operating costs, affecting the profitability of the operators[3].

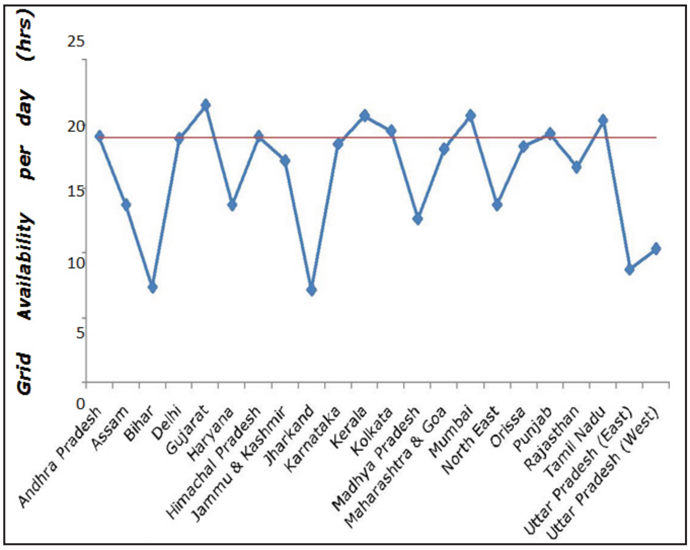

Fig. 1:

III. Telecom Site Operating Conditions

When the power from the electrical grid is available, the Power Interface Unit (PIU) selects the best phase of the 3 phase electrical grid and provides power to the rectifier or switched mode power supply (SMPS). The SMPS converts the 220 VAC to -48 VDC (in some cases to 24 VDC) providing power to the telecom tower equipment and additionally, to charge the batteries.

When the power from the grid is interrupted, the PIU sends a signal to the diesel generator to turn on and the diesel generator comes on line in a few minutes. It supports the entire power requirement at the site. During the transition of supply from the electricity grid to the diesel generator, the batteries provide the power required by the telecommunication equipment at the tower and ensure uninterrupted.

IV. Power Consumption of Base Station

Case study: 3 BTS Site with 12 hours of electrical grid supply [4]

The scenario in this case study is of a 3 BTS outdoor telecom tower site. The site includes a 10kVA diesel generator and a 48V, 600Ahr battery bank. The average electrical power demand of the site is 2.52 kW. On average, electrical grid power is available for 12 hours a day only. The information included in Exhibit 3 forms the basis for the calculation of energy costs. This information was derived from surveys of telecom tower sites and dealers of products used in providing power to the telecom tower sites.

And these case study reflects that, the increase in the number of base stations by the telephone and audiovisual companies not only increase in the global energy consumption but also the energy costs, which has a drastic impact on global warming

Number of BTS		3
Average power demand from the site	kW	2.52
Electrical grid		
Unit cost of electricity	INR/kWhr	6
Diesel generator data		
Average DG run hour per day	hrs/day	8
Size of diesel generator	kVA	10
Landed cost of diesel generator	INR	2,00,000
Average diesel consumption for 2.52 kW	lph	1.8
Cost of diesel	INR/L	45
Delivery cost of diesel to site	INR/L	2
Battery bank data		
Battery bank capacity at 48 VDC	Ahr	600
Landed cost of battery bank	INR	1,44,000
Battery run hours	hrs/day	4
SMPS and PIU data		
Landed cost of PIU	INR	1,00,000
Landed cost of SMPS	INR	50,000

Direct Cost of Energy per day		
Cost of unit of grid energy	INR/KWhr	6
Grid energy consumed per day	kWhr	29
Cost of grid energy	INR/day	177
Diesel consumption per day	lpd	14
Total cost of diesel	INR/day	677
Total direct energy cost per day	**INR/day**	**854**

Traffic Count Receiver

V. Approaches to Save Energy

A BTS in general has the following parts: Transceiver (TRX), Power Amplifier (PA), Combiner, Duplexer, Antenna, Alarm extension system, Control function, Baseband receiver unit (BBxx) and all the parts consume some portion of energy as shown in the below figure.

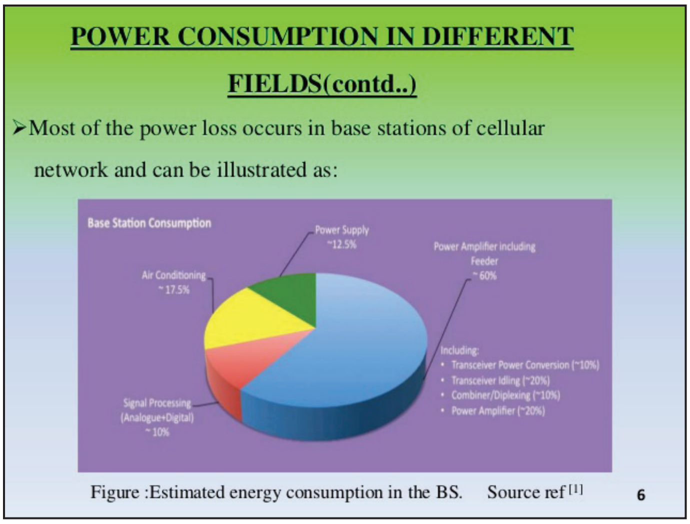

Fig. 2:

And among all the largest energy consumer in base stations is the radiofrequency equipment (power amplifier plus the transceivers and cables), which consumes approximately 65% of the total energy. Among the other components of the base station, the important energy consumers are air conditioning (17.5%), digital signal processor (10%), and the AC/DC converter (7.5%) [5]. Therefore the radio operator equipment (the module of digital signal processing, the power amplifiers of transceivers, the radio frequencies, and connecting wires) and the systems of air cooling are the large-scale consumers of energy in telecommunication base stations. Emphasis must thus be laid on these components to reduce the total energy consumption of base stations.
To optimize energy consumption in a telecommunication base station, we answer three principal questions: optimization of energy consumption of BTS (base transceiver stations), energy optimization of the site sheltering the BTS (base transceiver stations), and the energy optimization of the network and radio frequency connection.

VI. Power Optimization Consumption of BTS

Research is focused on several components of the BTS to improve their energy efficiency. Research is more focused on the amelioration of the linearization and energy efficiency of the power amplifier. The energy efficiency can be improved by using an especially designed power amplifier containing special materials for the transistors of the power amplifier, like materials of high frequency such as Si, GaAs[6]. The power consumption of the digital signal processor can be reduced by using, for example, integrated circuits architectures like ASIC, FPGA, or DSP which are combined to obtain a better efficiency.
Energy savings in a base station can also be obtained by putting into place the distributed architecture of a base station, where the radio frequency equipment is placed near the antenna in order to minimize losses in cables, moreover improving energy efficiency of hardware components, turning off components selectively, planning and deploying heterogeneous cells, adopting renewable energy resources The possibilities to use renewable energies such as photovoltaic panels and wind energy on the sites of base stations are under study. By combining these two sources of renewable energies, one can reduce the potential of power consumption cost of a base station by 50%.

VII. Conclusion

This type of traffic management system not only clears the congestion effectively but also improves the quality of life and provides a cleaner environment. However, the increased traffic day by day on the roads calls for systems that has the potential to take quick decisions and ensure smoother flow of traffic. The use of embedded devices with "in-built intelligence" can ensure the growing demands of traffic management in cities across the globe.

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