Various Techniques used in Wireless Mobile Communication Network for Energy optimization

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Abstract **-** Due to rapid growth of high data rate application, energy consumption is also more in wireless mobile networks to assure the quality of network. Various energy efficient techniques are used so as to limit the use of energy resources such as fuel and these techniques have no bad impact on environment. Reducing power consumption is the major issue in wireless mobile networks. In this paper, we discuss various techniques implemented in base transceiver station to optimize the energy by using renewable resources such as solar energy, wind energy, use of repeaters and sleep scheduling to achieve environment sustainability.

Keywords **-** *Mobile communication network, Energy optimization techniques in BTS, Solar energy, Wind energy, Green antenna, Sleep scheduling.*

I. INTRODUCTION

The consumption of electrical energy has increased all over the world due to its several advantages. Due to limited no of fossil fuels and their bad effect on environment conclude that it is mandatory for the researchers to have alternative energy sources. The alternative energy source is basically a power source which uses wind energy, solar energy, geothermal and hydropower etc. except fossil fuels generally defined as any power source that is not based on fossil fuels or various nuclear reactions used for power generation. The advantages of using renewable energy sources are that they are pollution free, unlimited and easily available. The wind power and solar power has been among the rising sources of energy in the developed countries. Now a day's energy saving is the major issue for Indian telecom industry. In rural areas the energy consumption contributes to 70% of the total network and in urban areas, the energy cost for network operation ranges between 15-30%. To improve network operation and to reduce energy costs, telecom industry has to evaluate all alternative resources of energy due to rising prices of diesel. To optimize the cost of energy many efforts have been made such as air eliminating on site air conditioning by converting indoor base transceiver stations to outdoor ones, using energy efficient techniques and also to power up sites, clean energy sources are used. Clean energy technologies such as solar photovoltaic, wind turbines, biomass power and fuel cells are various clean energy technologies [1]. Sleep scheduling is also a technique used to optimize the energy in telecom sites, is basically turning off the base station when congestion on the network is low. Green antenna in telecom industry is used to decrease the transmitted power by using a green antenna between mobile station and transceiver base station. The objective of this paper is to provide a broad outline on various techniques used for energy optimization and to achieve sustainability in the mobile wireless communication network [2].

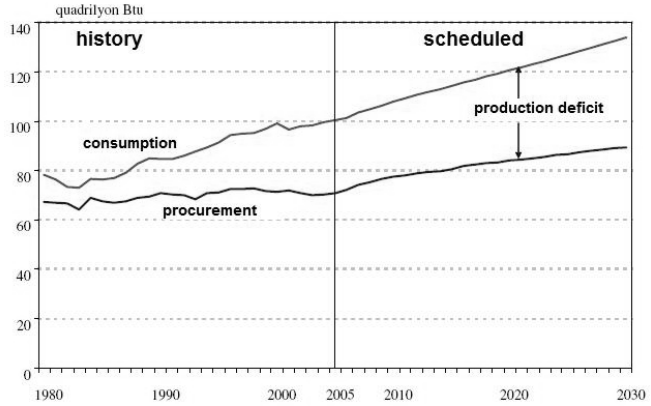

Fig. 1. World Energy Production/ Consumption profile [3]

II. BRIEF LITERATURE SURVEY

Amit Kumar, Dr. Yunfei Liu , et.al. (2011) discussed that rapid growth in information and communication technology industry is the one of the major sources energy consumption. Due to increase in the density of base stations of 4G networks, energy consumption by telecom industry is expected to increase. Power management is a major issue in wireless networks. Reducing energy consumption of wireless networks is considered very important for the future. This paper particularly discuss some important techniques like sleep scheduling, power saving algorithms for dynamic base stations, indoor distributed antenna systems, femtocells and Renewable Energy Resources like photovoltaic cells, wind turbines and hybrid systems for energy optimization and sustainability in wireless mobile networks [2].

Bimal Acharya, Animesh Dutta (2013) discussed the various challenges to provide reliable mobile service at a remote location where sufficient power supply is not available. The main reason of poor service is transmission losses and power supplies. This paper basically presents a solution of using hybrid of solar and wind power systems to

provide sufficient power for a mobile base station with a portable generator.. The power consumption by mobile base station depends up on the congestion in the network. Battery bank consists of series and parallel connections are used for storage purpose [4].

Amit Kumar, Dr. Yunfei Liu, et.al. (2010) Due to increasing demand of energy will leads to grow up the area of technology day by day. It also causes a bad impact on environment and also increases the cost. ICT (information and communication technology) industry is the one of the major sources of world energy consumption. In fact ICT industry ranks among the top energy consumers, with 2% to 10% energy consumption in the world. This paper basically discusses the various optimization techniques to achieve environmental sustainability. The alternative sources which are used for power generation in wireless networks are wind energy, solar energy .the purpose of using these sources is just to achieve environmental sustainability [5].

Ezri, D., Shilo, S. (2009) discussed that now a day's cell phones becomes an essential part of the life and one cannot imagine communication without cellular networks. However the radiation emitted from cellular network badly affect the health of its users which leads to a growing concern. This paper suggests a new infrastructure for cellular networks so the emission of radiation from mobile station can be reduced. The new architecture consist of Green Cellular, antenna with transceiver base station design and suggest the Green Cellular architecture on 3G and 4G cellular technologies. It reduces the transmitted power and the radiation emitted from mobile station. This is achieved without exposing the user to any additional radiation source [6].

III. PROBLEM FORMULATION

As the technology is growing day by day, so to reduce energy consumption is also a big problem. It is not only saves money but also helps in achieving environmental sustainability. The primary objective of energy management in wireless networks is to use such an efficient techniques having low cost and not having bad impact on environment. In this paper various energy optimization techniques are discussed like wind, solar energy used for power generation instead of using diesel generator that reduces the cost. Sleep scheduling and the green antenna is used to reduce the energy consumption of base transceiver station [7].

IV. VARIOUS TECHNIQUES FOR ENERGY MANAGEMENT IN BTS

A. Solar energy

In India the annual global solar radiation is about 5 KWh/ sqm per day with about 2300-3200 sun-shine hours per year. Solar energy or sun rays are the richest source of energy on the earth. The constant source of solar energy provides limitless supply and also having no bad effect on environment. The solar photovoltaic cells give us electrical energy in the form of direct current. It basically converts the solar energy into electricity and it also solves the problems of energy management. It is suitable for many applications and also it is environment friendly in nature which makes it an attractive option to enhancement the energy supply from various another sources. Solar power is the one of the important source of energy foe rural areas. The amount of energy produced by solar is depends upon the lengths of the sunshine hours. According to NASA, many developing countries are located in this sunlight rich region. So we use photovoltaic cell for generating electrical energy from radiation or sun rays. Numbers of solar panels are used in series to generate electricity. The efficiency of the PV technology depends on the type of material used. Mono-crystalline silicon, polycrystalline silicon are most commonly used material for manufacturing the solar cells [8].

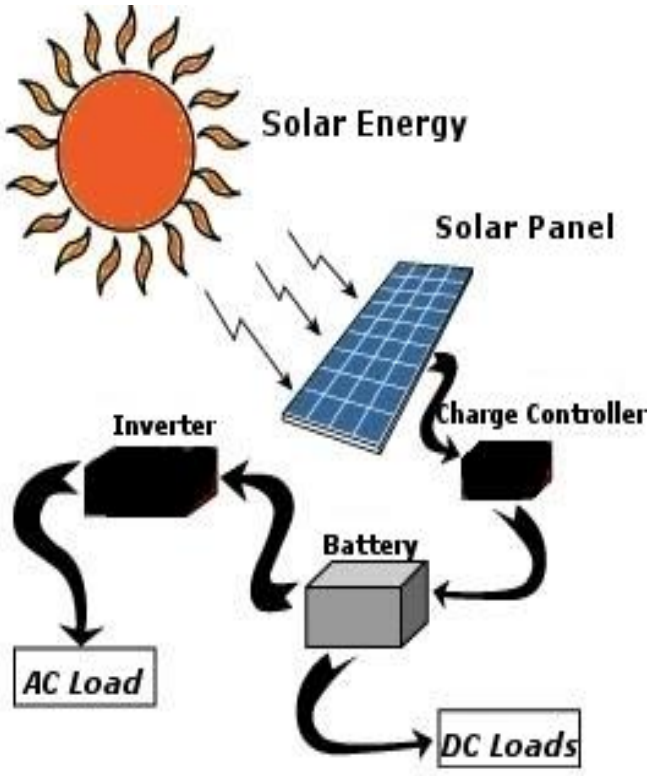

Fig. 2. Generation of Solar energy [9]
Source: http://www.bharatsolarenergy.com

B. Wind energy

Wind energy is also another option for energy generation. For the generation of energy using wind turbine and for such optimal operation wind turbine is designed at wind speed of 10-14 m/s. The Turbine Generator starts at a cut-in speed of 3-3.5 m/s and generates power at speeds 4.5 m/s and above. The annual national average wind speed considered is 5-6 m/s.

Wind generators can be mounted on tower at a height of 15-20 mt. with suitable modification in tower design and also considering the various effects of EMI & EMC.Wind is produced by various factors like sun heating, the atmosphere and the rotation of the earth. The wind is gathered by the wind turbines for the purpose of generating electricity. There are various factors that affect to the power gained from windmills. The power calculation of a wind mill is obtained by using eqs.1, 2 and 3.

Where

$$P_w = \frac{1}{2}\rho A V^3 \quad (1)$$

$$P_{max} = 0.59 P_w \quad (2)$$

$$P_{act} = P_{Max} P_p \quad (3)$$

Pw = Wind Power in W
Pmax = Maximum power output in W
ρ (rho) = Air density (kg/m3), 1.225 kg/m3 at sea level, less in higher altitudes
A = Swept rotor area (m2)
V = Speed of the wind (m/s)
Cp = Power Coefficient
Pact = Power Actual

By understanding above equation, it is clear that power generated by wind mill raise by a factor of 8 if we double the wind speed of a wind mill. The real extractable wind power depends on various factors such as type of machine, the rotor, the blade and the frictional losses. The energy generated by wind mill also depends upon daily and seasonal wind cycles and wind direction. Based on the information provided by NASA, it shall be noted at height of 50 m the wind potential increases also in the lands. Because wind is considered as a major source of energy so accurate wind speed data is required [8].

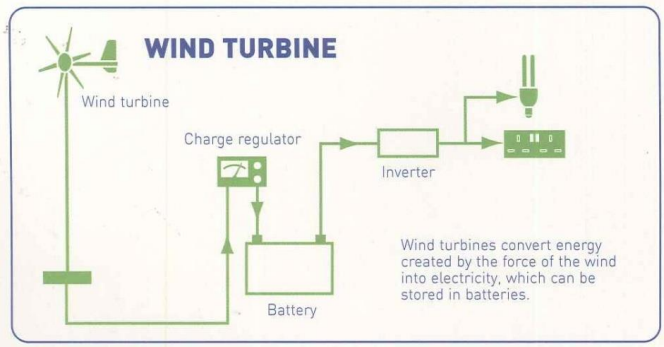

Fig.3. Generation of Wind Energy [10]
Source: www.greenvironeco.com

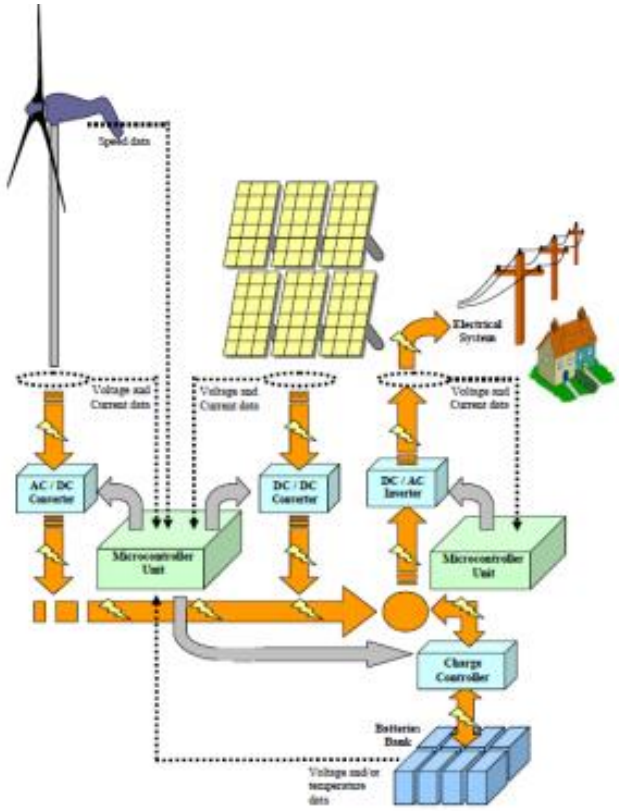

Fig. 4: Hybrid system block diagram [4]

C. Hybrid energy using solar and wind

The irregular nature of solar and wind power can be effectively mitigated by using a solar and wind hybrid system. Energy can be stored in batteries to run sites even if sun light and wind energy is not available. By combining solar and wind systems at one site can provide multiplicity shield against the variable natures of both energy sources. Expert system are designed by keeping in mind the various consideration of the local sunlight and wind patterns that maximizes energy capture through various conditions. There are several advantages of using Solar and wind power such as reduced fuel costs, no fuel deliveries, reduced maintenance requirements, environmental friendly and safe as no need to store fuel on-site, no pollution, noise or GHG emissions. Solar and wind power is an alternative to diesel generator using fuel for power generation. The rapid increase in the cost of energy and emission of gases now receive full attention on various considerations in design and purchase decisions of every business. Telecommunications operators can design radio access networks in such a way so as to minimize OpEx and cost. Using hybrid system composed of solar and wind power system offer more reliability, remote configurability, alarms

and continuously monitoring the demand of operators. Such severe requirements of world-class carriers can only meet by renewable energy systems and attain payback versus diesel generators in as little as six years. Installing solar panels and small wind turbines permit a company to express its solid dedication towards environmental sustainability [8].

D. Sleep scheduling

Due to high bandwidth demands from users for future 4G networks base stations will be more compactly deployed. Therefore large number of base station also consume more energy that mainly comes from data servers, routers etc. Therefore, it will be very important if the energy consumption of the BSs can be greatly reduced. The first way to reduce the energy is to use efficient base station hardware and the another way is to built a intelligent control of the network on software. The network planning is accomplished in such a way that the base station uses the energy efficient control for random traffic. During the busy hours or when the congestion in the network is more, energy saving is just a secondary option because the energy consumption of various processing units that comprises a wireless network. When the congestion in the network is low then by turning some of the base station off energy consumption can be reduced. By turning off some base station the remaining users can be served by base station in ON state. The main aim of energy optimization in wireless network is to minimize the number of base station in ON state. It also requires time to time full information about the congestion in the network so as to wake up the sleeping base station [2].

E. The Green Cellular Architecture

Modern cellular and wireless networks use sophisticated power control mechanism for controlling the transmitted power of both BSs and MSs. Now a days this power control mechanism comprises of small cell that lowers Transmitted power at both BSs and MSs. In transceiver system, the transmitted power during uplink depends upon the separation from BS receivers. So Green Antennas are comes into picture to reduce the Transmitted power of MSs and also to minimize the effect of radiation. Green Antennas must be merged in to the network infrastructure via using wired connection or point to point microwave link. Green Cellular is a broad concept that may be applied to various technologies whether it is small local area networks (LANs) or large metropolitan area networks (MANs). A schematic of the Green Cellular architecture is given in Figure. 5, compared with the standard architecture based on transceiver BS, given in Figure 6.

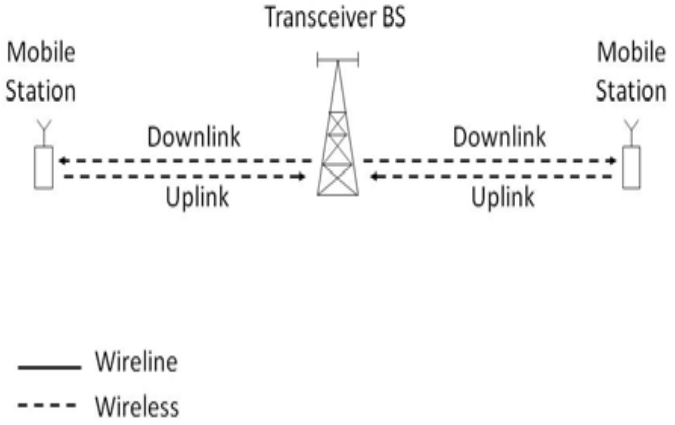

Fig. 5.standard transceiver architecture [6]

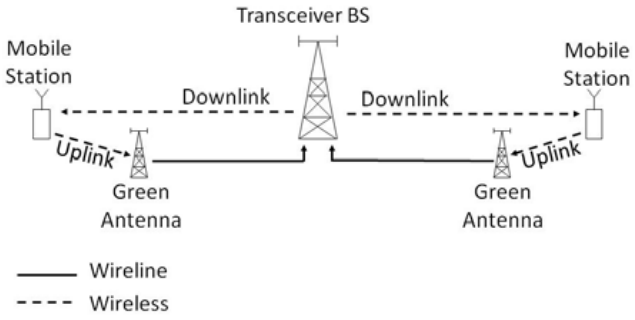

Fig. 6. The Green Cellular architecture in which transceiver BSs are augmented with Green Antennas. The UL to the BS is not shown [6]

Green antenna plays an important role in cellular architecture. By embedding a green antenna BS may be located at any distance from the school, still provide enough coverage that is why transmitted power by MSs to Green Antenna would be significantly low if it is compared with the same scenario without the Green Antenna also reduce the interference to users of both the same BS and neighboring BSs. So the transmitted power to other MSs is also decreases. Green antenna not only decreases MS transmitted power but also higher UL capacity both at the serving and neighboring BSs. Lowering transmitted power also results in prolonged MS battery life. At the end green antennas are easy to deploy and also have ability to reduce the emission from MSs without any additional radiation Sources [6].

V. CONCLUSION

As the demand of energy and data traffic in the network increases day by day which also leads to dramatic expansion of network architecture. Energy optimization and environmental sustainability become a major issue now a days. So there is an critical need to have various energy efficient techniques in the wireless mobile communication networks. In this paper we have particularly discussed some important techniques like sleep scheduling, Green antenna and

Renewable Energy Resources like Solar and Wind Energy hybrid systems. The purpose of using these technique is basically to achieve energy optimization in wireless mobile networks.

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