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Research Article

GREEN RADIO TECHNOLOGY FOR ENERGY SAVING IN MOBILE TOWERS-A SURVEY

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Abstract

The number of users and also the use of telecommunications systems are increasing space and this lead to bigger demands on energy usage .Based on the intensive life-cycle assessment (LCA) conducted by numerous network operators ,it is learned that energy consumption within the usage part of its magnitude relation access networks is that the most at hand issue about impact on the setting the amount of CO_2emission is increasing in communication system ,in parallel with increase in mobile shoppers .And it's additionally discovered that current wireless networks aren't energy-efficient ,mainly the base stations (BS). This minatory growth in mobile users and increase in CO_2 emission forces us to use higher rate mobile broadband .There is a desire for restructuring of existing specification .We need to stay dominant system in each base station for shift purpose .This paper discusses this energy consumption situation in base station devices .It additionally describes innovative and promising technique for enhancing the energy potency of the wireless networks and developing solutions that scale back operational prices and effects on the setting.

Key Words: BS (base stations), LCA(life-cycle assessment), solar cell, Relay, Energy saving.

I. Introduction

As part of the international efforts for energy conservation and CO_2 reduction, migration to an energy efficient mobile infrastructure is of high importance to the mobile communications industry .For network operators, energy efficiency is much more than a corporate social responsibility topic .It will be one of the key factors for successful operation of large-scale mobile communication services.

Due to the tremendous upswing of mobile internet access demand, the cellular wireless system is currently transitioning to LTE. This next generation mobile infrastructure provides broadband access and enables new classes of applications for mobile users. With the emerging traffic demand, mobile operators are under pressure to enhance their infrastructure in a competitive time frame.

However, the investment to enhance the infrastructure does not always pay off because the average revenue per connection continues to decrease .To overcome such a price-pressure trend ,energy saving is one of the key subjects for mobile operators total cost of ownership reduction .Because the base station accounts for most of the energy consumption by mobile operators, improving the energy efficiency of base station key components ,such as power amplifiers and air conditioners ,is of great importance.

Table 1.1 Power consumption/BTS

	GSM	WCDMA
Now(possible)	800W	500W
Target(2015)	650W	300W

- Exponential growth in data traffic.
- Number of base stations/area increasing for higher capacity.
- Revenue growth constrained and dependent on new service.

In the existing system all mobile towers are kept on in a particular locality irrespective of the number of users .As a result high power consumption occurs .A typical mobile phone consumed by user's handsets .When direct electricity connections are not ready available ,these service provides use diesel to power their network.As a result ,a polluted environment is established and a whole of about 1% of the total power generation is being consumed by the mobile networks itself .In addition to this the lighting and cooling units are always in on state thereby considerably increasing the power consumption rate day by day. The objective of the project is to design,simulate and assemble a microcontroller based energy saving unit so as to reduce the power consumption in the existing mobile base stations.

II. Current scenario

T .Elder, "Green base stations –how to minimize CO_2 emission in operator networks, "Ericsson seminar, Bath base station conf., 2008 [1]. In long-term-evolution-advanced(LTE-advanced),heterogeneous deployments of relays, femtocells and conventional macro cells are expected to provide coverage extension and throughput enhancement, while significantly lowering the energy consumption and total-cost-of-ownership(TCO) in cellular networks .This study presents a methodology for estimating the total energy consumption, taking into account the total operational power and embodied energy , and TCO of wireless cellular networks ,and in particular provides a means to compare homogeneous and heterogeneous network(HetNets) deployment.[1] J.N.Lanemen, D.N.C.Tse and G.W.Wornell,(2004) 'Cooperative Diversity in Wireless Networks: Efficient Protocols and Outage Behaviour,' IEEE Trans.info.Theory,vol.50,no.12,pp.3062-80.These protocols are particularly attractive in ad-hoc or peer-to-peer wireless networks in which radios are typically constrained to employ a single antenna. Sustainable energy-savings resulting from these protocols can lead to reduced battery drain, longer network lifetime, and improved network performance in terms of e.g., capacity[2].

C.Lubritto and A.Petragliaa (2011) 'Energy and environment aspects of mobile communication systems' Energy, Vol.36,Issue 2,pp.1109-1114.The role of mobile communications system in the general national energy framework and to plot the best areas of intervention for saving energy and improving the environmental impact, showing the role played by air conditioning and transmission equipments. Finally, new transmission algorithm and the use of renewable energy based techniques have been tested [3].

Nasir Faruk and Mujahid Y.Muhammad (2012) 'Energy Conservations through Site Optimization for mobile Cellular Systems (Base Tran receivers Station Optimization)' Epistemic in Science, Engineering and Technology, Vol.2,No.1.This paper presents an overview of integrating solar energy as alternative renewable energy to power cell sites in mobile cellular systems.

The power consumption for three and six sector size have been evaluated. Optimization strategies to reduce the power consumption deployed and hence, solar power solution for both the optimized and none optimized has been design. Analysis of results shows that, the average power consumption for the site increase in the number of trans receivers per sector [4].

Niranjan Balasubramanian, Aruna Balasubramanian and Aruna Venkataramani (2009), 'Energy Consumption in Mobile Phones: A measurement Study and Implications for Network Applications, Copyright 2009 ACM 978-1-60558-770-7/09/11 IMC'09, Chicago, USA. In this paper we present a measurement study of the energy consumption characteristics of three widespread mobile networking technologies: 3G, GSM and WiFi. We find that 3G and GSM incur a high tail energy overhead because of lingering in high power develop a model for the energy consumed by network activity for each technology [5].

Steve Mc Laughlin (2010),'University of Edinburgh green radio-Towards Sustainable Wireless Networks'. This paper investigates new transmission techniques for clustered feedback-based wireless networks that are characteristics by energy and secrecy constraints. The proposed schemes incorporate multiuser diversity gain with an appropriate power allocation (PA) in order to support a defined quality-of-service(QOS) and jointly achieve lifetime maximization and confidentially.

We show that an adaptive PA scheme that adjusts the transmitted power using instantaneous feedback and suspends the transmission when the required power is higher than a threshold significantly prolongs the network lifetime without affecting the Qos of the network [6].

P.Wright et al (2009),'A Methodology fir Realizing High Efficiency Class-J in a Linear and Broadband PA,'IEEE Trans. Microwave Theory and Techniques,Vol.57,pp.3196-3204.The results indicate the class-j mode's potential in achieving high efficiency across extensive bandwidth, while maintaining predistortable levels of linearity [7].

The article, "fundamentals trade-offs on green wireless networks" by yan Chen et al., presents an insightful design framework for energy-efficiency-oriented mobile wireless networks, which consists of four fundamental trades-offs deployment efficiency vs. energy efficiency, spectrum efficiency vs. Energy efficiency, bandwidth vs. power, and delay vs. power. With this article, the authors thoroughly analyze how to balance the deployment cost, throughput, and energy consumption in the network as a whole, how to guarantee the achievable rate while maintaining energy consumption of the system on a given available bandwidth, how to utilize the bandwidth and the power needed for transmission at a given target rate, and how to counterpoise the average end-to-end service delay and average power consumed in transmission, respectively. Hanna bogucka and andrea conti contribute the second article, "degrees of freedom for energy savings in practical adaptive wireless systems," and verify that adaptive communication techniques have degrees of freedom to potentially beexploited for energy saving; meanwhile, the target performance metrics can be satisfied as well, which depend on various system parameters such as the diversity technique, the energy partition between data and pilot symbols for channel estimation, and the constellation signalling, As a case study, the authors also investigatesing le-carrier as well as multicarrier communications systems applying both margin-adaptive and rate-adaptive pilot-assisted transmission to quantify the relevant energy savings opportunities.

The last article,"on the design of green reconfigurable router towards energy efficient internet"by chumming wu et al., discusses how to construct energy-efficient reconfigurable router with power aware routing mechanism through virtual networks with advanced rate adaptation processing inside the internet router.

III. Design and implementation:

In the overall block diagram the voltage and current sensing circuit senses the power from the power amplifier and feeds it to the monitoring system. The responder frequency which is received from the main server will activate the corresponding tower's base station components from idles state to charging state. When the responder frequency is received it is also displayed in the monitoring unit. The temperature and light sensor senses the temperature and illumination level of environment and then through localized power control, corresponding relays for cooling and lighting units are operated power control, corresponding relays for cooling and lighting units are operated .if the power amplifier output is found to be zero then there will be no users present in that particular instant. Similarly once the number of user's level exceeding more than 80 percent then relay to activate the neighbouring tower is energized.

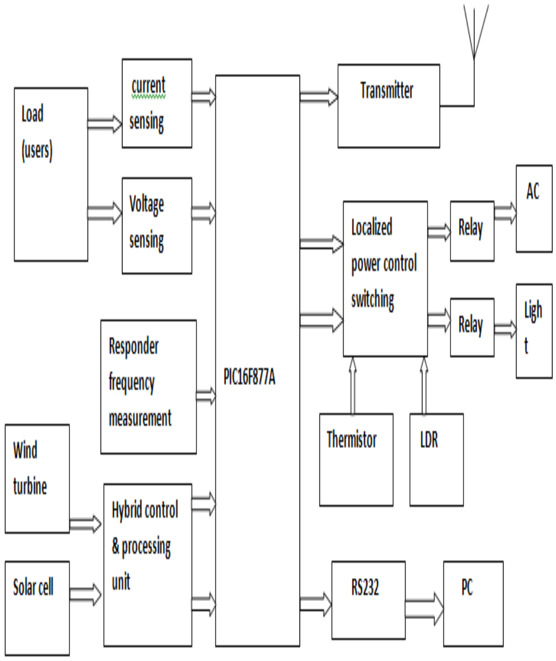

Fig1. Block diagram of abatement of power consumption in mobile base stations.

From the circuit it can be seen that the reference analog supply after being regulated by the 9v regulator enters the zener diode through the resistance R1 where it is again regulated to 5v since the zener diode used here has a cut off of 5v.Thus we have a double regulated completely filtered analog reference source. R2 is a potential divider used for setting the dynamic response range of the reference supply.This means that the reference 5v can be used as it is or it can be made into a fraction of the 5v for example 1v so that readings in this range can be read with more precision. This is because the ADC has 10 bit resolution which can be totally used for representing the 1v rather than 5v.The pins 2-5,7-10,35 and 36 are used as the 10 channels of the ADC. To these pins the analog inputs to be processed by the ADC are given. Y1 is the crystal oscillator used. It is of 10 MHz and gives a baud rate of 9600 bits/s. The capacitors C2 and C3 are used as decoupling capacitors to remove the high frequency noise signals.

The capacitor C1 is in the off condition when power is switched off. When the power is switched on or rests then this capacitor gets charged through the resistor R2 and then through R1 this appears at the MCLR pin of the PIC. This is the memory clear pin and thus the memory is cleared and is ready for use as soon as power is switched on. S1 is the synchronous switch, which is also used for the same operation and for PC and PC synchronous operation. The output of the voltage and current sensing circuit is given as input to the analog channels of the PIC. Thermistor is connected in analog channel to measure the substation temperature. The FM receiver connected in PORT B. Here PORT b configured as input digital port.

The ratio of the number of turns on each coil, called the turn's ratio, determines the ratio of the voltages. A step-down transformer has a large number of turns on its primary (input) coil which is connected to the high voltage mains supply, and a small number of turns on its secondary (output) coil to give a low output voltage.

$$\text{Turns ratio}=\frac{Vp}{Vs}=\frac{Np}{Ns}\text{and}$$

Power out=Power in

$$Vs \times Is = Vp \times Ip$$

Vp=primary (input) voltage

Vs=secondary (output) voltage

Np=number of turns on primary coil

Ns=number of turns on secondary coil

Ip=primary (input) current

Is=secondary (output) current

Smoothing is performed by a large value electrolytic capacitor connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling. The diagram shows the unsmoothed varying Dc(dotted line) and the smoothed DC(solid line). The capacitor charges quickly near the peak of the varying DC, and the discharges as it supplies current to the output.

Note that smoothing significantly increases the average DC voltage to almost the peak value (1.4×RMS value). For example 6v RMS AC is rectified to full wave DC of about 4.6V RMS(1.4V is lost in the bridge rectifier), with smoothing this increase to almost the peak value giving 1.4×4.6=6.4V smooth DC.

Smoothing capacitor for 10% ripple:

$$C=\frac{5\times Io}{Vs\times f}$$

C=smoothing capacitance in farads (F)

Io=output current from the supply in amps (A)

Vs=supply voltage in volts (V), this is the peak value of the unsmoothed DC

F=frequency of the AC supply in hertz (HZ), 50Hz in the UK

Bridge rectifier can be used to convert AC to DC. But a single conducting diode drops the voltage of 0.6v.During each cycle, 2 diodes are in conduction mode. So totally 1.2v is dropped across it. This is undesirable because the voltage (i.e.) to be measured is about 5v.Hence, as mentioned above full wave rectifier designed using op-amp is used, due to the drawbacks faced in using bridge rectifier. OP-AMPS are devices, which have high input impedance and low output impedance. Hence they are used for rectification purpose, as they do not affect any device. In the rectifier circuit, A1 is an inverting unity gain amplifier. The output from A1 is added to the original input signal in A2 (inverting summing mixed gain amplifier).In this circuit, the diode is always in conduction mode and D1 is kept at virtual ground. Ein feds A2 through a 20KΩ resistor and a1 through a 10Ω resistor. In this circuit diagram, there is a potential divider to divide the potential so that a sample of only 5.454v is given as an input to a rectifier. the gain of OP-AMP (A10)is-1.the op-amp(A2) has two parts having the gain of -1 and -2 respectively. During positive half cycle the op-amp A1 produces an output of 5.454v.Op-amp A2 produces an output of 10.908v across the path having gain of -2 and an output of -5.454v across the path having a gain of -1.thus the resultant output voltage is 5,454v it can be amplified to the required voltage by varying the trim pot. During negative half cycle the op-amp A1 produces an output of 0,454v.hence the diode does not conduct. The input of path 2 of A2 is 0v; hence the output voltage is 0v. But the input path1 of A2 is 5.454v and hence the across path1 is 5.454v.it can be amplified to require by varying the 500k trim pot. The 500k trim pot is adjusted so that a full-scale output voltage of 5v is produced for a primary voltage of 230v. A capacitor is connected to A2 so that it acts as an integrator .Hence the output voltage is a pure DC voltage it is then given to ADC. The 1K resistor is used to limit the current of 5mA.In the rectifier circuit, A1 is am inverting unit gain amplifier. The output from A1 is added to the original input signal in A2 (inverting summing mixed gain amplifier).In this circuit, the diode is always in conduction mode and D1 is kept at virtual ground. Ein feds A2 through a 10Ω resistor. During positive half cycle the op-amp A1 produces an output of 5.454v.op-amp A2 produces an output of 10.908v across the path having gain of -2 and an output of -5.454v across the path having a gain of -1.Thus the resultant output voltage is 5.454v.It can be amplified to the required voltage by varying the trim pot. During negative half cycle the op-amp A1 produces an output of 0.454v.Hence the diode does not conduct. The input of path2 of A2 is 0v:hence the output voltage is 0v.But the input of path1 of A2 is 5.454v and hence the across path 1 is 5.454v. It can be amplified to require voltage by varying the 500k trim pot. The 500k trim pot is adjusted so that a full-scale output voltage of 5v is produced for a primary voltage of 230v.operation is same as that of voltage sensing circuit excepta shunt resistance is used to convert current to voltage.

The LM1458/LM1458c series are dual general purpose operational amplifiers, having short circuits protected and require no external components for frequency compensation. High common mode voltage range and absence of 'latch up' make the LM1458 ideal for use as voltage followers. The high gain and wide range of operating voltage provides superior performance in integrator in integrator, summing amplifier and general feedback applications. Microcontroller is a software driven electronics device. It is a single chip monolithic IC, which is designed by VLSI design technology. Here the PIC 16F877A microcontroller IC is used. It has inbuilt A/D converter. The A/D converter is required to our project because the transducer output is in the form of analog voltage signal. But the inside operation of microcontroller is digital. So we require A/D converter. It is 18 pin packages. The voltage range is 3.0 to5.5v.The operating frequency of PIC 16F877A is 20MHz.

Each of the two transmitters is a CMOS inverter powered by +10v internally generated supply. The input is TTL and CMOS compatible with a logic threshold of about 26% of Vcc. The input if an unused transmitter section can be left unconnected: an internal 400KΩ pull up resistor connected between the transistor input and Vcc will pull the input high forming the unused transistor output low. The open circuit output voltage swing is guaranteed to meet the RS232 specification ±5v output swing under the worst of both transmitters driving the 3kΩ.Minimum load impedance, the Vcc input at 4.5v and maximum allowable ambient temperature typical voltage with 5kΩ and Vcc=+9v.To ensure compatibility with either RS232 IIP or TTL/CMOS input.The MAX232 receivers have VIL of 0.8V an VIH of 2.4v the receivers have 0.5v of hysteresis to improve noise rejection.

The TTL/CMOS compatible output of receiver will be low whenever the RS232 input is greater than 2.4V.The receiver output will be high when input is floating or driven between +0.8V and -0.3V.

Vcc=6V v+=12V v-=12v

Input voltage:

T1in, T2in:-0.3 to (Vcc+0.3v)

R1in, R2in:+30v or -30v

Output voltage:

T1out, T2out (V+) +0.3v) to ((V-)+0.3v)

R1our, R2out:-0.3V to (Vcc+0.3V)

Power dissipation: 375mW

Output resistance: 300Ω

Hybrid power system has been shown to reduce the energy cost of BTS by more than 60%. This is because it eliminates the cost of diesel around 75% along with other drawbacks of using diesel including fuel delivery, generator maintenance, fuel storage, greenhouse gas emission and uncertain future diesel prices. The capital cost of hybrid renewable powered system for a BTS is 50% more than one using diesel. However, if we use 9% cost of capital the renewable power system will recover the invested capital in less than six years. These benefit arise from gaining an energy cost hedge, energy reliability, brand enhancement and tax waivers. Indian companies being at a pity of irregular power supply from the grid, capriciously increasing fuel prices can benefit from all the factors. Investments in the renewable energy sector can benefit from tax exceptions. Switching to renewable energy is the way a corporation can signal to shareholders and institutional investors that it is mitigating climate related risk. Major corporations like Johnson and Johnson, FedEx, general motors' (GM) to name a few, now are obtaining their electricity from renewable sources including solar and wind.

Software-Visual Basic: The Microsoft VB programming system for windows is an exciting advance for anyone who is involved in writing window base applications. With this event driven programming engine and innovative, easy to use visual design tools, VB lets you take full advantage of the window graphical environment to built powerful applications quickly. As more people began to use computers the isotonic and complicated languages used for programming became more of an obstacle. A language called BASIC was developed to counteract this. Its simplicity made it easy for the users to write amazing programs.

Programming For Window with Vb

The VB programming system packages up the complexity of windows in a truly amazing way. It provides simplicity and ease of use without sacrificing performance or the graphical features that make window such a pleasant environment to work in menus, fonts, dialog, boxes etc are easily designed and these features require no more than a few lines of programming to control. Instead of writing a program that plots out every step in precise order, the programmer writes a program that responds the user's action like choosing a command, moving the mouse etc. Instead of writing on large program, the programmer creates an application, which is a collection of co-operating many programs. With VB such an application can be written with unprecedented speed and case.

Simulation Result:

Initially when none of the tower is in operation, the power amplifier will be in off state, there will not be any signal transmission to remote tower and both the cooling unit and lighting unit will be in OFF state.

Conclusion: The objective of the project is to design, simulate and assemble a microcontroller based energy saving unit so as to reduce the power consumption in the existing mobile base stations. Since cooling unit are found to be most energy craving part in the BJTS, its power consumption has to be reduced, this is done in our project by sensing the climate condition and by using a relay to control the cooling unit. To amplify signals, power amplifiers are used, here we sense the power amplifier voltage and current and through this, number of users utilizing a particular tower is destined. When there is no requirement of too many towers acting at the same instant, while a single tower itself can handle the load, the remaining towers are out into a power saving mode. This is visually brought in front end using VB software.

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