# Mobile Phone and System Are Designed In A Novel Way To Have Minimum Electromagnetic Wave Transmission In Air and Minimum Electrical Power Consumption

*Pijush Kanti Bhattacharjee*
*Department of Applied Electronics and Instrumentation Engineering,*
Dream Institute of Technology,
Kolkata-700104, West Bengal, INDIA.

***Abstract*—Presently human and biological lives along with the constructed structures are prone to be seriously affected by continuous radiation of electromagnetic (em) wave from the mobile communications equipment. The em wave radiation from the mobile system (BTS, BSC etc.) and the mobile phone (MS) have to be minimized to safe guard our life and environment. In this paper the mobile communications system and working pattern are designed in an innovative way so that the minimum amount of em wave is transmitted in the surrounding medium with the minimum electric power consumption by the mobile phone and the mobile stations equipment.**

***Keywords*-Mobile communications, Ultra high frequency, Electromagnetic (em) wave pollution, Electrical power expenditure, Pseudo Noise (PN) short code.**

## I. INTRODUCTION

In late 1990 AD, the mobile communication system [8]-[14] started its function in all over India and from 2000 AD onwards it was started in full fledge in the form of second Generation (2G) GSM and CDMA. Subsequently third Generation (3G) under WCDMA and CDMA-2000 are developed to enhance the speedy data communications in all over the world. Now the mobile phone becomes the part and parcel thing in our daily life. Every day there are lot of new mobile stations are installed by the different service providers like BSNL, Airtel, Reliance etc. in India. A mobile station consists of following things:

MS - Mobile Station or Mobile Telephone for transmitting and receiving signals.
BTS – Base Transceiver Station serves mobile connection to one or more cells and sectors in the cellular network, contains TRXs, i.e., transceivers or radio units.
MS to BTS path - Reverse or Up link,
BTS to MS path - Forward or Down link.
BSS – Base Station Sub System consisting of BSCs & BTSs.
BSC – Base Switching Center controls one or more BTSs and perform inter BTS and intra BTS switching and handovers.
MSC – Mobile Switching Center or Main Switching Center which is a basic digital electronics exchange, e.g., 5ESS means $5^{th}$ version of Electronics Switching System. It controls all the functions of a Mobile Network.
HLR – Home Location Register occupies identities of mobile subscriber as IMSI [International Mobile Subscriber Identity], service parameters, location information etc.
VLR – Visitor Location Register contains permanent and temporary (roaming) mobile subscriber's identity as TMSI, ISDN directory number, routing etc.
EIR – Equipment Identity Register contains identity of mobile equipment called IMEI [International Mobile Equipment Identity]. It may be valid, suspect or prohibited.
AUC – Authentication Center contains authentication data called $K_i$ for encrypting user speech and data security purpose.
OMC – Operation and Maintenance Center is centralized maintenance to operate, administer and monitor the functions of MSCs, BSSs etc. One OMC may control number of MSCs and BSSs. OMC is having mainframe computer.

These HLR, VLR, EIR, AUC, OMC etc. are linked inside the MSC. Generally the connected path from a mobile phone (MS) to its nearest available BTS is done by air interface called $U_m$ with electromagnetic (em) wave interchange and all other connections like BTS to MSC via BSC are done by optical fiber [6]-[7]. Sometimes microwave or satellite link [2]-[5] with the help of em wave transmission is used for BTS to MSC connection via BSC also, but em wave used in microwave or satellite link is having direct line of sight communication in which minimum portion has spread in surrounding medium.

Presently the mobile phone service has covered more than 75% total area in village based rural region and almost 100% area in urban or cities in most of the parts of the world. The communication establishes from a mobile phone (MS) to its nearest BTS in wireless medium via em wave having ultra high frequency (UHF), ranging from 800 MHz to 1000 MHz

(1 GHz) in India, even higher than this UHF range in all other countries. This high frequency em wave is very much unsuitable for smooth biological life and non biological structure also [15]-[16]. Thus we are passing days in the ocean of high frequency electromagnetic (em) waves whose main sources are mobile communications system including microwave system, satellite communications system, TV and Radio communications etc. Employing cable TV system, the use of high frequency em wave is somewhat restricted. Although em wave used in satellite communications [4]-[5] are in ultra and super high frequency (UHF and SHF) range, but they are specifically applied in a certain region with very low power, hence the cause of em wave pollution due to satellite communications is quite limited.

Now-a-days the main source of em wave pollution in the lower zone of atmosphere, i.e., troposphere (ground to 12 miles), stratosphere (13 miles to 35 miles from ground) is the source of mobile communications system (primarily BTS) and mobile phone set (MS). Enormous type of mobile communications system (BTSs) with mobile handsets (MSs) are operated throughout the country creating a storm of high frequency and sometimes high power (near BTSs) em wave. This high frequency em wave is penetrating everything including metal plates and concrete structures, causing unbalance in natural biological life and atomic structure in an atom also. By exposure of high frequency em wave, we are leading our life against the nature and its beauty afforded to us, benefitting by fast communications only. After a certain time we must realize that we can not properly trade off our loosing and gaining business for utilizing em wave in the field of communications. The effect of high frequency em wave on biological and non biological bodies has to be carefully studied. One of the causes of decreasing agricultural food production is due to excessive high frequency em wave propagation through the air medium and it is one of the factors to global warming also [15]-[17].

In this paper, the mobile communications system, i.e., mobile phone (MS) and mobile architecture pattern (BTS, BSC, MSC etc.) are designed in such a way that only restricted and very limited amount of em wave is exposed in air, at the same time electrical power supply to both the mobile phone (MS) and mobile stations (BTS, BSC, MSC etc.) are maintained at minimum level which cut short expenditure as well as em wave pollution to air medium.

## II. METHODOLOGY

We are using electromagnetic (em) wave having ultra frequency range 800 MHz to 1 GHz for mobile communications purpose in India. The mobile phone (MS), in switch on condition, but in idle phase, i.e., not communicating, is transmitting em wave signals in every 26 msec to its nearest BTS and the nearest BTS acknowledges the incoming signal from the MS by sending another em wave signal consisting of Pseudo Noise (PN) short code, i.e., identity of the BTS cell, sector, allotted free channel etc. Hence the covering BTS informs to the mobile subscriber (MS) that the proper care has been taken by it. Although a call has not been set up by the mobile phone user (MS), but em wave is transmitted and received continuously by the BTS and the MS while remain in switch on condition. This continuous transmission of em wave from the mobile phone (MS) keeps track the mobile system (BTS, BSC, MSC etc.) to facilitate mobile service by connecting to a called number through its MSC, HLR, VLR etc. If we can made arrangement to stop or avoid this continuous transmission of em wave signals from the switched on mobile phone (MS) and its nearest BTS in case of non operation time, i.e., non communicating time, then we can cut short a greater amount of em wave spreading in air. Therefore in this paper a mobile communications system has been designed in a novel way to nullify this continuous em wave transmission which is being transmitted at the ideal period, i.e., non communication phase. It is seen that in a day average using time of a mobile phone (MS) is 1~2 hours, therefore it is assumed that average ideal period of a mobile phone (MS) remains 22 hours in a day for a MS. If the mobile system (BTS, BSC etc.) and the mobile instrument (MS) are made to stop transmitting em wave during the idle period, then we can curtail huge amount of em wave transmission and at the same time minimize power cost towards this continuous sending em wave. This is achieved by designing and working pattern of the mobile communications system in the following manner.

### *A. Design of Power Distribution Circuit for a Mobile Phone (MS) and the Connecting Radio Unit in a Mobile System (BTS)*

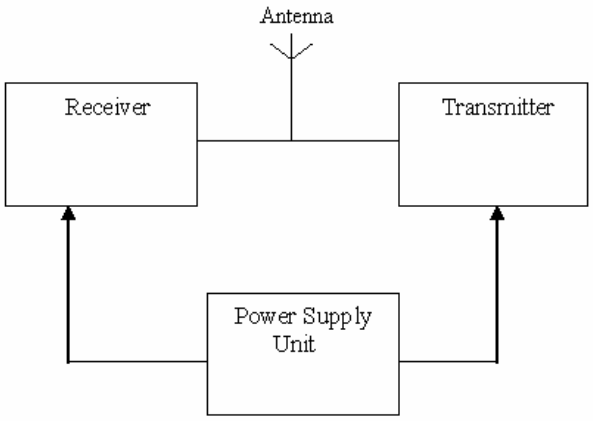


Fig. 1. *Block diagram of power distribution for a mobile phone (MS) and its connecting radio unit in BTS*

At present a mobile telephone under switch on condition is continuously sending em wave with a certain UHF range to the nearest BTS for ascertaining its present status and the nearest BTS also sending paging signal (acknowledgement) by em wave in every 26 ms. Electrical power is fed both transmitter and receiver simultaneously whenever switch on a mobile phone (MS) and a BTS as shown in Fig. 1. Therefore a continuous em wave transmission-reception is carried over by a mobile phone (MS) under switch on condition with the nearest available BTS, i.e., the service provider's BTS em wave signals covering (power above -95 dBm) the MS. The

nearest BTS intimate the MSC about the position and status of the MS. By adopting the invented process, we can stop this continuous transmission of em wave between the MS and its nearest BTS in idle condition. Now the proposed process is described. Generally in a day we are not in mobile or moving condition always. In an average, we are in moving condition, i.e., travelling by rail, bus, car etc., 3~4 hrs in a day. Then we have to switch on transmitter of mobile phone (MS) in case of calling a subscriber for urgent business only or we have to keep switch off during moving time to avoid em wave pollution, after reaching the destination we can switch on transmitter of the MS for a small duration (say 1 minute) to intimate the MSC regarding the latest position of the mobile phone (MS). In non operational (ideal) time, we switch off transmitter of the MS and its connecting transmitter unit of the BTS, only receiver unit of the MS and its corresponding receiver unit of the BTS remains switch on to receive a call as shown in Fig. 2.

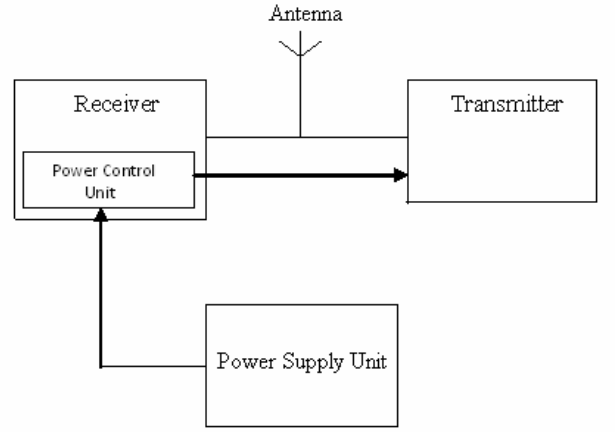


Fig. 2. *Modified block diagram of power distribution for a mobile phone (MS) and its connecting radio unit in BTS*

In modified circuit as described in Fig. 2, a mobile phone (MS) and its connecting radio unit of the BTS, electrical power is fed to the transmitter through power control circuit (in the receiver) which is controlled by the corresponding receiver unit. There are two status of switch on condition for a mobile phone (MS) and its connecting radio unit of the BTS, one is that the receiver remains switch on and the transmitter is switched off, the other is that both the transmitter and the receiver are in switch on condition. The second condition is existing only at the time of call connection and progressing, in all other times first condition is prevailing. Therefore two individual power switching conditions are required for a mobile phone (MS), one for receiver power switch and the other for transmitter power switch. When the transmitter becomes switch off condition, it does not transmit em wave, as a result its nearest BTS is also not required to acknowledge through em wave signal, so it is not causing environmental overloading with excessive em wave in air medium. In case of transmitting em wave signals either from a MS or a BTS, the power control circuit in the respective receiver unit supplies electrical power to the transmitter unit, i.e., switch on the transmitter.

MSC has to keep record all incoming caller numbers for a mobile subscriber (MS) during the unavailable time of the MS, i.e., transmitter of the MS switching off period, out of covering region etc. and whenever the MS will be connected to the MSC, the incoming unmatured caller number list is informed to the MS by its MSC. This procedure enhances the facility that the mobile subscriber (MS) can come to know the incoming called party list during in non-connected period. After reaching a place within a certain BTS, the MS has to switch on its transmitter power for a small duration (say 1 minute), its connecting radio unit in the BTS has received signals from the MS and then its receiver unit of the BTS turns on power to its transmitter unit which ultimately sends acknowledgement and upgrades the location and status of the MS in the corresponding BTS, BSC, MSC, HLR, VLR etc.

Thereafter the MS switches off its transmitter electric power and only receiver section of the MS remains in switch on condition. Whenever any incoming call meant for the MS is received by its MSC, the call is routed towards the latest location of the MS as noted. After receiving signal from the MSC, the BTS switches on the corresponding its transmitter unit which further transmits information to the MS. The MS receives the call, provided it is staying within the latest informed location. Power control circuit in receiver of the MS activates power in transmitter unit of the MS and the called MS starts communicating. On the other hand when a MS wants to make a call, first of all power in transmitter of the MS is switched on, then the called party number is transmitted. Since a MS must have two power switches, one for receiver unit and another for transmitter unit or whole unit. Therefore, power in the transmitter of a MS is switched on-off either by MS itself or power control unit in the receiver of the MS. Actually power to the transmitter of the MS is fed from the power control circuit lying in receiver of the MS. For this reason, the transmitter of a MS has to remain switch on condition only either in communicating time or very small period few seconds after certain interval for intimating the location. Thus it is avoiding unnecessary transmission of em wave through air all the time.

After a certain interval (say 1~3 hrs) or in case of location changed, a MS switches on the transmitter for a few seconds to intimate its current location and status. This power switch on-off business of the transmitter of a MS can be done automatically by software programming embedded in power control circuit. It facilitates the MSC to route the incoming call for the MS accordingly. If an incoming call is failed to land by a MSC to the proper destined MS, the MSC informs the entire unmatured incoming caller list to the MS while connection takes place. By adopting this technique, only actual communicating time of a MS, the em wave interchange (transmission) between the MS and the BTS is done, in case of non-operation or ideal period, no em wave is transmitted either by the MS and its connecting unit in the BTS. Hence by this technique, em wave transmission in the surrounding air is

minimized. Since in idle period the transmitter of a MS remains switch off condition, i.e., no power is fed to transmitter of the MS, no to and fro communications are set up between the MS and its nearest BTS. Therefore electrical power expenditure for a MS and a BTS are becoming very less, almost one tenth (1/10) of the present power requirement. It ultimately enhances battery life and its discharging period of the MS [17] and electrical power cost for the BTS. Thus this technique affords two way benefits, i.e., one is curtailing excessive em wave transmission in air and the other is minimizing electrical power cost, both for the MS and the BTS.

## III. CONCLUSIONS

On the present scenario our life is at stake due to excessive exposure of em wave emanating from huge number of mobile stations (BTSs) and subscribers (MSs) in operation all around. In this paper a simple power circuit designing and operation procedure are invented to safeguard the environment as well as human and biological life from the ill effect of em wave penetration or absorption. In this process, unnecessary em wave transmission in air is completely shut down and at the same time call throughput efficiency is in the highest order.

In idle period, transmitter of a mobile phone (MS) and that of the connecting BTS are kept switched off condition, as a result they do not transmit continuous em wave in nearby air medium. Therefore it minimizes power cost also, i.e., battery charging [15] for a MS are not required to do frequently and as a result battery life period of the MS is extended, also electrical power consumption for a BTS is minimized. In case of moving time of a mobile subscriber (MS), while the MS in train, bus, car etc., the call is made in special urgency only; otherwise transmitter of the MS is kept switched off. This technique meets two main targets simultaneously, one is eliminating em wave pollution in air and the other is the highest power saving means both for the MS and the BTS. By proper implementation of this technique in the field of mobile communications, one can get rid of excessive em wave pollution in air medium, at the same time electrical power expenditure for mobile communications are cut short in a great extent.

## REFERENCES

[1] J. Dunlop and D. G. Smith, Telecommunication Engineering, Chapman & Hall Publishers, 3rd Ed, 1994.
[2] M. Golio, Microwave and Rf Product Applications, CRC Press, 2000.
[3] J. M. Osepchuk, "Mircowave Power Applications", IEEE Trans on Microwave Theory and Tech, vol. 50, no.3, pp. 975-985, March 2002.
[4] J. Singh and N. Kaur, "Role of VSATs in Communication", Telecommunication Journal, T&D Circle, DoT, Jabalpur, pp. 35-38, October 1999.
[5] S. Pal, "Satellite Based Mobile Communication- A Perspective", IETE Technical Review, vol. 16, nos. 3&4, pp. 349-361, May-Aug 1999.
[6] J. M. Senior, Optical Fiber Communications- Principles and Practice, Prentice Hall Pub, 2nd Ed, 1992.
[7] T. R. Joseph and W. E. Stephens, "Fiber Optics: The Link to Future Systems", TRW Quest Magazine, TRW Inc, Winter 1987.
[8] T. S. Rappaport, Wireless Communication: Principles and Practice, Prentice Hall Pub Ltd, 2nd Edition, 2006.
[9] D. Goodman, "Cellular Packet Communication", IEEE Transactions on Communications, vol. 38, no. 8, pp. 1272-1280, August 1990.
[10] M. Rahnema, "Overview of the GSM System and Protocol Architecture", IEEE Transaction on Communications, pp. 92-100, April 1993.
[11] A. J. Viterbi, CDMA Principles of Spread Spectrum Communication, Addison-Wiseley Publishers, 1995.
[12] Xiaodong Wang and H. Vincent Poor, Wireless Communication Systems, Pearson Education Pvt Ltd, New Delhi, First Indian Reprint, 2004.
[13] William C. Y. Lee, Wireless and Cellular Communications, 3rd Edition, McGraw Hill Publishers, USA, 2008.
[14] Martin Sauter, Beyond 3G – Bringing Networks, Terminals and the Web Together, John Wiley & Sons Ltd., U. K., 2009.
[15] Ali Zamanian, and CY Hardiman, Electromagnetic Radiation and Human Health: A review of sources and effects, Fluor Corporation Industrial and Infrastructure, July 2005.
[16] European Commission Health and Consumer Protection Directorate General, SCENIHR, Possible Effects on Electromagnetic Fields (EMF) on Human Health, July 2006.
[17] J. A. C. Theeuwes, H. J. Visser, M. C. Van Beurden, G. J. N. Doodeman, "Efficient, Compact, Wireless Battery Design", Proceedings of 10th European Conference on Wireless Technology, Munich, Germany pp. 233-236, Oct, 2007.

**Dr. Pijush Kanti Bhattacharjee** is associated with the study in Engineering, Management, Law, Indo-Allopathy, Herbal, Homeopathic & Yogic medicines. He is having qualifications M.E, MBA, MDCTech, A.M.I.E (B.E or B.Tech), B.Sc(D), BIASM, CMS, PET, EDT, FWT, DATHRY, B.A, LLB, KOVID, DH, ACE, FDCI etc. He has started service in Government of India, Department of Telecommunications (DoT) since 1981 as an Engineer, where he has worked upto January, 2007, lastly holding Assistant Director post at Telecom Engineering Centre, DoT, Kolkata, India. Thereafter, he worked at IMPS College of Engineering and Technology, Malda, WB, India as an Assistant Professor in the Department of Electronics and Communication Engineering from January 2007 to Feb 2008, from Feb 2008 to Dec 2008 at Haldia Institute of Technology, Haldia, WB, India, from Dec 2008 to June 2010 at Bengal Institute of Technology and Management, Santiniketan, WB, India, June 2010 to Aug 2010 at Camellia Institute of Technology, Kolkata, India, Sept 2010 to July 2012 at Assam University [A Central University], Assam, India in the same post and department. He has joined as an Associate Professor in Applied Electronics and Instrumentation Engineering Department at Dream Institute of Technology, Kolkata, India in July, 2012 and continuing till date. He has written two books "Telecommunication India" & "Computer". He is a member of IACSIT, Singapore; CSTA, USA; IAENG, Hongkong; and IE, ISTE, IAPQR, IIM, India. His research interests are in Mobile Communications, Image Processing, VLSI, Nanotechnology, Management and Environmental Pollution etc.