IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 11, November 2016

Energy Consumption using Femtocell Network

Shatakshi Sharma[1], Naveen Kumar Saini[2]

M. Tech Student, Dept of Electronics and Communication Engg, Ajay Kumar Garg Engineering College, Ghaziabad[1]

Assistant Professor, Dept of Electronics and Communication Engg, Ajay Kumar Garg Engineering College, Ghaziabad[2]

Abstract: Today we are living in the era of mobile technology. Every third day new mobile technology develops. The load on the cellular network is increasing day by day and it will more and more increasing. Due to the increasing no. of mobile subscribers, demand of the mobile customers is increasing on per day basis. Customers need high data speed, lower call rate and many more services. To fulfill this demand of the customers cellular operators are trying to integrate small cells. Small cells operate at very low power and these are very Energy efficient. Small cells such as femtocell are very reliable and low range, low power cell, it operate in licensed spectrum with the range of 10m. to 3km. Femtocell are almost ten times smaller than a big mobile macrocell network. In this paper, we have used a two tier femtocell network which increases the capacity and coverage. Here, sleeping strategy is used to increase energy efficiency of the network.

Keywords: Energy Efficiency, Power Consumption, Two tier Network, Sleeping strategy.

1. INTRODUCTION

Now a day's many researchers are working on energy efficiency. Energy efficiency is becoming a major concern for all the stakeholders. There are several reasons behind the point that why all the stakeholders are interested in energy efficiency such as green technology, cost effect and design problems etc. Looking ahead to the year 2020 and beyond, there will be explosive growth in mobile data traffic. It is assumed that traffic of hotspot may grow up to 1,000 times. Use of femtocells provides benefits to both parties' means to operator and customer. For a mobile operator, the main aim of a femtocell is to improve both the coverage and capacity of network specially at indoors. Coverage is improved because femtocells can fill in the gaps and eliminate loss of signal through buildings.

Capacity is improved by a reduction in the number of users attempting to use the main network cells and by the off-load of traffic through the user's network (via the internet) to the operator's infrastructure. Instead of using the operator's private network (microwave links, etc.), the internet is used. Femtocell operates in three access modes: open access, closed access, and hybrid access. When femtocell operates in closed access mode, only a particular group of users are allowed to access to femtocell access point and that group is called closed subscriber group. . In open access mode, all kinds of users are allowed to access to the FAP. In hybrid access mode, registered users and non-registered macro users that satisfy certain constraints can connect to the FAP. Energy efficiency in cellular networks is becoming a important concern for cellular operators not only to maintain profitability, but also to reduce the environment effects. This emerging fashion of achieving energy efficiency in cellular networks is inspiring the standardization authorities and network companies to continuously explore new future technologies in order to provide better service in the entire network infrastructure. In this paper, we have presented a method to improve the power efficiency of cellular networks, explored some research issues and challenges and suggested some techniques to enable an energy efficient or "green" cellular network. Since base station is the main part which consume a maximum portion of the total energy which is used in a cellular system.

Before the development of small cells, there are several ways for energy saving: base stations (BSs), user terminals, and the exploitation of renewable energy. BS consumes approx 60% to 80% of the total energy in cellular networks, thus saving the energy consumption of BSs can implement green network effectively [3]. Big cell such as macrocell base stations (MBSs) are generally powered on, when the demands of traffic are different in various time and areas [4], MBSs waste unnecessarily energy seriously. In addition, in a two-tier femtocell network, to overcome with the problem of increasing demand of consumers, network operators deploy massive and uncoordinated FAPs, which lead to a considerable increase in energy consumption.

2. RELATED WORK

The best solution for power savings is a two tier scenario (macro+ femto) with sleep mode activation. The aim of the proposed scheme is to achieve high SINR with optimal transmit power of femto access point (FAP) when macro base station (MBS) is under sleep activation by coordinating downlink cross-tier interference and intra-interference with utility and traffic based power control (UTPC). Since according to dynamic coverage extension the optimal radius of femtocells can be obtained. Many

IJARCCE
ISSN (Online) 2278-1021
ISSN (Print) 2319 5940
International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 11, November 2016

sleep methods can be defined for open access permitted hybrid femtocells. In that case, many FAPs can be switched into sleep mode at a time by managing the main active FAPs in the cluster. As it results, the number of active femtocells can be controlled in accordance with dynamic cell clustering, which can effectively decrease the energy impact of the femtocell cluster [4]. Femtocell networks are considered as an energy efficient and cost effective way to improve the coverage and capacity of the network. However, the dense and random increment of femtocells and their uncoordinated operation raise very important questions related to interference pollution and spectrum allocation which is a major concern.

Inspired by the flexible subchannel allocation capabilities of cognitive radio, authors propose a cognitive hybrid division duplex (CHDD) that is suitable for heterogeneous networks in future mobile communication systems. Specifically, CHDD scheme uses pair of frequency bands to perform frequency division duplex (FDD) on the macrocell, while time division duplex (TDD) is simultaneously operated in these bands by overlapped cognitive femtocells. By doing this, the CHDD scheme exploits the advantages of both FDD and TDD schemes: intertier interference is controlled when femtocell operates in FDD at macrocell tier, whereas while it operates in TDD at the femtocell tier provides to femtocells the flexibility of adjusting uplink and downlink rates together with opportunistic access benefits [11].

Using sleeping mode in these unused BSs is the best and efficient method for energy conservation, so authors use the method in heterogeneous networks, while the coverage problem caused by such operation cannot be ignored. In this paper, authors use stochastic geometry [2] to study the trade-off between coverage extension problem (i.e., FAP additional connections by neighboring FUE or MUE) and saving of energy in two-tier femtocell networks. MBSs and FAPs are set to work in a coordinated sleeping mode, where certain MBSs will be shut off while other active MBSs and FAPs would extend their coverage to avoid coverage hole. Specifically, an activity-aware sleeping strategy for the two-tier femtocell network is proposed [2]. Coverage probability is termed as the probability of users which is successfully communicates with base stations. In addition, power consumption optimization and energy efficiency problems are proposed.

3. SYSTEM MODEL

In this paper, a two tier network model is considered. Two tier network, as it is clear from its name that there are two networks are involved. Two tier networks consist of a macro cell network and two or more femtocell network. Both the networks share same bandwidth. Femtocells are connected through femtocell access point.

(a) Femtocell
Femtocell is a very low power, low range device which operate in licensed frequency bands. It is specially designed for home, office or small areas mainly for indoors. Femtocell has a very short range around 10m to 3km. They are very small as compare to big macrocell.

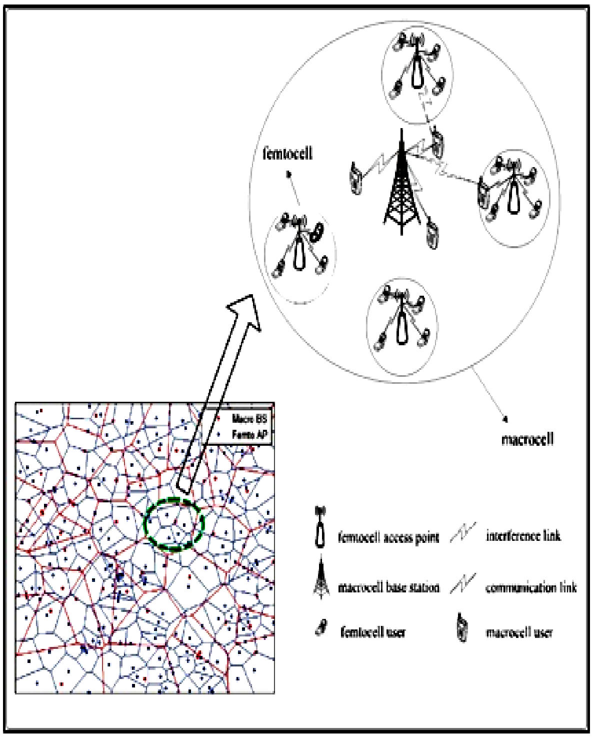

Fig.1. Two-tier femtocell network

It routes the mobile phone traffic through home. It is a plug and play device, very easy to operate. It improves coverage and capacity of the network and provides better data speed. Like cable modems and DSL routers, femtocells will be installed by customers and activated through network operators. This means that the Operator no longer has to employ installation teams or have a truck-roll every time a new femtocell is deployed.

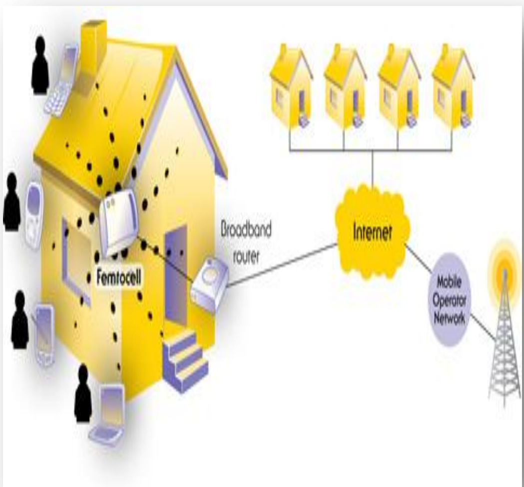

Fig. 2. Femtocell Concept

IJARCCE
ISSN (Online) 2278-1021
ISSN (Print) 2319 5940
International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 11, November 2016

It is a small cellular base station, also called a wireless access point that connects to a broadband Internet connection and broadcasts it into radio waves in its area of coverage. As a result, mobile handsets can handle phone calls through the femtocell, via the broadband Internet connection. Mobile cellular and 3G networks normally often suffer from poor penetration and reception in certain areas, like indoors. This decreases the quality of voice and video communication. It slows down high-speed services.

4. PROPOSED WORK

In this paper we have investigated the energy efficiency of a two tier femtocell network. Proposed methods are given below:

(a) Sleeping Strategies
Sleeping strategies are basically used to consume power. It is basically an on/off strategy based on the users. When there is no load or no subscriber to the network then send it to sleep mode. If there is any user switch it on. In this paper we have used grid based sleeping strategy but our results are compared with random sleeping strategy. Random sleeping strategy is that in which we consider a two tier network.

In the network a fraction of BSs are turned off, consider it as Bernoulli trail in which base station actives with probability q and sleeps with probability 1-q. On the other hand, grid based is different to that one. In the grid based sleeping strategy a femtocell grid is created outside the macrocell. In simple words we can say macrocell is divided into small segments of femtocell. According to the activity of user this strategy works. Firstly service will provide to that segment in which most of the users will active. This sleeping strategy is more energy efficient.

(b) Walfisch Ikegami Model
This model is a combination of walfisch and bertoni. It is a statistical model. It is mainly designed for finding the losses in indoor environment. It is mainly affected by the transmitter receiver distance, height of the antenna and height of the transmitter. Frequency range of this model is between 800 to 2000 MHZ. This model is further extended by COST 231 project as walfisch Ikegami COST 231 Model.

The formulation of the model is given as follow:
If a free LOS exists in a street canyon then, path loss defined as –

$$L_{los}=42.6+26\log R+20\log f \text{ for } R \geq 20m$$

If a non-LOS exists, path loss defined as follow:

$$L_b = \begin{cases} L_{FS} + L_{rts} + L_{msd} \\ L_{FS} \end{cases}$$

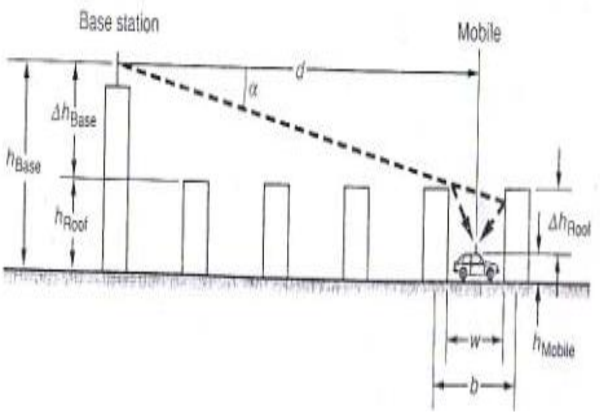

Fig 3. Geometry Model of Walfisch-Ikegami

(c) Monte Carlo Simulation
Monte carlo method is used for calculate the multidimensional numerical integration problems. It is basically used for probability or where the possibility of occurring two events. Monte Carlo simulations are used to model the probability of different outcomes in a process that cannot easily be predicted due to the intervention of random variables.

5. RESULTS

Fig.4 shows that here power consumption is almost 50% decreasing as compare to the previous work. When the no. of users will increase power consumption will also increase so here sleeping strategy is working. Here we are using only active users so our power consumption is decreasing here.

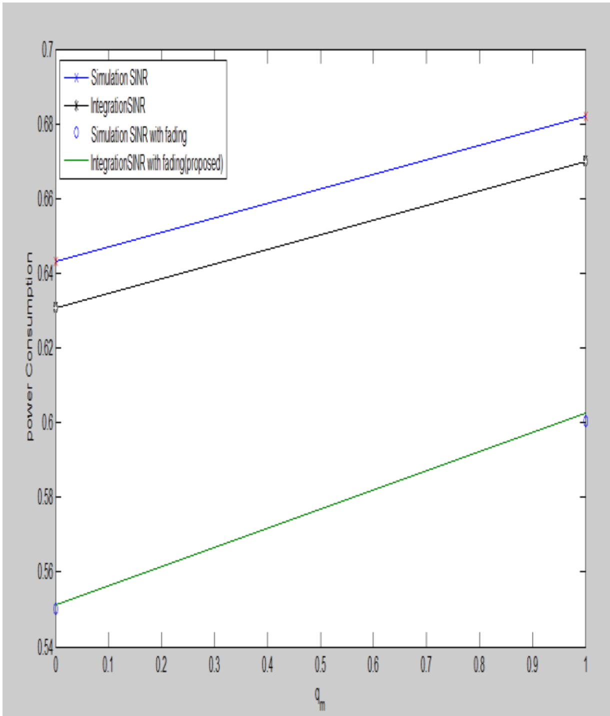

Fig.4. Power consumption using grid based sleeping strategy.

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified

Vol. 5, Issue 11, November 2016

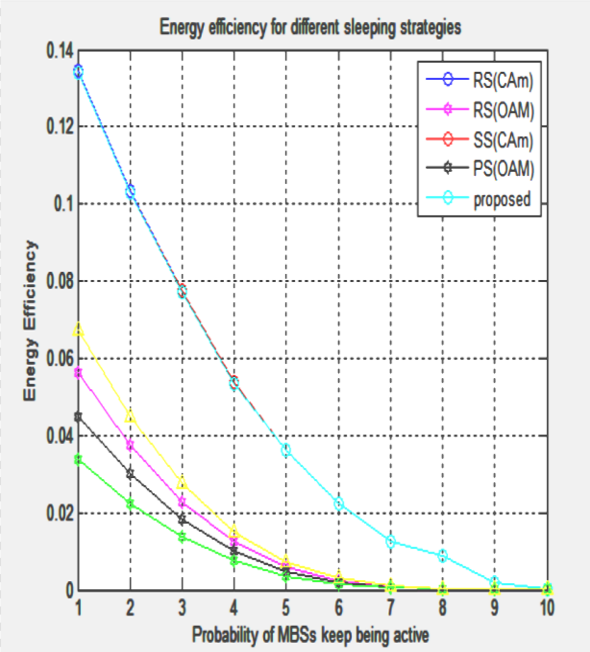

Fig. 5. Energy efficiency using different access modes and sleeping strategies

Fig. 5 shows improving energy efficiency. Energy efficiency is determined using different sleeping strategies and access modes of femtocell.

6. CONCLUSION

Now a days work on energy efficiency is increasing and it has become the concern point for all the network holders to provide better service to subscribers. Results prove that adopting sleeping strategy in both MBSs and FAPs can effectively improve energy efficiency, and the gain depends on the strategy and femtocell access mode Power Consumption and energy efficiency depend on the base station's status in this work. We can say sleeping strategies are energy efficient technology. This work can be extended in future by using chain based system.

REFERENCES

[1] I Ashraf and F Boccardi, 2011, Sleep mode techniques for small cell deployments, IEEE Communication Magzine, Vol. 49, No.8, pp.72–79.

[2] Ying Wang, Yuan Zhang, Yongce Chen and Rong Wei, 2015, Energy-efficient design of two- tier femtocell networks, EURASIP Journal on Wireless Communications and Networking, pp. 1-15.

[3] Z Hasan, H Boostanimehr, VK Bhargava, Green cellular networks: a survey,some research issues and challenges. IEEE Commun. Surveys Tutorials.**13**(4), 524–540 (2011).

[4] G Auer, V Giannini, C Desset, I Godor, P Skillermark, M Olsson, MA Imran, D Sabella, MJ Gonzalez, O Blume, A Fehske, How much energy is needed to run a wireless network? IEEE Wireless Commun. Mag. **18**(5), 40–49 (2011).

[5] O.A Akinlabi, B.S. Paul, M. Joseph and H.C. Ferreira,2014, A Review Femtocell, International Multi Conference of Engineers and Computer Scientists, Hong Kong, Vol. II, pp. 745-751.

[6] Xiaohu Ge, Tao Han, Yan Zhang, Guoqiang Mao, Cheng-Xiang Wang and Jing Zhang, 2014, Spectrum and energy efficiency evaluation of two-tier Femtocell networks with partially open channels, IEEE Transactions, Vehicular Technology, Vol.63, No.3, pp. 1306–1319.

[7] Tri Minh Nguye, Hyundong Shin and Tony Q.S. Quek, 2012, Network Throughput and Energy Efficiency in MIMO Femtocells, IEEE Communication, 18th European Wireless conference, pp.1-15.

[8] L. Saker and S.E. Elayoubi and Tijani Chahed, 2011, How femtocells impact the capacity and the energy efficiency of LTE-Advanced networks, IEEE 22nd International Symposium on Personal, Indoor and Mobile Radio Communications, pp. 177-181.

[9] Khaled Elleithy and Varun Rao, 2011, Femto Cells:Current Status and Future Directions, International Journal of Next-Generation Networks (IJNGN), Vol.3, No.1.

[10] 10. YS Soh, TQS Quek, M Kountouris and H Shin, 2013, Energy effcient heterogeneous cellular networks, IEEE Journal Selected Areas in Communication, pp. 840–850.

[11] Z Pan, S Shimamoto, in IEEE Wireless Communications and Networking Conference (WCNC). Cell sizing based energy optimization in joint Macro-Femto deployments via sleep activation (IEEE Shanghai, China, 2013), pp. 4765–4770.