International Journal of Electrical, Electronics and Computer Engineering 6(1): 114-117(2017)
ISSN No. (Online): 2277-2626

Maximization of SINR in femto cell network

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(Received 19 February, 2017 Accepted 02 April, 2017)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: As today 5th generation of cellular wireless network is envisaged to overcome existing challenges in cellular network such as higher data rate, great performance, increases in efficiency of circuitry, minimization of power consumption and interference challenges. Here in this paper we will discuss about interference challenges and technique to maximize SINR in femto cell network.

Keywords: femto cells, SINR, interference, LTE, FUT, MUT.

I. INTRODUCTION

From the time of 80s regularly different challenges are continuously occurring and every time by different technology the draw backs of past . but from the 1st generation interference remains the most problem that affect system performance.
Interference is the sum of all signal contribution that are neither noise, not the wanted signal.

Effects of interference:
1) Major limiting factor in cellular system performance.
2) Cause degradation of signal quality.
3) Introduce bit error.
4) Bit error are partly recoverable by channel coding and error correct technique.
5) Mobile and base station are exposed to different interference situation.

Sources of interference:
1) Another mobile unit in same cell
2) Call in progress in neighbor cell
3) Another base station with same frequency
4) Any non cellular system that leak energy.
LTE : here we developed small cellular base station called femto cell, it improves voice and data coverage for indoor sub carrier, therefore concept of deploying femto cells over macro cell has recently attracted growing interest.

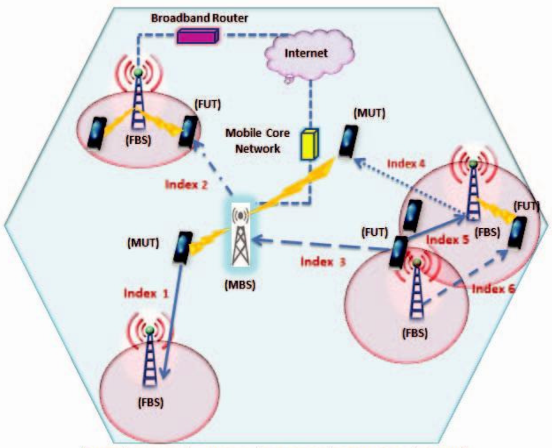
Types of interference:
Co-channel interference: Because of frequency reuse.
Adjacent channel interference: Signal adjacent to each cell are on quite similar frequency.

Co-tier interference: such interference occurs among same layer network elements e.g., inter-femto cell interference or inter-macro cell interference. In the case of heterogeneous network, the Co-interference is between the femto neighboring cells. For example, a FUT (Femto User Terminal), known aggressor, causes Co-uplink interference to neighboring FBS (s) (Femto Base Station), which are considered victims. On the other hand, a FBS is as a source of Co-downlink interference affecting adjacent FUT.

Cross-tier interference: this type of interference occurs between the elements that belong to different tiers of the network. There is talk interference between femto and macro cells. For example, the FUT and MUT (Macro User terminal) is a source of interference in uplink and affecting the MBS (Macro Base Station) to observe and nearby FBS (s) (index 1 and 3). On the other hand, the MBS and FBS (s) cause downlink interference. This particular attack FUT (s) and closest MUT (s) (Fig. 1).

There are basically four type of interference.
First interference is between macro base station and femto UE (user element).
Second interference is between macro UE and femto base station.
Third interference is between femto UE and neighboring femto base station.
While fourth, interference is between macro UE and neighboring macro base station.
The main problem to this continued micro-ization of cellular networks is that the network infrastructure for doing so is expensive. A recent development are femto cells, also called home base-stations, which are short range, low cost and low power base-stations, installed by the consumer for better indoor voice and data reception. The user-installed device communicates with the cellular network over a broadband connection such as DSL, cable modem, or a separate RF backhaul channel.

While conventional approaches require dual-mode handsets to deliver both in-home and mobile services, an in-home femtocell deployment promises fixed mobile convergence with existing handsets.



Index	Aggressor	Victim	Interference type	Transmission mode	Symbol
1	Macrocell UT	Femtocell BS	Cross-tier	Uplink	——→
2	Macrocell BS	Femtocell UT	Cross-tier	Downlink	– · –→
3	Femtocell UT	Macrocell BS	Cross-tier	Uplink	— —→
4	Femtocell BS	Macrocell UT	Cross-tier	Downlink	········→
5	Femtocell UT	Femtocell BS	Co-tier	Uplink	——→
6	Femtocell BS	Femtocell UT	Co-tier	Downlink	– – –→

Fig. 1. Interference scenarios in heterogonous networks.

Studies on wireless usage show that more than 50% of all voice calls and more than 70% of data traffic originates indoors. Voice networks are engineered to tolerate low signal quality, since the required data rate for voice signals is very low, on the order of 10 kbps or less. Data networks, on the other hand, require much higher signal quality in order to provide the multi-Mbps data rates users have come to expect.

For indoor devices, particularly at the higher carrier frequencies likely to be deployed in many wireless broadband systems, attenuation losses will make high signal quality and hence high data rates very difficult to achieve. This raises the obvious question: why not encourage the end-user to install a short-range low-power link in these locations? This is the essence of the win-win of the femtocell approach. The subscriber is happy with the higher data rates and reliability; the operator reduces the amount on traffic on their expensive macro cell network, and can focus its resources on truly mobile users.

Benefits of femto cell network

Best coverage and capacity: Due to their short transmit-receive distance, femtocells can greatly lower transmit power, prolong handset battery life, and achieve a higher signal-to-interference-plus-noise ratio (SINR). These translate into improved reception—the so-called five-bar coverage—and higher capacity. Because of the reduced interference, more users can be packed into a given area in the same region of spectrum, thus increasing the area spectral efficiency , or equivalently, the total number of active users per Hz per unit area.

Improved macrocell reliability: If the traffic originating indoors can be absorbed into the femtocell networks over the IP backbone, the macrocell BS can redirect its resources towards providing better reception for mobile users.

Cost benefits: Femtocell deployments will reduce the operating and capital expenditure costs for operators. The deployment of femtocells will reduce the need for adding macro-BS towers.

Reduced subscriber turnover: Poor in-building coverage causes customer dissatisfaction, encouraging them to either switch operators or maintain a separate wired line whenever indoors. The enhanced home coverage provided by femtocells will reduce motivation for home users to switch carriers.

The goal of this paper to show that how and in what way the femto cell network helps in maximization of SINR , by varing the height and distances of antennas we will use in a network,

As femto cell network is helpful in indoor system these are some short points about femto cell:

Low transmitted power, low range, average 2 to 4 user per femto cell.

In this paper our aim is to maximize SINR in femto cell network to increase system efficiency or to increase signal strength.

And this aim can be obtained by maximizing SINR using the below giving stations arrangements as shown in Fig. 2.

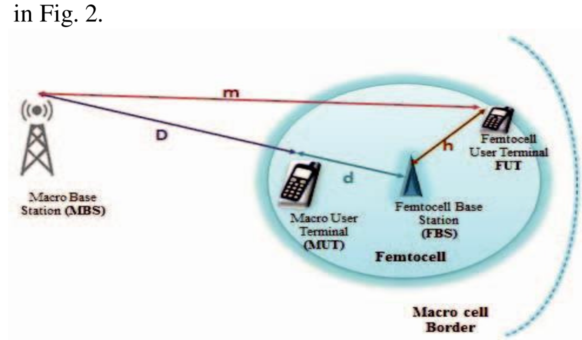


Fig. 2. Example of spectrum sharing between macro and femto cell.

Now we will see it by an example that how the SINR will be maximize using the frequencies and distances in femto call network in below figure.

On this scheme, one considers in fact,
a Macro Base Station (MBS),
a Femto Base Station (FBS) ,
a Macro User Terminal designed MUT and another Femto User Terminal noted FUT,
D is the distance between MBS and MUT,
d, that separating MUT of FBS,
m, distance from FUT to MBS,
And h, the distance between FBS and FUT.
Allowing for dominant interference, the composite SINR is expressed by.

$$SINR_{MUT} + SINR_{FUT} = \alpha_1 \left[\frac{m}{D}(dB)\right] + \alpha_2 \left[\frac{d}{h}(dB)\right] - [(f_1 + f_2)(dB)] \quad (1)$$

In above formula the received power is a function of path loss from MBS noted α_1 but also those caused from the FBS noted α_2 (with $\alpha_1 < \alpha_2$).
The height of the MBS is generally higher than that of FBS.
In addition, interference between macro and femto cells depends on many factors (modulation schemes, synchronization, orthogonality factor, noise…). It will be noted respectively by f_1 and f_2 the factors accruing to MBS and FBS.
Here let us take an example by considering parameters and plot a graph that how SINR be maximize for different values of h and d by varying them.
Parameters we are going to use these parameters are not fixed they can be vary and changed.

Parameter	values
m	Say 8 km
D	1000m
F_1	1
F_2	1
α_1	3.7
α_2	4

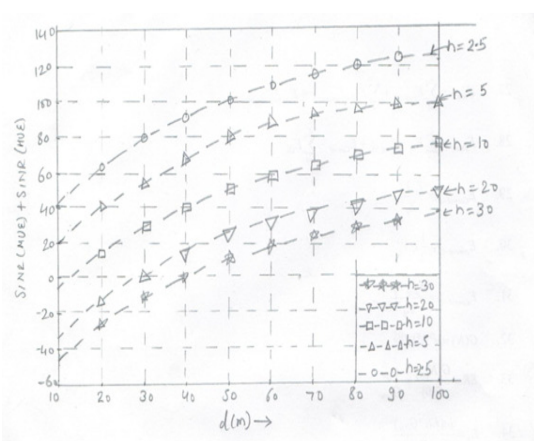


Fig. 3. SINR plot for different values of varying h and d.

Above parameters are going to be used in equation 1, to calculate SINR at different height and distances of antennas, and the graph plotted below on the basis of those calculation shows how the SINR comes out at different height and distances between antennas and users of femto cell user and macro cell users.
The obtained results show that when macro users will occur far way from FBS, the sum of SINRs increases. Similarly, for a
minimum distance h between a FBS and FUT, the SINR sum is maximum. For example, for h=2.5m and for a distance d= 90m, the ratio reach 120 dB. Similarly by varying h and d we try to reach the maximum SINR ratio as much we can to give strength to our signal.
To reduce co-tier and cross tier interference, different techniques are proposed in 4G that include; Femto-Aware spectrum arrangement scheme, clustering of femto cell, collaborative frequency scheduling, Beam subset selection strategy, power control approach, Fractional Frequency Reuse (FFR) and resource partitioning.
These techniques are more developed and studying in 5G to satisfy the requirements requested by this generation. Therefore, several works focusing on the importance of power control and cell association strategies and their limitations for interference management in 5G multi-tier cellular network.

II. CONCLUSION

Our paper represents how in femto cell network we can maximize SINR ratio by varying height and distance between antennas of FBS and FUT. Above plotted graph represents how for distance m ,h and d can be varied to maximize SINR . that increases efficiency of our network by diving network into femto cells.

REFERENCE

[1]. W. Yi *et al.*, “A Novel Spectrum Arrangement Scheme for Femtocell Deployment in LTE Macrocells,” *Proc. IEEE 20th Symp. Personal, Indoor and Mobile Radio Communications*, 13–16 Sept. 2009, pp. 6–11.
[2]. H. Li *et al.*, “Graph Method Based Clustering Strategy for Femtocell Interference Management and Spectrum Efficiency Improvement,” *Proc. IEEE 6th Int’l. Conf. Wireless Communications Networking and Mobile Computing (WiCOM)*, 23–25 Sept. 2010, pp. 1–5.
[3]. M. E. Sahin *et al.*, “Handling CCI and ICI in OFDMA Femtocell Networks Through Frequency Scheduling,” *IEEE Trans. Consumer Electronics*, vol. **55**, no. 4, Nov.2009, pp. 1936–44.
[4]. Ekram Hossain, Mehdi Rasti, Hina Tabassum, and Amr Abdelnasser, “Evolution Towards 5G Multi-tier Cellular Wireless Networks: An Interference Management Perspective”.

[5]. Nazmus Saquib, Ekram Hossain, Long Bao Le, and Dong in Kim, Interference Management In OFDM Femtocell Networks: Issues and Approaches. June 2012.

[6]. Interference Management in LTE Femtocell Systems Using an Adaptive Frequency Reuse Scheme.

[7]. Xiangfang Li, Lijun Qian, and Deepak Kataria. Downlink power control in co-channel macrocell femtocell overlay. In *Information Sciences and Systems, 2009. CISS 2009. 43rd Annual Conference on*, pages 383{388. IEEE, 2009.

[8]. Ejder Bastug, Mehdi Bennis3, Marios Kountouris2 and M_erouane Debbah1, « Cache-enabled Small Cell Networks: Modeling and Tradeoffs.

[9]. Michel Nahas, Ahmed Saadani, J Charles, and Zouhair El-Bazzal. Base stations evolution : Toward 4g technology. *In 19th International Conference on Telecommunications*, 2012, pages 1-6. IEEE, 2012.

[10]. Erik G. Larsson, ISY, Linköping University, Sweden Ove Edfors, Lund University, Sweden Fredrik Tufvesson, Lund University, Sweden Thomas L. Marzetta, Bell Labs, Alcatel-Lucent, USA, « Massive Mimo For Next Generation Wireless Systems », 23 January 2014.