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Performance Evaluation of Femtocell Analysis for Capacity and Throughput in Various Path Loss Models

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Abstract:- Femtocell are the smart cellular access point that support all mobile device using standard cellular air interface and academia Femtocells are deployed in existing macrocell network to improve network coverage in an indoor environment , it is a solution to the indoor coverage problems and congested areas .There are various applications (internet services and videos) were built and the number of mobile subscribers are increasing day by day, on the basis of this it was believed that the future mobile systems should provide optimized coverage, high capacity and efficient resource utilization. In the present work we studied femtocells on the dedicated and shared basis and also on the presence of UE with respect to the base station. The capacity increases and the quality performance is achieved when the transmitter and receiver are close to each other. The outdoor loss is zero when BS and UE both lie in the same house and therefore throughput we get is better from other two cases.

Keywords:- *FAP, FC, NLOS, UMTS, DSA, UE.*

I. INTRODUCTION

The demand for higher data rates is increasing in wireless networks, this has force to get high level of model and therefore enlarge the novel data – minded cellular standards such as LTE standards and 3GPP's High Speed Packet Access (HSPA), WiMAX (802.16e), and 3GPP2's EVDO and UMB standards. Wi-Fi spread the services in an additional distributed fashion [1]. The topology and architecture of cellular networks are undergoing a major paradigm shift from voice-centric, circuit switched and centrally optimized for coverage towards data centric, packet switched and organically deployed for capacity. The principle drivers for this shift are intense consumer demand for mobile data.. These are designed aiming at offering high performance 3G voice and data communications in and around the immediate home environment. They have the capability to make indoor broadcasting for mobile communications completely determined while delivering additional benefits to both the operator and end user when they are connected to the network of mobile operator over existing broadband connections in the home [3]. The whole indoor broadcasting solution is provided to the operators while developing femtocell network, all in a small, easy-to-install base station that can be effortlessly integrated into existing mobile networks, low-cost, low-power, and conditioned for service within minutes of switching it on femtocell gives a good quality of service (QoS) and performance[4]. The infrastructure of setup for doing so is very expensive and this is the main difficulty to this type of cellular setups. In recent developments, Femtocells are the best example that are short range, also called home base-stations[5],[6],[7], cheap and less power base-stations, for better receiving of data and indoor voice established by the end user. The communication takes place between the cellular network and user mounted device over a broadband connection such as a separate RF backhaul channel, cable modem, or DSL[8]. The dual-mode handsets are required in conventional techniques to deliver both in-home and mobile services, an in-home femtocell deployment promises fixed mobile convergence with existing handsets. Enhancing system capacity, such as distributed antenna systems [9] and microcells [10], and when compared to other techniques it is less costly and because of this femtocells are used.Only Call networks (Audio) are needed to provide low signal quality, because the required data rate for voice signals is very low, on the order of 10 kbps or less[11]. Video and other Data networks, on the other hand, needs much higher signal quality and efficiency in order to give output of the multi-Mbps[12] data rates users have come to expect. In indoor devices, mainly at the higher carrier frequencies likely to be installed in many wireless broadband systems due to attenuation losses will make high signal quality and therefore it becomes very difficult to achieve the high data rates and good quality srvice[13]. The distance between the femtocell and useris less and hence the good battery life of user equipment and then diminishes the interference and can focus its resources on truly mobile users[14] and therefore making the subscriber happy with higher data rates and reliability.

$$[(R_1, \emptyset_{CP}) | G(R_1, \emptyset_{CP}) \leq 0 \cap J(R_1, \emptyset_{CP}) \geq 0]$$

II. LITERATURE SURVEY

A. *Pekka Pirinen*

Proposed that Femtocells are proving to be an effective and low cost design to increase coverage and capacity. Femtocell is affected by co-channel interference from other macro cells. By varying certain parameters of outage probability and throughput we saw that Femtocell as robust against interference and described its path loss modal [15].

B. *Tom Priebe*

Proposed some problems regarding Femtocell networks and provide us some finite solutions. Due to variations in handling networks like LTE or mobile service network several problems occur. The paper includes interference issue and handover issues [16].

C. Jamel A. Hassan

Proposed model of UMTS network for increasing coverage and capacity in presence of co-channel interference. Certain parameters like voice activity factor, intercell interference, co-channel and handoff are studied for capacity and other parameters like frequency, ,bandwidth, ,QoS , bit rate are studied for coverage. The simulation results gives the effect of these on coverage, capacity of UMTS [17].

D. KrantiBhoitenetwork in 2015

Proposed that Femtocell can be used for less consumption, low cost and small distance indoor practises. It is a wireless communication standard to achieve high capacity, high data rate for easily deployment of Femtocell communication between Femtocell and macrocell is important. Handover algorithms are used to fulfil the need of handoff management in Femtocell [18].

E. Omar Arafat, Mark A. Gregory in 2015

Proposed that in urban and indoor locations, femtocells provides a good cost effective way to offer bandwidth required in advanced mobile data services femtocells improve the coverage and capacity of mobile network in highly crowed indoor areas and business enterprise atmosphere. In this paper. Analysis of LTE Femtocell is done [19].

F. O.A. Akinlabi, B.S. Paul, M.K. Joseph, H.C. Ferreirain 2015

Proposed that indoor mobile signals go through attenuation, call distortion and low voice quality due to interference. Instead of using a no. of base stations, femtocells were used in indoor areas to increase the signal strength and improved coverage. In this paper, simulation base on signal was provide and path loss model is prepared which shows that Femtocell improved indoor coverage with high signal strength and high QoS without interference [20].

G. VidyaSagar, R. Madhu in 2016

Proposed that mobile networks provides poor signal strength to indoor users due to signal distortion and interference. Femtocell deployed to get better coverage. But femtocell suffers co-channel interference from macro cell using same frequency band. This paper proposed a theme which provide another scheme for advanced LTE networks [21].

H. Chinar Garg, Anjali, J.P.Sharma, Lovely Chawla

Proposed path loss model for Femtocell. It is done by taking various cases of placing user equipment at different location with respect to femtocells. Here, coverage capacity is enhanced by taking different kinds of small cells, Femtocell is one among them. Femtocell increases coverage , enhanced voice quality and reception of signals in indoor areas. In this paper, analyses of Femtocell is done in urban areas using path loss models [22].

III. FEMTOCELLS

To enhance the coverage area and also the capacity of spectrum, Femtocells came into existence and proved to be the biggest solution for broad connectivity in mobile network. The capacity of spectrum has been increased in the third generation through various ways like using number of relays to a great extent, launching microcells and nanocells, enhancing antennas configurations, etc. but all of the above mentioned ways have different type of limitations. Like when it draws closer to indoor communication enhancing the number of relays is not useful. Therefore theory of femtocell came into existence. Femto denotes to the factor of 10^{15}. Femtocell is a small low power wireless access point which is modeled to get better data reception and indoor videos inside home, office or building etc. The device communicates with the mobile phone and converts the voice all into voice over IP (VoIP) Implementation of femtocells is done in existence of macro cells. Femtocell may be believed as a small cell with low power base station installed inside a home, office, or a building etc. Since it uses less power, it consumes less battery. As femtocell offers a high level of encryption this makes the data more secure.

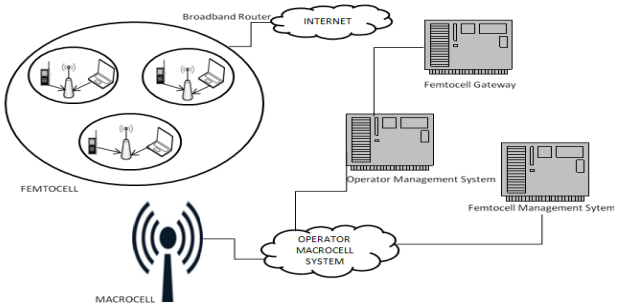

Fig 1:- Femtocell Scenario

IV. FEMTOCELL ACCESS CONTROL APPROACHES

In term of service distribution FCs are distributed in three modes : Open access mode , Closed access mode and Hybrid Access mode.

- *Open Access Mode*

Open access mode provides service even to unregistered MUs. Open access Femtocell enhance the network throughout and hence find application in public area like airports, business enterprise , buildings, shopping malls and colleges. Open access have huge handover mechanisms between under-laid MC and open access FC , non-guaranteed QoS to FUs with billing amount.

- *Closed Access Mode*

In closed access mode users are provided with their femto access points in advance and those points can be used by the only users provided with the points. This mode prevents an unregistered user from accessing the Femtocell .

Only emergency cases can be handled. This mode faces the co-tier and cross-tier interference which degrades the Femtocell efficacy.

- *Hybrid Access Mode*

This is identical to close access mode to some extent i.e. the access is given to the users who are already provided with their femto access points but when the request for the femto access points are made by other users then the access is given but this is done in the preferential order. Hybrid access mode has the provision to select , to choose and add the guest network users along with the registered home users.

V. FEMTOCELL NETWORK ARCHITECTURE

Femtocell includes the LTE , WiMAX, 3G(UMTS) .The illustration of femtocell network architecture is shown in the figure in which there is a femtocell gateway and homes connected to the gateway through internet service provider. For a femtocell setup homes must have a broadband connection (through cable or fiber). FCs gateway is connected to the core network on the one side and to the homes on the other side. In 3GPP network the scenario is like the above shown where there is acrossing point between FCs gateway and the core network. This crossing point is known as Iu-h. The core setup which is based on transmission of data packets, therefore all the traffic is IP based.

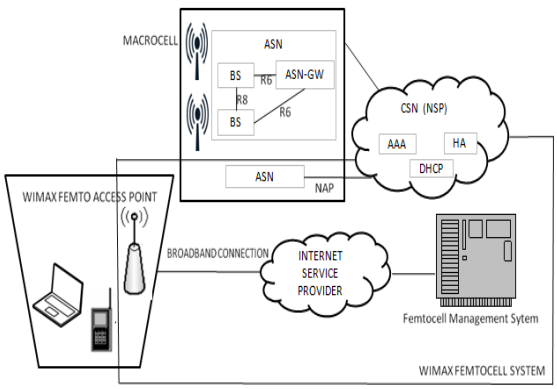

Fig 2:- An Example of Femtocell Network Architecture

Here cellular setup is also shown which offers access to PSTN (Public Switched Telephone Network) for broadband data and voice services.

VI. HANDOFF STRATEGIES

In wireless communication handover or handoff is defined as a process in which ongoing call or data session is transferred from one cell to another on an ongoing call or data session when communicating between different channels or base stations.

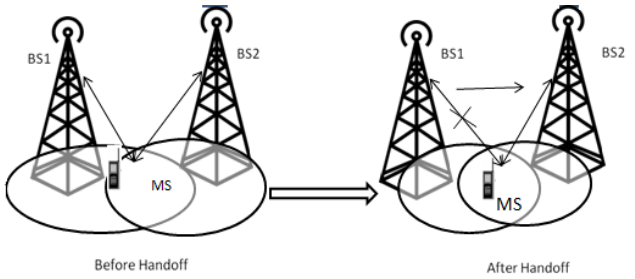

Fig 3:- Handoff process

According to network structure, there are generally two types of handovers in 2G and 3G systems:

- Hard Handoff
- Soft Handoff

A. Hard Handoff

Whenever a user is coming from one cell and then entered in another, a call is first disconnected from the home base station because power of the home base station decrease as the users move to the next station and then connected to the new base station. As the distance increases connections degrade and all may drops. Hard hand off is also known as break – before - make or inter fre quency handover.

B. Soft Handoff

When a user is coming from one cell and then entered to another, a call is first connected to the new base station because power of home base station decreases as the users moves to the next base station and then disconnected from the home base station. The call is not disconnected in soft handoff. Soft handoff is using make-before-break strategy and is also known as intra Frequency handoff.

VII. HANDOVER IN FEMTOCELLS

In femtocells, generally there are hard handoff because the femtocells uses the different and variable range of frequencies. This frequency range includes both type of licensed and unlicensed band of frequencies. There are different types of handover in femtocells

- Inbound (Macrocell to Femtocell)
- Outbound (Femtocell to Macrocell)
- Femtocell to Femtocell

A. Inbound (Macrocell to Femtocell)

This is a type of handover when one user travels from macrocell to femtocell while ongoing a call. This type of handover is most common of all. This is same as when handover is done between one macrocell to other macrocell. But handoff is a challenge because macrocell and femtocell have different backhaul. In a macrocell to macrocell type of handoff signaling is done through backhaul network.

B. Outbound (Femtocell to Macrocell)

Femtocell to macrocell handoff is also similar to macrocell to macrocell but with an exception that there is no interface present between the base stations. Femtocell route involves femtocell gateway for data and voice transmission

but for both macrocell and femtocell network signaling is done over the backhaul linkage to the core network.

C. Femtocell to Femtocell

Femtocell to femtocell handover is done through femtocell gateway. Handover includes radio technology so there is no soft handover in femtocell to femtocell handover. All the calls are switched immediately to the femtocell or from the femtocell.

VIII. CONCLUSION

In this present paper, we have studied different type of femtocell access control techniques and found that the femtocell is best carried out in hybrid access mode because the access is given not only to those users who are already assigned with their femto access points but also to the one who requests for femto access point and thus gives them the access in preferential order. It allows certain number of outage-experiencing mobile units to access the limited amount of Femtocell backhaul route without compromising with service quality. Also various handover strategies and handover in femtocells have been studied. Soft handoff technique is better due to make-before-break technique based on network structure. The outbound handover offers a good performance since there is no crossing point present between base stations and Femtocell route which involves femtocell gateway for transmission of data and voice. In the future, the proposed work can be extended for next generation heterogeneous mobile network that will contain different types of base stations such as microcell, microcell, picocell and femtocells.

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