

# Femtocell - A Small Cell

Thara Elizaba Thomas<sup>1</sup>

<sup>1</sup>M.tech Student, Department of Communication Engineering,  
Mount Zion College of Engineering, Kadammanitta, Pathanamthitta, Kerala, India

**Abstract:** Femtocell is a small cellular base station it is to boost service quality and provide value added services within a home or a small business and it connects to the service provider's network via broadband (such as DSL or cable). Its typically support 2 to 5 mobile phones. It is essentially routes mobile calls over the internet. A Femtocell increases its coverage, especially at indoors; it is true in many homes where wireless signal cannot reach inside or poor signal strength due to security. Femtocells are considered an important element of Fixed Mobile Convergence (FMC). Traditional FMC requires use of dual mode (WiFi) handsets but ordinary cellphones can be used for FMC. One of the most significant advantages of Femtocell wireless is that by directing home mobile calls on the internet, operators can free up the wireless network. In emerging markets, wireless network congestion rates point to the idea that Femtocells would be a boon in such locations.

**Keywords:** Closed subscriber group, digital subscriber line, femtocell, system description document, self organizing network.

## 1. Introduction

In telecommunication, a femtocell is a small cellular base station and is typically designed for use in home or small business and is connects to the service provider's network via broadband. Current designs typically support 2 to 5 active mobile phones in residential setting and 8to16 in enterprise settings. A femtocell increases or extends indoor coverage, otherwise be limited or unavailable. For a mobile operator, the main attractions are both coverage and capacity, especially indoors. Thus can reduce both expenditure and operating expense. It is typically the size of a residential gateway or smaller, and it connects to the end-user's via broadband line. Once femtocell connects to the MNO's mobile network, and it provides extra coverage in a range of 30 to 50 meters for residential.

The end-user must declare which mobile phone numbers are allowed to connect to the specific Femtocell, and is usually via a web interface provided by the MNO, these mobile phones arrive under coverage of the femtocell, and they will switch over from the Macrocell (outdoor) to the Femtocell automatically. Most MNOs provide means for the end-user to know this has happened, for example, different network name appear on the mobile phone. All communications will automatically go through the femtocell. When the end-user leaves the femtocell coverage (whether in a call or not), his phone hands over to the macro network

## 2. Existing System

Wireless communication technology, small exchanges (called cells equipped with low-power radio antennas (strategically located over a wide geographical area) are interconnected through a central exchange. As a receiver (cell phone) moves from one place to the next, identity, location, and radio frequency is handed-over by one cell to another without interrupting a call. Problem with cellular arrangement was that Lower re-use factor: Larger cells, High interference due to close interfering cells. High re-use factor:

## 3. Proposed System

Since mid-1990s, the mobile cellular communication industry has been enjoying its fastest growth. Today's wireless communication technology is the refined and mature version of what we called the new technology during the seventies. The worldwide success of wireless communication demonstrated that it is a workable medium for multimedia communication causing new wireless systems and standards being introduced for other types of telecommunication traffic besides voice and data service.

With the maturity in mobile communication technology, operators are deploying it both indoors and outdoors. Recent market surveys demonstrate that up to 80% wireless communication usage seems to occur indoors .Out of that, 50% of the traffic is because of phone calls and 70% due to data services holds true especially for indoor environments There is a continuously increasing trend in the demands of high speed data services among end users. It has been estimated that between the year 2010 and 2013, there will be 10 to 30 times increase In mobile phone data traffic .The demand of multimedia traffic is high and the existing cellular network system cannot meet the required demands as its coverage area and capacity is not sufficient. Providing these high speed data services to the dense urban areas is quite challenging. macrocell antenna's coverage very poor and cellular users feel lot of difficulties in receiving high speed services in the indoor environment. The femtocell provides excellent coverage in the indoor areas and it also avoid call dropping and provide call continuity. The problems faced by the indoor mobile users can be alleviated by employing femtocells. IEEE 802.16 SDD (system description document) initially introduced the concept of femtocells. They are low power, short range, low cost small Base stations that operate in a licensed spectrum. Femtocells provide strengthened cellular signals for indoor users. It usually has coverage of 30-40 meters and is placed indoors for stationary or less mobile users. The femtocell communicates with the cellular operators' network over a broadband connection such as digital subscriber line (DSL), cable modem or a separate radio frequency

backhaul channel. 90% data services and 2/3 services are expected to be indoors. Femtocells can prove to be a rational solution to this problem. Femtocell can provide “high coverage” to customers indoor.

## 4. Hardware Architecture

### 4.1 Femtocell

In telecommunications, a femtocell is a small, low-power cellular base station, and is typically designed for use in home or business. It connects to the service provider’s network via broadband (such as DSL or cable). It typically support 2 to 4 active mobile phones in a residential setting, and 8 to 16 active mobile phones in enterprise settings. A femtocell allows service providers to extend service coverage indoors, especially where the service be limited or unavailable. The main attractions of a femtocell are both coverage and capacity, especially in the indoors. Good coverage , potentially better voice quality and battery life will provide benefit for the users . Depending on the carrier they may also be offered more attractive tariffs, for e.g., discounted calls from home Due to the saturation property of the PA, D1 and D2 are positive and  $D2 < 0$ , therefore the fading channel gains are considered.  $g_1$  is the fading channel gain between ST and the PR1 and  $g_2$  is the fading channel gain between ST and the PR2.

### 4.2 Concept of Femtocell

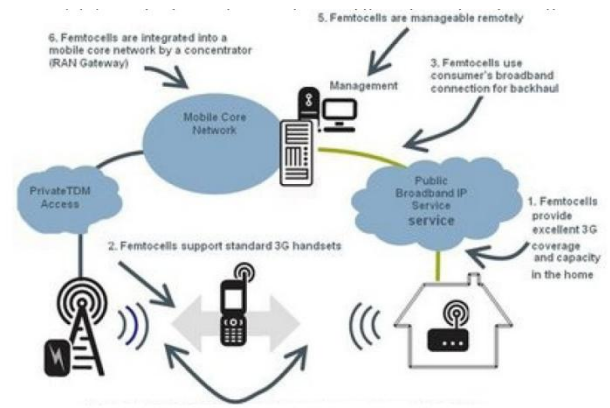
Indoor cellular coverage.  
 Can “talk” with any device.  
 Low cost backhauling.

### 4.3 Features Of Femtocell

Operates in licensed spectrum.  
 It uses fixed broadband connection for backhaul.  
 Principally intended for home and SOHO.  
 Smaller coverage.

### 4.4 Working of Femtocell

Femtocells are a part of mobile operator’s network. We can locate this at home or in the business .It function completely depends on a 3G cell site has been miniaturized on to a chip and operates like a Wi-Fi access point It is connected via broadband DSL back to the mobile operator’s network. A femtocell is installed at home and connected to mains power and standard broadband IP connection typically DSL through the mobile operator’s core network .Voice calls, text messages and data services are provided by the same systems. Femtocells are operates at very low radiation power levels and typically have a range of 200 meters. These types of signals do not travel through walls.



### 4.5 Access Control Modes

Femtocell base stations have a list of its users in order to limit and prevent the usage of femtocells against illegal subscribers. Three types of access control methods in which femtocells can be configured to allow or block the users are thoroughly proposed. There are three types of access control methods:

- Open access
- Closed access
- Hybrid access

The open type access control is similar to a typical macrocell, i.e., every subscriber is allowed to communicate with the femtocell. It can be used for general public users in malls, restaurants, and airports etc. In case of closed access method, the femtocell services can be availed by limited number of subscribers subscribed to the given base station. This case can be used for private usage such as in homes and offices etc. There is also an adaptive femtocell access policy, called hybrid access method .In hybrid access mode, the subscribed users get the preferential charging in comparison with the non-subscribed users to the cell to avail the services.

## 5. Femtocell Challenges

### 5.1 Interference Management

The interference can be classified as:

- Co-Layer Interference
  - Cross-Layer Interference
- Cross-layer refers to the interference between the users of two different network layers as the FAP and the macrocell.

A cancellation technique is proposed to overcome this kind of interference; however this technique is disregarded because of errors in the cancellation process.

### 5.2 Femtocell Handover Basics

- Inbound - This is where handover occurs from the macro-cell or standard cellular network to the femtocell.
- Outbound - This is where a handover occurs from the femtocell to the macro-cell or standard cellular network.

Femtocell to femtocell - There will be situations where handover will occur between one femtocell and another close by.

### 5.3 Economic, Regulatory Issues

The business case for femto-cells has been made by a number of studies. The basic value proposition is that the cost of the femtocell itself is greatly outweighed by the savings from offloading traffic from the macrocellular networks. These findings appear to be true across a range of market segments from residential to enterprise users. Femtocells offer a very different approach to that of WiFi and especially whitespace. Femtocells are provided by wireless operators as a managed service compared to the best-effort service offered by WiFi and possibly whitespace.

## 6. Experimental Results

The main benefits for the end users are “5 bar” coverage when there is no existing signal or poor coverage. Higher mobile data capacity for enterprises having femto instead of DECT (“codeless home”).

## 7. Future Scope

In solving the problems of femtocell the following some of the most challenging areas of concern the most challenging areas of concerns they are Security backhaul. Self Organizing Network enhanced MIMO Interference. One of the factors that will have tremendous impact on the global success of the femtocells will be the issue of security. Security is a critical point in the femto-cellular network, particularly in all aspects of its operation or use. Higher level of cryptographic algorithm needed that will protect the confidentiality and integrity, coupled with excellent authentication. The use or modification of the Hosting Party information must be allowed only with strict permission obtained by the Service Providers from the hosting party. The International Mobile Subscriber Identity (IMSI) data of us.

The future of femtocells (and particularly, the future networks) depends on SON's capabilities. Although, some of the concepts of SON have been used in some regards, a number of key 3GPP principles still need to be addressed in the future who are connected to the femtocell network with not be displaced or released to the Hosting party.

## 8. Conclusion

The most important benefits of wide scale femtocell deployment are lower cost of deployment, better indoor signal reception for voice and data, and decreased burden on Macro/ Microcell base stations i.e. if the femtocell base station uses DSL as the means to backhaul the user traffic. Apart from the technical issues and their proposed solutions that are highlighted. The effective development of attractive business models shall also facilitate the rapid deployment of femtocells. One of the main end user concerns related to femtocell deployment lie in the cost of

femtocell base station and the packages offered to the user for data access. In case when the user has access to both DSL and WLAN services that provides the user with a much higher bandwidth than data access on a cellular network, the extra costs incurred while accessing data services via a femtocell can also be an important cause of reluctance on behalf of the end user to opt for a femtocell solution. However, with better indoor signal strength and higher bandwidths offered by LTE and LTE advanced (4G and beyond), along with offering cheaper packages to the end consumers for data access while addressing the technical issues highlighted, femtocell deployment on a much wider scale can be made a reality.

## References

- [1] L. Wang; Y. Zhang, W. Zhenrong "Mobility Management Schemes at Radio Network Layer for LTE Femtocells", IEEE 69th Vehicular Technology Conference, pp.1-5, 26-29 April 2009
- [2] S. B. Kang, Y. M. Seo, Y. K. Lee, M.Z. Chowdhury, W. S. Ko, M.N. Irlam, S. W. Choi, Y. M. Jang, "Soft QoS-based CAC Scheme for WCDMA Femtocell Networks", 10th International Conference Advanced Communication Technology, pp.409-412, 17-20 Feb. 2008.
- [3] Chandrasekhar, J. Andrews, A. Gatherer, "Femtocell Networks: A Survey", IEEE Communications Magazine, vol.46, no.9, pp.59-67, September 2008.
- [4] "UMA Paves way for convergence", white paper, North Stream, September 2005.
- [5] S. Das, T.E. Klein, S. Mukherjee, G. Rittenhouse, L.G. Samuel, H Viswanathan, K.K. Leung, H. Zheng, "Distributed paging and registration in wireless networks", IEEE Network, vol.19, no.5, pp. 19- 25, Sept.-Oct. 2005.

## Author Profile



**Thara Elizaba Thomas** received the B.Tech degrees in Electronics and Communication Engineering from M.G University, Kerala at Mount Zion College of Engineering and Technology in 2013. And now she is pursuing her M.Tech degree in Communication Engineering under the same university in Mount Zion College of Engineering.