

Femtocell Technology Implementaion

CH.RayalaVinodkumar
Asst.Professor ,
IT Dept, GMRIT

K.Lakshmana Rao
Asst.Professor.
IT Dept, GMRIT

K.Kanaka Vardhini,
Asst.Professor
IT Dept,GMRIT

ABSTRACT:

Femtocells, a technology little-known outside the wireless world, promise better indoor cellular service. In telecommunication, a Femtocell is a small cellular base station, typically designed for use in a home or small business. It connects to the service provider's network via broadband. Current designs 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 access would otherwise be limited or unavailable. For a mobile operator, the attractions of a Femtocell are improvements to both coverage and capacity, especially indoors. This can reduce both capital expenditure and operating expense.

A Femtocell is typically the size of a residential gateway or smaller, and connects into the end-user's broadband line. Once plugged in, the Femtocell connects to the MNO's mobile network, and provides extra coverage in a range of typically 30 to 50 meters for residential Femtocells.

The end-user must declare which mobile phone numbers are allowed to connect to his/her Femtocell, usually via a web interface provided by the MNO. When these mobile phones arrive under coverage of the Femtocell, they 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 by having a different network name appear on the mobile phone. All

communications will then automatically go through the Femtocell. When the end-user leaves the Femtocell coverage (whether in a call or not), his phone hands over seamlessly to the macro network.

KEYWORDS: MNOs, GSM, CDMA2000,TD-SCDMA,WiMAX & LTE, UMA, WLAN.

1. INTRODUCTION:

In telecommunications, a Femtocell is a small, low-power cellular base-station, typically designed for use in a home or small business. A broader term which is more widespread in the industry is small cell, with femtocell as a subset. It connects to the service provider's network via broadband (such as DSL or cable);current design typically support two to four active mobile phones in a residential setting, and 8 to 16 active mobile phones in enterprise setting. A Femtocell allows service providers to extend service coverage indoors or at the cell edge, especially where access would otherwise be limited or unavailable. Although much attention is focuses on WCDMA, the concept is applicable to all standards, including GSM, CDMA2000,TD-SCDMA,WiMAX and LTE solutions.

2. WHAT IS THE FEMTOCELL?

A Femtocell is a small 3G base stations, designed to be deployed within home or small business premises to provide enhanced coverage for inbuilding cellular

services. The superior coverage and capacity made available by using the ‘smallcell’ approach within the turn building ensures a better user experience than can be achieved using outdoor macro cells. The enhanced data rates enable new multimedia services which in turn generate new revenue. The Femtocell is designed to be installed by the subscriber, with no technical knowledge, i.e. it is ‘plug and play’ device. The femtocell uses the customers’ broadband network (DSL or cable modem) to backhaul data to the mobile operators’ core network. The Femtocell developed from the idea of a ‘small UMTS base stations’ conceived by engineers at Motorola in 2002. During the next few years the idea was taken up by various interested parties, but commercial development was slow due to the lack of a standard. In 2007 The Femtocell Forum was formed, to promote Femtocell technology and to promote the creation of an open standard.

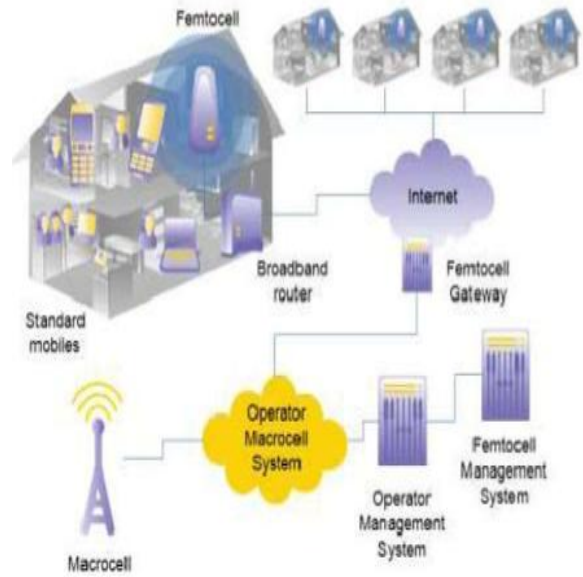


Figure 2:The Femtocell network architecture is shown in the following picture from the Femto Forum.

The Femtocell network architecture describes three main elements: The Home Node B (HNB) communicates with the Home Node B Gateway (HNBGW), over the consumer’s broadband internet link, via the Iu-h interface as described in the schematic below:

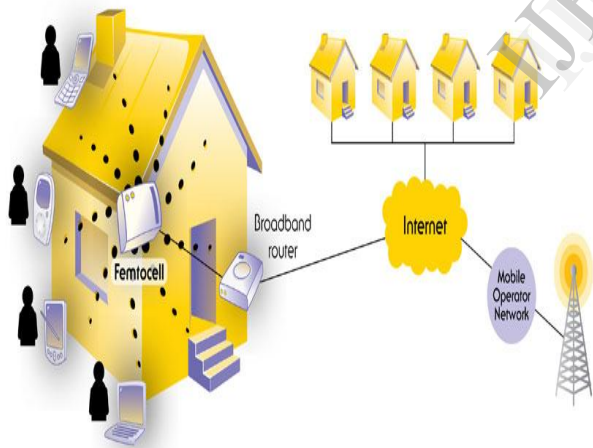


Figure1: Working process of Femtocell

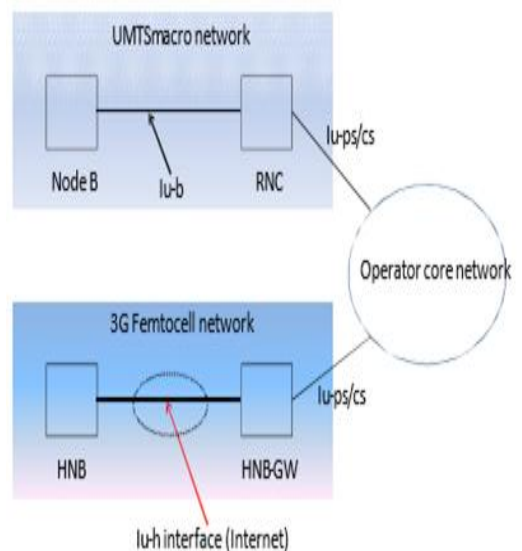


Figure3: 3GPP standardized network architecture.

The Home Node B Gateway (HNBGW) serves the purpose of an RNC

presenting itself to the operator core network as a concentrator or Home Node B (HNB) connections. Each HNB serves one cell and there is a one-to-many relationship between HNB-GW and a HNB's. Further detail on the Femtocell architecture is beyond the scope of this document but CAM is able to provide further information if required.

3. EXISTING SYSTEMS:

Mobile telecommunications is one of the fastest growing and most demanding of all telecommunications technologies. A recent development is Femtocell networks, also called home base-stations, that provide indoor wireless coverage to mobile phones using existing broadband internet connections is shown in above fig.2. Femtocell provide end users with dedicated access to the cellular network in the home environment. The Femtocell network is a more developed term in the sense that it distributes a number of users within the cellular network. Although every household is steadily increasing. According to a recently survey, the percentage of mobile phone usage inside households is as high as 50 to 60 percentage and 35 percentage of data usage takes place inside households. Hence, Femtocell network which considers not only the voice service of existing home-zone service but also data service is appealing approach. The Femtocell network concept aims to combine fixed-line broadband access with cellular telephony using the development of low cost, low power 3G base station in the subscriber's home.

4. FEMTOCELL DEVELOPMENT

✓ In 2002, a group of Motorola engineers introduced a Home Base Station technology.

✓ In 2007, vendor formed the Femto Forum to promote femtocell use.

✓ In 2008, Sprint Nextel released home-based 2G femtocell built by Samsung Electronics that works with Sprint handset.

✓ In 2009, Verizon and Vodafone rolled out their femtocell network service with 3G standard.

5. ADVANTAGES OF FEMTOCELL NETWORK

5.1 Advantages of Femtocell

✓ Assured in-building cellular coverage and higher data rates.

✓ User benefit from better in-building user experience.

✓ Low power consumption in mobile device.

✓ Localized services (a dedicated home subnet based around the femtocell).

✓ Traffic offload from macro network: offload from radio access network to Femtocell and offload backhaul to subscriber's broadband connection.

✓ Ability for the operation to place the coverage/capacity exactly where the demand exists i.e. where the revenue is greatest.

✓ Opportunity for LIPA and SIPTO.

Table 1: Advantages of Femtocell Networks

Advantage	Description
Cost	Very low cost
Power	Very less power ... Transmit at(10-100)Mw
Broad-band connected	By using a wired broadband internet service (fiber optics,..etc)
Standard	UMTS, CDMA, WiMAX, UMB and LTE

On the other hand, Femtocell is something that is related between users and operators or services providers. So, definitely it has advantages for both of them as shown in the Table 2 below:

Table 2: More advantages of Femtocell Networks.

User benefits	Increase indoor coverage	Higher performance data	Improved multimedia experience	Higher quality voice	Lower home zone calling
Operator benefits	Increase network capacity	Lower capital cost	Expanded revenue opportunities	Lower backhaul costs	Increase customer stickiness

6. COMPARISON OF FEMTOCELL WITH EXISTING TECHNOLOGY

6.1 Femtocell VS Macrocell

6.2 Femtocell VS WLAN

6.3 Femtocell VS UMA(Unlicensed mobile access)

6.1 Femtocell VS Macrocell:

	Femtocell	Macrocell
Air interface	Telecommunication standard	Telecommunication standard
Backhaul	Broadband Internet	Telephone network
Cost*	\$200/year	\$60000/year
Cell phone power consumption	Low	High
Radio Range	10-50 meters	300-2000meters

6.2 Femtocell VS WLAN:

	Femtocell	WLAN
Spectrum	Licensed	Unlicensed
Backhaul	Cable/DSL	Cable/DSL
Air interface	Cellular standard	802.11/b/g/n
Range	10-50m	35-70m

6.3 Femtocell VS UMA:

- Unlicensed Mobile Access (UMA), an IP-based 3GPP standard for connecting to mobile via broadband IP network.
- UMA provides access to mobile voice and data services over unlicensed spectrum technologies such as WLAN.

	Femtocell	UMA
Spectrum	Licensed	Unlicensed
Phone Mode	Single mode	Dual mode
Air interface	Cellular technology	WLAN
Backhaul	Broadband internet	Broadband internet

7. FEMTOCELL COMPARED WITH Wi-Fi ACCESS POINT

Since femtocell access point is similar to Wi-Fi access point that provide indoor wireless coverage to mobile phones using existing broadband internet connections, it is useful to be introduced some points regarding to each device that clarify both of them independently

Femtocell access point

- Enables cellular carriers to compete with VoIP, Wi-Fi and UMA
- No need for expensive dual-mode handsets
- Improve 3G coverage indoors and encourages use of data services
- Improves capacity Reduce Customer churn

Wi-Fi

- VoIP pricing on calls within the home
- Single phone for indoor/outdoor calls
- Provides indoor coverage via Wi-Fi or Bluetooth
- Use dual mode phones in Wi-Fi hot spots.

8. FEMTOCELL TECHNOLOGY IS COMPARED WITH PREVIOUS TECHNOLOGIES

- Here, there are eight technologies are there. Those are listed below
- 8.1. Macrocell
- 8.2. Microcell
- 8.3. Picocell

- 8.4. Dist'd Antenna System+RRU
- 8.5. High- power repeater
- 8.6. Low-power repeater
- 8.7. Wi-Fi
- 8.8. Femtocell
- 8.1. Macrocell

Macrocell is a cell in mobile phone network that provides radio coverage served by a high power cellular base stations (tower). Generally, macrocells provide coverage larger than microcell. The antennae for macrocells are mounted on ground-based masts, rooftops and other existing structures, at a height that provides a clear view over the surrounding buildings and terrain. Macrocell base stations have power outputs of typically tens of watts.

- 8.2. Microcell

Microcell is a cell in mobile phone network served by a low power cellular base stations (towers), covering a limited area such as a mall, a hotel, or a transportation hub. A microcell is usually larger than a Picocell, though the distinction is not always clear. A microcell uses power control to limit the radius of its coverage area

- 8.3. Picocell

Picocell is a wireless communication system typically covering small area, such as in-buildig like (offices, shopping mall, railway stations , stock exchanges, etc.), or more recently in-aircraft. In cellular networks, picocells are typically used to extend coverage to indoor

areas where outdoor signals do not reach well, or to add network capacity in areas with very dense phone usage, such as train stations. Picocells provide coverage and capacity in areas difficult or expensive to reach using the more traditional macrocell approach

- 8.7. Wi-Fi

Wi-Fi is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed internet and network connections.

- 8.8. Femtocell

Femtocell means it is a wireless network router that acts as a wireless access point for a home or business.



Figure 4. Femtocell diagram

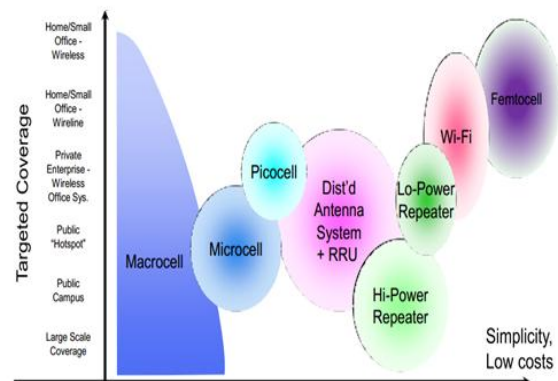


Figure 5. Targeted coverage and Low costs

9. COMMERCIAL CONSIDERATIONS AND OPPORTUNITIES GOING FORWARD

Sprint was the first company to market femtocells in the United States, closely followed by Verizon wireless and AT&T. Vodafone have launched femtocell product throughout Europe and now offer services in the UK, Spain and Greece. As of November 2010 there are 17 major operators deploying femtocells throughout the world. The 3G femtocell market is currently enjoying sustained growth (Femto Forum – May 2010).

Despite all this activity by the operator, the actual take up of femtocell by the consumer is surprisingly low (according to Cisco System-2010). Although the consumer wants the user experience that a femtocell may offer, they do not want to pay for it. From the consumer's point of view it is up to the services provider to provide good coverage in the first place.

In response to this reaction, the business proposition to the consumer seems to be changing for the better; service providers have been offering deals with up to 70% off the femtocell; some service providers offering to pay for the subscribers DSL backhaul link, and other such offers. Time will tell if the uptake on 3G femtocells improves.

The femtocell ecosystem and its accompanying technologies are in a stage of continual development, with vendors, operators, the femto forum, 3GPP and others, all striving for new levels of performance, efficiency and cost saving. Engineers at cellular Asset Management are continually monitoring the state of the art and will be happy to discuss matters in more detail if required.

10. FEMTO FORUM MEMBERS:



Figure 6: FEMTO FORUM MEMBERS IN 44 PROVIDERS OF FEMTOCELL TECHNOLOGY



Figure 7: FEMTO FORUM MEMBERS 26 OPERATORS COVERING 630 MILLION SUBSCRIBERS

11. CONCLUSION:

Femtocells are low-power wireless access points used for the home and office. They operate in licensed spectrum to

connect standard mobile devices and support all common air interfaces used by operators worldwide.

Femtocell have the potential to provide high quality network access to indoor users at low cost, femtocell will change the mobile industry. Operators will use femtocell to build a new generation of low cost, flat architecture network that can utilize the internet as backhaul and deliver expanded capacity for the customers. Femtocell will also change the mobile broadband experience for customers. Excellent wireless coverage in the home will become the normal and the exception.

REFERENCE:

- 1) Cisco, "cisco visual networking index: Global mobile data traffic forecast update ,20102015,whitepaper ,feb.2011
- 2) Femtocells: Past, Present, Future Jeffrey G. Andrews, Holger Claussen, Mischa Dohler, Sundeep Rangan, MarkC. Reed
- 3) JH.Claussen, L.T.T.W.Ho, and L.G.Samuel, "An overview of the femtocell concept," Bell Labs Technical Journal,vol.13,no.1, PP.221-245, may 2008.
- 4) Informa Telecoms & media, "femtocell market Status," femtoforum whitepaper,2011
- 5) "Picocell primer" Eetimes. Retrived 21-12-2010
- 6) <http://www.wireless.att.com/learn/why/3gmicrocell/faq.jsp>.

About Authors:

1. **CH.R.Vinod Kumar** has an M.Tech degree from AU College of Engineering in the area of Computer science and Technology. He is currently an Asst.

Professor of Information Technology Department at the GMR institute of technology, Rajam.

He has a passion for teaching and interest in doing Research work. His area of interest is in the subjects like Data Mining and warehousing, Software Engineering, OOAD, Cloud computing.

2. L.Lakshnana Rao has an M.Tech degree from GITAM College of Engineering, Visakhapatnam in the area of Computer science and Technology. He is currently an Asst. Professor of Information Technology Department at the GMR institute of technology, Rajam.

He has a passion for teaching and interest in doing Research work. His area of interest is in the subjects like Information Security, Computer Networks, Cloud computing.

3. K.Kanakavardhini has an M.Tech degree from JNTU-Kakinada in the area of Computer Networks and Neural Networks. She is currently an Asst. Professor of Information Technology Department at the GMR institute of technology, Rajam.

She has a passion for teaching and interest in doing Research work. Her area of interest is in the subjects like Information Security, Computer Networks, Cloud computing.