

# Economic Value of Femtocell Networks for Mobile Solution

O.A Akinlabi, B.S. Paul, M. K. Joseph and H.C. Ferreira

**Abstract**— The deployment of femtocell network in an indoor are used for the purpose of voice calling, data usage, mobile media, internet access and security service which has attracted the attention of economic values for telecom providers. However, femtocell works in the same full frequency band as well as macro cell. The mobile provider would prefer to choose femtocell rather than building macrocell site which leads to its quality of service and increase in profit; and thus, it increases savings compared to site building of macrocell. In this paper, the evaluations of the economic gain and impact factors of femtocell networks in the economy were investigated.

**Index Terms**— Femtocell, CAPEX, FAP

## I. INTRODUCTION

THE aim of a new generation of mobile operators is to provide high quality of services and data transmission within a large cellular coverage area due to the popularity of wireless networking. The indoor coverage suffers poor reception, poor performance, call distortion and lower voice quality. In order to meet the requirements and quality performance of the indoor coverage, a number of base station are required by the mobile operators. Therefore, to improve the quality of voice calls and data used in an indoor environment, Femtocells were introduced. The introduction of Femtocells technology has improved the network performance as well as providing an additional service to cellular network [1-5]. The results are: excellent data, good voice calls, and multimedia service for mobile devices used in an indoor environment. A study by ABI shows that more than 50% of voice calls and more than 70% of data traffic is expected to originate from the indoor users in future [6]. In other word, by providing good quality of service in an indoor, the revenue of mobile operator's increased, and reduced churn of calls.

Manuscript received November 11, 2014; revised December 1, 2014. This work was supported in part by Centre of Telecommunication, University of Johannesburg. This Paper: Economic Value of Femtocell Networks for Mobile Solution.

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Telecommunications provides a lot for the world, in that the commerce that it creates is enjoyable and a little chunk of the gross world product. It also provides business, money and market stability in the world. With opportunistic spectrum access due to femtocell, cognizance capabilities and benefits it's provided. This allowed efficient use of spectrum by combining radio advantages with the benefits of femtocells for business aspect.

The overwhelming merits of femtocell base station is that, there is a reduction in maintenance and operational cost of the operator and it also provides a good quality performance to the end user and high network capacity gain.

Femtocells are small base station, installed by the end user, and it is connected to the mobile operator's core through the internet access [3], [7]. This provides a cost effective and widely available data link for end users and more so, femtocell can be used as a standard for all application in the house like the security service. The Femtocell Access Point (FAP) is a link to the mobile operators' network core through the user Digital Subscriber Line (DSL) and optical fiber or broadband cable connection. The year 2012 record the highest market forecast for the user equipment [8] (i.e. the global market statistic of a femtocell). The economic value of femtocell has opened the opportunity for business for the mobile broadband, especially the added-value of service enjoyed by the end users.

More so, the value market of femtocell in Europe and other place where is being used for voice calls and other purposes have gain values. Within the African countries, femtocell will gain more economic values due to poor signal reception in the indoor environment. It works to allow mobile traffic load within the home and office in places like Europe, America, Japan and China.

The rest of this paper is structured as follows. The motivation behind mobile growth was discussed in section II. Section III describes the access point for femtocell networks. The reasons for deployment were emphasized in section IV. Section V reflects the value-added service. Section VI describes the economic influence of a femtocell and conclusions are drawn in section VII.

## II. MOTIVATION

Recently, the demand for mobile traffic has grown higher over the last two years due to commercial launch of flat rates, and this demand needs to be met by the new mobile communication systems, as well as to continue increasing revenue. Therefore, the key success of the future wireless systems will be the provision of mobile broadband access,

but at lower costs-per-bit for the network subscriber than the previous systems [9].

However, the traditional growth of mobile traffic such as increasing the number of base station, improving the spectrum efficiency, and also improving radio access technology has shown some drawbacks. Mostly, the mobile traffic is highly demanding in an indoor, according [10], more than 80% of the mobile traffic is used in an indoor environment. The introduction of new technology called Femtocells offer solution for the indoor signal problem and cost efficiency to the subscriber of the network. The aim of an entrepreneur is to satisfy the demand of mobile traffic for the users in an indoor environment and also to offer an additional functionality as the integration with a private branch exchange. Mobile operators benefit from femtocell service such that it saved coverage gaps and profit, and time wasting. Finally, femtocell provides a broadband access in remote places with a satellite backhaul. For example, femtocell is mostly used in an airplane, complex, shopping mall, train and war ship.

The access model is clearly related to the business model, for example, an open subscriber group approach will automatically lead to subsidized femtocell because no customer will pay for a femtocell that anyone can access.

### III. ACCESS MODEL FOR FEMTOCELL NETWORKS

The access model is mainly used by the subscriber to access a specific femtocell, which are usually called Femtocell Access Point (FAP). Also, the access model is usually used to improve the performance of the indoor coverage. FAPs work as a base station in the home or office of the end user. The access model is classified as: closed subscriber group (CSG) access, open subscriber group (OSG) access, and hybrid access method techniques, which have already been proposed [11].

#### ➤ Closed Access Model

In closed access model, only registered users are allowed to connect their femtocell to the mobile network core and setup operation. The femtocell is managed and protected by the owner of the femtocell that pays for the resource used. The closed access model is generally preferred for home or office user. The closed access model is usually called Closed Subscriber Group (CSG).

#### ➤ Open Access Model

The Open access model allows all users (both subscriber and non-subscriber) to access a femtocell network and benefit from its services. The open access model is used in the public area such as airports, hospitals, schools, train stations and shopping malls to provide network coverage to the users [12] [13].

#### ➤ Hybrid Access Model

This is a new access model that only allows a particular user to access a femtocell network due to the drawbacks of

open and closed access model. The access to this network is usually done by the operator at the owner's request.

### IV. DEPLOYMENT OF FEMTOCELL

The reasons of deploying femtocell network in an indoor environment are described as below:

#### ❖ Operator's perspective

In the presence of macrocell network, femtocell has a lot of benefits enjoy by the operators, as they planned to deliver service at the indoor and reduce macro cell sit, whereby reducing the operational cost of delivering signals at the indoors. The application of femtocell in an indoor environment, reduce the installation of macro cell sites and this may result in huge capital expenditure (CAPEX) savings for mobile operators in their radio access networks. This also leads to good result where the cost of a macro cell site is channelled to quality of service and voice performance in the indoor. This implies that a small amount of rent will be paid for the use of the sites; meanwhile site purchasing is a challenge for mobile operators.

In addition, femtocell helps the mobile operators to provide cost-effective in building network quality service and realize the extra cost for future planning. Femtocell is a promising solution for indoor network compared to other approaches. The sizeable amount of connection cost and operation of FAPs is less than the cost of building the macrocell sites.

For these reasons, femtocell has been credited with improving service quality, customer loyalty and reduced customer churn. This is the main concern for the mobile operators. Furthermore, femtocell may also service mobile operators to drive data usage and offer a healthier service, which in turn may boost average revenue per unit. Finally, femtocell networks help the operators deliver seamless network solutions across both the outdoor and indoor environment and ensure a basis for the new generation converged services that combine voice calling, video and data services to a mobile device.

#### ❖ Subscriber's perspective

Femtocell allows the subscriber to enjoy better services such as voice calling, data services, multimedia and videos. Femtocell promotes public phone such as a land line phone, broadband and mobile phone. Also, it serves as a main point of connection to other domestic devices or appliances to a home server and also acts as the gateway for all domestic devices to the internet services. It enables subscribers to experience seamless interaction between both the inside and the outside world, and enables the delivery of converged services. Another advantage of using femtocell is that it reduces the user's equipment and power since the distance between user equipment (UE) and femtocell access point

(FAP) are closer, this leads to power reduction. Fig 2 shows the worldwide femtocell deployment in 2012. Femtocell are basically deployed mostly in Europe, North America, Japan and China, place like African are still far behind the use of femtocell for communication and security, that is why African experience poor voice communication within the indoor environment.

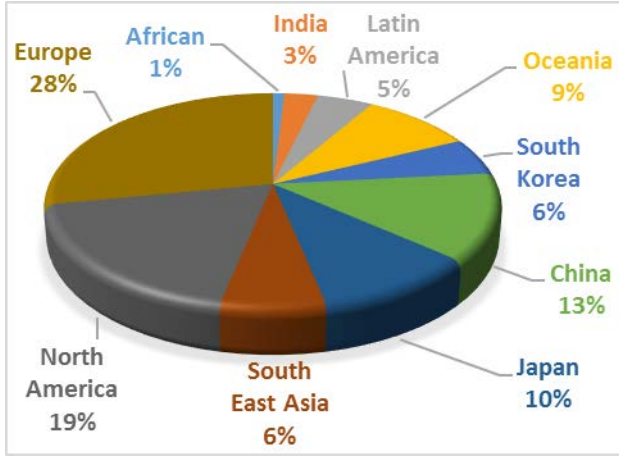


Fig 2: Femtocell deployment in 2012

#### V. VALUE ADDED SERVICE

The most interesting aspect of femtocell to the market is the valued-added service it renders to the end users at the indoor. It's a service in which most vendors are always eager to incorporate as much as possible. Hence, the value-added services are identified below:

- Remote home control and automation.
- Incoming call routing
- User location and inter-house calling
- Media distribution from femtocell
- Mentioning and control

The high level of intelligence of femtocell for new services to the market is centred on voice calling and data usage, security service and mobility and other applications delivered to the users. Some potential application has been identified and likely to be used as the first valued-added service release. It is likely that other value-added service will emerge later, and more importantly the exact nature of the service is yet unknown.

#### VI. ECONOMIC INFLUENCE OF FEMTOCELL

The economics values femtocell for mobile operators' networks, as a prospect to both the operator and subscriber. Femtocell address poor reception of calls at the indoor environment for end users. Table 1 illustrates the economic factors of a femtocell. This shows clearly the market influence of femtocell for the purposes of voice calling, data, multimedia, security service and internet in both home and office.

The economic factors around femtocell network deployment center on financial benefits associated against that of building on macro cell site in most of the area where telecom or mobile network is needed for both the end users in homes and offices for the purpose of communication.

TABLE I  
ECONOMIC FACTORS ON FEMTOCELL NETWORKS

No	Economic Factor	Cost more or less
1	CAPEX Requirement	High for Mobile Operator
2	Backhaul Traffic	High for Mobile Operator
3	Energy Cost	Less for Mobile Operator
4	Capacity Driven CAPEX	High for Mobile Operator
5	Organization, or Office	Less/Lower
6	Subscriber Purchase Cost	High for Mobile Operator

With this information, it is possible to put together the financial model of both the income and expenses of the femtocell network in order to know the market impact on our today economic deriving. The financial model is calculated in percentage, putting all the number of features such as the operation cost, advertising cost, backhaul traffic cost, maintenance cost and repairs. Fig 3 shows the Income and Expenses percentage of the financial model for femtocell network. Here, the income percentage is more than that of the expenses percentage, while the mobile service revenue increase and therefore the spending is less. It is preferable for business in African countries where there are poor receptions, especially in the rural areas.

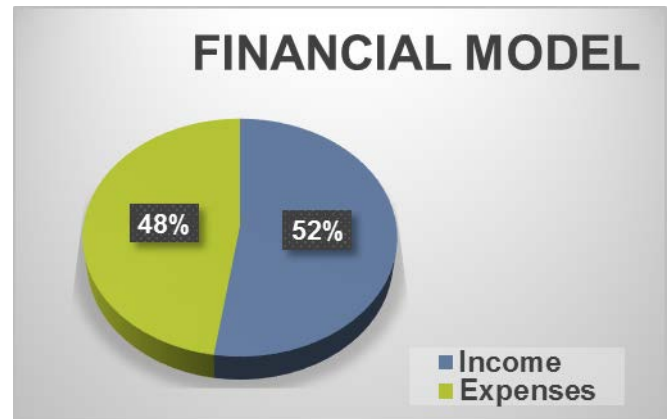


Fig 3: Financial model of femtocell networks

In fig 4, illustrates the operational breakdown cost for deploying femtocell network, and take into varieties of variable factors to get the percentage of each parameter. These costs are significant opportunities for both subscribers and operators, saving the CAPEX bill, tax bill, maintenance of core components as low in the form of backhaul cost, which is one of the major costs.

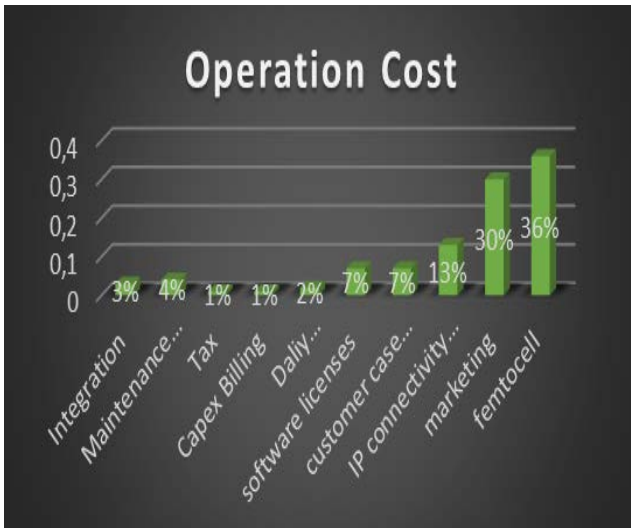


Fig 4: illustrate the operation breakdown cost for femtocell deployment.

According to [15], Cisco internet business solution group approved femtocell solution after many tests carried out by this group for communication and security purpose in the indoor environment. More so, they have also discovered that femtocell worth economic gain due to many services renders through the mobile operators of the network such as control of home appliance, added value service and most importantly the security alert from femtocell.

## VII. CONCLUSION

This paper studies the economic incentive for a cellular operator to introduce the femtocell service on top of its existing macrocell service. Although, the benefits of this new technology called femtocell will continue to play an important role in the markets if only the issue around the deployment of femtocell are overcome by the mobile operator's network.

More so, the mobile operator needs to define some of the complex model elements in order to allow the business model for the femtocell network such as cost, valued-added service and subscriber cost through an understanding of the consumer's unique business situation and service deliver.

In a positive sign that industry leaders are beginning to understand the need to shift business models in order to accelerate femtocell adoption, Vodafone [16] is slashing femtocell prices by 70 percent as the company re-launches its Home Gateway or Sure Signal product in the United Kingdom.

## ACKNOWLEDGMENT

The authors wish to acknowledge the effort and support of his supervisor and co-supervisors, Dr. Paul B.S and Dr. (Ms.) M. K. Joseph of Department of Electrical and Electronic Engineering Technology, University of Johannesburg and Prof. H.C. Ferreira of Department of Electrical and Electronic Engineering Science, University of Johannesburg, South Africa.

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