# Economic Value of Femtocell Networks for Mobile Solution

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

*Abstract* - **The indoor deployment of femtocell networks for the purpose of voice calls, data usage, mobile media, internet access and security service has varying economic implications for the Telecom providers. Furthermore, femtocell works in the same frequency band as macro cells. Thus, Telecom providers will prefer to use the femtocell rather than building macrocell site due to its improved quality of service and profit maximization. This paper evaluates the economic benefit and ancillary advantages of femtocell networks.**

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

## I. INTRODUCTION

THE aim of the next generation telecom operator is to provide high quality service and data transmission within a large cellular coverage area that will utilize the ubiquitous wireless network platform.. There is usually poor reception, and performance, call distortion and lower voice quality during indoor wireless calls. Many base stations are built by the telecom operators in order to meet the requirements and performance of the indoor coverage, Femtocells were therefore introduced to improve the quality of voice communication and call servicing in an indoor environment. Since its introduction, Femtocells technology has improved the network performance as well as providing an additional service to cellular network [1-5]. A study by ABI shows that more than 50% of voice calls and more than 70% of data traffic is expected to originate from indoor users **[**6]. Thus, telecom providers are likely to increase their revenue by ensuring good quality indoor telecommunication service which femtocell can help them to achieve.

With opportunistic spectrum access due to the femtocell, cognizance capabilities and benefits it's provided. This allowed efficient use of spectrum by combining radio advantages with the benefits of femtocell for business aspect.

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Femtocells are the small base station that is installed by the end user, and connected to the Telecom operator's core through the internet access [3], [7]. This device provides a cost effective and widely available data that link the users and this can be used as a platform for all applications. The Femtocell Access Point (FAP) is a link to the Telecom operators' network through the user's Digital Subscriber Line (DSL) and optical fiber or broadband cable connection. The use of the Femtocells base station leads to a reduction in the maintenance and operational cost of the providers and it also provides a good quality performance to the end users.

The economic value of femtocell has therefore created further business opportunities to be explored by the Telecom broadband providers, especially in the area of value-added services. This might explain the 2012 global forecast that there will be an exponential increase in the demand for femtocell technology [8].

Also, a femtocell is expected to be more appreciated in the Sub Saharan African Countries where there is usually poor signal reception at the indoor environment. However, there is currently a trade-off between the cost deployment of femtocell in term of capital investments and environmental impacts occasioning heavy taxation as opposed to the cost of deployment of macro cells sub-station with lesser environmental impacts and taxation. This is the crux of the present paper.

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

## II. MOTIVATION

Recently, the demand for Telecom traffic has grown higher over the last two years due to the commercial launch of flat rates, and this demand needs to be met by the Telecom operators. The operators have a challenge of providing high quality service with low tariff that would also ensure higher revenue accruals to them. Therefore, there is an urgent need for a wireless system that will provide highly efficient mobile broadband access, but at lower costs-per-bit for the network subscriber than the previous systems [9].

However, the traditional method of increasing the mobile traffic and access such as increasing the number of base stations, improving the spectrum efficiency, and also improving radio access technology has been shown to have

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some major drawbacks. Since the majority (about 80%) of the Telecom traffic is utilized by the indoor users [10], there is the need for a telecommunications solution that will improve the service quality among indoor users. The introduction of a new technology called Femtocell offers a way out of the indoor signal problems. It also potentially offers cost efficiency to the subscriber of the networks. The aim of a telecom entrepreneur is to satisfy the demand of mobile traffic users at the indoor environment and also to offer additional functionality such as the integration of a private branch exchange. The telecom operators also benefit from the introduction of femtocell because it saves coverage gaps, increase profit and reduce time wasted on troubleshooting problems. Finally, Femtocells provide broadband access in remote places with a satellite backhaul, such as in an airplane, 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 works as a base station in the home or office of the end user. The access models for femtocell are classified as: closed subscriber group (CSG) access, open subscriber group (OSG) access, and hybrid access a technique is also being proposed [11].

### ➢ Closed Access Model

In a closed access model, only registered users are allowed to connect their femtocell to the Telecom 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 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

Most of the reasons for deploying femtocell network in an indoor environment are described as below:

### ❖ Operator's perspective

Even with the presence of a macro cell within the vicinity, femtocell provides lots of benefits to the operators. As the operators plan to deliver services in the indoor environment using femtocell and thereby reducing the building of macro cell sites, the overhead incurred in delivering signals to the indoor environment would reduce. Thus, the applications of femtocell in an indoor environment will reduce the installation of macro cell sites which will invariably result in huge capital expenditure (CAPEX) savings for Telecom operators in their radio access networks. This also leads to improved service delivery since the costly burden of building a macro cell site is channelled to improving the quality of service and voice performance in the indoor. Furthermore, a small amount of rent will be paid for the usage of sites, whereas site purchasing and rentals has been a major challenge for mobile operators.

In addition, the networks that are built on femtocell technology are cheaper than those built from macro cell technology. Therefore the telecom operators using femtocell will be able to provide cost-effective service that will improve the quality of service and the extra cost obtained can be invested into future planning and research. Femtocell is therefore a very promising solution for indoor network, especially in Africa 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 have been credited with improving service quality, customer loyalty and reduced customer attrition. Furthermore, femtocell may also service telecom 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 outdoor and indoor environments and provide a basis for next-generation converged services that combine voice, video and data services to a mobile device.

### ❖ Subscriber's perspective

Femtocell allows the subscriber to enjoy better services such as voice services, 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 the inside and the outside world and enables the delivery of converged services. Another advantage of using femtocell is in the

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reduction of the user's equipment and power since the distance between user equipment (UE) and femtocell access point (FAP) are closer and leads to a reduction in the transmission of power. Fig 2 shows the worldwide femtocell deployment in 2012. Femtocells are basically deployed mostly in Europe, North America, Japan and China. African countries are still far behind in the use of femtocell for communication and security. That's why most of the African countries experience poor voice calling in the indoor environment.

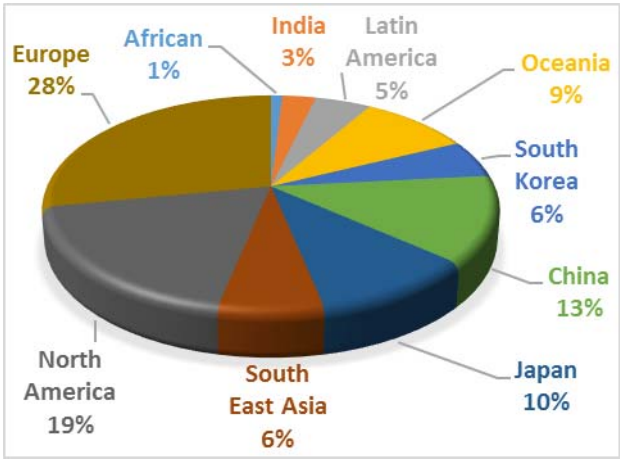


Fig 2: Femtocell deployment in 2012

## V. Value Added Service

The most interesting aspect of femtocell to the Telecom market is the value-added service it renders to the end users in the indoor environment. Most of these value added service are attractive to the subscribers, hence most vendors are always eager to incorporate them into the mainstream of Telecom services as much as possible. 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 is built around providing voice calls and data; security service and mobility; and other applications to the end users. Some potential applications have been identified and likely to be used as the first set of value-added services are released. Also, it is likely that more value-added services will emerge later, and the enormous potentialities of the value added services are still being explored.

## VI. Economic Value of Femtocell

The economic value of femtocell for Telecom operators' network has a potentially huge economic prospect to both the operators and the subscribers. Femtocell addresses the poor reception and distortion of calls at the indoor environment for end users. Table 1 illustrates the economic factors affecting femtocell deployment. This shows clearly the market forces driving the deployment of femtocell solution for communication purposes, security alerts at home, and office and complex halls.

The economic factors affecting femtocell network deployment center on the financial benefits associated against that of building of macro cell sites in most of the areas where telecom network is needed by end users such as in offices and homes 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 build or simulate the financial model that will take cognizance of both the income and expenses of femtocell network deployment in order to evaluate its impact on both the global and local economic. The model considers a number of economic inputs such as operating cost, advertising cost, backhaul traffic cost, maintenance and repairs. Fig 3 shows the Income and Expenses percentage of the financial model for femtocell network. Here, the income percentage (52%) is more than the expenses percentage (48%) of femtocell deployment. This confirms that the revenue of the Telecom service providers increases with corresponding lesser expenditure. There is, the hope that as research improves in femtocell deployment, efficiency will improve and the expenditure will further reduce. Femtocell is very useful for the business community in most African countries, especially in the rural communities where there are poor telecom receptions.

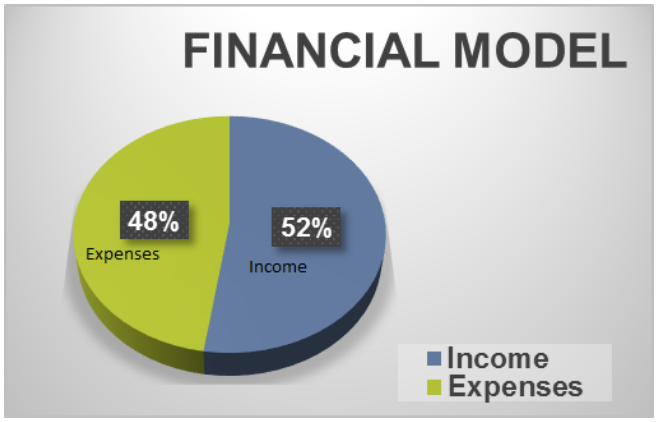


Fig 3: Financial model of femtocell networks

Fig 4 illustrates the operational breakdown cost for deploying femtocell networks and takes into cognizance

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several variable factors aimed at getting the percentage impact of each parameter. These virtual costs are significant opportunity costs for both subscribers and operators. This affords the operators an opportunity to avoid the CAPEX bill, tax bill, maintenance of core components and backhaul cost.

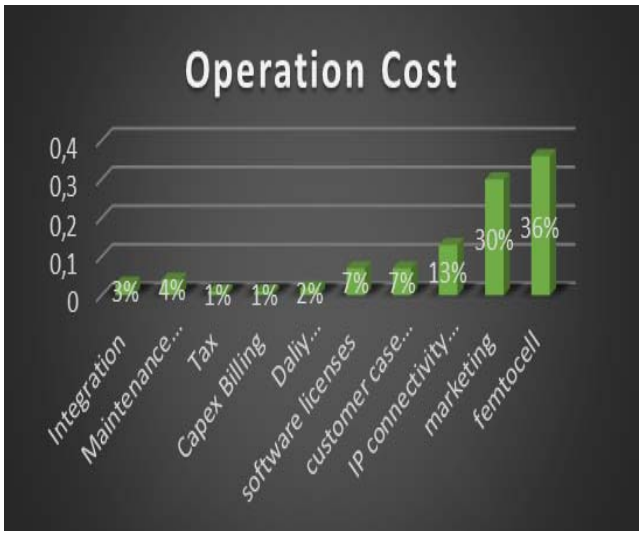


Fig 4: illustrate the operation breakdown cost for femtocell deployment.

According to [15], Cisco internet business solution group approved femtocell solution after conducting several researches and test-running the platform. Femtocell was therefore introduced to the telecom market by Cisco for communication and security purposes in the indoor environment. Furthermore, they have also discovered that femtocell economic worth is enormous when used for the value added services such as control of home appliance, and security alerts.

## VII. Conclusion

This paper studies the economic incentive for cellular operators to introduce the femtocell service on top of its existing macrocell service. Although, the benefits of this novel technology, femtocell cannot be over emphasized, the issues around the deployment of femtocell must be overcome by the Telecom operators in order for global market and especially the African continent to benefit from its economic potentials.

More so, the mobile operators need to define some of the complex model elements in order to arrive at the business model of the femtocell network that will include cost, value-added service and subscriber cost in its planning after understanding the consumer's unique business situation and service delivery.

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

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