Comparison of Efficient Handoff from Macro to femtocell using Different algorithms

Sonam Bhardwaj[1] and Prasanna Singh[2]

Abstract— Handoff algorithm decides the connection to user with system while minimizing latency and no. of handoff needed. In this paper the RSS based handoff decision algothim is proposed. This algorithm results in multiply the values of RSS by some constant which obtained from a target femto base station and which is connected to macro cell. The value of the constant α varies with distance increase from 100 m to 1km between the two stations and it is decreases with the distance. The factor α has an effect on the number of handoffs. The proposed algorithm gives much better performance in case of macro cell to femto cell handoff in performance analysis.

Keywords— **Handoff, Femtocell, RSS, BS and Macrocell.**

I. Introduction

While minimizing latency ,The main objective of handoff algorithm is to decide an optimal connection with respect to user or system performance, and the number of handoffs[1].

A minimum RSS used to set the threshold from a serving Base station (BS) and a margin to the RSS the hysteresis added from the serving BS over a target station. mobile station (MS) generally used this handoff decision algorithm when moving from aone macrocell to other femtocell [2]. Capability to detect from Mobile station (MS) has been assumed for detecting neighbouring femtocells. The macro/femtocell network has some requirements for mobility management.

The First requirement for mobility management, is that MS should gives higher priority to a femto BS while attempting to selects serving BS. between two types of cells different billing models are used results in such requirements. The operation of handoff from a macrocell to a femtocell can be seen efficiently in the form of increase in user satisfaction [3].

The Second requirement is the deployment of femtocell. Such things should not effect mobility management procedures in the drastic way while using conventional macrocell networks [4]. The conventional methods are, such as cell scanning and handoff. These methods can be used to apply in case of hierarchical macro/femto-cell networks. various handoff algorithms to fullfill such requirements are based on received signal strength. The can have hysteresis and threshold with a common and critical drawback. Which is a handoff criterion from a macrocell to a femtocell. And this hard to satisfied with the femto cell base station installed in the inner or center of the macrocell. The main cause of this phenomenon is the transmitting power of the femtocell is lesser than the that of the macrocell base station. For the femto, typical value of transmit power is 10 dBm BS. And 46 dBm is the typical value, in the case of the macro BS [5]. Such conditions and situation causes a demand to design a suitable handoff decision algorithm. So that, whenever a call needed a handoff, is made from a macrocell to a femtocell would be efficient.

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II. System Description

There are multiple values of RSS available. If these values are multiply by some constant suppose α which should be greater than 1 and is from a target femtocell base station. the Main objective of proposed Algorithm is to make the system efficient. Because due to the huge transmit power difference between macro cell and femto cell which is currently connected together cell in the consideration for efficient handoff, but not happend [6].

$$S_{fmod} = \alpha S_f \quad \text{where } \alpha \text{ is greater than 1} \qquad (1)$$

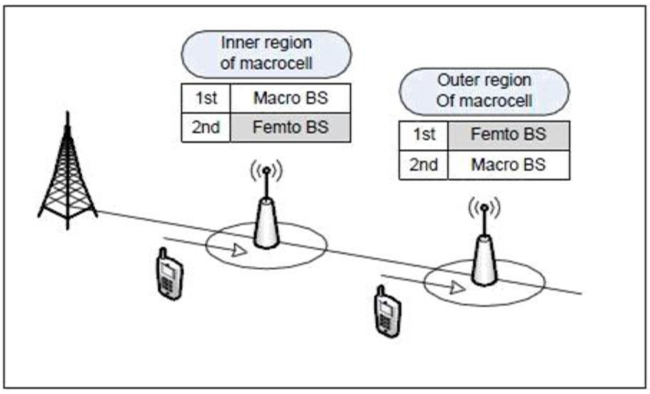

Figure 1 Macrocell to femtocell handoff while moving[1]

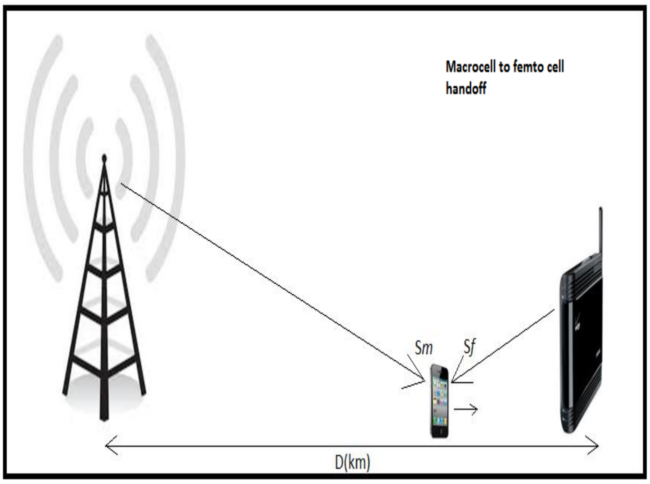

Figure 2 Boundary scenario of macrocell/femtocell

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MATHEMATICS IMPLEMENTATION:

Let D, is the distance between macro cell and femto cell in Km and r_f is the radius of Femto cell taken as 10m. 46 dBm is transmit power of Macro cell and for the femto cell it is 10 dBm. Path loss of Macrocell is give by

$$= 128 + 37.6 \log_{10} d(km)$$

And path loss of Femtocell is given by formula

$$= 42 + 28\log_{10} d(m)$$

Therefore it is observed that at boundary of femtocell, received signal strength should not be less than received strength of macro cell.

$S_f = [10-(42+28\log_{10}d)]$
$S_m = 46 - [128+37.6 \log_{10}(D-d)]$

By replacing d= radius, r_f = 10m= 0.01Km, we get

$S_f = [10 - (42 + 28\log_{10}10)] = - 60dBm$
$S_m = - 82 - 37.6 \log_{10}(D - 0.01)$ dBm
$S_{diff} = S_f - S_m = 22 + 37.6 \log_{10}(D - 0.01)$
And $\alpha = 1+(S_{diff}/S_f)$ (2)

PROPOSED ALGORITHM HANDOFF CRITERION PERFORMANCE ANALYSIS

if $S_f > S_{f,th}$ **and** $S_{fmod} > S_m + \Delta$
or if $S_f < S_{f,th}$ **and** $S_f > S_m + \Delta$

then connect to femto BS

if $S_f > S_{f,th}$ **and** $S_{fmod} < S_m + \Delta$
or if $S_f < S_{f,th}$ **and** $S_f < S_m + \Delta$

connect to macro BS (3)

$P_m[k]$, probability that the MS will be assigned to the macro BS and $P_f[k]$ probability assigned to the femto BS at time *k*, $M(k)$ and $F(k)$ represents events and the probability of handoff at times *k*, denoted by $P_{ho}[k]$, can be expressed as follows [2]:

$$P_m[k] = P_m[k-1](1 - P_{f|m}[k]) + P_f[k-1]P_{m|f}[k] \quad (4)$$

$$P_f[k] = P_m[k-1]P_{f|m}[k] + P_f[k-1](1 - P_{m|f}[k]) \quad (5)$$

$$P_{ho}[k] = P_m[k-1]P_{f|m}[k] + P_f[k-1]P_{m|f}[k] \quad (6)$$

Where, $P_{f|m}[k]$ represents macrocell to femtocell probability of handoff at *k*, and vice versa for $P_{m|f}[k]$. Conditional probability can be used for calculating $P_{f|m}[k]$ given by

$$P_{f|m}[K] = \frac{P_r\{F(K) \text{ and } M(K-1)\}}{P_m[K-1]} \quad (7)$$

N_{ho}, the total number of handoffs can be obtained by summation of probability of handoff for all *k*,

$$N_{ho} = \sum K\, P_{ho}[K] \quad (8)$$

III. RESULTS AND DISCUSSION

1. Decrease in Optimum multiplicational factor value at different positions of femto BS from macro BS.

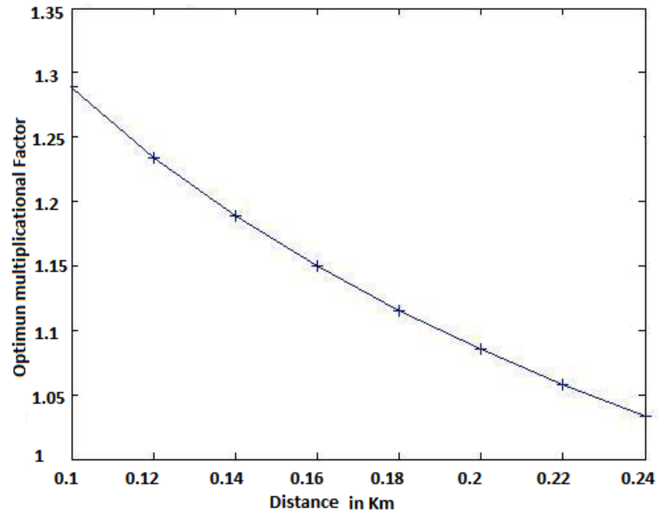

Figure 3 Change in Optimal multiplication factor with the distance

As shown in figure above with the increase in distance distance between macro base station and femto BS, α munltiplcation factor decreases continuously. It is observed that after 250 meter distance α is not needed, it is almost negligible. It concludes that α is required at lesser distance between FBS and MBS.

2. Probability of Femtocell assignment Changes with distance between Femtocell and macro cell.

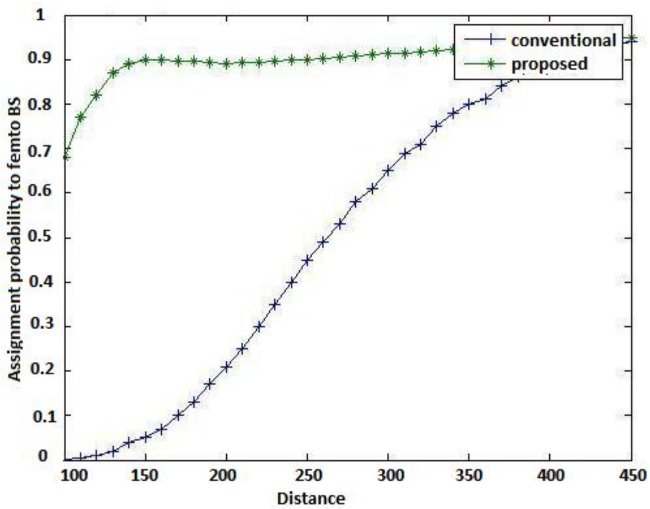

Figure 4 Comparision of Assignment probability to femto between conventional and prposed algorithm

When the distance of femto BS from macro BSis very less, proposed algorithm shows much higher assignment probability to femto BS than conventional algorithm. Proposed algorithm evalute the value measured at the every 10 m from the femto BS shows great performance over conventional algorithm.

3. Change in No. of handoffs with distance between femto and macro cell increases or decreases.

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It is observed that no. of handoffs increased when femto and macro BS are closely located. So there is one tradeoff exists between assignment prob. to femto BS and no. of handoffs that with the no. of handoff increases conventional algorithm and proposed algorithm performance decreases with the distance inceases.

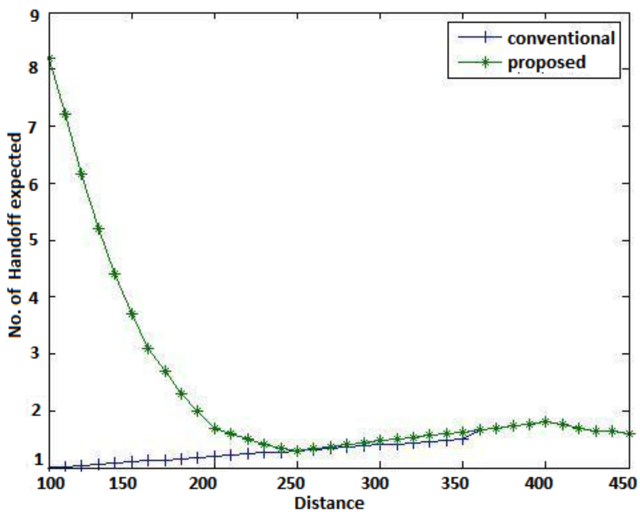

Figure 5 Probability of no. of handoff decreses with increase in distance between macro and femto BS

It has been measured that at distance is greater than 250 m, the number of handoffs decreases to the same level for both the algorithms, while the proposed algorithm has gain better in the assignment probability to the femto BS.

IV. CONCLUSIONS

It is concluded that distance is a major factor effecting the performance of different algorithms, as femtocell and macrocell BS are closely located the assignment probability and no. of handoffs are increased. So a tradeoff exists when the distance is greater than 250 m. Proposed algorithm performs better in each case of probability of assignment and no. of handoff and transmitting power. So, proposed algorithm can be used with adaptive hysteresis.

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