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Improved handoff mechanism for infiltrating user equipments in composite networks

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ABSTRACT

The wireless technology and communication plays a vital role in our daily life. The end users are expecting more Quality of Experience (QOE) rather than the Quality of Service (QOS). In order to provide full signal coverage the entire cellular network coverage is divided in to small cells called as femtocells, those femtocells are covered with femtocell antennas which are very small in size compared with regular antennas. With these femtocell coverage problem is solved but when a user moves from one location to another location the user has to switch from one base station to so many base station which cannot be maintained with present handoff methods. The present hand off methods working on distance calculation approach, the proposed method is based on the velocity and device direction calculated based on GPS location toward the Base Station (BS) of the device which may ping pong handoff effect.

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1. INTRODUCTION

The handoff mechanism in cellular network is the process when a user moves from one cellular network to another without disconnecting the session. In today's communication more demand for the wireless communication so providing facility to all users is a one challenging task. And providing signal to each and every corner of house or office or any public place is next challenging task full filled with the Femtocell [1]. The wireless technology and communication are became part of daily life. The communication is provided with the wireless links via radio transmission solution E.g. LTE, GSM, CDMA, Wi-Fi, WI-Max etc. To provide Quality of Service (QOS) to the user all networks are combined so that mobile users can roam seamlessly without interrupting any ongoing call or data transmission process [2]. But the Quality of Experience (QOE) is not achieved with the current mechanisms i.e. the user satisfaction level with the communication. The problem is that to provide the signal coverage to each and every corner of the home, working place or any public service places the femtocells are arranged with this QOS was achieved but the QOE is not happened because user has to move from one wireless coverage place to another wireless coverage place then handoff to be maintained to reduce the call drops.

In today communication the networks are wireless so user is may go from one location to another location; due to this infiltrating users from one location to another location will happen. Present network technology composite network i.e. grouping of different networks, so user switching is happened between different networks also. Without call drop the communication to be happened. To achieve the above features the new handoff mechanism is proposed.

This paper presents an improved handoff mechanism to improve the QOE by having clear cut idea when to perform, where to perform the handoff by having the metric values as free channel availability, frequency of user and person moving direction. The different handoff methods will present in section 2. The mechanism used to achieve QOS is in section 3. Conclusions are mentioned in the section 4.

2. THE EXISTING HANDOFF MECHANISMS AND THE PROBLEM WITH THE PRESENT METHODS

The handoff mechanism in cellular network is the process when a user moves from one cellular network to another without disconnecting the session. If the handoff is not performed then the signal attenuation will happen when the User Equipment (UE) move away from the antenna i.e. Base Station Transceiver (BST). The next important thing to be considering is signal should not be fade. The fading may either be due to multipath propagation, referred to as multipath induced fading, weather (particularly rain) or shadowing from obstacles affecting the wave propagation some time referred to as shadow fading.

Formula to calculate the received signal strength (RSS) is:

$$RS_b[m] = PT_b - PL_b[m] - U_b[m]$$
$$RS_f[m] = PT_f - PL_f[m] - U_f[m] \quad (1)$$

$RS_b[m]$: indicates the received signal strength from base station (b) at time interval (m).
PT_b: indicated the power transmitted from base station.
$PL_b[m]$: indicated the path loss at time interval m.
$U_b[m]$: indicates the fading value at time interval m.
$RS_f[m]$: indicates the received signal strength from fentocell (f) at time interval (m).
PT_f : indicated the power transmitted from femtocell.
$PL_f[m]$: indicated the path loss at time interval m.
$U_f[m]$: indicates the fading value at time interval m.

Based on the RSS value between the base station and femtocell the handoff will occur to maintain the communication of user who are in ongoing call [3]. The hand off is basically two types 1. Soft handoff 2. Hard handoff. In soft handoff the both Base Station (BS) information to be maintain the Activation Record. But in the hard hand off the Activation Record will maintain the one BS information in a particular time [4]. To provide the good signal the Femto cells are introduced in the uncovered macro cell regions. So now two networks are there, not only these two we have the heterogeneous networks as shown bellow [5].

The handoff mechanisms of soft and hard handoffs are maintaining the Active List is difficult to maintain the QOE. If the UE moves from one region to another region as shown in the above Figure 1, then the hand off will take time then it leads to the call blocking then QOE is not achieved. The hand off in composite network will be classified as:

- Horizontal handoff
- Vertical handoff
- Diagonal handoff

Horizontal handoff: The hand of will taken care between Intra BSC handoff or Inter BSC handoff or Inter MSC handoff. This leads to the one cell region i.e. same network. The Horizontal handoff process having the 3 basic things: First the handoff initiation to be done, next an available free channel to be given to the UE without disturbing the current communication process. The final thing is connection transfer and the handoff execution.

Vertical handoff: The vertical handoff will be performed in the Inter-network. In the Figure 1 if a user moves from In-Build corporate network to the next two networks are as Metropolitan Area, Regional area. Then to maintain the call without losing a vertical handoff should be happened. The vertical handoff challenge is focus more on user preferences in performing a handoff from one network to another network.

The handoff decision algorithms for the vertical handoff mainly classified based on Received signal strength (RSS) mentioned in formula (1). Bandwidth Based i.e. cognitive mechanism is applied in such a way that secondary user is going to use primary user channel without affecting the primary user. In this paper we are considering the RSS values of the BS and FS. Among the all values the feasible values will be considered without occurring the call blocking. By using the Support Vector Machine (SVM) the optimal solution will be given. The SVM is going to work with the limited RSS values in an effective manner. Diagonal handoff: The diagonal handoff is the combination of both horizontal and vertical handoff methods.

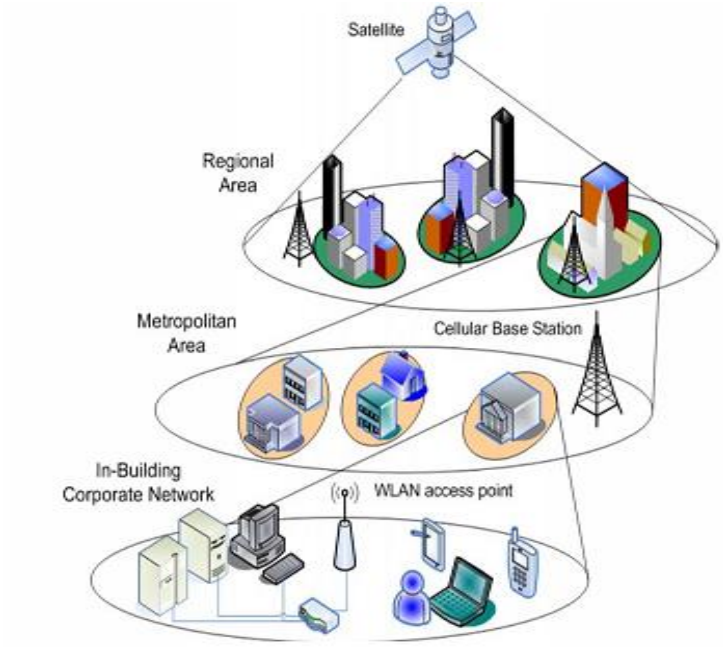

Figure 1. Representation of composite network

The decision logic takes both pre-configured parameters and runtime measurements as inputs (1), and determines the next appropriate cell (2). Once the decision is made, it executes the handoff procedure (3) and migrates the device to the chosen next cell as shown in Figure 2. Once the previous handoff procedure completes, the device switches to a new cell; New handoff procedures can be invoked and new serving cells will be further selected and switched to (4 and 5) as long as the handoff criteria is met [6].

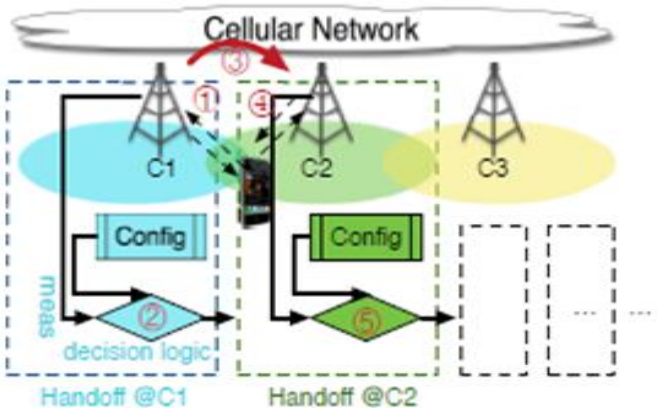

Figure 2. Distribute handoff process with each atomic handoff executed at the serving cell

2.1. Drawbacks of each handoff mechanism

In soft handoff the mobile device has to maintain the both BS information in Active List, it leads to difficult to maintain in the heavy load time [7]. With the hard handoff the ping pong affect will not be resolved i.e. unnecessary handoffs will not be resolved. Ping pong handover occur when the UE is handed over from one cell to another but is quickly handed back to the original cell. The both soft and hard handoff will not resolve the problem in heterogeneous wireless network handoff problems. To resolve those a vertical handoff should be performed between the different networks. Within network the horizontal handoff will be performed. By performing the above handoff mechanisms the through put also be increased so maximum number of packets will be transmitted without any loss [8].

3. THE MECHANISM USED TO ACHIEVE QOS

Base on the RSS, hand of mechanism will be performed. So for any user the RSS to be calculated, the RSb[m] and RSf[m] are representing the RSS values at 'm' time intervals. Based on the RSS value the handoff will be performed, the RSS values will be calculated by using formula (1). The RSS values are and distance values between the nodes to the BS are the dimensions to plat the graph [9]. When ever to a problem more dimensions are there but fewer samples available to a particular time then to classify the data super vector machines (SVM) can be used. See the Figure 3 it shows the vertical handoff and horizontal handoff, the vertical handoff is happening between the AP's points under the same BS. But the horizontal is crossing the BS and needs another channel from next BS [10]. Figure 3 is showing the case is when a user should go to the next BS based on RSS, how it has to choose one channel for the communication. The RSS of the node will be calculated from different stations then based on the values by applying SVM the feasible solution will be find.

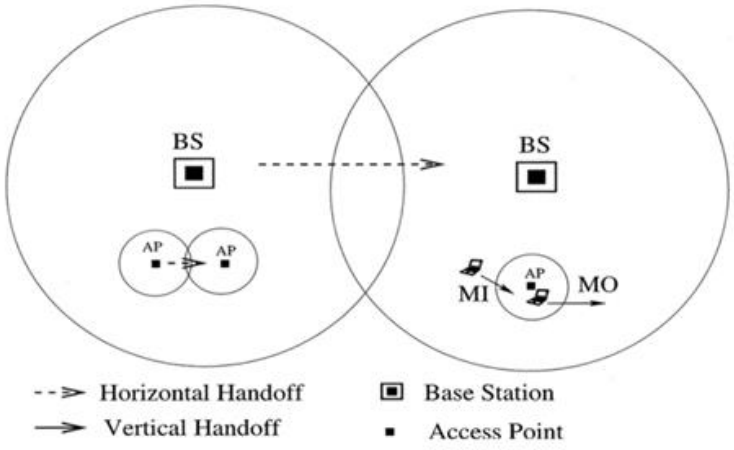

Figure 3. Handoff in composite network

3.1. Flow chart of handoff mechanism

In the above flow chart the handoff will be done by the RSS value and the threshold value in present cell. The first condition is that the RSS value of the device is more than the threshold value of the cell then handoff not required to the device [11, 12]. If the RSS value is less than the threshold value of the cell and which is nearer to the next cell and velocity is high and towards the new cell region then the handoff should be done, but the direction towards the existing cell then handoff is not required just a channel of present cell can be assigned based on the cognitive behavior of the nodes for channel allocation [13-16]. The direction of the device will be calculated by using the GPS location can be used available in the mobile devices, this data will be maintained at the VLR (Visitor Location Register) [17-19]. This data can be used to reduce the unnecessary handoff things so this will reduce the PINGPONG affect. Figure 4 shows the Flow Chart of handoff mechanism.

3.2. Channel allocation algorithm

The input is the node distance from the BS's, velocity of the node in case of mobile device. The output is the RSS values and the neighboring channels free list. These type of channel allocation are in these articles but the proposed channel allocation is best [20-22].

Step1. First the RSS values of the node to be calculated formula (1).
Step2. Measure the velocity of the user equipment and direction.
Step2. Based on the above values find the next expected BS to be chosen based on SVM.
Step3. The trained data will help you edge fining in a cellular network to a particular BS.
Step4. The active list of the node to be updated based on the RSS values and channel availability.
Step5. The active list should maintain the BS information's based on user requirements. So it can be soft or hard handoff based the values.
Step6. The free channel will be given to the user or mobile node.

The above algorithm will work with less parameter values also because for classification SVM is applied. The femtocell will provide the coverage to the each corner of the home and any office zone where we need full coverage of the signal [23-25]. The point we are going to address is that the newly penetrated

cell in to the region of femtocell will get the channel based on the cognitive principle i.e. the newly entered person we will consider as the secondary user (SU) in allocating the channel. The final conclusion is that the unnecessary handoff things will reduce the PINGPONG affect.

The Figure 5 is describing that when the device is having more distance from the BS then the RSS value is less. We have to switch the device to the nearest BS based on the direction and velocity of the device. Some devices just enter in to the next cellular region and they will return to the previous cell region then if handoff occurs then the channel allocation is waste of thing this effect in ping pong effect in the handoff. To avoid this effect the device velocity and direction to be consider. The velocity can be measured based on the distance traveled in particular time period and the direction can be measured based on the GPS location. If the velocity is more and device GPS direction is towards the current cell region BS but trying to enter little bit to new BS location then the handoff is not required. This problem will be resolved by having the above channel allocation algorithm. If the device switching to the new BS region, handoff will be performed based on the new cognitive technique of the femtocell.

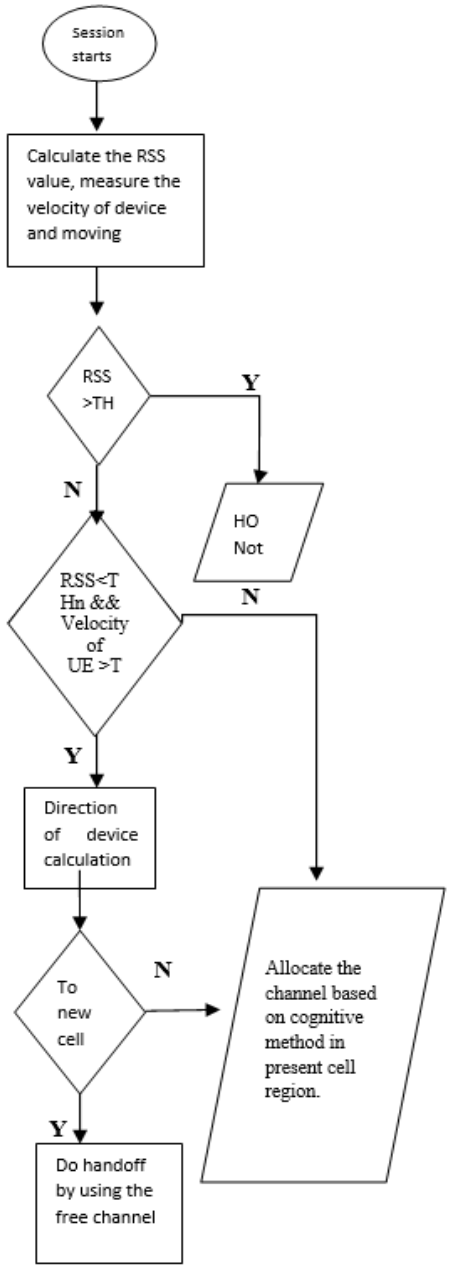

Figure 4. Flow chart of handoff mechanism

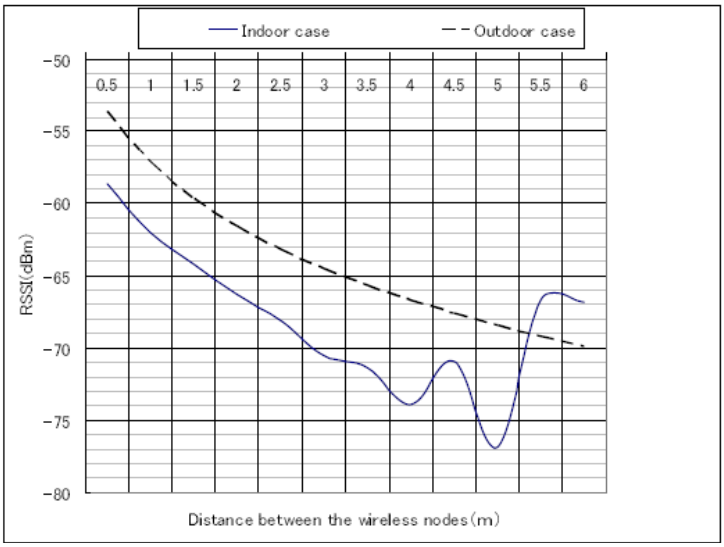

Figure 5. RSSI vs distances

4. CONCLUSION

The final conclusion is that present days the users are more relay on the network communication for any work. So when a user is in journey or he is in a office the location is not covered by the signal zone then femtocell will provide the coverage but user moving from one cell region to another cell region communication should not block or break. To keep the communication a vertical handoff mechanism is taken with little updating the RSS value classification to a node in m time intervals. In feature to the algorithm a training data set can be given and with machine learning approach of SVM the final channel of BS to be found for communication.

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