Handover Mechanism for Mobile User and Femtocell for LTE Network

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ABSTACT: *A femtocell network is used to enhance the signal strength. One of the goals of LTE network is to increase the data rate and to minimize the operation effort. Performance can also be enhanced by introducing the self optimized approach to handle the handover between femtocell and User Equipment (UE). Many users are passed by the femtocell coverage area at different speeds but there is no mechanism to handle such handover. In this paper, a novel mechanism of handover is introduced to handle such users. QoS and performance can be increased by this mechanism. The comparison of this novel technique with classical handover mechanism shows that the novel techniques shows better performance and minimization of the unnecessary handovers in the discussed method.*

Keywords: LTE Network, Mobile Users, Femtocell Network, QoS, Wireless Communication

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1. Introduction

Handover is the process which guarantees that a user can shift from on cell to other. The process is transparent for the user also where QoS is maintained during hand over. Hard hand over is normally used for the femtocell network. The femtocell selection for the Hand Over (HO) issue is solved by using NCL. In the currently implemented mobile network, HO is done manually or on need base only. This is not favored because it is time consuming and may be not taking on need basis [1]. So there is a need of self optimize the technique that provides a smooth handover with QoS also full fill the handover criteria.

UEs pass through femtocell with different speed normally become the cause of some redundant handovers specially users with high speed. These useless handovers reduce the performance of the system. Users with different speeds and they rapidly perform handover from macro cell to femtocell or femtocell to femtocell, and the classical handover method cannot maintain QoS in such situation. Unnecessary handovers become the cause of communication system's degradation and avoidable burden on wireless communication system; so QoS of user will be distressed. Classical handover decision algorithm failed to entertain the user with high speed.

A femtocell has three modes of operation. Closed mode, Open mode and Hybrid mode as shown in Figure 1 [2]. In open access mode every user can use the services of femtocell there is no need to authenticate a user. In close access mode only authorized user can utilize the services of femtocell, a CSG list is maintained to check the authorized user. If the name of the user is present

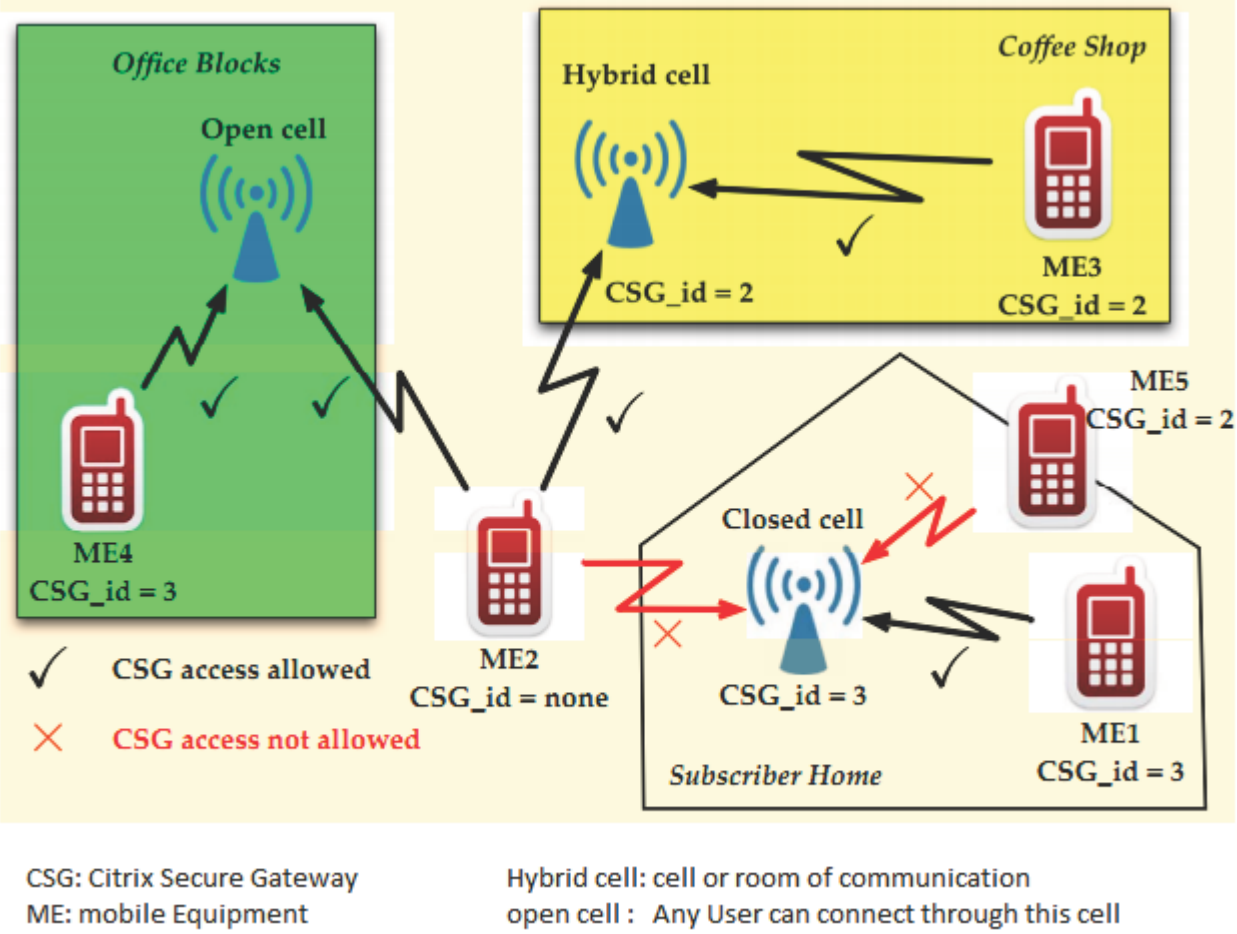

Figure 1. Femtocell Access Modes

in CSG then user is allowed to handover to targeted femtocell otherwise rejected. Hybrid access mode is the combination of open and close access mode. A user in this mode is authorized to communicate but under some restrictions.

The reset of the paper is divided into four sections. Section II elaborates architecture of the femtocell for the LTE networks. Section III consists of Proposed Hand over scheme for different users and their category on the basis of their speed. The paper is concluded in section IV.

2. Femtocell Architecture

Architecture for the E-UTRAN is still under discussion on Femto Forum and in 3GPP. As the architecture is still not finalized, there is strong opinion to keep it flexible. Because discussion is still going on to select the Signaling elect or Evolved packet core, a femtocell can independently handle the user [2]. The model of the LTE based femtocell architecture is shown in figure 2. Access Network Discovery and Selection Function (ANDSF) helps UE to find the nearest existing network, to give preference and to establish link. Evolved Packet Data Gateway (ePDG) provides a secure environment to UE and the EPC.

Inactive mod UE path and process of paging is the responsibility of Mobility Management Entity (MME), also selection of SGW and its connection with its first time or during handover mechanism issues are handled by the MME. Data forwarding or User packet is key task of Serving Gateway (SGW). SGW terminates the downlink connection for the idle state UE and activate paging process. PDN gateway or PGW perform various duties like packet screening, implementation of rules and packet filtering for various UE. EPS Mobility Management (EMM) protocol perform mobility management and provide security to NAS issues like UE going to use E-UTRAN [2].

3. Proposed Handover Scheme

Before handoff, a UE can sense many existing HeNB networks, inbound and outbound handover in this network which is the big issue now a day. According to outbound Mobility for Home HeNB scheme [8] there is no need of user authentication when a user handover from femtocell to macro cell but if an illegitimate user spoofed the ID of legitimate user and deployed a femtocell and initiate a call then attempted to switched from femtocell to macro cell. In this scenario illegitimate user get access to the macro cell.

If there are no rules to check the authorization of the user, then illegitimate user will consider as a legal user in the macro cell. Macro cell allows handover to such user. According to this modified mechanism, authorization and authentication are both necessary in any situation as the user handover from macro cell to femtocell or femtocell to macro cell.

When a UE going to use the services of the targeted femtocell then Closed Subscriber Group (CSG) list is checked on that user which can communicate whose identity present in the CSG list [3]. Then authentication of the UE is checked by using appropriate authentication protocol in the early stage of the handover. Novel handover mechanism is more difficult than the classical way of handover between macro cell and femtocell. In figure 3 novel handover mechanism is shown.

Femtocell coverage area is very small [6], so users passing through this small cell with high speed can cross this area within a short time period. Hand over in this small time become useless for such users and also QoS degrade as well as a useless burden on the communication system also increase. The above situation can be classified by just dividing the user into three categories [4]:

- **Low Speed State:** Users moving with the speed of 0 to 15 km/h. in this case user may be walking or standing
- **Average Speed State:** Users moving with the speed of 15 to 30 km/h
- **High speed State:** User moving above the speed of 30km/h

During hand over QoS must be maintained that is usually disturbed due inefficient algorithms. In some scenarios a user with low speed needs a rapid hand over and to continue for smooth communication tries to stay in same femtocell during current communication session [7]. For such scenario UE's algorithm is defined in algorithm 1.

To fulfill hand over parameters measurement values are taken from RSRP/RSRQ if value of source cell is lower than targeted cell, hand over continues otherwise hand over procedure will not executed [5].

But for the optimized handover scheme, we prefer "*X*" variable which use the value of RSRP/RSRQ [1] to select the cell for handover.

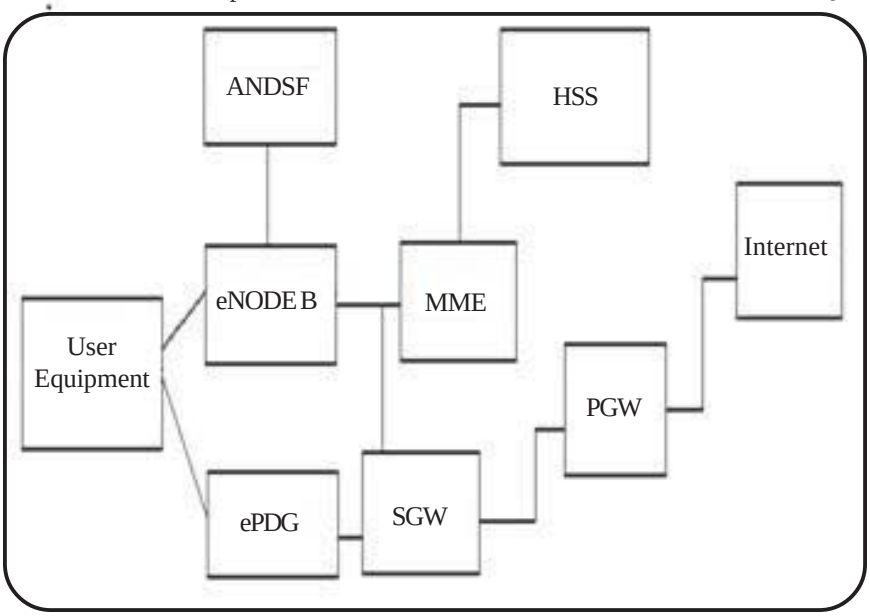

Figure 2. HeNB logical architecture

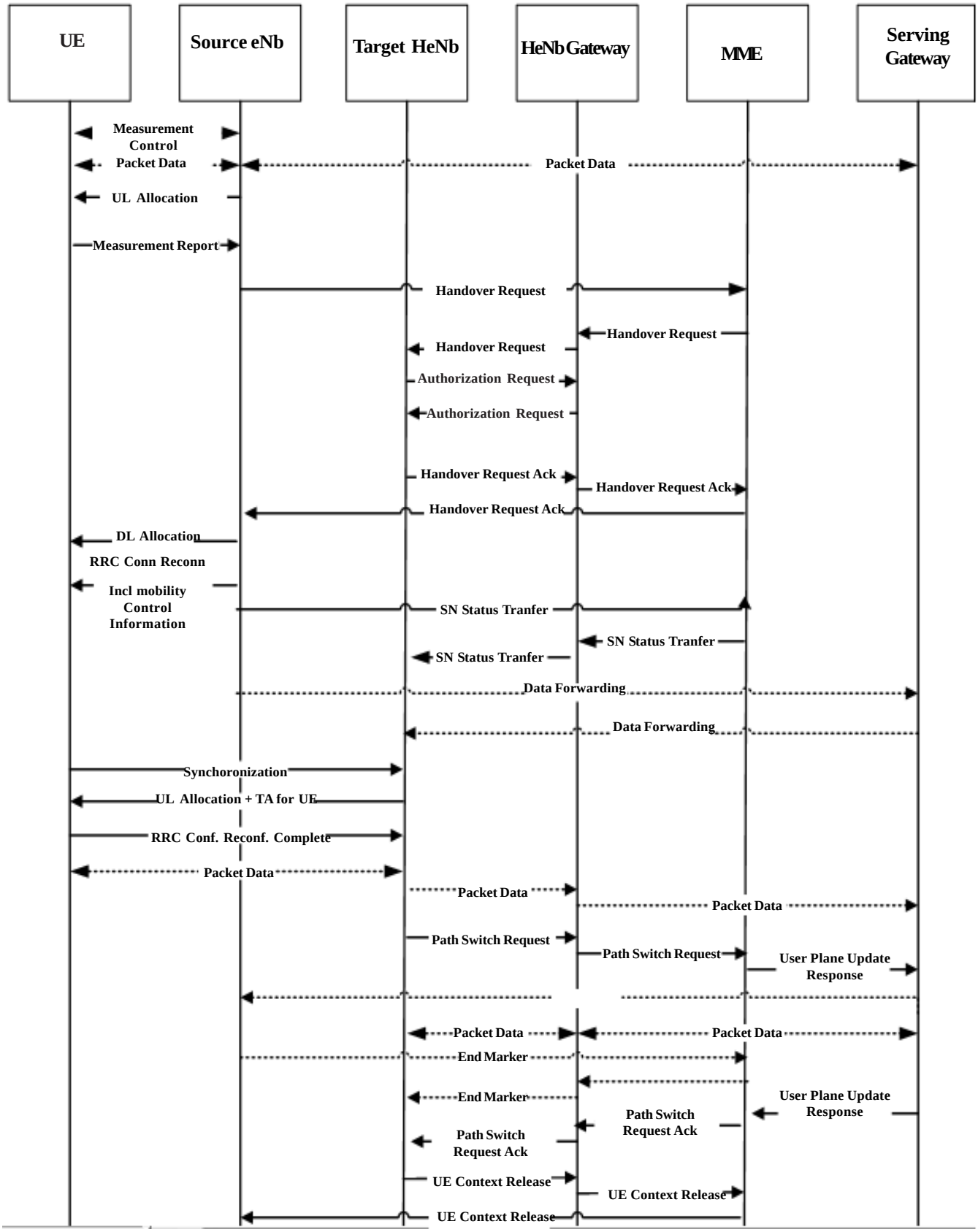

Figure 3. Novel Handover Mechanism

1. Handover Start
2. Check Speed of the User
3. **IF** SPEED > 30kmph
   No Hand over
4. **ELSE IF** SPEED > 15KMPH
   If communication in progress
   Hand over continue
   Otherwise
   NO HAND OVER
5. **ELSE**
   HAND OVER
6. Back TO Step 1

Algorithm 1. UE's algorithm

$$X = \frac{Xo}{log\,(e * k + n)} * N * G \qquad (1)$$

Xo is the value of RSRP and RSRQ, exponentials value is $e = 2.7182$, where *n* is the number of UEs that need handover, *K* is the nonce (Type of Cell) for different cells, *N* is neighboring Cell, *G* is used to maintain value of *X* [1].

5. Conclusion

Femtocell is used in wireless communication to get strong signal strength. Femtocell is created as lower layer of the macro cell. Different UEs need handover when they pass through the femtocell coverage area. In this paper a novel technique is proposed for hand over to handle user with different velocities. Also hand over scheme is elaborated that authentication is the key requirement of inbound or outbound handover, so that illegitimate users cannot use the services. Unnecessary handovers can degrade the system performance and also put a useless burden on the communication system.

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