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Optimization Handoff in Mobility Management for the Integrated Macrocell - Femtocell LTE Network

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Abstract - LTE is long-term evolution, is a standard for wireless communication of high-speed data for mobile phones and data terminals. In LTE, the Mobility Management Entity is responsible for the mobility management function. The mobility management entity is connected to a large number of evolved Node Base station that are grouped into the Tracking Areas. Mobility Management has key challenges Femtocell characterization / identification, Access Control, Network Discovery, Handover decision and Handover execution where going to focus on Handover. In Prominent cellular networks, the Handover decision phase performed at serving cell is based on signal quality measurement provide by the UE.

Keywords - *LTE, Mobility Management, Handover*

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I. INTRODUCTION

Mobile broadband has changed the way we live and work. LTE is future of mobile broadband. The recent increase of mobile data usage and emergence of new applications such as Multimedia Online Gaming, mobile TV, Web 2.0, streaming contents have motivated the 3rd Generation Partnership Project (3GPP) to work on the Long-Term Evolution (LTE).

Long-term evolution, marketed as 4G LTE, is a standard for wireless communication of high-speed data for mobile phones and data terminals. It is based on the GSM/EDGE and UMTS/HSPA network technologies, increasing the capacity and speed using a different radio interface together with core network improvements. The standard is developed by the 3rd Generation Partnership Project (3GPP) and is specified in its Release8 document series, with minor enhancements described in Release 9.

1.LTE system architecture

LTE system architecture is shown in figure. UE contains USIM (Universal Subscriber Identity Module) which holds authentication information. UE supports uplink downlink air interface. UE sends information to ENB. ENB is LTE base station. It is different from other base station that it can manage radio resource, while other base stations requires nodes like RNC (Radio Network Controller) for radio resource management. ENB sends mobility information to MME (Mobility Management Entity) and forwards uplink data to S-GW (Service Gate Way)[1].

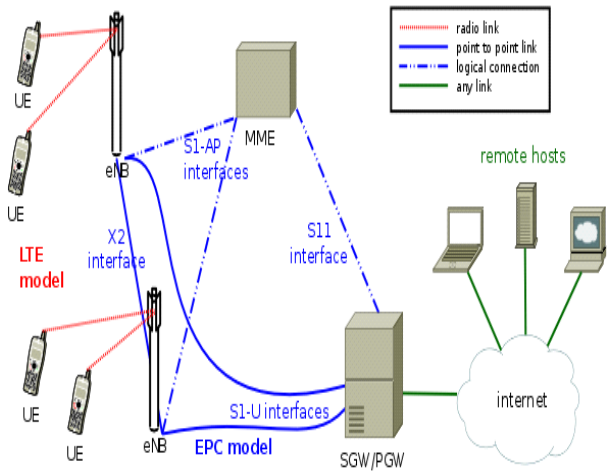

Fig-1 LTE system architecture

A. User Equipment (UE)

User Equipment is the device that the end user applies for communication. Typically it is a hand held device such as a smart phone or a data card such as those used currently in 2G and 3G, or it could be embedded. UE also contains the Universal Subscriber Identity Module that is a separate module from the rest of the UE, which is often called the Terminal Equipment (TE). USIM is used to identify and authenticate the user and to derive security keys for protecting the radio interface transmission. Functionally the UE is a platform for communication applications, which signal the network to set up, maintain and remove the communication links the end user needs. This includes mobility management

functions such as handovers and reporting the terminals location, and in these the UE performs as instructed by the network. Maybe most importantly, the UE provides the user interface to the end user.

B. E-UTRAN Node B (eNodeB)

The only node in the Evolved Universal Terrestrial Radio Access (eUTRAN) is the eUTRAN Node-B (eNodeB). It is a radio base station. Typically, the eNodeBs are distributed throughout the networks coverage area, each residing near the actual radio antennas. A fact is that most of the typical protocols implemented in today's Radio Network Controller (RNC) are moved to the eNodeB. The eNodeB is also responsible for header compression, ciphering and reliable delivery of packets.

C. Mobility Management Entity (MME)

The Mobility Management Entity (MME) is a signalling only entity, thus user's IP packets do not go through the MME. Its main function is to manage the users mobility. In addition, the MME also performs authentication and authorization; idle mode user tracking and reaching abilities; security negotiations; and Network-Architecture Specific (NAS) signalling. An advantage of a separate network element for signalling is that operators can grow signalling and traffic capacity independently.

D. Serving Gateway (S-GW)

The high level function of S-GW is tunnel management and switching of the UP. The S-GW is part of the network infrastructure maintained centrally in operation premises. The S-GW has a very minor role in control functions. It is only responsible for its own resources, and it allocates them based on requests from other network entities, such as MME, PDN-GW, or PCRF which in turn are acting on the need to setup, modify or clear bearers for the UE. If the request was received from the PDN-GW or PCRF, the S-GW will also relay the command on to the MME so that it can control the tunnel to eNodeB. Similarly, when the MME initiated the request, the S-GW will signal on to either the PDN-GW or the PCRF. During mobility between eNodeBs, the S-GW acts as the local mobility anchor. The MME commands the S-GW to switch the tunnel from one eNodeB to another. The MME may also request the S-GW to provide tunnelling resources for data forwarding, when there is a need to forward data from source eNodeB to target eNodeB during the time UE makes the radio handover. For all data flows belonging to a UE in connected mode, the S-GW relays the data between eNodeB and PDN-GW [1].

2.Femtocell-Macrocell Network

Femtocells are low-cost, low-power points deployed by the end-customers that provide indoor coverage of a given wireless cellular standard. They are connected to the network operator through a backhaul, e.g. optical fibre, Digital Subscriber Line (DSL). An extensive deployment of femtocells, which will heavily impact the architecture of current cellular systems, is foreseen. The new network architecture will be divided into two clearly separated tiers, the macrocell tier and the femtocell tier. In this case, the macrocell tier will be composed of long range base stations (macrocells) that provide cellular coverage to mobile users, while the femtocell tier will be comprised of short range access points (femtocells) that offer large throughputs and new applications to indoor customers [5].

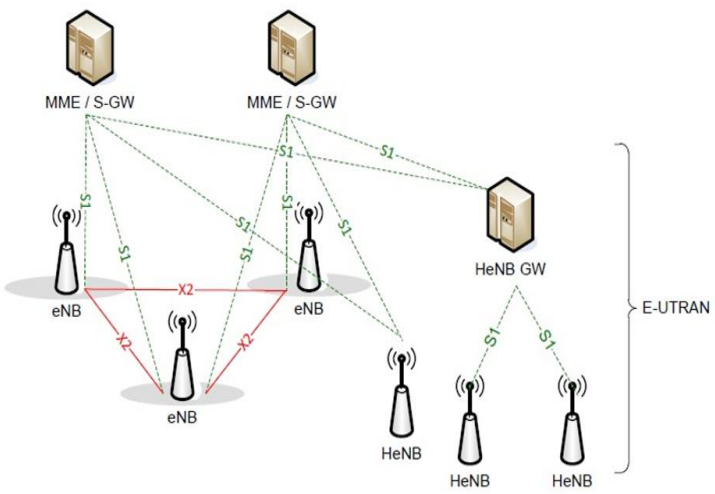

Fig-2 E-UTRAN Architecture with deployed HeNB GW[2]

The overall E-UTRAN architecture with deployed HeNB GW is showed in Fig-2. The interfaces between the HeNB and the EPC are the standard S1-MME and S1-U, with the HeNB GW optionally providing aggregation function for the S1-MME. The S1-U interface adopts a direct tunnel approach, but optionally also this interface can be aggregated by the HeNB GW. In this case, the HeNB GW may also provide support for user plane multiplexing, for efficient transmissions over limited bandwidth links. The functions supported by the HeNB shall be the same as those supported by an eNB and the procedures run between a HeNB and the EPC shall be the same as those between an eNB and the EPC [2].

3.Mobility Management

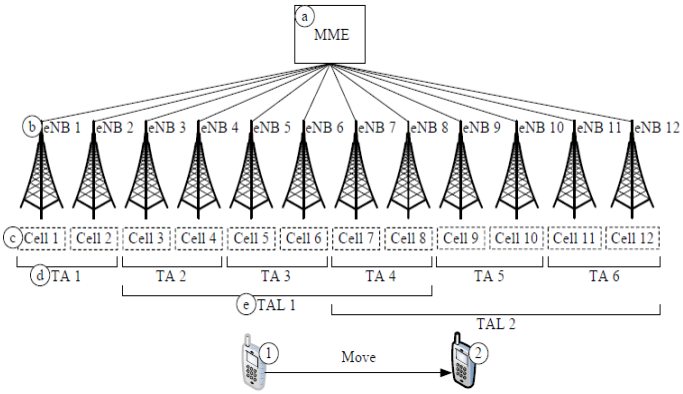

Fig-3 Mobility management architecture [3]

In Long Term Evolution (LTE), the Mobility Management Entity is responsible for the mobility management function, which is connected to a group of evolved Node Bs (Figure (b)). The radio coverage of an eNB is called a cell (Figure (c)). Every cell has a unique cell identity. The cells are grouped into the Tracking Areas(TAs; e.g., TA 1 contains Cell 1 and Cell 2 in Figure (d)). Every Tracking Areas has a unique Tracking Area identity (TAI). The Tracking areas are further grouped into TA Lists (TALs). In Figure, TAL 1consists of TA 2, TA 3 and TA 4 (Figure (e)).A UE stores the TAL that includes the TA where the UE resides [3].

Now, Mobility Management has four key Challenges which are listed below:

- Femtocell characterization / identification
- Access Control
- Network Discovery
- Handover

4. Handover

When a UE travels from one area of coverage or cell to another cell within a call's duration the call should be transferred to the new cell's base station. Otherwise, the call will be dropped because the link with the current base station becomes too weak as the mobile recedes. Indeed, this ability for transference is a design matter in mobile cellular system design and is call handoff. As shown below figure the scenario of before handoff & after handoff.

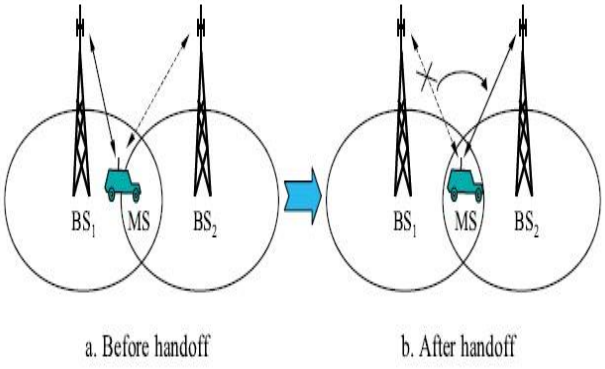

Fig-4 Handover concept

II. PREVIOUS WORK

A modified handover procedure using Double Threshold Algorithm and Call Access Control to reduce the unnecessary handovers. The Call Access Control is related to the time UEs stay in a femtocell area and how to differentiate between the pre-registered users and un-registered users. Previous algorithm shown below [4]

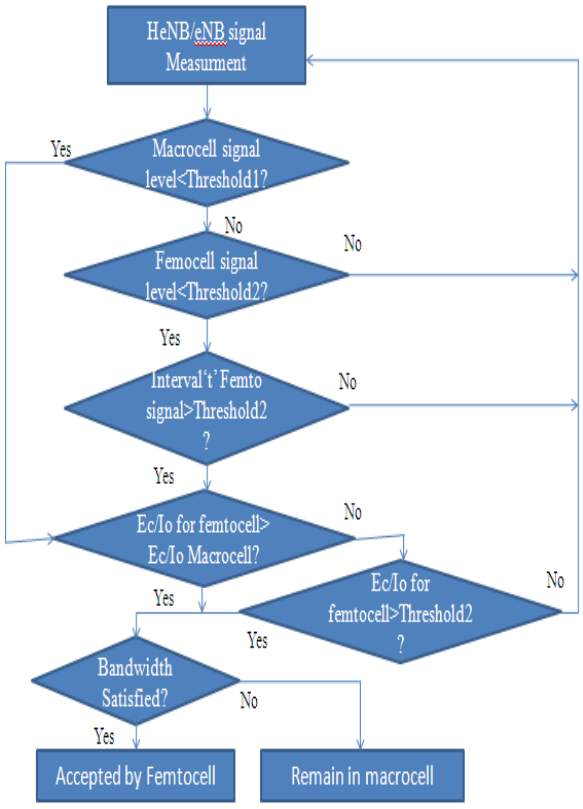

Fig-5 Flowchart of Double Threshold Algorithm [4]

When a UE moves from source cell to target cell, we compare the signal level of source cell with Threshold1 and the signal level of target cell with Threshold2,where Threshold1< Threshold2 and Threshold1 is the minimum level of signal

that must be needed to handover a UE from source cell to target cell. If the signal level of source cell is lower than Threshold1, the signal level is below the minimum level that has to execute the handover. Otherwise, the handover is executed unless the signal level is higher than Threshold2.

The Double Threshold Algorithm can reduce the unnecessary handover because all source signal level is compared with Threshold1 and all target signal level is compared with Threshold2. When a handover is finished, the source cell becomes the target cell and the target becomes the source. There is no need to make any change to the algorithm to this point to reduce the probability of frequent and unnecessary handovers [4].

III. PROPOSE WORK

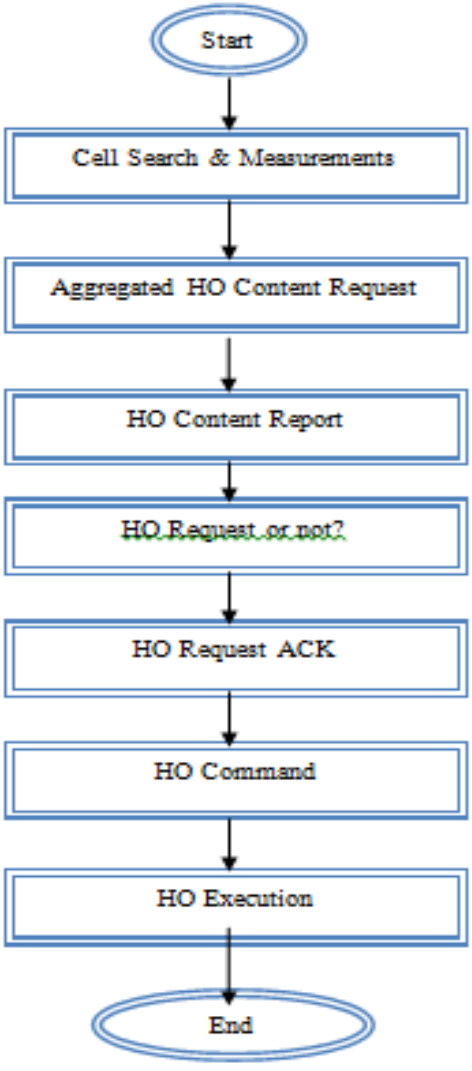

Fig-6 Flow of Propose method

IV. RESULT & DISCUSSION

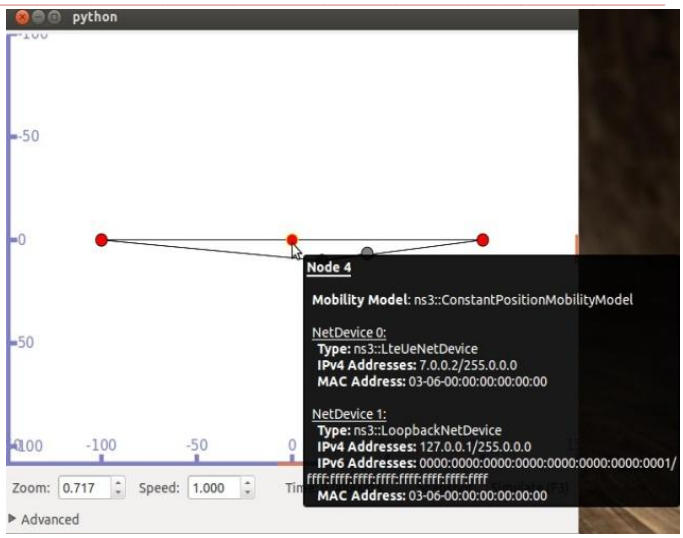

Fig-7 Handover of User Equipment (UE)

Simulation is done in NS-3. Program file is in .cc format

When User Equipment moves from one place to other place handover occur because of threshold value is change. So this is shown in above figure. It instantiates two eNodeB, attaches one UE to the 'source' eNB and triggers a handover of the UE towards the 'target' eNB.

V. CONCLUSION

Studied about the LTE Technology and referred the various papers consisting of handover algorithms for LTE Network. Thus created an LTE network with Femtocell and shown eNodeB and UE interconnected with X2 interface by applying basic handoff algorithm using NS3.

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