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Research Article

A Novel LTE Hand Over decision algorithm implemented in Open Source NS-3 Simulator

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Abstract

NS-3 is a C++ open source framework used by researchers and practitioners to test enhanced techniques for improving networks especially 4G cellular networks (LTE and A-LTE), many modules have still not covered completely by this simulator especially the Handover function. In this paper a new LTE HO decision algorithm is proposed and deployed in NS-3. The effectiveness of the proposed algorithm has been tested and verified into NetAnim simulator environment

Key-words: *NS-3, NetAnim, Open source simulator, LTE, Handover Decision..*

1. Introduction

LTE represents an emerging and promising technology for providing broadband ubiquitous Internet access. For this reason, several research groups are trying to optimize its performance. This improved performance has to be provided and guaranteed under various mobility conditions (Éric Hardouin *et al*, 2012).

Handover is one of the essential mobility functions in cellular mobile communication systems. A handover begins with a decision for a mobile station (MS) to handover its air-interface, service flow, and network attachment forms a serving base station (BS) to a target BS. This change may be required by the movement of the MS or caused by spectrum, capacity or network management issues (Sung Kyung Kim *et al*).

The handover procedure is described as consisting in three main phases: the first one is the measurement collection and evaluation that is processed parallel to the target cell determination algorithm; the second phase is the handover decision and triggering (in this paper we focus in this phase); the third phase is handover execution that performing the network procedures with the target BS (this phase is already implemented in NS-3).

Handover decision is essential because if the decision is wrong the data will be lost and we will have a bad QoS.

To decide handover we need many parameters (Signal power, signal quality….) but that is not enough. What we need more is an optimized algorithm that can use all those parameters to make the good decision.

In this paper, we are interested in the conception of a good function which should use different parameters values to decide when the HO should be started. We would rather integrate this function into NS-3 simulator. Our work is done under the supervision of LENA project team (Nicola Baldo, 2011) (http://www.iptechwiki.cttc.es). We have used Net Anim tool (http://www.nsnam.org/wiki/index.php/NetAnim) to simulate the handover process with decision algorithm.

In the next section, we describe all the phases that constitute the HO procedure. Decision algorithm is introduced in section III. Simulation results and corresponding analysis are presented in section IV, followed by our conclusion and perspective in section V.

2. HO procedure

The HO process as it is illustrated in figure 2 starts with the measurement report sent by the user equipment (UE). Periodically, the UE performs some measures on the downlink based on references symbols (RS) (Konstantinos Dimou *et al*); namely the UE can measure the quality and the power strength of the received signal (RSRQ and RSRP).

We should state that the UE has been configured to take into consideration some conditions relating to performed measurements, If these conditions are met, the UE send the measurement report including some information (Konstantinos Dimou *et al*).

Based on the information received on the measurement report (Konstantinos Dimou *et al*), the serving eNB starts the preparation of HO. In this phase, there is a signalization exchanged between the serving and the target eNB that guarantees the successfulness of this process.

Both of The eNBs concerned by the HO use X2 interface for communication (Alcatel Lucent, 2009). If the serving cell made a decision (HO decision) and the HO preparation succeed, a HO command will be sent to the UE and the connection between the serving cell and the UE will be released. Subsequently the UE try to access the

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target cell by using random access channel (Konstantinos Dimou *et al*).

Finally, all the allocated resources of the UE in the serving eNB will be released, and data units start to follow the new path to the target eNB (ETSI TS 136 331).

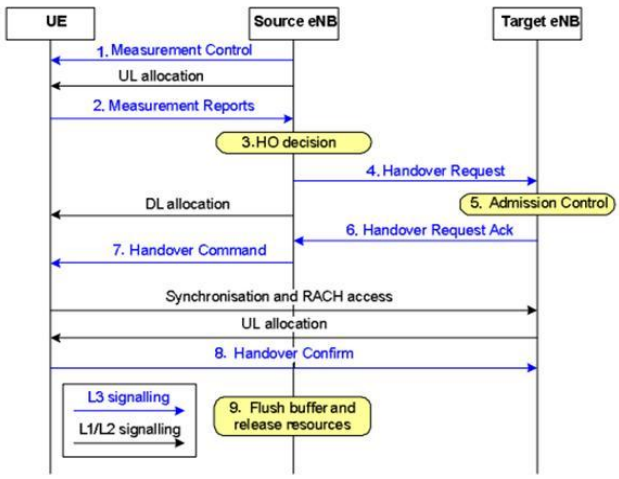

Fig.1 Hanover process

3. Decision algorithm

The decision algorithm is shown in figure 3, when the user equipment manager receive a measurement report, it verify if the signal quality is below the serving cell HO threshold. If it's the case, it will test if the report has the measures result for a neighbor cell. If there is a neighbor cell measurement result, we will verify if this cell exists in the neighbor relation table (NRT), if it is not the case we will add it to this table.

After this operation, we will update the neighbor cell information in the measurement table of the serving cell. Then, we must choose the best neighbor cell from the existing neighbor cells.

When we find it, we have to verify these two conditions:

- RSRQ of serving cell – RSRQ of best cell found < = neighbor cell HO Offset
- UE state =CONNECTED_NORMALLY

To start the HO process, these two conditions must be met, until a number (Report Amount) of measurement report is achieved.

The role of Report Amount parameter is to avoid the fast decision of the HO. It allows waiting for a period of time equal to Report Amount * time interval between two measurement reports.

4. Simulation results

The parameters we have considered in this simulation are the following:

- Velocity of UE: 20m/s,
- Distance between UE and target eNB: 1000m,
- Simulation time: 50s.

Others parameters relating to the network like signal power are also considered.

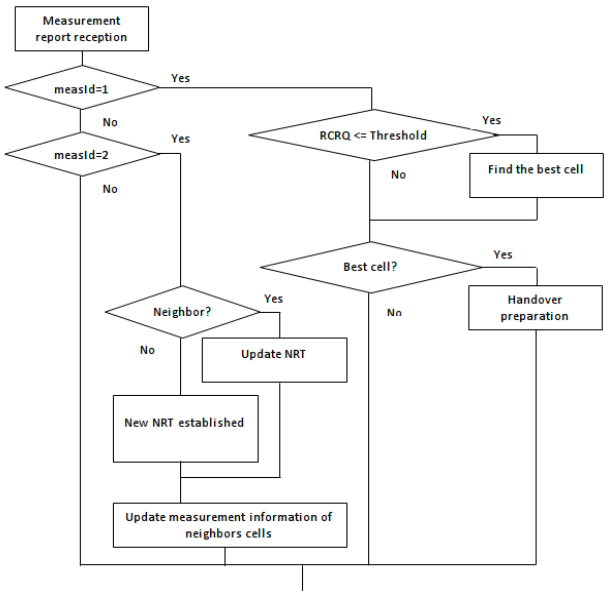

Fig.2 Handover decision algorithm

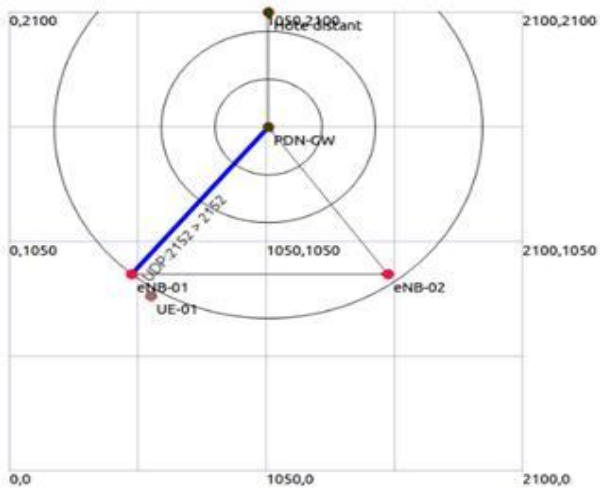

Fig.3 First phase where the UE is connected to the first eNB

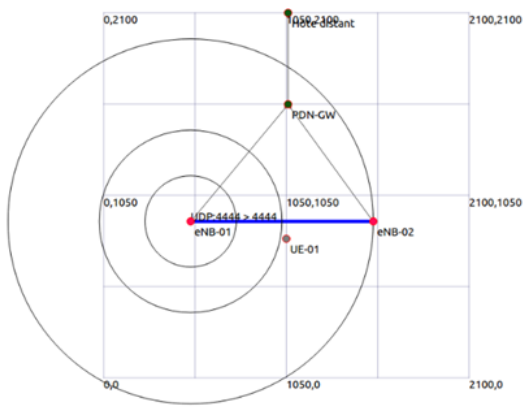

Fig.4 The serving eNB communicate with the target eNB to success handover process

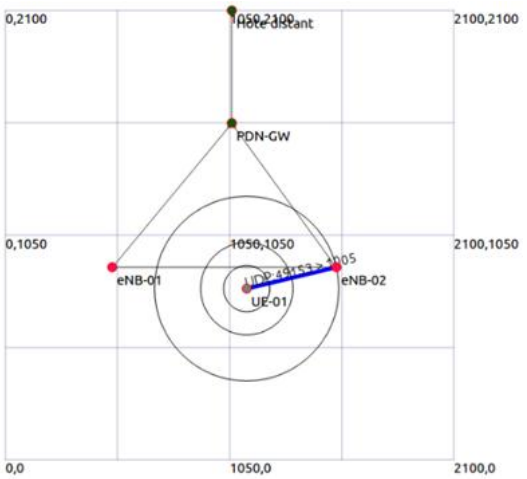

Fig.5 The UE is connected to the second eNB

When the UE exceeds 400m, this fastness starts to decrease because the signal power and the signal quality become lower than the beginning. This depends on the distance between the UE and the eNB. In this phase, the serving eNB decides the moment when the UE needs a HO, and starts to communicate with the target eNB as it is illustrated in figure 5. The main reason for this communication is to avoid data loses and to guarantee a best service quality for the user.

The figure 6 shows that if the HO procedure succeeded, the UE will be attached to the target eNB which become its serving eNB.

5. Conclusion and perspective

In this paper, we have implemented a new HO decision module in NS-3, the simulation results prove that we managed to make a decision to start a HO process based on several parameters. We note also that the decision here concerns cells which belong to the same technology.

In future work, we plan to extend this decision algorithm and use it in different technologies of mobiles networks.

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