

# Handover Techniques Analysis For Dense LTE Network

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**Abstract:** In order to face the increasing demand for bandwidth caused by mobile data applications and value-added mobile services, 4G/LTE network deployments are Based on the emerging paradigm of networks, Among the various factors that are affecting factors of wireless cellular technology such as delay, throughput, latency etc ,the most effective one is Inter cell Interference(ICI). There are many methods for reducing this ICI, two of them are Frequency Reuse(FR) techniques and Handover techniques. In the dense LTE environment, the deployment of small cells, also called microcells or femto cells are very near in order to provide high data rates and improved quality of services. Different handover algorithms are used and are compared for the good quality of communications. LTE network topology is constructed and simulated done using Ns3 tool. RSRP and RSRQ values are used to calculate the performance of the system. NS-3 is used to simulate this environment and calculate different parameters for different cells like macrocell, microcell, etc using different handover techniques like A3 RSRP handover algorithm and A2A4 RSRQ handover algorithm.

**Index Terms:** LTE; handover; NS-3; RSRP; RSRQ; microcell; macrocell.

## 1. INTRODUCTION

There has been major pattern shifts or changes in terms of technologies and architecture in mobile networks during the technological growth from 1st generation(1G) from 1980s towards 5th generation(5G) by 2020. There has been a drastic change in technology in mobile networks from 1G to 4G. Using advance digital signal processing and modulations techniques the thirst of system is towards high speed with great capacity. This project mainly focuses on the comparison study between different cell sizes with user equipments travelling in different speeds and different handover techniques used. This study is used in determining which handover technique to be used in different scenarios. Handover is the most important feature of a network which greatly impacts the performance of a system. There are many types of handover algorithms like A2A4 handover, A3 handover, no operation handover. When these parameters (RSRP, RSRQ) fall below threshold value handover procedure takes place. Handover is a process where one user equipment connected to one enodeB, which is called source enodeB is then connected to another enodeB, which is called neighbouring enodeB. The control transfer takes place considering RSRP (Reference signal Received power), RSRQ(Reference signal received quality), SINR(signal to interference noise ratio) etc. depending upon the handover algorithm. The main objective of this project is to simulate LTE environment, move the user equipment from one eNodeB to another eNodeB which are located at different distances for different cells where the speed of the user equipment also varies and then tabulate RSRP and RSRQ value at the time of handover. The results have been recorded by differing values of distance between enodeB's and speed of user equipment. The performance decreases when the handover time is more. Therefore, rate of call drops will increase leading to poor QOS( Quality of Service). The mobility management becomes difficult to achieve when

the distance between eNodeB's is more. The increasing speed of the user equipment decreases the SINR ratio when the handover does not take place at the cell boundaries. The Paper is organized as, in chapter II explains about Handoff in Cellular network. Chapter III describes LTE handover measurement events, Chapter IV includes simulation procedure and Methodology following with results in chapter V along with future work and conclusion in chapter VI.

## 2 HANDOFF IN CELLULAR

In cellular communications, the handoff is the way toward exchanging a functioning call or an information session from one cell in a phone arrange or starting with one channel then onto the next cell or another channel. Handoff is vital for counteracting loss of interference of administration to a guest or an information session client. Handoff is also called handover. The 3 different handover procedures are based on three different phases. These includes Handover information gathering, Handover decision policies and Handover E Cases of Handoff: Handoffs are triggered in many cases . Some of them are of the following situations: Every cell has a pre-characterized limit, for example, it can deal with just a particular execution. number of users. On the Off chance that the quality of clients utilizing a specific cell achieves its greatest limit at the point of handoff happens. A portion of calls are exchanged to bordering cells. Gave that the supporter is in the covering inclusion zone of both of the phones

Cells are regularly subdivided into microcells. A handoff may happen where there is exchange of obligations from the expansive cell to the smaller cell and the other way around. For instance, there is a voyaging client moving inside the ward of big cell. On the Off chance that the explorer stops, at the point locale is exchanged to microcell to alleviate the heap on the huge cell. Handoff may likewise happen when there is an impedance of call utilizing a similar recurrence for correspondence.

Type of Handoffs: There are two types of handoffs.

- **HARD HANDOFF:** In the hard handoff, a real break in the association happens while changing starting with one cell then onto the next. The radio connection from the portable station to the current cell is first break before building up the connection with the following cell. It is commonly

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between recurrence handoff. It is 'break before make' policy.

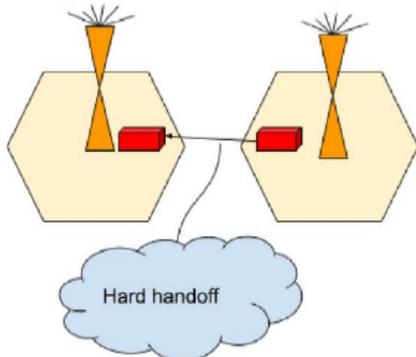


Figure1. Hard handoff

- SOFT HANDOFF: In the soft handoff, no less than one of the connections are added and evacuated to the portable station. This guarantees amid the handoff, no break happens. This is commonly embraced in co-found locales. It is 'make before break' policy.

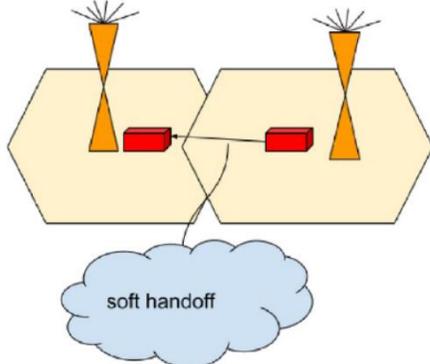


Figure 2: Soft handoff

Event	Description
A1	Serving becomes better than threshold
A2	Serving becomes worse than (=) threshold
A3	Neighbour becomes an offset better than serving
A4	Neighbour becomes better than threshold
A5	Serving becomes worse than threshold and neighbour becomes better than threshold2

In A2-A4 Event based algorithm, event A2 indicating the UE receiving very low signal quality, and can be benefited by hand overing to the new cell, whereas event A4 is used to detect neighbouring cells by considering RSRQ of that cell from UE entering to new cell. The A3-RSRP algorithm is also called Power budget Algorithm. The stronger RSRP is detected by the UE and the triggering of handover is done to the best cell with highest RSRP values. This handover is based on hysteresis and time to trigger parameter. The flowcharts given below shows the procedure followed during A-A4 RSRQ and A3 RSRP algorithm for handover handover

### 3. LTE HANDOVER MEASUREMENT EVENTS

In this paper, the handover is basically taking place based on the measured parameters such as RSRP(Reference Signal Received Power) and RSRQ(Reference Signal Received Quality) [1] . RSRP can also be defined as the average power in dBm of the resource element carrying cell specific reference signals within the considerable bandwidth. RSRQ is measured in dB which usually helps in providing the ranking between different neighbouring cells in reference with their signal quality. After calculating these RSRP and RSRQ values by the UE, the five different types of predefined events are examined. These five different reporting events which depends on values of RSRP and RSRQ are represented by A1,A2,A3,A4 and A5. The figure below shows the description of all differebt types of events occuring during the UE moves from one cell to another cell.

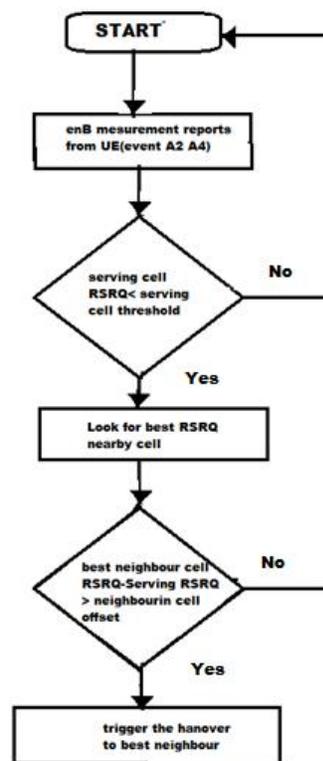


Figure 3: Flowchart for RSRQ based A2-A4 algorithm

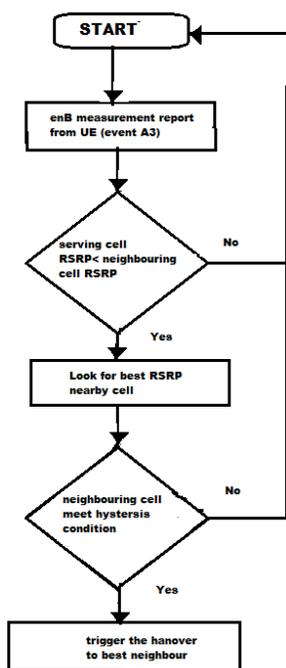


Figure 4: Flowchart for RSRP based A3 algorithm

eNodeB while the last node is the user equipment. It also gives the information about the time of handover

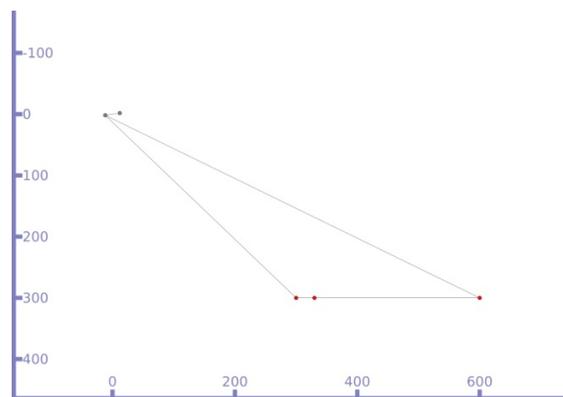


Figure 3. Animation of handover

**B. Simulation Results**

From the RSRP/RSRQ traces obtained from the simulations, their reported values and actual values are obtained at the points of handover for both the serving and target cells. They are presented in Tables II and III, for the A2A4RSRQ handover algorithm and A3RSRP handover algorithm respectively for both microcell and macro cell.

Table II results for A2A4 RSRQ handover algorithm

DISTANCE (m)	SPEED (m/s)	CELLID 1		CELLID 2	
Microcell		RSRQ	RSRP	RSRQ	RSRP
500	100	26	74	30	76
	250	19	73	32	82
	310	16	73	32	86
1000	150	26	65	29	67
	350	26	65	30	68
	700	25	65	30	68
Marco cell	700	27	48	28	49
5000	2500	26	48	29	49
	3500	26	48	29	49
3000	700	27	53	28	54
	2500	26	53	29	54
	2900m/s	24	52	30	54

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**4 SIMULATION PROCEDURES AND METHODOLOGY**

**A. Test Scenarios and Simulation Parameters**

The scenario was simulated with the help of a modified version of lena-x2-handover-measures.cc.[6] . It is included in the LTE module of NS-3.

Table I Simulation parameters

Parameter	Value
Number of UE's	1
Number of eNB's	2
Number of bearers per UE	0
Transmitted power of eNB(dbm)	46
Udp client interval	10
Udp client max packets	1000000

**B. Tools and Software**

The simulation was carried on Ubuntu 12.04 LTS operating system on a core i5 Dell laptop out using ns-3.27 version installed.

**5. RESULTS AND ANALYSIS**

The results and analyses of the simulations are presented in the following subsections.

**Animation of Network Topology**

A snapshot of the topology is shown in Figure 1. The first node is the SGW/PGW, the next node is the remote host and the third node is the serving eNodeB. The other node is the target

Table III Results for A3 RSRP handover algorithm

DISTANCE (m)	SPEED (m/s)	CELLID 1		CELLID 2	
Microcell		RSRQ	RSRP	RSRQ	RSRP
500	100	20	73	33	82
	150	20	73	33	80
	250	11	72	33	82
1000	100	23	64	30	68
	150	23	64	31	68
	200	23	64	31	68
Marco cell	100	24	47	28	50

5000					
	1000	24	47	31	50
	5000	22	45	31	48
3000	200	24	52	30	55
	2500	23	51	31	55

Formula for calculating actual RSRP from reported RSRP (n) in dbm is

$$n-139 < \text{RSRP}(\text{dbm}) < n-140 \quad (1)$$

### C. Analysis and Discussion

From the above results the following analysis have been made. Performance is better in microcell than macro cell in A2A4 RSRQ handover algorithm. There is similar performance in macro cell for both the handover algorithms. There is similar performance in microcell for both the handover algorithms. As speed increases in microcell RSRQ values decrease thus decreasing call quality in both the handover algorithms. The difference in performance between the serving and the target cells at the point of handover was higher in microcells than macro cells. This shows that the macro cells are more stable in handling control signaling than small cells.

## 6. CONCLUSIONS AND FUTURE WORK

In the project we have seen the performances of different handover techniques (A2A4 RSRQ Handover algorithms, A3 RSRP Handover algorithm) in different cells at handover. This kind of study helps us in research and attempt to enhance the functioning of LTE. It also lays bricks to the development of future generations of the technology. In the future we can include real time data transmission between these nodes thus developing the idea of compact small cells where virtual nodes act as base stations and thus we help in the development of 5G.

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