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Evaluate the Performance of Handover Management Algorithms in 5G Wireless Networks

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ABSTRACT

Increasing density of base stations (BSs) in 5G is the key approach which is widely used by network operators to increase capacity and coverage, despite of the gain achieved with increasing density, it causes unnecessary and frequent handover processes which affecting not only the network performance, but also the mobile phone battery. This draws the attention to the importance of handover management to select the most appropriate base station (BS) to ensure the continuous of the communication when the UE crosses from one cell to another. In this paper we present a comparison between three algorithms to determine which is better in managing handover in terms of throughput and delay while moving in different user velocity speed.

***Keywords* :-** 5G , Handover, Alternating Single Skipping, Multiple Skipping, RBSE-Based , Throughput, Delay.

I. INTRODUCTION

5G is the next generation of mobile standards being defined by the ITU, 5G networks promises to deliver improved end-user experience by offering new applications and services through gigabit speeds, and significantly improved performance and reliability. Handover is an important content of radio resource management in 5G. Thus, optimization of handover has a great effect on improving the effectiveness and reliability of the whole system as it is considered an important guarantee of communication continuity. Efficient handover (HO) management techniques are required in order to select the suitable base station. Several handover management algorithms are proposed in order to minimize unnecessary HO events, in this paper we will study three of them: (i) Single Alternating Skipping algorithm which is based on the idea that the user alternates between the blackout and best connected state which allows users to skip associating with some of the BSs along their trajectories [8]. (ii) Multiple Skipping algorithm which based on the idea of skipping two base stations in one step in order to minimize HO rate, and (iii) which is RBSE-based algorithm, which based on a new metric called Reference Base Station Efficiency (RBSE). This parameter takes into account three metrics[9] (the BS transmitted power, the BS traffic load and the users' spectral efficiency) , after collecting all the needed measurements parameters from the adjacent BSs , all the candidate base stations have been collected in a list , the UE selects the BS that maximize the RBSE which is defined as follows:

$$RBSE = S_{effi} \cdot (L / P_{Tb}) \qquad (9)$$

II. RELATED WORK

In [1] a new Handover algorithm based on CoMP joint transmission scheme was presented in order to minimize the Inter Cell Interference (ICI).Three different topology-aware HO skipping techniques were proposed in [2] including, location-aware, cell size aware and hybrid HO skipping and compared with the conventional best connected scheme. An algorithm was proposed in [3] using the actual distance between the UE and the SCs and the UE angle of movement to construct a shortened candidate list which helps in reducing the signal overhead of scanning and the number of unnecessary HOs. A user-velocity-aware HO skipping scheme was proposed in [4] to improve the average throughput of the mobile user in a two-tier cellular network. The proposed scheme sacrifices the best BS connectivity to reduce the HO rate and maintain a longer connection duration .To quantify the performance of the proposed HO schemes in terms of user throughput, a mathematical model is presented using stochastic geometry. Authors in [5] proposed a Markov-chain-based handover management strategy for software-defined ultra-dense 5G networks that selects the most optimal eNBs and assigns these to the mobile node virtually. While [6] presented a method to adapt the start of the handover based on a prediction of the signal-to-interference-plus-noise ratio. In [7] in order to solve the unwanted handover problems, a frequent handover mitigation algorithm for ultra-dense HetNets was proposed,[8] studied the effect of HO delay on the user average rate in dense cellular network environments [9] improved the average end-to-end delay increases with the densification of the BSs in the system and finally[10] illustrated that if a device undergoes multiple HO, the HO delay will be accumulate resulting in a severe deterioration to the user experience .

III. RESULTS AND DISCUSSION

The performance of the three algorithms which was mentioned in the section (I) has been evaluated through the open source simulator NS3.27, The scenario consists of 7 small BSs (femtocell) , algorithms were studied for 5 cases of UE's velocity (100,200,300,400,500) km/h.

A. Evaluate the Performance of Algorithms in Case of 4 User Equipment's

By adding 4 users to the network and let them move between cells while making VOIP call, Simulation results become as follows:

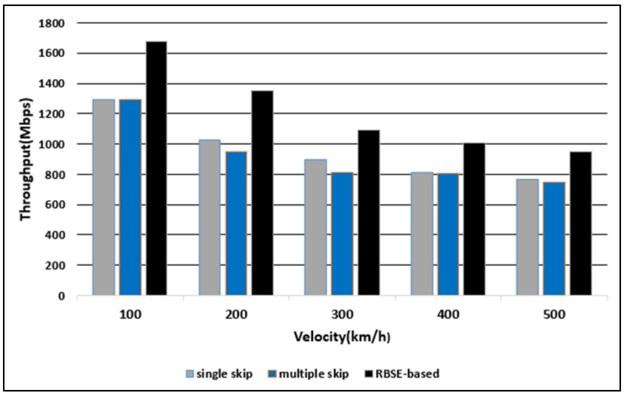

Fig.1 Throughput (Mbps) in case of (number of UE=4)

Fig.1 Makes obvious that RBSE-based algrithm has the highest value of throughput compared to the skipping algorithms for all tested velocity values, Whereas, the multiple skipping algorithm gave the lowest throughput values for all values of the tested velocity.

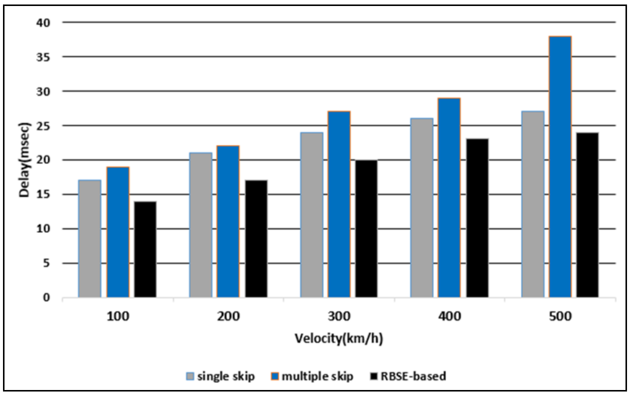

Fig .2 Delay (msec) in case of (number of UE=4)

In fig.2 we notice that the multiple skipping has the highest value in delay in msec which rises significantly at the value of velocity =500 km/h , Whereas, the RBSE-based algorithm has the lowest value of delay.

B. The Impact of Increasing the Number of Users to 10 on the Performance.

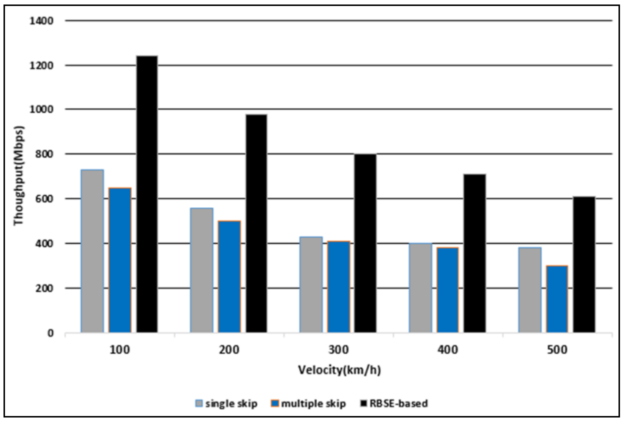

Fig.3 Throughput (Mbps) in case of (number of UE=10)

As the number of user equipment's increase, we notice a decrease in the throughput values than they were in the case of only 4 UE, The RBSE-based algorithm has twice the throughput value that the multiple skip algorithm gave, fig.3.

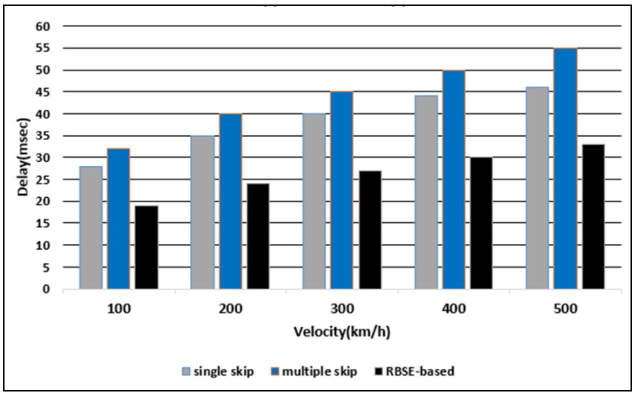

Fig .4 Delay (msec) in case of (number of UE=10)

In terms of delay, we notice an increase in delay when increasing the number of users. However, the RBSE-based algorithm still gives the lowest value of delay compared with skipping algorithms, fig.4.

C. The Effect of Increasing the Number of Users to 20 On the Performance of Algorithms

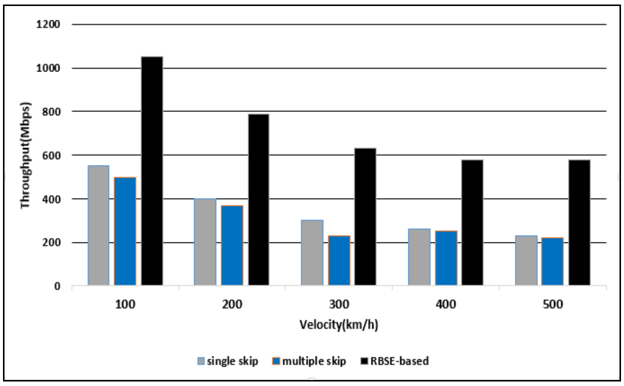

Fig .5 Throughput (Mbps) in case of (number of UE=20)

Fig.5 shows us that by doubling the number of users we notice that throughput has decreased, and the RBSE-based algorithm still gave the highest throughput.

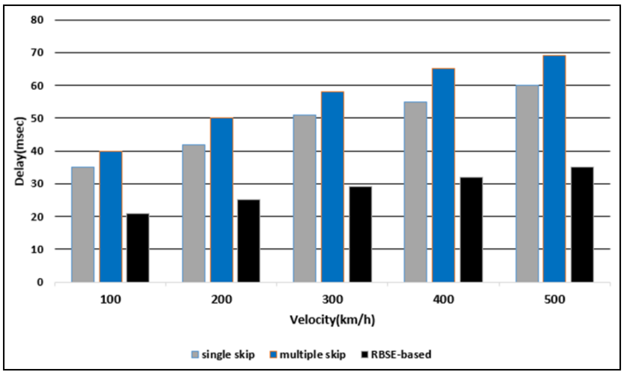

Fig.6 Delay (msec) in case of(number of UE=20)

When the number of users is doubled, the performance of skipping algorithms is significantly reduced,fig.6.

D. Changing the Service from VOIP to Browsing to Determine which Service the Algorithms are Most Effective with

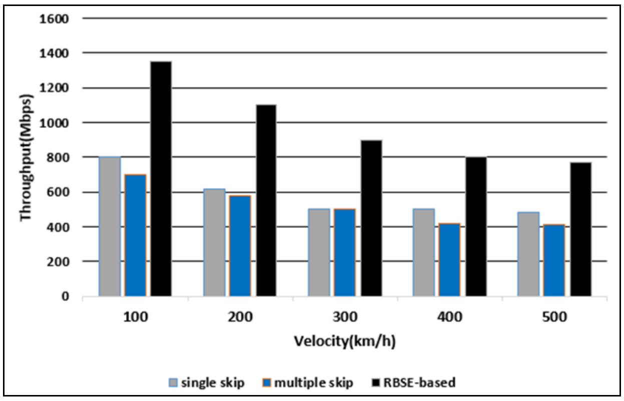

Fig.7 Throughput (Mbps) in case of (number of UE=4 and browsing service)

The performance of the three handover management algorithms was better with VOIP service than the browsing service, and the RBSE-based algorithm performed better compared to the skipping algorithms,fig.7.

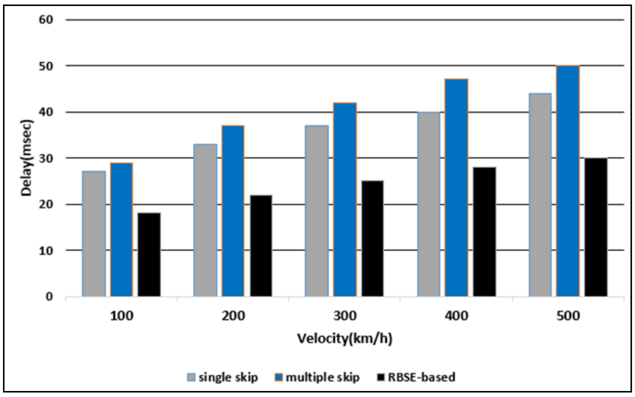

Fig.8 Delay (msec) in case of (number of UE=4 and browsing service)

Fig.8, clearly shows that the performance of those algorithms with the browsing service gave higher delay values than it was in the voip service. Also that, the multiple skipping algorithm gave the highest delay values compared to other algorithms.

IV. CONCLUSION

This paper compared both the single alternating skipping algorithm, multiple skipping algorithm with RBSE-based algorithms in order to detect the better algorithm in managing horizontal ho in 5G networks. Results showed that the RBSE-based algorithm is the better algorithm in term of throughput and delay and those algorithms performance is better with VOIP service than browsing service. For future work, we will study the performance of those algorithms in managing vertical handover.

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