International Journal of Electronics Engineering (ISSN: 0973-7383)
Volume 10 • Issue 2 pp. 378-384 June 2018-Dec 2018 www.csjournals.com

Vertical Handover Technique for LTE-A Heterogeneous Network by using Expectation Maximization Algorithm

Konika Mahajan [1], Garima Saini[2]
[1]ME Scholar, [2]Assistant Professor
Electronics and Communication Department
National Institute of Technical Teacher's Training & Research, Chandigarh

Abstract: In the latest trends with increase in the demand of users the traffic load on the wireless network increases. In order to meet this demand heterogeneous networks is the most effective way but there are some challenges like handovers, packet loss etc. In fourth generation wireless networks vertical handover decision algorithms plays an important role for providing quality of service in applications. In this paper we have proposed Expectation Maximization algorithm that is used for the optimization of the results. The results of proposed approach are verified using MATLAB 2015 a simulation. This paper targets on decreasing the number of unnecessary handovers and packet loss ratio of the overall system in LTE-A Networks.
Keywords: Long Term Evolution-Advanced (LTE-A), Vertical Handover, Heterogeneous Networks (HetNets).

I. INTRODUCTION

LTE is third generation partnership project (3GPP) IP based OFDMA (Orthogonal Frequency Division Multiple Access) technology [1]. LTE provides low latency, very fast speed and increases the capacity. Data traffic has increased to 30 times between 2010 and 2015 and geater than 4 billion 3GPP wireless subscriptions will be operating in the network [2]. Today voice is 60% and traffic is 70% that are generated indoors. To provide proper coverage and increase throughput in the indoor 3GPP LTE-A small cells are deployed like femto, pico and micro cells. These cells formed two tier LTE Heterogeneous Networks. Macro cell is called eNB and femto cells is called HeNB or femto cells. Mobility management is the main challenge for these networks. For the proper management of mobility handovers should be there in LTE-A HetNets. There are femto-macro, macro-femto and femto-femto handovers are possible in LTE-A HetNets. The vertical handover technique is used to reduce the unnecessary handovers by using the speed of user equipment and its trajectory. Heterogeneous networks increases reliability of the overall communication system [3].

Long Term Evolution-Advanced (LTE-A)that is supporting HeNBs is called two tier or multi-tier network because they are using macro cells , femto cells for two tier and also included pico cells for three tier and so on. The base stations of HeNBshave low cost that are basically made for offices and homes. Also HeNBs are low-power and less range.HeNBs have features like self-optimization and healing along with security and interference. HeNBs help in increasing QoS and data rate. HeNBs are deployed in hundreds or thousands inside of eNodeBs to increasethe spectral efficiency and effectiveness of cost. Inspite of the advantages of using HeNB technology there are some challenges also that the researcher has to think such as management of mobility and interference management. There is one big challenge of seamless handover between the two nodes HeNB and the eNBthat becomes more complex. So the handover algorithm is proposed based on user's velocity, its trajectory and its future position [2].

The handover methods can be used between two same networks or it can be used between two different networks. To reduce the packet loss during handovers there should not be unnecessary handovers. In non-CDMA networks when the behaviour of the user changes e.g. when the user which is travelling very fast is connected to a umbrella-type cell which is very fast, stops then the call can transferred to a small macro or even to a micro cell in order to free capacity of the umbrella cell for other users that are travelling very fast and to reduce the interference to other users.

II RELATED STUDY

Jaechan Lim et al. in [4] have discussed that the main aim of LTE-A is to increase the performance of LTE by providing more capacity and coverage. It can be done by using heterogeneous networks in which extra nodes are deployed.As compared with homogeneous networks, HetNets have to be more careful about mobility management and handover. So the author has scrutinise hysteresis margin of each cell that is deployed and selected the TTT values depends on user speed. Optimum setting of hysteresis margin and TTT values has to be calculated using UE speed, environment of propagation and HetNets that are deployed. The author has investigated the hysteresis margin with adaptive values of TTT and ping pong with lowest rate within 2% of failure in the radio link rate.Carlo Fischione et al. in [5] have discussed algorithms for efficient handover that are important for today's wireless environment. It depends on parameters whose settings we have to optimised to maintain connectivity. Such optimization is hard in time varying system so adaptive schemes have to be used. The author has proposed a system for handover that takes handover parameter as input. In this outage and handover probability is taken into account.Based on these calculations a new approach like distribution optimization algorithm has been proposed for the optimization of handovers. It has been shown from the simulations that handover performance is improved as compared to other approaches.

Alessandro Bazzi1 et al. in [6] have discussed that in the coming 5G network, to enhance the performance of network and experience of user quality integration of HetNets Radio access Technology took place. The author focused on the SRVH (softer vertical handover) and its performance. Analytical model has been proposed to calculate the performance of SRVH and results are declared depend on the best services in 2 RATs. Two studies are evaluated: controlled approach for mobile where RATs are not coordinated and another controlled approach for network with RATs are coordinated. It has been proved that SRVH can not be done by users that are performed selfishly. But it provides finer granularity in allocation of resources when RATs are coordinated. Li Danyang et al. in [7] have discussed that the most of the systems that helps in making the handover decision have high cost and unbalance. The author has proposed an algorithm for handover in 5G heterogeneous networks with load index. The parameters for handover helps in selection of network like Quality of service (QoS), degree of satisfaction (DS) and user preference (UP). The level of load is obtained by the fusion parameter like triangle module. The result shows that the proposed algorithm helps reduction of number of handovers and helps in maintain the degree of satisfaction very high. Also the execution time decreased about 1.4 second.

Maissa Boujelben et al. in [8] have discussed that 4G and 5G are increasing very fast to meet user's demand. Cost becomes an issue due to the cells of small sizedeployed to increase the capacity and coverage of wireless network. The author has presented a model for an OPEX (Operational Expenditure) cost and CAPEX (Capital Expenditure) cost for user's networks. Then again a model is presented for LTE HetNets depends on green self optimization module for handover whose main goal is to decrease the cost of consumption of energy for the network. The main criteria is self configuration and self healing. Simulations show that the proposed model generate better results when the users of the mobile moves with very low speed like in dense areas. This method helps in the saving of upto 80%of consumption of energy.

Yao Sun et al. in [9] have presented reinforcement learning based mechanism SMART for reducing the number of handovers in mm wave HetNets while maintaining user's (QoS) Quality of Services. After the handover conditions are met, user equipment have to select suitable target Base Station by using the algorithms SMART-M and SMART-S. The use of SMART-Mis for multiple user equipments and of SMART-S is for specific UE. The author compared SMART handover policy with two policies: Rate-based handover and SINR based handover policies. After simulations in MATLAB, it has been concluded that the count of unnecessary handovers can be reduced by 50% by using SMART as compared to two other policies while user's QoS is maintained. Olusegun O. Omitola et al. in [10] have discussed that in the cellular network to increase the capacity, small cells like femto cells are used and are best to increase the bandwidth and coverage of the network. But with the use of femto cells mobile equipment faces the problem like handovers , interference, power and security problems. The author has proposed the algorithm that reduces the number of unnecessary handovers and probability of call blocking. For the evaluation of an algorithm an event-driven simulator was formed in Visual Studio environment using C. There is a reduction of probability of call blocking by approximately 45% by using the proposed algorithm.

Kranti Shrirang Bhoite et al. in [11] have proposed a new approach for uninterrupted handover between the macrocell and femtocells. Two factors to be achieved in for better handover; first one is seamless handover and second is fast handover. Three handover cases are to be taken, first is hand in that is from macro to femtocell, second is hand off which is from femtocell to macrocell and Third is Inter-FAP which is in between two femtocells. This proposed work improves the femtocell utilization and number of handover is also decreased. Rami Ahmad et al. in [12] have proposed a handover scheme by applying two policies for two tier LTE networks, the method of moving direction prediction and the distance between location of HeNB and the current position of UE. The path of UE is used to guess its position in future and on the basis of these guesses target cell is selected. The proposed algorithm MDD VHD (Movement direction distance vertical handover) increases the performance of the system by reducing the handovers by 48%, the ratio of packet delay by 91%, the ratio of packet loss by 86.2%, the average number of signalling measurements by more than 99% and throughput is improved by (15.3%) of the proposed algorithm as compared to Deswal algorithm.

III PROPOSED METHODOLOGY

The algorithm used in this is Expectation Maximization and is performed in the following process

Step 1: Firstly choose the initial state λ.

Step 2: Expectation step: compute the auxiliary Q-function $Q\left(\lambda, \bar{\lambda}\right)$ (which is also the expectation of the log likelihood of the data) based on λ.

$$E_{z|x,\lambda^t}\left[\log\left(p(x,z|\lambda)\right)\right] = \sum_z log\left(p(x,z|\lambda)\right)p\left(z|x,\lambda^{(t)}\right)$$

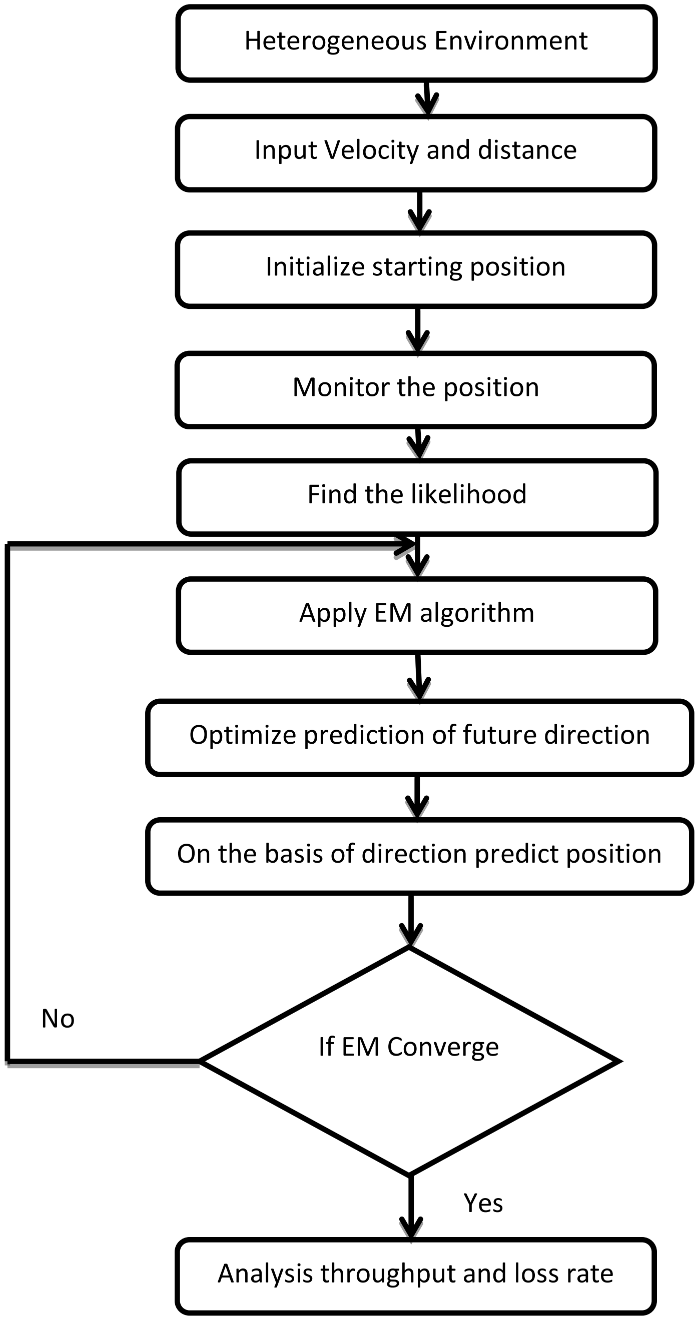
Step 3: Maximization step: $Compute\ \hat{\lambda} = \arg max\ Q\left(\lambda, \bar{\lambda}\right)$ to maximize the auxiliary Q-function.

$$\lambda^{(t+1)} = \underset{\lambda}{\arg max} \sum_z log\left(p(x,z|\lambda)\right)p\left(z|x,\lambda^{(t)}\right)$$

Step 4: iteration: Set $\lambda = \hat{\lambda}$, and repeat from step 2 until convergence.

International Journal of Electronics Engineering (ISSN: 0973-7383)
Volume 10 • Issue 2 pp. 378-384 June 2018-Dec 2018 www.csjournals.com

This algorithm is used for the optimization of the result. EM algorithm is basically an iterative method to find the maximum likelihood to estimate the parameters in the statistical model. This algorithm is also used to handle the hidden data.



IV Results and Discussion

This section presents the results in the graphical form by using the parameters. The performance evaluation is done on the basis of loss rate and average number of handovers.

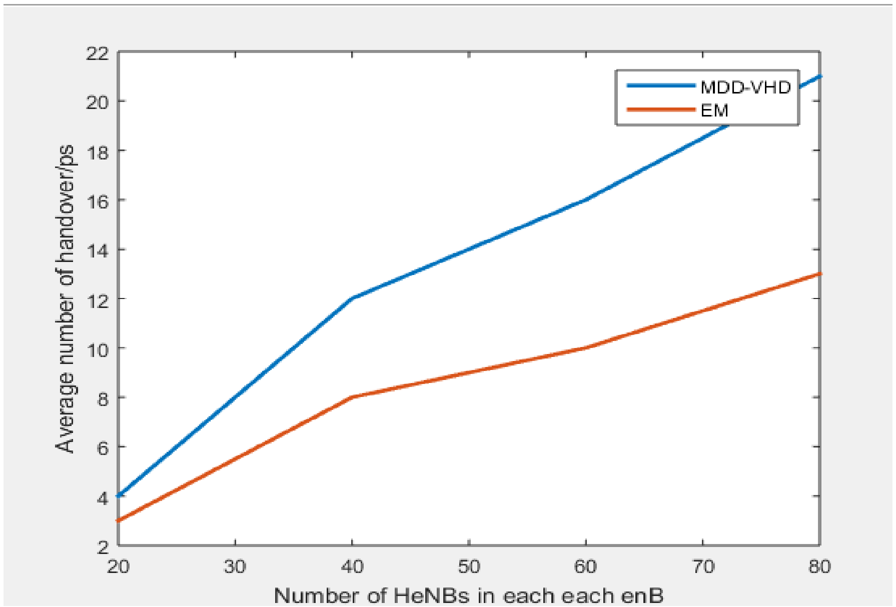


Figure 1.1 Average Number of handovers/ps

In figure 1.1 it depicts the average number of handovers in the proposed approach and existing approach. The curve shows that the average number of handovers in existing approach is more as compared to proposed approach. The above graph can be represented in the form of bar graphs also.

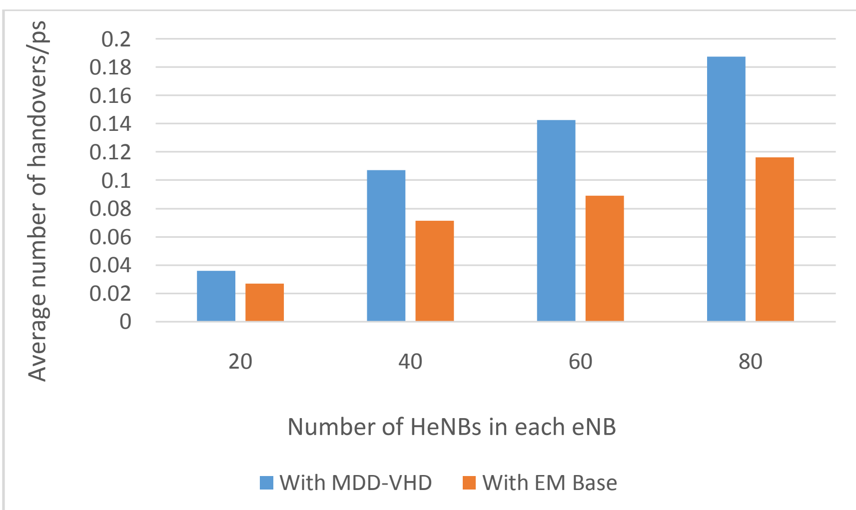


Figure 1.2 Comparison of Average number of handovers/ps.

Figure 1.2 is the description of average number of handovers in the form of bar graph showing that the average number of handovers of proposed EM base is less as compared to the existing MDD-VHD that results in the improvement of the overall LTE-A system. The average number of handovers of MDD-VHD comes out to be 13.25 and of EM comes out to be 8.5. So there is the improvement in the average number of handovers/ps in the proposed algorithm as compared to the existing algorithm. The reduction in the handovers helps to increase the efficiency of the system.

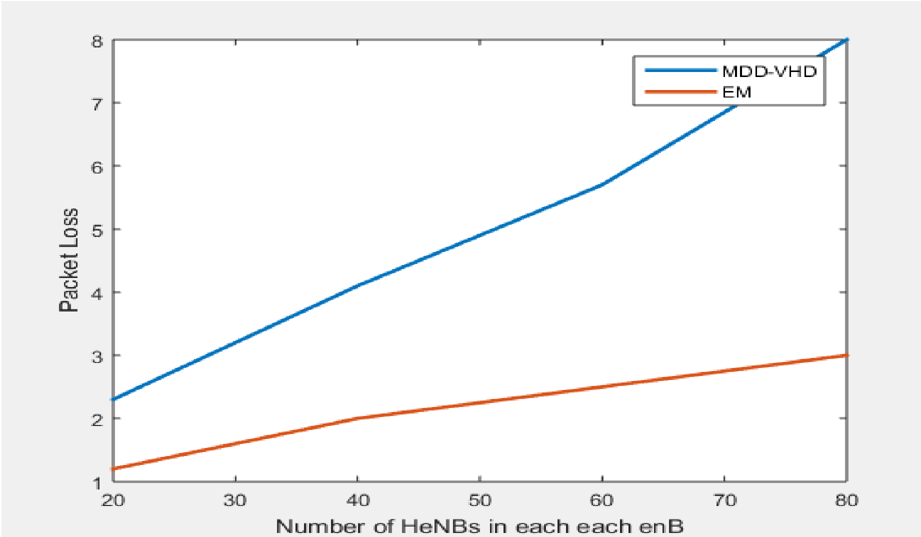


Figure 1.3 Packet loss rate in proposed and existing approach

The packet loss rate is high in the existing approach and low in the proposed approach and shown in figure 1.3. The red curve shows the loss rate of proposed approach which makes it effective and provides better communications.

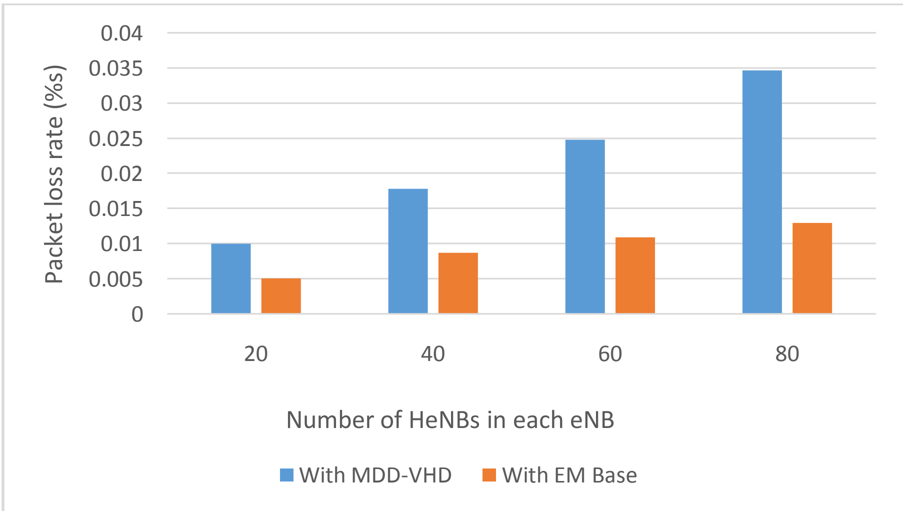


Figure 1.4 Comparison of Packet Loss/s.

Figure 1.4 is the description of packet loss rates in the form of bar graph showing that the packet loss rate of proposed is less as compared to the existing helps in the improvement of the overall system. The average packet loss rate of MDD-VHD comes out to be 5.025 and of EM comes out to be 2.175 which is less as compared to existing.

V. CONCLUSION

This paper presents the need of vertical handover technique in the wireless communication network. This paper uses the EM algorithm to increase the performance of the devices on network. This algorithm is used to estimate the parameters in the statistical model to handle the hidden data. The results of proposed approach are verified using MATLAB 2015 a simulation. The main aim of this paper is to reduce the number of unnecessary handovers and packet loss ratio of the overall system in LTE-A Networks. The number of unnecessary handovers are reduced by 35.85% and packet loss rate by 56.71% as compared to the existing algorithm make the system more efficient.

REFERENCES

[1] Amit Kumar, Jyotsna Sengupta and Yun-fei Liu, ‘‘3GPP LTE: The Future of Mobile Broadband’’, Wireless Personal Communications, Springer, Vol. 62, No. 3, pp-671- 686, February 2012.
[2] Ian F. Akyildiz, David M. Gutierrez Estevez, Ravi Kumar Balakrishnan and Elias Chavarria-Reyes, ‘‘LTE-Advanced and the Evolution to Beyond 4G (B4G) Systems’’, Physical Communication, Elsevier, Vol. 10, pp. 31-60, March 2014.
[3] GyozoGodor, Zoltan Jako Adam Knapp and Sandorlmre, ‘‘A Survey of Handover Management in LTE-based Multi-tier Femtocell Networks: Requirements, Challenges and Solutions’’, Computer Networks, Elsevier, Vol. 76, pp. 17-41, January 2015.
[4] Jaechan Lim and Daehyoung Hong, ‘‘Mobility and Handover Management for Heterogeneous Networks in LTE-Advanced’’, Wireless Personal Communication, Springer, Vol. 72, No. 4, pp. 2901-2912, October 2013.
[5] Carlo Fischione, George Athanasiou and Fortunato Santucci, ‘‘Dynamic Optimization of Generalized Least Squares Handover Algorithms’’, IEEE Transactions on Wireless Communication, Vol. 13, No. 3, pp. 1235 – 1249, March 2014.
[6] Alessandro Bazzi1, Barbara M. Masini1, Alberto Zanella1 and DavideDardari, ‘‘Performance Evaluation of Softer Vertical Handovers in Multiuser Heterogeneous WirelessNetworks’’, Wireless Networks, Springer, Vol. 23, No. 1, pp. 159-176, January 2017.
[7] Li Danyang and Zhang Zhizhong and Gao Yiyi, ‘‘Modular Handover Algorithm for 5G Hetnets with Comprehensive Load Index’’ The Journal of China Universities of Posts and Telecommunication, Elsevier, Vol. 24, No. 2, pp. 57–65, April 2017.
[8] MaissaBoujelben, Sonia Ben Rejeb and Sami Tabbane, ‘‘SON Handover Algorithm for Green LTE-A/5G HetNets’’, Wireless Personal Communication, Springer, Vol. 95, No. 4, pp. 4561-4577, August 2017.
[9] Yao Sun, Gang Feng, Shuang Qin, Ying-Chang Liang and Tak-Shing Peter Yum’ ‘‘The SMART Handover Policy for Millimeter Wave Heterogeneous Cellular Networks’’ IEEE Transactions on Mobile Computing, Vol 17, No. 5, October 2017.
[10] Olusegun O. Omitola and Viranjay M. Srivastava, ‘‘An Enhanced Handover Algorithm in LTE-Advanced Network’’, Wireless Personal Communications, Springer, Vol. 97, No. 2, pp. 2925-2938, November 2017.
[11] KrantiShrirangBhoite, SachinGengaje, “Handover Management in Two-Tier Femtocell-Macrocell Network”, Wireless Personal Communication, Springer, Vol. 98, No. 3, pp. 2849–2866, February 2018.
[12] Rami Ahmad, Elankovan A. Sundararajan, Nor E. Othman and Mahamod Ismail, ‘‘An Efficient Handover Decision in Heterogeneous LTE-A Networks under the Assistance of Users’ Profile’’, Telecommunication System, Springer, Vol. 68, No. 1, pp. 27-45, May 2018.