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Minimizing Handover Delay and Maximizing Throughput by Heterogeneous Handover Algorithm (HHA) in Telecommunication Networks

M. Phemina Selvi[1,*] *and S. Sendhilnathan*[2]

[1] Department of ECE, University College of Engineering, Vilupuram, India.
[2] Department of Physics,University College of Engineering, Rajamadam, Pattukkottai, India.

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Abstract: Handover mechanism plays a vital role in the wireless telecommunication networks. The process of transferring the control of Mobile Terminal (MT)/Mobile Nodes (MN) due to mobility from one point of attachment to another point of attachment creates problems of delay, link failure, packet loss and error rate in the packets. The proposed work is modeled to analyze the performance of vertical handover considering 4G and wireless data networks. The vertical handover delay is estimated based on radio link quality and merit function of access network. A Matlab based heterogeneous model is considered and with the designed algorithm the performance is analyzed and the delay is evaluated. The comparison of the graphical results is done. Results show the delay estimated is within the pre-assumed range and hence the performance is better. In this paper, a Heterogeneous Handover Algorithm (HHA) is proposed to control the handover mechanism between Wifi, WiMax and LTE networks to reduce the handover delay. The proposed Heterogeneous Handover Algorithm (HHA) is implemented in a wireless scenarios with WiMAX, WiFi and LTE technology and the performance of the technique in different scenario is evaluated through simulation. The results show a significant improvement compared to the existing handover algorithms in terms of delay, service rate and handover dropping probability in heterogeneous networks.

Keywords: WiFi, WiMax, LTE, Delay, HHA

1 Introduction

In the present technology world wireless communication plays a vital role in day to day life. As there has been a tremendous increase in the demands of the market, wireless communication technologies have advanced from the first generation to the third generation and is also stepping towards next generation 4G. The next generation of wireless communication systems will involve the integration of diverse but complementary wireless technologies, all of which will coexist in a heterogeneous wireless access environment and use a common IP core to offer a diverse range of high data rate multimedia services to end users. With the fast development of wireless technologies, a number of wireless access networks have been successfully deployed. The cellular network and wireless local area network are the most common access networks among them, where the former has a broader coverage and lower transmission rate, but the latter has the inverse characteristics. The heterogeneous networks can utilize the advantages of wide coverage and high transmission rate.

Future paradigm of the wireless network will be based on the diverse access technologies and networks which will pose great challenges while implementation. The most pronounced issue and challenge is the convergence and coordination between networks. The major challenge in the network is vertical handover. Vertical handover is the important process required to provide ubiquitous connectivity to the mobile users. Various network technologies and networks available are UMTS, GPRS, GSM, WiFi, WiMax, LTE, etc. Development of various standards is done by 3GPP and 3GPP2, are concerned with the technological growth of UMTS and CDMA standards respectively. The latest technology LTE and LTE-A puts forth many challenges in the process of making Vertical Handover.

The transfer of point of attachment from one network to another different type of network is called vertical

* Corresponding author e-mail: pheminaselvi@hotmail.com

handover which is an important focus to be studied in the integration of heterogeneous networks.

The key features of the next generation, especially in 4G are as follows [1] 4G enables low transmission cost for a higher data rate, Supported data rate will be more than 10 times compared to 3G, with nearly 20 Mbps bandwidth providing anytime, anywhere any type of service. 4G enables integration of all systems and have a structure based on all IP. Based on this system, IP packets will be able to traverse distinctive access networks connected to an IP based backbone network without any protocol conversion. Therefore, an all IP based heterogeneous wireless networks will enable the mobile users to use any radio access system anytime and anywhere.

There are three main stages in the process of vertical handover. The first is the network discovery. In this stage, nodes periodically search if there are some other different types of wireless networks, and take these discovered networks as candidates [2]. The second is the handover decision stage where nodes compare the state of the current network with the candidates, and select one as the handover target from them according to a certain criterion. The last is the handover implementation stage where nodes execute the handover actions, and transfer the point of attachment from one network to another. This stage is a bit complicated and includes some procedures, such as authentication, authority, handover in the link layer and the IP layer, etc. Among these three stages, the second is very important, because it has a direct influence on the network performance and the quality of service of nodes.

The principle objective of the next generation network systems is Always Best Connected (ABC) which provides users access to services over an optimal network. In heterogeneous networks, a mobile terminal (MT) may choose any network among the available multiple connectivity, based on the criteria pertaining to network performances, users preferences and service requirements [3]. In conventional networks, handover is required when the user moves or crosses the access coverage area. In a heterogeneous environment, handover can occur more frequently in order to improve the communication quality and to provide service continuity. A number of techniques for handover initiation and selection of optimal access network are proposed in the literature which uses different metrics and heuristics for performing the handover. But all the proposed methods were unable to meet all the requirements related to functionality and efficiency.

The various access technologies available are UMTS, WiFi, WiMAX, WiBro, LTE, LTE-A, etc. and their evolutionary details are given in Fig. 1. As heterogeneous network is an overlay of various network, the performance of vertical handover is analysed/studied using the availability of two heterogeneous or three heterogeneous at the same time.(UMTS-WLAN, UMTS-WIMAX, WIMAX-WIFI-UMTS and vice-versa.)

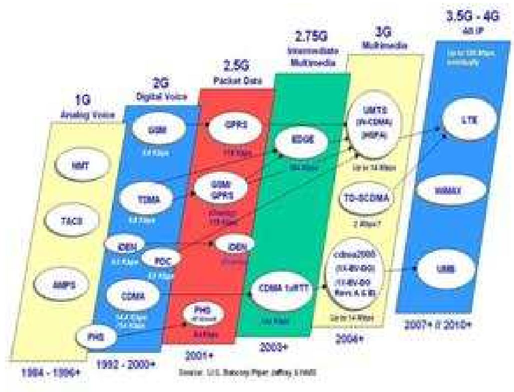


Fig. 1: Growth and Migration of Wireless Technologies.

As a wide variety of access technologies are considered, a standard handover solution uniquely applicable to all the available technology is not developed because of the diverse and complement characteristics of all the available networks. So the research work is extensively made in the area vertical handover addressing various issues and challenge.

The 3rd Generation Partnership Project (3GPP) introduced Long-Term Evolution (LTE) and LTE-Advanced (LTE-A) cellular networks to meet the need the growing data usage by the mobile users and service providers. Specifically, LTE-A is designed to meet out the advanced requirements of IMT-Advanced systems. It also increases spectral efficiency, bandwidth utilization, supports mobility, and enhances cell edge performance too. The LTE-A is designed such that it reduces latency and network load had increased enormously as the mobile users demand high quality, high-data-rate applications such as video streaming with good QoS. The other design challenges of LTE/LTE-A is to increase the network capacity, reduce the cost/bit delivered so as to satisfy the user requirements. Heterogeneous networks (HetNets) in LTE-A has been considered as a promising solution to improve spectral bandwidth, efficiency, and mobility support.

The existence of various networks like 2G, GSM, GPRS, EDGE, WCDMA, LTE, WiMax, WiFi etc., has been developed as the user and mobile data usage increased. Wifi networks are widely used since it supports higher data rate with low cost but it has some limited coverage. WiMax is an IEEE standard referred by 802.16 is an air interface for which has higher coverage radius in the range of tens of kilometers. WiMax can work in both licensed and unlicensed frequency band but for commercial use licensed frequency are used to avoid interference supporting data rate upto 75 Mbps. Long term Evaluation(LTE) which is also referred as fourth generation (4G) networks supports high speed data communications and it is a self-configurable network. It supports higher data rate upto 300 Mbps for downlink which is higher when compared with WiMax latest communication network environment comprises of various radio access technologies converged at single point such that high performance in terms of QoS, data rate is achieved with low delay and less error probability.

The organization of the paper is as follows. The review of current literature on vertical handover decision is presented in Section 2. Section 3 explain the proposed approach in detail, and experimental analysis and results are presented in Section 4. Finally, the conclusion of the proposed work is described in Section 5.

2 Related work

Lee et al. [4] have proposed a call admission control mechanism during the handover in a heterogeneous network. But they don't work on the different traffic load environment in the heterogeneous networks. A QoS/QoE assisted handover framework over the MIH architecture is proposed by Valenzuela and Rosario et al. [5] In such work, the handover is addressed and performed only from the mobile user terminal.

Whenever an MT notices a service degradation in QoS or QoE it performs a handover. Ma et al. [6] have proposed a WiFi-WiMax integrated hetnet architecture based on tight coupling.

A QoS assisted handover procedure was developed by them in their work. The available bandwidth and probable delay are estimated at both the networks considered and that information is used to direct the user to move between two different technologies. The feature of the architecture is such that their architecture provides priority equally to both WiFi and WiMax. This equal priority becomes a disadvantage because the cost per bit becomes high and also power consumption becomes high.

Luhan Wang et al. [7] proposed an SDN based convergence approach to provide seamless mobility among WLAN and LTE networks. The software defined network can be used either in core network or only in access network, but in their work, they have used SDN approach only in the core network and an architecture is proposed to achieve seamless mobility, which have a services interruption delay less than 100ms. For this, a virtual middle box is designed in the user equipment (UE), which takes care of transmitting control messages to the network controller, and maintains the same IP address for an UE even if it moves from LTE to WLAN and vice-versa and thereby provides seamless connectivity without interruption. Here only the delay is considered, and other metrics like signal constant etc, were not addressed.

Jumana Bukhari et al. [8] have proposed a vertical handover method in which without adding any new entity handover is performed between LTE WiFi and vice-versa. Their proposed approach used a cross layer technique to provide vertical handover in which MIP messages are used for location management and MSCTP messages are used for handover management. The proposed approach is compared with that of WiFi first approach considering the VHO delay, QoS scores, VHO signaling cost and WiFi blocking probability. In this work the handover decision is taken considering SNR, class of service and quality of service. They have considered SNR because SNR reflects the real power of mobile signals. The mobile terminal searches the neighboring networks and chooses two networks which has good SNR, compares the SNR with the predefined threshold. Once the measured SNR is greater than the threshold, then handover is triggered and deferred if vice-versa. The QoS scores information of the new network is sent through the agent advertisement messages. Once the decision is taken using the messages, the handover is executed using the cross layer technique. mSCTP which is a transport layer approach support to exchange IP information between the two end points, but does not have any mechanism to update the new PoA of the mobile terminal to the home location. So Mobile IP (MIP), a network layer protocol is used to exchange the new IP address to HA through the MIP messages. AHP is used to find QoS scores and the score information is carried by the MIP modified Agent Advertisement (AA) messages. In their work they have not considered the fast mobility of MT.

Hwang et al. [9] in their work, developed a dynamic multipath TCP control mechanism which will support seamless VHO during the network transition. They integrated traditional handover technique with the Multipath Transmission Control Protocol (MPTCP). Their work comprises of two main transition phase, transition from WLAN to MPTCP and cellular to MPTCP. Once MPTCP is exhausted, the disconnection of the WLAN / cellular network will not disrupt the ongoing streaming application. The main work in their algorithm is to precisely predict the WLAN coverage edge area, and to turn the cellular radio ON correctly and thereby maintain seamless connectivity and high throughput for the streaming application and secondly to track the quality of WLAN signal, and based on threshold RSS, the decision is made to move from WLAN to MPTCP transmission. In order to avoid ping Pong effect, a value of RSS threshold is deciding between a high and lower value.

Abhijit Sharma [10] have studied and analyzed the interoperability between, WiFi and WiMax hetnets. Even though many research works had been made on interoperability and handover, one main point has not been considered, that is when a user must move from one network to another network. Authors proposed a handover decision mechanism in an integrated WiFi-wimax scenario, which can support QoS and QoE of the end users. Authors has proposed a bandwidth management and admission control scheme in order to properly distribute the total traffic of the network over the integrated WiFi-WIMAX environment, with QoS. They have designed a class aware load balancing and context aware handover policy which helps to decrease the delay, connection drop probability.

Murad Khan et al. [11]., have proposed the Vertical Handover Management to support seamless connectivity in the heterogeneous networks. Network selection is based on the QoS parameters like delay, Jitter, cost and network load. But the limitations are energy savings in the above types of networks are kept radio bandwidth are idle. In [12] authors proposed a new model and algorithm by introducing multiple relay nodes as an application of the 3GPP release 12 of LTE-A standards. The main aim of using the multi hop relay technique is to provide larger and maximum coverage and capacity. While introducing the multi hop relay technique, mobility management and resource allocation issues are to be focused mainly, in order to provide fast, secure and seamless communication. Mostly relay nodes are similar to user equipment communicating to eNB or can be used the other way. In multi hop scenario, a user can be connected to the network using Relay Node (RN) to eNB or directly to the eNB as in conventional methods. The process of selection of RN to provide less hops, less delay and good coverage is the problem to be addressed while using multi hop relay technology in the LTE-A. It reduces path loss by the used of multi hop relays. The authors in their work formulated the relay node selection based on bandwidth i.e frequency slots which are distributed continuously between users, SINR of Relay Node and the data rate which is calculated based on SINR and bandwidth. The formulation objective is made such that the new resource allocation must be minimum during the handoff process.

Enrica Zola et al. [13] have proposed multi-objective optimization function in the WiFi networks that maximizes the download rates and minimizes the number of handovers. The proposed handover cost function which will reduce the higher throughput leads to number of handover is reduced.

Yang et al. [14] proposed the Customer Surplus function to deal with non real-time transmission. In this protocol, users first survey their network interfaces and determine the list of available access networks. They subsequently predict the transfer rate of each available network, taking the average of the last five data transfers and then derive completion times. After that, they compute the predicted utility, which is the relationship between the budget and the user's flexibility in the transfer completion time. Finally, for each candidate network, users compute consumer surplus, which is the difference between utility and cost charged by the network, and they choose the best one to request for connection. It can be noticed that this scheme works fine in non-real-time traffic but not for real-time multimedia services, which are the most popular nowadays.

In [15], Benslimane et al. worked on the integration of VANET and 3G networks through introducing mobile gateways. In this work the probability of frequent handover is reduced in the base stations. The merit of their work is improving spectral efficiency. Nadembega et al. [16] proposed a novel method for predicting the entire or partial moving path of a vehicle, supported by the prediction of the final destination or intermediate points along the path based on historical data, contextual knowledge, and spatial conceptual maps.

Han et al. [17] has addressed the problem of service interruption in an LTE technology. They have devised a procedure to enhance the handover performance in terms of delay and handover interruption time for different scenario. Also, a reference probability density function which is based on estimated number of user in a particular cell is obtained. The result of the works infers that as load increases in a cell the handover interruption time also increases. Also they have suggested minimizing the Qos degradation by increasing the number of gateways or by sharing the duties of gateways and optimizing the random access channel configuration and handover parameters. They also inferred that as the preamble is splited the handover performance may improve but other operations related to RACH will be highly affected.

3 Proposed methodology

The work is separated in to two modules the first module estimates the delay and testing. To analyze the vertical handover performance a switching is done between the access technologies networks considered. Here an LTE system is taken with two data networks, WiFi and WiMax for testing purpose. Since both are wireless data networks, for handover processes both are assumed to be same. So the attention is made at the changing point of attachment i.e. From eNodeB to Access Point(AP). To perform switching analyses, the hard handover method is taken. In hard handover the current point of attachment connection breaks and then the new point of attachment. In the case the new point of attachment may be an eNodeB or a new AP/BS. Since its hard handover type there will be a service disruption during the process of handover time that will degrade the performance of the system. Hence there is a need of prior exposure about the handover performance, which will support to test and find out where and why actually the performance of the system gets disrupted, so that proper modifications can be made for performance enhancements. The proposed work is based on such assumption; the handover interval presumed is 0.05 ms. With this the switching process is tested for using simulation. In this paper Access point and Point of attachment (PoA) is used alternatively to refer the current point of attachment. In this work we focus on handover delay estimation for Handover Decision making problem.

The Mobile Host Sends a request message to the neighbor Point of attachment (PoA)(LTE eNodeB or WiMax BS) through their Serving/Gateway GPRS Support node, the request includes the IMSI of the user, LAI(Location Area Identity). Based on IMSI the new PoA creates the virtual id and inform to Home Subscriber

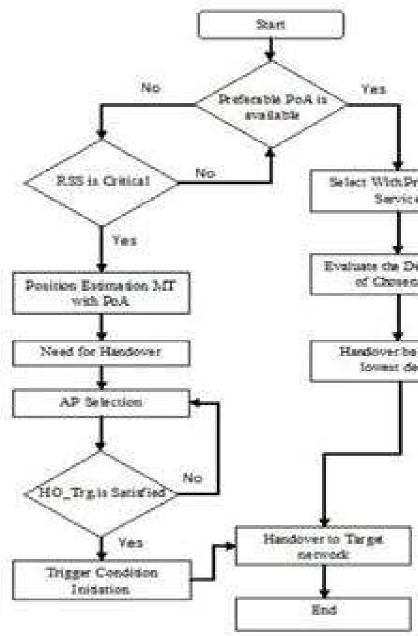


Fig. 2: Flowchart of the proposed work.

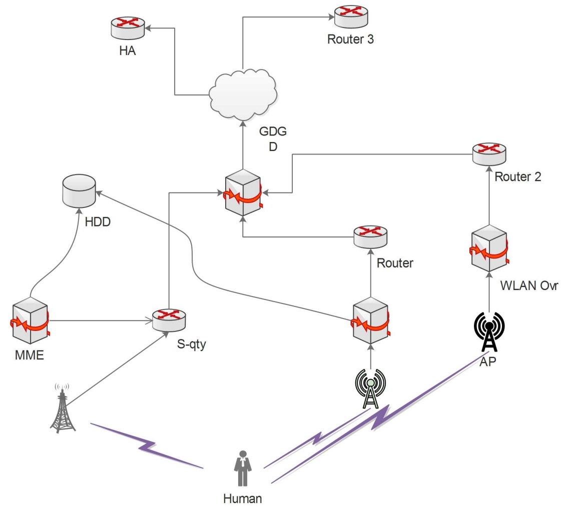


Fig. 3: Proposed Architecture.

Server by the assigned virtual id and IP addresses that assigned to the mobile host. The AP sends a query message to Home Subscriber server, the server checks if the subscriber has been registered or not. The server stores the id and support when the handover takes place in the AP.

The Fig. 2 describes the proposed flow of the work. Initially the mobile station is assumed to be in LTE coverage. As the MN moves from the coverage area of the current network it searches for the available neighboring networks and request for service. Handover is hard handover so as the control plane searches for the available connectivity, once the preferred network is detected, the old point of attachment gets broken and the MN gets connected to new PoA. While this handover process is triggered there is a service disruption. The time taken for the handover is estimated.

The performance of the proposed algorithm has been simulated and evaluated. The simulation scenario (Fig. 3) comprises of one eNodeB and one WiMax base station. A mobile node/ User Equipment (UE) provides mobility and with the proposed algorithm the performance of handover is evaluated. The simulated environment was outdoors with UEs in the mobility model displaced randomly at fixed speed of 0.5 meters per second.

In the second work, focus on handover delay reduction of the Handover Decision making problem is done. It is the competence to decide about the targeted Access Point and the exact time of handover. This decision depends on several issues / policies pertinent to network to which a Mobile Terminal is already connected and to the one that it is going to handover, i.e. (Network) available bandwidth, close integrated processes: Estimation of Handover Necessity, Target network Selection for Handover, and power consumption, monetary costs, QoS, security, user preferences, etc. VHD schemes generally comprise of three Triggering Condition Estimation for Handover. Flow chart depicts the detailed steps involved in a VHO decision and triggering the handover algorithm. The need for handover ascertains that whether a particular handover is necessary to an available network. The access Point selection (AP) selects the best possible network among the available candidates based on a fixed set of criteria and the Handover Triggering Condition Estimation determines right / exact moment in order to commence the handover out of the currently connected network.

The algorithm considers the distance between the MN and the base station / Access point/ eNodeB, the bandwidth available in the networks and the range of the networks and the user velocity to decide the point of handover. Mobile User Sends a request message to the neighboring Point of Attachment (PoA) among the available networks(LTE/WiMax,WiFi)through their Serving/Gateway GPRS Support node, the request included the IMSI of the user, LAI(Location Area Identity). The architecture consists of BS of LTE, WiMax and WLAN and various gateways in the networks.

3.1 The basic idea of proposed algorithm

In our contribution a novel decision making algorithm is developed through learning connection properties before changing the connection. The algorithm is as follows:

1. Compute the distance between Base Station (BS) and Mobile Node (MN) with the requirements the node radius (r) and bandwidth (β) i.e for all available networks WL1, WL2, WiMax, LTE).

2. Determine the bandwidth(β) available on all the networks
3. If the bandwidth is available in all the networks LTE, WiMax and Wifi networks, then determine to which network the mobile node is connected.
4. Determine the minimum distance between BS and MN by $d_i = \min d\{(BS, MN)\}$
5. Determine the network to which the MN is connected
6. Returns Mobile Node to the network connected.
7. Compute the distance d_j between Mobile Node and base stations by $d_j = d\{(MNi, BSj)\}$
8. If the mobile node is connected to BS_j then check the bandwidth available for BS_j
9. Compute the bandwidth (β) available in the network BS_j as the node moves.
10. Compare the bandwidth required by the MN with bandwidth available for BS_j, $\beta(MN) < \beta(BS_j)$
11. Then MN remains the same network BS_j
12. else Handover is required from BS_j
13. Determine the neighboring networks that have Sufficient Bandwidth.
14. Calculate the velocity (V) of the MN in a network either decreasing or increasing $V_1 < 1 || V_1 > 1$ then execute steps 10, 11 and 12.
15. Compute the number of packets transferred during handover.
16. If in any network, the node is out of range, then proceed with next, else go to step 22.
17. Determine the network to which the MN is currently connected
18. If the distance dj is greater than the radius R of Target eNodeB (LTE) base station node then perform handover from target eNodeB
19. Otherwise, calculate the availability of next neighboring networks (WiFi).
20. Compute the total number of handovers in the networks.
21. Find the signal to noise interference (SINR) of all available networks.
22. If the velocity lies between $60 < V < 250$ km/hr then the MN must get connected to 4G network if available, else to WiMax else to the WLAN.
23. If the velocity lies between $15 < V < 60$ km/hr then MN gets connected to the network of WiMax if available else to WLAN or remains in the same network if no neighboring networks are detected..
24. else if the velocity is less then 15 km/hr then the MN connects to WLAN if it is available nearby, else to the network of WiMax else to the available 4G network
25. Stop the algorithm.

4 Results and discussion

The simulated results for first module are shown in Figs. 4, 5 and 6 shows the state of mobile nodes in LTE and WiMax networks. It is assumed that if the network state is 0 it represents an LTE network and if the network state is 1 it denotes that the MN has moved into WiMax network. These figures show the switching state from which the delay can be estimated. From these graphs comparison, it can be seen that as the time interval is decreased the switching characteristics gets better. Its is evident from the graph that the assumed time does not exceed the times of 0.5 ms, which is the minimum time for handover.

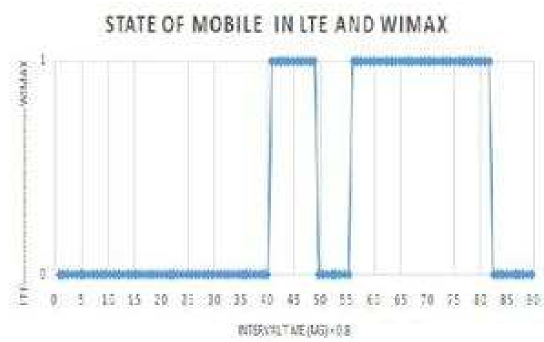


Fig. 4: State of Mobile node in LTE and WiMax for a time interval of 0.8 ms.

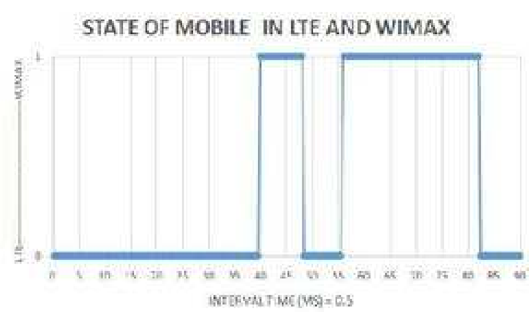


Fig. 5: State of Mobile node in LTE and WiMax for a time Interval of 0.5 ms.

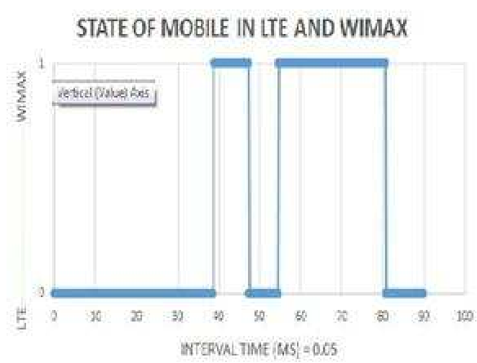


Fig. 6: State of Mobile node in LTE and WiMax for a time interval of 0.05 ms.

The Fig. 7 shows the variation of the received signal strength and thereby its dwell time inside a particular

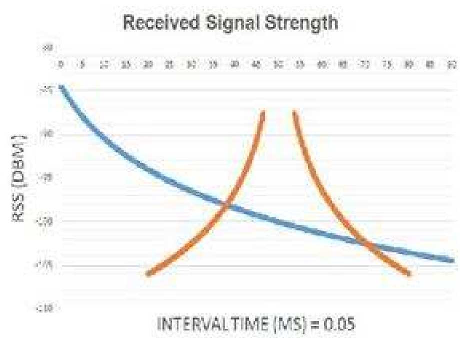


Fig. 7: Variation of Received Signal Strength in LTE and WiMax for 0.8 ms time Interval.

access network. As the RSS decreases beyond threshold value and if it finds the increasing RSS of the WiMax network the handover gets triggered.

Even though the resource is available on both the networks depending on the threshold limit the handover occurs. When the RSS of the WiMax network decreases beyond the threshold its selects LTE by default. Similarly the time interval of estimated handover time is varied as 0.05 ms and again the performance is analsyed. Similar simulation is done to perform comparative analysis.

The response for the varied time interval is shown in Figs. 8, 9.

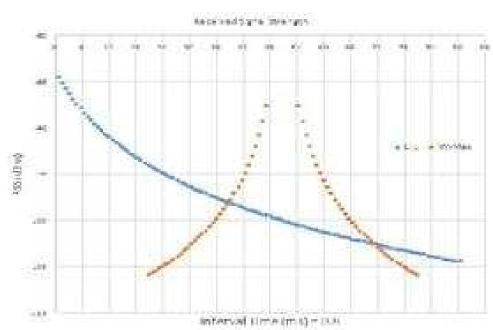


Fig. 8: Variation of Received Signal Strength in LTE and WiMax for 0.05 ms Time Interval.

Simulation Results for second module are shown in Fig. 10(a), 10(b), 10(c), 10(d) a graphical user interface (GUI) was established to investigate the process result and the algorithm operation expediently. We compare the performance of Heterogeneous Handover Algorithm (HHA) with other handover algorithms. The simulation experiments were carried out in NS-2 version2.35. We generated scenarios for 150 nodes moving in an area of 500×500 kilometers. All nodes use 802.11 MAC operating at 2 Mbps The Quality of Service (QoS) parameters like Networks selected by user equipment's for different networks, random access delay, handover

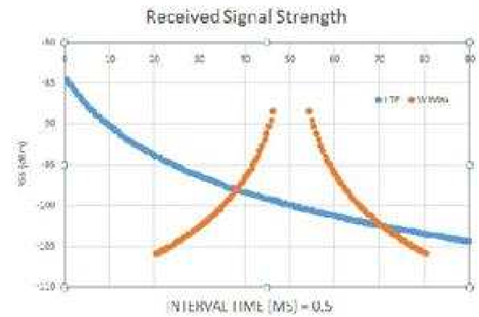


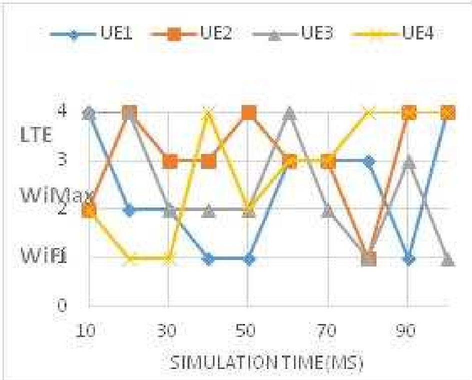
Fig. 9: Variation of Received Signal Strength in LTE and WiMax for 0.5ms Time Interval.

Table 1: Probability rate of LTE, WiMAX, WiFi.

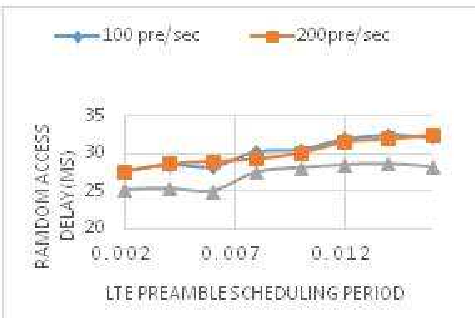
Number of preambles	Probability
10	1
20	1
30	1
40	1
59	1
60	1
70	1
80	1
90	0.99
100	0.985
110	0.98
120	0.975
130	0.97
140	0.96
150	0.95

packet dropping rate and random access probabilities functions for handover algorithm are compared with proposed algorithm. The Proposed Heterogeneous Handover Algorithm (HHA) provides better performance in the terms of QoS.

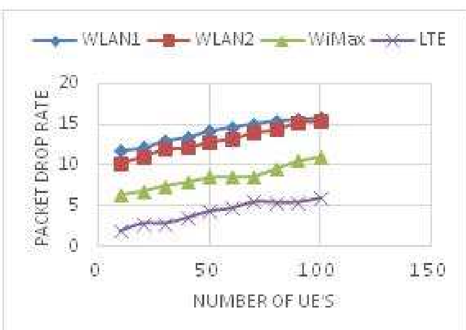
The Fig. 10(a) shows the position of the MN / UE connected network at different instances of simulation time. It can be inferred from the graph that the HHA performs the handover properly without any connection disruption in order to maintain seamless communication. The networks is taken on the Y axis to show its current network connection. Based on the algorithm the UE selects the network avoiding connection loss. Fig. 10(b) shows the relation between the random access delay, the delay caused in the process of acquiring the channel and depends on the preambles. Table 1 shows number of preambles with their respective probabilities measured for the different types of networks. As the number of preambles increases, the access delay reduces which reduces the handover delay.



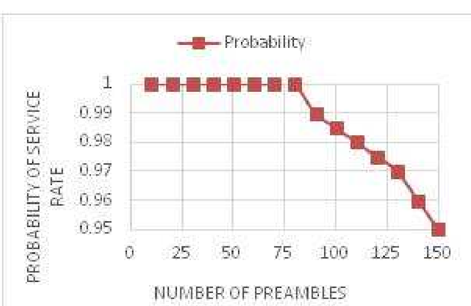
(a) Network Selected by UE's.



(b) Random Access Delay (ms).

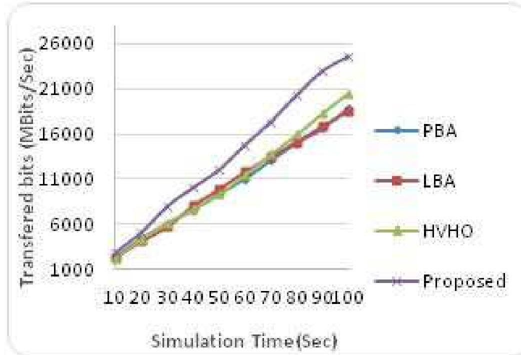


(c) Handover Packet Dropping Rate.

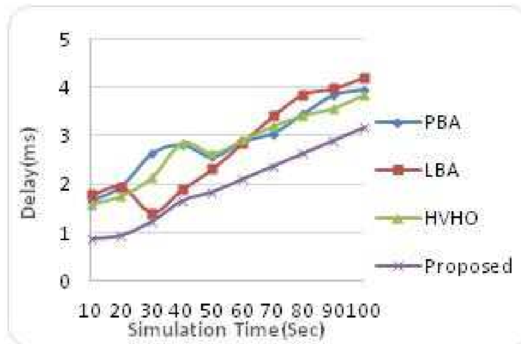


(d) Random Access Probabilities.

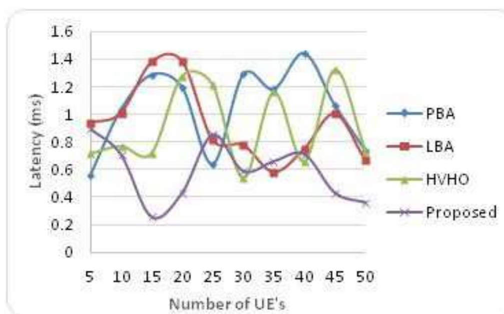
Fig. 10: Delay Estimation with Preambles.



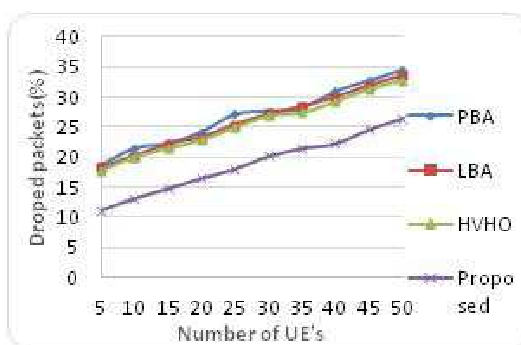
(a) Throughput Comparison.



(b) End to End Packet Delay



(c) Vertical Handover latency



(d) Packet Dropping Rate

Fig. 11: Simulation results for Proposed Algorithm.

The proposed HHA performance is compared with the existing power based algorithm [19], location based algorithm [20] and hybrid algorithms. Comparison shows Fig. 11(a), Fig. 11(b), Fig. 11(c), Fig. 11(d) that the proposed HHA outperforms in terms of throughput, latency and packet loss rate.

In Table 2, Random access delay can be measured for the different types of networks by calculating the preamble scheduling period. As the processing speed of each network increases, the scheduling period of each network was found to be reduced.

Table 2: Random access delay for LTE, WiMAX, WiFi.

Network preamble schedule period	Samples/sec		
	100	200	300
0.002	27.55607	27.6730356	25.17589215
0.004	28.4912187	28.6800764	25.37524779
0.006	28.224263	29.0452362	25.04474137
0.008	30.2479256	29.3723055	27.57041665
0.010	30.5249622	30.1496045	28.16692218
0.012	31.9543993	31.6094231	28.57001995
0.014	32.518915	32.0065542	28.70421387
0.016	32.1724653	32.5674468	28.28225758

5 Conclusion

As heterogeneous networks can provide larger coverage area and by properly designing an efficient handover algorithm to perform handover, the delay in handover can be reduced to an optimum value. As a initiation first the delay obtained through simulation and the presumed delay are compared and analyzed for the performance of heterogeneous networks. Through this deployment in networks the throughput, end to end delay, packet loss can be enhanced. This work focused the delay measurement in network selection scheme to reduce handover delay. The Numerical results analysis reveals that better handover performance can be achieved. A further research would be on to implement and analyses this measured delay with proposed simulated environment. The test results show that the proposed heterogeneous handover algorithm (HHA) can recognize the handover points accurately under different conditions. The proposed algorithm shows better packet delivery ratio and better throughput with minimized packet drop and delay in the communication networks.

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M. Phemina Selvi received her engineering degree in Electronics and Communication Engineering from university of Madras in 1995 and a M.Tech from Pondicherry University.Currently working as Assistant Professor in University College of Engineering Villupuram in the Department of Electronics and Communication Engineering area of research includes Wireless networks, Wireless sensor networks, Mobility management in heterogeneous wireless networks, Mobile Computing etc.

S. Sendhilnathan is working as Associate Professor in the Department of Physics, University college of Engineering Pattukkottai, (Constituent College of Anna University, Chennai) Rajamadam, Thanjavur, Tamilnadu, India. His area of interests including Nanotechnology, Communication Networks. He has published more than 18 journals