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Optimized Centralized Network Selection in Heterogeneous Wireless Network

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***Abstract* - Seamless continuity of service and to stay always best connected will be the feature of next generation wireless communication networks. Wireless networks which are of different radio access technology and having different characteristic such as Wi-Fi, UMTS, Wi-MAX, LTE etc.. coexist forming a heterogeneous wireless network. Mobile nodes (MN) which have multiple radio access interfaces can interoperate in heterogeneous networks by initiating vertical handoff, to achieve seamless continuity of service. Achieving vertical handoff in heterogeneous networks is facilitated by IEEE802.21 media independent specifications. In the regions covered by overlaid heterogeneous wireless networks mobile nodes can make vertical handover to the best network for want of quality of service thus achieving always best connected. Selecting an appropriate radio access technology as a candidate network to handover is critical issue. Vertical handover algorithms consider various network parameters such as RSS, Band width, average delay, security etc as metrics to estimate the quality of service(qos) provided by different networks . Vertical handover algorithms are designed based on different mathematical methods to select appropriate candidate network. To achieve optimization in handover process quick decision of suitable candidate network assumes importance. This paper presents an innovative method for achieving less delay in candidate network selection process.**

Keywords - Heterogeneous wireless network, vertical handoff, candidate network, Access point, Mobile Node ,MIIS server, qos

I. INTRODUCTION

The extensive use of mobile communication by the users has revolutionized the growth of mobile networks. In many regions different networks are simultaneously available .These networks may be of different type and of different radio access technology. A large geographical area is covered by mobile network facility by one or another network type. If the mobile devices possess the capacity to access these different network types and the networks are suitably linked to provide interoperability for mobile nodes such networks are referred to as heterogeneous networks. The heterogeneous networks opened up the scope for always connected to mobile users.

The heterogeneous networks of different type which differ in the characteristic as signal strength, bandwidth, coverage area, delay etc.. co exists and are overlaid and simultaneously available to the users. These overplayed networks make the possibility of always best connected to users. The networks such as Wi-Fi have small coverage area and large bandwidth ,UMTS network have large coverage area at lower bandwidth [1]. The existence of overlaid heterogeneous networks in a location make provision for the wireless network users to stay connected to best network among the simultaneously available different radio access technologies. To harness the benefit of heterogeneity the mobile devices should posses the capacity to access these networks on a single mobile node. The mobile nodes which have multiple interfaces to interact with different radio access technologies are referred to as multimode nodes. The multimode terminals can interoperate in a heterogeneous network by vertical handover mechanism. Vertical handover is a process of continuation of ongoing session by hand over from one radio access technology to another network of different radio access technology, by the usage of multimode mobile devices [2]

The handover process in homogeneous network take place by considering a single parameter mainly RSS. In heterogeneous environment different networks have different characteristic handover based on single parameter do not provide quality of service [3], To ensure qos in handover operation following issues are to be given attention. (i)Maintaining seamless connectivity (ii) Selection the most suitable candidate network to handover (iii) choosing the right time to initiate handover. The handover management in heterogeneous environment involve the following phases.(i) Deciding the necessity to handover (ii) Gathering the information about neighboring networks and access points (iii) selection of appropriate candidate network to handover (iv)To decide to handover and execute handover.

To facilitate vertical handover IEEE802.21 Media Independent Handover (MIH) standard has specified three typed of services

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i) Media Independent Event Service (MIES): MIES is concerned with identifying the events triggered at lower layers. It reports the occurrence of an event from local and remote interfaces to upper layer MIH users.

ii) Media Independent Command Service (MICS): MICS are commands sent from MIH users to lower layers for implementation. Commands are mandatory and are the decisions taken by the upper layers.

iii) Media Independent Information Service (MIIS): Through MIIS the MIH user obtain the network related information required for handover. The information are available with a MIIS Server. The mobile node can consult the MIIS server to obtain network related information. The vital information that can be got from MIIS server are information about available nearby networks, point of attachment of networks, qos parameters such as SNR, available bandwidth, delay, security level of the neighbor networks, etc.. The nodes can utilize this information to take decision of the better network access point to handover.

A mobile node situated in heterogeneous environment where various networks are overlapped, to achieve always best connected mobile nodes can handover to a best available network of the surrounding networks. For the condition of mobile nodes moving at higher speeds, taking a quick decision to handover become most essential to maintain qos[4]. Selecting an appropriate candidate network to handover depend on accessing the quality of the candidate network, which depend on various performance metrics. These metrics are obtained from MIIS Server. The quickness in obtaining network related parameter from MIIS server considerably reduces the handover time and improves the performance. The present paper suggests a scheme for optimizing candidate network selection process which helps in reducing the handover delay.

II. LITERATURE REVIEW

IEEE802.21 standard specifies an media independent information (MIIS) server. Mobile nodes can make a request to MIIS server to obtain qos parameters of neighboring networks. MIIS server was used to optimize vertical hand over form UMTS to WLAN [2]. All mobile nodes tend to make handover to a network which has high signal strength and large band width. This tendency overloads a certain network and off load other networks. The overall network resources can be optimally utilized by using load aware handover [5]. User preference can also be considered as an important parameter along with other parameters as available bandwidth, average delay, and signal strength. The qos offered by a network can be estimated in terms of link reward function which can be computed based on Markov decision process(MDP). The network having high link reward can be considered as candidate network for handover [6]. Various Candidate network selection schemes as RSS based, cost function based, MADM based , FUZZY based ,Game theory based, AI based and Context aware based schemes were described in [7][9]. Using a single MIIS server for neighbor discover will load the MIIS server, resulting in large delay in neighbor search. Neighbor discovery can be optimized by hierarchically distributing the MIIS as zonal MIIS, local MIIS, and global MIIS [8]. Network users have various preferences for their application requirements, while network operator's offer various qos preferences, user and operator can come in to a negotiation to converge at a optimal candidate network to handover [10]. Different applications demand different qos levels, to select a candidate network which provide qos level required for an application, was suggested in [11] . High speed mobile nodes may handover from macro cell to femto cells for want of higher qos but they stay in the femtocell for a short duration resulting in loading the femtocell, to optimize resource utilization high speed nodes are to be avoided from making handover to femtocells[12]. Reduction of delay in candidate network selection reduces the handover delay. A method was suggested in [13] which distribute qos evaluation function to neighbor nodes there by claimed to achieve fast candidate network selection in comparison to centralized qos evolution scheme. Various timings involved in MIIS assisted network selection were measured, the time required for different steps are mentioned in [14].

All the above approaches are focused on various handoff decision schemes, where calculation of qos level of neighboring network is done at mobile node with the assistance of MIIS server which provides network related parameters to mobile node.

III. METHODOLOGY

From the literature review it is found that for vertical handover in heterogeneous networks the Vertical Hand Over algorithms were designed based on IEEE 802.21 standard. In vertical handover selection of appropriate candidate network to handover is a very important issue. Mobile nodes need to know about the surrounding neighbor networks, their characteristics and qos level offered by them. IEEE 802.21 specifies MIIS server which has the data base of the network related information. The vertical handover schemes utilize MIIS server to get network related information such as neighboring network access points, their characteristics and qos relate parameters. When a mobile node experience degradation in the qos offered by the present network it initiates candidate network selection process. The mobile nodes make use of MICS to send a command word "MIH-network-info-request" to MIIS server to obtain network parameters of neighboring access points. In response to request from mobile node MIIS server carries out neighbor network search and collects network parameters of all the neighbor network access points and sends back a message "MIH-network-info–response" to mobile node. This response message contains a list of surrounding networks radio access points N/w-IDs and qos related parameters as

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Available band width , Bit Error rate, SNR, current load etc.. The mobile node on receiving the "MIH-network-info–response", calculate the qos of the all the networks in the list based on the metric and predetermined function to calculate qos and select the best network among the list supplied by the MIIS server.[15] In this procedure MIIS has to carryout neighbor network discovery which is time consuming. MIIS has to compose "MIH-network–info–response" which has information of all the neighbor network access points, their network related parameters. Thus response message from MIIS will be a large frame and current traffic will experience large overhead. To avoid the overheads and to improve the performance by reducing the time of the candidate network selection in hand over process, we have proposed a novel method in this paper. In the suggested method MIIS will not perform neighbor network search hence saving time delay involved in neighbor network discovery. The suggested algorithm assigns MIIS server with the function of calculation of qos metric of the neighboring access point specified by the mobile node and send only the network parameters of the best network in the " MIH-network-info –response" message. MN by utilizing the information got from MIIS serve recomputed the qos metric of the selected access point and if found suitable decides to make handover.

IV. THE PROPOSED SYSTEM ARCHITECTURE

The proposed algorithm is applied to a heterogeneous wireless network consisting of Wi-Fi and UMTS. The mobile nodes are MIHF enabled, multimode having dual interfaces to access Wi-Fi and UMTS networks. MN can access Wi-Fi network by connecting to the Wi-Fi Access Points (AP). It can also access UMTS network by connecting to Radio Network Controller (RNC) of UMTS. The MN is situated in a region which is covered by overlaid Wi-Fi and UMTS network and is simultaneously available to the user mobile node. The MN can access internet either by Wi-Fi Network or by UMTS network. Both UMTS and WI-Fi networks share a common MIIS server. All the network elements are MIHF enabled. The proposed system architecture is as shown in the figure-1.

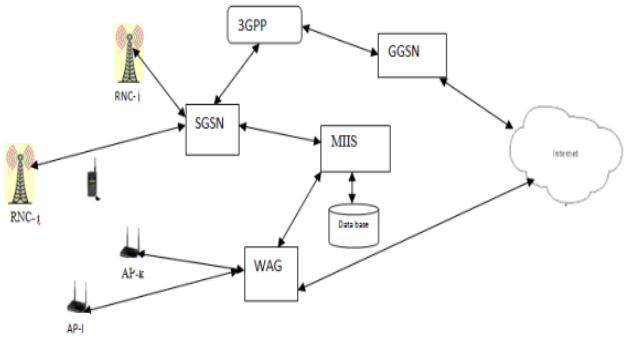

Figure-1 Proposed system architecture

Any mobile node can get information related to qos of possible candidate network by enquiring MIIS by sending a MIH request command to MIIS server "MIH- network – info-request". In the situations of the networks experience varying degree of traffic and frequent changes in the load, the qos of the current link will not be maintained constantly, it observes fluctuations. The mobile node in motion will frequently changes the boundary of coverage area of a access point need to make quick handover. Mobile nodes are wanted to be associated with best available network for want of better qos. The Always Best Connected is possible by handoff to better network among available networks and connecting to a access point among neighbor network access points for want of greater quality of service. To reduce handover latency in selecting an appropriate network access point quickly becomes important. The proposed work focus towards fast candidate network selection in heterogeneous wireless networks.

V. PROPOSED METHOD FOR THE CANDIDATE NETWORK SELECTION

In the proposed method of candidate network selection, mobile node is constantly monitoring the status of the current traffic by measuring the link quality. The quality of the link is accessed by a cost function "C" C is given by $C = \alpha (1-1/(1+SNR)) + (1-\alpha)(1-1/(1+BW))$.[16]. BW is the band width of the current traffic , calculated by making measurements on current traffic[17]. SNR is signal to noise ratio computed from the bit error rate of current traffic using theoretical tables[18]. Constant ' α ' take values depending on the application such that $0<\alpha<1$. All Access Points (AP) and RNCs periodically broadcast Beacon messages. Mobile nodes hear to the Beacon messages, measure the RSS of the link by using the Beacon messages and list the ID of strong networks who's RSS is greater than a threshold value. When cost function "C" of ongoing traffic go below a threshold the MN send "MIH- Network –info - request" command on the present ongoing link to MIIS Server. The request message includes the list of ID's of nearby networks from which MN has received strong beacon messages. After receiving the "MIH--network-info-request" message MIIS server compute the quality function "Q" of all the networks listed in the request message. The MIIS server makes use of its data base to obtain the measured network parameters. The qos is measured by using the quality factor "Q" which is estimated by Simple Additive Weight (SAW) method [19] which is different from that used at the mobile node. $Q_i = (W_S * SNR_i) + (W_B * B_i) + (W_D * 1/D_i)$. In the qos estimation MIIS server consider three parameters as the essential parameters. One is SNR, the SNR is compute by gate ways form all their access points by measuring the BER of the current traffic flow and reported to MIIS server .From BER, SNR is calculated using theoretical table[18]. B is the available bandwidth, periodically estimated by the gateways using the proactive bandwidth measuring method[17] and reported

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to MIIS server. D is the average delay in the network measure by gateways and reported to MISS server. MIIS server on reception of "MIH-network-info-request" message from a MN, compute the quality factor " Q" of all the network access points in the list sent from MN and select a network access point which has highest quality factor. The MIIS server send back to the MN a response message " MIH-network-info–response" which has information of the candidate network which include N/w-ID of selected network access point and network parameters used in quality factor calculations. Mobile node compute the cost function C_C, utilizing the SNR and available bandwidth "B" obtained from the received "MIH-network-info–response" message .$C_C = \alpha\ (1-1/(1+SNR)\ ) + (1-\alpha\ )\ (1-1/(1+B))$. The network parameter average delay " D" is not utilized for link cost estimation at MN. MN compare the computed cost function with the cost function of the current link, if the cost function of the current link is less than the cost function of the received candidate network link and N/w-ID is not the same as current ongoing N/w- ID the suggested network for the hand over is accepted by MN and send an handover accepted message to MIIS server and initiates handover operation to the candidate network access point. The proposed candidate network selection algorithm is shown in the figure- 2 and figure-3.

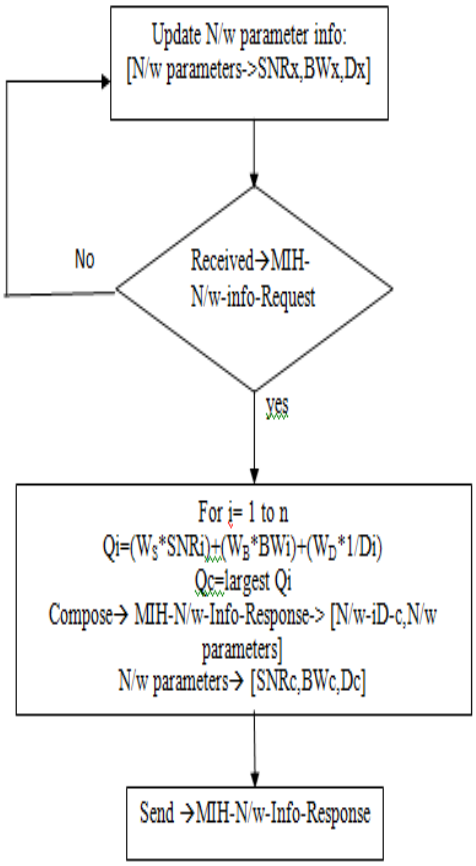

Figure 2. Processing at MIIS server

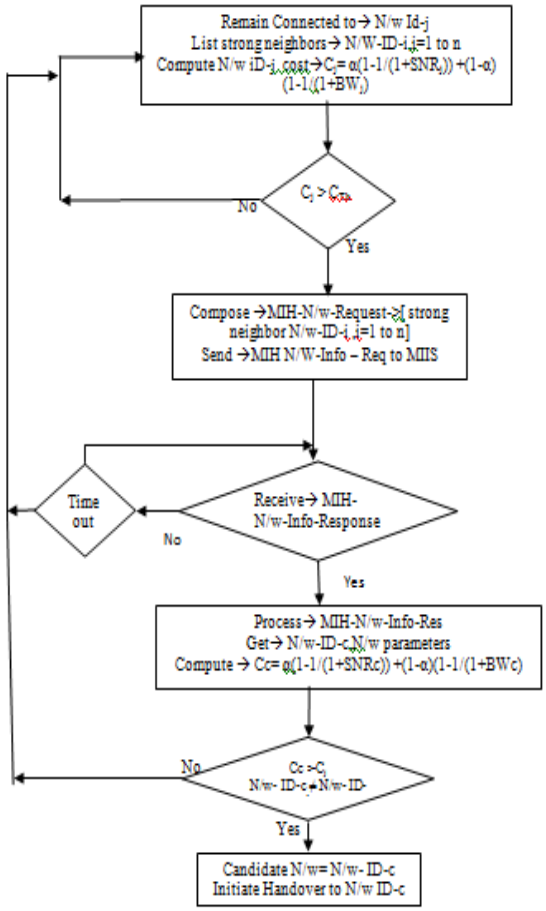

Figure 3. Processing at mobile node

VI. RESULTS ANALYSIS

The proposed method of candidate network selection is compare with other two methods, one is MIIS assisted method, another is MN-MIIS assisted method. Candidate selection time is taken as the parameter to compare the performance of the proposed algorithm. The effect of variation number of neighbor network access points on the candidate network selection delay is observed while mobile nodes is moving at a speed of 3m/sec.

In the MIIS assisted method MIIS server in response to MN request for neighbor network information initiate a neighbor network search and collect network qos parameters of all the neighbor network access points and sends to MN. MN compute cost of all access points listed by MIIS server and select the best network.

In the MN-MIIS assisted method MN lists the neighbor network access points which have strong RSS and pass this information to MIIS server. MIIS server collects qos parameters of the access points listed by MN and send to MN. MN compute the cost of all the neighbor network access point using the qos parameter send from MIIS server and select the best network which has high cost.

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In the proposed MIIS selected method MIIS server will not perform candidate network search thus save the time on candidate network search. MIIS server compute the quality function 'Q' only for the neighbor network access points listed by the mobile node, this will save time of computation, when compare to the computation time required if computation is carried out at the MN. The time saved in decision making is more as the number of neighboring network access points increases. It can be observed from the figure 4 that the proposed scheme of candidate network selection take minimum time in selecting a candidate network access point in comparison to other two methods.

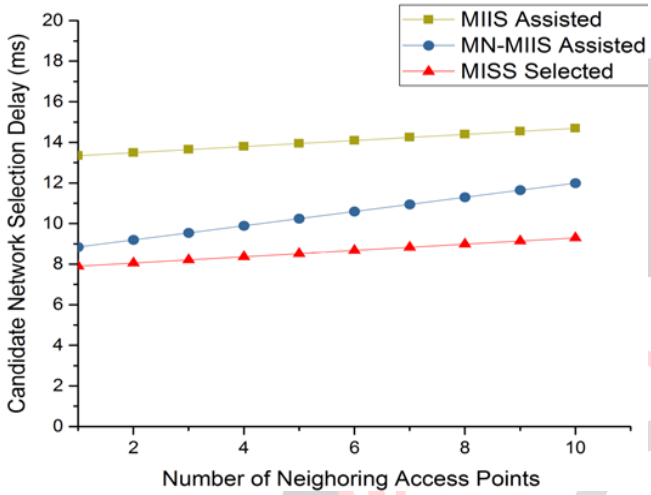

Figure 4: Candidate selection delay v/s number of neighbor access points

In the fig 5 and fig 6 the PDR is plotted against number of nodes when moving at a speed 4m/sec and 8m/sec respectively. In the proposed scheme as number of neighbor network access points increases PDR is maintained at higher value compared other methods. PDR drops slowly as number of nodes increases and also PDR drops slowly as speed increases. The proposed scheme has minimum time of hand over decision making and offer less overhead on the current traffic in obtaining the information about the status of the neighboring

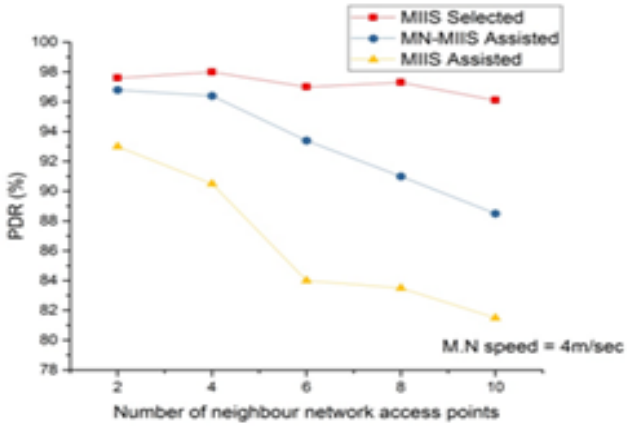

Figure 5. PDR v/s number of neighbor access points at speed 4m/sec

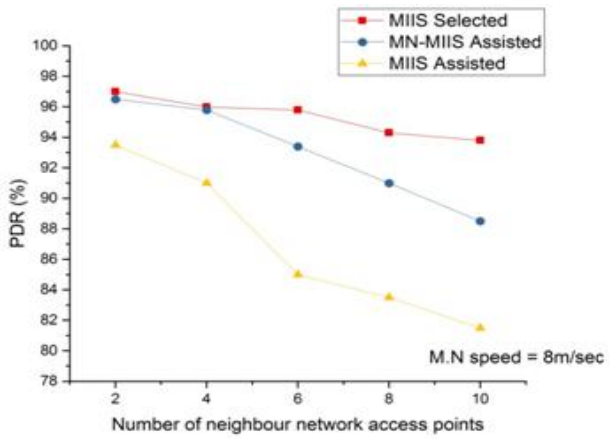

Figure 6: PDR v/s number of neighbor access points at speed 8m/sec

VII. CONCLUSION

Next generation wireless communication networks will be an area of heterogeneous networks involving diverse networks having diverse characteristics. IEEE802.21 specifications facilitate interoperability in heterogeneous networks by initiating vertical handover. Always best connected (ABC) could be achieved by choosing an appropriate candidate network to handover. Candidate network selection is a challenging and important issue in the design of vertical handover algorithms for heterogeneous networks. Reducing the delay in candidate network selection will reduce overall delay in handover and improve packet delivery ratio. In the proposed method of candidate network selection, MIIS server will not carryout neighbor discovery, hence delay in neighbor discovery is avoided. MIIS server will compute quality estimation of the neighbor networks reported by the mobile node and select a network which offer high quality factor as candidate network. In the response message MIIS will send only the network parameters of the selected candidate network, which reduces the size of the response and delay involved in the propagation of response message. These two provisions contribute in reducing the delay involved in candidate network selection.

REFERENCE

[1] F. L. L. Z. Ying Wang Jun Yuan, "Optimized Handover Scheme Using IEEE 802.21 MIH Service in Multi-Service Environment," in *IEEE confererne*, 2010.

[2] N. . V.; Tyagi Kumar, "Media independent handover for seamless mobility in IEEE 802.11 and UMTS based on IEEE 802.21," in *3rd IEEE International Conference on Computer Science and Information Technology (ICCSIT)*, 2010.

[3] F. Buiati, L. J. G. Villalba, D. Corujo, J. Soares, S. Sargento, and R. L. Aguiar, "Hierarchical neighbor discovery scheme for handover optimization," *IEEE*

 DOI : 10.18231/2454-9150.2018.0385 © 2018, IJREAM All Rights Reserved.

Communications Letters, vol. 14, no. 11, pp. 1020–1022, 2010.

[4] G. Lampropoulos, C. Skianis, and P. Neves, "Optimized fusion of heterogeneous wireless networks based on media-independent handover operations [accepted from open call]," *IEEE Wireless Communications*, vol. 17, no. 4, 2010.

[5] M. Ali, P. Pillai, Y. Hu, and K. Xu, "LOAD-AWARE RADIO ACCESS SELECTION IN HETEROGENEOUS TERRESTRIAL WIRELESS NETWORKS," *International Journal of Computer Networks & Communications*, vol. 3, no. 6, p. 95, 2011.

[6] E. Stevens-Navarro, Y. Lin, and V. W. Wong, "An MDP-based vertical handoff decision algorithm for heterogeneous wireless networks," *IEEE Transactions on Vehicular Technology*, vol. 57, no. 2, pp. 1243–1254, 2008.

[7] H. A. Bhute, P. Karde, and V. Thakare, "Vertical handover decision strategies in heterogeneous wireless networks," in *International Conference on Recent Trends in Information, Telecommunication and Computing, ITC. Citeseer*, 2014, pp. 100–116.

[8] F. Buiati, L. J. G. Villalba, D. Corujo, J. Soares, S. Sargento, and R. L. Aguiar, "Hierarchical neighbor discovery scheme for handover optimization," *IEEE Communications Letters*, vol. 14, no. 11, pp. 1020–1022, 2010.

[9] L. Wang and G.-S. (G. S. . Kuo, "Mathematical Modeling for Network Selection in Heterogeneous Wireless Networks – A Tutorial," in *IEEE COMMUNICATIONS SURVEYS & TUTORIALS, ACCEPTED FOR PUBLICATION*.

[10] M. A. Khan, U. Toseef, S. Marx, and C. Goerg, "Auction based interface selection with Media Independent Handover services and flow management," in *Wireless Conference (EW), 2010 European*, 2010, pp. 429–436.

[11] A. Gharsallah, N. Omheni, F. Zarai, M. S. Obaidat, and K.-F. Hsiao, "Network selection in heterogeneous wireless system environments," *Journal of Networks*, vol. 10, no. 12, pp. 633–642, 2015.

[12] G. Araniti, J. Cosmas, A. Iera, A. Molinaro, A. Orsino, and P. Scopelliti, "Energy efficient handover algorithm for green radio networks," in *International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB), 2014 IEEE*, 2014, pp. 1–6.

[13] R. Tawil, J. Demerjian, G. Pujolle, and O. Salazar, "Processing-delay reduction during the vertical handoff decision in heterogeneous wireless systems," in *International Conference on Computer Systems and Applications, 2008. AICCSA 2008. IEEE/ACS*, 2008, pp. 381–385.

[14] M. Tauil, A. Dutta, Y.-H. Cheng, S. Das, D. Baker, M. Yajnik, D. Famolari, Y. Ohba, V. Fajardo, K. Taniuchi, and others, "Realization of IEEE 802.21 services and preauthentication framework," in *5th International Conference on Testbeds and Research Infrastructures for the Development of Networks & Communities and Workshops, 2009. TridentCom 2009.*, 2009, pp. 1–10.

[15] F. Farid, S. Shahrestani, and C. Ruan, "QoS evaluation of heterogeneous networks: application-based approach," *arXiv preprint arXiv:1602.03563*, 2016.

[16] G. Gurumurthy, K. Shivakumar, G. Srinidhi, and H. Shivaram, "Link Stability based Handoff for QoS Provisioning In 4G Network," *International Journal of Application or Innovation in Engineering & Management (IJAIEM)*, vol. 3, no. 3, 2014.

[17] D. K. B. S. Gurumurthy G D and D. H. S. S. Srinidhi G A, "Assessment of Available Bandwidth in Heterogeneous 4G Network," *IJRECE*, vol. 2, no. 2, pp. 86–92, Apr. 2014.

[18] X. Wu, "Simulate 802.11 b Channel within NS2," *National University of Singapore, Tech. Rep*, 2004.

[19] R. Tawil, O. Salazar, and G. Pujolle, "Vertical handoff decision scheme using madm for wireless networks," in *Wireless Communications and Networking Conference, 2008. WCNC 2008. IEEE*, 2008, pp. 2789–2792.

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