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Avoiding Unbeneficial Handoff and Reducing Handoff Latency in Wlans Based on Network Condition

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Abstract

In wireless networks, mobile node frequently performs handoff. The handoff may occur due to many factors like signal strength, load balancing, number of connections, network status and frequencies engaged etc. This frequent handoff may disturb the services and create few milliseconds of interruption. This delay and number of unwanted handoffs should be minimized for break less performance. Increasing in packet loss rates and heavy traffic will initiate incorrect handoff. In this paper we proposed a numerical method to calculate the network status for avoiding unbeneficial handoffs and to eliminate unwanted traffic.

Keywords: Handoff, Delay, Neighbours Information, Multicasting, Monitoring Network Condition, Information Exchange.

Introduction

As the number of IEEE 802.11 network grows recently, the wireless LANs are widely used for distributing internet among users in different places like university campuses and hotels. These Wireless LANs have many limitations and out of that few important limitations are as follows:

a. ***QoS:*** WLANs offer typically lower QoS, since it has lower bandwidth comparing with wired counter part due to limitations in radio transmission and higher error rates due to interference.
b. ***Cost:*** Ethernet adapter vs wireless LAN adapters.
c. ***Safety and Security:*** Using radio waves for data transmission might interfere with other high-tech equipments. Shielding is not simple and radio transmission can interfere with other senders or signal from electrical devices can destroy data transmitted.
d. ***Frequency Bands:*** It is only permitted in certain frequency bands. Very limited ranges of license free bands are available but they are not same in all the countries.
e. ***Limited Orthogonal frequencies:*** Orthogonal Frequency Division Multiplexing (OFDM), an FDM modulation technique for transmitting large amounts of digital data over a radio wave. In OFDM splits the signal into multiple sub-signals to make the simultaneous transmission possible between source and destination. Generating more number of orthogonal frequencies is not too easy.

From the above limitations, one important limitation is number of orthogonal channels. The orthogonal channels can be generated using numerical methods. Generating more number of orthogonal channels is a difficult task. So, to overcome this issue multiple access points (APs) are used to cover large service area, which creates high interference and high loads, especially when WLANs need to support sudden increase in number of nodes. This interference and high loads will result in unreliable network and unbeneficial handoffs.

Handoff is a process of disconnecting old access point (AP) and connecting to the new AP to continue the service. This handoff process could introduce a delay in the ongoing service, which should be reduced for uninterrupted performance. Handoff can be categorized into Layer 2 (L2) and Layer 3 (L3) as shown in figure 1. To get a service from the network, the mobile node (MN) should be inside anyone of the AP’s Coverage limit. When the MN moves, if it goes away from the current AP, then the signal strength may get reduced and it may get disconnected. It may not get any service until the user reaches another AP’s coverage area. To minimize this inconvenience, the network can be established with overlapped cells with huge number of APs. Normally, the handoff will be triggered, when the MN moves far away from the old AP and moving closer to another AP. In this case we can have two possibilities:

1) L2 Handoff.
2) L3 Handoff.

L2 Handoff:

It consists of two phases namely, discovery phase and authentication phase. During the discovery phase MN starts the discovery process by switching to each channel defined by the standard used and scans for any available APs [2, 27]. The MN does this because it does not have any information about the surrounding APs so it must discover them by itself. The scanning can be divided into two types namely active and passive scanning. In active scanning, the MN scans each channel by sending probe request frames and waits for responses from all available APs on that channel. This scanning type can take a long time, up to 400ms, as the MN must wait for the minimum channel time on each channel while it is being scanned [4, 27]. On the other hand, by using passive scanning, the MN only switches on each channel and waits for beacons sent by the APs located on that channel. Although this type looks easier for MN, as it does not consume lot of power or bandwidth, it takes longer than active scanning because MN has to wait for at least a one-beacon interval on each channel (normally 100ms) introducing big delays which are not acceptable for real time applications [27].

L3 Handoff:

First the mobile has to perform the steps of L2 handoff and then it has to perform additional steps to change its IP address. As the L3 handoff steps include the L2 handoff, the handoff delay of L3 is greater than L2.

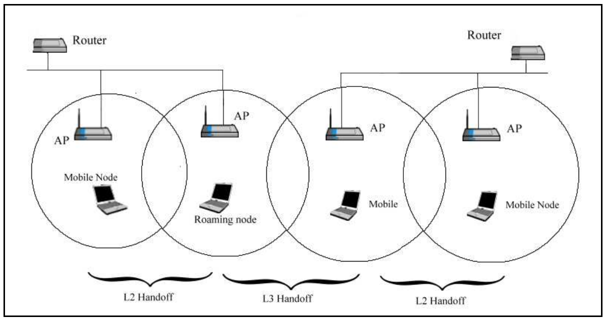


Fig. 1. Layer 2 and Layer 3 Handoff Environment

In this paper we have focused on two things, first on information exchange between MNs (That is Mutual Roaming) and second on monitoring of network (By dedicated node or by the mobile clients) to perform soft L2 and L3 handoff for uninterrupted services. We refer mutual information exchange enabled roaming as mutual roaming (MR). The basic idea of the MR is the MNs can collect the information about the nearby APs, subnets and network status from nearby MNs. Also, using the MR a MN can request another MN (which is in new subnet) to reserve an IP address in a nearby subnet (new subnet) while still it is in old subnet. This work evolves from our previous work in [30].

Related Works

In last few years, many analysis papers were revealed over the usage and performance of wireless networks. In [3], the metropolitan area networks have been analyzed for understanding the performance. In [5], summary of quick authentication strategies when roaming inside or across IEEE 802.11 Wireless-LANs have presented. Besides this summary, the paper analyses the relevance of IEEE 802.11f and Seamy solutions to alter quick authentication for inter-domain handovers. They introduced associate Extended Service Set (ESS) that is essentially a hotspot with a group of APs. They have tried to reduce the latency because it could occur owing to the exchange authentication messages quick Authentication in Inter domain Handovers. They analyzed three techniques, easy Extension of IAPP, Inter-domain Proactive Key Distribution and Pre-authentication over Multiple Domains for minimizing latency concerned in authentication throughout the hand over. Minimizing the L2 probe delay is an implementation issue instead of a protocol issue.

Link Layer Estimation Delay is between 50ms to few hundred milliseconds as in [19] and [20]. This delay is at 100ms as specified in [21] and it may vary from 100-300ms as specified in [22]. In [23], by A.Mishra, et al, the variation is from 50-400ms.The L2 delay depends on the physical medium. In [24], completely different IEEE 802.11 primarily based network has been analyzed and that they propose a way to cut back the delay by probe procedure. Conjointly they gave in a different way to cut back L2 handoff by permitting access routers to send to MNs, few details which may would like for fast association with new access purpose like frequency, ESSID and authentication data. As stated in [25], the movement history of a MN is unbroken by Foreign Agents to predict the handoff ahead. This theme is prescribed to town streets. In [26], Feng and Reeves, on the other hand, states that a MN will record the antecedently visited subnets. Throughout the handoff of process these recorded data might accustom guess the long run target. Just in case the MN has no records for a couple of specific subnet (that is 1st time visit), then IPv4 are going to be used. These strategies might increase burden for the MNs, since MNs are limited in resources and it's exhausting to record, calculate and predict throughout the handoff process.

Many others put lot of efforts to investigate the performance of L2 and L3 handoff in wireless networks. Analyzing the performance of L2 and L3 handoff isn't a straightforward task. At the time of inscribing this paper, several wireless standards are approved and few standards were rising, attempting to unravel a number of issues a wireless network introduces. All of those standards show distinction in infrastructure and within the protocol. To deal with this gap, recent studies have analyzed traces captured from the wireless face of the network.

Network Monitoring

The network status may change due to many reasons like arrival of huge number of MNs in a short period of time, flooding of unwanted traffic and some other reasons. When a network is busy for a long time, the mobile devices may get disconnected. To avoid these disconnections keep-alive packets are used by the mobile devices for preserving connections. When a MN moves and loses connectivity to its AP, it starts collecting information about the APs available to that area by broadcasting a special message called probe message. These keep alive packets and probe messages will increase the unwanted traffic in the network. Also the utilization of WLAN has to be understood properly to control the handoff frequency. In this section, we present a numerical method to calculate the available bandwidth and packet delay of a WLAN for better handoff decision.

Proposed network condition detection method

We can say that the network condition is good if the available bandwidth is high and the packet delay is low, else we can say the network condition is bad or busy. The available bandwidth of a link can be calculated numerically with the help of parameters discussed in [28]. In CSMA/CA, to avoid the collision Network Allocation Vector (NAV) scheme is used. This NAV can be used to collect much information about the network to predict its condition. The available bandwidth can be calculated from NAV as follows

$$A_{bw} = T_{bw} - FS\left(\frac{NAV}{T_s + \frac{1}{2}T_c(AT-1)}\right)$$

Where A_{bw} is the total bandwidth, FS is the mean frame size, T_s and T_c are the NAV duration for a successful frame transmission and collision respectively, AT is the average number of trials of a transmission. Also the packet delay can be calculated as

$$PD = AD + QD$$

Where PD is the packet delay, AD is the accessing delay of the packet (The time taken to transmit the complete packet) and QD is the Queuing delay of the packet. As said in [29], the exponential distribution seems to be a good approximation for the MAC layer service time. Also two models M/M/1/K and M/G/1/K can be used for estimating QD and when the mobile stations are at the nonsaturated state, M/M/1/K gives a good approximation. So, we can take M/M/1/K model for calculating QD as follows

$$QD = \frac{PAR \times AD^2}{1 - PAR \times AD}$$

Where PAR is the mean packet arrival rate at the station. Also the AD can be derived as said in [28] as follows

$$AD = t_0 + t_f + t_{sent}$$

$$AD = \frac{b(p_c T_{col} + (1-p_c)T_s}{2} + b\frac{v(CW_{min})}{2}$$
$$+ p_0 T_s \sum_{j=1}^{S-1} p_1^{j-1} + T_{col} \sum_{j=1}^{S-1} p_1^j + \sum_{j=1}^{S-1} p_1^j v(2^j CW_{min}))$$

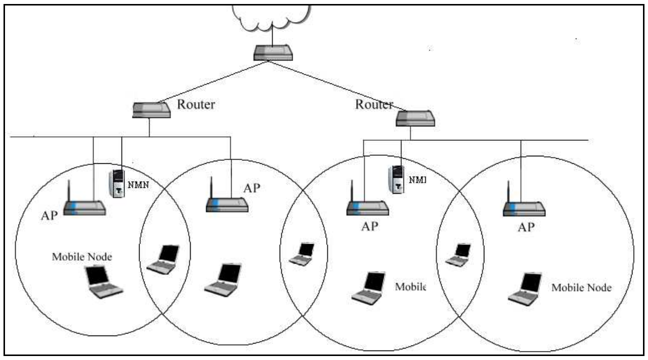


Fig. 2. System Model

The Monitoring of network and traffic will be done by our proposed numerical method. The network monitoring work can be installed in one or more nodes of a subnet. This monitoring node can keep on capturing the frames and it can check whether the network is fully loaded or not. This network status can be updated to the MNs by multicasting. This multicasting information may create flooding in the network and to control this flood the Time to Live (TTL) flags can be used. The change in network condition can be intimated to all the MNs only once. It should not be repeated unless there is no change in network condition. Since, the repeated multicast may generate unwanted traffic. The MNs have to maintain this information in its cache optionally.

Handoff Decision

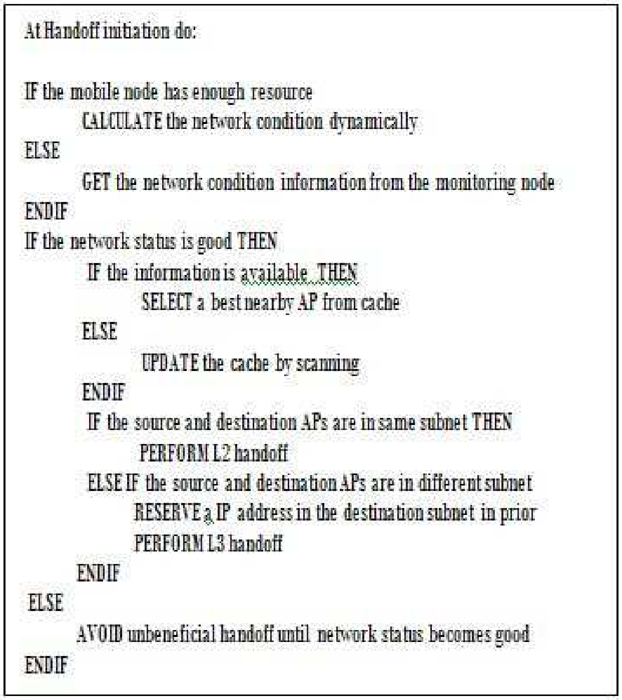
Each mobile in the network can take handoff decision based on the neighbor information stored in cache and the network condition. The network condition can be determined dynamically by the MN itself, if it has enough resources. If the mobile is low in resource level, then the network status can be received from the monitoring nodes and can be saved it in the cache for a short period of time. The procedure to perform handoff using our proposed model is given in figure 3 and the proposed network model is given in figure 2.

During the handoff initiation, the mobiles have to check for the valid information in the cache. If the cache contains no information about the neighbor APs then it has to scan for the available APs and the same can be save in its cache for future references. If the cache contains required information then the target AP can be selected without time consuming scanning process.

After the scanning process, the APs are ordered according to the signal strength. Also, the mobile can collect the information about the APs by sending request to the nearby MNs via multicasting. Any node can send the request and any node can respond. Here more than one mobile can reply for a single request and the collected messages have to be validated before updating the cache. During the L3 handoff the required information like default router's IP address and subnet identifier of both source and destination, can be read from the cache, which quickened the detection of handoff type i.e., L3 instead of L2. In table 1 a sample cache structure of the MN is provided.

Table i. SAMPLE MOBILE NODE'S CACHE STRUCTURE

	Current AP	**Neighbor AP1**	**Neighbor AP2**	**Neighbor AP3**
BSSID	MAC A	MAC B	MAC C	MAC D
Signal Strength	85%	75%	68%	59%
Channel	6	114	1	4
Subnet ID	152.41.6.0	152.41.3.0	152.41.3.0	152.41.7.0



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At Handoff initiation do:

IF the mobile node has enough resource
    CALCULATE the network condition dynamically
ELSE
    GET the network condition information from the monitoring node
ENDIF
IF the network status is good THEN
    IF the information is available THEN
        SELECT a best nearby AP from cache
    ELSE
        UPDATE the cache by scanning
    ENDIF
    IF the source and destination APs are in same subnet THEN
        PERFORM L2 handoff
    ELSE IF the source and destination APs are in different subnet
        RESERVE a IP address in the destination subnet in prior
        PERFORM L3 handoff
    ENDIF
ELSE
    AVOID unbeneficial handoff until network status becomes good
ENDIF
```

Fig. 3. Procedure to Perform Handoff Using our Proposed Model

Cooperative Information exchange

If a roaming MN wants data concerning its neighbor APs and subnet, it sends associate INFOREQUEST multicast frame with applicable TTL value. The aim of TTL is to manage the flood in the network. In this frame the present data offered within the cache are going to be hooked up. The neighbor mobiles can receive the INFOREQUEST frames and every mobile can explore for its cache to see, minimum one entry is there in both the cache entry and the data received by INFOREQUEST. If a minimum of one AP is in common then, the MNs send associate INFORESPOND multi frame. This INFORESPOND frame can contain data concerning the APs and subnet that isn't best-known to the roaming MN. This INFORESPOND frames are going to be sent after a random interval of time to make sure, that the nearby mobiles don't seem to be sending the same data. The MNs that have common APs with roaming MN could also be within the same location of the roaming MN and then the specified data for the roaming MN are going to be gathered in high chance.
When MNs (except the roaming MN) receives the INFORESPOND multicast frame, it'll perform the below mentioned two tasks.

1. Every MN can check its own cache and it'll make sure that the data provided is correct or not. If the data appears to be wrong then it'll attempt to fix it.

2. It'll record the data offered within the frame to its cache even supposing it's not requested earlier.

By doing this the cache are going to be stuffed presently with helpful data. The data within the INFOREQUEST message ought to be collected for higher result.

Acquiring IP Address during L3 handoff in Advance

Before the handoff activity, the subnet symbol of present AP and new AP are going to be compared. If both the present AP and target AP has the same subnet symbol then the L2 handoff has to be performed. In case the subnet symbol of both APs is totally different, then L3 Handoff must be performed. At the time of the L3 handoff the roaming MN can communicate to the other MN via multicasting. Once a roaming MN desires to urge a new IP address for the new subnet, it sends a unicast IP_REQUEST packet to any one of the active MN within the destination subnet. This IP_REQUEST packet contains the MAC address of the roaming MN. This request is going to be processed by a specific MN and it'll reserve an IP address on behalf of the roaming MN with the assistance of DHCP. When obtaining the new IP address the MN will send an IP_RESPOND multicast frame. The roaming MN will receive this frame and it will save the new IP address with default routers IP address. Therefore the roaming MN will get the informatics address for the new subnet before Handoff. This can save the time and also the handoff latency are going to be reduced.

Network Condition Information for Reducing Unwanted Traffic

The network conditions determined by our proposed mathematical model can be used by any mobile or constant data send by the monitoring node are going to be saved by all the mobiles in its cache. If the network status is "busy" then the mobile should scale back the frequency of keep-alive packets and probe request. By reducing the frequency of those two types of packet, the unwanted traffic is going to be eliminated. Ensuing huge advantage of this data is that the unbeneficial handoffs are going to be avoided. If the network condition isn't good then handoff should not be initiated till the network condition becomes good enough. Again, by avoiding the unbeneficial handoff we tend to eliminate the traffic created by the handoff procedure.

Simulation Results

The experiment result of our proposed model is presented in this section. Our proposed method improves both L2 and L3 handoff performance and the typical performance achieved by the proposed method is compared with the legacy handoff in figure 4. From the result it is very clear that the cache that contains the helpful data like signal strength, subnet ID of the neighbor APs and the network condition improves the handoff performance considerably, since the scanning time is reduced if the table entry is available. The unbeneficial handoffs are avoided many times, since our algorithm might not encourage the handoff process during the unhealthy network condition.

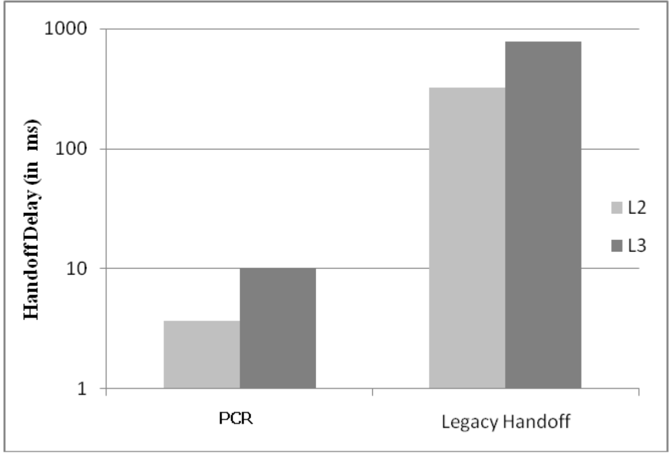

Fig. 4. Comparison between proposed method and legacy handoff.

Conclusion

In this paper we have defined a numerical method to calculate the network condition dynamically. The proposed method has much compensation in both L2 an L3 handoff. It helps in reducing the handoff latency and it avoids the unbeneficial handoff which is necessary for uninterrupted service.

References

[1] D. Tang and M. Baker, "Analysis of a local-area wireless network," in Proceedings of the ACM MobiCom, Boston, MA, Aug. 2000, pp. 1–10.

[2] IEEE 802.11 standard Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications‘, IEEE Standard, 2007.

[3] D. Tang and M. Baker, "Analysis of a metropolitan-area wireless network," Wireless Networking, vol. 8, no. 2/3, pp. 107–120, 2002.

[4] H. Ping-Jung and T. Yu-Chee, A Fast Handoff Mechanism for IEEE 802.11 and IAPP Networks‘, IEEE Vehicular Technology Conference (VTC), vol.2, pp: 966-970, 2006.

[5] M.S. Bargh, R.J. Hulsebosch, E.H. Eertink, A. Prasad, H.Wang, P. Schoo, "Fast Authentication Methods for Handovers between 802.11 WLAN", WMASH‟04 October 1, 2010.

[6] Ishwar Ramani, Stefan Savage, "Syncscan: Practical Fast Handoff for 802.11 Infrastructure Networks" IEEE Proceedings, 2005, Pages: 675-684.

[7] S. Shin, A. G. Forte, A. S. Rawat, and H. Schulzrinne, "Reducing MAC layer handoff latency in IEEE 802.11 wireless LANs," in MobiWac '04:

Proceedings of the second international workshop on Mobility management & wireless access protocols. New York, NY, USA: ACM Press, 2004, pp. 19–26.

[8] F. Akyildiz, J. Xie, and S. Mohanty, "A survey of mobility management in next-generation all-IP-based wireless systems," IEEE Wireless Commun., Aug. 2004.

[9] C. Blondia, O. Casals, L. Cerda, N. Wijngaert, and G. Willems, "Performance evaluation of Layer 3 low latency handoff mechanisms," Mobile Networks and Applications, vol. 9, no. 6, pp. 633-645, Dec. 2004.

[10] P. Jardosh, K. N. Ramachandran, K. C. Almeroth, and E. M. Belding-Royer, Understanding Link-Layer Behavior in Highly Congested IEEE 802.11b Wireless Networks," in Proceedings of EWIND, Philadelphia, PA, Aug. 2005, pp. 11–16.

[11] P. Jardosh, K. N. Ramachandran, K. C. Almeroth, and E. M. Belding-Royer, "Understanding congestion in ieee 802.11b wireless networks," in Proceedings of IMC, Oct. 2005.

[12] Jochen Schiller, "Mobile Communications", PHI/Pearson Education, Second Edition, 2003.

[13] H. Velayos and G. Karlsson, "Techniques to reduce IEEE 802.11b handoff time," in Proceedings of ICC, Paris, France, June 2004.

[14] Sangheon Pack, Xuemin (Sherman) Shen, Jon W. Mark, and Jianping Pan, " Adaptive Route Optimization in Hierarchical Mobile IPv6 Networks", IEEE transaction on mobile computing, vol 6, no 8, august 2007.

[15] Janusz Gozdecki, Piotr Pacyna, Victor Marques, Rui L. Aguiar, Carlos García, Jose Ignacio Moreno, Christophe Beaujean, Eric Melin, Marco Liebsch, "An IP QoS Architecture for 4G Networks", In Proceedings of Art-QoS'2003. pp.18~28.

[16] Vasos Vassiliou and Zinon Zinonos, "An analysis of the handover latency components", Journal of internet engineering, Vol 3, No 1, 2009.

[17] Ramanathan, P., Sivalingam, K.M., Agrawal, P., Kishore, S.: Dynamic Resource Allocation Schemes during Handoff for Mobile Multimedia Wireless Networks. IEEE Journal on Selected Areas in Communications, Vol. 17, No. 7, July 1999.

[18] Saha, S., Jamtgaard, M., Villasenor, J.: Bringing the Wireless Internet to Mobile Devices. IEEE Computer, Vol. 34, No. 6, June 2001.

[19] H. Soliman, C. Castelluccia, K. El-Makri, and L. Bellier, "Hierarchical Mobile IPv6 Mobility Management (HMIPv6)", Request for Comment 4140, Internet Engineering Task Force, Aug. 2005.

[20] R. Koodli, et al, "Fast Handovers for Mobile IPv6", Request for Comment 4068, Internet Engineering Task Force, Jul 2005.

[21] S. Ryu1, Y. Lim, S. Ahn, and Y. Mun, "Enhanced Fast Handover for Mobile IPv6 Based on IEEE 802.11 Network". ICCSA 2005, LNCS 3480, pp. 398 – 407, 2005.

[22] Y. Y. An, B. H. Yae, K. W. Lee, Y. Z Cho, and W. Y. Jung, "Reduction of Handover Latency Using MIH Services in MIPv6". Proceedings of the 20th International Conference on Advanced Information Networking and Applications (AINA'06).

[23] A.Mishra, et al, "An Empirical Analysis of the IEEE802.11 MAC Layer Handoff Process". Proc. of ACM SIGCOMM Computer Communication Review, Vol.33, Issue 2, Apr. 2003.

[24] Cabellos-Aparicio, H. Julian-Bertomeu, J. Núñez-Martínez, L. Jakab, R. Serral-Gracia, J. Domingo-Pascual, "Measurement-Based Comparison of IPv4/IPv6 Mobility Protocols on a WLAN Scenario". Proceedings of the 3rd International Working Conference on Performance Modelling and Evaluation of Heterogeneous Networks. IEE UK, 2005.

[25] Van den Wijngaert, N. and Blondia, C, "A Predictive low latency handover scheme for mobile IP", Proceedings of OPNETWORK, 2002. August.

[26] Feng, F. and Reeves, D, "Explicit Proactive Handoff with Motion Prediction for Mobile JP", IEEE Wireless Communications and Networking Conference, 2004. WCNC. 2004, Volume: 2, pp 855-860.

[27] Laeth A. Al-Rawi, Rosli Salleh, Ghaith A. Al-Rawi, Hassan A. Al-Rawi, H.Keshavarz, Reducing Layer 2 Handoff Latency in WLANs using Advanced Context Distribution, International Journal of Scientific & Engineering Research Volume 2, Issue 11, November-2011.

[28] Chuanxiong Guo, Zihua Guo, Qian Zhang and Wenwu Zhu, A seamless and Proactive End-to-End Mobility Scheme for Roaming across Heterogenous Wireless Networks, IEEE Journal of selected area in communications, vol.22, no. 5, pp. 834-848, June 2004.

[29] Hongqiang Zhai, Younggoo Kwon2 and Yuguang Fang, Performance analysis of IEEE 802.11 MAC protocols in wireless LANs, Wirel. Commun. Mob. Comput., vol. 4, no. 8, pp. 917–931, December 2004.

[30] V.Saravanan and A.Sumathi, Dynamic Handoff Decision Based on Current Traffic Level and Neighbor Information in Wireless Data Networks, IEEE – Fourth International Conference on Advanced Computing, pp.1-5, December 2012. DOI: 10.1109/ICoAC.2012.6416797.