ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

An ISO 3297: 2007 Certified Organization   Vol. 3, Special Issue 3, April 2014

International Conference on Signal Processing, Embedded System and Communication Technologies and their applications for Sustainable and Renewable Energy (ICSECSRE '14)

Organized by

Department of ECE, Aarupadai Veedu Institute of Technology, Vinayaka Missions University,

Paiyanoor-603 104, Tamil Nadu, India

Efficient Mobility Management in Different Wireless Network for Continuous Flow of Information

Mr. P.Thirunavukkarasu, Ms. P.Irene Beril Yazhini

PG Scholar, Dept. of CSE, SRM University, Chennai, India

Assistant Professor, Dept. of CSE, SRM University, Chennai, India

Abstract **–** Next generation wireless communication systems are expected to relay on integrated networks consisting of multiple wireless technologies. Heterogeneous wireless networks, for instance WiMAX and Wi-Fi can combine their respective advantages, offering a high Quality of Service (QoS) and Always Best Connected with mobile users. Mobility management was deployed in Application layer using SIP protocol to provide quality of Real time services to the end user. The vertical handoff decision is crucial in heterogeneous networks. In this paper, we propose Enhanced vertical handoff decision based on BANS in WiMAX and Wi-Fi heterogeneous wireless networks. The algorithm consider the factors of Received Signal Strength (RSS), Bandwidth (BW), mobile node velocity (V) and User Preference (P), to evaluate Network Selection Function of the available networks and select best one which support on going real time application (i.e., video streaming).To decrease Call Blocking Probability we propose Adaptive Bandwidth Allocation Algorithm(ABAA). We propose TBHO method to make an early handover to avoid Ping-Pong effect which causes the unwanted packet loss.

Keywords **–** Heterogeneous wireless networks, Network Selection Function, Adaptive Bandwidth Allocation Algorithm, Received Signal Strength, and Time before Handoff.

I. INTRODUCTION

Communication technology has become outdated for future requirement as the growth of the communication industry is tremendous and unimaginable. Different modes as mobile, wired, wireless, adhoc, supports growth of the communication industry but with certain limits. Mobility plays a vital role in wireless communication, where it is necessary to satisfy the requirements of the modern world. It is now a challenge to provide the seamless flow of information without re-modifying the existing infrastructure. The most challenging aspect is to provide mobility management for real time communication services.

Mobile IP is struggling with the triangular routing, i.e., a packet to a mobile host travels via the home agent from the correspondent node which incurs overhead of tunnelling [1]. To solve triangular routing through route optimization by sending binding updates to the sending host about the actual location of the mobile host. For real-time traffic such as voice or video over IP, it is more common to use the Real-Time Transport Protocol (RTP) over UDP, and important issues are fast handoff, low latency, and for wireless networks, high bandwidth utilization. Hence, this necessitates introducing mobility awareness at higher layer. The application layer protocol Session Initiation Protocol (SIP) [2] already supports personal mobility, and the changes needed to support device mobility are minor.

In heterogeneous wireless networks, traditionally the network is initiated with any request and immediately the type of request is identified as voice, data, image, data and image, motion pictures, live information, online videos, store and forward. In case of emergency situation such as natural calamities and disaster requires immediate recovery and medical help. The medical experts can establish virtual communication such that the experts from remote areas can view the condition of the patient and provide directions for initial treatment until they reach the affected area. This can

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

An ISO 3297: 2007 Certified Organization Vol. 3, Special Issue 3, April 2014

International Conference on Signal Processing, Embedded System and Communication Technologies and their applications for Sustainable and Renewable Energy (ICSECSRE '14)

Organized by

Department of ECE, Aarupadai Veedu Institute of Technology, Vinayaka Missions University,

Paiyanoor-603 104, Tamil Nadu, India

be achieved only if seamless mobility is possible in reality. Seamless and efficient Vertical Handoff between different access technologies is an essential and challenging problem in the development toward the next-generation wireless networks [3]. The handoff process can be further carried out using the following steps: neighbour discovery, handoff decision and handoff execution. During the neighbour discovery phase, mobile terminals equipped with multiple interfaces have to determine which networks can be used and the services available in each network. During the handoff decision phase, the mobile device determines which network it should connect to. During the handoff execution phase, connections need to be rerouted from the existing network to the new network in a seamless manner.

One of the main purposes of so-called fourth generation (4G) [4] networks is to allow mobile users to be always best connected (ABC) through a number of underlying wireless technologies and networks. It is expected that wireless devices will increasingly have multiple heterogeneous interfaces. In this scenario the selection of the most appropriate network should be based on various criteria such as economic cost, coverage, and transmission rate, quality of service (QoS), security, and user preferences [5] . Efficient schemes are needed to provide seamless vertical handovers in integrated heterogeneous networks. New heterogeneous networks, including IEEE 802.11 wireless LANs, and IEEE 802.16 wireless metropolitan area networks [6], also known as worldwide interoperability for microwave access (WiMAX), seem to be promising approaches as both technologies support very high data rates as well as QoS. Hence, this integrated network will bring a synergetic improvement to the services provided to mobile users. The integration and inter operation of these heterogeneous networks pose several challenges. One of the important issues is the design of intelligent network selection algorithms is to provide better performance to the multi-interface terminals. This paper proposes a network selection algorithm based on multiple attribute decision making. A handoff algorithm must be capable of making a decision based on incomplete information and in a region of uncertainty.

A. *Organization of the paper*

Section II presents the proposed method. Section III presents the results and related discussion. Section IV discusses directions for future work and concludes this study.

II. System Model

The proposed system for best access network selection is shown in fig.1. The Mobile Node is a multi-interface and multitask device (eg: small-size multi-band antenna). The Home Agent (HA) is a specialized router responsible for forwarding packets to Mobile Node. The Mobile Node is assigned a home address (HoA) in the same subnet as the Home Agent [8]. The Foreign Agent is responsible for assigning a care of address (CoA) for the Mobile Node and forwarding packets for the Mobile Node. On its home link, the mobile node uses its HoA just like a stationary node.

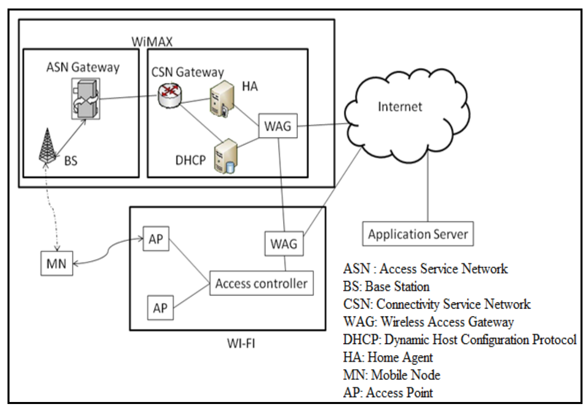

Fig.1. System Model

Mobility Management incorporates Session Initiation Protocol and location management is handled through SIP Registrar servers. The SIP session is been established from the mobile node through the home agent which acts as the SIP server to the CN. Once the session is established then RTP packet streaming takes place. When the MN Received Signal strength reduces below the threshold, the access network selection is triggered, taken care by the controller. The access network selection algorithm determines the next network for the mobile node to avoid re-connection latency with CN. The mobility of the MN remains transparent to the correspondent node [9].

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

An ISO 3297: 2007 Certified Organization Vol. 3, Special Issue 3, April 2014

International Conference on Signal Processing, Embedded System and Communication Technologies and their applications for Sustainable and Renewable Energy (ICSECSRE '14)

Organized by

Department of ECE, Aarupadai Veedu Institute of Technology, Vinayaka Missions University, Paiyanoor-603 104, Tamil Nadu, India

A. Signaling through SIP

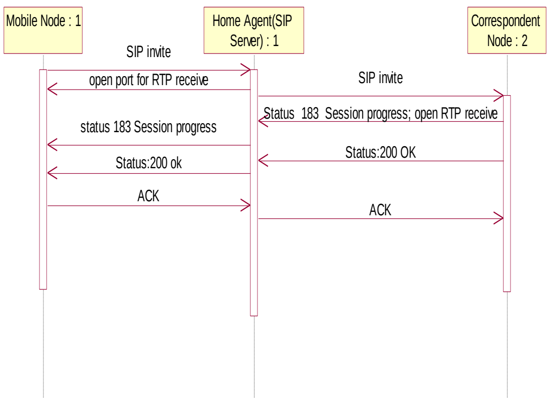

Fig.2. SIP Call setup

SIP supports personal mobility, i.e., a user can be found independent of location and network device (PC, laptop, IP phone, etc.). The step from personal mobility to IP mobility support is basically the roaming frequency, and that a user can change location (IP address) during traffic flow. In order to support IP mobility, we enable the ability to move while session is active. It is assumed that the MN belongs to a home network, which acts as SIP server and receives registrations from the MN each time it changes location. This is similar to home agent registration in Mobile IP. Note that the mobile host does not need to have a statically allocated IP address on the home network. When the correspondent host sends an INVITE to the mobile host, the home agent has current information about the mobile host's location and redirects the INVITE there (Fig.2). SIP specifies support for both authentication and encryption of SIP messages, using either challenge-response**.**

B. Streaming using Real time Transport Protocol (RTP)

Once the session is initiated between the MN and the CN, packets are streamed to the MN from the CN. The MN regularly sends BU messages to the HA indicating its CoA [10]. When a new CoA is indicated in the BU message, the HA updates the binding cache and returns Back messages to the MN. Packets in the direction from the MN to the CN can be sent directly to the CN when BU is sent to the CN. Thus triangular routing problem is overcome through route optimization.

C. Best Access Network Selection

Once the received signal strength of the MN reduces below the threshold, the MN notifies CN with "Handover notification Message" and Best access Network Selection Algorithm is initiated, which selects the next optimal and promising to maintain the QoS for the application. The network selection algorithm is based on Fuzzy multiple attribute decision making [13]. The algorithm considers the factors of Received Signal Strength (RSS), available band width (BW), mobile terminal velocity (V) of the candidate networks for choosing the target network.

i. Finding Normalization Functions:

Different kinds of parameters can be considered for finding the best access network. Each parameter has some characteristic which contributes for normalizing function and hence determine the best access network [11]. The parameters that are considered for making handover decision are defined in table 1. The parameters are classified as high parameters and low parameters to facilitate normalization.

Table 1 Normalization Parameter Description

Parameter Name	**Description**
RSS	The strength of the signal received from the Candidate network.
BW	The amount of available band width of the Candidate network
V	The Velocity that is supported by the Candidate Network

The Normalization Function is given as follows:

$$N(X) = \frac{x - x_{\min}}{x_{\max} - x_{\min}} \qquad (1)$$

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

An ISO 3297: 2007 Certified Organization Vol. 3, Special Issue 3, April 2014

International Conference on Signal Processing, Embedded System and Communication Technologies and their applications for Sustainable and Renewable Energy (ICSECSRE '14)

Organized by

Department of ECE, Aarupadai Veedu Institute of Technology, Vinayaka Missions University,

Paiyanoor-603 104, Tamil Nadu, India

Normalization functions for RSS:

$$N_{RSS} = \begin{cases} 0, 0 \le RSS \le RSS_{TH} \\ \dfrac{RSS_x - RSS_{TH}}{RSS_{max} - RSS_{TH}}, RSS_x > RSS_{TH} \end{cases} \quad (2)$$

RSS_x - received signal strength from the candidate base station. RSS_{TH} – threshold signal strength. RSS_{max} is the maximum received signal strength received from the base station. RSS – signal strength received from the base station.

Normalization function for Bandwidth

$$N_{BW} = \begin{cases} 0, BW_x > BW_{max} \\ \dfrac{BW_x}{BW_{max}}, 0 \le BW_x \le BW_{max} \end{cases} \quad (3)$$

BW_X – required bandwidth of mobile node and BW_{max} - Maximum bandwidth that can be provided by the base station.

Normalization function for Velocity [15]

$$N_v = \begin{cases} 0, V_x > V_{max} \\ 1 - \dfrac{V_x}{V_{max}}, 0 \le V_x \le V_{max} \end{cases} \quad (4)$$

Where V_X – velocity with which the mobile node is moving and V_{max} – maximum velocity supported by the base station.

ii. Computation of the Weight Vector:

The weight of an attribute is denoted by "i". W^i indicates the importance of the attribute. The weight is represented as W^{RSS}, W^{BW}, W^V. W^i is given by

$$W^i = \frac{\sigma_i}{\sum_{i=0}^{3} \sigma_i} \quad (5)$$

Where σ_i is the standard deviation of the normalization function values of all the candidate base stations for the given parameter "i".

iii. Evaluation of Network Selection Function:

The network selection function (NSF) for the candidate network is calculated by

$$f = \sum_{i=1}^{3} N_i \times W_i \quad (6)$$

After evaluating the NSF values for all the candidate networks decision is made as follows. The k^{th} network is selected with the Network having highest NSF value,

$$NSF_K = \max\{NSF_1, NSF_2, ...NSF_n\} \quad (7)$$

D. Call Admission Control

Call Admission Control [12] is always performed when a mobile initiates communication in a new cell, either through a new call or a handoff. The flowchart for Call Admission is shown in Fig. 3.

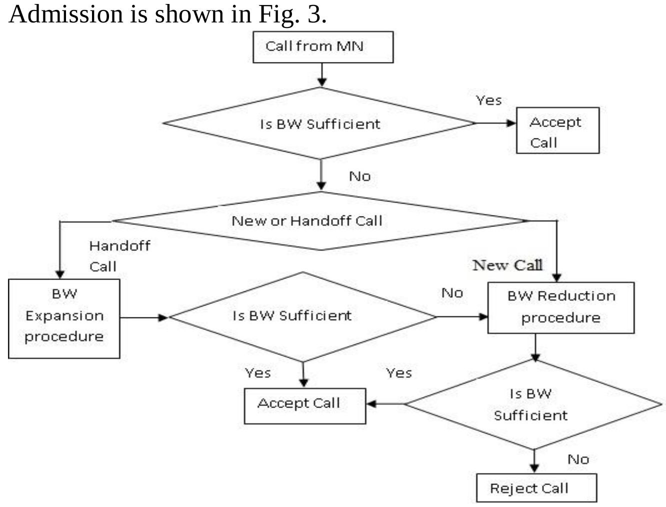

Fig.3. Adaptive Bandwidth Allocation Algorithm

During call setup, MN running a user multimedia service defines its requirements in a traffic profile. This profile consists of the connection type (new or handoff) and the BW requirements.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

An ISO 3297: 2007 Certified Organization   Vol. 3, Special Issue 3, April 2014

International Conference on Signal Processing, Embedded System and Communication Technologies and their applications for Sustainable and Renewable Energy (ICSECSRE '14)

Organized by

Department of ECE, Aarupadai Veedu Institute of Technology, Vinayaka Missions University,

Paiyanoor-603 104, Tamil Nadu, India

Adaptive Bandwidth Allocation Algorithm

The adaptive bandwidth allocation (ABA) algorithm is utilized to adapt calls whenever there is an insufficient bandwidth for call admission [13]. The algorithm will be triggered whenever there is a call arrival acceptance event or a service departure event. A class-i handoff connection is accepted if the following is satisfied.

$$b_{i,request} + \sum_{i=1}^{k} b_{ni} \le t_0 \, and \, b_{i,request} \le b_A$$

t_0 Denotes the maximum number of total bandwidth units that can be allocated to new / handoff connection.

b_A Denotes the bandwidth in the cell.

b_{nci} Denote the total capacity allocated for class-i new connections

b_{ni} Denote the total capacity allocated for class-i handoff connections.

E. Binding Messages

The MN initiates access request to the selected network (Fig.4.), which then provides ACK for the requested access. Once ACK is received the MN sends BU to the access router of the selected network [14]. Once it receives the binding acknowledgement message from the access router, the MN performs BU to the HA and then with the CN. Hence packet transfer takes place directly between the MN and the CN.

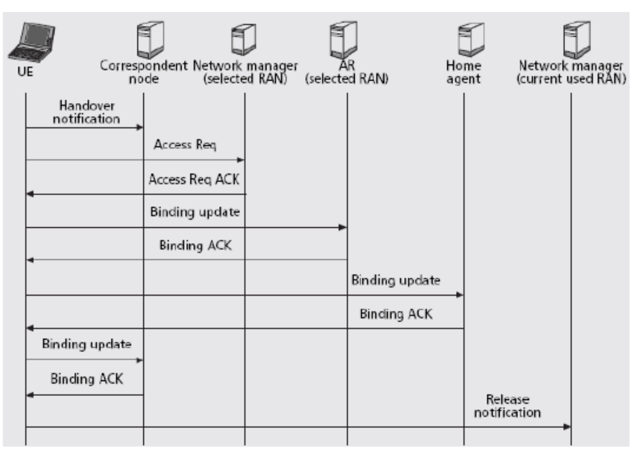

Fig.4. Message Binding

F. Handover Prediction and Execution

Two BS are considered in our proposed approach, one is old BS (OBS) where the call generates and other is new BS (NBS), next destination of the MN. When the MN tends to move out the coverage area of OBS it needs handoff with NBS to continue the call.

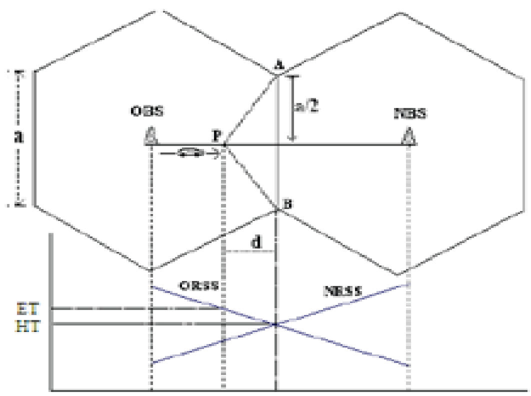

Fig.5. Handoff management

EaT (Exit Threshold) = the threshold value of the RSS to initiate the handoff process. When the RSS of OBS drops below, the MN starts the registration procedures for handoff to new BS (NBS).

HT (Handoff threshold) = the minimum value of RSS required for successful communication between the MN and OBS.

a = cell size.

d= threshold distance from cell (OBS) boundary

From the Fig.5., the time before vertical handover is determined as follows. The time during which, the connection would be terminated and would cause packet loss. To avoid this, time before handover is calculated.

$$TBHO = \frac{\sqrt{\left(\left(\frac{a}{2}\right)^2 + d^2\right)}}{v_m} \quad (9)$$

When the handoff delay is less than TBHO, the buffer is triggered the gateway between the different network.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

An ISO 3297: 2007 Certified Organization Vol. 3, Special Issue 3, April 2014

International Conference on Signal Processing, Embedded System and Communication Technologies and their applications for Sustainable and Renewable Energy (ICSECSRE '14)

Organized by

Department of ECE, Aarupadai Veedu Institute of Technology, Vinayaka Missions University,

Paiyanoor-603 104, Tamil Nadu, India

III. RESULT AND PERFORMANCE ANALYSIS

The results to provide the seamless flow of information in a practical context that addresses the integrating of WiMAX and Wi-Fi access networks are considered. In order to implement the different functions listed earlier, some initial technological choices need to be made. Intra technology handoffs are taken care of by technology-specific mechanisms. Then Mobile IP has been chosen as the L3 protocol for handoff execution in the proof of concept and is used on top of either IPv4 or IPv6 in order to provide session continuity during inter technology handoff. A clear separation of handoff decision and execution processes allows any evolution of IP protocols to minimize new care-of address configuration and rerouting latencies, for instance, to replace baseline Mobile IP without modifying the proposed architecture.

Our simulation scenario first assumes that the coverage area of Wi-Fi is overlapped by WiMAX and is implemented in OmNet++. The multi-mode mobile, starts moving towards WiMAX and then towards Wi-Fi and stops there. We assume that the input parameters required for best access network selection algorithm are acquired from the network and mobile terminal.

Table 2 Mobile Node moves from WiMAX to Wi-Fi

	RSS	BW	V	NSF
WiMAX	0	0.6	0.2	0.339
Wi-Fi	0.8	0.6	0.3	0.673
Weight	0.33	0.231	0.174	

When the mobile node moves from WiMAX to Wi-Fi, the network selection module in the mobile terminal acquires the input parameters and normalized values of these parameters are determined. Then network selection function value is computed for the available networks. Due to complexity reasons, we have directly considered the normalized values of the parameters. The NSF computation for all the networks is as shown in Table 2.

Table 3 Mobile node moves from Wi-Fi to WiMAX

	RSS	BW	V	NSF
Wi-Fi	0	0.6	0.2	0.314
WiMAX	0.8	0.6	0.5	0.646
Weight	0.33	0.231	0.174	

When the mobile node moves from Wi-Fi to WiMAX, the network selection module in the mobile terminal acquires the input parameters and normalized values of these parameters are determined. Then network selection function value is computed for the available networks. Due to complexity reasons, we have directly considered the normalized values of the parameters. The NSF computation for all the networks is as shown in Table 3. The graph plotted between Movement of the mobile node and NSF value of each network is shown in fig. 6.

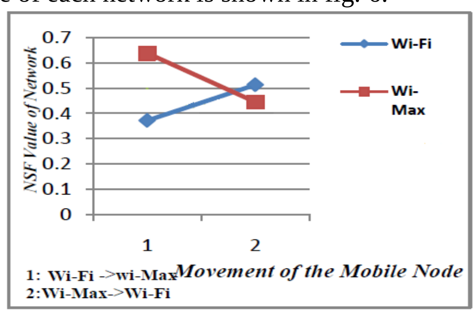

Fig.6. Movement of the mobile node Vs. NSF values

III. CONCLUSION AND FUTURE WORK

In this paper we presented a Best network selection algorithm based on Fuzzy Multiple Criteria Decision making that calculates the quantitative value of each normalized parameter and finds the weight of each quantitative value. This weight vector together with normalized parameter values are used to evaluate Network Selection Function of the available networks. The network with highest NSF is selected as the target network. Since the algorithm is taking mobility parameters like speed of the mobile into account, it supports seamless mobility and reduces unnecessary handoffs. Further the performance of the algorithm can be improved by taking considering a threshold on the NSF value in order to prevent frequent handoffs.

REFERENCES

[1] C. Perkins and D. Johnson, "Route optimization in mobile IP" Internet Draft, Internet Engineering Task Force, Feb. 1999.

[2] Elin Wedlund, Henning Schulzrinne, "Mobility Support using SIP" *IEEE Communications Magazine*, vol. 33, June 2001.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

An ISO 3297: 2007 Certified Organization *Vol. 3, Special Issue 3, April 2014*

International Conference on Signal Processing, Embedded System and Communication Technologies and their applications for Sustainable and Renewable Energy (ICSECSRE '14)

Organized by

Department of ECE, Aarupadai Veedu Institute of Technology, Vinayaka Missions University,

Paiyanoor-603 104, Tamil Nadu, India

[3] Adiline Macriga, T., P. Anandha Kumar, "Mobility Management for Seamless Flow of Information in Wireless Networks", European Journal of Scientific Research, pp.147-155, 2011

[4] Chen Yiping and Yang Yuhang , " A new 4g architecture providing multimode terminals always best connected services", IEEE Wireless Communications , April 2007

[5] Dong Ma and Maode Ma, "A QoS Oriented Vertical Handoff Scheme for WiMAX/WLAN Overlay Networks", IEEE Transactions, April 2012.

[6] IEEE 802.11 WG, IEEE Standard for Local and Metropolitan Area networks; Part 11: Wireless LAN Medium Access Control and Physical Layer Specifications, IEEE Std. 802.11-2007, Feb. 2007

[7] IEEE 802.16 WG, IEEE Standard for Local and Metropolitan Area Networks; Part 16: Air Interface for Fixed Broadband Wireless Access Systems, IEEE Std. 802.16e, Dec. 2005

[8] Archan Misra, Abhishek Roy and Sajal K. Das, "Information-Theory Based Optimal Location Management Schemes for Integrated Multi-System Wireless Networks", IEEE/ACM Transactions on Networking, Vol. 16, No. 3, pp. 1426-1440, 2008.

[9] Daniel Morris and A. Hamid Aghvami, "Location Management Strategies for Cellular Overlay Networks—A Signaling Cost Analysis", IEEE Transactions on Broadcasting, Vol. 53, No. 2, Pp. 126 -139, 2007.

[10] Di-Wei Huang, Phone Lin and Chai-Hien Gan, "Design and Performance Study for a Mobility Management Mechanism (WMM) Using Location Cache for Wireless Mesh Networks", IEEE Transactions on Mobile Computing, Vol. 7, Pp. 546-556, 2008.

[11] Dusit Niyato, and Ekram Hossain, "A Non-cooperative Game-Theoretic Framework for Radio Resource Management in 4G Heterogeneous Wireless Access Networks", IEEE Transactions on Mobile Computing, Vol. 7, No. 3, pp. 332-345, 2008.

[12] Fei Yu, and Vikram Krishnamurthy, "Optimal Joint Session Admission Control in integrated WLAN and CDMA Cellular Networks with Vertical Handoff", IEEE Transaction on Mobile Computing, Vol 6, No. 1, pp. 126 -139, 2007.

[13] Haining Chen, Hongyi Wu, Sundara Kumar and Nian-Feng Tzeng, "Minimum-Cost Data Delivery in Heterogeneous Wireless Networks", IEEE Transactions on Vehicular Technology, Vol. 56, No. 6, pp. 36–47, 2007.

[14] Jaroslav Holis and Pavel Pechac," Elevation Dependent Shadowing Model for Mobile Communications via High Altitude Platforms in Built-Up Areas", IEEE Transactions on Antennas and Propagation, Vol. 56, No. 4, pp. 1078-1084, 2008.

[15] Mohammed M. Olama, Seddik M. Djouadi, Ioannis G. Papageorgiou, and Charalambos D.Charalambous, ―Position and Velocity Tracking in Mobile Networks Using Particle and Kalman Filtering With Comparison‖, IEEE Transactions On Vehicular Technology, Vol. 57, No. 2, pp. 1001-1010, 2008.