Volume 1, No. 5, December 2010
Journal of Global Research in Computer Science
ISSN-2229-371X
RESEARCH PAPER
Available Online at www.jgrcs.info

VERTICAL HANDOFF DECISION SCHEMES IN HETEROGENEOUS WIRELESS NETWORK USING MADM

K.Savitha*[1] and Dr.C.Chandrasekar[2]

[1] Research Scholar, Department of Computer Science,
Periyar University, Salem, Tamil Nadu, India
ksavi_tha@yahoo.com
[2]Associate Professor, Department of Computer Science,
Periyar University, Salem, Tamil Nadu, India

Abstract: The most challenged one in Fourth generation wireless networks is service continuity in heterogeneous wireless access technology. For continuous service, HANDOFF technique is used as the main key to switch from one network to another network. Vertical handoff with processing delay was used for service continuity. In this paper, we compared the three schemes, centralized vertical handoff decision (C-VHD), Distributed vertical handoff decision (D-VHD) and Trusted Distributed vertical handoff decision (T-DVHD). The result of the simulation shows that T-DVHD is the best schemes to provide seamless vertical handoff in terms of processing delay, end-end delay and throughput.

Keywords: Vertical HANDOFF technique, V-VHD, D-VHD, T-VHD.

INTRODUCTION

Future generation wireless networks (FGWN) are expected to support heterogeneous access technologies than homogeneous wireless networks. In FGWN, heterogeneous network is managed by different operators like WiMax,WiFi etc., with objective to exploit the high data rates. In this Heterogeneous wireless network (HWN) environment, always best connected (ABC) [2] which requires dynamic selection of the best network and access technologies when multiple options are available simultaneously.

The typical scenario of Wifi and WiMax are: WiFi with high bandwidth, low-cost and short coverage and WiMax with high-speed mobile, fixed internet access to the end users, it provides services for data, voice and video. In this paper, these wireless technologies are used to provide wireless access for mobile terminals with multiple network interfaces

Mobility is one important issue in FGWN, when a mobile user is switch from one network to another network or base station to BS there a mechanism is used “Handover”.

Handover is used to redirect the mobile user service from current network to a new one, here handoff processing delay to select the suitable network must be as small as possible to make seamless handover show in Fig. 1

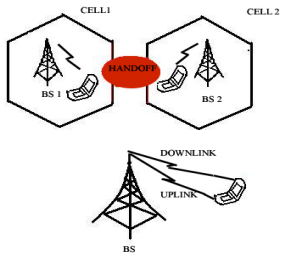

Figure 1 Handoff

Handoff can be classified into horizontal (intra-system) and Vertical (inter-system) cases. As in Fig 2.When the mobile users switching between the networks with the same technology (Wimax to WiMax) this process called horizontal handoff (HHO). In vertical handoff (VHO), the mobile users switching in different networks which have different technology (WiMax to WiFi). So in heterogeneous network vertical handoff decision (VHD) is mainly used for continuous service [15].

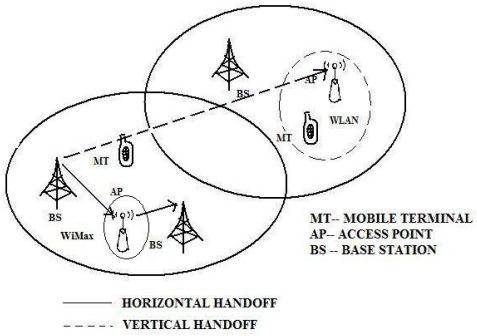

Figure 2 Vertical and Horizontal Handoff

There are four phases in handover mechanism: Handover Initiation, System discovery, Handover decision, and Handoff execution.

- Han doff Initiation phase: The handover process was modified by some criteria value like signal strength, link quality etc.,
- System discovery phase: It is used to decide which mobile user discovers its neighbour network and exchanges information about Quality of Service (QOS) offered by these networks.
- Handover Decision phase: This phase compares the neighbour network QOS and the mobile users QOS with this QOS decision maker makes the decision

to which network the mobile user has to direct the connection.

- Handoff Execution phase: This phase is responsible for establishing the connection and release the connections and as well as the invocation of security service.

In our work handover decision phase is used by the decision maker to choose from a set of available visited networks, suitable visited network will redirects its connection to the mobile user. Handoff execution phase is also used to connect the target-visited network (TVN).

In this paper, we compared two vertical handoff decision schemes D-VHD and T-DVHD, which uses the Multiple Attribute Decision making (MADM) method, Simple Additive Weighting (SAW) in a distributed manner and dropping probability, the bandwidth, delay and energy of the node as handoff parameters to make the decision. The 'best' network is selected using a network selection function (NSF) with handoff parameters.

VERTICAL HANDOFF DECISION SCHEMES

In our work, we have been going to compare the centralized vertical handoff decision (C-VHD), Distributed vertical handoff decision (D-VHD), and Trusted - Distributed vertical handoff decision (T-DVHD) these schemes are used to reduce the processing delay. Processing delay was caused by exchanging the information between mobile node and neighbour networks. To distribute the processing task, the vertical handoff decision is formulated as MADM problem. There are several algorithms are used [1]. In our work simple additive weighting (SAW) method is used in distributed manner.

Centralized Vertical Handoff Decision (C-VHD)

In this scheme a Mobile Node (MN) exchanged the information message between the MN and the Neighbour networks. When exchanged has done major effects has processed at MN and it increases the processing delay. When processing delay had increased overall handover delay and power consumption increase. To avoid this causes by the C-VHD, Distributed Vertical handoff decision (D-VHD) schemes was proposed in [7][8].

Distributed Vertical Handoff Decision (D-VHD)

The D-VHD scheme is used to decrease the processing delay than the C-VHD scheme. When a MN is exchanging the message to neighbour network processing delay happened, thus, D-VHD handles the handoff calculation to the target visited network (TVN). TVN is nothing but the network to which the mobile node may connect. TVN is calculated rather than the mobile node as some approaches proposed. D-VHD also takes into account: Jitter, Packet Loss and cost as evaluation metrics to select a suitable visited network (VN). These metrics are gathered as an MADM access selection function. Distributed network selection consists of following steps:

a) Network Selection Function (NSF):

NSF have used to evaluate from set of network using multiple criteria, the network selection decision process has denoted as MADM problem. There are several parameters used to calculate NSF. The above - mentioned parameters are used to calculate NSF. These parameters measure the Network Quality Value (NQV) of each TVN. The highest NQV value of TVN will be selected as Visited Network (VN) by the mobile node. The generic weighted NSF is defined by (1):

$$NQV_i = \sum_{i=1,j=1}^{N,n_p^+} W_j * P_{ij} \qquad (1)$$

Where, NQV_i represents the quality of i^{th} TVN. W_j is the weight of the P_{ij}, P_{ij} represents the j^{th} parameter of the i^{th} TVN. N is the number of TVNS. While n_p^+ is the number of parameters.

The HN, based on the user service profile, handoff decision parameters have assigned different "Weights" to determine the level of importance of each parameter. In equation (2), the sum of these weights must be equal to one.

$$\sum_{j=1}^{n_p^+} W_j = 1 \qquad (2)$$

As stated before, in our work we use some parameters, so the evaluation NSF is as follows in the equation (3)

$$NQV_i = (W_j * J_i) + (W_{PL} * PL_i) + (W_C * C_i)$$

Where J_i is the Jitter of i^{th} TVN, PL_i is the packet loss of the i^{th} TVN and C_i is the cost of the service of the i^{th} TVN.

1. Distributed Decision scheme:

The DVHD scheme is based on SAW method in distributed manner DVHD allows the Mobile Node to choose the "best" TVN to connect.

- Once the handoff request is done by the potential VNs, which identified by the mobile terminal, it broadcasts a handoff request message. The request message includes the terminal required handoff metrics with their respective weights.
- The handoff decision metrics calculation is performed on the VNs, each VN applies the SAW method using "(1)" on the required (J_{req}, PL_{req}, C_{req}) and offered (J_{off}, PL_{off}, C_{off}) parameters in (4)

$$NQV = \begin{bmatrix} J_{off} & PL_{off} & C_{off} \\ J_{req} & PL_{req} & C_{req} \end{bmatrix} * \begin{bmatrix} W_j & W_{PL} & W_C \end{bmatrix} \qquad (4)$$

- Finally, the mobile node compare the NQV_i metrics and from that it will pick the highest NQV value TVN's and consider it as the VN for the mobile node.
- *Trusted Distributed Vertical Handoff Decision (T-DVHD)*
- The extension work of the DVHD scheme is T-DVHD scheme. The scheme is mainly introduced[10] for decreasing the processing delay than DVHD scheme.
- The T-DVHD was proposed for purpose of exchanging trust information between network and mobile node is an important factor which

guarantees a trusted handoff decision and to avoid the unnecessary handoff events.

- The T-DVHD have the following steps:
- The handoff initiation done, then the mobile node sends the reference to each TVN, and applies the SAW decision method to compute the NQV, then each TVN sends its NQV to the Mobile node, which group them in a list and compares the NQV_i "(3)" and it picks up the highest NQV from the received list and the trusted process is initiated.
- The trusted process consists of two function: LOT (Level Of Trust) test function [10] and trust-test function.
- LOT –test function is initiated and the algorithm as follows
- 01 If LoTi >= threshold02 Connect to the TVNi03 Initiate Trust-test function04 else if LoTi < threshold {05 if (suitable-TVN available)06 i = i + 107 Goto 01 (test another network)08 else if (no suitable-TVN) OR HD >Max_HD09 Handoff blocked
- The Trusted test function test the mobile node executes the connected VN to accommodate knowledge about the neighbour TVNs. If the test is positive the mobile node redirects its connection to the chosen visited network. If the test is negative the mobile node picks up another available TVN and executes trusted test function for this network.

RESULT AND DISCUSSION

In Fig.3 we have explained, a cell covered by the area with WiMax technology and another cell covered by both technologies Wifi and WiMax. There a mobile node runs with a VoIP application. Now the mobile node intends to connect the appropriate visited network with the decision process.

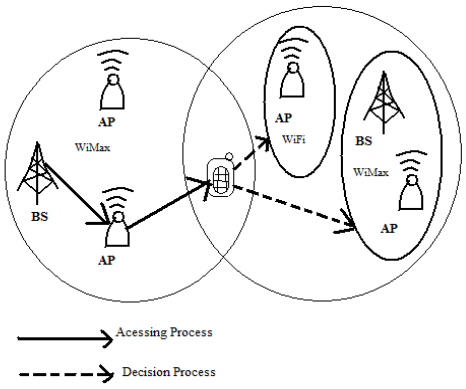

Figure 3 Scenarios

SIMULATION

In this section, the comparison of vertical handoff decision scheme, we provide the evaluation parameters used to analyze the performance of the CVHD, DVHD and T-DVHD schemes as well as the output of simulation. In our simulation we consider two mobile nodes are moving in an area covered by the heterogeneous wireless networks managed by Base stations (BS_i=1,2). Mobility area covered by access point, supporting two types of technologies: WiMax and WiFi. These access points offer different characteristic in terms of coverage and QOS [Jitter, Packet loss]. VoIP is used as application in this simulation.

Table I: Table for simulation metrics

Topography	1000 * 1000
Mobile Node	10 nodes
Base Station	2
Access points	4
Routing Protocol	AODV
Packet Size	500 kb
Simulation time(s)	500
Wireless Standards	802.16,802.11

Evaluation parameters

There are different evaluation parameters are used, in order to evaluate our schemes. We have used: Decision Processing Delay, Throughput and End – End delay.

- Processing Delay: It is a process which takes time by the terminal for making the decision towards which network to handoff for network to handoff
- Throughput: It is measured by the data are sent by the mobile node after a set of matching decision during a defined period.
- End to End Delay:It refers the time taken for a packet to be transmitted across a network from source to destination

A. Simulation Analysis

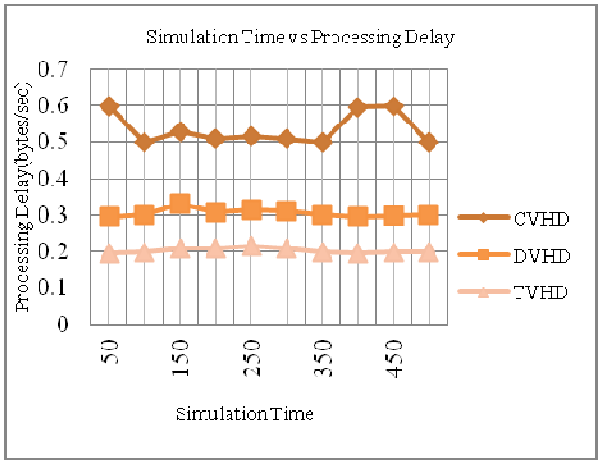

Figure 4 Handoff Processing Delay

Figure 4 Explains that the processing delay between the three schemes of VHD. From the graph it shows T-VHD have less processing delay between the packets. The processing delay time is taken in seconds. Comparing with other two scheme T-VHD shows the best processing delay

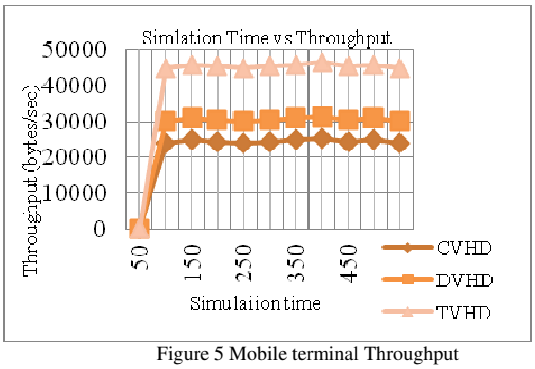

Figure 5 Mobile terminal Throughput

Fig.5 Explains that Throughput of the three schemes in that it also shows that T-VHD have the high Throughput.

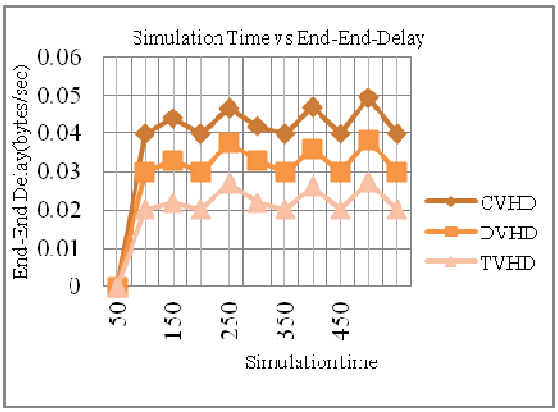

Figure 6 End – End delay

Figure 6 explains that End-to-End delay between the node and destination access point with required QOS service.

CONCLUSION

In our work, we have compared the three schemes of vertical handoff decision in the literature for the heterogeneous wireless network. The main observation of these schemes to reduce the processing delay and a trust handoff decision in a heterogeneous wireless network. Still there are some false decision are taken by the mobile node to select the visited network. Our main goal to improve the decision algorithm for vertical handoff decision for heterogeneous wireless network.

REFERENCES

[1] E.Steven-Navarro and V.W.S.Wong, "Comparison between Vertical Handoff DecisionAlgorithms for Heterogeneous Wireless Networks", IEEE VTC, pp. 947-951, May 2006.

[2] E.Gustafsson and Annika Jonsson, "Always Best Connected", IEEE Wireless Communications, Vol.10, pp. 49-55, Feb 2003.

[3] E.Steven-Navarro, V.W.S. Wong and Yuxia Lin, " A Vertical Handoff Decision Algorithm For Heterogeneous Wireless Networks.", IEEE WCNC, pp. 3199-3204, Mar 2007.

[4] N.D.Tripathi, J.H.Reed and H.F.VanLandinoham, " Handoff In Cellular Systems", IEEE Personal Communications, Vol. 5, pp.26-37, Dec 1998.

[5] Wenhui Zhang ," Handover Decision Using Fuzzy MADM In Heterogeneous Networks", IEEE WCNC, Vol.2, pp. 653-658, Mar 2004.

[6] A.Hasswa, N.Nasser and H.Hassanein, " Generic Vertical Handoff Decision Function For Heterogeneous Wireless", WOCN, second IFIP International conference, pp. 239-243, Mar 2005.

[7] R.Tawil, G.Pujolle and O.Salazar, " A Vertical Handoff Decision Schemes In Heterogeneous Wireless Systems", IEEE VTC, pp. 2626-2630, May 2008.

[8] R.Tawil, J.Demerjain, G.Pujolle And O.Salazar, " Processing-Delay Reduction During The Vertical Handoff Decision In Heterogeneous Wireless System", IEEE AICCSA, pp.381-385, April 2008.

[9] LIU yu, Ye Min-hue and ZHANG Hui-min, "The Handoff Schemes in mobile IP", IEEE-VTC, pp. 485-489, Apr 2003

[10] R.Tawil, J.Demerjain and G.Pujolle, " A Trusted Handoff Decision Scheme For The Next Generation Wireless Networks", IJCSNS, Vol.8, pp.174-182, June 2008.

[11] R.Tawil, G.Pujolle and O.Salazar, " Vertical Handoff Decision Schemes For The Next Generation Wireless Networks", IEEE-WCNC, pp. 2789-2792, Apr 2008.

[12] R.Tawil, G.Pujolle and J.Demerjain, " Distributed Handoff Decision Scheme Using MIH Function For The Fourth Generation Wireless Networks", ICTTA, pp. 1-6, Apr 2008.

[13] A.Dvir, R.Giladi, I.Kitroser and M.Segal, "Efficient Decision Handoff Mechanism For Heterogeneous Networks", IJWMN, Vol.2, Feb 2010.

[14] Lusheng Wang and David Binet, " MADM- Based Network Selection In Heterogeneous Wireless Networks: A Simulation Study", IEEE VITAE, pp. 559-564, May 2009.

[15] N.Nasser, A.Hasswa and H.Hassanein, " Handoff In Fourth Generation Heterogeneous Networks", IEEE communication Magazine, Vol.44, pp. 96-103, Oct 2006.

AUTHORS

Mrs.K.Savitha received the Master of Science from the Bharathiar University, India in 2006, M.Phil Degree from periyar university, India in 2007. She is a Research Scholar in Department of computer science , Periyar University, Salem, India. She is Pursing her Ph.D in Mobile computing. Her research area interest includes Networking, Multimedia.

Dr. C. Chandrasekar received his Ph.D. degree

from Periyar University, Salem. He has been working as Associate Professor at Dept. of Computer Science, Periyar University, Salem – 636 011, Tamil Nadu, India. His research interest includes Wireless networking, Mobile computing, Computer Communication and Networks. He was a Research guide at various universities in India. He has been published more than 50 technical papers at various National/ International Conference and Journals.