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Thesis Title: Mobile WiMAX Handovers Control

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RESEARCH PROPOSAL FOR MS DEGREE PROGRAMME

MOBILE WIMAX HANDOVERS CONTROL

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Abstract

Mobile WiMAX supports high bandwidth and numerous applications such as interactive media, video streaming, voice over IP and so on, making WiMAX one of the major broadband innovations. In any case, adaptation is the key problem in Mobile WiMAX. Several end-to-end WiMAX transition strategies for final subscriber which move freely within the Network of WiMAX beyond loss of data are presented in IEEE 802.16e 2005. For the whole WiMAX architecture, different handoff methods at IP layer, like Access Service Network (ASN) mobility are define by WiMAX Network Working Group (NWG).

The focus of this thesis is the discussion of Different types of handoff schemes in mobile WiMAX. For the simulation purpose, OPNET Network simulator will be used which is very powerful simulation tool. The three MAC-layer Handoff procedures i.e., FBSS & MDHO and the basic relationship between the steps that are characterized in IEEE 802.16-2009 will be simulated using OPNET. During each handoff mechanism, same MAC messages format will be used but with different parameters settings for each cell. At network level, Access Service Network handoff will be simulated by considering various delivery parameters, such as handoff delay, throughput, Serving Base Station (parameter missing here) and Jitter. The performance of the three handoff mechanisms will be compared based on throughput, delay and jitter. Between the three (HHO, FBSS & FBSS) the simulation results show that the best handoff scheme at MAC layer is the Fast-Base Switching Station (FBSS).

Introduction

Due to the advancement in telecommunications in past one decade our lives have been totally transformed. Wireless connection has been quickly urbanized as an infamous novelty that gives connectivity around half the population on Earth. Because of quick raise of the web, it

is the demand of time to have higher-speed-web internet broadband. DSL which gives broadband services has a speed of couple of megabits/sec. Alone in America, more than 50 million individuals utilize broadband which is lingering considerably by utilizing remote broadband modernization. To overcome the demand of high data speed broadband, the answer is WiMAX. The alternate technology that will replace DSL in the coming years is WiMAX [1]. There are two types of WiMAX communication i.e., conventional/fixed WiMAX that uses IEEE 802.16.2004 & Mobile WiMAX that uses IEEE 802.16.2005e. In fixed WiMAX, there is no mobility but still uses radio resources to commune between BS and MS. As compared with fixed WiMAX, mobile WiMAX is more reliable and faster by providing more speed for browsing, streaming, tele-conferencing, multi-player online gaming, live TV channels and audios. This new technology provides high speed mobile station based on IP which is more secure and will be the main ingredient for the 4^{th} and 5^{th} Generation of mobile Internet. To provide smoother mobile WiMAX mobility, IEEE 802.16e-2005 provides three types of handoff mechanisms: Hard Handoff (HH), Micro Diversity Handoff (MDHO) and Fast Base Switching Station (FBSS). Hard Handoff is mandatory, however, to improve the performance, MDHO and FBSS can also be used. The edge of WiMAX technology over current technology in the market is that WiMAX has the lowest delay and disturbance during handoff. Comparison of different Handoff mechanisms will be the focus of this thesis to evaluate their effect on mobile WiMAX and to study the effect of messages exchanged by different MAC layers during different Handoff mechanisms. End-to-End WiMAX Engineering is not defined by IEEE 802.16e-2005 which was then stated by Network Working Group. Hence it is meaningful to examine the reaction of Handoff at IP layer.

Literature Review

IEEE 802.16 was formed by group of friends in 1998 [2] so that they can make rules and regulations for Wi-Fi communication. The main purpose was to make or build Line-of-Sight (LOS) base P-2M (Point-to-Multi) point WBS (Wi-Fi Broadband Scheme) and it will serve in frequency range of 10GHx to 66GHz wave band. The first step to make this venture possible was in December 2001 [2]. The 1^{st} original standard was IEEE 808.16 based on TDMA (Time Division Multiplexing) MAC (Media Access Control) layer [2]. It operated on single carrier Physical Layer (PHY) [2].

After IEEE 802.16 the group added IEEE 802.16A so that they cover NLOS (Non-Line of Sight) and frequency used was 2 to 11GHz OFDM (Orthogonal Frequency Division) band

and OFDM support some addition to MAC layers [3]. In 2004 the previous standards were merged into one final redefined standard IEEE 802.16-2004. IEEE 802.16-2004 only supports fixed applications and hence called WiMAX [4].

To support mobility, current standard was redefined into IEEE 802.16-2005 that supported mobility and known as Mobile WiMAX and provided solutions or services to Fixed (Nomadic) and Mobile Applications.

Aims and Objectives/Proposed Solutions

In this thesis, different Handoff mechanisms will be compared to evaluate their effect on mobile WiMAX and to study the effect of messages exchanged by different MAC layers during different Handoff mechanisms. End-to-End WiMAX Engineering is not defined by IEEE 802.16e-2005 which was then stated by Network Working Group. Hence it is meaningful to examine the reaction of Handoff at IP layer. All the scenarios will be simulated using OPNET simulation tool.

- The contributions of this research thesis are summarized as follows: In depth study of Mobile WiMAX for better understaning.
- Detail analysis of numerous Handoff systems including MAC layer of Mobile WiMAX.
- Simulation of various handover schemes based on various handover parameters like, serving BS, deferral, and jitter and so on.
- Performance comparison of the handover schemes will be performed to identify the best handover scheme.

Methodology

In this thesis I use OPNET as my simulation tool so that I can simulate the different Handover schemes and find out which one is more efficient and with less handover delay. The HHO, MDHO and FBSS conditions are expected for handoff at the MAC level, while for WiMAX, ASN binding is passed through end-to-end.

My focus was on three MAC layer handoff procedures (HHO, FBSS & MDHO). At network level of OPNET, Access Service Network handoff is also simulated by considering various delivery parameters, such as handoff delay, throughput, Serving Base Station and Jitter.

Between the three (HHO, FBSS & FBSS) the simulation results show that the best handoff scheme at MAC layer is the **Fast-Base Switching Station (FBSS)**. The simulation results of Access Service Network (ASN) mobility gives us the average handoff delay of around 145MS, which is under the recommended delay range of 150MS fixed in WiMAX forum for Voice Over IP (VoIP). During handoff operation the output of voice traffic shows great improved results, but the delay increases a bit when Mobile Station (MS) switch to other Base Station (BS) but still remain under the limit of 150MS (recommended).

Conclusion

This chapter has introduced handover association of Mobile WiMAX at both layer 2 and layer 3 of wireless networks institutionalized by IEEE 802.16-2009. The experiment results of Handoff system for Layer 2 that Hard handover has the most efficiently bandwidth but the cost of more Handoff Delay. On the other hand, Macro Diversity Handover gives reliable convertibility to end customers, but it requires more information exchange. That is why MDHO is not sufficiently utilizing the bandwidth. The result shows that Fast Base Station Switching method is best suitable for both efficiently utilizing bandwidth as well as having very less handover delay. In case of Access Service Network, it has very less handover delay when Mobile Station is moving within the premises of a base station while handover delay increases when Mobile Station moves across base station.

Recommendations

- To minimize the packet loss and handover delay Mobile WiMAX need to be improved so that the packet loss, handover delay and jitter should be removed or at least minimized.
- This project can be upgraded by utilizing heterogeneous handover, for example, WiMAX-UMTS, WiMAX – Satellite and so on supplanting WiMAX homogenous by actualizing MFH (media free handover) handover conspire which is one of the key issues for 4G.
- For the initial three situations in which the handover techniques and the MAC messages amid handover are customized in OPNET by utilizing the static connections

rather than wireless. Subsequently, by utilizing wireless connections will break down these situations in more extent/depth.

- For WiMAX ASN architecture, it is highly recommended to use IPv4 instead of IPv6 for more better analyzing.
- A portion of the equipment's like BS or MS which are intended for the simulation of this thesis can be coordinated with different activities worked in models because of their nonspecific nature.
- As of now ASN anchor mobility is only practiced for voice traffic, so in future it can be used for video traffic as well for more reliable communication without any handover delay or jitter etc.

References

[1] Parvizyegani, 2005, WiMAX Overview (accessed on 5th, 11thmarch 2010) http://www.ietf.org/proceedings/64/slides/16ng-4.pdf

[2] J. G. Andrews, A. Ghost, and R. Mohamed, Fundamentals of WiMAX: understanding broadband wireless networking, Upper saddle River, N.J.; London: Prentice Hall, 2007

[3] WiMAX – A Study of mobility and a MAC-layer implementation, http://www.cs.umu.se/education/examina/Rapporter/CarlbergDammander.pdf. [Accessed June 2010]

[4] Claudio Cicconetti, Luciano Lenzini, and Enzo Mingozzi, University of Pisa
Carl Eklund, Nokia Research Center; Quality of service support in IEEE 802.16 networks

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