

**Deanship of Graduate Studies
Al-Quds University**



**STUDY OF FACTORS AFFECTING HANDOFF
PROCESS IN WIMAX NETWORK**

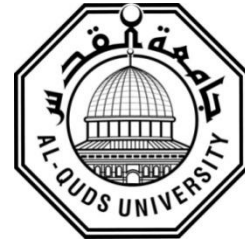
Mahmoud Saleh Obaid

M.Sc. Thesis

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**A thesis submitted in partial fulfilment of the
requirements for the Master degree of Electronic and
Computer Engineering/Al-Quds University
/Faculty of Engineering**

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Al-Quds University
Faculty of Engineering
Master of Electronics and Computer Engineering

Thesis Approval

**STUDY OF FACTORS AFFECTING HANDOFF
PROCESS IN WIMAX NETWORK**

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Declaration:

I certify that this thesis submitted for the degree of Master, is the result of my own research, except where otherwise acknowledged, and that this study (or any part of the same) has not been submitted for a higher degree to any other university or institution.

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Mahmoud Saleh Obaid

Date:

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First, I would like to thank almighty ALLAH for finally finishing the writing of this thesis for my Master's degree in Electronic and Computer Engineering, despite all the difficulties and the unstable situation in Palestine as a result of the Israeli occupation and travel restrictions.

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Abstract

The world has become a very fast technology consumer in the last decade. In particular, the broadband access technology has a great influence on the telecommunication industry. Therefore, broadband in general and especially WiMAX (Worldwide Interoperability for Microwave Access) has become the trend for all researchers to enhance the communication media, eliminate the obstacles of the Wi-Fi and 3G broadband, and reduce the cost and time rate of satellite broadband. WiMAX can make high speed wireless broadband internet services available to larger areas and it can provide a wireless connectivity range for up to 30 miles (or 50 kilometers), which is much greater than a typical Wi-Fi or DSL. It can also be interconnected with existing Wi-Fi networks.

The main goal of this work is to determine the parameters that have the greatest impact on the handoff process. Simulation experiments will be conducted that some of the parameters do not influence the handoff times at all. However, changing some of other factors, even slightly, has direct consequences. For example, link Going Down-factor, which determines the sensitivity of detecting a failing link, is considered a significant impact in the results.

We find the link going down-factor is the most important factor of the WiMAX module that influences handoff and the best value we got is **1.4**, the scan iteration is **two** iteration, inter leaving interval is **4** frames, while the time-to-searching the DL-Map is set to **5ms**.

The handoff latency, throughput and end-to-end delay are measured and the parameters of the simulator are adjusted, in order to achieve the best possible handoff times, comparing the results with the objectives set by the WiMAX Forum. The WiMAX Forum [3] says that the Mobile WiMAX supports mobility up to 72 km/h and the handoff should take less than 50ms. The results of this study show that there are some parameters which could be enhanced to reduce handoff time since it is still below the 50 ms limit up to 28 m/s (100 km/h).

Keywords: Handoff, WiMAX, 802.16.e, Mobility

المخلص:

لقد أصبح العالم في العقد الاخير مستهلك سريع للتكنولوجيا ، وخصوصا على مستوى تكنولوجيا الاتصالات ، ولما كانت تكنولوجيا النطاق العريض لديها التأثير الاكبر على صناعة الاتصالات السلكية واللاسلكية ، وعليه فان النطاق العريض وبشكل خاص ما يعرف "واي ماكس WiMAX" أصبح مقصد جميع الباحثين والعاميلن على تحسين وسائل الاتصال ، وازالة جميع المعوقات التي تواجه الواي ماكس والجيل الثالث للنطاقات العريضة ، كما يسعون لتخفيض تكلفة زمن "عملية الانتقال (Handoff)" للنطاق العريض.

يستطيع "واي ماكس" تقديم خدمات الانترنت بسرعات عالية ويمكن توفيرها لاماكن واسعة وعلى مسافات عالية يمكن ان تغطي مسافات هوائية تصل الى 30 ميل (50 كيلومتر) وهي مسافة اكبر بكثير من المسافة التي يغطيها "واي فاي (Wi-Fi)" التقليدي او "دي اس ال DSL" ، كما انه يمكن استغلال وجود هذه الخيارات من خلال عمل توافق وترابط ما بين شبكات "واي فاي" المتوفرة والموجودة وربطها مع شبكات "واي ماكس".

ان الهدف الرئيسي التي نسعى له من خلال دراستنا في هذه الرسالة والتي ستكون محور حديثنا ونتائجنا هو تحديد المتغيرات والعوامل التي سيكون لها الاثر الاكبر على "عملية الانتقال"، ومدى اهمية هذه العوامل على التقليل من الوقت اللازم ل "عملية الانتقال" لتكون في افضل حالاتها ، وبناء على النتائج التي حصلنا عليها ، استطعنا تحديد مدى اهمية كل عامل من هذه العوامل بناء على القيمة التي يجب ان يكون عليها واستخلصنا ان بعض هذه العوامل والتغيير في قيمها لا يعكس اي تأثير على "عملية الانتقال" اطلاقا ، ولكن على صعيد اخر وجدنا ان بعض التغييرات في قيم عوامل اخرى حتى ولو بشكل طفيف كان لها اثار كبير ، واستطعنا على سبيل المثال تحديد عامل مثل : link going down factor

وفي النتيجة وجدنا في تجاربنا ان هذا العامل link-going-down-factor هو اهم العوامل واكثرها تأثيرا على وحدة "واي ماكس" والتي ينعكس تأثيرها على "عملية الانتقال" وبالتالي وجدنا ان افضل قيمة يمكن لهذا العامل والتي يمكن ان تعكس افضل حالة للتحويل هي عندما تكون قيمته تماما 1.4 ، على الصعيد الاخر وجدنا ان افضل قيمة للمتغير scan_iteration هو "اطارين (2 frames)" ، كما ان متغير interleaving interval وهي فترة المغادرة والتسليم كانت افضل قيمها "4 اطارات (4 frames)" ، ومتغير البحث عن dl-map كان من المتغيرات المؤثرة وذات الاهمية على نتيجة "عملية الانتقال" والتي كان افضل قيمها هو 5 ميلي من الثانية.

ان عملية القياس لكل من "عملية الانتقال" شملت "معدل البث (throughput)" ومعدل وقت التأخير (end-to-end delay) ، بالإضافة الى تعديل المتغيرات الخاصة بالمحاكاة كما ذكر تفصيلا من اجل الوصول الى افضل قيم تخص "عملية الانتقال" ووضعنا اساس عملية المقارنة لهذه النتائج بان تكون المرجعية هي النتائج التي اعلن عنها مؤتمر "واي ماكس"، حيث ان هذا المؤتمر يعتبر كمرجعية علمية وعملية في العالم بما يخص "واي ماكس"، وقد نشر نتائج تفيد بان "واي ماكس" باستخدام الموبايل تدعم "عملية الانتقال" حتى سرعة 72 كم/ساعة وبالمقابل يجب ان تكون "عملية الانتقال" تقل عن 50ميلي من الثانية كحد اعلى ، وعليه كانت النتائج التي حصلنا عليها تفيد بان هناك بعض المتغيرات التي يمكن التحسين على قيمها بما يكفل التخفيض من وقت

التسليم والتحول مع الحفاظ على الحد الاعلى ليكون اقل من 50 ميللي من الثانية والذي اظهرت دراستنا انه تم المحافظة على وقت التسليم ليكون في احسن قيمة نصل اليها وهو 28 ميللي من الثانية كحد اعلى وبسرعة 100 كم/ساعة وهي قيم مهمة جدا واكثر فعالية .

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Chapter One: Introduction

1.1 Background

Several years ago WiMAX Forum developed the most modern wireless technology named WiMAX, which is a telecommunications protocol that provides fixed and fully mobile Internet access. There are many positive aspects of this technology; one of the most important is the support of a large coverage area. WiMAX provides the support of wireless connectivity with a minimum range of 30 miles. WiMAX technology also offers high speed broadband access to mobile users, which transfers data, voice, and video. In WiMAX, when a user uses a 20 MHz of bandwidth, the corresponding data rate can be up to 75 Mbps..

Broadband access technology has significant influences on the telecommunication industry. It does not only provide faster web surfing but also quicker file downloads, several multimedia applications and reliable voice communications. Until recent times, broadband users have been restricted to digital subscriber line (DSL) technology which provided broadband over twisted-pair copper wires as well as to cable modem technology which was delivered over coaxial cable. Both of these wired lines infrastructures are highly expensive and consumes time to deploy compared to the wireless technology. Another way for getting broadband access is satellite service, but it is costly and there is half a second delay between the data transmission and reception. Wireless technology also has clear advantage in rural areas and developing countries that lacks wired infrastructures for broadband services. WiMAX is a broadband wireless technology which brings broadband experience to a wireless technology. There are two different types of broadband wireless services. One is the fixed wireless broadband which is similar to the traditional fixed line broadband access technology like DSL or cable modem but using wireless as a medium of transmission. Another type is the broadband wireless, also known as mobile broadband, which has additional functionality of portability, mobility. The IEEE 802.16 family WiMAX is designed to accommodate both fixed and mobile broadband application. WiMAX promises to solve the last mile problem which refers to the expense and time needed to connect individual homes and offices to trunk route for communications. WiMAX also offer higher peak data rates and greater flexibility than 3G networks. [1] Figure 1.1 shows the different models of WiMAX.

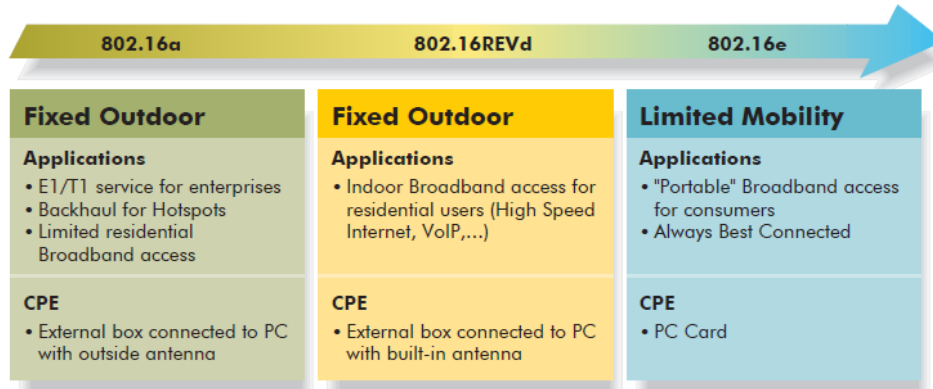


Figure 1.1: The different models of WiMAX[2]

This thesis endeavor to find out best values of some parameters for handoff in WiMAX .

The network architecture of Mobile WiMAX is defined by the WiMAX Forum [1]. The 802.16-2005 [2] is the new, mobile version of the older WiMAX specification known as 802.16-2004 [3], which is a fixed wireless data transmission scheme for providing broadband connection to metropolitan areas.

The traditional WiMAX does not support mobility which means the user is allowed to move anywhere but still the service is the issue. A moving user needs to change the serving base station i.e. a handoff, which creates demands for the Mobile WiMAX. The handoffs should be fast enough so that the ongoing video call or Voice over IP (VoIP) conversation are not interrupted, at least not for a long period of time that a user can notices it.

The communications industry is heading towards wireless data transfer with great speed and several competing technologies are emerging to replace the old ones. The traditional Wireless Local Area Network (WLAN) has gained a strong place in the market and is definitely the leader for short distance wireless networks. However, the coverage and mobility are adequate for indoor usage only. The Mobile WiMAX is planned to be independent or to extend the mobile access when a user exits in the WLAN hotspot coverage area.

WiMAX is one of the states of art broadband wireless technology that offers high speed, last mile broadband services. In this chapter, we present the evolution of WiMAX and its features.