PERFORMANCE ANALYSIS OF VIDEO TRANSMISSION OVER IEEE 802.16
ARCHITECTURE

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ABSTRACT

The worldwide interoperability for microwave access (WiMAX) technology is a certification mark for the IEEE 802.16 standard. This standard is implemented for point-to-multipoint broadband wireless access. WiMAX is a wireless WAN technology that can connect IEEE 802.11 WiFi hotspots with one another and to other parts of the Internet. WiMAX devices are capable of forming wireless connections to allow Internet packets to be carried across a network. The objectives of this paper are to study in detail the architecture of IEEE 802.16 and to simulate video transmission based on MPEG 4 and H.263 coding schemes on the 802.16 network. Specifically, the study examined various performance of Quality of Service (QoS) parameters included video packet loss (number of packet dropped), end-to-end packet delay, and throughput of several subscriber stations over rtps service flows as defined in WiMAX networks. The OPNET modeler with integrated WiMAX support has been adopted for this effort.

ABSTRAK

Keupayaan seluruh dunia bagi teknologi capaian gelombang mikro merupakan tanda pensijilan untuk piawaian IEEE 802.16. Piawaian ini dilaksanakan bagi capaian jalur lebar aplikasi tanpa wayar untuk penghantaran dari satu lokasi ke multilokasi. WiMAX merupakan aplikasi tanpa wayar bagi teknologi WAN yang bersambung antara satu sama lain dengan 'IEEE 802.11 WiFi Hotspots' dan juga mana-mana bahagian dalam internet. Peranti WiMAX merupakan pelengkap sambungan untuk membenarkan paket internet dibawa sepanjang rangkaian. Objektif projek ini adalah untuk membuat kajian lebih mendalam tentang senibina IEEE 802.16 dan juga untuk membuat simulasi bagi penghantaran video berdasarkan MPEG-4 dan H.263 kod dalam rangkaian perhubungan IEEE 802.16. Selain itu, projek ini juga adalah untuk mengkaji prestasi pelbagai parameter Servis Kualiti (Quality of service), termasuk kehilangan paket (packet loss), kelewatan pada hujung penghantaran paket (end-to-end delay) dan juga kadar terus penghantaran data (throughput) pada sebahagian stesen pengguna melalui aliran servis rtPS yang ada dalam rangkaian WiMAX. Perisian 'OPNET Modeler' digunakan untuk membuat simulasi.

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LIST OF ABBREVIATION

BE   -   Best Effort

DES   -   Discrete Event Simulation

IEEE   -   Institute of Electrical and Electronics Engineers

MPEG   -   Moving Pictures Expert Group

NLoS   -   Non-line-of-sight

nrtPS   -   Non-Real-Time Polling Service

OPNET   -   Optimized Network Engineering Tools

QoS   -   Quality of Service

rtPS   -   Real-Time Polling Service

UGS   -   Unsolicited Grant Service

VoIP   -   Voice over Internet Protocol

WAN   -   Wide Area Network

WiMAX   -   Worlwide Interoperability for Microwave Access

CHAPTER I

INTRODUCTION

1.1   Project Background

As the growth of Broadband Wireless Access (BWA) increases it needs to keep up with the need of different service requirements of different subscribers. Video conferencing, VoIP, online gaming and other is nowadays becoming the most common reed of most of the subscribers. Varity applications such as video streaming, large audio needs guaranteed bandwidth and delay requirements. To meet up all the needs of the subscribers the broadband wireless industry is currently adapting WiMAX as the standard for broadband wireless internet access.

The WiMAX (Worldwide Interoperability for Microwave Access) is based on IEEE 802.16 wireless Metropolitan Area Network standard which focuses on solving the problems associated with point-to-multipoint broadband outdoor wireless network. WiMAX networks prove to be a much more efficient method in NLOS (non-line-of-sight) environments compared to fixed link DSL or cable systems which are more expensive to install. The 802.16 standard involves numerous innovative features enabling high traffic rates, bounded delays, flexible and scalable system architecture, which makes it commercially attractive for various broadband wireless services.

This project were conduct to studies in details the architecture of IEEE 802.16 and to simulate video transmission based on MPEG 4 or H.263 coding schemes on the 802.16 network by using the OPNET software. Then the performance of the network were analyze based on Quality of Service parameters.

1.2   Problems Statement

Nowadays, we all were pretty familiar with the benefits and shortcomings of Wi-Fi. The benefit side is cheap, easy, and fast enough for most home networking needs. But, with all this benefit, there are some limitations that need to be take action. Security and interference are the main issues with current Wi-Fi standards, as well as its inability to reliably stream high definition audio and video.

Unlike Wi-Fi, WiMAX has its basic fundamental requirements of data reliability, data integrity, data security, data availability to deliver the best multimedia content. WiMAX is a protocol that allows faster bandwidth use with less interference and through WiMAX it allows higher transfer of data rates which travel longer distance. Through WiMAX, wireless networking is easy and it has the capacity to offer different types of services in one platform.

For high-definition audio and video file, its bandwidth and time-delivering-intensive and typical wireless networks neither the transfer speed nor the consistency to transfer them flaw less. With the advent of WiMAX technology, there is more capabilities can be provided such as it could provide 'real' QoS in the home, for things like video transmission and VoIP. That is why this project is conducted.

1.3   Project Objectives

1.   To study in details the architecture of IEEE 802.16.

2.   To simulate video transmission based on MPEG 4 or H.263 coding schemes on the 802.16 network.

3.   To analyze the performance of the network based on Quality of Service (QoS) parameters.

1.4   Scopes of Project

The scopes of this project were divided into several parts. First parts are the literature study on the details about the architecture of IEEE 802.16 and WiMAX. For this project, IEEE 802.16e standard is used for the mobile WiMAX standard.

Second part is about OPNET software. One network model (network topology) and two different scenario can be create and simulate by using OPNET Modeler software The performance analysis of video transmission that based on MPEG 4 or H.263 coding scheme over IEEE 802.16 Architecture was observed.

Then, the results obtained from simulation were analyzed to obtain the performance of the network based on QoS parameters. In video transmission for Broadband Wireless Applications, the requirement of traffic parameters are data up must higher that 1Mbps (> 1Mbps), continuous traffic flow, packet loss below $< 10^{-8}$, delay and delay variation is below < 100ms and < 2sec. Other typical network parameters that determine in this QoS parameters are bit error rate, jitter, latency, average data throughput, minimum throughput and etc.

1.5   Project Methodology

This project start with literature study and research of the functions of WiMAX, IEEE 802.16 standard and others topic that related to this project. This literature study is done by find out all the journal, articles and books that related to this project either in website or any materials.

Next, all the process to setup OPNET software, the network model of WiMAX for video transmission that based on MPEG 4 or H.263 coding schemes and the flow on how to run the simulation were learned.

Then, from the simulation network that gained, the performance of the network was analyzed based on Quality of Service (QoS) parameters. Below is the flow chart for the whole process of this project;
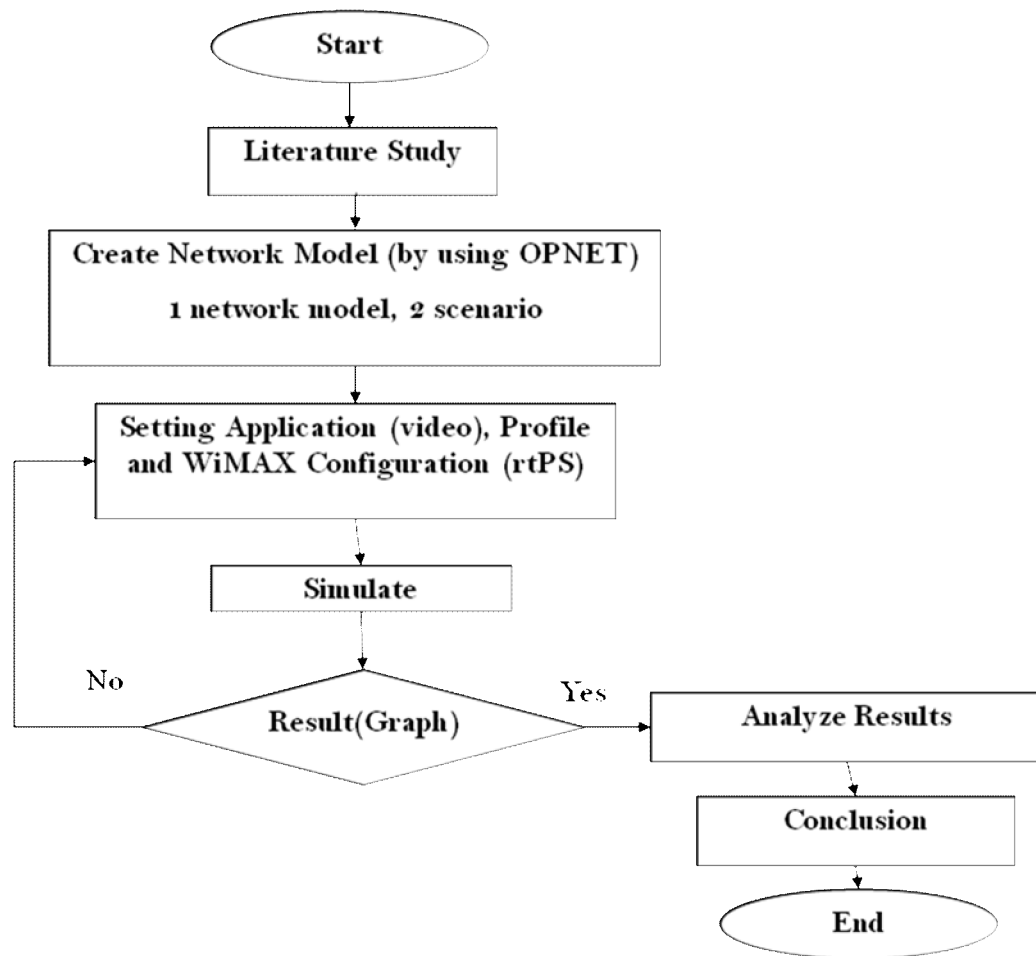
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                    ┌─────────────┐
                    │    Start    │
                    └──────┬──────┘
                           │
                    ┌──────▼──────┐
                    │ Literature  │
                    │    Study    │
                    └──────┬──────┘
                           │
              ┌────────────▼────────────────┐
              │ Create Network Model         │
              │ (by using OPNET)             │
              │ 1 network model, 2 scenario  │
              └────────────┬─────────────────┘
```

Figure 1.1: Flow chart for the whole process of the project

1.6   Report Structure

This report consists of chapters that will explain and discuss more details about this project. This report was divided into 5 chapters. The first chapter gives a brief explaination about WiMAX. It also gives an introduction about the overall process of project.

The second chapter is about the literature review of the project. Background knowledge of IEEE 802.16 or WiMAX, video transmission and OPNET software

was studied in order to understand on how to perform the performance analysis of video transmission over IEEE 802.16 Architecture.

The third chapter is about research methodology which explained about the methods used and all the process involved in this project.

The fourth chapter is about the result and discussion. All the data and results that obtained will be documented in this chapter.

The fifth chapter is about the conclusion of this project and future works that need can be done in the future to improve the project.

CHAPTER II

LITERATURE REVIEW

2.1 IEEE 802.16

As the growth of Broadband Wireless Access (BWA) increases it needs to keep up with the need of different service requirements of different subscribers. Video conferencing, VoIP, online gaming and other is nowadays becoming the most common reed of most of the subscribers. Varity applications such as video streaming, large audio needs guaranteed bandwidth and delay requirements. To meet up all the needs of the subscribers the broadband wireless industry is currently adapting WiMAX as the standard for broadband wireless internet access.

IEEE 802.16 is written by a working group established by IEEE Standards Board in 1999 to develop standards for the global deployment of broadband Wireless Metropolitan Area Networks. The Workgroup is a unit of the IEEE 802 LAN/MAN Standards Committee. Although the 802.16 family of standards is officially called WirelessMAN in IEEE, it has been commercialized under the name "WiMAX" (from "Worldwide Interoperability for Microwave Access") by the industry alliance called the WiMAX Forum. The mission of the Forum is to promote and certify compatibility and interoperability of broadband wireless products based on the IEEE 802.16 standards.

The most popular implementation of the IEEE 802.16 standard is the Mobile Wireless MAN originally defined by the 802.16e-2005 amendment that is now in process of being deployed around the world in more than 140 countries by more than 475 operators. The IEEE 802.16e-2005 specification offers improvements over the technology specified by the original fixed WiMAX standard. These significant improvements can cost-effectively deliver broadband services to end-users, offering increased performance in NLOS (non-line-of- sight) environments for mobility and fixed indoor applications. These improvements can be categorized as Mobility, High availability, NLOS performance, Security and QOS.

Both the connection and service-type based QOS are designed to meet the requirements of mobile broadband services. These two QOS mechanisms manage both UL (uplink) and DL (downlink) directions and support two-way traffic, such as VoIP. The mobile WiMAX QOS has the features of service multiplexing, low data latency and varying granularity to support real-time broadband multimedia application.

2.1.1 IEEE 802.16 Architecture Advantages

2.1.1.1 Flexibility

The MAC defined in IEEE 802.16 is capable of working with multiple PHY technologies.

2.1.1.2 Modularity

Both IEEE 802.16 MAC and PHY have a set of mandatory and optional features for fixed and mobile configurations. The optional features are negotiable between Base Station (BSs) and Subscriber Station (SSs).