

PERPUSTAKAAN UMP



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ANALYZING NETWORK PERFORMANCE IN UNIVERSITI MALAYSIA PAHANG
RESIDENTIAL COLLEGE MAIN CAMPUS (GAMBANG)

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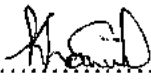
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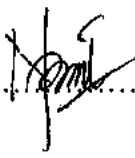
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ABSTRACT

High-speed networks allow users to use various types of services such as voice, data, image or images, video and others in a good condition or without interruption. Knowing the network performance is a necessity to get the best network performance. The purpose of this study was to investigate the mechanisms affecting traffic management network performance based on sources supplied. In preparing this research, a survey was conducted on the network system of Residential College University Malaysia Pahang main campus (Gambang). A study includes network delay, media access delay, traffic received, traffic sent and others by the use of the network. Wireless network system has many limitations compared to a wired network system in order to get the best performance but wireless networks system now have a place in society. This situation occurs because the wireless network system can facilitate all business and user friendly. A study conducted in this paper covers an area of wireless networks in the Residential College Universiti Malaysia Pahang Gambang campus. Wireless performance was analyzed using the OPNET Modeler 14.5. Network design of Residential College Universiti Malaysia Pahang Gambang was redesign using OPNET Modeler 14.5. The study conducted by three physical layer technologies, which is Infra-Red, Direct Sequence Spread Spectrum (DSSS) and Frequency Hopping Spread Spectrum (FHSS) with the different transfer rates.

ABSTRAK

Jaringan berkelajuan tinggi membolehkan pengguna menggunakan pelbagai jenis perkhidmatan seperti suara, data, gambar atau imej, video dan lain-lain dalam sesuatu masa dengan baik atau tanpa gangguan. Mengetahui prestasi sesuatu rangkaian adalah satu keperluan untuk mendapatkan system rangkaian yang terbaik. Tujuan kajian ini dijalankan adalah untuk mengkaji mekanisma-mekanisma pengurusan trafik mempengaruhi prestasi rangkaian berdasarkan sumber-sumber yang dibekalkan. Dalam menyiapkan kajian ini, satu kajian telah dibuat pada sistem rangkaian Kolej Kediaman Universiti Malaysia Pahang kampus Gambang. Kajian yang dibuat merangkumi kelewatan rangkaian, kelewatan akses media, trafik terima, trafik hantar dan lain-lain lagi berdasarkan penggunaan rangkaian. Sistem rangkaian tanpa wayar mempunyai banyak kekangan berbanding sistem rangkaian berwayar dalam mendapatkan prestasi yang terbaik tetapi sistem rangkaian tanpa wayar kini mendapat tempat dalam kalangan masyarakat. Keadaan ini terjadi kerana sistem rangkaian tanpa wayar ini boleh memudahkan semua urusan. Kajian yang dilakukan dalam kertas ini meliputi kawasan rangkaian tanpa wayar di Kolej Kediaman Universiti Malaysia Pahang kampus Gambang. Prestasi rangkaian tanpa wayar ini dianalisis dengan menggunakan OPNET Modeler 14.5. Sistem rangkaian di Kolej Kediaman Universiti Malaysia Pahang kampus Gambang di reka bentuk semula menggunakan OPNET Modeler 14.5. Kajian yang dilakukan berdasarkan tiga teknologi lapisan fizikal yang utama iaitu Infra-Red, Direct Sequence Spread Spectrum dan Frequency Hopping Spread Spectrum dengan nilai kadar pemindahan yang berbeza.

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CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

This chapter explains briefly about the process in analysing network performance in Universiti Malaysia Pahang residential college main campus, which that is situated in Gambang, Pahang. The network analysis recognizes the architecture and the problem of the current network of by doing some research. Therefore, the objective of this analysis can be classified or specified by the scope of the analysis like current network environments, network structure and network performance of this analysis which explains the performance and the capabilities of the network can be stated. Generally, the analyser must identify the project significance to end users and area of the research and the expected output as a conclusion.

1.1 PROJECT BACKGROUND

In computer networks, the terms of the network's performance can be referred to the level of quality of services of a telecommunications product as seen by the customer. It should not be seen merely as an attempt to get more through the network. It can be improved by:

- I. Ensuring that the network components are working efficiently and in harmony to deliver the prescribed grade of service.
- II. Ensuring that the network resources are operating in an error-free manner.
- III. Maintaining the quality of service in a cost-effective manner.

There are many different ways to measure the performance of a network because each network is different in nature and design. The network performance also can be modelled instead of measure; one example is by using state transition diagrams to model queuing performance in a circuit-switched network. These diagrams allow the network planner to analyse how the network will perform in each state, ensuring that the network using the optimal designed.

Generally, the network performance is examined at all levels of connectivity (LAN, WAN, backbone, end-to-end, application). Measurement usually looks at the bandwidth utilization, delay and packet loss. According to Dean A. Gratton (2007), the bandwidth measurement usually is to see how much data can be transferred per unit time. The delay measurement is to see how long it takes an individual piece of data to transverse the network while the packet loss is to see when a piece of data disappears in transmission affects both bandwidth and real-time applications. The different aspects of network performance can be measured, giving the information that can be used to improve the application's performance.

This study course will be analysing the network traffic in Universiti Malaysia Pahang where by using the simulation that will be developed using OPNET MODELER 14.5. By using the OPNET MODELER simulator, the experiment with different aspects of user behaviour or session behaviour network configurations and focusing on network packet loss and bandwidth control in actual internet traces. This simulation is useful in evaluating the behaviour of real world implementations when subjected to adverse network conditions that are not protocol specific.

This research is more focus on analysing on network performance on how the delay and bandwidth utilization control. This depends upon whether to analyse traffic for a particular network segment or the entire network. Besides that, it also depends upon the network size and structure as well.

1.2 PROBLEM STATEMENT

I. Analysing the network design

Before any enhancement on network performance can be done. The existing network need to be analysed as we do not want any problem occur in future. This is one of the challenges as the existing network can be designed properly or not using the simulator. If the current design has some problems that need to be solved or improved, then there will be a problem and a big challenge to make it better with the enhancement to the network performance.

II. Delay

As mentioned above, delay can be described as the time taken by an individual piece of data to transverse the network. Lachhman, Asad and Malkani (2011) found that it is important for real-time applications like video conferencing and it will impact the bandwidth as well. There is a certain minimum level of delay that will be experienced due to the time it takes to transmit a packet serially through a link. Onto this added a more bearable level of delay due to network congestion. Network delay can be range from just a few milliseconds to several hundred milliseconds.

Some application in Universiti Malaysia Pahang is especially used the internet connection had faced a problem when being used especially during the peak hours. Based on the current design and details on the applications in Universiti Malaysia Pahang, the performance of delay will be measured and compared.

III. Bandwidth Utilization

Bandwidth utilization will be measured on the total of data that can be transferred during per unit time. As Rajan and Shipra (2012) demonstrated by looking at the applications used, the measurement of the utilization can be determined to look for the usage of the bandwidth. Measuring performance in an application involves instrumenting the application. At the very basic level, instrumenting means keeping track of how long a transfer takes and the bandwidth is measured from that. For instance, FTP clients typically report the size, duration and average bandwidth after each file transfer. Real-time applications often keep track of delay and variations in delay.

IV. Limited wifi access at the students residential college.

There is only one student café (K4) that provides a wifi connection. The students at Kolej Kediaman 1, 2 and 3 did not have a wireless connection. The students will have problems to access the internet if there is any congestion on the wired networks. The students did not have any backup connectivity to access the internet.

1.3 MOTIVATION

The research will allow pursuing the interests about the network performance. Network performance is one of the interesting things to learn because it is one of the important parts of our life. This topic also could encourage learning something new in the wireless technology. Although I am do not know in deep about network performance in wireless, it give me an opportunity to learn something new in my life. Study about security also will help to hone the problem-solving skills. As students, problem solving skills is one of the important elements to become successful students nowadays. The students also, will face and need to solve many problems in daily life. Besides that, doing this research will give the challenge into a new ways of life. It is not an easy task to complete the research especially in this topic but I will challenge myself to do my best in order to complete this research.

Doing a research is a good chance because it greatly enhances classroom learning because as students, I can see how concepts can be applied to the real world. During the class learn about the theory of networking but with this research can help to show how the networking elements were applied in the real device. Research can provide a path to independent thinking and intuition. It will attract attention to know more about the networking and it also will make the intuition is more realistic about networking. As we know today's tuition rates, students are deserve something more than coursework and this research is one way of giving "something extra".

1.4 OBJECTIVES

This research was conducted to make sure that this analysis reaches the goals and main objectives. The main objectives of this research are:

I. To analyse the network performance in Universiti Malaysia Pahang residential college main campus.

Analyse the network performance in Universiti Malaysia Pahang residential college main campus from measuring the delay and bandwidth utilization. The result can be obtained by capture the data using the simulation, optimized network engineering tool, OPNET Modeler 14.5.

II. To simulate the current network design and enhancement design proposal.

To gather all the data based delay and utilization, the simulation of current Universiti Malaysia Pahang residential college main campus network design and the enhancement proposed design will be compared. The applications used to play the important role to support the result that will be obtained from the simulation. The simulation will be run on 1848 users and the details of users will be mapped using OPNET MODELER.

III. To suggest improvements regarding the wireless architecture.

After getting the entire outcome needed for the analysis, a few suggestions will be forwarded for reference in order to enhance the network coverage in student's resident Universiti Malaysia Pahang main campus (GAMBANG). In this research, the suggestion will cover the wireless architecture.

1.5 SCOPE

This research involves the simulation that will be used to analyse the network performance in Universiti Malaysia Pahang residential college. As for performance scope, the simulation will analyse parameters like delay and measure and manage bandwidth utilization.

The target scope is based on Universiti Malaysia Pahang residential college current network environment. The target user is the residential college of Universiti Malaysia Pahang main campus (Gambang). The size of the users is 1484 users and it involved the students who stayed at Kolej Kediaman 1, Kolej Kediaman 2, Kolej Kediaman 3 and Kolej Kediaman 4 of Universiti Malaysia Pahang main campus. By using the OPNET MODELER simulator, the network topology will be created and it consists of a collection of nodes, links and applications.

1.6 RESEARCH SIGNIFICANT

For this research the network performance that is going to be measure are delay and network bandwidth utilization. The delay test measures the time taken by individual piece of data to transverse the network. This will help to enhance the performance of the internet used in Universiti Malaysia Pahang. According to Kritika and Namarta (2011), the bandwidth utilization test can determine whether the usage of bandwidth provided for each application satisfied the users needed and requirements. The analysing of network performance will allow the administrator to enhance the network performance become more efficient and faster. Basically, the analysis will give many benefits to an inhabitant of the Universiti Malaysia Pahang residential college because it will enhance the network capability. The network has become more manageable and the traffic condition will be much better than current condition.

1.7 EXPECTED OUTPUT

The expected output of this research is to have the data on simulation been made. This data will be used to check any problem occur on the network performance so that the enhancement will be made in order to overcome or to avoid or minimized the current problems.

The other expected output of this research also is to make Universiti Malaysia Pahang residential college main campus become more stable and the network bandwidth can be controlled.

Besides that, another output is the data for analysis of the existing network and the actual data will be used to enhance the network performance.

1.8 CONCLUSION

As the conclusion of the introduction, this chapter clarifies briefly about the flow process based on research background, research objectives, problem statements, research scope, research significant and the expected output of this research. Other than that, this chapter also is about the purpose of this research which is to do an analysis of existing network performance, make a simulation of the existing network to check the network performance and problems probability can occur.

The next chapter in this thesis which is chapter two will explain about the literature review of this research, advantage and disadvantage of this research and some fact and finding of the existing research. This chapter will help to become more understanding about this research.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

The literature review is a body of text that aims to review the critical points of current knowledge on a particular topic. Most often associated with science-oriented literature, like a thesis, the literature review usually precedes a research proposal. Its ultimate goal is to bring the reader up to date with the current review on a topic and forms the basis for another goal such as the justification for future research in this area. A good literature review is characterized by a logical flow of ideas, current and relevant references with consistent, appropriate referencing style, proper use of terminology and an unbiased and comprehensive view of the previous research on this topic.

2.1 FACT AND FINDINGS

As Xiaodong and H. (2002) demonstrated, there are a lot of techniques can be used to gather information that is related to this research. The information can be gathered through journals, white paper, internet, book and other related information. These initial documents will provide some valuable information to determine the basic view for the research. The theory and the concept of the passed research, references, case study and others can be applied in order to understand the topic.

2.1.1 Domain

The domain about this research has been defined from the other research and references as follows:

I. Network Performance

As Rahul and Bansal (2011) demonstrated, high-speed networks are capable of carrying many types of services such as voice, data, images and video without any congestion. The purpose of network performance is to investigate how traffic-management mechanisms deployed in the network affect the allocation of resources among its users and the performance they experience. This task can be studied by the construction of traffic management mechanism model and also by observing how it performs when applying to some flow of the network traffic.

Network performance refers to the overall effectiveness of a network at a given point. Generally, performance is measured at all levels of connection (LAN, WAN, backbone, end-to-end, application). Different aspects of network performance measured will give several of information that can be used to improve the network performance.

The measurements will usually be looking at one or more of the following:

I. Bandwidth

In computer networks, bandwidth is often used as a synonym for data transfer rate. According to Wu and Bogaerts (1995), data transfer rate refers to the amount of data that can be carried from one point to another point in a given time period (usually a second). This kind of bandwidth is usually expressed in bits per second (bps).

II. Delay

Delay is defined as how long it takes an individual piece of data to traverse the network. This is important for real-time applications like video conferencing and remote instrument control and also impacts bandwidth.

III. Packet Loss

Packet loss means when a piece of data disappears in transmission over the network that will affect both bandwidth and real-time applications.

According to Liebhart (1997), a high-performance network can be defined when it has high bandwidth utilization, small delay and small packet loss. For this research, it will focus on the bandwidth utilization and delay measurement as stated in the objectives.

IV. Network Simulation

In computer network research, network simulation is a technique where a program simulates the behaviour of a network. This simulation is performed by the program either by calculating the interaction between the different network entities like host or routers, data links, packets and others by using mathematical formulas or actually capturing and playing back network parameters from a production network.

The network behaviour and the various applications or services, supports can be observed in a test lab using the input. The various attributes of the environment also can be modified. Either a simulation program is used in conjunction with live applications and services in order to observed end-to-end performance to the user, this technique also referred as network simulation.

Usually, the commercial simulations are GUI driven, while some network simulators require input scripts or network parameters. Important outputs of simulations are trace files. As Halliday and Urquhart (2008) found, the network parameters describe the state of the network (node placement, existing links) and the events (data transmissions, link failures). By tracing files, all documents on every event that occurred in the simulation can be recorded. The documents can be used for analysis. Network simulator also can capture the data directly from a functioning production environment. The data capture can be done at various times of day, week and month in order to obtain average, worst-case and the best-case condition. Other than that, network simulator also can provide other tools to facilitate visual analysis of trends and potential trouble spots.

2.2 EXISTING SYSTEMS

Network performance is the qualitative level at which a network fulfils its function. Based on the (National Laboratory for Applied Network Research [NLANR], 2007) network performance refers to the overall effectiveness of a network at a given point. Generally, performance is examined at all levels of connectivity (LAN, WAN, backbone, end-to-end, application). According to Jeffry and Jackie (2001), the different aspect of network performance can be measured by giving the user information so that they can use to improve the application's performance. According to these statements, the target parameter must best set off and the target parameter is measured end-to-end delay and bandwidth utilization in order to implement this research.

The network traffic analysis and modelling, play a major role in order to characterize network performance. Gunnar Ronneberg (1999) posited that, models that accurately capture the salient characteristics of traffic are useful for analysis and simulation. This will further our understanding of network dynamics and so aid design and control. There are many things to be considered before the analysing can be done. Measuring and analysing network traffic dynamics between end hosts has provided the foundation for the development of many different network protocols and systems.

2.3 OPNET NETWORK SIMULATION TECHNIQUE

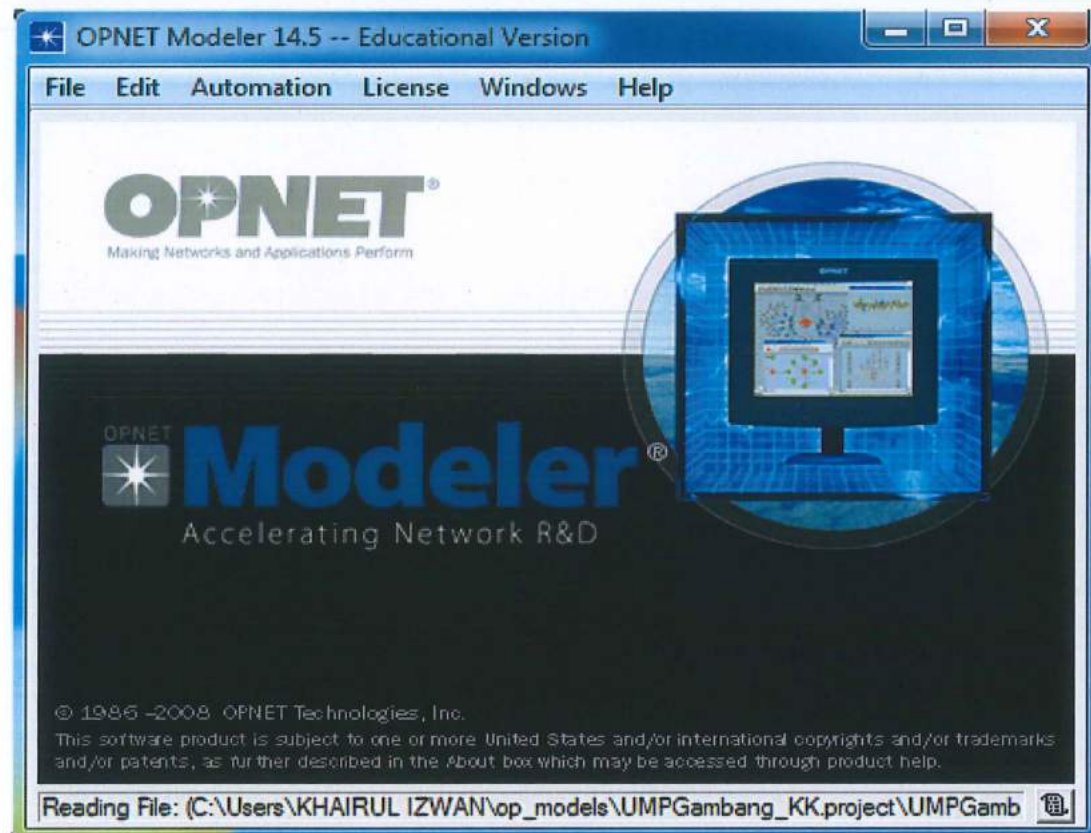


Figure 1: The main interface of the OPNET Modeler 14.5

OPNET Modeler 14.5 is a network simulation tool. This simulation tool comes with the following tool sets:

- I. Node models that specify the interfaces of a network
- II. Packet format defines protocols
- III. A process model that abstracts the behaviour of a network component
- IV. Project windows that define network topology and link connections
- V. Simulation window that captures and display simulation results

OPNET Modeler 14.5 is a network simulation tool that allows the definition of a network topology, the nodes and of course the link that will make up a network. The process might be happening in a particular node can be defined by the user, as can be the properties of the transmission links. A simulation can be executed, and the results analysed for any network elements in the simulated network.

Simulation, modelling becomes a popular method for network performance analysis. Generally, there are two forms of network simulation which is analytical modelling and computer simulation. The first is by mathematical analysis that characterizes a network as a set of equations. The main disadvantage of this method is it's over simplistic view of the network and inability to simulate the dynamic nature of a network.

The simulator software is a valuable tool, especially for today's network with complex architecture and topologies. Designers can simulate and test their ideas and carry out the performance that relates to their studies. Therefore, free from the burden of the trial and error, hardware is important to get a good result.

Optimized Network Engineering Tool (OPNET) provides a comprehensive development environment for the specification, simulation and performance analysis of communication networks. A large range of communication systems from a single Local Area Network (LAN) to a global satellite network can be supported. Discrete event simulations are used as the means of analysing system performance and its behaviour.

The key features of OPNET Modeler 14.5 are summarized as follows:

I. Modeling and Simulation Cycle

OPNET Modeler 14.5 provides powerful tools to assist user to go through three out of five phases in a circle design. Example is the building of models, the execution of a simulation and the analysis of the output data.

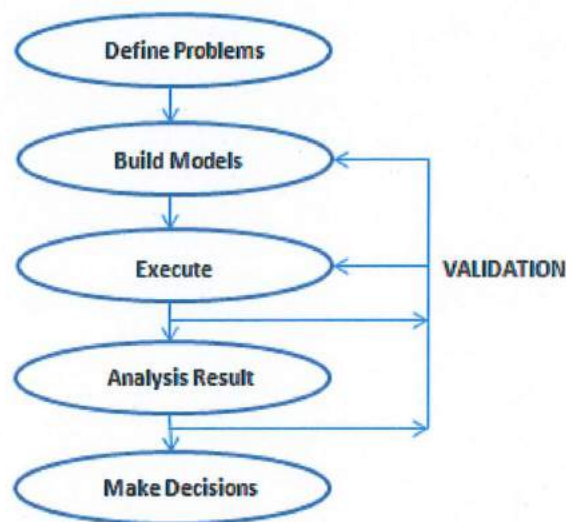


Figure 2: Modeling and Simulation Cycle

II. Hierarchical Modelling

OPNET Modeler 14.5 employs a hierarchical structure to modelling. Each level of the hierarchy describes different aspects of the complete model being simulated.

III. Specialized in Communication Networks

Detailed library models provide support for existing protocols and allow researchers and developers to develop a new model or modify the existing model by their own characteristics.

IV. Automatic Simulation Generation

OPNET Modeler 14.5 tools can compile the designed model into executable code. An executable discrete-event simulation can be debugged or simplify executed and the result in the output data.

CHAPTER 3

RESEARCH METHODOLOGY

3.0 INTRODUCTION

The research methodology is the method for collecting data in order to complete this research. It consists of the data collection system. Research methodology also known as science of studying on how the research is done scientifically its techniques, methods and procedures needed to achieve the research objective. This chapter will define the important items on this research include the research method, requirements, research, architecture, tested available, hardware used, software and others as its related in this research. All these items will be identified in this chapter in order to ensure that the objective of this research are achieved and to make sure the research methodology used is on the right path. Therefore, a few steps had been identified as a guideline for this research. The perspective steps as follows:

- I. Gather information to start the research.
- II. Planning the components and the system architecture.
- III. List all the necessary hardware and software needed and developed the testing procedure model.
- IV. Design and configure the required hardware and software which are required for testing used.

- V. Performed the testing based on the predefined procedure model by using the OPNET Modeler 14.5.
- VI. Gather some information from the respective experiment and analyse the data from the findings.
- VII. Suggest the wireless architecture for the current network.

3.1 METHODOLOGY

Methodology is a something will help during the development as it help to guide phase by phase involve in research. For this analysis, research, the phase involves being feasibility phase, analysis phase, design phase, implementation phase and testing phase. These phases will rotate until the result obtain is satisfied.

The outcome at the design phase will describes in much detail on how the simulation will be implemented. Then, this outcome will be used in the implementation phase to produce the actual simulation and get the result.

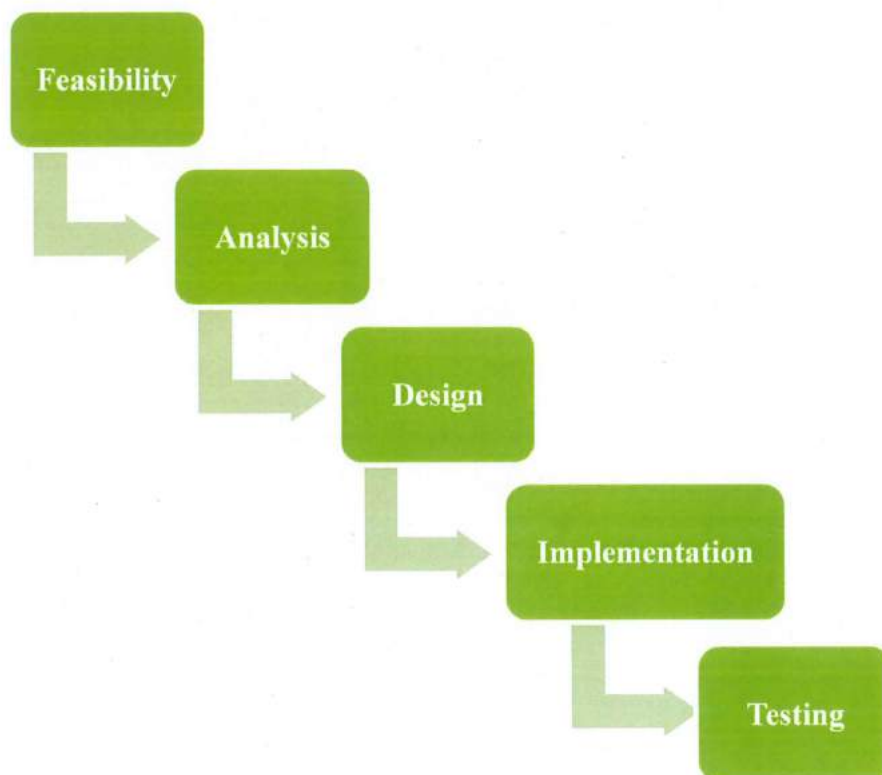


Figure 3: The methodology of the research

Feasibility

The feasibility phase used to determine if the project should get the go-ahead and also will produce a project plan and budget estimates for the future stages of development.

Analysis

Analysis phase is the second phase of this research. Analysis gathers the requirements to do the analysing. This phase includes a detailed study of the business needs at Universiti Malaysia Pahang. Analysis phase also known as a phase where the data's are obtained is used for this research. The data that obtain and collected from many sources will be interpreted and will be analysed.

Design

Architecture design phase is the third phase of the research. Architecture design phase consists of the assembly, installation and configuration of the hardware and software. This action was taken in order to provide the complete test in order to capture the data. Design focus on high level design. The design includes the parameter to analyse, how to analyse the network performance and how to design the simulation. Any problem occurs in design phase would be difficult to solve in the next stage of simulation.

Implementation

Implementation is the fourth phase in the research. The implementation phase is the designs are translated into simulation based on the analysis that has been done. The simulation will be developed using OPNET Modeler 14.5 with respect to the type of application and the right programming language.

Testing

Testing is the last phase of the research. In this phase, the simulation is tested. The simulation is tested as a whole means the separate modules are brought together and tested as a complete simulation. The simulation is tested to ensure that the interfaces between nodes is worked (integration testing), the network performance on the intended platform and with the expected volume of data (volume testing) and that simulated with the user requirements.

3.2 PROJECT REQUIREMENTS

3.2.1 Software Requirements:

- I. Microsoft office 2010
 - Used for project report writing
- II. Microsoft Visio 2010
 - Used for network design development
- III. Microsoft project 2010
 - Used for Gantt chart development
- IV. Microsoft power point 2010
 - Used for slide presentation
- V. Adobe reader
 - Used to open PDF file
- VI. Microsoft windows 7
 - Used as computer operating system
- VII. OPNET (Optimized Networking Engineering Tool) Modeler 14.5
 - Used to simulate the network design and gain data.

3.2.2 Hardware Requirements:

- I. Laptop
 - Laptops with a high specification, the basic or minimum specifications of the laptop are 2 GB RAM 5 GB total size of hard disk, 10 GB additional hard disk space needed and dual core processor with Windows 7 operating system to support OPNET Modeler 14.5. To get a smooth process, a better specification of laptop is advised.

3.3 SUMMARY OF METHODOLOGY

The methodology this research consists of five phases. The phases of this methodology are:

- I. Feasibility phase
- II. Analysis phase
- III. Design phase
- IV. Implementation phase
- V. Testing phase

The phases were done accordingly and cannot be skipping its phase because each phase has linked and it's chained together. But, it can be started again at the beginning after the last phase in order to get a good result.

3.4 CONCLUSION

As overall of this chapter, the research methodology, project requirements are identified and being complete doing the research. Since the network performance becomes slowly nowadays, it is compulsory to search an alternative to improve the network performance.

The next chapter would be detailed on the analysis phase of this research. In that phase, it has included the problem analysis as well as requirement analysis. In the analysis phase, the current network scenario will be investigated to show how it runs and get some data by using OPNET Modeler 14.5 simulations. The other requirements that will be used also will be identified during the analysis phase. The requirement includes software, hardware, and others like network requirements.

CHAPTER 4

DESIGN AND IMPLIMENTATION

4.0 INTRODUCTION

This research project was carried out based on the objectives of this research that has been defined earlier. It is crucial to state the step-by-step of the procedure in detail to ensure that this research project is on the right course and the defined procedure of methodology always coincides with the objectives of this research. The experimental setup was made to provide an approved about the network performance. Based on the methodology in the design phase, it is important to ensure that the hardware and software tools used will be able to perform and carry out the task of obtaining the required data.

4.1 ANALYSIS

The analysis phase is the second phase where the project lifecycle begins. The only exception is a situation where we have broken a large project down into smaller components. In that case, it may have an entire project that is only focused on the analysis phase, while the next project may start at the design phase. The analysis phase also is the phase where the high-level project definition was broken down into the more detailed project requirements. The analysis phase also is the part of identifying the

overall direction that the project will take through the creation of the project strategy documents.

The requirement gathering is the main attraction of the analysis phase. The process of requirement gathering is usually more than simply asking the users what they want or need or in other words is information gathering. The user will write their requirements into a piece of paper. The process of gathering requirements depending on the complexity of the application has been defined. This process might have repeatable processes that utilize certain techniques to capture, document, communicate and manage requirements.

Even though the gathering requirement is the main focus during the analysis phase, there are other important activities during this phase as well. One of the other activities is to create a requirements management plan to define how the requirements will be documented, communicate, tracked and changed throughout the rest of the project lifecycle. This plan will specifically address establishing a baseline, change control process and a way to track the requirements through the rest of the life cycle. The other important activity is to set the overall direction for work that does not take place until later. This is accomplished through a series of strategy documents.

4.2 CURRENT SCENARIO

Based on the research title, the problem analysis will focus on the analysis of problems that bring out the development of the analysis on UMP Gambang resident college environment and the network performance.

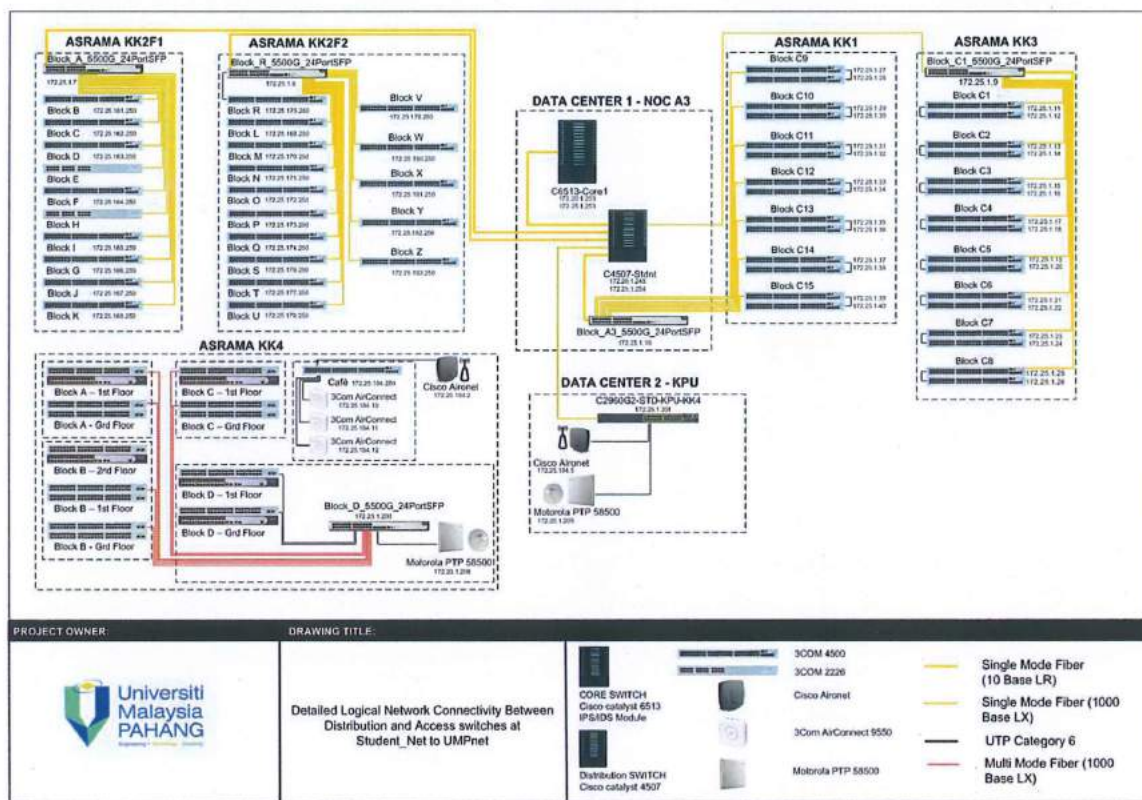


Figure 4: The student residential college network design

Currently, there are only simple network designs that only locate the location of network distribution for every building in UMP Gambang residential college is PTMK core switch. The unit that is responsible for network management is “Pusat Teknologi Maklumat dan Komunikasi (PTMK)”. There are a few people as the official staff will

monitor, configure and maintain the network services in UMP Gombang residential college.

In order to make sure the analyzing will run smoothly, the knowledge on how application runs is very important or might have difficulty during the simulation part. So, a new design should be created to make sure this entire research can be done properly. Based on this, there is a needed to design the existing network structure and show the enhancement based on the proposed wireless architecture in the new design.

Since the network infrastructure on UMP resident is built without proper analysis and design steps, possibility of low network performance is higher in the organization. Network performance will be analysed based on the bandwidth utilization, delay and respond time and packet loss rate for this analysis the performance that will be looked into the delay and bandwidth utilization. This is because the parameters determine how healthy a network is and how efficiently it can support application and request from nodes. Excessive usage of network in term of application, number of users and peak usage time degrades network performance of the organization.

Problems also occurred when there are so many users wanting used the internet to surf the website especially during the office hour. Furthermore, internet usage on UMP resident main campus is not limited for users. This is one of the reasons causes the network congestion. This is because internet gets slow when many people try to access it. In the other words, when many user visit web pages, download or upload files in the internet, the network services becomes very slow or at lower performance.

The analysis of the current network performance and solutions for the network problems must have highest merit in terms of better efficiency, cost effective and easiest to implement and enhance the network performance. Before getting any result, the design and the data collected need to be in simulation as to know any problem can occur if the new network performance is to be implemented. This is not an easy task because the

proper calculation, analysing and many other things need to be done. If not, the greater problem can occur in the future.

4.3 REQUIREMENT ANALYSIS

Requirement analysis encompasses those tasks that go into determining the requirements of new or altered design, taking account of the possibly conflicting requirements of the various stakeholders like others. This consists of identifying, gathering and understanding system requirements and their characteristics and developing thresholds for performance to distinguish between low and high performance services, as well as to determine specified services for the network.

4.3.1 User Requirements

Table 1: User Requirements Information

User Service Requirements	Description of Requirement
Location(s) and Number(s) of users	
Kolej Kediaman 1	392
Kolej Kediaman 2	299
Kolej Kediaman 3	448
Kolej Kediaman 4	345
User Expectations	
Interactivity	<ul style="list-style-type: none"> • Users can retrieve data very fast. • Human Response Time (HRT) is less than 100ms.

Reliability	<ul style="list-style-type: none"> • Some application needs 99% reliability during application session.
Quality	<ul style="list-style-type: none"> • Quality in response time must be excellent which can operate 24 hours and 7 days per week.
Adaptability	<ul style="list-style-type: none"> • The network must adapt to users addition, editing, and deleting any unneeded data.
Security	<ul style="list-style-type: none"> • Have internal and external firewall in the network. • Every device has setup with highest security implementation. • Backup server to retrieve data in case the other server down. • Network box that act as security hardware and software.

4.3.2 Hardware Requirements

The following table is the list of hardware requirements used by PTMK UMP in order to make network connection with the student residential college in Gambang campus:

Table 2: Existing Hardware Information

Types of hardware	Description
Cisco Catalyst 6513 Switch	The 13-slot Cisco Catalyst 6513 Switch chassis is ideally suited for high-performance, high port density Fast Ethernet and Gigabit Ethernet aggregation in all parts of the network, including the access, distribution, and backbone layers as well

	<p>as the server farm and data center environments. With up to 12 payload slots available, the 13-slot chassis offers industry-leading 10/100/1000 Gigabit Ethernet and 10 Gigabit Ethernet port densities while providing high levels of network resilience.</p> <ul style="list-style-type: none"> • Important Features: <p>Supports all Cisco Catalyst 6500 Series modules, including:</p> <ul style="list-style-type: none"> • Supervisor engines • Fast Ethernet modules (with IEEE 802.3af Power over Ethernet [PoE]) • Gigabit Ethernet modules (with IEEE 802.3af PoE) • 10 Gigabit Ethernet module • Flex WAN modules • Shared Port Adaptors/SPA Interface Processors • Multi-Gigabit services modules (content services ,firewall, intrusion detection, IP Security [IPSec], VPN, network analysis, and Secure Sockets Layer [SSL] acceleration) <p>Retrieved from alatest.com</p>
Cisco Catalyst 4507	<ul style="list-style-type: none"> • Distributed Intelligent Services • The Cisco Catalyst 4500E delivers comprehensive, intelligent services and features across wired and wireless networks, including: • Flexible NetFlow and Wireshark on all ports, which includes wireless attributes • Medianet capabilities to simplify video QoS,

monitoring, and security

- Automation for fast provisioning, diagnosis, and reporting
- Exceptional resiliency with redundant components, NSF/SSO, Cisco In-Service Software Upgrade (ISSU), and VSS
- Energy-Efficient Ethernet (EEE) and Cisco EnergyWise technology to manage networks, PoE+, and PCs

Specifications at a Glance

Number of slots	3, 6, 7, and 10
Bandwidth per slot	48 Gbps
Maximum switching capacity	1.8 Tbps (VSS mode)
Maximum wireless termination	20 GB (hardware-read)
Maximum packets per second	500 million (VSS mode)
10 GE port density	104 (8 uplinks ports line-card ports)
1 GE port density	Up to 384
Redundant supervisor	Yes (for 7- and models)
Virtualization	Virtual Switching (VSS)
Cisco Universal Power over Ethernet (UPOE) (60 W)	Yes
PoE+ (30 W)	Yes

Retrieved from alatest.com

3Com 4500	<p>The 3Com 3CR17561-91 Switch 4500 26-Port stackable Ethernet switch features rich Layer 2 switching and dynamic Layer 3 routing in a cost-effective, high performance platform.</p> <p>802.1X network access control combined with RADIUS authentication ensures secure access to resources. Additionally, RADIUS Authenticated Device Access (RADA) enables authentication of attached devices via MAC address</p> <p>Port-based Access Control Lists (ACLs) effectively enable usage policies at each point of access to the network via the switch</p> <p>Aggregate switching capacity up to 8.8 Gbps</p> <p>Secure Shell (SSHv2) and SNMPv3 support ensure secure management, access to switches via authentication and encryption of management traffic.</p> <p>Dual Gigabit uplinks on each switch unit enable high-speed connections to the network backbone or locally attached servers.</p> <p>Retrieved from alatest.com</p>
3Com 2226	<p>The 3Com Baseline Switch 2226 delivers highly affordable wire speed Layer 2 switching for small to mid-sized networks that don't need management capabilities. The switch includes 24 10/100 switching ports and two dual-purpose ports for copper or fiber Gigabit connections. Choose between running high-speed 10/100/1000 for fixed copper network backbones or servers or Gigabit SFPs (Small Form-Factor Plug-in or mini-GBIC) with 1000BASE-LX or -SX transceiver modules</p>

	<p>for connections to fibre backbones or servers. Advanced switching features such as IEEE 802.1p traffic prioritization with two Class-of-Service (CoS) priority queues make sure that real-time applications such as video and audio take priority so they run effectively, and enable the switch to operate in larger network environments. Auto MDI/MDIX ports identify and adapt to the Ethernet cable type, eliminating the most common cabling errors and simplifying installation. Autosensing ports detect and adjust to the speed of the connected device to optimize network performance. The switch is designed to operate as a freestanding or rack-mounted switch with an included mounting kit. The standard 19-inch, one rack-unit-high (1 RU) enclosure optimizes valuable office space. Its sturdy design and construction pays off in high reliability and long service life.</p> <p>Retrieved from alatest.com</p>
3Com AirConnector 9550	<p>With wireless speeds of up to 300 Mbps, the 3Com Wireless 11n Cable/DSL Firewall Router - compliant with the IEEE 802.11n draft 2.0 standard and WI-Fi CERTIFIED - is able to handle high-bandwidth applications confidently. IP Quality of Service (QoS) helps ensure that critical, time-sensitive traffic gets the priority needed for quality communications. This 11n router delivers significant wireless speed and range improvements over IEEE 802.11g. Its robust and high-speed routing engine and security features allow up to 253 wired and wireless users to share a single broadband connection. The 3Com Wireless 11n Cable/DSL Firewall Router uses IEEE</p>

	<p>802.11n draft 2.0 technology to deliver significant wireless speed and range improvements over IEEE 802.11g networks. With two external and one internal antenna and advanced Multiple Input Multiple Output (MIMO) technology, the enhanced wireless range of this router helps provide single point coverage in small office and home networking environments, and can eliminate dead spots common with other wireless LANs. Advanced wireless security and multiple firewall features offer high levels of protection for the network. To help shield wireless connections, this router provides 128-bit WPA/WPA2 with TKIP/AES encryption that encodes and protects information, providing maximum security. URL filtering, a Stateful Packet Inspection (SPI) firewall with hacker pattern detection and other security features help protect the entire network from attacks and other Internet security risks. Support for initiation and termination of Internet Protocol security (IPSec) tunnels helps enable security between business sites. A unique combination of features helps assure reliable delivery - with no interruption - of delay-sensitive information like voice and video. This access point uses OFDM Spread Spectrum Method. Product Description: 3Com Wireless 11n Cable/DSL Firewall Router - wireless router.</p> <p>Retrieved from networkworld.com</p>
Motorola PTP 58500	<p>Delivering high-speed data from Point A to Point B has never been easier. With the Motorola Point-to-Point (PTP) wireless Ethernet bridges, enterprises, carriers, ISPs and municipalities</p>

can easily connect expansive IP networks to form a cohesive system. Delivering an outstanding ROI and superior performance, the point-to-point solutions possess exceptional interference mitigation techniques, multiple layers of security and can transmit across long distances, over water or around obstacles.

- PTP 58500 Integrated – Up to 52 Mbps solutions with built-in antennas
- PTP 58500 Connectorized – Up to 52 Mbps solutions with the high-gain advantage of external antennas.

Motorola combines Multiple-Input Multiple-Output (MIMO) and Intelligent Orthogonal Frequency Division Multiplexing with advanced signal-processing algorithms, allowing 500 Series solutions to create four simultaneous signals between pairs of transceivers at each end of the link – without losing spectrum efficiency. This technique increases signal integrity by an unprecedented 300 times.

- Multiple-Input Multiple-Output (MIMO)
- Intelligent Orthogonal Frequency Division Multiplexing
- Advanced Spectrum Management with Intelligent Dynamic Frequency Selection
- Adaptive Modulation
- Spatial Diversity
- Best-in-Class Radios

Retrieved from wifigear.co

4.3.3 Network Requirements OR Cabling

Table 3: Existing Network or Cabling Information

Type of Cable	Description
Single Mood Fiber (10 base LR)	<p>10GBase-LR can reach up to 10km over single mode fibre. There is no minimum distance for LR, either, so it is suitable for short connections over single mode fibre as well.</p> <p>Product Highlights</p> <p>XFP optical transceiver for 10GBASE-LR (long-range) single-mode fibre extensions up to 10 kilometres (6.2 mi.).</p> <p>Supports 10-Gigabit (10-GbE) communications within the 9.95 Gbps–11.32 Gbps range.</p> <p>Great for telecoms and enterprises requiring long-distance 10-GbE fibre extension.</p> <p>Retrieved from blackbox.com</p>
Single Mode Fiber (1000 base LX)	<p>1000BASE-LX is a fiber optic Gigabit Ethernet standard specified in IEEE 802.3 Clause 38 which uses a long wavelength laser (1,270–1,355 nm), and a maximum RMS spectral width of 4 nm.</p> <p>1000BASE-LX is specified to work over a distance of up to 5 km over 10 μm single-mode fibre.</p> <p>1000BASE-LX can also run over all common types of multi-mode fibre with a maximum segment length of 550 m. For link distances greater than 300 m, the use of a special launch conditioning patch cord may be required.^[6] This launches the laser at a precise offset from the centre of the fibre which</p>

	<p>causes it to spread across the diameter of the fiber core, reducing the effect known as differential mode delay which occurs when the laser couples onto only a small number of available modes in multi-mode fiber.</p> <p>Retrieved from Wikipedia.org</p>
<p>UTP Category 6</p>	<p>Cat-6 network cabling is used as the cabling infrastructure for 10BASE-T (Ethernet), 100BASE-TX (Fast Ethernet), 1000BASE-T (Gigabit Ethernet, or GbE) and 10GBASE-T (10-Gigabit Ethernet, or 10 GbE) networks. The Cat 6 standard provides performance of up to 250 MHz (500 MHz for the newer Cat 6a standard) and can be used up to a maximum length of 100 meters (55 meters for 10GBASE-T networks).</p> <p>Retrieved from webopedia.com</p>
<p>Multi- Mode Fiber (1000 Base LX)</p>	<p>In fiber optics technology multimode fiber is used for signal transmission over short distances. In multimode fiber light waves are dispersed into numerous paths as they travel through the cable's core. The modal bandwidth for the MMF options ranges from 400 MHz/km to 500 MHz/km, and maximum distance is 550 meters.</p> <p>Retrieved from Wikipedia.com</p>

4.3.4 Other Requirements

Table 4: Others Requirement Information

Name	Description
OPNET Modeler 14.5	OPNET Modeler 14.5 is a network simulation tool. This tool allows the definition of a network, topology, nodes and links that will make up a network. The simulation can be executed and the results analysed for any network element in the simulated network.
Microsoft Office Word 2010	Microsoft Office Word 2010 is an essential tool for creating a document. It is easy of used. The document can be complete or can be done easily using this tool.
Microsoft Office Visio 2010	Microsoft Office Visio 2010 provides a powerful single platform for a custom drawing solution. New ShapeSheet sections, rows, and cells along with Automation objects, properties, methods and events. It will give more options for defining the behaviour of the elements in solutions.

Microsoft Office Project 2010	Microsoft Office Project 2010 is the leading project management solution that helps to develop a GANTTCHART. It helps in order to arrange the time management of the project.
Microsoft Power Point 2010	Microsoft Power Point 2010 is the software that helps in the presentation task. This software will be used when want to present about the project, progress, result and others.

4.4 QUALITY OF DATA (Simulation Data)

For this research, the simulation data will be carried out as the result. The simulations will run and will be testing the certain performance or data to see either it meet the project scope or not. This consists of packet loss and network bandwidth control in the performance.

The term bandwidth in computer networking refers to the data rate supported by a network connection or interface. One most commonly expresses bandwidth in terms of bytes per second (bps). The term comes from the field of electrical engineering, where the bandwidth represents the total distance or range between the highest and lowest signals on the communication channel (band). Network bandwidth is not the only factor that determines the speed of network as perceived by the end user. The other key element of network performance is latency that also affects network applications in important ways.

4.4.1 Current Network Design Plan

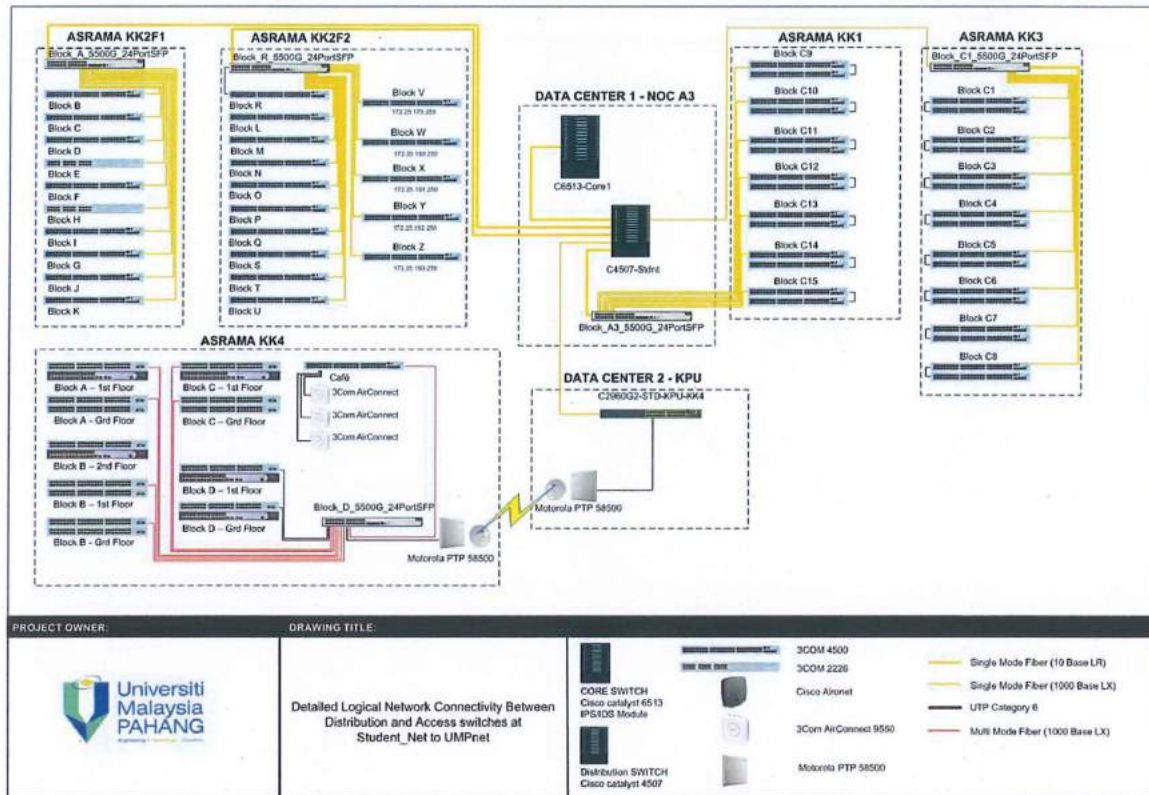


Figure 5: The current network design of UMP residential college

4.4.2 Current Network Design On The Simulation

In order to make the UMP residential college network model, the OPNET Modeler 14.5 is used. By using the OPNET Modeler 14.5, the network design of UMP residential college is created. The UMP current network model is design part by part orderly. The model created was divided by KOLEJ KEDIAMAN 1, KOLEJ KEDIAMAN 2, KOLEJ KEDIAMAN 3 and KOLEJ KEDIAMAN 4. For the network design at KOLEJ KEDIAMAN 1 and KOLEJ KEDIAMAN 3, the network design is same because the structured designed for KOLEJ KEDIAMAN 1 and KOLEJ KEDIAMAN 3 is same. For the KOLEJ KEDIAMAN 2, the

network design was divided by two parts which is ASRAMA KK2F1 and ASRAMA KK2F2. For the KOLEJ KEDIAMAN 4, the design was divided into the wired and wireless part because inside the student residential college, the wired structure is provided and the wireless also provided at café.

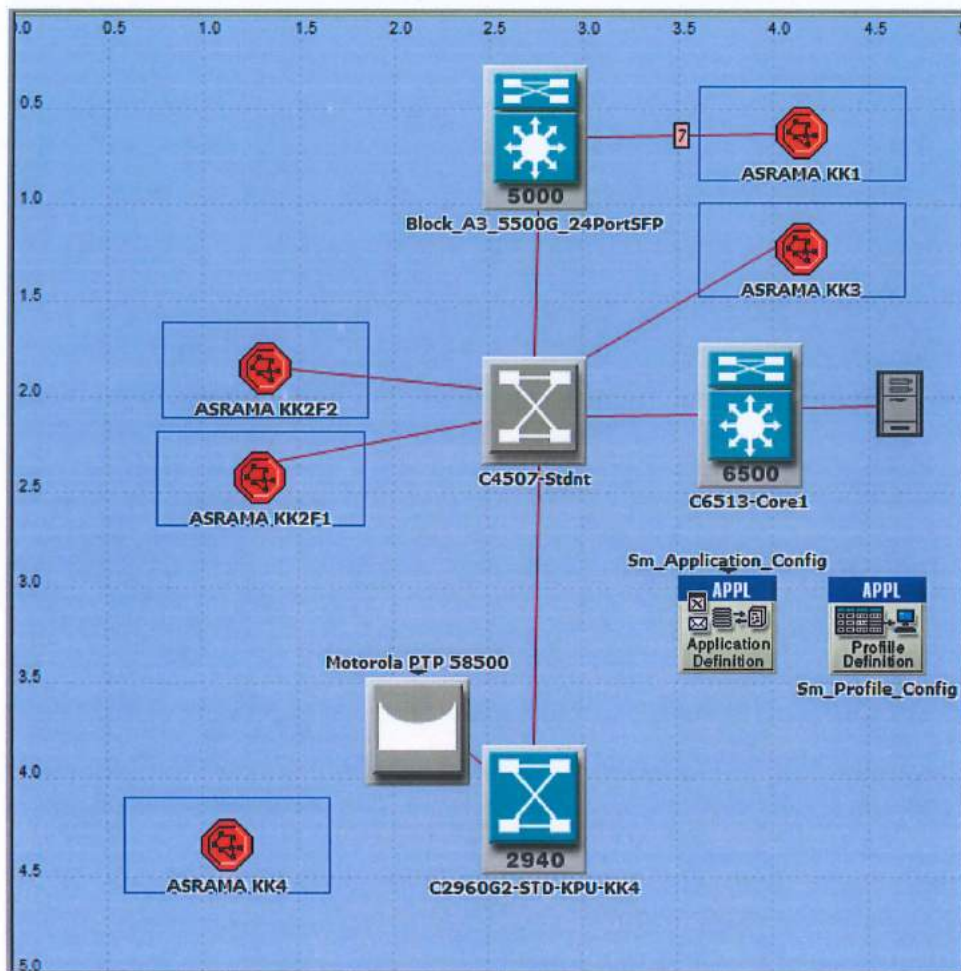


Figure 6: The main part of the network simulation design for the UMP residential college

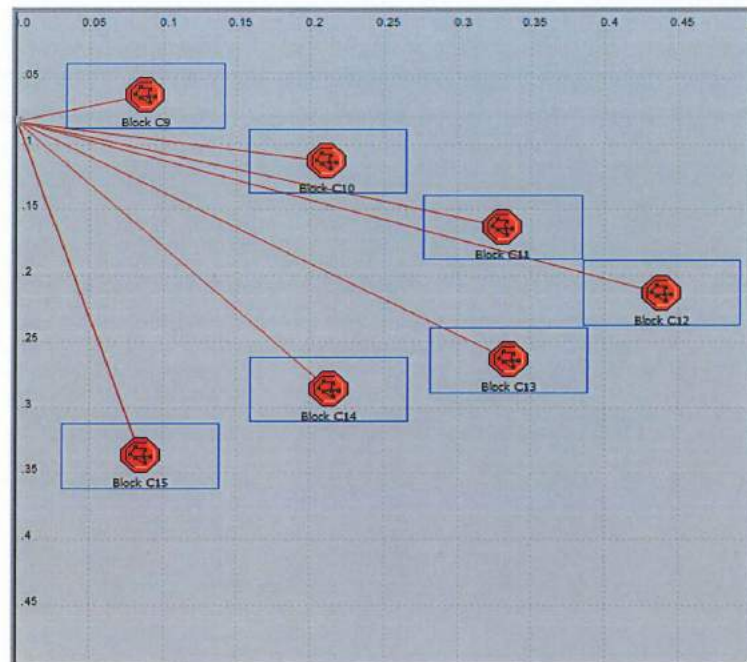


Figure 7: KOLEJ KEDIAMAN 1 blocks structured view

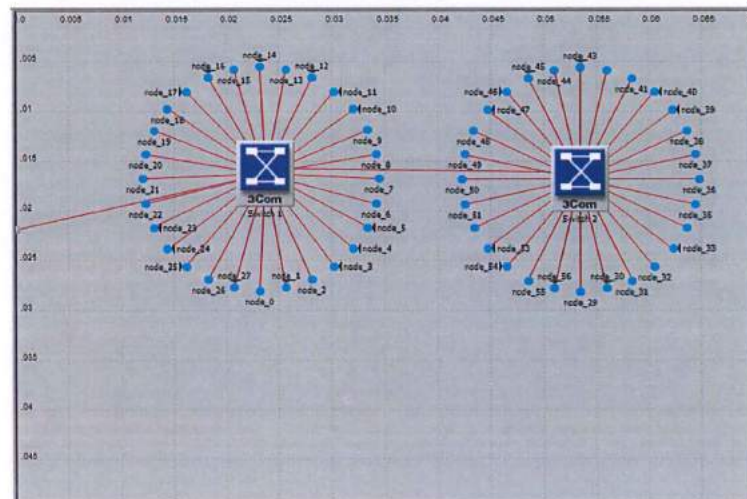


Figure 8: KOLEJ KEDIAMAN 1 network distribution to the user on each block

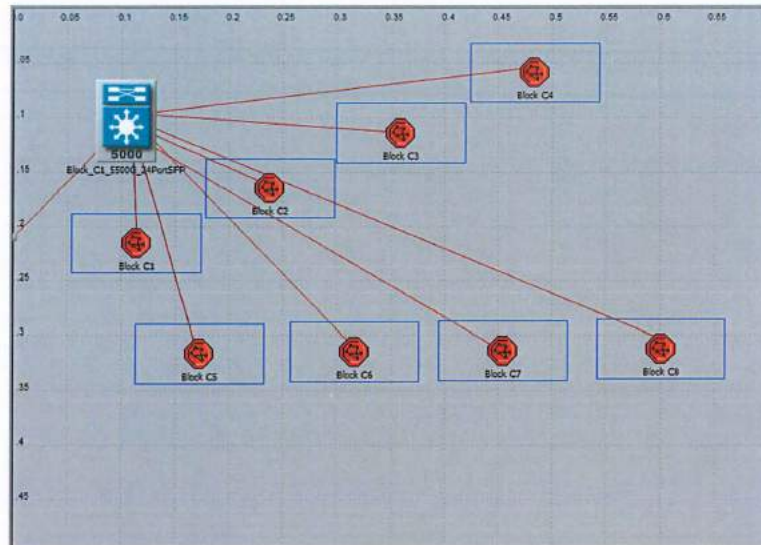


Figure 9: KOLEJ KEDIAMAN 3 block structured view

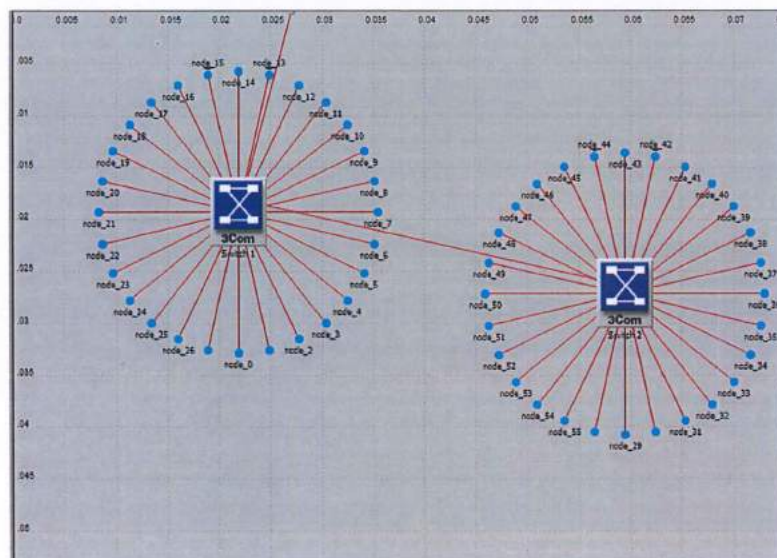


Figure 10: KOLEJ KEDIAMAN 3 Network Distribution to the User on Each Block

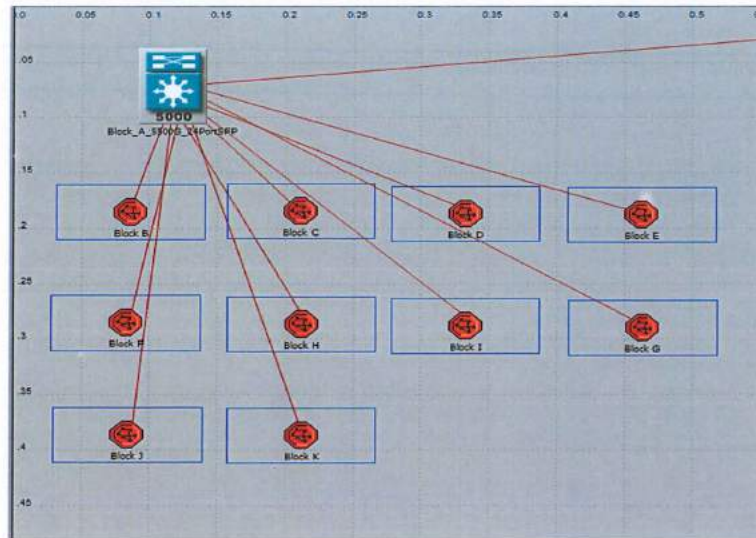


Figure 11: KOLEJ KEDIAMAN 2 F1 network block structured covered

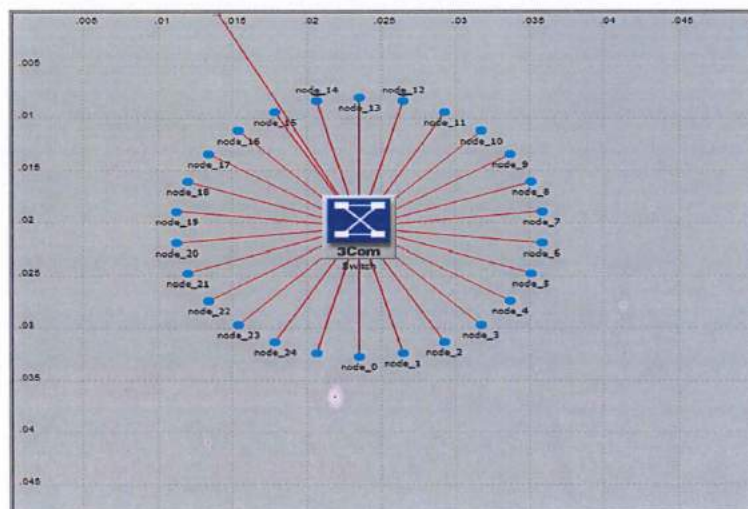


Figure 12: KOLEJ KEDIAMAN 2 F1 network distribution each block

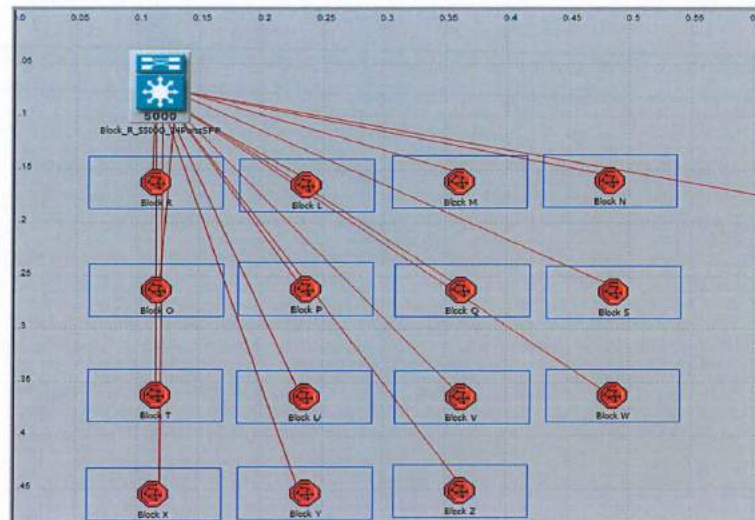


Figure 13: KOLEJ KEDIAMAN 2 F2 network block structured covered

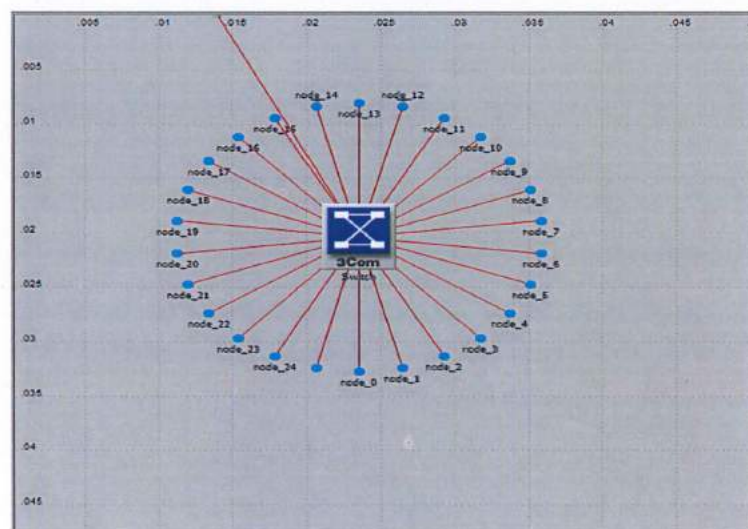


Figure 14: KOLEJ KEDIAMAN 2 F2 network distribution each block

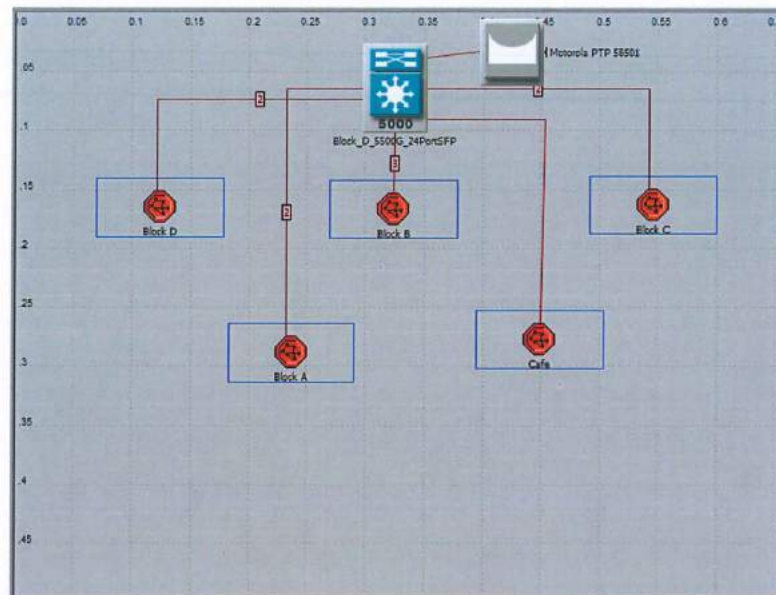


Figure 15: KOLEJ KEDIAMAN 4 block structured

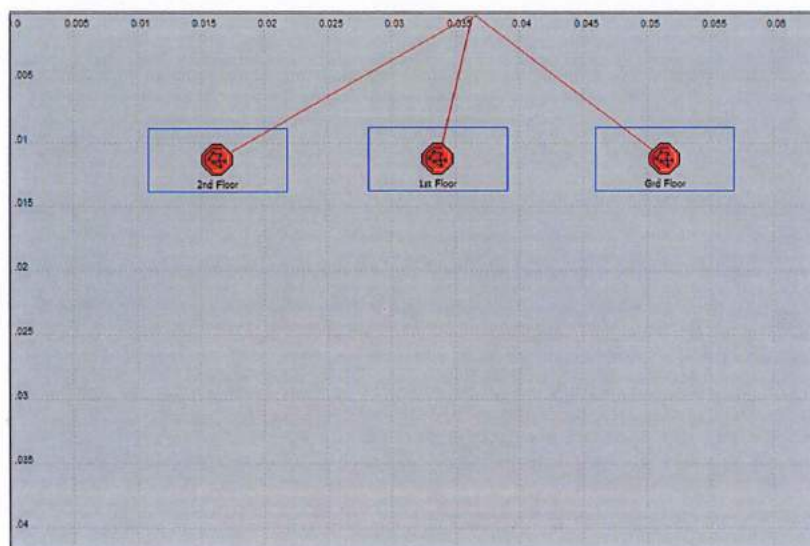


Figure 16: KOLEJ KEDIAMAN 4 block floor

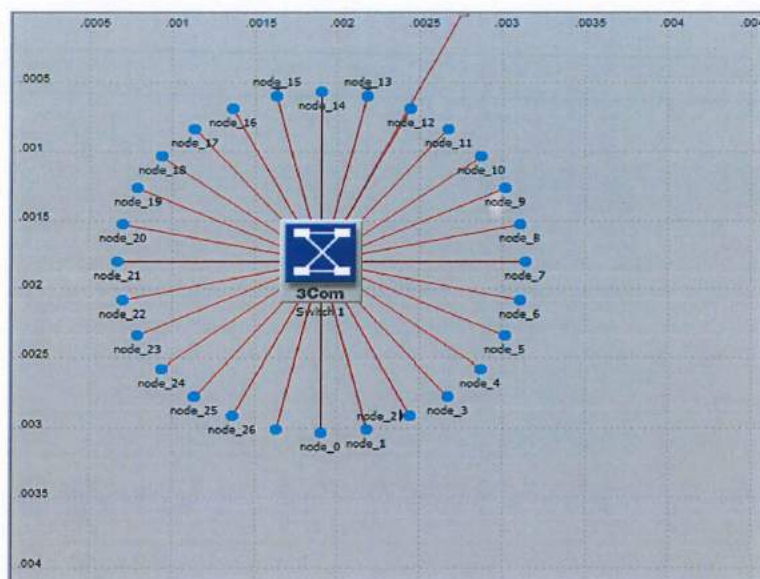


Figure 17: KOLEJ KEDIAMAN 4 for the 2nd floor distribution

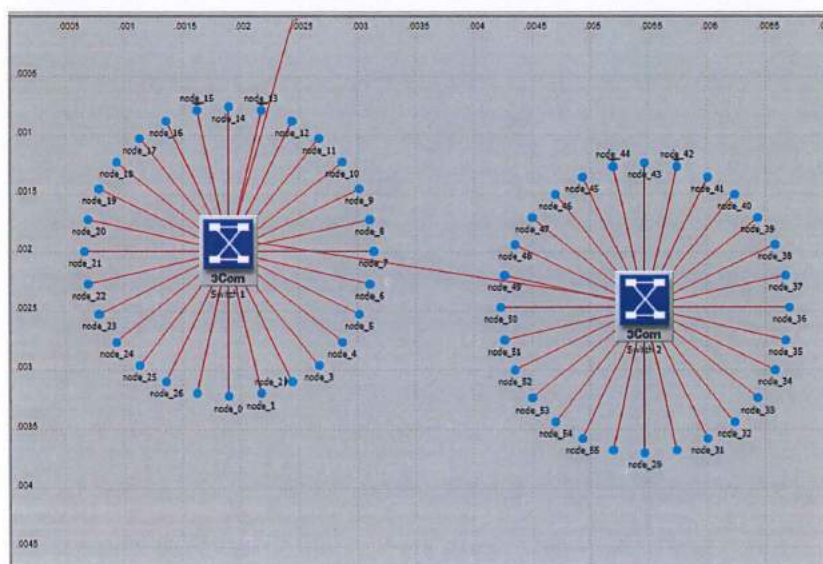


Figure 18: KOLEJ KEDIAMAN 4 for the 1st floor distribution

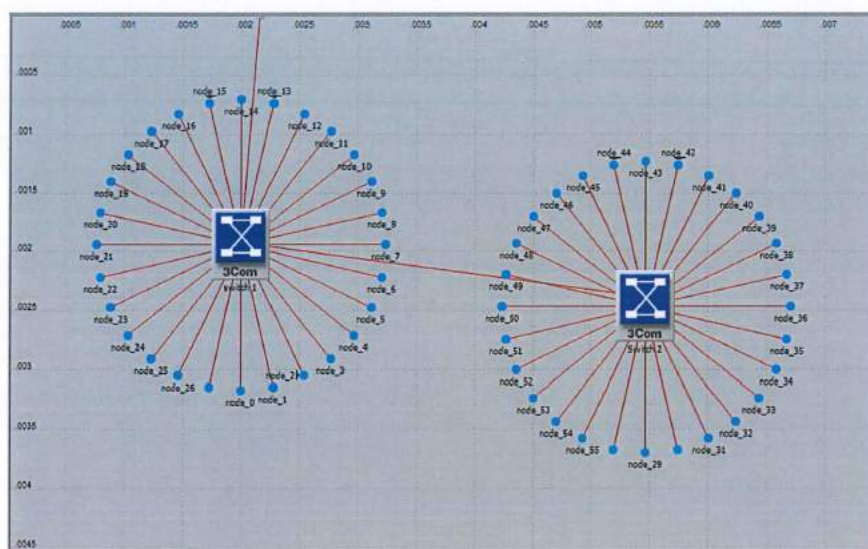


Figure 19: KOLEJ KEDIAMAN 4 for the ground floor distribution

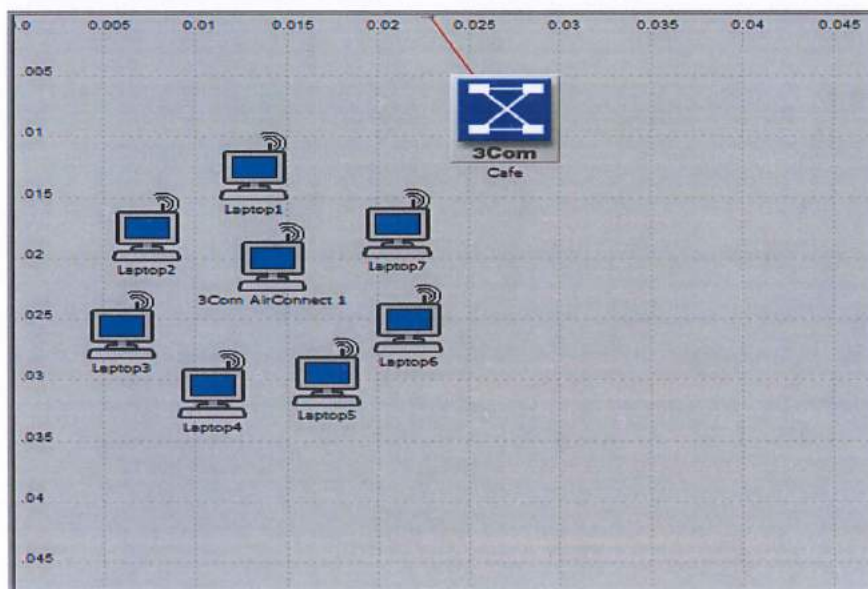


Figure 20: KOLEJ KEDIAMAN 4 wireless coverage at cafe

4.4.3 Current Network Designs for the Focus Area

For this research, the focus area is on the wireless transmission technology. According to the current network design, there is only at KOLEJ KEDIAMAN 4 café was covered the wireless means KOLEJ KEDIAMAN 4 café only was provided the wireless. The wireless access point used at the café to provide the wireless connection to the user is 3Com AirConnect 9550. The transmission technology for the 3Com AirConnect 9550 is Orthogonal Frequency Division Multiplexing (OFDM).

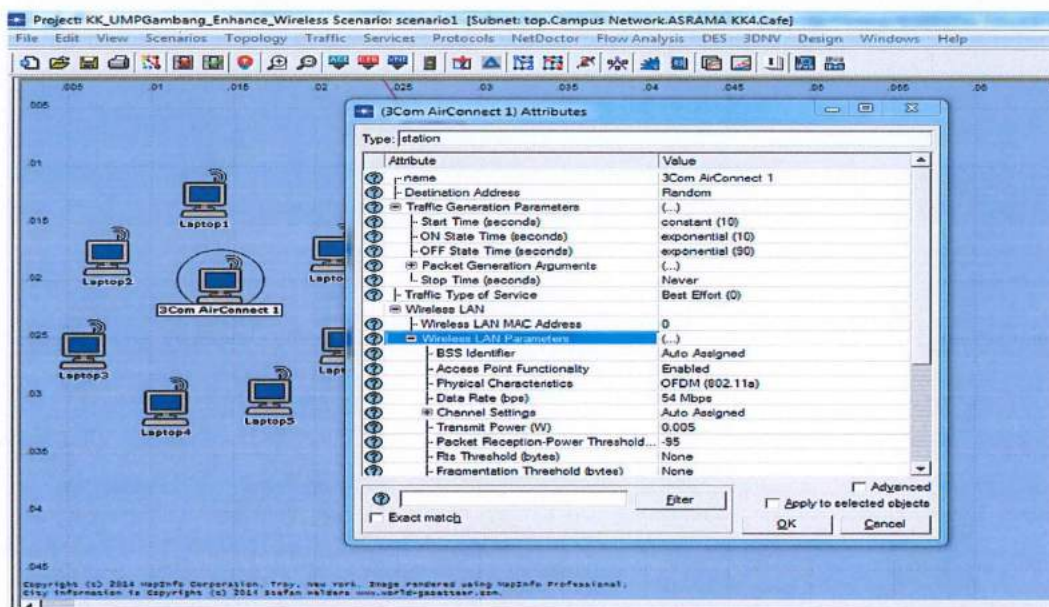


Figure 21: KOLEJ KEDIAMAN 4 wireless parameter setting for the testing

For the simulation, the wireless access point was placed at café area. The wireless was set with parameters according to the 3Com AirConnect 9550 which used orthogonal Frequency Division Multiplexing (OFDM). The data rate is set to the maximum value, which is 54Mbps.

4.5 THE NETWORK DESIGN WITH THE DIFFERENT WIRELESS PARAMETERS FOR THE ENCHANCEMENT TESTING

4.5.1 Parameters And Wireless Setup For The Enhancement Testing For Direct Sequence Transmission Technology

Table 5: Traffic Generation Parameters

Attribute	Value
Start Time (seconds)	Constant(10)
On State Time (seconds)	Constant(600)
Off State Time (seconds)	Constant(0)
Interval Time (seconds)	0.004
Packet Size (bytes)	512
Stop Time (seconds)	Never

Table 6: WLAN Parameters

Attribute	Value
BSS Identifier	Auto Assigned
Access Point Functionality	Enable
Physical Characteristics	Direct Sequence
Data Rate	1Mbps, 2Mbps, 5.5Mbps, 11Mbps
Channel Setting	Auto Assigned
Buffer Size (bits)	2560000

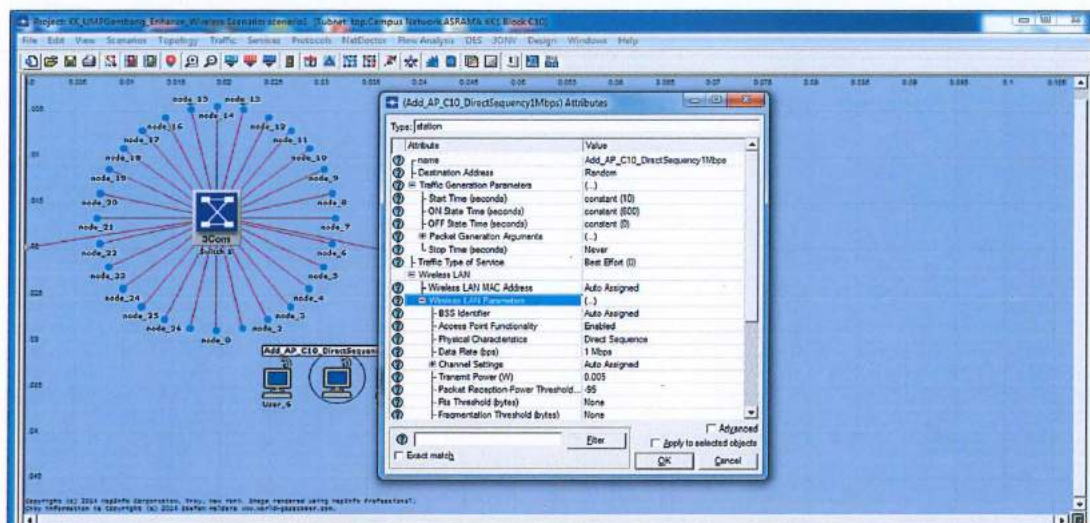


Figure 22: The wireless design with Direct Sequence transmission technology and 1Mbps data rate parameters

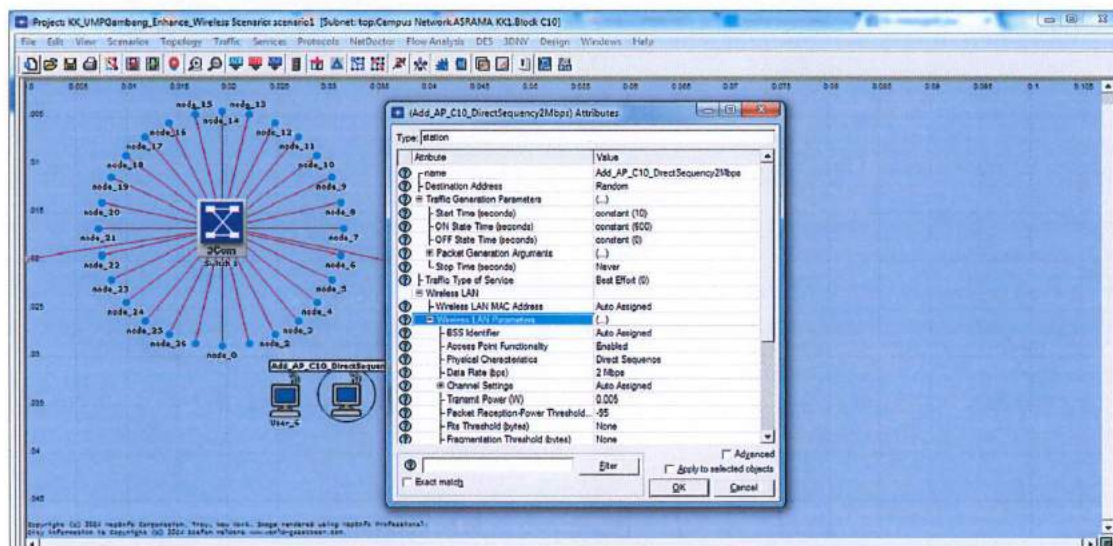


Figure 23: The wireless design with Direct Sequence transmission technology and 2Mbps data rate parameters

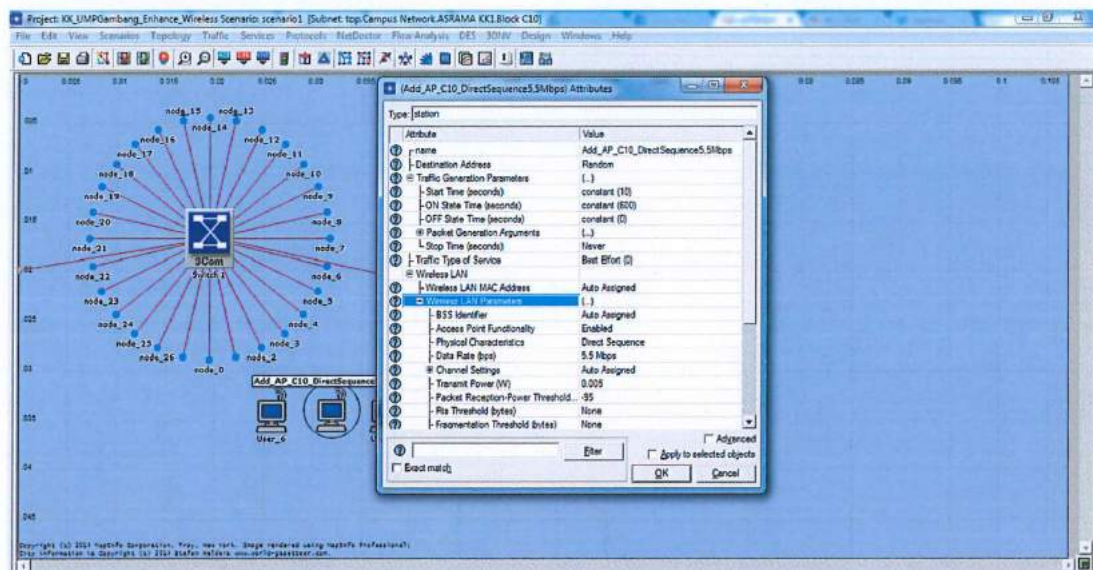


Figure 24: The wireless design with Direct Sequence transmission technology and 5.5Mbps data rate parameters

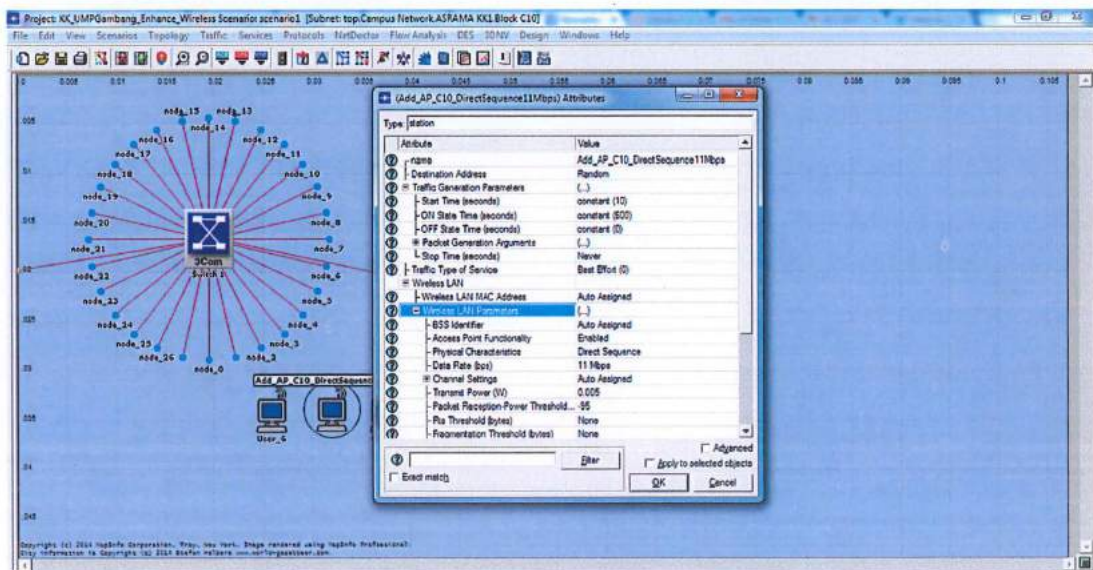


Figure 25: The wireless design with Direct Sequence transmission technology and 11Mbps data rate parameters

4.5.2 Parameters And Wireless Setup For The Enhancement Testing For Frequency Hopping Transmission Technology

Table 7: Traffic Generation Parameters

Attribute	Value
Start Time (seconds)	Constant(10)
On State Time (seconds)	Constant(600)
Off State Time (seconds)	Constant(0)
Interval Time (seconds)	0.004
Packet Size (bytes)	512
Stop Time (seconds)	Never

Table 8: WLAN Parameters

Attribute	Value
BSS Identifier	Auto Assigned
Access Point Functionality	Enable
Physical Characteristics	Frequency Hopping
Data Rate	1Mbps, 2Mbps
Channel Setting	Auto Assigned
Buffer Size (bits)	2560000

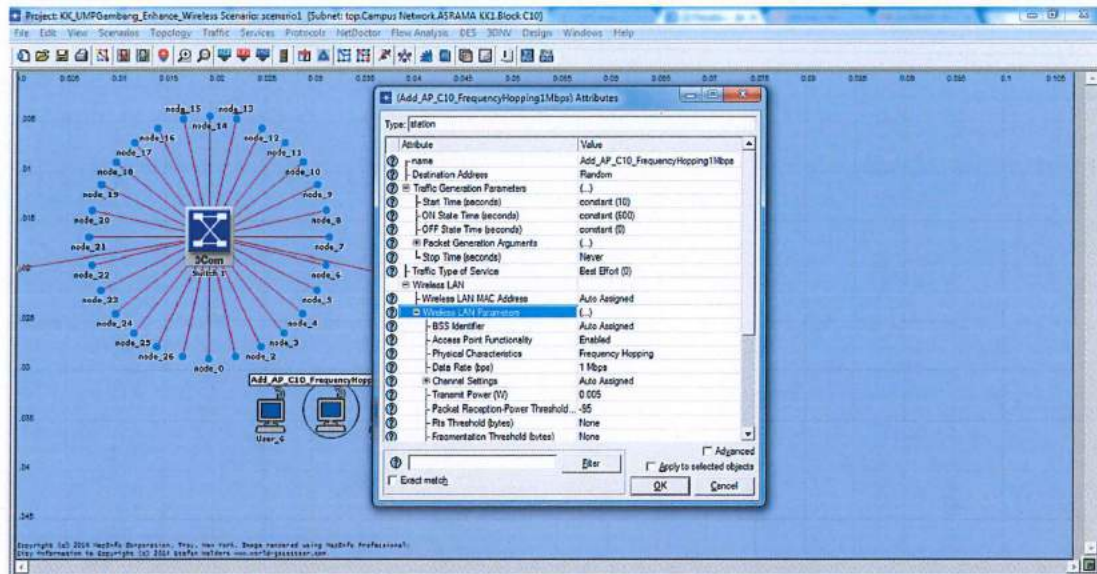


Figure 26: The wireless design with Frequency Hopping transmission technology and 1Mbps data rate parameters

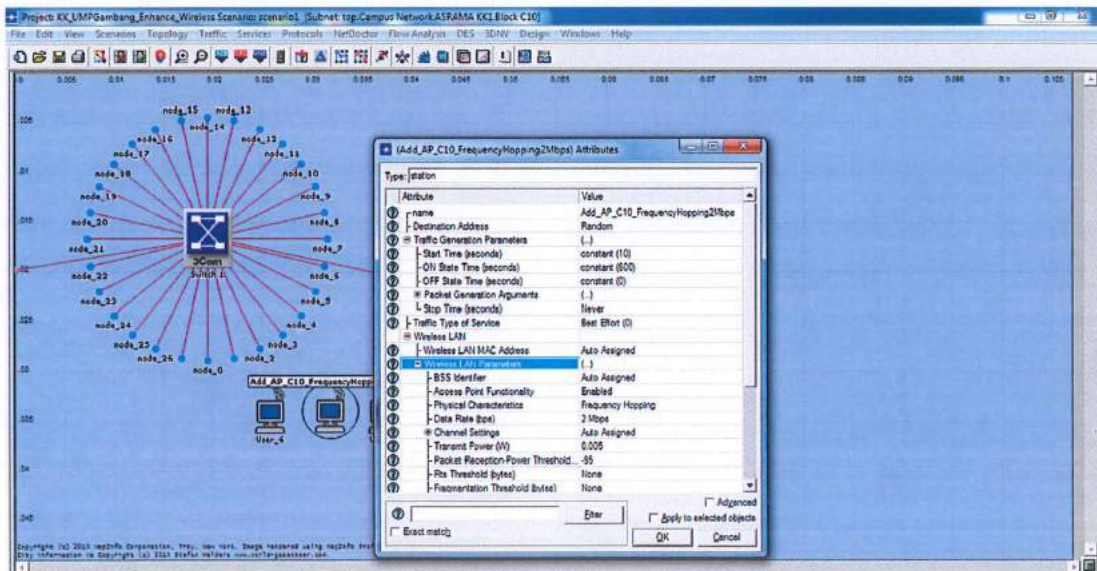


Figure 27: The wireless design with Frequency Hopping transmission technology and 2Mbps data rate parameters

4.5.3 Parameters And Wireless Setup For The Enhancement Testing For Infra-Red Transmission Technology

Table 9: Traffic Generation Parameters

Attribute	Value
Start Time (seconds)	Constant(10)
On State Time (seconds)	Constant(600)
Off State Time (seconds)	Constant(0)
Interval Time (seconds)	0.004
Packet Size (bytes)	512
Stop Time (seconds)	Never

Table 10: WLAN Parameters

Attribute	Value
BSS Identifier	Auto Assigned
Access Point Functionality	Enable
Physical Characteristics	Infra-Red
Data Rate	1Mbps, 2Mbps
Channel Setting	Auto Assigned
Buffer Size (bits)	2560000

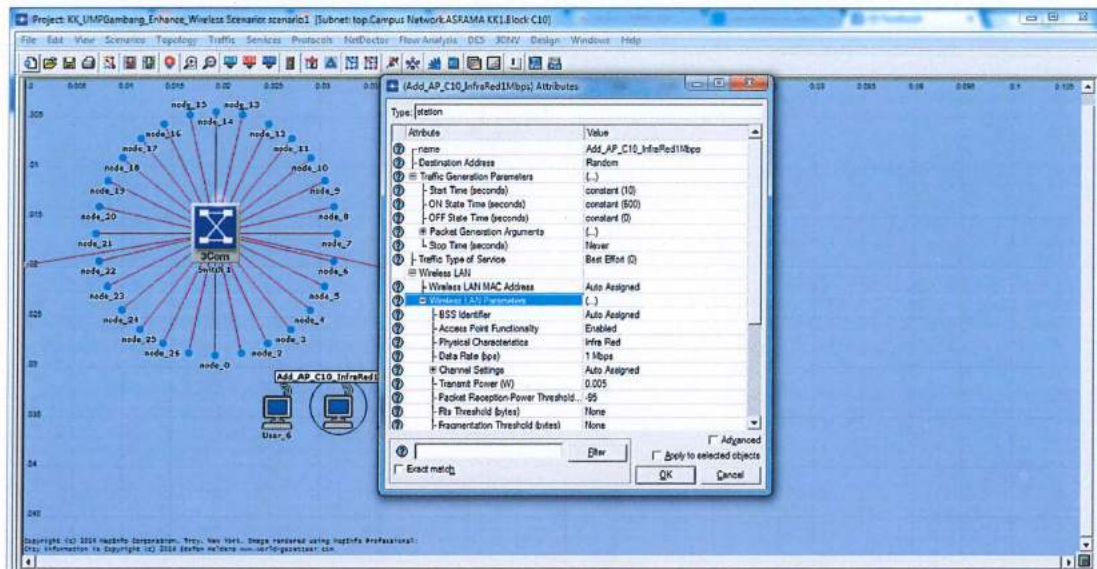


Figure 28: The wireless design with Infra-Red transmission technology and 1Mbps data rate parameters

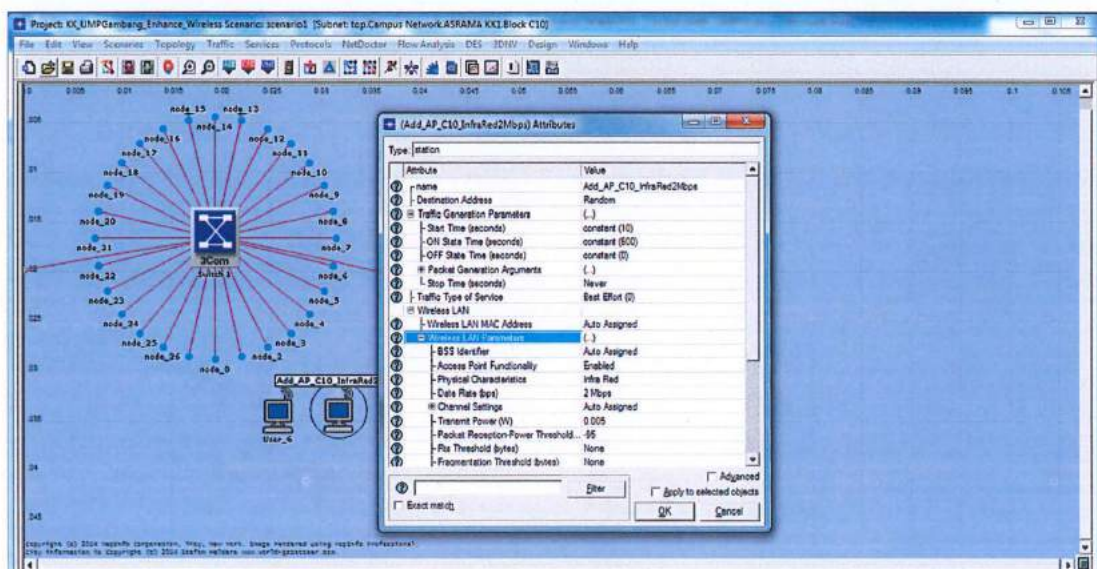


Figure 29: The wireless design with Infra-Red transmission technology and 2Mbps data rate parameters

4.6 THE ENCHANCEMENT SUGGESTIONS REGARDING THE WIRELESS ARCHITECTURE TO APPLY AT STUDENTS RESIDENTIAL COLLEGE.

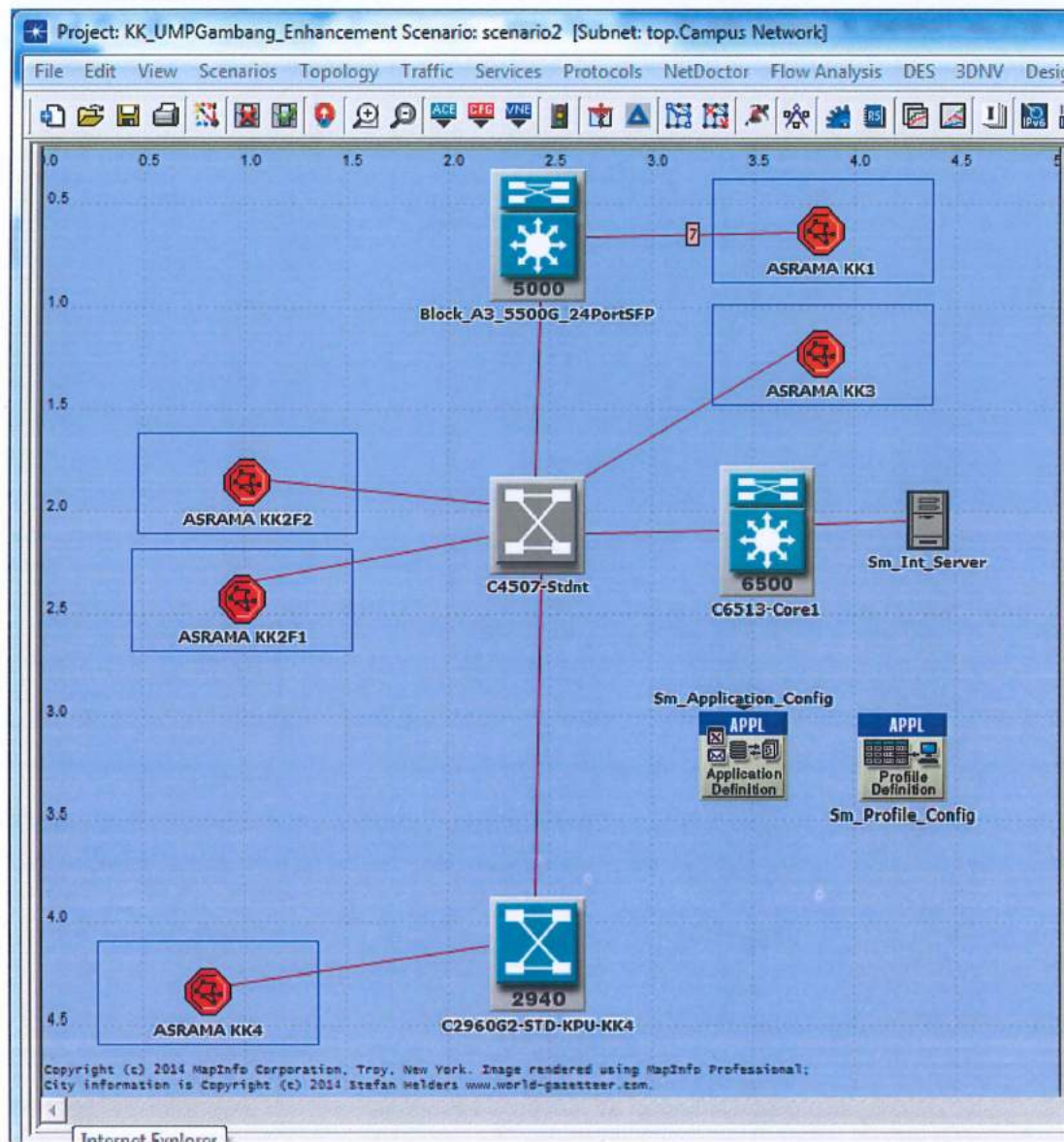


Figure 30: Main Interface Enhancement with Single Mode Fiber (10 base LR)

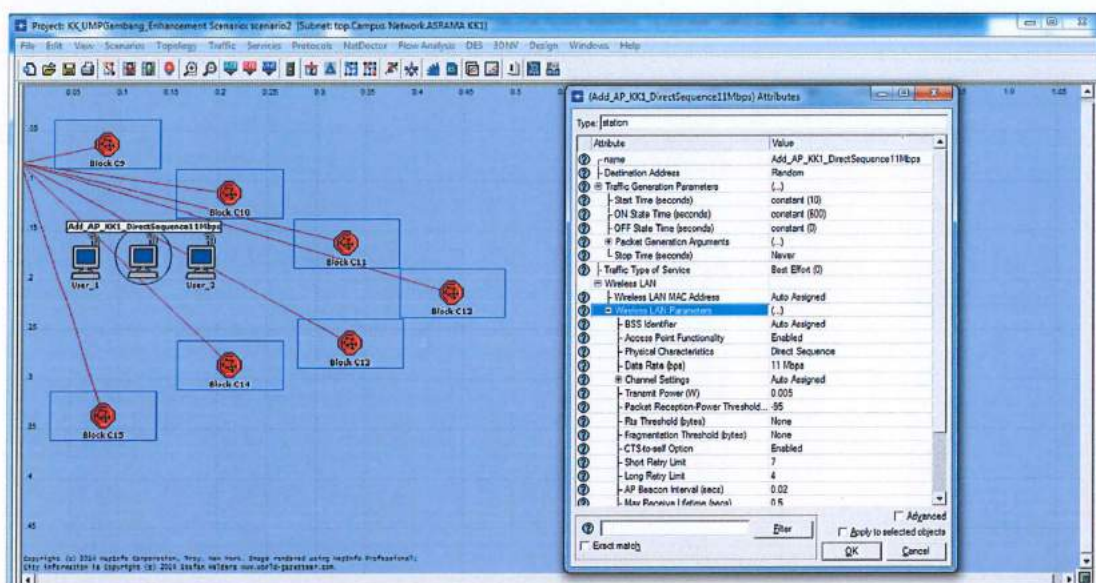


Figure 31: KK1 Enhancement with Direct Sequence transmission technology and 11Mbps data rate parameters

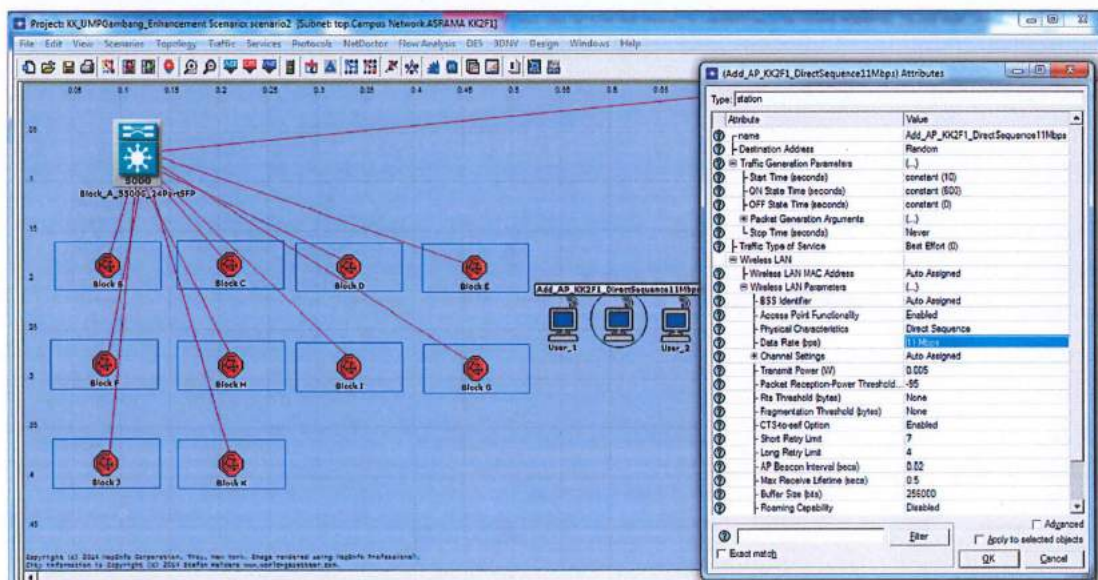


Figure 32: KK2F1 Enhancement with Direct Sequence transmission technology and 11Mbps data rate parameters

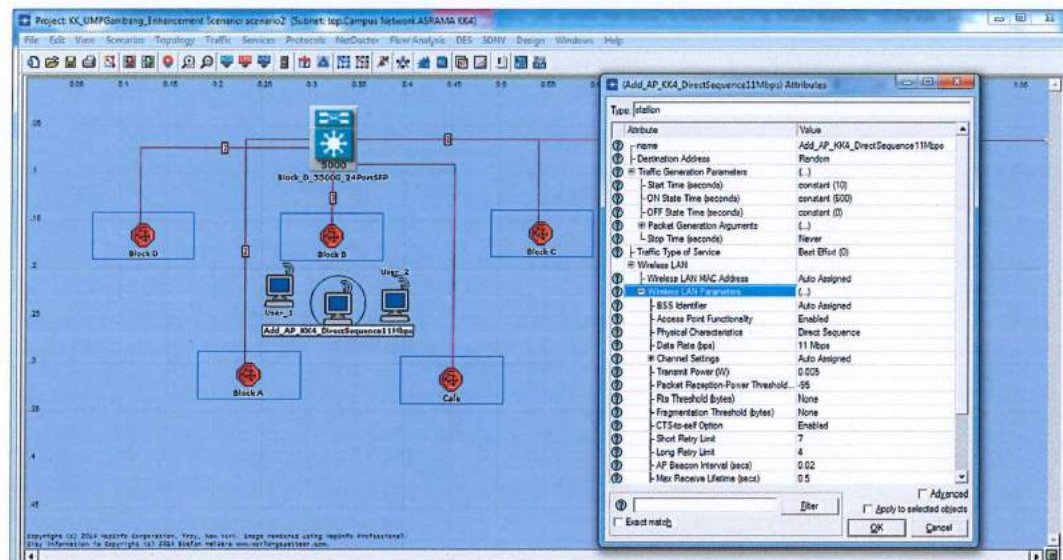


Figure 35: KK4 Enhancement with Direct Sequence transmission technology and 11Mbps data rate parameters

CHAPTER 5

DISCUSSION

5.0 WLAN TRANSMISSION TECHNOLOGY

The main transmission technology for WLAN is spread spectrum and infrared. Frequency hopping (FHSS) and Direct Sequence (DSSS) modulation are two methods used by spread spectrum transmission.

At the physical layer, the IEEE 802.11 defines the three physical techniques for wireless local area networks: diffused infrared (IR), frequency hopping spread spectrum (FH or FHSS) and Direct sequence spread spectrum (DS or DSSS). While the infrared technique operates at the baseband, the other two radio based techniques operate in the 2.4-GHz band. They can be used for operating wireless LAN devices without the need for end-user licenses. In order for wireless devices being interoperable, they have to conform to the same PHY standard. All three techniques specify support for 1 Mbps and 2 Mbps data rates.

5.1 FREQUENCY HOPPING SPREAD SPECTRUM (FHSS)

The frequency hopping spread spectrum is analogous to the FM radio transmission. The data signal is superimposed on or carried by a narrow band carrier that can change its frequency. The IEEE 802.11 standard provides 22 hop patterns, or frequency shifts, to choose from the 2.4 GHz ISM band. Each channel is on 1 MHz, and the signal must shift frequency or hop at a fixed hop rate. The signal hops from one frequency to another within a given frequency range. The transmitter device listens to a channel, and if it detects an idle time it transmits the data using the full channel bandwidth. If the channel is full, it hops to another channel and repeats the process. This technique splits the bandwidth into many small sub channels (1MHz). The signal then hops from sub channel to sub channel transmitting short bursts of data on each channel for a set period of time, called the dwell time. The hopping sequence must be synchronized at the sender and the receiver or information is lost. The FCC requires that the band is split into at least 75 sub channels and that the dwell time is no longer than 400ms. Frequency hopping is less susceptible to interference because the frequency is constantly shifting. This makes frequency hopping systems extremely difficult to intercept. The receiver must be set to the same hopping code and must listen to the incoming signal at the right time and the correct frequency in order to properly receive the signal. This feature gives FH systems a high degree of security. In order to jam a frequency hopping system the whole band must be jammed. These features are very attractive to agencies involved with law enforcement or the military. Many FHSS LANs can be co-located if an orthogonal hopping sequence is used. Because the sub channels are smaller than in DSSS, the number of co-located LANs can be greater with FHSS systems. Most new products in wireless LAN technology are currently being developed with FHSS technology. Some examples are Wave Access's Jaguar, Proxim RangeLAN2, and Breeze Com's Breeze Net Pro.

Retrieved from webopedia.com

5.1.1 Frequency Hopping Spread Spectrum 1Mbps Results

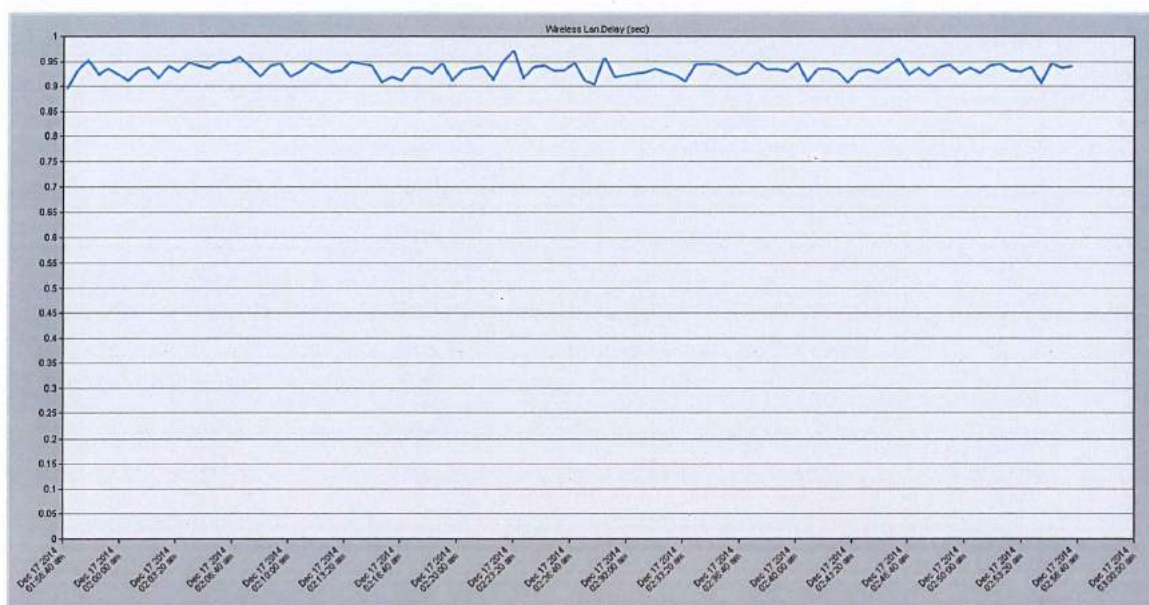


Figure 36: Delay Frequency Hopping Spread Spectrum Result at 1Mbps

The above figure shows the delay result for frequency hopping spread spectrum at 1Mbps transfer rate. The result shows the minimum delay value is starting under 0.9 seconds and the maximum value is more than 0.95 seconds. The average delay value is around 0.9 to 0.95 seconds. The graph also shows the delay pattern is not consistent.

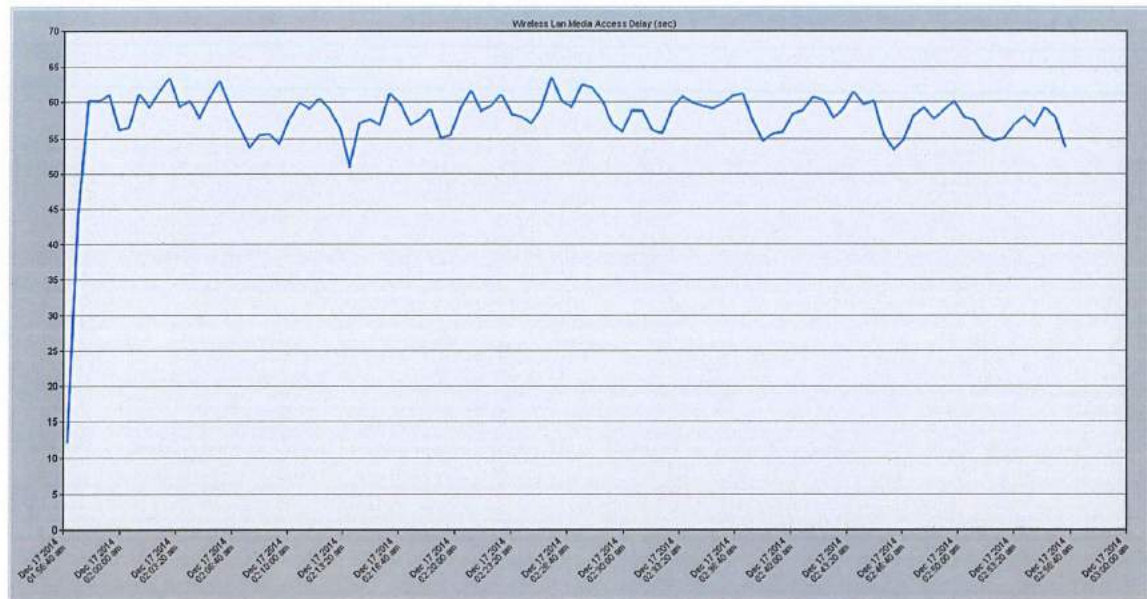


Figure 37: Media Access Delay Frequency Hopping Spread Spectrum Result at 1Mbps

The above figure shows the media access delay result for frequency hopping spread spectrum at 1Mbps transfer rate. The result shows the media access delay start around 12 seconds and the maximum value is around 64 seconds. The average value for media access delay is around 55 to 60 seconds. The graft also shows the media access delay pattern is not consistent.

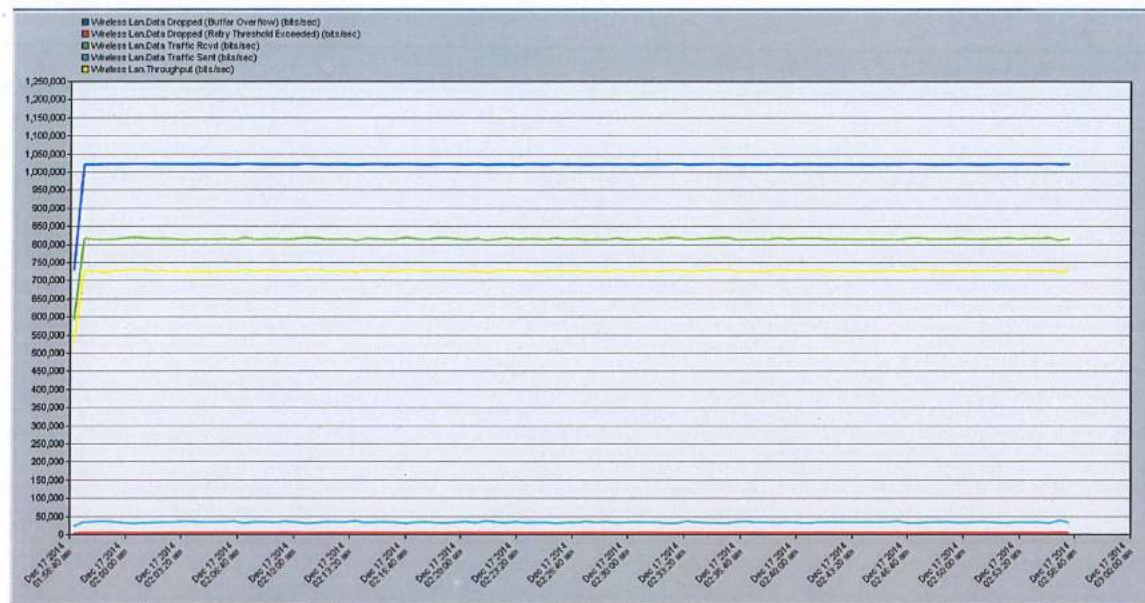


Figure 38: Data Dropped, Data Traffic Received, Data Traffic Sent and Throughput
Result of Frequency Hopping Spread Spectrum Result at 1Mbps

The above figure shows the data dropped, data traffic received, data traffic sent and throughput result for frequency hopping spread spectrum at 1Mbps transfer rate. The data dropped for frequency hopping spread spectrum is around 1 025 000 bits per seconds and the graph shows it is horizontal. The data traffic received for frequency hopping spread spectrum 1Mbps is about 815 000 bits per seconds. The data traffic sent for frequency hopping spread spectrum is around 40 000 bits per seconds and the throughput is about 725 000 bits per seconds. The graph of data traffic received, data traffic sent and throughput shows the inconsistency which sometimes it was increasing and sometimes it decreasing.

5.1.2 Frequency Hopping Spread Spectrum 2Mbps Results



Figure 39: Delay Frequency Hopping Spread Spectrum Result at 2Mbps

The above figure shows the delay result for frequency hopping spread spectrum at 2Mbps transfer rate. The result shows the minimum delay value is starting under 0.44 seconds and the maximum value is about 0.45 seconds. The average delay value is around 0.44 seconds. The graft also shows the delay pattern is not consistent.

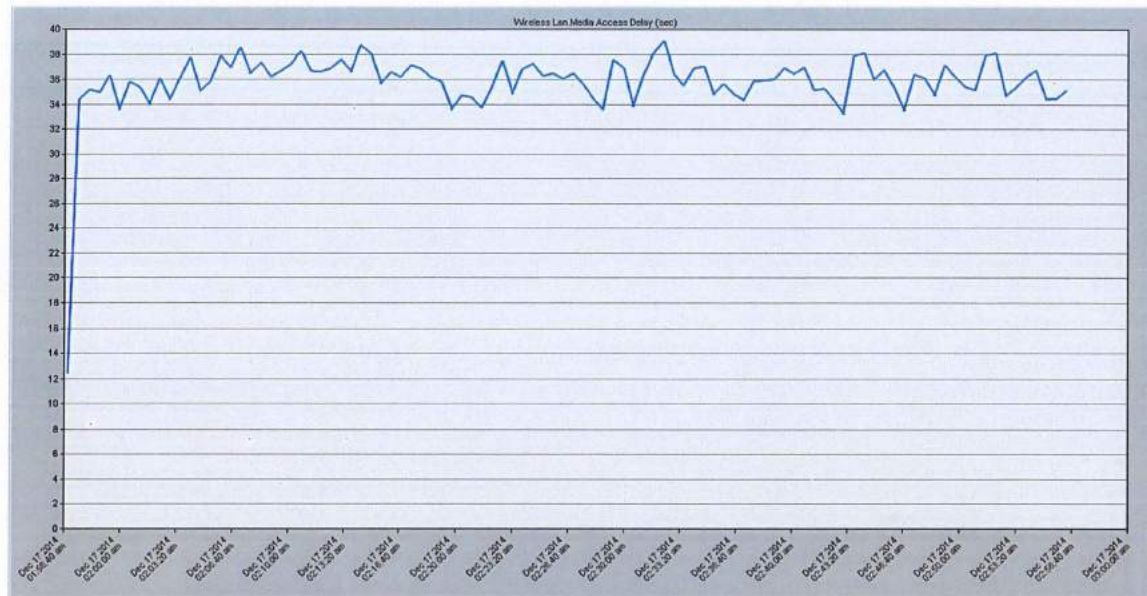


Figure 40: Media Access Delay Frequency Hopping Spread Spectrum Result at 2Mbps

The figure shows the media access delay result for frequency hopping spread spectrum at 2Mbps transfer rate. The result shows the media access delay start around 12.5 seconds and increasing to the maximum value is around 39 seconds. The average value for media access delay is around 34 to 38 seconds. The graft also shows the media access delay pattern is not consistent.



Figure 41: Data Dropped, Data Traffic Received, Data Traffic Sent and Throughput
Result of Frequency Hopping Spread Spectrum Result at 2Mbps

The above figure shows the data dropped, data traffic received, data traffic sent and throughput result for frequency hopping spread spectrum at 2Mbps transfer rate. The data dropped for frequency hopping spread spectrum is around 1 020 000 bit per seconds and the graph shows it is horizontal. The data traffic received for frequency hopping spread spectrum 2Mbps is almost 1 400 000 bits per seconds. The data traffic sent for frequency hopping spread spectrum is around 50 000 bits per seconds and the throughput is about 1 200 000 bits per seconds. The graph of data traffic received, data traffic sent and throughput shows the inconsistency which sometimes it was increasing and sometimes it decreasing.

5.2 DIRECT SEQUENCE SPREAD SPECTRUM (DSSS)

This method uses a wide frequency band together with Code Division Multiple Access (CDMA). Signals from different units are transmitted at a given frequency range. A code is transmitted with each signal so that the receiver can identify the appropriate signal transmitted by the sender unit. The power levels of these signals are very low, just above background noise. Spread spectrum was first developed by the military as a secure wireless technology. It modulates a radio signal in a pseudo-random manner, and so it is difficult to decode. With a direct sequence spread spectrum the transmission signal is spread over an allowed band (for example 25MHz). A random binary string is used to modulate the transmitted signal. This random string is called the spreading code. The data bits are mapped into a pattern of "chips" and mapped back into a bit at the destination. The number of chips that represent a bit is the spreading ratio. The higher the spreading ratio, the more the signal is resistant to interference. The lower the spreading ratio, the more bandwidth is available to the user.

The FCC dictates that the spreading ratio must be more than ten. Most products have a spreading ratio of less than 20 and the new IEEE 802.11 standard requires a spreading ratio of eleven. The transmitter and the receiver must be synchronized with the same spreading code. If orthogonal spreading codes are used, then more than one LAN can share the same band. DSSS used in LAN transmissions where a data signal at the sending station is combined with a higher data rate, bit sequence, or chipping code, that divides the user data according to a spreading ratio. The chipping code is a redundant bit pattern for each bit that is transmitted, which increases the signal's resistance to interference. If one or more bits in the pattern are damaged during transmission, the original data can be recovered due to the redundancy of the transmission. Recovery is faster in DSSS systems because of the ability to spread the signal over a wider band.

Current DSSS products include Digital's RoamAbout and NCR's WaveLAN. Article from webopedia.com

5.2.1 Direct Sequence Spread Spectrum (DSSS) 1Mbps Results



Figure 42: Delay Result of Direct Sequence Spread Spectrum at 1Mbps

The figure shows the delay result for direct sequence spread spectrum at 1Mbps transfer rate. The result shows the minimum delay value start at 0.86 seconds and the maximum value is 0.91 seconds. The average delay value is around 0.88 seconds. The graph also shows the delay pattern is not consistent.

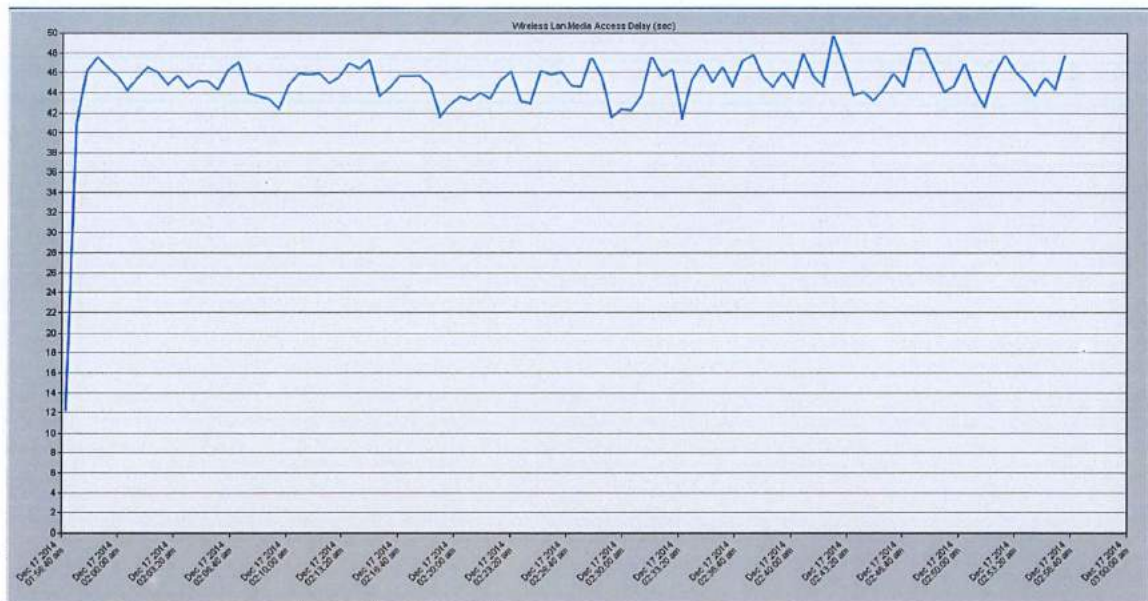


Figure 43: Media Access Delay Result of Direct Sequence Spread Spectrum at 1Mbps

The figure shows the media access delay result for direct sequence spread spectrum at 1Mbps transfer rate. The result shows the media access delay start from 12 seconds and increasing to the maximum value is around 49.5 seconds. The average value for media access delay is around 44 to 47 seconds. The graft also shows the media access delay pattern is not consistent.

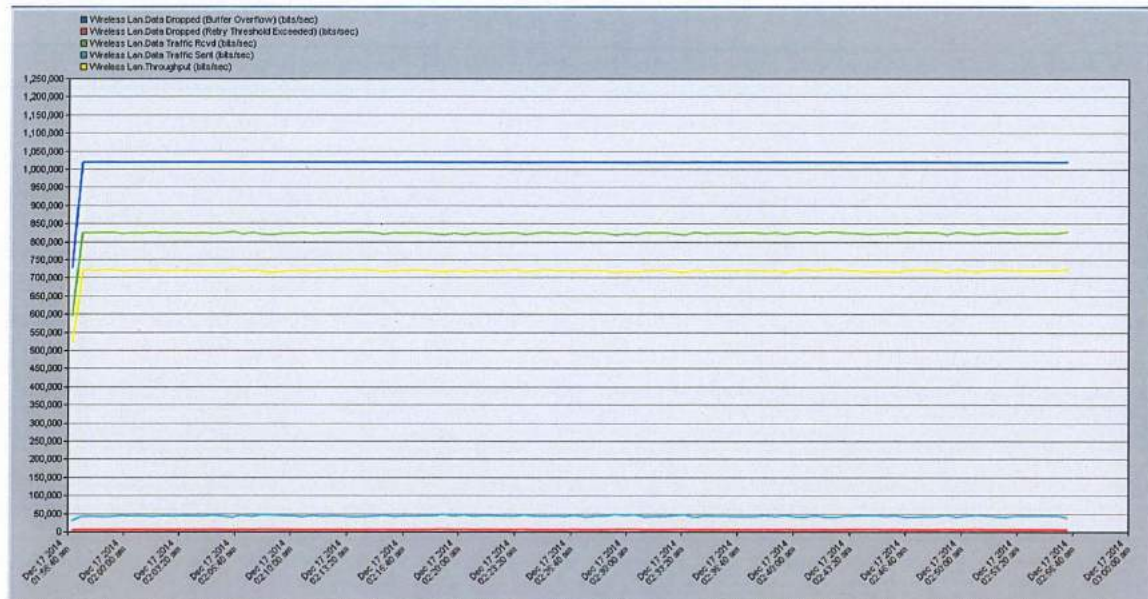


Figure 44: Data Dropped, Data Traffic Received, Data Traffic Sent and Throughput Result of Direct Sequence Spread Spectrum Result at 1Mbps

The above figure shows the data dropped, data traffic received, data traffic sent and throughput resulting for direct sequence spread spectrum at 1Mbps transfer rate. The data dropped for direct sequence spread spectrum is around 1 020 000 bit per seconds and the graph shows it is horizontal. The data traffic received for direct sequence spread spectrum 1Mbps is around 825 000 bits per seconds. The data traffic sent for direct sequence spread spectrum is around 49 000 bits per seconds and the throughput is about 720 000 bits per seconds. The graph of data traffic received, data traffic sent and throughput shows the inconsistent patterns.

5.2.2 Direct Sequence Spread Spectrum (DSSS) 2Mbps Result

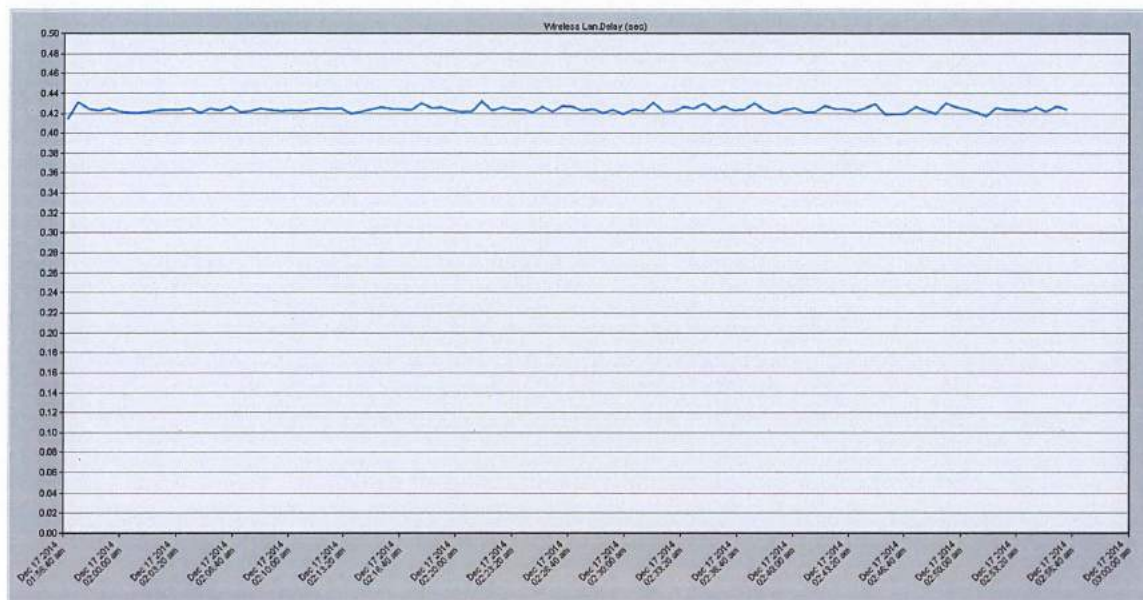


Figure 45: Delay Result of Direct Sequence Spread Spectrum at 2Mbps

The figure shows the delay result for direct sequence spread spectrum at 2Mbps transfer rate. The result shows the minimum delay value is starting below 0.42 seconds and the maximum value is 0.43 seconds. The average delay value is around the minimum and maximum value which is 0.42 to 0.43 seconds. The graph also shows the delay pattern is not consistent.

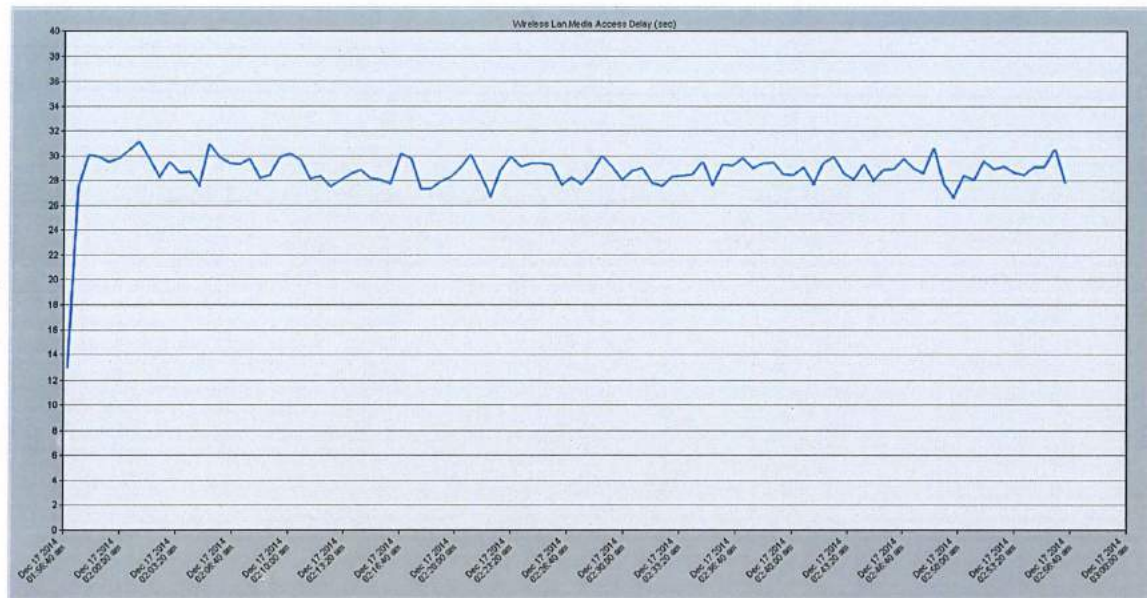


Figure 46: Media Access Delay Result of Direct Sequence Spread Spectrum at 2Mbps

The figure shows the media access delay result for direct sequence spread spectrum at 2Mbps transfer rate. The result shows the media access delay start from 13 seconds and increasing to the maximum value 31 seconds. The average value for media access delay is around 28 to 30 seconds. The graft also shows the media access delay pattern is not consistent.

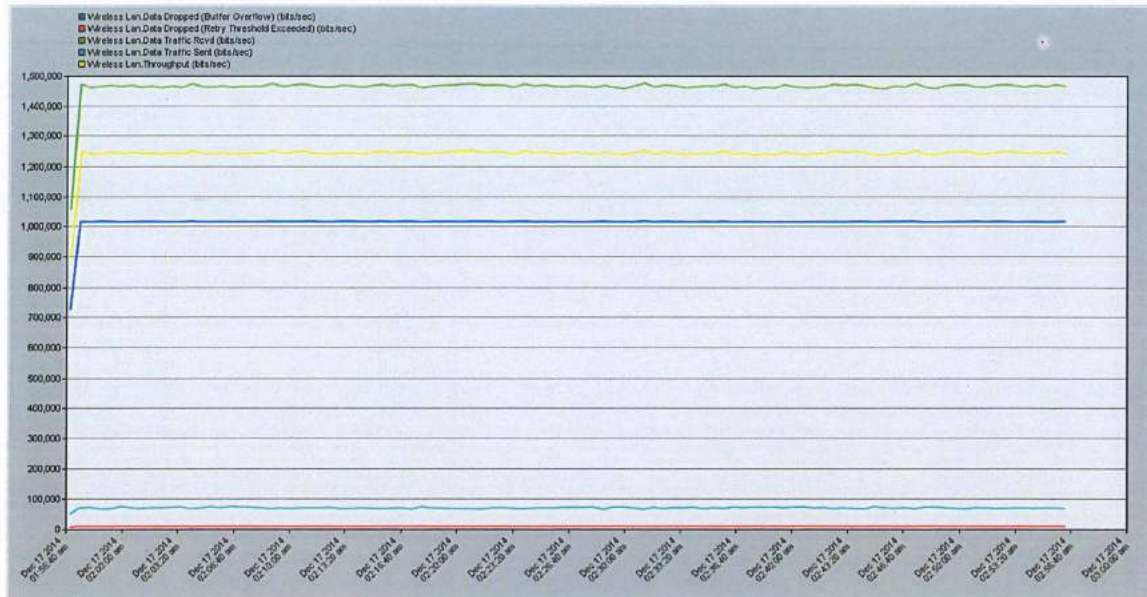


Figure 47: Data Dropped, Data Traffic Received, Data Traffic Sent and Throughput
Result of Direct Sequence Spread Spectrum Result at 2Mbps

The above figure shows the data dropped, data traffic received, data traffic sent and throughput resulting for direct sequence spread spectrum at 2Mbps transfer rate. The data dropped for direct sequence spread spectrum is about 1 020 000 bits per seconds and the graph shows it is horizontal. The data traffic received for direct sequence spread spectrum 2Mbps is around 1 480 000 bits per seconds. The data traffic sent for direct sequence spread spectrum is about 80 000 bits per seconds and the throughput are about 1 250 000 bits per seconds. The graph of data traffic received, data traffic sent and throughput shows the inconsistent patterns.

5.2.3 Direct Sequence Spread Spectrum (DSSS) 5.5Mbps Results

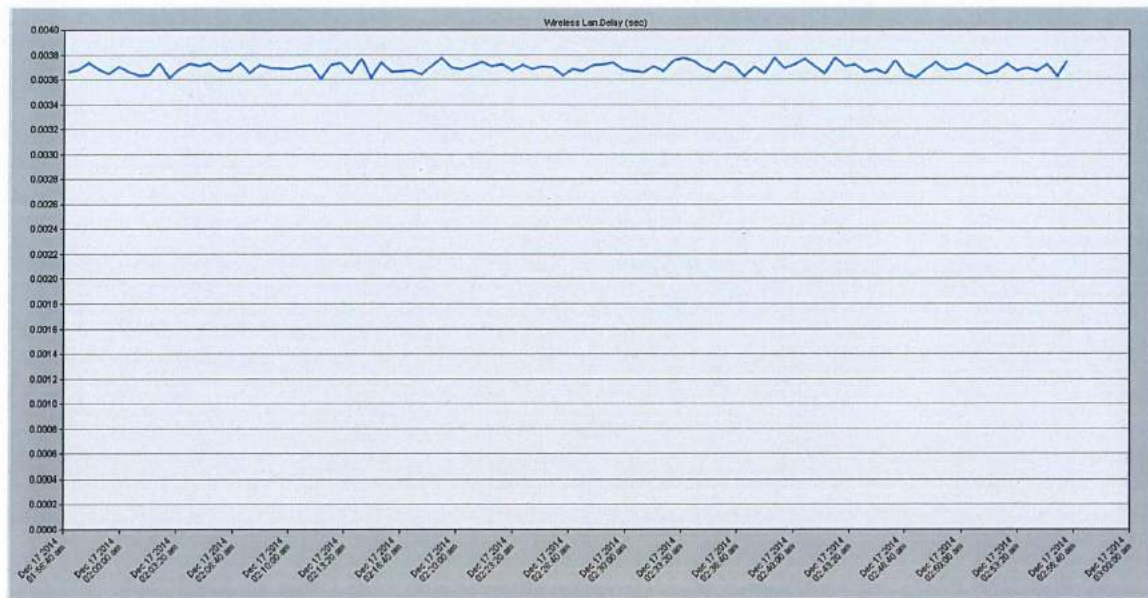


Figure 48: Delay Result of Direct Sequence Spread Spectrum at 5.5Mbps

The figure shows the delay result for direct sequence spread spectrum at 5.5Mbps transfer rate. The result shows the minimum delay value is 0.0036 seconds and the maximum value is 0.0038 seconds. The average delay value is around the minimum and maximum value which is 0.0037 seconds. The graph also shows the delay pattern is not consistent.

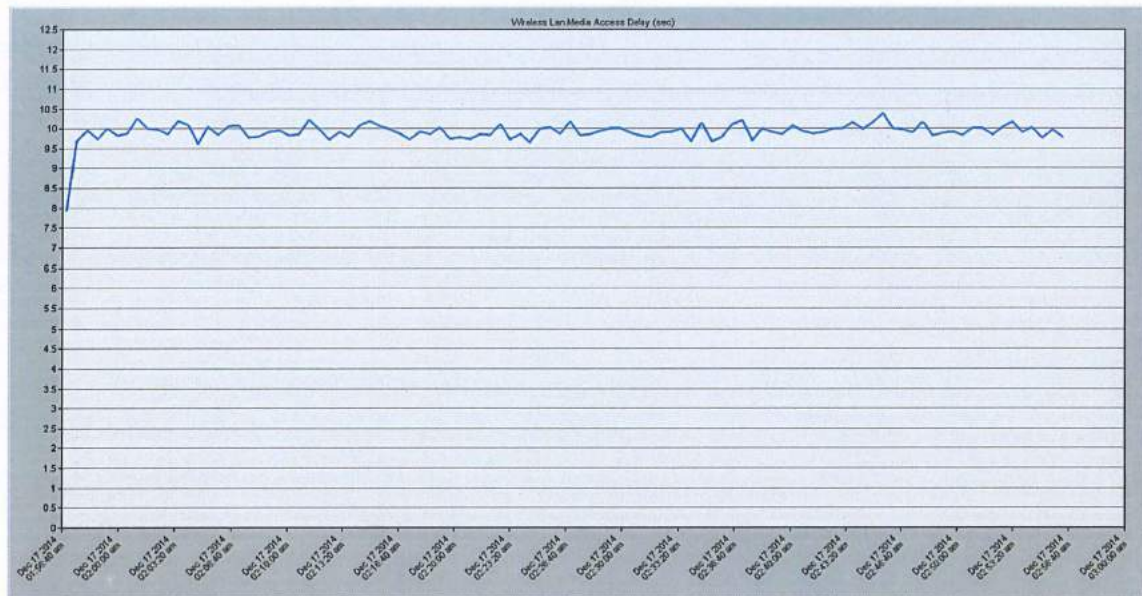


Figure 49: Media Access Delay Result of Direct Sequence Spread Spectrum at 5.5Mbps

The figure shows the media access delay result for direct sequence spread spectrum at 5.5Mbps transfer rate. The result shows the media access delay start from 8 seconds and the maximum value is 10.5 seconds. The average value for media access delay is around 9.7 to 9.9 seconds. The graft also shows the media access delay pattern is not consistent.



Figure 50: Data Dropped, Data Traffic Received, Data Traffic Sent and Throughput
Result of Direct Sequence Spread Spectrum Result at 5.5Mbps

The above figure shows the data dropped, data traffic received, data traffic sent and throughput resulting for direct sequence spread spectrum at 5.5Mbps transfer rate. The data dropped for direct sequence spread spectrum is about 1 000 000 bits per seconds and the graph shows it is horizontal. The data traffic received for direct sequence spread spectrum 5.5Mbps is around 2 600 000 bits per seconds. The data traffic sent for direct sequence spread spectrum is about 225 000 bits per seconds and the throughput are about 2 000 000 bits per seconds. The graph of data traffic received, data traffic sent and throughput shows the inconsistent patterns.

5.2.4 Direct Sequence Spread Spectrum (DSSS) 11Mbps Results

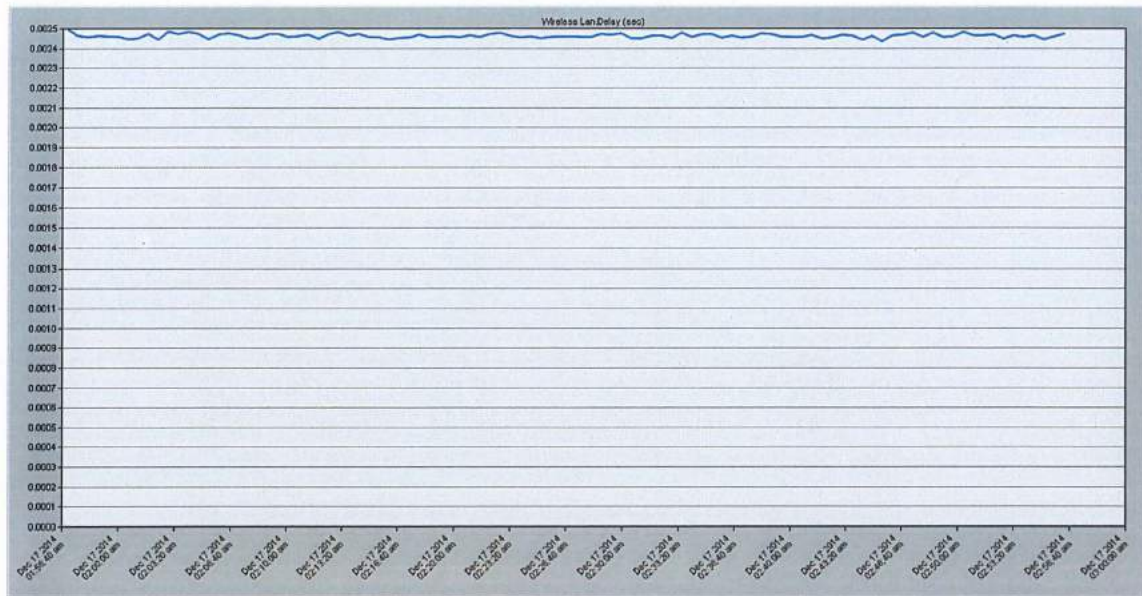


Figure 51: Delay Result of Direct Sequence Spread Spectrum at 11Mbps

The figure shows the delay result for direct sequence spread spectrum at 11Mbps transfer rate. The result shows the minimum delay value is 0.0024 seconds and the maximum value is 0.0025 seconds. The average delay value is around the minimum and maximum value which is 0.0024 to 0.0025 seconds. The graph also shows the delay pattern is not consistent.

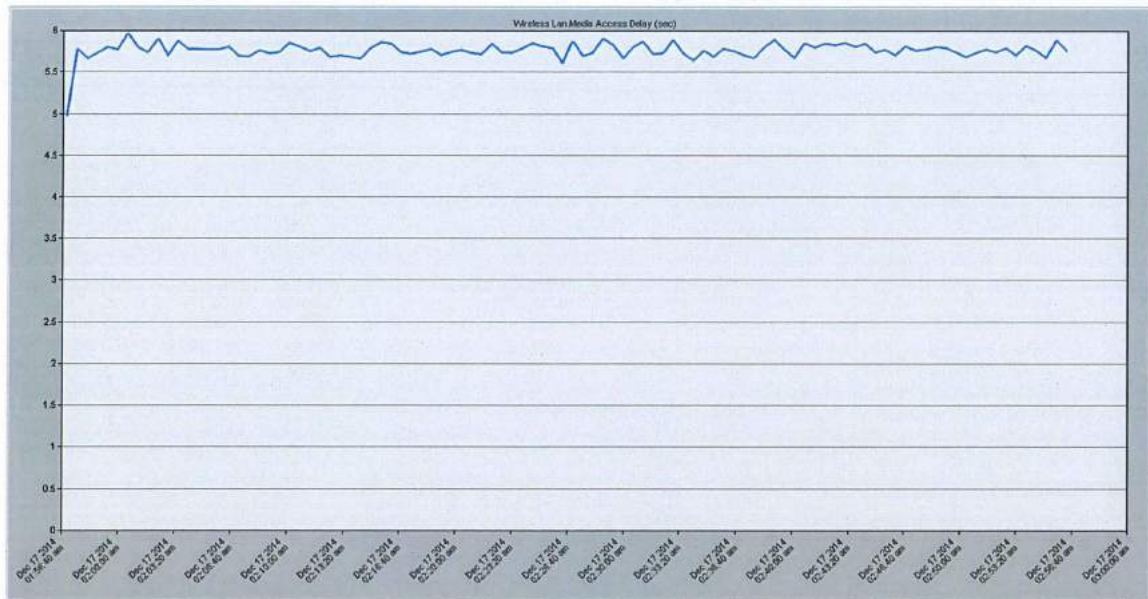


Figure 52: Media Access Delay Result of Direct Sequence Spread Spectrum at 11Mbps

The figure shows the media access delay result for direct sequence spread spectrum at 11Mbps transfer rate. The result shows the media access delay start from 5 seconds and the maximum value is 6 seconds. The average value for media access delay is 5.58 seconds. The graph also shows the media access delay pattern is not consistent.

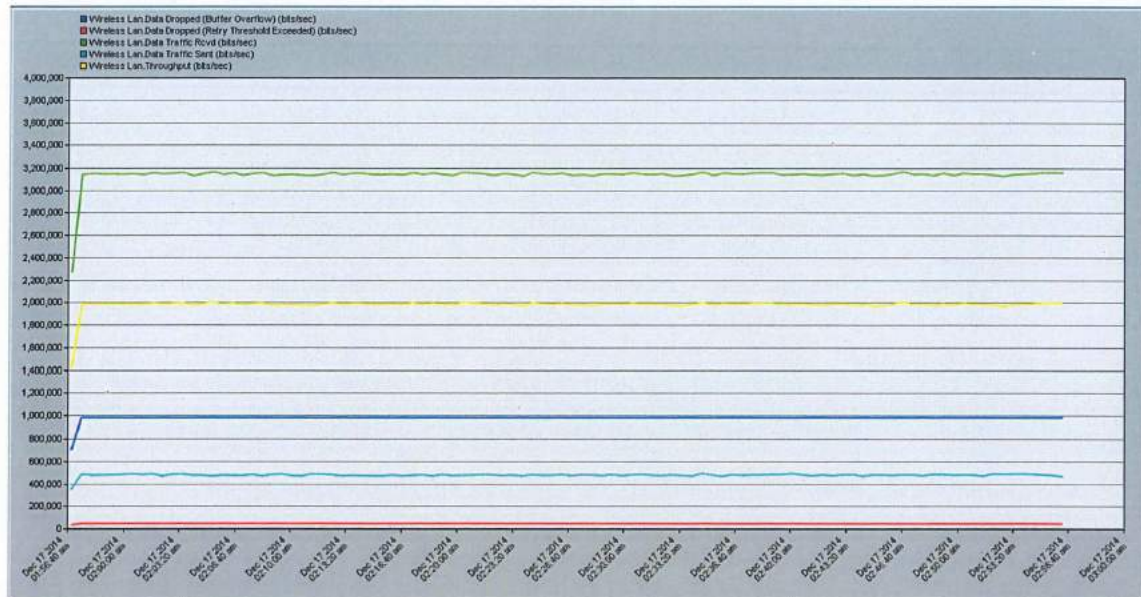


Figure 53: Data Dropped, Data Traffic Received, Data Traffic Sent and Throughput
Result of Direct Sequence Spread Spectrum Result at 11Mbps

The above figure shows the data dropped, data traffic received, data traffic sent and throughput resulting for direct sequence spread spectrum at 11Mbps transfer rate. The data dropped for direct sequence spread spectrum is below 1 000 000 bit per seconds and the graph shows it is horizontal. The data traffic received for direct sequence spread spectrum 11Mbps is around 3 180 000 bits per seconds. The data traffic sent for direct sequence spread spectrum is about 500 000 bits per seconds and the throughput are about 2 000 000 bits per seconds. The graph of data traffic received, data traffic sent and throughput shows the inconsistent patterns.

5.3 INFRA-RED TRANSMISSION

Infrared transmission uses infrared light to carry information. There are three types of infrared transmission, which is diffused, directed and directed point-to-point.

I. Diffused

Infrared light transmitted by the sender unit fills the particular area such as an office. Therefore, the receiver unit located anywhere in that area can receive the signal.

II. Directed

Infrared light is focused before transmitting the signal. This method increases the transmission speed.

III. Directed point-to-point

The directed point-to-point infrared transmission provides the highest transmission speed. Here, the receiver is aligned with the sender unit. The infrared light is then transmitted directly to the receiver.

The light source used in infrared transmission depends on the environment. Light emitting diode (LED) is used in indoor areas, while lasers are used in outdoor areas. Infrared wireless is the use of wireless technology in devices or systems that convey data through infrared (IR) radiation. Infrared is electromagnetic energy at a wavelength or wavelengths somewhat longer than those of red light. The short-wavelength IR borders visible red in the electromagnetic radiation spectrum; the longest-wavelength IR borders radio waves. Some engineers consider IR technology to be a sub-Specialty of optical technology. The hardware is similar, and the two forms of energy behave in much the same way. But strictly define that, "optical" refers to *visible* electromagnetic radiation, while "infrared" is *invisible* to the unaided eye. To compound the confusion, IR is

sometimes called "infrared light". IR wireless is used for short and medium range communications and control. Some systems operate in *line-of-sight mode* means that there must be a visually unobstructed straight line through space between the transmitter (source) and receiver (destination) and some systems operate in *diffuse mode*, also called *scatter mode*. This type of system can function when the source and destination are not directly visible to each other. The example is a television remote-control box. The box does not have to be pointed directly at the set, although the box must be in the same room as the set, or just outside the room with the door open. IR wireless technology is used in intrusion detectors; home-entertainment control units; robot control systems; medium-range, line-of-sight laser communications; cordless microphones, headsets, modems, and printers and other peripherals. Unlike radio-frequency (RF) wireless links, IR wireless cannot pass through walls. Therefore, IR communications or control is generally not possible between different rooms in a house or between different houses in a neighbourhood (unless they have facing windows). This might seem like a disadvantage of IR, but IR wireless is more private than radio frequency (RF) wireless. Some IR wireless schemes, offer a level of security comparable to that of hardwired systems. It is difficult, for example, to eavesdrop on a well-engineered, line-of-sight, IR laser communications link. Article from Margaret Rouse, 2010

5.3.1 Infra-Red Transmission 1Mbps Results

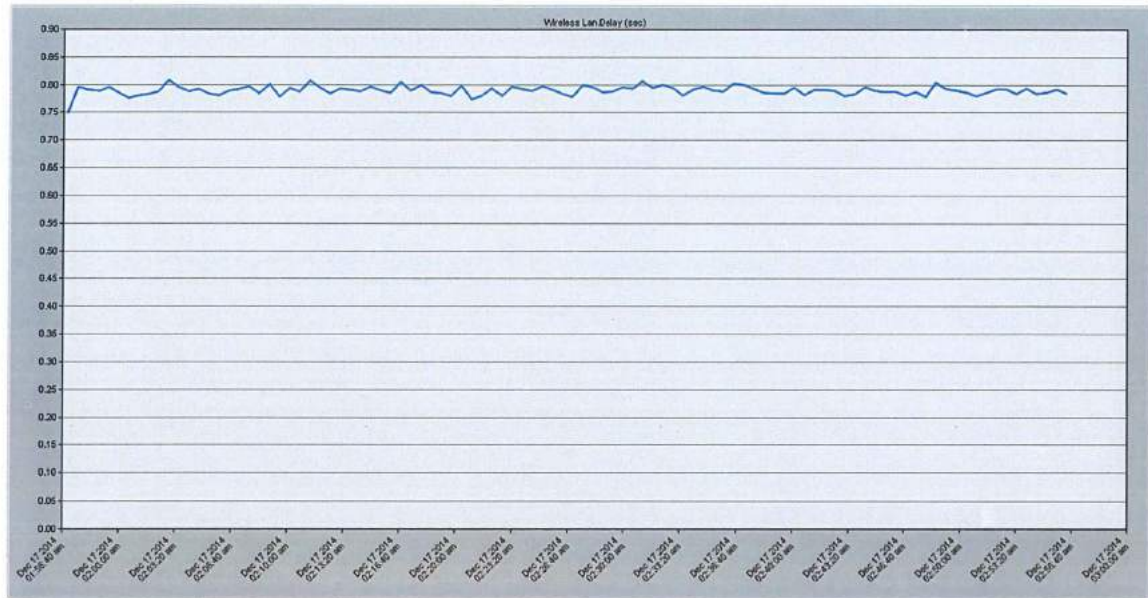


Figure 54: Delay Result of Infra-Red at 1Mbps

The above figure shows the delay result in infra-red transmission at 1Mbps transfer rate. The result shows the minimum delay value is starting under 0.75 seconds and the maximum value is about 0.81 seconds. The average delay value is around 0.78 seconds. The graft also shows the delay pattern is not consistent.

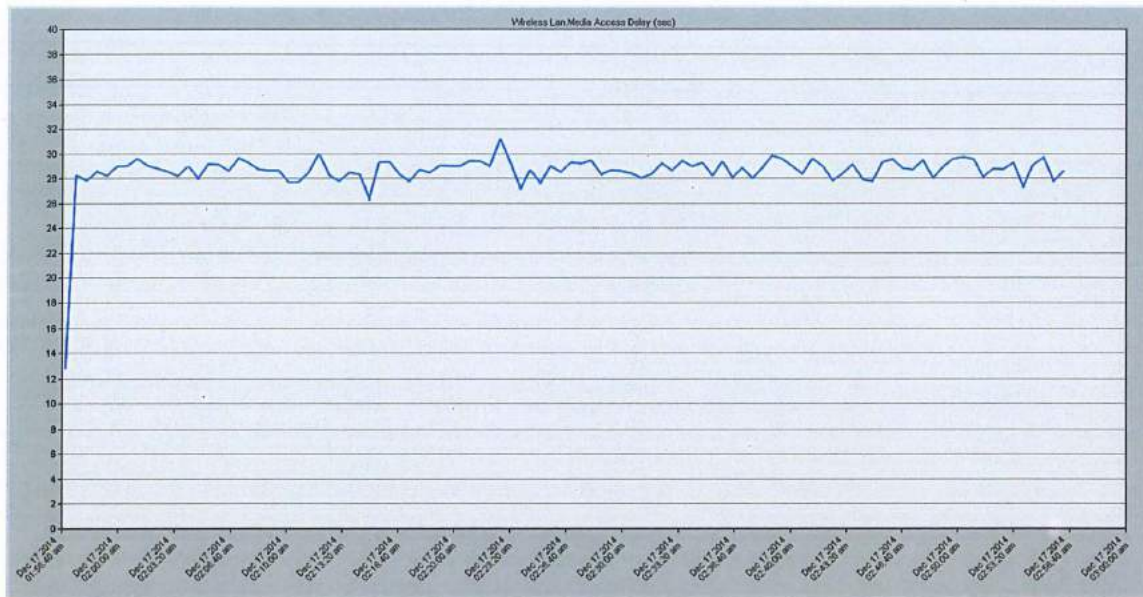


Figure 55: Media Access Delay Result of Infra-Red at 1Mbps

The figure shows the media access delay result in infra-red transmission at 1Mbps transfer rate. The result shows the media access delay start from 13 seconds and the maximum value is 31 seconds. The average value for media access delay is 29 seconds. The graft also shows the media access delay pattern is not consistent.

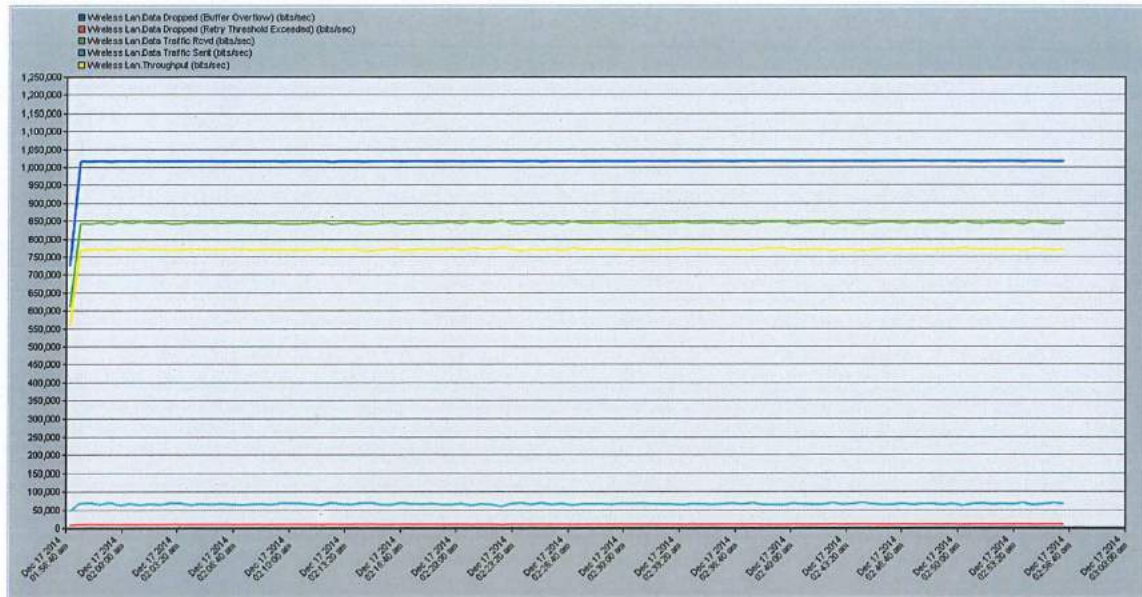


Figure 56: Data Dropped, Data Traffic Received, Data Traffic Sent and Throughput
Result of Infra-Red Result at 1Mbps

The figure shows the data dropped, data traffic received, data traffic sent and throughput result in infra-red transmission at 1Mbps transfer rate. The data dropped for infrared transmission is 1 020 000 bits per seconds and the graph shows it is horizontal. The data traffic received for infra-red transmission 1Mbps is around 850 000 bits per seconds. The data traffic sent for infra-red transmission is around 70 000 bits per seconds and the throughput is about 770 000 bits per seconds. The graph of data traffic received, data traffic sent and throughput shows the inconsistent patterns.

5.3.2 Infra-Red Transmission 2Mbps Results



Figure 57: Delay Result of Infra-Red at 2Mbps

The above figure shows the delay result for infra-red transmission at 2Mbps transfer rate. The result shows the minimum delay value start under 0.340 seconds and the maximum value is about 0.355 seconds. The average delay value is around 0.350 seconds. The graft also shows the delay pattern is not consistent.

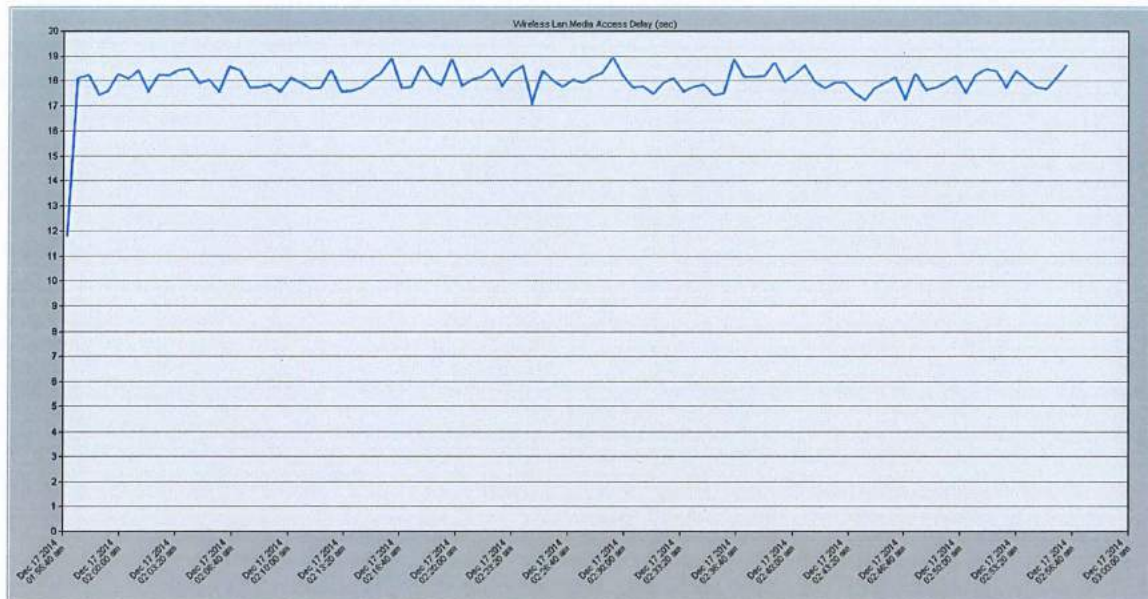


Figure 58: Media Access Delay Result of Infra-Red at 2Mbps

The figure shows the media access delay result in infra-red transmission at 2Mbps transfer rate. The result shows the media access delay start below 12 seconds and the maximum value is 19 seconds. The average value for media access delay is 17.5 to 18.5 seconds. The graft also shows the media access delay pattern is not consistent.

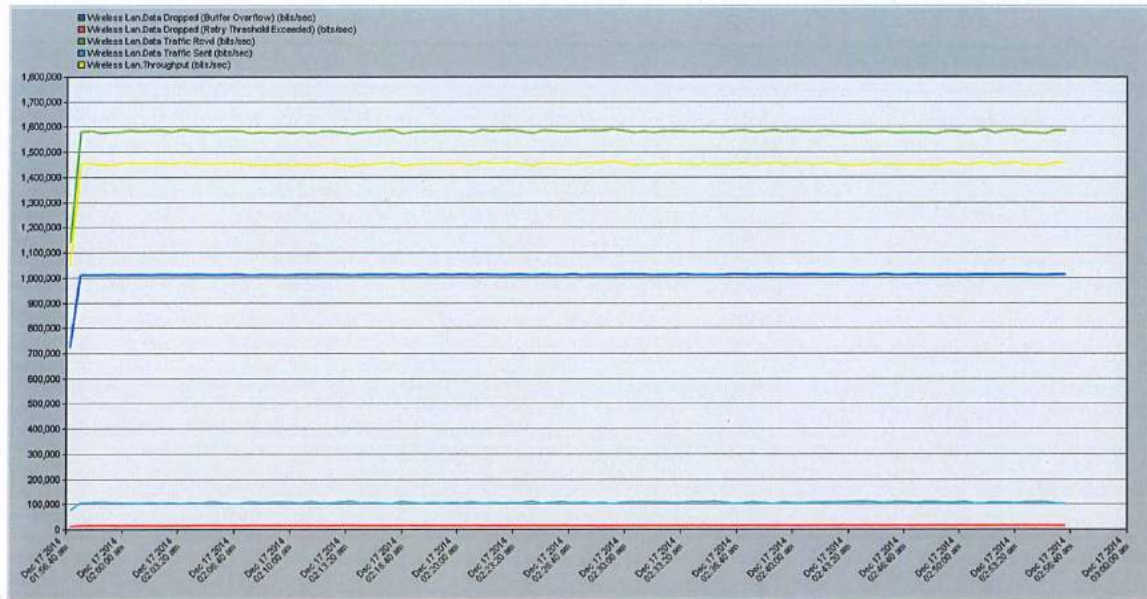


Figure 59: Data Dropped, Data Traffic Received, Data Traffic Sent and Throughput
Result of Infra-Red Result at 2Mbps

The figure shows the data dropped, data traffic received, data traffic sent and throughput result in infra-red transmission at 2Mbps transfer rate. The data dropped for infrared transmission is 1 010 000 bits per seconds and the graph shows it is horizontal. The data traffic received for infra-red transmission 2Mbps is around 1 590 000 bits per seconds. The data traffic sent for infra-red transmission is 100 000 bits per seconds and the throughput is about 1 450 000 bits per seconds. The graph of data traffic received, data traffic sent and throughput shows the inconsistent patterns.

5.4 THE CONCLUSION FROM THE TESTING RESULT OF FREQUENCY HOPPING, DIRECT SEQUENCE AND INFRA-RED TRANSMISSION TECHNOLOGY

At the conclusion of the testing of all three transmission technology, it is proved that the data transfer rate is one of the factors will affect wireless local area network (WLAN) performance. The increasing data rate transfer, the higher performance of the WLAN. So, the high transfer rate very recommended for use in WLAN to have a high performance.

Besides that, the type of transmission technology also will affect the performance. The testing has proven that the difference type of transmission technology shows different performance results.

5.5 COMPARISON DATA WITH DIFFERENT TRANSMISSION TECHNOLOGY

The comparison data are obtained in order to select the best transmission technology that can be applied in the wireless access point. The correct transmission technology will provide the best performance for the wireless connection to the users.

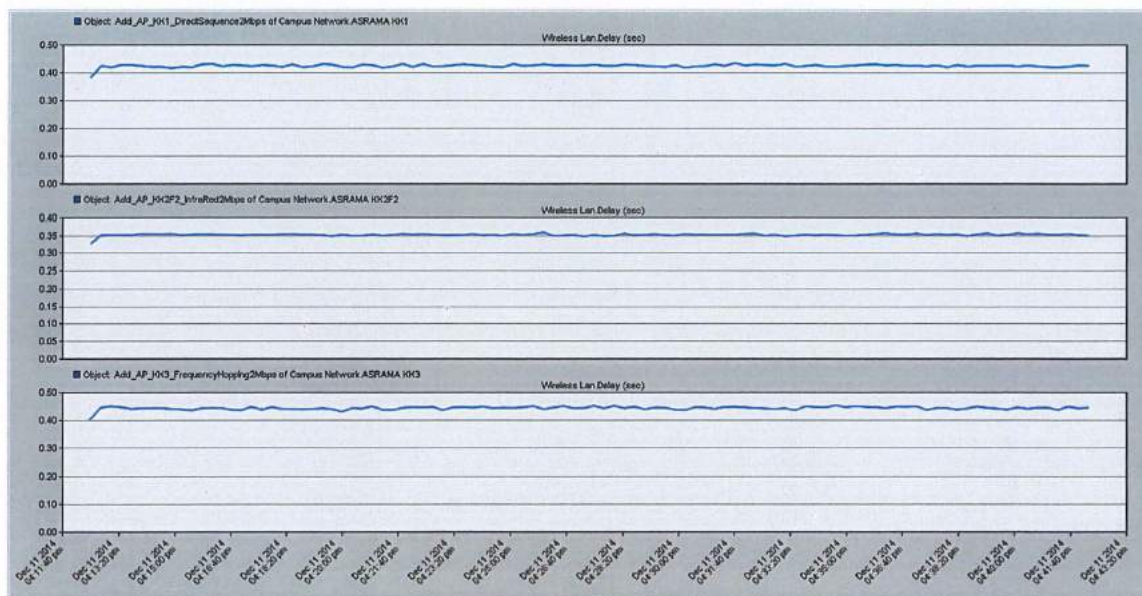


Figure 60: The Delay Comparison Result

From this result, the lowest delay is Infra-Red transmission technology, which is lower than 0.40 seconds. The highest delay is on the Frequency Hopping Spread Spectrum Transmission Technology is higher than 0.45 seconds and the middle delay result is Direct Sequence Spread Spectrum Transmission Technology which is lower than 0.45 seconds.

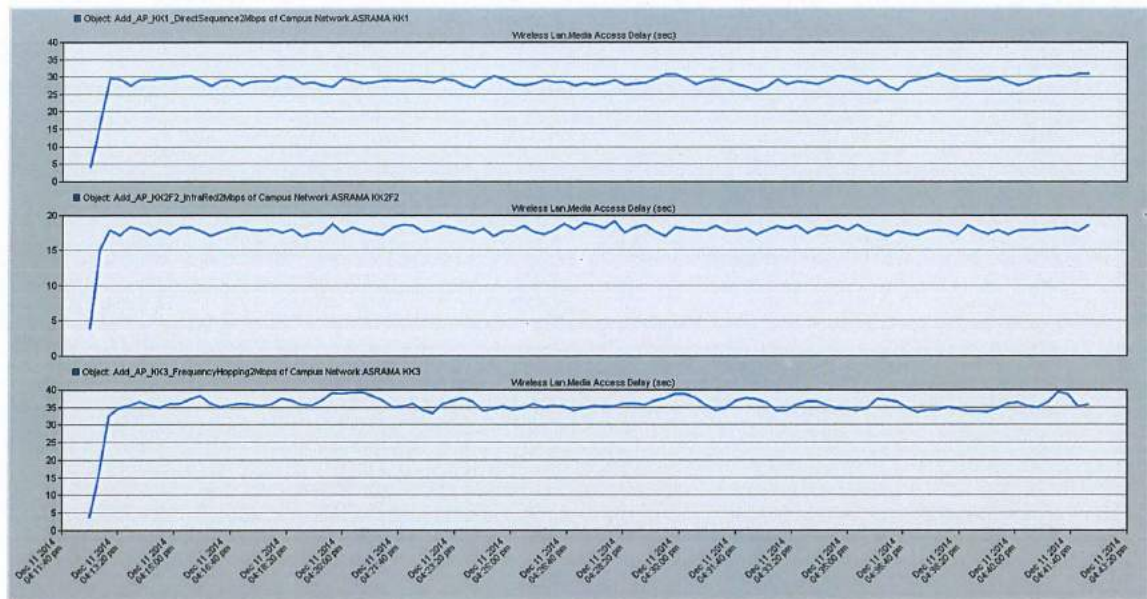


Figure 61: Media Access Delay Comparison Result

From this result, the lowest media access delay is Infra-Red transmission technology, which is lower than 20 seconds. The highest media access delay is on the Frequency Hopping Spread Spectrum Transmission Technology which less than 40 seconds and the middle media access delay result is Direct Sequence Spread Spectrum Transmission Technology is under than 30 seconds.

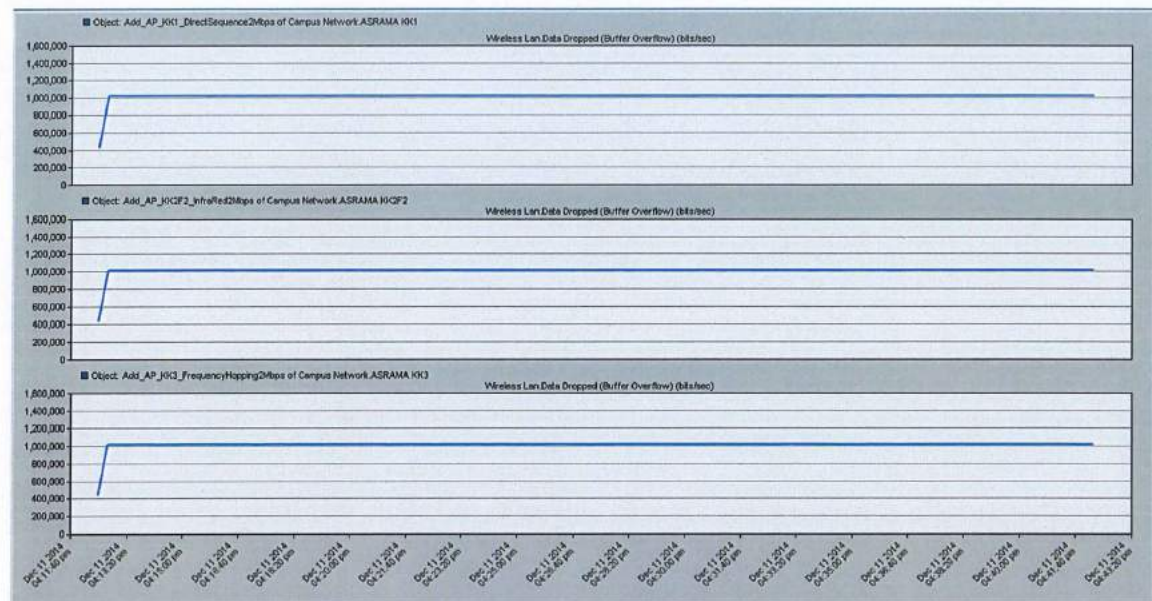


Figure 62: Data Dropped Comparison Result

From the result, it shows that the value of the data dropped result is same for the all three transmission technology.

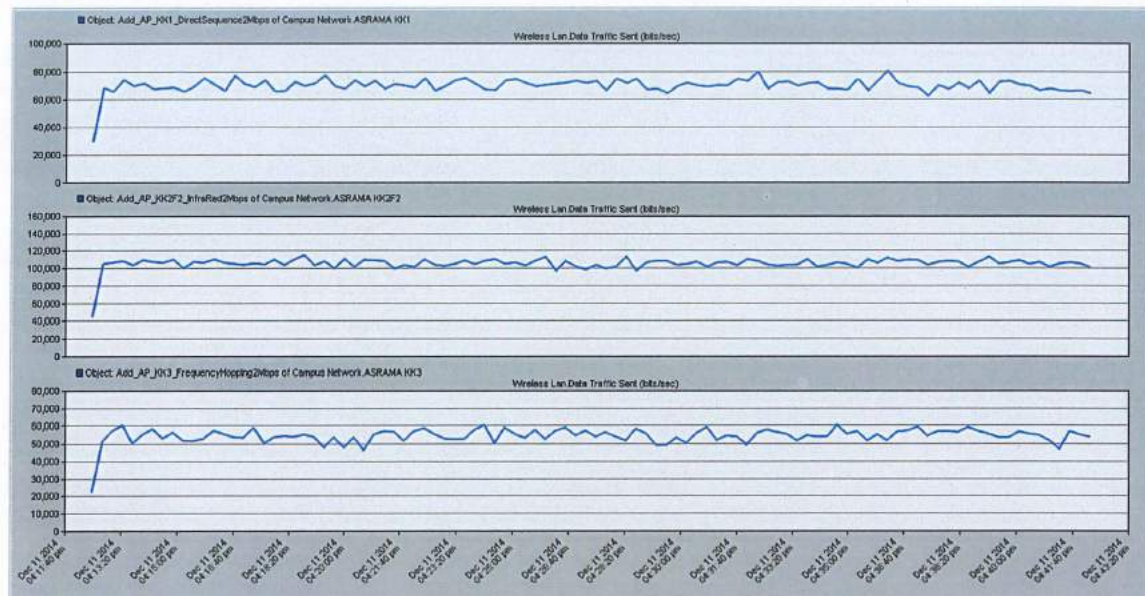


Figure 63: Data Traffic Sent Comparison Result

From this result, the highest data traffic sent is Infra-Red transmission technology, which is higher than 100 000 bit/seconds. The lowest data traffic sent is on the Frequency Hopping Spread Spectrum Transmission Technology which less than 60 000 bits/seconds and the middle data traffic sent result is Direct Sequence Spread Spectrum Transmission Technology is under than 80 000 bits/seconds.

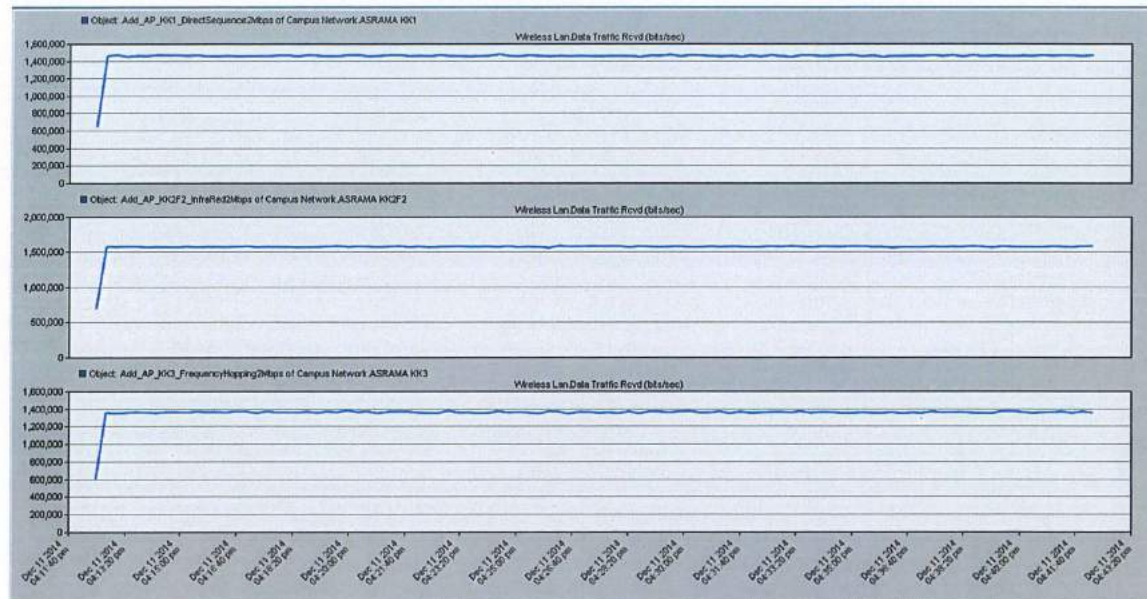


Figure 64: Data Traffic Received Comparison Result

From this result, the highest data traffic received is Infra-Red transmission technology, which is higher than 1 500 000 bit/seconds. The lowest data traffic sent is on the Frequency Hopping Spread Spectrum Transmission Technology which less than 1 400 000 bits/seconds and the middle data traffic sent result is Direct Sequence Spread Spectrum Transmission Technology is under than 1 500 000 bits/seconds.

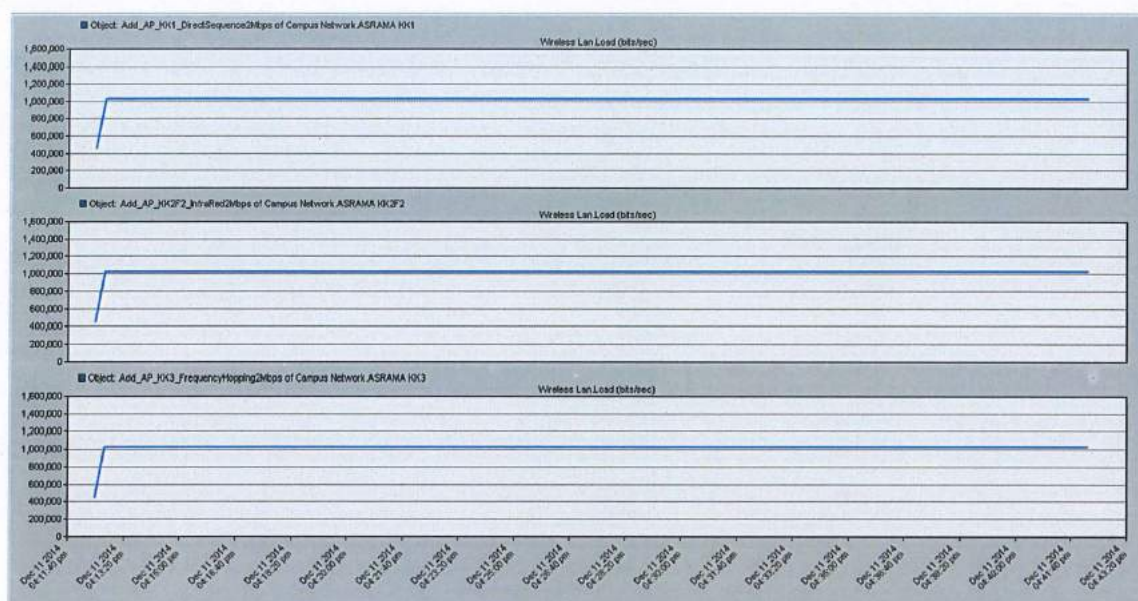


Figure 65: Load Comparison Result

From the result, it shows that the value of load is same for the all three transmission technology.

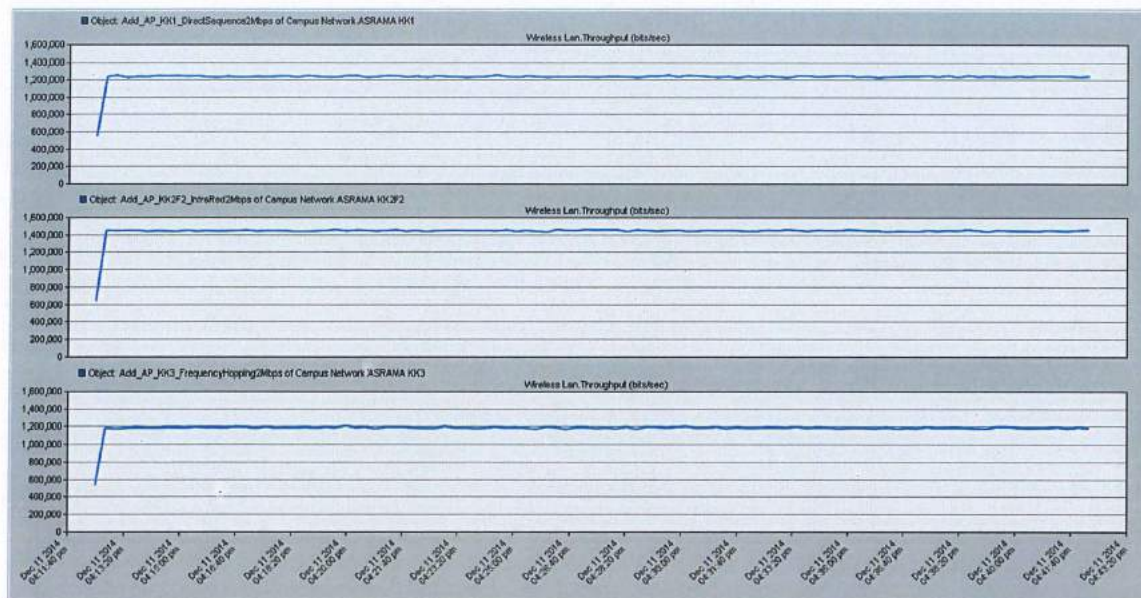


Figure 66: The Throughput Comparison Result

From this result, the highest data traffic received is Infra-Red transmission technology which is higher than 1 400 000 bit/seconds. The lowest data traffic sent is on the Frequency Hopping Spread Spectrum Transmission Technology which less than 1 200 000 bits/seconds and the middle data traffic sent result is Direct Sequence Spread Spectrum Transmission Technology is higher than 1 200 000 bits/seconds.

5.5.1 The Conclusion from the Comparison

After analysing the comparative results, it shows that the Infra-Red transmission technology is the best transmission to apply as a wireless transmission method. But, as the description of Infra-Red technology above, the Infra-Red transmission technology is not suitable for large area so, the second best is the correct choice to be applied as wireless transmission technology. The second best is Direct Sequence Spread Spectrum transmission technology.

5.6 THE COMPARISON RESULT BEFORE AND AFTER ENHANCEMENT AT KOLEJ KEDIAMAN 4 CAFÉ

5.6.1 The first comparison is the delay result.

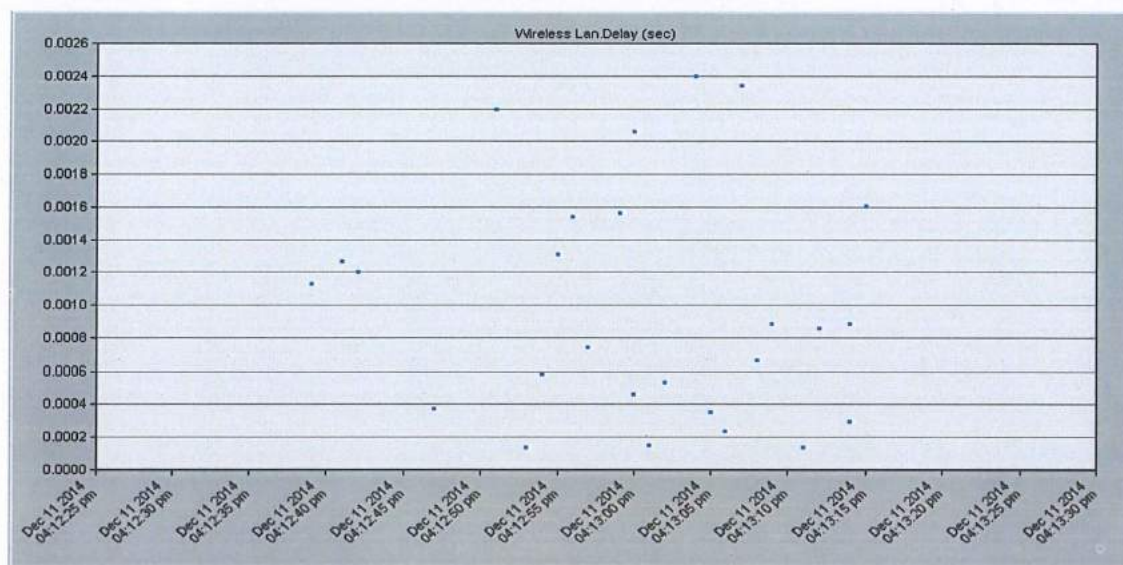


Figure 67: Before enhancement delay result

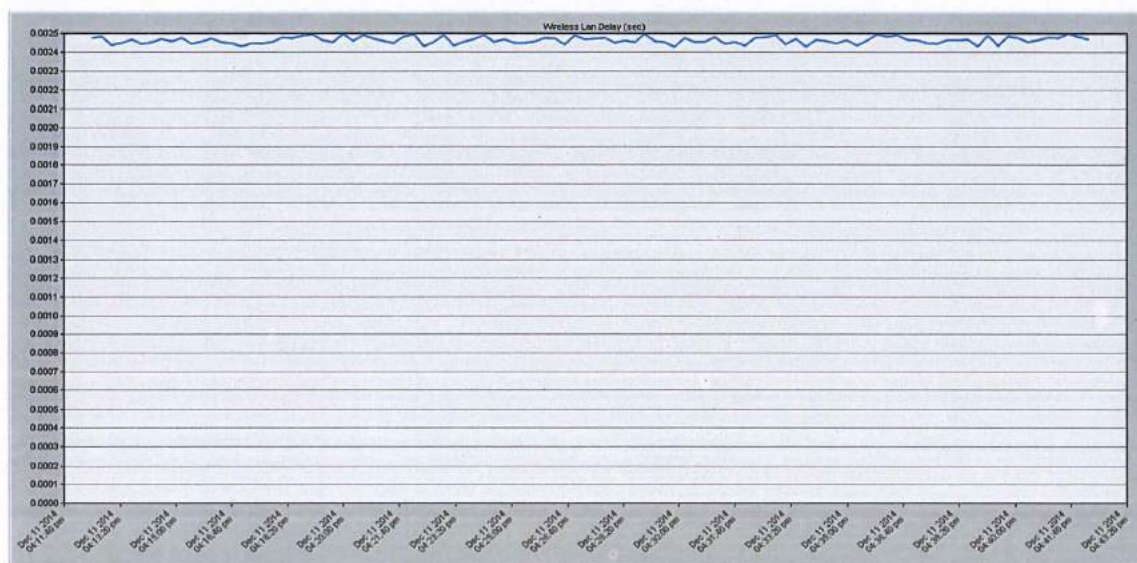


Figure 68: After enhancement delay result

5.6.2 The second comparison is the Media Access Delay result



Figure 69: Before enhancement media access delay result

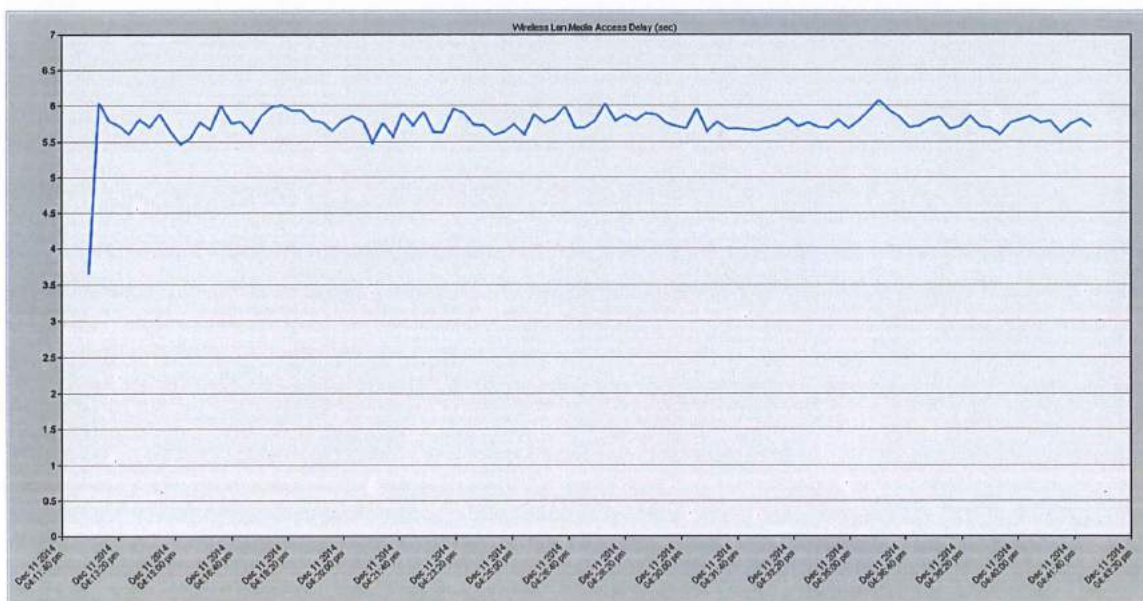


Figure 70: After enhancement media access delay result

5.6.3 The third comparison is Data Dropped result

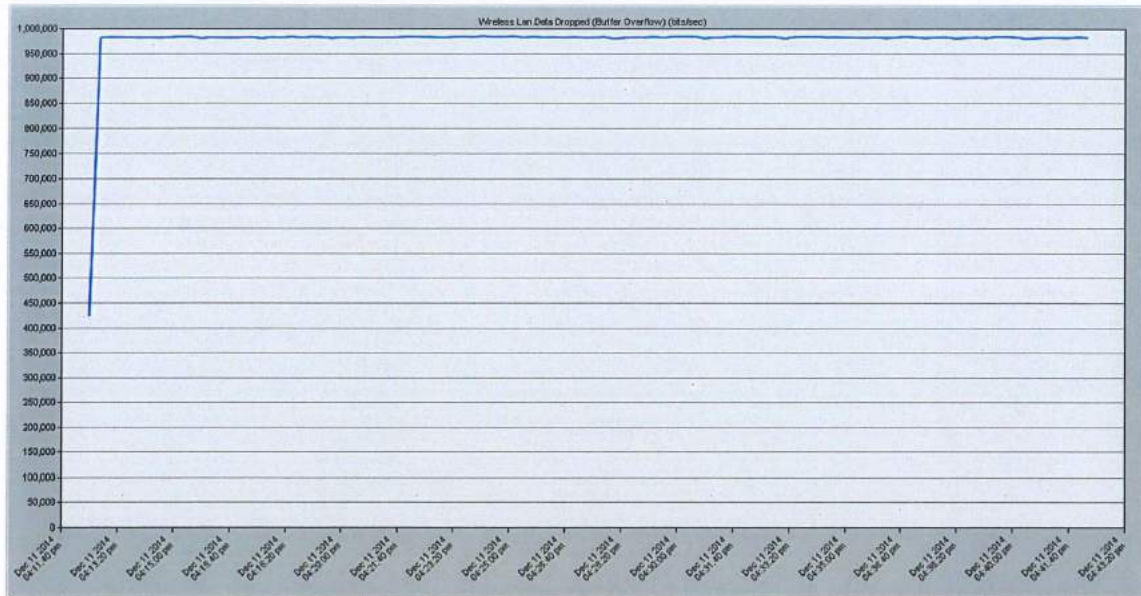


Figure 71: Before enhancement data dropped result

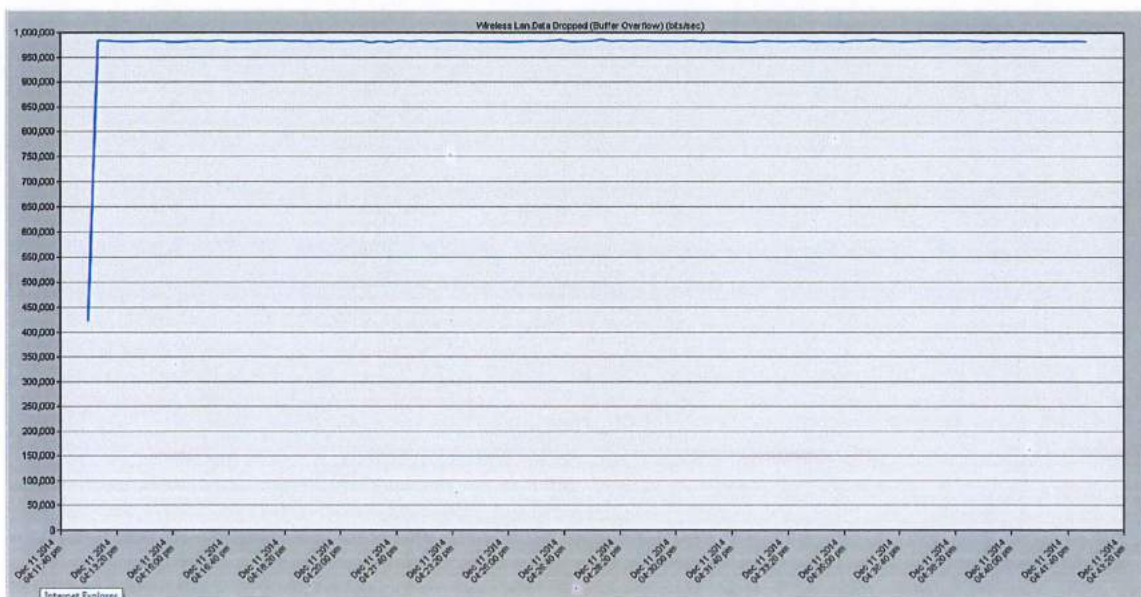


Figure 72: After enhancement data dropped result

5.6.4 The fourth comparison is Traffic Received result

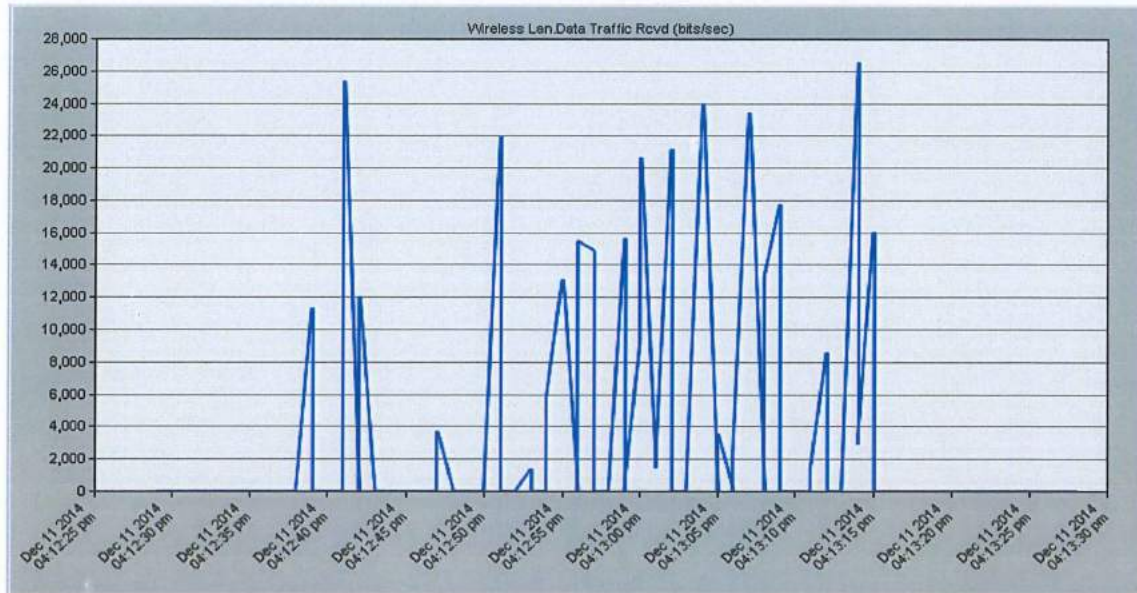


Figure 73: Before enhancement traffic received result

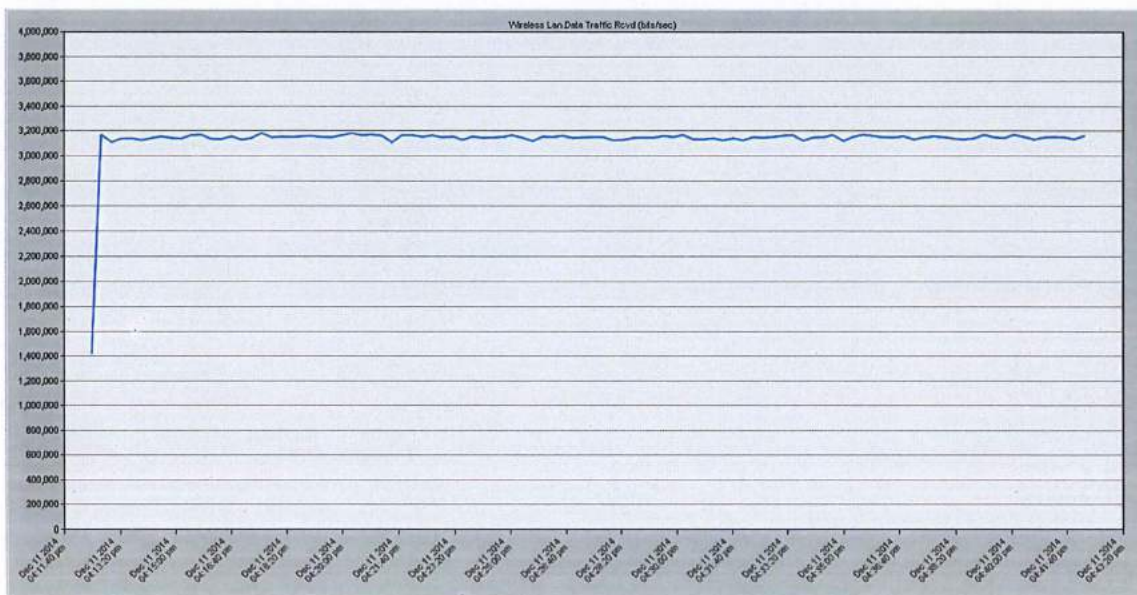


Figure 74: After enhancement traffic received result

5.6.5 The fifth comparison is Traffic Sent result

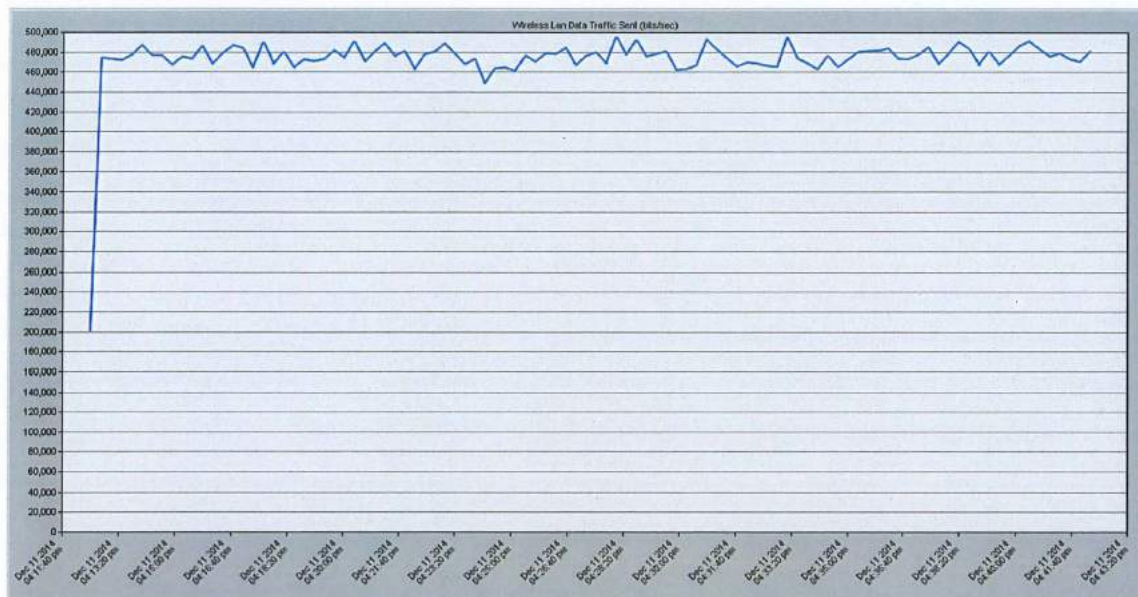


Figure 75: Before enhancement traffic sent result

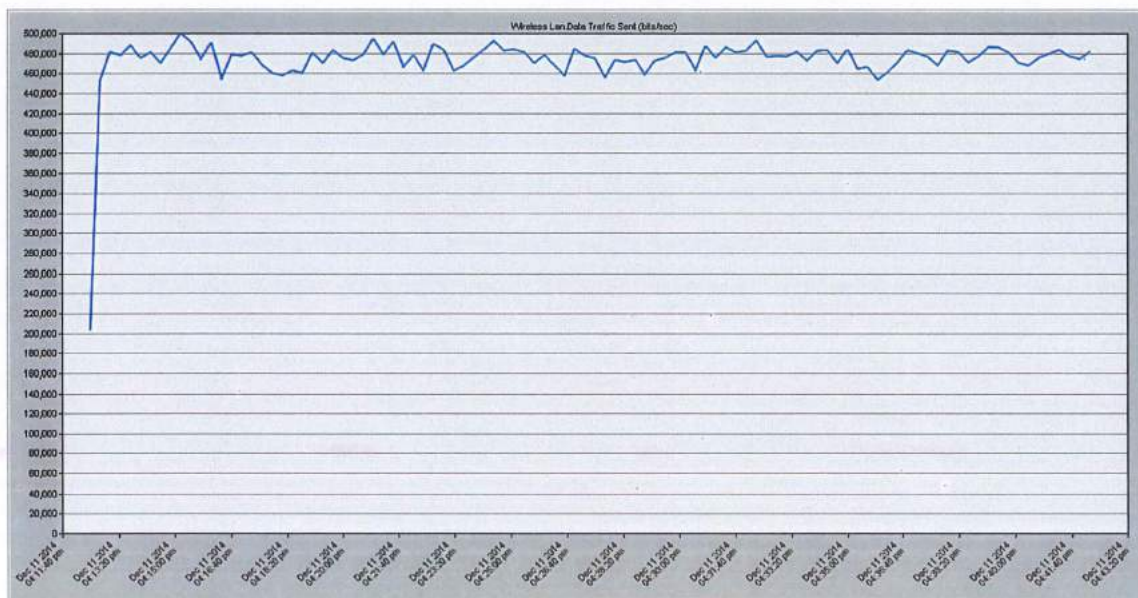


Figure 76: After enhancement traffic sent result

5.6.6 The sixth comparison is the Throughput result

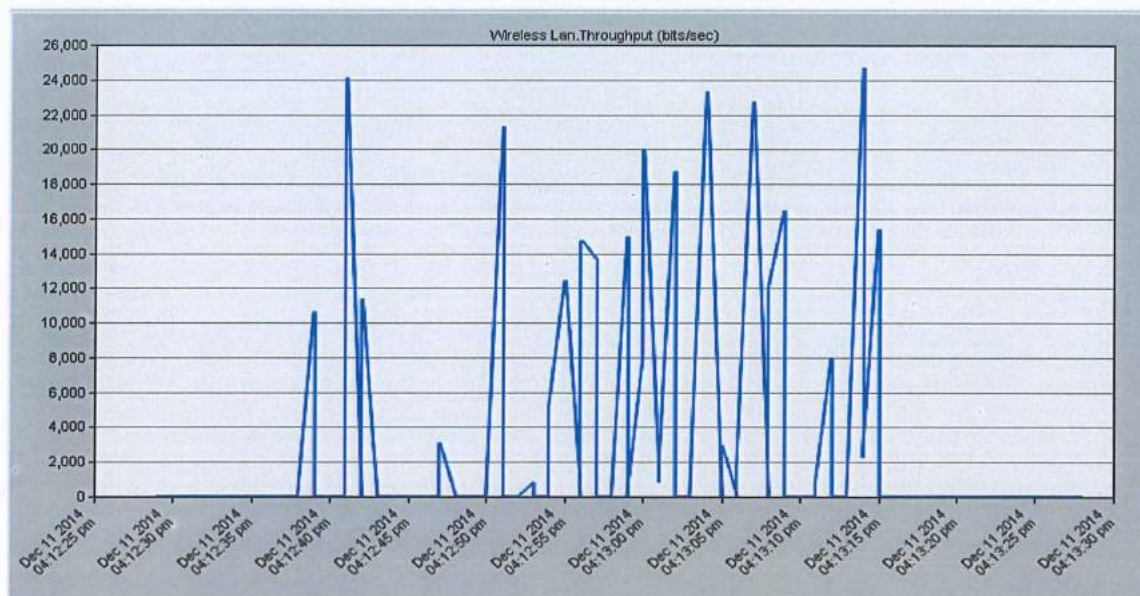


Figure 77: Before enhancement throughput result

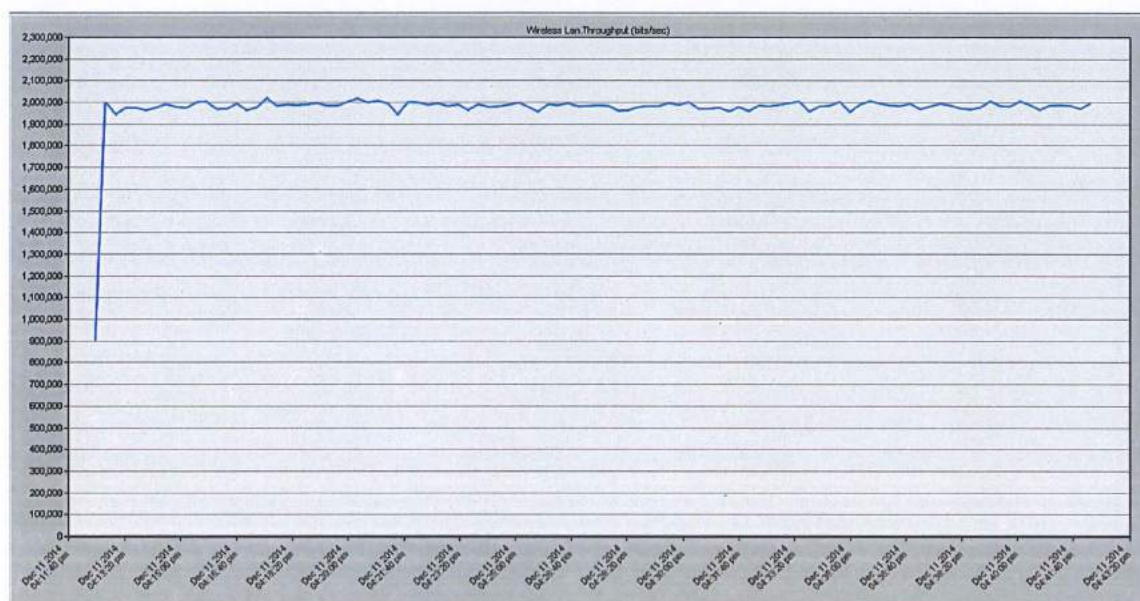


Figure 78: After enhancement throughput result

5.6.7 The seventh comparison is Load result

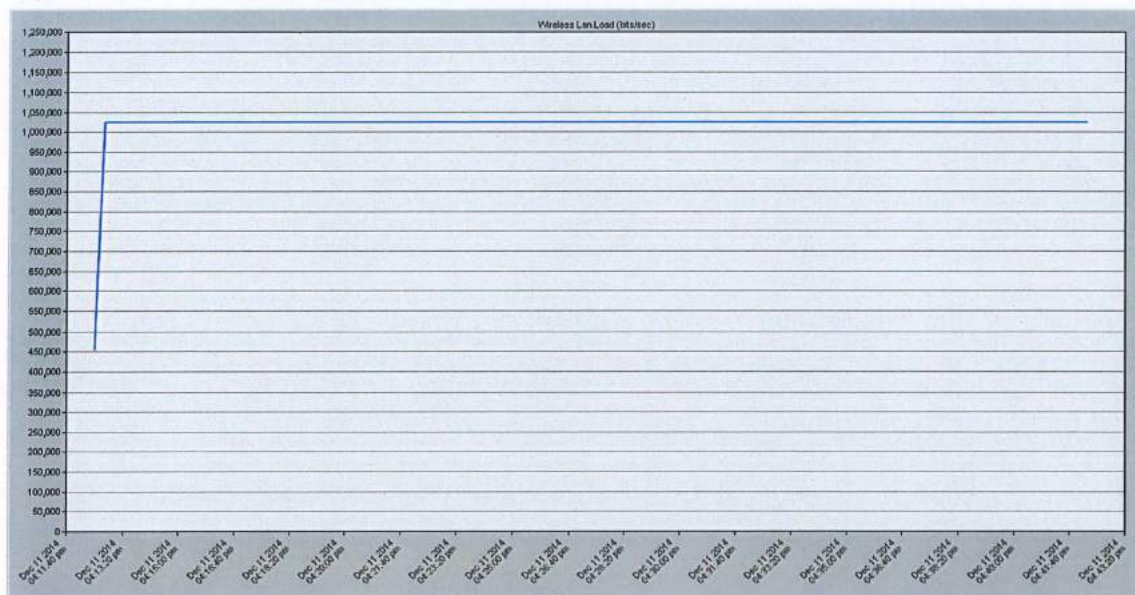


Figure 79: Before enhancement load result

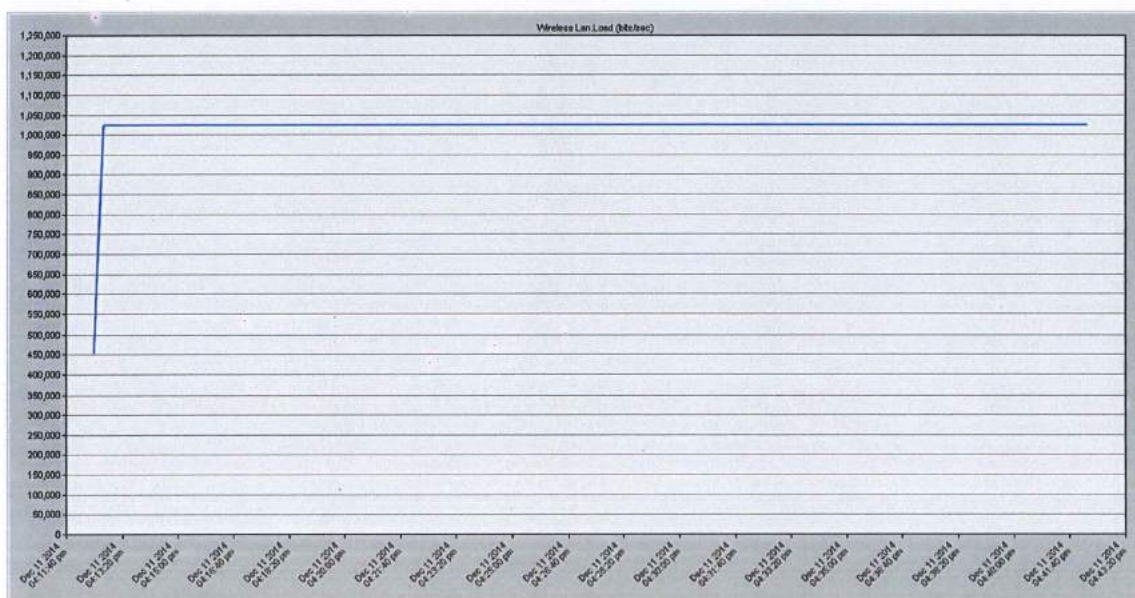


Figure 80: After enhancement load result

5.6.8 The Conclusion from the Comparison Results

From the comparison result above, it shows that the result after enhancement is better than before enhancement. The delay result before enhancement is inconsistent, but after the enhancement it show result in better condition. The traffic received also show the increasing performance after enhancement. The other result also shows the different results after the enhancement have been made from the current scenario.

CHAPTER 6

CONCLUSION

In the proposed architecture, the performance of wireless network scenarios in OPNET Modeler 14.5 is evaluated. The delay, media access delay and other are evaluated for the physical layer technologies Infra-Red, Direct Sequence Spread Spectrum (DSSS) and Frequency Hopping Spread Spectrum (FHSS). Delay at the same transmission rate for Infra-Red is better than others, but it is not suitable for wireless in large area. So, the Direct Sequence is better than Infra-Red and Frequency Hopping. It is most important to use a simulation in order to make a decision making about the network product and network design. This will help the network designer, network engineer to develop a high and good network performance to their client or customer. A correct decision making of a network product and network design will produce a good result or in other words a good network performance. This situation is very important, especially when develop a big network coverage, such as a big company, university, corporate building and others. Of course the big companies need a high performance network in order to undertake their company operation smoothly. It is important to select the correct technology of the hardware used in order to get high coverage performance to the users. The type of the hardware used must be in a same technology to avoid interference.

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APPENDIX

Gantt Chart

The Gantt chart shows the research management time.

