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Network Traffic WLAN Monitoring based SNMP using MRTG with Erlang Theory

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***Abstract*— Best internet network connection because of the smooth flow of data and affects performance. A network admin must supervise the internet network both in software and in terms of hardware. The main thing that a network admin does in the Central Room is to be able to realize a software such as the Multi Router Traffic Grapher (MRTG) which can function to monitor the internet network in the environment. Internet speed is determined by the amount of bandwidth available with many users accessing the network. This work was conducted using the SNMP-based MRTG application, which is used to monitor and analyze bandwidth usage. The results of the bandwidth usage will be calculated using the Erlang-B theory from the results of calculations carried out using the Erlang-B theory algorithm, a Grade of Service (GoS) value for the busiest hour is 0.095%, rounded to 0.001. This means that the probability value of all channels being active at that hour is 0.001%. This GoS value is good enough because failed access is unlikely.**

***Keywords*— Network Traffic, WLAN, SNMP, MRTG, Erlang Theory, GoS**

I. Introduction

The development of network technology has made many changes to human life. This is marked by the technological development of various hardware and software. It has a considerable impact in terms of data transfer or the media for presenting information data. Presentation of information data becomes faster, more precise, and accurate without being limited by distance, space, and time. As for the development of computer network technology, including a Local Area Network (LAN) is a network that uses cables and a Wireless Local Area Network (WLAN) is a wireless network technology [1]–[4]. Internet is a network system that connects every computer globally in all corners of the world. The connection that connects each of these computers has a standard in use called the Transmission Control Protocol / Internet Protocol, abbreviated as TCP/IP. A computer connected to internet will have the ability to transmit data online and in real-time. Accessing Internet can be done in various ways, including using a LAN using cables and other developed methods such as Bluetooth, Wireless and others [4].

The existing network traffic density can describe the density of data traffic that passes through the existing network at the provider. To find out the network traffic, Multi Router Traffic Grapher (MRTG) software is needed. MRTG is an application used to monitor traffic loads on network links. MRTG will create an HTML page containing a GIF image depicting traffic over the network. While the SNMP Protocol is one of the official protocols in the Internet Protocol suite developed by the Internet Engineering Task Force (IETF) [2], [4]. In this case, the provider takes advantage of the development of internet network technology. And the provider has internet network facilities that connect computer networks between agencies, rooms, and also networks outside the office area. To communicate between branch offices and the head office, a transmission medium is required to communicate data. To build a network in one city, you can use WLAN media to connect between offices. To determine the quality of the network at the provider, good research was carried out on the level of bandwidth usage that was not evenly distributed and different at each location. This is because bandwidth usage on the network is influenced not only by the number of users, but also by the different types and levels of data sending and receiving (upload and download) requirements [4].

II. Literature Review

A. Network Traffic

Traffic is the movement of an object from one place to another. In the telecommunications sector, what is meant by objects here are information signals such as pulses and frequencies. So traffic is the transfer of information signals from one place to another via telecommunications media. Traffic can also be interpreted using a system of telecommunications equipment or channels that are regulated by time, also related to what is used, from where, to where, and others. A busy CPU system so it cannot process data or delay processing indicates traffic congestion [1], [4].

B. WLAN

WLAN is a wireless local area network with transmission media using radio frequency (RF) and infrared (IR). To provide a network connection to all users in the surrounding area, a WLAN uses radio frequency technology as a data storage medium and has various conveniences for its users to apply. WLAN has several components in its network architecture, namely access point, and wireless station/client. The WLAN standard refers to the IEEE 802.11 which was

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first published in 1997 by the IEEE, an independent institution that focuses on developing technological innovations [2], [4].

C. SNMP

SNMP (Simple Network Management Protocol) is one of the official protocols in the Internet Protocol suite created by the Internet Engineering Task Force (IETF). SNMP is an example of a layer 7 application used by network management systems to monitor network devices to provide the information needed for their managers. SNMP is a protocol for the management of equipment connected to an IP network. The kit includes switches, routers, modems, computers, servers, and others. SNMP uses data obtained from UDP communication with devices or equipment that enter the network. SNMP can request data or make settings to the equipment concerned [5], [6].

D. MRTG

MRTG is a tool commonly used to monitor traffic loads in a network at a specific time in a graphical display. This software created by Tobias Oetiker and Dave Rand uses the SNMP (Simple Network Management Protocol) protocol which is usually owned by network devices (such as hubs, switches, routers, network interface cards, access points, etc. Only devices support SNMP which MRTG can monitor.

E. Erlang

The queuing theory was first put forward by A.K. Erlang, a Danish mathematician, in 1913. A queue is a waiting line in a system of units that wish to receive service from a service facility. Erlang is a unit of traffic intensity. In Table I Erlang is equal to one call in occupation of 3600 seconds. Grade of Service (GoS) as a comparison of lost traffic (rejected) with traffic that is offered to the network. The smaller the GoS value, the better the service. The recommended GoS value in Indonesia is 0.01 or 1%, which means that one call fails every 100 calls comes. Meanwhile, a GoS value that exceeds 1% means that the network service possibility is not good [6]–[9].

III. METHODOLOGY

This type of research is a type of experimental research entitled Network Traffic Monitoring WLAN using SNMP-based MRTG, where this work will monitor network traffic using the Cacti tool by calculating the amount of bandwidth usage using Erlang's standard calculation method to get the GoS value to know the network quality. In general, traffic is the movement of an object from one place to another. in telecommunications, what is meant by things are information signals such as pulses and frequencies. So traffic is the transfer of information signals from one place to another via telecommunications media. Traffic amount is an object of traffic measurement, the number of occupations on an equipment/channel is measured by time (when and for how long).

TABLE I. GOS STANDARD WITH ERLANG THEORY

Category	Grade
Bad	> 4 %
Norma	3 %
Good	1 – 2 %
Best	< 1 %

A. Erlang-B Theory

Erlang determines the service level (Grade of Service) on a lost call system (Lost-Coll System) which has N channels with the offered traffic. Pure-chance Traffic, namely the arrival of a call on a system is a random event and is independent. Statistical equilibrium, namely the probability of traffic on a system that does not change or a system with an unexpected and stationary process. Full Availability is every incoming call is forwarded to each outgoing channel. And incoming calls during busy times will be lost. The probability of a missing call is the first Erlang distribution and is called GoS or Erlang-B as shown in equation (1). Equation is given symbol $E1, N$ (A), which represents the probability of missing a call on an N number of channels. Full Availability with the offered traffic of An Erlang can be calculated by Equation (1) [9]. To make it easier to find the calculation of the GoS value in a computer program, it can be used by iterating as in Equation (2). Equation is the Erlang-B Equation [8].

$$B = E_{1.N(A)} \frac{A^N/N!}{\sum_{K=0}^{N} A^N/N!} \quad (1)$$

$$B = E_{1.N(A)} \frac{AE_{1.N-1}(A)}{N+AE_{1.N-1}(A)} \quad (2)$$

By entering Traffic Intensity into the formula above, the GoS value will be obtained at the network's busiest hour. GoS is a comparison of lost traffic with the traffic that is offered to the network. The smaller the GoS value, the better the service. Based on the theory of erlang-b, the recommended GoS value is 0.01 or rounded 1%, which means that one call fails every 100 calls comes. Meanwhile, a GoS value that exceeds 1% means that the network service possibility is not good.

B. Traffic Calculation

MRTG provides the results of the total data bandwidth usage in bits during an observation period. The volume of traffic in hours can be determined by dividing the unlimited bandwidth in an observation period by the average bit rate for each channel. as seen in Equation (3) [10]. The Traffic Intensity value is obtained in an observation period using Equation (4) [10]. GoS values can be retrieved at the busiest hours on the provider's network. Equation 1 can be used to find GoS by entering the Traffic Intensity value from equation 3.

$$\text{Traffic Volume} = (\text{Bandwidth}) / (\text{Bit Rate}) \quad (3)$$

$$\text{Traffic Intensity} = (\text{Volume}) / (\text{Observation Period}) \quad (4)$$

C. Scenario

The test scenario monitors traffic bandwidth using SNMP-based MRTG. The test will be carried out by taking a reference to daily data obtained using MRTG, which is a sample of the five-minute average value of bandwidth usage. Still, the author uses a 1-hour reference to see bandwidth usage in a day. Analysis of daily bandwidth usage was carried out for two weeks, from 08.00-10.00. Thus, the observation time of daily bandwidth usage is 6 hours. The author's problem is the internet speed that causes many to enter, so that internet access is slow, and observations are not maximal.

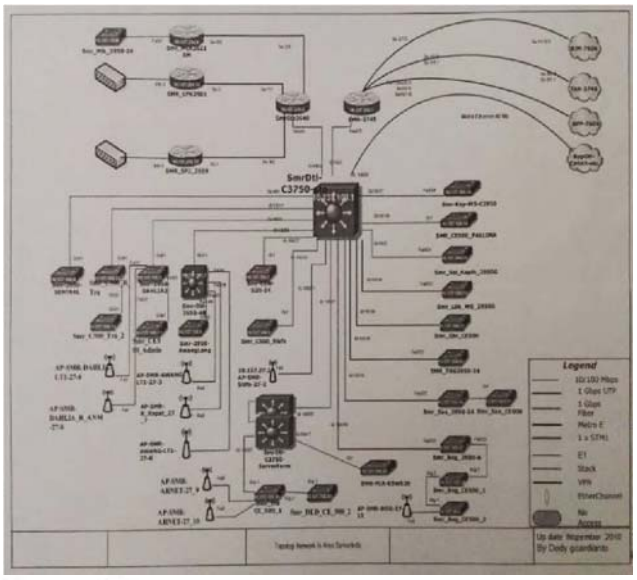

Fig. 1. Provider Network Topology

IV. RESULT

After determining the monitoring data retrieval process, which is in the form of data collection at locations with WLAN access to the provider, the retrieval is done three times, and one monitoring data is collected using the Ubuntu version of Cacti. The test is carried out at the beginning of the day using the reference for the first day of monitoring, which is determined by looking at Cacti's usage graph as a network tool analyser can be seen in Fig. 1.

If the known results have been obtained and the maximum, then the calculation will be carried out to get the intensity and volume in bandwidth from the experiment carried out. But in this work, three experimental data were collected into one. After the data obtained are met, the data is copied in Table II form to make it easier to perform calculations and get the Grade of Service (GoS) value. Then each variable is calculated based on the calculation method determined based on the standard Erlang theory.

A. Analysis of Bandwidth Usage

In knowing the user's characteristics on the provider network in detail, the analysis of bandwidth usage is divided into several time ranges, namely days, weeks and months. Here, the author uses the daily time span as a reference for calculating the use of internet traffic data. Following are the variables as the basic assumption of network traffic to the provider. From Fig. 2 it can be seen that the total bandwidth usage is 8.82 Gb. To find the Traffic Volume, equation three can be used with an average Bit Rate of 1.285.71 KBps. Meanwhile, to see the traffic intensity can use equation 4 with an observation period of 6 hours.

B. Value of GoS

To analyse the performance of a telecommunications network is to calculate the possibility of an offered blocking. The Erlang-B formula can be used to calculate the probability of a call being rejected as in equation 1. If this calculation is done using a computer programming language, to be precise, using the Matlab tools. In finding the GoS value, data is needed at the busiest hours of the day on the provider network. In Table III, it can be seen that the most significant traffic intensity value is 5.58 Erlang. The most active hours on this day are between 14.00 and 15.00 can be seen in Fig. 3.

TABLE II. BITRATE AND BANDWIDTH CHANNEL

Total Bit Rate	KBPS	Bandwith
9 mbps	9000 kbps	1285 kbps
3.5 mbps	3500 kbps	500 kbps
2.5 mbps	2500 kbps	357 kbps
2.2 mbps	2200 kbps	314 kbps
2.0 mbps	2000 kbps	285 kbps
1.8 mbps	1800 kbps	257 kbps
1.4 mbps	1400 kbps	200 kbps

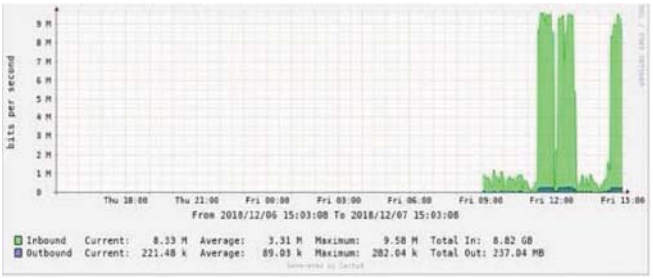

Fig. 2. Bandwidth Usage Graph Data

Thus the total bandwidth obtained at the busiest hour on the provider network is 6.09 Gb. Traffic Volume or Traffic Intensity's value can be found with equation 3 and equation 4 with the assumption that the average bit rate for each channel is 1285.71 KBps. Calculation of Traffic Volume and Traffic Intensity. Based on calculations using the Matlab program, the GoS value is 0.009572% or rounded up to 0.01%. This means that the probability value of all channels being busy at that hour is 0.01%. So it can be concluded that the GoS value is good enough because it is unlikely that network access will fail.

TABLE III. DAILY TRAFFIC INTENSITY

Daily Period	Use of bandwidth Daily	Traffic Volume	Traffic Intensity (Erlang)
07/12/20	8.82 GB	190.55	3.17
10/12/20	5.73 GB	114.60	0.5
11/12/20	7.13 GB	3	0.5
12/12/20	4.43 GB	95.71	15.95
13/12/20	3.06 GB	270.45	4.01
14/12/20	3.41 GB	265.22	4.42
17/12/20	2.47 GB	53.36	8.89
18/12/20	1.46 GB	2	0.34
19/12/20	2.11 GB	186.49	31.08
20/12/20	2.08 GB	224.69	37.44
21/12/20	1.42 GB	30.68	22.17
27/12/20	15.47 GB	334.2	5.58
28/12/20	9.98 GB	215.61	3.59

Fig. 3. Busiest Hour Detail Chart

V. Conclusion

From the traffic density analysis that has been carried out on the provider network, conclusions can be drawn such as. Research for daily bandwidth usage was carried out from December 7, 2020 to December 28, 2020. The results of the analysis of traffic data obtained the lowest traffic volume value of 2 hours while the lowest traffic intensity value was 0.34 erlang. For the results, the value of the largest traffic volume in this daily analysis is 33.42 hours, while for the largest traffic intensity value, it is 5.58 erlang with 9 MB Bit Rate. The daily erlang value is obtained from occupying a circuit continuously for 6 hours. From the analysis results above, the problem that occurs is the use of bandwidth at the busiest hours, which results in congestion on the network. This congestion resulted in many lost traffic during peak hours. The grade of service or the busiest hourly traffic intensity on the provider network is 131.57 erlang with a GoS value of 0.009572% or if rounded to 0.01%. This means that the probability value of all channels being busy at that hour is 0.01%. So, the conclusion is that the value of GoS is excellent because there is little chance of network access failing. This value shows an excellent central performance because the standard value shows <1%. This is due to the lack of rejected calls.

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