IJISIT

http://ejournal.enlightenlearner.com

Analysis Quality of Service (QoS) on Ad Hoc Networks with Network Simulator Version 3 (NS-3)

[1]Rahmadani, Universitas Pembangunan Panca Budi, Indonesia
[2]Supiyandi, Universitas Pembangunan Panca Budi, Indonesia
[3]Lia Kristina Manalu, Universitas Pembangunan Panca Budi, Indonesia

Correspondence: E-mail: rahm4dani@gmail.com

Article Info	ABSTRACT
	QoS (*Quality of Service*) results for throughput, packet loss and delay as well as data transfer process performance tests were carried out with the NS-3 simulator based on the number of nodes that are continuously added according to the scenario on the ad hoc network. The scenario of adding nodes is carried out in stages starting from 10 nodes, increasing to 20 nodes, up to 40 nodes. The results of the analysis and measurements obtained for throughput produce an average value of 3.1872 Kbps so that it is included in the good category. The packet loss parameter produces an average value of 3.48% which is included in the good category and the delay parameter produces an average value of 6,824 ms which is also included in the good category. The final results of the ad hoc network simulation process with NS-3 are presented in graphical view.

1. INTRODUCTION

Wireless network has become one of the common services in many public services provided to users which can be accessed through various communication devices, such as; laptops, smartphones, tablets and other devices that support wireless network services. These services have helped users a lot in the process of searching for information and other daily activities. A wireless computer network known as a Wireless LAN (WLAN) with the IEEE 802.11 standard [1]. The evolution of wireless devices continues to grow and is increasingly diverse based on radio waves, such as; remote control, cordless phone and so on. The need to make various devices easy to carry (*mobile*) and easy to connect to the

available wireless network or network services. Devices or nodes on the WLAN use the same frequency channel and SSID which shows the identity of the wireless device. Wireless networks have two modes that can be used, namely infrastructure and Ad-Hoc. Infrastructure configuration is communication between devices through a terminal access point on the WLAN. Ad-Hoc mode is direct communication between several network devices using wireless devices [2]. Ad Hoc Mode is a wireless network model of mobile devices that can be setup dynamically from anywhere and anytime [3]. *Network Simulator* version 3 (NS-3) is a discrete-event network simulator, targeted primarily for research and educational use. NS-3 is free

software, licensed under the GNU GPLv2 license, and is publicly available for research, development, and use. The goal of the ns-3 project is to develop a preferred, open simulation environment for networking research: it should be aligned with the simulation needs of modern networking research and should encourage community contribution, peer review, and validation of the software [4]. NS-3 was developed with the C++ programming language. NS-3 is a simulator capable of simulating various routing protocols on an ad-hoc networking model and supports many popular network protocols. Ad hoc network simulation process on NS-3 by creating simulation scenarios. Each NS-3 object has a set of attributes (*name, type, initial value*). Other NS-3 features can be integrated with other software such as wireshark which can be used to view trace output. The representation of simulation data results on the NS-3 can be displayed in graphical view, making it easier to analyze and evaluate the results of an ad hoc network model to be tested and simulated.

In this research will be tested and simulated the performance of the data transfer system using NS-3 based on the number of nodes which will continue to be added according to the scenario. The results obtained in the simulation process with NS-3 will be measured by QoS (*Quality of Service*) for throughput, packet loss and delay values in ad hoc networks. Furthermore, the results of the simulation process with NS-3 will be presented in graphical view.

2. METHODS

The stages of research conducted in this study are as follows;

2.1. Create Simulation Scenario

The simulation scenario process that will be carried out is as follows;
1. Running NS-3 simulator→ the user will run the command by typing the source script contained in the NS3 simulator.
2. Parameter configuration→ the user makes settings and provides values for some parameters that are static.
3. Creates *node*→ the user will create a number of nodes according to the needs of the

test scenario, namely 10 nodes, 20 nodes and 40 nodes.
4. Creates *channel*→ used to connect between nodes as a medium for sending and receiving data packets.
5. Creates *device*→ device created to connect nodes and channels, with MAC identifiers and IP addresses.
6. *Routing*→ selection of routing protocols to be used in the simulation, in this scenario the OLSR routing technique will be used in making the routing table list.
7. Define sender and receiver *packet*→ each node that sends and receives data packets will be paired during the simulation process. When the simulation starts, several nodes will broadcast to create a routing table, then the nodes will send data packets.
8. Creates *trace file* → when the simulation is running, the NS-3 simulator will create a trace file which is saved in the form of an animation with the .xml extension. The animation files can be viewed and run using the NetAnim application.
9. Produce *receive rate* → the NS-3 simulator will generate a file with the extension .csv which contains information on data delivery in the form of received rate. This file will later be used to calculate throughput, packet loss and delay.
10. Scenarios are completed by generating simulation reports presented in graphical view.

2.2 Measure *Quality Of Services* (QoS)

Quality of Service (QoS) will generate information on the quality of available network services. *Quality of Service* (QoS) refers to any technology that manages data traffic to reduce packet loss, latency, and jitter in wireless network systems. *Quality of Service* (QoS) will control and manage network resources by setting priorities for certain types of data on wireless networks. Wireless network systems will require predictable and measurable services for applications such as; text, images, voice, and video to get to the destination across the network system [5]. *Quality of service* (QoS) is used to meet the traffic requirements of sensitive applications, such as real-

time voice and video, and to prevent quality degradation caused by packet loss, latency and jitter.

Some standard measures of *Quality of Service* (QoS), as follows [6];

1. *Throughput*, namely the speed (*rate*) of effective data transfer, which is measured in bps (*bits per second*). Throughput is the total number of successful packet arrivals observed at a destination during a specified time interval divided by the duration of that time interval.

$$Throughput = \frac{Data\ Sent}{Data\ Transfer\ Time}$$

2. *Packet Loss*, namely a parameter that describes a condition that shows the total number of lost packets that can occur due to collisions and congestion in the network system.

$$Packet\ Loss = \frac{(Data\ Sent - Data\ Received)}{Data\ Sent} \times 100\%$$

3. *Delay*, i.e. the time it takes the data to travel the distance from the origin to the destination. Delay can be affected by distance, physical media, congestion or long processing time.

$$Delay = \frac{Total\ Delay}{Packets\ Received}$$

2.3 Simulation Prosessed with NS-3

To start the simulation process with NS-3, it can be run with certain commands or scripts according to the available features. The command will adjust to the simulation scenario that will be run. The user will first have to enter the NS-3 simulator directory which already contains the .waf file. Then the user runs the terminal by typing the command: *"/waf –run manet-routing-compare"*.

Figure 1. Start NS-3

After running the program execution command, then NS-3 will carry out a simulation by building and compiling the program and the simulation runs.

Figure 2. Running NS-3

After the NS-3 simulator is run according to the predetermined processing time, the NS-3 simulator will stop and finish running the simulation process of transferring data from sender to receiver.

Figure 3. Finish NS-3

After the simulation process runs well, the NS-3 simulator will generate an output file with the .csv extension. This file contains some information, namely the length of simulation time, the amount of data received, packets received, number of connections, type of protocol, and transmission power. This .csv file is needed during data analysis to calculate throughput values. To calculate the throughput value, it is necessary to know the total packets received and the length of time it takes for packets to be sent, calculated from the first packet sent to the last packet received. In the simulation process with NS-3 using the OLSR routing protocol to calculate the *Quality Of Service*.

Data analysis was performed by calculating the values contained in the .csv file. To calculate the throughput, we will calculate the total of the receive rate and the difference between the time the packet was first sent to the last time the packet was received. The throughput value will be obtained after dividing the total receive rate by the packet delivery time. Then, to calculate packet loss, *txPackets* is reduced by *rxPackets*, then the result is divided by *txPackets*, then converted in percent by multiplying it by 100%. Finally, to calculate the delay by looking at the total delay then the total delay on each connection will be divided by the total packets received.

3. RESULTS AND DISCUSSION

After the simulation process with the scenario of adding nodes gradually starting from 10 nodes, adding to 20 nodes, until a total of 40 nodes is complete, then the results of the analysis will be displayed based on the average value of throughput, packet loss and delay according to the Quality of Service parameters that have been measured.

3.1 Throughput

The results of calculating the average throughput resulting from the simulation for the scenario of adding nodes in stages, starting from 10 nodes: 3.072 Kbps, then adding to 20 nodes: 3.6352 Kbps then adding again to 40 nodes: 2.8544 Kbps. The results of the calculation of the average throughput of 3.1872 Kbps (Kilobits per second).
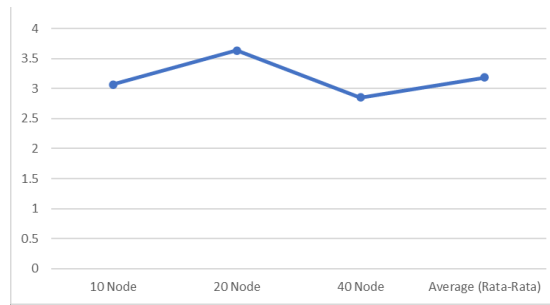
Figure 4. Graph Throughput vs Nodes

3.2 Packet Loss
The results of calculating the average packet loss resulting from the simulation for the scenario of adding nodes in stages, starting from 10 nodes: 0.63%, then added to 20 nodes: 1.75% then added again to 40 nodes: 8.07%. The average packet loss calculation result is 3.48%.
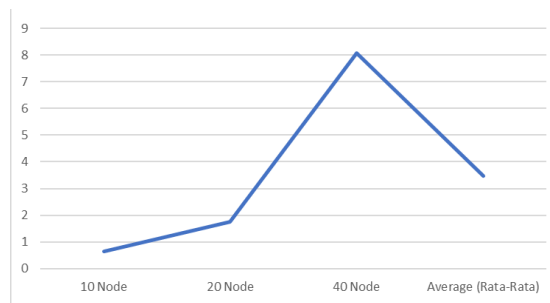

Figure 5. Graph Packet Loss vs Nodes

3.3 Delay
The results of calculating the average delay in milliseconds are generated from the simulation for the scenario of adding nodes in stages, starting with 10 nodes: 5.243ms then adding to 20 nodes: 8.974ms then adding again to 40 nodes: 6.255ms The results of the average calculation average delay of 6.284ms.
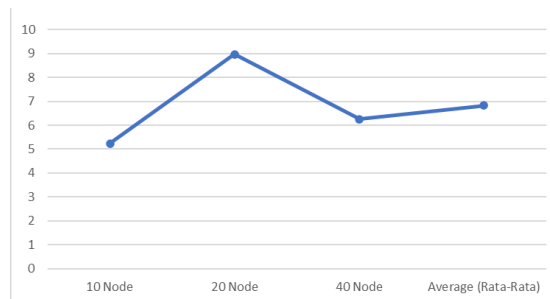

Figure 6. Graph Delay vs Nodes

4. CONCLUSION

To measure and calculate the Quality of Service of an ad hoc network with NS-3, a simulation scenario must first be created according to the parameters of the Quality of Service measurement. Based on the simulation process that has been carried out, several characteristics of the data packet delivery process are obtained, namely; throughput, packet loss and delay. Based on the simulation results with NS-3 according to the scenario, it can be explained that the resulting throughput data rate can provide good service quality, and if the throughput quality decreases, it will cause a decrease in ad hoc network quality. The results of the analysis and measurements obtained for throughput produce an average value of 3.1872 Kbps so that it is included in the good category. The packet loss parameter produces an average value of 3.48% which is included in the good category and the delay parameter produces an average value of 6,824 ms which is also included in the good category.

6. REFERENCES

[1] Abdul-Kader, S. A., & Woods, J. C. (2015). Survey on chatbot design techniques in speech conversation systems. International Journal of Advanced Computer Science and Applications, 6(7), 72-80.

[2] Alman, A., Balder, K. J., Maggi, F. M., & Van der Aa, H. (2020). Declo: A chatbot for userfriendly specification of declarative process models. Available from Business Process Management Demos https://hanvanderaa.com/wpcontent/uploads/2020/07/BPMDemos2020-Declo.pdf, Retrieved on 20 August 2020.

[3] Azwary, F., Indriani, F., & Nugrahadi, D. T. (2016). Question answering system berbasis artificial intelligence markup language sebagai media informasi. Klik-Kumpulan Jurnal Ilmu Komputer, 3(1), 48-60.

[4] Balaji, S., & Murugaiyan, M. S. (2012). Waterfall vs. v-model vs. agile: A comparative study on sdlc. International Journal of Information Technology and Business Management, 2(1), 26-30. Bii, P. (2013).

[5] Chatbot technology: A possible means of unlocking student potential to learn how to learn. Educational Research, 4(2), 218-221.

[6] Blanco, J. A., & Upton, D. (2009). CodeIgniter 1.7. Birmingham: Packt Publishing. Chari, K., & Agrawal, M. (2018). Impact of incorrect and new requirements on waterfall software project outcomes. Empirical Software Engineering, 23(1), 165-185.

[7] Chow, C. Y., Kumar, K. N., Showman, K. A., & Vincent, J. (2011). United States Patent No. 7,987,459. Washington, DC: United States Patent and Trademark Office. Dabbagh, N., & Kitsantas, A. (2012).

[8] Personal learning environments, social media, and selfregulated learning: A natural formula for connecting formal and informal learning. The Internet and Higher Education, 15(1), 3-8

[9] Achadiyah, R. U. C. R. B. N. (2014). Pengembagnan Media Evaluasai Pembelajaran dalam Bentuk Online Berbasis ELearning Menggunakan Software Wondershare Quiz Creator Dalam Mata Pelajaran Akuntansi SMA Brawijaya Smart School (BSS),. Jurnal Pendidikan Akuntansi Indonesia 12, 41–48

[10] Suparto, S. P. (2012). Evaluasi Program E-Learning Bagi Petugas Lapangan,. Cakrawala Pendidikan 12, 112–128

[11] Sutedjo, A. (2013). Implementasi dan Evaluasi Pembelajaran E-Learning Pada Mata Kuliah Geografi Transportasi dan Komunikasi Mahasiswa yang Memprogram di Semester Gasal Tahun Akademik 2012/2013,. Jurnal Geografi 11, 51–63