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ANALYSIS OF CABLE NETWORK READINESS FOR THE IMPLEMENTATION OF ENTERPRISE RESOURCE PLANNING INFORMATION SYSTEMS AT THE FACULTY OF INDUSTRIAL ENGINEERING

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Abstract

With the rapid advancement of information and communication technology, organizations increasingly adopt integrated systems to enhance efficiency and productivity. One widely adopted technology is Enterprise Resource Planning (ERP), a comprehensive management system that integrates various business functions, including finance, manufacturing, inventory, and human resources. Implementing an ERP system requires a robust network infrastructure, particularly in terms of quality of service (quality of service). This study aims to evaluate the readiness of the cable network infrastructure across three buildings at the Faculty of Industrial Engineering, Telkom University, to implement an Odoo-based ERP system. The research employs the Network Development Life Cycle (NDLC) methodology, focusing on crucial quality of service parameters such as throughput, delay, jitter, and packet loss. Data were collected through observations, interviews, and network analysis using Wireshark, with tests conducted at different times (low, peak, and intermediate). The results show that the TULT Building, Mangudu Building, and Building B Cacuk networks are generally prepared for ERP implementation. For instance, in the TULT Building, the average throughput without filters at low, peak, and intermediate times was 45.296 Kbps, 50.923 Kbps, and 61.399 Kbps, respectively. Packet loss averaged 0.56%, 0.50%, and 0.65% without filters. Despite jitter values ranging from 103.73 ms to 582.40 ms, below the TIPHON standard, the ERP system remains functional as it is not highly sensitive. The study concludes that the existing network infrastructure is sufficient mainly for the Odoo-based ERP implementation, with recommendations for further improvements to address jitter issues.

Keywords: *ERP, Quality of Service, Network Development Life Cycle, Cable Network*

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1. INTRODUCTION

The rapid development of information and communication technology has encouraged many organizations to adopt integrated systems that can improve their efficiency and productivity. One of the widely adopted technologies is Enterprise Resource Planning (ERP), which is an integrated management system that integrates various business functions within a company, including finance, manufacturing, inventory, and human resources, in one comprehensive platform. The implementation of an ERP system requires a robust and reliable network infrastructure, especially in terms of quality of service (QoS).

Bandwidth is a calculation of data consumption requirements on a telecommunications network. Bandwidth can also be said to be a measure of information that can be sent from one place to another in one second. Bandwidth can be measured in bits per second (bps). Bandwidth is a bandwidth on a computer network that can determine the speed of computer network access[1]. For ERP systems, bandwidth requirements are usually in the range of 500 Kbps to 2 Mbps, which falls into the high bandwidth usage category.

Local Area Network (LAN) is a network that can be used in a building such as a house, office, or multi-story building[2]. LAN are used to exchange information, but the distance between devices is limited to a few kilometers[2]. LAN networks are also referred to as intranet networks. The main difference between LAN and internet networks lies in their nature. On a LAN, this network is private and only intended for particular users within an organization, company, agency, or specific room. LANs can cover distances between 1 and 10 kilometers in the form of wired, wireless, or a combination of both[3] . Connection stability on the LAN is very important for applications that demand speed and accuracy of data, such as ERP.

Quality of Service (QoS) can be defined as the ability of a network administrator to control bandwidth, delay, jitter, loss, and congestion of throughput in a network [4]. QoS is designed to meet the requirements of diverse services that use similar infrastructure, and to characterize the services provided in both quality and quantity [5]. QoS is designed to facilitate clients so that they can increase productivity by ensuring that users get good performance from the applications used[6]. QoS aims to bring different service requirements but uses the same infrastructure[6]. Qos parameters can be categorized into throughput, delay, jitter, and packet loss.

Throughput results from the number of packets successfully transmitted in a given period divided by the time required. Throughput can be defined as the rate of data within a specific duration. Throughput is usually measured in bits per second (bps), kilobits per second (kbps), megabits per second (Mbps), or gigabits per second (Gbps). The results of the throughput calculation can be related to the bandwidth in actual conditions[7]. Throghput can be calculated by dividing the amount of data sent by the sending time[8].

Delay is the time it takes for the network to send packets from one computer to another. Delays in packet delivery can be caused by long queues of packets or the selection of packet paths to avoid path congestion. Factors that affect delay are distance, physical media, density on network routes, or the length of processing time [9]. Delay can be calculated by dividing the total delay by the number of packets [8]. Delay Standardization according to TIPHON classifies delay into four categories based on duration and assigns a quality index to each category. The very good category includes delays of less than 150 ms, with the highest index being 4, indicating excellent conditions. The good category includes delays between 150 and 300 ms, with an index of 3 indicating good conditions. The medium category includes delays between 300 to 400 ms, with an index of 2 indicating a medium condition. Meanwhile, the poor category includes delays of more than 450 ms, with the lowest index being 1, indicating poor conditions. This index provides a quality assessment standard based on the duration of the delay.

Jitter or delay variation is the change in transmission delay or the difference between the first delay and the subsequent delay. If the change in delay time is too significant, it can affect the quality of the transmitted data. Jitter is very important in QoS, especially for applications requiring real-time data transmission [9]. Jitter can be calculated by dividing the total delay variation by the number of packets [8]. Jitter Standardization according to TIPHON classifies jitter variations based on a specific time range and provides a quality index for each category. In the very good category, jitter is 0 ms and gets the highest index of 4, indicating excellent conditions. The good category includes jitter between 0 and 75 ms, with an index of 3 indicating good conditions. For the medium category, jitter is in the range of 75 to 125 ms and is assigned an index of 2, which indicates medium conditions. The poor category includes jitter between 125 to 225 ms, with the lowest index being 1, which indicates poor conditions. This index helps assess network quality based on the level of jitter that occurs.

Packet Loss is a parameter that describes the total number of packets lost due to congestion or collisions on the network [10]. Packet loss is usually presented in the form of a percentage of the results of lost packets. Packet loss can be calculated by calculating the difference between packets sent and packets received, divided by packets sent. After that, it can be multiplied by one hundred percent[8]. Packet Loss Standardization according to TIPHON groups packet loss rates into several categories and assigns a quality index to each. In the very good category, the packet loss rate is 0%, which gets the highest index of 4, indicating excellent conditions. The good category shows a packet loss of 3% with an index of 3, indicating good conditions. For the medium, the packet loss rate is 15%, with an index of 2 indicating medium conditions. Meanwhile, the poor category also has a 15% packet loss rate, but is assigned the lowest index of 1, indicating poor conditions. This index makes it easy to assess network quality based on the percentage of packet loss.

Wireshark is a network analysis tool used to monitor and measure QoS parameters. Before its current name knew it, Wireshark was known as Ethernal. This application was developed by Gerald Combs in 1988. This application is used as a tool to troubleshoot and analyze networks on computers. Wireshark can run on Windows and UNIX operating systems [11]. Wireshark is also an open-source application that helps analyze the network being used[12]. In addition to analyzing networks, Wireshark can also be used for network debugging analysis[13].

By considering the above factors, this research aims to evaluate the readiness of the wired network in three buildings of the Faculty of Industrial Engineering, Telkom University for the implementation of Odoo-based ERP system. Through

QoS analysis, this research will provide a comprehensive overview of the current network condition and provide recommendations for necessary improvements.

2. RESEARCH METHOD

This research uses the NDLC method. Network Development Life Cycle (NDLC) is the definition of the development cycle of a network system [14]. NDLC has elements that describe specific stages or phases. The word cycle in NLDC is a descriptive keyword of the network system development cycle that describes the outline of the process that will be passed in the continuous network development stages [15]. In this research, the NDLC cycle is applied mainly at the analysis stage to evaluate the readiness of the wired network infrastructure in three buildings of the Faculty of Industrial Engineering, Telkom University (TULT Building, B Cacuk Building, and Mangudu Building) in supporting the implementation of the Odoo-based ERP system. The analysis focuses on several essential Quality of Service (QoS) parameters: throughput, delay, jitter, and packet loss.

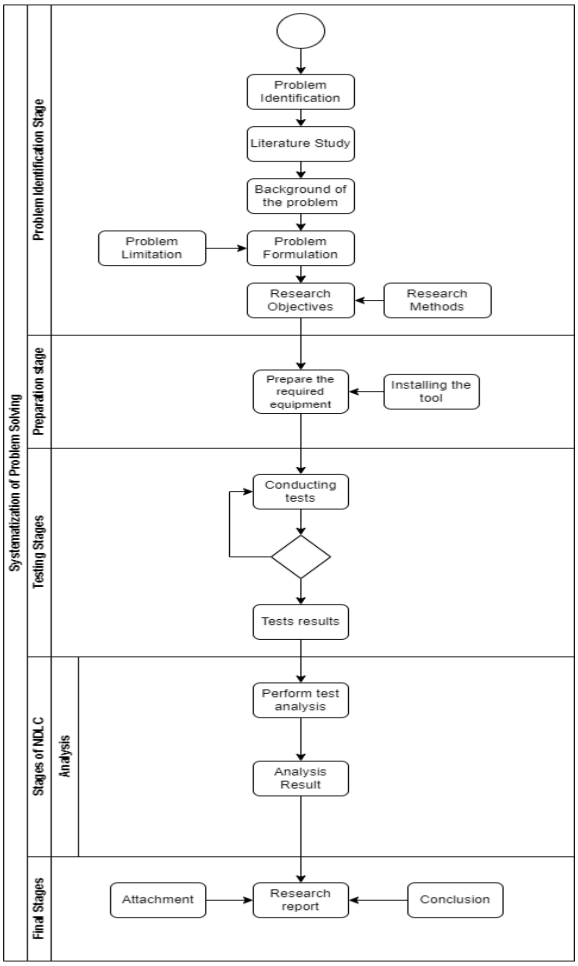

Figure 1 Problem Solving Statement

Figure 1 is the organized steps taken in this research. This stage is divided into six stages, namely the problem identification stage, problem identification stage, preparation stage, testing stage, analysis stage, and final stage. The following is a description of the stages in the problem-solving statement:

1. Problem identification stage
   The initial stage of this research is to identify research problems, conduct literature studies, determine problem formulations, and determine research objectives.
2. Preparation Stage
   The preparation stage is related to the preparation of equipment for testing and installing the tools needed for testing.
3. Testing Stage
   The testing stage includes conducting tests and the results of the tests.
4. Analysis Stage
   The analysis stage includes test analysis activities, which will later be used as analysis results.
5. Final Stage
   The final stage contains the final report on the analysis results, which includes the calculation results and the conclusion of the final report.

3. RESULT AND DISCUSSION

This analysis is carried out to determine the readiness of network infrastructure in the TULT Building, Mangudu Building, and Building B Cacuk in the implementation of the Odoo-based ERP system by calculating the results of throughput, packet loss, jitter, and delay from the results of data sampling that has been carried out in the TULT Building, Mangudu Building, and Building B Cacuk. Data samples can be grouped into three different time sections: low, peak, and intermediate. The low time starts from 06.00 - 08.00 and 16.00 - 17.00. While the peak time starts from 09:00 - 11:00 and 13:00 - 15:00. Intermediate time can start from 12:00 - 13:00 and 15:00 - 16:00. The calculation is divided into two parts, namely calculations without filters and calculations using port filters used in the SAP Logon application. The port used by SAP Logon is port 3206, with IP address 118.99.107.30. The following are the results of the average QoS calculation:

1. Table 4 shows the results average throughput calculation results without filters
2.

Table 1 Average Throughput Without Filters

	TULT Building	**Mangudu Building**	**Building B Cacuk**
Low	43,077 Kbps	51,531 Kbps	80,582 Kbps
Peak	50,923 Kbps	36,298 Kbps	60,322 Kbps
Intermediate	61,399 Kbps	43,655 Kbps	62,852 Kbps

3. Table 5 shows the results average throughput calculation results using filters

Table 2 Average Throughput Using Filters

	TULT Building	**Mangudu Building**	**Building B Cacuk**
Low	20,456 Kbps	32,172 Kbps	17,662 Kbps

Peak	24,820 Kbps	27,142Kbps	13,855 Kbps
Intermediate	40,136 Kbps	27,658 Kbps	28,200 Kbps

4. Table 6 shows the results average packet loss calculation results without filters

Table 3 Average Packet Loss Without Filters

	TULT Building	**Mangudu Building**	**Building B Cacuk**
Low	0,42 %	1,57 %	0,59 %
Peak	0,50 %	0,70 %	0,40 %
Intermediate	0,65 %	1,54 %	0,51 %

5. Table 7 shows the results average packet loss calculation results using filters

Table 4 Average Packet Loss Using Filters

	TULT Building	**Mangudu Building**	**Building B Cacuk**
Low	0,52 %	1,17 %	0,42 %
Peak	0,48 %	0,69 %	0,39 %
Intermediate	0,62 %	1,01 %	0,48 %

6. Table 8 shows the results average delay calculation results without filters

Table 5 Average Delay Calculation Without Filters

	TULT Building	**Mangudu Building**	**Building B Cacuk**
Low	89,82 ms	124,52 ms	71,11 ms
Peak	61,10 ms	108,93 ms	30,18 ms
Intermediate	66,65 ms	115,35 ms	53,44 ms

7. Table 9 shows the results average delay calculation results using filters

Table 6 Average Delay Using Filters

	TULT Building	**Mangudu Building**	**Building B Cacuk**
Low	301,98 ms	197,18 ms	344,28 ms
Peak	252,70 ms	190,56 ms	237,08 ms
Intermediate	152,12 ms	212,43 ms	228,41 ms

8. Table 10 shows the results average jitter calculation results without filters

Table 7 Average Jitter Without Filters

	TULT Building	**Mangudu Building**	**Building B Cacuk**
Low	103,73 ms	217,60 ms	72,61 ms
Peak	71,23 ms	174,77 ms	42,15 ms
Intermediate	79,85 ms	208,97 ms	71,27 ms

9. Table 11 shows the results average jitter calculation results using filters

Table 8 Average Jitter Using filters

	TULT Building	**Mangudu Building**	**Building B Cacuk**
Low	582,40 ms	377,10 ms	671,40 ms
Peak	484,22 ms	363,05 ms	459,83 ms
Intermediate	285,78 ms	413,08 ms	437,99 ms

4. CONCLUSION

Based on the results of the wired network analysis carried out in Building B Cacuk, TULT Building, and Mangudu Building, it can be concluded that the networks in the three buildings can implement the Odoo-based ERP system. This is reinforced by the throughput results without filters in the TULT Building at low, peak, and intermediate times, namely 45.296 Kbps, 50.923 Kbps, and 61.399 Kbps. The throughput calculation using port filters in the TULT Building at low, peak, and intermediate times is 20,456 Kbps, 24,820 Kbps, and 40,136 Kbps. Packet Loss obtained in calculations without filters at low, peak, and intermediate times in the TULT Building are 0.56%, 0.50%, and 0.65%. The packet loss calculation obtained using port filters at low, peak, and intermediate times in the TULT Building is 0.52%, 0.48%, and 0.62%. The results of delay without filters in the TULT Building at low, peak, and intermediate times are 89.82 ms, 61.10 ms, and 66.65 ms. The delay calculation using port filters in the TULT Building at low, peak, and intermediate times is 301.98 ms, 252.70 ms, and 152.12 ms. The jitter calculation without filters in the TULT Building at low, peak, and intermediate times is 103.73 ms, 71.23 ms, and 79.85 ms. The jitter calculation using port filters in the TULT Building at low, peak, and intermediate times is 582.40 ms, 484.22 ms, and 285,78 ms.

The throughput results without filters in Mangudu Building at low, peak, and intermediate times are 51.531 Kbps, 36.298 Kbps, and 43.655 Kbps. The calculation of throughput using port filters in the Mangudu Building at low, peak, and intermediate times is 32.172 Kbps, 27.142 Kbps, and 27.658 Kbps. Packet Loss obtained in calculations without filters at low, peak, and intermediate times in Mangudu Building are 1.57%, 0.70%, and 1.54%. The packet loss calculation obtained using port filters at low, peak, and intermediate times in the Mangudu Building is 1.17%, 0.69%, and 1.01%. The results of delay without filters in the Mangudu Building at low, peak, and intermediate times are 124.52 ms, 108.93 ms, and 115.35 ms. The delay calculation using the port filter in Mangudu Building at low, peak, and intermediate times is 197.18 ms, 190.56 ms, and 212.43 ms. Calculation of jitter without filters in Mangudu Building at low, peak, and intermediate times, namely 217.60 ms, 174.77 ms, and 208.97 ms. The calculation of jitter using port filters in the Mangudu Building at low, peak, and intermediate times is 377.10 ms, 363.05 ms, and 413.08 ms.

The throughput results without using filters at Cacuk Building B during low, peak, and intermediate times were 80.582 Kbps, 60.322 Kbps, and 62.852 Kbps, respectively. Meanwhile, the throughput calculations using port filters at Cacuk Building B during low, peak, and intermediate times were 69.214 Kbps, 33.772 Kbps, and 49.084 Kbps, respectively. The packet loss obtained from calculations without filters during low, peak, and intermediate times at Cacuk Building B was 0.59%, 0.40%, and 0.51%, respectively. Meanwhile, the packet loss obtained from calculations using port filters during low, peak, and intermediate times at Cacuk Building B was 0.89%, 0.85%, and 1.00%, respectively. The delay results without using filters at Cacuk Building B during low, peak, and intermediate times are 71.11 ms, 30.18 ms, and 53.44 ms, respectively. Meanwhile, the delay calculations using port filters at Mangudu Building during low, peak, and intermediate times are 85.99 ms, 118.78 ms, and 102.04 ms, respectively. The jitter calculations without using filters at Cacuk Building B during low, peak, and intermediate times are 72.61 ms, 42.15 ms, and 71.27 ms, respectively. Meanwhile, the jitter calculations using port filters at Cacuk Building B during low, peak, and intermediate times are 177.61 ms, 223.51 ms, and 185.08 ms.

The packet loss results without using filters and with port filters in the three buildings showed excellent results according to TIPHON standards. The delay calculations in the three buildings showed results ranging from very good to moderate according to TIPHON standards. However, the jitter analysis in the three buildings still showed poor results according to TIPHON standards. Despite the poor jitter analysis results in the three buildings, the Odoo-based ERP system continued to function well because ERP systems are generally not sensitive to poor jitter.

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