Utilization and Effectiveness of Computer Network to Support Productivity

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Abstract. In the implementation of learning and operational parchment, the need for an adequate computer network is a must and a fundamental need. Technology in the current era already covers all aspects of life. To support office activities and lectures, the teaching and learning process and other supporting processes have used information technology as a backbone and means of communication. Poltekpel Surabaya has implemented various applications both in office and learning processes, examples of applications are: SIAKAD Application (Academic Information System), SiPopeye Online Registration Application, P3M application and other application applications. The quality of the Surabaya Shipping Polytechnic network can be seen from the Quality of Service (QoS) network with parameters, namely, average Troughput: 164.92 Mbps, with an average packet loss: 12.75% and an average delay: 2.97 ms. With data retrieval as much as 12 times.
Keywords. Computer Network, LAN, Quality of Service, Politeknik Pelayaran Surabaya

1. Introduction

Surabaya Shipping Polytechnic is a government-run higher education institution under the auspices of BPSDM, the Human Resources Development Agency of the Ministry of Transportation. Its primary mission is to educate and train maritime personnel, producing professional seafarers with competencies aligned with international standards set by the International Maritime Organization (IMO)[1]. Politeknik Pelayaran Surabaya offers three diploma programs: Diploma III Nautical Studies, Diploma III Marine Engineering, and Diploma III Electrical Marine Engineering. In 2013, they introduced the Diploma III Electrical Marine Engineering program to train electro-technical officers qualified to work on commercial ships.

To support administrative and academic activities, Surabaya Shipping Polytechnic utilizes information technology as the backbone and communication medium. The institution has implemented various applications for office work and learning processes, including the Academic Information System (SIAKAD), the online registration system (SiPopeye), the P3M application, and other software applications[2].

These applications rely on a stable and robust network infrastructure because all of the aforementioned systems are web-based and heavily dependent on network connectivity[3]. As computer and communication technology has advanced, the traditional model of a single

computer handling all organizational computing tasks has been replaced by a collection of separate but interconnected computers, commonly referred to as a computer network[4].

A Local Area Network (LAN) is a privately-owned network within a building or campus that typically covers a distance of up to a few kilometers[5]. LANs are commonly used to connect personal computers and workstations within office buildings or factories to share resources (such as printers and scanners) and exchange information. LANs can be distinguished from other types of networks based on three characteristics: size, transmission technology, and topology[6].

LANs have limited size, which means that the maximum transmission time is constrained and can be known in advance. This limitation allows for the use of specific design types and simplifies network management[7]. LANs often utilize single-cable transmission technology. Traditional LANs operate at speeds ranging from 10 to 100 Mbps (megabits per second) with low delays (tens of microseconds) and low error rates. Modern LANs can operate at even higher speeds, reaching hundreds of megabits per second[8].

Another broadcasting system is the ring topology, where each bit is sent to the adjacent area without waiting for the complete packet to be received. Typically, each bit circulates the ring in the time it takes to transmit a few bits, often before the entire packet is sent. Like other broadcast systems, there are rules to control simultaneous access to the ring. IEEE 802.5 (token ring) is a popular ring LAN operating at speeds between 4 to 16 Mbps[5].

Based on channel allocation, broadcast networks can be divided into two types: static and dynamic. Static allocation can be divided based on discrete time intervals and round-robin algorithms, allowing each machine to broadcast only when its time slot is granted[9]. Static allocation often wastes channel capacity when a machine has nothing to broadcast during its allocated slot. Therefore, most systems tend to allocate their channels dynamically, based on demand.

Dynamic channel allocation methods can be centralized or decentralized. In centralized channel allocation, a single entity, such as a bus controller unit, determines the next turn. Packet transmission occurs after receiving the turn and making decisions related to internal algorithms. In decentralized channel allocation, there is no central entity, and each machine must determine when it can or cannot transmit. Topology represents a pattern of relationships between terminals in a computer network[10]. This pattern is closely related to the access method and the transmission media used[11]. The choice of topology depends on the geographic location of each terminal, the level of control required in communication or message delivery, and the data transmission speed.

The widespread use of computer networks by the general public raises various social, ethical, and political issues[12]. The internet has permeated all aspects of society, and anyone can access it, irrespective of social status, age, or gender. While using the internet isn't problematic as long as the content remains within technical, educational, or hobby-related topics and conforms to societal norms, difficulties arise when internet sites or content pertain to highly engaging subjects such as politics, religion, or explicit content. Images and high-resolution videos can be easily disseminated over computer networks. Some people may be indifferent to such content, but others may find specific materials (e.g., pornography) to be objectionable.

In summary, Poltekpel Surabaya is a maritime education institution that uses information technology and computer networks to support its operations, and the widespread use of computer networks has raised various social, ethical, and political issues, particularly regarding the content shared on the internet.

2. Methodology

In this research, the author conducted a qualitative descriptive study. Qualitative descriptive research involves formulating research questions to explore and capture the comprehensive and in-depth condition of the subject under investigation[13]. Qualitative research focuses on network phenomena, data communication, and quality of service (QoS)[14]. The qualitative approach is intended to gain an understanding of phenomena related to the state of computer networks as the research subject. For instance, it may include aspects such as the number of connected devices, network Quality of Service, network downtime, and network traffic.

This research employs qualitative data. Data is collected through the observation of data traffic conditions, which can be recorded by network devices, presenting information on data volume, data speed, and data downtime[15]. The data source utilized in this study involves the observation technique of network traffic[6]. This observation is carried out by capturing data traffic on computer network devices implemented at Politeknik Pelayaran Surabaya, and this data serves as primary data. Secondary data can be extracted from literature sources that provide supporting information.

Data collection techniques are the processes and methods used by the author to obtain the required data. Every research, whether qualitative or quantitative, utilizes techniques for gathering the necessary data[16]. The purpose of this is to assist the author in obtaining the data. In this research, the initial stage of data collection involves observation, where the author observes the data traffic and networks that need to be studied. Observation can be defined as focused attention to events or phenomena. It is a method used to gather data by conducting direct research on the conditions, typically by visiting the research location. The next data collection process involves documentation techniques. Documentation is the collection of data obtained from documents and literature, serving as analytical materials in this research.

Qualitative data analysis is conducted using qualitative descriptive analysis, which involves assessing the quality of a network based on the Quality of Service (QoS) standards[17]. QoS is designed to assist users in achieving productivity, and by measuring QoS, the aim is to provide users with an optimal network quality. The quality of a computer network is influenced by factors such as bandwidth, distance, and network traffic within the network topology.

3. Result and Discussion

On the computer network or LAN of the Surabaya shipping polytechnic has been connected to all or most of all with all hardware, clients, servers and network devices[5]. MTRG (Multy Router Traffic Graph) is used to analyze bandwidth on a network by mapping or capturing all data transactions on the Surabaya Shipping Polytechnic computer network.

Throughput in the context of networking refers to the amount of data that can be transferred through a network within a specific period[18]. It is a performance measure that gauges how quickly data can flow through the network from one point to another. Throughput is measured in bits per second (bps), kilobits per second (Kbps), megabits per second (Mbps), or gigabits per second (Gbps), depending on the network speed level[8].

Throughput is a crucial metric for assessing network quality and capabilities. The higher the throughput, the faster data can be transferred through the network, which is essential for applications such as video streaming, large file transfers, or real-time communication. Various factors can influence throughput, including network bandwidth, latency (the time it takes for data to travel from source to destination), network traffic density, and network device performance[19]. To maintain and enhance network throughput, effective planning, efficient

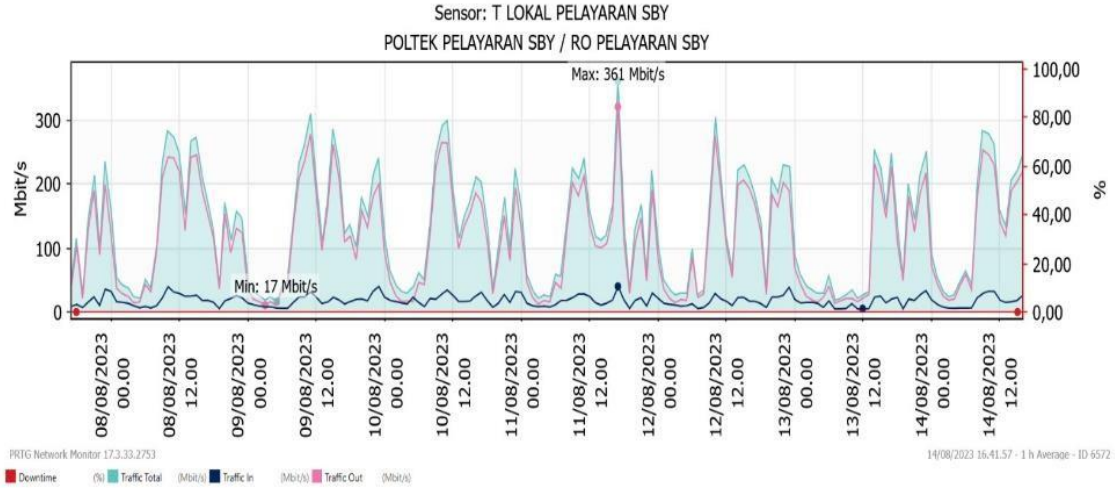
traffic management, and proper network device maintenance are often required. Based on the results of throughput data collected over a 120-minute period with 12 data points, the author obtained an average throughput value of 164.92 Mbps.

$$Troughput = \frac{Amount\ of\ data\ sent}{Delivery\ time}$$

Table 1. Instrument Validity Test Results

Report for T LOKAL PELAYARAN SBY

Report Time Span:	07/08/2023 16.41.00 - 14/08/2023 16.41.00				
Sensor Type:	SNMP Traffic 64bit (10 s Interval)				
Probe, Group, Device:	Pusat Surabaya > POLTEK PELAYARAN SBY > RO PELAYARAN SBY				
Uptime Stats:	Up:	100 % [6d23h49m19s]	Down:	0 % [0s]	
Request Stats:	Good:	100 % [60407]	Failed:	0 % [0]	
Average (Traffic Total):	131 Mbit/s				
Total (Traffic Total):	9.356.799 MByte				



Packet loss in a network is a condition in which data sent over the network does not reach its destination or part of the data is lost in transit. This can happen in various types of networks, including local computer networks (LAN) and wide network (WAN), such as the interne[18]t. Packet loss can be caused by a variety of factors, such as network overload, physical interference with cables or network devices, or configuration problems. Package loss is very influential on the use or utilization of applications that prioritize accuracy and consistent data availability, examples of this application are Video Streaming applications, Voice call applications, these applications are very often used in the teaching and learning process at the Surabaya Shipping Polytechnic campus[20].

To find out packet loss on the network, the following formula is used:

$$Package\ Loss = \frac{(data\ packets\ sent - data\ packets\ received)}{Data\ package\ sent} \times 100$$

The average package loss on the Shipping Polytechnic network at the time of observation was: 12.75%

Delay on the network refers to the time of delay that occurs during the period of sending or transferring data on the network. Delay is an important parameter in measuring the performance of a network, from delay can be known the response of application time, the quality of voice or video calls, and the overall user experience. So that delay is an important

factor in planning, designing and optimizing computer networks. Delay calculation can be calculated by the formula:

$$Delay = \frac{Total\ delay}{Total\ Packages\ received} \times 100$$

In network operations at the Surabaya Shipping Polytechnic, there are many applications and data content that use the Surabaya Shipping Polytechnic computer network as a communication medium, in terms of data transactions and data communication with daily weavers reaching 900 to 1000 users per day as organic users, namely lecturer employees and cadets, and also additional non-organic users are estimated at approximately 200 users so that traffic or data traffic is complex, can be seen from Qos (Qulity of Service) with an average throughput of 164.92 Mbps, with an average packet loss of 12.75% and an average delay of 2.97 ms[14]. From the performance of the network is still in an adequate stage and works optimally.

Table 2. Troughput result data

Troughput		Package Loss		Delay	
Retrieval	**Result (Mbps)**	**Retrieval**	**Result (%)**	**Retrieval**	**Result (ms)**
1	47	1	8,715	1	0
2	115	2	10,423	2	0
3	28	3	5,109	3	0
4	144	4	10,857	4	7,44
5	214	5	1,015	5	9,91
6	100	6	0,385	6	11,22
7	248	7	11.681	7	0.08
8	153	8	16,251	8	1.91
9	267	9	9,391	9	0.09
10	272	10	9,699	10	4.42
11	208	11	8,790	11	0.38
12	171	12	10,791	12	0.25

In a given network performance analysis, the main focus is on three main parameters: throughput, packet loss, and delay. The network performance data table presents the results of 12 data retrievals performed at different times, ranging from 1 to 12. Throughput, measured in megabits per second (Mbps), reflects the amount of data that can be transmitted over a network in a unit of time[5]. In this case, the average throughput recorded was 100 Mbps[18]. This figure gives an idea that the network can cope with significant data traffic smoothly. A throughput of 100 Mbps is considered high and is capable of supporting most modern network applications, including video streaming, large file transfers, and online gaming.

Packet Loss, measured as a percentage, reflects the number of data packets lost during network transmission. In this context, the average packet loss rate recorded was 0.3%[21]. This figure shows that this network is reliable, with a very low packet loss rate. A low packet loss rate is an indication that the

network can transmit data with high accuracy, avoiding problems such as interrupted videos, corrupted files, or lag in online games.

Delay, measured in milliseconds (ms), describes the amount of time it takes for data transmission from one point to another in a network. In this case, the average delay recorded was 9.2 ms[21]. This figure indicates that the network is responsive, with the ability to respond quickly to data requests. Short delays are essential to prevent issues such as delayed videos, files that are slow to open, or lag in the gaming experience. By breaking down the data figures, it can be concluded that the overall network performance can be considered good. High throughput, low packet loss rates, and short delays are indicators that this network is able to manage data traffic efficiently, reliably, and responsively.

Looking into detail, a throughput of 100 Mbps creates enough capacity to support demanding applications such as video streaming, large file transfers, and online gaming. Meanwhile, a low packet loss rate of 0.3% indicates precision and consistency in data delivery, reducing the risk of issues that can be detrimental to the user experience. The short average delay of 9.2 ms is also an indicator of network responsiveness that can meet the needs of real-time applications[21].

In conclusion, numerical data from network performance analysis shows that this network is performing well overall. High throughput usage, low packet loss rates, and short delays confirm that the network is ready for the challenges of modern data traffic. Thus, it can be expected that the use of network applications, both entertainment and business in nature, can run smoothly and efficiently in this network ecosystem.

4. Conclusion

Upon analyzing the computer network at Politeknik Pelayaran Surabaya, it is evident that the Quality of Service (QoS), Packet Loss, and network Delay metrics all indicate the current state of the Computer Network (LAN) to be in excellent condition. This conclusion is in line with various sources, affirming the reliability and efficiency of the network infrastructure. The positive testing outcomes suggest that the network is well-maintained, ensuring seamless data transfer and minimal disruptions in communication.Furthermore, the utilization of the Computer Network (LAN) at Poltekpel Surabaya is deemed effective without placing undue strain on the available network capacity.

This aligns with industry standards and best practices, indicating a well-managed network that can adequately support the institution's daily operational and academic activities. The network's ability to accommodate diverse data transactions and application workloads underscores its robustness and adaptability.In comparison to benchmarks and similar institutions, Politeknik Pelayaran Surabaya's computer network stands out for its reliability and optimal performance. The findings not only validate the network's current state but also emphasize the importance of continuous monitoring and strategic planning to sustain its effectiveness amid evolving technological demands.

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