Journal of Artificial Intelligence and Engineering Applications

Website: https://ioinformatic.org/

June 2026. Vol. 5. No. 3; e-ISSN: 2808-4519

Network Device Performance Monitoring Using the Simple Network Management Protocol (SNMP) Method

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Abstract

Network problems frequently occur at Politeknik Negeri Pontianak due to the increasing number and scale of network devices. These issues require continuous monitoring to ensure service availability across all network devices. To address this problem, the author conducted network monitoring using the SNMP (Simple Network Management Protocol) method and network performance measurement using the Wireshark application. SNMP is a standard protocol used to monitor and manage network devices such as routers, switches, servers, and other networking equipment. The research stages began with data collection, followed by monitoring and performance testing of the network. After testing the network in the Informatics Engineering Building, both satisfactory and unsatisfactory results were obtained. The results of SNMP measurements on MRTG showed the lowest throughput values on the second day of testing, with 485.6 kbps for daily traffic, 236.8 kbps for weekly traffic, 232 kbps for monthly traffic, and 121.6 kbps for yearly traffic. Meanwhile, the Quality of Service measurement produced the lowest throughput value of 0.225 kbps, packet loss of 0.354%, delay of 3.331 ms, and jitter of 8.763 ms.

Keywords: *Decision Support System, VIKOR, Employee Recruitment, Website, Multi-Criteria Decision Making (MCDM)*

1. Introduction

The Politeknik Negeri Pontianak (POLNEP) is one of the well-known polytechnic institutions in Pontianak, West Kalimantan, consisting of many department buildings equipped with network devices and internet services used by students, lecturers, and staff for various academic activities such as accessing learning materials, completing assignments, conducting research, attending online classes, and finishing final projects. As the number of users and connected devices continues to increase, network problems such as unstable connections, traffic congestion, and device failures may occur more frequently. Therefore, continuous monitoring is needed to maintain network performance, stability, and service availability. However, POLNEP still does not have a dedicated network monitoring system, making it difficult for administrators to supervise network conditions, analyze traffic usage, and detect failures quickly. This condition can cause delays in troubleshooting and may affect the quality of internet services within the campus environment.

To overcome these problems, a Network Management System (NMS) can be implemented to monitor and manage network devices efficiently. One of the protocols commonly used for network monitoring is SNMP (Simple Network Management Protocol), which allows administrators to collect network information remotely through a centralized system. SNMP supports various network devices such as routers, switches, servers, workstations, and printers while using UDP transport to reduce network overhead. SNMP is considered effective for monitoring network performance because of its compatibility, efficiency, and centralized monitoring capabilities [1]. In addition, SNMP enables administrators to monitor network conditions continuously and obtain important information related to network performance in real time.

In this research, the author uses SNMP together with MRTG (Multi Router Traffic Grapher) to monitor network traffic performance. MRTG is a monitoring tool used to display graphical visualizations of incoming and outgoing traffic data through network interfaces in HTML (Hypertext Markup Language) format, allowing administrators to analyze network conditions in real time through a web browser. The graphical display generated by MRTG can help administrators identify traffic increases, network instability, and possible disruptions more easily. By implementing SNMP and MRTG, administrators can monitor network performance more effectively, detect problems faster, analyze network traffic conditions more accurately, and improve the reliability and availability of internet services at POLNEP.

2. Theoritical Basis

2.1. Literature review

Previous studies related to network monitoring include research by Susmini Indriani Lestariningati and Fathur Rozak from Universitas Komputer Indonesia, which developed a web-based SNMP monitoring application to help administrators maintain network availability

[2], research by Herman Kuswanto from STMIK Nusa Mandiri using Nagios to monitor network devices and provide accurate web and email notifications [3], and research by Ainul Hizriadi, Radela Shiddiq, Ivan Jaya, and Santi Prayudani, which combined GIS and SNMP to monitor network traffic and display device locations in real time [4]; therefore, these studies serve as references for developing network monitoring and performance analysis systems in this research.

2.2. Computer Network Protocols

Network protocols are systems that enable communication and data transfer between computers within a network by following specific rules between senders and receivers, allowing communication to run properly, and serving as intermediaries that connect devices in almost all computer network communications [5].

2.3. OSI Model

The OSI (Open Systems Interconnection) Model, developed by the International Organization for Standardization, is a conceptual framework used to explain communication processes in computer networks. The model consists of seven layers: Physical, Data Link, Network, Transport, Session, Presentation, and Application, where each layer has a specific role in data communication [6]. The OSI model helps users understand networking concepts and supports the development of communication protocols, although modern networks more commonly use the TCP/IP model.

2.4. Network Management

Network management is a set of activities used to manage, monitor, and optimize computer network performance to ensure efficiency, reliability, and security. It includes tasks such as network monitoring, device configuration, troubleshooting, security management, and capacity planning. Network management is especially important in large and complex environments, as it helps organizations maintain service availability, security, and optimal performance [7].

2.5. Simple Network Management Protocol (SNMP)

Employee recruitment is the selection process used to identify the best candidates who meet the qualifications for specific positions within a company, typically involving stages such as applicant data collection, interviews, and evaluation of both technical and non-technical skills, and with the application of appropriate methods, this process can be managed more objectively and efficiently.

2.6. Network Traffic Type

Unicast traffic is a one-to-one communication method where data is sent from one source to a single destination through a dedicated data path, making it the most common and simple type of network communication, while multicast traffic is a one-to-many communication method where data is transmitted from one source to multiple receivers within a specific group simultaneously, making bandwidth usage more efficient because the data only needs to be sent once and can be accessed by many devices at the same time [9]

2.7. Quality of Service (QOS)

Quality of Service (QoS) is a method used to measure and evaluate network performance in providing reliable services through several technical parameters, including throughput as the effective data transfer rate, delay as the time required for packets to travel from sender to receiver, packet loss as the percentage of lost data packets during transmission, and jitter as the variation of delay in packet delivery, where these parameters are influenced by factors such as network capacity, congestion, distance, transmission errors, routing, and types of services used [10].

2.8. MRTG

Multi Router Traffic Grapher (MRTG) is a free and open-source network monitoring tool developed by Tobias Oetiker and Dave Rand that uses the Simple Network Management Protocol (SNMP) to monitor network traffic on devices such as routers, switches, and access points through graphical web-based displays, offering wide compatibility and informative traffic visualization, although it has a simple interface, limited real-time monitoring, and restricted notification features [11]

3. Research Methods

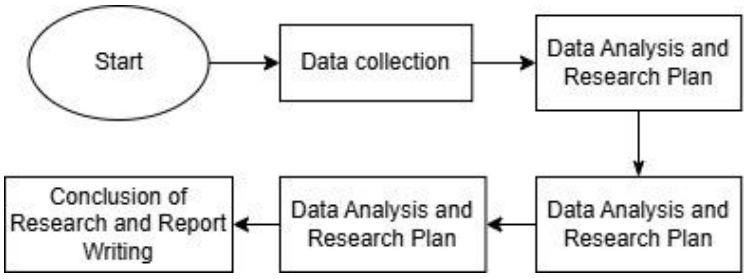

Fig. 1: Flowchart Metode

3.1. Literature Study

The first stage of this research involved conducting a literature review on several topics related to the study, including Simple Network Management Protocol (SNMP), Quality of Service (QoS), Multi Router Traffic Grapher (MRTG), and Wireshark. This stage aimed to provide a deeper understanding of the concepts, methods, and tools used in network monitoring and analysis, as well as to establish a strong theoretical foundation to support the research before proceeding to the implementation and testing stages.

3.2. Make Observations

In the observation stage, the researcher conducted direct observations at the Informatics Engineering Building of Politeknik Negeri Pontianak to understand the existing network conditions and internet usage activities within the area. In addition, the researcher gathered information related to the implementation and utilization of the internet network through interviews with relevant parties, aiming to obtain detailed and accurate data to support the research process.

3.3. Simple Network Management Protocol Requirements Analysis

The fourth stage involved analyzing the requirements of the Simple Network Management Protocol (SNMP) method to monitor internet network performance at the Informatics Engineering Building of Politeknik Negeri Pontianak using Multi Router Traffic Grapher (MRTG), with the aim of evaluating network performance, monitoring traffic graphs, and determining the parameters to be measured.

3.4. Quality of Service Needs Analysis

The fifth stage involved analyzing the requirements of the Quality of Service (QoS) method to measure internet network performance at the Informatics Engineering Building of Politeknik Negeri Pontianak using Wireshark. This analysis aimed to evaluate network performance and determine the parameters to be measured.

3.5. SNMP Configuration on MRTG

The seventh stage involved configuring the Simple Network Management Protocol (SNMP) and Multi Router Traffic Grapher (MRTG) after obtaining approval, SNMP access rights, and the router IP address, as well as completing the software installation process. This configuration stage was carried out to support the monitoring and measurement of internet network performance, where the entered IP address would generate monitoring results displayed as graphical visualizations on an HTML page.

3.6. Implementation of Simple Network Management Protocol on Polnep

The ninth stage involved implementing the Simple Network Management Protocol (SNMP) on the configured Multi Router Traffic Grapher (MRTG) system followed by testing. The implementation results were displayed through a web-based graphical interface on MRTG and further analyzed using Quality of Service (QoS) calculation methods to measure network performance.

3.7. Implementation of Quality of Service at Polnep

The next stage involved implementing the Quality of Service (QoS) method on Wireshark after the configuration process, followed by testing. The implementation was carried out by capturing and analyzing network traffic data in Wireshark, where the available data was then adjusted and used for QoS parameter calculations to evaluate network performance.

4. System Analysis and Design

4.1. Systems Analysis

System/Network analysis is conducted to identify the requirements of the network during the research process. This section describes the implementation of the Simple Queue and Content Filtering methods for bandwidth management in WLAN and LAN networks. The network aims to optimize internet usage and will be evaluated using Quality of Service (QoS) to achieve effective and satisfactory performance in the WLAN and LAN of the SMK Negeri 1 Sungai Raya laboratory.

4.2. System/Network Implementation Design Process

The implementation phase uses hardware with Simple Queue and Content Filtering methods on a MikroTik router to manage bandwidth in the WLAN and LAN of the SMK Negeri 1 Sungai Raya laboratory aiming to prevent buffering, network downtime, and bandwidth contention by designing a new topology, configuring internet access, applying Simple Queue and Filtering Content, and evaluating performance using Quality of Service (QoS) parameters: throughput, packet loss, delay, and jitter.

4.3. Developing a Research Plan

The author analyzed the network problem by implementing the Simple Network Management Protocol (SNMP) on Monitoring Router Traffic Grapher (MRTG) to manage and monitor network devices. SNMP was used to monitor network traffic data, while the Quality of Service (QoS) method was added to measure more complete parameters such as delay, packet loss, and jitter, since SNMP on MRTG has limitations in accessing these parameters. The monitoring process was conducted from 09:00 to 16:00 at the Informatics Engineering Building of Politeknik Negeri Pontianak, and the results from both methods were analyzed to evaluate network quality and support early

network problem detection.

4.4. Testing Process

During the testing phase, the research was conducted for three days at the P-Net office of Politeknik Negeri Pontianak. The implementation process involved monitoring network performance using MRTG software through a browser-based interface that displayed network activity in graphical form. In this method, the main parameter observed was throughput or bandwidth usage, which represented the speed of data transfer per second on the network interface. MRTG utilized incoming and outgoing traffic parameters to calculate and display network performance, allowing bandwidth usage on network devices to be monitored and analyzed more effectively. The following section presents the results of the SNMP method implementation on MRTG.

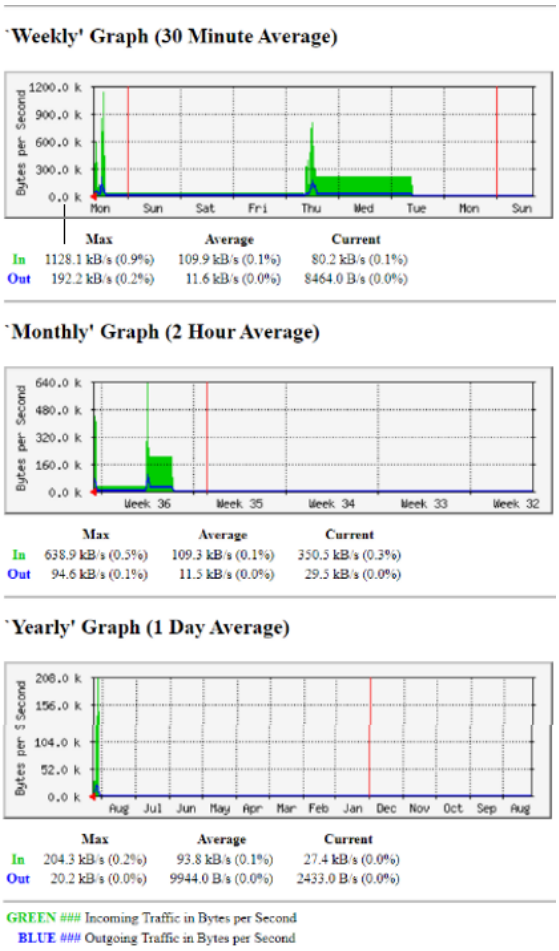

Fig. 2: Network Monitoring Test Results with SNMP

The figure above shows the results of one day of network monitoring using MRTG. The daily graph updates every 5 minutes, the weekly graph every 30 minutes, the monthly graph every 2 hours, and the yearly graph once a day. In addition, Wireshark was used to measure internet network performance over three days.

5. Results and Discussion

5.1. SNMP Method Test Results on MRTG

In this research, testing was carried out by changing the IP address configuration in the MRTG file from a local IP to a router IP so the network device could be detected and displayed on the MRTG web interface. The testing process was monitored through the MRTG web interface using a browser.

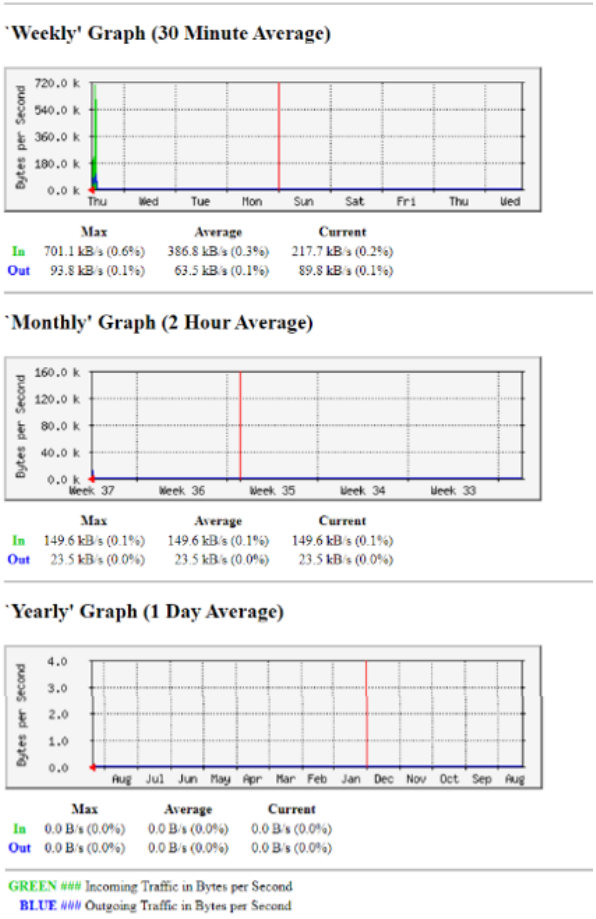

Fig. 3: Results of the third day of SNMP network testing

The figure above shows the monitoring results on the third day, where the daily graph recorded an average throughput of 3.5 Mbps, the weekly graph recorded 3.6 Mbps, and the monthly graph recorded 1.3 Mbps, while annual data was unavailable because the monitoring period was insufficient; overall, the throughput results indicate that network usage was far below the maximum network capacity of 125 Mbps or 1000 Mbps, meaning the network performance was categorized as very good and not overloaded, although students still reported slow internet speeds during large file uploads due to bandwidth sharing among many active users, therefore solutions such as implementing Quality of Service (QoS) and limiting excessive bandwidth usage are needed to optimize network performance

Table 1: Results of SNMP Method Analysis on MRTG in the Informatics Engineering Building

Lokasi Penelitian	***Traffic***	**Hasil Monitoring (Nilai *Throughput*)**	**Standart Nilai**	**Kategori Jaringan**
Gedung Teknik Informatika	Harian	804,8 *kbps*	Bagus	Memuaskan
	Mingguan	972 *kbps*	Bagus	
	Bulanan	966,4 *kbps*	Bagus	
	Tahunan	749,6 kbps	Bagus	
Gedung Teknik Informatika	Harian	485,6 *kbps*	Sedang	Kurang Memuaskan
	Mingguan	236,8 *kbps*	Buruk	
	Bulanan	232 *kbps*	Buruk	
	Tahunan	121,6 *kbps*	Buruk	
Gedung Teknik Informatika	Harian	3,5 *Mbps*	Sangat Bagus	Memuaskan
	Mingguan	3,6 *Mbps*	Sangat Bagus	
	Bulanan	1,3 Mbps	Sangat Bagus	
	Tahunan	-	-	

6. Conclusion

Based on the network analysis conducted in the Informatics Engineering building at Politeknik Negeri Pontianak, SNMP on MRTG and Wireshark with the Quality of Service (QoS) method were used to monitor and analyze network performance. SNMP on MRTG was effective for long-term and centralized monitoring, while Wireshark provided detailed real-time analysis of throughput, packet loss, delay, and jitter. The results showed that network performance was categorized as satisfactory to less satisfactory, with several issues caused by unstable network conditions, inappropriate sampling intervals, and low-specification monitoring devices. Therefore, SNMP and QoS can complement each other in improving network monitoring, troubleshooting, and performance analysis.

7. Advice

The author suggests that future research should improve network quality in the Informatics Engineering building by increasing bandwidth capacity, implementing failover connections, and conducting long-term network quality measurements such as latency, jitter, packet loss, and throughput. In addition, future studies should evaluate network infrastructure, optimize network topology and VLAN segmentation, and implement real-time monitoring to improve network performance, stability, and security.

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