Simulation of Bandwidth Management Using Queue Tree and PCQ Techniques in the IT Service Department of PT Pusri Palembang

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Abstract

The IT Service Building of PT Pusri Palembang is equipped with adequate internet facilities; however, bandwidth distribution across rooms remains uneven, resulting in the absence of fair bandwidth allocation throughout the network. This leads to user competition and reduced internet performance because upload and download limits are not applied per room. Network instability in terms of upload and download speed affects the smoothness of data transmission; thus, bandwidth management is necessary to address these issues. This study applies the Action Research method, consisting of the stages of Diagnosing, Action Planning, Action Taking, Evaluating, and Specifying Learning to analyze the results for future improvements. In the implementation of bandwidth management, the Per Connection Queue (PCQ) and Queue Tree techniques are applied to regulate data flow based on priority levels. The results of the simulation show that the application of bandwidth management in the IT Service Department network is highly effective in reducing bandwidth-related issues in each room and achieving equal bandwidth distribution.

Keywords

Bandwidth; MikroTik; PCQ; Queue Tree

Article History

Received 11 December 2023
Accepted 23 February 2024

How to Cite

Rusdi, D. (2024). Simulation of Bandwidth Management Using Queue Tree and PCQ Techniques in the IT Service Department of PT Pusri Palembang. ***Jurnal Jaringan Komputer dan Keamanan,*** *5*(1), 25-31.

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Introduction

In a digital work environment, corporate internet networks must be carefully monitored and regulated to prevent misuse such as unauthorized access, excessive bandwidth consumption, and potential data theft. Activities that require high data throughput—such as video streaming, online gaming, large file transfers, and continuous downloading—can significantly degrade network performance when not properly managed. As emphasized by Faisal & Diansyah (2024), simultaneous high-bandwidth usage by multiple users results in latency, slow browsing, and declining productivity across the organization. When network performance deteriorates, it disrupts workflow processes and reduces overall operational efficiency.

The KP Room network of PT Pusri Palembang currently relies on a Local Area Network (LAN) with a total shared bandwidth capacity of 20 Mbps distributed among numerous clients. This limited capacity causes unstable download and upload speeds, especially during peak usage hours. According to Christanto et al. (2021), equitable bandwidth distribution is essential to prevent congestion and ensure that each user receives sufficient capacity to perform their tasks effectively. Bandwidth refers to the rate of data transfer between server and client, typically measured in bits per second (bps), and must be managed to maintain a smooth and reliable communication flow.

The absence of structured bandwidth management in the IT Service Department of PT Pusri Palembang exacerbates network instability. Without prioritization mechanisms, users who consume excessive bandwidth—intentionally or unintentionally—reduce the available capacity for others, causing uneven distribution of data flow. This situation leads to connection interruptions, poor upload/download performance, and delays in critical data transmission. A proper monitoring and management framework is therefore necessary to ensure that network resources are utilized optimally and fairly.

One effective approach to addressing these challenges is the implementation of Bandwidth Management, a method used to regulate, control, and optimize traffic load within a network. Bandwidth management commonly utilizes the Quality of Service (QoS) concept to assign traffic priorities and guarantee service levels for specific types of communication. As stated by Septyani et al. (2024), QoS represents a performance metric in data communication systems that ensures prioritized and reliable packet delivery, thereby maintaining overall network quality. Through QoS, network administrators can determine which services require higher bandwidth priority, such as internal systems and essential communication platforms.

This study employs the Queue Tree and Per Connection Queue (PCQ) techniques as key solutions for managing bandwidth effectively within the IT Service Department of PT Pusri Palembang. Queue Tree, one of MikroTik's most flexible yet technically complex features, allows hierarchical structuring of bandwidth allocation by marking packets using the Mangle function in the Firewall. This enables detailed traffic categorization according to user groups or service types. PCQ complements this approach by automatically identifying connection patterns and distributing bandwidth evenly among users. Together, Queue Tree and PCQ create a comprehensive and scalable mechanism for optimizing network performance and ensuring fairness in bandwidth allocation.

The objective of this study is to design and implement a bandwidth management system tailored to the needs of PT Pusri Palembang's IT Service Department. By dividing bandwidth allocations into subclasses or subqueues for each user through Queue Tree and PCQ, the available bandwidth can be utilized more efficiently and equitably. This systematic allocation is expected to reduce congestion, enhance upload/download stability, and support a more reliable network environment that aligns with the operational demands of the organization.

Methodology

This research applies the Action Research method, which aims to test, develop, discover, and create new action-oriented solutions that improve performance or resolve problems within specific contexts [5]. Action Research consists of five stages: Diagnosing, Action Planning, Action Taking, Evaluating, and Specifying Learning.

Diagnosing

Diagnosing refers to the process of collecting and analyzing data to understand existing problems or challenges. In this stage, the researcher monitored and diagnosed network issues in the IT Service Department of PT Pusri Palembang.

Bandwidth Issues

The researcher identified the primary bandwidth problems by applying bandwidth management. Bandwidth was limited to a download speed of 10 Mbps and an upload speed of 5 Mbps for AVP and employees, while KP received 10 Mbps for both upload and download. Bandwidth management was conducted using a MikroTik router with Queue Tree and PCQ.

Action Planning

In this stage, the researcher configured the system used to resolve the network issues in the IT Service Department of PT Pusri Palembang using a MikroTik router according to the proposed network design. With the addition of a MikroTik router and Queue Tree system, internet service from the Internet Service Provider (ISP) could be managed more optimally.

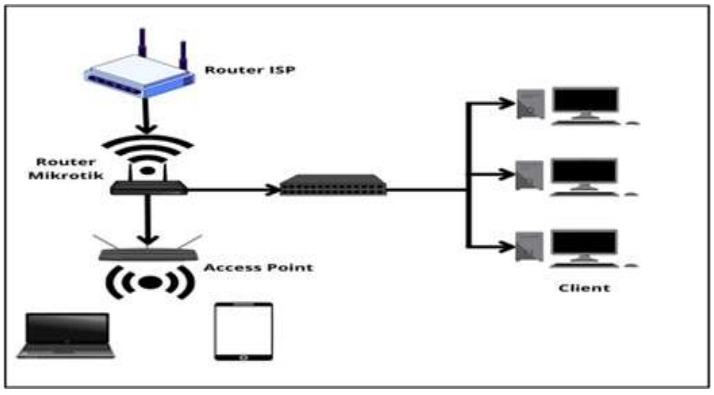

Figure 1. Network Topology

Researchers distributed 10 Mbps of bandwidth to each room to ensure equitable allocation, enabling smoother and more stable internet access.

Table 1. Bandwidth Allocation Management

No	Room	Download Bandwidth	Upload Bandwidth
1	KP/Internship	10M	10M
2	Employees	5M	10M
3	AVP	5M	10M

Following are the stages of configuring bandwidth management using Queue Tree and PCQ in MikroTik:

1. Determine Requirements, Identify the amount of bandwidth required for browsing, streaming, and downloading. Determine the maximum speed permitted for each user and service.
2. Configure Interfaces, Ensure that the interface used to manage bandwidth is configured correctly.
3. Create Mangle Rules, Create Mangle rules to mark packets based on service type and interface.
4. Create Queue Tree, Create child Queue Trees to manage bandwidth per service and a parent Queue Tree to divide total bandwidth.
5. Create PCQ Rules, Apply PCQ queues to distribute bandwidth fairly among users or connections.
6. Test Configuration, Ensure that bandwidth distribution meets the objectives of the study.

Results

Action Taking

This stage involves implementing the required steps to achieve desired outcomes. The researcher initially configured the MikroTik router to optimize the computer network in the IT Service Department and subsequently presented the results of bandwidth management.

Configuration

Before configuration, users must log in through Winbox. The MAC Address used to connect to the router was 78:9A:18:16:72:26.

Figure 2. Winbox Login

Interface Configuration

Add Interface → select ether1 → Apply → OK.

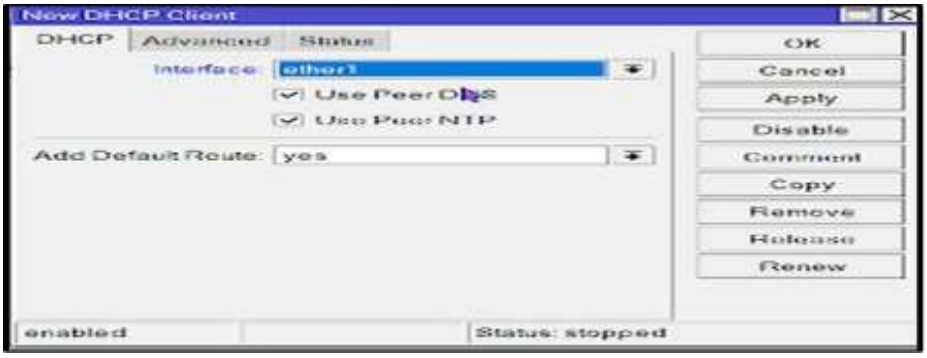

Figure 3. Winbox Interface

IP Address Configuration

IP Address → Add → 192.168.10.1/24 → Apply.

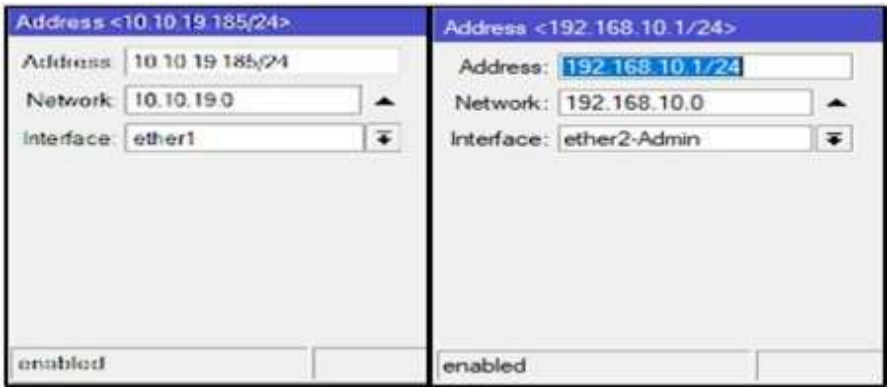

Figure 4. IP Address Configuration

This configuration establishes:

- 192.168.10.1/24: Laptop to MikroTik
- 192.168.20.1/24: MikroTik to PC

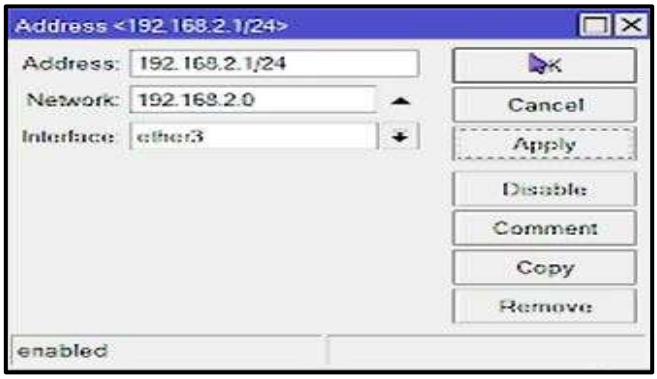

Figure 5. IP Address Connection

Conclusion

Based on the analysis of bandwidth management using Queue Tree and PCQ, the following conclusions are drawn: Bandwidth management was successfully configured using the Mikro Tik router with Queue Tree and PCQ methods. The bandwidth management configuration allocated 10 Mbps per PC effectively, yielding improved download and upload speeds. The application of Queue Tree and PCQ techniques optimized network performance in the IT Service Department of PT Pusri Palembang.

Disclosure Statement

The authors declare no conflict of interest regarding this study.

Acknowledgments

The authors express appreciation to PT Pusri Palembang and Universitas Bina Darma (UBD) for providing access, facilities, and support throughout this research.

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Biographical Notes

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