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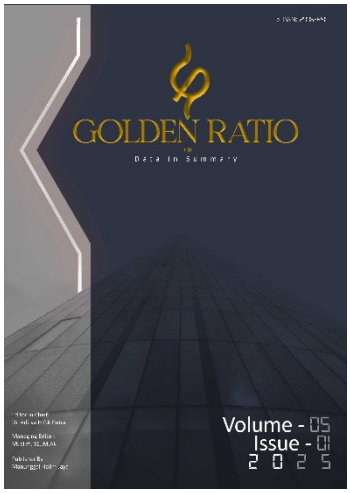

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DATA IN SUMMARY | COMPUTER SCIENCE

LAN Bandwidth Management Using the Queue Tree Method

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Abstract: The advancement of technology, particularly in computer networks, has enabled global connectivity through the Internet. Computer networks connecting various devices allow for information sharing and communication. One common issue is slow internet speed due to suboptimal bandwidth utilization. To address this issue, bandwidth management becomes crucial, especially in managing multiple applications at PT. XYZ, bandwidth management is implemented using a Mikrotik router using the Queue Tree method. This method allows for flexible and fair bandwidth allocation, ensuring every device has a stable internet connection. This method helps enhance efficiency and ensures bandwidth allocation is aligned with user needs, resulting in smooth and evenly distributed connectivity across the network.

Keywords: Computer Network, Bandwidth Management, Queue Tree.

1. INTRODUCTION

In the ever-evolving digital era, data management has become a critical aspect of organizations and a fundamental need across various sectors, including recreational industries like fishing. Based on fisheries, fishing businesses provide facilities for fishing activities as a hobby or an economic venture (Kordi, 2010). One challenge fishing business owners face is the scattered and poorly integrated customer data management. Customer data, including identity information, fishing preferences, transaction history, and customer feedback, is often stored in disparate systems, such as manual formats, spreadsheets, or separate applications. This situation leads to inefficient data management, duplication, and difficulty deriving valuable insights into better decision-making. In this modern era, technological advancements continue to progress significantly, particularly in computer technology and networking (Dasmen et al., 2022). Computer networks enable users worldwide to connect via the internet, serving as a global network that facilitates the rapid and efficient exchange of information (Prayoga, 2021). However, slow connection issues often arise with the increasing use of applications and devices, primarily due to poorly managed bandwidth (Rahmawati, 2020). Bandwidth, the maximum amount of data transmitted over a network within a certain period, is crucial in determining internet speed and connection quality (Noviriandini et al., 2022). The greater the available bandwidth, the faster the internet connection users can enjoy.

Effective bandwidth management is essential to maintaining a stable connection and ensuring that all devices in the network can access data smoothly (Tampubolon et al., 2022). Without proper management, users in a network may experience issues such as slow internet access, failed downloads or uploads, and disruptions in online communication (Tyagi, 2020). This becomes a critical concern for organizations relying on the internet as a primary tool for daily operations, including PT. XYZ is a printing company that was established in 2018.

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PT. XYZ often faces issues with uneven bandwidth distribution among users. This imbalance may result from factors such as high user numbers, application types, and individual user bandwidth needs (Winarsih, 2021). Consequently, some employees may experience slow or disconnected connections while performing critical tasks. This not only hampers workflow but can also lead to delays in task completion, negatively affecting overall company productivity (Fauzi, 2019). To address these bandwidth distribution challenges, PT. XYZ needs to implement a more efficient bandwidth management system. A practical solution is to use a Mikrotik router with the Queue Tree method (Siregar et al., 2023). The Queue Tree method is designed to allocate bandwidth equitably among all devices connected to the network. By applying this method, each device receives bandwidth allocation proportional to its needs, enabling users to complete their tasks on time without experiencing slow internet connections.

The implementation of the Queue Tree method at PT. XYZ is expected to optimize overall bandwidth utilization. With proper configuration, this method allows network administrators to monitor and control bandwidth usage more effectively (Ardhiansyah et al., 2020). Moreover, it prevents bandwidth monopolization by one or a few users, creating a fairer work environment for all employees. As a result, employees can efficiently perform activities such as editing documents, sending files, or browsing without connectivity issues.

This study focuses on applying the Queue Tree method to optimize bandwidth usage at PT. XYZ. It is hoped that the company can enhance its efficiency and productivity by adopting improved bandwidth management practices. A more stable and seamless internet connection will assist employees in completing their tasks more effectively, positively impacting the company's overall performance by leveraging the full potential of information and communication technology, PT. XYZ can remain competitive in the ever-evolving digital era.

2. RESEARCH DESIGN AND METHOD

This research employs a qualitative descriptive approach to obtain accurate and relevant data related to bandwidth management at PT. XYZ. The research process is designed to provide an in-depth understanding of network issues and find appropriate solutions based on the company's operational needs. The study combines several primary methods to achieve these objectives, including observation, interviews, and literature review.

The initial phase of the research began with direct observation of PT. XYZ's operational activities. The researcher documented patterns of internet usage, devices connected to the network, and bandwidth consumption levels at various times, such as peak and off-peak hours. This observation aimed to identify issues in bandwidth distribution and its impact on the company's productivity. Direct observation provided a realistic overview of the network's condition and allowed the researcher to understand user requirements comprehensively. In addition to observation, in-depth interviews were conducted with Mr. Shovwan Shany Hanum, who serves as the HRD of PT. XYZ. Through these interviews, the researcher explored information about the organizational structure, network management, and common challenges in bandwidth usage within the workplace. Direct interaction with primary data sources ensured the validity of the information, particularly concerning the technical issues faced by the company and the bandwidth management strategies previously implemented. This information formed a crucial foundation for designing solutions based on actual needs. Furthermore, the research was enriched with a literature review to strengthen the theoretical foundation and provide insights into relevant solutions. The researcher examined literature related to bandwidth management, computer networks, and the application of the Queue Tree method. These references included physical books, scientific articles, and digital publications, which supported the theoretical understanding of bandwidth allocation and the effectiveness of the proposed method. The literature review bridged the gap between theory and practice, ensuring the proposed solutions aligned with technological developments and PT. XYZ's operational requirements.

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The research progressed to data analysis obtained from observations and interviews. This data was compared with theoretical insights from the literature review to identify gaps between current conditions and optimization potential. Based on this analysis, the researcher designed the implementation of the Queue Tree method on a Mikrotik router to address uneven bandwidth distribution issues. The implementation was tested and evaluated based on efficiency, connection stability, and user bandwidth allocation fairness. By combining these methods, the research provides a comprehensive approach to understanding and addressing bandwidth management issues at PT. XYZ. The results are expected to improve network efficiency and support company productivity through a more stable and optimized internet connection.

3. RESULT AND DISCUSSION

3.1. Network Analysis

PT. XYZ utilizes Indihome's Dual Play package, which includes internet and telephone services. As an internet service provider (ISP), Indihome provides an internet speed of 50 Mbps, distributed across two rooms and used by eight users. Each room is equipped with a switch that functions to distribute the internet connection from the ISP modem. Every day, all users rely on the internet for work-related tasks, such as creating and editing orders, sending files, browsing, and printing documents.

3.2. Network Block

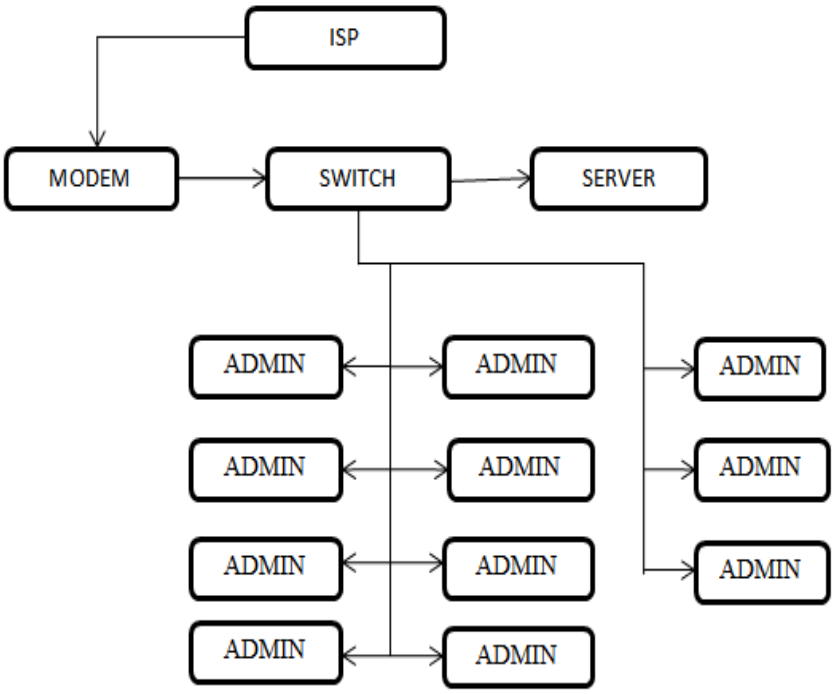

Figure 1. Network Block Design Structure at PT. XYZ

The computer network system at PT. XYZ is distributed across a two-story building, where computers and other devices form a wireless network supporting the company's operations. This network comprises several key elements. First, the Internet serves as a medium for receiving and processing client orders. Second, the Indihome modem is an intermediary between the internet network and devices such as computers and smartphones, enabling unlimited device connections. Third, the company uses a cloud server to centrally store and manage operational data. Fourth, the router functions to divide the network and ensure data packet connections to various devices. Fifth,

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switches connect devices such as computers, printers, and servers, facilitating seamless communication between devices. Finally, PCs or client devices are used by staff to access information on the server and manage customer orders. This combination of devices ensures that the entire network operates efficiently and supports productivity at PT. XYZ.

3.3. Network Schema

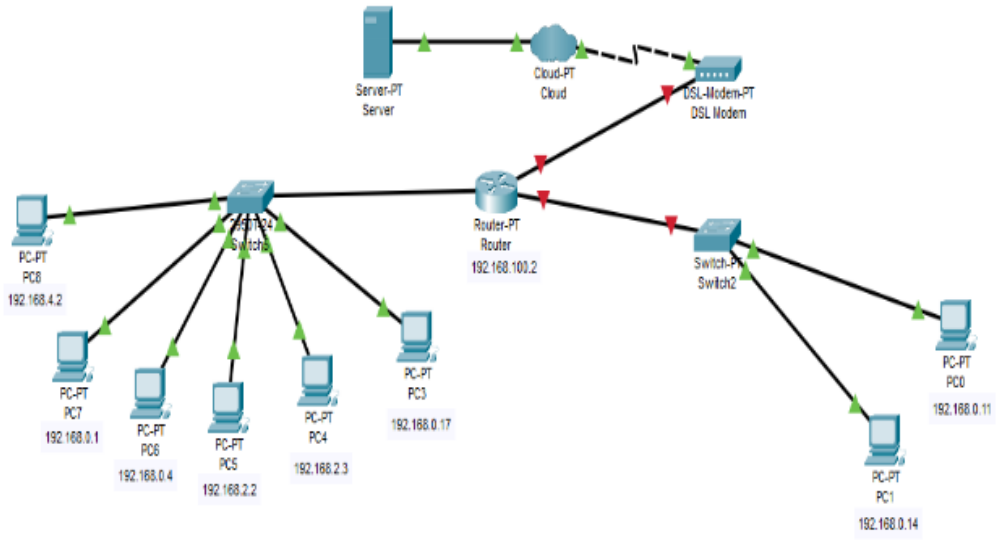

Figure 2. Network Schema of PT. XYZ

The computer network devices and supporting equipment at PT. As outlined in the network block, XYZ is the primary focus when implementing the network design. The network schema design illustrates how the network will operate within the company, which is one of the critical elements in PT. XYZ's network is the cloud server. A cloud server provides hosting services via the Internet, enabling access and usage from anywhere with an Internet connection—the primary function of the cloud server at PT. XYZ is to run various computer programs through internet access. As long as the computers (PCs) are connected to the internet, they will remain linked to the cloud server, ensuring smooth company operations.

3.4. Computer Network Security

Computer network security at PT. XYZ is implemented on each user's PC. One of the measures to ensure secure access is setting specific firewall rules. Each user's PC is equipped with a built-in firewall from the operating system and computer and protected by Smadav antivirus. For wireless network security, every client wishing to connect to the internet must enter a password. This ensures that only authorized users can access the company's internet network.

3.5. Hardware Specifications

The server at PT. XYZ is equipped with robust hardware to ensure reliable performance. It features an Intel® Xeon Processor E5 520 with a clock speed of 1.86 GHz, 4 MB L3 Cache, and a 4.8T/s Front Side Bus, supported by an Intel 5500 Server Chipset. The server includes 8 GB of DDR3 PC 10600 RAM and a 200 GB SATA hard disk for storage. Additionally, it is equipped with a DVD-RW LG disk drive and an onboard VGA integrated with a 5U Tower Chassis powered by a 460W power supply. The server runs on the Windows 2007 operating system. The client computers are designed for efficient day-to-day operations. They are powered by an Intel Core i3-2130 processor, 4

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GB DDR4-2400 DRAM, and a 500 GB hard disk. Each unit also includes a DVD-RW LG disk drive and onboard VGA. These client computers operate on Microsoft Windows 7, offering a stable platform for daily tasks—the server at PT. XYZ utilizes various software to support its operations. The operating system in use is Windows Server 2007, which provides a solid foundation for managing network resources. Microsoft Office 2010 is also installed for productivity tasks, while Cisco Packet Tracer is used for network simulation and design. Other essential tools include WinRar for file compression and extraction and Winbox for managing the Mikrotik router.

3.6. Core Issue and Proposed Solution

The network system at PT. XYZ faces a primary issue of unstable internet speeds among users. This imbalance arises due to the absence of bandwidth management to allocate internet speed effectively for each user. As a result, activities such as uploading and downloading are not optimized, hindering the company's productivity. To address this issue, several alternative solutions are proposed. First, bandwidth usage patterns should be identified to understand their distribution across PT. XYZ's network. Second, implementing bandwidth management using the Queue Tree method, designed to allocate bandwidth fairly and efficiently. Third, employing network monitoring tools to observe real-time bandwidth usage ensures network stability.

Based on the network analysis conducted, the author proposes adding switches to expand network capacity and implementing a bandwidth management system based on the Queue Tree method. This system addresses the current network shortcomings by ensuring equitable bandwidth distribution among all users. With this implementation, internet connection stability at PT will be improved. XYZ is expected to improve and support more efficient company operations.

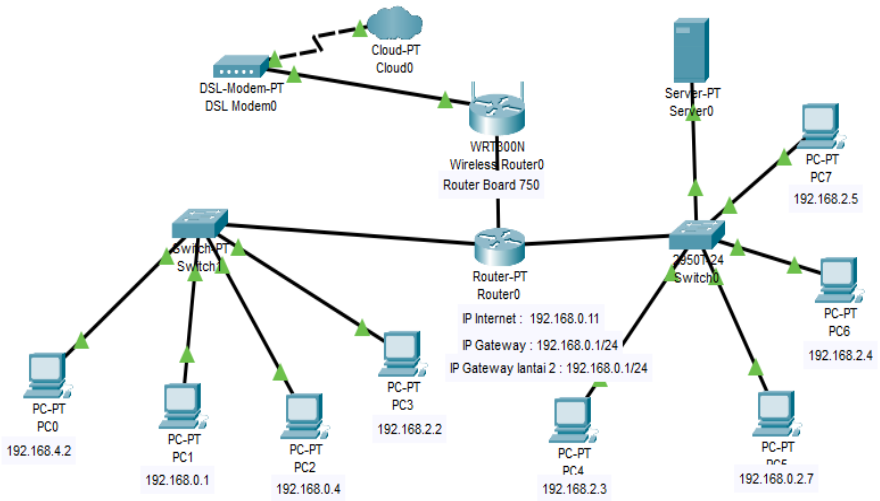

Figure 3. Proposed Network Schema of PT. XYZ

Computer devices and other supporting equipment are the primary objects used in designing the network at PT. XYZ, as explained in the previous schema. This proposed schema outlines the computer network design that the author intends to implement. The author utilizes a LAN network for internet connectivity and Indihome as the ISP (Internet Service Provider) in this design. Additionally, a Mikrotik 750 is integrated into the network to manage bandwidth, ensuring stable internet connectivity for each client.

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3.7. Proposed Configuration

At this stage, the author first implements the Queue Tree Bandwidth Management configuration using a Mikrotik Router within a virtual machine. This simulation aims to minimize errors before direct implementation into the network system. VirtualBox software virtualizes the Queue Tree Bandwidth Management with the Mikrotik Router on PT. XYZ's network. Prior to configuration, necessary software installations and preliminary configurations are completed.

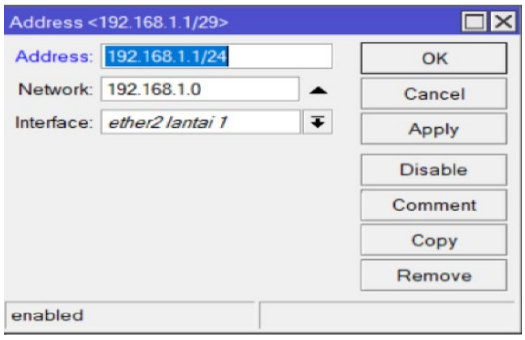

Figure 4. Display for Creating IP Address List

In the mangle settings, connection marking (mark connection) and packet marking (mark packet) are configured before applying bandwidth limitations using the Queue Tree. The purpose of mangle is to differentiate between download and upload traffic for each IP address, allowing bandwidth limitations to be applied. This is done by marking connections and packets. Mark Connection is used to mark the initial connections that have occurred. The parameter passthrough=yes ensures that the packet marking configuration can still mark packets already processed by the connection marking configuration. Meanwhile, the Mark Packet marks all subsequent packets after the initial connection marking. The Mangle list is the result of mangle markings configured by the administrator. The Src address (source address) indicates the IP initiating the connection, and the Dst address (destination address) refers to the target IP to be accessed. The byte count monitors the data uploaded and downloaded by each network user. The configuration in this context is unidirectional, meaning Queue settings in the Queue Tree method can only control one type of traffic direction. If the Queue is set to manage download bandwidth, it will not manage upload bandwidth, and vice versa. Therefore, two Queue Tree configurations must be created for both uploading and download traffic through a wireless router: one for upload and one for download. Monitoring is used to identify active internet users and determine whether they have exceeded, are close to exceeding, or are within their allocated bandwidth limits. The icons provide visual indicators of usage levels: 1). Green: Bandwidth usage is below the maximum limit. 2). Yellow: Bandwidth usage is nearing the maximum limit. 3). Red Bandwidth usage has reached the maximum limit.

3.8. Test Results

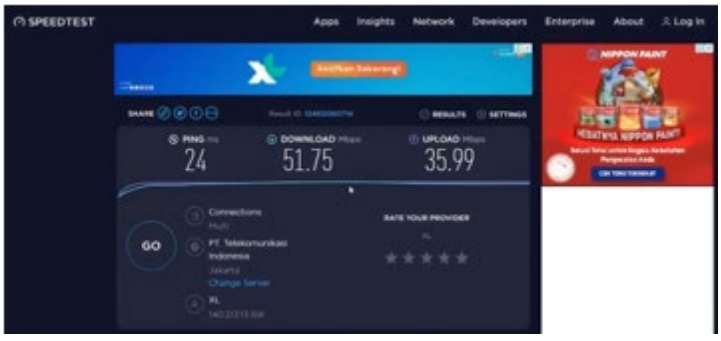

Figure 5. Initial Internet Connection Speed Display Using Speedtest

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In data collection, the author conducted bandwidth testing using a Mikrotik router. Before the testing, the author performed a network test using the Speedtest website.

Figure 6. Final Internet Connection Speed Display Using Speedtest

Image 6 shows bandwidth testing for users at PT using the Speedtest website. XYZ after configuring bandwidth management. With the target address parameter set to IP 192.168.1.0, the maximum download bandwidth allocated is 1 Mbps, as shown in the image above.

4. CONCLUSION

Several conclusions can be drawn after designing and implementing bandwidth management on the user network at PT, XYZ. First, using the Queue Tree method has proven effective in meeting bandwidth management needs when clients are active and connected to the internet. Bandwidth is automatically allocated fairly and evenly according to the predetermined distribution, resulting in a more stable network. Second, the implementation of Queue Tree has been highly beneficial in monitoring and managing each client's bandwidth usage. This prevents bandwidth monopolization by specific users, ensures fair distribution across the network, and enhances the efficiency and stability of the company's internet connection.

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