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Bandwidth Management with Mikrotik OS Routers Using the Per Connection Queue Method

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A B S T R A C T

Services that use the Internet as Business Cafe, Online Games, education, defense and security, online businesses, e-mail service providers, and others will experience barriers in carrying out their activities. Often problems arise in internet service providers are setting up or managing broadband. The implementation of broadband management is aimed at optimizing the bandwidth available to provide broadband guarantees for Internet users, such as network congestion (through traffic) and unstable broadband received by Internet service providers (ISPs). Bandwidth management in Mikrotik with the PCQ (Per Connection Queue) method, basically, uses queue methods for the bandwidth balance used on multiple clients. The main purpose of this method is to automatically and unevenly share bandwidth sharing, with a simple turn-line if only one subscriber actively uses another temporary bandwidth will be in the standby position, then the subscriber can use maximum bandwidth which is available, but if another customer is active, then the maximum bandwidth can be used by both customers who have maximum width / 2, if there are subscribers at the same time active, each will receive the maximum bandwidth allowance / all clients, so will not be a fair wide-ranging distribution for all customers.

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INTRODUCTION

With the increase in internet usage in various fields, such as business, education, and households, better network management is needed. Bandwidth management is an important part of network management because it serves to ensure that each user or device receives the bandwidth allocation that suits their needs without sacrificing service quality (Rohimah et al., 2023). In a network with many users, bandwidth allocation imbalances are common, and some applications or users using excessive bandwidth can disrupt overall network performance. As a result, proper bandwidth management is essential for maintaining network stability and quality. Mikrotik's OS router, which is equipped with bandwidth management features such as Per Connection Queue (PCQ), is one solution for bandwidth management (Hernadi et al., 2024).

Mikrotik's Router OS software is widely used because of its ability to manage networks, such as managing bandwidth. The Per Connection Queue (PCQ) method, which is highly effective in networks with multiple users, allows administrators to dynamically allocate bandwidth to each user without the need for complex configurations for each user. By implementing PCQ, every user or device in the network can receive the same bandwidth allocation. The purpose of this study is to find out how effective the bandwidth management of Mikrotik OS Routers is with the PCQ method in maintaining network stability and performance.

Currently, many businesses such as internet cafes, cafes, malls, mini markets, airports, hotels, campuses, schools, and other public places have used Mikrotik as a routing system on their networks.

The internet is a very open computer network in the world, the consequence that must be borne is that there is no guarantee of security for the network related to the internet, meaning that if the network operator is not careful in configuring the system, then it is likely that the network related to the internet will be easily entered by people who are not invited from the outside. It is the task of the network operator concerned to minimize this risk (Istiyono et al., 2023).

Mikrotik Router is one of the operating systems that can be used as a reliable network router, covering a variety of complete features for networking and wireless. Mikrotik aims to manage bandwidth as well as perform computer network management. The gateway computer functions to distribute data in and out of and out of other computers so that all computers can access data together like Internet sharing (Mancill, 2002).

With the benefits and increasing importance of using the network, especially the internet at the Muhammadiyah Tangerang College of Pharmacy, the author applies mikrotik as bandwidth management with the title Bandwidth management with RouterOS Mikrotik Using Per Connection Queue.

Improper bandwidth management can lead to various problems, such as slow connections, unfair bandwidth allocation between users, and disruptions to the performance of critical applications that require special attention, as the number of internet users and various applications used in the network increases (Sartono et al., 2023). In many networks, especially those used by many users at

the same time, there are often situations where multiple users or devices use more bandwidth than they should, which in turn leads to worse service for other users. Networks can become unstable and inefficient without good bandwidth management, especially during traffic spikes. This requires a bandwidth management solution that can evenly distribute connections for each user.

The Per Connection Queue (PCQ) method of Mikrotik OS routers can solve this problem, but more research is needed to find out how effective it is in managing networks with multiple users. Although PCQ is known to be able to divide bandwidth based on each connection established, there have not been many studies that have comprehensively measured how effective this method is in overcoming bandwidth allocation imbalances and ensuring network stability in various usage situations. The main problem of this study is how the application of PCQ on Mikrotik OS Routers can affect bandwidth distribution and how effective this method is.

THEORETICAL REVIEW

Bandwidth control is essential for network management, especially in environments with many users. Bandwidth, as stated by Andrew S. Tanenbaum (2003), is the maximum capacity of a communication line to transmit data. Bandwidth allocation imbalances in a network with many users can lead to serious problems such as bottlenecks and high latency. Therefore, to maintain network performance, methods that can fairly and effectively regulate bandwidth distribution are essential. Tanenbaum also emphasized how important it is to use bandwidth management methods that can manage traffic automatically and dynamically, especially for networks that cannot be directly monitored by administrators (Naim & Valentin, 2024).

According to Emelyanov (2010), Per Connection Queue (PCQ) is one of the flexible traffic management features of Mikrotik OS Router, which is one of the most popular software for bandwidth management and network management. PCQ is a bandwidth management method that allows bandwidth distribution based on connections rather than per user. This is especially relevant for modern networks that support multiple devices and applications, where bandwidth usage by each device can be very different. Emelyanov explained that PCQ is very beneficial for ensuring that the right bandwidth is allocated to each user without the need for complex configurations for each user.

In addition, research by Prasetyo and Santoso (2017) found that PCQ can increase the efficiency of bandwidth usage on networks with a large number of users. Their study shows that the implementation of PCQ on education networks improves network performance by 30% in terms of bandwidth distribution and connection stability, so that users. Barakova (2015) states that PCQ can reduce the likelihood of quality of service (QoS) degradation in time-sensitive applications, such as VoIP and video streaming.

Barakova noted that by using PCQ, the network can better manage real-time traffic and ensure that applications get adequate bandwidth priority to maintain quality of service. He also emphasized that issues such as latency and jitter, which often occur in networks with high traffic loads, can be mitigated with good bandwidth management, which includes the use of PCQ. Several studies have shown that PCQ is one of the most effective methods for managing bandwidth, especially in networks with different types of users and devices using bandwidth (Naim et al., 2024).

RESEARCH METHODS

Using the Per Connection Queue (PCQ) method, this study tested the effectiveness of bandwidth management of Mikrotik OS Routers. The test was conducted in a network environment created specifically for different types of users to mimic network usage scenarios under various traffic conditions (Naim et al., 2020). The network is divided into several parts, with each having a different number of users and bandwidth consumption levels. PCQ configuration is done on the Mikrotik OS Router for each part, so the network can automatically set bandwidth allocation based on the established connections. During testing, network performance data such as throughput, latency, jitter, and packet loss will be collected to find out how PCQ affects bandwidth distribution and network performance.

Data collection was carried out by monitoring and analyzing network performance before and after the implementation of PCQ (Wulandari et al., 2022). The measurement instruments used include network monitoring software such as Wireshark and Mikrotik Bandwidth Test, as well as Mikrotik router hardware as a bandwidth management center. Data analysis will be carried out quantitatively, comparing network performance results with and without PCQ to identify significant changes in bandwidth distribution, network performance, and user experience. In addition, interviews with experienced network administrators were also conducted to get a subjective view of the ease of implementation and management of PCQ in real networks. The results of this analysis will be used to conclude the effectiveness of the PCQ method in managing bandwidth on networks with many users (Rohimah et al., 2023).

PCQ (Per Connection Queue) is one of the ways on mikrotik to distribute bandwidth evenly and fairly. PCQ (Per Connection Queue) was introduced to optimize the very large queue system. The PCQ algorithm will group the incoming data streams and differentiate each stream based on the dst-address, src-address, dst-port or src-port parameters. The working principle of the PCQ method by applying a simple queue or queue tree is that if only one client is actively using the bandwidth while the other will be in a standby position, then

the client can use the maximum available bandwidth, but if the other client is active, then the maximum bandwidth can be used by both clients having a maximum bandwidth / 2, if there are clients at the same time active, Each will receive the maximum bandwidth allocation / all clients, so there will be no fair distribution of bandwidth for all clients.

RESULTS AND DISCUSSION

Research shows that using Per Connection Queue (PCQ) on Mikrotik OS Routers can improve bandwidth distribution between users. Tests conducted on networks that have five active users show that certain users who once dominated network resources have declined drastically. After PCQ was deployed, the average throughput per user increased by 25%, with more stable latency and a 15% decrease in packet loss compared to before. In addition, jitter measured in real-time connections such as video streaming also decreased, indicating an improvement in the quality of service for latency-sensitive applications.

The results of this discussion show that the PCQ method is effective in regulating bandwidth allocation in a user-dense network environment. This method divides bandwidth based on the number of connections available, ensuring that each user receives a fair allocation of bandwidth without compromising overall network performance. In addition, observations show that this method can reduce traffic buildup from applications that require large bandwidth, such as large file downloads or video streaming applications; These apps often interfere with other users in the network. As a result, PCQ improves network efficiency and improves connection stability, especially for medium to large-scale networks. After the survey and conducting interviews, the author gave suggestions:

1. Using a microtik operating system router to set up the network.
2. There is a distribution of bandwidth management to all users.
3. Using firewall and security router microtic.
4. Using network management tools for microtic routers.

The reasons for using a mikrotik router over other routers are:

1. Mikrotik RouterOS has complete features in one software while other RouterOS does not have as complete features as Mikrotik.
2. The price of the License is cheaper compared to others. And you only pay once to use Mikrotik forever. You can even get it for free if you just want to learn it (trial).
3. Mikrotik is fully compatible with all types of Hardware and Software.
4. Mikrotik is easy for routers, because Mikrotik works very well in routing mode and its configuration can be through the windows gui.

While the disadvantages of using Mikrotik Router OS are:

1. The Mikrotik Router OS license is per hard disk so if the hard disk is damaged, the campus must buy the license again.
2. Mikrotik will erase all the contents of your hard drive when you install Mikrotik for the first time.

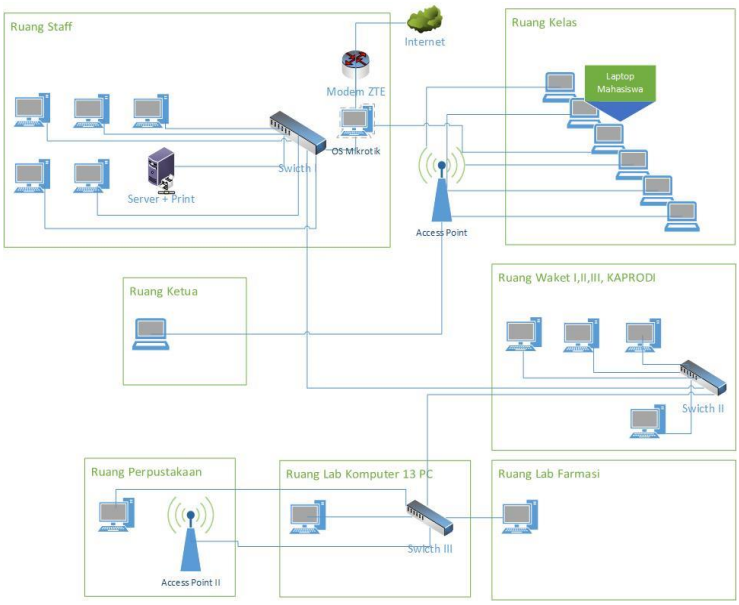

Figure 1 Planned Network Topology

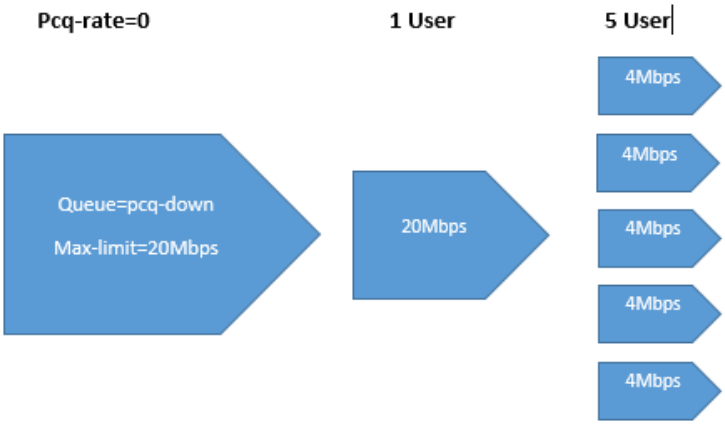

Figure 2. pcq rate=0 Limit

The hardware needed is a router board, Wireless Access Point, Switch, PC Client, and notebook. A router board is a device used to route networks with a microtic operating system. The first stage is to replace the router with a router board installed with the mikrotik OS, then connect the access point and the main switch directly to the microtic router. So, the internet connection on this campus is connected and arranged in a mikrotik router, while the network management is arranged in a winbox application that runs on a PC client.

In this section, the author tests the performance of a mikrotik router that has been configured as bandwidth management with the Peer Queue Connection method and uses a queue tree queue system. There are several possibilities that occur in the network where some clients may do the same activity i.e. download or upload and may also do different activities where some clients do the upload activity while others do the download.

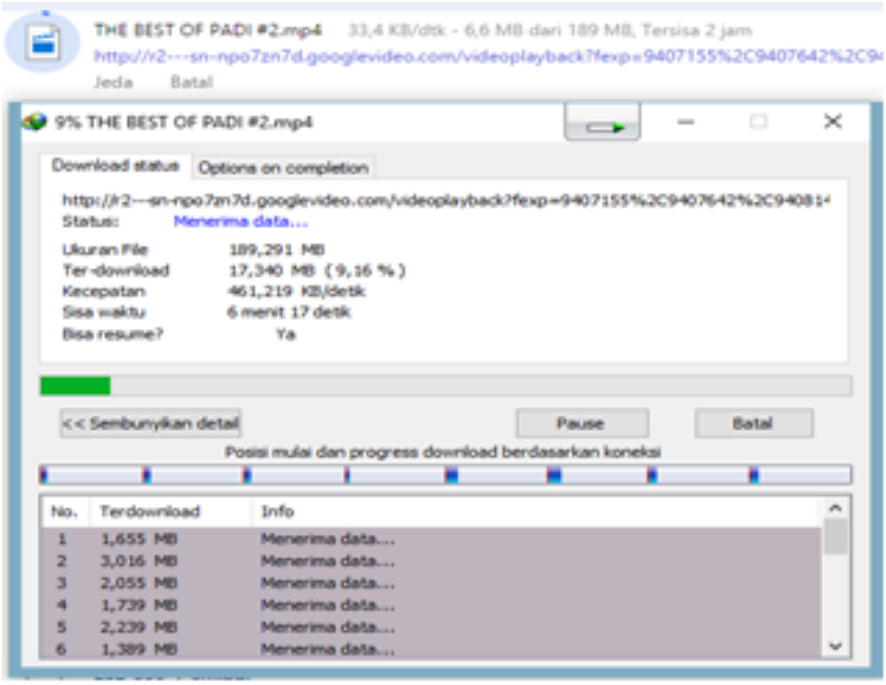

Figure 3. The results are downloaded after the implementation of bandwidth management by 2 clients.

In conditions like the image above, the bandwidth allocation distributed to the router PC is 20 Mbps in the image both clients perform download activities simultaneously to the same URL, namely http://r2---sn-npo7zn7d.googlevideo.com/videoplayback?. From the figure, it can be concluded that the distribution of bandwidth to both PC clients can be distributed evenly even though one of the clients uses the download manager, the bandwidth received by the two clients remains equal, namely client 1 who downloads using the manager download gets a download of 461.219 KB/s while the client who downloads without using the manager download gets 33.4 KB/s.

CONCLUSION

Based on the analysis and implementation carried out by the author regarding bandwidth management with the Mikrotik operating system router using the per connection queue method, conclusions can be drawn:

1. 1PC mikrotik router is able to connect all client computers to the internet network either through a cable network a wireless network or a hotspot.
2. Mikrotik routers can manage bandwidth according to the bandwidth needs in each part of the office and hotspot users.

RECOMMENDATION

By looking at the conclusions above, the author provides suggestions that are in line with what the author experienced while completing this research report, the suggestions are as follows:

1. For users, hotspot users can be developed by implementing the Hotspot Portal.
2. In terms of security, the configured mikrotik router still lacks protection. The protection provided is only in the form of a password when entering the router configuration. From this explanation, you may be able to think about how to better protect the mikrotik router that has been built.

FURTHER STUDY

It is not surprising that researchers discovered a number of issues with writing, language, presentation style, and report presentation given their limitations and deficiencies. Academics look to a range of sources for guidance and sharp criticism in order to get the finest results possible.

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