A study of network bandwidth management by using queue tree with per connection queue

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Abstract. This paper presents a study of network bandwidth management by using the queue tree function with per connection queue function (PCQ). To study a bandwidth management by configuring a network system that uses a Mikrotik router and configures IP number in the network system. WinBox software is used for testing network bandwidth management by download file testing from the internet. The results show a performance of queue tree function and PCQ function for bandwidth management. All users in a network have been received an equal bandwidth of utilization network.

1. Introduction
Nowadays, the internet system and computer networks are necessary for human life. For using a communication, information searching, entertainment, etc., all information on the internet has been continuity developed that includes an audio system, video, and graphics system that causes a big information or data file. From as describes, an organization that uses internet or independent computer networks system. Because a fundamental function of computer networks equipment or tools that use first in-first out queuing technique [1]. It causes information to wait. Benefit for each user bandwidth management can be done using a proxy, it has been providing facilities to manage the bandwidth of one simple queue and PCQ, both facilities have the same function, with different levels of effectiveness seen from the analysis that has been groove carried out from the groove configuration, the effectiveness of both methods [2]. This paper proposes an analysis of computer networks bandwidth management with function queue tree with per connection queue for experimental and analysis of results for network performance.

2. Queue tree function and PCQ
Queue tree is a limit data for certain IP address, subnets, protocols, ports, and another parameter. It is a limit peer-to-peer traffic [3]. Prioritize some packet flows over others. Configure traffic bursts for faster web browsing. Apply different limits based on time. And share available traffic among user equally or depending on the load of the channel. Per connection queue (PCQ) function is one of function that uses for bandwidth management for increasing a performance of the system [3-7]. It divides bandwidth from ISP or related rules from setting menu that divides equally as a user who uses a network at the time.

3. Network design and experiment
3.1 Network connection
This section describes computer networks design that use to test and experiment. The scheme is shown in Fig. 1.

![Network Design](image)

**Figure 1.** Network design and configuration for this study

Figure 1 presents an infrastructure network design of this system. That shows the connection with LAN and IP configuration of each device in a network to experiment. For the configuration section, Mikrotik router is used [4]. It has a Linux operating system that design for using divide into 2 parts as router operating system and router board. Mikrotik router board hardware is designed by proxy itself by having a variety of series and interface. Router board use router OS for the operating system.

3.2 Queue tree function configuration
In the experiment, we use the WinBox software for configuration network system, function, and experiment. First, we configure a device and router board as shown in Fig. 1, then enable a queue tree function. And then experiment by file download testing size 1 GB from a website that provides a file download testing on the internet. Fig. 2 shows a configuration of queue tree function for maximum bandwidth download. In this experiment, we set a maximum bandwidth of 10 Mbps. In the next step, the configuration of the queue tree to IP 10.0.0.253 and 10.0.0.254. For maximum bandwidth upload, we set as same as bandwidth download. A configuration of bandwidth download. In this experiment, we set the maximum bandwidth download is 1 Mbps. A configuration of queue tree with bandwidth upload for IP 10.0.0.253 and we do the same with IP 10.0.0.254.

![Queue Tree Configuration](image)

**Figure 2.** The configuration of mangle rule for out interface and upload configuration to IP 10.0.0.253

3.3 PCQ function setting of queue tree
In this section, setting a PCQ function configuration of queue tree for maximum bandwidth both download and upload. A configuration of PCQ function in bandwidth download and upload show in Fig. 3.

![Figure 3. A configuration of queue tree with PCQ function of maximum bandwidth download and upload](image)

4. File download testing and experiment

In this section, we experimented by using a configuration of section 3. And then testing of network bandwidth management by download file in free-ISP download file testing on the internet. Section 4.1 and section 4.2 are the experiment of 1 GB file downloading of the device on the internet by using queue tree function and by using queue tree with PCQ function, respectively.

4.1 Experiment of file downloading by queue tree function

For testing a bandwidth management by queue tree function, we set a maximum limit of download at 10 Mbps and upload 1 Mbps only. This configuration used for setting corresponds with system design in section 3. It not others rules or priority. Fig. 4 shows the windows of file download testing of IP 10.0.0.253 and IP 10.0.0.254 with queue tree function, respectively.

![Figure 4. File download testing of IP 10.0.0.253 and IP 10.0.0.254 with queue tree function](image)
The results of file download testing are shown in Fig. 5.

Figure 5. The results of file download testing using queue tree function

From the results, queue tree function has the complexity to config due to an average of the bandwidth of each IP is 1.5 Mbps to 2 Mbps that is continuity. In addition, a period of working time of each IP is completed with a different time 6 minutes and using maximum CPU for processing at 44%.

4.2 Experiment of file downloading by queue tree and PCQ functions

This section enables a PCQ function by changing the checking queue type menu to PCQ-upload default at target upload menu and change to PCQ-download default at target upload menu only. Fig. 6 and Fig. 7 show the windows of file downloading of the device on the internet and the results by queue tree and PCQ functions of IP 10.0.0.253 and IP 10.0.0.254, respectively.

Figure 6. File download testing of IP 10.0.0.253 and IP 10.0.0.254 by queue tree function and PCQ function

Figure 7. Results of file download testing by using queue tree function and PCQ function
From the results, queue tree function with PCQ function have an average of the bandwidth of each IP is 5 Mbps that is continuity. In addition, a period of working time of each IP is completed with a different time 6 minutes and using maximum CPU for processing at 46%. Results in section 4.1 and 4.2 present an information to confirm the performance of queue tree function with PCQ function that a queue tree with PCQ has an average bandwidth of each IP is 5 Mbps that more than using queue tree function only.

5. Conclusion
This paper presents a studying of network bandwidth management by using queue tree functions with PCQ. We configured a device and used Mikrotik router and set IP in the network system and then using WinBox software for testing a network performance of the function. The results show a performance of queue tree function. It may be complex to use due to it has more detail about the configuration follow as rules or limits. PCQ function has more average bandwidth than the queue tree function. Because PCQ not calculate the bandwidth of each IP in download and upload from ISP. PCQ calculated bandwidth from ISP and user in a network. All users in a network have been received an equal bandwidth of utilization network.

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