

# Implementing bandwidth management on computer networks using MIKROTIK router

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## ABSTRACT

Today's expansion of information technology is paralleled by the development of computer networks; with tools and software for bandwidth control, the computer network can function properly. Campuses, agencies, and businesses in general require bandwidth management with a Mikrotik router to help overcome the density of traffic that can interfere with computer network connections, where when the network is down or the computer network has problems due to the absence of an even distribution of bandwidth for each user, by Therefore, it is necessary to manage the distribution of the amount of bandwidth, with the goal of achieving the optimal bandwidth capacity for each user. Later, the bandwidth capacity will be allocated to each user according to their internet usage priority in order to optimize the available bandwidth capacity. Bandwidth management, often known as QOS (Quality of Services), is an alternative term for bandwidth management. This application is executed in multiple stages, including network design, implementation, and testing, which is characterized by the availability of a more reliable network.

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## 1. Introduction

Currently, both software and hardware advancements in the field of information technology are expanding at a rapid rate, in tandem with modern human needs. Internet, one of the information technologies, has had a tremendous impact on many facets of human life. XYZ Campus is outfitted with a computer network infrastructure to facilitate internet access for faculty, staff, and students.

The authors are therefore interested in analyzing campus computer networks. This research aims to optimize the network utilizing a Mikrotik router, using the XYZ Campus as a case study. The gained conclusion is to optimize the existing network system with the Mikrotik Router by implementing a more complex and optimal network management system in terms of firewalls and bandwidth management for clients on the existing computer network on the XYZ Campus.

This application research was conducted with the objectives of optimizing the use of computer networks, identifying the causes or factors that influence the use of computer networks, determining the model or method for using computer networks, and providing suggestions or input for computer network users.

Computer System Network, (Kadir & Triwahyuni, 2013) "A computer network is a group of computers functioning as a single system. A computer network is a collection of computers that share

resources offered by or located on network nodes. The computers communicate using standard communication protocols across digital links. These linkages are comprised of telecommunication network technologies, which are based on physically wired, optical, and wireless radio-frequency means and can be configured in a number of network topologies.

A computer network's nodes may consist of personal computers, servers, networking devices, or other specialized or general-purpose hosts. They are recognized by their network addresses and hostnames, if any. After initial assignment, hostnames serve as memorable labels for the nodes and are rarely modified. Network addresses are used by communication protocols such as the Internet Protocol to locate and identify nodes.

The transmission medium used to convey signals, the network's capacity, the communications protocols used to manage network traffic, the network's size, its topology, its traffic control mechanism, and its organizational purpose can all be used to classify computer networks. Computer networks provide a variety of applications and services, including access to the World Wide Web, digital video, digital music, shared usage of application and storage servers, printers, fax machines, and email and instant messaging apps.

Network topology, (Soepomo, 2014) "Network topology has two distinct meanings when seen from the perspective of cabling and data flow." A communication network's topology is the organization of its elements (links, nodes, etc.). Network topology can be used to define or explain the configuration of numerous types of telecommunication networks, including as command and control radio networks, industrial fieldbuses, and computer networks.

Physical or conceptual representations of network topology are possible. It is an application of graph theory in which communicating devices are treated as nodes and their connections as links or lines between the nodes. Physical topology refers to the arrangement of a network's components (e.g., device location and cable installation), whereas logical topology depicts how data moves inside a network. Distances between nodes, physical connectivity, transmission rates, and signal types may vary between networks with identical logical topologies. The physical layer of the OSI model is particularly concerned with the physical topology of a network.

Local area networks (LAN), a common computer network installation, feature network topologies. Any specific LAN node has one or more physical links to other network devices; mapping these links graphically results in a geometric shape that may be used to explain the network's physical architecture. LANs have utilized a variety of physical topologies, including ring, bus, mesh, and star. Inversely, mapping the data flow between the components determines the network's logical structure. In contrast, Controller Area Networks, which are used in automobiles, are largely dispersed control system networks consisting of one or more controllers associated with sensors and actuators via a physical bus topology.

Internet, (Wonkar et al., 2015) The internet is comprised of numerous LANs and WANs distributed throughout the world. The Internet (or internet)[a] is a global system of interconnected computer networks that communicate using the Internet protocol suite (TCP/IP)[b]. It is a network of networks consisting of private, public, academic, business, and government networks with local to global reach that are interconnected by a wide range of electronic, wireless, and optical networking technologies. Internet provides access to a broad array of information resources and services, including the interlinked hypertext pages and applications of the World Wide Web (WWW), electronic mail, telephone, and file sharing.

Bandwidth Management or Quality of Services (QoS) is a technique or configuration used to meet the requirements of a computer network. (Pamungkas, 2016) Bandwidth is the amount of data packet traffic that an Ethernet cable can accommodate. Bandwidth management is the technique of measuring and regulating the communications (traffic, packets) over a network link in order to avoid filling the link to capacity or overfilling the link, which would cause network congestion and poor network performance. Bandwidth is quantified in bits per second (bits/s) or bytes per second (Bytes/s).

Implementation Strategy, (Triyono & Dharmas, 2018) Identifying difficulties, formulating problems, analyzing problems and formulating actions, establishing plans, implementing actions, observing them, processing, interpreting application data, and reporting implementation results are suggested as steps in an implementation strategy. (Stringer, 2007) However, there are other stages that can be passed

during implementation, including the planning stage, the execution stage, the observation stage, and the reflection stage. (Stringer, 2007) Then, the four steps proposed by Lewin and Stringer are as follows: Planning (planning), Execution (executing), and Evaluation (evaluation)

## 2. Methods

In this application research, the XYZ campus served as the case study location for four phases of the procedure. These four steps are executed sequentially and are interconnected. The search for data consists of three stages, the first of which is observing the existing Internet network and Internet service status on the XYZ campus. Next, create a mechanism for managing bandwidth. The second method involves an interview. The interview process is tied to the campus network architecture so that the network analysis procedure is in line with the anticipated outcomes. The final one employs the library method, namely searching for references in reading materials.

A network analysis is performed to determine the present network architecture. This investigation will examine the utilized network topology and the campus network's regulations and configurations. Using the results of the preceding study, the design for bandwidth management is created. This concept generates a reasonable bandwidth control strategy that may be applied to specific lines or all existing lines.

After the design has been successfully tested on the implemented bandwidth management system, the testing phase is executed. The test evaluates the success of the primary system, where bandwidth management will be effective if other tests linked to the connection's balance and IP address are successful.

## 3. Results And Discussion

In this application research, the author installs bandwidth control on the tangerang campus of the university for informatics. According to network analysis, the internet connection is less stable, which might result in job delays and material losses owing to late work. This prevents the optimal performance of personnel. Therefore, the authors employ bandwidth management to ensure that each user receives an equal amount of bandwidth. The author will employ the study topology depicted in Figure 1.

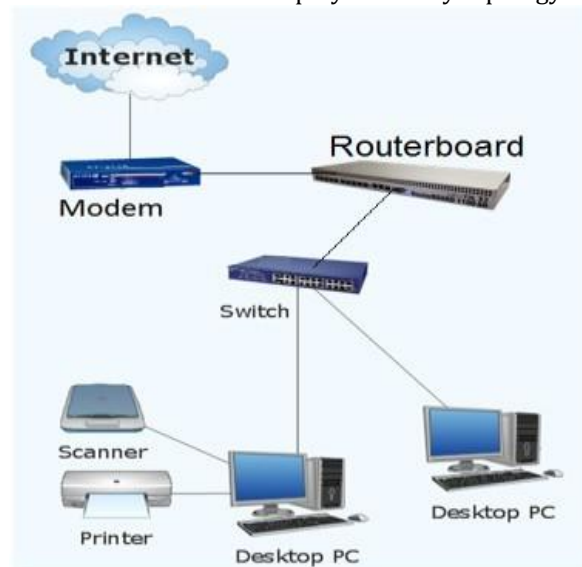


Figure 1. Applied research topology

The implementation phases utilized by the author are depicted in Figure 2.

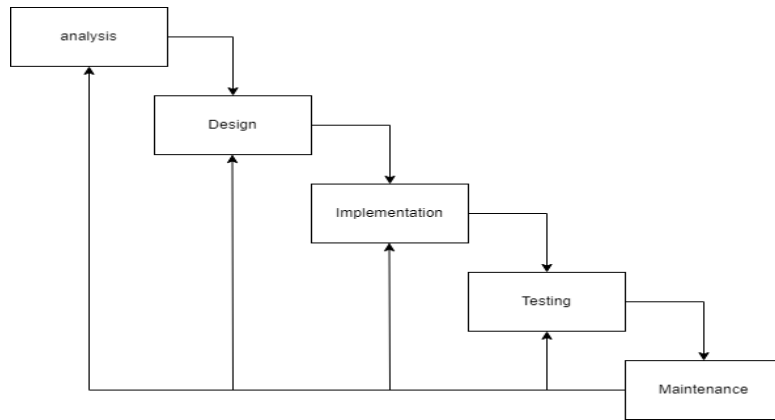


Figure 2. Procedures for implementation

**Bandwidth Management Configuration:**

Bandwidth Sharing Method, Almost the same as a firewall, bandwidth management position is in the middle, can be bridge or routing.

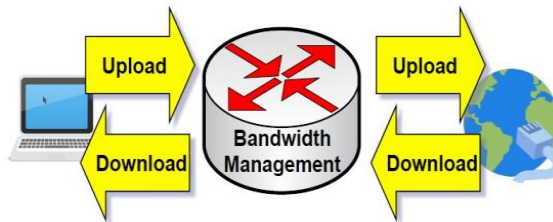


Figure 3. Simple Queue Bandwidth Management Method Implementation or configuration

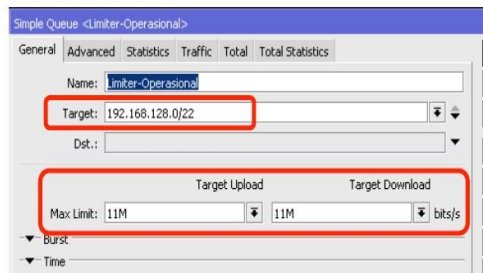


Figure 4. Implimentation Simple Queue

**Case Example 1**

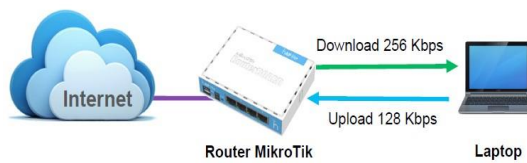


Figure 5. Case study plan 1

**Simple Queue Rules**

The target is populated with the client IP for which we will limit the settings, and then the max-limit is specified to limit the bandwidth usage.

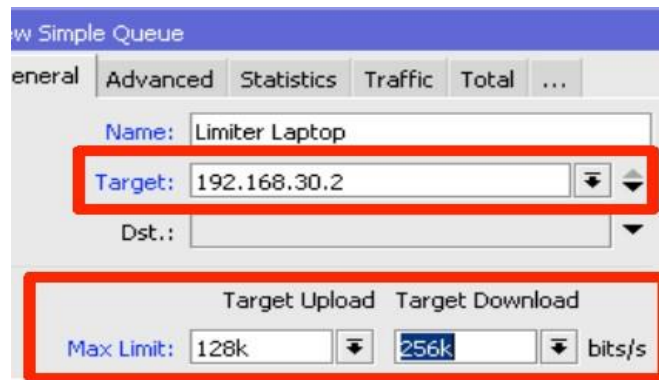


Figure 6. Simple Queue Rules

### Case Example 2

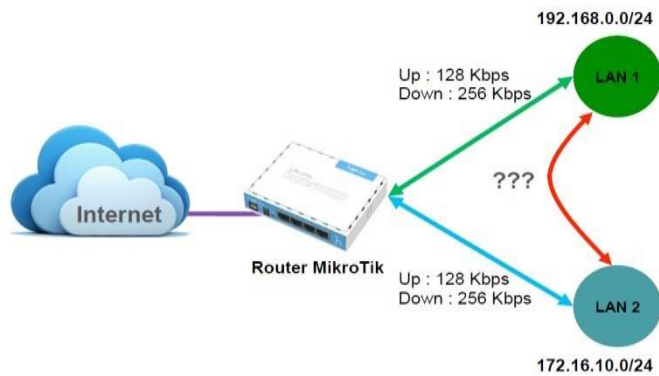


Figure 7. Case study scheme 2

### Destination Parameters

The Destination parameter is used to determine the limitation to a particular destination, this case study Dst is filled with the destination LAN segment IP.

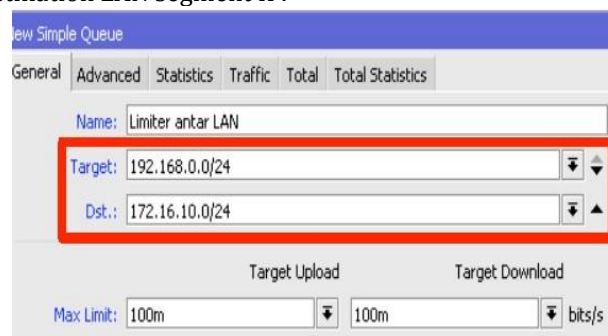


Figure 8. Parameter

Simple Queue Rule Sequence

#	Name	Target	Det.	Upload Max Limit	Download Max
0	Limitier antar LAN	192.168.30.2	172.16.10.0/24	100M	100M
1	Limitier Laptop	192.168.30.2		128k	256k

Figure 9. Rules

Example Case 3, The first step involves limiting the maximum upload and download on the client via a drop-down menu or by hand. the number of bits per second (bps).

Figure 10. Client Limit Configuration

Using the arrangement depicted in Figure 10, each connected user will experience a more consistent and reliable speed.

Sharing Bandwidth Case Study Example 4, We will configure the bandwidth for three clients.

Figure 11. Total Bandwidth Configuration

Next, we will configure the childqueue to define the limit per user. Repeat to restrict other customers.

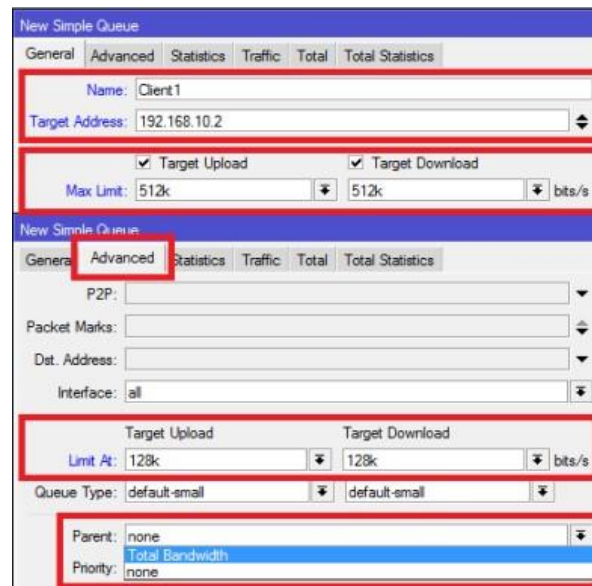


Figure 12. Configure Limitations per user

Next is testing or downloading and testing from the user's perspective.

#	Name	Target Address	Tx Max Limit	Tx Limit At	Parent	Tx
0	Total Bandwidth		512k	unlimited	none	513.8 kbps
1	Client1	192.168.10.1	512k	128k	Total Bandwidth	513.5 kbps
2	Client2	192.168.10.2	512k	128k	Total Bandwidth	0 bps
3	Client3	192.168.10.3	512k	128k	Total Bandwidth	0 bps

Figure 13. user download testing

Condition 1: In Figure 13 the Limit-at user is satisfied. Because there are no other active users

#	Name	Target Address	Tx Max Limit	Tx Limit At	Parent	Tx
0	Total Bandwidth		512k	unlimited	none	515.5 kbps
1	Client1	192.168.10.1	512k	128k	Total Bandwidth	256.4 kbps
2	Client2	192.168.10.2	512k	128k	Total Bandwidth	259.0 kbps
3	Client3	192.168.10.3	512k	128k	Total Bandwidth	0 bps

Figure 14. download test for two users

Figure 14 depicts Condition 2 when just two users are utilizing bandwidth. Will first provide limit-at to all users.

#	Name	Target Address	Tx Max Limit	Tx Limit At	Parent	Tx
0	Total Bandwidth		512k	unlimited	none	505.6 kbps
1	Client1	192.168.10.1	512k	128k	Total Bandwidth	179.2 kbps
2	Client2	192.168.10.2	512k	128k	Total Bandwidth	173.1 kbps
3	Client3	192.168.10.3	512k	128k	Total Bandwidth	170.6 kbps

Figure 15. download test for threeusers

Condition 3: In Figure 15 will meet the Limit-at of each user first, so that it is evenly distributed.

Example Case 5, Client 1 is a VVIP user, hence Priority 1 can be assigned to it (highest).

**New Simple Queue**

General | **Advanced** | Statistics | Traffic | Total | Total Statistics

Name: Client1  
 Target Address: 192.168.10.2

Target Upload     Target Download  
 Max Limit: 512k    Limit At: 512k    bits/s

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**New Simple Queue**

General | **Advanced** | Statistics | Traffic | Total | Total Statistics

P2P:   
 Packet Marks:   
 Dst. Address:   
 Interface: all

Target Upload: Limit At: 128k    Target Download: Limit At: 128k    bits/s  
 Queue Type: default-small    default-small

Parent: none  
 Priority: none

Figure 16. User Limit Configuration

If we apply the priority calculation in Figure 16, the bandwidth distribution is almost the same as before.

#	Name	Target Address	Tx Max Limit	Tx Limit At	Parent	Tx
0	Total Bandwidth		512k	unlimited	none	505.6 kbps
1	Client1	192.168.10.1	512k	128k	Total Bandwidth	179.2 kbps
2	Client2	192.168.10.2	512k	128k	Total Bandwidth	173.1 kbps
3	Client3	192.168.10.3	512k	128k	Total Bandwidth	170.6 kbps

Figure 17. Download Test

Client 1: has the highest priority, the router will try to provide bandwidth up to the Max-Limit limit.  
 Bypass Local Traffic

#	Name	Target Address	Rx Max Limit	Tx Max Limit	Dst. Address	Rx Limit At	Tx Limit At
0	ByPassLokal	192.168.10.0/24	100M	100M	192.168.11.0/24	unlimited	unlimited
3	Total Bandwidth		512k	512k		unlimited	unlimited
1	LimitLAN1	192.168.10.0/24	512k	512k		256k	256k
2	LimitLAN2	192.168.11.0/24	512k	512k		256k	256k

Figure 18. Bypass Local Traffic

The Simple Queue rule in Figure 18 is read from the top (no. 0)

### Bandwidth Management Test

The author conducted Bandwidth Management testing utilizing three client computer units, which serve as a success metric. Each computer that is network-attached and already connected to the internet will attempt to download a size-specified amount of data from the internet. This is performed to determine whether or not the established bandwidth management allows the Mikrotik Router to divide the available bandwidth equitably. Figure 19 below displays the test data for this test.

Based on the outcomes of the Bandwidth Management implementation utilizing a Mikrotik Routerboard testing depicted in Figure 19, the results were fairly excellent. As shown in Figure 19, the bandwidth obtained by the three computers has a nearly identical average bandwidth, which is in the region of 170 kbps, indicating that the bandwidth is uniform and stable.

### 4. Conclusion

In this study, the author employs the simple queue approach, whose purpose is to distribute network bandwidth across all network-connected client computers. After conducting an examination of the application of bandwidth management usage, the author reaches the following conclusion: By managing the bandwidth of Simple Queue demands, bandwidth usage by a single user is limited. By calculating the bandwidth capacity divided by the number of existing users, the minimum and maximum bandwidth limits for each user are determined. All gadgets can use the internet effectively and reliably. All components of the unit or client receive bandwidth based on their specific requirements.

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