

# **HOW TO MANAGE A NETWORK INFRASTRUCTURE USING LOAD BALANCE AND BANDWIDTH MANAGEMENT ON SCHOOL**

MikroTik User Meeting 2021

# INTRODUCE MYSELF



**Name** : Ferdian Sakti  
**Work** : IT Admin on SMK Dwija Bhakti 1 Jombang  
Managing Director on CV. Jasaraya Dinamika  
**E-mail** : [ferdian@smkdb1jombang.sch.id](mailto:ferdian@smkdb1jombang.sch.id)  
**Linux User**

Using MikroTik since 2015 and fully make MikroTik in daily activity or teaching activities.

**Experiences :**

1. Handle some Virtual Private Server (VPS) as e-Learning activity on several school.
2. Installing some client using Mikrotik Router as a network management, like RT/RW Net, office, or school.

# How to make internet reliable?



In study case 4 ISP have various amount bandwidth?  
And how to IT Admin make proper distribution to avoid  
stacking in one ISP line.

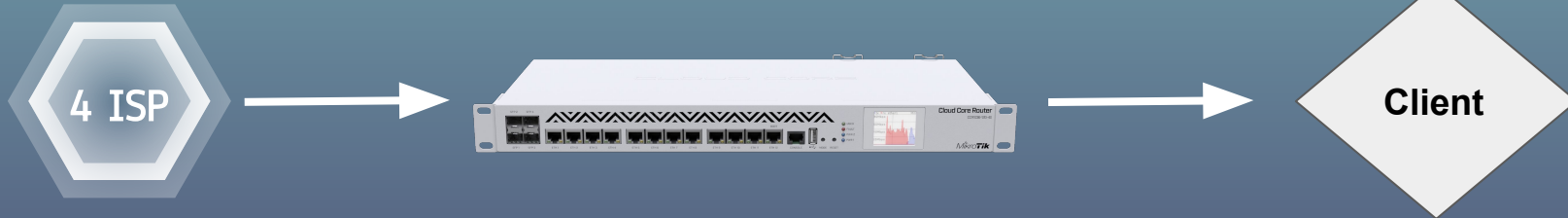
# Metode Load Balance di MikroTik



1. **Static Route with Address List** : Mengelompokkan range IP Address agar melewati salah satu gateway dengan menggunakan static routing.
2. **Equal Cost Multi Path (ECMP)** : Pemilihan jalur bergantian traffict koneksi yang melewati gateway.
3. **NTH** : Parameter utama dari NTH ini yaitu “Every” and “Packet”. NTH menggunakan algoritma round robin untuk menentukan pembagian pemecahan connection yang akan di-mangle ke rute yang dibuat untuk load balancing.
4. **Per Connection Classifier** : Pengelompokkan traffict yang keluar masuk berdasarkan src-address, dst-address, src-port, & dst-port.

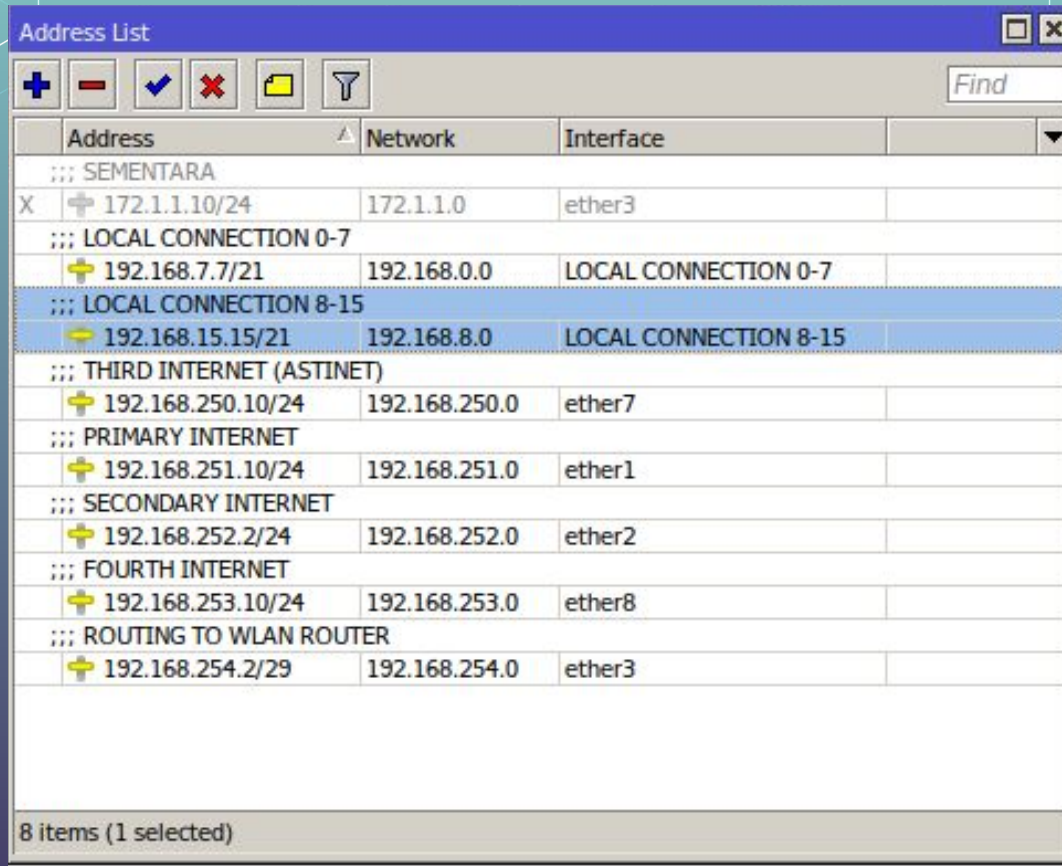
# Load Balance With ECMP

## *Improvement from Round Robin*



ECMP is "persistent per-connection load balancing" atau  
"per-src-dst-address combination load balancing"

# Add IP Interfaces



The screenshot shows the Windows Address List window with a table of IP addresses and their corresponding network interfaces. The table is organized into sections separated by ';;;'. The selected row is highlighted in blue.

	Address	Network	Interface
;;; SEMENTARA			
X	+ 172.1.1.10/24	172.1.1.0	ether3
;;; LOCAL CONNECTION 0-7			
	+ 192.168.7.7/21	192.168.0.0	LOCAL CONNECTION 0-7
;;; LOCAL CONNECTION 8-15			
	+ 192.168.15.15/21	192.168.8.0	LOCAL CONNECTION 8-15
;;; THIRD INTERNET (ASTINET)			
	+ 192.168.250.10/24	192.168.250.0	ether7
;;; PRIMARY INTERNET			
	+ 192.168.251.10/24	192.168.251.0	ether1
;;; SECONDARY INTERNET			
	+ 192.168.252.2/24	192.168.252.0	ether2
;;; FOURTH INTERNET			
	+ 192.168.253.10/24	192.168.253.0	ether8
;;; ROUTING TO WLAN ROUTER			
	+ 192.168.254.2/29	192.168.254.0	ether3

8 items (1 selected)

# Don't forget NAT Public interface

Firewall

Filter Rules NAT Mangle Raw Service Ports Connections Address Lists Layer7 Protocols

+ - ✓ ✗ 📄 🔍 Reset Counters Reset All Counters Find all

#	Action	Chain	Src. Address	Dst. Address	Proto...	Src. Port	Dst. Port	In. Int...	Out. Interface	In. Int...	Out. In...	Src. Address List	Dst. Ad...	Bytes	Packets
::: NAT PRIMARY PUBLIC INTERFACE															
0	mas...	srcnat							ether1			INTERNET		208.5 MiB	3 408 270
::: NAT SECONDARY PUBLIC INTERFACE															
1	mas...	srcnat							ether2			INTERNET		212.9 MiB	3 463 456
::: NAT THIRD PUBLIC INTERFACE															
2	mas...	srcnat							ether7			INTERNET		1069.7 MiB	17 355 613
::: NAT FOURTH PUBLIC INTERFACE															
3	mas...	srcnat							ether8			INTERNET		213.6 MiB	3 475 247
::: DVR CCTV															
4 X	dst...	dstnat		192.168.25...	6 (tcp)		80							0 B	0
5 X	src...	srcnat	192.168.7...						ether2					0 B	0
6 X	src...	srcnat	192.168.7...		6 (tcp)		5000		ether7					0 B	0
7 X	mas...	srcnat	192.168.0...	192.168.7...	6 (tcp)		8080		LOCAL CONN...					0 B	0
8 X	mas...	srcnat							ether3			INTERNET		0 B	0

# Notice! Perhatikan rasio bandwidth antar ISP yang digunakan

Route <0.0.0.0/0>

General Attributes

Dst. Address: 0.0.0.0/0

Gateway:	192.168.251.1	↕	reachable ether1	↕
	192.168.252.1	↕	reachable ether2	↕
	192.168.250.1	↕	reachable ether7	↕
	192.168.250.1	↕	reachable ether7	↕
	192.168.250.1	↕	reachable ether7	↕
	192.168.250.1	↕	reachable ether7	↕
	192.168.250.1	↕	reachable ether7	↕
	192.168.250.1	↕	reachable ether7	↕
	192.168.253.1	↕	reachable ether8	↕

Check Gateway: ping

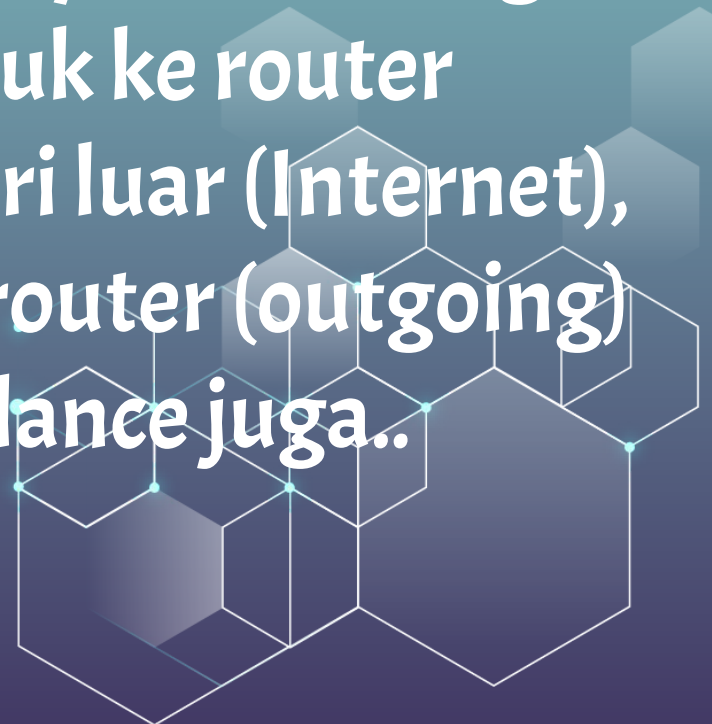
Type: unicast

enabled active static

OK  
Cancel  
Apply  
Disable  
Comment  
Copy  
Remove



**Dengan load balance, maka gateway akan lebih dari satu dan kasusnya terkadang ketika ada packet masuk ke router (incoming) yang berasal dari luar (Internet), maka traffict respons dari router (outgoing) akan terkena load balance juga..**



# Konfigurasi Firewall mangle

Mangle Rule <>

General Advanced Extra Action Statistics

Chain:

Src. Address:

Dst. Address:

Protocol:

Src. Port:

Dst. Port:

Any. Port:

In. Interface:  ether1

Out. Interface:

In. Interface List:

Out. Interface List:

Packet Mark:

Connection Mark:

Routing Mark:

Routing Table:

Connection Type:

Connection State:  invalid  established  related  new  untracked

Connection NAT State:

enabled

OK  
Cancel  
Apply  
Disable  
Comment  
Copy  
Remove  
Reset Counters  
Reset All Counters

Mangle Rule <>

General Advanced Extra Action Statistics

Action:

Log

Log Prefix:

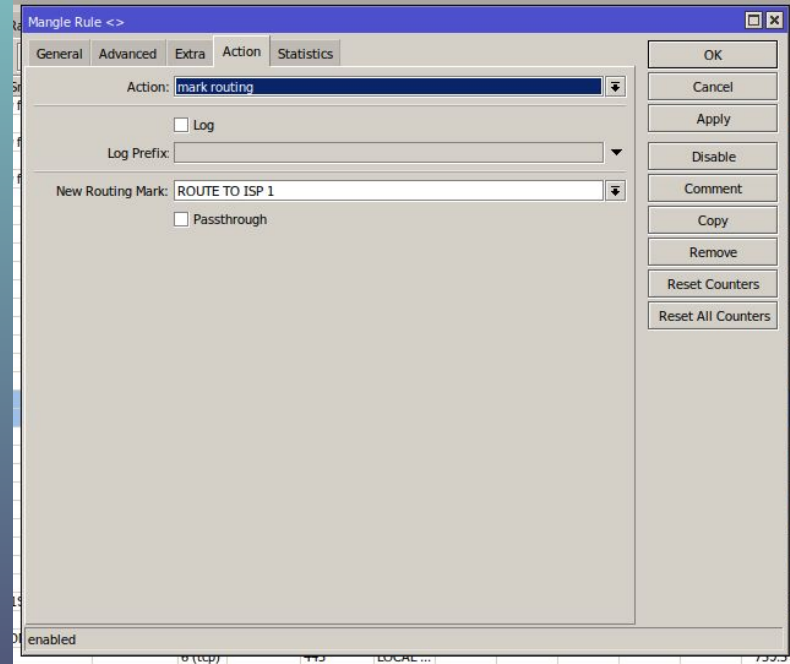
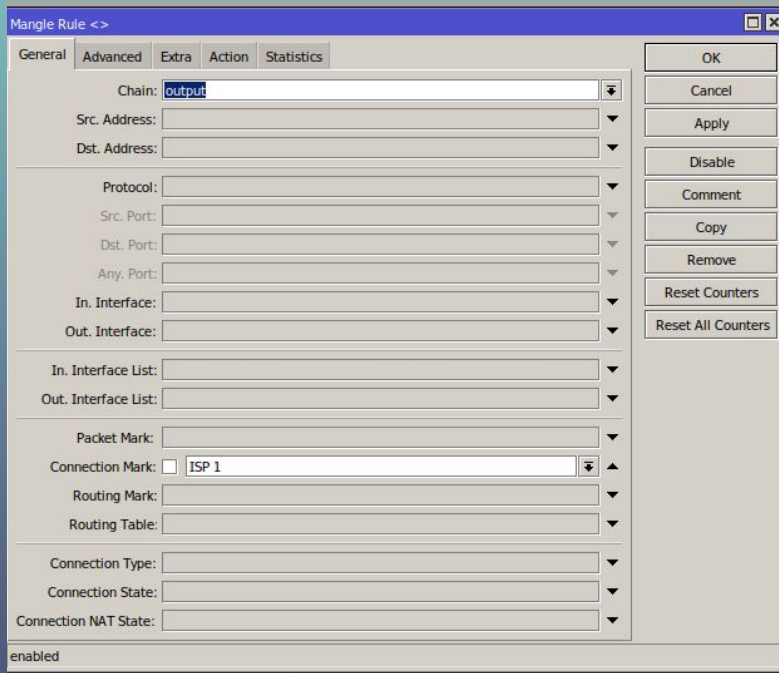
New Connection Mark:

Passthrough

enabled

OK  
Cancel  
Apply  
Disable  
Comment  
Copy  
Remove  
Reset Counters  
Reset All Counters

# Konfigurasi Routing Mark



# Konfigurasi di Tabel Routing

Route <0.0.0.0/0>

General Attributes

Dst. Address: 0.0.0.0/0

Gateway: 192.168.251.1 reachable ether1

Check Gateway:

Type: unicast

Distance: 1

Scope: 30

Target Scope: 10

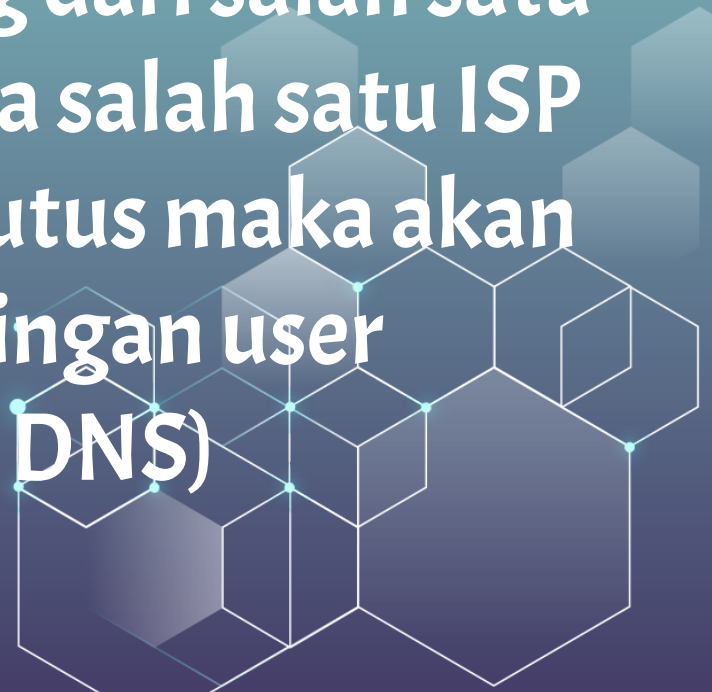
Routing Mark: ROUTE TO ISP 1

Pref. Source:

OK  
Cancel  
Apply  
Disable  
Comment  
Copy  
Remove

enabled active static

Permasalahan lain juga akan muncul ketika kita menggunakan setting dari salah satu DNS yang digunakan pada salah satu ISP dan ketika ISP tersebut putus maka akan berdampak pada jaringan user  
(Cannot resolve DNS)

A decorative graphic in the bottom right corner consisting of a network of interconnected hexagons. Some hexagons are filled with a light blue color, while others are just white outlines. Small blue dots are placed at the vertices where the hexagons meet, resembling a network or data structure.

**Attention!**

**Masih banyak user yang salah paham  
mengenai load balance**

**Contohnya ketika kita memiliki 3 ISP,  
dengan besaran bandwidth**

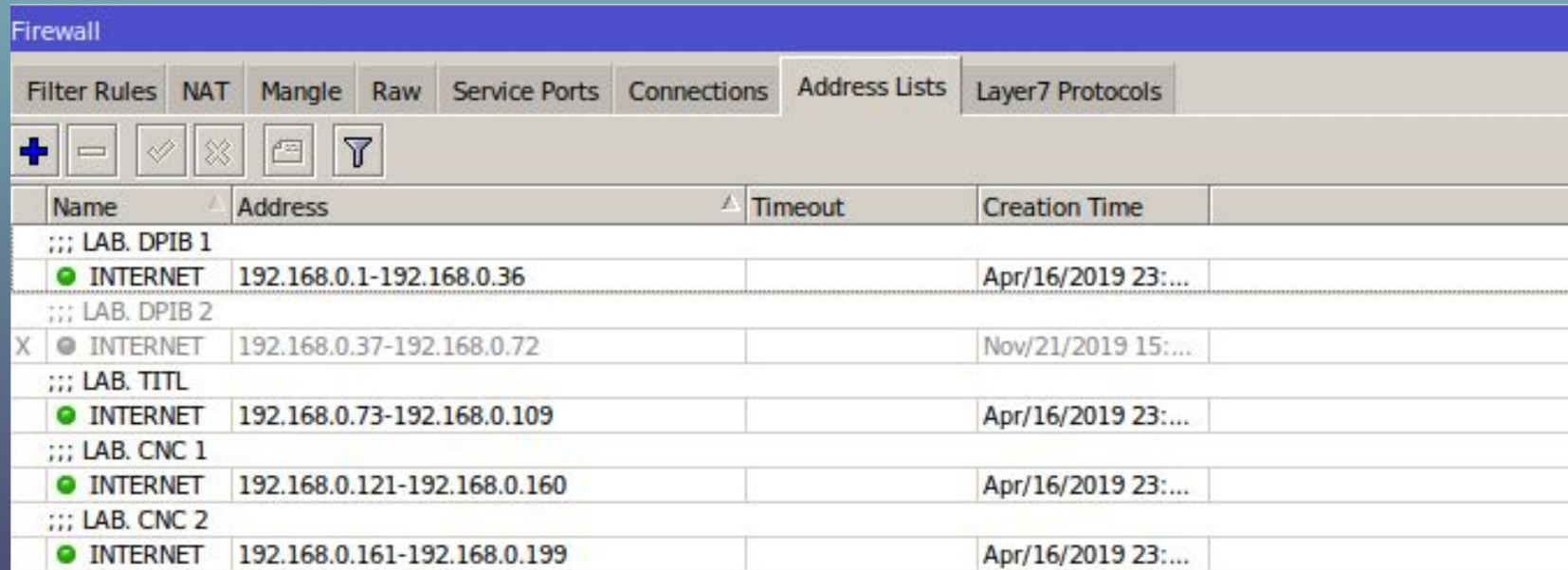
$$20 + 20 + 20 = 60$$

**1 : 1 : 1**



# trick

Bisa gunakan fitur address list IP Address yang akan di NAT untuk memudahkan untuk network management



The screenshot shows the Mikrotik WinBox interface for configuring Firewall Address Lists. The 'Address Lists' tab is selected. The table below lists several address lists, including 'LAB. DPIB 1', 'LAB. DPIB 2', 'LAB. TTL', 'LAB. CNC 1', and 'LAB. CNC 2'. Each list is associated with an 'INTERNET' profile and a specific IP address range.

Name	Address	Timeout	Creation Time
::: LAB. DPIB 1			
<input checked="" type="radio"/> INTERNET	192.168.0.1-192.168.0.36		Apr/16/2019 23:...
::: LAB. DPIB 2			
X <input type="radio"/> INTERNET	192.168.0.37-192.168.0.72		Nov/21/2019 15:...
::: LAB. TTL			
<input checked="" type="radio"/> INTERNET	192.168.0.73-192.168.0.109		Apr/16/2019 23:...
::: LAB. CNC 1			
<input checked="" type="radio"/> INTERNET	192.168.0.121-192.168.0.160		Apr/16/2019 23:...
::: LAB. CNC 2			
<input checked="" type="radio"/> INTERNET	192.168.0.161-192.168.0.199		Apr/16/2019 23:...

# Bandwith Management

1. Simple Queue

2. Queue Tree

Target Address yang bisa dilimit diantaranya :

- Single IP (192.168.7.2)
- Network IP (192.168.7.0/24)
- Beberapa IP sekaligus (192.168.7.3,192.168.7.4)
- Interface ethernet



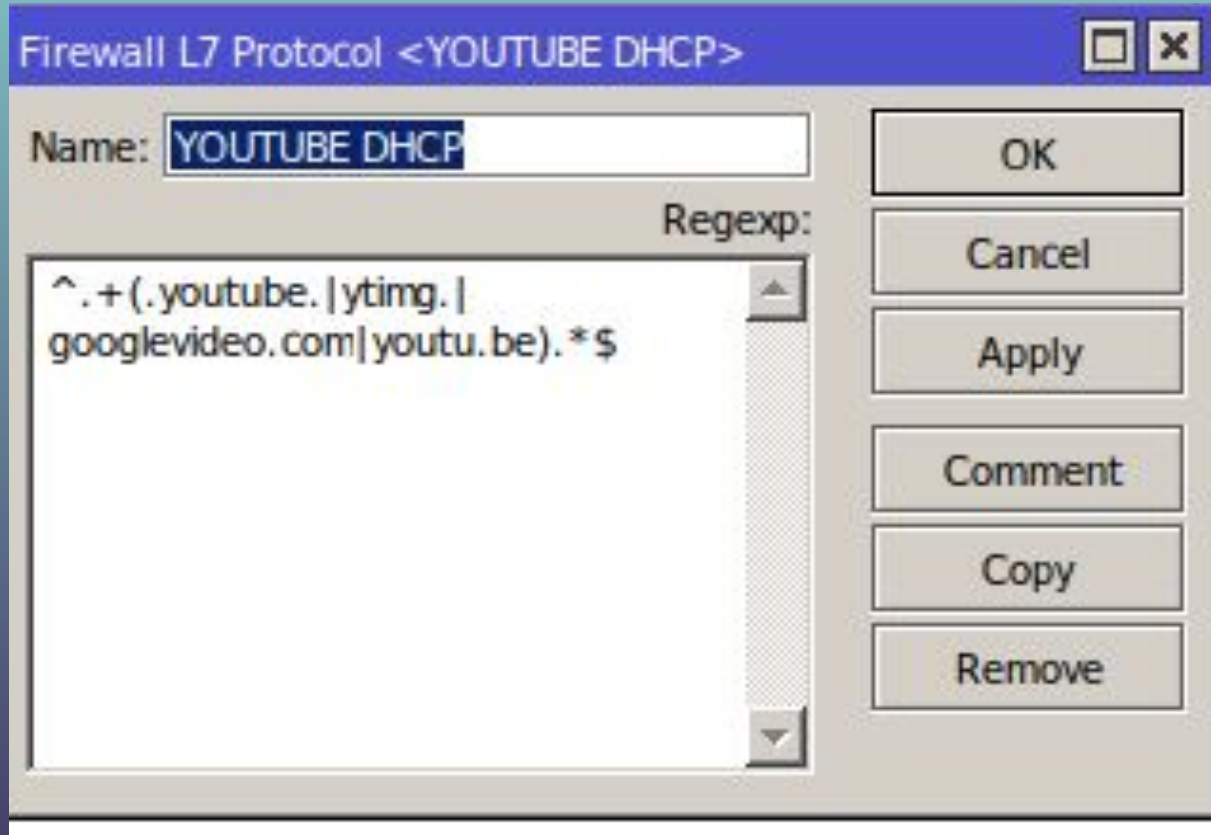


# Bandwith Priority (Koneksi apa yang menghabiskan bandwith paling besar) itulah yang akan dilimit terlebih dahulu.

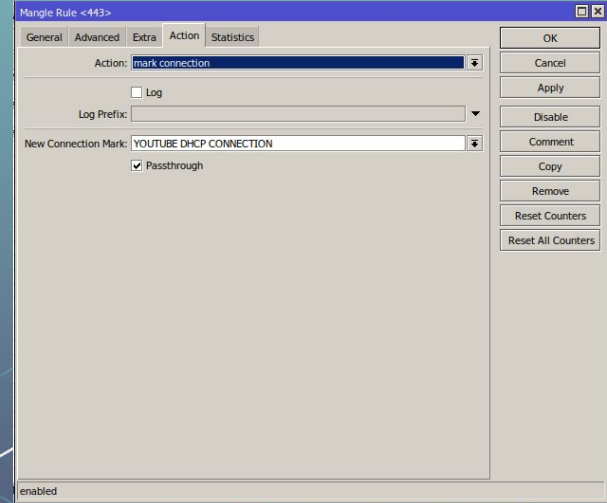
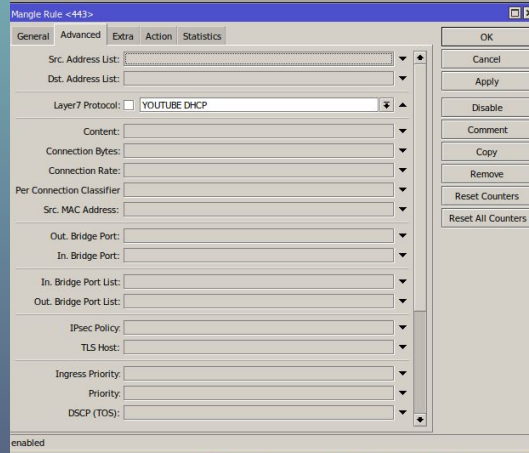
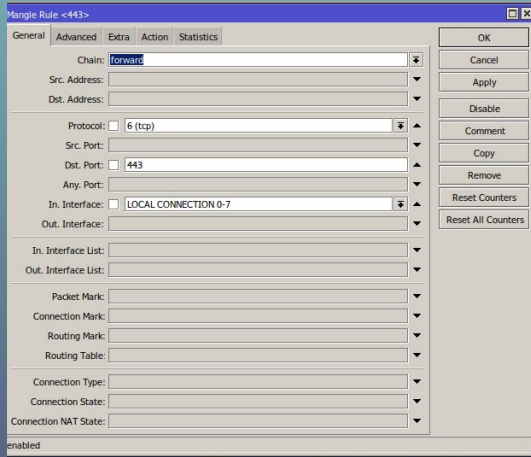
- 1) 144p =  $\pm 200$ Kbps (0.2Mbps)
- 2) 240p =  $\pm 300$ Kbps (0.3Mbps)
- 3) 360p =  $\pm 400$ Kbps (0.4Mbps)
- 4) 480p =  $\pm 500$ Kbps (0.5Mbps)
- 5) 720p @30fps =  $\pm 1.500$ Kbps (1.5Mbps)
- 6) 720p @60fps =  $\pm 2.250$ Kbps (2.2Mbps)
- 7) 1080p @30fps =  $\pm 3.000$ Kbps (3Mbps)
- 8) 1080p @60fps =  $\pm 4.500$ Kbps (4.5Mbps)
- 9) 1440p @30fps =  $\pm 6.000$ Kbps (6Mbps)
- 10) 1440p @60fps =  $\pm 9.000$ Kbps (9Mbps)
- 11) 4k / 2160p @30fps =  $\pm 13.000$ Kbps (13Mbps)
- 12) 4K/2160p @60fps =  $\pm 20.000$ Kbps (20Mbps)



# Limitasi koneksi YouTube



# Marking TCP Connection YouTube



# Marking UDP Connection YouTube

Mangle Rule <443>

General Advanced Extra Action Statistics

Chain: forward

Src. Address:

Dst. Address:

Protocol:  17 (udp)

Src. Port:

Dst. Port: 443

Any. Port:

In. Interface: LOCAL CONNECTION 0-7

Out. Interface:

In. Interface List:

Out. Interface List:

Packet Mark:

Connection Mark:

Routing Mark:

Routing Table:

Connection Type:

Connection State:

Connection NAT State:

enabled

OK Cancel Apply Disable Comment Copy Remove Reset Counters Reset All Counters

Mangle Rule <443>

General Advanced Extra Action Statistics

Src. Address List:

Dst. Address List:

Layer7 Protocol: YOUTUBE DHCP

Content:

Connection Bytes:

Connection Rate:

Per Connection Classifier

Src. MAC Address:

Out. Bridge Port:

In. Bridge Port:

In. Bridge Port List:

Out. Bridge Port List:

IPsec Policy:

TLS Host:

Ingress Priority:

Priority:

DSCP (TOS):

enabled

OK Cancel Apply Disable Comment Copy Remove Reset Counters Reset All Counters

Mangle Rule <443>

General Advanced Extra Action Statistics

Action: mark connection

Log

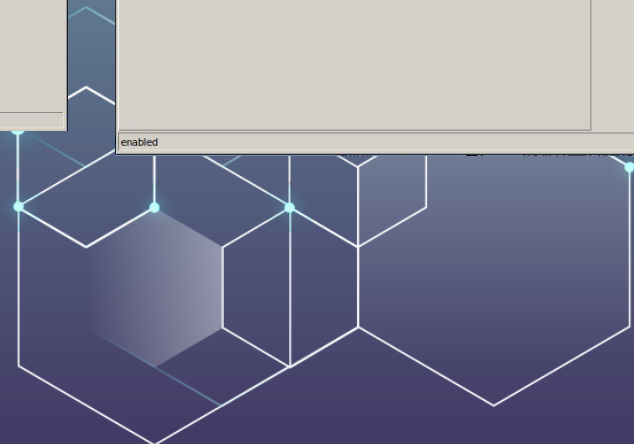
Log Prefix:

New Connection Mark: YOUTUBE DHCP CONNECTION

Passthrough

enabled

OK Cancel Apply Disable Comment Copy Remove Reset Counters Reset All Counters



# Mark Packet Connection YouTube

Mangle Rule <>

General Advanced Extra Action Statistics

Chain: forward

Src. Address:

Dst. Address:

Protocol:

Src. Port:

Dst. Port:

Any. Port:

In. Interface:

Out. Interface:

In. Interface List:

Out. Interface List:

Packet Mark:

Connection Mark:  YOUTUBE DHCP CONNECTION

Routing Mark:

Routing Table:

Connection Type:

Connection State:

Connection NAT State:

enabled

OK  
Cancel  
Apply  
Disable  
Comment  
Copy  
Remove  
Reset Counters  
Reset All Counters

Mangle Rule <>

General Advanced Extra Action Statistics

Action: mark packet

Log

Log Prefix:

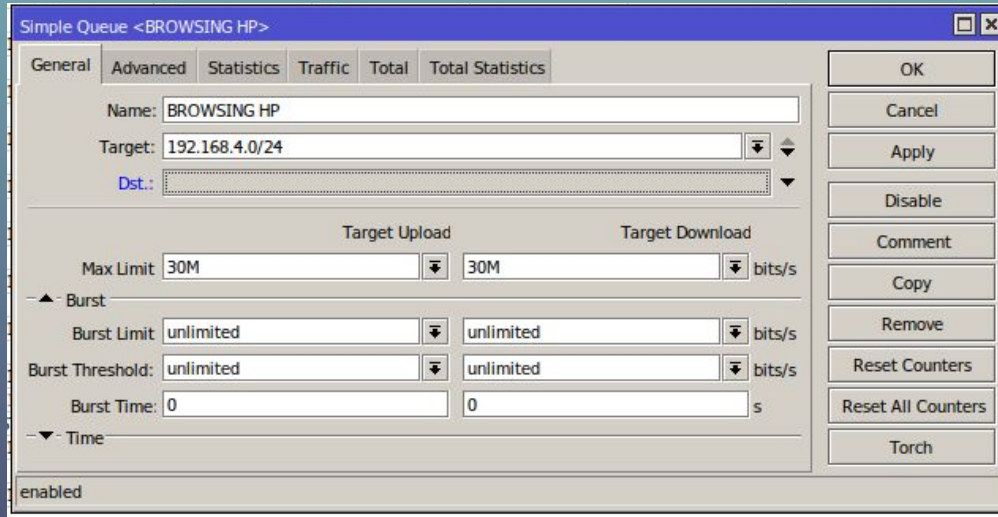
New Packet Mark: YOUTUBE DHCP

Passthrough

enabled

OK  
Cancel  
Apply  
Disable  
Comment  
Copy  
Remove  
Reset Counters  
Reset All Counters

# Setting Total besaran limitasi bandwith terlebih dahulu



Simple Queue <BROWSING HP>

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

Name: BROWSING HP

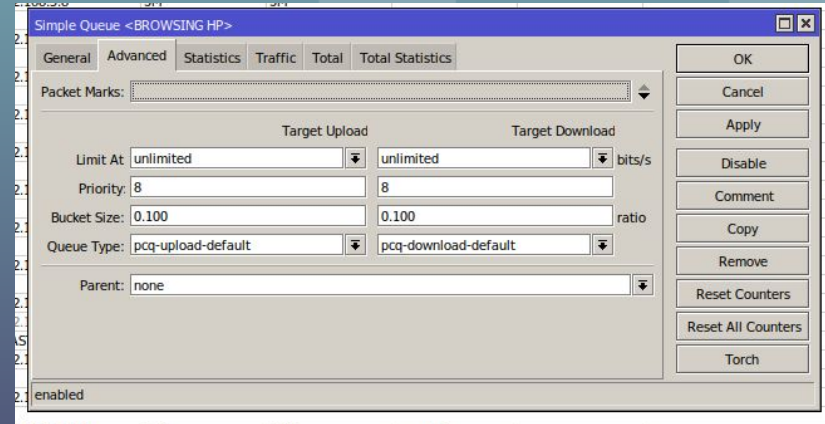
Target: 192.168.4.0/24

Dst:

	Target Upload	Target Download
Max Limit	30M	30M
Burst Limit	unlimited	unlimited
Burst Threshold	unlimited	unlimited
Burst Time	0	0

Buttons: OK, Cancel, Apply, Disable, Comment, Copy, Remove, Reset Counters, Reset All Counters, Torch

enabled



Simple Queue <BROWSING HP>

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

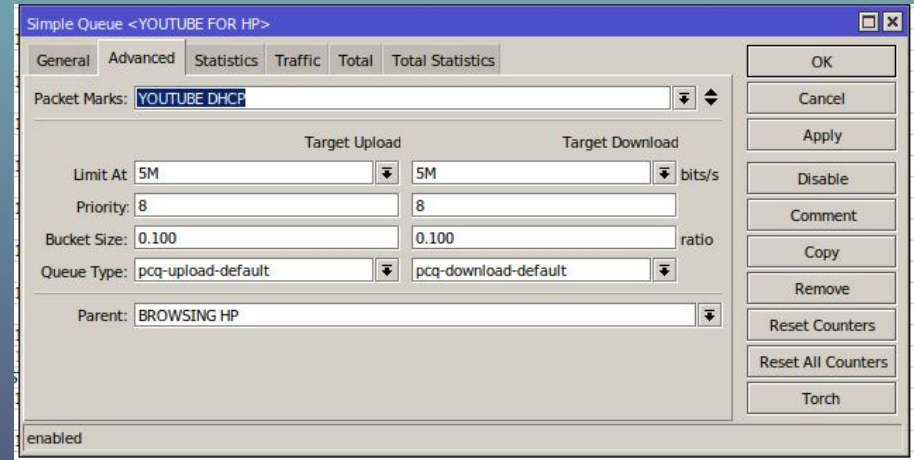
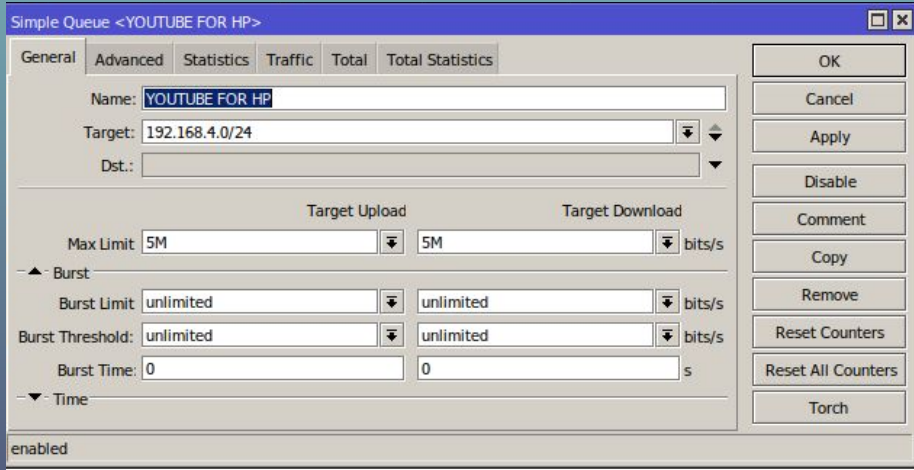
Packet Marks:

	Target Upload	Target Download
Limit At	unlimited	unlimited
Priority	8	8
Bucket Size	0.100	0.100
Queue Type	pcq-upload-default	pcq-download-default
Parent	none	

Buttons: OK, Cancel, Apply, Disable, Comment, Copy, Remove, Reset Counters, Reset All Counters, Torch

enabled

# Setting besaran max limit koneksi bandwidth YouTube yang akan dilimitasi



# Setting besaran other connection (Untuk browsing atau koneksi yang selain streaming YouTube)

Simple Queue <OTHER CONNECTION HP>

General Advanced Statistics Traffic Total Total Statistics

Name: OTHER CONNECTION HP

Target: 192.168.4.0/24

Dst.:

	Target Upload	Target Download
Max Limit	25M	25M
Burst Limit	unlimited	unlimited
Burst Threshold	unlimited	unlimited
Burst Time	0	0

enabled

OK  
Cancel  
Apply  
Disable  
Comment  
Copy  
Remove  
Reset Counters  
Reset All Counters  
Torch

Simple Queue <OTHER CONNECTION HP>

General Advanced Statistics Traffic Total Total Statistics

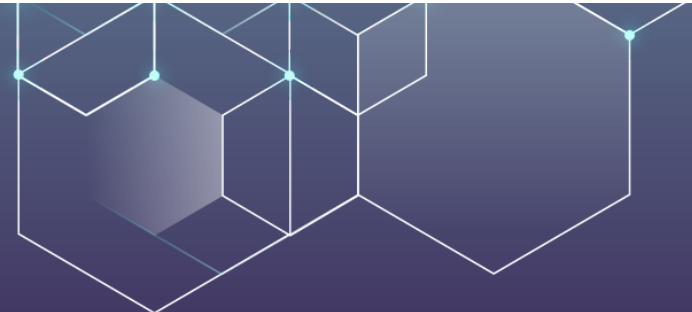
Packet Marks: no-mark

	Target Upload	Target Download
Limit At	unlimited	unlimited
Priority	8	8
Bucket Size	0.100	0.100
Queue Type	pcq-upload-default	pcq-download-default

Parent: BROWSING HP

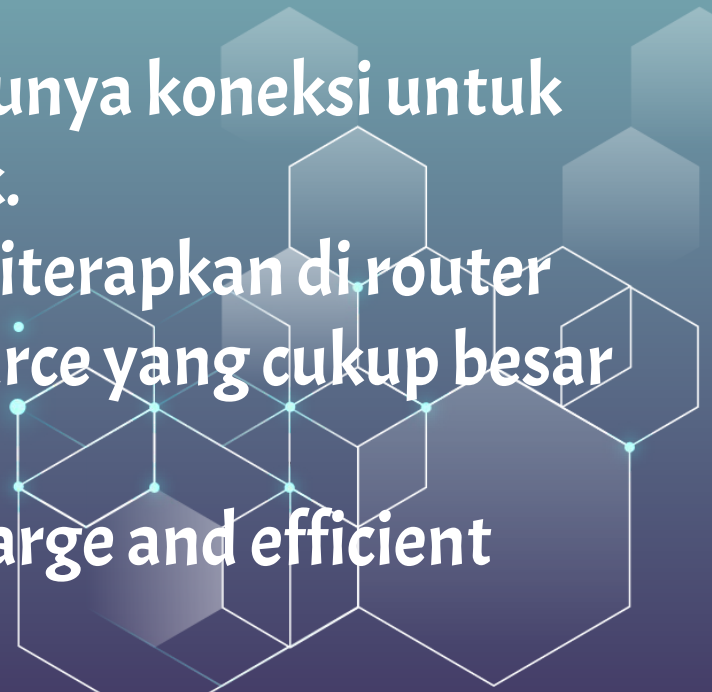
enabled

OK  
Cancel  
Apply  
Disable  
Comment  
Copy  
Remove  
Reset Counters  
Reset All Counters  
Torch





# Attention!!

1. Konfigurasi yang diterapkan di masing-masing instansi berbeda-beda.
  2. Untuk institusi pendidikan tentunya koneksi untuk game akan dibatasi atau diblock.
  3. Semakin banyak firewall yang diterapkan di router maka akan menggunakan resource yang cukup besar pula.
  4. cAP is recommended for use in large and efficient networks
- 

# Q & A

# Thanks

Link presentasi : [dik.si/mum-ferdian](https://dik.si/mum-ferdian)

