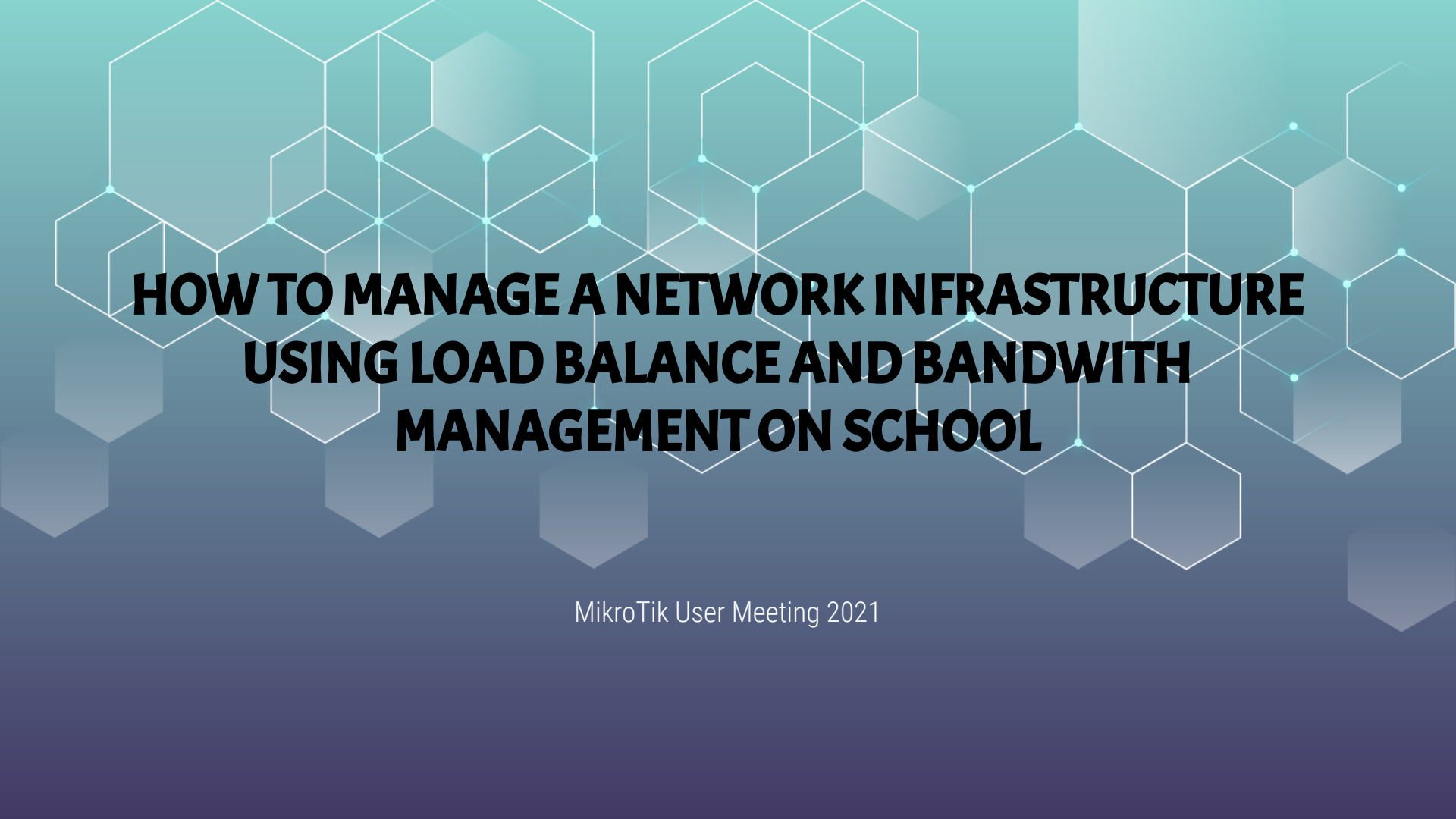




HOW TO MANAGE A NETWORK INFRASTRUCTURE USING LOAD BALANCE AND BANDWIDTH MANAGEMENT ON SCHOOL

MikroTik User Meeting 2021

INTRODUCE MYSELF



Name : Ferdian Sakti
Work : IT Admin on SMK Dwija Bhakti 1 Jombang
Managing Director on CV. Jasaraya Dinamika
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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.

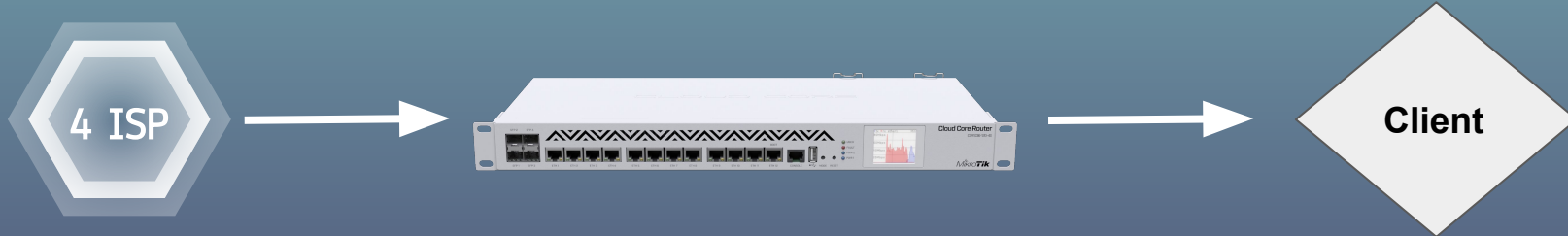
Metode Load Balance di Mikrotik



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.

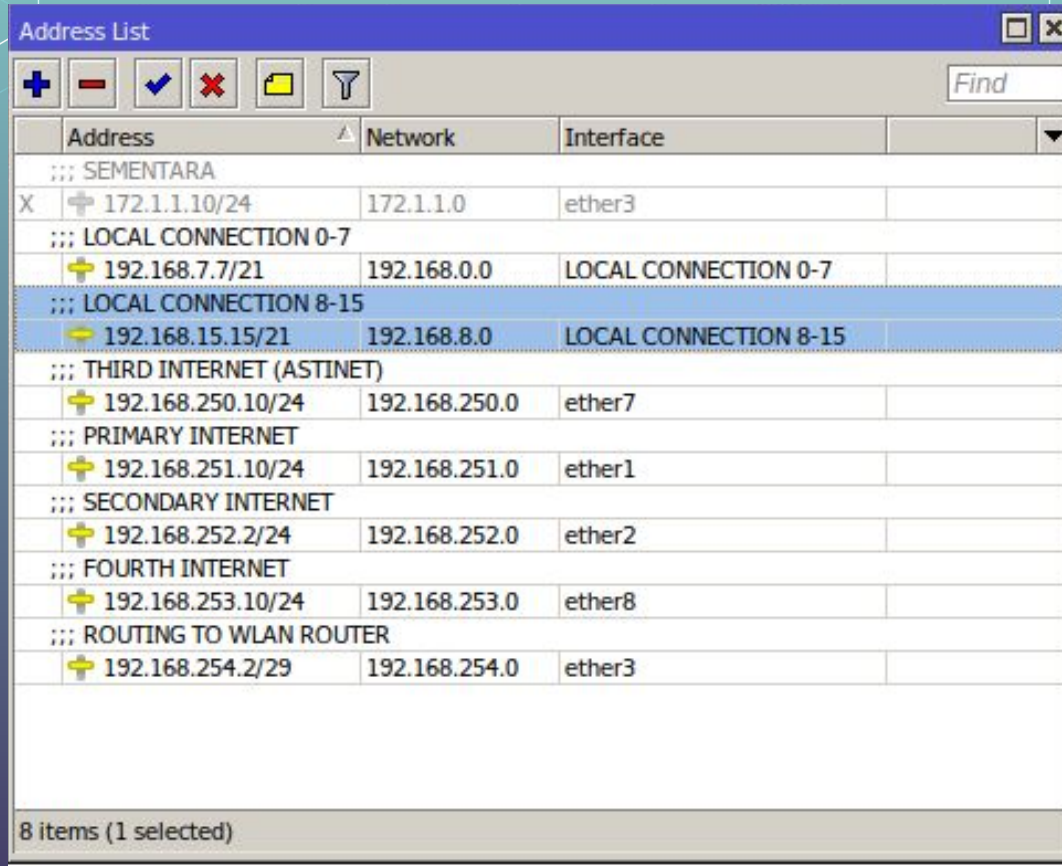
Load Balance With ECMP

Improvement from Round Robin



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

Add IP Interfaces



	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)

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 MB	3 408 270	
::: NAT SECONDARY PUBLIC INTERFACE																
1	mas...	srcnat							ether2			INTERNET		212.9 MB	3 463 456	
::: NAT THIRD PUBLIC INTERFACE																
2	mas...	srcnat							ether7			INTERNET		1069.7 MB	17 355 613	
::: NAT FOURTH PUBLIC INTERFACE																
3	mas...	srcnat							ether8			INTERNET		213.6 MB	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

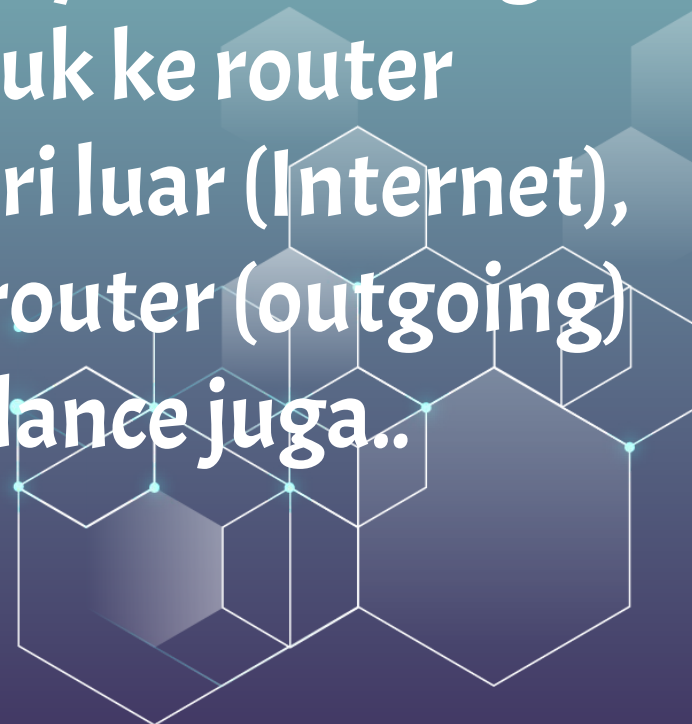
Check Gateway: ping

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: **input**

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: **mark connection**

☐ Log

Log Prefix:

New Connection Mark: **ISP 1**

☒ Passthrough

enabled

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

Konfigurasi Routing Mark

Mangle Rule <>

General Advanced Extra Action Statistics

Chain: **output**

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: ☐ **ISP 1**

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 routing**

☐ Log

Log Prefix:

New Routing Mark: **ROUTE TO ISP 1**

☐ Passthrough

enabled

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

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)



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

Firewall				
Filter Rules NAT Mangle Raw Service Ports Connections Address Lists Layer7 Protocols				
+ - ✓ ✗ [icon] [icon]				
Name	Address	Timeout	Creation Time	
::: LAB. DPIB 1				
● INTERNET	192.168.0.1-192.168.0.36		Apr/16/2019 23:...	
::: LAB. DPIB 2				
X ● INTERNET	192.168.0.37-192.168.0.72		Nov/21/2019 15:...	
::: LAB. TTL				
● INTERNET	192.168.0.73-192.168.0.109		Apr/16/2019 23:...	
::: LAB. CNC 1				
● INTERNET	192.168.0.121-192.168.0.160		Apr/16/2019 23:...	
::: LAB. CNC 2				
● 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

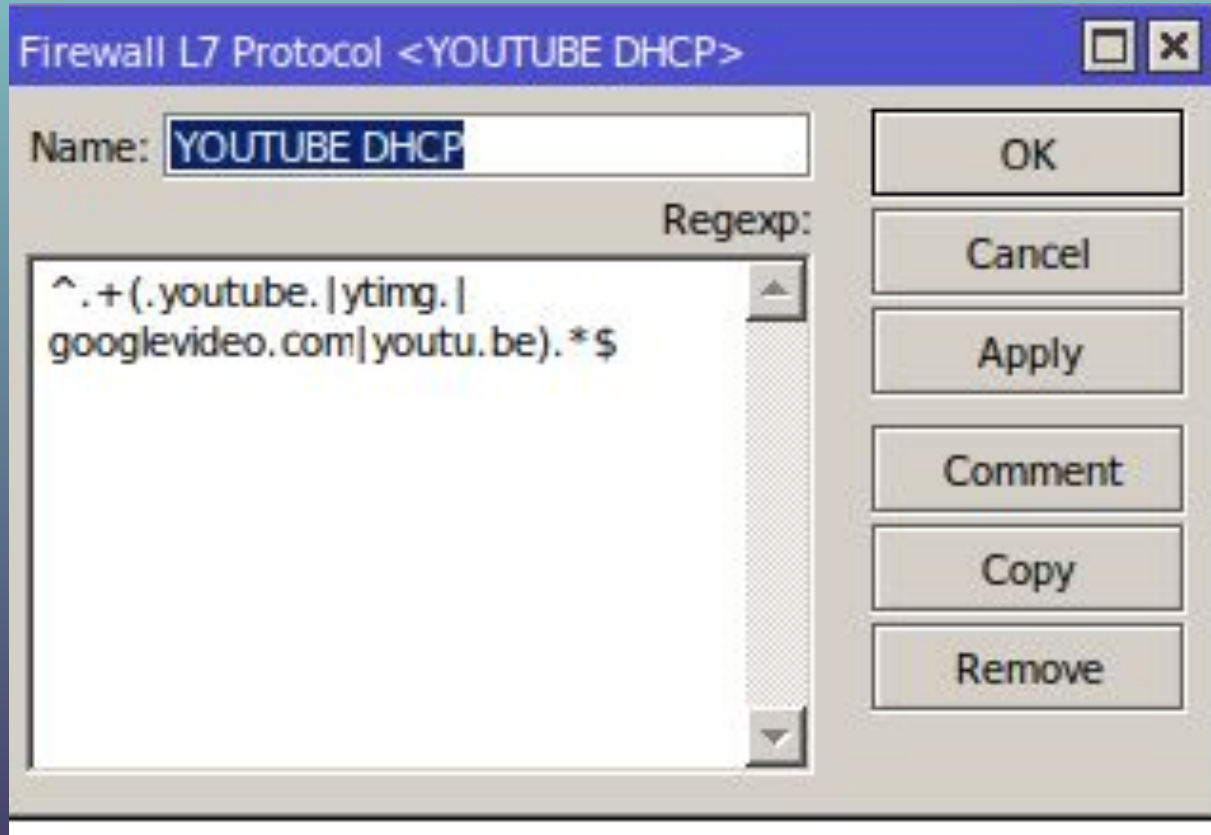


Bandwith Priority (Koneksi apa yang menghabiskan bandwith paling besar) itulah yang akan dilimit terlebih dahulu.

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



Limitasi koneksi YouTube



Marking TCP Connection YouTube

Mangle Rule <443>

General Advanced Extra Action Statistics

Chain: **forward**

Src. Address:

Dst. Address:

Protocol: **6 (tcp)**

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:

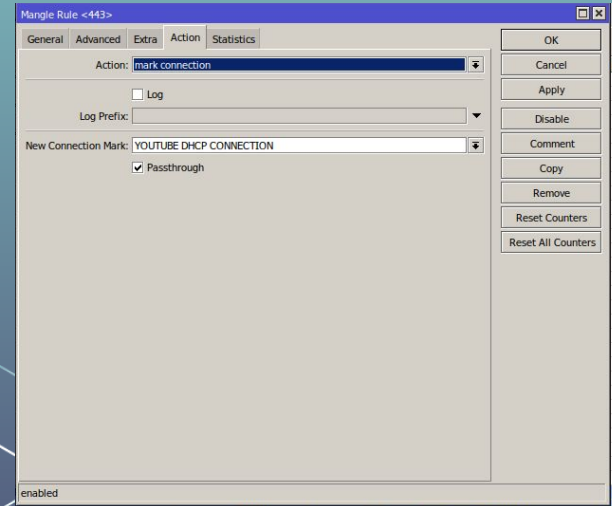
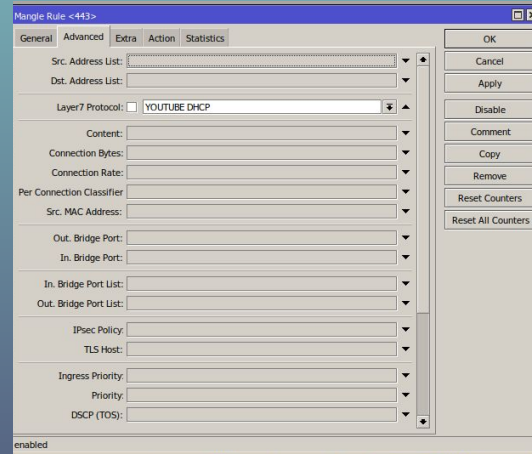
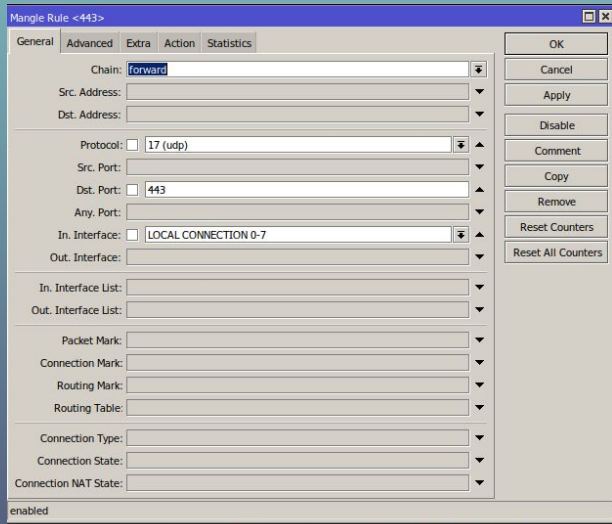
New Connection Mark: **YOUTUBE DHCP CONNECTION**

☒ Passthrough

enabled

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

Marking UDP Connection YouTube



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 bits/s

Burst

Burst Limit: unlimited unlimited bits/s

Burst Threshold: unlimited unlimited bits/s

Burst Time: 0 0 s

Time

enabled

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

Simple Queue <BROWSING HP>

General Advanced Statistics Traffic Total Total Statistics

Packet Marks:

Target Upload Target Download

Limit At: unlimited unlimited bits/s

Priority: 8 8

Bucket Size: 0.100 0.100 ratio

Queue Type: pcq-upload-default pcq-download-default

Parent: none

enabled

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

Setting besaran max limit koneksi bandwidth YouTube yang akan dilimitasi

Simple Queue <YOUTUBE FOR HP>

General Advanced Statistics Traffic Total Total Statistics

Name:

Target:

Dst.:

Target Upload Target Download

Max Limit: bits/s

Burst: bits/s

Burst Threshold: bits/s

Burst Time: s

enabled

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

Simple Queue <YOUTUBE FOR HP>

General Advanced Statistics Traffic Total Total Statistics

Packet Marks:

Target Upload Target Download

Limit At: bits/s

Priority:

Bucket Size: ratio

Queue Type:

Parent:

enabled

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



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 bits/s

Burst

Burst Limit: unlimited unlimited bits/s

Burst Threshold: unlimited unlimited bits/s

Burst Time: 0 0 s

Time

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 bits/s

Priority: 8 8

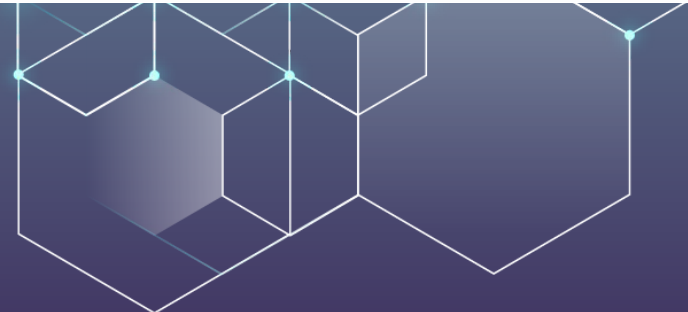
Bucket Size: 0.100 0.100 ratio

Queue Type: pcq-upload-default pcq-download-default

Parent: BROWSING HP

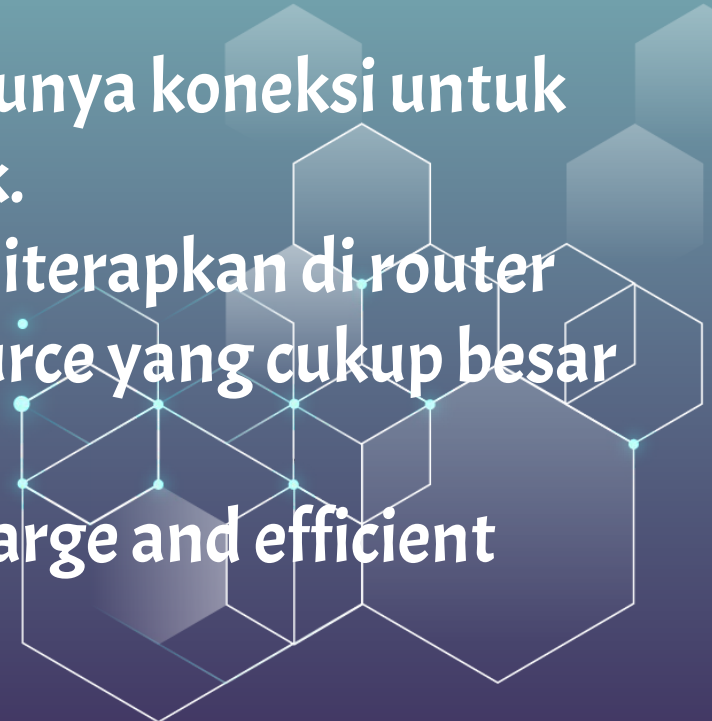
enabled

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

