



**ID-Networkers**  
Indonesian IT Expert Factory



**MIKROTIK**

**MTCNA**

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Candra Milad Ridha Eislam, Mikrotik Trainer #TR610,  
Mikrotik Academy Coordinator

# About me



## Candra Milad Ridha Eislam

Using Mikrotik since ROSv5

2016 - now, IT Trainer at ID-Networkers

2018 - now, Mikrotik Certified Trainer

2018 - now, NOC at Connexin, Hull, UK (ISP)

2019 - now, Mikrotik Academy Coordinator

Holding Cisco CCNA, Juniper JNCIA, Ubiquity UBWA, UEWA, Mikrotik MTCNA, MTCRE, MTCWE, MTCTCE, MTCUME, MTCIPv6E, MTCSE, MTCEWE, MTCINE

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# Perkenalkan Diri Anda

- Nama Lengkap / Panggilan?
- Alamat Asal?
- Instansi / pekerjaan?
- Pengalaman di Networking?
- Pengalaman menggunakan Mikrotik?
- Apa yang diharapkan dari training ini?



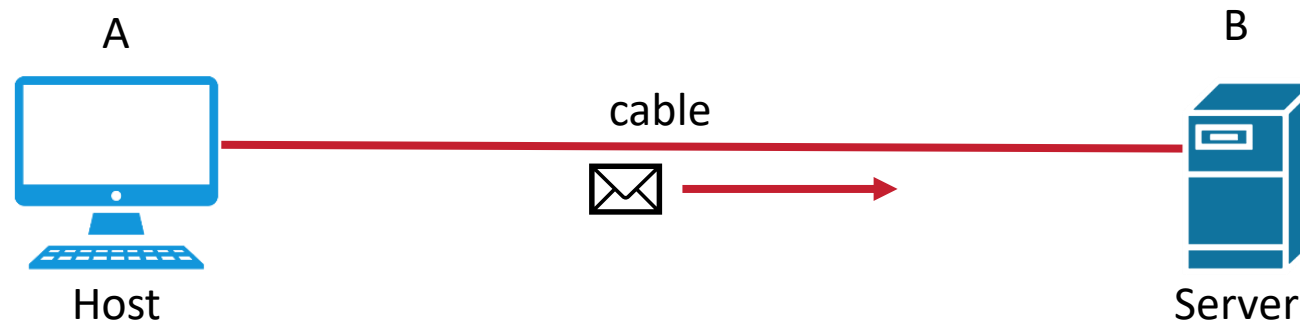


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# **NETWORK FUNDAMENTAL TRAINING SESSION**

# What is Network?

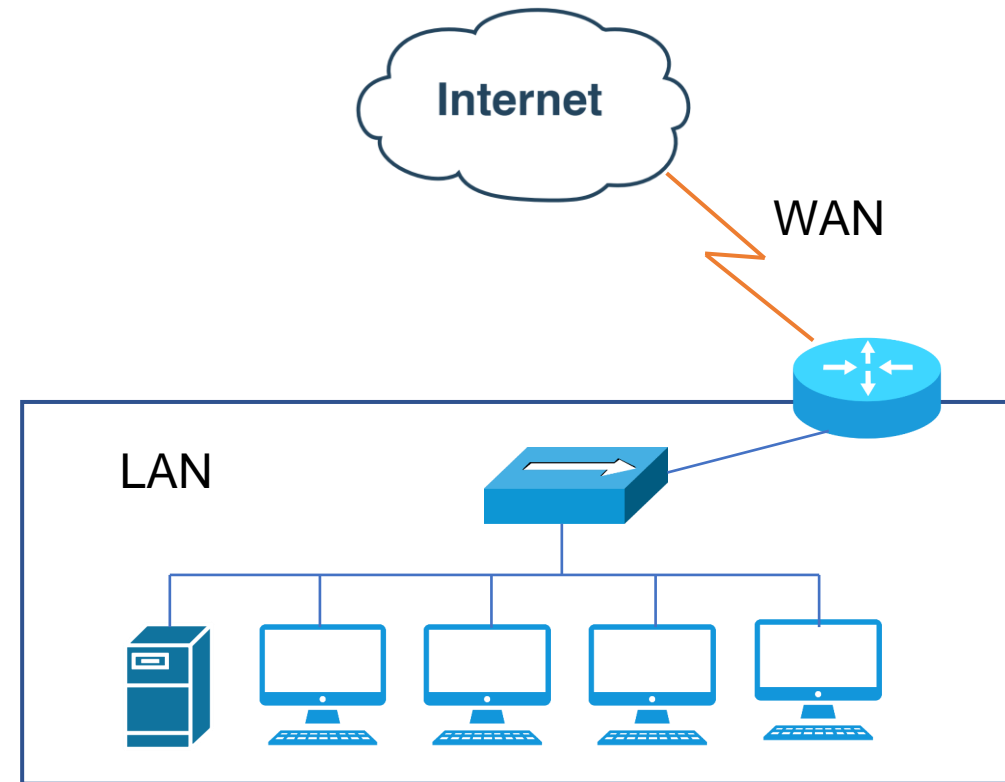
- Sebuah platform dimana kita membuat jalur supaya komunikasi dari point A ke B itu bisa tercapai.



- Network Engineer?

# LAN, WAN and Internet

- Ada 3 type jaringan :
  - Local Area Network (LAN)
  - Wide Area Network (WAN)
  - Internet



# Element Network

Devices

Medium

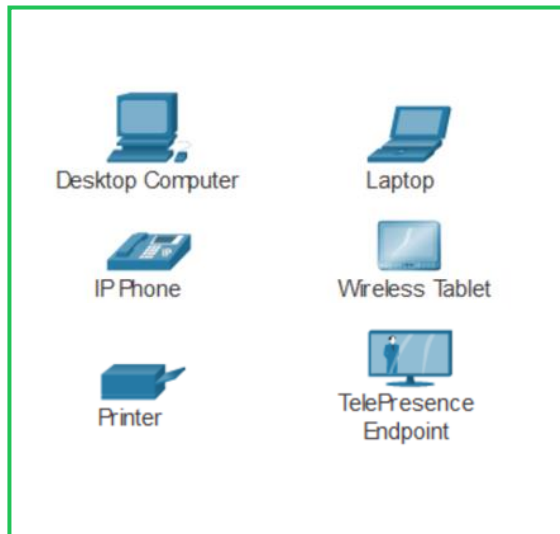
Messages

Rules

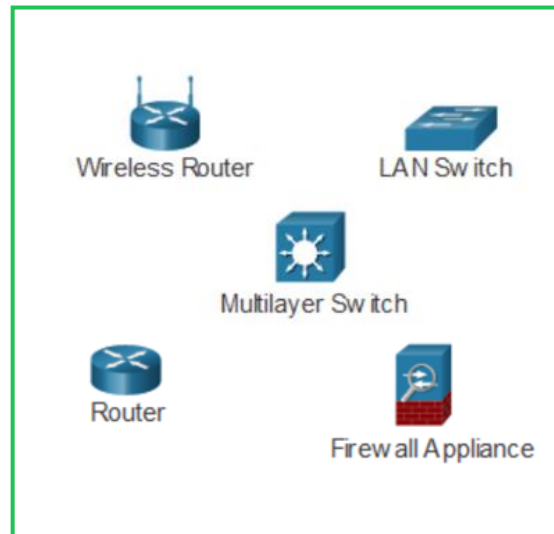


# Element Network

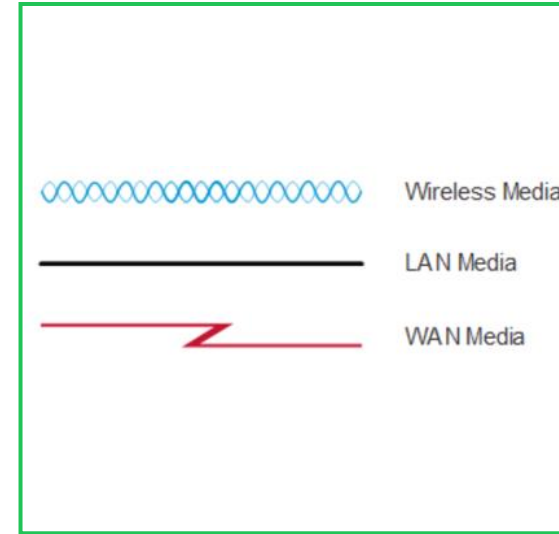
- Komponen Jaringan



End Devices



Intermediary Devices



Network Media



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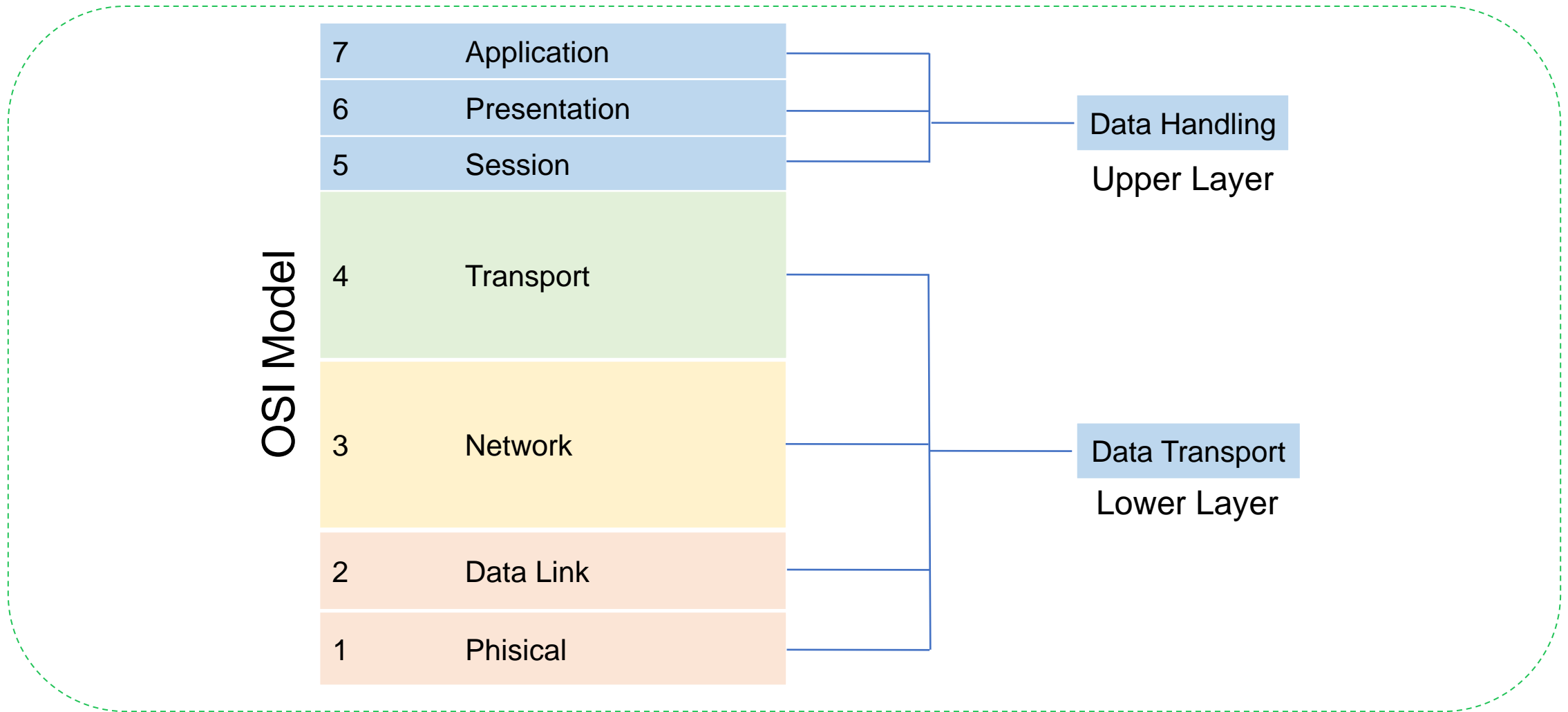
# OSI LAYER

## NETWORK FUNDAMENTAL

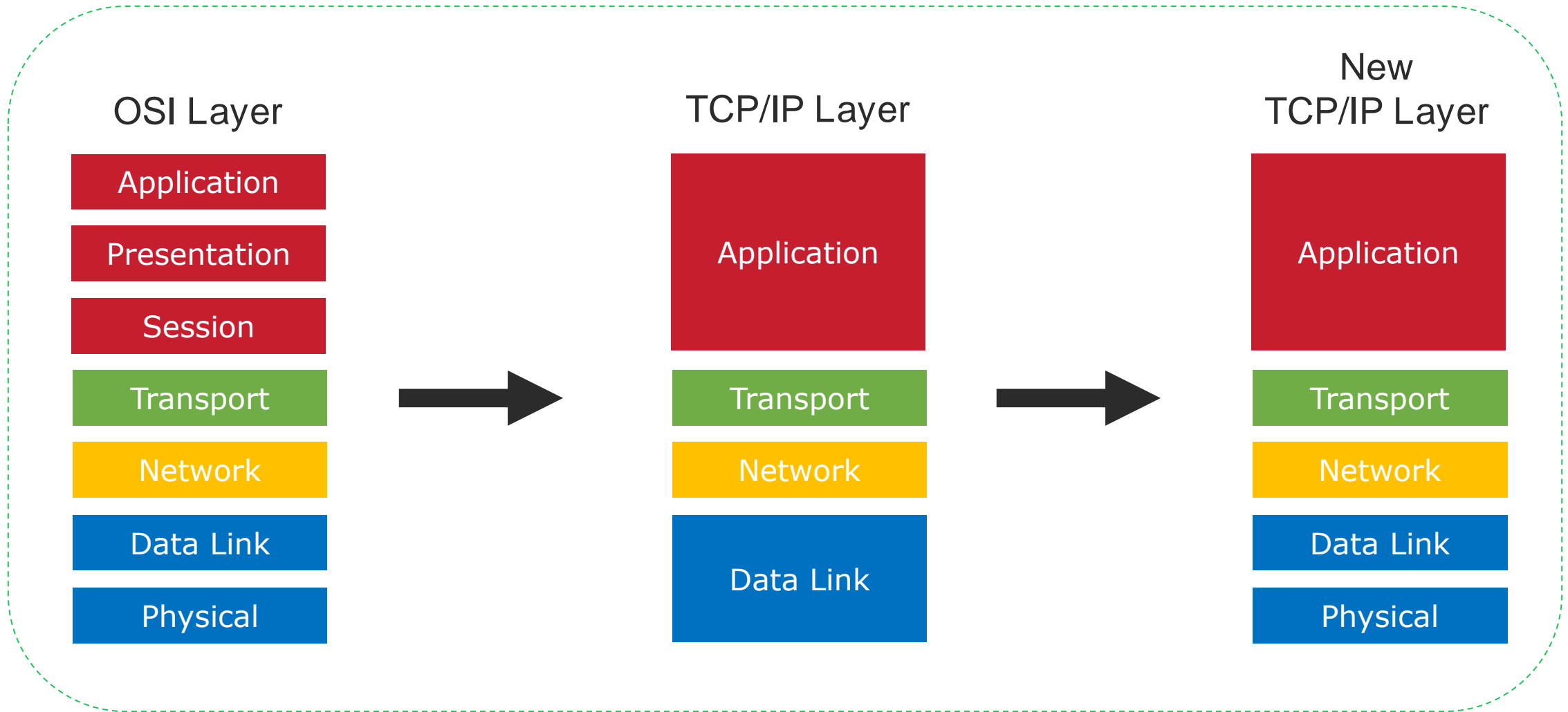
# OSI Layer

- Tidak ada suatu protocol yang sama membuat banyak perangkat tidak bisa saling komunikasi.
- Open System Interconnection (OSI) merupakan model arsitektural jaringan yang dikembangkan oleh International Organization for Standardization (ISO) di Eropa (1977).
- Sebelum ada OSI, system jaringan sangat tergantung pada vendor.
- OSI Layer secara logic mempunyai 7 tingkatan layer.

# OSI Layer



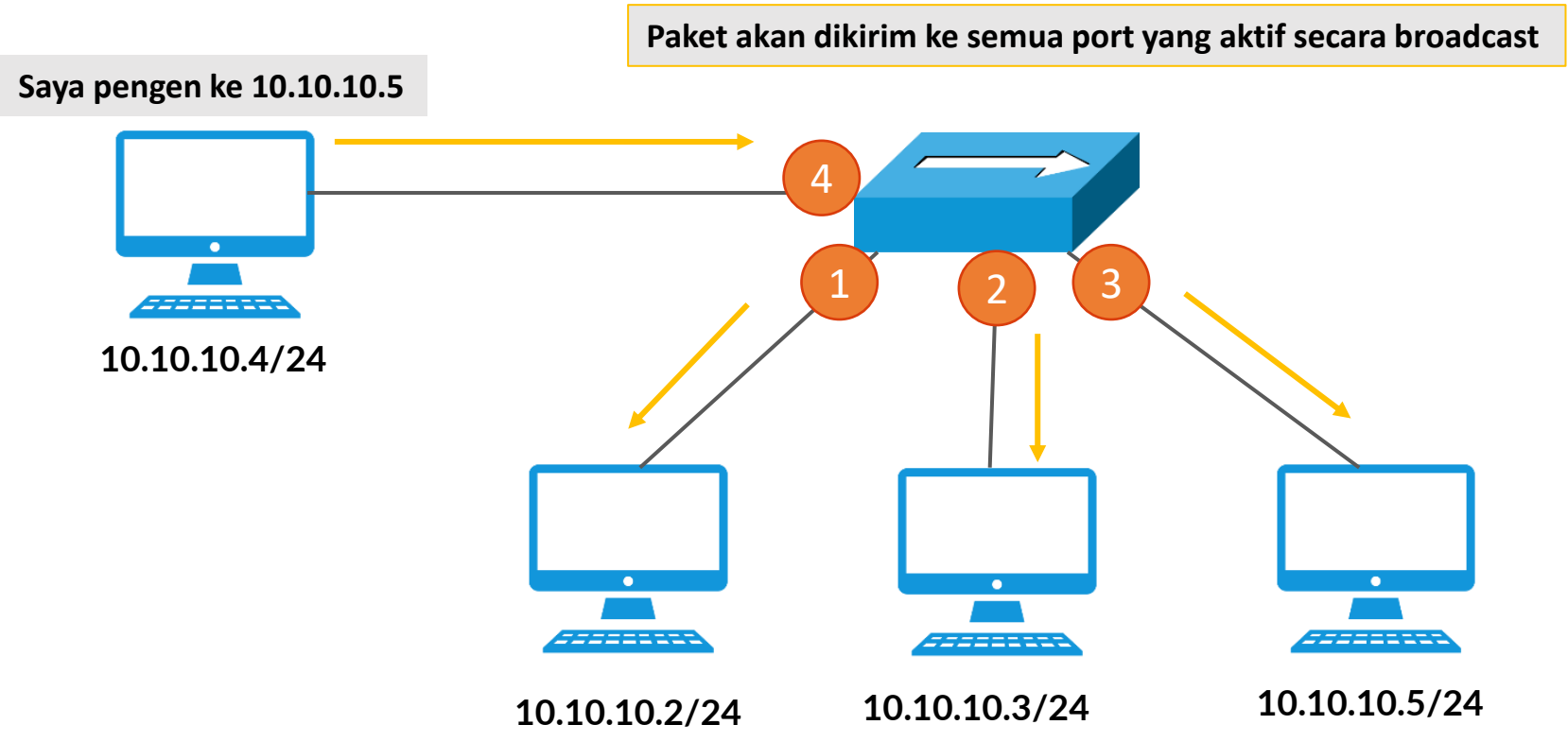
# Layer Evolution



# OSI Layer

Layer	Nama	Perangkat	Data Unit	Pengalamatan
Layer 1	Physical	Hub	Bit	0111001110
Layer 2	Data Link	Switch	Frame	Mac Address
Layer 3	Network	Router	Paket	IP Address

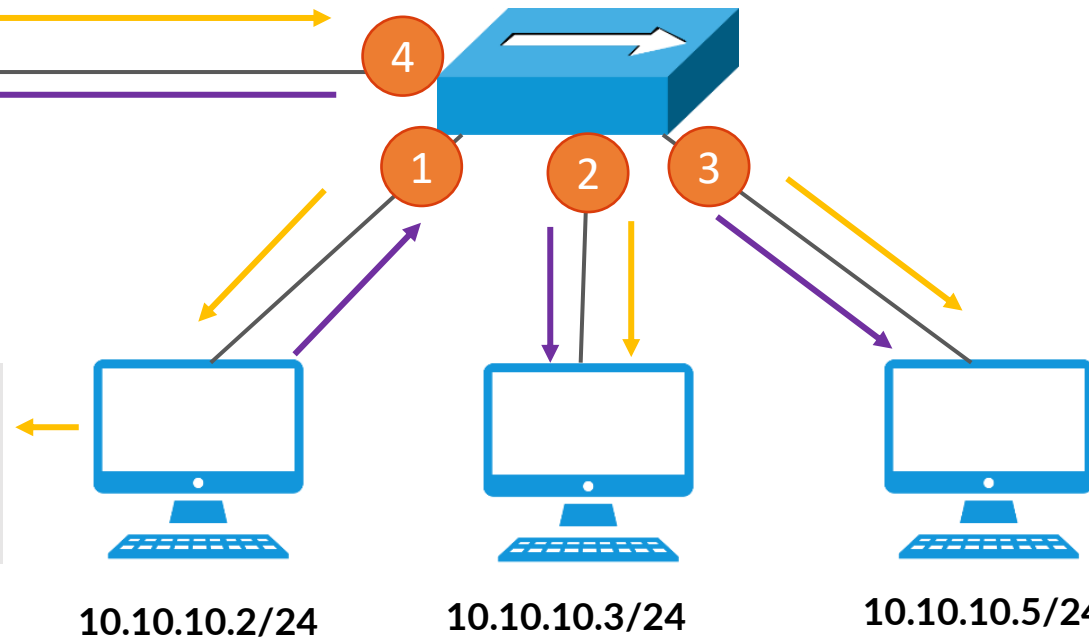
# Layer 1 - Hub



# Layer 1 - Hub

Setiap ada data yang melewati HUB, maka akan dikirim ke semua port yang aktif secara broadcast, karena HUB tidak punya Memory

Saya pengen ke 10.10.10.5



10.10.10.4 : "Hallo bro, apakah kamu 10.10.10.5?  
Ini ada paket untukmu"

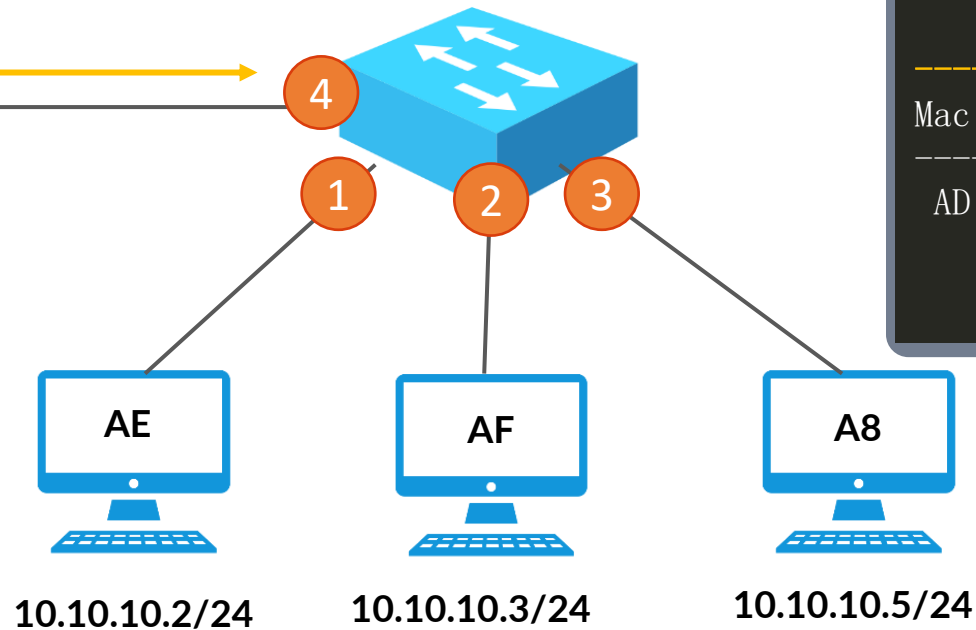
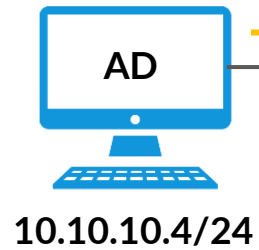
10.10.10.2 : "Bukan bre, aku 10.10.10.2"



# Layer 2 - Switch

Berbeda dengan HUB, Switch punya memory Namanya **Mac Address Table**

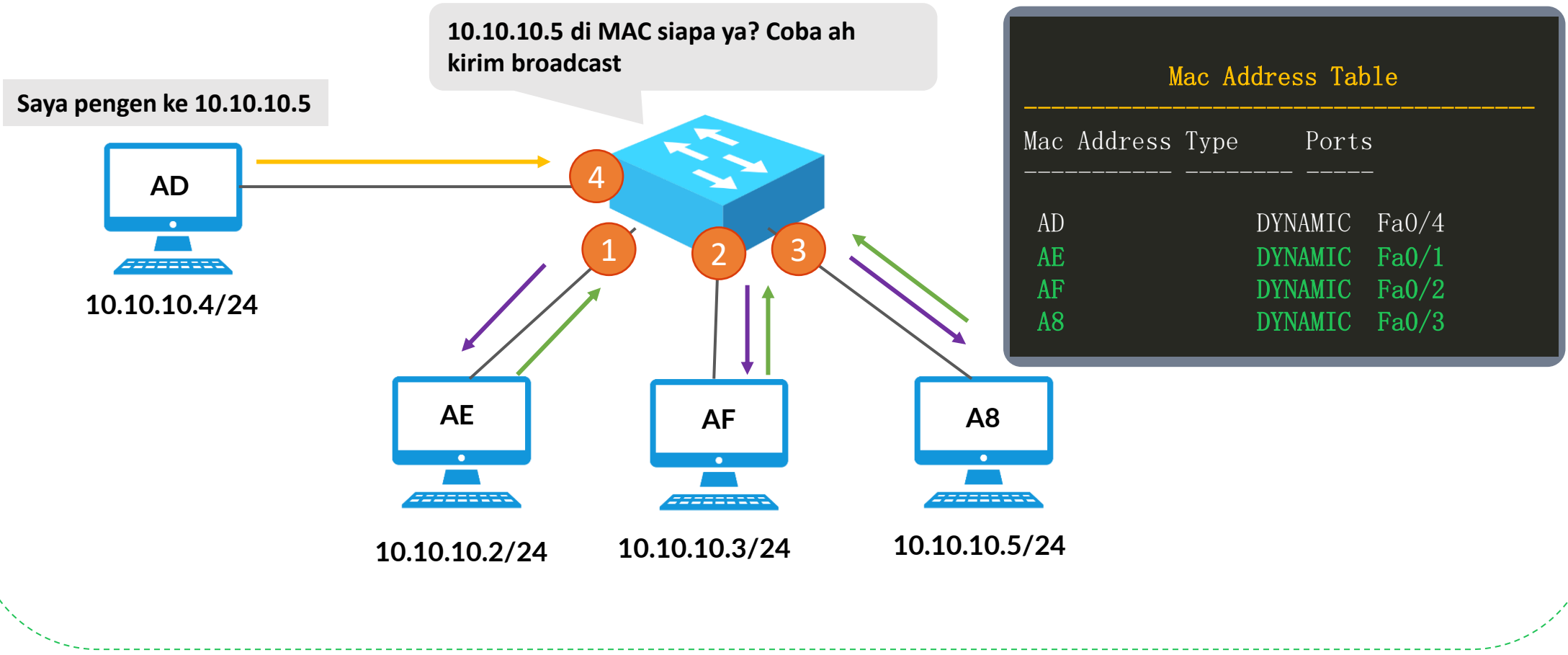
Saya pengen ke 10.10.10.5



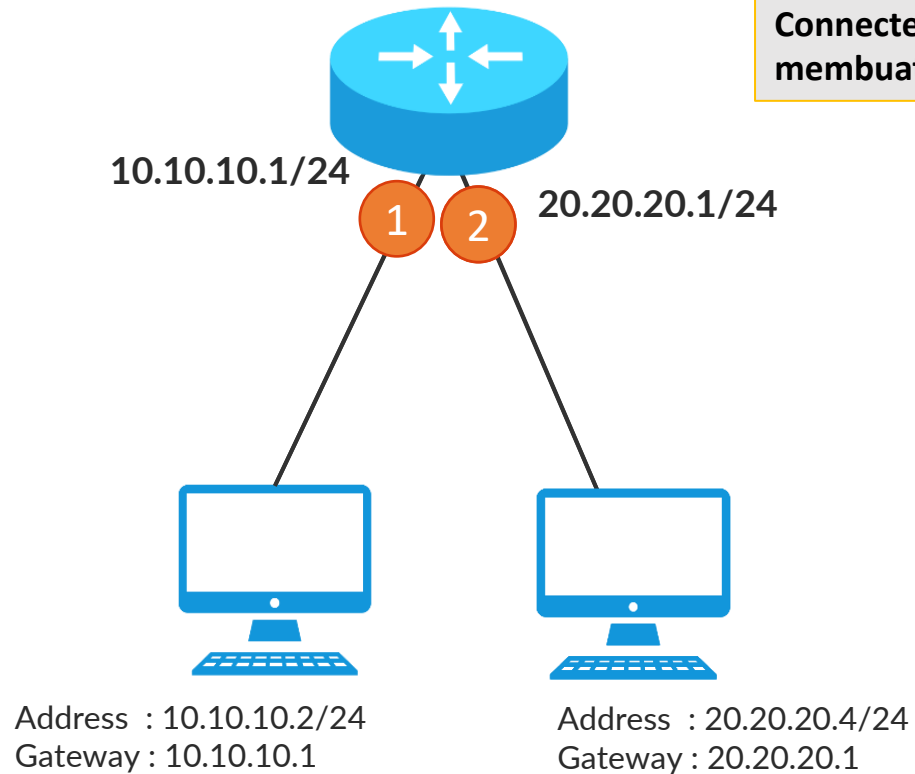
## Mac Address Table

Mac Address	Type	Ports
AD	DYNAMIC	Fa0/4

# Layer 2 - Switch



# Layer 3 - Router



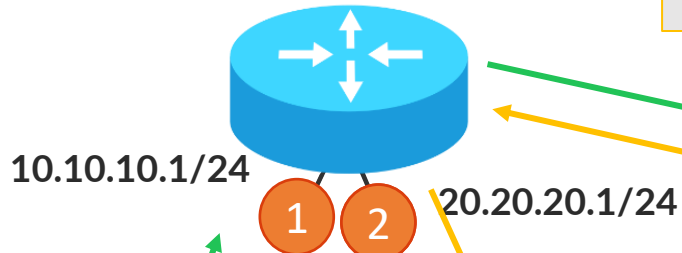
Connected Route (DAC) merupakan route otomatis yang ditambahkan setelah membuat IP pada interface yang aktif di router.

## Routing Table

Flag	Dst Address	Gateway
DAC	10.10.10.0/24	ether1
DAC	20.20.20.0/24	ether2

# Layer 3 - Router

Setiap packet yang dikirimkan melalui router, packet tersebut akan di filter melalui Routing Table



Saya pengen ke  
20.20.20.4

Address : 10.10.10.2/24  
Gateway : 10.10.10.1

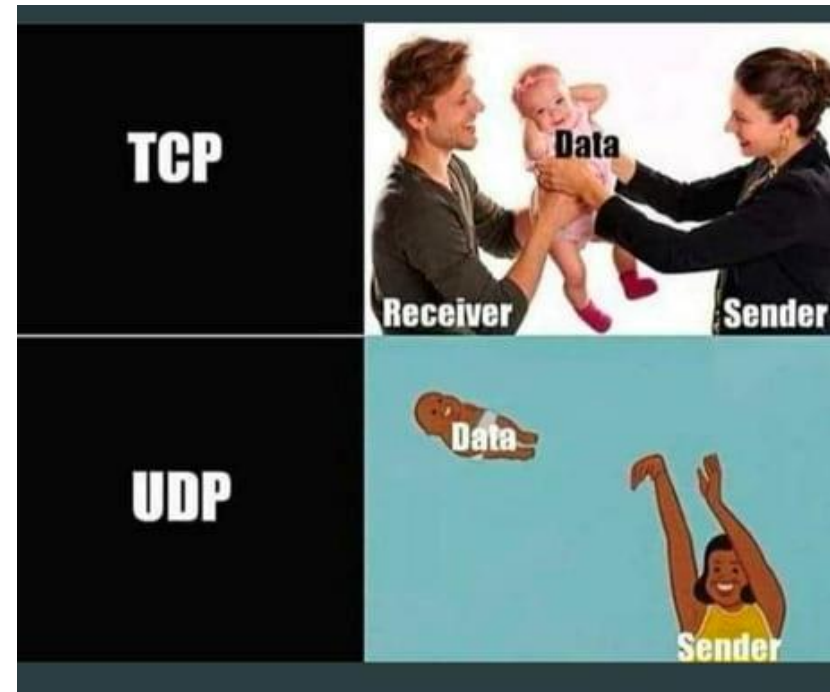
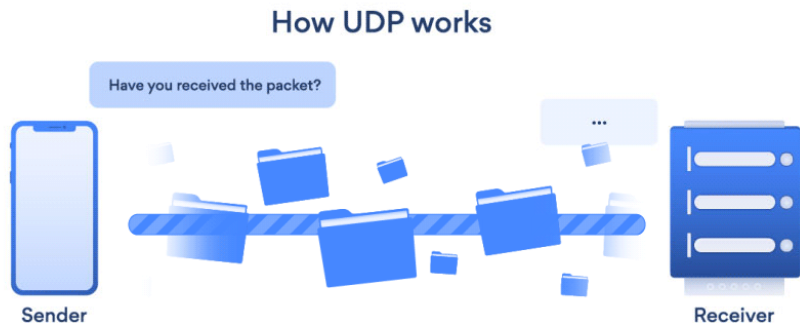
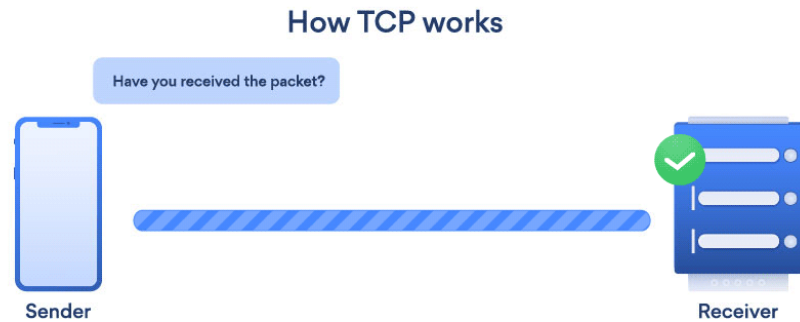
Address : 20.20.20.4/24  
Gateway : 20.20.20.1

## Routing Table

Flag	Dst Address	Gateway
DAC	10.10.10.0/24	ether1
DAC	20.20.20.0/24	ether2 ✓

# Protocol

- Protocol menentukan prosedur pengiriman data.



Source : <https://nordvpn.com/blog/tcp-or-udp-which-is-better/>

# Protocol – TCP & UDP

- TCP is more reliable.
- TCP digunakan untuk IP karena support Error Checking.
- UDP is more faster.
- UDP digunakan untuk video streaming, games, dan aplikasi lain yang membutuhkan kecepatan data.

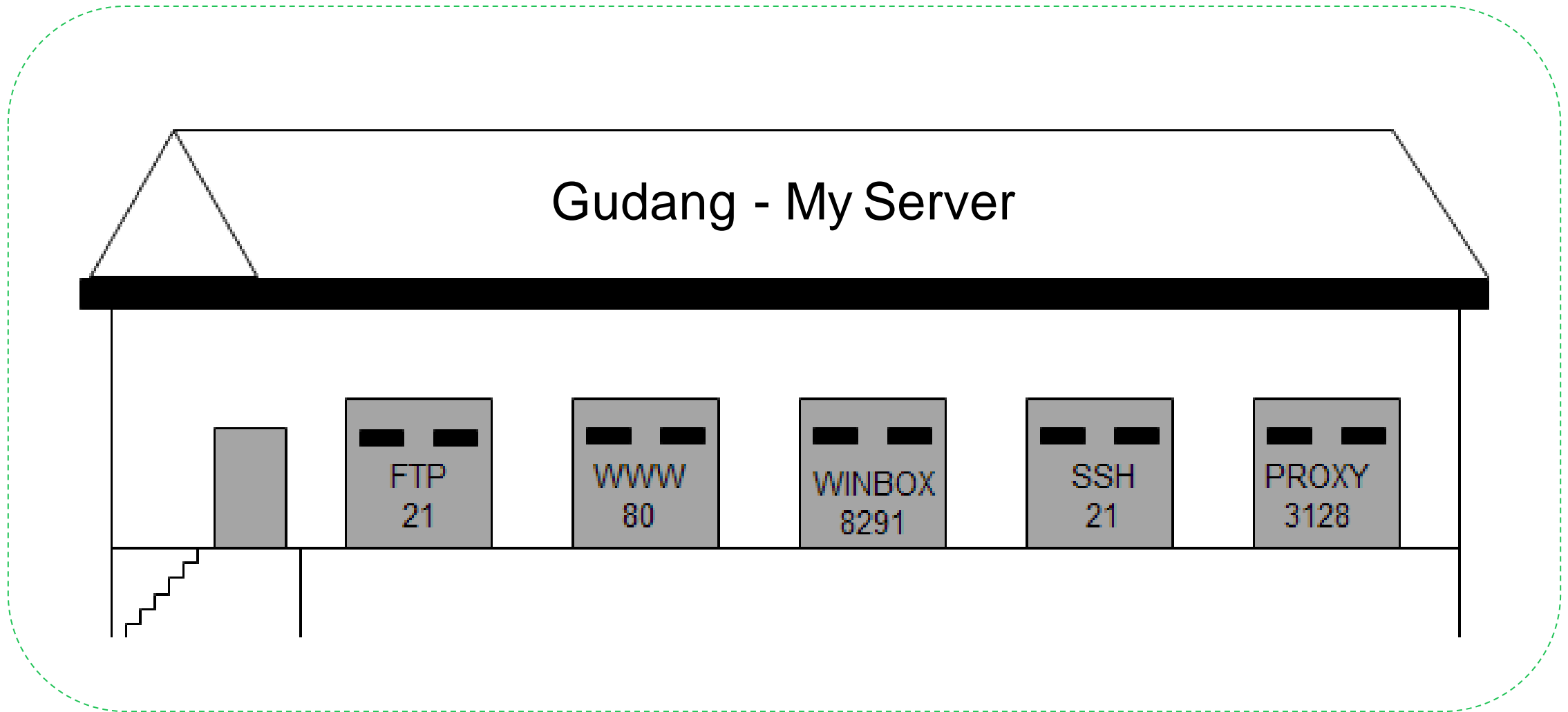
# Port

- Pintu Masuk.
- Digunakan untuk menjalankan service pada komunikasi jaringan.
- Terdapat total 65535, dengan klasifikasi sebagai berikut :
  - 0 - 1023 (well known ports),
  - 1024 – 49151 (registered ports),
  - 49152 – 65535 (unregistered / dynamic, private or ephemeral ports)

# Port yang Biasa Dipakai

Port No	Protocol	Service	Remark
21	TCP	FTP	File Transfer Protocol
22	TCP	SSH	Remote Access (Secure)
23	TCP	Telnet	Remote Access
53	UDP	DNS	Domain Name Server
80	TCP	HTTP	Hypertext Transfer Protocol (WEB)
110	TCP	POP3	Post Office Protocol v3
123	UDP	NTP	Network Time Protocol
161	UDP	SNMP	Simple Network Monitoring Protocol
443	TCP	HTTPS	Hypertext Transfer Protocol Secure
8080	TCP	HTTP-Proxy	Web-Cache
8291	TCP	Winbox	Remote Access (Mikrotik RouterOS)

# Port Analogi





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# ADDRESSING NETWORK FUNDAMENTAL

# MAC Address

- MAC Address (Media Access Control Address) pengalamatan suatu device pada lapisan data link (Layer2).
- MAC Address biasanya ada pada network interface / NIC
- Panjangnya 48-Bit, terdiri dari 12 digit heksadesimal (0 – 9 dan A – F) dan ada 2 bagian :

48 Bit

6C:88:14

Organizationally Unique Identified (OUI)

BA:69:A0

Unique Address Assigned by Vendor (UAA)

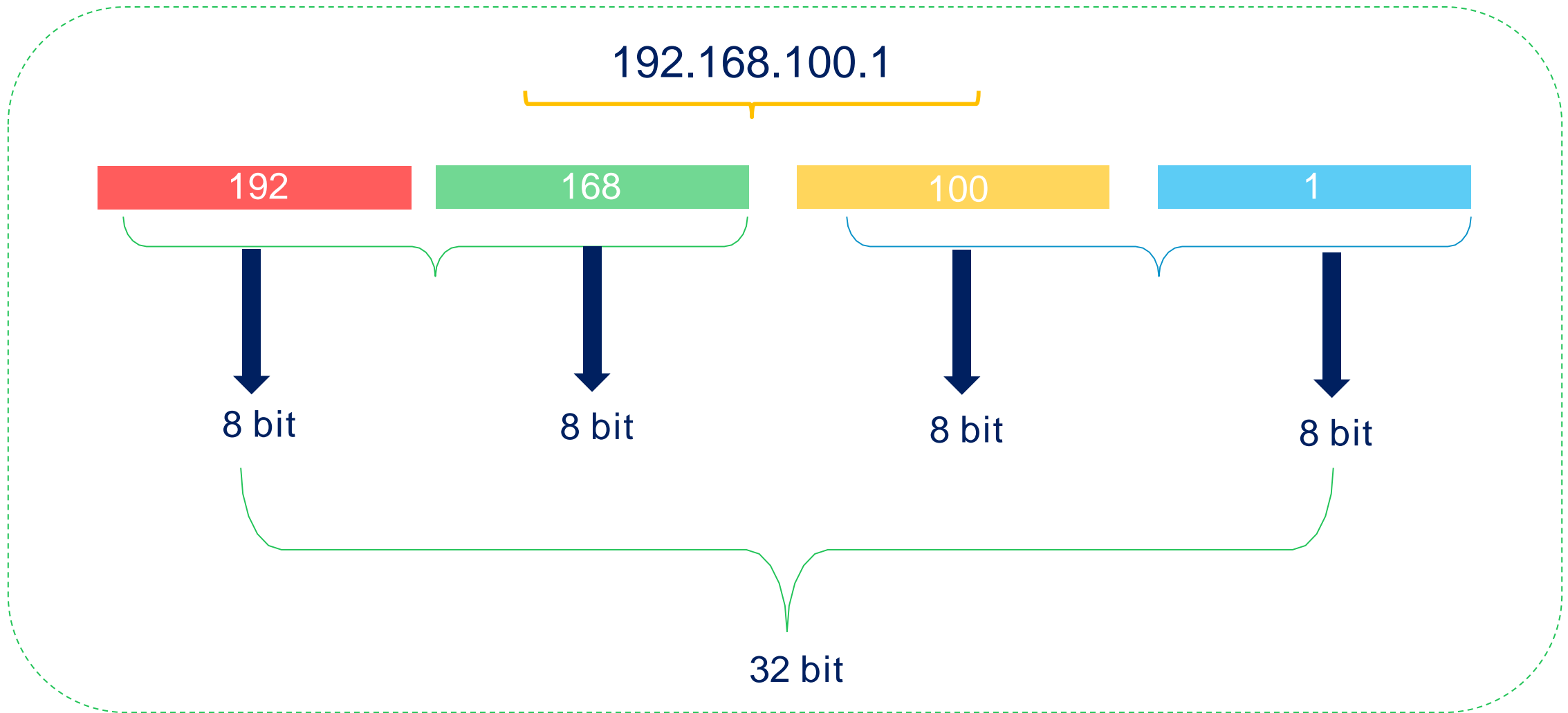
6C:88:14:BA:69:A0

# IP Address

- Internet Protocol (IP)
- Digunakan untuk pengalamatan suatu host.
- Terdapat 2 jenis IP address
  - IPv4
    - 32-bit
    - Jumlah max host 4,294,967,296
    - Dotted Decimal Notation
  - IPv6
    - 128-bit
    - Jumlah max host 340,282,366,920,938,463,374,607,431,768,211,456
    - Hexadecimal Notation

Description	Intel(R) Centrino(R) Advanced-N
Physical Address	6C-88-14-46-ED-C8
DHCP Enabled	Yes
IPv4 Address	192.168.98.200
IPv4 Subnet Mask	255.255.255.0
Lease Obtained	16 October 2021 08:49:19
Lease Expires	16 October 2021 14:34:19
IPv4 Default Gateway	192.168.98.1
IPv4 DHCP Server	192.168.98.1
IPv4 DNS Server	192.168.98.1
IPv4 WINS Server	
NetBIOS over Tcpip En...	Yes
Link-local IPv6 Address	fe80::1090:5dcb:ce64:d58e%46
IPv6 Default Gateway	

# Format IPv4



# IP Address

- Classfull Address : Berdasarkan kepala IP atau kelas
- Classless Address : Berdasarkan prefix atau tanda slash (/)

# Classfull Address

Kelas	High Order Bit	Mulai	Akhir
A	0	0.0.0.0	126.255.255.255
B	10	128.0.0.0	191.255.255.255
C	110	192.0.0.0	223.255.255.255
D	1110	224.0.0.0	239.255.255.255
E	1111	240.0.0.0	255.255.255.255

# Classless Address

- Subnet mask digunakan untuk mengetahui sebuah IP address mana yang merepresentasikan Network ID, dan mana yang merupakan Host ID
- Ada dua metode yang dapat digunakan untuk merepresentasikan subnetmask yakni:
  - Notasi Desimal Bertitik (Dotted-Decimal)  
contoh : 255.255.255.0
  - Notasi Panjang Prefiks (slash notation or prefix)  
contoh : /24

# Subnet Mask

	Oktet ke -1	Oktet ke -2	Oktet ke -3	Oktet ke -4	Subnet Mask
A	Network	Host	Host	Host	255.0.0.0 atau /8
B	Network	Network	Host	Host	255.255.0.0 atau /16
C	Network	Network	Network	Host	255.255.255.0 atau /24

# IPv4 – Private and Public

- IP Public digunakan untuk konek ke internet.
- IP Private digunakan untuk jaringan local (LAN).
- Alokasi IP private adalah sebagai berikut :

Kelas	Private Address Range	Network Address and Prefix
A	10.0.0.0 – 10.255.255.255	10.0.0.0/8
B	172.16.0.0 – 172.16.31.255	172.16.0.0/12
C	192.168.0.0 – 192.168.255.255	192.168.0.0/16

# IPv4 – Private and Public

Ada juga range IP khusus yang digunakan untuk keperluan tertentu:

- 127.x.x.x = used for localhost
- 0.0.0.0 = used for routing the entire network
- 169.254.0.0/16 = used for link-local address (APIPA)





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# **SUBNETTING**

## **NETWORK FUNDAMENTAL**

# Perhitungan Subnet

Untuk menghitung Subnet ada beberapa parameter yang harus dicari terlebih dahulu.

- Jumlah IP
- IP network
- IP broadcast
- IP Host
- Subnetmask

# Perhitungan Subnet – Mencari Jumlah IP

Untuk mencari jumlah IP bisa menggunakan rumus sebagai berikut:

$$2^{(32-n)}, \text{ dimana } n=\text{prefix subnet}$$

Contoh, IP kelas C 192.168.255.121/30

Tentukan jumlah Ipnya

$$= 2^{(32-30)}$$

$$= 2^{(2)}$$

$$= 4$$

Jadi jumlah IP dari /30 adalah 4

# Perhitungan Subnet – Mencari IP Network

Untuk mencari IP network bisa menggunakan rumus sebagai berikut :

- (1) Host ID / Jumlah IP =  $A$
- (2)  $A * \text{Jumlah IP} = B$
- (3)  $B = \text{adalah IP host network}$

Contoh, IP kelas C 192.168.255.121/30

- (1)  $121 / 4 = 30,25$  (bila hasil koma, ambil angka sebelum koma)
- (2)  $30 * 4 = 120$
- (3) maka IP networknya akan jadi sebagai berikut 192.168.255.120



# Perhitungan Subnet – Mencari IP Broadcast

Untuk mencari IP Broadcast bisa menggunakan rumus sebagai berikut :

- (1) **B** = adalah IP host network sebelumnya
- (2) **B** + (jumlah IP – 1)

Contoh, IP kelas C 192.168.255.121/30

- (1) **B** = 120
- (2) 120 + (4 – 1) = 123

maka IP Broadcastnya adalah 192.168.255. 123



# Perhitungan Subnet – Mencari Subnetmask

- Subnetmask = Prefix
- Biasanya setiap device ada yang hanya support prefix (Mikrotik) atau hanya yang support subnetmask (Komputer).
- Untuk mencari subnetmask bisa menggunakan rumus berikut :
  - Kelas A =  $255.(256\text{-jumlah IP}).0.0$
  - Kelas B =  $255.255.(256\text{-jumlah IP}).0$
  - Kelas C =  $255.255.255.(256\text{-jumlah IP})$

Contoh IP kelas C 192.168.255.121/30

$$= 255.255.255.(256-4)$$

$$= 255.255.255.252$$

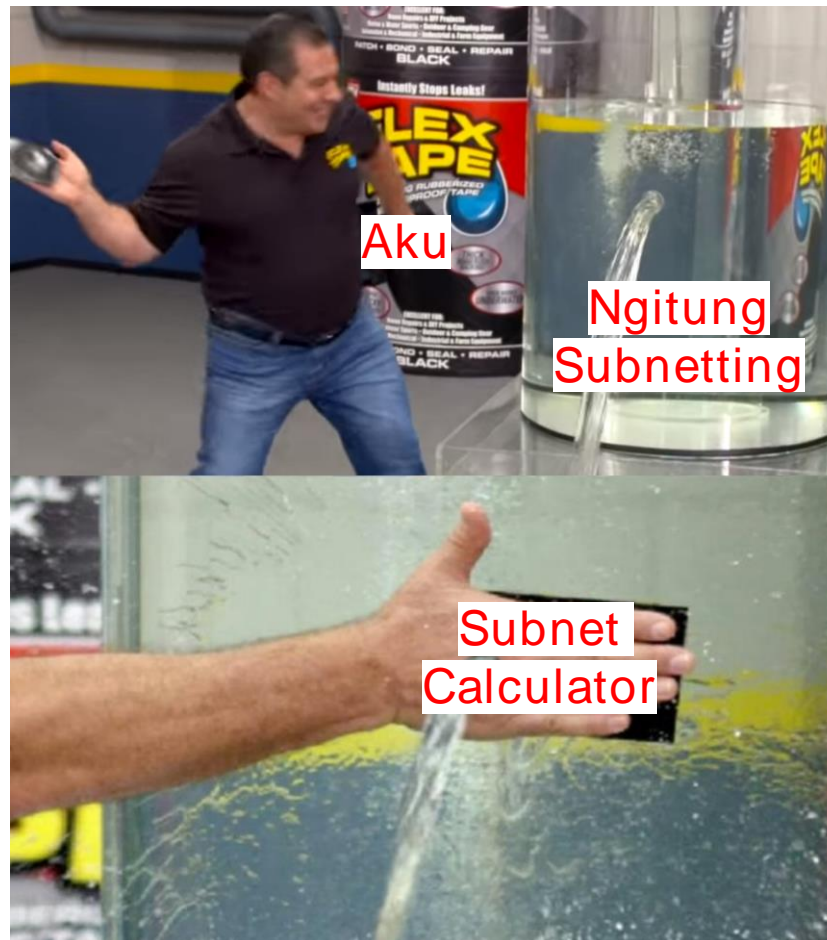
jadi subnetmasknya adalah 255.255.255.252



# Latihan

Soal :

1. 192.168.100.111 /29
2. 192.168.0.222 / 27
3. 172.16.20.33 / 25
4. 10.10.10.104 / 28
5. Buatlah soal subnettingmu sendiri dan coba kerjakan...!!!





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# **MIKROTIK MTCNA**

## **TRAINING SESSION**

# Tujuan Training MTCNA

- Mempelajari karakteristik, fitur-fitur, kemampuan Mikrotik RouterOS dan RouterBOARD.
- Mempelajari cara instalasi, konfigurasi, fungsi, maintenance dan troubleshoot dasar Mikrotik RouterOS.
- Mendapatkan Kualifikasi sebagai Mikrotik Certified Network Associate.

# Sertifikat MTCNA



Please enter certificate number or person

Search

Search results

Number	Type	Issuer	Issue date	Person	Certificate
<u>2108NA1905</u>	MTCNA	ID-Networkers	2021-08-17	<u>Candra Milad Ridha Eislam</u>	

MikroTik issued associate and engineer certificates are valid for 3 years from the date of issue. The information about MikroTik certified courses is available [here](#).

**Note:** Starting from February 2021, a new certificate design was implemented. Certificates that were issued using [previous design](#) are still valid as before. The certificate numbers remain the same. If you are a certificate holder, you can download your certificate in new design from your MikroTik.com account.

# Registrasi Account

- Untuk training dan ujian MTCNA peserta harus teregistrasi di official web mikrotik.
- Register account di [www.mikrotik.com](http://www.mikrotik.com), pada menu account isi semua form yang di sediakan.
- Pastikan nama anda ditulis lengkap dalam profil, karena otomatis akan tercetak dalam sertifikat.

**REGISTER** [LOG IN](#)

Registration type  Natural person  Legal person

First name

Last name

E-mail

# Exam MTCNA

- Online Test.
- English, ada beberapa soal menggunakan Bahasa.
- 25 Soal (Single, Multiple, True/False)
- 60 Menit
- Soal Random
- Passing grade 60%, nilai 50%-59% bisa exam ulang (second chance).
- Syarat Mikrotik Academy, Mikrotik Consultant, Trainer nilai harus minimal 75% untuk Associate level (MTCNA) dan engineer level (MTC\*E).

# Outline

- Modul 1 – Introduction
- Modul 2 – DHCP
- Modul 3 – Bridging
- Modul 4 – Routing
- Modul 5 – Wireless
- Modul 6 - Firewall
- Modul 7 - QoS
- Modul 8 - Tunnels
- Modul 9 - Misc

Detailed outline available on [https://mikrotik.com/download/pdf/MTCNA\\_Outline.pdf](https://mikrotik.com/download/pdf/MTCNA_Outline.pdf)





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# MTCNA

Modul 1  
Introduction

# Mikrotik



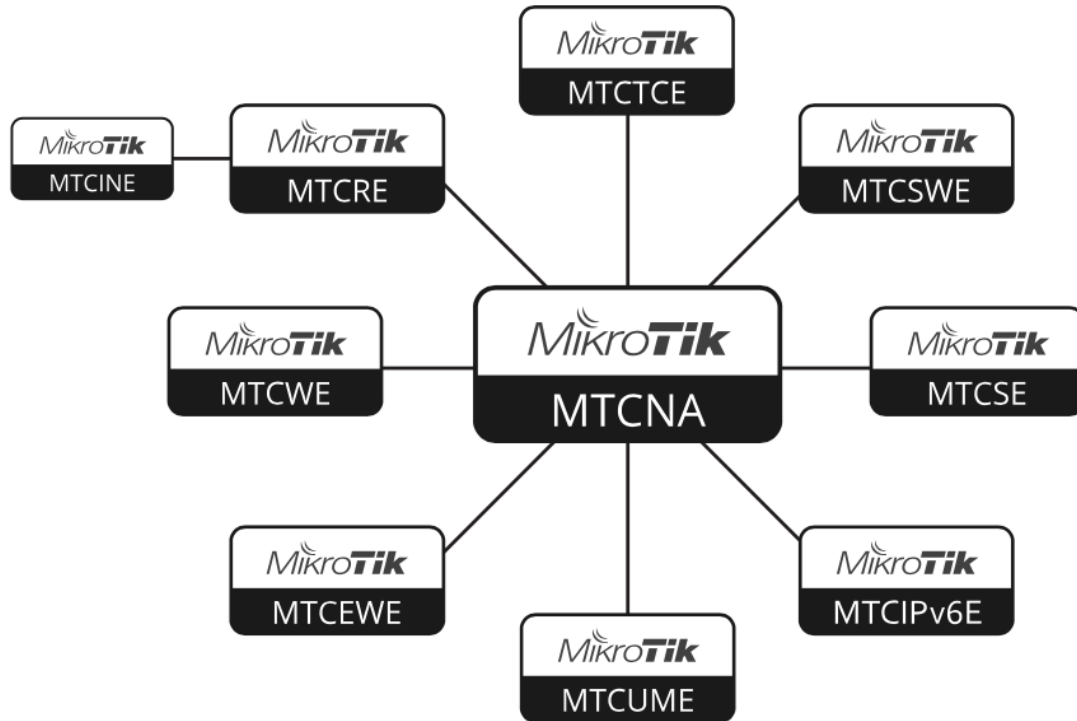
- Produsen software and hardware router
- Lokasi : Riga, Latvia (Eropa Utara)
- Motto Mikrotik : Routing the World
- Founder (1996) : John Trully & Arnis Reikstins
  
- [mikrotik.com](http://mikrotik.com)
- [mum.mikrotik.com](http://mum.mikrotik.com)
- [wiki.mikrotik.com](http://wiki.mikrotik.com)
- [forum.mikrotik.com](http://forum.mikrotik.com)

# Mikrotik Timeline



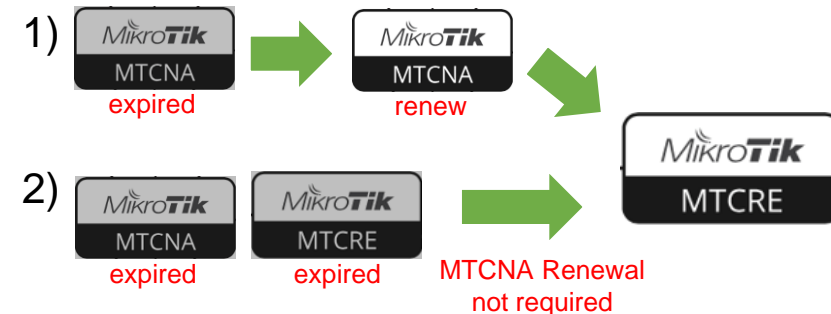
- 1996 : Founded
- 1997 : RouterOS software x86 (PC)
- 2002 : Perangkat RouterBOARD pertama
- 2006 : MikroTik User Meeting (MUM) pertama Prague, Czech Republic
- 2015 : MUM terbesar : Indonesia, 2500+

# Mikrotik Certifications Track



- Sertifikasi berjenjang.
- Masa berlaku 3 tahun.
- Perpanjang dengan cara ujian lagi.

Jika sertifikat expired...?



# Mikrotik RouterOS

- System Operasi yang digunakan oleh perangkat Mikrotik RouterBOARD.
- Dapat diinstall di PC atau sebagai VM (Virtual Machine).
- Stand-alone operating system berbasis Linux v3.3.5 kernel.

```
MMMM   MMMM   KKK           TTTTTTTTTT   KKK
MMM MMMM MMM III KKK KKK RRRRRR   000000   TTT   III KKK KKK
MMM MM  MMM III KKKKK   RRR RRR 000 000   TTT   III KKKKK
MMM    MMM III KKK KKK RRRRRR   000 000   TTT   III KKK KKK
MMM    MMM III KKK KKK RRR RRR  000000   TTT   III KKK KKK

MikroTik RouterOS 6.45.9 (c) 1999-2020      http://www.mikrotik.com/

ROUTER HAS NO SOFTWARE KEY
-----
You have 14h49m to configure the router to be remotely accessible,
and to enter the key by pasting it in a Telnet window or in Winbox.
Turn off the device to stop the timer.
See www.mikrotik.com/key for more details.

Current installation "software ID": QGP6-SP7C
Please press "Enter" to continue!

[candra@Mikrotik] > _
```

# RouterOS Features

- Support 802.11 a/b/g/n/ac wireless network.
- Routing (RIP, OSPF, BGP, RIPng, OSPFv3).
- Firewall & NAT (Fully-customized, linux based).
- QoS / Bandwidth (Fully-customized, linux based).
- Point to point tunneling (PPTP, PPPoE, SSTP, OpenVPN).
- User Management (DHCP / Proxy / Hotspot / Radius, dll).
- Tools (Bandwidth test, torch, mac-ping, MRTG, dll)
- [https://wiki.mikrotik.com/wiki/Manual:RouterOS\\_features](https://wiki.mikrotik.com/wiki/Manual:RouterOS_features)



# Mikrotik RouterBOARD

- Built in hardware (board).
- Dibuat untuk menjalankan sistem operasi RouterOS.
- Tersedia mulai dari low-end s/d high-end router.



- <http://routerboard.com/>

# RouterBOARD Name

- Detail penamaan untuk produk RouterBoard

RouterBoard (short version RB)

<board name> <board features>-<wireless feature>-<connector type>-<enclosure type>

Contoh

RB D52G-5HacD2HnD-TC

RouterBOARD

D series

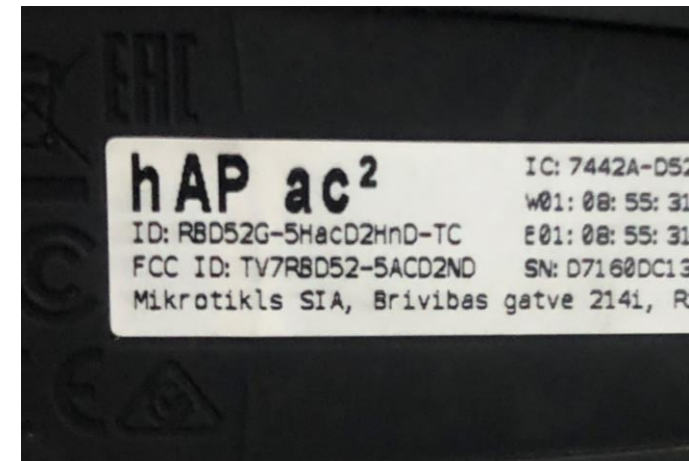
Ethernet

Wireless

Board features

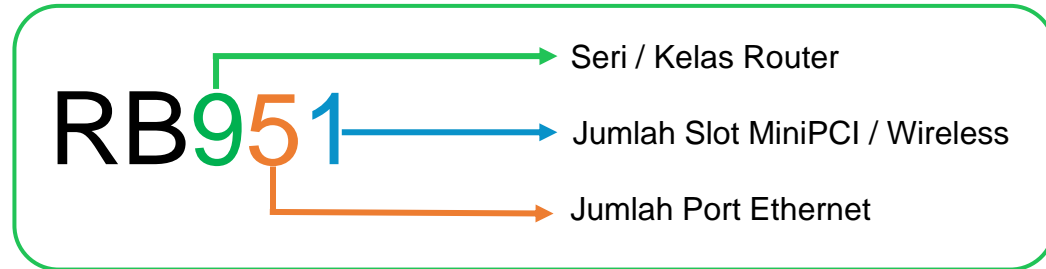
Wireless features

enclosure type



# RouterBOARD - Board Name

- 3-symbol name



- Word
  - OmniTIK, Groove, SXT, LHG, DynaDish, cAP, wAP, hAP, hEX
- Exceptional naming
  - Nama disederhanakan atau disesuaikan dengan tahun pengembangan.
  - Contoh : RB600, 800, 1000, 1100, 1200, 2011, 3011, 4011

# RouterBOARD - Board Features

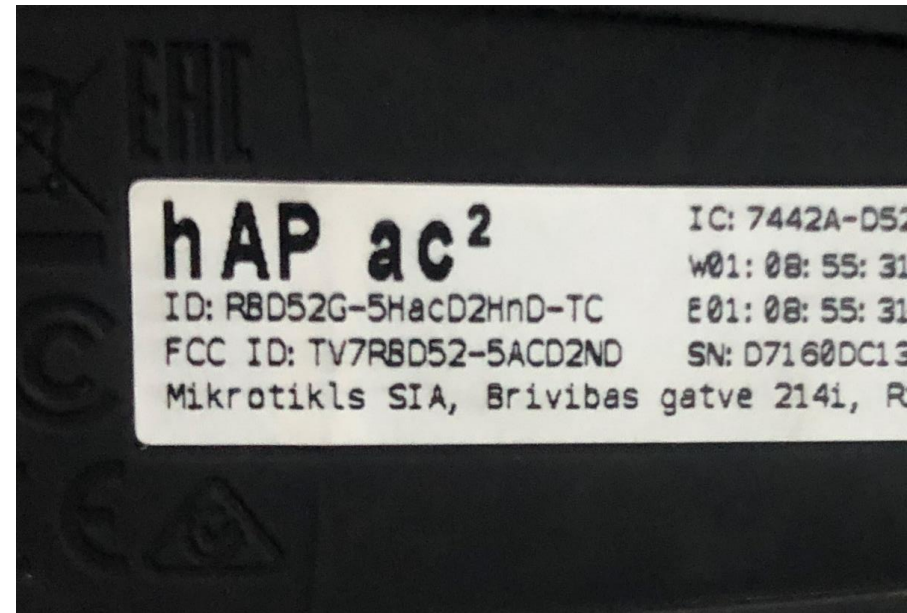
- Kode lain yang ada pada RouterBOARD :
  - **U** – support port USB
  - **A** – memory lebih tinggi dan dan level lisensi lebih tinggi
  - **H** – more powerfull CPU
  - **G** – support port Gigabit
  - **S** – support port SFP
  - **P** – power injection with controller
  - **i** – single port power injector without controller
  - **L** – lite edition
  - **R** – MiniPCI or MINIPCIe slot

# RouterBOARD - Built-in Wireless

- Format Built-in Wireless sebagai berikut :

<band> <power\_per\_chain>-<protocol> <number\_of\_chains>

- Band
  - 5 – support freq 5Ghz
  - 2 – support freq 2.4Ghz
  - 52 – dual band 5Ghz and 2.4GHz
- Protocol
  - (not used) – only for 802.11a/b/g support
  - n – mendukung protocol 802.11n
  - ac – mendukung protocol 802.11ac



# RouterBOARD - Enclosure Type

- Jenis case
  - **RM** – rack-mount case
  - **TC** – Tower vertical case (hEX, hAP and other home routers)
  - **PC** – Passive Cooling case (CCR)
  - **LM** – lite memory
  - **BU** – board unit - hanya unit papan (tanpa penutup)

- More info about product naming :

[https://wiki.mikrotik.com/wiki/Manual:Product\\_Naming](https://wiki.mikrotik.com/wiki/Manual:Product_Naming)



# CloudCoreRouter (CCR) Name

- Detail penamaan untuk produk Cloud Core Router

CloudCoreRouter (short version CCR)

<4 digit number> - <list of ports> - <enclosure type>

Contoh

CCR2004-16G-2S+-PC

CloudCoreRouter

2xxx series

(reserved)

total CPU cores

16x Gigabit port

2x10G SFP+

enclosure type



# CloudRouterSwitch (CRS) & CloudSmartSwitch (CSS) Name

- Detail penamaan untuk produk CRS dan CSS (SwOS)

CloudCoreRouter (short version CCR)

<3 digit number> - <list of ports> - <wireless feature> - <enclosure type>

Contoh

**CRS326-24G-2S+-RM**

CloudCoreRouter

jumlah ports  
3xx series

24x Gigabit port

2x10G SFP+

enclosure type



# RouterBOARD Architecture

- Arsitektur RouterBOARD dibedakan berdasarkan jenis dan kinerja processor.
- Software / OS tiap arsitektur berbeda

Architecture	Product Name
MIPSBE	CRS1xx, hAP, hAP ac, hAP ac lite, LHG, RB9xx, SXT, cAP, RB2011, dll
SMIPS	hAP mini, hAP lite
TILE	CCR1xxx
ARM	cAP ac, DISC AC, hAP ac2, RB3011, RB1100AHx4, RB450Gx4
X86	RB230, X86
PPC	RB3xx, RB600, RB1100, RB1200
MMIPS	hEX, hEX S, RBMxx

- <https://mikrotik.com/download>





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# **AKSES PERANGKAT MIKROTIK MTCNA**

# Cara Mengakses Mikrotik

Akses Via	Koneksi	Text Base	GUI	Need IP
Keyboard	Langsung di PC	Yes	-	-
Serial Console	Konektor Kabel Serial	Yes	-	-
Remote Server (Telnet / SSH)	Layer 3	yes	-	yes
Winbox	Layer 2	yes	yes	-
FTP	Layer 3	yes	-	yes
API	Socket Programming	-	-	yes
Quick Set & WebFig (HTTP)	Layer 3	Yes	yes	yes
MAC-Telnet	Layer 2	Yes	-	no
Local (Winbox Terminal Menu)	Terminal winbox	Yes	-	-
Mikrotik APP (smartphone)	Android / iOS	Yes	yes	yes

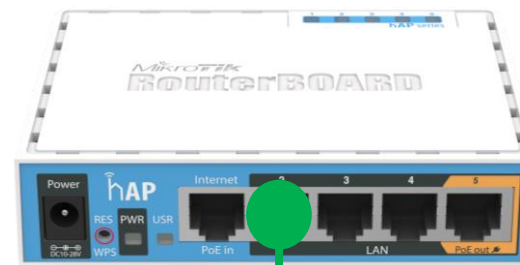


# Mengakses Mikrotik

- Belajar cara akses mikrotik
- Topologi



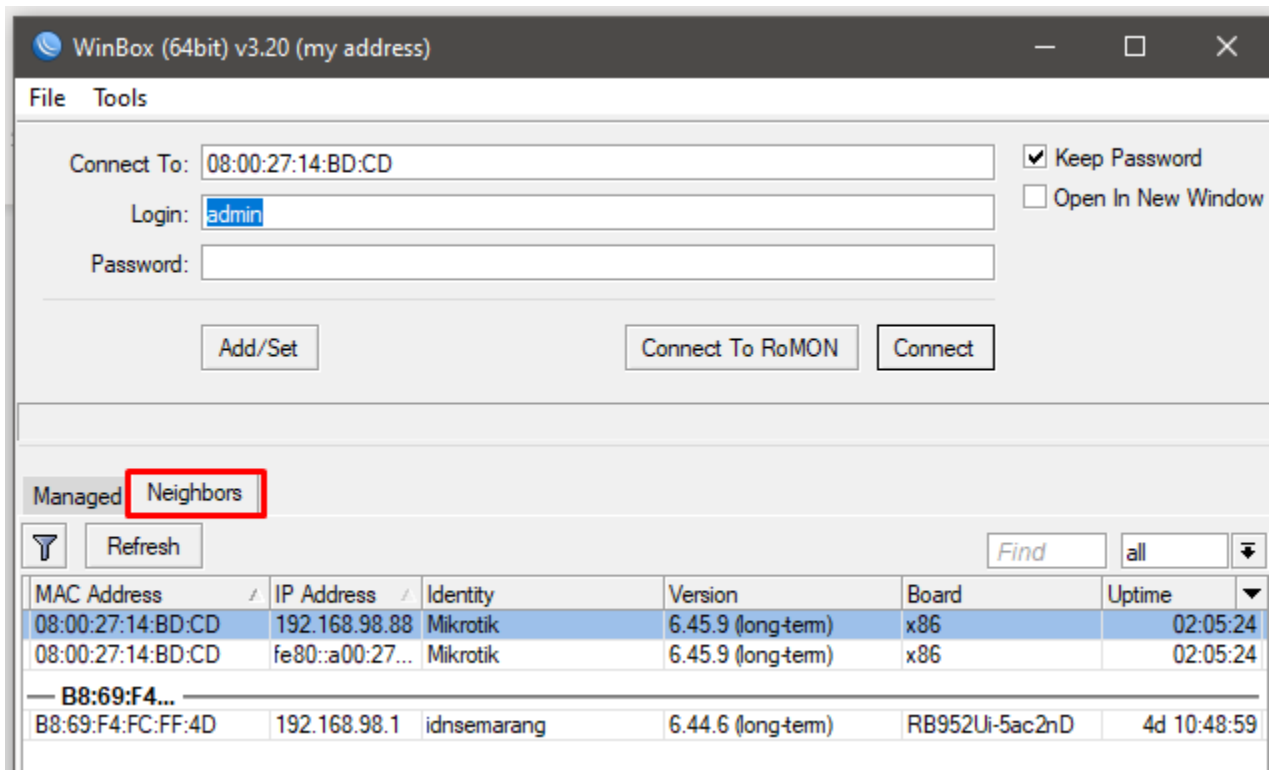
**Ethernet LAN**  
192.168.88.2/24



**Ether2-5**  
192.168.88.1/24

# Mengakses Mikrotik - Winbox

- Available access by MAC and IP address
- Default IP Address : 192.168.88.1/24
- User : admin
- Tanpa password

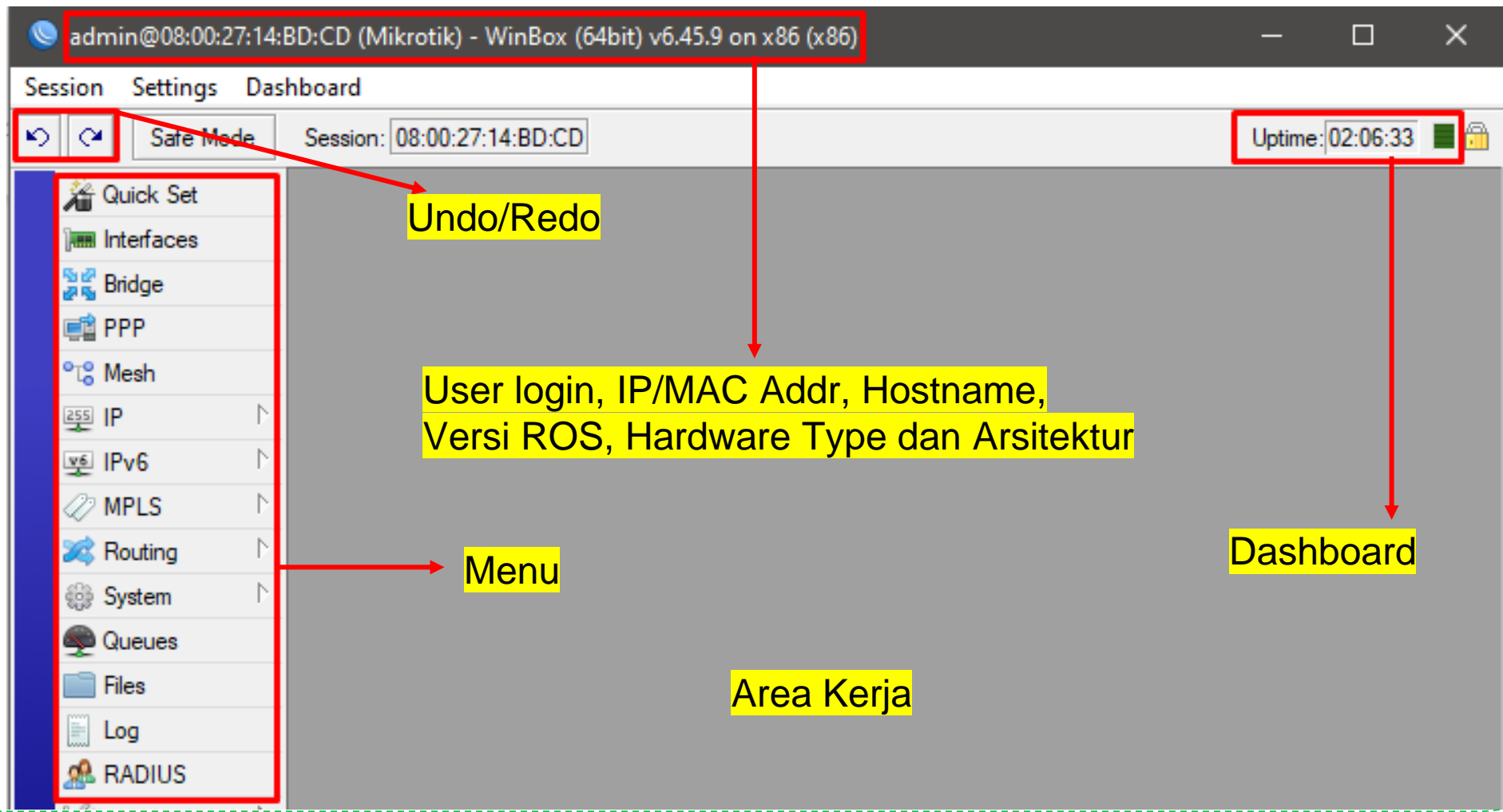


The screenshot shows the WinBox interface for connecting to a Mikrotik device. The 'Connect To' field is set to the MAC address 08:00:27:14:BD:CD. The 'Login' field is set to 'admin' and the 'Password' field is empty. The 'Keep Password' checkbox is checked, and the 'Open In New Window' checkbox is unchecked. Below the connection fields are buttons for 'Add/Set', 'Connect To RoMON', and 'Connect'.

The 'Managed Neighbors' section is highlighted with a red box. It contains a table with the following data:

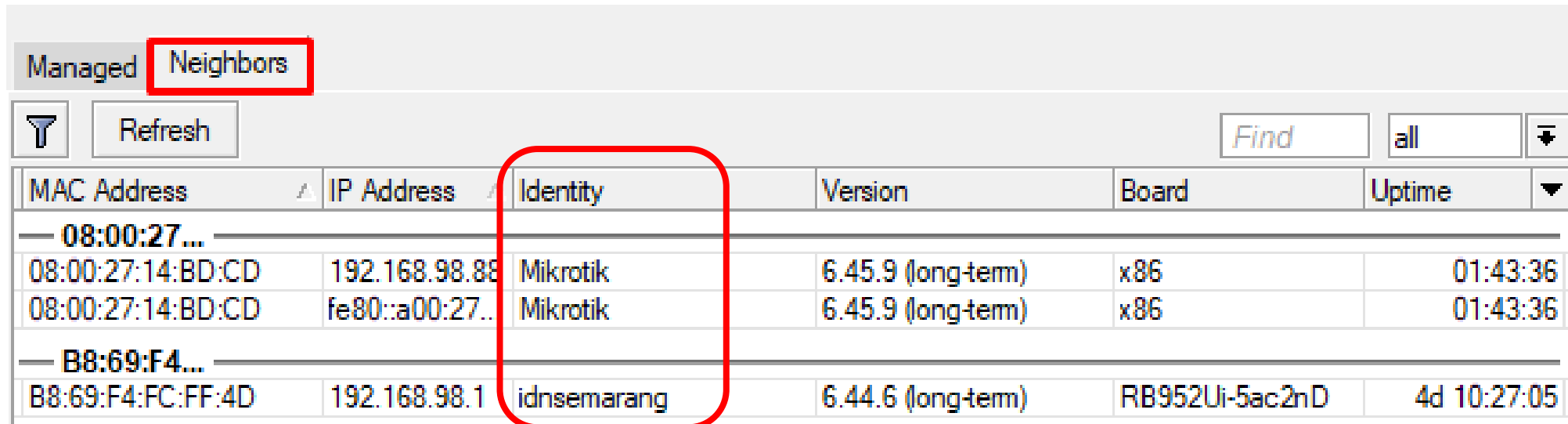
MAC Address	IP Address	Identity	Version	Board	Uptime
08:00:27:14:BD:CD	192.168.98.88	Mikrotik	6.45.9 (long-term)	x86	02:05:24
08:00:27:14:BD:CD	fe80::a00:27...	Mikrotik	6.45.9 (long-term)	x86	02:05:24
— B8:69:F4...					
B8:69:F4:FC:FF:4D	192.168.98.1	idnsemarang	6.44.6 (long-term)	RB952Ui-5ac2nD	4d 10:48:59

# Tampilan Winbox



# Router Identity (Hostname)

- Router Identity (hostname) digunakan sebagai pengenalan / identitas mengenai router itu sendiri.

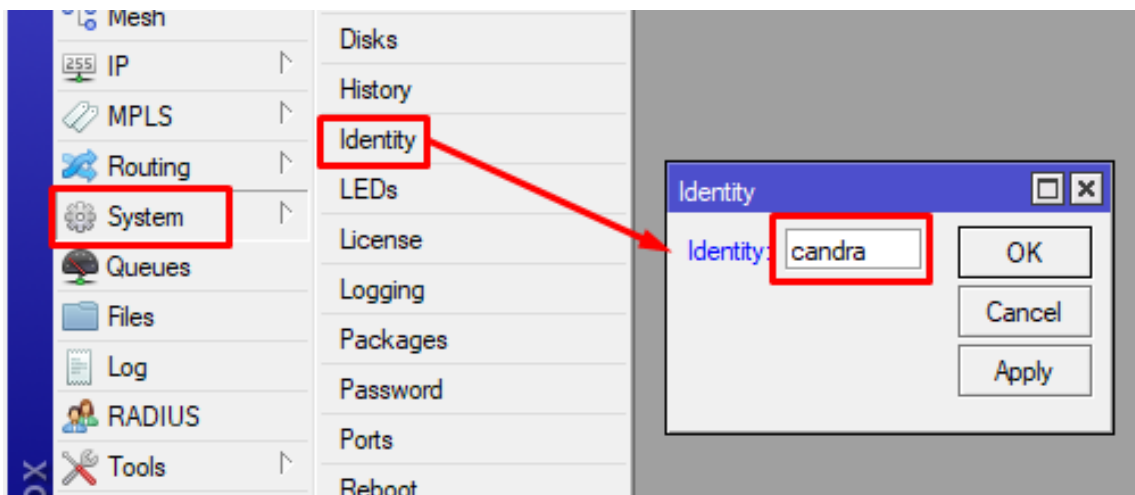


The screenshot shows the Mikrotik Neighbors table with the following data:

MAC Address	IP Address	Identity	Version	Board	Uptime
<b>08:00:27...</b>					
08:00:27:14:BD:CD	192.168.98.88	Mikrotik	6.45.9 (long-term)	x86	01:43:36
08:00:27:14:BD:CD	fe80::a00:27...	Mikrotik	6.45.9 (long-term)	x86	01:43:36
<b>B8:69:F4...</b>					
B8:69:F4:FC:FF:4D	192.168.98.1	idnsemarang	6.44.6 (long-term)	RB952Ui-5ac2nD	4d 10:27:05

# Router Identity (Hostname)

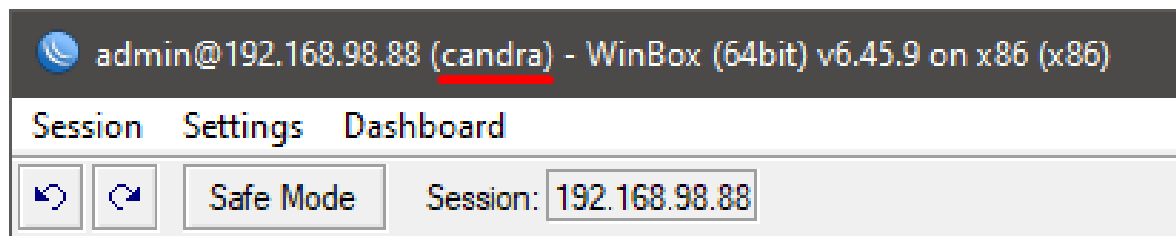
- System > Identity



```
[admin@Mikrotik] > system identity set name=candra  
[admin@candra] >
```

# Router Identity (Hostname)

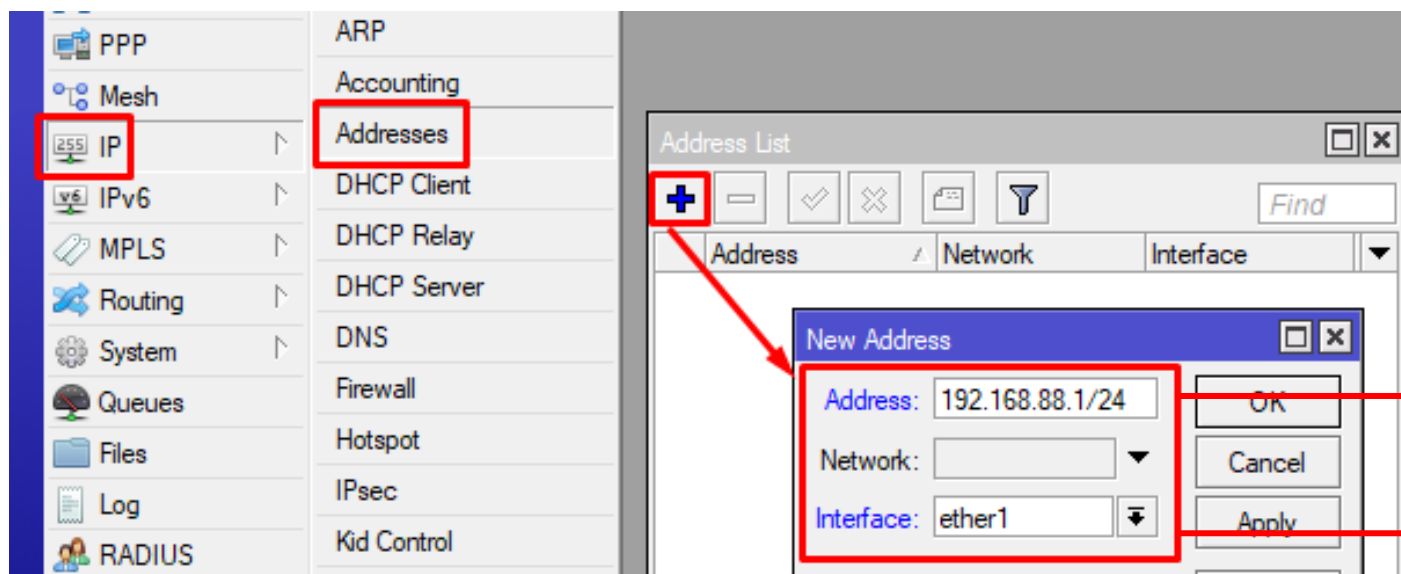
- Verifikasi



MAC Address	IP Address	Identity	Version	Board
08:00:27:14:BD:CD	192.168.98.88	candra	6.45.9 (long-term)	x86
08:00:27:14:BD:CD	fe80::a00:27...	candra	6.45.9 (long-term)	x86
— B8:69:F4... —				
B8:69:F4:FC:FF:4D	192.168.98.1	idnsemarang	6.44.6 (long-term)	RB952Ui-5ac2nD

# IP Address

- Belajar membuat IP address pada Router Mikrotik
- IP > Address

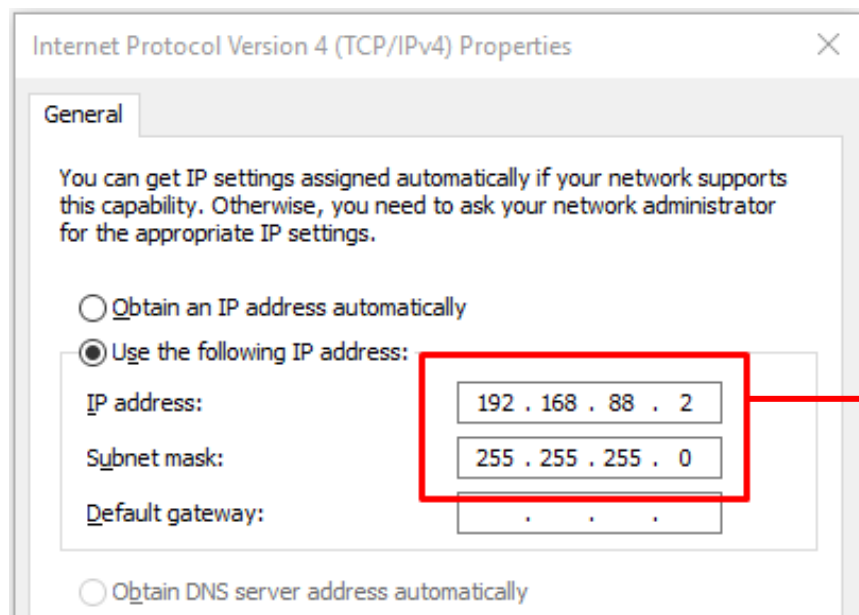


IP address/prefix

Interface yang akan di pasang IP tersebut

# Client connection

- Setting IP address supaya laptop dapat komunikasi secara langsung dengan router



IP address dan subnetmask  
satu jaringan dengan router

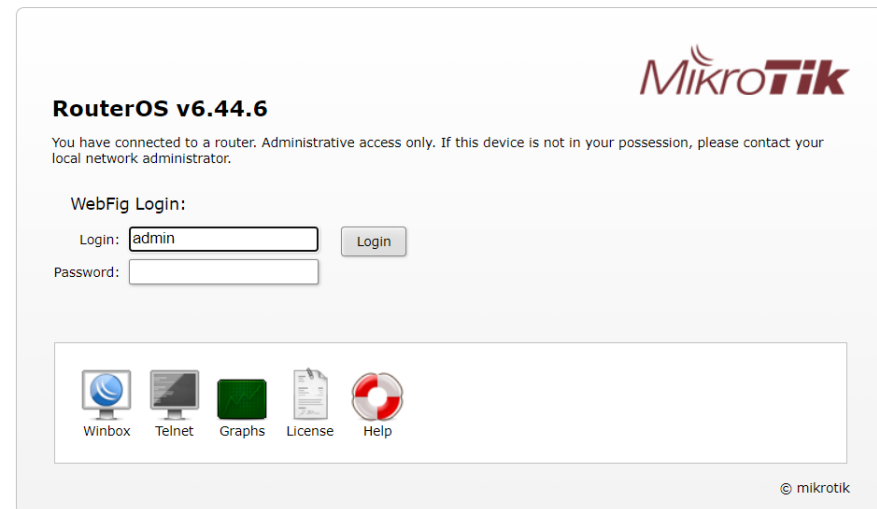
- Test Ping dari laptop ke router, pastikan reply

# Mengakses Mikrotik - WebFig

- Diperkenalkan sejak ROSv5.0 (fungsi sama dengan winbox)
- Support IPv4 dan IPv6
- Support HTTP dan HTTPS

<https://wiki.mikrotik.com/wiki/Manual:Webfig>

- Akses via browser :
- `http://<ip_router>`



**RouterOS v6.44.6**

You have connected to a router. Administrative access only. If this device is not in your possession, please contact your local network administrator.

WebFig Login:

Login:  Login

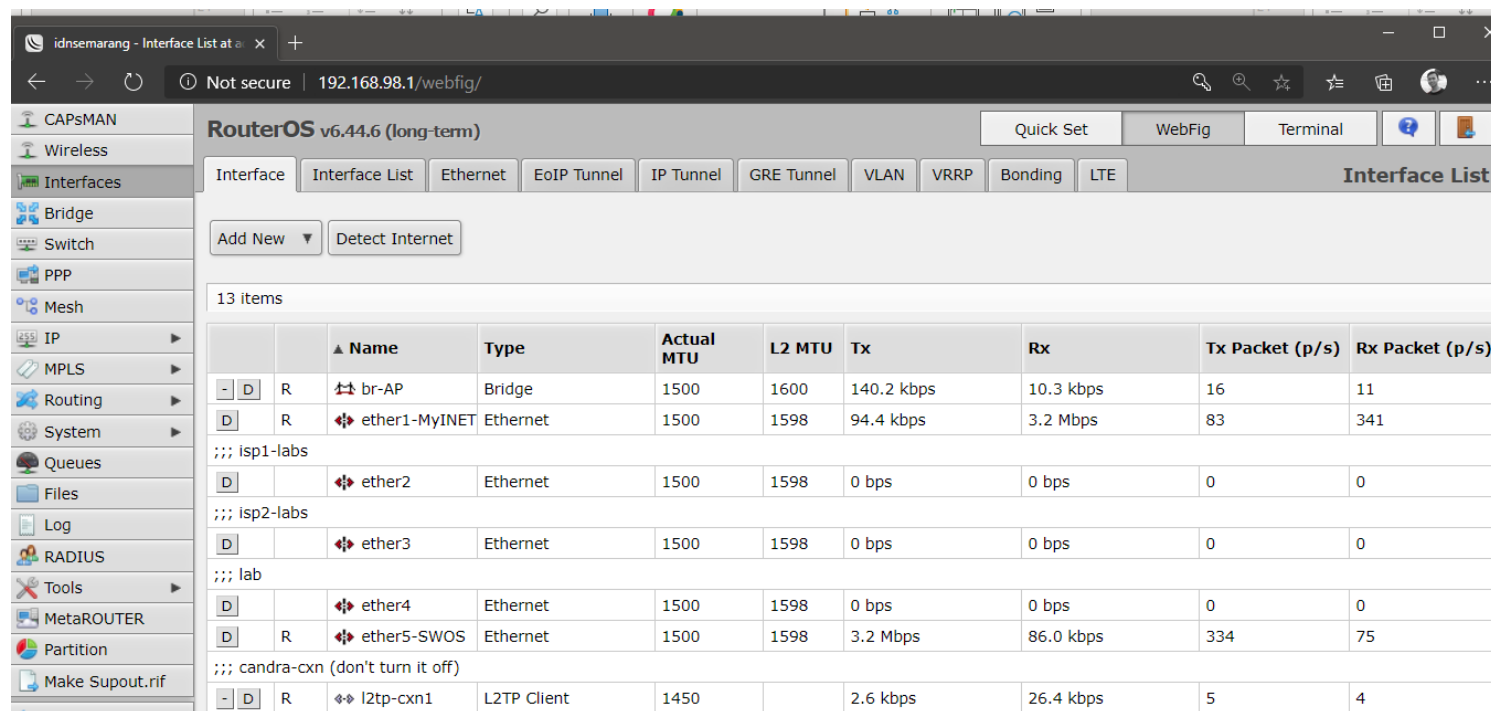
Password:

Winbox Telnet Graphs License Help

© mikrotik

# Mengakses Mikrotik - WebFig

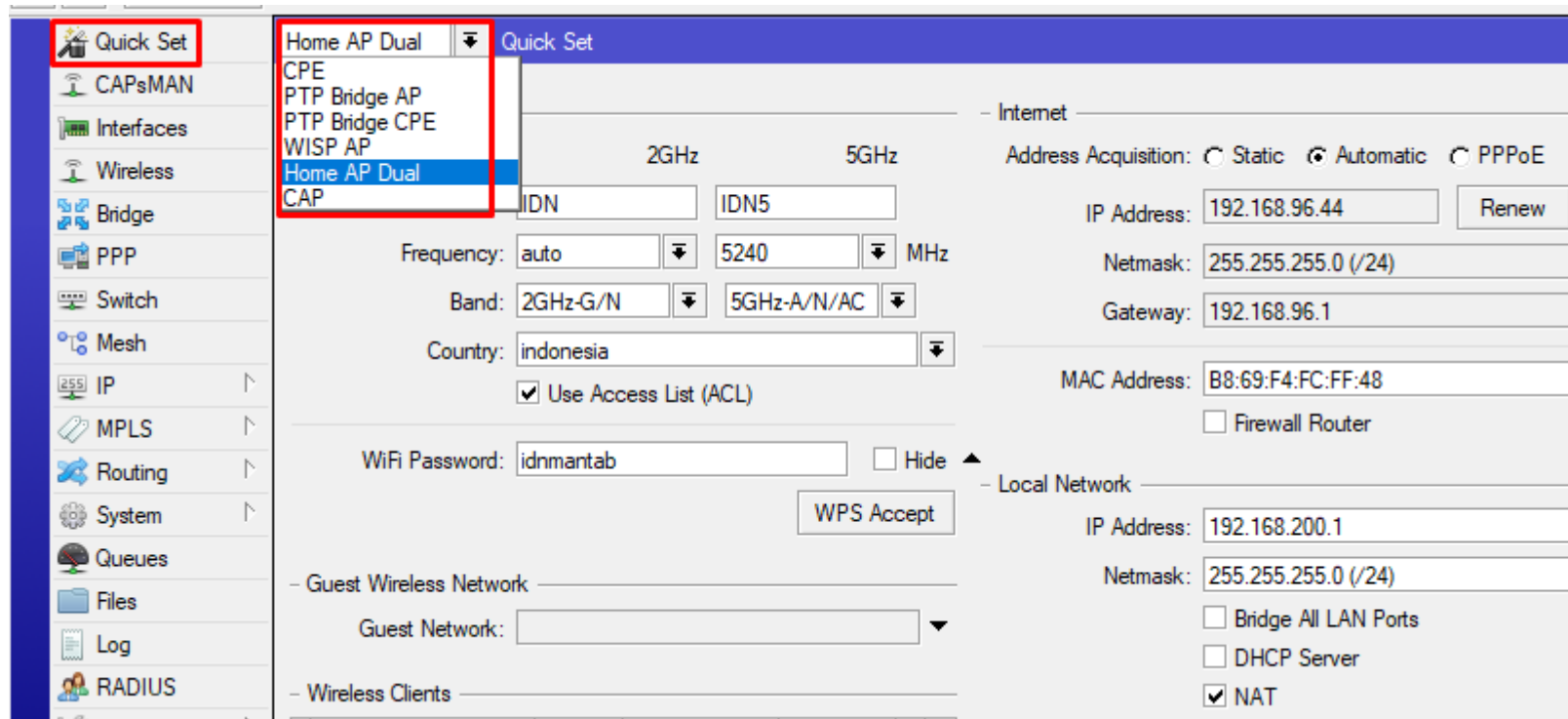
- Setting IP address pada router dan laptop (satu jaringan)
- Ketikkan IP address router di browser



		▲ Name	Type	Actual MTU	L2 MTU	Tx	Rx	Tx Packet (p/s)	Rx Packet (p/s)	
-	D	R	↕ br-AP	Bridge	1500	1600	140.2 kbps	10.3 kbps	16	11
	D	R	↕ ether1-MyINET	Ethernet	1500	1598	94.4 kbps	3.2 Mbps	83	341
;;; isp1-labs										
	D		↕ ether2	Ethernet	1500	1598	0 bps	0 bps	0	0
;;; isp2-labs										
	D		↕ ether3	Ethernet	1500	1598	0 bps	0 bps	0	0
;;; lab										
	D		↕ ether4	Ethernet	1500	1598	0 bps	0 bps	0	0
	D	R	↕ ether5-SWOS	Ethernet	1500	1598	3.2 Mbps	86.0 kbps	334	75
;;; candra-cxn (don't turn it off)										
-	D	R	↕ l2tp-cxn1	L2TP Client	1450		2.6 kbps	26.4 kbps	5	4

# Quick Set

- Settingan dasar router dalam satu tampilan.
- Dapat di akses melalui winbox atau webfig



# Quick Set

- Terdapat beberapa mode:
  - **CPE (Client device)** : digunakan untuk konek ke AP, terdapat fasilitas scan
  - **PTP Bridge AP** : mode AP untuk menghubungkan 2 lokasi dalam satu jaringan
  - **PTP Bridge CPE** : mode station untuk menghubungkan 2 lokasi dalam satu jaringan
  - **WISP AP** : merupakan mode Home AP dengan tambahan fitur advanced seperti SSID dan WPA
  - **Home AP** : merupakan mode default sebagai AP
  - **Home AP Dual** : merupakan mode default sebagai AP yang menyediakan dual band (2Ghz/5GHZ)
  - **CAP (Controlled Access Point)** : merupakan mode AP yang di manage oleh CAPsMAN (mode ini hanya running bila ada CAPsMAN)



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# **BASIC COMMAND LINE INTERFACE**

## **MIKROTIK MTCNA**

# Command Line Interface

- Akses router via text / CLI dapat dilakukan melalui SSH, Telnet, Console, New Terminal (winbox) dan Terminal (WebFig).
- Digunakan untuk merunning script atau ketika akan mengakses router dengan keterbatasan bandwidth.

```
192.168.98.88 - PuTTY

MMM      MMM      KKK
MMMM     MMMM     KKK
MMM MMMM MMM III KKK KKK RRRRRR 000000 TTT III KKK KKK
MMM MM  MMM III KKKKK RRR RRR 000 000 TTT III KKKKK
MMM     MMM III KKK KKK RRRRRR 000 000 TTT III KKK KKK
MMM     MMM III KKK KKK RRR RRR 000000 TTT III KKK KKK

MikroTik RouterOS 6.45.9 (c) 1999-2020      http://www.mikrotik.com/

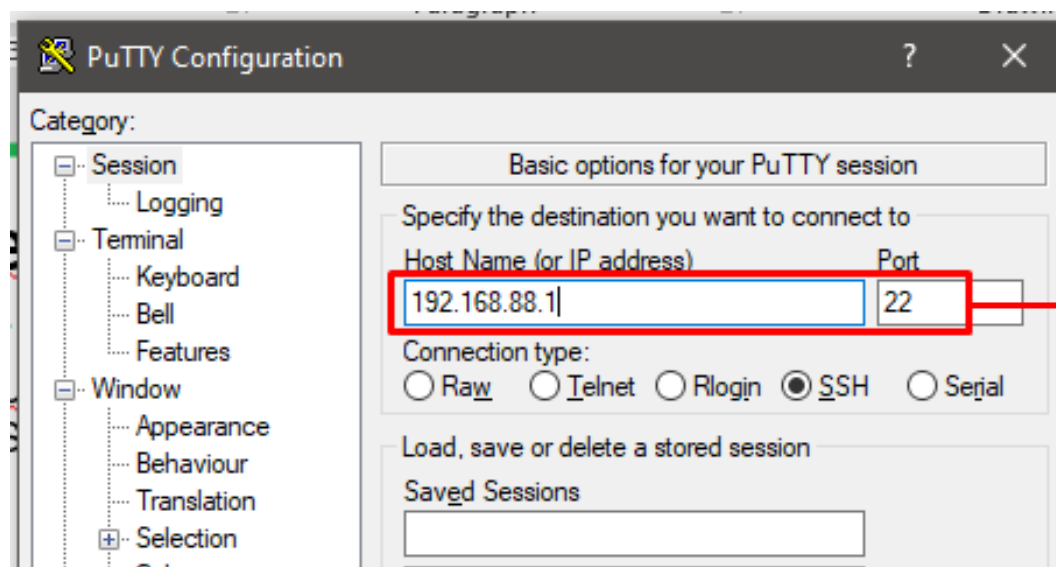
ROUTER HAS NO SOFTWARE KEY
-----
You have 11h9m to configure the router to be remotely accessible,
and to enter the key by pasting it in a Telnet window or in Winbox.
Turn off the device to stop the timer.
See www.mikrotik.com/key for more details.

Current installation "software ID": QGP6-SP7C
Please press "Enter" to continue!

[admin@candra] > |
```

# Mengakses Mikrotik – SSH/Telnet

- Untuk mengakses router via SSH/Telnet, bias menggunakan program SSH/Telnet client seperti putty, WinSCP dll.



IP Address router dan port

- Link download Putty <https://www.putty.org/>

# Command Line Interface

- Hierarchical Structure (sama seperti menu pada winbox)
- <tab> completes command
- Double <tab> untuk melihat ketersediaan command
- “?” untuk menampilkan bantuan command disertai keterangan
- Untuk navigasi command bisa menggunakan tombol ← ↑ → ↓ di keyboard
- Informasi selengkapnya bisa di lihat pada wiki mikrotik  
<https://wiki.mikrotik.com/wiki/Manual:Console>



# Command Line Interface

Perintah masuk ke suatu menu (IP address)

```
[admin@candra] > /ip address  
[admin@candra] /ip address >
```

Perintah Kembali ke directory sebelumnya (IP address)

```
[admin@candra] /ip address > ..  
[admin@candra] /ip >
```

Perintah Kembali ke directory awal (Root)

```
[admin@candra] /ip > /  
[admin@candra] >
```

# Command Line Interface

Perintah masuk ke konfigurasi IP Address

```
[admin@candra] > /ip address
```

Perintah melihat konfigurasi IP Address

```
[admin@candra] > /ip address print
```

Perintah lain di konfigurasi IP address

**add** – menambah IP address

**remove** – menghapus IP address

**disable** – mematikan IP address

**set / edit** – memodifikasi IP address

# Command Line Interface

Perintah menambahkan konfigurasi (IP Address)

```
[admin@candra] > /ip address [Enter]
```

```
[admin@candra] /ip address > add address=192.168.100.1/24 interface=ether5
```

Verifikasi

```
[admin@candra] > /ip address print
```

Flags: X - disabled, I - invalid, D - dynamic

#	ADDRESS	NETWORK	INTERFACE
0	192.168.88.1/24	192.168.88.0	ether2
1	<b>192.168.100.1/24</b>	<b>192.168.100.0</b>	<b>ether5</b>

# Command Line Interface

Perintah menghapus konfigurasi (IP Address)

Sebelum menghapus IP address lakukan pengecekan list nomor urut IP dulu.

```
[admin@candra] > /ip address print
```

Flags: X - disabled, I - invalid, D - dynamic

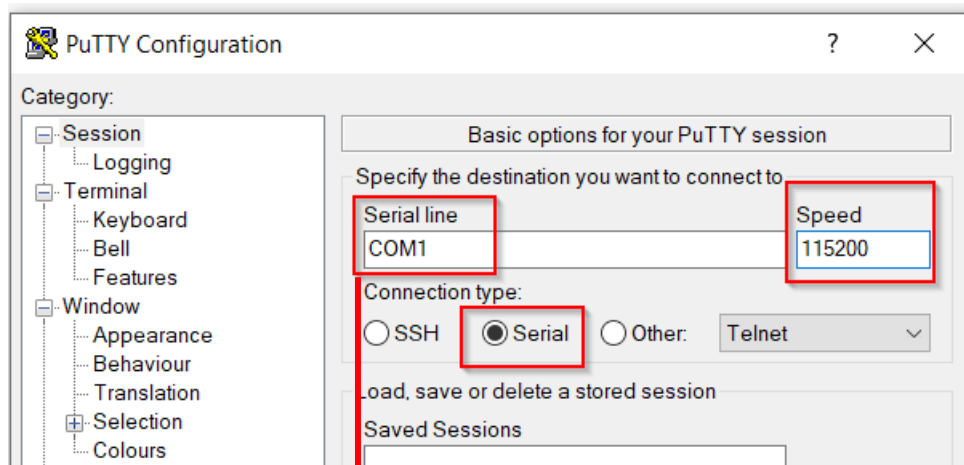
#	ADDRESS	NETWORK	INTERFACE
0	192.168.88.1/24	192.168.88.0	ether2
<b>1</b>	<b>192.168.100.1/24</b>	<b>192.168.100.0</b>	<b>ether5</b>

Tujuan kali ini akan menghapus IP address 192.168.100.1/24 karena IP address tersebut berada pada nomor urut 1 maka perintahnya adalah

```
[admin@candra] /ip address > remove number=1
```

# Mengakses Mikrotik – Serial Console

- Akses lewat terminal emulator, putty.
- Pilih Connection type = Serial
- Serial line disesuaikan dengan serial numbernya → check device manager.
- Speed baudrate : 115200



Serial line (COM X), nilai X disesuaikan number serial pada device manager



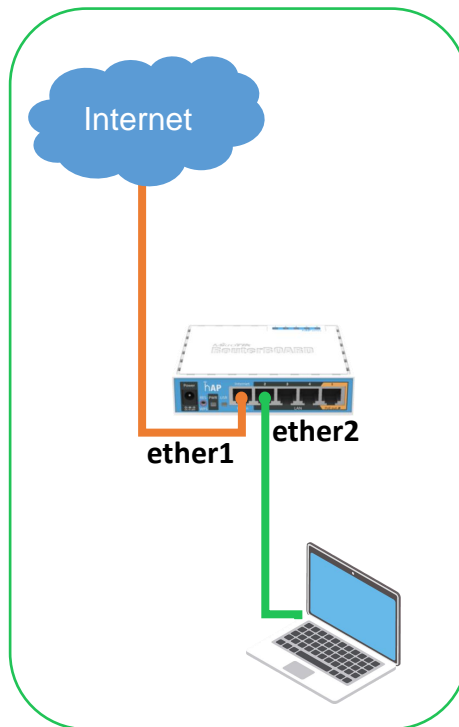
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# **INTERNET ACCESS**

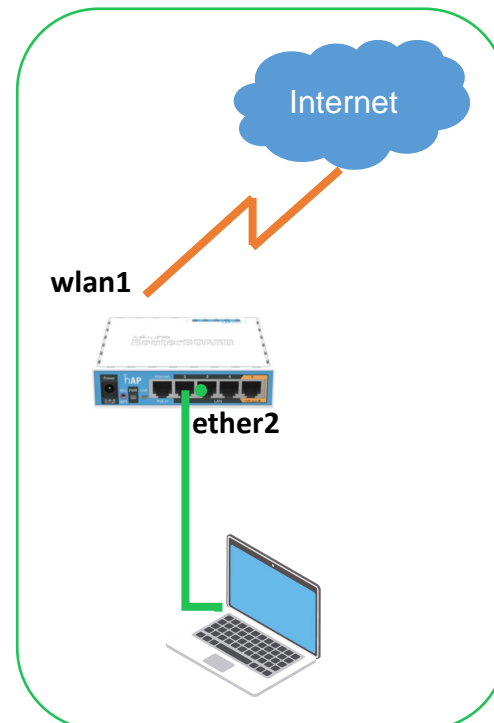
## **MIKROTIK MTCNA**

# Mengkoneksikan Router ke Internet

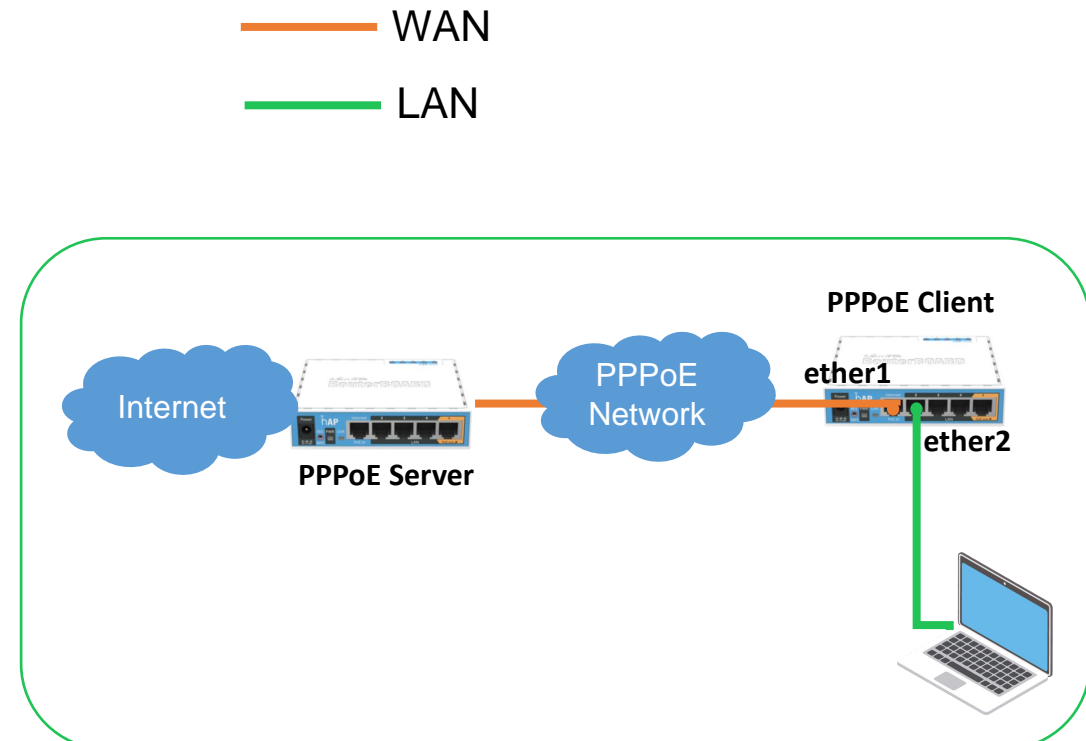
Ada beberapa cara untuk mengkoneksikan Router Mikrotik ke Internet



Internet via wired



Internet via wireless



Internet via pppoe

— WAN  
— LAN



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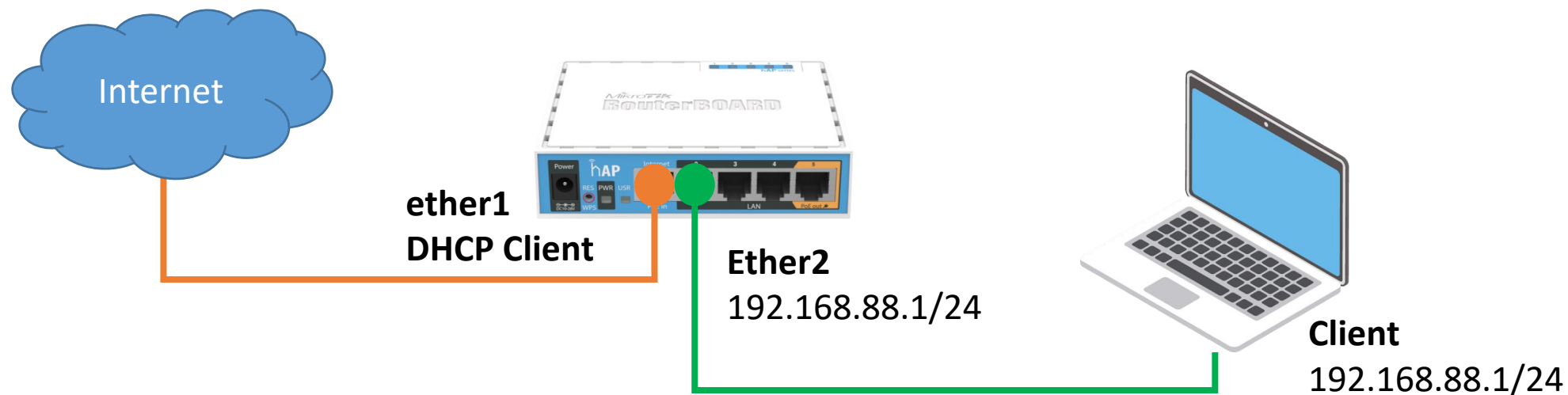
# **INTERNET ACCESS VIA WIRED**

## **MIKROTIK MTCNA**

# Internet Access via Wired

- Belajar mengkoneksikan router ke Internet melalui ether1
- Koneksikan port LAN laptop ke ether2
- Disable wireless interface di laptop

— WAN  
— LAN



# Konfigurasi LAN - Router

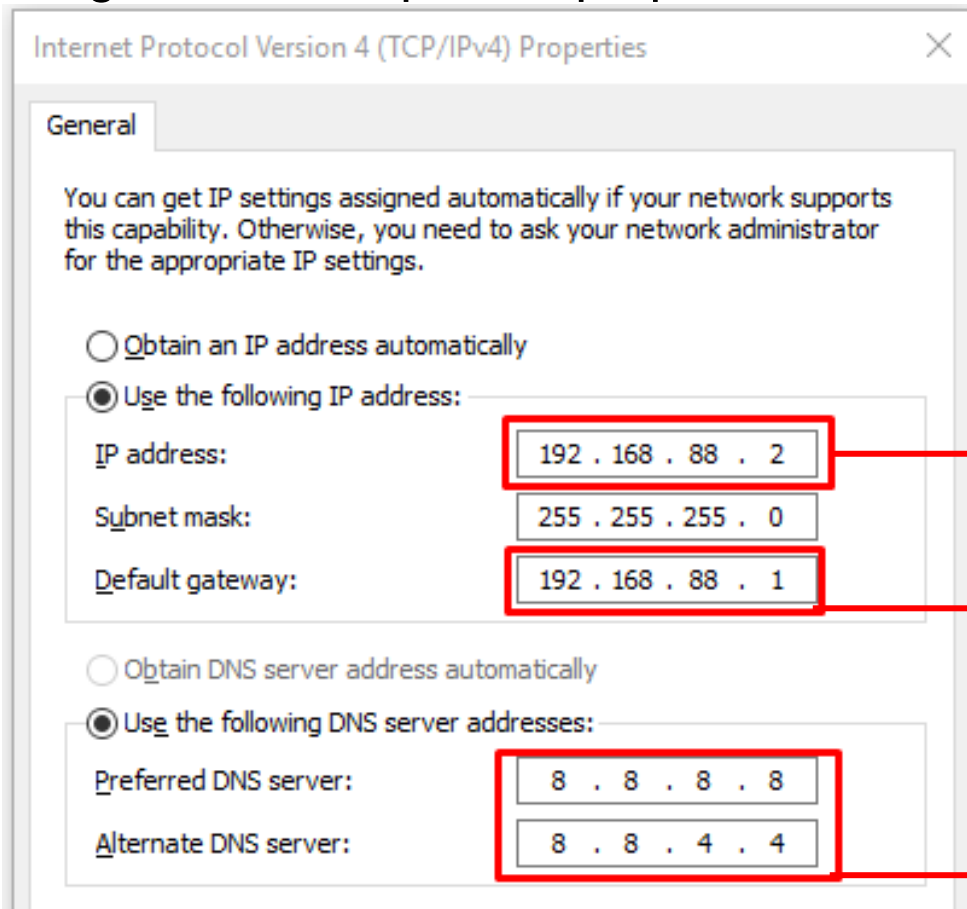
- Setting IP address pada router

The screenshot illustrates the steps to configure an IP address on a Mikrotik router. It shows the WinBox interface with the following elements:

- Left Panel:** A tree view of configuration categories. 'IP' is highlighted with a red box, and a red arrow points to the 'Addresses' sub-category in the middle panel.
- Middle Panel:** A list of IP-related services. 'Addresses' is highlighted with a red box, and a red arrow points to a '+' icon in the 'Address List' table.
- Address List Table:** A table with columns 'Address', 'Network', and 'Interface'. A '+' icon is highlighted with a red box, and a red arrow points to the 'New Address' dialog box.
- New Address Dialog Box:** A small window titled 'New Address' with the following fields:
  - Address:** 192.168.88.1/24 (highlighted with a red box)
  - Network:** (empty dropdown)
  - Interface:** ether2 (highlighted with a red box)Buttons for 'OK', 'Cancel', and 'Apply' are visible on the right.

# Konfigurasi LAN - Laptop

- Setting IP address pada leptop



IP Leptop satu jaringan dengan IP interface Mikrotik

Gateway Leptop adalah IP interface Mikrotik

DNS Public google

# Konfigurasi WAN – Addressing Router

- Ada 2 metode untuk addressing pada interface WAN
  1. Static IP
  2. Dynamic IP (DHCP Client)
- Untuk static IP diperlukan beberapa konfigurasi sebagai berikut;
  - IP address
  - Subnetmask
  - Gateway
  - DNS
- Sedangkan bila kita menggunakan Dynamic IP, hanya cukup request DHCP Client, maka secara otomatis router akan mendapat beberapa parameter seperti IP address, subnetmask, gateway, dan DNS

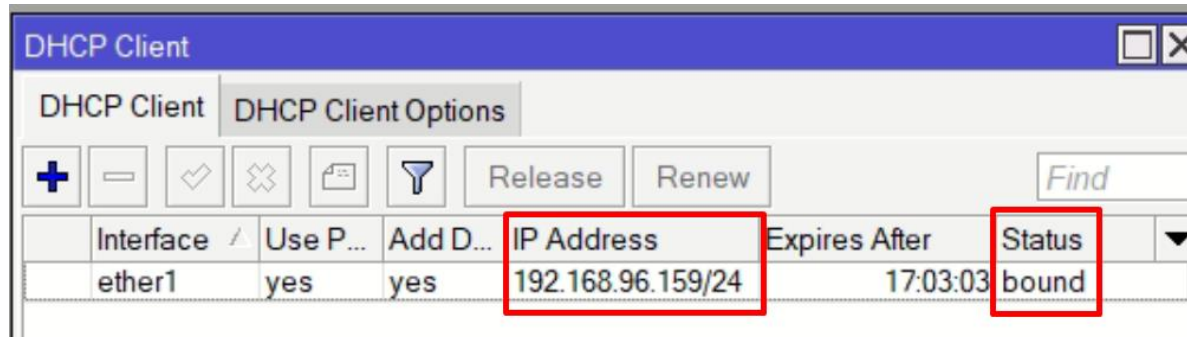
# Konfigurasi WAN - Addressing (DHCP Client)

- Untuk addressing secara dynamic, bisa memanfaatkan fitur DHCP Client melalui IP > DHCP Client

The screenshot displays the Mikrotik WinBox interface. On the left, the 'IP' menu is highlighted, and the 'DHCP Client' option is selected. The main window shows the 'DHCP Client' configuration page. A red box highlights the '+' button in the 'Interface' column of the table. A red arrow points from this button to a dialog box titled 'DHCP Client <ether1>'. In this dialog, the 'Interface' dropdown is set to 'ether1', which is also highlighted with a red box. A yellow box with the text 'Interface ke WAN (Internet)' has an arrow pointing to the 'ether1' selection. The dialog also shows options for 'Use Peer DNS' and 'Use Peer NTP', both checked, and 'Add Default Route' set to 'yes'.

# Verifikasi - Addressing (DHCP Client)

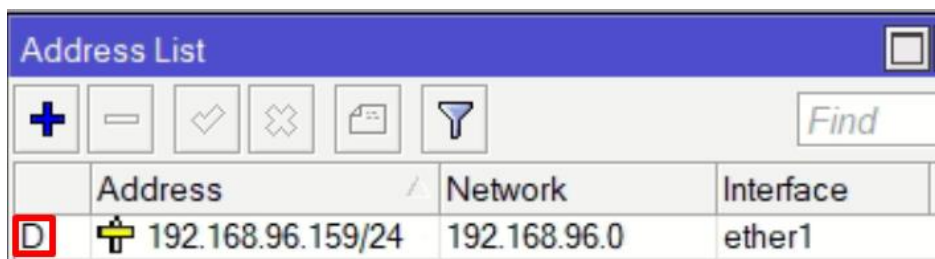
- Tandanya kita sudah berhasil request IP melalui DHCP Client adalah munculnya status “bound”



Interface	Use P...	Add D...	IP Address	Expires After	Status
ether1	yes	yes	192.168.96.159/24	17:03:03	bound

- Selain itu kita juga bisa melihat flag D (Dynamic address)

IP > address

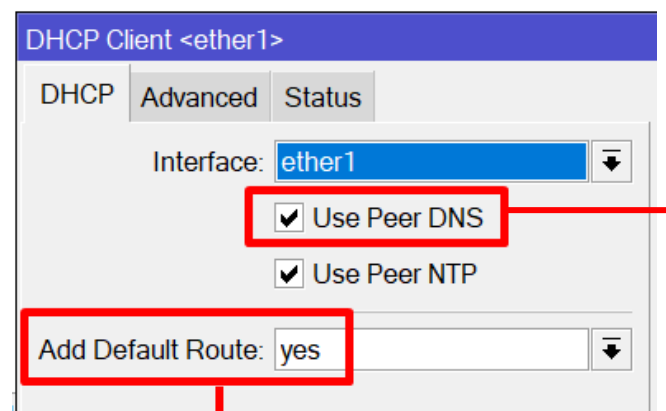


Address	Network	Interface
192.168.96.159/24	192.168.96.0	ether1

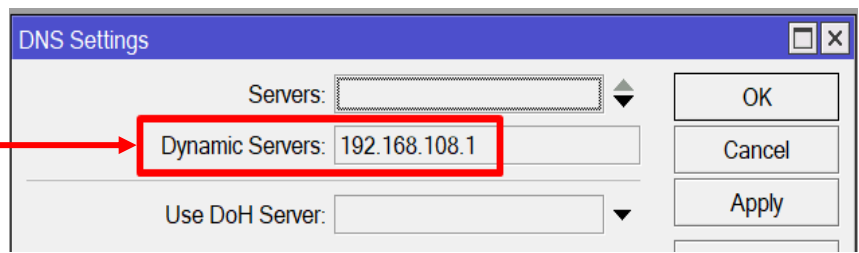
Menandakan bahwa router mendapat alokasi IP secara otomatis melalui DHCP Client

## Verifikasi - Addressing (DHCP Client)

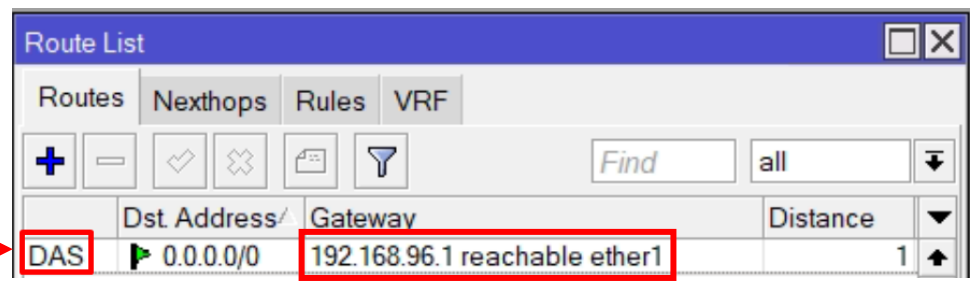
- Secara default bila mengaktifkan opsi “Use Peer DNS” dan “Add Default Route=yes” maka router secara otomatis akan mendapatkan DNS dan IP gateway dari Internet



IP > DNS



IP > Routes



# Verifikasi - Ping ke Internet melalui Router

- Ping dari Router ke Internet

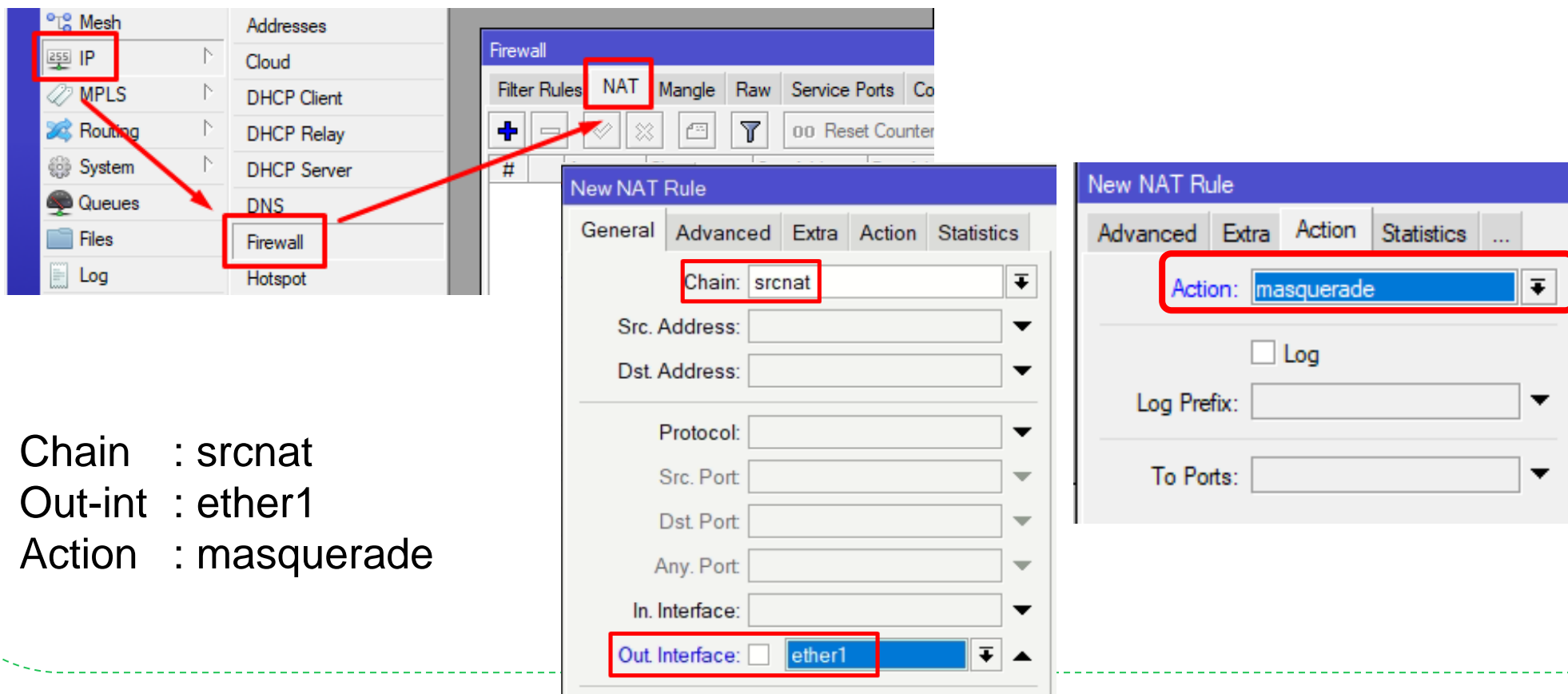
New Terminal

```
[admin@candra] > ping google.com
```

SEQ	HOST	SIZE	TTL	TIME	STATUS
0	74.125.68.100	56	40	32ms	
1	74.125.68.100	56	40	124ms	
2	74.125.68.100	56	40	207ms	
3	74.125.68.100	56	40	150ms	
4	74.125.68.100	56	40	72ms	
5	74.125.68.100	56	40	175ms	
6	74.125.68.100	56	40	32ms	
7	74.125.68.100	56	40	40ms	
8	74.125.68.100	56	40	61ms	

# Konfigurasi WAN – NAT

- NAT (Network Address Translation) digunakan untuk menghubungkan client yang ada di jaringan lokal (LAN) supaya dapat terhubung ke jaringan public (Internet)



Chain : srcnat  
Out-int : ether1  
Action : masquerade



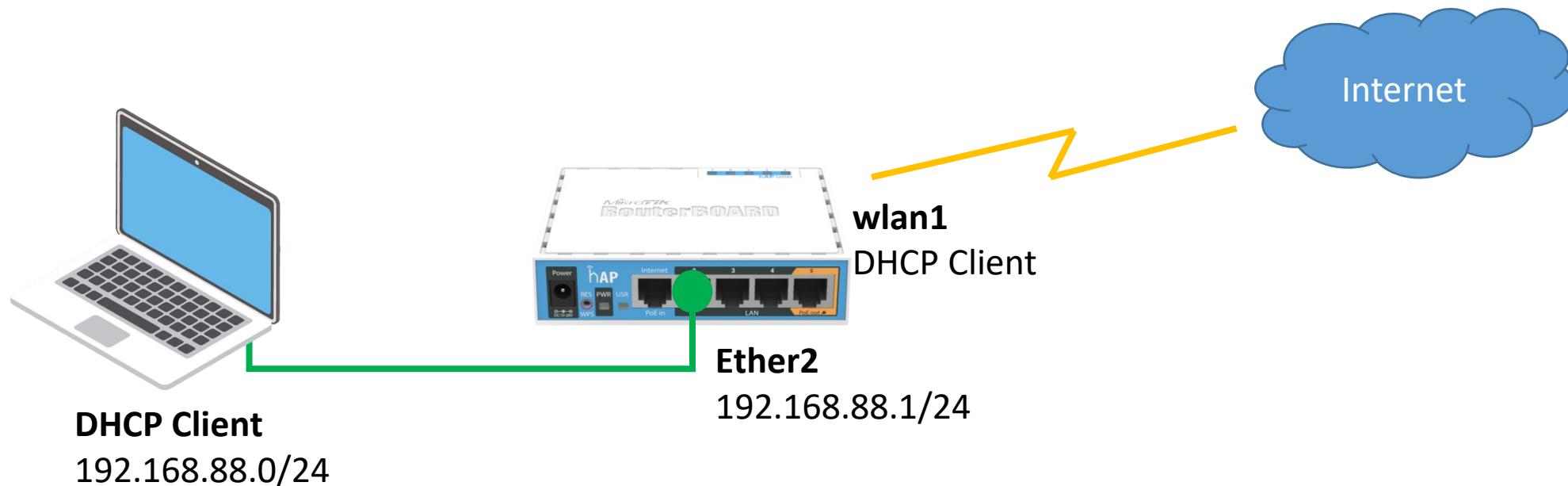
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# **INTERNET ACCESS VIA WIRELESS**

## **MIKROTIK MTCNA**

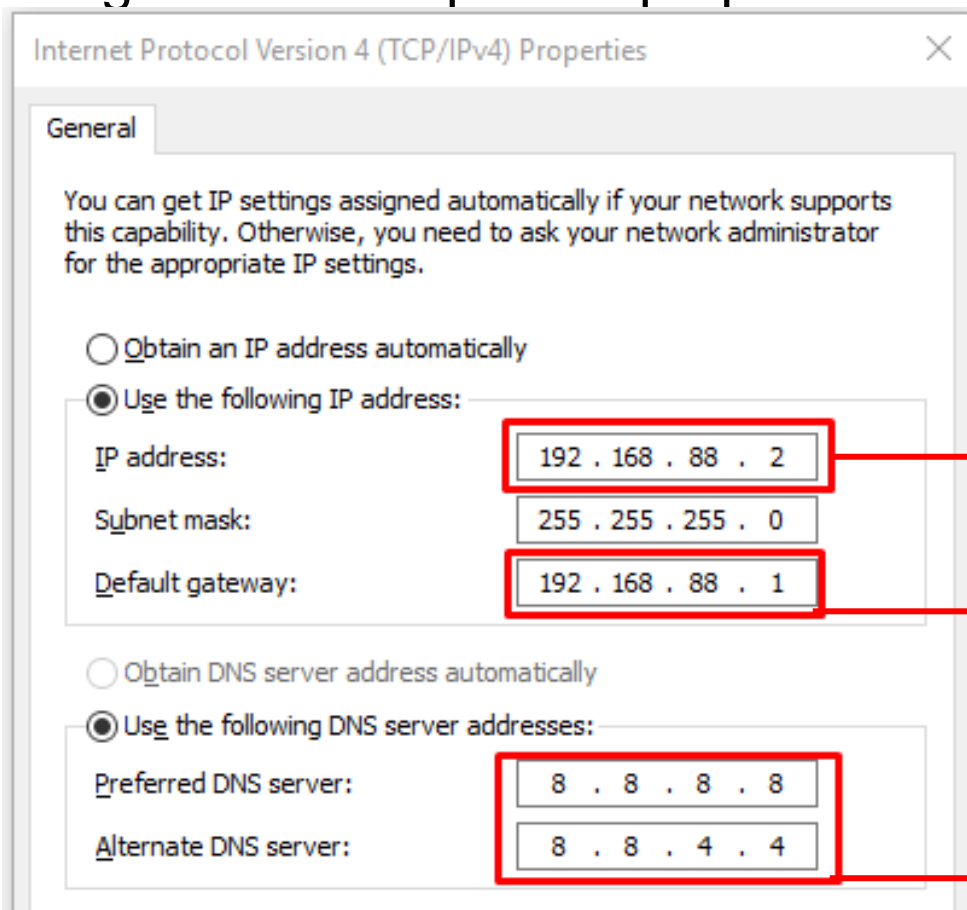
# Internet Access via Wireless

- Belajar mengkoneksikan router mikrotik ke internet via wireless
- Koneksikan port LAN laptop ke ether2
- Disable wireless interface di laptop



# Konfigurasi LAN - Laptop

- Setting IP address pada leptop



IP Laptop satu jaringan dengan IP interface Mikrotik

Gateway Leptop adalah IP interface Mikrotik

DNS Public google

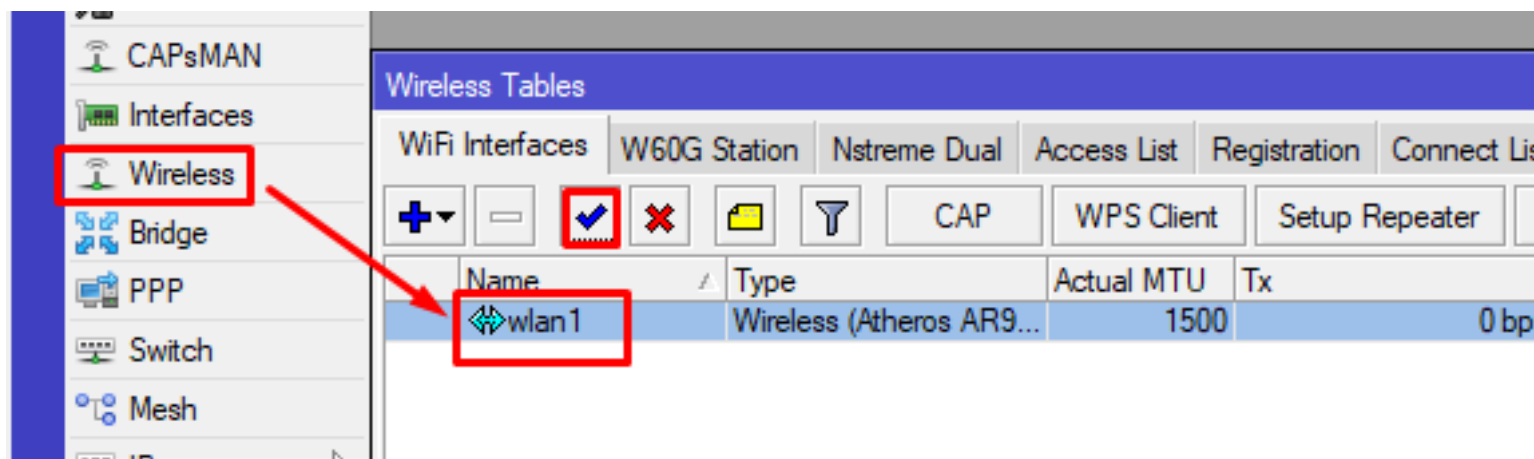
# Konfigurasi LAN - Router

- Setting IP address pada router

The screenshot shows the Mikrotik WinBox interface. On the left sidebar, the 'IP' menu item is highlighted with a red box. A red arrow points from this box to the 'Addresses' menu item in the main menu, which is also highlighted with a red box. Another red arrow points from the 'Addresses' box to a '+' icon in the 'Address List' window, which is also highlighted with a red box. Below this, a 'New Address' dialog box is open, with its input fields highlighted by a red box. The 'Address' field contains '192.168.88.1/24', the 'Interface' field contains 'ether2', and the 'Network' field is empty. The dialog box has 'OK', 'Cancel', and 'Apply' buttons.

# Konfigurasi WAN - Wireless

- Default penamaan untuk Interface wireless di mikrotik adalah wlan1 (Wireless LAN Interface)
- By default setelah router di reset interface tersebut dalam keadaan disable
- Enable interface tersebut melalui menu Wireless > checklist wlan1



# Konfigurasi WAN - Security Profile

- Wireless Security Profile merupakan tempat untuk menyimpan password yang nantinya digunakan untuk konek ke suatu SSID AP.
- Buat password di Wireless > Security profile untuk konek ke AP yang akan di koneksikan.

New Security Profile

General RADIUS EAP Static Keys

Name: profile 1-mtcna

Mode: dynamic keys

Authentication Types:  WPA PSK  WPA2 PSK  
 WPA EAP  WPA2 EAP

Unicast Ciphers:  aes ccm  tkip

Group Ciphers:  aes ccm  tkip

WPA Pre-Shared Key: mtcna123

WPA2 Pre-Shared Key: mtcna123

OK Cancel Apply Comment Copy Remove

Nama Security Profile yang akan di buat.

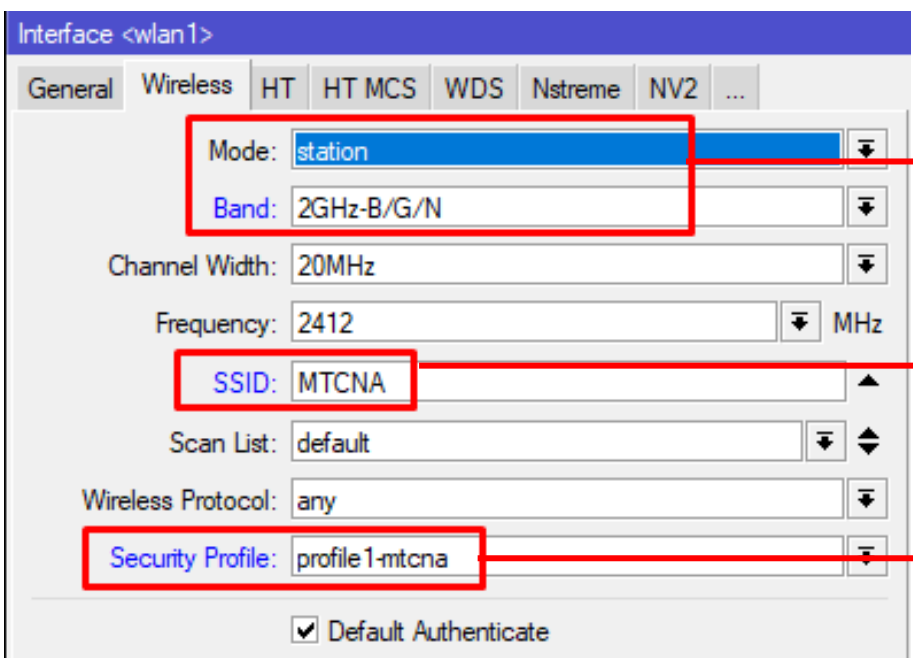
Password dari SSID yang akan di koneksi.

\*password harus sama dengan AP

# Konfigurasi WAN – Mode Station (1)

- Wireless mikrotik bisa kita fungsikan sebagai station (penerima sinyal) dengan merubah parameter mode di menu wireless.
- Sesuaikan parameter lainnya (band, frekuensi, security profile sesuai AP).

Double klik wlan1 > Wireless Tab



Mode: station  
Band: 2GHz-B/G/N  
Channel Width: 20MHz  
Frequency: 2412 MHz  
SSID: MTCNA  
Scan List: default  
Wireless Protocol: any  
Security Profile: profile1-mtcna  
 Default Authenticate

Mode = Station (penerima)  
Band = sesuai band AP

SSID = menyesuaikan dengan SSID AP

Pasang Security Profile yang sebelumnya dibuat

# Konfigurasi WAN – Mode Station (2)

- Untuk mempermudah konek ke AP bisa menggunakan tool scan

Scanner (Running)

Interface: *wlan1*

Background Scan

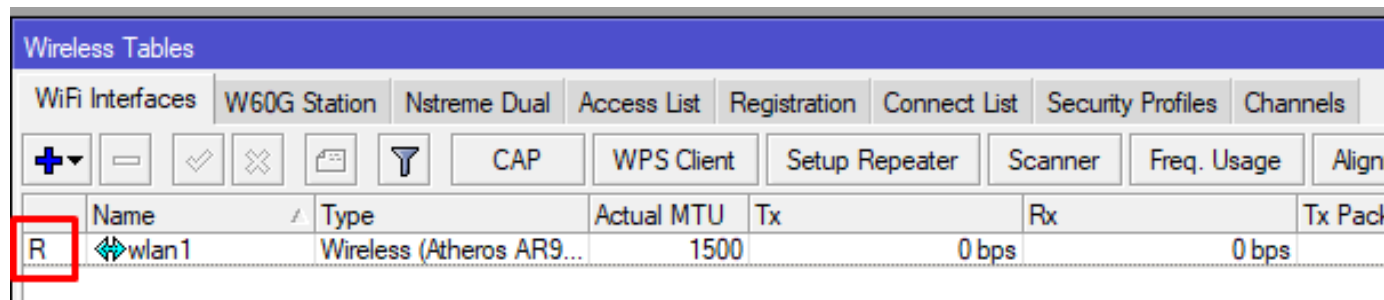
Start  
Stop  
Close  
Connect  
New Window

	Address	SSID	Channel	Signa...	Noise...	Signa...	Radio Name	RouterO...
APRB	CE:2D:E0:DF:DA:E3	MTCNA	2412/20/gn	-39	-118	79	CC2DE0DFDAE3	6.43.8
APRB	CC:2D:E0:DF:DA:E3	IDN	2412/20/gn	-39	-118	79	CC2DE0DFDAE3	6.43.8
AP	5C:93:A2:BE:EE:ED	up	2412/20/g	-83	-118	35		
AP	0E:A8:A7:0E:7F:E4	AndroidAP7FE4	2437/20/gn	-88	-107	19		
AP	4A:88:CA:6A:00:70	Lenovo A7010	2437/20/gn	-88	-107	19		
ARB	CE:2D:E0:C3:F5:0F	NOVAL RIDHA	2412/20/gn	-66	-118	52	CC2DE0C3F50F	6.43.12
ARB	CE:2D:E0:C3:F4:8B	angga aadt	2412/20/gn	-62	-118	56	CC2DE0C3F48B	6.43.12

Pilih SSID yang akan di koneksikan kemudian klik tombol Connect

# Konfigurasi WAN – Station Mode (Verifikasi)

- Pastikan Wireless sudah terkoneksi



Wireless Tables

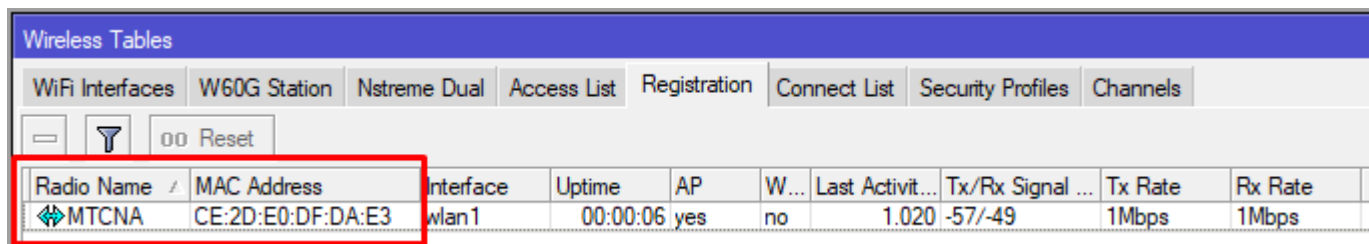
WiFi Interfaces W60G Station Nstreme Dual Access List Registration Connect List Security Profiles Channels

+ - ✓ ✗ CAP WPS Client Setup Repeater Scanner Freq. Usage Align

	Name	Type	Actual MTU	Tx	Rx	Tx Pack
R	wlan1	Wireless (Atheros AR9...	1500	0 bps	0 bps	

Huruf **R** (Running), menandakan wireless telah terkoneksi.

- AP yang terkoneksi akan terdaftar di menu Registration



Wireless Tables

WiFi Interfaces W60G Station Nstreme Dual Access List Registration Connect List Security Profiles Channels

oo Reset

Radio Name	MAC Address	Interface	Uptime	AP	W...	Last Activit...	Tx/Rx Signal ...	Tx Rate	Rx Rate
MTCNA	CE:2D:E0:DF:DA:E3	wlan1	00:00:06	yes	no	1.020	-57/-49	1Mbps	1Mbps

# Konfigurasi WAN – Request DHCP Client (1)

- Walaupun wireless sudah terkoneksi ke AP, router belum dapat akses ke internet. Hal ini dikarenakan router belum mendapat IP secara otomatis dari AP.
- Sehingga kita perlu request IP address dari AP melalui menu IP > DHCP > Client.

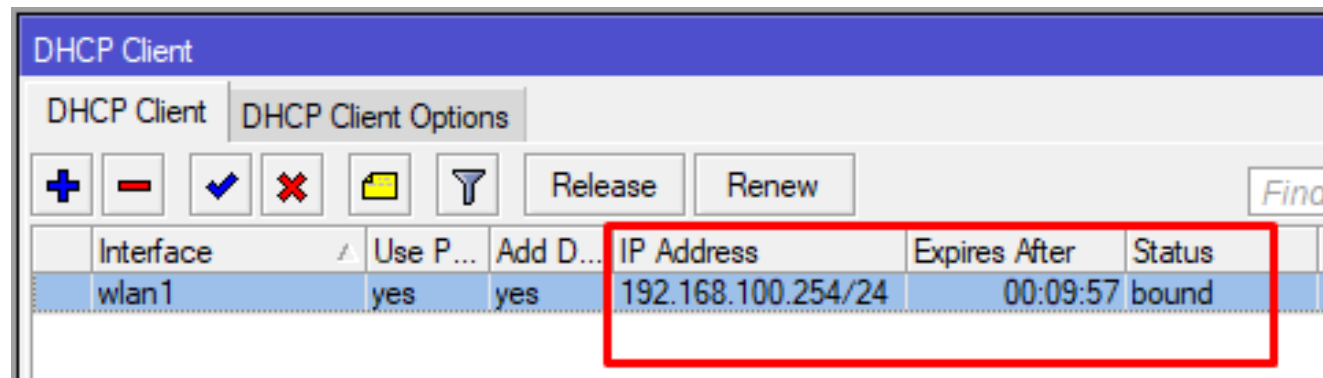
The screenshot shows the Mikrotik WinBox interface. On the left, the 'IP' menu is expanded, and 'DHCP Client' is selected. The main window displays the 'DHCP Client' configuration page. A red box highlights the '+' button to add a new client. A 'New DHCP Client' dialog box is open, showing the 'Interface' dropdown set to 'wlan1'. Two checkboxes, 'Use Peer DNS' and 'Use Peer NTP', are checked. The 'Add Default Route' dropdown is set to 'yes'. Red arrows point from these elements to yellow callout boxes on the right.

Interface ke WAN (Internet)

Set agar DNS, NTP dan default route otomatis didapatkan dari server

# Konfigurasi WAN – Request DHCP Client (2)

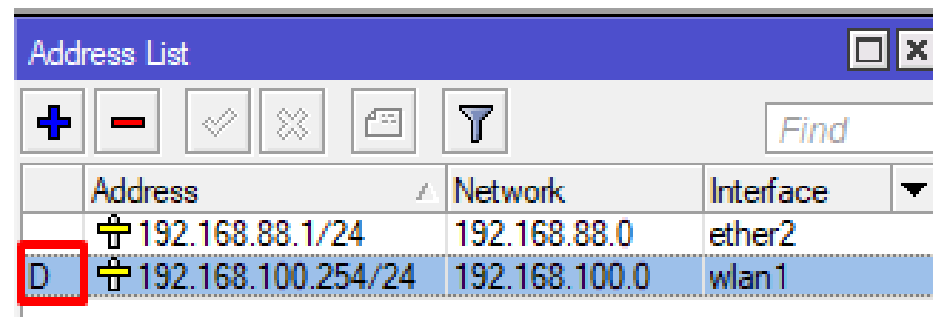
- Pastikan mendapat status bound, menandakan bahwa wlan1 sudah mendapatkan IP address dari AP



The screenshot shows the DHCP Client configuration window in Mikrotik WinBox. The 'DHCP Client Options' tab is active. A table lists the DHCP client configuration for the 'wlan1' interface. The 'IP Address' column shows '192.168.100.254/24' and the 'Status' column shows 'bound'. A red box highlights the IP Address and Status columns.

Interface	Use P...	Add D...	IP Address	Expires After	Status
wlan1	yes	yes	192.168.100.254/24	00:09:57	bound

- Pada menu IP Address terdapat dynamic IP address ada wlan1



The screenshot shows the Address List window in Mikrotik WinBox. The table lists the IP addresses assigned to the interfaces. The 'wlan1' interface has a dynamic IP address '192.168.100.254/24' assigned to it. A red box highlights the dynamic IP address entry.

Address	Network	Interface
192.168.88.1/24	192.168.88.0	ether2
D 192.168.100.254/24	192.168.100.0	wlan1

# Verifikasi Ping ke Internet melalui Router

- Ping dari Router ke Internet
- New Terminal

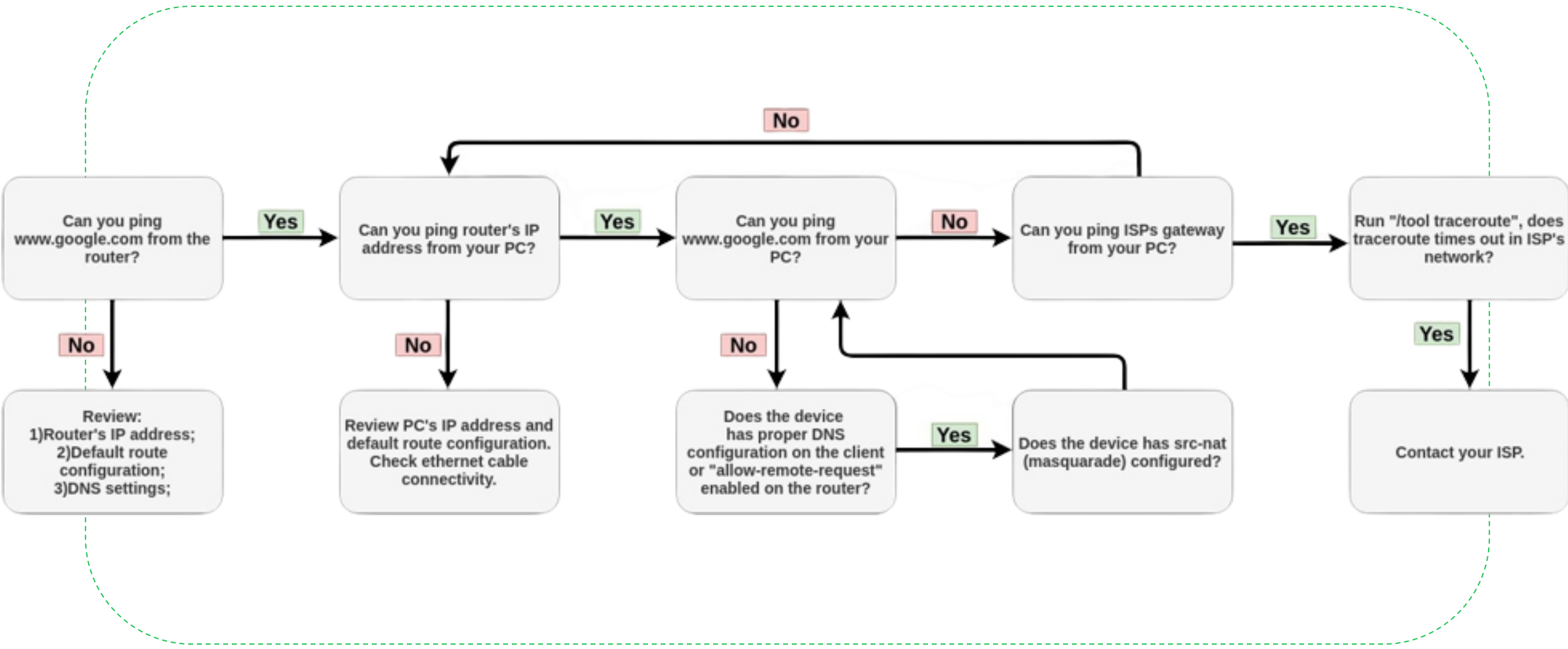
```
[admin@candra] > ping google.com
```

SEQ	HOST	SIZE	TTL	TIME	STATUS
0	74.125.68.100	56	40	32ms	
1	74.125.68.100	56	40	124ms	
2	74.125.68.100	56	40	207ms	
3	74.125.68.100	56	40	150ms	
4	74.125.68.100	56	40	72ms	
5	74.125.68.100	56	40	175ms	
6	74.125.68.100	56	40	32ms	
7	74.125.68.100	56	40	40ms	
8	74.125.68.100	56	40	61ms	

# Konfigurasi WAN – NAT

Chain : srcnat  
Out-int : wlan1  
Action : masquerade

# Troubleshooting





**ID-Networkers**  
Indonesian IT Expert Factory

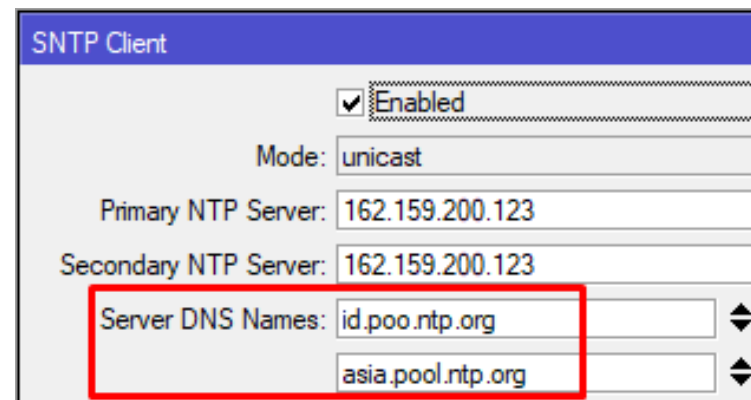
# **NTP**

# **MIKROTIK MTCNA**

# NTP (Network Time Protocol)

- NTP digunakan untuk sinkronisasi waktu antar router/server lainnya.
- Kebanyakan RouterBoard tidak memiliki battery untuk clock internal (kecuali RB230 dan powerpc)
- Terdapat 2 jenis NTP :
  - NTP Server (Penyedia)
  - NTP Client (Penerima)
- NTP juga bisa diarahkan ke public NTP Server seperti id.pool.ntp.org atau asia.pool.ntp.org.

- Konfigurasinya melalui  
System > SNTP Client



The screenshot shows the Mikrotik SNTP Client configuration window. The 'Enabled' checkbox is checked. The 'Mode' is set to 'unicast'. The 'Primary NTP Server' and 'Secondary NTP Server' are both set to '162.159.200.123'. The 'Server DNS Names' field is highlighted with a red box and contains two entries: 'id.pool.ntp.org' and 'asia.pool.ntp.org'.



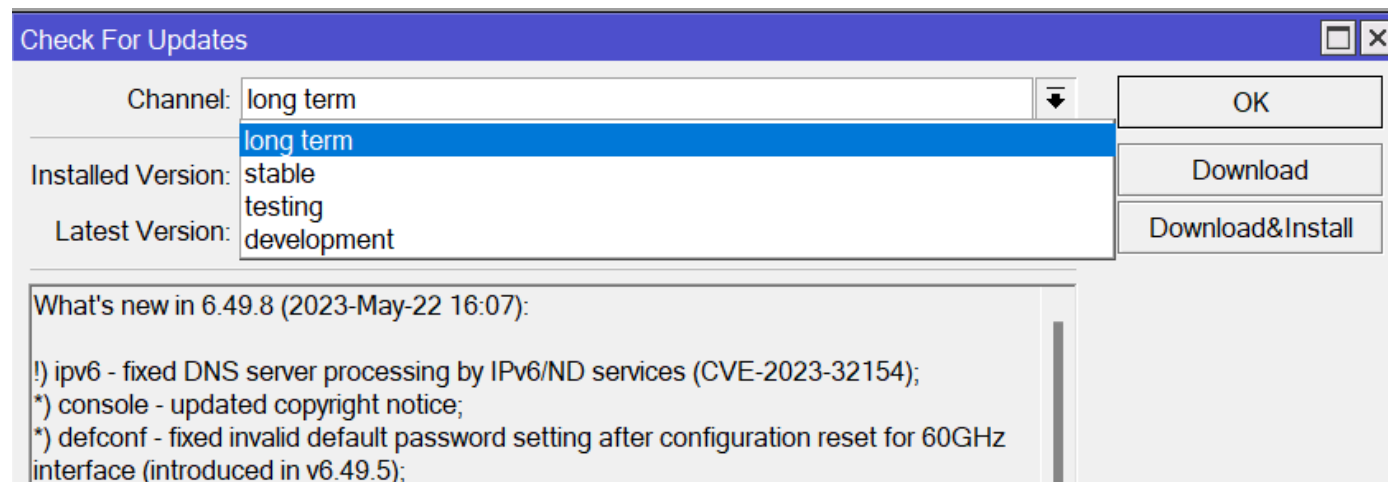
**ID-Networkers**  
Indonesian IT Expert Factory

# MANAGEMENT FITUR ROUTER MIKROTIK MTCNA

# RouterOS Releases

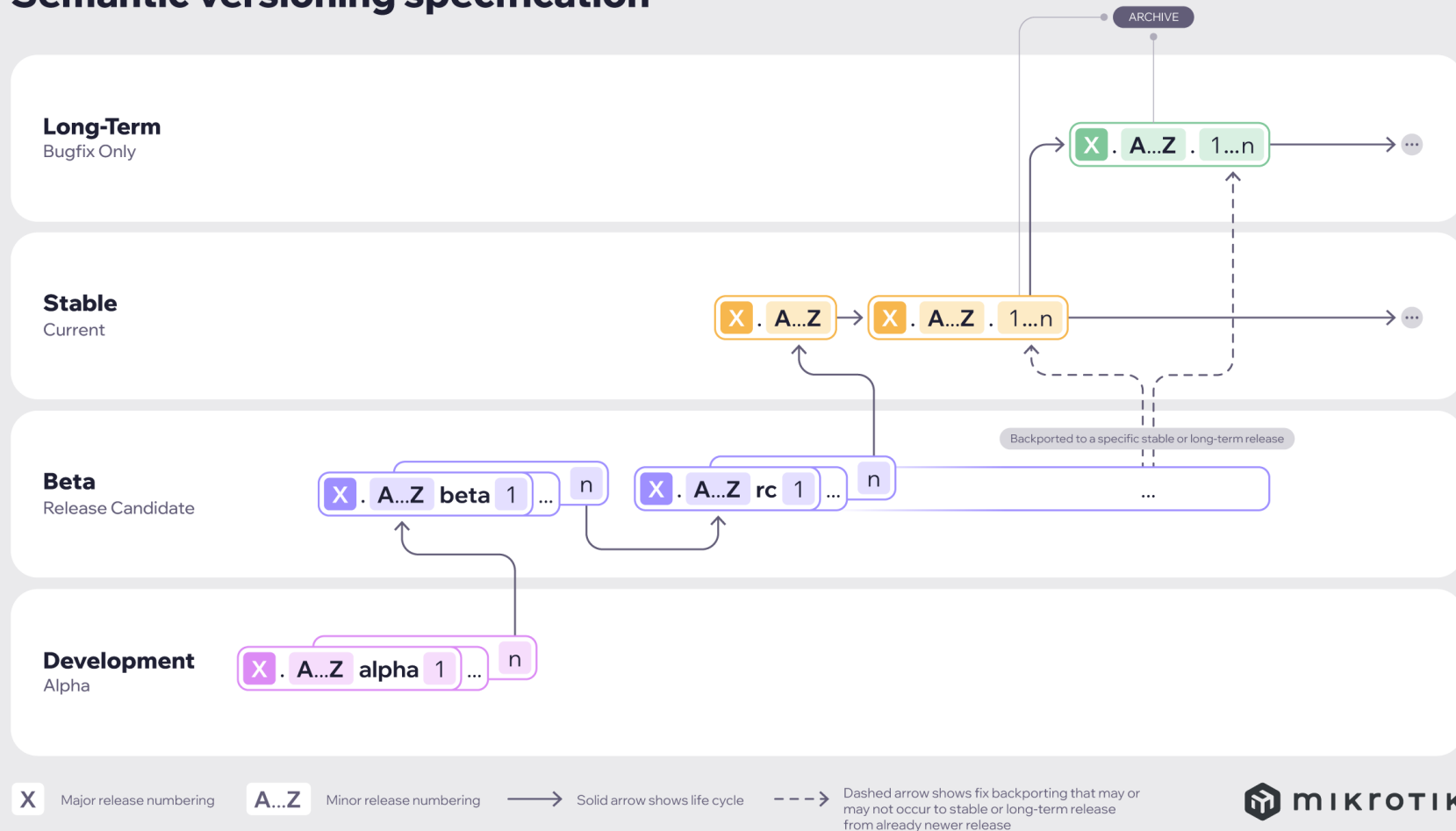
- long term : versi yang jarang direlease, versi perbaikan dari Stable.
- stable : release tiap bulan and new features release.
- testing : release tiap minggu, hanya untuk internal testing tidak direkomendasikan diinstall direal production.
- development : release bila diperlukan. is available for software enthusiasts for testing new features.

System > Packages > Check  
For Updates



# RouterOS Releases

## Semantic versioning specification



# Upgrade RouterOS

- Upgrade digunakan untuk fix bugs, security update, new feature dll.
- Untuk alasan security Mikrotik menyarankan agar selalu melakukan upgrade router ke versi terbaru.
- Upgrade harus memperhatikan aturan level dan lisensi yang berlaku.
- Selain itu juga harus memperhatikan kompatibilitas terhadap jenis arsitektur hardware.
- Upgrade ada 2 cara :
  - Upgrade from router (**internet required**)
  - Manual Upgrade

# Upgrade RouterOS – Upgrade from Router

- Pastikan router sudah punya akses internet dan bisa resolve domain.
- Upgrade melalui menu **System > Packages**

The screenshot displays the Mikrotik WinBox interface. On the left, the 'System' menu is expanded, and the 'Packages' option is highlighted with a red box. A red arrow points from 'Packages' to the 'Check For Updates' button in the 'Package List' window. The 'Package List' window shows a table with the following data:

Name	Version	Build Time	Scheduled
routeros-mipsbe	6.44.6	Oct/24/2019 09:37:41	
advancedt...	6.44.6	Oct/24/2019 09:37:41	

Below the table, the 'Check For Updates' dialog box is open. The 'Channel' dropdown is set to 'long term', and the 'Download&Install' button is highlighted with a red box. The dialog also shows the 'Installed Version' as 'stable' and the 'Latest Version' as 'development'. Below the dialog, the 'What's new in 6.46.8 (2020-Oct-29 8:29):' section is visible, listing changes since 6.46.7:

- \*) cap - fixed L2MTU path discovery;
- \*) chr - fixed file system quiescing;
- \*) crs3xx - fixed IGMP snooping for CRS312, CRS326-24S+2Q+ and CRS354 devices;
- \*) crs3xx - fixed switch rules for CRS309 and CRS317 devices (introduced in v6.46.7);
- \*) crs3xx - improved system stability on CRS354 devices;
- \*) defconf - fixed default configuration loading on RBmAP-2nD;
- \*) defconf - improved default configuration operation on devices with changed wireless

# Upgrade RouterOS – Manual Upgrade

- Upgrade ini dilakukan dengan mengupload beberapa packages ke router.
- Packages bisa didownload di situs mikrotik <https://mikrotik.com/download>
- Pemilihan paket harus memperhatikan jenis & arsitektur hardware pada router.
- Disarankan untuk mendownload yang versi Long Term / Stable.
- Untuk manual upgrade bisa melalui beberapa cara sebagai berikut :
  - FTP (package harus di upload dibagian root directory).
  - Winbox (drag n drop) dari komputer ke winbox menggunakan protocol TCP Port 8291.
  - WebFig (upload files from files menu)

# Main Package

- Main Package berisi fitur standard RouterOS (wireless, dhcp, ppp, routing, etc.)
- Untuk mendownload Main Packages bisa melalui link berikut [www.mikrotik.com/download](http://www.mikrotik.com/download)

The screenshot shows the Mikrotik website's 'Software' section. The 'Downloads' link is highlighted in the navigation bar. Below it, the 'RouterOS v6' section is visible, with two columns for '6.49.8 Long-term' and '6.49.10 Stable'. Under the '6.49.8 Long-term' column, the 'Main package' link is highlighted with a red box, and a download icon is visible next to it. The 'Extra packages' link is also visible below it.

	6.49.8 Long-term	6.49.10 Stable
ARM		
<b>Main package</b>		
Extra packages		

# Extra Packages

- Berisi fitur-fitur tambahan untuk router (user-manager, gps, ntp, ups, dll)
- Untuk menambahkan extra packages ke dalam router, caranya download extra packages, kemudian ekstrak dan upload salah satu packages ke dalam router. Terakhir reboot router

The screenshot shows the Mikrotik website's software download page. The 'Downloads' link in the navigation bar is highlighted with a red box. Below it, a table lists download links for RouterOS v6. The table has two columns for versions: '6.49.8 Long-term' and '6.49.10 Stable'. Under the '6.49.10 Stable' column, the 'Extra packages' link is highlighted with a red box.

	6.49.8 Long-term	6.49.10 Stable
ARM		
Main package		
Extra packages		

- Untuk penambahan packages/fitur harus memperhatikan versi OS yang sama dengan fitur yang nantinya mau kita tambahkan.

# Manual Upgrade RouterOS

- Check type arsitektur di router.

System > Resources

Architecture Name:	mipsbe
Board Name:	hAP
Version:	6.43.8 (stable)
Build Time:	Dec/21/2018 07:10:42
Factory Software:	6.40

- Download extra packages di situs [mikrotik.com/download](http://mikrotik.com/download) sesuai type arsitektur. (misal arsitektur yang digunakan MIPSBE).

	6.42.12 (Long-term)	6.44 (Stable)	6.44rc4 (Testing)
<b>MIPSBE</b>	CRS1xx, CRS2xx, DISC, FiberBox, hAP, hAP ac, hAP ac lite, LDF, LHG, ItAP mini, mANTBox, mAP, NetBox, NetMetal, PowerBox, PWR-Line, QRT, RB9xx, SXTsq, cAP, hEX Lite, RB4xx, wAP, BaseBox, DynaDish, RB2011, SXT, OmniTik, Groove, Metal, Sextant, RB7xx		
Main package			
Extra packages			
<b>SMIPS</b>	hAP mini, hAP lite		

# Manual Upgrade RouterOS - Winbox

- Ekstrak packages yang tadi di download, dan hasilnya di drag n drop ke router

The screenshot shows the Mikrotik WinBox interface. On the left, a file list displays various NPK packages for RouterOS version 6.44. A red box highlights the list. On the right, a 'File List' dialog box is open, showing a file named 'system-6.44-mipsbe.npk' being uploaded. A red arrow points from the 'system-6.44-mipsbe.npk' entry in the file list to the 'Uploading Files' dialog box.

Name	Date modified	Type
advanced-tools-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
calea-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
dhcp-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
gps-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
hotspot-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
ipv6-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
lcd-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
lte-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
mpls-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
multicast-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
ntp-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
openflow-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
ppp-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
routing-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
security-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
system-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
tr069-client-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
ups-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
user-manager-6.44-mipsbe.npk	26/02/2019 9:13	NPK File
wireless-6.44-mipsbe.npk	26/02/2019 9:13	NPK File

File Name	Type	Size	Creation Time
auto-befo			2/22/2019 16:55:35
hotspot			2/22/2019 10:48:38
hotspot			2/22/2019 10:48:38
hotspot			2/22/2019 10:48:38
hotspot			2/22/2019 10:48:38
hotspot			2/22/2019 10:48:38
hotspot			2/22/2019 10:48:38
hotspot/hotspot-IDN/hotspot	directory		Feb/22/2019 13:07:55
hotspot/hotspot-IDN/hots...	.html file	2399 B	Feb/22/2019 13:07:55
hotspot/hotspot-IDN/hots...	.html file	898 B	Feb/22/2019 13:07:55
hotspot/hotspot-IDN/hots...	.txt file	3615 B	Feb/22/2019 13:07:55
hotspot/hotspot-IDN/hots...	.png file	14.3 KB	Feb/22/2019 13:07:55
hotspot/hotspot-IDN/hots...	.css file	2622 B	Feb/22/2019 13:07:55
hotspot/hotspot-IDN/hots...	.html file	2403 B	Feb/22/2019 13:07:55
hotspot/hotspot-IDN/hots...	.html file	1813 B	Feb/22/2019 13:07:55

- Reboot Router (System > Reboot)

# Manual Upgrade RouterOS - Winbox

- Check Versi router
- System > Resources

The screenshot shows the 'Resources' window in Mikrotik Winbox. The window displays various system metrics and hardware information. A red box highlights the 'Architecture Name', 'Board Name', 'Version', 'Build Time', and 'Factory Software' fields. A red arrow points from the 'Version' field in the highlighted box to a larger, magnified view of the same fields on the right.

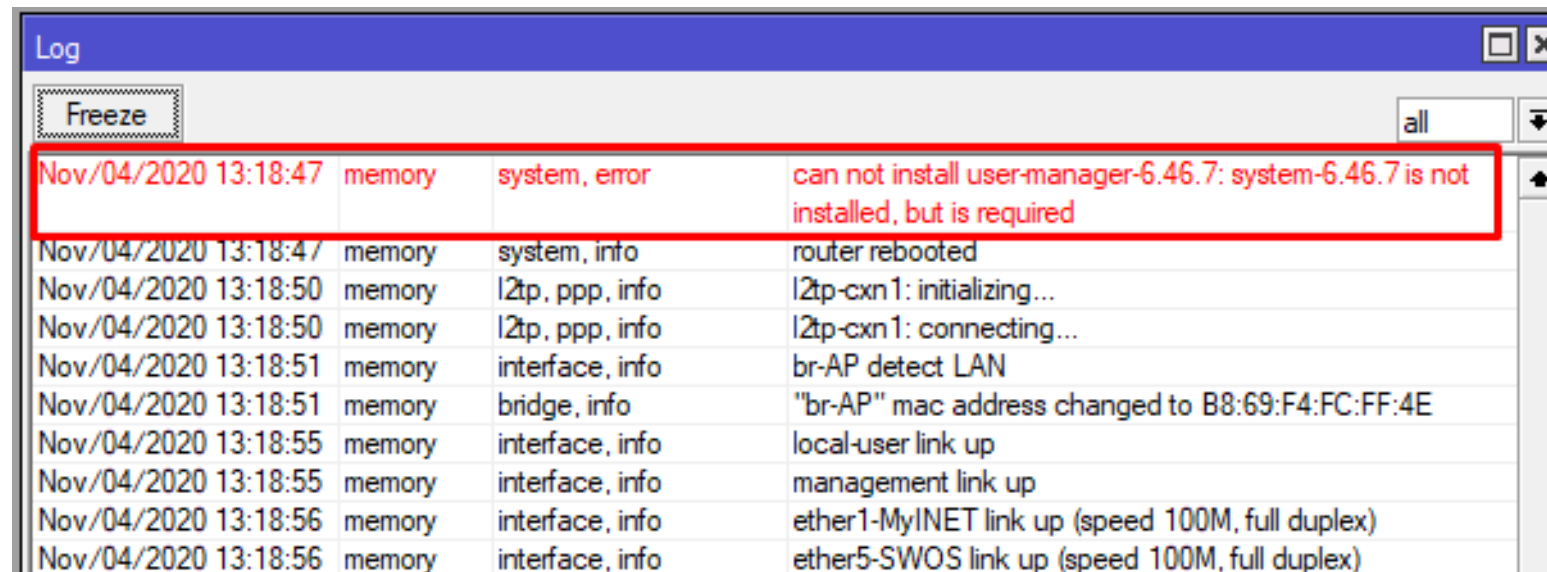
Field	Value
Uptime	00:19:56
Free Memory	40.6 MiB
Total Memory	64.0 MiB
CPU	MIPS 24Kc V7.4
CPU Count	1
CPU Frequency	400 MHz
CPU Load	1 %
Free HDD Space	98.5 MiB
Total HDD Size	128.0 MiB
Sector Writes Since Reboot	525
Total Sector Writes	274 293
Bad Blocks	0.6 %
Architecture Name	mipsbe
Board Name	RB951-2n
Version	6.44 (stable)
Build Time	Feb/25/2019 14:11:04
Factory Software	

This is a magnified view of the system information fields from the Resources window. The 'Version' field, containing '6.44 (stable)', is highlighted with a red box. A red arrow points from this box to the 'Version' field in the Resources window screenshot on the left.

Architecture Name:	mipsbe
Board Name:	RB951-2n
Version:	6.44 (stable)
Build Time:	Feb/25/2019 14:11:04
Factory Software:	

# Troubleshooting - Upgrade Router

- Versi masih sama ?
- Upload diskonek ?
- Packages tidak terinstall ?














The screenshot shows a 'Log' window with a 'Freeze' button and a search filter set to 'all'. The log entries are as follows:

Time	Source	Level	Message
Nov/04/2020 13:18:47	memory	system, error	can not install user-manager-6.46.7: system-6.46.7 is not installed, but is required
Nov/04/2020 13:18:47	memory	system, info	router rebooted
Nov/04/2020 13:18:50	memory	l2tp, ppp, info	l2tp-cxn1: initializing...
Nov/04/2020 13:18:50	memory	l2tp, ppp, info	l2tp-cxn1: connecting...
Nov/04/2020 13:18:51	memory	interface, info	br-AP detect LAN
Nov/04/2020 13:18:51	memory	bridge, info	"br-AP" mac address changed to B8:69:F4:FC:FF:4E
Nov/04/2020 13:18:55	memory	interface, info	local-user link up
Nov/04/2020 13:18:55	memory	interface, info	management link up
Nov/04/2020 13:18:56	memory	interface, info	ether1-MyINET link up (speed 100M, full duplex)
Nov/04/2020 13:18:56	memory	interface, info	ether5-SWOS link up (speed 100M, full duplex)

# Management Packages

- Fitur-fitur routerOS tergantung dari packages yang di install
- Setiap packages memiliki fitur yang berbeda-beda

System > Packages

Package List								
	Check For Updates	Enable	Disable	Uninstall	Unschedule	Downgrade	Check Installation	F
Name	Version	Build Time	Scheduled					
 advanced-tools	6.44.6	Oct/24/2019 09:37:41						
 dhcp	6.44.6	Oct/24/2019 09:37:41						
 hotspot	6.44.6	Oct/24/2019 09:37:41						
 multicast	6.44.6	Oct/24/2019 09:37:41						
 ntp	6.44.6	Oct/24/2019 09:37:41						
 ppp	6.44.6	Oct/24/2019 09:37:41						
 routing	6.44.6	Oct/24/2019 09:37:41						
 security	6.44.6	Oct/24/2019 09:37:41						
 system	6.44.6	Oct/24/2019 09:37:41						
 wireless	6.44.6	Oct/24/2019 09:37:41						

# Management Packages

Packages	Features
advanced-tools	Advanced ping tools (flood-ping, ping-speed), netwatch, ip-scan, SMS tools, Wake-on-LAN
dhcp	Dynamic Host Control Protocol client and server
hotspot	HotSpot captive portal server for user management
ipv6	IPv6 addressing support
ppp	MIPP client, PPP, PPTP, L2TP, PPPoE, ISDN PPP clients and servers
routing	<b>Dynamic routing</b> protocols (RIP, BGP, OSPF and routing utilities like BFD, routing filter)
system	Basic router features like <b>static route</b> , IP Address, sNTP, telnet, API, queue, firewall, web proxy, DNS cache, TFTP, IP pool, SNMP, EoIP, IPIP, VLAN, bridge, VRRP dll

<https://wiki.mikrotik.com/wiki/Manual:System/Packages>



# Management Packages

Command	Description
disable	Menjadwalkan package untuk di disable ( <b>disable package = disable fitur</b> )
downgrade	downgrade versi OS (perlu mengupload RouterOS old version terlebih dahulu)
enable	Menjadwalkan package untuk di enable
uninstall	Menjadwalkan untuk menghapus package dari router ( <b>uninstall package = hapus fitur</b> )
unschedule	Remove schedule task for the package

Command diatas baru bisa dijalankan oleh router, setelah kita melakukan reboot/restart router

# Management Packages

- Perhatikan list menu yang ada di winbox
- Buka System Packages
- Disable MPLS Package
- Enable IPv6 Package
- Reboot router
- Check list menu yang ada di Winbox kembali.

# Downgrade

- Downgrade dilakukan apabila hardware kurang mendukung terhadap versi baru atau terdapat bug pada versi aktifnya.
- Downgrade harus memperhatikan kompatibilitas terhadap jenis arsitektur hardware.
- Untuk mendownload packages versi lama bisa melalui menu Download archive



Software

Downloads Changelogs Download archive RouterOS The Dude Mobile app

Long-term release tree

Release 6.46.8

2020-11-02

 routers-x86-6.46.8.npk	x86
 all_packages-x86-6.46.8.zip	x86
 mikrotik-6.46.8.iso	x86
 netinstall-6.46.8.zip	x86

# Downgrade

- Downgrade from router
  - System Packages > Check for Updates
  - Pilih channel yang berbeda (bug-fix only/Long term) / versi lebih lama.
  - Klik download & Install
- Manual Downgrade
  - Download packages versi sebelumnya dari web <https://mikrotik.com/download/archive>
  - Ekstrak kemudian upload ke dalam router
  - Masuk ke system Packages
  - Klik downgrade



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# **MANAGEMENT USER**

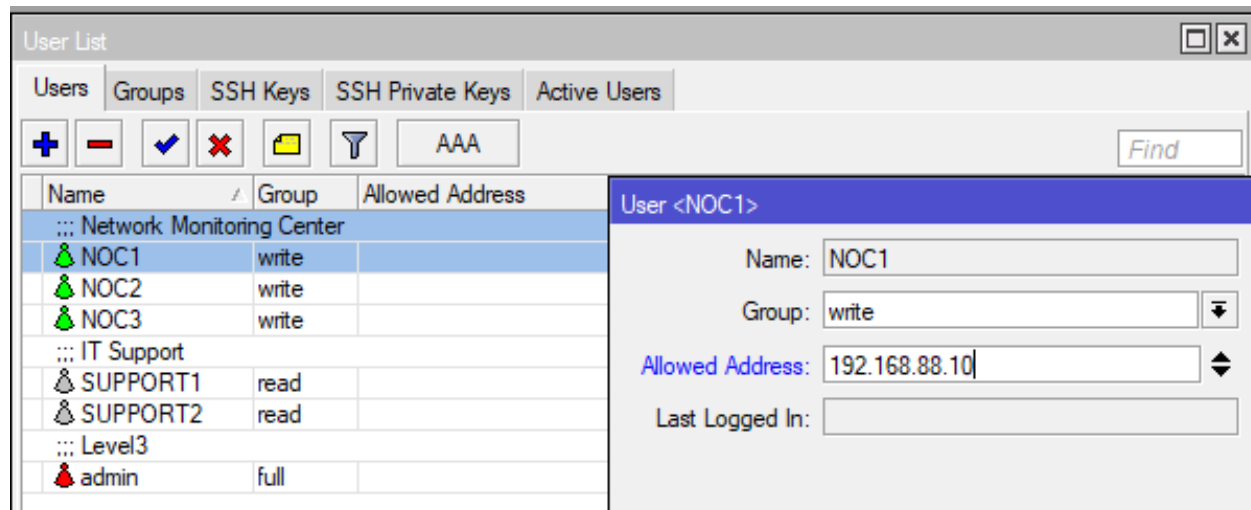
## **MIKROTIK MTCNA**

# RouterOS Login Management

- RouterOS Login Management digunakan untuk mengatur siapa saja yang diijinkan masuk kedalam router (Console, Serial terminal, Telnet, SSH, WebFig, Winbox).
- Untuk mengatur dan membuat siapa saja yang boleh masuk ke dalam router terdapat 2 option : lokal database dan RADIUS server.
- Manajemen user dilakukan dengan:
  - GROUP – profile pengelompokan user, menentukan privilege yang bisa diperoleh suatu user
  - USER – merupakan login (username & password dari suatu user)

# RouterOS Login Management - User

- By default mikrotik menggunakan user admin tanpa password untuk login.
- Selain itu kita bisa membuat user baru dan memberikan hak akses yang berbeda terhadap user tersebut.
- Dapat juga melakukan pembatasan berdasarkan IP address yang digunakannya.



The screenshot shows the Mikrotik WinBox 'User List' interface. It features a table of users and a detailed view for a selected user.

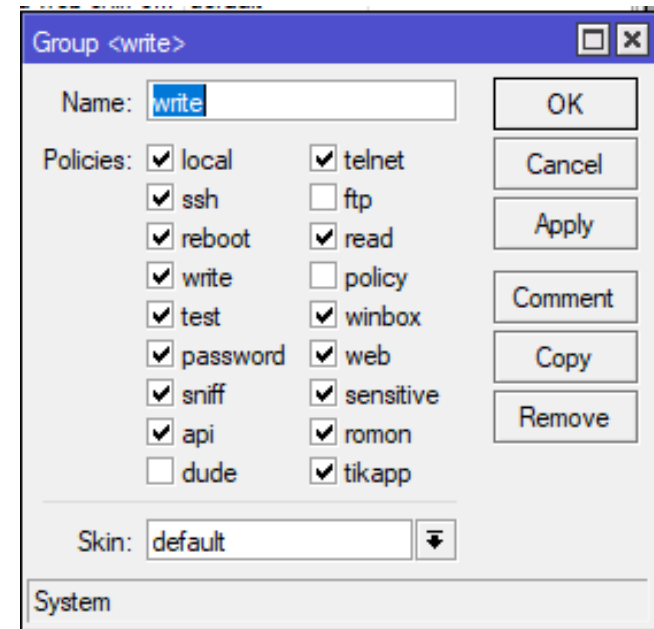
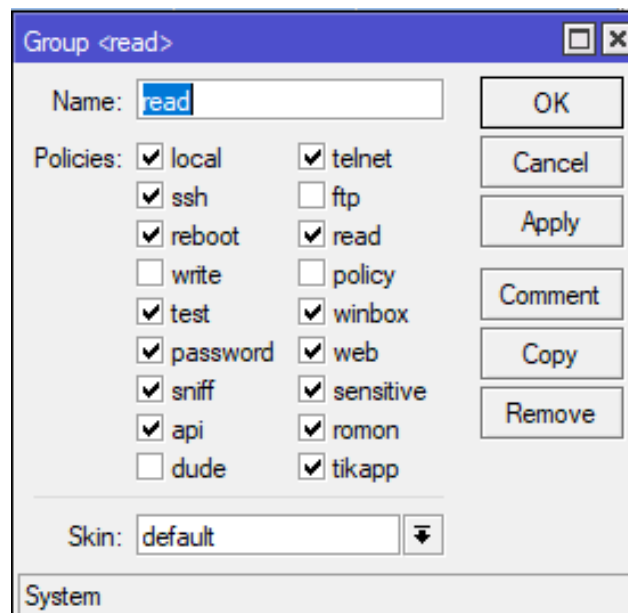
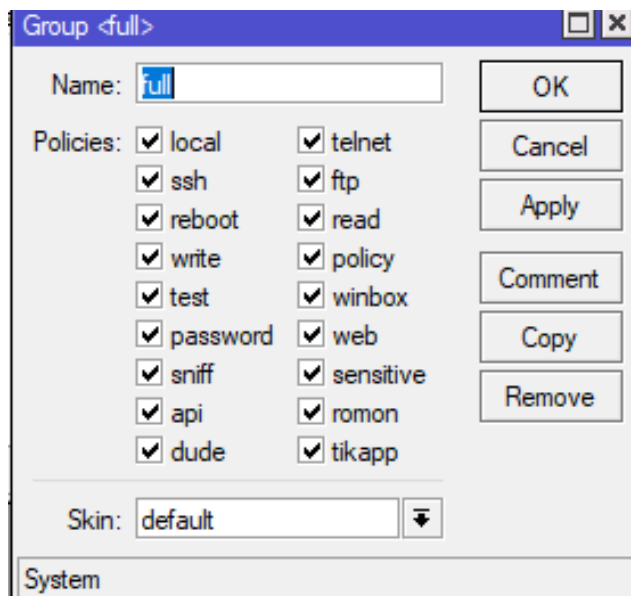
Name	Group	Allowed Address
::: Network Monitoring Center		
NOC1	write	
NOC2	write	
NOC3	write	
::: IT Support		
SUPPORT1	read	
SUPPORT2	read	
::: Level3		
admin	full	

The detailed view for 'User <NOC1>' shows the following fields:

- Name: NOC1
- Group: write
- Allowed Address: 192.168.88.10
- Last Logged In: (empty)

# RouterOS Login Management - Group

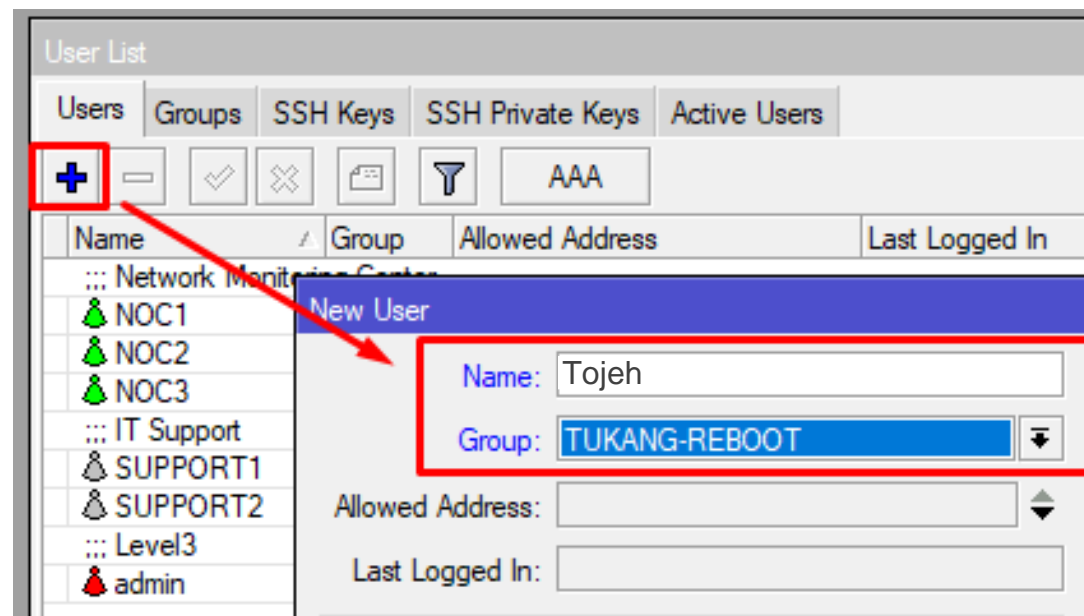
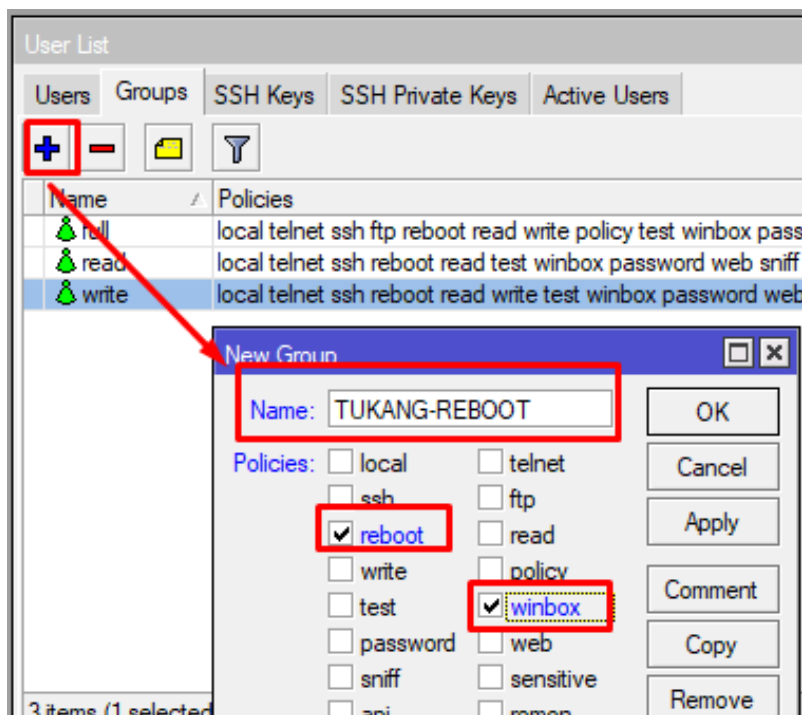
- Group digunakan untuk memberikan hak akses terhadap user.
- By default terdapat 3 Group di mikrotik : full, write dan read.



- kita juga bisa membuat custom group baru sesuai dengan aturan yang kita inginkan.

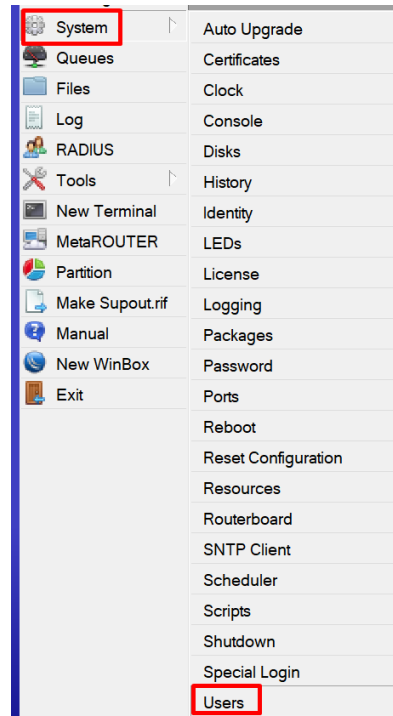
# User Login Management

- Buatlah sebuah user dengan nama “Tojeh”
- Berikan privilege agar user tersebut hanya bisa melakukan reboot via winbox.



# Active Users

- Untuk melihat sesi user yang sedang melakukan koneksi ke Router
- Cara checknya melalui menu System > Users > Active Users

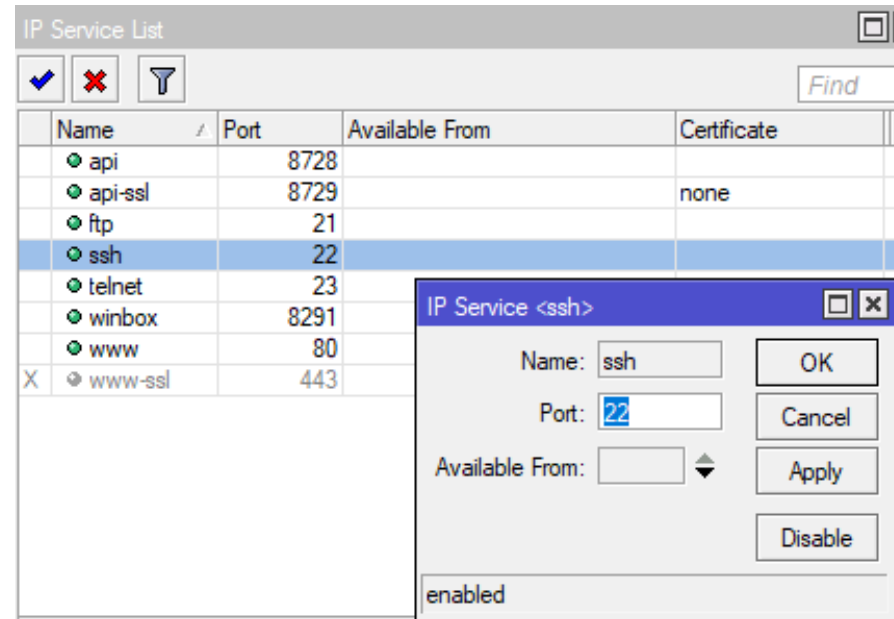


A screenshot of the 'User List' window in Mikrotik WinBox. The window has tabs for 'Users', 'Groups', 'SSH Keys', 'SSH Private Keys', and 'Active Users'. The 'Active Users' tab is selected. Below the tabs is a search bar with the text 'Find'. The main area displays a table with the following data:

Name	At	From	Via	Group
admin	Nov/04/2020 18:47:15	192.168.98.12	winbox	full
candra	Nov/04/2020 18:55:39	192.168.98.12	ssh	full
tojeh	Nov/04/2020 18:55:11	192.168.98.12	web	read

# IP Services

- IP services merupakan berbagai cara untuk masuk/login kedalam RouterOS
- Dapat juga digunakan untuk membatasi user untuk login dari salah satu service dengan cara mematikan atau merubah nilai port pada service tersebut.



# IP Services

- Disable semua service kecuali SSH dan Winbox.
- Rubah port SSH menjadi 9022 dan winbox menjadi 3000.
- Login kembali ke router menggunakan default port.
- Login kembali ke router menggunakan port yang sudah di rubah.



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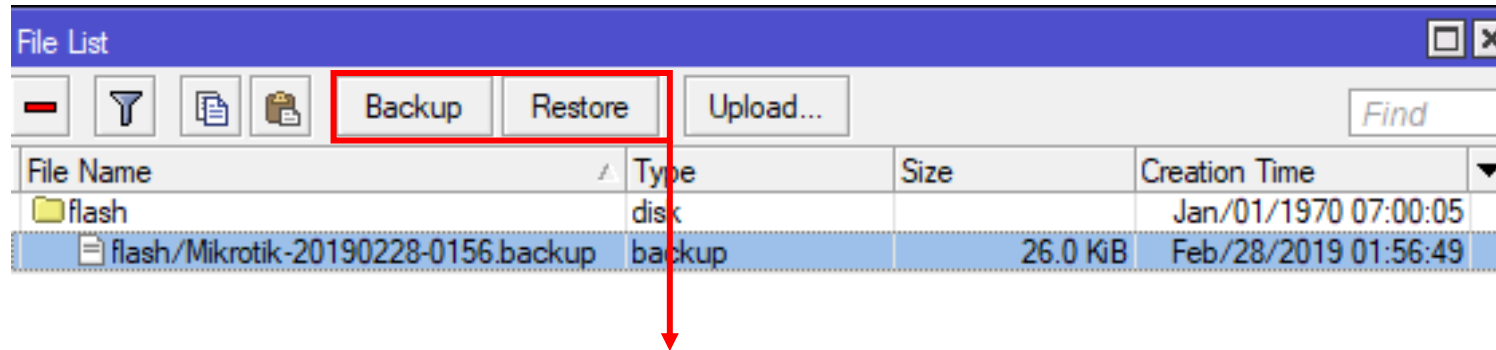
# **MANAGEMENT KONFIGURASI MIKROTIK MTCNA**

# Backup dan Restore

- Konfigurasi di router bisa di simpan, kemudian bisa digunakan juga di kemudian hari.
- Di Mikrotik terdapat 2 jenis Backup
  - Binary File (.backup) – restoring config on same router
    - Tidak dapat dibaca text editor
    - membackup semua konfigurasi router
    - create return point (kembali seperti semula)
  - Script File (.rsc) – moving config and restoring to another router
    - Berupa script, dapat dibaca oleh text editor
    - dapat membackup sebagian konfigurasi router
    - dapat digunakan untuk menambahkan konfig baru atau script terbaru pada mikrotik

# Backup dan Restore – Binary File

- Backup file dapat dibuat melalui menu Files
- Backup file adalah binary, secara default terenkripsi dengan user password.
- Berisi seluruh konfigurasi yang terdapat pada router (termasuk username dan password)

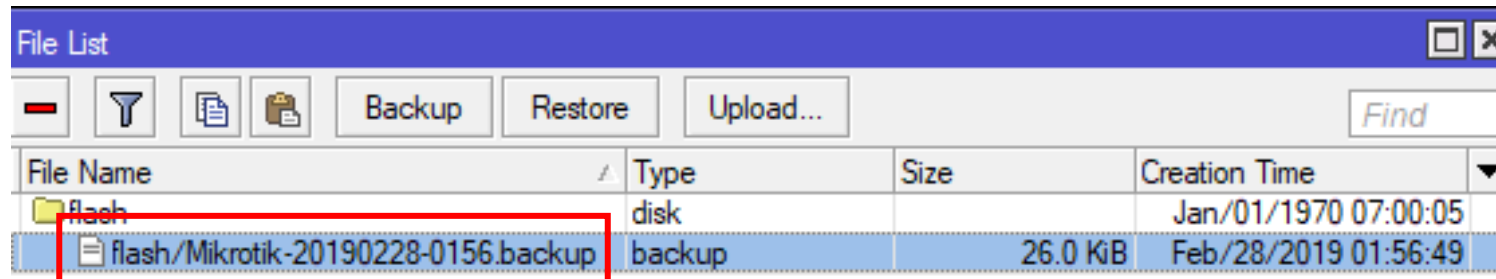


Tombol **backup** digunakan untuk membackup konfigurasi pada Mikrotik.  
Tombol **restore** digunakan untuk mengembalikan konfigurasi.

# Backup dan Restore – Binary File

- By default ketika membackup tanpa mengisi parameter name, maka secara otomatis router akan menggunakan format sebagai berikut:

**HOSTNAME-[tahun][bulan][tanggal]-[jam][menit]**



File Name	Type	Size	Creation Time
flash	disk		Jan/01/1970 07:00:05
flash/Mikrotik-20190228-0156.backup	backup	26.0 KiB	Feb/28/2019 01:56:49

- Waktu dan tanggal akan menyesuaikan saat kita melakukan backup.
- Selain itu juga dapat mengcustom nama file backup dan menambahkan password yang dapat digunakan ketika akan merestore.

# Backup dan Restore – Script File

- File export ( .rsc) merupakan salah satu jenis file backup yang berupa script.
- File export menggunakan type Plain Text (dapat di edit).
- Berisi beberapa konfigurasi yang ada pada router.
- Script tidak akan membackup settingan username dan password router.
- Dapat juga membackup sebagian konfigurasi yang ada pada router.
- Untuk membuat File export harus menggunakan terminal/CLI.
- Konfigurasi dapat dipindahkan ke RouterBOARD yang berbeda.
- Restore harus menggunakan perintah **'/import'**

# Backup dan Restore – Script File

- Backup dan restore dengan menggunakan mode script dilakukan dengan perintah :
  - EXPORT, akan menyimpan konfigurasi dengan bentuk script yang dapat di olah.
  - IMPORT, akan menjalankan perintah yang terdapat dalam script.

- Perintah Export

```
[admin@candra] > export file=backup-all
```

- Export sebagian config (IP Address)

```
[admin@candra] > /ip address export file=cuma-ip
```

# Backup dan Restore – Script File

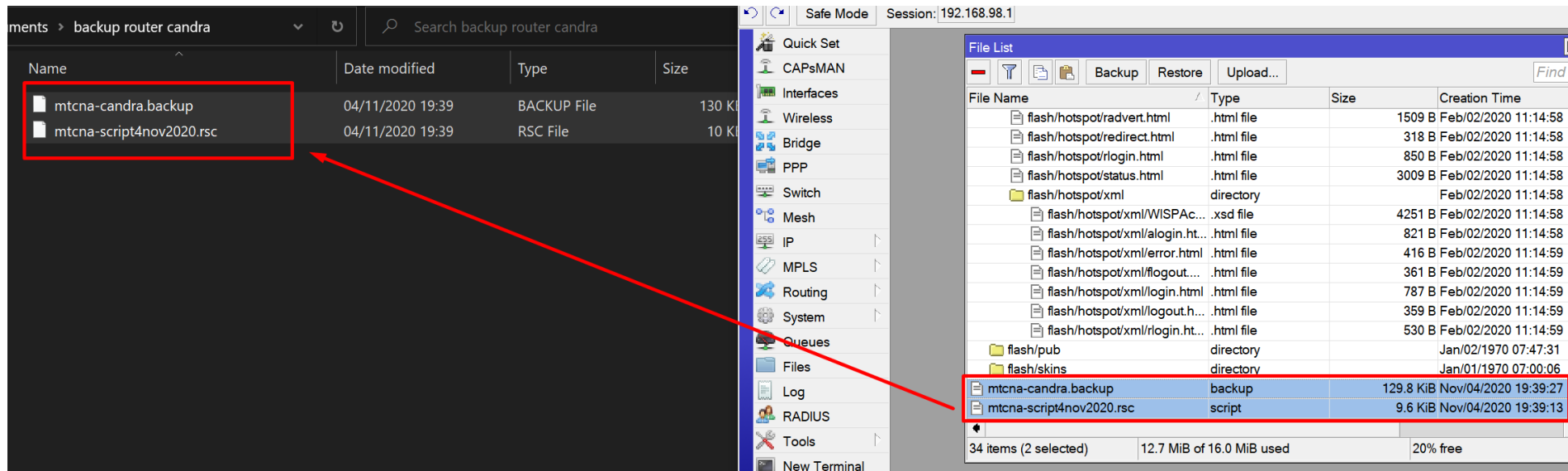
- Import digunakan untuk mengembalikan konfigurasi yang sudah di export
- Perintah import hanya tersedia di menu root ( / ).
- Bila konfigurasi yang sebelumnya sudah ada, maka tidak bisa di import kembali

- Perintah Import

```
[admin@candra] > import file-name=backup-all.rsc
```

# Backup dan Restore

- File Binary dan Script dapat disimpan kedalam komputer/laptop menggunakan WinBox (drag & drop), FTP atau melalui WebFig.
- Tidak direcomendasikan menyimpan file backup hanya pada router.



# Backup dan Restore

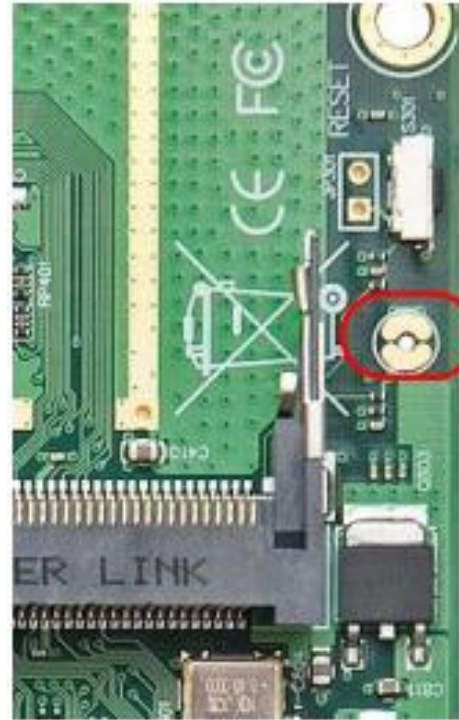
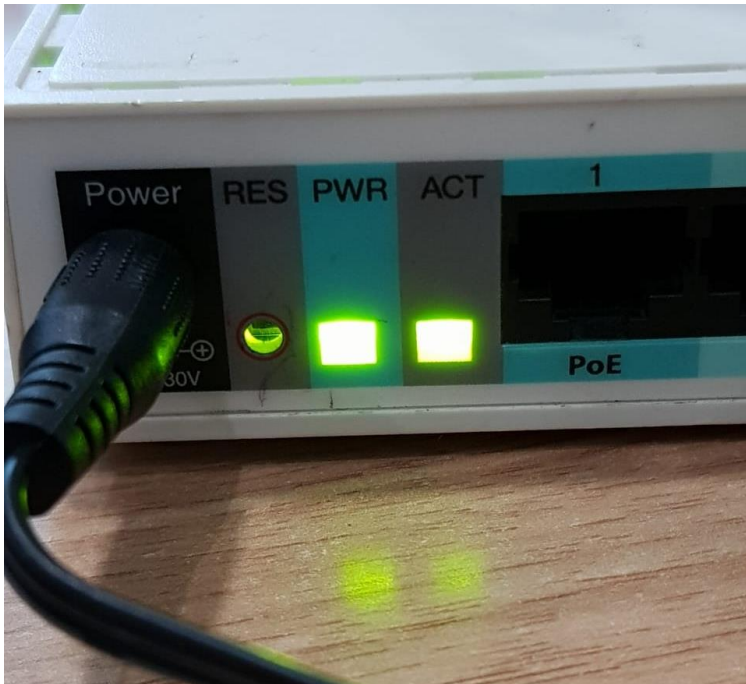
- Backup konfigurasi menggunakan binary (backup) dan script (export).
- Pindah kedua file tersebut ke laptop.
- Buka menggunakan text editor.
- Manakah dari kedua file tersebut yang bisa di edit (konfigurasi bisa dibaca melalui text editor).

# Reset Konfigurasi

- Reset konfigurasi digunakan untuk mengembalikan setting ke default/settingan pabrik.
- Reset Konfigurasi Mikrotik di perlukan jika:
  - Lupa username atau password ketika akan login
  - Perlu menata dari nol, konfigurasi yang sudah komplek
- Reset Konfigurasi dapat dilakukan dengan cara:
  - Hard Reset (reset secara fisik).
  - Soft Reset (reset secara software).
  - Install Ulang.

# Reset Konfigurasi – Hard Reset

Reset dengan menjumper atau menggunakan tombol fisik yang ada dibagian belakang router



# Reset Konfigurasi – Hard Reset

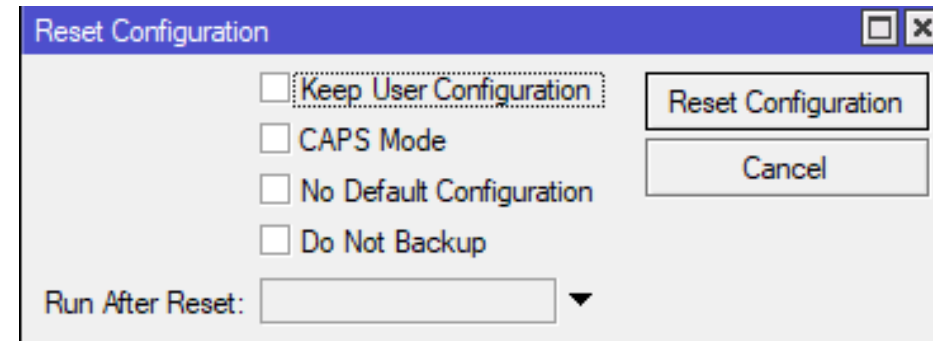
- Fungsi lain tombol reset pada router :
  - Load backup RouterBOOT loader
  - Reset konfigurasi router
  - Enable mode CAPs (Controlled AP)
  - Memulai mode Netinstall
  - Selengkapnya bisa dilihat di wiki mikrotik – reset button  
[https://wiki.mikrotik.com/wiki/Manual:Reset#Using\\_reset\\_button](https://wiki.mikrotik.com/wiki/Manual:Reset#Using_reset_button)



# Reset Konfigurasi – Soft Reset

- Soft reset, reset by software (bila masih bisa akses ke Mikrotik)

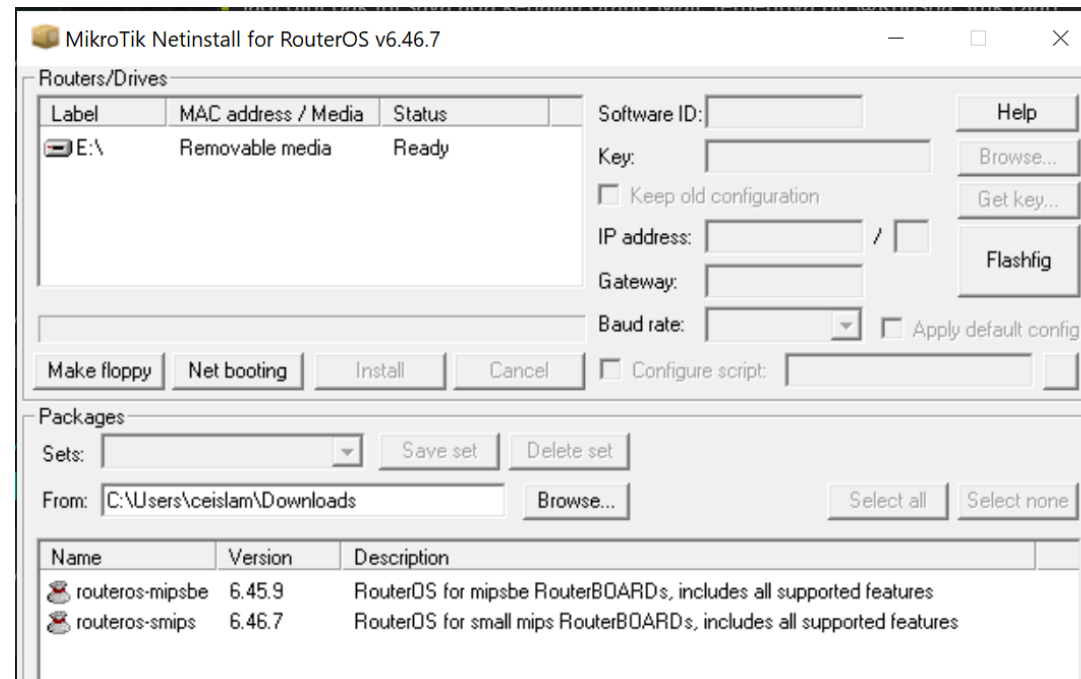
System > Reset Configuraton



- Keep User Configuration, reset semua konfigurasi kecuali user dan password.
  - CAPS Mode, setting mode CAPs (mode AP yang dimanage oleh CAPsMAN).
  - No Default Configuration, menghapus semua settingan yang ada di router.
  - Do Not Backup, ketika di reset RouterOS tidak akan melakukan backup file.
- \*) Apabila semua parameter tidak di pilih maka router akan kembali ke factory default

# Reset Konfigurasi – Install Ulang

- Mikrotik dapat di install ulang layaknya system operasi lain.
- Install ulang dapat mengembalikan mikrotik ke posisi awal/default
- Disarankan ketika install ulang harus menggunakan aplikasi Netinstall.



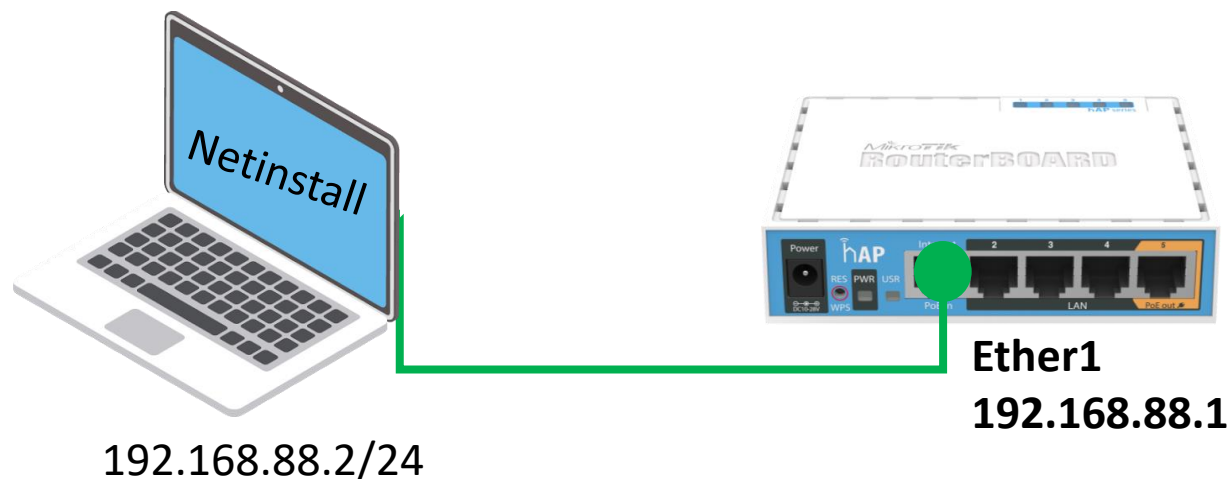
# Netinstall

- Software yang di sediakan oleh Mikrotik untuk install ulang RouterOS.
- Netinstall dapat di download di situs resmi Mikrotik.
- PC/Komputer yang menjalankan netinstall harus terhubung langsung dengan router melalui UTP atau LAN dan harus menggunakan ether1 (kecuali CCR dan RB1xxx harus menggunakan port terakhir)



# Install Ulang – Netinstall (1)

- Buat topologi seperti berikut:

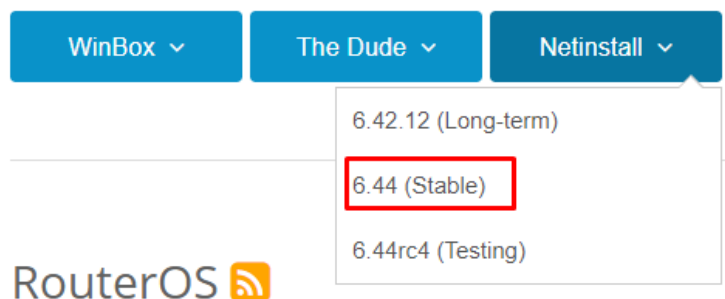


- Pastikan router terkoneksi ke laptop (boot server) menggunakan ether1.

# Install Ulang – Netinstall (2)










- Download beberapa tool yang perlu dipersiapkan untuk install ulang router.

- Netinstall



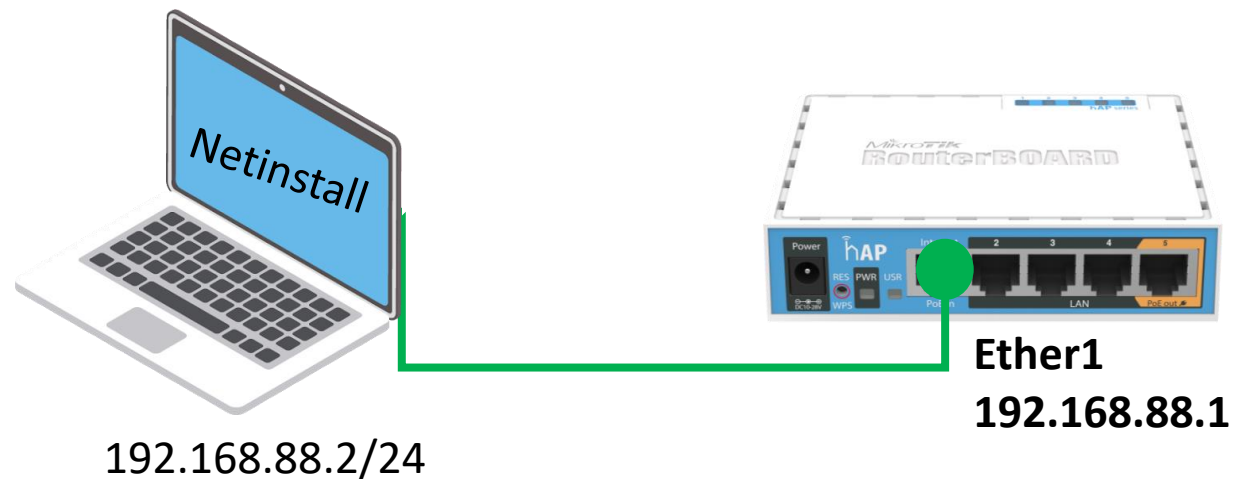
- Main packages (type arsitektur di sesuaikan)

RouterOS 

	6.42.12 (Long-term)	6.44 (Stable)	6.44rc4 (Testing)
<b>MIPSBE</b>	CRS1xx, CRS2xx, DISC, FiberBox, hAP, hAP ac, hAP ac lite, LDF, LHG, ITAP mini, mANTBox, mAP, NetBox, NetMetal, PowerBox, PWR-Line, QRT, Lite, RB4xx, wAP, BaseBox, DynaDish, RB2011, SXT, OmniTik, Groove, Metal, Sextant, RB7xx		
<b>Main package</b>			
Extra packages			
<b>SMIPS</b>	hAP mini, hAP lite		
<b>Main package</b>			

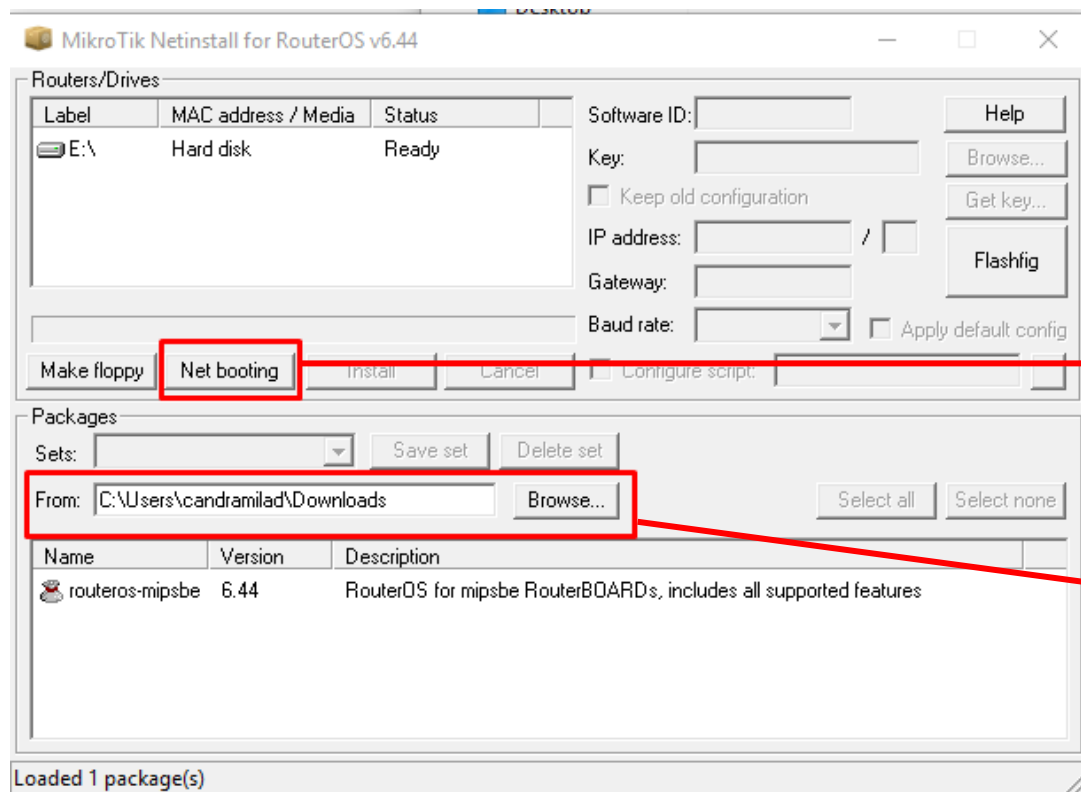
# Install Ulang – Netinstall (3)

- Disable beberapa security di windows :
  - Windows defender off
  - Windows firewall off
  - Antivirus off
  - Adapter Virtual off

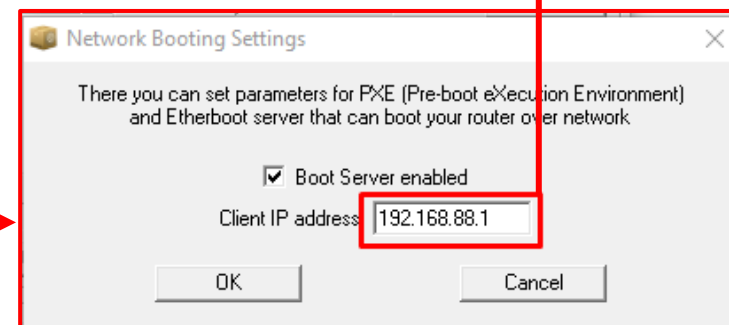


# Install Ulang – Netinstall (4)

- Jalankan Netinstall



IP RouterOS

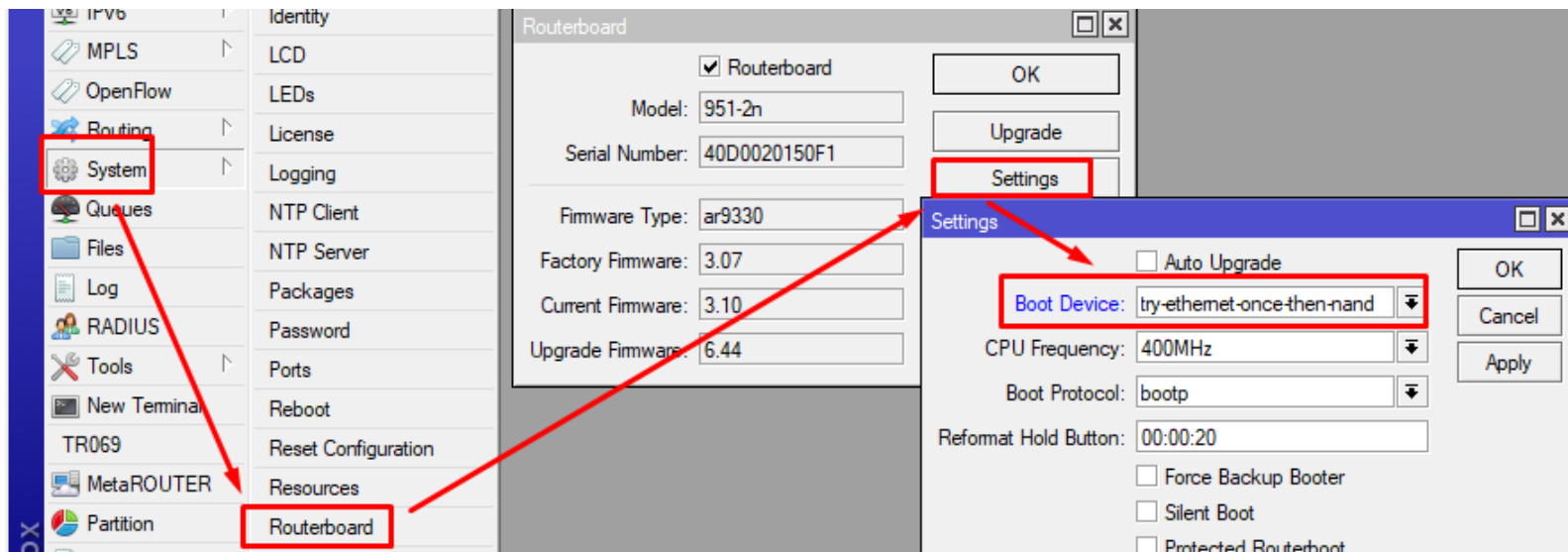


Arahkan ke folder dimana main paket (.npk) routerOS tersimpan di laptop.

# Install Ulang – Netinstall (5)

- Setting Router, supaya ketika device booting akan memilih ethernet dulu (etherboot)

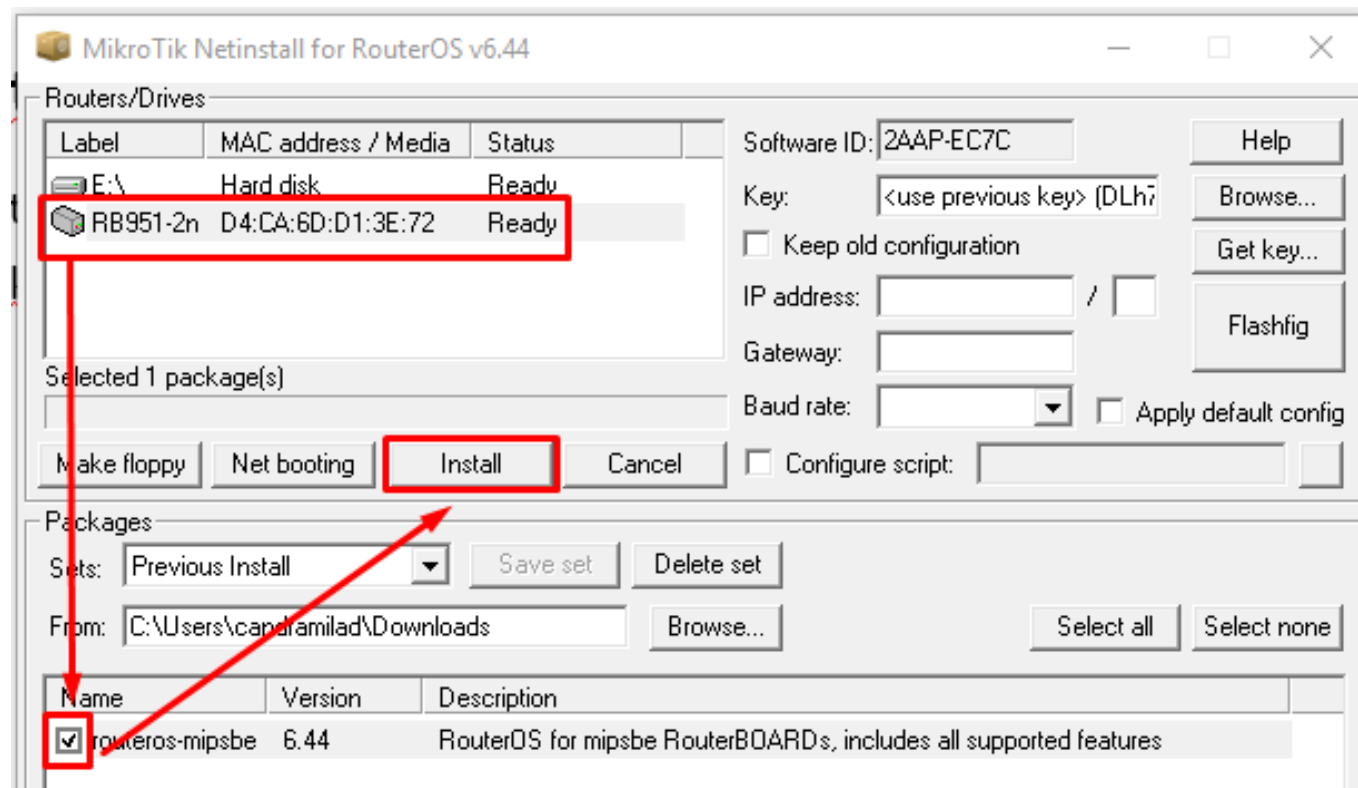
System > Routerboard > Setting



- Reboot router (system > reboot)

# Install Ulang – Netinstall (6)

- Setelah device di reboot, pastikan terdeteksi 1 device mikrotik di netinstall
- Klik install, untuk memulai instalasi



# Troubleshooting – Install Ulang

- RouterBOARD tidak terbaca di Netinstall.
- Packages List tidak bisa dipilih (dicentang).





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# **ROUTEROS LICENSE**

## **MIKROTIK MTCNA**

# Lisensi Mikrotik

- Ketika membeli semua type RouterBOARD sudah include lisensi didalamnya.
- Lisensi melakat pada media penyimpanan (NAND).
- Lisensi menentukan fitur-fitur yang dimiliki oleh setiap router.
- Lisensi terdiri dari level 0-6
- Level lisensi juga menentukan Batasan upgrade packet.
- Lisensi akan hilang jika di uninstall menggunakan software non mikrotik.
- Khusus untuk x86 harus membeli license di mikrotik.com atau bisa melalui distributor.

# Level Lisensi - RouterOS

Level	Type	Typical Use
0	Trial Mode	24h trial
1	Free Demo	Limited RouterOS features
3	CPE	Wireless client (station), wireless bridge (AP PTP)
4	AP	Wireless AP : WISP, HOME, Office
5	ISP	Support more tunnels than L4
6	Controller	Unlimited RouterOS features

# Level Lisensi - RouterOS

Level number	0 (Trial mode)	1 (Free Demo)	3 (WISP CPE)	4 (WISP)	5 (WISP)	6 (Controller)
Price	no key	registration required	do not sell	\$45	\$95	\$250
Initial Config Support	-	-	-	15 days	30 days	30 days
Wireless AP	24h trial	-	-	yes	yes	yes
Wireless Client and Bridge	24h trial	-	yes	yes	yes	yes
RIP, OSPF, BGP protocols	24h trial	-	yes(*)	yes	yes	yes
EoIP tunnels	24h trial	1	unlimited	unlimited	unlimited	unlimited
PPPoE tunnels	24h trial	1	200	200	500	unlimited
PPTP tunnels	24h trial	1	200	200	500	unlimited
L2TP tunnels	24h trial	1	200	200	500	unlimited
OVPN tunnels	24h trial	1	200	200	unlimited	unlimited
VLAN interfaces	24h trial	1	unlimited	unlimited	unlimited	unlimited
HotSpot active users	24h trial	1	1	200	500	unlimited
RADIUS client	24h trial	-	yes	yes	yes	yes
Queues	24h trial	1	unlimited	unlimited	unlimited	unlimited
Web proxy	24h trial	-	yes	yes	yes	yes
User manager active sessions	24h trial	1	10	20	50	Unlimited
Number of KVM guests	none	1	Unlimited	Unlimited	Unlimited	Unlimited

# Level Lisensi - CHR (Cloud Hosted Router)

License	Speed Limit	Price
Free	1 Mbit	FREE
P1	1 Gbit	\$ 45
P10	10 Gbit	\$ 95
P-Unlimited	Unlimited	\$ 250



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# MTCNA

Modul 2  
DHCP dan ARP

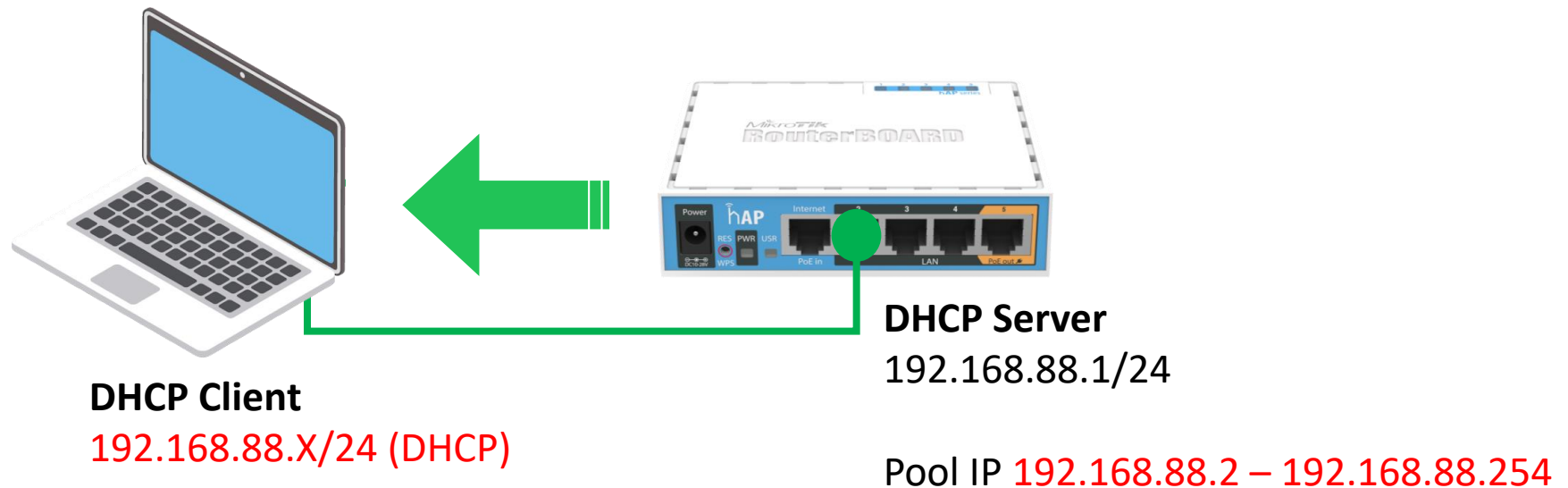
# DHCP (Dynamic Host Configuration Protocol)

- DHCP merupakan service yang digunakan untuk mempermudah distribusi IP address dalam suatu jaringan.
- DHCP running dalam satu broadcast domain (satu jaringan)
- Terdapat 3 type DHCP :
  - DHCP Server : sebagai penyedia layanan DHCP ke client
  - DHCP Client : sebagai penerima layanan DHCP dari server
  - DHCP Relay : penghubung layanan DHCP Server ke Client



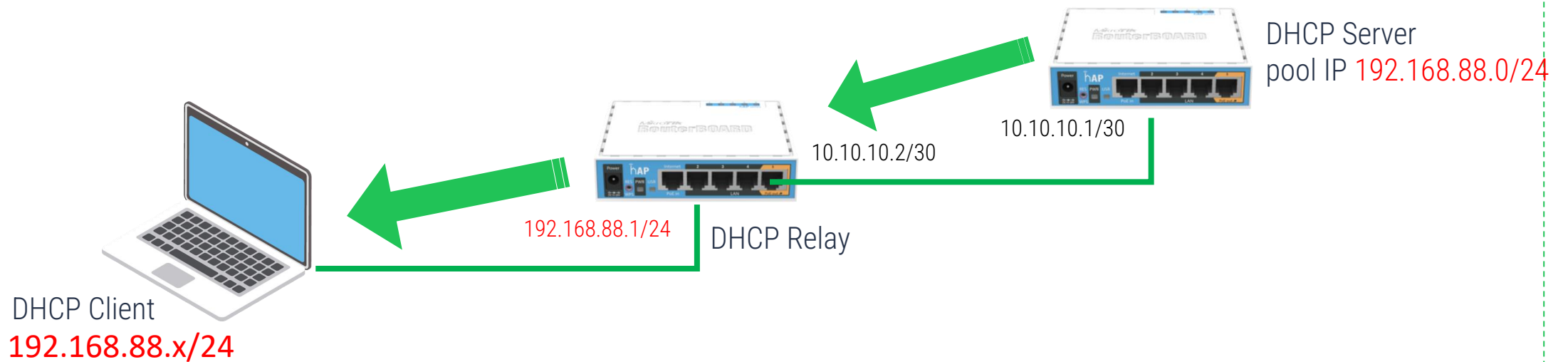
# DHCP Server dan DHCP Client

- DHCP Server : penyedia layanan pool IP
- DHCP Client : penerima layanan IP dari DHCP Server



# DHCP Server dan DHCP Client

- DHCP Relay : penerus layanan dari server ke client



- DHCP Relay memanfaatkan DHCP server yang terpusat di router lain

# DHCP Process – D.O.R.A



DHCP Client

(1) Discover (Broadcast : server dimana ya?)



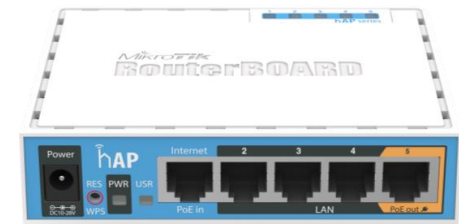
(2) Offer (Unicast : aku punya address a.b.c.d mau engga?)



(3) Request (Broadcast : mau, minta address lengkapnya dong)



(4) Ack (Unicast : OK, silahkan)



DHCP Server

# DHCP Client

- DHCP Client digunakan untuk melakukan request address secara otomatis ke penyedia (server).
- Parameter yang didapat ketika request DHCP Client :
  - IP Address
  - Subnet mask
  - Default gateway
  - DNS Server, dan informasi tambahan lain.
- Mikrotik SOHO router by default mempunyai settingan DHCP client pada interface ether1 (WAN).

# DHCP Client

- IP > DHCP Client

The screenshot displays the Mikrotik WinBox DHCP Client configuration interface. At the top, the 'DHCP Client' window is open, showing a table with one entry for the 'ether1-INET' interface. Below this, two configuration dialog boxes are visible: 'New DHCP Client' and 'DHCP Client <ether1-INET>'. The 'New DHCP Client' dialog shows the interface set to 'ether1-INET', with 'Use Peer DNS' and 'Use Peer NTP' checked, and 'Add Default Route' set to 'yes'. The 'DHCP Client <ether1-INET>' dialog shows the specific configuration for the selected interface, including IP Address (192.168.5.226/24), Gateway (192.168.5.1), DHCP Server (192.168.5.1), Expires After (16:19:40), Primary DNS (192.168.5.1), and Secondary DNS (empty).

Interface	Use P...	Add D...	IP Address	Expires After	Status
ether1-INET	yes	yes	192.168.5.22...	16:19:40	bound

**New DHCP Client**

Interface: ether1-INET

Use Peer DNS

Use Peer NTP

Add Default Route: yes

**DHCP Client <ether1-INET>**

IP Address: 192.168.5.226/24

Gateway: 192.168.5.1

DHCP Server: 192.168.5.1

Expires After: 16:19:40

Primary DNS: 192.168.5.1

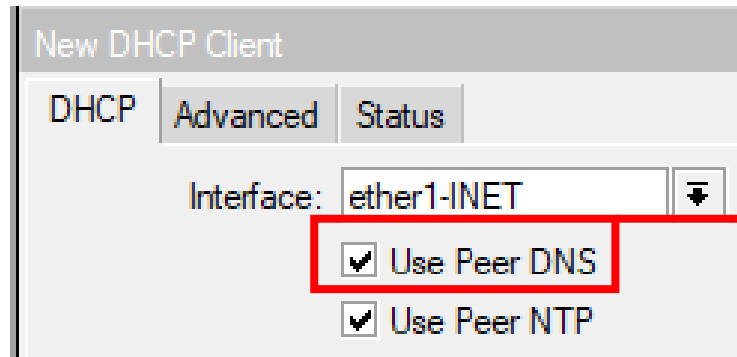
Secondary DNS:

Primary NTP:

Secondary NTP:

# DHCP Client – Use Peer DNS

- By default DHCP client juga akan meminta IP DNS Server. Ketika Use Peer DNS enable



New DHCP Client

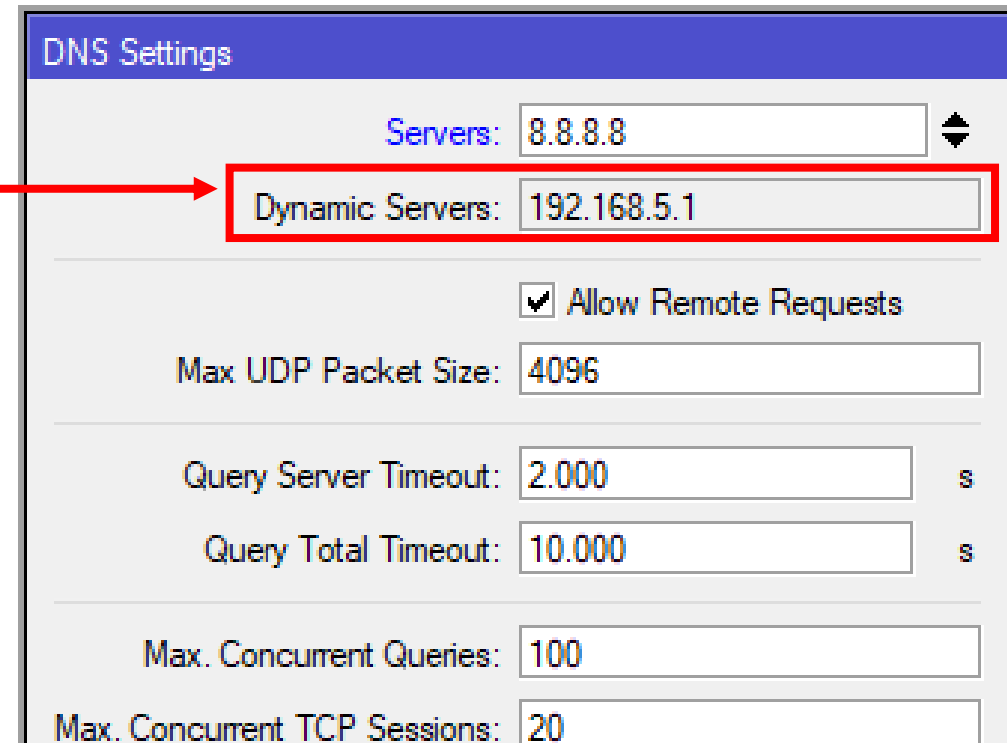
DHCP Advanced Status

Interface: ether1-INET

Use Peer DNS

Use Peer NTP

- Walaupun dapat juga DNS kita definisikan secara manual.



DNS Settings

Servers: 8.8.8.8

Dynamic Servers: 192.168.5.1

Allow Remote Requests

Max UDP Packet Size: 4096

Query Server Timeout: 2.000 s

Query Total Timeout: 10.000 s

Max. Concurrent Queries: 100

Max. Concurrent TCP Sessions: 20

# DHCP Server

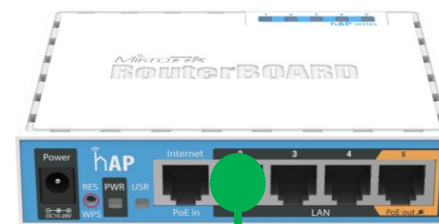
- Secara otomatis akan memberikan alokasi range IP ke host yang merequest IP.
- Sebelum setting DHCP server, pastikan interface tersebut sudah tersetting IP Address.
- Untuk mengkonfigurasi DHCP server gunakan perintah “**DHCP Setup**” pada menu IP > DHCP-Server.

# DHCP Server (1)

Setting DHCP server pada router, sehingga laptop dapat IP secara otomatis melalui router



**DHCP Client**  
192.168.88.X/24 (DHCP)



**DHCP Server**  
192.168.88.1/24  
  
Pool IP 192.168.88.2 – 192.168.88.254

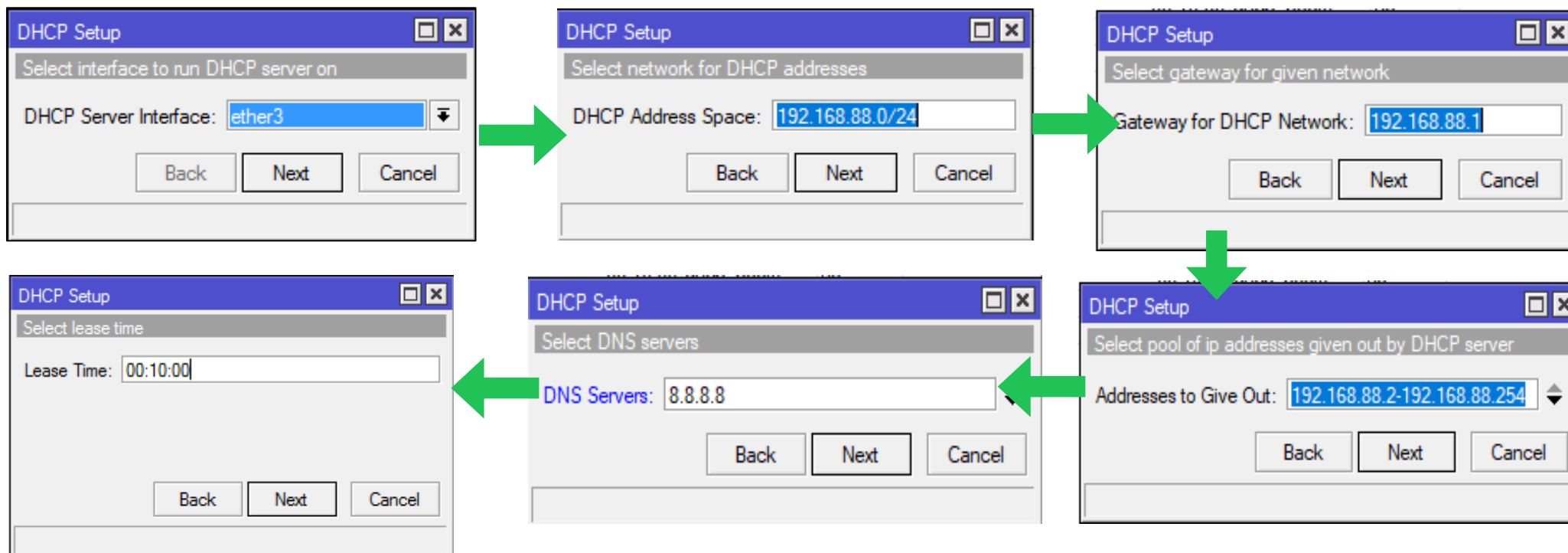
# DHCP Server (2)

IP > DHCP Server > Setup

The screenshot displays the Mikrotik WinBox interface. On the left, the 'IP' menu item is highlighted with a red box. A red arrow points from this box to the 'DHCP Server' menu item, which is also highlighted with a red box. Another red arrow points from the 'DHCP Server' box to the 'DHCP Setup' button in the main window. The main window shows the 'DHCP Server' configuration page with tabs for 'DHCP', 'Networks', 'Leases', 'Options', 'Option Sets', and 'Alerts'. The 'DHCP Setup' button is highlighted with a red box. Below the tabs, there are several icons and buttons, including a plus sign, a minus sign, a checkmark, a cross, and a funnel icon. The 'DHCP Config' and 'DHCP Setup' buttons are also highlighted with red boxes. At the bottom, there is a table with columns for 'Name', 'Interface', 'Relay', and 'Lease Time'.

# DHCP Server (3)

IP > DHCP Server > Setup



- Lakukan verifikasi dari laptop masing-masing dan pastikan mendapatkan IP secara otomatis.

# DHCP Server - Setup Wizard

- DHCP setup wizard secara otomatis akan membuat beberapa parameter seperti :
  - Dynamic IP pool
  - DHCP server setting
  - DHCP Network

The screenshot displays three overlapping windows from the Mikrotik WinBox DHCP configuration interface:

- Address List:** A table showing two entries. The first entry is highlighted with a red box:

Address	Network	Interface
192.168.88.1/24	192.168.88.0	ether3
192.168.97.51/24	192.168.97.0	wlan1

- IP Pool:** A table showing one entry, also highlighted with a red box:

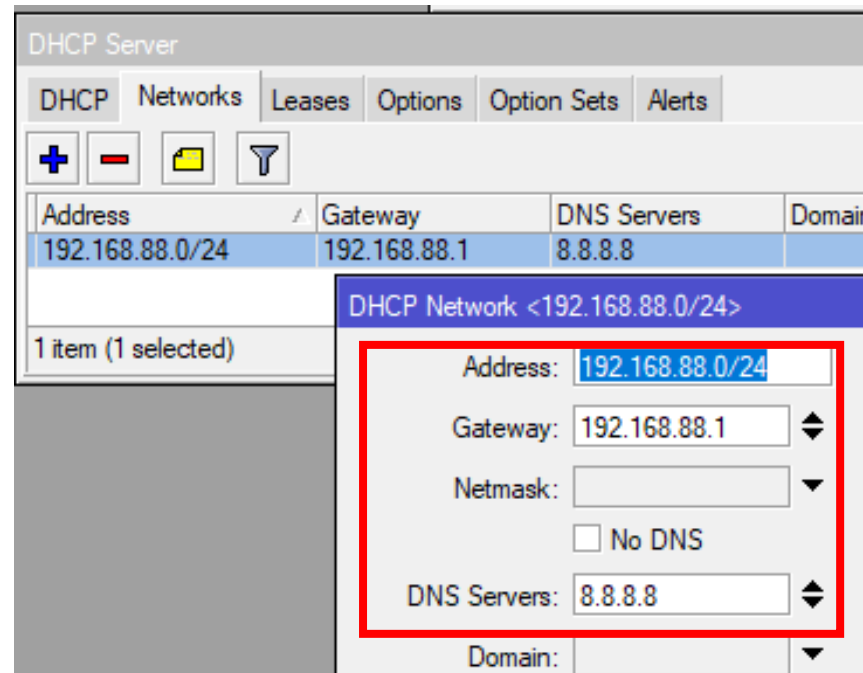
Name	Addresses	Next Pool
dhcp_pool1	192.168.88.2-192.168.88.254	none

- DHCP Server:** A table showing one entry, highlighted with a red box:

Name	Interface	Relay	Lease Time	Address Pool	Add ARP For Leases
dhcp2	ether3		00:10:00	dhcp_pool1	no

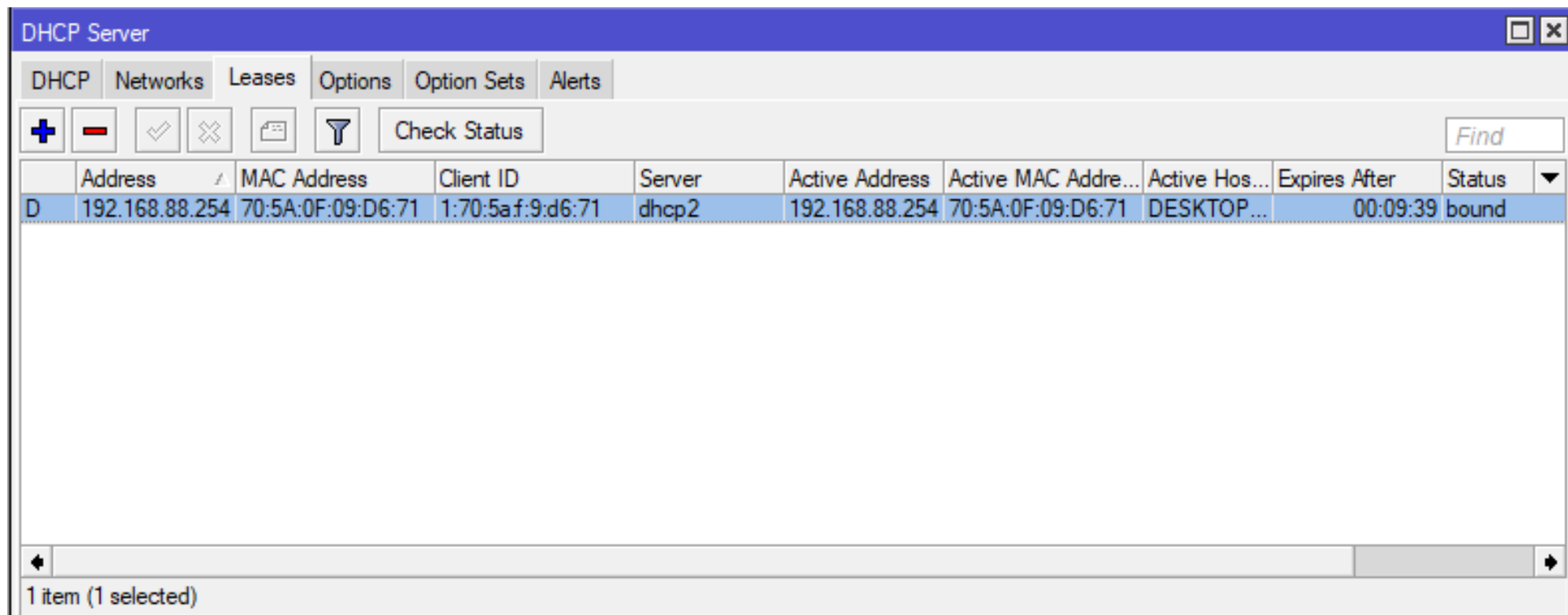
# DHCP Server - Setup Wizard

- DHCP setup wizard secara otomatis akan membuat beberapa parameter seperti :
  - Dynamic IP pool
  - DHCP server setting
  - DHCP Network



# DHCP Leases

Untuk melihat list client yang mendapatkan IP DHCP secara otomatis bisa melalui menu IP > DHCP Server > Leases.



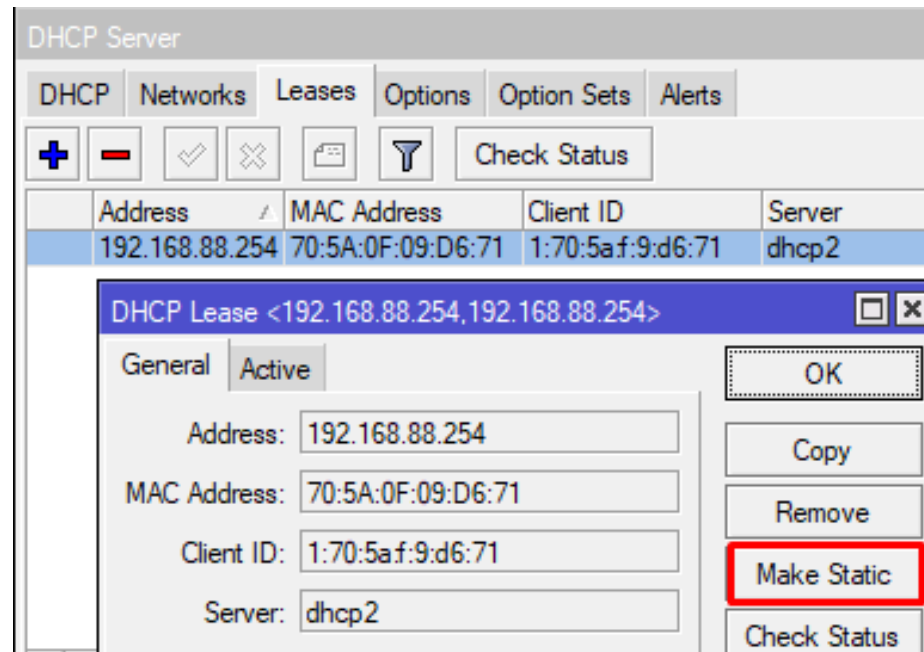
The screenshot shows the Mikrotik WinBox interface for the DHCP Server configuration. The 'Leases' tab is selected, displaying a table of active leases. The table has the following columns: Address, MAC Address, Client ID, Server, Active Address, Active MAC Address, Active Hostname, Expires After, and Status. One lease is listed with the following details:

Address	MAC Address	Client ID	Server	Active Address	Active MAC Address	Active Hostname	Expires After	Status
192.168.88.254	70:5A:0F:09:D6:71	1:70:5af:9:d6:71	dhcp2	192.168.88.254	70:5A:0F:09:D6:71	DESKTOP...	00:09:39	bound

The status bar at the bottom indicates '1 item (1 selected)'.

# DHCP Static

- Dapat memungkinkan untuk memberikan alamat IP address yang sama pada device yang sama berdasarkan MAC Address.
- DHCP Server dapat di gunakan tanpa Dynamic IP pool dan hanya menetapkan alamat yang telah dikonfigurasi.



IP > DHCP Server > Leases

Merubah dynamic entries menjadi static

# DHCP Static

- Buat static leases untuk laptop.
- Rubah IP address leases untuk laptop menjadi 192.168.88.123.
- Renew IP address di laptop.
- Check kembali IP address di laptop



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# **ARP**

## **MIKROTIK MTCNA**

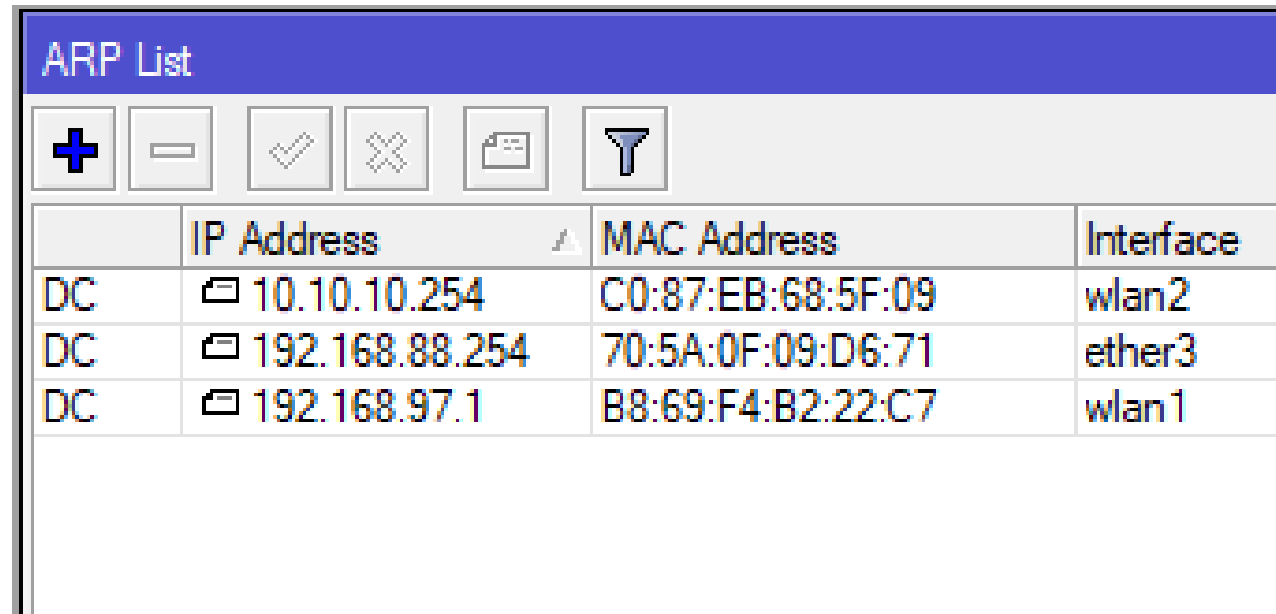
# ARP

- Address Resolution Protocol.
- Digunakan untuk mapping IP address (Layer 3) dengan MAC address (Layer 2).
- Untuk menghubungkan kedua device informasi ARP keduanya harus saling memiliki.
- ARP bekerja secara dynamic (otomatis).
- Semua interface memancarkan ARP (enable).
- Dapat juga dikonfigurasi secara manual (Static ARP).

# ARP Table

- Berisi informasi mengenai IP address, MAC address dan interface yang terkoneksi ke router.

IP > ARP



	IP Address	MAC Address	Interface
DC	10.10.10.254	C0:87:EB:68:5F:09	wlan2
DC	192.168.88.254	70:5A:0F:09:D6:71	ether3
DC	192.168.97.1	B8:69:F4:B2:22:C7	wlan1

# ARP Modes

- Disable
- Enable
- Proxy ARP
- Reply Only / Static
- Local Proxy ARP

## Interfaces

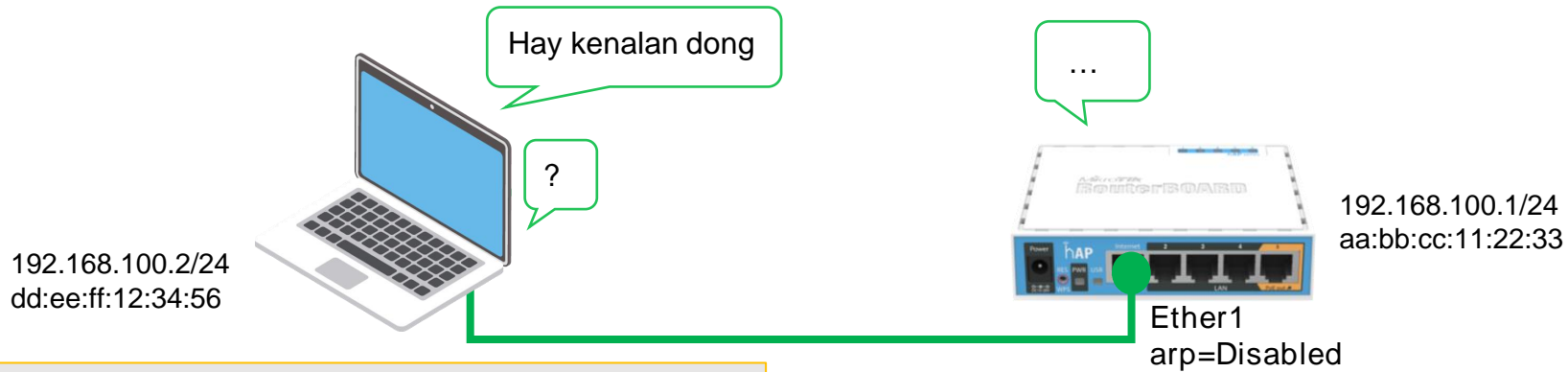
The screenshot shows the Mikrotik WinBox interface configuration page. The 'Interface List' table is visible, with 'ether2' selected. A red box highlights 'ether2' in the table. A red arrow points from this box to the 'Interface <ether2>' configuration window. In this window, the 'ARP' mode is set to 'enabled', which is also highlighted with a red box. The 'ARP Timeout' is set to 'disabled'.

Name	Type	Actual MTU	L2 MTU	Tx	Rx
ether1	Ethernet	1500	1598	458.1 kbps	27.8 Mbps
ether2	Ethernet	1500	1598	0 bps	0 bps
ether3-LAN	Ethernet	1500	1598	0 bps	0 bps

Interface <ether2> configuration:

- Name: ether2
- Type: Ethernet
- MTU: 1500
- Actual MTU: 1500
- L2 MTU: 1598
- Max L2 MTU: 2028
- MAC Address: 48:8F:5A:DD:37:87
- ARP: enabled
- ARP Timeout: disabled

# ARP Mode - Disable



**ARP request from client not answered by the router.  
Therefore, static arp entry must be added to the client as well**

Adding Static ARP entry via CMD (Command Prompt)

```
Administrator: Command Prompt
Microsoft Windows [Version 10.0.19044.1889]
(c) Microsoft Corporation. All rights reserved.

C:\Windows\system32>arp -s 192.168.100.1 aa-bb-cc-11-22-33
```

# ARP Mode - Enable

Siyapp, aku 192.168.100.2  
rumahku dd:ee:ff:12:23:56

Hay kenalan dong

kuy, namaku 192.168.100.1 tempat  
tinggalku aa:bb:cc:11:22:33, kamu siapa?

192.168.100.2/24  
dd:ee:ff:12:34:56



192.168.100.1/24  
aa:bb:cc:11:22:33

OK

Ether1  
arp=enable

## ARP table windows

```
C:\Users\ceislam>arp -a  
  
Interface: 192.168.100.2 --- 0x8  
Internet Address      Physical Address      Type  
192.168.100.1        aa-bb-cc-11-22-33    dynamic
```

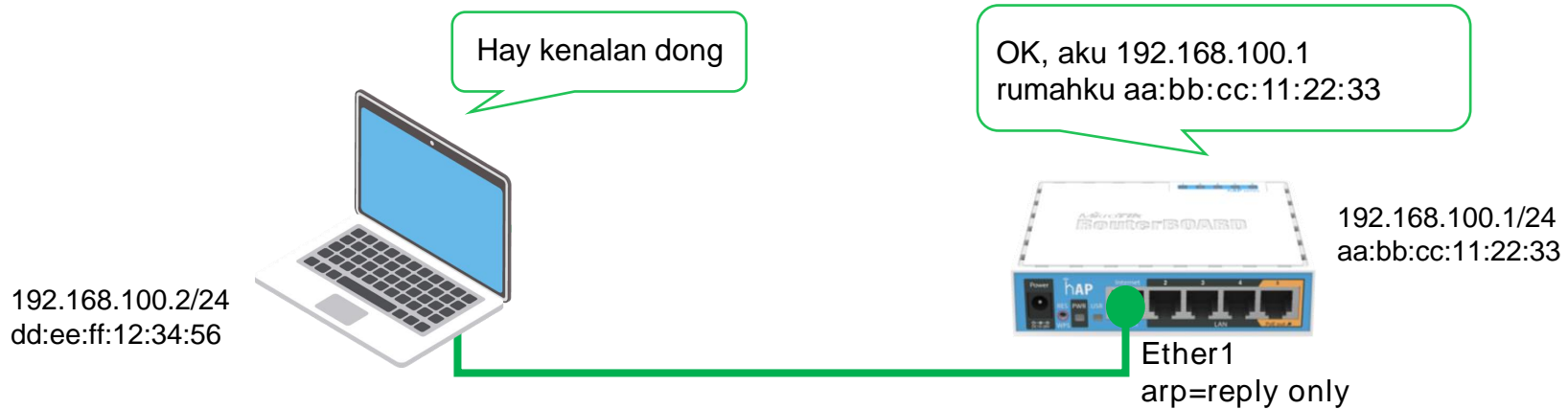
This mode is enabled by default on all interface. ARPs will be discovered automatically and new dynamic entries will be added to ARP table

## ARP table mikrotik (IP > ARP)

IP Address	MAC Address	Interface
192.168.100.2	DD:EE:FF:12:23:56	ether1

DC = ARP terdaftar secara dynamic

# ARP Mode - Reply Only / Static



## ARP table windows

```
C:\Users\ceislam>arp -a

Interface: 192.168.100.2 --- 0x8
Internet Address      Physical Address      Type
192.168.100.1        aa-bb-cc-11-22-33    dynamic
```

Router only replies to ARP request, for communicate neighbour should be listed statically on ARP table

## ARP table mikrotik (IP > ARP)

ARP List			
Find			
	IP Address	MAC Address	Interface
C	192.168.100.2	DD:EE:FF:12:23:56	ether1

C = ARP didaftarkan secara static

# ARP Mode - Reply Only / Static

- Daftarkan ARP entries untuk laptop menjadi static.
- Rubah arp mode di interface yang mengarah ke laptop menjadi Reply-only.
- Pastikan laptop masih bisa terkoneksi ke jaringan dan ke internet.
- Rubah informasi MAC address laptop di ARP table.
- Test ping ke jaringan dan test koneksi internet.

# ARP Static (1)

- IP > ARP

ARP List

	IP Address	MAC Address	Interface
DC	10.10.10.254	C0:87:EB:68:5F:09	wlan2
C	192.168.88.254	70:5A:0F:09:D6:71	ether3
DC	192.168.97.1	B8:69:F4:B2:22:C7	wlan1

ARP <192.168.88.254>

IP Address: 192.168.88.254

MAC Address: 70:5A:0F:09:D6:71

Interface: ether3

Published

Buttons: OK, Cancel, Apply, Disable, Comment, Copy, Remove, **Make Static**, Ping, MAC Ping

# ARP Static (2)

- Interface > ether3

Interface <ether3>

General | Ethernet | Loop Protect | Overall Stats | Rx Stats | ...

Name: ether3

Type: Ethernet

MTU: 1500

Actual MTU: 1500

L2 MTU: 1598

Max L2 MTU: 2028

MAC Address: CC:2D:E0:C3:F5:0C

ARP: reply-only

ARP Timeout:

# DHCP dan ARP

- DHCP Server dapat menambahkan ARP entri secara otomatis.
- Dengan mengkombinasikan static leases dan reply-only pada interface DHCP server.
- Fungsinya untuk alasan security, device yang sudah mendapatkan DHCP address tidak dapat mengganti addressnya ke alamat yang lain.

# DHCP dan ARP

The image shows the Mikrotik WinBox DHCP Server configuration interface. On the left, the 'DHCP Server' window displays a table of servers:

Name	Interface
dhcp1	wlan2
dhcp2	ether3

Below the table, it indicates '2 items (1 selected)'. On the right, the 'DHCP Server <dhcp2>' configuration window is open, showing various settings:

- Name: dhcp2
- Interface: ether3
- Relay: (empty)
- Lease Time: 00:10:00
- Bootp Lease Time: forever
- Address Pool: dhcp\_pool1
- DHCP Option Set: (empty)
- Src. Address: (empty)
- Delay Threshold: (empty)
- Authoritative: yes
- Bootp Support: static
- Always Broadcast
- Insert Queue Before: first
- Allow Dual Stack Queue
- Add ARP For Leases (highlighted in red)
- Conflict Detection

Buttons on the right include OK, Cancel, Apply, Disable, Copy, and Remove.

# LAB DHCP Static Leases with ARP

- Melanjutkan lab sebelumnya
- Pastikan laptop konek ke router dan mendapatkan IP DHCP server secara otomatis.
- Aktifkan 'Add ARP for Leases' pada DHCP server.
- Hapus static entri untuk laptop di ARP Table.
- Pastikan laptop tidak bisa akses internet.
- Renew IP address laptop
- Check kembali koneksi Internet, pastikan laptop bisa akses internet
- Perhatikan ARP Table.



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**MTCNA**

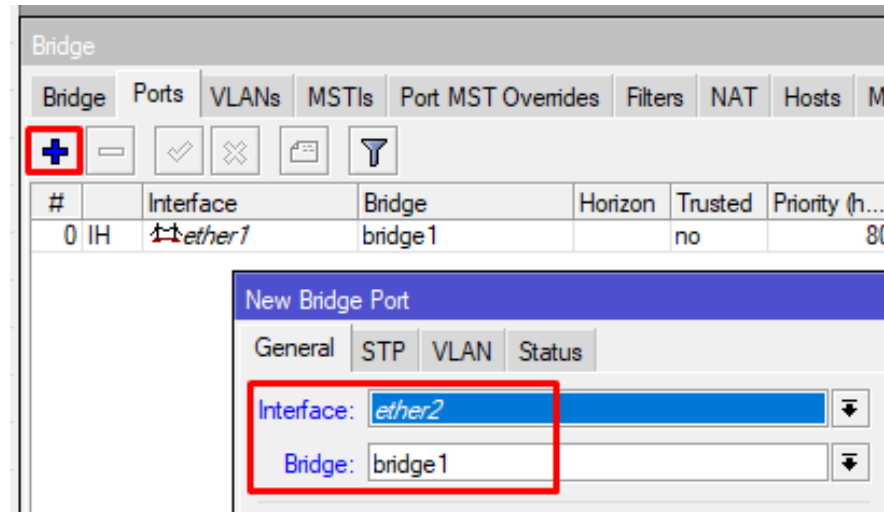
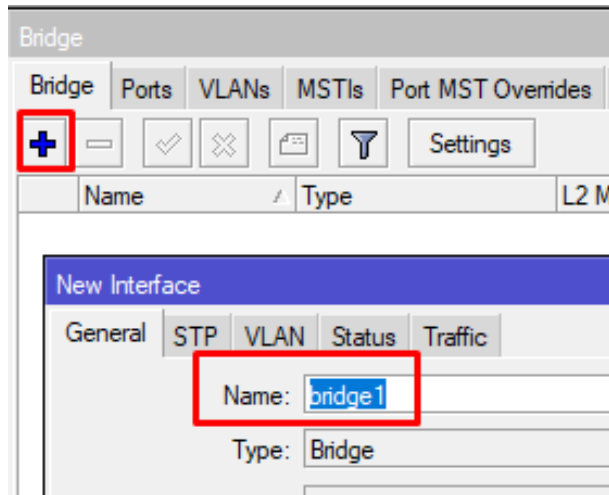
**Modul 3**  
**Bridging**

# Bridging

- Bridge adalah menggabungkan beberapa interface menjadi satu interface virtual (satu jaringan).
- Bridge bekerja pada Layer 2
- Bridge memisahkan collision domain menjadi 2 bagian.
- Semua type interface (Ethernet, Wireless, SFP, tunnel) bisa di bridge.
- By default untuk Router SOHO sudah tersetting bridge (ether2-ether5).
- Ether2-5 tergabung dalam satu switch chip, ether2 master, ether3-5 slave.

# Bridging

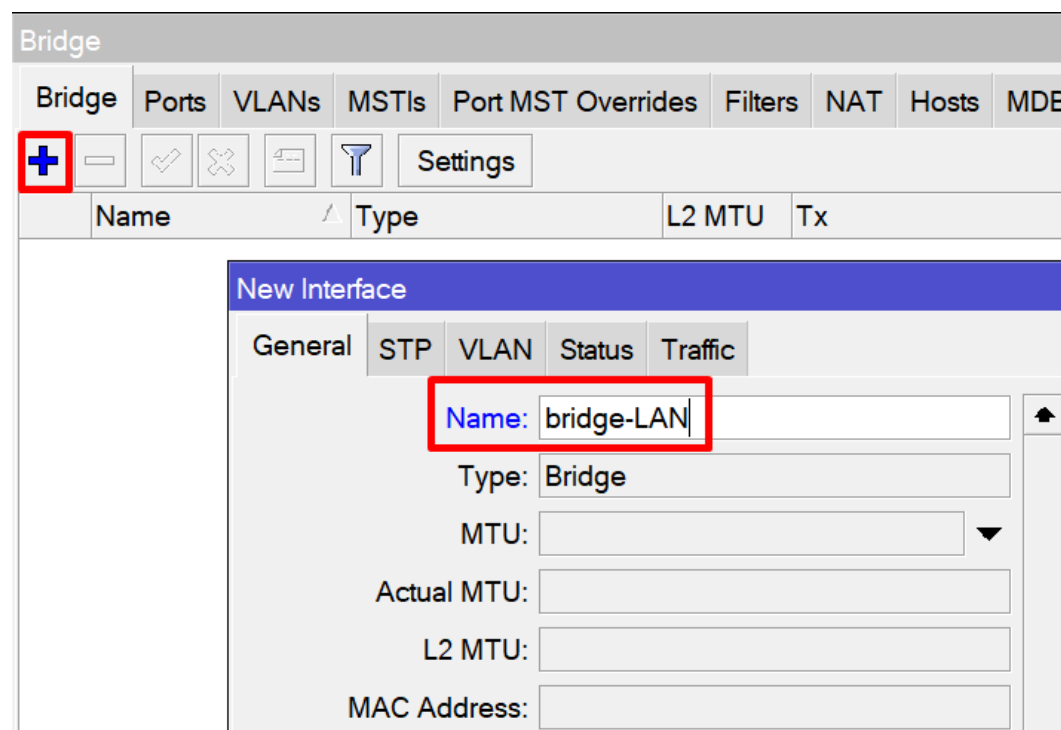
- Tahap pembuatan bridge adalah membuat interface bridge baru dan menambahkan interface fisik kedalam port bridge.



- Bila hanya membuat interface bridge tanpa menambahkan port, maka bridge tersebut disebut sebagai interface loopback.

# Bridging (1)

- Bridge semua interface supaya berada pada satu jaringan yang sama.
- Buat Interface bridge (Bridge-LAN)
  - Bridge > add
- Buat bridge port



The screenshot shows the Mikrotik WinBox interface for configuring a bridge. The 'Bridge' tab is selected, and the '+ add' button is highlighted with a red box. Below the bridge list, the 'New Interface' dialog is open, with the 'Name' field set to 'bridge-LAN' and highlighted with a red box. The 'Type' is set to 'Bridge'. Other fields like MTU, Actual MTU, L2 MTU, and MAC Address are visible but empty.

Name	Type	L2 MTU	Tx
------	------	--------	----

**New Interface**

General	STP	VLAN	Status	Traffic
Name: bridge-LAN				
Type: Bridge				
MTU:				
Actual MTU:				
L2 MTU:				
MAC Address:				

# Bridging (2)

- Buat bridge port untuk membridge semua interface

Bridge

Bridge Ports VLANs MSTIs Port MST Overrides Filters NAT Hosts MDB

+ - ✓ ✗ [icon] [icon]

#		Interface	Bridge	Horizon	Trusted	Priority (h... F
0	IH	ether1	bridge-LAN		no	80
1	H	ether2	bridge-LAN		no	80
2	IH	ether3	bridge-LAN		no	80

New Bridge Port

General STP VLAN Status

Interface: ether4

Bridge: bridge-LAN

Horizon: [dropdown]

Learn: auto



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# **WIRELESS BRIDGING**

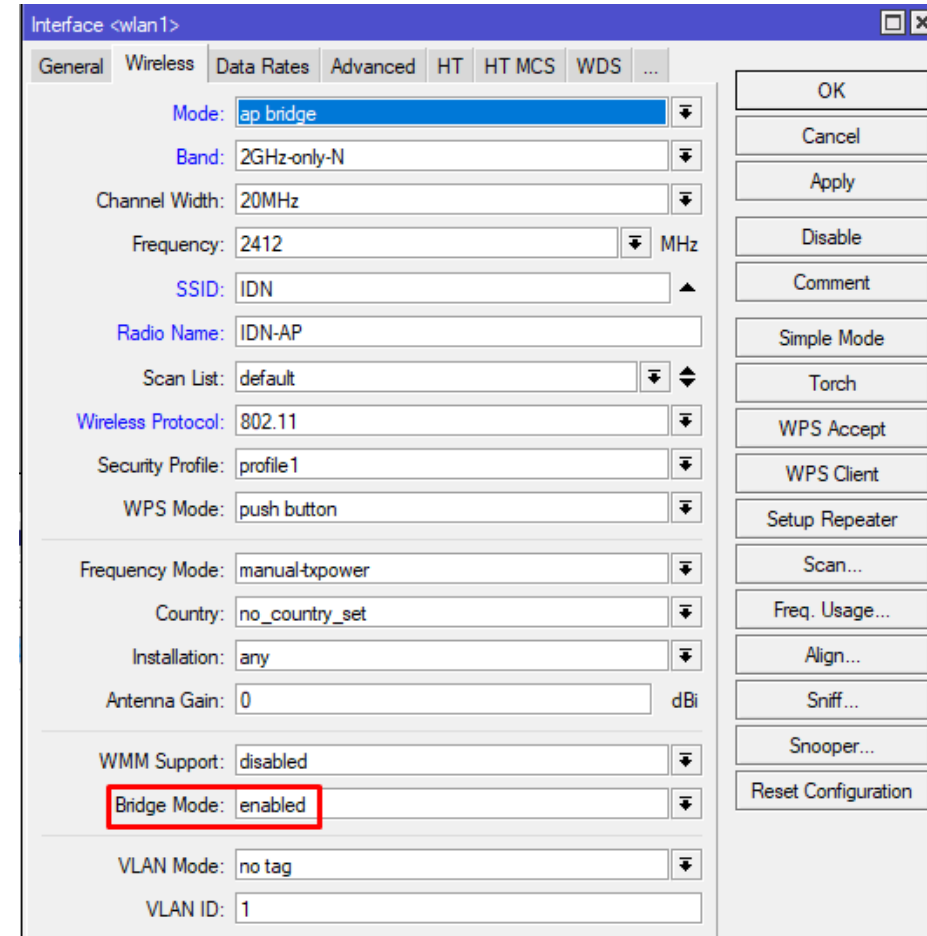
## **MIKROTIK MTCNA**

# Wireless Bridging

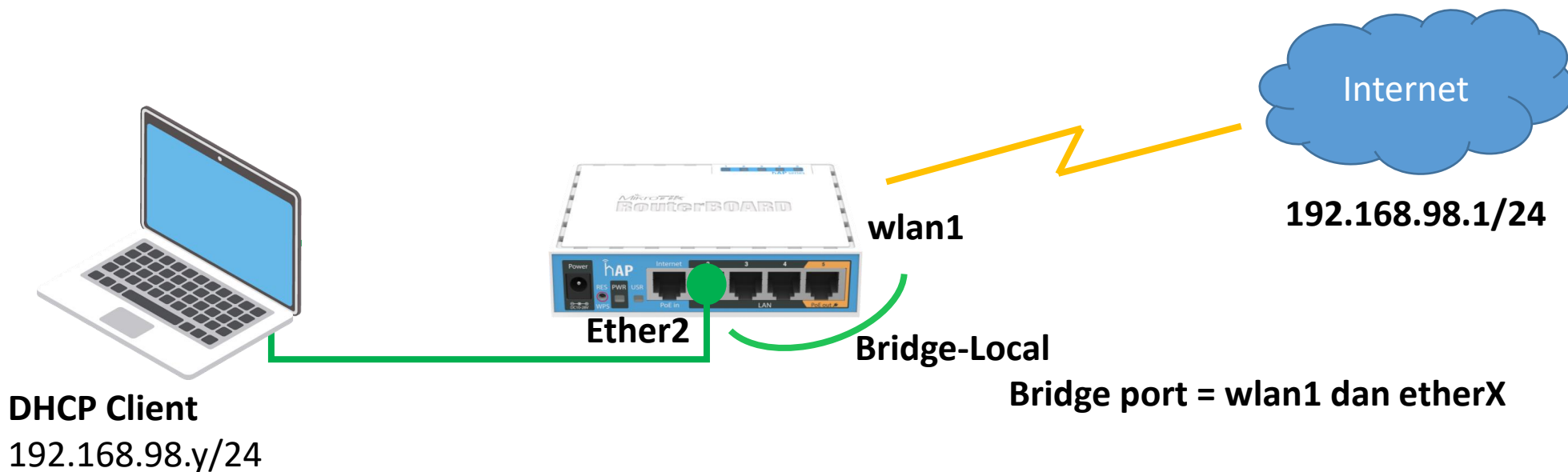
- Karena ada batasan dari standar wireless 802.11, wireless client (mode: station) tidak bisa dibridge.
- Mode station tidak bisa dibridged sehingga RouterOS membuat mode lain yang bisa dibridging.
- Mode tersebut diciptakan sejak ROS v5.
  - Station Bridge - RouterOS to RouterOS.
  - Station Pseudobridge - RouterOS to non-RouterOS.
  - Station WDS (Wireless Distribution System) - RouterOS to RouterOS.

# Wireless Bridging

- Untuk menggunakan station bridge, bridge mode pada AP harus diaktifkan terlebih dahulu.



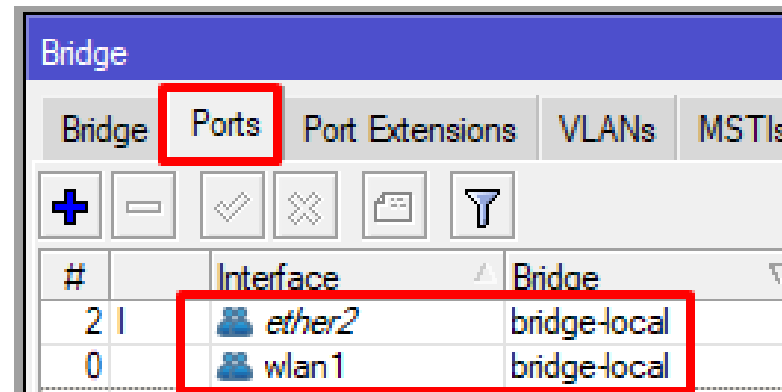
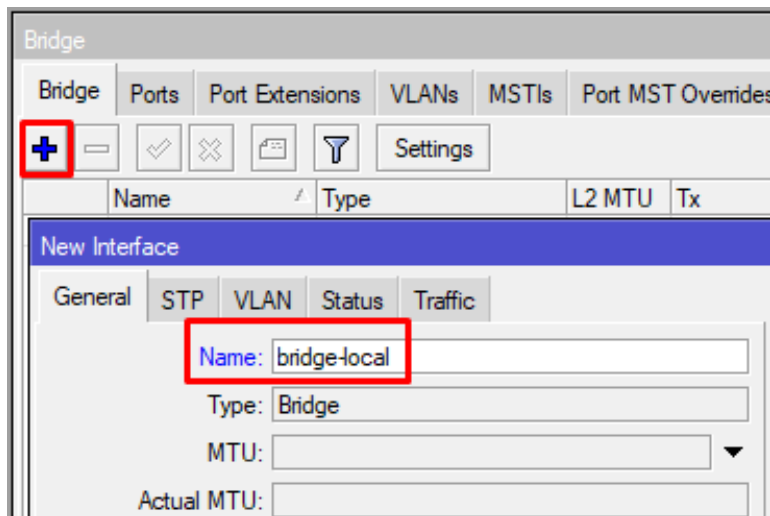
# Wireless Bridging (1)



- Koneksikan router ke internet via Wireless
- Bridge interface local dengan wan (wlan1)
- Ubah interface DHCP Client menjadi Interface bridge1
- Rubah beberapa mode wireless di router (Station, Station Bridge dll)

# Wireless Bridging (2)

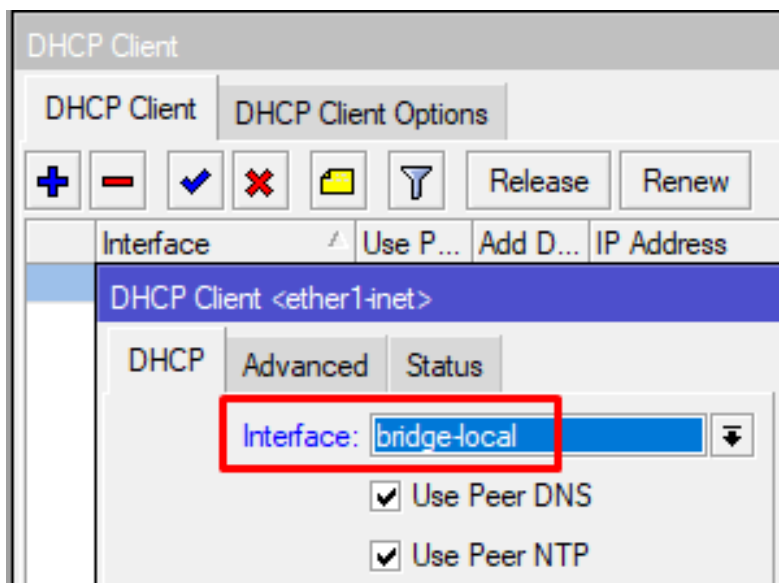
- Bridge interface local dengan wan (wlan1)



- Ubah interface DHCP Client menjadi Interface bridge1
- Rubah beberapa mode wireless di router (Station, Station Bridge dll)

# Wireless Bridging (3)

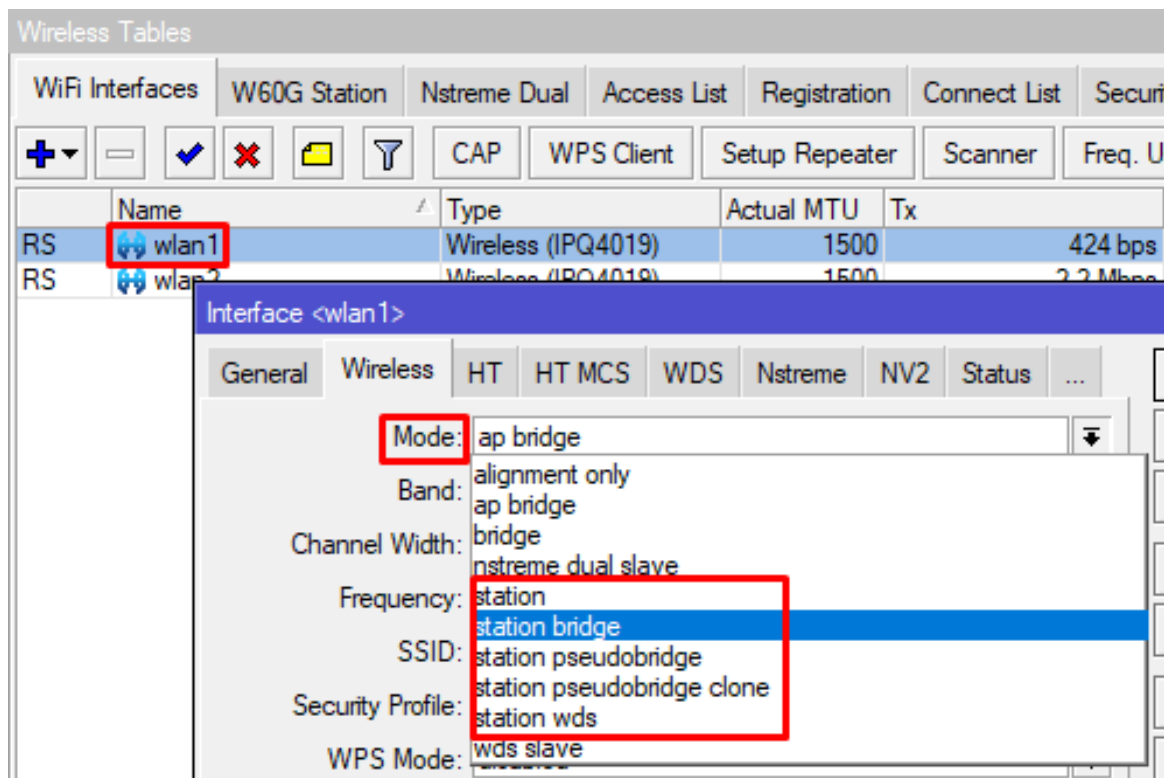
- Ubah interface DHCP Client menjadi Interface bridge1



- Pastikan Router dan Laptop mendapat alamat IP satu network dengan WAN

# Wireless Bridging (4)

- Rubah beberapa mode wireless di router



1. Station
2. Station Bridge
3. Station Pseudobridge
4. Station Pseudobridge clone

Tes koneksi ke Internet



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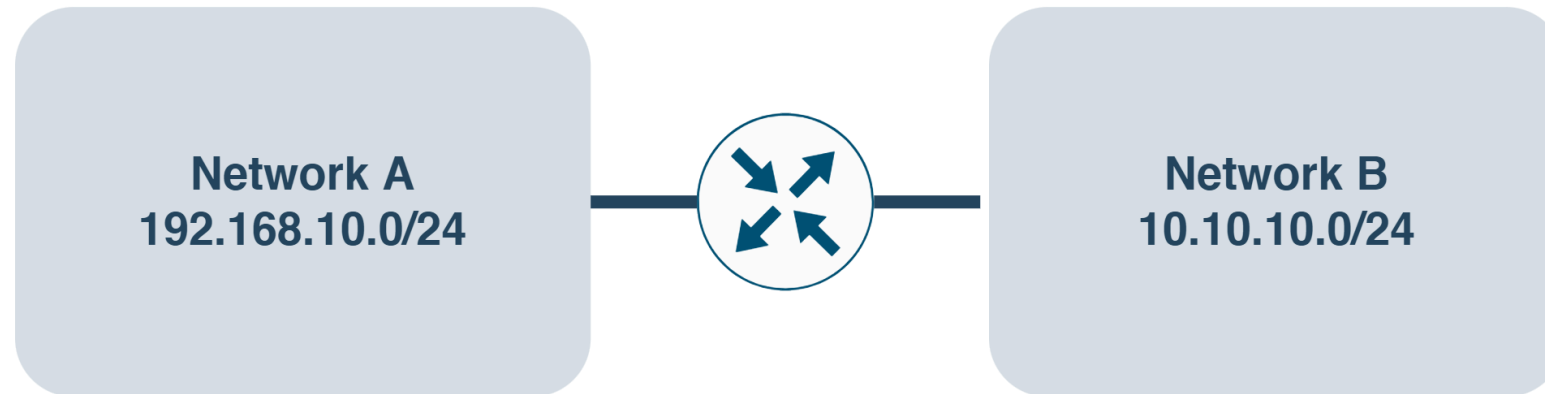


**MTCNA**

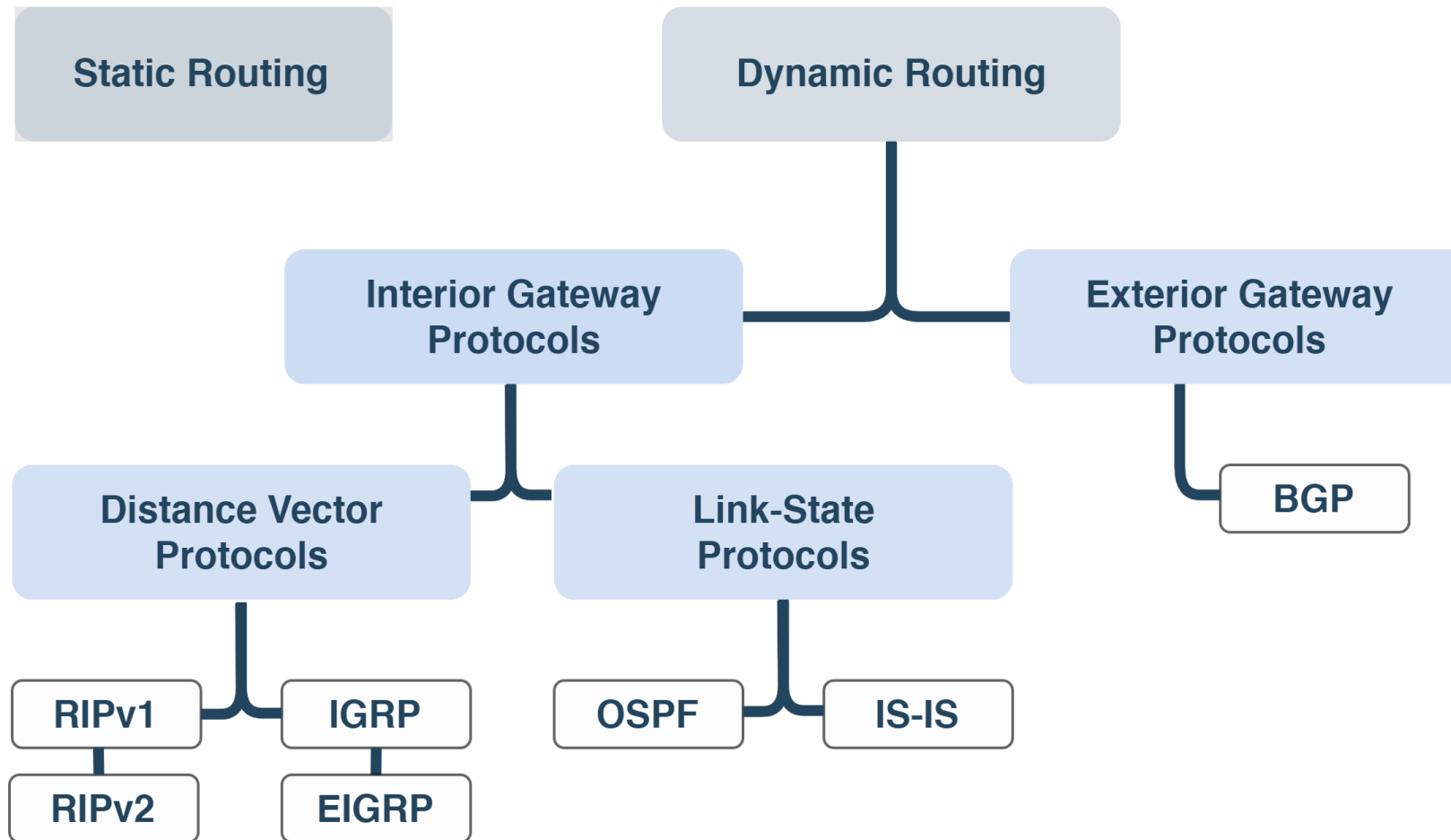
Modul 4  
Routing

# Routing

- Proses melewatkan data dari satu jaringan ke jaringan lain melalui router.
- Routing bekerja pada OSI layer 3.



# Klasifikasi Routing



# Klasifikasi Routing

- Static Routing

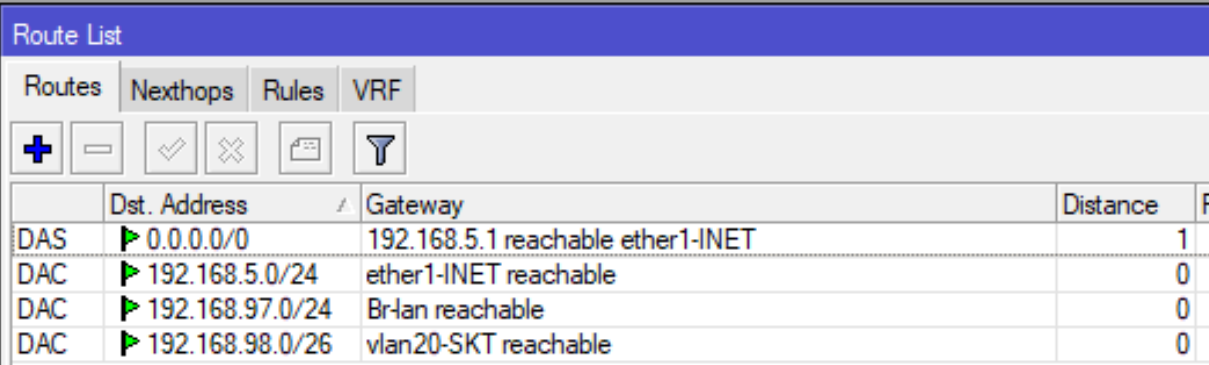
Routing yang dibuat dengan menambahkan secara manual kedalam routing table.

- Dynamic Routing

Routing yang dibuat dengan melakukan enable fungsi protocol pada router tersebut. Maka secara otomatis router akan mencari jalurnya sendiri.

# Routing Table

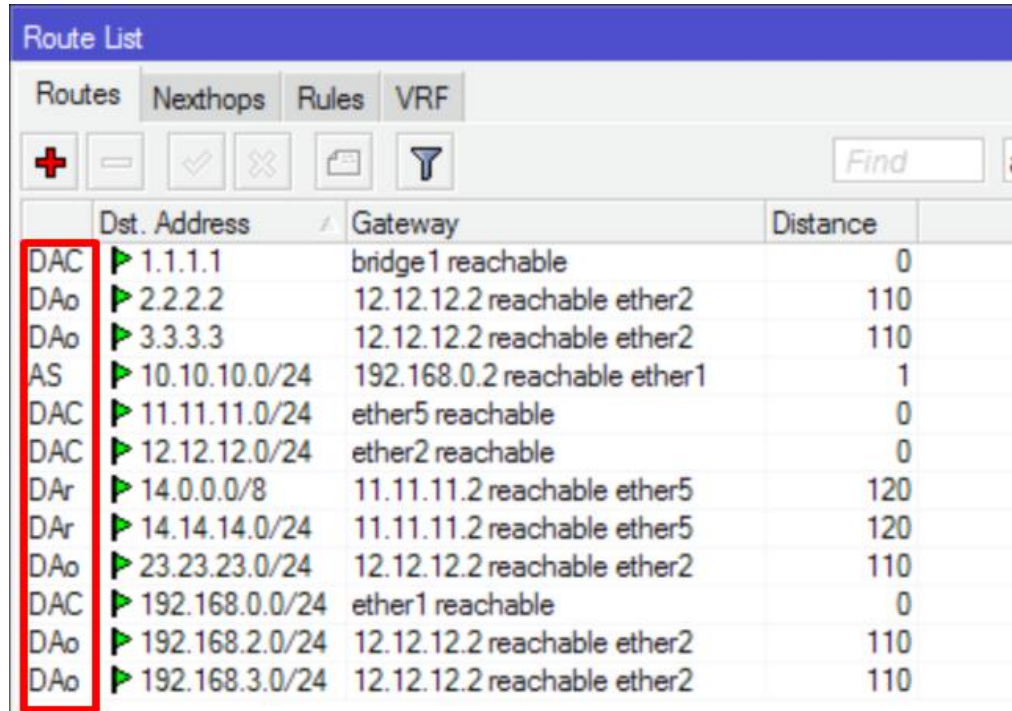
- Berisi informasi mengenai rute ke jaringan/network tertentu.
- Berisi nilai prioritas/metric dari masing-masing rute.



	Dst. Address	Gateway	Distance	F
DAS	▶ 0.0.0.0/0	192.168.5.1 reachable ether1-INET	1	
DAC	▶ 192.168.5.0/24	ether1-INET reachable	0	
DAC	▶ 192.168.97.0/24	Br-lan reachable	0	
DAC	▶ 192.168.98.0/26	vlan20-SKT reachable	0	

- Routing Table terbentuk dari:
  - Semua rute yang berasal dari dynamic routing protocol.
  - Semua rute untuk network yang directly connected ke router.
  - Konfigurasi tambahan (static route).

# Route Flags



The screenshot shows the 'Route List' window in Mikrotik WinBox. The table contains the following data:

	Dst. Address	Gateway	Distance
DAC	1.1.1.1	bridge1 reachable	0
DAo	2.2.2.2	12.12.12.2 reachable ether2	110
DAo	3.3.3.3	12.12.12.2 reachable ether2	110
AS	10.10.10.0/24	192.168.0.2 reachable ether1	1
DAC	11.11.11.0/24	ether5 reachable	0
DAC	12.12.12.0/24	ether2 reachable	0
DAr	14.0.0.0/8	11.11.11.2 reachable ether5	120
DAr	14.14.14.0/24	11.11.11.2 reachable ether5	120
DAo	23.23.23.0/24	12.12.12.2 reachable ether2	110
DAC	192.168.0.0/24	ether1 reachable	0
DAo	192.168.2.0/24	12.12.12.2 reachable ether2	110
DAo	192.168.3.0/24	12.12.12.2 reachable ether2	110

- D = Dynamic
- A = Active
- C = Connected
- S = Static
- o = OSPF
- r = RIP
- b = BGP
- m = MME
- B = Blackhole
- P = Prohibit
- U = Unreachable
- X = Disable

# Connected Route

- Dibuat secara otomatis setiap menambahkan sebuah IP pada interface yang aktif

The screenshot displays the Mikrotik WinBox interface configuration and routing tables. The 'Interface List' window shows 'ether2' selected. The 'Address List' window shows the IP address '192.168.10.1/24' assigned to 'ether2'. The 'Route List' window shows a connected route for '192.168.10.0/24' via 'ether2 reachable' with a distance of 0.

Interface	Name	Type	Actual MTU	L2 MTU	Tx	Rx	Tx Packet (p/s)
	ether1	Ethernet	1500	1598		0 bps	0 bps
R	ether2	Ethernet	1500	1598	63.6 kbps	4.6 kbps	
	ether3					0 bps	0 bps
	ether4					0 bps	0 bps
	pwr-line1					0 bps	0 bps
X	wlan1					0 bps	0 bps

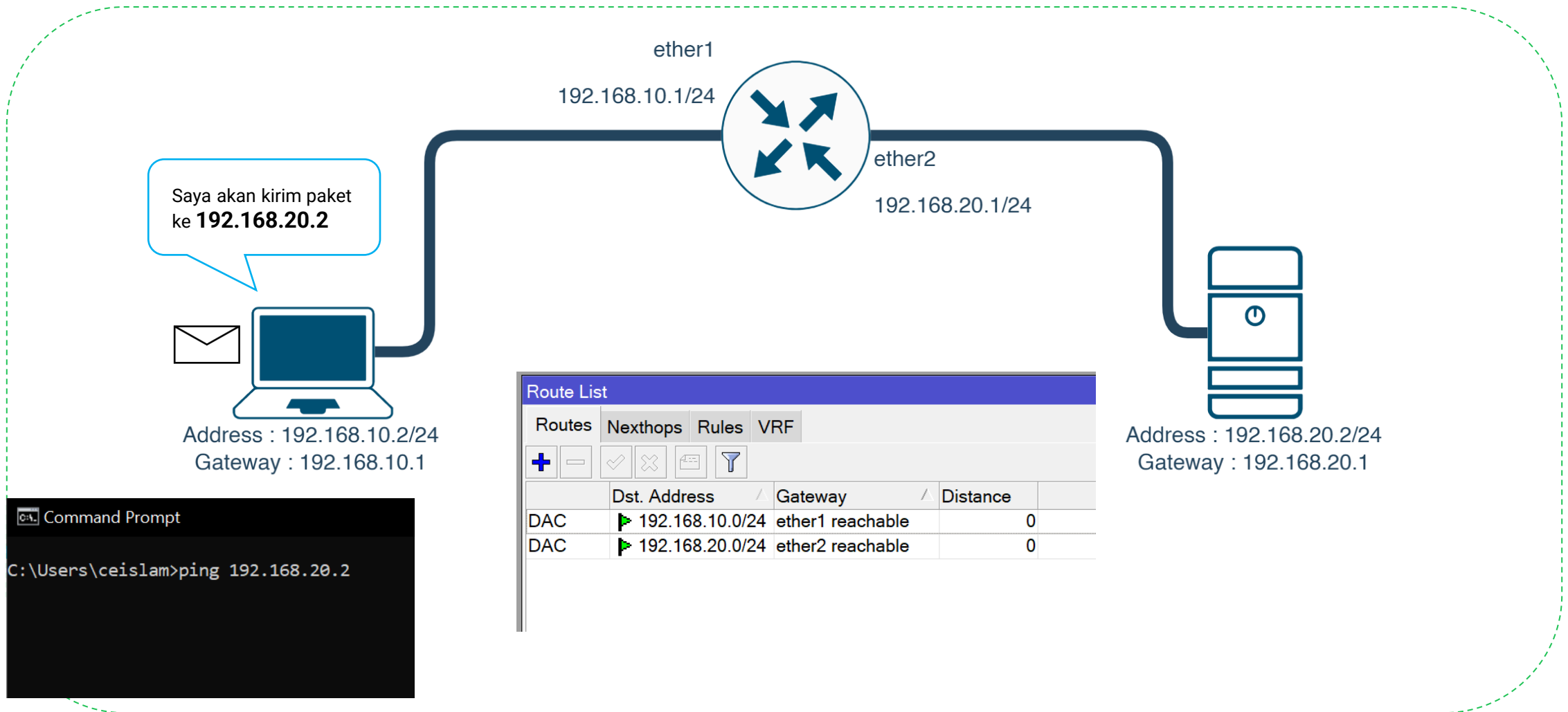
  

Address	Network	Interface
192.168.10.1/24	192.168.10.0	ether2

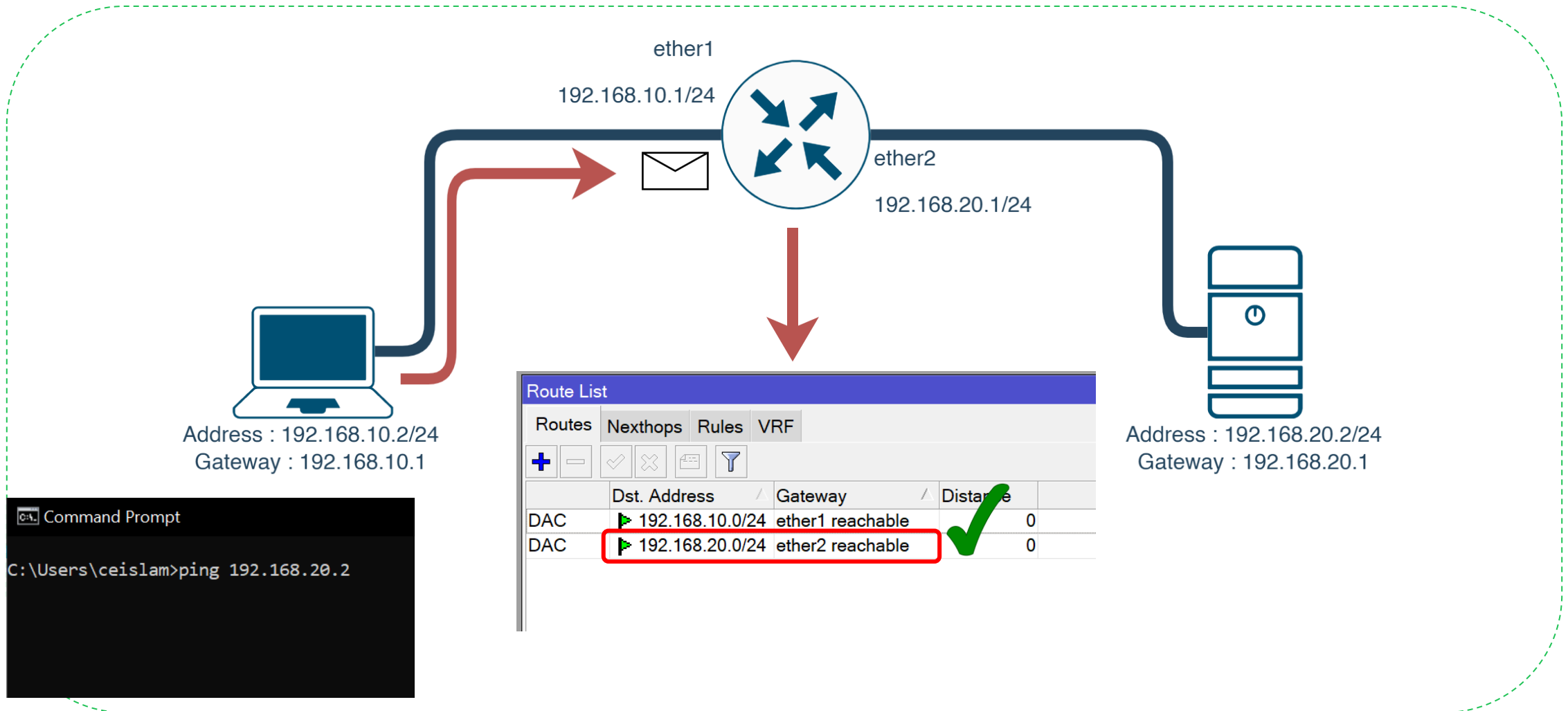
  

Routes	Nexthops	Rules	VRF	
DAC	192.168.10.0/24	ether2 reachable	0	192.168.10.1

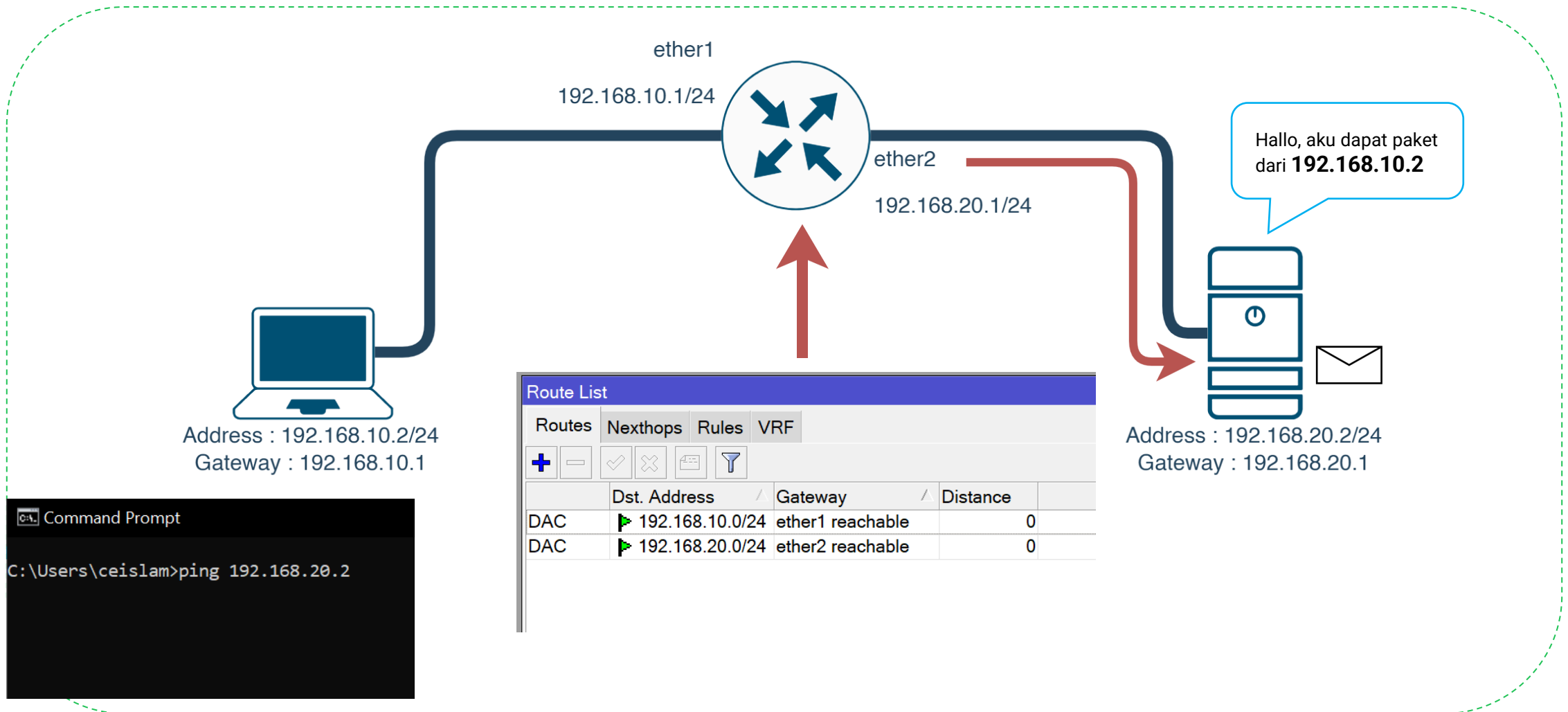
# How Routing Works (1)



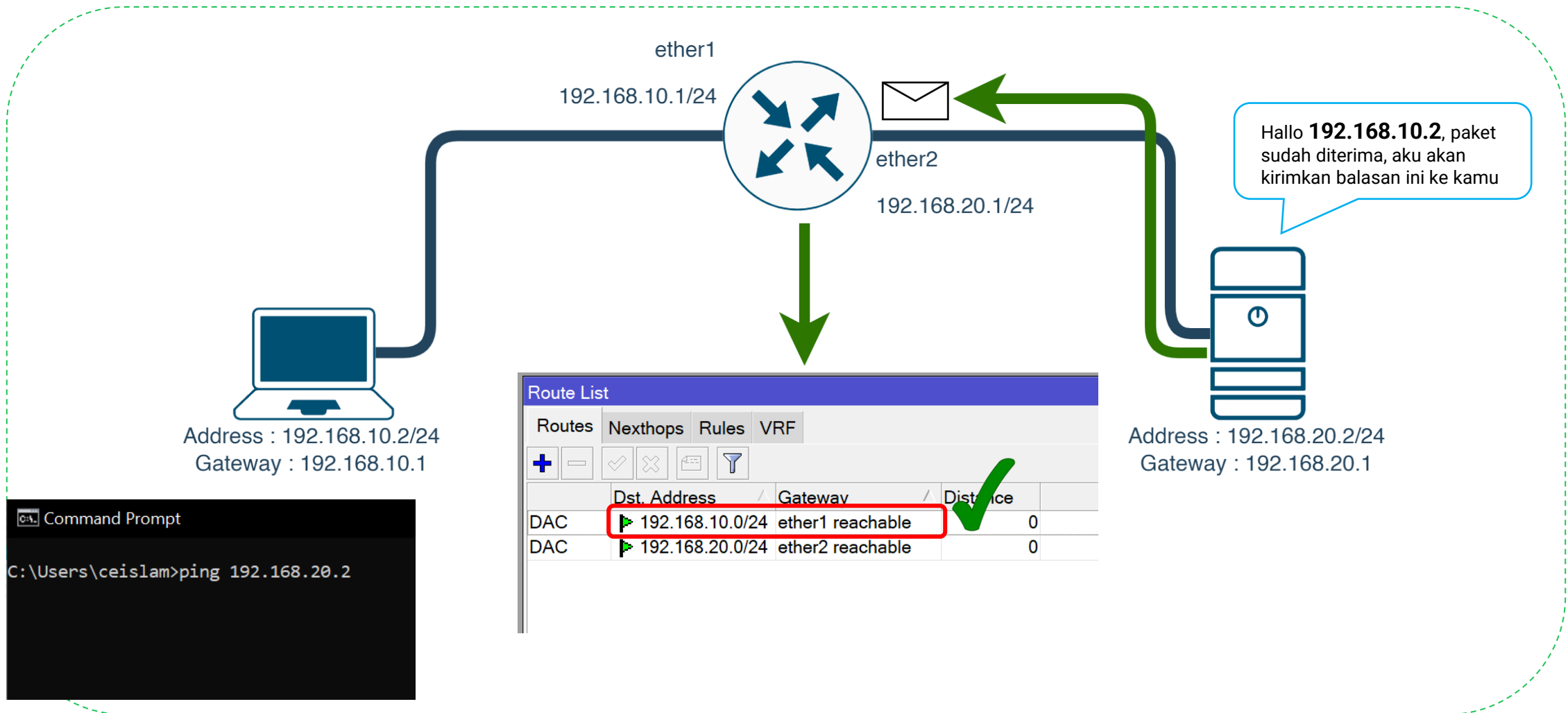
# How Routing Works (2)



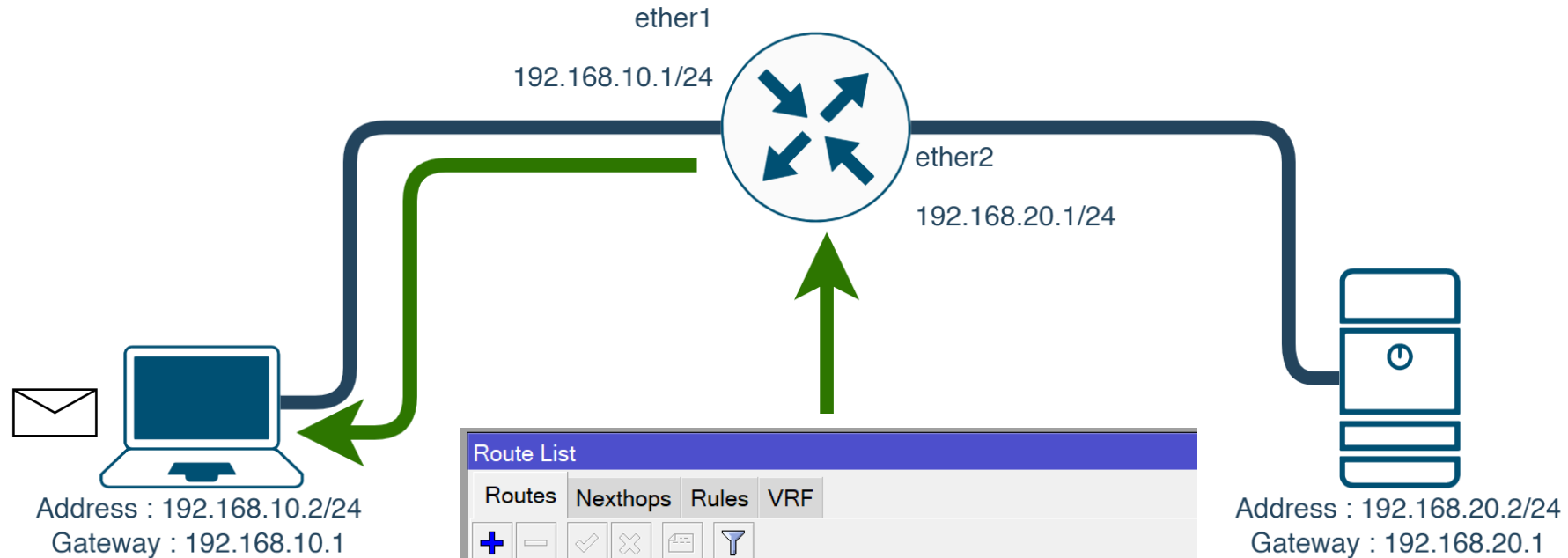
# How Routing Works (3)



# How Routing Works (4)



# How Routing Works (5)



Route List			
Routes	Nexthops	Rules	VRF
+	-	✓	✗
Dst. Address	Gateway	Distance	
DAC	192.168.10.0/24 ether1 reachable	0	
DAC	192.168.20.0/24 ether2 reachable	0	

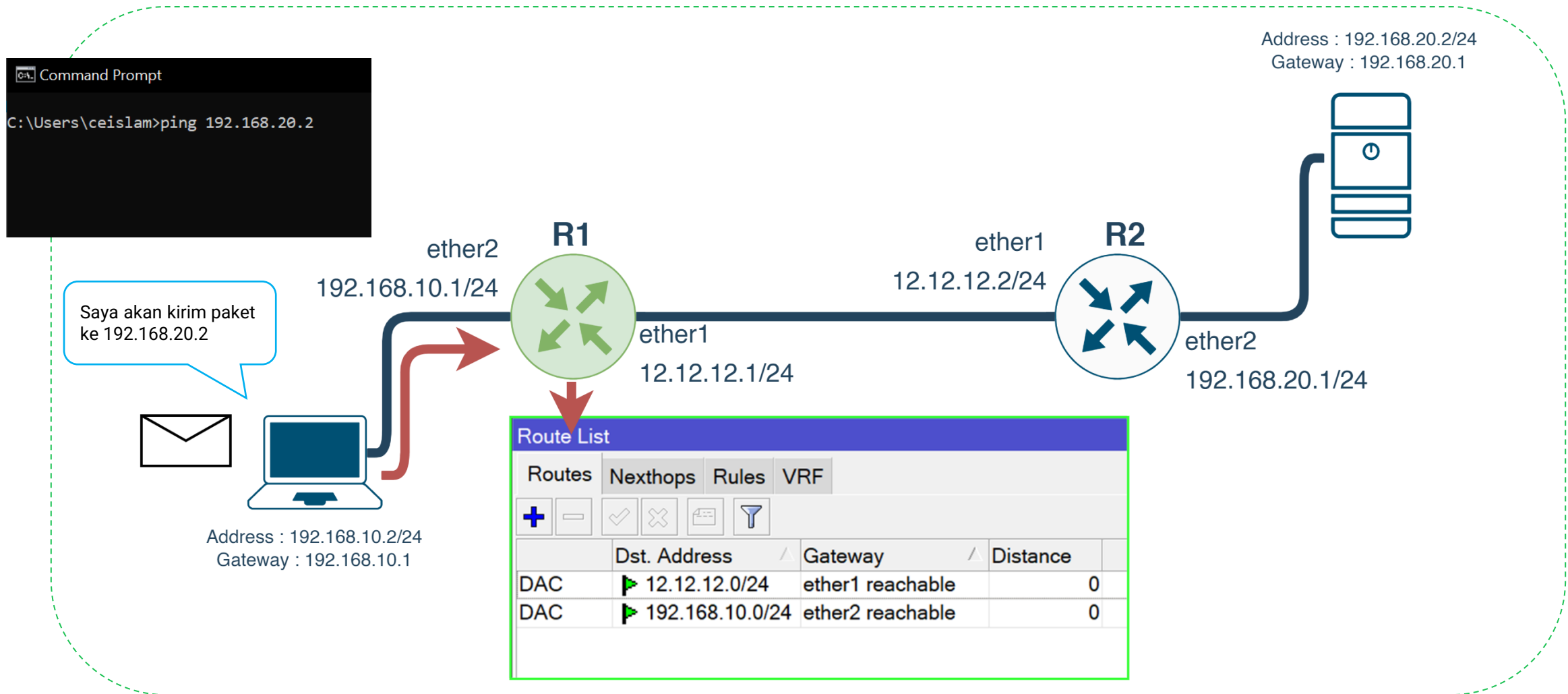
```
Command Prompt
C:\Users\ceislam>ping 192.168.20.2

Pinging 192.168.20.2 with 32 bytes of data:
Reply from 192.168.20.2: bytes=32 time=1ms TTL=64
Reply from 192.168.20.2: bytes=32 time=1ms TTL=64
Reply from 192.168.20.2: bytes=32 time=1ms TTL=64
Reply from 192.168.20.2: bytes=32 time=3ms TTL=64

Ping statistics for 192.168.20.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 3ms, Average = 1ms

C:\Users\ceislam>
```

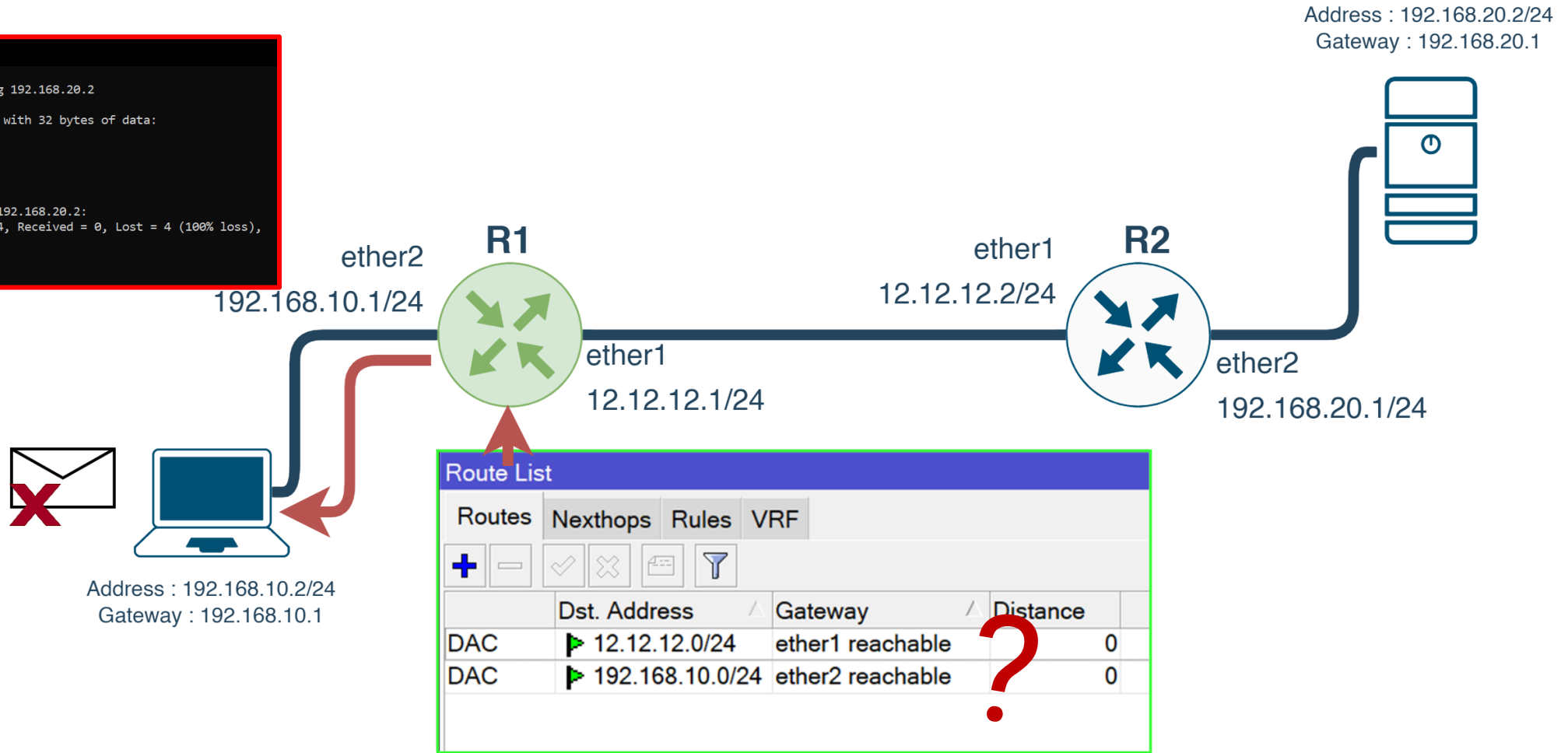
# How Routing Works (6)



R1-Routing Table

# How Routing Works (7)

```
Command Prompt
C:\Users\ceislam>ping 192.168.20.2
Pinging 192.168.20.2 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Ping statistics for 192.168.20.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\Users\ceislam>
```



R1-Routing Table



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# **STATIC ROUTE**

## **MIKROTIK MTCNA**

# Static Route

- Static routing dibuat dengan cara menambahkan jalur manual ke routing table.
- Pada static route yang perlu menambahkan parameter routing (Dst. Address dan Gateway) secara manual kedalam routing table.

IP > Routes > add

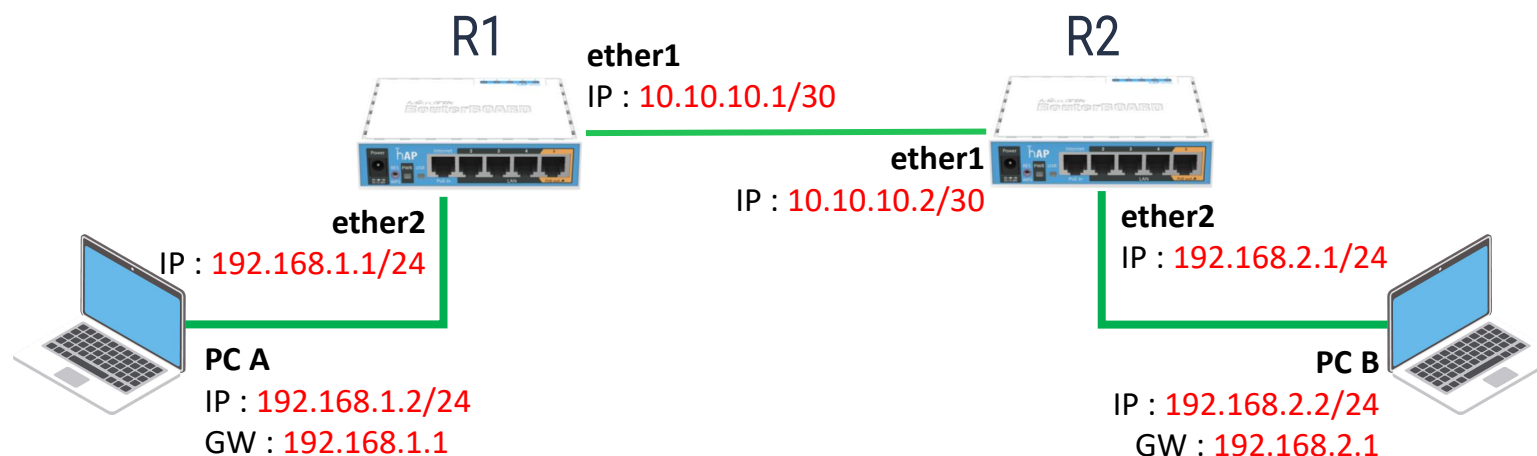
The screenshot shows the 'New Route' configuration window in Mikrotik WinBox. The 'General' tab is selected. The 'Dst. Address' field contains '0.0.0.0/0' and the 'Gateway' field contains '192.168.97.1'. A red rectangular box highlights these two fields. Below these fields is a 'Check Gateway' checkbox which is currently unchecked.

# Static Route

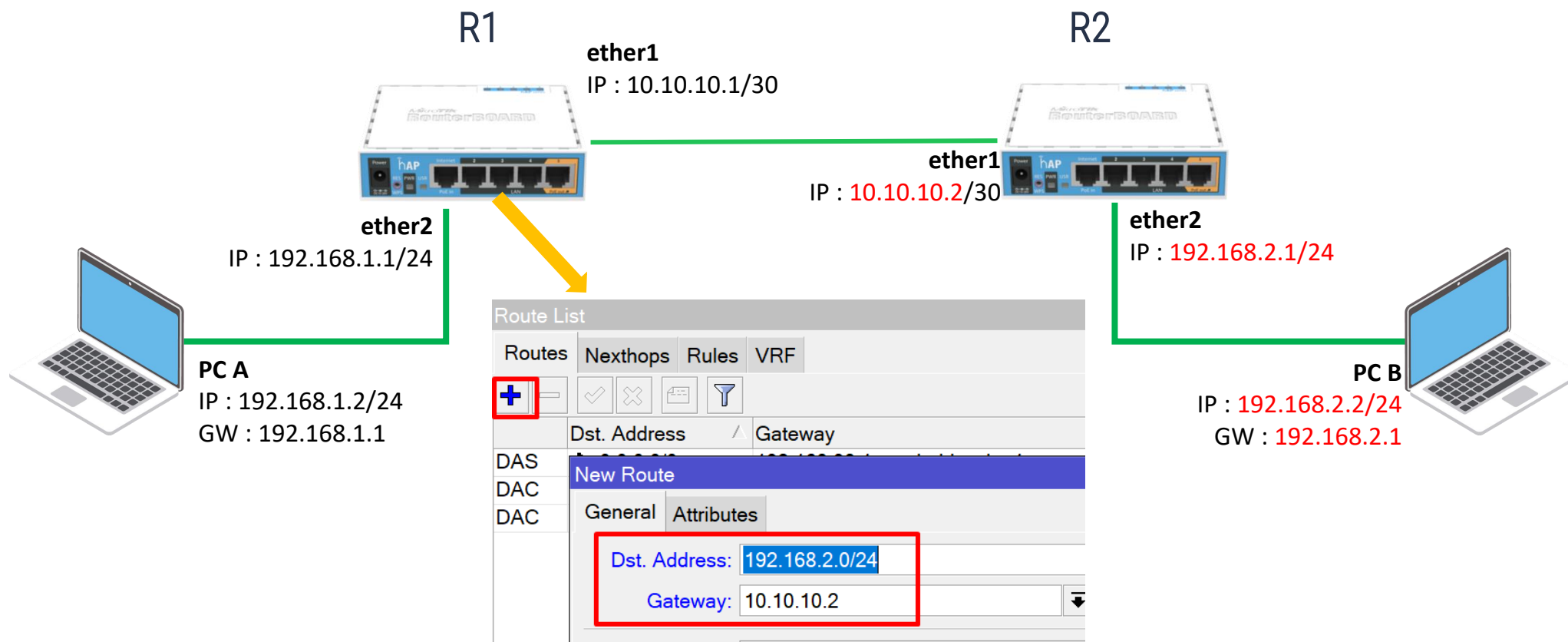
- Mudah dikonfigurasi pada jaringan skala kecil.
- Membutuhkan resource yang ringan.
- Tidak cocok digunakan untuk jaringan skala besar.
- Manual konfigurasi setiap penambahan jaringan baru.

# Static Route

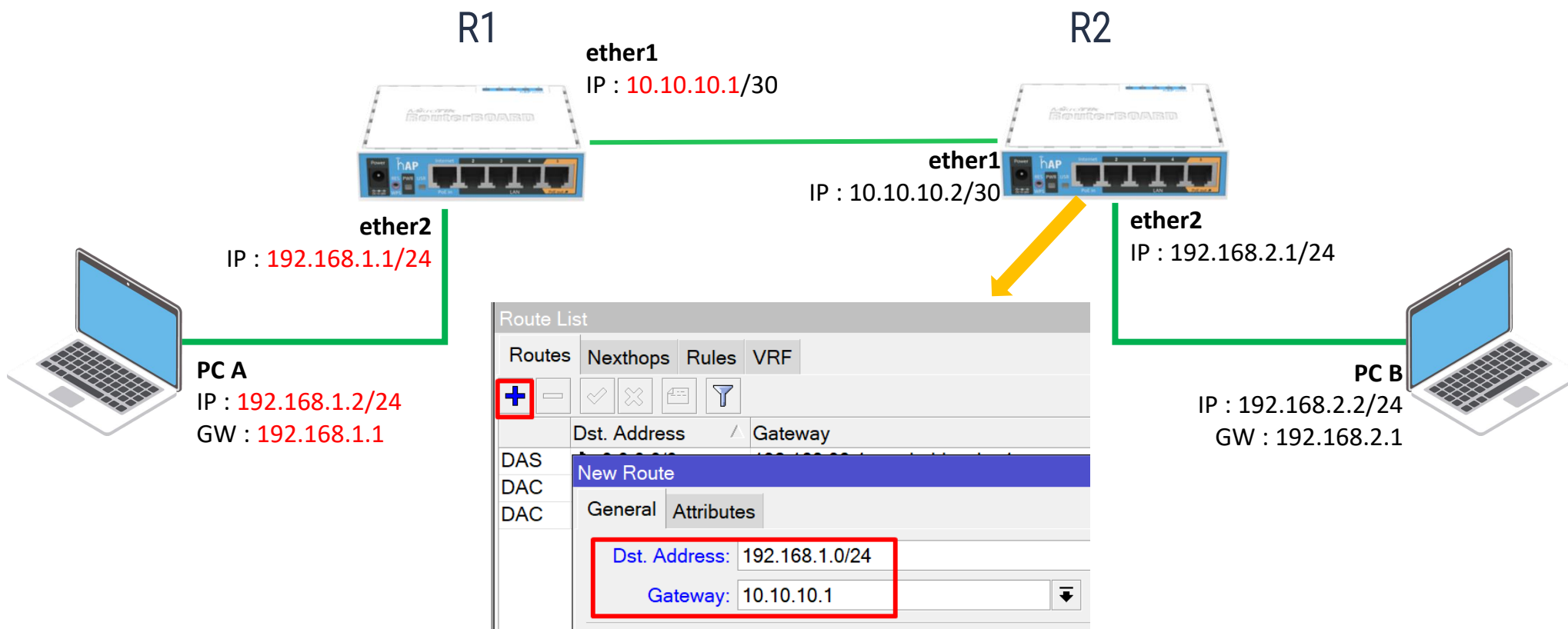
- Buat topologi seperti dibawah ini.
- Setting IP address dan pastikan link peer to peernya reachable dengan cara di PING.
- Konfigurasikan static route agar PC A bisa berkomunikasi dengan PC B.



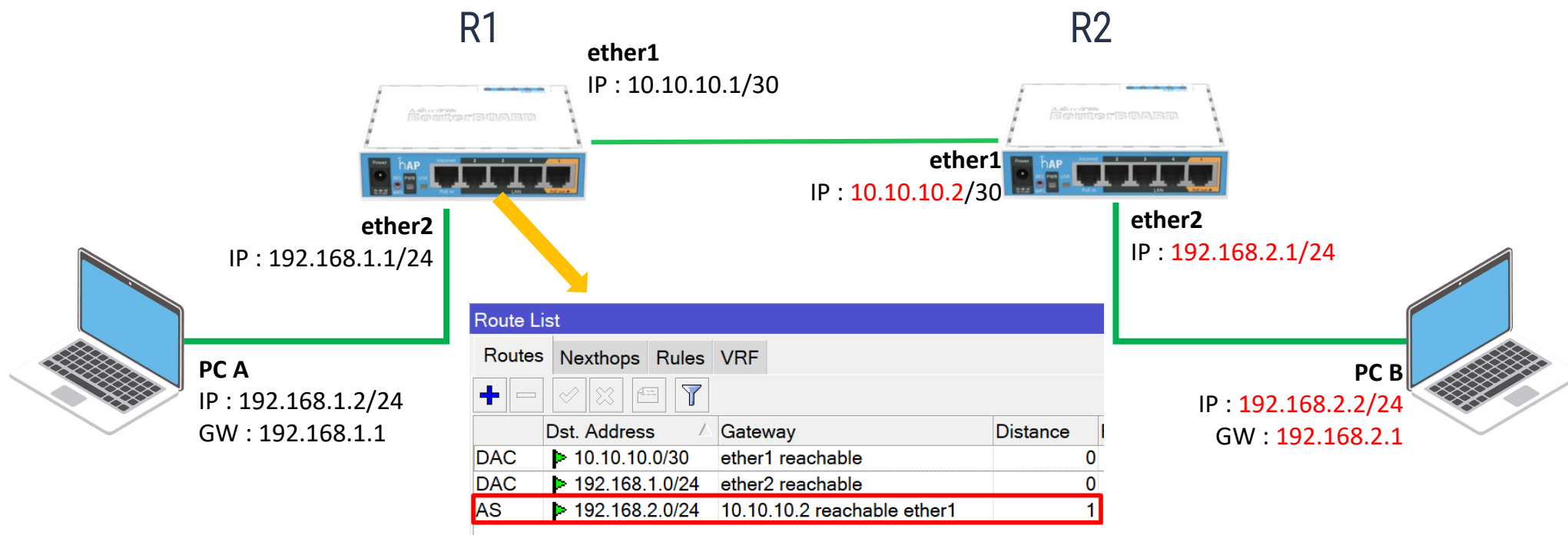
# Static Route – R1



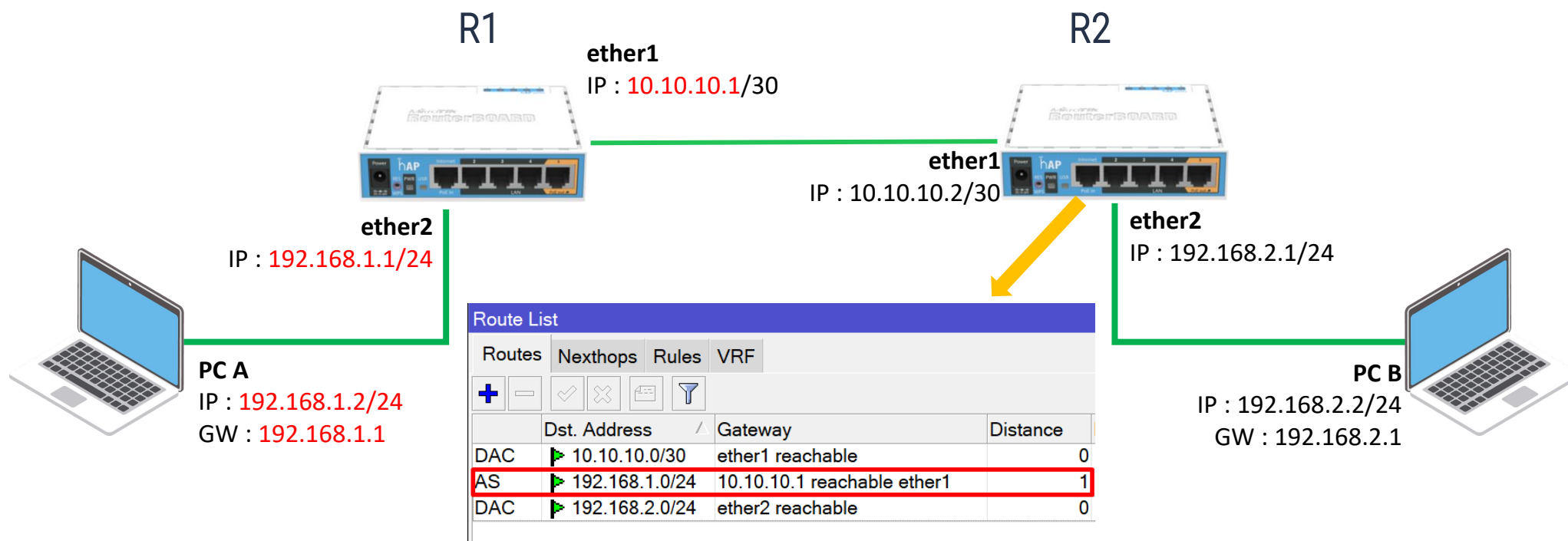
# Static Route – R1



# Verifikasi – R1

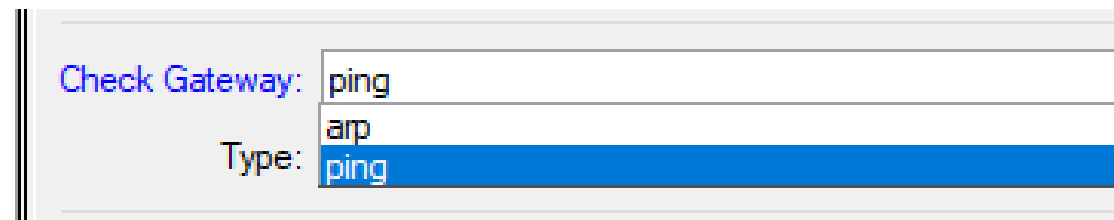


# Verifikasi – R2



# Check Gateway

- Check Gateway adalah pengecekan gateway oleh router melalui Layer 3 setiap interval 10 detik sekali.
- Request Time Out bila dalam 10 detik tidak menerima respon dari gateway.
- Unreachable bila 2x 10 detik tidak menerima respon dari gateway.
- Check gateway bisa berupa ICMP echo request (PING) dan ARP request.



Check Gateway: ping  
Type: ping

- Semua route akan terkena efek check gateway bila menggunakan gateway yang sama, bila gateway tersebut diaktifkan check gateway.



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# **BEST SELECTION ROUTE**

## **MIKROTIK MTCNA**

# Routing – Best Selection Route

- Untuk pemilihan route / jalur terbaik secara otomatis router akan melihat beberapa parameter sebagai berikut :
  - Network (pastikan dst-address dengan yang akan dituju sama)
  - Prefix (spesifik prefix)
  - Distance (semakin kecil distance, semakin prioritas)

# Routing – Best Selection Route

- Network (pastikan dst-address dengan yang akan dituju sama)

Contoh :

Bila ada paket yang akan dikirimkan ke tujuan 192.168.97.190, terdapat 2 buah gateway sebagai berikut:

#1 dst-address=192.168.97.0/25

gateway=192.168.1.1

#2 dst-address=192.168.97.128/25

gateway=192.168.2.1

Manakah gateway yang akan digunakan?

Paket akan dikirimkan melalui 192.168.2.1, karena 192.168.97.190 masuk ke dalam range network 192.168.97.128

# Routing – Best Selection Route

- Prefix (semakin spesifik, semakin di pilih)

Contoh :

Bila ada paket yang akan dikirimkan ke tujuan 192.168.88.10, terdapat 2 buah gateway sebagai berikut:

#1 dst-address=192.168.88.0/28

gateway=192.168.3.1

#2 dst-address=192.168.88.0/26

gateway=192.168.4.1

Manakah gateway yang akan digunakan?

Paket akan dikirimkan melalui 192.168.3.1, karena prefix yang digunakan lebih spesifik.  
/28 = 16 address sedangkan /26 = 64 address

# Routing – Best Selection Route

- Distance (semakin kecil, semakin prioritas)

Contoh :

Bila ada paket yang akan dikirimkan ke tujuan 192.168.100.20, terdapat 2 buah gateway sebagai berikut:

#1 dst-address=192.168.100.0/27 distance=1 gateway=192.168.5.1

#2 dst-address=192.168.100.0/27 distance=2 gateway=192.168.6.1

Manakah gateway yang akan digunakan?

Paket akan dikirimkan melalui 192.168.5.1, karena distance terkecil.

# Routing – Best Selection Route

Contoh :

Bila ada paket yang akan dikirimkan ke tujuan 192.168.200.3, terdapat 2 buah gateway sebagai berikut:

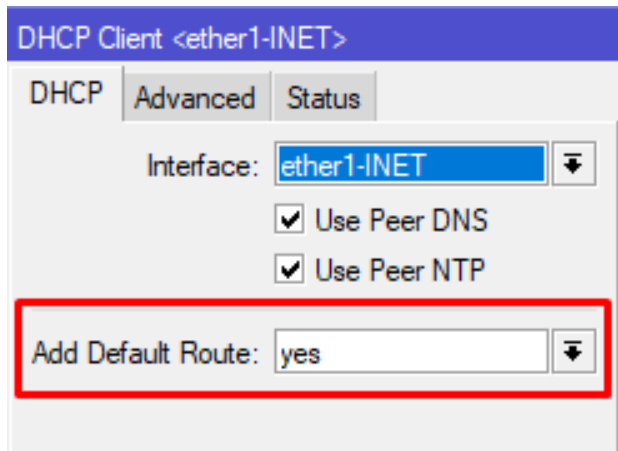
#1 dst-address=192.168.200.0/29 distance=5 gateway=192.168.7.1

#2 dst-address=192.168.200.0/28 distance=3 gateway=192.168.8.1

Manakah gateway yang akan digunakan?

# Default Gateway

- Default Gateway : rute yang mewakili semua address ketika akan dikirimkan.
- Menggunakan alamat 0.0.0.0/0.
- 0.0.0.0/0 mewakili semua alamat di IP Address.
- By default ketika request DHCP Client secara otomatis default gateway akan dikonfigurasi dan ditambahkan ke dalam routing table (DAS)



Route List

Routes Nexthops Rules VRF

	Dst. Address	Gateway	Distance	Routi
DAS	0.0.0.0/0	192.168.5.1 reachable ether1-INET	1	
DAC	192.168.5.0/24	ether1-INET reachable	0	
DAC	192.168.97.0/24	Br-lan reachable	0	
DAC	192.168.98.0/26	vlan20-SKT reachable	0	

# Default Gateway

- Disable 'Add Default Route' di DHCP Client setting.
- Pastikan router tidak bisa mengakses internet.
- Tambahkan default gateway secara manual.
- Check koneksi internet kembali.



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**MTCNA**

**Modul 5**  
**Wireless**

# Wireless pada Mikrotik

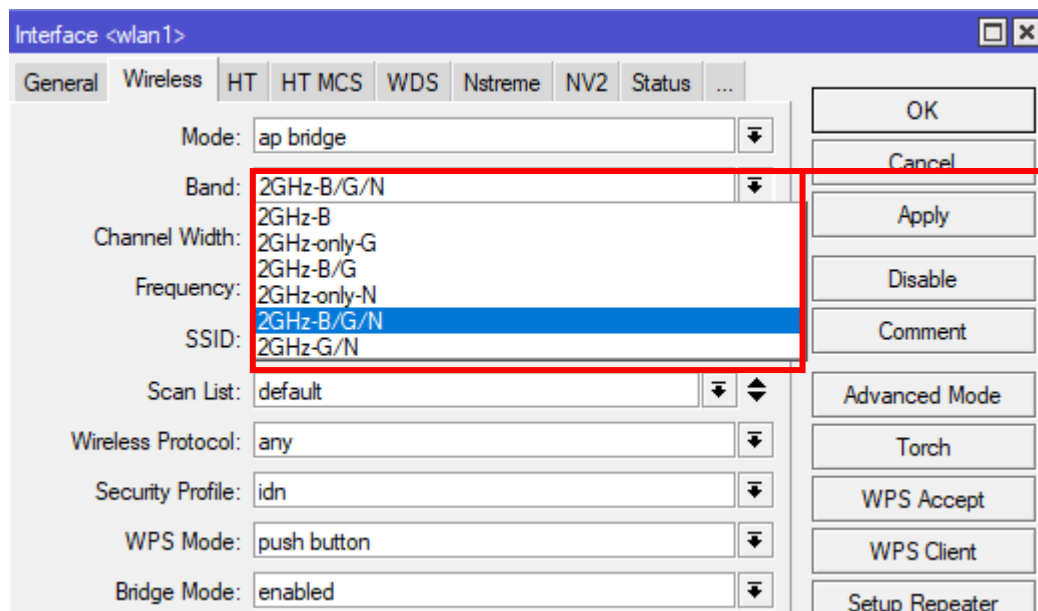
- Wireless memiliki standard & spesifikasi IEEE 802.11 dan menggunakan frekuensi 2,4 GHz dan 5,8 GHz
- RouterOS mendukung protocol standard & spesifikasi IEEE 802.11 a/n/ac (5Ghz) dan 802.11 b/g/n (2,4 Ghz).

IEEE Standard	Frequency	Speed
802.11a	5 GHz	54Mbps
802.11b	2,4 GHz	11Mbps
802.11g	2,4 GHz	54Mbps
802.11n	2,4 GHz dan 5Ghz	Up to 450 Mbps*
802.11ac	5 GHz	Up to 1300 Mbps *

\*Tergantung pada jenis RouterBOARD

# Wireless Band

- Band merupakan standard protocol yang akan digunakan oleh jaringan wireless yang akan kita buat.
- Untuk menghubungkan 2 perangkat, keduanya harus bekerja pada protocol dan band yang sama.



Band yang ada pada list, tergantung pada jenis wireless card yang digunakan.

# Wireless Protocol

- By default Wireless Protocol yang digunakan oleh mikrotik adalah any (support open standard dan proprietary protocol).
- Kita bisa menyesuaikan dengan kebutuhan dengan cara merubah ke protocol yang lain.

Wireless Protocol: any

Security Profile: 802.11  
any  
nstreme  
nv2

Frequency Mode: nv2

Country: nv2 nstreme  
nv2 nstreme 802.11

Installation: unspecified

WMM Support: disabled

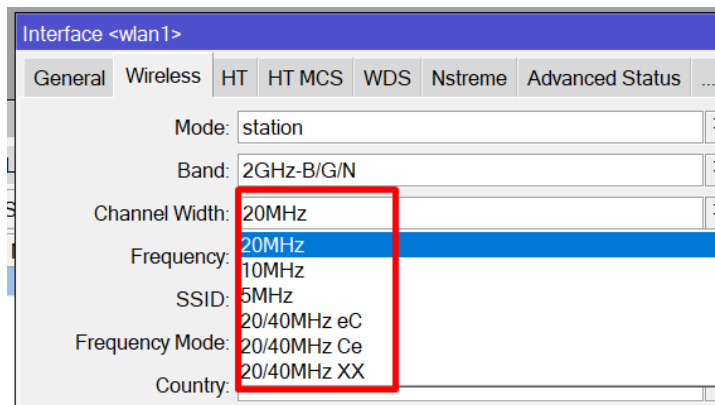
# Wireless Protocol

- unspecified - protocol mode used on previous RouterOS versions (v3.x, v4.x). Nstreme is enabled by old enable-nstreme setting, Nv2 configuration is not possible.
- any : on AP - regular 802.11 Access Point or Nstreme Access Point; on station - selects Access Point without specific sequence, it could be changed by connect-list rules.
- nstreme - enables Nstreme protocol (the same as old enable-nstreme setting).
- nv2 - enables Nv2 protocol.
- nv2 nstreme : on AP - uses first wireless-protocol setting, always Nv2; on station - searches for Nv2 Access Point, then for Nstreme Access Point.
- nv2 nstreme 802.11 - on AP - uses first wireless-protocol setting, always Nv2; on station - searches for Nv2 Access Point, then for Nstreme Access Point, then for regular 802.11 Access Point.
- Warning! Nv2 doesn't have support for Virtual AP
- <https://wiki.mikrotik.com/wiki/Manual:Interface/Wireless>



# Channel Width

- Channel Width (lebar channel) merupakan lebar jalur yang digunakan untuk melewatkan data di Jaringan Wireless.
- Default Channel width 22MHz (ditulis 20MHz)
- Lebar channel dapat dikecilkan (5 MHz) untuk meminimalkan frekuensi atau dibesarkan (40 MHz) untuk mendapatkan throughput yang lebih besar.
- Semaki besar CW semakin besar juga kemungkinan terjadi interferensi di jaringan wireless.

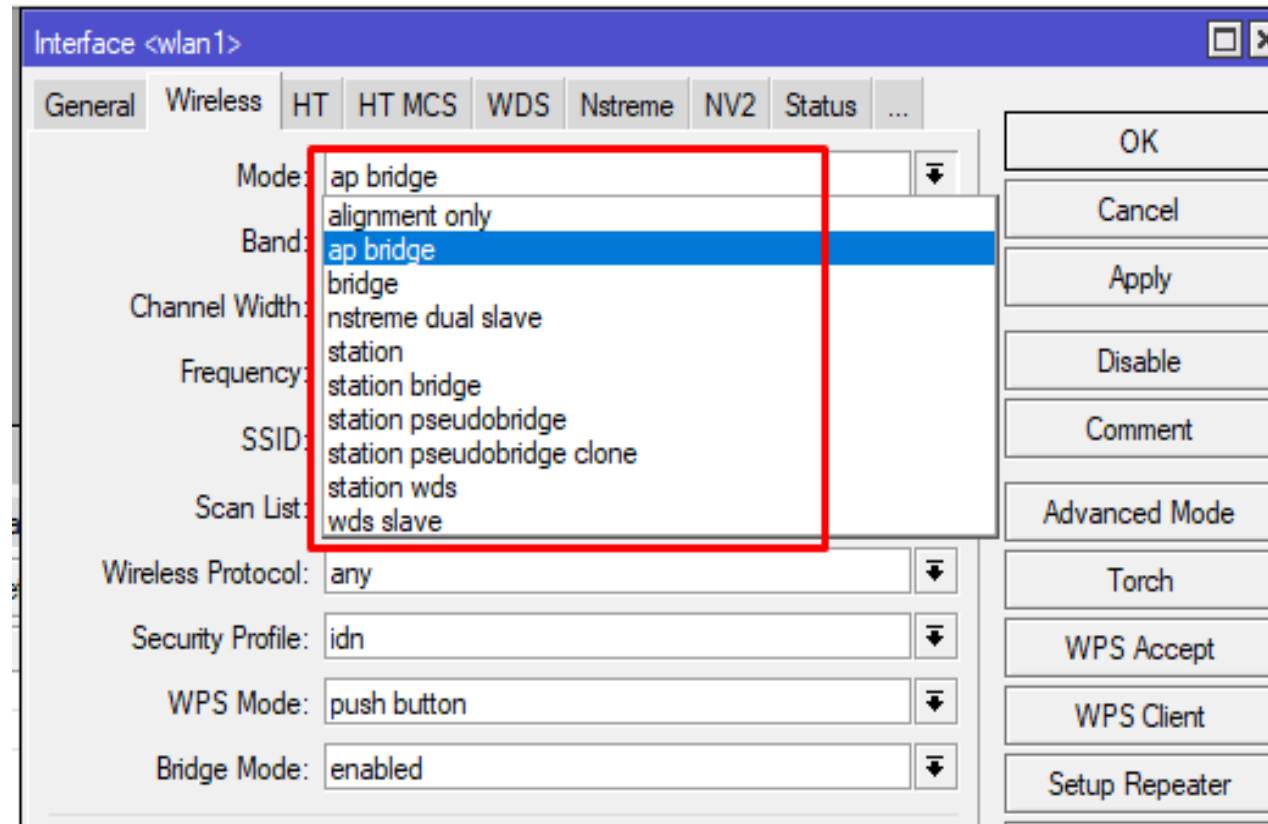


- 20/40MHz eC (HT-Bellow) 20MHz frekuensi normal dan 20MHz di bawahnya.
- 20/40MHz Ce (HT-Above) 20MHz frekuensi normal dan 20MHz di atasnya.
- 20/30MHz XX (Otomatis Scan channel)

Ketiga channel width di atas bekerja di band N

# Wireless Mode

- Wireless Mode menentukan fungsi suatu wireless tersebut.



# Wireless Mode

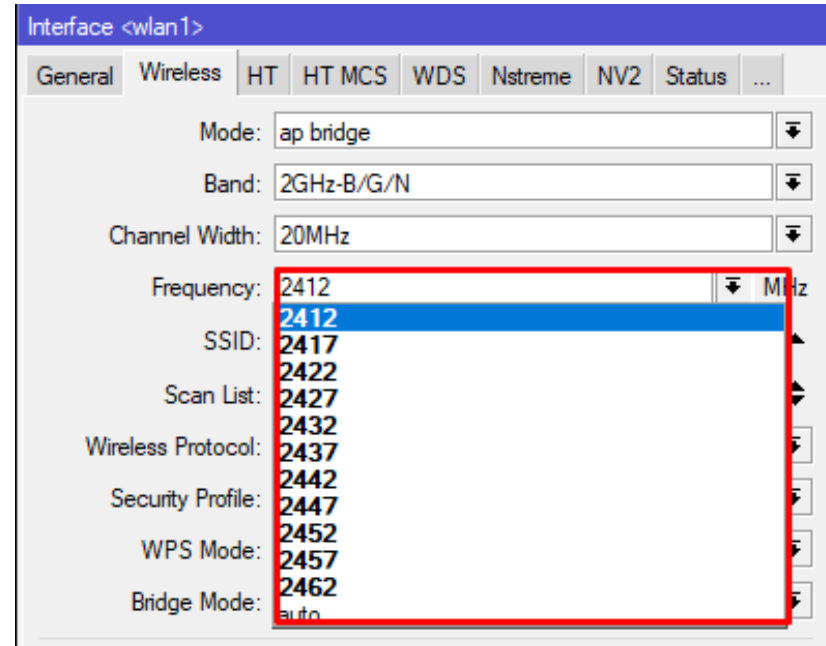
- AP Mode
  - AP Bridge merupakan mode pemancar yang bisa melayani banyak client (PTMP).
  - Bridge merupakan mode pemancar yang hanya bisa melayani satu client (PTP).
- Station Mode
  - Station merupakan mode penerima yang bersifat routing.
  - Station Bridge merupakan mode penerima yang support bridge.
  - Station Psudobridge merupakan mode penerima yang digunakan untuk menghubungkan mikrotik dengan non mikrotik secara bridging.
  - Station Psudobridge Clone merupakan mode yang sama dengan station Psudobridge yang harus melakukan cloning MAC address ketika akan konek.
  - Station WDS berfungsi sebagai penerima untuk AP yang mengaktifkan fitur WDS.

# Wireless Mode

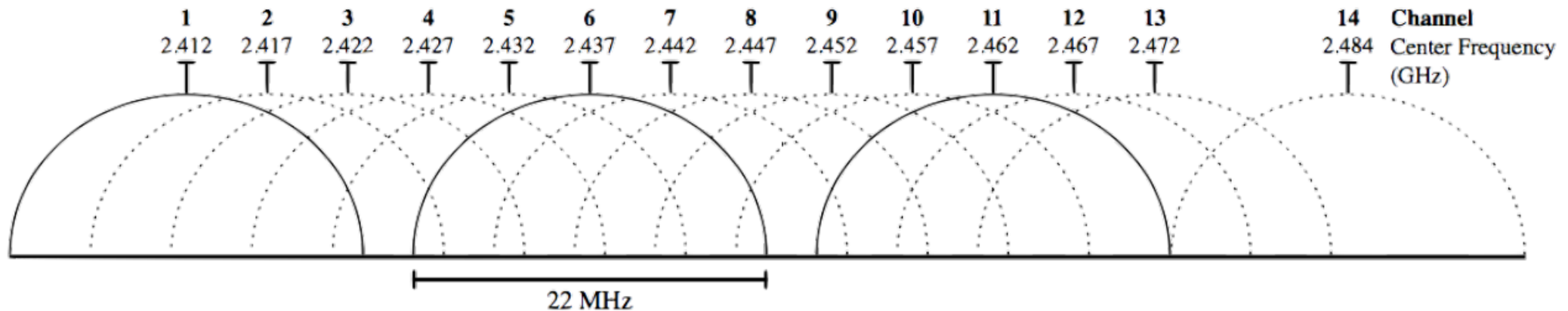
- Special Mode
  - Alignment Only merupakan mode yang biasanya digunakan untuk pointing. Hasil outputnya dapat berupa suara beep. Semakin kencang suara semakin bagus sinyal yang di dapat.
  - Nstreme-Dual-Slave mode untuk membuat jaringan wireless jadi full duplex. Karena pada dasarnya jaringan wireless itu adalah half duplex. Untuk membuat mode ini diperlukan 2 wireless card dan 2 antenna pada kedua radio.
  - WDS-Slave merupakan mode untuk membuat repeater.

# Frequency

- Merupakan pembagian dari frekuensi dalam suatu band dimana jaringan wireless beroperasi.
- Pentingnya pemilihan frekuensi adalah untuk mencegah terjadinya interferensi.

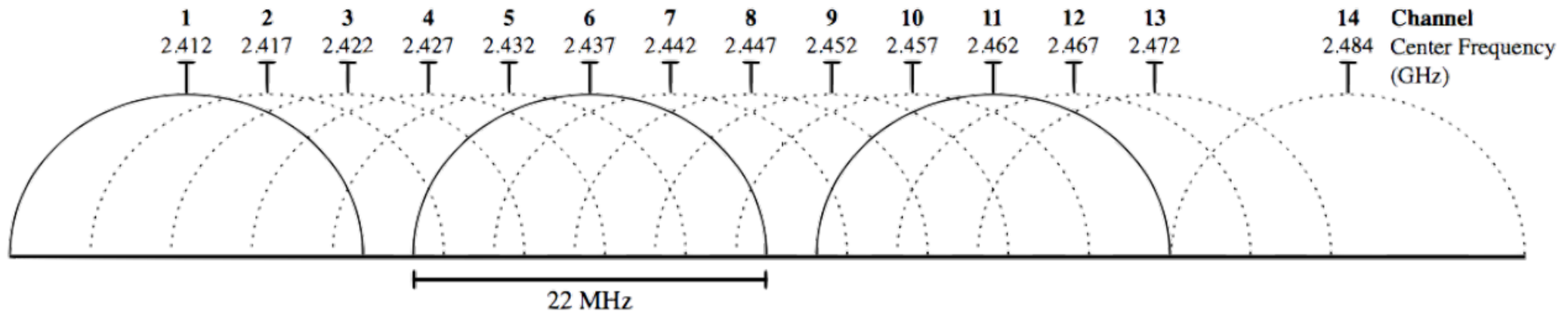


# Wireless – 2,4Ghz Channels



- 13x 22Mhz channel
- 3 non-overlapping channels (1,6,11)
- 3 AP dalam area yang sama bisa menggunakan non-overlapping channels untuk menghindari interference.

# Wireless – 2,4Ghz Channels



- Setiap negara mempunyai regulasi channel yang berbeda-beda, contohnya US punya 11 channels. Sedangkan Jepang punya 14 channels.
- Channel width :
  - 802.11b 22Mhz, 802.11g 20MHz, 802.11n 20/40Mhz

# Wireless – 5Ghz Channels

- RouterOS juga telah mendukung frekuensi 5Ghz.
- 5180-5320 Mhz (channel 36-64)
- 5500-5720 Mhz (channel 100-144)
- 5747-5825 Mhz (channel 149-165)
- Tergantung juga pada regulasi di setiap negara.

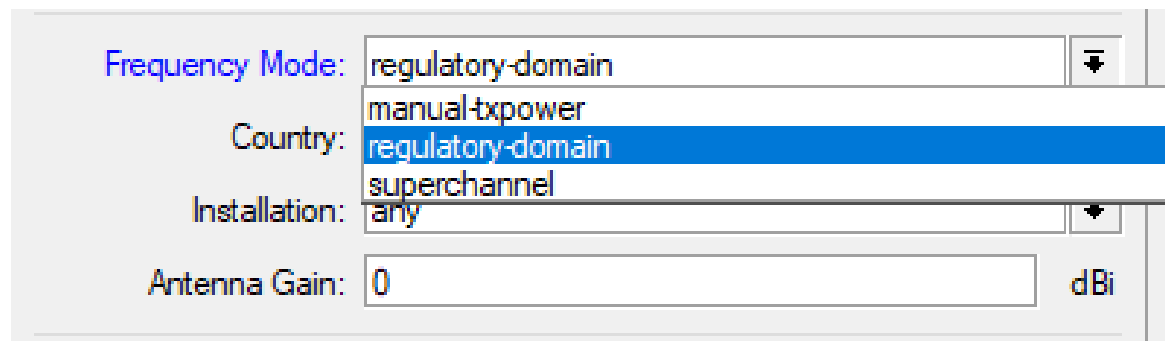


# Wireless – 5Ghz Channels

IEEE Standard	Channel Width
802.11a	20MHz
802.11n	20MHz
	40MHz
802.11ac	20MHz
	40MHz
	80MHz
	160MHz

# Country Regulations

- Regulatory-domain digunakan untuk menyesuaikan regulasi di suatu negara.
- Setiap negara memiliki regulasi tertentu dalam hal frekuensi wireless untuk internet carrier.
- Regulasi tersebut dalam mikrotik didefinisikan pada parameter wireless advanced frequency mode = regulatory-domain, kemudian tinggal di arahkan ke suatu negara.
- Namun apabila ingin membuka semua frekuensi yang dapat digunakan oleh wireless card, dapat menggunakan pilihan superchannel



The image shows a screenshot of the Mikrotik wireless advanced settings interface. The 'Frequency Mode' dropdown is set to 'regulatory-domain'. The 'Country' dropdown is open, showing three options: 'manual-txpower', 'regulatory-domain' (which is highlighted in blue), and 'superchannel'. The 'Installation' dropdown is set to 'any'. The 'Antenna Gain' is set to '0' dBi.

Frequency Mode:	regulatory-domain
Country:	regulatory-domain
Installation:	any
Antenna Gain:	0 dBi

# Country Regulations

Frequency Mode: manual-txpower

Country: no\_country\_set

Installation: any

Antenna Gain: 0 dBi

## Frequency Mode

### 1. Manual-txpower

frekuensi default mikrotik.

### 2. Regulatory-domain

frekuensi sesuai regulasi disuatu

negara

### 3. Superchannel

membuka semua frekuensi yang di support oleh wireless card

Pemilihan Country / Negara

Default 0, akan otomatis menyesuaikan agar tidak melebihi EIRP country regulation

# DFS

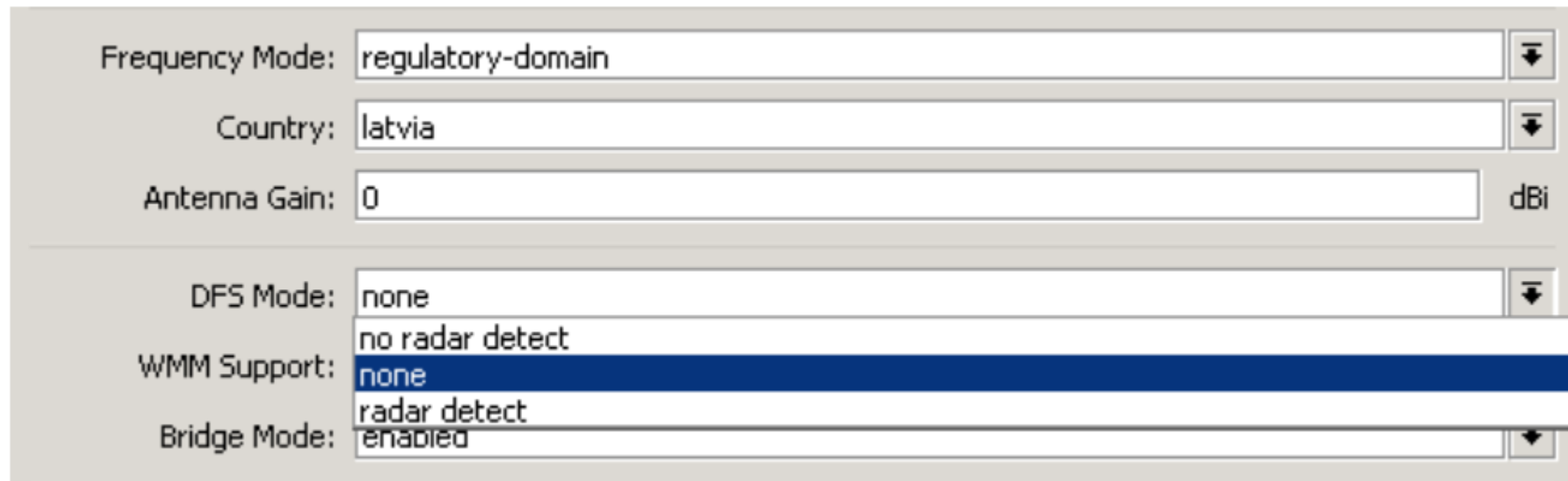
- Dynamic Frequency Selection (DFS) merupakan sebuah fitur yang digunakan untuk mendeteksi radar.
- Biasanya ada pada frekuensi 5Ghz outdoor, bila terdeteksi radar gunakan channel lain.
- Bila DFS enable hanya ada beberapa channel saja yang bisa digunakan.

Contoh : EU = 52-144, US = 50-144

- Di UK DFS membutuhkan waktu sekitar 10-20 menit, ketika radio terdeteksi atau sedang diperiksa radar (DFS Event) semua client akan terkoneksi akan diskonek dan membutuhkan 10-20 menit untuk konek.

# DFS

- DFS mode **radar detect** akan memilih channel yang lebih kecil, dan menggunakannya jika tidak terdeteksi oleh radar sekitar 60s
- Untuk mengaktifkan DFS enable advance mode di wireless



The image shows a screenshot of a Mikrotik wireless configuration interface. The 'DFS Mode' dropdown menu is open, showing the following options: 'none', 'no radar detect', 'radar detect', and 'enabled'. The 'radar detect' option is currently selected and highlighted in blue. Other visible settings include 'Frequency Mode' set to 'regulatory-domain', 'Country' set to 'latvia', and 'Antenna Gain' set to '0 dBi'.

Frequency Mode:	regulatory-domain	↓
Country:	latvia	↓
Antenna Gain:	0	dBi
DFS Mode:	none	↓
WMM Support:	no radar detect	
	none	
	radar detect	
Bridge Mode:	enabled	↓

# Radio Name

- Radio Name merupakan hostname dari radio itu sendiri.
- Hanya akan terlihat apabila sama-sama menggunakan RouterOS.
- Untuk mengetahui radio name lawan bias di cek di Registration table.

The screenshot shows the Mikrotik WinBox configuration window for the 'wlan1' interface, specifically the 'Wireless' tab. The configuration includes the following fields:

- Mode: station
- Band: 2GHz-only-N
- Channel Width: 20MHz
- Frequency: 2462 MHz
- SSID: IDN
- Radio Name: Candra** (highlighted with a red box)
- Scan List: default

On the right side of the window, there are several action buttons: OK, Cancel, Apply, Disable, Comment, Simple Mode, and Torch.

# Radio Name

- Wireless > Registration

Wireless Tables

WiFi Interfaces | W60G Station | Nstreme Dual | Access List | Registration | Connect List | Security Profiles | Channels

☰ ☹ 00 Reset

Radio Name	MAC Address	Interface	Uptime	AP	W...	Last Activit...	Tx/Rx Signal S...	Tx Rate	Rx Rate
	F4:5C:89:B1:51:23	wlan1	1d 04:59:36	no	no	0.010	-45	144.4Mbps...	144.4Mbps...
	78:FF:CA:97:19:EA	wlan1	07:06:39	no	no	0.350	-52	72.2Mbps...	65Mbps-20...
	D8:1E:DD:3C:40:C7	wlan1	00:38:46	no	no	0.020	-54	72.2Mbps...	72.2Mbps...
	2A:7A:D1:17:1E:6D	wlan1	00:25:36	no	no	0.150	-40	130Mbps-2	144.4Mbps
candra	64:D1:54:F5:0F:74	wlan1	00:01:04	no	no	0.060	-45/-46	36Mbps	6Mbps

# Radio Name

- Rubah radio name menjadi nama anda

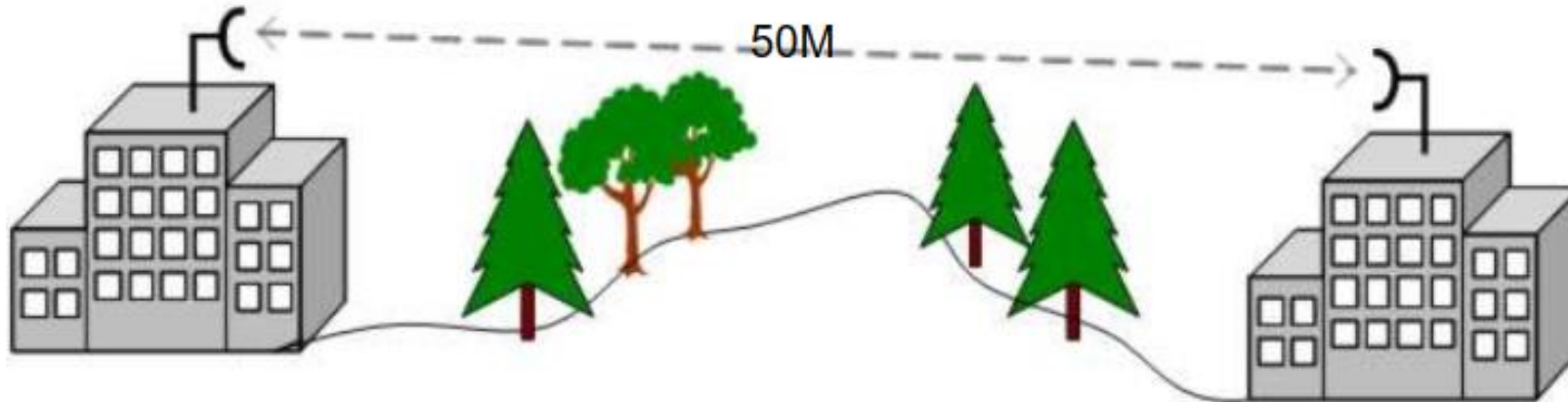


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# **WIRELESS CONNECTION**

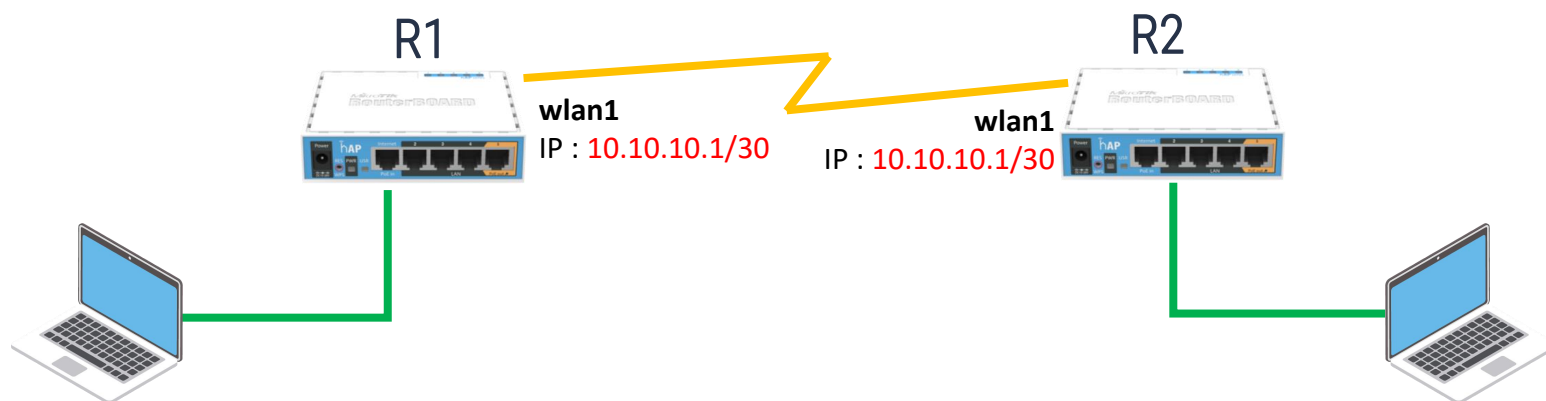
## **MIKROTIK MTCNA**

# Konsep Koneksi Wireless



- Kesesuaian Mode : (AP-Station, AP-Repeater, Repeater-repeater)
- Kesesuaian BAND
- Kesesuaian SSID
- Kesesuaian enkripsi dan autentikasi
- Frekuensi channel tidak perlu sama, station secara otomatis akan mengikuti channel frekuensi pada AP.

# Koneksi Wireless



Konfigurasi	Peserta I	Peserta II
Mode	AP-Bridge/Bridge	Station/Station-Bridge
Band	Samakan	
SSID	Samakan (Unik untuk tiap pasangan)	
Frequensi	Pilih	Tidak harus sama
Security Profile	Samakan	
IP address wlan1	10.10.10.1/30	10.10.10.2/30

# Koneksi Wireless

## Peserta 1 (Access Point)

Interface <wlan1>

General Wireless HT HT MCS WDS Nstreme NV2 Status ...

Mode: ap bridge

Band: 2GHz-B/G/N

Channel Width: 20MHz

Frequency: 2412 MHz

SSID: IDN

Scan List: default

Wireless Protocol: any

Security Profile: profile1

## Peserta 2 (Station)

Interface <wlan1>

General Wireless HT HT MCS WDS Nstreme NV2 ...

Mode: station bridge

Band: 2GHz-B/G/N

Channel Width: 20MHz

Frequency: 2412 MHz

SSID: IDN

Scan List: default

Wireless Protocol: any

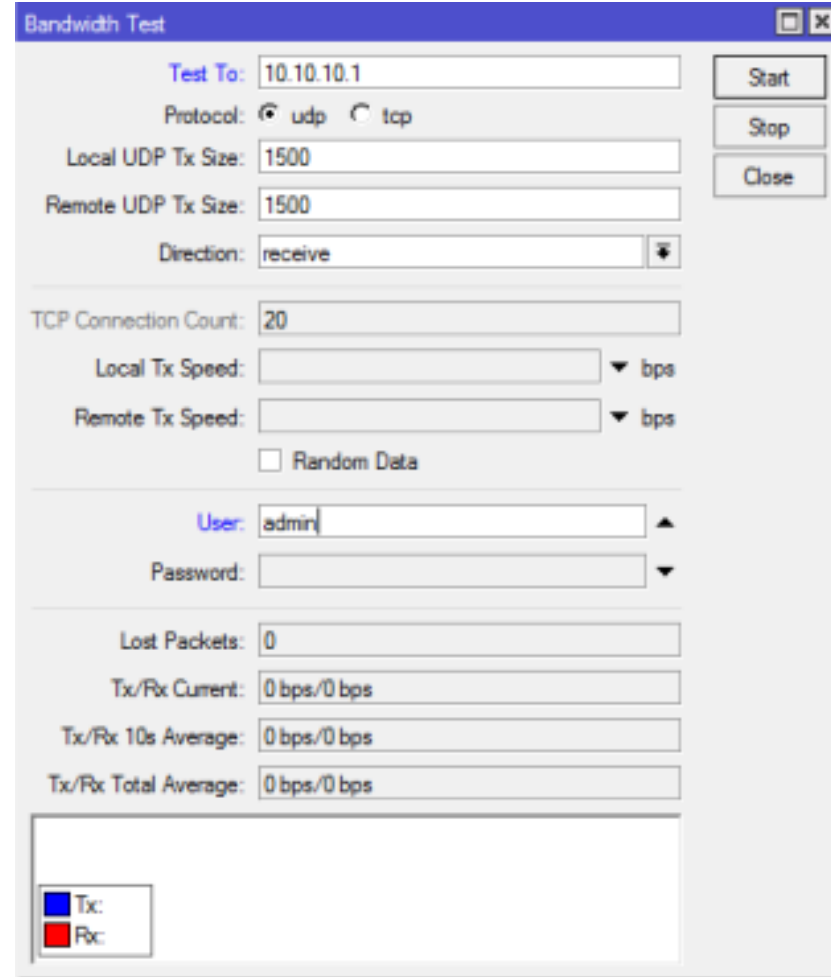
Security Profile: profile1

Default Authenticate

Check pastikan muncul R (Running) di interface wlan1 / check di registration  
Setting IP address sesuai topologi, pastikan antar router bisa saling ping

# Bandwidth Test

- Bandwidth test digunakan untuk mengukur seberapa besar link dapat mendeliver bandwidth.
- Untuk menjamin keakuratan, bandwidth test hanya dijalankan di salah satu sisi.
- Tool > Bandwidth Test
  - Test to = IP lawan
  - User & password = user password router lawan



The screenshot shows the Mikrotik Bandwidth Test tool interface. The window title is "Bandwidth Test". The "Test To" field is set to "10.10.10.1". The "Protocol" is set to "udp". The "Local UDP Tx Size" and "Remote UDP Tx Size" are both set to "1500". The "Direction" is set to "receive". The "TCP Connection Count" is set to "20". The "Local Tx Speed" and "Remote Tx Speed" fields are empty, with "bps" units. The "Random Data" checkbox is unchecked. The "User" field is set to "admin" and the "Password" field is empty. The "Lost Packets" field is set to "0". The "Tx/Rx Current", "Tx/Rx 10s Average", and "Tx/Rx Total Average" fields are all set to "0 bps/0 bps". A legend at the bottom left shows a blue square for "Tx" and a red square for "Rx".

# CCQ (Client Connection Quality)

- CCQ merupakan nilai yang menyatakan seberapa efektifkah bandwidth yang dapat digunakan.
- Untuk mengetahui CCQ bias melalui menu Wireless > Registration klik MAC Address

AP Client <44:91:60:3C:66:F1>

General 802.1x Signal Nstreme NV2 Statistics

Last Activity: 5.150 s

Tx/Rx Signal Strength: -36 dBm

Tx/Rx Signal Strength Ch0: -51 dBm

Tx/Rx Signal Strength Ch1: -36 dBm

Tx/Rx Signal Strength Ch2:

Signal To Noise: 80 dB

Tx/Rx CCQ: 91 %

P Throughput: 93511 kbps

- Signal Strengths

Rate	Strength	Last Measured	
6Mbps	-42	00:02:47.83	
HT20-3	-41	00:02:25.53	
HT20-4	-41	00:01:43.41	

signal strength



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# **WIRELESS FILTERING**

## **MIKROTIK MTCNA**

# Wireless MAC Filtering

- Salah satu keamanan di Wireless menggunakan fitur MAC Filtering.
- MAC Filtering bisa diterapkan di AP dan Station.
- MAC Filtering disisi AP bisa menggunakan Access List.
- MAC Filtering disisi Station bisa menggunakan Connect List.

# Wireless MAC Filtering – Access List

- Access List (Wireless > Access List) digunakan untuk memfilter station mana saja yang boleh terkoneksi ke AP dengan mendaftarkan informasi MAC Address Station

The screenshot shows the Mikrotik RouterOS configuration interface for Wireless Tables. The 'Access List' tab is selected. A 'New AP Access Rule' dialog box is open, showing the following fields:

- MAC Address: 44:91:60:3C:66:F1
- Interface: any
- Signal Strength Range: -120..120
- Allow Signal Out Of Range: 00:00:10
- AP Tx Limit: [dropdown menu]
- Client Tx Limit: [dropdown menu]
- Authentication:
- Forwarding:

MAC Address station yang Ingin difilter

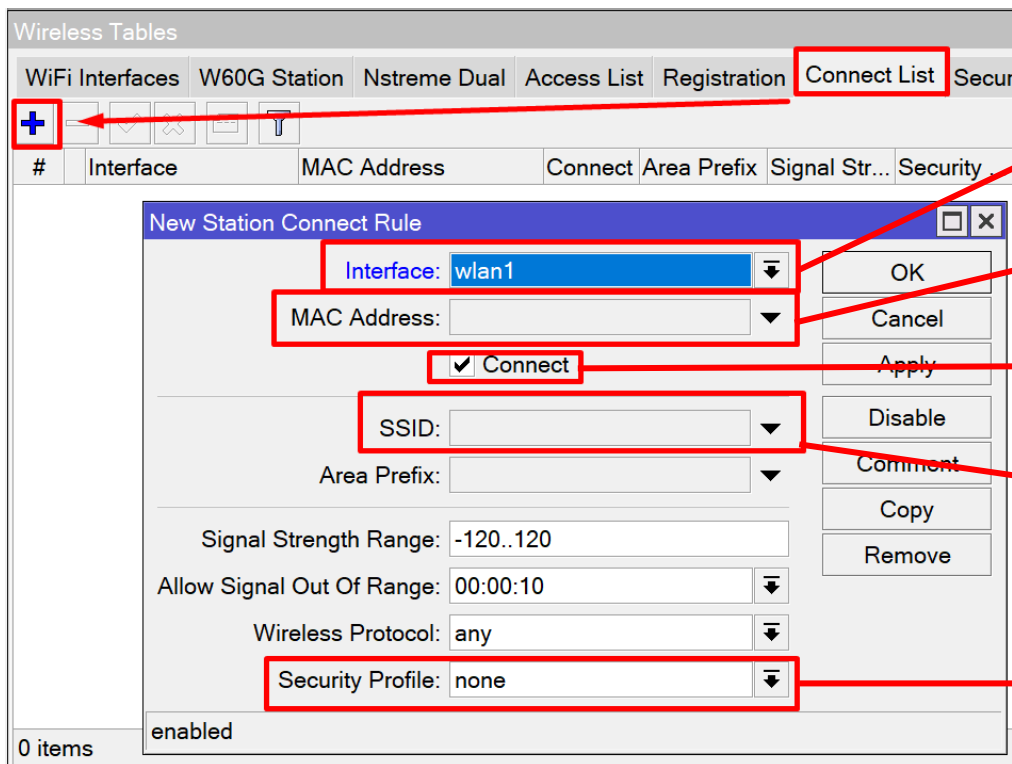
Batas nilai kekuatan signal dari Station yang ingin di filter

Mengatur management bandwidth station (RouterOS)

Boleh Konek atau tidak

# Wireless MAC Filtering – Connect List

- Connect List (Wireless > Connect List) digunakan untuk membatasi AP mana saja yang boleh / tidak boleh terkoneksi oleh station.



Interface radio yang difungsikan sebagai client

MAC Address AP

Boleh / tidak boleh konek dengan MAC Addrss diatas

SSID yang akan dikoneksikan. Bila kosong berarti any AP

Bisa menambahkan security profile yang dibuat sebelumnya

# Default Authenticate

- Digunakan untuk mengizinkan semua station terkoneksi ke AP (Baik yang sudah terfilter ataupun belum bisa konek)
- Wifi Interface > wlan1 > Wireless Tab

The screenshot shows the Mikrotik wireless configuration interface. On the left, there are several configuration fields: Scan List (default), Wireless Protocol (any), Security Profile (idn), WPS Mode (push button), Bridge Mode (enabled), VLAN Mode (no tag), and VLAN ID (1). Below these are Default AP Tx Rate and Default Client Tx Rate fields. At the bottom, there are three checkboxes: 'Default Authenticate' (unchecked and highlighted with a red box), 'Default Forward' (checked), and 'Hide SSID' (unchecked). On the right side, there is a vertical stack of buttons: Advanced Mode, Torch, WPS Accept, WPS Client, Setup Repeater, Scan..., Freq. Usage..., Align..., Sniff..., Snooper..., and Reset Configuration.

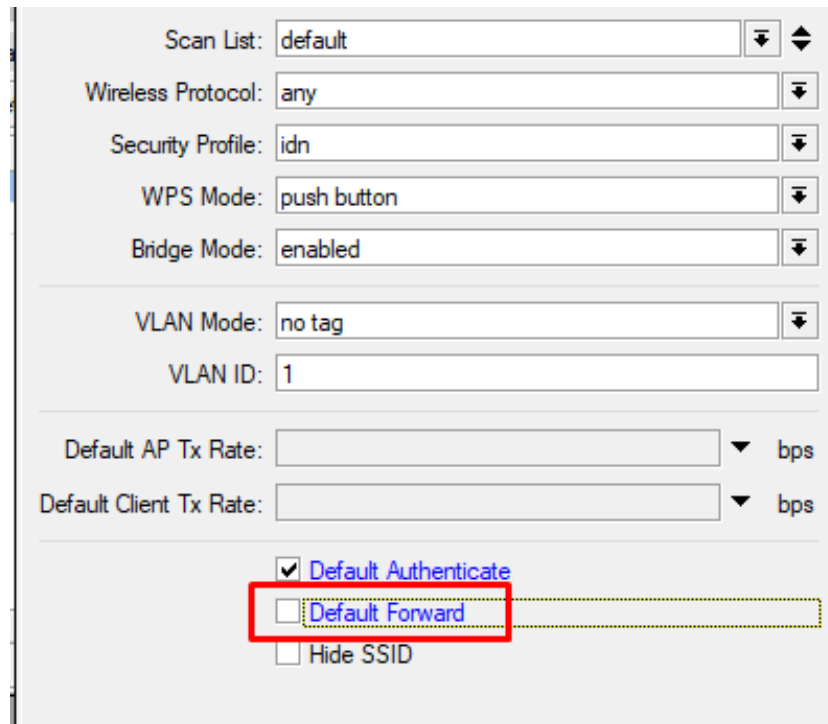
Bila diuncheck, hanya station yang sudah terdaftar (terfilter di MAC Filtering) saja yang bias konek ke AP

# Default Authenticate

Default Authentication	Access / Connect List Entry	Behavior
Enable	+	Based on access/connect list settings
	-	Authenticate
Disable	+	Based on access/connect list settings
	-	Don't authenticate

# Default Forward

- Digunakan untuk mengizinkan komunikasi antar station yang terkoneksi dalam satu AP (default = enable).
- Fitur ini cuman ada di sisi AP. (Wireless Interface > wlan1 > Wireless Tab)

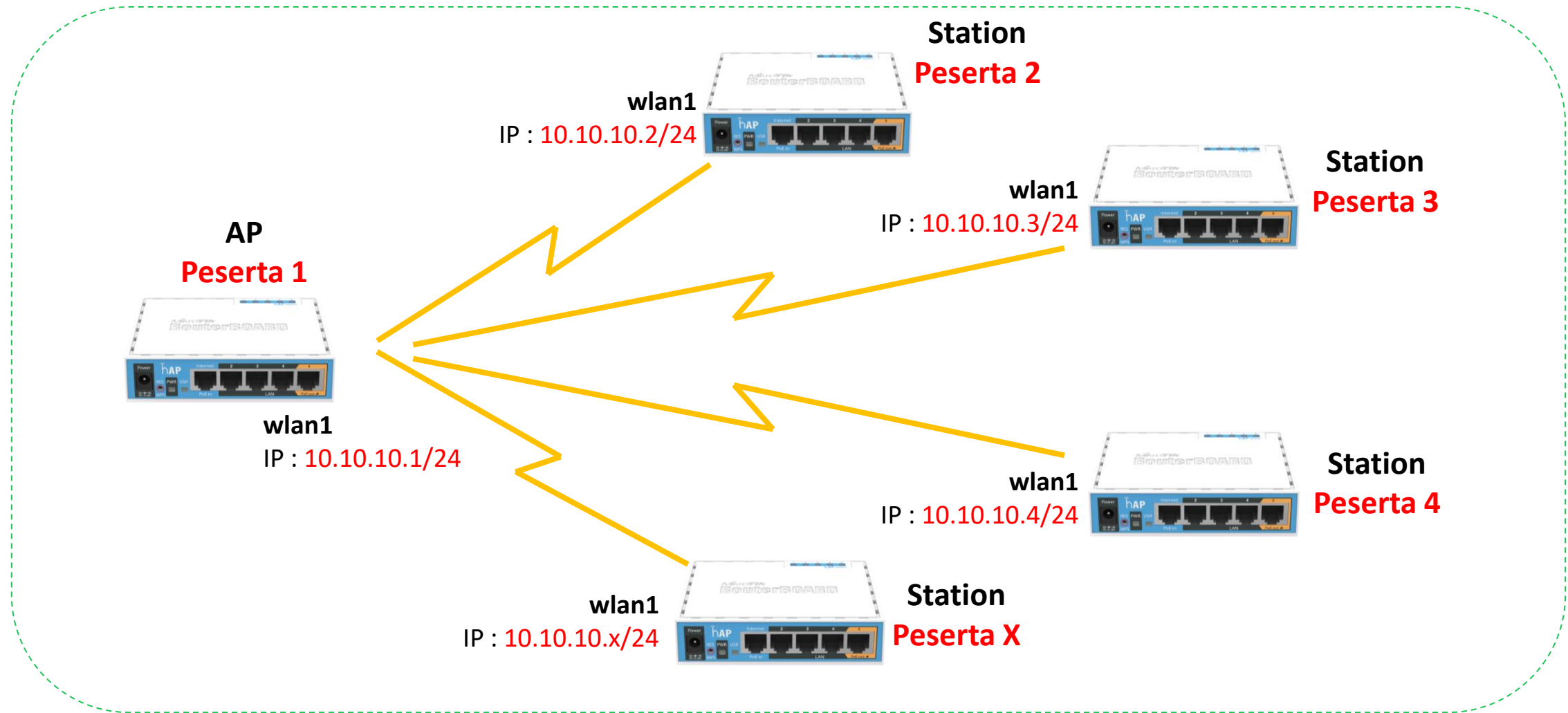


The screenshot shows the configuration page for a wireless interface. The 'Default Forward' checkbox is highlighted with a red box. Other visible settings include:

- Scan List: default
- Wireless Protocol: any
- Security Profile: idn
- WPS Mode: push button
- Bridge Mode: enabled
- VLAN Mode: no tag
- VLAN ID: 1
- Default AP Tx Rate: [ ] bps
- Default Client Tx Rate: [ ] bps
- Default Authenticate
- Default Forward
- Hide SSID

Bila diuncheck, maka antar station tidak akan bisa saling komunikasi.

# Wireless MAC Filtering – Access List



# Wireless Security

- Untuk pengamanan koneksi wireless, tidak hanya dengan MAC-Filtering saja, karena masih ada cara untuk melakukan cloning MAC Address.
- Selain itu, data yang dilewatkan di jaringan bias di ambil dan dianalisa.
- Terdapat metode keamanan lain yang dapat digunakan yaitu:
  - Autentikasi (WPA-PSK, WPA-EAP)
  - Enkripsi (AES, TKIP, WEP)
- Kedua metode keamanan tersebut ada di menu Wireless > Security Profile.
- Mode wireless security profile :
  - None : mode tanpa autentikasi dan enkripsi (open wireless)
  - Dynamic : mode yang support autentikasi dan enkripsi
  - Static : mode yang hanya support enkripsi (WEP)

# Wireless Security

- Wireless > Security Profile

Security Profile <idn>

General RADIUS EAP Static Keys

Name: nama

Mode: dynamic keys

Authentication Types:  WPA PSK  WPA2 PSK  
 WPA EAP  WPA2 EAP

Unicast Ciphers:  aes ccm  tkip

Group Ciphers:  aes ccm  tkip

WPA Pre-Shared Key: password

WPA2 Pre-Shared Key: password

Supplicant Identity:

OK Cancel Apply Comment Copy Remove

Nama Security Profile

Jenis Authentikasi

Model Enkripsi

Key autentikasi/password

# Wireless Security

- Implementasi

Interface <wlan1>

General Wireless HT HT MCS WDS Nstreme NV2 Status ...

Mode: ap bridge

Band: 2GHz-B/G/N

Channel Width: 20MHz

Frequency: 2412 MHz

SSID: IDN

Scan List: default

Wireless Protocol: any

Security Profile: nama

WPS Mode: push button

Bridge Mode: enabled

VLAN Mode: no tag

VLAN ID: 1

OK

Cancel

Apply

Disable

Comment

Advanced Mode

Torch

WPS Accept

WPS Client

Setup Repeater

Scan...

Freq. Usage...

Pilih security profile yang telah di buat sebelumnya.



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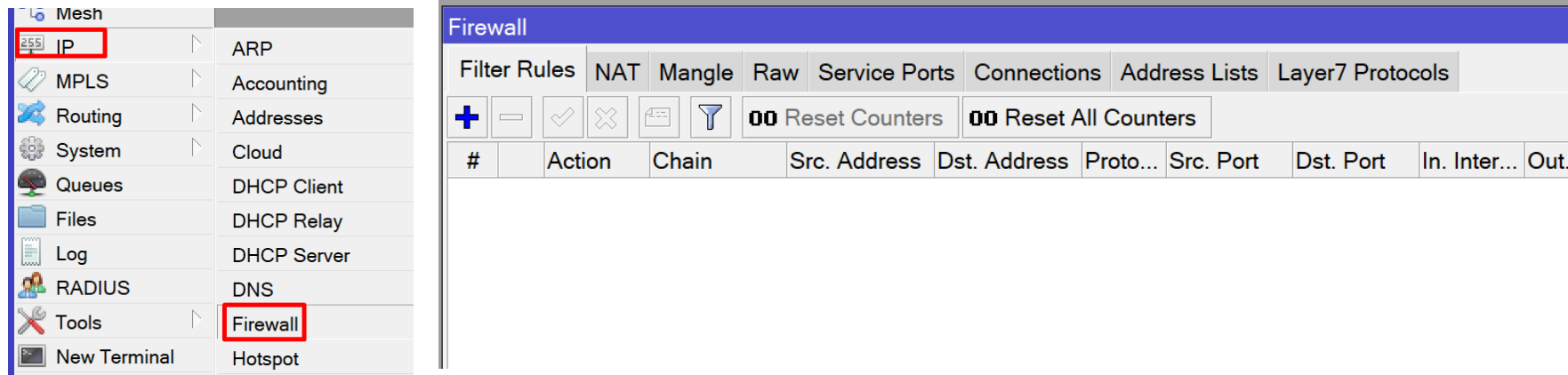


**MTCNA**

**Modul 6**  
**Firewall**

# Firewall

- Firewall digunakan sebagai pelindung jaringan, baik yang berasal dari WAN (Internet) maupun dari LAN (Local).
- Melindungi dari network lain yang melewati router.
- Fitur firewall pada RouterOS ada pada menu IP > Firewall.



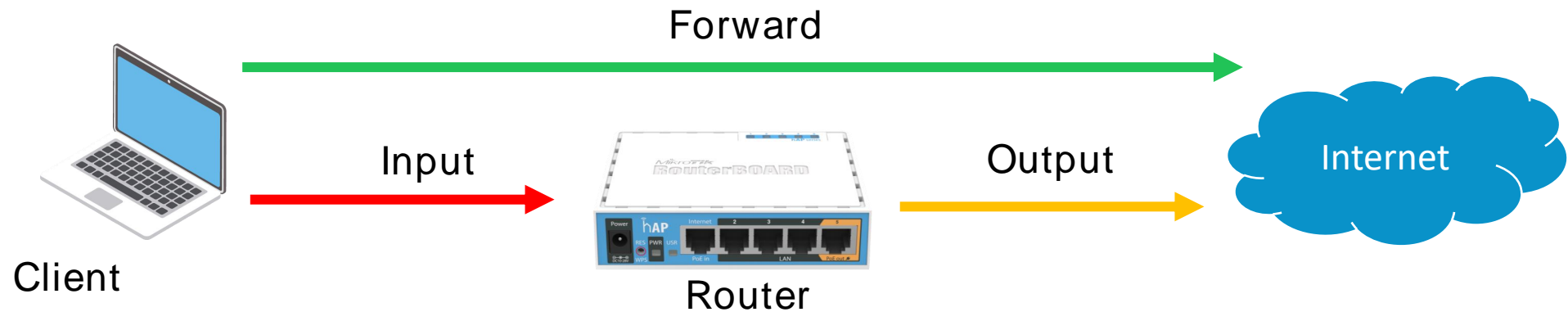
- Basic Firewall ada di IP > Firewall > Filter Rules

# Firewall – Filter Rules

- Firewall filter rule merupakan basic firewall di RouterOS.
- Setiap firewall filter rule di organisir dalam chain (rantai) yang berurutan.
- Setiap chain yang dibuat akan dibaca oleh router dari atas ke bawah.
- Paket dicocokkan dengan kriteria/persyaratan dalam suatu chain, apabila cocok paket akan dieksekusi. Namun apabila paket yang masuk ke firewall tidak cocok maka akan dilarikan ke rule dibawahnya sampai dia match.
- Terdapat 3 default chain (input, output, forward).
- Dimungkinkan juga kita dapat membuat custom chain sesuai dengan yang diinginkan.
- By default jika di Filter Rules tidak ada settingan sama sekali, artinya semua traffic yang masuk atau melewati router akan diijinkan baik itu yang aman atau yang tidak aman.

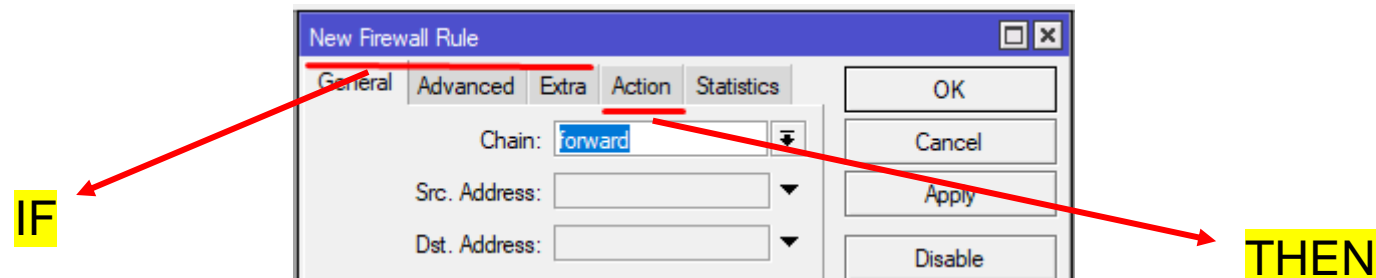
# Firewall – Simple Packet Flow

- Tiga aturan dasar packet flow:
  - Input – ke router
  - Output – dari router
  - Forward – melewati router



# Firewall – IF (Condition)

- Prinsip IF .... Then ....
  - IF (Jika) paket memenuhi syarat kriteria yang kita buat.
  - Then (maka) action apa yang akan kita berikan ke paket tersebut.
- Di firewall Filter Rule IF condition ada dimenu (General, Advanced dan Extra) sedangkan Then condition ada dimenu action



# Firewall Filter – IF (General)

- IP > Firewall Filter > General

New Firewall 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:

Source address (alamat sumber), Destination address (alamat tujuan) format bisa spesifik IP, spesifik network atau semua network (any).

Protocol (TCP/UDP/ICMP, dll)  
Source Port (port sumber/ dari client)  
Destination port (port tujuan)

Interface (traffic masuk atau keluar)

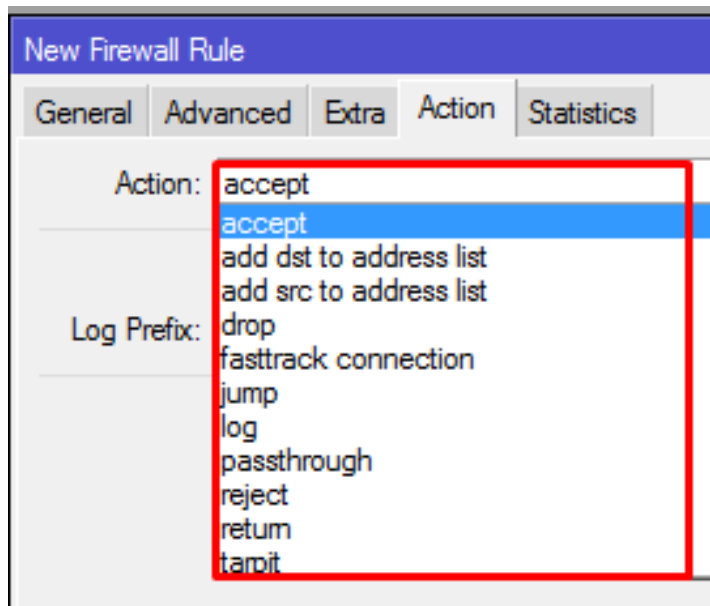
# Frequently Used Ports

- Beberapa port yang biasanya sering digunakan pada Firewall

Port	Service
80/tcp	HTTP
443/tcp	HTTPS
22/tcp	SSH
23/tcp	Telnet
20,21/tcp	FTP
8291/tcp	Winbox
5678/udp	MNDP
20561/udp	MAC Winbox

# Firewall Filter – Then (Action)

- IP > Firewall Filter > Action



accept – paket akan di terima (di ijinan)

add-dst-to address-list – alamat tujuan akan di tambahkan ke dalam address list (grup ip address)

add-src-to address-list – alamat source akan di tambahkan ke dalam address list

drop – paket akan di tolak (tidak di ijinan)

fasttrack connection – fitur alternative untuk speedboost traffic data.

jump - paket akan di lempar ke spesifik custom chain yang kita buat

log – paket akan dibuatkan sebuah catatan atau log khusus.

Passthrough – paket akan di biarkan (di eksekusi) dan di ijinan membaca rule selanjutnya

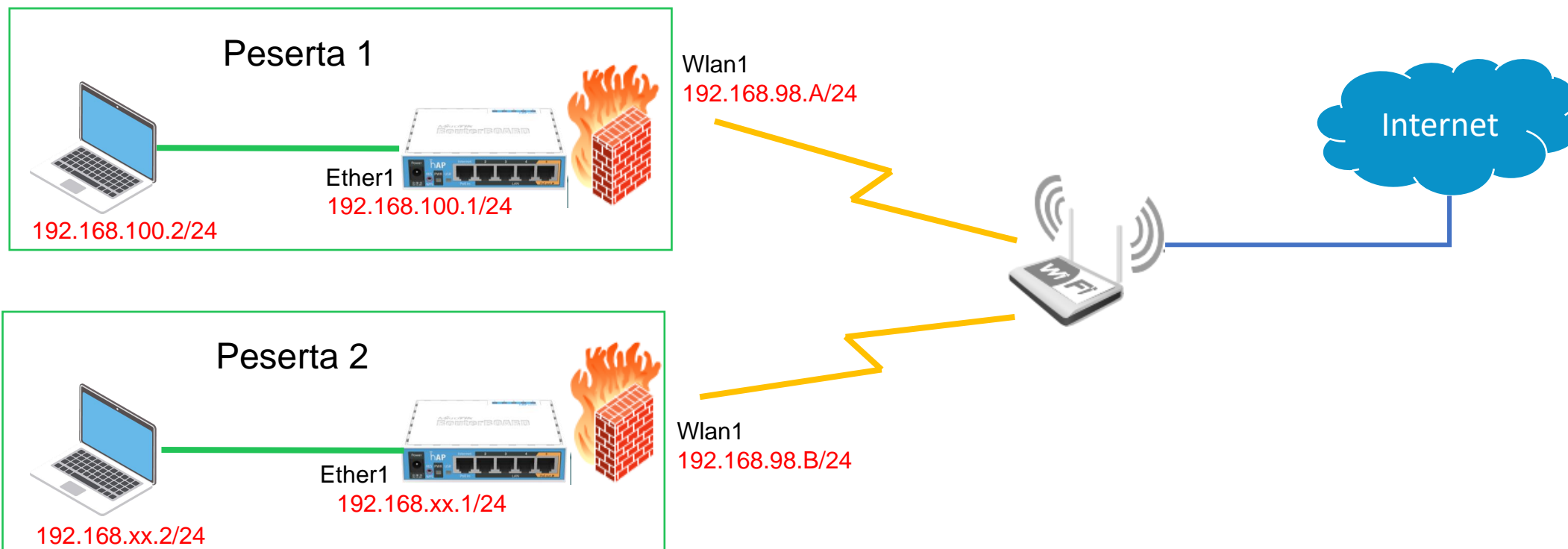
reject - sama kayak drop, cuman nanti keluar pesan ICMP reject.

return – paket akan dikembalikan dimana lokasi action jump di buat.

tarpit - membuka port bayangan yang ada di router, seolah-olah semua port di router aktif, tetapi tidak akan pernah bisa di akses.

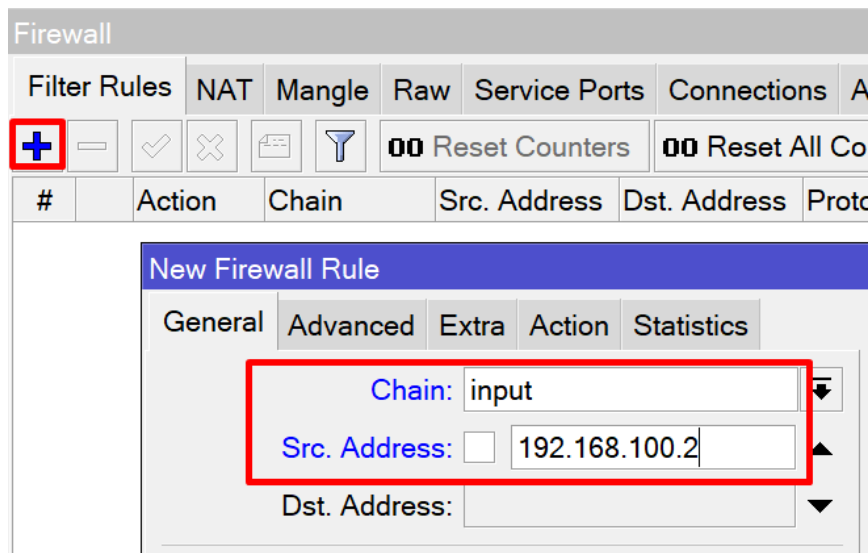
# Firewall – Protecting our Router (1)

- Buatlah firewall untuk mengizinkan hanya IP laptop saja yang bisa akses router.

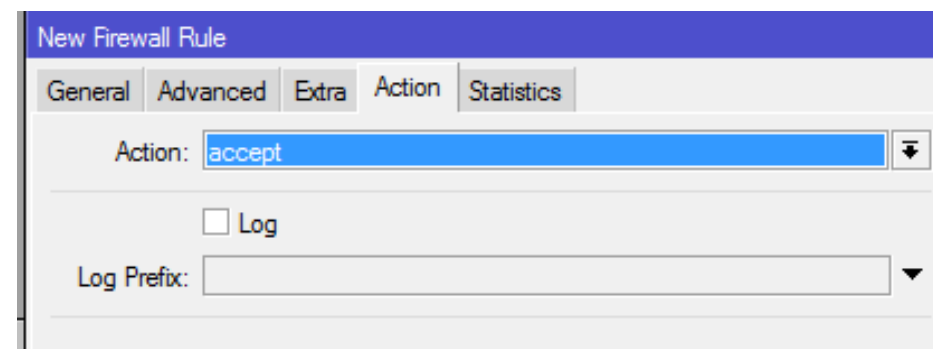


# Firewall – Protecting our Router (2)

- IF ada traffic input yang berasal dari IP laptop (192.168.100.2)

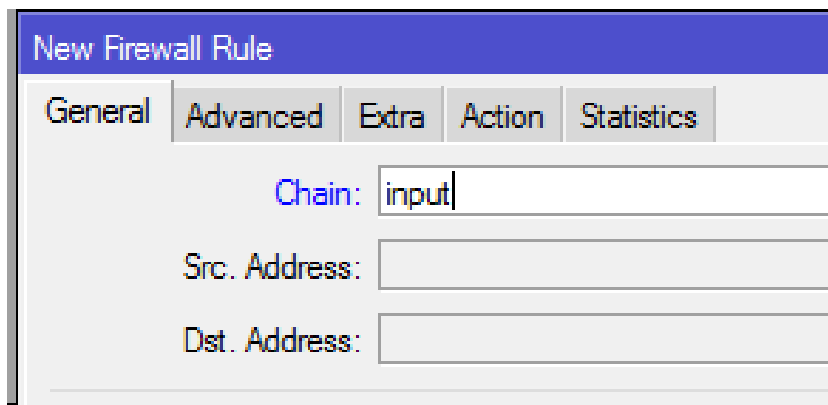


- THEN tentukan action > accept



# Firewall – Protecting our Router (3)

- IF ada traffic input yang berasal dari <kosong> atau “any address/network”



New Firewall Rule

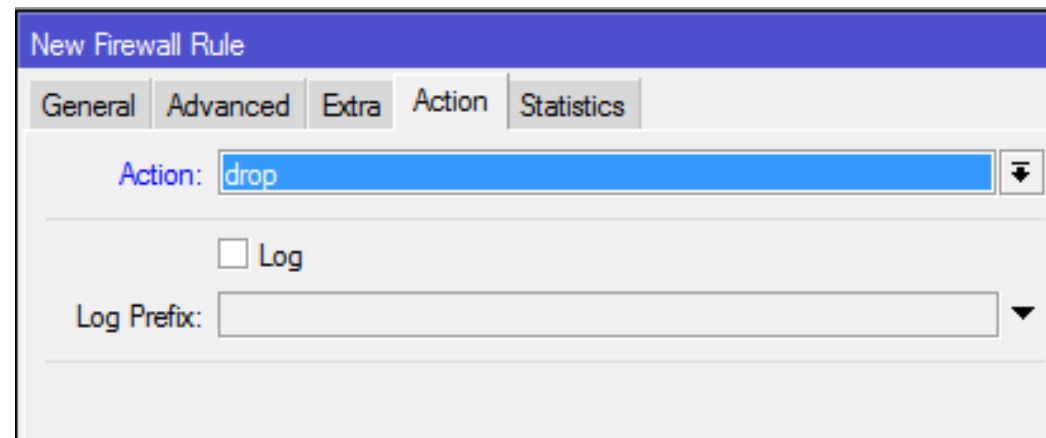
General Advanced Extra Action Statistics

Chain: input

Src. Address:

Dst. Address:

- THEN tentukan action > drop



New Firewall Rule

General Advanced Extra Action Statistics

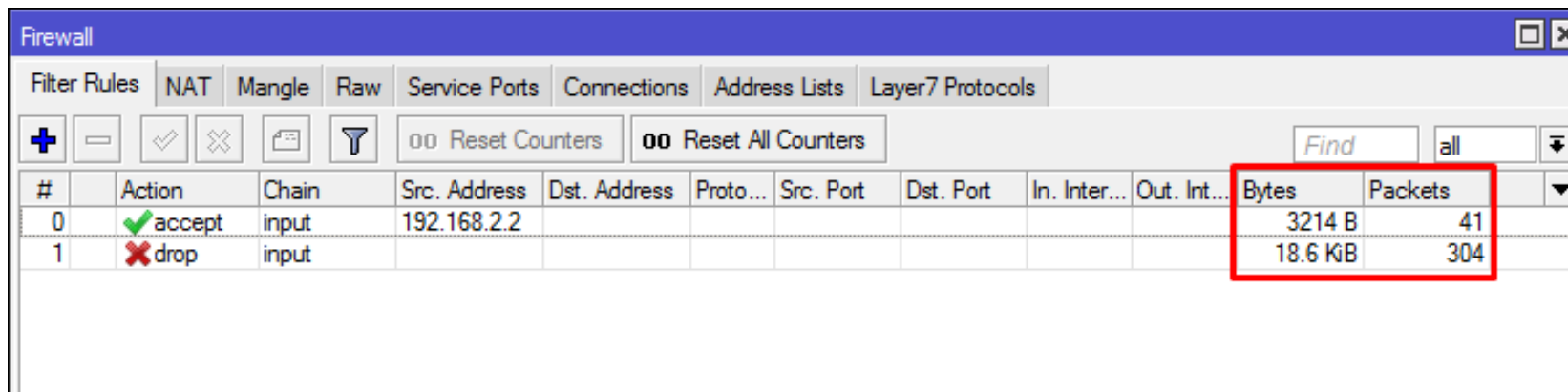
Action: drop

Log

Log Prefix:

# Firewall – Protecting our Router (4)

- Akan ada 2 chain rules



#	Action	Chain	Src. Address	Dst. Address	Proto...	Src. Port	Dst. Port	In. Inter...	Out. Int...	Bytes	Packets
0	✓ accept	input	192.168.2.2							3214 B	41
1	✗ drop	input								18.6 KiB	304

- Perhatikan jumlah bytes di setiap chain rule, tetap ataukah bertambah ketika kita melakukan akses ke router
- Coba masing-masing peserta untuk melakukan ping, akses web, dan remote winbox ke router peserta lain.



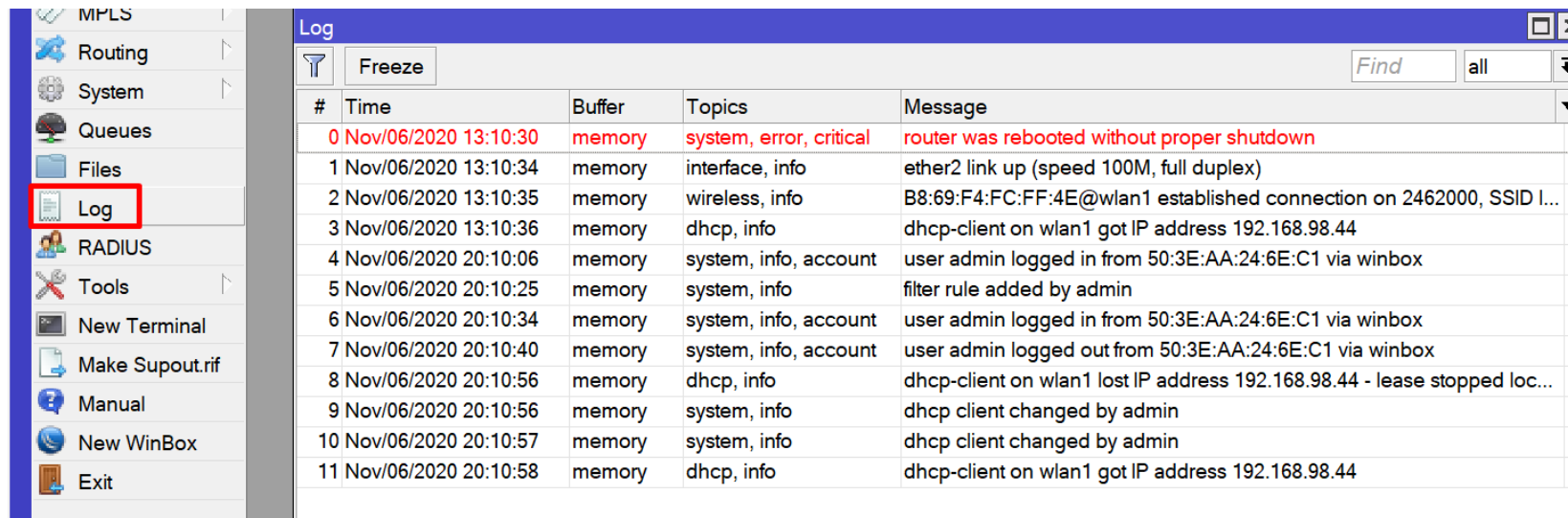
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# **FIREWALL LOGGING**

## **MIKROTIK MTCNA**

# Firewall – Log

- Log merupakan fitur yang digunakan untuk menampilkan beberapa informasi / aktivitas yang ada pada router.



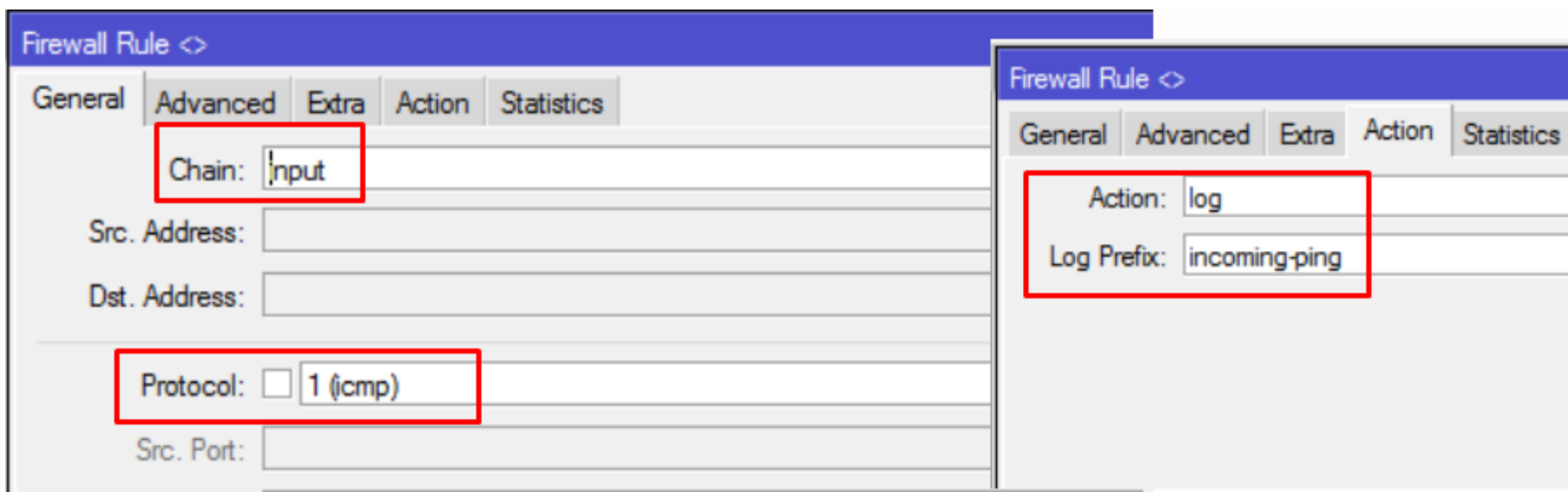
The screenshot shows the Mikrotik WinBox interface with the 'Log' window open. The left sidebar has 'Log' highlighted. The main window displays a table of log entries with columns for #, Time, Buffer, Topics, and Message.

#	Time	Buffer	Topics	Message
0	Nov/06/2020 13:10:30	memory	system, error, critical	router was rebooted without proper shutdown
1	Nov/06/2020 13:10:34	memory	interface, info	ether2 link up (speed 100M, full duplex)
2	Nov/06/2020 13:10:35	memory	wireless, info	B8:69:F4:FC:FF:4E@wlan1 established connection on 2462000, SSID I...
3	Nov/06/2020 13:10:36	memory	dhcp, info	dhcp-client on wlan1 got IP address 192.168.98.44
4	Nov/06/2020 20:10:06	memory	system, info, account	user admin logged in from 50:3E:AA:24:6E:C1 via winbox
5	Nov/06/2020 20:10:25	memory	system, info	filter rule added by admin
6	Nov/06/2020 20:10:34	memory	system, info, account	user admin logged in from 50:3E:AA:24:6E:C1 via winbox
7	Nov/06/2020 20:10:40	memory	system, info, account	user admin logged out from 50:3E:AA:24:6E:C1 via winbox
8	Nov/06/2020 20:10:56	memory	dhcp, info	dhcp-client on wlan1 lost IP address 192.168.98.44 - lease stopped loc...
9	Nov/06/2020 20:10:56	memory	system, info	dhcp client changed by admin
10	Nov/06/2020 20:10:57	memory	system, info	dhcp client changed by admin
11	Nov/06/2020 20:10:58	memory	dhcp, info	dhcp-client on wlan1 got IP address 192.168.98.44

- Kita dapat membuat atau menambahkan catatan aktivitas apa saja sesuai yang diinginkan melalui firewall filter dengan menggunakan action log.

# Firewall – Log

- Buatlah log untuk mencatat aktivitas ping yang masuk ke router.
- Caranya buat rule baru pada IP > Firewall > Filter Rules.



- Ping IP router dari laptop atau dari peserta lain, amati log pada router.



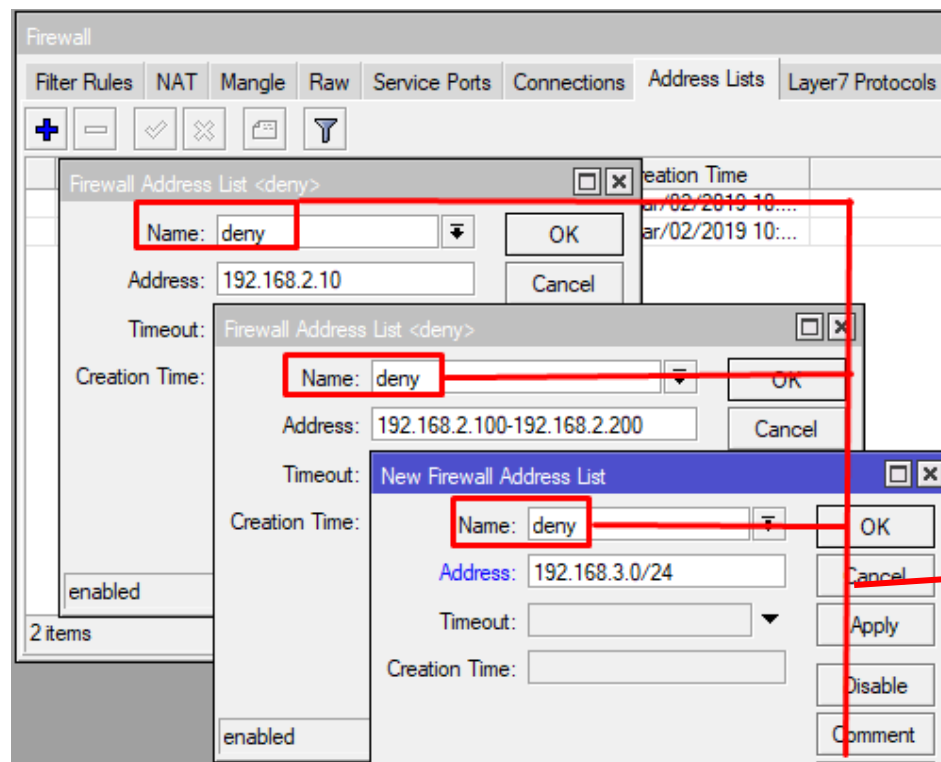
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# **FIREWALL ADDRESS-LIST**

## **MIKROTIK MTCNA**

# Firewall – Address List

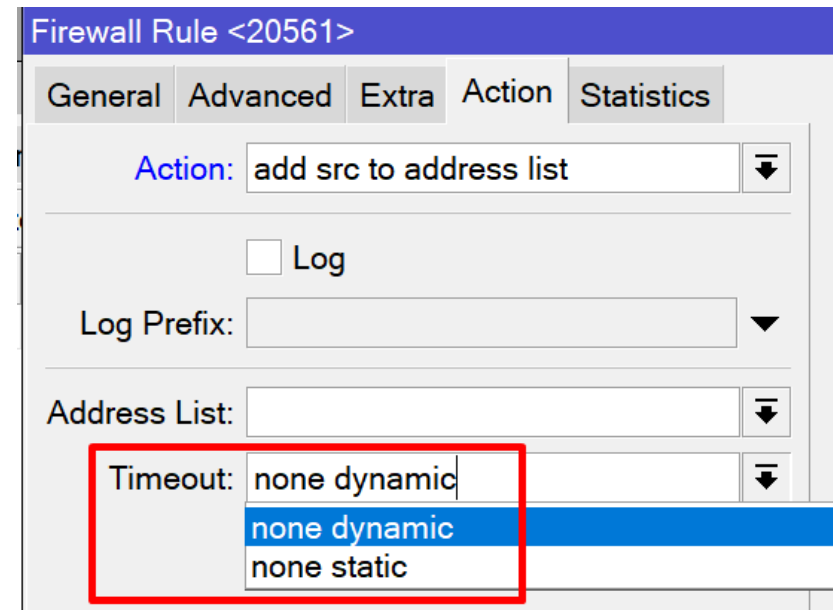
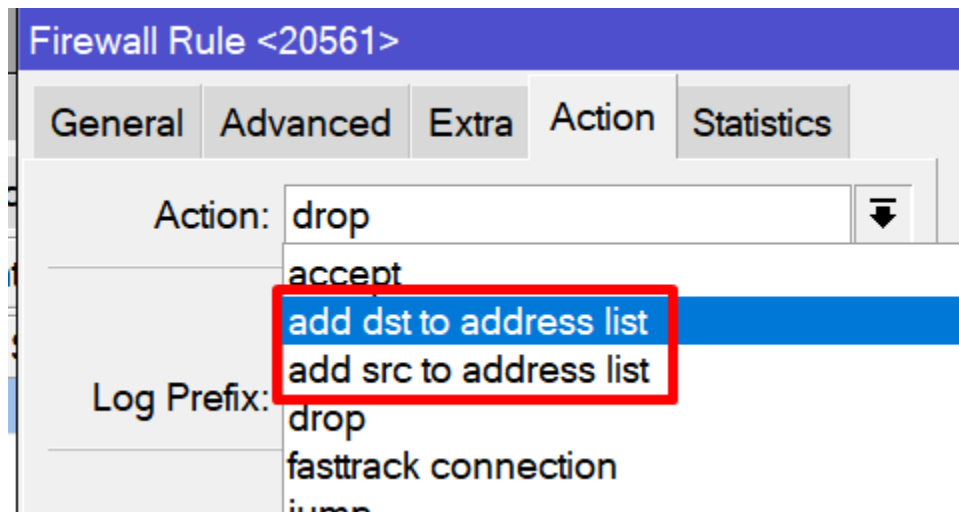
- Address list digunakan untuk memfilter berdasarkan group IP.
- Satu line address-list dapat berupa subnet, range IP atau spesifik IP.



Beberapa address dengan nama grup yang sama.

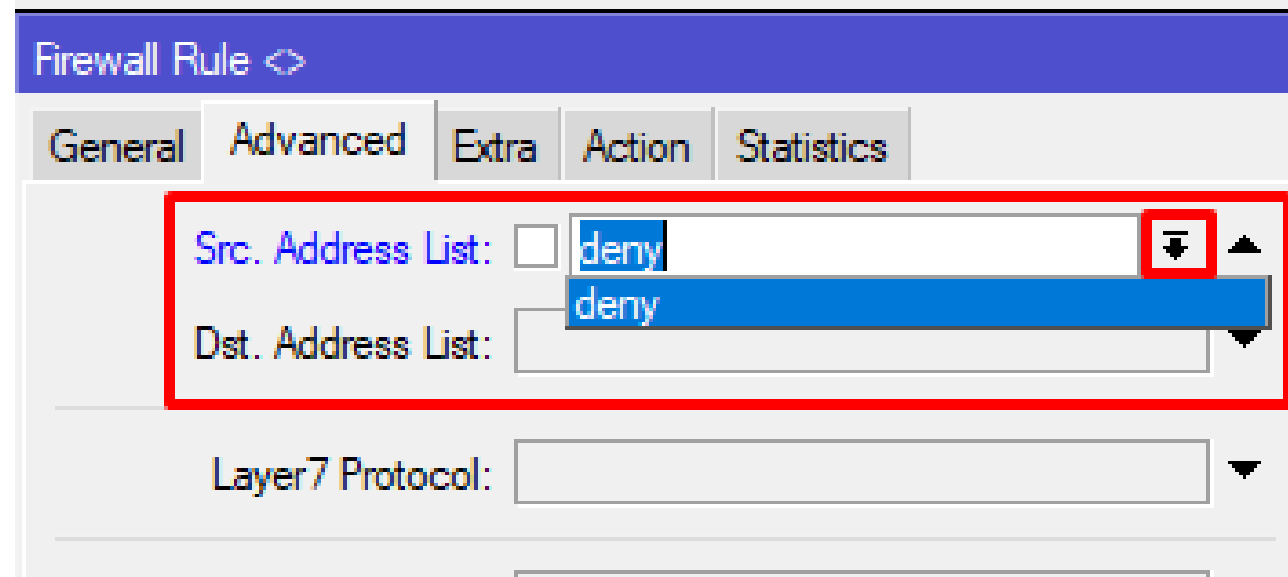
# Firewall – Address List

- Address list dapat dibuat juga secara otomatis dengan memanfaatkan action “add-to-address list”.
- Kita juga dapat mengatur apakah address-list yang dibuat secara permanen atau sementara dengan mengatur timeout



# Firewall – Address List Implementation

- Address list dapat dibuat juga secara otomatis dengan memanfaatkan action “add-to-address list”.



# Firewall – Address List

- Siapa dari local ping ke router, dia tidak bias akses ke Internet selama 30 detik.
- Buat Firewall rule untuk memasukan setiap IP yang melakukan PING secara otomatis ke dalam address-list dan beri nama address-list “PINGER”. (1)
- Buat Firewall rule baru untuk memblock setiap address yang berasal dari address-list “PINGER” (2).

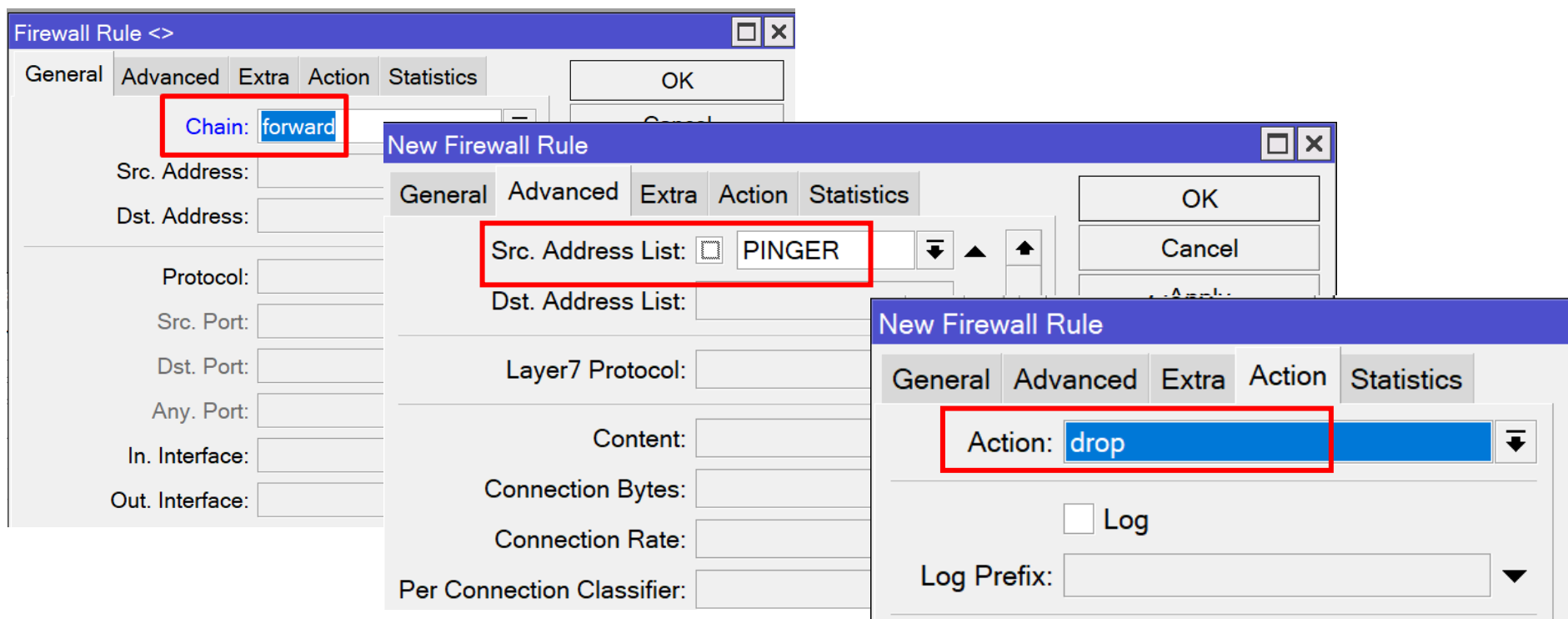
# Firewall – Address List (1)

- Buat Firewall rule untuk memasukan setiap IP yang melakukan PING secara otomatis ke dalam address-list dan beri nama address-list “PINGER”. (1)

The image displays two side-by-side screenshots of the Mikrotik WinBox Firewall Rule configuration interface. The left pane, titled "Firewall Rule <>", shows the configuration for an existing rule. The "Chain" is set to "input", the "Protocol" is "1 (icmp)", and the "In. Interface" is "ether2". The right pane, titled "New Firewall Rule", shows the configuration for a new rule. The "Action" is "add src to address list", the "Address List" is "PINGER", and the "Timeout" is "00:00:30". A red arrow points from the "ether2" field in the left pane to a yellow box labeled "Interface Local" in the right pane.

# Firewall – Address List (2)

- Buat Firewall rule baru untuk memblock setiap address yang berasal dari address-list “PINGER” (2).



# Firewall – Address List (3)

- Pastikan terdapat 2 rule yang tadi kita buat

#	Action	Chain	Src. ...	Dst. ...	Protocol	Src. ...	Dst....	In. Inter...	Out.../	In....	Out. Int...	Src. Ad...	Ds
0	add src to address list	input			1 (icmp)			ether2					
1	drop	forward										PINGER	

- Ping IP router dari laptop, perhatikan di menu Firewall Address-list.
- Check koneksi Internet.



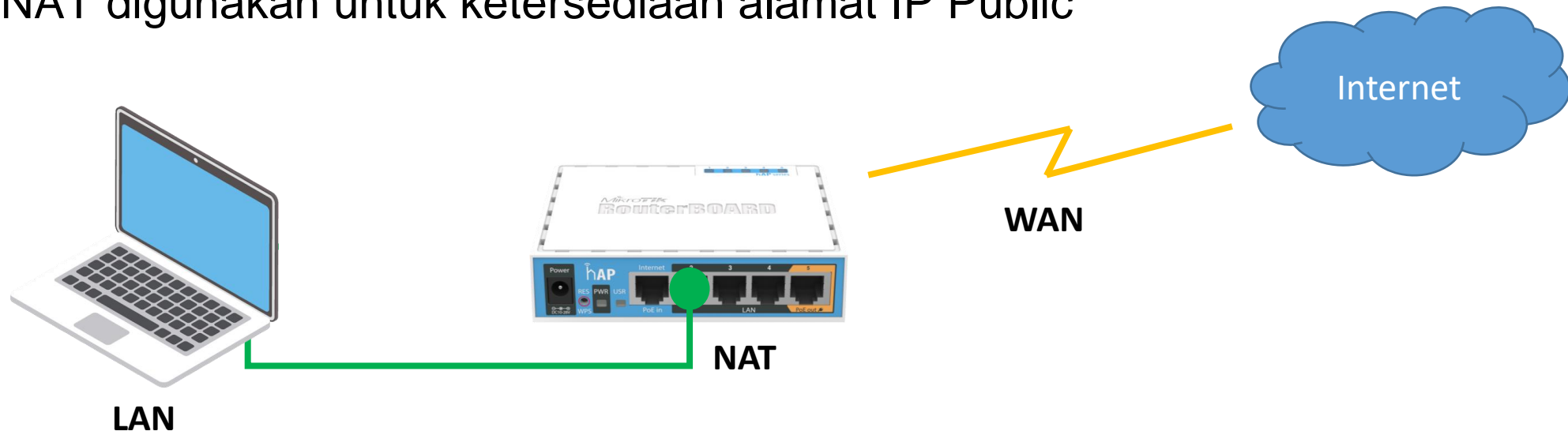
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# **NAT**

## **MIKROTIK MTCNA**

# Firewall – NAT

- NAT (Network Address Translation) merupakan metode yang digunakan untuk menghubungkan banyak computer ke jaringan Internet dengan menggunakan satu / lebih alamat IP.
- NAT digunakan untuk ketersediaan alamat IP Public



- Prinsip NAT sama seperti Filter Rule, bekerja dengan “IF-THEN”.

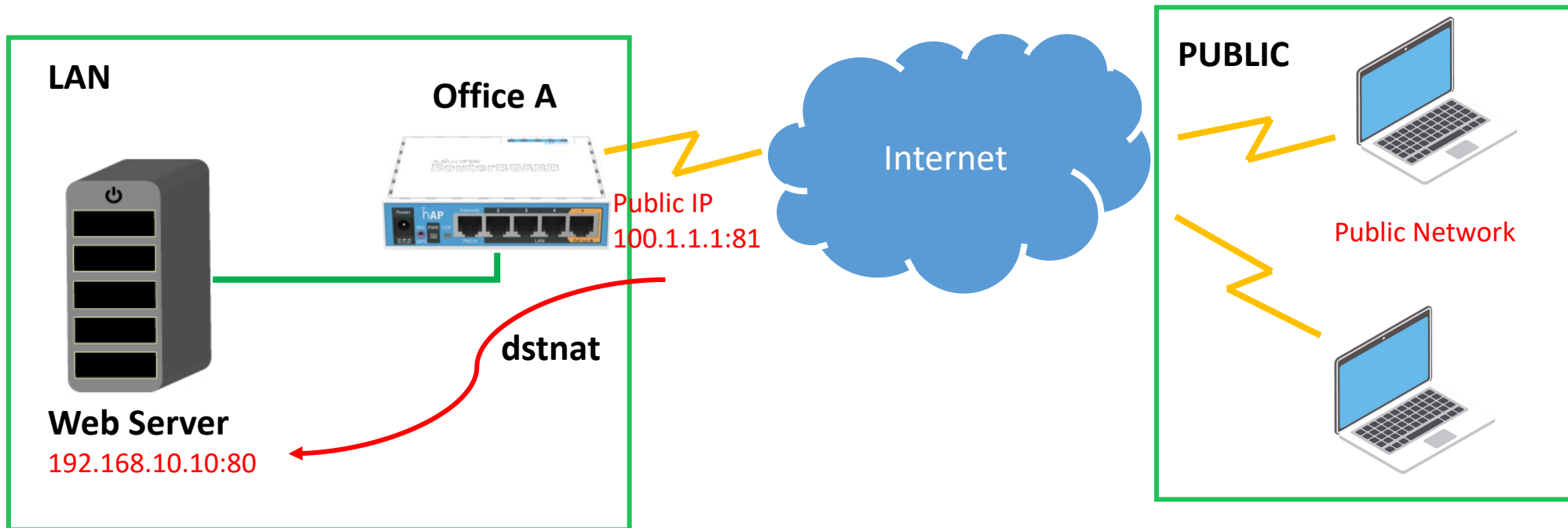
# Firewall – NAT

Di Mikrotik terdapat 2 type NAT :

- Srcnat, digunakan ketika client yang ada di dalam router ingin keluar (Internet).
  - **Masquerade** : digunakan untuk menghubungkan jaringan lokal ke internet menggunakan IP public dynamic.
  - **Src-nat** : digunakan untuk menghubungkan jaringan lokal ke internet menggunakan IP public static.
- Dstnat, digunakan ketika client di internet ingin mengakses jaringan local dari internet
  - **Dst-nat** : digunakan ketika akan mengakses jaringan lokal melalui internet (port forwarding). → melempar trafik ke luar router.
  - **Redirect** : digunakan ketika akan membelokkan traffic ke router itu sendiri. contoh : hotspot, webproxy, dns server router dll

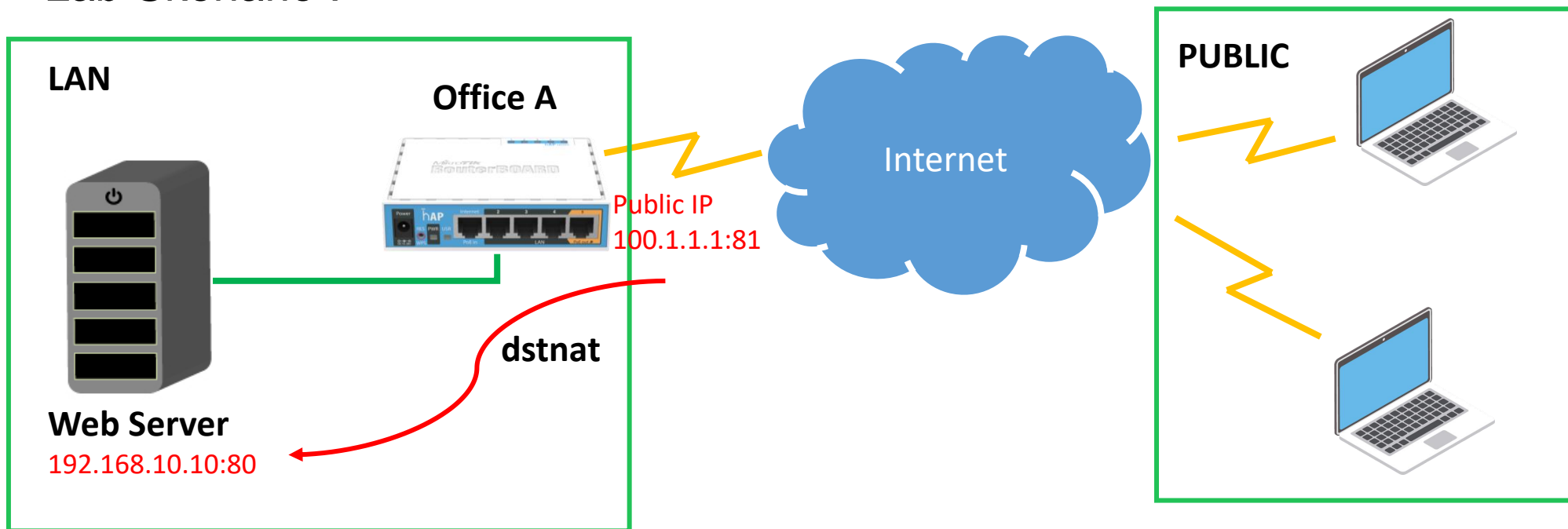
# Firewall – DSTNAT

- DSTNAT digunakan untuk mengakses host/service yang ada di Lokal melalui Public Internet.



# Firewall – DSTNAT

- Install dan jalankan web server di laptop.
- Lab Skenario :



# Firewall – DSTNAT

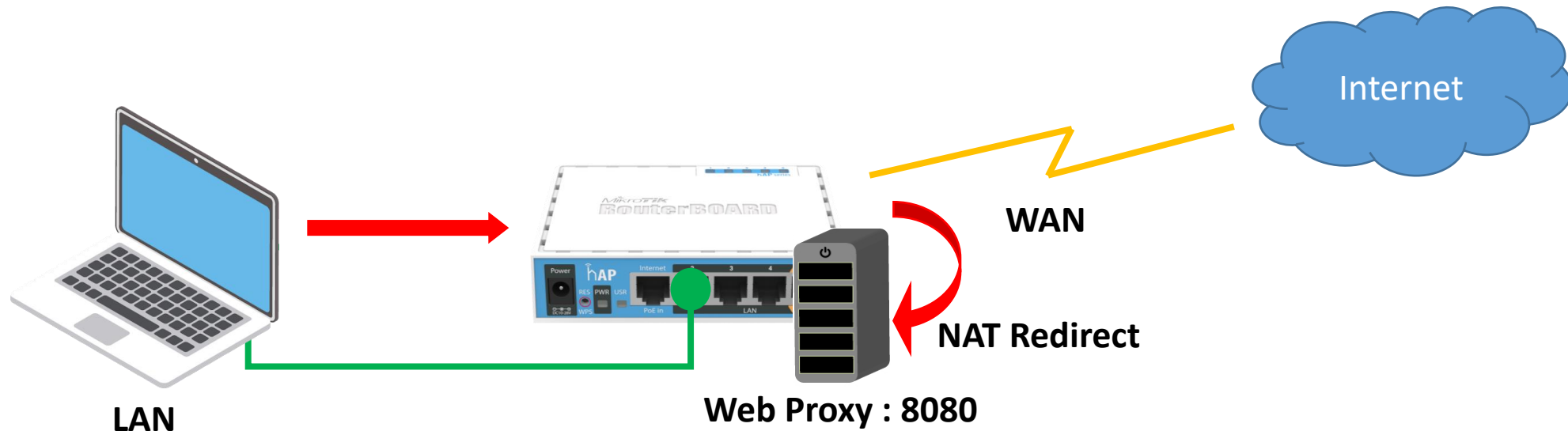
- Buat rule pada IP > Firewall > NAT untuk redirect port 81 router ke IP laptop dan port 80.

The image shows two screenshots of the Mikrotik WinBox NAT Rule configuration interface. The left screenshot shows the 'General' tab with the following fields highlighted by red boxes: Chain: dstnat, Protocol: 6 (tcp), Dst. Port: 81, and In. Interface: wlan1. The right screenshot shows the 'Action' tab with the following fields highlighted by red boxes: Action: dst-nat, To Addresses: 192.168.88.2, and To Ports: 80. A red arrow points from the 'To Ports: 80' field to the text 'IP web server (laptop)'.

- Akses IP Public router `http://<ip wlan1 router>:81` dari laptop peserta lain.

# Firewall – Redirect

- Merupakan action yang digunakan untuk mengarahkan suatu paket kedalam spesifik servis / port yang ada pada router. (DNS, Web Proxy).
- Redirect hanya bisa digunakan apabila kita menggunakan chain dstnat

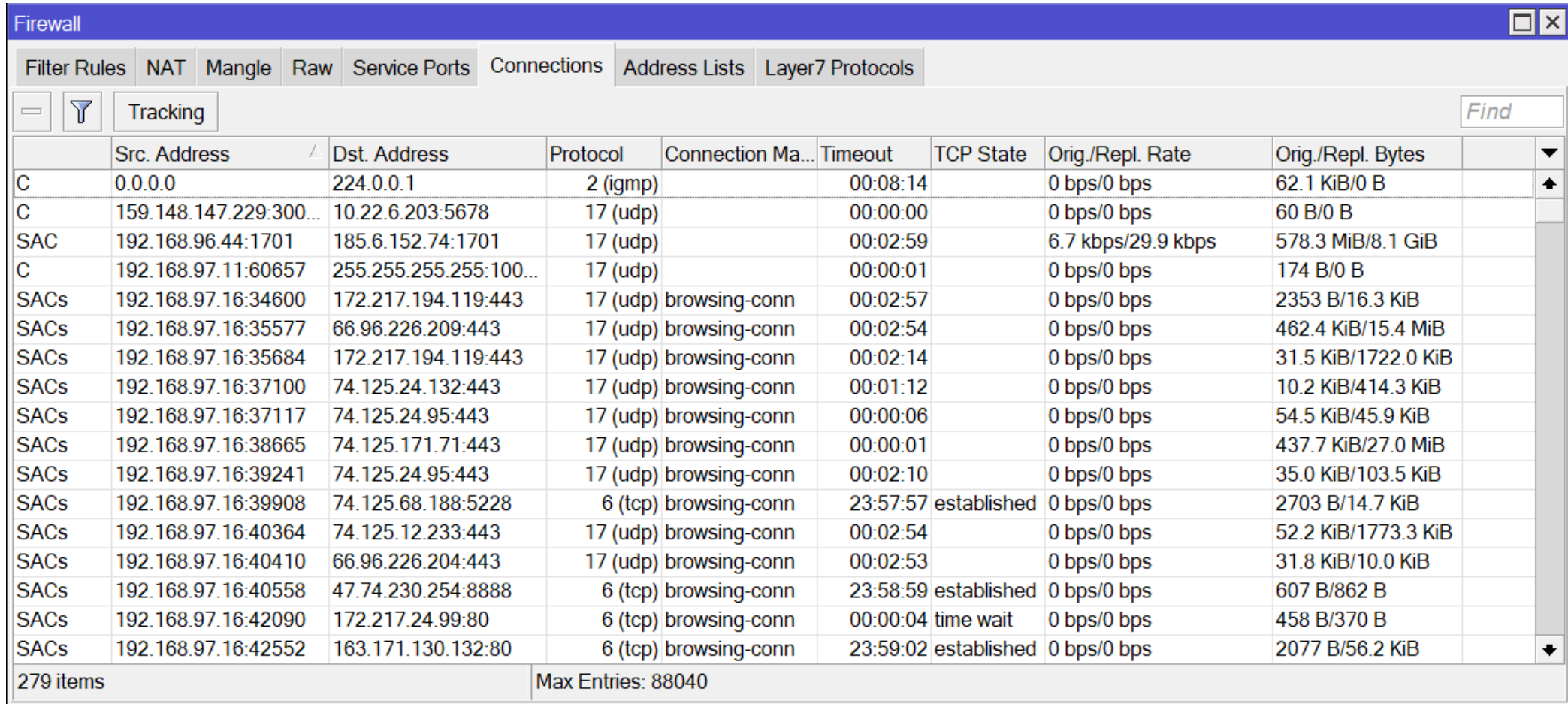




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# CONNECTION TRACKING MIKROTIK MTCNA

# Firewall – Connection Tracking



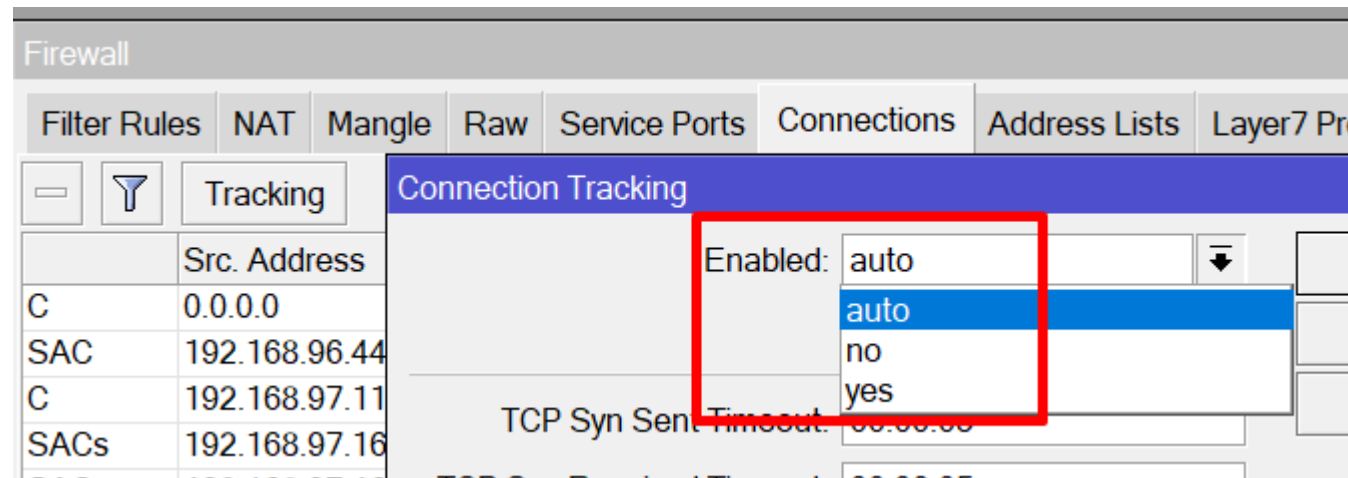
The screenshot shows the Mikrotik WinBox Firewall Connection Tracking window. The window title is "Firewall" and it has several tabs: Filter Rules, NAT, Mangle, Raw, Service Ports, Connections (selected), Address Lists, and Layer7 Protocols. Below the tabs, there is a "Tracking" button and a "Find" search box. The main area displays a table of active connections with the following columns: Src. Address, Dst. Address, Protocol, Connection Ma..., Timeout, TCP State, Orig./Repl. Rate, and Orig./Repl. Bytes. The table contains 17 rows of data, including connections for igmp, udp, and tcp protocols. At the bottom of the window, it shows "279 items" and "Max Entries: 88040".

	Src. Address	Dst. Address	Protocol	Connection Ma...	Timeout	TCP State	Orig./Repl. Rate	Orig./Repl. Bytes	
C	0.0.0.0	224.0.0.1	2 (igmp)		00:08:14		0 bps/0 bps	62.1 KiB/0 B	▼
C	159.148.147.229:300...	10.22.6.203:5678	17 (udp)		00:00:00		0 bps/0 bps	60 B/0 B	▲
SAC	192.168.96.44:1701	185.6.152.74:1701	17 (udp)		00:02:59		6.7 kbps/29.9 kbps	578.3 MiB/8.1 GiB	
C	192.168.97.11:60657	255.255.255.255:100...	17 (udp)		00:00:01		0 bps/0 bps	174 B/0 B	
SACs	192.168.97.16:34600	172.217.194.119:443	17 (udp)	browsing-conn	00:02:57		0 bps/0 bps	2353 B/16.3 KiB	
SACs	192.168.97.16:35577	66.96.226.209:443	17 (udp)	browsing-conn	00:02:54		0 bps/0 bps	462.4 KiB/15.4 MiB	
SACs	192.168.97.16:35684	172.217.194.119:443	17 (udp)	browsing-conn	00:02:14		0 bps/0 bps	31.5 KiB/1722.0 KiB	
SACs	192.168.97.16:37100	74.125.24.132:443	17 (udp)	browsing-conn	00:01:12		0 bps/0 bps	10.2 KiB/414.3 KiB	
SACs	192.168.97.16:37117	74.125.24.95:443	17 (udp)	browsing-conn	00:00:06		0 bps/0 bps	54.5 KiB/45.9 KiB	
SACs	192.168.97.16:38665	74.125.171.71:443	17 (udp)	browsing-conn	00:00:01		0 bps/0 bps	437.7 KiB/27.0 MiB	
SACs	192.168.97.16:39241	74.125.24.95:443	17 (udp)	browsing-conn	00:02:10		0 bps/0 bps	35.0 KiB/103.5 KiB	
SACs	192.168.97.16:39908	74.125.68.188:5228	6 (tcp)	browsing-conn	23:57:57	established	0 bps/0 bps	2703 B/14.7 KiB	
SACs	192.168.97.16:40364	74.125.12.233:443	17 (udp)	browsing-conn	00:02:54		0 bps/0 bps	52.2 KiB/1773.3 KiB	
SACs	192.168.97.16:40410	66.96.226.204:443	17 (udp)	browsing-conn	00:02:53		0 bps/0 bps	31.8 KiB/10.0 KiB	
SACs	192.168.97.16:40558	47.74.230.254:8888	6 (tcp)	browsing-conn	23:58:59	established	0 bps/0 bps	607 B/862 B	
SACs	192.168.97.16:42090	172.217.24.99:80	6 (tcp)	browsing-conn	00:00:04	time wait	0 bps/0 bps	458 B/370 B	
SACs	192.168.97.16:42552	163.171.130.132:80	6 (tcp)	browsing-conn	23:59:02	established	0 bps/0 bps	2077 B/56.2 KiB	▼

279 items      Max Entries: 88040

# Firewall – Connection Tracking

- Connection Tracking berisi informasi koneksi (source, destination IP, port, protocol yang sedang digunakan)
- Harus diaktifkan bila kita akan menggunakan beberapa service Firewall.
- IP > Firewall > Connections > Tracking



# Firewall – Connection Tracking

- Bila connection tracking mati, beberapa fitur firewall tidak akan berfungsi sebagai berikut :
- NAT
- Firewall :
  - connection-bytes
  - connection-mark
  - connection-type
  - connection-state
  - connection-limit
  - connection-rate
  - layer7-protocol
  - new-connection-mark
  - tarpit

# Firewall – Connection Tracking

- Status koneksi pada connection tracking :
  - New : membuka koneksi baru
  - Established : memiliki koneksi yang sudah dikenal
  - Related : paket membuka koneksi baru tetapi memiliki hubungan dengan koneksi yang sudah diketahui
  - Invalid : paket tidak termasuk koneksi yang diketahui.
- Connection state  $\neq$  TCP state

# Firewall – FastTrack

- Metode untuk mempercepat aliran paket melalui router.
- Fasttrack juga dapat digunakan untuk membypass firewall, connection tracking, simple queue, queue tree dll.
- Hanya mendukung protocol TCP dan UDP.
- Dengan adanya fitur ini kita bias memberikan prioritas khusus kepada user tertentu.



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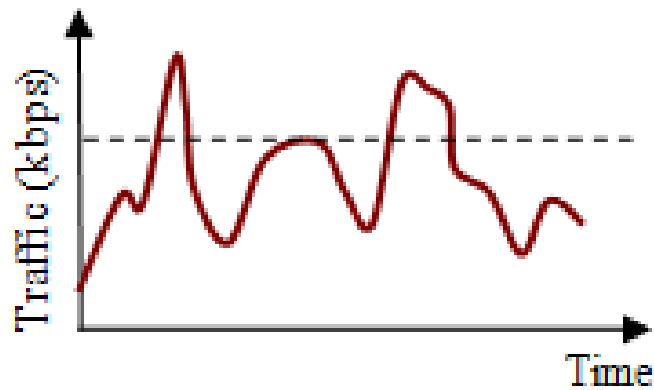
**MTCNA**

Modul 7  
QoS

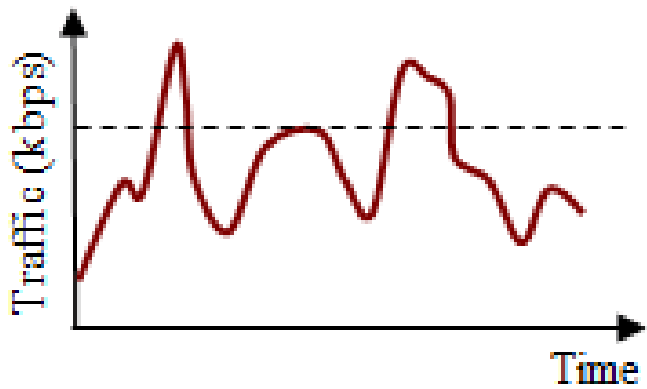
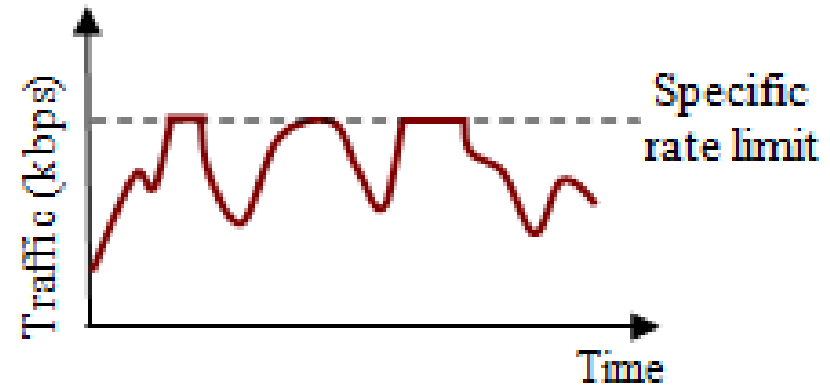
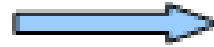
# QoS

- Quality of Service merupakan mekanisme pengaturan bandwidth dengan tujuan mencegah terjadinya monopoli penggunaan sehingga semua client mendapat jatah bandwidth yang sesuai.
- Manajemen bandwidth di RouterOS dapat dilakukan melalui :
  - Simple queue (pengaturan bandwidth secara simple)
    - single client upload/download
    - Limitasi p2p traffic
  - Queue tree (pengaturan bandwidth tingkat lanjut)
    - Global prioritization policy
    - User group limitation
    - Membutuhkan settingan mangle untuk menandai paket.

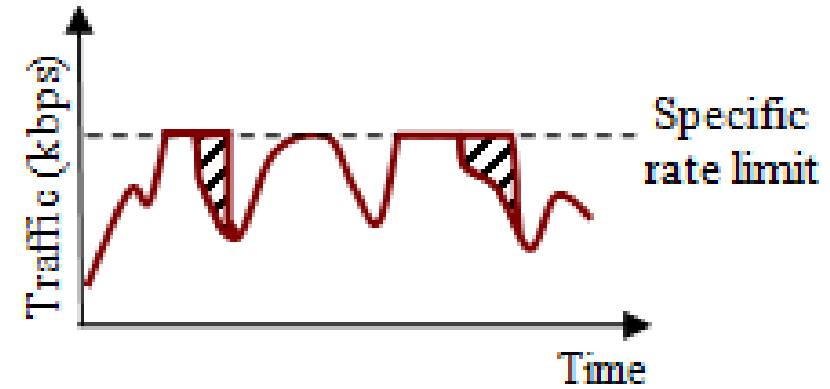
# QoS – Rate Limitation



Rate limiting  
(*shaper*)



Rate equalizing  
(*Scheduler*)

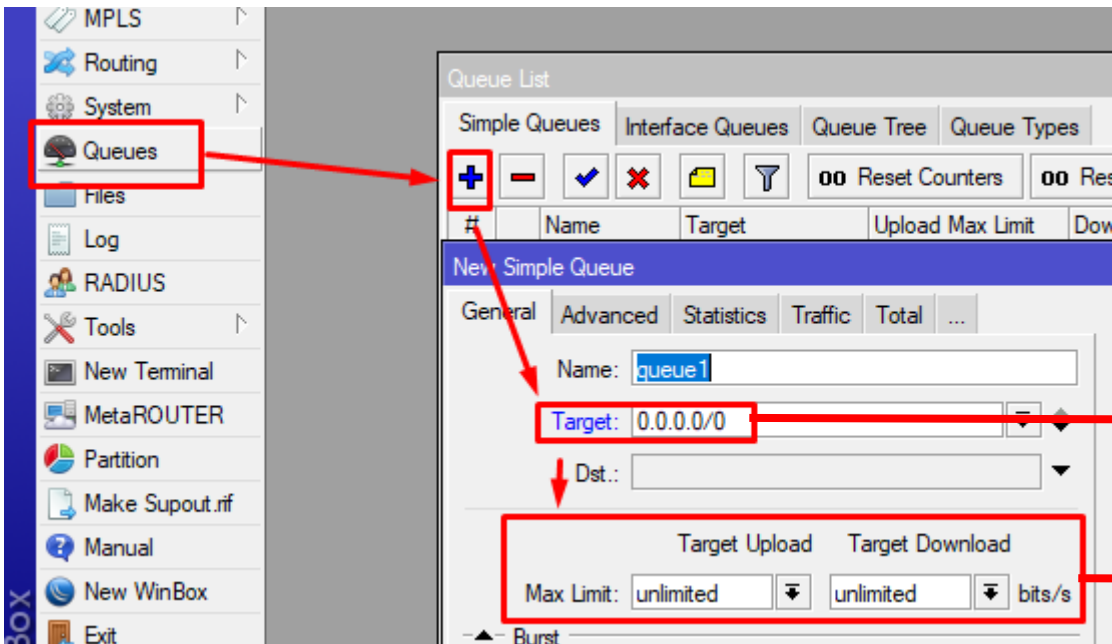


# QoS – Rate Limitation

- Pada RouterOS, dikenal 2 jenis Batasan rate limit :
- CIR (Committed Information Rate)
  - Limit-at
  - Pada keadaan terburuk, client akan mendapatkan bandwidth sesuai dengan limit-at. (asumsi bandwidth yang tersedia cukup untuk semua client).
- MIR (Maximum Information Rate)
  - Max-limit
  - Sisa bandwidth yang diberikan ketika semua client sudah mencapai “limit-at”, maka client bisa mendapatkan bandwidth tambahan hingga “max-limit”.

# QoS – Simple Queue

- Pembagian bandwidth yang paling sederhana pada RouterOS
- Simple queue mendefinisikan parameter address (target address) dari host/koneksi yang dilimit.



- Target address bisa berupa spesifik client/host, alamat server, network, interface

- Total = Upload + Download

Target address yang akan di limit

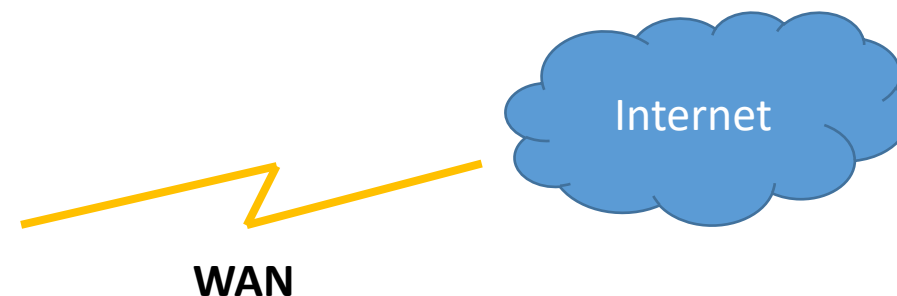
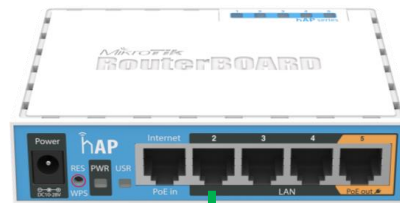
Target upload dan download

# QoS – Simple Queue (1)

- Limit bandwidth laptop dengan ketentuan sebagai berikut:
  - Download = 2 Mb
  - Upload = 1 Mb
- Lakukan speedtest dari laptop dan amati.



**Download 2Mb**  
**Upload 1Mb**



# QoS – Simple Queue (2)

- Limit bandwidth laptop dengan ketentuan sebagai berikut:
  - Download = 2 Mb
  - Upload = 1 Mb

The screenshot shows the Mikrotik WinBox interface for configuring a Simple Queue. The 'Queue List' window is open, and the 'Simple Queues' tab is selected. A new queue named 'laptop' is being created. The configuration is as follows:

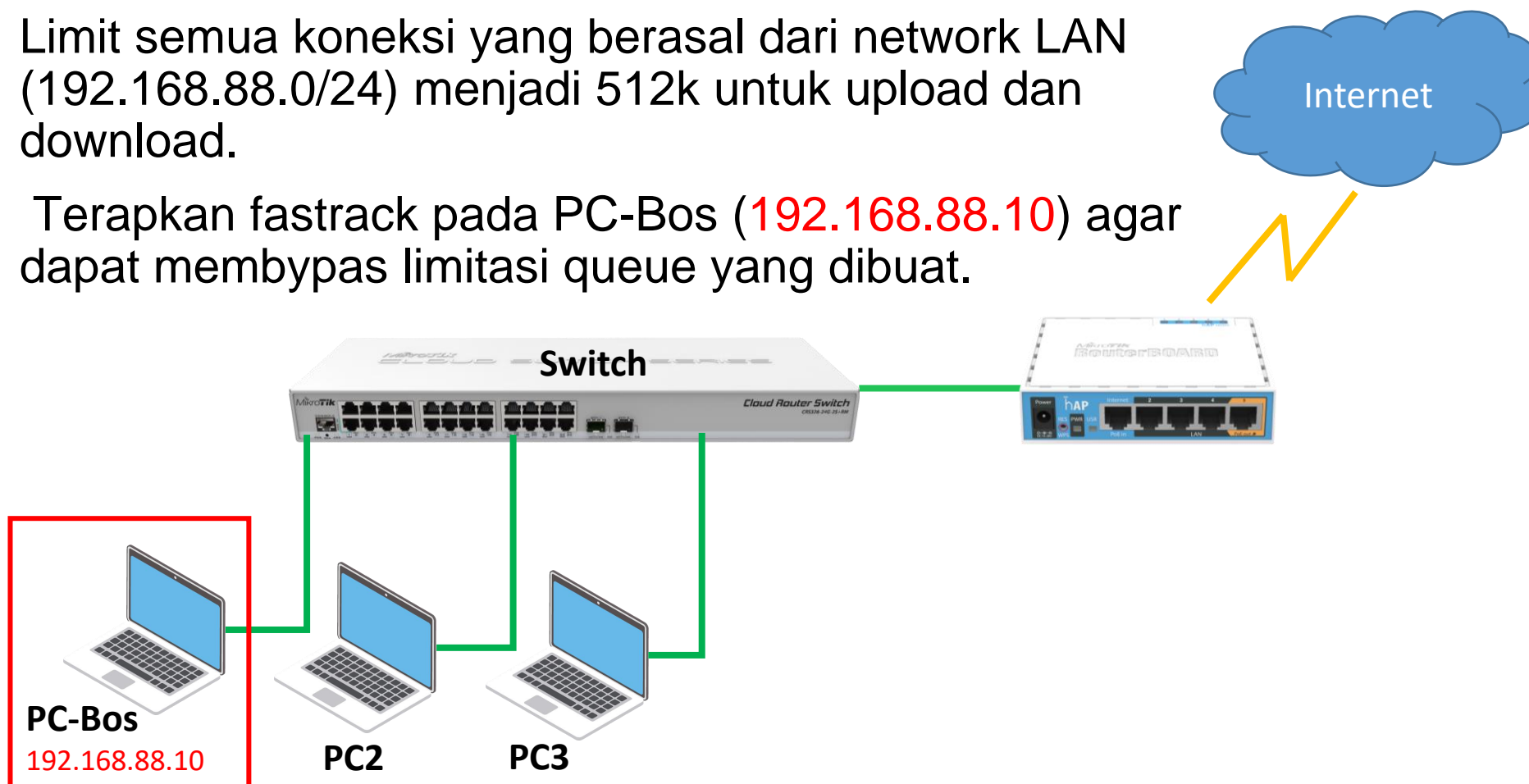
#	Name	Target	Upload Max Limit	Download Max Limit	Packet Marks	Total I
	laptop	192.168.88.2	1M	2M		

The 'New Simple Queue' dialog box is open, showing the following fields:

- Name: laptop
- Target: 192.168.88.2
- Target Upload: 1M
- Target Download: 2M

# Simple Queue + Fasttrack (1)

- Limit semua koneksi yang berasal dari network LAN (192.168.88.0/24) menjadi 512k untuk upload dan download.
- Terapkan fastrack pada PC-Bos (192.168.88.10) agar dapat membypas limitasi queue yang dibuat.



# Simple Queue + Fasttrack (2)

- Buat simple queue untuk melimit network (192.168.88.0/24) menjadi 512k upload dan download

The screenshot shows the Mikrotik WinBox interface. On the left sidebar, the 'Queues' menu item is highlighted with a red box. In the main window, the 'Queue List' tab is active, and the 'Simple Queues' sub-tab is selected. A red box highlights the '+' icon in the toolbar, with a red arrow pointing to the 'New Simple Queue' dialog box. In this dialog, the 'Name' field is set to 'queue1'. The 'Target' field is set to '192.168.88.0/24' and is highlighted with a red box. Below it, the 'Dst.' field is empty. At the bottom of the dialog, the 'Target Upload' and 'Target Download' sections are highlighted with red boxes. The 'Max Limit' for both is set to '512k'.

#	Name	Target	Upload Max Limit	Download Max Limit	Packet Marks	Tot
---	------	--------	------------------	--------------------	--------------	-----

New Simple Queue

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

Name: queue1

Target: 192.168.88.0/24

Dst.:

Target Upload

Max Limit: 512k

Target Download

512k bits/s

# Simple Queue + Fasttrack (2)

- Buatlah fasttrack pada filter rules di firewall untuk membypass PC-Bos 192.168.88.10 dari simple queue.
- IP > Firewall > Filter

New Firewall Rule

General Advanced Extra Action Statistics

Chain: forward

Src. Address:  192.168.88.10

Dst. Address:

Protocol:

Src. Port:

Dst. Port:

Any. Port:

In. Interface:  ether2

Out. Interface:

New Firewall Rule

General Advanced Extra Action Statistics

Action: fasttrack connection

Log

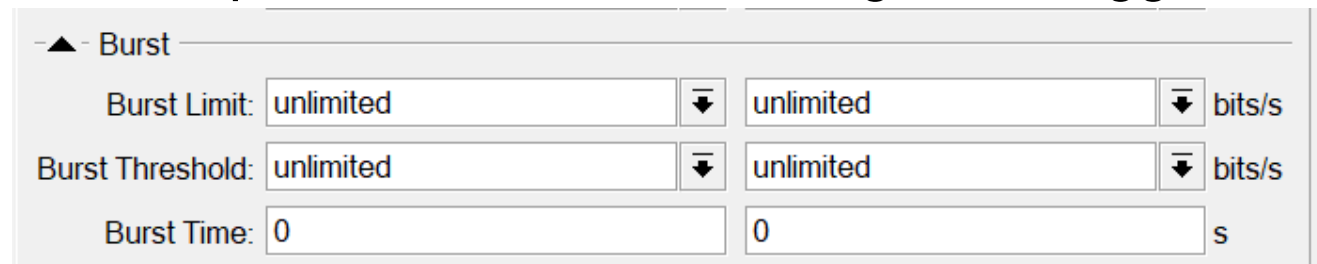
Log Prefix:

Interface ke lokal

Lakukan speed test dari PC dengan IP 192.168.88.10

# QoS – Burst

- Burst memungkinkan kita mendapat kecepatan tambahan dalam periode waktu tertentu.
- Mempercepat ketika akan load akses halaman web (http / https).
- Burst limit : kecepatan maksimum upload / download data yang dapat dicapai selama burst
- Burst time : waktu (detik), dimana laju data rata-rata dihitung (bukan waktu burst actual)
- Burst threshold : kecepatan data rata-rata melebihi / turun dibawah ambang batas, menentukan apakah burst akan running atau engga.



The screenshot shows the configuration interface for QoS Burst. It includes three rows of settings:

- Burst Limit:** Two dropdown menus, both set to "unlimited", followed by "bits/s".
- Burst Threshold:** Two dropdown menus, both set to "unlimited", followed by "bits/s".
- Burst Time:** Two input fields, both containing the value "0", followed by "s".



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# PCQ

## MIKROTIK MTCNA

# QoS – PCQ

- Dimungkinkan untuk melakukan pembagian bandwidth rata menggunakan PCQ.
- Dengan PCQ dapat membatasi maksimal data rate untuk setiap sub-queue dan jumlah paket data (pcq limit)
- Beberapa klasifikasi yang digunakan:
  - Source/destination address
  - Source/destination port

New Queue Type

Type Name: queue1

Kind: pcq

Rate: 0 bits/s

Queue Size: 50 KiB

Total Queue Size: 2000 KiB

Burst Rate: bits/s

Burst Threshold:

Burst Time: 00:00:10

Classifier:  Src. Address  Dst. Address  
 Src. Port  Dst. Port

Src. Address Mask: 32

Dst. Address Mask: 32

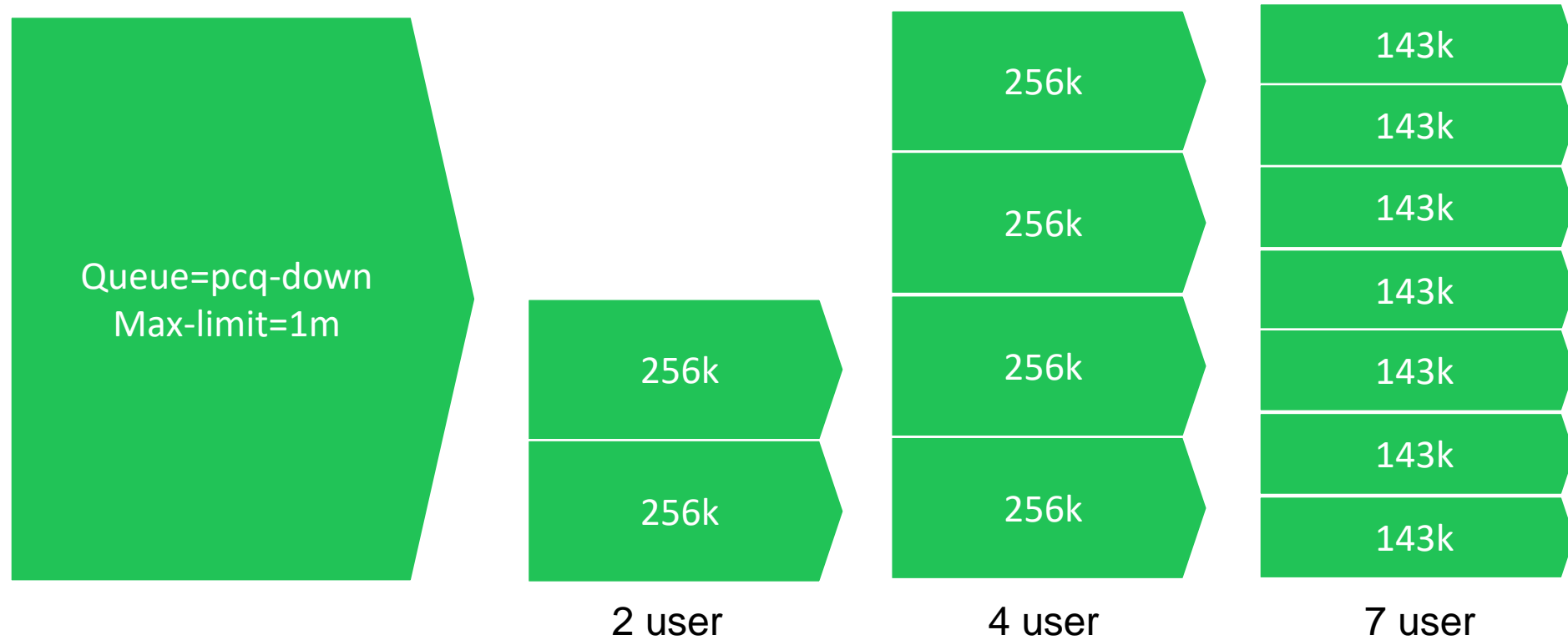
Src. Address6 Mask: 64

Dst. Address6 Mask: 64

OK  
Cancel  
Apply  
Copy  
Remove

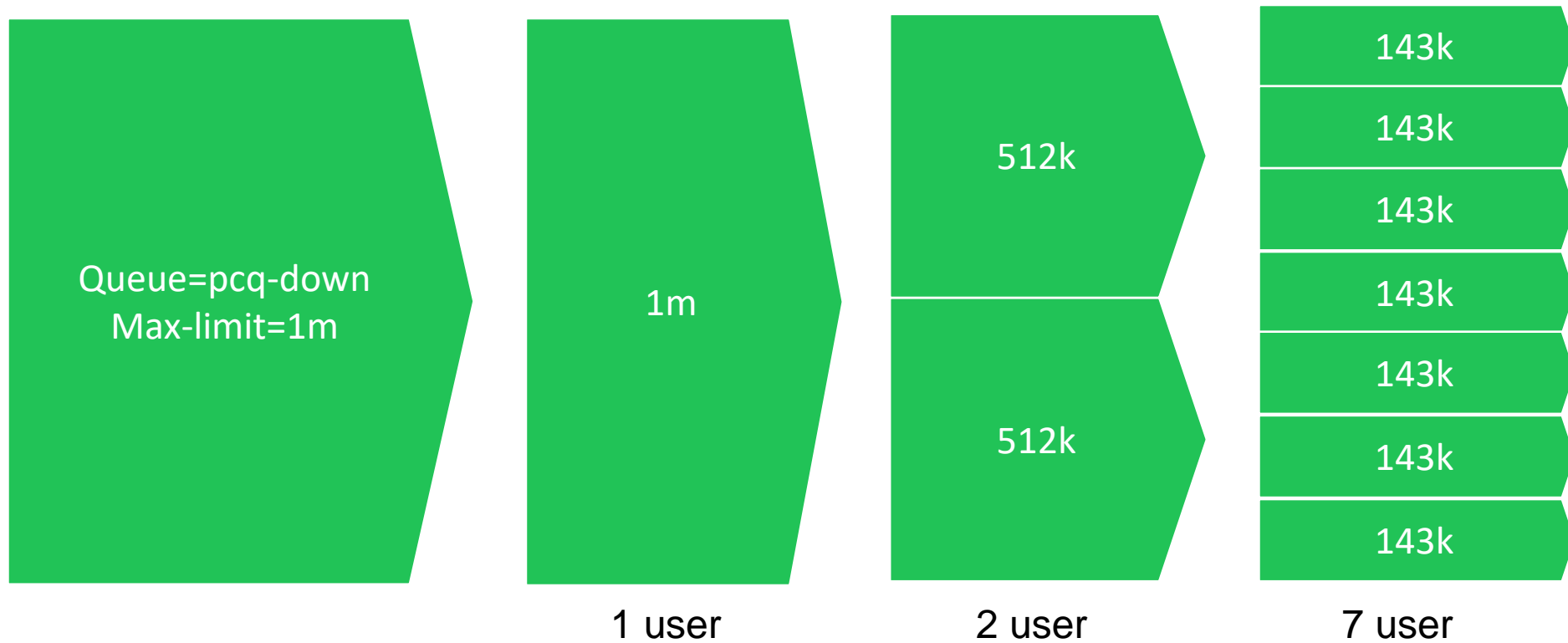
# QoS – PCQ

- PCQ Rate = 256k



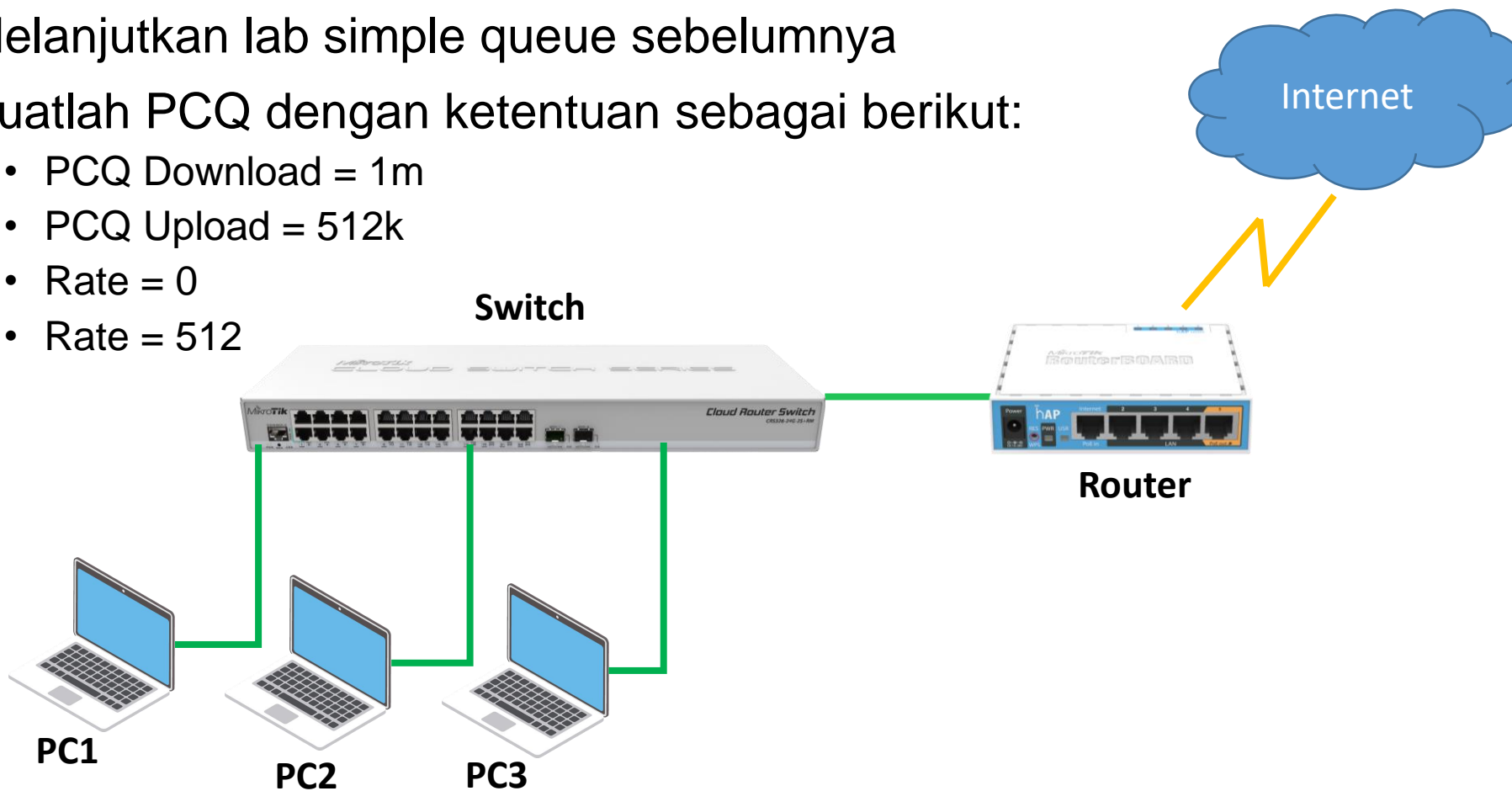
# QoS – PCQ

- PCQ Rate = 0



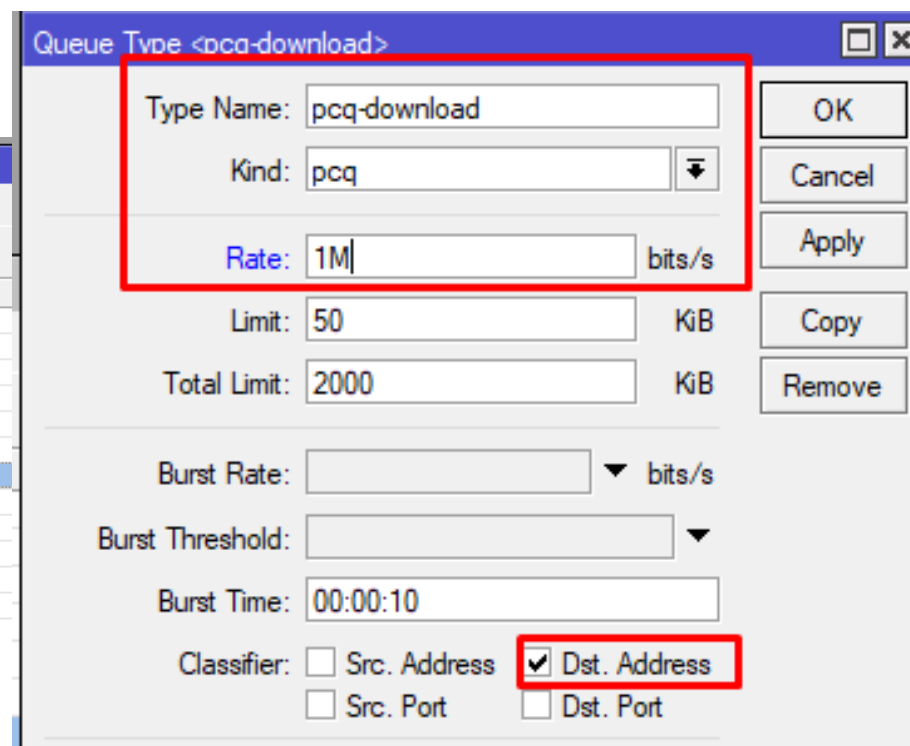
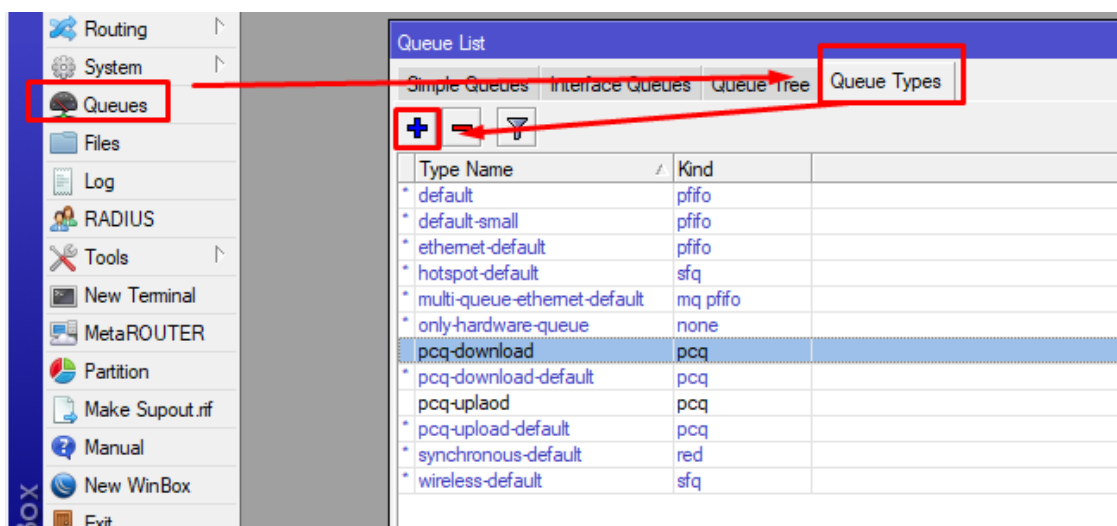
# QoS – PCQ (1)

- Melanjutkan lab simple queue sebelumnya
- Buatlah PCQ dengan ketentuan sebagai berikut:
  - PCQ Download = 1m
  - PCQ Upload = 512k
  - Rate = 0
  - Rate = 512



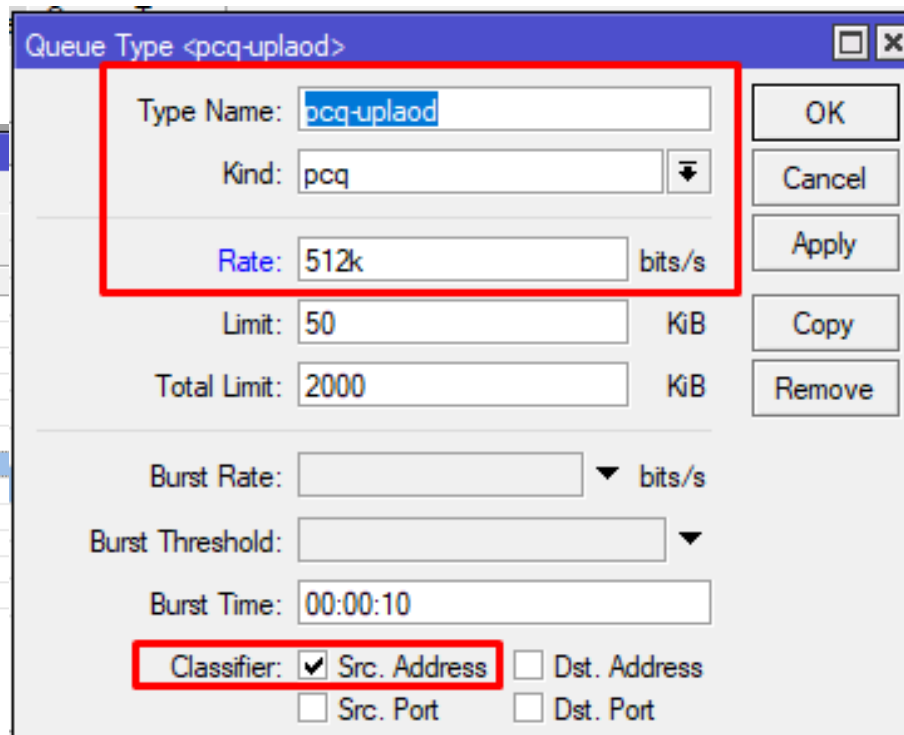
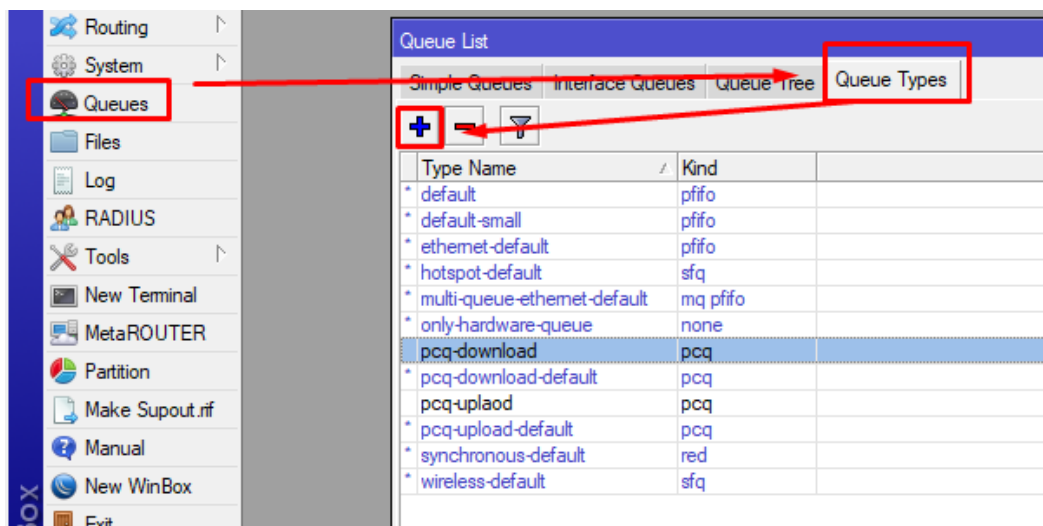
# QoS – PCQ (2)

- PCQ Download
- Queue > Queue Types > add



# QoS – PCQ (3)

- PCQ Upload
- Queue > Queue Types > add



# QoS – PCQ (4)

- Simple Queue Advanced

The screenshot shows the Mikrotik WinBox interface for configuring a Simple Queue. The 'Queue List' window is open, showing a table with one entry: 'Wifi' with target '192.168.97.0/24'. A red box highlights the 'Wifi' entry, and a red arrow points to the 'Advanced' tab of the configuration panel. In the 'Advanced' tab, the 'Queue Type' is set to 'pcq-uplaod' (with a typo) for upload and 'pcq-download' for download, both highlighted with red boxes. Other settings include 'Limit At: unlimited' for both directions, 'Priority: 8', and 'Bucket Size: 0.100'.

#	Name	Target	Upload Max Limit	Download Max Limit	Packet Marks	Total Max Limit
0	Wifi	192.168.97.0/24				

Simple Queue <Wifi>

General Advanced Statistics Traffic Total Total Statistics

Packet Marks: [ ]

Target Upload Target Download

Limit At: unlimited [v] unlimited [v] bits/s

Priority: 8 [ ] 8 [ ]

Bucket Size: 0.100 [ ] 0.100 [ ] ratio

Queue Type: pcq-uplaod [v] pcq-download [v]

Parent: none [v]

1 item (1 selected) 0 B queued



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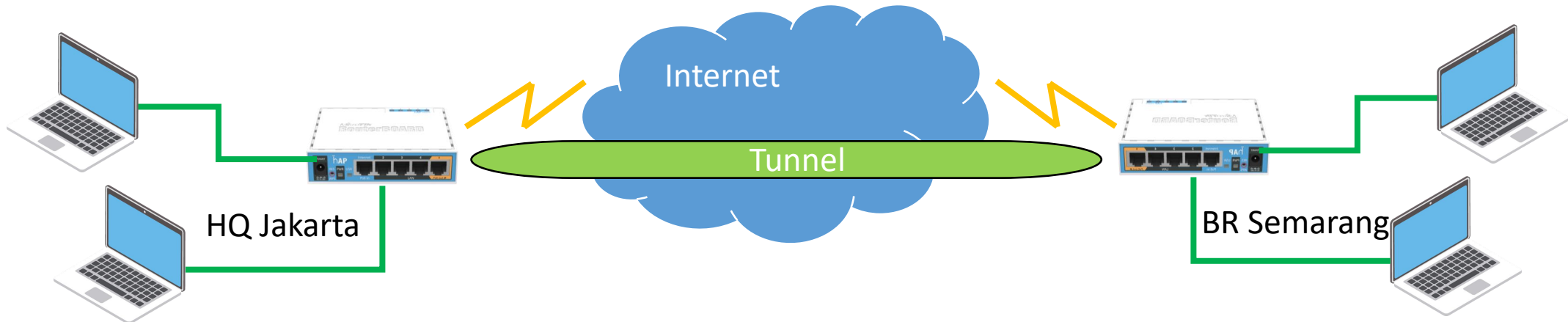


**MTCNA**

**Modul 8**  
**Tunnel**

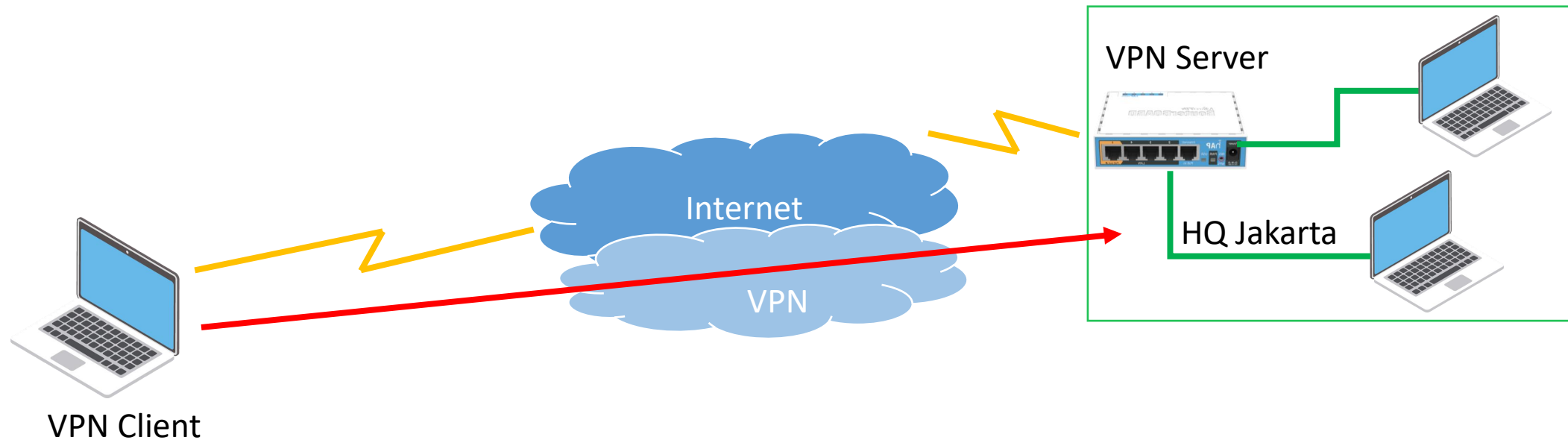
# Tunnel

- Tunnel merupakan metode menghubungkan jaringan yang berbeda lokasi menggunakan sebuah jalur khusus di internet.
- Paket akan mengalami modifikasi atau perubahan (penambahan header) selama paket dikirimkan.
- Ketika paket sudah melewati tunnel dan sampai tujuan, maka header paket akan dikembalikan seperti semula (header dilepas).



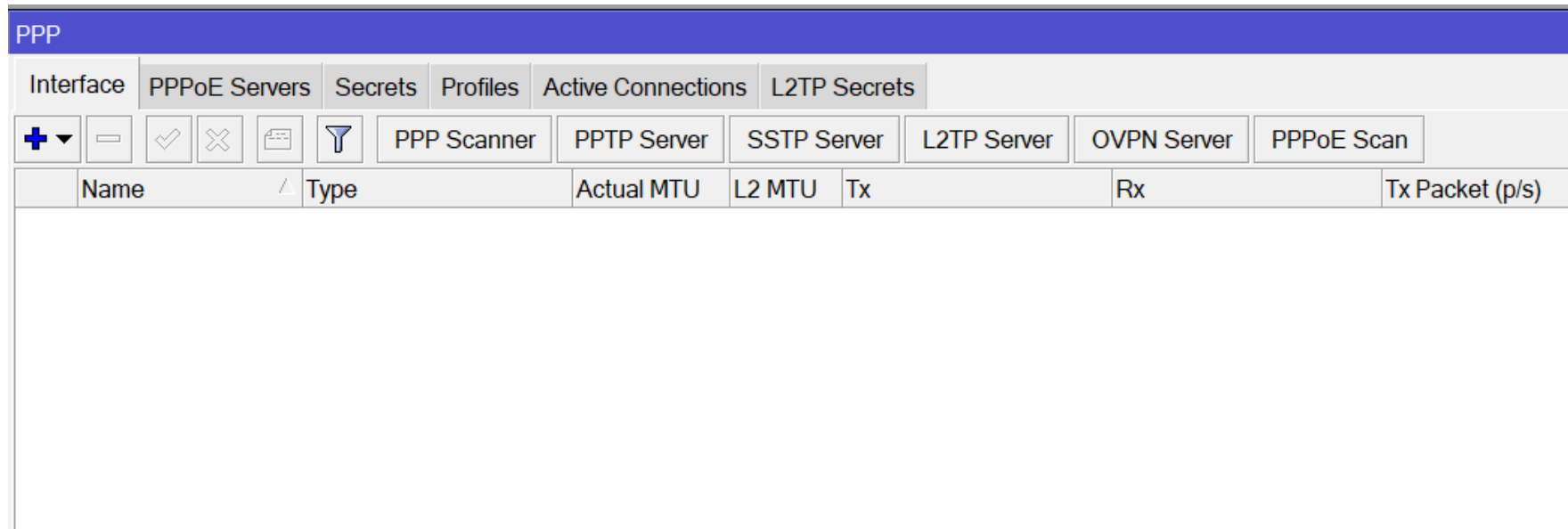
# VPN

- VPN (Virtual Private Network) cara aman untuk mengakses jaringan LAN melalui internet dengan tunnel.
- VPN terbentuk dari beberapa tunnel yang digabung.



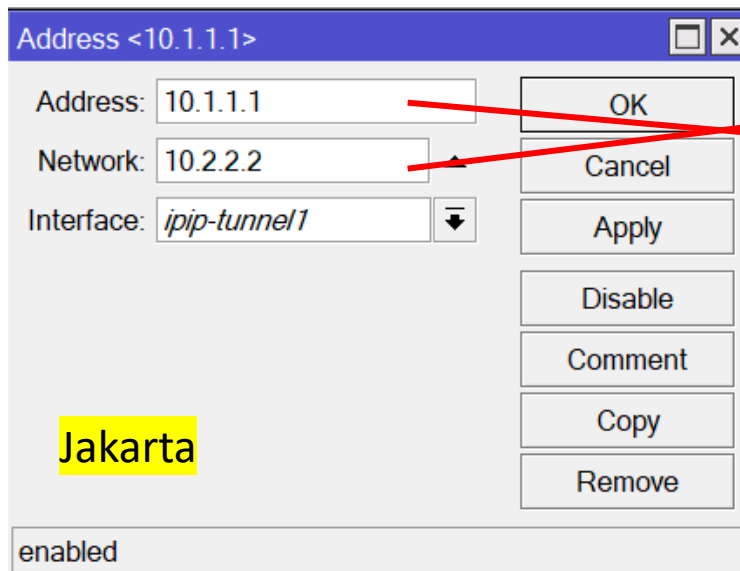
# Point-to-Point Protocol

- Point to Point Protocol (PPP) digunakan untuk membangun tunnel (koneksi langsung) antara dua lokasi yang berbeda melalui internet.
- PPP dapat menyediakan autentikasi koneksi, enkripsi dan kompresi.
- RouterOS mendukung berbagai tunnel PPP seperti PPPoE, SSTP, PPTP dll.



# Point-to-Point Addressing

- Merupakan tipe addressing yang digunakan untuk pengalamatan di jaringan tunnel.
- Biasanya menggunakan pengalamatan IP /32, bisa menggunakan /30 sebagai alternative bila ada perangkat yang tidak support /32



Address <10.1.1.1>

Address: 10.1.1.1

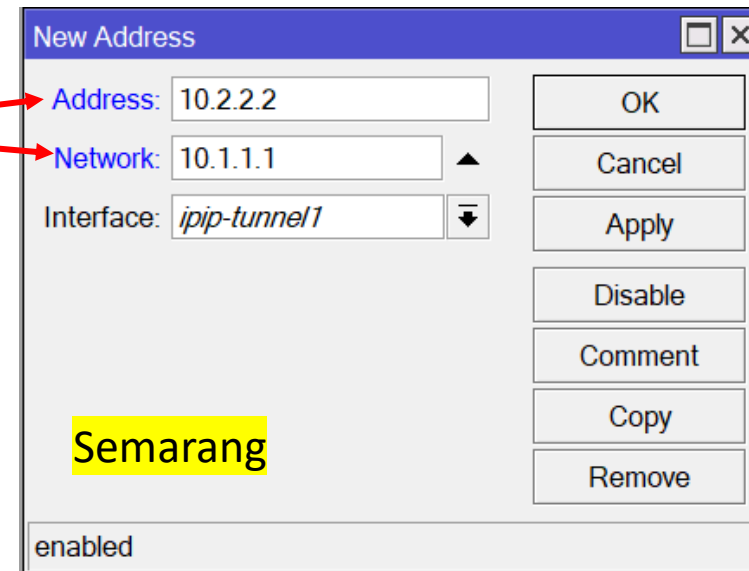
Network: 10.2.2.2

Interface: *ipip-tunnel1*

Jakarta

enabled

Buttons: OK, Cancel, Apply, Disable, Comment, Copy, Remove



New Address

Address: 10.2.2.2

Network: 10.1.1.1

Interface: *ipip-tunnel1*

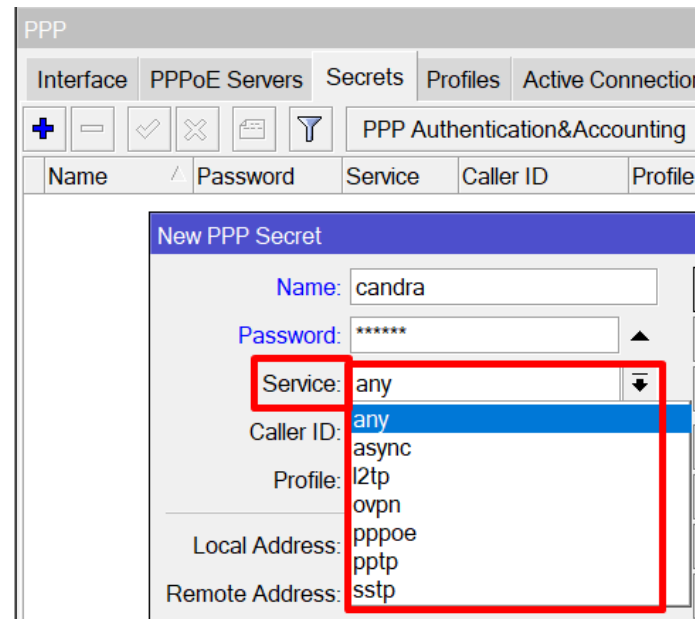
Semarang

enabled

Buttons: OK, Cancel, Apply, Disable, Comment, Copy, Remove

# PPP User Database

- Digunakan sebagai autentikasi username password di Tunnel.
- By default username password tunnel di simpan di menu PPP > Secret
- Selain itu juga dapat disimpan di Radius Server terpisah.
- PPP Secret dapat digunakan untuk beberapa service seperti berikut :
  - Async
  - L2TP
  - PPTP
  - OVPN
  - PPPoE
  - SSTP



# PPP Secret

- Local Address (alamat IP tunnel server)
- Remote Address (alamat IP tunnel client)

The screenshot shows the Mikrotik WinBox interface for configuring a PPP Secret. The 'Secrets' tab is selected, and a table lists the secret 'candra' with password 'mypass321', service 'any', and profile 'default'. A configuration dialog for 'candra' is open, showing fields for Name, Password, Service, Caller ID, Profile, Local Address, and Remote Address. The Local Address is set to 10.10.10.1 and the Remote Address is set to 10.10.10.2, both of which are highlighted with a red rectangular box.

Name	Password	Service	Caller ID	Profile	L
candra	mypass321	any		default	1

PPP Secret <candra>

Name: candra

Password: mypass321

Service: any

Caller ID:

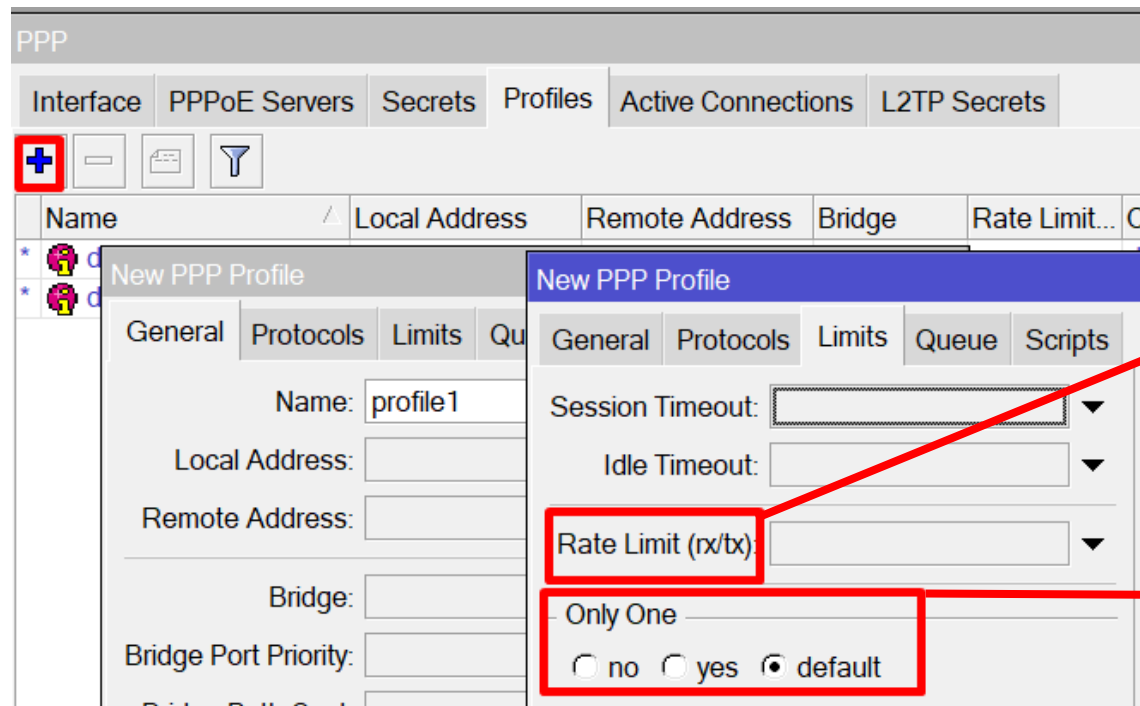
Profile: default

Local Address: 10.10.10.1

Remote Address: 10.10.10.2

# PPP Profile

- PPP Profile menentukan aturan yang digunakan oleh server PPP untuk clientnya.
- Bisa digunakan untuk mengatur pengaturan yang sama untuk banyak client.



digunakan untuk membatasi bandwidth

digunakan untuk membatasi jumlah session client yang konek



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# **PPTP TUNNEL**

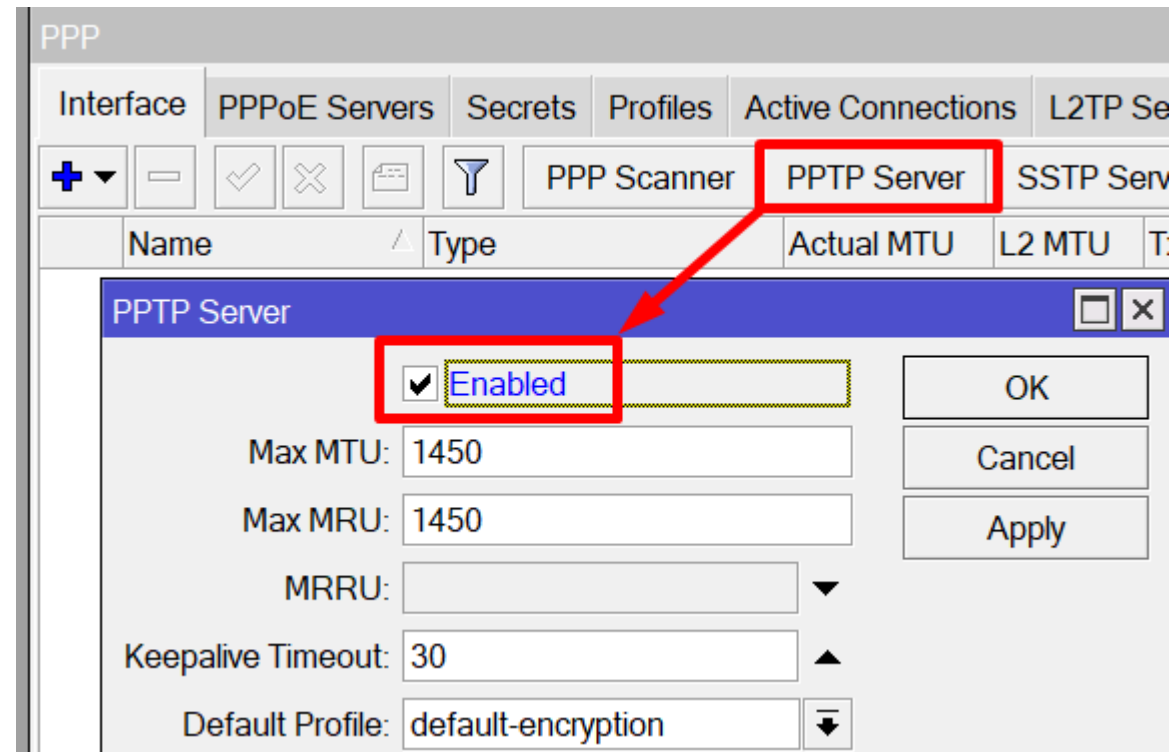
## **MIKROTIK MTCNA**

# PPTP Tunneling

- Point-to-Point Tunneling Protocol (PPTP) merupakan salah satu tunnel yang menyediakan enkripsi melalui IP.
- Merupakan tunnel yang banyak digunakan karena hampir semua OS support PPTP client.
- Dapat digunakan untuk membuat koneksi aman antara jaringan local melalui internet.
- RouterOS mendukung PPTP client dan PPTP Server.
- PPTP menggunakan port TCP 1723 dan IP protocol 47 GRE (Generic Routing Encapsulation).
- NAT helpers digunakan untuk mendukung PPTP di jaringan NAT.

# PPTP Server

- Untuk mengaktifkan PPTP sebagai server, yang harus dilakukan adalah enable service pada menu PPP > Interface > PPTP Server.



# PPTP Server

- Membuat autentikasi username dan password pada database (PPP Secret)

PPP

Interface | PPPoE Servers | Secrets | Profiles | Active Connections | L2TP Secret

PPP Authentication & Accounting

Name	Password	Service	Caller ID	Profile	Local Ad
candra	mypass321				

PPP Secret <candra>

Name: candra

Password: mypass321

Service: any

Caller ID:

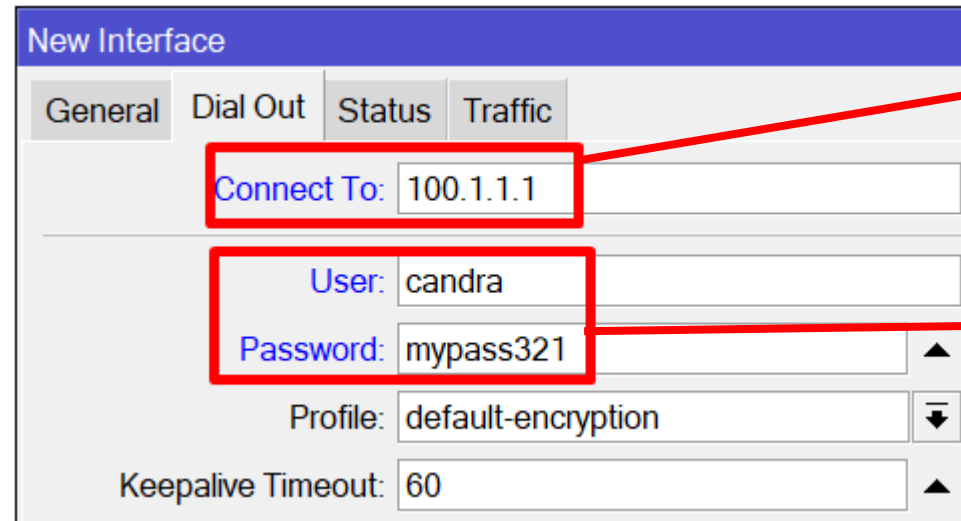
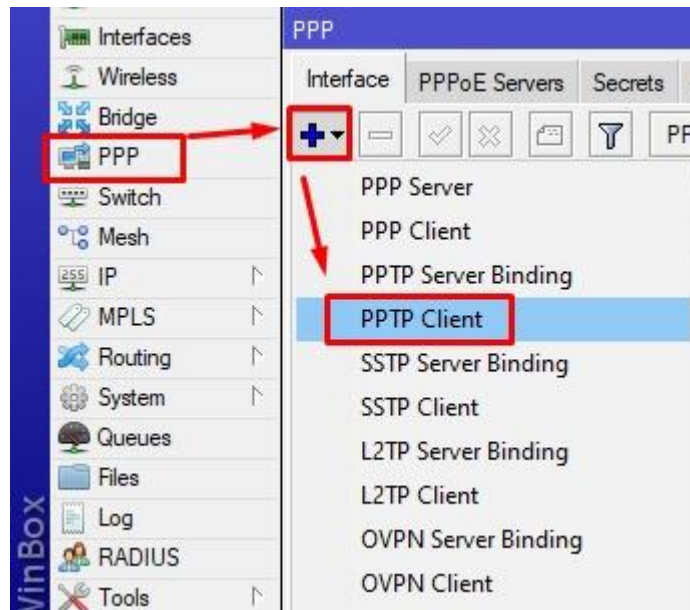
Profile: default

Local Address: 10.10.10.1

Remote Address: 10.10.10.2

# PPTP Client

- Digunakan untuk melakukan Dial Out dari client ke server.
- Untuk pembuatan PPTP Client melalui menu PPP > Interface > Add > PPTP Client.

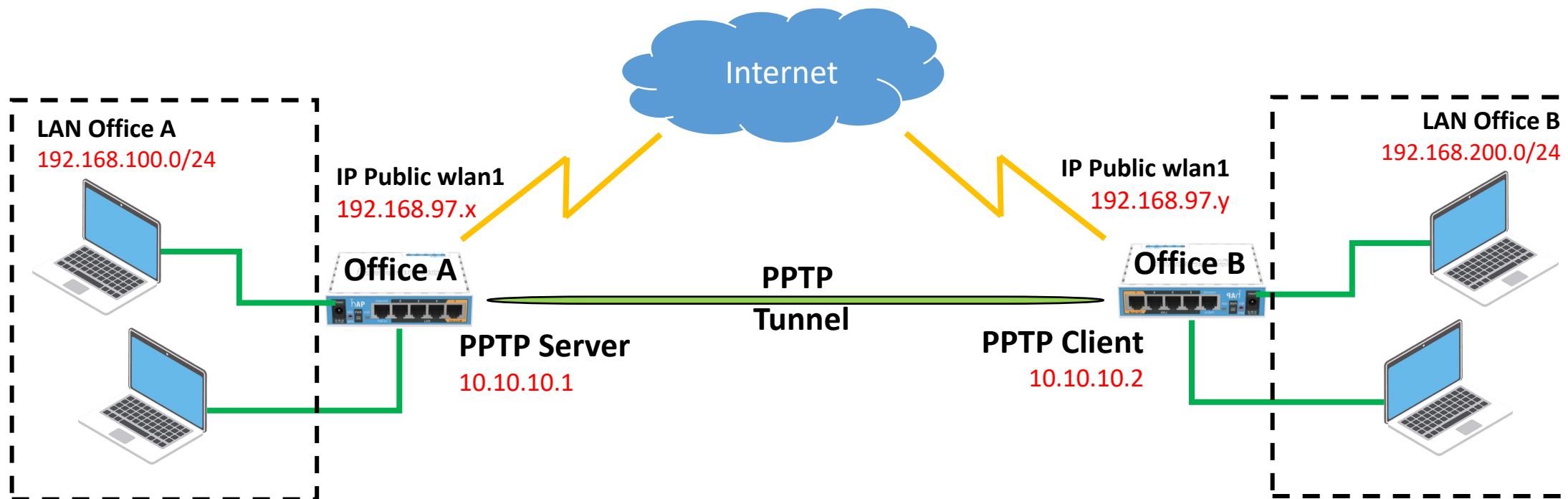


IP Public PPTP Server

Username dan password yang dibuat di PPP Secret PPTP Server

# PPTP Site to Site (Mikrotik – Mikrotik)

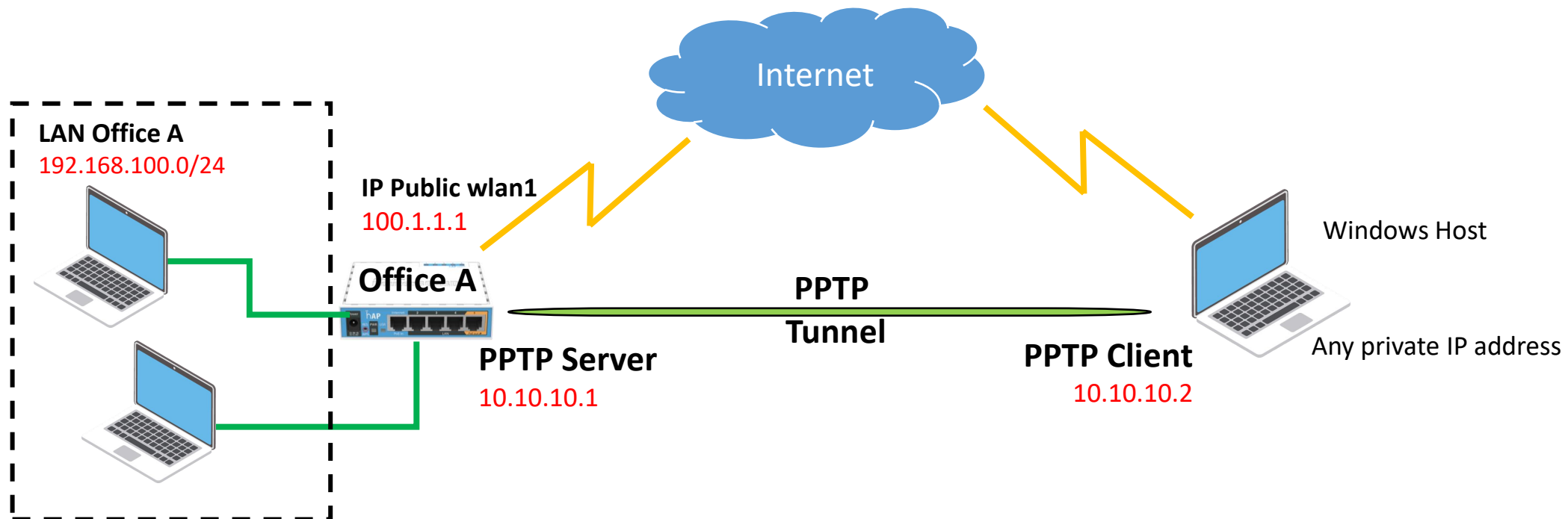
- Buatlah topologi seperti berikut



- Gunakan static route untuk menghubungkan antar client

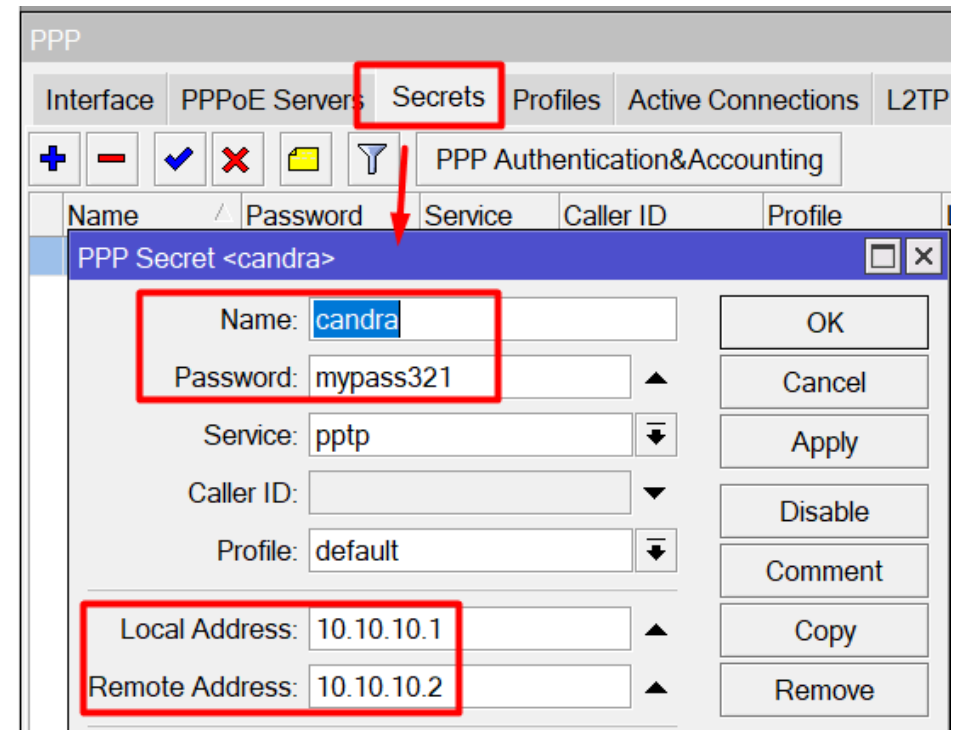
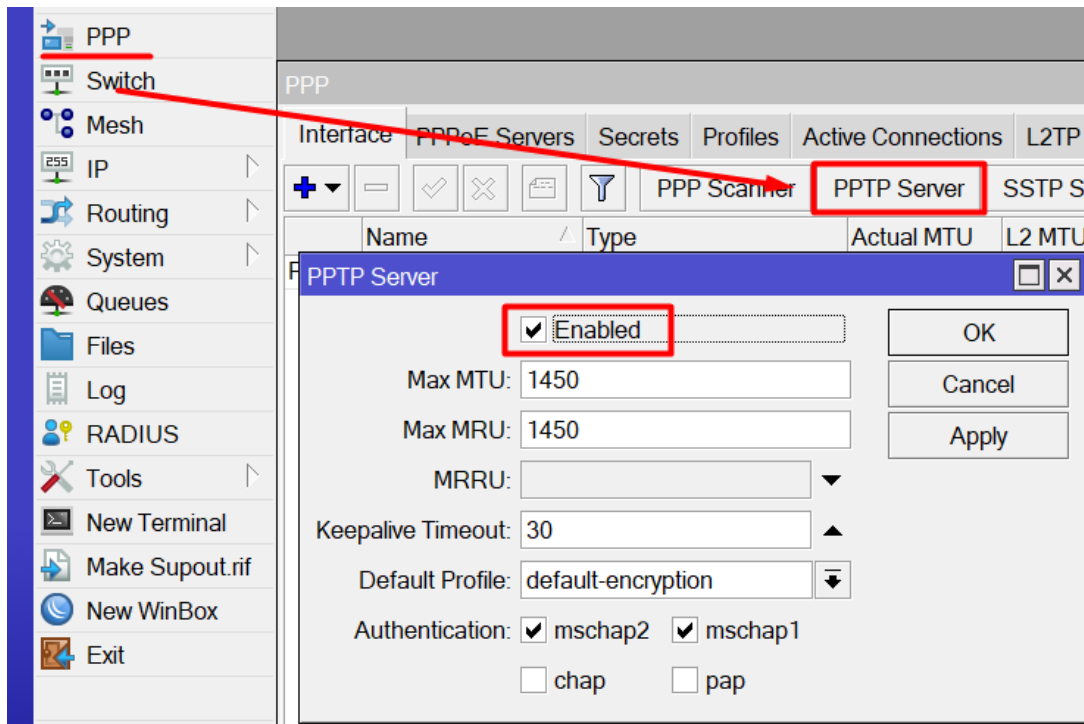
# PPTP VPN (Mikrotik – Windows)

- Buatlah topologi seperti berikut



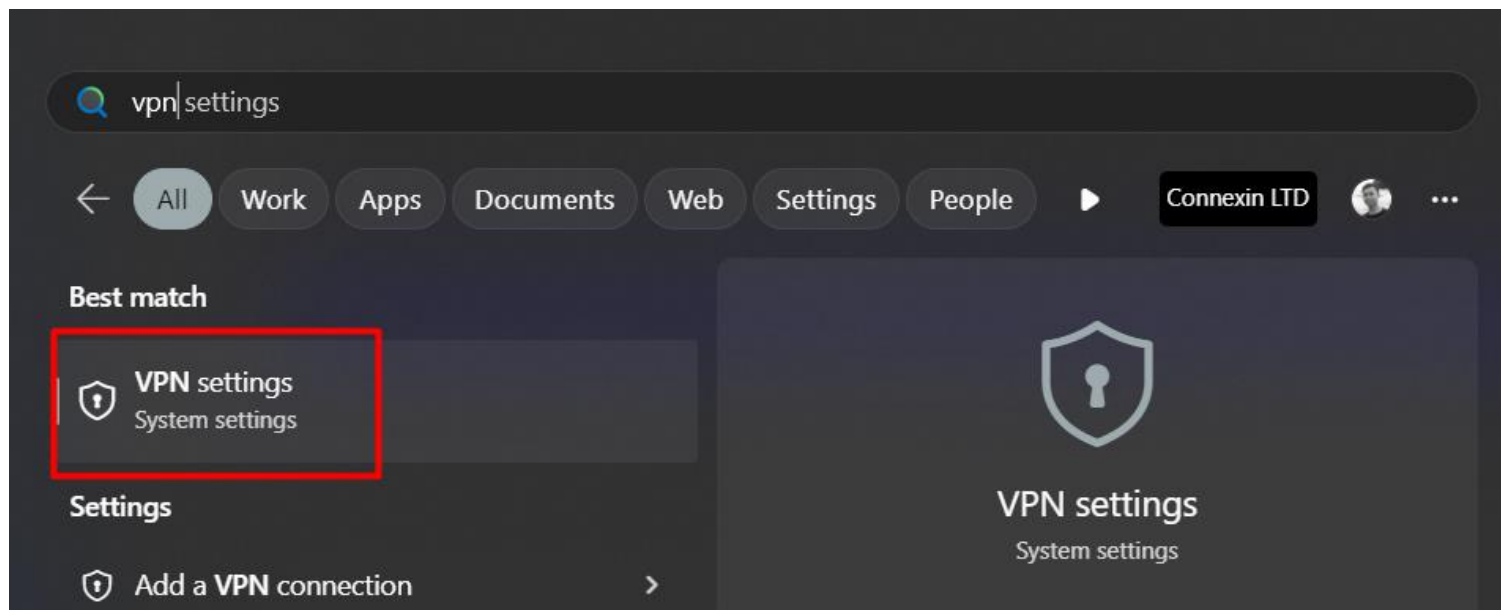
# PPTP VPN (Mikrotik – Windows)

- PPTP Server



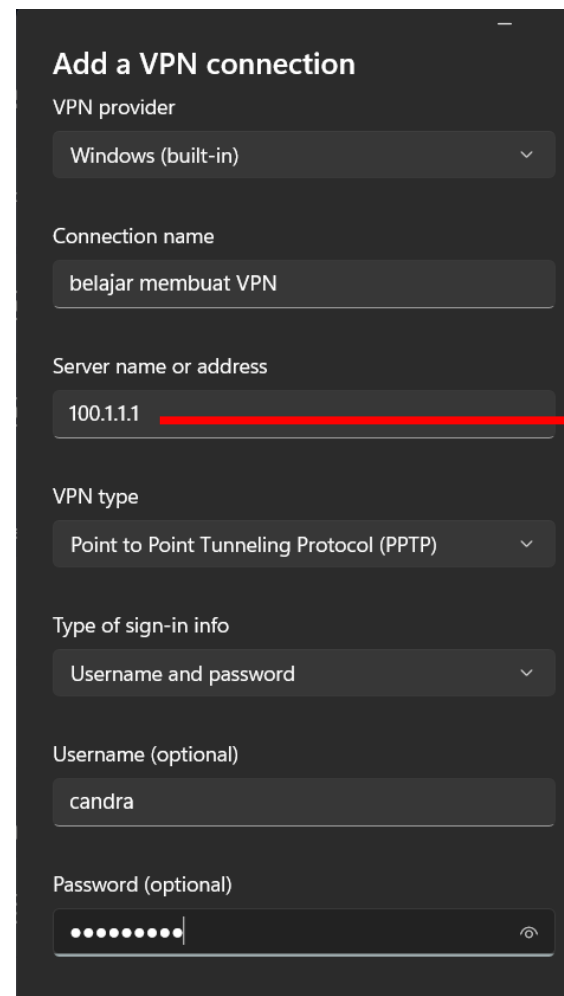
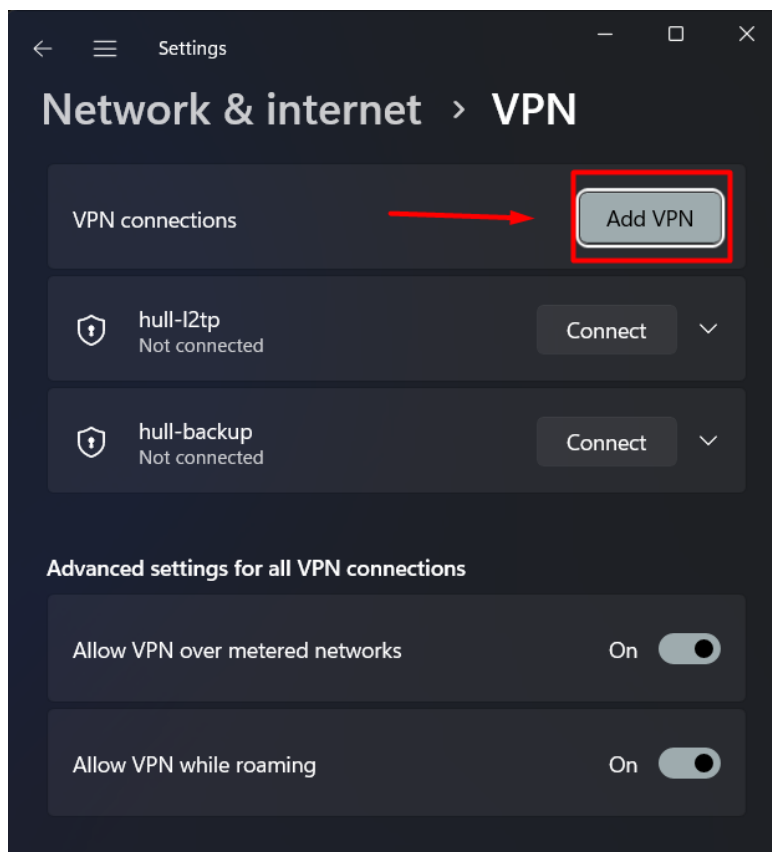
# PPTP VPN (Mikrotik – Windows)

- PPTP Client
- Windows search → VPN settings



# PPTP VPN (Mikrotik – Windows)

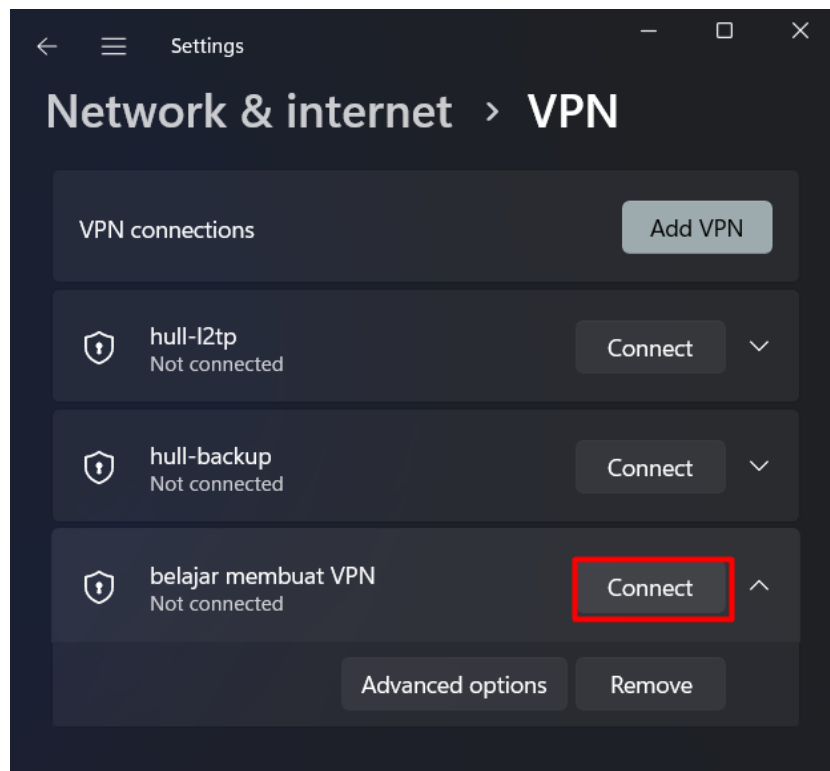
- Create new VPN



IP Public Router

# PPTP VPN (Mikrotik – Windows)

- Create new VPN




PPP adapter belajar membuat VPN:

```
Connection-specific DNS Suffix . :  
IPv4 Address . . . . . : 10.10.10.2  
Subnet Mask . . . . . : 255.255.255.255  
Default Gateway . . . . . : 0.0.0.0
```

IP PPTP Client yang didapat dari  
remote address PPP > Secret

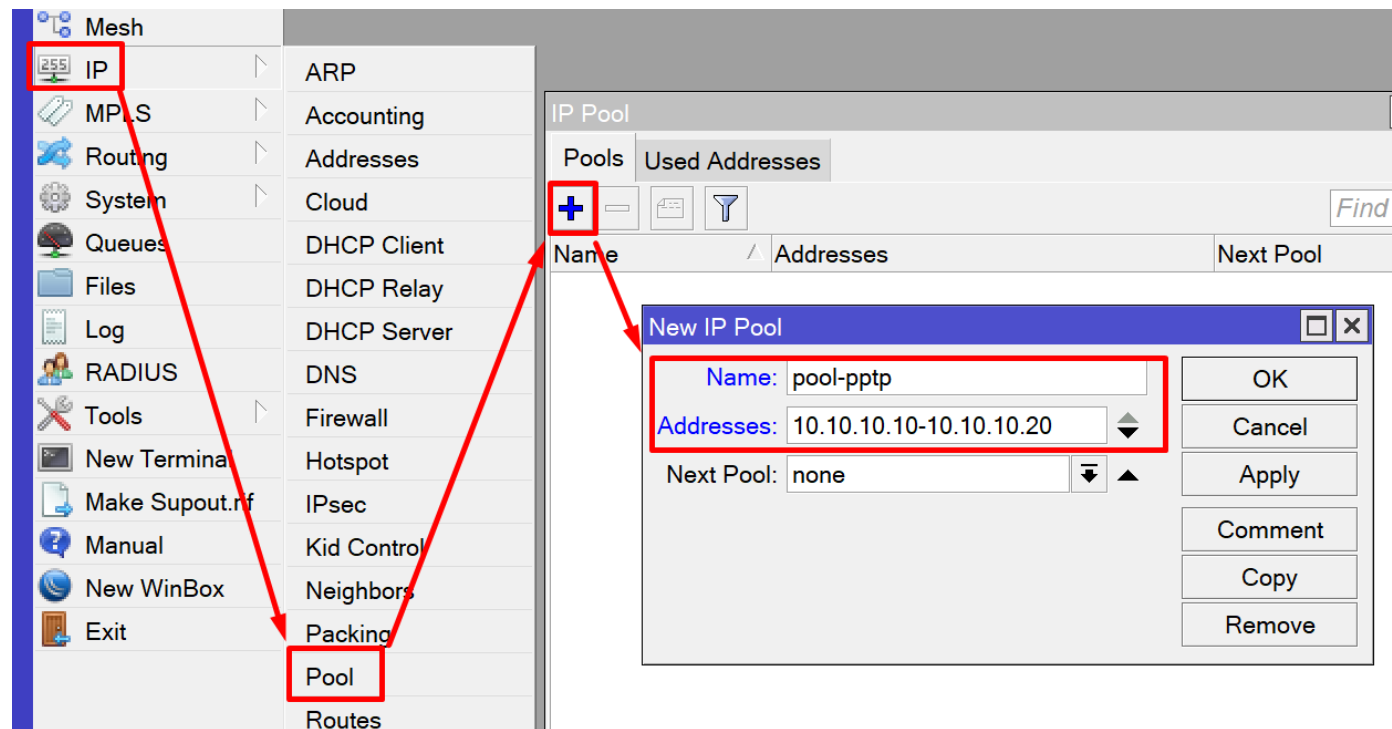
# PPP Active Connections

- PPP Active connections digunakan untuk melihat list session client yang sedang melakukan koneksi ke PPTP Server.
- Terdapat 2 flags :
  - L = Local (username dan password yang digunakan berasal dari PPP Secret).
  - R = Radius (username dan password yang digunakan untuk login berasal dari radius server).

PPP							
Interface	PPPoE Servers	Secrets	Profiles	Active Connections	L2TP Secrets		
Name	Service	Caller ID	Encoding	Address	Uptime		
L  candra	pptp	192.168.98.74	MPPE128 stateless	10.10.10.2	00:04:49		

# IP Pool

- Menentukan range alamat IP yang bisa digunakan untuk service pada RouterOS (DHCP, PPP, Hotspot, dll).
- Address diambil dari pool secara otomatis





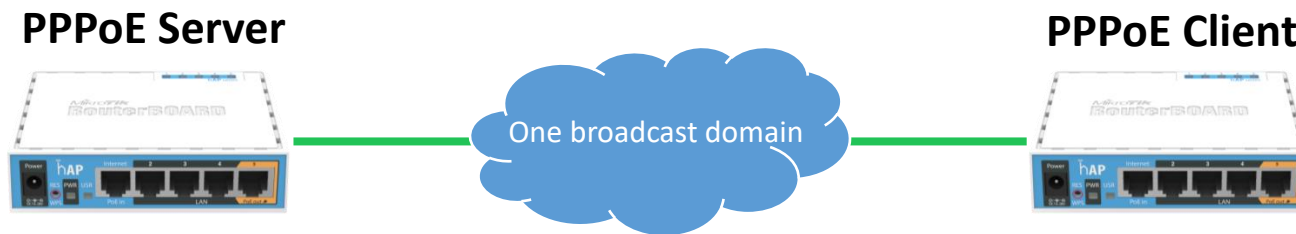
**ID-Networkers**  
Indonesian IT Expert Factory

# PPPOE

## MIKROTIK MTCNA

# PPPoE

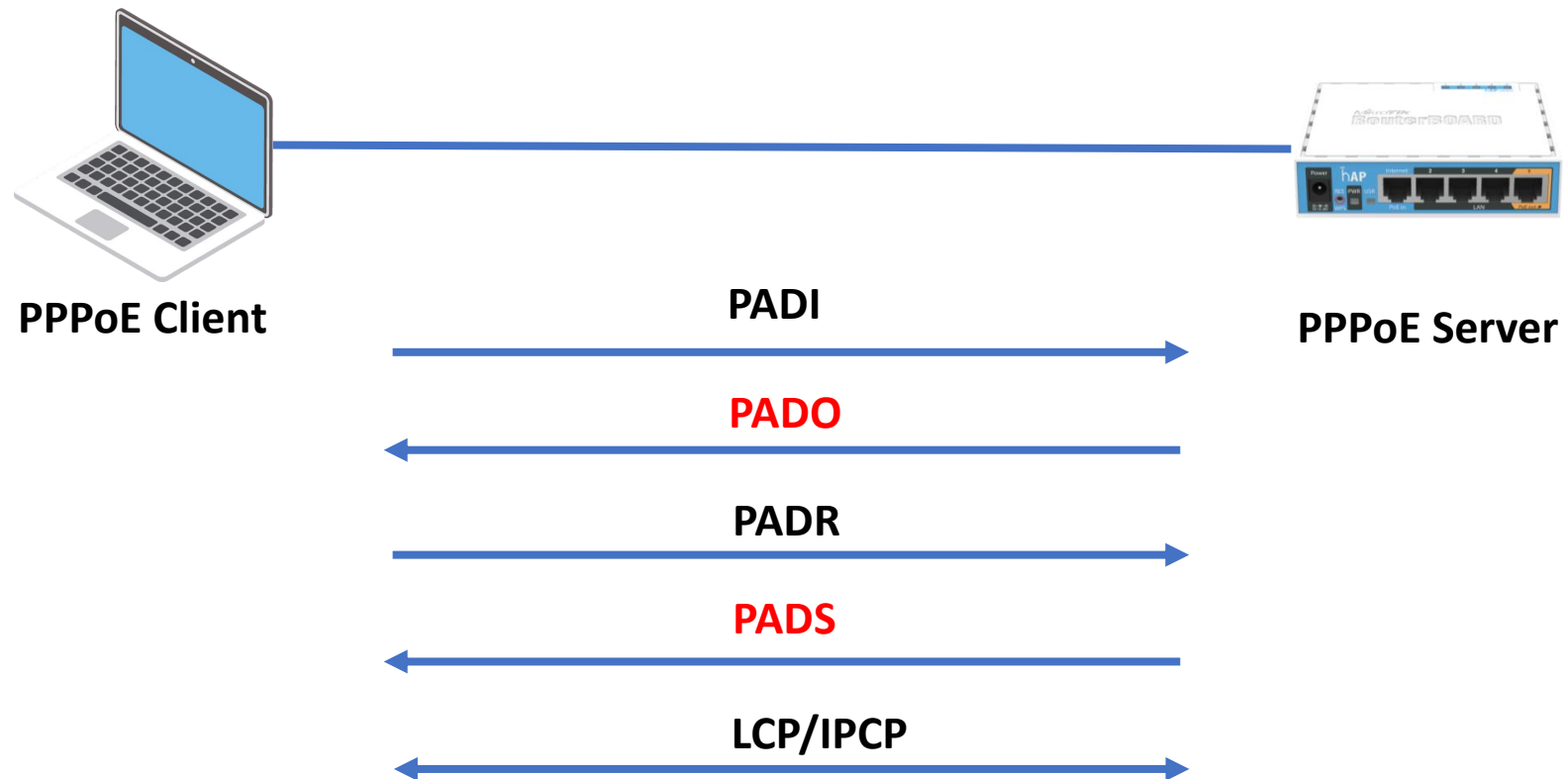
- Point-to-Point Protocol over Ethernet merupakan jenis protocol tunnel layer 2 yang digunakan untuk mengontrol akses ke jaringan.
- Salah satu jenis protocol tunnel yang banyak digunakan di ISP, karena dapat dengan mudah melakukan management banyak client tanpa menggunakan IP Public.
- Memberikan autentikasi, enkripsi dan kompresi.
- PPPoE hanya bekerja pada satu jaringan (one broadcast domain).



# PPPoE

- PPPoE mempunyai 2 tahapan
- Discovery Stages
  - Sebelum konek ke server, client akan melakukan pencarian dengan cara melakukan discovery stage untuk membuat sebuah koneksi yang established.
- Session
  - Kondisi dimana PPPoE client sudah terkoneksi ke server (established).

# PPPoE Discovery Stages



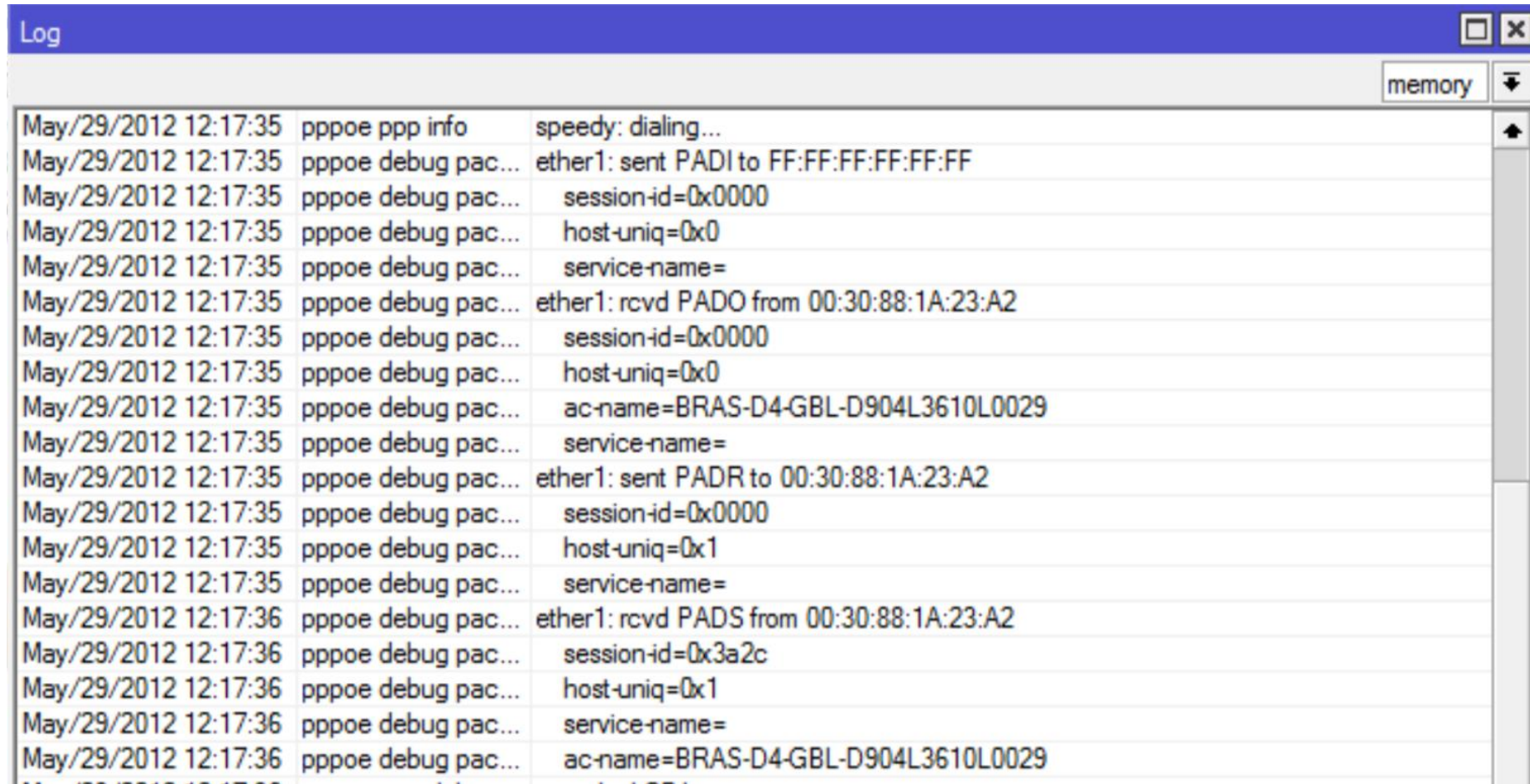
# PPPoE Discovery Stages

- PADI (PPP Active Discovery Initiation), PPPoE Client mengirimkan paket broadcast ke jaringan dengan alamat pengiriman MAC Address FF:FF:FF:FF:FF:FF:FF:FF untuk mencari di mana lokasi PPPoE server dalam jaringan.
- PADO (PPP Active Discovery Offer). Merupakan jawaban dari PPPoE Server atas PADI yang didapatkan sebelumnya, dengan memberikan identitas berupa MAC Addressnya.
- PADR (PPP Active Discovery Request), merupakan informasi dari PPPoE client ke server dengan menghubungi ulang server melalui MAC address yang diberikan sebelumnya.

# PPPoE Discovery Stages

- PADS (PPP Active Discovery Session-confirmation) dari PPPoE Server ke Client, isinya mengenai session ID dan pada tahap ini akan terjadi negosiasi username, password dan IP address.
- PADT (PPP Active Discovery Terminate) digunakan untuk mengakhiri session. Bisa dikirim dari Server atau dari Client.

# PPPoE Discovery Stages



Time	Level	Message
May/29/2012 12:17:35	pppoe ppp info	speedy: dialing...
May/29/2012 12:17:35	pppoe debug pac...	ether1: sent PADI to FF:FF:FF:FF:FF:FF
May/29/2012 12:17:35	pppoe debug pac...	session-id=0x0000
May/29/2012 12:17:35	pppoe debug pac...	host-uniq=0x0
May/29/2012 12:17:35	pppoe debug pac...	service-name=
May/29/2012 12:17:35	pppoe debug pac...	ether1: rcvd PADO from 00:30:88:1A:23:A2
May/29/2012 12:17:35	pppoe debug pac...	session-id=0x0000
May/29/2012 12:17:35	pppoe debug pac...	host-uniq=0x0
May/29/2012 12:17:35	pppoe debug pac...	ac-name=BRAS-D4-GBL-D904L3610L0029
May/29/2012 12:17:35	pppoe debug pac...	service-name=
May/29/2012 12:17:35	pppoe debug pac...	ether1: sent PADR to 00:30:88:1A:23:A2
May/29/2012 12:17:35	pppoe debug pac...	session-id=0x0000
May/29/2012 12:17:35	pppoe debug pac...	host-uniq=0x1
May/29/2012 12:17:35	pppoe debug pac...	service-name=
May/29/2012 12:17:36	pppoe debug pac...	ether1: rcvd PADS from 00:30:88:1A:23:A2
May/29/2012 12:17:36	pppoe debug pac...	session-id=0x3a2c
May/29/2012 12:17:36	pppoe debug pac...	host-uniq=0x1
May/29/2012 12:17:36	pppoe debug pac...	service-name=
May/29/2012 12:17:36	pppoe debug pac...	ac-name=BRAS-D4-GBL-D904L3610L0029

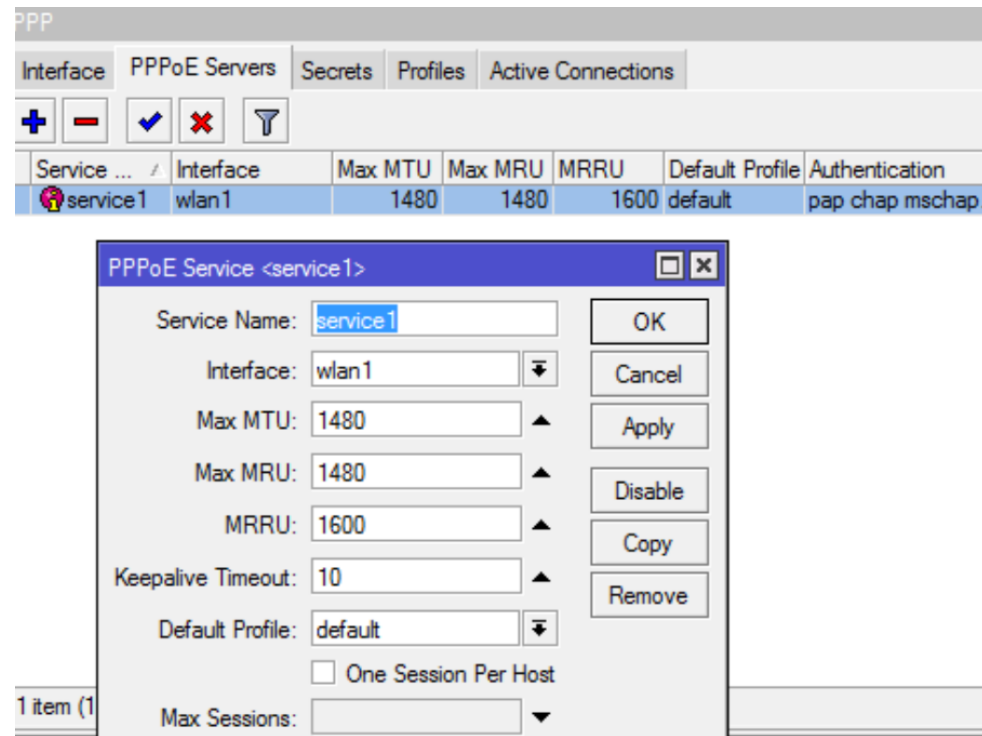
# PPPoE Session Stage

- LCP Negotiation
- Authentication
- IPCP Negotiation (Pembagian IP address ke client)



# PPPoE Server

- PPPoE Server support beberapa type interface.
- Tidak bisa dikonfigurasi pada interface yang merupakan bagian dari bridge



# PPPoE Client

- PPPoE Client digunakan untuk melakukan dial out PPPoE Server

Interface <pppoe-out1>

General | Dial Out | Status | Traffic

Name: pppoe-out1

Type: PPPoE Client

L2 MTU: [ ]

Max MTU: 1480 ▲

Max MRU: 1480 ▲

MRRU: 1600 ▲

Interfaces: wlan1 ▼

Buttons: OK, Cancel, Apply, Disable, Comment, Copy, Remove, Torch, PPPoE Scan

enabled | running | slave | Status: connected

Interface <pppoe-out1>

General | Dial Out | Status | Traffic

Service: [ ] ▼

AC Name: [ ] ▼

User: user1

Password: 123 ▲

Profile: default ▼

Keepalive Timeout: 60 ▲

Dial On Demand

Use Peer DNS

Add Default Route

Default Route Distance: 0

Allow:  mschap2  mschap1  
 chap  pap

Buttons: OK, Cancel, Apply, Disable, Comment, Copy, Remove, Torch, PPPoE Scan

enabled | running | slave | Status: connected



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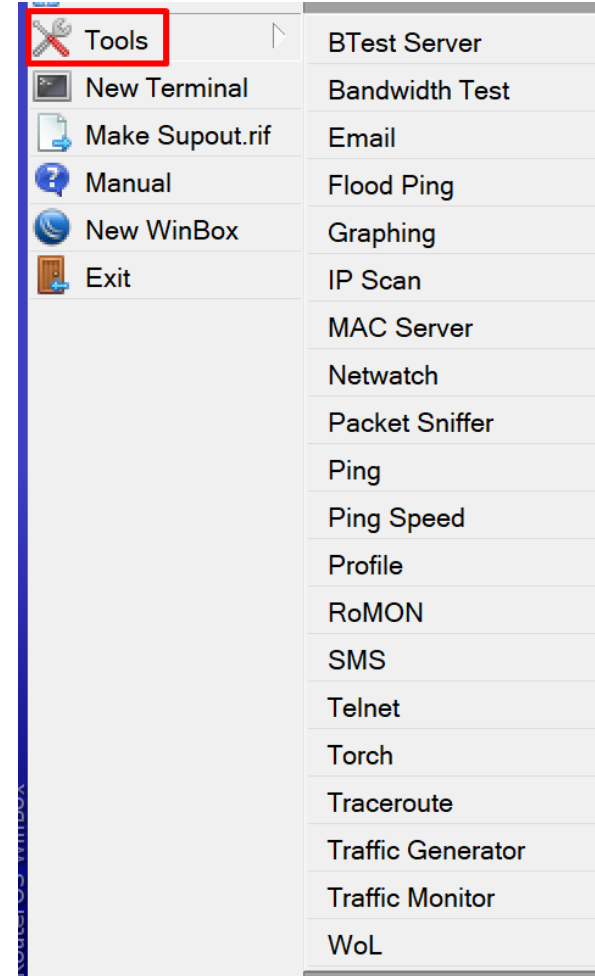


# MTCNA

Modul 9  
MISC

# RouterOS Tools

- RouterOS menyediakan berbagai utilitas yang membantu mengelola dan memonitor router dengan lebih efisien.



# Torch

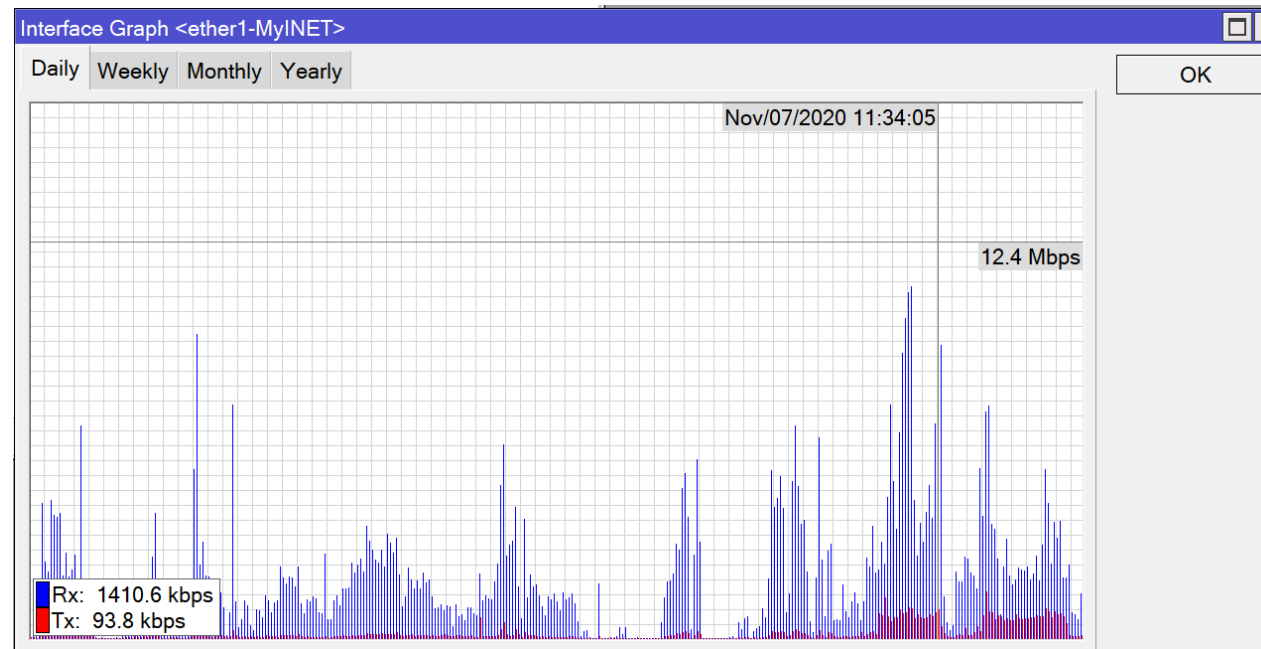
- Digunakan untuk memantau traffic dari sebuah paket melalui interface.
- Real-time monitoring tool
- Dapat memantau lalu lintas yang diklasifikasikan berdasarkan nama protocol IP, sumber / alamat tujuan (IPv4 / IPv6), dan port.

The screenshot shows the Mikrotik Torch (Running) window. The 'Basic' tab is active, showing the interface 'ether1-MyINET' and an entry timeout of '00:00:03'. The 'Collect' section has several checkboxes: 'Src. Address', 'Dst. Address', 'MAC Protocol', 'Protocol', 'DSCP', 'Src. Address6', 'Dst. Address6', 'Port', and 'VLAN Id'. The 'Filters' section has dropdown menus for 'Src. Address', 'Dst. Address', 'Src. Address6', 'Dst. Address6', 'MAC Protocol', 'Protocol', 'Port', 'VLAN Id', and 'DSCP'. The 'Start', 'Stop', 'Close', and 'New Window' buttons are visible on the right. Below the configuration is a table showing traffic monitoring data.

Eth. ...	Protocol	Src.	Dst.	VLAN Id	DSCP	Tx Rate	Rx Rate	Tx Pack...	Rx Pa
800 (ip)	17 (udp)	185.6.152.74:1701 (l2tp)	192.168.96.44:1701 (l2tp)			13.4 kbps	243.1 kb...	16	
800 (ip)	1 (icmp)	74.125.130.102	192.168.96.44			592 bps	592 bps	1	
800 (ip)	6 (tcp)	17.57.145.52:5223	192.168.96.44:49488			0 bps	0 bps	0	
800 (ip)	6 (tcp)	52.63.63.51:443 (https)	192.168.96.44:57651			0 bps	0 bps	0	
800 (ip)	6 (tcp)	147.92.165.28:443 (https)	192.168.96.44:49498			0 bps	0 bps	0	

# Graphs

- Digunakan untuk memonitoring traffic yang melewati interface dalam waktu tertentu.
- Traffic rata-rata diambil tiap interval 5 menit sekali.
- Dapat digunakan untuk memonitoring penggunaan CPU, memory dan disk



# Graphs

- Untuk melihat hasil monitoring graphs bisa melalui 2 cara :
  - Winbox : Tool > Graphing > Interface Graphs
  - WebFig : [http://router\\_ip/graphs](http://router_ip/graphs)

## Traffic and system resource graphing

[CPU usage](#)

[Memory usage](#)

[Disk usage](#)

You have access to 2 interfaces:

[ether1-lan](#)

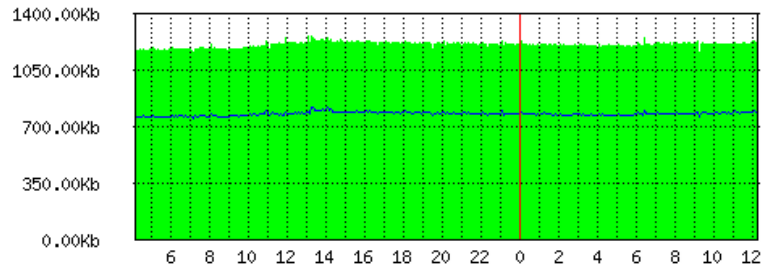
[wlan1](#)

# Graphs

## Interface <ether1-gateway> Statistics

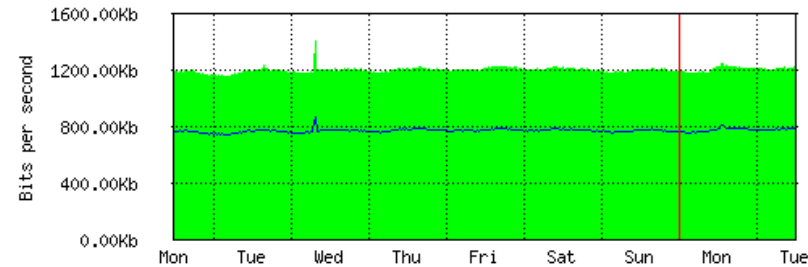
• Last update: Wed Dec 31 23:59:59 2015

"Daily" Graph (5 Minute Average)



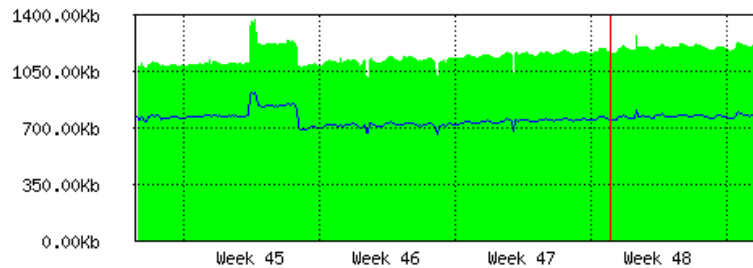
Max In: 1.26Mb; Average In: 1.21Mb; Current In: 1.22Mb;  
Max Out: 821.58Kb; Average Out: 780.56Kb; Current Out: 793.75Kb;

"Weekly" Graph (30 Minute Average)



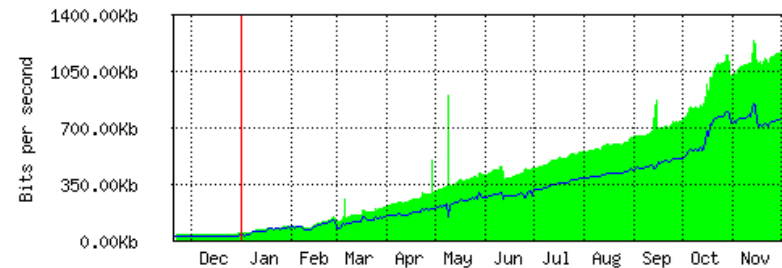
Max In: 1.41Mb; Average In: 1.20Mb; Current In: 1.22Mb;  
Max Out: 872.20Kb; Average Out: 772.71Kb; Current Out: 792.54Kb;

"Monthly" Graph (2 Hour Average)



Max In: 1.37Mb; Average In: 1.15Mb; Current In: 1.21Mb;  
Max Out: 922.93Kb; Average Out: 757.19Kb; Current Out: 786.12Kb;

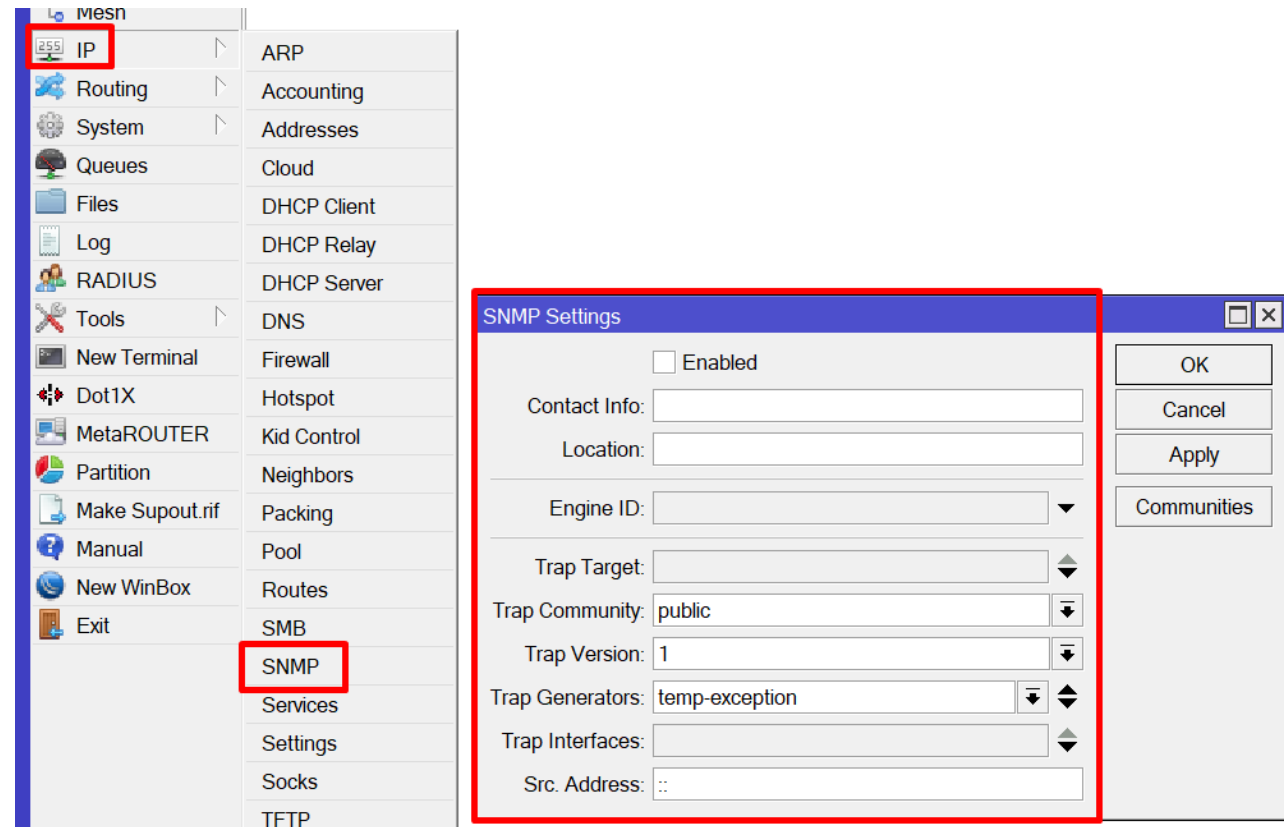
"Yearly" Graph (1 Day Average)



Max In: 1.24Mb; Average In: 445.51Kb; Current In: 1.20Mb;  
Max Out: 850.52Kb; Average Out: 303.36Kb; Current Out: 772.42Kb;

# SNMP

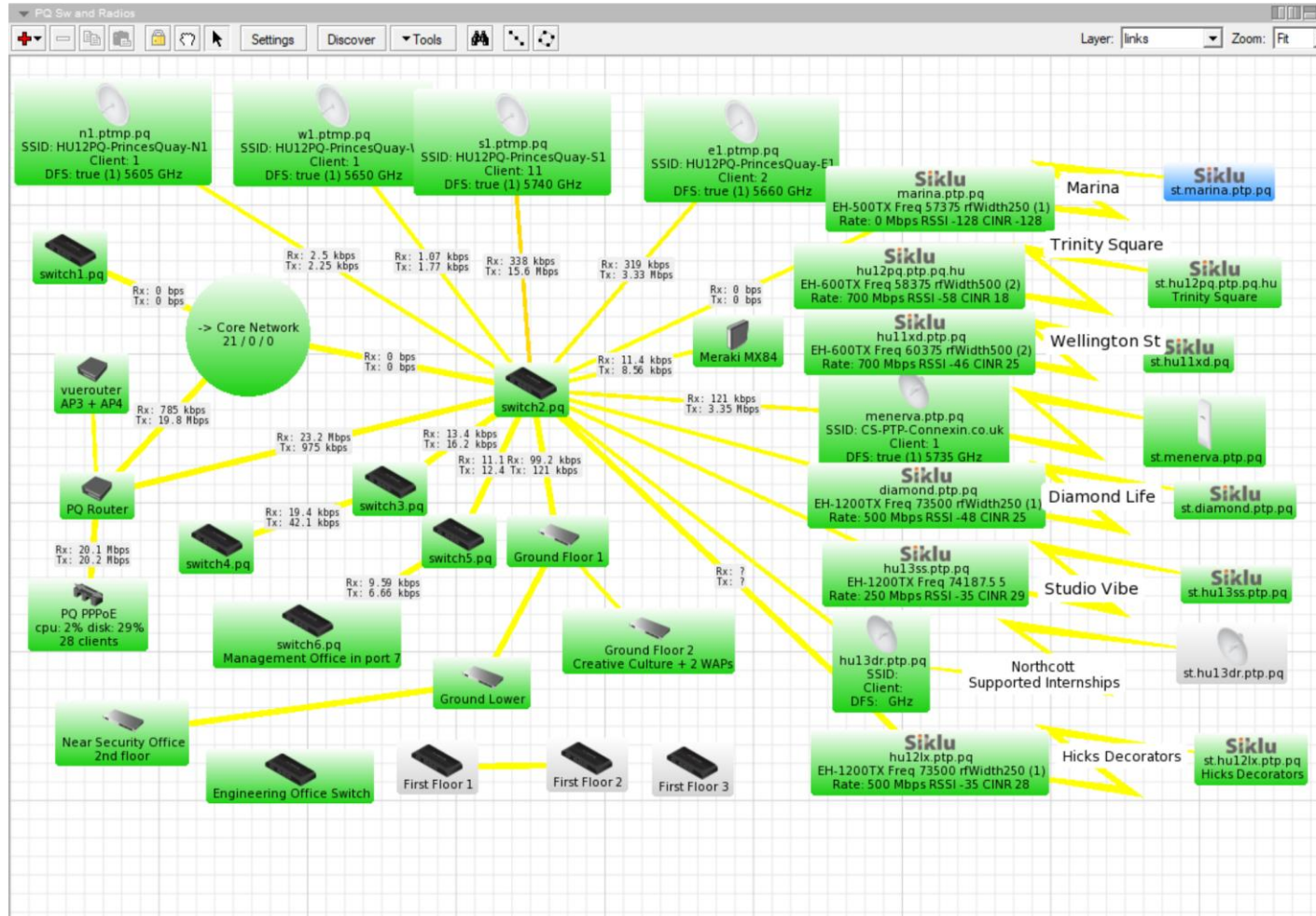
- Simple Network Management Protocol (SNMP)
- Digunakan untuk memonitor dan mengelola perangkat.
- RouterOS mendukung SNMP v1, v2 dan v3
- IP > SNMP



# The Dude

- Aplikasi bawaan Mikrotik yang digunakan untuk memonitoring jaringan secara realtime.
- Device yang akan dimonitoring bisa ditambahkan secara manual kedalam The Dude atau secara otomatis menggunakan fitur Discovery.
- Monitoring services dan alerting.
- Free
- Mendukung SNMP, ICMP, DNS dan TCP monitoring.
- Terdapat 2 tipe The Dude :
  - The Dude Server (digunakan sebagai SNMP master untuk menjalankan service The Dude → CCR, CHR, or x86)
  - The Dude Client (digunakan sebagai SNMP Agent menampilkan device yang sedang dimonitoring → windows, linux dan OS X menggunakan aplikasi pihak ketiga)

# The Dude



# Terimakasih

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