



Wireless



Certified Mikrotik Training Basic Class

Organized by: Citraweb Nusa Infomedia

(Mikrotik Certified Training Partner)



Wireless LAN – 802.11

○ Band 2.4Ghz

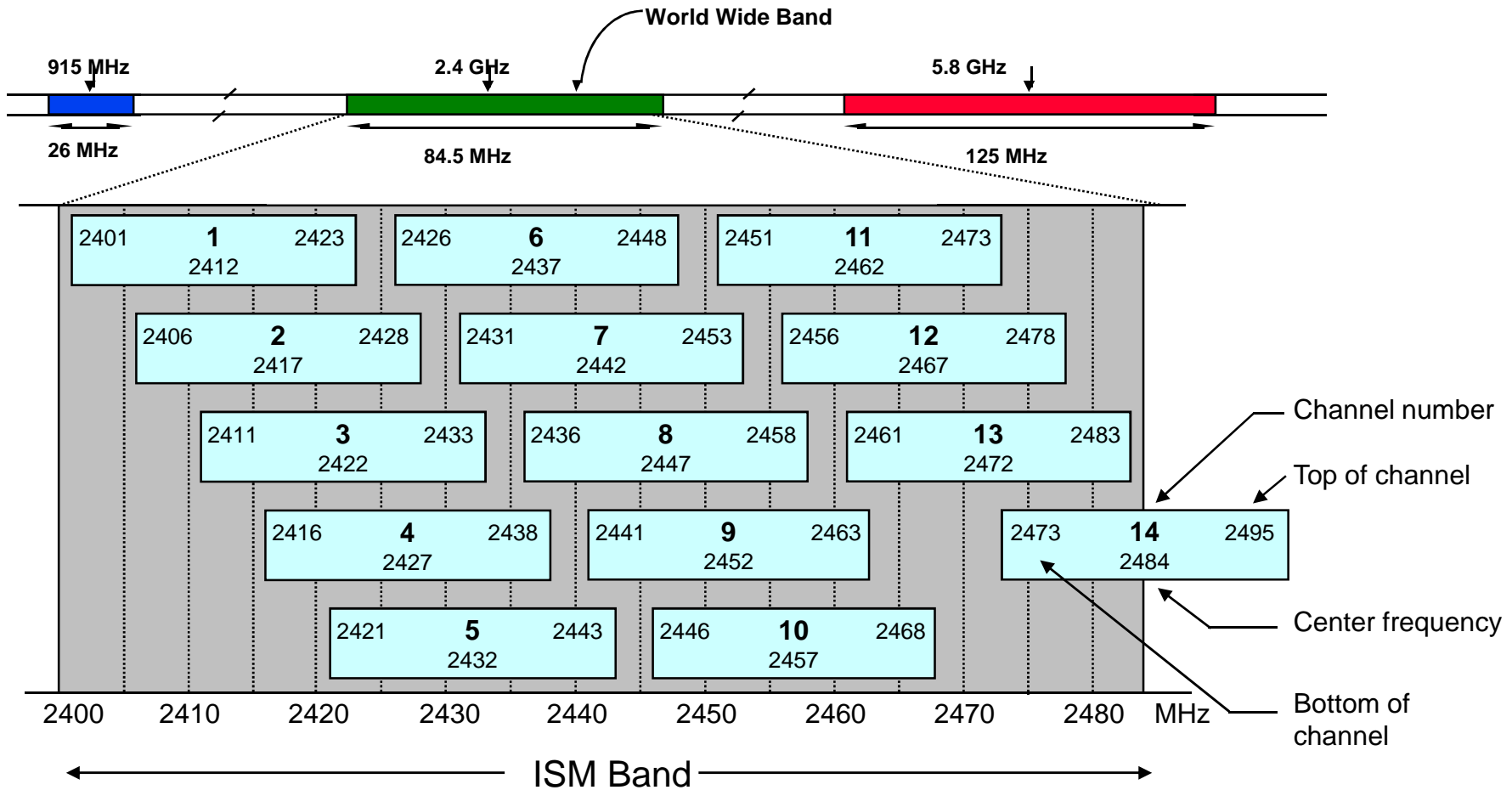
- **802.11-b** : Wireless Lan yang menggunakan Frequency 2.4Ghz berkecepatan transfer data **11Mbps**
- **802.11-b/g** : Wireless Lan yang menggunakan Frequency 2.4Ghz berkecepatan transfer data **54Mbps**
- **802.11-b/g/n** : Wireless Lan yang menggunakan Frequency 2.4Ghz berkecepatan transfer data **300Mbps**

○ Band 5Ghz

- **802.11-a/g** : Wireless Lan yang menggunakan Frequency 5Ghz berkecepatan transfer data **54Mbps**
- **802.11-a/g/n** : Wireless Lan yang menggunakan Frequency 5Ghz berkecepatan transfer data **300Mbps**



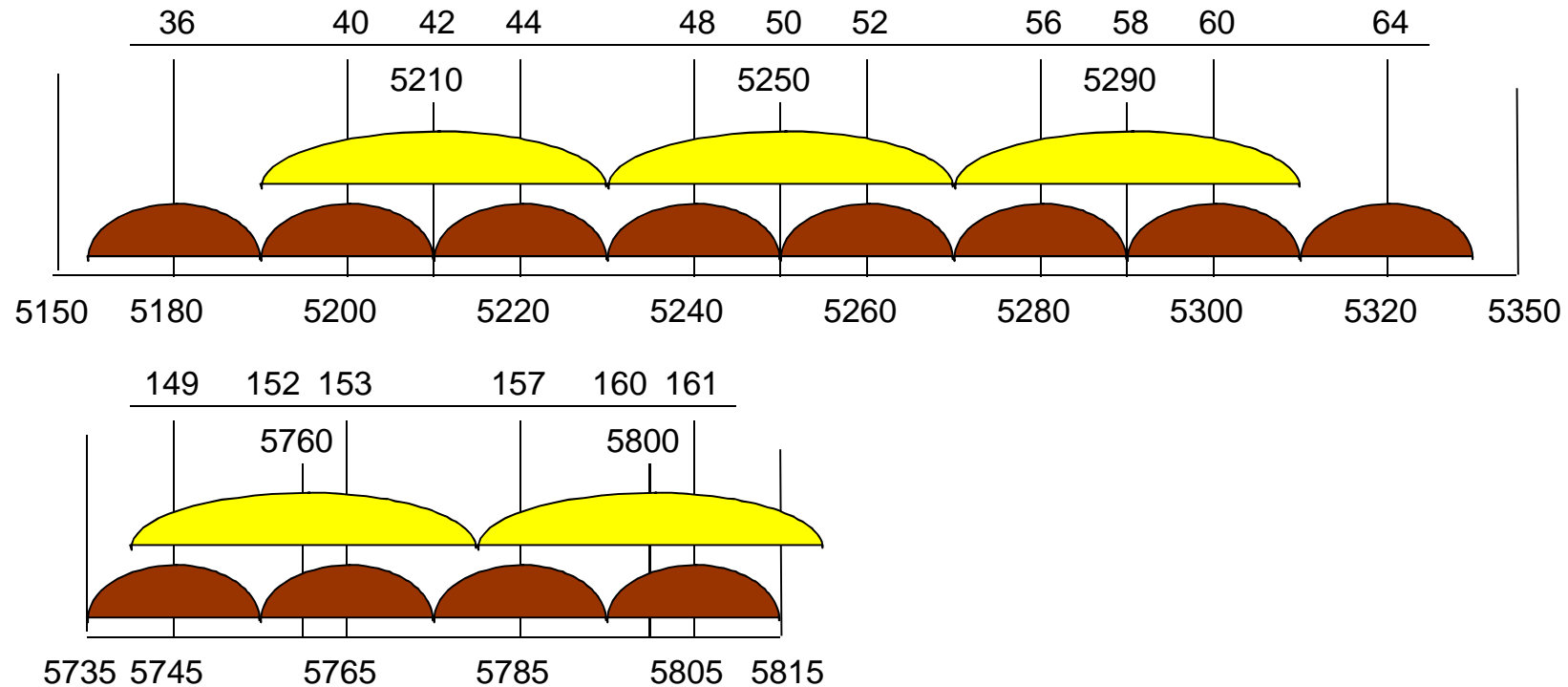
Channels 80211-b



(14) 20 MHz wide channels



Channels 80211-a



- (12) 20 MHz wide channels
- (5) 40MHz wide turbo channels

● ● ● | Wireless Configuration

- Basic Configuration :
 - **Wireless Tools** – Scan, Snoop, Freq-Usage (site survey)
 - **Point to Point** – only “**one**” Client
 - **Registration Table** – Wireless Link Monitoring
 - **Wireless N (example)** – For “**N Wireless Card**”
 - **Wireless Bridge** – Inter-building Connection
 - **Point to Multi Point** – more than one Client
 - **Access List** – **mac-address** security
 - **Wireless Security** – **Encryption** wireless security
- Wireless Protocol
 - **VAP** – Virtual Access Point
 - **Nstreme** – Mikrotik Wireless Performance Protocol
 - **WDS** – Wireless Mesh Network

Scan Tool

Scanner (Running)

Interface: *wlan1*

Start
Stop
Close
New Window
Connect

	Address	SSID	Band	Chan...	Frequ...	Signa...	Noise...	Signa...	Radio Name	RouterOS...
ARB	4C:5E:0C:27:D8:53	MikroTik-Karyawan	2GHz-B	20MHz	2412	-24	-107	83	4C5E0C27D853	6.11
ARB	4E:5E:0C:27:D8:54	Mikrotik-Hotspot	2GHz-B	20MHz	2412	-25	-107	82	4C5E0C27D853	6.11
ARB	00:0C:42:6D:42:D3	qc2	2GHz-B	20MHz	2437	-66	-108	42	000C426D42D5	5.21
ARB	00:0C:42:61:B8:02	MikroTik-Karyawan	2GHz-B	20MHz	2462	-77	-111	34	000C4261B802	6.11
ARB	02:0C:42:61:B8:02	TEST-2.4	2GHz-B	20MHz	2462	-77	-111	34	000C4261B802	6.11
APR	D6:CA:6D:12:62:FB	ma2-2	2GHz-B	20MHz	2462	-80	-111	31	D4CA6D1262F9	5.22
APR	D6:CA:6D:12:62:FC	ma2-3	2GHz-B	20MHz	2462	-79	-111	32	D4CA6D1262F9	5.22
APR	D6:CA:6D:12:62:FD	ma2-4	2GHz-B	20MHz	2462	-80	-111	31	D4CA6D1262F9	5.22
APR	D6:CA:6D:12:62:FA	ma2-1	2GHz-B	20MHz	2462	-80	-111	31	D4CA6D1262F9	5.22
ARB	D4:CA:6D:12:62:F9	ma2g	2GHz-B	20MHz	2462	-79	-111	32	D4CA6D1262F9	5.22
P	F8:1A:67:D3:46:CC	Radio Unisia	2GHz-B	20MHz	2437	-91	-108	17		
APR	D4:CA:6D:F6:26:69	MikroTik-F62669	2GHz-B	20MHz	2412	-49	-107	58	D4CA6DF62669	6.5

12 items



Snoop Tool

Wireless Snoop (Running)

Interface: [v]

Start
Stop
Close
Settings
New Window

all [v]

	Frequenc...	Band	Address	SSID	Sig...	Of Freq. (%)	Of Traf. (%)	Bandwidth	Ne...	Stati...
	2412		00:1A:95:BD:52:AA		-83	0.0	0.0	0 bps		
	2412	2GHz-B				4.6		42.4 kbps	2	11
	2412	2GHz-B	4C:5E:0C:27:D8:53	Mikro Tik-...		2.3	50.0	21.2 kbps		8
N	2...		4C:5E:0C:27:D8:53	Mikro Tik-...	-24	2.3	50.0	21.2 kbps		
	2...		78:CA:39:AF:70:EC	Mikro Tik-...	-67	0.0	0.0	0 bps		
	2...		F4:F1:5A:E4:47:35	Mikro Tik-...	-81	0.0	0.0	0 bps		
	2...		20:C9:D0:DB:91:DD	Mikro Tik-...	-58	0.0	0.0	0 bps		
	2...		48:60:BC:3F:65:EF	Mikro Tik-...	-71	0.0	0.0	0 bps		
	2...		D0:DF:9A:19:FC:2A	Mikro Tik-...	-73	0.0	0.0	0 bps		
	2...		4C:8D:79:91:06:48	Mikro Tik-...	-63	0.0	0.0	0 bps		
	2...		9C:E6:E7:48:D5:64	Mikro Tik-...	-60	0.0	0.0	0 bps		
	2412	2GHz-B	4E:5E:0C:27:D8:54	Mikrotik-...		2.3	49.9	21.1 kbps		2
N	2...		4E:5E:0C:27:D8:54	Mikrotik-...	-23	2.3	49.9	21.1 kbps		
	2...		50:CC:F8:2E:AA:40	Mikrotik-...	-95	0.0	0.0	0 bps		
	2417	2GHz-B				4.7		43.3 kbps	0	0

51 items (1 selected)

● ● ● | Wireless Menu

Wireless Menu:

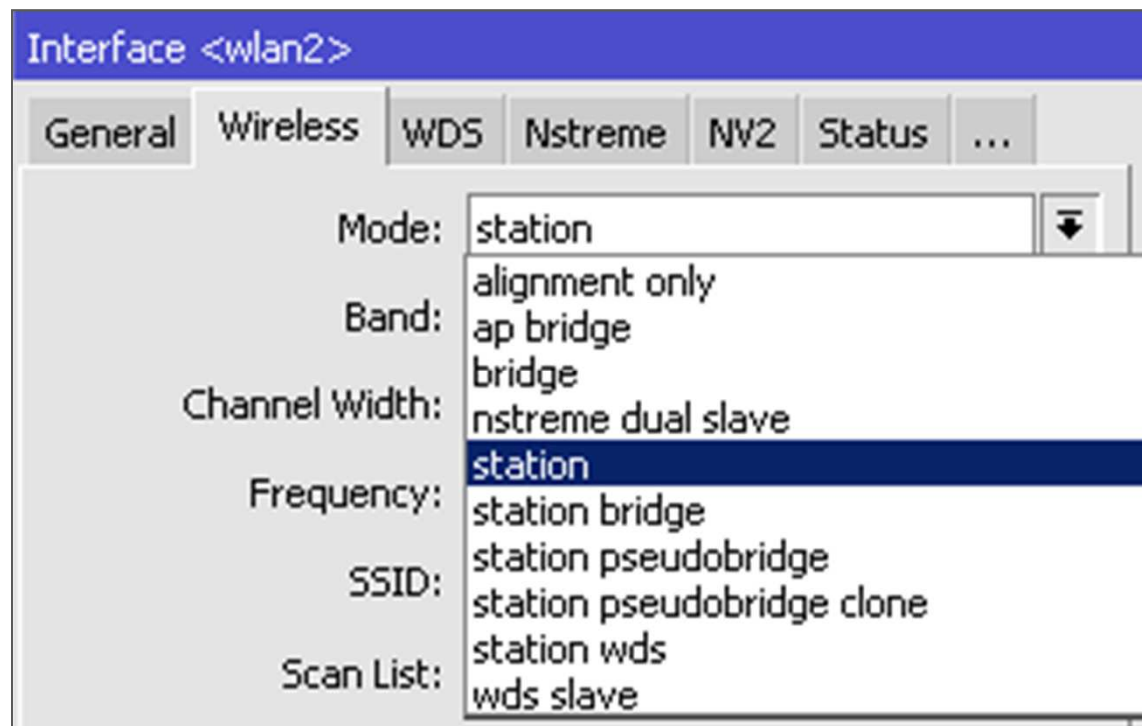
- **Interface** – Daftar Interface wireless yang terpasang
- **Access-List** – Security Mac-address Client (AP Mode)
- **Registration** – Daftar Wireless yang terkoneksi
- **Connect-List** – Security Mac-address AP (Station Mode)
- **Security-Profile** – Konfigurasi Wireless Security (WPA/WEP)

Name	Type	L2 MTU	Tx	Rx	Tx Packet (p/s)	Rx Packet (p/s)	Tx Drops	Rx Drops	Tx Errors
wlan1	Wireless (Atheros AR9300)	2290	0 bps	0 bps	0	0	0	0	0

● ● ● | Wireless Mode List

Wireless Mode :

- alignment-only
- ap-bridge
- bridge
- nstreme-dual-slave
- station
- station-wds
- wds-slave
- station-pseudobridge
- station-pseudobridge-clone
- station-bridge



● ● ● | Wireless Mode - 1

- **alignment-only** – Digunakan untuk melakukan pointing dengan bantuan “**Beeper**” pada Routerboard.
- **ap-bridge** – Mode wireless sebagai Access Point untuk topologi **Point-to-Multipoint**.
- **bridge** – Mode wireless sebagai Access Point untuk topologi **Point-to-Point** (hanya bisa menerima satu client).
- **nstreme-dual-slave** – Mode wireless untuk mengaktifkan topologi Nstreme-dual (Wireless Full Duplex)
- **station** – Mode Wireless sebagai Client untuk topologi **Point-to-Point** dan juga **Point-to-Multipoint**

● ● ● | Wireless Mode – 2

- **station-wds** – Mode wireless sebagai client tetapi mengaktifkan protocol WDS (Digunakan untuk wireless WDS client)
- **wds-slave** – Mode wireless sebagai Access Point dan juga mengaktifkan protocol WDS (Digunakan untuk wireless WDS repeater)
- **station-pseudobridge** – Mode wireless sebagai client yang bisa mengaktifkan bridge pada “**station**” tanpa harus menggunakan protocol WDS
- **station-pseudobridge-clone** – Mode wireless sama seperti **station-pseudobridge** yang dilengkapi dengan fungsi cloning mac-address dari interface ethernet
- **station-bridge** – Mode wireless client untuk bridge network sesama perangkat Mikrotik

Mode	AP	PTP (only one client)	CPE	Repeater	Bridge	WDS	MikroTik Only
Alignment Only	-	-	-	-	-	-	Yes
AP Bridge	Yes	-	-	-	Yes	Yes	-
Bridge	-	Yes	-	-	Yes	-	-
Nstreme Dual Slave	-	-	-	-	-	-	Yes
Station	-	-	Yes	-	-	-	-
Station Pseudobridge	-	-	Yes	-	Yes	-	-
Station Pseudobridge clone	-	-	Yes	-	Yes	-	-
Station Bridge	-	-	Yes	-	Yes	-	Yes
Station WDS	-	-	Yes	-	Yes	Yes	-
WDS Slave	-	-	-	Yes	Yes	Yes	-

● ● ● | [LAB-1] Point to Point

AP Side

- Mikrotik Minimum Licence Level 3
- Set mode, ssid, band, frequency
- mode=bridge
 - **Hanya menerima 1 station**

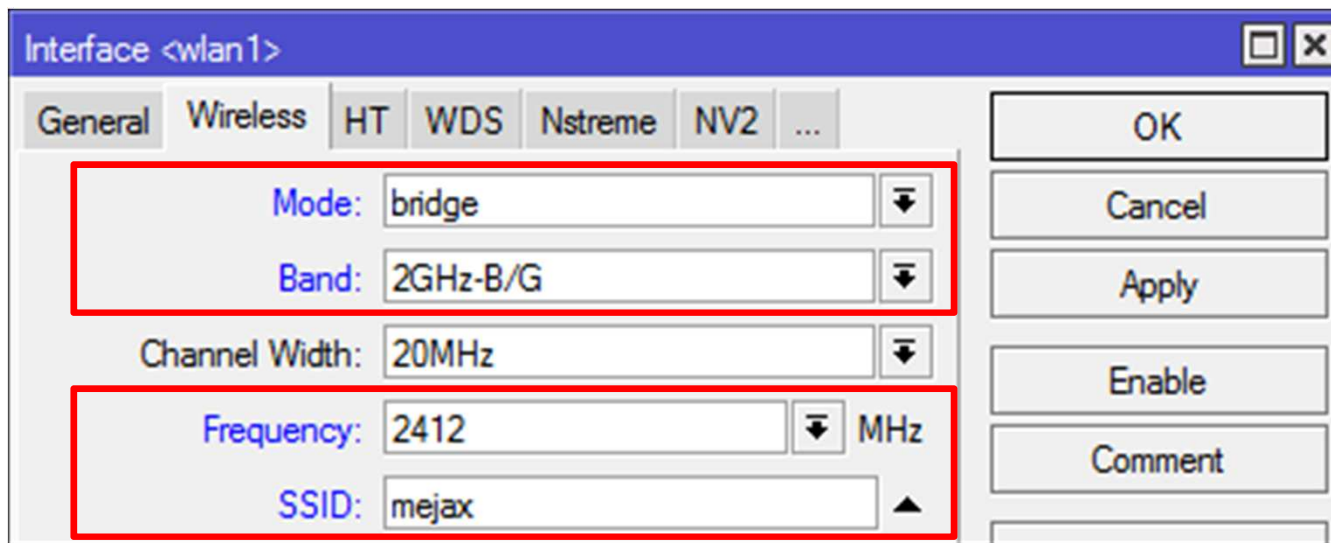


Client Side

- Mikrotik Minimum Licence Level 3
 - Set mode, ssid, band, scan-list
 - mode=station
- Make sure frequency is in scan-list

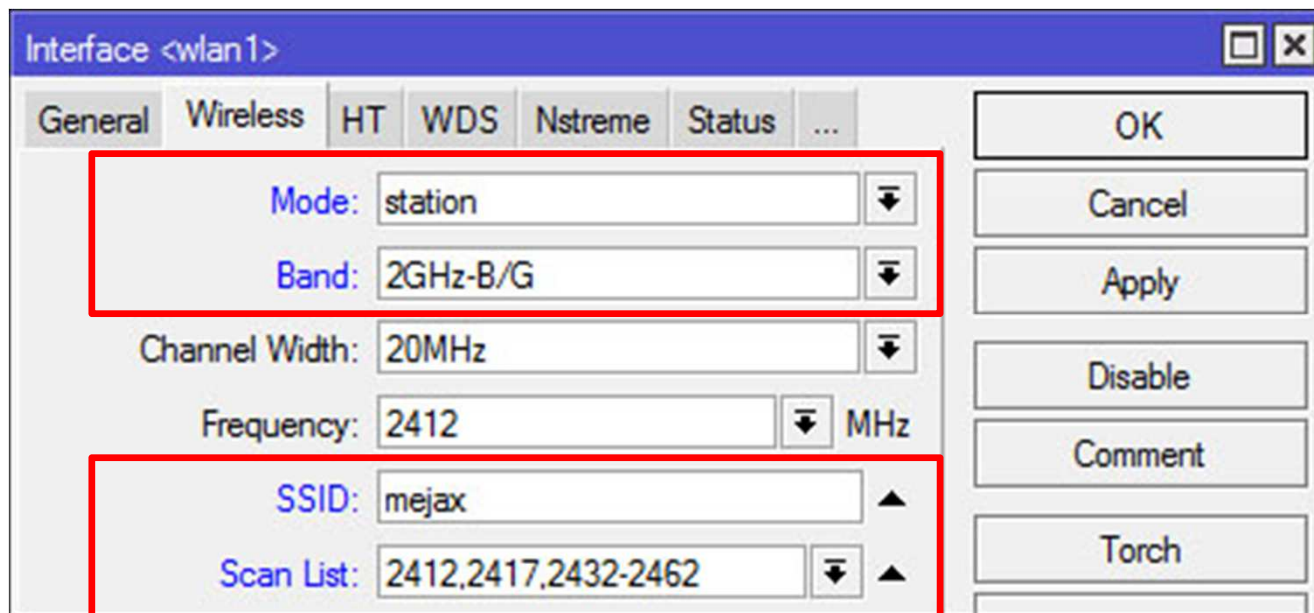
● ● ● | [LAB-1] P2P (AP Side)

- Konfigurasi :
- Set **mode**, **ssid**, **band** dan **frequency**
- mode=bridge
 - Hanya bisa terkoneksi dengan 1 station (1 client)



● ● ● | [LAB-1] P2P (Client Side)

- Konfigurasi :
- Set **mode**, **ssid**, **band** dan **scan-list**
- mode=station
- Pastikan frequency yang dipilih oleh
- AP masuk dalam range scan-list



Monitoring Wireless Interface

The screenshot shows the Mikrotik WinBox interface. On the left, the 'Wireless Tables' window has the 'Registration' tab selected and highlighted with a red box. Below it, a table lists wireless clients. The selected client is highlighted in blue:

MAC Address	Interface	Tx/Rx Signal...	Tx/Rx Rate
4E:5E:0C:27:D8:54	wlan1	-42/-26	72.2Mbps/72.2Mbps

The right window, titled 'AP Client <4E:5E:0C:27:D8:54>', shows detailed statistics for the selected client. The 'Signal' tab is active, displaying the following data:

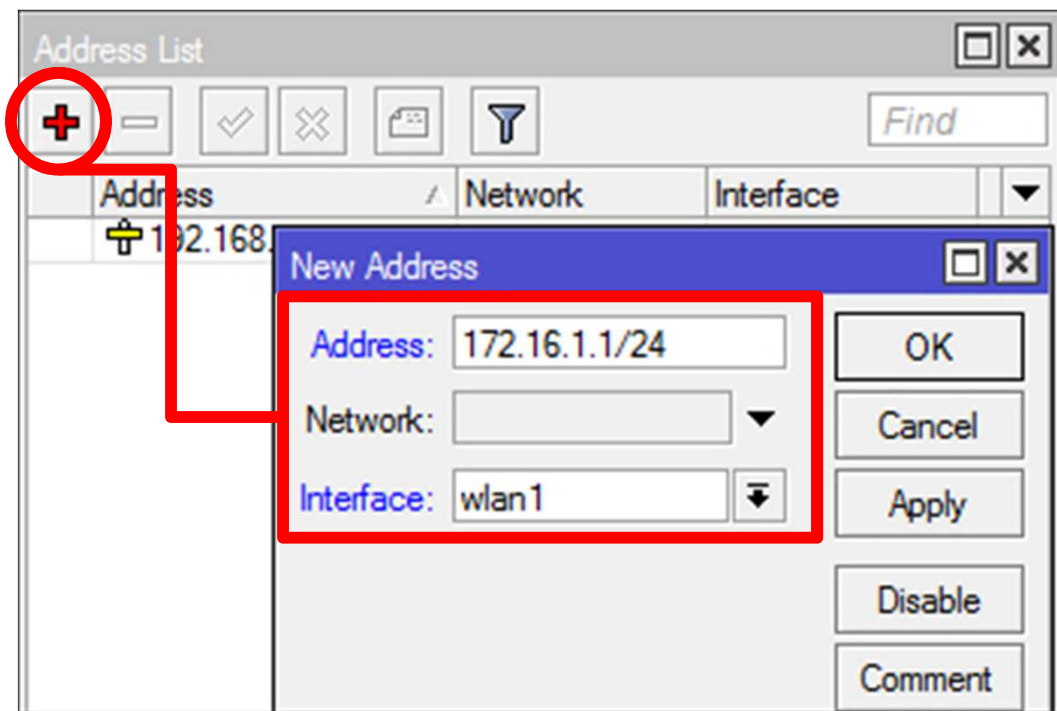
- Last Activity: 0.010 s
- Tx/Rx Signal Strength: -42/-26 dBm
- Tx/Rx Signal Strength Ch0: -45/-26 dBm
- Tx/Rx Signal Strength Ch1: -46 dBm
- Tx/Rx Signal Strength Ch2: -74 dBm
- Signal To Noise: 81 dB
- Tx/Rx CCQ: 65/60 %
- P Throughput: 32391 kbps

Below the statistics is a 'Signal Strengths' table with a bar chart showing signal strength over time for various rates:

Rate	Strength	Last Measure
HT20-7	-34	00:00:00
5.5Mbps	-31	00:05:20
54Mbps	-31	00:02:27
2Mbps	-30	00:05:32
11Mbps	-29	00:05:09
48Mbps	-29	00:03:14
HT20-6	-29	00:02:06
6Mbps	-28	00:06:14
9Mbps	-28	00:05:19
18Mbps	-28	00:04:36
36Mbps	-28	00:03:50

● ● ● | [LAB-2] Point to Point Test

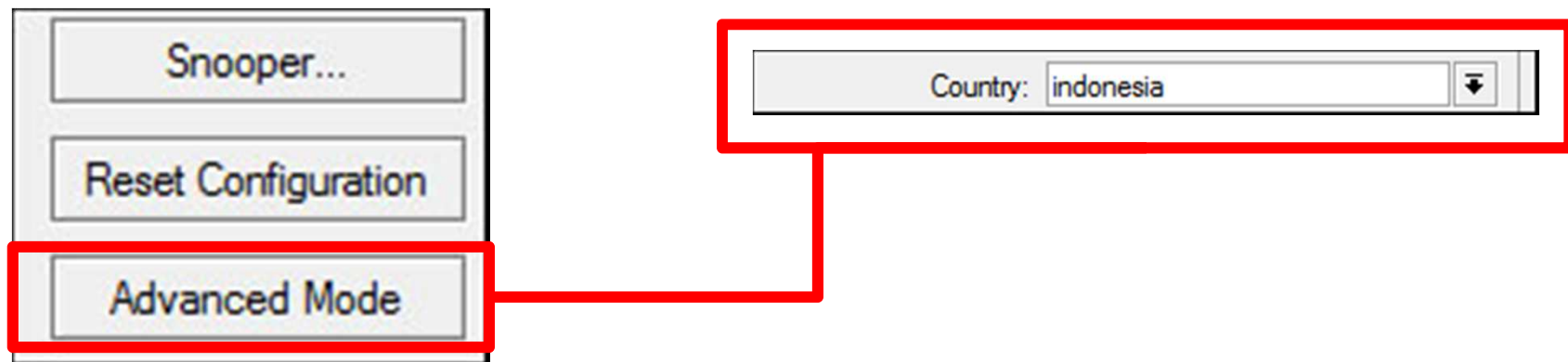
- Tambahkan IP address di interface **Wlan1**.
- Test koneksi wireless kedua router dengan tool Ping.
- Setelah test ping berhasil maka wireless point-to-point sudah siap.



● ● ● | Tips

Country : Membatasi channel yang bisa digunakan sesuai dengan regulasi sebuah Negara.

Jika di set "*no_country_set*" maka akan menggunakan standart channel FCC compliant.



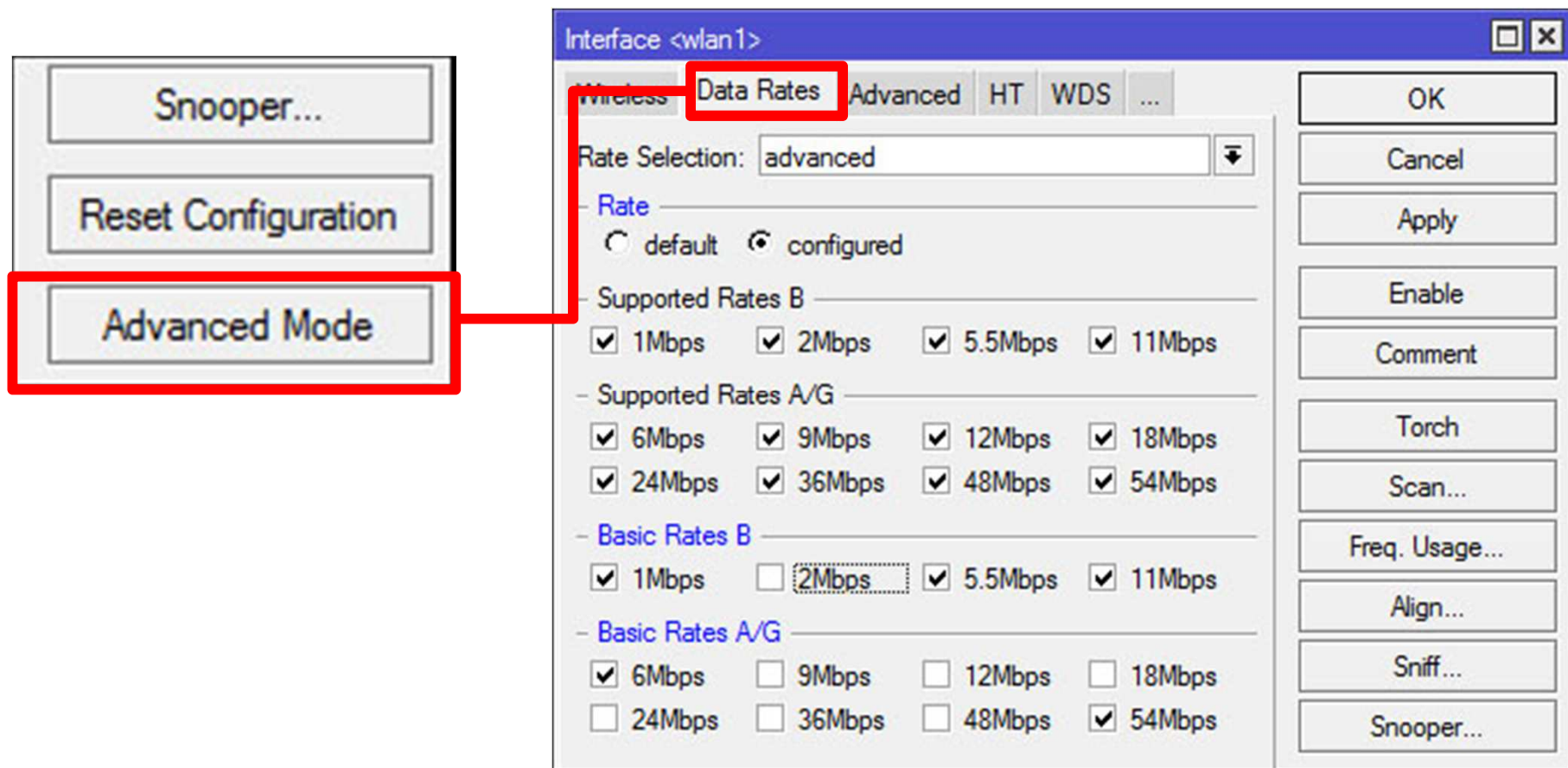


Quiz!

- Station yang menggunakan band 2.4 B bisa terkoneksi dengan Access Point pada band 2.4 B/G/N, benar atau salah? Kenapa?
- Sebuah station memiliki konfigurasi scan-list=2412+2430,2440-2462. Apa yang akan dilakukan oleh interface wireless ?
- Dengan opsi “country” yang berbeda, apakah wireless link bisa terkoneksi ?

● ● ● | Data rates

Data rate : Informasi kecepatan transmisi data yang bisa dilewatkan pada link wireless.





TX Power

Tx power : Pengaturan Daya pancar interface wireless.

default : card wireless akan menggunakan nilai tx-power dari eeprom

card-rates : Router akan melakukan perhitungan data rates menggunakan algoritma eeprom **berdasarkan nilai tx power yang diinput user**

all-rates-fixed : Menggunakan satu nilai tx-power untuk semua data rates.

Interface <wlan1>

Nstreme Tx Power Current Tx Power Status ...

Tx Power Mode: manual

- Tx Powers

1Mbps:	17	dBm	2Mbps:	17	dBm
5.5Mbps:	17	dBm	11Mbps:	17	dBm
6Mbps:	17	dBm	9Mbps:	17	dBm
12Mbps:	17	dBm	18Mbps:	17	dBm
24Mbps:	17	dBm	36Mbps:	17	dBm
48Mbps:	17	dBm	54Mbps:	17	dBm
HT20-0:	17	dBm	HT20-1:	17	dBm
HT20-2:	17	dBm	HT20-3:	17	dBm
HT20-4:	17	dBm	HT20-5:	17	dBm
HT20-6:	17	dBm	HT20-7:	17	dBm
HT40-0:	17	dBm	HT40-1:	17	dBm
HT40-2:	17	dBm	HT40-3:	17	dBm
HT40-4:	17	dBm	HT40-5:	17	dBm
HT40-6:	17	dBm	HT40-7:	17	dBm

Wireless N Config - Example

Interface <wlan1>

Advanced HT HT MCS WDS Nstreme Tx Power Status ...

HT Tx Chains: 0 (chain0) 1 (chain1)

HT Rx Chains: 0 (chain0) 1 (chain1)

HT AMPDU Maximum Length: 8192

HT AMSDU Threshold: 8192

HT Guard Interval: any

HT Extension Channel: below control

- HT AMPDU Priorities -

<input checked="" type="checkbox"/> 0	<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 3
<input checked="" type="checkbox"/> 4	<input checked="" type="checkbox"/> 5	<input checked="" type="checkbox"/> 6	<input checked="" type="checkbox"/> 7

Aktifkan **1xMIMO** atau **2xMIMO**

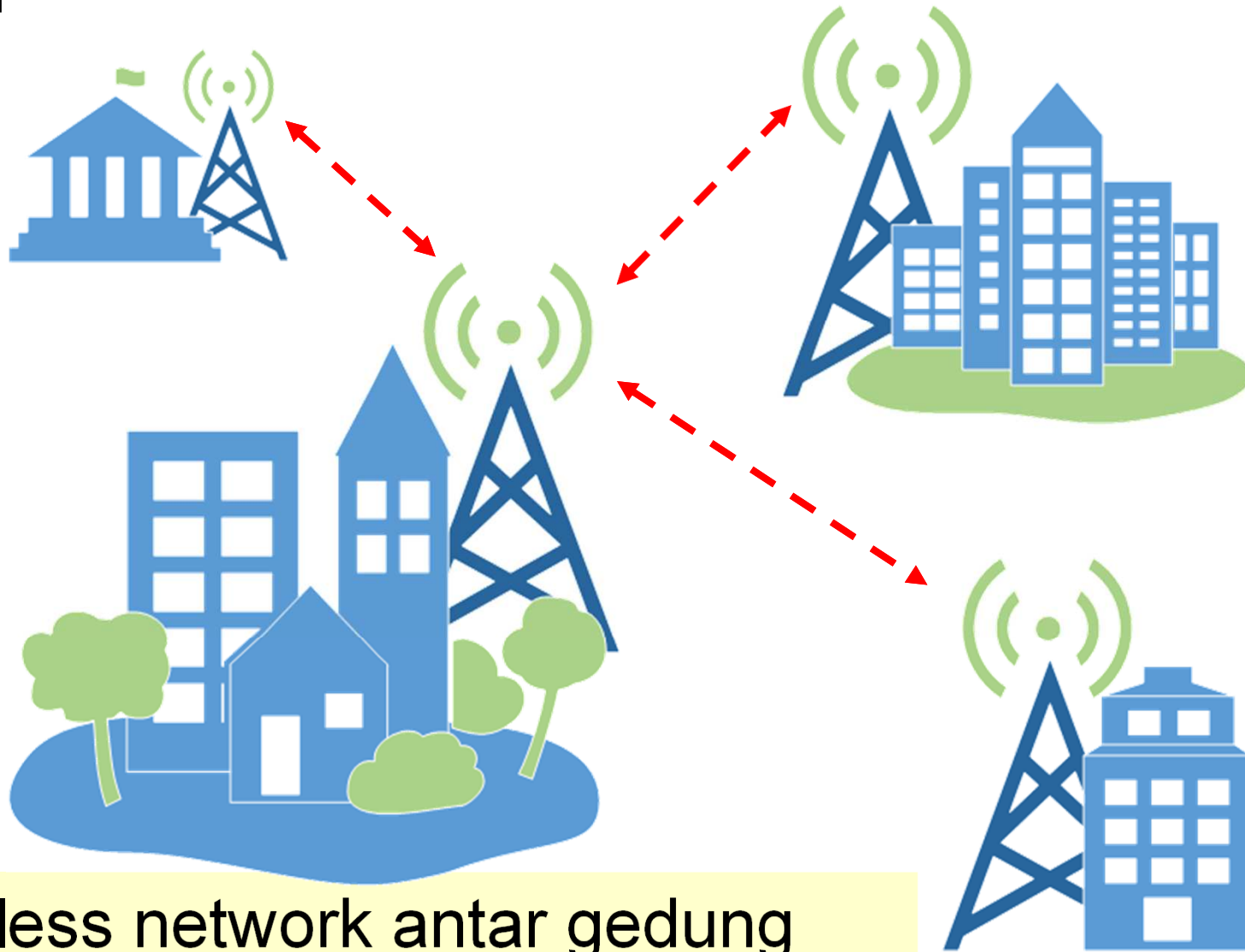
Aktifkan **channel** tambahan

● ● ● | Wireless Bridge

- Mikrotik **Station** mode “**tidak bisa**” langsung dimasukkan ke bridge port (keterbatasan protocol)
- maka?
 - Bisa menggunakan **EoIP** antara **ap-bridge** and **station** – seperti pada lab di materi bridge
 - Pilihan kedua menggunakan mode **WDS-station!** (Throughput drop...).
 - Pilihan ke 3 menggunakan mode baru yaitu **station-pseudobridge**
 - **Station bridge**



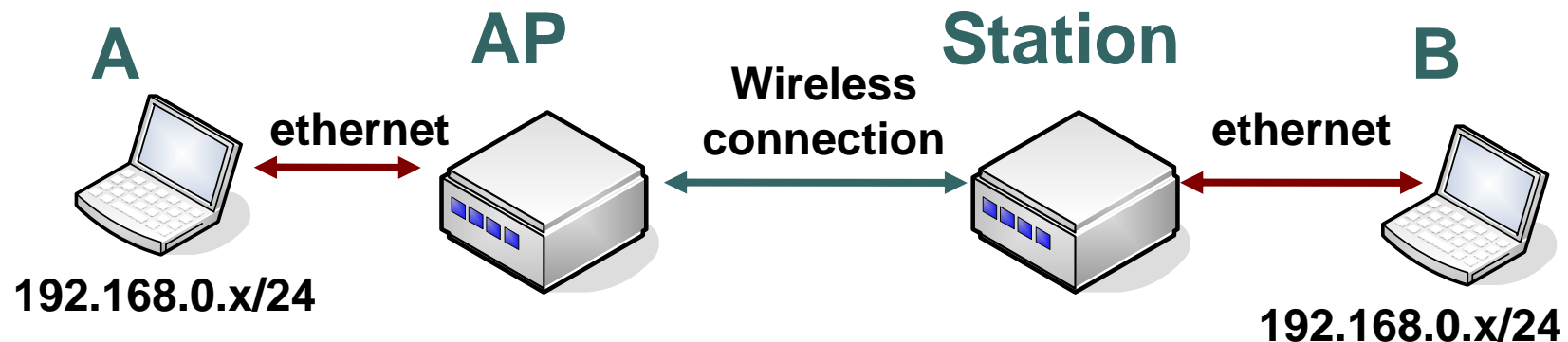
Wireless Bridge - Implementation



Wireless network antar gedung

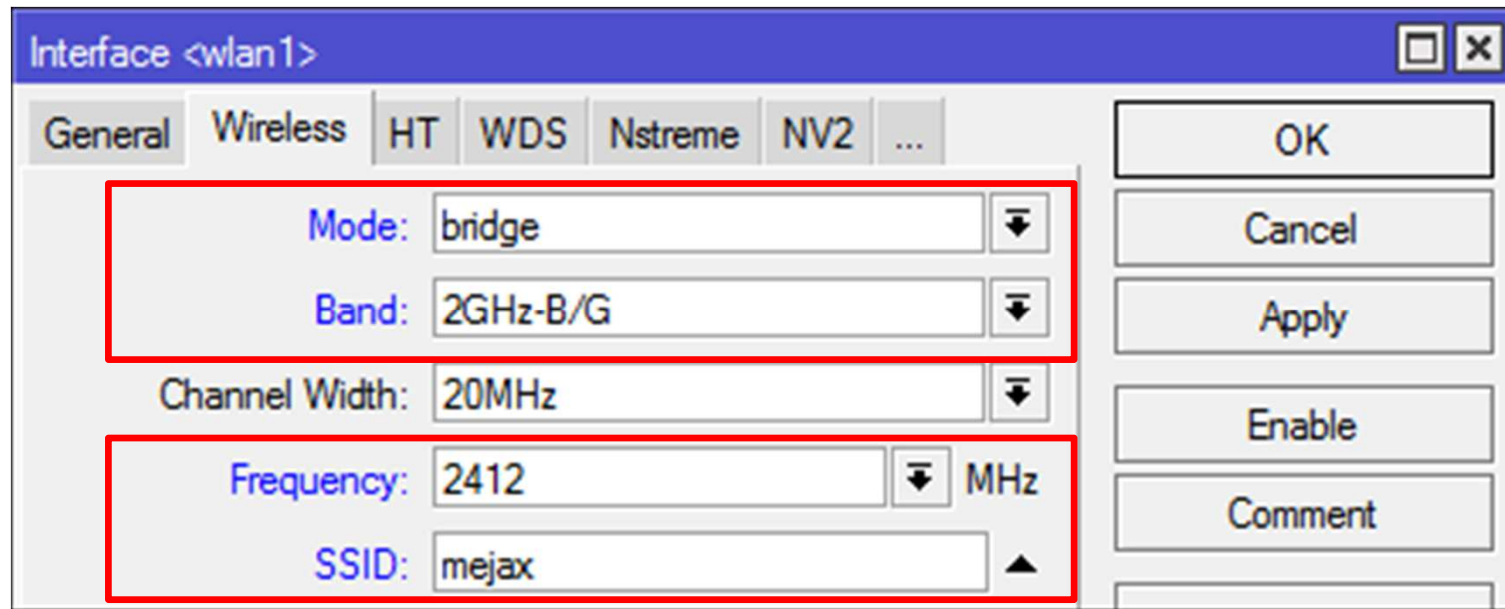
● ● ● | [LAB-3] Wireless Bridge

- Buatlah konfigurasi **AP** vs **client** yang digunakan untuk Bridge Network via wireless, sisi client menggunakan mode **station-pseudobridge**.
- Setelah wireless sudah terkoneksi masukkan interface wireless Wlan2 dan ether1 ke dalam **Bridge Port** (dilakukan di kedua router). Maka laptop kedua sisi bisa berkomunikasi dalam satu segmen.



● ● ● [LAB-3] Wireless Bridge – AP side

AP Side using Bridge Mode



● ● ● [LAB-3] Wireless Bridge – Client side

Client Side:

- Set mode= **station-pseudobridge**

Interface <wlan1>

General Wireless HT WDS Nstreme Status ...

Mode: station pseudobridge

Band: 2GHz-B/G

Channel Width: 20MHz

Frequency: 2412 MHz

SSID: mejax

Scan List: 2412,2417,2432-2462

OK

Cancel

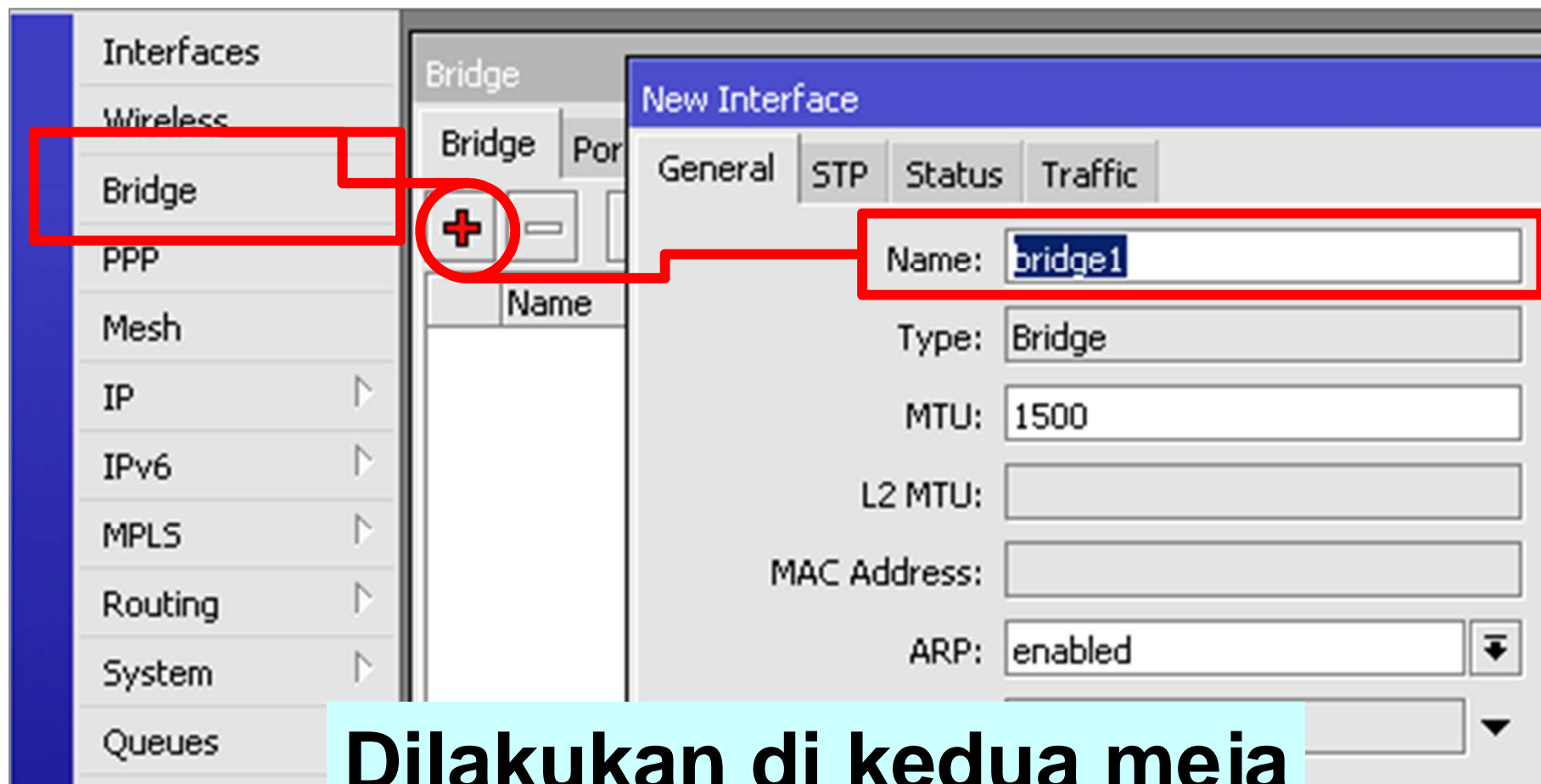
Apply

Disable

Comment

Torch

● ● ● [LAB-3] Wireless Bridge- Bridge Config





[LAB-3] Wireless Bridge – Bridge Ports Config

The image shows a Mikrotik WinBox interface. On the left, the 'Bridge' menu item is highlighted with a red box. In the main window, the 'Bridge' tab is selected, and a red circle highlights a '+' icon. Below this, two 'New Bridge Port' dialog boxes are shown. The left dialog has 'Interface' set to 'ether1' and 'Bridge' set to 'bridge1'. The right dialog has 'Interface' set to 'wlan1' and 'Bridge' set to 'bridge1'. Both dialog boxes have 'Priority' set to 80 and 'Path Cost' set to 10. A red box highlights the 'Interface' and 'Bridge' fields in both dialogs. A red line connects the '+' icon to the 'Interface' field in the right dialog. A light blue box at the bottom contains the text 'Dilakukan di kedua meja'.

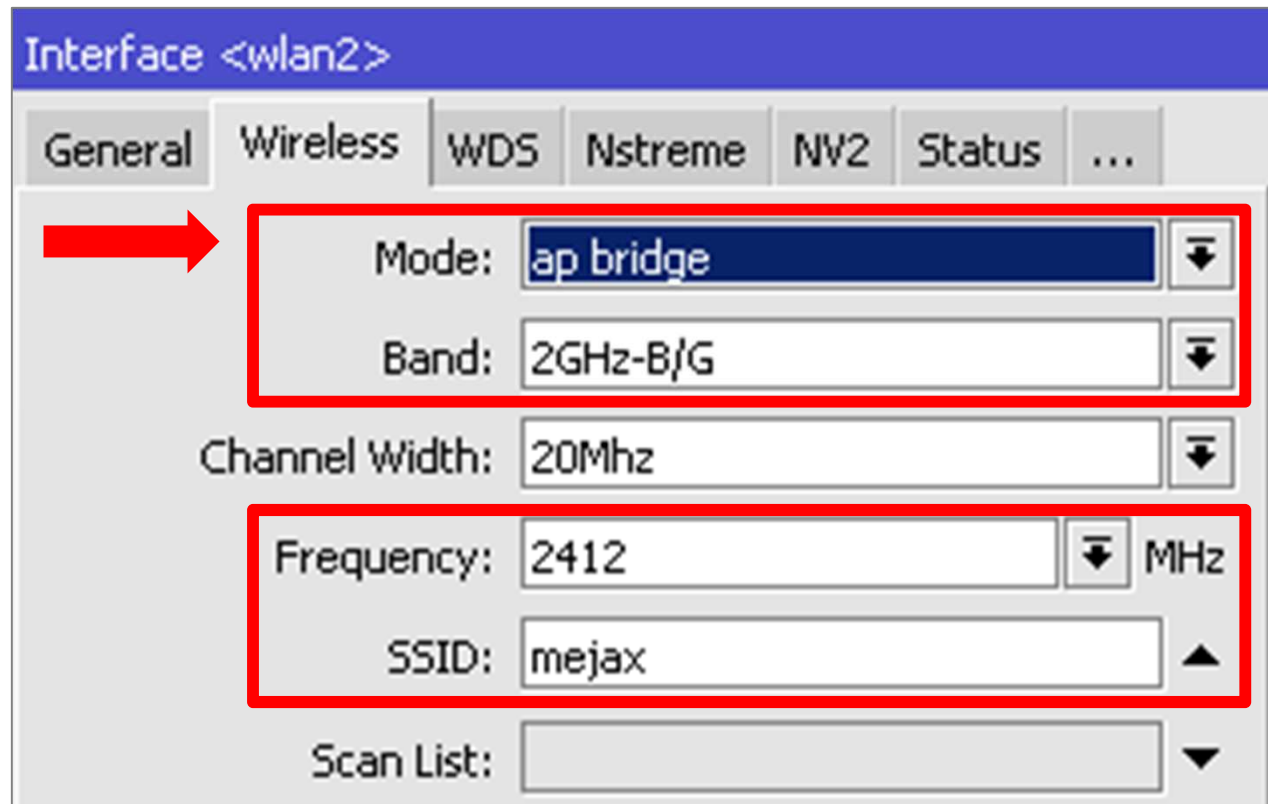
● ● ● | [LAB 4] Point to Multi Point

Mikrotik difungsikan sebagai access point. Digunakan standart 80211b atau 80211b/g sehingga semua client (berbagai vendor dan berbagai type) dapat terkoneksi.



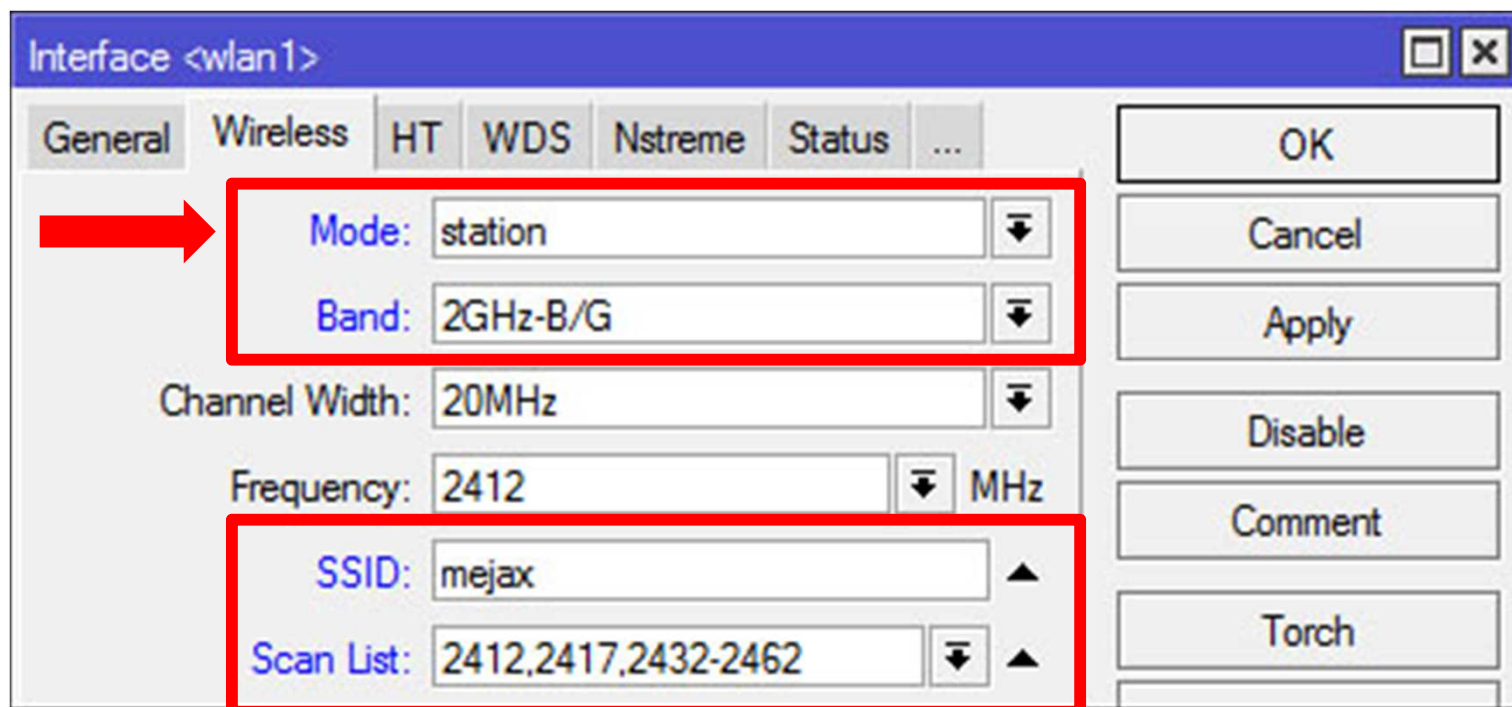
● ● ● | [LAB 4] P2MP – AP Side

- Membutuhkan lisensi level 4
- Set mode=ap-bridge
- Konfigurasi lainnya sama dengan konfigurasi point-to-point



● ● ● | [LAB 4] P2MP – Station Side

- Dapat menggunakan lisensi level 3
- Set mode, ssid, band, scan-list
- Set mode=station

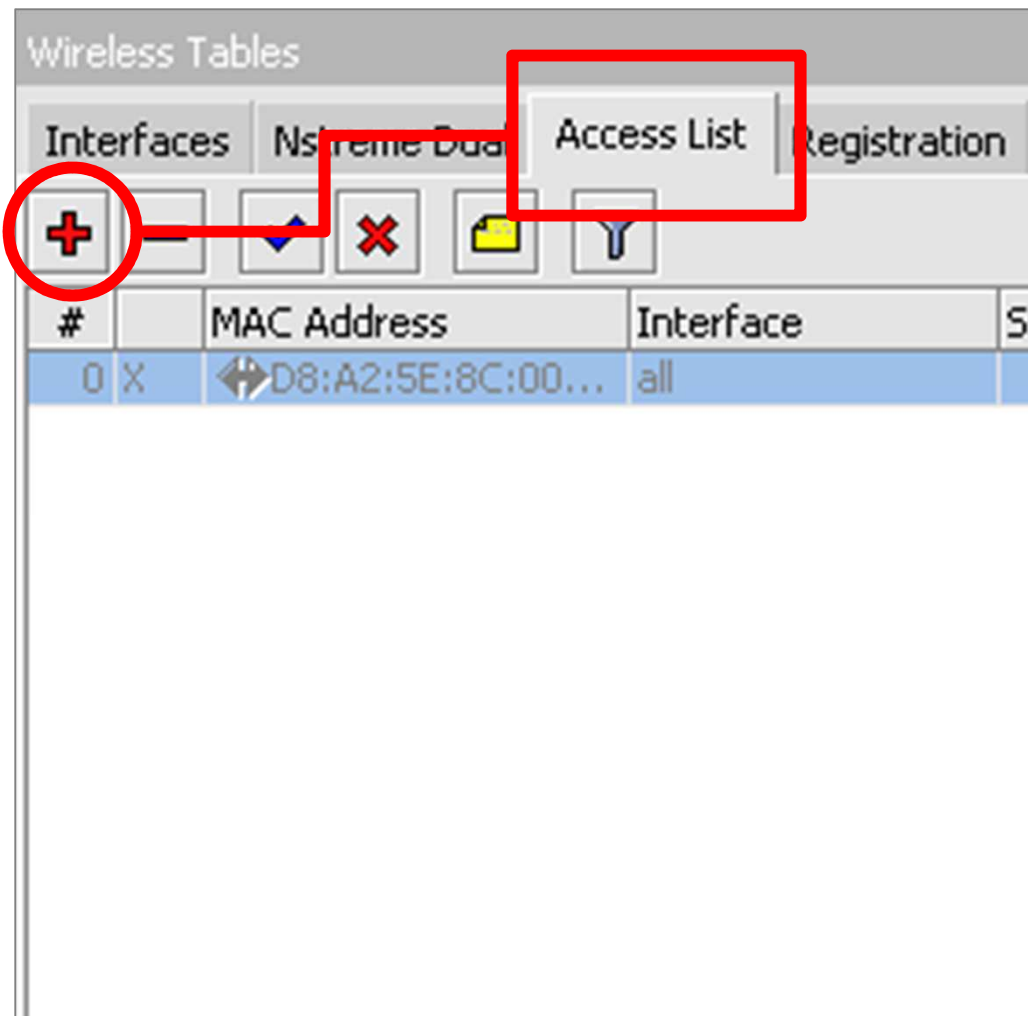


● ● ● | Wireless Access Management

- **Access List** – adalah filter autentikasi sebuah AP (AP side) terhadap client yang terkoneksi.
- **Connect List** – adalah filter autentikasi sebuah wireless station (client side) terhadap AP mana yang ingin terkoneksi.
- Rule autentikasi atau filter autentikasi dibaca secara terurut dari atas ke bawah seperti halnya sebuah filter firewall sampai request autentikasi mencapai kecocokan.
- Sangat dimungkinkan untuk memasang beberapa filter untuk mac-address yang sama dan juga satu rule untuk semua mac-address.
- Sebuah rule filter mac-address bisa diterapkan pada sebuah interface wireless saja atau bisa juga untuk semua interface.
- Jika tidak ada rule yang sesuai maka akan digunakan default policy (**default authentication & default forward**) dari wireless interface tersebut.

Client Management

- Kita dapat melakukan pengaturan untuk setiap klien menggunakan :
 - Access List :
 - MAC Address
 - Signal Strength
 - Time



AP Access Rule <D8:A2:5E:8C:00:B9>

MAC Address:

Interface:

Signal Strength Range:

AP Tx Limit:

AP Rx Limit:

Authentication

Forwarding

WPA Key: 0x

WPA2 Key:

Management Protection Key:

Time: -

sun mon tue wed thu fri sat

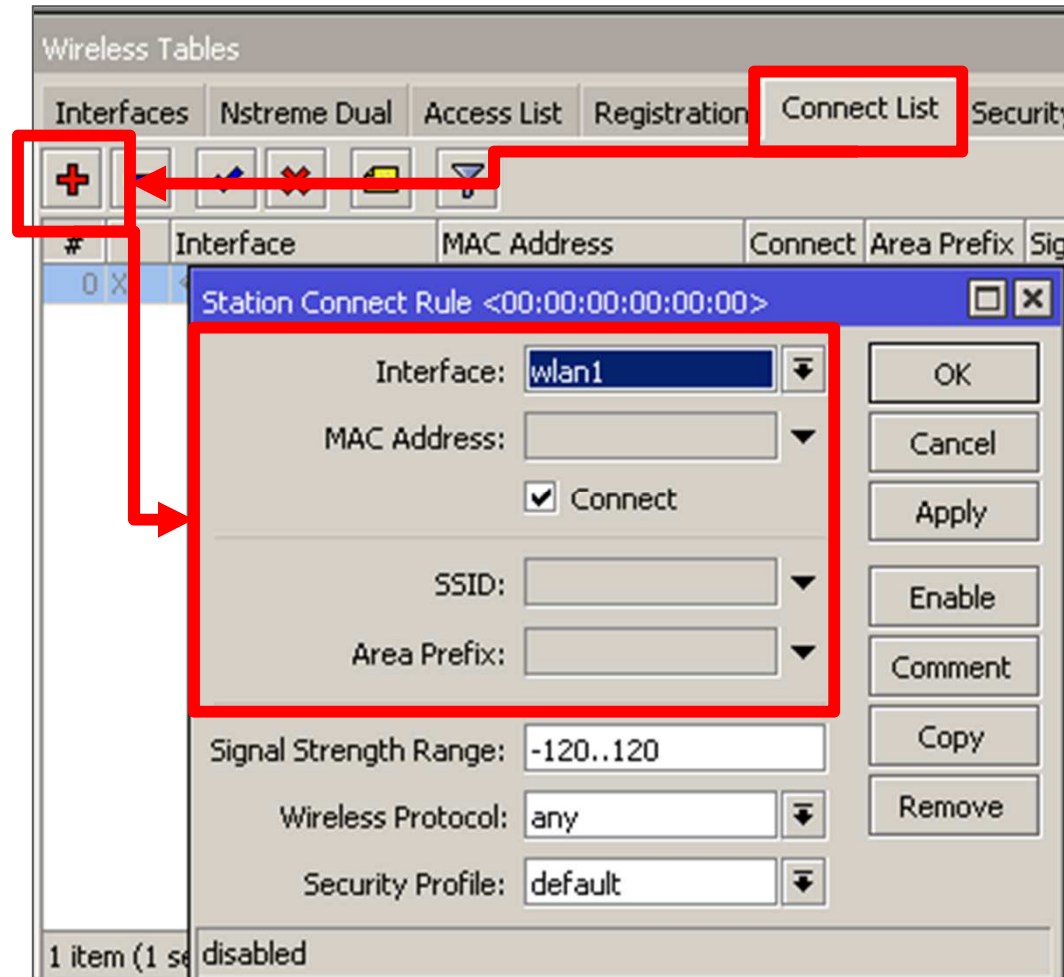
Klasifikasi **mac-address** dari client

Option **policy** boleh terkoneksi atau tidak

Option **waktu** untuk mengaktifkan rule access list

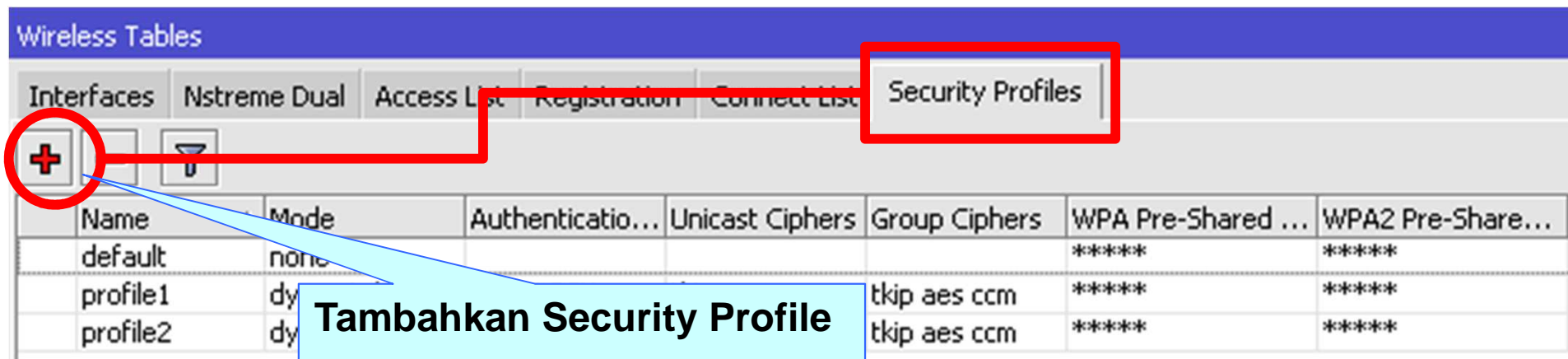
AP Management

- Kita dapat melakukan pengaturan untuk AP yang akan kita hubungkan
- Connect List:
 - MAC Address
 - SSID
 - Area



Wireless Security

- Karena sifat dari wireless yang “open access” maka sebuah access point akan rentan terhadap serangan dari pihak yang tidak bertanggung jawab.
- Sudah saatnya untuk mengimplementasikan Wireless Security untuk menjaga AP tersebut dari berbagai serangan.



Name	Mode	Authenticatio...	Unicast Ciphers	Group Ciphers	WPA Pre-Shared ...	WPA2 Pre-Share...
default	none				*****	*****
profile1	dy			tkip aes ccm	*****	*****
profile2	dy			tkip aes ccm	*****	*****



Security Profile <profile1 >

General | **RADIUS** | EAP | Static Keys

Name: profile1

Mode: dynamic keys

Authentication Types

- WPA PSK
- WPA EAP
- WPA2 PSK
- WPA2 EAP

Unicast Ciphers

- aes ccm

Group Ciphers

- tkip
- aes ccm

WPA Pre-Shared Key: mikrotik1

WPA2 Pre-Shared Key: mikrotik2

Tentukan metode securitynya

Tentukan passwordnya



General Wireless HT HT MCS WDS Nstreme ...

Mode: ap bridge

Band: 2GHz-B/G/N

Channel Width: 20Mhz

Frequency: 2442 MHz

SSID: mejax

Wireless Protocol: unspecified

Security Profile: default

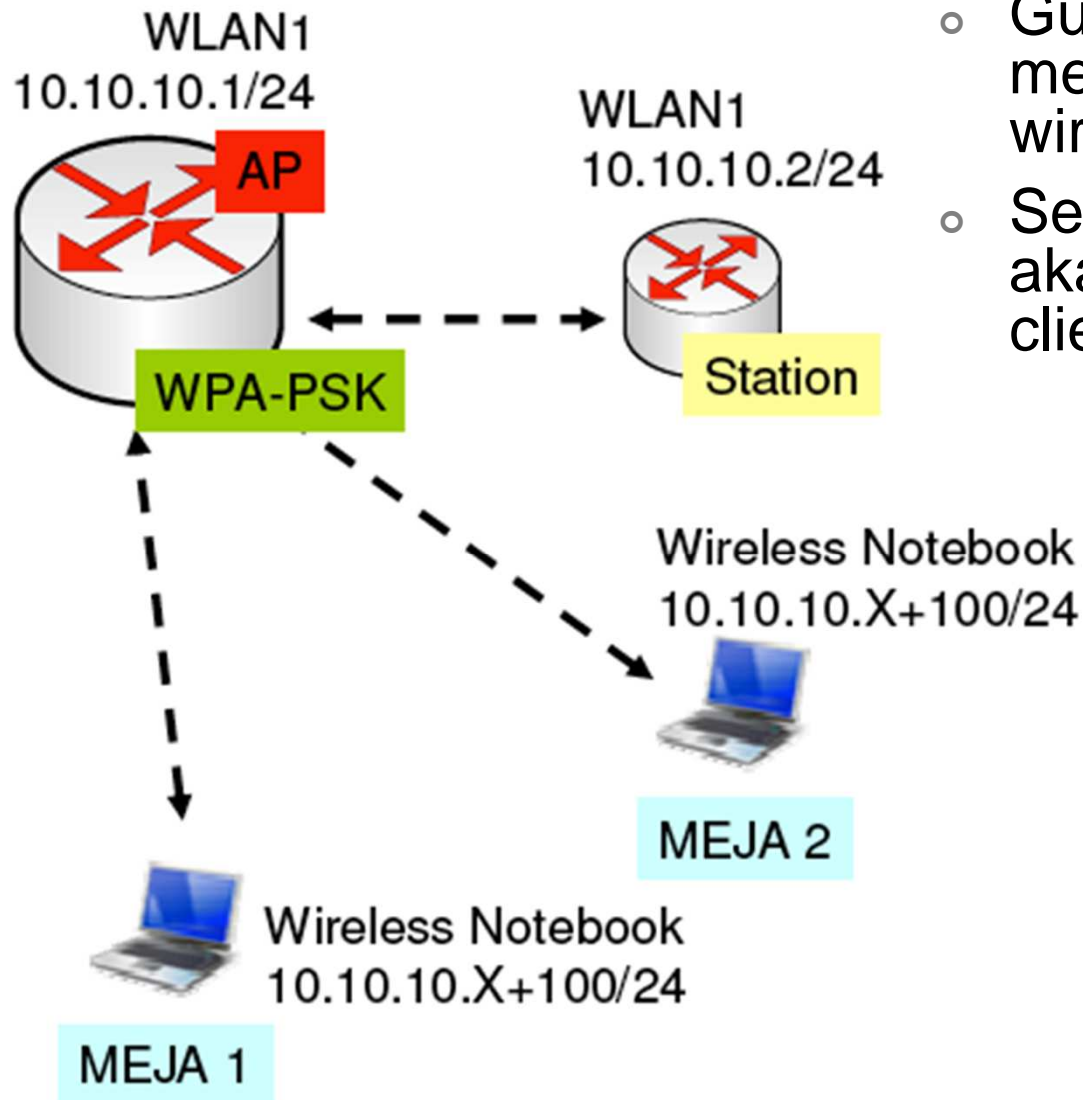
Bridge Mode: profile1

profile2

Pasang security pada interface



[LAB-6] WPA Lab



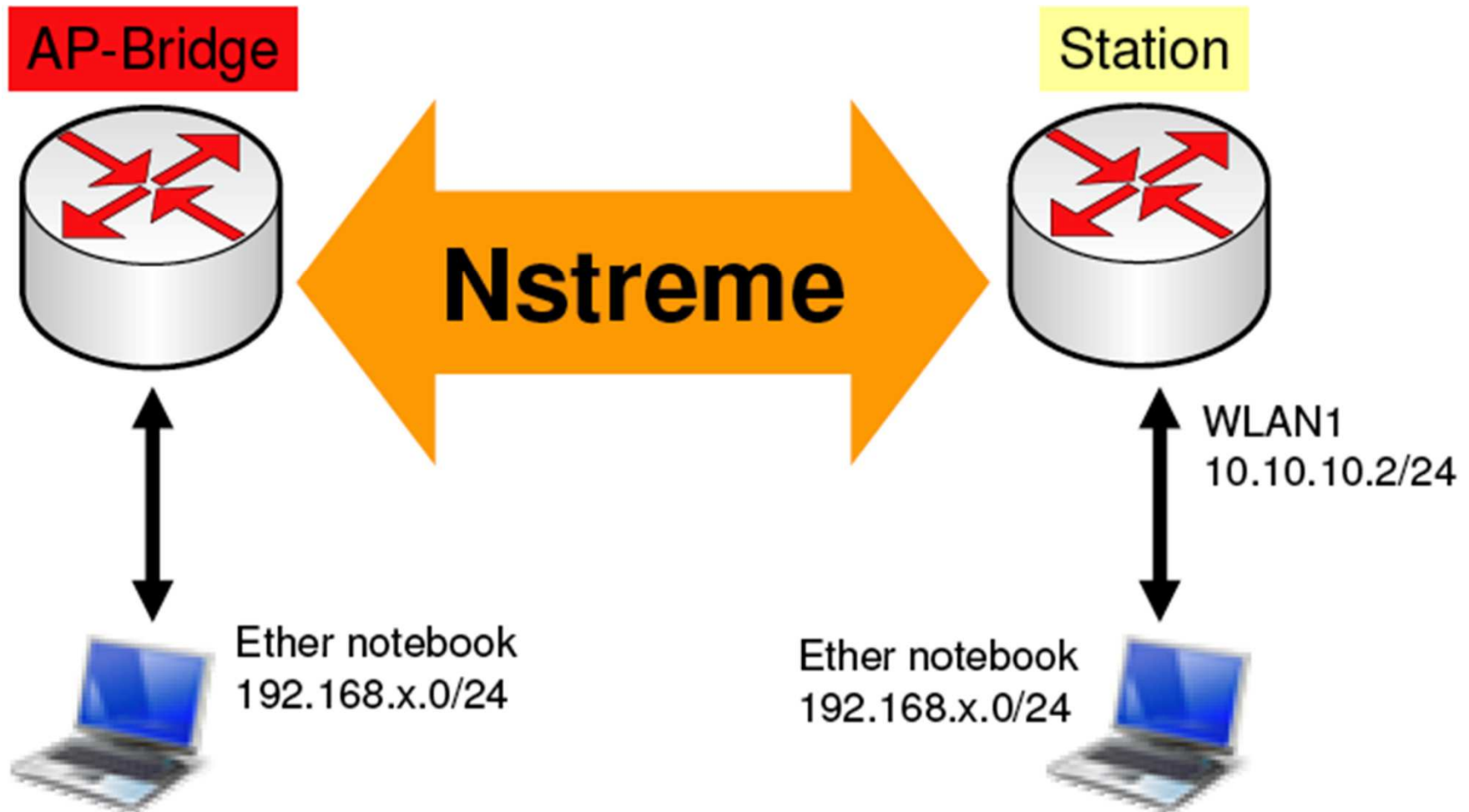
- Gunakan WPA-PSK untuk mengamankan jaringan wireless.
- Security profile pada interface akan mempengaruhi semua client.



Wireless Protocol – Nstreme dan NV2

- Nstreme dan NV2 adalah wireless protocol yang **MikroTik's proprietary** (protocol yang tidak kompatibel dengan vendor lain), yang digunakan untuk meningkatkan unjuk kerja jaringan wireless point-to-point maupun point-to-multipoint.
- Hanya bisa dilaktifkan di AP dan Client Mikrotik, tidak disupport oleh perangkat wireless brand lain.
- NV2 merupakan pengembangan dari Nstreme

● ● ● | [LAB-8] Nstreme





Activate Nstreme on AP & Client

The image shows two overlapping configuration windows from Mikrotik WinBox. The top window is for 'Interface <wlan1>' and the bottom window is for 'Interface <wlan2>'. In the wlan1 window, the 'Wireless' tab is active, and the 'Wireless Protocol' is set to 'nstreme', which is highlighted with a red box. In the wlan2 window, the 'Nstreme' tab is active, and the 'Enable Nstreme' checkbox is checked and highlighted with a red box. Other settings in the wlan2 window include 'Enable Polling' (checked), 'Disable CSMA' (unchecked), 'Framer Policy' set to 'best fit', and 'Framer Limit' set to '3200'.

Interface <wlan1>

General Wireless HT WDS Nstreme Status Traffic

Mode: ap bridge

Band: 2GHz-B/G

Channel Width: 20MHz

Frequency: 2412

SSID: MikroTik

Scan List:

Wireless Protocol: nstreme

Interface <wlan2>

WDS Nstreme NV2 Tx Power Current Tx Power ...

Enable Nstreme

Enable Polling

Disable CSMA

Framer Policy: best fit

Framer Limit: 3200

Nstreme dan NV2 - Results

