

Wireless 802.11 a/b/g



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Wireless LAN

- Teknologi yang menghubungkan 2 buah komputer atau lebih dengan menggunakan media transmisi gelombang radio.
- Teknik radio tersebut memanfaatkan kelemahan panca indera manusia.
- Teknologi radio mengabungkan sinyal frekuensi rendah dan gelombang pembawa yang frekuensi tinggi ke dalam modulator untuk kemudian di konversi ke gelombang elektromagnet dan dipancarkan ke udara.

Mode Frekuensi

- ***802.11b***

- Menggunakan frekuensi 2400 MHz-2485 MHz dan bandwidth dari 2 Mbps-108 Mbps
- Hanya ada 11 kanal dalam bandwidth 83,5 Mhz
- Menggunakan gelombang pembawa 2,4Ghz yang dikategorikan gratis oleh ITU

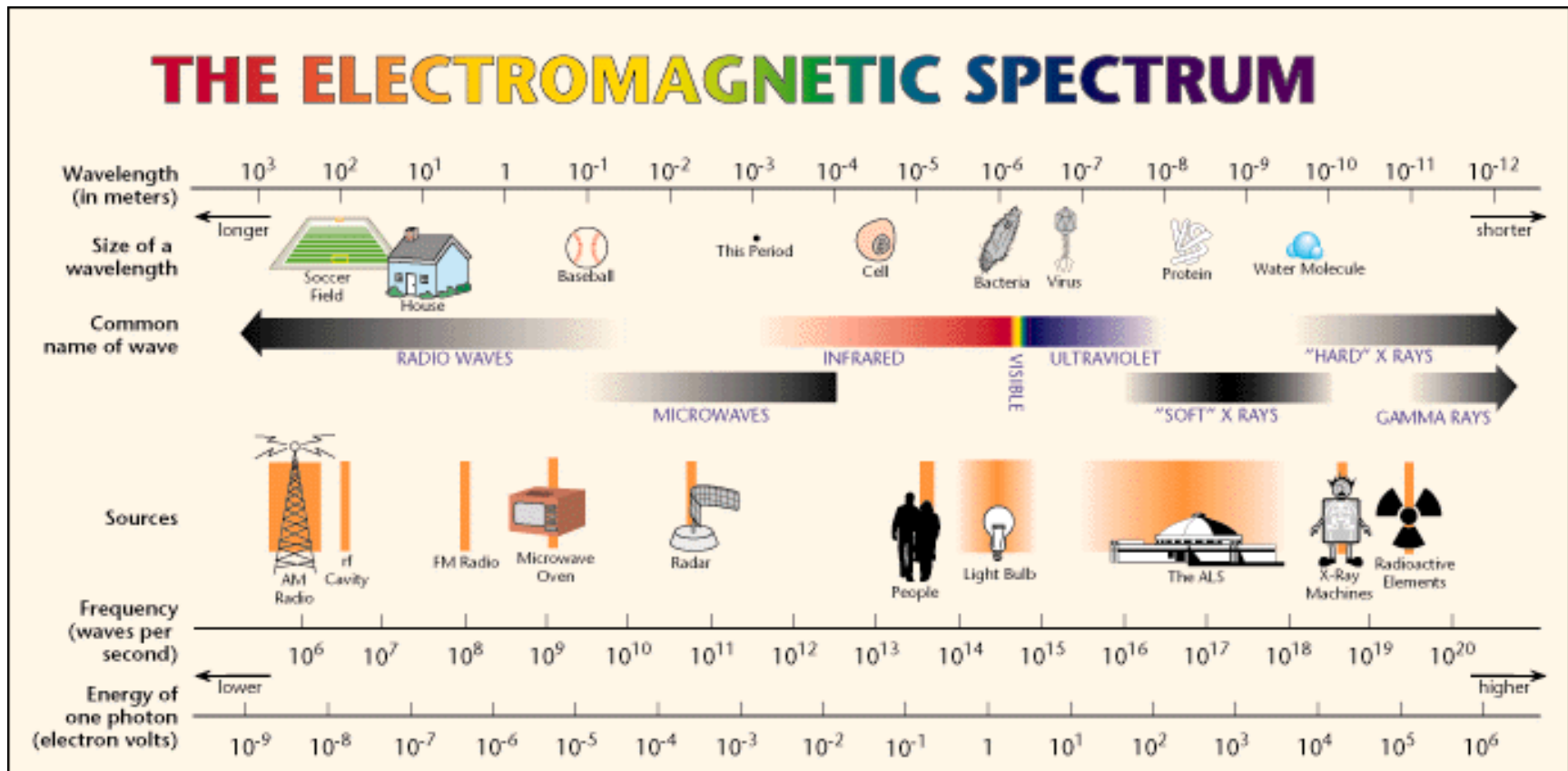
- ***802.11a***

- Menggunakan frekuensi 5,2-5,8 Ghz

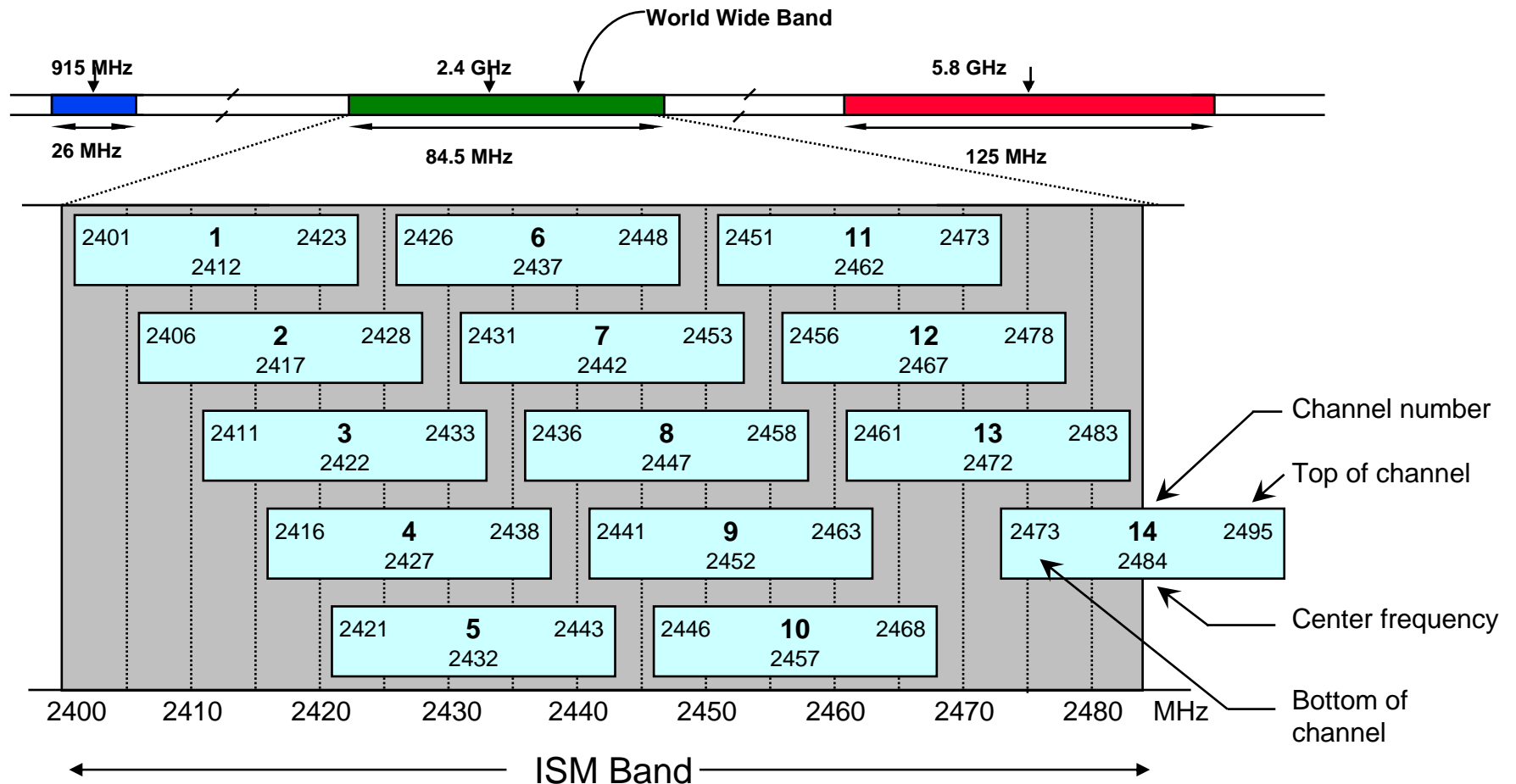
- ***802.11g***

- Sama dengan 802.11b hanya bandwidth sampai 108 Mbps

Spektrum Frekuensi



Pemetaan Frekuensi 2,4 Ghz



Wireless Data Transport

- FHSS

- Data dikirim dengan melompat-lompat dari satu frekuensi ke frekuensi lainnya, tergantung dari kondisi frekuensinya. Tersedia 78 kanal dengan lebar kanal masing-masing sekitar 1 Mbps

- DSSS

- Data dikirim langsung pada satu frekuensi tertentu dan tidak dipindah-pindah. Tersedia 11 kanal dengan lebar masing-masing 22 Mbps

- OFDM

- Menggunakan prinsip FDM (frekuensi-division multiplexing) dan diimplementasikan sebagai komunikasi digital. Menggunakan bit stream dalam komunikasi datanya.

Fungsi wireless LAN

- Dalam kategori penggunaan wireless LAN , ada 2 penggunaan yang bisa dimanfaatkan :
 - Penggunaan wireless LAN dalam ruangan (indoor)
 - Penggunaan wireless LAN luar ruangan (outdoor) yang gunanya untuk menghubungkan dua titik diluar rumah atau gedung.
- Untuk standar outdoor menggunakan 802.16

Kaidah dalam Wireless

- Frekuensi
- Tx power
- Rx sensitivity
- Looses
- EIRP
- Free Space Lose (FSL)
- Line Of Sight
- Fresnel Zone

Tx Power

- Radio mempunyai daya untuk menyalurkan sinyal pada frekuensi tertentu, daya tersebut disebut Transmit (Tx) power dan dihitung dari besar energi yang disalurkan melalui satu lebar frekuensi (bandwidth)
- Contoh , satu radio memiliki Tx power +18dBm maka jika dikonversi ke Watt akan didapat 0,064 W atau 64 mW.

Perhitungan dB-mWatt

- dBm adalah nilai $10 \log$ dari sinyal untuk 1 mW
- dBw adalah nilai $10 \log$ dari sinyal untuk 1 W
- Sinyal 100 mW jika dijadikan dBm akan menjadi :

$$\text{Persamaan dBm} = \frac{10 \log 100 \text{ (mW)}}{1\text{mW}} = 20 \text{ dBm}$$

Rx Sensitivity

- Semua radio memiliki point of no return yaitu keadaan dimana radio menerima sinyal kurang dari Rx sensitivity yang ditentukan dan radio tidak mampu melihat datanya.
- Misal 802.11b mempunyai received sensitivitinya -78 dBm maka pada level ini bit Error Ratenya (BER) dari 10^{-5} (99,999 %) akan terlihat.
- Rx sensitivity akan bervariasi bergantung dari banyak faktor

EIRP

- Effective Isotropic Radiated Power adalah daya pancar total perangkat setelah diperhitungkan dengan antena dan gangguan lainnya
- $EIRP = \text{dBm alat} + \text{dBi antena} - \text{Losses}$
- Losses = akibat dari konektor , panjang kabel pigtail dll

Losses Kabel

- Setiap transmisi akan kehilangan daya pada setiap 30 meter kabel untuk frekuensi 2,4 Ghz
- RG 8 losses 10 dB setiap 30 meter
- LMR 400 losses 6,8 dB setiap 30 meter
- LMR 600 losses 5,4 dB
- Heliax 3/8 “ losses 5,36 dB
- Heliax 1/2 “ losses 3,47 dB
- Heliax 5/8 “ losses 2,15 dB



Andrew
Corporation
Heliax



Times
Microwave
LMR types

Free Space Loss

- Rambatan frekuensi di udara akan mengalami loss dengan rumus :
 - $FSL (dB) = 32,45 + 20 \log_{10} F (MHz) + 20 \log_{10} D (Km)$
- Untuk FSL pada jarak 1 km menggunakan frekuensi 2,4 GHz adalah :
 - $FSL = 32,45 + 20 \log_{10} (2400) + 20 \log_{10} (1)$
 $= 100,05 \text{ dB}$

Line Of Sight

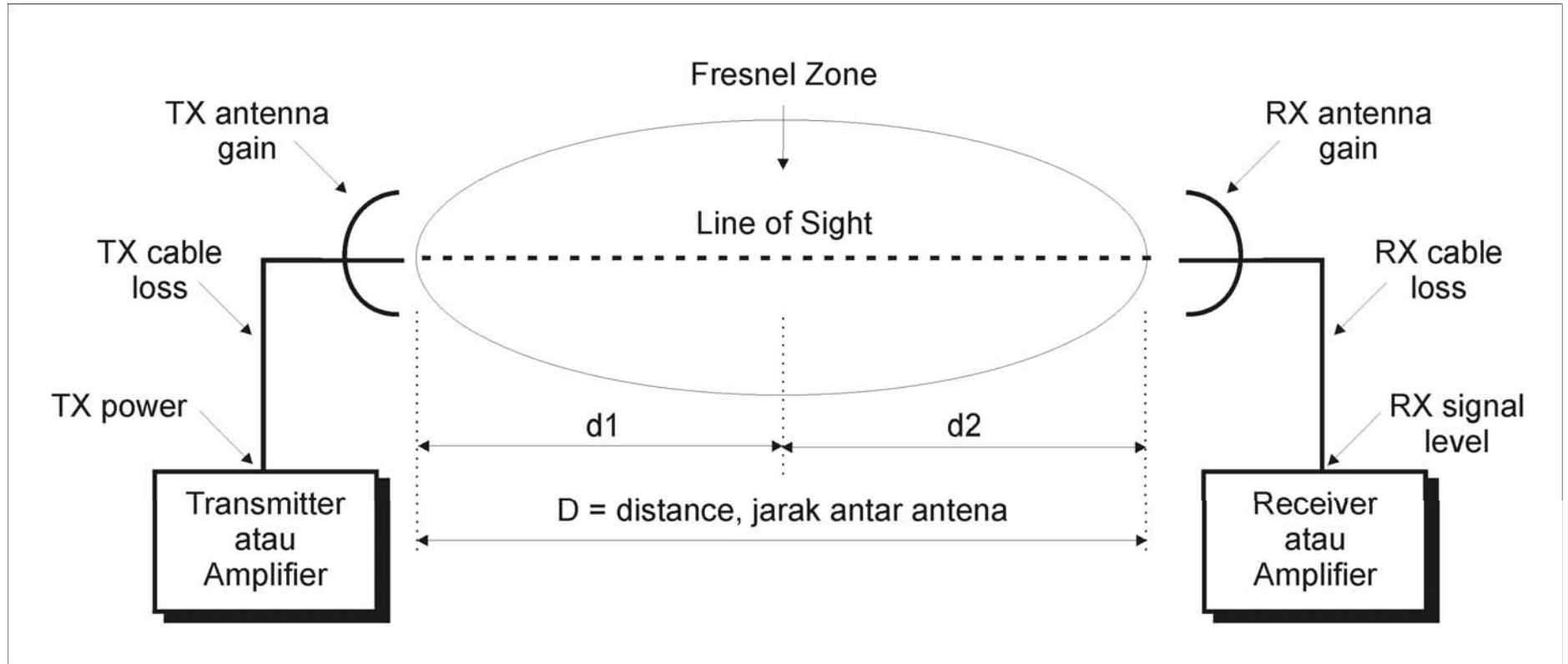
- Aplikasi wireless LAN di luar ruangan harus memenuhi prinsip Line of sight (tanpa penghalang)



Fressnel Zone

- Adalah area disekitar garis lurus antar antena yang digunakan sebagai media rambat frekuensi.
- Secara ideal fresnel zone harus dipenuhi.
- 20 % gangguan fresnel zone akan mempengaruhi kualitas link namun lebih dari itu akan sangat mempengaruhi.
- Halangan fresnel zone dapat berupa bangunan dan juga pepohonan (karena air pada daun akan menyerap sinyal)

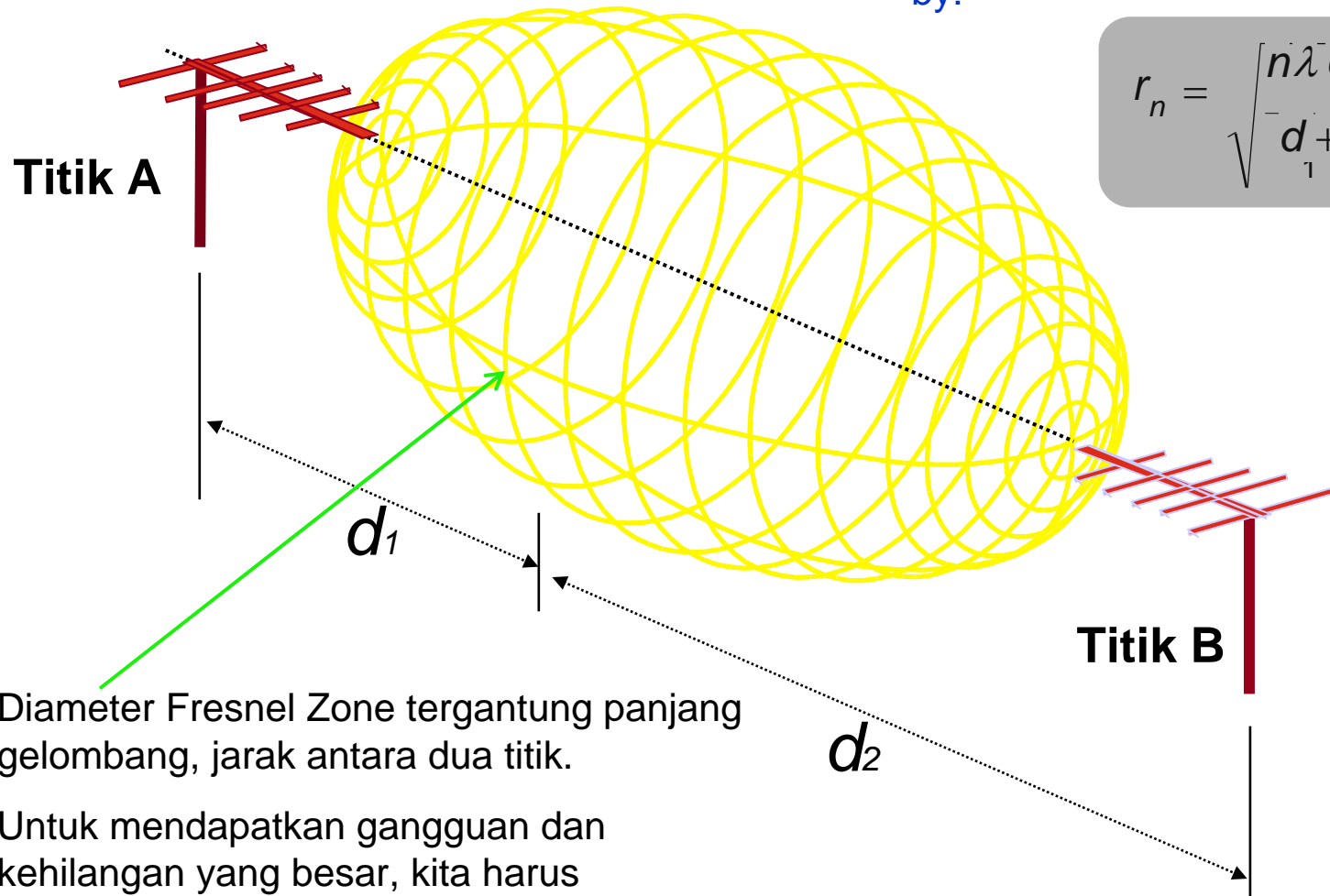
Gambar Fresnel Zone



Penjabaran Fresnel Zone

Radius of n^{th}
Fresnel Zone given
by:

$$r_n = \sqrt{\frac{n\lambda d_1 d_2}{d_1 + d_2}}$$



- Diameter Fresnel Zone tergantung panjang gelombang, jarak antara dua titik.
- Untuk mendapatkan gangguan dan kehilangan yang besar, kita harus mendapatkan jalur yang bersih pada $0.6F1 + 3m$

Mengatasi Fresnel Zone

- Meningkatkan letak posisi antenna pada infrastruktur yang ada
- Membangun tower dengan posisi antenna pada posisi tertinggi
- Meningkatkan ketinggian tower
- Meletakkan posisi antenna yang berbeda
- Membuat repeater
- Memotong pohon yang mengganggu RF

GPS

- Global Positioning System adalah Alat untuk mengukur ketinggian dan posisi pemasangan di dua titik .



Konsep Antena

- Antena merupakan device pasif yang hanya mengarahkan gelombang elektromagnet.
- Dalam antena dikenal istilah :
- Directionality (Arah) dalam satuan derajat
 - Omnidirectional (360 derajat)
 - Directional (45 , 30, 60 derajat)
- Antena gain (penguatan antena)
 - Dalam satuan dB (lebih besar db maka jarak area lebih jauh / luas)
- Polarisasi (arah rambat gelombang)
 - Vertikal
 - Horisontal

Radiated Power Pada Antena

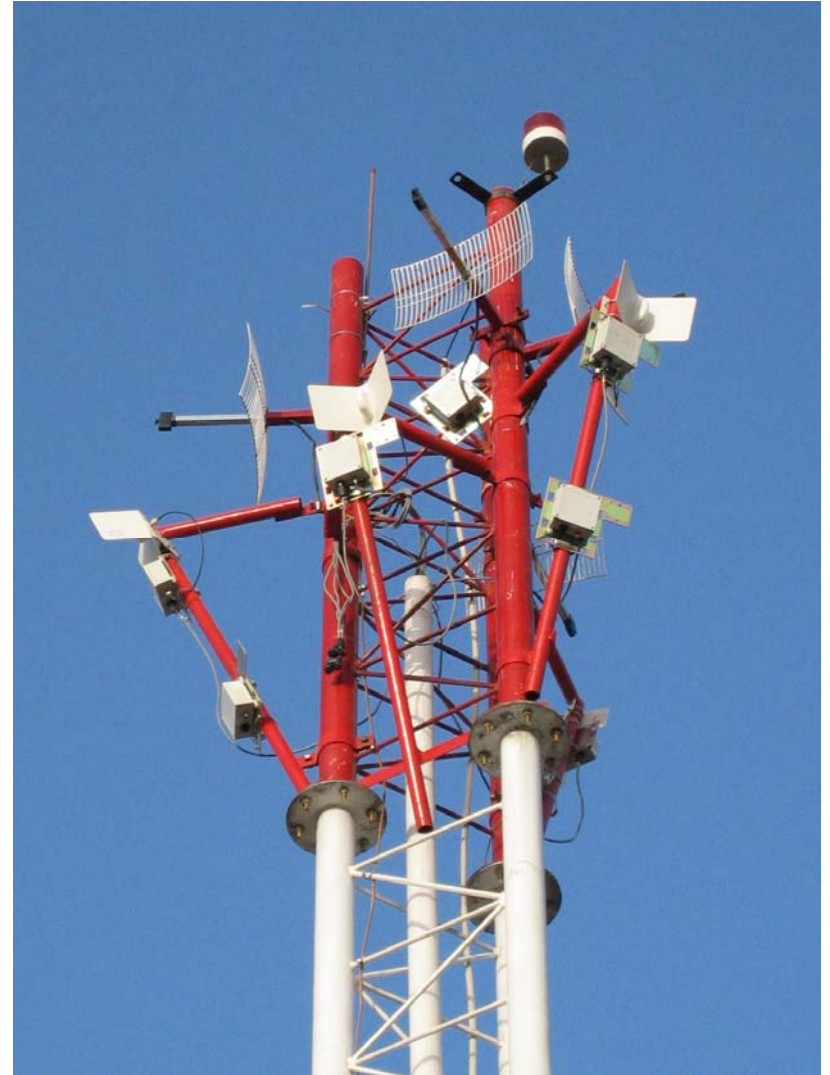
Dalam sistem wireless, antena digunakan untuk mengkonversi gelombang listrik menjadi gelombang elektromagnet. Besar energi antena dapat memperbesar sinyal terima dan kirim, yang disebut sebagai Antenna Gain yang diukur dalam :

dBi : relatif terhadap isotropic radiator

dBd: relatif terhadap dipole radiator

dimana $0 \text{ dBd} = 2,15 \text{ dBi}$

Jenis –jenis Antena

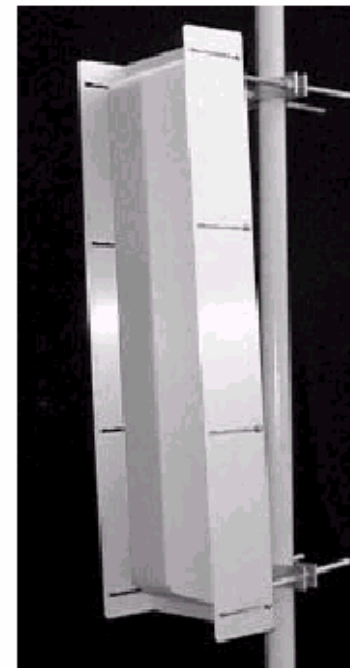


Polarisasi Antena



← *Horizontal*

Vertical →

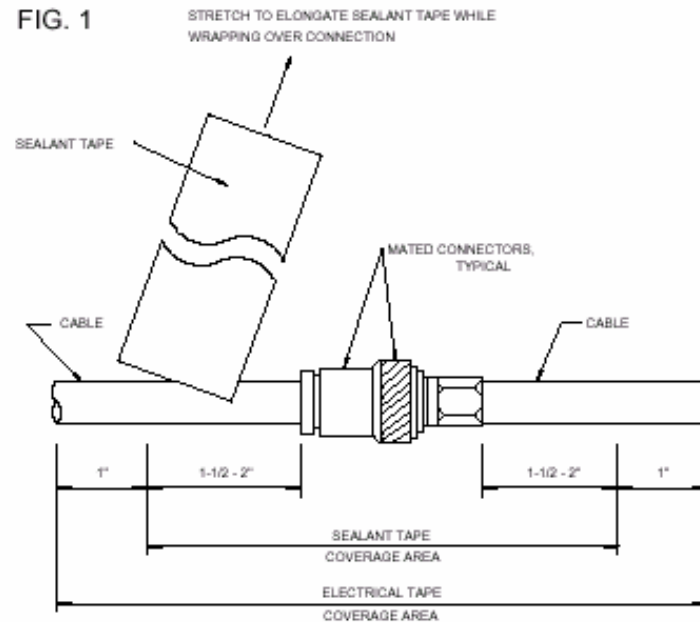


Sambungan Antena

Sambungan antena harus diperhatikan

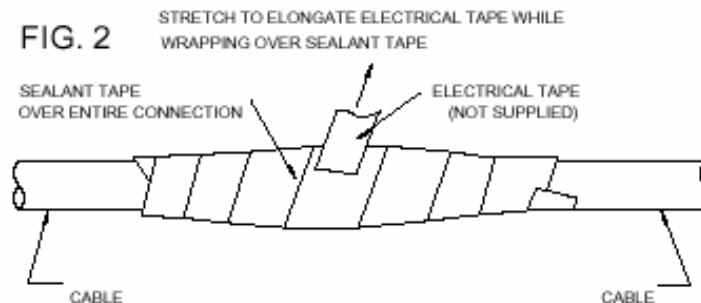
Step 1.

Beginning as shown in Fig. 1, by overlapping half-width, wrap sealant tape over entire connection.



Step 2.

Gently press on the sealant tape, forming it to the connection, itself and the cable jackets, as shown in Fig. 2.



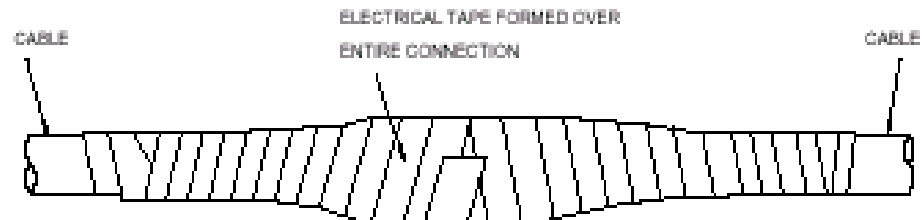
Sambungan Antena

Pemakaian selotape harus betul-betul diperhatikan

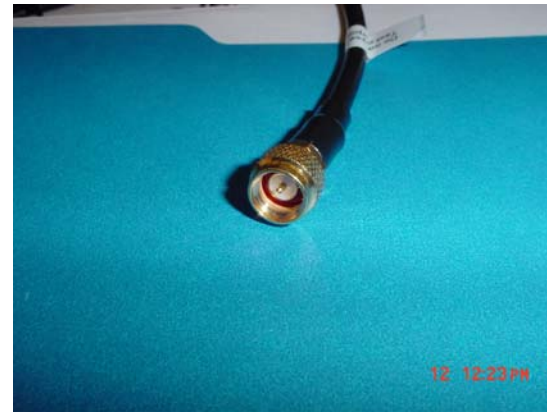
Step 3.

By overlapping half-width, wrap electrical tape (not supplied) over the entire sealant tape connection. While stretching tape, begin at center of formed sealant tape and wrap towards one end approximately one inch beyond end of sealant tape. Insure tight electrical tape coverage onto cable jacket. Without breaking electrical tape, reverse direction and wrap to other end, again extending approximately one inch beyond end of sealant tape. Again, insure tight electrical tape coverage onto cable jacket. Reverse direction again and wrap electrical tape to center of connection and stop.

FIG. 3 ELECTRICAL TAPE WRAPPED TIGHTLY AGAINST CABLE JACKET, TYPICAL BOTH ENDS.



Jenis – Jenis Konektor

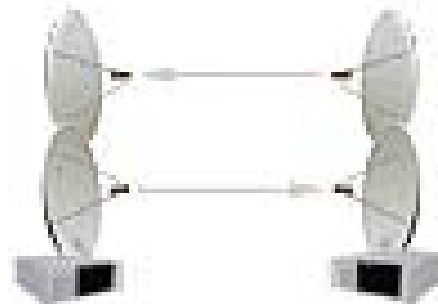


Proteksi Cuaca

- Cuaca akan sangat berpengaruh dalam sistem jaringan wireless maka perlu diperhatikan antara lain :
- Konektor harus tertutup rapi dan dilapisi dengan bahan plastik (selotip karet)
- Persiapkan penangkal petir dan grounding yang baik pada pemasangan antena di luar ruangan. Ground harus disambung maksimal 2 meter dari bangunan.
- Pastikan penggunaan radio yang tepat. Radio outdoor yang khusus (kedap Air).



Topologi wireless 2,4 Ghz



Point To Point

- Menghubungkan 2 buah alat biasanya jarak jauh dan menggunakan antena directional
- Kedua alat cukup menggunakan lisensi level 4 (bridge dan station)
- Bisa menggunakan propetiery setting (nstream, custom frekuensi)
- Pada AP
 - Min lisensi level 4
 - Set mode , SSID, band , dan frekuensi
 - Mode = bridge (hanya 1 client)
- Pada Client
 - Min lisensi level 4
 - Set mode , SSID , band ,frekuensi, dan scan-list
 - Mode= station
 - Pastikan frekuensi dalam scan-list

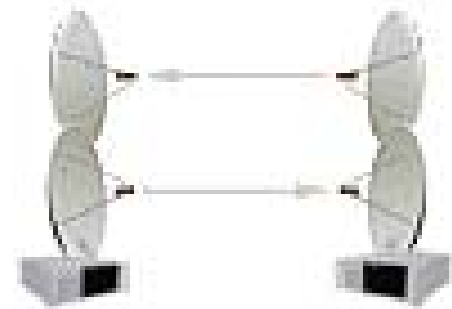


Konfigurasi dan Testing

- Tambahkan ip address kedua router pada wlan interface
- Cobalah ping dari winbox ke router yang lain
- Router udah siap untuk melewati trafik tetapi tidak bisa di bridge. (mikrotik station tidak dapat di bridge)
- Jika di bridge pakailah WDS atau EoIP

Point to point Dual Nstream

- Masing –masing titik menggunakan 2 buah antena dan 2 buah wireless card
- Satu link untuk transmit dan satu link lainnya untuk receive
- Merupakan Mikrotik proprietary setting
- Meningkatkan throughput
- Wireless delay hampir tidak ada



Point to Multipoint

- Digunakan untuk jarak dekat
- 1 buah akses point dapat melayani beberapa station
- Sebagai base station
- Menggunakan antena omni atau sectoral
- Jika client berada pada satu area bisa menggunakan flat panel
- Menggunakan standard 802.11 b/g biar semua device bisa terkoneksi.

Konfigurasi PTMP

- Membutuhkan lisensi level 4
- Set mode AP-bridge
- Mode ap bridge dapat dibridge
- Mempunyai default autentifikasi untuk mac address akses list (hanya radio tertentu yang bisa konek dengan ap tersebut)



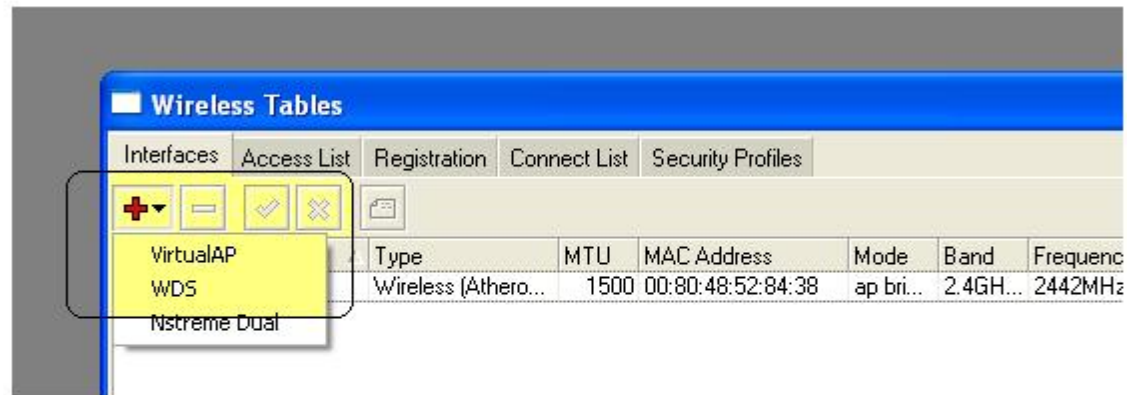
WDS

- Merupakan cara terbaik untuk interkoneksi banyak akses point dalam satu wilayah. Sehingga semua user dapat bergerak tanpa terputus koneksinya.
- Terdiri dari banyak akses point
- Topologi Mesh
- Akses point harus sama standarnya (802.11) dan mempunyai frekuensi yang sama.



Virtual AP (Vlan)

- Dapat membentuk AP pada satu interface wlan
- Masing-masing VAP dapat diberi SSID
- Masing-masing VAP dapat diberi ip address
- Sebuah VAP dapat dibentuk menjadi wds



Konfigurasi VAP

The image shows a Mikrotik WinBox interface. The main window is titled "Wireless Tables" and contains a table with the following data:

Name	Type	MTU	MAC Address	Mode	Band	Frequency	SSID
wlan1	Wireless (Athero...	1500	00:80:48:52:84:87	ap bri...	2.4GH...	2412MHz	UfoAkses
wlan4	VirtualAP	1500	02:80:48:52:84:87				NUXER
wlan2	Wireless (Athero...	1500	00:80:48:52:84:5B	station	2.4GH...	2412MHz	UfoAkses
wlan3	Wireless (Athero...	1500	00:80:48:52:84:F3	station	2.4GH...	2412MHz	UfoAkses

The "Interface wlan4" configuration window is open, showing the following settings:

- Master Interface: wlan1
- SSID: NUXER
- Area:
- Security Profile: default
- Max Station Count: 20
- Proprietary Extensions: post-2.9.25
- Default AP Tx Limit: bps
- Default Client Tx Limit: bps
- Default Authenticate
- Default Forward
- Hide SSID

Buttons on the right side of the configuration window include OK, Cancel, Apply, Disable, and Comment.

Alignment Only

- Feature untuk posisi link wireless
- Pada mode alignment-only interface akan mendengar paket yang dikirim pada sebuah AP dengan frekuensi dan channel yang sama.
- Audio = sinyal strength berdasarkan bunyi beeper diset max , maka frekuensi beepernya diset tinggi.
- Jika mengaktifkan interface alignment-only maka secara otomatis merubah interface mode dari station ,AP menjadi alignment-only.

- [admin@UfoAkses] interface wireless align> pr
frame-size: 300
active-mode: yes
receive-all: no
audio-monitor: 00:00:00:00:00:00
filter-mac: 00:00:00:00:00:00
ssid-all: no
frames-per-second: 25
audio-min: -100
audio-max: -20
- [admin@UfoAkses] interface wireless align> monitor wlan1

Alignment di winbox

The image shows two overlapping windows from WinBox. The background window is titled "Alignment <wlan1 >" and contains a table with the following data:

Address	SSID	Rx Qu...	Avg. Rx ...	Last Rx	Tx Qu...	Last Tx	Correct
00:16:CF:62:4...		-78	0	1.50	0	0.00	0%
00:19:FC:05:0...		-26	-26	0.02	0	0.00	0%
00:80:48:47:1...		-79	-79	0.22	0	0.00	0%
02:19:FC:05:0...		-26	-26	0.02	0	0.00	0%
02:19:FC:05:0...		-26	-26	0.02	0	0.00	0%

On the right side of the "Alignment" window are buttons for "Start", "Stop", "Close", and "Settings...".

The foreground window is titled "Wireless Alignment Settings" and contains the following configuration options:

- Frame Size: 300
- Active Mode
- Receive All
- Filter MAC Address: 00:00:00:00:00:00
- SSID All
- Frames per Second: 25
- Audio Monitor: 00:00:00:00:00:00
- Audio Min: -100
- Audio Max: -20

Buttons for "OK", "Cancel", and "Apply" are located on the right side of the "Wireless Alignment Settings" window.

Keamanan Wireless

- Hidden SSID
- Disable default authenticate
 - Mac address list
- WEP
- Didepan server VPN
- Menggunakan Hotspot



Security Profile

- WEP = Wired Equivalent Privacy
 - Enkripsi data hanya pada 802.11 menggunakan static key
 - Sangat simple
 - 40 bit = menggunakan enkripsi 40 bit (juga dikenal sebagai 64bit-wep)
 - 104 bit = menggunakan enkripsi 104bit (juga dikenal sebagai 128bit-wep)
 - Static key = text (dalam hexa key)
- WPA = Wi-fi Protected Access
 - Kombinasi dari 802.1x, EAP , MIC, TKIP, dan AES

Security Profiles Dalam winbox

The image shows the Mikrotik WinBox interface for configuring Security Profiles. The main window is titled "Wireless Tables" and has tabs for "Interfaces", "Access List", "Registration", "Connect List", and "Security Profiles". The "Security Profiles" tab is active, showing a table with the following data:

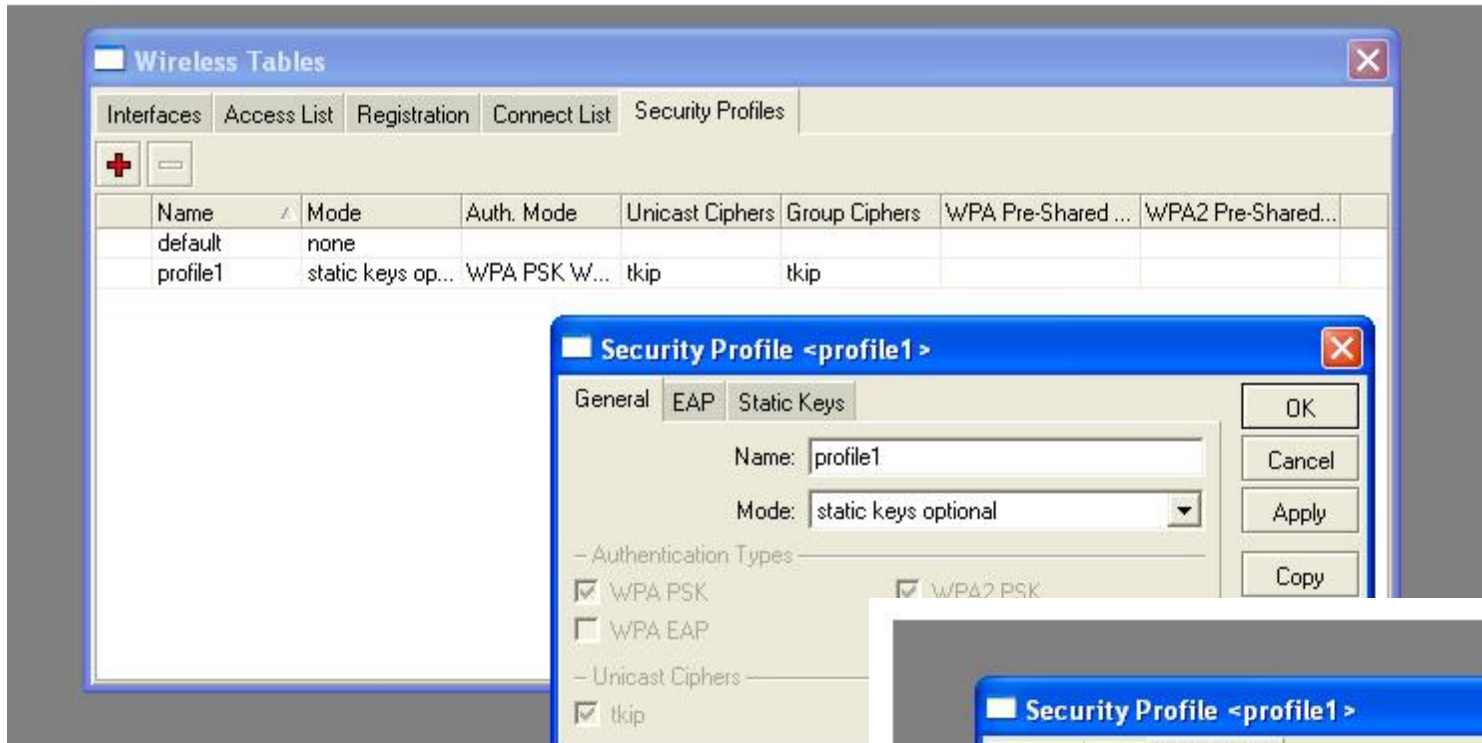
Name	Mode	Auth. Mode	Unicast Ciphers	Group Ciphers	WPA Pre-Shared ...	WPA2 Pre-Shared...
default	none					
profile1	dynamic keys	WPA PSK W...	tkip	tkip	1234567890	1234567890

A "New Security Profile" dialog box is open in the foreground, showing the configuration for a new profile named "profile2". The dialog has three tabs: "General", "EAP", and "Static Keys". The "General" tab is selected, and the configuration is as follows:

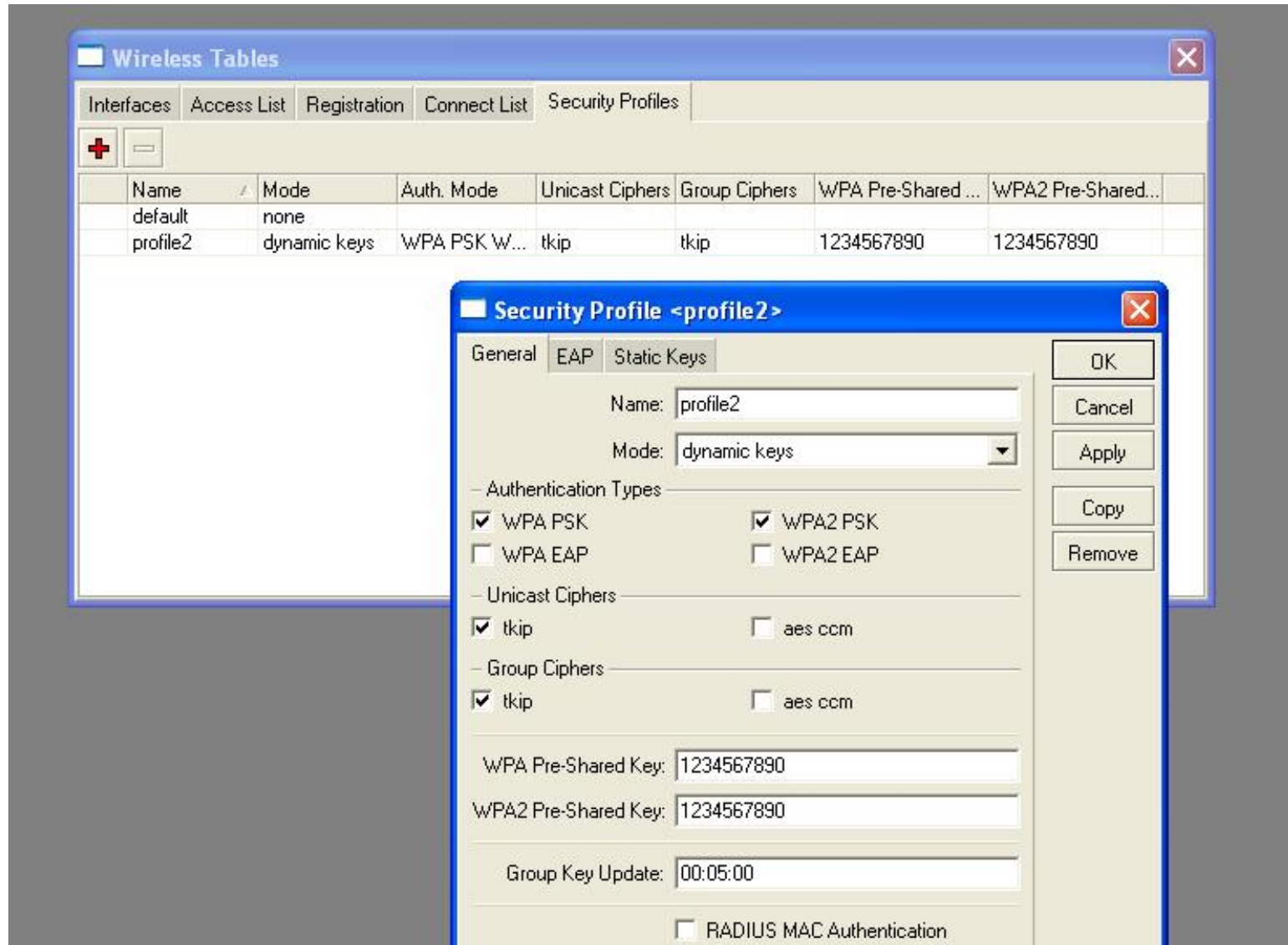
- Name: profile2
- Mode: dynamic keys
- Authentication Types:
 - WPA PSK
 - WPA EAP
 - WPA2 PSK
 - WPA2 EAP
- Unicast Ciphers:
 - tkip
 - aes ccm
- Group Ciphers:
 - tkip
 - aes ccm
- WPA Pre-Shared Key: [Empty text box]
- WPA2 Pre-Shared Key: [Empty text box]
- Group Key Update: 00:05:00
- RADIUS MAC Authentication

Buttons on the right side of the dialog include OK, Cancel, Apply, Copy, and Remove.

Aplikasi WEP Security

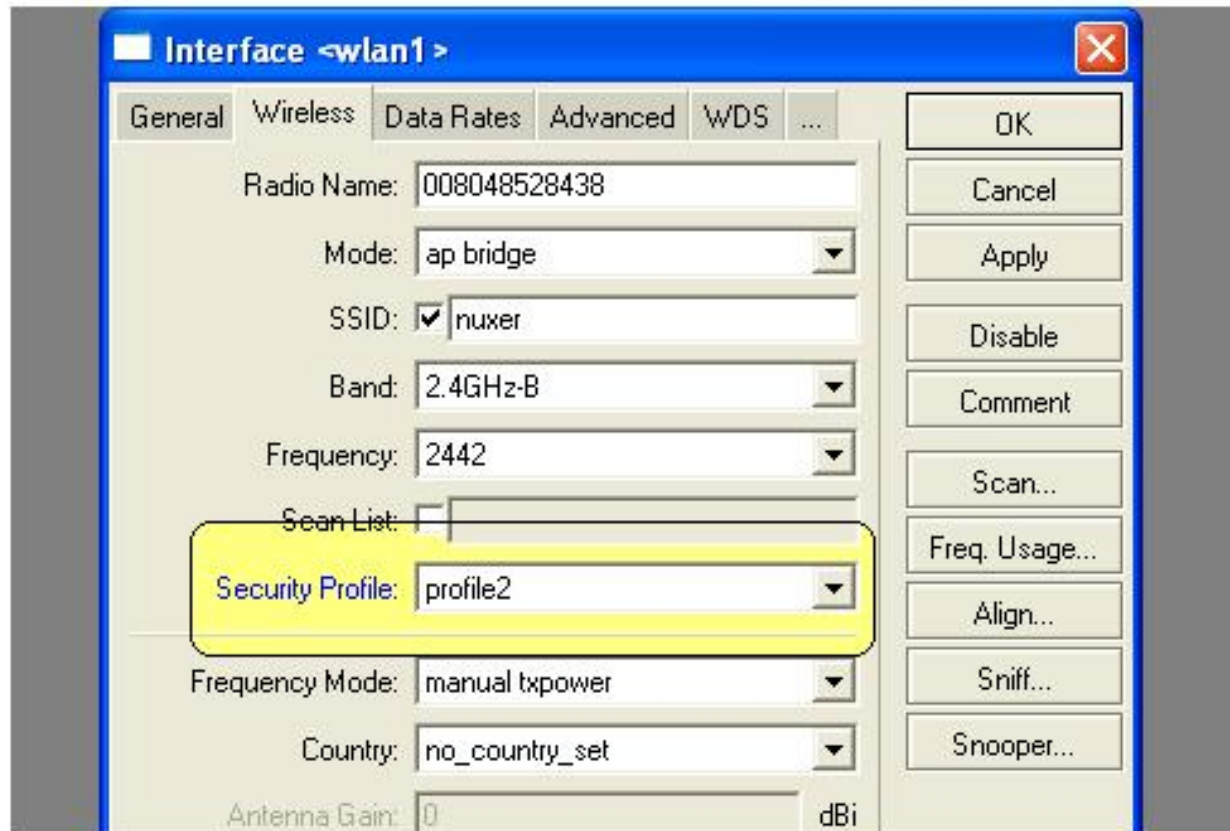


Aplikasi WPA Security



Note : Pada kedua router (AP dan Station set WPA harus sama persis)

Penggunaan WPA Security



Wireless Standards

- IEEE 802.11b
 - 2.4GHz, 22MHz bandwidth
 - 11Mbit max air rate
- IEEE 802.11g
 - 2.4GHz, 22MHz bandwidth
 - 802.11b compatibility mode
 - 54Mbit max air rate
- IEEE 802.11a
 - 5GHz, 20MHz bandwidth
 - 54Mbit max air rate

Band Variations

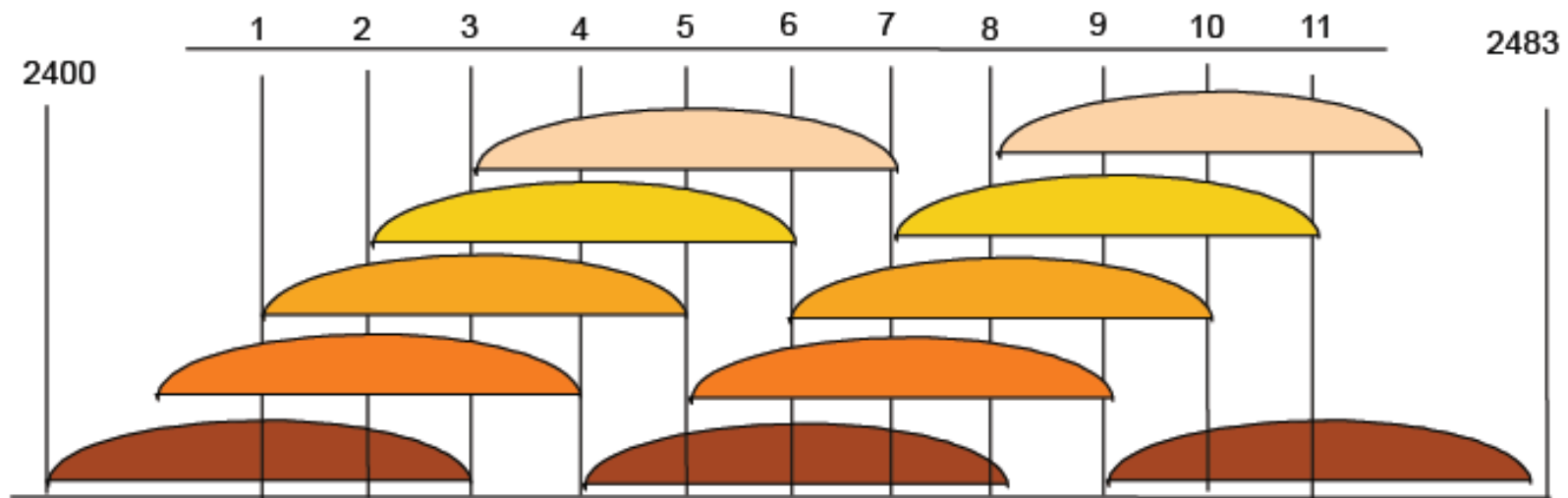
- Double channel (40MHz) – 108Mbit max air rate
 - 2.4ghz-g-turbo
 - 5ghz-turbo
- Half channel (10MHz) – 27Mbit max air rate
 - 2ghz-10mhz
 - 5ghz-10mhz
- Quarter channel (5MHz) – 13.5Mbit max air rate
 - 2ghz-5mhz
 - 5ghz-5mhz

Supported Frequencies

- Wireless cards usually support the following frequencies:
 - For all 2.4GHz bands: 2192-2539MHz
 - For all 5GHz bands: 4920-6100MHz
- Your country regulations allow only particular frequency ranges
- Custom frequency license unlocks all frequencies supported by the wireless hardware

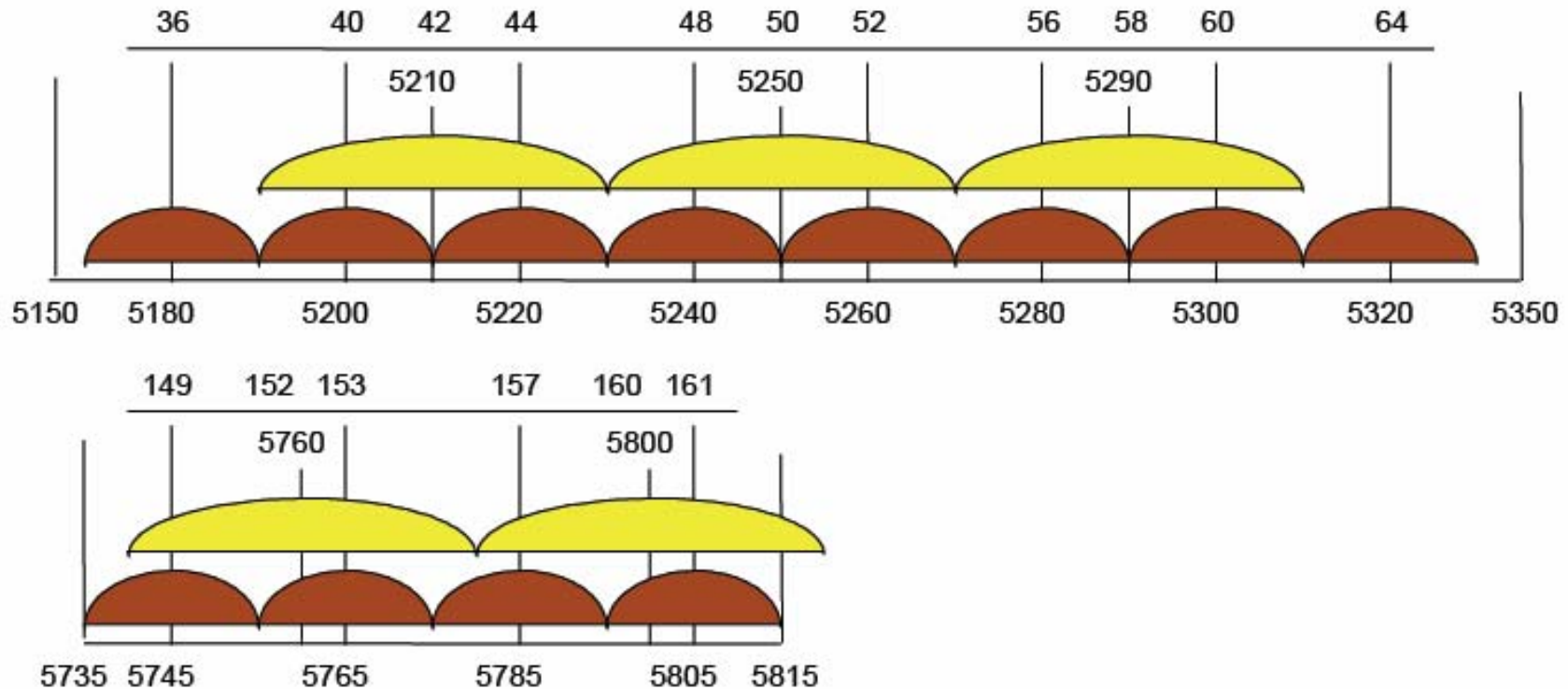
Channels- 802.11b/g

- 11 channels (US), 22 MHz wide
- 3 non-overlapping channels
- 3 Access Points can occupy same area without interfering



Channels- 802.11a

- 12 channels, 20 MHz wide
- 5 turbo channels, 40MHz wide



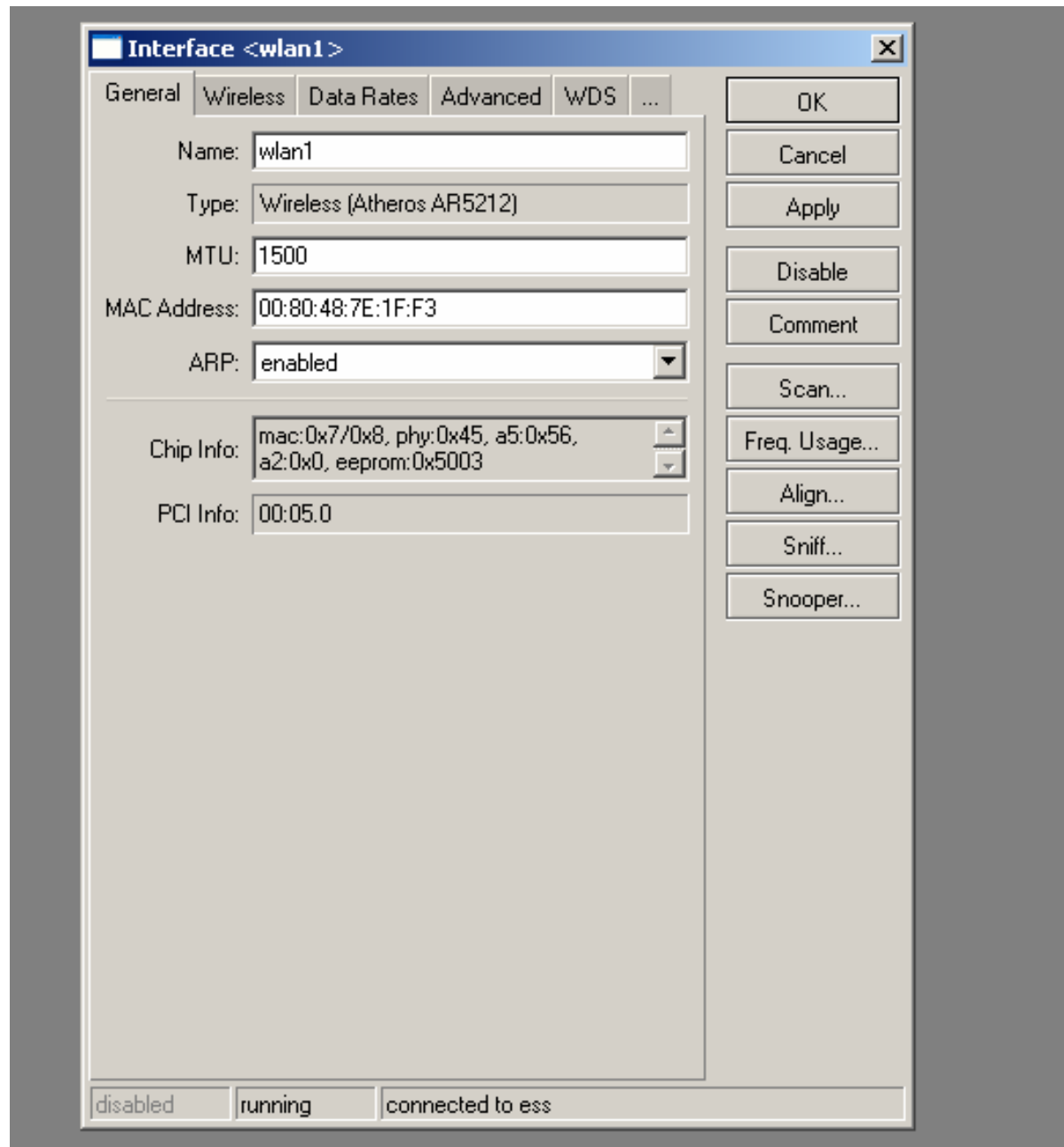
Winbox: Wireless Regulations

The screenshot displays the RouterOS WinBox interface. On the left, the 'Interfaces' menu is open, with 'Wireless' highlighted. A red arrow points from 'Wireless' to the 'Wireless Tables' section in the main panel. In the 'Wireless Tables' section, a table lists wireless interfaces, with 'wlan1' highlighted. A red arrow points from 'wlan1' to the 'Interface <wlan1>' configuration window. This window has the 'Wireless' tab selected, and a red box highlights the 'Frequency Mode' section, which includes the following settings:

- Radio Name: 0_Teache{
- Mode: ap bridge
- SSID: ap_ub532
- Band: 5GHz
- Frequency: 5180
- Scan List:
- Security Profile: default
- Frequency Mode: regulatory domain
- Country: lalvia
- Antenna Gain: 3 dBi
- DFS Mode: radar detect
- Proprietary Extensions: post-2.9.25
- Default AP Tx Rate: bps
- Default Client Tx Rate: bps
- Default Authenticate
- Default Forward
- Hide SSID

At the bottom of the configuration window, there are three status buttons: 'disabled', 'running', and 'running ap'. The 'running ap' button is currently selected.

Interface Wireless di Mikrotik



Fitur Wifi di Mikrotik

The screenshot shows the 'Wireless Tables' window in Mikrotik WinBox. The window has a title bar and a close button. Below the title bar are tabs for 'Interfaces', 'Access List', 'Registration', 'Connect List', and 'Security Profiles'. A toolbar contains icons for adding (+), deleting (-), checking (✓), unchecking (✗), and saving (floppy disk). A dropdown menu is open, showing options: 'VirtualAP', 'WDS', and 'Nstreme Dual'. The main area contains a table with the following data:

Type	MTU	MAC Address	Mode	Band	Frequency	SSID	
Wireless (Athero...	1500	00:80:48:7E:1F:F3	station	2.4GH...	2412MHz	compex-n...	

Access Management

- *default-forwarding* (on AP) – whether the wireless clients may communicate with each other directly (access list may override this setting for some particular clients)
- *default-authentication* – enables AP to register a client even if it is not in access list. In turn for client it allows to associate with AP not listed in client's connect list

Wireless Access list

The image shows a network configuration interface with two windows. The background window, titled "Wireless Tables", has tabs for "Interlaces", "Nsireme Dual", "Access List", "Registration", "Connect List", and "Security Profiles". The "Access List" tab is active, displaying a table with the following data:

MAC Address	Interface	Signal Str...	Authentication	Forwarding
00:0C:42:0C:0A:ED	wlan1	-120..120	no	no
00:0C:42:0C:0A:ED	wlan1	-120..120	yes	yes

The foreground window, titled "AP Access Rule <00:0C:42:0C:0A:ED>", provides configuration options for the selected rule:

- MAC Address: 00:0C:42:0C:0A:ED
- Interface: wlan1
- Signal Strength Range: -120..120
- AP Tx Limit: [dropdown]
- Client Tx Limit: [dropdown]
- Authentication:
- Forwarding:
- Private Key: none [dropdown] 0x [text]
- Private Pre Shared Key: [text]
- Time: 08:00:00 - 18:00:00
- Days: sun mon tue wed thu fri sat
- Status: disabled

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

Wireless Access List

Access list entries are ordered, just like in firewall

The screenshot shows a configuration window for an AP Access Rule. The title bar reads "AP Access Rule <00:0C:42:0C:0A:ED>". The window contains several input fields and checkboxes:

- MAC Address:** 00:0C:42:0C:0A:ED
- Interface:** wlan1
- Signal Strength Range:** -80..120
- AP Tx Limit:** 256k
- Client Tx Limit:** 128k
- Authentication
- Forwarding
- Private Key:** none
- Private Pre Shared Key:** (empty field)
- Time:** (dropdown menu)

On the right side of the window, there are several buttons: OK, Cancel, Apply, Disable, Comment, Copy, and Remove. At the bottom left, the status "disabled" is shown.

Wireless Connect List

- Allow or deny clients from connecting to specific AP by using Connect list
- Connect list entries can be made from the registration table entries by using action 'Copy to Access List'
- Connect list entries are ordered, just like in firewall
- Used also for WDS links

Wireless Connect List

New Station Connect Rule

Interface: wlan1

MAC Address: 00:02:6F:45:15:43

Connect

SSID: AP2G

Area Prefix:

Signal Strength Range: -120..120

Security Profile: default

OK
Cancel
Apply
Disable
Comment
Copy
Remove

disabled

1

New Station Connect Rule

Interface: wlan1

MAC Address:

Connect

SSID: AP2G

Area Prefix:

Signal Strength Range: -75..120

Security Profile: default

OK
Cancel
Apply
Disable
Comment
Copy
Remove

disabled

2

New Station Connect Rule

Interface: wlan1

MAC Address:

Connect

SSID:

Area Prefix:

Signal Strength Range: -120..120

Security Profile: default

OK
Cancel
Apply
Disable
Comment
Copy
Remove

disabled

3

Wireless Connect List

The screenshot shows a window titled "Wireless Tables" with a close button in the top right corner. The window has several tabs: "Interfaces", "Nstreme Dual", "Access List", "Registration", "Connect List", and "Security Profiles". The "Connect List" tab is active. Below the tabs is a toolbar with icons for adding (+), deleting (-), checking (✓), unchecking (✗), and a folder icon. To the right of the toolbar is a search box labeled "Find".

#	Interface	MAC Address	Connect	Area Prefix	Signal Str...	Security ...
0	wlan1	00:02:6F:45:15:43	yes		-120..120	default
1	wlan1		yes		-75..120	default
2	wlan1		no		-120..120	default

3 items (1 selected)

Registration Table

The screenshot displays the 'Registration' tab in the 'Wireless Tables' window. The table below shows the registration details for a client on the 'wlan1' interface.

Interface	Radio Name	MAC Address	AP	Tx/Rx Rate	Last Activity	Signal Strength	WDS	Uptime
wlan1	X_unknown	00:0C:42:05:00:1C	no	54Mbps	0.000	-68	no	00:01:37

Below the table, three detailed configuration windows for the selected client (MAC: 00:0C:42:05:00:1C) are shown:

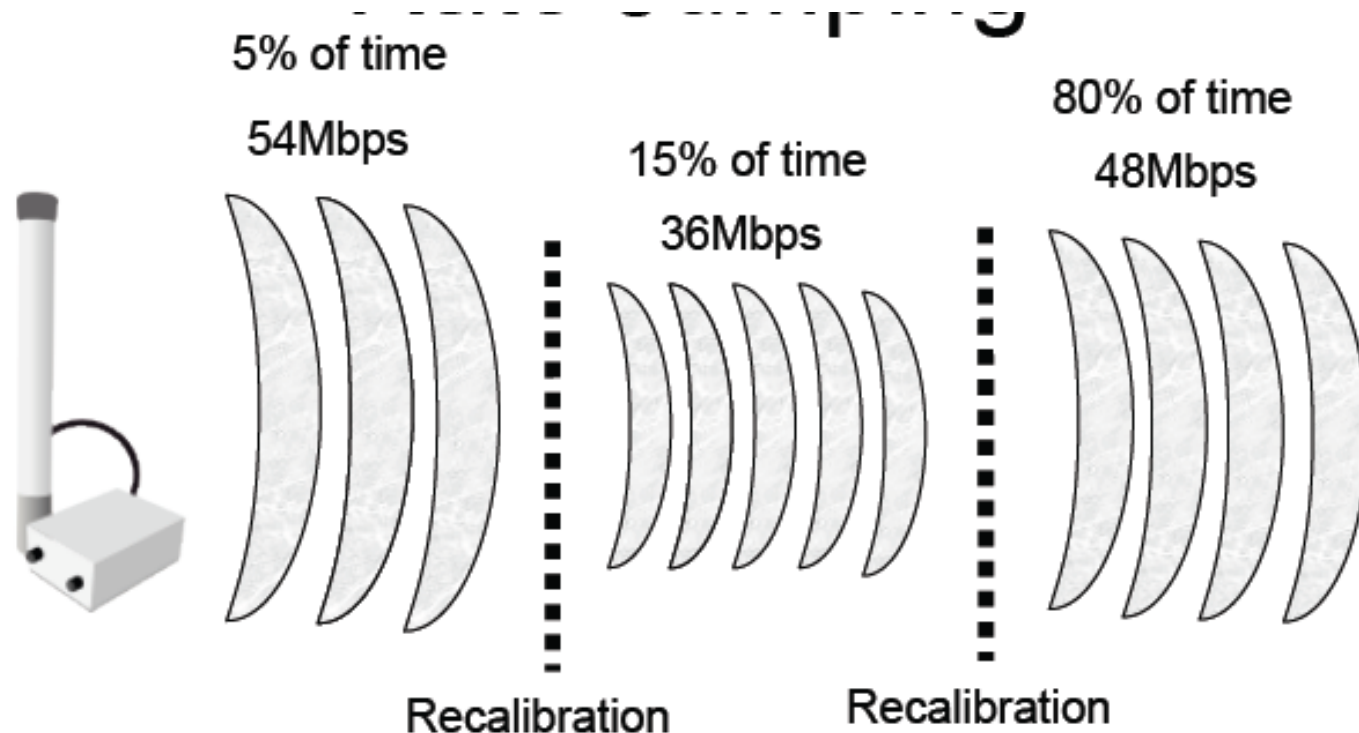
- General Tab:** Shows basic client information: Radio Name: X_unknown, MAC Address: 00:0C:42:05:00:1C, Interface: wlan1, Uptime: 00:01:37, Ack. Timeout: 25 us, RouterOS Version: 2.9 XX, AP Tx Limit, Client Tx Limit, and Last IP.
- Signal Tab:** Shows signal strength and quality metrics: Last Activity: 0.000, Signal Strength: -58 dBm, Tx Signal Strength: -53 dBm, Signal To Noise: 37 dB, Tx/Rx CQ: 93/95 %. It also includes a 'Signal Strengths' table:

Rate	Strength
5Mbps	-54
9Mbps	-54
12Mbps	-56
18Mbps	-58
24Mbps	-60
36Mbps	-62
48Mbps	-64
54Mbps	-68

- Statistics Tab:** Shows transmission and reception statistics: Tx/Rx Rate: 54Mbps, Tx/Rx Packets: 550/794745, Tx/Rx Bytes: 41576/1202538377, Tx/Rx Frames: 550/794804, Tx/Rx Frame Bytes: 38630/1197770772, Tx/Rx Hw Frames: 550/794813, Tx/Rx Hw. Frame Bytes: 51830/1216846302.

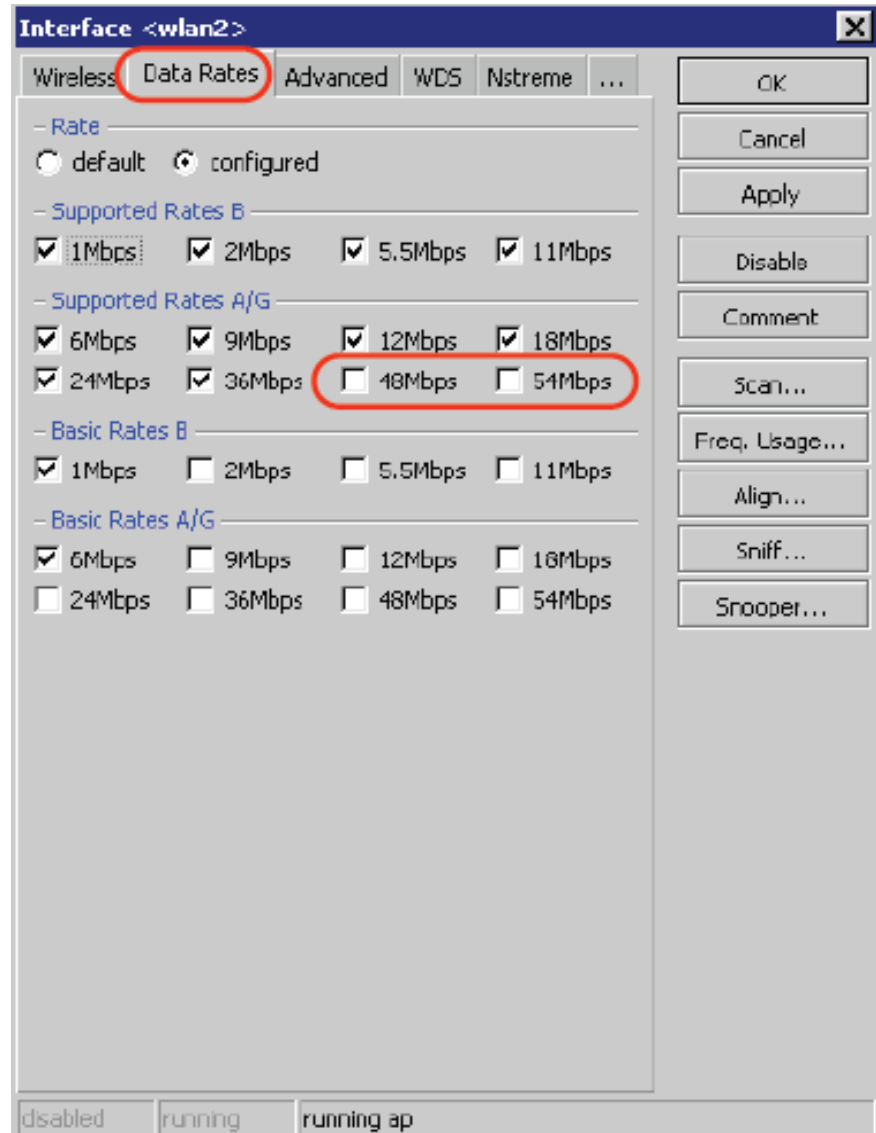
Rate Jumping

- You can optimize link performance, by avoiding rate jumps, in this case link will work more stable at 36Mbps rate



Basic and Supported Rates

- Supported rates – client data rates
- Basic rates – link management data rates
- If router can't send or receive data at basic rate – link goes down



Wireless MultiMedia (WMM)

- 4 transmit queues with priorities:
 - 1,2 – background
 - 0,3 – best effort
 - 4,5 – video
 - 6,7 – voice
- Priorities set by
 - Bridge or IP firewall
 - Ingress (VLAN or WMM)
 - DSCP

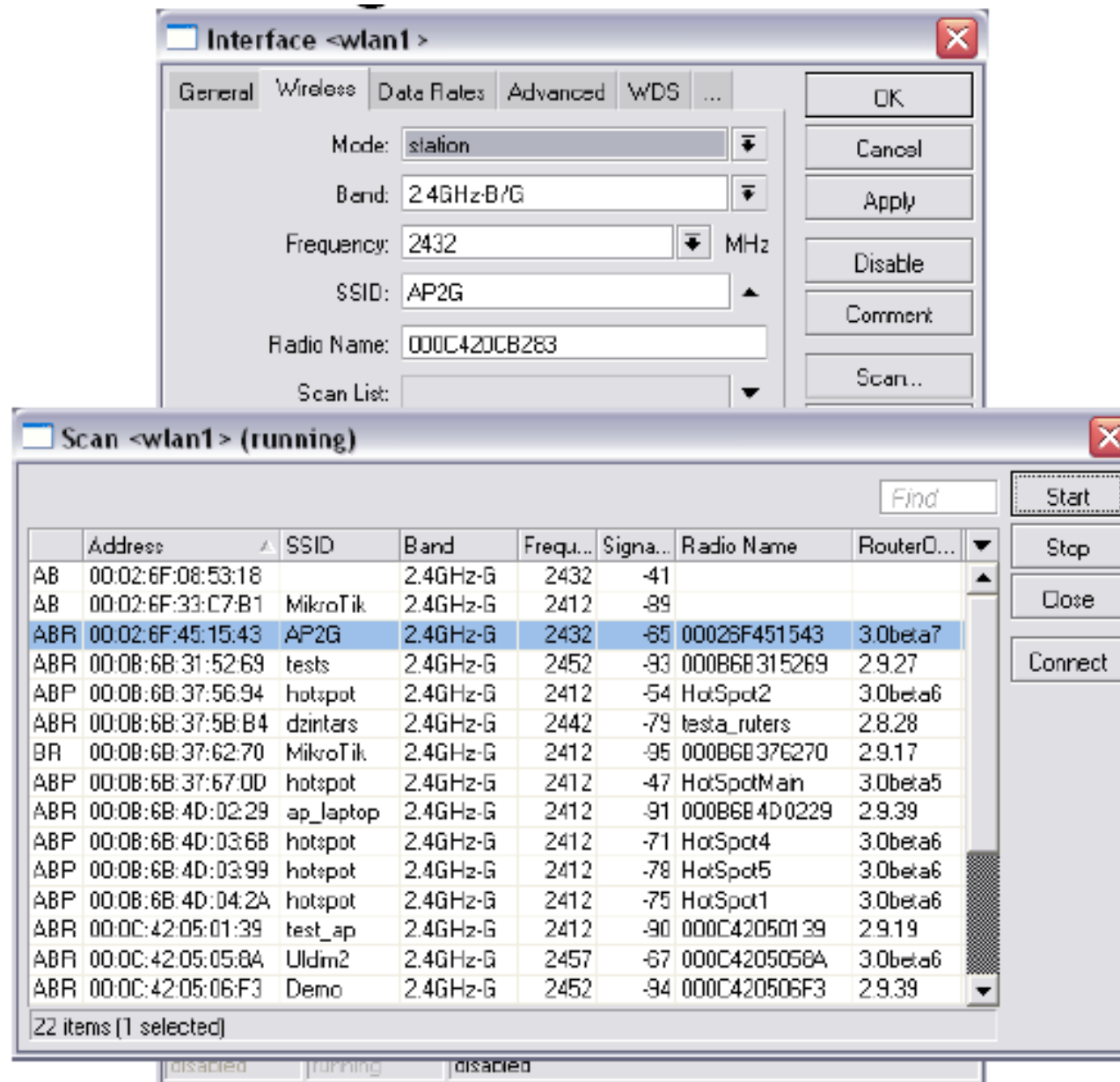
Mikrotik Mode Wifi

- bridge/ap-bridge – AP mode; bridge mode supports only oneclient
- station – a regular client (can **not** be bridged)
- station-pseudobridge/station-pseudobridge-clone – client, which can be bridged (implements MAC address translation)
- alignment-only – for positioning antennas
- nstreme-dual-slave – card will be used in nstreme-dual interface
- wds-slave – works as ap-bridge mode but adapts to the WDS peers frequency
- station-wds – client, which can be bridged (AP should support WDS feature)

Wireless Station

- Joins a Service Set
- Follows the Access Point within the Scan List
- Restrictions based on Connect List

Finding Access Points



Konfigurasi Client (Station)

The screenshot displays the configuration window for the 'wlan1' interface, specifically the 'Wireless' tab. The window is titled 'Interface <wlan1>' and contains the following settings:

- Radio Name:** Radio Test
- Mode:** station
- SSID:** TRAINING-UFOAKSES
- Band:** 2.4GHz-B
- Frequency:** 2442
- Scan List:**
- Security Profile:** default
- Frequency Mode:** manual txpower
- Country:** no_country_set
- Antenna Gain:** 0 dBi
- DFS Mode:** none
- Proprietary Extensions:** post-2.9.25
- Default AP Tx Rate:** bps
- Default Client Tx Rate:** bps
- Default Authenticate
- Default Forward
- Hide SSID

At the bottom of the window, the status is shown as 'connected to ess'. On the right side, there are several control buttons: OK, Cancel, Apply, Disable, Comment, Scan..., Freq. Usage..., Align..., Sniff..., and Snooper...

Konfigurasi Wireless Akses Point

The image shows a configuration window titled "Interface <wlan1>". It has several tabs: "General", "Wireless", "Data Rates", "Advanced", "WDS", and "...". The "Wireless" tab is selected. The configuration fields are as follows:

- Radio Name: Radio Test
- Mode: ap bridge
- SSID: TRAINING-UFOAKSES
- Band: 2.4GHz-B
- Frequency: 2442
- Scan List:
- Security Profile: default
- Frequency Mode: manual txpower
- Country: no_country_set
- Antenna Gain: 0 dBi
- DFS Mode: none
- Proprietary Extensions: post-2.9.25
- Default AP Tx Rate: bps
- Default Client Tx Rate: bps
- Default Authenticate
- Default Forward
- Hide SSID

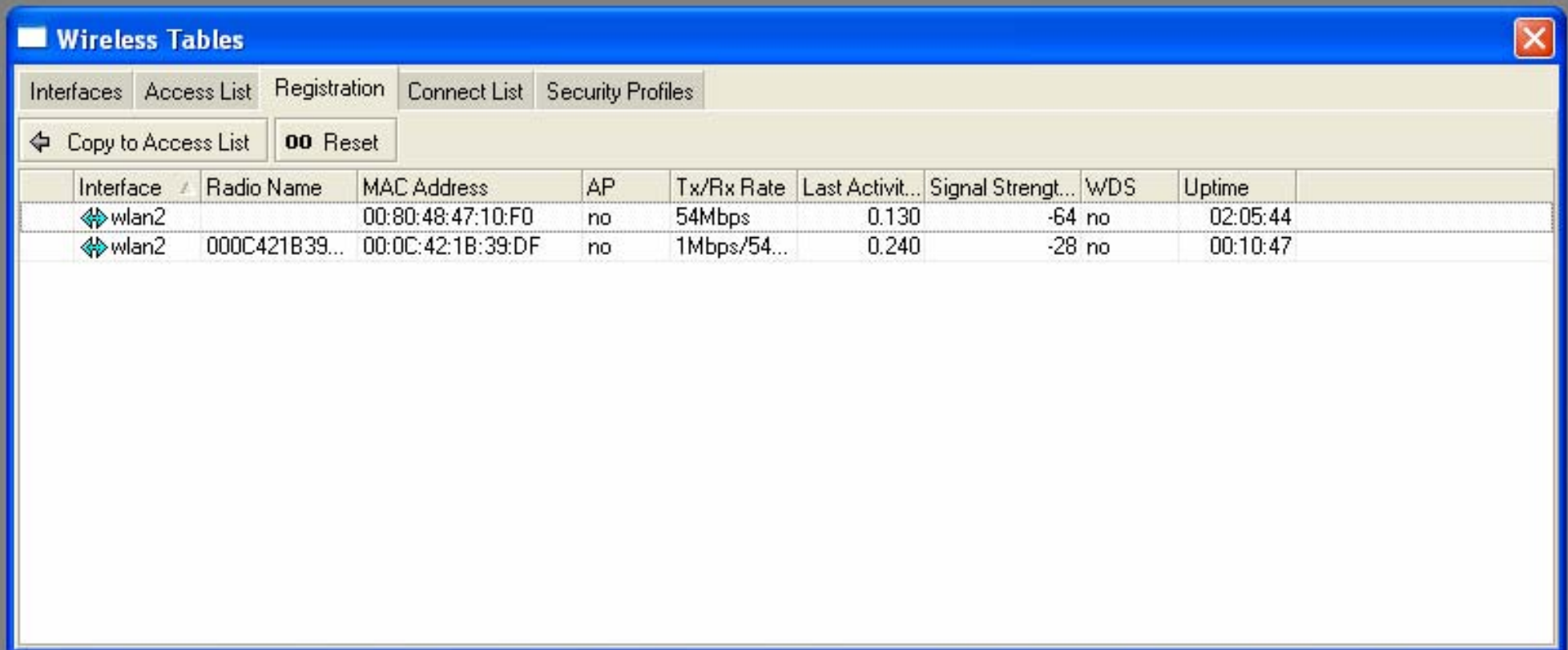
At the bottom, there are three status buttons: "disabled", "running", and "running ap". On the right side of the window, there is a vertical column of buttons: "OK", "Cancel", "Apply", "Disable", "Comment", "Scan...", "Freq. Usage...", "Align...", "Sniff...", and "Snooper...".

Cara mengkoneksikan Station ke AP

The screenshot shows a network configuration window for a wireless interface named 'wlan1'. The 'General' tab is selected, and the 'Station' mode is chosen. The SSID is set to 'TRAINING-UFOAKSES' and the band is 2.4GHz-B. A scan is currently running, showing several detected networks in the 'Scan <wlan1> (running)' window.

	Address	SSID	Band	Frequ...	Signa...	Radio Name	RouterO...	
BR	00:02:6F:43:8E:20	USL-ADI...	2.4GHz-B	2417	-94	00026F438E20	2.9.40	Start
ABR	00:19:FC:05:00:57		2.4GHz-B	2442	-13	Training	2.9.48	Stop
ABP	00:80:48:3E:97:ED	compex-n...	2.4GHz-B	2412	-59			Close
ABR	02:19:FC:05:00:57	TRAININ...	2.4GHz-B	2442	-13	Training	2.9.48	Connect

Mengecek client yang telah berhasil bergabung dengan Akses Point



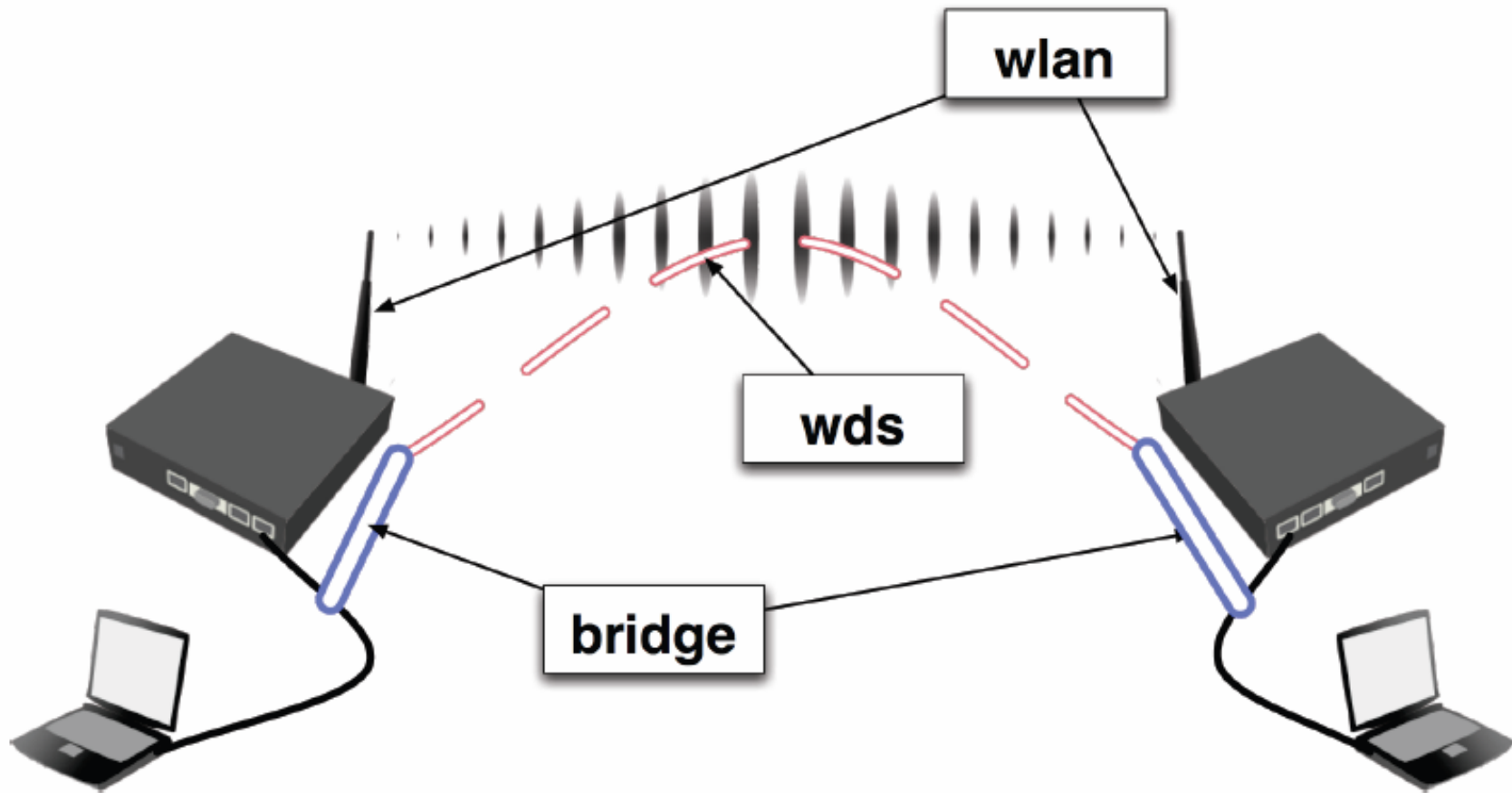
The screenshot shows a window titled "Wireless Tables" with a blue header and a close button in the top right corner. Below the header, there are several tabs: "Interfaces", "Access List", "Registration", "Connect List", and "Security Profiles". The "Access List" tab is currently selected. Below the tabs, there are two buttons: "Copy to Access List" and "Reset". The main area of the window contains a table with the following columns: Interface, Radio Name, MAC Address, AP, Tx/Rx Rate, Last Activit..., Signal Strengt..., WDS, and Uptime. There are two rows of data in the table.

Interface	Radio Name	MAC Address	AP	Tx/Rx Rate	Last Activit...	Signal Strengt...	WDS	Uptime
wlan2		00:80:48:47:10:F0	no	54Mbps	0.130	-64	no	02:05:44
wlan2	000C421B39...	00:0C:42:1B:39:DF	no	1Mbps/54...	0.240	-28	no	00:10:47

Wireless Distribution System

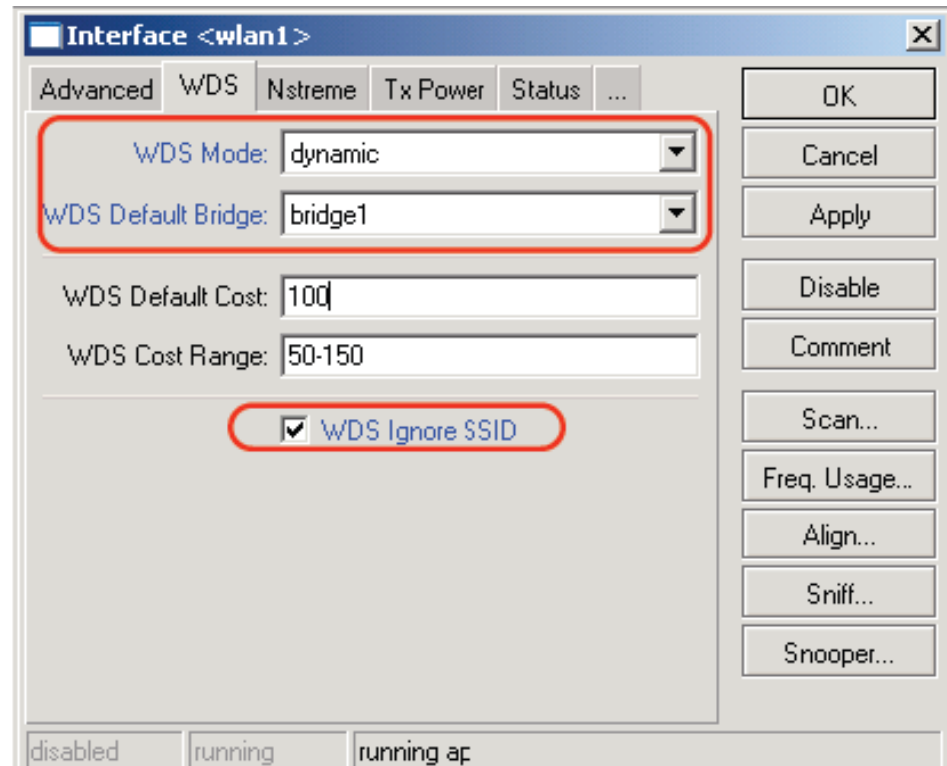
- WDS link can be created between wireless interfaces in several mode variations:
 - bridge/ap-bridge – bridge/ap-bridge
 - bridge/ap-bridge – wds-slave
 - bridge/ap-bridge – station-wds
- You must disable DFS setting when using WDS with more than one AP

Simple WDS Topologies



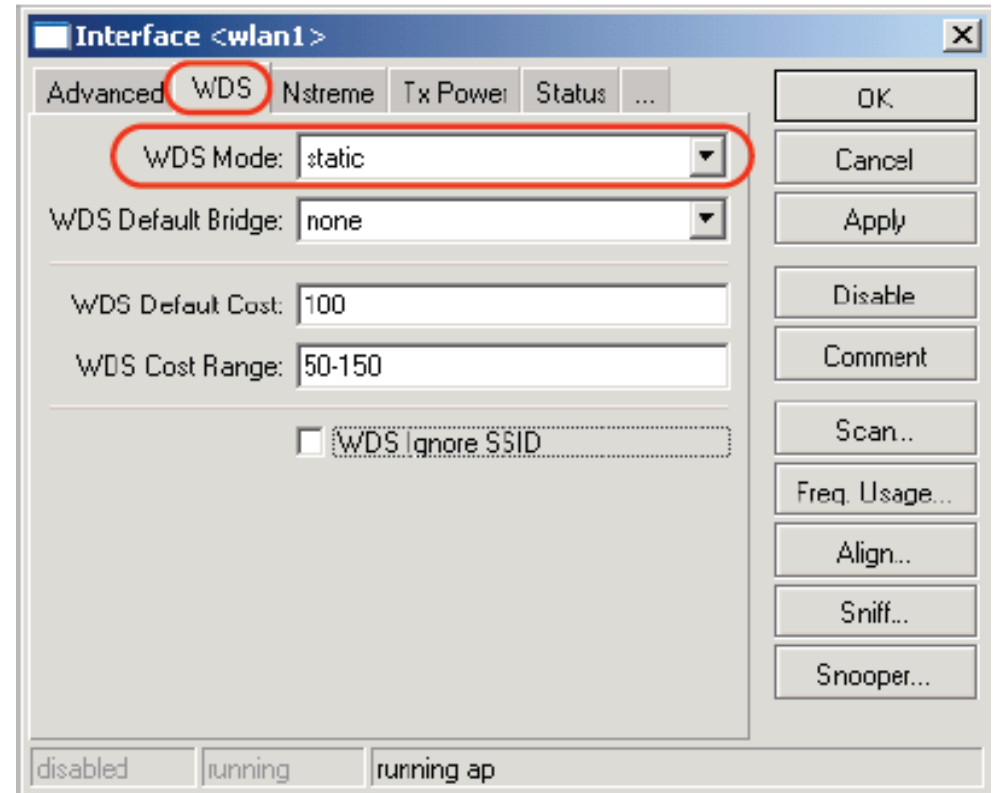
Dynamic WDS Interface

- WDS can be created between two APs, both must have WDS (static or dynamic) feature enabled
- APs must have same SSID or the “WDS ignore SSID” feature enabled
- We must create a bridge to use dynamic wds feature



Static WDS

- To use static WDS use “ap-bridge” mode
- Set WDS mode to “static” and WDS default bridge to “none”
- Create static WDS interfaces



Static WDS Interface

The screenshot shows the Mikrotik WinBox interface for configuring wireless tables. The 'Wireless Tables' window is open, and the 'New Interface' dialog is displayed. The 'WDS' option is selected in the 'VirtualAP' dropdown, and the 'Master Interface' is set to 'wlan1'. The 'WDS Address' field is set to '<clients MAC address>'.

	Type	MTU	MAC Address	Mode	Band	Frequency	SSID
	Wireless (Athero...	1500					
	Wireless (Athero...	1500					
	Wireless (Athero...	1500					
R	wlan1	1500					
RA	wds1	1500					

New Interface

General WDS Traffic

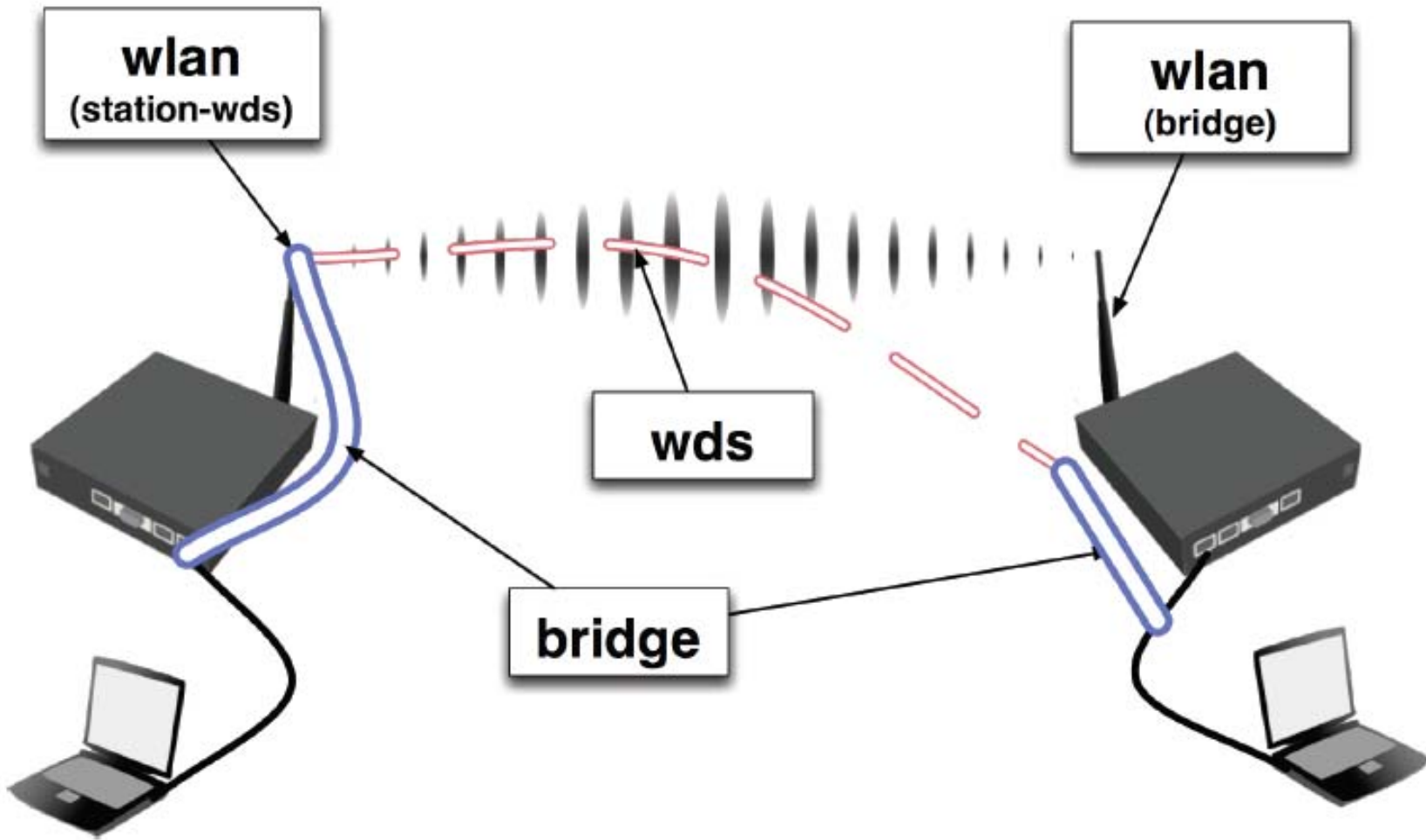
Master Interface: wlan1

WDS Address: <clients MAC address>

OK Cancel Apply Disable Comment

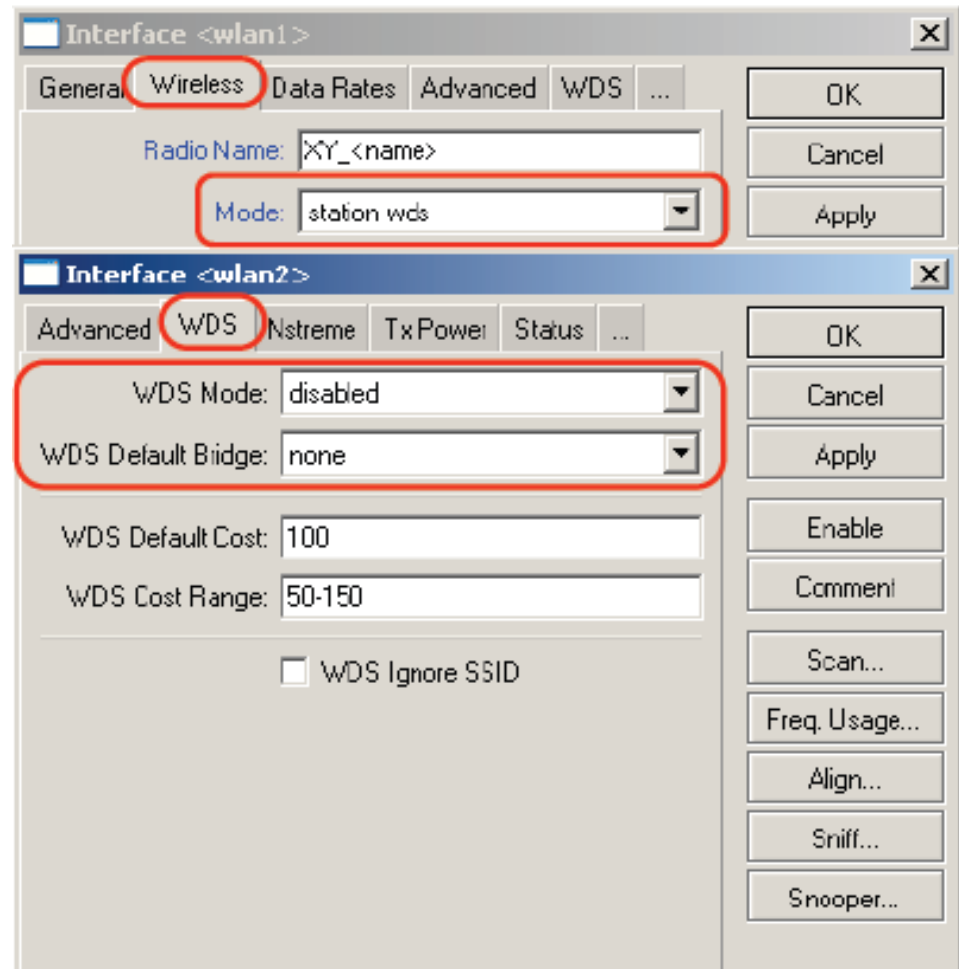
disabled running

Station-WDS

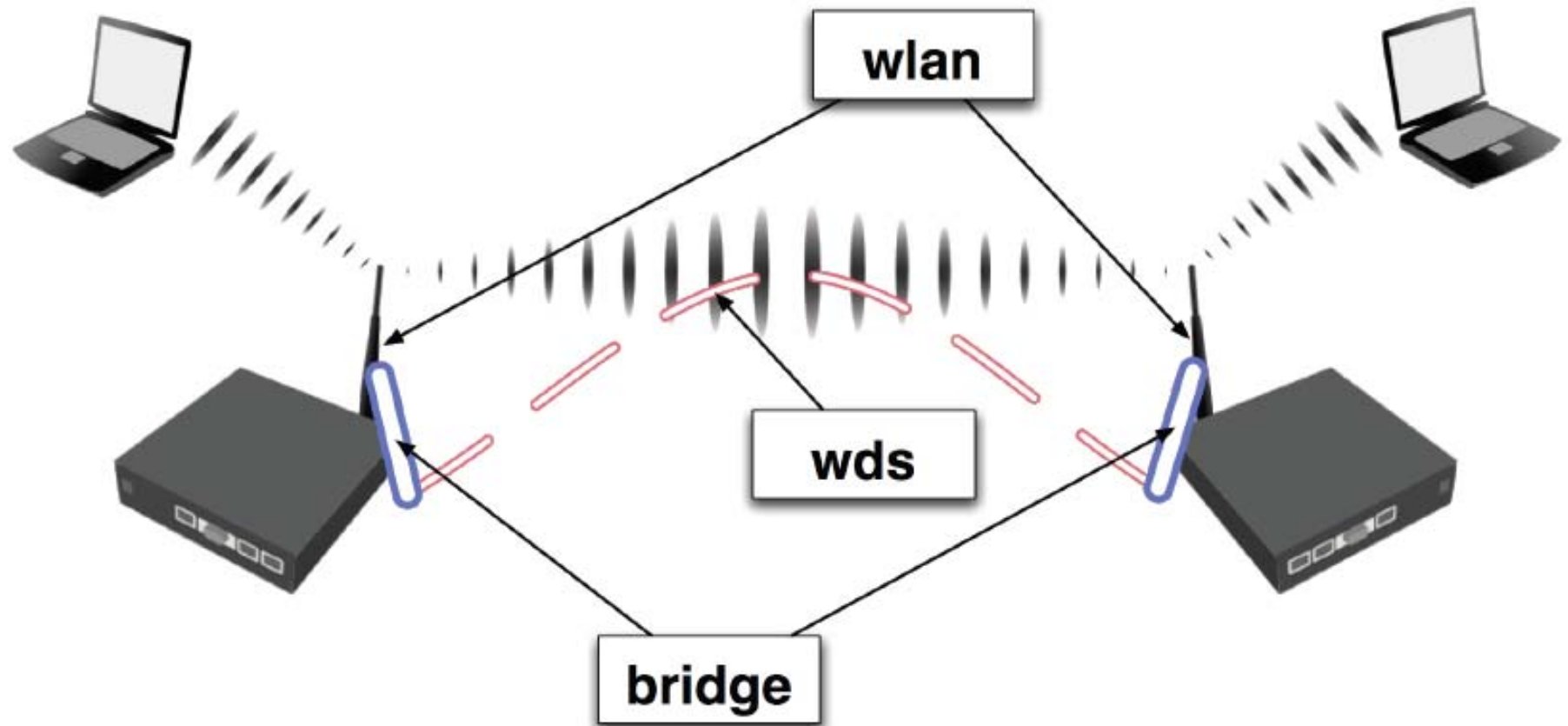


Station-WDS

- Use station-wds mode to create clients with WDS capabilities
- WDS-mode must be disabled on the wireless card
- Now your wireless interface will work in the bridge



Simple MESH using WDS



WDS Setting

Konfigurasi router 1

The screenshot shows the 'Interface <wlan1>' configuration window with the 'WDS' tab selected. The window has a blue title bar and a standard Windows-style interface with a close button (X) in the top right corner. The 'WDS' tab is highlighted in the top navigation bar. The main area contains various configuration fields and checkboxes. On the right side, there is a vertical stack of buttons: OK, Cancel, Apply, Disable, Comment, Scan..., Freq. Usage..., Align..., Sniff..., and Snooper... At the bottom, there are three status indicators: 'disabled', 'running', and 'running ap', with 'running' and 'running ap' being active.

Interface <wlan1 >

General Wireless Data Rates Advanced **WDS** ...

Radio Name: 008048528438

Mode: ap bridge

SSID: WDS_TEST

Band: 2.4GHz-B

Frequency: 2412

Scan List:

Security Profile: default

Frequency Mode: manual txpower

Country: no_country_set

Antenna Gain: 0 dBi

DFS Mode: none

Proprietary Extensions: post-2.9.25

Default AP Tx Rate: bps

Default Client Tx Rate: bps

Default Authenticate

Default Forward

Hide SSID

OK

Cancel

Apply

Disable

Comment

Scan...

Freq. Usage...

Align...

Sniff...

Snooper...

disabled running running ap

The screenshot shows the 'Interface <wlan1>' configuration window with the 'Advanced' tab selected. The window has a blue title bar and a standard Windows-style interface with a close button (X) in the top right corner. The 'Advanced' tab is highlighted in the top navigation bar. The main area contains WDS-specific configuration fields and checkboxes. On the right side, there is a vertical stack of buttons: OK, Cancel, Apply, Disable, Comment, Scan..., Freq. Usage..., Align..., Sniff..., and Snooper... At the bottom, there are three status indicators: 'disabled', 'running', and 'running ap', with 'running' and 'running ap' being active.

Interface <wlan1 >

Advanced **WDS** Nstreme Tx Power Status ...

WDS Mode: dynamic

WDS Default Bridge: bridge1

WDS Default Cost: 100

WDS Cost Range: 50-150

WDS Ignore SSID

OK

Cancel

Apply

Disable

Comment

Scan...

Freq. Usage...

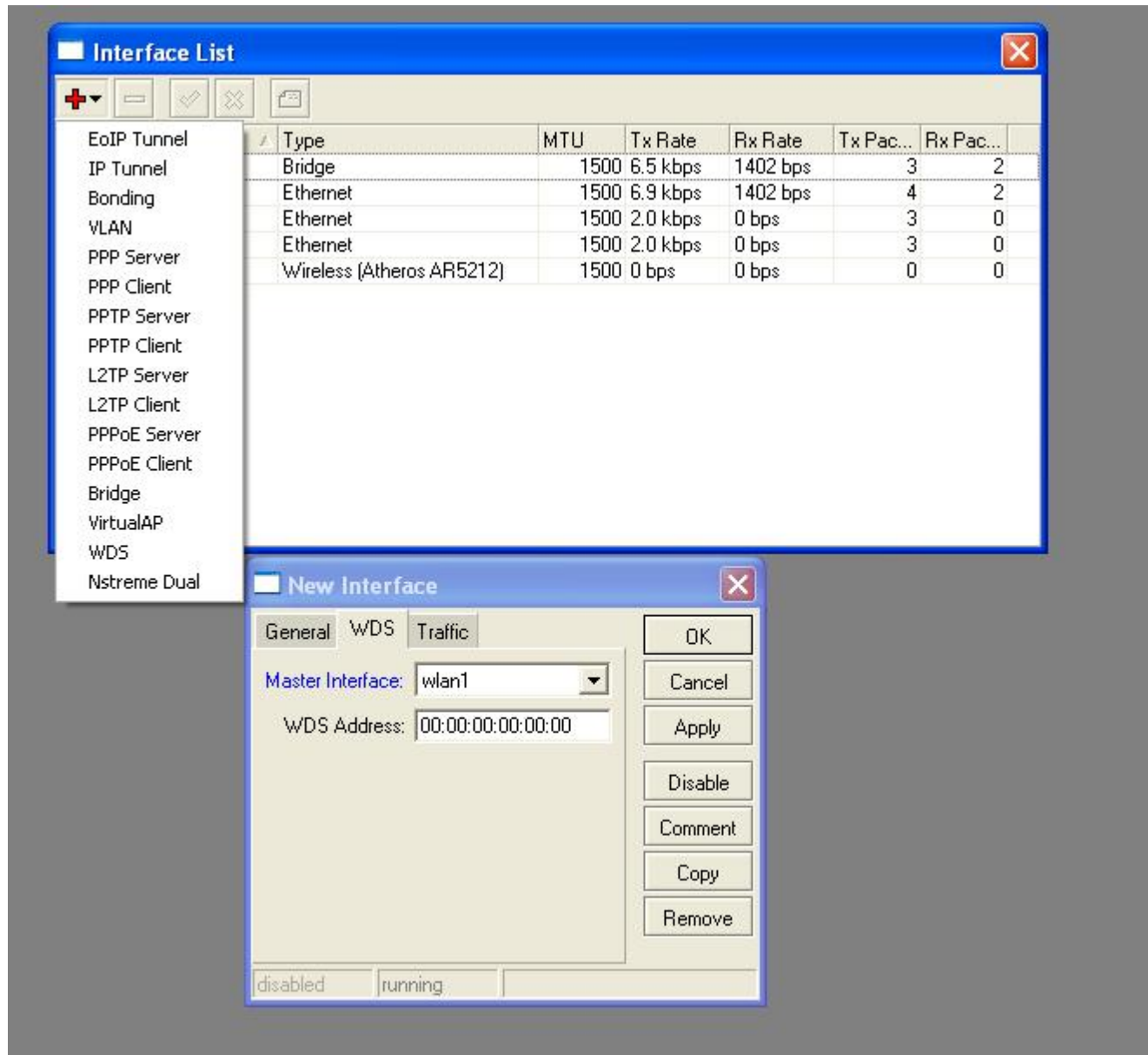
Align...

Sniff...

Snooper...

disabled running running ap

Membuat interface WDS



Konfigurasi router 2

admin@00:0C:42:19:C0:54 (MikroTik) - WinBox v3.0rc9 on RB192

00:48:22 Memory: 18.2 MiB CPU: 100% Hide Passwords

RouterOS WinBox

Interfaces
Wireless
Bridge
PPP
IP
IPv6
Routing
Ports
Queues
Drivers
System
Files
Log
SNMP
Users
Radius
Tools
New Terminal
Telnet
Password
Certificate
Make Supout.tif
Manual
Exit

Wireless Tables

Interfaces: Nstreme Dual Access List Registration Connect List Security Profiles

Name	Type	Tx	Rx	Tx Pac...	Rx Pac...	MAC Address	ARP	Mode	Band	Frequen...	SSID
wlan1	Wireless (Atheros AR5...	0 bps	424 bps	0	1	00:0C:42:1B:39:DF	enabled	ap bri...	2.4GH...	2412	WDS_TE...
wds1	WDS	0 bps	424 bps	0	1	00:0C:42:1B:39:DF	enabled				

2 items (1 selected)

Interface <wlan1>

General Wireless Data Rates Advanced WDS ...

Mode: ap bridge
Band: 2.4GHz-B/G
Frequency: 2412 MHz
SSID: WDS_TEST
Radio Name: 000C421B39DF
Scan List:
Security Profile: default
Frequency Mode: manual txpower
Country: no_country_set
Antenna Gain: 0 dBi
DFS Mode: none
Proprietary Extensions: post-2.9.25
WMM Support: disabled
Default AP Tx Rate: bps
Default Client Tx Rate: bps
 Default Authenticate
 Default Forward
 Hide SSID

OK
Cancel
Apply
Disable
Comment
Torch
Scan...
Freq. Usage...
Align...
Sniff...
Snooper...

start My Documents Command Prompt Fresnel Zone - Pe... antena - Penelus... Microsoft PowerP... untitled - Paint admin@00:0C:42... Desktop 11:19 AM

Bridge dan mengaktifkan WDS

The screenshot displays the MikroTik WinBox interface for configuring WDS on the wlan1 interface. The 'Interface <wlan1>' window is open, showing the 'WDS' tab. The configuration includes:

- WDS Mode: dynamic
- WDS Default Bridge: bridge1
- WDS Default Cost: 100
- WDS Cost Range: 50-150
- WDS Ignore SSID

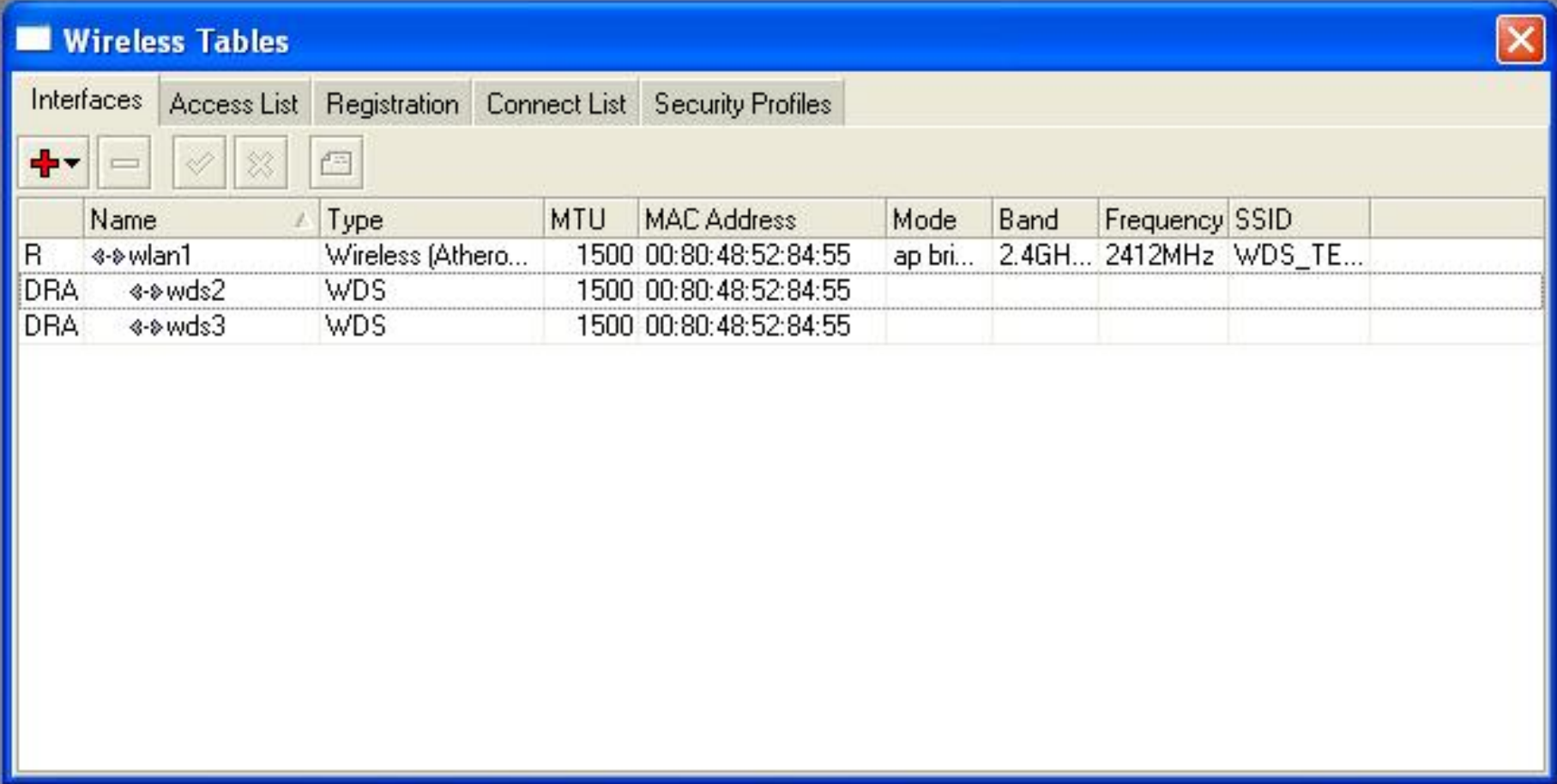
Below the configuration fields, there are status indicators for various components: disabled, running, slave, and running ap.

The 'Bridge' window is also open, showing a table of bridge entries:

Name	Type	Tx	Rx	Tx Pac...	Rx Pac...	MAC Address	Protoco...
R bridge1	Bridge	0 bps	0 bps	0	0	00:0C:42:1B:39:DF	none

The table shows one item, 'R bridge1', with a status of '1 item'.

WDS Interface yang berhasil dibentuk



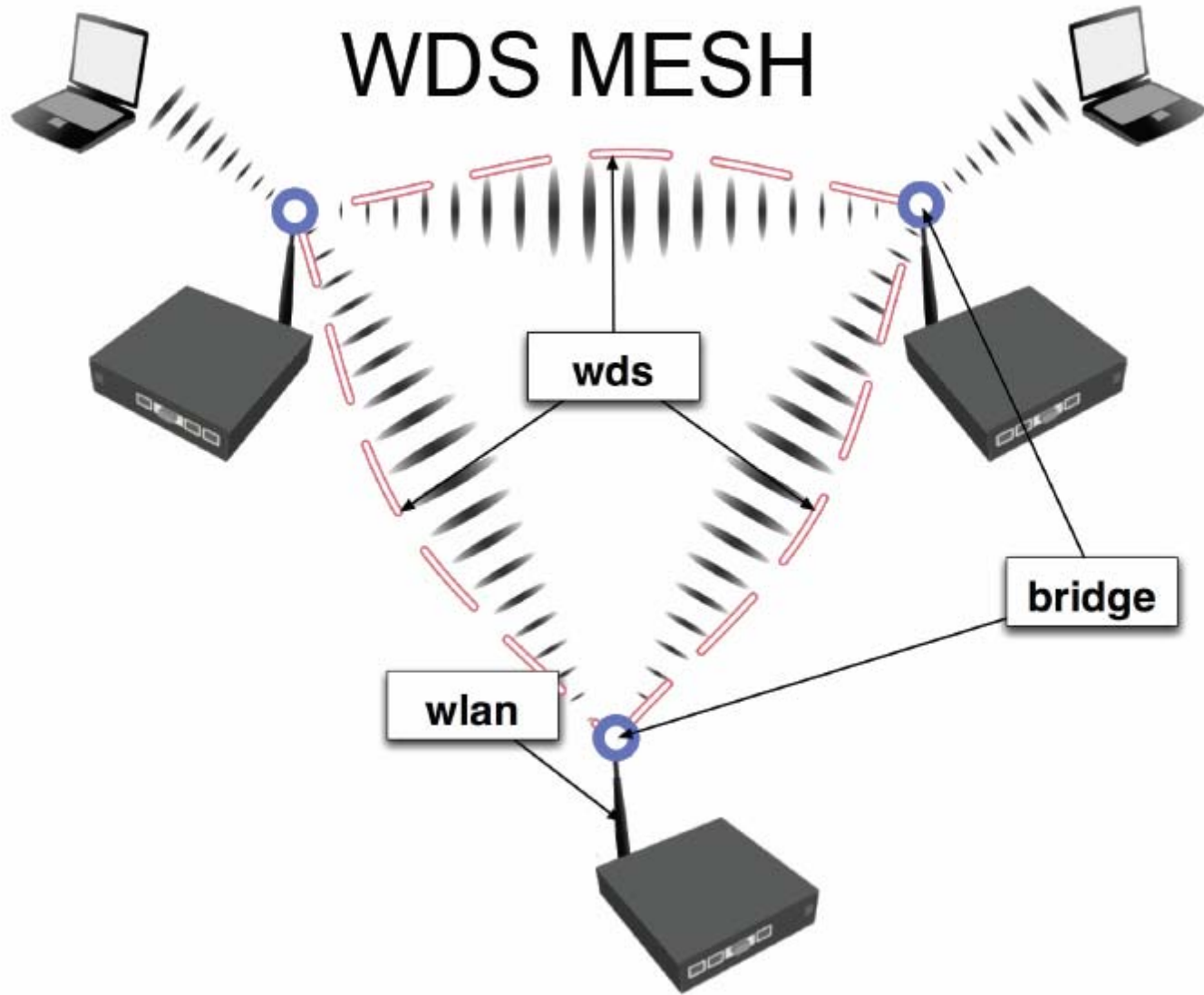
The screenshot shows a window titled "Wireless Tables" with a blue header and a red close button. Below the header are tabs for "Interfaces", "Access List", "Registration", "Connect List", and "Security Profiles". The "Interfaces" tab is active, showing a toolbar with icons for adding (+), deleting (-), checking (✓), unchecking (✗), and saving (floppy disk). Below the toolbar is a table with the following data:

	Name	Type	MTU	MAC Address	Mode	Band	Frequency	SSID
R	wlan1	Wireless (Athero...	1500	00:80:48:52:84:55	ap bri...	2.4GH...	2412MHz	WDS_TE...
DRA	wds2	WDS	1500	00:80:48:52:84:55				
DRA	wds3	WDS	1500	00:80:48:52:84:55				

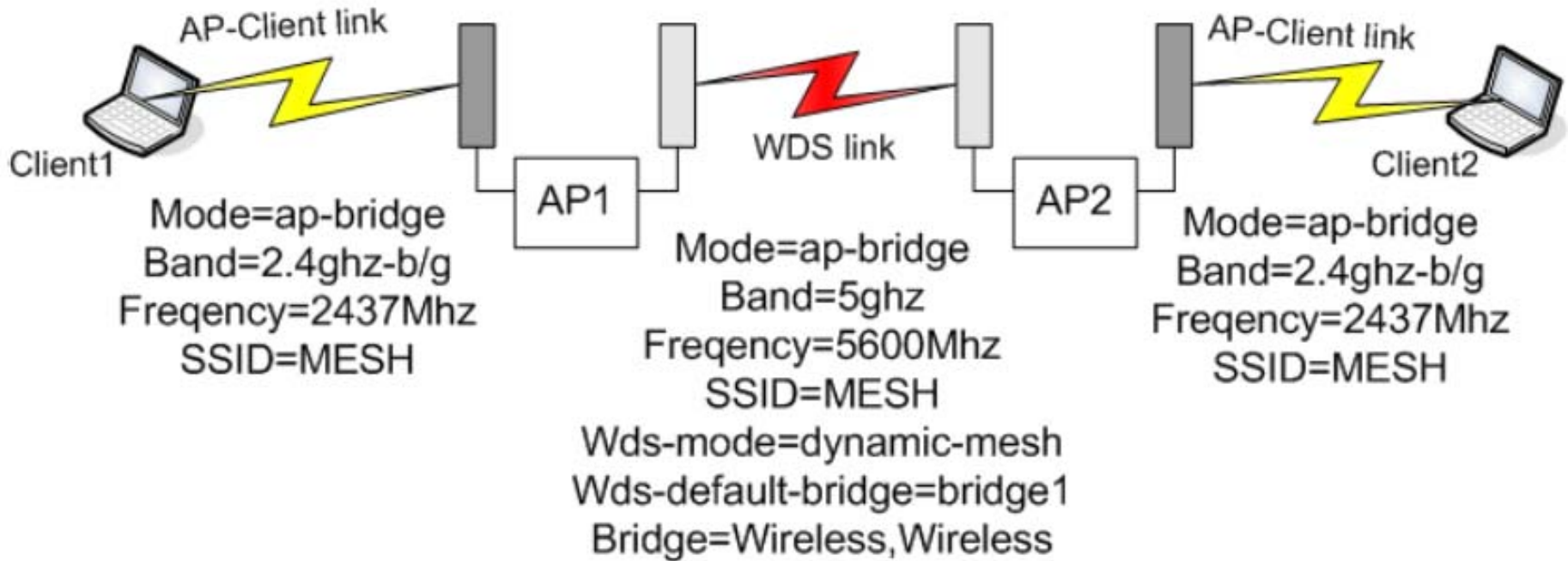
WDS Interface Mode

- Ap-bridge dengan ap-bridge
 - Dapat diset frekuensi pada masing-masing AP
 - Dapat melayani banyak station
- Ap-bridge dengan wds-slave
 - Frekuensi pada slave mengikuti Ap-bridge
 - Dapat melayani banyak station
- Ap-bridge dengan station-wds
 - Frekuensi pada slave mengikuti Ap-bridge
 - Tidak dapat melayani station

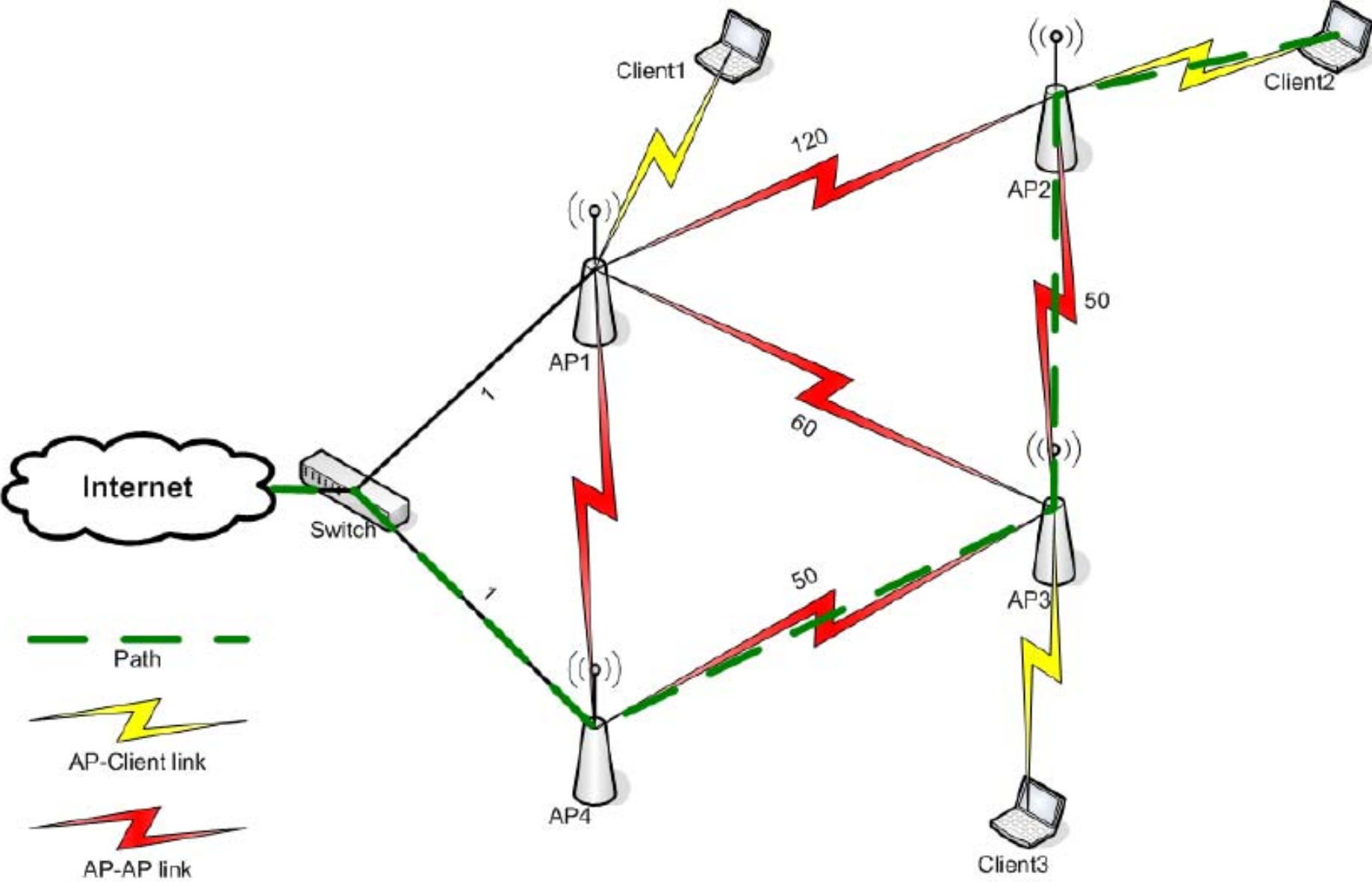
WDS MESH



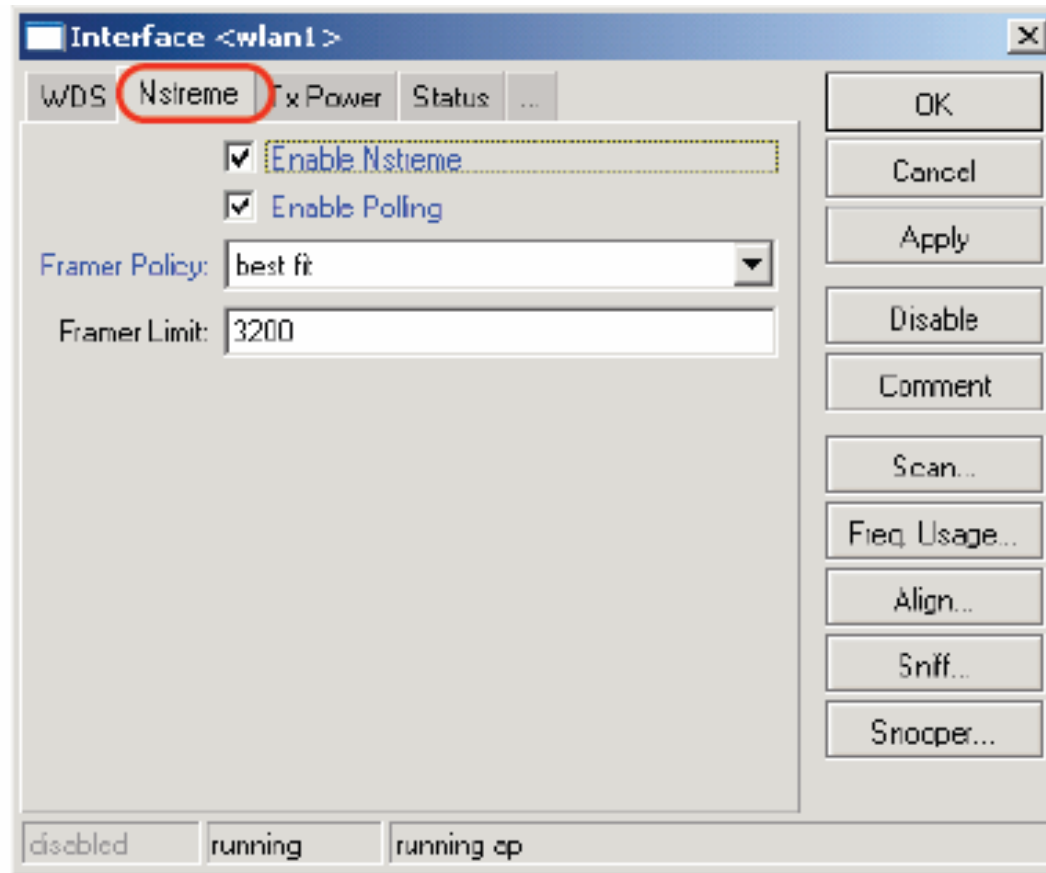
Dual Band MESH



MESH Network



Fitur Nstream



Nstreme Protocol

- Benefits of Nstreme protocol:
- Client polling
- Very low protocol overhead per frame allowing super-high data rates
- No protocol limits on link distance
- No protocol speed degradation for long link distances
- Dynamic protocol adjustment depending on traffic type and resource usage

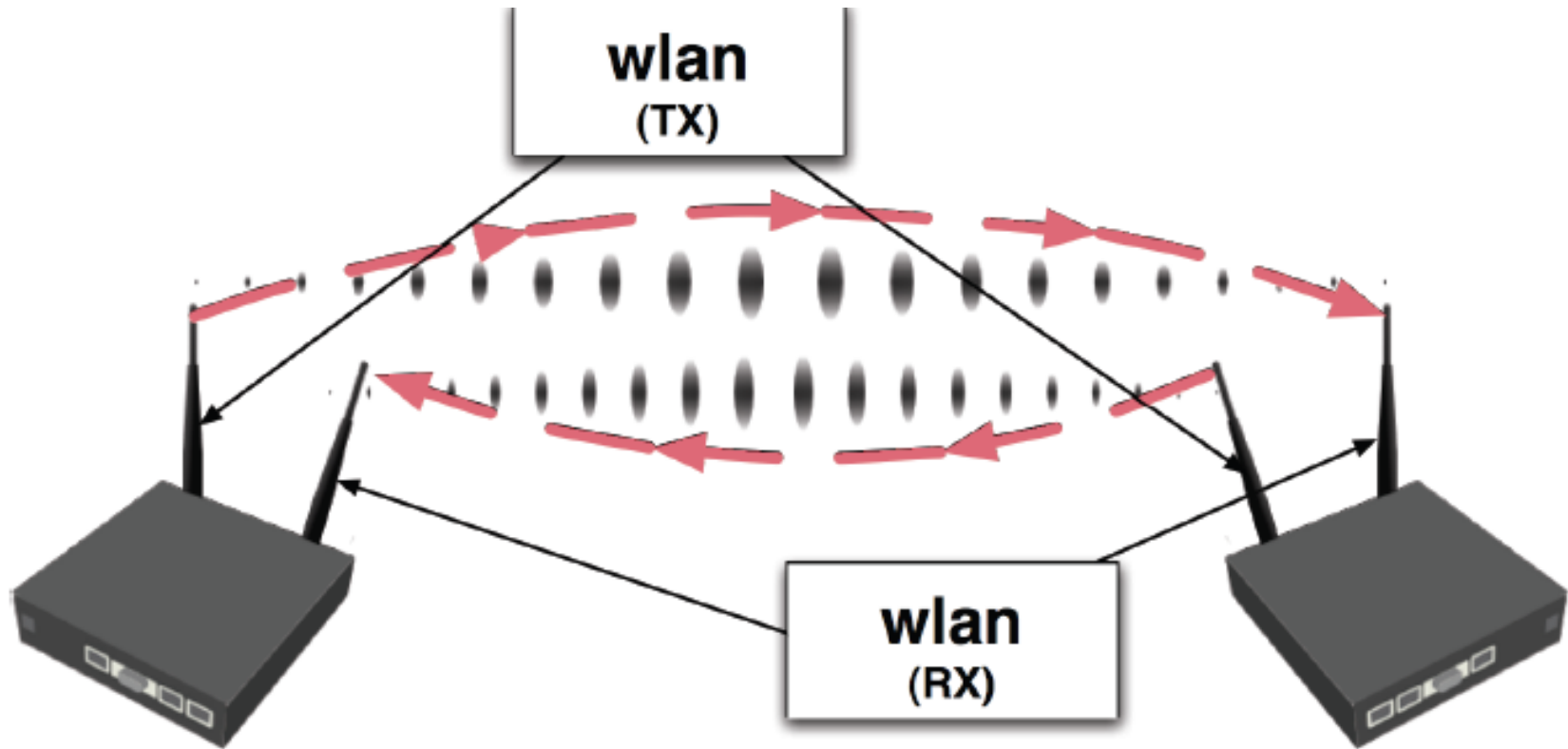
Nstream Frames

- Framer limit = maximal frame size
- Framer-policy = bagaimana mengkombinasi frames
 - None = do not combine packet
 - Best-fit = put as much packets as possible in one frame until the limit is met but do not fragment packetz
 - Exact-size = put as much packets as possible in one frame until the limit is met even if fragmentation will be needed
 - Dynamic-size = choose the best frame size dynamically

Konfigurasi Nstream untuk 2 wireless

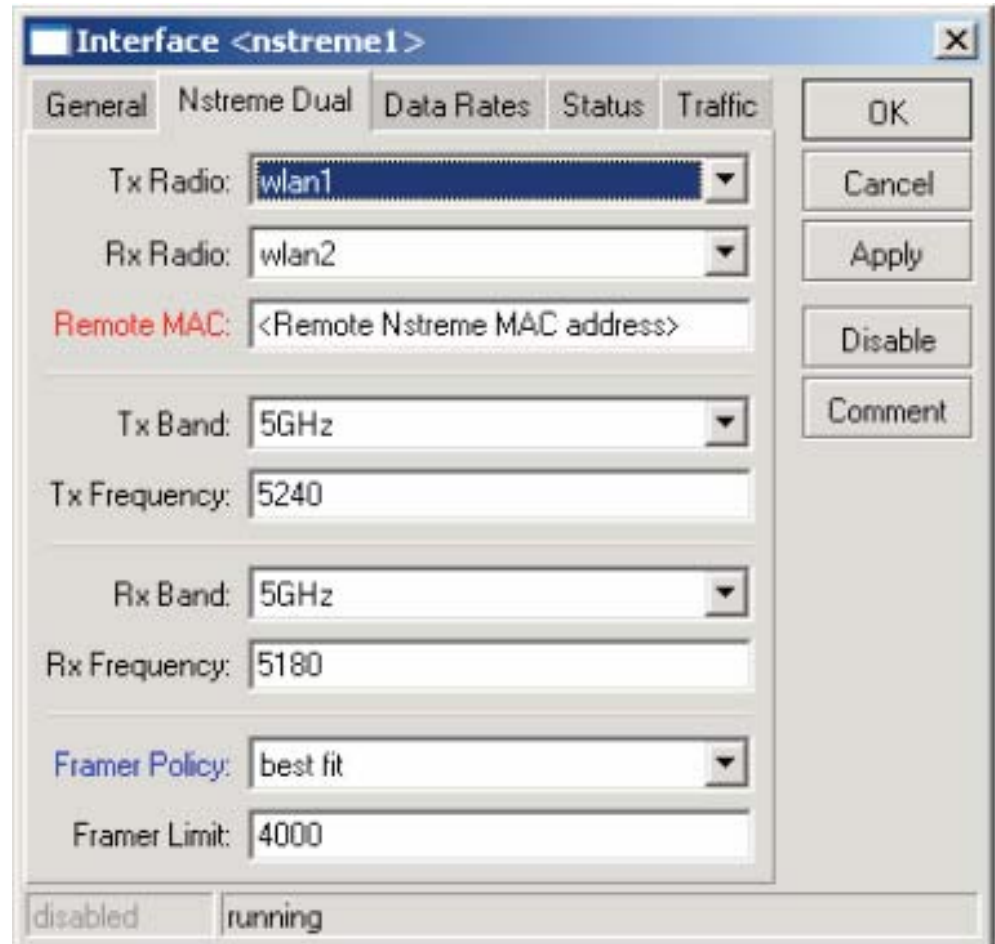
- Router 1
 - Set mode Ap-bridge pada wlan1 interface
 - /interface wireless nstream set wlan1 enable-nstream=yes
- Router 2
 - Set mode station pada wlan1 interface
 - Konekkan ke AP
 - /interface wireless nstream set wlan1 enable-nstream=yes
 - Kemudian monitor link dengan script :
 - /interface wireless monitor wlan1

Nstreme Dual Protocol



Nstreme Dual Interface

- Set both wireless cards into “nstreme_dual_slave” mode
- Create Nstreme dual interface (press “plus” button in wireless interface window)
- Use framer policy only if necessary

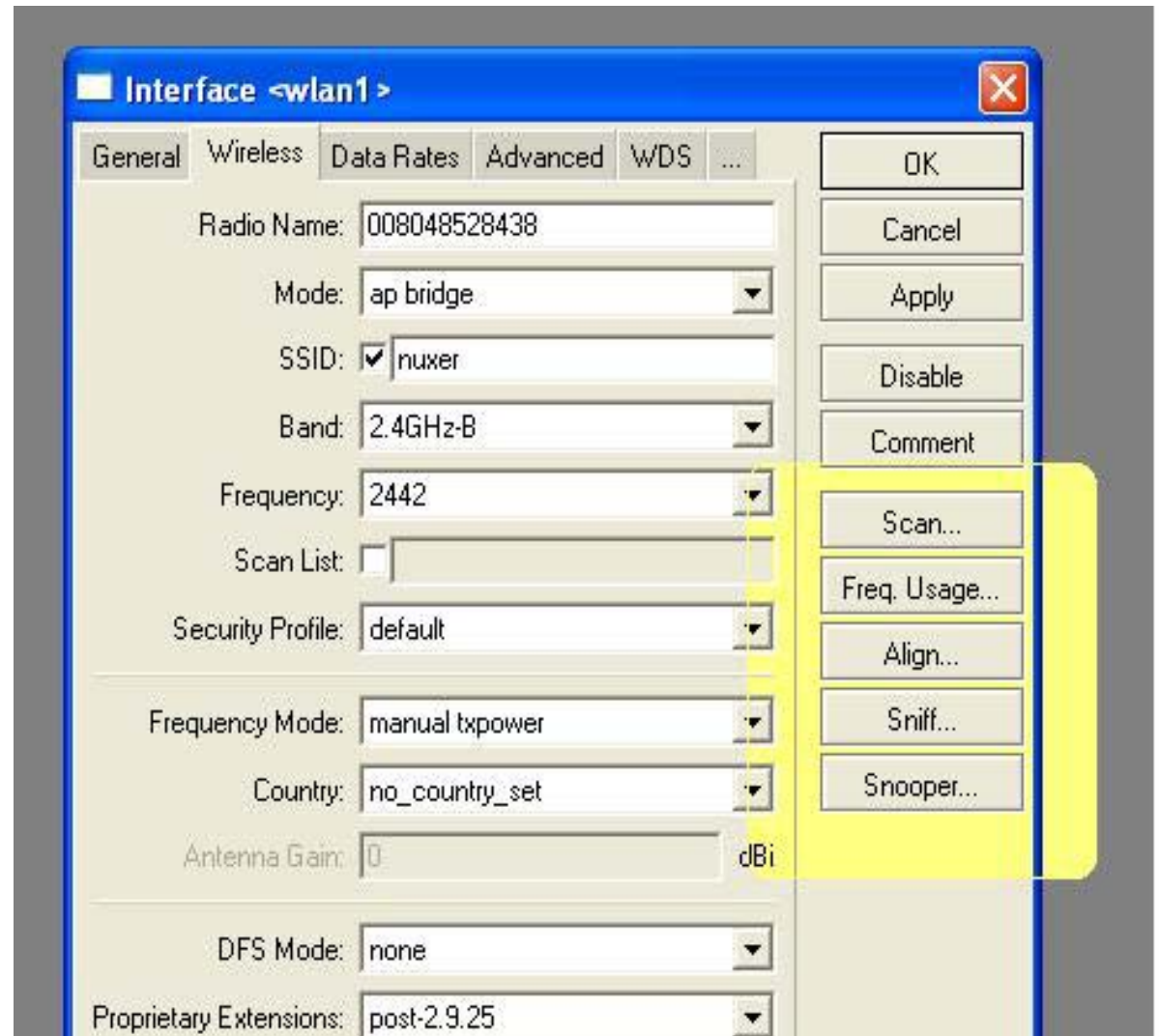


Fitur –fitur dalam wireless

- Default forward : mengallow client untuk saling berkomunikasi
- Ack-timeout : acknowledge code timeout untuka acknowledgement messages.
- Connect list : dapat mengallow atau deny clients yang terkoneksi dengan akses point.
- Supported –rates : client data rates.
- Basic rates : link management data rates
- Jika router tidak dapat mengirim atau menerima data pada basic rate maka link akan down.

Tool dalam wireless

- Scan
- Frequency Used
- Sniffer
- Snooper



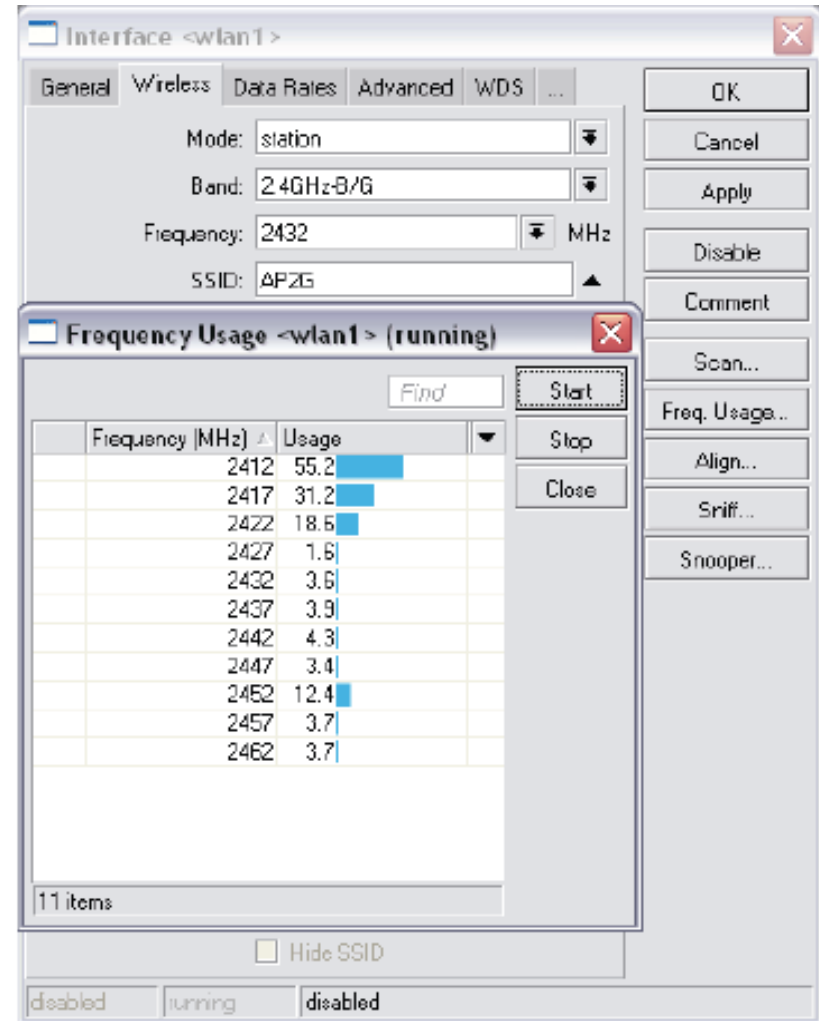
Scan = untuk menscan wifi yang ada disekitar area jangkauan antena



	Address	SSID	Band	Frequ...	Signa...	Radio Name	RouterO...
ABR	00:19:FC:05:00:57		2.4GHz-B	2442	-26	Training	2.9.48
ABP	00:80:48:3E:97:ED	compex-np27g	2.4GHz-B	2412	-59		
ABR	02:19:FC:05:00:57	TRAINING-UF...	2.4GHz-B	2442	-25	Training	2.9.48
ABR	02:19:FC:05:00:58	BRIDGE	2.4GHz-B	2442	-25	Training	2.9.48

Frequency Usage Tool

- Frequency Usage Monitor looks only for IEEE 802.11 frames
- Interface is disabled during the Frequency usage monitor



Sniffer = mencapture paket wifi

The image shows a network sniffer application interface. The main window, titled "Sniffed Wireless Packets", displays a table of captured packets. The table has columns for Time, Interface, Band, Frequency, Signal strength, Rate, Destination (Dst.), Source (Src.), and Type. The packets are all beacons from the wlan1 interface, captured between 0.033s and 5.882s. The configuration dialog box, titled "Sniffer <wlan1>", is open on the right, showing various settings and statistics.

Time	Interface	Band	Frequ...	Signal ...	Rate	Dst.	Src.	Type
0.033s	wlan1	2.4GHz-B	2412...	-65dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:80:48:3E:97:ED	beacon
0.135s	wlan1	2.4GHz-B	2412...	-63dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:80:48:3E:97:ED	beacon
0.238s	wlan1	2.4GHz-B	2417...	-69dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:80:48:3E:97:ED	beacon
0.340s	wlan1	2.4GHz-B	2417...	-69dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:80:48:3E:97:ED	beacon
1.171s	wlan1	2.4GHz-B	2437...	-25dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:58	beacon
1.280s	wlan1	2.4GHz-B	2437...	-25dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:58	beacon
1.373s	wlan1	2.4GHz-B	2442...	-25dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:19:FC:05:00:57	beacon
1.374s	wlan1	2.4GHz-B	2442...	-25dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:57	beacon
1.376s	wlan1	2.4GHz-B	2442...	-24dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:58	beacon
1.483s	wlan1	2.4GHz-B	2442...	-25dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:19:FC:05:00:57	beacon
1.578s	wlan1	2.4GHz-B	2447...	-32dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:19:FC:05:00:57	beacon
1.579s	wlan1	2.4GHz-B	2447...	-32dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:57	beacon
1.580s	wlan1	2.4GHz-B	2447...	-32dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:58	beacon
1.687s	wlan1	2.4GHz-B	2447...	-32dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:58	beacon
2.388s	wlan1	2.4GHz-B	2412...	-65dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:80:48:3E:97:ED	beacon
2.491s	wlan1	2.4GHz-B	2412...	-65dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:80:48:3E:97:ED	beacon
2.695s	wlan1	2.4GHz-B	2417...	-68dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:80:48:3E:97:ED	beacon
3.422s	wlan1	2.4GHz-B	2437...	-26dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:19:FC:05:00:57	beacon
3.423s	wlan1	2.4GHz-B	2437...	-25dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:57	beacon
3.524s	wlan1	2.4GHz-B	2437...	-25dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:19:FC:05:00:57	beacon
3.526s	wlan1	2.4GHz-B	2437...	-25dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:57	beacon
3.527s	wlan1	2.4GHz-B	2437...	-26dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:58	beacon
3.627s	wlan1	2.4GHz-B	2442...	-25dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:19:FC:05:00:57	beacon
3.628s	wlan1	2.4GHz-B	2442...	-25dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:57	beacon
3.629s	wlan1	2.4GHz-B	2442...	-25dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:58	beacon
3.729s	wlan1	2.4GHz-B	2442...	-26dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:19:FC:05:00:57	beacon
3.730s	wlan1	2.4GHz-B	2442...	-25dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:57	beacon
3.732s	wlan1	2.4GHz-B	2442...	-25dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:58	beacon
3.832s	wlan1	2.4GHz-B	2447...	-33dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:19:FC:05:00:57	beacon
3.833s	wlan1	2.4GHz-B	2447...	-32dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:57	beacon
4.641s	wlan1	2.4GHz-B	2412...	-63dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:80:48:3E:97:ED	beacon
4.745s	wlan1	2.4GHz-B	2412...	-63dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:80:48:3E:97:ED	beacon
4.949s	wlan1	2.4GHz-B	2417...	-64dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:80:48:3E:97:ED	beacon
5.678s	wlan1	2.4GHz-B	2437...	-26dBm	1Mbps	FF:FF:FF:FF:FF:FF	02:19:FC:05:00:58	beacon
5.778s	wlan1	2.4GHz-B	2437...	-25dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:19:FC:05:00:57	beacon
5.882s	wlan1	2.4GHz-B	2442...	-27dBm	1Mbps	FF:FF:FF:FF:FF:FF	00:19:FC:05:00:57	beacon

Sniffer <wlan1>

- Processed Packets: 246
- Memory Size: 9.9 KiB
- Memory Saved Packets: 134
- Memory Over Limit Packets: 112
- File Size: 0 B
- File Saved Packets: 0
- File Overlimit Packets: 0
- Stream Dropped Packets: 0
- Stream Sent Packets: 0
- File Limit: 10KiB
- Memory Limit: 10KiB

Buttons: Start, Stop, Close, Save..., Settings..., Packets...

Snooper = untuk mencapture paket secara detail tiap wifi yang berada pada jangkuan antenna

The image shows a screenshot of the 'Snooper' application interface. The main window, titled 'Snooper <wlan1> (running)', displays a list of detected wireless networks. The table below shows the data for these networks:

Frequency	Band	Address	SSID	Of Freq. (%)	Of Traf. (%)	Bandwidth	Networks	Stations
2412	2.4GHz...	00:08:6B:4D:03:6B	hotspot	0.0	0.0	0 bps		1
2412	2.4GHz...	00:08:6B:4D:03:99	hotspot	0.0	0.0	0 bps		1
2412	2.4GHz...	00:08:6B:4D:04:2A	hotspot	1.7	18.5	15.5 kbps		1
2412	2.4GHz...	00:0C:42:05:01:39	test_ap	0.4	5.1	3.8 kbps		
2412	2.4GHz...	00:0C:42:05:28:30	hotspot	0.0	0.0	0 bps		
2412	2.4GHz...	02:08:6B:37:67:0D	hot	0.5	5.7	4.4 kbps		
2417	2.4GHz...			4.5		24.6 kbps		
2422	2.4GHz...			1.8		15.2 kbps		
2422	2.4GHz...	00:0C:42:0C:83:47	m pak	0.0	0.0	0 bps		
2427	2.4GHz...			2.1		17.4 kbps		
2432	2.4GHz...			15.3		3.7 Mbps		
2432	2.4GHz...	00:02:6F:08:53:18		0.6	4.1	4.3 kbps		
2432	2.4GHz...	00:02:6F:45:15:43	AP2G	12.8	83.4	3.7 Mbps		
2432	2.4GHz...	00:0E:2E:40:89:A7	MY AP	0.3	2.5	2.8 kbps		
2437	2.4GHz...			1.7		14.1 kbps		
2437	2.4GHz...	00:16:86:D9:53:D6	linksys	0.5	31.8	4.4 kbps		
2442	2.4GHz...			2.3		18.1 kbps		
2442	2.4GHz...	00:08:6B:37:5B:B4	dainars	0.9	41.8	7.7 kbps		
2442	2.4GHz...	00:17:9A:FD:F7:81	racer	0.4	20.9	3.8 kbps		
2447	2.4GHz...			1.9		15.7 kbps		
2452	2.4GHz...			1.7		10.5 kbps		
2452	2.4GHz...	00:08:6B:31:52:69	tests	0.0	0.0	0 bps		
2452	2.4GHz...	00:0C:42:05:06:F3	Demio	0.0	0.0	0 bps		
2452	2.4GHz...	00:0C:42:05:0A:5D	UML-2	0.0	0.0	0 bps		

The 'Wireless Network <00:02:6F:45:15:43>' configuration window is open, showing the following details:

- General: Frequency: 2432 MHz, Band: 2.4GHz-B/G, Address: 00:02:6F:45:15:43, SSID: AP2G
- Beacon: Of Freq.: 12.8%, Of Traf.: 83.4%, Bandwidth: 3.7 Mbps, Stations: 2
- Mikrotik: SSID source: beacon, Supported Rates: 1Mbps 2Mbps 5.5Mbps..., Basic Rates: 1Mbps 2Mbps 5.5Mbps..., Capabilities: ess short-preamble