

# Wireless Tips and Tricks for RouterOS v6

MUM South Africa 2013

Johannesburg

Uldis Cernevskis

MikroTik

# Topics

- Quickset for Wireless
- Transparent wireless links
- Useful configuration settings and features

# Quickset

- Few clicks to setup MikroTik router
- AP and CPE modes
- Point to Point Bridge mode (starting from RouterOS v5.21)

# How to get Quickset Winbox

admin@D4:CA:6D:2B:B4:4E (MikroTik) - WinBox v5.20 on RB951-2n (mipsbe)

Safe Mode

Hide Passwords

Quick Set

Interfaces

Wireless

Bridge

PPP

Switch

Mesh

IP

MPLS

Routing

System

Queues

Files

Log

Radius

Tools

New Terminal

MetaROUTER

Make Supout.rif

Manual

Exit

RouterOS WinBox

CPE Quick Set

Info

WLAN MAC Address: D4:CA:6D:2B:B4:52

LAN MAC Address: D4:CA:6D:2B:B4:4D

Wireless

Country: united states

Channel Width: 20/40MHz HT Above

	Address	SSID	Band	Protocol	Frequ...	Sig...
R	00:0C:42:00:63:67	ap_lapto...	2GHz-B 20MHz	802.11	2462	-91
PR	00:0C:42:00:8A:31	hotspot	2GHz-B 20MHz	802.11	2452	-41
R	00:0C:42:00:8A:3D	mega-bu...	2GHz-B 20MHz	802.11	2462	-58
PR	00:0C:42:0C:0A:C5	gtest	2GHz-B 20MHz	802.11	2412	-91
PR	00:0C:42:0C:0A:C9	gwifi	2GHz-B 20MHz	802.11	2412	-83
PR	00:0C:42:6B:91:7C		2GHz-B 20MHz	802.11	2442	-78
PR	00:0C:42:6B:E1:3B		2GHz-B 20MHz	802.11	2412	-69
P	00:16:B6:DD:B4:46	linksys	2GHz-B 20MHz	802.11	2462	-89
R	02:0C:42:00:8A:31	hot	2GHz-B 20MHz	802.11	2452	-38

Signal Strength: -76 dB

SSID:

WPA Password:

Connect

Configuration

Mode: Router Bridge

WLAN

Address Acquisition: DHCP PPPOE Static

WLAN IP Address: 0.0.0.0/0

Gateway: 0.0.0.0

Upload: unlimited bits/s

Download: unlimited bits/s

LAN

LAN IP Address: 10.0.100.1/24

DHCP Server

DHCP Server Range: 10.0.100.10-10.0.100.100

NAT

System

Router Identity: MikroTik

Password:

Confirm Password:

Reset Configuration

OK

Cancel

Apply

DHCP Renew

DHCP Release

# How to get Quickset Web-interface

**WebFig v5.20**  
CPE Quick Set

**Info**

WLAN MAC Address: D4:CA:6D:2B:B4:52  
LAN MAC Address: D4:CA:6D:2B:B4:4D

**Wireless**

Country: united states  
Channel Width: 20MHz

	Address	SSID	Band	Prot...	Fre...	Signal Strength
R	D4:CA:6D:55:EE:91	MikroTik	2GHz-B 20MHz	802.11	2412	-58
R	D4:CA:6D:53:38:83	MikroTik	2GHz-B 20MHz	802.11	2412	-62
R	D4:CA:6D:4C:B2:41	MikroTik	2GHz-B 20MHz	802.11	2412	-59
R	D4:CA:6D:2B:71:B1	MikroTik	2GHz-B 20MHz	802.11	2412	-89
R	D4:CA:6D:2D:78:81	MikroTik	2GHz-B 20MHz	802.11	2412	-87
R	D4:CA:6D:55:EE:85	MikroTik	2GHz-B 20MHz	802.11	2412	-69

Signal Strength: cur: -59 dB, avg: -60 dB, max: -51 dB

SSID: MikroTik

**Configuration**

Mode: ☒ Router ☐ Bridge

**WLAN**

Address Acquisition: ☐ Static ☒ DHCP ☐ PPPoE

WLAN IP Address: 0.0.0.0/0  
DHCP Release  
DHCP Renew

Gateway: 0.0.0.0

Upload: unlimited bits/s  
Download: unlimited bits/s

**LAN**

LAN IP Address: 10.5.8.52/24

DHCP Server: ☒

DHCP Server Range: 10.0.100.10-10.0.100.100

NAT: ☒

**System**

Router Identity: MikroTik

Password:

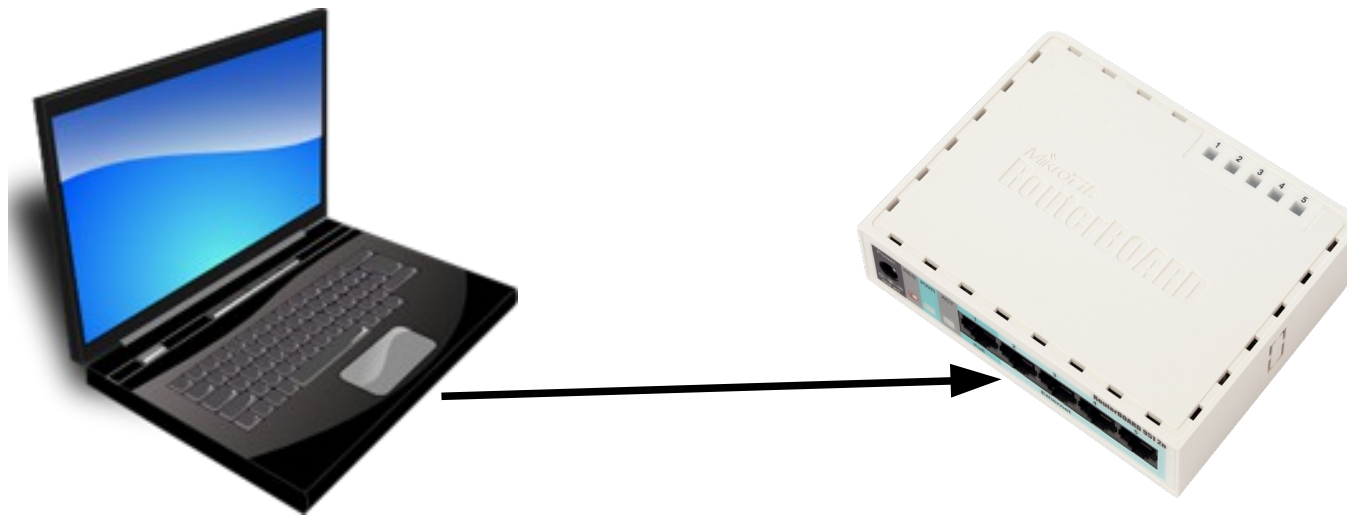
Confirm Password:

Upgrade:  Nav izvēlēts neviena fails

# Quickset feature support

- RB SXT
- RB Groove
- RB Metal
- RB 911/711/411
- Other RouterBoards (using first wireless interface)

# Quickset Setup



# AP Quickset

- Access router by browser or Winbox
- Configure AP settings
  - IP address, gateway
  - Wireless (SSID, frequency, band, security, etc.)
  - NAT
  - Additional configuration



# AP Quickset Demo

admin@D4:CA:6D:2B:B4:4E (MikroTik) - WinBox v5.20 on RB951-2n (mipsbe)

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Hide Passwords

RouterOS WinBox

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AP Quick Set

Wireless

SSID: Workshop

Frequency: 2412 MHz

Band: 2GHz-B/G/N

Channel Width: 20/40MHz HT Above

Country: united states

MAC Address: D4:CA:6D:2B:B4:52

Use ACL

Security: ☐ WPA ☐ WPA2

Encryption: ☐ tkip ☒ aes ccm

Pre-Shared Key:

Wireless Clients

MAC Address	In ACL	Last IP	Uptime	Signal Strength
-------------	--------	---------	--------	-----------------

Signal Strength:

Copy To ACL

Configuration

Mode: ☒ Router ☐ Bridge

WAN

Address Acquisition: ☒ DHCP ☐ PPPoE ☐ Static

WLAN IP Address: 10.5.8.62/24

DHCP Renew

DHCP Release

Gateway: 10.5.8.1

MAC Address: D4:CA:6D:2B:B4:4D

LAN/WLAN

LAN IP Address: 10.0.100.1/24

☒ Bridge All LAN Ports

☒ DHCP Server

DHCP Server Range: 10.0.100.10-10.0.100.100

☒ NAT

System

Router Identity: MikroTik

Password:

Confirm Password:

Reset Configuration

OK

Cancel

Apply

# CPE Quickset

- Access router by browser or Winbox
- Configure CPE settings:
  - Router or Bridge
  - IP address, gateway
  - Wireless (SSID, band, security)

# CPE Quickset Demo

**WebFig v5.20**  
CPE Quick Set

**Info**

WLAN MAC Address: D4:CA:6D:2B:B4:52  
LAN MAC Address: D4:CA:6D:2B:B4:4D

**Wireless**

Country: united states  
Channel Width: 20MHz

PR	MAC	Name	Freq	Ch	Power	Signal
PR	D4:CA:6D:12:56:F5	MikroTik	2GHz-B 20MHz	802.11	2437	-72
PR	D4:CA:6D:10:DC:A		2GHz-B 20MHz	802.11	2437	-81
PR	D4:CA:6D:10:DC:B		2GHz-B 20MHz	802.11	2437	-63
PR	00:0C:42:00:8A:31	hotspot	2GHz-B 20MHz	802.11	2452	-40
R	02:0C:42:00:8A:31	hot	2GHz-B 20MHz	802.11	2452	-38
R	00:0C:42:00:8A:3D	mega-bum	2GHz-B 20MHz	802.11	2462	-53
P	00:16:B6:DD:B4:46	linksys	2GHz-B 20MHz	802.11	2462	-91

Signal Strength: cur: -40 dB, avg: -40 dB, max: -31 dB

SSID: hotspot  
WPA Password: .....

**Configuration**

Mode: ☒ Router ☐ Bridge

**WLAN**

Address Acquisition: ☐ Static ☒ DHCP ☐ PPPoE  
WLAN IP Address: 0.0.0.0/0  
Gateway: 0.0.0.0  
Upload: unlimited bits/s  
Download: unlimited bits/s

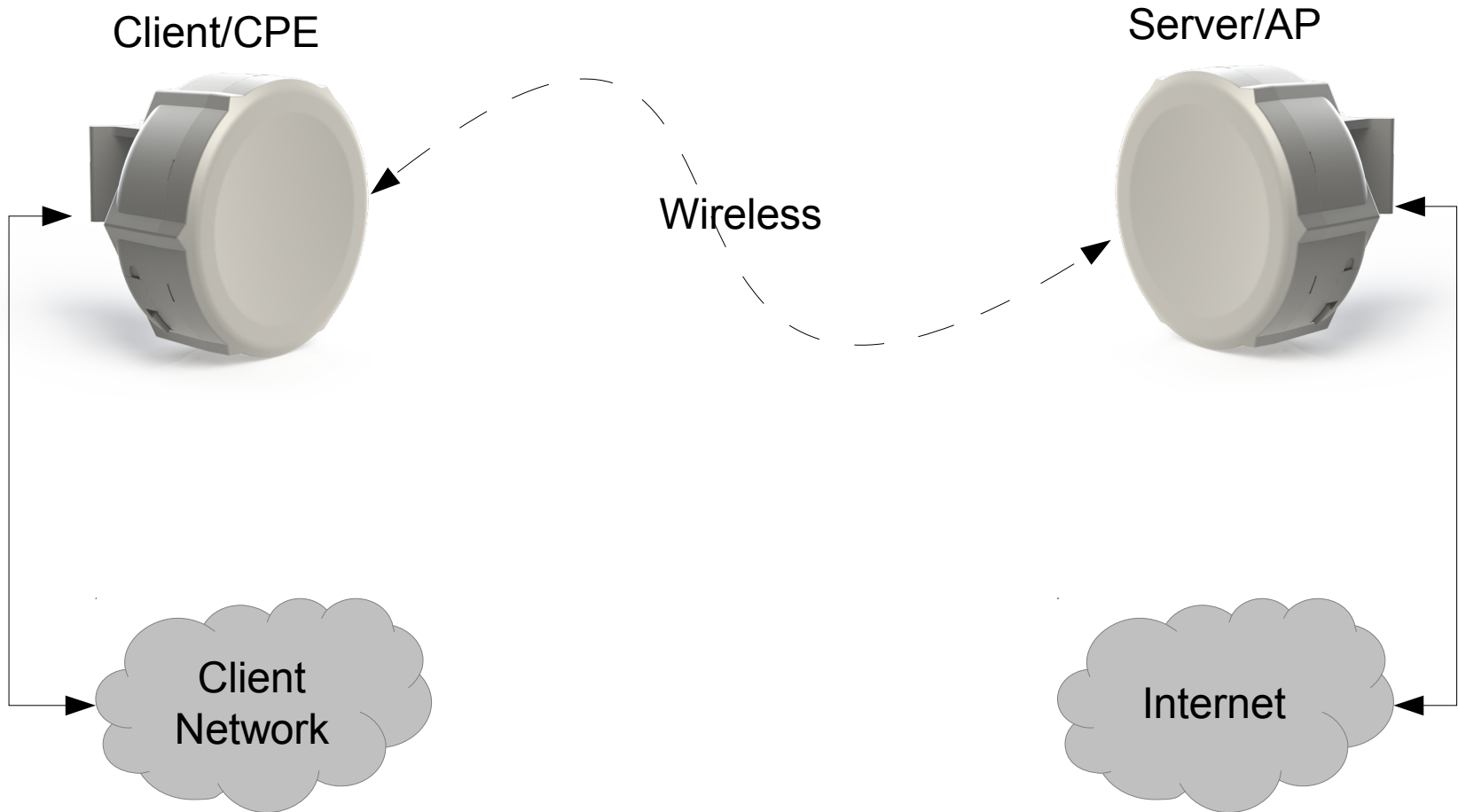
**LAN**

LAN IP Address: 10.0.100.1/24  
DHCP Server: ☒  
DHCP Server Range: 10.0.100.10-10.0.100.100  
NAT: ☒

**System**

Router Identity: MikroTik  
Password:   
Confirm Password:   
Upgrade:  Nav izvēlēts neviena fails

# Point to Point Bridge Quicket



# Server/AP Bridge Quickset

- Access router by browser or Winbox
- Configure Server/AP settings:
  - Wireless Bridge Mode to Server/AP
  - IP address, gateway
  - Wireless (SSID, band, frequency, security)

# Server/AP Bridge Quickset Demo

The screenshot displays the MikroTik WebFig v5.21rc1 Quick Set interface for configuring a Wireless Bridge. The left sidebar contains a navigation menu with options like Quick Set, Interfaces, Wireless, Bridge, PPP, Mesh, IP, MPLS, Routing, System, Queues, Files, Log, Radius, New Terminal, Tools, Make Supout.rif, Undo, Redo, Hide Menu, Hide Passwords, Safe Mode, Design Skin, Manual, WinBox, Graphs, End-User License, and Logout.

The main configuration area is divided into three sections:

- Wireless Bridge Mode:** Includes settings for Mode (Client/CPE, Server/AP), SSID (PTP), Frequency (5805 MHz), Band (5GHz-A/N), Channel Width (20/40MHz HT Above), Country (united states), MAC Address (00:0C:42:F6:34:55), Use ACL, Security (WPA, WPA2), Encryption (aes ccm, tkip), and Pre-Shared Key.
- Configuration:** Includes Address Acquisition (Static, DHCP), Address Source (Any, Ethernet, WLAN), IP Address (10.0.100.244/24), Gateway (10.0.100.1), and buttons for DHCP Release and DHCP Renew.
- System:** Includes Router Identity (MikroTik), Password, Confirm Password, and an Upgrade button.

The **Wireless Clients** section shows a table of connected clients:

MAC Address	In ACL	Last IP	Uptime	Signal Strength
00:0C:42:F7:47:8D	no	10.0.100.249	00:05:36	-31

Below the table, a signal strength graph shows a bar chart for the client's signal strength over time. The graph indicates a current signal strength of -31 dB, an average of -28 dB, and a maximum of -12 dB.

The bottom of the interface includes a "Copy To ACL" button.

# Client/CPE Bridge Quicket

- Access router by browser or Winbox
- Configure Client/CPE settings:
  - Wireless Bridge Mode to Client/CPE
  - IP address, gateway
  - Wireless (SSID, band, security)

# Client/CPE Bridge Quickset Demo

admin@00:0C:42:F7:47:8C (MikroTik) - WinBox v5.21rc1 on RB SXT G-5HnD (mipsbe)

Safe Mode

Hide Passwords

Quick Set

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Wireless

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PPP

Switch

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MetaROUTER

Make Supout.rif

Manual

Exit

RouterOS WinBox

PTP Bridge Quick Set

Wireless Bridge Mode

Mode: ☒ Client/CPE ☐ Server/AP

Wireless

Country: united states

Channel Width: 20MHz

	Address	/	SSID	Band	Protocol	Frequ...	Signal Streng
R	00:0C:42:18:48:C0		Demo	5GHz-A 20MHz	802.11	5300	-88
PR	00:0C:42:6B:91:7E			5GHz-A 20MHz	802.11	5300	-80
PR	00:0C:42:6B:E9:79			5GHz-A 20MHz	802.11	5180	-87
PR	00:0C:42:6B:ED:26		wave	5GHz-A 20MHz	802.11	5180	-89
R	00:0C:42:F6:34:56		PTP	5GHz-A 20MHz	802.11	5805	-10
PR	D4:CA:6D:12:56:F4			5GHz-A 20MHz	802.11	5260	-87
PR	D4:CA:6D:12:57:19			5GHz-A 20MHz	802.11	5260	-88

Signal Strength: -33 dB

SSID: PTP

Connect

Configuration

Address Acquisition: ☒ DHCP ☐ Static

Address Source: ☒ Any ☐ Ethernet ☐ WLAN

IP Address: 0.0.0.0/0

Gateway: 0.0.0.0

System

Router Identity: ClientCPE

Password:

Confirm Password:

Reset Configuration

OK

Cancel

Apply

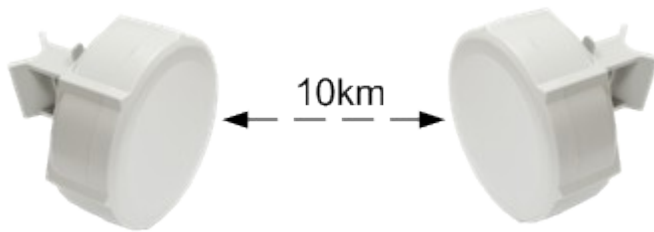
DHCP Renew

DHCP Release



# Connection Types

Point to Point (PTP)



Point to Multi Point (PTMP)



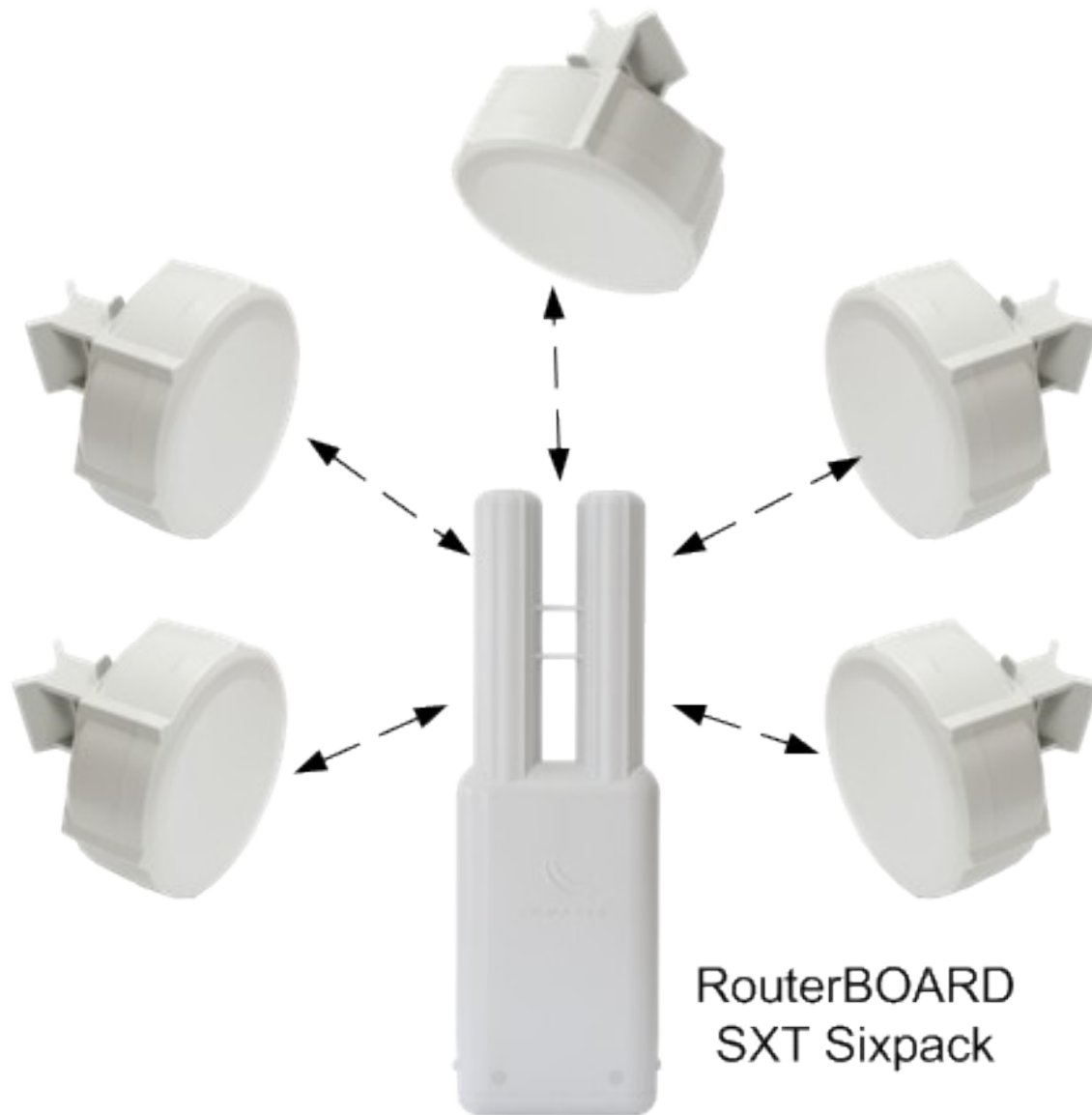
# PTP/PTMP connection modes

- AP-bridge/Bridge <=> Station
- AP-bridge/Bridge <=> Station-wds/Station-bridge
- AP-bridge/Bridge <=> Station-pseudobridge
- AP-bridge/Bridge <=> AP-bridge/Bridge
- AP-bridge <=> WDS-slave

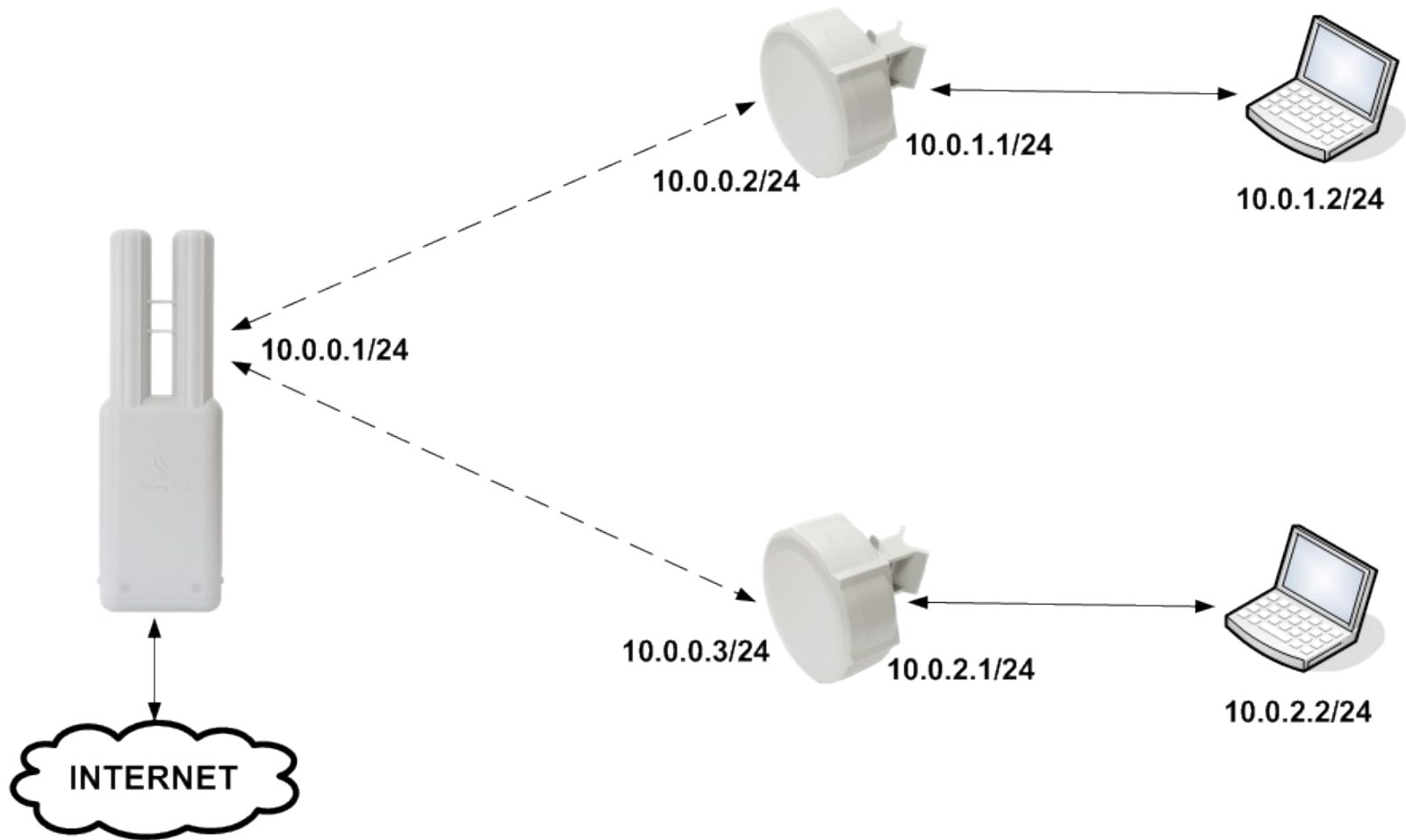
# RouterOS license requirements

- PTP link requires at least Level 3
  - Example: Bridge <-> Station
- PTMP link requires on AP at least Level 4 and on clients at least Level 3
  - Example: AP-bridge <-> Station

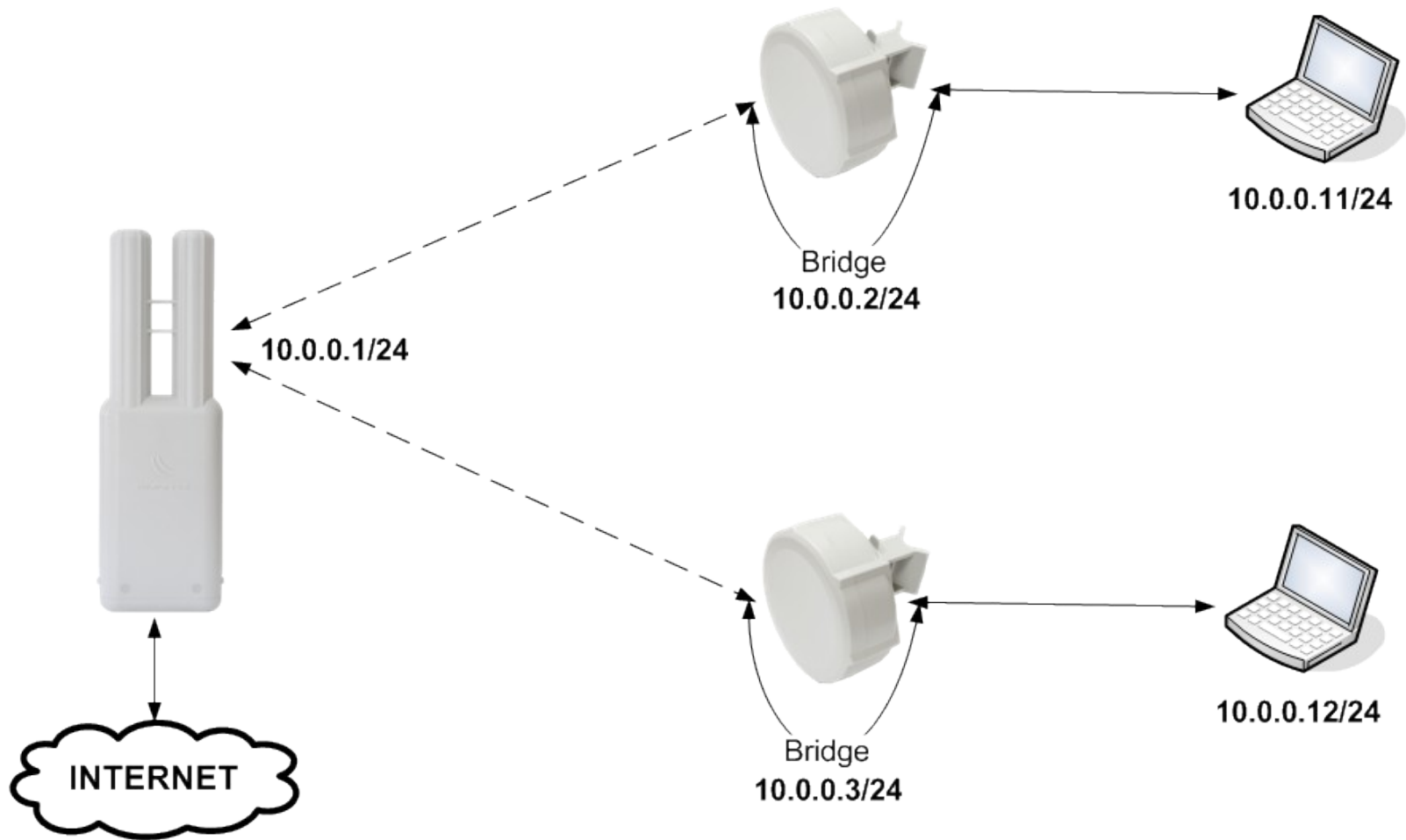
# Regular PTMP setup



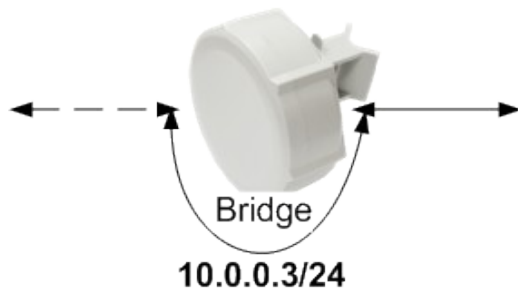
# Wireless Setup Type - Routing



# Wireless Setup Type - Bridging



# Wireless Setup Types



- **Bridging**

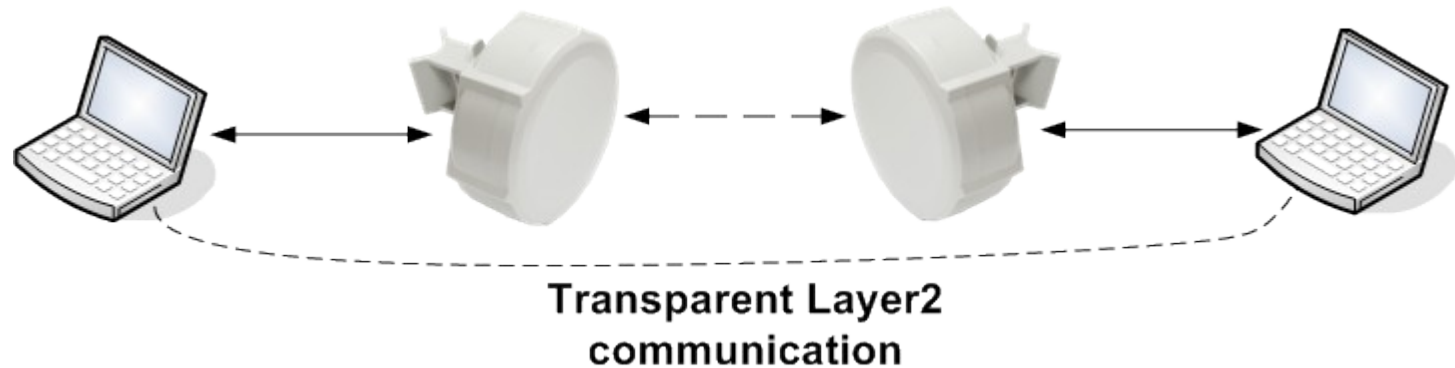
- Advantage
  - Less IP configuration needed
- Disadvantage
  - Clients broadcast traffic or flood can lower wireless network performance
  - Not suitable for large network



- **Routing**

- Advantage
  - No broadcast traffic or flood that could lower wireless network performance
- Disadvantage
  - More configuration needed: multiple IP networks or use of routing protocols

# Transparent Wireless Links



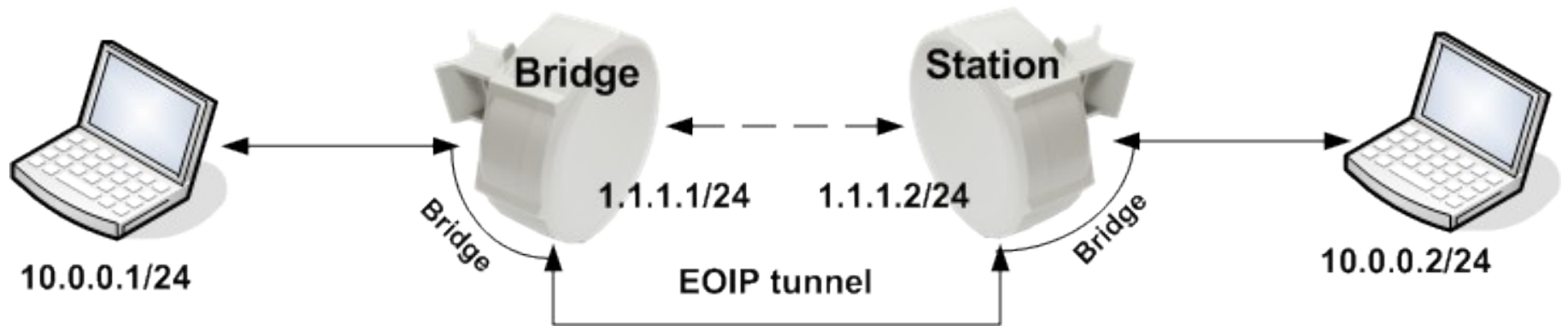
- Less configuration needed
- Extends Layer 2 protocol to clients (wireless ethernet switch)
- Suitable for PPPoE access



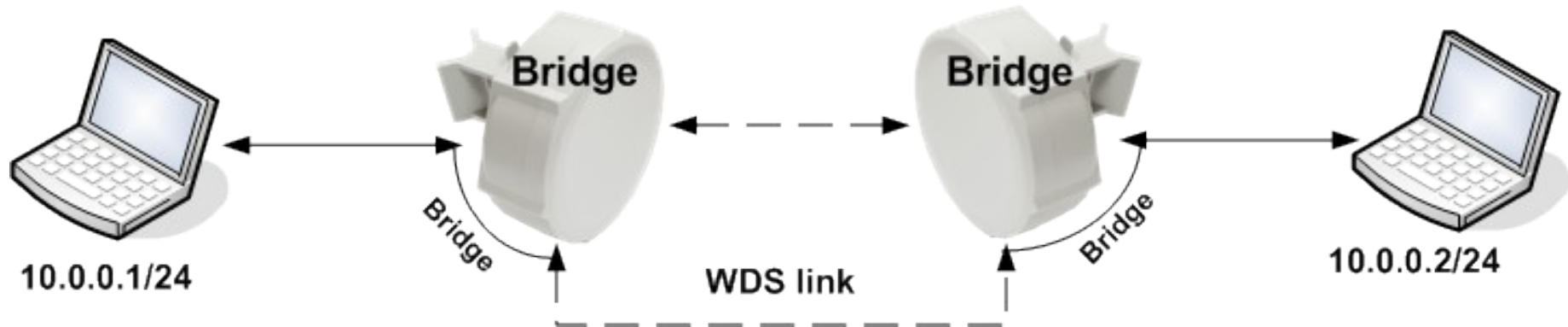
# Transparent Wireless Links Setups

- Bridge <-> Station-pseudobridge
- Bridge <-> Station using EOIP
- Bridge <-> Bridge
- Bridge <-> Station-wds
- Bridge <-> Station-bridge

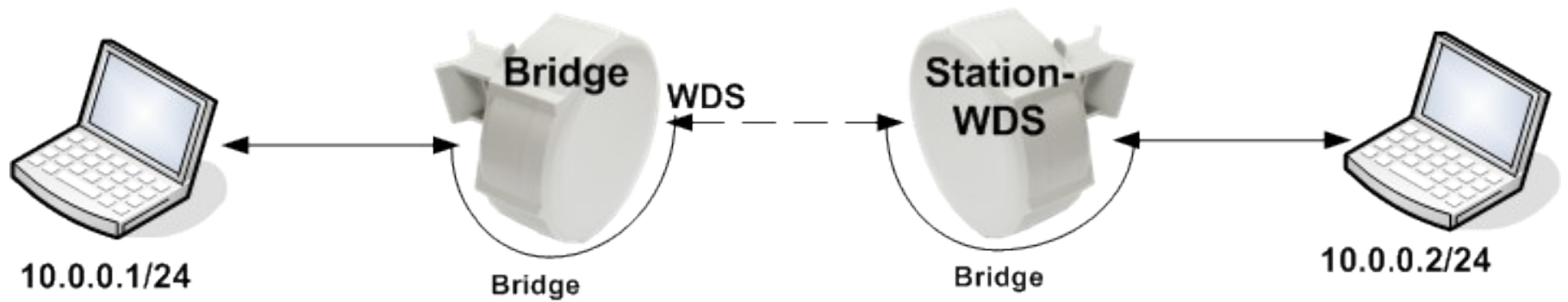
# EOIP bridging setup



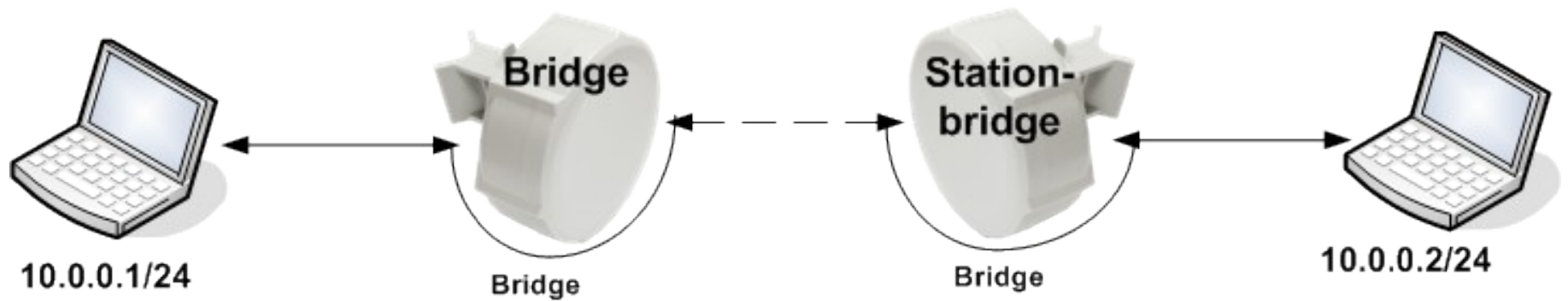
# Bridge <-> Bridge setup



# Station-wds setup



# Station-bridge setup



# Station-bridge

- AP maintains forwarding table with information on what MAC addresses are reachable over which station device
- AP should have bridge-mode parameter enabled in order to accept station-bridge clients
- Can be connected only to RouterOS AP based devices
- Even less configuration needed compared to station-wds mode

# Station-bridge configuration

- On AP enable the bridge-mode parameter
- Configure client to use station-bridge mode
- Bridge wireless interface with ethernet interface to make transparent link

# Wireless protocol limitations on transparent links

	802.11	ROS 802.11	Nstreme	Nv2
station	V	V	V	V
station-wds		V	V	V
station-pseudobridge	V	V	V	
station-pseudobridge-clone	V	V	V	
station-bridge		V	V	V



# 802.11n

- Works both in 2.4 and 5ghz
- Increased data rates – up to 300Mbps or 450Mbps
- 20Mhz and 2x20Mhz channel support
- Uses multiple antennas for receive and transmit
- Frame aggregation

# 802.11n 2x20Mhz channel option

- Adds additional 20Mhz channel to existing channel
- Channel placed below or above the main channel frequency
- Adds support for higher data-rates – 150Mbps/300Mbps/450Mbps
- Backwards compatible with 20Mhz clients – connection made to the main channel
- Not compatible with legacy 40Mhz Turbo mode

# Upgrade legacy wireless link to 802.11n?

- We recommend to upgrade your legacy wireless links to 802.11n even if you have one antenna:
  - Higher data-rate than legacy wireless, data-rates up to 72.2Mbps or 150Mbps
  - Real UDP traffic up to 125Mbps
  - No need to change antennas or board – only wireless card

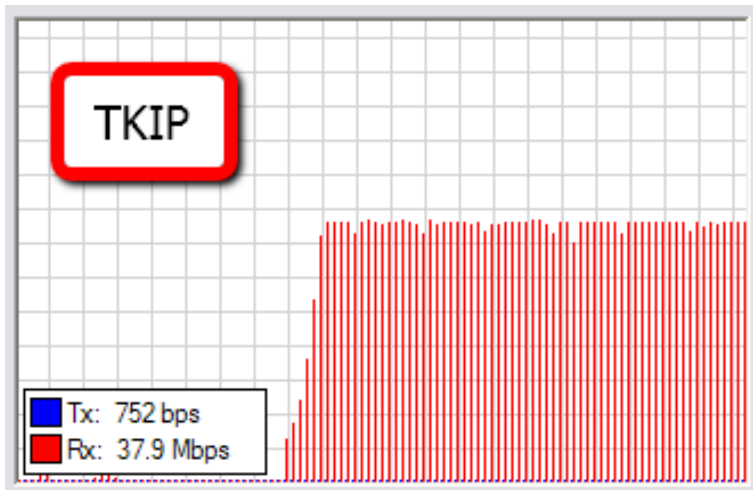
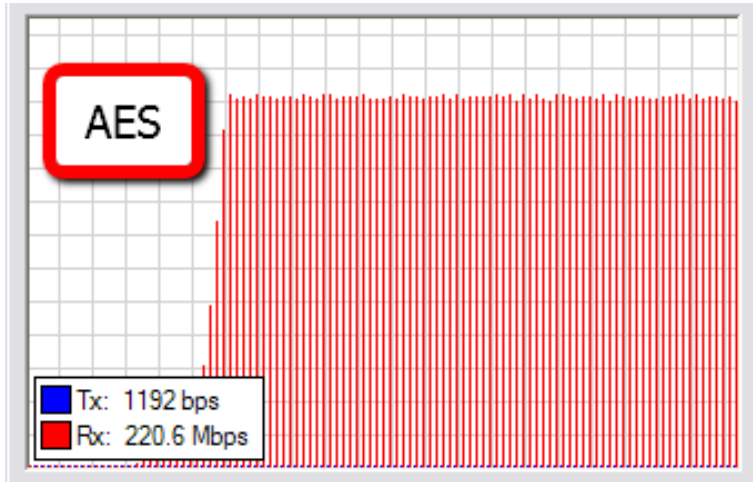
# 802.11n and WDS

- 802.11n frame aggregation can't be used together with WDS
- Max transmit speed drops from 220Mbps to 160Mbps using WDS (UDP traffic)
- Station-bridge has the same speed limitations as Station-wds
- Avoid using WDS or use Nstreme/Nv2 wireless protocol to overcome this limitation

# 802.11n Outdoor Setup

- For 2 chain operation suggested to use different polarization for each chain
- When dual-polarization antennas are used isolation of the antenna recommended to be at least 25db
- If possible test each chain/antenna separately before using both chains at the same time

# 802.11n speed with encryption



- Avoid using wireless encryption with TKIP cipher as it slows down the wireless link – speed drop from 220Mbps to 38Mbps
- Use AES cipher for 802.11n wireless encryption

# AR93xx/95xx wireless support

- Short Guard Interval support on 20Mhz mode – data rates up to 72.2/144Mbps
- 3 antenna connector support for 3x3 MIMO setup
- Up to 3 Spatial Streams
- Up to MCS 23 – data-rate up to 450Mbps
- UDP transfer up to 370Mbps
- No support for advanced channels yet

# AR93xx/95xx wireless support

admin@10.5.8.60 (MikroTik) - WinBox v6.2 on RB912UAG-5HPnD (mipsbe)

Safe Mode CPU: 70% ☒ Hide Passwords

**RouterOS WinBox**

- Quick Set
- Interfaces
- Wireless
- Bridge
- PPP
- Switch
- Mesh
- IP
- MPLS
- Routing
- System
- Queues
- Files
- Log
- Radius
- Tools
- New Terminal
- MetaROUTER
- Partition
- Make Supout.nif
- Manual
- Exit

**Interface <wlan3>**

Current Tx Power	Status	Advanced Status	Traffic	...
Band:	5GHz-N			
Frequency:	5320 MHz			
Wireless Protocol:	802.11			
Tx/Rx Rate:	450.0Mbps/6.0Mbps			
SSID:	3chain			
BSSID:	04:F0:21:02:46:B3			
Radio Name:	04F0210246B3			
Tx/Rx Signal Strength:	-53/-50 dBm			
Tx/Rx Signal Strength Ch0:	-55/-58 dBm			
Tx/Rx Signal Strength Ch1:	-63/-52 dBm			
Tx/Rx Signal Strength Ch2:	-58/-56 dBm			
Noise Floor:	-108 dBm			
Signal To Noise:	58 dB			
Tx/Rx CCQ:	100/89 %			
Overall Tx CCQ:	100 %			
Distance:	3 km			
RouterOS Version:	6.2			

enabled running slave connected

**Bandwidth Test (Running)**

Test To: 1.1.1.1 Start Stop Close

Protocol: ☒ udp ☐ tcp

Local UDP Tx Size: 1500

Remote UDP Tx Size: 1500

Direction: send

TCP Connection Count: 20

Local Tx Speed: bps

Remote Tx Speed: bps

☐ Random Data

User:

Password:

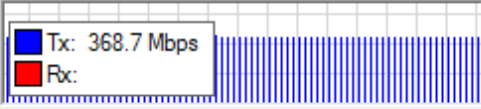
Lost Packets: 0

Tx/Rx Current: 368.7 Mbps/0 bps

Tx/Rx 10s Average: 367.5 Mbps/0 bps

Tx/Rx Total Average: 355.7 Mbps/0 bps

Tx: 368.7 Mbps Rx:





# Hidden node issue

- In PTMP setups when client doesn't see other clients traffic and sends at the same time AP gets “collisions” – lowers performance
- Use hw-protection CTS/RTS or “CTS to self”
- Use Nstreme or Nv2 protocol

# NV2

- Proprietary wireless protocol developed by MikroTik
- Based on TDMA (Time Division Multiple Access) media access technology
- Works on Atheros chipset cards:
  - AR5413 and newer chipset cards (R52)
  - N chipset cards (R52n,R52Hn,R11e)
- Supported from RouterOS v5

# TDMA benefits

- More throughput
- Lower latency
- Suited well for Point-to-MultiPoint networks
- Solves hidden node problems

# Nv2 compatibility and coexistence with other wireless protocols

- Only RouterOS devices will be able to participate in Nv2 network
- Only RouterOS devices will see Nv2 AP when scanning
- Nv2 network will disturb other networks in the same channel
- Nv2 network may be affected by any (Nv2 or not) other networks in the same channel
- Nv2 enabled device will not connect to any other TDMA based network

# Nv2 UDP on RB800

admin@10.5.8.67 (RB800\_2) - WinBox v5.8 on RB800 (powerpc)

Uptime: 03:11:35 Memory: 226.6 MiB CPU: 55% ☒ Hide Passwords

Safe Mode

Interfaces

Wireless

Bridge

PPP

Switch

Mesh

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MPLS

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Radius

Tools

New Terminal

MetaROUTER

Make Supout.rtf

Manual

Exit

Registration Connect List Security Profiles

Interface	Uptime	AP	W...	Last Activit...	Tx/Rx Signal ...	Tx/Rx Rate
wlan1	00:05:10	yes	no	0.000	-56/-56	300.0Mbps/300.0Mbps

Resources

Uptime: 03:11:35 OK

Free Memory: 226.6 MiB PCI

Total Memory: 250.3 MiB USB

CPU: e500v2 CPU

CPU Count: 1 IRQ

CPU Frequency: 799 MHz

CPU Load: 55 %

Free HDD Space: 998.5 MB

Total HDD Size: 1044.4 MB

Sector Writes Since Reboot: 266

Total Sector Writes: 2 821 233

Bad Blocks: 0.0 %

Architecture Name: powerpc

Board Name: RB800

Version: 5.8

Interface <wlan1>

Current Tx Power Status Advanced Status Traffic ...

Tx/Rx Rate: 251.1 Mbps / 1216 bps

Tx/Rx Packet Rate: 20 679 p/s / 2 p/s

Tx/Rx Bytes: 20.6 GiB / 2315.3 MiB

Tx/Rx Packets: 14 570 954 / 1 602 653

Tx/Rx Drops: 0 / 0

Tx/Rx Errors: 0 / 0

OK

Cancel

Apply

Disable

Comment

Torch

Scan...

Freq. Usage...

Align...

Sniff...

Snooper...

Reset Configuration

Simple Mode

Tx: 251.1 Mbps

Rx: 1216 bps

Tx Packet: 20 679 p/s

Rx Packet: 2 p/s

enabled running slave connected to ess

# Nv2 TCP on RB800

admin@10.5.8.67 (RB800\_2) - WinBox v5.8 on RB800 (powerpc)

Uptime: 03:33:06 Memory: 226.6 MiB CPU: 51% ☒ Hide Passwords

Safe Mode

Interfaces

Wireless

Bridge

PPP

Switch

Mesh

IP

MPLS

Routing

System

Queues

Files

Log

Radius

Tools

New Terminal

MetaROUTER

Make Supout.rif

Manual

Exit

Registration Connect List Security Profiles

Interface	Uptime	AP	W...	Last Activ...	Tx/Rx Signal ...	Tx/Rx Rate
wlan1	00:18:03	yes	no	0.000	-56/-55	300.0Mbps/300.0Mbps

Resources

Uptime: 03:33:06 OK

Free Memory: 226.6 MiB PCI

Total Memory: 250.3 MiB USB

CPU: e500v2 CPU

CPU Count: 1 IRQ

CPU Frequency: 799 MHz

CPU Load: 51 %

Free HDD Space: 998.5 MB

Total HDD Size: 1044.4 MB

Sector Writes Since Reboot: 294

Total Sector Writes: 2 821 261

Bad Blocks: 0.0 %

Architecture Name: powerpc

Board Name: RB800

Version: 5.8

Interface <wlan1>

Current Tx Power Status Advanced Status Traffic ...

Tx/Rx Rate: 120.5 Mbps / 118.1 Mbps

Tx/Rx Packet Rate: 12 188 p/s / 12 015 p/s

Tx/Rx Bytes: 27.3 GiB / 5.5 GiB

Tx/Rx Packets: 19 812 603 / 4 765 454

Tx/Rx Drops: 0 / 0

Tx/Rx Errors: 0 / 0

Tx: 120.5 Mbps

Rx: 118.1 Mbps

Tx Packet: 12 188 p/s

Rx Packet: 12 015 p/s

enabled running slave connected to ess

OK

Cancel

Apply

Disable

Comment

Torch

Scan...

Freq. Usage...

Align...

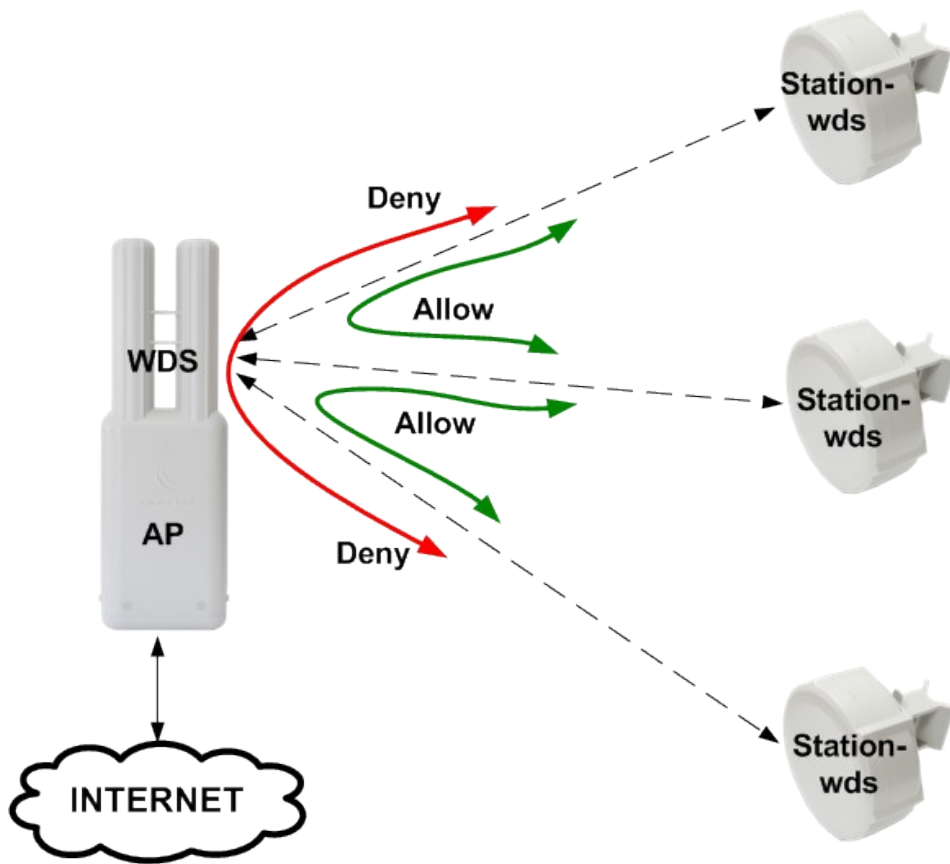
Sniff...

Snooper...

Reset Configuration

Simple Mode

# Split horizon feature



- To disable communication between WDS devices usually you would need to add bridge firewall rules which might be complex
- Another solution is to use split horizon feature in the bridge ports configuration – packets will not be forwarded between ports with the same horizon value

# Split horizon feature

- Create bridge interface
- Add internet access interface to the bridge port
- Add each WDS interface to the bridge port and specify the same horizon value, for example 1
- If you wish to allow communication from every WDS clients to a specific WDS client then add that specific WDS to the bridge port without horizon value



# HT TX/RX chain configuration

Interface <wlan1>

Advanced HT HT MCS WDS Nstreme NV2

HT Tx Chains: ☒ chain0 ☒ chain1

HT Rx Chains: ☒ chain0 ☒ chain1

- When board has both antennas connected it is suggested to use all the TX/RX chains to get the best speed and stability

Interface <wlan1>

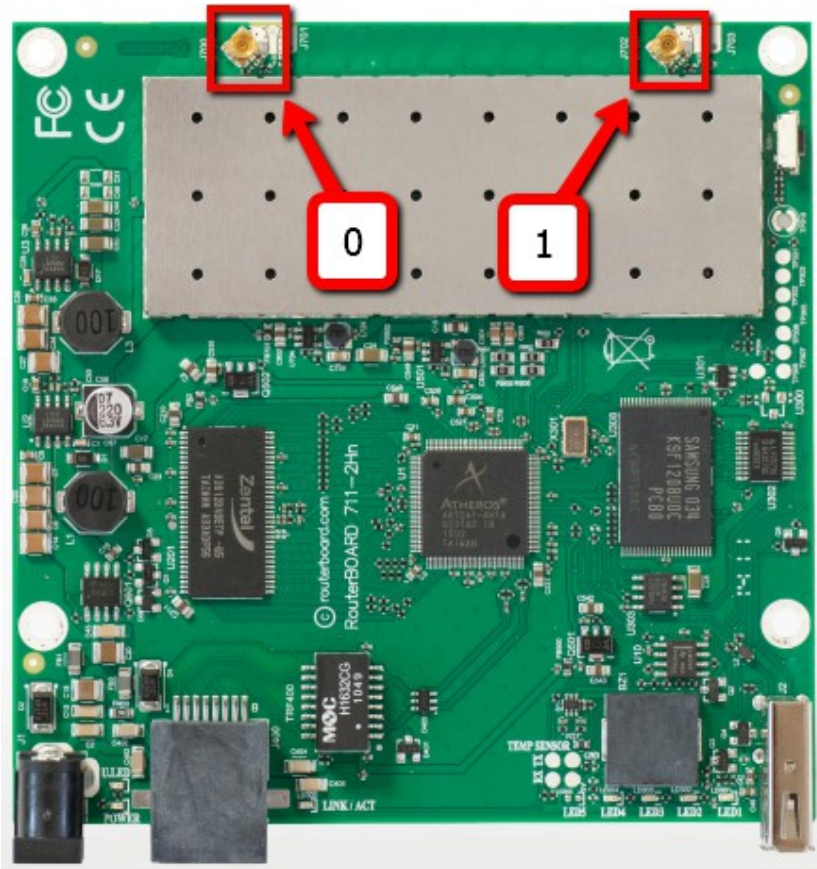
Advanced HT HT MCS WDS Nstreme NV2

HT Tx Chains: ☐ chain0 ☒ chain1

HT Rx Chains: ☒ chain0 ☒ chain1

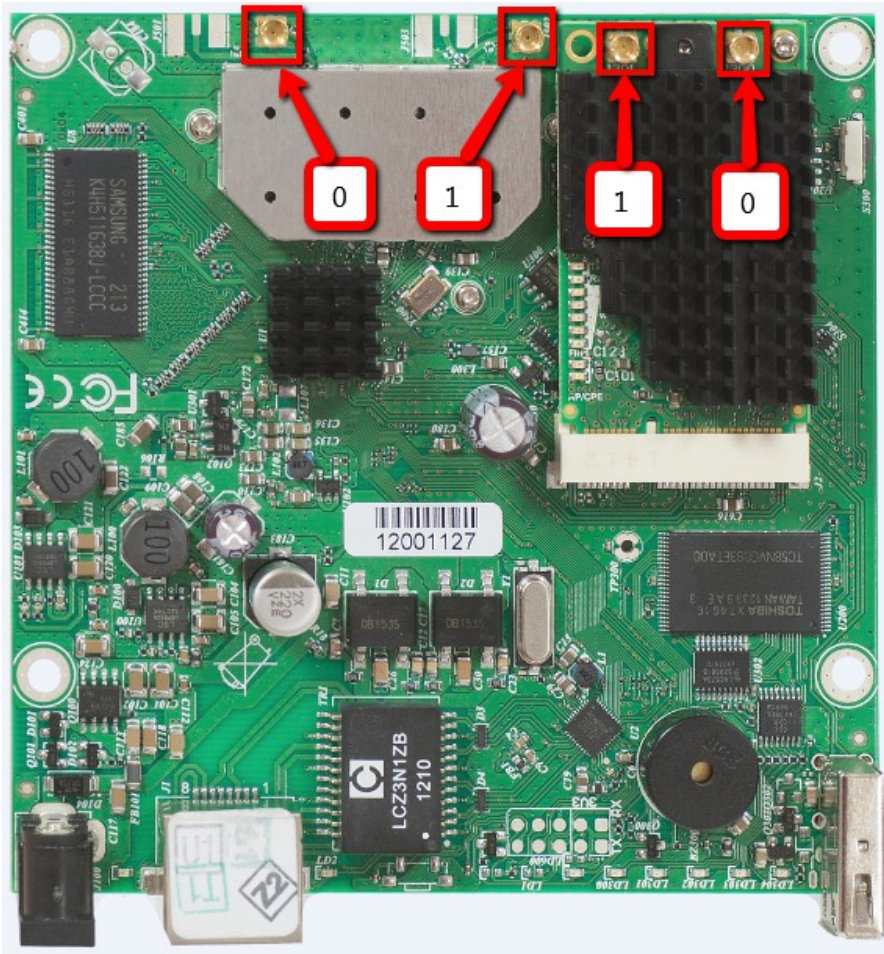
- In order to use only chain1 the chain0 RX should be always enabled in order to make the wireless link to work

# RouterBoard wireless boards



- Every wireless RouterBoard has RouterOS default-configuration script enabled on the first boot
- For wireless boards default-configuration enables all available wireless chains
- Make sure that you have antennas connected to all antenna connectors to avoid damaging wireless cards amplifier!
- Also if you use only one chain on the board make sure you don't enable it if you don't have antenna connected to it.

# RouterBoard wireless boards



- Routerboard R11e wireless mini-pcie card chains are inverse compared to other mini-pci wireless cards:
  - Chain 0 – Right
  - Chain 1 – Left

# WPA2 Private Pre Shared Key

- Allows to specify for a MAC address different pre-shared key from the pre-shared key in the security profile
- It is possible to specify for each MAC address different pre-shared key
- Increases the security level of the AP
- Can be given also by RADIUS

# WPA2 Private Pre Shared Key

The image displays two overlapping network configuration windows from a router's web interface.

**AP Access Rule <00:0C:42:05:36:4C>**

- MAC Address: 00:0C:42:05:36:4C
- Interface: wlan1
- Signal Strength Range: -120..120
- AP Tx Limit: [empty]
- Client Tx Limit: [empty]
- ☒ Authentication
- ☒ Forwarding
- Private Key: none
- Private Pre Shared Key: keykeykey2** (highlighted with a red circle)
- Time: [empty]
- Status: disabled

**Security Profile <PSK\_security>**

- General tab selected
- Name: PSK\_security
- Mode: dynamic keys
- Authentication Types:
  - ☒ WPA PSK
  - ☒ WPA2 PSK
  - ☐ WPA EAP
  - ☐ WPA2 EAP
- Unicast Ciphers:
  - ☐ tkip
  - ☒ aes ccm
- Group Ciphers:
  - ☐ tkip
  - ☒ aes ccm
- WPA Pre-Shared Key: keykeykey1
- WPA2 Pre-Shared Key: keykeykey1
- Supplicant Identity: [empty]
- Group Key Update: 00:05:00

# Rate-selection – legacy

- Rate-selection default value for RouterOS versions older than v5.9
- Removed in v6.x – replaced with advanced
- Works when wireless link is good in all data-rates
- Doesn't switch so well from B standard to G standard data-rates
- Doesn't switch from A/G to N data rates where frame aggregation can be used
- Doesn't switch from 20mhz to 40mhz in N data-rates, for example, when mcs13-15 doesn't work stable

# Rate-selection – legacy

Legacy

Modulation	Rate	MCS	Streams	Modulation	Data rate (Mbit/s)			
					20 MHz		40 MHz	
					800ns	400ns	800ns	400ns
		0	1	BPSK	6.5	7.2	13.5	15
		1	1	QPSK	13	14.4	27	30
		2	1	QPSK	19.5	21.7	40.5	45
		3	1	16-QAM	26	28.9	54	60
BPSK	1	4	1	16-QAM	39	43.3	81	90
QPSK	2	5	1	64-QAM	52	57.8	108	120
QPSK	5.5	6	1	64-QAM	58.5	65	121.5	135
QPSK	11	7	1	64-QAM	65	72.2	135	150

BPSK	6	8	2	BPSK	13	14.4	27	30
BPSK	9	9	2	QPSK	26	28.9	54	60
QPSK	12	10	2	QPSK	39	43.3	81	90
QPSK	18	11	2	16-QAM	52	57.8	108	120
16-QAM	24	12	2	16-QAM	78	86.7	162	180
16-QAM	36	13	2	64-QAM	104	115.6	216	240
64-QAM	48	14	2	64-QAM	117	129	243	270
64-QAM	54	15	2	64-QAM	130	144.4	270	300

# Rate-selection – advanced

- Rate-selection default value for RouterOS versions newer than v5.8
- Next data-rate is calculated/tested simultaneously in all data-rate “blocks” and used the best from the gathered results
- For 1 stream link on 20mhz the switch to N rates goes faster allowing to utilize frame aggregation feature
- Data-rate could go up very fast and doesn't suffer from problems, like in, legacy when mcs13-15 didn't work well for 20mhz it couldn't switch to 40mhz



# Rate-selection – advanced

Advanced

Advanced

					Data rate (Mbit/s)			
		MCS	Streams	Modulation	20 MHz		40 MHz	
					800ns	400ns	800ns	400ns
		0	1	BPSK	6.5	7.2	13.5	15
		1	1	QPSK	13	14.4	27	30
		2	1	QPSK	19.5	21.7	40.5	45
Modulation	Rate	3	1	16-QAM	26	28.9	54	60
BPSK	1	4	1	16-QAM	39	43.3	81	90
QPSK	2	5	1	64-QAM	52	57.8	108	120
QPSK	5.5	6	1	64-QAM	58.5	65	121.5	135
QPSK	11	7	1	64-QAM	65	72.2	135	150
BPSK	6	8	2	BPSK	13	14.4	27	30
BPSK	9	9	2	QPSK	26	28.9	54	60
QPSK	12	10	2	QPSK	39	43.3	81	90
QPSK	18	11	2	16-QAM	52	57.8	108	120
16-QAM	24	12	2	16-QAM	78	86.7	162	180
16-QAM	36	13	2	64-QAM	104	115.6	216	240
64-QAM	48	14	2	64-QAM	117	130	243	270
64-QAM	54	15	2	64-QAM	130	144.4	270	300

# Wireless-protocol setting

Value	AP	Client
<b>unspecified</b>	establish nstreme or 802.11 network based on old <b>nstreme</b> setting	connect to nstreme or 802.11 network based on old <b>nstreme</b> setting
<b>any</b>	same as <b>unspecified</b>	scan for all matching networks, no matter what protocol, connect using protocol of chosen network
<b>802.11</b>	establish 802.11 network	connect to 802.11 networks only
<b>nstreme</b>	establish Nstreme network	connect to Nstreme networks only
<b>nv2</b>	establish Nv2 network	connect to Nv2 networks only
<b>nv2-nstreme-802.11</b>	establish Nv2 network	scan for Nv2 networks, if suitable network found - connect, otherwise scan for Nstreme networks, if suitable network found - connect, otherwise scan for 802.11 network and if suitable network found - connect
<b>nv2-nstreme</b>	establish Nv2 network	scan for Nv2 networks, if suitable network found - connect, otherwise scan for Nstreme networks and if suitable network found - connect

# Bridge MAC address

- Bridge MAC address is taken from the first added and running bridge port interface
- If the bridge port gets invalid the bridge takes MAC address from the next active bridge port
- When the first bridge port gets active again the MAC address of bridge is changed back to first ports MAC address
- Bridge MAC address changes could cause IP connectivity to bridge IP address
- Use Admin MAC setting to lock the MAC address to one specific that do not change

# Bridge MAC address

Interface <bridge2>

General STP Status Traffic

Name:

Type:

MTU:

L2 MTU:

MAC Address:

ARP:

Admin. MAC Address:

Interface <bridge2>

General STP Status Traffic

Name:

Type:

MTU:

L2 MTU:

MAC Address:

ARP:

Admin. MAC Address:

# Signal reading for each chain

Interface <wlan2>

Nstream	NV2	Status	Advanced Status	Traffic	...
---------	-----	--------	-----------------	---------	-----

Band: 5GHz-N

Frequency: 5700 MHz

Tx/Rx Rate: 19.5Mbps/19.5Mbps

SSID: RB800\_ar9

BSSID: 00:03:7F:40:81:5C

Tx/Rx Signal Strength: -37/-24 dBm

Tx/Rx Signal Strength Ch0: -39/-26 dBm

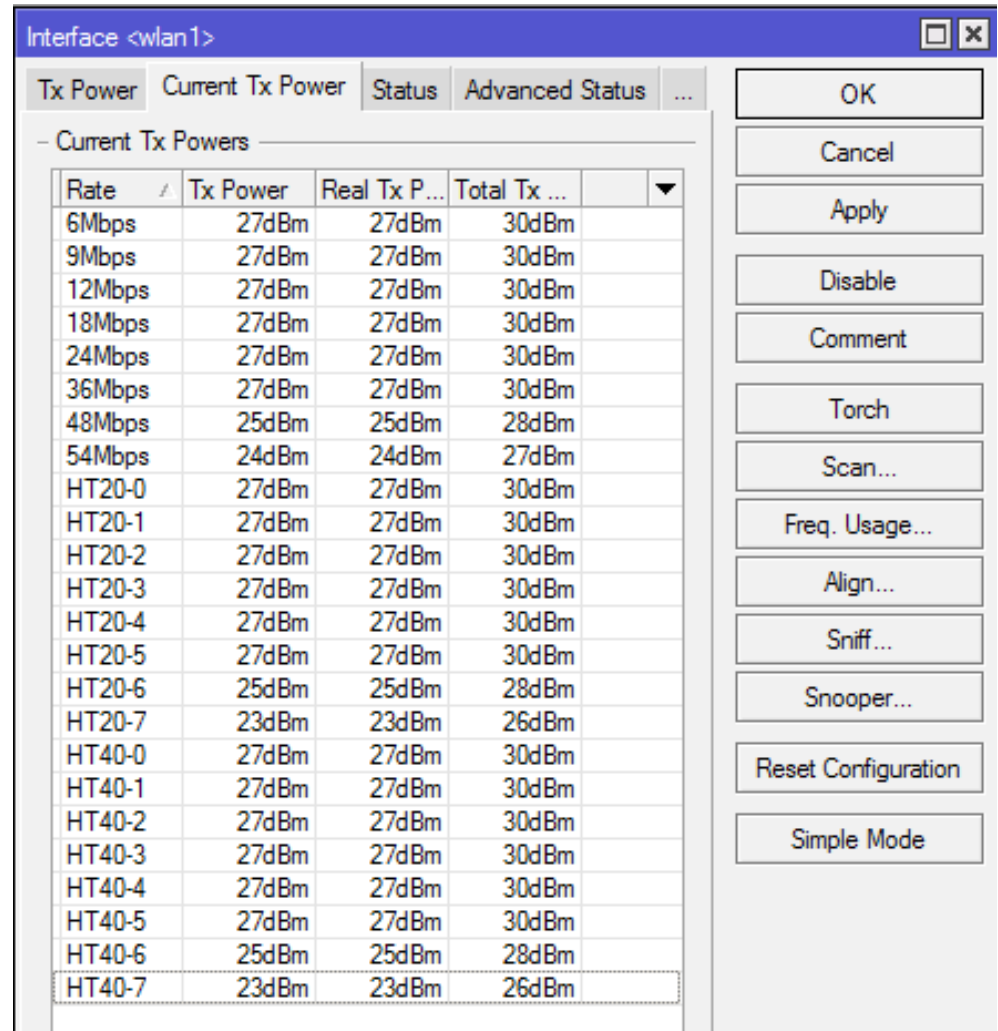
Tx/Rx Signal Strength Ch1: -40/-27 dBm

Tx/Rx Signal Strength Ch2: -51/-41 dBm

- "signal-strength" - combination of all active chains on the control and extension channels
- "signal-strength-ch0" - chain 0 control channel
- "signal-strength-ch1" - chain 1 control channel
- "signal-strength-ch2" - chain 2 control channel
- No separate signal readings for extension channel
- TX chains signal readings gathered from the remote RouterOS wireless device

# TX-power for N cards

- When using two chains at the same time the tx-power is increased by 3db – see total-tx-power column
- When using three chains at the same time tx-power is increased by 5db



Interface <wlan1>

Tx Power   Current Tx Power   Status   Advanced Status   ...

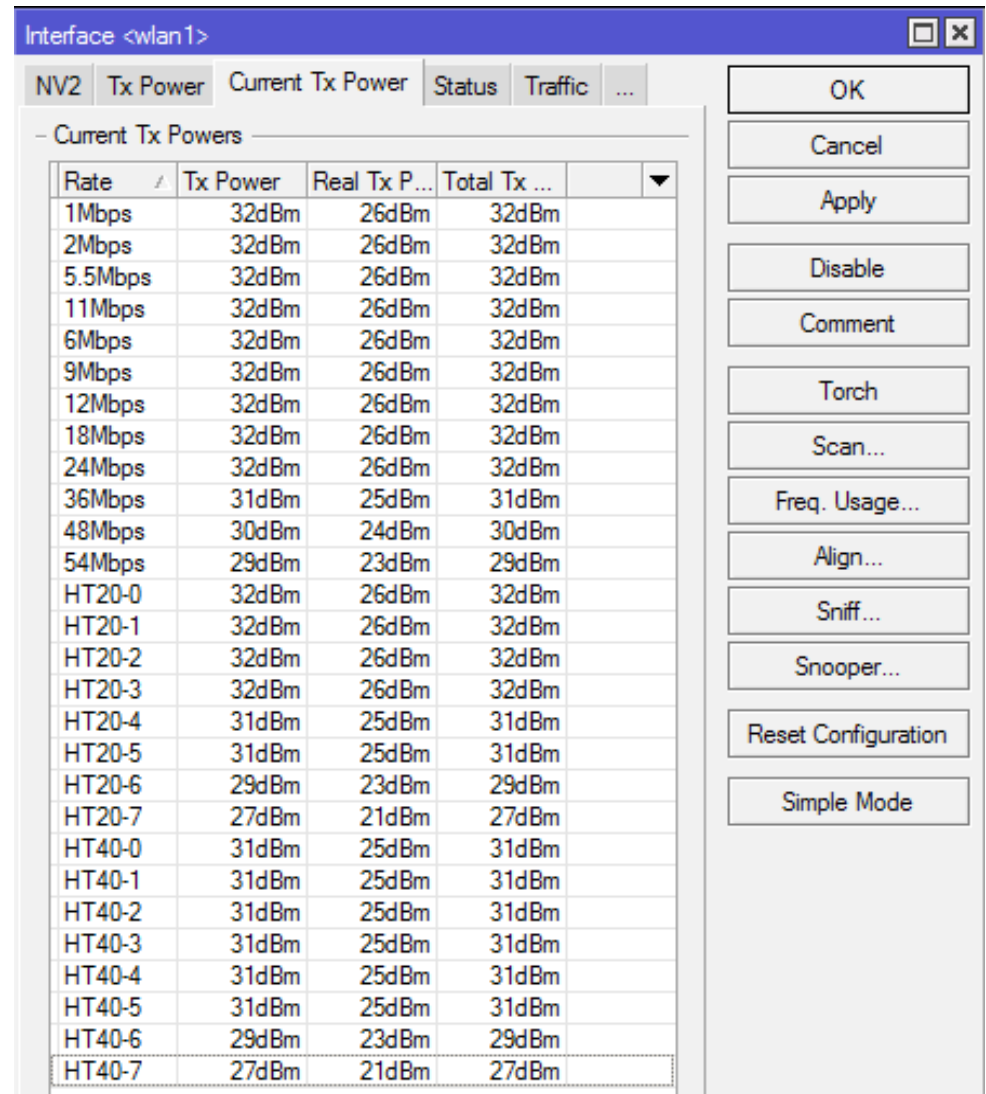
– Current Tx Powers –

Rate	Tx Power	Real Tx P...	Total Tx ...
6Mbps	27dBm	27dBm	30dBm
9Mbps	27dBm	27dBm	30dBm
12Mbps	27dBm	27dBm	30dBm
18Mbps	27dBm	27dBm	30dBm
24Mbps	27dBm	27dBm	30dBm
36Mbps	27dBm	27dBm	30dBm
48Mbps	25dBm	25dBm	28dBm
54Mbps	24dBm	24dBm	27dBm
HT20-0	27dBm	27dBm	30dBm
HT20-1	27dBm	27dBm	30dBm
HT20-2	27dBm	27dBm	30dBm
HT20-3	27dBm	27dBm	30dBm
HT20-4	27dBm	27dBm	30dBm
HT20-5	27dBm	27dBm	30dBm
HT20-6	25dBm	25dBm	28dBm
HT20-7	23dBm	23dBm	26dBm
HT40-0	27dBm	27dBm	30dBm
HT40-1	27dBm	27dBm	30dBm
HT40-2	27dBm	27dBm	30dBm
HT40-3	27dBm	27dBm	30dBm
HT40-4	27dBm	27dBm	30dBm
HT40-5	27dBm	27dBm	30dBm
HT40-6	25dBm	25dBm	28dBm
HT40-7	23dBm	23dBm	26dBm

OK  
Cancel  
Apply  
Disable  
Comment  
Torch  
Scan...  
Freq. Usage...  
Align...  
Sniff...  
Snooper...  
Reset Configuration  
Simple Mode

# TX-power offset for wireless

- Some cards use tx-power offset to get power above 30db – Atheros eeprom limitation
- Real-tx-power – power written in the eeprom
- Tx-power/Total-tx-power – actual output power
- In picture example with 6db offset



Interface <wlan1>

NV2 Tx Power Current Tx Power Status Traffic ...

– Current Tx Powers

Rate	Tx Power	Real Tx P...	Total Tx ...
1Mbps	32dBm	26dBm	32dBm
2Mbps	32dBm	26dBm	32dBm
5.5Mbps	32dBm	26dBm	32dBm
11Mbps	32dBm	26dBm	32dBm
6Mbps	32dBm	26dBm	32dBm
9Mbps	32dBm	26dBm	32dBm
12Mbps	32dBm	26dBm	32dBm
18Mbps	32dBm	26dBm	32dBm
24Mbps	32dBm	26dBm	32dBm
36Mbps	31dBm	25dBm	31dBm
48Mbps	30dBm	24dBm	30dBm
54Mbps	29dBm	23dBm	29dBm
HT20-0	32dBm	26dBm	32dBm
HT20-1	32dBm	26dBm	32dBm
HT20-2	32dBm	26dBm	32dBm
HT20-3	32dBm	26dBm	32dBm
HT20-4	31dBm	25dBm	31dBm
HT20-5	31dBm	25dBm	31dBm
HT20-6	29dBm	23dBm	29dBm
HT20-7	27dBm	21dBm	27dBm
HT40-0	31dBm	25dBm	31dBm
HT40-1	31dBm	25dBm	31dBm
HT40-2	31dBm	25dBm	31dBm
HT40-3	31dBm	25dBm	31dBm
HT40-4	31dBm	25dBm	31dBm
HT40-5	31dBm	25dBm	31dBm
HT40-6	29dBm	23dBm	29dBm
HT40-7	27dBm	21dBm	27dBm

OK

Cancel

Apply

Disable

Comment

Torch

Scan...

Freq. Usage...

Align...

Sniff...

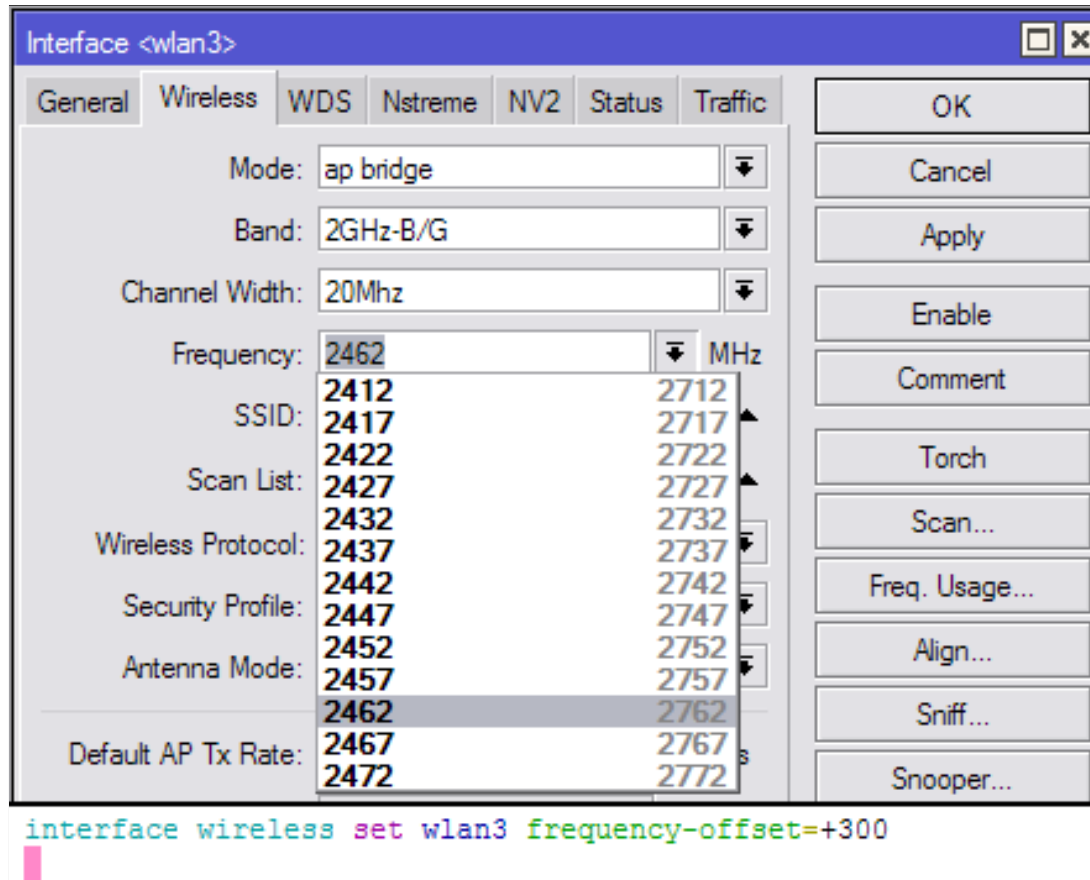
Snooper...

Reset Configuration

Simple Mode

# Frequency-offset feature

- Frequency-offset feature is designed for easier frequency selection on wireless cards with built-in frequency converter





# Antenna-mode selection for RB751U and RB751G

- RB 751U and RB751G has 3 built-in wireless antennas
  - Chain0:
    - one antenna for TX
    - one antenna for RX
  - Chain1:
    - one antenna for TX/RX
    - MMCX connector for external antenna
- Note that enabling the external antenna disables the built-in Chain1 antenna

# Antenna-mode selection for RB751U and RB751G

Interface <wlan1>

Advanced HT HT MCS WDS Nstreme NV2 ...

HT Tx Chains: ☒ chain0 ☒ chain1  
HT Rx Chains: ☒ chain0 ☒ chain1

Antenna Mode: antenna b

HT AMSDU Limit: 8192

HT AMSDU Threshold: 8192

HT Guard Interval: any

HT AMPDU Priorities

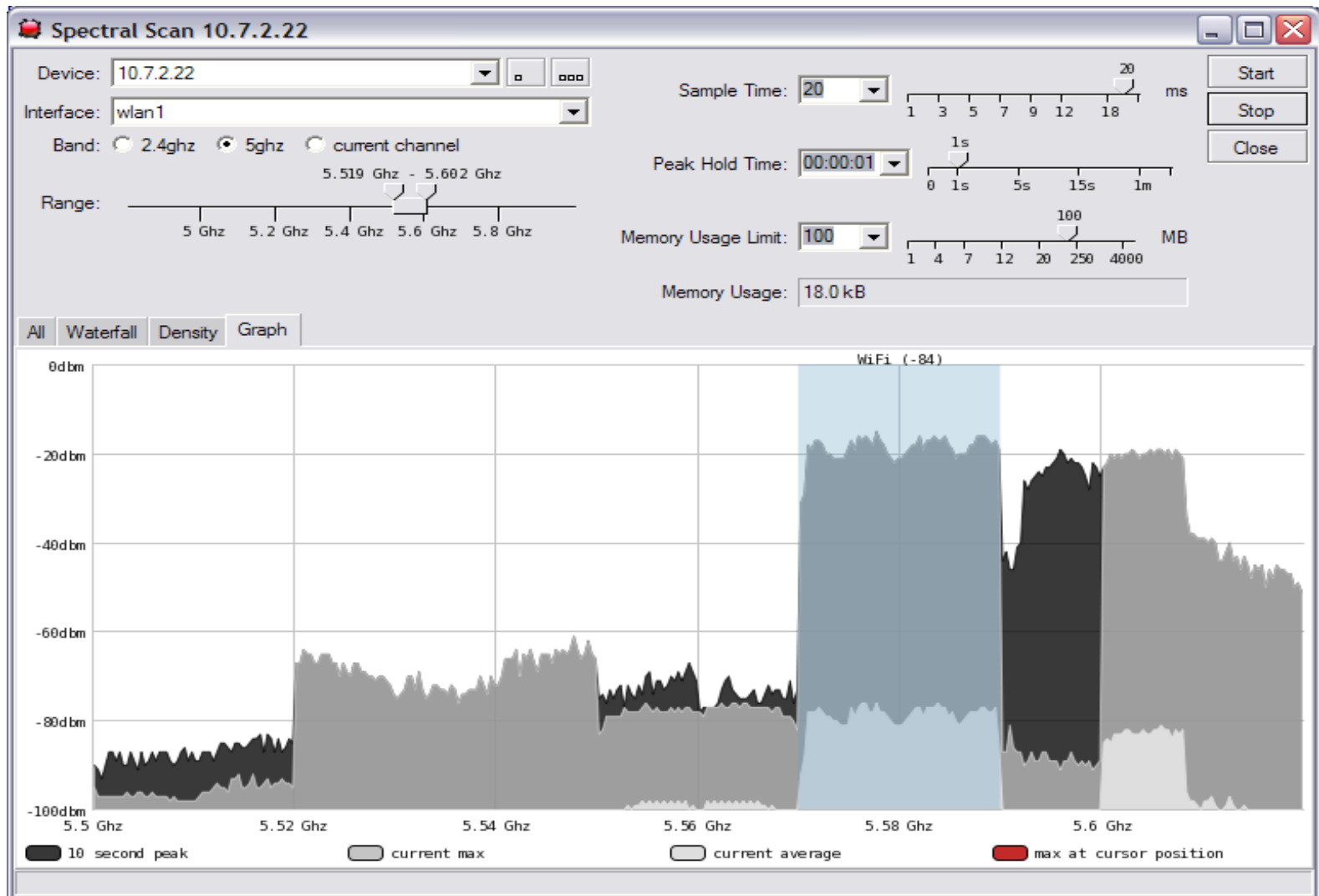
<input checked="" type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3
<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7

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

# Spectral Scan/History

- Uses RouterOS
- Uses Atheros Merlin and newer 802.11n chipset wireless cards
- Frequency span depending on card:
  - 5ghz: 4790-6085mhz
  - 2ghz: 2182-2549mhz
- Scan with 10mhz frequency increments for improved data quality
- Audio monitor

# Spectral Scan using the Dude



# Wireless-signal LED feature

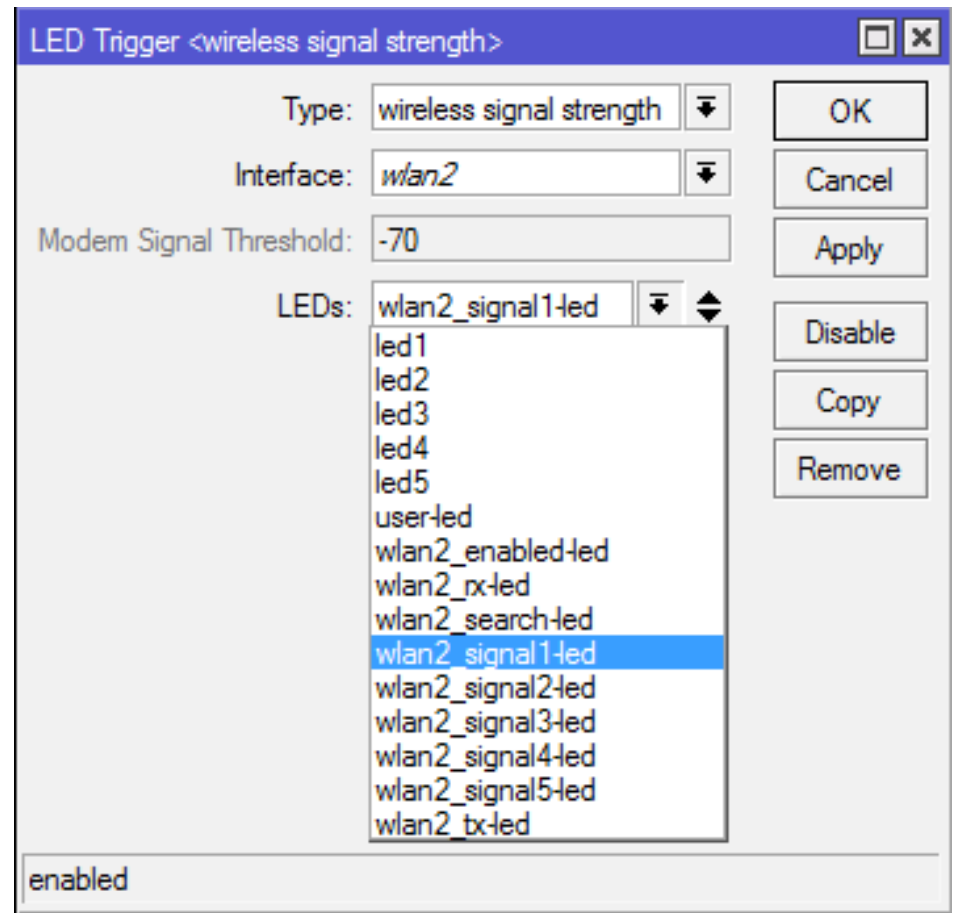
- Wireless signal LEDs supported added for RB400 series, RB911/711, RB SXT and RB Groove/Metal:
  - 1 LED - on, if wireless client is connected to AP (usually  $\geq -89\text{dBm}$ )
  - 2 LEDs - on, if signal strength  $\geq -82\text{dBm}$
  - 3 LEDs - on, if signal strength  $\geq -75\text{dBm}$
  - 4 LEDs - on, if signal strength  $\geq -68\text{dBm}$
  - 5 LEDs - on, if signal strength  $\geq -61\text{dBm}$

# Wireless-status LED

- Used for RB751/RB751G
  - ON when no activity
  - Blinks when there is TX/RX traffic (interval depends on traffic activity – minimal 100ms)
  - OFF for 1s and ON for 2s – no wireless connection made to the wireless card

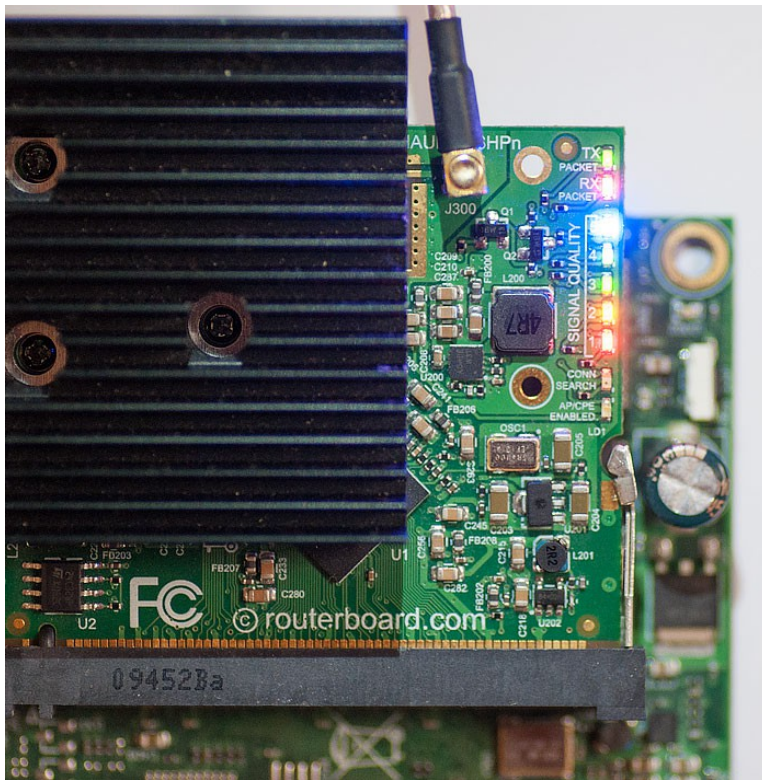
# Additional LEDs on RB wireless cards

- R2/5SHPn and R11e wireless cards has additional 9 LEDs:
  - Enabled-led
  - Search-led
  - Rx-led
  - Tx-led
  - Signal1-led
  - Signal2-led
  - Signal3-led
  - Signal4-led
  - Signal5-led

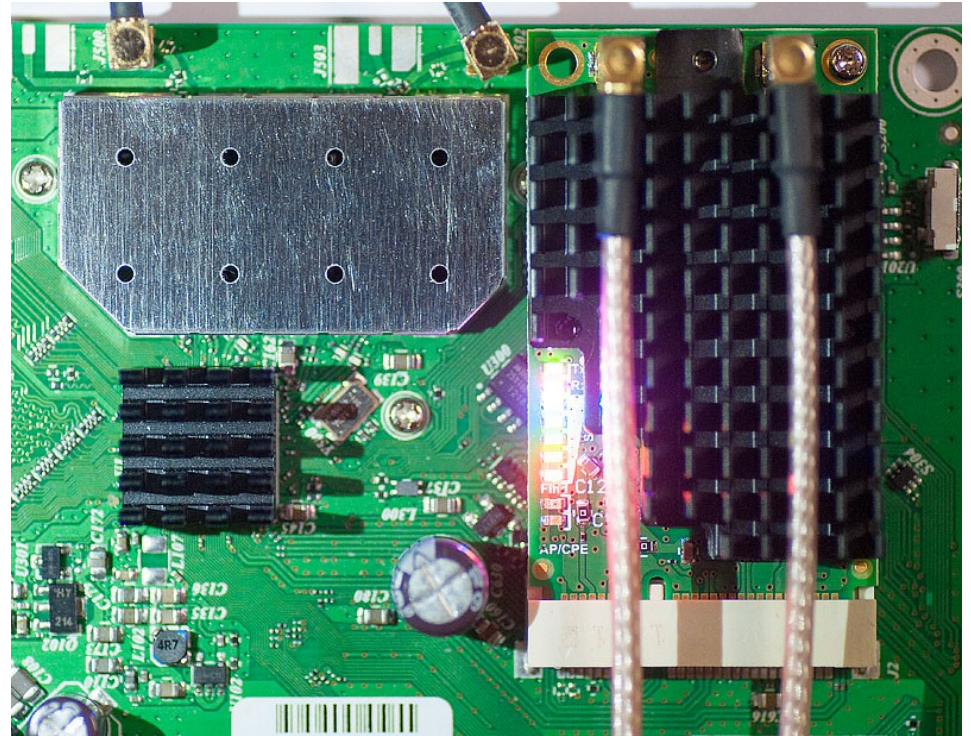


# Additional LEDs on RB wireless cards

- R2/5SHPn

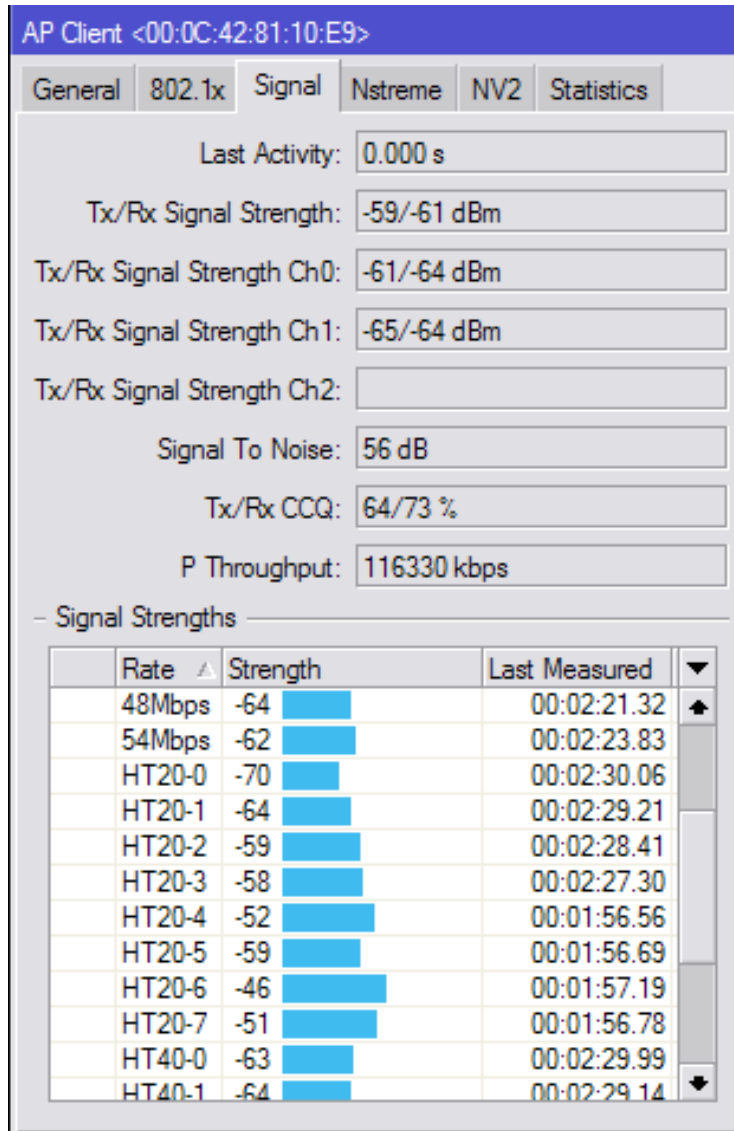


- R11e-2/5HPnD



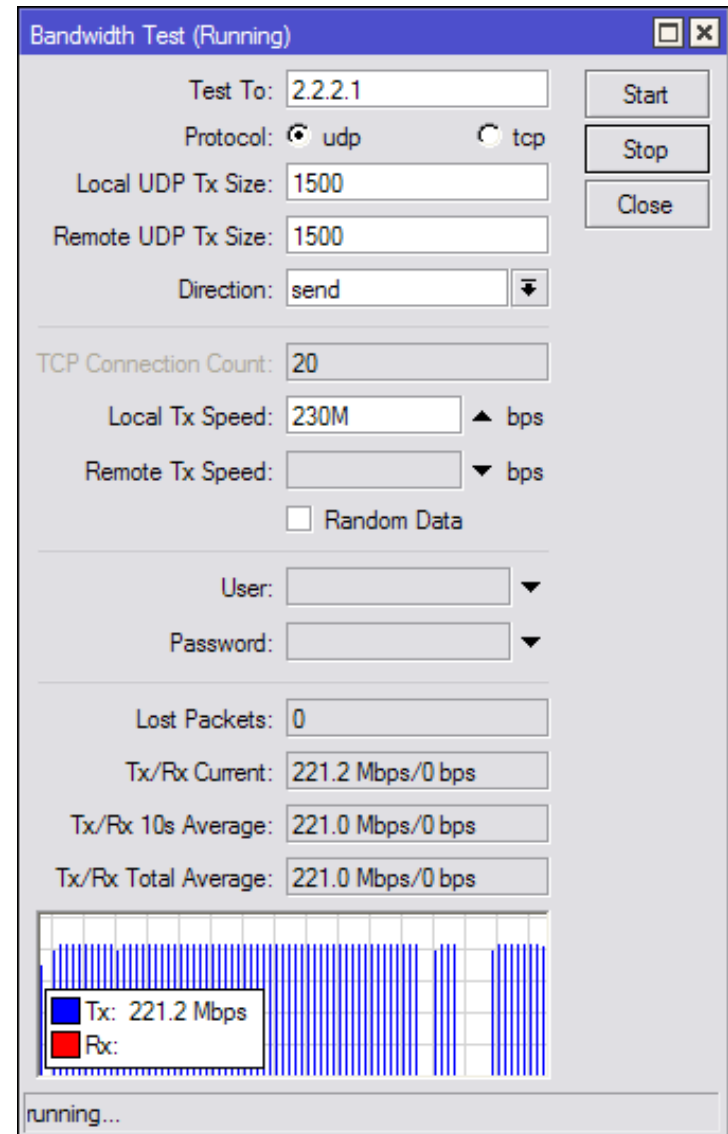
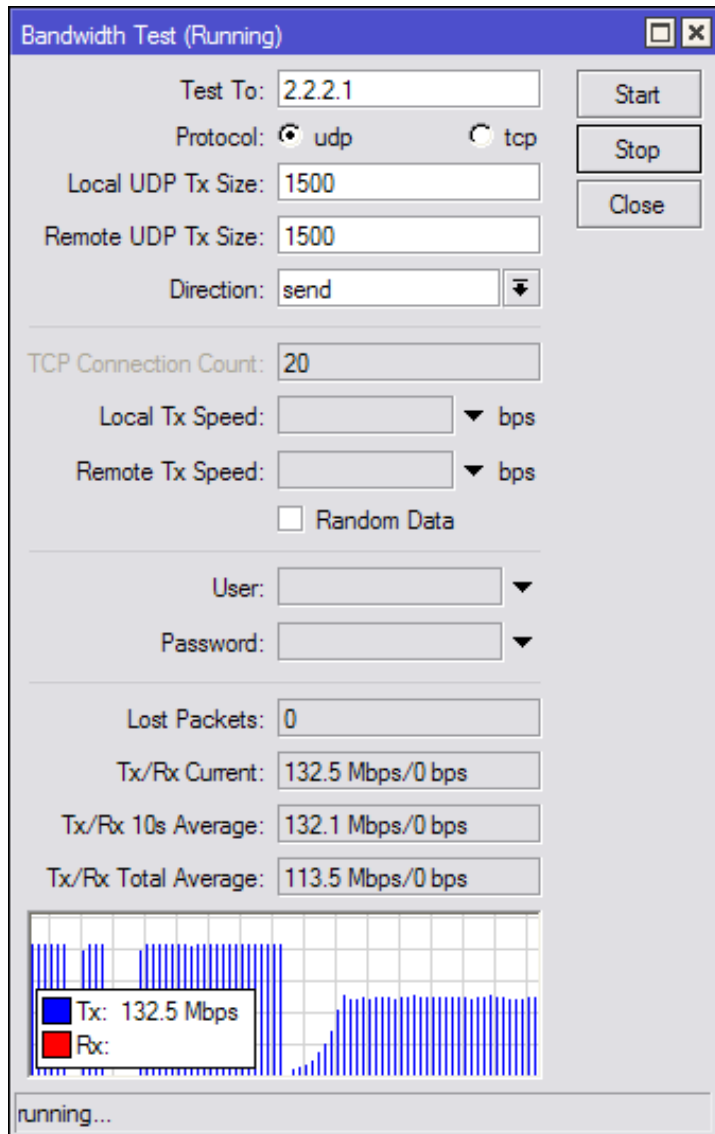


# Registration table entries



- Wireless registration table in Winbox is refreshed every 5s
- Use specific client registration table entry for monitoring the settings every second
- Historical measurements of signal for each previously used data-rate

# Bandwidth Test max speed



# Wireless Advanced Channels

- Located under 'interface wireless channels'
- Custom center frequency support with 0.5Mhz step
- Custom channel width range from 2.5-30mhz with 0.5mhz step
- Only Atheros AR92xx support and center frequency range 2192-2734mhz and 4800-6100mhz
- Custom 'scan-list' feature
- Support added in RouterOS v6
- Superchannel licenese required to use custom advanced channels features

# Wireless Advanced Channels

- Custom scan-list options:
  - default, numeric frequency range, advanced channel name, advanced channel list name
- Example: Scan 10 and 20mhz option on the client
  - /interface wireless channels

```
add frequency=5180 width=20 band=5ghz-a list=20mhz-list
add frequency=5200 width=20 band=5ghz-a list=20mhz-list
add frequency=5180 width=10 band=5ghz-a list=10mhz-list
add frequency=5200 width=10 band=5ghz-a list=10mhz-list
```

```
/interface wireless set wlan1 scan-list=20mhz-list,10mhz-list
```

# Wireless Advanced Channels

- Example: Indoor and Outdoor ranges

- /interface wireless channels

```
add frequency=5180 width=20 band=5ghz-a/n list=indoor
```

```
add frequency=5200 width=20 band=5ghz-a/n list=indoor
```

```
....
```

```
add frequency=5500 width=20 band=5ghz-a/n list=outdoor
```

```
add frequency=5520 width=20 band=5ghz-a/n list=outdoor
```

```
....
```

```
/interface wireless set wlan1 scan-list=indoor
```

```
/interface wireless set wlan2 scan-list=outdoor
```

# Wireless Advanced Channels

- Example: Scan for AP in 2.4ghz and 5ghz band
  - /interface wireless channels

```
add frequency=5180 width=20 band=5ghz-a/n list=band5
```

```
add frequency=5200 width=20 band=5ghz-a/n list=band5
```

```
....
```

```
add frequency=2412 width=20 band=2ghz-b/g/n list=band2
```

```
add frequency=2417 width=20 band=2ghz-b/g/n list=band2
```

```
....
```

```
/interface wireless set wlan1 scan-list=band5,band2
```

# Wireless Advanced Channels

admin@10.5.8.64 (4) - WinBox v6.2 on RB800 (powerpc)

Safe Mode CPU: 44% ☒ Hide Passwords

**RouterOS WinBox**

- Quick Set
- Interfaces
- Wireless
- Bridge
- PPP
- Switch
- Mesh
- IP
- MPLS
- Routing
- System
- Queues
- Files
- Log
- Radius
- Tools
- New Terminal
- MetaROUTER
- Partition
- Make Supout.tif
- Manual
- Exit

**Interface <wlan1>**

Current Tx Power	Status	Advanced Status	Traffic	...
Band:	5GHz-N			
Frequency:	5320 MHz			
Wireless Protocol:	802.11			
Tx/Rx Rate:	405.0Mbps/405.0Mbps			
SSID:	width30			
BSSID:	00:0C:42:6C:4D:20			
Radio Name:	000C426C4D20			
Tx/Rx Signal Strength:	-59/-57 dBm			
Tx/Rx Signal Strength Ch0:	-61/-59 dBm			
Tx/Rx Signal Strength Ch1:	-61/-61 dBm			
Tx/Rx Signal Strength Ch2:				
Noise Floor:	-117 dBm			
Signal To Noise:	60 dB			
Tx/Rx CCQ:	90/63 %			
Overall Tx CCQ:	90 %			
Distance:				
RouterOS Version:	6.2			
Last IP:	1.1.1.1			

enabled running slave connected running...

**Bandwidth Test (Running)**

Test To: 1.1.1.1 Start Stop Close

Protocol: ☒ udp ☐ tcp

Local UDP Tx Size: 1500

Remote UDP Tx Size: 1500

Direction: send

TCP Connection Count: 20

Local Tx Speed: bps

Remote Tx Speed: bps

☐ Random Data

User:

Password:

Lost Packets: 0

Tx/Rx Current: 358.9 Mbps/0 bps

Tx/Rx 10s Average: 357.7 Mbps/0 bps

Tx/Rx Total Average: 333.6 Mbps/0 bps

Tx: 358.9 Mbps

Rx:

Thank you!