

Wireless Workshop

MUM 2012 – New Orleans

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MikroTik

Topics

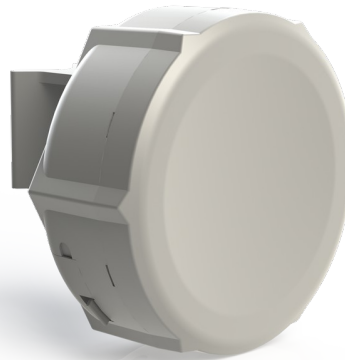
- Quickset for Wireless
- Transparent wireless links
- Useful configuration settings and features

Workshop Equipment

- RB951-2n



- 2 x RB SXT G-5HnD



- Laptop



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

WLAN

Address Acquisition: DHCP

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...	Signa	Stren
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:

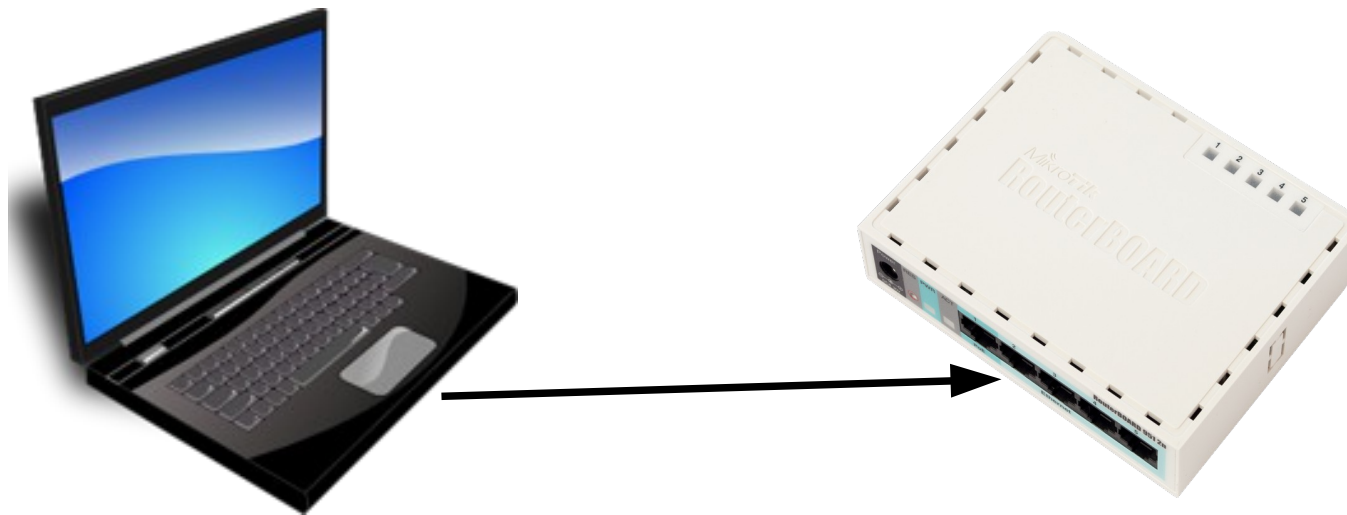
Confirm Password:

Upgrade: Nav izvēlēts neviena fails

Quickset feature support

- RB SXT
- RB Groove
- RB Metal
- RB 711, RB 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)

Safe Mode

Hide Passwords

RouterOS WinBox

Quick Set

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Make Supout.rif

Manual

Exit

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

AP Quickset Demo

- SSID “Workshop”
- IP 10.0.100.1
- Login demo and no password

CPE Quickset

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

CPE Quickset Demo

MikroTik - Quick Set at ad x

10.0.100.1/webfig/

WebFig v5.20

CPE Quick Set

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

Logout

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	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

Connect

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

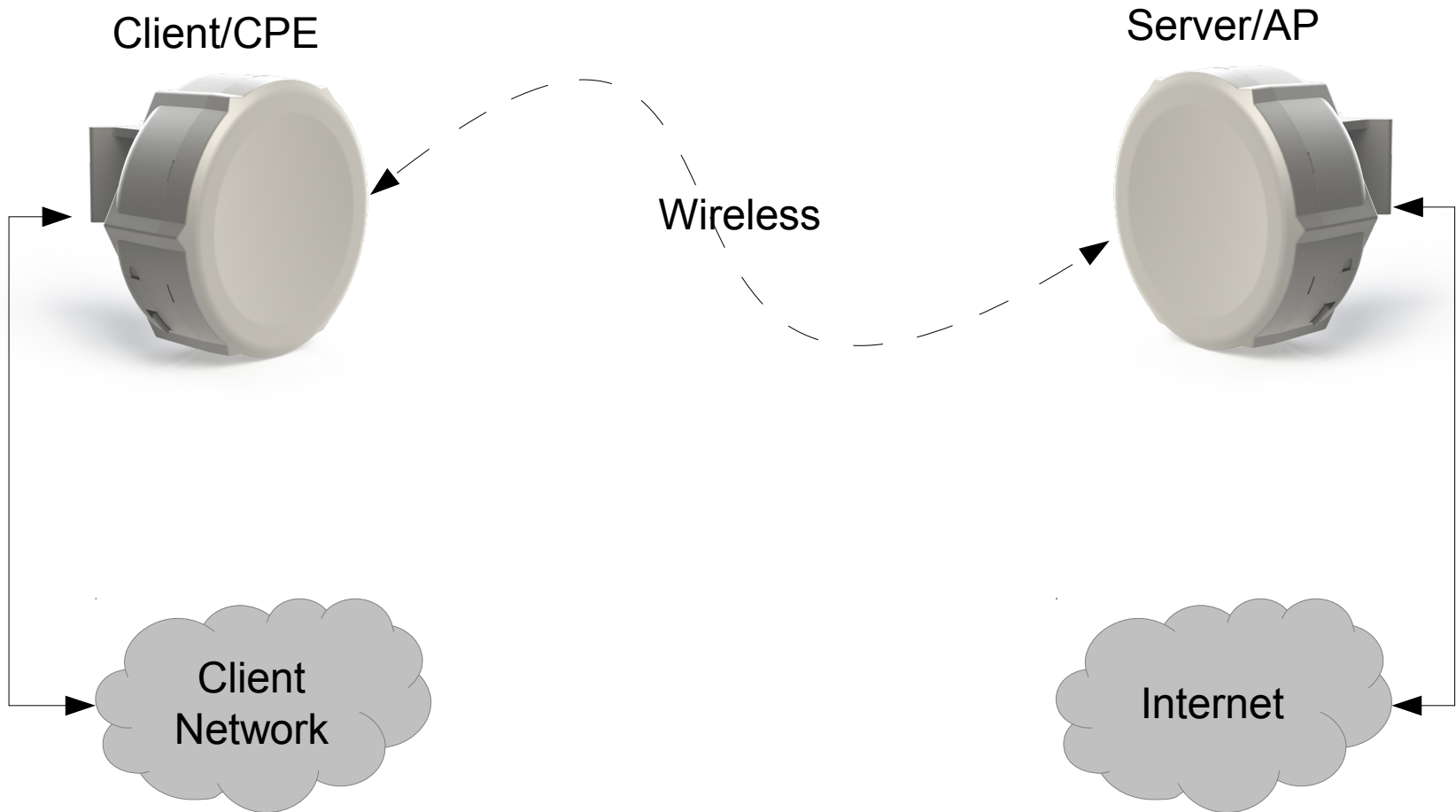
Confirm Password

Upgrade Izvēlieties failu Nav izvēlēts neviena fails

Apply Configuration

Reset Configuration

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 interface is divided into several sections: Wireless Bridge Mode, Configuration, System, and Wireless Clients.

Wireless Bridge Mode

- 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
- Pre-Shared Key:**

Configuration

- Address Acquisition:** ☐ Static ☒ DHCP
- Address Source:** ☒ Any ☐ Ethernet ☐ WLAN
- IP Address:** 10.0.100.244/24 (Buttons: DHCP Release, DHCP Renew)
- Gateway:** 10.0.100.1

System

- Router Identity:** MikroTik
- Password:**
- Confirm Password:**
- Upgrade:** Izvēlieties failu (Nav izvēlēts neviens fails)
- Buttons:** Apply Configuration, Reset Configuration

Wireless 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

Signal Strength: cur: -31 dB, avg: -28 dB, max: -12 dB

Copy To ACL

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

Bridge

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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

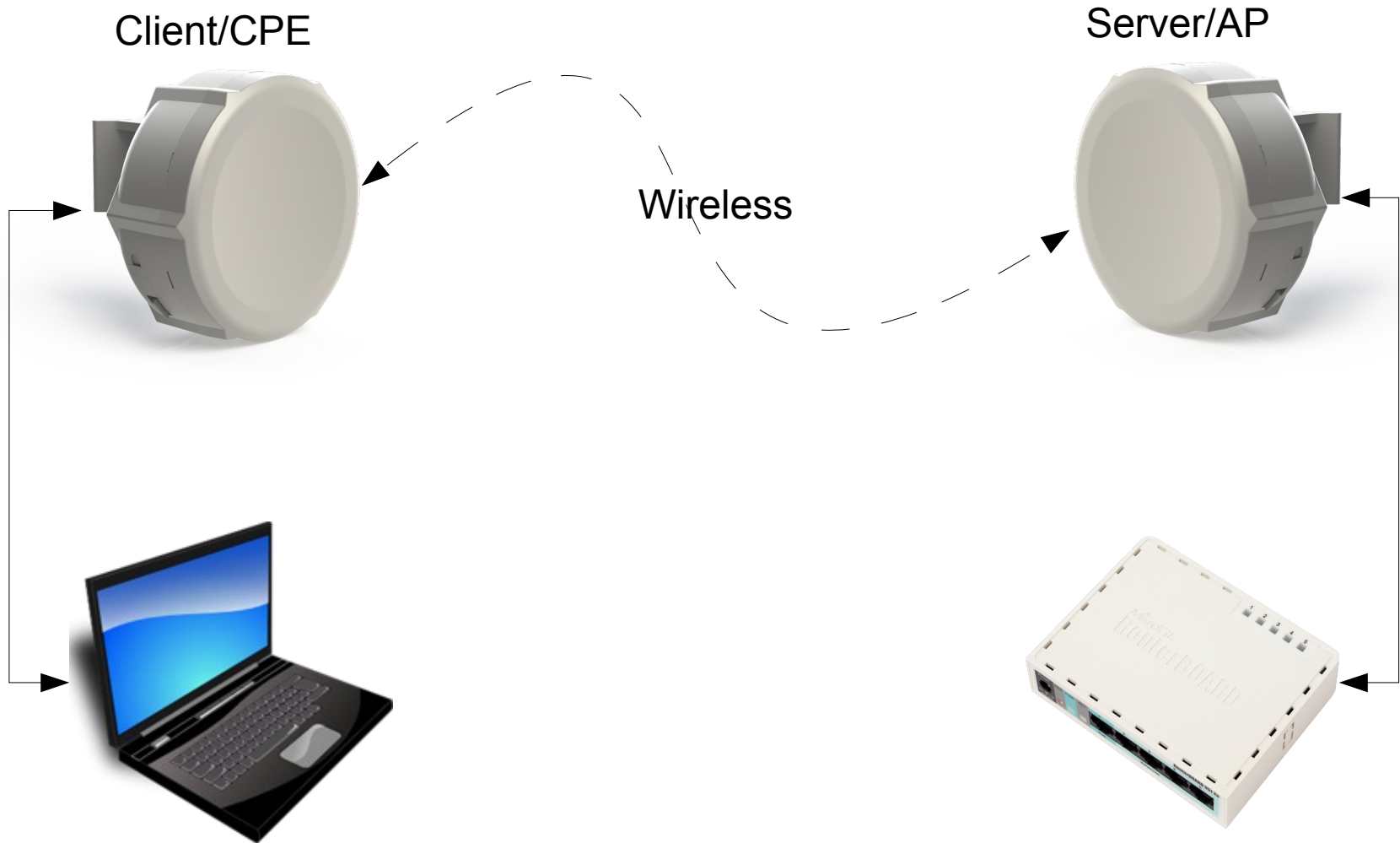
Cancel

Apply

DHCP Renew

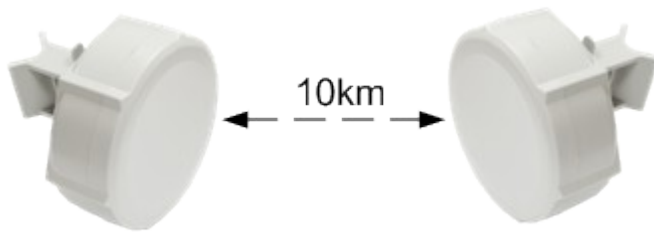
DHCP Release

Point to Point Bridge Quickset Setup



Connection Types

Point to Point (PTP)



Point to Multi Point (PTMP)



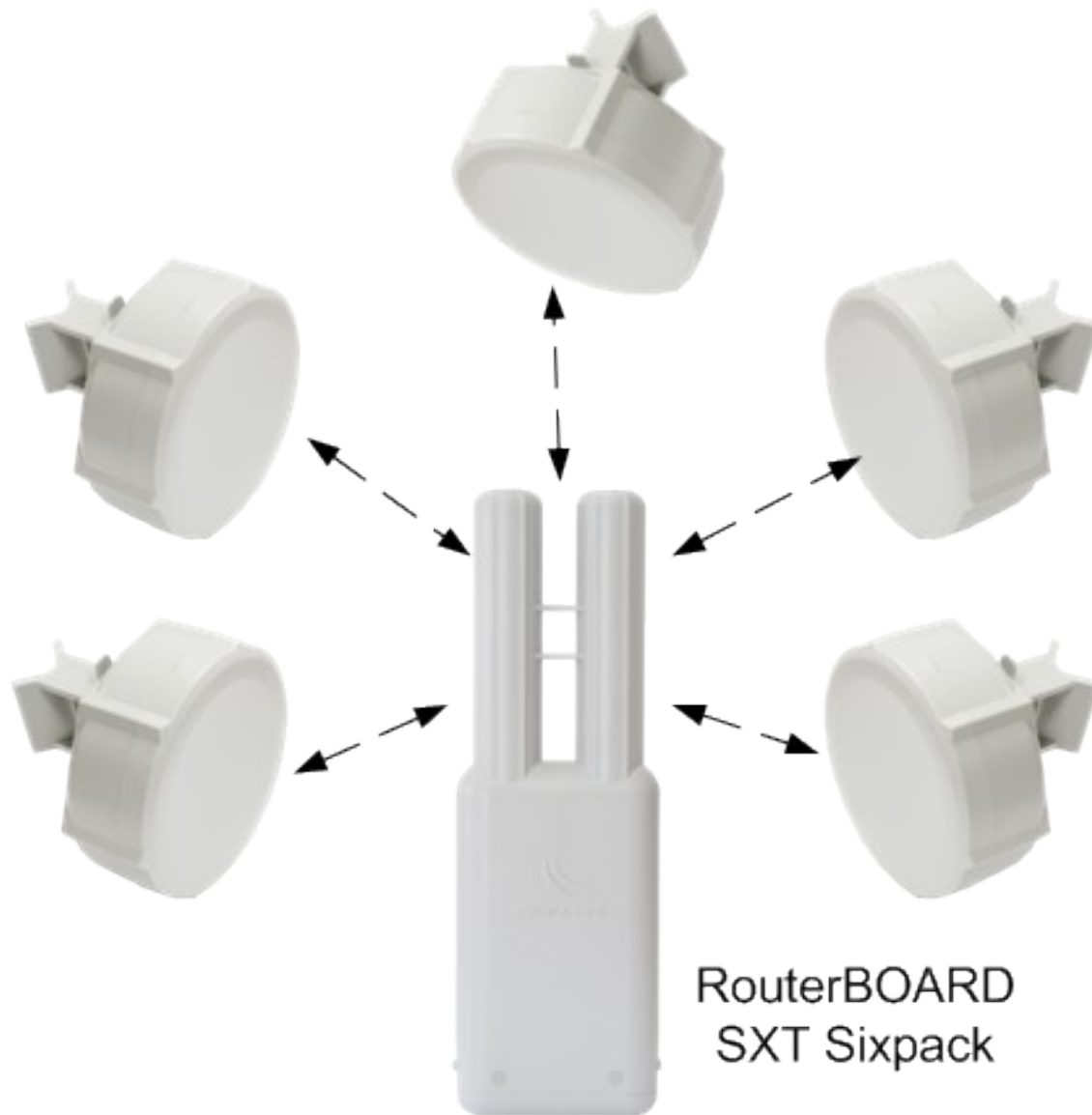
PTP/PTMP connection modes

- 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

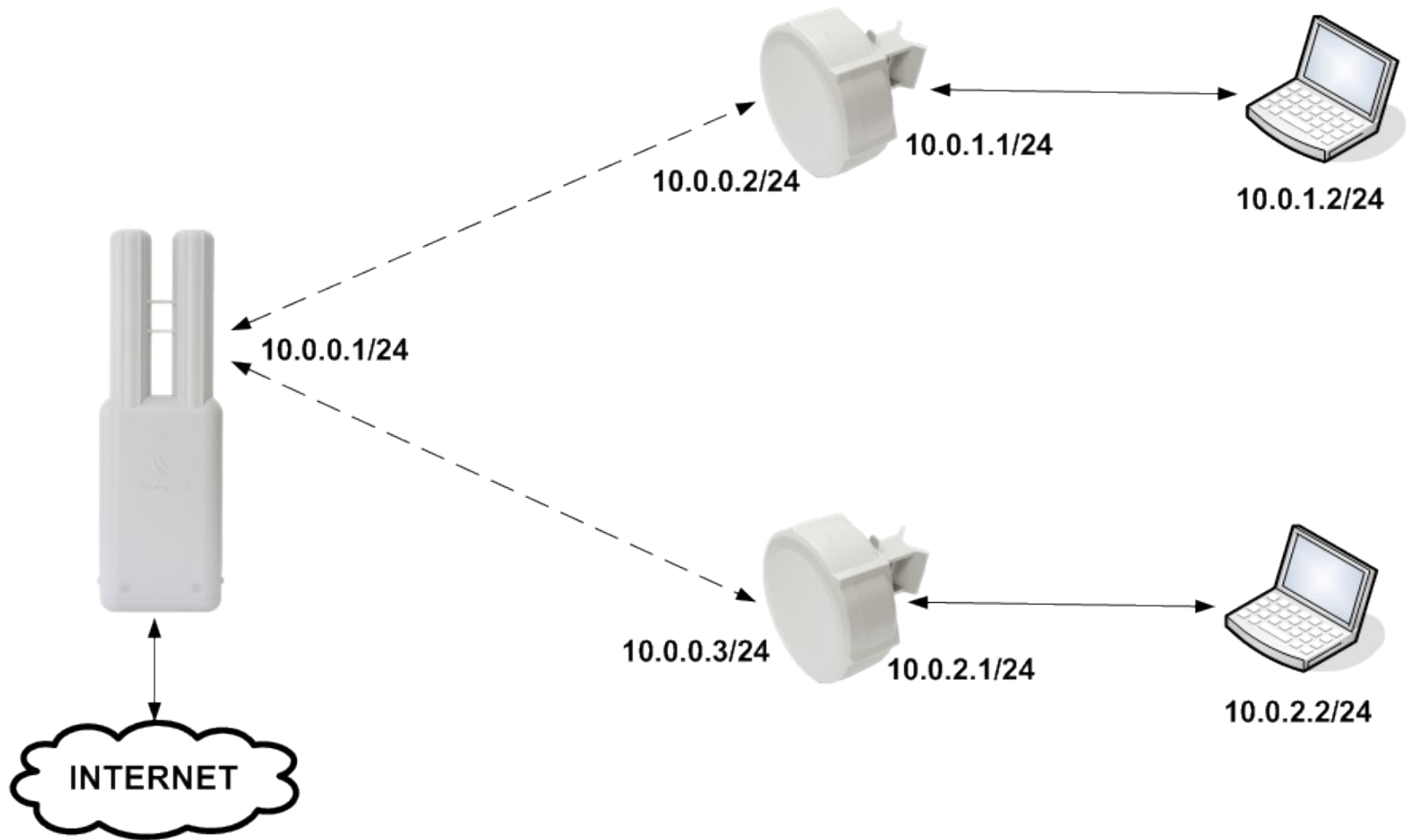
RouterOS license requirements

- 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

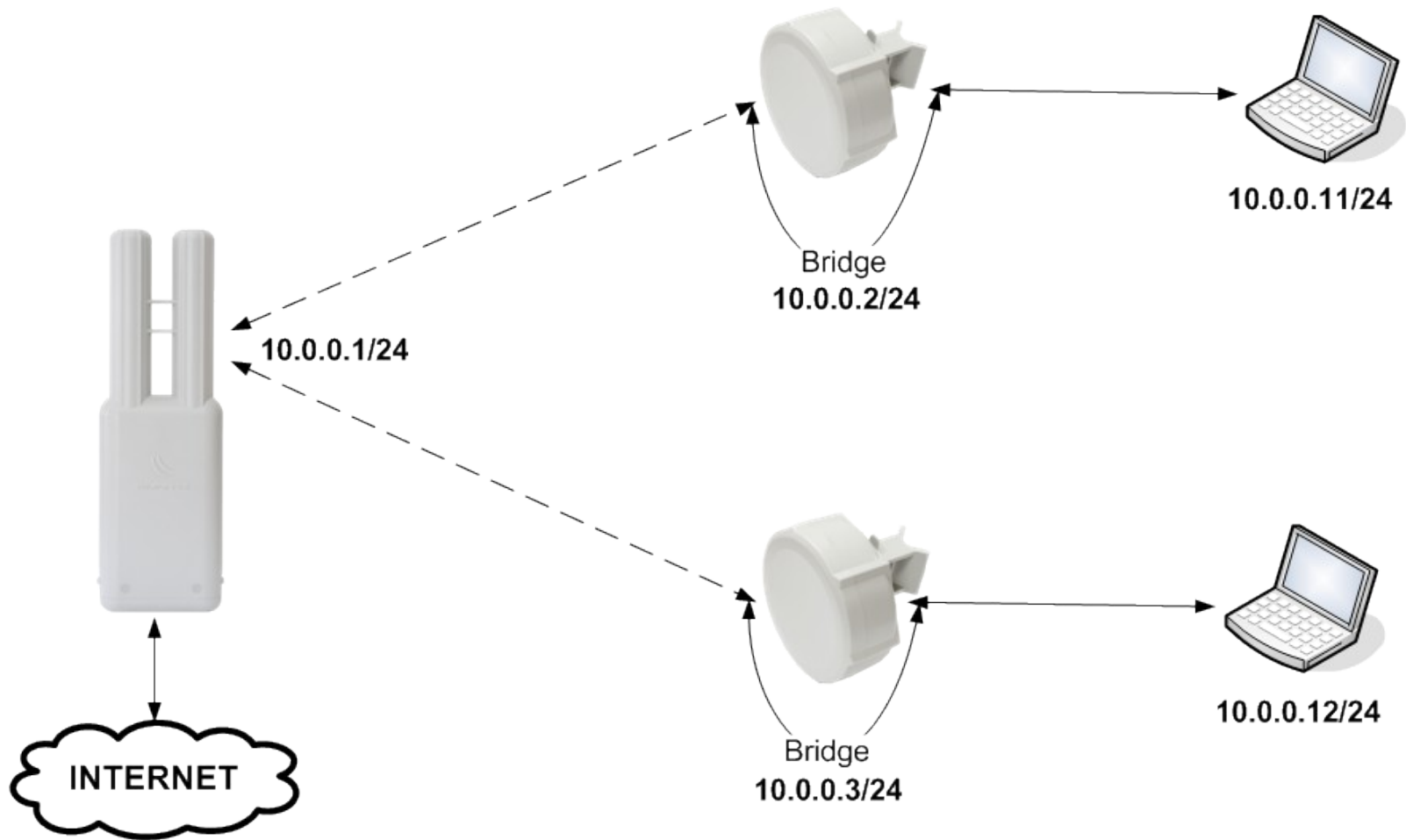
Regular PTMP setup



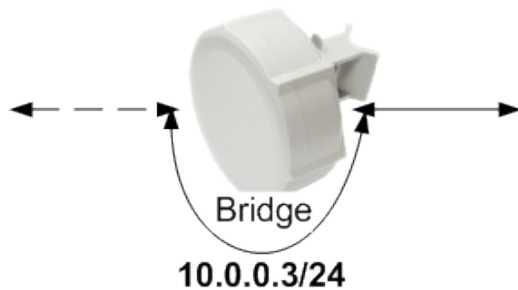
Wireless Setup Type - Routing



Wireless Setup Type - Bridging



Wireless Setup Types



- **Bridging**

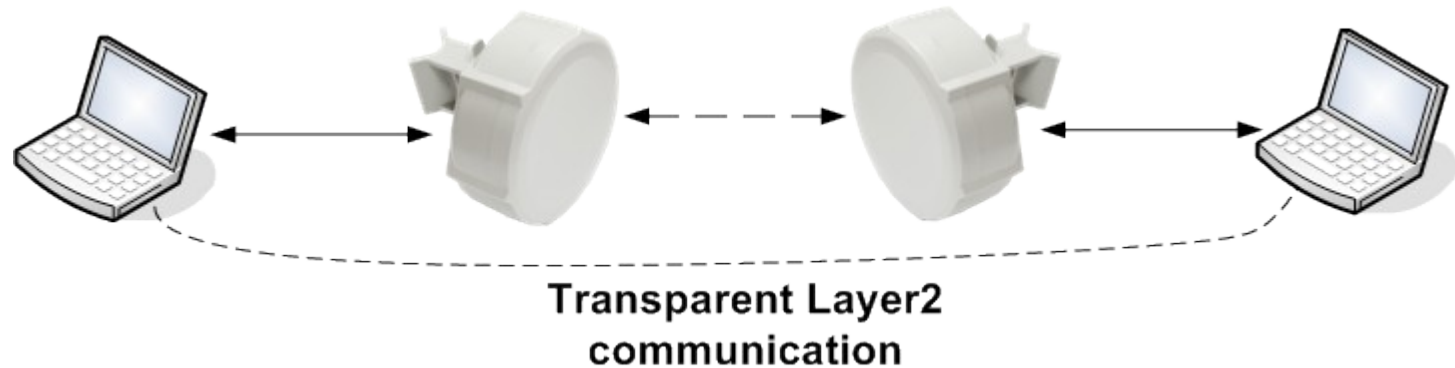
- Advantage
 - Less IP configuration needed
- Disadvantage
 - Clients broadcast traffic or flood can lower wireless network performance
 - Not suitable for large network



- **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

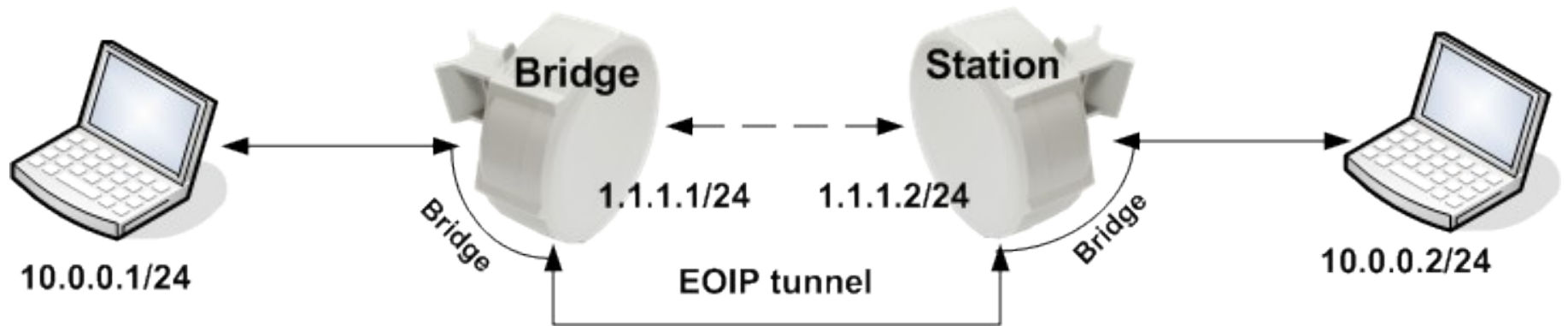


- Less configuration needed
- Extends Layer 2 protocol to clients (wireless ethernet switch)
- Suitable for PPPoE access

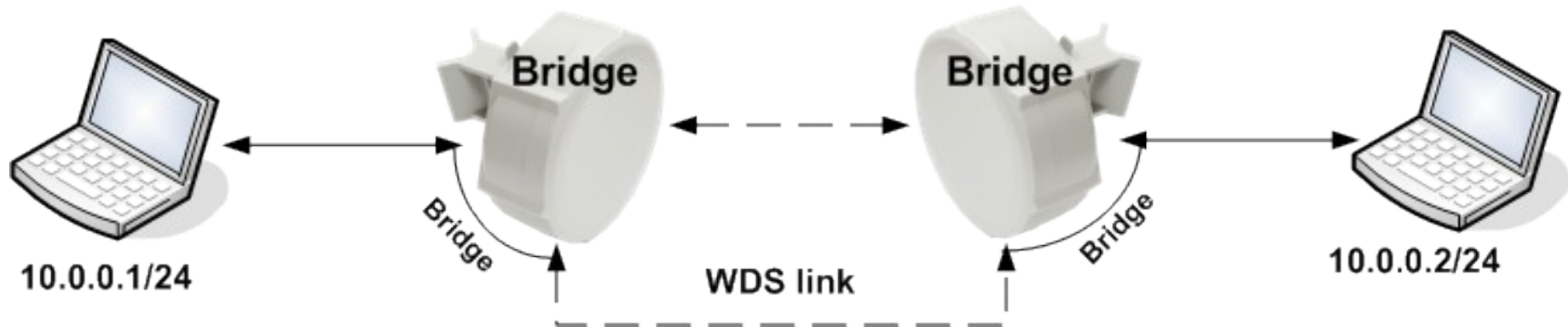
Transparent Wireless Links Setups

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

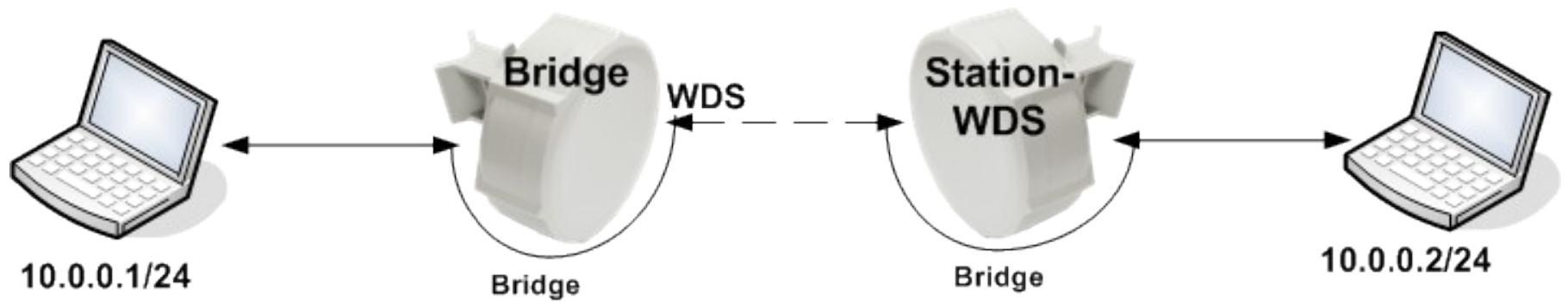
EOIP bridging setup



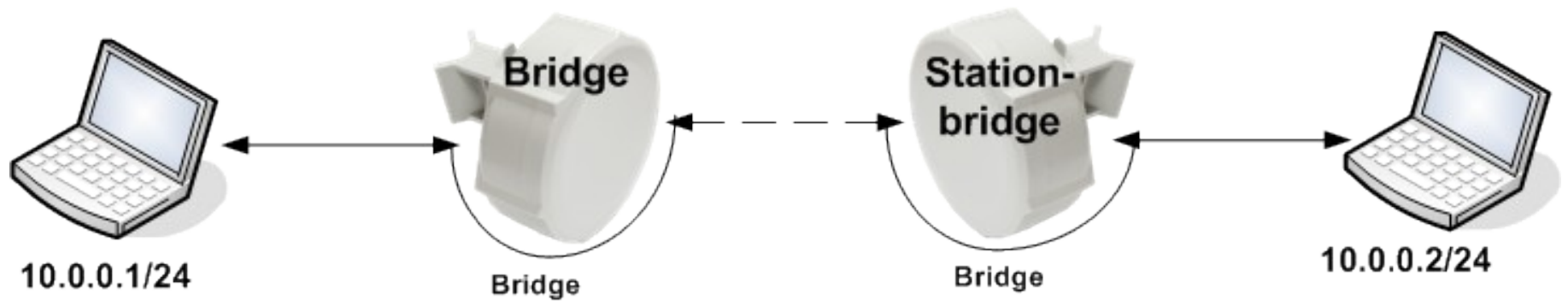
Bridge <-> Bridge setup



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 65Mbps or 150Mbps
 - Real UDP traffic up to 125Mbps
 - No need to change antennas or board – only wireless card

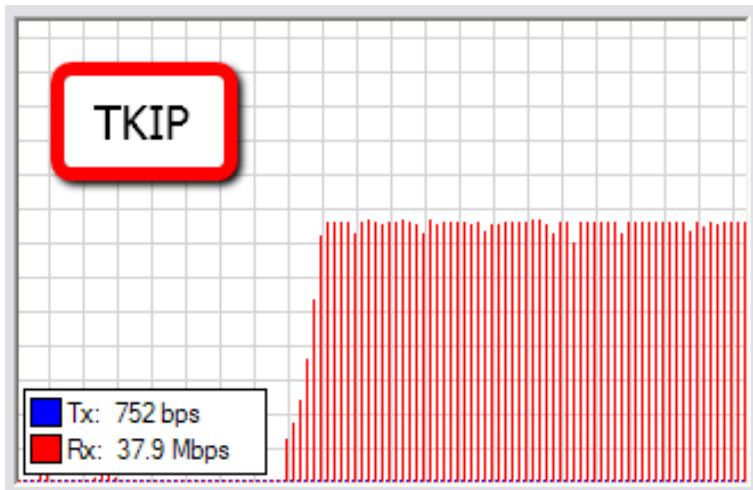
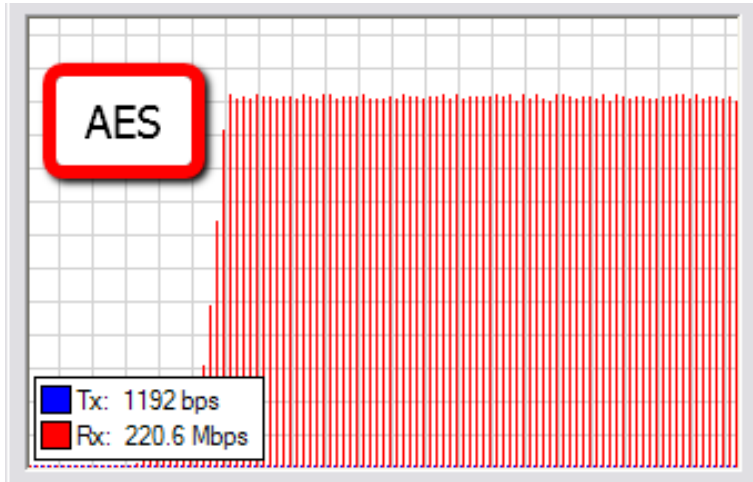
802.11n and WDS

- 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

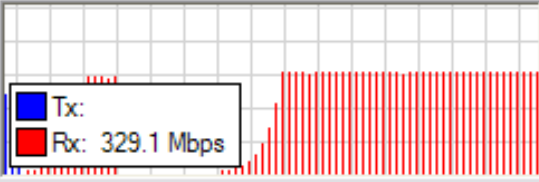


- Avoid using wireless encryption with TKIP cipher as it slows down the wireless link – speed drop from 220Mbps to 38Mbps
- Use AES cipher for 802.11n wireless encryption

AR9300 wireless support

- 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 328Mbps

AR9300 wireless support

Bandwidth Test (Running)		Interface <wlan2>	
Test To: <input type="text" value="2.2.2.1"/>		Current Tx Power Status Advanced Status Traffic ...	
Protocol: <input checked="" type="radio"/> udp <input type="radio"/> tcp		Band: <input type="text" value="5GHz-N"/>	
Local UDP Tx Size: <input type="text" value="1500"/>		Frequency: <input type="text" value="5450 MHz"/>	
Remote UDP Tx Size: <input type="text" value="1500"/>		Wireless Protocol: <input type="text" value="nstream"/>	
Direction: <input type="text" value="receive"/> ▼		Tx/Rx Rate: <input type="text" value="450.0Mbps/450.0Mbps"/>	
TCP Connection Count: <input type="text" value="20"/>		SSID: <input type="text" value="RB800_nv2"/>	
Local Tx Speed: <input type="text"/> ▼ bps		BSSID: <input type="text" value="00:0B:6B:7E:50:4D"/>	
Remote Tx Speed: <input type="text"/> ▼ bps		Radio Name: <input type="text" value="000B6B7E504D"/>	
<input type="checkbox"/> Random Data		Tx/Rx Signal Strength: <input type="text" value="-61/-48 dBm"/>	
User: <input type="text"/> ▼		Tx/Rx Signal Strength Ch0: <input type="text" value="-68/-54 dBm"/>	
Password: <input type="text"/> ▼		Tx/Rx Signal Strength Ch1: <input type="text" value="-64/-50 dBm"/>	
Lost Packets: <input type="text" value="1765"/>		Tx/Rx Signal Strength Ch2: <input type="text" value="-69/-54 dBm"/>	
Tx/Rx Current: <input type="text" value="0 bps/329.1 Mbps"/>		Noise Floor: <input type="text" value="-114 dBm"/>	
Tx/Rx 10s Average: <input type="text" value="0 bps/327.9 Mbps"/>		Signal To Noise: <input type="text" value="66 dB"/>	
Tx/Rx Total Average: <input type="text" value="0 bps/280.0 Mbps"/>		Tx/Rx CCQ: <input type="text" value="95/100 %"/>	
		Overall Tx CCQ: <input type="text" value="95 %"/>	
running...		Distance: <input type="text"/>	
		RouterOS Version: <input type="text" value="5.8"/>	
		Last IP: <input type="text" value="2.2.2.1"/>	
		<input type="checkbox"/> WDS Link	

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)
- 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

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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.rtf

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...

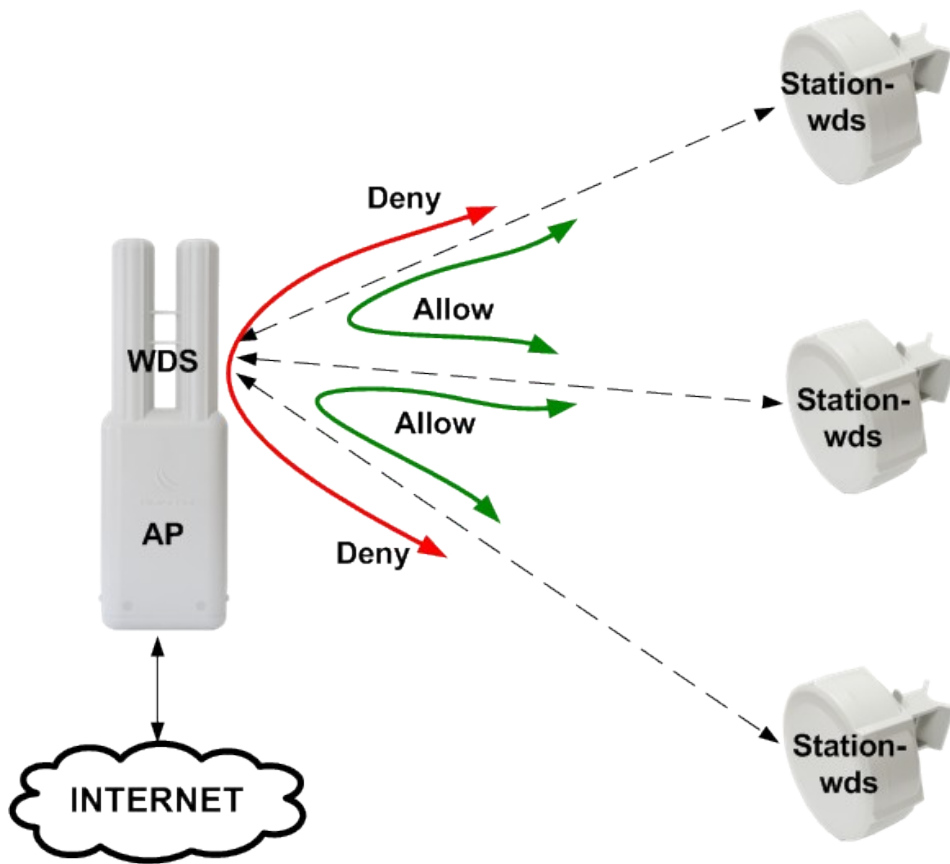
Sniff...

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>

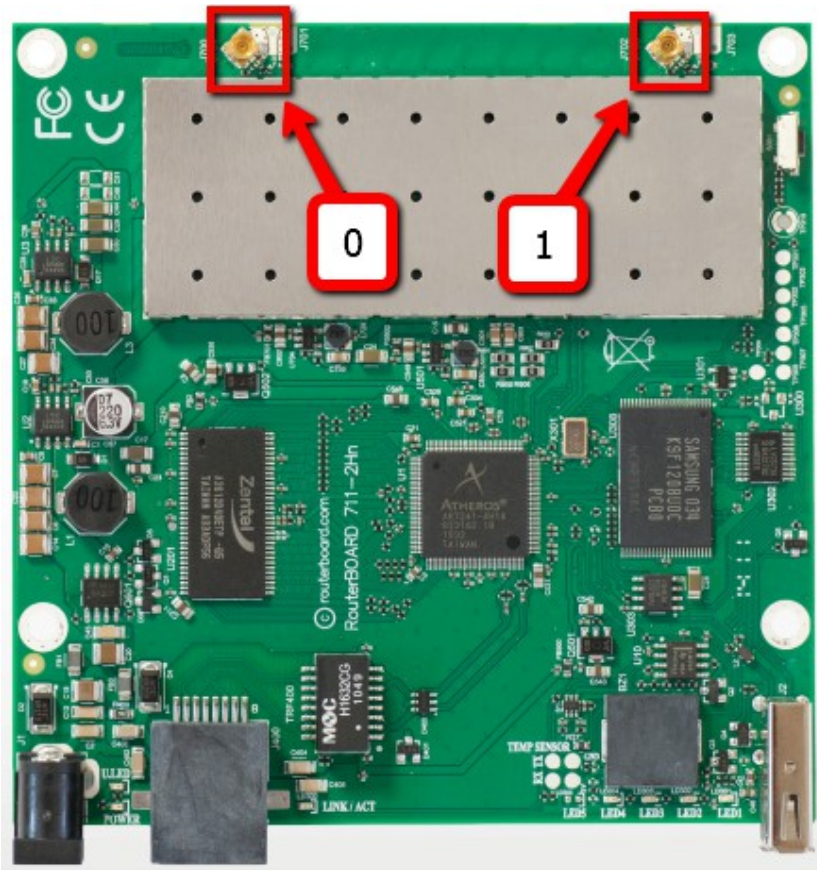
Advanced HT HT MCS WDS Nstreme NV2

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.

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

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: [dropdown]

Client Tx Limit: [dropdown]

☒ Authentication

☒ Forwarding

Private Key: none 0x [text]

Private Pre Shared Key: keykeykey2

Time: [dropdown]

disabled

Security Profile <PSK_security>

General | RADIUS | EAP | Static Keys

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: [text]

Group Key Update: 00:05:00

Rate-selection – legacy

- Rate-selection default value for RouterOS versions older than v5.9
- 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
unspecified	establish nstreme or 802.11 network based on old nstreme setting	connect to nstreme or 802.11 network based on old nstreme setting
any	same as unspecified	scan for all matching networks, no matter what protocol, connect using protocol of chosen network
802.11	establish 802.11 network	connect to 802.11 networks only
nstreme	establish Nstreme network	connect to Nstreme networks only
nv2	establish Nv2 network	connect to Nv2 networks only
nv2-nstreme-802.11	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
nv2-nstreme	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>

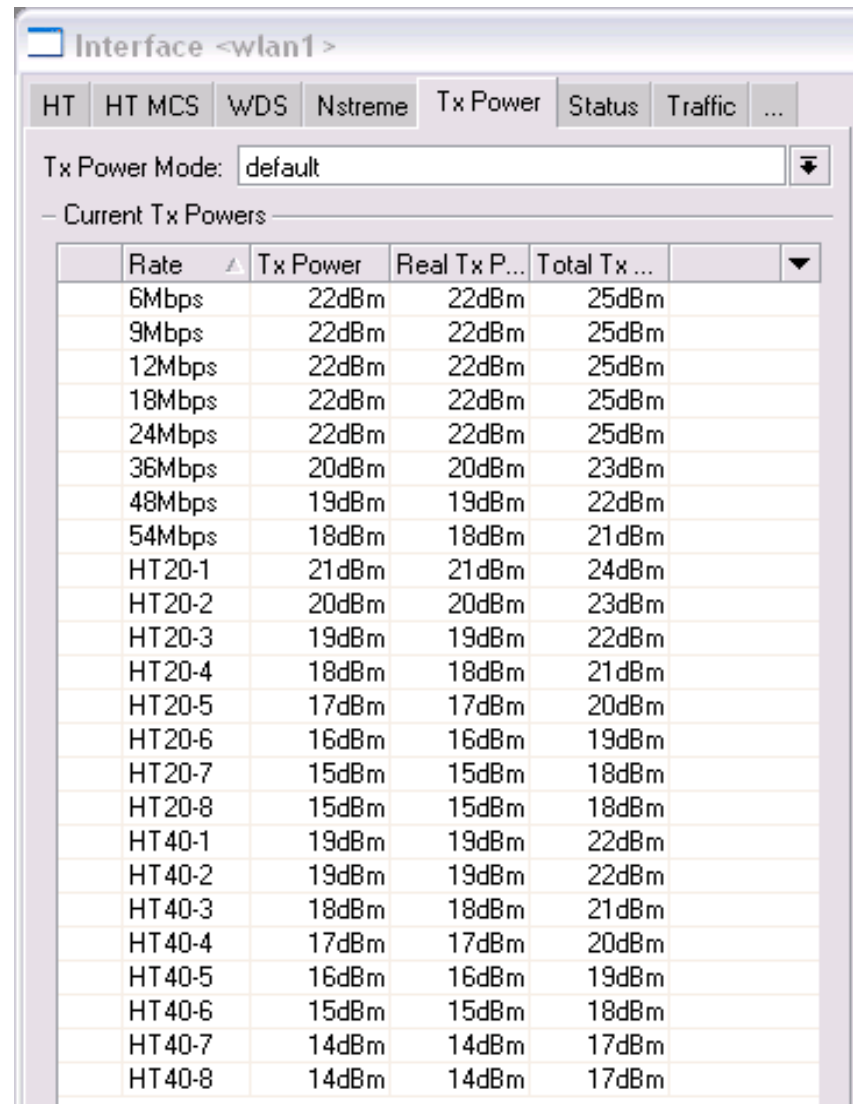
Nstream	NV2	Status	Advanced Status	Traffic	...
---------	-----	--------	-----------------	---------	-----

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-strenght-ch0" - chain 0 control channel
- "signal-strenght-ch1" - chain 1 control channel
- "signal-strenght-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>

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

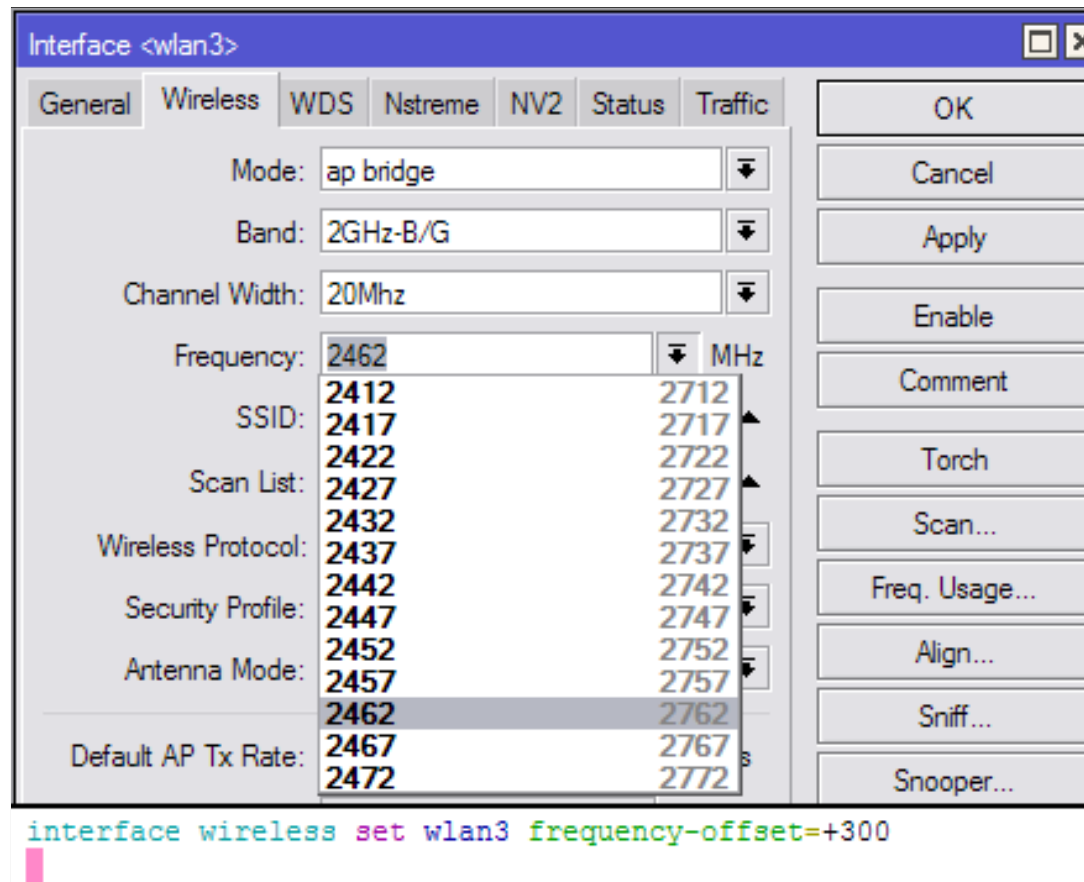
Tx Power Mode: default

- Current Tx Powers

	Rate ▲	Tx Power	Real Tx P...	Total Tx ...	▼
	6Mbps	22dBm	22dBm	25dBm	
	9Mbps	22dBm	22dBm	25dBm	
	12Mbps	22dBm	22dBm	25dBm	
	18Mbps	22dBm	22dBm	25dBm	
	24Mbps	22dBm	22dBm	25dBm	
	36Mbps	20dBm	20dBm	23dBm	
	48Mbps	19dBm	19dBm	22dBm	
	54Mbps	18dBm	18dBm	21dBm	
	HT20-1	21dBm	21dBm	24dBm	
	HT20-2	20dBm	20dBm	23dBm	
	HT20-3	19dBm	19dBm	22dBm	
	HT20-4	18dBm	18dBm	21dBm	
	HT20-5	17dBm	17dBm	20dBm	
	HT20-6	16dBm	16dBm	19dBm	
	HT20-7	15dBm	15dBm	18dBm	
	HT20-8	15dBm	15dBm	18dBm	
	HT40-1	19dBm	19dBm	22dBm	
	HT40-2	19dBm	19dBm	22dBm	
	HT40-3	18dBm	18dBm	21dBm	
	HT40-4	17dBm	17dBm	20dBm	
	HT40-5	16dBm	16dBm	19dBm	
	HT40-6	15dBm	15dBm	18dBm	
	HT40-7	14dBm	14dBm	17dBm	
	HT40-8	14dBm	14dBm	17dBm	

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

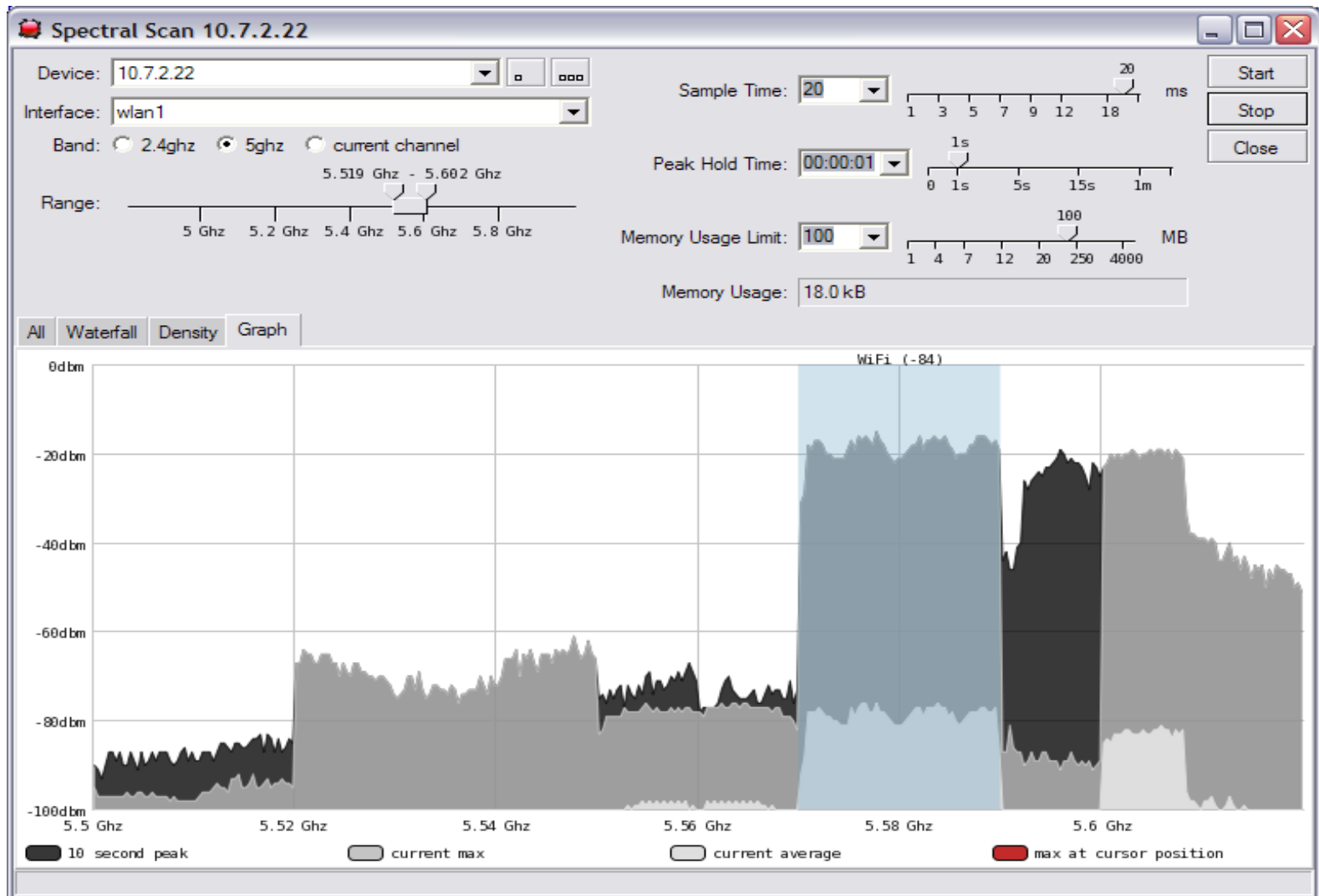
<input checked="" type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3
<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7

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

Spectral Scan/History

- Uses RouterOS
- Uses Atheros Merlin 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



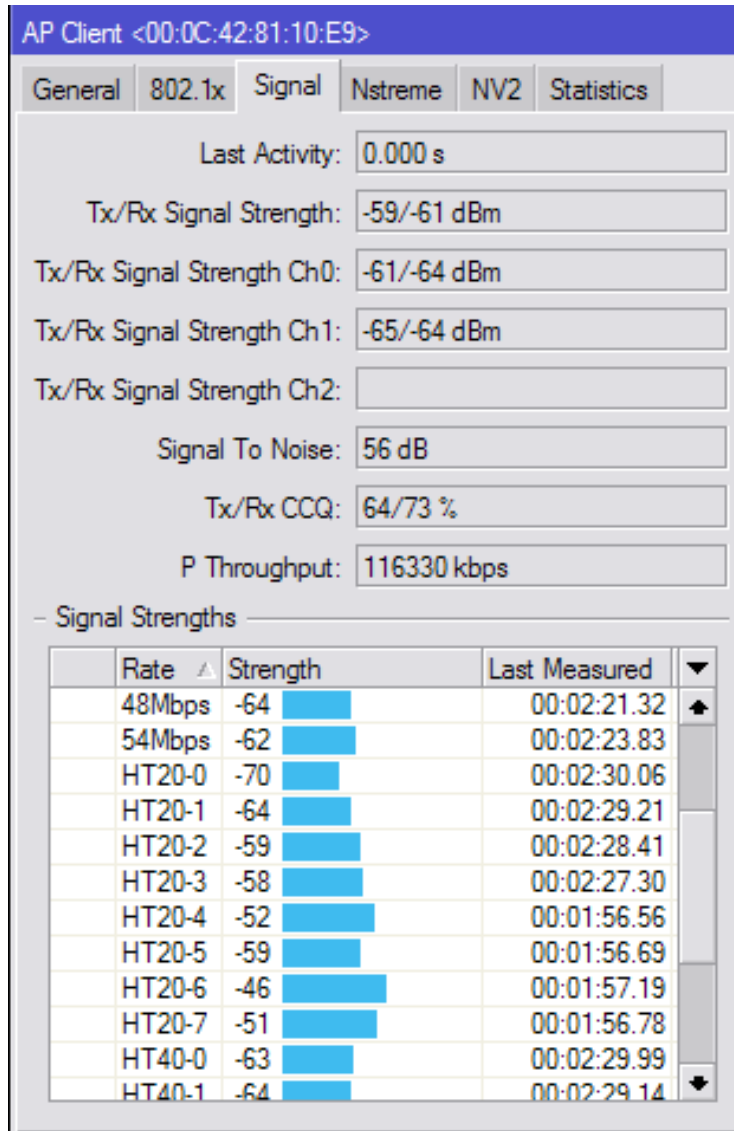
Wireless-signal LED feature

- Wireless signal LEDs supported added for RB400 series, RB711, RB SXT and RB Groove:
 - 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

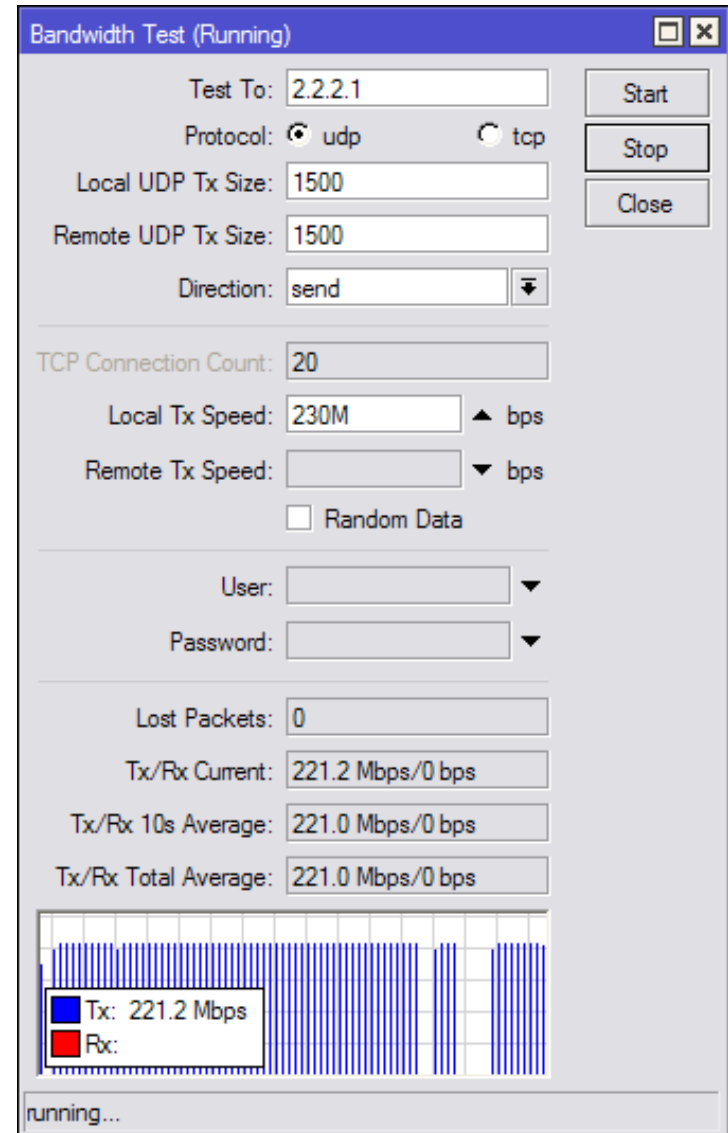
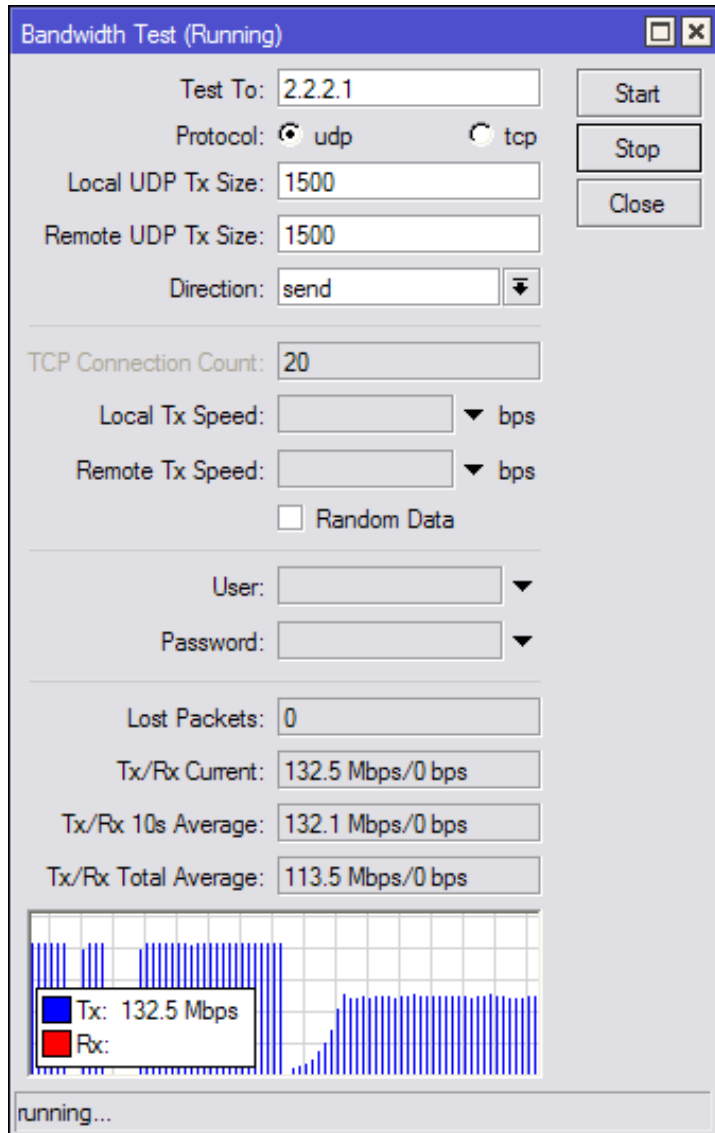
- Used for RB751/RB751G
 - ON when no activity
 - Blinks when there is TX/RX traffic (interval depends on traffic activity – minimal 100ms)
 - OFF for 1s and ON for 2s – no wireless connection made to the wireless card

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 advanced channels

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

admin@10.5.8.52 (MikroTik) - WinBox v6.0alpha1 on RB800 (powerpc)

Safe Mode Uptime: 2d 21:35:58 CPU: 48% ☒ Hide Passwords

Interfaces

Wireless

Bridge

PPP

Switch

Mesh

IP

MPLS

Routing

System

Queues

Files

Log

Radius

Tools

New Terminal

MetaROUTER

Make Supout.tif

Manual

Exit

Interface <wlan2>

Current Tx Power	Status	Advanced Status	Traffic	...
Band: 5GHz-N				
Frequency: 5360 MHz				
Wireless Protocol: 802.11				
Tx/Rx Rate: 27.0Mbps/405.0Mbps				
SSID: MikroTik1				
BSSID: 00:0C:42:62:B6:45				
Radio Name: 000C4262B645				
Tx/Rx Signal Strength: -56/-55 dBm				
Tx/Rx Signal Strength Ch0: -62/-58 dBm				
Tx/Rx Signal Strength Ch1: -56/-58 dBm				
Tx/Rx Signal Strength Ch2:				
Noise Floor: -111 dBm				
Signal To Noise: 56 dB				
Tx/Rx CCQ: 80/91 %				
Overall Tx CCQ: 80 %				
Distance: 1 km				
RouterOS Version: 6.0alpha1				
Last IP: 8.8.8.1				
<input type="checkbox"/> WDS Link				

OK

Cancel

Apply

Disable

Comment

Torch

Scan...

Freq. Usage...

Align...

Sniff...

Snooper...

Reset Configuration

Simple Mode

Bandwidth Test (Running)

Test To: 8.8.8.1

Protocol: ☒ udp ☐ tcp

Local UDP Tx Size: 1500

Remote UDP Tx Size: 1500

Direction: receive

TCP Connection Count: 20

Local Tx Speed: bps

Remote Tx Speed: bps

☐ Random Data

User:

Password:

Lost Packets: 2879

Tx/Rx Current: 0 bps/345.1 Mbps

Tx/Rx 10s Average: 0 bps/339.5 Mbps

Tx/Rx Total Average: 0 bps/270.8 Mbps

Tx: Rx: 345.1 Mbps