Wireless Interface

Overview

Package: wireless

RouterOS wireless complies with IEEE 802.11 standards, it provides complete support for 802.11a, 802.11b, 802.11g, 802.11n and 802.11ac as long as additional features like WPA, WEP, AES encryption, Wireless Distribution System (WDS), Dynamic Frequency selection (DFS), Virtual Access Point, Nstreme and NV2 proprietary protocols and many more. Wireless features compatibility table for different wireless protocols.

Wireless can operate in several modes: client (station), access point, wireless bridge etc. Client/station also can operate in different modes, a complete list of supported modes can be found here.

General interface properties

Sub-menu: `/interface wireless`

Property	Description
adaptive-noise-immunity (*ap-and-client-mode* | *client-mode* | *none*; Default: **none**)	This property is only effective for cards based on Atheros chipset.
allow-sharedkey (*yes* | *no*; Default: **no**)	Allow WEP Shared Key clients to connect. Note that no authentication is done for these clients (WEP Shared keys are not compared to anything) - they are just accepted at once (if access list allows that)
ampdu-priorities (*list of integer [0..7]*; Default: **0**)	Frame priorities for which AMPDU sending (aggregating frames and sending using block acknowledgment) should get negotiated and used. Using AMPDUs will increase throughput, but may increase latency, therefore, may not be desirable for real-time traffic (voice, video). Due to this, by default AMPDUs are enabled only for best-effort traffic.
amsdu-limit (*integer [0..8192]*; Default: **8192**)	Max AMSDU that device is allowed to prepare when negotiated. AMSDU aggregation may significantly increase throughput especially for small frames, but may increase latency in case of packet loss due to retransmission of aggregated frame. Sending and receiving AMSDUs will also increase CPU usage.
amsdu-threshold (*integer [0..8192]*; Default: **8192**)	Max frame size to allow including in AMSDU.
antenna-gain (*integer [0..4294967295]*; Default: **0**)	Antenna gain in dBi, used to calculate maximum transmit power according to **co untry** regulations.
antenna-mode (*ant-a* | *ant-b* | *rxa-txb* | *txa-rxb*; Default:)	Select antenna to use for transmitting and for receiving - *ant-a* - use only 'a' antenna - *ant-b* - use only 'b' antenna - *txa-rxb* - use antenna 'a' for transmitting, antenna 'b' for receiving - *rxa-txb* - use antenna 'b' for transmitting, antenna 'a' for receiving
area (*string*; Default:)	Identifies group of wireless networks. This value is announced by AP, and can be matched in connect-list by **area-prefix**. This is a proprietary extension.
arp (*disabled* | *enabled* | *proxy-arp* | *reply-only*; Default: **enabled**)	`Read more >>`
arp-timeout (*auto* | *integer*; Default: **auto**)	ARP timeout is time how long ARP record is kept in ARP table after no packets are received from IP. Value **auto** equals to the value of **arp-timeout** in **/ip settings** , default is 30s

band (*2ghz-b | 2ghz-b/g | 2ghz-b/g/n | 2ghz-onlyg | 2ghz-onlyn | 5ghz-a | 5ghz-a/n | 5ghz-onlyn | 5ghz-a/n/ac | 5ghz-onlyac | 5ghz-n/ac*; Default:)	Defines set of used data rates, channel frequencies and widths.
basic-rates-a/g (*12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps | 6Mbps | 9Mbps*; Default: **6Mbps**)	Similar to the **basic-rates-b** property, but used for 5ghz, 5ghz-10mhz, 5ghz-5mhz, 5ghz-turbo, 2.4ghz-b/g, 2.4ghz-onlyg, 2ghz-10mhz, 2ghz-5mhz and 2.4 ghz-g-turbo bands.
basic-rates-b (*11Mbps | 1Mbps | 2Mbps | 5.5Mbps*; Default: **1Mbps**)	List of basic rates, used for 2.4ghz-b, 2.4ghz-b/g and 2.4ghz-onlyg bands. Client will connect to AP only if it supports all basic rates announced by the AP. AP will establish WDS link only if it supports all basic rates of the other AP. This property has effect only in AP modes, and when value of **rate-set** is configured.
bridge-mode (*disabled | enabled*; Default: **enabled**)	Allows to use station-bridge mode. `Read more >>`
burst-time (*integer | disabled*; Default: **disabled**)	Time in microseconds which will be used to send data without stopping. Note that no other wireless cards in that network will be able to transmit data during burst-time microseconds. This setting is available only for AR5000, AR5001X, and AR5001X+ chipset based cards.
channel-width (*20/40/80/160mhz-Ceeeeeee | 20/40/80/160mhz-XXXXXXXX | 20/40/80/160mhz-eCeeeeee | 20/40/80/160mhz-eeCeeeee | 20/40/80/160mhz-eeeCeeee | 20/40/80/160mhz-eeeeCeee | 20/40/80/160mhz-eeeeeCee | 20/40/80/160mhz-eeeeeeCe | 20/40/80/160mhz-eeeeeeeC | 20/40/80mhz-Ceee | 20/40/80mhz-eCee | 20/40/80mhz-eeCe | 20/40/80mhz-eeeC | 20/40/80mhz-XXXX | 20/40mhz-Ce | 20/40mhz-eC | 20/40mhz-XX | 40mhz-turbo | 20mhz | 10mhz | 5mhz*; Default: **20mhz**)	Use of extension channels (e.g. Ce, eC etc) allows additional 20MHz extension channels and if it should be located below or above the control (main) channel. Extension channel allows 802.11n devices to use up to 40MHz (802.11ac up to 160MHz) of spectrum in total thus increasing max throughput. Channel widths with XX and XXXX extensions automatically scan for a less crowded control channel frequency based on the number of concurrent devices running in every frequency and chooses the “C” - Control channel frequency automatically.
comment (*string*; Default:)	Short description of the interface
compression (*yes | no*; Default: **no**)	Setting this property to *yes* will allow the use of the hardware compression. Wireless interface must have support for hardware compression. Connections with devices that do not use compression will still work.
country (*name of the country | no_country_set*; Default: **etsi**)	Limits available bands, frequencies and maximum transmit power for each frequency. Also specifies default value of **scan-list**. Value *no_country_set* is an FCC compliant set of channels.
default-ap-tx-limit (*integer [0..4294967295]*; Default: **0**)	This is the value of **ap-tx-limit** for clients that do not match any entry in the access-list. 0 means no limit.
default-authentication (*yes | no*; Default: **yes**)	For AP mode, this is the value of **authentication** for clients that do not match any entry in the access-list. For station mode, this is the value of **connect** for APs that do not match any entry in the connect-list
default-client-tx-limit (*integer [0..4294967295]*; Default: **0**)	This is the value of **client-tx-limit** for clients that do not match any entry in the access-list. 0 means no limit
default-forwarding (*yes | no*; Default: **yes**)	This is the value of **forwarding** for clients that do not match any entry in the access-list
disable-running-check (*yes | no*; Default: **no**)	When set to **yes** interface will always have running flag. If value is set to **no'**, the router determines whether the card is up and running - for AP one or more clients have to be registered to it, for station, it should be connected to an AP.
disabled (*yes | no*; Default: **yes**)	Whether interface is disabled
disconnect-timeout (*time [0s..15s]*; Default: **3s**)	This interval is measured from third sending failure on the lowest data rate. At this point 3 * (**hw-retries** + 1) frame transmits on the lowest data rate had failed. During **disconnect-timeout** packet transmission will be retried with **on-fail-retry-time** interval. If no frame can be transmitted successfully during **disconnect-timeout**, the connection is closed, and this event is logged as "extensive data loss". Successful frame transmission resets this timer.

distance (*integer* | *dynamic* | *indoors*; Default: **dynamic**)	How long to wait for confirmation of unicast frames (**ACKs**) before considering transmission unsuccessful, or in short **ACK-Timeout**. Distance value has these behaviors: • *Dynamic* - causes AP to detect and use the smallest timeout that works with all connected clients. • *Indoor* - uses the default ACK timeout value that the hardware chip manufacturer has set. • *Number* - uses the input value in formula: ACK-timeout = ((**distance** * 1000) + 299) / 300 us; Acknowledgments are not used in Nstreme/NV2 protocols.
frame-lifetime (*integer [0..4294967295]*; Default: **0**)	Discard frames that have been queued for sending longer than **frame-lifetime**. By default, when value of this property is *0*, frames are discarded only after connection is closed.
frequency (*integer [0..4294967295]*; Default:)	Channel frequency value in MHz on which AP will operate. Allowed values depend on the selected band, and are restricted by **country** setting and wireless card capabilities. This setting has **no effect** if interface is in any of **station** modes, or in *wds-slave* mode, or if DFS is active. *Note*: If using mode "superchannel", any frequency supported by the card will be accepted, but on the RouterOS client, any non-standard frequency must be configured in the scan-list, otherwise it will not be scanning in non-standard range. In Winbox, scanlist frequencies are in *bold*, any other frequency means the clients will need scan-list configured.
frequency-mode (*manual-txpower* | *regulatory-domain* | *superchannel*; Default: **regulatory_domain**)	Three frequency modes are available: • *regulatory-domain* - Limit available channels and maximum transmit power for each channel according to the value of **country** • *manual-txpower* - Same as above, but do not limit maximum transmit power. • *superchannel* - Conformance Testing Mode. Allow all channels supported by the card. List of available channels for each band can be seen in **/interface wireless info allowed-channels**. This mode allows you to test wireless channels outside the default scan-list and/or regulatory domain. This mode should only be used in controlled environments, or if you have special permission to use it in your region. Before v4.3 this was called Custom Frequency Upgrade, or Superchannel. Since RouterOS v4.3 this mode is available without special key upgrades to all installations.
frequency-offset (*integer [-2147483648..2147483647]*; Default: **0**)	Allows to specify offset if the used wireless card operates at a different frequency than is shown in RouterOS, in case a frequency converter is used in the card. So if your card works at 4000MHz but RouterOS shows 5000MHz, set offset to 1000MHz and it will be displayed correctly. The value is in MHz and can be positive or negative.
guard-interval (*any* | *long*; Default: **any**)	Whether to allow use of short guard interval (refer to 802.11n MCS specification to see how this may affect throughput). "any" will use either short or long, depending on data rate, "long" will use long.
hide-ssid (*yes* | *no*; Default: **no**)	• *yes* - AP does not include SSID in the beacon frames, and does not reply to probe requests that have broadcast SSID. • *no* - AP includes SSID in the beacon frames, and replies to probe requests that have broadcast SSID. This property has an effect only in AP mode. Setting it to *yes* can remove this network from the list of wireless networks that are shown by some client software. Changing this setting does not improve the security of the wireless network, because SSID is included in other frames sent by the AP.

ht-basic-mcs (*list of (mcs-0 | mcs-1 | mcs-2 | mcs-3 | mcs-4 | mcs-5 | mcs-6 | mcs-7 | mcs-8 | mcs-9 | mcs-10 | mcs-11 | mcs-12 | mcs-13 | mcs-14 | mcs-15 | mcs-16 | mcs-17 | mcs-18 | mcs-19 | mcs-20 | mcs-21 | mcs-22 | mcs-23)*; Default: **mcs-0; mcs-1; mcs-2; mcs-3; mcs-4; mcs-5; mcs-6; mcs-7**)	Modulation and Coding Schemes that every connecting client must support. Refer to 802.11n for MCS specification.
ht-supported-mcs (*list of (mcs-0 | mcs-1 | mcs-2 | mcs-3 | mcs-4 | mcs-5 | mcs-6 | mcs-7 | mcs-8 | mcs-9 | mcs-10 | mcs-11 | mcs-12 | mcs-13 | mcs-14 | mcs-15 | mcs-16 | mcs-17 | mcs-18 | mcs-19 | mcs-20 | mcs-21 | mcs-22 | mcs-23)*; Default: **mcs-0; mcs-1; mcs-2; mcs-3; mcs-4; mcs-5; mcs-6; mcs-7; mcs-8; mcs-9; mcs-10; mcs-11; mcs-12; mcs-13; mcs-14; mcs-15; mcs-16; mcs-17; mcs-18; mcs-19; mcs-20; mcs-21; mcs-22; mcs-23**)	Modulation and Coding Schemes that this device advertises as supported. Refer to 802.11n for MCS specification.
hw-fragmentation-threshold (*integer[256..3000] | disabled*; Default: **0**)	Specifies maximum fragment size in bytes when transmitted over the wireless medium. 802.11 standard packet (MSDU in 802.11 terminologies) fragmentation allows packets to be fragmented before transmitting over a wireless medium to increase the probability of successful transmission (only fragments that did not transmit correctly are retransmitted). Note that transmission of a fragmented packet is less efficient than transmitting unfragmented packet because of protocol overhead and increased resource usage at both - transmitting and receiving party.
hw-protection-mode (*cts-to-self | none | rts-cts*; Default: **none**)	Frame protection support property `read more >>`
hw-protection-threshold (*integer [0..65535]*; Default: **0**)	Frame protection support property `read more >>`
hw-retries (*integer [0..15]*; Default: **7**)	Number of times sending frame is retried without considering it a transmission failure. Data-rate is decreased upon failure and the frame is sent again. Three sequential failures on the lowest supported rate suspend transmission to this destination for the duration of **on-fail-retry-time**. After that, the frame is sent again. The frame is being retransmitted until transmission success, or until the client is disconnected after **disconnect-timeout**. The frame can be discarded during this time if **frame-lifetime** is exceeded.
installation (*any | indoor | outdoor*; Default: **any**)	Adjusts scan-list to use indoor, outdoor or all frequencies for the country that is set.
interworking-profile (*enabled | disabled*; Default: **disabled**)	
keepalive-frames (*enabled | disabled*; Default: **enabled**)	Applies only if wireless interface is in mode=**ap-bridge**. If a client has not communicated for around 20 seconds, AP sends a "keepalive-frame". **Note**, disabling the feature can lead to "ghost" clients in registration-table.
l2mtu (*integer [0..65536]*; Default: **1600**)	
mac-address (*MAC*; Default:)	
master-interface (*string*; Default:)	Name of wireless interface that has *virtual-ap* capability. Virtual AP interface will only work if master interface is in *ap-bridge*, *bridge*, *station* or *wds-slave* mode. This property is only for virtual AP interfaces.
max-station-count (*integer [1..2007]*; Default: **2007**)	Maximum number of associated clients. WDS links also count toward this limit.

mode (*station* | *station-wds* | *ap-bridge* | *bridge* | *alignment-only* | *nstreme-dual-slave* | *wds-slave* | *station-pseudobridge* | *station-pseudobridge-clone* | *station-bridge*; Default: **station**)	Selection between different station and access point (AP) modes. Station modes: • *station* - Basic station mode. Find and connect to acceptable AP. • *station-wds* - Same as *station*, but create WDS link with AP, using proprietary extension. AP configuration has to allow WDS links with this device. Note that this mode does not use entries in wds. • *station-pseudobridge* - Same as *station*, but additionally perform MAC address translation of all traffic. Allows interface to be bridged. • *station-pseudobridge-clone* - Same as *station-pseudobridge*, but use **station-bridge-clone-mac** address to connect to AP. AP modes: • *ap-bridge* - Basic access point mode. • *bridge* - Same as *ap-bridge*, but limited to one associated client. • *wds-slave* - Same as *ap-bridge*, but scan for AP with the same **ssid** and establishes WDS link. If this link is lost or cannot be established, then continue scanning. If **dfs-mode** is *radar-detect*, then APs with enabled **hide-ssid** will not be found during scanning. Special modes: • *alignment-only* - Put the interface in a continuous transmit mode that is used for aiming the remote antenna. • *nstreme-dual-slave* - allow this interface to be used in nstreme-dual setup. MAC address translation in pseudobridge modes works by inspecting packets and building a table of corresponding IP and MAC addresses. All packets are sent to AP with the MAC address used by pseudobridge, and MAC addresses of received packets are restored from the address translation table. There is a single entry in the address translation table for all non-IP packets, hence more than one host in the bridged network cannot reliably use non-IP protocols. Note: Currently IPv6 doesn't work over Pseudobridge
mtu (*integer [0..65536]*; Default: **1500**)	
multicast-buffering (*disabled* | *enabled*; Default: **enabled**)	For a client that has power saving, buffer multicast packets until next beacon time. A client should wake up to receive a beacon, by receiving beacon it sees that there are multicast packets pending, and it should wait for multicast packets to be sent.
multicast-helper (*default* | *disabled* | *full*; Default: **default**)	When set to **full**, multicast packets will be sent with a unicast destination MAC address, resolving multicast problem on the wireless link. This option should be enabled only on the access point, clients should be configured in **station-bridge** mode. Available starting from v5.15. • disabled - disables the helper and sends multicast packets with multicast destination MAC addresses • full - all multicast packet mac address are changed to unicast mac addresses prior sending them out • default - default choice that currently is set to *disabled*. Value can be changed in future releases.
name (*string*; Default:)	name of the interface
noise-floor-threshold (*default* | *integer [-128..127]*; Default: **default**)	For advanced use only, as it can badly affect the performance of the interface. It is possible to manually set noise floor threshold value. By default, it is dynamically calculated. This property also affects received signal strength. This property is only effective on non-AC chips.

nv2-cell-radius (*integer [10..200]*; Default: **30**)	Setting affects the size of contention time slot that AP allocates for clients to initiate connection and also size of time slots used for estimating distance to client. When setting is too small, clients that are farther away may have trouble connecting and/or disconnect with "ranging timeout" error. Although during normal operation the effect of this setting should be negligible, in order to maintain maximum performance, it is advised to not increase this setting if not necessary, so AP is not reserving time that is actually never used, but instead allocates it for actual data transfer. • on AP: distance to farthest client in km • on station: no effect
nv2-noise-floor-offset (*default* / *integer [0..20]*; Default: **default**)	
nv2-preshared-key (*string*; Default:)	
nv2-qos (*default* / *frame-priority*; Default: **default**)	Sets the packet priority mechanism, firstly data from high priority queue is sent, then lower queue priority data until 0 queue priority is reached. When link is full with high priority queue data, lower priority data is not sent. Use it very carefully, setting works on AP • **frame-priority** - manual setting that can be tuned with Mangle rules. • **default** - default setting where small packets receive priority for best latency
nv2-queue-count (*integer [2..8]*; Default: **2**)	
nv2-security (*disabled* / *enabled*; Default: **disabled**)	
on-fail-retry-time (*time [100ms..1s]*; Default: **100ms**)	After third sending failure on the lowest data rate, wait for specified time interval before retrying.
periodic-calibration (*default* / *disabled* / *enabled*; Default: **default**)	Setting *default* enables periodic calibration if info **default-periodic-calibration** property is *enabled*. Value of that property depends on the type of wireless card. This property is only effective for cards based on Atheros chipset.
periodic-calibration-interval (*integer [1..10000]*; Default: **60**)	This property is only effective for cards based on Atheros chipset.

preamble-mode (*both* / *long* / *short*; Default: **both**)	Short preamble mode is an option of 802.11b standard that reduces per-frame overhead.
	• On AP:
	  ◦ *long* - Do not use short preamble.
	  ◦ *short* - Announce short preamble capability. Do not accept connections from clients that do not have this capability.
	  ◦ *both* - Announce short preamble capability.
	• On station:
	  ◦ *long* - do not use short preamble.
	  ◦ *short* - do not connect to AP if it does not support short preamble.
	  ◦ *both* - Use short preamble if AP supports it.

prism-cardtype (*100mW* / *200mW* / *30mW*; Default:)	Specify type of the installed Prism wireless card.
proprietary-extensions (*post-2.9.25* / *pre-2.9.25*; Default: **post-2.9.25**)	RouterOS includes proprietary information in an information element of management frames. This parameter controls how this information is included. • *pre-2.9.25* - This is older method. It can interoperate with newer versions of RouterOS. This method is incompatible with some clients, for example, Centrino based ones. • *post-2.9.25* - This uses standardized way of including vendor specific information, that is compatible with newer wireless clients.
radio-name (*string*; Default: **MAC address of an interface**)	Descriptive name of the device, that is shown in registration table entries on the remote devices. This is a proprietary extension.
rate-selection (*advanced* / *legacy*; Default: **advanced**)	Starting from v5.9 default value is advanced since legacy mode was inefficient.

rate-set (*configured | default*; Default: **default**)	Two options are available: • *default* - default basic and supported rate sets are used. Values from **basic-rates** and **supported-rates** parameters have no effect. • *configured* - use values from **basic-rates**, **supported-rates**, **basic-mcs**, **mcs**. Read more >>.
rx-chains (*list of integer [0..3]*; Default: **0**)	Which antennas to use for receive. In current MikroTik routers, both RX and TX chain must be enabled, for the chain to be enabled.
scan-list (*Comma separated list of frequencies and frequency ranges	default. Since v6.35 (wireless-rep) type also support range:step option*; Default: **default**)	The *default* value is all channels from selected band that are supported by card and allowed by the **country** and **frequency-mode** settings (this list can be seen in info). For default scan list in *5ghz* band channels are taken with 20MHz step, in *5ghz-turbo* band - with 40MHz step, for all other bands - with 5MHz step. If **scan-list** is specified manually, then all matching channels are taken. (Example: **scan-list**=*default,5200-5245,2412-2427* - This will use the default value of scan list for current band, and add to it supported frequencies from 5200-5245 or 2412-2427 range.) Since RouterOS v6.0 with Winbox or Webfig, for inputting of multiple frequencies, add each frequency or range of frequencies into separate multiple scan-lists. Using a comma to separate frequencies is no longer supported in Winbox/Webfig since v6.0. Since RouterOS v6.35 (wireless-rep) scan-list support step feature where it is possible to manually specify the scan step. Example: **scan-list**=*5500-5600:20* will generate such scan-list values *5500,5520,5540,5560,5580,5600*
security-profile (*string*; Default: **default**)	Name of profile from security-profiles
secondary-channel (*integer*; Default: **""**)	Specifies secondary channel, required to enable 80+80MHz transmission. To disable 80+80MHz functionality, set secondary-channel to "" or unset the value via CLI/GUI.
ssid (*string (0..32 chars)*; Default: **value of system/identity**)	SSID (service set identifier) is a name that identifies wireless network.
skip-dfs-channels (*string | 10min-cac | all | disabled*; Default: **disabled**)	These values are used to skip all DFS channels or specifically skip DFS CAC channels in range 5600-5650MHz which detection could go up to 10min.
station-bridge-clone-mac (*MAC*; Default:)	This property has effect only in the *station-pseudobridge-clone* mode. Use this MAC address when connection to AP. If this value is *00:00:00:00:00:00* , station will initially use MAC address of the wireless interface. As soon as packet with MAC address of another device needs to be transmitted, station will reconnect to AP using that address.
station-roaming (*disabled | enabled*; Default: **disabled**)	Station Roaming feature is available only for 802.11 wireless protocol and only for station modes. Read more >>
supported-rates-a/g (*list of rates [12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps | 6Mbps | 9Mbps]*; Default: **6Mbps; 9Mbps; 12Mbps; 18Mbps; 24Mbps; 36Mbps; 48Mbps; 54Mbps**)	List of supported rates, used for all bands except *2ghz-b*.
supported-rates-b (*list of rates [11Mbps | 1Mbps | 2Mbps | 5.5Mbps]*; Default: **1Mbps; 2Mbps; 5.5Mbps; 11Mbps**)	List of supported rates, used for *2ghz-b*, *2ghz-b/g* and *2ghz-b/g/n* bands. Two devices will communicate only using rates that are supported by both devices. This property has effect only when value of **rate-set** is *configured*.
tdma-period-size (*integer [1..10]*; Default: **2**)	Specifies TDMA period in milliseconds. It could help on the longer distance links, it could slightly increase bandwidth, while latency is increased too.
tx-chains (*list of integer [0..3]*; Default: **0**)	Which antennas to use for transmitting. In current MikroTik routers, both RX and TX chain must be enabled, for the chain to be enabled.
tx-power (*integer [-30..40]*; Default:)	For 802.11ac wireless interface it's total power but for 802.11a/b/g/n it's power per chain.

tx-power-mode (*default, card-rates, all-rates-fixed, manual-table*; Default: **default**)	sets up tx-power mode for wireless card • default - use values stored in the card • all-rates-fixed - use same transmit power for all data rates. Can damage the card if transmit power is set above rated value of the card for used rate. • manual-table - define transmit power for each rate separately. Can damage the card if transmit power is set above rated value of the card for used rate. • card-rates - use transmit power calculated for each rate based on value of **tx-power** parameter. Legacy mode only compatible with currently discontinued products.
update-stats-interval (; Default:)	How often to request update of signals strength and ccq values from clients. Access to registration-table also triggers update of these values. This is proprietary extension.
vht-basic-mcs (*none* | *MCS 0-7* | *MCS 0-8* | *MCS 0-9*; Default: **MCS 0-7**)	Modulation and Coding Schemes that every connecting client must support. Refer to 802.11ac for MCS specification. You can set MCS interval for each of Spatial Stream • *none* - will not use selected Spatial Stream • *MCS 0-7* - client must support MCS-0 to MCS-7 • *MCS 0-8* - client must support MCS-0 to MCS-8 • *MCS 0-9* - client must support MCS-0 to MCS-9
vht-supported-mcs (*none* | *MCS 0-7* | *MCS 0-8* | *MCS 0-9*; Default: **MCS 0-9**)	Modulation and Coding Schemes that this device advertises as supported. Refer to 802.11ac for MCS specification. You can set MCS interval for each of Spatial Stream • *none* - will not use selected Spatial Stream • *MCS 0-7* - devices will advertise as supported MCS-0 to MCS-7 • *MCS 0-8* - devices will advertise as supported MCS-0 to MCS-8 • *MCS 0-9* - devices will advertise as supported MCS-0 to MCS-9
wds-cost-range (*start [-end] integer[0..4294967295]*; Default: **50-150**)	Bridge port cost of WDS links are automatically adjusted, depending on measured link throughput. Port cost is recalculated and adjusted every 5 seconds if it has changed by more than 10%, or if more than 20 seconds have passed since the last adjustment. Setting this property to *0* disables automatic cost adjustment. Automatic adjustment does not work for WDS links that are manually configured as a bridge port.
wds-default-bridge (*string* | *none*; Default: **none**)	When WDS link is established and status of the wds interface becomes *running*, it will be added as a bridge port to the bridge interface specified by this property. When WDS link is lost, wds interface is removed from the bridge. If wds interface is already included in a bridge setup when WDS link becomes active, it will not be added to bridge specified by , and will (needs editing)
wds-default-cost (*integer [0..4294967295]*; Default: **100**)	Initial bridge port cost of the WDS links.
wds-ignore-ssid (*yes* | *no*; Default: **no**)	By default, WDS link between two APs can be created only when they work on the same frequency and have the same SSID value. If this property is set to *yes*, then SSID of the remote AP will not be checked. This property has no effect on connections from clients in *station-wds* mode. It also does not work if **wds-mode** is *static-mesh* or *dynamic-mesh*.

wds-mode (*disabled* / *dynamic* / *dynamic-mesh* / *static* / *static-mesh*; Default: **disabled**)	Controls how WDS links with other devices (APs and clients in *station-wds* mode) are established. • *disabled* does not allow WDS links. • *static* only allows WDS links that are manually configured in WDS • *dynamic* also allows WDS links with devices that are not configured in WDS, by creating required entries dynamically. Such dynamic WDS entries are removed automatically after the connection with the other AP is lost. -mesh modes use different (better) method for establishing link between AP, that is not compatible with APs in non-mesh mode. This method avoids one-sided WDS links that are created only by one of the two APs. Such links cannot pass any data.When AP or station is establishing WDS connection with another AP, it uses connect-list to check whether this connection is allowed. If station in station-wds mode is establishing connection with AP, AP uses access-list to check whether this connection is allowed.If mode is station-wds, then this property has no effect.
wireless-protocol (*802.11* / *any* / *nstreme* / *nv2* / *nv2-nstreme* / *nv2-nstreme-802.11* / *unspecified*; Default: **any**)	Specifies protocol used on wireless interface; • *unspecified* - protocol mode used on previous RouterOS versions (v3.x, v4.x). Nstreme is enabled by old enable-nstreme setting, Nv2 configuration is not possible. • *any* : on AP - regular 802.11 Access Point or Nstreme Access Point; on station - selects Access Point without specific sequence, it could be changed by connect-list rules. • *nstreme* - enables Nstreme protocol (the same as old enable-nstreme setting). • *nv2* - enables Nv2 protocol. • *nv2 nstreme* : on AP - uses first wireless-protocol setting, always Nv2; on station - searches for Nv2 Access Point, then for Nstreme Access Point. • *nv2 nstreme 802.11* - on AP - uses first wireless-protocol setting, always Nv2; on station - searches for Nv2 Access Point, then for Nstreme Access Point, then for regular 802.11 Access Point. **Warning!** Nv2 doesn't have support for Virtual AP
wmm-support (*disabled* / *enabled* / *required*; Default: **disabled**)	Specifies whether to enable WMM. Only applies to bands B and G. Other bands will have it enabled regardless of this setting
wps-mode (*disabled* / *push-button* / *push-button-virtual-only*; Default: **depending on the device model**)	`Read more >>`

802.11n wireless chipsets represent power per chain and the 802.11ac

wireless chipsets represent the total power, for reference see the table below:Transmit Power representation on 802.11n and 802.11ac

Wireless chipset signal level representation

Wireless chipset	Enabled Chains	Power per Chain	Total Power
802.11n	1	Equal to the selected Tx Power	Equal to the selected Tx Power
802.11n	2	Equal to the selected Tx Power	+3dBm
802.11n	3	Equal to the selected Tx Power	+5dBm
802.11ac	1	Equal to the selected Tx Power	Equal to the selected Tx Power
802.11ac	2	-3dBm	Equal to the selected Tx Power
802.11ac	3	-5dBm	Equal to the selected Tx Power
802.11ac	4	-6dBm	Equal to the selected Tx Power

Basic and MCS Rate table

Default basic and supported rates, depending on selected band

band	basic rates	basic-HT-mcs	basic-VHT-mcs	VHT-mcs	HT-mcs	supported rates
2.4ghz-b	1	-	-	-	-	1-11
2.4ghz-onlyg	6	-	-	-	-	1-11,6-54
2.4ghz-onlyn	6	0-7	-	-	0-23	1-11,6-54
2.4ghz-b/g	1-11	-	-	-	-	1-11,6-54
2.4ghz-b/g/n	1-11	none	-	-	0-23	1-11,6-54
2.4ghz-g/n	6	none	-	-	0-23	6-54
2.4ghz-g-turbo	6	-	-	-	-	6-54
5ghz-a	6	-	-	-	-	6-54
5ghz-a/n	6	none	-	-	0-23	6-54
5ghz-onlyn	6	0-7	-	-	0-23	6-54
5ghz-a/n/ac	6	none	none	0-9	0-23	6-54
5ghz-onlyac	6	none	0-7	0-9	0-23	6-54

Used settings when **rate-set=configured**

band	used settings
2.4ghz-b	basic-b, supported-b
2.4ghz-b/g, 2.4ghz-onlyg	basic-b, supported-b, basic-a/g, supported-a/g
2.4ghz-onlyn, 2.4ghz-b/g/n	basic-b, supported-b, basic-a/g, supported-a/g, ht-basic-mcs, ht-supported-mcs
2.4ghz-g/n	basic-a/g,supported-a/g,ht-basic-mcs,ht-supported-mcs
5ghz-a	basic-a/g,supported-a/g
5ghz-a/n, 5ghz-onlyn	basic-a/g,supported-a/g,ht-basic-mcs,ht-supported-mcs
5ghz-a/n/ac, 5ghz-onlyac	basic-a/g,supported-a/g,ht-basic-mcs,ht-supported-mcs,vht-basic-mcs,vht-supported-mcs

Settings independent from **rate-set**:

1. allowed mcs depending on number of chains:
    - 1 chain: 0-7
    - 2 chains: 0-15
    - 3 chains: 0-23
2. if standard channel width (20Mhz) is not used, then 2ghz modes (except 2.4ghz-b) are not using b rates (1-11)

Frame protection support (RTS/CTS)

802.11 standard provides means to protect the transmission against other device transmission by using RTS/CTS protocol. Frame protection helps to fight "hidden node" problem. There are several types of protection:

- RTS/CTS based protection - device willing to send frame at first sends RequestToSend frame and waits for ClearToSend frame from intended destination. By "seeing" RTS or CTS frame 802.11 compliant devices know that somebody is about to transmit and therefore do not initiate transmission themselves
- "CTS to self" based protection - device willing to send frame sends CTS frame "to itself". As in RTS/CTS protocol every 802.11 compliant device receiving this frame know not to transmit. "CTS to self" based protection has less overhead, but it must be taken into account that this only protects against devices receiving CTS frame (e.g. if there are 2 "hidden" stations, there is no use for them to use "CTS to self" protection, because they will not be able to receive CTS sent by other station - in this case stations must use RTS/CTS so that other station knows not to transmit by seeing CTS transmitted by AP).

Protection mode is controlled by **hw-protection-mode** setting of wireless interface. Possible values: **none** - for no protection (default), **rts-cts** for RTS/CTS based protection or **cts-to-self** for "CTS to self" based protection.

Frame size threshold at which protection should be used is controlled by **hw-protection-threshold** setting of wireless interface.

For example, to enable "CTS-to-self" based frame protection on AP for all frames, not depending on size, use command:

```
[admin@MikroTik] /interface wireless> set 0 hw-protection-mode=cts-to-self hw-protection-threshold=0
```

To enable RTS/CTS based protection on client use command:

```
[admin@MikroTik] /interface wireless> set 0 hw-protection-mode=rts-cts hw-protection-threshold=0
```

Nv2

MikroTik has developed a new wireless protocol based on TDMA technology (Time Division Multiple Access) - (Nstreme version 2). See the Nv2 documentation: NV2

TDMA is a channel access method for shared medium networks. It allows several users to share the same frequency channel by dividing the signal into different time slots. The users transmit in rapid succession, one after the other, each using his own time slot. This allows multiple stations to share the same transmission medium (e.g. radio frequency channel) while using only a part of its channel capacity.

The most important benefits of Nv2 are:

- Increased speed
- More client connections in PTM environments
- Lower latency
- No distance limitations
- No penalty for long distances

Nv2 protocol limit is 511 clients.

Warning: Nv2 doesn't have support for Virtual AP

Nv2 Troubleshooting

Increase throughput on long distance with **tdma-period-size**. In Every "period", the Access Point leaves part of the time unused for data transmission (which is equal to *round trip time* - the time in which the frame can be sent and received from the client), it is used to ensure that client could receive the last frame from Access Point, before sending its own packets to it. The longer the distance, the longer the period is unused.

For example, the distance between Access Point and client is 30km. Frame is sent in 100us one direction, respectively round-trip-time is ~200us. **tdma-period-size** default value is 2ms, it means 10% of the time is unused. When tdma-period-size is increased to 4ms, only 5% of time is unused. For 60km wireless link, round-trip-time is 400ms, unused time is 20% for default tdma-period-size 2ms, and 10% for 4ms. Bigger tdma-period-size value increases latency on the link.

Access List

Sub-menu: `/interface wireless access-list`

Access list is used by access point to restrict allowed connections from other devices, and to control connection parameters.

Access list rules are processed one by one until matching rule is found. Then the action in the matching rule is executed. If action specifies that client should be accepted, client is accepted, potentially overriding it's default connection parameters with ones specified in access list rule.

There are the following parameters for access list rules:

- client matching parameters:
  - address - MAC address of the client
  - interface - optional interface to compare with the interface to which client actually connects to
  - time - time of day and days when rule matches
  - signal-range - range in which client signal must fit for the rule to match
  - allow-signal-out-of-range - option which permits client's signal to be out of the range always or for some time interval
- connection parameters:
  - ap-tx-limit - tx speed limit in direction to client
  - client-tx-limit - tx speed limit in direction to AP (applies to RouterOS clients only)
  - private-passphrase - PSK passphrase to use for this client if some PSK authentication algorithm is used
  - vlan-mode - VLAN tagging mode specifies if traffic coming from client should get tagged (and untagged when going to client).

- vlan-id - VLAN ID to use if doing VLAN tagging

Operation:

- Access list rules are checked sequentially.
- Disabled rules are always ignored.
- Only the first matching rule is applied.
- If there are no matching rules for the remote connection, then the default values from the wireless interface configuration are used.
- If remote device is matched by rule that has **authentication**=*no* value, the connection from that remote device is rejected.

Warning: If there is no entry in ACL about client which connects to AP (wireless,debug wlan2: A0:0B:BA:D7:4D:B2 not in local ACL, by default accept), then ACL for this client is ignored during all connection time.

For example, if client's signal during connection is -41 and we have ACL rule

```
/interface/wireless/access-list
add authentication=yes forwarding=yes interface=wlan2 signal-range=-55..0
```

Then the connection is matched to the ACL rule, but if signal drops below -55, client will not be disconnected.

Please note that if "default-authentication=yes" is set on the wireless interface, clients will be able to join even if there are no matching access-list entries. To make it work correctly it is required that client is matched by any of ACL rules.

If we modify ACL rules in the previous example to:

```
/interface/wireless/access-list
add interface=wlan2 signal-range=-55..0
add authentication=no forwarding=no interface=wlan2 signal-range=-120..-56
```

Then if signal drops to -56, client will be disconnected.

Properties

Property	Description
ap-tx-limit (*integer [0..4294967295]*; Default: **0**)	Limit rate of data transmission to this client. Value *0* means no limit. Value is in bits per second.
authentication (*yes* | *no*; Default: **yes**)	- *no* - Client association will always fail. - *yes* - Use authentication procedure that is specified in the **security-profile** of the interface.
client-tx-limit (*integer [0..4294967295]*; Default: **0**)	Ask client to limit rate of data transmission. Value *0* means no limit. This is a proprietary extension that is supported by RouterOS clients. Value is in bits per second.
comment (*string*; Default:)	Short description of an entry
disabled (*yes* | *no*; Default: **no**)	
forwarding (*yes* | *no*; Default: **yes**)	- *no* - Client cannot send frames to other station that are connected to same access point. - *yes* - Client can send frames to other stations on the same access point.
interface (*string* | *any* | *all*; Default: **any**)	Rules with **interface**=*any* are used for any wireless interface and the **interface**=*all* defines interface-list “all” name. To make rule that applies only to one wireless interface, specify that interface as a value of this property.
mac-address (*MAC*; Default: **00:00:00:00:00:00**)	Rule matches client with the specified MAC address. Value *00:00:00:00:00:00* matches always.

management-protection-key (*string*; Default: **""**)	
private-algo (*104bit-wep | 40bit-wep | aes-ccm | none | tkip*; Default: **none**)	Only for WEP modes.
private-key (*string*; Default: **""**)	Only for WEP modes.
private-pre-shared-key (*string*; Default: **""**)	Used in WPA PSK mode.
signal-range (*NUM..NUM - both NUM are numbers in the range -120..120*; Default: **-120..120**)	Rule matches if signal strength of the station is within the range. If signal strength of the station will go out of the range that is specified in the rule, access point will disconnect that station.
time (*TIME-TIME,sun,mon,tue,wed,thu,fri,sat - TIME is time interval 0..86400 seconds; all day names are optional; value can be unset*; Default:)	Rule will match only during specified time. Station will be disconnected after specified time ends. Both start and end time is expressed as time since midnight, 00:00. Rule will match only during specified days of the week.

Align

Sub-menu: `/interface wireless align`

Align tool is used to help in alignment devices running this tool.

Property	Description
active-mode (*yes | no*; Default: **yes**)	If in active mode, will send out frames for align.
audio-max (*integer [-2147483648..2147483647]*; Default: **-20**)	Maxumum signal strength for beeper
audio-min (*integer [-2147483648..2147483647]*; Default: **-100**)	Minimum signal strength for beeper
audio-monitor (*MAC*; Default: **00:00:00:00:00:00**)	Which MAC address to use for audio monitoring
filter-mac (*MAC*; Default: **00:00:00:00:00:00**)	Filtered out MAC address that will be shown in monitor screen.
frame-size (*integer [200..1500]*; Default: **300**)	Size of the frames used by monitor.
frames-per-second (*integer [1..100]*; Default: **25**)	Frame transmit interval
receive-all (*yes | no*; Default: **no**)	If set to "yes", monitor will find all available devices.
ssid-all (*yes | no*; Default: **no**)	Whether to show all SSIDs in the monitor or only one configured in wireless settings.

Menu Specific Commands

Property	Description
monitor (*interface name*)	Start align monitoring
test-audio (*integer [-2147483648..2147483647]*)	Test the beeper

Connect List

Sub-menu: `/interface wireless connect-list`

connect-list is used to assign priority and security settings to connections with remote access points, and to restrict allowed connections. connect-list is an ordered list of rules. Each rule in connect-list is attached to specific wireless interface, specified in the `interface`property of that rule (this is unlike access-list, where rules can apply to all interfaces). Rule can match MAC address of remote access point, it's signal strength and many other parameters.

Operation:

- connect-list rules are always checked sequentially, starting from the first.
- disabled rules are always ignored.

- Only the first matching rule is applied.
- If SSID or exact wireless protocol is provided in the wireless interface configuration Connect List SSIDs or wireless protocols not covered by wireless interface configuration are ignored.
- If connect-list does not have any rule that matches remote access point, then the default values from the wireless interface configuration are used.
- If access point is matched by rule that has **connect**=*no* value, connection with this access point will not be attempted.
- If access point is matched by rule that has **connect**=*yes* value, connection with this access point will be attempted.
    - In station mode, if several remote access points are matched by connect list rules with **connect**=*yes* value, connection will be attempted with access point that is matched by rule higher in the connect-list.
    - If no remote access points are matched by connect-list rules with **connect**=*yes* value, then value of **default-authentication** interface property determines whether station will attempt to connect to any access point. If **default-authentication**=*yes*, station will choose access point with best signal and compatible security.
- In access point mode, connect-list is checked before establishing WDS link with remote device. If access point is not matched by any rule in the connect list, then the value of **default-authentication** determines whether WDS link will be established.

Properties

Property	Description
3gpp (*string*; Default:)	
area-prefix (*string*; Default:)	Rule matches if area value of AP (a proprietary extension) begins with specified value.**area** value is a proprietary extension.
comment (*string*; Default:)	Short description of an entry
connect (*yes* | *no*; Default: **yes**)	Available options: - *yes* - Connect to access point that matches this rule. - *no* - Do not connect to any access point that matches this rule.
disabled (*yes* | *no*; Default: **no**)	
mac-address (*MAC*; Default: **00:00:00:00:00:00**)	Rule matches only AP with the specified MAC address. Value *00:00:00:00:00:00* matches always.
security-profile (*string* | *none*; Default: **none**)	Name of security profile that is used when connecting to matching access points, If value of this property is *none*, then security profile specified in the interface configuration will be used. In station mode, rule will match only access points that can support specified security profile. Value *none* will match access point that supports security profile that is specified in the interface configuration. In access point mode value of this property will not be used to match remote devices.
signal-range (*NUM..NUM - both NUM are numbers in the range -120..120*; Default: **-120..120**)	Rule matches if signal strength of the access point is within the range. If station establishes connection to access point that is matched by this rule, it will disconnect from that access point when signal strength goes out of the specified range.
ssid (*string*; Default: **""**)	Rule matches access points that have this SSID. Empty value matches any SSID. This property has effect only when station mode interface **ssid** is empty, or when access point mode interface has **wds-ignore-ssid**=*yes*
wireless-protocol (*802.11* | *any* | *nstreme* | *tdma*; Default: **any**)	
interface (*string*; Default:)	Each rule in connect list applies only to one wireless interface that is specified by this setting.

Usage

Restrict station connections only to specific access points

- Set value of **default-authentication** interface property to *no*.

/interface wireless set station-wlan default-authentication=no

- Create rules that matches allowed access points. These rules must have **connect**=*yes* and **interface** equal to the name of station wireless interface.

/interface wireless connect-list add interface=station-wlan connect=yes mac-address=00:11:22:33:00:01/interface wireless connect-list add interface=station-wlan connect=yes mac-address=00:11:22:33:00:02

Disallow connections to specific access points

- Set value of **default-authentication** interface property to *yes*.

/interface wireless set station-wlan default-authentication=yes

- Create **connect**=*no* rules that match those access points that station should not connect to. These rules must have **connect**=*no* and **interface** equal to the name of station wireless interface.

/interface wireless connect-list add interface=station-wlan connect=no mac-address=00:11:22:33:44:55

Select preferred access points

- Create rules that match preferred access points. These rules must have **connect**=*yes* and **interface** equal to the name of station wireless interface.
- Put rules that match preferred access points higher in the connect-list, in the order of preference.

Restrict WDS link establishment

- Place rules that match allowed access points at the top.
- Add deny-all rule at the end of connect list.

Info

Sub-menu: `/interface wireless info`

Property	Description
2ghz-10mhz-power-channels ()	
2ghz-11n-channels ()	
2ghz-5mhz-power-channels ()	
2ghz-b-channels ()	
2ghz-g-channels ()	
2ghz-g-turbo-channels ()	
5ghz-10mhz-power-channels ()	
5ghz-11n-channels ()	
5ghz-5mhz-power-channels ()	
5ghz-channels ()	
5ghz-turbo-channels ()	
allowed-channels	List of available channels for each band
capabilities ()	

country-info()	Takes country name as argument, shows available bands, frequencies and maximum transmit power for each frequency.
chip-info ()	
default-periodic-calibration ()	
firmware ()	
ht-chains ()	
interface-type ()	
name ()	
pci-info ()	
supported-bands ()	

Manual TX Power Table

Sub-menu: `/interface wireless manual-tx-power-table`

Property	Description
comment (*string*; Default:)	Short description of an entry
manual-tx-powers (*list of [Rate:TxPower];* Rate ::= 11Mbps | 12Mbps | 18Mbps | 1Mbps | 24Mbps | ... *TxPower ::= integer [-30..30]*; Default:)	
name (*string*)	Name of the wireless interface to which tx powers will be applied.

Wireless hardware table

Warning: You must follow to regulatory domain requirements in your country. If you are allowed to use other frequencies, note that Antenna Gain and Transmit Power may decrease depending on board and frequency. Devices are calibrated only for regulatory frequencies, use non standard frequencies at your own risk. The list only specifies frequencies accepted by the wireless chip, these frequencies might not always work due to antenna that is built into the product, device design, filters and other factors. USE STRICTLY AT YOUR OWN RISK

Integrated wireless interface frequency table

Board name	Wireless interfaces	Frequency range [MHz]	Supported channel widths [Mhz]
2011UAS-2HnD	1	2312-2732	20,40
751G-2HnD	1	2200-2700	20,40 and advanced channel support
751U-2HnD	1	2200-2700	20,40 and advanced channel support
911-2Hn	1	2312-2732	20,40
911-5HacD	1	4920-6100	20,40,80
911-5Hn	1	4920-6100	5,10,20,40
911-5HnD	1	4920-6100	20,40
911G-2HPnD	1	2312-2732	20,40
911G-5HPacDr2 /-NB /-QRT	1	4920-6100	5,10,20,40,80
911G-5HPnD /-QRT	1	4920-6100	5,10,20,40

912UAG-2HPnD /-OUT	1	2312-2732	20,40
912UAG-5HPnD /-OUT	1	4920-6100	5,10,20,40
912UAG-6HPnD /-OUT	1	5500-6500	20,40
921GS-5HPacD-15S /-19S	1	4920-6100	5^1,10^1,20,40,80
921UAGS-5SHPacD-NM	1	4920-6100	20,40,80
921UAGS-5SHPacT-NM	1	4920-6100	20,40,80
922UAGS-5HPacD /-NM	1	4920-6100	20,40,80
922UAGS-5HPacT /-NM	1	4920-6100	20,40,80
941-2nD /-TC	1	2312-2732	20,40
951G-2HnD	1	2312-2732	20,40
951Ui-2HnD	1	2312-2732	20,40
951Ui-2nD	1	2312-2732	20,40
952Ui-5ac2nD /-TC	2	2312-2732,4920-6100	20,40 and 20,40,80
953GS-5HnT /-RP	1	4920-6100	5,10,20,40
962UiGS-5HacT2HnT	2	2312-2732,4920-6100	20,40 and 20,40,80
cAP2n	1	2312-2732	20,40
cAP2nD	1	2312-2732	20,40
cAPL-2nD	1	2312-2732	20,40
CRS109-8G-1S-2HnD-IN	1	2312-2732	20,40
CRS125-24G-1S-2HnD-IN	1	2312-2732	20,40
Disc-5nD	1	4920-6100	20,40
DynaDishG-5HacD	1	4920-6100	5^1,10^1,20,40,80
DynaDishG-6HnD	1	5500-6500	20,40
Groove52HPn	1	4920-6100,2312-2732	5,10,20,40 and 5,10,20,40
GrooveA-52HPn	1	4920-6100,2312-2732	5,10,20,40 and 5,10,20,40
GrooveG-52HPacn	1	4920-6100,2312-2732	20,40,80 and 20,40
GrooveGA-52HPacn	1	4920-6100,2312-2732	20,40,80 and 20,40
LDF-5nD	1	4920-6100	20,40
LHG-5nD	1	4920-6100	20,40
mAP2n	1	2312-2732	20,40
mAP2nD	1	2312-2732	20,40
mAPL-2nD	1	2312-2732	20,40
Metal2SHPn	1	2200-2700	20,40 and advanced channel support
Metal5SHPn	1	4800-6100	5,10,20,40 and advanced channel support
Metal9HPn	1	902-928	5,10,20
MetalG-52SHPacn	1	4920-6100,2312-2732	20,40,80 and 20,40
OmniTikG-5HacD	1	4920-6100	20,40,80
OmniTikPG-5HacD	1	4920-6100	20,40,80
OmniTIKU-5HnD	1	4800-6100	5,10,20,40
OmniTIKUPA-5HnD	1	4800-6100	5,10,20,40
QRTG-2SHPnD	1	2312-2732	20,40
SEXTANTG-5HPnD	1	4920-6100	20,40

SXT2nDr2	1	2312-2732	20,40
SXT5HacD2n	2	2312-2732,4920-6100	5[1],10[1],20,40 and 5[1],10[1],20,40,80
SXT5HPnDr2	1	4920-6100	20,40
SXT5nDr2	1	4920-6100	20,40
SXTG-2HnD	1	2200-2700	20,40
SXTG-2HnDr2	1	2300-2700	20,40
SXTG-5HPacD	1	4920-6100	5[1],10[1],20,40,80
SXTG-5HPacD-HG /-SA	1	4920-6100	5[1],10[1],20,40,80
SXTG-5HPnD-HGr2 /-SAr2	1	4920-6100	20,40
SXTG-6HPnD	1	5500-6500	20,40
SXTsq2nD	1	2312-2484	20,40
wAP2nD /-BE	1	2312-2732	20,40
wAPG-5HacT2HnD /-BE	2	2312-2732,4920-6100	20,40 and 20,40,80
R11e-2HnD	1	2312-2732	20,40
R11e-2HPnD	1	2312-2732	20,40
R11e-5HacD	1	4920-6100	20,40,80
R11e-5HacT	1	4920-6100	20,40,80
R11e-5HnD	1	4920-6100	20,40
R2SHPn	1	2200-2700	20,40 and advanced channel support
R52H	1	4920-6100,2192-2507	20 and 20
R52HnD	1	4800-6100,2200-2700	20,40 and 20,40
R52nM	1	4800-6100,2200-2700	20,40 and 20,40 and advanced channel support
R5SHPn	1	4800-6100	20,40 and advanced channel support

NOTES:

1. - Only in 802.11a/n standard

Overview

Advanced Channels feature provides extended opportunities in wireless interface configuration:

- scan-list that covers multiple bands and channel widths;
- non-standard channel center frequencies (specified with KHz granularity) for hardware that allows that;
- non-standard channel widths (specified with KHz granularity) for hardware that allows that.

Hardware support

Non standard center frequency and width channels can only be used with interfaces that support it.

Currently **only Atheros AR92xx** based chips support non-standard center frequencies and widths with the following ranges:

- center frequency range: 2200MHz-2500MHz with step 0.5MHz (500KHz), width range: 2.5MHz-30MHz width step 0.5MHz (500KHz);
- center frequency range: 4800MHz-6100MHz with step 0.5MHz (500KHz), width range: 2.5MHz-30MHz width step 0.5MHz (500KHz);

AR93xx doesn't support this feature

Configuring Advanced Channels

Advanced Channels are configured in **interface wireless channels** menu. This menu contains ordered list of user-defined channels that can be grouped by means of **list** property. Channels have the following properties:

- **name** - name by which this channel can be referred to. If **name** is not specified when adding channel, it will be automatically generated from channel frequency and width;
- **list** - name of list this channel is part of. Lists can be used to group channels;
- **frequency** - channel center frequency in MHz, allowing to specify fractional MHz part, e.g. **5181.5**;
- **width** - channel width in MHz, allowing to specify fractional MHz part, e.g. **14.5**;
- **band** - defines default set of data rates when using this channel;
- **extension-channel** - specifies placement of 11n extension channel.

Using Advanced Channels

In order to use Advanced Channels in wireless interface configuration, several interface settings accept channel names or list names as arguments. It is possible to configure interface with channel that interface does not support. In this case interface will not become operational. It is sole responsibility of administrator to configure channels in proper way.

frequency

To use particular Advanced Channel for wireless interface (applies to modes that make use of interface **frequency** setting) specify channel name in interface **frequency** setting. For example, to configure interface to operate with center frequency 5500MHz and channel width 14MHz, use the following commands:

```
[admin@MikroTik] /interface wireless> channels add name=MYCHAN frequency=5500 width=14 band=5ghz-onlyn
 list=MYLIST
[admin@MikroTik] /interface wireless> set wlan1 frequency=MYCHAN
```

scan-list

Interface **scan-list** is used in multiple modes that either gather information for list of channels (like interactive **scan** command) or selects channel to work on (like any of **station** modes or AP modes performing DFS). Interface **scan-list** can be configured with comma-separated list of the following items:

- **default** - default .11 channel list for given country and interface band and channel width;
- numeric frequency ranges in MHz;
- Advanced Channel, referred to by name;
- Advanced Channel list, referred to by list name.

For example, to configure interface to scan 5180MHz, 5200MHz and 5220MHz at first using channel width 20MHz and then using channel width 10MHz, the following commands can be issued:

```
[admin@MikroTik] /interface wireless> channels add frequency=5180 width=20 band=5ghz-a list=20MHz-list
[admin@MikroTik] /interface wireless> channels add frequency=5200 width=20 band=5ghz-a list=20MHz-list
[admin@MikroTik] /interface wireless> channels add frequency=5220 width=20 band=5ghz-a list=20MHz-list
[admin@MikroTik] /interface wireless> channels add frequency=5180 width=10 band=5ghz-a list=10MHz-list
[admin@MikroTik] /interface wireless> channels add frequency=5200 width=10 band=5ghz-a list=10MHz-list
[admin@MikroTik] /interface wireless> channels add frequency=5220 width=10 band=5ghz-a list=10MHz-list
[admin@MikroTik] /interface wireless> set wlan1 scan-list=20MHz-list,10MHz-list
```

Nstreme

Sub-menu: `/interface wireless nstreme`

This menu allows to switch a wireless card to the nstreme mode. In this case the card will work only with nstreme clients.

Property	Description
comment (*string*; Default:)	Short description of an entry
disable-csma (*yes* | *no*; Default: **no**)	Disable CSMA/CA when polling is used (better performance)
enable-nstreme (*yes* | *no* ; Default: **no**)	Whether to switch the card into the nstreme mode
enable-polling (*yes* | *no*; Default: **yes**)	Whether to use polling for clients

framer-limit (*integer [100..4000]*; Default: **3200**)	Maximal frame size
framer-policy (*best-fit* | *dynamic-size* | *exact-size* | *none*; Default: **none**)	The method how to combine frames. A number of frames may be combined into a bigger one to reduce the amount of protocol overhead (and thus increase speed). The card is not waiting for frames, but in case a number of packets are queued for transmitting, they can be combined. There are several methods of framing: • **none** - do nothing special, do not combine packets (framing is disabled) • **best-fit** - put as many packets as possible in one frame, until the framer-limit limit is met, but do not fragment packets • **exact-size** - put as many packets as possible in one frame, until the framer-limit limit is met, even if fragmentation will be needed (best performance) • **dynamic-size** - choose the best frame size dynamically
name (*string*)	Name of an interface, to which setting will be applied. Read only.

Note: The settings here (except for enabling nstreme) are relevant only on Access Point, they are ignored for client devices! The client automatically adapts to the AP settings.
WDS for Nstreme protocol requires using station-wds mode on one of the peers. Configurations with WDS between AP modes (bridge and ap-bridge) will not work.

Nstreme Dual

Sub-menu: `/interface wireless nstreme-dual`

Two radios in nstreme-dual-slave mode can be grouped together to make nstreme2 Point-to-Point connection. To put wireless interfaces into a nstreme2 group, you should set their mode to nstreme-dual-slave. Many parameters from /interface wireless menu are ignored, using the nstreme2, except:

- frequency-mode
- country
- antenna-gain
- tx-power
- tx-power-mode
- antenna-mode

Property	Description
arp (*disabled* | *enabled* | *proxy-arp* | *reply-only*; Default: **enabled**)	Read more >>
comment (*string*; Default:)	Short description of an entry
disable-csma (*yes* | *no*; Default: **no**)	Disable CSMA/CA (better performance)
disable-running-check (*yes* | *no*; Default: **no**)	Whether the interface should always be treated as running even if there is no connection to a remote peer
disabled (*yes* | *no*; Default: **yes**)	
framer-limit (*integer [64..4000]*; Default: **2560**)	Maximal frame size

framer-policy (*best-fit | exact-size | none*; Default: **none**)	The method how to combine frames. A number of frames may be combined into one bigger one to reduce the amout of protocol overhead (and thus increase speed). The card are not waiting for frames, but in case a number packets are queued for transmitting, they can be combined. There are several methods of framing: • **none** - do nothing special, do not combine packets • **best-fit** - put as much packets as possible in one frame, until the framer-limit limit is met, but do not fragment packets • **exact-size** - put as much packets as possible in one frame, until the framer-limit limit is met, even if fragmentation will be needed (best performance)
ht-channel-width (*2040mhz | 20mhz | 40mhz*; Default: **20mhz**)	
ht-guard-interval (*both | long | short*; Default: **long**)	
ht-rates (*list of rates [1,2,3,4,5,6,7,8]*; Default: **1,2,3,4,5,6,7,8**)	
ht-streams (*both | double | single*; Default: **single**)	
l2mtu (*integer [0..65536]*; Default:)	
mtu (*integer [0..65536]*; Default: **1500**)	
name (*string*; Default:)	Name of an entry
rates-a/g (*list of rates [6Mbps,9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps]*; Default: **6Mbps,9Mbps,12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps**)	Rates to be supported in 802.11a or 802.11g standard
rates-b (*list of rates [1Mbps, 2Mbps, 5.5Mbps, 11Mbps]*; Default: **1Mbps, 2Mbps, 5.5Mbps, 11Mbps**)	Rates to be supported in 802.11b standard
remote-mac (*MAC*; Default: **00:00:00:00:00:00**)	Which MAC address to connect to (this would be the remote receiver card's MAC address)
rx-band (*2ghz-b | 2ghz-g | 2ghz-n | 5ghz-a | 5ghz-n*; Default:)	Operating band of the receiving radio
rx-channel-width (*10mhz*; Default: **20mhz**)	
rx-frequency (*integer [0..4294967295]*; Default:)	RX card operation frequency in Mhz.
rx-radio (*string*; Default:)	Name of the interface used for receive.
tx-band (*2ghz-b | 2ghz-g | 2ghz-n | 5ghz-a | 5ghz-n*; Default:)	Operating band of the transmitting radio
tx-channel-width (*10mhz*; Default: **20mhz**)	
tx-frequency (*integer [0..4294967295]*; Default:)	TX card operation frequency in Mhz.
tx-radio (*string*; Default:)	Name of the interface used for transmit.

Warning: WDS cannot be used on Nstreme-dual links.

Note: The difference between tx-freq and rx-freq should be about 200MHz (more is recommended) because of the interference that may occur!

Note: You can use different bands for rx and tx links. For example, transmit in 2ghz-g and receive data, using 2ghz-b band.

Registration Table

Sub-menu: `/interface wireless registration-table`

In the registration table, you can see various information about currently connected clients. It is used only for Access Points.

All properties are read-only.

Property	Description
802.1x-port-enabled (*yes | no*)	whether the data exchange is allowed with the peer (i.e., whether 802.1x authentication is completed, if needed)
ack-timeout (*integer*)	current value of ack-timeout
ap (*yes | no*)	Shows whether registered device is configured as access point.
ap-tx-limit (*integer*)	transmit rate limit on the AP, in bits per second
authentication-type ()	authentication method used for the peer
bridge (*yes | no*)	
bytes (*integer , integer*)	number of sent and received packet bytes
client-tx-limit (*integer*)	transmit rate limit on the AP, in bits per second
comment (*string*)	Description of an entry. comment is taken from appropriate Access List entry if specified.
compression (*yes | no*)	whether data compresson is used for this peer
distance (*integer*)	
encryption (*aes-ccm | tkip*)	unicast encryption algorithm used
evm-ch0 ()	
evm-ch1 ()	
evm-ch2 ()	
frame-bytes (*integer, integer*)	number of sent and received data bytes excluding header information
frames (*integer, integer*)	Number of frames that need to be sent over wireless link. This value can be compared to **hw-frames** to check wireless retransmits. `Read more >>`

framing-current-size (*integer*)	current size of combined frames
framing-limit (*integer*)	maximal size of combined frames
framing-mode ()	the method how to combine frames
group-encryption ()	group encryption algorithm used
hw-frame-bytes (*integer, integer*)	number of sent and received data bytes including header information
hw-frames (*integer, integer*)	Number of frames sent over wireless link by the driver. This value can be compared to **frames** to check wireless retransmits. `Read more >>`
interface (*string*)	Name of the wireless interface to which wireless client is associated
last-activity (*time*)	last interface data tx/rx activity
last-ip (*IP Address*)	IP address found in the last IP packet received from the registered client
mac-address (*MAC*)	MAC address of the registered client
management-protection (*yes | no*)	
nstreme (*yes | no*)	Shows whether Nstreme is enabled
p-throughput (*integer*)	estimated approximate throughput that is expected to the given peer, taking into account the effective transmit rate and hardware retries. Calculated once in 5 seconds
packed-bytes (*integer, integer*)	number of bytes packed into larger frames for transmitting/receiving (framing)
packed-frames (*integer, integer*)	number of frames packed into larger ones for transmitting/receiving (framing)
packets (*integer. integer*)	number of sent and received network layer packets
radio-name (*string*)	radio name of the peer

routeros-version (*string*)	RouterOS version of the registered client
rx-ccq ()	Client Connection Quality (CCQ) for receive. `Read more >>`
rx-rate (*integer*)	receive data rate
signal-strength (*integer*)	average strength of the client signal recevied by the AP
signal-strength-ch0 ()	
signal-strength-ch1 ()	
signal-strength-ch2 ()	
signal-to-noise ()	
strength-at-rates ()	signal strength level at different rates together with time how long were these rates used
tdma-retx ()	
tdma-rx-size ()	
tdma-timing-offset ()	tdma-timing-offset is proportional to **distance** and is approximately two times the propagation delay. AP measures this so that it can tell clients what offset to use for their transmissions - clients then subtract this offset from their target transmission time such that propagation delay is accounted for and transmission arrives at AP when expected. You may occasionally see small negative value (like few usecs) there for close range clients because of additional unaccounted delay that may be produced in transmitter or receiver hardware that varies from chipset to chipset.
tdma-tx-size (*integer*)	Value in bytes that specifies the size of data unit whose loss can be detected (data unit over which CRC is calculated) sent by device. In general - the bigger the better, because overhead is less. On the other hand, small value in this setting can not always be considered a signal that connection is poor - if device does not have enough pending data that would enable it to use bigger data units (e.g. if you are just pinging over link), this value will not go up.
tdma-windfull ()	
tx-ccq ()	Client Connection Quality (CCQ) for transmit. `Read more >>`
tx-evm-ch0 ()	
tx-evm-ch1 ()	
tx-evm-ch2 ()	
tx-frames-timed-out ()	
tx-rate ()	

tx-signal-strength ()	
tx-signal-strength-ch0 ()	
tx-signal-strength-ch1 ()	
tx-signal-strength-ch2 ()	
uptime (*time*)	time the client is associated with the access point
wds (*yes* | *no*)	whether the connected client is using wds or not
wmm-enabled (*yes* | *no*)	Shows whether WMM is enabled.

Security Profiles

Sub-menu: `/interface wireless security-profiles`

Security profiles are configured under the **/interface wireless security-profiles** path in the console, or in the "Security Profiles" tab of the "Wireless" window in the WinBox. Security profiles are referenced by the Wireless interface security-profile property and security-profile property of Connect Lists.

Basic properties

Property	Description
mode (*none* | *static-keys-optional* | *static-keys-required* | *dynamic-keys*; Default: **none**)	Encryption mode for the security profile. • none - Encryption is not used. Encrypted frames are not accepted. • static-keys-required - WEP mode. Do not accept and do not send unencrypted frames. Station in *static-keys-required* mode will not connect to an Access Point in *static-keys-optional* mode. • static-keys-optional - WEP mode. Support encryption and decryption, but allow also to receive and send unencrypted frames. Device will send unencrypted frames if encryption algorithm is specified as *none*. Station in *static-keys-optional* mode will not connect to an Access Point in *static-keys-required* mode. See also: static-sta-private-algo, static-transmit-key. • dynamic-keys - WPA mode.
name (*text*; Default:)	Name of the security profile

WPA properties

These properties have effect only when **mode** is set to *dynamic-keys*.

Property	Description
authentication-types (*wpa-psk* | *wpa2-psk* | *wpa-eap* | *wpa2-eap*; Default:)	Set of supported authentication types, multiple values can be selected. Access Point will advertise supported authentication types, and client will connect to Access Point only if it supports any of the advertised authentication types.

disable-pmkid (*no* | *yes*; Default: **no**)	Whether to include PMKID into the EAPOL frame sent out by the Access Point. Disabling PMKID can cause compatibility issues with devices that use the PMKID to connect to an Access Point. • yes - removes PMKID from EAPOL frames (improves security, reduces compatibility). • no - includes PMKID into EAPOL frames (reduces security, improves compatibility). This property only has effect on Access Points.
unicast-ciphers (*tkip* | *aes-ccm*; Default: **aes-ccm**)	Access Point advertises that it supports specified ciphers, multiple values can be selected. Client attempts connection only to Access Points that supports at least one of the specified ciphers. One of the ciphers will be used to encrypt unicast frames that are sent between Access Point and Station.
group-ciphers (*tkip* | *aes-ccm*; Default: **aes-ccm**)	Access Point advertises one of these ciphers, multiple values can be selected. Access Point uses it to encrypt all broadcast and multicast frames. Client attempts connection only to Access Points that use one of the specified group ciphers. • tkip - Temporal Key Integrity Protocol - encryption protocol, compatible with legacy WEP equipment, but enhanced to correct some of the WEP flaws. • aes-ccm - more secure WPA encryption protocol, based on the reliable AES (Advanced Encryption Standard). Networks free of WEP legacy should use only this cipher.
group-key-update (*time: 30s..1d*; Default: **5m**)	Controls how often Access Point updates the group key. This key is used to encrypt all broadcast and multicast frames. property only has effect for Access Points.
wpa-pre-shared-key (*text*; Default:)	WPA pre-shared key mode requires all devices in a BSS to have common secret key. Value of this key can be an arbitrary text. Commonly referred to as the network password for WPA mode. property only has effect when *wpa-psk* i s added to **authentication-types**.
wpa2-pre-shared-key (*text*; Default:)	WPA2 pre-shared key mode requires all devices in a BSS to have common secret key. Value of this key can be an arbitrary text. Commonly referred to as the network password for WPA2 mode. property only has effect when *wpa2-psk* is added to **authentication-types**.

Note: RouterOS also allows to override pre-shared key value for specific clients, using either the private-pre-shared-key property, or the Mikrotik-Wireless-Psk attribute in the RADIUS MAC authentication response. This is an extension.

WPA EAP properties

These properties have effect only when **authentication-types** contains *wpa-eap* or *wpa2-eap*, and **mode** is set to *dynamic-keys*.

Property	Description
eap-methods (*eap-tls* | *eap-ttls-mschapv2* | *passthrough* | *peap*; Default: **passthrough**)	Allowed types of authentication methods, multiple values can be selected. This property only has effect on Access Points. • eap-tls - Use built-in EAP TLS authentication. Both client and server certificates are supported. See description of **tls-mode** and **tls-certificate** properties. • eap-ttls-mschapv2 - Use EAP-TTLS with MS-CHAPv2 authentication. • passthrough - Access Point will relay authentication process to the RADIUS server. • peap - Use Protected EAP authentication.
supplicant-identity (*text*; Default: **Identity**)	EAP identity that is sent by client at the beginning of EAP authentication. This value is used as a value for User-Name attribute in RADIUS messages sent by RADIUS EAP accounting and RADIUS EAP pass-through authentication.
mschapv2-username (*text*; Default:)	Username to use for authentication when *eap-ttls-mschapv2* authentication method is being used. This property only has effect on Stations.
mschapv2-password (*text*; Default:)	Password to use for authentication when *eap-ttls-mschapv2* authentication method is being used. This property only has effect on Stations.

tls-mode (*verify-certificate* / *dont-verify-certificate* / *no-certificates* / *verify-certificate-with-crl*; Default: **no-certificates**)	This property has effect only when **eap-methods** contains *eap-tls*. • verify-certificate - Require remote device to have valid certificate. Check that it is signed by known certificate authority. No additional identity verification is done. Certificate may include information about time period during which it is valid. If router has incorrect time and date, it may reject valid certificate because router's clock is outside that period. See also the Certificates configuration. • dont-verify-certificate - Do not check certificate of the remote device. Access Point will not require client to provide certificate. • no-certificates - Do not use certificates. TLS session is established using 2048 bit anonymous Diffie-Hellman key exchange. • verify-certificate-with-crl - Same as *verify-certificate* but also checks if the certificate is valid by checking the Certificate Revocation List.
tls-certificate (*none* / *name*; Default: **none**)	Access Point always needs a certificate when configured when **tls-mode** is set to *verify-certificate*, or is set to *dont-verify-certificate*. Client needs a certificate only if Access Point is configured with **tls-mode** set to *verify-certificate*. In this case client needs a valid certificate that is signed by a CA known to the Access Point. This property only has effect when **tls-mode** is not set to *no-certificates* and **eap-methods** contains *eap-tls*.

Note: The order of allowed authentication methods in `eap-methods` is important, the same order is going to be used to send authentication method offers to the Station. Example: Access Point uses security-profile where **eap-methods** is set to *eap-tls*,*passthrough*; 1) Access Point offers EAP-TLS method to the client; 2) Client refuses; 3) Access Point starts relaying EAP communication to the radius server.

Note: When the AP is used for passthrough it is not required to add certificates on the AP itself, the AP device works as a transparent bridge and forwards the EAP-TLS association data from RADIUS server to the end client.

Note: When `tls-mode` is using either `verify-certificate` or `dont-verify-certificate`, then the remote device has to support one of the *RC4-MD5*, *RC4-SHA* or *DES-CBC3-SHA* TLS cipher suites. When using `no-certificates` mode, then the remote device must support "ADH-DES-CBC3-SHA" cipher suite.

RADIUS properties

Property	Description
radius-mac-authentication (*yes* / *no*; Default: **no**)	This property affects the way how Access Point processes clients that are not found in the Access List. • no - allow or reject client authentication based on the value of default-authentication property of the Wireless interface. • yes - Query RADIUS server using MAC address of client as user name. With this setting the value of default-authentication has no effect.
radius-mac-accounting (*yes* / *no*; Default: **no**)	
radius-eap-accounting (*yes* / *no*; Default: **no**)	
radius-called-format (*mac* / *mac:ssid* / *ssid*; Default: **mac:ssid**)	
interim-update (*time*; Default: **0**)	When RADIUS accounting is used, Access Point periodically sends accounting information updates to the RADIUS server. This property specifies default update interval that can be overridden by the RADIUS server using Acct-Interim-Interval attribute.
radius-mac-format (*XX:XX:XX:XX:XX:XX* / *XXXX:XXXX:XXXX* / *XXXXXX:XXXXXX* / *XX-XX-XX-XX-XX-XX* / *XXXXXX-XXXXXX* / *XXXXXXXXXXXX* / *XX XX XX XX XX XX*; Default: **XX:XX:XX:XX:XX:XX**)	Controls how MAC address of the client is encoded by Access Point in the User-Name attribute of the MAC authentication and MAC accounting RADIUS requests.

radius-mac-mode (*as-username* | *as-username-and-password*; Default: **as-username**)	By default Access Point uses an empty password, when sending Access-Request during MAC authentication. When this property is set to *as-username-and-password*, Access Point will use the same value for User-Password attribute as for the User-Name attribute.
radius-mac-caching (*disabled* | *time*; Default: **disabled**)	If this value is set to time interval, the Access Point will cache RADIUS MAC authentication responses for specified time, and will not contact RADIUS server if matching cache entry already exists. Value *disabled* will disable cache, Access Point will always contact RADIUS server.

WEP properties

These properties have effect only when **mode** is set to *static-keys-required* or *static-keys-optional*.

Property	Description
static-key-0 | static-key-1 | static-key-2 | static-key-3 (*hex*; Default:)	Hexadecimal representation of the key. Length of key must be appropriate for selected algorithm. See the Statically configured WEP keys section.
static-algo-0 | static-algo-1 | static-algo-2 | static-algo-3 (*none* | *40bit-wep* | *104bit-wep* | *tkip* | *aes-ccm*; Default: **none**)	Encryption algorithm to use with the corresponding key.
static-transmit-key (*key-0* | *key-1* | *key-2* | *key-3*; Default: **key-0**)	Access Point will use the specified key to encrypt frames for clients that do not use private key. Access Point will also use this key to encrypt broadcast and multicast frames. Client will use the specified key to encrypt frames if **static-sta-private-algo** is set to *none*. If corresponding **static-algo-N** property has value set to *none*, then frame will be sent unencrypted (when **mode** is set to *static-keys-optional*) or will not be sent at all (when **mode** is set to *static-keys-required*).
static-sta-private-key (*hex*; Default:)	Length of key must be appropriate for selected algorithm, see the Statically configured WEP keys section. This property is used only on Stations. Access Point uses corresponding key either from private-key property, or from Mikrotik-Wireless-Enc-Key attribute.
static-sta-private-algo (*none* | *40bit-wep* | *104bit-wep* | *tkip* | *aes-ccm*; Default: **none**)	Encryption algorithm to use with station private key. Value *none* disables use of the private key. This property is only used on Stations. Access Point has to get corresponding value either from private-algo property, or from Mikrotik-Wireless-Enc-Algo attribute. Station private key replaces key 0 for unicast frames. Station will not use private key to decrypt broadcast frames.

Management frame protection

***Used for**: Deauthentication attack prevention, MAC address cloning issue.*

RouterOS implements proprietary management frame protection algorithm based on shared secret. Management frame protection means that RouterOS wireless device is able to verify source of management frame and confirm that particular frame is not malicious. This feature allows to withstand deauthentication and disassociation attacks on RouterOS based wireless devices.

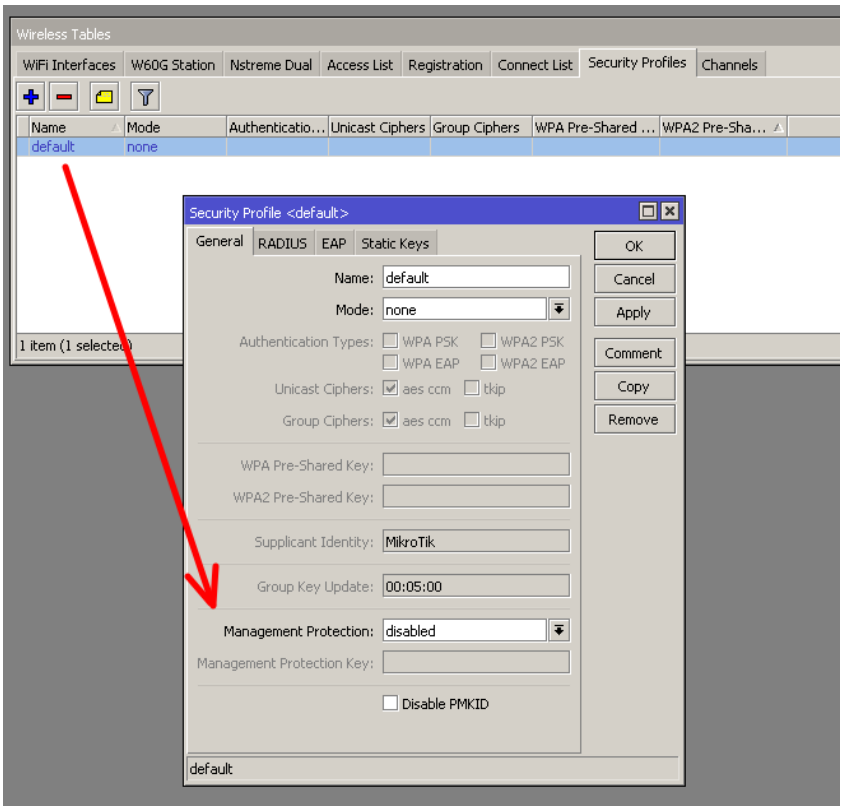
Management protection mode is configured in security-profile with **management-protection** setting. Possible values are: **disabled** - management protection is disabled (default), **allowed** - use management protection if supported by remote party (for AP - allow both, non-management protection and management protection clients, for client - connect both to APs with and without management protection), **required** - establish association only with remote devices that support management protection (for AP - accept only clients that support management protection, for client - connect only to APs that support management protection).

Management protection shared secret is configured with security-profile **management-protection-key** setting.

When interface is in AP mode, default management protection key (configured in security-profile) can be overridden by key specified in access-list or RADIUS attribute.

```
[admin@mikrotik] /interface wireless security-profiles> print
 0 name="default" mode=none authentication-types="" unicast-ciphers=""
   group-ciphers="" wpa-pre-shared-key="" wpa2-pre-shared-key=""
   supplicant-identity="n-str-p46" eap-methods=passthrough
   tls-mode=no-certificates tls-certificate=none static-algo-0=none
   static-key-0="" static-algo-1=none static-key-1="" static-algo-2=none
   static-key-2="" static-algo-3=none static-key-3=""
   static-transmit-key=key-0 static-sta-private-algo=none
   static-sta-private-key="" radius-mac-authentication=no
   radius-mac-accounting=no radius-eap-accounting=no interim-update=0s
   radius-mac-format=XX:XX:XX:XX:XX:XX radius-mac-mode=as-username
   radius-mac-caching=disabled group-key-update=5m
   management-protection=disabled management-protection-key=""

[admin@mikrotik] /interface wireless security-profiles> set default management-protection=
                                                        allowed  disabled  required
```



Operation details

RADIUS MAC authentication

Note: RAIDUS MAC authentication is used by access point for clients that are not found in the access-list, similarly to the **default-authentication** property of the wireless interface. It controls whether client is allowed to proceed with authentication, or is rejected immediately.

When **radius-mac-authentication**=*yes*, access point queries RADIUS server by sending Access-Request with the following attributes:

- User-Name - Client MAC address. This is encoded as specified by the **radius-mac-format** setting. Default encoding is "XX:XX:XX:XX:XX:XX".
- Nas-Port-Id - **name** of wireless interface.
- User-Password - When **radius-mac-mode**=*as-username-and-password* this is set to the same value as User-Name. Otherwise this attribute is empty.
- Calling-Station-Id - Client MAC address, encoded as "XX-XX-XX-XX-XX-XX".
- Called-Station-Id - MAC address and SSID of the access point, encoded as "XX-XX-XX-XX-XX-XX:SSID" (minus separated pairs of MAC address digits, followed by colon, followed by SSID value).
- Acct-Session-Id - Added when **radius-mac-accounting**=*yes*.

When access point receives Access-Accept or Access-Reject response from the RADIUS server, it stores the response and either allows or rejects client. Access point uses following RADIUS attributes from the Access-Accept response:

- Ascend-Data-Rate

- Ascend-Xmit-Rate
- Mikrotik-Wireless-Forward - Same as access-list **forwarding**.
- Mikrotik-Wireless-Enc-Algo - Same as access-list **private-algo**.
- Mikrotik-Wireless-Enc-Key - Same as access-list **private-key**.
- Mikrotik-Wireless-Psk - Same as access-list **private-pre-shared-key**.
- Mikrotik-Wireless-Mpkey - Same as Management-protection-key in Access list
- Session-Timeout - Time, after which client will be disconnected.
- Acct-Interim-Interval - Overrides value of **interim-update**.
- Class - If present, value of this attribute is saved and included in Accounting-Request messages.

Caching

Caching of RADIUS MAC authentication was added to support RADIUS authentication for clients that require from the access point very quick response to the association request. Such clients time out before response from RADIUS server is received. Access point caches authentication response for some time and can immediately reply to the repeated association request from the same client.

RADIUS EAP pass-through authentication

When using WPA EAP authentication type, clients that have passed MAC authentication are required to perform EAP authentication before being authorized to pass data on wireless network. With pass-through EAP method the access point will relay authentication to RADIUS server, and use following attributes in the Access-Request RADIUS message:

- User-Name - EAP supplicant identity. This value is configured in the **supplicant-identity** property of the client security profile.
- Nas-Port-Id - **name** of wireless interface.
- Calling-Station-Id - Client MAC address, encoded as "XX-XX-XX-XX-XX-XX".
- Called-Station-Id - MAC address and SSID of the access point, encoded as "XX-XX-XX-XX-XX-XX:SSID" (pairs of MAC address digits separated by minus sign, followed by colon, followed by SSID value).
- Acct-Session-Id - Added when **radius-eap-accounting**=*yes*.
- Acct-Multi-Session-Id - MAC address of access point and client, and unique 8 byte value, that is shared for all accounting sessions that share single EAP authentication. Encoded as *AA-AA-AA-AA-AA-AA-CC-CC-CC-CC-CC-CC-XX-XX-XX-XX-XX-XX-XX-XX*. Added when radius-eap-accounting=yes.

Access point uses following RADIUS attributes from the Access-Accept server response:

- Class - If present, value of this attribute is saved and included in Accounting-Request messages.
- Session-Timeout - Time, after which client will be disconnected. Additionally, access point will remember authentication result, and if during this time client reconnects, it will be authorized immediately, without repeating EAP authentication.
- Acct-Interim-Interval - Overrides value of **interim-update**.

Statically configured WEP keys

Different algorithms require different length of keys:

- *40bit-wep* - 10 hexadecimal digits (40 bits). If key is longer, only first 40 bits are used.
- *104bit-wep* - 26 hexadecimal digits (104 bits). If key is longer, only first 104 bits are used.
- *tkip* - At least 64 hexadecimal digits (256 bits).
- *aes-ccm* - At least 32 hexadecimal digits (128 bits).

Key must contain even number of hexadecimal digits.

WDS security configuration

WDS links can use all available security features. However, they require careful configuration of security parameters.

It is possible to use one security profile for all clients, and different security profiles for WDS links. Security profile for WDS link is specified in connect-list. Access point always checks connect list before establishing WDS link with another access point, and used security settings from matching connect list entry. WDS link will work when each access point will have connect list entry that matches the other device, has **connect**=*yes* and specifies compatible **security-profile**.

WDS and WPA/WPA2

If access point uses security profile with **mode**=*dynamic-keys*, then encryption will be used for all WDS links. Since WPA authentication and key exchange is not symmetrical, one of the access points will act as a client for the purpose of establishing secure connection. This is similar to how *static-mesh* and *dynamic-mesh* WDS modes work. Some problems, like single sided WDS link between two incorrectly configured access points that use non-*mesh* mode, is not possible if WPA encryption is enabled. However, non-*mesh* modes with WPA still have other issues (like constant reconnection attempts in case of configuration mismatch) that are solved by use of the *-mesh* WDS modes.

In general, WPA properties on both access points that establish WPA protected WDS link have to match. These properties are **authentication-types**, **unicast-ciphers**, **group-ciphers**. For non-*mesh* WDS mode these properties need to have the same values on both devices. In *mesh* WDS mode each access point has to support the other one as a client.

Theoretically it is possible to use RADIUS MAC authentication and other RADIUS services with WDS links. However, only one access point will interact with the RADIUS server, the other access point will behave as a client.

Implementation of *eap-tls* EAP method in RouterOS is particularly well suited for WDS link encryption. **tls-mode**=*no-certificates* requires no additional configuration, and provides very strong encryption.

WDS and WEP

mode, **static-sta-private-key** and **static-sta-private-algo** parameters in the security profile assigned to the WDS link need to have the same values on both access points that establish WDS link with WPA encryption.

Security profile and access point matching in the connect list

Client uses value of connect-list **security-profile** property to match only those access points that support necessary security.

- **mode**=*static-keys-required* and **mode**=*static-keys-optional* matches only access points with the same **mode** in interface **security-profile**.
- If **mode**=*dynamic-keys*, then connect list entry matches if all of the **authentication-types**, **unicast-ciphers** and **group-ciphers** contain at least one value that is advertised by access point.

Virtual interfaces

VirtualAP

It is possible to create virtual access points using the *add* command in the wireless menu. You must specify the *master-interface* which the virtual interface will belong to. If "master-interface" mode is "station", Virtual AP will work only when "master-interface" will be active. The Virtual AP can have it's own SSID and Security Profile.

Virtual AP interface will only work if master interface is in *ap-bridge*, *bridge*, *station* or wds-slave mode. It works only with 802.11 protocol, Nv2 is not supported.

This feature is useful for separating access for different types of users. You can assign different bandwidth levels and passwords and instruct users to connect to the specific virtual network, it will appear to wireless clients as a different SSID or a different device. For example, when using QuickSet to configure a guest network, the VirtualAP feature is used in the background.

To create a new virtual-ap: `/interface> wireless add mode=ap-bridge master-interface=wlan1 ssid=guests security-profile=guests` (*such security profile first needs to be created*)

Note: you can create up to 127 virtual interfaces per physical interface. It is not recommended to create more 30, since the performance will start to degrade.

Virtual Clients

Note: Starting from 6.35 only in wireless-rep or wireless-cm2 package

It is also possible to create virtual clients and have both an AP and a Client on the same physical interface. This allows to make a repeater setup with only using one hardware card. The process of configuration is exacly the same as above, but use mode **station**:

To create a new virtual-client: `/interface> wireless add mode=station master-interface=wlan1 ssid=where-to-connect security-profile=your-profile` (*such security profile first needs to be created*)

Note: Virtual interfaces will always use the Master interface wireless frequency. If the Master interface has 'auto' frequency enabled it will use the wireless frequency that the Master interface selected.

Sniffer

Sub-menu: `/interface wireless sniffer`

Wireless sniffer allows to capture frames including Radio header, 802.11 header and other wireless related information.

Property	Description
channel-time (; Default: **200ms**)	How long to sniff each channel. Used only if **multiple-channels=yes**
file-limit (*integer [10..4294967295]*; Default: **10**)	Allocated file size in bytes which will be used to store captured data. Applicable if **file-name** is specified.
file-name (*string*; Default:)	Name of the file where to store captured data.
memory-limit (*integer [10..4294967295]*; Default: **10**)	Allocated memory buffer in kilobytes used to store captured data.
multiple-channels (*yes* | *no*; Default: **no**)	Whether to sniff multiple channels or a single channel. **No** means that all channel settings will be taken from **/interface wireless**, **Yes** means that all channel settings will be taken from **scan-list** under **/interface wireless**.
only-headers (*yes* | *no*; Default: **no**)	If set to yes, then sniffer will capture only information stored in frame headers.
receive-errors (*yes* | *no*; Default: **no**)	Whether to process packets which have been received with errors judging by their FCS.
streaming-enabled (*yes* | *no*; Default: **no**)	Whether to stream captured data to the specified streaming server
streaming-max-rate (*integer [0..4294967295]* ; Default: **0**)	Maximum packets per second allowed. **0** equals unlimited
streaming-server (*IPv4*; Default: **0.0.0.0**)	IP address of the streaming server.

Use the command **/interface wireless info scan-list** to verify your **scan-list** defined under **/interface wireless channels** when using **multiple-channels=yes**

Packets

Sub-menu: `/interface wireless sniffer packet`

Sub-menu shows captured packets.

Scan

Scan command allows to see available AP in the frequency range defined in the scan-list. Using scan command the interface operation is disabled (wireless link is disconnected during the scan operation) Since RouterOS v6.35 (wireless-rep) background scan is supported which can be used during the wireless interface operation without disconnecting the wireless link. Background scan is supported only using 802.11 wireless protocol.

Scan tool will continue scanning for AP until user stops the scan process. It is possible to use 'rounds' setting for the scan tool to do scan through the scan-list entries specific times. It is useful when running scan tool using scripts. Example of scan command for one round:

```
/interface wireless scan wlan1 rounds=1
```

'save-file' option allows to do scripted/scheduled scans and save the results in file for future analysis. Also this feature together with rounds setting allows to get scan results from the remote wireless clients - executing that command will start the scan tool which disconnect the wireless link, does the scan through the scan-list frequencies and saves the results to file, exits the scan and connects the wireless link back. Example:

```
/interface wireless scan wlan1 rounds=1 save-file=scan1
```

To use background wireless scan the 'background=yes' setting should be provided. Example:

```
/interface wireless scan wlan1 background=yes
```

Background scan feature is working in such conditions:

- Wireless interface should be enabled
- For wireless interface in AP mode - when it is operating in 802.11 protocol mode and is on fixed channel (that is - channel selection and initial radar checking is over)

- For wireless interface in Station mode - when it is connected to 802.11 protocol AP.

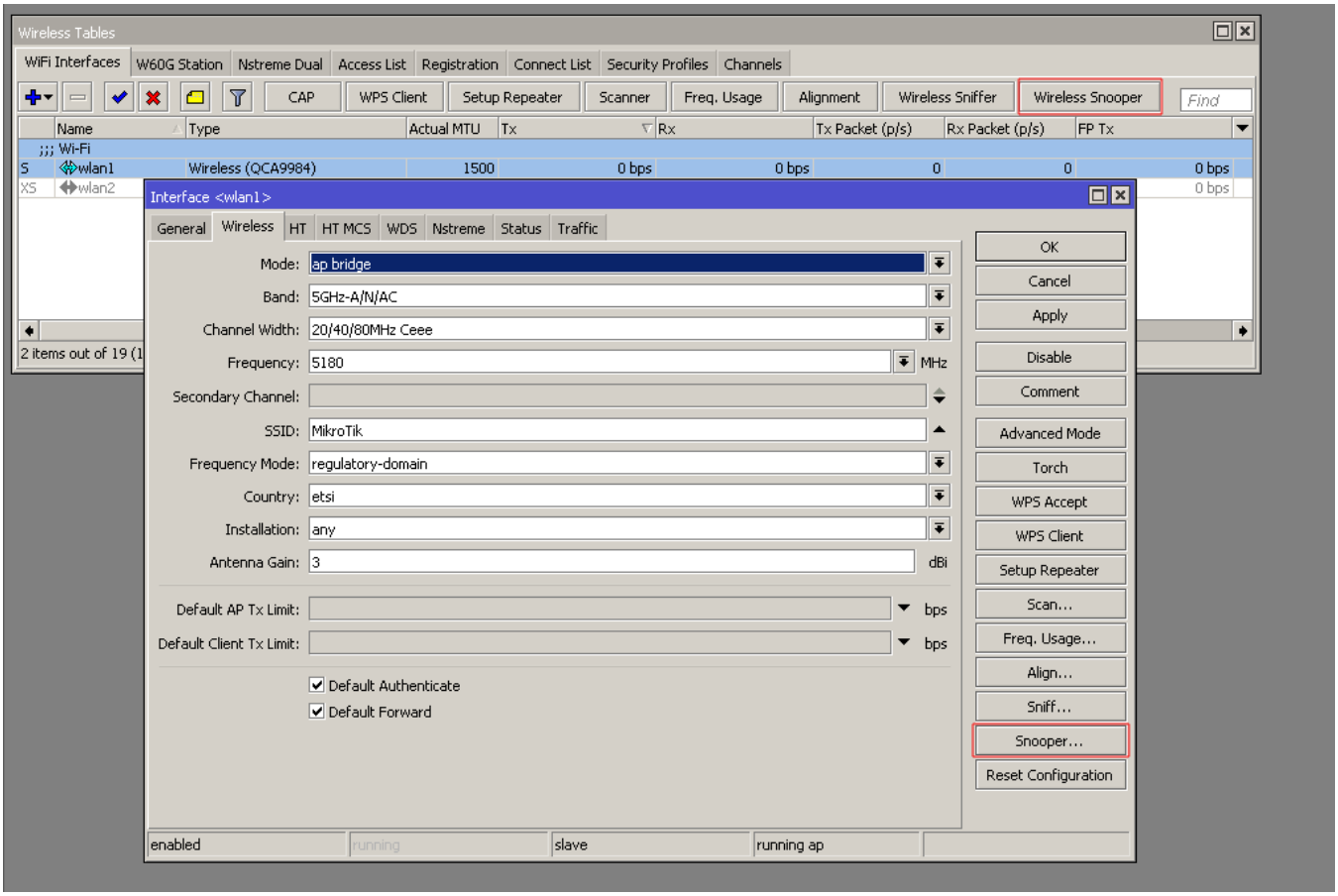
Scan command is supported also on the Virtual wireless interfaces with such limitations:

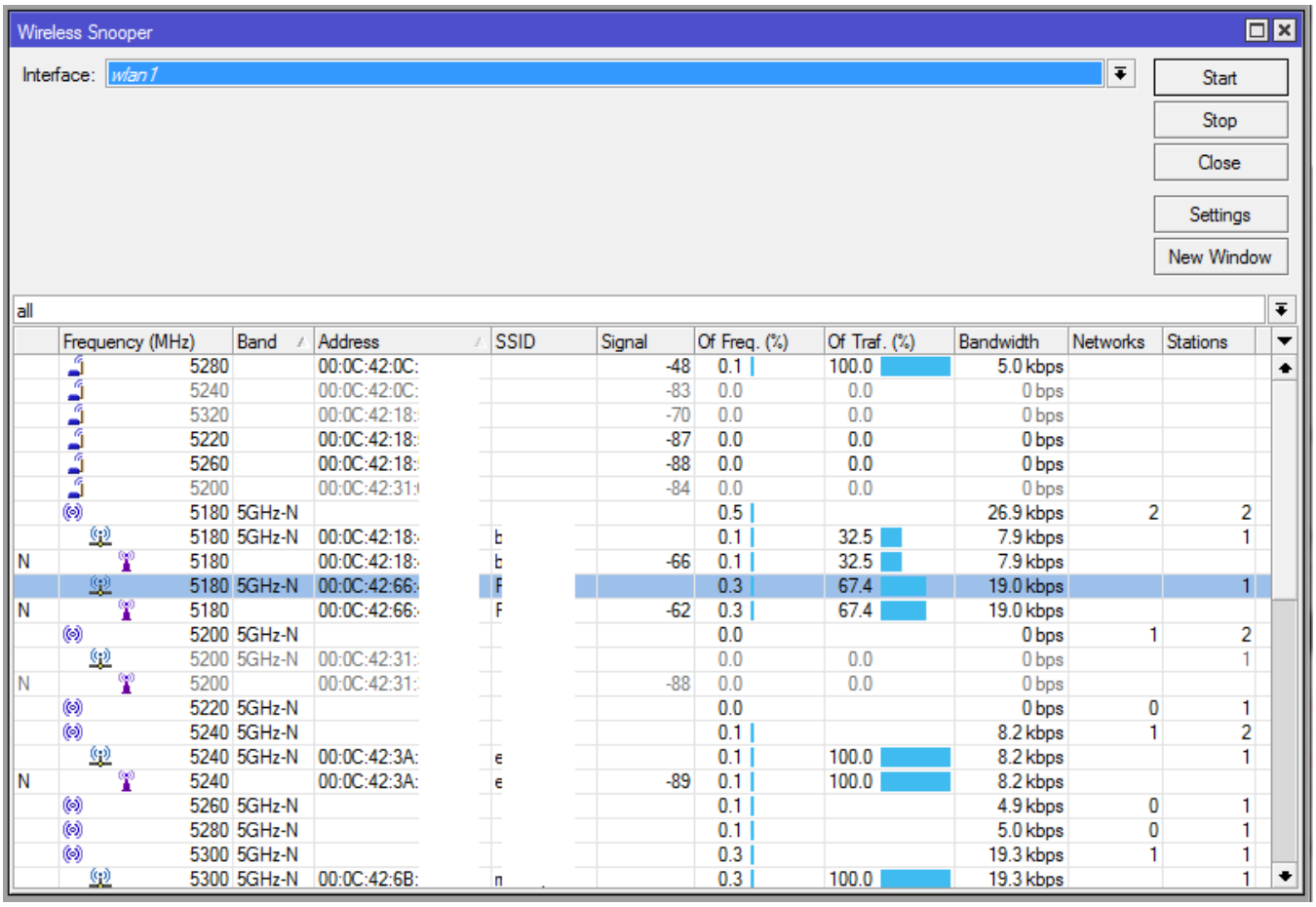
- It is possible when virtual interface and its master is fixed on channel (master AP is running or master station is connected to AP).
- Scan is only performed in channel master interface is on.
- It does not matter if background=yes|no - on virtual interface scan does not disconnect clients/AP, so it is always "background".

Snooper

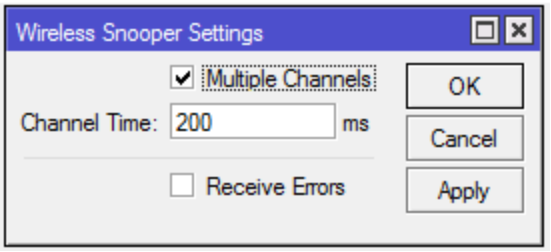
This tool monitors surrounding frequency usage, and displays which devices occupy each frequency. It's available both in console, and also in Winbox. Sn ooper will use frequencies from scan-list.

Sub-menu: `/interface wireless snooper`





Settings



Spectral scan

- See separate document Manual:Spectral_scan

WDS

Sub-menu: `/interface wireless wds`

Properties:

Property	Description
arp (*disabled* | *enabled* | *proxy-arp* | *reply-only*; Default: **enabled**)	
comment (*string*; Default:)	
disable-running-check (*yes* | *no*; Default: **no**)	

disabled (*yes* | *no*; Default: **yes**)	
l2mtu (*integer [0..65536]*; Default:)	
master-interface (*string*; Default:)	
mtu (*integer [0..65536]*; Default: **1500**)	
name (*string*; Default:)	
wds-address (*MAC*; Default: **00:00:00:00:00:00**)	

Read-only properties:

Property	Description
dynamic (*yes* | *no*)	
mac-address (*MAC*)	
running (*yes* | *no*)	

WPS

Wireless interface supports WPS Server and also WPS Client (supported by wireless-rep package starting from RouterOS v6.35).

WPS Server

WPS Server allows to connect wireless clients that support WPS to AP protected with the Pre-Shared Key without specifying that key in the clients configuration.

WPS Server can be enabled by changing the WPS Mode setting for the wireless interface. Example:

```
/interface wireless set wlan1 wps-mode=push-button
```

Wps-mode has 3 options

- disabled
- push-button - WPS is activated by pushing physical button on the board (few boards has such button marked on the board case/label)
- push-button-virtual-only - WPS is activated by pushing "WPS Accept" button from the RouterOS wireless interface menu

By pushing the WPS physical/virtual button the AP enables the WPS functionality. If within 2 minutes the WPS process isn't initiated the WPS Accept Function is stopped.

WPS Server is enabled by default on few boards that has physical WPS button marked. For example, hap lite, hap, hap ac lite, hap ac, map lite

WPS Server is active only when wireless AP interface has Pre-Shared Key Authentication (PSK) enabled. It is possible to configure this mode for the Virtual AP interfaces as well.

WPS Client

WPS Client function allows the wireless client to get the Pre-Shared Key configuration of the AP that has WPS Server enabled. WPS Client can be enabled by such command:

```
/interface wireless wps-client wlan1
```

WPS Client command outputs all the information of the WPS Enabled AP on the screen. Example:

```
[admin@MikroTik] /interface wireless> wps-client wlan1
          status: disconnected, success
            ssid: MikroTik
     mac-address: E4:8D:8C:D6:E0:AC
      passphrase: presharedkey
  authentication: wpa2-psk
      encryption: aes-ccm
```

It is possible to specify additional settings for the WPS-Client command:

- create-profile - creates wireless security profile with the specified name, configures it with security details received from the WPS AP, specifies the wireless interface to use the new created security profile
- ssid - get WPS information only from AP with specified SSID
- mac-address - get WPS information only from AP with specified mac-address

Repeater

Wireless repeater will allow to receive the signal from the AP and repeat the signal using the same physical interface locally for connecting other clients. This will allow to extend the wireless service for the wireless clients. Wireless repeater function will configure the wireless interface to connect to the AP with station-bridge or station-pseudobridge option, create a virtual AP interface, create a bridge interface and add both (main and the virtual) interfaces to the bridge ports.

If your AP **supports button-enabled WPS** mode, you can use the automatic setup command:

```
/interface wireless setup-repeater wlan1
```

The setup-repeater does the following steps:

- searches for WPS AP with button pushed
- acquires SSID, key, channel from AP
- resets main master interface config (same as reset-configuration)
- removes all bridge ports that were added for virtual interfaces added to this master (so there are no dangling invalid bridge ports later)
- removes all virtual interfaces added to this master
- creates security profile with name "<interfacename>-<ssid>-repeater", if such security profile already exists does not create new, just updates settings
- configures master interface, interface mode is selected like this: if AP supports bridge mode, use station-bridge, else if AP supports WDS, use station-wds, else use station-pseudobridge
- creates virtual AP interface with same SSID and security profile as master
- if master interface is not in some bridge, creates new bridge interface and adds master interface to it
- adds virtual AP interface to the same bridge master interface is in.

If your AP **does not support WPS**, it is possible to specify the settings manually, using these parameters:

- **address** - MAC address of AP to setup repeater for (optional)
- **ssid** - SSID of AP to setup repeater for (optional)
- **passphrase** - key to use for AP - if this IS specified, command will just scan for AP and create security profile based on info in beacon and with this passphrase. If this IS NOT specified, command will do WPS to find out passphrase.

Roaming

Station Roaming

Station Roaming feature is available only for 802.11 wireless protocol and only for station modes. When RouterOS wireless client is connected to the AP using 802.11 wireless protocol it will periodically perform the background scan with specific time intervals. When the background scan will find an AP with better signal it will try to roam to that AP. The time intervals between the background scans will become shorter when the wireless signal becomes worse and the background scan interval will become longer when the wireless client signal will get better.

VLAN tagging

Sub-menu: `/interface wireless`

With VLAN tagging it is possible to separate Virtual AP traffic on Ethernet side of "locally forwarding" AP (the one on which wireless interfaces are bridged with Ethernet). This is necessary to separate e.g. "management" and "guest" network traffic of Ethernet side of APs.

VLAN is assigned for wireless interface and as a result all data coming from wireless gets tagged with this tag and only data with this tag will send out over wireless. This works for all wireless protocols except that on Nv2 there's no Virtual AP support.

You can configure your RADIUS authentication server to assign users or groups of users to a specific VLAN when they authenticate to the network. To use this option you will need to use RADIUS attributes.

Note: In case to use this option you must enable wireless-fp or wireless-cm2 package for RouterOS version up to 6.37. Starting from RouterOS v6.37 you can do that with regular wireless package.

Property	Description
vlan-mode (*no tag* | *user service tag* | *use tag*; Default: **no tag**)	Three VLAN modes are available: • *no-tag* - AP don't use VLAN tagging • *use-service-tag* - VLAN ID use 802.1ad tag type • *use-tag* - VLAN ID use 802.1q tag type
vlan-id (*integer [1..4095]*; Default: **1**)	VLAN identification number

Vlan tag override

Per-interface VLAN tag can be overridden on per-client basis by means of access-list and RADIUS attributes (for both - regular wireless and wireless controller).

This way traffic can be separated between wireless clients even on the same interface, but must be used with care - only "interface VLAN" broadcast /multicast traffic will be sent out. If working broadcast/multicast is necessary for other (overridden) VLANs as well, multicast-helper can be used for now (this changes every multicast packet to unicast and then it is only sent to clients with matching VLAN ids).

Winbox

Winbox is a small utility that allows the administration of Mikrotik RouterOS using a fast and simple GUI.

Note: Current Tx Power gives you information about transmit power currently used at specific data rate. Currently not supported for Atheros 802.11ac chips (e.g. QCA98xx).

Interworking Realms setting

For more information about interworking-profiles see the manual.

realms-raw - list of strings with hex values. Each string specifies contents of "NAI Realm Tuple", excluding "NAI Realm Data Field Length" field.

Each hex encoded string must consist of the following fields:

```
- NAI Realm Encoding (1 byte)
- NAI Realm Length (1 byte)
- NAI Realm (variable)
- EAP Method Count (1 byte)
- EAP Method Tuples (variable)
```

For example, value "00045465737401020d00" decodes as:

```
- NAI Realm Encoding: 0 (rfc4282)
- NAI Realm Length: 4
- NAI Realm: Test
- EAP Method Count: 1
- EAP Method Length: 2
- EAP Method Tuple: TLS, no EAP method parameters
```

Note, that setting "realms-raw=00045465737401020d00" produces the same advertisement contents as setting "realms=Test:eap-tls".

Refer to 802.11-2016, section 9.4.5.10 for full NAI Realm encoding.