Link Settings

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In the "Link Settings" section you can configure the parameters for the Radio interface, for the Pseudo Radio interface and for the Join function:

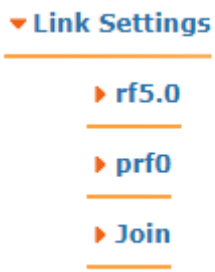


Figure - Link Settings section

The "Link Setting" section is consist from the following subsections:

"rf5.0" subsection

This subsection is used for:

- Radio link settings
- Frequency limitation
- Setting channel type mode

Radio link settings

Radio link settings depends from the installed firmware version ("*MINT*" or "*TDMA*"). In the "*MINT*" version Polling technology is used (marker access), in the "*TDMA*" - TDMA technology (time division access).

NOTE

For more detailed information about **TDMA** and **Polling** technologies, their benefits and applications please refer to the document "Application features of TDMA and Polling" - White paper via http://infinetwireless.com/products/materials#white-papers (free registration is required).

Radio link settings in the marker access networks (MINT firmware) allows using two modes of access to the environment:

- Marker access mode - Polling enabled.
- CSMA-CA mode (Carrier-sense multiple access with collision avoidance) - Polling disabled.

Title

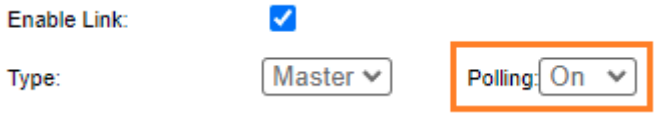


Figure - Polling configuration

The marker access mode (Polling technology) can be enabled on the **Master** node.

Radio link configuration in networks with time division (**TDMA** technology) involves setting parameters related to the frame duration and the uplink/downlink ratio.

"rf5.0" subsection is divided in two zones:

- The panel that describes global link settings, in the left side of the page
- The panel that describes the radio channel settings which are currently in use, in the right side of the page.

Title

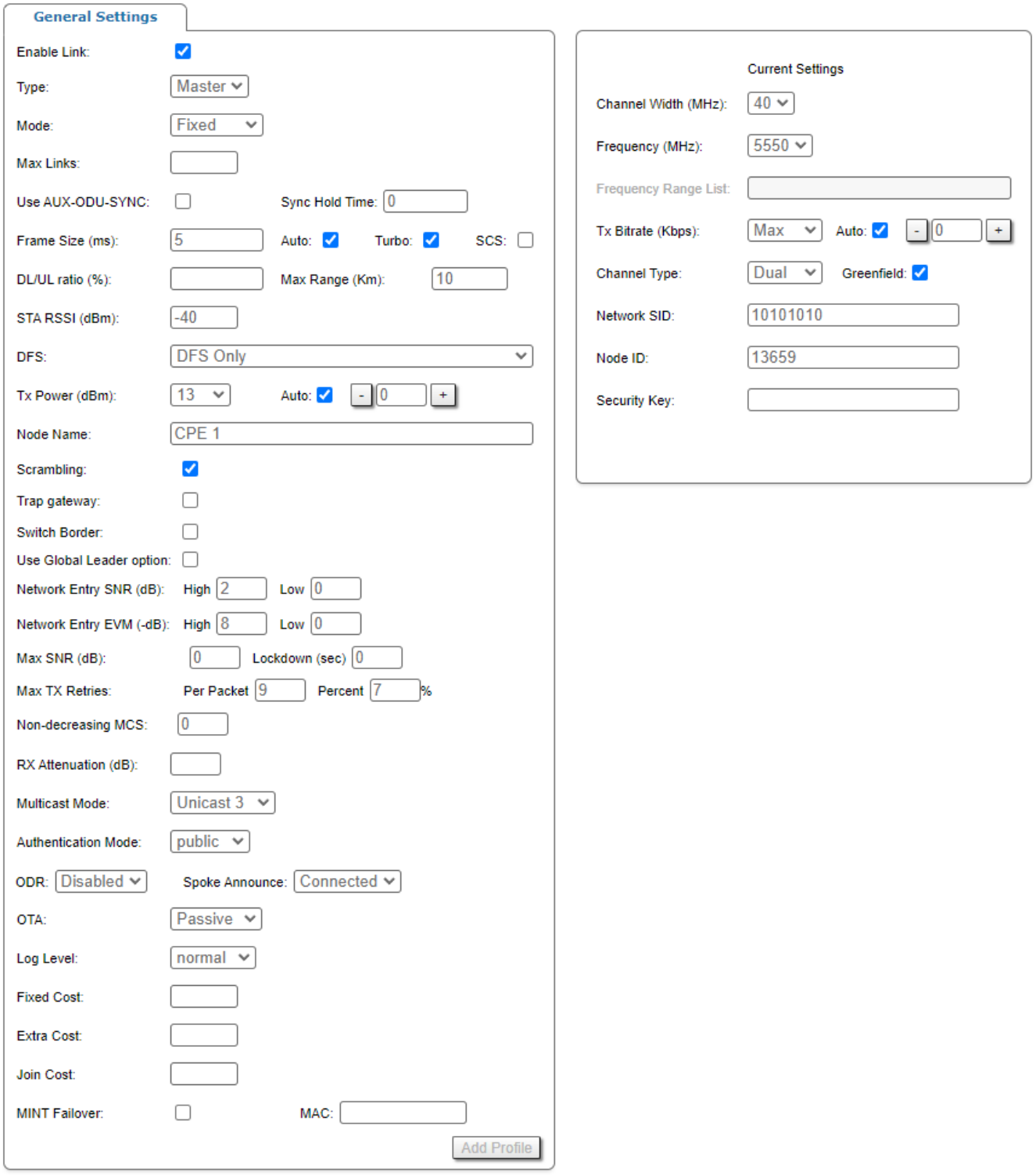


Figure - Master node configuration

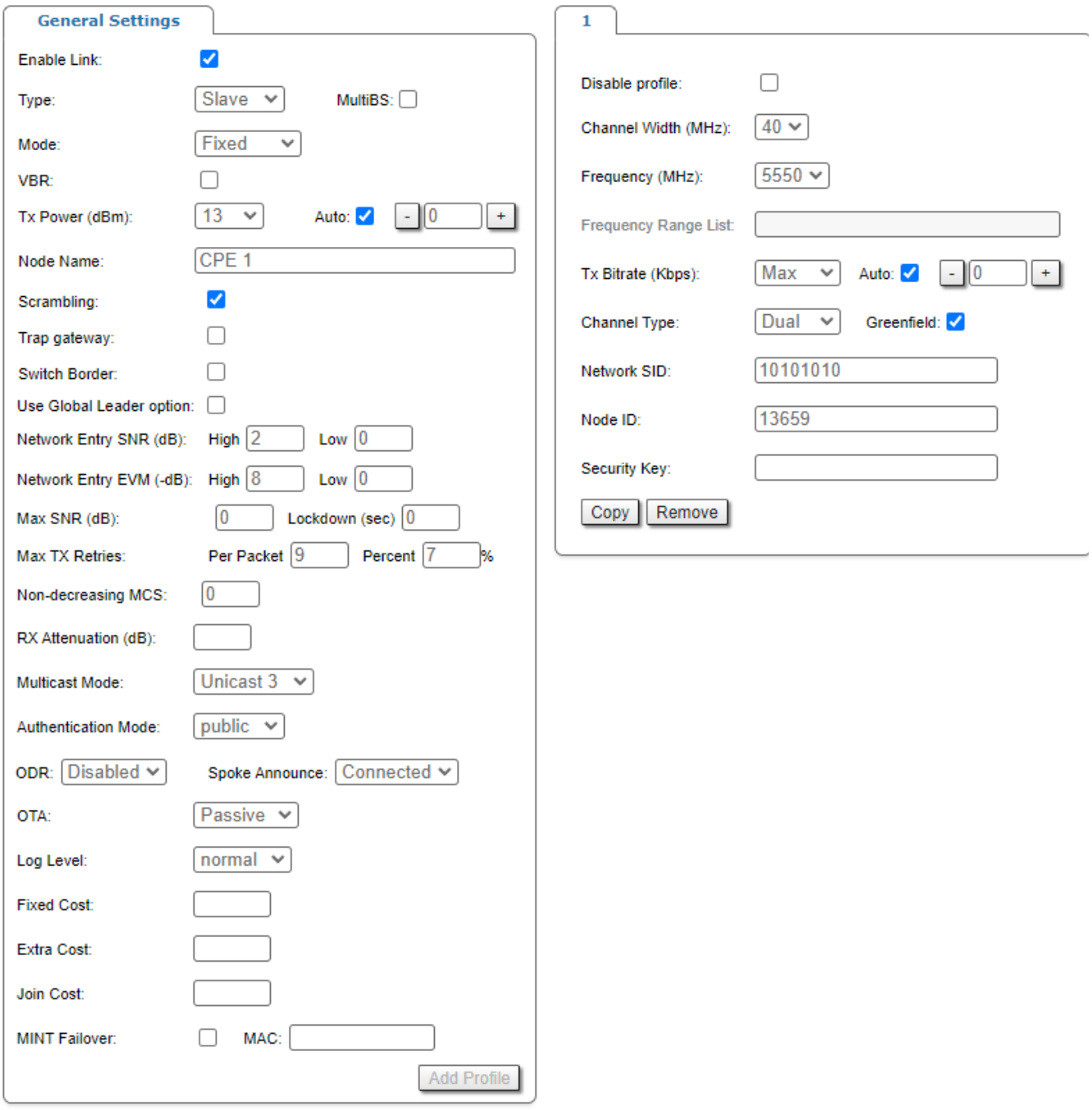


Figure - Slave node configuration

Parameter	Description
General Settings	
Enable link	• Enable/disable wireless link (enabled by default)

Title

Type	• Set the node type to Master or Slave
	  • **Master**: can establish connections with all other types of nodes. It is able to form a network of any topology with other master nodes. A master node is usually used in the configuration of the both sides of the PtP links and in the configuration of the BS for the PtMP links
	  • **Slave**: can only connect to master type nodes (the connection cannot be established between two slave nodes). A slave node is usually used in the configuration of the CPE.

Polling
 	
(Master, MINT firmware only)
	• Set the polling mode:
	  • *"Off"* - Polling is disabled, CSMA-CA technology is used.
	  • *"On"* - unit operates in "Polling Master" mode.
	  • *"QoS"* - polling operates taking into account the traffic priority for uplink.
	• It is strongly recommended to keep Polling on at all times to maximize the link performance
	• Polling is especially required for PtMP systems and long haul PtP links.
	• Can be enabled on master node only.

MultiBS (Slave)	• Enabled: when the link parameters deteriorate, the CPE will disconnect from the current base station and try to find the sector with the best parameters values • Disabled: the CPE will keep the connection with a current base station until the signal is completely lost • It is available for Slave node only
VBR (Slave)	• The mode at which the service information is carried out at above a minimum bitrate (if possible)
Radar Detection (Slave)	• Enable/disable "*Radar Detection*" features (a special license with the country code is necessary) • The DFS system performs radar detection and if a radar signal is detected, that frequency is marked as occupied and it can be used again only after a hold-down interval (the link is switched automatically to another frequency)
Max Links (Master)	• Maximum allowed number of connected CPEs (in the case of radio connection) . When this value is reached, other attempts to connect to the base station will be rejected
Use AUX-ODU-SYNC (Master, TDMA firmware only)	• Enable/disable external synchronization unit, in seconds **NOTE** Information about AUX-ODU-SYNC connection is described in the section "Connection to the synchronization unit".
Sync Hold Time (Master, TDMA firmware only)	• Standalone downtime in case of external synchronization unit disable. Value "0" (zero) disables this parameter control, command to work always is set • In case of external synchronization unit disable, the devices can synchronously work for some time using own clock signal generator. However, eventually, because of generators frequencies mismatch, the time discrepancy can reach unacceptable values and devices will begin to interfere with each other. In this case, through fixed time the device will stop the transmitter and will stop operation of TDMA until synchronization unit enable

Frame Size
 	
(Master, TDMA firmware only)
	• Set the time slot duration (in milliseconds)
	  • Consists of transfer time, reception time and guard intervals
	  • The range is from 0.5 to 10 ms in increments of 0.1 ms
	  • The recommended values for links PtP at the balanced channel depending on channel width: 2-2,5 ms for 40 MHz, 2-4 ms for 20 MHz, 3-5 ms for 10 MHz, >5 ms for 5 MHz
	  • The recommended values for links PtMP depending on channel width: 5 ms for 20 and 40 MHz

Auto (Master, TDMA firmware only)	• This option works only for links "PtP" and allows to reduce the window size and a delay at absence or a small amount of traffic. Automatically selects the frame size
Turbo (Master, TDMA firmware only)	• Increase the throughput in case of link degradation due to errors in the radio. The sliding window of the ARQ algorithm are extended from three to five frames, which increases its efficiency.
SCS (Master, TDMA firmware only)	• In case of retries, increase throughput and reduce latency. • In this mode, ACKs are sent in the same frame as the transmitted data, thus it is most effective in point-to-point mode.

DL/UL ratio (%)
 	
(Master, TDMA firmware only)
	• Set the DL percentage of the time slot
	  • The range is from 5 to 95% in increments of 1%
	  • The empty field enables the mode of flexible DL/UL ratio adjustment depending on traffic load
	• Real accepted values depend on the used bandwidth, the frame size and the used modulations. To determine the established value acceptability it is necessary to control parameters (*Tx Time Limit/Rx Time Limit*) in radio interface statistics. Any of these parameters shall not be less than zero. In the PtMP system with a large number of clients, the ratio of real throughput in this or other way does not match the established DL/UL value. Uplink performance will always be less, because of big overheads of the uplink traffic servicing. In case of a large number of clients value more than 65% practically do not lead to throughput increase in Downlink. Rated speed in Uplink and Downlink (Rx Cap/Tx Cap) is reached only in case of sector full and balanced load by all clients

Max Distance (Km)
 	
(Master, TDMA firmware only)
	• Set the maximum operational distance (in kilometers)
	  • Has an impact on guard intervals duration
	  • The range is from 1 to 100 km in increments of 1 km
	• It allows the system to calculate signal propagation time to the furthest subscriber and value of the guard interval between transmission and receiving phases. It is recommended to set 3-5 km more than really measured distance. In case of LOS condition violation or with a large number of reflections larger value as 10-20 km can be required

STA RSSI (dBm) (Master)	• Set the target power of received radio signal from **Slave** node at the input of **Master** node • The range is from -90 to -20 dBm in increments of 1 • It allows to reduce the radiation influence from the subscriber units to the neighbor sector due to insufficient suppression of the antenna pattern back lobe • To achieve maximum TDMA network performance it is important to obtain the highest possible signal level and modulation (bitrates), so transmitter power reducing is a necessary measure. If possible, it is better to try to reduce the impact of clients on neighbor sector (and vice versa), organizational measures (shielding, antennas diversity, etc.)
DFS (Master)	• Enable/disable DFS • If "*DFS only*" is set, the DFS system monitors interferences but does not perform radar detection • If "*DFS with Radar Detection*" is set, the DFS system monitors interferences and performs radar detection • For the two radios base stations, the "*Instant DFS*" option is available (one of the two radios is used for DFS scanning, Radar detection and Spectrum analyzing) **CAUTION** Please note that, in some countries, switching "DFS off" and/or failing to detect public service radar signals are against the regulations and may result in legal action.

Tx Power	• Set the output power of the radio interface • Acts as a top limit for the output power control if the ATPC mechanism is turned on • By default, it is turned on (it is strongly recommended to remains “on”) • The offset parameter is used to adjust the thresholds
Node Name	• Set the name for this node in the network • By default, it is the "*Unknown*" node • This node name will appear on the neighbor lists
Scrambling	• Enable/disable the data scrambling to improve the connection stability (enabled by default)
Trap gateway	• Enable/disable gateway for SNMP-traps
Switch border	• Enable/disable the switch border mode. In this mode the unit operates as a "borderline" between the MINT domains, i.e. prevents the distribution of information about the switch groups and data transfer between these domains, while retaining all the capabilities of the MINT protocol (obtaining information about the whole MINT network, sending remote commands etc.)
Use Global Leader option	• When enabled on the Master, sets it as the global leader node of the MINT network. • If enable on Slave, device should search and connect only to a network which has one or more global roaming leaders. • It helps to prevent the creation of locally closed segments that are separated from the main network. • Any MINT device (including InfiMUX) that has direct access from the control center or has access to the Internet can be assigned as a leader.
Network Entry SNR (dB)	• "*low*" - this option sets the minimal signal level for the neighbor. Signal level is measured in dB above the noise threshold for the current bitrate. If the level gets lower than specified value the connection with a neighbor will be lost. • "*high*" - this option sets the minimal SNR for a new neighbor. Signal level is measured in dB above the noise threshold for the current bitrate. If neighbor’s signal level is equal or higher than a specified value the node will consider this neighbor to be a candidate
Network Entry EVM (dB)	• "*high*" - sets the minimal EVM for a new neighbor. Signal quality is measured in dB. If neighbor’s EVM level is equal or higher than a specified value the node will consider this neighbor to be a candidate. Value by defaut is 8. • "*low*" - sets the minimal EVM level for the neighbor. Signal quality is measured in dB. If EVM gets lower than specified value the connection with a neighbor will be lost. Value by defaut is 0.
Max SNR (dB)	Limits the maximum signal level, preventing devices connection. If the SNR level of an already connected neighbor is exceeded, the connection will be terminated. • *Lockdown* – blocks attempts to connect from a device whose signal level has exceeded the limit for a specified time in seconds.
Max TX Retries	• Per Packet – sets the maximum number of packets retries at which the system lowers the modulation, 9 by default. • Percent – sets the percentage of retries at which the system lowers the modulation, 7 by default.
Non-decreasing MCS	• Allows to influence autobitrate mechanism in the following way: it sets upper bitrate index threshold below which errors and retries checks are not performed, just energetic ability to upper bitrate is taken into consideration. • Bitrate indexes are from 1 to 8 and correspond with bitrates available on the device’s radio interface (bitrate list is available in the "Current settings" part). • The "0" value cancels the limitation.

RX Attenuation	• The noise level measured by the radio module is calculated as the minimum received signal level (RSSI) in a certain period • The "*RX Attenuation*" parameter allows manually raise noise threshold on several dB. In this case the radio module won't react to signals below the established threshold. In certain cases it gives the ability to be protected from the low signals interferences which disrupt the radio module as a result of capture effect. This effect is expressed in the fact that the radio module having captured the low signal from the foreign source, tries to strengthen it and to accept completely ignoring a strong signal from the client which has appeared later • This parameter allows to protect the receiver from the powerful signal source overload

Multicast Mode
 	
(Master)
	• Traffic transmission mode:
	  • "*Multicast*" - conventional mode that uses modulation one step lower than the lowest modulation among the traffic receivers when transmitting the "*multicast/broadcast*" frames. In the case of "*multicast*" streams information from "*IGMP Snooping*" module is used to obtain a list of subscribers. Consequently, the list of all connected sector clients is used for the "*broadcast*" traffic.
	  • Transformation of "*Multicast*" to "*Unicast*". In case two or more clients are assigned to the same "*multicast*" stream a copy of source stream will be sent to each of them in the "*Unicast*" mode.
	  • "*Unicast 2", "Unicast 3", "Unicast 4", "Unicast 5"* - the number of subscribers limitation. Conventional "*Multicast*" mode will be used when the number is exceeded.
	  • "*Unicast All*" - transformation is always executed.
	
	Transformation to "*Unicast*" requires memory data copying that increases CPU load. Besides, the use of "*Unicast*" streams increases the volume of transmitted traffic proportional to the number of subscribers and reduces the sector available throughput.
	
	NOTE
	"*Unicast 3*" mode is set by default.
	
	NOTE
	Transformation of "*Multicast*" to "*Unicast*" via CLI is described in the section "mint command".

Authentication Mode	• Set the mode:
	  • *"static"* - the unit can establish connections only with units, which MAC-addresses are listed in the "Static Links" section
	  • *public* - the unit can establish connections with any other units which have the same security key and the corresponding wireless connection settings
	  • "*remote*" - centralized authentication mode with remote server (e.g. RADIUS or relay). In this mode any node can request the information from a remote authentication server (remote authentication server parameters are set using "*AAA*" command). This means that the node must have an access to this server (e.g. using IP)

ODR	Activate routing using the ODR protocol. The following modes are available: • "Disable" - routing using ODR is not performed. • "Hub" - the device acts as a central node. • "Spoke" - the device acts as a peripheral node. The main advantage of ODR protocol is a network throughput efficient use. Part of the link throughput is usually used by the routing protocol to transmit service information, this part can be released by ODR using. The ODR protocol transmits the hosts IP prefixes using the MINT protocol at the data link layer. The ODR protocol can only be used in networks with star topology, where all nodes are connected to the central node only. An example of such a network is a point-to-multipoint topology, where each subscriber is connected only to a base station. The "Spoke Announce" parameter allows to select the type of notifications sent by the spoke node to the hub: • "connected" – allows announcing IP addresses/networks set on the spoke's own interfaces. • "kernel" – allows announcing static routes. • "full" – allows announcing both types of routes. • "none" – forbides all announcement.

OTA	Automatic updates in the MINT domain may be configured in the following modes: • “Disabled” - the device does not check if other devices in the MINT domain have a newer software versions. • "Passive" - in case a newer software version is detected on one of the neighboring nodes, the device requests and updates the software. The device does not announce own software version. • "Active" - the device announces its software version in the MINT domain, making it available to download by other nodes.

Log Level	• Set the log level:
	  • *off*
	  • *normal*
	  • *detailed*

Fixed Cost	• Allows to set fixed cost value to all routes passing through this interface • The device will select the route with the lower cost, if any
Extra Cost	• Allows to add additional cost value to all routes passing through this interface
Join Cost	• Allows to add additional cost value to all routes passing through interfaces that are joined to this interface by the join option
MINT Failover	• Activate the failover function on this interface. For more information about this function proceed to the article "Link aggregation, balancing and redundancy" • If the MAC address of a neighbor is specified, then the device will monitor the availability of this address. If the MAC field remains empty - the neighbor's address will be determined automatically
Current Settings	
Channel Width	• Set the bandwidth of the radio interface in MHz • It must be the same at both ends of the link
Frequency	• Set the radio interface frequency (in MHz) • It must be the same at both ends of the link • If it is set to “*Auto*”, the Slave node is scanning on all frequencies for the Master nodes
Frequency Range List	• Set the frequencies that are allowed to be chosen by the DFS mechanism (available only when the DFS system is enabled) • It is available to support the legacy products • Note that this option is different from the "*Customer Frequency Grid*" tool which allows narrowing down the frequency range available in the "*Frequency*" option from the Radio profile
Tx Bitrate	• Set the maximum operating bitrate of the radio interface (from 13000 to 300000 Kbps) • Acts as a top limit for the bitrate if the Autobitrate mechanism is turned on • By default, it is turned on (it is strongly recommended to remain “on”) • Adjust the Autobitrate system thresholds when the remote SNR doesn’t have the normal level

Channel Type	• The channel type can be set as:
	  • Dual: enables MIMO operational mode with different Tx and Rx data streams (recommended)
	  • Single: allows to operate as MIMO with duplicate Tx streams, MISO or SISO depending on the Tx/Rx chain configuration (description below)
	• Infinet MIMO 2x2 technology effectively doubles the spectrum efficiency and allows to achieve a real throughput up to 280 Mbps in 40 MHz band

Greenfield	• Enable/disable the "*Greenfield*" mode • When activated, the "*Greenfield*" mode increases the link performance by 10-15%, by reducing the packet overhead (optimizes the frames transmitted via the RF link) • "*Greenfield*" mode must be enabled at both ends of the link (the wireless link does not establish if "*Greenfield*" mode is enabled at one end of the link and disabled at the other end of the link)
Network SID	• Set the network system identifier (up to 8-digit HEX figure) • It must be the same at both ends of the link
Node ID	• Set the device identification number • The parameter is optional • Node ID can be configured by the administrator for a better representation of a neighbors table (nodes within a wireless network)
Security Key	• Set the secret key word for encoding of the protocol messages • It must be up to 64 characters long, without spaces • It must be the same at both ends of the link

Table - Radio settings parameters in the time division networks

On each radio profile, the following options are available (for the **Slave** unit only):

- "**Disable profile**" check box disable a radio profile
- Add a new radio profile by clicking the «**Add Profile**» button
- Copy the radio profile values to a new radio profile by clicking the «**Copy**» button
- Remove the radio profile by clicking the «**Remove**» button.

It is suitable to configure radio profiles for the Slave units (with complete radio parameters of each BS) in a PtMP deployment when the CPEs can be linked to more than one BS either in fixed, nomadic or mobile situations, for the redundancy purpose (different profile for each BS). When the CPE tries to establish a wireless connection, it chooses the BS with the best link quality (determined by the RSSI, SNR, bitrate, number of errors, number of retries, etc.). If the connected BS is down, the CPE retries to connect to it once and in case of failure, it looks for a new BS to connect, if the SNR allows it and if one of its radio profiles matches with the radio parameters of the new BS (in case of "MultiBS" option disabled)

Software with TDMA technology support ensure more faster base station search. When the CPE tries to establish a wireless connection, it chooses the BS with the best link quality (determined by the RSSI, SNR, bitrate, number of errors, number of retries, etc.). If the connected BS is down, the CPE doesn't try reconnect, but evaluate the signal parameters of all available base stations sectors.

The frequency roaming feature (which is enabled in the default configuration) allows the CPE with auto frequency set (roaming enable) to:

- Automatically switch from the main BS (roaming leader) to the backup BS (if it is provisioned with the radio profiles of both BSs)
- Automatically switch between different BSs while the CPE is moving (if it is provisioned with the radio profiles of the BSs)
- Automatically switch to the new frequency of the BS in case the current frequency was changed by the BS.

Data traffic is not interrupted during frequency roaming.

NOTE

In case of first TDMA firmware installation (instead of polling), the system automatically will starts the **Master** TDMA mode, which works in the **Master** Polling mode (*mint pollstart*) with the parameters "*win = 5, dist = 70, dlp = 50, rssi = -20*". These settings are not optimal for most networks, but allow to recover quickly network functioning at the first start. All other devices will be launched in the **Slave** TDMA mode. It gives the opportunity to transfer already operating network to TDMA. At first it is necessary to update firmware on **Slave** devices and reboot them. Then to update the firmware on the base station.

NOTE

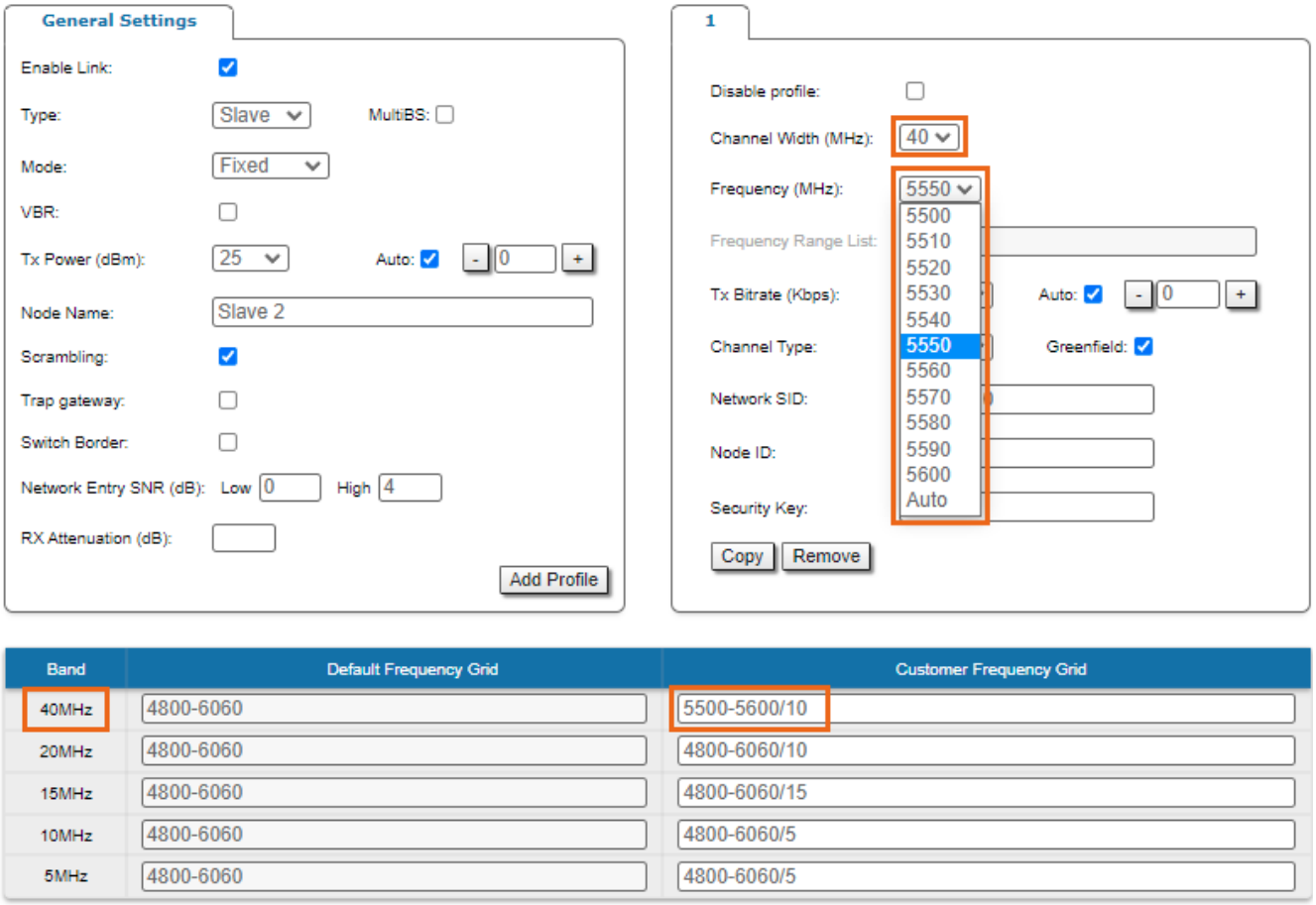
Read the information in the section "Apply, Try and Preview buttons for the configuration" in order to find out the output of the «**Apply**», «**Test**», «**Preview**» and «**Show changes**» buttons for the new configuration performed.

Frequency limitation

The licensed frequencies range per each bandwidth is displayed in the "rf5.0" subsection, in "*Default Frequency Grid*" fields. Changes to these default values can be performed in the "*Customer Frequency Grid*" fields; you can:

- Limit the licensed frequencies range per each Channel width (see the screenshot below)
- Change the center frequency step (for example: 4915-5945/5 means that the step between the center frequencies from 4915 GHz and 5945 GHz is 5MHz).

The changes performed in "*Customer Frequency Grid*" will be available in the "*Frequency*" drop down list from the radio profiles and in DFS page in "*Frequency grid* " field.



Band	Default Frequency Grid	Customer Frequency Grid
40MHz	4800-6060	5500-5600/10
20MHz	4800-6060	4800-6060/10
15MHz	4800-6060	4800-6060/15
10MHz	4800-6060	4800-6060/5
5MHz	4800-6060	4800-6060/5

Figure - Customer frequency grid

Setting channel type mode

When Channel Type is set to "*Single*", then *Tx* and/or *Rx of Chain #1* (for horizontal polarization antenna) can be deactivated:

- "Chain #0" is connected to the port of the vertical polarized integrated antenna
- "Chain #1" is connected to the port of the horizontal polarized integrated antenna

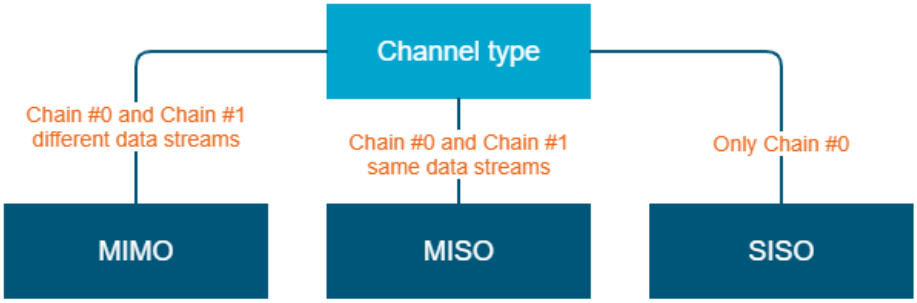


Figure - Configuration options

If the "Single" mode is selected when, then "Chain #1" column (horizontal polarization) can be disabled for transmission (TX) and / or reception (RX):

Figure - Chain #

> **NOTE**
>
> MIMO, MISO and SISO are defined from the perspective of the data sent by the local unit (not considering the number of physical antennas used for tx and rx like in the classical definition). Therefore, these represent local configuration options. For example, one stream of data can be sent by one chain (1 antenna) corresponding to SISO or the same stream can be sent by both chains (2 antennas) corresponding to MISO.

Settings for "MIMO" mode

Different data streams are transmitted over "Chain #0" and "Chain #1". MIMO uses multiple antennas at both the transmitter and receiver side to improve communication performance and data is sent on both the horizontal and vertical polarizations (data is space-time coded - spatial multiplexing, to improve the reliability of data transmission):

Channel Type	Dual	
Radio Chain	#0	#1
Rx	Activated	Activated
Tx	Activated	Activated

Table - Settings for MIMO mode

Settings for "MISO" mode

The same data streams are transmitted over "Chain #0" and "Chain #1", lowering the performance of the link, but enhancing the ability to transmit data in case of interference or obstacles in transmission path (a special mode of operation of MIMO devices used in NLOS conditions or in a noisy RF environment):

Channel Type	Single	
Radio Chain	#0	#1
Rx	Activated	Activated

Tx	Activated	Activated

Table - Settings for MISO mode

Settings for "SISO" mode

The data streams are transmitted over Chain #0 (corresponding to vertical polarization) only, lowering the performance of the link, but increasing the link distance (transmitter operates with one antenna as does the receiver; there is no diversity and no additional processing for recomposing the Rx signal):

Channel Type	Single	
Radio Chain	#0	#1
Rx	Activated	Deactivated
Tx	Activated	Deactivated

Table - Settings for SISO mode

The picture below summarizes the link establishment between two units that are configured in different operational modes. As it can be noticed, only the combination MIMO – SISO is not functional.

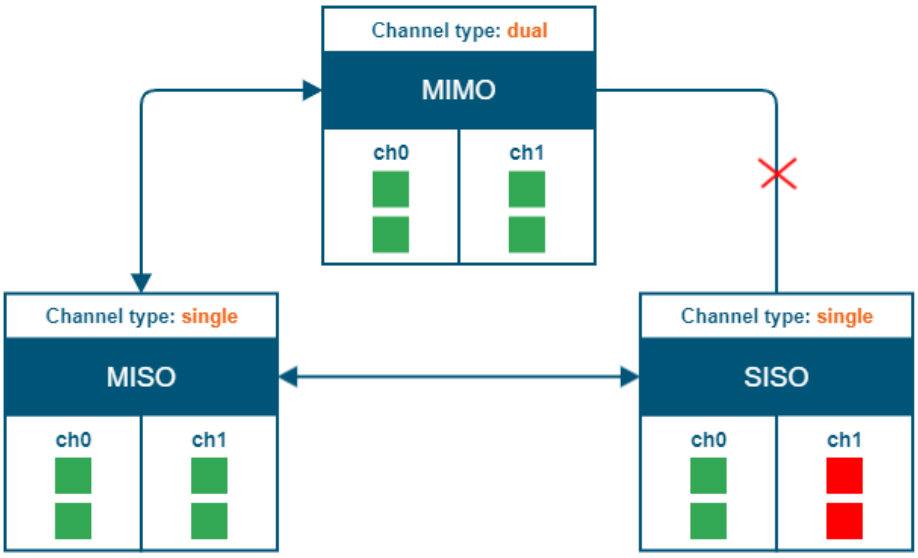


Figure - Radio link establishment

"prf" subsection

In the "prf" subsection, you can configure the pseudo-RF link as a MINT network node. The "prf" subsection is available for configurations only after at least one pseudo-RF interface has been created in "Network Settings" section. Pseudo-RF virtual interface is used to provide MINT-over-Ethernet.
Every BS or CPE supports PRF interfaces. All parameters available in "prf" subsection are explained in "rf5.0" subsection above:

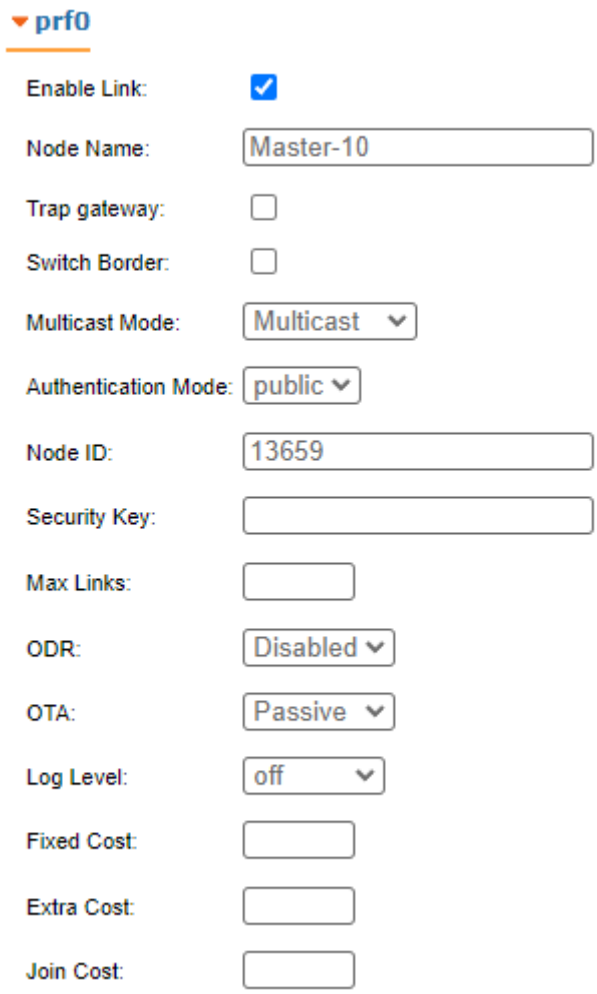


Figure - PRF settings

"Join" subsection

In the "Join" subsection, you can link two or more radio/pseudo-RF interfaces of one unit into one MINT domain. Each of these interfaces may act as an independent MINT network node. The "Join" subsection is available for configurations only after at least one pseudo-RF interface has been created in "Network Settings" section.

In order to join the interfaces, simply enable the check boxes of the corresponding interfaces, as shown in the screenshot below:

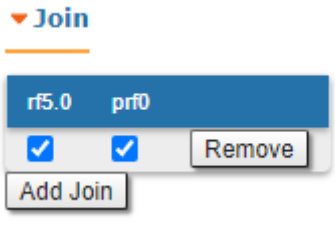


Figure - «Remove» and «Add Join» buttons