Title

The wireless link throughput is lower than expected

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Performance tests

Web interface

The throughput test can be performed with the "Performance Tests" tool built into the web interface, in the section "Device status" → "Link statistics for the rf5.0 interface". This tool generates test traffic between the devices and it allows to obtain data about the real link throughput both in one direction and in a two-way manner. The throughput evaluation is performed using traffic with the specified priority without taking into account the service traffic required to maintain the link operational. To exclude the influence of the data traffic on the test's result, it is recommended to set the highest priority for the test traffic (at least 15). When the MINT testing mode is enabled (the "use MINT" checkbox), performance tests are always performed on the highest modulation, otherwise testing will be performed on each modulation available. The detailed description of the parameters and the performance test settings are available in the "Device Status menu" article.

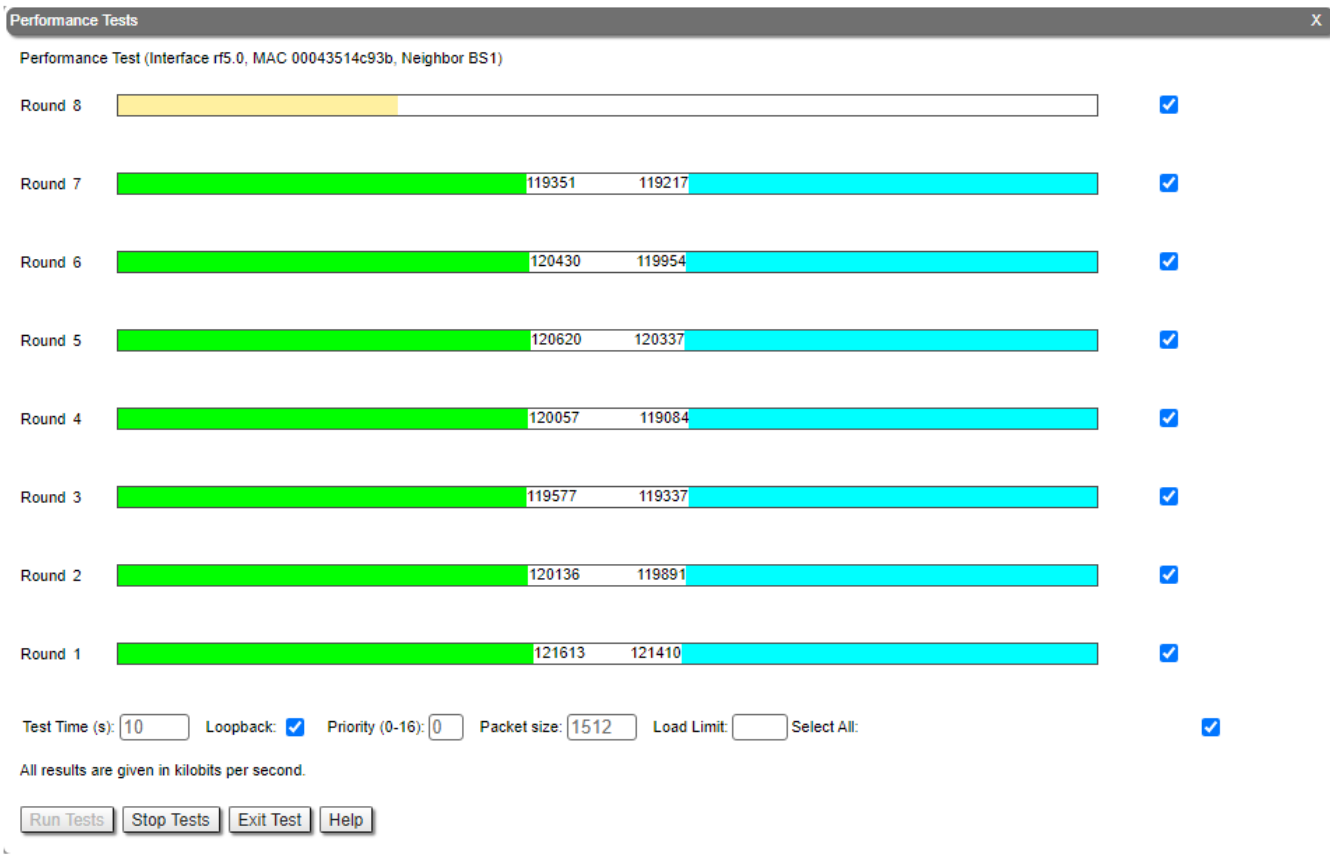


Figure - Performance tests

Command line interface

When using the command line interface to manage the device, it is possible to test the radio link via the "*ltest*" command.

Wireless link status

Link statistics on the rf5.0 interface

Web interface

To evaluate the quality of the wireless connection with the neighboring device, use the color indication in the "Status" column of the "Link statistics on rf5.0" subsection:

- Red: bad connection.
- Yellow: good connection.
- Green: perfect connection.

The following symbols indicate problems:

- In the wireless connection uptime column:
  - F - the local device has a newer software version than the remote device.
  - E - the Ethernet port of the remote device is flapping.
- In the TX power column:
  - * - hardware device failure.
- In the RSSI column (only for software versions with TDMA support):
  - * - significant difference in the signal power between the vertical and horizontal polarizations.

Make sure that the "TX Power" and "Bitrate" parameters match with the values of the planning phase. In the "Link statistics on rf5.0" of the "Device status" section, pay attention to the wireless connection parameters. The main parameters are the retries number and the bitrate. It is not recommended to use the link with a retries number exceeding 5%. The actual bitrate (modulation level) depends on the SNR parameter - the signal-to-noise ratio. The highest modulations are available at SNR values of 27-50 dB.

For detailed description of the link parameters proceed to the "Device Status menu" article.

Command line interface

To display information about the wireless link status via the command line interface, use the "mint rf5.0 map detail" command.

```
LINAR3#console>mint rf5.0 map detail

================================================================================
Interface rf5.0  TDS
Node  00043523FA96  "Slave", Id 60758, Nid 0, (Slave)
Freq 5550, Band 40, Sid 10101010, autoBitrate 300000 (min 30000), Noise -87

 ------- ---------------------------- ------------ -----  ------- ----- -------
   Id         Name                        Node      SNR   Bitrate Retry Options
 ------------------------------------ ------------ rx/tx   rx/tx  rx/tx -------
   13659 LINAR                       00043514C93B 45/45  300/300  0/0  /TM/F
         load 5/3, pps 4/0, cost 51
          pwr 10/10, rssi -39/-46, thr 22/23
          dist 0.02, evm -28/-29
          H08v2.1.25, up 00:00:21, IP=192.168.103.82
 ------- ---------------------------- ------------ -----  ------- ----- -------
 1 active neighbors
 Total load: 3/3 (rx/tx), 6 (sum) Kbps
 Point-To-Point mode
 Total nodes in area: 2
```

Command: mint rf5.0 map detail

Execute Clear All Fields

Figure - The "mint rf5.0 map detail" command output

Pay attention to the indicators in the "Options" column. The following values are possible:

- M - Master device;
- S - Slave device;
- TM - Master device with software having support for the TDMA technology;
- P - polling mode is enabled;
- L - the throughput is limited by license;
- F - the software version is older than the one on the local device.

A question mark in front of the remote's device name indicates that it has no password.

Pay attention to the "*" symbol, which can represent the following:

- At the "pwr" column - hardware device failure.
- At the "rssi" column (only for software with TDMA technology support) - significant difference between the signal power of the vertical and horizontal polarizations.

Radio statistics

Web interface

In case of a high retries level, use the built-in statistics tools. The "General statistics" section contains information about the link load, queue overflow, etc..

Radio Interface statistics X

RF rf5.0 status	UP (band 40, freq 4900) :ACTIVE
DFS status	DFSONLY (mode STA)
TDMA status	Slave

Receive statistics		Transmit statistics	
Broadcast Rate	30000	Voice Mode	OFF
Bytes Received	94270	Bytes Transmitted	0
Frames Received OK	657	Frames Transmitted OK	0
Multicast Frames	0	Multicast Frames	0
Load (kbps)	0	Load (kbps)	0
Load (pps)	0	Load (pps)	0
Frame size (bytes)	0	Frame size (bytes)	0
RX Medium Load	1.7%	TX Medium Load	0.0%
Total Medium Busy	1.5%	Frame Time Used	0.0%
Duplicate Received	0	Too Short/Long Frame	0 / 0
Lost frames	0	Aggr Subframe Retries	0
Rx Collision	0	Aggr Full Retries	0
FIFO Overrun	0	FIFO Underrun	0
CRC Errors	0	Excessive Retries	0
Noise Floor	-94	Max aggr frames	0
Rx Subslots/Nodes	1 / 0	Max aggr bytes	0
Scrambled frames	0	Scrambled frames	0
Scramble errors	0	Tx queue overflow	0
Rx Cap (Mbps)	0	Tx Cap (Mbps)	0

Close Reset Auto Refresh:

Figure - General statistics

Pay attention to the following indicators:

- "Lost Frames" - the number of frames that were not received by the device, even after retrying.
- "Duplicates Received" - the number of frames that were received several times because the other side did not receive an acknowledgment of the frame.
- "Aggr Subframe Retries" and "Aggr Full Retries" - the number of frames that the device has sent several times because the other side did not acknowledge the receipt.
- "Excessive Retries" - the number of frames that failed to to be sent after all the retry attempts.

Command line interface

To display statistics via the command line interface, use the ""*rfconfig stat*" command.

QoS statistics

Web interface

The "QoS statistics" section provides information about the transmitted and dropped packets in each priority queue configured on the device. Drops present in the traffic processing queues indicate that the throughput threshold has been exceeded. Losses in queue q00 (P16) are acceptable because this queue contains performance test data.

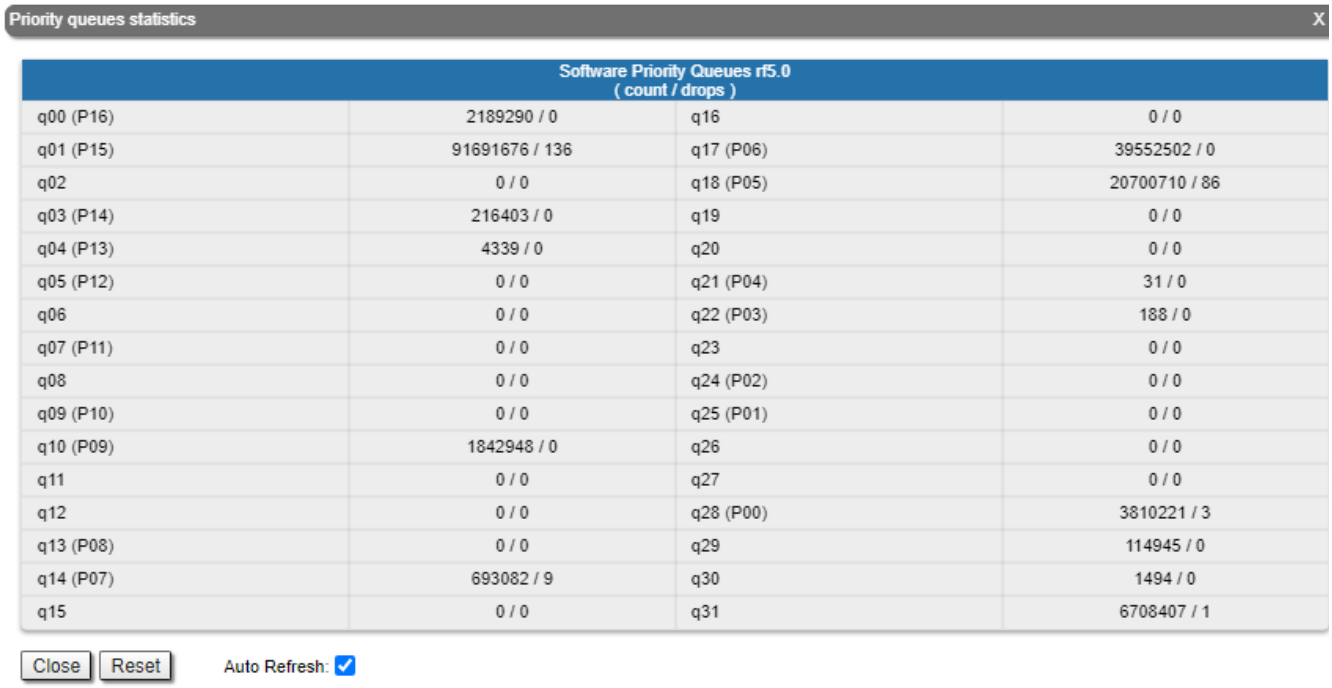


Figure - QoS statistics

Command line interface

To display statistic via the command line interface, use the "*rfconfig rf5.0 stat qos*" command. The number of dropped packets for each configured queue can be displayed by the "*qm stat*" command.

Statistics graphs

If the link has deteriorated during its operation, having the initial parameters corresponding to the calculated ones, it is necessary to find out when the problem has occured. Use the "Statistics graphs" tool to determine when or how often the problem occurs by changing the display options.

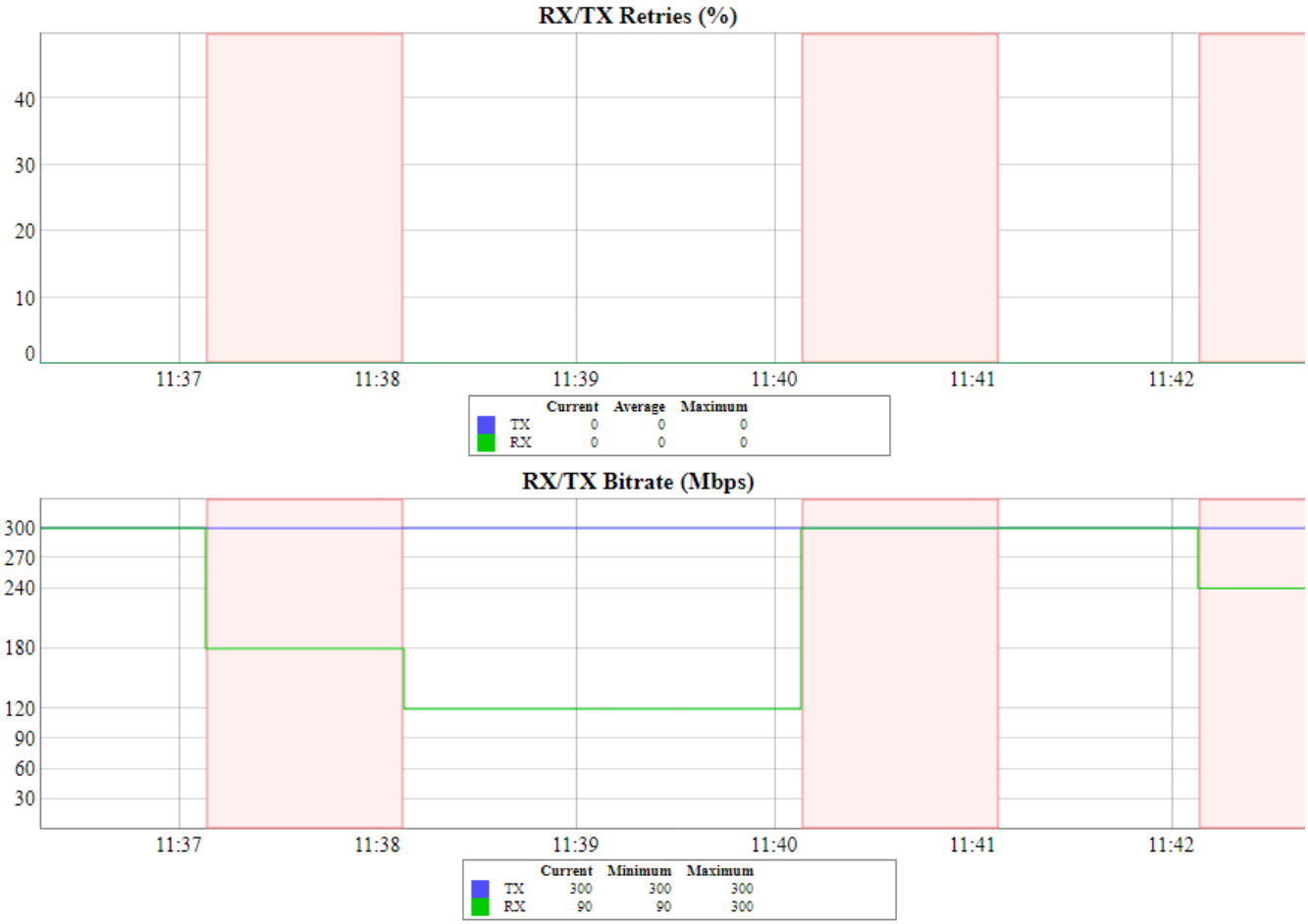


Figure - Statistics graphs

Device status

Pay attention to the CPU and memory usage indicators in the "Device status" section. Excessive processes running on a device can overflow the volatile memory and overload the CPU (over 95% usage), leading to a deterioration in the wireless link's quality. The CPU load can be displayed using the "*system cpu*" command an d information about the device's memory state can be shown using the "*mem*" command.

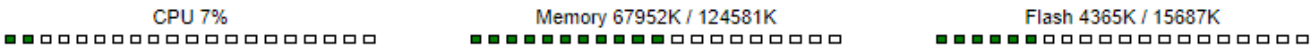


Figure - CPU and memory usage

Last reboot reason

Disruptions in the wireless link may be caused by the reboot of the device. In the "Maintenance" section or in the "*system uptime*" command output pay attention to the last device reboot reason. The following values are possible:

- "*Software fault*".
- "*Unexpected restart*".
- "*Manual restart*".
- "*Manual delayed restart*".
- "*Firmware upgrade*".
- "*SNMP managed restart*".
- "*Test firmware loaded*".
- "*Power-on reset*".

System log

Proceed to the System Log tool in the "Device status" section or by using the "*system log*" command. Using the log entries, check if the link degradation was caused by a configuration change ("system reconfiguration" message). Restore the previous version of the configuration if necessary. Detailed information about saving and uploading the configuration is available in the "General Purpose Command Set" article.

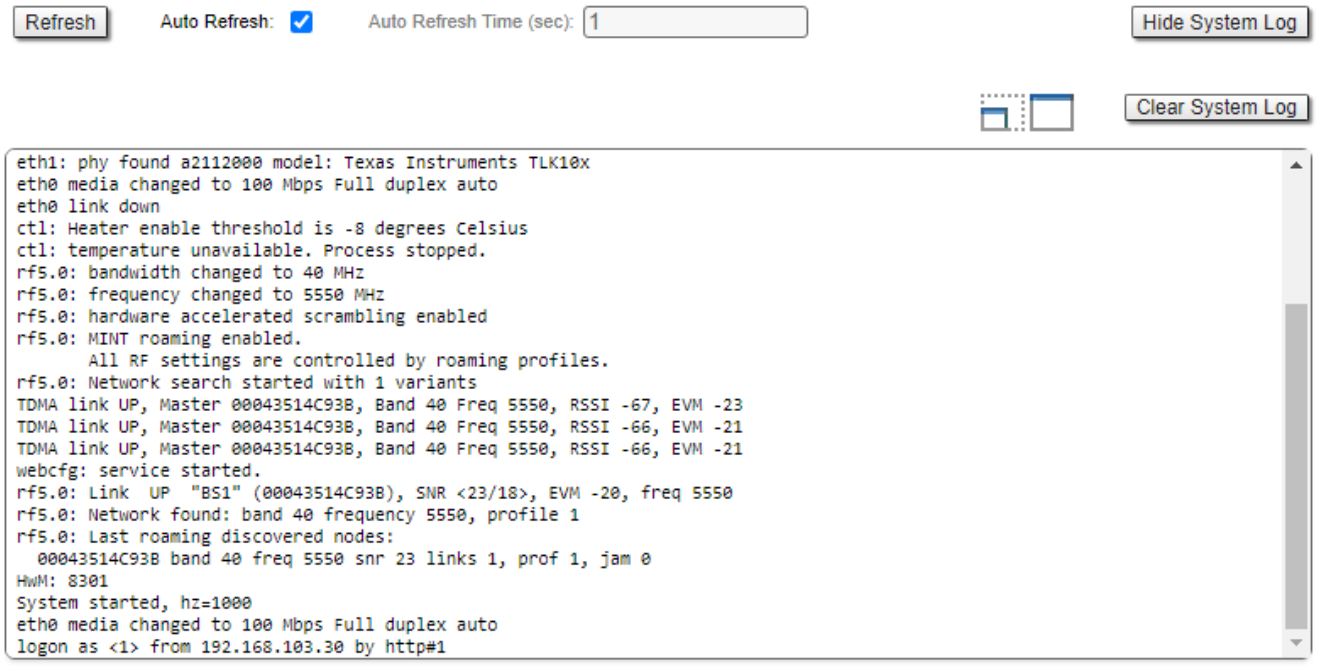


Figure - System log

Pay attention to the following messages:

Messages in the log	Description
Link DOWN	The wireless link has disconnected. The reason for the disconnection is indicated in the same entry.
"too many transmit errors"	The wireless link was interrupted due to transmission errors.
"link reconnecting"	The wireless link is reestablished.
"no signal from the remote side detected"	There is no signal received, check the remote device.
Scrambling engine overflow	The hardware capabilities of the scrambling module are exceeded. To connect more subscribers (more than 62) scrambling should be disabled.
Warning: Abnormal transmit power disbalance!	May indicate a hardware problem.

Frequent changes in the status of the Ethernet interface ("Up" and "Down") may indicate problems with the Ethernet interface, the cable connected to it, with the power supply, or with the switch.

Antenna alignment

Web interface

The link degradation can be caused by antenna misalignment or by the appearance of obstacles along the signal's propagation path. Use the built-in "Antenna Alignment Tool". The recommended parameters are shown in the table below. If the parameters differ significantly from the calculated ones, check the alignment accuracy on both link sides.

RSSI (dBm)

-90 ... -80	The value is close to the receiver sensitivity level, only lower modulations are available
-80 ... -60	Low level. Average modulations are available
-60 ... -40	The recommended value for maximum performance
>-40	The received signal level is too high
Absolute value EVM (dB)	
>21	Recommended value
CINR (dB)	
>28	Higher modulations are available
Absolute value Crosstalk (dB)	
>20	Recommended value

If the value of the RSSI parameter remains high while the CINR value decreases, it may indicate high interference levels near one of the devices. The deterioration of both the RSSI and the CINR parameters can indicate a misalignment of the devices. A detailed description of the "Antenna Alignment" tool is available in the "Device status menu" article.

Command line interface

When using the command line to manage the device, fine antenna alignment can be performed using the "ltest rf5.0 MAC ADDRESS -align" command. The command output will show the average CINR for the local and the remote devices.

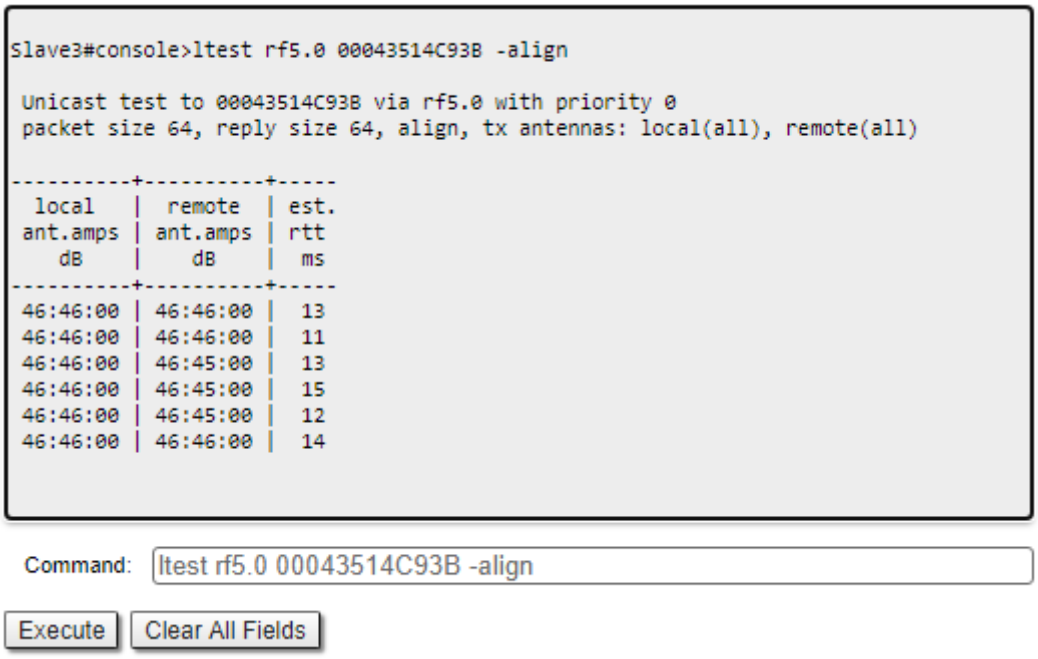


Figure - "ltest - align" command output

Analysis of the radio environment

Web interface

To assess the state of the radio environment proceed to the "Radio Scanner" tool. The tool has the following purposes:

- allows to evaluate the radio sources on the current central frequency and, if necessary, perform frequency diversity in order to reduce their mutual influence;
- displays information about the impulse noise. A number of pulses per second over 50 indicates significant interference on the selected frequency.

Use the "Spectrum Analyzer" tool to select a frequency free from interference or use the automatic frequency selection mechanisms. For more information about the dynamic frequency selection algorithms proceed to the "Dynamic Frequency Selection" article.

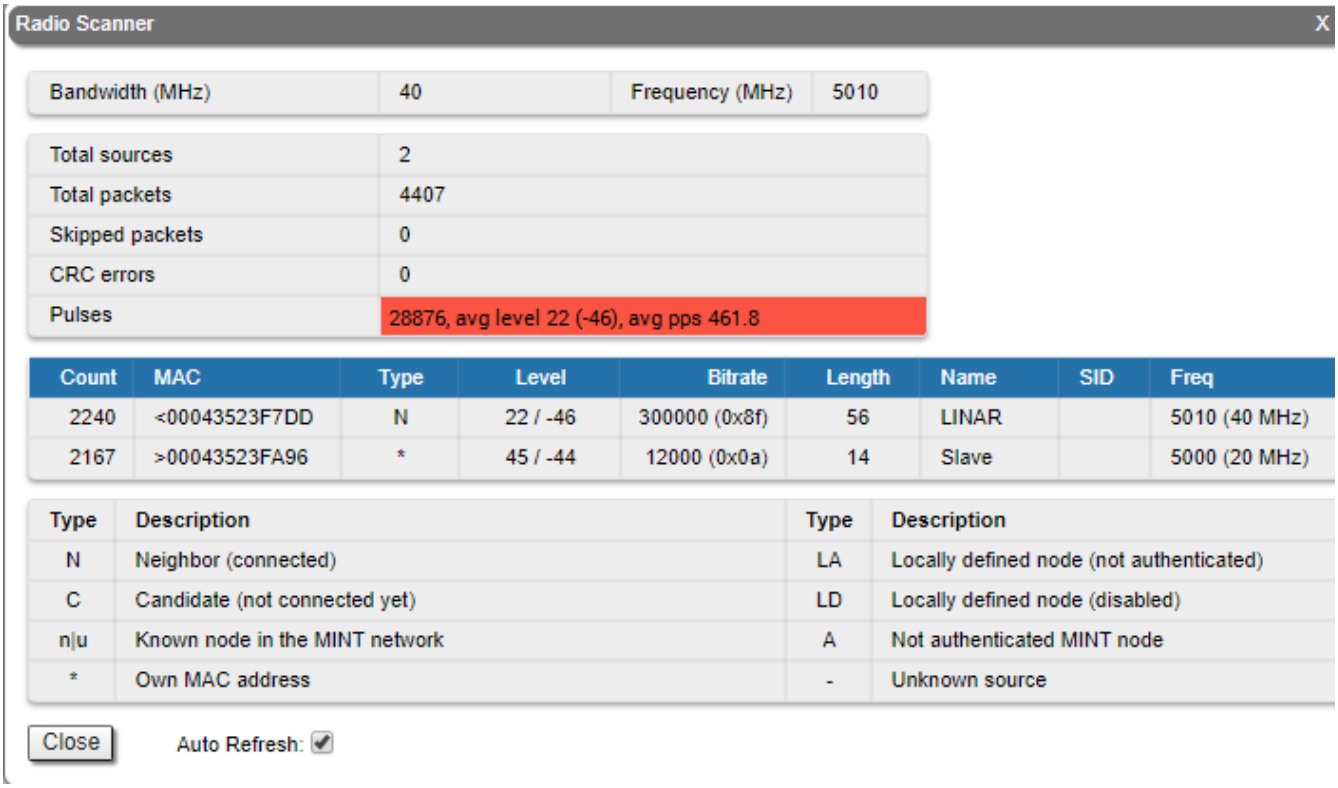


Figure - Radio Scanner

Command line interface

Detailed information about the state of the radio environment is available via the "*muffer*" command. The "*muffer rf5.0 scan*" command allows to check the radio environment for the presence of radio signal sources on all the available frequencies.

> **NOTE**
>
> The "*muffer rf5.0 scan*" command can take a long time to execute and disrupt the normal operation of the radio module.