Wireless Instruments

breaking the limits

MUM 2014 Venice

How to configure MikroTik wireless system to work effectively in noisy enviroment.

Wireless Instruments sp. z o.o.

Wireless Instruments
breaking the limits

PRESENTATION GOAL

Share our experience and knowledge about wireless links settings in noisy enviroment.

PRESENTATION PLAN

- The presentation is divided for few fundamental parts:
- How to prepare the bridge
- How to set the bridge
- How to improve the bridge

Wireless Instruments
breaking the limits

CHAPTER I

HOW TO PREPARE TO CREATE THE BRIDGE

I. HOW TO PREPARE TO CREATE THE BRIDGE

Wireless Instruments
breaking the limits

1. Determine what to we need:

- Type of the connection (topology) & application
- Expected throughput
- Installation points
- Economical aspect

Wireless Instruments
breaking the limits

2. Check the environment

First thing to do is a scan of the network (Spectral Scan). It's possible using MikroTik feature Spectral Scan which is available on DUDE program. It can be used on operating systems like Windows, Linux.

- ***Find the frequencies in the considering band if there are a free space to be used for a link.***
- ***Determine the channel width which is needed to get expected signal/throughput***
- ***Determine wireless protocol which you are going to use (we suggest to use NV2, because of it's very good parameters and resistance for the noise)***
- ***If there isn't any free frequencies… then you are in troubles (how to solve it, we wil present in the point III. How to improve the bridge).***

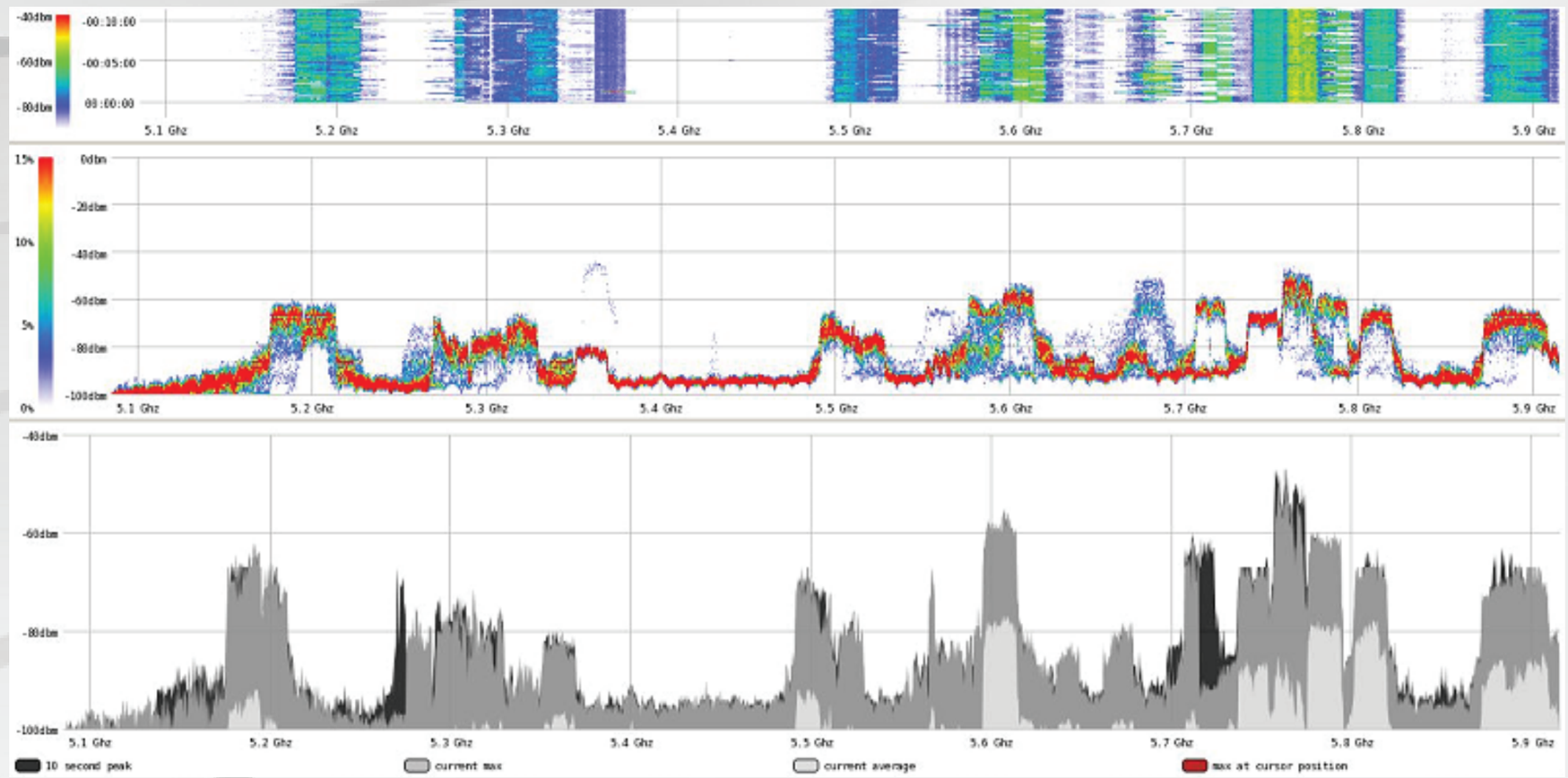
Wireless Instruments
breaking the limits

2. Check the environment

Spectral Scan

Using this feature you are able to determine where you can locate your link and its channel width.

⚠ **In the EU we can use 5,47 – 5,75 GHz**



Pic. Spectral scan for 5,1 – 5,9 GHz frequency (taken in Wrocław).

Wireless Instruments
breaking the limits

3. Hardware

This point depends on the terrain conditions and expected results.

Antennas

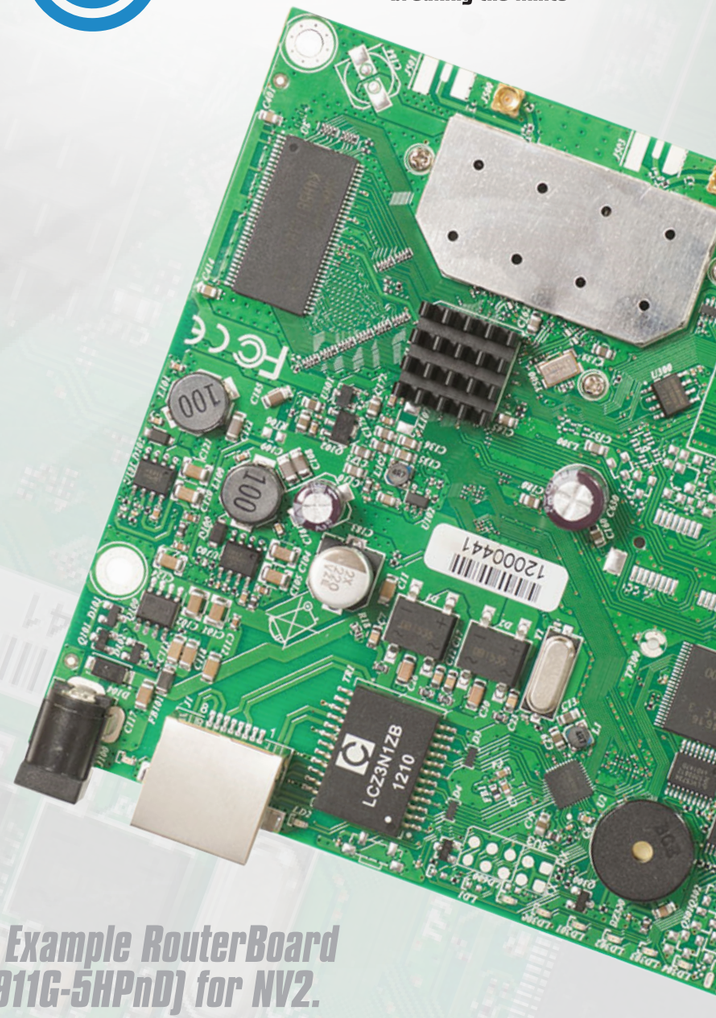
- LOS (Line of Sight)
- NLOS (Non-Line of Sight)

Radio

We recommend to use RouterOS compatible devices with NV2 MikroTik protocol.
All the Atheros radios, beginning from Atheros 5212 support NV2.

Radio device criteries:

- Output power
- Number of chains
- Sensitivity



Pic. Example RouterBoard (RB911G-5HPnD) for NV2.

Wireless Instruments
breaking the limits

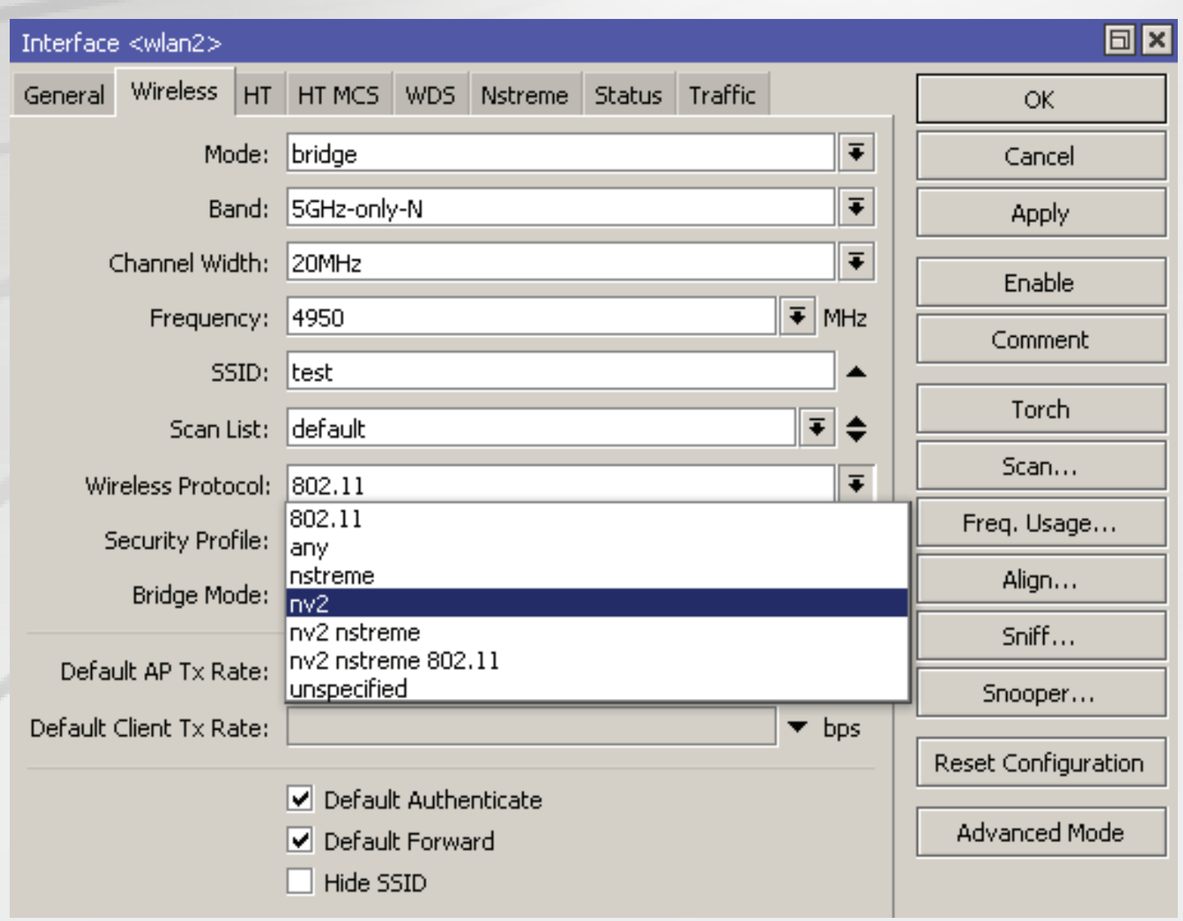
CHAPTER II

RouterOS
MAIN SETTINGS

Wireless Instruments
breaking the limits

NV2 protocole

- Much more efficient than previous versions of CSMA (Carrier Sense Multiple Access), NV2 uses TDMA (Time Division Multiple Access).
- NV2 has features minimalizing overheads and another special features helping in reducing received noise.
- NV2 is available from 5,0rc1 RouterOS level.

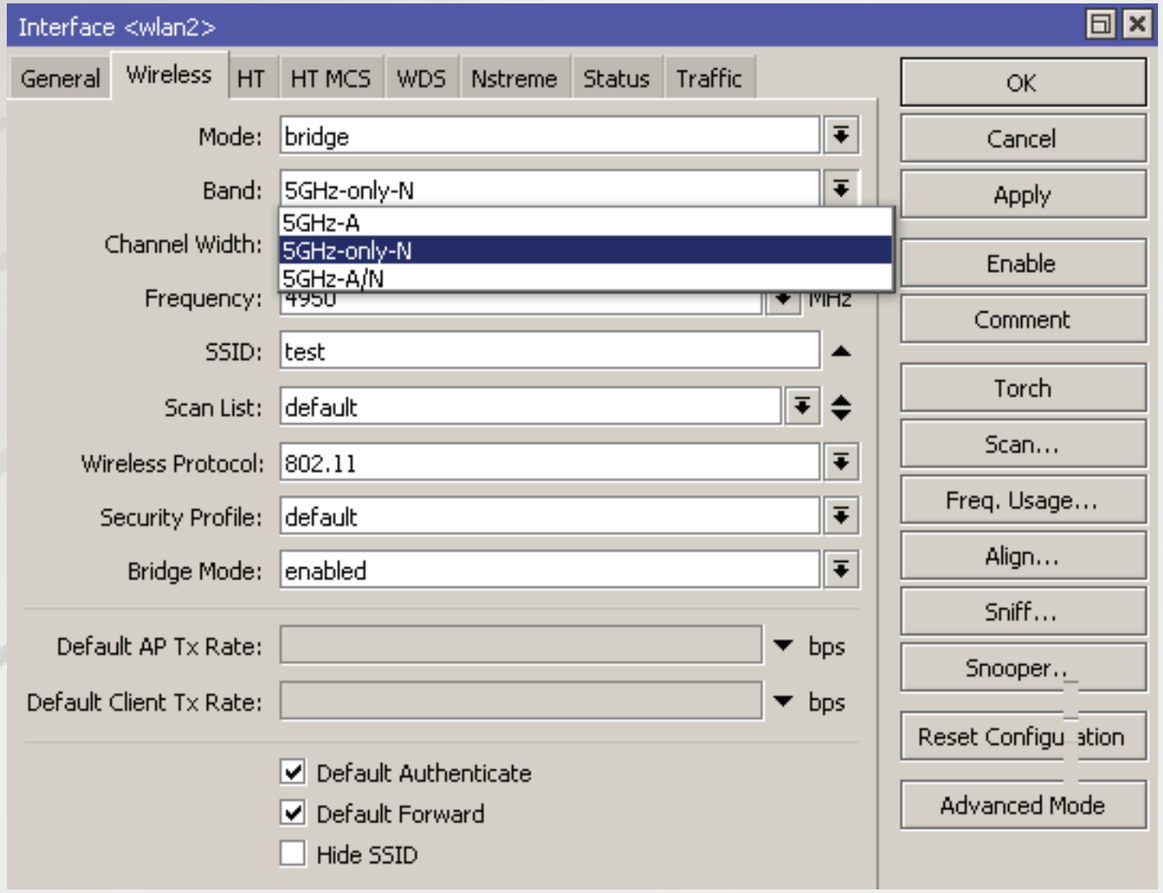


Pic. Where to set NV2.

Wireless Instruments
breaking the limits

Set „Band” in Wireless

- set one protocole networks, not combined.
- set comparable signal levels (with the same protocole) in case of p2mp connections.



Band settings

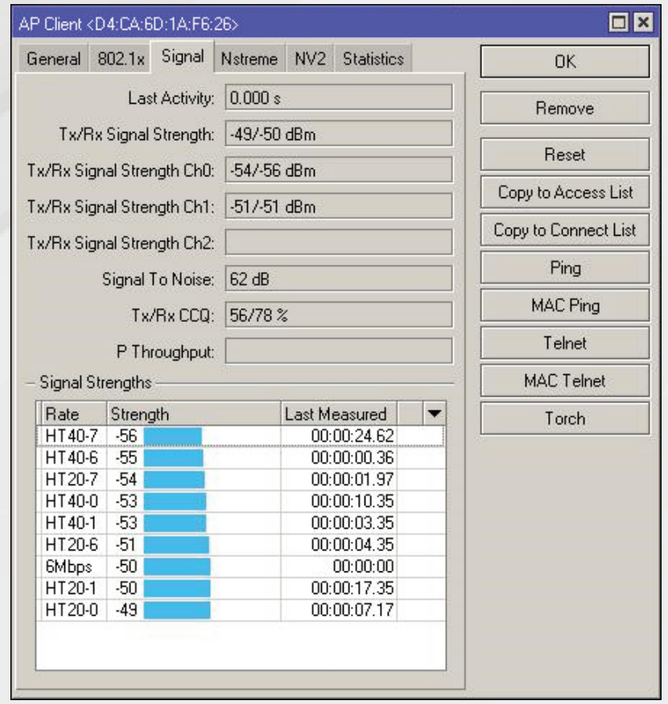
Wireless Instruments
breaking the limits

HT-MCS settings

Depending on the signal results, we choose the best option for us using a table provided by MikroTik software.

MCS index	Spatial streams	Modulation type	Coding rate	Data rate (Mbit/s)			
				20 MHz channel		40 MHz channel	
				800 ns GI	400 ns GI	800 ns GI	400 ns GI
0	1	BPSK	1/2	6.50	7.20	13.50	15.00
1	1	QPSK	1/2	13.00	14.40	27.00	30.00
2	1	QPSK	3/4	19.50	21.70	40.50	45.00
3	1	16-QAM	1/2	26.00	28.90	54.00	60.00
4	1	16-QAM	3/4	39.00	43.30	81.00	90.00
5	1	64-QAM	2/3	52.00	57.80	108.00	120.00
6	1	64-QAM	3/4	58.50	65.00	121.50	135.00
7	1	64-QAM	5/6	65.00	72.20	135.00	150.00
8	2	BPSK	1/2	13.00	14.40	27.00	30.00
9	2	QPSK	1/2	26.00	28.90	54.00	60.00
10	2	QPSK	3/4	39.00	43.30	81.00	90.00
11	2	16-QAM	1/2	52.00	57.80	108.00	120.00
12	2	16-QAM	3/4	78.00	86.70	162.00	180.00
13	2	64-QAM	2/3	104.00	115.60	216.00	240.00
14	2	64-QAM	3/4	117.00	130.00	243.00	270.00
15	2	64-QAM	5/6	130.00	144.40	270.00	300.00

Pic. MCS list for MIMO 2x2



Pic. Signal options.

Every link is to be planned individually. For more info, come to our stand and talk with our engineer.

Wireless Instruments
breaking the limits

CHAPTER III

HOW TO IMPROVE THE BRIGE

Wireless Instruments
breaking the limits

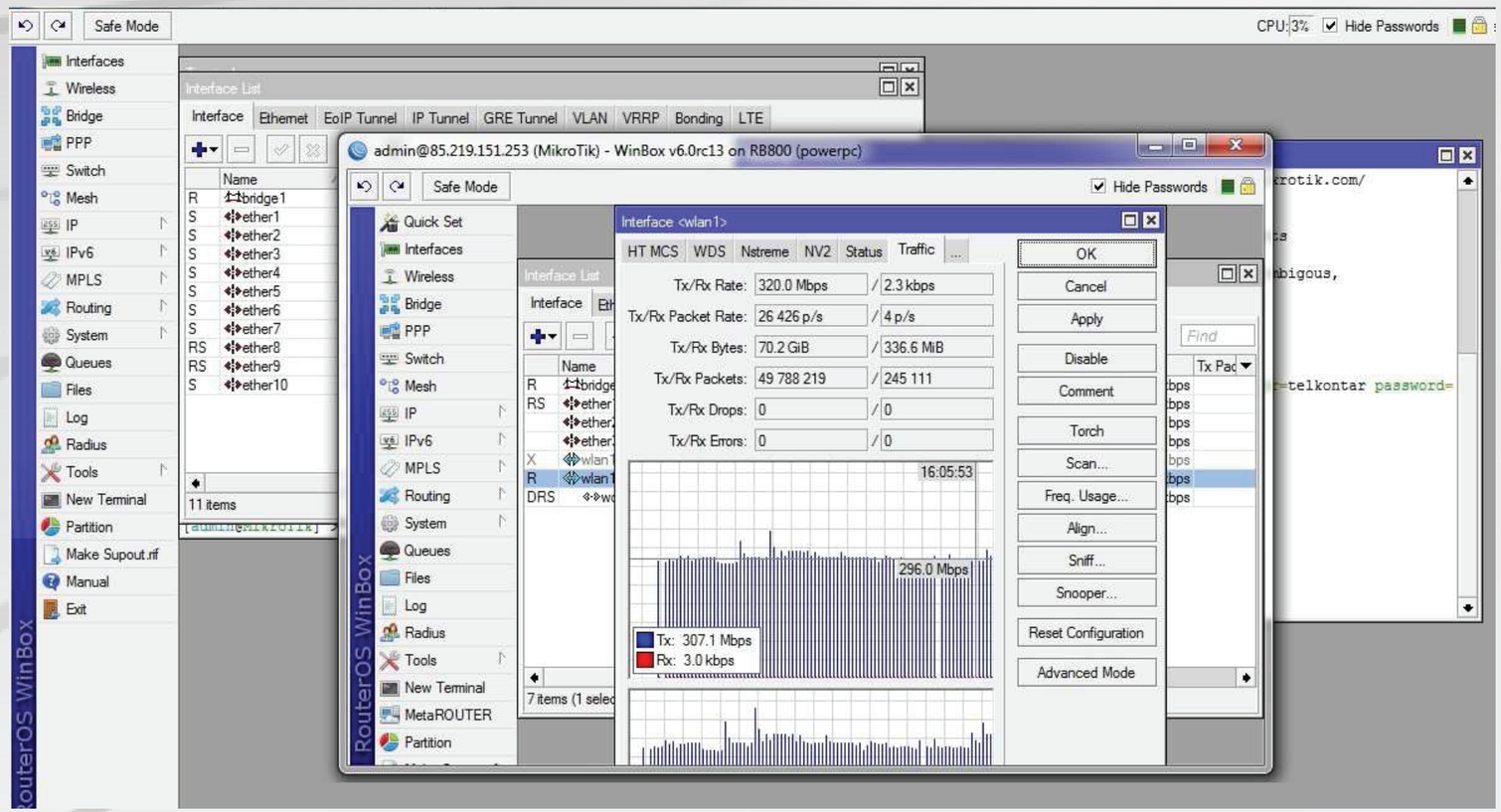
If the previous settings don't help, there are 4 solutions:

- Wider channel to have better throughput
- Narrower channelto have better spectral power density (longer link, but worse throughput)
- Free frequency
- Find the method how to separate your signal from existing signals on given frequencies

Wireless Instruments
breaking the limits

Wider channel

MikroTik RouterOS enables to set 30MHz channels for MIMO 2x2, then the maximum possible transfer on MIMO 2x2 can be up to 450Mbps. In our case it's 320Mbps



Pic. Test link with 30MHz channel widths.

Wireless Instruments
breaking the limits

Free frequency

- hard to find any frequency free from another networks and interferences.
- band over 6.1GHz (there are also modules operating 5.9 – 6.5GHz. In Poland these frequencies can be rented).

The system requires special radio modules and 6 GHz antenna series from Wireless Instruments. The system works well using MiktoTik RouterBoards and RouterOS software. For details regarding ROS settings and hardware, we invite for personal contact.

Wireless Instruments
breaking the limits

Find the method how to separate your signal from existing signals on given frequencies

- In standard there are two polarizations H and V. But what in case when there is a high portion of noise in all band ?
- We discovered that X-polarity is very effective polarization in very noisy environment. X means the rotation of 45 deg of H&V polarization, so H+45 deg and H-45 deg.

Wireless Instruments
breaking the limits

Test to compare X with H&V

To check this thesis we set two links on the same place, the same settings, same antennas (but with different polarizations X vs. H&V).

Test parameters:

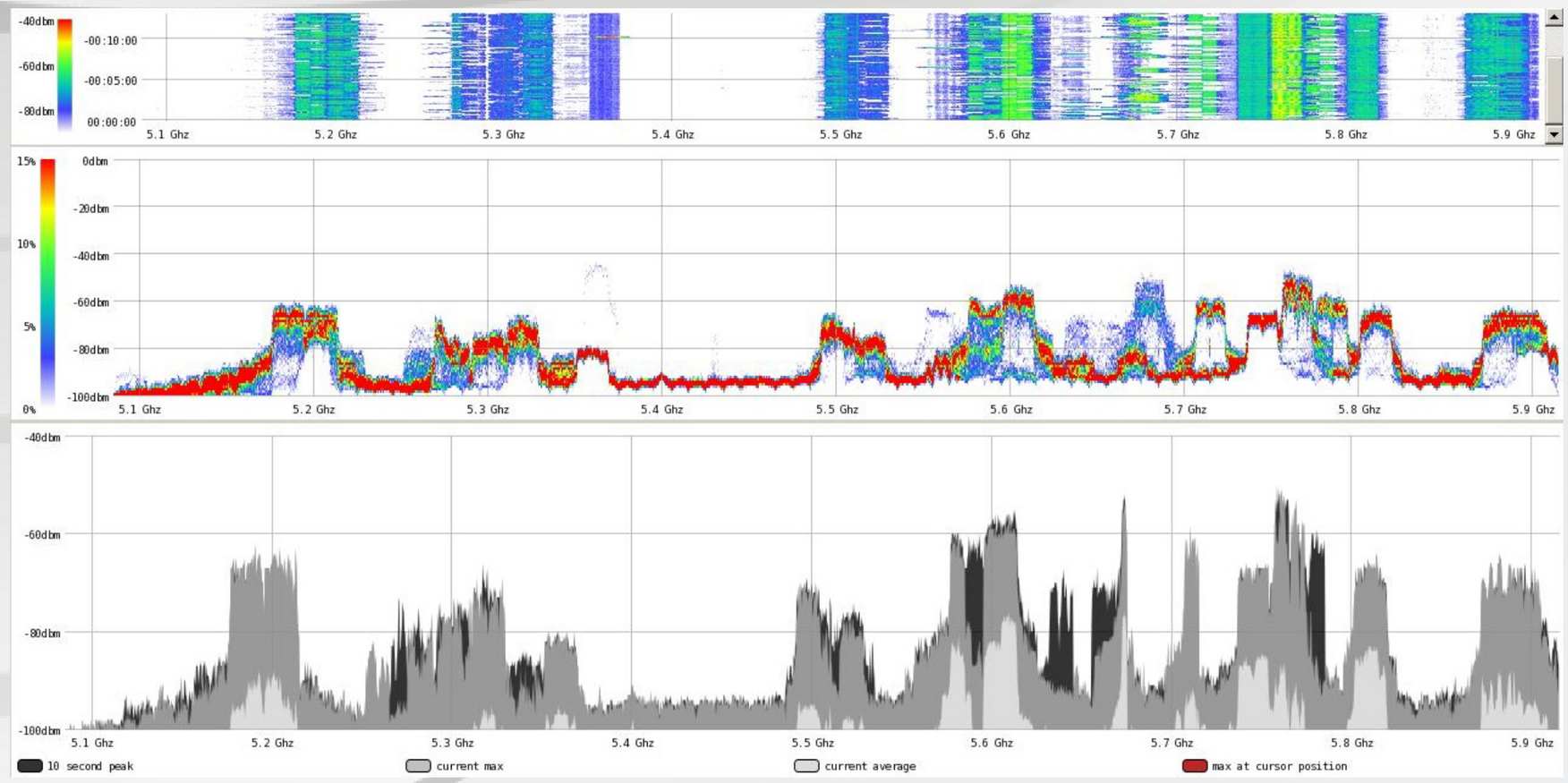
- Distance 2,5km
- 1st point – 10-floor building
- 2nd point 2-floor building
- LOS (Line Of Sight)

Hardware:

- RouterBoard RB911G-5HPnD
- 20 dBi panel dual polarity MIMO 2x2 antenna WiBOX PA M5-20HV / WiBOX PA M5-20X

Wireless Instruments
breaking the limits

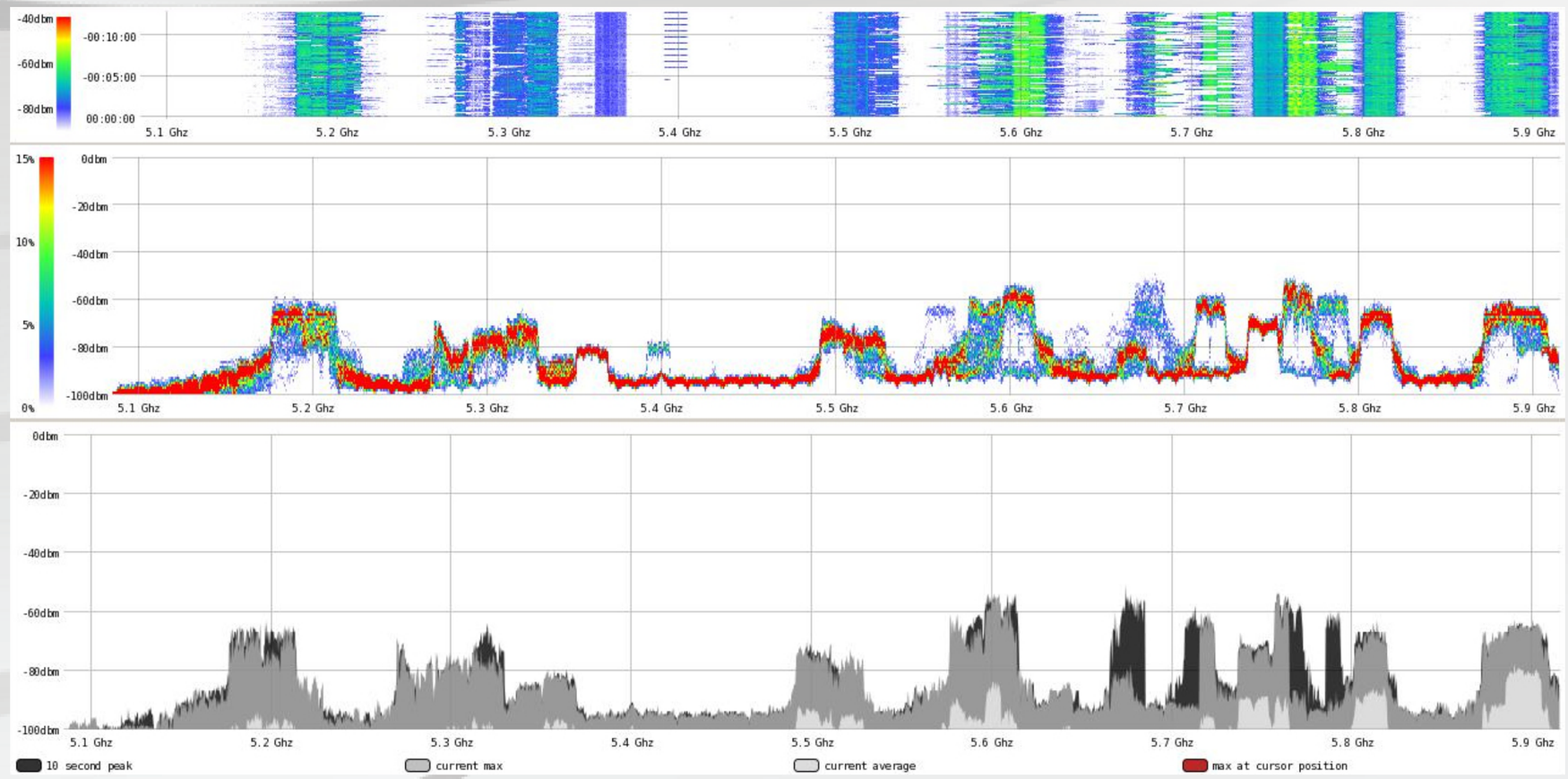
There is a spectral scan in HV polarization



Pic. Spectral scan (5.1–5.9GHz) in HV polarization, WI PA M5-20HV + RB911G-5HPnD.

Wireless Instruments
breaking the limits

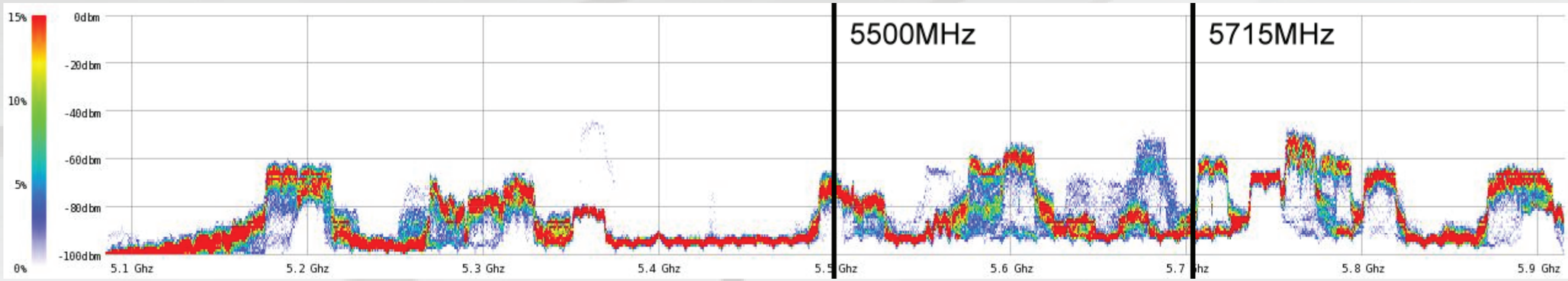
There is a spectral scan for X polarization



Pic. Spectral scan (5.1–5.9GHz) in X polarization, WI PA M5-20X + RB911G-5HPnD.

Wireless Instruments
breaking the limits

There has been set two noisy frequencies: 5500 MHz and 5715 MHz.

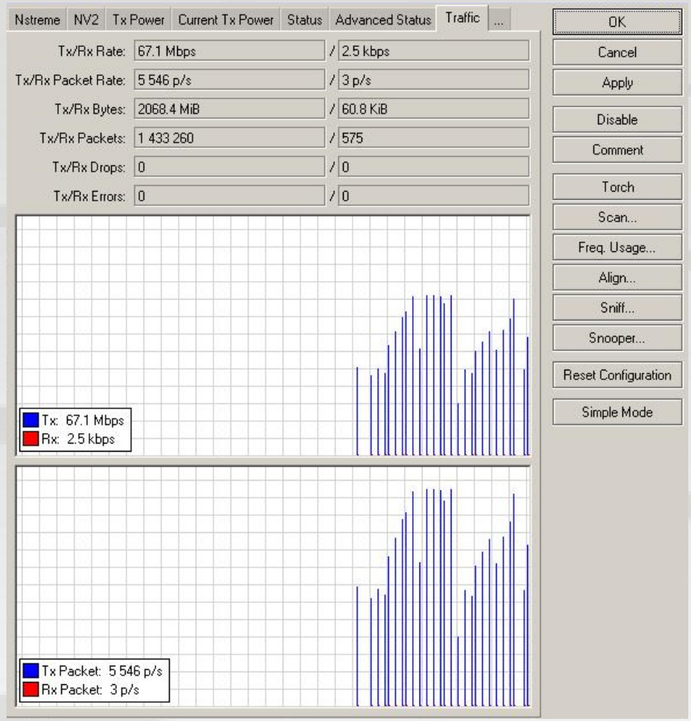


Pic. Spectral scan and marked test frequencies.

Wireless Instruments
breaking the limits

Test process - Frequency of 5500 MHz

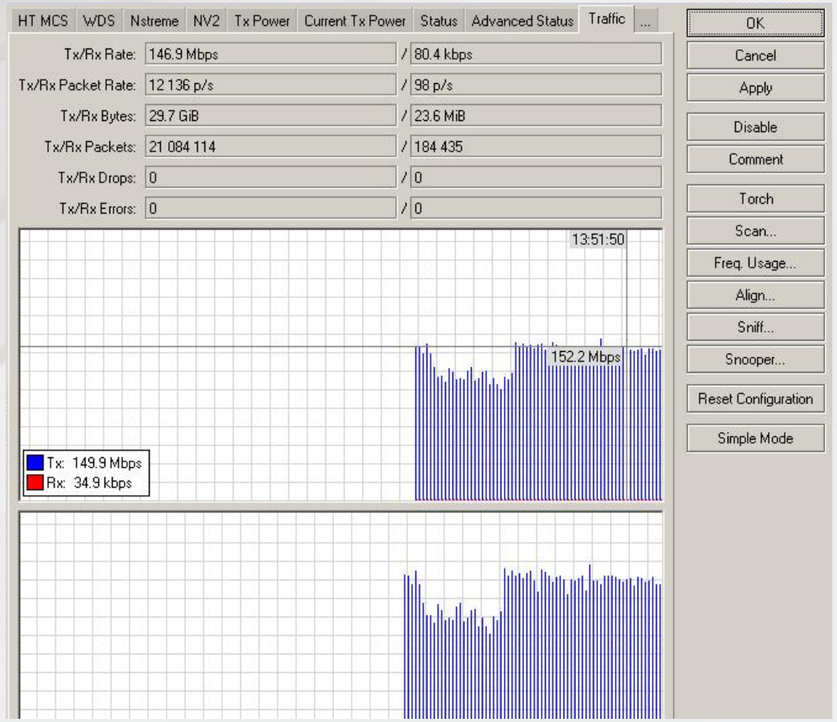
HV polarization (WiBOX PA M5-20HV + RB911G-5HPnD)



Pic. UDP transfer achieved on our link (5500MHz) with H&V polarization.

We got a transfer of the level of 70Mbps, but the link was not stable, and the link disconnectedpermanently. Good bridge impossible.

X polarization (WiBOX PA M5-20X + RB911G-5HPnD)



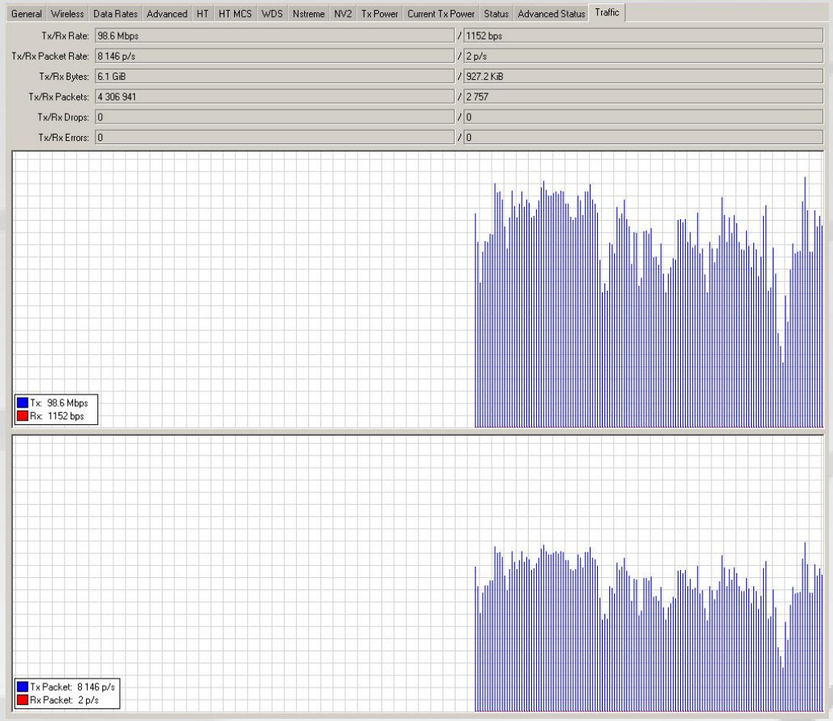
Pic. UDP transfer achieved on our link (5500 MHz) with X polarization.

We have achieved very stable connection with the max speed of 152Mbps with not big throughput fluctuation, and pings 11-48ms, which is very satysfying result.

Wireless Instruments
breaking the limits

Test process - Frequency of 5715 MHZ

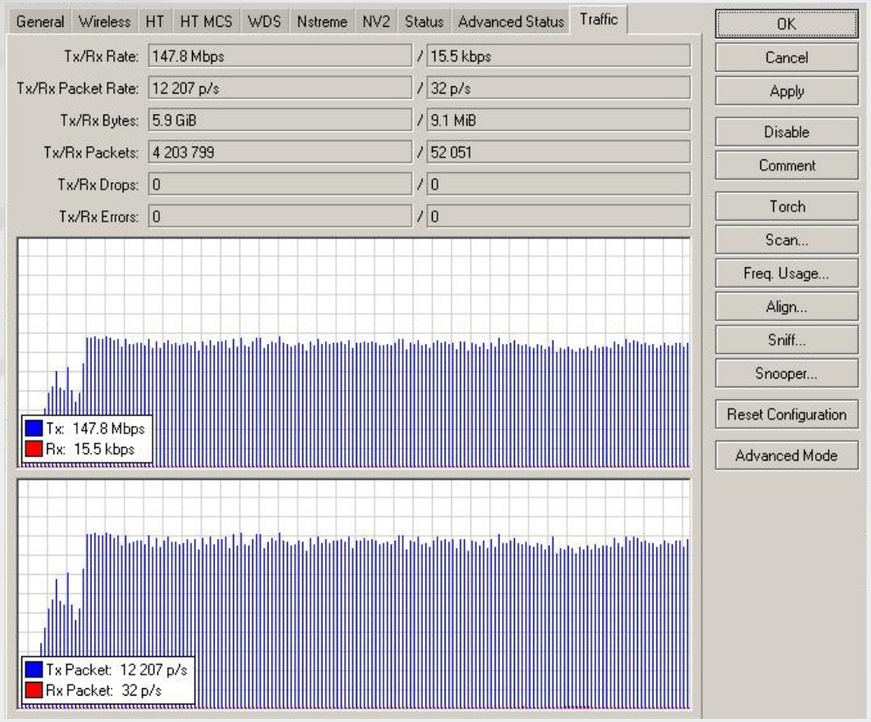
HV polarization (WiBOX PA M5-20HV + RB911G-5HPnD)



Pic. UDP transfer achieved on our link (5715MHz) with H&V polarization.

The achieved signal had max. throughput of 90Mbps, but was very unstable, the fluctuation was 30-90Mbps. Setting the throughput on the level of 50Mbps helped to get stable link.

X polarization (WiBOX PA M5-20X + RB911G-5HPnD)



Pic. UDP transfer achieved on our link (5715MHz) with X polarization.

We have achieved around 145Mbps without a big throughput influence.

This test shows that there are some possibilities to work effectively in crowded 5 GHz band and that there are some solutions for noisy environment.

For more information regarding our solutions and tests we invite to our stand.

Thanks for Your attention

Wireless Instruments
breaking the limits

Wireless Instruments Technical Team

www.wireless-instruments.com