

# Low cost 60GHz solutions by MikroTik

Antons Beļajevs

MikroTik, Latvia

September 2018



- Established in 1996
- RouterOS created in 1997
- RouterBOARD created in 2002
- MikroTik User Meetings all over the world
- First MUM event in Prague 2006
- First 60GHz devices announced in 2017 MUM Milan







raus, karsch fixou dacoß may neufmarat 6. Rankteet driljfun  
Lucirot. Tririe



Fabrika

Kautoria



# Why MikroTik?

- Continuous software development and improvements
- Best price/performance ratio
- Advanced configuration options – same software used on all devices
- Configuration freedom
- Documentation and support:
  - <https://wiki.mikrotik.com>
  - <https://forum.mikrotik.com>
  - [support@mikrotik.com](mailto:support@mikrotik.com)

# Wireless unlicensed band comparison

2.4 GHz 802.11b/g/n	5 GHz 802.11a/n/ac	60 GHz 802.11ad
-	-	-
<ul style="list-style-type: none"><li>• Crowded spectrum</li><li>• Low available channel count</li></ul>	<ul style="list-style-type: none"><li>• DFS and radar detection</li><li>• Rapidly increasing channel widths</li></ul>	<ul style="list-style-type: none"><li>• Oxygen absorption</li><li>• Low distance</li><li>• Less channels</li></ul>
+	+	+
<ul style="list-style-type: none"><li>• Higher distances</li><li>• Better penetration through objects</li></ul>	<ul style="list-style-type: none"><li>• High throughput</li><li>• More available channels</li></ul>	<ul style="list-style-type: none"><li>• The highest throughput</li><li>• Free spectrum</li></ul>

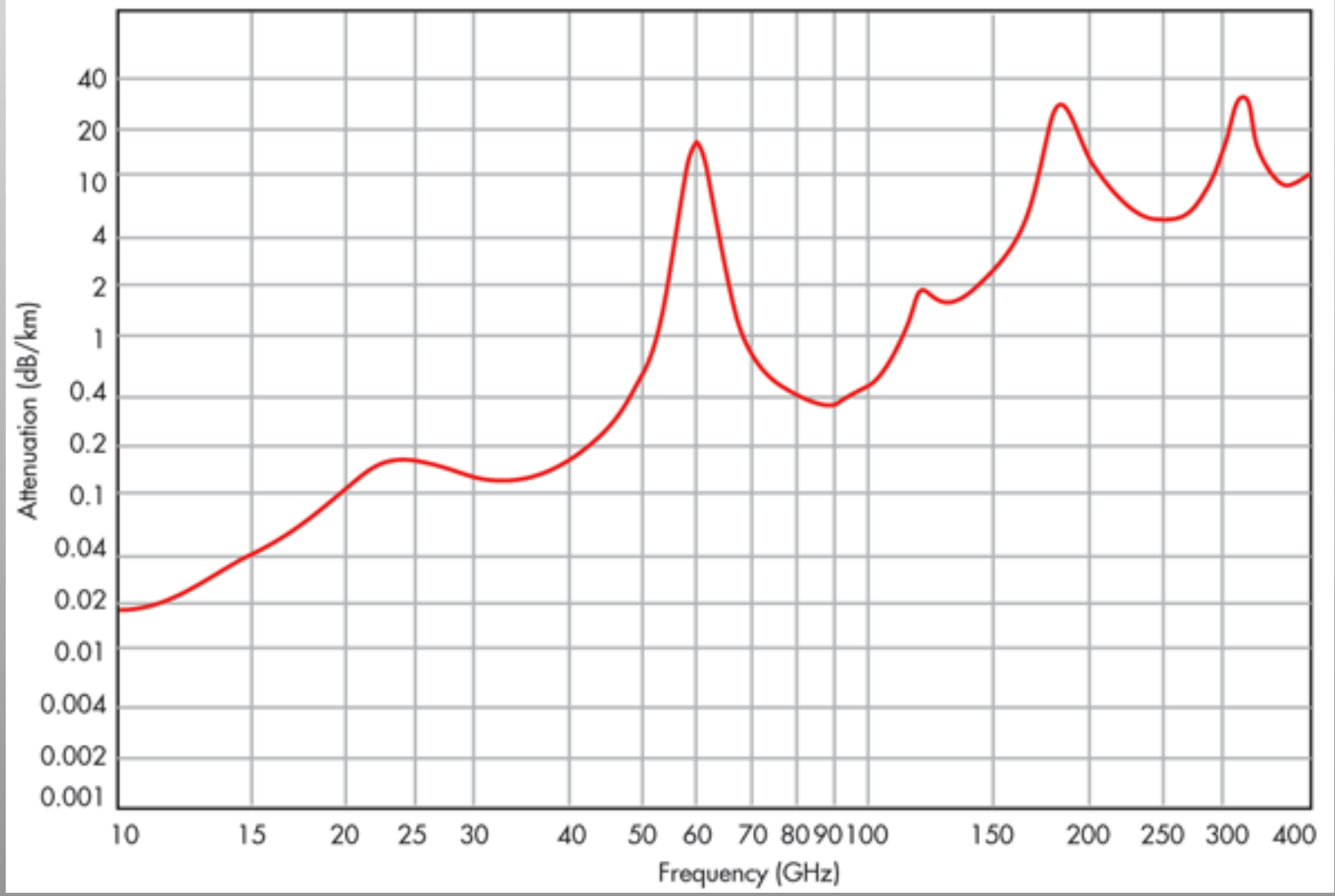


Image Source:  
<http://www.electronicdesign.com>

# 802.11ad

- Unlicensed\*
- Attenuation helps avoiding radio interference
- To get higher gain very narrow radiation patterns are used
- Physically smaller antennas can provide high gain



# Wireless Wire



# Wireless Wire

- Pre-configured 60 GHz radio link (Plug and Play)
- 4 core CPU running at 716 MHz, 256 MB of RAM
- Only 5 W of maximum power consumption
- 802.11af/at
- Range of 200 meters or more
- Beamforming and PtMP support

# Wireless Wire

- Channel bandwidth 2.16 GHz
- Total EIRP under 40 dBm
- EN 302 567
- 32 antenna elements
- Sweeps between 64 antenna patterns
- Wireless coverage close to 180 degrees
- Price \$198 for kit of two devices



# SXTsq Lite60

- For distances 200m+
- Slim design
- EN 305 550 and EN 302 567
- License level 3
- Fast Ethernet
- Price \$69



# LHG60G kit

- For distances up to 1500 m+
- Antenna gain 42 dBi
- Total EIRP under 55dBm
- EN 302 217 – Fixed Point to Point compliant
- License level 3
- Price \$298 for kit



# Wireless modes

- Wireless modes for 60 GHz
  - “ap-bridge”
  - “bridge”
  - “station-bridge” (WDS equivalent)
  - “sniff”
- Configuration under “/interface w60g” menu
  - SSID
  - Password
  - Mode



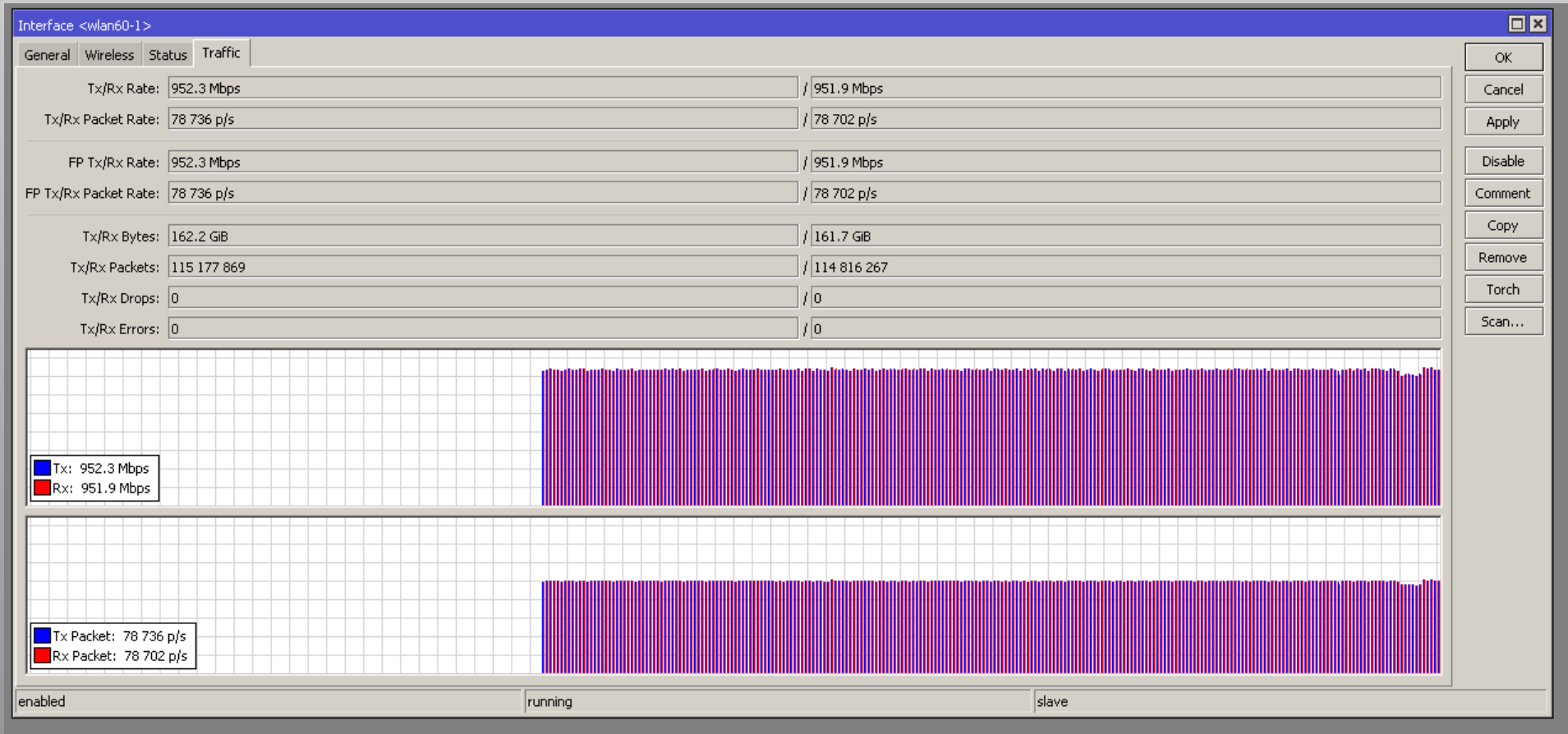
# Wireless comparison with other MikroTik devices

- The highest wireless throughput compared to any MikroTik wireless device at the moment

Band	Max throughput			Tested devices
	TX	RX	TX+RX	
2.4 GHz dual chain	256Mbps	255Mbps	252Mbps	r11e-2HPnD + RB800
5 GHz dual chain	560Mbps	561Mbps	570Mbps	r11e-5HPacD + RB800
60 GHz	1Gbps	1Gbps	2Gbps	Wireless Wire kit

- Price/performance sweet spot for short wireless links

# Performance in 1500 meter link



Winbox traffic graph showing “Wireless Wire Dish” speed on 1500 m link

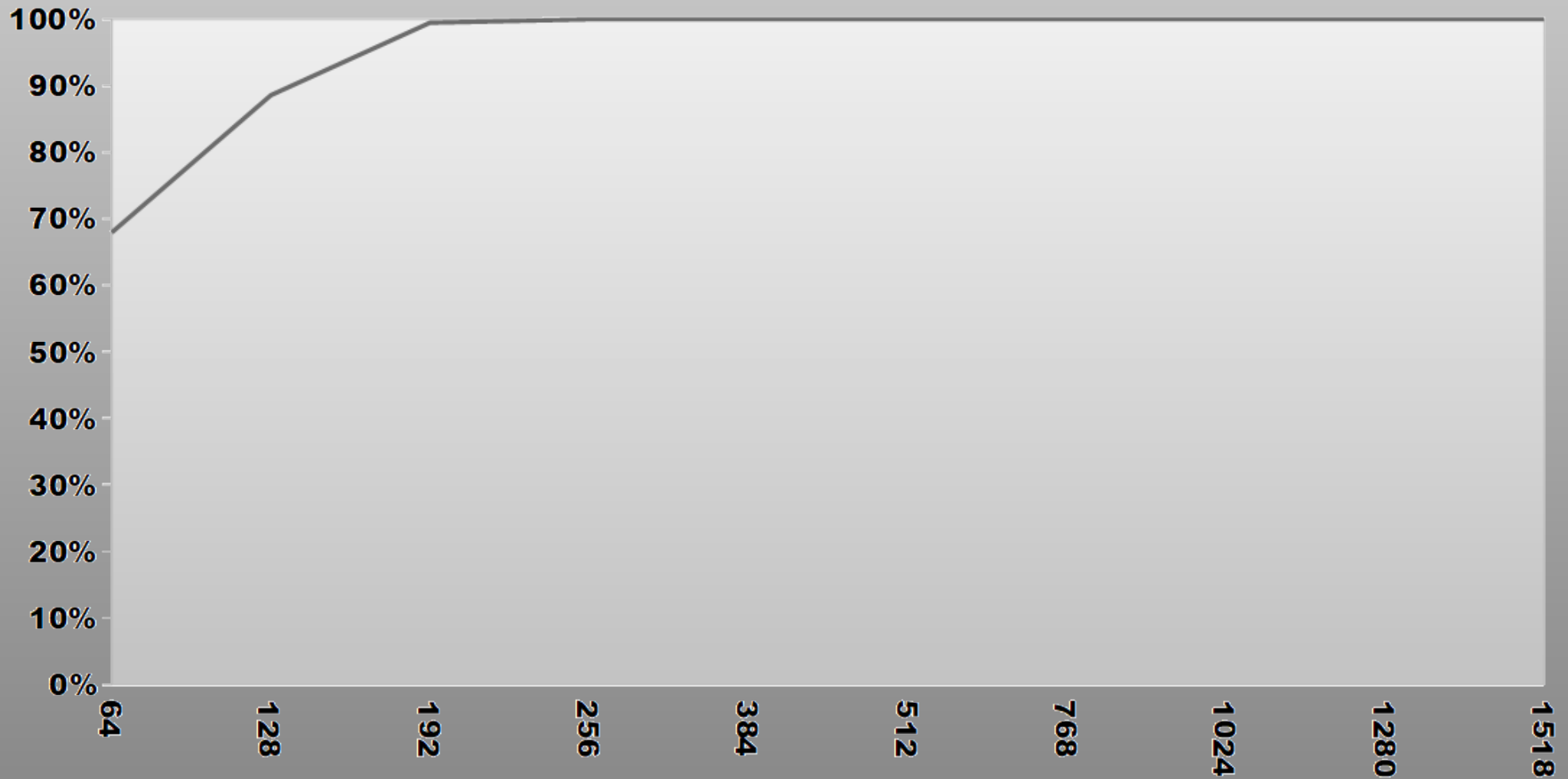
# Performance comparison to wired network

Throughput (<0,1% loss)	Theoretical max		16 Streams both ways			4096 Streams both ways		
	Frame size (bytes)	kpps	Mbps	kpps	Mbps	%	kpps	Mbps
<b>64</b>	2976,1	1 523,8	2022	1 035,3	<b>67,94</b>	1977	1 012,2	<b>66,43</b>
<b>128</b>	1689,2	1 729,7	1496,2	1 532,1	<b>88,57</b>	1612	1 650,7	<b>95,43</b>
<b>192</b>	1179,2	1 811,3	1173	1 801,7	<b>99,47</b>	1173	1 801,7	<b>99,47</b>
<b>256</b>	905,8	1 855,1	905,8	1 855,1	<b>100,00</b>	905,8	1 855,1	<b>100,00</b>
<b>384</b>	618,8	1 901,0	618,8	1 901,0	<b>100,00</b>	618,8	1 901,0	<b>100,00</b>
<b>512</b>	469,9	1 924,7	469,9	1 924,7	<b>100,00</b>	469,9	1 924,7	<b>100,00</b>
<b>768</b>	317,2	1 948,9	317,2	1 948,9	<b>100,00</b>	317,2	1 948,9	<b>100,00</b>
<b>1024</b>	239,4	1 961,2	239,4	1 961,2	<b>100,00</b>	239,4	1 961,2	<b>100,00</b>
<b>1280</b>	192,3	1 969,2	192,3	1 969,2	<b>100,00</b>	192,3	1 969,2	<b>100,00</b>
<b>1518</b>	162,5	1 973,4	162,5	1 973,4	<b>100,00</b>	162,5	1 973,4	<b>100,00</b>
<b>TCP connection</b>	181,6	1 970,6	181,6	1 970,6	<b>100,00</b>	181,6	1 970,6	<b>100,00</b>

All UDP tests are done with Xena Networks specialized test equipment (XenaBay), and done according to RFC2544 (Xena2544) with 0,1% acceptable loss  
 TCP tests done by using iperf3:  
<https://iperf.fr/>



# Performance comparison to wired network



# Point to Multi Point support

- Experimental support already available starting from 6.41
- Requires level 4 license for AP device
- Connected clients are treated as individual interfaces - easy to configure and manage
- Supports 8 simultaneously connected clients

# PtMP performance

- Up to 400 Mbps simultaneously to each client in PtMP setup with 4 clients

```
[admin@60_AF] > interface monitor-traffic wlan60-slave-1,wlan60-slave-2,wlan60-slave-3,wlan60-slave-4
      name:  wlan60-slave-1 wlan60-slave-2 wlan60-slave-3 wlan60-slave-4
rx-packets-per-second:      16 431      16 034      16 106      16 933
rx-bits-per-second:         198.7Mbps    193.9Mbps    194.8Mbps    204.8Mbps
fp-rx-packets-per-second:   16 431      16 034      16 106      16 933
fp-rx-bits-per-second:     198.7Mbps    193.9Mbps    194.8Mbps    204.8Mbps
rx-drops-per-second:        0          0          0          0
rx-errors-per-second:       0          0          0          0
tx-packets-per-second:      16 431      16 050      16 106      16 622
tx-bits-per-second:         198.7Mbps    194.1Mbps    194.8Mbps    201.0Mbps
fp-tx-packets-per-second:   16 431      16 050      16 106      16 622
fp-tx-bits-per-second:     198.7Mbps    194.1Mbps    194.8Mbps    201.0Mbps
tx-drops-per-second:        0          0          0          0
tx-queue-drops-per-second:  13         364        318         0
tx-errors-per-second:       0          0          0          0
-- [Q quit|D dump|C-z pause]
```



# wAP 60G, SXTsq 60 and LHG60G

- All devices are mutually compatible
- wAP60G – makes excellent Access Point for PTMP usage case together with LHG60G client devices
- Easy to deploy, easy to configure and monitor
- Fastest PTMP solution at this price range

# wAP 60G and LHG60G

Distance Meters*	RSSI wAP60G	RSSI LHG60G	Total Throughput
300	-63	-68	1.8Gbps
500	-63	-68	1.8Gbps
600	-65	-69	1.8Gbps
700	-66	-69	1.5Gbps
800	-66	-69	1.2Gbps
850	-68	-69	800Mbps
900	-70	-72	100Mbps

\*Tests done before latest software changes increasing distance

# W60G new features

- Re-calibrated antenna sectors increasing distance over 200m for wAP60G (RouterOS update required) and increasing Wireless Wire dish maximum distance
- Added RSSI for monitoring signal strength
- Added distance measurement tool
- Added used Beamforming pattern information for easier LHG60G alignment

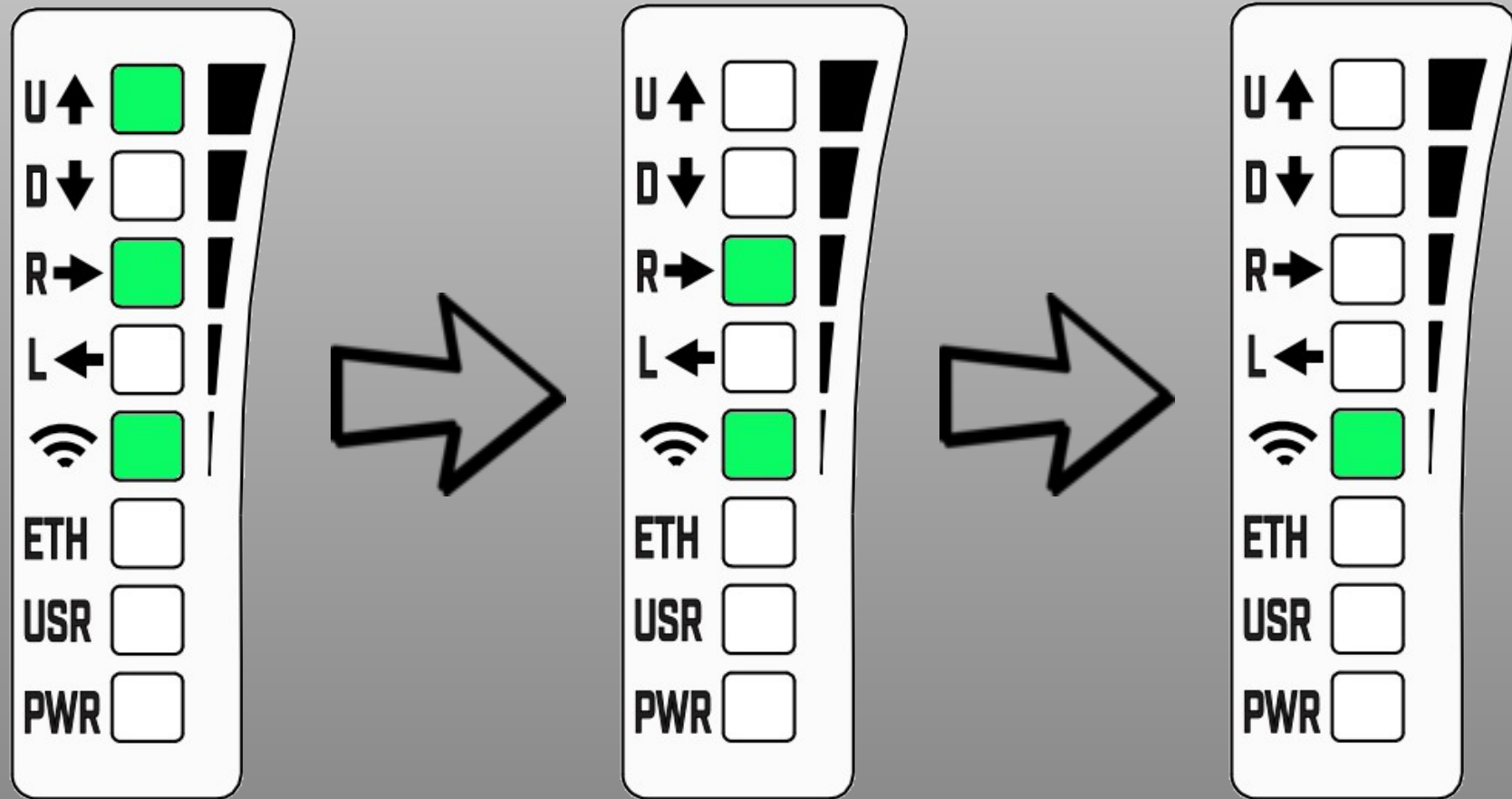
# W60G new features

- More improvements in Beamforming efficiency
- Throughput improvements when link fully utilized
- Added used Beamforming pattern information for easier LHG60G alignment
- Added 4<sup>th</sup> channel (Center frequency 64800) for testing purposes



# W60G new features

- LEDs help to find best Beamforming pattern



# Certification adoption

United States (FCC)	United Kingdom (Ofcom)	Europe (ETSI)
<b>Point to Point</b> <ul style="list-style-type: none"><li>• Free use for &lt;40dBm EIRP</li><li>• Max EIRP 82 dBm minus 2 dB for every dB that the antenna gain is below 51 dBi</li></ul>	<b>Point to Point</b> <ul style="list-style-type: none"><li>• Minimum antenna gain 30dBi, max EIRP 55 dBm</li><li>• Proposed free use for &lt;40dBm EIRP</li></ul>	<b>Point to Point</b> <ul style="list-style-type: none"><li>• Different rules in different countries</li><li>• Minimum antenna gain 30dBi, max EIRP 55 dBm</li></ul>
<b>PtMP</b> <ul style="list-style-type: none"><li>• Free use for &lt;40dBm EIRP</li><li>• Max EIRP 82 dBm minus 2 dB for every dB that the antenna gain is below 51 dBi</li></ul>	<b>PtMP</b> <ul style="list-style-type: none"><li>• Minimum antenna gain 30dBi, max EIRP 55 dBm</li><li>• Proposed free use for &lt;40dBm EIRP</li></ul>	<b>PtMP</b> <ul style="list-style-type: none"><li>• Different rules in different countries</li><li>• Minimum antenna gain 30dBi, max EIRP 55 dBm</li></ul>

# Where are we now...

- WAP60G devices for indoor use in most of EU countries (EN 302 567)
- SXTsq outdoor use with 20dBm power limitation (EN 302 567)
- LHG60G – outdoor fixed link usage (EN 302 217)

# Thank you for your attention!

<https://www.mikrotik.com>

<https://wiki.mikrotik.com>

<https://forum.mikrotik.com>

[support@mikrotik.com](mailto:support@mikrotik.com)