



LigoWave Training

2018

Established in 2007

Worldwide presence

R&D in Europe

We Are Global



50



Engineers



Selling to over **100+** countries worldwide

Why LigoWave: Advantages



Software

Proprietary protocols for prioritized data transfer & cloud controller



Profitability

Substantial channel management, higher distributor margins



Support

Pre/post sales & technical engineering support with multiple channels available



Production

Own manufacturing facility: higher quality control, shorter lead-time.



Innovation

Products designed in-house under close collaboration to ensure innovation



Reliability

Less Than 1% Defective Rate



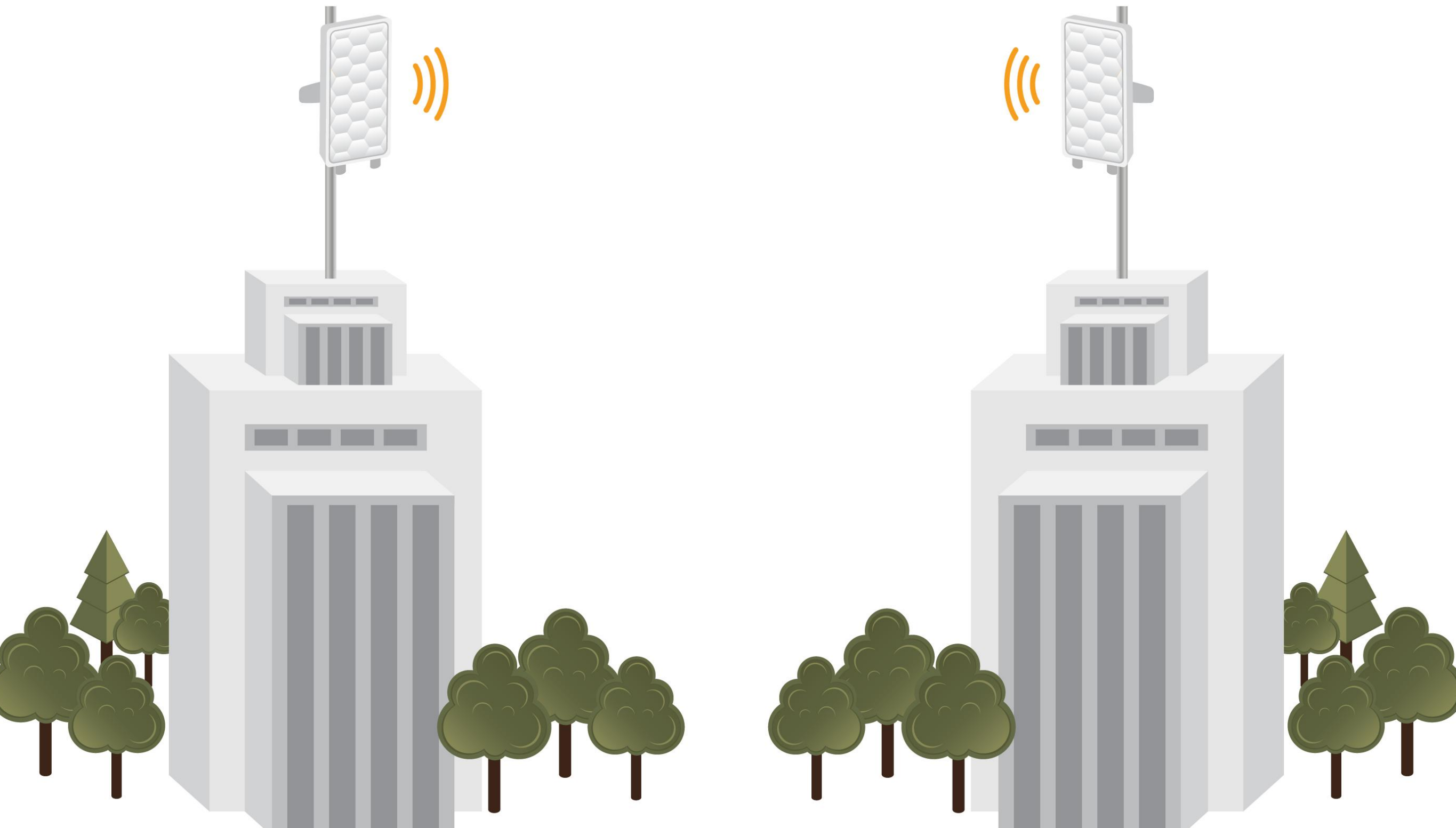
LigoWave

Product lines

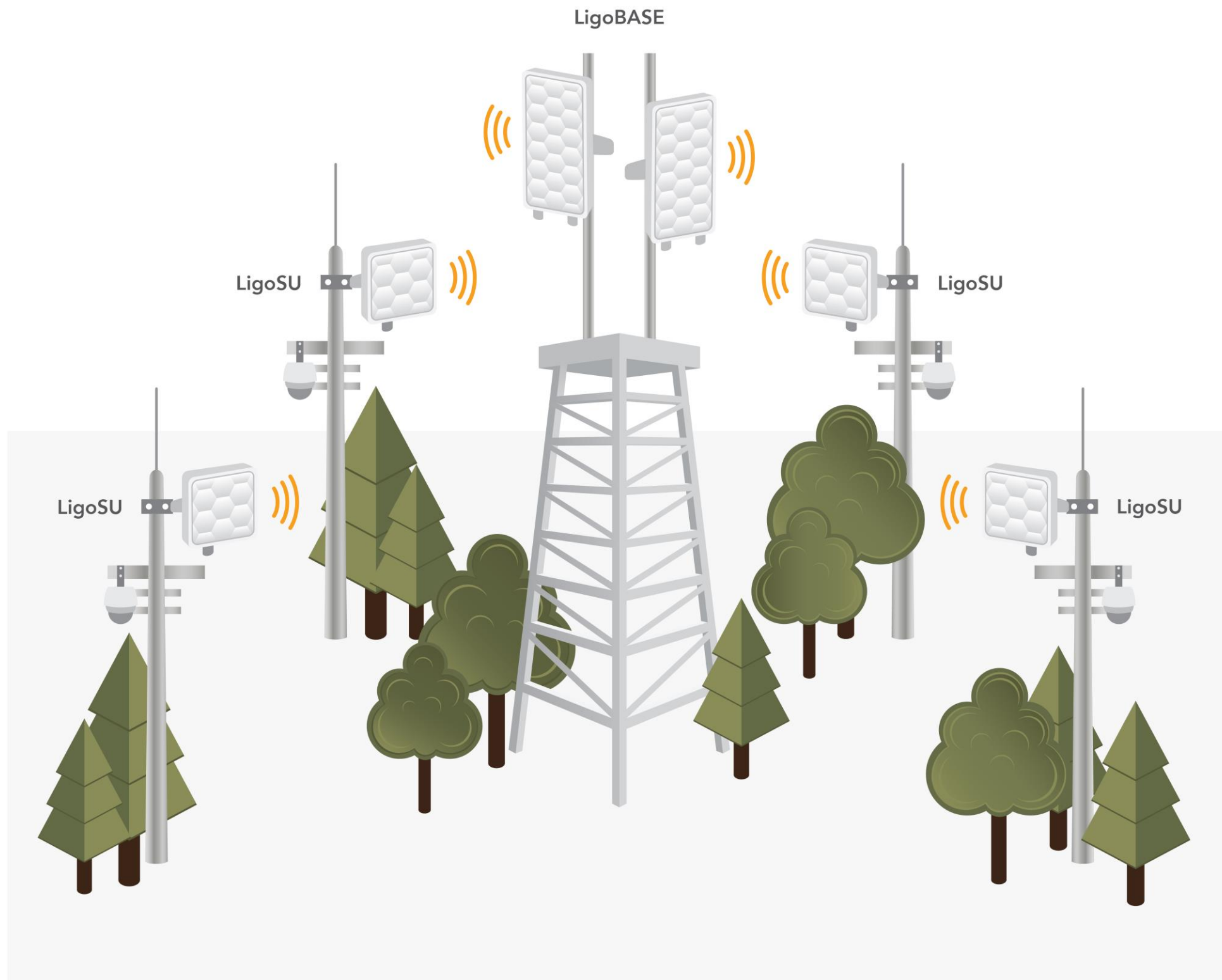
Our Product Portfolio

- LigoPTP - Carrier grade wireless Point-To-Point
- LigoPTMP - Carrier grade Point-To-Multipoint
- LigoDLB - Cost-effective Base Stations/CPE
- Infinity - AP series for small to large enterprises

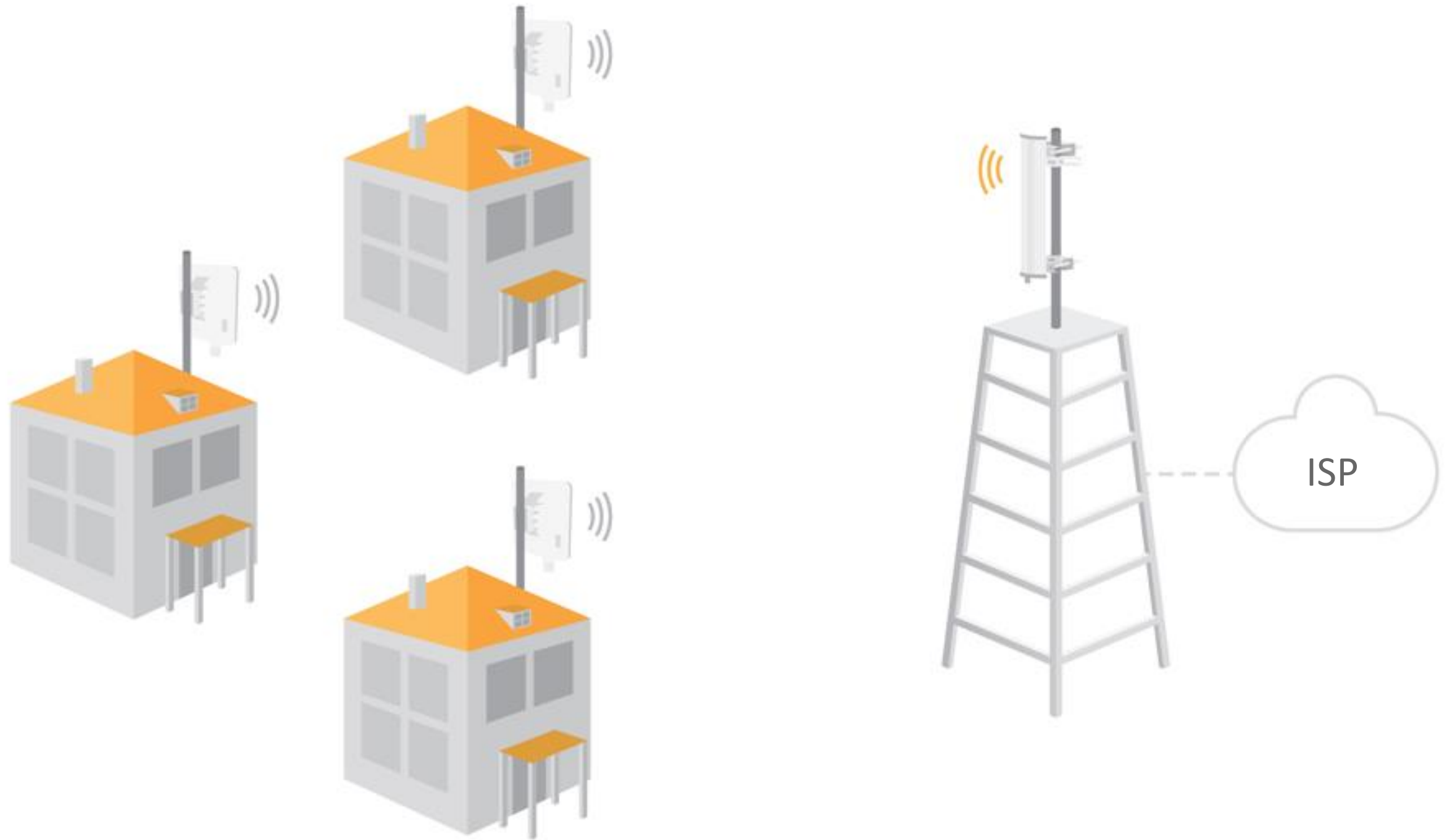
LigoPTP product line



LigoPTMP product line



LigoDLB product line

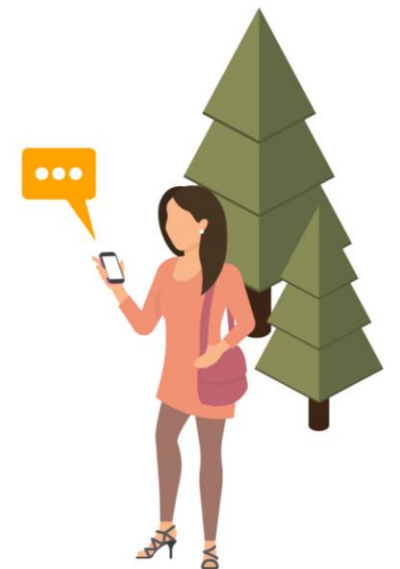
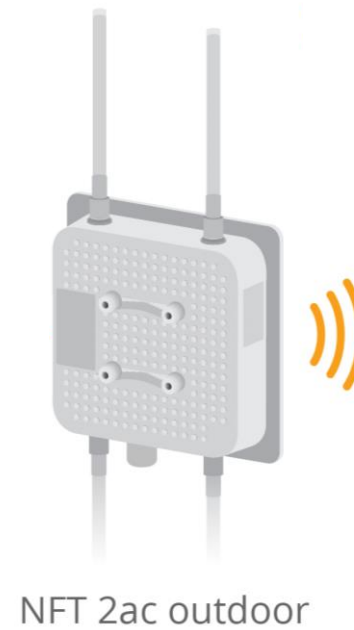


Infinity product line

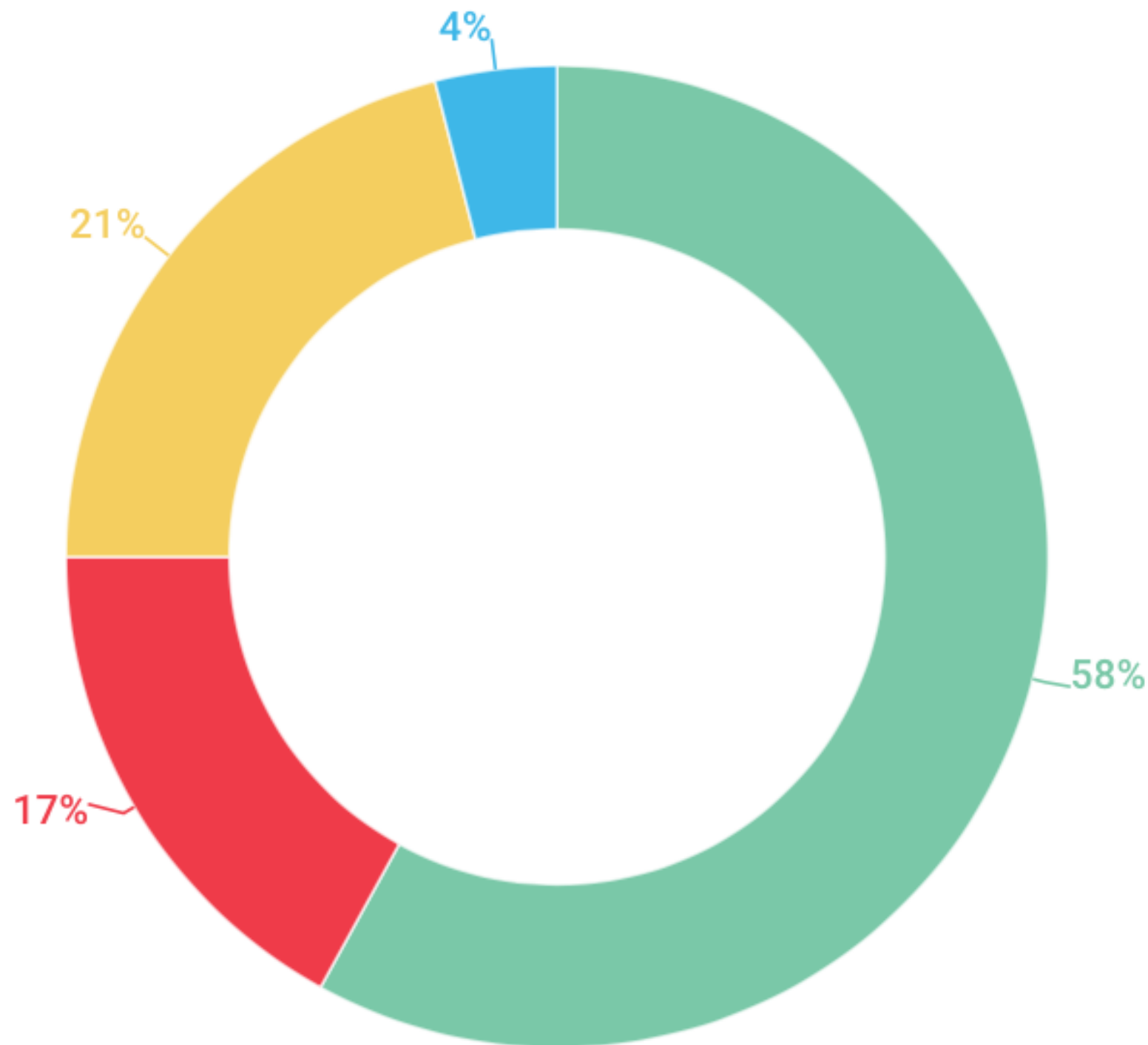
1



2



Product families distribution in Europe



● DLB ● PTP ● NFT ● Others

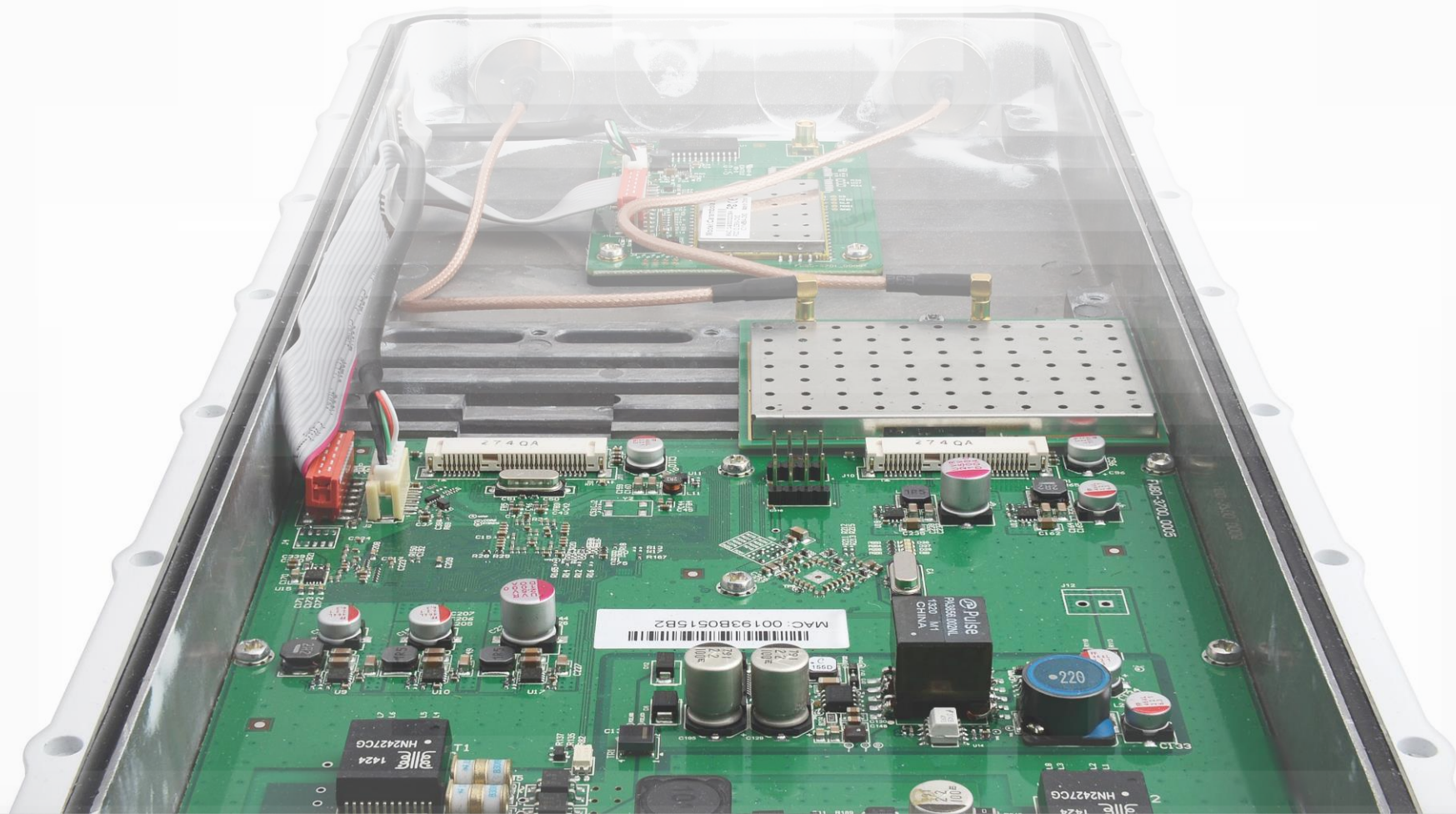
LigoPTP RapidFire Training



LigoPTP RapidFire 5-23/ 5-N

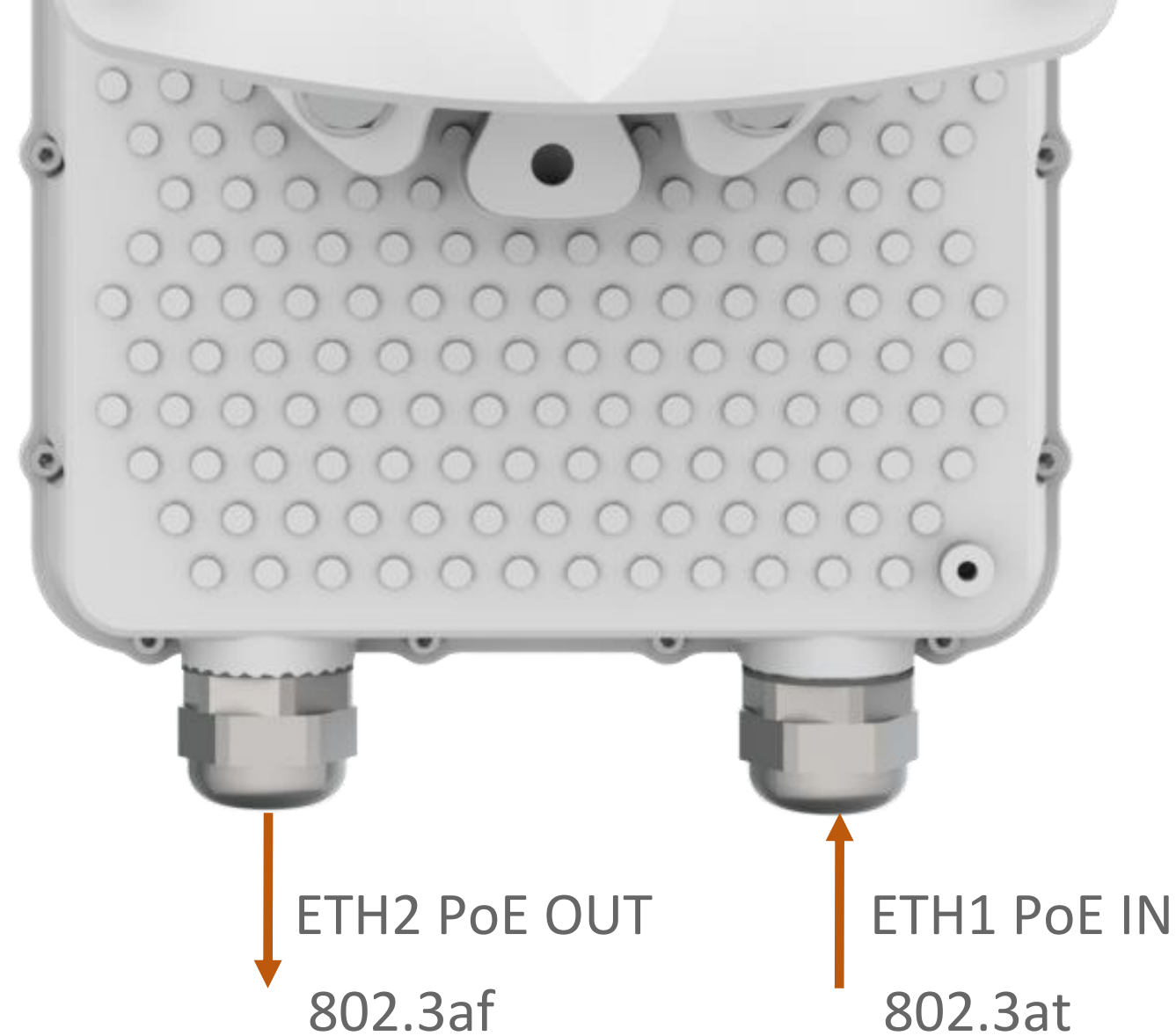


- 1.2 GHz dedicated Marvel Armada CPU
- 700+ Mbps (2x2)
- 220k PPS rate
- Integrated 2.4 GHz radio for management
- 2 x 1000 BaseT Ethernet ports (802.3 at/af compatible) with PoE passthrough
- 23 dBi (2x2) integrated antenna or external N connectors



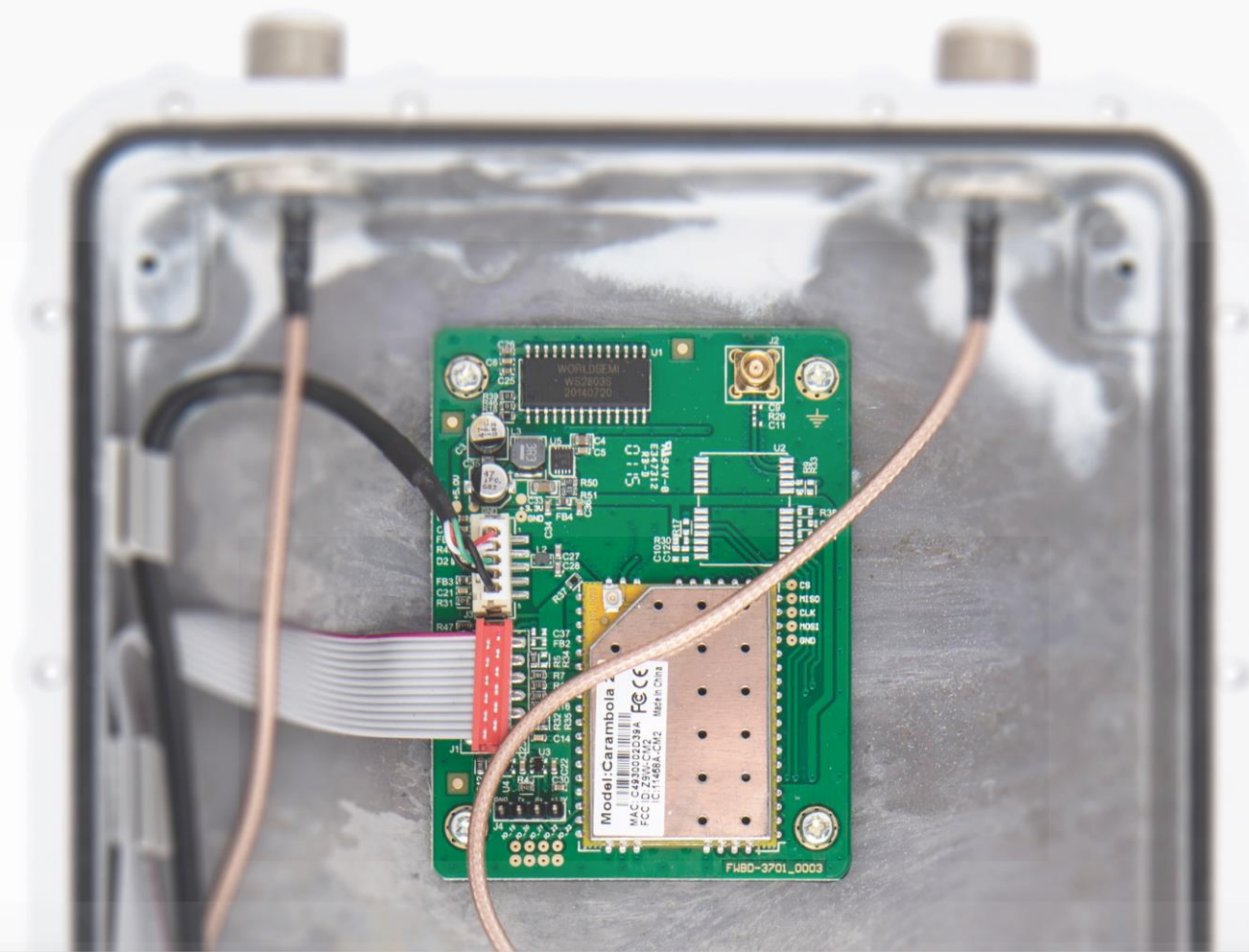
Powerful hardware platform

- 1.2 GHz dedicated Marvel Armada CPU
- 220k PPS rate
- 2 x 1000 BaseT Ethernet ports (802.3 at/af compatible) with PoE passthrough



2 x Gigabit Ethernet ports:

- With a real PoE passthrough
- Ideal for repeater and video surveillance scenarios



Integrated 2.4 GHz radio:

- Allows accessing LigoPTP devices from the distance
- Simplifies the installation of the link:
 - HTML 5 based GUI plays sound
 - Link configuration and testing can be performed onsite



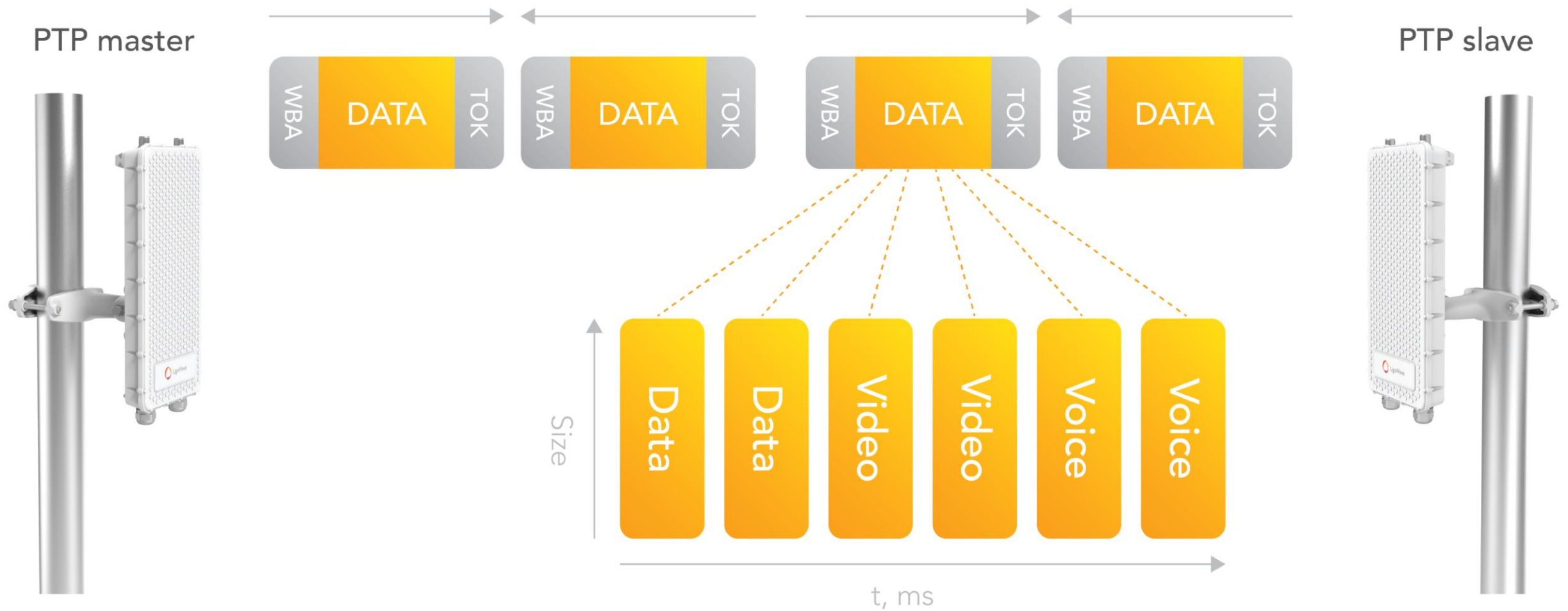
SLA control

1. Proprietary protocol








- 700+ Mbps at 256 QAM
- W-Jet V:
 - More efficient spectrum usage
 - Long distance support
 - Robustness against interference
 - Smart auto rate management
 - Custom hybrid TDMA mode
 - High PPS


W-Jet V in action



Advanced software features


 **WIRELESS**



Operating mode: Master **Operating country:** LT


Radio settings


Link ID: RAPIDFIRE


Broadcast link ID: ☒ 


Channel selection: Auto / 80 MHz

Max data rate, Mbps: 866.7 (256-QAM 5/6)

Tx power (dBm):  23

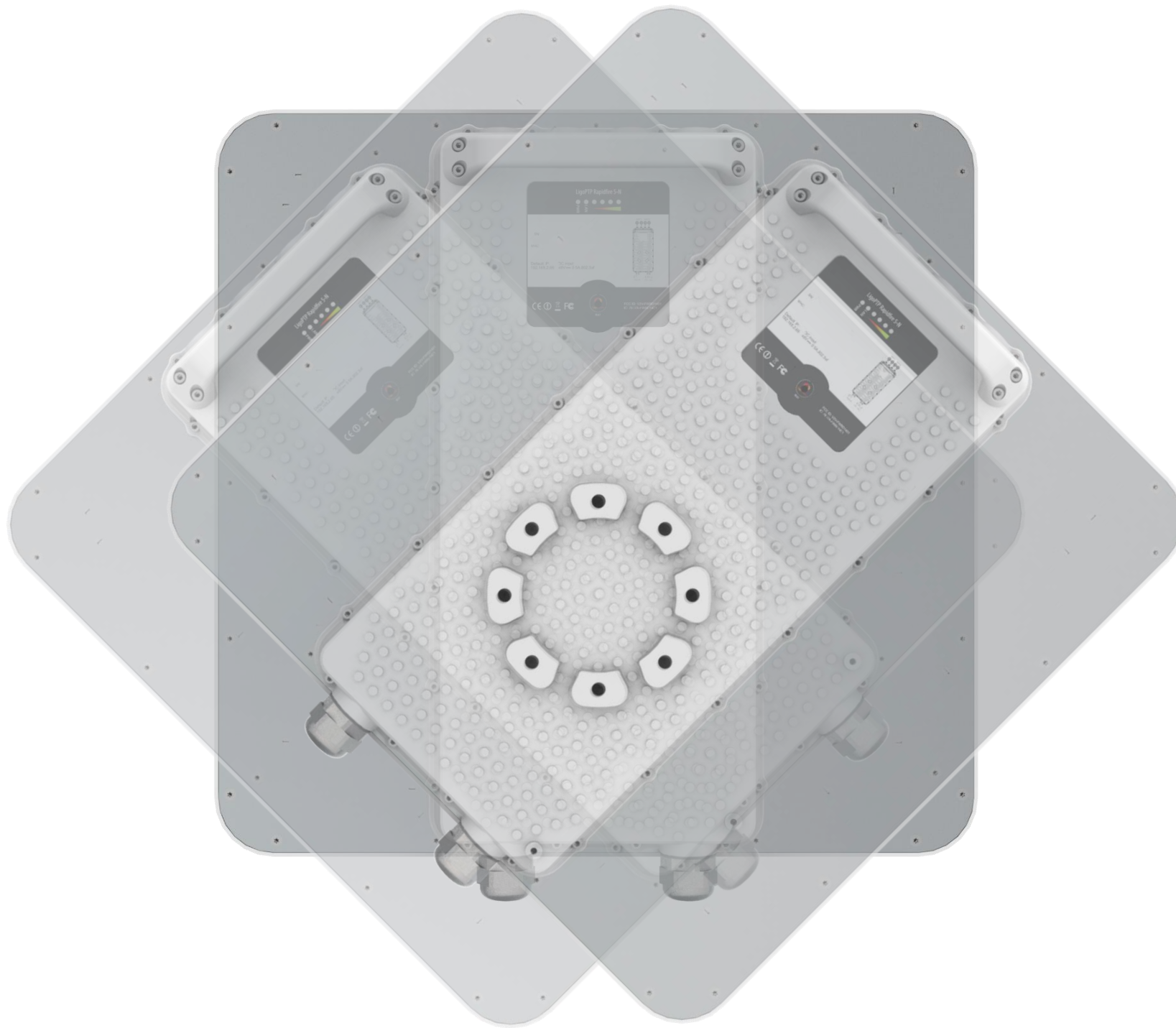
Spatial data streams: 2 

ATPC: ☒ 

Target signal level, dBm  -55

1. Smart Auto-Channel
2. Efficient Data Rate Control Algorithm
3. Automatic Transmit Power Control

2. Interference reduction



45 degree
antenna rotation



3. Integrated surge protection:

Designed according to IEC standards:

- Surge: EN 6100-4-5, Class 4, 4 kV line to ground, 2 kV line to line discharge
Tested: 6 kV line to ground and 2 kV line to line discharge

4. Two firmware images

MAINTENANCE

Firmware update:

Update

Reboot device:

Reboot

Backup configuration:

Backup

Restore device config:

Restore

Reset to factory defaults:

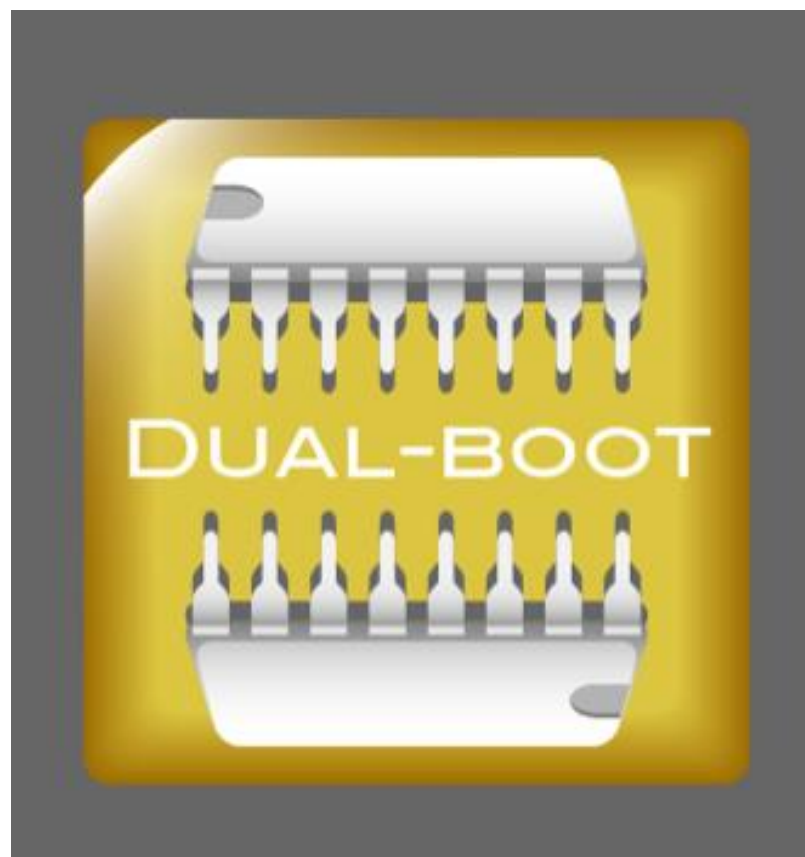
Reset

Dual boot firmware images

Active firmware: PTP.MA-1.v7.53-3.19939

Backup firmware: PTP.MA-1.v7.53-3.20669 (Activate)

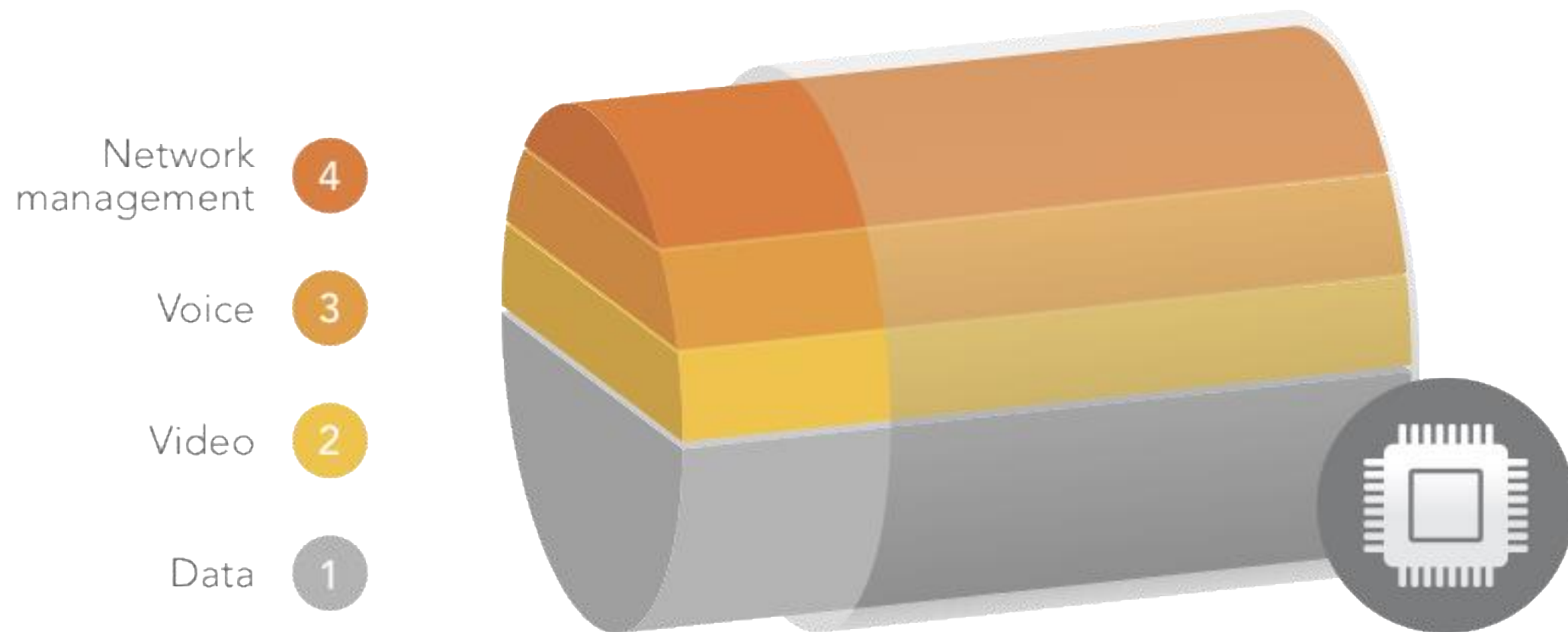
Note: updating firmware image always replaces backup firmware image and activates it automatically after reboot!



Two firmware images:

- Safe upgrades
- Easy maintenance

5. Wire speed QoS



- Hardware based - no extra load on a CPU
- 4 priority queues for different traffic types (4th queue is the highest)
- Strict and weighted round robin policies for data transmission
- Packet prioritisation by VLAN/CoS (L2) and IP/ToS/DSCP (L3) marks

5. Wire speed QoS

QoS

Policy: Strict

Precedence: 802.1p

Enable L2 802.1p: ☒ ☐

802.1p Queue

0 1

1 1

802.1p Queue

2 2

3 2

802.1p Queue

4 3

5 3

802.1p Queue

6 4

7 4

Enable L3 DSCP: ☒ ☐

DSCP Queue

0 1

1 1

2 1

3 1

4 1

DSCP Queue

16 2

17 2

18 2

19 2

20 2

DSCP Queue

32 3

33 3

34 3

35 3

36 3

DSCP Queue

48 4

49 4

50 4

51 4

52 4



Improved security

- RapidFire PTP link is always encrypted (AES-128)
- Administrator doesn't need to input wireless password separately - link password is generated from system/GUI password automatically
- For GUI access we also recommend to use HTTPS, for console - SSH



RapidFire - simple installation

RapidFire installation



- Pole diameter up to 124 mm (4.8")

- Handle to carry on tower



Twisted pair cabling

1



Use FTP cable

2



Use shielded
RJ-45 plugs

3



Solder drain wire
to RJ-45 plug

4



Cable length from
LigoPTP to switch is
up to 100 meters

5



Assemble the gland

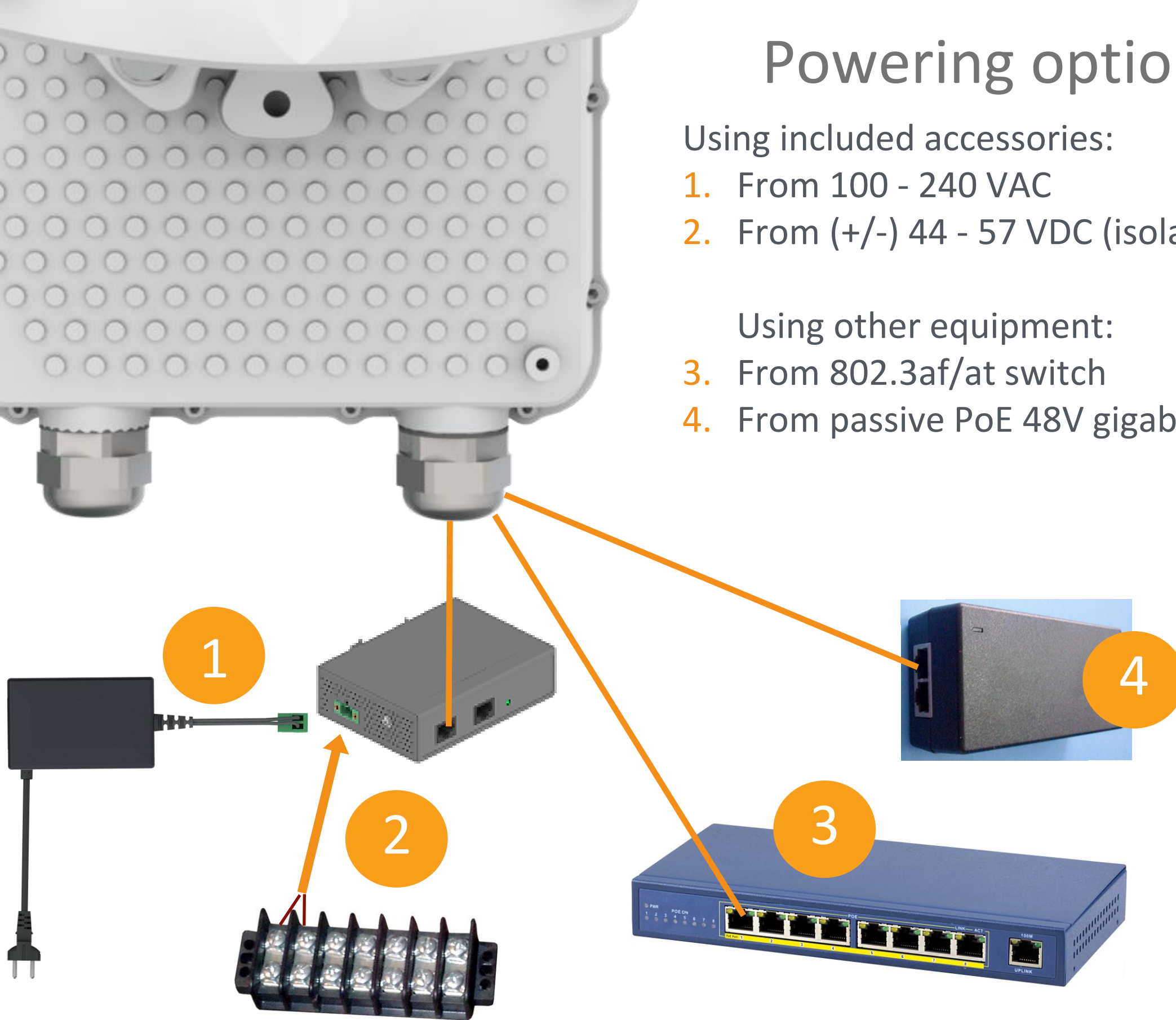
Powering options

Using included accessories:

1. From 100 - 240 VAC
2. From (+/-) 44 - 57 VDC (isolated)

Using other equipment:

3. From 802.3af/at switch
4. From passive PoE 48V gigabit adaptor



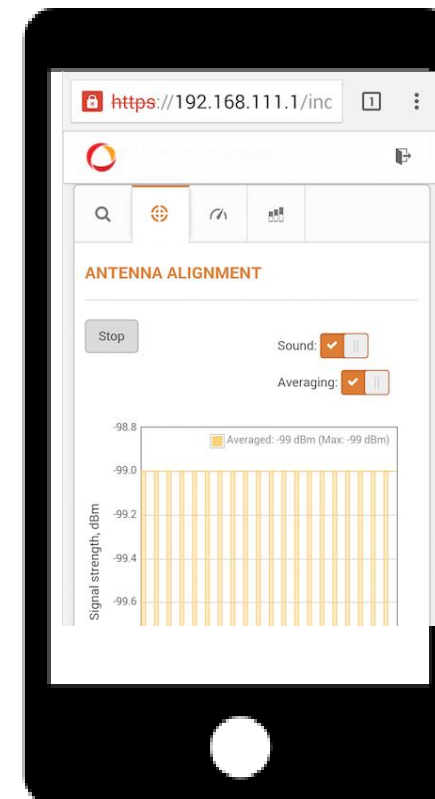
RapidFire antenna alignment options

A



Look at RGB LEDs

B



+



Get sound from antenna alignment tool via GUI

RGB LEDs with multifunction button



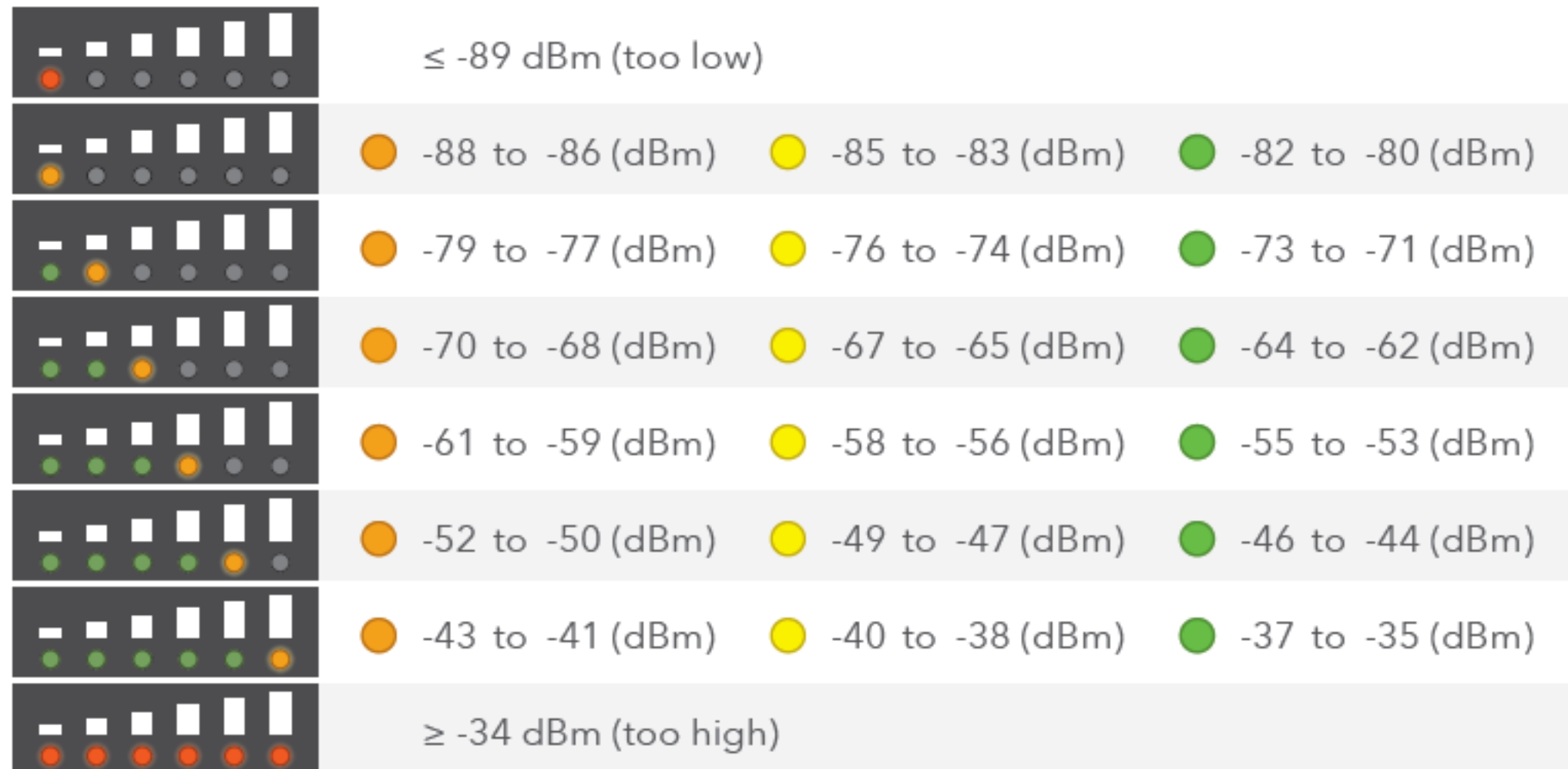
LEDs indicate device status:

- Booting up/ rebooting
- Firmware upgrading
- Reseting to defaults
- Recovery mode

When operating a link:

- Ethernet port status and speed
- Signal level in 1 dBm step
- 2.4 GHz radio activity
- PoE OUT

Link signal indication



Device status indication



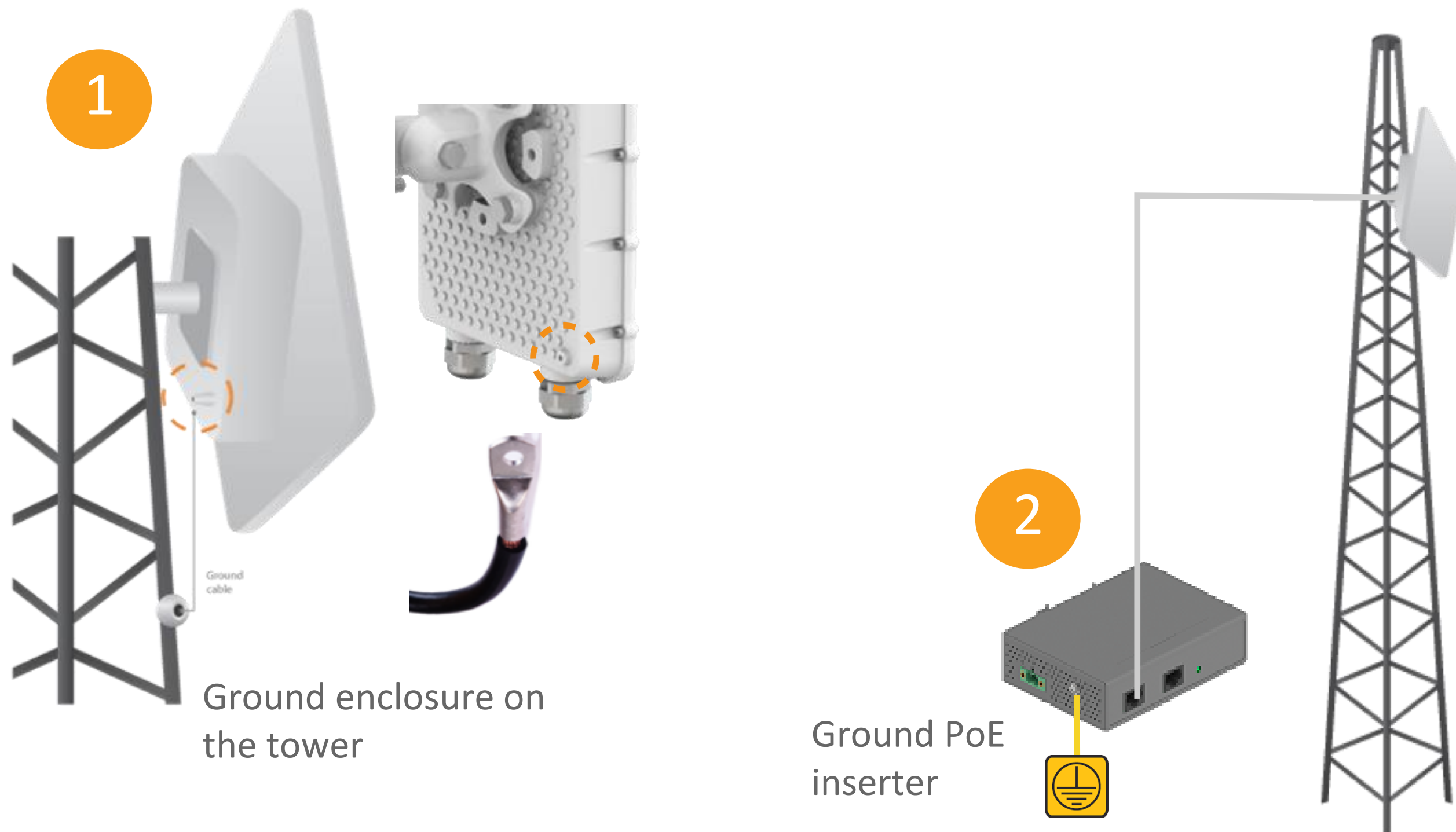
- PWR: ON
- ETH1: 1000 Mbps 10/100 Mbps
- ETH2: 1000 Mbps 10/100 Mbps
- PoE OUT: ON
- LINK: Established
- MNG: 2.4 GHz radio ON
- Booting up: Bootloader Kernel Userspace Radio License
- Upgrading: "running snake"
- Recovery: blinking

Additional information about lightning and installation

About **90%**
of equipment
fails
due to **lightning.**

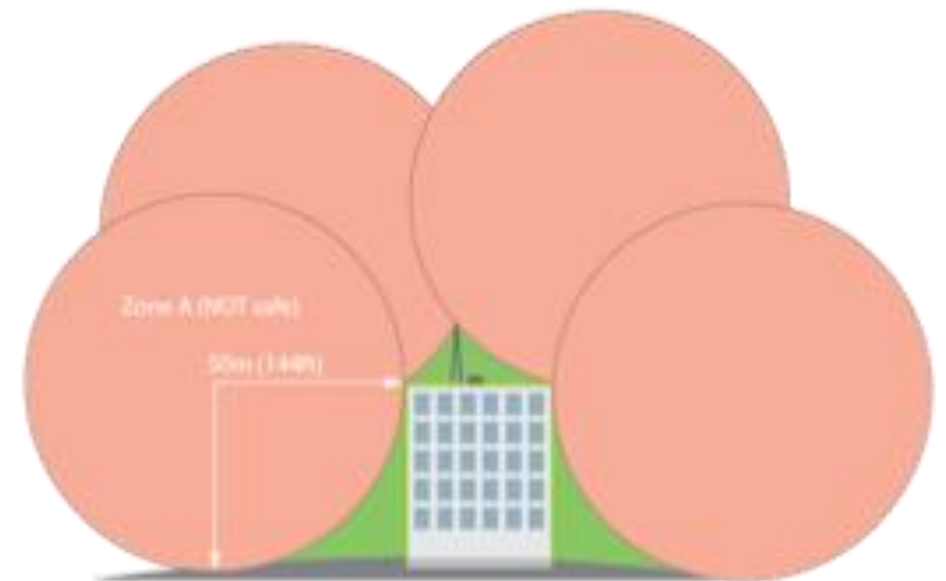
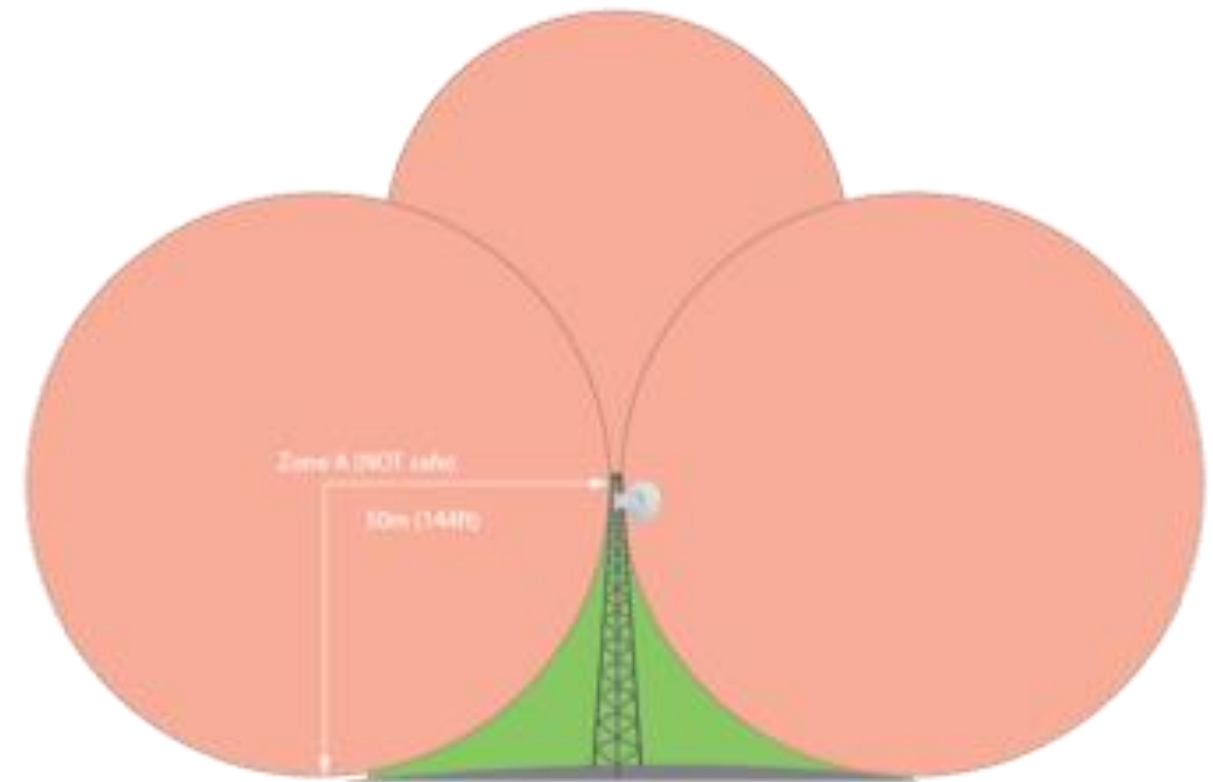
- More than 2,000 thunderstorms occur throughout the world at any given time. They produce about 40-50 lightning flashes per second.
- Towers are struck by lightning more often than any other buildings.
- Any lightning strike can destroy a radio system.
- Proper grounding reduces the probability of damage.

RapidFire grounding



Installation place

- **Principle:** draw an imaginary sphere ~50m (144ft) over the structure. Anything touched by the sphere could be hit by lightning (**Zone A**).
- All the space under the sphere is considered to be in the protection zone (**Zone B**).
- **Zone A (NOT safe):** In this zone a direct lightning strike is possible. It is not recommended to mount the device in this zone.
- **Zone B (safe):** In this zone, direct lightning strikes are still possible, but mounting in this zone significantly reduces this possibility.





RapidFire success stories

Why people choose LigoPTP?



- Best in the class transmission protocol
- Affordable price per Mbps ratio
- Carrier grade components
- Customer base ranges from T1 operators to small ISPs
- Professional support
- Very easy to configure and deploy
- Free NMS
- Developed for PTP applications



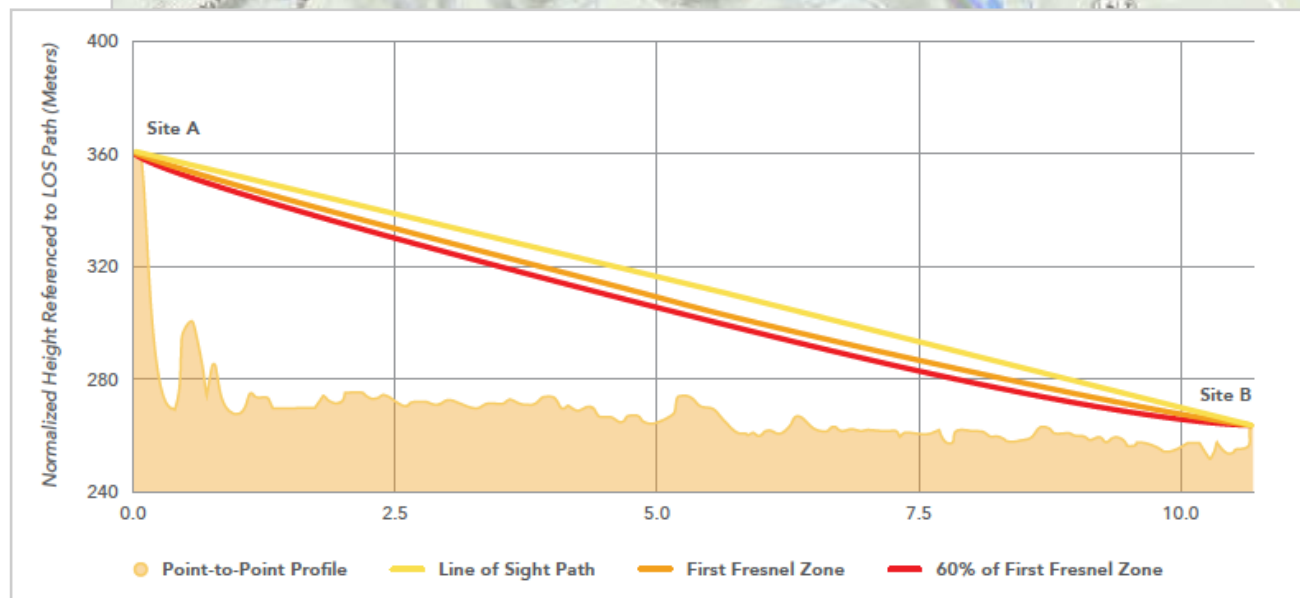
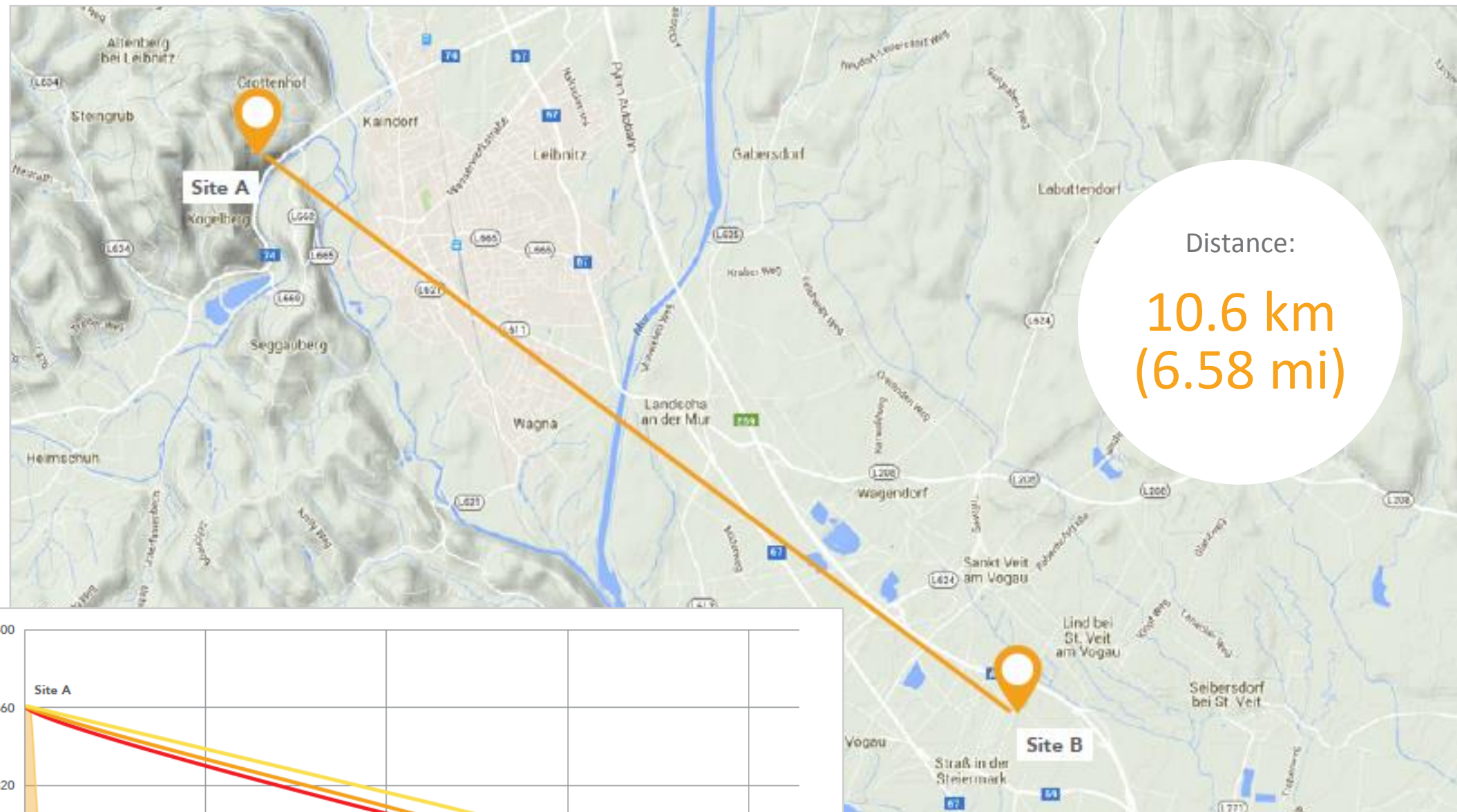
LigoPTP 5-N RapidFire award

Spectral Efficiency with 80 MHz Channel Bandwidth 8.9 bit/Hz



10.6 km (6.58 mi) Link in Austria

Link profile





Result

Signal levels:
-57 / -60 dBm
(very good)

Frequency:
5340 MHz

Throughput is measured with Mikrotik bandwidth tester

Channel size	UDP throughput simplex
40 MHz	270 Mbps
80 MHz	450 Mbps

19 km (11.8 mi) link test in Hungary



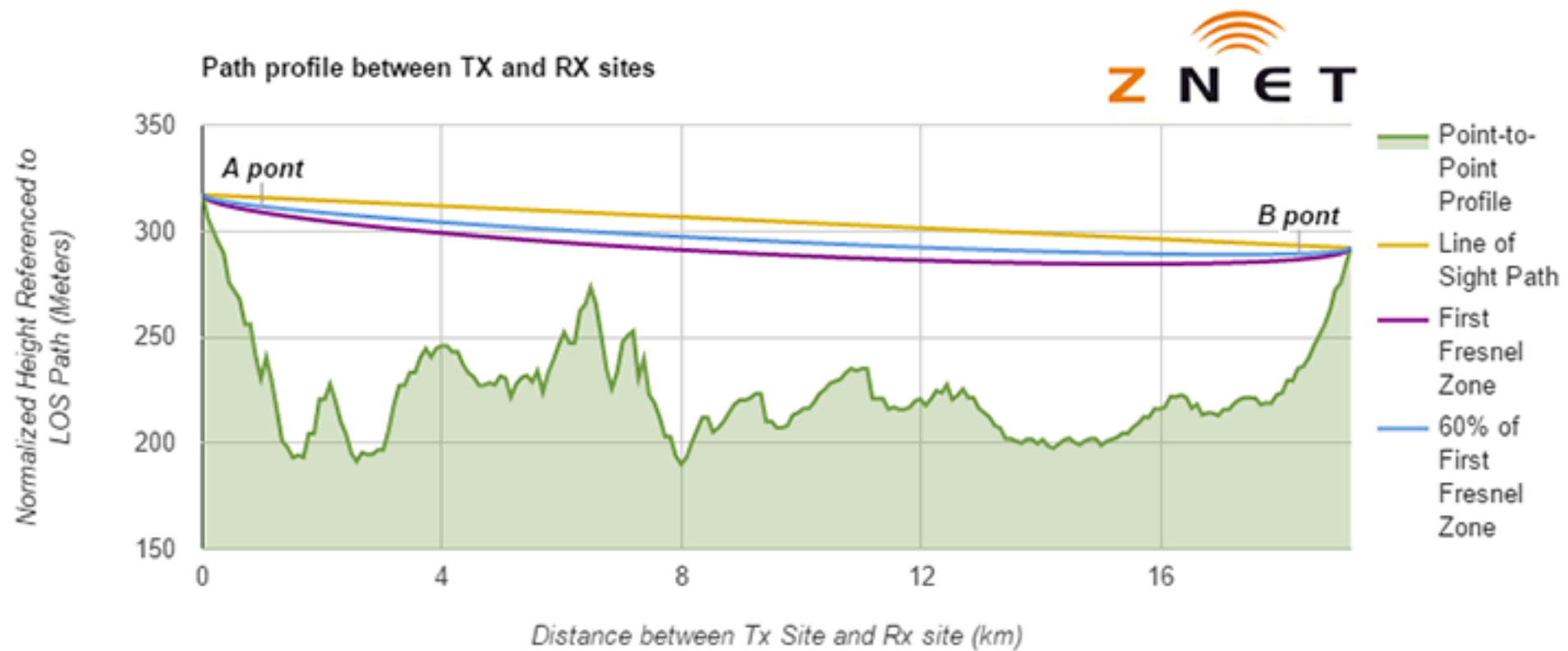
INTERNET
TELEFON
TELEVÍZIÓ



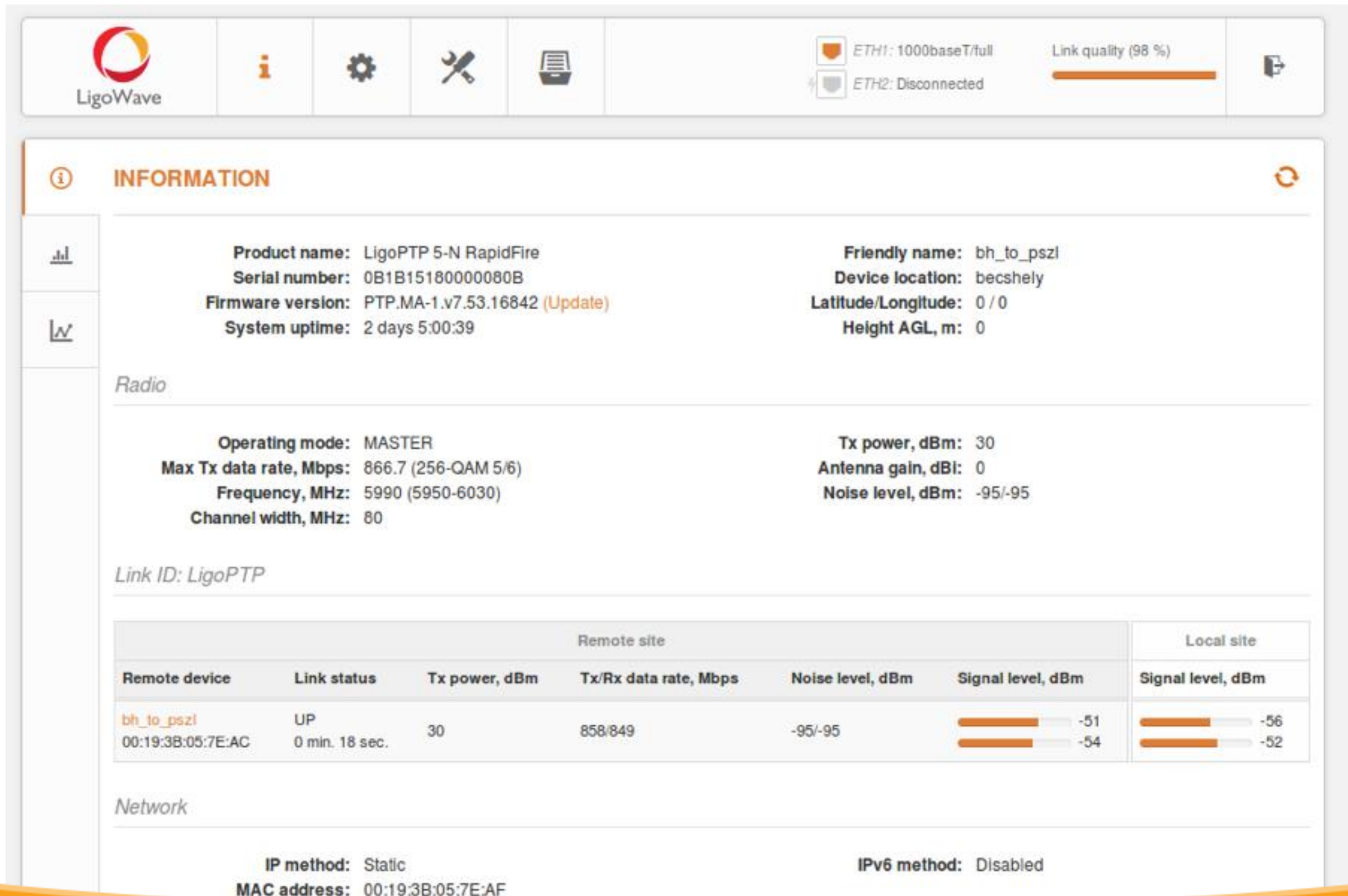
General information

- Distance: 19.16 (11.9 mi) km
- Location: Hungary
- Equipment: LigoPTP RapidFire 5-N
- Antennas: 34 dBi Grante HPA's

Link path analysis



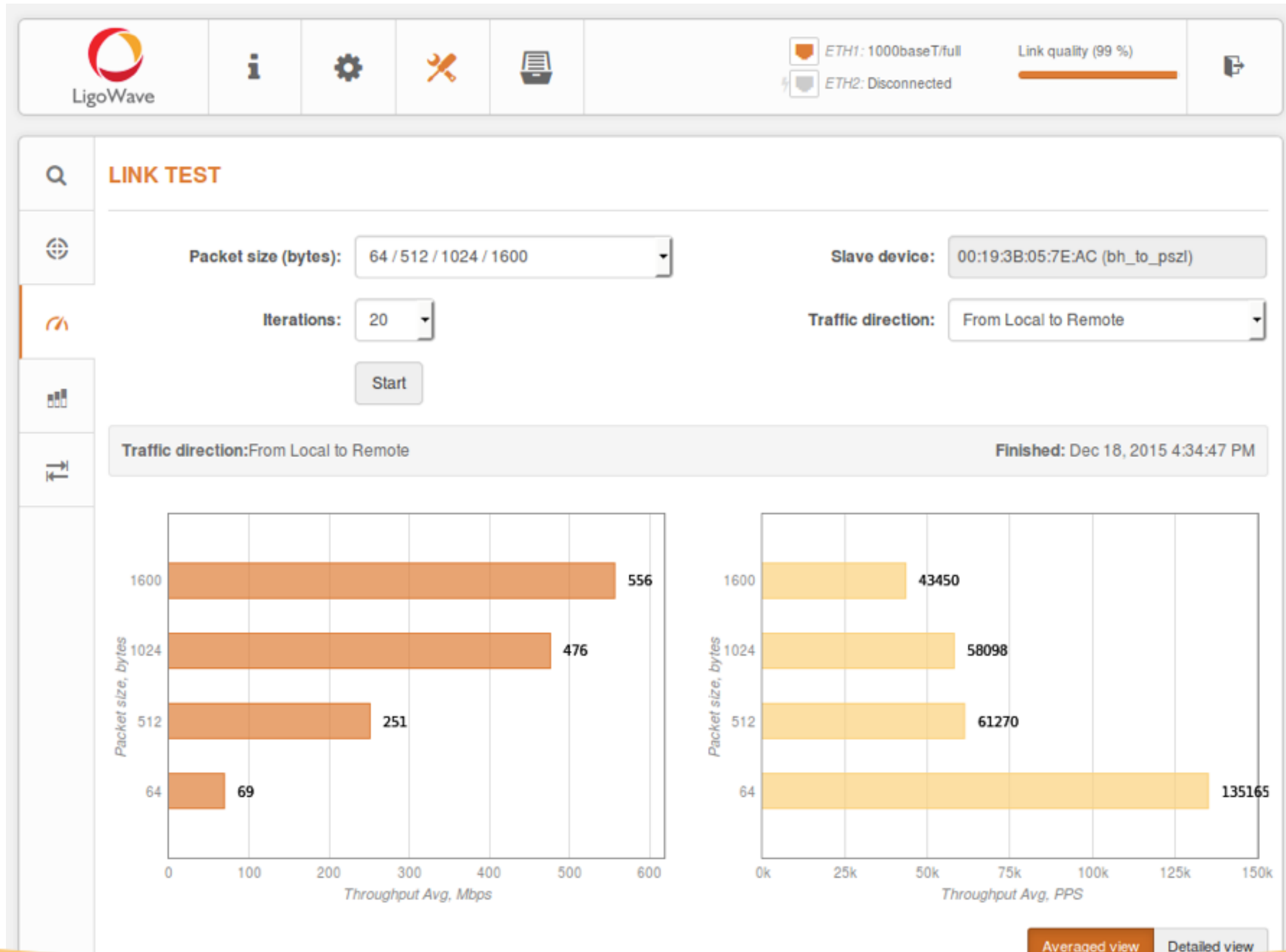
Link stats



Spectrum analysis



Performance test



24 km (14.9 mi) link test in Mexico





Link path analysis









Equipment: LigoPTP RapidFire 5-N


Antenna: 30 dBi directional dual-pol dishes


Height (AGL): 24 m (78.7 ft)


Link stats



 ETH1: 100baseT/full

 ETH2: Disconnected

Link quality (62 %)




Configuration saved

 INFORMATION 



Product name: LigoPTP 5-N RapidFire

Serial number: 0B1B15180000080C

Firmware version: PTP.MA-1.v7.53.16912 (Update)

System uptime: 5 days 7:04:54

Friendly name: LigoPTP 5-N RapidFire

Device location: RP Cañadas

Latitude/Longitude: 0 / 0

Height AGL, m: 0

Radio

Operating mode: MASTER

Max Tx data rate, Mbps: 866.7 (256-QAM 5/6)

Frequency, MHz: 5500 (5460-5540)

Channel width, MHz: 80

Tx power, dBm: 30

Antenna gain, dBi: 30

Noise level, dBm: -95/-95

Link ID: LigoPTP-Rapidlink

Remote site						Local site
Remote device	Link status	Tx power, dBm	Tx/Rx data rate, Mbps	Noise level, dBm	Signal level, dBm	Signal level, dBm
LigoPTP 5-N RapidFire	UP	30	481/592	-95/-95	 -65	 -64
00:19:3B:05:7E:BB	4 min. 51 sec.				 -68	 -67

Network

IP method: Static

MAC address: 00:19:3B:05:7E:B0

IP address: 192.168.10.200

Subnet mask: 255.255.255.0

IPv6 method: Disabled

Spectrum analysis



Link test



LINK TEST



Packet size (bytes): 64 / 512 / 1024 / 1600 ▼

Slave device: 00:19:3B:05:7E:BB (LigoPTP ...)

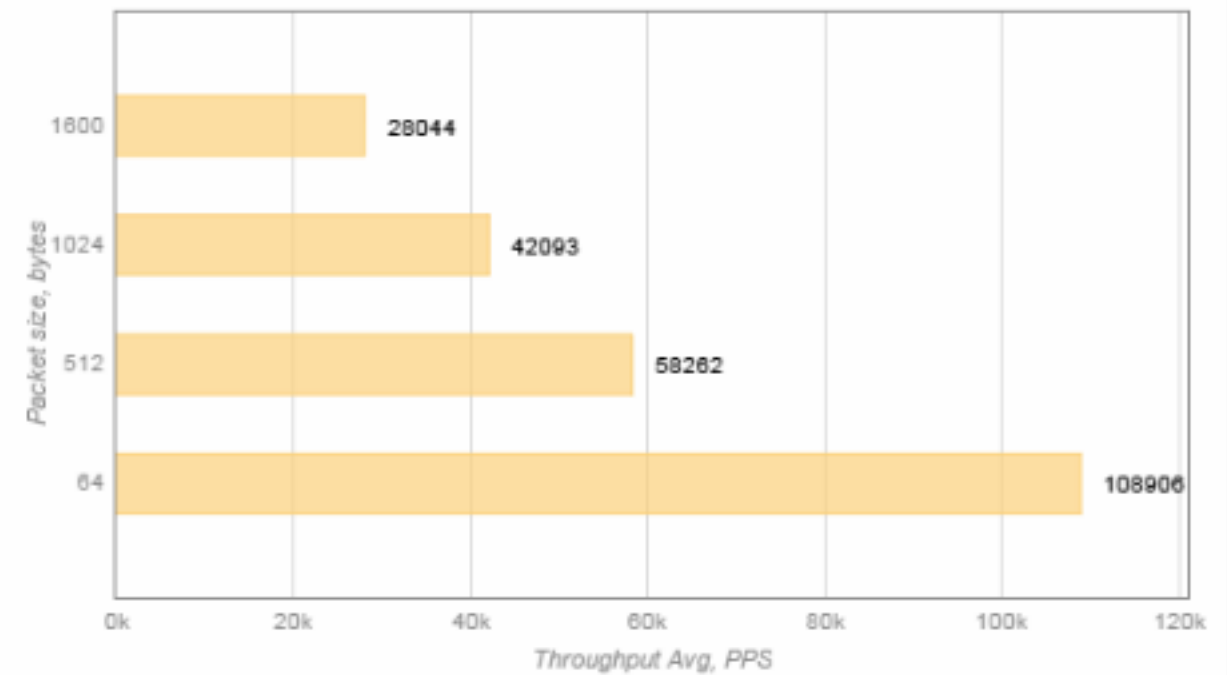
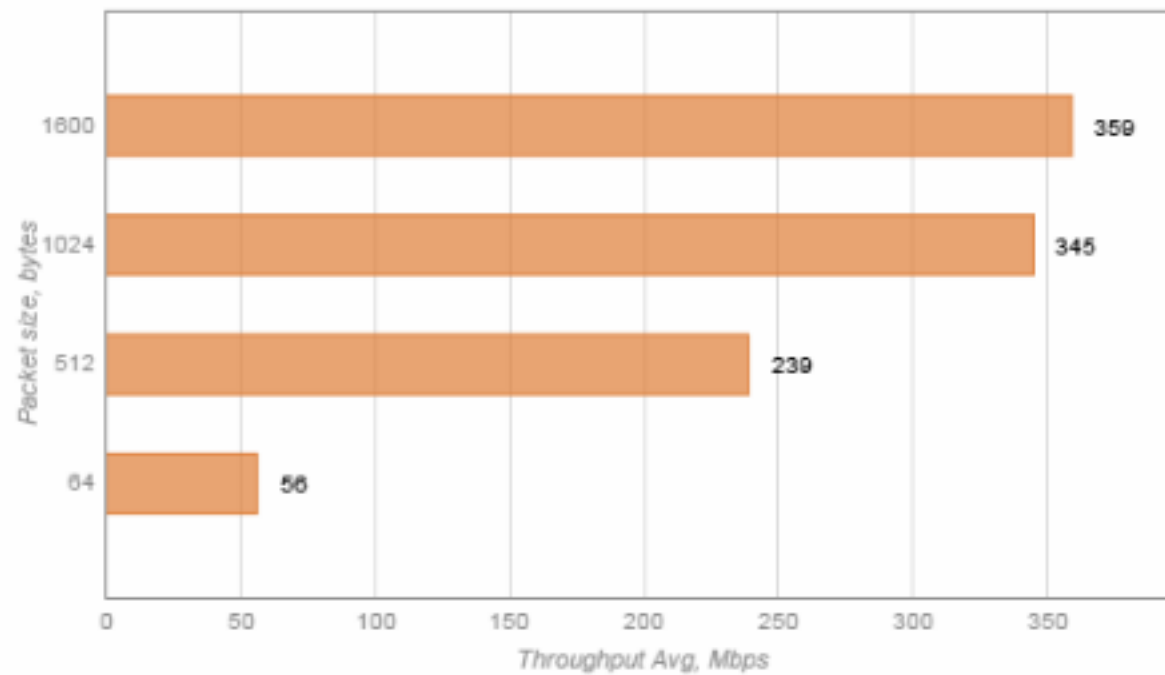
Iterations: 20 ▼

Traffic direction: From Local to Remote ▼

Start

Traffic direction: From Local to Remote

Finished: Dec 15, 2015 1:15:01 AM



Averaged view

Detailed view

Pkt size, bytes	Throughput, Mbps	Throughput, PPS	Packet loss, %
From Local to Remote			
64	56	108906	

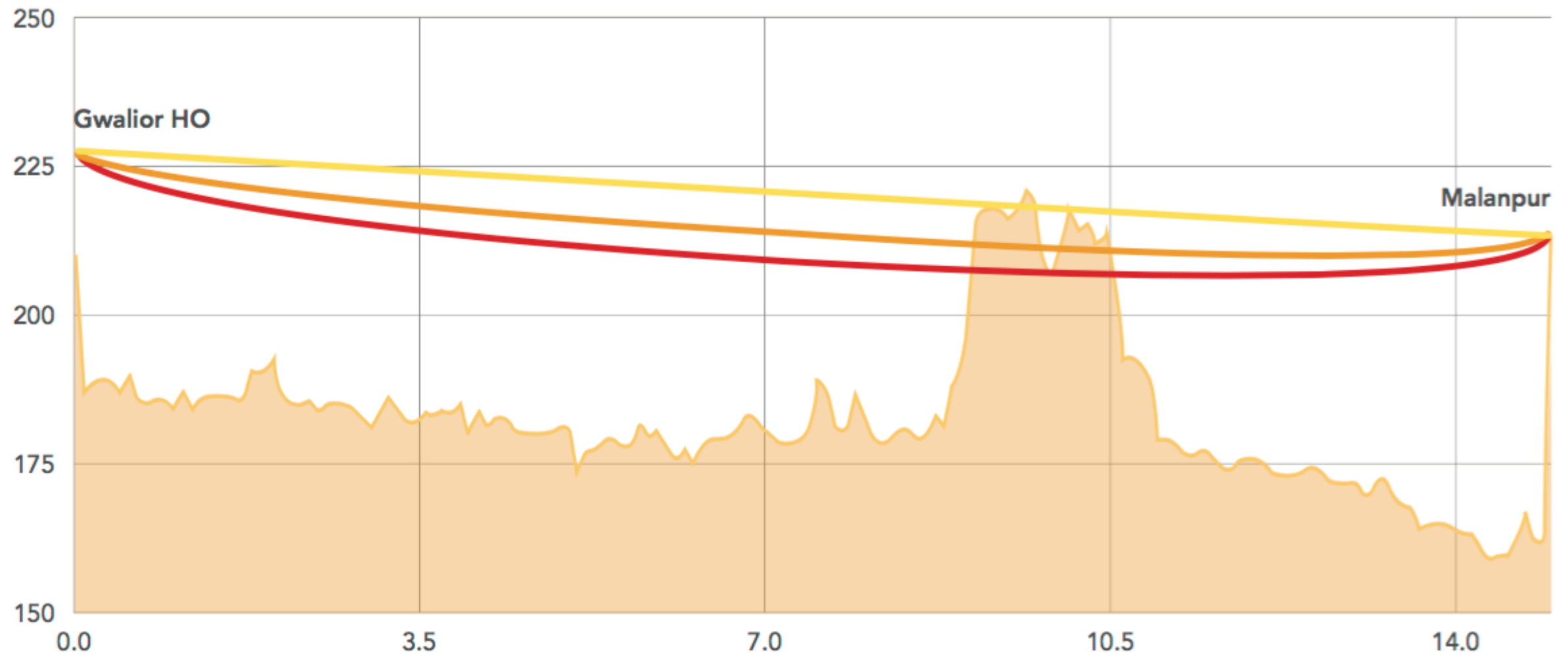
NLOS

14.9 km (9.3 mi) solution in India



- LigoPTP RapidFire 5-N
- Antennas: 32 dBi Telimart dishes

Link path profile



There are 19 IP cameras (5 fixed and 14 PTZ) installed in the entire Malanpur Plant premises

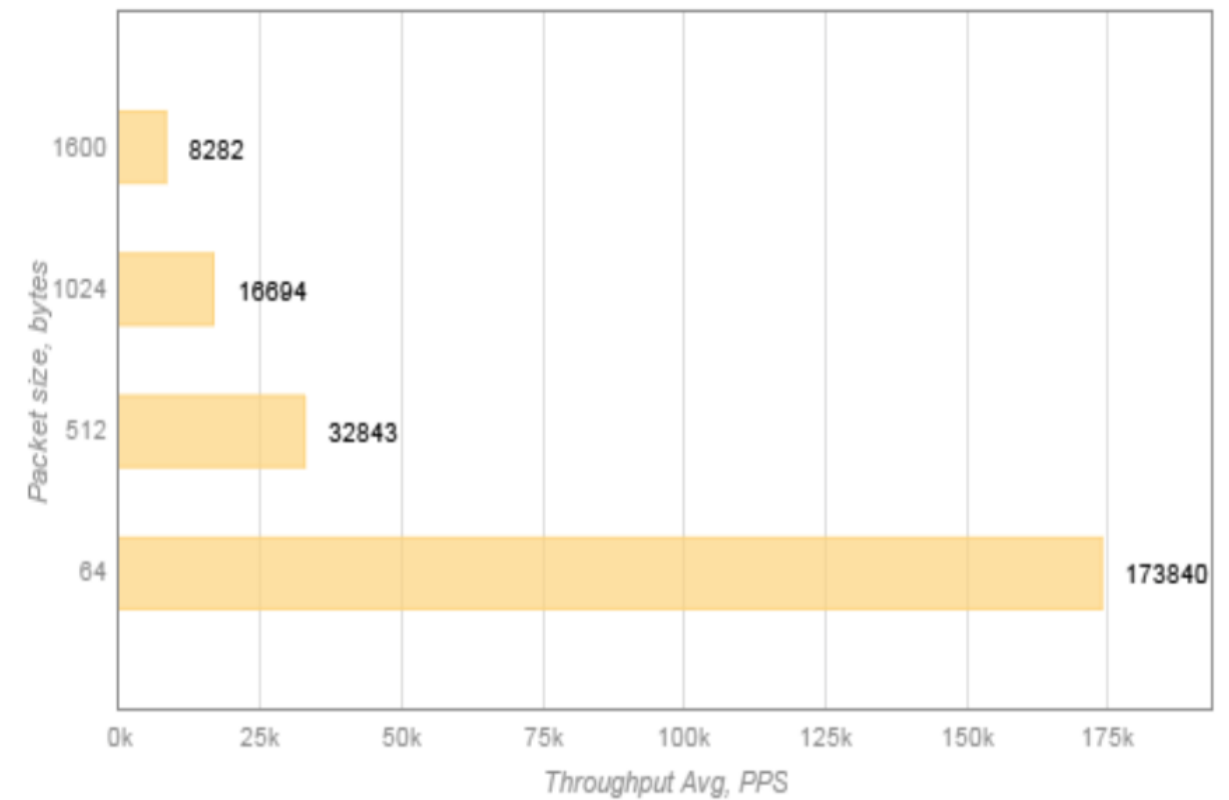
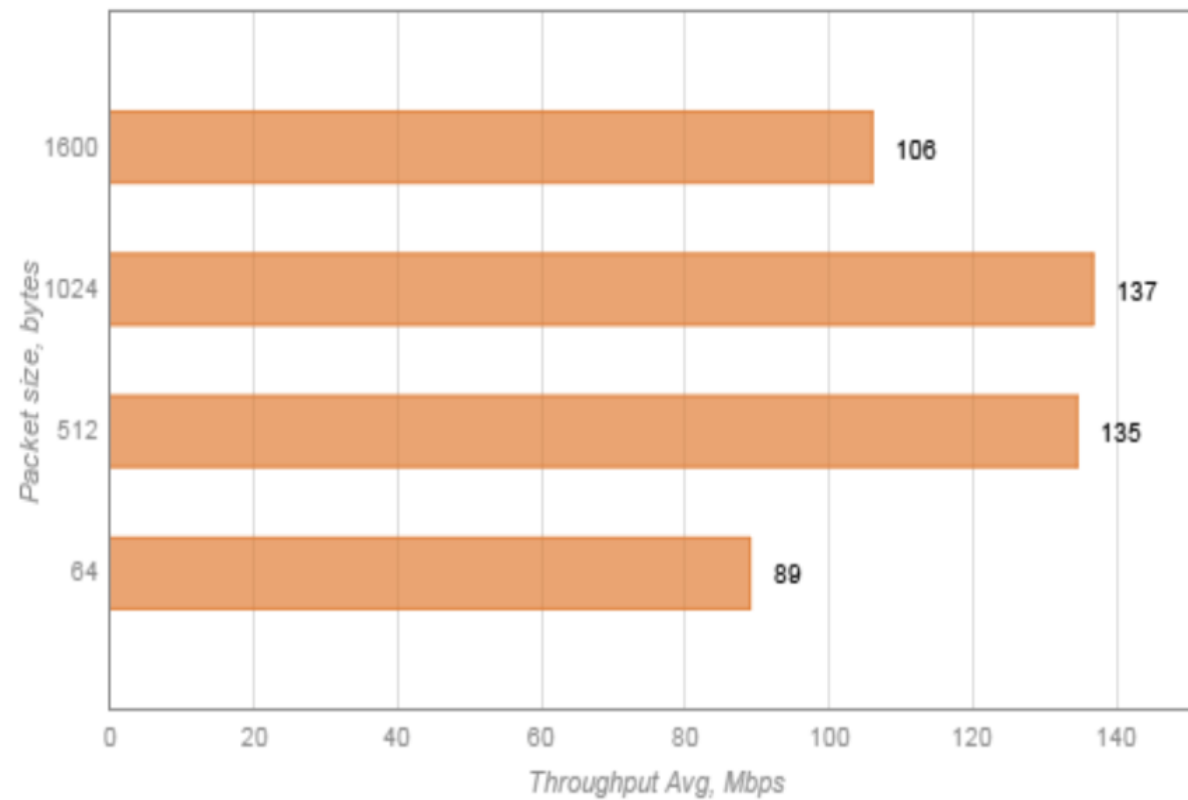
Link stats

</

Link test

Traffic direction: From Local to Remote

Finished: Feb 29, 2016 7:28:58 PM



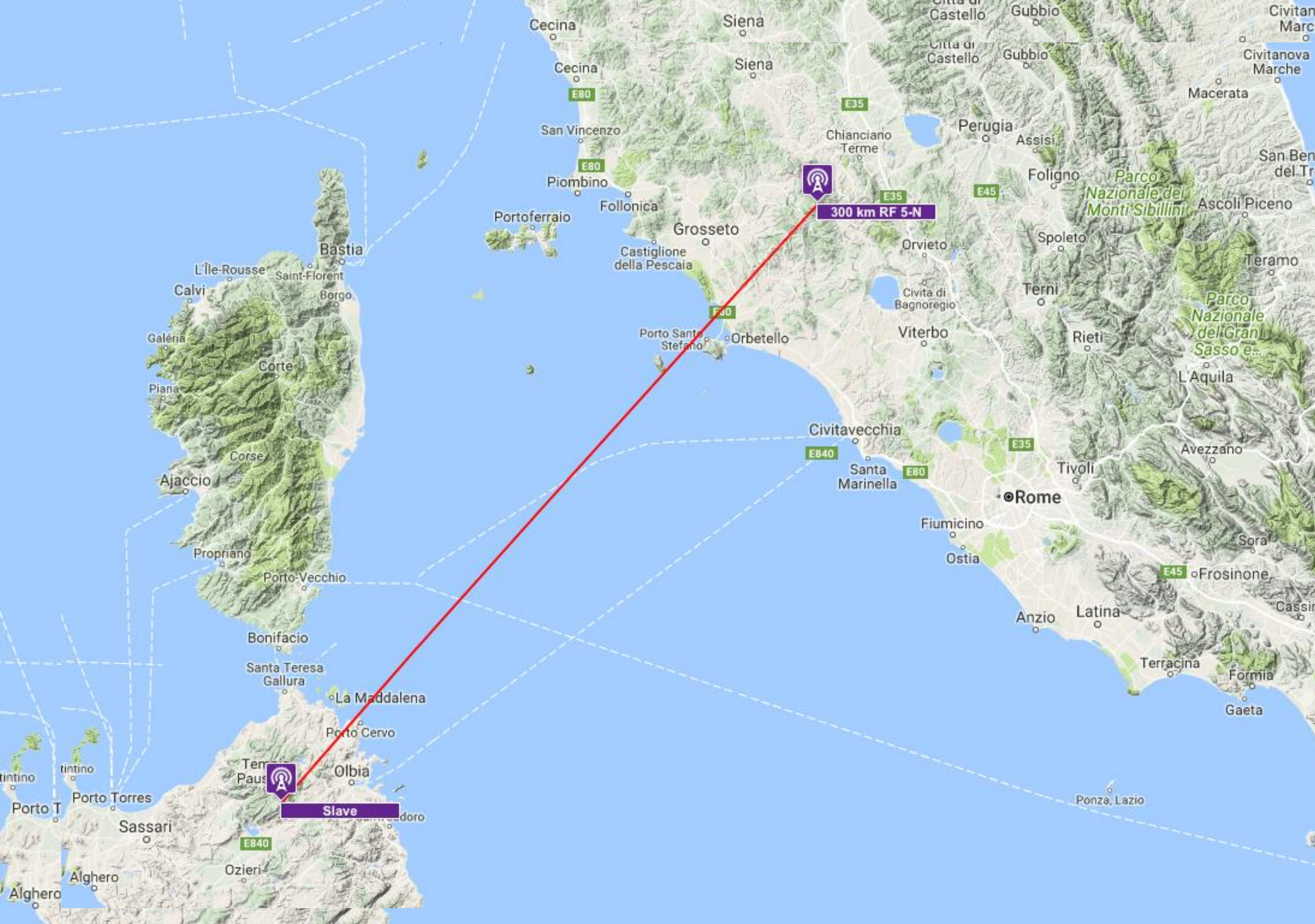
Averaged view

Detailed view

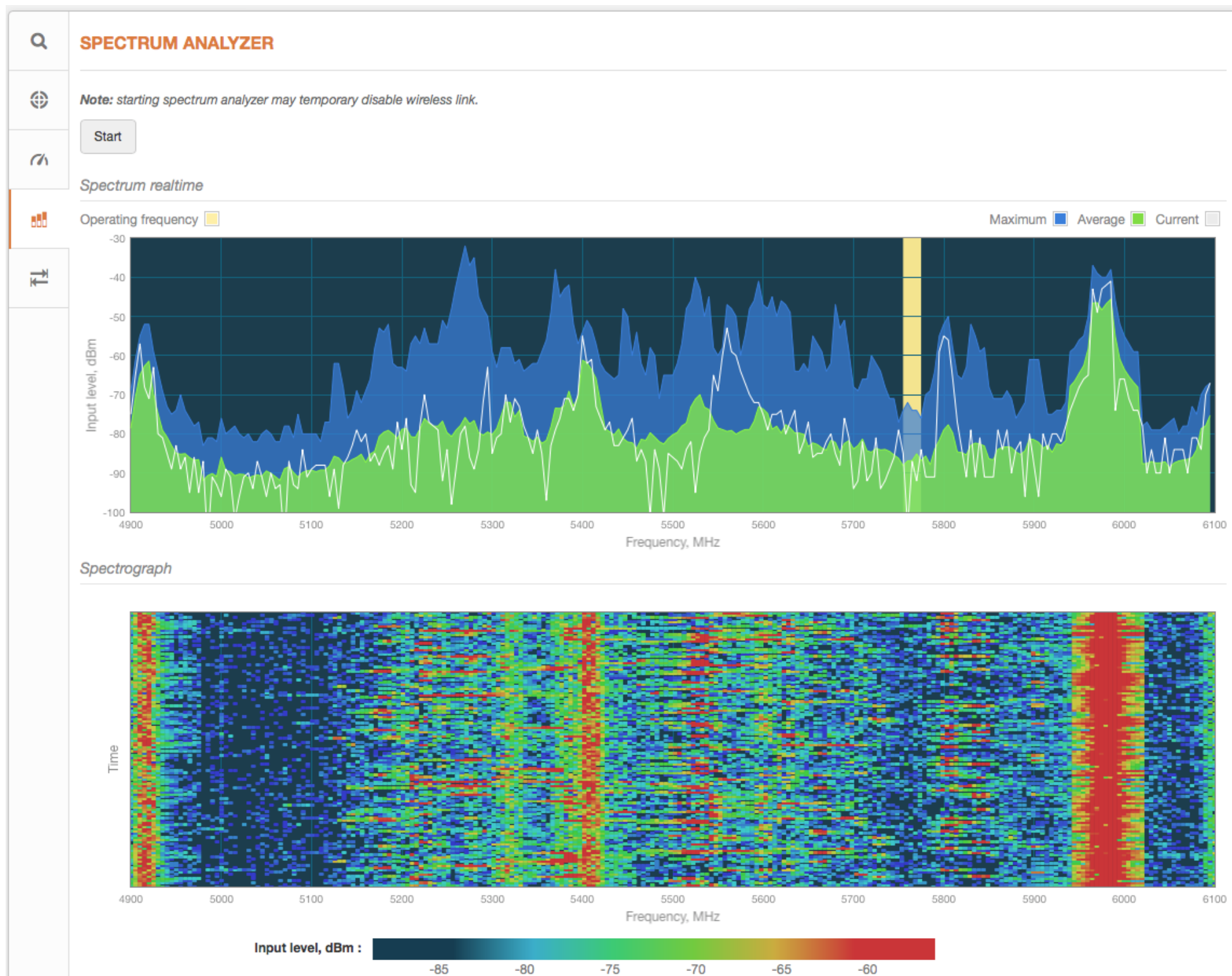
Pkt size, bytes	Throughput, Mbps	Throughput, PPS	Packet loss, %
From Local to Remote			
64	89	173,840	0.0
512	135	32,843	0.0
1024	137	16,694	0.0
1600	106	8,282	0.0

303 km (1 88.3mi) link in Italy

- LigoPTP RapidFire 5-N
- Antennas: 34 dBi dishes



Spectrum analysis



Link stats



INFORMATION



Product name: LigoPTP 5-N RapidFire
Serial number: 0B1B1618000000A8
Firmware version: PTP.MA-1.v7.53-5.33528 (Update)
System uptime: 6 days 2:22:38

Friendly name: Amiata>Limbara
Device location: Monte Amiata
Latitude/Longitude: 42.88744 / 11.623718
Height AGL, m: 10



Radio

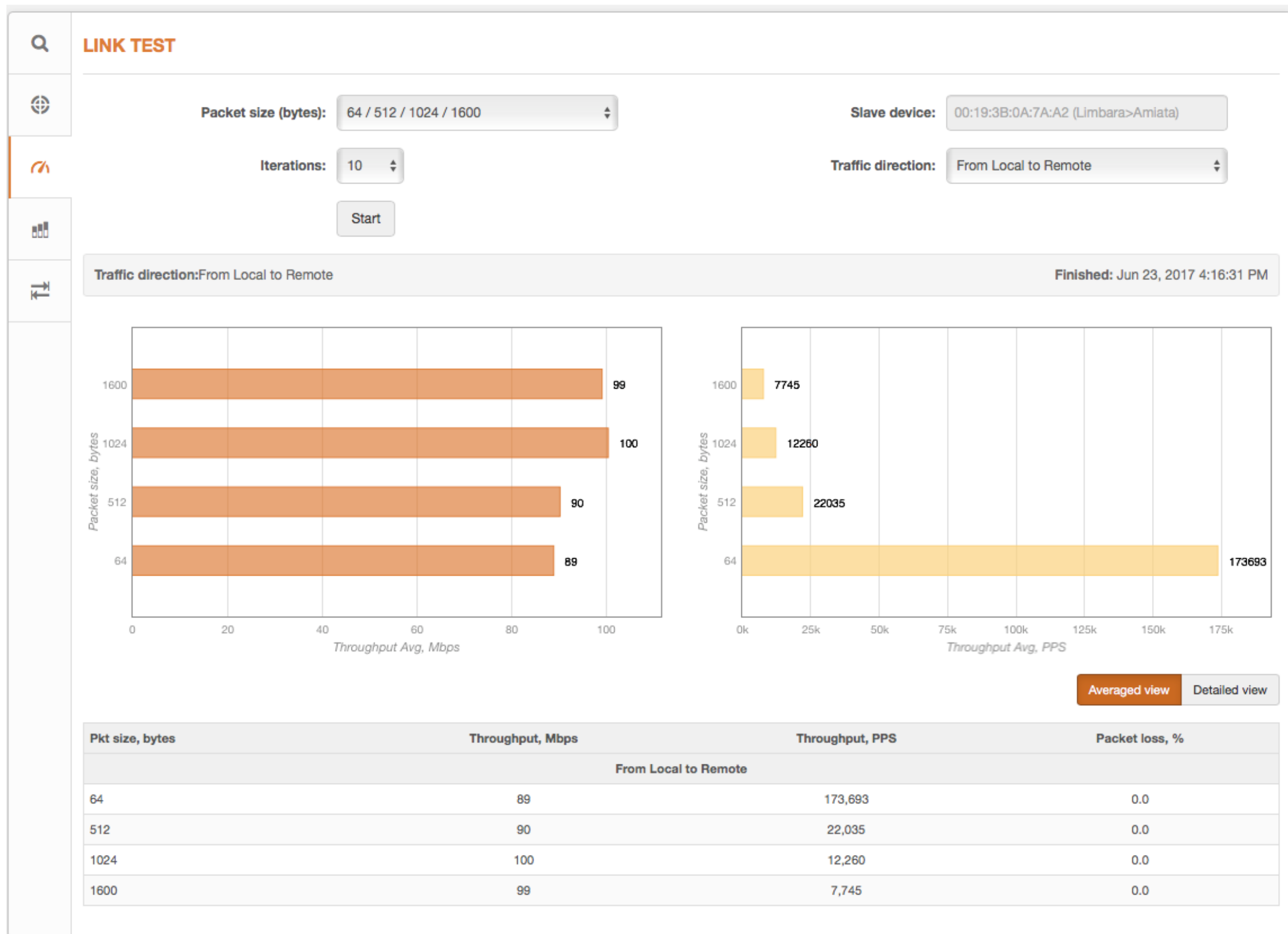
Operating mode: MASTER
Max Tx data rate, Mbps: 400 (256-QAM 5/6)
Frequency, MHz: 5745 (5735-5775)
Channel width, MHz: 40

Tx power, dBm: 31
Antenna gain, dBi: 0
Noise level, dBm: -95/-95

Link ID: IR5UK-IR0UDY

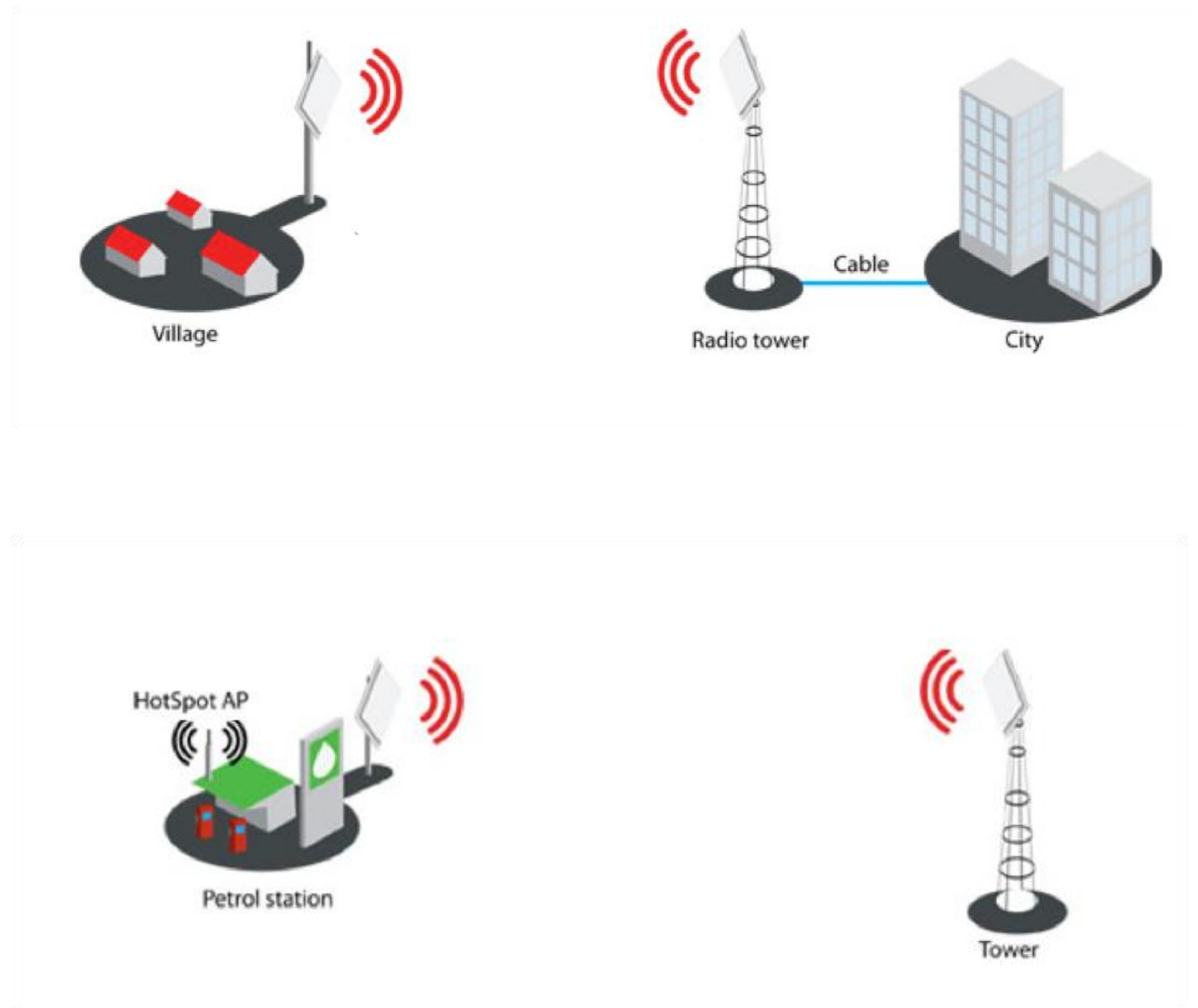
Remote site						Local site
Remote device	Link status	Tx power, dBm	Tx/Rx data rate, Mbps	Noise level, dBm	Signal level, dBm	Signal level, dBm
Limbara>Amiata 00:19:3B:0A:7A:A2	UP 22 min. 56 sec.	31	153/168	-95/-95	<div><div></div></div> -65 <div><div></div></div> -62	<div><div></div></div> -67 <div><div></div></div> -70

Link test



LigoPTP RapidFire Applications

- IP Metro connectivity
- Rural connectivity
- 3G/ 4G backhauling
- DSLAM backhauling
- PTMP backhauling
- Fiber extension
- Remote branch connectivity
- Video surveillance
- Backup for E-band links



Hands-on LABs





RapidFire - link simulation

LinkCalc PTP simulation

<https://linkcalc.ligowave.com>


Welcome to LinkCalc

Quick Links

- Google Maps
 - PtP Mode
 - PtMP Mode
 - PtMPC Mode
- Bing Maps
 - PtP Mode
 - PtMP Mode
 - ~~PtMPC Mode~~ Coming soon
- Baidu Maps
 - PtP Mode
 - PtMP Mode
 - ~~PtMPC Mode~~ Coming soon


Free

LinkCalc PTP simulation




 LinkCalc [Contact](#) [Quick Links](#)

[Map](#) [Parameters](#) [Results](#) [Saved Links](#)




Polarization ☐ Horizontal ☒ Vertical Frequency MHz ☒ Metric



TX Site

Name	RapidFire Site A		
Radio Type	LigoPTP 5-23 RapidFire		
Latitude / Longitude	<input type="text" value="41.00477542"/> <input type="text" value="-73.63311761"/>		
Ant. Height	<input type="text" value="25.00"/>		<input type="text" value="meter"/>
Ant. Gain	<input type="text" value="23"/>		<input type="text" value="dBi"/>
TX Power	<input type="text" value="28"/>		<input type="text" value="dBm"/>
Azimuth	<input type="text" value="162.34"/>		<input type="text" value="°"/>
ASL	<input type="text" value="12.00"/>		<input type="text" value="meter"/>

RX Site

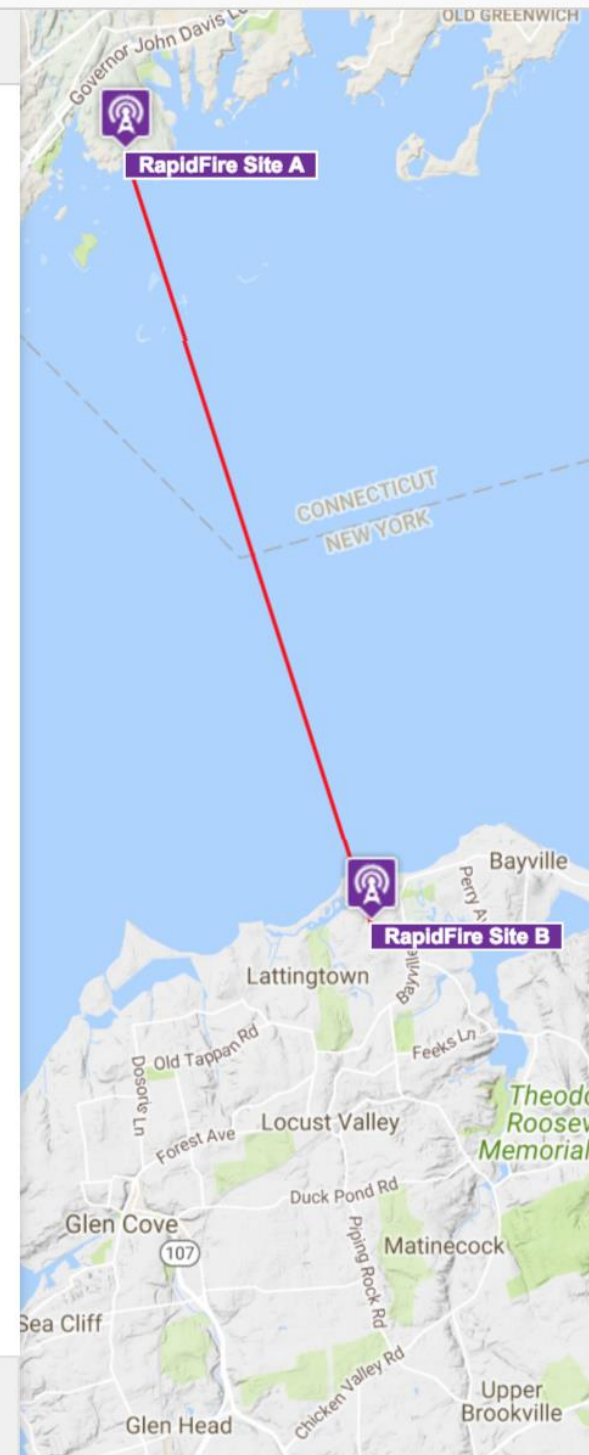
Name	RapidFire Site B		
Radio Type	LigoPTP 5-23 RapidFire		
Latitude / Longitude	<input type="text" value="40.90209584"/> <input type="text" value="-73.58985901"/>		
Ant. Height	<input type="text" value="30.00"/>		<input type="text" value="meter"/>
Ant. Gain	<input type="text" value="23"/>		<input type="text" value="dBi"/>
RX Threshold	<input type="text" value="-96"/>		<input type="text" value="dBm"/>
Azimuth	<input type="text" value="342.36"/>		<input type="text" value="°"/>
ASL	<input type="text" value="11.00"/>		<input type="text" value="meter"/>

Other Parameters (optional)


Misc Loss	<input type="text" value="0.00"/>	<input type="text" value="dBm"/>
-----------	-----------------------------------	----------------------------------

Site Climate	<input type="text" value="Continental Temperate"/>	
ITU Rain Rate (0.01%)	<input type="text" value="-1.00"/>	<input type="text" value="mm/hr"/>
<input checked="" type="checkbox"/> Show TDWR Locations		

Distance between points



LinkCalc PTP simulation

 LinkCalc [Contact](#) [Quick Links](#) ▾

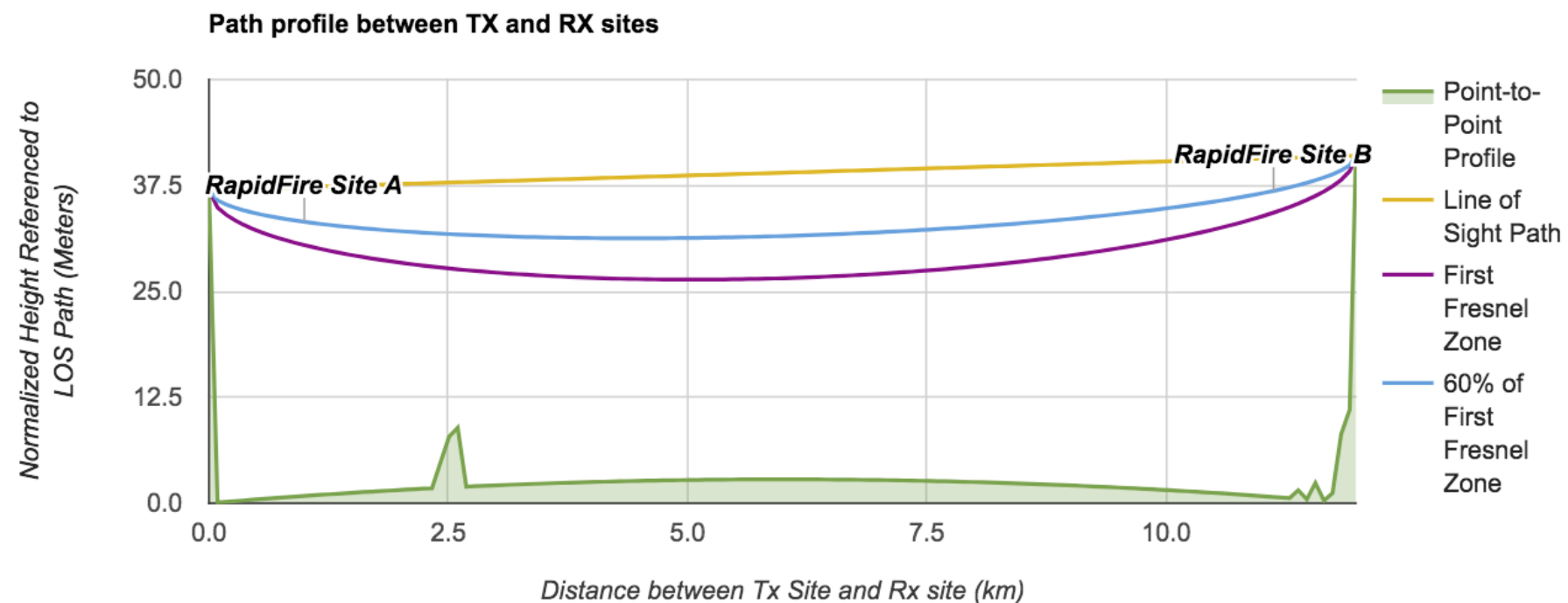
[Map](#) [Parameters](#) [Results](#) [Saved Links](#) [?](#)

Total Path loss	130	dB	Thermal fade margin	40	dB
Signal level at the RX site	-55.51	dBm	Distance between sites	11.98	km
EIRP	51.00	dBm	Link availability due to rain	n/a	Q

[Share Link](#) ⓘ [Public Link](#) ⓘ [Private Link](#) ⓘ [Create Report \(PDF\)](#) [Save Record](#)

Expected bidirectional throughput in a noise free link: ⓘ

[Click here to request a quote for this link?](#) ⓘ



LAB 1 - Point to Point Link simulation

<https://linkcalc.ligowave.com>

Welcome to LinkCalc

Quick Links

- Google Maps
 - PtP Mode
 - PtMP Mode
 - PtMPC Mode
- Bing Maps
 - PtP Mode
 - PtMP Mode
 - ~~PtMPC Mode~~Coming soon
- Baidu Maps
 - PtP Mode
 - PtMP Mode
 - ~~PtMPC Mode~~Coming soon

Free

LAB 1 - Point to Point Link simulation

Map Parameters Results Saved Links

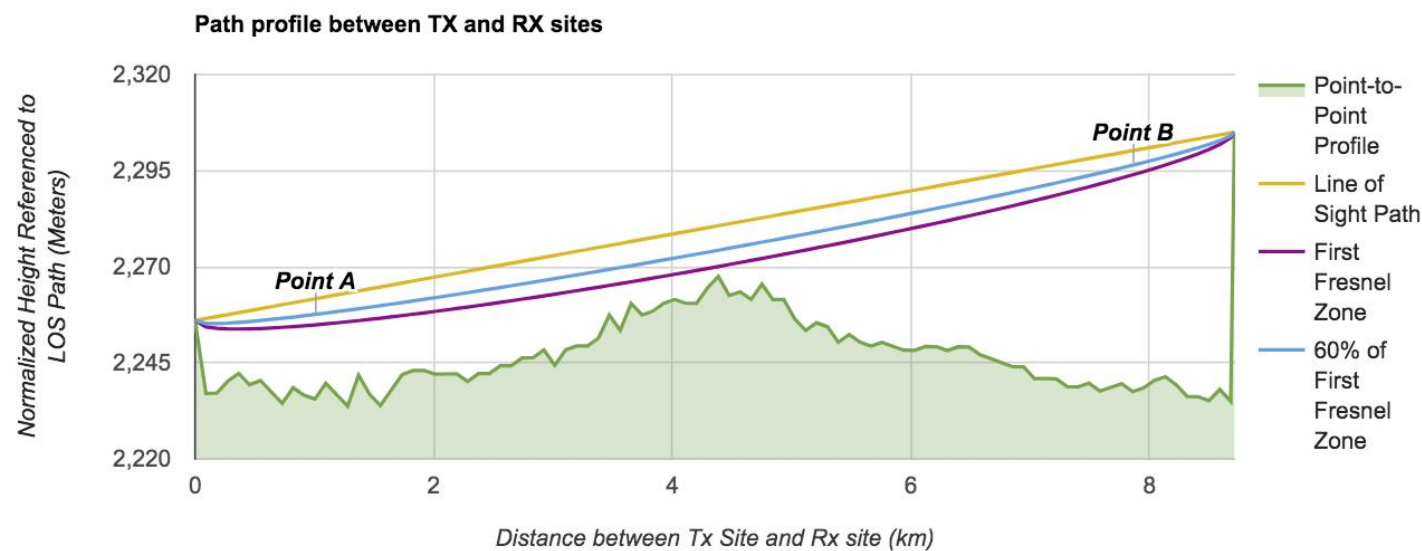
Total Path loss	127	dB	Thermal fade margin	43	dB
Signal level at the RX site	-52.56	dBm	Distance between sites	8.71	km
EIRP	51.00	dBm	Link availability due to rain	n/a	Q

Share Link Public Link Private Link

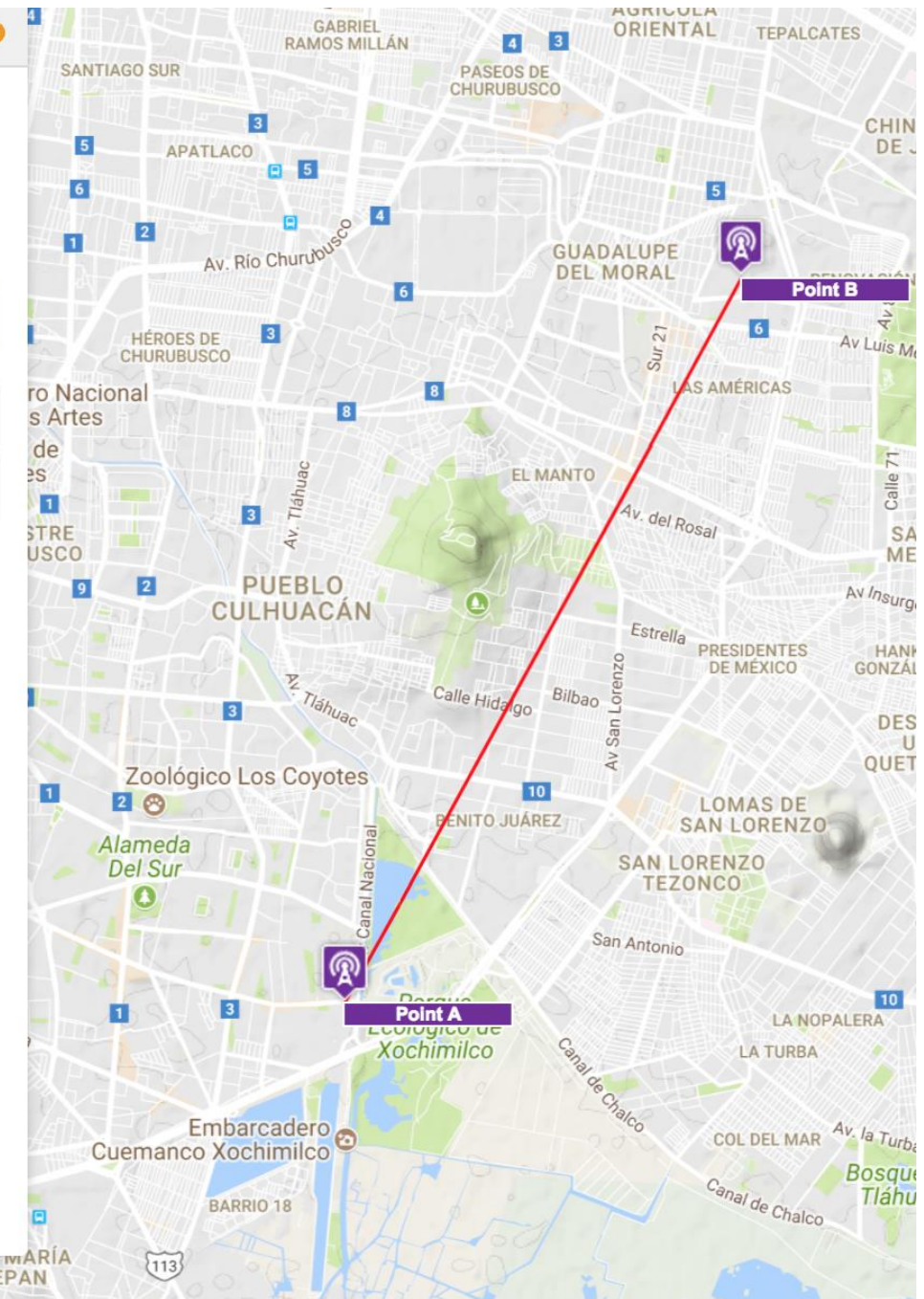
Create Report (PDF) Save Record

Expected bidirectional throughput in a noise free link:

Click here to request a quote for this link?



DISCLAIMER: LigoWave provides this link calculator as a courtesy. Results are provided as is with no warranty



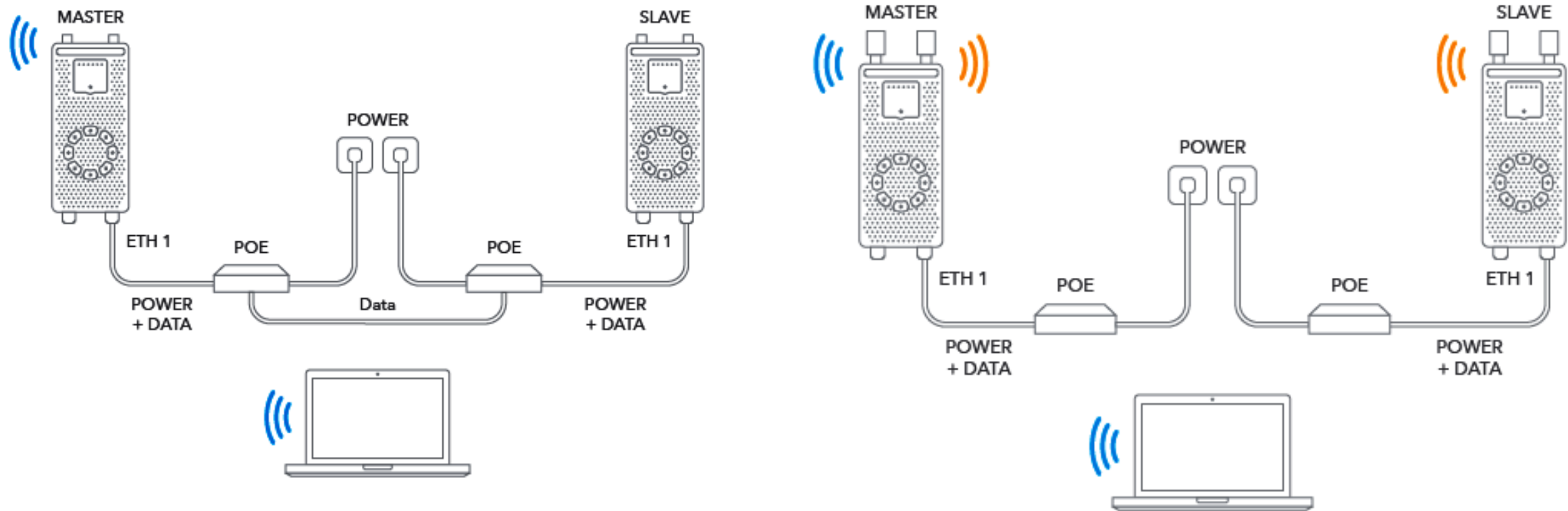
LAB 1 - Point to Point Link simulation

- Goal: Learn how to use “LinkCalc” for link simulation
- Import the coordinates from Lab_1 doc file
- Create and save the link analysis in PDF format
- Increase the distance by moving pointers and calculate the results again
- Calculate the link with LigoPTP 5-N RapidFire and 34dBi antenna gain in a new location.
- Finish line: What distance can be reached while signal stays at -55 dBm?





RapidFire - easy configuration


RapidFire configuration wizard



Note: N-Type radios have to be connected with UTP cable or have additional omni antennas or RF cables with attenuators

RapidFire configuration wizard

 192.168.2.66 



☒ START

☐ MODE

☐ SETUP

☐ FINISH

Product name: LigoPTP 5-N RapidFire

Serial number: 0B1B1518000007E2

Firmware version: PTP.MA-1.v7.53-5.33528 (Update)

MAC address: 00:19:3B:05:7E:86

START

UI Language:

English

User agreement

The correct country code must be selected before using the equipment to meet the regulatory requirements for authorized channels, channel width, output power, Dynamic Frequency Selection (DFS) and Automatic Transmit Control (ATC).

Installer or equipment owner takes all responsibility for proper product usage according to the regulatory rules.

Vendor or distributor/reseller is not responsible for illegal wireless equipment operation.

☒ I agree

Operating country:

United States

5 GHz Antenna gain, dBi:

0

Manual setup

Guided setup

Copyright ©2018 LigoWave

RapidFire configuration wizard

OPERATING MODE

Please choose the operating mode for the current device:

Master

Slave

Load from file

< Back

Next >

RapidFire configuration wizard

MASTER - SETUP

Friendly name: LigoPTP 5-N RapidFire

Contact information: Contact

Location: Location

Security

Password: *****

*IMPORTANT: this password is used to manage all devices on the same wireless network and is also used to **generate** wireless connection security passphrase. On all devices in same wireless network it must be the same otherwise wireless link will not work.*

Radio settings

Link ID: LigoPTP_Bridge_Group_1

Channel selection: Auto / 40 MHz

Network settings

IP method: Static

IP address: 192.168.6.100

Subnet mask: 255.255.255.0

Default gateway: 192.168.6.1

RapidFire configuration wizard

Discovered devices: 1



LigoPTP 5-N RapidFire

SN: 0B1B151400000BBC

MAC: 00:19:3B:05:5E:F1

Media: wireless

Friendly name:

Friendly device name

Location:

Some location description

IP address:

192.168.6.200


Antenna gain, dBm:


10


← Back

Apply configuration

RapidFire configuration - status







INFORMATION

Product name: LigoPTP 5-N RapidFire

Serial number: 0B1B151400000BBC

Firmware version: PTP.MA-1.v7.51.12661 (Update)

System uptime: 1 hour 20 min. 59 sec.

Friendly name: LigoPTP 5-N RapidFire

Device location: Location

Latitude/Longitude: 0 / 0

Height AGL, m: 0

Radio

Operating mode: SLAVE

Max TX data rate, Mbps: 400 (256-QAM 5/6)

Frequency, MHz: 5180 (5170-5210)

Channel width, MHz: 40

TX power, dBm: 10

Antenna gain, dBi: 10

Noise level, dBm: -95/-95

Link: [LigoPTP_Group_1](#)

Remote site						Local site
Remote device	Link status	TX power, dBm	TX/RX data rate, Mbps	Noise level, dBm	Signal level, dBm	Signal level, dBm
LigoPTP 5-N RapidFire	UP	10	156/156	-95/-95	<div><div></div></div> -59	<div><div></div></div> -58
00:19:3B:05:5E:F2	1 min. 25 sec.				<div><div></div></div> -60	<div><div></div></div> -59

RapidFire configuration - remote

Global parameters
(configurable from master):

- System settings
- Radio settings
- Network settings
- System password
- Traffic control

The screenshot displays the LigoWave configuration interface. A modal window titled "MANAGE REMOTE DEVICE" is open, showing the following details:

- Serial number:** 0B1B1518000007F1
- MAC address:** 00:19:3B:05:7E:95
- Firmware version:** PTP.MA-1.v7.53-5.33528 (Update)
- System uptime:** 59 min. 9 sec.

Below these details are four expandable sections:

- ⊕ System settings
- ⊕ Radio settings
- ⊕ Network settings
- ⊕ Traffic control on Ethernet ports

A "Save" button is located at the bottom right of the modal.

In the background, the "INFORMATION" section of the LigoWave interface is visible, showing:

- Product name:** Ligo
- Serial number:** 0B1B1518000007F1
- Firmware version:** PTP.MA-1.v7.53-5.33528
- System uptime:** 5 h 59 min. 9 sec.

The "Radio" section shows:

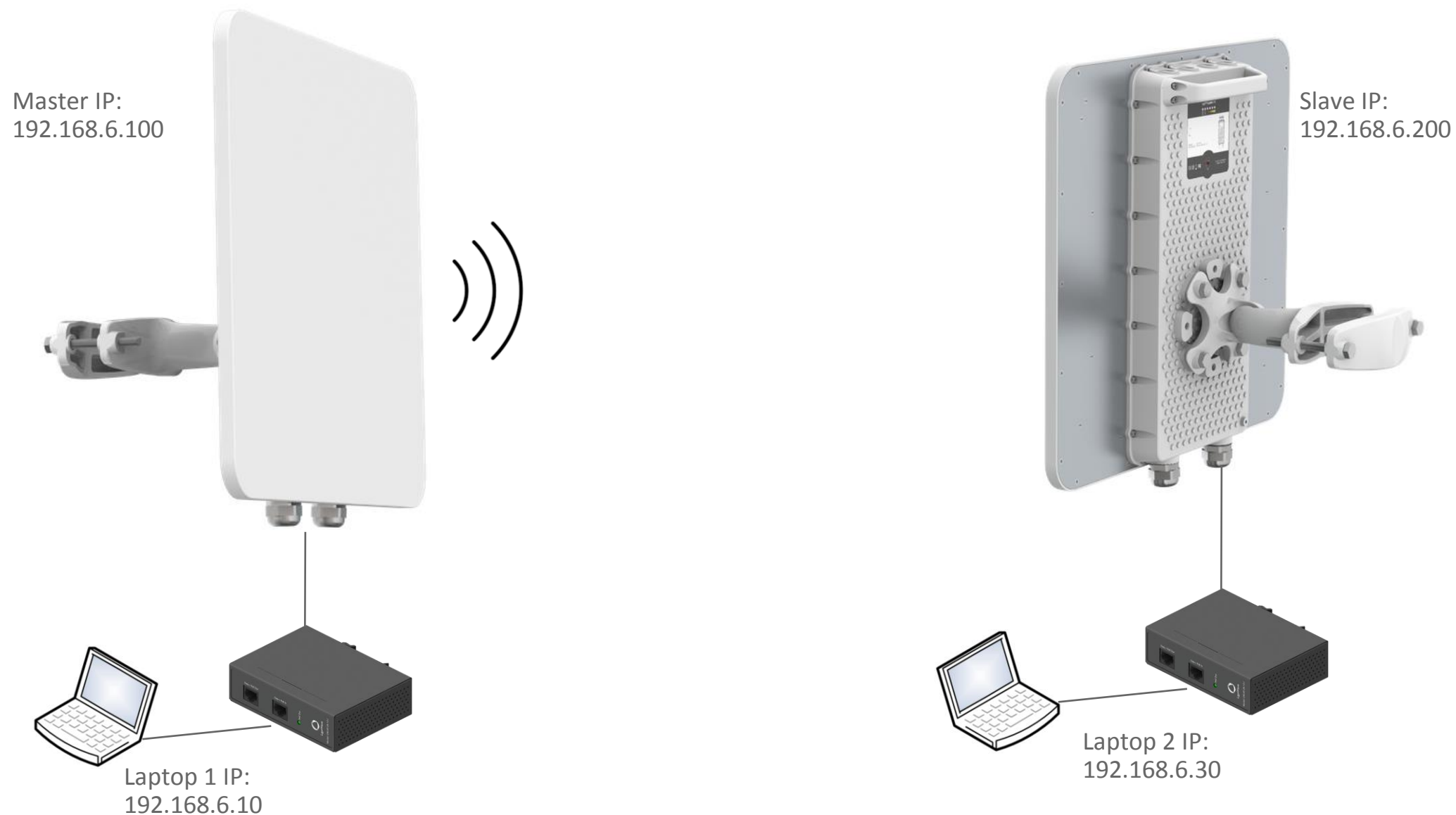
- Operating mode:** MAS
- Max Tx data rate, Mbps:** 866
- Frequency, MHz:** 5180
- Channel width, MHz:** 80

The "Link ID: LigoPTP" section is also visible.

At the bottom, a table lists remote devices:

Remote device	Link s
Friendly device name 00:19:3B:05:7E:95	UP 20 min. 1 sec. 31 866/866 -95/-95

LAB 2 - Basic RapidFire Link configuration



Note: The images of the equipment could change according to the model and frequency available during the course.

LAB 2 - Basic RapidFire Link configuration

- Goal: “Guided setup” of the wireless link
- Change default settings
- Use “Passphrase” as a login key
- Collect statistics and link parameters
- Test speed with Linktest
- Test the ping through the link
- Finish line: Collect the backup of whole network
- Reset devices to defaults via GUI



RapidFire - link optimisation

Frequency planning

1. Run Site survey and Spectrum analyzer in each location points
2. Consider channel size according to throughput demand:
 - 80 MHz - 700 Mbps
 - 40 MHz - 320 Mbps
 - 20 MHz - 138 Mbps
 - 10 MHz - 70 Mbps
 - 5 MHz - 35 Mbps
3. If possible, avoid DFS channels 5.600 - 5.650 GHz (ETSI CAC = 10 min)

Frequency planning

Standard channels

80 MHz

36 (5180 MHz)

40 (5200 MHz)

44 (5220 MHz)

48 (5240 MHz)

52 (5260 MHz)

56 (5280 MHz)

60 (5300 MHz)

64 (5320 MHz)

100 (5500 MHz)

104 (5520 MHz)

108 (5540 MHz)

Non-Standard channels

80 MHz

32 (5160 MHz)

33 (5165 MHz)

34 (5170 MHz)

35 (5175 MHz)

36 (5180 MHz)

37 (5185 MHz)

38 (5190 MHz)

39 (5195 MHz)

40 (5200 MHz)

41 (5205 MHz)

42 (5210 MHz)

43 (5215 MHz)

44 (5220 MHz)

45 (5225 MHz)

46 (5230 MHz)

47 (5235 MHz)

48 (5240 MHz)

49 (5245 MHz)

50 (5250 MHz)

51 (5255 MHz)

52 (5260 MHz)

53 (5265 MHz)

54 (5270 MHz)

55 (5275 MHz)

56 (5280 MHz)

57 (5285 MHz)

58 (5290 MHz)

59 (5295 MHz)

60 (5300 MHz)

61 (5305 MHz)

62 (5310 MHz)

63 (5315 MHz)

64 (5320 MHz)

65 (5325 MHz)

66 (5330 MHz)

67 (5335 MHz)

68 (5340 MHz)

96 (5480 MHz)

97 (5485 MHz)

98 (5490 MHz)

99 (5495 MHz)

100 (5500 MHz)

101 (5505 MHz)

102 (5510 MHz)

103 (5515 MHz)

104 (5520 MHz)

105 (5525 MHz)

106 (5530 MHz)

- Channel list is country dependent

RapidFire - link optimisation

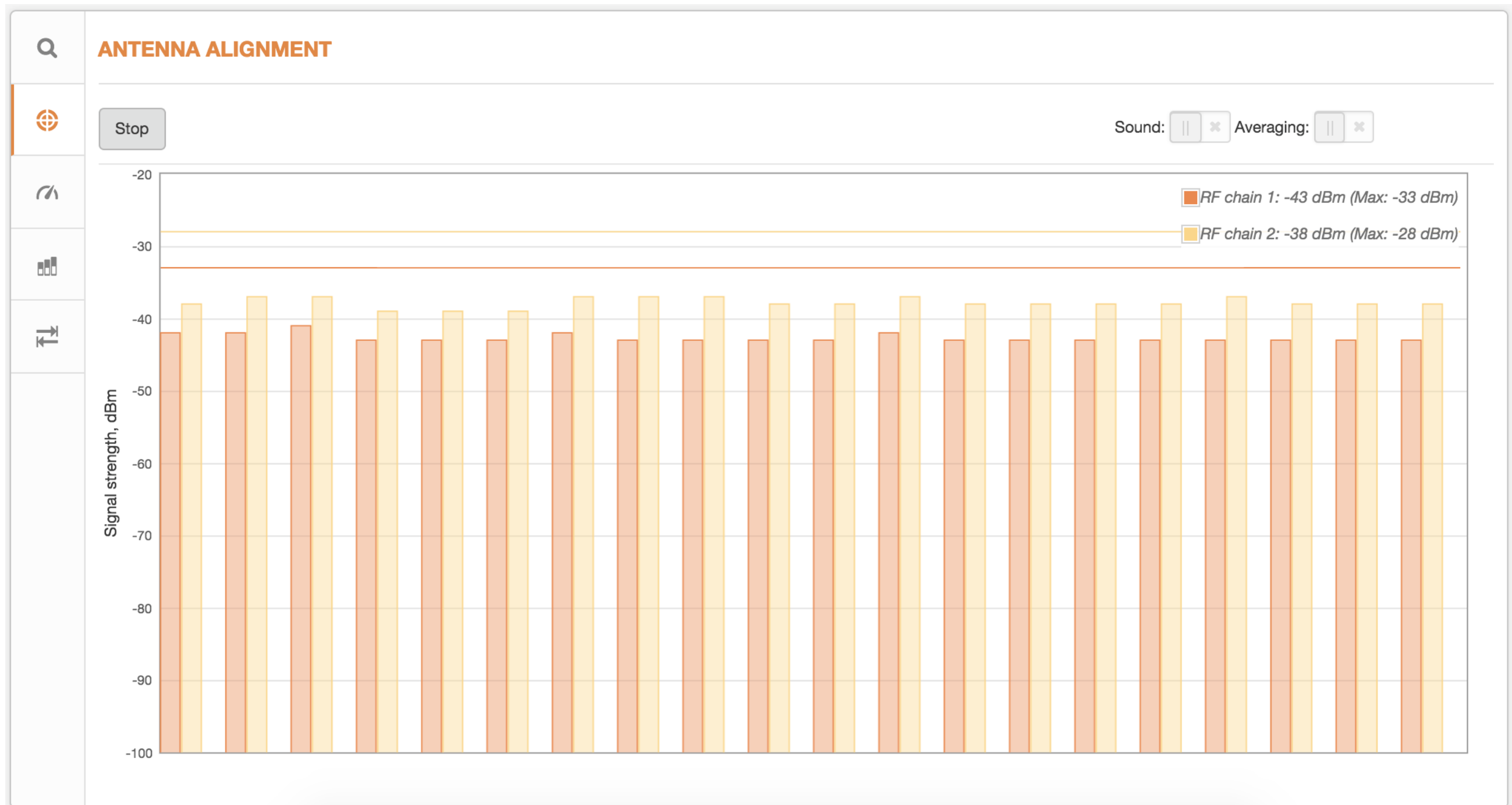
- Find the channel with maximum EIRP.
- Avoid if possible DFS frequencies.
- Select smaller channel width.
- Use “Antenna alignment” tool for link alignment

Channel width (MHz):

<input type="checkbox"/>	60 (5300 MHz)	13	23	Yes
<input type="checkbox"/>	61 (5305 MHz)	13	23	Yes
<input type="checkbox"/>	62 (5310 MHz)	13	23	Yes
<input type="checkbox"/>	63 (5315 MHz)	13	23	Yes
<input type="checkbox"/>	64 (5320 MHz)	13	23	Yes
<input checked="" type="checkbox"/>	149 (5745 MHz)	20	30	No





RapidFire - link optimisation

- Correct antenna alignment



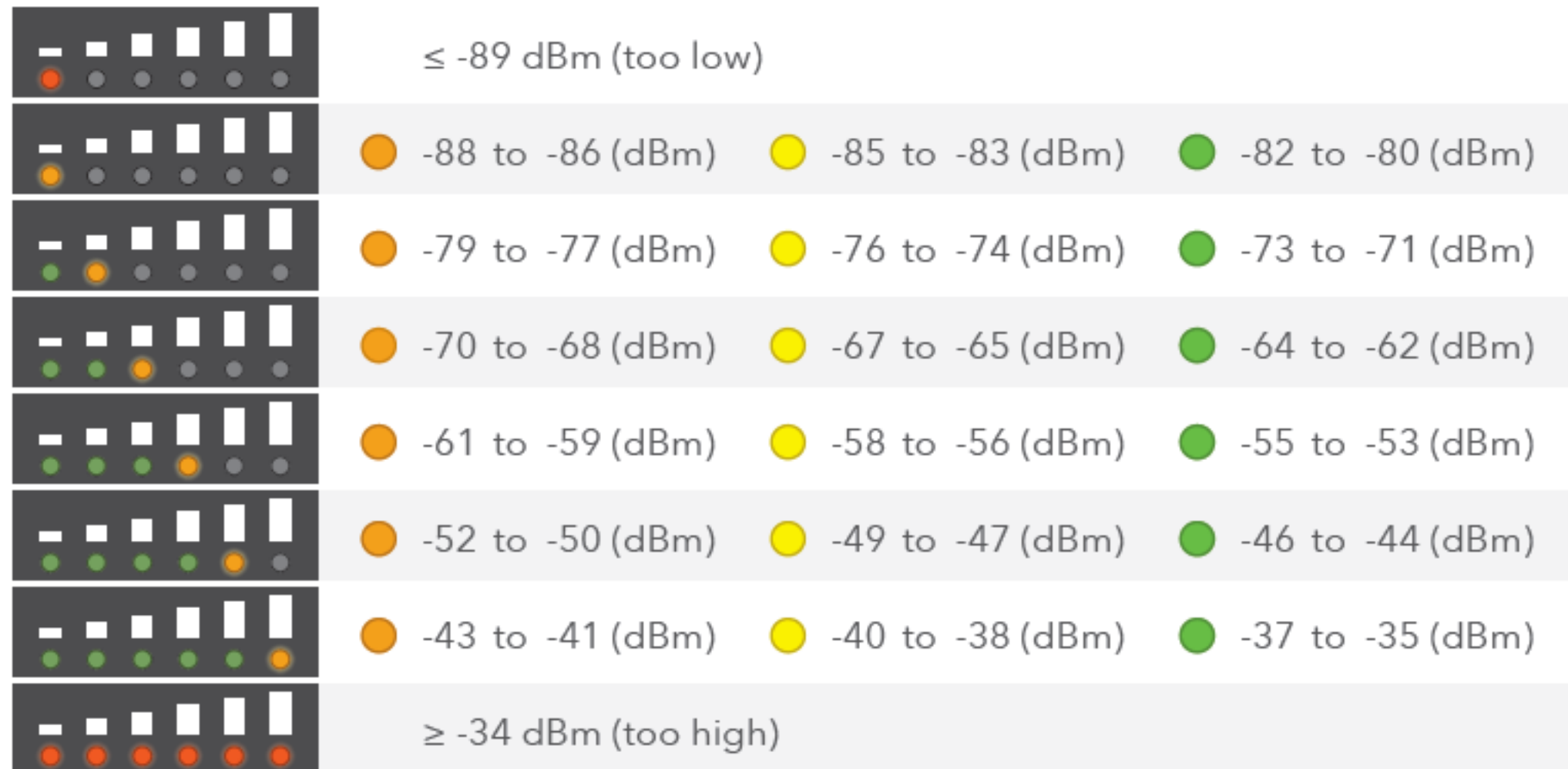
RapidFire - link optimisation

- Recommended signal levels: from -35 to -50 dBm
- Check signals at GUI Status/Information page

Remote site						Local site
Remote device	Link status	TX power, dBm	TX/RX data rate, Mbps	Noise level, dBm	Signal level, dBm	Signal level, dBm
LigoPTP 5-N RapidFire	UP	10	156/156	-95/-95	 -59	 -58
00:19:3B:05:5E:F2	1 min. 25 sec.				 -60	 -59

- Check signals at RGB LEDs

RapidFire - link optimisation



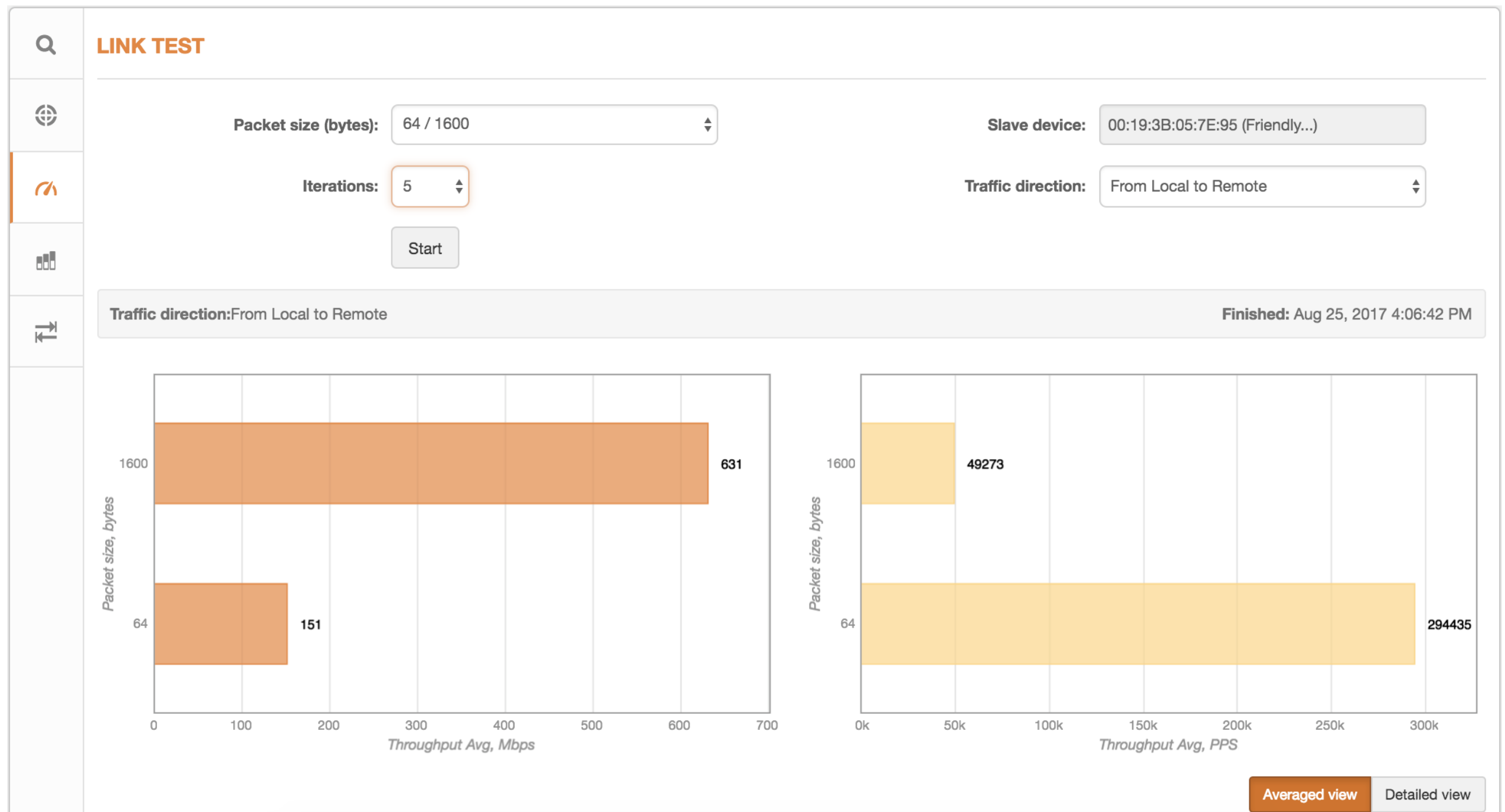
RapidFire - link optimisation

- Find the best operating frequency
- Run spectrum analyzer at least for 3min.
- Select less occupied band.
- Use Linktest to measure available throughput.



RapidFire - link optimisation

- “Linktest” measures available UDP throughput.



RapidFire - link optimisation

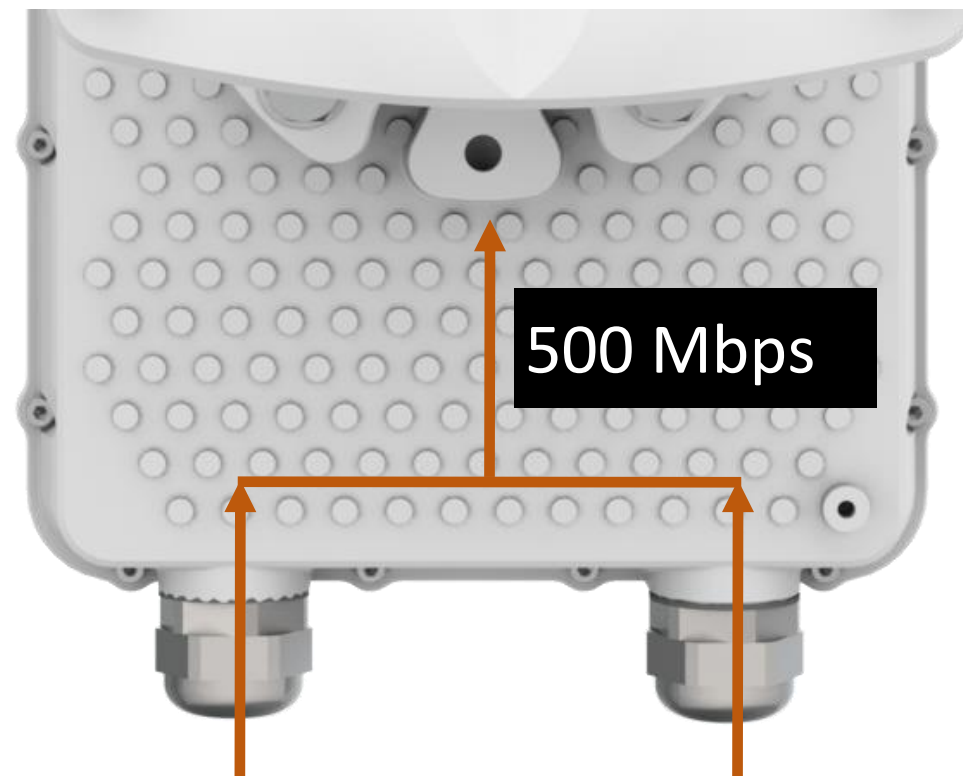
- CLI tool - “linktest-chan-selector”

```
# linktest -h
Usage: linktest [options]
    -t sessions count
    -c packet count per session
    -d packet send delay
    -s packet size in bytes
    -p peer number
    -n peer name substring (overrides -p)
    -l list peers
    -v verbose mode
    -j output each line as a separate JSON object
      (this option disables verbose mode)
    -h usage

# linktest-chan-selector -h
Usage: /sbin/linktest-chan-selector [OPTIONS]
Use linktest throughput measurements to set radio channel in AP mode

    -h, --help                Print this menu
    -s, --packet-size         Packet size (default 1500)
    -r, --remote              Measure from Local->Remote and from Remote->Local
    -z, --only-remote         Measure from Remote->Local
    -a, --step <5|10|20>     Frequency step (default 20)
    -c, --sessions <1-1xxx>  How many linktest sessions to use when measuring (default 30)
    -f, --freq-range <5180-5500 or 5180,5200,5300,5400,5500>
                             Frequency range or a list of 3 or more frequencies
```

RapidFire - bandwidth control



Traffic control on Ethernet ports

Enable speed limit:



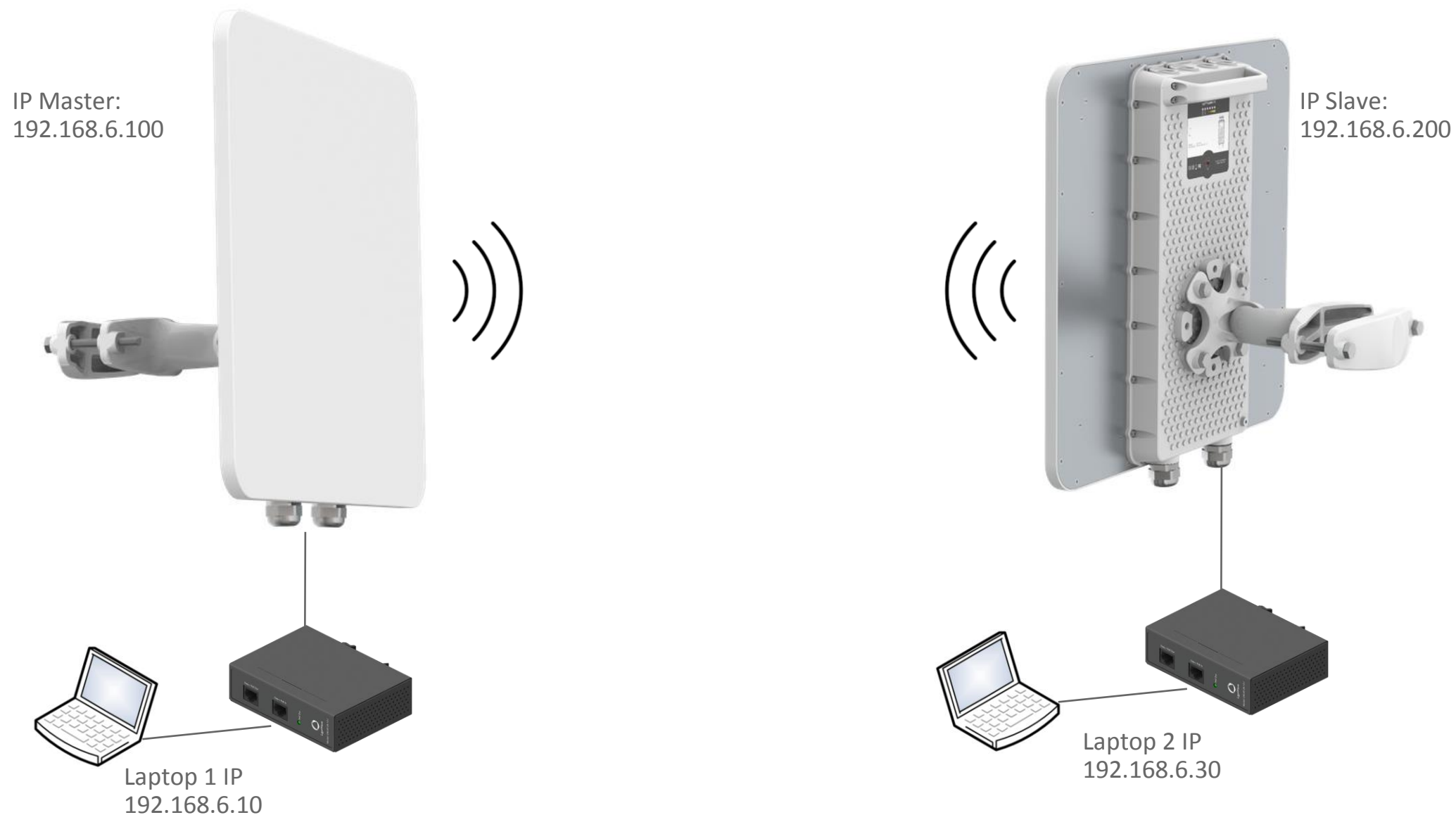
Incoming speed, Mbps



500

Note: speed limit is applied on both ports ETH1 + ETH2

LAB 3 - RapidFire Link optimisation



Note: The images of the equipment could change according to the model and frequency available during the course.

LAB 3 - RapidFire Link optimization

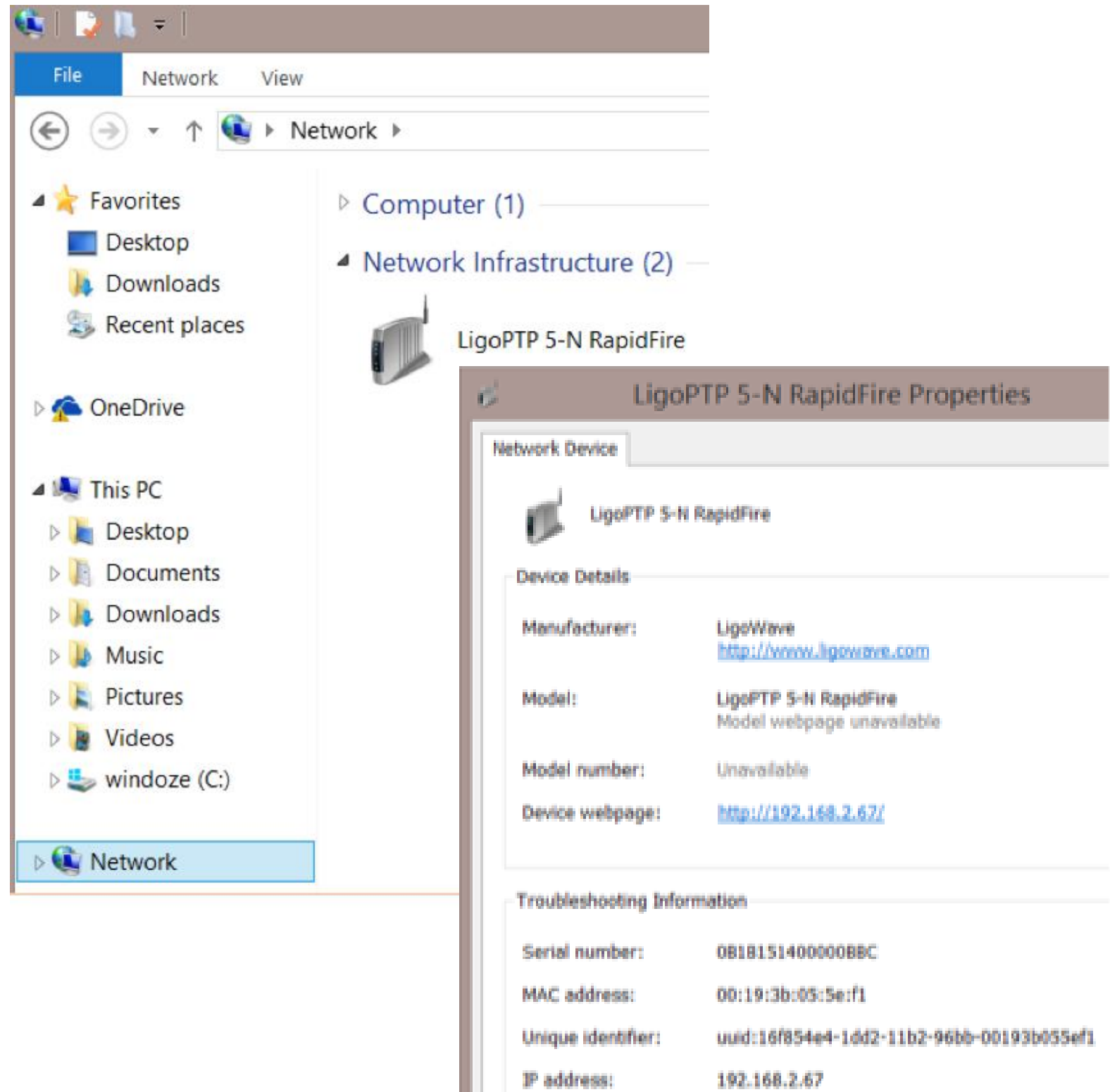
- Goal: Receive 600Mbps+ in “Linktest”
- “Discover” device IP address
- Restore “whole network config”, change LinkID
- Select one operating frequency, understand EIRP value
- Achieve RSSI levels as close as possible to -40 dBm, disable ATPC
- Usage of tools: Site survey, Antenna alignment, Spectrum analyzer
- Understanding DFS channel
- Finish line: “linktest-chan-selector” CLI tool
- Don’t reset to the defaults



Monitoring and maintenance

RapidFire - Device discovery

- Radio can be discovered on the network without external tools
- SSDP and Bonjour protocols are supported



Monitoring and management

Monitoring

1. Using operator system via SNMP walk (read-only)
2. Using operator system via SNMP trap

System alerts

Enable system alerts:	<input checked="" type="checkbox"/>	<input type="checkbox"/>
System check interval (s):	<input type="range"/>	10
Wireless link status change:	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Ethernet link status change:	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RSSI level lower than (dBm):	<input checked="" type="checkbox"/>	60
Device reboot:	<input checked="" type="checkbox"/>	<input type="checkbox"/>
System uptime:	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Uptime send interval (min):	<input type="range"/>	60
Noise level greater than (dBm):	<input checked="" type="checkbox"/>	-90
RX drop greater than (%):	<input checked="" type="checkbox"/>	15
TX retry greater than (%):	<input checked="" type="checkbox"/>	15
Ping delay (ms):	<input checked="" type="checkbox"/>	1000
Ping host/IP address:	10.0.1.10	

Monitoring & management

1. Using LigoWave WNMS

Monitoring with WNMS

<https://wnmscloud.com/>



The background image is a promotional graphic for WNMS Cloud. It features a blue and green color scheme with various icons and text. At the top left, there is a logo that says 'cloud WNMS'. Below it, a large banner reads 'take your wireless network management to a HIGHER level!'. To the right, there are several callouts: 'Premium Customer', 'get FREE', 'get Premium', '3rd party devices', 'compare', and 'deliberant'. At the bottom right, there is a 'LigoWave' logo. The registration form is a light blue box with a close button (X) in the top right corner.

WNMS Cloud Free Instance Registration

All fields in the form below are required

Your full name: *

Your e-mail address: *

Confirm e-mail: *


Company name: *

Domain name: * .wnmscloud.com

I accept [Terms and Conditions](#) * ☒

I agree to receive latest updates from Deliberant and LigoWave ☐

RapidFire - Monitor with WNMS

 WIRELESS NETWORK MANAGEMENT SYSTEM

HomeAlertsInventorySWEAP

Devices

Advanced search

Quick search

Network filter

☒ Select all

☒ (No network)

☒ HotSpot

☒ Multi-Point

☒ Point-to-Point

MAC

Serial number

Name

IP address

Firmware

☐ Match exact phrases

Status

Availability

Device type

☒ Registered ☒ Unregistered

☒ Up ☒ Down

(All) ▼

Search

Clear

?

IP, MAC, Serial, ...

Search

Remove selected

Export results to CSV

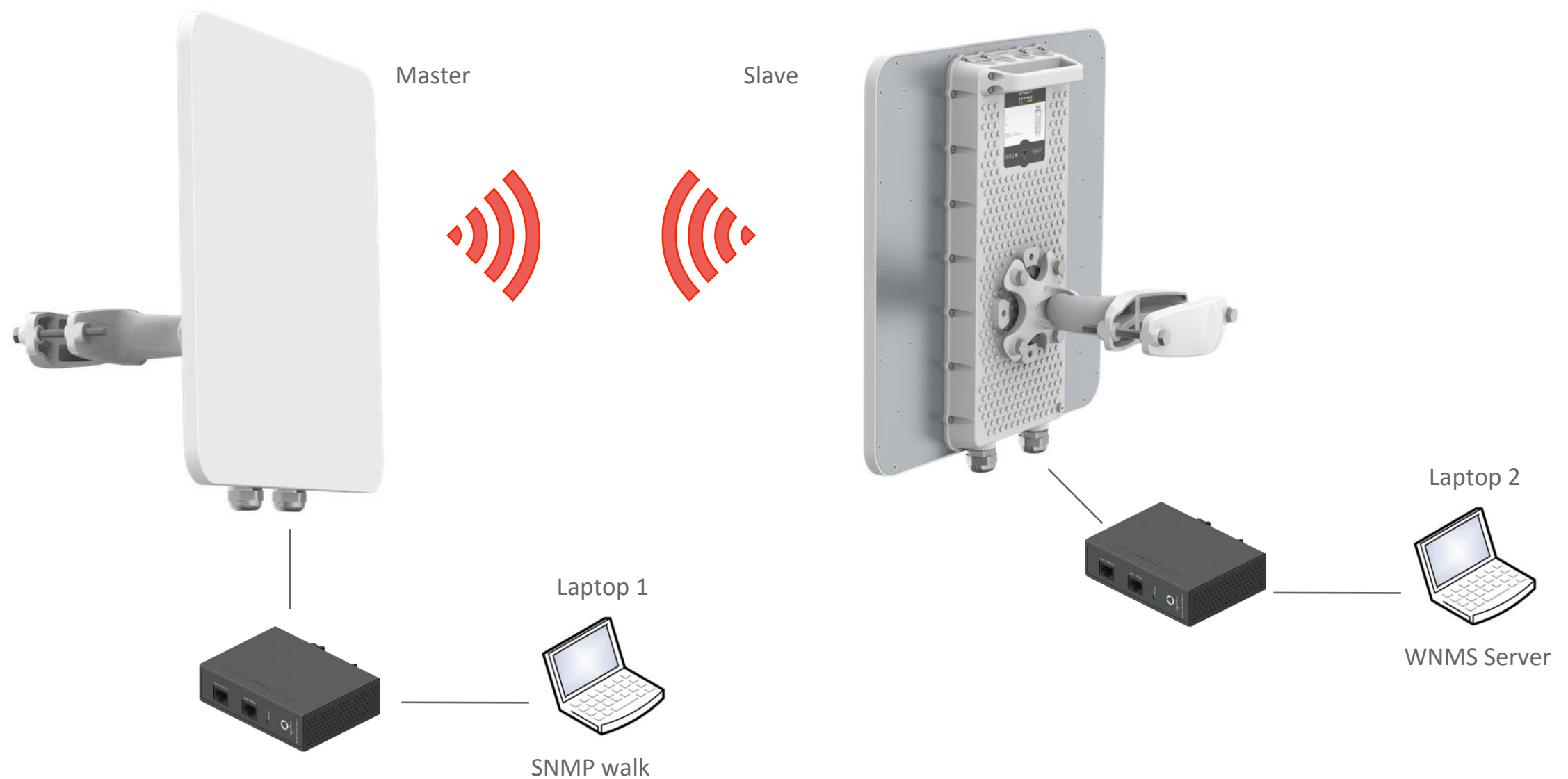
Refresh

☒ Auto refresh

<< Page 1 of 1 >>

- Any LigoWave radio can be monitored by the WNMS

LAB 4 - RapidFire monitoring (WNMS and SNMP)



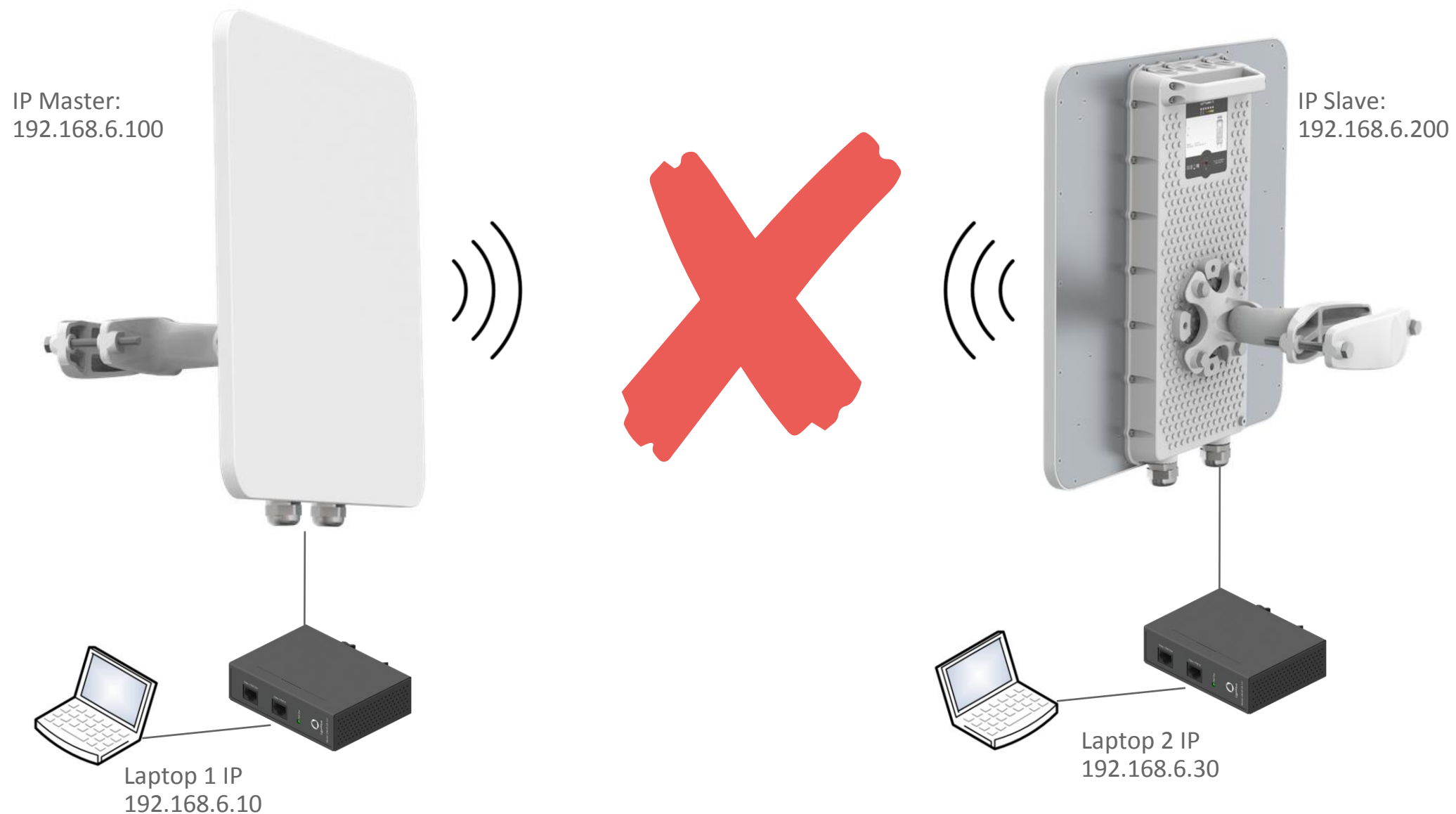
LAB 4 - RapidFire monitoring (WNMS and SNMP)

- Goal: Assign device to WNMS server, receive an alert
- Connect to the “Management radio”. Change gateway, friendly name, NTP
- Create free WNMS account, change default login
- Register device to WNMS server, assign Alerts profile, receive notification via email
- Create new task, receive configuration file from the device
- SNMP, “snmpwalk”, OID, MIB files
- Finish line: Reset device to defaults via reset button



RapidFire - link troubleshooting

LAB 5.1 — RapidFire troubleshooting



Note: The images of the equipment could change according to the model and frequency available during the course.

RapidFire troubleshooting

- System log messages in GUI

The screenshot displays the LigoWave web interface. At the top left is the LigoWave logo. To its right are four circular icons: an information icon (i), a settings gear, a wrench, and a first aid kit. On the top right, there are two status boxes: 'Uptime' showing '6 min. 52 sec.' and 'CPU load (0 %)' with a progress bar. Below these, network status is shown: 'eth0: 100BaseT/full' and '1 stations'. The main content area is titled 'SYSTEM LOG' with a refresh icon on the right. Below the title is a search bar with the placeholder text 'Enter keyword to filter results'. The log itself is a scrollable list of system messages. The messages include kernel logs for network interface state changes (eth0 and ath0), packet generator status, mDNSResponderPosix errors, crond startup, IEEE80211 ioctl mode changes, and various system initialization messages from init and lua. The log ends with an ipoll_peer_add message.

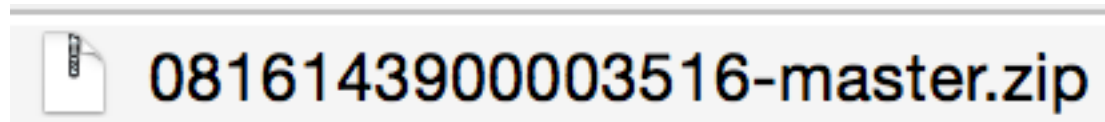
SYSTEM LOG

Enter keyword to filter results

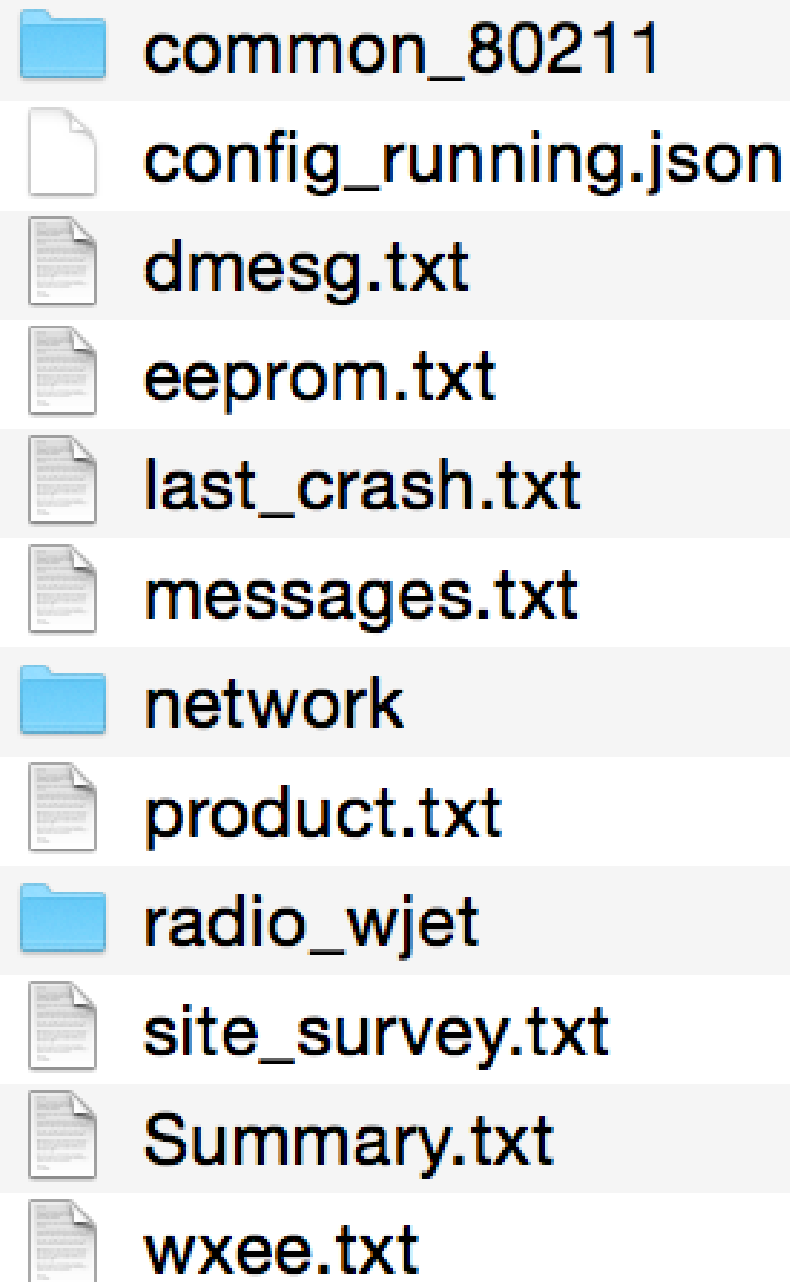
```
Feb 27 19:32:16 kernel: [ 17.779000] br0: port 1(eth0) entering forwarding state
Feb 27 19:32:16 kernel: [ 17.820000] br0: port 2(ath0) entering forwarding state
Feb 27 19:32:17 kernel: [ 18.705000] pktgen 2.75: Packet Generator for packet performance testing.
Feb 27 19:32:17 kernel: [ 18.767000] pktgen: device not present all. Using all
Feb 27 19:32:17 mDNSResponderPosix: mDNS_Register_internal: ERROR!! Tried to register AuthRecord 0047F944 LigoDLB-5-04A03B.local. (Addr) that's already in the list
Feb 27 19:32:17 mDNSResponderPosix: mDNS_Register_internal: ERROR!! Tried to register AuthRecord 0047FCC8 100.6.168.192.in-addr.arpa. (PTR) that's already in the list
Feb 27 19:32:17 crond[290]: crond: crond (busybox 1.21.1) started, log level 8
Feb 27 19:32:18 kernel: [ 19.802000] ieee80211_ioctl_siwmode: imr.ifm_active=66176, new mode=3, valid=1
Feb 27 19:32:18 kernel: [ 19.848000] br0: port 2(ath0) entering disabled state
Feb 27 19:32:18 kernel: [ 19.854000] DEVICE IS DOWN ifname=ath0
Feb 27 19:32:18 kernel: [ 19.859000] DEVICE IS DOWN ifname=ath0
Feb 27 19:32:19 kernel: [ 20.336000] br0: port 2(ath0) entering learning state
Feb 27 19:32:19 kernel: [ 20.471000] system_start: 'file' configuration was applied successfully
Feb 27 19:32:19 kernel: [ 20.555000] dfs_attach: use DFS enhancements
Feb 27 19:32:19 init: starting pid 305, tty '': '/usr/sbin/launchd'
Feb 27 19:32:19 init: starting pid 310, tty '/dev/ttyS0': '/sbin/getty ttyS0 115200'
Feb 27 19:32:19 kernel: [ 21.341000] br0: port 2(ath0) entering forwarding state
Feb 27 19:32:20 lua[311]: ase_parse_state_file(): creating default state
Feb 27 19:32:20 alertrd[259]: Disabling email notifications.
Feb 27 19:32:20 alertrd[259]: Disabling SNMP notifications.
Feb 27 19:32:27 kernel: [ 29.292000] ipoll_peer_add: 00:19:3b:04:a0:21 peer added.
```

RapidFire troubleshooting

- Troubleshooting file collects device configuration, logs, statistics and various system outputs in the one bundle file.
- To extract troubleshooting file from zip archive use Winzip or any other program on Windows.



RapidFire troubleshooting - Content



- Common ath statistics like tx/rx counters, channels list
- Current system configuration - JSON format
- System kernel messages for debugging purposes
- Contains system info (radio calibration, board info)
- Stores last kernel crashes - used for debugging
- Contains operating system logs
- Contains network interfaces configuration
- Contains product related information
- Protocol counters
- The last site survey results
- Contains the most useful system information
- System production info

RapidFire troubleshooting - Summary.txt

Device stats:

```
{
  "latitude": 0,
  "deviceName": "LigoDLB 5",
  "deviceLocation": "Device location",
  "serialNo": "0816143900003516",
  "memory": {
    "total": 61948,
    "free": 26280
  },
  "productName": "LigoDLB 5",
  "longitude": 0,
  "uptime": 5670.09,
  "systemClock": "2015\08\01 00:23",
  "operatingMode": "bridge",
  "firmwareVersion": {
    "active": "APCPE.QM-1.v7.52-DEVEL.12699",
    "backup": "APCPE.QM-1.v7.51.9320"
  }
}
```

Network information:

```
{
  "br0": {
    "status": "UP",
    "bridge": [
      "ath0",
      "eth0"
    ],
    "mac": "00:19:3b:04:9f:01",
    "gateway": "192.168.6.1",
    "ip": "192.168.6.100\24"
  },
  "ath0": {
    "status": "UP",
    "mac": "00:19:3b:04:9f:01"
  },
  "eth0": {
    "status": "DOWN",
    "mac": "00:19:3b:04:9f:02"
  }
}
```


RapidFire troubleshooting - Summary.txt

```
# wlanconfig ath0 list
ADDR          AID CHAN TXRATE RXRATE RSSI  UPTIME
00:19:3b:04:9e:ad  1  36  180M  180M  28   5006
```

```
ADDR          AID CHAN TXRATE RXRATE RSSI  UPTIME
00:19:3b:04:9e:ad  1  36  180M  180M  37   41
```

"peers": [

```
# cat /var/run/stats/wireless.json
```

"ipAddress": "192.168.6.200",

"rxRate": 64,

293 admin 2136 S /usr/sbin/launchd

300 admin 1220 S /sbin/getty ttyS0 115200

386 admin 2128 S resetd

389 admin 1532 S dropbear -p 22 -K 60 -d

/data/dropbear_key.dss

392 admin 1204 S alertrd

406 admin 5196 S {wsxavante} /usr/bin/lua

/usr/sbin/wsxavante /etc/ht

416 admin 1924 S /usr/sbin/ssdpd -p 80 -w 30 br0

429 admin 1220 S crond -c /var/run/crontabs

436 admin 2128 S ltsd -i ath0

442 admin 1156 S coap-server -i ath0

4048 admin 1208 S syslogd -l 8 -s 1024 -b0 -S

"mac": "00:19:3B:04:9E:DF",

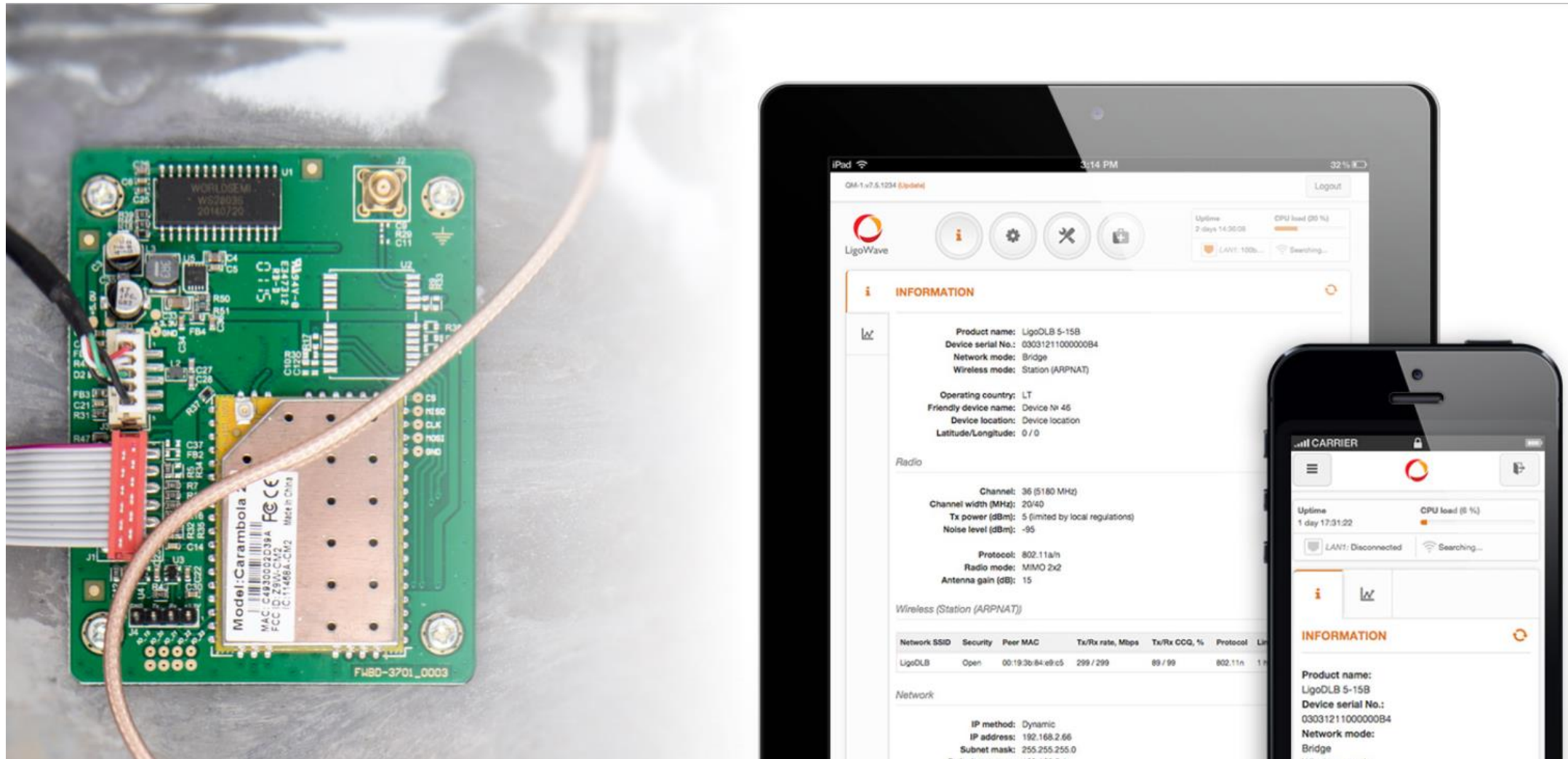
"signal": [

-60,

-62

],

LAB 5.1 — RapidFire troubleshooting



LAB 5.1 — RapidFire troubleshooting

LigoPTP-mng-055EF2

- Every radio has an open SSID name with the last 3 octets of the RapidFire MAC
- Once connected, the management of the device can be accessed via IP address

<https://192.168.111.1>

LAB 5.1 — RapidFire troubleshooting

- Goal: Investigate why link is not established.
- Correct the mistakes!
- Restore configuration with provided images
- master_t1.cfg - for master (login admin123)
- slave_t1.cfg - for slave (login admin1234)

THANK YOU

GOOD LUCK :)