LigoPTP series overview

LigoWave

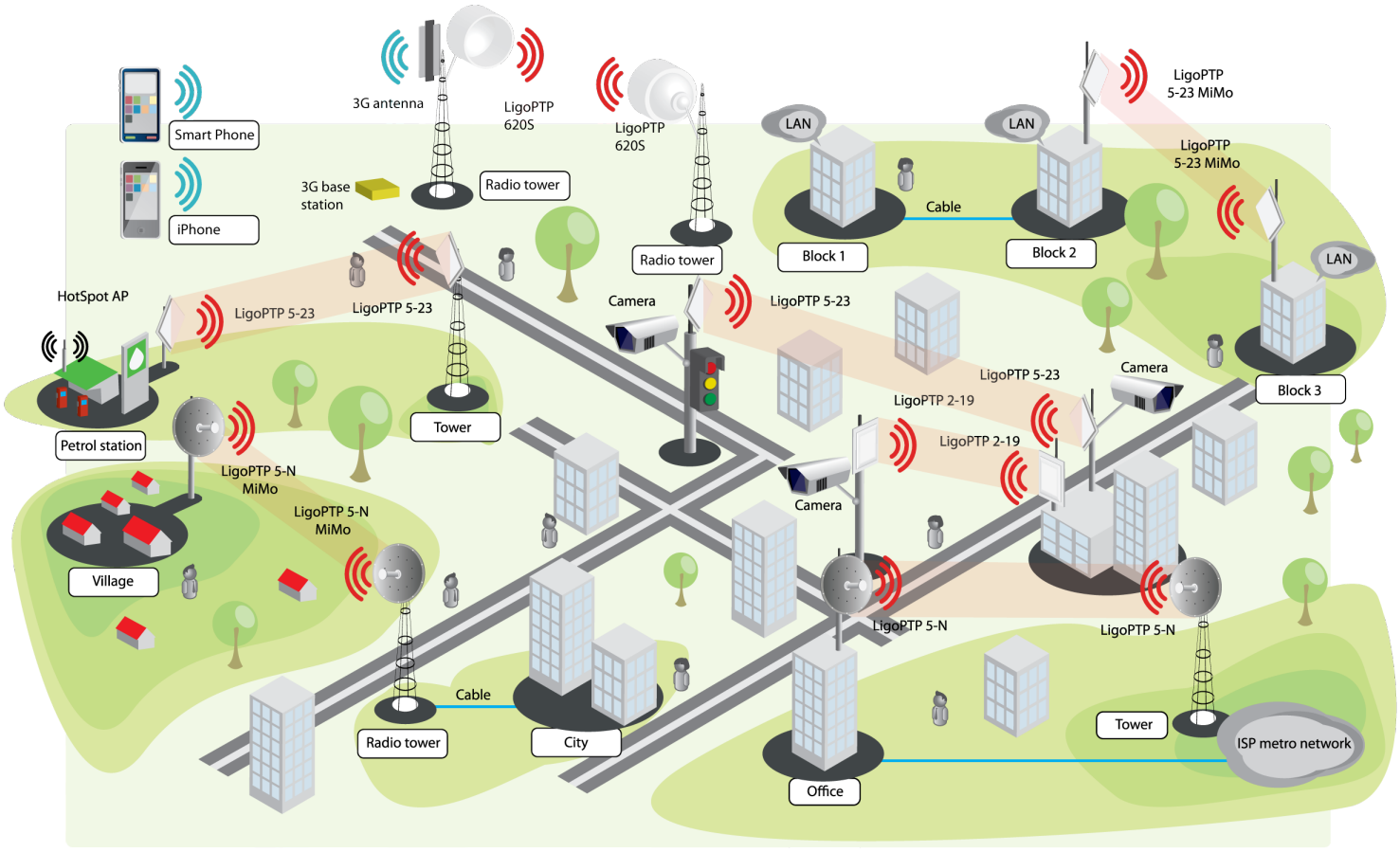
Introduction

This document describes the basic characteristics and key features of the LigoWave LigoPTP product line. For in-depth technical product information, please consult the product specific data sheets.

Acronyms

AES	Advanced Encryption Standard – strong hardware based data encryption that prevents unauthorized access to data.
ARQ	Automatic Repeat reQuest is the error control method for data transmission which uses acknowledgments and timeouts to achieve reliability.
BER	Bit Error Ratio - the number of received data bits that have been altered due to noise or interference, divided by the total number of transferred data bits during a studied time interval.
BPSK	Binary Phase-Shift Keying – radio signal modulation technique that uses two phases which are separated by 180°.
FEC	Forward Error Correction – a system of error control for data transmission when sender adds redundant data to its messages so errors can be corrected at receiver side without the need to retransmit data.
GUI	Graphic User interface.
IP-67	Protection standard with no dust ingress and no water ingress when submersed up to 1M in water.
MIMO	Multiple-Input Multiple-Output – radio system that uses several transmitters and several receivers at the same time to improve communication performance.
PoE	Power over Ethernet.
PPS	Packets per second.
QAM	Quadrature Amplitude Modulation - radio signal modulation technique that uses combined phase and amplitude manipulation.
QPSK	Quadrature Phase-Shift Keying - radio signal modulation technique that uses four phases equidistant around a circle.
SISO	Single Input Single Output – radio system that use one transmitter and one receiver.
SNMP	Simple Network Management Protocol.
SSH	Secure Shell – network protocol that allows exchanging data over encrypted secure channel.
TDD	Time-Division Duplex – technique that achieve full duplex communication over half duplex data link allocating data over time.
W-Jet 2	LigoWave's proprietary protocol that eliminates distance, PPS and throughput limitations inherent in standards based protocols.

MAIN APPLICATIONS



LigoWave delivers high reliability and great performance point to point (PTP) solutions ideally suited to both small WISP and carriers, small companies and large enterprises, municipalities, public projects and others. LigoWave devices work in unlicensed and licensed frequency bands. Our equipment combines the laest wireless technologies (including microwave) and proprietary techniques to achieve best in the market results in a point to point scenario and with the quickest ROI.

LigoPTP product series is dedicated but not limited for following solutions:

- IP/Cellular backhaul
- Broadband access connectivity
- Rural connectivity
- Private networks
- Security and surveillance

PRODUCT SUMMARY

	LigoPTP 1st gen.	LigoPTP PRO	LigoPTP UNITY	LigoPTP 620HP
Frequencies, GHz	900 MHz, 2.4, 3.5, 4.9, 5*	5 (5.1 - 5.9)*	5 (5.1 - 5.9)*	6, 7, 8, 11, 13, 15, 18, 23, 26, 28, 32, 38
Channel size, MHz	5, 10, 20, 40	20, 40	20, 40	7, 10, 14, 20, 25, 27.5, 28, 30, 40, 50, 56, 60
Capacity, Mbps	70	220	220	730 (365 full duplex)
PPS, k	50	60	140	>1,000
Max distance km/mi	>100/ 62	>100/ 62	>100/ 62	>100/ 62
Duplexing system	Dynamic TDD	Dynamic TDD	Dynamic TDD	FDD
Highest modulation	QAM 64	QAM 64	QAM 64	QAM 256
Data interface	10/100 Base-T	10/100/1000 Base-T	2 x 10/100/1000 Base-T	3 x 10/100/1000 Base-T

* Country dependent - FCC 5.745 to 5.825 MHz

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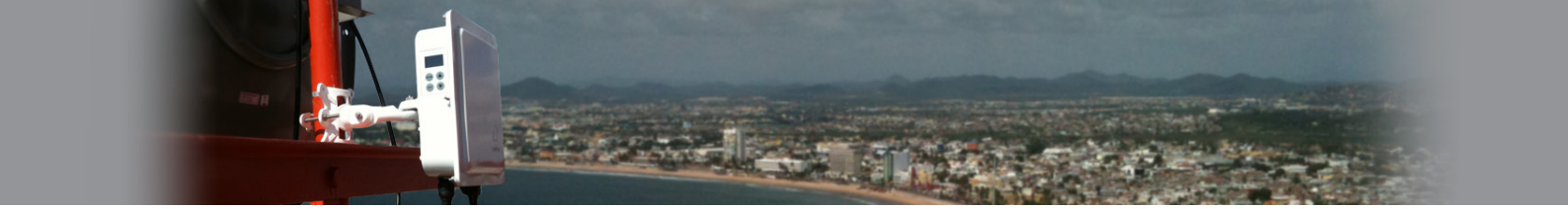


UNLICENSED BAND

1st generation LigoPTP products

- A wide range of frequency options **(900 Mhz, 2.4 GHz, 3.5 GHz, 5 GHz*)**
- Flexible channel sizes **(5, 10, 20, 40 Mhz)**
- **70 Mbps** of real capacity
- Advanced proprietary **W-Jet protocol** to enhance PTP communication
- High transmit power and high receive sensitivity ensure long range data links **(up to 25 dB)**
- Excellent packets per second value **(up to 50,000)**
- Low packet latency **(<2 ms)**
- External OLED screen for antenna alignment and throughput testing
- Advanced but easy to use operating system
- Professional articulating mounting bracket
- Integrated surge protection
- **IP-67** standards compliant
- WNMS management system support

All products come in an integrated antenna or an N-connectorized model

W-Jet protocol turns LigoPTP devices into extremely efficient wireless backhaul equipment

LigoPTP PRO

- **5.1-5.9 GHz*** frequency support (full 5 GHz spectrum)
- Flexible channel sizes **(20, 40 Mhz)**
- **220 Mbps** of real capacity
- Advanced proprietary **W-Jet 2 MiMo** protocol to enhance PTP communication
- High transmit power and high receive sensitivity ensure long range data links **(up to 28 dB per chain)**
- **DFS 3 and ATPC** support
- Excellent packets per second value **(up to 60,000)**
- Low packet latency **(<2 ms)**
- External OLED screen for antenna alignment and throughput testing
- Advanced but easy to use operating system
- Professional articulating mounting bracket
- Integrated surge protection **(IEC standards compliant)**
- **IP-67** standards compliant
- WNMS management system support

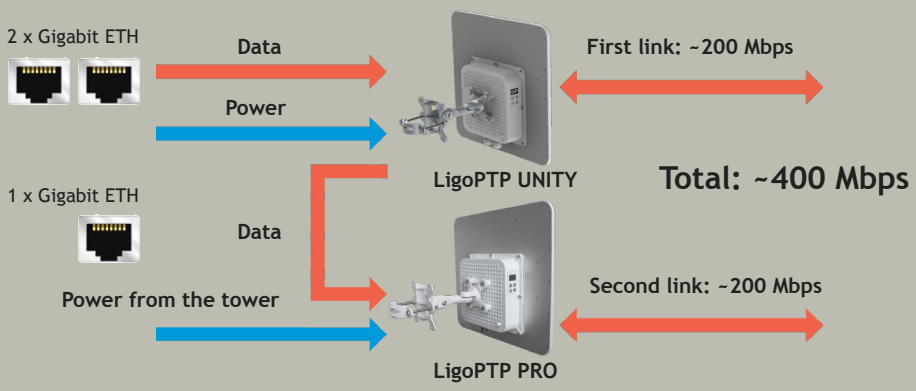
New LigoPTP models have a sleek and slim antenna design with a rugged, aluminum, IP-67 rated housing and professional articulating mounting bracket

W-Jet is Ligowave's proprietary wireless protocol that combines special techniques to achieve superior performance and reliability even over long distances. The **W-Jet** protocol is the result of years of development and gives Ligowave PTP products the ability to outperform higher cost products on the market while improving the return on investment.

* Country dependent - FCC 5.745 to 5.825 MHz

LigoPTP UNITY

- **5.1-5.9 GHz*** frequency support (full 5 GHz spectrum)
- Flexible channel sizes **(20, 40 Mhz)**
- **220 Mbps** of real capacity (extendable up to **400 Mbps**)
- Advanced proprietary **W-Jet 2 MiMo** protocol to enhance PTP communication
- High transmit power and high receive sensitivity ensure long range data links **(up to 28 dB per chain)**
- **2 x Gigabit Ethernet** ports
- 2nd Ethernet port used for **bonding or backup** of 2 links
- **L2** and ***L3* QoS** (quality of service) support
- **DFS 3 and ATPC** support
- Very high packet per second rate **(up to 140,000)**
- Low packet latency **(<2 ms)**
- External OLED screen for antenna alignment and throughput testing
- Advanced but easy to use operating system
- Professional articulating mounting bracket
- Integrated surge protection **(IEC standards compliant)**
- **IP-67** standards compliant



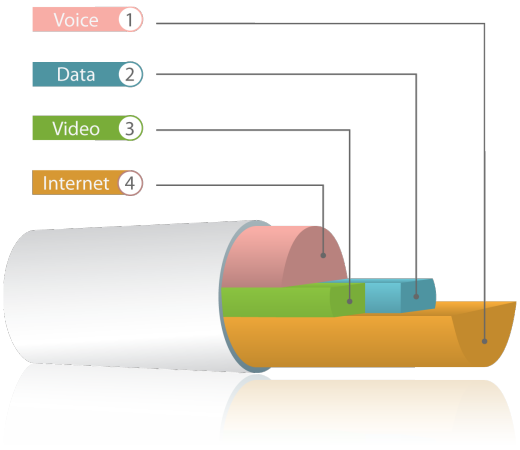
LigoPTP UNITY bonding

Link bonding is a new functionality available in LigoPTP UNITY devices. An extremely powerful CPU allows bonding LigoPTP UNITY together with LigoPTP MiMO or LigoPTP PRO series devices. The 2nd Ethernet port is where the additional device is connected. Fair queuing mechanism is used for bonding of two links operating simultaneously. Besides doubling the throughput over the same link (from 200 Mbps to 400 Mbps) it also provides redundancy for the wireless radios; if one of the radios fails the other link will continue to operate.

QoS on LigoPTP UNITY

LigoPTP UNITY devices support L2 (802.1p) and L3 (DSCP) QoS. In layer 2 QoS data is prioritized according to VLANs while in layer 3 according to IP addresses. Both types of QoS can run together or independently and traffic can be mapped into 4 different queues for each type applying strict or WRR policies. Having QoS on your link allows you to prioritize mission critical data and real time data that requires more capacity and higher PPS rate. Max capacity for each of the queues is calculated according to the wireless link dynamically.

Example: The picture on the right shows that internet traffic receives lowest priority, data and video receive middle priority and voice traffic receives highest priority.



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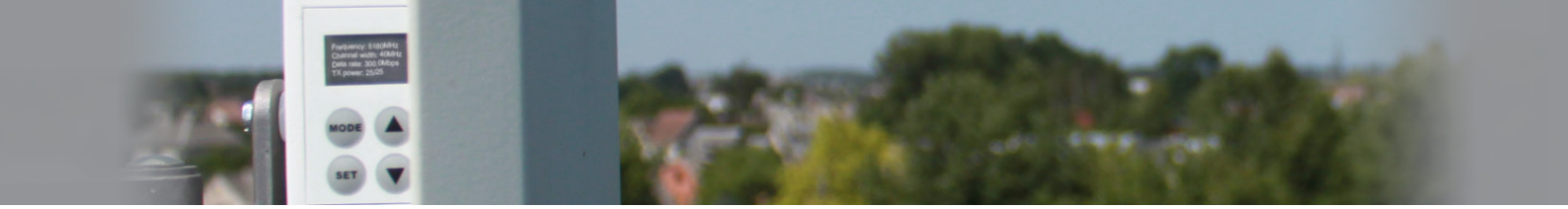
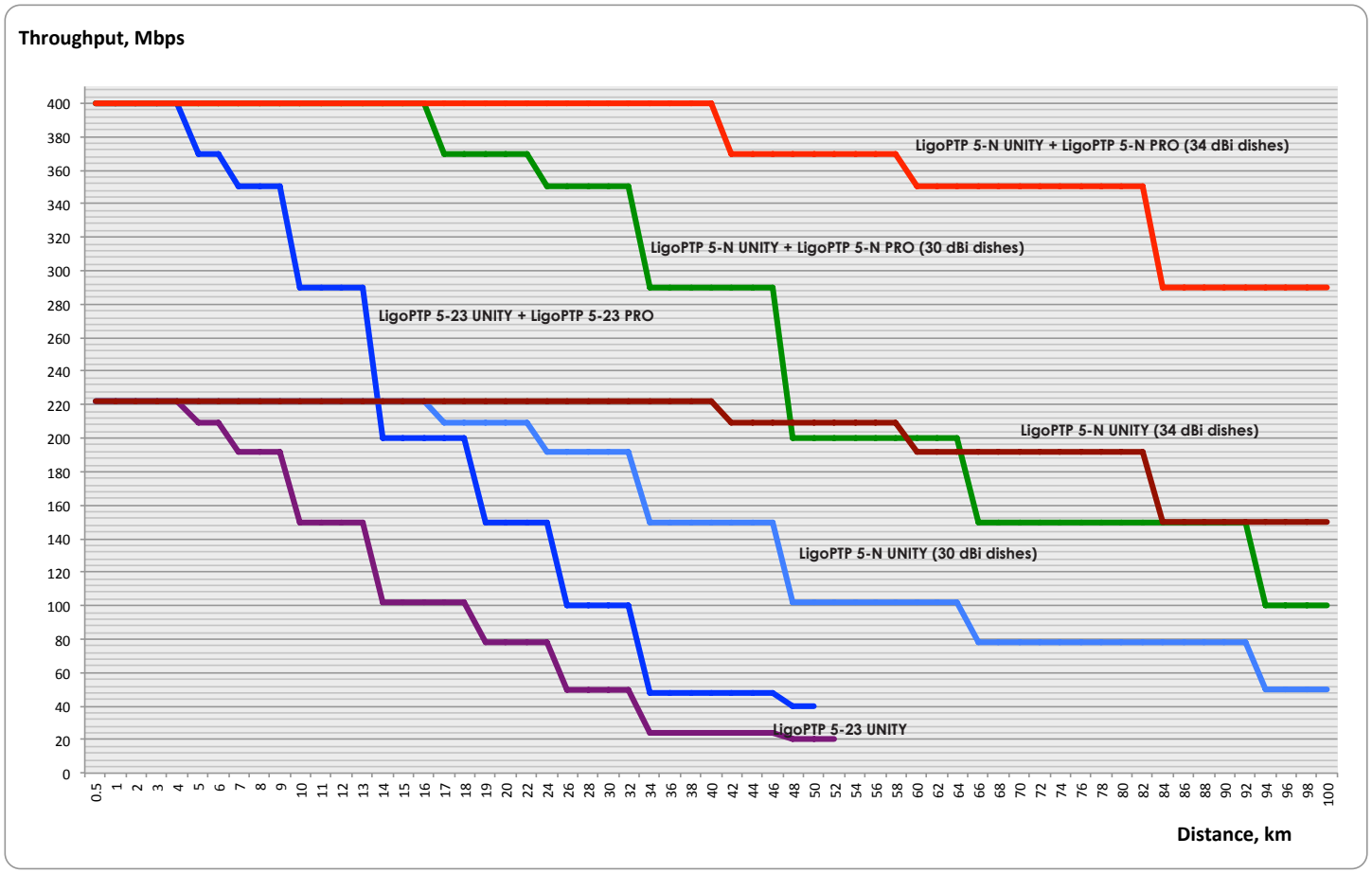


Wireless protocol comparison

The table and the graphs compare standard WLAN performance against W-Jet 2 protocol.

	WLAN 802.11N 1x1	WLAN 802.11n 2x2	W-Jet 2 / LigoPTP PRO	W-Jet 2/ LigoPTP UNITY
Max data rate, Mbps	150	300	300	300
Max real throughput, Mbps	70 - 90	120 - 150	220	220
Max packet per second ratio, k	15 - 20	15 - 20	60	140
Max transmit power, dBm*	20 - 25	20 - 25	28 (+/-2)	28 (+/- 2)
Real data bit/Hz	1.75 - 2.25	3 - 3.75	5.5	5.5
Traffic symmetry	No	No	Yes	Yes
QoS	No	No	No	Yes
Bonding/ wireless failover	No	No	No	Yes

*Output power is measured per chain



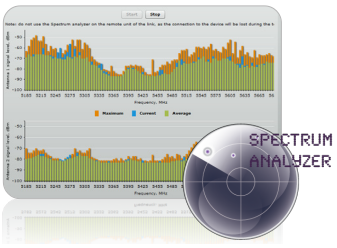
The graph above represents LigoPTP 5-23 UNITY, LigoPTP 5-N UNITY, LigoPTP 5-23 PRO and LigoPTP 5-N PRO capacity at different distances. The calculations were done with a 15 dB fade margin and no interference on the link.

ADVANTAGES

OLED screen for antenna alignment and link testing without a laptop on the tower.

Best in class OS made for easy and reliable backlhaul setup. Smart auto-channel, auto-rate and automatic transmit power control makes link setup extremely easy.

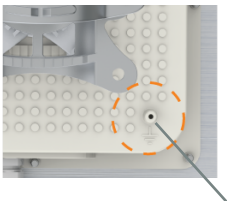
Dynamic TDD protocol made for PTP applications delivers high PPS rate and low latency which are extremely important for reliable backhaul performance.



Integrated spectrum analyzer. It is a real-time spectrum scanning tool, which provides a graphical signal representation and displays maximum, average and current signal (noise) levels.

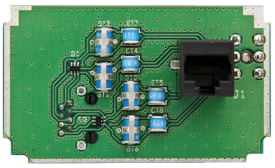
Internal link testing tool for on the spot link performance and PPS measurement.

Grounding feature on the enclosure for ease in grounding the unit.



Weather-proof IP-67 rated enclosure

External OLED screen for antenna alignment, link testing and statistical review



Integrated surge protection dsigned according to IEC standards

Professional N-connectors for external antenna
(Note: all LigoPTP unlicensed band products come in an integrated antenna or N-connectorized version)

Metal gland for Ethernet jack

Professional articulating mounting bracket for easy antenna alignment and reliable mounting

PoE adapter with a grounding option

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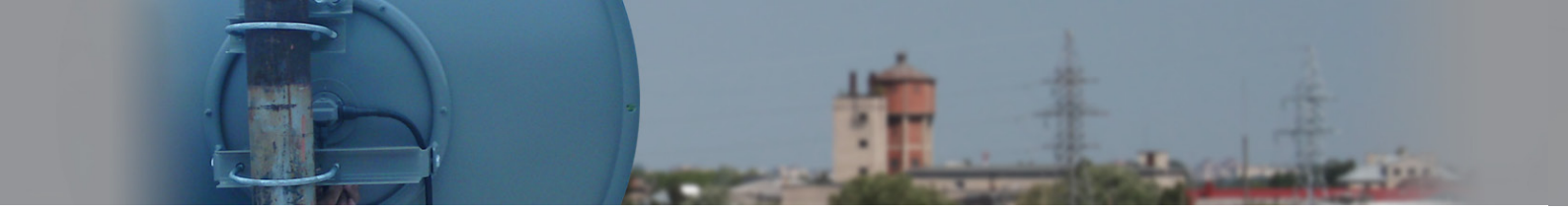
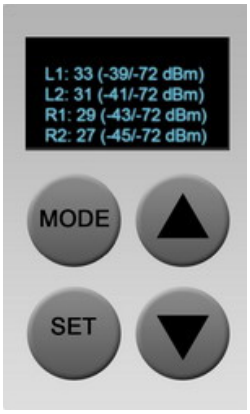
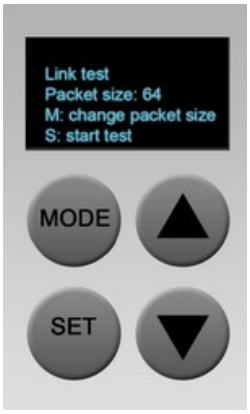


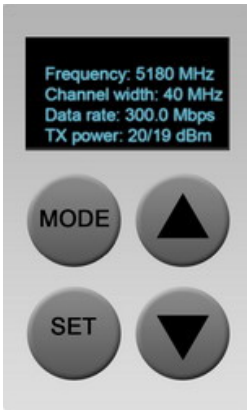
OLED screen overview



During the antenna alignment procedure current RSSI levels of the local and remote unit can be seen



After link deloyment it can be tested with different packet sizes for additional performance optimization



Various statistical information reviewing:

- Wireless settings
- TX/RX information
- Ethernet statistics
- Device information
- IP settings

External OLED screen allows easy rebooting and resetting the unit to defauls

PIN code functionality is available for additional security of the LigoPTP units

LinkCalc™

Available at: http://www.ligowave.com/linkcalc

Link calculator is a link planning tool available online. The link calculator allows users to calculate link performance expectations taking into account geographical information, distance between the units, antenna height and gain, transmit power, and other factors in order to choose the most suitable product available from the LigoWave and Deliberant extensive product portfolios. In addition, custom calculations using other vendors' equipment specs can be used, making link calculator the ultimate link planning tool.

Google maps integration

Downloadable PDF reports

PTP and PTMP mode support

Online storage for saved calculations

620HP

LICENSED BAND

Highlights:

- Wide frequency range support from 6 to 38 GHz
- Flexible channel sizes: from 7 to 56 MHz ETSI, from 10 to 60 MHz ANSI
- Double capacity mode 2+0
- Protection modes: 1+1 Hot Standby, 1+1 Space diversity, 1+1 Freqeuency diversity
- Modulation types: QPSK, 8PSK, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM
- Up to 730 Mbps real data throughput (365 Mbps full duplex) in 1+0 configuration
- Up to 1460 Mbps real data throughput (730 Mbps full duplex) in 2+0 configuration
- Low latency, less than 0.5 msec
- Up to 23 - 30 dBm transmit power (frequency dependant)
- Hitless auto-rate support (ACM)
- Automatic transmit power control
- Three copper gigabit Ethernet ports
- SFP expansion port
- Pilot system for phase noise improvement
- Short synchronization time up to 50 msec
- External TDM module for 16 E1/T1
- Separated data channels support over microwave link
- VLAN support 802.1q
- Quality of Service 802.1p, IPv4 ToS/DiffServ
- Ethernet traffic limitation support
- SyncEthernet support
- Online Ethernet header compression
- Jumbo frames support up to 10K
- Secure management and monitoring via HTTP, HTTPS, Telnet, SSH, SNMP, Serial
- Built-in useful tools: BER tester, spectrum analyzer, ping, telnet
- No speed-based license fees
- Compact IDU design

LigoPTP 620HP capacity

LigoPTP 620HP data throughput depends directly on the channel size and modulation which is related to received signal level and fade margin. For a more detailed information on a specific link the LinkCalc should be used.

Channel size -> / Modulation	7 MHz	14 MHz	28 MHz	40 MHz	56MHz
QPSK	21 Mbps	42.8 Mbps	88 Mbps	123.4 Mbps	170.6 Mbps
8PSK	31.4 Mbps	63.6 Mbps	130.8 Mbps	182.6 Mbps	255.2 Mbps
16-QAM	42.6 Mbps	86 Mbps	176.6 Mbps	246.6 Mbps	342 Mbps
32-QAM	52.6 Mbps	106.2 Mbps	218 Mbps	304.2 Mbps	434.8 Mbps
64-QAM	65.4 Mbps	131.8 Mbps	271.2 Mbps	372.2 Mbps	532.4 Mbps
128-QAM	76.6 Mbps	155.4 Mbps	317.6 Mbps	439.6 Mbps	628.4 Mbps
256-QAM	88.4 Mbps	177.4 Mbps	363.4 Mbps	506.6 Mbps	724.6 Mbps

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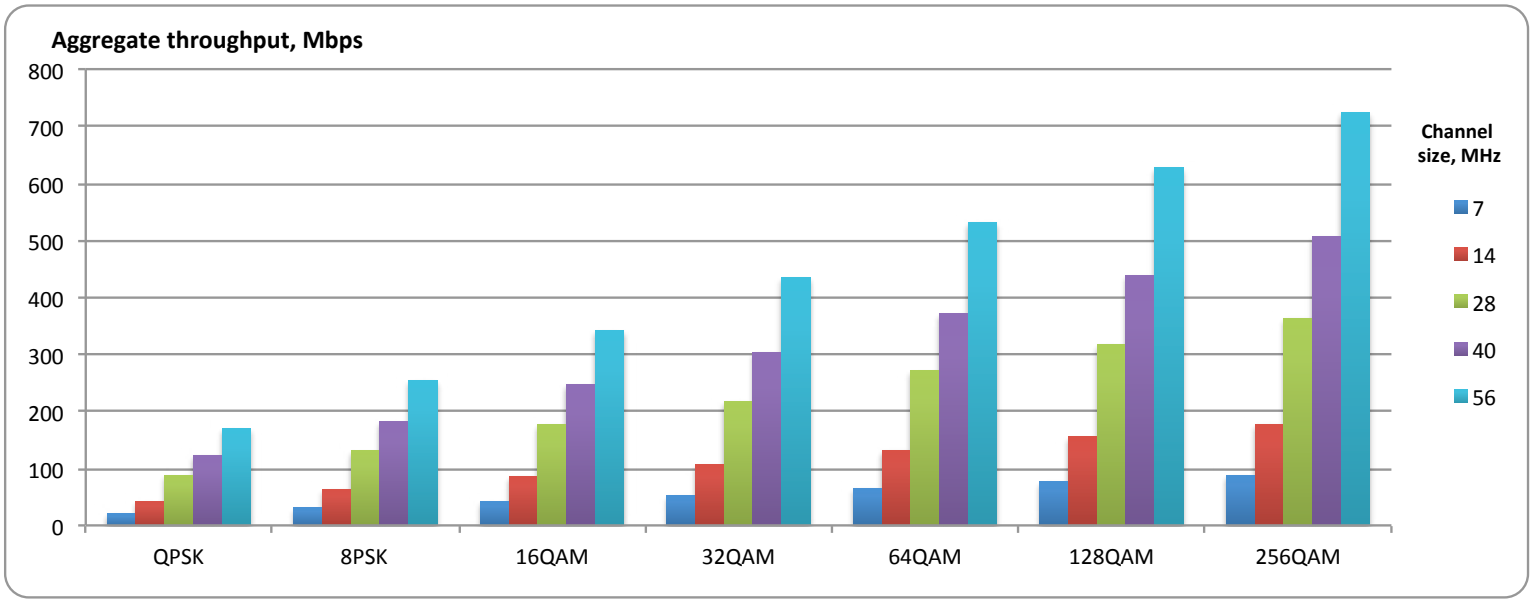
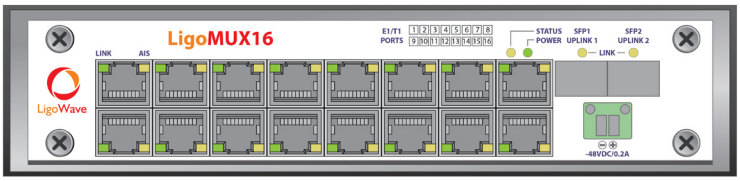
LigoPTP 620HP throughput graph



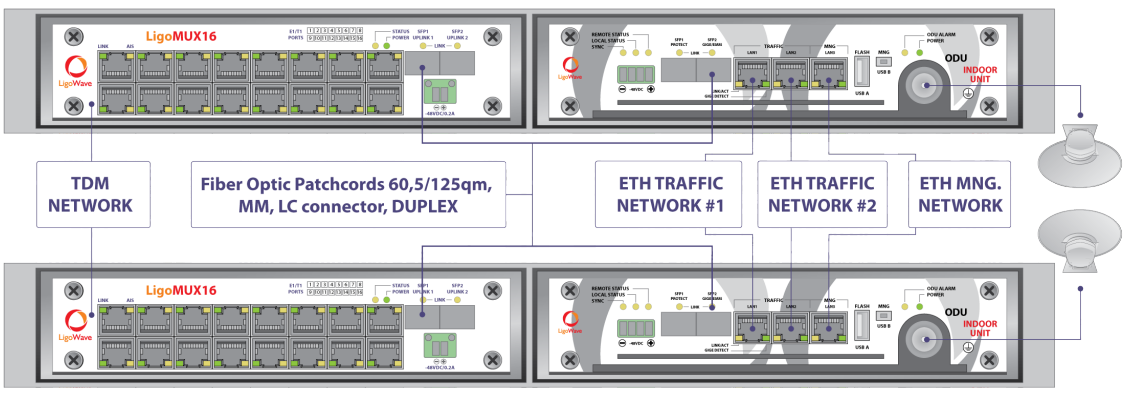
LigoMUX 16 - external multiplexer for 16 E1/T1 lines

LigoMUX 16 is an external multiplexer module that provides E1/T1 extension for the IDU (indoor unit) of LigoPTP 620S microwave licensed-band equipment. The module allows multiplexing up to 16 E1/T1 circuits. LigoMUX 16 has 16 x E1/T1 built-in ports and 2 x SFP 1000 Base-SX ports. It is a really compact and easy to configure device (configuration is done via LigoPTP 620S unit) and has scalable design which can be extended for up to 32 E1/T1



E1/T1 setup example:

Simple (1+0) scenario with interconnected LigoMUX 16 for 365 Mbps full duplex (730 Mbps aggregate) link with 16 E1/T1 interfaces (expandable up to 32 E1/T1 interfaces). External LigoMUX multiplexer can be used in a 1+0, 1+1 and 2+0 scenario. To find more information about LigoMUX 16 please visit our website http://www.ligowave.com.

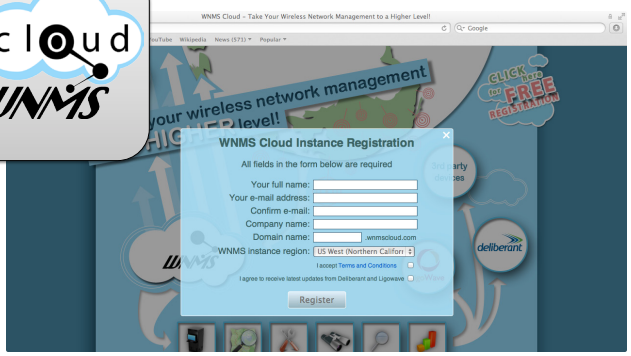


WIRELESS NETWORK MANAGEMENT SYSTEM

WNMS is a FREE enterprise grade Wireless Network Management system available for download at LigoWave's website. A single software solution simplifies a large number of management and monitoring tasks for the network administrator. Comprehensive network management software supports several thousand devices. Main WNMS tasks:

- Supporting LigoWave, Deliberant and 3rd party equipment*
- Multiple OS support (Windows, Virtual Machine, Linux)
- Network visualization on Google Maps
- Configuration and maintenance
- Monitoring and alerting
- Smart discovery and provisioning
- Statistical data collection and reporting

* For the control and monitoring of 3rd party equipment the SWEAP application is necessary



WNMS Cloud is a new mobile way to manage your network. The setup is as easy as 1-2-3 and you get your virtual WNMS server running online.

Highlights:
- Easy and quick WNMS server setup
- World-wide availability
- High reliability (based on Amazon cloud)
- Strong security (HTTPS and OpenVPN)
- No hardware and maintenance costs reducing CAPEX and OPEX
- Third party equipment monitoring through WNMS remote agent (SWEAP application)*

*Needs additional hardware, working as a data collector.

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