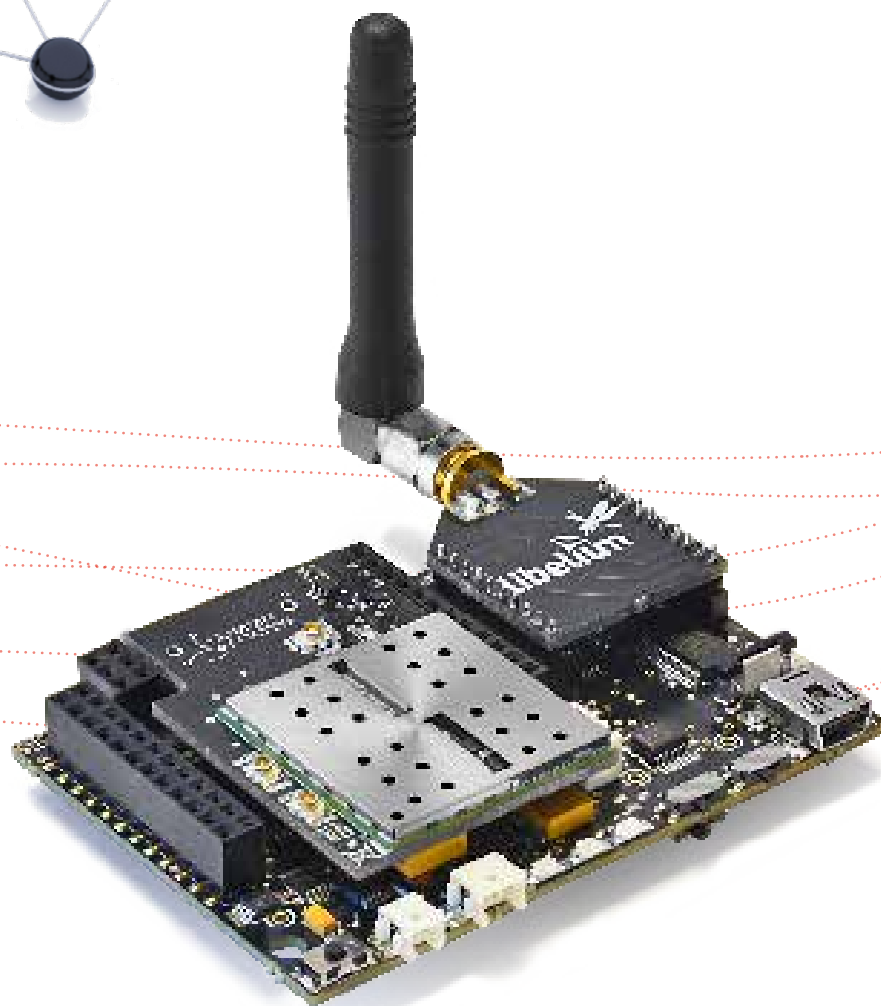
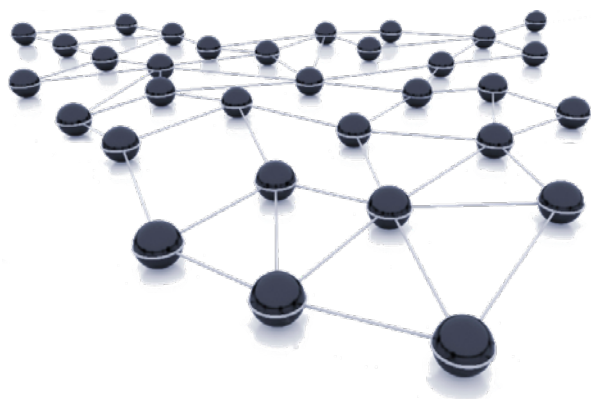


Wasp mote

Datasheet



Important:

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New version: Waspmote v15

This datasheet summarizes the benefits of the new Waspmote platform. This line was released on October 2016. It is an evolution from the previous Waspmote v12.

Waspmote v15 is not compatible with Waspmote v12, so it is NOT recommended to mix product generations. If you are using previous versions of our products, please use the corresponding guides, available on our [Development website](#).

You can get more information about the generation change on the document "[New generation of Libelium product lines](#)".

Waspote

General data:

Microcontroller: ATmega1281
Frequency: 14.7456 MHz
SRAM: 8 kB
EEPROM: 4 kB
FLASH: 128 kB
SD card: 16 GB
Weight: 20 g
Dimensions: 73.5 x 51 x 13 mm
Temperature range: [-30 °C, +70 °C]*
Clock: RTC (32 kHz)
**Temporary extreme temperatures are supported.
 Regular recommended usage: -20, +60 °C.*



Figure: Waspote

Consumption:

On: 17 mA
Sleep: 30 µA
Deep Sleep: 33 µA
Hibernate: 7 µA
Operation without recharging: 1 year*

**Time obtained using the Hibernate mode as energy saving mode*

Inputs/Outputs:

7 analog (I), 8 digital (I/O), 1 PWM, 2 UART, 1 I2C, 1 USB, 1 SPI

Electrical data:

Battery voltage: 3.3 – 4.2 V
USB charging: 5 V – 480 mA (max current input) → 100 mA in batches since summer 2018
Solar panel charging: 6 - 12 V – 300 mA (max current input)

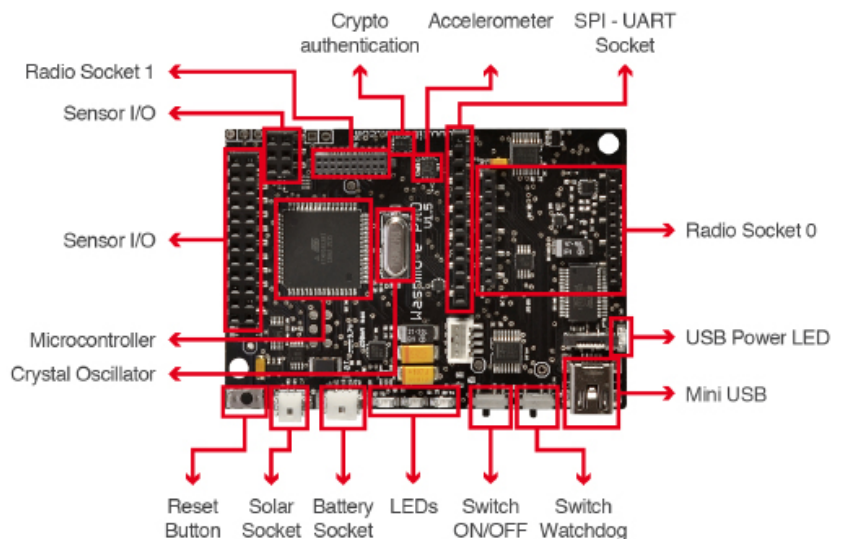


Figure: Waspote board top

Built-in sensors on the board:

Accelerometer: ±2g/±4g/±8g
 Low power: 0.5/1/2/5/10 Hz
 Normal mode: 50/100/400/1000 Hz

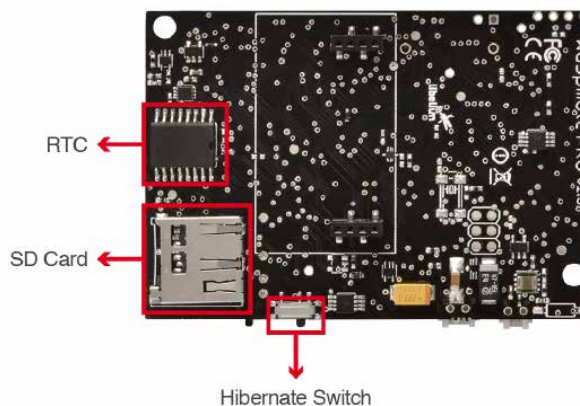


Figure: Waspote board bottom

802.15.4/ZigBee

Radio version	Frequency	Transmission power	Sensitivity	Range*
XBee-PRO 802.15.4 EU	2.4 GHz	10 dBm	-100 dBm	750 m
XBee-PRO 802.15.4	2.4 GHz	18 dBm	-100 dBm	1600 m
XBee-PRO DigiMesh	2.4 GHz	18 dBm	-100 dBm	1500 m
XBee ZigBee 3	2.4 GHz	8 dBm	-103 dBm	1200 m
XBee 868LP	863 - 870 MHz	14 dBm	-106 dBm	8.4 km
XBee-PRO 900HP US	902 - 928 MHz	24 dBm	-110 dBm	15.5 km
XBee-PRO 900HP BR	902 - 906.8 MHz 915.6 - 928 MHz	24 dBm	-110 dBm	15.5 km
XBee-PRO 900HP AU	915.6 - 928 MHz	24 dBm	-110 dBm	15.5 km



Figure: XBee module

* To determine your range, perform a range test under your operating conditions

- Antennas:** 2.4 GHz: 5 dBi
868/900 MHz: 4.5 dBi
- Connector:** RP-SMA
- Encryption:** AES 128 bits
- Control Signal:** RSSI
- Standards:** XBee-PRO 802.15.4: IEEE 802.15.4 compliant. XBee ZigBee 3: ZigBee 3.0
- Topologies:** Star, tree, mesh

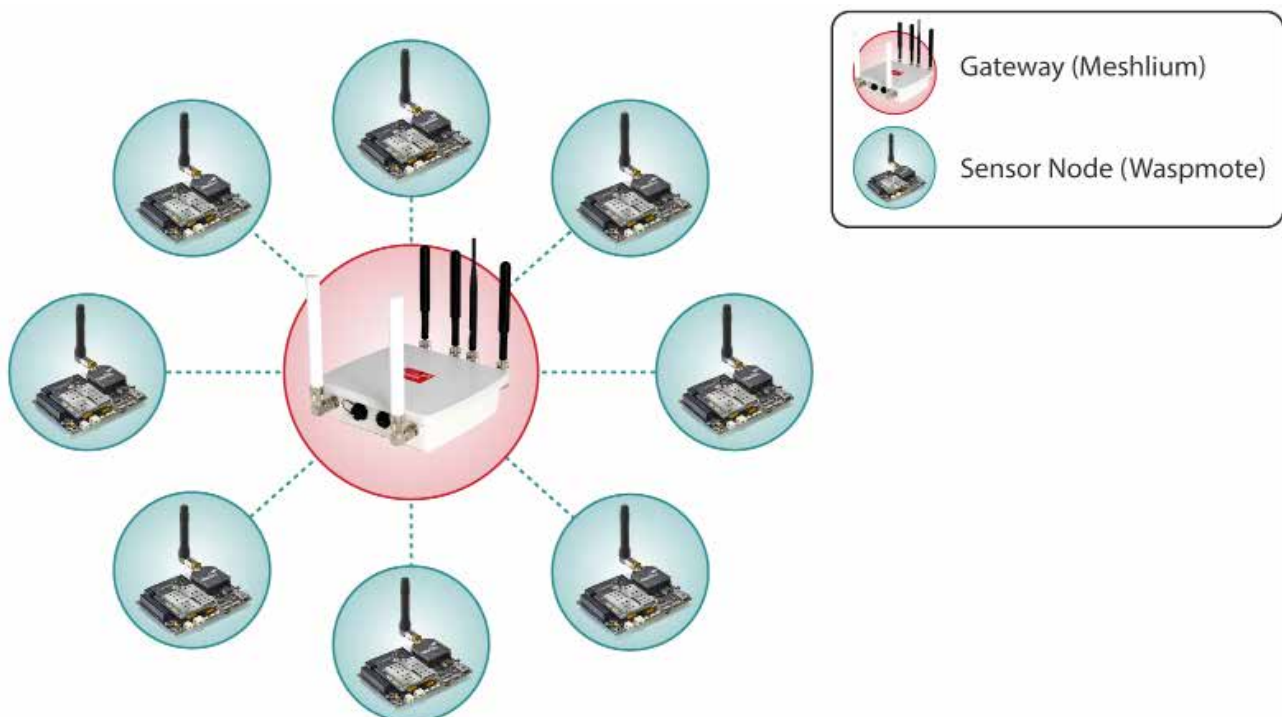


Figure: Star network

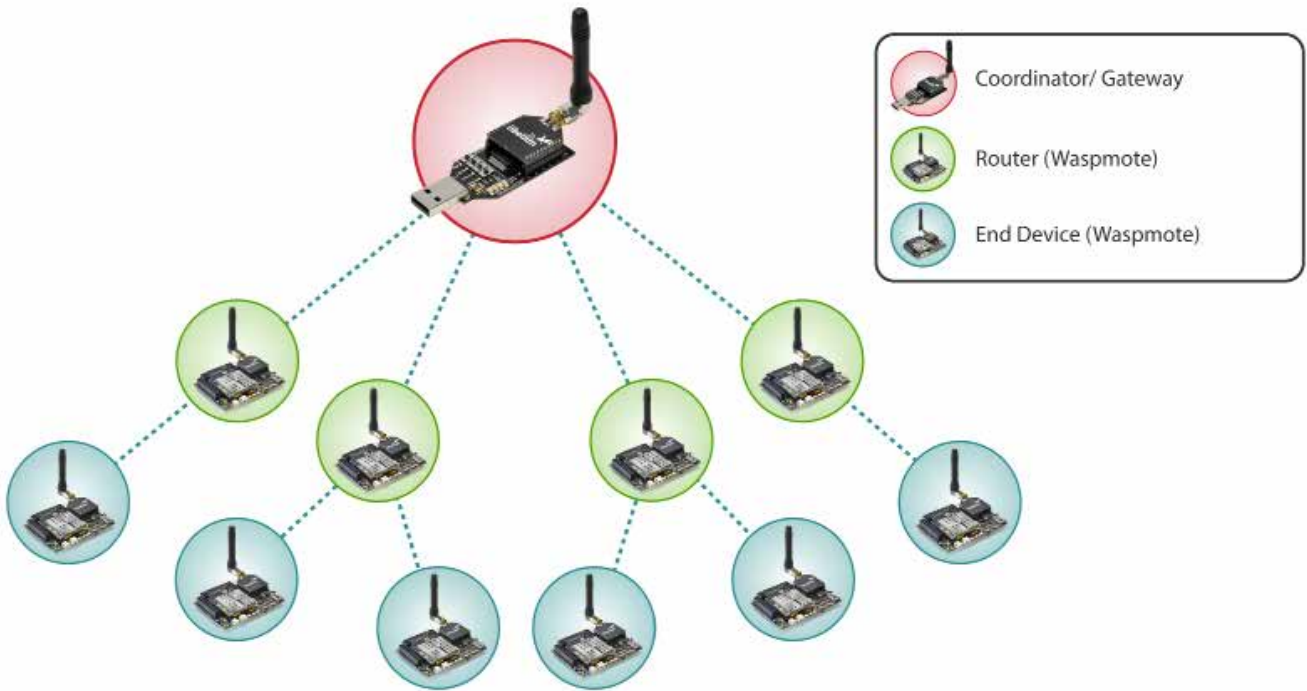


Figure: Tree network

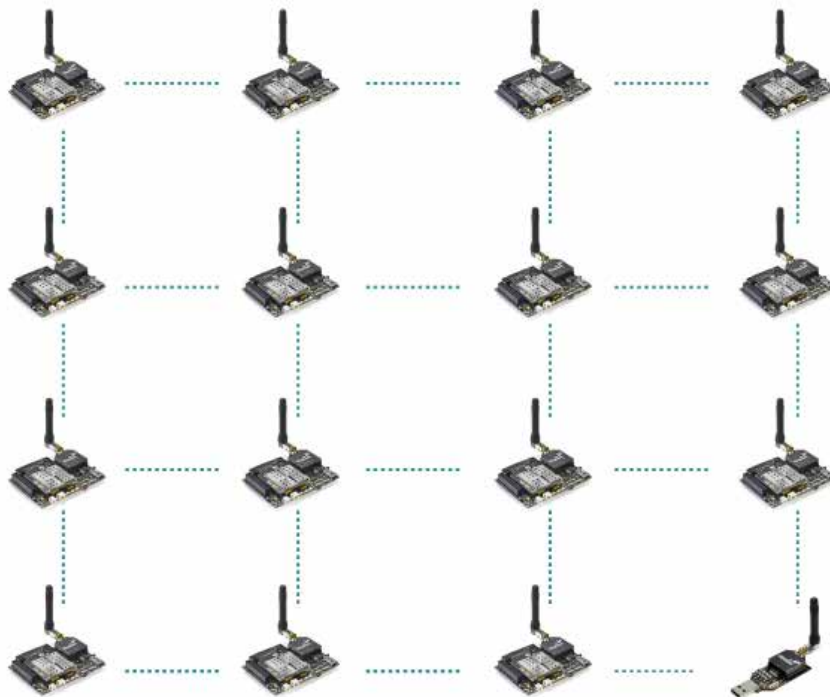


Figure: Mesh network

LoRaWAN modules

Protocol: LoRaWAN 1.0, Class A

LoRaWAN-ready

Frequency:

- LoRaWAN EU module: 868 MHz and 433 MHz ISM bands
- LoRaWAN US module: 902-928 MHz ISM band
- LoRaWAN AU module: 915-928 MHz ISM band
- LoRaWAN IN module: 865-867 MHz ISM band
- LoRaWAN ASIA-PAC / LATAM module: 923 MHz ISM band
- LoRaWAN JP / KR module: 923 MHz ISM band Japan / KR920-923 MHz ISM band

TX power:

- LoRaWAN EU module: up to 14 dBm
- LoRaWAN US module: up to 18.5 dBm
- LoRaWAN AU module: up to 18.5 dBm
- LoRaWAN IN module: up to 18.5 dBm
- LoRaWAN ASIA-PAC / LATAM module: up to 18.5 dBm
- LoRaWAN JP / KR module: up to 16 dBm in Japan / up to 14 dBm in Korea

Sensitivity: down to -136 dBm

Range: >15 km at suburban and >5 km at urban area. Typically, each base station covers some km. Check the LoRaWAN Network in your area.

Chipset consumption:

- LoRaWAN EU module: 38.9 mA
- LoRaWAN US module: 124.4 mA
- LoRaWAN AU module: 124.4 mA
- LoRaWAN IN module: 124.4 mA
- LoRaWAN ASIA-PAC / LATAM module: 124.4 mA
- LoRaWAN JP / KR module: 96.1 mA

Radio data rate:

- LoRaWAN EU module: from 250 to 5470 bps
- LoRaWAN US module: from 250 to 12500 bps
- LoRaWAN AU module: from 250 to 12500 bps
- LoRaWAN IN module: from 250 to 12500 bps
- LoRaWAN ASIA-PAC / LATAM module: from 250 to 5470 bps
- LoRaWAN JP / KR module: from 250 to 5470 bps

Receiver: purchase your own base station or use networks from LoRaWAN operators



Figure: LoRaWAN EU module



Figure: LoRaWAN JP/KR module

Compatibility with territories:

- LoRaWAN EU module: Europe (EU863-870 protocol)
- LoRaWAN US module: US, Canada, Mexico (US902-928 protocol)
- LoRaWAN AU module: Australia (AU915-928 protocol)
- LoRaWAN IN module: India (IN865-867 protocol)
- LoRaWAN ASIA-PAC / LATAM module: Australia, Bolivia, Brunei Darussalam, Cambodia, Chile, China, Costa Rica, Ecuador, Guatemala, Hong Kong, Indonesia, Laos, Malaysia, New Zealand, Pakistan, Panama, Paraguay, Peru, Salvador, Singapore, Taiwan, Thailand, Uganda, Uruguay and Venezuela (AS923 protocol)
- LoRaWAN JP / KR module: Japan (AS923 protocol) and Korea (KR920-923 protocol)



Figure: LoRaWAN network

Sigfox modules

Frequency:

- Sigfox EU module: ISM 868 MHz
- Sigfox US module: ISM 900 MHz
- Sigfox AU / APAC / LATAM module: ISM 900 MHz

TX Power:

- Sigfox EU module: 16 dBm
- Sigfox US module: 24 dBm
- Sigfox AU / APAC / LATAM module: 24 dBm

ETSI limitation: 140 messages of 12 bytes, per module per day

Range: Typically, each base station covers some km. Check the [Sigfox Network](#)

Chipset consumption:

- Sigfox EU module: TX 51 mA @ 14 dBm
- Sigfox US module: TX 230 mA @ 24 dBm
- Sigfox AU / APAC / LATAM module: TX 230 mA @ 24 dBm

Radio data rate: 100 bps

Receive sensitivity: -126 dBm

Sigfox certificate: Class 0u (the highest level)

Sigfox service available in these territories:

- EU module: RC1 zone (Europe, Oman, Iran, South Africa, Tunisia, UAE)
- US module: RC2 zone (USA, Mexico, Brazil)
- AU / APAC / LATAM module: RC4 zone (Australia, New Zealand, Singapore, Taiwan, Hong Kong, Thailand, Malaysia, Colombia, Argentina, Chile, Costa Rica, Ecuador, Panama, El Salvador)

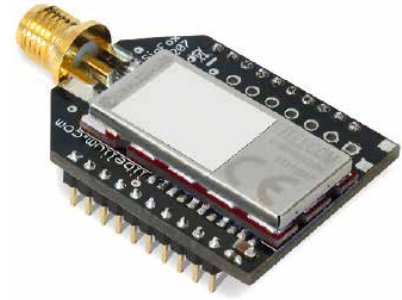


Figure: Sigfox module



Figure: Sigfox network

LoRa module

Protocol: Own, developed at Libelium. Not compatible with LoRaWAN.

Model: Semtech SX1272

Frequencies available: 860-1000 MHz, fits both 868 (Europe) and 900 MHz (USA) ISM bands

Max TX power: 14 dBm

Sensitivity: -137 dBm

Range:

- **Line of Sight:** 21+ km / 13.4+ miles (LoS and Fresnel zone clearance)
- **Non Line of Sight:** 2+ km / 1.2+ miles (nLoS going through buildings, urban environment)

Antenna: 868 / 915 MHz: 0 / 4.5 dBi

Connector: RPSMA

Encryption: AES 128/192/256 bits (performed by Waspote API)

Control Signal: RSSI

Topology: Star

Receiver/Central node: Special Gateway LoRa (SPI) or another Waspote unit



Figure: LoRa module

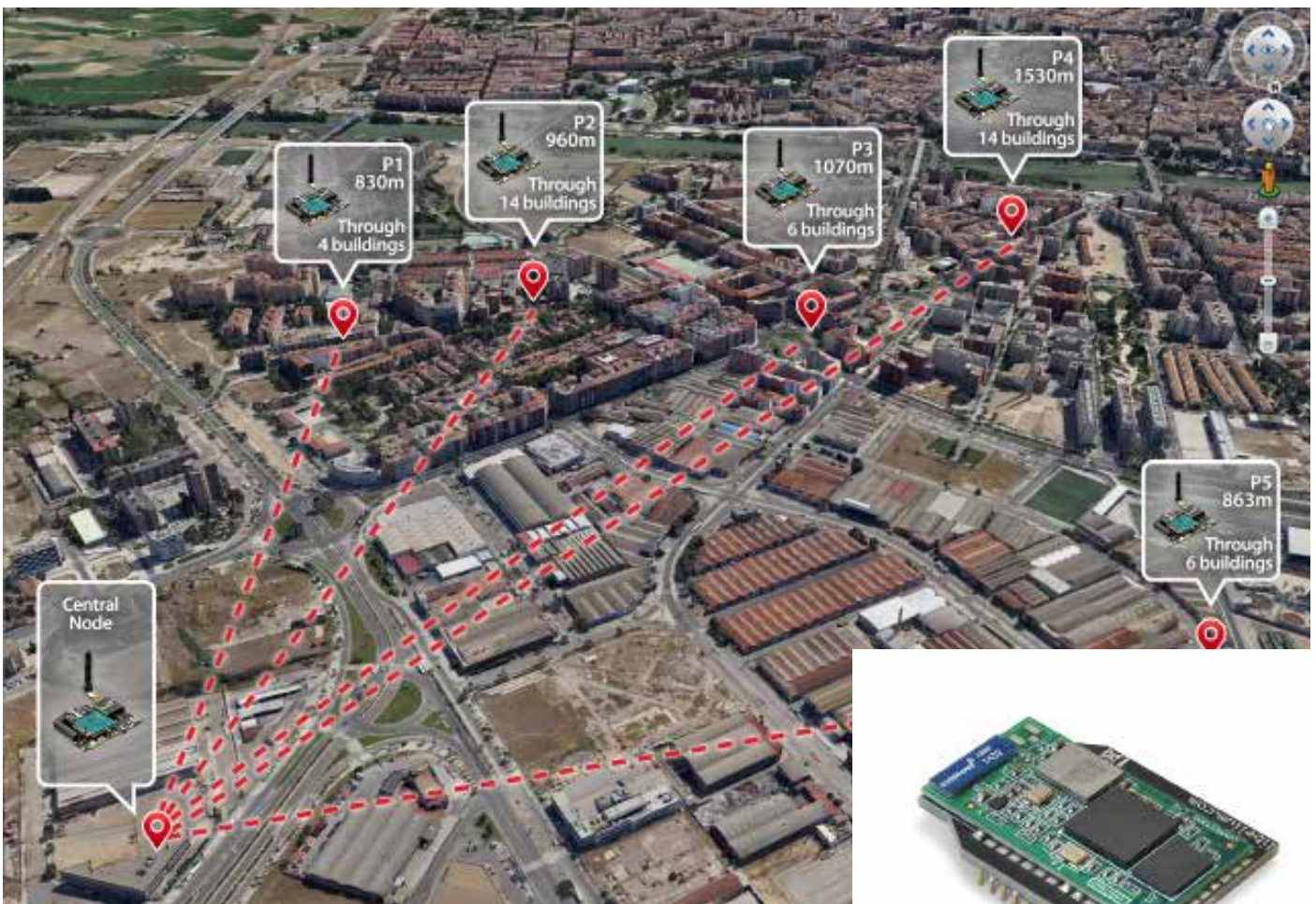


Figure: Star topology

WiFi PRO module

TX power:

- 802.11b: 17 dBm
- 802.11g: 14 dBm
- 802.11n: 12 dBm

RX sensitivity:

- 802.11b @11Mbps PER<8%: -87 dBm
- 802.11b @1Mbps PER<8%: -94 dBm
- 802.11g @54Mbps PER<10%: -73 dBm
- 802.11g @6Mbps PER<10%: -86 dBm
- 802.11n MCS0 PER<10%: -86 dBm
- 802.11n MCS0 PER<10%: -70 dBm

Chipset consumption:

- TX mode: 350 mA
- RX mode: 130 mA

Internet protocols:

- ARP, ICMP, IP, UDP, TCP, DHCP, DNS, NTP, HTTP, HTTPS, FTP

Security protocols:

- SSL3/TLS1, HTTPS, RSA, AES-128/256, 3DES, RC-4, SHA-1, MD-5, WEP, WPA and WPA2 accelerated in hardware: AES, 3DEC and SHA

Wireless specifications:

- Standards:
 - IEEE 802.11b/g/n
- Frequency:
 - Europe: 2.412 – 2.472 GHz
 - USA: 2.412 – 2.462 GHz
 - Japan: 2.412 – 2.484 GHz
- Channels:
 - Europe: 13
 - USA: 11
 - Japan: 14

Antenna:

- Plug and Sense!: internal U.FL-to-SMA connector
- Waspote OEM: on-chip antenna

NB-IoT / Cat-M module

Model: BG96 (Quectel)

Frequency bands:

- Cat NB1 / Cat M1: LTE FDD: B1/B2/B3/B4/B5/B8/B12/B13/B18/ B19/B20/B25**/B26*/B28



JL)
(UL)
(UL)
JL)

SS, BeiDou/Compass,

Antenna connectors:

- U.FL for main antenna (cellular)
- U.FL for GNSS antenna

External antenna: 5 dBi

Sensitivity:

- -113 dBm @Cat NB1, CE Level 0
- -107 dBm @Cat M1, 1.4 MHz Bandwidth, CE Mode A

SIM size: Nano-SIM (4FF standard) (not included)

Protocols: PPP/TCP/UDP/SSL/TLS/FTP(S)/HTTP(S)/NITZ/ PING/MQTT

Actions:

- Sending/receiving SMS
- TCP/IP and UDP/IP clients
- HTTP and HTTPS service (SSL/TLS for fully secured comms)

Certifications:

- GCF/Vodafone (Global)
- CE/Deutsche Telekom (Europe)
- FCC/PTCRB/AT&T/Verizon/T-Mobile*/Sprint* (North America)
- RCM/Telstra (Australia)
- IC/Telus/Bell* (Canada)
- Telefónica (Spain)
- JATE/TELEC/KDDI/SoftBank/DOCOMO* (Japan)
- KC/SKT/LGU+* (Korea)
- IFETEL (Mexico)
- IMDA (Singapore)
- NCC (Taiwan)
- CCC (China)

* Under development

**LTE B25 will be supported on BG96 with R1.2 hardware version

4G module

Model: LE910 (Telit)

Versions:

- Europe/Brazil (new v2 in November 2019)
- America (new v2 in April 2019)

Europe/Brazil version:

- 2G: 900/1800 MHz
- WCDMA: 900/2100 MHz
- LTE: 800/900/1800/2100/2600 MHz

America version:

- 2G: 850/1900 MHz
- WCDMA: 850/1900 MHz
- LTE: 700/850/1700/1900 MHz

LTE (downlink):

- Europe/Brazil version up to 100 Mbps
- America version up to 100 Mbps

LTE (uplink): up to 50 Mbps

TX power:

- Europe/Brazil:
 - Class 4 (2 W, 33 dBm) @ GSM 900
 - Class 1 (1 W, 30 dBm) @ GSM 1800
 - Class E2 (0.5 W, 27 dBm) @ EDGE 900
 - Class E2 (0.4 W, 26 dBm) @ EDGE 1800
 - Class 3 (0.25 W, 24 dBm) @ UMTS
 - Class 3 (0.2 W, 23 dBm) @ LTE
- America:
 - Class E2 (0.5 W, 27 dBm) @ EDGE 900
 - Class E2 (0.4 W, 26 dBm) @ EDGE 1800
 - Class 3 (0.25 W, 24 dBm) @ UMTS
 - Class 3 (0.2 W, 23 dBm) @ LTE

Antenna connector:

- U.FL for cellular main antenna
- U.FL for cellular diversity antenna

External antenna: +5 dBi

This module can carry out the following tasks:

- Sending/Receiving SMS
- Multisocket up to 6 TCP/IP and UDP/IP clients
- TCP/IP server
- TCP SSL
- HTTP service
- FTP service (downloading and uploading files)
- Sending/receiving email (SMTP/POP3)



Figure: NB-IoT / Cat-M module

Figure: 4G module

Certifications:

- LE910-EUG (Europe / Brazil): CE, GCF, ANATEL
- LE910-NAG (US / Canada): FCC, IC, PTCRB, AT&T approved
- LE910-SKG (South Korea): KCC, SK Telecom approved
- LE910-JN V2 / LE910-JK V2 (Japan): NTT DoCoMo, KDDi

Bluetooth low energy module

Protocol: Bluetooth v.4.0 / Bluetooth Smart

Chipset: BLE112

RX Sensitivity: -103 dBm

TX Power: [-23 dBm, +3 dBm]

Antenna: 2 dBi/5 dBi antenna options

Security: AES-128 bits

Range: 100 m (at maximum TX power)

Actions:

- Send broadcast advertisements (iBeacons)
- Connect to other BLE devices as Master / Slave
- Connect with smartphones and tablets
- Set automatic cycles sleep / transmission
- Calculate distance using RSSI values
- Perfect for indoor location networks (RTLS)
- Scan devices with maximum inquiry time
- Scan devices with maximum number of nodes
- Scan devices looking for a certain user by MAC address



Figure: Bluetooth Low Energy module

Bluetooth module for device discovery

Protocol: Bluetooth 2.1 + EDR. Class 2

TX Power: 3 dBm

Antenna: 2 dBi

Max Scan: Up to 250 unique devices in each inquiry

Power levels: 7 [-27 dBm, +3 dBm]

Application:

- Vehicular and pedestrian traffic monitoring

Features:

- Received Strength Signal Indicator (RSSI) for each scanned device
- Scan devices with maximum inquiry time
- Scan devices with maximum number of nodes
- Scan devices looking for a certain user by MAC address
- Class of Device (CoD) for each scanned device



Figure: Bluetooth module for device discovery

RFID/NFC

Features:

- **Compatibility:** Reader/writer mode supporting ISO 14443A / MIFARE / FeliCaTM / NFCIP-1
- **Distance:** 5 cm
- **Max capacity:** 4 kB
- **Tags:** Cards, keyrings, stickers

Applications:

- Located based services (LBS)
- Logistics (assets tracking, supply chain)
- Access management
- Electronic prepaid metering (vending machines, public transport)
- Smartphone interaction (NFCIP-1 protocol)

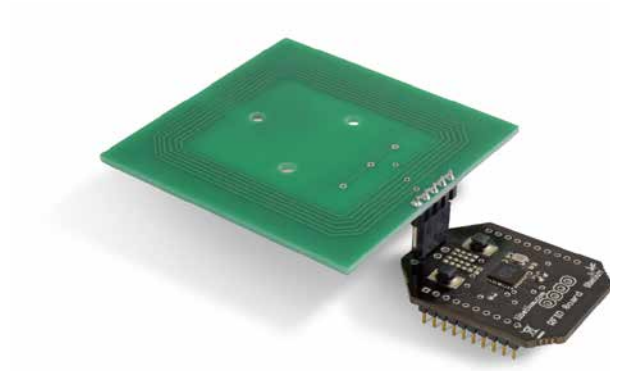


Figure: RFID/NFC module

Over the Air Programming (OTA)

Over the Air Programming (OTA) can be done with 4G and WiFi modules via FTP.

Benefits:

- Enables the upgrade or change of firmware versions without physical access.
- Upgrades the new firmware by querying a FTP server which helps to keep battery life.
- Upload new firmware in few minutes.

Topologies:

- Protocols which support FTP transmissions are directly connected to the Network Access Point.

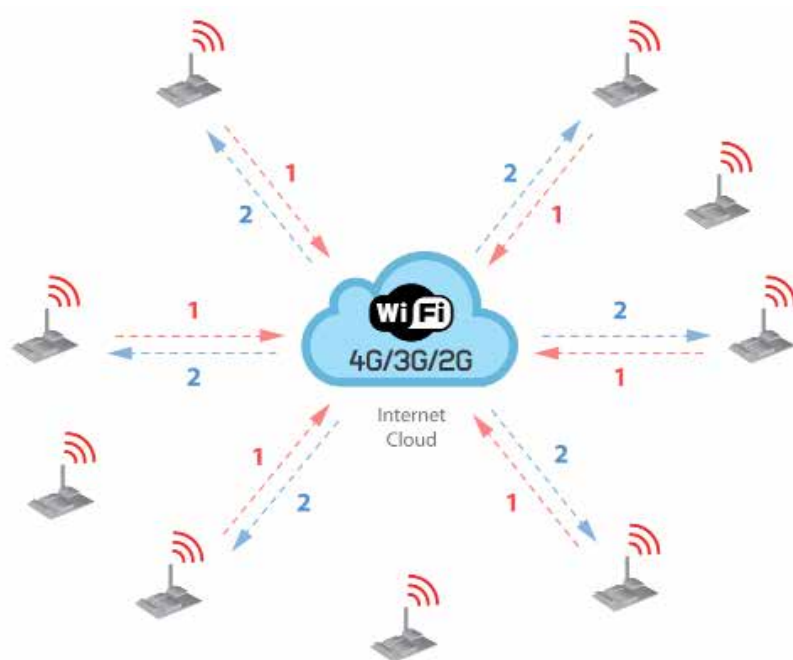


Figure: OTA with 4G/WiFi fundamentals

Encryption Libraries

The new Encryption Libraries are designed to add to the Wasp mote sensor platform the capabilities necessary to protect the information gathered by the sensors. To do so, **two cryptography layers** are defined:

- **Link Layer:** In the first one all the nodes of the network share a common **presared key** which is used to encrypt the information using **AES 128**. This process is carried out by specific hardware integrated in the same 802.15.4/ZigBee radio, allowing the maximum efficiency of the sensor nodes energy consumption. This first security layer ensures no third party devices will be able to even connect to the network (access control).
- **Secure Web Server Connection:** The third security technique is carried out in Meshlium -the Gateway- where **HTTPS** and **SSH** connections are used to send the information to the Cloud server located on the Internet.

A third optional encryption layer allows each node to encrypt the information using the Public key of the Cloud server. Thus, the information will be kept confidentially all the way from the sensor device to the web or data base server on the Internet.

Information is encrypted in the application layer via software with **AES 256** using the key shared exclusively between the origin and the destination. Then the packet is encrypted again in the link layer via hardware with **AES 128** so that only trusted packets be forwarded, ensuring access control and improving the usage of resources of the network.

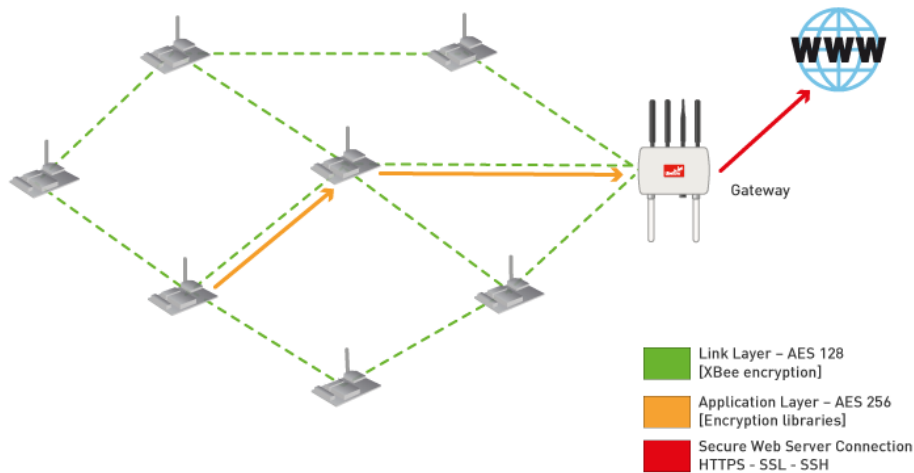





Figure: Communication diagram

Industrial Protocols

RS-485, CAN Bus and Modbus are widely used standards in the industrial and automation market. Waspote can be interfaced with standard devices and sensors thanks to the Industrial Protocols modules.

MODULE	MAIN APPLICATIONS	
RS-485 / Modbus module	<ul style="list-style-type: none"> Industrial Equipment Machine to Machine (M2M) communications Industrial Control Systems, including the most common versions of Modbus and Profibus Programmable Logic Controllers RS-485 is also used in building automation Interconnect security control panels and devices 	 <p><i>Figure: RS-485 module</i></p>
CAN Bus module	<ul style="list-style-type: none"> Automotive applications Home automation Industrial Networking Factory automation Marine electronics Medical equipment Military uses 	 <p><i>Figure: Can Bus module</i></p>
Modbus software layer	<ul style="list-style-type: none"> Modbus is a software layer which can be run over the RS-485 module Multiple master-slave applications Sensors and instruments Industrial Networking Building and infrastructure Transportation and energy applications 	 <p><i>Figure: RS-485 module</i></p>

Expansion Radio Board

The Expansion Board allows to connect two communication modules at the same time in the Waspote sensor platform. This means a lot of different combinations are possible using any of the wireless radios available for Waspote: 802.15.4, ZigBee, DigiMesh, 868 MHz, 900 MHz, LoRa, WiFi, GPRS, NB-IoT / Cat-M, 4G, Sigfox, LoRaWAN, Bluetooth Pro, Bluetooth Low Energy and RFID/NFC. Besides, the following Industrial Protocols modules are available: RS-485/Modbus and CAN Bus.

Some of the possible combinations are:

- LoRaWAN - 4G
- 802.15.4 - Sigfox
- 868 MHz - RS-485
- NB-IoT / Cat-M - WiFi
- DigiMesh - 4G
- NB-IoT / Cat-M - RFID/NFC
- WiFi - 4G
- CAN Bus - Bluetooth
- etc.

Remark: 3G, NB-IoT / Cat-M and 4G modules do not need the Expansion Board to be connected to Waspote. They can be plugged directly in the socket1.

Applications:

- Multifrequency Sensor Networks: (2.4 GHz - 868/900 MHz)
- Bluetooth - ZigBee hybrid networks
- NFC (RFID) applications with LoRaWAN
- ZigBee - WiFi hybrid networks

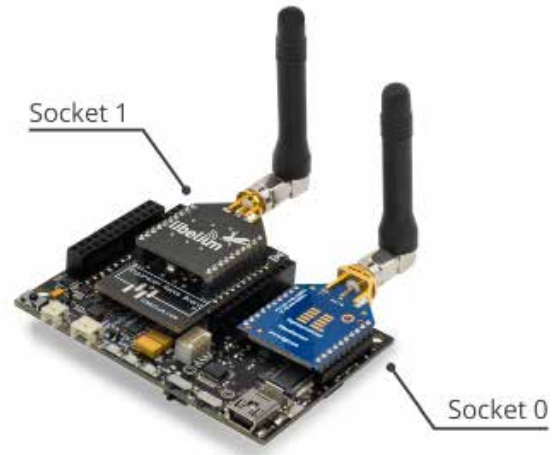


Figure: Expansion Radio Board

GPS module

Model: JN3 (Telit)

Sensitivity:

- Acquisition: -147 dBm
- Navigation: -160 dBm
- Tracking: -163 dBm

Hot start time: <1 s

Cold start time: <35 s

Positional accuracy error: < 2.5 m

Speed accuracy: < 0.01 m/s

EGNOS, WAAS, GAGAN and MSAS capability

Antenna:

- Cable lenght: 9cm
- Connector: UFL
- Gain:24 dBi (active)

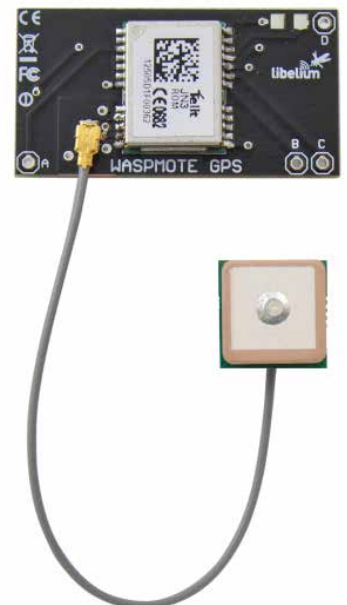


Figure: GPS module

Available information: latitude, longitude, altitude, speed, direction, date/time and ephemeris management

Programmable interruptions

- **Asynchronous**
 - Sensors (programmable threshold)
 - Accelerometer: Free-fall, impact (programmable threshold)
- **Synchronous:**
 - Watchdog: programmable alarms: from 32 ms to 8 s
 - RTC: programmable alarms: from 1 s to days

Watchdog reset

An RTC Watchdog has been implemented for resetting Waspote if it gets stuck. That periodical reset avoids erratic behaviour.

Sensor Boards

GASES PRO*



Figure: Gases PRO Board

(*) Calibrated gas sensors are manufactured once the order has been placed to ensure maximum durability of the calibration feature. Manufacturing process and delivery may take from 4 to 6 weeks. Lifetime of calibrated gas sensors is 6 months working at its maximum accuracy. We strongly encourage our customers to buy extra gas sensor probes to replace the originals after that time to ensure maximum accuracy and performance.

APPLICATIONS

- **City pollution**
CO, NO, NO₂, O₃, SO₂, Particle Matter - Dust
- **Air Quality Index calculation**
SO₂, NO₂, Particle Matter - Dust, CO, O₃, NH₃
- **Emissions from farms and hatcheries**
CH₄, H₂S, NH₃
- **Greenhouse management**
CO₂, CH₄, Humidity
- **Control of chemical and industrial processes**
CH₄, SO₂, CO₂
- **Indoor air quality**
CO₂, CO, Particle Matter - Dust, O₃
- **Forest fires**
CO, CO₂

SENSORS

- Carbon Monoxide – CO
- Carbon Dioxide – CO₂
- Molecular Oxygen – O₂
- Ozone – O₃
- Nitric Oxide – NO
- Nitric Dioxide – NO₂
- Sulfur Dioxide – SO₂
- Ammonia – NH₃
- Methane – CH₄ – and other combustible gases
- Hydrogen Sulfide – H₂S
- Particle Matter (PM1 / PM2.5 / PM10) – Dust Sensor [only for [Plug & Sense!](#)]
- Temperature, Humidity and Pressure

EVENTS



Figure: Events Board

APPLICATIONS

- **Security**
Hall effect (doors and windows), person detection PIR
- **Emergencies**
Presence detection and water level sensors, temperature
- **Control of goods in logistics**

SENSORS

- Pressure/Weight
- Hall Effect
- Temperature, Humidity and Pressure
- Liquid Presence
- Liquid Level
- Liquid flow
- Luminosity (Luxes)
- Presence (PIR)
- Ultrasound (distance measurement)

SMART WATER
APPLICATIONS
SENSORS


Figure: Smart Water Board

- **Potable water monitoring**
pH, ORP, Dissolved Oxygen (DO), Nitrates, Phosphates
- **Chemical leakage detection in rivers**
Extreme pH values signal chemical spills, Dissolved Oxygen (DO)
- **Swimming pool remote measurement**
pH, Oxidation-Reduction Potential (ORP)
- **Pollution levels in the sea**
Temperature, Conductivity (Salinity), pH, Dissolved Oxygen (DO) and Nitrates

- pH
- Oxidation-Reduction Potential (ORP)
- Dissolved Oxygen (DO)
- Conductivity
- Temperature

SMART WATER XTREME
APPLICATIONS
SENSORS


Figure: Plug & Sense! Smart Water Xtreme

- Industrial and public sewage treatment plants
- Wastewater management (nitrification and de-nitrification)
- Surface water monitoring
- Fish farming, aquaculture
- Drinking water monitoring
- Process engineering plants

- Optical dissolved oxygen and temperature OPTOD
- Titanium optical dissolved oxygen and temperature OPTOD
- pH, ORP and temperature PHEHT
- Conductivity, salinity and temperature C4E
- Inductive conductivity, salinity and temperature CTZN
- Turbidity and temperature NTU
- Suspended solid, turbidity, sludge blanket and temperature MES5
- COD, BOD, TOC, SAC254 and temp StacSense, 2 mm path
- COD, BOD, TOC, SAC254 and temp StacSense, 50 mm path
- Total coliform bacteria, TLF, turbidity and temperature Proteus
- Manta+ 35A
- Manta+ 35B
- Chlorophyll sensor
- BGA sensor
- Organic matter sensor CDOM/ FDOM
- Ammonium
- Nitrate
- Chloride
- Sodium
- Calcium
- Bromide
- Total Dissolved Gas TDG
- Rhodamine
- Crude oil
- Refined oil
- Flourescein
- Optical brighteners
- Tryptophan
- Radar level VEGAPULS C21

This sensor board is only available for [Plug & Sense!](#)

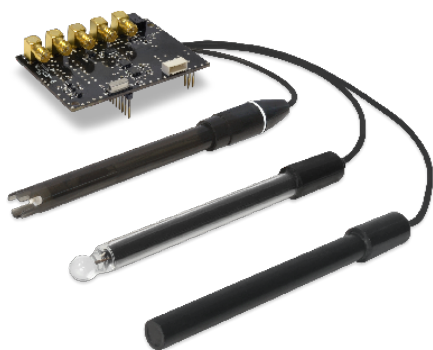
SMART WATER IONS


Figure: Smart Water Ions Board

APPLICATIONS

- **Drinking water quality control**
Calcium (Ca^{2+}), Iodide (I^-), Chloride (Cl^-), Nitrate (NO_3^-), Magnesium (Mg^{2+}), Sodium (Na^+), pH
- **Agriculture water monitoring**
Calcium (Ca^{2+}), Nitrate (NO_3^-), Magnesium (Mg^{2+}), Sodium (Na^+), Potassium (K^+), Ammonium (NH_4^+), pH
- **Swimming pools**
Bromide (Br^-), Chloride (Cl^-), Fluoride (F^-), pH
- **Waste water treatment**
Cupric (Cu^{2+}), Silver (Ag^+), Fluoroborate (BF_4^-), Lithium (Li^+), Nitrite (NO_2^-), Perchlorate (ClO_4^-), pH

SENSOR

- Ammonium (NH_4^+)
- Bromide (Br^-)
- Calcium (Ca^{2+})
- Chloride (Cl^-)
- Cupric (Cu^{2+})
- Fluoride (F^-)
- Iodide (I^-)
- Fluoroborate (BF_4^-)
- Lithium (Li^+)
- Nitrate (NO_3^-)
- Nitrite (NO_2^-)
- Magnesium (Mg^{2+})
- Perchlorate (ClO_4^-)
- Potassium (K^+)
- Silver (Ag^+)
- Sodium (Na^+)
- pH
- Temperature

SMART CITIES PRO*


Figure: Smart Cities PRO Board

(*) Calibrated gas sensors are manufactured once the order has been placed to ensure maximum durability of the calibration feature. Manufacturing process and delivery may take from 4 to 6 weeks. Lifetime of calibrated gas sensors is 6 months working at its maximum accuracy. We strongly encourage our customers to buy extra gas sensor probes to replace the originals after that time to ensure maximum accuracy and performance.

APPLICATIONS

- **Noise maps**
Monitor in real time the acoustic levels in the streets of a city
- **Air quality**
Detect the level of gases and particulates in the air
- **Waste management**
Measure the garbage levels in bins to optimize the trash collection routes

SENSORS

- Carbon Monoxide – CO
- Carbon Dioxide – CO_2
- Molecular Oxygen – O_2
- Ozone – O_3
- Nitric Oxide – NO
- Nitric Dioxide – NO_2
- Sulfur Dioxide – SO_2
- Ammonia – NH_3
- Methane – CH_4 – and other combustible gases
- Hydrogen Sulfide – H_2S
- Particle Matter (PM1 / PM2.5 / PM10) – Dust Sensor [only for Plug & Sense!]
- Temperature, Humidity and Pressure
- Noise level (dBA) [only for [Plug & Sense!](#)]
- Ultrasound (distance measurement)
- Luminosity (Luxes)

SMART PARKING



Figure: Smart Parking node

APPLICATIONS

- Car detection for available parking information
- Detection of free parking slots outdoors
- Parallel, perpendicular and angled parking slots control
- LoRaWAN connectivity (EU, US, APAC / LATAM / AU / AU915, IN, APAC / LATAM / AU / AS923 and JP / KR)
- Extreme battery life
- Surface-mount enclosure, fast installation
- Easy configuration, remote management from the cloud

SENSORS

- Radar
- Magnetic field
- Temperature

AGRICULTURE PRO



Figure: Smart Agriculture PRO Board

APPLICATIONS

- **Precision Agriculture**
Leaf temperature, fruit diameter
- **Irrigation systems**
Soil moisture, leaf wetness
- **Greenhouses**
Solar radiation, humidity, temperature
- **Weather stations**
Anemometer, wind vane, pluviometer

SENSORS

- Air Temperature, Humidity and Pressure
- Soil Temperature / Moisture
- Leaf Wetness
- Atmospheric Pressure
- Solar Radiation - PAR
- Ultraviolet Radiation - UV
- Trunk Diameter
- Stem Diameter
- Fruit Diameter
- Anemometer
- Wind Vane

AGRICULTURE XTREME



Figure: Plug & Sense! Agriculture Xtreme

APPLICATIONS

- Precision Agriculture
- Irrigation systems
- Greenhouses
- Weather monitoring
- Soil management
- Accurate fruit observation

SENSORS

- Non-contact surface temperature measurement SI-411
- Leaf and flower bud temperature SF-421
- Soil oxygen level O-411
- Shortwave radiation SP-510
- Solar radiation (PAR) SQ-110
- Ultraviolet radiation (UV) SU-100
- Ultraviolet radiation sensor probe SU-202 for Smart Agriculture Xtreme
- Air temperature, humidity and pressure temperature TERSO 11
- Conductivity, water content and soil temperature TERSO 12
- Soil water potential TERSO 21
- Vapor pressure, humidity, temperature, and atmospheric pressure in soil and air VP-4
- Leaf wetness Phytos 31
- Trunk Diameter DC2
- Stem Diameter DD-S
- Fruit Diameter DF
- Weather station GMX-100 (PO)
- Weather station GMX-101 (R)
- Weather station GMX-200 (W)
- Weather station GMX-240 (W-PO)
- Weather station GMX-300 (T-H-AP)
- Weather station GMX-301 (T-H-AP-R)
- Weather station GMX-400 (PO-T-H-AP)
- Weather station GMX-500 (W-T-H-AP)
- Weather station GMX-501 (W-T-H-AP-R)
- Weather station GMX-531 (W-PT-T-H-AP-R)
- Weather station GMX-541 (W-PO-T-H-AP-R)
- Weather station GMX-550 (W-x-T-H-AP)
- Weather station GMX-551 (W-x-T-H-AP-R)
- Weather station GMX-600 (W-PO-T-H-AP)
- Solar radiation and temperature Datasol MET
- Luminosity (Luxes)
- Ultrasound (distance measurement)
- 4-20 mA type (generic input)
- RS-232 type (generic input)

4-20 mA CURRENT LOOP	APPLICATIONS	FEATURES
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Figure: 4-20 mA Current Loop Board

- Sensors and instruments
- Remote transducers
- Monitoring processes
- Data transmission in industrial ambients

- Type: Analog
- Media: Twisted Pair
- No. of devices: 4
- Distance: 900m
- Supply: 12 V

The user can choose among a wide variety of standard sensors

PROTOTYPING SENSOR	APPLICATIONS	
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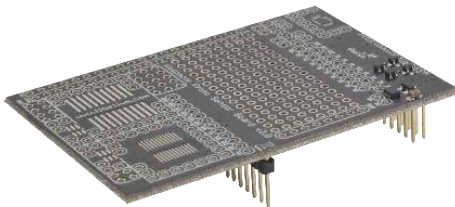


Figure: Prototyping Sensor Board

- Prepared for the **integration of any kind of sensor.**

- Pad Area
- Integrated Circuit Area
- Analog-to-Digital Converter (16b)

It is possible to find more detailed information in the manual for each board at:

<http://www.libelium.com/development/waspote/documentation>

Power supplies

- 6600 mAh Li-Ion rechargeable // 52000 mA·h **non-rechargeable**
- Solar Panel: rigid (7 V – 500 mA) and flexible (7.2 V – 100 mA)
- USB (220 V - USB, car lighter USB)

USB-PC interface

- Model: Waspote Gateway
- Communication: 802.15.4/ZigBee 3/DigiMesh/868/900/LoRa/Bluetooth/BLE - USB PC
- Programmable buttons and LEDs

Compiler:

- IDE - Waspote (open source)
- Language: C++
- Versions Windows, Linux and Mac-OS



Figure: Waspote Gateway

Waspote vs Waspote Plug & Sense!

Waspote is the original line in which developers have a total control over the hardware device. You can physically access to the board and connect new sensors or even embed it in your own products as an electronic sensor device.

The Waspote Plug & Sense! line allows developers to forget about electronics and focus on services and applications. Now you can deploy wireless sensor networks in an easy and scalable way ensuring minimum maintenance costs. The platform consists of a robust waterproof enclosure with specific external sockets to connect the sensors, the solar panel, the antenna and even the USB cable in order to reprogram the node. It has been specially designed to be scalable, easy to deploy and maintain.



Figure: Waspote



Figure: Waspote Plug & Sense!

For more information about Waspote Plug & Sense! go to:

<http://www.libelium.com/plug-sense>

Meshlium - The IoT Gateway



Figure: Meshlium device

The sensor data gathered by the Waspote Plug & Sense! nodes is sent to the Cloud by Meshlium, the IoT gateway router specially designed to connect Waspote sensor networks to the Internet via Ethernet and 4G/3G/2G interfaces.

Meshlium can work as:

- an RF (XBee) to Ethernet router for Waspote nodes
- an RF (XBee) to 4G/3G/GPRS/GSM router for Waspote nodes
- a WiFi Access Point
- a WiFi to 4G/3G/GPRS/GSM router
- a GPS – 4G/3G/GPRS/GSM real-time tracker
- a smartphone scanner (detects iPhone and Android devices)

Meshlium storage options

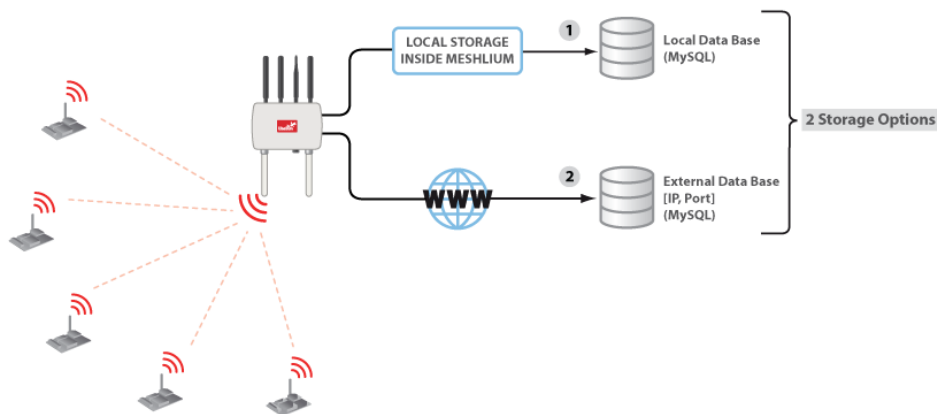


Figure: Meshlium storage options

- Local data base
- External data base

Meshlium connection options

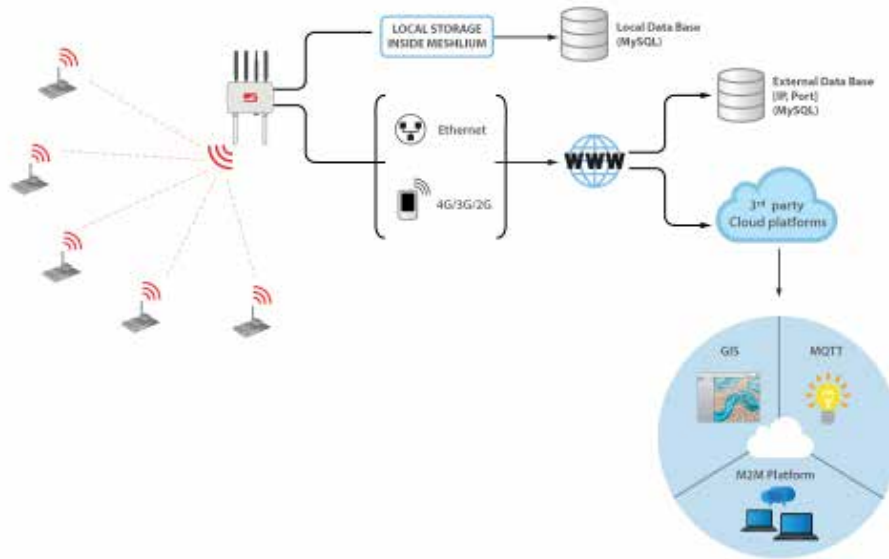


Figure: Meshlium connection options

- XBee / 4G / 3G / 2G / WiFi → Ethernet
- XBee / 4G / 3G / 2G / WiFi → 4G / 3G / 2G

All the networking options can be controlled from the Manager System, a web interface which comes with Meshlium. It allows to control all the interfaces and system options in a secure, easy and quick way.



Figure: Meshlium Manager System

All information about Meshlium can be found in the [Meshlium Technical Guide](#).

All the Meshlium documentation is located in the [Development section](#) in the Libelium website.

Meshlium Visualizer

Meshlium Visualizer is a plugin which plots graphs and maps with the data stored in the database. It can also export data in common formats. Meshlium Visualizer is a special software feature only available in the Meshlium units included in the IoT Vertical Kits (Smart Cities IoT Vertical Kit, Smart Water IoT Vertical Kit, etc).



Figure: Meshlium visualizer

Cloud Connectors

Meshlium allows developers to connect easily with third party cloud servers such as Amazon, IBM, Microsoft, Alibaba, Telefónica, ESRI, ThingWorks, etc. Just select the desired plugin in the Manager System and add the account info to synchronize the internal data base of Meshlium with the desired platform.



The Bridge

The Bridge is a service on the cloud created by Libelium. It sends information from any IoT device to the main worldwide cloud platforms simultaneously and without having to implement each specific cloud protocol or authentication process.

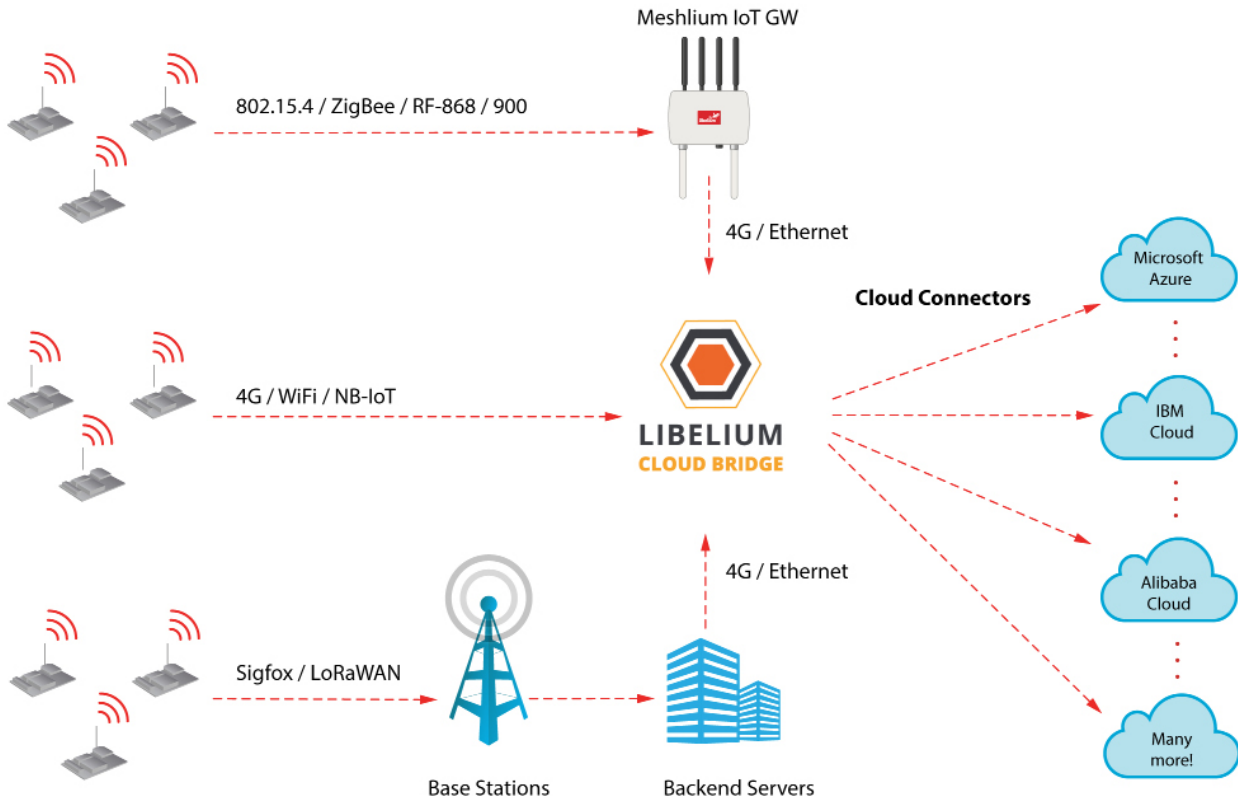


Figure: The Bridge

For more info about Meshlium go to:
<http://www.libelium.com/products/meshlium/>

Certifications

Libelium offers 2 types of IoT sensor platforms, Waspote OEM and Plug & Sense!:

- **Waspote OEM** is intended to be used for research purposes or as part of a major product so it needs final certification on the client side. More info at: www.libelium.com/products/waspote
- **Plug & Sense!** is the line ready to be used out-of-the-box. It includes market certifications. See below the specific list of regulations passed. More info at: www.libelium.com/products/plug-sense

Besides, Meshlium, our multiprotocol router for the IoT, is also certified with the certifications below. Get more info at:

www.libelium.com/products/meshlium

List of certifications for Plug & Sense! and Meshlium:

- CE (Europe)
- FCC (US)
- IC (Canada)
- ANATEL (Brazil)
- RCM (Australia)
- PTCRB (cellular certification for the US)
- AT&T (cellular certification for the US)



Figure: Certifications of the Plug & Sense! product line

You can find all the certification documents at:

www.libelium.com/certifications

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