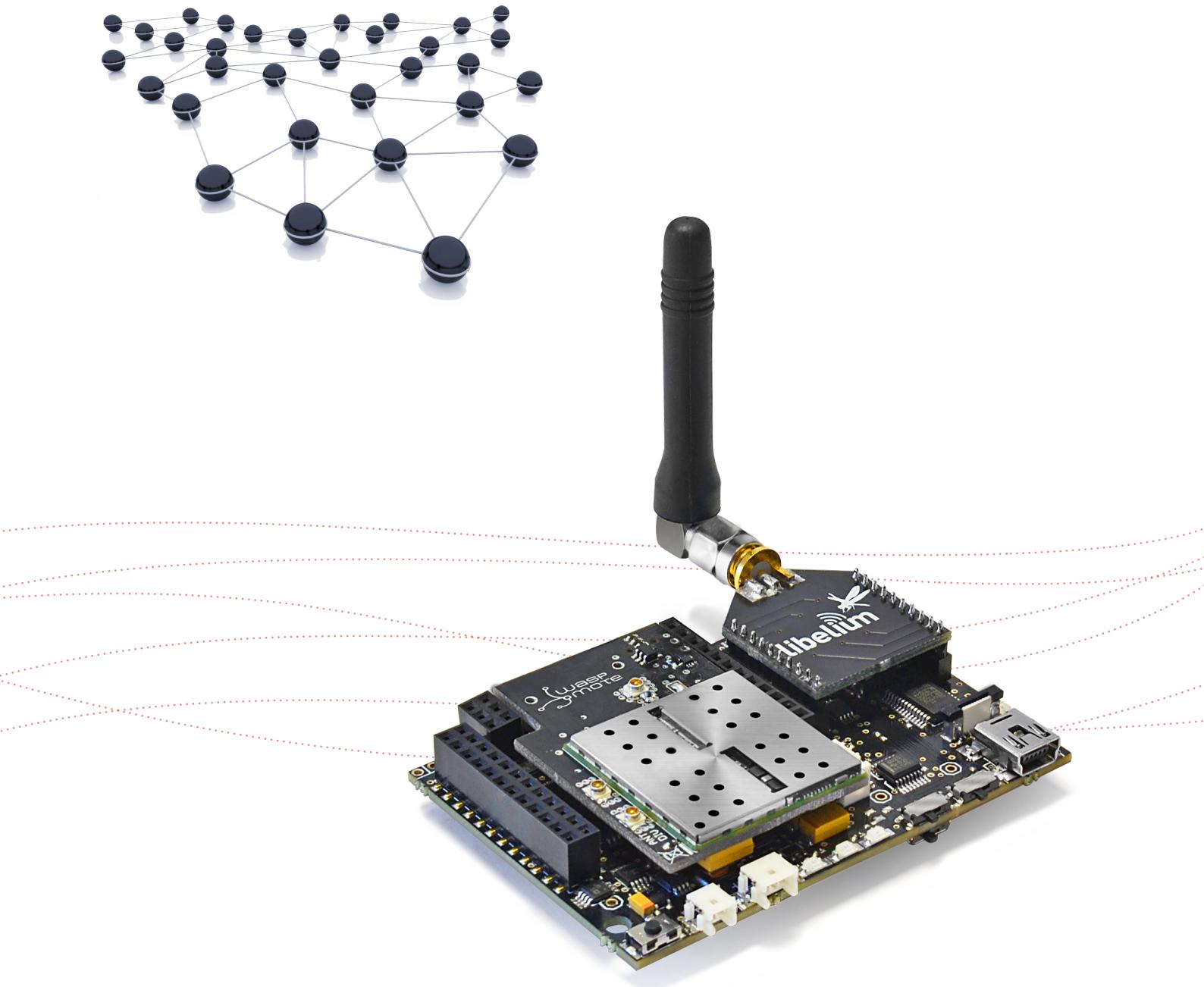


Waspmote

Datasheet



Important:

- All documents and any examples they contain are provided as-is and are subject to change without notice. Except to the extent prohibited by law, Libelium makes no express or implied representation or warranty of any kind with regard to the documents, and specifically disclaims the implied warranties and conditions of merchantability and fitness for a particular purpose.
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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](#)".

Wasp mote

General data:

Microcontroller:	ATmega1281
Frequency:	14.7456 MHz
SRAM:	8 kB
EEPROM:	4 kB
FLASH:	128 kB
SD card:	2 GB
Weight:	20 g
Dimensions:	73.5 x 51 x 13 mm
Temperature range:	[-10 °C, +65 °C]
Clock:	RTC (32 kHz)



Consumption:

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

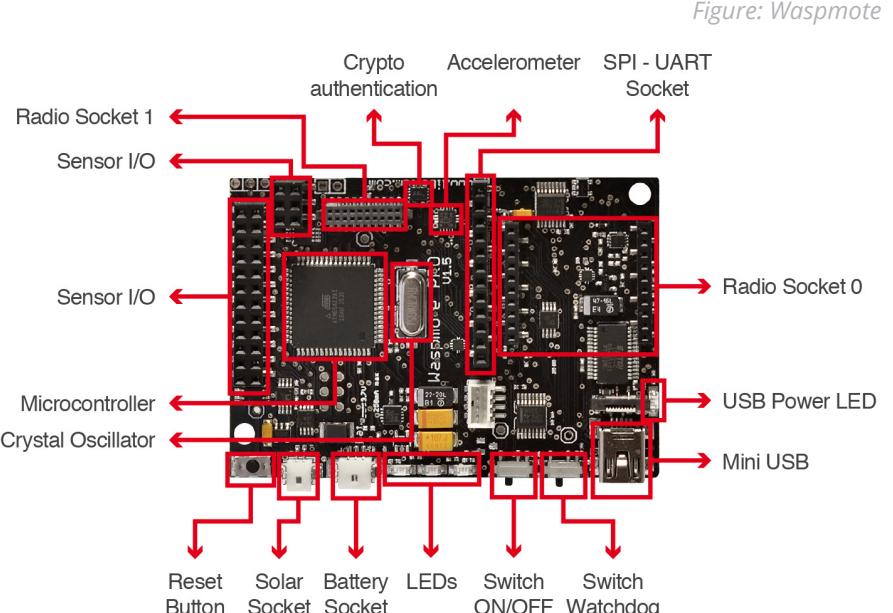
* Time obtained using the Hibernate mode as energy saving mode

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
Solar panel charging:	6 - 12 V - 330 mA



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

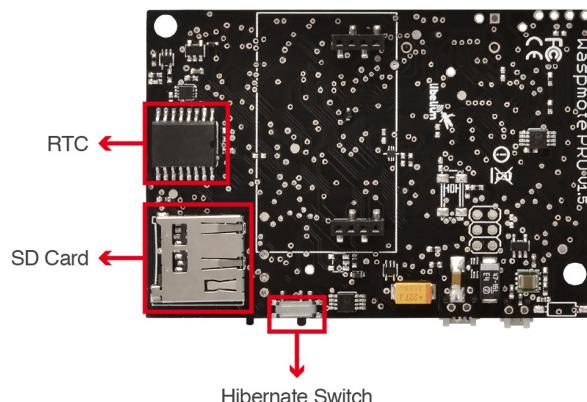


Figure: Wasp mote board bottom

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-PRO ZigBee	2.4 GHz	17 dBm	-102 dBm	3200 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: 2 dBi / 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-PRO ZigBee: ZigBee-Pro v2007 compliant

Topologies: Star, tree, mesh

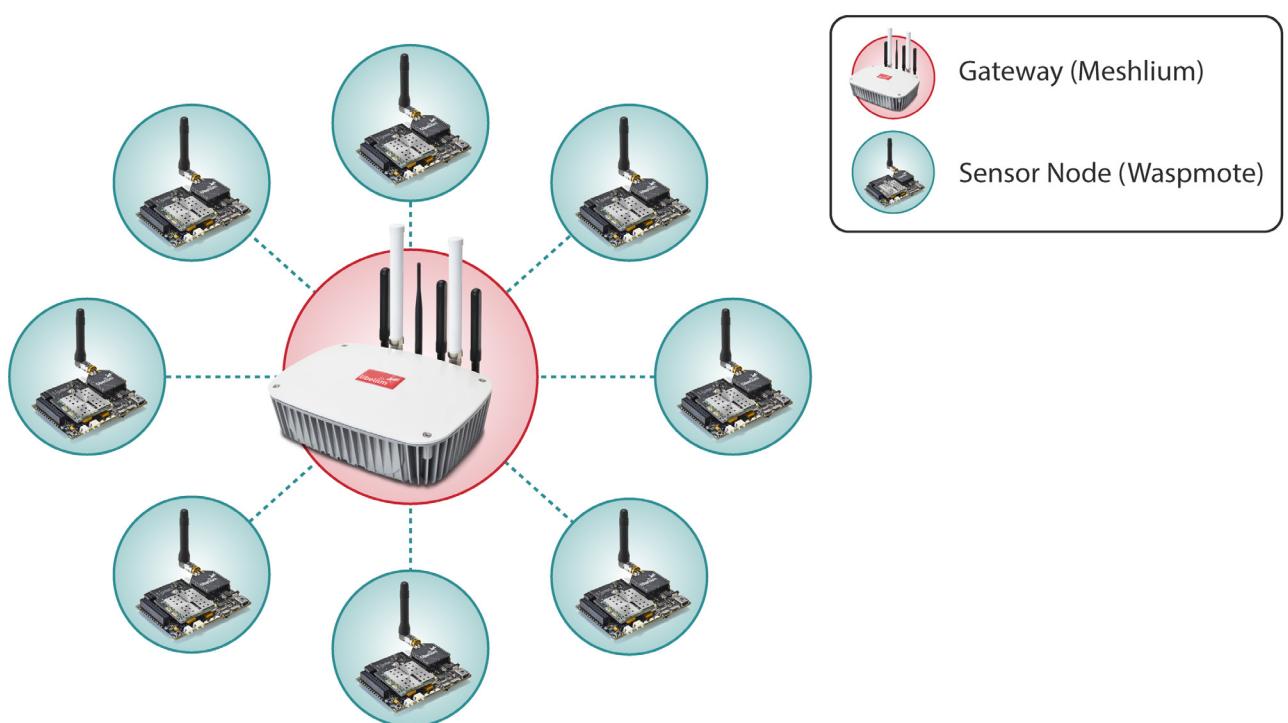


Figure: Star network

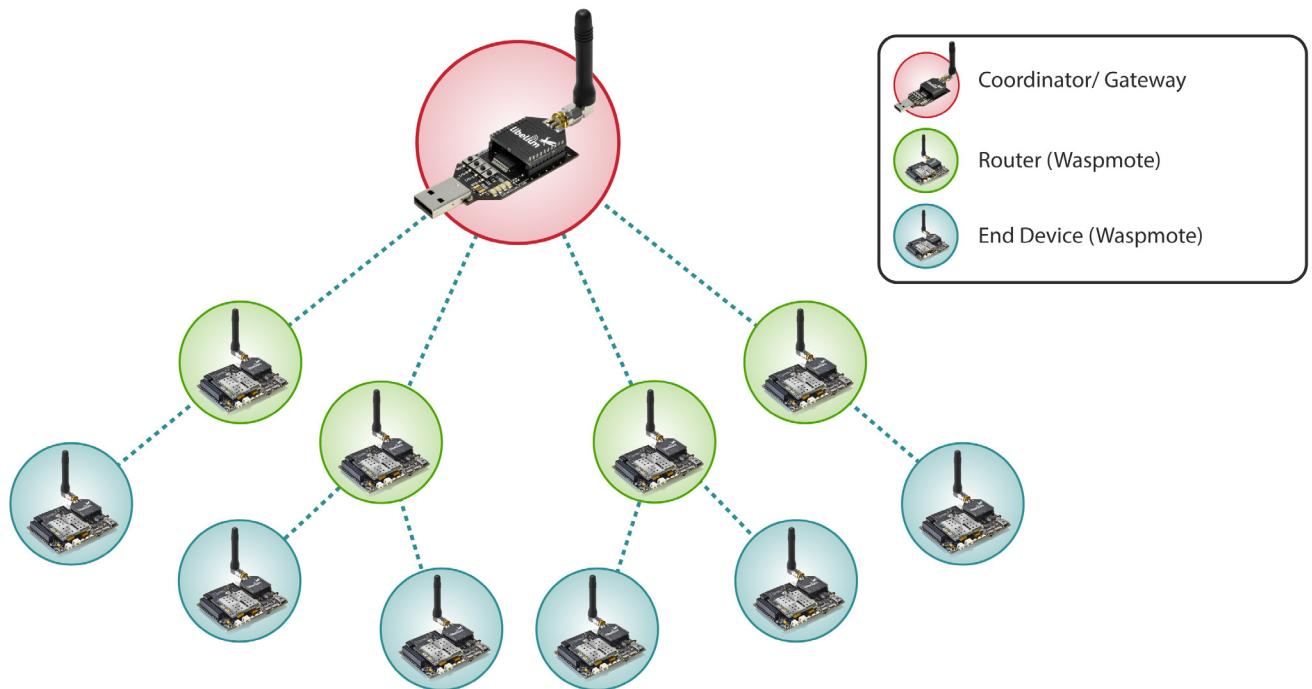


Figure: Tree network

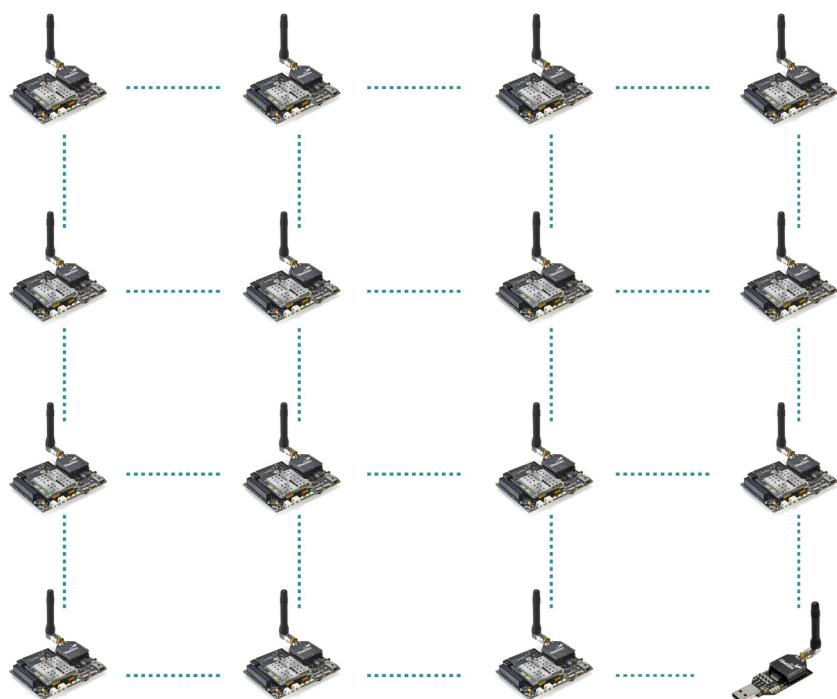


Figure: Mesh network

LoRaWAN modules

Protocol: LoRaWAN 1.0, Class A

LoRaWAN-ready

Frequency:

- LoRaWAN 868/433 modules (EU): 868 MHz and 433 MHz ISM bands
- LoRaWAN 900 module (US): 900-930 MHz ISM band

TX power:

- LoRaWAN 868/433 modules (EU): up to 14 dBm
- LoRaWAN 900 module (US): up to 18.5 dBm

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 868/433 modules (EU): 38.9 mA
- LoRaWAN 900 module (US): 124.4 mA

Figure: LoRaWAN EU module



Radio data rate:

- LoRaWAN 868/433 modules (EU): from 250 to 5470 bps
- LoRaWAN 900 module (US): from 250 to 12500 bps

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

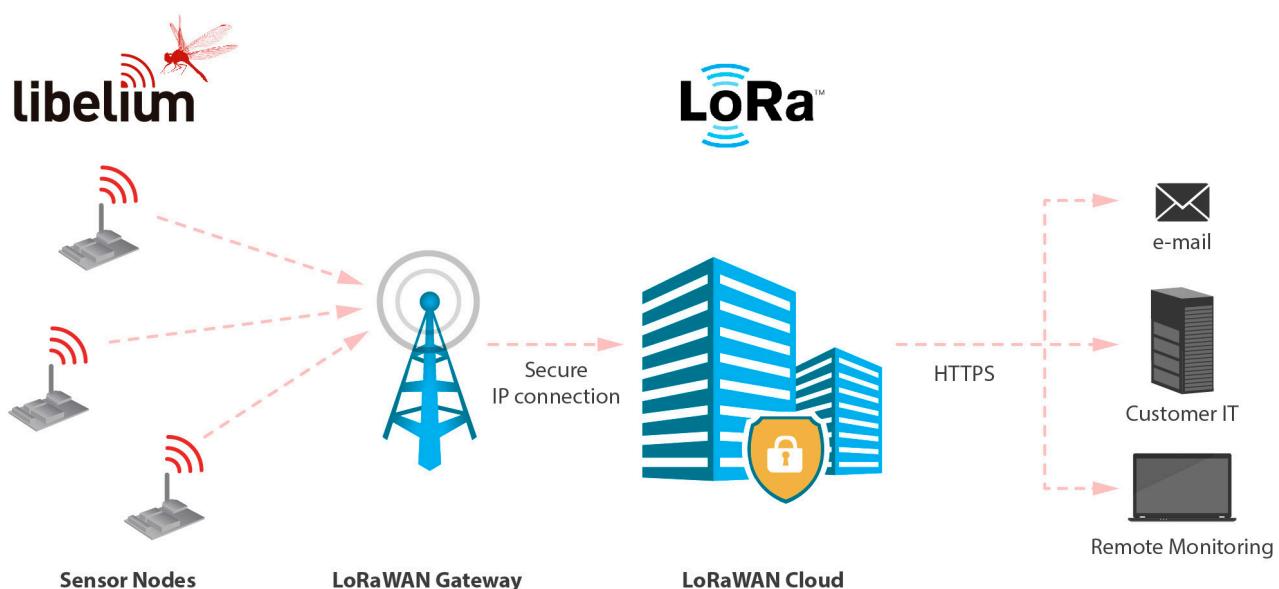


Figure: LoRaWAN EU network

Sigfox modules

Frequency:

- Sigfox EU module: ISM 868 MHz
- Sigfox US module: ISM 900 MHz

TX Power:

- Sigfox EU module: 16 dBm
- Sigfox US 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

Radio data rate: 100 bps

Receive sensitivity: -126 dBm

Sigfox certificate: Class 0u (the highest level)

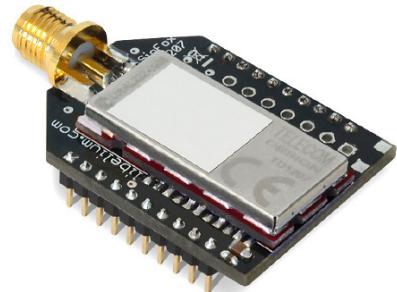


Figure: Sigfox module



Figure: Sigfox network

LoRa module

Protocol: LoRa "raw". P2P links (node to node).

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)



Figure: LoRa module

Antenna: 868 / 915 MHz: 0 / 4.5 dBi

Connector: RPSMA

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

Control Signal: RSSI

Topology: Star

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



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



Figure: WiFi PRO module

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
- Wasp mote OEM: on-chip antenna

GSM/GPRS

Model: SIM900 (SIMCom)

Quadband: 850/900/1800/1900 MHz

TX Power: 2 W (Class 4) 850/900 MHz, 1 W (Class 1) 1800/1900 MHz

Sensitivity: -109 dBm

Antenna connector: U.FL

External antenna: 0 dBi

Consumption in sleep mode: 1 mA

Consumption in power off mode: 0 mA

Actions:

- Making/Receiving calls
- Making 'x' tone missed calls
- Sending/Receiving SMS
- Single connection and multiple connections TCP/IP and UDP/IP clients
- TCP/IP server
- HTTP service
- FTP service (downloading and uploading files)



Figure: GSM/GPRS module

GPRS + GPS

Model: SIM928 (SIMCom)

Quadband: 850/900/1800/1900 MHz

TX power: 2 W (Class 4) 850/900 MHz, 1 W (Class 1) 1800/1900MHz

Sensitivity: -109 dBm

Antenna connector: U.FL

External antenna: 0 dBi

Consumption in sleep mode: 1 mA

Consumption in power off mode: 0 mA



GPS features:

Time-To-First-Fix: 30 s (typ.)

Sensitivity:

- Tracking: -160 dBm
- Acquisition: -147 dBm

Figure: GPRS+GPS module

Accuracy horizontal position : < 2.5 m CEP

Power consumption (GSM engine in idle mode):

- Acquisition : 72 mA
- Tracking : 67 mA

Actions:

- Making/Receiving calls
- Making 'x' tone missed calls
- Sending/Receiving SMS
- Single connection and multiple connections TCP/IP and UDP/IP clients
- TCP/IP server
- HTTP service
- FTP service (downloading and uploading files)
- GPS receiver

3G module

Model: SIM5215 (SIMCom)

Versions: Europe and America/Australia

Europe version:

- Dual-Band: 900/2100MHz
- Tri-Band: 850/900/1800MHz

America/Australia version:

- Dual-Band: 850/1900 MHz
- Quad-Band: 850/900/1800/1900 MHz

WCDMA (downlink): up to 384 kbps

WCDMA (uplink): up to 384 kbps

TX power:

- UMTS 850/900/1900/2100: 0.25 W
- GSM 850/900: 2 W
- DCS 1800 / PCS 1900: 1 W

Sensitivity: -106 dBm

Antenna connector: U FL

External antenna: 0 dBi

Consumption in sleep mode (RF circuits power off previously): 1 mA

Actions:

- Videocall using 3G network available with Video Camera Sensor Board
- Record video (res. 320 x 240) and take pictures (res. 640 x 480) available with Video Camera Sensor Board
- Support microSD card up to 32 GB
- 64 MB of internal storage space
- Making/Receiving calls
- Making 'x' tone missed calls
- Sending/Receiving SMS
- Single connection and multiple connections TCP/IP and UDP/IP clients
- TCP/IP server
- HTTP and HTTPS service
- FTP and FTPS service (downloading and uploading files)
- Sending/receiving email (SMTP/POP3)



Figure: 3G module

4G module

Model: LE910 (Telit)

Versions:

- Europe/Brazil
- America
- Australia

Europe/Brazil version:

- 2G: 900/1800 MHz
- WCDMA: 850/900/2100 MHz
- LTE: 800/1800/2600 MHz

America version:

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

Australia version:

- 4G: 700/1800/2600 MHz

LTE (downlink):

- Europe/Brazil version up to 100 Mbps
- America version up to 100 Mbps
- Australia version up to 150 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 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
- Australia:
 - Class 3(0.2W, 23 dBm) @ LTE

Antenna connector:

- U.FL for main antenna
- U.FL for cellular diversity antenna
- U.FL for GPS antenna (only for Europe/Brazil and America modules)



Figure: 4G module

External antenna: +5 dBi

GPS: GPS feature is supported only in Europe/Brazil and America versions

Actions:

- 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)

Certifications:

- LE910-EUG (Europe / Brasil): CE, GCF, ANATEL
- LE910-NAG (US / Canada): FCC, IC, PTCRB, AT&T approved
- LE910-AU V2 (Australia): RCM, Telstra 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)

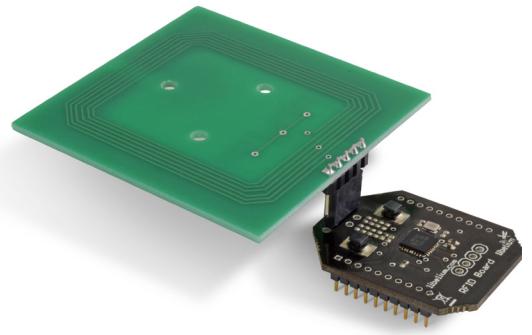


Figure: RFID/NFC module

Over the Air Programming (OTA)

Over the Air Programming (OTA) can be made with 4G, 3G, GPRS, GPRS+GPS 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.

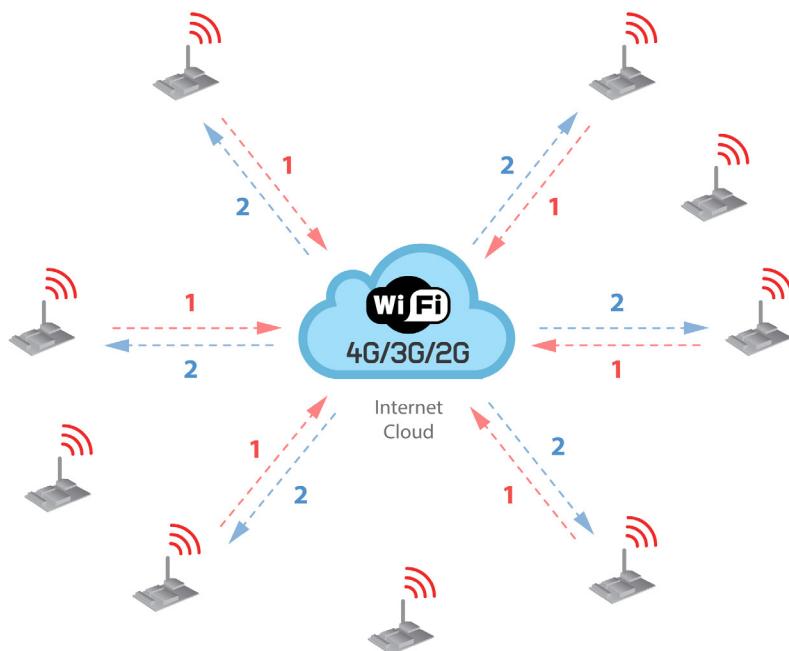


Figure: OTA with 4G/3G/GPRS/WiFi fundamentals

Encryption Libraries

The new Encryption Libraries are designed to add to the Waspmote 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 **preshared 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.

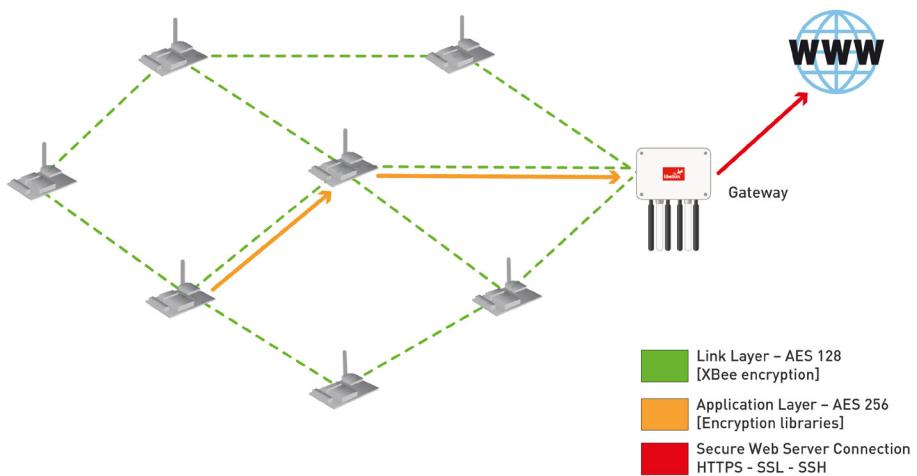
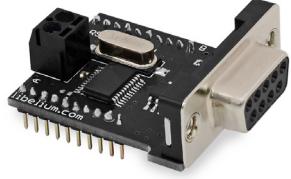


Figure: Communication diagram

Industrial Protocols

RS-485, RS-232, CAN Bus and Modbus are widely used standards in the industrial and automation market. Waspmote 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 	
RS-232 Serial / Modbus module	<ul style="list-style-type: none"> • Dial-up modems • GPS receivers (typically NMEA 0183 at 4,800 bit/s) • Bar code scanners and other point of sale devices • LED and LCD text displays • Satellite phones, low-speed satellite modems and other satellite based transceiver devices • Flat-screen (LCD and plasma) monitors to control screen functions by external computer, other AV components or remotes • Test and measuring equipment such as digital multimeters and weighing systems • Updating firmware on various consumer devices • Some CNC controllers • Uninterruptible power supply • Stenography or Stenotype machines • Software debuggers that run on a 2nd computer • Industrial field buses 	
CAN Bus module	<ul style="list-style-type: none"> • Automotive applications • Home automation • Industrial Networking • Factory automation • Marine electronics • Medical equipment • Military uses 	
Modbus software layer	<ul style="list-style-type: none"> • Modbus is a software layer which can be run over the RS-485 or RS-232 modules • Multiple master-slave applications • Sensors and instruments • Industrial Networking • Building and infrastructure • Transportation and energy applications 	

Expansion Radio Board

The Expansion Board allows to connect two communication modules at the same time in the Wasp mote sensor platform. This means a lot of different combinations are possible using any of the wireless radios available for Wasp mote: 802.15.4, ZigBee, DigiMesh, 868 MHz, 900 MHz, LoRa, WiFi, GPRS, GPRS+GPS, 3G, 4G, Sigfox, LoRaWAN, Bluetooth Pro, Bluetooth Low Energy and RFID/NFC . Besides, the following Industrial Protocols modules are available: RS-485/Modbus, RS-232 Serial/Modbus and CAN Bus.

Some of the possible combinations are:

- LoRaWAN - GPRS
- 802.15.4 - Sigfox
- 868 MHz - RS-485
- RS-232 - WiFi
- DigiMesh - 4G
- RS-232 - RFID/NFC
- WiFi - 3G
- CAN Bus - Bluetooth
- etc.

Remark: GPRS, GPRS+GPS, 3G and 4G modules do not need the Expansion Board to be connected to Wasp mote. They can be plugged directly in the socket1.

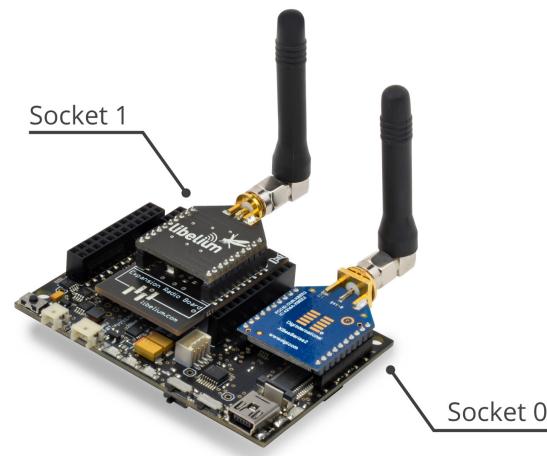


Figure: Expansion Radio Board

Applications:

- Multifrequency Sensor Networks: (2.4 GHz - 868/900 MHz)
- Bluetooth - ZigBee hybrid networks
- NFC (RFID) applications with 3G/GPRS
- ZigBee - WiFi hybrid networks

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)

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 Wasp mote if it gets stuck. That periodical reset avoids erratic behaviour.

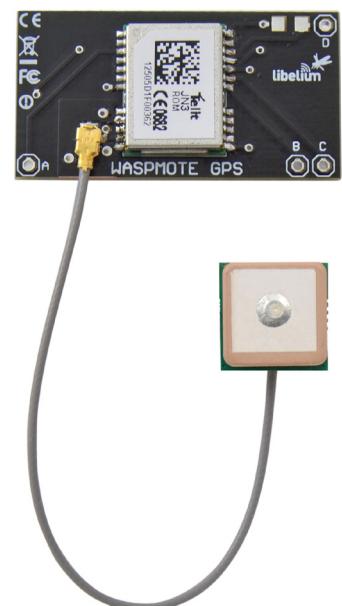
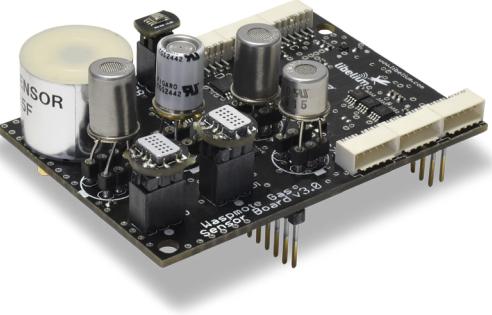


Figure: GPS module

Sensor Boards

GASES	APPLICATIONS	SENSORS
	<ul style="list-style-type: none"> City pollution CO, CO₂, NO₂, O₃ Emissions from farms and hatcheries CH₄, H₂S, NH₃ Control of chemical and industrial processes C₄H₁₀, H₂, VOC Forest fires CO, CO₂ 	<ul style="list-style-type: none"> Carbon Monoxide – CO Carbon Dioxide – CO₂ Oxygen – O₂ Methane – CH₄ Hydrogen – H₂ Ammonia – NH₃ Isobutane – C₄H₁₀ Ethanol – CH₃CH₂OH Toluene – C₆H₅CH₃ Hydrogen Sulfide – H₂S Nitrogen Dioxide – NO₂ Ozone – O₃ Hydrocarbons – VOC Temperature, Humidity and Pressure Luminosity (Luxes) Ultrasound (distance measurement)

Note: Calibrated sensors are available for more accurate measurement.

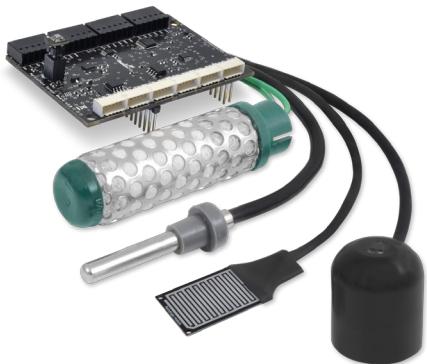
GASES PRO v3*	APPLICATIONS	SENSORS
	<ul style="list-style-type: none"> City pollution CO, NO, NO₂, O₃, SO₂, Particle Matter - Dust Air Quality Index calculation SO₂, NO₂, Particle Matter - Dust, CO, O₃, NH₃ Emissions from farms and hatcheries CH₄, H₂S, NH₃ Greenhouse management CO₂, CH₄, Humidity Control of chemical and industrial processes H₂, HCl, CH₄, SO₂, CO₂ Indoor air quality CO₂, CO, Particle Matter - Dust, O₃ Forest fires CO, CO₂ 	<ul style="list-style-type: none"> 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 Molecular Hydrogen – H₂ Hydrogen Sulfide – H₂S Hydrogen Chloride – HCl Hydrogen Cyanide - HCN Phosphine – PH₃ Ethylene Oxide – ETO Chlorine – Cl₂ Particle Matter (PM1 / PM2.5 / PM10) – Dust Sensor [only for Plug & Sense!] Temperature, Humidity and Pressure

(*) 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.

EVENTS v3	APPLICATIONS	SENSORS
	<ul style="list-style-type: none"> Security Hall effect (doors and windows), person detection PIR Emergencies Presence detection and water level sensors, temperature Control of goods in logistics 	<ul style="list-style-type: none"> Pressure/Weight Hall Effect Temperature, Humidity and Pressure Liquid Presence Liquid Level Liquid flow Luminosity (Luxes) Presence (PIR) Ultrasound (distance measurement)
SMART WATER v3	APPLICATIONS	SENSORS
	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> pH Oxidation-Reduction Potential (ORP) Dissolved Oxygen (DO) Conductivity Temperature Turbidity
SMART WATER IONS	APPLICATIONS	SENSORS
	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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*	APPLICATIONS	SENSORS
	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 Molecular Hydrogen – H₂ Hydrogen Sulfide – H₂S Hydrogen Chloride – HCl Hydrogen Cyanide - HCN Phosphine – PH₃ Ethylene Oxide – ETO Chlorine – Cl₂ Particle Matter (PM1 / PM2.5 / PM10) – Dust Sensor [only for Plug & Sense!] Temperature, Humidity and Pressure Noise level (dBA) [only for <u>Plug & Sense!</u>] Ultrasound (distance measurement) Luminosity (Luxes)
<p>(*) 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.</p>		
SMART PARKING	APPLICATIONS	SENSORS
	<ul style="list-style-type: none"> Car detection for available parking information Detection of free parking lots outdoors Parallel and perpendicular parking lots control Sigfox and LoRaWAN connectivity (EU and US) Extreme battery life Surface-mount enclosure, fast installation Easy configuration, remote management from the cloud 	<ul style="list-style-type: none"> Magnetic field Temperature

Figure: Plug & Sense! Smart Parking node

AGRICULTURE v30

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
- Pluviometer
- Luminosity (Luxes)
- Ultrasound (distance measurement)

4-20 mA CURRENT LOOP

APPLICATIONS

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

FEATURES

- 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

VIDEO CAMERA

APPLICATIONS

- Security and surveillance
- Take photos (640 x 380)
- Record video (320 x 240)
- Realtime Videocall using 3G network
- Night Vision mode available

SENSORS

- Image sensor
- Luminosity
- Infrared
- Presence (PIR)

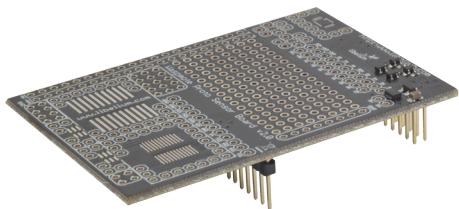
RADIATION

APPLICATIONS

- Monitor the radiation levels wirelessly without compromising the life of the security forces
- Create prevention and control radiation networks in the surroundings of a nuclear plant
- Measure the amount of Beta and Gamma radiation in specific areas autonomously

SENSORS

- Geiger tube [β , γ] (Beta and Gamma)

PROTOTYPING SENSOR

APPLICATIONS

- 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/waspmote/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: Wasp mote Gateway
- Communication: 802.15.4/ZigBee/DigiMesh/868/900/LoRa/Bluetooth/BLE - USB PC
- Programmable buttons and LEDs



Figure: Wasp mote Gateway

Compiler:

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

Wasp mote vs Wasp mote Plug & Sense!

Wasp mote 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 Wasp mote 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: Wasp mote



Figure: Wasp mote Plug & Sense!

For more information about Wasp mote Plug & Sense! go to:

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

Meshlium - The IoT Gateway



Figure: Meshlium device

Meshlium is an IoT gateway that may contain up to 4 different radio interfaces: WiFi 2.4 GHz (Access Point), 4G/3G/GPRS/GSM, 2 XBee/RF communications. Meshlium also integrates a GPS module for mobile and vehicular applications, and may include Bluetooth and WiFi radios too for scanning applications. These features along with an aluminum IP65 enclosure allows Meshlium to be placed outdoors.

Meshlium is a market-ready device because it is certified for CE (Europe), FCC (USA), IC (Canada), PTCRB (US cellular certification), AT&T (US cellular certification), ANATEL (Brazil) and RCM (Australia).

Meshlium can work as:

- an RF (XBee) to Ethernet router for Wasp mote nodes*
- an RF (XBee) to 4G/3G/GPRS/GSM router for Wasp mote 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)

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

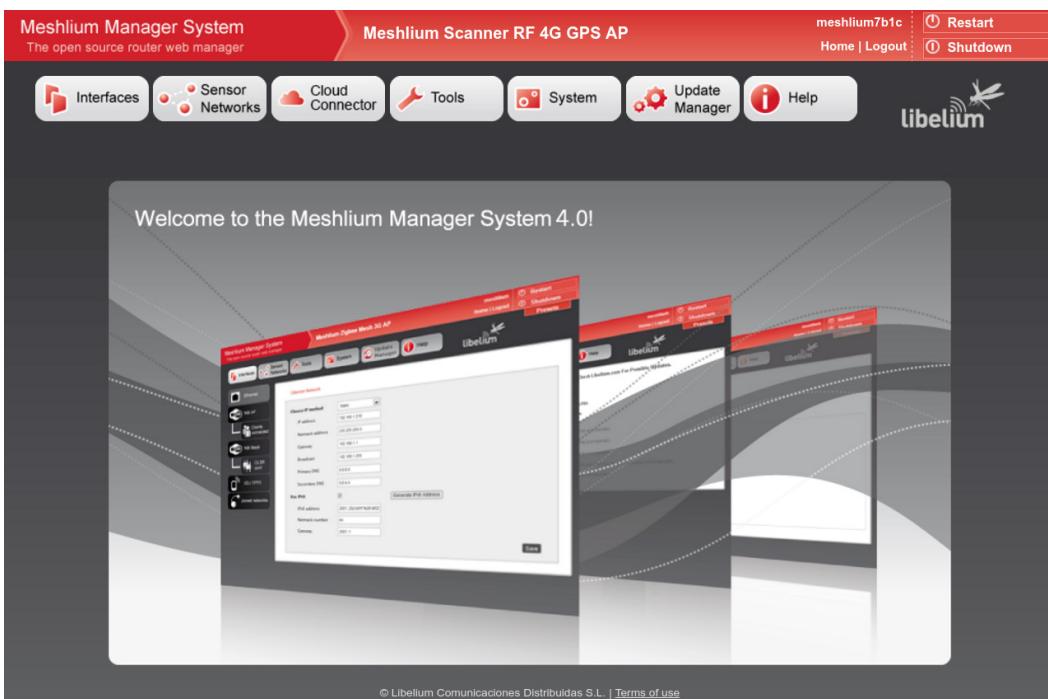


Figure: Meshlum Manager System

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

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

Meshlum Visualizer

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



Figure: Meshlum visualizer

Cloud Connector

Meshlium allows developers to connect easily with third party cloud servers such as Amazon, IBM, 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.



Certifications

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

- **Waspmote 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/waspmote
- **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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