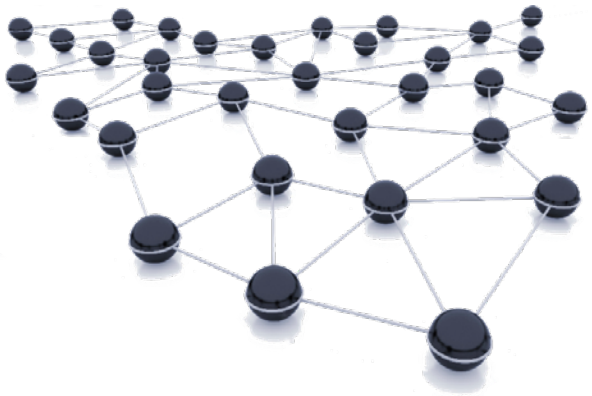
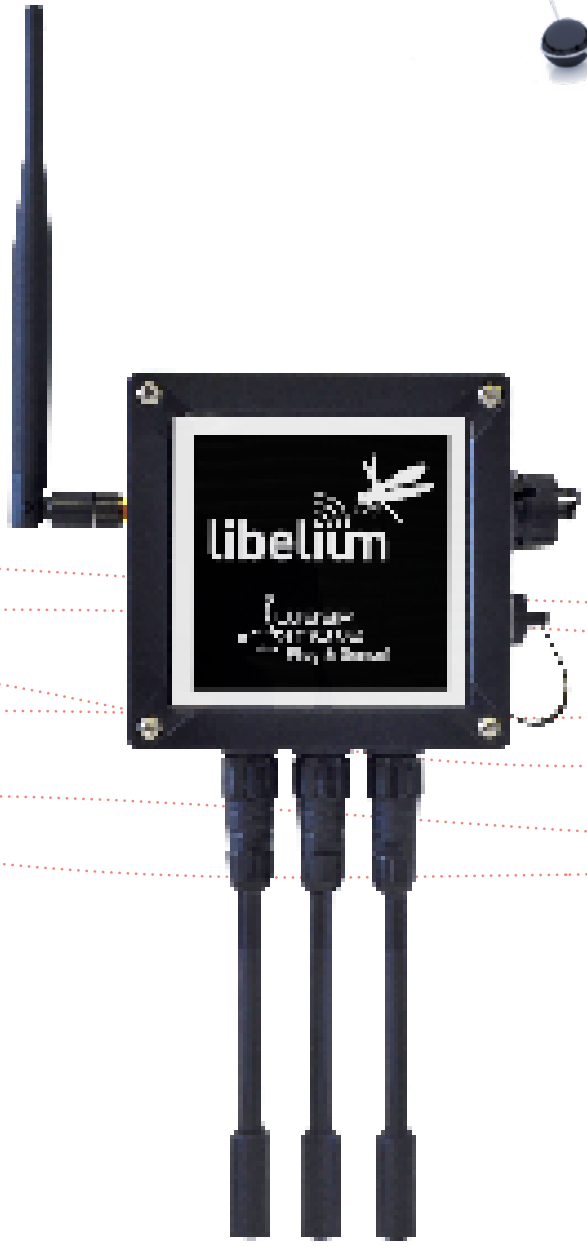
# Waspmote Plug & Sense

## Quick Overview



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# INDEX

# 1. Waspmote Plug & Sense! v15

This overview summarizes the benefits of the Plug & Sense! platform. This line is based on Waspmote v15 and was released on October 2016. It is an evolution from the previous Plug & Sense! v12.

Plug & Sense! v15 is not compatible with Waspmote v12 or Plug & Sense! 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".

# 2. Waspmote Plug & Sense!

The Waspmote Plug & Sense! line allows you to easily deploy Internet of Things 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.

*Note: For a complete reference guide download the "Waspmote Plug & Sense! Technical Guide" in the Development section of the Libelium website.*

## 2.1. Features

- Robust waterproof IP65 enclosure
- Add or change a sensor probe in seconds
- Solar powered external panel option
- Radios available: 802.15.4, Zigbee, 868 MHz, 900 MHz, WiFi, 4G, Sigfox and LoRaWAN
- Over the air programming (OTAP) of multiple nodes at once (via WiFi or 4G radios)
- Special holders and brackets ready for installation in street lights and building fronts
- Graphical and intuitive interface Programming Cloud Service
- Built-in, 3-axes accelerometer
- External, contactless reset with magnet
- Optional industrial protocols: RS-485, Modbus, CAN Bus
- Optional GPS receiver
- Optional External Battery Module
- External SIM connector for the 4G models
- Fully certified: CE (Europe), FCC (USA), IC (Canada), ANATEL (Brazil), RCM (Australia), PTCRB (USA, cellular connectivity), AT&T (USA, cellular connectivity)


*Figure: Waspmote Plug & Sense!*

# 3. General view

This section shows main parts of Waspmote Plug & Sense! and a brief description of each one. In later sections all parts will be described deeply.

## 3.1. Specifications

- **Material:** polycarbonate
- **Sealing:** polyurethane
- **Cover screws:** stainless steel
- **Ingress protection:** IP65
- **Impact resistance:** IK08
- **Rated insulation voltage AC:** 690 V
- **Rated insulation voltage DC:** 1000 V
- **Heavy metals-free:** Yes
- **Weatherproof:** true - nach UL 746 C
- **Ambient temperature (min.):** -30 °C*
- **Ambient temperature (max.):** 70 °C*
- **Approximated weight:** 800 g

* *Temporary extreme temperatures are supported. Regular recommended usage: -20, +70 ºC.*

In the pictures included below it is shown a general view of Waspmote Plug & Sense! main parts. Some elements are dedicated to node control, others are designated to sensor connection and other parts are just identification elements. All of them will be described along this guide.

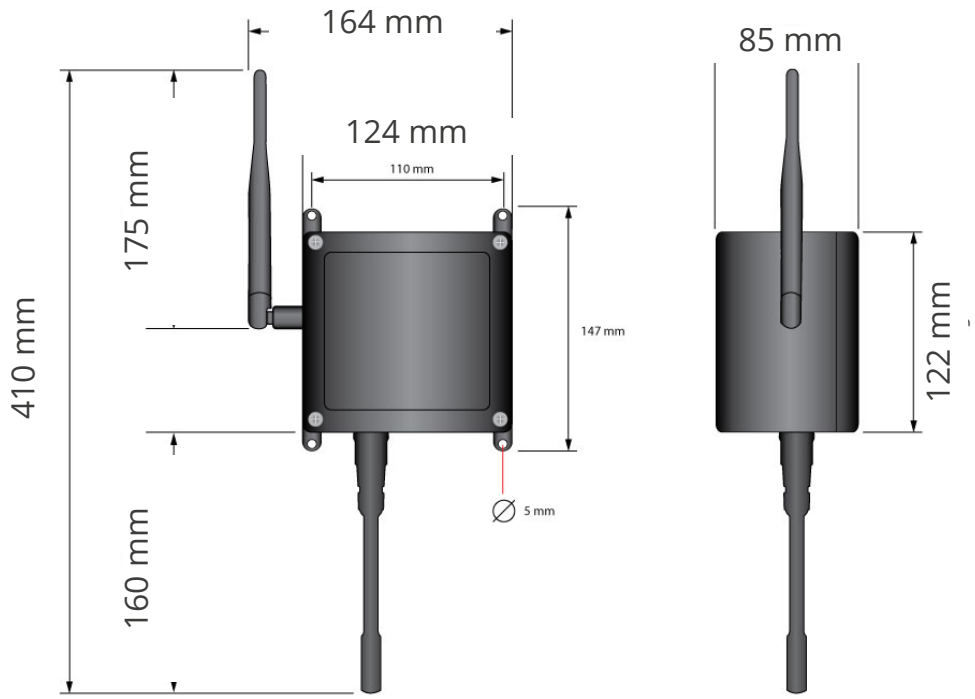



*Figure: Main view of Waspmote Plug & Sense!*

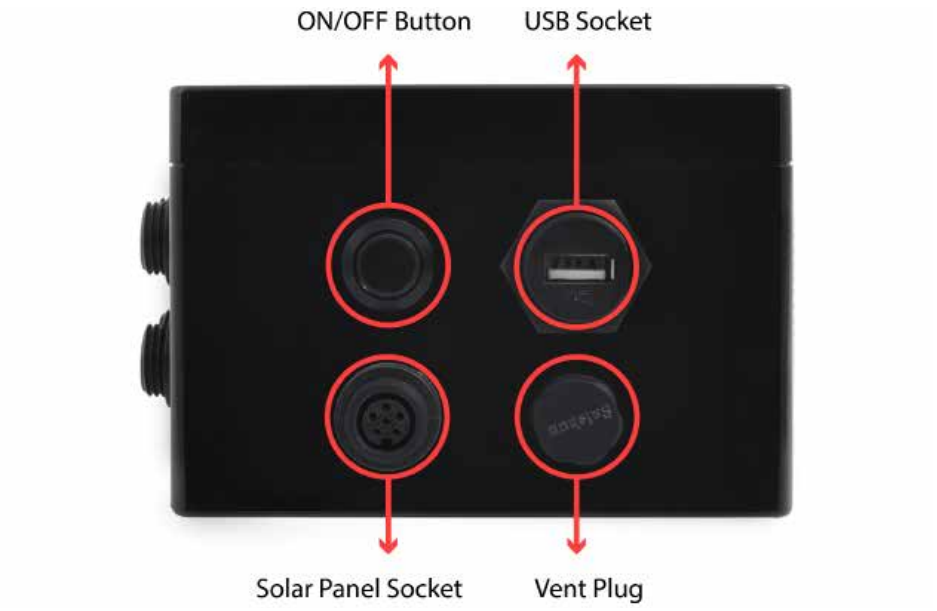
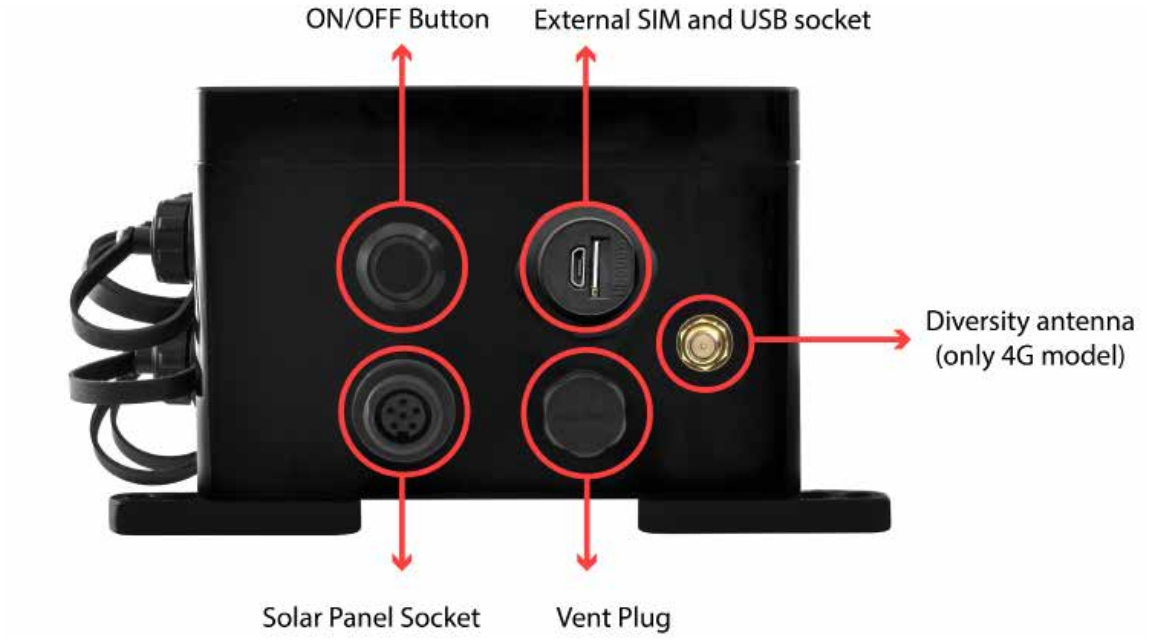



*Figure: Control side of the enclosure*




*Control side of the enclosure for 4G model*


*Figure: Sensor side of the enclosure*

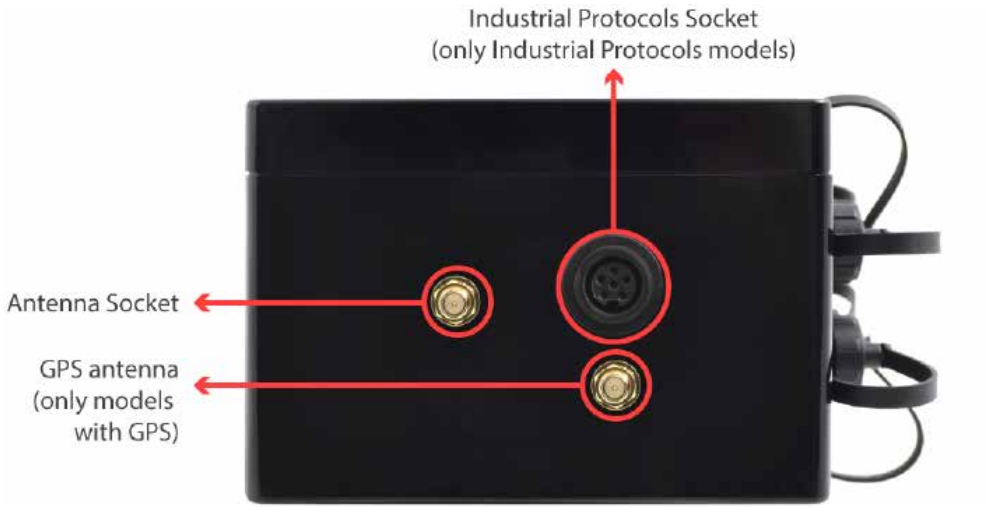



*Figure: Antenna side of the enclosure*


*Figure: Front view of the enclosure*


*Figure: Back view of the enclosure*


*Figure: Warranty stickers of the enclosure*

*Important note: Do not handle black stickers seals of the enclosure (Warranty stickers). Their integrity is the proof that Waspmote Plug & Sense! has not been opened. If they have been handled, damaged or broken, the warranty is automatically void.*

## 3.2. Parts included

Next picture shows Waspmote Plug & Sense! and all of its elements. Some of them are optional accessories that may not be included.


*Figure: Waspmote Plug & Sense! accessories: 1 enclosure, 2 sensor probes, 3 external solar panel, 4 USB cable, 5 antenna, 6 cable ties, 7 mounting feet (screwed to the enclosure), 8 extension cord, 9 solar panel cable, 10 wall plugs & screws*

## 3.3. Identification

Each Waspmote model is identified by stickers. Next figure shows front sticker.

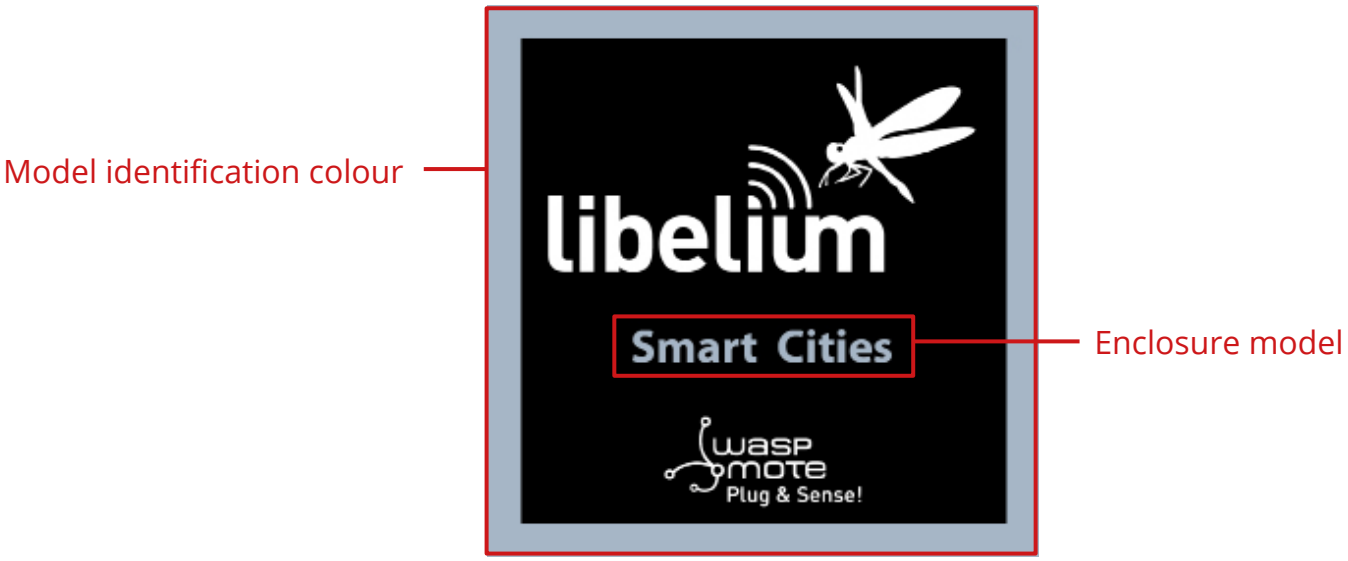



*Figure: Front sticker of the enclosure*

There are many configurations of Waspmote Plug & Sense! line, all of them identified by one unique sticker. Next image shows all possibilities.


*Figure: Different front stickers*

Moreover, Waspmote Plug & Sense! includes a back sticker where it is shown identification numbers, radio MAC addresses, etc. It is highly recommended to annotate this information and save it for future maintenance. Next figure shows it in detail.

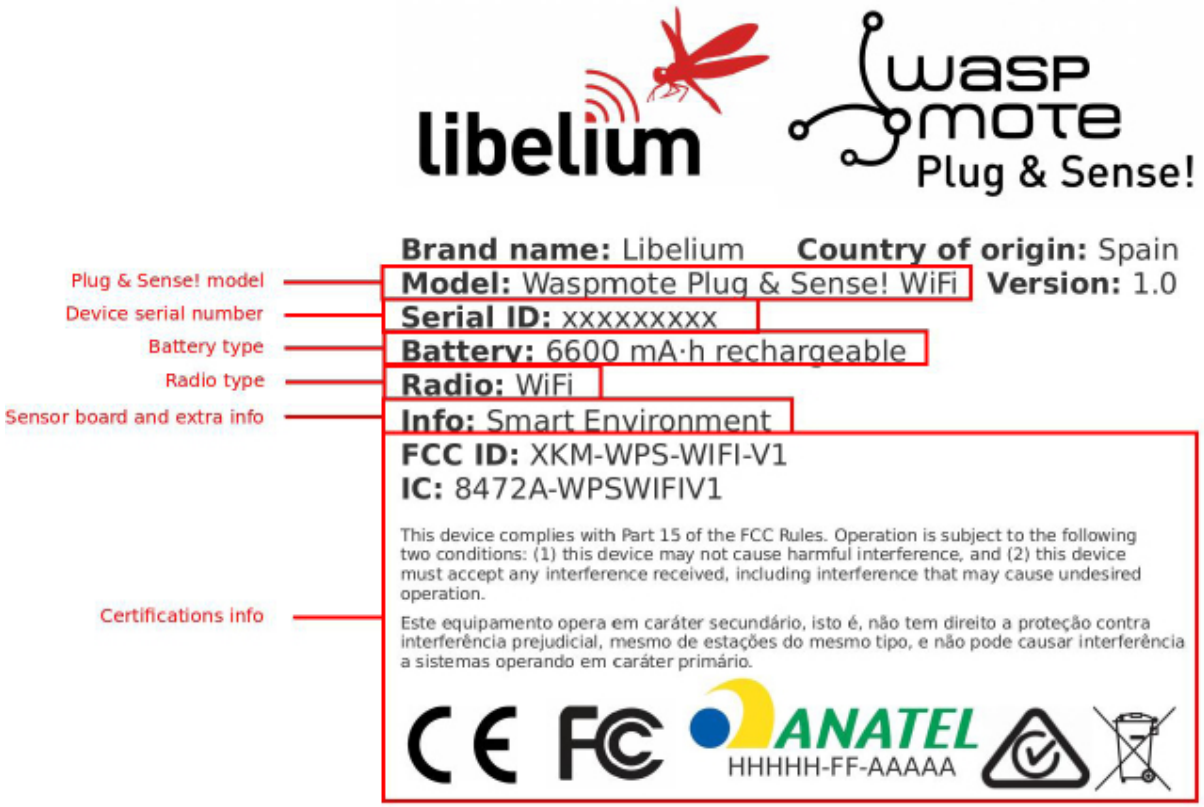



*Figure: Back sticker*

Sensor probes are identified too by a sticker showing the measured parameter and the sensor manufacturer reference.



*Figure: Sensor probe identification sticker*

# 4. Sensor probes

Sensor probes can be easily attached by just screwing them into the bottom sockets. This allows you to add new sensing capabilities to existing networks just in minutes. In the same way, sensor probes may be easily replaced in order to ensure the lowest maintenance cost of the sensor network.


*Figure: Connecting a sensor probe to Waspmote Plug & Sense!*

Go to the Plug & Sense! Sensor Guide to know more about our sensor probes.

# 5. Solar powered

The battery can be recharged using the waterproof USB cable but also the external solar panel option.

The external solar panel is mounted on a 45º holder which ensures the maximum performance of each outdoor installation.


*Figure: Waspmote Plug & Sense! powered by an external solar panel*

# 6. External Battery Module

The External Battery Module (EBM) is an accessory to extend the battery life of Plug & Sense!. The extension period may be from months to years depending on the sleep cycle and radio activity. The daily charging period is selectable among 5, 15 and 30 minutes with a selector switch and it can be combined with a solar panel to extend even more the node's battery lifetime.

**Note:** Nodes using solar panel can keep using it through the External Battery Module. The EBM is connected to the solar panel connector of Plug & Sense! and the solar panel unit is connected to the solar panel connector of the EBM.

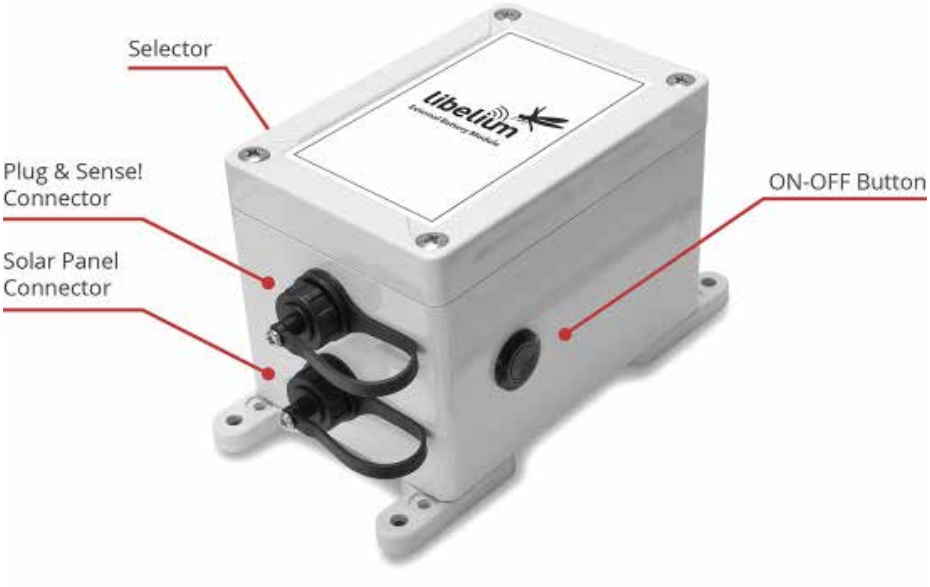



*Figure: Plug & Sense! with External Battery Module*


*Figure: Plug & Sense! with External Battery Module and solar panel*

# 7. Programming the Nodes

Waspmote Plug & Sense! can be reprogrammed in two ways:

The basic programming is done from the USB port. Just connect the USB to the specific external socket and then to the computer to upload the new firmware.


*Figure: Programming a node*

Over the Air Programming (OTAP) is also possible once the node has been installed (via WiFi or 4G radios). With this technique you can reprogram, wireless, one or more Waspmote sensor nodes at the same time by using a laptop and Meshlium.


*Figure: Typical OTAP process*

# 8. Program in minutes

The Programming Cloud Service is an intuitive graphic interface which creates code automatically. The user just needs to to fill a web form to obtain binaries for Plug & Sense!. Advanced programming options are available, depending on the license selected.

Check how easy it is to handle the Programming Cloud Service at:

https://cloud.libelium.com/

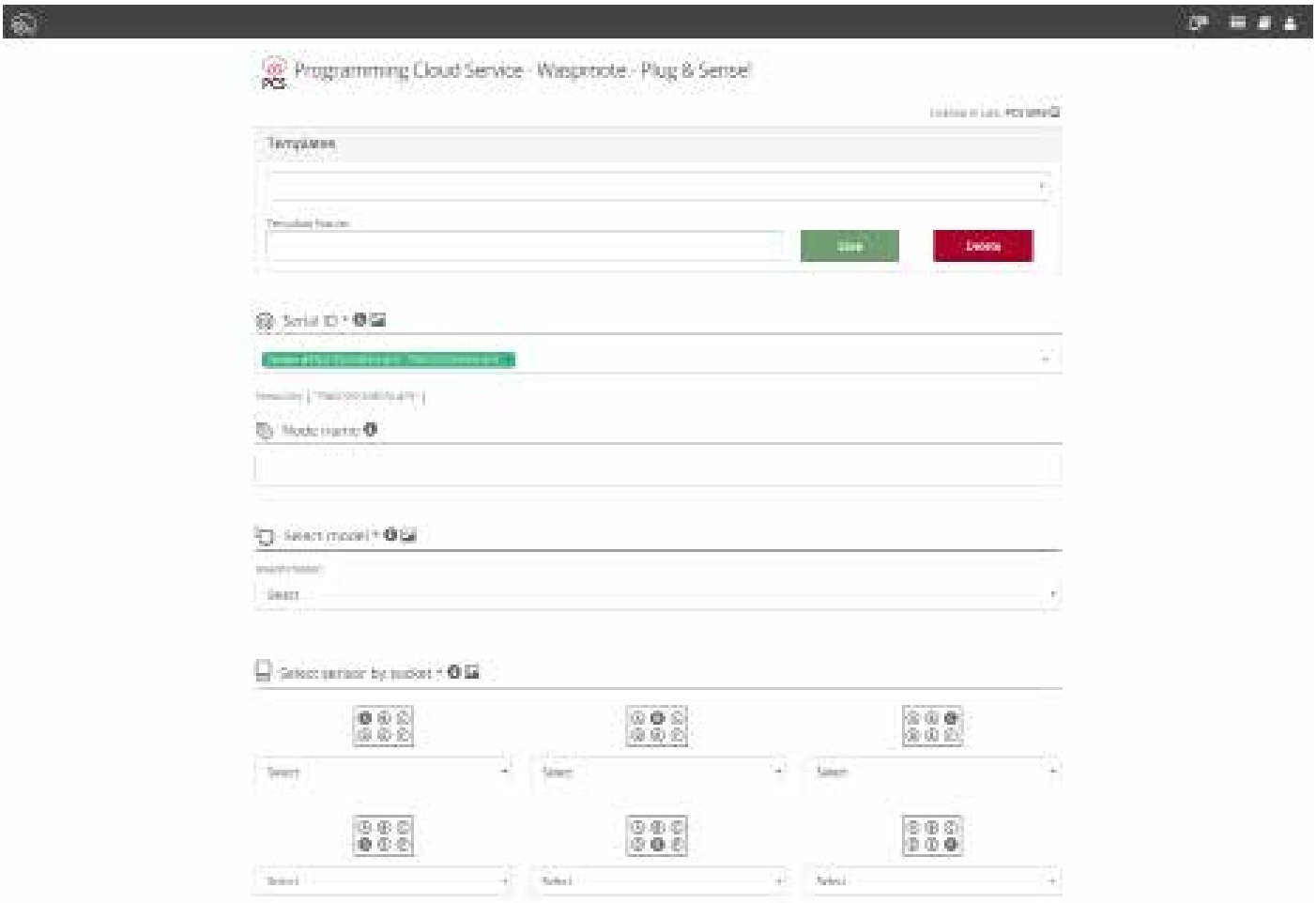



*Figure: Programming Cloud Service*

# 9. Radio interfaces

| Radio | Protocol | Frequency bands | Transmission power | Sensitivity | Range* | Certification |
|---|---|---|---|---|---|---|
| XBee-PRO 802.15.4 EU | 802.15.4 | 2.4 GHz | 10 dBm | -100 dBm | 750 m | CE |
| XBee-PRO 802.15.4 | 802.15.4 | 2.4 GHz | 18 dBm | -100 dBm | 1600 m | FCC, IC, ANATEL, RCM |
| XBee ZigBee 3 | ZigBee 3 | 2.4 GHz | 8 dBm | -103 dBm | 1200 m | CE |
| XBee 868LP | RF | 868 MHz | 14 dBm | -106 dBm | 8.4 km | CE |
| XBee 900HP US | RF | 900 MHz | 24 dBm | -110 dBm | 15.5 km | FCC, IC |
| XBee 900HP BR | RF | 900 MHz | 24 dBm | -110 dBm | 15.5 km | ANATEL |
| XBee 900HP AU | RF | 900 MHz | 24 dBm | -110 dBm | 15.5 km | RCM |
| WiFi | WiFi (HTTP(S), FTP, TCP, UDP) | 2.4 GHz | 17 dBm | -94 dBm | 500 m | CE, FCC, IC, ANATEL, RCM |
| 4G EU/BR v2 | 4G/3G/2G (HTTP, FTP, TCP, UDP) | 800, 900, 1800, 2100, 2600 MHz | 4G: class 3 (0.2 W, 23 dBm) | 4G: -102 dBm | - km - Typical base station range | CE, ANATEL |
| 4G US v2 | 4G/3G (HTTP, FTP, TCP, UDP) | 700, 850, 1700, 1900 MHz | 4G: class 3 (0.2 W, 23 dBm) | 4G: -103 dBm | - km - Typical base station range | FCC, IC, PTCRB, AT&T |
| 4G AU | 4G (HTTP, FTP, TCP, UDP) | 700, 1800, 2600 MHz | 4G: class 3 (0.2 W, 23 dBm) | 4G: -102 dBm | - km - Typical base station range | RCM |
| Sigfox EU | Sigfox | 868 MHz | 16 dBm | -126 dBm | - km - Typical base station range | CE |
| Sigfox US | Sigfox | 900 MHz | 24 dBm | -127 dBm | - km - Typical base station range | FCC, IC |
| Sigfox AU / APAC / LATAM | Sigfox | 900 MHz | 24 dBm | -127 dBm | - km - Typical base station range | - |
| LoRaWAN EU | LoRaWAN | 868 MHz | 14 dBm | -136 dBm | > 15 km | CE |
| LoRaWAN US | LoRaWAN | 902-928 MHz | 18.5 dBm | -136 dBm | > 15 km | FCC, IC |
| LoRaWAN AU | LoRaWAN | 915-928 MHz | 18.5 dBm | -136 dBm | > 15 km | - |
| LoRaWAN IN | LoRaWAN | 865-867 MHz | 18.5 dBm | -136 dBm | > 15 km | - |
| LoRaWAN ASIA-PAC / LATAM | LoRaWAN | 923 MHz | 18.5 dBm | -136 dBm | > 15 km | - |
| LoRaWAN JP / KR | LoRaWAN | 923 MHz, 920-923 MHz | 16 dBm / 14 dBm | -135.5 dBm | > 15 km | - |

** Line of sight and Fresnel zone clearance with 5 dBi dipole antenna.*

# 10. Industrial Protocols

Besides the main radio of Waspmote Plug & Sense!, it is possible to have an Industrial Protocol module as a secondary communication option. This is offered as an accessory feature.

The available Industrial Protocols are RS-485, Modbus (software layer over RS-485) and CAN Bus. This optional feature is accessible through an additional, dedicated socket on the antenna side of the enclosure.


*Figure: Industrial Protocols available on Plug & Sense!*

Finally, the user can choose between 2 probes to connect the desired Industrial Protocol: A standard DB9 connector and a waterproof terminal block junction box. These options make the connections on industrial environments or outdoor applications easier.

*Figure: DB9 probe*

*Figure: Terminal box probe*

# 11. GPS

Any Plug & Sense! node can incorporate a GPS receiver in order to implement real-time asset tracking applications. The user can also take advantage of this accessory to geolocate data on a map. An external, waterproof antenna is provided; its long cable enables better installation for maximum satellite visibility.


*Figure: Plug & Sense! node with GPS receiver*

**Chipset:** 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 length: 2 m
- Connector: SMA
- Gain: 26 dBi (active)

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

# 12. Models

There are some defined configurations of Waspmote Plug & Sense! depending on which sensors are going to be used. Waspmote Plug & Sense! configurations allow to connect up to six sensor probes at the same time.

Each model takes a different conditioning circuit to enable the sensor integration. For this reason, each model allows connecting just its specific sensors.

This section describes each model configuration in detail, showing the sensors which can be used in each case and how to connect them to Waspmote. In many cases, the sensor sockets accept the connection of more than one sensor probe. See the compatibility table for each model configuration to choose the best probe combination for the application.

It is very important to remark that each socket is designed only for one specific sensor, so **they are not interchangeable**. Always be sure you have connected the probes in the right socket. Otherwise, they can be damaged.

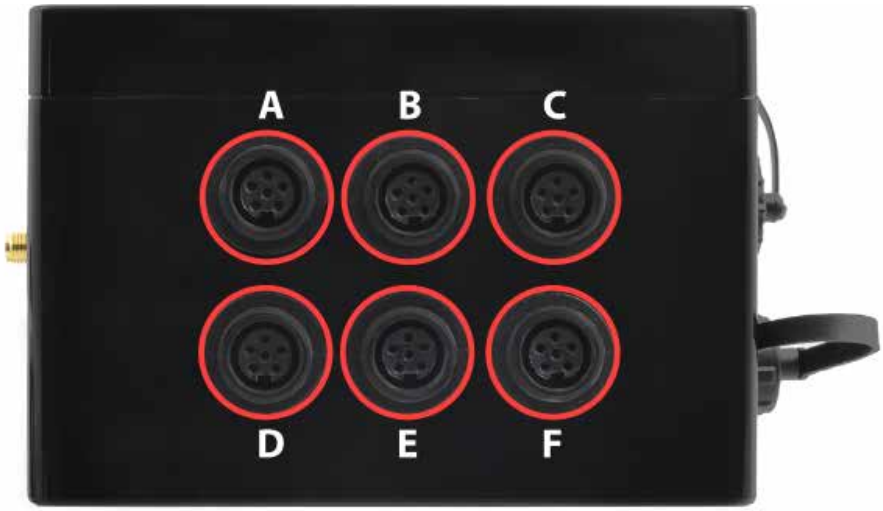



*Figure: Identification of sensor sockets*

# 12.1. Smart Environment PRO

The Smart Environment PRO model has been created as an evolution of Smart Environment. It enables the user to implement pollution, air quality, industrial, environmental or farming projects with high requirements in terms of high accuracy, reliability and measurement range as the sensors come calibrated from factory.


*Figure: Smart Environment PRO Waspmote Plug & Sense! model*

Sensor sockets are configured as shown in the figure below.

| Sensor Socket | Sensor probes allowed for each sensor socket | |
|---|---|---|
| | Parameter | Reference |
| A, B, C or F | Carbon Monoxide (CO) for low concentrations [Calibrated] | 9371-LC-P |
| | Carbon Dioxide ($CO_2$) [Calibrated] | 9372-P |
| | Oxygen ($O_2$) [Calibrated] | 9373-P |
| | Ozone ($O_3$) [Calibrated] | 9374-P |
| | Nitric Oxide (NO) for low concentrations [Calibrated] | 9375-LC-P |
| | Nitric Dioxide ($NO_2$) high accuracy [Calibrated] | 9376-HA-P |
| | Sulfur Dioxide ($SO_2$) high accuracy [Calibrated] | 9377-HA-P |
| | Ammonia ($NH_3$) for low concentrations [Calibrated] | 9378-LC-P |
| | Ammonia ($NH_3$) for high concentrations [Calibrated] | 9378-HC-P |
| | Methane ($CH_4$) and Combustible Gas [Calibrated] | 9379-P |
| | Hydrogen Sulfide ($H_2S$) [Calibrated] | 9381-P |
| D | Particle Matter (PM1 / PM2.5 / PM10) - Dust | 9387-P |
| E | Temperature, humidity and pressure | 9370-P |
| | Luminosity (Luxes accuracy) | 9325-P |
| | Ultrasound (distance measurement) | 9246-P |

*Figure: Sensor sockets configuration for Smart Environment PRO model*

*Note: For more technical information about each sensor probe go to the Development section on the Libelium website.*

Calibrated gas sensors are manufactured once the order has been placed to ensure maximum durability of the calibration feature. The manufacturing process and delivery may take from 4 to 6 weeks. The lifetime of calibrated gas sensors is 6 months working at maximum accuracy. We strongly encourage our customers to buy extra gas sensors to replace the original ones after that time to ensure maximum accuracy and performance.

## 12.2. Smart Security

The main applications for this Waspmote Plug & Sense! configuration are perimeter access control, liquid presence detection and doors and windows openings. Besides, a relay system allows this model to interact with external electrical machines.


*Figure: Smart Security Waspmote Plug & Sense! model*

***Note**: The probes attached in this photo could not match the final location. See next table for the correct configuration.*

| Sensor Socket | Sensor probes allowed for each sensor socket | |
|---|---|---|
| | **Parameter** | **Reference** |
| A, C, D or E | Temperature + Humidity + Pressure | 9370-P |
| | Luminosity (Luxes accuracy) | 9325-P |
| | Ultrasound (distance measurement) | 9246-P |
| | Presence - PIR | 9212-P |
| | Liquid Level (combustible, water) | 9239-P, 9240-P |
| | Liquid Presence (Point, Line) | 9243-P, 9295-P |
| | Hall Effect | 9207-P |
| B | Liquid Flow (small, medium) | 9296-P, 9297-P |
| F | Relay Input-Output | 9270-P |

*Figure: Sensor sockets configuration for Smart Security model*

As we see in the figure below, thanks to the directional probe, the presence sensor probe (PIR) may be placed in different positions. The sensor can be focused directly to the point we want.


*Figure: Configurations of the Presence sensor probe (PIR)*

*Note: For more technical information about each sensor probe go to the Development section on the Libelium website.*

## 12.3. Smart Water

The Smart Water model has been conceived to facilitate the remote monitoring of the most relevant parameters related to water quality. With this platform you can measure more than 5 parameters, including the most relevant for water control such as dissolved oxygen, oxidation-reduction potential, pH, conductivity and temperature.

The Smart Water Ions line is complementary for these kinds of projects, enabling the control of concentration of ions like Ammonium ($NH^4_+$), Bromide ($Br^-$), Calcium ($Ca^2_+$), Chloride ($Cl^-$), Cupric ($Cu^2_+$), Fluoride ($F^-$), Iodide ($I^-$), Lithium ($Li_+$), Magnesium ($Mg^2_+$), Nitrate ($NO^3_-$), Nitrite ($NO^2_-$), Perchlorate ($ClO^4_-$), Potassium ($K_+$), Silver ($Ag_+$), Sodium ($Na_+$) and pH. Take a look to the Smart Water Ions line in the next section.

Refer to Libelium website for more information.


*Figure: Smart Water Plug&Sense! model*

Sensor sockets are configured as shown in the figure below.

| Sensor Socket | Sensor probes allowed for each sensor socket | |
|---|---|---|
| | **Parameter** | **Reference** |
| A | pH | 9328 |
| B | Dissolved Oxygen (DO) | 9327 |
| C | Conductivity | 9326 |
| E | Oxidation-Reduction Potential (ORP) | 9329 |
| F | Soil/Water Temperature | 9255-P (included by default) |

*Figure: Sensor sockets configuration for Smart Water model*

*Note: For more technical information about each sensor probe go to the Development section on the Libelium website.*

## 12.4. Smart Water Xtreme

Smart Water Xtreme was created as an evolution of Smart Water. This model integrates high-end sensors, calibrated in factory, with enhanced accuracy and performance. Their reduced recalibration requirements and robust design enlarge maintenance periods, making it more affordable to deploy remote Smart Water applications. This line includes a great combination of the most significant water parameters like dissolved oxygen, pH, oxidation-reduction potential, conductivity, salinity, turbidity, suspended solids, sludge blanket or temperature.

Refer to Libelium website for more information.


*Figure: Smart Water Xtreme Waspmote Plug & Sense! model*

*Note: For more technical information about each sensor probe go to the Development section on the Libelium website.*

Sensor sockets are configured as shown in the figure below.

| Sensor | Sensor probes allowed for each sensor socket | |
|---|---|---|
| | **Parameter** | **Reference** |
| A, B, C, D and E | Optical dissolved oxygen and temperature OPTOD | 9488-P |
| | Titanium optical dissolved oxygen and temperature OPTOD | 9489-P |
| | pH, ORP and temperature PHEHT | 9485-P |
| | Conductivity, salinity and temperature C4E | 9486-P |
| | Inductive conductivity, salinity and temperature CTZN | 9487-P |
| | Turbidity and temperature NTU | 9353-P |
| | Suspended solids, turbidity, sludge blanket and temperature MES5 | 9490-P |
| | COD, BOD, TOC, SAC254 and temp StacSense, 2 mm path | 9500-P |
| | 2COD, BOD, TOC, SAC254 and temp StacSense, 50 mm path | 9501-P |
| A, B, C and D | Radar level VEGAPULS C21 | 9514-P |
| A and D | Temperature, air humidity and pressure | 9370-P |
| | Luxes | 9325-P |
| | Ultrasound | 9246-P |
| F | Total coliform bacteria, TLF, turbidity and temperature Proteus | 9513-P |
| | Manta+ 35A sensor probe | 9495-P |
| | Manta+ 35B sensor probe | 72470 |
| | Chlorophyll sensor for Manta probe | 72470 |
| | BGA sensor for Manta probe | 72471 |
| | Organic matter CDOM/FDOM sensor for Manta probe | 72472 |
| | Ammonium sensor for Manta probe | 72473 |
| | Nitrate sensor for Manta probe | 72474 |
| | Chloride sensor for Manta probe | 72475 |
| | Sodium sensor for Manta probe | 72476 |
| | Calcium sensor for Manta probe | 72477 |
| | Bromide sensor for Manta probe | 9504-P |
| | Total Dissolved Gas TDG sensor for Manta probe | 9505-P |
| | Rhodamine sensor for Manta probe | 9506-P |
| | Crude oil sensor for Manta probe | 9507-P |
| | Refined oil sensor for Manta probe | 9508-P |
| | Flourescein sensor for Manta probe | 9509-P |
| | Optical brighteners sensor for Manta probe | 9510-P |
| | Tryptophan sensor for Manta probe | 9511-P |

*Figure: Sensor sockets configuration for Smart Water Xtreme model*

## 12.5. Smart Water Ions

The Smart Water Ions models specialize in the measurement of ions concentration for drinking water quality control, agriculture water monitoring, swimming pools or waste water treatment.

The Smart Water line is complementary for these kinds of projects, enabling the control of parameters like conductivity, oxidation-reduction potential and dissolved oxygen. Take a look to the Smart Water line in the previous section. Refer to Libelium website for more information.

There are 3 variants for Smart Water Ions: Single, Double and PRO. This is related to the type of ion sensor that each variant can integrate. Next section describes each configuration in detail.


*Figure: Smart Water Ions Waspmote Plug & Sense! model*

## Single

This variant includes a Single Junction Reference Probe, so it can read all the single type ion sensors.
Sensor sockets are configured as shown in the table below.

| Sensor Socket | Sensor probes allowed for each sensor socket | |
|---|---|---|
| | **Parameter** | **Reference** |
| A, B, C and D | Fluoride Ion ($F^-$) | 9353 |
| | Fluoroborate Ion ($BF4^-$) | 9354 |
| | Nitrate Ion ($NO_3^-$) | 9355 |
| | pH (for Smart Water Ions) | 9363 |
| E | Single Junction Reference | 9350 (included by default) |
| F | Soil/Water Temperature | 9255-P (included by default) |

*Figure: Sensor sockets configuration for Smart Water Ions model, single variant*

*Note: For more technical information about each sensor probe go to the Development section on the Libelium website.*

## Double

This variant includes a Double Junction Reference Probe, so it can read all the double type ion sensors.
Sensor sockets are configured as shown in the table below.

| Sensor Socket | Sensor probes allowed for each sensor socket | |
|---|---|---|
| | **Parameter** | **Reference** |
| A, B, C and D | Bromide Ion ($Br^-$) | 9356 |
| | Chloride Ion ($Cl^-$) | 9357 |
| | Cupric Ion ($Cu^{2+}$) | 9358 |
| | Iodide Ion ($I^-$) | 9360 |
| | Silver Ion ($Ag^+$) | 9362 |
| | pH (for Smart Water Ions) | 9363 |
| E | Double Junction Reference | 9351 (included by default) |
| F | Soil/Water Temperature | 9255-P (included by default) |

*Figure: Sensor sockets configuration for Smart Water Ions model, double variant*

*Note: For more technical information about each sensor probe go to the Development section on the Libelium website.*

## Pro

This special variant integrates extreme quality sensors, with better performance than the Single or Double lines. In this case, there is only one type of reference probe and up to 16 different ion parameters can be analyzed in 4 sockets.

Sensor sockets are configured as shown in the table below.

| Sensor Socket | Sensor probes allowed for each sensor socket | |
|---|---|---|
| | **Parameter** | **Reference** |
| A, B, C or D | Ammonium Ion ($NH_4^+$) [PRO] | 9412 |
| | Bromide Ion ($Br^-$) [PRO] | 9413 |
| | Calcium Ion ($Ca^{2+}$) [PRO] | 9414 |
| | Chloride Ion ($Cl^-$) [PRO] | 9415 |
| | Cupric Ion ($Cu^{2+}$) [PRO] | 9416 |
| | Fluoride Ion ($F^-$) [PRO] | 9417 |
| | Iodide Ion ($I^-$) [PRO] | 9418 |
| | Lithium Ion ($Li^+$) [PRO] | 9419 |
| | Magnesium Ion ($Mg^{2+}$) [PRO] | 9420 |
| | Nitrate Ion ($NO_3^-$) [PRO] | 9421 |
| | Nitrite Ion ($NO_2^-$) [PRO] | 9422 |
| | Perchlorate Ion ($ClO_4^-$) [PRO] | 9423 |
| | Potassium Ion ($K^+$) [PRO] | 9424 |
| | Silver Ion ($Ag^+$) [PRO] | 9425 |
| | Sodium Ion ($Na^+$) [PRO] | 9426 |
| | pH [PRO] | 9411 |
| E | Reference Sensor Probe [PRO] | 9410 (included by default) |
| F | Soil/Water Temperature | 9255-P (included by default) |

*Figure: Sensor sockets configuration for Smart Water Ions model, PRO variant*

*Note: For more technical information about each sensor probe go to the Development section on the Libelium website.*

## 12.6. Smart Parking

The Smart Parking node allows to detect available parking spots by placing the node on the pavement. It works with a radar sensor and a magnetic sensor which detect when a vehicle is present or not.

The node benefits from LoRaWAN technology, getting ubiquitous coverage with few base stations. The device is very optimized in terms of power consumption, resulting in a long battery life. Its small size and the robust and surface-mount enclosure enables a fast installation, without the need of digging a hole in the ground. Finally, the developer does not need to program the node, but just configure some key parameters. Remote management and bidirectional communication allow to change parameters from the Cloud.

*Figure: Smart Parking node*

*Note: There are specific documents for parking applications on the Libelium website. Refer to the Smart Parking Technical Guide to see typical applications for this model and how to make a good installation.*

*Figure: Smart Parking application diagram*

## 12.7. Smart Agriculture PRO

The Smart Agriculture models allow to monitor multiple environmental parameters involving a wide range of applications. It has been provided with sensors for air and soil temperature and humidity, solar visible radiation, wind speed and direction, rainfall, atmospheric pressure, etc.

The main applications for this Waspmote Plug & Sense! model are precision agriculture, irrigation systems, greenhouses, weather stations, etc. Refer to Libelium website for more information.


*Figure: Smart Agriculture PRO Waspmote Plug & Sense! model*

Sensor sockets are configured as shown in the figure below.

| Sensor Socket | Sensor probes allowed for each sensor socket | |
|---|---|---|
| | **Parameter** | **Reference** |
| A | Weather Station WS-3000 (anemometer + wind vane + pluviometer) | 9256-P |
| B | Soil Moisture 1 | 9248-P, 9324-P, 9323-P |
| | Solar Radiation (PAR) | 9251-P |
| | Ultraviolet Radiation | 9257-P |
| C | Soil Moisture 3 | 9248-P, 9324-P, 9323-P |
| | Dendrometers | 9252-P, 9253-P, 9254-P |
| D (digital bus) | Soil Temperature (Pt-1000) | 9255-P |
| | Temperature + Humidity + Pressure | 9370-P |
| | Luminosity (Luxes accuracy) | 9325-P |
| | Ultrasound (distance measurement) | 9246-P |
| E | Leaf Wetness | 9249-P |
| | Soil Moisture 2 | 9248-P, 9324-P, 9323-P |
| F (digital bus) | Temperature + Humidity + Pressure | 9370-P |
| | Luminosity (Luxes accuracy) | 9325-P |
| | Ultrasound (distance measurement) | 9246-P |

*Figure: Sensor sockets configuration for Smart Agriculture PRO model*

* Ask Libelium Sales Department for more information.

*Note: For more technical information about each sensor probe go to the Development section on the Libelium website.*

## 12.8. Smart Agriculture Xtreme

The Plug & Sense! Smart Agriculture Xtreme is an evolution of our Agriculture line with a new selection of high-end professional sensors. It allows to monitor multiple environmental parameters involving a wide range of applications, from plant growing analysis to weather observation. There are sensors for atmospheric and soil monitoring and plants health. More than 30 sensors can be connected.


*Figure: Smart Agriculture Xtreme Waspmote Plug & Sense! model*

Sensor sockets are configured as shown in the figure below.

| Sensor Socket | Sensor probes allowed for each sensor socket | |
|---|---|---|
| | **Parameter** | **Reference** |
| A and D | Non-contact surface temperature measurement SI-411 | 9468-P |
| | Leaf and flower bud temperature SF-421 | 9467-P |
| | Soil oxygen level SO-411 | 9469-P |
| | Volumetric water content and soil temperature TEROS 11 | 9512-P |
| | Conductivity, water content and soil temperature TEROS 12 | 9499-P |
| | Soil water potential TEROS 21 | 9465-P |
| | Vapor pressure, humidity, temperature, and atmospheric pressure in soil and air VP-4 | 9471-P |
| | Temperature, air humidity and pressure | 9370-P |
| | Luxes | 9325-P |
| | Ultrasound | 9246-P |
| B | Non-contact surface temperature measurement SI-411 | 9468-P |
| | Leaf and flower bud temperature SF-421 | 9467-P |
| | Soil oxygen level SO-411 | 9469-P |
| | Volumetric water content and soil temperature TEROS 11 | 9512-P |
| | Conductivity, water content and soil temperature TEROS 12 | 9499-P |
| | Soil water potential TEROS 21 | 9465-P |
| | Vapor pressure, humidity, temperature, and atmospheric pressure in soil and air VP-4 | 9471-P |
| | Leaf wetness Phytos 31 | 9466-P |
| | Shortwave radiation SP-510 | 9470-P |
| | Solar radiation (PAR) SQ-110 for Smart Agriculture Xtreme | 9251-PX |
| | Ultraviolet radiation SU-100 for Smart Agriculture Xtreme | 9257-PX |
| | Ultraviolet radiation SU-202 for Smart Agriculture Xtreme | 9515-PX |
| | 4-20 mA type (generic) | - |
| C | Non-contact surface temperature measurement SI-411 | 9468-P |
| | Leaf and flower bud temperature SF-421 | 9467-P |
| | Soil oxygen level SO-411 | 9469-P |
| | Volumetric water content and soil temperature TEROS 11 | 9512-P |
| | Conductivity, water content and soil temperature TEROS 12 | 9499-P |
| | Soil water potential TEROS 21 | 9465-P |
| | Vapor pressure, humidity, temperature, and atmospheric pressure in soil and air VP-4 | 9471-P |
| | Dendrometers (DC3, DD-S, DF) for Smart Agriculture Xtreme | 9252-PX, 9253-PX, 9254-PX |
| | Shortwave radiation SP-510 | 9470-P |
| | Solar radiation (PAR) SQ-110 for Smart Agriculture Xtreme | 9251-PX |
| | Ultraviolet radiation SU-100 for Smart Agriculture Xtreme | 9257-PX |
| | Ultraviolet radiation SU-202 for Smart Agriculture Xtreme | 9515-PX |

*table continues*

| | | |
|---|---|---|
| E | Shortwave radiation SP-510 | 9470-P |
| | Solar radiation (PAR) SQ-110 for Smart Agriculture Xtreme | 9251-PX |
| | Ultraviolet radiation SU-100 for Smart Agriculture Xtreme | 9257-PX |
| | Ultraviolet radiation SU-202 for Smart Agriculture Xtreme | 9515-PX |
| | Weather station GMX-100 (PO) Probe | 9472-P |
| | Weather station GMX-101 (R) | 9473-P |
| | Weather station GMX-200 (W) | 9474-P |
| | Weather station GMX-240 (W-PO) | 9463-P |
| | Weather station GMX-300 (T-H-AP) | 9475-P |
| | Weather station GMX-301 (T-H-AP-R) | 9476-P |
| | Weather station GMX-400 (PO-T-H-AP) | 9477-P |
| | Weather station GMX-500 (W-T-H-AP) | 9478-P |
| | Weather station GMX-501 (W-T-H-AP-R) | 9479-P |
| | Weather station GMX-531 (W-PT-T-H-AP-R) | 9480-P |
| | Weather station GMX-541 (W-PO-T-H-AP-R) | 9481-P |
| | Weather station GMX-550 (W-x-T-H-AP) | 9482-P |
| | Weather station GMX-551 (W-x-T-H-AP-R) | 9483-P |
| | Weather station GMX-600 (W-PO-T-H-AP) | 9484-P |
| | Solar radiation and temperature Datasol MET probe | 9496-P |
| F | Shortwave radiation SP-510 | 9470-P |
| | Solar radiation (PAR) SQ-110 for Smart Agriculture Xtreme | 9251-PX |
| | Ultraviolet radiation SU-100 for Smart Agriculture Xtreme | 9257-PX |
| | Ultraviolet radiation SU-202 for Smart Agriculture Xtreme | 9515-PX |
| | RS-232 type (generic) | - |
| | 4-20 mA type (generic) | - |

*Figure: Sensor sockets configuration for Smart Agriculture model*

*Note: For more technical information about each sensor probe go to the Development section on the Libelium website.z*

## 12.9. Ambient Control

This model is designed to monitor the main environment parameters easily. Only three sensor probes are allowed for this model, as shown in next table.


*Figure: Ambient Control Waspmote Plug & Sense! model*

Sensor sockets are configured as it is shown in figure below.

| Sensor Socket | Sensor probes allowed for each sensor socket | |
|---|---|---|
| | **Parameter** | **Reference** |
| A | Temperature + Humidity + Pressure | 9370-P |
| B | Luminosity (LDR) | 9205-P |
| C | Luminosity (Luxes accuracy) | 9325-P |
| D, E and F | Not used | - |

*Figure: Sensor sockets configuration for Ambient Control model*

As we see in the figure below, thanks to the directional probe, the Luminosity (Luxes accuracy) sensor probe may be placed in different positions. The sensor can be focused directly to the light source we want to measure.


*Figure: Configurations of the Luminosity sensor probe (luxes accuracy)*

*Note: For more technical information about each sensor probe go to the Development section on the Libelium website.*

## 12.10. Smart Cities PRO

The main applications for this Waspmote Plug & Sense! model are noise maps (monitor in real time the acoustic levels in the streets of a city), air quality, waste management, smart lighting, etc. Refer to Libelium website for more information.


*Figure: Smart Cities PRO Waspmote Plug & Sense! model*

Sensor sockets are configured as shown in the figure below.

| Sensor Socket | Sensor probes allowed for each sensor socket | |
|---|---|---|
| | Parameter | Reference |
| A | Noise level sensor | NLS |
| | Temperature + Humidity + Pressure | 9370-P |
| | Luminosity (Luxes accuracy) | 9325-P |
| | Ultrasound (distance measurement) | 9246-P |
| B, C, and F | Carbon Monoxide (CO) for low concentrations [Calibrated] | 9371-LC-P |
| | Carbon Dioxide ($CO_2$) [Calibrated] | 9372-P |
| | Oxygen ($O_2$) [Calibrated] | 9373-P |
| | Ozone ($O_3$) [Calibrated] | 9374-P |
| | Nitric Oxide (NO) for low concentrations [Calibrated] | 9375-LC-P |
| | Nitric Dioxide ($NO_2$) high accuracy [Calibrated] | 9376-HA-P |
| | Sulfur Dioxide ($SO_2$) high accuracy [Calibrated] | 9377-HA-P |
| | Ammonia ($NH_3$) for low concentrations [Calibrated] | 9378-LC-P |
| | Ammonia ($NH_3$) for high concentrations [Calibrated] | 9378-HC-P |
| | Methane ($CH_4$) and Combustible Gas [Calibrated] | 9379-P |
| | Hydrogen Sulfide ($H_2S$) [Calibrated] | 9381-P |
| | Hydrogen Chloride (HCl) [Calibrated] | 9382-P |
| | Temperature + Humidity + Pressure | 9370-P |
| | Luminosity (Luxes accuracy) | 9325-P |
| | Ultrasound (distance measurement) | 9246-P |
| D | Particle Matter (PM1 / PM2.5 / PM10) - Dust | 9387-P |
| E | Temperature + Humidity + Pressure | 9370-P |
| | Luminosity (Luxes accuracy) | 9325-P |
| | Ultrasound (distance measurement) | 9246-P |

*Figure: Sensor sockets configuration for Smart Cities PRO model*

*Note: For more technical information about each sensor probe go to the Development section in Libelium website.*

Calibrated gas sensors are manufactured once the order has been placed to ensure maximum durability of the calibration feature. The manufacturing process and delivery may take from 4 to 6 weeks. The lifetime of calibrated gas sensors is 6 months working at maximum accuracy. We strongly encourage our customers to buy extra gas sensors to replace the original ones after that time to ensure maximum accuracy and performance.

# 12.11. 4-20 mA Current Loop

The applications for this Plug & Sense! model are focused on adding wireless connectivity to 4-20 mA devices and connecting them to the Cloud.


*Figure: 4-20 mA Current Loop Waspmote Plug & Sense! model*

Sensor sockets are configured as shown in the figure below.

| Sensor Socket | Sensor probes allowed for each sensor socket | |
|---|---|---|
| | **Board channel** | **Reference** |
| A | Channel 1 (type 2 and type 3) | 9270-P, DB9-P |
| B | Channel 2 (type 2 and type 3) | 9270-P, DB9-P |
| C | Channel 3 (type 2 and type 3) | 9270-P, DB9-P |
| D | Channel 4 (type 4) | 9270-P, DB9-P |

*Figure: Sensor sockets configuration for 4-20 mA Current Loop model*

*Note: For more technical information about each sensor probe go to the Development section on the Libelium website.*

# 13. Meshlium - The IoT Gateway

*Figure: Meshlium device*

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

Meshlium can work as:

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

## 13.1. Meshlium storage options

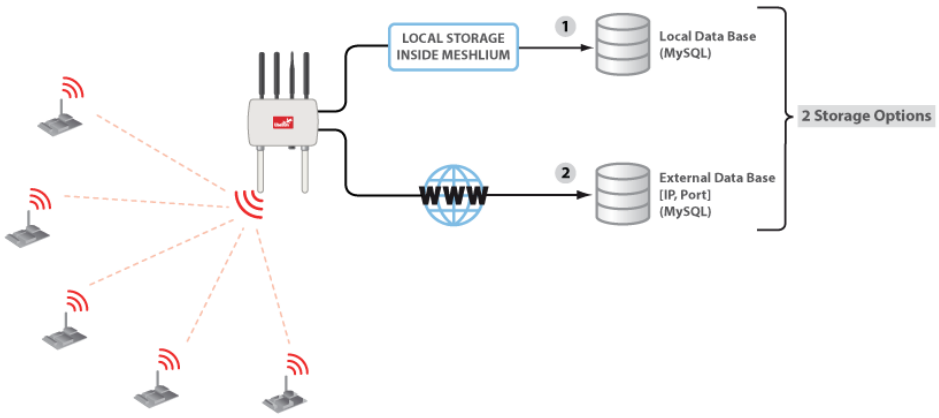



*Figure: Meshlium storage options*

- Local data base
- External data base

# 13.2. Meshlium connection options

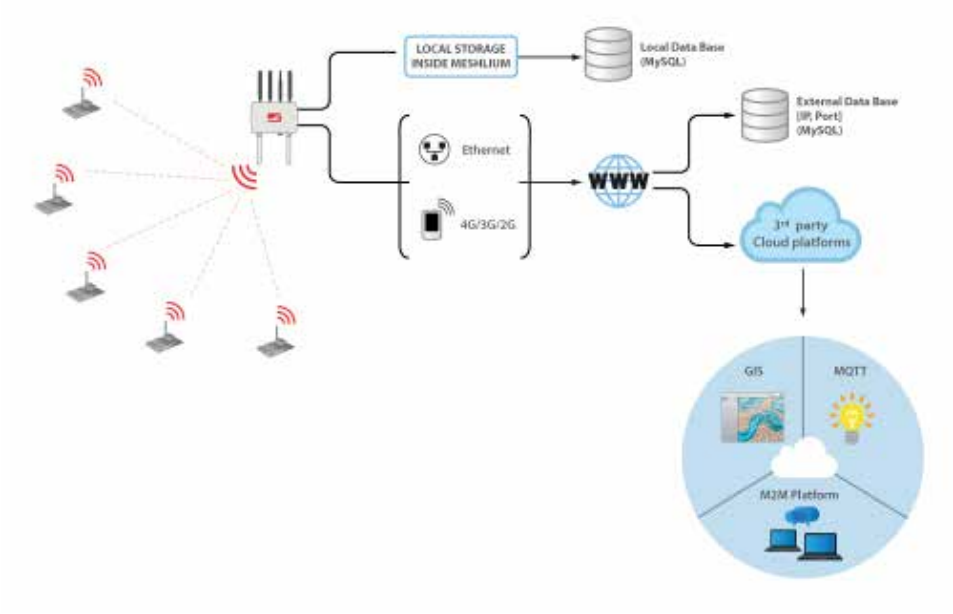



*Figure: Meshlium connection options*

- 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.

# 13.3. 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).

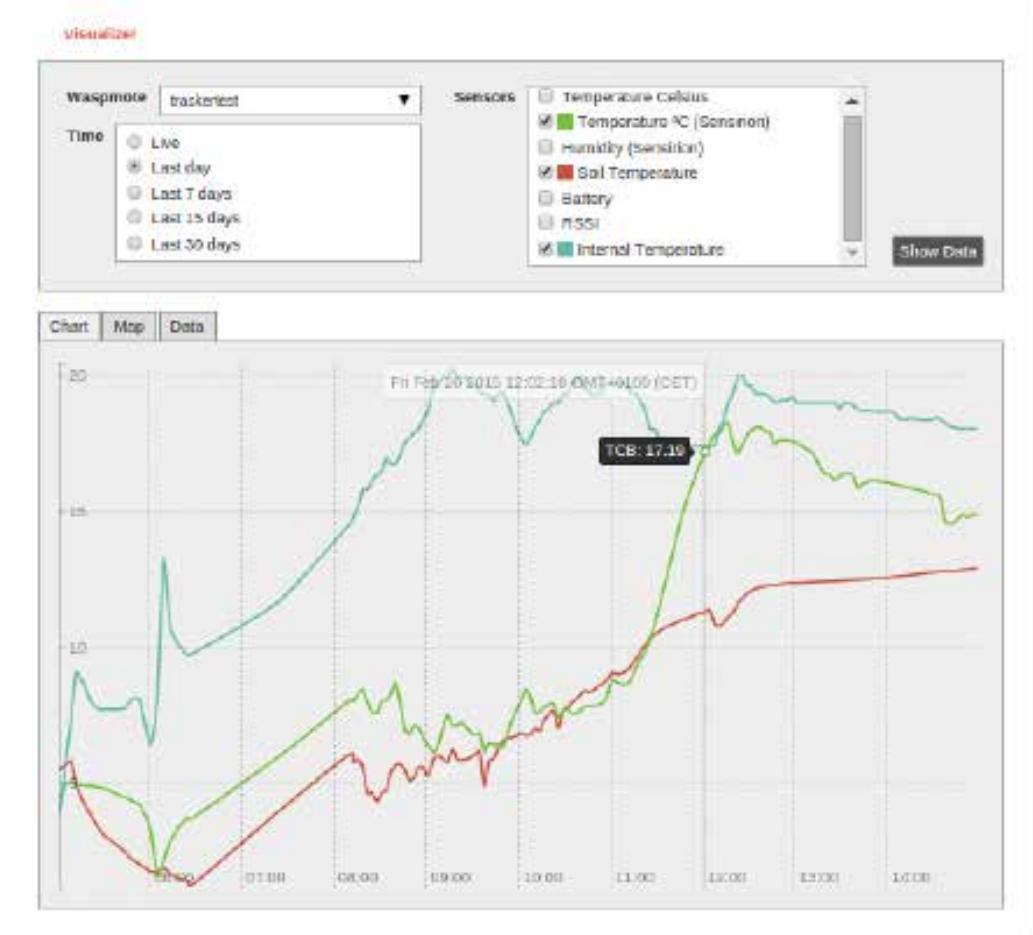



*Figure: Meshlium visualizer*

## 13.4. 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.

# 13.5. 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.

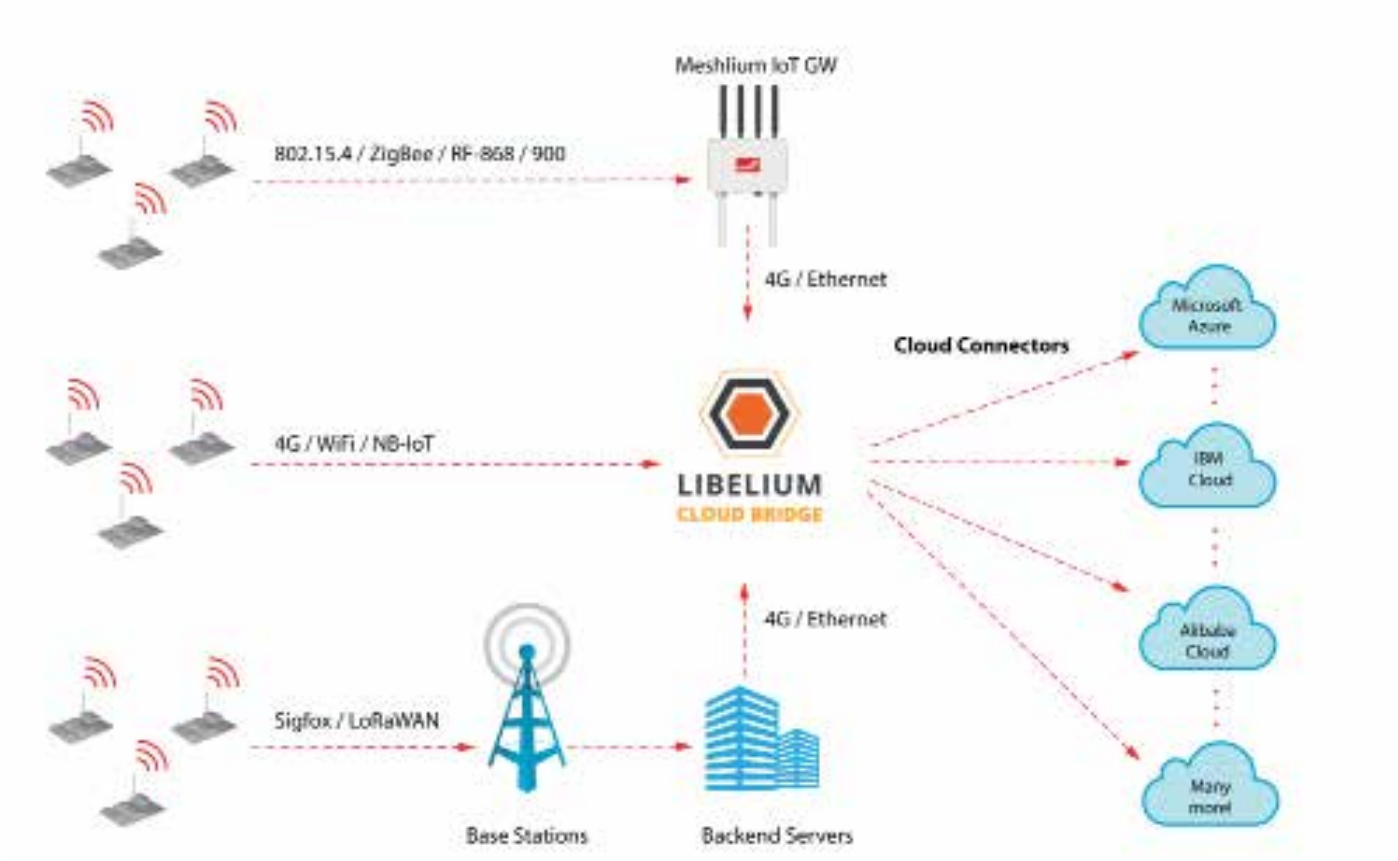



*Figure: The Bridge*

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

# 14. 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