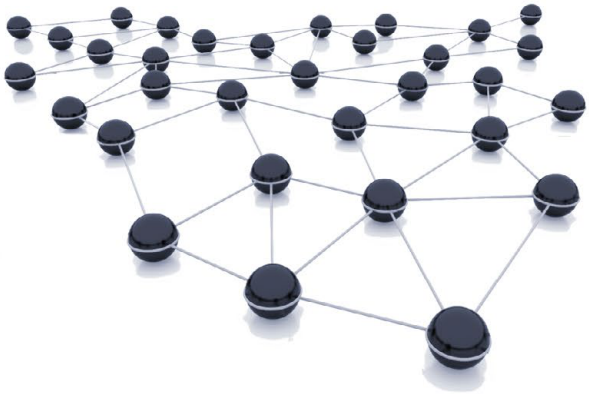
Waspmote Plug & Sense!

Quick Overview



libelium

wasp mote
Plug & Sense!

Waspmote Plug & Sense!

The new Waspmote Plug & Sense! line allows you to easily deploy wireless sensor networks in a easy and scalable way ensuring minimum maintenance costs. The new 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.*

Features

- Robust waterproof IP65 enclosure
- Add or change a sensor probe in seconds
- Solar powered with internal and external panel options
- Radios available: ZigBee, 802.15.4, WiFi, 868MHz, 900MHz, LoRaWAN, LoRa, Sigfox, 3G/GPRS and Bluetooth Low Energy.
- Over the air programming (OTAP) of multiple nodes at once
- Special holders and brackets ready for installation in street lights and building fronts
- Graphical and intuitive programming interface
- External, contactless reset with magnet
- External SIM socket for GPRS or 3G models

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!

Solar Powered

Battery can be recharged using the internal or external solar panel options.
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

For the internal option, the solar panel is embedded on the front of the enclosure, perfect for use where space is a major challenge.

Figure : Internal solar panel

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

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 is also possible once the node has been installed. With this technique you can reprogram wirelessly one or more Waspmote sensor nodes at the same time by using a laptop and the Waspmote Gateway.

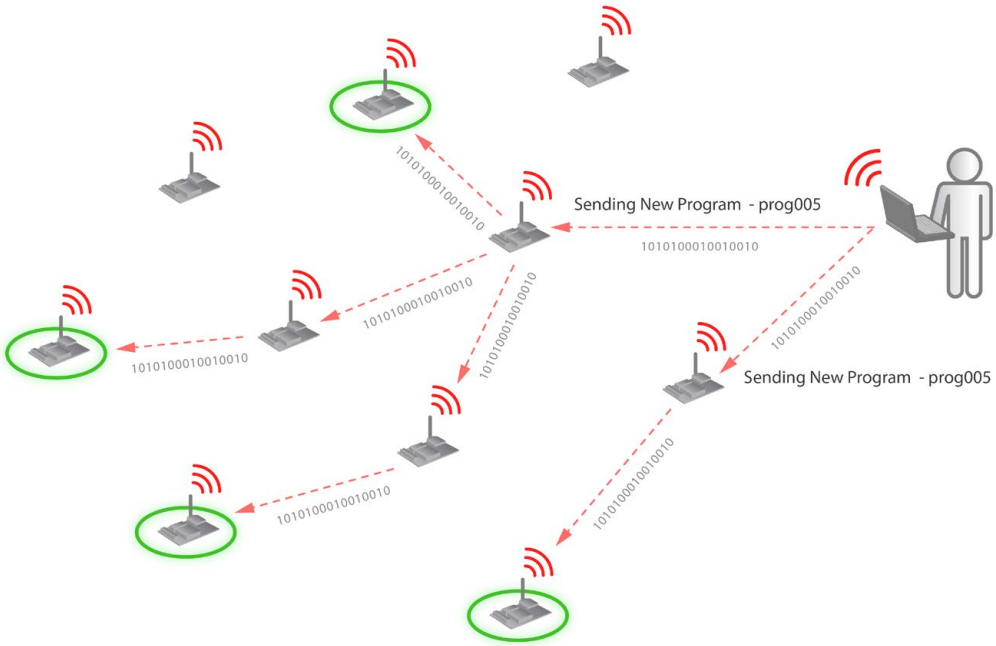


Figure : Typical OTAP process

Radio Interfaces

Model	Protocol	Frequency	txPower	Sensitivity	Range *
XBee-802.15.4-Pro	802.15.4	2.4GHz	100mW	-100dBm	7000m
XBee-ZB-Pro	ZigBee-Pro	2.4GHz	50mW	-102dBm	7000m
XBee-868	RF	868MHz	315mW	-112dBm	12km
XBee-900	RF	900MHz	50mW	-100dBm	10Km
LoRaWAN	LoRaWAN	868, 900 and 433 MHz bands	up to 18.5 dBm	-136dBm	- km - Typical base station range
LoRa	RF	868 and 900 MHz	14 dBm	-137dBm	21+Km
Sigfox	Sigfox	868MHz	14 dBm	-126dBm	- km - Typical base station range
WiFi	802.11b/g	2.4GHz	0dBm - 12dBm	-83dBm	50m-500m
GPRS Pro and GPRS+GPS	-	850MHz/900MHz/ 1800MHz/1900MHz	2W(Class4) 850MHz/900MHz, 1W(Class1) 1800MHz/1900MHz	-109dBm	- Km - Typical carrier range
3G/GPRS	-	Europe version: Dual-band UMTS, tri-band GSM/GPRS/EDGE America/Australia version: Dual-Band: UMTS, quad-Band GSM/ GPRS/EDGE	UMTS 0.25 W, GSM 2 W, DCS/ PCS 1 W	-106dBm	- Km - Typical carrier range
Bluetooth Low Energy	Bluetooth v.4.0 / Bluetooth Smart	2.4GHz	3dBm	-103dBm	100m

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

Program in minutes

In order to program the nodes an intuitive graphic interface has been developed. Developers just need to fill a web form in order to obtain the complete source code for the sensor nodes. This means the complete program for an specific application can be generated just in minutes. Check the Code Generator to see how easy it is at:

http://www.libelium.com/development/plug_&_sense/sdk_and_applications/code_generator

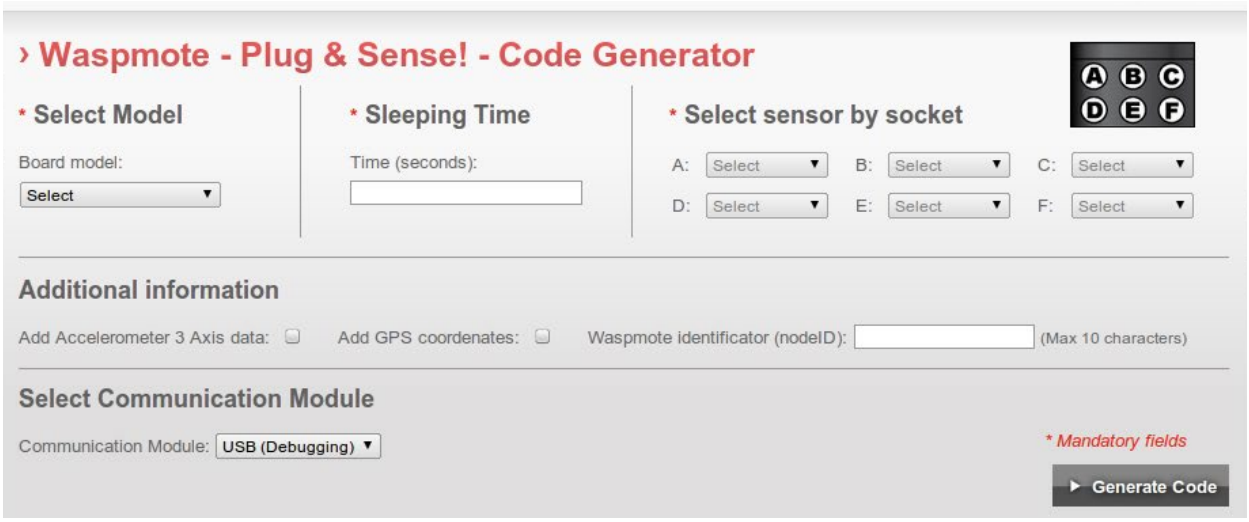


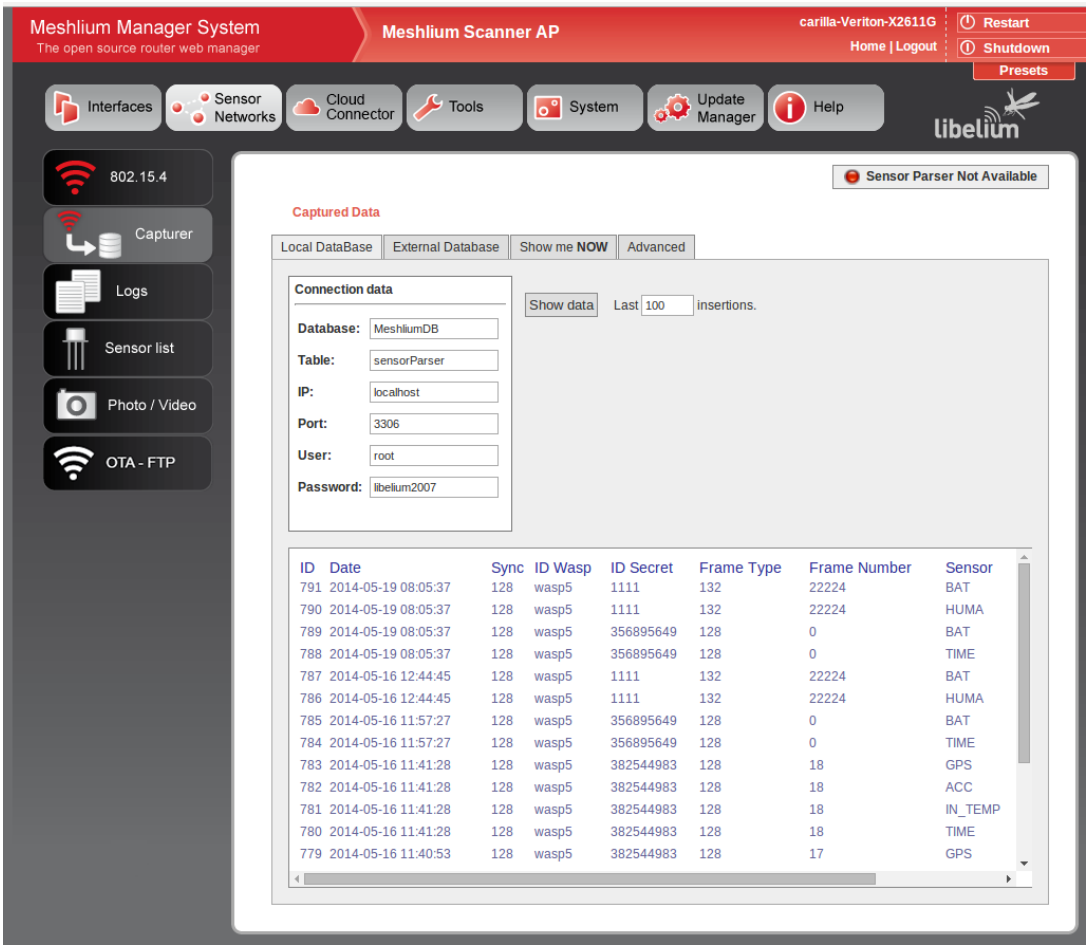
Figure: Code Generator

Data to the Cloud

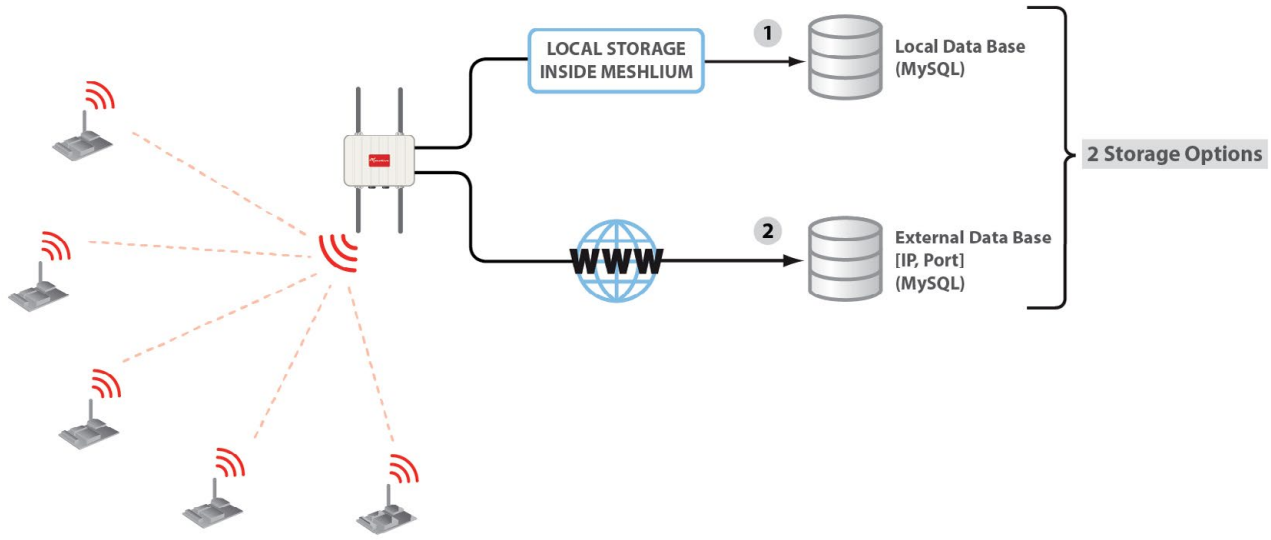
The Sensor data gathered by the Waspmote Plug & Sense! nodes is sent to the Cloud by Meshlium, the Gateway router specially designed to connect Waspmote sensor networks to the Internet via Ethernet, WiFi and 3G interfaces.

Figure: Meshlium

Now it is much easier to receive frames Waspmote to Meshlium in an automatic way. Inside the “Sensor Network” section, the user can use the new feature Sensor Parser.

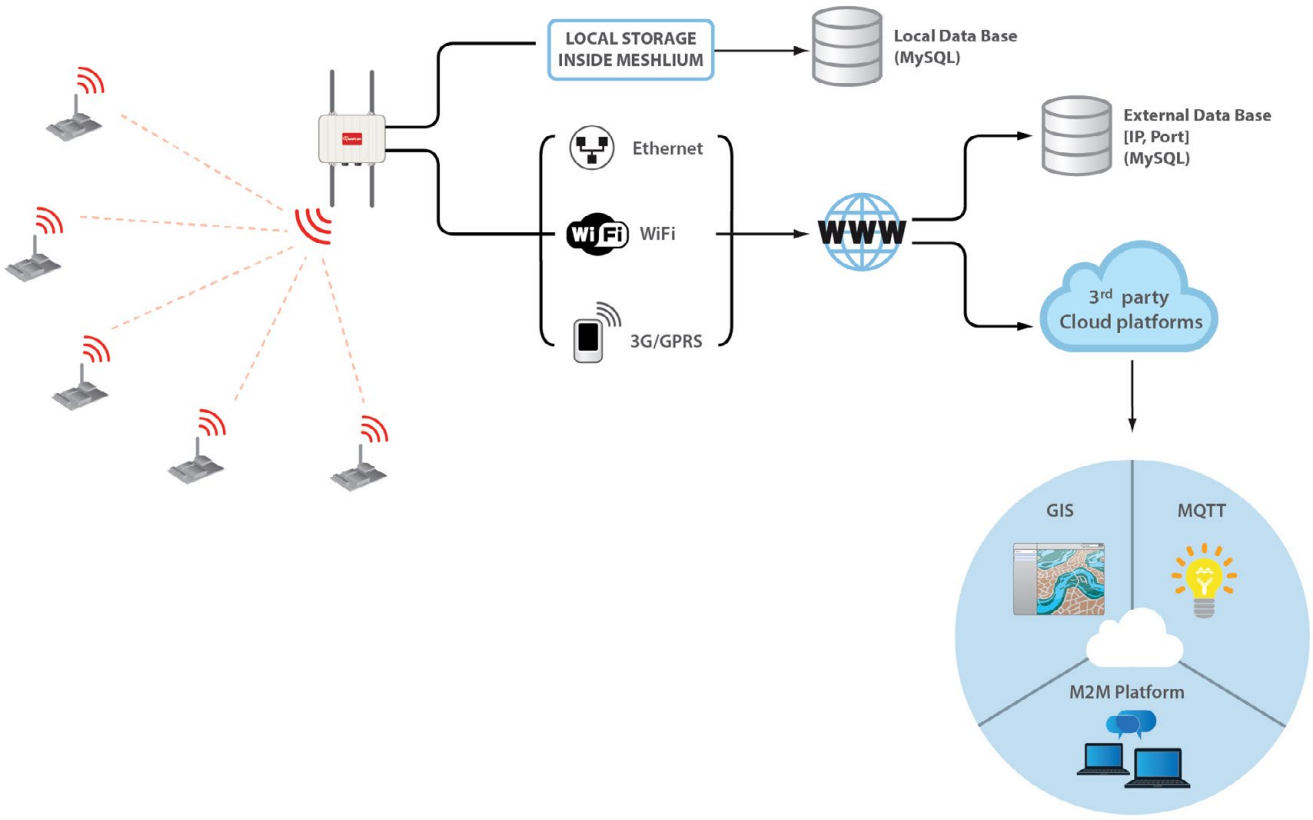


Meshlium Storage Options:



- Local Data Base
- External Data Base

Meshlium Connection Options:



- XBee / LoRa / GPRS / 3G / WiFi → Ethernet
- XBee / LoRa / GPRS / 3G / WiFi → WiFi
- XBee / LoRa / GPRS / 3G / WiFi → 3G/GPRS

Models

There are some defined configurations of Waspmote Plug & Sense! depending on which sensors are going to be used. Waspmote Plug & Sense! configurations allows connecting 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 to connect 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 connected probes in the right socket, otherwise they can be damaged.

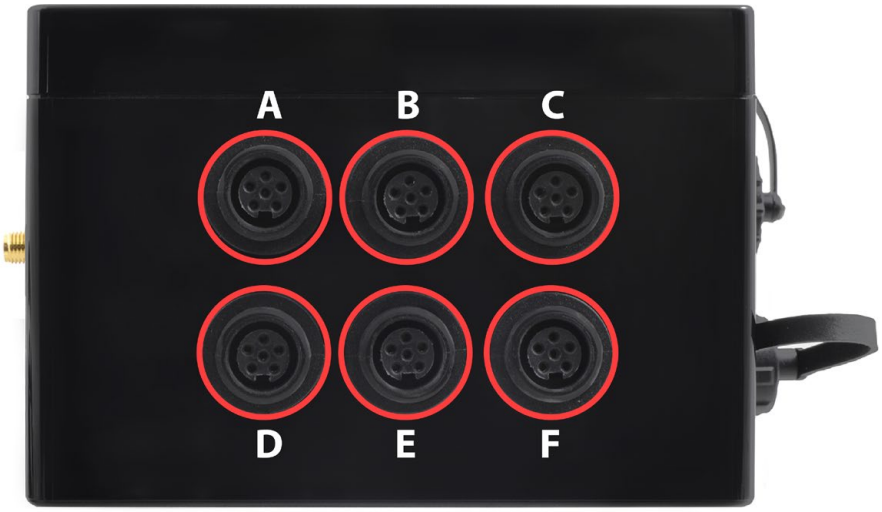


Figure: Identification of sensor sockets

Smart Environment

Smart Environment model is designed to monitor environmental parameters such as temperature, humidity, atmospheric pressure and some types of gases. The main applications for this Waspmote Plug & Sense! configuration are city pollution measurement, emissions from farms and hatcheries, control of chemical and industrial processes, forest fires, etc. Go to the application section in the Libelium website for a complete list of services.

Figure: Smart Environment 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	Temperature	9203
	Carbon monoxide - CO	9229
	Methane - CH_4	9232
	Ammonia – NH_3	9233
	Liquefied Petroleum Gases: H_2, CH_4, ethanol, isobutene	9234
	Air pollutants 1: C_4H_{10}, CH_3CH_2OH, H_2, CO, CH_4	9235
	Air pollutants 2: $C_6H_5CH_3$, H_2S, CH_3CH_2OH, NH_3, H_2	9236
	Alcohol derivates: CH_3CH_2OH, H_2, C_4H_{10}, CO, CH_4	9237
B	Humidity	9204
	Atmospheric pressure	9250
C	Carbon dioxide - CO_2	9230
D	Nitrogen dioxide - NO_2	9238 , 9238 -B
E	Ozone - O_3	9258 , 9258 -B
	Hydrocarbons - VOC	9201 , 9201-B
	Oxygen - O_2	9231
F	Carbon monoxide - CO	9229
	Methane - CH_4	9232
	Ammonia – NH_3	9233
	Liquefied Petroleum Gases: H_2, CH_4, ethanol, isobutene	9234
	Air pollutants 1: C_4H_{10}, CH_3CH_2OH, H_2, CO, CH_4	9235
	Air pollutants 2: $C_6H_5CH_3$, H_2S, CH_3CH_2OH, NH_3, H_2	9236
	Alcohol derivates: CH_3CH_2OH, H_2, C_4H_{10}, CO, CH_4	9237

Figure: Sensor sockets configuration for Smart Environment model

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

Smart Environment PRO

The Smart Environment PRO model has been created as an evolution of Smart Enviroment. 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 and F	Carbon Monoxide (CO) [Calibrated]	9371-P
	Carbon Dioxide (CO_2) [Calibrated]	9372-P
	Oxygen (O_2) [Calibrated]	9373-P
	Ozone (O_3) [Calibrated]	9374-P
	Nitric Oxide (NO) [Calibrated]	9375-P
	Nitric Dioxide (NO_2) [Calibrated]	9376-P
	Sulfur Dioxide (SO_2) [Calibrated]	9377-P
	Ammonia (NH_3) [Calibrated]	9378-P
	Methane (CH_4) and Combustible Gas [Calibrated]	9379-P
	Hydrogen (H_2) [Calibrated]	9380-P
	Hydrogen Sulfide (H_2S) [Calibrated]	9381-P
	Hydrogen Chloride (HCl) [Calibrated]	9382-P
	Phosphine (PH_3) [Calibrated]	9384-P
	Ethylene (ETO) [Calibrated]	9385-P
	Chlorine (Cl_2) [Calibrated]	9386-P
D	Particle Matter (PM1 / PM2.5 / PM10) - Dust	9387-P
E	Temperature, Humidity and Pressure	9370-P

Figure: Sensor sockets configuration for Smart Environment PRO model

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

Smart Security

The main applications for this Waspmote Plug & Sense! configuration are perimeter access control, liquid presence detection and doors and windows openings.

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	Temperature + Humidity (Sensirion)	9247
B	Liquid flow	9296, 9297, 9298
C	Presence - PIR	9212
D	Luminosity (LDR)	9205
	Liquid level	9239, 9240, 9242
	Liquid presence	9243, 9295
	Hall effect	9207
E	Luminosity (LDR)	9205
	Liquid level	9239, 9240, 9242
	Liquid presence	9243
	Hall effect	9207
F	Luminosity (LDR)	9205
	Liquid level	9239, 9240, 9242
	Liquid presence	9243
	Hall effect	9207

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 in Libelium website.*

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 6 parameters, including the most relevant for water control such as dissolved oxygen, oxidation-reduction potential, pH, conductivity and temperature. An extremely accurate turbidity sensor has been integrated as well.

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**
B	pH	9328
	Oxidation-Reduction Potential (ORP)	9329
C	pH	9328
	Oxidation-Reduction Potential (ORP)	9329
D	Soil/Water Temperature	9255 (included by default)
E	Dissolved Oxygen (DO)	9327
F	Conductivity	9326
	Turbidity	9353

Figure: Sensor sockets configuration for Smart Water model

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

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 turbidity, 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	Calcium Ion (Ca^{2+})	9352
	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 (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 in 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 (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 in 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 (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 in Libelium website.*

Smart Cities

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, structural health, smart lighting, etc. Refer to Libelium website for more information.

Figure: Smart Cities 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	Temperature	9203
	Soil temperature	86949*
	Ultrasound (distance measurement)	9246
B	Humidity	9204
	Ultrasound (distance measurement)	9246
C	Luminosity (LDR)	9205
D	Noise sensor (dBA)	9259
F	Linear displacement	9319

Figure: Sensor sockets configuration for Smart Cities model

* Ask Libelium Sales Department for more information.

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

Figure: Configurations of the ultrasound sensor probe

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

Smart Parking

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

The node benefits from Sigfox and LoRaWAN technologies (868 and 900 MHz bands), 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: Plug & Sense! Smart Parking node

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

Smart Agriculture

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 (Sensirion), 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.

Two variants are possible for this model, normal and PRO. Next section describes each configuration in detail.

Figure: Smart Agriculture Waspmote Plug & Sense! model

Normal

Sensor sockets are configured as shown in the figure below.

Sensor Socket	Sensor probes allowed for each sensor socket	
	Parameter	**Reference**
A	Humidity + Temperature (Sensirion)	9247
B	Atmospheric pressure	9250
C	Soil temperature	86949*
	Soil moisture	9248
D	Weather Station WS-3000 (anemometer + wind vane + pluviometer)	9256
E	Soil moisture	9248
F	Leaf wetness	9249
	Soil moisture	9248

Figure: Sensor sockets configuration for Smart Agriculture model

* Ask Libelium Sales Department for more information.

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

PRO

Sensor sockets are configured as shown in the figure below.

Sensor Socket	Sensor probes allowed for each sensor socket	
	Parameter	**Reference**
A	Humidity + Temperature (Sensirion)	9247
B	Soil temperature	9255
C	Solar radiation	9251, 9257
D	Soil temperature	86949*
	Soil moisture	9248
E	Dendrometers	9252, 9253, 9254
	Soil moisture	9248
F	Lear wetness	9249
	Soil moisture	9248

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 in Libelium website.*

Ambient Control

This model is designed to monitor main environment parameters in an easy way. 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	Humidity + Temperature (Sensirion)	9247
B	Luminosity (LDR)	9205
C	Luminosity (Luxes accuracy)	9325
D	Not used	-
E	Not used	-
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 in Libelium website.*

Radiation Control

The main application for this Waspmote Plug & Sense! configuration is to measure radiation levels using a Geiger sensor. For this model, the Geiger tube is already included inside Waspmote, so the user does not have to connect any sensor probe to the enclosure. The rest of the other sensor sockets are not used.

Figure: Radiation Control Waspmote Plug & Sense! model

Sensor sockets are not used for this model.

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

Certifications

- CE (Europe)
- FCC (USA)
- IC (Canada)

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