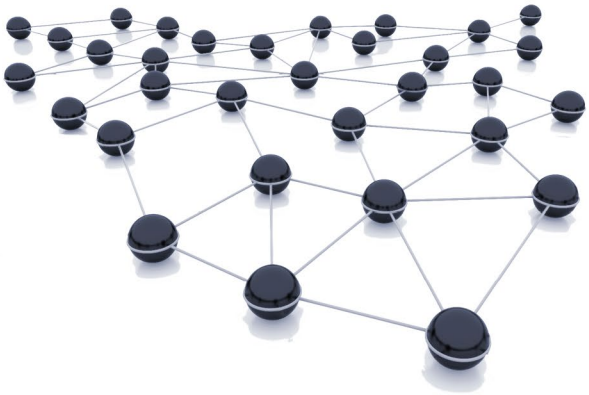
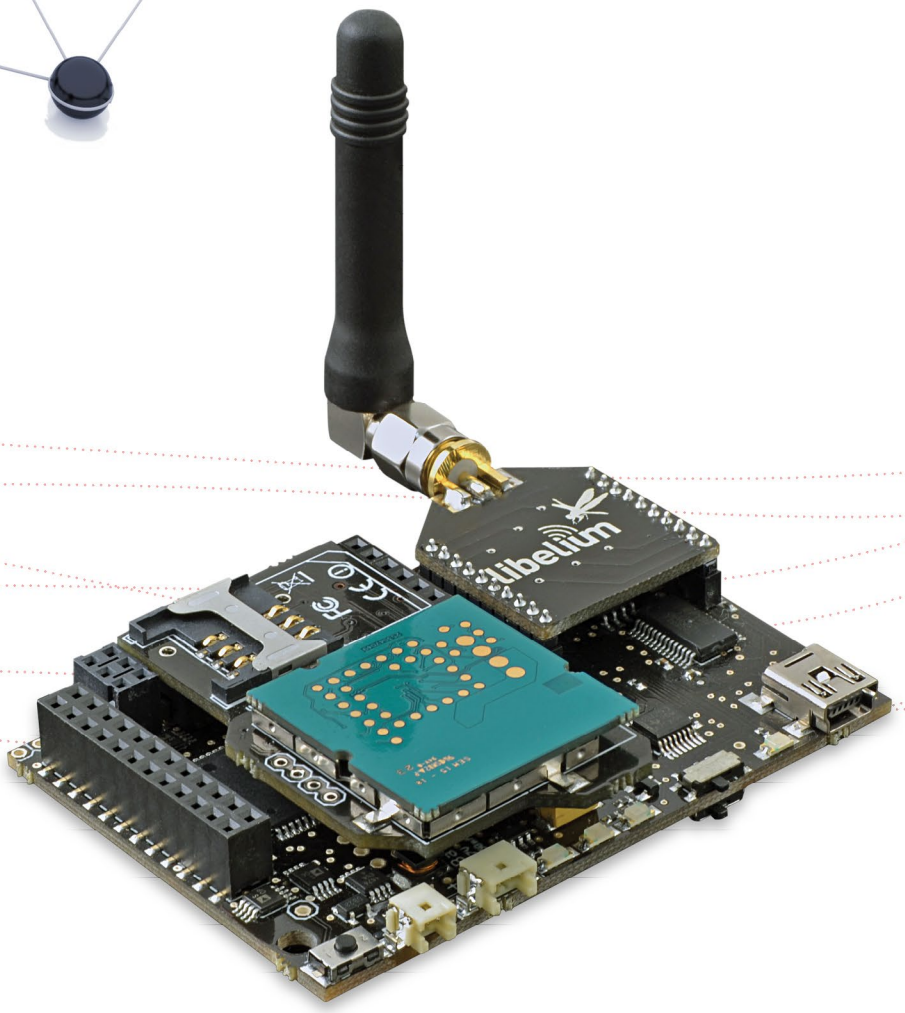
# Waspmote

## Datasheet

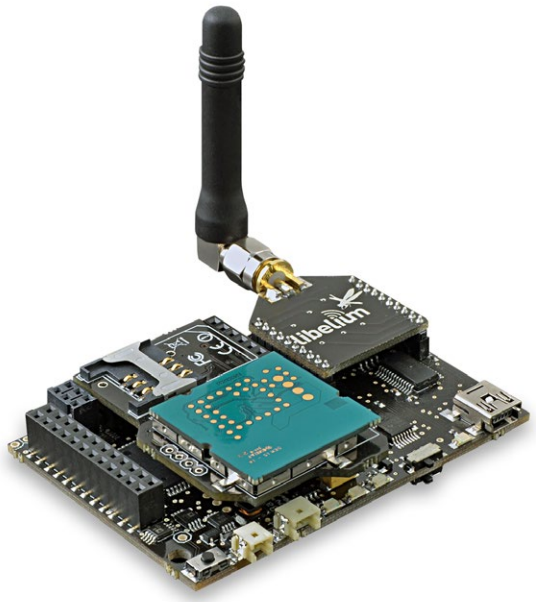





libelium

wasp mote

# Waspmote



## General data:

| | |
|---|---|
| **Microcontroller:** | ATmega1281 |
| **Frequency:** | 14.7456 MHz |
| **SRAM:** | 8KB |
| **EEPROM:** | 4KB |
| **FLASH:** | 128KB |
| **SD Card:** | 2GB |
| **Weight:** | 20gr |
| **Dimensions:** | 73.5 x 51 x 13 mm |
| **Temperature Range:** | [-10ºC, +65ºC] |
| **Clock:** | RTC (32KHz) |

## Consumption:

| | |
|---|---|
| **ON:** | 15mA |
| **Sleep:** | 55µA |
| **Deep Sleep:** | 55µA |
| **Hibernate:** | 0.07µA |

**Operation without recharging:** 1 year *

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

## Inputs/Outputs:

7 Analog (I), 8 Digital (I/O), 1 PWM,
2 UART, 1 I2C, 1USB, 1SPI

## Electrical data:

| | |
|---|---|
| **Battery voltage:** | 3.3 V - 4.2V |
| **USB charging:** | 5 V - 100mA |
| **Solar panel charging:** | 6 - 12 V - 280mA |

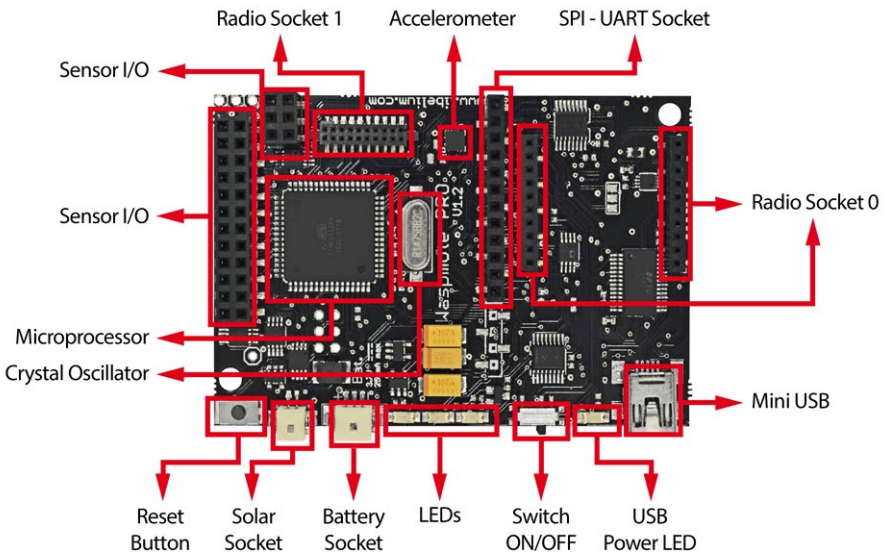



*Figure: Waspmote Board Top*

## Built-in sensors on the board:

**Temperature** (+/-): -40ºC , +85ºC. Accuracy: 0.25ºC
**Accelerometer:** ±2g/±4g/±8g
Low power: 0.5 Hz/1 Hz/2 Hz/5 Hz/10 Hz
Normal mode: 50 Hz/100 Hz/400 Hz/1000 Hz

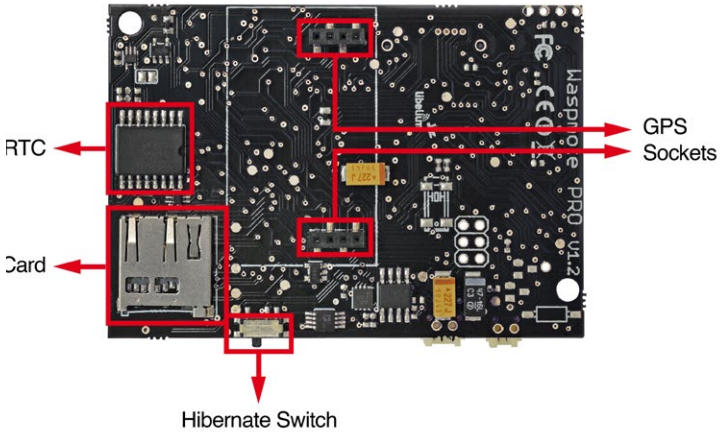



*Figure: Waspmote Board Bottom*

# 802.15.4/ZigBee

| 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 |

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

*Figure: XBee*

**Antennas:** 2.4GHz: 2dBi / 5dBi
868/900MHz: 0dBi / 4.5dBi
**Connector:** RPSMA
**Encryption:** AES 128b
**Control Signal:** RSSI
**Standards:** XBee-802.15.4 - 802.15.4 Compliant / XBee-ZB - ZigBee-Pro v2007 Compliant
**Topologies:** star, tree, mesh

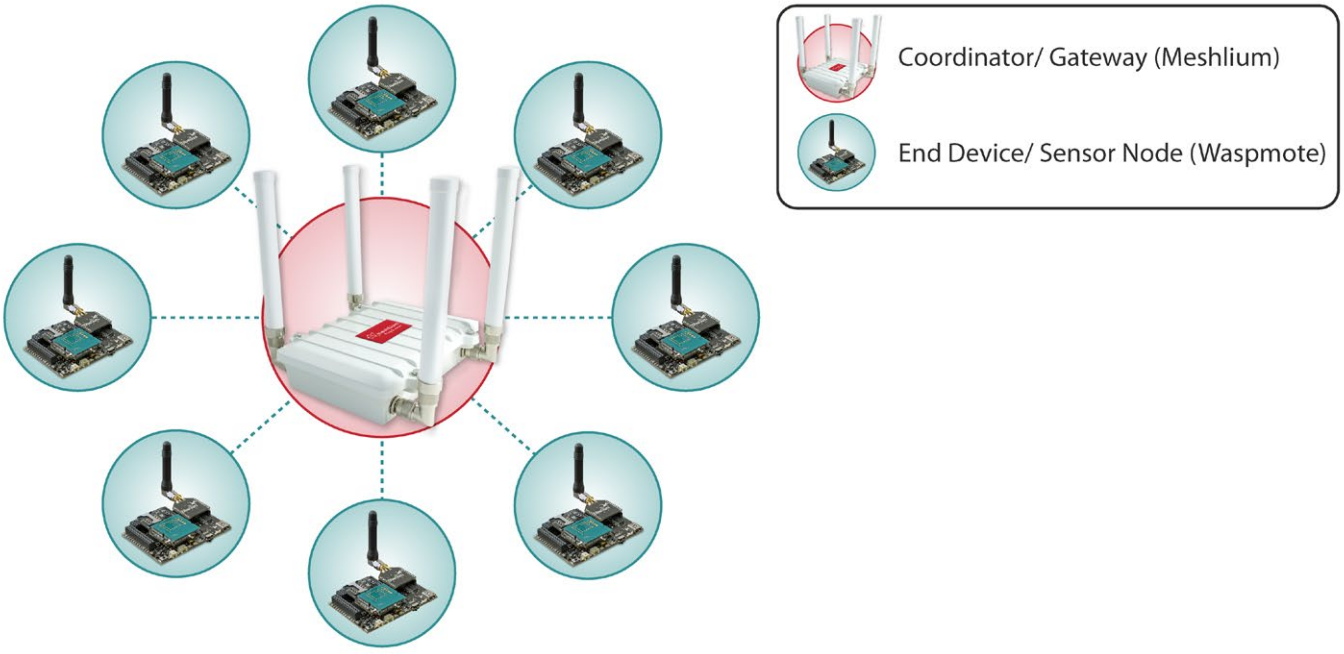



*Figure: Star*

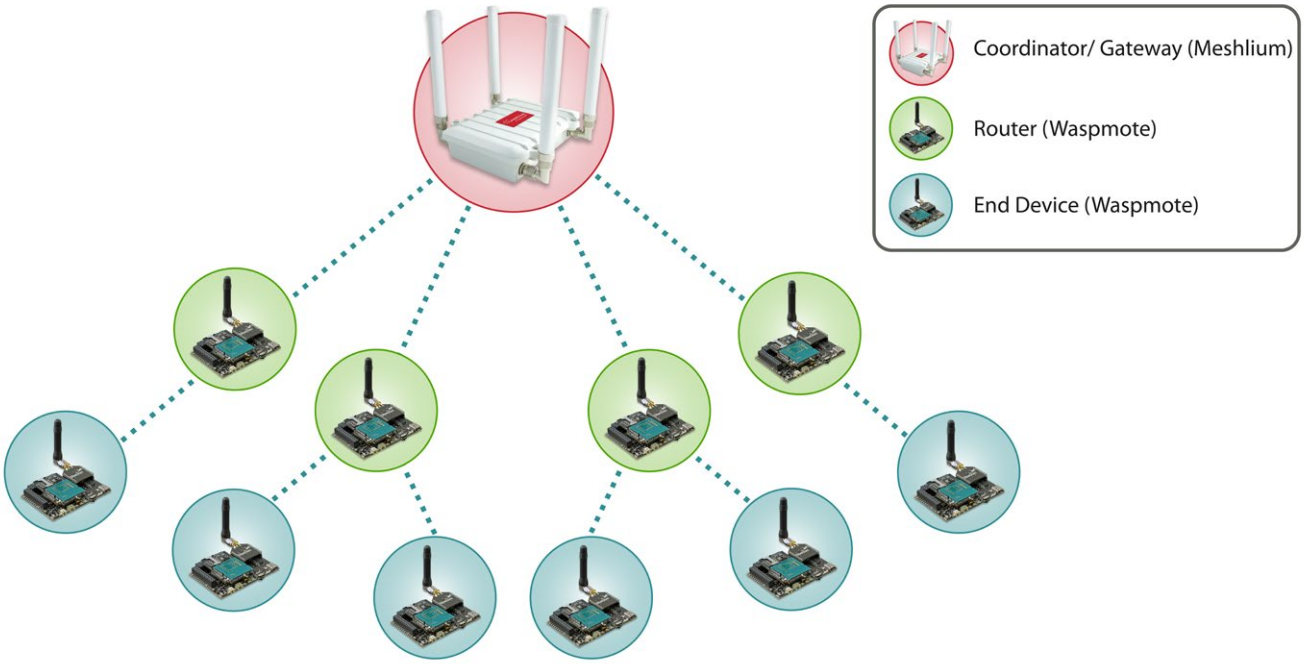



*Figure: Tree*

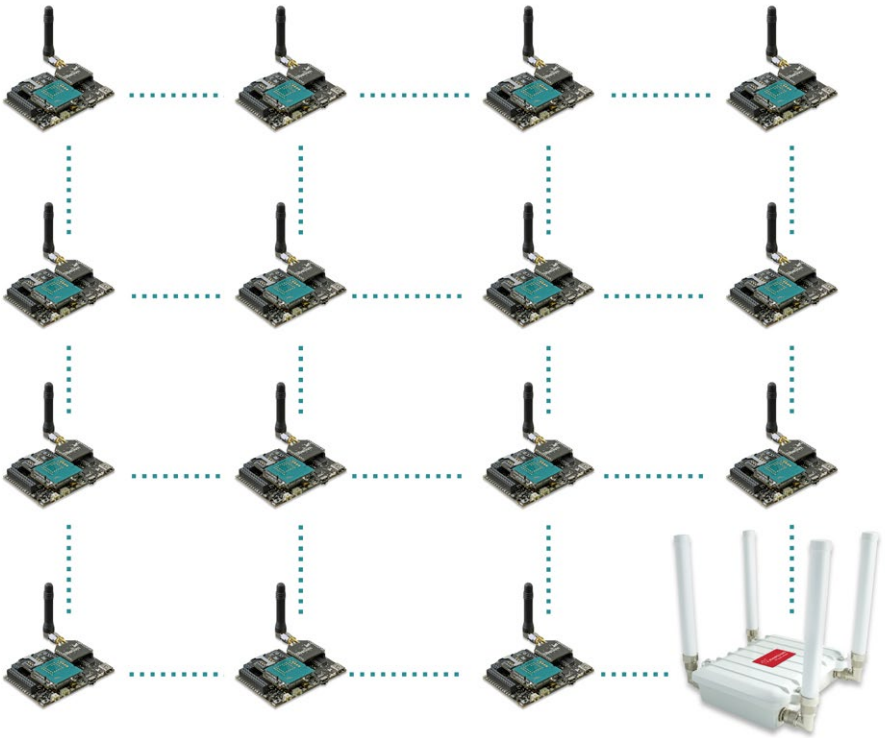


*Figure: Mesh*

# LoRaWAN module

**Protocol:** LoRaWAN 1.0, Class A
**LoRaWAN-ready**
**Frequency:** 868 MHz and 433 MHz ISM frequency bands. 900-915 MHz ISM band coming in 2016.
**TX Power:** up to +14 dBm
**Sensitivity:** as good as -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:** 38.9 mA
**Radio Data Rate:** from 250 to 5470 bps
**Receiver:** purchase your own base station or use networks from LoRaWAN operators


*Figure: LoRaWAN module*

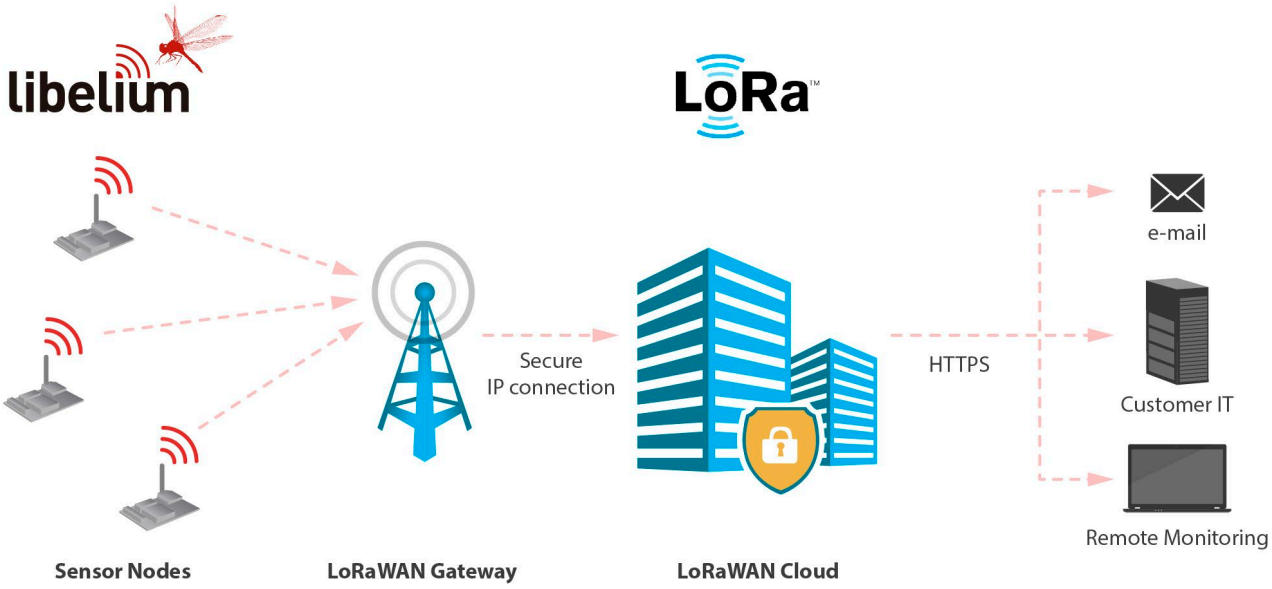



*Figure: LoRaWAN network*

# Sigfox module

**Frequency:** ISM 868 MHz

**TX Power:** 14 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:** TX: 49 mA @ +14 dBm

**Radio Data Rate:** 100 bps

**Receive sensitivity:** -126 dBm

**Sigfox certificate:** Class 0u (the highest level)

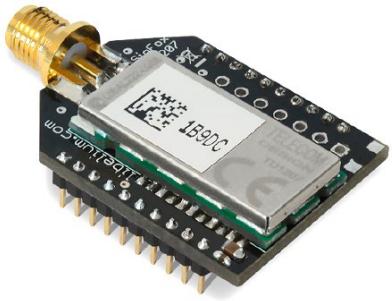


*Figure: Sigfox module*


*Figure: Sigfox network*

# LoRa module

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

**Model:** Semtech SX1272

**Frequencies available:** 860-1000 MHz, fits both 868 (Europe) and 915 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 128/192/256b (performed by Waspmote API)

**Control Signal:** RSSI

**Topology**: Star

**Receiver/Central node:** Meshlium LoRa, special Gateway LoRa (SPI) or another Waspmote or Plug & Sense! unit

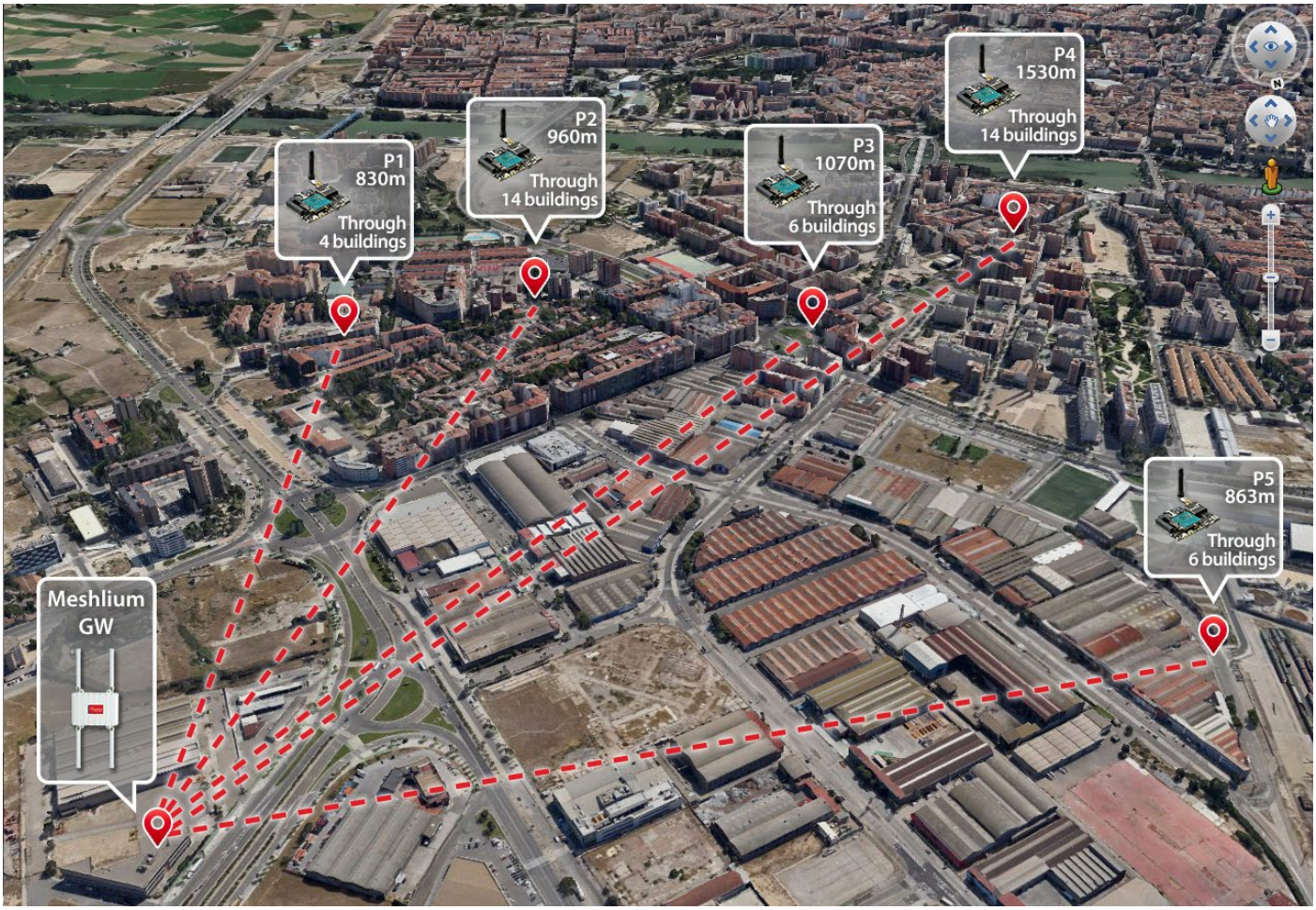



*Figure: Star topology*

# Over the Air Programming (OTA)

There are two different OTA methodologies:

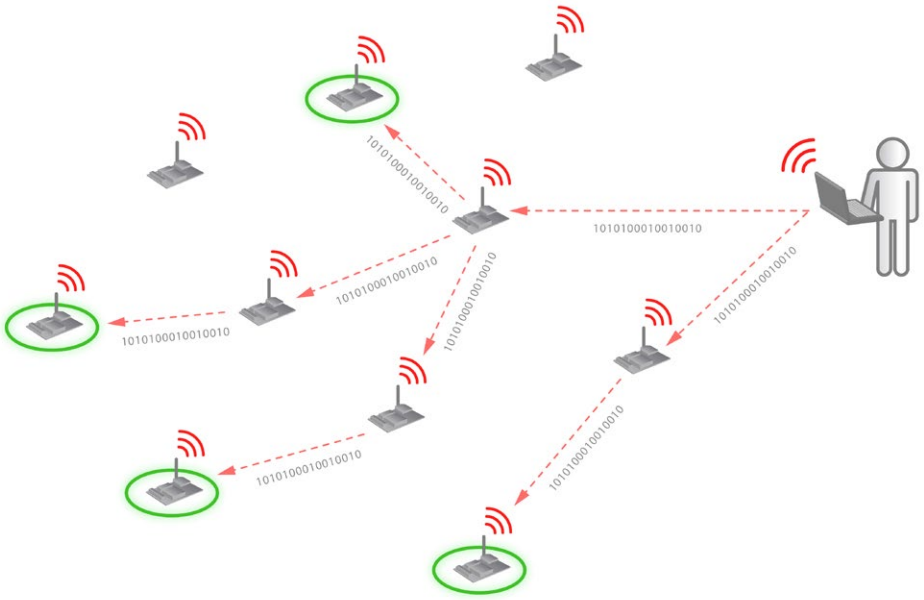
- OTA with 802.15.4/ZigBee modules
- OTA with 3G/GPRS/WiFi modules via FTP

**OTA with 802.15.4/ZigBee modules**

**Benefits:**

- Enables the upgrade or change of firmware versions without physical access
- Discover nodes in the area just sending a broadcast discovery query
- Upload new firmware in few minutes
- No interferences: OTA is performed using a change of channel between the programmer and the desired node so no interferences are generated to the rest of the nodes

Over The Air Programming with 802.15.4 / ZigBee




**Topologies:**

- Direct access: when the nodes are accessed in just one hop (no forwarding of the packets is needed).
- Multihop: when the nodes are accessed in two or more hops. In this mode some nodes have to forward the packets sent by the Gateway in order to reach the destination.

**Modes:**

- Unicast: Reprogram an specific node
- Multicast: Reprogram several nodes at the same time sending the program just once
- Broadcast: Reprogram the entire network sending the program just once

**OTA with 3G/GPRS/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.

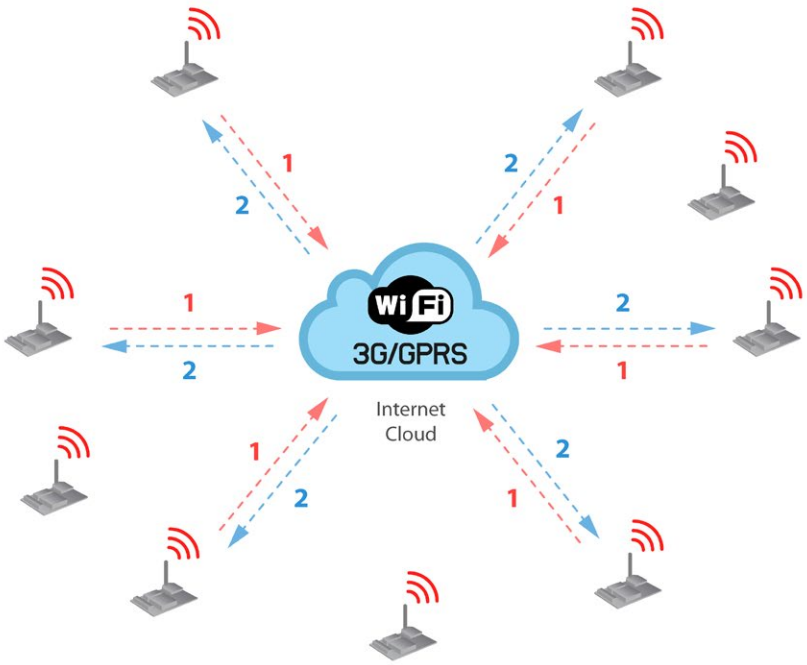



*Figure: OTA with GPRS/3G/WiFi fundamentals*

# 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.

# Transmission of sensor data:

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.

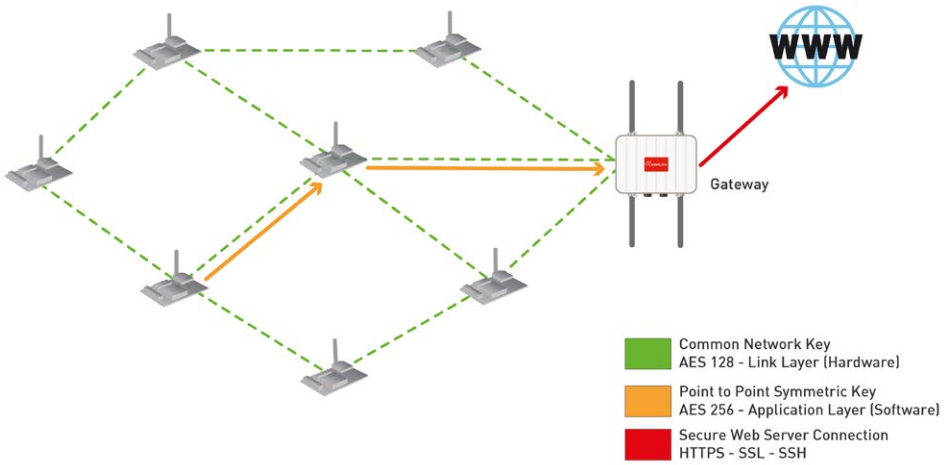



*Figure: Communication diagram*

# WiFi

**Protocols:** 802.11b/g - 2.4GHz
**TX Power:** 0dBm - 12dBm (variable by software)
**RX Sensitivity:** -83dBm
**Antenna connector:** RPSMA
**Antenna:** 2dBi/5dBi antenna options
**Security:** WEP, WPA, WPA2
**Topologies:** AP
**802.11 roaming capabilities**

**Actions:**

- TCP/IP - UDP/IP socket connections
- HTTP web connections
- FTP file transfers
- Direct connections with iPhone and Android
- Connects with any standard WiFi router
- DHCP for automatic IP assignation
- DNS resolution enabled

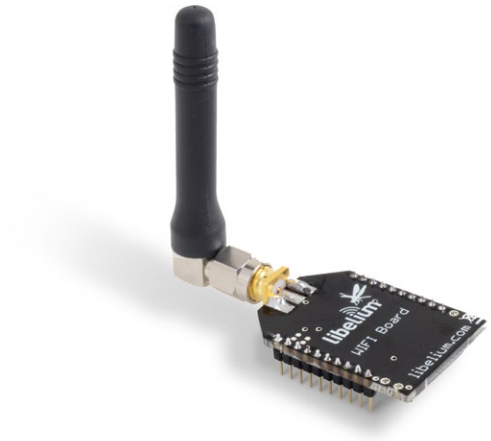



*Figure: WiFi Module*

# GSM/GPRS

**Model:** SIM900 (SIMCom)
**Quadband:** 850MHz/900MHz/1800MHz/1900MHz
**TX Power:** 2W(Class 4) 850MHz/900MHz, 1W(Class 1) 1800MHz/1900MHz
**Sensitivity:** -109dBm
**Antenna connector:** UFL
**External Antenna:** 0dBi
**Consumption in sleep mode:** 1mA
**Consumption in power off mode:** 0mA


*Figure: GSM/GPRS*

**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)

# GPRS + GPS


*Figure: GPRS+GPS*

**Model:** SIM928 (SIMCom)

**GPRS features:**
**Quadband:** 850MHz/900MHz/1800MHz/1900MHz
**TX Power:** 2W (Class 4) 850MHz/900MHz, 1W (Class 1) 1800MHz/1900MHz
**Sensitivity:** -109dBm
**Antenna connector:** UFL
**External Antenna:** 0dBi
**Consumption in sleep mode:** 1mA
**Consumption in power off mode:** 0mA

**GPS features:**

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

- Tracking: -160 dBm
- Adquisition: -147 dBm

**Accuracy horizontal position :** <2.5m CEP
**Power consumption (GSM engine in idle mode):**

- Acquisition : 72mA
- Tracking : 67mA

**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 + GPS module

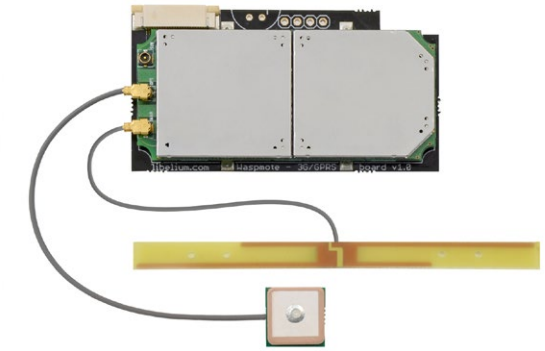


*Figure: 3G/GPRS board*

**Model:** SIM5218E (SIMCom)
Tri-Band UMTS 2100/1900/900MHz
Quad-Band GSM/EDGE, 850/900/1800/1900 MHz
HSDPA up to 7.2Mbps
HSUPA up to 5.76Mbps
**TX Power:**

- UMTS 900/1900/2100 0,25W
- GSM 850MHz/900MHz 2W
- DCS1800MHz/PCS1900MHz 1W

**Sensitivity:** -106dBm
**Antenna connector:** UFL
**External Antenna:** 0dBi
**Consumption in sleep mode (RF circuits power off previously):** 1mA

**Actions:**

- WCDMA and HSPA 3G networks compatibility
- 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 32GB
- 64MB of internal storage space
- Making/Receiving calls
- Making 'x' tone missed calls
- MS-assisted (A-GPS), MS-based (S-GPS) or Stand-alone GPS positioning
- 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)

# Bluetooth low energy module

**Protocol:** Bluetooth v.4.0 / Bluetooth Smart
**Chipset:** BLE112
**RX Sensitivity:** -103dBm
**TX Power:** [-23dBm, +3dBm]
**Antenna:** 2dBi/5dBi antenna options
**Security:** AES-128
**Range:** 100 meters (at maximum TX power)

*Figure: Bluetooth Low Energy module*

**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

# Bluetooth module for device discovery

**Protocol:** Bluetooth 2.1 + EDR. Class 2
**TX Power:** 3dBm
**Antenna:** 2dBi
**Max Scan:** Up to 250 unique devices in each inquiry
**Power levels:** 7 [-27dBm, +3dBm]

*Figure: Bluetooth module for device discovery*

**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

# RFID/NFC

## 13.56MHz

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

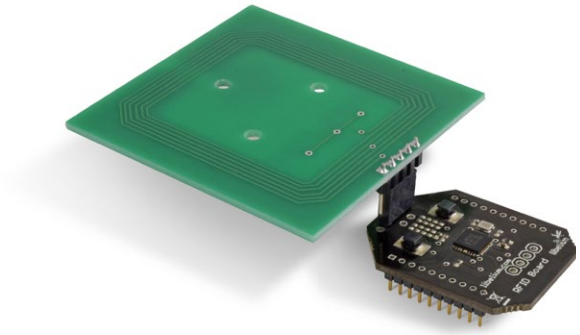


*Figure: 13.56MHz RFID/NFC module*

**Applications:**

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

## 125KHz

- **Compatibility:** Reader/writer mode supporting ISO cards - T5557 / EM4102
- **Distance:** 5cm
- **Max capacity:** 20B
- **Tags available:** cards, keyrings

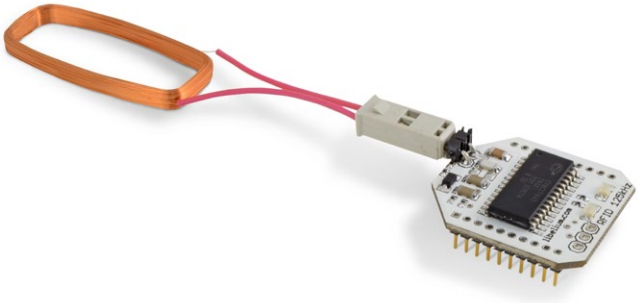


*Figure: 125KHz RFID module*

**Applications:**

- Located based services (LBS)
- Logistics (assets tracking, supply chain)
- Product management
- Animal farming identification

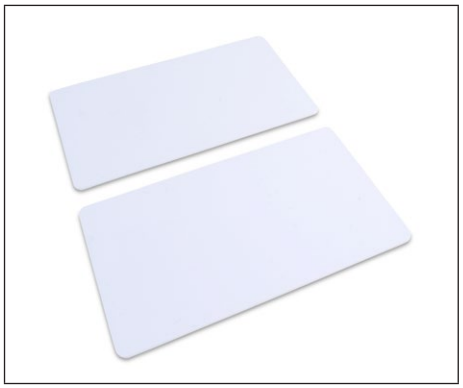


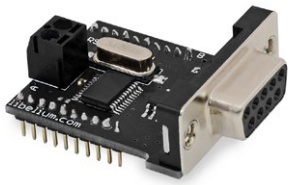
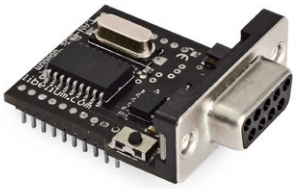
*Figure: RFID cards*

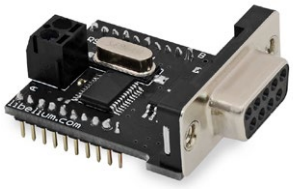
*Figure: RFID keyrings*

*Figure: RFID sticker*

# 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 | • Industrial Equipment<br>• Machine to Machine (M2M) communications<br>• Industrial Control Systems, including the most common versions of Modbus and Profibus<br>• Programmable Logic Controllers<br>• RS-485 is also used in building automation<br>• Interconnect security control panels and devices |  <br>*Figure: RS-485 module* |
| RS-232 Serial / Modbus module | • Dial-up modems<br>• GPS receivers (typically NMEA 0183 at 4,800 bit/s)<br>• Bar code scanners and other point of sale devices<br>• LED and LCD text displays<br>• Satellite phones, low-speed satellite modems and other satellite based transceiver devices<br>• Flat-screen (LCD and plasma) monitors to control screen functions by external computer, other AV components or remotes<br>• Test and measuring equipment such as digital multimeters and weighing systems<br>• Updating firmware on various consumer devices<br>• Some CNC controllers<br>• Uninterruptible power supply<br>• Stenography or Stenotype machines<br>• Software debuggers that run on a 2nd computer<br>• Industrial field buses |  <br>*Figure: RS-232 module* |
| CAN Bus module | • Automotive applications<br>• Home automation<br>• Industrial Networking<br>• Factory automation<br>• Marine electronics<br>• Medical equipment<br>• Military uses |  <br>*Figure: Can Bus module* |

| | | |
|---|---|---|
| Modbus software layer | • Modbus is a software layer which can be run over the RS-485 or RS-232 modules<br>• Multiple master-slave applications<br>• Sensors and instruments<br>• Industrial Networking<br>• Building and infrastructure<br>• Transportation and energy applications |  <br>*Figure: RS-485 module* |

# Expansion Radio Board

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

**Some of the possible combinations are:**

- LoRa - GPRS
- 802.15.4 - Bluetooth
- 868 MHz - RS-485
- RS-232 - WiFi
- DigiMesh - 3G/GPRS
- RS-232 - RFID/NFC
- WiFi - 3G/GPRS
- CAN bus - Bluetooth
- etc.

***Remark:*** *GPRS Pro, GPRS+GPS and 3G/GPRS modules do not need the Expansion Board to be connected to Waspmote. They can be plugged directly in the socket1.*

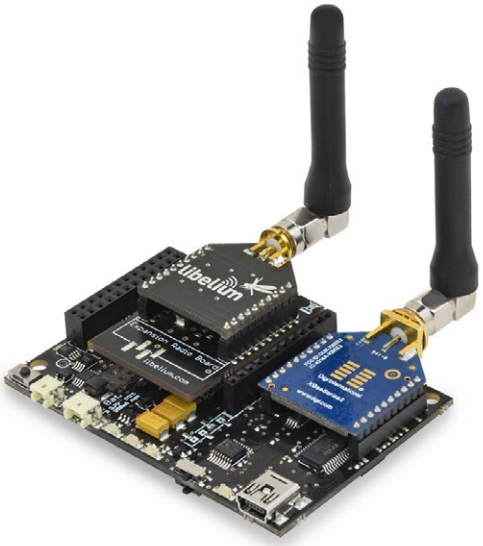


*Figure: Expansion Radio Board*

**Applications:**

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

# GPS

**Model:** JN3 (Telit)
**Sensitivity :**
- Acquisition: -147 dBm
- Navigation: -160 dBm
- Tracking: -163 dBm

**Hot Start Time:** <1s
**Cold Start Time:** <35s
**Antenna connector:** UFL
**External antenna:** 26dBi
**Possitional accuracy error** < 2.5 m
**Speed accuracy** < 0.01 m/s
**EGNOS, WAAS, GAGAN and MSAS capability**

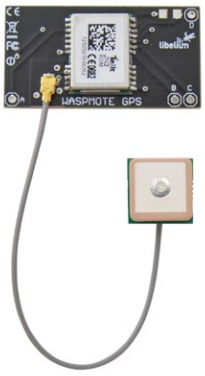



*Figure: GPS*

**Available information:** latitude, longitude, altitude, speed, direction, date/time and ephemerids management.

# Programmable interruptions

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

# Sensor Boards

| GASES | APPLICATIONS | SENSORS |
|---|---|---|

*Figure: Gases Board*

**APPLICATIONS**

- **City pollution**
  $CO$, $CO_2$, $NO_2$, $O_3$
- **Emissions from farms and hatcheries**
  $CH_4$ ,$H_2S$ , $NH_3$
- **Control of chemical and industrial processes**
  $C_4H_{10}$ ,$H_2$, VOC
- **Forest fires**
  $CO$, $CO_2$

**SENSORS**

- Carbon Monoxide – $CO$
- Carbon Dioxide – $CO_2$
- Oxygen – $O_2$
- Methane – $CH_4$
- Hydrogen – $H_2$
- Ammonia – $NH_3$
- Isobutane – $C_4H_{10}$
- Ethanol – $CH_3CH_2OH$
- Toluene – $C_6H_5CH_3$
- Hydrogen Sulfide – $H_2S$
- Nitrogen Dioxide – $NO_2$
- Ozone – $O_3$
- Hydrocarbons – VOC
- Temperature
- Humidity
- Atmospheric pressure

| GASES PRO | APPLICATIONS | SENSORS |
|---|---|---|

*Figure: Gases PRO Board*

**APPLICATIONS**

- **City pollution**
  $CO$, $NO$, $NO_2$, $O_3$, $SO_2$, Particle Matter - Dust
- **Air Quality Index calculation**
  $SO_2$, $NO_2$, Particle Matter - Dust, $CO$, $O_3$, $NH_3$
- **Emissions from farms and hatcheries**
  $CH_4$, $H_2S$, $NH_3$
- **Greenhouse management**
  $CO_2$, $CH_4$, Humidity
- **Control of chemical and industrial processes**
  $H_2$, HCl, $CH_4$, $SO_2$, $CO_2$
- **Indoor air quality**
  $CO_2$, $CO$, Particle Matter - Dust, $O_3$
- **Forest fires**
  $CO$, $CO_2$

**SENSORS**

- Carbon Monoxide – $CO$
- Carbon Dioxide – $CO_2$
- Molecular Oxygen – $O_2$
- Ozone – $O_3$
- Nitric Oxide – $NO$
- Nitric Dioxide – $NO_2$
- Sulfur Dioxide – $SO_2$
- Ammonia – $NH_3$
- Methane – $CH_4$ – and other combustible gases
- Molecular Hydrogen – $H_2$
- Hydrogen Sulfide – $H_2S$
- Hydrogen Chloride – HCl
- Hydrogen Cyanide – HCN
- Phosphine – $PH_3$
- Ethylene Oxide – ETO
- Chlorine – $Cl_2$
- Particle Matter (PM1 / PM2.5 / PM10) – Dust Sensor [only for Plug & Sense!]
- Temperature, Humidity and Pressure

## EVENTS

*Figure: Events Board*

## APPLICATIONS

- **Security**

  Hall effect (doors and windows), person detection PIR

- **Emergencies**

  Presence detection and water level sensors, temperature

- **Control of goods in logistics**

## SENSORS

- Pressure/Weight
- Hall Effect
- Temperature (+/-)
- Liquid Presence
- Liquid Flow
- Luminosity
- Presence (PIR)

## SMART WATER

*Figure: Smart Water Board*

## APPLICATIONS

- **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

## SENSORS

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

## SMART WATER IONS

*Figure: Smart Water Ions Board*

## APPLICATIONS

- **Drinking water quality control**

  Calcium ($Ca^{2+}$), Iodide ($I^-$), Chloride ($Cl^-$), Nitrate ($NO_3^-$), pH

- **Agriculture water monitoring**

  Calcium ($Ca^{2+}$), Nitrate ($NO_3^-$), pH

- **Swimming pools**

  Bromide ($Br^-$), Chloride ($Cl^-$), Fluoride ($F^-$), pH

- **Waste water treatment**

  Cupric ($Cu^{2+}$), Silver ($Ag^+$), Lead ($Pb^{2+}$), Fluoroborate ($BF_4^-$), pH

## SENSORS

- Calcium ($Ca^{2+}$)
- Fluoride ($F^-$)
- Fluoroborate ($BF_4^-$)
- Nitrate ($NO_3^-$)
- Bromide ($Br^-$)
- Chloride ($Cl^-$)
- Cupric ($Cu^{2+}$)
- Iodide ($I^-$)
- Lead ($Pb^{2+}$)
- Silver ($Ag^+$)
- pH
- Temperature

## SMART CITIES

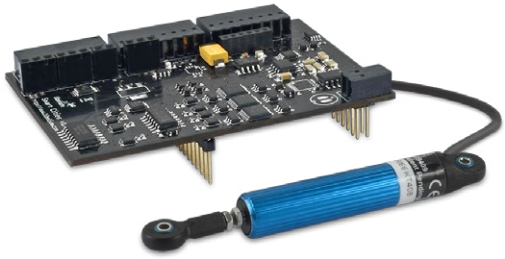


*Figure: Smart Cities Board*

## APPLICATIONS

- **Noise maps**

  Monitor in real time the acoustic levels in the streets of a city

- **Structural health monitoring**

  Crack propagation

- **Air quality**

  Detect the level of particulates and dust in the air

- **Waste management**

  Measure the garbage levels in bins to optimize the trash collection routes

## SENSORS

- Microphone (dBA)
- Crack propagation gauge
- Linear displacement
- Dust
- Ultrasound (distance measurement)
- Temperature
- Humidity
- Luminosity

## SMART PARKING

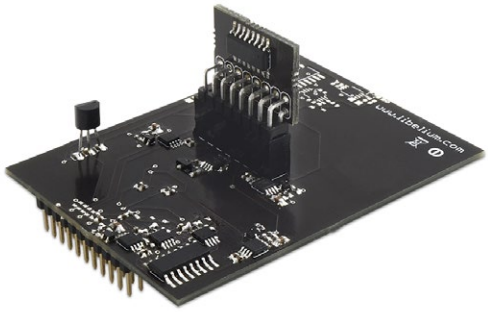


*Figure: Smart Parking Board*

## APPLICATIONS

- Car detection for available parking information
- Detection of free parking lots outdoors
- Parallel and perpendicular parking slots control

## SENSORS

- Magnetic Field
- Temperature

## AGRICULTURE

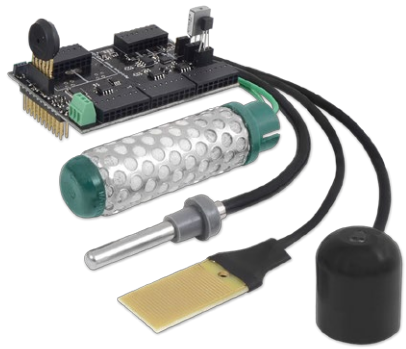


*Figure: Agriculture Board*

## APPLICATIONS

- **Precision Agriculture**

  Leaf wetness, fruit diameter

- **Irrigation Systems**

  Soil moisture, leaf wetness

- **Greenhouses**

  Solar radiation, humidity, temperature

- **Weather Stations**

  Anemometer, wind vane, pluviometer

## SENSORS

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

## 4-20 mA CURRENT LOOP

*Figure: 4-20 mA Current Loop Board*

### APPLICATIONS

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

### FEATURES

- **Type:** Analog
- **Media:** Twisted Pair
- **No. of devices:** 1
- **Distance:** 900m
- **Supply:** 5-24V

*The user can choose among a wide variety of standard sensors*

## VIDEO CAMERA

*Figure: Video Camera Sensor Board*

### 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

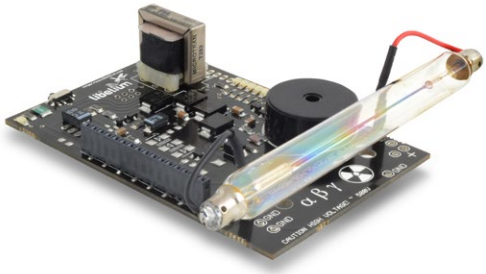


*Figure: Radiation Board*

### 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

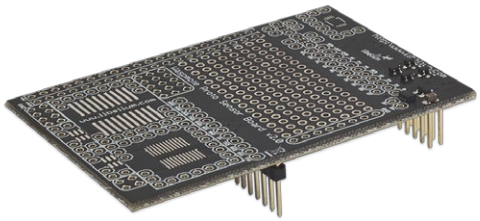


*Figure: Prototyping Sensor Board*

## APPLICATIONS

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

## SENSORS

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

# Power supplies

- 6600mAh Li-Ion rechargeable // 13000 /26000/52000mAh **non - rechargeable**
- Solar Panel: rigid (7V – 500mA) and flexible (7.2V – 100mA)
- USB (220V-USB, car lighter USB)

# USB-PC interface

Model: Waspmote Gateway *
Communication: 802.15.4/ZigBee - USB PC
Programmable buttons and leds
** Included in the developers Kit*

**Compiler:**

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

*Figure: Waspmote Gateway*

# Waspmote vs Waspmote Plug & Sense!

Waspmote 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 new Waspmote 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 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.

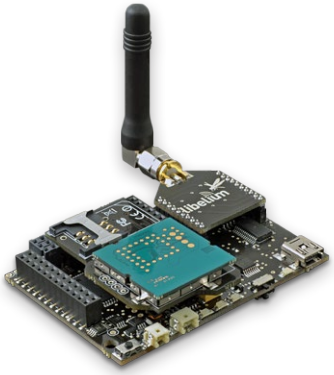


*Figure: Waspmote*


*Figure: Waspmote Plug & Sense!*

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

http://www.libelium.com/plug_&_sense

# Certifications

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

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