

Meshlium Xtreme

Technical Guide



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INDEX

| | |
|---|-----------|
| 1. General and safety information..... | 6 |
| 2. Important: read me before using..... | 7 |
| 3. Meshlium v4.0 vs Meshlium v3.5..... | 8 |
| 3.1. Capabilities comparison..... | 8 |
| 3.2. Compatibility with Wasp mote and Plug & Sense! nodes | 9 |
| 3.3. Compatibility with current cloud software | 9 |
| 3.4. XBee-PRO 868 vs XBee 868LP..... | 10 |
| 3.5. XBee-PRO 900 vs XBee-PRO 900HP | 11 |
| 3.6. 3G (SIM5215) vs 4G (LE910) | 11 |
| 4. Contents of the box | 13 |
| 5. Specifications | 15 |
| 6. How to use Meshlium..... | 18 |
| 6.1. Power supply | 18 |
| 6.2. External SIM socket..... | 20 |
| 6.3. How to install the antennas..... | 21 |
| 6.4. Installation of the IP65 Ethernet cable | 22 |
| 6.5. Installing Meshlium..... | 25 |
| 6.6. Initialization, restart and shutdown..... | 25 |
| 6.7. Setting the time | 26 |
| 7. Understanding Meshlium | 27 |
| 7.1. Concepts | 27 |
| 7.2. Meshlium models | 27 |
| 7.3. Storage | 28 |
| 7.4. Application model by model..... | 28 |
| 8. Accessing Meshlium – make it easy!..... | 30 |
| 9. Network interfaces setup..... | 32 |
| 9.1. Ethernet setup..... | 32 |
| 9.2. WiFi Access Point setup..... | 35 |
| 9.2.1. Configuration | 35 |
| 9.2.2. Clients connected | 37 |
| 9.3. Network setup confirmation | 38 |
| 9.4. 4G setup | 39 |

| | |
|--|-----------|
| 9.5. Proxy setup | 40 |
| 9.6. No-IP setup | 41 |
| 10. Wireless Sensor Networks | 43 |
| 10.1. Meshlium and Wespmove..... | 43 |
| 10.2. Receiving and storing data | 44 |
| 10.2.1. Receiving trough RF communications | 44 |
| 10.2.2. Receiving trough 4G / WiFi / Ethernet (HTTP) | 51 |
| 10.3. Capturer | 51 |
| 10.3.1. Local database..... | 53 |
| 10.3.2. External Database..... | 54 |
| 10.3.3. Show me Now..... | 57 |
| 10.3.4. Advanced database options | 57 |
| 10.4. Logs | 59 |
| 10.5. Sensor list | 60 |
| 10.6. OTA via FTP | 61 |
| 11. Meshlium Visualizer | 63 |
| 11.1. Working with the Visualizer | 63 |
| 12. Cloud Connectors..... | 66 |
| 12.1. Premium Cloud Partners | 68 |
| 12.1.1. Arrow | 68 |
| 12.1.2. IBM Bluemix..... | 73 |
| 12.1.3. Microsoft Azure Event Hubs | 74 |
| 12.1.4. Microsoft Azure IoT Hub | 81 |
| 12.1.5. Nexmachina | 85 |
| 12.1.6. ElementBlue – RightSensor..... | 87 |
| 12.1.7. Sofia2 | 89 |
| 12.1.8. ThingPlus..... | 95 |
| 12.1.9. ThingWorx..... | 98 |
| 12.2. Advanced Cloud Partners | 102 |
| 12.2.1. Amazon IoT | 102 |
| 12.2.2. Cumulocity | 107 |
| 12.2.3. SmartCityPlatform..... | 108 |
| 12.2.4. Telefónica IoT Platform | 110 |
| 12.2.5. Telit | 111 |
| 12.3. Basic Cloud Partners | 115 |
| 12.3.1. Amplía's OpenGate | 115 |
| 12.3.2. BaseN..... | 116 |
| 12.3.3. B-Scada..... | 118 |
| 12.3.4. C2M | 120 |
| 12.3.5. DeviceLynk | 122 |
| 12.3.6. eagle.io | 124 |

| | |
|---------------------------------------|------------|
| 12.3.7. Ensura..... | 125 |
| 12.3.8. Ericsson ApploT..... | 126 |
| 12.3.9. Esri | 129 |
| 12.3.10. Extunda | 133 |
| 12.3.11. HaibuSmart..... | 134 |
| 12.3.12. infiswift..... | 135 |
| 12.3.13. IoT-Ticket..... | 137 |
| 12.3.14. IoTsens | 143 |
| 12.3.15. Kii | 144 |
| 12.3.16. Labeeb..... | 147 |
| 12.3.17. MQTT | 150 |
| 12.3.18. Orchestra | 153 |
| 12.3.19. Redd..... | 156 |
| 12.3.20. RIOT Platform | 157 |
| 12.3.21. SensorUp IoT Platform | 158 |
| 12.3.22. Sentilo..... | 159 |
| 12.3.23. Simfony | 160 |
| 12.3.24. SmartPlants | 163 |
| 12.3.25. TechEdge SAP HANA..... | 164 |
| 13. Device connectors..... | 166 |
| 13.1. Device Partners | 167 |
| 13.1.1. Axis..... | 167 |
| 14. Smartphone detection | 170 |
| 14.1. Devices detected..... | 172 |
| 14.2. WiFi Scanner | 177 |
| 14.2.1. Concepts..... | 177 |
| 14.2.2. Local database..... | 180 |
| 14.2.3. External database | 181 |
| 14.3. Bluetooth Scanner | 183 |
| 14.3.1. Concepts..... | 183 |
| 14.3.2. Local database..... | 185 |
| 14.3.3. External database | 186 |
| 15. Tools | 188 |
| 15.1. Fresnel calculator..... | 188 |
| 15.2. Iperf | 188 |
| 15.3. Ping | 189 |
| 15.4. Traceroute | 190 |
| 15.5. Netstat..... | 190 |
| 15.6. GPS | 191 |
| 15.6.1. Concepts..... | 191 |
| 15.6.2. Configuring GPS service | 191 |

| | |
|--|------------|
| 15.6.3. Local database..... | 193 |
| 15.6.4. External database | 194 |
| 15.7. Beep..... | 195 |
| 16. Database management..... | 196 |
| 16.1. Direct access..... | 196 |
| 16.2. PhpMyAdmin..... | 196 |
| 17. System Information..... | 198 |
| 17.1. Hostname | 198 |
| 17.2. Password management | 198 |
| 17.3. Disk usage..... | 199 |
| 17.4. Internal temperature sensor..... | 199 |
| 17.5. Time synchronization | 200 |
| 18. Upgrading Meshlium | 201 |
| 18.1. Checking for updates | 201 |
| 18.2. Local file | 202 |
| 18.3. URL..... | 203 |
| 19. Rescue System..... | 204 |
| 19.1. Rescue steps..... | 204 |
| 20. Expansion port | 206 |
| 21. Manager System changelog..... | 207 |
| 22. Documentation changelog | 209 |
| 23. Certifications | 210 |
| 23.1. General overview | 210 |
| 23.2. CE (Europe) | 210 |
| 23.3. FCC (USA) | 211 |
| 23.4. IC (Canada)..... | 212 |
| 23.5. ANATEL (Brazil)..... | 212 |
| 23.6. RCM (Australia)..... | 212 |
| 24. Maintenance..... | 213 |
| 25. Disposal and recycling..... | 214 |

1. General and safety information

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- All documents and any examples they contain are provided as-is and are subject to change without notice. Except to the extent prohibited by law, Libelium makes no express or implied representation or warranty of any kind with regard to the documents, and specifically disclaims the implied warranties and conditions of merchantability and fitness for a particular purpose.
- The information on Libelium's websites has been included in good faith for general informational purposes only. It should not be relied upon for any specific purpose and no representation or warranty is given as to its accuracy or completeness.

Read carefully the Limited Warranty and Terms and Conditions of Use before using "Meshlium".

- Read carefully the "General Conditions of Sale and Use of Libelium". This document can be found at http://www.libelium.com/development/meshlium/technical_service
As specified in the Warranty document which you can find at
<http://www.libelium.com/development/meshlium/documentation>, the client has 7 days from the day the order is received to detect any failure and report that to Libelium. Any other failure reported after these 7 days may not be considered under warranty.
- Do NOT open the enclosure. If you do so, you will lose the guarantee.
- Do not remove any of the components.
- Do not allow contact between metallic objects and the electronic part to avoid injury and burns.
- NEVER immerse the equipment in any liquid.
- Keep the equipment in a dry place away from any liquids that could spill.
- Check from the label that comes with the equipment the maximum permitted voltage and amperage range.
- Keep the equipment within the temperature range indicated in the specifications section.
- Do not connect or power the equipment using cables that have been damaged.
- Place the equipment in an area to which only maintenance personnel can have access (in a restricted access zone).
- In any case, keep children away from the machine.
- If there is a power failure, immediately disconnect from the mains electricity.
- If using the car lighter as a power source, make sure that you follow the voltage and current specifications indicated in the section "How to use Meshlium".
- If a software failure occurs, consult the section web support.
- Do not place the equipment on trees or plants as they could be damaged by its weight.
- Be particularly careful if you are connected through Ethernet or WiFi; if the settings are incorrectly altered, Meshlium could become inaccessible.

2. Important: read me before using

The following list shows **just some** of the actions that produce **the most common failures and warranty-voiding**. Complete documentation about usage can be found at:

http://www.libelium.com/development/meshlium/technical_service

Failure to comply with the recommendations of use will entail the guarantee cancellation.

- Do not interrupt the power supply before shutting down Meshlium properly through the "Shutdown" or "Restart" buttons in the Manager System.
- Do not open the Meshlium enclosure in any case. This will automatically make the warranty void.
- Do not submerge Meshlium in liquids.
- Do not place Meshlium on places or equipment where the device could be exposed to shocks and/or vibrations.
- Do not expose Meshlium to temperatures below -20° C or above 50° C.
- Meshlium's microprocessor must not overpass 75 Celsius degrees. The user must ensure that this temperature never overpass. Especially when using WiFi Scan.
- Do not power Meshlium with other power sources than the original provided by Libelium.

For more information: <http://www.libelium.com/meshlium>

3. Meshlium v4.0 vs Meshlium v3.5

This evolution of Meshlium includes an important upgrade of the hardware capabilities. The most important changes are:

- Big step forward in performance, CPU performance 10 times better and RAM capacity 8 times bigger.
- Cellular connection upgraded to 4G for a very fast Internet connection and data synchronization.
- WiFi AP upgraded to WiFi b/g/n (up to 144 Mbps).
- New models of radio module for the 868 MHz and 900 MHz bands.
- Up to two RF (XBee) modules can be installed in the device, working with the 4G radio at the same time (2.4 GHz and 868/900 MHz).
- GPS/GLONASS capabilities for a faster global location.
- New improved design.
- Operating system updated including new versions of programs and system.
- New expansion port for future use of external I2C, USB or UART devices.
- New Meshlium is Microsoft Azure Certified (More info: <https://azure.microsoft.com/es-es/marketplace/programs/certified/>).

3.1. Capabilities comparison

| | Previous Meshlium version | New Meshlium |
|-----------------------------|--|---|
| CPU cores | 1 | 4 |
| CPU architecture | 32 bits | 64 bits |
| CPU frequency | 500 MHz | 1 GHz |
| RAM | 256 MB DDR | 2 GB DDR3 |
| Storing | Compact Flash 8 GB | SSD disk 16 GB |
| Linux Kernel | 2.6 | 3.16 |
| Simultaneous cloud services | 2-4 | 15-20 |
| Boot time | ~2 minutes | Less than 1 minute |
| WiFi | a/b/g (up to 54 Mbps) | a/b/g/n (up to 144 Mbps) |
| Cellular | Up to 7.2 Mbps downlink (SIM5218) Up to 384 kbps downlink (SIM5215) | Up to 42 Mbps downlink |
| Antenna connectors | 4 | 10 |
| RF module sockets | 1 | 2 |
| Geolocation | GPS | GPS + GLONASS |
| Root access | Yes | No |
| Power consumption | ~10 W | ~15 W (depending on number of radios) |
| Enclosure (mm) | 210 x 190 x 60 | 30 x 220 x 80 |
| Certifications | CE / FCC / IC | CE (Europe) / FCC (US) / IC (Canada) / ANATEL (Brazil) / RCM (Australia) / PTCRB (US) / AT&T (US) |

3.2. Compatibility with WaspMote and Plug & Sense! nodes

| Old hardware | Compatible | Notes |
|--|------------|---|
| Plug & Sense! (WaspMote v1.2) 802.15.4 | YES | |
| Plug & Sense! (WaspMote v1.2) ZigBee | NO | Old ZigBee modules are EoL |
| Plug & Sense! (WaspMote v1.2) DigiMesh | NO | |
| Plug & Sense! (WaspMote v1.2) 900 | NO | Old 900 MHz modules are EoL. Substituted by the new 900HP radios. |
| Plug & Sense! (WaspMote v1.2) 868 | NO | Old 868 MHz modules are EoL. Substituted by the new 868 radios. |
| Plug & Sense! (WaspMote v1.2) WiFi | YES | |
| Plug & Sense! (WaspMote v1.2) 3G | YES | |
| Plug & Sense! (WaspMote v1.5) 802.15.4 | YES | |
| Plug & Sense! (WaspMote v1.5) 900 | YES | |
| Plug & Sense! (WaspMote v1.5) 868 | YES | |
| Plug & Sense! (WaspMote v1.5) WiFi | YES | |
| Plug & Sense! (WaspMote v1.5) 4G | YES | |
| Plug & Sense! (WaspMote v1.5) ZigBee | NO | Meshlium does not support this RF module |

3.3. Compatibility with current cloud software

| Cloud software | Compatible | Notes |
|---------------------|------------|--------------------------|
| Amazon IoT | yes | |
| Esri | yes | Only ArcGIS online |
| IBM Bluemix | yes | |
| IOT-Ticket | yes | |
| Azure Event Hubs | yes | |
| Azure Service Bus | no | Obsolete: use Event Hubs |
| MQTT | yes | |
| Telefónica | yes | |
| ThingWorx | yes | |
| amplía | yes | |
| Symfony | yes | |
| Smart City Platform | yes | |
| B-Scada | yes | |
| DeviceLynk | yes | |

| Cloud software | Compatible | Notes |
|----------------|------------|-------|
| devicify | yes | |
| Eagle.io | yes | |
| ElementBlue | yes | |
| Extunda | yes | |
| IoTSens | yes | |
| Sentilo | yes | |
| Sofia2 | yes | |
| Solver | yes | |
| Thing+ | yes | |

Compatibility with other software:

| Software | Compatible | Notes |
|---|------------|---|
| External DB synchronization of sensor data. | yes | Some changes in the tables needed, can be done without losing data. |

3.4. XBee-PRO 868 vs XBee 868LP

The new XBee 868LP module supports some changes:

- The new XBee 868LP operates between 863 and 870 MHz, making it deployable in several regions throughout the world including approved European countries and India by utilizing a software selectable channel masking feature.
- The XBee 868LP is also the industry's first RF module using 868 MHz and surrounding frequencies for LBT + AFA (Listen Before Talk and Adaptive Frequency Agility). This virtually eliminates interference by listening to the radio environment before any transmission starts, and automatically shifting to a new channel when interference is detected. This patent-pending frequency scan occurs automatically and in a matter of microseconds so as not to impact performance.

Features comparison:

| Feature | [Old] XBee-PRO 868 | [New] XBee 868LP |
|-----------------------------|---------------------|------------------------------|
| Frequency band | 868 MHz (1 channel) | 863 to 870 MHz (32 channels) |
| RF data rate | 24 kbps | 10 kbps |
| Indoor/urban range | Up to 550 m | Up to 112 m |
| Outdoor/line-of-sight range | Up to 40 km | Up to 8.4 km |
| Transmit power | 25 dBm | 14 dBm |
| Receive sensitivity | -112 dBm | -106 dBm |
| Transmit current | 500 mA | 48 mA |
| Receive current | 65 mA | 27 mA |
| LBT + AFA | No | Yes |

3.5. XBee-PRO 900 vs XBee-PRO 900HP

The new XBee 900HP modules support some changes:

- The new XBee-PRO 900HP uses greater power transmission compared to the old version. Thus, the ranges achieved by these new modules are larger than before.
- The XBee-PRO 900HP modules are certified for use in multiple countries: Brazil, Australia, US. Through the new channel selection it is possible to enable/disable the preferred frequency channels within the 902-928 MHz band.
- The power consumption has been improved compared to the old modules. Better ranges have been achieved with almost the same TX power. On the other hand, RX power consumption has been reduced.

Features comparison:

| Feature | [Old] XBee-PRO 900 | [New] XBee-PRO 900HP |
|-----------------------------|---|----------------------------------|
| Frequency band | 902-928 MHz (8 hopping patterns on 12 channels) | 902 MHz to 928 MHz (64 channels) |
| RF data rate | 156 kbps | 10 kbps |
| Indoor/urban range | Up to 450 ft (140 m) | Up to 2000 ft (610 m) |
| Outdoor/line-of-sight range | Up to 1.8 miles (3 km) | Up to 9 miles (15.5 km) |
| Transmit power | 17 dBm | 24 dBm |
| Receive sensitivity | -100 dBm | -110 dBm |
| Transmit current | 210 mA | 215 mA |
| Receive current | 80 mA | 29 mA |

3.6. 3G (SIM5215) vs 4G (LE910)

The new 4G module supports some changes:

- The new 4G counts with many different models, one specifically designed for each market:
 - LE910-EU (Europe / Brazil): CE, GCF, ANATEL
 - LE910-NAG (US / Canada): FCC, IC, PTCRB, AT&T Approved
 - LE910-AU V2 (Australia): RCM, Telstra Approved
- The GPS module also makes possible perform geolocation services using NMEA sentences offering information such as latitude, longitude, altitude and speed what makes it perfect to perform tracking applications.
- The new 4G module offers the maximum performance of the 4G network as it uses two different antennas (normal + diversity) for RX (MIMO DL 2x2) choosing the best received signal at any time and getting a maximum download speed of 100 Mbps.

Features comparison:

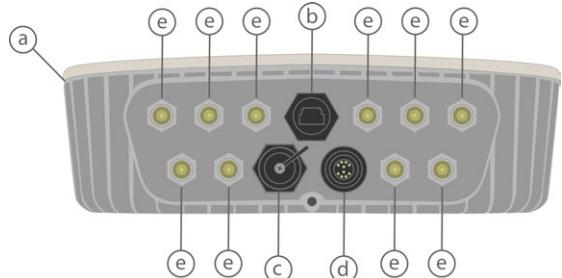
| Features | [Old] 3G (SIM5215) | [New] 4G (LE910) |
|----------------|-------------------------|---|
| Protocols | 3G / GPRS / GSM | 4G / 3G / GPRS / GSM / WCDMA / HSPA+ / LTE |
| Certifications | CE, GCF, FCC, IC, PTCRB | CE, GCF, ANATEL, FCC, IC, PTCRB, AT&T Compliant, KCC, RCM, NTT DoCoMo, KDDI |
| GPS | No | Yes |

| Features | [Old] 3G (SIM5215) | [New] 4G (LE910) |
|--------------------|--------------------|---|
| Download max speed | 384 kbps | 100 Mbps |
| Upload max speed | 384 kbps | 50 Mbps |
| Antenna diversity | No | Yes |
| Cellular carriers | Any | Any + Specially tested with AT&T, SK Telecom, Telstra, NTT DoCoMo or KDDI |

4. Contents of the box

Meshlium

- a)** IP65 casing
- b)** Ethernet connector
- c)** micro-SIM + micro-USB connector
- d)** Expansion connector
- e)** Antenna connectors



Antennas *

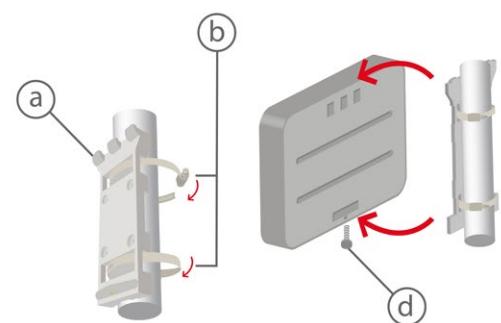
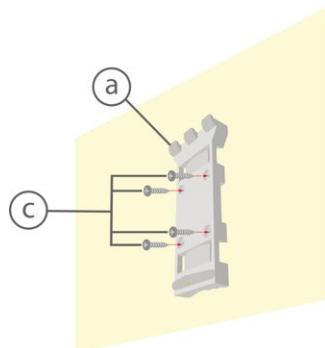
- a)** Dipole 5 dBi (Bluetooth, WiFi, XBee-PRO 802.15.4)
- b)** 4G / GPS (3 antennas for EU, US or BR models; 2 antennas for AU models)
- c)** Dipole 4.5 dBi (XBee 868LP, XBee-PRO 900HP)

(*). Number and type of antennas depend on the model purchased.



Fixing

- a)** Fixing plate
- b)** 2 metal brackets
- c)** Screws and wall plugs
- d)** Mounting screw



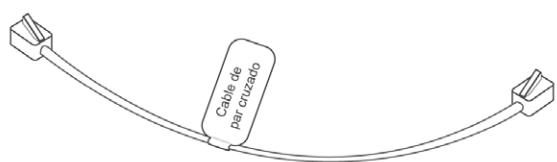
Ethernet cable



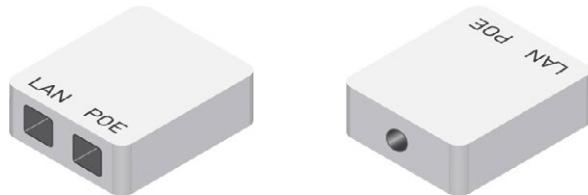
IP65 Ethernet cap



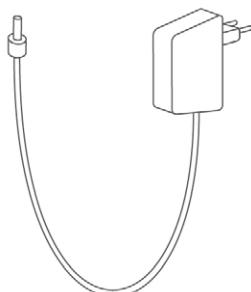
Ethernet crossover cable



POE injector



AC/DC adapter



5. Specifications



Figure: Meshlium unit

| | | |
|--|--------------------------------------|-------------------|
| Processor | 1 GHz Quad Core (x86) | |
| RAM memory | 2 GB (DDR3) | |
| Disk memory | 16 GB | |
| Power | 6 to 12 W (12 V) | |
| Power source | PoE (Power Over Ethernet) | |
| Max current supply | 2 A | |
| Enclosure | Material | Aluminum |
| | Dimensions | 300 x 220 x 87 mm |
| | Weight | 2.2 kg |
| | External protection | IP65 |
| Temperature range | -20 °C / 50 °C | |
| Response time to Ethernet ping | 60 s | |
| Time to have all the services running | 60 s | |
| Types of power supply* | AC-220 V (DC-12 V) | |
| | Linux, Debian based | |
| | Meshlium Manager System | |
| Management software | (open source) | |
| Security | Authentication WEP, WPA, WPA2, HTTPS | |

(*) Only with the accessories supplied by Libelium

WiFi (2.4 GHz) radio (Access Point/Scanner)



| WiFi radio | |
|---------------------|--------------------------|
| Chipset | Qualcomm Atheros QCA9882 |
| TX power | 20 dBm |
| Range | 500 m* |
| Antenna 5dBi dipole | |
| Type | Omni-directional, dipole |
| Gain | 5 dBi |
| Dimensions | 224 x 22 mm |

(*) Depending on antenna and line of sight

RF radio modules



| | |
|-----------------------|-------------------------------|
| Model | XBee-PRO 802.15.4 |
| Frequency | 2.4 GHz |
| TX power | 18 dBm (10 dBm for EU models) |
| Rx sensitivity | -100 dBm |
| Antenna | 5 dBi dipole |
| Range | 1.6 km (750 m in EU models)* |



| | |
|-----------------------|----------------|
| Model | XBee 868LP |
| Frequency | 868 MHz |
| TX power | 14 mW |
| Rx sensitivity | -106 dBm |
| Antenna | 4.5 dBi dipole |
| Range | 8.4 km* |



| | |
|-----------------------|----------------|
| Model | XBee-PRO 900HP |
| Frequency | 900 MHz |
| TX power | 24 dBm |
| Rx sensitivity | -110 dBm |
| Antenna | 4.5 dBi dipole |
| Range | 15.5 km* |

(*) Depending on antenna and line of sight

4G/LTE module



| | |
|---------------------------------------|--|
| Protocols | 4G, LTE, 3G, WCDMA, HSPA, UMTS, GPRS, GSM |
| Frequency bands, EU/BR version | LTE - 800 (B20) / 1800 (B3) / 2600 (B7) UMTS - 850 (B5) / 900 (B8) / 2100 (B1) GSM/GPRS - 900 /1800 |
| Frequency bands, US version | LTE - 700 (B17) / 850 (B5) / AWS1700 (B4) / 1900 (B2) UMTS - 850 (B5) / 1900 (B2) GSM/GPRS - 850 / 1900 |
| Frequency bands, AU version | LTE - 700 (B17) / 1800 (B3) / 2600 (B7) (AU models do not support 3G, GPRS or GSM) |
| Output power | Class 4 (2 W, 33 dBm) @ GSM 850/900 Class 1 (1 W, 30 dBm) @ GSM 1800/1900 Class E2 (0.5 W, 27 dBm) @ EDGE 850/900 Class E2 (0.4 W, 26 dBm) @ EDGE 1800/1900 Class 3 (0.25 W, 24 dBm) @ UMTS Class 3 (0.2 W, 23 dBm) @ LTE |
| RX rate | Up to 100 Mb/s |
| TX rate | Up to 50 Mb/s |
| Antenna | 4 dBi |
| SIM card | Access via the External micro-SIM socket |

GPS Module



| | |
|----------------|--|
| Modes | Assisted GPS (A-GPS), Standalone mode (NMEA frames) |
| Antenna | 4 dBi |

The AU models do not have a GPS receiver

Bluetooth Scanner



| | |
|-----------------|-----------------------------|
| Protocol | Bluetooth 2.1 + EDR Class 2 |
| TX power | 3 dBm |
| Antenna | 5 dBi dipole |
| Range | 20-30 m* |

() Depending on antenna and line of sight*

6. How to use Meshlium

6.1. Power supply

Meshlium needs a 220 V power connection. The device must be powered with the power source provided by Libelium.

How to connect Meshlium to 220 V (110 V compatible):

- 1. Unscrew the Ethernet connector cap in Meshlium.
- 2. Join the end that has the IP65 protection of the Ethernet cable to the connector and screw the cap on to fix it.
- 3. Connect the free end of the cable to the PoE injector input marked as **PoE**. As explained in the section "Before using Meshlium", make sure that the PoE is indoors.
- 4. Take the supplied power adapter and plug it into the corresponding PoE injector connector, labeled as **DC**.
- 5. Plug the other end of the adapter into the 220 V socket and your Meshlium is now ready to operate.

Note: For equipment powered by an electric outlet, a power outlet must be installed near the equipment, and it must be easily accessible.

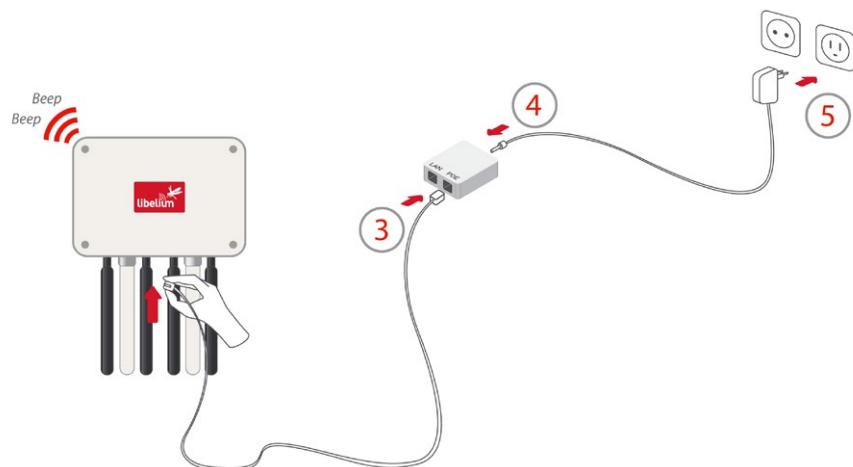


Figure: Connecting Meshlium to 220 V

How to connect Meshlium in order to get access by the Ethernet interface:

- 1. Connect the network crossover cable (it has an identifying label) included in the box to the PoE injector input marked **LAN** and to the network socket of your PC as shown in the diagram.

(*) See the "Accessing Meshlium" section in order to see how to get access via wireless.

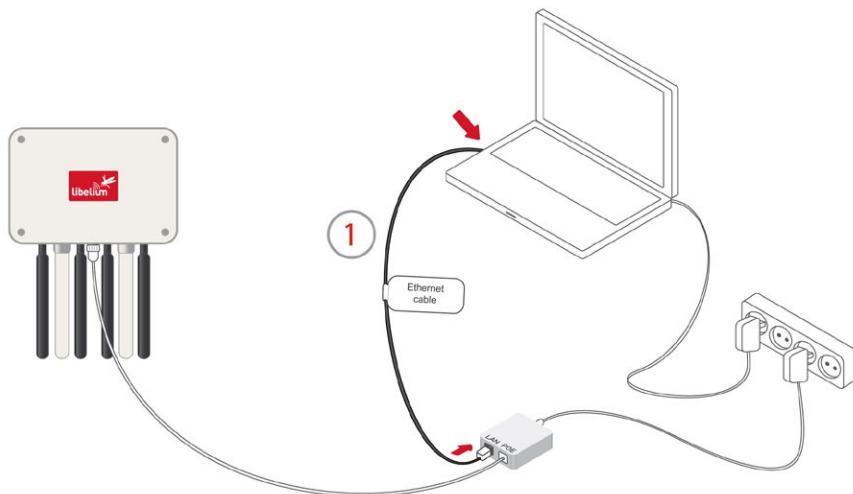


Figure: Connecting LAN cable to a PC

You can also carry out this connection through a switch (not supplied with Meshlium):

- 1. Connect the Ethernet cable (not the crossover) to the PoE input marked LAN and to one of the switch inputs.
- 2. Connect another Ethernet cable to another one of the switch inputs and the opposite end to the network socket of your PC.

(*) See the "Accessing Meshlium" section in order to see how to get access via wireless.

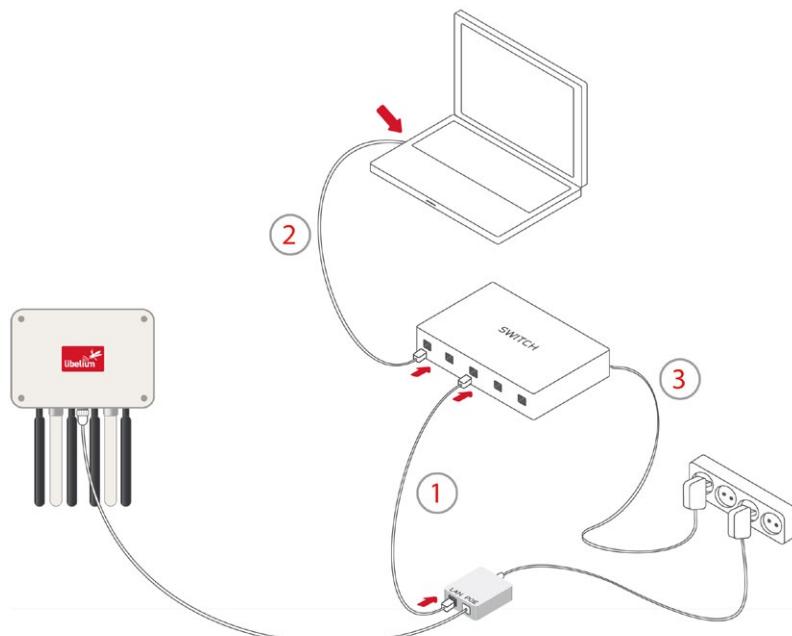


Figure: Connecting LAN cable to a switch

6.2. External SIM socket

The External SIM socket is composed of 2 connectors:

- micro-SIM card
- micro-USB (type B)



Figure: External SIM socket in a Meshlium with 4G/3G/GPRS/GSM module

The micro-SIM card connector allows the user to connect the SIM card. You can ask your Mobile Network Operator for a micro-SIM card. It is better to use a normal micro-SIM card, not a card which can be broken into a nano-SIM card.

The micro-SIM card connector has a push-push mechanism, so it is really easy to remove the card using one nail or a small tool. To insert the SIM, press until a click is heard. To release the card, press until a click is heard and the spring will push the card free.



Figure: Push-push mechanism External SIM socket

It is very important to turn off Meshlium in a secure way before inserting a micro-SIM card, or removing an existing SIM card. The user can damage the device if this operation is done with the device on.

Make sure the External SIM socket is closed with its protection cap tightly screwed before an outdoors deployment.

The operation with the micro-USB socket is just the same than with a normal USB socket. A USB OTG cable can be used to plug in standard A USB connector (like pendrives).

Take into account that the External SIM socket has a limited resistance so please be gentle and push with care.

6.3. How to install the antennas

Every antenna for each technology has a defined position in which it has to be installed. The different positions are:

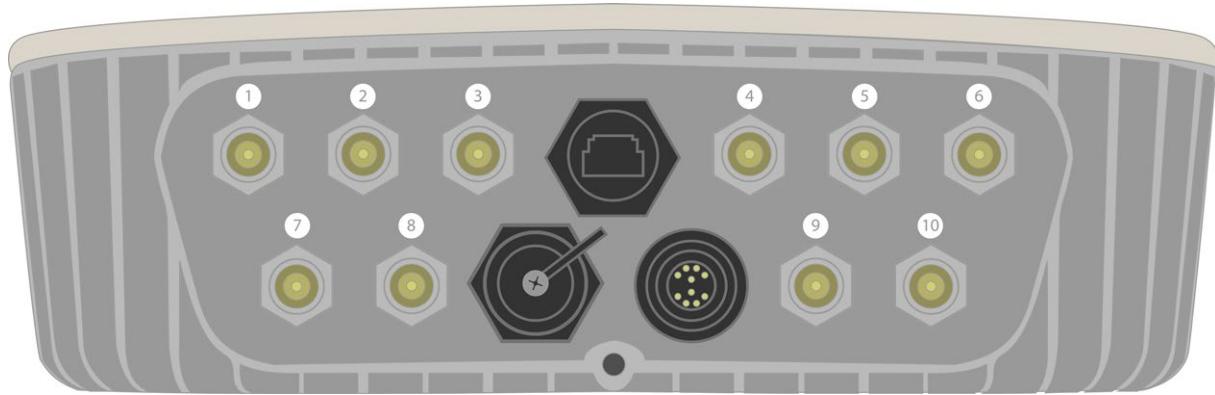


Figure: Antenna socket numbers

- WiFi AP – Socket 2
- 4G with adapter n-to-SMA– Socket 1 and 6
- GPS with adapter n-to-SMA – Socket 3
- RF module 802.15.4 – Socket 5
- RF module 868 MHz / 900 MHz with adapter n-to-RP-SMA – Socket 4
- Bluetooth Scanner – Socket 5
- WiFi Scanner – Socket 4

The antennas have to be gently screwed on the connector. Do not force the antenna, if you need too much strength to screw it is probably being installed in a wrong position.

If you have any reception issue with 4G or GPS, you can try bending the affected antenna in order to improve isolation.

6.4. Installation of the IP65 Ethernet cable

Installation of the IP65 cap:

In order to install the IP65 cap you will need a connector-free RJ45 cable. This cable is NOT included in the Meshlium box.

Important: Make sure that you have a cable long enough to connect Meshlium from its definitive location to the PoE located indoors. It is not recommended to install Meshlium too far from the PoE injector due to the power loss in the cable. Always test the device with a cable of the same length before installing.

The Ethernet cable can be used for indoors and outdoors deployments. Just note that its resistance is limited, so in order to maximize its lifetime in harsh conditions (direct sunlight, extreme temperatures, very wet climate), we advise to protect the cable with some isolating tube or heat-shrink sleeve. This is also important for installations where insects, birds, rats or other animals could try to bite the cable.

- 1. Take from the Meshlium box the bag containing the parts for installing the IP65 cap. Check that you have all the parts that appear in the picture.

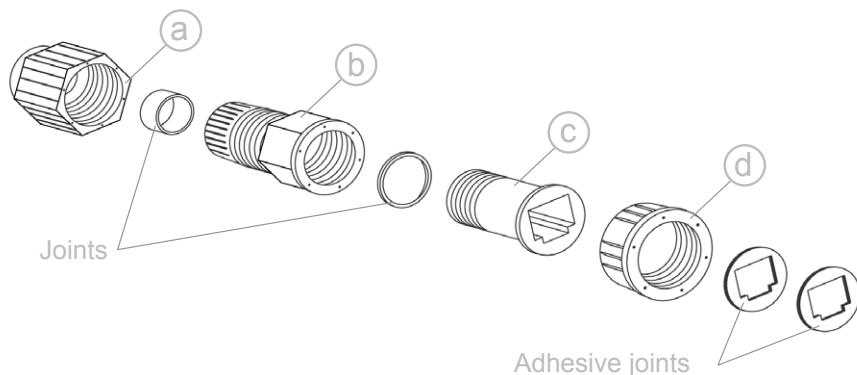


Figure: Cap parts

- 2. Stick one of the supplied adhesive joints to part C.

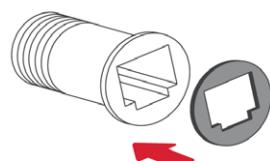


Figure: Stick joint

- 3. Introduce the joints into part B as shown in the drawing.

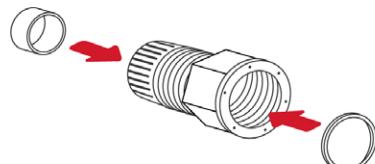


Figure: Introduce joints

- 4. Insert part C into part D.

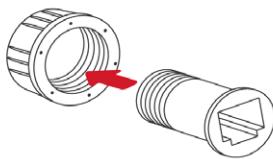


Figure: Insert part C

- 5. Screw both sets of parts in the direction shown in the diagram.

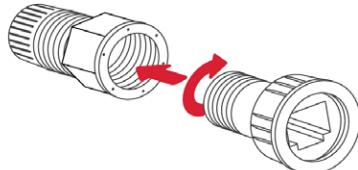


Figure: Screw both parts

- 6. Partially screw part D to the end.

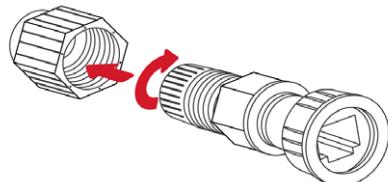


Figure: Screw part D

- 7. Pass the cable through the fitted cap.

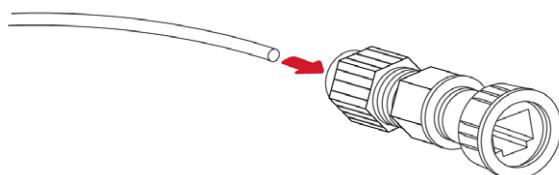


Figure: Pass the cable

- 8. Crimp the RJ45 connectors at the ends of the cable (the crimping tool is not supplied with Meshlium).

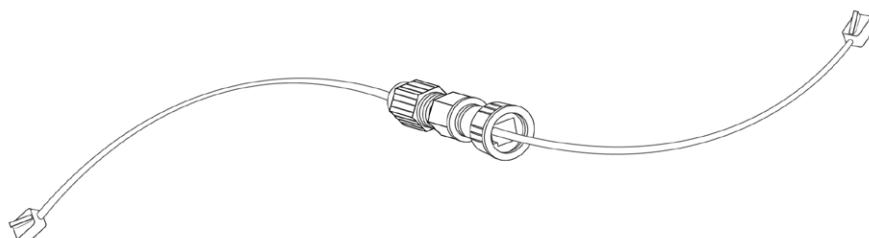


Figure: Crimp RJ45

Your IP65 Ethernet cable is now ready for use.

How to connect the IP65 Ethernet cable to Meshlium:

- 1. Take the adhesive joint that has not been used for fitting the cap and stick it to the Meshlium Ethernet connector.



Figure: Stick joint

- 2. Connect the end of the Ethernet cable to the Meshlium Ethernet socket.

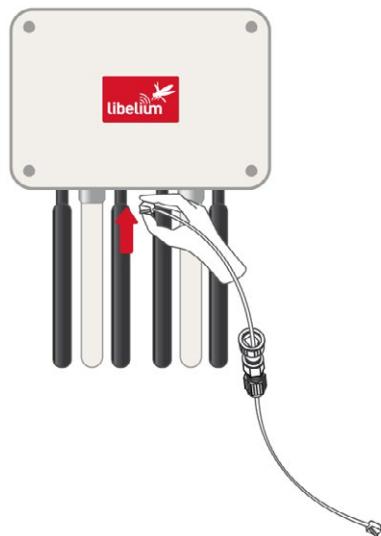


Figure: Connect RJ45

- 3. Screw part C onto the Meshlium connector. Screw tighter part D to fix the cable too. Your Meshlium is now ready to work outdoors.



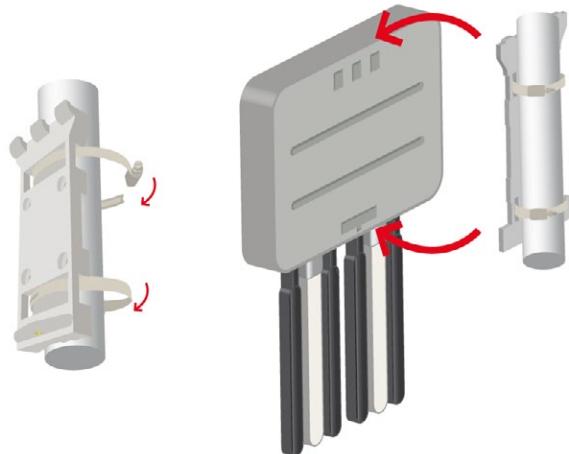
Figure: Screw connector and tighten part D

6.5. Installing Meshlium

Meshlium has been designed to operate in a vertical position with the antennas and connectors facing down. You will find the required bracket to mount Meshlium in a pole or in a wall.

To fix the bracket to a wall:

- 1. Attach bracket to the wall using wall plugs and screws. Screws provided are for general use and could not be valid for every surface. Use hardware adapted for the surface you are installing Meshlium on.



To fix the bracket to a mast:

- 1. Attach the bracket to the mast using the hose clamps. Hose clamps provided are for 50-70mm circumference masts. If your mast is thicker, use clamps with the proper metric.

Once the bracket is fixed:

- 1. Attach the box to the bracket, fitting the three top notches in the holes of the box.
- 2. Secure the screw in the bottom of the box.
- 3. Secure the Ethernet cable to avoid accidental pulls, do not let it loose. If the cable gets stretched, the joint of the cable with its connector could be damaged.

6.6. Initialization, restart and shutdown

In order to allow Meshlium to close correctly all the daemons and applications it is important to use the buttons **Restart** and **Shutdown** placed in the upper right corner in the Manager System. This way you will keep maximum the performance and lifetime of the system.

Figure: Restart screen

Once you click on the **Restart** or **Shutdown** button of manager system you have one minute to confirm the operation. If you do not confirm in that time, you will need to click in the button again to perform the operation.

Beep! System

Meshlium includes an internal speaker which will emit “beep!” sounds when initializing, rebooting and shutting down in order to inform about the state of the process.

Initialization beeps:

- Long beep when Meshlium has finished starting and it is ready to be used

Reboot beeps:

- Long beep when the reboot order is executed
- Initialization beeps when Meshlium starts again
- Do not remove the power cable during this process is carried out

Shutting-down beeps:

- This process could take up to one minute
- Long beep when Meshlium is about to shut down. A few seconds after the beeps, Meshlium can be unplugged.
- Do not remove the power cable until this process is totally completed

Note: The “beep!” sound is not really loud so you will have to take attention and be close to the Meshlium box in order to hear them clearly.

Note 2: If Meshlium is unplugged before the acoustic signal of shutdown, internal memory could be damaged. Be sure to wait for several minutes if you are not sure the beeps sounded.

Note 3: The duration of the reboot or shut-down processes may vary. Make sure you heard the corresponding beeps and be patient.

Note 4: If the user does not follow these instructions, the risk is very high. Meshlium will become unresponsive and inaccessible. This problem is out of the warranty scope, because it is produced by bad use. The only possible solution will be a repair process in Libelium’s facilities, paid by the user.

6.7. Setting the time

In order to get all the data stored in the Meshlium local database with the right timestamp, you must adjust the System time.

To do so, go to the “Setting the Time” section, inside the “System Information” chapter in the current guide.

7. Understanding Meshlium

7.1. Concepts

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

Meshlium can work as:

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

* More info about Wasp mote at: <http://www.libelium.com/wasp mote>

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

7.2. Meshlium models

There are different Meshlium models depending on the radios integrated:

| Meshlium model | Ethernet | WiFi AP | 4 G / 3 G / G P R S / GSM | 802.15.4 | 868/900 | WiFi & Bluetooth scanners |
|--------------------------------|----------|---------|------------------------------|------------------|---------|---------------------------------|
| Meshlium 4G 802.15.4 AP 868 EU | ✓ | ✓ | EU/BR version | EU version | 868 | |
| Meshlium 4G 802.15.4 AP 900 US | ✓ | ✓ | US version | World version | 900 US | |
| Meshlium 4G 802.15.4 AP 900 BR | ✓ | ✓ | EU/BR version | World version | 900 BR | |
| Meshlium 4G 802.15.4 AP 900 AU | ✓ | ✓ | AU version | World version | 900 AU | |
| Meshlium 4G AP 868 EU | ✓ | ✓ | EU/BR version | | 868 | |
| Meshlium 4G AP 900 US | ✓ | ✓ | US version | | 900 US | |
| Meshlium 4G AP 900 BR | ✓ | ✓ | EU/BR version | | 900 BR | |
| Meshlium 4G AP 900 AU | ✓ | ✓ | AU version | | 900 AU | |
| Meshlium 4G 802.15.4 AP EU | ✓ | ✓ | EU/BR version | EU version | | |
| Meshlium 4G 802.15.4 AP US | ✓ | ✓ | US version | World version | | |
| Meshlium 4G 802.15.4 AP BR | ✓ | ✓ | EU/BR version | World version | | |
| Meshlium 4G 802.15.4 AP AU | ✓ | ✓ | AU version | World version | | |
| Meshlium 4G AP Scanner EU/BR | ✓ | ✓ | EU/BR version | | | ✓ |

| | | | | | | | |
|---------------------------|---|---|------------|--|--|--|---|
| Meshlium 4G AP Scanner US | ✓ | ✓ | US version | | | | ✓ |
| Meshlium 4G AP Scanner AU | ✓ | ✓ | AU version | | | | ✓ |

Each model with RF modules can have XBee-PRO 802.15.4 and XBee 868LP or XBee-PRO 900HP (depending on the region).

7.3. Storage

The size of the Meshlium hard disk is 16 GB. The Operating System and the Manager System take ~3 GB. This means the space which can be used to store the data captured and to be used by the applications loaded by the user is:

- $16\text{ GB} - 3\text{ GB} = 13\text{ GB}$

Some of this space (7.2 GB) is assigned to the user partition: “/mnt/user”.

The local database files can be found in: “/mnt/user/mysql/MeshliumDB”.

7.4. Application model by model

Meshlium RF 4G AP

Meshlium can take the sensor data which comes from a Wireless Sensor Network (WSN) made with Waspmove sensor devices* equipped with RF (XBee) radios and send it to the Internet using the Ethernet interface or the 4G/3G/GPRS/GSM interface. Besides, Waspmotes with GPRS, GPRS+GPS, 3G, 4G or WiFi can send sensor info through the access point or through the Internet via HTTP protocol. Users can connect directly to Meshlium using the WiFi interface to control it and access to the sensor data. Users can also connect to Meshlium via WiFi with laptops and smart phones and get access to the Internet (as a common Access Point).

(*) <http://www.libelium.com/waspmove>

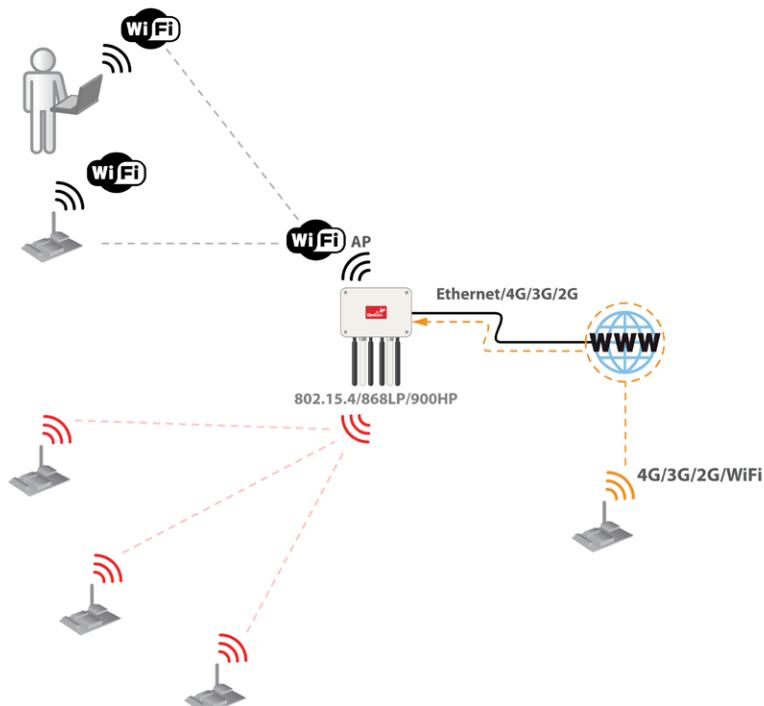


Figure: Meshlium RF 4G AP

Meshlium Scanner 4G AP

It allows to detect Smartphones (iPhone, Android) and in general any device which works with **WiFi** or **Bluetooth** interfaces. The collected data can be send to the Internet by using the Ethernet interface or the 4G/3G/GPRS/GSM connectivity. Besides, Waspmotes with GPRS, GPRS+GPS, 3G, 4G or WiFi can send sensor info through the access point or through the Internet via HTTP protocol. Users can connect directly to Meshlium using the WiFi interface to control it and access to the sensor data. Users can also connect to Meshlium via WiFi with laptops and smart phones and get access to the Internet (as a common Access Point).

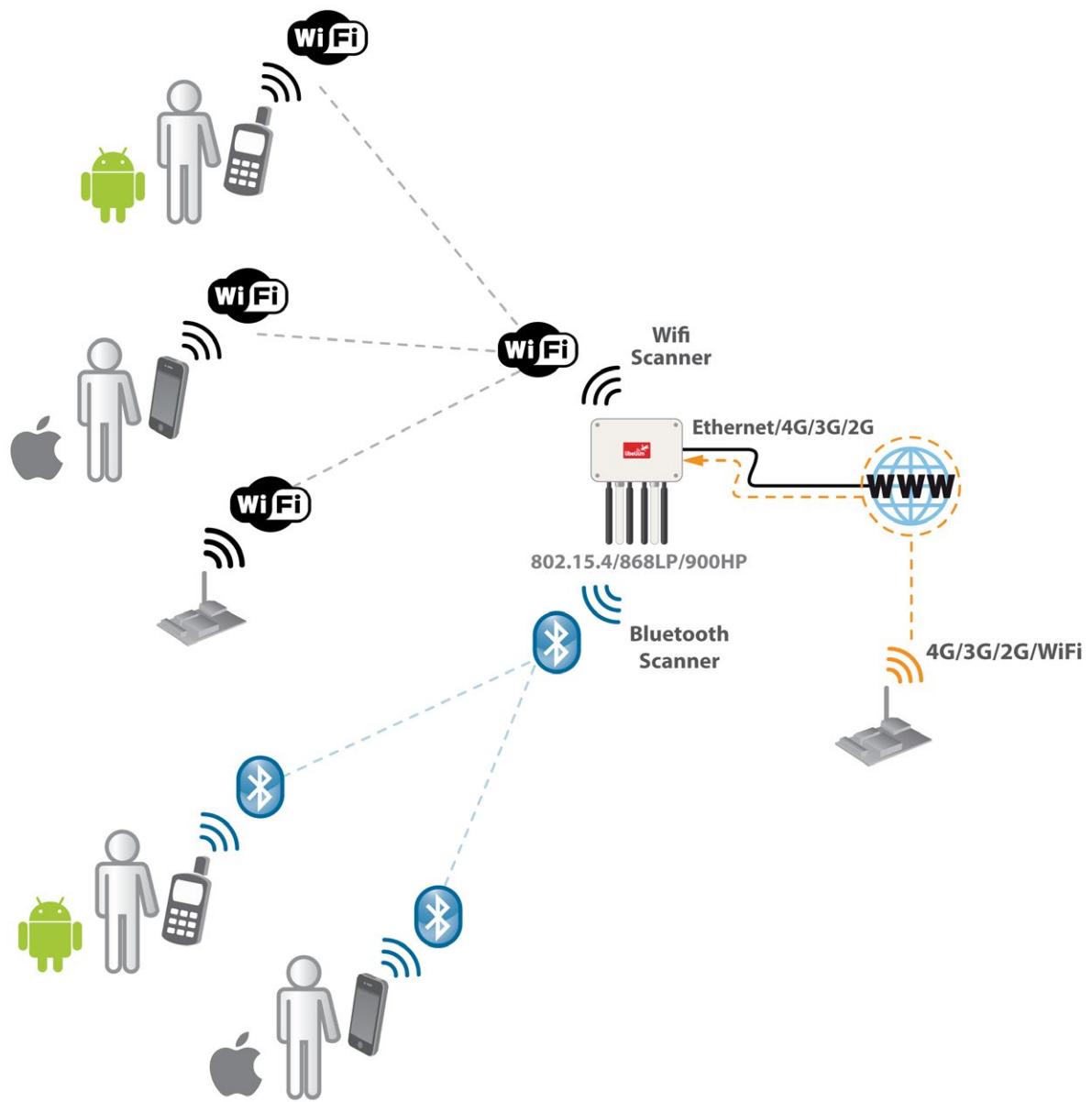


Figure: Meshlium Scanner 4G AP

8. Accessing Meshlium – make it easy!

Meshlium comes with all the radios ready to be used. All the Meshlium units come with the WiFi Access Point ready, so that users can connect using their WiFi devices. Connect the Ethernet cable to your network hub, restart Meshlium and it will automatically get an IP address from your network using DHCP.

Then access Meshlium through the WiFi connection. First of all, search the available access points and connect to "MeshliumXXXX". The four digits at the end allow to identify different Meshliums when working near each other.

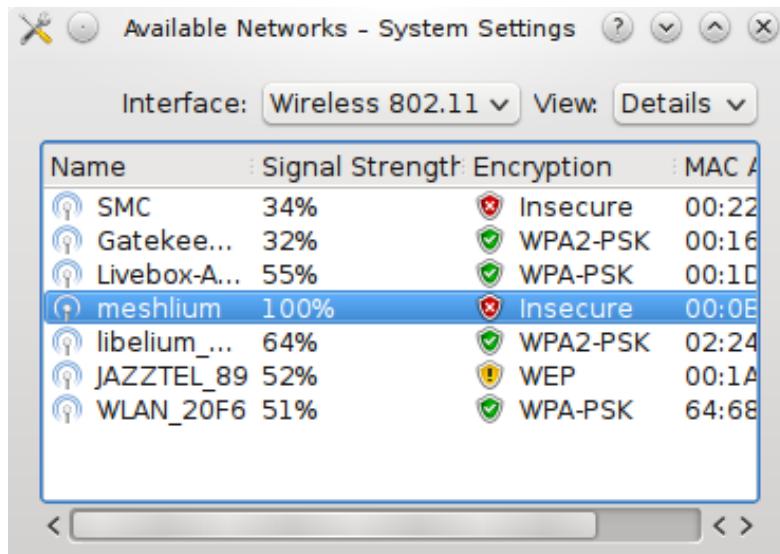


Figure: List of AP with Meshlium network

No password is needed as the network is open (you should change it later in the WiFi AP interface options). When you select it, Meshlium will give an IP address from the range 10.10.10.10 – 10.10.10.250.

Now you can open your browser on your PC, tablet or smartphone and access the Meshlium Manager System:

- URL:** <http://10.10.10.1/ManagerSystem>
- user:** admin
- password:** libelium



Figure: Manager System login screen



Figure: Manager System landing page

If your network does not offer DHCP service, Meshlium starts with a default IP address (192.168.1.100). In this case you can connect Meshlium through the WiFi connection (which is always available) or with the crossover cable provided with Meshlium.

If you want to access to the Manager System using the crossover Ethernet cable go to:

- **URL:** <http://192.168.1.100/ManagerSystem>
- **user:** admin
- **password:** libelium

9. Network interfaces setup

Access the network interfaces setup clicking on the button “Interfaces”:

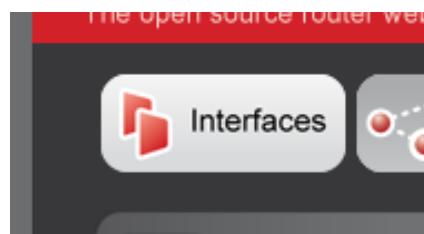


Figure: Interfaces setup plugin

9.1. Ethernet setup

By default Meshlium comes with the Ethernet interface activated to get dynamically the IP using the DHCP service. In case a static configuration is required the next parameters can be configured:

A screenshot of the Meshlium Manager System web interface. The top navigation bar includes "Meshlium Manager System", "Meshlium Scanner RF 4G GPS AP", "meshlium9d50", "Restart", "Home | Logout", and "Shutdown". On the left, there's a sidebar with icons for "Interfaces", "Sensor Networks", "Cloud Connector", "Tools", "System", and "Help". The main content area is titled "Ethernet Network" and contains a form for "Choose IP method" (set to "Static"), "IP address" (192.168.3.110), "Netmask address" (255.255.128.0), "Gateway" (192.168.1.2), "Primary DNS" (8.8.8.8), "Secondary DNS" (8.8.4.4), and a "Use IPv6" checkbox (unchecked). A "Save" button is at the bottom right. The footer says "© Libelium Comunicaciones Distribuidas S.L. | Terms of use".

Figure: Ethernet setup

A screenshot of the "Ethernet Network" configuration form. It shows the "Choose IP method" dropdown set to "Static", and the following static IP settings: IP address (192.168.3.110), Netmask address (255.255.128.0), Gateway (192.168.1.2), Primary DNS (192.168.1.9), and Secondary DNS (192.168.11.9). There is also an unchecked "Use IPv6" checkbox and a "Save" button at the bottom right.

Figure: Ethernet setup form

You can also use IPv6 (Internet Protocol version 6) by setting the check box "Use IPv6". IPv6 is a version of the Internet Protocol (IP) intended to replace IPv4. The next parameters can be configured:

Ethernet Network

| | |
|-------------------------------------|--|
| Choose IP method | <input type="button" value="Static"/> |
| IP address | 192.168.3.110 |
| Netmask address | 255.255.128.0 |
| Gateway | 192.168.1.2 |
| Primary DNS | 192.168.1.9 |
| Secondary DNS | 192.168.11.9 |
| Use IPv6 | <input checked="" type="checkbox"/> <input type="button" value="Generate IPv6 Address"/> |
| IPv6 address | 2001::20d:b9ff:fe3f:9d88 |
| Netmask number | 64 |
| Gateway | 2001::1 |
| <input type="button" value="Save"/> | |

Figure: IPV6 setup

In many cases, IPv6 addresses are composed of two logical parts: a prefix of 64-bit (2001::) and a 64 bit part that is generated automatically from the MAC address of the interface.

The button "Generate IPv6 address" performs this task.

After saving the new options and once you have restarted Meshlium you have to validate the new configuration before the next 5 minutes, if not, the factory default configuration will be restored to avoid leaving Meshlium without connectivity. See section "Network setup confirmation" for more information.

To check IPv6 configuration, after save and restart Meshlium, go to Tools → Ping. Select Ethernet (IPv6), by default ipv6.google.com appears as destination host.

Ping

| | |
|--|--|
| Select interface | <input type="button" value="Ethernet (IPv6)"/> |
| Destination Host | ipv6.google.com |
| <input type="button" value="Do Test"/> | |
| | |

Figure: Ping IPv6 with name

If your Internet Service Provider does not support external IPv6 addresses yet, you can change it to a local address.

Ping

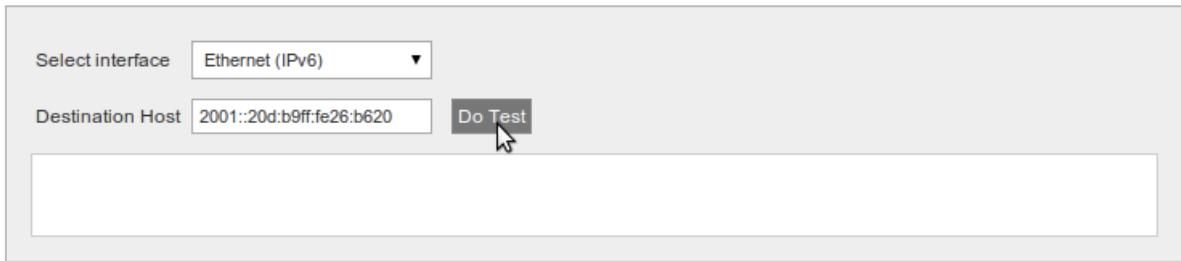


Figure: Ping IPv6 with address

Then press "Do Test". If something like next image appears, you have IPv6 correctly configured.

Ping

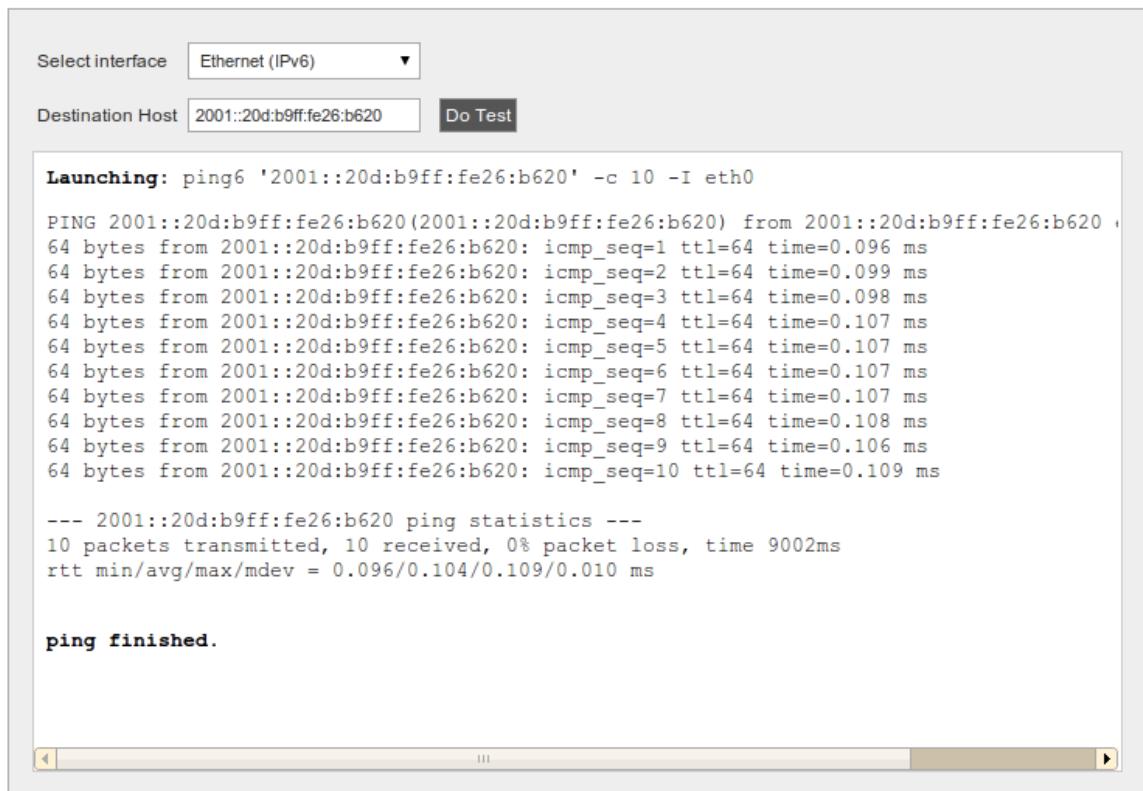


Figure: Ping results

9.2. WiFi Access Point setup

Meshlium is a WiFi Access Point and can supply network connectivity through WiFi. The most useful feature of the AP is to provide access to Manager System from a tablet or laptop without any physical connection with Meshlium.

By default the AP has the ESSID "meshliumXXXX" where XXXX are the last four digits of Ethernet MAC. This allows to identify different Meshliums installed nearby.

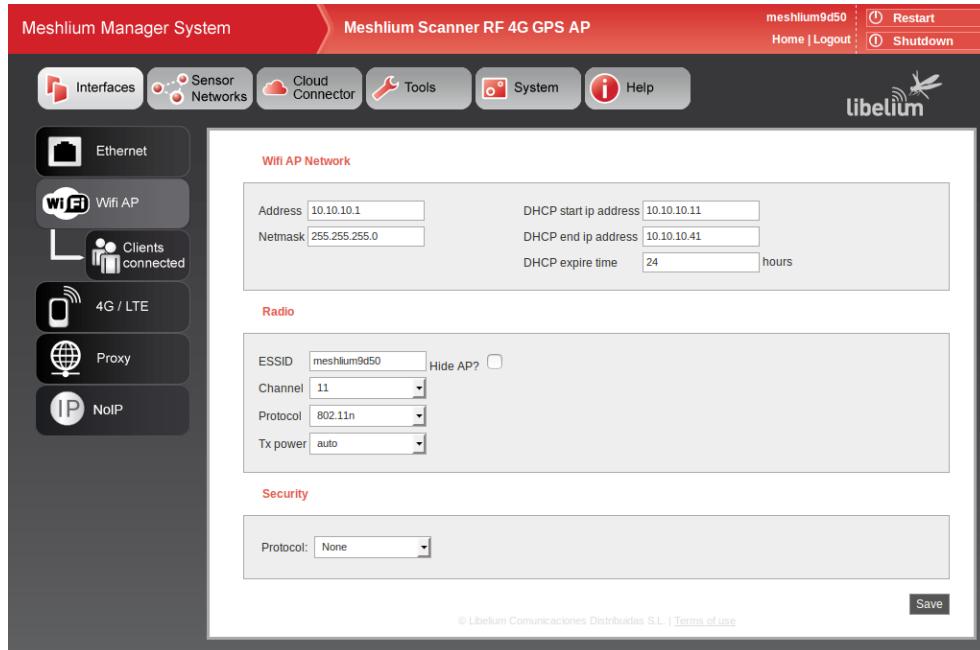


Figure: WiFi Access Point setup

9.2.1. Configuration

There are three sections in the configuration page: Network, Radio and Security.

Network

Here you can change the IP of the device in the network and the DHCP setup. Here can be setup:

- IP address of the AP.
- Netmask of the Address.
- DHCP range. The address range in the DHCP setup must be inside the network defined by the IP address and netmask of the AP.
- DHCP lease time.

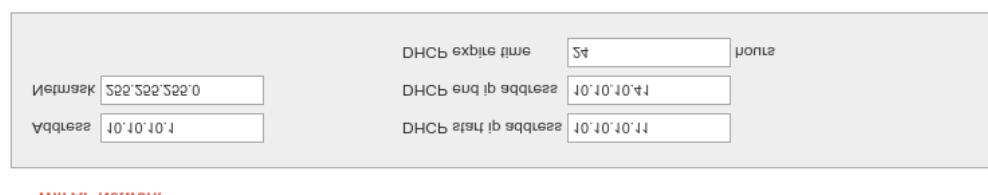


Figure: WiFi AP Network setup

Radio

These are specific WiFi parameters. Here can be setup:

- ESSID of the network. This is the name that appear in the devices that are searching WiFi networks. It can be public or hidden, allowing only connections manually started.
- Channel. It is possible to change the radio channel which is used for transmission, according to the next diagram.

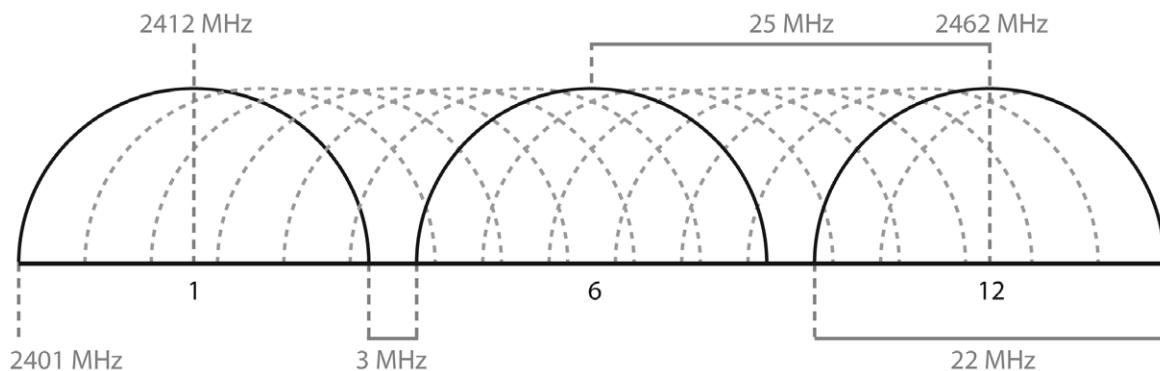


Figure: WiFi radio channels

- Protocol. It is possible to use 802.11g and 802.11n.
- Tx power. It allows to control the transmission power, thus the range of the AP.

Radio

| | | | |
|----------|--------------|----------|--------------------------|
| ESSID | meshlium7b1c | Hide AP? | <input type="checkbox"/> |
| Channel | 11 | | |
| Protocol | 802.11g | | |
| Tx power | 20 dB | | |

Figure: WiFi radio settings

Security

The WiFi AP can be protected with encryption. WEP, WPA and WPA2 are available.

WEP is enabled in the 5 and 13 characters configurations while WPA-PSK can be used with a password from 8 to 63 characters.

We recommend use WPA2 in order to get the a good security in the network.

Security

| | |
|-------------------|---------|
| Protocol: | WEP |
| Key size: | 40 bits |
| Password: | ***** |
| Confirm password: | ***** |
| *5 characters | |

Figure: WiFi AP WEP setup

Security

| | |
|---------------------|-------|
| Protocol: | WPA2 |
| Password: | ***** |
| Confirm password: | ***** |
| *8 to 63 characters | |

Figure: WiFi AP WPA2

Saving

After saving the setup, a message will warn the user about setup confirmation. A reboot is needed to apply new settings. The setup has to be confirmed within 5 minutes after reboot. More info in "**Network setup confirmation**".

Wifi AP Network

| | | | |
|--|---------------|---|--------------------------|
| Address: | 10.10.10.1 | DHCP start ip address: | 10.10.10.11 |
| Netmask: | 255.255.255.0 | Restart the machine to take effect 0.41 hours | |
|  <p>Once you restart you have to confirm the changes in the next 5 minutes.</p> | | | |
| Radio | | | |
| SSID: | meshlium7b1c | Hide AP? | <input type="checkbox"/> |
| Channel: | 11 | | |
| Protocol: | 802.11g | | |
| Tx power: | 20 dB | | |

Figure: Confirmation warning

9.2.2. Clients connected

This section shows the list of clients connected to the WiFi AP, showing information like the MAC address and the IP assigned. It is a quick way to know how many devices are connected and who are they.

Meshlium Manager System **Meshlium Scanner RF 4G GPS AP** meshlium9d50 |  Restart |  Home | Logout |  Shutdown

libelium

Ethernet

Wifi AP

Clients connected

4G / LTE

Proxy

NoIP

Clients Connected

| Time | MAC address | IP address | Hostname |
|------|-------------|------------|----------|
| | | | |

Figure: Clients connected

9.3. Network setup confirmation

After changing Ethernet or WiFi AP setup, a reboot is needed to apply new settings. After this reboot, the user has to confirm the settings in order to definitely apply them. If after 5 minutes of the reboot the user has not confirmed the new settings, last validated settings will be applied again. If there are no validated settings, default settings will be applied.

In the confirmation screen the user can select to confirm new settings, change to last validated settings or change to default settings. All the information of every setup will be shown. After the confirmation is done, the new settings will be stored as last validated settings for future confirmations.

The system will show a confirmation window for every setting changed, one for Ethernet setup and one for WiFi AP setup, so it can be independently confirmed.

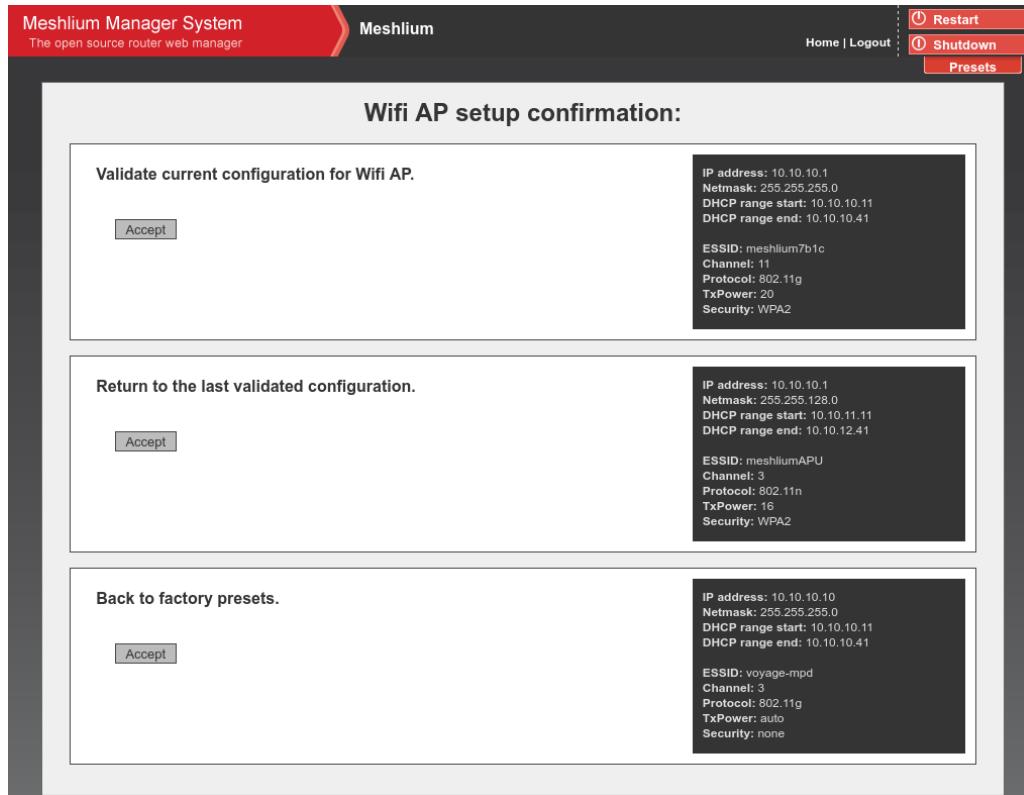


Figure: Confirmation screen

9.4. 4G setup

This plugin allows to setup the parameters of the modem connection. There is a list with some initial configurations depending on the country and the operator. However, this list may not be updated with the last valid configuration of your mobile provider. Ask your mobile company for the information required to connect (APN, Username, Password) and add the PIN code of the SIM card used (leave empty if there is no PIN). We recommend to disable the PIN in the SIM card as this will make easier the test and validation process and will avoid to block the SIM card.

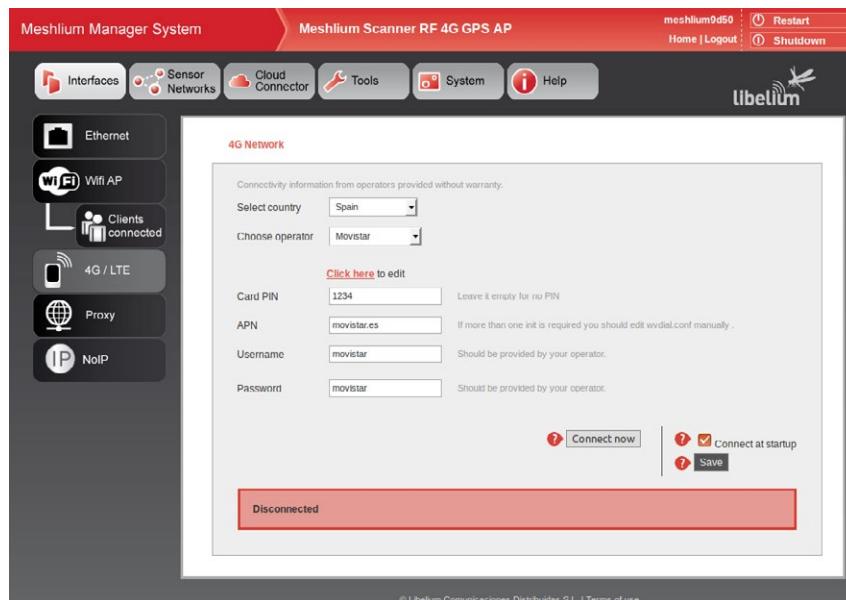


Figure: 4G setup plugin

After setting the 4G parameters and before save them you can test your connection through the "Connect now" button. It will try to connect to your carrier and get a valid IP. Once the connection has been made the default gateway of the machine is changed so all the clients connected through WiFi will reach the Internet via 4G.

Important: once you get a valid 4G IP through the "Connect now" button, you will not be able to access Meshlium via Ethernet unless you are connected through the same Local Area Network. For this reason we recommend to make all the tests using the WiFi connection.

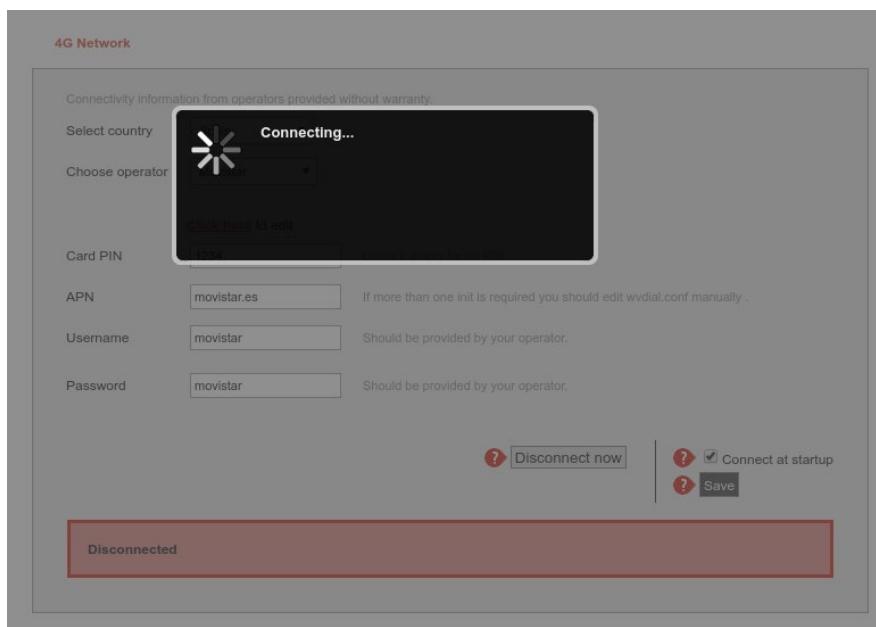


Figure: 4G connecting

If connection is established, the IP will be shown in the interface. Once the modem is connected a process will check the connection every 15 minutes and will try to reconnect in case of disconnection.



Figure: 4G successfully connected

Once validated your settings press the Disconnect button and save your configuration. If you want the 4G to be the Default Gateway of Meshlium each time it starts just activate the service in the "Set as Default Gateway" check box before saving. Setting this on will connect to the Internet using the 4G radio each time Meshlium restarts.

If any problem is preventing the device to connect at boot or to reconnect after a connection fall, a message will be displayed in the plugin. The user can manually stop automatic reconnection by pressing "Disconnect now" button.



Figure: 4G trying to reconnect

9.5. Proxy setup

This plugin allows to setup an HTTP proxy for some features of Meshlium. Here can be configured the proxy address, the port and the credentials (leave blank if not authentication needed).

| Proxy setup | |
|---------------------------------------|---------------|
| <input type="checkbox"/> Enable Proxy | |
| Address | 192.168.1.100 |
| Port | 8000 |
| User name | user |
| Password | **** |
| <input type="button" value="Save"/> | |

Figure: Proxy setup plugin

The proxy can be enabled or disabled from the control of the interface.

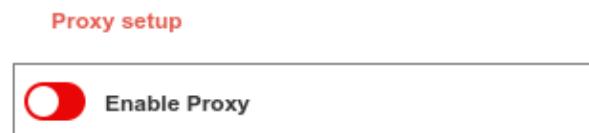


Figure: Proxy enable control



Figure: Proxy disable control

Note: Currently the proxy feature is only available for visualizer plugin. This feature will be gradually included in other services.

9.6. No-IP setup

This plugin allows to setup a No-IP account (<https://www.noip.com>) for dynamic IP remote access.

Configure the following parameters with the information of a valid and active No-IP account, previously created in the No-IP platform:

- **Hostname:** Name of the host to link with the Meshlium IP
- **Username:** No-IP account username
- **Password:** No-IP account password
- **Interval:** Update interval in minutes

Noip2 setup

Disable Noip2

| | |
|--------------------|-----------------------|
| Hostname | meshlium.org |
| User name | meshlium@libelium.com |
| Password | ***** |
| Interval (minutes) | 60 |

Save

Figure: NoIP setup plugin

Please, refer to the interface configuration section to use a proxy.



Figure: NoIP enable control



Figure: NoIP disable control

10. Wireless Sensor Networks

10.1. Meshlium and WaspMote

One of the main applications of Meshlium is being a gateway for Wireless Sensor Networks based on WaspMote and Plug & Sense! devices. These are sensor nodes that can work with different communication technologies like WiFi, 4G or XBee among others. More than 70 sensors are already available and a complete open source IDE (API libraries + compiler) make really easy to start working with the platform.

More info at:

<http://www.libelium.com/products/waspmote/>

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

In the main page of “**Sensor Networks**” tab will be shown the devices in the system showing the last received data.

The screenshot shows the Meshlium Manager System web interface. At the top, there's a red header bar with the title "Meshlium Manager System" and "The open source router web manager". To the right of the title are buttons for "meshlium7b1c", "Restart", "Home | Logout", and "Shutdown". Below the header is a navigation bar with icons for "Interfaces", "Sensor Networks", "Cloud Connector", "Tools", "System", "Update Manager", and "Help". On the far right, there's a "libelium" logo with a small antenna icon. The main content area is titled "WaspMotes current status" and displays four nodes: B_EV_1, B_GA_2, B_GA_3, and B_GA_4. Each node card shows its last update time and a list of sensors with their values. For example, B_EV_1 has sensors BEND (41.2), HALL (0), PW (141.25), and VBR (0). B_GA_2 has AP1 (12.2), AP2 (3.5), LPG (12.5), and NH3 (123.52). B_GA_3 has NO2 (13.52), O3 (13.523), SV (13.53), and VOC (12.52). B_GA_4 has HUMA (123.5), PA (123.5), TCA (123.5), and TFA (123.5). At the bottom of the content area, there's a copyright notice: "© Libelium Comunicaciones Distribuidas S.L. | [Terms of use](#)".

Figure: Nodes with last data

10.2. Receiving and storing data

10.2.1. Receiving through RF communications

10.2.1.1. RF module setup

Meshlium can equip three different RF modules: XBee-PRO 802.15.4 (2.4 GHz), XBee 868LP (868 MHz) and XBee-PRO 900HP (900 MHz). It can equip several modules at the same time.

RF modules setup can be found in:

[Sensor Networks → RF modules](#)

The plugin will show a tab for each module detected in the device.

10.2.1.1.1. XBee-PRO 802.15.4 radio setup

RF Modules

Disable Service

Module 1 Module 2

802.15.4

| | |
|---|-------------------------------------|
| <input checked="" type="checkbox"/> SensorParser Running | <input type="button" value="Stop"/> |
| PAN ID: | 3332 |
| Channel: | 0x15 ▾ |
| Network address (4 hex digits): | 2222 |
| Node ID: | |
| Power Level: | 4 ▾ |
| Encrypted mode: | Off ▾ |
| Encryption key (must be 16 characters): | |
| MAC high: | 13A200 |
| MAC low: | 41023A9A |
| <input type="button" value="Load MAC"/> <input type="button" value="Check status"/> <input type="button" value="Save"/> | |

Figure: XBee-PRO 802.15.4 setup

In this module the parameters to setup are:

- **PAN ID:** Personal Area Network ID (also known as Network ID). It is the identifier of the network. It has to be the same in all the nodes in order to be able to send data to this Meshlium.
- **Channel:** Frequency channel used for transmissions.
- **Network Address:** User defined identifier for the node in the network. 4 hexadecimal digits (MY).
- **Node ID:** readable name set for the device, by default "Meshlium". Up to 20 characters.
- **Power level:** [0-4] By default 4.
- **Encrypted mode:** Internal XBee AES 128 bits encryption. Disabled by default.
- **Encryption key:** 16 characters.
- **MAC:** 64 bits hardware address of the module. It is a read-only value divided in two parts:
 - MAC-high: 32 bits (8 hexadecimal digits)
 - MAC-low: 32 bits (8 hexadecimal digits)

This setup must be consistent with those set on the Wasp mote and Plug and Sense nodes.

In the bottom part of the interface, the button "**Check status**" allows to check if the module setup is concordant with values shown in the interface. The button "**Save**" will write the parameters in the module.

Both process ("Save" and "Check status") require the sensorParser daemon to be stopped. This means no frames will be received while executing this actions. Be patient this can take up to 1 minute to finish.

10.2.1.1.2. XBee 868LP radio setup

RF Modules

XBee 868LP

SensorParser Running

| | |
|-----------------|----------|
| PAN ID: | 7FFF |
| Node ID: | meshlium |
| Preamble (0-7): | 0 |

Channels:

| | | | |
|--|--|--|--|
| <input checked="" type="checkbox"/> Channel 0 | <input checked="" type="checkbox"/> Channel 1 | <input checked="" type="checkbox"/> Channel 2 | <input checked="" type="checkbox"/> Channel 3 |
| <input checked="" type="checkbox"/> Channel 4 | <input checked="" type="checkbox"/> Channel 5 | <input checked="" type="checkbox"/> Channel 6 | <input type="checkbox"/> Channel 7 |
| <input checked="" type="checkbox"/> Channel 8 | <input checked="" type="checkbox"/> Channel 9 | <input checked="" type="checkbox"/> Channel 10 | <input type="checkbox"/> Channel 11 |
| <input checked="" type="checkbox"/> Channel 12 | <input checked="" type="checkbox"/> Channel 13 | <input checked="" type="checkbox"/> Channel 14 | <input type="checkbox"/> Channel 15 |
| <input checked="" type="checkbox"/> Channel 16 | <input checked="" type="checkbox"/> Channel 17 | <input type="checkbox"/> Channel 18 | <input type="checkbox"/> Channel 19 |
| <input checked="" type="checkbox"/> Channel 20 | <input checked="" type="checkbox"/> Channel 21 | <input type="checkbox"/> Channel 22 | <input type="checkbox"/> Channel 23 |
| <input checked="" type="checkbox"/> Channel 24 | <input checked="" type="checkbox"/> Channel 25 | <input checked="" type="checkbox"/> Channel 26 | <input checked="" type="checkbox"/> Channel 27 |
| <input checked="" type="checkbox"/> Channel 28 | <input checked="" type="checkbox"/> Channel 29 | | |

Current Frequency Mask: 3F33777F

Power Level: 4

Encrypted mode: Off

Encrypt key (must be 16 characters):

MAC high: 0013A200

MAC low: 408E079B

Figure: XBee 868LP setup

In this module the parameters to setup are:

- **PAN ID:** Personal Area Network ID (also known as Network ID). It is the identifier of the network. It has to be the same in all the nodes in order to be able to send data to this Meshlium.
- **Node ID:** readable name set for the device, by default "Meshlium". Up to 20 characters.
- **Preamble:** An extension to PAN ID. It needs to be the same in the nodes too.
- **Channel:** This module allow to select the channels that can be used. The module automatically selects the channel for the communication between available ones. Once the channels are selected, the plugin generates the "**Channel Frequency Mask**" (read-only 8 hex digits) that the needs to be set in the nodes.
- **Power level:** [0-4] By default 4.
- **Encrypted mode:** Internal XBee AES 128 bits encryption. Disabled by default.
- **Encryption key:** 16 characters.
- **MAC:** 64 bits hardware address of the module. It is a read-only value divided in two parts:
 - MAC-high: 32 bits (8 hexadecimal digits)
 - MAC-low: 32 bits (8 hexadecimal digits)

10.2.1.1.3. XBee-PRO 900HP radio setup

RF Modules

Module 1 Module 2

XBee 900HP

SensorParser Running Stop

PAN ID (PAN ID): 7FFF

Node ID: meshli1

Preamble (0-7): 0

Channels:

| | | | |
|--|--|--|--|
| <input checked="" type="checkbox"/> Channel 0 | <input checked="" type="checkbox"/> Channel 1 | <input checked="" type="checkbox"/> Channel 2 | <input checked="" type="checkbox"/> Channel 3 |
| <input checked="" type="checkbox"/> Channel 4 | <input checked="" type="checkbox"/> Channel 5 | <input checked="" type="checkbox"/> Channel 6 | <input checked="" type="checkbox"/> Channel 7 |
| <input checked="" type="checkbox"/> Channel 8 | <input checked="" type="checkbox"/> Channel 9 | <input checked="" type="checkbox"/> Channel 10 | <input checked="" type="checkbox"/> Channel 11 |
| <input checked="" type="checkbox"/> Channel 12 | <input checked="" type="checkbox"/> Channel 13 | <input checked="" type="checkbox"/> Channel 14 | <input checked="" type="checkbox"/> Channel 15 |
| <input checked="" type="checkbox"/> Channel 16 | <input checked="" type="checkbox"/> Channel 17 | <input checked="" type="checkbox"/> Channel 18 | <input type="checkbox"/> Channel 19 |
| <input checked="" type="checkbox"/> Channel 20 | <input checked="" type="checkbox"/> Channel 21 | <input checked="" type="checkbox"/> Channel 22 | <input checked="" type="checkbox"/> Channel 23 |
| <input checked="" type="checkbox"/> Channel 24 | <input checked="" type="checkbox"/> Channel 25 | <input checked="" type="checkbox"/> Channel 26 | <input checked="" type="checkbox"/> Channel 27 |
| <input checked="" type="checkbox"/> Channel 28 | <input checked="" type="checkbox"/> Channel 29 | <input checked="" type="checkbox"/> Channel 30 | <input checked="" type="checkbox"/> Channel 31 |
| <input checked="" type="checkbox"/> Channel 32 | <input checked="" type="checkbox"/> Channel 33 | <input checked="" type="checkbox"/> Channel 34 | <input checked="" type="checkbox"/> Channel 35 |
| <input checked="" type="checkbox"/> Channel 36 | <input checked="" type="checkbox"/> Channel 37 | <input checked="" type="checkbox"/> Channel 38 | <input checked="" type="checkbox"/> Channel 39 |
| <input checked="" type="checkbox"/> Channel 40 | <input checked="" type="checkbox"/> Channel 41 | <input checked="" type="checkbox"/> Channel 42 | <input checked="" type="checkbox"/> Channel 43 |
| <input checked="" type="checkbox"/> Channel 44 | <input checked="" type="checkbox"/> Channel 45 | <input checked="" type="checkbox"/> Channel 46 | <input checked="" type="checkbox"/> Channel 47 |
| <input checked="" type="checkbox"/> Channel 48 | <input checked="" type="checkbox"/> Channel 49 | <input checked="" type="checkbox"/> Channel 50 | <input checked="" type="checkbox"/> Channel 51 |
| <input checked="" type="checkbox"/> Channel 52 | <input checked="" type="checkbox"/> Channel 53 | <input checked="" type="checkbox"/> Channel 54 | <input checked="" type="checkbox"/> Channel 55 |
| <input checked="" type="checkbox"/> Channel 56 | <input checked="" type="checkbox"/> Channel 57 | <input checked="" type="checkbox"/> Channel 58 | <input checked="" type="checkbox"/> Channel 59 |
| <input checked="" type="checkbox"/> Channel 60 | <input checked="" type="checkbox"/> Channel 61 | <input checked="" type="checkbox"/> Channel 62 | <input checked="" type="checkbox"/> Channel 63 |

Current Frequency Mask: FFFFFFFF7FFF

Power Level: 4

Encrypted mode: Off

Encrypt key (must be 16 characters):

MAC high: 13A200

MAC low: 40A66E5A

Minimum Frequency count: 25

Load Module Info Check status Save

Figure: XBee-PRO 900HP setup

In this module the parameters to setup are:

- **PAN ID:** Personal Area Network ID (also known as Network ID). It is the identifier of the network. It has to be the same in all the nodes in order to be able to send data to this Meshlium.
- **Node ID:** readable name set for the device, by default "Meshlium". Up to 20 characters.
- **Preamble:** An extension to PAN ID. It needs to be the same in the nodes too.
- **Channel:** This module allow to select the channels that can be used. The module automatically selects the channel for the communication between available ones. Once the channels are selected, the plugin generates the "Channel Frequency Mask" (read-only 16 hex digits) that the needs to be set in the nodes. In the bottom part of the interface is shown the minimum number of channels that have to be selected.
- **Power level:** [0-4] By default 4.
- **Encrypted mode:** Internal XBee AES 128 bits encryption. Disabled by default.
- **Encryption key:** 16 characters.
- **MAC:** 64 bits hardware address of the module. It is a read-only value divided in two parts:
 - MAC-high: 32 bits (8 hexadecimal digits)
 - MAC-low: 32 bits (8 hexadecimal digits)

10.2.1.2. Encryption setup

Link layer key management (AES-128)

This feature is provided by XBee modules.

Encryption is this layer provided through the AES 128b algorithm. Specifically through the type AES-CTR. In this case the Frame Counter field has a unique ID and encrypts all the information contained in the Payload field which is the place in the link layer frame where the data to be sent is stored. The way in which the libraries have been developed for module programming means that encryption activation is as simple as running the initialization function and giving it a key to use in the encryption.

```
{
    xbee.encryptionMode(1);
    xbee.setLinkKey(key);
}
```

In Manager System, on Sensor Network section, users can encrypt messages on link layer. It can be achieved by setting the parameters:

- **Encrypted mode:** true/false (by default false)
- **Encryption Key:** Must be 16 characters

See section "XBee module setup" for more details about setting encryption.

10.2.1.2.1. Application layer key management

Meshlium is capable to properly receive encrypted data from Waspmove. The coding process is made in the application layer, so it is Waspmove and Meshlium processor and not XBee module who encrypts and decrypts the messages.

The user have to set a key for the encryption in Waspmove and Meshlium.

In Manager System it can be found:

[Sensor Networks → Encryption](#)

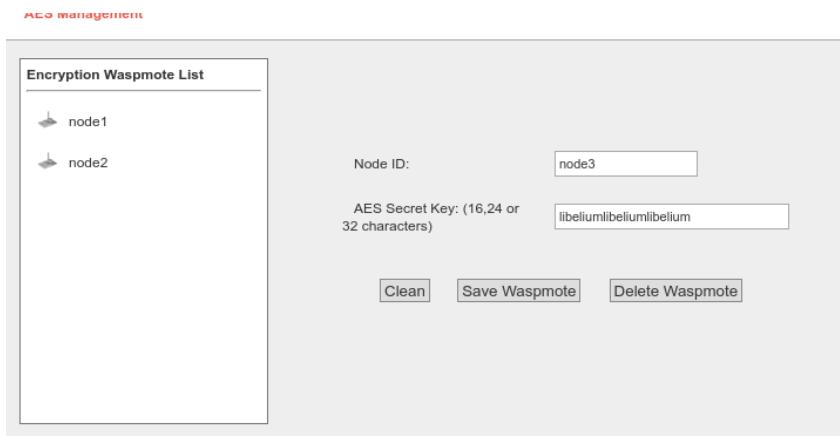


Figure: Encryption key setup

For each Waspmove can send frames to Meshlium, Waspmoves keys can be added to an encryption Key file. In this interface the user must specify the node ID and the Waspmove AES secret key (128, 192 or 256 bits).

After defining the above fields to press the button "Add Waspmove". A new entry is generated in the left list.

To delete Waspmove of list, select the Waspmove and press "Delete Waspmove". The encrypted frames received from this node cannot be decrypted anymore.

The AES secret key is necessary to recognize the frames sent each Waspmove to Meshlium.

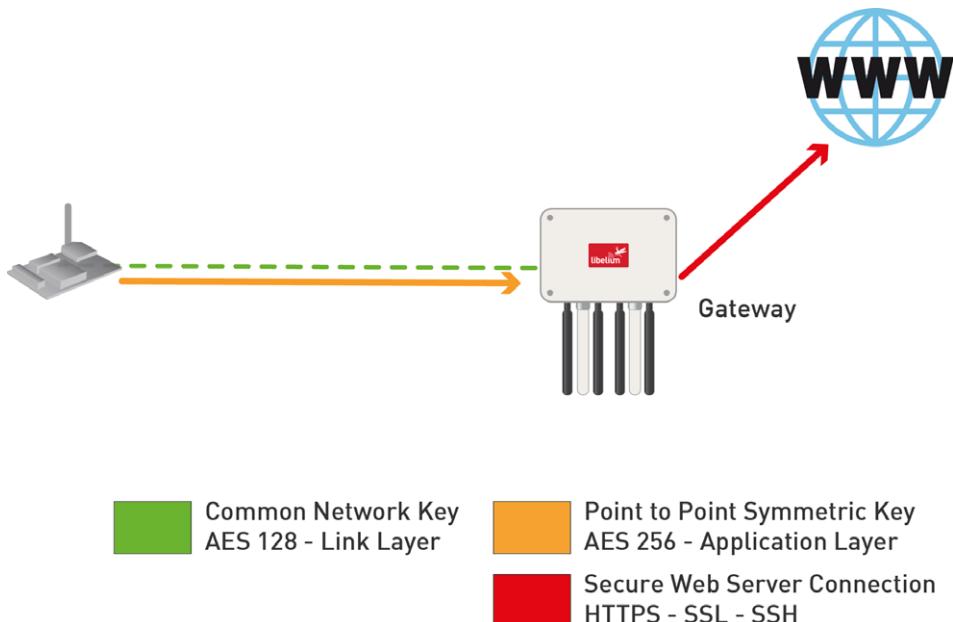


Figure: Encryption in communications

Once the user has properly set the AES keys associated to every waspmote, receiving AES encrypted frames in Meshlium is a straightforward process.

As an encrypted frame arrives to Meshlium, sensorParser program takes the appropriate key for the WaspMote ID. The frame is decoded with the key and the information is extracted to the sensor database.

Bear in mind that to use this feature, the frame have to be created with the WaspMote libraries for AES frames. You can see further information about this in the WaspMote guides.

<http://www.libelium.com/waspMote>

10.2.1.3. Capturing and storing sensor data from RF module

Meshlium will receive the sensor data sent by WaspMote and Plug and Sense using the RF radio and it will store the frames in the local database.

That can be done in an automatic way thanks to the Sensor Parser.

The Sensor Parser is a software system which is able to do the following tasks in an easy and transparent way:

- receive frames from XBee modules (with the Data Frame format)
- parse these frames
- store the data in the local database

Besides, the user can add his own sensors, and the data will be parsed in the database too. In order to add your own sensor frames properly go to the section "Sensor list".

We can perform two different storage options with the frames captured:

- Local database
- External database

All the data is stored in the local database in the first place, then it can be synchronized to an external database as per user needs.

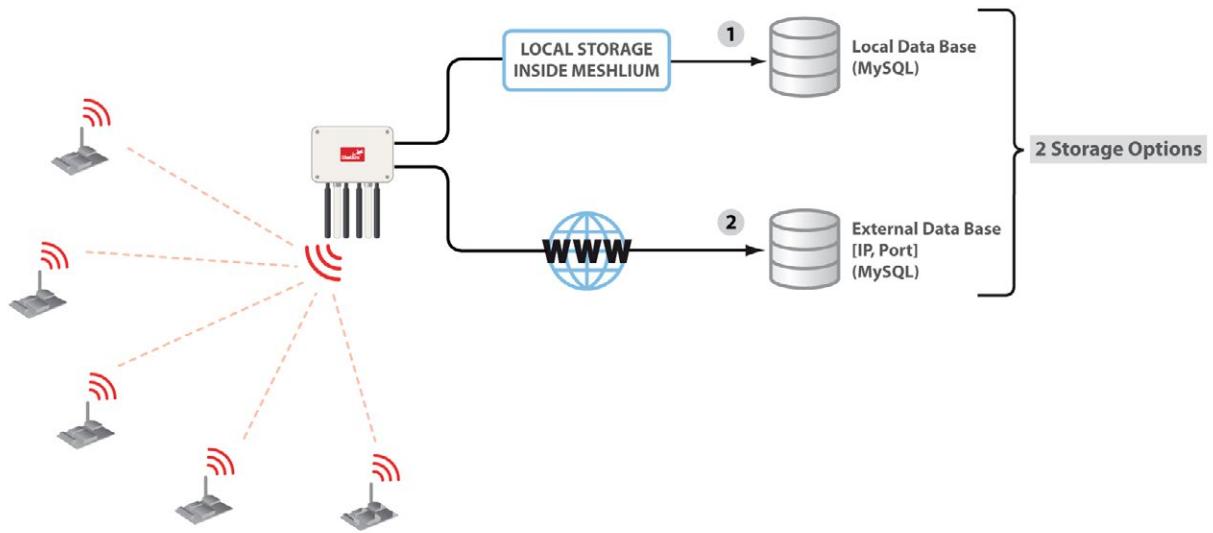


Figure: Storage options

The data stored can be synchronized too to external services using the Internet connection.

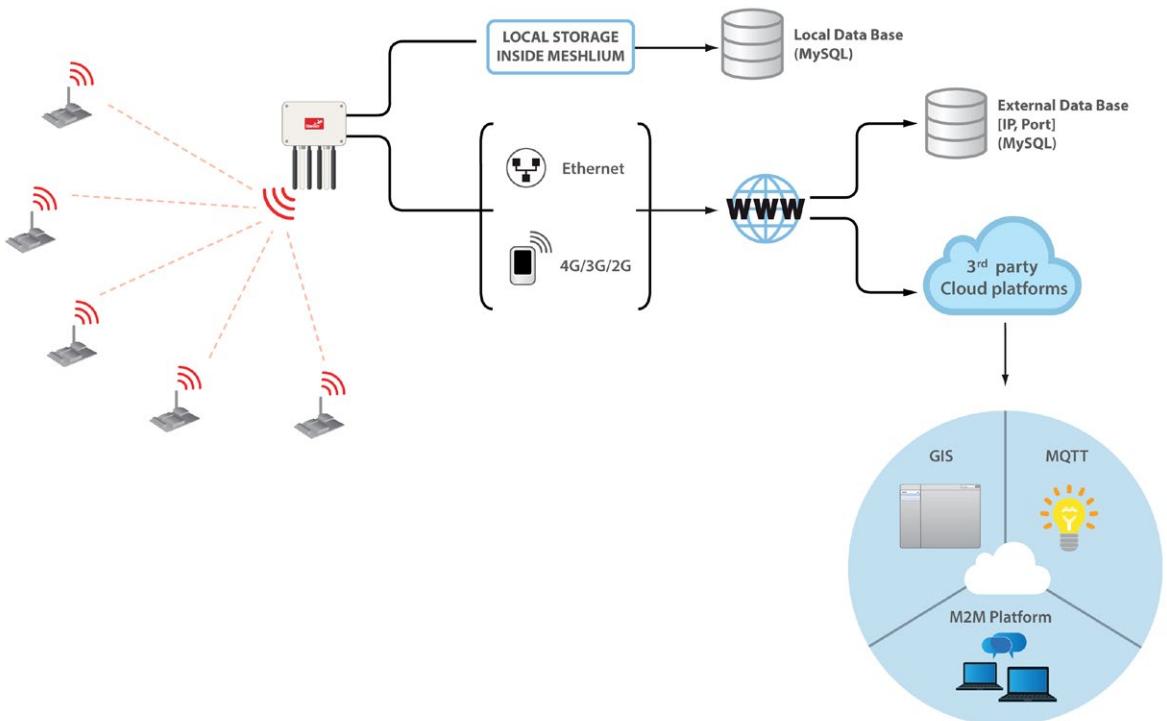


Figure: External synchronization options

10.2.2. Receiving through 4G / WiFi / Ethernet (HTTP)

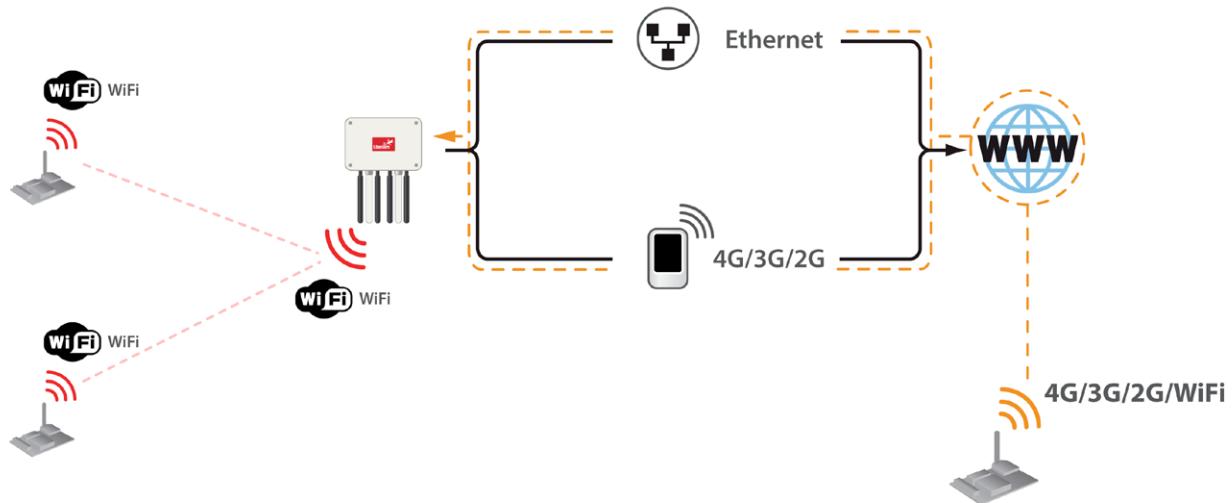


Figure: HTTP data reception

Meshlium accepts POST and GET requests in any of its interfaces so Waspmotes are capable of sending frames, through GPRS, 3G, 4G or WiFi modules, via HTTP requests. Meshlium, through HTTP requests is capable of:

- receive frames from 4G/3G/GPRS/GSM, WiFi or Ethernet via HTTP
- parse these frames
- store the data in local Database
- synchronize the local Database with an external database

Frames received by this method are stored the same way that RF frames, and are identically processed at synchronization stage.

No configuration of any kind is needed to use HTTP. If HTTPS is needed, certificate configuration would be needed in many cases (self signed certificate is included with Meshlium).

Like the case of RF modules reception, the user can add his own sensors.

10.3. Capturer

The Capturer plugin is where the user can check most recent data received in order to check if the nodes are sending information.

It can be found in:

[Sensor Networks → Capturer](#)

Capturer plugin have several tabs where the user can see recent data received, manage external database synchronization and perform some local database operations.

The screenshot shows the Meshlium Manager System web interface. At the top, there are tabs for "Meshlium Manager System" (selected), "Meshlium Scanner RF 4G GPS AP", and "meshlium7b1c". On the right, there are buttons for "Restart" and "Shutdown". Below the tabs, there is a navigation menu with icons for "Interfaces", "Sensor Networks", "Cloud Connector", "Tools", "System", "Update Manager", and "Help". A "libelium" logo is also present.

The main content area is titled "Captured Data" and includes tabs for "Local DataBase", "External Database", "Show me NOW", and "Advanced". Under "Connection data", there are fields for "Database" (MeshliumDB), "Table" (sensorParser), "IP" (localhost), "Port" (3306), "User" (root), and "Password" (libelium2007). There is also an "Auto-purge" section with options to keep the last 1 day in the database, deleting only synchronized data, or deleting all data. A "Save" button is located in this section. Below this, a message says "Show data Last 100 insertions.".

At the bottom, there is a table titled "Captured Data" showing sensor readings:

| ID | Date | SyncID | Wasp ID | Secret | Fr. | Type | Fr. Number | Sensor | Value |
|--------|-----------------------|--------|------------------|--------|-----|---------|---------------------|-----------|-------|
| 824066 | 2016-08-05 12:53:49 0 | A_AD_4 | 280C530E695B4AAD | 134 | 159 | MILLIS | | 347414906 | |
| 824065 | 2016-08-05 12:53:49 0 | A_AD_4 | 280C530E695B4AAD | 134 | 159 | ACC | 0;0;0 | | |
| 824064 | 2016-08-05 12:53:47 0 | A_AD_3 | 280C530E695B4AAD | 134 | 158 | IN_TEMP | 1.00 | | |
| 824063 | 2016-08-05 12:53:47 0 | A_AD_3 | 280C530E695B4AAD | 134 | 158 | RAM | 2478 | | |
| 824062 | 2016-08-05 12:53:47 0 | A_AD_3 | 280C530E695B4AAD | 134 | 158 | GMT | 1 | | |
| 824061 | 2016-08-05 12:53:47 0 | A_AD_3 | 280C530E695B4AAD | 134 | 158 | TIME | 1-22-59+1 | | |
| 824060 | 2016-08-05 12:53:44 0 | A_AD_2 | 280C530E695B4AAD | 134 | 157 | TIME | 1-22-59 | | |
| 824059 | 2016-08-05 12:53:44 0 | A_AD_2 | 280C530E695B4AAD | 134 | 157 | DATE | 0-5-10 | | |
| 824058 | 2016-08-05 12:53:44 0 | A_AD_2 | 280C530E695B4AAD | 134 | 157 | NID | 5566 | | |
| 824057 | 2016-08-05 12:53:44 0 | A_AD_2 | 280C530E695B4AAD | 134 | 157 | NA | 1234 | | |
| 824056 | 2016-08-05 12:53:42 0 | A_AD_1 | 280C530E695B4AAD | 134 | 156 | MAC | 013 | | |
| 824055 | 2016-08-05 12:53:42 0 | A_AD_1 | 280C530E695B4AAD | 134 | 156 | RSSI | -8 | | |
| 824054 | 2016-08-05 12:53:42 0 | A_AD_1 | 280C530E695B4AAD | 134 | 156 | GPS | 41.599998;-0.880000 | | |

Figure: Capturer plugin

10.3.1. Local database

Meshlium has a MySQL database up and running which is used to locally store the information captured. In the "Local Data Base" tab the user can see the default connection parameters.

- Database:** MeshliumDB
- Table:** sensorParser
- IP:** localhost
- Port:** 3306
- User:** root
- Password:** libelium2007

Captured Data

Local DataBase External Database Show me NOW Advanced

| | |
|--|--|
| Connection data <hr/> <p>Database: <input type="text" value="MeshliumDB"/></p> <p>Table: <input type="text" value="sensorParser"/></p> <p>IP: <input type="text" value="localhost"/></p> <p>Port: <input type="text" value="3306"/></p> <p>User: <input type="text" value="root"/></p> <p>Password: <input type="text" value="libelium2007"/></p> | <p><input checked="" type="checkbox"/> Auto-purge</p> <p>Keep the last <input type="text" value="1"/> days in the database</p> <p><input checked="" type="radio"/> deleting only synchronized data <input type="radio"/> deleting all data</p> <p>Show data Last <input type="text" value="100"/> insertions.</p> <p style="text-align: right;">Save</p> |
|--|--|

| ID | Date | SyncID | Wasp ID | Secret | Fr. | Type | Fr. Number | Sensor | Value |
|--------|-----------------------|--------|------------------|--------|-----|---------|------------|---------------------|-------|
| 824066 | 2016-08-05 12:53:49 0 | A_AD_4 | 280C530E695B4AAD | 134 | 159 | MILLIS | | 347414906 | |
| 824065 | 2016-08-05 12:53:49 0 | A_AD_4 | 280C530E695B4AAD | 134 | 159 | ACC | | 0;0;0 | |
| 824064 | 2016-08-05 12:53:47 0 | A_AD_3 | 280C530E695B4AAD | 134 | 158 | IN_TEMP | 1.00 | | |
| 824063 | 2016-08-05 12:53:47 0 | A_AD_3 | 280C530E695B4AAD | 134 | 158 | RAM | | 2478 | |
| 824062 | 2016-08-05 12:53:47 0 | A_AD_3 | 280C530E695B4AAD | 134 | 158 | GMT | | 1 | |
| 824061 | 2016-08-05 12:53:47 0 | A_AD_3 | 280C530E695B4AAD | 134 | 158 | TIME | 1-22-59+1 | | |
| 824060 | 2016-08-05 12:53:44 0 | A_AD_2 | 280C530E695B4AAD | 134 | 157 | TIME | 1-22-59 | | |
| 824059 | 2016-08-05 12:53:44 0 | A_AD_2 | 280C530E695B4AAD | 134 | 157 | DATE | 0-5-10 | | |
| 824058 | 2016-08-05 12:53:44 0 | A_AD_2 | 280C530E695B4AAD | 134 | 157 | NID | | 5566 | |
| 824057 | 2016-08-05 12:53:44 0 | A_AD_2 | 280C530E695B4AAD | 134 | 157 | NA | | 1234 | |
| 824056 | 2016-08-05 12:53:42 0 | A_AD_1 | 280C530E695B4AAD | 134 | 156 | MAC | 013 | | |
| 824055 | 2016-08-05 12:53:42 0 | A_AD_1 | 280C530E695B4AAD | 134 | 156 | RSSI | | -8 | |
| 824054 | 2016-08-05 12:53:42 0 | A_AD_1 | 280C530E695B4AAD | 134 | 156 | GPS | | 41.599998;-0.880000 | |

Figure: Local database tab

In this tab the user can:

- Show last insertions, up to 500.



Figure: Show last data

- Setup Auto-purge. This function allow to program a daily maintenance in the local database that deletes old data, keeping only the number of days configured, and allowing to delete synchronized data (only external database) or all data.



Figure: Autopurge setup

10.3.2. External Database

Meshlium can synchronize all the sensor information stored in the local database to an external MySQL database managed by the user.

The screenshot shows the 'External Database' tab with the following interface elements:

- Captured Data** section: Includes tabs for Local DataBase, External Database, Show me NOW, and Advanced. The External Database tab is selected.
- Connection data** form:
 - Database: MeshliumDB
 - Table: sensorParser
 - IP: 192.168.2.13
 - Port: 3306
 - User: root
 - Password: libelium2007
- Store frames in the external data base** checkbox (checked), Save button.
- Show data** button, Last 100 insertions, Show sql script, and a note '(to create database and table)'.
- Save**, **Check Connection**, and **Mark all as synchronized** buttons.
- Data table** showing sensor data:

| ID | Date | ID Wasp | ID Secret | Fr. type | Fr. number | Sensor | Value |
|---------|---------------------|---------|------------------|----------|------------|--------|---------|
| 3606268 | 2016-08-08 06:01:30 | B_GA_2 | 280C530E695B4AAD | 6 | 91 | AP1 | 12.2 |
| 3606267 | 2016-08-08 06:01:30 | B_GA_2 | 280C530E695B4AAD | 6 | 91 | AP2 | 3.5 |
| 3606266 | 2016-08-08 06:01:33 | B_GA_3 | 280C530E695B4AAD | 6 | 92 | SV | 13.53 |
| 3606265 | 2016-08-08 06:01:33 | B_GA_3 | 280C530E695B4AAD | 6 | 92 | NO2 | 13.52 |
| 3606264 | 2016-08-08 06:01:33 | B_GA_3 | 280C530E695B4AAD | 6 | 92 | O3 | 13.523 |
| 3606263 | 2016-08-08 06:01:33 | B_GA_3 | 280C530E695B4AAD | 6 | 92 | VOC | 12.52 |
| 3606262 | 2016-08-08 06:01:35 | B_GA_4 | 280C530E695B4AAD | 6 | 93 | TCA | 123.5 |
| 3606261 | 2016-08-08 06:01:35 | B_GA_4 | 280C530E695B4AAD | 6 | 93 | TFA | 123.5 |
| 3606260 | 2016-08-08 06:01:35 | B_GA_4 | 280C530E695B4AAD | 6 | 93 | HUMA | 123.5 |
| 3606259 | 2016-08-08 06:01:35 | B_GA_4 | 280C530E695B4AAD | 6 | 93 | PA | 123.5 |
| 3606258 | 2016-08-08 06:01:37 | B_EV_1 | 280C530E695B4AAD | 6 | 94 | PW | 141.25 |
| 3606257 | 2016-08-08 06:01:37 | B_EV_1 | 280C530E695B4AAD | 6 | 94 | BEND | 41.2 |
| 3606256 | 2016-08-08 07:50:35 | A_AG_3 | 280C530E695B4AAD | 134 | 16 | TD | 321.120 |

Figure: External database tab

In this tab the user can:

- Setup the parameters of the external database and check the connection.

| Connection data | |
|------------------|--------------|
| Database: | MeshliumDB |
| Table: | sensorParser |
| IP: | 192.168.2.13 |
| Port: | 3306 |
| User: | root |
| Password: | libelium2007 |

Store frames in the external data base

Show data Last 100 insertions.

Figure: External database setup

- Enable or disable the synchronization.

Store frames in the external data base

Figure: Control to enable or disable synchronization

Show last data inserted in the external database (up to 500 data).

Show data Last 100 insertions.

Figure: Show last inserted data

Show the SQL script used to create the database and table needed for the synchronization.

Show sql script (to create database and table)

Figure: Show SQL script

Mark all data in the local database as synchronized so it will not be sent to the external database.

Mark all as synchronized

Figure: Mark as synchronized button

The steps to setup the synchronization are:

- Before configuring anything, make sure you have a MySQL database working under your control. Make sure the database listen to connections in an external IP.
- Press the “Show SQL script” button, copy the SQL code. You can modify user, password, database name and table, as long as you change the setup of the connection to match.

```

Just copy and paste:

CREATE database MeshliumDB;

CREATE TABLE `sensorParser` (
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `id_wasp` varchar(16) COLLATE utf8_unicode_ci DEFAULT NULL,
  `id_secret` varchar(22) COLLATE utf8_unicode_ci DEFAULT NULL,
  `frame_type` int(11) DEFAULT NULL,
  `frame_number` int(11) DEFAULT NULL,
  `sensor` varchar(16) COLLATE utf8_unicode_ci DEFAULT NULL,
  `value` varchar(50) COLLATE utf8_unicode_ci DEFAULT NULL,
  `timestamp` timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP,
  `sync` bigint(10) unsigned NOT NULL DEFAULT '0',
  `raw` varchar(100) COLLATE utf8_unicode_ci NOT NULL DEFAULT 'noraw',
  `parser_type` tinyint(3) NOT NULL DEFAULT '0',
  `MeshliumID` varchar(150) COLLATE utf8_unicode_ci NOT NULL DEFAULT 'meshlium'
  PRIMARY KEY (`id`),
  KEY `id_wasp` (`id_wasp`),
  KEY `visualizer` (`id_wasp`, `timestamp`),
);

```

Figure: SQL script

- Enter the connection settings and press “Save” button. You can check the connection now to ensure the settings are correct.
- Enable the service with the checkbox and save.

The synchronization service runs every 60 seconds and synchronizes up to 200 data every loop. The service synchronizes first newer data, as it is more relevant for decision making. This could make data in external database to be out of order. As every data has a timestamp, this should not be a problem for using the data in any external application.

10.3.3. Show me Now

In this tab the user can show the last frame received. The user can show only last frame or can specify if the information will be updated periodically with the defined interval just checking the "Use the Defined Interval" button.

Captured Data

| | | | |
|----------------|-------------------|-------------|----------|
| Local DataBase | External Database | Show me NOW | Advanced |
|----------------|-------------------|-------------|----------|

Stop Scan Use the defined Scan interval 10 Seconds Clean

```
2016-08-01 09:31:28.37 - BINARY frame
Internal ID:665C530E695B4A26 - Waspmove ID:B_AG_1 - Frame Type:6 - Frame Number:140
TCB:321.135
TFB:321.125
HUMB:321.1345
SOILT:321.345

2016-08-01 09:31:28.37 - BINARY frame
Internal ID:665C530E695B4A26 - Waspmove ID:B_AG_1 - Frame Type:6 - Frame Number:140
TCB:321.135
TFB:321.125
HUMB:321.1345
SOILT:321.345

2016-08-01 09:31:28.37 - BINARY frame
Internal ID:665C530E695B4A26 - Waspmove ID:B_AG_1 - Frame Type:6 - Frame Number:140
TCB:321.135
TFB:321.125
HUMB:321.1345
SOILT:321.345

2016-08-01 09:31:28.37 - BINARY frame
Internal ID:665C530E695B4A26 - Waspmove ID:B_AG_1 - Frame Type:6 - Frame Number:140
TCB:321.135
TFB:321.125
HUMB:321.1345
SOILT:321.345

2016-08-01 09:31:28.37 - BINARY frame
Internal ID:665C530E695B4A26 - Waspmove ID:B_AG_1 - Frame Type:6 - Frame Number:140
TCB:321.135
TFB:321.125
HUMB:321.1345
SOILT:321.345
```

Figure: Show me Now tab

The screen can be cleaned with the button in the top right.

10.3.4. Advanced database options

This tab shows information about local database.

Captured Data

| | | | |
|----------------|-------------------|-------------|----------|
| Local DataBase | External Database | Show me NOW | Advanced |
|----------------|-------------------|-------------|----------|

Local Database

| | |
|-----------------------|--------------|
| Database: | MeshliumDB |
| Database Size: | 220.250 Mb |
| Table: | sensorParser |
| Entries: | 1149110 |
| Synchronized Frames: | 246420 |
| Unsyncronized Frames: | 902690 |

Remove synchronized Data Remove ALL Content

Figure: Mark as synchronized button

It shows:

- Database name
- Database size
- Database table used
- Number of total sensor entries
- Number of frames already synchronized with external services
- Number of unsynchronized frames

There are two controls to:

- Remove synchronized data. It removes from the database all the frames already synchronized with external database. Be careful as this could give unexpected results if you are using several cloud or external services. A confirmation will be prompted.
- Remove ALL content. This removes all the sensor information from the database. A confirmation will be prompted.

WARNING: *The sensor data will permanently deleted from the database and will be impossible to recover. Be sure to have a backup of the database before deleting the content.*

10.4. Logs

In this section the user can see the last lines of the logs of frames and sensor data received.

Refresh
 Delete logs
Sensor Parser Available

Sensor Log

```

2016-08-08 08:44:25.112 - ASCII-280C530E695B4AAD-A AG 4-134-89-,ANE:321.15,WV:15,PLV:321.15
2016-08-08 08:44:27.147 - ASCII-280C530E695B4AAD-A RA 1-134-90-,RAD:0,123400
2016-08-08 08:44:29.172 - ASCII-280C530E695B4AAD-A ME 1-134-91-,CU:1.25,WF:14.400,LC:4.250,DF:1.250
2016-08-08 08:44:31.719 - ASCII-280C530E695B4AAD-A AD 1-134-
92-,BAT:100,GPS:41.599998,-0.880000,RSSI:-8,MAC:013#
2016-08-08 08:44:33.762 - ASCII-280C530E695B4AAD-A AD 2-134-93-,NA:1234,NID:5566,DATE:0-5-12,TIME:21-13-45
2016-08-08 08:44:35.811 - ASCII-280C530E695B4AAD-A AD 3-134-94-,TIME:21-13-45+1,GMT:1,RAM:2478,IN_TEMP:1.00
2016-08-08 08:44:38.354 - ASCII-280C530E695B4AAD-A AD 4-134-95-,ACC:0;0;0,MILLIS:591664541
2016-08-08 08:44:40.38 - ASCII-280C530E695B4AAD-A ES 1-134-96-,STR:st,MBT:BT
2016-08-08 08:44:42.914 - ASCII-280C530E695B4AAD-A ES 2-134-97-,MIFI:wf,UID:ID,RB:RFID
2016-08-08 08:44:44.948 - ASCII-280C530E695B4AAD-A WA 1-134-98-,PH:5.30,OPR:1.100,D0:2.2,COND:3.3
2016-08-08 08:44:47.494 - ASCII-280C530E695B4AAD-A WA 2-134-99-,WT:4.40,DINA:5.500,DICA:6.600,DF:7.700
2016-08-08 08:44:49.54 - ASCII-280C530E695B4AAD-A WA 3-134-100-,DIDL:8.800,DIBR:9.900,DII:1.100,DICU2:2.200
2016-08-08 08:44:52.145 - ASCII-280C530E695B4AAD-A WA 4-134-101-,DIK:3.300,DIMG2:4.400,DIN03:5.500
2016-08-08 08:44:54.182 - BINARY-280C530E695B4AAD-B GA 1-6-102-,CO:12.52,C02:12.52,O2:12.5,CH4:13.5
2016-08-08 08:44:56.237 - BINARY-280C530E695B4AAD-B GA 2-6-103-,LPG:12.5,NH3:123.52,API:12.2,AP2:3.5
2016-08-08 08:44:58.283 - BINARY-280C530E695B4AAD-B GA 3-6-104-,SV:13.53,N02:13.52,O3:13.523,VOC:12.52
2016-08-08 08:45:00.828 - BINARY-280C530E695B4AAD-B GA 4-6-105-,ICA:123.5,TFA:123.5,HUMA:123.5,PA:123.5
2016-08-08 08:45:02.876 - BINARY-280C530E695B4AAD-B EV 1-6-106-,PW:141.25,BEND:41.2,VBR:0,HALL:0
2016-08-08 08:45:04.923 - BINARY-280C530E695B4AAD-B EV 2-6-107-,LP:0,LL:0,LUM:141.25
2016-08-08 08:45:06.965 - BINARY-280C530E695B4AAD-B EV 3-6-108-,PIR:0,ST:1341.24
2016-08-08 08:45:09.499 - BINARY-280C530E695B4AAD-B CT 1-6-109-,MCP:87,CDG:0,CPG:757.45
2016-08-08 08:45:11.536 - BINARY-280C530E695B4AAD-B CT 2-6-110-,LD:652.452,DUST:562.45,US:5655.452
2016-08-08 08:45:13.571 - BINARY-280C530E695B4AAD-B PA 1-6-111-,MF:342;845;363,PS:0
2016-08-08 08:45:15.6 - BINARY-280C530E695B4AAD-B AG 1-6-
112-,TCB:321.135,TFB:321.125,HUMB:321.1345,SOLIT:321.345
2016-08-08 08:45:17.645 - BINARY-280C530E695B4AAD-B AG 2-6-113-,SOIL:321.145,PAR:321.23,UV:321.12
2016-08-08 08:45:19.686 - BINARY-280C530E695B4AAD-B AG 3-6-114-,TD:321.12,SD:321.12,FD:321.12
2016-08-08 08:45:22.222 - BINARY-280C530E695B4AAD-B AG 4-6-115-,ANE:321.15,WV:15,PLV:321.15
2016-08-08 08:45:24.259 - BINARY-280C530E695B4AAD-B RA 1-6-116-,RAD:0,1234
2016-08-08 08:45:26.279 - BINARY-280C530E695B4AAD-B ME 1-6-117-,CU:1.245,WF:14.4,LC:4.25,DF:1.25
2016-08-08 08:45:28.331 - BINARY-280C530E695B4AAD-B AD 1-6-118-,BAT:100,GPS:41.6;-0.88,RSSI:65528,MAC:013#
2016-08-08 08:45:30.383 - BINARY-280C530E695B4AAD-B AD 2-6-119-,NA:1234,NID:5566,DATE:0;5;12,TIME:21;13;45
2016-08-08 08:45:32.427 - BINARY-280C530E695B4AAD-B AD 3-6-120-,TIME:21;13;45,GMT:1,RAM:2478,IN_TEMP:-105.0
2016-08-08 08:45:34.977 - BINARY-280C530E695B4AAD-B AD 4-6-121-,ACC:0;0;0,MILLIS:591721174
2016-08-08 08:45:37.008 - BINARY-280C530E695B4AAD-B ES 1-6-122-,STR:st,MBT:BT

```

Frame Log

```

2016-08-08 08:44:25.112 - <>>#280C530E695B4AAD#A AG 4#89#ANE:321.15#WV:15#PLV:321.15#
2016-08-08 08:44:27.147 - <>>#280C530E695B4AAD#A RA 1#90#RAD:0,123400#
2016-08-08 08:44:29.172 - <>>#280C530E695B4AAD#A ME 1#91#CU:1.25#WF:14.400#LC:4.250#DF:1.250#
2016-08-08 08:44:31.719 - <>>#280C530E695B4AAD#A AD 1#92#BAT:100#GPS:41.59998;-0.880000#RSSI:-8#MAC:013#
2016-08-08 08:44:33.762 - <>>#280C530E695B4AAD#A AD 2#93#NA:1234#NID:5566#DATE:0-5-12#TIME:21-13-45#
2016-08-08 08:44:35.811 - <>>#280C530E695B4AAD#A AD 3#94#TIME:21-13-45+1#GMT:1#RAM:2478#IN_TEMP:1.00#
2016-08-08 08:44:38.353 - <>>#280C530E695B4AAD#A AD 4#95#ACC:0;0;0,MILLIS:591664541#
2016-08-08 08:44:40.38 - <>>#280C530E695B4AAD#A ES 1#96#STR:st#MBT:BT#
2016-08-08 08:44:42.913 - <>>#280C530E695B4AAD#A ES 2#97#MIFI:wf#UID:ID#RB:RFID#
2016-08-08 08:44:44.948 - <>>#280C530E695B4AAD#A WA 1#98#PH:5.30#OPR:1.100#D0:2.2#COND:3.3#
2016-08-08 08:44:47.494 - <>>#280C530E695B4AAD#A WA 2#99#WT:4.40#DINA:5.500#DICA:6.600#DF:7.700#
2016-08-08 08:44:49.539 - <>>#280C530E695B4AAD#A WA 3#100#DIDL:8.800#DIBR:9.900#DII:1.100#DICU2:2.200#
2016-08-08 08:44:52.145 - <>>#280C530E695B4AAD#A WA 4#101#DIK:3.300#DIMG2:4.400#DIN03:5.500#
2016-08-08 08:44:54.181 - Bin frame (hex): 3C 3D 3E 06 24 28 0C 53 0E 69 5B 4A AD 42 5F 47 41 5F 31 23 66 00
EC 51 48 41 01 EC 51 48 41 02 00 00 48 41 03 00 00 58 41
2016-08-08 08:44:56.236 - Bin frame (hex): 3C 3D 3E 06 24 28 0C 53 0E 69 5B 4A AD 42 5F 47 41 5F 32 23 67 04
00 00 48 41 05 3D 0A F7 42 06 33 33 43 41 07 00 00 60 40
2016-08-08 08:44:58.283 - Bin frame (hex): 3C 3D 3E 06 24 28 0C 53 0E 69 5B 4A AD 42 5F 47 41 5F 33 23 68 08
E1 7A 58 41 09 EC 51 58 41 0A 35 5E 58 41 0B EC 51 48 41
2016-08-08 08:45:00.828 - Bin frame (hex): 3C 3D 3E 06 24 28 0C 53 0E 69 5B 4A AD 42 5F 47 41 5F 34 23 69 0C
00 00 F7 42 00 00 F7 42 00 00 F7 42 00 00 F7 42
2016-08-08 08:45:02.876 - Bin frame (hex): 3C 3D 3E 06 1E 28 0C 53 0E 69 5B 4A AD 42 5F 45 56 5F 31 23 6A 10
00 40 0D 43 11 CD CC 24 42 12 00 13 00
2016-08-08 08:45:04.922 - Bin frame (hex): 3C 3D 3E 06 19 28 0C 53 0E 69 5B 4A AD 42 5F 45 56 5F 32 23 6B 14
00 15 00 16 00 40 0D 43
2016-08-08 08:45:06.965 - Bin frame (hex): 3C 3D 3E 06 17 28 0C 53 0E 69 5B 4A AD 42 5F 45 56 5F 33 23 6C 17
00 18 AE A7 A7 44
2016-08-08 08:45:09.499 - Bin frame (hex): 3C 3D 3E 06 19 28 0C 53 0E 69 5B 4A AD 42 5F 43 49 5F 31 23 6D 19

```

Figure: Logs visualizing plugin

- The “Refresh” button will load again the log files
- The “Delete logs” button will delete the files, allowing to clean some space in the device

10.5. Sensor list

In this section, the user can view the list of available sensors in the system and add or delete user custom sensors.

By default, Meshlium recognize all Libelium official sensors frames. All sensor frames that Meshlium can capture and store must be specified in an XML file. The button “update sensors” update the Libelium official sensor list. User sensors remaining unchanged.

Users can add and remove custom sensors in an easy and simple way.

To add a new sensor the user must complete the fields:

- ASCII ID: sensor id for ASCII frame.
- Fields: This field specifies the number of sensor fields sent in the frame. This helps to calculate the frame length.
- Type: type of fields:
 - uint8_t
 - int
 - float
 - string
 - ulong
 - array (ulong)
- Units: Units for the sensor added.

Once all fields are filled in, click on the button “Add sensor”.

| ID | ASCII ID | Fields | Type | Units |
|----|----------|--------|--------|-----------------------|
| 0 | CO | 1 | float | Volts |
| 1 | CO2 | 1 | float | Volts |
| 2 | O2 | 1 | float | Volts |
| 3 | CH4 | 1 | float | Volts |
| 4 | LPG | 1 | float | Volts |
| 5 | NH3 | 1 | float | Volts |
| 6 | AP1 | 1 | float | Volts |
| 7 | AP2 | 1 | float | Volts |
| 8 | SV | 1 | float | Volts |
| 9 | NO2 | 1 | float | Volts |
| 10 | O3 | 1 | float | Volts |
| 11 | VOC | 1 | float | Volts |
| 12 | TCA | 1 | float | °C |
| 13 | TFA | 1 | float | °F |
| 14 | HUMA | 1 | float | %RH |
| 15 | PA | 1 | float | KPa |
| 16 | PW | 1 | float | Ohms |
| 17 | BEND | 1 | float | Ohms |
| 18 | VBR | 1 | uint_8 | Open/Closed |
| 19 | HALL | 1 | uint_8 | Open/Closed |
| 20 | LP | 1 | uint_8 | Open/Closed |
| 21 | LL | 1 | uint_8 | Open/Closed |
| 22 | LUM | 1 | float | Ohm |
| 23 | PIR | 1 | uint_8 | presence/not presence |
| 24 | ST | 1 | float | Ohms |
| 25 | MCP | 1 | uint_8 | dBA |
| 26 | CDG | 1 | uint_8 | boolean |

| ID | ASCII ID | Fields | Type | Units |
|-----|-------------|--------|-------|-------|
| 300 | custom_tmpl | 1 | int | °C |
| 301 | custom_acc | 6 | float | g |

Figure: Sensor list plugin

Note: Extensive information about how to build the frame is available on the “Waspmove Data Frame Guide”.

To delete sensor the user must press the garbage can that appears to the left of the description of the sensor. To complete the action should accept a confirmation message.

10.6. OTA via FTP

Meshlium can also be used as an FTP server to prepare the binary files to be downloaded by Wasp mote.

For more info about Over the Air Programming go to:

<http://www.libelium.com/development/wasp mote/documentation/over-the-air-programming-guide-otap/>

This feature allows reprogramming Wasp mote using an FTP server (inside Meshlium) and FTP client (Wasp mote itself).

There are two basic steps involved in OTA procedure:

- **Step 1:** Wasp mote requests a special text file which gives information about the program to update: program name, version, size, etc.
- **Step 2:** If the information given is correct, Wasp mote queries the FTP server for a new program binary file and it updates its flash memory in order to run the new program.

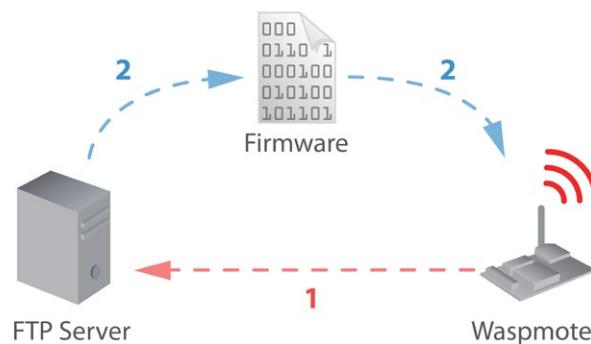


Figure: OTA via FTP protocol

Besides, a default user is configured in Meshlium FTP Server with the following settings:

- user: ota
- password: libelium

This user directly connects to the following path in Meshlium's system directory where the application creates all the binary and UPGRADE.TXT files:

/mnt/user/ota

Inside "Sensor Network" there is the section OTA - FTP. Users can prepare the binary files to be downloaded by Wasp mote. Then, the user can generate UPGRADE.TXT text file necessary to do OTA with 4G/3G/GPRS/GSM/WiFi via FTP.

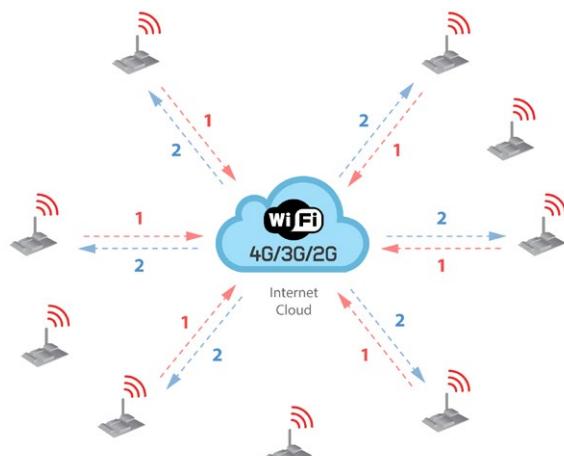


Figure: OTA-FTP in Meshlium

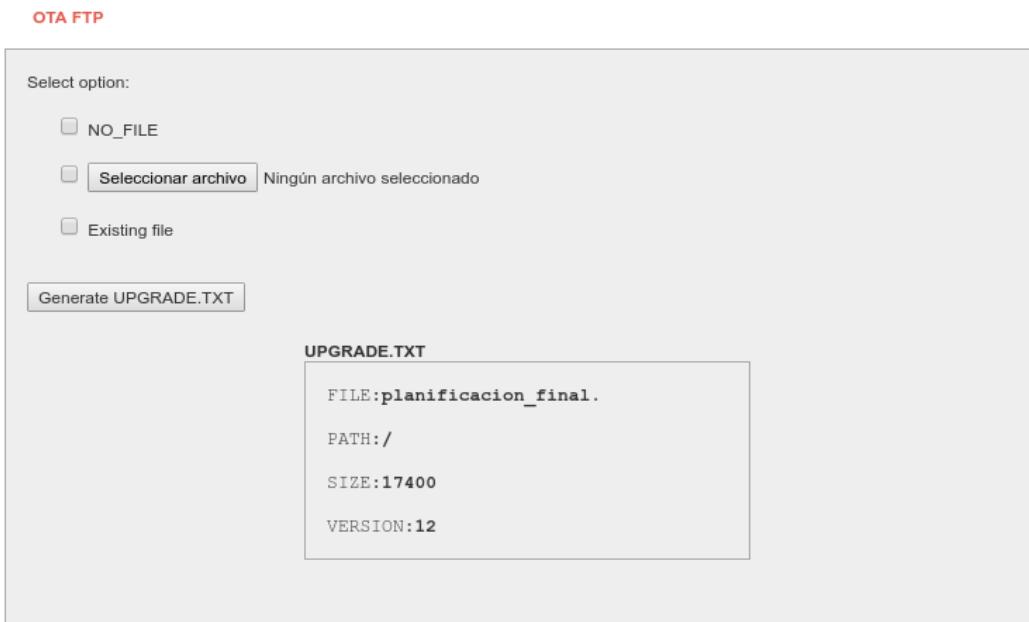


Figure: OTA-FTP plugin

Firstly, there are three possibilities to be chosen:

- Select NO_FILE to inform Waspnote that no OTA is necessary
- Select a new file generated by the Waspnote platform IDE so as to update the Waspnote's program.
- Select an existing binary if the user needs to update to an older program. The files are stored in the following path: /mnt/user/ota.

Secondly, the program version is always set by the user before generating the new UPGRADE.TXT file. There is a specific input to indicate the program version. It must be defined as a 1-unsigned-byte number (range: from 0 to 255).

Finally, there is a button to generate the new UPGRADE.TXT file.

Once these steps have been completed, the binary file and the proper UPGRADE.TXT file will be ready for the Waspnote devices deployed which try to perform OTA via FTP transmission. This file is shown in the window of the application representing the actual binary prepared for OTA.

11. 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).

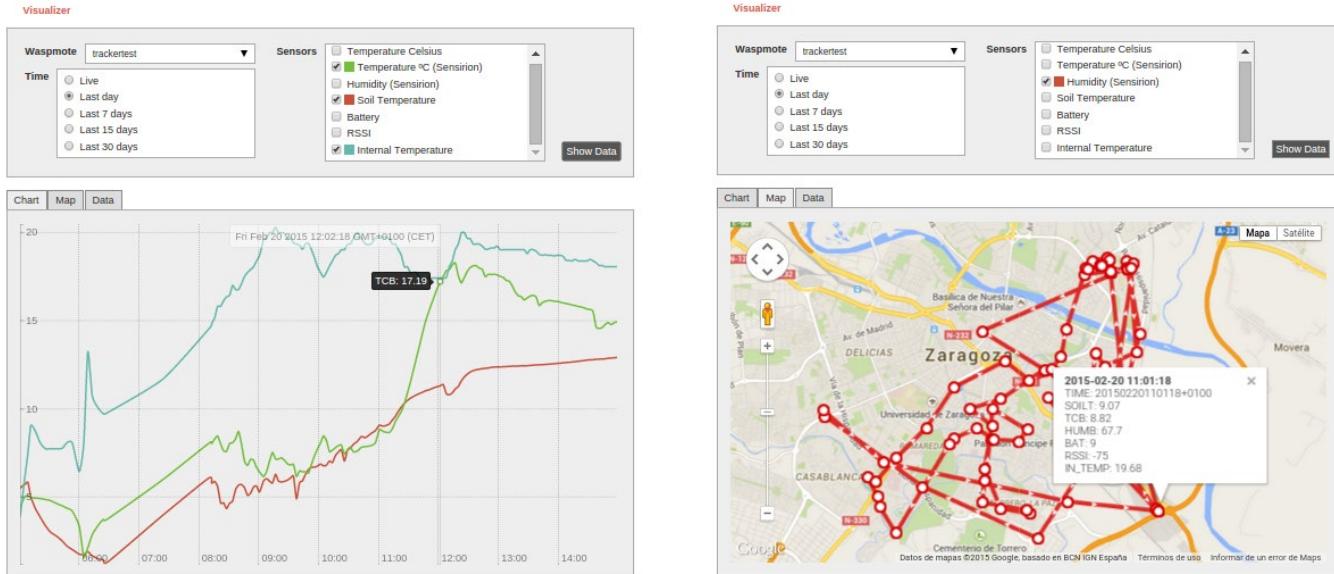


Figure: Meshlium Visualizer can plot graphs and geo-locate data on maps

Please note that this is a paid service. In every IoT Vertical Kit, each Meshlium comes with **100** visualizations. After 100 visualizations, users can contact Libelium Sales Department (salesteam@libelium.com) if they want to continue using the service.

11.1. Working with the Visualizer

On the top of the page you can use a simple form to make all your queries. To do so, just follow these steps:

Figure: Filling Meshlium Visualizer's form

- 1.- Select one Plug & Sense! from the list. All Plug & Sense! units with frames in the database will be shown.
- 2.- Once a Plug & Sense! Is selected, all its sensors will be loaded. This process is repeated each time you change the selected Plug & Sense!.
- 3.- Select the period of time you want to see in the chart. The "Live" option reads directly from the database, while the rest options read from a file generated everyday by the service cron. For each Plug & Sense!, cron generates 4 files each day, one for the last day, other for last 7 days, other for last 15 days and other for the last 30 days.
- 4.- Hit on the "Show Data" button and, if your query has results to show, Meshlium Visualizer will show them. The remaining visualization number will decrease in one unit. If the query does not have any results, a message will appear notifying the situation; the available visualizations remain without changes.

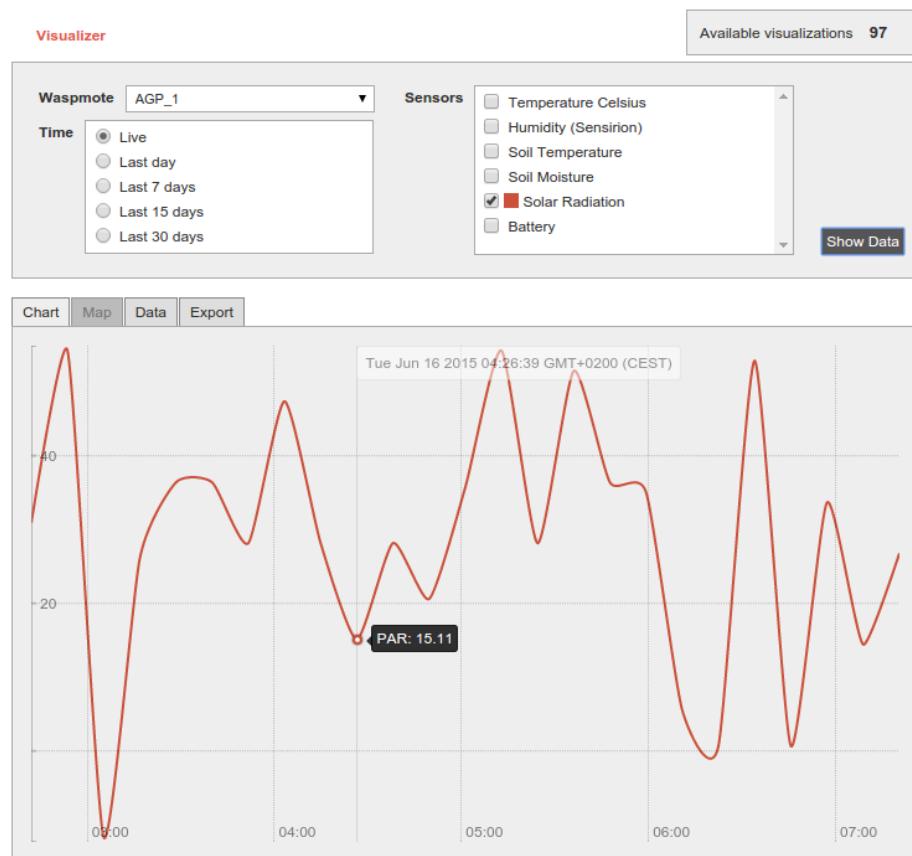


Figure: Meshlium Visualizer showing one graph

If your query has GPS results (data frames with GPS information), the “Map” tab will be shown. If it is not the case, like in the previous picture, this tab remains disabled.

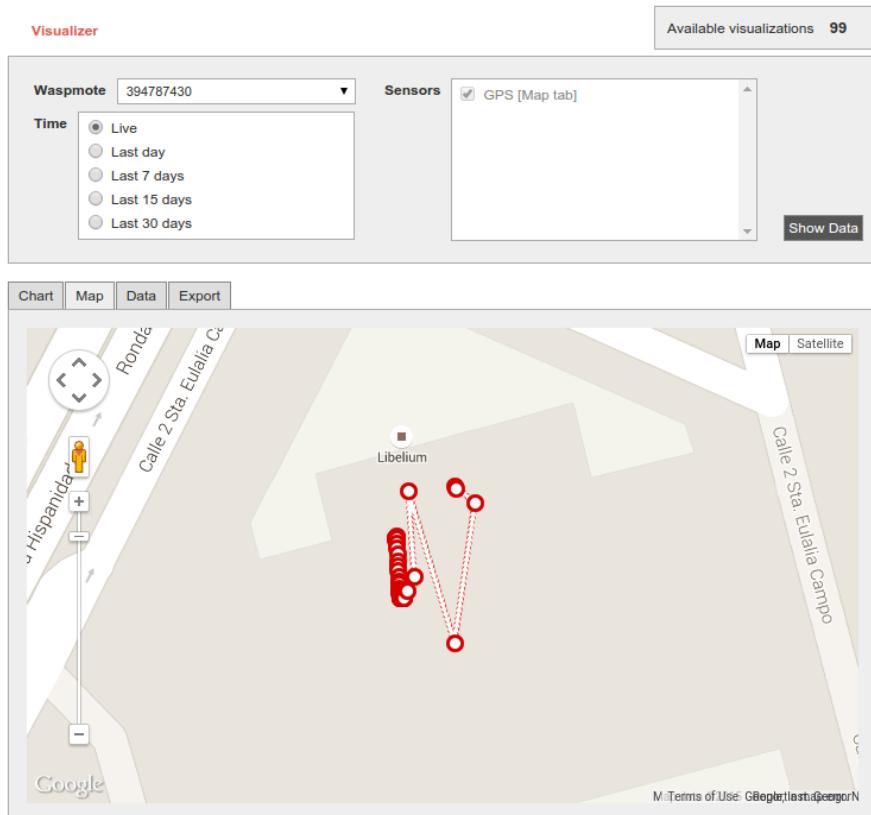


Figure: Locating nodes on a map thanks to Meshlium Visualizer

The “Data” tab shows a list of sensor values, ordered by time.

The screenshot shows the Meshlium Visualizer interface with the "Data" tab selected. At the top, there are dropdown menus for "Visualizer" (set to "Waspmote AGP_1") and "Sensors" (listing Temperature Celsius, Humidity (Sensirion), Soil Temperature, Soil Moisture, Solar Radiation, and Battery, with Solar Radiation checked). Below these are time selection options: "Live" (selected), "Last day", "Last 7 days", "Last 15 days", and "Last 30 days". A "Show Data" button is also present. The main area displays a table of sensor data:

| time | sensors |
|---------------------|----------------------------|
| 2015-06-16 00:42:17 | SOIL: 50.15 SOILT: 5671.49 |
| | BAT: 28 ACC: 123;-28;999 |
| 2015-06-16 00:53:51 | TCA: -39.71 HUMB: -2.1 |
| | PAR: 54.25 |
| 2015-06-16 00:53:53 | SOIL: 50.15 SOILT: 5670.54 |
| | BAT: 28 ACC: 126;-15;991 |
| 2015-06-16 01:05:27 | TCA: -39.71 HUMB: -2.1 |
| | PAR: -11.67 |
| 2015-06-16 01:05:28 | SOIL: 50.16 SOILT: 5670.54 |
| | BAT: 28 ACC: 122;-26;994 |
| 2015-06-16 01:17:03 | TCA: -39.71 HUMB: -2.1 |
| | PAR: 26.09 |
| 2015-06-16 01:17:04 | SOIL: 50.16 SOILT: 5671.49 |
| | BAT: 28 ACC: 125;-25;991 |
| 2015-06-16 01:28:39 | TCA: -39.71 HUMB: -2.1 |
| | PAR: 36.39 |
| 2015-06-16 01:28:40 | SOIL: 50.16 SOILT: 5670.54 |

Figure: Meshlium Visualizer showing the Data tab

The “Export” tab shows two calendars to select the initial and final date. This feature does not take into account the block on the top of the page, it will export all data from all Plug & Sense! units between these dates. Data can be exported in 5 formats (CSV, SQL, XML, TXT & HTML) and compressed in ZIP.

The screenshot shows the Meshlium Visualizer interface with the "Export" tab selected. At the top, there are dropdown menus for "Visualizer" (set to "Waspmote AGP_1") and "Sensors" (listing Temperature Celsius, Humidity (Sensirion), Soil Temperature, Soil Moisture, Solar Radiation, and Battery, with Solar Radiation checked). Below these are time selection options: "Live" (selected), "Last day", "Last 7 days", "Last 15 days", and "Last 30 days". A "Show Data" button is also present. The main area displays two date selection calendars:

| Start date | | End date | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|-----|----------|-----|-----|-----|-----|-----|-----|----|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|--|--|
| <input type="button" value="◀"/> <input type="button" value="▶"/> <input type="button" value="2015"/> <input type="button" value="▼"/> <table border="1"> <tr><td>Sun</td><td>Mon</td><td>Tue</td><td>Wed</td><td>Thu</td><td>Fri</td><td>Sat</td></tr> <tr><td>31</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr> <tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td></tr> <tr><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr> <tr><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td></tr> <tr><td>28</td><td>29</td><td>30</td><td>1</td><td>2</td><td>3</td><td>4</td></tr> </table> | | Sun | Mon | Tue | Wed | Thu | Fri | Sat | 31 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 1 | 2 | 3 | 4 | <input type="button" value="06:00"/> <input type="button" value="07:00"/> <input type="button" value="08:00"/> <input type="button" value="09:00"/> <input type="button" value="10:00"/> <input type="button" value="11:00"/> <input type="button" value="06:00"/> <input type="button" value="07:00"/> <input type="button" value="08:00"/> <input type="button" value="09:00"/> <input type="button" value="10:00"/> <input type="button" value="11:00"/> | |
| Sun | Mon | Tue | Wed | Thu | Fri | Sat | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 31 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 28 | 29 | 30 | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Below the calendars are "Output file" options: CSV (selected), SQL, XML, TXT, and HTML, and a checkbox for "Compress in ZIP file". A "Export" button is located at the bottom right.

Figure: Configuring Meshlium Visualizer to export data

12. Cloud Connectors

The aim of this chapter is to introduce the user to the Meshlium Cloud Connector functionality. This section will help you to connect your Meshlium to a third party cloud platform.

Only sensor data can be sent to the cloud services.

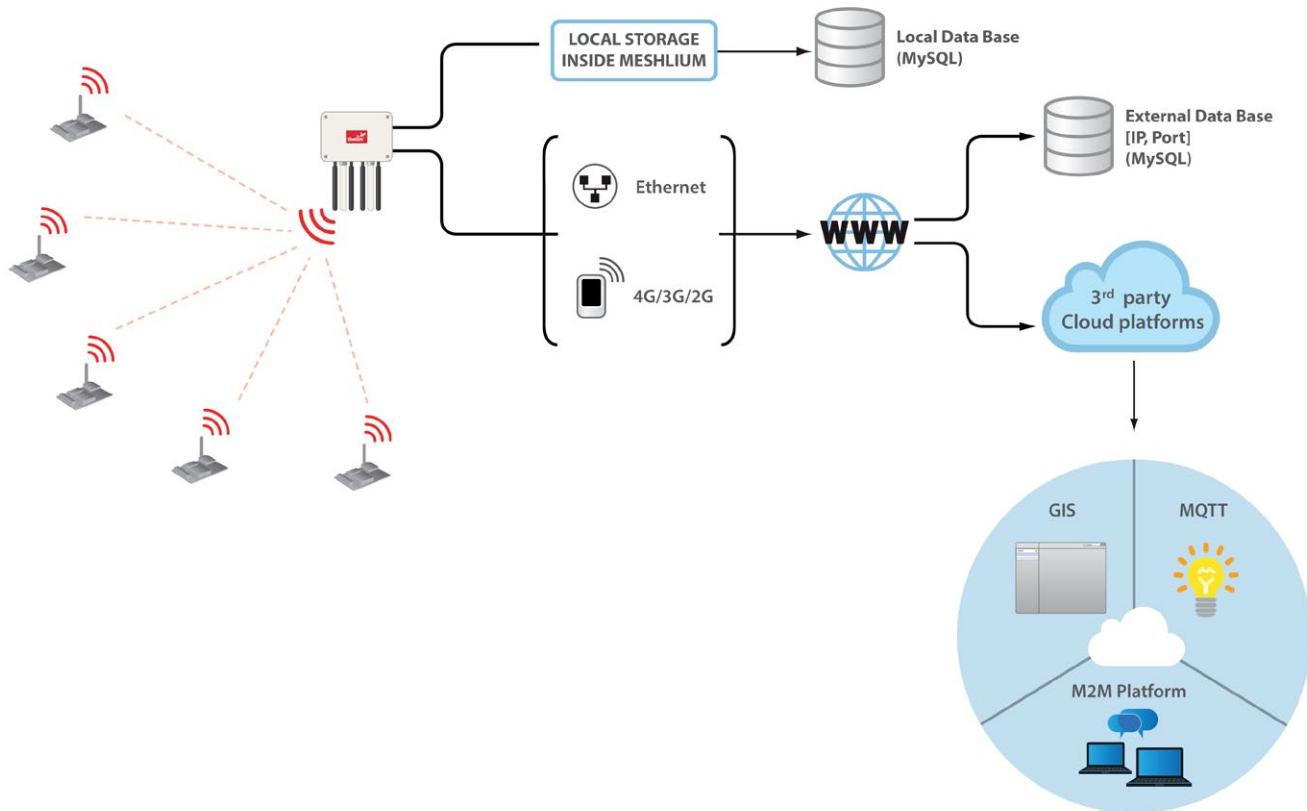


Figure: Cloud connector diagram

Interfacing Meshlium with 3rd party cloud services should be the last step the user develops in any project. The user should analyze if the use of clouds is needed, and if so, that will be the last step in the project. Before trying clouds, make sure all the Waspmove units are sending frames to Meshlium, and Meshlium is receiving and inserting them on the local database properly.

What is a cloud platform?

Cloud computing is a major change in our industry. One of the most important parts of that paradigm are cloud platforms. This kind of platforms let developers write applications that run in the cloud, use services provided from the cloud or both.

Meshlium Cloud Connector

Meshlium runs a set of scripts for implementing the data synchronization from its internal database "to the cloud". In other words, those scripts send data to webservers where the cloud service providers host their clouds. Those scripts are called Cloud Connector.

We have divided the Cloud Connector into 2 groups: "IoT Solutions" and "IoT Platforms".

IoT Platforms are professional development frameworks for developing data management applications, including Esri, ThingWorx, IBM Bluemix, Telefónica and Microsoft Azure.

IoT Solutions are specific applications focused in different verticals. Libelium promotes the Cloud Partnership Program for any cloud service provider that would like to foster their very own solution using our products.

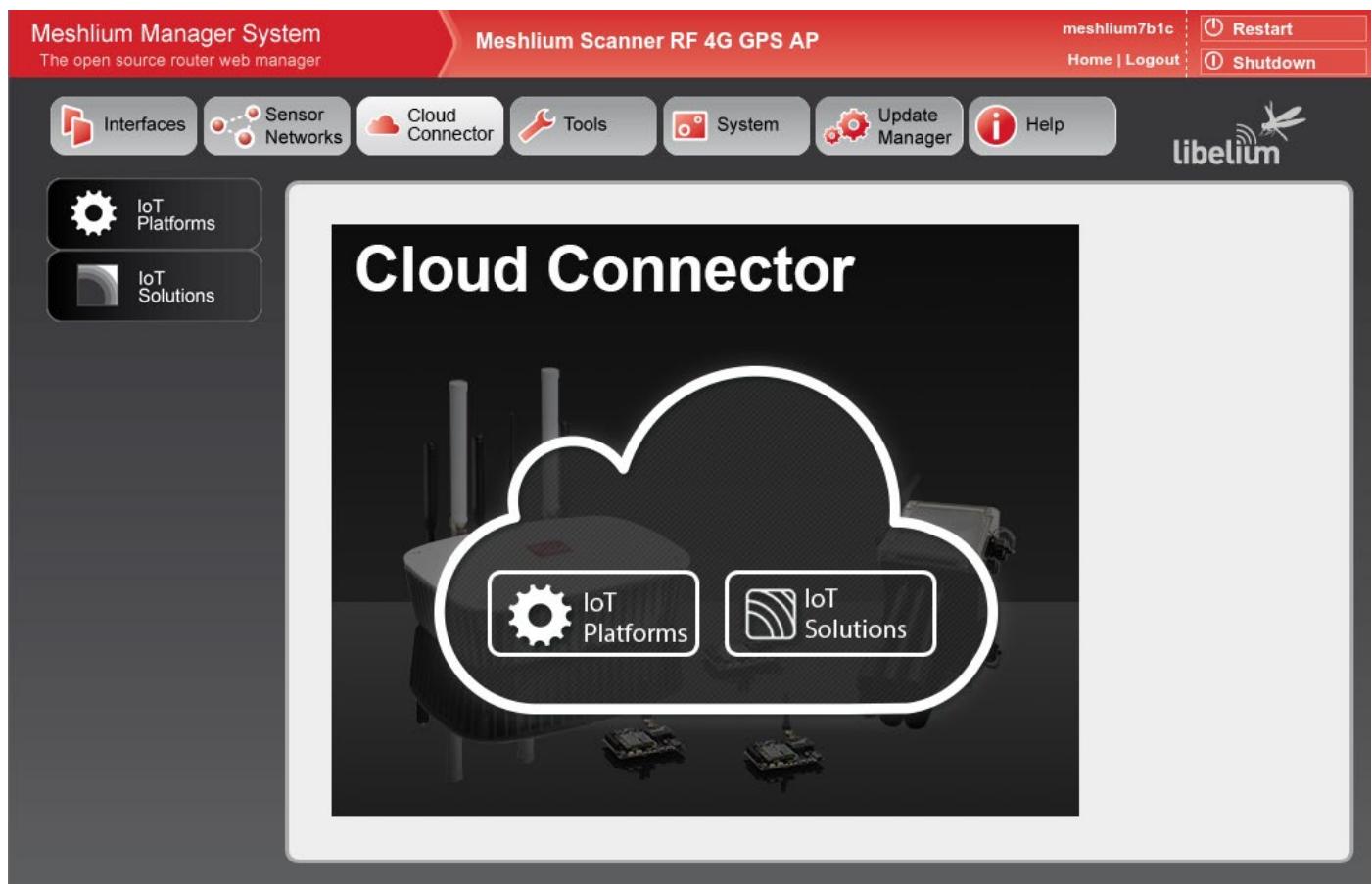


Figure: Cloud Connector main menu on the Manager System

12.1. Premium Cloud Partners

12.1.1. Arrow

12.1.1.1. Arrow Connect IoT Cloud Platform

Arrow Connect is a software solution that plumbs the data from the edge to the cloud. Developed by Arrow Electronics and designed with security, scale, flexibility, device management, open APIs and extensibility as core tenants enabling broad use cases across multiple industries. You can provision, control, import, assign, activate, update, suspend, replace, deactivate, and more, all from a single platform. Arrow Connect makes device management easy so you can focus on driving business value via data analytics and machine learning tools.

Visit <http://iot.arrow.com/developer.html> for more information.

12.1.1.2. Register Meshlium in Arrow Connect

To request for a developer account in Arrow Connect platform, follow the Developer Registration process on <https://portal.arrowconnect.io/#/signup> or please email to tnguyen@arrow.com including the following information:

- Company name
- Full name
- Title
- Email address
- How did you hear about us?
- Short description of your project

Log on to the portal at <https://portal.arrowconnect.io> using your developer account.

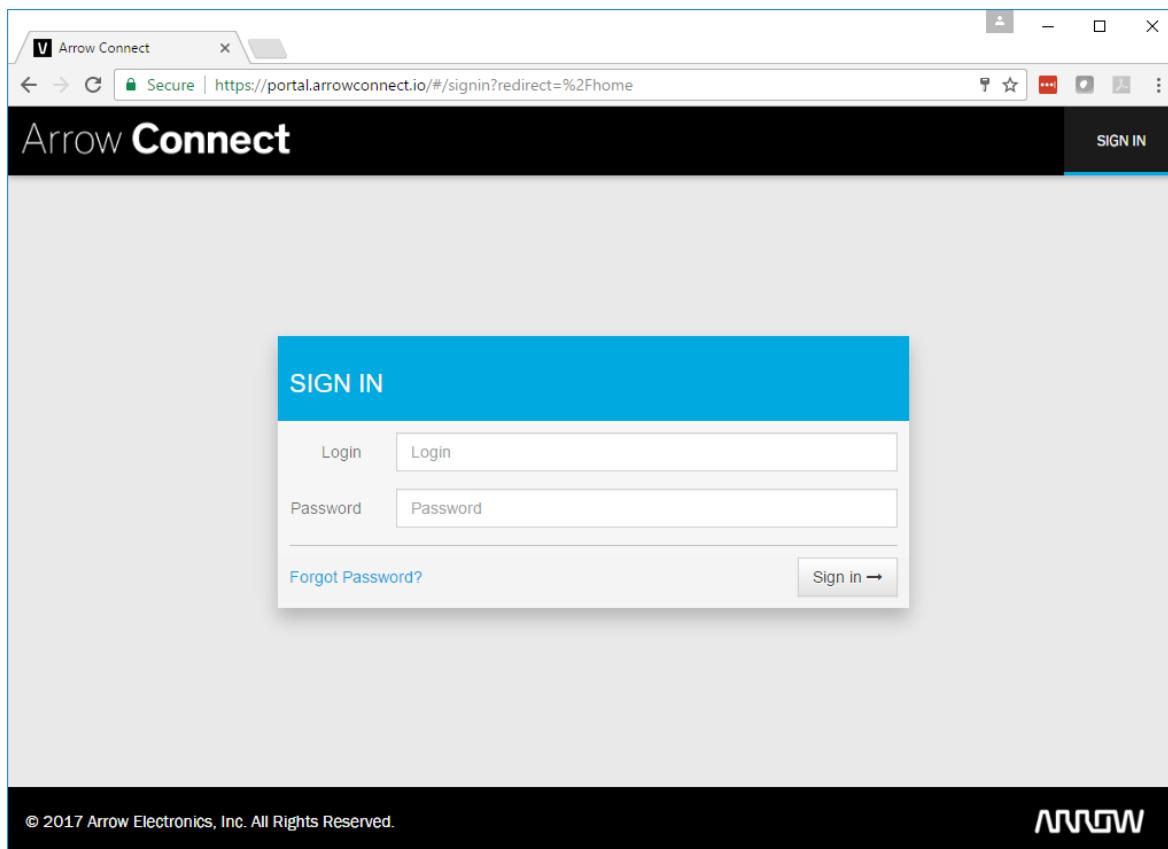


Figure: Arrow portal

With the developer account, you have a private application instance with full admin access. Upon logging in, click on Administration > Access Keys, then click on the Master Key. You can save the "Client Encrypted API Key" and "Client Encrypted Secret Key" to the notepad. This pair of keys will be used to configure the Meshlium to connect to your cloud account.

The screenshot shows the 'Edit Access Key' interface. It includes fields for 'Name' (TEST KEY), 'Expiration Date' (01/27/2037 08:03:11 PM) with a calendar icon and a red 'Expire Now' button, and two large text areas for 'Raw API Key' and 'Raw Secret Key' (both blurred). Below these are two more blurred text areas for 'Client Encrypted API Key' and 'Client Encrypted Secret Key'. A 'Privileges' section shows a single row for 'OWNER' with a blurred 'PRI' value. At the bottom are 'Save' and 'Close' buttons.

Figure: Access Key

12.1.1.3. Configuration

Paste the keys above into the 2 text areas as screen-shot below.

The screenshot shows the 'Configuration' tab. It contains fields for 'Gateway Name' (Meshlium 17135120110521), 'Gateway UID' (meshlium-17135120110521), 'API URL' (https://api-a01.arrowconnect.io), 'MQTT URL' (ssl/mqtt-a01.arrowconnect.io), and several interval settings: 'Sending Interval (ms)' (5000), 'Heartbeat Interval (ms)' (60000), 'Sync Interval (ms)' (60000), 'Limit (#records per sync)' (150), and 'Log Level' (INFO). At the bottom are 'Save' and 'Reset Local Database' buttons. Two large text areas for 'Encrypted API Key' and 'Encrypted Secret Key' are highlighted with red arrows pointing to them. The entire configuration panel is set against a background featuring the Arrow logo.

Figure: Configure Arrow

All the default configuration values should be appropriate and you do not need to change them. Click on the "Save" button for storing the configuration fields.

- API URL
- MQTT URL
- Encrypted API Key
- Encrypted Secret Key

After clicking the "Save" button, you also need to click on "Reset Local Database", otherwise your changes will not be affected.

In all cases, to prevent local database corruption, the configuration should never be updated while the Arrow Connect IoT Cloud Connector is running. Use the Start/Stop buttons as described below to stop it before making changes, restart it after saving changes.

12.1.1.4. Controlling synchronization

Launch the Meshlium Arrow Connect IoT Cloud background process (Start button). The program will search for the received frames on the local database, and will send them to the Arrow Connect IoT Cloud Platform. The status indicator displays the current state. Green colour means running.

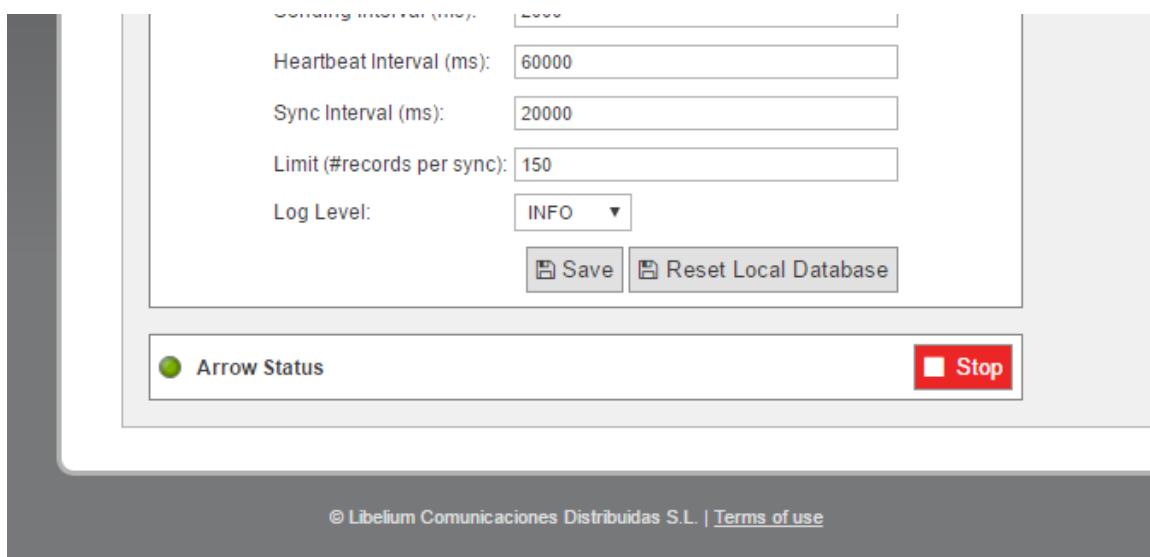


Figure: Synchronization stopped

Stop the Arrow Connect program anytime by clicking on the "Stop" button. Red colour means stopped.



Figure: Synchronization running

While the program is running, log on to the Arrow Connect portal to check that the Meshlium and Waspmotes have been properly registered and are sending telemetry data. See some example screen-shots below:

| Gateway | UID | Type | Owner | OS Name | Software Name | Software Version | Enabled |
|-------------------------|-------------------------|-------|-------|----------------------------------|----------------|------------------|---------|
| Meshlium 16326151136518 | meshlium-16326151136518 | Local | | Linux, 3.16.7-ckt9-voyage, amd64 | Kronos Gateway | 0.1 | true |

Figure: Arrow gateways display

| Name | UID | Device Type | Enabled | Commands |
|-----------------------------------|---------------------------------------|-------------|---------|------------|
| Meshlium 16326151136518 | meshlium-16326151136518 | gateway | true | Start Stop |
| Meshlium 16326151136518 Connector | meshlium-16326151136518-connector | meshlium | true | Start Stop |
| wasmote-tam-1 | meshlium-16326151136518-wasmote-tam-1 | wasmote | true | Start Stop |
| wasmote-tam-2 | meshlium-16326151136518-wasmote-tam-2 | wasmote | true | Start Stop |
| wasmote-tam-3 | meshlium-16326151136518-wasmote-tam-3 | wasmote | true | Start Stop |

Figure: Arrow Meshlium display

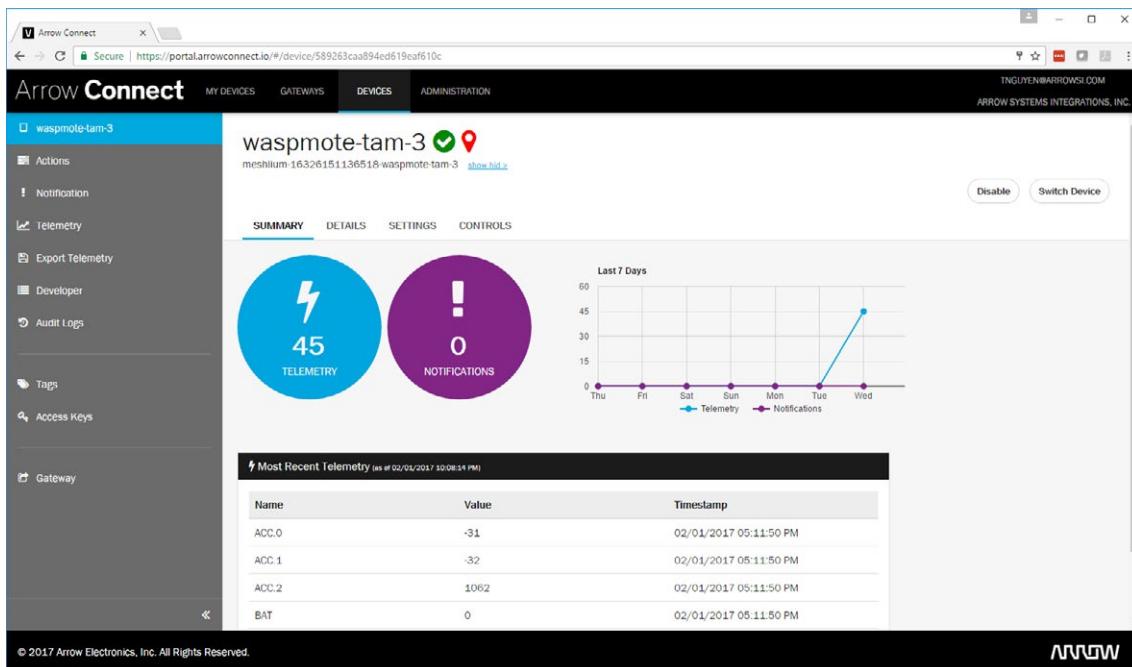


Figure: Arrow Waspmove display

12.1.2. IBM Bluemix

IBM Bluemix is a cloud [platform as a service \(PaaS\)](#) developed by IBM that gives a wide scope of services to use the cloud, one of them is based on MQTT communications. This is a great alternative if the user do not want to build his own MQTT server.

12.1.2.1. Configuration

Configuration options are shown in the M2M Platform menu, enlarging the IBM Bluemix MQTT section. You will notice that the configuration for this plugin is very straight-forward, you have most of the needed parameters on the IBM Bluemix web panel:

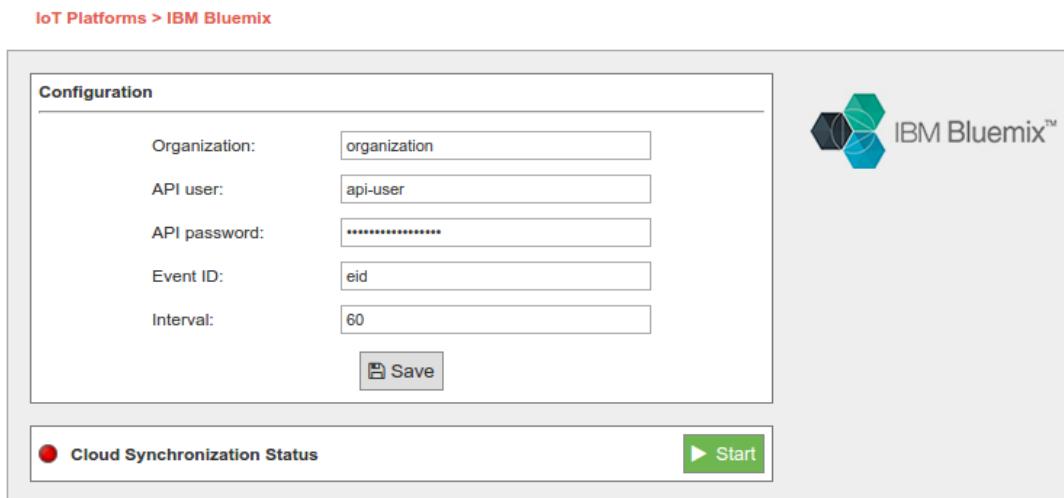


Figure: Configuring IBM Bluemix in Meshlium

- **Organization ID:** Identifier of your organization; you can get it from the platform credentials.
- **API user:** User generated in the API platform section.
- **API password:** Password generated in the API platform section.
- **Event ID:** Used to configure the event where you want to send the information. If you do not know what to type in this field, you can use 'eid'.
- **Interval:** Used to delay the communication after a bunch of messages were sent.

12.1.2.2. Controlling synchronization

You can stop or start the IBM Bluemix synchronization process anytime, hitting on the buttons "Start" and "Stop". Then, the status indicator displays the current state, saying "Running" or "Stopped".

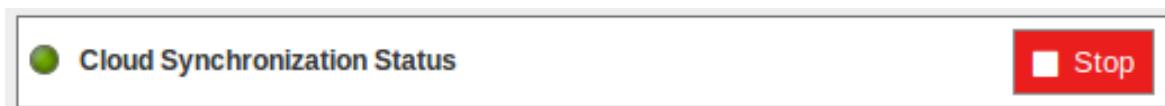


Figure: IBM Bluemix synchronization service is running

You can stop the synchronization anytime clicking on the "Stop" button.



Figure: IBM Bluemix synchronization service is stopped

More information can be found on this Recipe we created for IBM:

<https://developer.ibm.com/recipes/tutorials/bluemix-configuration-guide-for-meshlium/>

12.1.3. Microsoft Azure Event Hubs

Azure is a cloud platform provided by Microsoft. This platform has a lot of services to reach communication between machines and devices.

This section focuses on Event Hubs, we can refer this technology as a way to send short messages via HTTP REST request. Event Hubs is part of Service Bus. Event Hubs implements a simple message consumer M2M technology.

For more information about Event Hubs, see the following link:

<https://azure.microsoft.com/en-us/services/event-hubs/>

12.1.3.1. Setup in Azure - Creating NameSpace

Before getting the parameters to connect to Event Hub, it is necessary to create a Service Bus Namespace (skip this section if you already have one).

Go to the Azure Event Hub Portal:

<https://manage.windowsazure.com>

Select the *Service Bus* menu. At the bottom of the Bus service manager screen you will see a *NEW* button with a plus image, click on it. A pop-up window will appear where you must select message type "EVENT HUB".

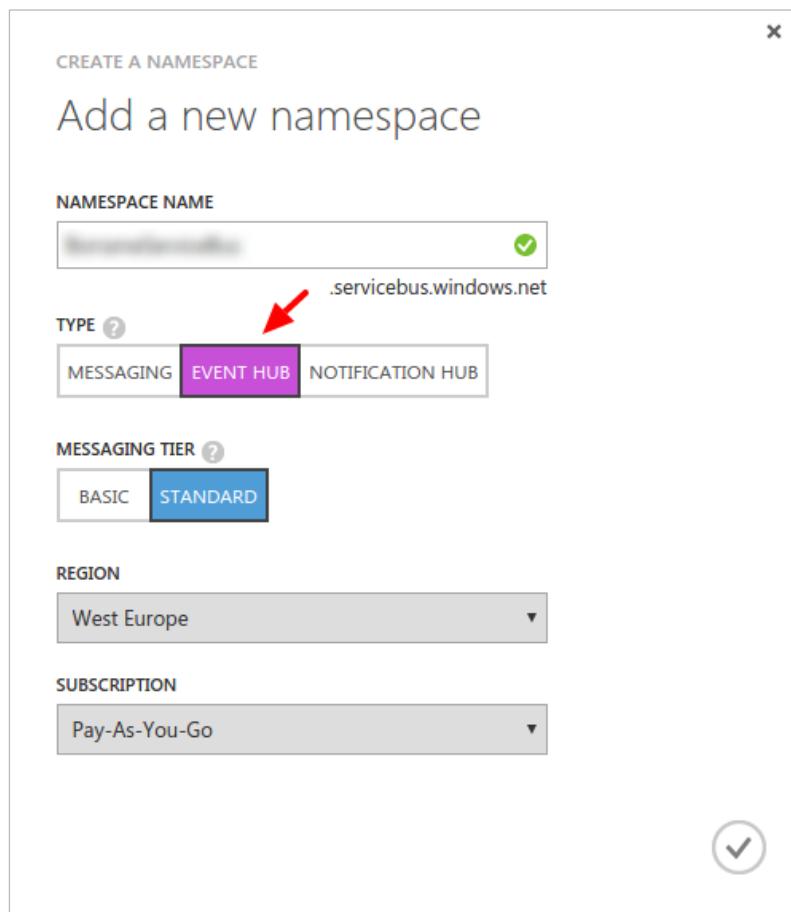


Figure: Create new Namespace

12.1.3.2. Setup in Azure - Creating an Event Hub

In this section we will create an Event Hub that will receive our data from Meshlium. After we dive into the Service Bus we have previously created, we can see a menu on the top of the screen, then we should choose "Event Hubs" and "Create a New Event Hub":

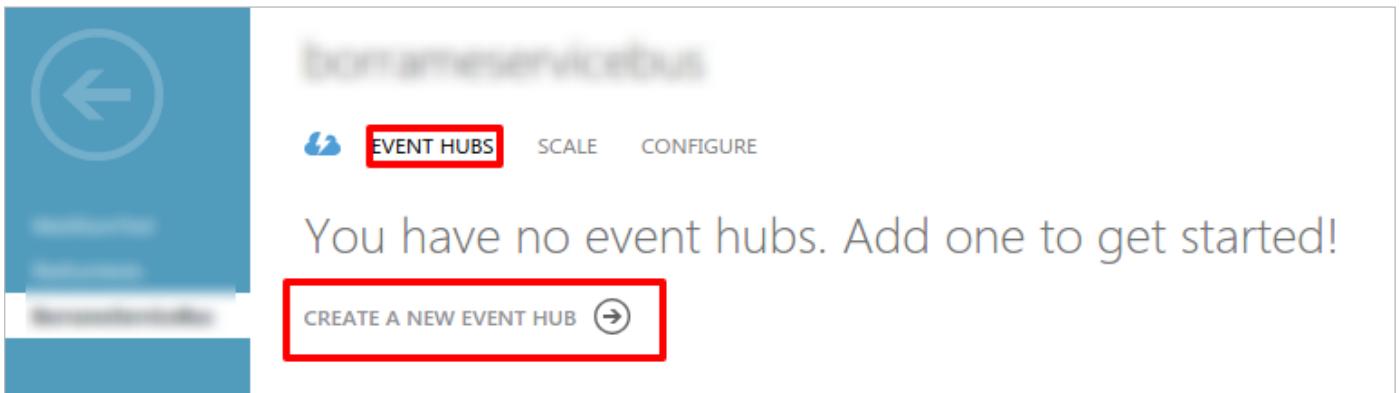


Figure: Create New Event Hub

Figure: After clicking on this menu, a new screen will appear. At this point we can create a new event hub clicking on the bottom left icon labeled as New:

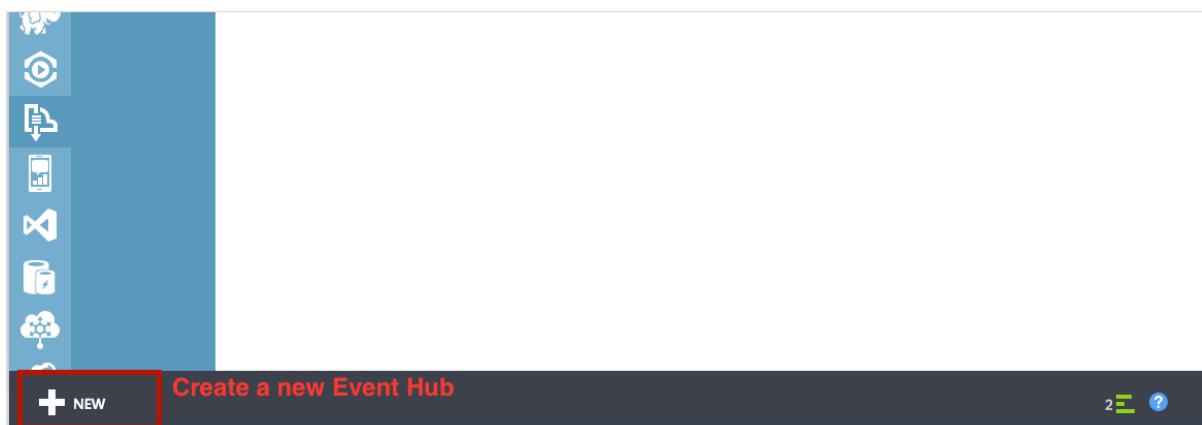


Figure: Create a New Event Hub

After click this button, a pop-up window raises above and you are now able to create an event hub, we are going to choose "quick create" option to make this step easier:

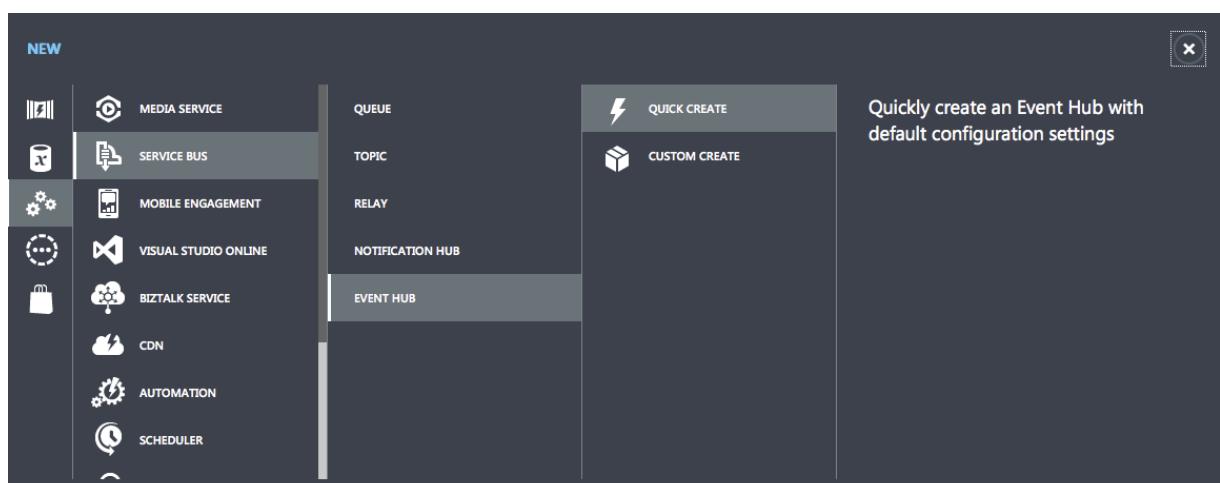


Figure: Quick Create

Type your event hub name and click “Create a new event hub” button to finish the configuration process.

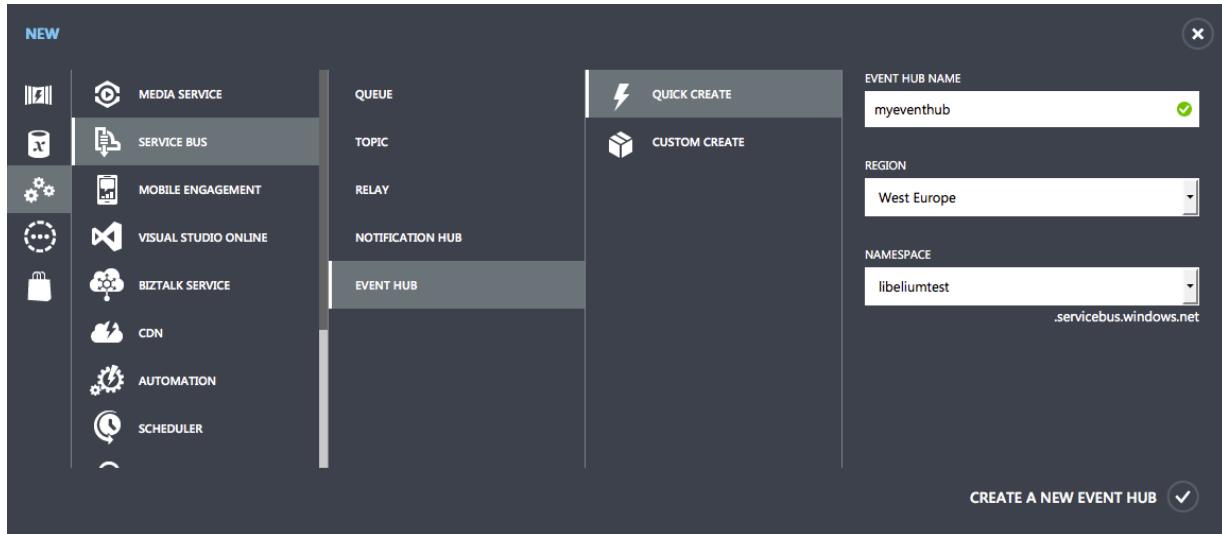


Figure: Type the new Event Hub name

You have created an Event hub for one day data retention, which means that your data will be kept one day. This method sets a partition section with value '4', which means the number of partitions the Event Hub may have.

12.1.3.3. Setup in Azure – Setting up shared access in Event Hub

We set up a shared directive to send data with custom credentials. Once we entered on event hub information (by clicking on event hub), these credentials can be set up in the configuration section, this menu is on top of the screen:

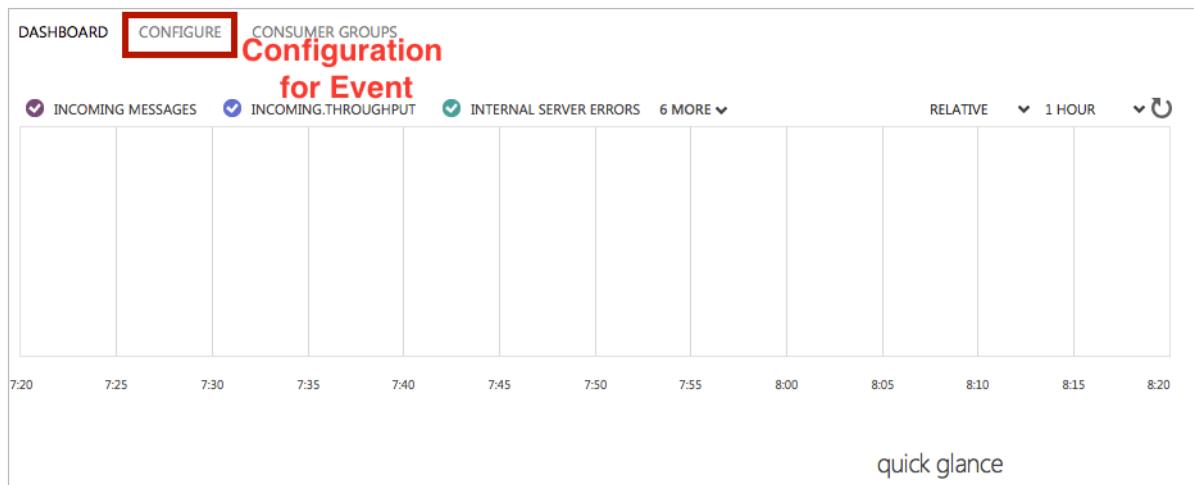


Figure: Configure the Event

Click on the “configure” option and a new screen will be displayed. Here you can configure message retention, event hub state, partition count and shared access policies. This last point (shared access policies) manages credentials to send and listen messages (or both action), we will create a new credential to send messages. On “shared access policies”, type a name for your key, and in the permissions drop-down menu, select “Manage” permission. Then press “save” on the bottom of the screen.

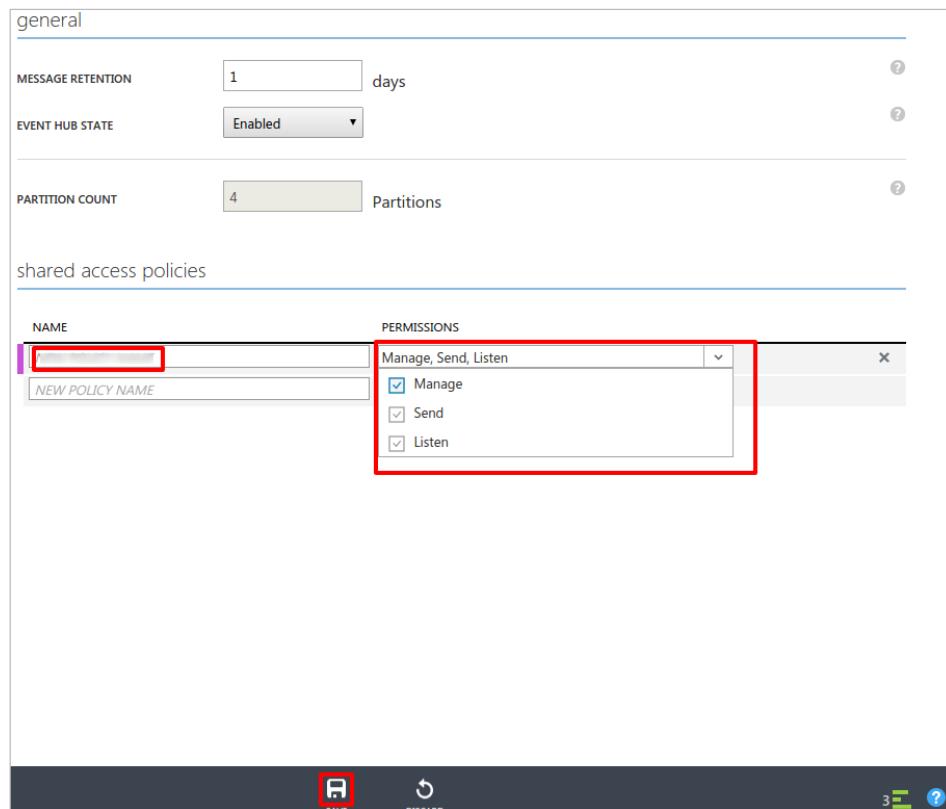


Figure: Configure the Event Permissions

Finally, we will copy the information needed to connect the Event Hub connector. In order to do that, go to the "Dashboard" of the Event Hub and select "View Connection String".



Figure: Event Hub Dashboard

Copy the "Connection String" that appears in the screen.

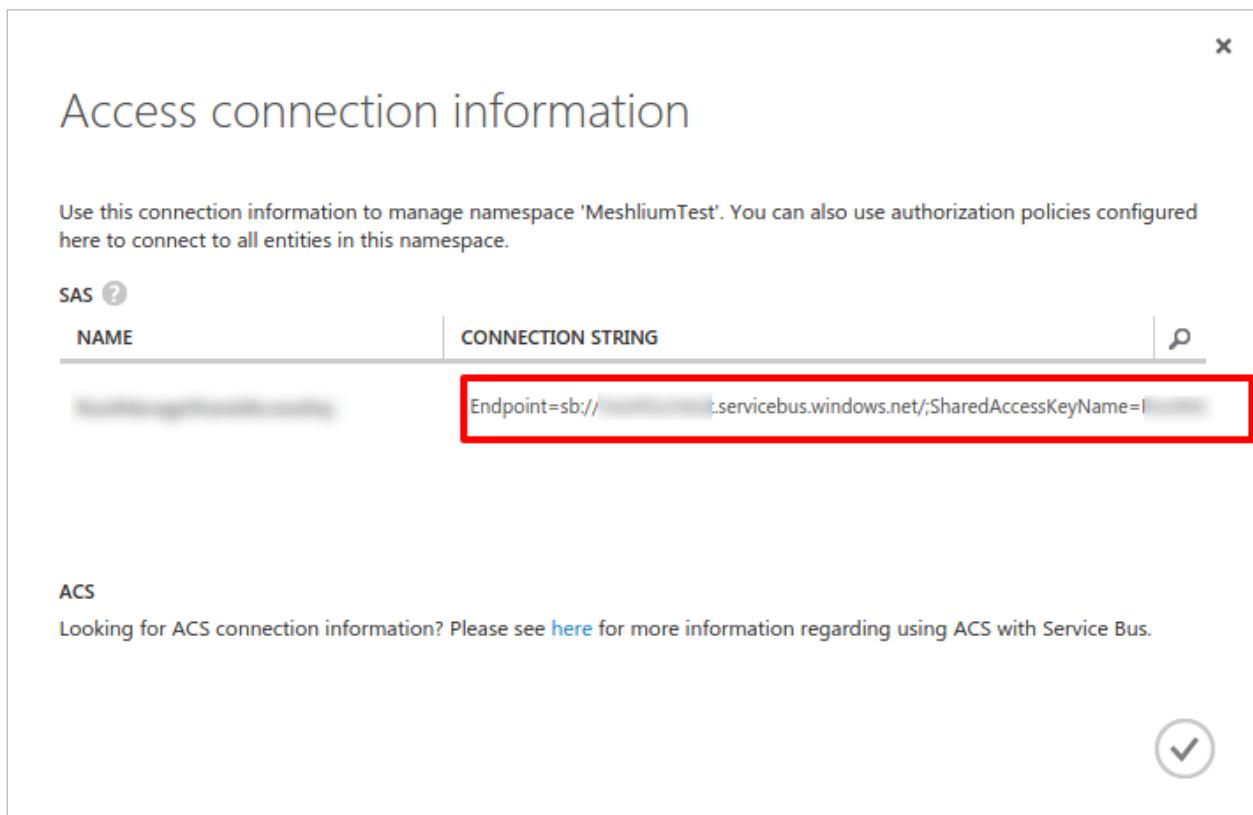


Figure: Connection String

We will extract the information needed to connect the Meshlium from the "Connection String". You have to copy the **NAMESPACE**, the **DIRECTIVE_NAME**, the **DIRECTIVE_KEY** and the **EVENTHUB_NAME** from the string as the following example:

Namespace=Endpoint=sb://**NAMESPACE**.servicebus.windows.net/;SharedAccessKeyName=**DIRECTIVE_NAME**;SharedAccessKey=**DIRECTIVE_KEY**;EntityPath=**EVENTHUB_NAME**

Note that the namespace is only a part of the string Endpoint, it does NOT include the "sb://" neither the ".servicebus.windows.net/" part.

12.1.3.4. Configuration

As result of previous steps, we should have a **namespace**, a **directive name**, a directive key and an **event hub name**. These are the main properties we should set in the Manager System to configure an Event Hub connection.

Now we can access the Meshlium Manager and fulfill the Azure Event Hub fields with the previously obtained configuration.

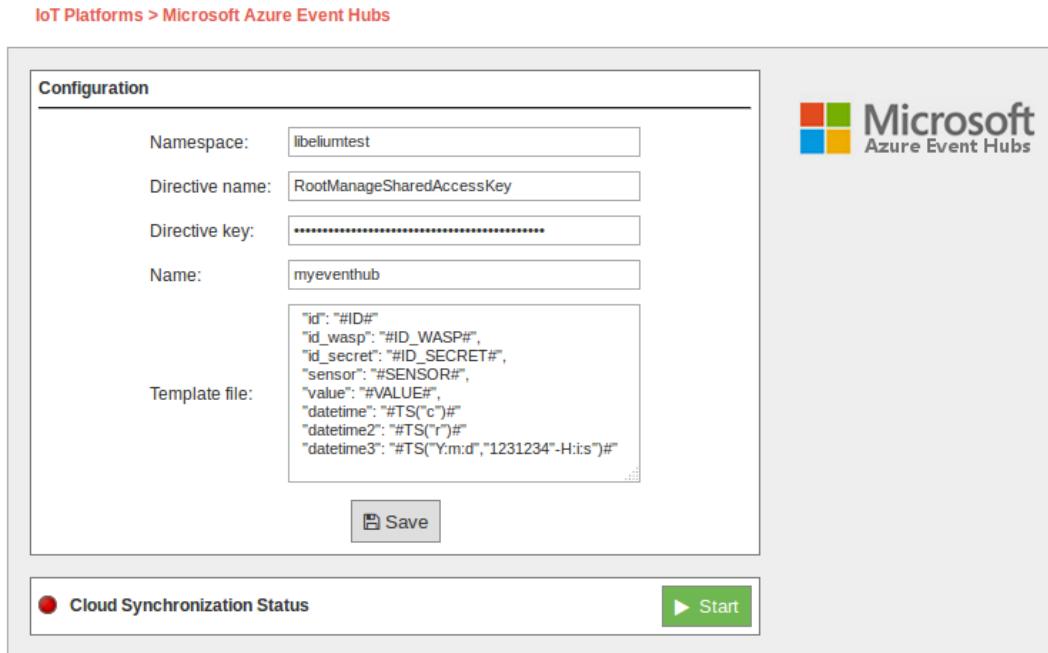


Figure: Configuring Azure Event Hubs in Meshlium

- **Namespace:** Name of the space created in the Azure service cloud.
- **Directive name:** Name of the directive created in Azure.
- **Directive key:** Key of the directive associated to the previous name.
- **Name:** Name of the Event Hub established in Azure.
- **Template file:** Users can define their own data structure using these wild-cards (as you can see in the previous figure):
 - #ID# : Unique identifier for data
 - #ID_WASP#: Identifies the Wasp mote unit
 - #ID_SECRET#: Secret identifier
 - #SENSOR#: Identifies the sensor
 - #VALUE#: Value obtained from the sensor

#TS("c")#: Date with custom format. The parameter passed in this wild-card corresponds to the same ones you can use in PHP date function (see format parameters in <http://php.net/manual/es/function.date.php#refsect1-function.date-parameters>).

12.1.3.5. Controlling synchronization

Once you have saved the configuration, you can start sending your data via Event Hub to your Azure Cloud by pressing the "Start" button. You will notice about it because the screen shows a spinning wheel when the process starts and displays a "running" status.



Figure: Azure Event Hubs synchronization service is running

If you want to stop this process just press the "Stop" button. You can start/stop this process whenever you want.



Figure: Azure Event Hubs synchronization service is stopped

12.1.4. Microsoft Azure IoT Hub

Azure IoT Hub is a fully managed service that enables reliable and secure bi-directional communications between millions of Internet of Things (IoT) devices and a solution back end. One of the biggest challenges that IoT projects face is how to reliably and securely connect devices to the solution back end. To address this challenge, IoT Hub:

- Offers reliable device-to-cloud and cloud-to-device hyper-scale messaging.
- Enables secure communications using per-device security credentials and access control.
- Includes the most popular communication protocols.

More information: <https://www.microsoft.com/en-us/cloud-platform/internet-of-things-azure-iot-suite>.

With this plugin, Meshlium can send messages to your cloud back-end.

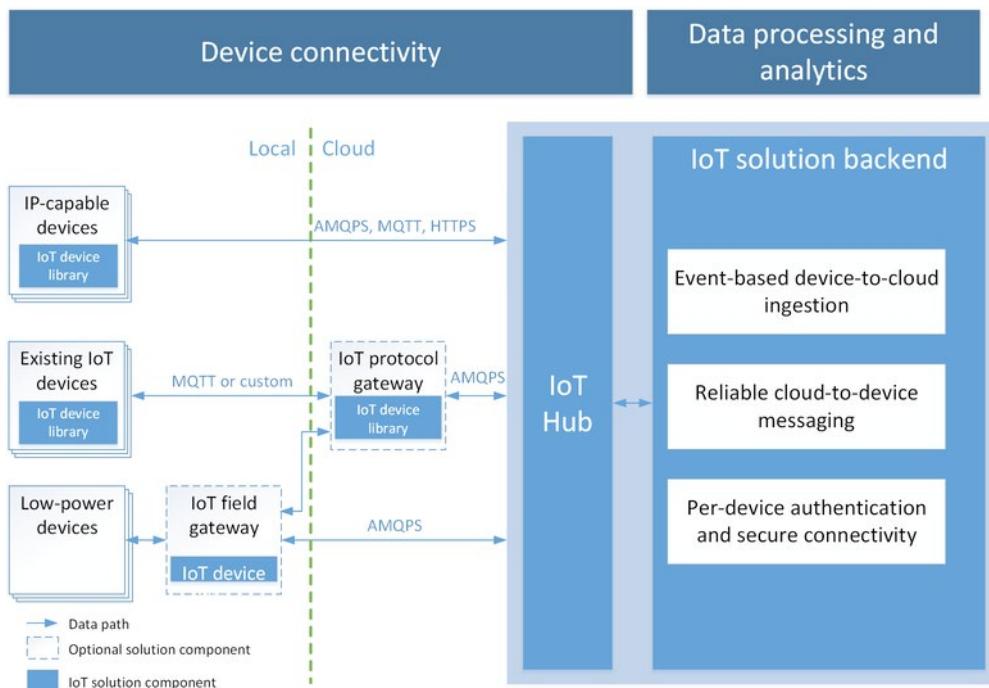


Figure: Azure IoT Hub plugin

12.1.4.1. Register Meshlium in Azure Portal

To register Meshlium in Azure Portal, you have to follow the guide:

Get started with Azure IoT Hub for Java:

<https://azure.microsoft.com/en-us/documentation/articles/iot-hub-java-javascript-getstarted/>.

The guide explains how to create an IoT Hub and a device entity. It is important to annotate the connection string generated after creating the device entity. You will need this parameter later for the Meshlium configuration.

In the Microsoft Azure Portal, go to IoT Hub menu and select:

Devices > myCreatedDevice > Shared access policies > iothubowner > Connection string – primary key

You have to annotate the value of this field.

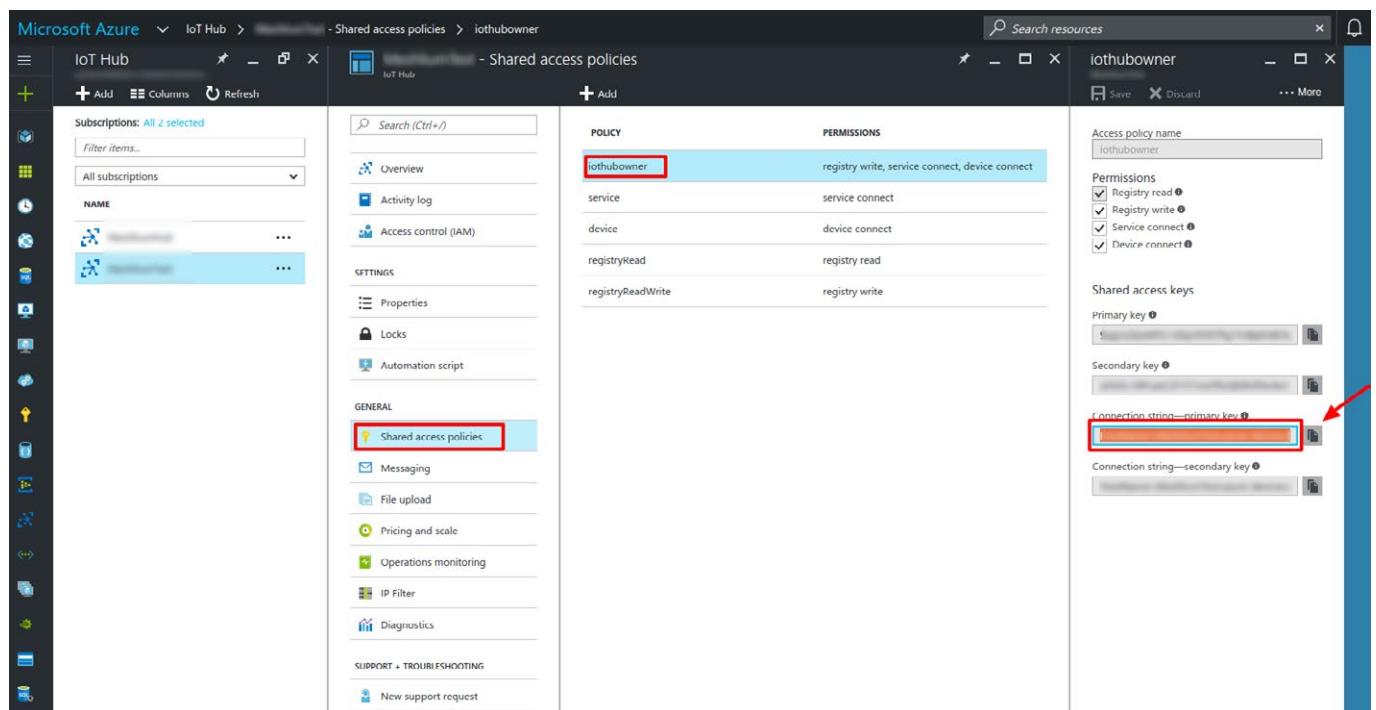


Figure: Annotation the value of the field

12.1.4.2. Configuration

You will use the previously obtained “connection string” from the Azure portal to certificate your Meshlium as a valid sender of messages.

Microsoft Azure IoT Hub plugin is located in:

Manager System > Cloud Connector > IoT Platforms > Azure IoT Cloud

In the Configuration panel, the user can set:

- **Connection String:** Connection string previously copied.
- **Number Requests:** Number of requests to send per iteration.
- **Protocol:** Choose the protocol to communicate with Azure IoT Hub. Valid protocols are: MQTT (by default), AMQPS and HTTPS.

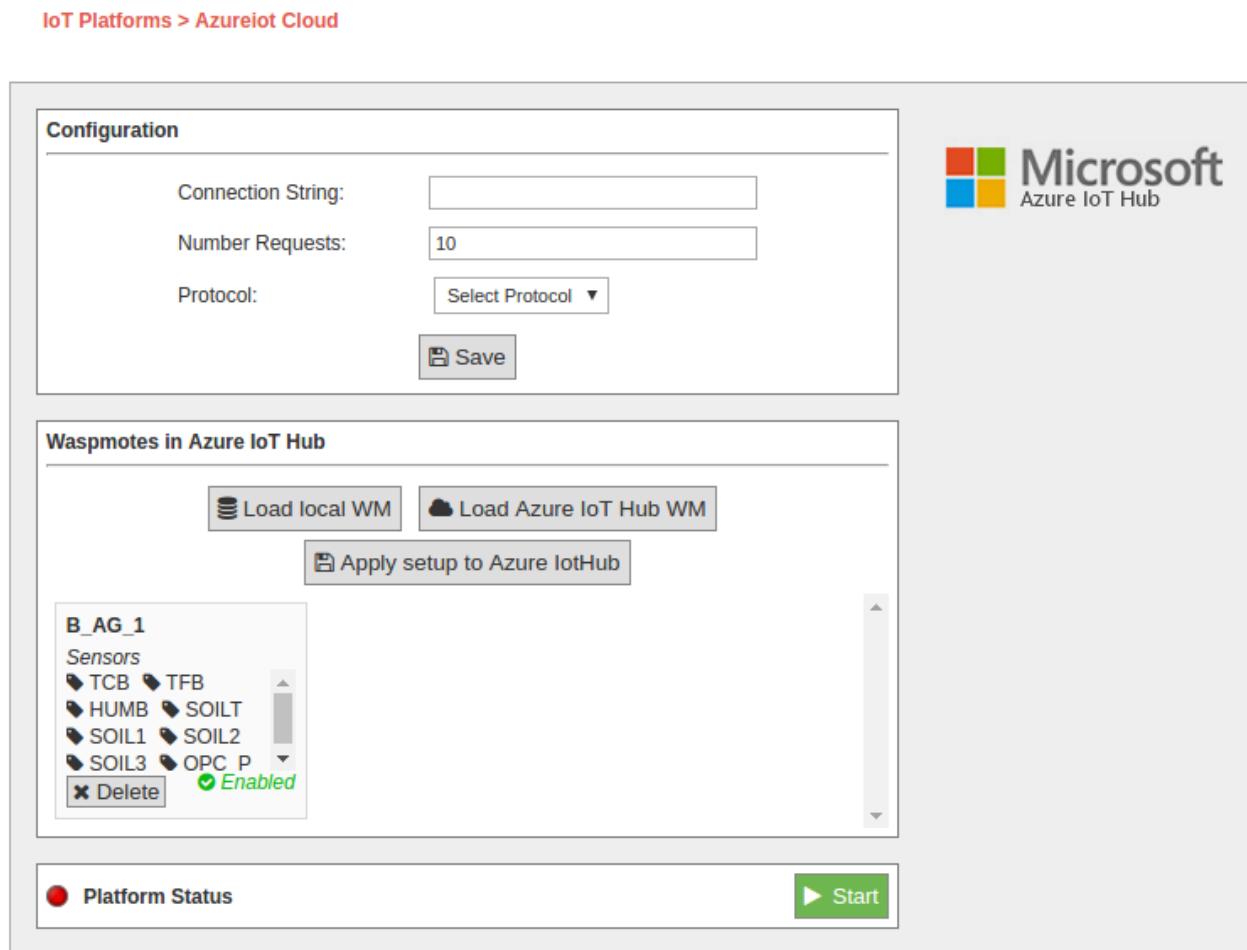


Figure: Azure IoT Hub configuration panel

12.1.4.3. Controlling synchronization

Once configured the server/broker, the user can launch the Meshlium Microsoft Azure IoT Hub script (Start button). The program will send test messages to the Azure IoT Hub platform via the selected protocol. The status indicator displays the current state, saying "Running" or "Stopped".



Figure: Azure IoT Hub sender is running

You can stop the Azure IoT Hub program anytime clicking on the "Stop" button.



Figure: Azure IoT sender is stopped

12.1.5. Nexmachina

12.1.5.1. What is iQmenic?

iQmenic is a cloud solution for the Internet of Things created by Nexmachina.

Characteristics:

- Simple and practical
- Multi-language
- Multi-device
- Multi-user



Features:

- Monitoring devices and sensors
- Display data
- Configurable alarms
- Export data
- Configurable interface



Technical requirements User:

Web browser Chrome, Firefox, IE8 or higher.



Figure: iQmenic Dashboard

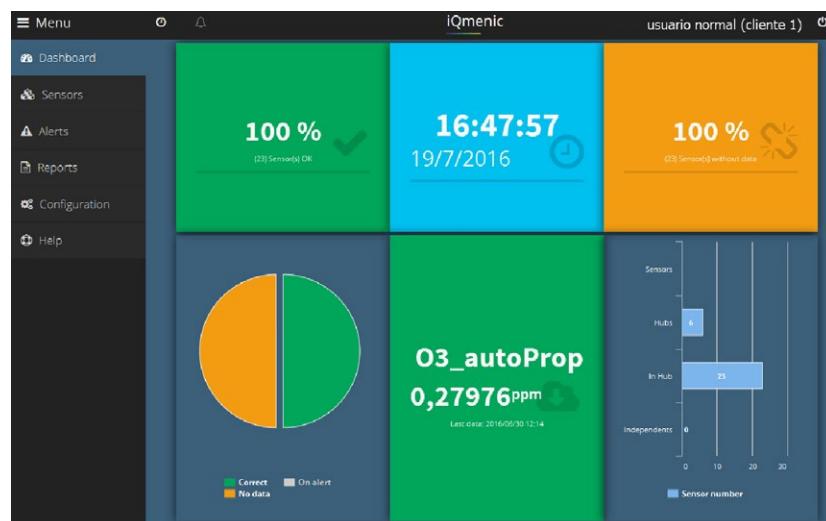


Figure: Sensors on the map

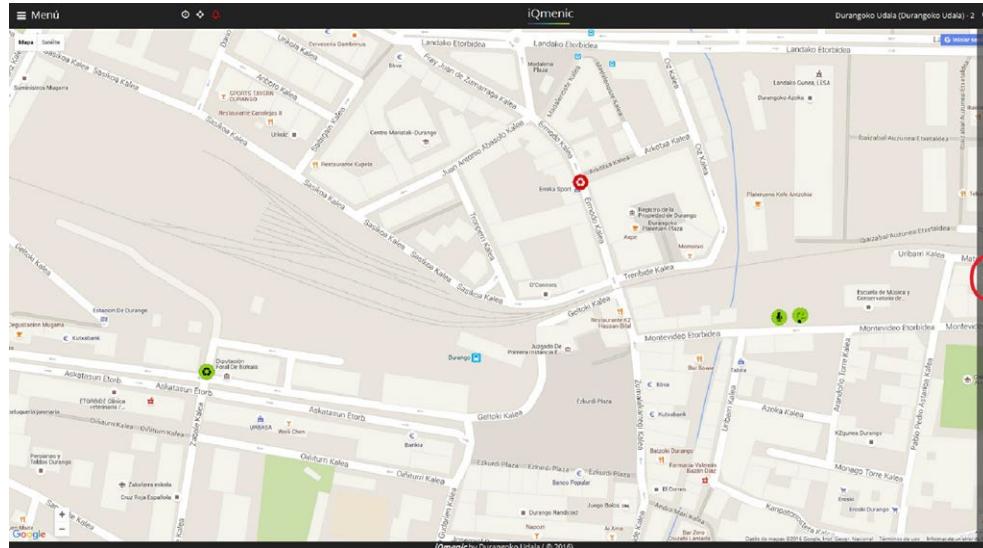


Figure: Graphic data from sensors

12.1.5.2. Meshlium cloud connection to iQmenic

If you want to connect your Meshlium with iQmenic, follow these steps:

- 1. Contact Nemachina. We will provide you a URL, User and Password for your iQmenic platform as well as the configuration parameters for connecting your Meshlium to iQmenic.
- 2. Log in your Meshlium and go to Cloud Connector > IoT Solutions > iQmenic. Fill the form with the configuration data and click on the **Save** button.

[IoT Solutions > Nemachina Cloud](#)

Configuration
iQmenic

| | | |
|--|---|--|
| MQTT Server: | <input type="text" value="serve.com"/> | |
| MQTT Port number: | <input type="text" value="1885"/> | |
| MQTT User: | <input type="text" value="meshlium-iqmenic"/> | |
| MQTT Password: | <input type="password" value="*****"/> | |
| <input type="button" value="Save"/> | | |
| ● Nemachina MQTT Sender | ▶ Start | |

Figure: Configuring Orchestra

- 3. To send data from Meshlium to iQmenic, just click on the Start button. Data will be sent by MQTT protocol and you will be able to check the reception on iQmenic.

12.1.6. ElementBlue – RightSensor

RightSensor is a solution company designed to provide sensors, services and support for Industrial Internet of Things projects.

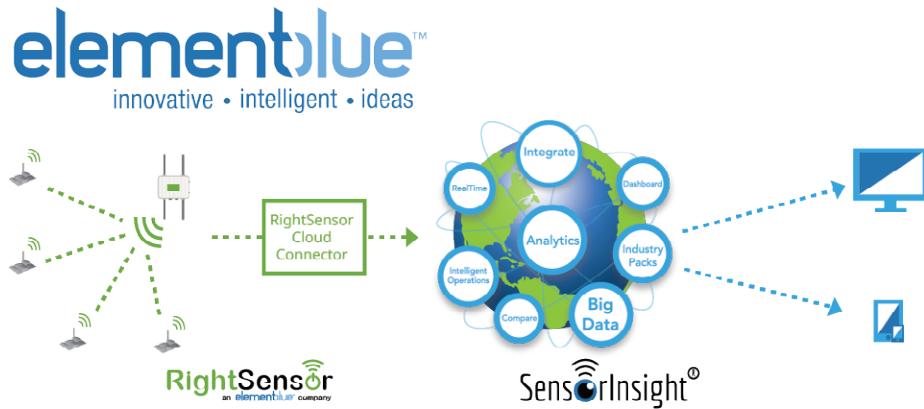


Figure: ElementBlue RightSensor Cloud

The RightSensor cloud connects interface works directly with Element Blue's SensorInsight® Industrial Internet of Things Platform.

SensorInsight® is used by companies for the integration, display and detailed analysis of data from multiple sources providing an environment where users can view and compare real-time and historic data patterns, receive alerts and notifications, and trigger workflows and actions based on the data for use in industrial environments.

To use the service you must have an account with Element Blue's SensorInsight Industrial Internet of Things Platform. For more information visit: www.sensorinsight.io and www.rightsensor.com.

12.1.6.1. Configuration

By expanding the RightSensor menu item on the list you can see the form in which to set your connection parameters. The form accepts the following 4 parameters:

- Client ID:** This is a unique ID provided to you from the SensorInsight service.
- Gateway ID:** This is an ID you provide to uniquely identify this Meshlium device.
- User Name:** This is the Username required to send your data to the SensorInsight cloud.
- Password:** This is the Password required to send your data to the SensorInsight cloud.

IoT Solutions > Elementblue

| Configuration | |
|--|--|
| Client ID: | <input type="text" value="123456789"/> |
| Gateway ID: | <input type="text" value="gateway"/> |
| User Name: | <input type="text" value="username"/> |
| Password: | <input type="password" value="*****"/> |
| <input type="button" value="Save"/> | |
| ● SensorInsight Synchronization Status Start | |

Figure: Configuring ElementBlue RightSensor in Meshlium

The form accepts the following 4 parameters:

- **Client ID:** This is a unique ID provided to you from the SensorInsight service.
- **Gateway ID:** This is an ID you provide to uniquely identify this Meshlium device.
- **User Name:** This is the Username required to send your data to the SensorInsight cloud.
- **Password:** This is the Password required to send your data to the SensorInsight cloud.

These parameters can be obtained from your SensorInsight account page. Learn more at www.sensorinsight.io.

12.1.6.2. Controlling synchronization

To launch the cloud connector service and start sending your data to RightSensor press the “Start” button.



Figure: ElementBlue RightSensor synchronization service is running

You can stop at any moment clicking on the “Stop” button.

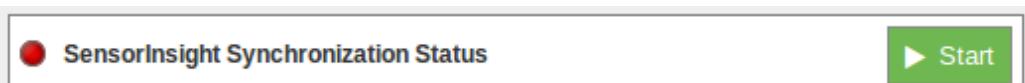


Figure: ElementBlue RightSensor synchronization service is stopped

12.1.6.3. Problems

The RightSensor Cloud Connector service has built-in logging and debugging capability. Please contact RightSensor at www.rightsensor.com for troubleshooting information.

12.1.7. Sofia2

Sofia2 is a middleware developed by Indra that allows the interoperability of multiple systems and devices, offering a semantic platform to make real world information available to smart applications (Internet of Things).

It is multi-language and multi-protocol, enabling the interconnection of heterogeneous devices. It provides publishing and subscription mechanisms, facilitating the orchestration of sensors and actuators in order to monitor and act on the environment.

12.1.7.1. Configuration

The plugin to connect Meshlium to Sofia2 platform is in the Manager System section **Cloud Connector > IoT Solutions > Sofia2**.

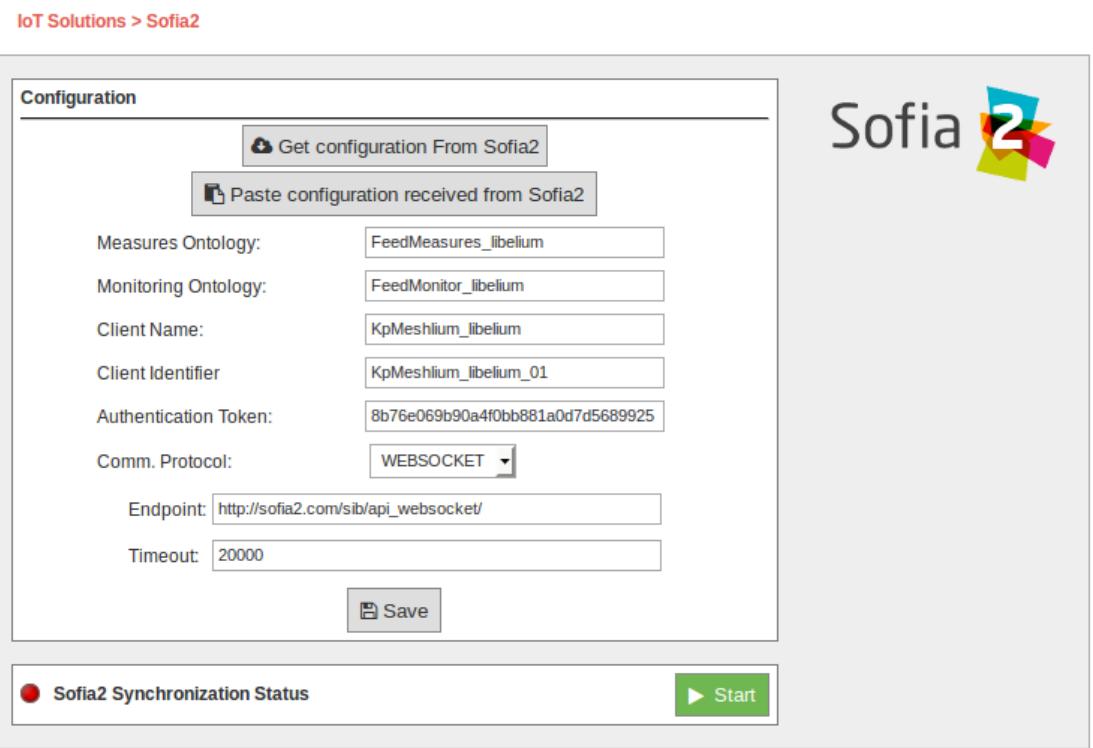


Figure: Sofia2 configuration

Registering the Meshlium device in Sofia2 is a previous step required to connect the Meshlium with Sofia2. At the end of the registration process you will obtain the configuration parameters needed to set up the Meshlium plugin properly.

This configuration includes the following information:

- **Measures Ontology:** Collection (table or storage) where the measures from Waspmove sensors sent by Meshlium (the gateway) will be stored into the platform.
- **Monitoring Ontology:** Collection (table or storage) where monitoring values (internal temperature, battery level...) of the Waspmotes connected to Meshlium, will be stored into the platform.
- **Client Name:** Name of the Meshlium unit to be identified by Sofia2 platform, checking if it has permission to write on the ontologies.
- **Client Identifier:** Identifier of the Meshlium unit to differentiate between several Meshliums using the same Client Name.
- **Authentication Token:** Token to authenticate the Meshlium device during the establishment of a session with Sofia2 platform.

12.1.7.2. Register Meshlium in Sofia2

To register Meshlium in Sofia2, click on the link Get Configuration From Sofia2.

IoT Solutions > Sofia2

Configuration

Get configuration From Sofia2

Paste configuration received from Sofia2

Measures Ontology: FeedMeasures_libelium

Monitoring Ontology: FeedMonitor_libelium

Client Name: KpMeshlium_libelium

Client Identifier: KpMeshlium_libelium_01

Authentication Token: 8b76e069b90a4f0bb881a0d7d5689925

Comm. Protocol: WEBSOCKET

Endpoint: http://sofia2.com/sib/api_websocket/

Timeout: 20000

Save

Sofia 2

Sofia2 Synchronization Status

Start

Figure: Sofia2 configuration link

You will be redirected to the following page:

[Web access portal](#)

To start working with your meshlium device you need to be logged in the platform

[Login or Register for this site](#)

Figure: Sofia2 configuration portal

Where:

- Login using your Sofia2 account.
- Create a new account if you do not have a valid login user.

Logging in Sofia2 platform will redirect to the following page that suggests a name for your collections of measures and monitoring data, and for your gateway identifier (KP in Sofia2 terms):

Meshlium Cloud Conector

The screenshot shows a configuration form for a Meshlium Cloud Conector. It includes fields for:

- Measures ontology:** FeedMeasures_New
- Monitoring ontology:** FeedMonitor_New
- Kp:** KpMeshlium_New
- Create:** A blue button at the bottom left.

Figure: Sofia2 configuration information

Finally, after creating the configuration, you will obtain a JSON file containing all configuration values ready to be pasted on the Manager System, in order to setup the Sofia2 Cloud Connector:

The screenshot shows a configuration form for Sofia2, displaying the following fields:

- User:** sofia
- Measures ontology:** FeedMeasures_New
- Monitoring ontology:** FeedMonitor_New
- Kp:** KpMeshlium_New
- Token:** 2ec91cae08f04fb2b2db34dcc1c0297f
- Configuration:** A scrollable text area containing the following JSON configuration:

```
{  
  "kpName": "KpMeshlium_New",  
  "kpInstance": "KpMeshlium_New_01",  
  "measuresOntology": "FeedMeasures_New",  
  "monitoringOntology": "FeedMonitor_New",  
  "token": "2ec91cae08f04fb2b2db34dcc1c0297f"}  
}
```

Figure: Sofia2 JSON configuration

12.1.7.3. Configure the Cloud connector

The configuration from Sofia2 can be setup in Meshlium just by clicking Paste configuration received from Sofia2 and pasting the JSON generated in the previous step.

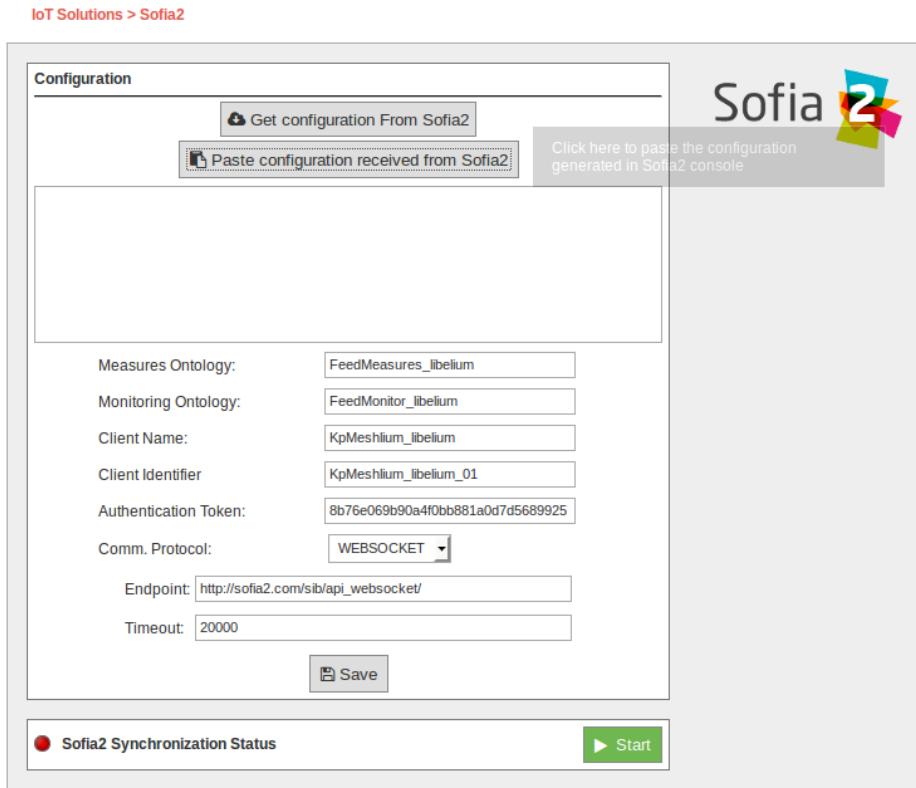


Figure: Sofia2 pasting JSON configuration

Configuring the plugin this way, the fields for Measures Ontology, Monitoring Ontology, Client Name, Client Identifier and Authentication Token will be completed.

Alternatively, these fields can be filled in manually, with the information received from the configuration page of Sofia2 showed in the first step.

12.1.7.4. Select communication protocol

12.1.7.4.1. REST

REST is a stateless communication protocol over HTTP. Using this protocol, the Cloud Connector is a client of the Sofia2 platform, that periodically opens a connection with the platform to send an HTTP POST operation containing the sensor measurements.

The parameter of the REST protocol are:

Endpoint: URL of the REST Gateway of Sofia2 platform. It is the REST server that will receive requests from clients.



Figure: Sofia2 REST protocol

12.1.7.4.2. MQTT

MQTT is a stateful communication protocol over TCP. Using this protocol, the Cloud Connector is a client of the Sofia2 platform, that initially opens a connection with the platform, maintains it alive during that time, and periodically sends an MQTT packet containing the sensor measurements. In case of disconnection, the connector periodically tries to reconnect.

The parameters of the MQTT protocol are:

- **Server:** IP or machine name of the MQTT gateway in the Sofia2 server.
- **Port:** Port of the MQTT gateway in the Sofia2 server.
- **KeepAlive:** Interval in seconds that the connector will use to check the status of the connection.
- **Connection Timeout:** Timeout to establish a connection.
- **Response Timeout:** Timeout to wait response from the Sofia2 server.
- **Auth user:** Optional. MQTT protocol authentication user.
- **Auth password:** Optional. MQTT protocol authentication password.

| | | |
|-------------------------|---|-------------------------------|
| Comm. Protocol: | <input style="border: 1px solid black; padding: 2px 10px; width: 100px; height: 20px; border-radius: 5px; font-size: 10px; font-weight: bold; margin-bottom: 5px;" type="button" value="MQTT"/> | Connection protocol Sofia2 |
| Server: | <input style="width: 100%; height: 25px; border: 1px solid #ccc; border-radius: 5px; padding: 5px; margin-bottom: 5px;" type="text" value="sofia2.com"/> | |
| Port: | <input style="width: 100%; height: 25px; border: 1px solid #ccc; border-radius: 5px; padding: 5px; margin-bottom: 5px;" type="text" value="1883"/> | |
| KeepAlive: | <input style="width: 100%; height: 25px; border: 1px solid #ccc; border-radius: 5px; padding: 5px; margin-bottom: 5px;" type="text" value="5"/> | |
| Connection Timeout(ms): | <input style="width: 100%; height: 25px; border: 1px solid #ccc; border-radius: 5px; padding: 5px; margin-bottom: 5px;" type="text" value="5000"/> | |
| Response Timeout(ms): | <input style="width: 100%; height: 25px; border: 1px solid #ccc; border-radius: 5px; padding: 5px; margin-bottom: 5px;" type="text" value="6000"/> | |
| Auth user: | <input style="width: 100%; height: 25px; border: 1px solid #ccc; border-radius: 5px; padding: 5px; margin-bottom: 5px;" type="text"/> | |
| Auth password: | <input style="width: 100%; height: 25px; border: 1px solid #ccc; border-radius: 5px; padding: 5px; margin-bottom: 5px;" type="text"/> | |

Figure: Sofia2 MQTT protocol

12.1.7.4.3. Websocket

It is a stateful communication protocol over HTTP. Using this protocol, the Cloud Connector is a client of Sofia2 platform, that initially open a connection with the platform, maintains it alive during a defined time, and periodically sends a HTTP packet containing the sensor measurements. In case of disconnection, the connector periodically tries to reconnect.

The parameters of the Websocket protocol are:

- **Endpoint:** URL of the Websocket gateway of Sofia2 platform. It is the server that will receive requests from clients.
- **Timeout:** Timeout for any operation with the server.

| | |
|-----------------|--|
| Comm. Protocol: | <input style="border: 1px solid black; padding: 2px 10px; width: 100px; height: 20px; border-radius: 5px; font-size: 10px; font-weight: bold; margin-bottom: 5px;" type="button" value="WEBSOCKET"/> |
| Endpoint: | <input style="width: 100%; height: 25px; border: 1px solid #ccc; border-radius: 5px; padding: 5px; margin-bottom: 5px;" type="text" value="http://sofia2.com/sib/api_websocket/"/> |
| Timeout: | <input style="width: 100%; height: 25px; border: 1px solid #ccc; border-radius: 5px; padding: 5px; margin-bottom: 5px;" type="text" value="20000"/> |

Figure: Sofia2 Websocket protocol

12.1.7.5. Save the configuration and start the connector

Once all configuration and connection parameters are setup, they can be stored and the connector can be started to send information to Sofia2.

To save the configuration, click on the “Save” button:

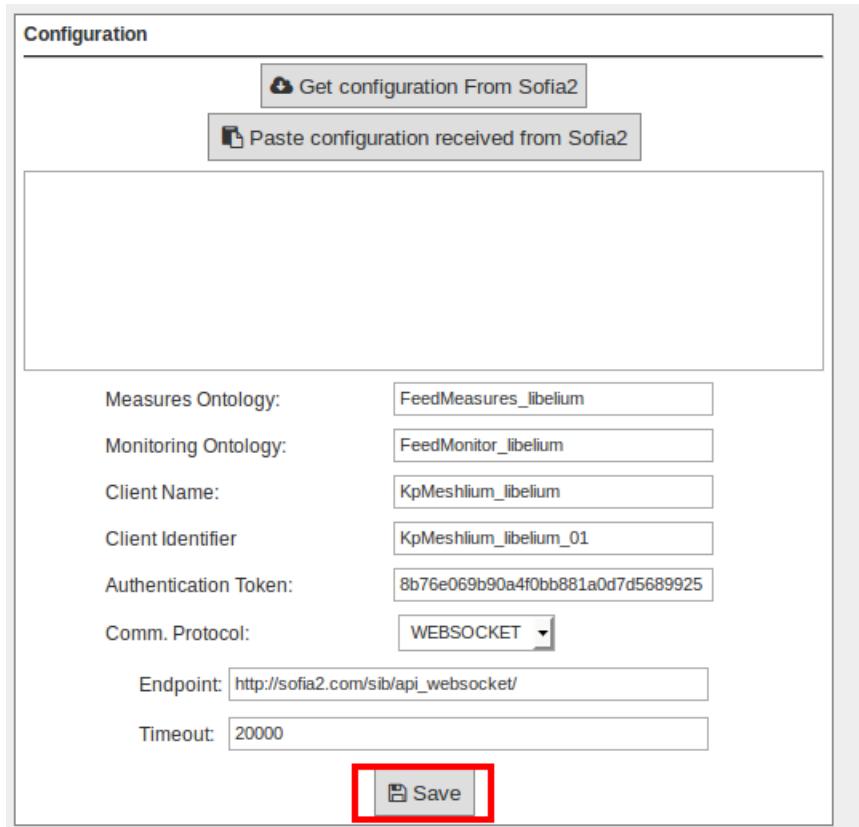


Figure: Sofia2 save configuration button

After saving the configuration, the Cloud Connector can be started by clicking on the “Start” button:



Figure: Sofia2 synchronization service running

You can stop the process at any moment by clicking on the “Stop” button.



Figure: Sofia2 synchronization service stopped

12.1.8. ThingPlus

Thing+ allows customers to build their own IoT services with high speed, reliability, scalability, and cost competitiveness, connected by a SaaS or PaaS IoT platform. When Thing+ Embedded devices connect to the Thing+ Cloud (public or private), customers can visualize various data graphs and charts from sensors directly on the Thing+ Portal. Device registration is easy as the Thing+ Portal provides dashboard widgets, a trigger-condition-action-based rule engine for alert notifications or to control actuators, and results in the form of an event timeline.

12.1.8.1. Get API Key

- Get the “Gateway ID” to register:
 - Open the Meshlium Manager System
 - Click Cloud Connector
 - Open the ThingPlus plugin
 - You can see ThingPlus configuration and “Gateway ID”
 - Copy the “Gateway ID”
- Get the API Key:
 - Go to your ThingPlus service (if you have no registered service, register your service) <https://yourservice.thingplus.net>
 - Go to Gateway Management page (via upper right menu)
 - Click the + button in the upper right corner
 - Click “Request for Gateway certificates or API Key” button

The screenshot shows a web-based interface titled "Gateway Management". At the top, there is a button labeled "Request for Gateway Certificates or API Key". Below this, there is a form titled "Register Gateway" with four fields: "Gateway Model" (dropdown menu), "Gateway ID" (text input field containing "Mac address" with "Required" validation message), "Gateway Name" (text input field containing "Gateway Name" with "Required" validation message), and "Site Name" (dropdown menu). At the bottom of the form is a yellow button labeled "Register a Gateway, Devices and Sensors".

Figure: Request API Key in the ThingPlus panel

- Fill form
 - Gateway ID
 - Select "API Key" (Authentication Type)
- Click "Get API Key"
- Copy the "API Key"

Gateway Management

[Register Gateway](#)

Request for Gateway Certificates or API Key

| | |
|---|---|
| Gateway ID | <input style="width: 100%;" type="text" value="00:0d:....."/> |
| Authentication Type | <input style="width: 100%;" type="button" value="API Key"/> |
| API Key | <input style="width: 100%;" type="text" value="oitQ8.....="/> |
| <input style="background-color: yellow; border: none; padding: 2px 10px;" type="button" value="Get API Key"/> | |
| After installing the downloaded certification or API Key to your gateway, register your gateway. X | |

Figure: Get the API Key in the ThingPlus panel

- Set "API Key" in the Meshlium Manager System
 - Go to ThingPlus configuration again
 - Paste the "API Key"

IoT Solutions > Thing+

Configuration

| | |
|---|--|
| Gateway ID: | <input style="width: 100%;" type="text"/> |
| API Key: | <input style="width: 100%;" type="text" value="...."/> |
| <input style="background-color: #e0f2e0; border: none; padding: 2px 10px;" type="button" value="Save"/> | |
| ● Cloud Synchronization Status ▶ Start | |

Figure: Enter API Key in the ThingPlus plugin

- Click the "Save" button (ThingPlus gateway app will restart)
- If the status is "STOPPED", then click on the "Start" button after saving API Key

12.1.8.2. Register Gateway and Sensors

- Go to your ThingPlus service
- Go to Gateway Management page (via upper right menu)
- Click the + button in the upper right corner
- Fill the form:
 - Select Gateway Model as "Libelium Meshlium"
 - Input Gateway ID (the same MAC address when registering gateway)
 - Select Device Model as "Waspmove Basic"
 - Input Device Address (Waspmove address is the id_wasp field)
 - Input Device Name
 - Select Sensors to register (all sensors are selected as default)
 - Select Site Name (default)
- Click "Register a Gateway, Devices and Sensors" button:
 - ThingPlus gateway app will restart and send the sensor data in a few minutes
 - You can see the sensor data at Dashboard or Sensor page

Gateway Management

Request for Gateway Certificates or API Key

Register Gateway

| | |
|----------------|----------------------|
| Gateway Model | Libelium Meshlium |
| Gateway ID | 00:0d:xxxx:xxxx |
| Gateway Name | Mesh GW Office 1 |
| Device Model | Waspmove Basic |
| Device ID | 000d:xxxx:xxxx:1 |
| Device Address | 1 |
| Device Name | Mesh Device Office 1 |

Sensors to create

| Type | Name | ID | Bus | Address | Model |
|-------------------------------------|---------------------------------|--------------------|-----|---------------------|-----------------------|
| <input checked="" type="checkbox"/> | accelerometer_ACC Required | 000db:xxxx:xxxx:1- | 1 | accelerometer-ACC | libeliumAccelerometer |
| <input checked="" type="checkbox"/> | batteryGauge_BAT Required | 000dt:xxxx:xxxx:1- | 1 | batteryGauge-BAT | libeliumBatteryGauge |
| <input checked="" type="checkbox"/> | string_MAC Required | 000d:xxxx:xxxx:1- | 1 | string-MAC | libeliumString |
| <input checked="" type="checkbox"/> | temperature_IN_TEMP Required | 000d:xxxx:xxxx:1- | 1 | temperature-IN_TEMP | libeliumTemp |

Site Name: default

Add Device

Register a Gateway, Devices and Sensors

Figure: Registering a Gateway in ThingPlus service.

12.1.9. ThingWorx

ThingWorx is the first software platform designed to build and run the applications of the connected world. ThingWorx reduces the time, cost, and risk required to build innovative Machine-to-Machine (M2M) and Internet of Things applications by providing a complete application design, runtime, and intelligence environment. The ThingWorx platform includes flexible device connectivity options, rapid application development tools, scalable storage, and supports various deployment models.

More information: <http://www.thingworx.com>.

ThingWorx includes the following features:

- ThingWorx Composer™ - an end-to-end application-modeling environment designed to help you easily build the unique applications of today's connected world. Composer makes it easy to model the Things, Business Logic, Visualization, Data Storage, Collaboration, and Security required for a connected application.
- Codeless Mashup Builder – a "drag and drop" Mashup Builder empowers developers and business users to rapidly create rich, interactive applications, real-time dashboards, collaborative workspaces, and mobile interfaces without the need for coding.
- Execution and Storage Engine - ThingWorx's event-driven execution engine and 3-Dimensional storage allows companies to make business sense of the massive amounts of data from their people, systems, and connected "Things" – making the data useful and actionable. It also features a data collection engine that provides unified, semantic storage for time-series, structured, and social data at rates 10X faster than traditional RDBs.
- Search-based Intelligence - ThingWorx SQUEAL™ (Search, Query, and Analysis) brings Search to the world of connected devices and distributed data. With SQUEAL's interactive search capabilities, users can correlate data that delivers answers to key business questions.

Note: If you need more information about these components, go to <http://www.thingworx.com/platform/>

12.1.9.1. Configuration

Inside the "ThingWorx" plugin you can setup which Waspmotes in the system will be published in ThingWorx server.

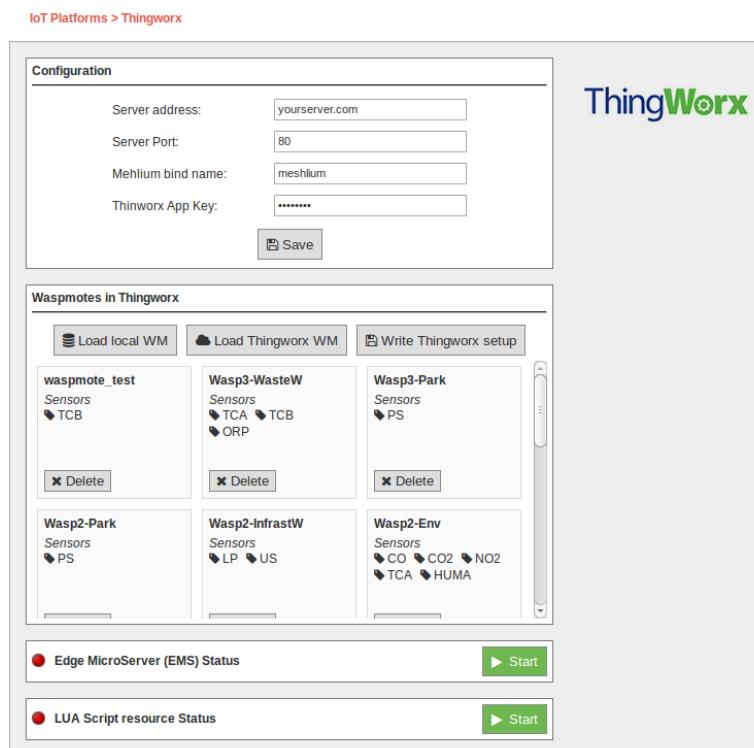


Figure: ThingWorx configuration

The parameters to setup are:

- **Server address:** The address of your ThingWorx server.
- **Server Port:** The port where your ThingWorx server is accessible.
- **Meshlium bind name:** The name of the Meshlium “thing” in ThingWorx. Meshlium thing is detected in ThingWorx but will not send any data.
- **ThingWorx App Key:** Security key to send data to your ThingWorx server.

Click on the “Save” button to write this setup to the ThingWorx service.

The steps to setup Waspmotes to send to ThingWorx are:

- Click on the button “Load local WM”. This will read Waspmotes that have data in the sensor database.

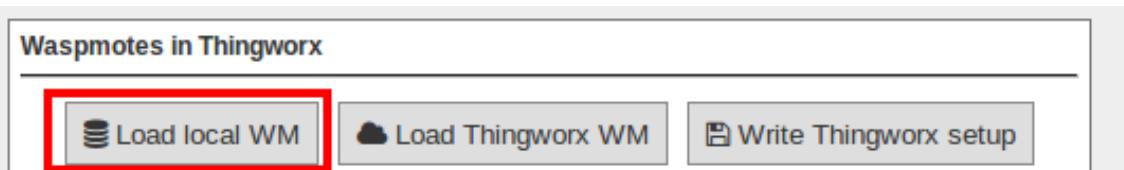


Figure: Getting Waspmotes from the system

- A panel with the devices is displayed, with a list of the sensors received from each Waspmote.

| | | |
|--|--|------------------------------------|
| waspmote_test Sensors TCB | Wasp3-WasteW Sensors TCA TCB ORP | Wasp3-Park Sensors PS |
| X Delete | X Delete | X Delete |

| | | |
|------------------------------------|---|---|
| Wasp2-Park Sensors PS | Wasp2-InfrastW Sensors LP US | Wasp2-Env Sensors CO CO2 NO2 TCA HUMA |
| X Delete | X Delete | X Delete |

Figure: Waspmotes to be send to ThingWorx

- It is possible to delete a Waspmote from the list clicking on its “Delete” button. This device will not be published to the ThingWorx platform.

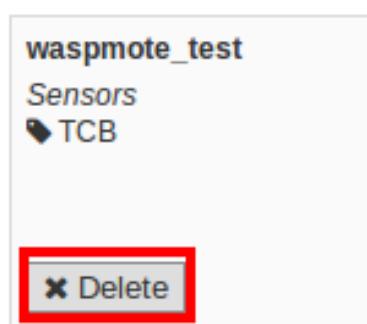


Figure: Delete a Waspmote from the list

- Once the list is correct, clicking on the button "Write ThingWorx setup" will push this setup to the ThingWorx EMS service.



Figure: Write the setup to ThingWorx service

After restarting the EMS and LUA Script services, the setup will be applied and you will see your devices in your ThingWorx server.

If you click again on the "Get Waspmotes from DB" button, the plugin will read again the DB and display all the Waspmotes. If you do not write this changes to ThingWorx setup, this will not propagate to the EMS service.

You can recover the current ThingWorx EMS service setup by clicking on the "Load WM from ThingWorx".



Figure: Write the setup to ThingWorx service

12.1.9.2. Using the Edge MicroServer (EMS)

ThingWorx has the ability to connect very quickly and easily to the physical world and structured data systems. ThingWorx supports a variety of communication protocols and system interfaces. Many are implemented directly on the ThingWorx Platform. However, for edge devices or data stores that need to connect to the platform using the Internet or through firewalls on an Intranet, ThingWorx provides an Edge MicroServer (EMS) solution that can be deployed where the data is, and allows secure, efficient communication back to the ThingWorx Platform. This section will concentrate on the EMS and the corresponding Edge Thing software components.

In order to send data to the ThingWorx environment, another component is needed: the LUA Script Resource service. This service needs to be running at the same time with Edge Micro Server to allow data acquisition.

To launch the Edge MicroServer (EMS) press Start button, and to stop it, press Stop button.



Figure: ThingWorx Edge MicroServer running



Figure: ThingWorx Edge MicroServer stopped

To launch the LUA Script resource press the Start button, and to stop it, press the Stop button.



Figure: ThingWorx Edge MicroServer running



Figure: ThingWorx Edge MicroServer stopped

12.2. Advanced Cloud Partners

12.2.1. Amazon IoT

Amazon Web Services IoT enables secure, bi-directional communication between Internet-connected things (such as sensors, actuators, embedded devices, or smart appliances) and the AWS cloud over MQTT and HTTP.

More information: <http://aws.amazon.com/iot/>.

With this plugin, Waspmove sensor data can be directly integrated with Amazon AWS IoT broker.



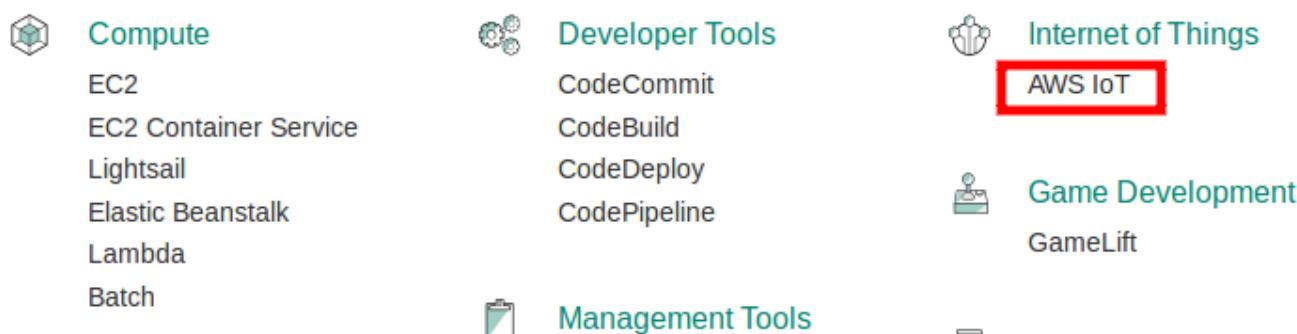
Figure: Amazon IoT plugin

12.2.1.1. Register Meshlium in Amazon IoT

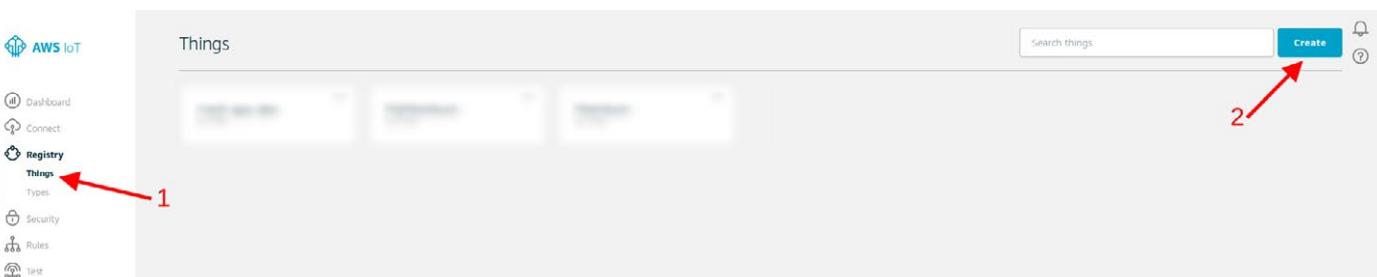
To register Meshlium in Amazon IoT, you have to create a “thing” in your Amazon AWS IoT dashboard, attach a security certificate and policy statement and copy the parameters to the plugin. Follow these steps to register your Meshlium:

1. Select **AWS IoT** in the Amazon Dashboard

All services



2. Create a “Thing”



Register a thing

This step creates an entry in the thing registry and a thing shadow for your device.

Name 1

[Hide options ▾](#)

Choose a thing type

You can associate a thing type to your thing.

Choose a thing type

Set searchable thing attributes

Next (optional), you can use thing attributes to describe the identity and capabilities of your device.

| | |
|---|---|
| Attribute key | Value |
| Provide an attribute key, e.g. Manufacturer | Provide an attribute value, e.g. Acme-Corporation |

[Clear](#)

[Add another](#)

[Show thing shadow ▾](#)



3. Create a security certificate and download the files for later use

THING
my_thing
NO TYPE Actions ▾

| | |
|---|--|
| Details | Certificates |
| Security 1 | To securely connect to AWS IoT, your thing will need a certificate and policy. Certificates help things establish a secure connection. AWS IoT policies give things permission to access AWS IoT resources (like other things, MQTT topics, or thing shadows). 2  <input type="button" value="Create certificate"/> <input type="button" value="View other options"/> |

Certificate created!

Download these files and save them in a safe place. Certificates can be retrieved at any time, but the private and public keys cannot be retrieved after you close this page.

In order to connect a device, you need to download the following:

| | | |
|------------------------------|------------------------|----------------------------|
| A certificate for this thing | 5613cec38f.cert.pem | Download 1 |
| A public key | 5613cec38f.public.key | Download |
| A private key | 5613cec38f.private.key | Download |

You also need to download a root CA for AWS IoT from Symantec:

A root CA for AWS IoT [Download](#)

[Activate](#) 2



[Done](#) [Attach a policy](#) 3

Figure: Save the credential files when connecting device

4. Create and attach a policy

Add authorization to certificate

You are attaching a policy to the following certificate:
1c3ae60b6639c7a956b96fecc9fdf7c241235fd5f447857cd22b2d2ff63a4ba

Select a policy to attach to this certificate:

Meshlium-Policy View

Create new policy 1

0 policies selected Done **Attach policy**

Create a policy

Create a policy to define a set of authorized actions. You can authorize actions on one or more resources (things, topics, topic filters).

Name 1

Action 2
3

Effect
 Allow Deny 4

Add statement

5 **Create**

5. Copy the HTTPS connection string for later use

THING
my_thing
 NO TYPE Actions

Details Connect a device

Security 1

Shadow

Interact 2

Activity

This thing already appears to be connected.

HTTPS

Update your Thing Shadow using this Rest API Endpoint. [Learn more](#)

REDACTED CONNECTION STRING 2

Figure: Annotate the value of the field

It is important to annotate the configuration displayed and save the credential files when connecting the device. You will need these files and parameters later for the Meshlium configuration.

12.2.1.2. Configuration

You will use the previously obtained configuration from the AWS IoT platform to certificate your Meshlium as a valid sender of MQTT messages.

Amazon IoT plugin is located in:

Manager System > Cloud Connector > IoT Platforms > Amazon Web Services

In the Configuration panel, the user can set:

- **Public key:** User public key file previously downloaded.
- **Private key:** User private key file previously downloaded.
- **Certificate:** Certificate file previously downloaded.
- **Host:** HTTPS connection string previously annotated.
- **Port:** AWS IoT MQTT port (by default 8883 for MQTT).
- **ClientID:** AWS IoT Client identification.
- **Log Level:** Generate log messages. From fewer to more details, the levels are: OFF, ERROR, INFO, DEBUG, REPORT. Default is OFF.
- **Topic template:** Topic of your message. The user can use these wild-cards creating a personalized structure:
 - #ID#: Unique identifier for data
 - #MESHLIUM#: Host name of the Meshlium unit
 - #ID_WASP#: Identifies the Waspmove unit
 - #ID_SECRET#: Secret identifier
 - #SENSOR#: Identifies the sensor
 - #VALUE#: Value obtained from the sensor
 - #TIMESTAMP#: MySQL [TIMESTAMP](#) type ('YYYY-MM-DD HH:MM:SS' UTC)
- **Message template:** Data structure of your message. The user can use these wild-cards creating a customized content:
 - #ID#: Unique identifier for data
 - #MESHLIUM#: host name of the Meshlium
 - #ID_WASP#: Identifies the Waspmove unit
 - #ID_SECRET#: Secret identifier
 - #SENSOR#: Identifies the sensor
 - #VALUE#: Value obtained from the sensor
 - #TIMESTAMP#: MySQL [TIMESTAMP](#) type ('YYYY-MM-DD HH:MM:SS' UTC)

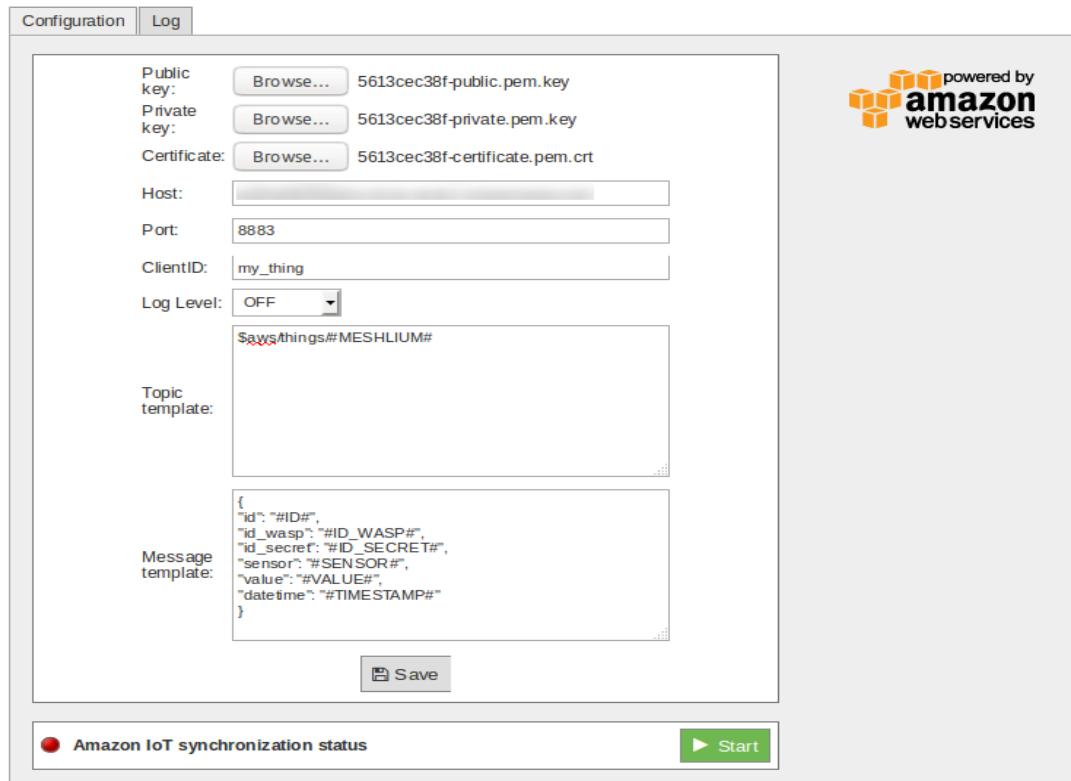


Figure: Amazon IoT configuration panel

12.2.1.3. Controlling synchronization

Once configured the server/broker, the user can launch the Meshlium Amazon IoT script (Start button). The program will search for the received frames on the local database, and will send them to the Amazon IoT platform via MQTT protocol. The status indicator displays the current state, saying "Running" or "Stopped".



Figure: Amazon IoT sender is running

You can stop the Amazon IoT program anytime clicking on the "Stop" button.



Figure: Amazon IoT sender is stopped

12.2.2. Cumulocity

Cumulocity IoT solution allows for a seamless integration of your Meshlium and WaspMote devices to the cloud. Once Meshlium is connected to this cloud, the Cumulocity IoT solution will automatically manage all your devices. Registering and gathering device data to Cumulocity Platform provides a fully customizable interface, allowing for deep data analysis.

Cumulocity works with a multitude of devices, centralizing all your IoT technologies in a single place. For more information, visit www.cumulocity.com.

12.2.2.1. Configuration

First of all, make sure your Meshlium is receiving data from your WaspMote or Plug & Sense! units. Please access to the Cumulocity cloud configurator in the Manager System. You need to fill the following fields with your correct Cumulocity account settings.

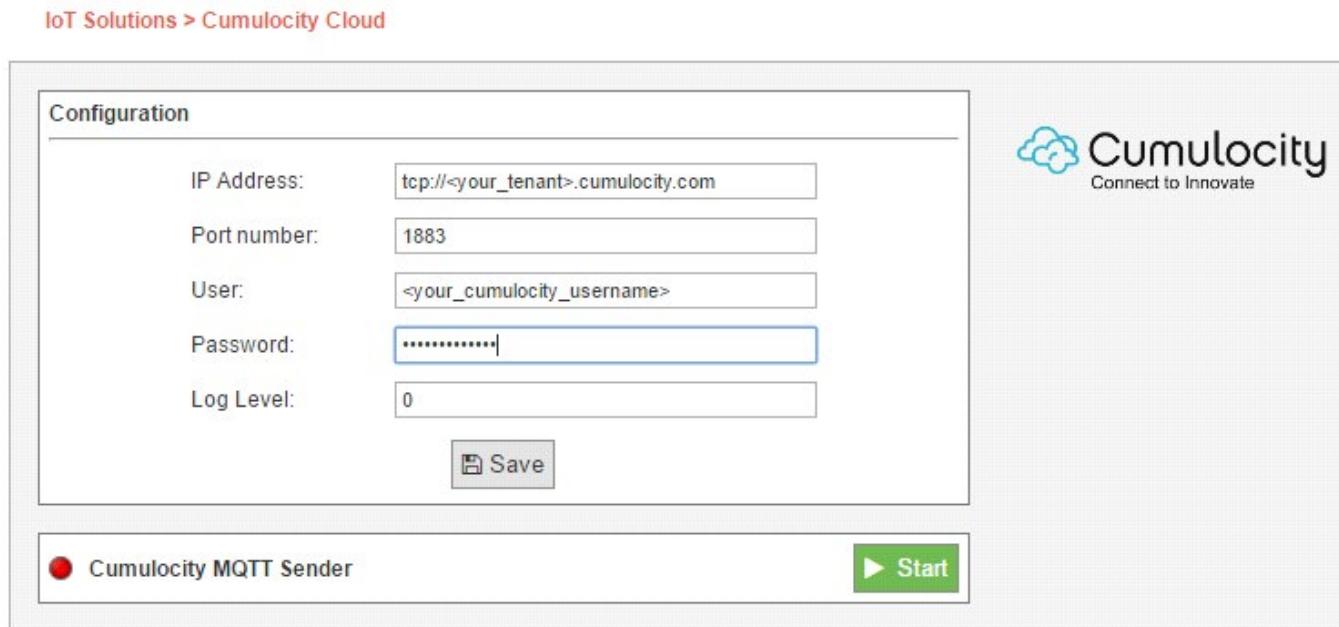


Figure: Configuring Cumulocity in Meshlium

- **IP address:** Address provided by Cumulocity
- **Port number:** Port Number provided by Cumulocity
- **User:** Username provided by Cumulocity
- **Password:** Password provided by Cumulocity
- **Log level:** Generate log messages. Valid values go from 0 (no log) to 4 (debug).

Then click "Save" to store your new settings.

After that, the only thing left to do is to activate the Cumulocity MQTT Sender by clicking on "Start".

The Cumulocity platform will handle all the devices' creation and data gathering for you. You can access now to your Cumulocity account with your browser and you should be able to see your devices and incoming data.

12.2.3. SmartCityPlatform

The SmartCityPlatform connects all the core elements of a successfully managed city. It allows the SmartMayor to manage urban development, socio-economic development and technological development of the city, measuring and reporting progress in real time.

By using this cloud connector, you connect to the Sense module, which is a part of SmartCityPlatform. It allows an overview of the city's pulse by gathering, measuring & monitoring happenings in the city.

www.smartiscity.eu

12.2.3.1. Configuration

To use the SmartCityPlatform cloud connector, you need to register your Meshlium in the authentication server. The server provides you with credentials, which you will enter in the form below. When you finish configuring, click the "Save" button to save the configuration.

IoT Solutions > SmartCityPlatform

Configuration

| | |
|-----------------|---|
| Hostname: | <input type="text" value="broker.smartis.si"/> |
| Port: | <input type="text" value="1883"/> |
| Account server: | <input type="text" value="account.smartis.si"/> |
| Client ID: | <input type="text" value="De8e048c-90ed-4d0d-826a-53ffdd51fa84"/> |
| Client secret: | <input type="text" value="*****"/> |
| Device ID: | <input type="text" value="57022239a35518524bf8fdb9"/> |
| Device secret: | <input type="text" value="*****"/> |
| Device group: | <input type="text" value="libelium"/> |
| Interval: | <input type="text" value="60"/> |

● Cloud Synchronization Status ▶ Start

Figure: SmartCityPlatform cloud connector configuration panel

- **Hostname:** the IP or hostname of the sensor broker.
- **Port:** the port where the sensor broker is listening for connections.
- **Account server:** the IP or hostname of the account server.
- **Client ID:** client identification provided by the authentication server.
- **Client secret:** client secret provided by the authentication server.
- **Device ID:** device identification provided by the authentication server.
- **Device secret:** device secret provided by the authentication server.
- **Device group:** the name you set for your device group.
- **Interval:** time duration in seconds between synchronizing data batches.

12.2.3.2. Controlling synchronization

With the configuration saved, you can start using the cloud connector. To start the synchronization, press the green "Start" button on the right.



Figure: SmartCityPlatform start button

You get a "loading" status inside the synchronization control section, indicating the synchronization is starting.



Figure: SmartCityPlatform loading button

When the cloud connector starts, a green dot on the left appears, indicating the synchronization is running. To stop the synchronization, simply click on the red "Stop" button on the right.



Figure: SmartCityPlatform stop button

12.2.4. Telefónica IoT Platform

Telefónica provides an M2M cloud to collect and analyze data. This platform is based on assets and models and you can optimize your business processes implementing rules and notifications, and subscribing to data from different hosts.

12.2.4.1. Configuration

A new option is shown in M2M Platform menu, in the Cloud Connector main option. If you expand it, you can see this form with 3 fields in it:

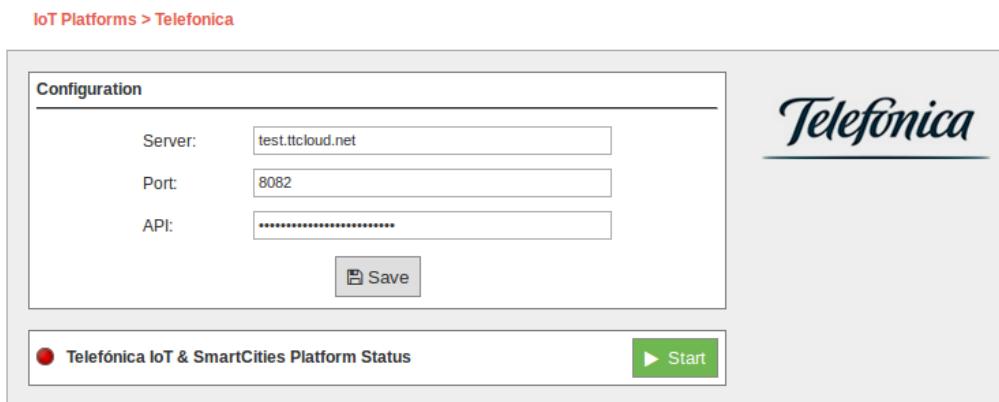


Figure: Telefónica IoT setup example on Manager System

- **URL:** Address of the API service of Telefónica IoT. This address should be provided without the "http://", usually int.dca.tid.es.
- **Port:** The port in which the API listens to connections.
- **API:** The security key to send data to Telefónica IoT.

All this data are provided by Telefónica service administrators.

12.2.4.2. Controlling synchronization

The synchronization will be done in packs of 100 data at a time, so the system is not overloaded. You can start and stop the data synchronization to the Telefónica service. In the interface, you can see an indicator of whether the Telefónica service is running or not. If you click on "Start", the synchronization will begin:

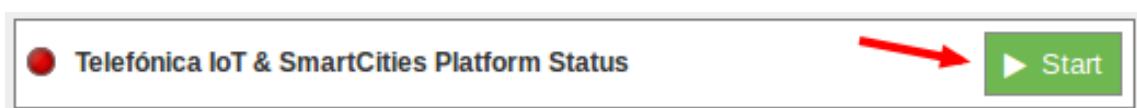


Figure: Telefónica IoT Start button

You can stop at any moment clicking on "Stop" button.

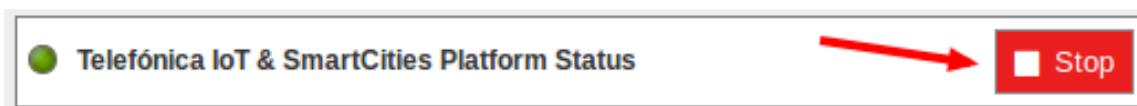


Figure: Telefónica IoT Stop button

12.2.5. Telit

The Meshlium Cloud Connector for the Telit deviceWISE IoT Cloud platform is provided to connect Libelium Waspmove sensor devices to the Telit Cloud Platform.

12.2.5.1. Register in Telit

The basic steps required to connect Waspmove sensors to the cloud platform are simple and straight forward:

A) Using the Telit Management Portal at portal.telit.com

- Create/Obtain a Telit IoT Portal Account on a Cloud Organization
- Define 2 Thing Definitions:
 - Meshlium Cloud Connector
 - Waspmove Sensor
- Create an Application Token for the Meshlium Cloud Connector Definition

B) Using the Meshlium Manager System web browser interface

- Access the Telit deviceWISE TR-50 Cloud Platform Configuration Panel
- Enter and Save the configuration details for your Meshlium including the Application Token created above
- Start the deviceWISE TR-50 Sensor Processing Service

Once your Telit IoT Cloud account has been configured with the new 'Thing Definitions' and 'Application' in support of the Meshlium Cloud Connector, you are ready to proceed with configuring your Meshlium gateway.

12.2.5.2. Configuration

Select the 'Telit deviceWISE Cloud Connector' service icon located on the 'IoT Platforms' panel. Configure the fields to provide the required configuration and control information on the 'Telit deviceWISE Cloud Connector' management panel as shown below.

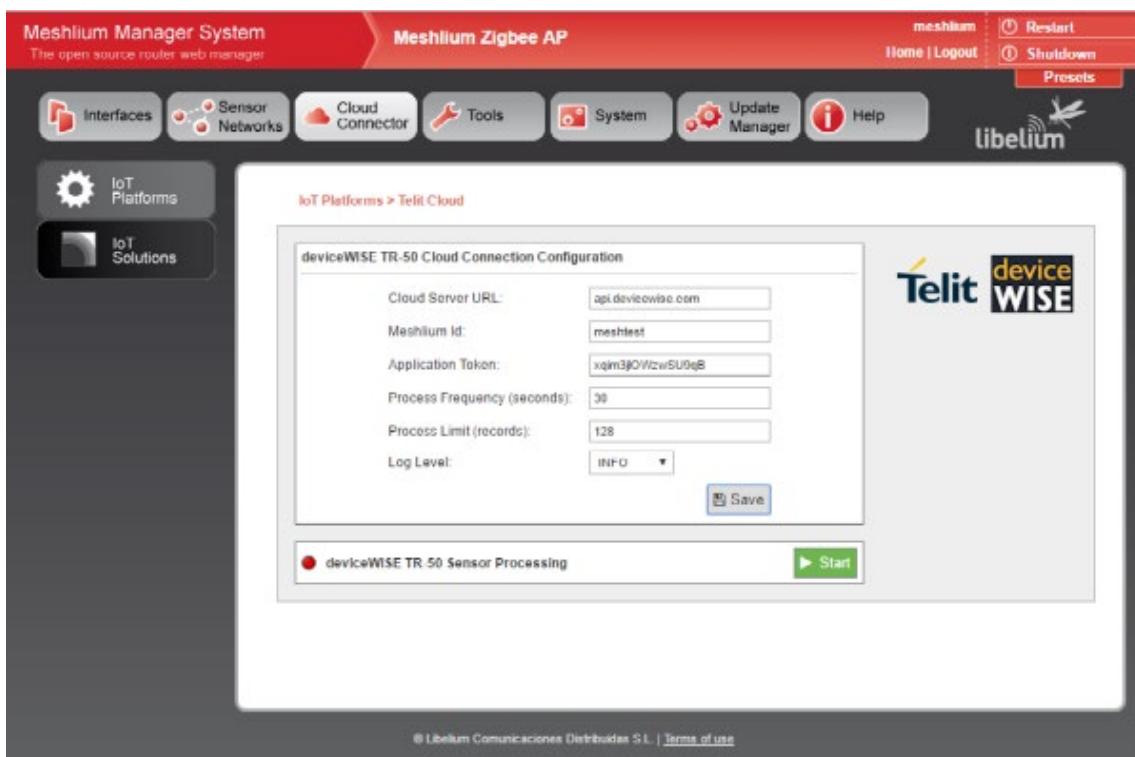


Figure: Telit configuration panel

The screenshot shows a configuration form with the following fields and their descriptions:

- Cloud Server URL:** api.devicewise.com (1) Enter the public platform URL.
- Meshlium Id:** mymeshlium (2) Provide a logical unique name for the gateway
- Application Token:** <your application token here> (3) Specify your specific Application Token (*)
- Process Frequency (seconds):** 30 (4) Specify a process frequency (30-120 seconds)
- Process Limit (records):** 128 (5) Specify a process limit (32-200 records)
- Log Level:** INFO

(*) This refers to the Application Token you created earlier

Figure: Telit configuration options

Where:

- 'Cloud Server URL' specifies the target Telit IoT Cloud Platform.
- 'Meshlium Id' indicates the unique name that you would like your Meshlium Gateway to be known as in the Telit IoT Cloud Platform.
- 'Application Token' indicates the unique secure token generated by the Telit IoT Cloud Platform for devices to be able to access your private cloud organization.
- 'Process Frequency' indicates how often the cloud connector should check for and process newly received data frames from the associated Waspmove/Edge devices. Valid values range from 30 to 120 seconds.
- 'Process Limit' specifies the maximum number of waiting records to process during the data frame processing cycle. Valid values range from 8 to 200.

Once all settings are provided, save the configuration settings by pressing the **Save** button.

The screenshot shows the 'deviceWISE TR-50 Cloud Connection Configuration' screen with the following fields:

- Cloud Server URL:** api.devicewise.com
- Meshlium Id:** meshtest
- Application Token:** xqim3jlOWzwSU9qB
- Process Frequency (seconds):** 30
- Process Limit (records):** 128
- Log Level:** INFO

A blue arrow points to the **Save** button at the bottom right, which is circled in red.

Figure: Save configuration error

In the event that a field has been left blank or a string has been entered into a numeric data field, the field entry frame will be highlighted and an error message will be displayed as shown in the screen images below.

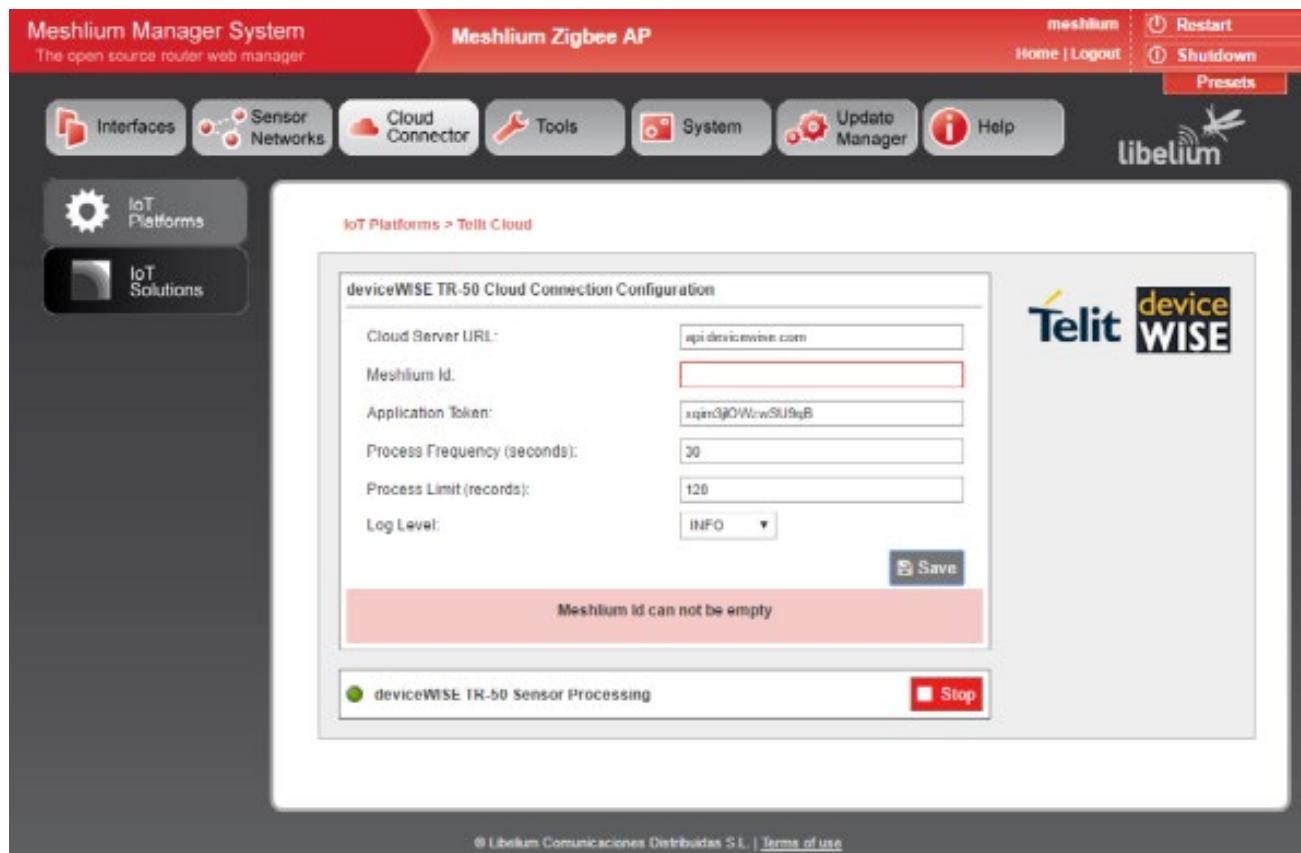


Figure: Save configuration button

At this point the Meshlium Cloud Connector is configured and ready to start.

12.2.5.3. Controlling synchronization

Once the Telit deviceWISE IoT Cloud Connector has been configured with the proper runtime parameters, it is ready for operation. To initiate the connection from the Meshlium gateway to the Telit IoT Cloud Platform and start the background service awaiting data frames from Waspmove sensor device nodes, press the Start button.

To initiate the connection from the Meshlium gateway to the Telit IoT Cloud Platform and start the background service awaiting data frames from Waspmove sensor device nodes, press the Start button.

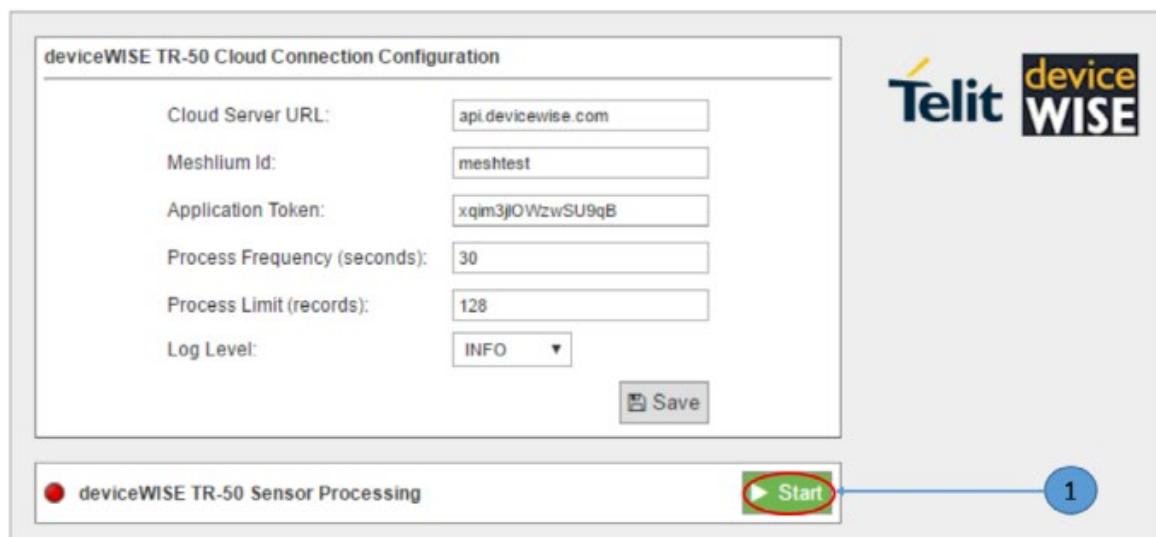


Figure: Telit Start button

To stop the background service from awaiting data frames from Wasp mote sensor device nodes and terminate the connection from the Meshlium gateway to the Telit IoT Cloud Platform, press the Stop button.



Figure: Telit Stop button

12.3. Basic Cloud Partners

12.3.1. Amplía's OpenGate

12.3.1.1. Configuration

Inside the Amplía's plugin you can find the different fields that you must configure for using your Meshlium against OpenGate.

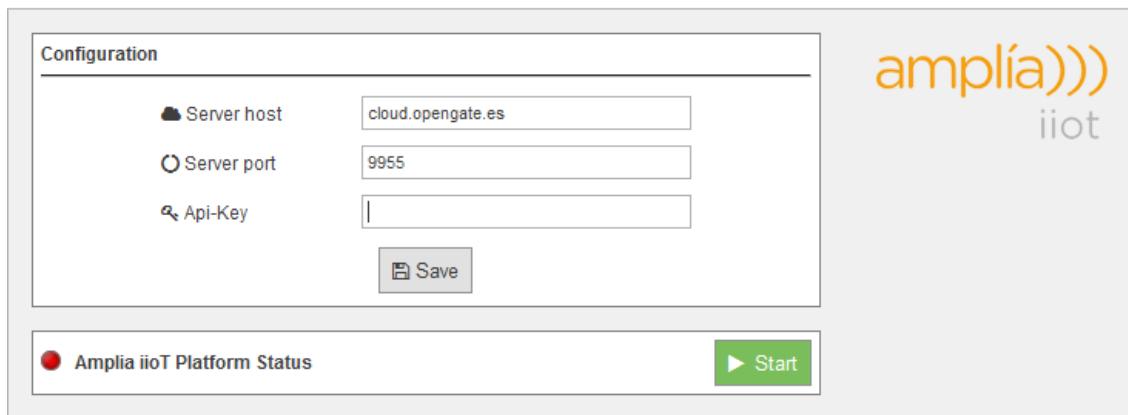


Figure: Amplía Cloud Connector configuration panel

- **Server Host:** You must enter the host name that you are going to use for collecting the Meshlium events.
- **Server Port:** The port where the host is accessible.
- **API-Key:** Security key used for validating the access to the Host.

Click on the "Save" button for storing the configuration fields.

After that, press the "Start" button, and you will start to receive data from the configured Meshlium.

If you want to stop the event sending, just press the "Stop" button.

In the OpenGate OSS web portal you could check the different values collected by Meshlium and by the Waspmove units which have sent messages using the configured Meshlium as gateway.

12.3.1.2. How to get your own API-key

For getting your own API-key you have to send an e-mail to info@amplia.es and Amplía Solutions will provide one for you. In the same mail send the serial number of your device for creating it in the OpenGate platform.

12.3.2. BaseN

Follow this short instruction to get Meshlium synchronized to BaseN Platform running. This guide assumes that you are already a customer of BaseN and have access to your BaseN admin wiki.

12.3.2.1. Configuring Microagent receiver in the BaseN Platform

In your chosen wiki page, configure the following minimum setup for synchronizing with the BaseN Platform.

Create: MeshliumExample

Save and reload Save Cancel

```
1 [{MicroAgentConfig
2   id='meshlium1'
3   path='microagent/meshlium1'
4   username='OcNHZsSJRK'
5   password='bttvc71f3M'
6 }]
7
```

Figure: Configuration of Microagent Receiver

- **Id:** Unique ID of this Microagent receiver
- **Path:** Measurement data path for data storage
- **Username:** Username for authentication of Microagent receiver
- **Password:** Password for authentication of Microagent receiver

12.3.2.2. Configuring BaseN Platform in Meshlium

Use the same Microagent receiver parameters in the Meshlium BaseN Cloud Connector plugin.

BaseN plugin is located in:

Manager System > Cloud Connector > IoT Solutions > BaseN

IoT Platforms > BaseN

Configuration

| | |
|-----------------|--|
| BASEN_URL: | <input type="text" value="http://libelium.pilot.basen.com/_ua"/> |
| BASEN_ID: | <input type="text" value="meshlium1"/> |
| BASEN_USER: | <input type="text" value="OcNHZsSJRK"/> |
| BASEN_PASSWORD: | <input type="password" value="*****"/> |

Platform Status

Baseⁿ

Figure: Configuring BaseN Platform in Meshlium

- **BASEN_URL:** Usually http://customername.basen.com/_ua/customername/
- **BASEN_ID:** Unique ID of this Microagent receiver
- **BASEN_USER:** Username to authenticate the Microagent receiver
- **BASEN_PASSWORD:** Password to authenticate the Microagent receiver

After setting the parameters, save the configuration clicking on the “Save” icon.

12.3.2.3. Start BaseN Cloud Connector

Click on “Start” for Cloud Synchronization. A green icon should start rolling to indicate synchronization is running.

12.3.2.4. Verify BaseN Cloud Connector synchronization

Go to the BaseN Platform wiki where the Microagent Receiver and MicroAgentConfig were configured, and check under “Debug Information for <id>” and “Stats” that the Observer Request Counts does show requests arriving.

12.3.3. B-Scada

B-Scada® VoT platform allows you to create rich, sophisticated IoT and M2M applications that consolidate and organize data from anywhere, and visualize it in real-time on any device. Connect to thousands of potential data sources. Visualize your data using modern, high-performance customized graphics. Leverage powerful analytic tools and automation. Connect your devices, processes and people in a continuous real-time information system.

More information about VoT Platform: <http://www.votplatform.com/>.

12.3.3.1. Configuration

A new option is shown in the M2M Platforms menu: the **B-Scada Cloud Connector**. If you expand it, you can see this form with 6 fields in it:

IoT Solutions > B-Scada

| Configuration | |
|---------------|-------------------------------------|
| Url : | 80.32.200.207 |
| Port: | 1883 |
| Client ID : | Client123 |
| Secret Key : | ***** |
| Interval(s) : | 60 |
| Enable Log : | <input checked="" type="checkbox"/> |

● Cloud Synchronization Status ▶ Start

Figure: Configuring B-Scada in Meshlium

- **URL:** IP address of the VoT platform service by B-Scada. This address should be provided by B-Scada.
- **Port:** The port in which the VoT Server is listening to connections.
- **Client ID:** Customer's identifier or company name.
- **Secret Key:** The security key to send encrypted data to VoT.
- **Interval(s):** Time duration in seconds between operations of updating data.
- **Enable Log:** This option enables the creation of log files to save all communications processed to the VoT server.

12.3.3.2. Controlling synchronization

The synchronization will be done for all data that has not been synchronized in the Sensor Parser table each time. You can start and stop the data synchronization to the VoT service. In the interface you can see an indicator of whether the status service is running or not. If you click on "Start", the synchronization will begin.



Figure: B-Scada synchronization service is running

You can stop the synchronization at any moment clicking on the "Stop" button.



Figure: B-Scada synchronization service is stopped

12.3.4. C2M

C2M® is an end-to-end IoT and Digital Enterprise platform that allows easy, secure and rapid prototyping and deployment of IoT/M2M solutions.

12.3.4.1. Configuring C2M Platform in Meshlium

1. Select the C2M® plugin located in:

Manager System > Cloud Connector > Basic Cloud Partner > C2M

2. Login with your C2M® credentials.

(If you do not have C2M® credentials, please click the “Sign Up” button at the bottom of the screen to register).



Figure: C2M logging

12.3.4.2. Controlling synchronization

1. Select the Onboard tab and press the "+" button on the Waspmote/Sensors that you wish to onboard.

- Turn the switch On to enable the Waspmote/Sensor
- To Disable the Channel: Toggle the On/Off switch to Off
- To Delete the Channel: Press the Trashcan icon

Note: This will delete the channel and all data will be permanently removed.

For a temporary pause in sending data, see next step.

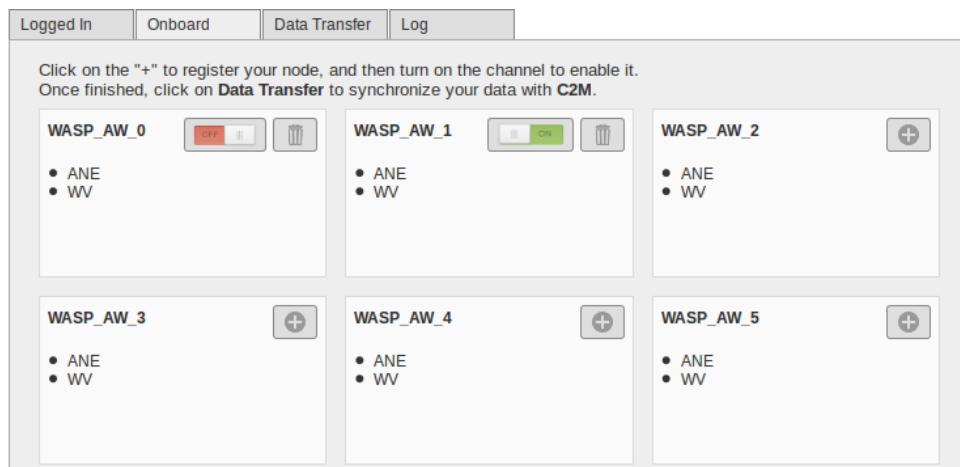


Figure: C2M Onboard tab

2. Select the Data Transfer tab. Here you will see your enabled Waspmove/Sensors. Select your Transmission method, toggle on the devices in which you want to send data and press "Save".

3. Click on the "Start" button to begin the C2M Sync service. Click the "Stop" button to terminate the C2M Sync service.

To temporarily pause a node, toggle the On/Off switch to Off and press "Save".

The screenshot shows the 'Data Transfer' tab of the C2M interface. At the top, there's a navigation bar with tabs: Logged In, Onboard, Data Transfer (which is selected and highlighted in grey), and Log. Below the tabs, a section titled 'Transmission Method' has a dropdown menu set to 'TCP'. A note below the dropdown says: 'Please use the switch button to Enable / Disable data transmission of the node. **Save your settings every time !**' followed by a blue link: 'You are all set ! Now Click Start to begin C2M sync and go to the C2M website to analyze, visualize and automate your data.' At the bottom of this section are two buttons: 'Save' and 'Start'.

Figure: C2M Data Transfer tab

4. Login to your C2M account at <https://cloud.c2m.net/login.aspx> to analyze, visualize and automate your data.

The screenshot shows the 'Log' tab of the C2M interface. At the top, there's a navigation bar with tabs: Logged In, Onboard, Data Transfer, and Log (selected). Below the tabs, a section titled 'Log Level' has a dropdown menu set to 'DEBUG'. The main area displays log messages: '[2017-03-10 11:55:32] DEBUG: Message Send Success.' and '[2017-03-10 11:55:32] DEBUG: Sync Bit Update Success.' At the bottom right is a 'Save' button.

C2M Tutorial | Send Feedback

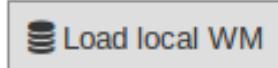
Figure: C2M log

There is also a Log tab. Here you will find access to various log levels. Default log view is set to WARNING. Once you change the Log Level you must press "Save" to store this operation and to view the updated information.

12.3.5. DeviceLynk

DeviceLynk is a high-level cloud service based on the ThingWorx cloud.

Interface walk-through:

| Interface Feature | Description |
|---|--|
|  | <u>DeviceLynk logo</u> Click to jump to the DeviceLynk website. |
| Server Address: <input type="text" value="666"/> | <u>Server Address</u> The DeviceLynk Server address you wish to connect to. |
| Meshlium Bind Name: <input type="text" value="777"/> | <u>Meshlium Bind Name</u> The name that the DeviceLynk Server uses to identify the Meshlium unit. |
| Enable Logging: <input type="checkbox"/> | <u>Logging Check-box</u> Check-box to enable/disable internal logging. |
|  | <u>Save Button</u> Click to save the Server Address, Meshlium Bind Name, and Logging configuration. |
|  | <u>Load Local Waspmotes button</u> Click this button to load the list of Waspmotes that the Meshlium is connected to. |
|  | <u>Load WM Config. from DeviceLynk button</u> Click to load the list of Waspmotes which are connected to the DeviceLynk Server. |
|  | <u>Write DeviceLynk Setup button</u> Click to write the current list of Waspmotes to the DeviceLynk Server (Waspmotes details are sent to the Server). |
|  | <u>Waspmote</u> Click the "Delete" button to remove that Waspmote unit from the current Waspmote clicking the "Load Local Waspmotes" button, or by clicking the "Load WM Config. from DeviceLynk" button. |

| Interface Feature | Description |
|--|--|
|  Edge MicroServer (EMS) Status ▶ Start | <u>DeviceLynk Agent Status</u> The status of the DeviceLynk Agent will be indicated, displaying "Running" or "Stopped". |
|  LUA Script resource Status ▶ Start | <u>LUA Script Resource Status</u> The status of the LUA Script Resource will be indicated, displaying "Running" or "Stopped". |
| ▶ Start | <u>Start/Stop Service Toggle button</u> Click to start/stop the service that this button is next to. |

Steps to start the DeviceLynk plugin:

- 1. Type the DeviceLynk Server address that you wish to connect to in the Server Address field.
- 2. Type the Meshlium Bind Name that the DeviceLynk Server will use to identify the Meshlium device.
- 3. Click the "Save" button.
- 4. Click the "Load Local Waspmotes" button. All Waspmotes connected to this Meshlium unit will show up.
- 5. Delete the Waspmotes that you do not want to be connected to the DeviceLynk Server by clicking on their respective "Delete" button.
- 6. Click the "Write DeviceLynk Setup" button to make the DeviceLynk Server listen to those Waspmotes.
- 7. To show the Waspmotes units that the DeviceLynk Server is currently listening to, click the "Load WM Config. from DeviceLynk" button.
- 8. Click the "Start" button under "DeviceLynk Agent Status". "Running" will be displayed.
- 9. Click the "Start" button under "LUA Script Resource Status". "Running" will be displayed.

12.3.6. eagle.io

eagle.io is a hub connecting monitoring assets, engineers and decision makers. Acquire data in real-time from Meshlium and WaspMote devices, receive alerts for critical events, and share access with stakeholders. Transform your time-series data into beautifully presented, actionable information.

More information can be found at www.eagle.io.

12.3.6.1. Configuration

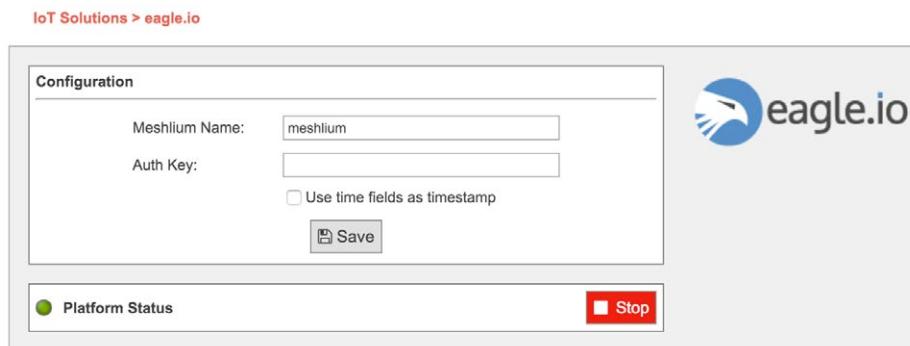


Figure: eagle.io cloud connector configuration panel

The eagle.io plugin is configured with the following three parameters:

- **Meshlium Name:** a name to help identify this device (required parameter).
- **Auth Key:** optional secret key; if this is defined then the same key will be required when configuring the device within eagle.io as a data source. If this key is not defined, then the Meshlium device ID is sufficient to identify the device within eagle.io configuration.
- **Use time fields as timestamp:** if this box is checked, then any time field contained in a Meshlium database record will be used as the eagle.io timestamp for the record. If this box is not checked, the data reception time of the record will be used as the eagle.io timestamp.

After changing any of these parameters, save the configuration by clicking the "Save" button, then restart the eagle.io synchronization (if it is currently running) by clicking the "Stop" button followed by the "Start" button.

12.3.6.2. Controlling synchronization

The synchronization will be done in batches of 200 records at a time, so the system is not overloaded. The time between batches is 60 seconds. This means that when synchronization is first started on a device with many existing records in the database, it may take some time for all the records on the device to be synchronized with eagle.io.

When the synchronization is not running (red status indicator), it can be started by clicking the green "Start" button.



Figure: Eagle.io start button

When the synchronization is running (green status indicator), it can be stopped by clicking the red "Stop" button.



Figure: Eagle.io stop button

12.3.7. Ensura

The Ensura Command & Control platform (<http://www.ensuracc.com/>) manages live and recorded video, audio, and data flows, and shows simultaneous live and recorded views in a single window. The system provides server-side and sensor-side Video Content Analytics for all video channels, displaying triggered alerts from any 3rd party end-element.

The system supports biometric and face recognition modules, ANPR systems, Access Control solutions, Security and Failsafe platforms. Open-ended and integration-agnostic, additional systems can be rapidly and effectively integrated into an Ensura deployment.

Ensura supports event-driven triggering of activities throughout the system, and supports definition of predefined scenarios for management of routine and emergency events.

Ensura enables users to manage multiple remote sites using a single client interface, displaying real-time and archived data of all monitored sites concurrently.

Ensura uses its Sensor Server to receive data from the Meshlium devices over HTTP requests.

12.3.7.1. Configuration

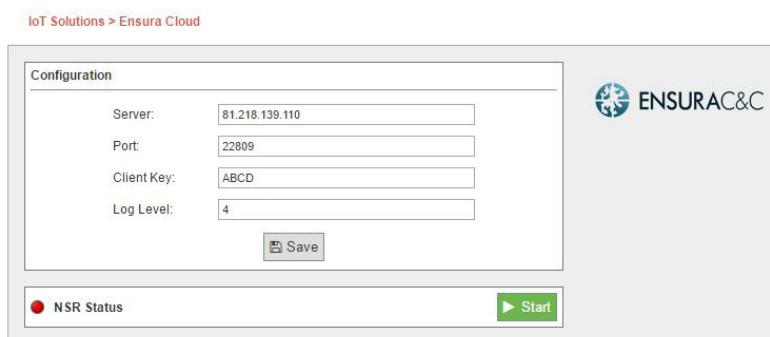


Figure: Configuring Ensura in Meshlium

- **Server:** The IP address or the URL of your Ensura Sensor Server
- **Port:** The port number on which the Ensura Sensor Server is listening for connections
- **Client Key:** The identifier that the Ensura Sensor Server is configured to accept information from
- **Log Level:** This is the log level used by the cloud connector within the Meshlium device. Should be 0, except for debugging purposes.

This data will be provided by the administrators of the Ensura platform.

12.3.7.2. Controlling synchronization

The synchronization will be done for all data that has not been synchronized in the Sensor Parser table each time. You can start and stop the data synchronization to the Ensura Sensor Server. In the interface you can see an indicator of whether the status service is running or not. If you click on "Start", the synchronization will begin.



Figure: Ensura cloud connector status "Stopped"

You can stop the synchronization at any moment clicking on the "Stop" button.



Figure: Ensura cloud connector status "Running"

12.3.8. Ericsson AppIoT

The Ericsson AppIoT cloud connector will integrate Meshlium as an AppIoT gateway with minimal effort and configuration.

More information on AppIoT and IoT Accelerator:

<https://www.ericsson.com/en/industries/iot-for-industry/appiot>

<https://www.ericsson.com/ourportfolio/products/iot-accelerator>

12.3.8.1. Register Meshlium in AppIoT

Register a gateway with the pre-configured Meshlium gateway type in your device network in AppIoT. If the Meshlium gateway type is missing in your instance of AppIoT, please contact AppIoT support. If you are unfamiliar with AppIoT, you can read more about how the platform works on <http://docs.appiot.io/>.

12.3.8.2. Configuration

The figure below shows the main configuration page for the AppIoT cloud connector. The following is a description of the components in the connector's User Interface.

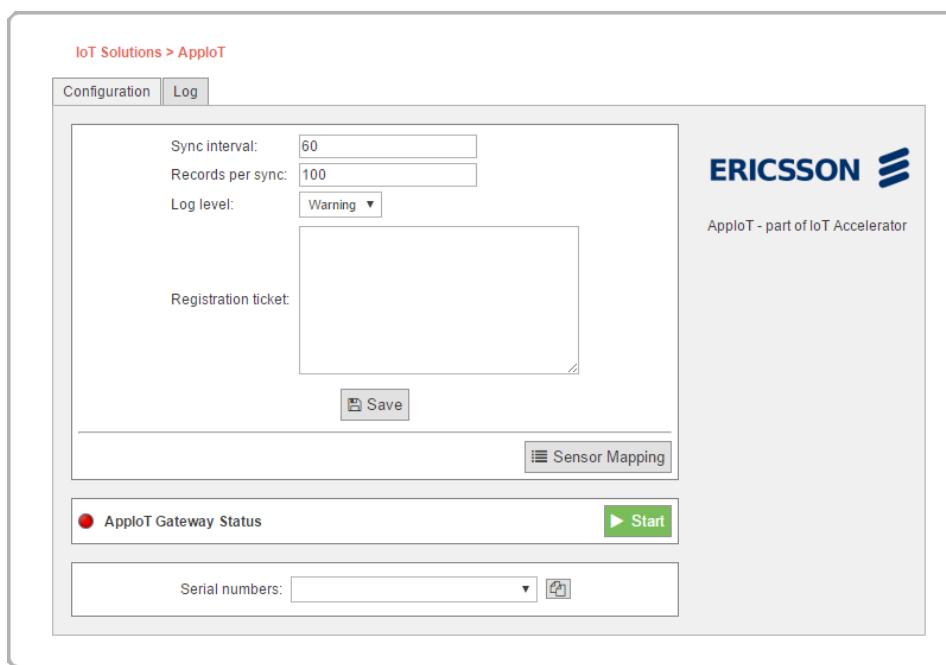


Figure: Configuration overview

Sync Interval: Sets the number of seconds to synchronize with AppIoT. The default value is 60 seconds. Please take into consideration when setting this value that Meshlium is a resource-constrained device. The shortest synchronization interval is 30 seconds.

Records per sync: Sets the number of sensor values read from the Meshlium's database per synchronization. The default value is 100 records per synchronization. It is not recommended to set this value any higher than 200 due to the memory limitations of Meshlium.

Log level: This controls the log output from the AppIoT connector. The log levels Severe and Warning will only output messages that in some way may affect operational functionality of the cloud connector. All other levels of logging, except Off, will output general events from the cloud connector. The log level Info will focus on events regarding actions taken by the connector. Other levels, like Fine, will output third party library logs as well.

Registration ticket: The registration ticket that will be used by the gateway integrated in the cloud connector.

Sensor mapping: Toggles the sensor mapping table used to translate sensor types between Meshlium and ApploT. An example of the table can be seen in the next image, where the left hand side lists the sensors from Meshlium and the right hand side lists the sensor hardware types from ApploT. Note that the value -1 represents an unmapped sensor. The ApploT connector will only try to synchronize sensor values that have a non-negative number.

| Meshlium ID | ApploT ID | Sensor Mapping |
|-------------|-----------|----------------|
| CO | -1 | x |
| CO2 | 12 | x |

Figure: Sensor mapping

As shown in the figure below, add custom mappings in the case that your sensor type is not present in the standard set of sensor types on the Meshlium. Click the 'X' next to the mapping to remove a mapping.

| | | |
|-------------|-----------|-----|
| New Mapping | | |
| Meshlium ID | ApploT ID | Add |

Figure: Adding a sensor mapping

ApploT Gateway Status and Start/Stop: The round icon indicates the current state of the connector. The icon will be either green or red depending on if the connector is running or not. The green start button will start the connector. When clicked, it changes into a stop button. To stop the connector press the red stop button.



Figure: Gateway status

Serial numbers: The drop-down lists all the Waspmotes available and/or registered in ApploT. The configured state between ApploT and the Waspmotes are displayed next to the Wasp mote ID. There are 3 states: Not registered, Registered and Registered (Not seen). The Not registered state represents a Wasp mote transmitting to the Meshlium that is not registered in ApploT. The Registered state represents a Wasp mote transmitting to the Meshlium that is registered in ApploT. This is the state where the connector synchronizes data with ApploT. The last state, Registered (Not seen), is when a Wasp mote is registered in ApploT but has no record of transmitting to the Meshlium. The button next to the drop-down will copy the selected Wasp mote ID to your clipboard.

Log tab: As seen the following screenshot, you can review the latest logs from the connector. The refresh button will reload the log window and display the latest logs. The delete button will empty the log file on the Meshlium unit.

The screenshot shows a 'Log' tab interface. At the top, there are two tabs: 'Configuration' and 'Log'. Below the tabs is a large, empty scrollable text area. At the bottom of this area are two buttons: 'Refresh' and 'Delete'. To the right of the log area, there is a vertical sidebar with the 'ERICSSON' logo and the text 'ApploT - part of IoT Accelerator'.

Figure: Log overview

12.3.8.3. Setup

- Create device types in ApploT to represent your Waspmotes.
- Set the desired synchronization interval and limit, please select these parameters following recommendations.
- Set the desired logging level.
- Supply the registration ticket field with a valid ticket.
- Map the Meshlium sensor types to the corresponding sensor hardware types in ApploT.
- If you are using user-defined sensor types on Meshlium, make sure to add these to the connector's sensor mapping table.
- Register your Waspmotes in ApploT with their unique IDs. The unique IDs will appear in the serial number drop-down when the Waspmotes transmit data to the Meshlium or when registered in ApploT. If the Waspmotes are already transmitting to your Meshlium, use the copy function to get the correct IDs.
- Save and start. A restart of the connector is always required for saved changes to take effect. Stop the connector before saving.

12.3.8.4. Notes

- When registering a Waspmote in ApploT, the serial number used in ApploT must correspond to the serial number shown in the drop-down in the connector interface.
- The connector does not support string values.
- The connector can handle sensor types with multiple fields if they are defined in the sensors table on Meshlium. Example: ACC has three fields and translates to APPIOT0_ACC, APPIOT1_ACC and APPIOT2_ACC. The APPIOT prefix will appear on all multi-field types and the numbering is the index of each field value.
- The connector does not support multi-field, user-defined sensor types.

12.3.9. Esri

ArcGIS is a complete spatial information platform provided by **Esri**, that allows to create, analyze, store and spread data, models, maps and 3D globes. It can be accessed via desktop application, browser or handsets. ArcGIS is targeted at GIS professionals, location analysts and developers that want to create their own applications based on geographical data.

More information: <http://www.esri.com/products>

Wasp mote sensor data could be integrated into your existing maps and ArcGIS applications following the configuration steps described for ArcGIS Online service.

12.3.9.1. ArcGIS Online

We can configure in this form all the parameters needed to connect and send data to the ArcGIS Online platform.

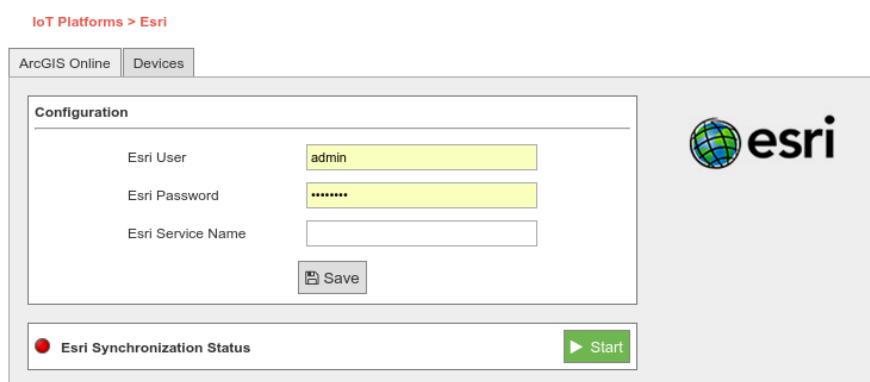


Figure: ArcGIS Online configuration

The parameters to setup are:

- **esri_user:** User for the Esri ArcGIS online platform.
- **esri_password:** Password for this Esri user.
- **esri_service_name:** Name of the service which will receive the data.

Clicking on the "Save" button, this setup is sent to the ArcGIS online service.

Clicking on the "Start" button enables the Esri Cloud Connector to send data periodically to the ArcGIS Online service previously configured. A "running" status is displayed on screen showing that the Cloud Connector is sending data.



Figure: ArcGIS Online "Start" button

Clicking on the "Stop" button will disable the Esri Cloud connector so Meshlium device stops feeding the ArcGIS Online service with data.



Figure: ArcGIS Online "Stop" button

12.3.9.1.1. Check the Feature Server in ArcGIS Online

In order to check that data is arriving to ArcGIS Online, you should login in the platform:

<https://www.arcgis.com/home/signin.html>

Click on the option named "Gallery" and you should see a new Feature Server with the name that you provided in the Meshlium configuration plugin:

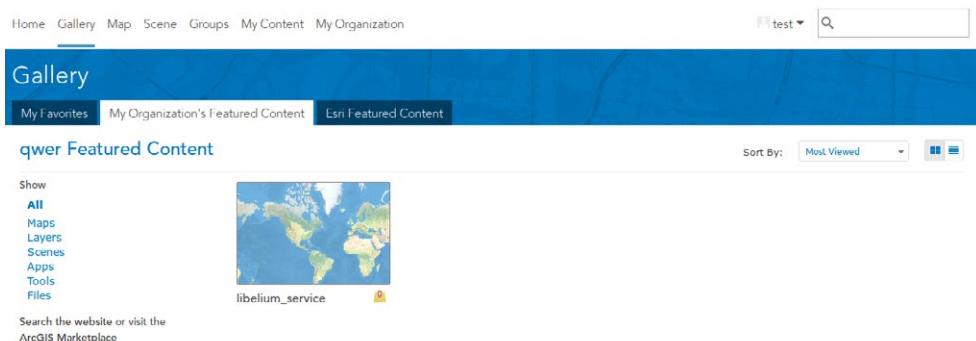


Figure: ArcGIS Gallery

Opening the new content, you should see a map where each layer is one sensor type available in your project. Clicking on the table icon, all the data collected for this type of sensor will be displayed.

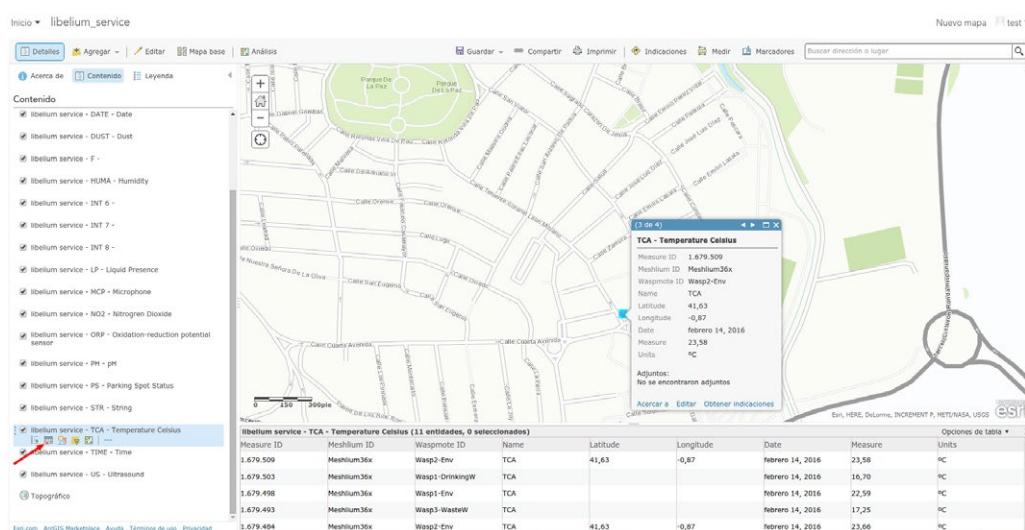


Figure: ArcGIS sensor map view

At this point, it is possible to use this data to create new maps, collaborative apps or analytics making use of the complete array of services provided by ArcGIS Online: <https://developers.arcgis.com/en/>.

12.3.9.2. Devices

12.3.9.2.1. Meshlium

In the Meshlium section, the user can set and modify the name and description of the Meshlium.

| Meshlium Meshlium36 - IP: 192.168.3.136 | |
|---|-------------------------|
| Name | Meshlium36 |
| Description | Meshlium development 36 |
| Lat. | -0.871977155116426 |
| Long. | 41.6259690136454 |
| Spatial Ref. | 0 |
| <input type="button" value="Save"/> | |

Figure: Meshlium info in ArcGIS

12.3.9.2.2. Waspmotes

In the Waspmotes section, the user can manage the Waspmove units which are sending information to Meshlium.

| Waspmotes | |
|---|--|
| <input type="button" value="Wasp2-Env"/> | <input type="button" value="Add new"/> |
| <input type="button" value="Wasp1-Cities"/> | |

Figure: Waspmotes list in ArcGIS

To add a new Waspmove, click on "Add new". Then fill up this information:

- Name: The Waspmove name. **Must match with the Waspmove identifier used with the frame**. See chapter "Capturing and storing sensor data" for more information.
- Description: A description of that Waspmove unit.
- Sensor count: Number of sensors on that Waspmove. **Must match with the number of fields of the frame**. See chapter "Capturing and storing sensor data" for more information.

And click on the "Add" button.

To modify a Waspmove, click on the Waspmove name for showing the attributes view.

| Wasp2-Env | |
|---------------------------------------|-------------------------------------|
| Name | Wasp2-Env |
| Description | Wasp2-Env |
| Lat. | -0.871859137919 |
| Long. | 41.626522375660 |
| Spatial Ref. | 0 |
| Sensor count | 5 |
| <input type="button" value="Delete"/> | <input type="button" value="Save"/> |

Figure: Modify Waspmove in ArcGIS

Then the user can modify the name, description, and sensor count information. To save the properties, click on "Save".

To delete this Waspmove unit, click on "Delete".

12.3.9.2.3. Devices location

In the section Devices location, there is a viewer where the user can see Meshlium and Waspmove located on a map.

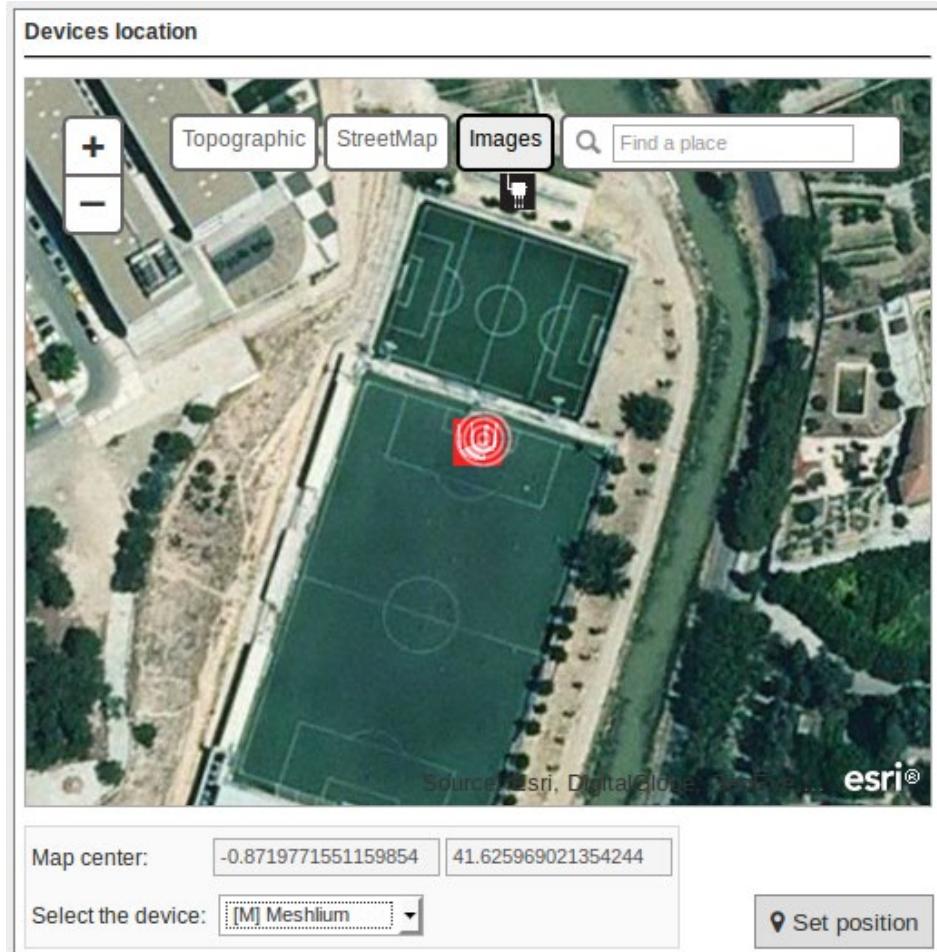


Figure: Devices location in ArcGIS

To change the location of the devices, center the map on the desired location, select the device, and click on "Set Position".

12.3.10. Extunda

Extunda IoT platform (<http://www.extunda.com/>) is a horizontal platform which also enables vertical applications. Libelium Smart Cities, agriculture and various devices are ready to be launched for service over Extunda IoT platform. The sensor data can be gathered, analyzed, stored and reported so the users can interpret and develop actions based on online data.

Extunda uses MQTT structure for the integration of your Meshlium devices to its platform easily. Therefore, the connector will easily send the sensor data to Extunda platform.

12.3.10.1. Configuration

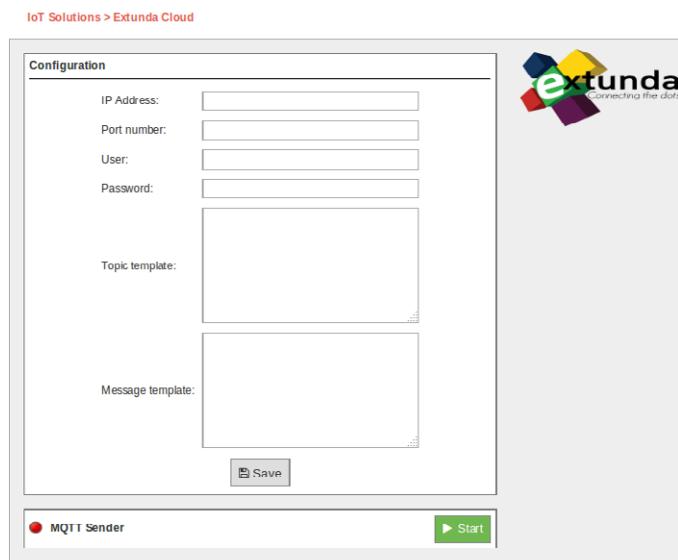


Figure: Extunda cloud connector configuration panel

- IP Address / URL:** The IP address or the URL will be provided to you by Extunda.
- Port Number:** This is the port which Extunda server is listening for connections.
- User Name & Password:** This is the Extunda Server username & password to be used for connecting to Extunda servers. This information will be provided by Extunda.
- Waspmove ID:** When you login to your Extunda IoT platform account with your username and password, you are authorized to define and match your Waspmove with a specific definition (i.e. Istanbul_gases_1). Your Waspmove data will be transferred to the server as in the above message template.

12.3.10.2. Controlling synchronization

The synchronization will be done for all data that has not been synchronized in the Sensor Parser table each time. You can start and stop the data synchronization to the Extunda service. In the interface you can see an indicator of whether the status service is running or not. If you click on "Start", the synchronization will begin.



Figure: Extunda start button

You can stop the synchronization at any moment clicking on the "Stop" button.



Figure: Extunda stop button

12.3.11. HaibuSmart

HaibuSmart is an IoT platform for business. The services include Enterprise Business Applications that involves near real-time information and the integration of sensors as primary data acquisition point.

For more information you can reach us at:

<http://www.haibusmart.com>

12.3.11.1. HaibuSmart Cloud

This IoT platform was design to be simple and scalable and Meshlium fits perfectly in HaibuSmart's solutions catalog including Agriculture and other associated services.

The following diagram shows the interaction between Meshlium and HaibuSmart.

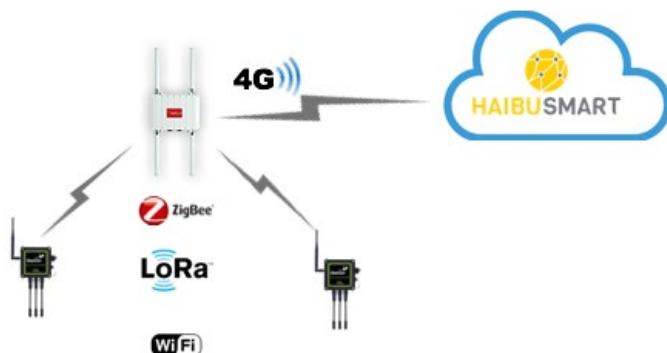


Figure: HaibuSmart architecture

12.3.11.2. Registering your Meshlium with HaibuSmart

Add your API KEY in the HaibuSmart panel of the Cloud Connector tab in the Manager System. Enter your API KEY, choose the Log Level and press "Save".

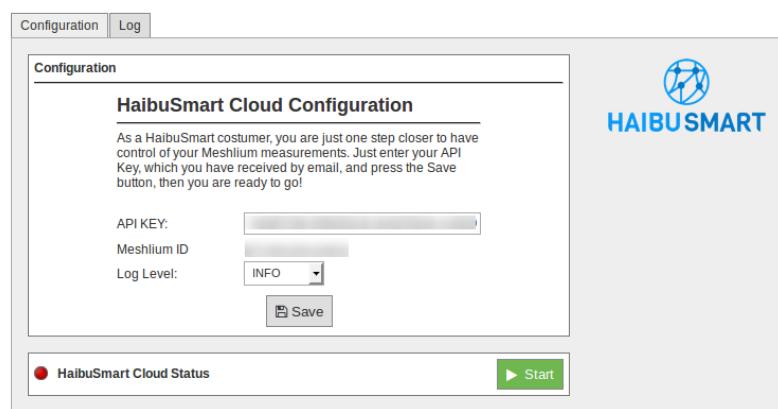


Figure: HaibuSmart Cloud configuration

12.3.11.3. Synchronization services

Pressing the "Start Button", the HaibuSmart Cloud Connector will be launched. Every time that Meshlium receives frames that are stored on the local database, the HaibuSmart Cloud Connector will send them to the HaibuSmart Cloud Platform. You can check if the service is running with the message on the left and the red (stopped) / green (running) indicators.

You can find further information on our website at <http://www.haibusmart.com/meshlium/#/connector>.

12.3.12. infiswift

For more details on the platform, please visit <https://www.infiswift.com> and review swiftLab documentation.

12.3.12.1. Configuration

In order to publish data from the Meshlium Gateway to the infiswift broker, you will need to login to the Meshlium Manager for configuration. Navigate to Cloud Connector > Basic Cloud Partner > infiswift. You will need to complete the following fields in the infiswift Configuration:

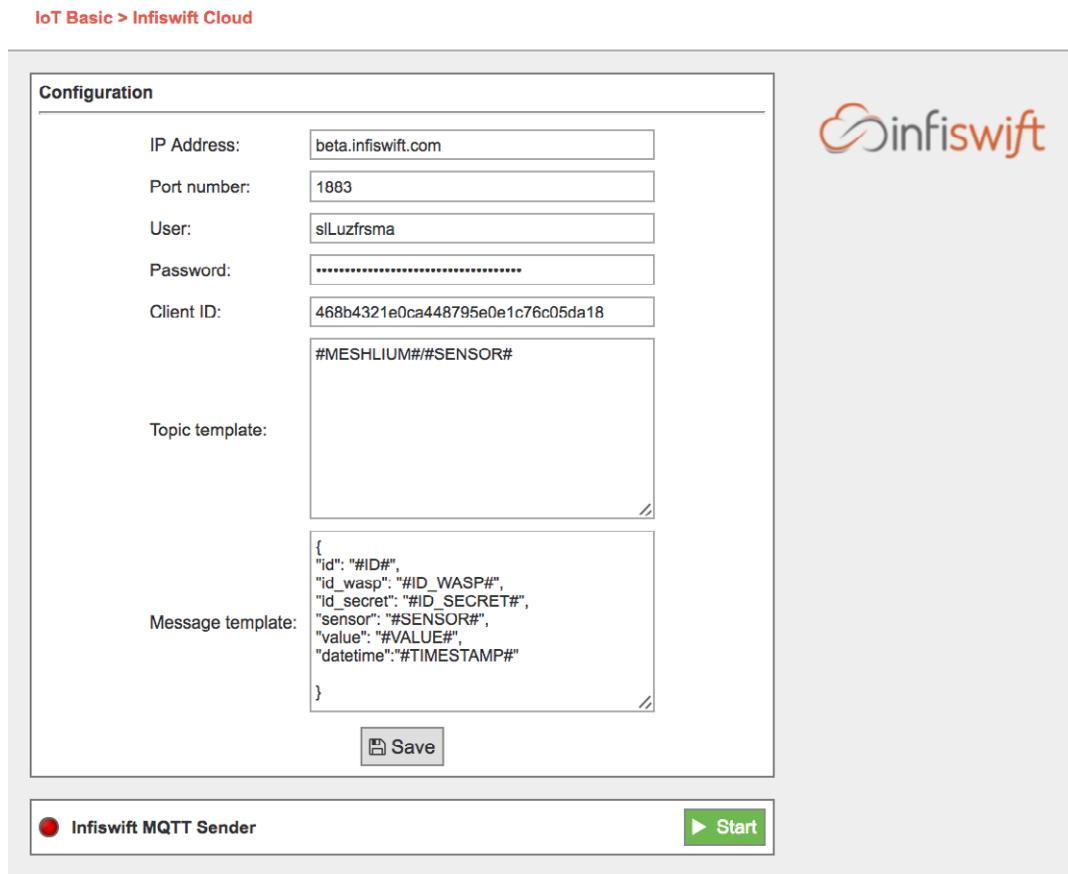


Figure: Configuration panel

With this plugin, the Waspmove sensor data can be directly integrated with an infiswift MQTT broker.

Pull required configuration information from infiswift portal using email id created in previous steps.

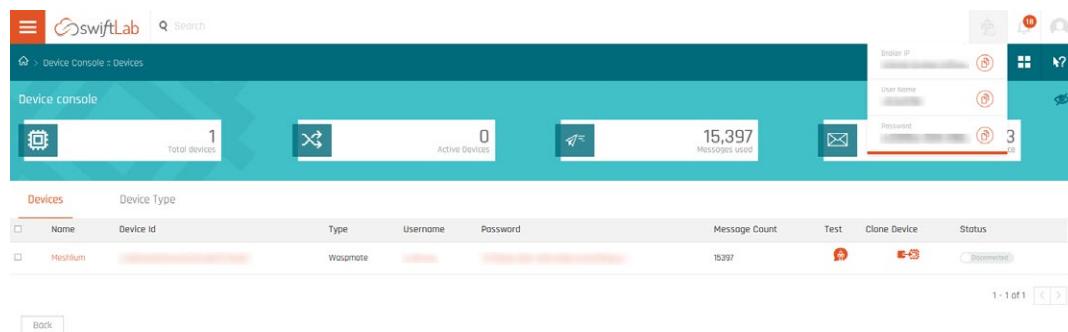


Figure: infiswift portal

- IP Address: This is the broker IP address (beta.infiswift.com) of the Gateway you want to connect to
- Port Number: This is the port you opened upon configuration of Meshlium plugin
- User: This is the username of the device created and to be supplied upon configuration of Meshlium plugin
- Password: This is the password of the device created and to be supplied upon configuration of your Meshlium plugin
- Client ID: This is the device ID from DEVICE CONSOLE page and to be supplied upon configuration of Meshlium plugin
- Topic Template: This is the topic you supplied upon configuration of Meshlium plugin
- Message Template: This is the message template of the data you want to send. Meshlium generates a default template, but you can provide your own if it is aligned with the Meshlium specifications.

Meshlium will start to listen for and ingest data coming from your device, and then forward it to infiswift's cloud.

12.3.12.2. Controlling synchronization

Once infiswift's swiftPV server/broker is configured, the user can launch the Meshlium infiswift script ("Start" button). The program will search for the received frames on the local database, and will send them to the swiftLab platform via the MQTT protocol. The status indicator displays the current state, saying "Running" or "Stopped".



Figure: swiftLab IoT sender is running

You can stop the infiswift IoT program anytime by clicking on the "Stop" button on the bottom of the page.



Figure: swiftLab IoT sender is stopped

12.3.13. IoT-Ticket

IoT-Ticket is one of the world's most complete, advanced and easy to use Industrial Internet of Things platforms with over 1.6 million users mainly in the energy and mobile machinery industry. Using IoT-Ticket you can build IoT applications in your web-browser in minutes, no plug-ins required. You can create dashboards, reports, analytics or augmented reality based on big-data collected from your things.

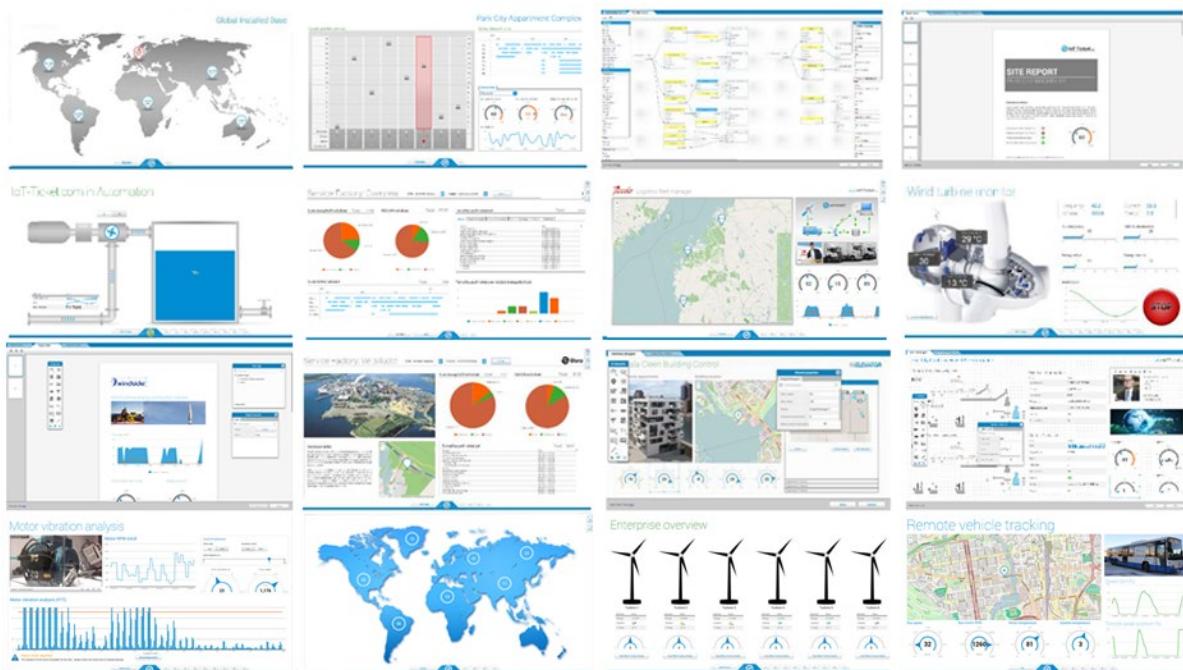


Figure: IoT-Ticket panel examples

Some benefits offered by IoT-Ticket:

- **Complete, up-to-date solution.** IoT-Ticket is a complete remote management system which includes the electronics, software and server. The platform is continuously developed further with new features and options.
- **Easy to get started and integrated.** You can use the platform as a service (SaaS or PaaS) or deploy to your own servers. We can integrate IoT-Ticket with any of your other information systems.
- **Flexibility and choice.** Use the whole IoT-Ticket platform or part of it. Use IoT-Ticket specific electronics or use your own, already deployed, electronics. Easy to use API in many programming languages allows a huge selection of devices to be easily connected.
- **Easy to use and Customizable.** The IoT-Ticket web dashboards allows you to be up and running in minutes using only your web browser. IoT-Ticket can be customized to meet your unique needs, even the look and feel can be made to match your corporate brand identity.

More information can be found at www.iot-ticket.com.

12.3.13.1. IoT-Ticket Meshlium integration

Once Libelium's Cloud Connector has been configured, all your available data will show up automatically in your IoT-Ticket web-based dashboard / report designer from where you can easily design Internet of Things applications.

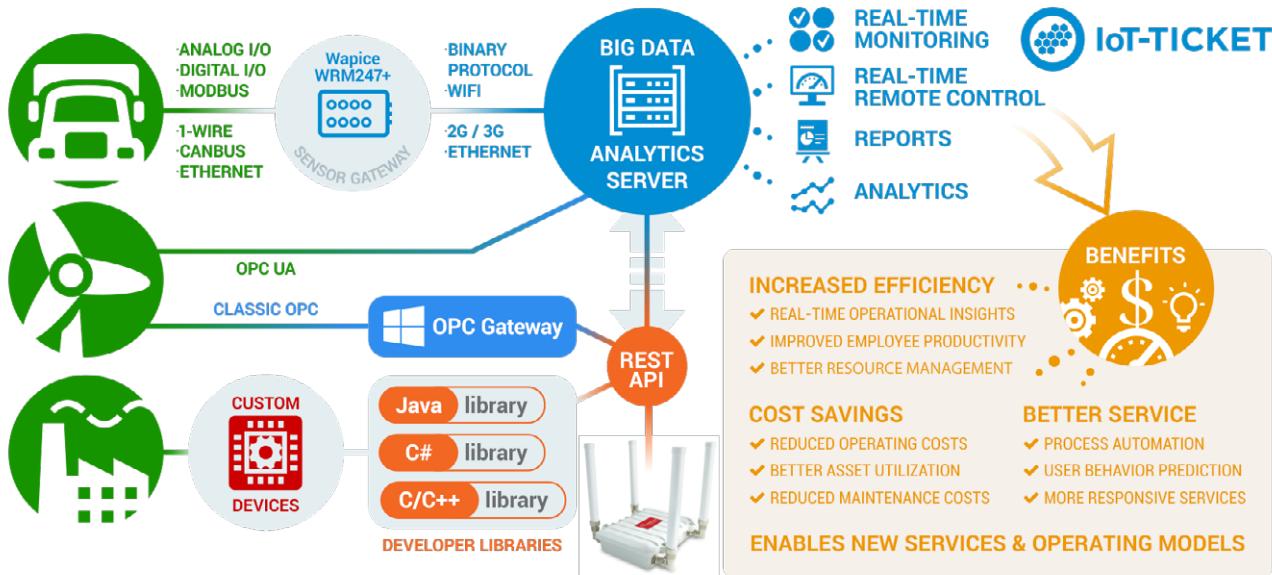


Figure: IoT-Ticket Meshlium integration

The IoT-Ticket cloud connector settings can be found under the IoT section of the browser-based Meshlium Manager System. The configuration is split into three parts Login Configuration, Connector Settings and Waspmove Filtering, as well as a section for information about the current status of the connector with controls to start and stop the program.

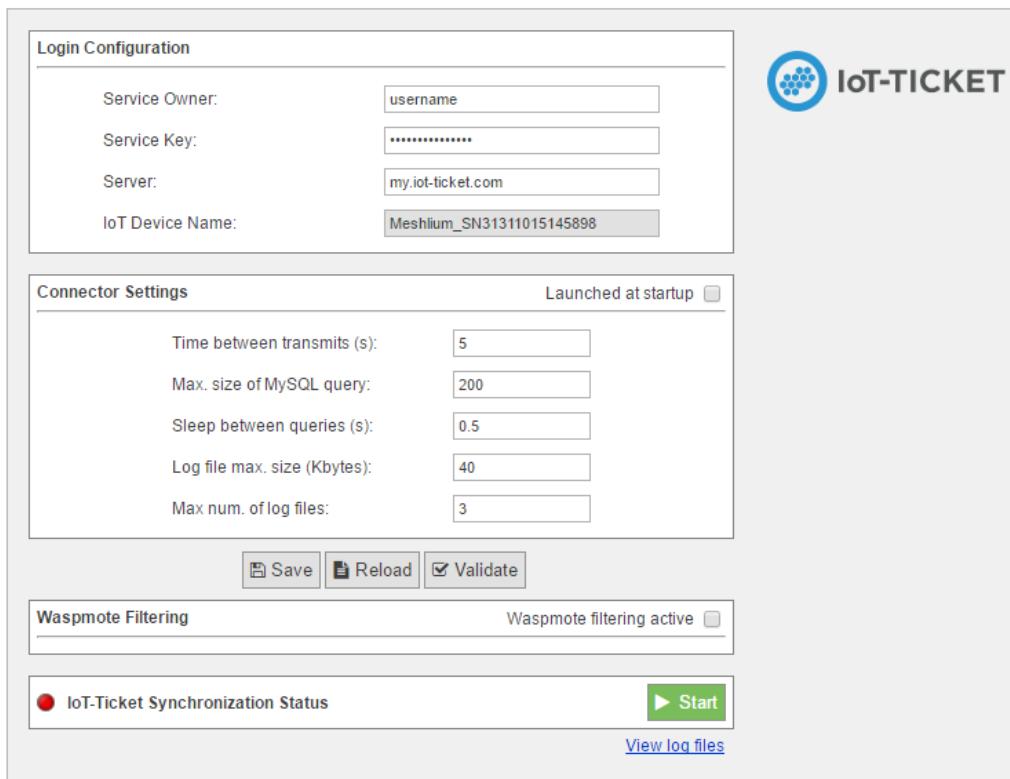


Figure: IoT-Ticket plugin panel

The Login Configuration section sets up the information for your IoT-Ticket account, and consists of four parts:

- **Service Owner/Key** gives the username and password of the my.iot-ticket.com service account to which you wish to connect your Meshlium device.
- **Server** specifies the IoT-Ticket server to use, by default **my.iot-ticket.com**.
- **IoT Device Name** is a read-only field showing the IoT-Ticket device name used for that Meshlium unit. It is set when the connector is started and is empty if no name has yet been set (in such a case, use browser “Refresh” after connector has started to see the name).

The Connector Settings section has parameters for the operation of the connector itself. These values affect time between updates to IoT-Ticket as well as size of transmitted batches of data. More frequent data updates may come at the cost of increased system resource usage.

- **Launch at start**. This checkbox indicates whether the connector is set to start automatically when the Meshlium is powered on.
- **Time between transmits** gives the minimum elapsed time between transmissions to IoT-Ticket. Values less than 60 seconds may consume high system resources.
- **Sleep between queries** is the time the program sleeps between SQL queries, in order to conserve resources.
- **Max. size of SQL query** is the maximum number of results for a single SQL query to the Meshlium database. Values greater than 200 may lead to high system load.

The section also allows for configuring connector logging:

- **Log file max. size (kbytes)**. The maximum size of a single log file in kilobytes.
- **Max. num. of log files** is the number of log files that can be written before the logging handler begins overwriting the first.

12.3.13.2. Save, load and verify

These buttons allow saving, loading and validating entered configuration data to a local file on the Meshlium disk which is read by the connector. The saved data includes both the Login and Connector settings as well as any entered Waspmote filtering rule (see “Waspmotes” section below).

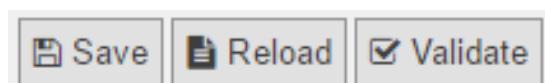


Figure: Save, Load and Verify buttons

- **Save** validates the data entered into the form and saves to it to disk.
- **Reload** reads data back from disk, erasing any fields that have been changed since last save.
- **Validate** runs a check that entered fields are of the correct type and connects to IoT-Ticket to check the entered username and password. If verification fails for a field, it will be marked in red and an error message appears.

12.3.13.3. Validation of settings

Configuration settings are validated to make sure the entered data fields make sense (e.g. numeric fields such as sleep and query size must be numbers). Additionally, the validation will issue warnings if any parameters might cause high system load on Meshlium.

Additionally the "Validate" button checks entered login information with the IoT-Ticket server and shows a warning if settings are incorrect and a green confirmation message if they are correct.

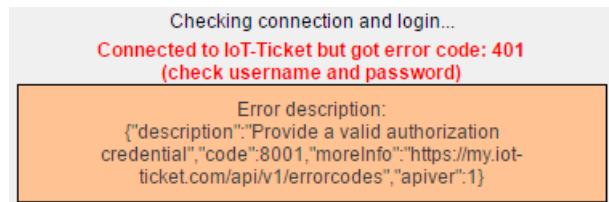


Figure: Validation error



Figure: Validation success

12.3.13.4. Waspmove filtering

This section allows filtering of which Waspmove data is synchronized to IoT-Ticket. The section is enabled by ticking the Waspmove filtering active checkbox.

| No name | Last seen | Sensors: | Include: |
|-----------|------------|-------------------|-------------------------------------|
| 403369636 | 2016-06-02 | MAC, ACC, IN_TEMP | <input checked="" type="checkbox"/> |
| 403470429 | 2016-06-02 | MAC, ACC, IN_TEMP | <input checked="" type="checkbox"/> |

Figure: Waspmoves list

- **Refresh Waspmoves** reloads the list of Waspmoves from the Meshlium database
- **Select / Unselect All** allows for quick selection or deselection of all present Waspmoves

The Waspmove infobox contains the following values:

- **Name** in the top-left shows the name a Waspmove broadcasts to the Meshlium with its readings (this is set in Waspmove code). If not set, No name is displayed instead.
- **Last Seen** is the last date at which a sensor entry was sent from the Waspmove to the Meshlium.
- **Sensors** is a list of sensors present on that Waspmove device. Only the latest detected set is displayed here, in case sensors are changed. Full names may be seen by hovering the mouse over the abbreviated names in the list.
- **Include** specifies whether the Waspmove should be included in the data transmitted by the connector. Deselected Waspmoves have their info box greyed out.

12.3.13.5. Synchronization status

This section allows the user to start and stop the connector and displays information about its current status. When the connector is off, the indicator marker is red.



Figure: Start button

After clicking "Start", the connector shows a startup sequence, and when finished the running status will be indicated by the status icon turning green. The start button becomes a red "Stop" button.



Figure: Stop button

The link "View log files" will allow you to see the status of the running connector via its log files. A filtered set of this logging data will also be available as a data node in your IoT-Ticket enterprise.

12.3.13.6. IoT-Ticket view

Once the connector is running you can use your web browser to see the Meshlium data coming into your IoT-Ticket Dashboards and Enterprise Manager on my.iot-ticket.com.

In your IoT-Ticket enterprise the Meshlium device will be viewable as an IoT-Ticket device under your enterprise and can now easily be used in Enterprise Dashboards to create views of your incoming data, even mixing it with data coming from other IoT sources.

A screenshot of the IoT-Ticket Enterprise Manager interface. On the left is a sidebar titled "Enterprise Assets" showing a tree structure with "Robert's Enterprise" expanded, revealing "Meshlium_SN3131015145898" which further expands to show "EVENT", "LOG", and "RUN" nodes, and two specific device entries: "waspmove403369636" and "waspmove403470429". The main content area is titled "Asset Information" and shows details for "waspmove403470429" with Device Id "1cb48b724a15414eb7396b751e33a580" and Asset name "waspmove403470429". Below this is a "Datanodes" table listing various sensor values: ACC-403470429-x (10), ACC-403470429-y (0), ACC-403470429-z (987), BAT-403470429 (18), IN_TEMP-403470429 (28.25), and MAC-403470429 (40F5BBA6). Each row includes a "View" link.

Figure: IoT-Ticket panel

You can now configure your own dashboard with sensor data and have it up and running in a matter of minutes.

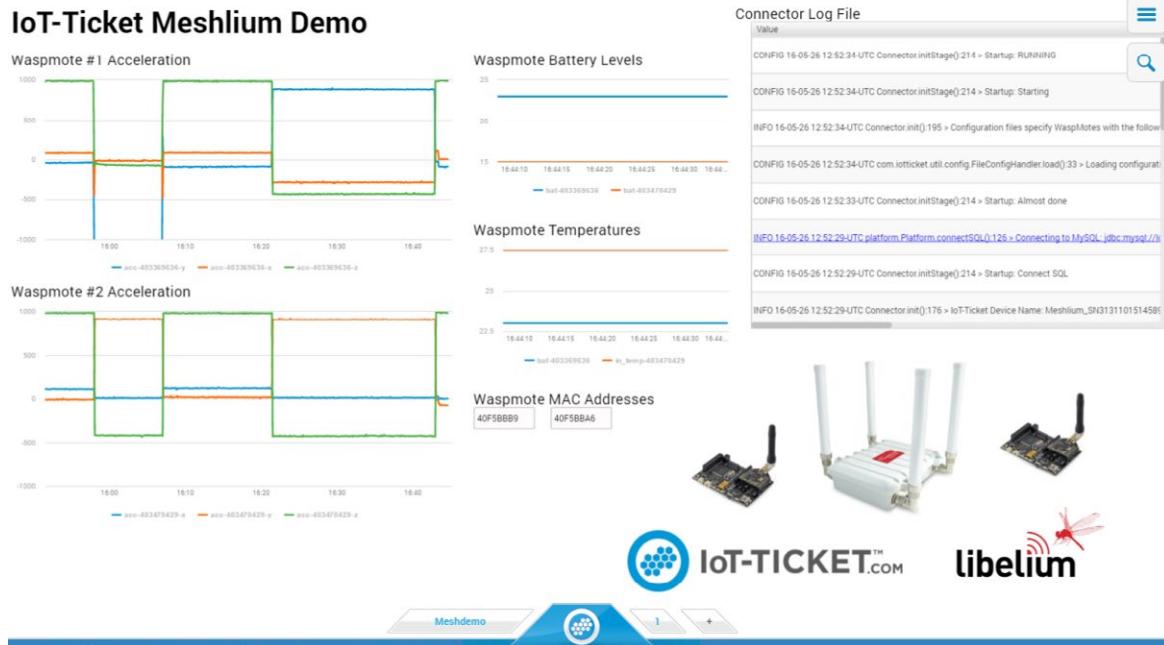


Figure: IoT-Ticket panel

12.3.14. IoTSens

IoTSens (<http://www.iotsens.com/>) is a horizontal platform for the development of smart cities which provides functionalities for gathering, integrating, storing and analyzing data from the city from a global point of view, so managers and citizens know what is happening and can immediately act.

IoTSens seamlessly integrates with Meshlium devices by means of MQTT queues so the connector will send all the sensors data to your IoTSens platform in order to be processed.

12.3.14.1. Configuration

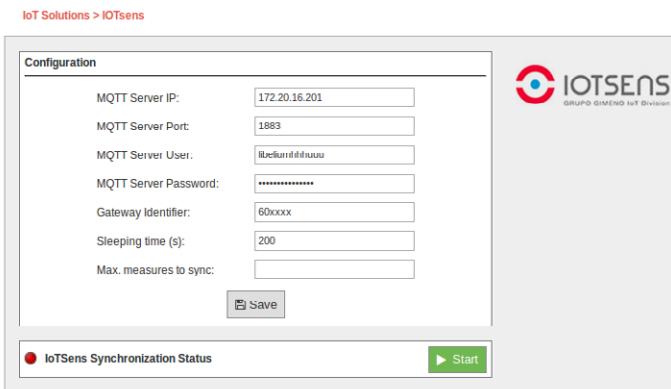


Figure: Configuring IoTSens in Meshlium

The IoTSens provider will supply you with the MQTT connection configuration attending your particular deployment:

- **MQTT Server IP:** IP address where the MQTT Server is deployed.
- **MQTT Server Port:** Port number where the MQTT Server is listening for connections.
- **MQTT Server User:** User name for connecting to the MQTT Server. This field can be empty if no user is required.
- **MQTT Server Password:** Password for connecting to the MQTT Server. This field can be empty if no user is required.

Additionally, the IoTSens plugin supports the configuration of some parameters regarding how the synchronization process works:

- **Sleeping time:** The synchronization process sleeps some time between executions. This parameter configures how many seconds it will sleep before starting the synchronization process again once it has finished. The sleeping time must be long enough to give time to other device processes to do their work.
- **Max. measures to sync:** This parameter configures how many sensor measures are synchronized at most in every synchronization process. The number of measures to synchronize must be limited in order to avoid the synchronization process to overload the system for a long time.

12.3.14.2. Controlling synchronization

You can start and stop the synchronization of the data to the IoTSens service. In the interface, you can see an indicator of whether the IoTSens service is running or not. If you click on "Start", the synchronization will begin.



Figure: IoTSens synchronization service is running

You can stop at any moment clicking on "Stop" button.



Figure: IoTSens synchronization service is stopped

12.3.15. Kii

12.3.15.1. Introduction

Kii Cloud is an MBaaS (Mobile Backend as a Service) and an IoT (Internet of Things) cloud platform provided by Kii Corporation.

Kii offers a cloud service that provides various server-side functions as versatile APIs for mobile apps and IoT solutions. By leveraging these APIs, the user can provide services making mobile apps and things Internet-ready without the server-side implementations and operations.

To learn more about the advantages of using the Kii Cloud see this page:

<http://docs.kii.com/en/start/merits>

In order to make it easier for developers and system integrators to use these APIs, Kii offers a set of SDKs (<http://docs.kii.com/en/references>) for multiple platforms.

12.3.15.2. Internet of Things (IoT)

For IoT scenarios Kii offers the Thing-IF SDK (<https://docs.kii.com/en/guides/thingif sdk>). Thing Interaction Framework (Thing-IF https://docs.kii.com/en/start/iot-functions/basic_function) is a framework positioned above the Kii Cloud SDK. It is a combination of selected features of the Kii Cloud SDK to accelerate IoT solutions.

Devices which are part of IoT solutions are called things in the Kii Cloud environment.

12.3.15.3. Connector basics

The Kii Cloud connector runs on Meshlium as an agent/daemon that periodically checks the local database for incoming sensor data (eg. frames coming from remote Waspmotes). The Meshlium unit itself is registered as a gateway against the Kii Cloud and the nodes sending sensor data are dynamically registered as end-nodes of the gateway. The sensor data itself provided by the nodes is sent to the Kii Cloud as Thing-IF states (<http://docs.kii.com/en/functions/thingif sdk/thingif sdk/model/states>) which reflect a node's sensor data snapshot at a specific point in time.

Once the nodes are sending states on the Kii Cloud you could for example browse the node's current and historical sensor values on a mobile application by using the Thing-IF SDK for Android (<https://docs.kii.com/en/guides/thingif sdk/android>) or iOS (<https://docs.kii.com/en/guides/thingif sdk/ios>).

12.3.15.4. Connector configuration and operation

You can configure the Kii Cloud connector in the Cloud Connector tab of the Meshlium Manager System. Click on IoT Platforms and select Kii.

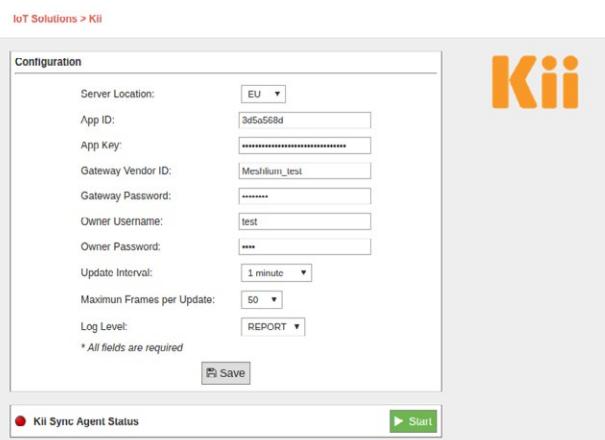


Figure: Kii Cloud Connector

Then fill in the fields as follows:

- **Server Location:** Enter server location of your app (either US, JP, EU, CN3 or SG) created at developer.kii.com. For more info on creating an app see this page.
- **App ID:** Enter the App Id of your app created at developer.kii.com. For more info on creating an app see this page.
- **App Key:** Enter the App Key of your app created at developer.kii.com. For more info on creating an app see this page.
- **Gateway Vendor ID:** Enter a unique name for this gateway (Meshlium). It will be created if it does not exist on the Kii cloud.
- **Gateway Password:** Enter a password for this gateway (Meshlium). If the gateway already exists on the Kii cloud, the password must match the previous registration.
- **Owner Username:** Enter a username to define which Kii user will own the gateway and nodes. It will be created on the Kii cloud if it does not exist.
- **Owner Password:** Enter a password for the user you specified above. If the user already exists on the Kii cloud, the password must match the previous registration.
- **Update Interval:** Enter the frequency in which the Kii agent queries the local database for new sensor data (frames). Minimum and default is 60 seconds.
- **Maximum Frames per Update:** Enter the maximum number of frames to fetch from the local database per update cycle. Default is 50, maximum is 200. Only frames not previously synchronized will be fetched. As a general rule of thumb we advise you at least allow for 1 second per frame in order to allow the daemon to keep up (eg. if you choose 200 frames, select an interval of at least 200 seconds).
- **Log Level:** Enter the log level. From fewer to more details, the levels are: OFF, ERROR, INFO, DEBUG, REPORT. Default is OFF.

You can start and stop the service by using the "Start/Stop" button in the Manager System plugin:



Figure: Configuring Kii in Meshlium



Figure: Configuring Kii in Meshlium

12.3.15.5. How to verify that the Kii Cloud Connector is working properly

You can manually verify that the Kii Cloud Connector is working properly doing a visual inspection of the devices and sent data at our developer console. These are the steps:

- Go to developer.kii.com and sign in with the same credentials you used to create the app as described in the previous section of this document.
- Select the app you created before. You will see a set of icons representing the different services provided by Kii.
- Click on the Things icon (the cube), then click on the Console tab and make sure you can see the Meshlium (and the nodes that you tested to submit data) in the list.
- Click on the Objects icon (the cylinder), then click on the Data Browser tab. In the combo box select Normal bucket and then click on Application scope. Now click on states. Make sure you see a row that when expanded shows the data from one frame (this is fine, you can see them all here). Make sure the version column shows a number equal to the number of frames you sent (if you click on Refresh on the top left, this number should increase on each interval time by the number of maximum frames that you configured on the connector configuration page).

- Click again on the Objects icon (the cylinder), then click on the Data Browser tab. In the combo box select Time series bucket and then click on Thing scope. In the second combo box select Vendor Thing ID and in the text box below, type the name of the node you want to verify. A pop-up box will appear with the node and you must click on it. Now click on ts_history and you will see a list of sensor entries for that node. Click on each of them to verify the sensor data.

12.3.16. Labeeb

Labeeb IoT is a Cloud and On-Premise Internet of Things (IoT) Services Enablement Platform. It provides an attractive environment (i.e. platform-as-a-service, open APIs, development tools, and documentation) for entrepreneurs, third party developers and companies to accelerate the development and deployment of new IoT services, and to help them achieve faster time-to-market.

For more information: <http://www.labeeb-iot.com>.



Figure: Labeeb IoT plugin

12.3.16.1. Register Meshlium in Labeeb IoT Platform

Create a Labeeb IoT account previously to register Meshlium in Labeeb IoT Platform:

<http://mea.labeeb-iot.com>

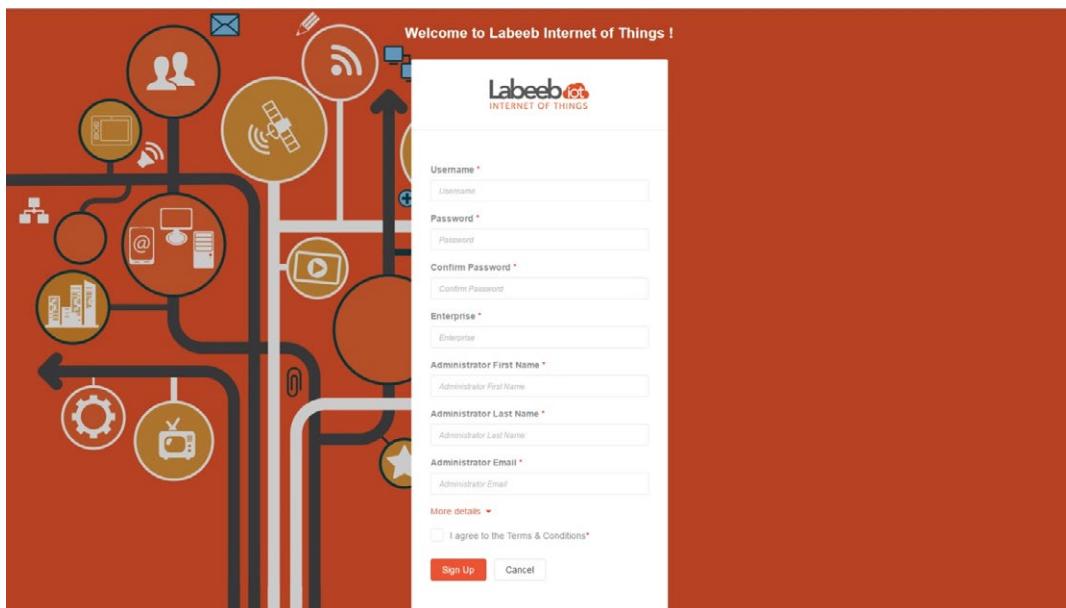


Figure: Creating a new Labeeb account

12.3.16.2. Configuration

After creating your account, you can use your credentials (enterprise name, username and password) to configure Meshlium.

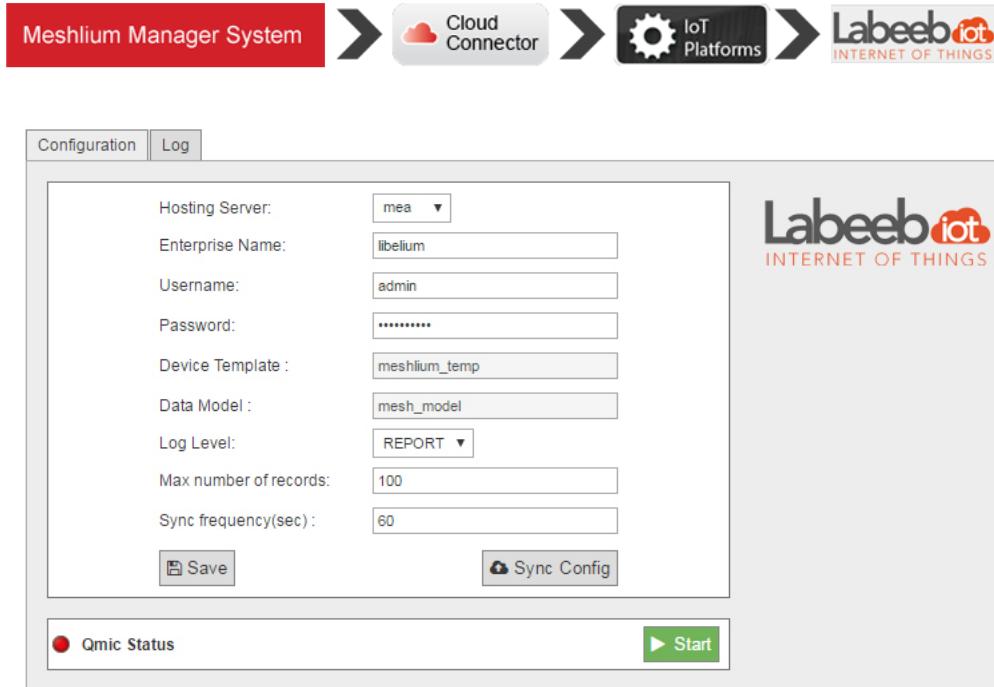


Figure: Labeeb IoT configuration panel

1. Fill the configuration fields with your Labeeb IoT credentials:

- **Hosting Server:** the server where your Labeeb IoT account is hosted in (default: MEA for mea.labeeb-iot.com)
- **Enterprise Name:** enterprise name used to create portal account
- **Username:** username of your portal account
- **Password:** password of your portal account
- **Log level:** used for debugging level, errors, reports, etc
- **Max number of records:** The maximum number of records to be synchronized to Labeeb IoT every some time interval
- **Sync frequency (sec):** specific time interval to perform synchronization, defined in seconds

2. Save the configuration by pressing the button "Saves". This will store them locally and create all needed devices and sensors automatically on Labeeb IoT platform.

3. Whenever you make a change, add a sensor or a device, press on "Sync Config" to update these parameters on Labeeb IoT portal.

12.3.16.3. Controlling synchronization

Once the connector is configured, the user can launch the Meshlium Labeeb IoT script ("Start" button). The program will search for the received frames on the local database, and will send them to the Labeeb IoT Platform. The status indicator displays the current state: "Running" or "Stopped".

The Meshlium Labeeb IoT cloud connector will start sending the data of any new Wasp mote device to Labeeb IoT Platform after a maximum of 60 min.



Figure: Labeeb IoT sender is running

You can stop the Labeeb IoT script anytime by clicking on the "Stop" button.



Figure: Labeeb IoT sender is stopped

You can get all the data sent from the Wasp mote devices on the Labeeb IoT portal:

Click on Data > Data retrieval > select the related device or data type to retrieve collected data.

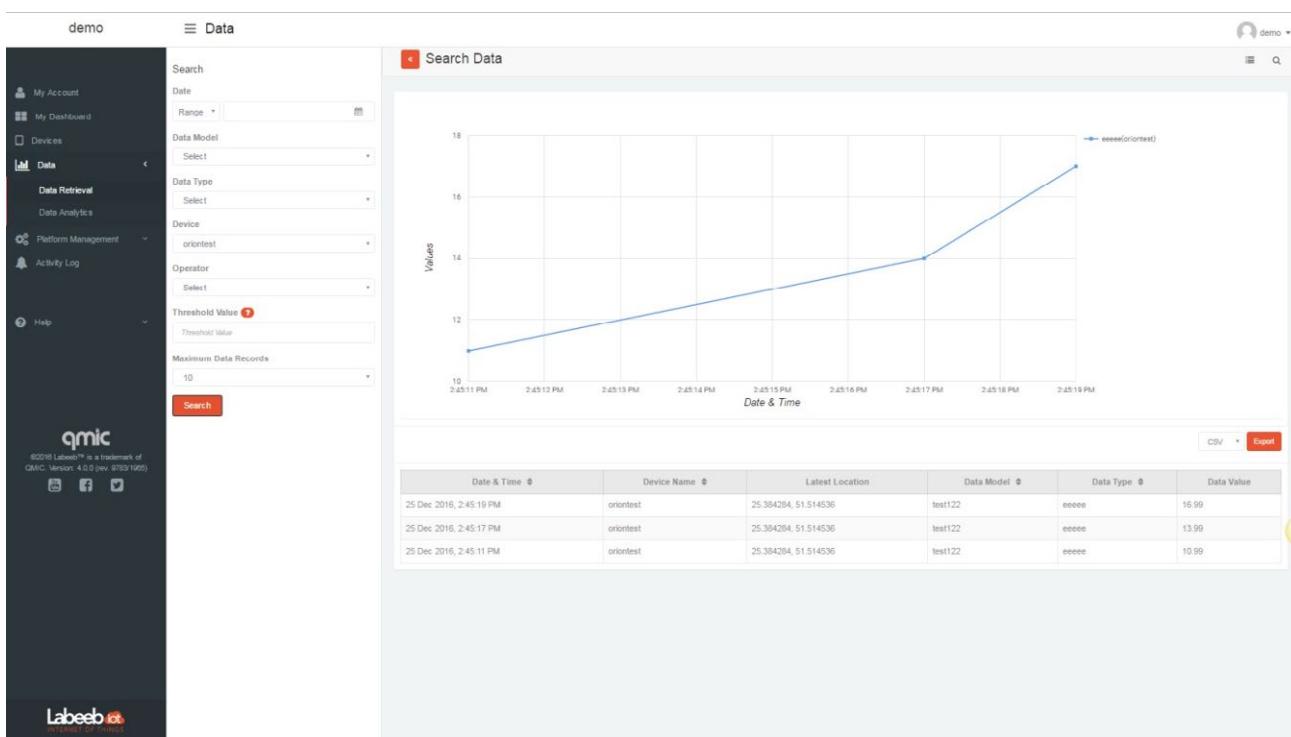


Figure: Labeeb IoT Platform data retrieval

12.3.17. MQTT

MQTT is a publish/subscribe, extremely simple and lightweight messaging protocol, designed by IBM for constrained devices and low-bandwidth, high-latency or unreliable networks, where battery power is critical. Due to its features of delivery assurance and bandwidth reduction, MQTT is being used by some Cloud platforms such as IBM or Carriots, which means that Wasp mote data can be stored inside them or in any other one based on this protocol.

More information: <http://mqtt.org/faq>.

With this plugin, Wasp mote sensor data can be directly integrated with a MQTT broker.



Figure: MQTT plugin

12.3.17.1. Configuration

The broker is a key agent in MQTT protocol. The broker is a server which receives all the frames and distributes each one of them to the subscribers clients.

MQTT plugin is located in:

Manager System > Cloud Connector > IoT Platforms > MQTT Solutions

In Server/Broker Configuration, the user can set:

- **IP Address:** Server IP address.
- **Port number:** Server port number.
- **User:** Server user name to log in the MQTT system.
- **Password:** Server password to log in the MQTT server.
- **Topic template:** Topic of your message. The user can use these wild-cards creating a personalized structure:
 - #MESHLIUM#: Identifier for Meshlium
 - #ID#: Unique identifier for data
 - #ID_WASP#: Identifier for Wasp mote
 - #SENSOR#: Sensor identification
- **Message template:** Data structure of your message. The user can use these wild-cards creating a customized content:
 - #ID#: Unique identifier for data
 - #ID_WASP#: Identifies the Wasp mote unit
 - #ID_SECRET#: Secret identifier
 - #SENSOR#: Identifies the sensor
 - #VALUE#: Value obtained from the sensor
 - #TS("c")#: Date with custom format. The parameter passed in this wild-card corresponds to the same ones you can use in PHP date function (see format parameters in <http://php.net/manual/es/function.date.php#refsect1-function.date-parameters>).

IoT Platforms > MQTT

| Configuration | |
|--|---|
| IP Address: | broker.mqttdashboard.com |
| Port number: | 1883 |
| User: | root |
| Password: | |
| Topic template: | #MESHLIUM##ID_WASP##SENSOR# |
| Message template: | <pre>{ "id": "#ID#", "id_wasp": "#ID_WASP#", "id_secret": "#ID_SECRET#", "sensor": "#SENSOR#", "value": "#VALUE#", "datetime": "#TS("c")#", "datetime2": "#TS("r")#", "datetime3": "#TS("Y:m:d\"1231234-H:i:s")#" }</pre> |
| <input type="button" value="Save"/> <input type="button" value="Start"/> | |
| ● MQTT Sender ▶ Start | |

Figure: Server/Broker Configuration

Examples about MQTT Servers/Brokers:

- <http://mqtt.org/wiki/doku.php/brokers>
- <http://mosquitto.org/>
- <http://mqtt.io/>

Note: in this example, the broker was running on a computer inside our local network for test purposes only. For professional use, it is recommended to work with a 24/7 server with static IP address.

12.3.17.2. Controlling status

Once configured the server/broker, the user can launch the Meshlium MQTT program (Start button). The program will search for the received frames on the local database, and will send them to the broker via MQTT protocol. The status indicator displays the current state, saying “Running” or “Stopped”.



Figure: MQTT sender is running

You can stop the MQTT sender anytime clicking on the “Stop” button.



Figure: MQTT sender is stopped

12.3.17.3. Platforms using MQTT

MQTT has been widely implemented across a variety of industries. As of March 2013, MQTT is in the process of undergoing standardization at OASIS protocol stack. The protocol specification has been openly published with a royalty-free license for many years, and companies such as Eurotech (formerly known as Arcom) have implemented the protocol in their products.

Here are a number of notable projects that have made use of MQTT and related technologies. Companies like Cisco, Eclipse Foundation, Eurotech, IBM, Kaazing, M2Mi, Red Hat, Software AG, TIBCO and Carriots, among other companies, are working with this protocol.

More information about examples and uses: http://mqtt.org/wiki/doku.php/example_uses.

12.3.18. Orchestra

The Orchestra platform IoT enables the possibility to collect all the data from sensors attached to Meshlium over MQTT and manage them in a user-friendly dashboard.

12.3.18.1. How to get your own API-key

For getting your own API-key you have to send a mail to services@orchestra.it with the subject "[Libelium – Activation] New activation request", signaling the number of sensors and the numbers of venues or Meshliums being used, and Orchestra will provide the account to access the platform where you can get the needed information.

To: services@orchestra.it ▾

Cc:

Bcc:

Subject: [Libelium - Activation] New activation request

From:

Signature: **None** ▾

- **Number of sensor:** -
- **Venues / Meshlium Number:** -

Figure: Configuring Orchestra

Below there are a couple of images showing where you will find the API information on the Orchestra website.

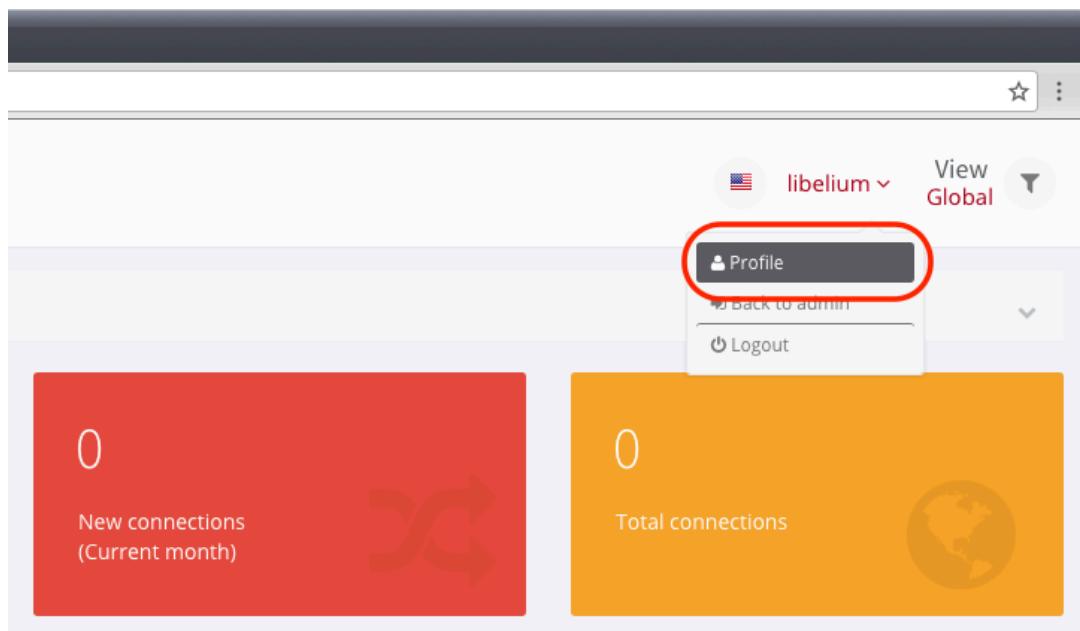


Figure: Orchestra platform user panel

To activate the API secret key and get the client Id, you have to go to the "Profile" section of the Orchestra account and then select the checkbox in the "Orchestra API" section and click the "Generate key" button.

Then you have to save the information generated by clicking on the "Save" button in the same section.

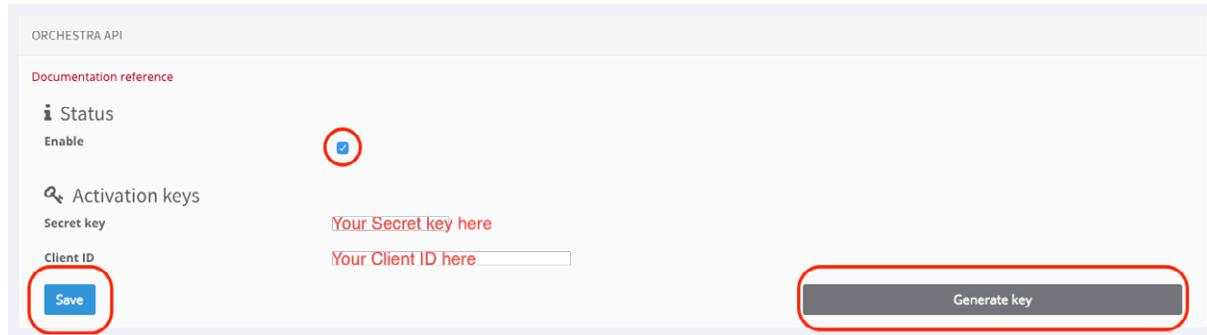


Figure: Orchestra platform API panel

12.3.18.2. Configuration

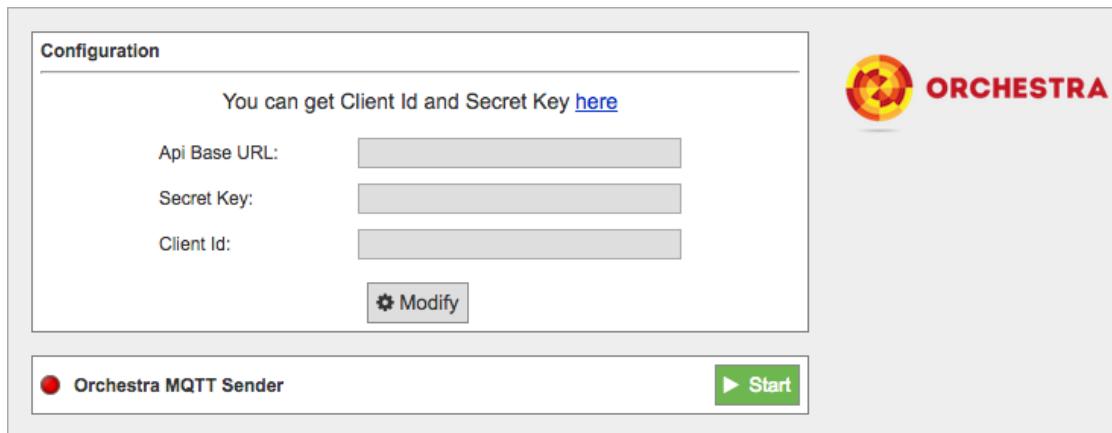


Figure: Orchestra Cloud Connector configuration panel

- **API Base URL:** You must enter the API URL that you are going to use for collecting the Meshlium data.
- **Secret Key:** The secret key to access the API.
- **Client Id:** Security key used for validating the access to the Host.

Click on the "**Modify**" button to enable the fields and insert the values previously obtained.

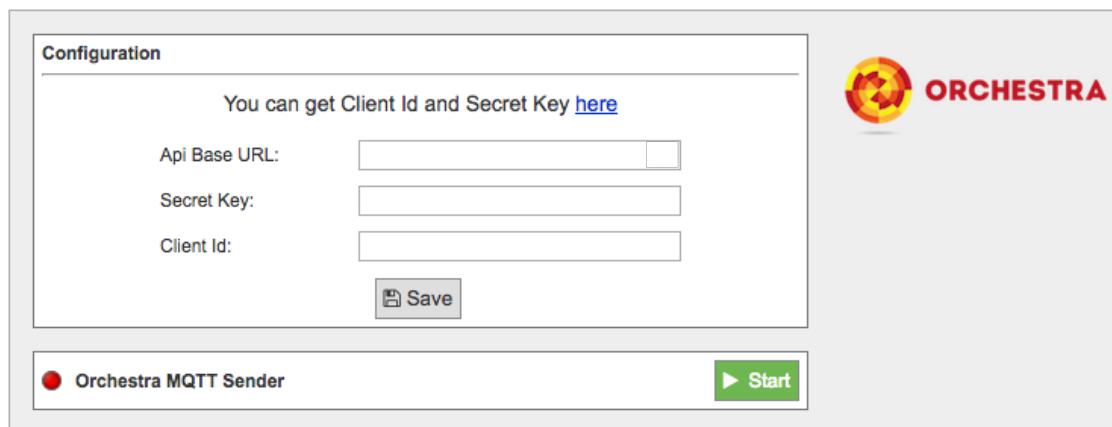


Figure: Orchestra Cloud Connector configuration panel

Once you click the “**Save**” button, a select box will appear with the venues you can choose.

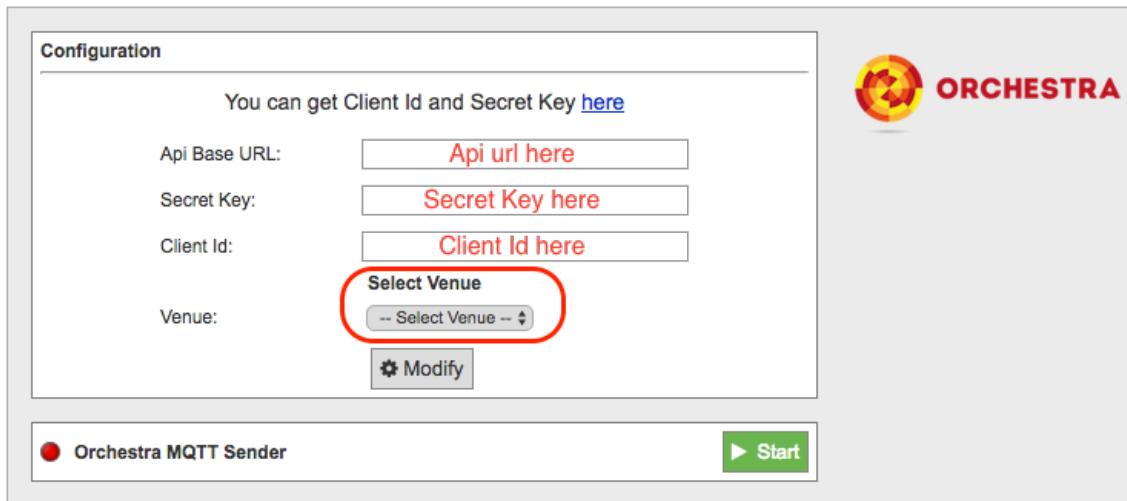


Figure: Orchestra Cloud Connector configuration panel

After that, press the “**Start**” button, and you will start to receive data from the configured Meshlium.

If you want to stop the event sending, just press the “**Stop**” button.

12.3.19. Redd

Redd is a company focused on delivering telemetry and telecontrol solutions for clients assets, with the aim of optimizing and simplifying operations, and most importantly, providing them with the necessary information to make quick and timely decisions.

For more information, please contact iot@reddsystem.com.

12.3.19.1. Configuration

You can locate the Redd Cloud Connector at:

Manager System > Cloud Connector > Basic Cloud Partner > Redd Cloud Connector

Inside the configuration panel you can fill 2 parameters with the information provided by Redd. These are:

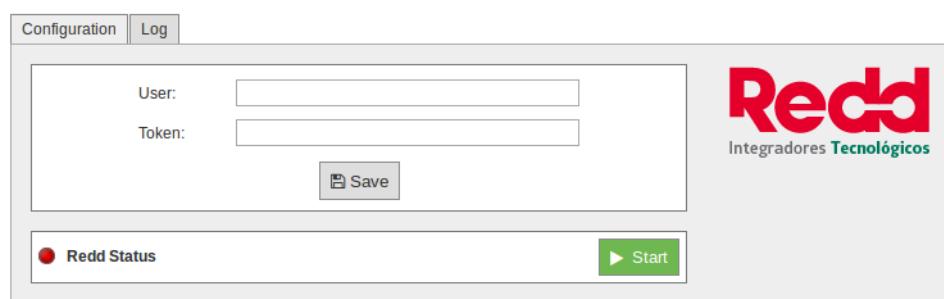


Figure: Redd Cloud Connector configuration panel

- **User:** this field recognizes the information sent to Redd by you
 - **Token:** unique identifier that enables access of your information to Redd
- Click on the "Save" button for storing the configuration fields.

The tab "log" will allow you to see the status of the running connector via its log files.

12.3.19.2. Controlling synchronization

Once configured the Redd Cloud Connector, you can launch the sync script by pushing the "Start" button. The synchronization will search for the received frames on the local database, and will send them to the Redd IoT platform via TCP protocol.



Figure: Redd Cloud Connector synchronization service in standby

After clicking on the "Start" button, it becomes a red "Stop" button. Click again and you will stop the synchronization.



Figure: Redd Cloud Connector synchronization service running

12.3.20. RIOT Platform

RIOT is a Sensing as a Service Platform developed by REDtone IOT. It manages connectivity from sensors or data sources with various communication protocols including MQTT and RESTful.

Please visit <http://riot.com.my/> for more information.

12.3.20.1. Configuration

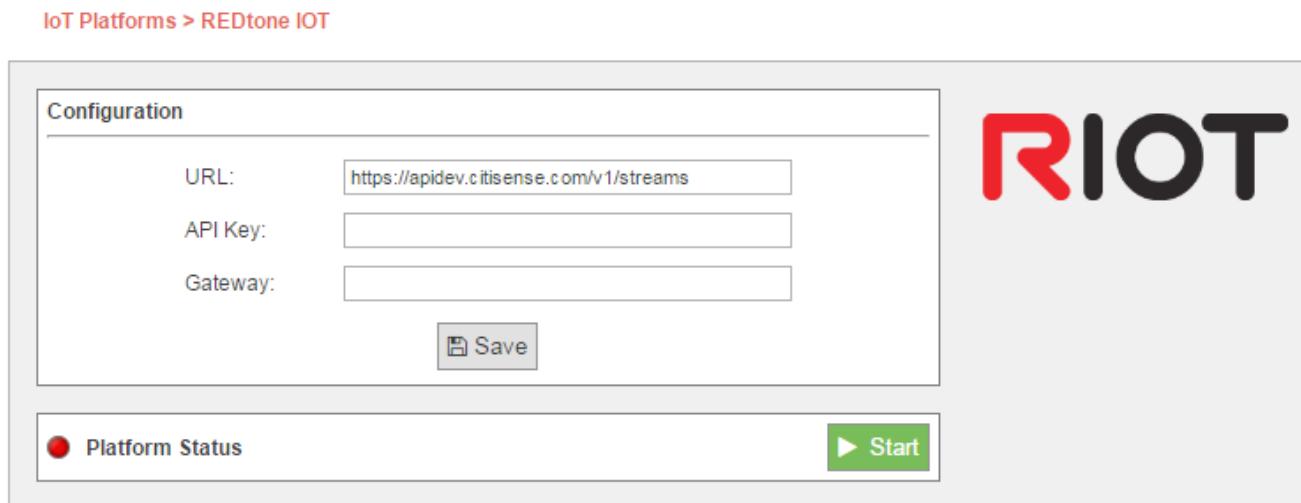


Figure: RIOT plugin Configuration

The RIOT plugin is configured with the following parameters:

- **URL:** The IP address or the URL will be provided by REDtone IOT.
- **API Key:** An API Key will be provided by REDtone IOT as one of the authorization information in order to send data to the RIOT platform.
- **Gateway:** Field to identify which Meshlium device the data came from when the platform receives the data, so that we can trace the location.

Note: In the Waspmove sensor board, make sure you identify each board with their own ID so that we can trace which sensor board the data originated.

12.3.20.2. Controlling synchronization

The synchronization will be executed for all the data that has not been synchronized in the Sensor Parser database table. You can start and stop the synchronization process. In the interface of our service, you can see if the status of our service is either running or not. If you click on "Start", the synchronization will start.



Figure: RIOT sender is running

If you want to stop the synchronization process, you can simply just click on "Stop" and the process will stop.



Figure: RIOT sender is stopped

12.3.21. SensorUp IoT Platform

SensorUp provides an open standard IoT platform that enables information from all different kinds of sensors accessible in a single platform.

12.3.21.1. Configuration

You can access the SensorUp IoT platform plugin from the Cloud Connector menu, and setup all the information needed to connect Meshlium to the SensorUp IoT platform.

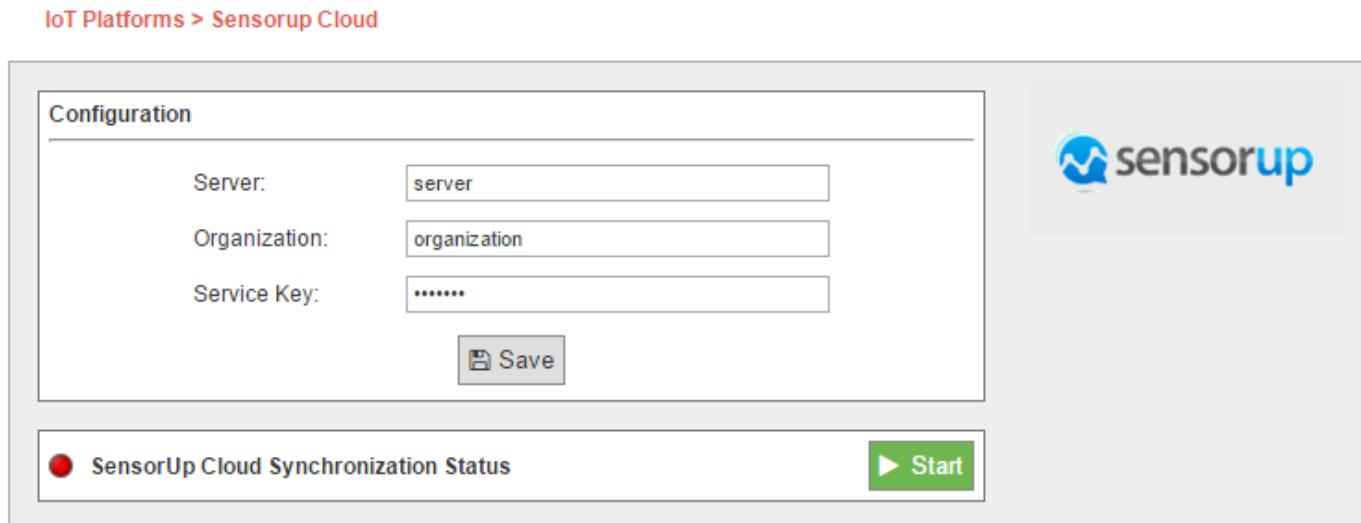


Figure: SensorUp configuring plugin

- **Server:** SensorUp IoT platform server
- **Organization:** Identifier of your organization
- **Service Key:** Key used to access SensorUp IoT platform

All these parameters are provided by SensorUp.

12.3.21.2. Controlling synchronization

Once you have saved the configuration, you can send your data to the SensorUp IoT platform by pressing the "Start" button. You will notice about it because the screen shows a spinning wheel when the process starts and displays a "running" status.



Figure: SensorUp status "Running"

If you want to stop this process, just press the "Stop" button. You can start/stop this process anytime.



Figure: SensorUp status "Stopped"

12.3.22. Sentilo

Sentilo is an open source sensor and actuator platform designed to fit in the Smart City architecture of any city who looks for openness and easy interoperability. It is built, used, and supported by an active and diverse community of cities and companies that believe that using open standards and free software is the first smart decision a Smart City should take.

12.3.22.1. Configuration

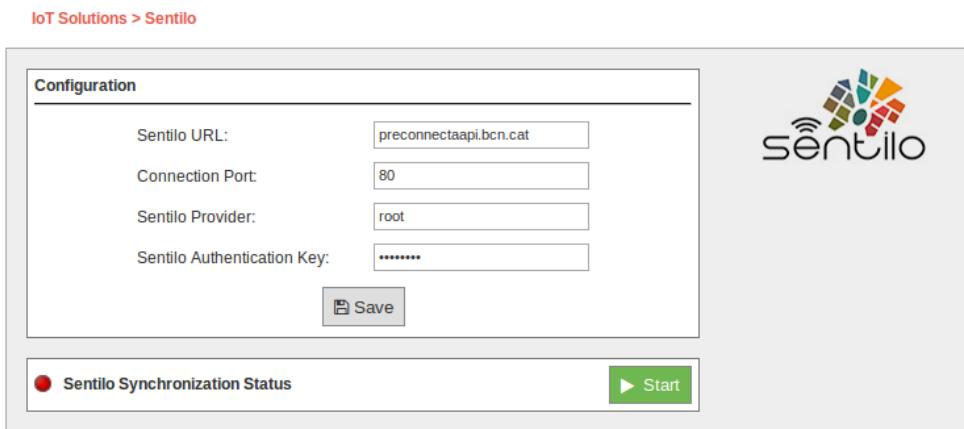


Figure: Configuring Sentilo in Meshlium

Inside the “Sentilo” plugin, you have a form to introduce your credentials to access your Sentilo system. You have to enter here these parameters:

- **Sentilo URL:** Address of the API service of Sentilo. This address should be provided without the “http://”.
- **Connection Port:** The port in which the API listens to connections.
- **Sentilo Provider:** The provider is the identity of who is sending data to Sentilo.
- **Sentilo Key:** The security key to send data to Sentilo.

This data will be provided by the administrators of the Sentilo system you are using.

Sensor, Types and Components are not created automatically, you need to manually create them in Sentilo as a previous step.

12.3.22.2. Controlling synchronization

The synchronization will be done in packs of 100 data at a time, so the system is not overloaded. You can start and stop the synchronization of the data to the Sentilo service. In the interface, you can see an indicator of whether the Sentilo service is running or not. If you click on “Start”, the synchronization will begin.



Figure: Sentilo synchronization service is running

You can stop at any moment clicking on “Stop” button.



Figure: Sentilo synchronization service is stopped

12.3.23. Symfony

Symfony's IoT Platform is focused on providing the core set of tools that enables the rapid roll-out of any IoT project or service. Companies can use the service to easily and rapidly design, prototype and deploy IoT projects that match their exact needs and requirements, rather than looking for an off the shelf product that fits best. The platform provides the following services: global mobile data connectivity, SIM management and control, device authentication and authorization, a visual service designer, data storage, reporting and visualization, IoT VPN and an extensive API exposing all of these capabilities for enterprise integration. All these services are available on a "pick and choose" basis enabling maximum flexibility and optimizing costs.

More information can be found at www.symfonymobile.com.

12.3.23.1. Configuration

The Symfony Cloud Connector is capable of self-configuration using data already provisioned from the Symfony Cloud Platform. This function requires that the user is authenticated and authorized into the Cloud Service with a specific set of credentials provided through the Self-Care portal. These credentials are not stored on the Meshlium or by the Connector and will have to be entered manually each time an Auto-Configuration action is requested through the web GUI. This functionality runs on the user's browser that is connected to the Meshlium device and requires Internet access, i.e. from the browser to the Cloud Platform API.

Once the user is authenticated, a list of all the Cloud provisioned devices is available for selection. If one of the devices is selected in the drop-down list, the web GUI will automatically fill in or overwrite the following parameter: Client ID, Device ID, Device Name, and Device Password.



Figure: Symfony cloud connector configuration panel

If the Cloud Connector is already configured with a valid Device ID the Auto-Configuration feature will automatically retrieve the Cloud provisioned data corresponding to that Device ID and fill in the parameters mentioned above. Any previous configuration is overwritten. This functionality can be used to resync the data provisioned in the Cloud with the configuration data of the Connector.

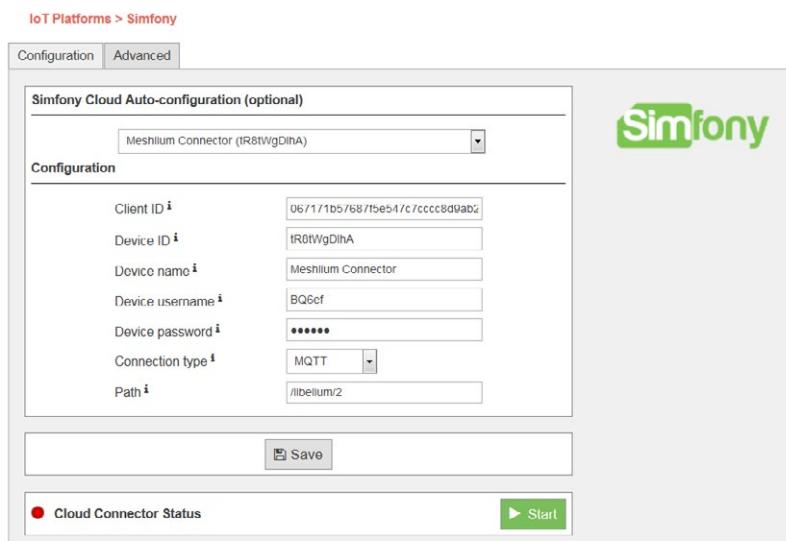


Figure: Symfony cloud connector configuration synchronization panel

All the data retrieved automatically from the Cloud can also be entered manually.

The user must use the Save button to save any newly configured data or apply any changes to it.

12.3.23.2. Advanced configuration

The advanced configuration window of the Connector allows the setting of the following parameters:

- **Connection retries:** Controls the number of connection testing retries before suspending operations and going to the sleeping phase (see the Functional description chapter, Test connectivity phase in "[Symfony Meshlium Connector- User Guide](#)"). **Default: 3.**
- **MQTT QoS:** Controls the QoS of the MQTT PUBLISH messages. Default: 1.
- **Permanent MQTT connection:** In case of MQTT connections, controls if the Connector will close the MQTT connection or not during the sleep phase. **Default: false.**
- **Refresh Interval:** The number of seconds the Connector will suspend its operations (sleep time) before starting a new extract and transmit cycle (see the Functional description chapter in "[Symfony Meshlium Connector- User Guide](#)"). **Default: 300.**
- **Maximum transmit interval:** The number of Refresh Intervals after which the Connector will transmit the data independently of the number of new database records found and the "Minimum number of DB records" parameter value. **Default: 5.**
- **Minimum number of DB records:** The minimum number of new database records that will trigger a sending procedure of the Connector. If the found new number of records is lower (strictly) than the value of this parameter, the transmit phase will be suspended until the number of records reaches the threshold or the condition expires (see Maximum transmit interval in "[Symfony Meshlium Connector- User Guide](#)"). **Default: 1.**
- **Aggregate sensor data:** Controls the way the Connector aggregates the sensor data found in the DB. If "true", the connector will aggregate sensor data from the same Wasmote frames into a single message. If "false" the Connector will transmit the data individually as extracted from the database. **Default: true.**

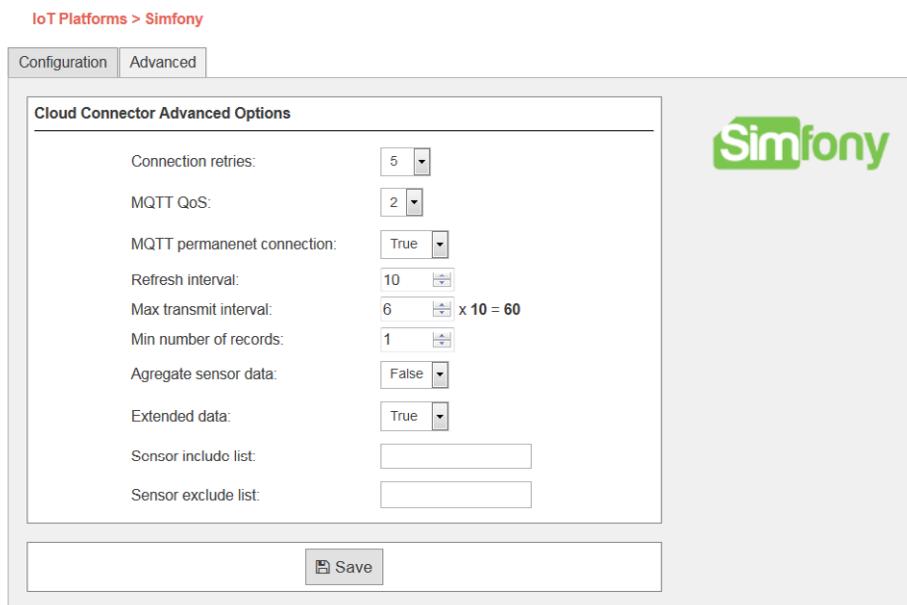


Figure: Symfony cloud connector advanced configuration panel

- **Extended sensor data:** Controls the number of parameters the Connector will transmit to the cloud. If "true", the whole data extracted from the database will be sent. If "false", only a subset of the data stored in the database is sent. **Default: false.**
- **Include sensor list:** The sensor ID list ([Meshlium Technical Guide](#)) that the Connector will look for when extracting data from the Meshlium database. The "Include" and "Exclude" lists are exclusive with the Exclude list having higher precedence. **Default: empty.**
- **Exclude sensor list:** The sensor ID list ([Meshlium Technical Guide](#)) that the Connector will exclude when extracting data from the Meshlium database. The "Include" and "Exclude" list are exclusive with the Exclude list having higher precedence. **Default: empty.**

12.3.23.3. Running the connector

After the entire configuration is complete, the user can start the connector using the “Start” button of the GUI. The Connector will be started and run seamlessly in background.



Figure: Simfony start button

The Status box will show the Connector’s state whenever the page is viewed by the user.

To stop the Connector, the user can press the “Kill” button that will stop the connector from running.

Warning: The “Kill” operation will terminate the Connector process and all its procedures abruptly independently of the stage they are in, i.e. extracting, transmitting, etc.



Figure: Simfony stop/kill button

To stop gracefully the connector the “Stop” button can be used. This will not interrupt any ongoing operations but rather wait for the connector to finish any ongoing activities. The Connector will look for this graceful stop signal each time it is starting or finishing the sleep cycle.

12.3.23.4. Integration with Simfony’s IoT platform

The Simfony Cloud Connector is intended to work with any type of connectivity provided by the Meshlium device it is deployed on. The Connector has two standard protocols available for communicating with the Simfony Cloud: MQTT and HTTP. Both of them are available in the encrypted version also, i.e. MQTT+SSL and HTTPS. The customer is able to choose the most appropriate protocol for his application.

Each Cloud Connector/Meshlium device must be individually authenticated and authorized before it can send data to the Simfony Cloud Service. The IoT platform will perform protocol specific authentication and authorization procedures and will allow the connectors to send data only if these are successful. The Connector configuration data must contain these credentials before the Connector can run properly.

Before data can be sent from the Connector to the Cloud Platform, a Cloud IoT Application must be deployed in order to listen for data. Customers can easily create, test and deploy their own applications via the Application Designer GUI. Each application can have a specific entry point for the data coming from the sensor and connectors. This entry point is defined by the used Protocol (MQTT or HTTP) and a custom target (MQTT-topic; HTTP-path). This entry point must be also configured in the Connector via the “Connection Type” and “Connection Path” parameters. Once the application is deployed, the connectors can start sending data into it and the custom business logic will be triggered.

Find out more about running the connector in the [“Symfony Meshlium Connector- User Guide”](#).

12.3.24. SmartPlants

Smartplants Cloud integration enables secure communications between the devices connected to the Meshlium device and the cloud.

Smartplants plugin is located in:

Manager System > Cloud Connector > IoT Solutions > Smartplants

12.3.24.1. Configuration

You will receive the configuration information that is required to connect your Meshlium to the SmartPlants system via an e-mail from Smartplants.

12.3.24.2. Controlling synchronization

Once you configured the server/broker, the user can launch the Meshlium SmartPlants script (clicking on the "Start" button). The program will search for the received frames on the local database, and will send them to the Smartplants Cloud platform via an MQTT protocol. The status indicator displays the current state, saying "Running" or "Stopped".



Figure: Smartplants sender is running

You can stop the Smartplants program anytime clicking on the "Stop" button.



Figure: Smartplants sender is stopped

12.3.25. TechEdge SAP HANA

SAP HANA Cloud Platform is a platform-as-a-service open (PaaS) that provides unique services for databases and applications in memory. It is the cloud platform that allows you to quickly develop new applications or extend existing ones. Allowing anyone to extend SAP applications within minutes, all in the cloud.

With SAP HANA Cloud Platform you can:

- Deploy in the cloud and their existing on-premise applications. You can quickly add a new functionality to their existing applications in the cloud and on-premise.
- Connect your cloud and on-premise applications to eliminate data silos and make a simple, secure and scalable digital access
- Create and run new applications in the cloud to solve new problems, make new customers and new income
- It allows to connect the business processes with field devices through Internet of things (IoT) services.

This platform allows:

- Enable remote services management of devices
- Communicate through secure protocols with field devices
- Manage devices and their messages remotely through programming interfaces (API)

12.3.25.1. Configuring SAP HANA

To make the connection between the platform and the SAP HCP Gateway Meshlium by Libelium, so we can receive the data sent from the gateway, a pre-configuration of Things Internet service is required.

For more information about how to configure the Things Internet service, please contact your TechEdge contact.

12.3.25.2. Configuration

Select the “IoT Platforms” and press on SAP HCP to access the service configuration screen of TechEdge cloud connector for SAP HANA Cloud Platform.

By accessing the SAP HCP connector configuration screen, a form with the necessary fields to configure is displayed.

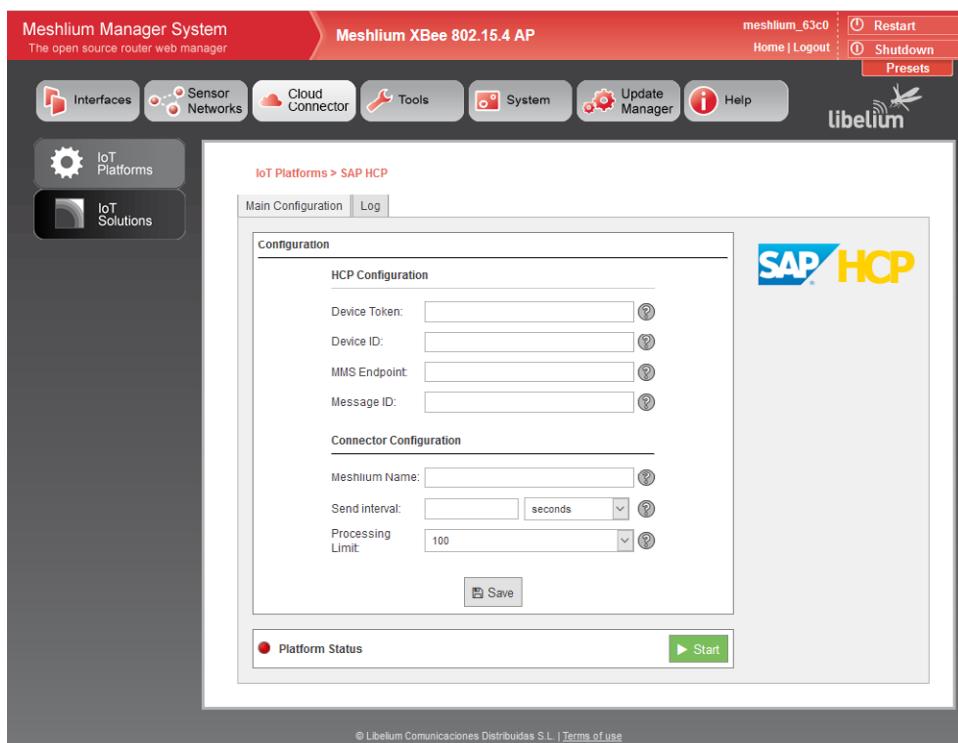


Figure: TechEdge configuration plugin

- **Device Token:** The Token OAuth2.0 provided by HCP to the device create (you must configure SAP HCP IoT before, as described in the previous sections)
- **Device ID:** Identifier of the device created in HCP
- **MMS Endpoint:** Data Endpoint of HCP MMS services
- **Message ID:** ID of message type created in HCP
- **Meshlium Name:** Meshlium unit identifying name (free field)
- **Send Interval:** Defines the connector's space of time to wait between each HCP cloud deliveries. Each delivery contains between 100 and 200 sensors traces, and in order to not saturating the Gateway memory, the minimum accepted is 5 seconds.
- **Processing Limit:** Limit of simultaneous messages processing in each of HCP cloud deliveries, the figures are considered between 100 and 200, these are the figures recommended by Libelium to ensure a high performance in the Gateway.

After setting all fields described above, it is necessary to save the changes by clicking the "Save" button at the bottom of the configuration form.

12.3.25.3. Controlling synchronization

After saving the configuration, you can now start the service. To do this click on the "Start" button.



Figure: TechEdge status "Running"

When the service has started, "Platform Status" is displayed in green, and the "Start" button changes to "Stop".

Note: The Data synchronization with Meshlium will be held as maximum packet size defined in "Processing Limit" field. All those new data received since the last delivery will be synchronized, if the data exceeds the maximum size set to "Processing Limit" several deliveries will be made to complete the synchronization.

With the service has started, to stop the service you must click on the "Stop" button on the HCP configuration screen in Meshlium.



Figure: TechEdge status "Stopped"

Pressing the "Stop" button, a stop will start in a controlled manner, allowing you to stop the service without incident (close files, ends active processes of polling, etc.), ensuring a proper functioning of the Meshlium gateway.

When the service has stopped, "Platform Status" is displayed in red, and the "Stop" button will change by "Start".

13. Device connectors

The aim of this chapter is to introduce the user to the Meshlium's Device Connector functionality. This section will help you to connect your Meshlium to a 3rd party device platform.

3rd party certified connectors are linked with Meshlium by an IP interface.

What is a device platform?

Devices are equipments which could be easily correlated with Meshlium through an Ethernet or wireless connection. Devices perform actions like taking images, activation on systems, industrial control, etc. Interfacing with 3rd party devices allows Meshlium to execute actions manually or automatically responding to events detected in the info sent by Waspmove or Plug & Sense! and received on Meshlium.

Meshlium Device Connector

Meshlium runs the software necessary for implementing the analysis of its internal database and the control of devices. In other words, this software checks the occurrence of events and performs the rules specified to execute actions on the device. This software is called Device Connector.

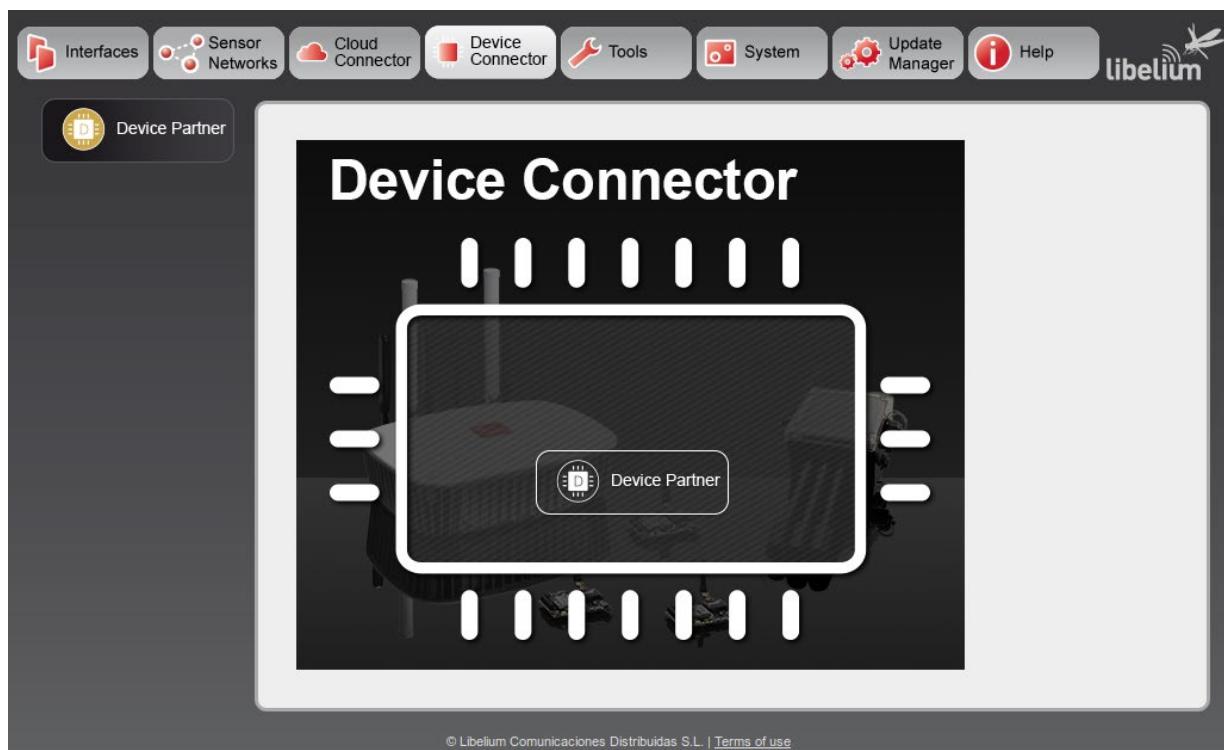


Figure: Device Connector main menu on the Manager System

13.1. Device Partners

13.1.1. Axis

Axis offers a wide variety of network videocameras and advanced analytic applications. More information: <https://www.axis.com/global/en/products/network-cameras>.

Thanks to this plugin, the sensor data received on Meshlium can trigger actions on Axis cameras.



Figure: Axis plugin

13.1.1.1. Configuration

Prior to configure Meshlium, make sure you set these parameters on the camera: IP, username, password and presets.

For information about how to configure your camera, please check the installation guide of your camera model.

The Axis plugin is located in:

Manager System > Device Connector > Device Partner > Axis

In the "Configuration" panel, the user can set:

- **Log Level:** Generate log messages. From fewer to more details, the levels are: OFF, ERROR, INFO, DEBUG and REPORT. The option by default is OFF.
- **Execution interval:** Time interval between checking camera's rules.

In the "Add Camera" panel, the user can set:

- **Name:** Device rule name.
- **IP:** IP address of the camera.
- **User:** User name configured on the camera.
- **Password:** The password configured on the camera by the user (defined in the previous step).
- **PTZ Preset:** Preset of the camera to be used when the rule is executed. For obtaining a list of available presets on the camera you have to fill the parameters above (IP, user and password). They will be used for getting the presets when you press the button "Get Presets". After pushing the button, the list of presets will be shown and you will be able to select one of them.
- **Threshold:** Threshold in a sensor value for taking a picture. This field is not mandatory, but if you want to add a threshold, you have to select one:
 - Wasp mote sensor: Available sensor which will trigger the rule.
 - Operation: Available operations are: greater, less, greater or equal, less or equal, equal than or different from.
 - Value: Value to be compared to the sensor selected.

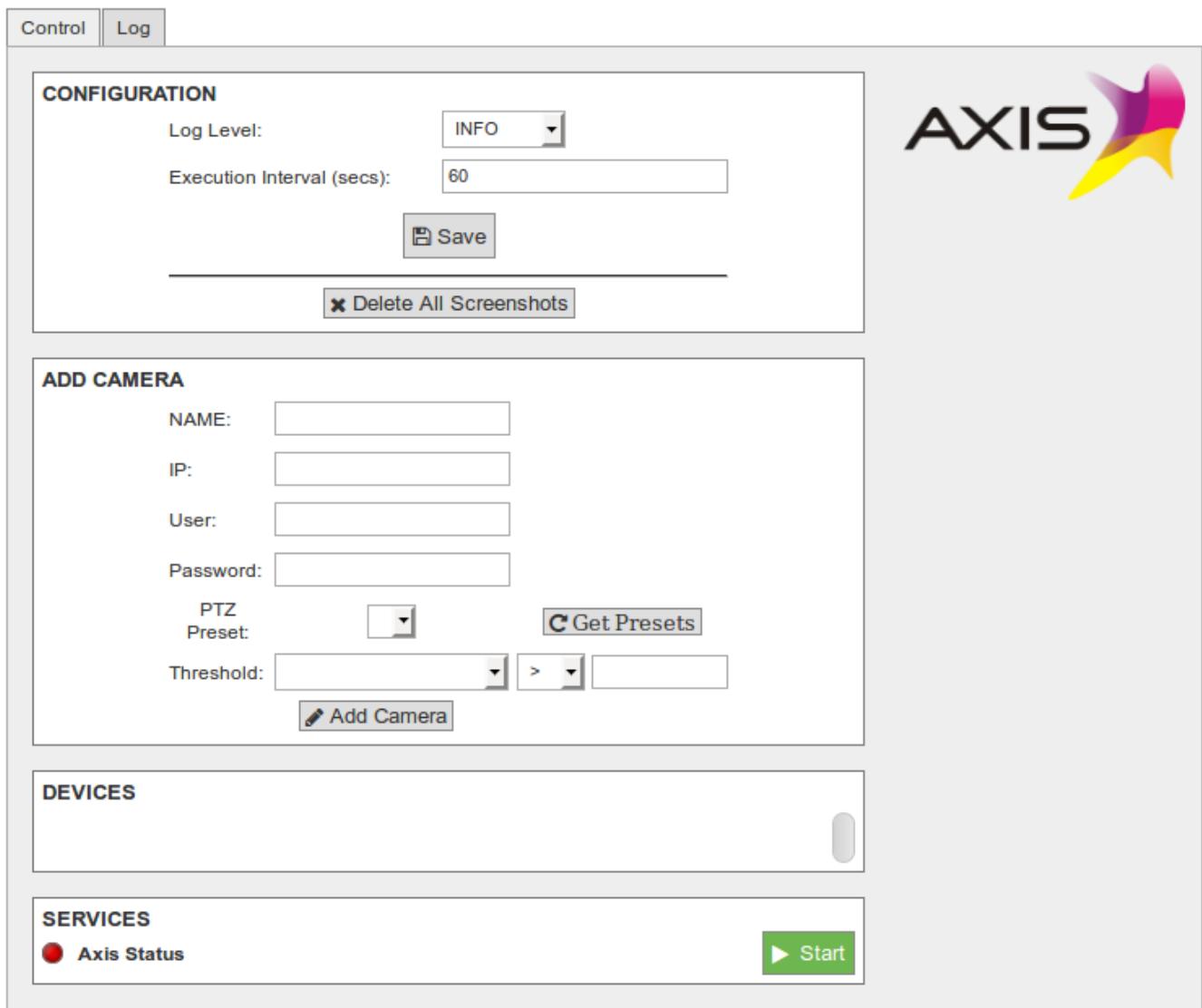


Figure: Axis configuration panel

When all the parameters have been configured, press the "Add Camera" button. This action will add a new rule in the "Devices" section.



Figure: New device

13.1.1.2. Devices

In the “Devices” section you can see all the rules that will be evaluated for each device. Apart from checking that the rules are properly configured, you can execute 2 actions:

- **Delete:** Delete the device. It will disappear from this section and the rule will not be evaluated.
- **Take a picture:** The camera will take a picture in the predefined preset.

For accessing to the pictures taken (both manual or automatic) you have to access to the FTP server of the Meshlium unit. The folder “axis” inside the FTP main directory contains the images taken. The image names will vary depending if the picture was taken manually or automatically:

- **Manually:** the name of the file will be **NAME_YYYY-MM-DD_HH-MM-SS.jpg**
- **Automatically:** the name of the file will be **NAME_WASPNAME_SENSORMAME.jpg**

13.1.1.3. Controlling synchronization

Once the devices are configured, the user can launch the Meshlium Axis service (“Start” button). The program will search for the received frames on the local database, and will check the rules configured. If a rule is evaluated positively, then a picture in the preset position of the rule will be taken and stored. The status indicator displays the current state, red means ‘stopped’ and green means ‘running’.



Figure: Axis service is running

You can stop the Axis service anytime by clicking on the “Stop” button.



Figure: Axis service is stopped

14. Smartphone detection

Meshlium allows to detect iPhone and Android devices and in general any device which works with WiFi or Bluetooth interfaces.

These devices can be detected without the need of being connected to a specific Access Point, enabling the detection of any smartphone, laptop or hands-free car kit device which comes into the coverage area of Meshlium.

The idea is to be able to measure the amount of people and cars which are present in a certain point at a specific time, allowing the study of the evolution of the traffic congestion of pedestrians and vehicles.



Figure: Smartphone detection

Users have to do nothing to be detected as the WiFi and Bluetooth radios integrated in their smartphones periodically send a "hello!" message telling about their presence. The information read from each user contains:

- The MAC address of the wireless interface, which allows to identify it uniquely
- The strength of the signal (RSSI), which gives us the average distance of the device from the scanning point
- The vendor of the smartphone (Apple, Nokia, etc)
- The WiFi Access Point where the user is connected (if any) and the Bluetooth friendly name. Users no connected to an AP will be showed as "free users".
- The Class of Device (CoD) in case of Bluetooth which allows us to differentiate the type of device (smartphone, hands-free, laptop, LAN/network AP). With this parameter we can differentiate among pedestrians and vehicles.

The coverage areas may be modified by changing the power transmission of the radio interfaces allowing the creation of different scanning zones from a few meters (in order to study a specific point) to dozens of meters (to study the whole street or even the entire floor of a shopping mall).

Applications related to shopping and street activities:

- Number of people passing daily in a street
- Average time of the stance of the people in a street
- Differentiate between residents (daily matches) and visitants (sporadic matches)
- Walking routes of people in shopping malls and average time in each area

The Vehicle Traffic Monitoring is also another important application as understanding the flow and congestion of vehicular traffic is essential for efficient road systems in cities. Smooth vehicle flows reduce journey times, reduce emissions and save energy. Similarly the efficient flow of pedestrians in an airport, stadium or shopping center saves time and can make the difference between a good and a bad visit. Monitoring traffic - whether road vehicles or people - is useful for operators of roads, attractions and transport hubs.

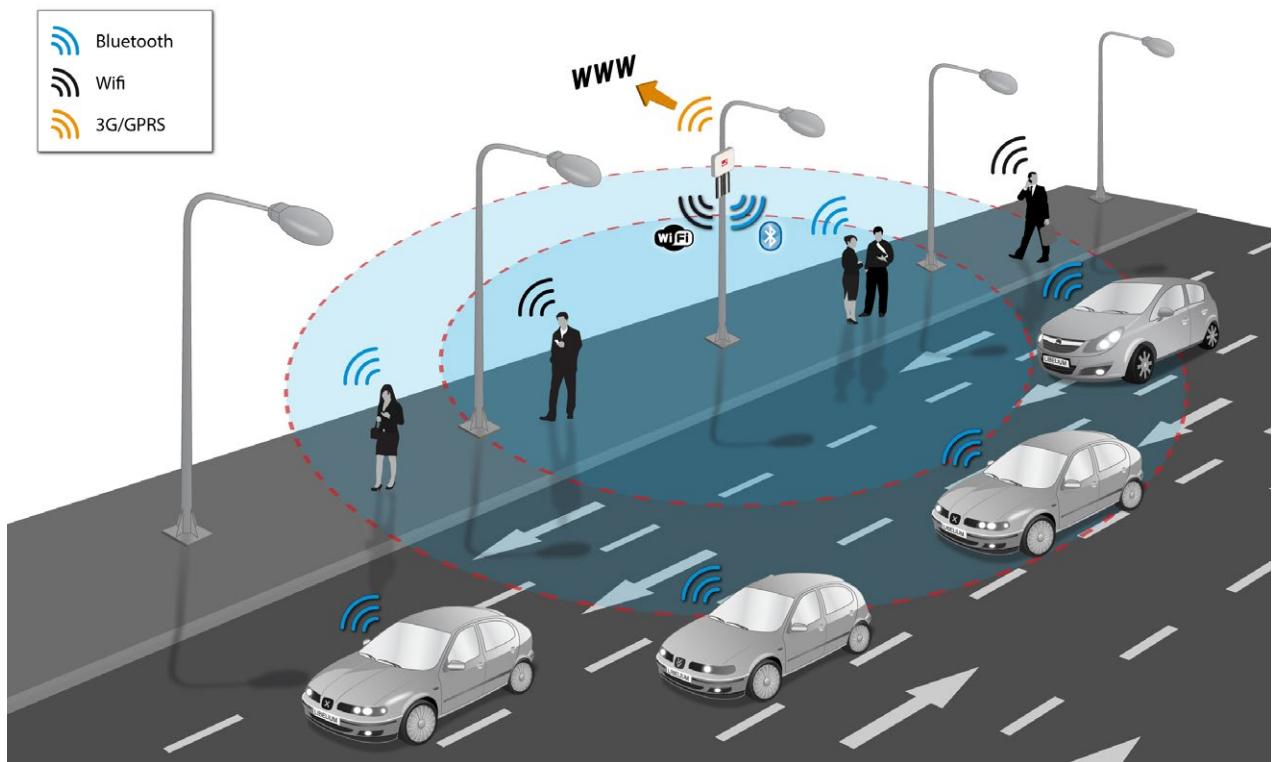


Figure: Vehicle Traffic Detection

Applications for Vehicle Traffic Detection:

- Monitor in real time the number of vehicles passing for a certain point in highways and roads
- Detect average time of vehicle stance for traffic congestion prevention
- Monitor average speed of vehicles in highways and roads
- Provide travel times on alternate routes when congestion is detected

The monitoring system can also be used to calculate the average speed of the vehicles which transit over a roadway by taking the time mark at two different points.

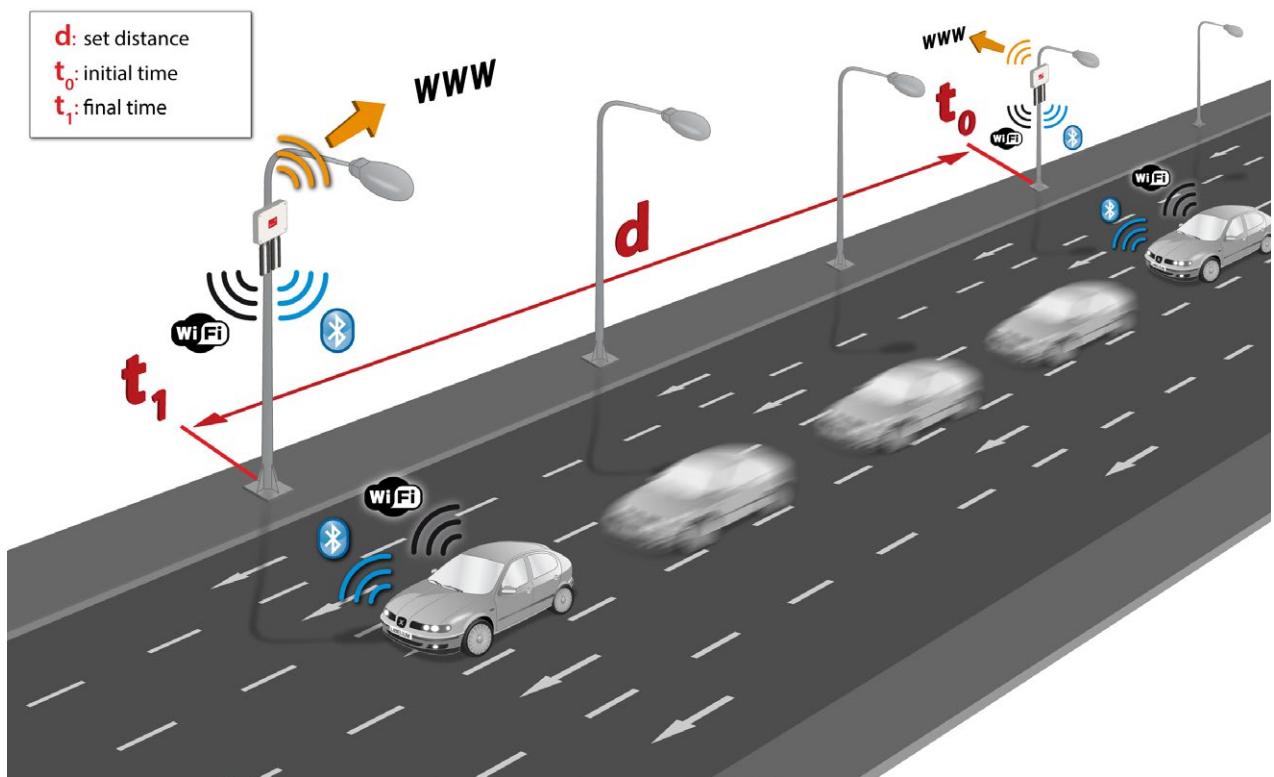


Figure: Calculate the average speed

14.1. Devices detected



Figure: Devices detection

Detection includes any of the last models even those that implement low consumption techniques when using the radio interfaces:

- iPhone (*all models*): 4, 4S, 5, 5S, 5C, iPad (2, 3, 4, Air, Mini, Retina)
- Android (*all models*): Nexus, Samsung Galaxy, LG, Sony Xperia, HTC, Motorola, Huawei, Asus...



Figure: Some of the supported smartphones

Vehicle Traffic Monitoring

Due to the reduction of the time between scanning intervals, now vehicle traffic detection rate has increased **from 50% to 80%** even at a speed of 100 km/h (62 miles/h)

- Monitor in real time the number of vehicles passing for a certain point in highways and roads
- Detect average time of vehicle stance for traffic congestion prevention
- Monitor average speed of vehicles in highways and roads
- Provide travel times on alternate routes when congestion is detected

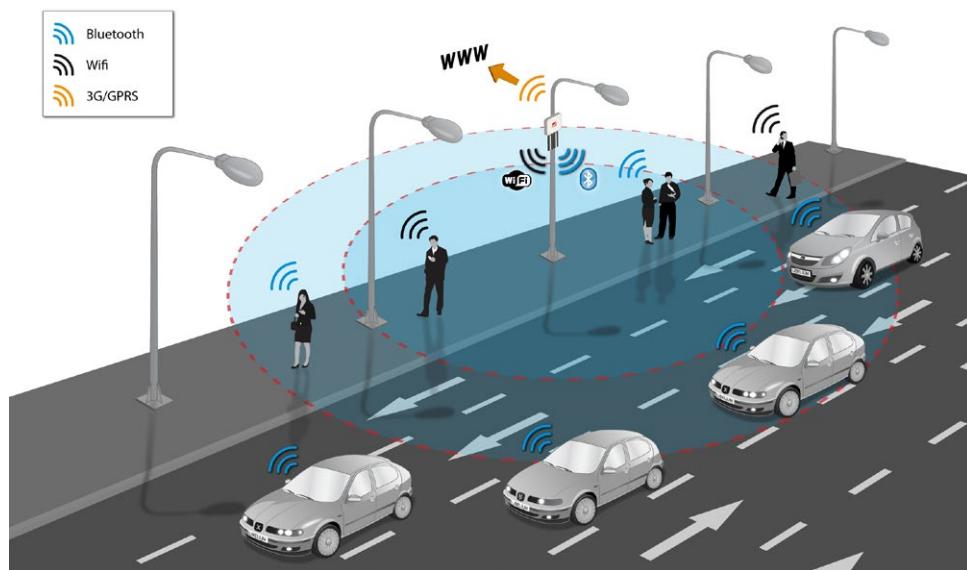


Figure: WiFi and Bluetooth scanning in the street

For Vehicle Traffic Monitoring applications, it is recommended to purchase the special pack of 2 directional antennas which will extend the range of WiFi and Bluetooth scanning in the required direction. The size of one antenna is 40 x 36 x 4 cm. Each one weights about 2 kg. The antennas are 18 dBi and come with the needed mounting system, 2 m cables and screw adapters.



Figure: Directional antenna for Meshlium Scanner

Do the users need to have a specific app installed or interact somehow to be detected?

No, the scan is performed silently, Meshlium just detects the “beacon frames” originated by the WiFi and Bluetooth radios integrated in the smartphones. Users just need to have at least one of the two wireless interfaces turned on.

How do we differentiate if the Bluetooth device detected is a car’s hands-free or a smartphone?

In the scanning process each Bluetooth device gives its “Class of Device” (CoD) attribute which allows to identify the type of service it gives. We can differentiate easily the CoD’s generated by the car’s hands-free from the people’s phone ones.

How do I control the inquiry area?

In the Bluetooth inquiry there are seven different power levels which go from -27 dBm to 3 dBm in order to set different coverage zones from 10 to 50m. In both WiFi and Bluetooth radios these zones can also be increased or decreased by using a different antenna for the module as it counts with a standard N-Male connector. The default antenna which comes with the scanning modules is an omnidirectional antenna with a gain of 5dBi.

How do I calculate the distance of any of the devices detected?

In the inquiry process we receive the MAC address of the Bluetooth device along with the Received Signal Strength Indicator (RSSI) which gives us the quality of the transmission with each device. RSSI values usually go from -40 dBm (nearest nodes) to -90 dBm (farthest ones). In the tests performed Bluetooth devices at a distance of 10 m reported -50 dBm as average, while the ones placed at 50 m gave us an average of -75 dBm.

What about privacy?

The anonymous nature of this technique is due to the use of MAC addresses as identifiers. MAC addresses are not associated with any specific user account or mobile phone number nor even to any specific vehicle. Additionally, the “inquiry mode” (visibility) can be turned off so people have always chosen if their device will or will not be detectable.

How do the Bluetooth, WiFi and ZigBee radios coexist without causing interferences with each other?

WiFi, XBee and Bluetooth work in the 2.4GHz frequency band (2.400-2.480 MHz), however, the Bluetooth radio integrated in Meshlium uses an algorithm called Adaptive Frequency Hopping (AFH) which improves the common algorithm used by Bluetooth (FHSS) and enables the Bluetooth radio to dynamically identify channels already in use by XBee and WiFi devices and to avoid them.

Anyway, in the case of sending 802.15.4 frames from WaspMote or Plug & Sense! to a Meshlium Scanner equipped with XBee-PRO 802.15.4, it is recommended to perform re-tries in the sender application, just to minimize possible interferences and ensure a good percentage of received frames in Meshlium.

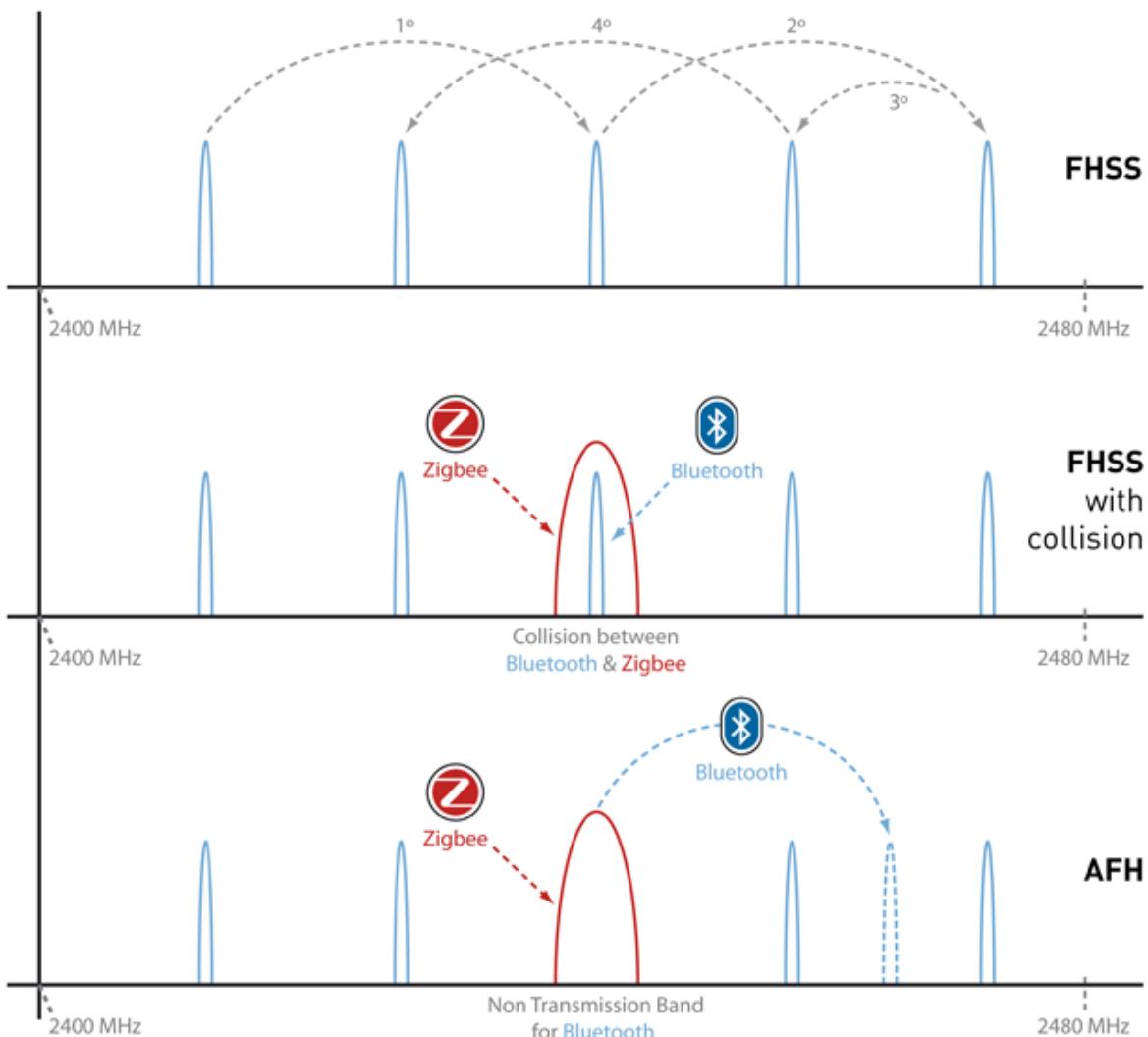


Figure: Bluetooth, WiFi and ZigBee radios coexist

Under which conditions do you get a 95% detection rate of devices?

A set of conditions must be respected to keep the detection rate high.

The devices to be detected must be some meters away from the Scanner and must remain some seconds inside the coverage area to give time to the system to detect them.

The setup of the WiFiScan feature in Meshlium is 40 seconds of scan span. This means Meshlium Scanner listens for 40 seconds and then stores the results of the scan.

Android and iOS devices have a special option to disable WiFi connection when the user locks the screen in order to save battery. All cases are studied here. This option changes with the iOS version, but will be present in the majority of iOS devices. It makes iOS devices difficult to detect: the device is not undetectable, but it would need several scan cycles to get one beacon.

When a device is connected to a WiFi Access Point it is easier to detect, as it needs to send radio packets to allow communication.

The results not Android or iOS devices may vary depending on the type of system. Usually, APs are detected easily, as they broadcast the SSID. Hidden SSID are detected too. The only APs that can be hard to detect are the APs that do not broadcast their presence. These APs can only be detected when there is traffic from connected devices.

Regarding other WiFi devices, the individual behaviour will define if they are detectable. As a general rule, every device that broadcasts beams or is connected generating traffic will be detected.

Our tests results are shown in these tables:

Android:

| | Screen ON | Screen OFF (power saving off) | Screen OFF (power saving on) |
|---|----------------------------------|----------------------------------|---------------------------------|
| WiFi radio OFF | NO | NO | NO |
| WiFi radio ON (not connected to an AP) | YES (almost every scan cycle) | YES (most of scan cycle) | NO |
| WiFi radio ON (connected to an AP) | YES | YES | NO |

iOS:

| | Screen ON | Screen OFF (power saving off) |
|---|------------------------------|---|
| WiFi radio OFF | NO | NO |
| WiFi radio ON (not connected to an AP) | YES (after several scans) | SOMETIMES (after a random number of scans) |
| WiFi radio ON (connected to an AP) | YES | YES (after several scans) |

Bluetooth scanning, unlike WiFi scanning, is based on polling, and not in passive listening. This makes Bluetooth detection slower and left the device the chance of avoiding detection (it just needs to ignore the polling request).

Nevertheless, Bluetooth scan is still useful in some applications, like car detection, as most of modern cars have a Bluetooth hands-free device, and these devices are most of the time listening for connections.

Any smartphone can be configured to be visible (or not) by other Bluetooth devices. Putting this option as "NOT VISIBLE" will make the smartphone undetectable by any other Bluetooth device, which includes Meshlium Scanner. Note that some latest-technology hands-free devices implement the "not visible" mode too.

When the Bluetooth interface is set as visible, the phone will be listening for incoming queries. This way the device can be scanned. The visibility setup may be different in different devices. Some of them activate visibility for a limited time (usually 30 seconds), some others have a manual control to enable/disable the visibility.

Different Android and iOS versions have different behaviours about Bluetooth visibility. In most of the modern versions, Bluetooth visibility is disabled when the screen is locked (or even when the user exits the Bluetooth configuration menu). There is no way to detect an Android or iOS phone with the screen off, which makes it very difficult to scan Android or iOS devices in a real environment.

There are a lot of types of Bluetooth devices. Most of slave Bluetooth devices are designed to wait for incoming connections. This makes highly possible to detect devices like hands-free car kits, headsets, HID, etc.

The scanning time is more important in Bluetooth as the devices need some time to reply to the queries.

Device name is not always obtained, as some devices take some time to reply to the name queries. Nevertheless, the device can be easily identified by its MAC address.

How can I calculate the total number of people from the number of detected devices?

It depends. Not all the people have a smartphone. Also, not all the people switch WiFi and/or Bluetooth radios on their smartphones. It all depends on so many economic, social and cultural factors. The percentage of people with WiFi or Bluetooth on depends on the scenario where they are too. For example, if a Meshlium Scanner is installed in a college campus which provides free WiFi service, many students will be detected because they will probably keep their smartphones, tablets or notebooks with WiFi on. The same would happen in a mall, airport or hotel with free WiFi.

Besides, consider that not all the people who could be detected will remain enough time inside of the coverage area of Meshlium Scanner.

Also, keep in mind that some people can carry several WiFi or Bluetooth devices. For example, a driver with smartphone in his pocket and a Bluetooth device in his car can be detected as 2 different users by Meshlium.

To sum up, in Libelium we consider that the total number of people can be approximated multiplying the number of detected devices by a factor, from 3 or 5:

$$3 \times \text{Detected devices} < \text{Total people} < 5 \times \text{Detected devices}$$

It all depends on a number of variables. The administrator of Meshlium Scanner can perform real tests in order to find the exact value of this factor in the specific scenario under study.

14.2. WiFi Scanner

14.2.1. Concepts

The additional 2nd WiFi radio integrated in Meshlium Scanner allows to scan WiFi devices in a range of action up to 200 m depending on the line of sight conditions.

The idea is to search for WiFi devices in a defined interval which can be configured. Meshlium will get the **MAC address**, information about the detected **Device**. Regarding these devices, we can distinguish Access Points  and Clients   . In the case of each client, Meshlium gets which Access Point the device is connected to (if any). Also, the signal strength (**RSSI**) of the devices along with a **timestamp** which identifies when the scan detects it. For this reason, it is important to set the correct time in the System before starting with the storage of the data. See the Time Synchronization in the System section.

As extra information, the System also identifies the **Vendor** of the WiFi devices using its MAC address and if the information is synchronized to the external database (**Sync**).

Example of information scanned:

| B ID | Sync | Timestamp | MAC | Device | RSSI | Vendor |
|-------|------|---------------------|-------------------|--|------|-------------------|
| 53483 | 0 | 2012-04-24 07:56:25 | C4:2C:03:96:0E:4A |   (not detected) | 69 | Apple |
| 53482 | 1 | 2012-04-24 09:11:26 | D8:2A:7E:10:1E:63 |  libelium_wsn1 | 60 | Nokia Corporation |

We can select the Scanning Time from a drop-down list. This time specifies how many seconds the scanner will spend searching. After each scanning process, the system performs a pause of one second before starting again.

The Scanning Time must be trimmed in order to avoid that a temperature of 70 °C is reached in the Meshlium's microprocessor. See chapter "Internal temperature sensors" to know how to monitor the microprocessor's temperature.

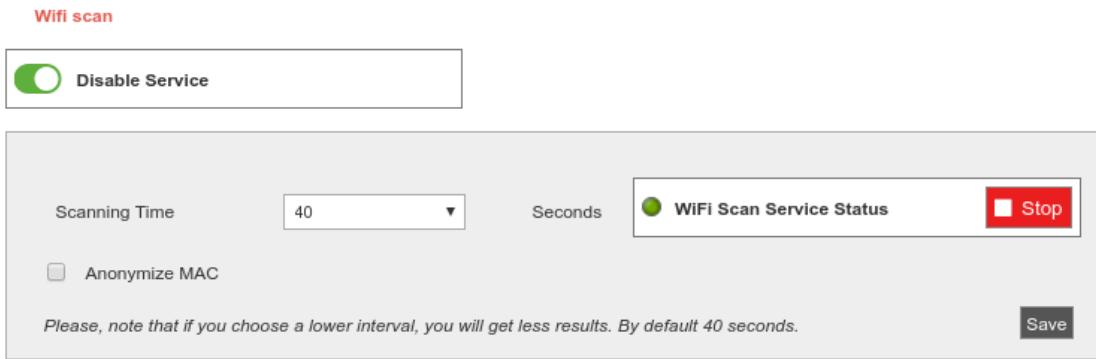


Figure: Configuring WiFi Scanner

We can also activate the anonymization of the MAC addresses. This option will store the MAC address encoded with an MD5 hash. The hash will be consistent in the same day, but will change from one day to another. This system allows to follow a particular user in the same day, but keeps the privacy of the user, not storing the real MAC of the device and not allowing to track a user more than one day.

From this section the user can start and stop the service from the button next to the status indicator.

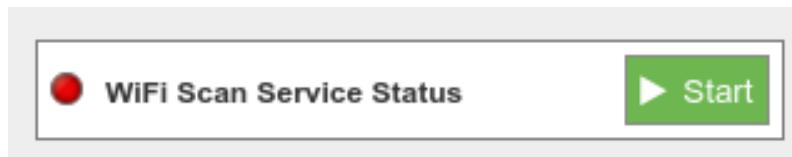


Figure: WiFi Scanner was stopped

If the user manually stops the service, it will be automatically relaunched upon reboot. In order to completely disable service, the user have to click on the slider "Disable Service". This will stop the service and avoid it to run upon reboot. Setup cannot be changed when disabled, but already stored data is available to be shown.

To enable the service again, click on the slider "Enable Service".



Figure: Enable and Disable controls

It is possible to perform two different storage options with the data captured:

- Local database. This is always used.
- External database The data is synchronized to an external database from the local database.

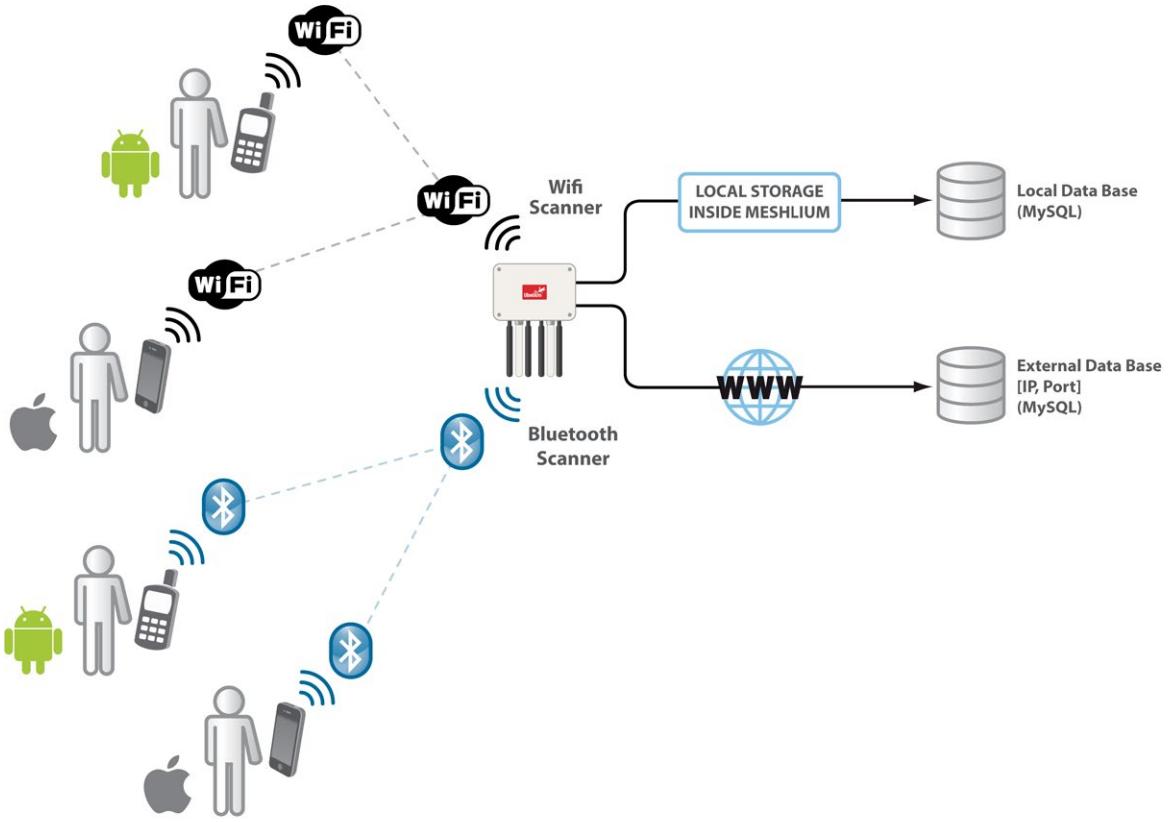


Figure: WiFi Scanner data storing

14.2.2. Local database

Meshlium has a MySQL data base up and running which is used to store locally the information captured. In the "Local Data Base" tab you can see the connection parameters.

- Database:** MeshliumDB
- Table:** wifiScan
- IP:** localhost
- Port:** 3306
- User:** root
- Password:** libelium2007

Captured Data

Local DataBase External DataBase

| TimeStamp | Sync | MAC | Device | RSSI | Vendor |
|---------------------|------|-------------------|-------------------|------|------------------------|
| 2016-08-06 14:32:36 | 1 | 2A:A4:3C:99:2F:C3 | libelium_wsn2 | -87 | Unknown |
| 2016-08-06 14:32:32 | 1 | 0A:18:D6:63:E5:2C | libelium_wsn2 | -84 | Unknown |
| 2016-08-06 14:32:31 | 1 | 04:F0:21:1B:61:0D | meshlium7b1c | -32 | Compex Systems Pte Ltd |
| 2016-08-06 14:32:29 | 1 | A8:54:B2:92:FE:C5 | meshlium_bcc0 | -72 | Wistron Neweb Corp. |
| 2016-08-06 14:32:29 | 1 | A8:54:B2:9F:46:6E | libelium_AP | -86 | Wistron Neweb Corp. |
| 2016-08-06 14:32:24 | 1 | DC:09:4C:86:E0:36 | 2A:A4:3C:99:2F:C3 | -74 | Unknown |
| 2016-08-06 14:32:13 | 1 | 00:1B:B1:B1:4F:01 | meshlium_6b74 | -85 | Wistron Neweb Corp. |
| 2016-08-06 14:32:07 | 1 | 2A:A4:3C:99:2F:C3 | libelium_wsn2 | -87 | Unknown |
| 2016-08-06 14:31:51 | 1 | 0A:18:D6:63:E5:2C | libelium_wsn2 | -85 | Unknown |
| 2016-08-06 14:31:50 | 1 | 04:F0:21:1B:61:0D | meshlium7b1c | -31 | Compex Systems Pte Ltd |
| 2016-08-06 14:31:49 | 1 | A8:54:B2:92:FE:C5 | meshlium_bcc0 | -72 | Wistron Neweb Corp. |
| 2016-08-06 14:31:48 | 1 | A8:54:B2:9F:46:6E | libelium_AP | -85 | Wistron Neweb Corp. |
| 2016-08-06 14:31:10 | 1 | 0A:18:D6:63:E5:2C | libelium_wsn2 | -84 | Unknown |
| 2016-08-06 14:31:08 | 1 | A8:54:B2:92:FE:C5 | meshlium_bcc0 | -72 | Wistron Neweb Corp. |
| 2016-08-06 14:31:08 | 1 | 04:F0:21:1B:61:0D | meshlium7b1c | -31 | Compex Systems Pte Ltd |

Figure: Local database for WiFi Scanner

At any time you can see the last "x" records stored, filtered by access points or clients. Just set how many and what kind of insertions you want to see and press the "Show data" button. The maximum number of data to display is 500.

The data from the database can be deleted pressing the button "Delete all data". Be careful, as this option deletes all the information of WiFi scans in the local database.

There is an option to program an automatic purge in the database every day, keeping the information in the database the days you specify. Furthermore, if you intend to configure the external database, you can choose if you want to delete only synchronized data or everything, taking care of the days established before.

14.2.3. External database

Meshlium can synchronize all the WiFi devices information stored in the local database to an external MySQL database managed by the user.

Captured Data

| Local DataBase | External DataBase | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|-------------------|-------------------|-------------------|------|----------------------|------|--------|---------------------|--------------|-------------------|---------------|-----|---------|---------------------|--------------|-------------------|---------------|-----|---------|---------------------|--------------|-------------------|--------------|-----|----------------------|---------------------|--------------|-------------------|---------------|-----|---------------------|---------------------|--------------|-------------------|-------------|-----|---------------------|---------------------|--------------|-------------------|-------------------|-----|---------|---------------------|--------------|-------------------|---------------|-----|---------------------|---------------------|--------------|-------------------|---------------|-----|---------|---------------------|--------------|-------------------|---------------|-----|---------|---------------------|--------------|-------------------|--------------|-----|----------------------|---------------------|--------------|-------------------|---------------|-----|---------------------|---------------------|--------------|-------------------|-------------|-----|---------------------|---------------------|--------------|-------------------|---------------|-----|---------|---------------------|--------------|-------------------|--------------|-----|----------------------|
| Connection data <div style="display: flex; justify-content: space-between;"> <div style="flex: 1;"> Database: MeshliumDB Table: wifiScan Host: 192.168.2.13 Port: 3306 User: root Password: libelium2007 </div> <div> <input checked="" type="checkbox"/> Store frames in the external data base Save </div> </div> <div style="margin-top: 10px;"> <input checked="" type="checkbox"/> Access points <input checked="" type="checkbox"/> Clients Last 100 insertions. (to create database and table) </div> <div style="text-align: center; margin-top: 10px;"> Show data Show sql script </div> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>TimeStamp</th> <th>MeshliumID</th> <th>MAC</th> <th>Device</th> <th>RSSI</th> <th>Vendor</th> </tr> </thead> <tbody> <tr><td>2016-08-06 14:32:36</td><td>meshlium7b1c</td><td>2A:A4:3C:99:2F:C3</td><td>libelium_wsn2</td><td>-87</td><td>Unknown</td></tr> <tr><td>2016-08-06 14:32:32</td><td>meshlium7b1c</td><td>0A:18:D6:63:E5:2C</td><td>libelium_wsn2</td><td>-84</td><td>Unknown</td></tr> <tr><td>2016-08-06 14:32:31</td><td>meshlium7b1c</td><td>04:F0:21:1B:61:0D</td><td>meshlium7b1c</td><td>-32</td><td>Compex Systems Pte L</td></tr> <tr><td>2016-08-06 14:32:29</td><td>meshlium7b1c</td><td>A8:54:B2:92:FE:C5</td><td>meshlium_bcc0</td><td>-72</td><td>Wistron Neweb Corp.</td></tr> <tr><td>2016-08-06 14:32:29</td><td>meshlium7b1c</td><td>A8:54:B2:9F:46:6E</td><td>libelium_AP</td><td>-86</td><td>Wistron Neweb Corp.</td></tr> <tr><td>2016-08-06 14:32:24</td><td>meshlium7b1c</td><td>DC:09:4C:86:E0:36</td><td>2A:A4:3C:99:2F:C3</td><td>-74</td><td>Unknown</td></tr> <tr><td>2016-08-06 14:32:13</td><td>meshlium7b1c</td><td>00:1B:B1:B1:4F:01</td><td>meshlium_6b74</td><td>-85</td><td>Wistron Neweb Corp.</td></tr> <tr><td>2016-08-06 14:32:07</td><td>meshlium7b1c</td><td>2A:A4:3C:99:2F:C3</td><td>libelium_wsn2</td><td>-87</td><td>Unknown</td></tr> <tr><td>2016-08-06 14:31:51</td><td>meshlium7b1c</td><td>0A:18:D6:63:E5:2C</td><td>libelium_wsn2</td><td>-85</td><td>Unknown</td></tr> <tr><td>2016-08-06 14:31:50</td><td>meshlium7b1c</td><td>04:F0:21:1B:61:0D</td><td>meshlium7b1c</td><td>-31</td><td>Compex Systems Pte L</td></tr> <tr><td>2016-08-06 14:31:49</td><td>meshlium7b1c</td><td>A8:54:B2:92:FE:C5</td><td>meshlium_bcc0</td><td>-72</td><td>Wistron Neweb Corp.</td></tr> <tr><td>2016-08-06 14:31:48</td><td>meshlium7b1c</td><td>A8:54:B2:9F:46:6E</td><td>libelium_AP</td><td>-85</td><td>Wistron Neweb Corp.</td></tr> <tr><td>2016-08-06 14:31:10</td><td>meshlium7b1c</td><td>0A:18:D6:63:E5:2C</td><td>libelium_wsn2</td><td>-84</td><td>Unknown</td></tr> <tr><td>2016-08-06 14:31:08</td><td>meshlium7b1c</td><td>04:F0:21:1B:61:0D</td><td>meshlium7b1c</td><td>-31</td><td>Compex Systems Pte L</td></tr> </tbody> </table> | | TimeStamp | MeshliumID | MAC | Device | RSSI | Vendor | 2016-08-06 14:32:36 | meshlium7b1c | 2A:A4:3C:99:2F:C3 | libelium_wsn2 | -87 | Unknown | 2016-08-06 14:32:32 | meshlium7b1c | 0A:18:D6:63:E5:2C | libelium_wsn2 | -84 | Unknown | 2016-08-06 14:32:31 | meshlium7b1c | 04:F0:21:1B:61:0D | meshlium7b1c | -32 | Compex Systems Pte L | 2016-08-06 14:32:29 | meshlium7b1c | A8:54:B2:92:FE:C5 | meshlium_bcc0 | -72 | Wistron Neweb Corp. | 2016-08-06 14:32:29 | meshlium7b1c | A8:54:B2:9F:46:6E | libelium_AP | -86 | Wistron Neweb Corp. | 2016-08-06 14:32:24 | meshlium7b1c | DC:09:4C:86:E0:36 | 2A:A4:3C:99:2F:C3 | -74 | Unknown | 2016-08-06 14:32:13 | meshlium7b1c | 00:1B:B1:B1:4F:01 | meshlium_6b74 | -85 | Wistron Neweb Corp. | 2016-08-06 14:32:07 | meshlium7b1c | 2A:A4:3C:99:2F:C3 | libelium_wsn2 | -87 | Unknown | 2016-08-06 14:31:51 | meshlium7b1c | 0A:18:D6:63:E5:2C | libelium_wsn2 | -85 | Unknown | 2016-08-06 14:31:50 | meshlium7b1c | 04:F0:21:1B:61:0D | meshlium7b1c | -31 | Compex Systems Pte L | 2016-08-06 14:31:49 | meshlium7b1c | A8:54:B2:92:FE:C5 | meshlium_bcc0 | -72 | Wistron Neweb Corp. | 2016-08-06 14:31:48 | meshlium7b1c | A8:54:B2:9F:46:6E | libelium_AP | -85 | Wistron Neweb Corp. | 2016-08-06 14:31:10 | meshlium7b1c | 0A:18:D6:63:E5:2C | libelium_wsn2 | -84 | Unknown | 2016-08-06 14:31:08 | meshlium7b1c | 04:F0:21:1B:61:0D | meshlium7b1c | -31 | Compex Systems Pte L |
| TimeStamp | MeshliumID | MAC | Device | RSSI | Vendor | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-08-06 14:32:36 | meshlium7b1c | 2A:A4:3C:99:2F:C3 | libelium_wsn2 | -87 | Unknown | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-08-06 14:32:32 | meshlium7b1c | 0A:18:D6:63:E5:2C | libelium_wsn2 | -84 | Unknown | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-08-06 14:32:31 | meshlium7b1c | 04:F0:21:1B:61:0D | meshlium7b1c | -32 | Compex Systems Pte L | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-08-06 14:32:29 | meshlium7b1c | A8:54:B2:92:FE:C5 | meshlium_bcc0 | -72 | Wistron Neweb Corp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-08-06 14:32:29 | meshlium7b1c | A8:54:B2:9F:46:6E | libelium_AP | -86 | Wistron Neweb Corp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-08-06 14:32:24 | meshlium7b1c | DC:09:4C:86:E0:36 | 2A:A4:3C:99:2F:C3 | -74 | Unknown | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-08-06 14:32:13 | meshlium7b1c | 00:1B:B1:B1:4F:01 | meshlium_6b74 | -85 | Wistron Neweb Corp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-08-06 14:32:07 | meshlium7b1c | 2A:A4:3C:99:2F:C3 | libelium_wsn2 | -87 | Unknown | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-08-06 14:31:51 | meshlium7b1c | 0A:18:D6:63:E5:2C | libelium_wsn2 | -85 | Unknown | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-08-06 14:31:50 | meshlium7b1c | 04:F0:21:1B:61:0D | meshlium7b1c | -31 | Compex Systems Pte L | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-08-06 14:31:49 | meshlium7b1c | A8:54:B2:92:FE:C5 | meshlium_bcc0 | -72 | Wistron Neweb Corp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-08-06 14:31:48 | meshlium7b1c | A8:54:B2:9F:46:6E | libelium_AP | -85 | Wistron Neweb Corp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-08-06 14:31:10 | meshlium7b1c | 0A:18:D6:63:E5:2C | libelium_wsn2 | -84 | Unknown | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-08-06 14:31:08 | meshlium7b1c | 04:F0:21:1B:61:0D | meshlium7b1c | -31 | Compex Systems Pte L | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Figure: External database tab

In this tab the user can:

- Setup the parameters of the external database and check the connection.
- Enable or disable the synchronization.
- Show last data inserted in the external database (up to 500 data).
- Show the SQL script used to create the database and table needed for the synchronization.
- Mark all data in the local database as synchronized so it will not be sent to the external database.

The steps to setup the synchronization are:

- Before configuring anything, make sure you have a MySQL database working under your control. Make sure the database listen to connections in an external IP.
- Press the “Show sql script” button, copy the SQL code. You can modify user, password, database name and table, as long as you change the setup of the connection to match.

Just copy and paste:

```
CREATE database MeshliumDB;

CREATE TABLE `wifiScan` (
  `ID_frame` int(11) NOT NULL AUTO_INCREMENT,
  `TimeStamp` timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP,
  `MAC` varchar(17) COLLATE utf8_unicode_ci NOT NULL,
  `SSID` varchar(32) COLLATE utf8_unicode_ci NOT NULL,
  `RSSI` varchar(4) COLLATE utf8_unicode_ci NOT NULL,
  `Vendor` varchar(150) COLLATE utf8_unicode_ci NOT NULL,
  `Type` varchar(45) COLLATE utf8_unicode_ci NOT NULL,
  `AP` varchar(17) COLLATE utf8_unicode_ci NOT NULL,
  `MeshliumID` varchar(150) COLLATE utf8_unicode_ci NOT NULL default 'meshlium'
  PRIMARY KEY (`ID_frame`)
) ENGINE=InnoDB DEFAULT CHARSET=utf8 COLLATE=utf8_unicode_ci AUTO_INCREMENT=1

GRANT ALL PRIVILEGES ON *.* TO root@'%' IDENTIFIED BY 'passw';
```

Figure: SQL script

- Enter the connection settings and press “Save” button. You can check the connection now to ensure the settings are correct.
- Enable the service with the checkbox and save.

The synchronization service runs every 60 seconds and synchronizes up to 200 data every loop. The service synchronizes first newer data, as it is more relevant for decision making. This could make data in external database to be out of order. As every data has a timestamp, this should not be a problem for using the data in any external application.

14.3. Bluetooth Scanner

14.3.1. Concepts

This Bluetooth radio integrated in Meshlium Scanner allows to scan Bluetooth devices in a range of action up to 200m depending on the line of sight conditions.

The idea is to search for Bluetooth devices in a defined interval which can be configured. Meshlium will get the **MAC address**, the **Bluetooth ID** and the **RSSI** of the devices along with a **timestamp** which identifies when the scan was performed. For this reason it is important to set the correct time in the System before starting with the storage of the data. See the Time Synchronization in the System section.

Other interesting parameters the system also detects are the **Class of Device (CoD)** which allows us to differentiate the type of device (smartphone, hands-free, laptop, LAN/Network AP) and the **Vendor** of the Bluetooth devices using its MAC address.

With these parameters we can differentiate among pedestrians and vehicles.

| B ID | Timestamp | MAC | ID | RSSI | CoD | Vendor |
|-------|------------------------------|-------------------|--------|------|------------|-------------------|
| 45400 | 2012-05-16 16:18:12 07:56:25 | 00:26:7e:5f:3c:18 | myCar | -72 | Handsfree | PARROT SA |
| 78005 | 2012-04-20 12:59:27 09:11:26 | D8:2A:7E:0E:C3:10 | Tropic | -85 | Smartphone | Nokia Corporation |

We can configure the Scanning Type which specifies the use of our Bluetooth Scanner:

- Indoor type is recommended to scan static devices or devices with slow movement (offices, malls, etc). This option retrieves device names after about 15 seconds scanning.
- Outdoor type focus on devices which stay a brief period of time in our Bluetooth action range (roads, highways,...). This option does not ask the device name and the scanning period is about 45 seconds.

In both types, there is a second between two consecutive scans.

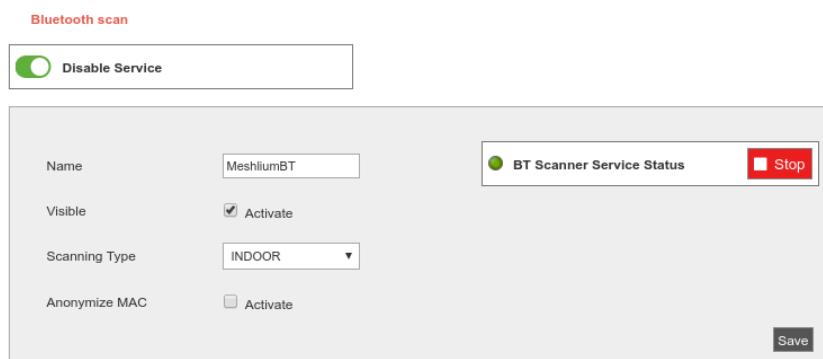


Figure: Configuring Bluetooth Scanner

We can also activate the anonymization of the MAC addresses. This option will store the MAC address encoded with an MD5 hash. The hash will be consistent in the same day, but will change from one day to another. This system allows to follow a particular user in the same day, but keeps the privacy of the user, not storing the real MAC of the device and not allowing to track a user more than one day.

From this section the user can start and stop the service from the button next to the status indicator.

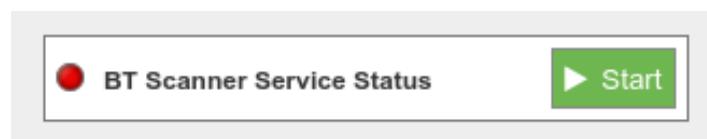


Figure: Bluetooth Scanner was stopped

If the user manually stops the service, it will be automatically relaunched upon reboot. In order to completely disable service, the user have to click on the slider "Disable Service". This will stop the service and avoid it to run upon reboot. Setup cannot be changed when disabled, but already stored data is available to be shown.

To enable the service again, click on the slider "Enable Service".



Figure: Enable and Disable controls

Note: Last versions of Android and iOS devices may need the Bluetooth Setup Screen be activated to be detected.

We have two different storage options for the data captured:

- Local database. This is always active.
- External database. This synchronizes local database data to an external MySQL database.

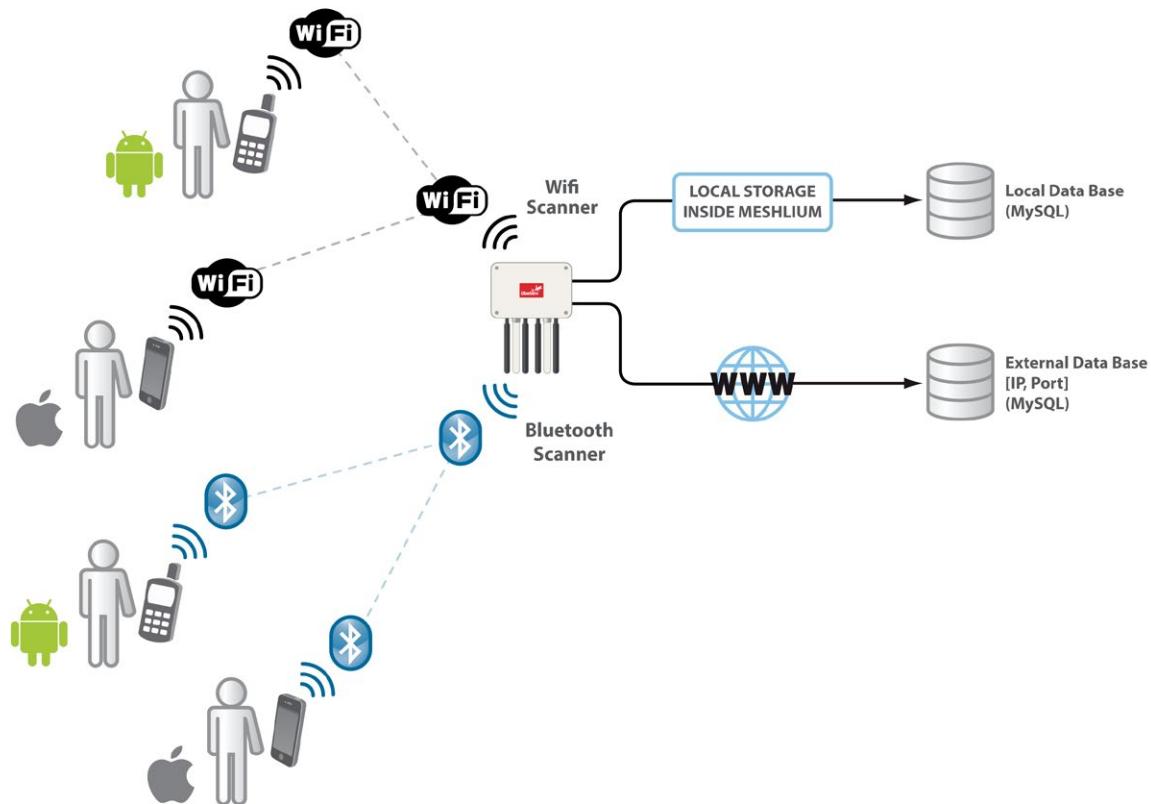


Figure: Bluetooth scan storing options

14.3.2. Local database

Meshlium has a MySQL database up and running which is used to store locally the information captured. In the "Local Data Base" tab you can see the connection parameters.

- Database:** MeshliumDB
- Table:** bluetoothData
- IP:** localhost
- Port:** 3306
- User:** root
- Password:** libelium2007

Captured Data

Local Database
External DataBase

Connection data

Database: MeshliumDB

Table: bluetoothData

IP: localhost

Port: 3306

User: root

Password: libelium2007

Auto-purge

Keep the last days in the database

deleting only synchronized data

deleting all data

Save

Miscellaneous

Computer

Smartphone

LAN/Network AP

Audio/Video

Peripheral

Imaging

Wearable

Toy

Health

Uncategorized

Unknown

Last insertions.

Show data

Delete all data

| TimeStamp | Sync | MAC | Name | RSSI | Vendor | COD |
|---------------------|------|-------------------|--------------|------|--------------------------|-----|
| 2016-10-25 08:55:26 | 0 | c114a7978407bcd86 | k6000_pro | -60 | Unknown | |
| 2016-10-25 08:55:25 | 0 | 6d2686749b76b0d1e | lap-045-0 | -82 | Unknown | |
| 2016-10-25 08:55:22 | 1 | 6591e1af06882362a | | -86 | PARROT S.A. | |
| 2016-10-25 08:55:21 | 1 | cfa9757e46a44047d | wt12-a | -79 | Bluegiga Technologies OY | |
| 2016-10-25 08:55:21 | 1 | ddf85ceeeaa007e7a | | -82 | Logitech Europe SA | |
| 2016-10-25 08:55:21 | 1 | 5740658fb47b74f8e | | -85 | TomTom Software Ltd | |
| 2016-10-25 08:55:19 | 1 | a15afa54658754c71 | deh-4700bt__ | -88 | PIONEER CORPORATION | |
| 2016-10-25 08:55:18 | 1 | 6d2686749b76b0d1e | lap-045-0 | -80 | Unknown | |
| 2016-10-25 08:54:52 | 1 | c114a7978407bcd86 | k6000_pro | -60 | Unknown | |

Figure: Local database for Bluetooth Scanner

At any time you can see the last "x" records stored, filtered by access points or clients. Just set how many and what kind of insertions you want to see and press the "Show data" button. The maximum number of data to display is 500.

The data from the database can be deleted pressing the button "Delete all data". Be careful, as this option deletes all the information of Bluetooth scans in the local database.

There is an option to program an automatic purge in the database every day, keeping the information in the database the days you specify. Furthermore, if you intend to configure the external database, you can choose if you want to delete only synchronized data or everything, taking care of the days established before.

-185-

v7.3

14.3.3. External database

Meshlium can synchronize all the WiFi devices information stored in the local database to an external MySQL database managed by the user.

Captured Data

| Local Database | External DataBase | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|-------------------|-------------|------|--------------------------|---|--------|-----|---------------------|-------------------|-----------|-----|---------|-------------------------------------|---------------------|-------------------|-----------|-----|---------|-----------------------------------|---------------------|-------------------|--|-----|-------------|--------------------------------------|---------------------|-------------------|--------|-----|--------------------------|----------------------------------|---------------------|-------------------|--|-----|--------------------|-------------------------------------|---------------------|-------------------|--|-----|---------------------|---|---------------------|-------------------|-------------|-----|---------------------|--------------------------------------|---------------------|-------------------|-----------|-----|---------|-----------------------------------|---------------------|-------------------|-----------|-----|---------|-------------------------------------|
| <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> Connection data <hr/> <p>Database: MeshliumDB</p> <p>Table: bluetoothData</p> <p>IP: 192.168.2.13</p> <p>Port: 3306</p> <p>User: root</p> <p>Password: libelium2007</p> <hr/> <p><input type="button" value="Save"/> <input type="button" value="Check Connection"/></p> </div> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <input type="checkbox"/> Store frames in the external data base <input type="button" value="Save"/> <hr/> <p><input checked="" type="checkbox"/> Miscellaneous <input checked="" type="checkbox"/> Computer <input checked="" type="checkbox"/> Smartphone <input checked="" type="checkbox"/> LAN/Network AP <input checked="" type="checkbox"/> Audio/Video <input checked="" type="checkbox"/> Peripheral <input checked="" type="checkbox"/> Imaging <input checked="" type="checkbox"/> Wearable <input checked="" type="checkbox"/> Toy <input checked="" type="checkbox"/> Health <input checked="" type="checkbox"/> Uncategorized <input checked="" type="checkbox"/> Unknown</p> <p>Last 100 insertions. (to create database and table)</p> <p><input type="button" value="Show data"/> <input type="button" value="Show sql script"/></p> </div> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; padding: 5px;">TimeStamp</th> <th style="text-align: left; padding: 5px;">MAC</th> <th style="text-align: left; padding: 5px;">Name</th> <th style="text-align: left; padding: 5px;">RSSI</th> <th style="text-align: left; padding: 5px;">Vendor</th> <th style="text-align: left; padding: 5px;">COD</th> </tr> </thead> <tbody> <tr><td>2016-10-25 08:55:26</td><td>c114a7978407bcd86</td><td>k6000_pro</td><td>-60</td><td>Unknown</td><td><input type="checkbox"/> Smartphone</td></tr> <tr><td>2016-10-25 08:55:25</td><td>6d2686749b76b0d1e</td><td>lap-045-0</td><td>-82</td><td>Unknown</td><td><input type="checkbox"/> Computer</td></tr> <tr><td>2016-10-25 08:55:22</td><td>6591e1af06882362a</td><td></td><td>-86</td><td>PARROT S.A.</td><td><input type="checkbox"/> Audio/Video</td></tr> <tr><td>2016-10-25 08:55:21</td><td>cfa9757e46a44047d</td><td>wt12-a</td><td>-79</td><td>Bluegiga Technologies OY</td><td><input type="checkbox"/> Unknown</td></tr> <tr><td>2016-10-25 08:55:21</td><td>cddf85ceeee007e7a</td><td></td><td>-82</td><td>Logitech Europe SA</td><td><input type="checkbox"/> Peripheral</td></tr> <tr><td>2016-10-25 08:55:21</td><td>5740658fb47b74f8e</td><td></td><td>-85</td><td>TomTom Software Ltd</td><td><input type="checkbox"/> LAN/Network AP</td></tr> <tr><td>2016-10-25 08:55:19</td><td>a15afa54658754c71</td><td>deh-4700bt_</td><td>-88</td><td>PIONEER CORPORATION</td><td><input type="checkbox"/> Audio/Video</td></tr> <tr><td>2016-10-25 08:55:18</td><td>6d2686749b76b0d1e</td><td>lap-045-0</td><td>-80</td><td>Unknown</td><td><input type="checkbox"/> Computer</td></tr> <tr><td>2016-10-25 08:54:52</td><td>c114a7978407bcd86</td><td>k6000_pro</td><td>-60</td><td>Unknown</td><td><input type="checkbox"/> Smartphone</td></tr> </tbody> </table> | | TimeStamp | MAC | Name | RSSI | Vendor | COD | 2016-10-25 08:55:26 | c114a7978407bcd86 | k6000_pro | -60 | Unknown | <input type="checkbox"/> Smartphone | 2016-10-25 08:55:25 | 6d2686749b76b0d1e | lap-045-0 | -82 | Unknown | <input type="checkbox"/> Computer | 2016-10-25 08:55:22 | 6591e1af06882362a | | -86 | PARROT S.A. | <input type="checkbox"/> Audio/Video | 2016-10-25 08:55:21 | cfa9757e46a44047d | wt12-a | -79 | Bluegiga Technologies OY | <input type="checkbox"/> Unknown | 2016-10-25 08:55:21 | cddf85ceeee007e7a | | -82 | Logitech Europe SA | <input type="checkbox"/> Peripheral | 2016-10-25 08:55:21 | 5740658fb47b74f8e | | -85 | TomTom Software Ltd | <input type="checkbox"/> LAN/Network AP | 2016-10-25 08:55:19 | a15afa54658754c71 | deh-4700bt_ | -88 | PIONEER CORPORATION | <input type="checkbox"/> Audio/Video | 2016-10-25 08:55:18 | 6d2686749b76b0d1e | lap-045-0 | -80 | Unknown | <input type="checkbox"/> Computer | 2016-10-25 08:54:52 | c114a7978407bcd86 | k6000_pro | -60 | Unknown | <input type="checkbox"/> Smartphone |
| TimeStamp | MAC | Name | RSSI | Vendor | COD | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-10-25 08:55:26 | c114a7978407bcd86 | k6000_pro | -60 | Unknown | <input type="checkbox"/> Smartphone | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-10-25 08:55:25 | 6d2686749b76b0d1e | lap-045-0 | -82 | Unknown | <input type="checkbox"/> Computer | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-10-25 08:55:22 | 6591e1af06882362a | | -86 | PARROT S.A. | <input type="checkbox"/> Audio/Video | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-10-25 08:55:21 | cfa9757e46a44047d | wt12-a | -79 | Bluegiga Technologies OY | <input type="checkbox"/> Unknown | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-10-25 08:55:21 | cddf85ceeee007e7a | | -82 | Logitech Europe SA | <input type="checkbox"/> Peripheral | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-10-25 08:55:21 | 5740658fb47b74f8e | | -85 | TomTom Software Ltd | <input type="checkbox"/> LAN/Network AP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-10-25 08:55:19 | a15afa54658754c71 | deh-4700bt_ | -88 | PIONEER CORPORATION | <input type="checkbox"/> Audio/Video | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016-10-25 08:55:18 | 6d2686749b76b0d1e | lap-045-0 | -80 | Unknown | <input type="checkbox"/> Computer | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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Figure: External database tab

In this tab the user can:

- Setup the parameters of the external database and check the connection.
- Enable or disable the synchronization.
- Show last data inserted in the external database (up to 500 data).
- Show the SQL script used to create the database and table needed for the synchronization.
- Mark all data in the local database as synchronized so it will not be sent to the external database.

The steps to setup the synchronization are:

- Before configuring anything, make sure you have a MySQL database working under your control. Make sure the database listen to connections in an external IP.
- Press the “Show SQL script” button, copy the SQL code. You can modify user, password, database name and table, as long as you change the setup of the connection to match.

```
Just copy paste:  
CREATE database MeshliumDB;  
  
Just copy paste:  
CREATE TABLE IF NOT EXISTS `bluetoothData` (  
    `ID_frame` int(11) NOT NULL auto_increment,  
    `TimeStamp` timestamp NOT NULL default CURRENT_TIMESTAMP,  
    `MAC` varchar(17) collate utf8_unicode_ci NOT NULL,  
    `ID` varchar(30) collate utf8_unicode_ci NOT NULL,  
    `RSSI` varchar(4) collate utf8_unicode_ci NOT NULL,  
    `Vendor` varchar(150) collate utf8_unicode_ci NOT NULL,  
    `cod` varchar(20) collate utf8_unicode_ci NOT NULL,  
    `MeshliumID` varchar(150) COLLATE utf8_unicode_ci NOT NULL default 'meshlium',  
    PRIMARY KEY (`ID_frame`)  
) ENGINE=InnoDB DEFAULT CHARSET=utf8 COLLATE=utf8_unicode_ci AUTO_INCREMENT=1 ;  
  
Just copy paste:  
GRANT ALL PRIVILEGES ON *.* TO root@'%' IDENTIFIED BY 'passw';
```

Figure: SQL script

- Enter the connection settings and press “Save” button. You can check the connection now to ensure the settings are correct.
- Enable the service with the checkbox and save.

The synchronization service runs every 60 seconds and synchronizes up to 200 data every loop. The service synchronizes first newer data, as it is more relevant for decision making. This could make data in external database to be out of order. As every data has a timestamp, this should not be a problem for using the data in any external application.

15. Tools

15.1. Fresnel calculator

The Fresnel Zone is the space which should be empty of objects in a wireless transmission between two points to get the maximum throughput and transmission quality. Here you can find a tool in order to calculate when choosing the right points for your nodes.

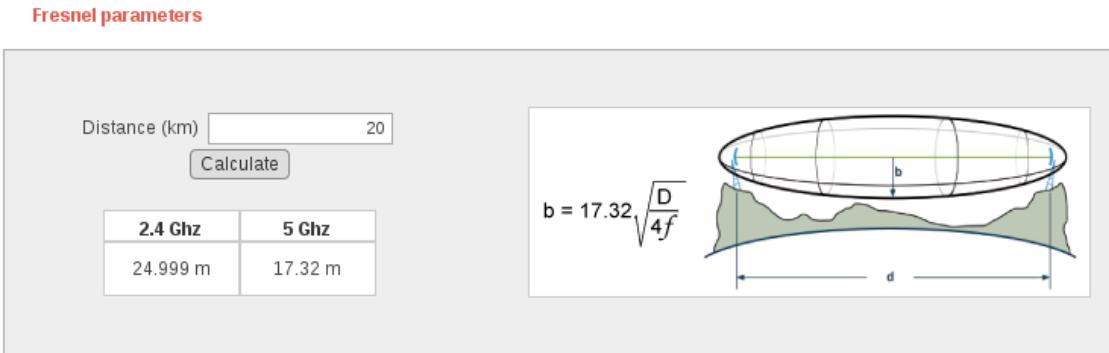


Figure: Fresnel calculator plugin

15.2. Iperf

This tool lets you know the real bandwidth between Meshlium and an iperf server. This plugin uses the correct interface in local networks and uses the default gateway for external networks. The default gateway is 4G/LTE if connected or Ethernet otherwise.

To use the tool, enter the IP address or the host of the iperf server. Iperf v3 is used so ensure the server is compatible with that version.

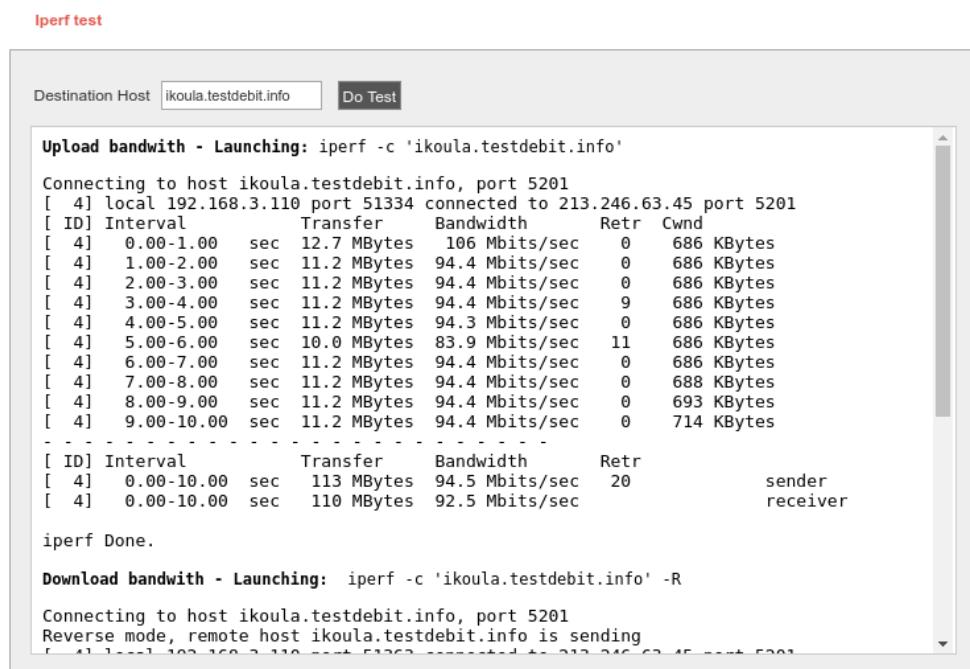


Figure: Iperf plugin

15.3. Ping

It lets you test if you can reach a certain IP or Hostname through a specific network Interface: Ethernet (IPv4), Ethernet (IPv6), WiFi AP, and 4G/LTE.

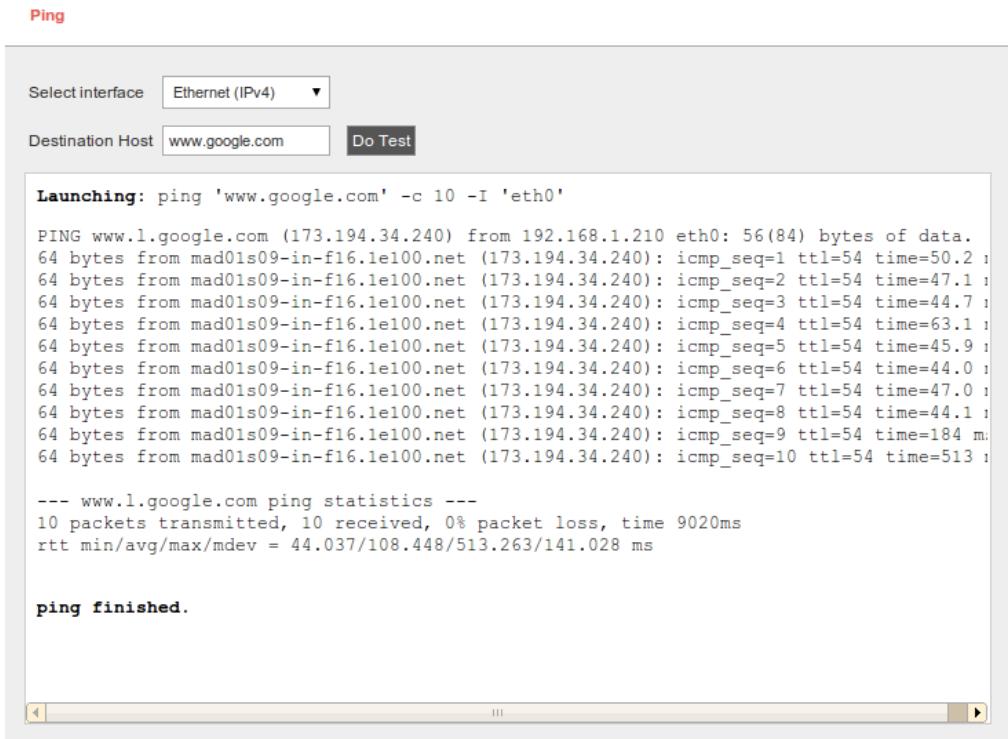


Figure: Ping plugin

Meshlium can also perform this test over IPv6 on Ethernet interface.

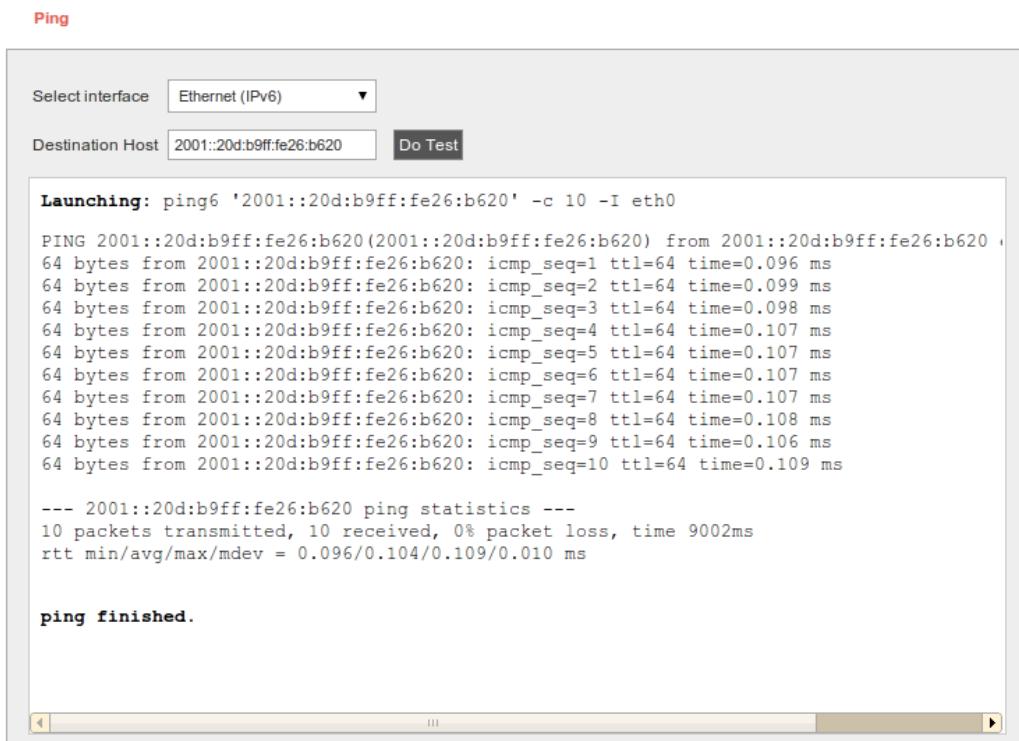


Figure: IPv6 ping

15.4. Traceroute

Another interesting tool to discover the path of the communication between Meshlium and the selected host.

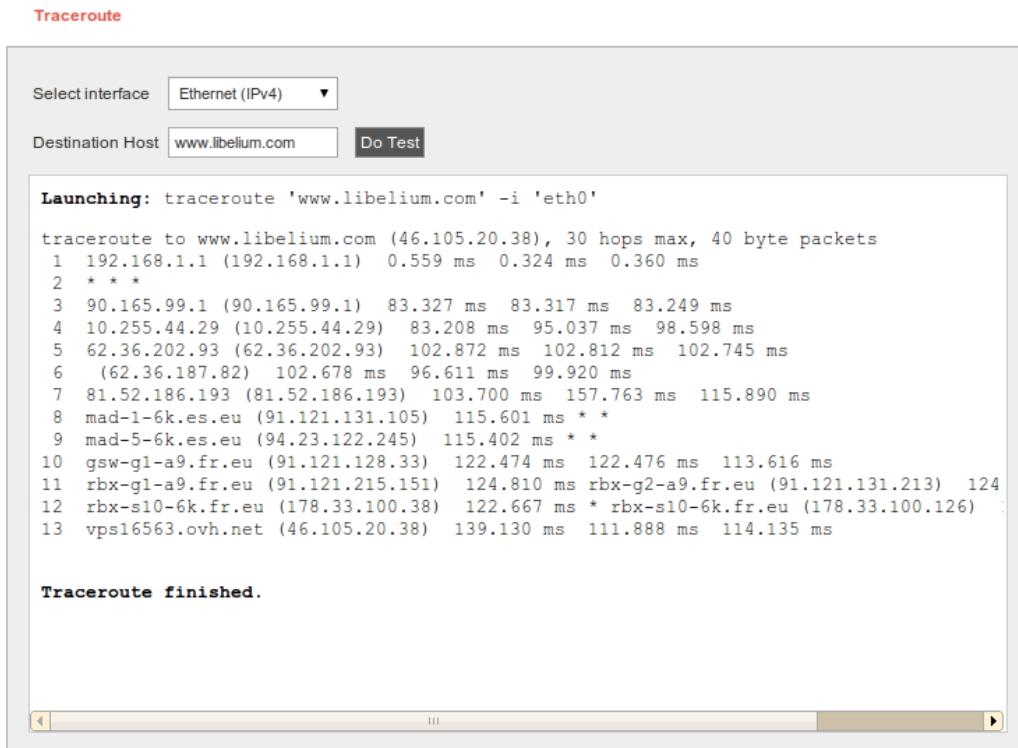


Figure: Traceroute plugin

Meshlium can also perform this test over the Ethernet (IPv6) interface.

15.5. Netstat

Discover which connections IPv4-Port (tcp), and IPv6-Port (tcp6) are active.

| Active Internet connections (servers and established) at Mon, 07 May 12 12:53:31 +0000 | | | | | | |
|--|--------|--------|------------------|---------------------|-------------|------------------|
| Proto | Recv-Q | Send-Q | Local Address | Foreign Address | State | PID/Program name |
| tcp | 0 | 0 | 0.0.0.0:5001 | 0.0.0.0:* | LISTEN | - |
| tcp | 0 | 0 | 0.0.0.0:3306 | 0.0.0.0:* | LISTEN | - |
| tcp | 0 | 0 | 0.0.0.0:111 | 0.0.0.0:* | LISTEN | - |
| tcp | 0 | 0 | 192.168.1.210:80 | 192.168.1.150:43059 | SYN_RECV | - |
| tcp | 0 | 0 | 0.0.0.0:8080 | 0.0.0.0:* | LISTEN | - |
| tcp | 0 | 0 | 0.0.0.0:53 | 0.0.0.0:* | LISTEN | - |
| tcp | 0 | 0 | 0.0.0.0:2006 | 0.0.0.0:* | LISTEN | - |
| tcp | 0 | 0 | 0.0.0.0:22 | 0.0.0.0:* | LISTEN | - |
| tcp | 0 | 0 | 0.0.0.0:1723 | 0.0.0.0:* | LISTEN | - |
| tcp | 0 | 0 | 192.168.1.210:22 | 192.168.1.150:48102 | ESTABLISHED | - |
| tcp | 0 | 0 | 192.168.1.210:22 | 192.168.1.150:48095 | ESTABLISHED | - |
| tcp6 | 0 | 0 | :::80 | :::* | LISTEN | 31743/netstat |
| tcp6 | 0 | 0 | :::53 | :::* | LISTEN | - |
| tcp6 | 0 | 0 | :::22 | :::* | LISTEN | - |
| tcp6 | 0 | 0 | :::443 | :::* | LISTEN | 31743/netstat |
| tcp6 | 0 | 0 | 192.168.1.210:80 | 192.168.1.150:43058 | ESTABLISHED | 31743/netstat |

Figure: Netstat information

15.6. GPS

15.6.1. Concepts

Meshlium can integrate a GPS receiver which allows to know the exact location of the router any time. It is specially interesting for mobile and vehicular applications and when setting long range links as the GPS position also gives information about the height of each point so the Fresnel Zone can be accurately known.

The GPS module gives us information about:

- latitude
- longitude
- height (meters)
- speed (km/h)
- date/time

Data captured from GPS is stored in the local database. In addition, the data can be synchronized to an external MySQL database to be used in other systems.

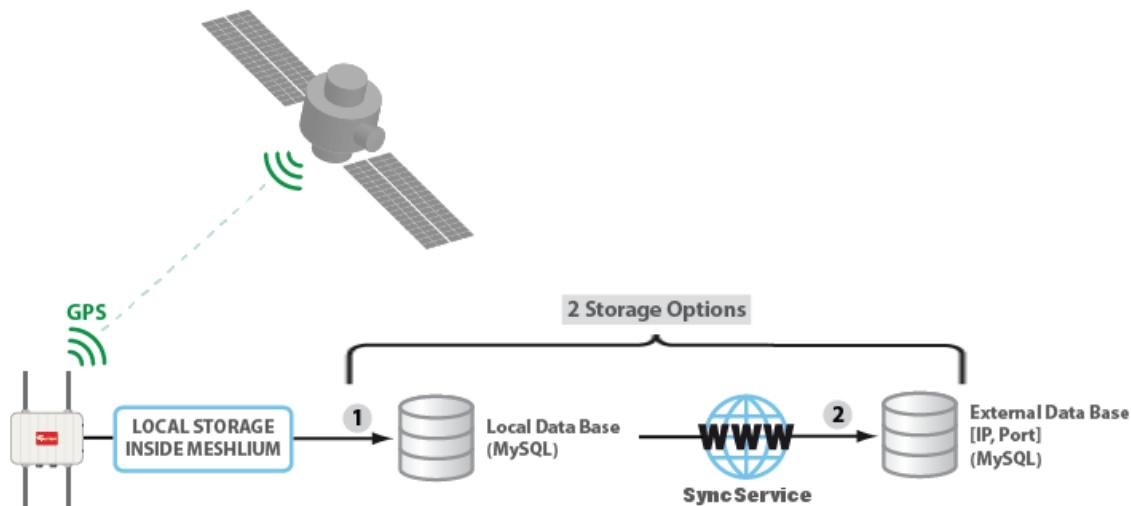


Figure: GPS storage options

15.6.2. Configuring GPS service

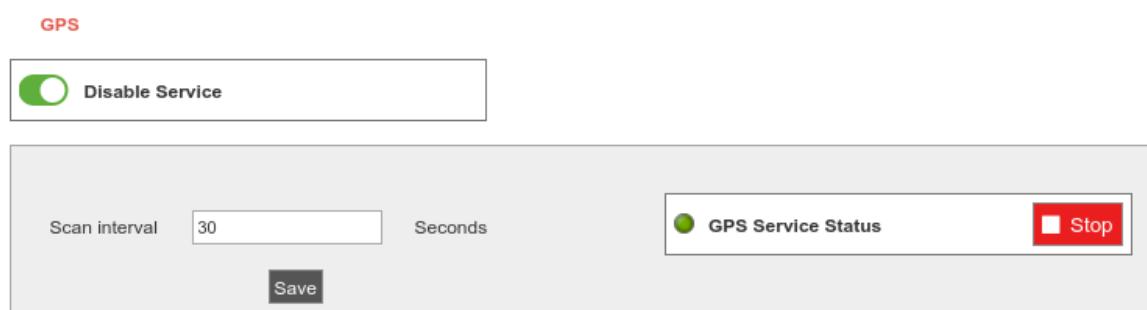


Figure: GPS plugin setup

The GPS service can be enabled or disabled. If the user disables the service the service will be stopped and will not be launched when Meshlium is powered on. In addition, setup will be blocked and cannot be changed. When the service is disabled no GPS information will be read or stored.



Figure: Enable control



Figure: Disable control

The user can set the time interval between data acquisition.

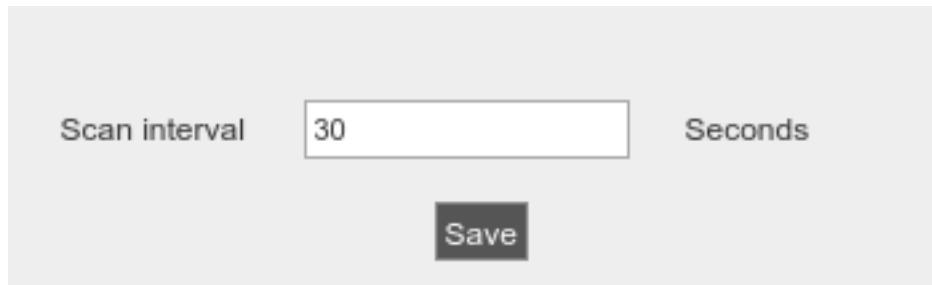


Figure: GPS data read interval

The service can be manually started and stopped.

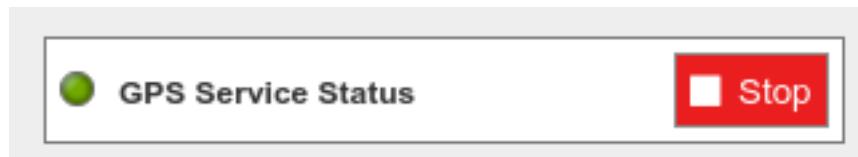


Figure: Service stop button

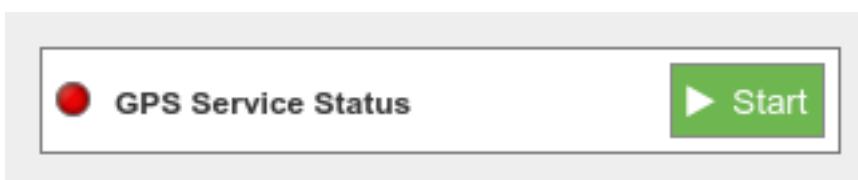


Figure: Service start button

15.6.3. Local database

Meshlium has a MySQL database up and running which is used to store locally the information captured. In the “**Local Data Base**” tab you can see the connection parameters.

A service in Meshlium will read periodically the GPS to gather location and will store it in the local database.

- **Database:** MeshliumDB
- **Table:** gpsData
- **IP:** localhost
- **Port:** 3306
- **User:** root
- **Password:** libelium2007

Captured Data

| Local DataBase | External Database | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|----------------|---------------|-----------|----------|----------|-------|-------|-------------------------|----------------|---------------|---------|--------|-------|-------------------------|----------------|---------------|---------|--------|-------|-------------------------|----------------|---------------|---------|--------|-------|-------------------------|----------------|---------------|---------|--------|-------|-------------------------|----------------|---------------|---------|--------|-------|-------------------------|----------------|---------------|---------|--------|-------|-------------------------|----------------|---------------|---------|--------|-------|-------------------------|----------------|---------------|---------|--------|-------|-------------------------|----------------|---------------|---------|--------|-------|-------------------------|----------------|---------------|---------|--------|
| Connection data <hr/> <p>Database: <input type="text" value="MeshliumDB"/></p> <p>Table: <input type="text" value="gpsData"/></p> <p>IP: <input type="text" value="localhost"/></p> <p>Port: <input type="text" value="3306"/></p> <p>User: <input type="text" value="root"/></p> <p>Password: <input type="password" value="*****"/></p> | <input checked="" type="checkbox"/> Auto-purge Keep the last <input type="text" value="1"/> days in the database <input checked="" type="radio"/> deleting only synchronized data <input type="radio"/> deleting all data <input type="button" value="Save"/> <input type="button" value="Show data"/> Last <input type="text" value="100"/> insertions. (500 Max.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1"> <thead> <tr> <th>ID</th> <th>Timestamp</th> <th>Longitude</th> <th>Latitude</th> <th>Altitude</th> <th>Speed</th> </tr> </thead> <tbody> <tr><td>45372</td><td>2016-08-05 09:24:43 GMT</td><td>00051.432536,W</td><td>4140.145529,N</td><td>201.3 m</td><td>0.0 kn</td></tr> <tr><td>45371</td><td>2016-08-05 09:24:13 GMT</td><td>00051.432495,W</td><td>4140.145510,N</td><td>201.3 m</td><td>0.0 kn</td></tr> <tr><td>45370</td><td>2016-08-05 09:23:43 GMT</td><td>00051.432469,W</td><td>4140.145490,N</td><td>201.5 m</td><td>0.0 kn</td></tr> <tr><td>45369</td><td>2016-08-05 09:23:13 GMT</td><td>00051.432430,W</td><td>4140.145480,N</td><td>201.5 m</td><td>0.0 kn</td></tr> <tr><td>45368</td><td>2016-08-05 09:22:43 GMT</td><td>00051.432421,W</td><td>4140.145470,N</td><td>201.3 m</td><td>0.0 kn</td></tr> <tr><td>45367</td><td>2016-08-05 09:22:13 GMT</td><td>00051.432415,W</td><td>4140.145469,N</td><td>201.4 m</td><td>0.0 kn</td></tr> <tr><td>45366</td><td>2016-08-05 09:21:43 GMT</td><td>00051.432449,W</td><td>4140.145474,N</td><td>201.2 m</td><td>0.0 kn</td></tr> <tr><td>45365</td><td>2016-08-05 09:21:13 GMT</td><td>00051.432459,W</td><td>4140.145478,N</td><td>201.1 m</td><td>0.0 kn</td></tr> <tr><td>45364</td><td>2016-08-05 09:20:43 GMT</td><td>00051.432430,W</td><td>4140.145484,N</td><td>201.1 m</td><td>0.0 kn</td></tr> <tr><td>45363</td><td>2016-08-05 09:20:13 GMT</td><td>00051.432365,W</td><td>4140.145482,N</td><td>201.3 m</td><td>0.0 kn</td></tr> </tbody> </table> | | ID | Timestamp | Longitude | Latitude | Altitude | Speed | 45372 | 2016-08-05 09:24:43 GMT | 00051.432536,W | 4140.145529,N | 201.3 m | 0.0 kn | 45371 | 2016-08-05 09:24:13 GMT | 00051.432495,W | 4140.145510,N | 201.3 m | 0.0 kn | 45370 | 2016-08-05 09:23:43 GMT | 00051.432469,W | 4140.145490,N | 201.5 m | 0.0 kn | 45369 | 2016-08-05 09:23:13 GMT | 00051.432430,W | 4140.145480,N | 201.5 m | 0.0 kn | 45368 | 2016-08-05 09:22:43 GMT | 00051.432421,W | 4140.145470,N | 201.3 m | 0.0 kn | 45367 | 2016-08-05 09:22:13 GMT | 00051.432415,W | 4140.145469,N | 201.4 m | 0.0 kn | 45366 | 2016-08-05 09:21:43 GMT | 00051.432449,W | 4140.145474,N | 201.2 m | 0.0 kn | 45365 | 2016-08-05 09:21:13 GMT | 00051.432459,W | 4140.145478,N | 201.1 m | 0.0 kn | 45364 | 2016-08-05 09:20:43 GMT | 00051.432430,W | 4140.145484,N | 201.1 m | 0.0 kn | 45363 | 2016-08-05 09:20:13 GMT | 00051.432365,W | 4140.145482,N | 201.3 m | 0.0 kn |
| ID | Timestamp | Longitude | Latitude | Altitude | Speed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 45372 | 2016-08-05 09:24:43 GMT | 00051.432536,W | 4140.145529,N | 201.3 m | 0.0 kn | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 45371 | 2016-08-05 09:24:13 GMT | 00051.432495,W | 4140.145510,N | 201.3 m | 0.0 kn | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 45370 | 2016-08-05 09:23:43 GMT | 00051.432469,W | 4140.145490,N | 201.5 m | 0.0 kn | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 45369 | 2016-08-05 09:23:13 GMT | 00051.432430,W | 4140.145480,N | 201.5 m | 0.0 kn | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 45368 | 2016-08-05 09:22:43 GMT | 00051.432421,W | 4140.145470,N | 201.3 m | 0.0 kn | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 45367 | 2016-08-05 09:22:13 GMT | 00051.432415,W | 4140.145469,N | 201.4 m | 0.0 kn | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 45366 | 2016-08-05 09:21:43 GMT | 00051.432449,W | 4140.145474,N | 201.2 m | 0.0 kn | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 45365 | 2016-08-05 09:21:13 GMT | 00051.432459,W | 4140.145478,N | 201.1 m | 0.0 kn | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 45364 | 2016-08-05 09:20:43 GMT | 00051.432430,W | 4140.145484,N | 201.1 m | 0.0 kn | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 45363 | 2016-08-05 09:20:13 GMT | 00051.432365,W | 4140.145482,N | 201.3 m | 0.0 kn | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Figure: Local database for GPS data

At any time you can see the last “x” records stored, filtered by access points or clients. Just set how many and what kind of insertions you want to see and press the “Show data” button. The maximum number of data to display is 500.

The data from the database can be deleted pressing the button “Delete all data”. Be careful, as this option deletes all the information of Bluetooth scans in the local database.

There is an option to program an automatic purge in the database every day, keeping the information in the database the days you specify. Furthermore, if you intend to configure the external database, you can choose if you want to delete only synchronized data or everything, taking care of the days established before.

15.6.4. External database

Meshlium can synchronize all the WiFi devices information stored in the local database to an external MySQL database managed by the user.

| ID | Date | Longitude | Latitude | Altitude | Speed |
|-------|-------------------------|----------------|---------------|----------|--------|
| 78812 | 2016-08-05 09:24:13 GMT | 00051.432495,W | 4140.145510,N | 201.3 m | 0.0 kn |
| 78811 | 2016-08-05 09:24:43 GMT | 00051.432536,W | 4140.145529,N | 201.3 m | 0.0 kn |
| 78810 | 2016-08-05 09:23:13 GMT | 00051.432430,W | 4140.145480,N | 201.5 m | 0.0 kn |
| 78809 | 2016-08-05 09:23:43 GMT | 00051.432469,W | 4140.145490,N | 201.5 m | 0.0 kn |
| 78808 | 2016-08-05 09:22:13 GMT | 00051.432415,W | 4140.145469,N | 201.4 m | 0.0 kn |
| 78807 | 2016-08-05 09:22:43 GMT | 00051.432421,W | 4140.145470,N | 201.3 m | 0.0 kn |
| 78806 | 2016-08-05 09:21:13 GMT | 00051.432459,W | 4140.145478,N | 201.1 m | 0.0 kn |
| 78805 | 2016-08-05 09:21:43 GMT | 00051.432449,W | 4140.145474,N | 201.2 m | 0.0 kn |
| 78804 | 2016-08-05 09:20:13 GMT | 00051.432365,W | 4140.145482,N | 201.3 m | 0.0 kn |
| 78803 | 2016-08-05 09:20:43 GMT | 00051.432430,W | 4140.145484,N | 201.1 m | 0.0 kn |

Figure: External database tab

In this tab the user can:

- Setup the parameters of the external database and check the connection.
- Enable or disable the synchronization.
- Show last data inserted in the external database (up to 500 data).
- Show the SQL script used to create the database and table needed for the synchronization.
- Mark all data in the local database as synchronized so it will not be sent to the external database.

The steps to setup the synchronization are:

- Before configuring anything, make sure you have a MySQL database working under your control. Make sure the database listen to connections in an external IP.
- Press the "Show sql script" button, copy the SQL code. You can modify user, password, database name and table, as long as you change the setup of the connection to match.

```
Just copy and paste:  
CREATE database MeshliumDB;  
  
CREATE TABLE IF NOT EXISTS `gpsData` (  
  `ID_frame` int(11) NOT NULL auto_increment,  
  `TimeStamp` timestamp NOT NULL default CURRENT_TIMESTAMP,  
  `date` DATETIME NOT NULL,  
  `longitude` text collate utf8_unicode_ci NOT NULL,  
  `latitude` text collate utf8_unicode_ci NOT NULL,  
  `altitude` text collate utf8_unicode_ci NOT NULL,  
  `satellites` int(11) NOT NULL,  
  `speed` text collate utf8_unicode_ci NOT NULL,  
  `MeshliumID` varchar(150) COLLATE utf8_unicode_ci NOT NULL default 'meshlium',  
  PRIMARY KEY (`ID_frame`)  
) ENGINE=MyISAM DEFAULT CHARSET=utf8 COLLATE=utf8_unicode_ci AUTO_INCREMENT=1 ;  
  
GRANT ALL PRIVILEGES ON *.* TO root@'%' IDENTIFIED BY 'passw';
```

Figure: SQL script

- Enter the connection settings and press “Save” button. You can check the connection now to ensure the settings are correct.
- Enable the service with the checkbox and save.

The synchronization service runs every 60 seconds and synchronizes up to 200 data every loop. The service synchronizes first newer data, as it is more relevant for decision making. This could make data in external database to be out of order. As every data has a timestamp, this should not be a problem for using the data in any external application.

15.7. Beep

When configuring several Meshlium at the same time in the laboratory, it can be difficult to distinguish between them (specially when the IP addresses are given by a external DHCP router). For this reason we have added a **Beep** button in the **Tools** section which will make the current Meshlium emit a short sound (“beep!”).



Figure: Beep plugin

16. Database management

16.1. Direct access

In order to access to the Meshlium Database from an external application you have to use the next parameters:

- **IP:**
 - **WiFi:** 10.10.10.1
 - **Ethernet:** Depending on your DHCP server (You can specify a static IP in the Interfaces section). 192.168.1.100 (if there is no DHCP server).
- **Database:** MeshliumDB.
- **Table:** Depending on the data to be extracted. Some options are: sensorParser, bluetoothData, gpsData, wifiScan. You can list the tables of the database.
- **Port:** 3306
- **User:** root
- **Password:** libelium2007

You can use any management MySQL application like MySQL Workbench or SQLYog to access the database in Meshlium and perform any maintenance operation.

16.2. PhpMyAdmin

Meshlium has a built in PhpMyAdmin instance that allow local database management. Go to:

Tools → phpMyAdmin

Click on “Open in a new window” to open the phpMyAdmin panel.

You can directly access phpMyAdmin panel in the URL:

[http://\[Meshlium_IP\]/phpmyadmin](http://[Meshlium_IP]/phpmyadmin)

Where [Meshlium_IP] has to be replaced for the IP used in Meshlium. It can be WiFi AP, Ethernet or 4G IP.

To login, use the credential shown in the section “Direct access”.

Bienvenido a phpMyAdmin

Idioma - Language

Español - Spanish

Iniciar sesión

Usuario: root

Contraseña:

Continuar

Figure: phpMyAdmin login page

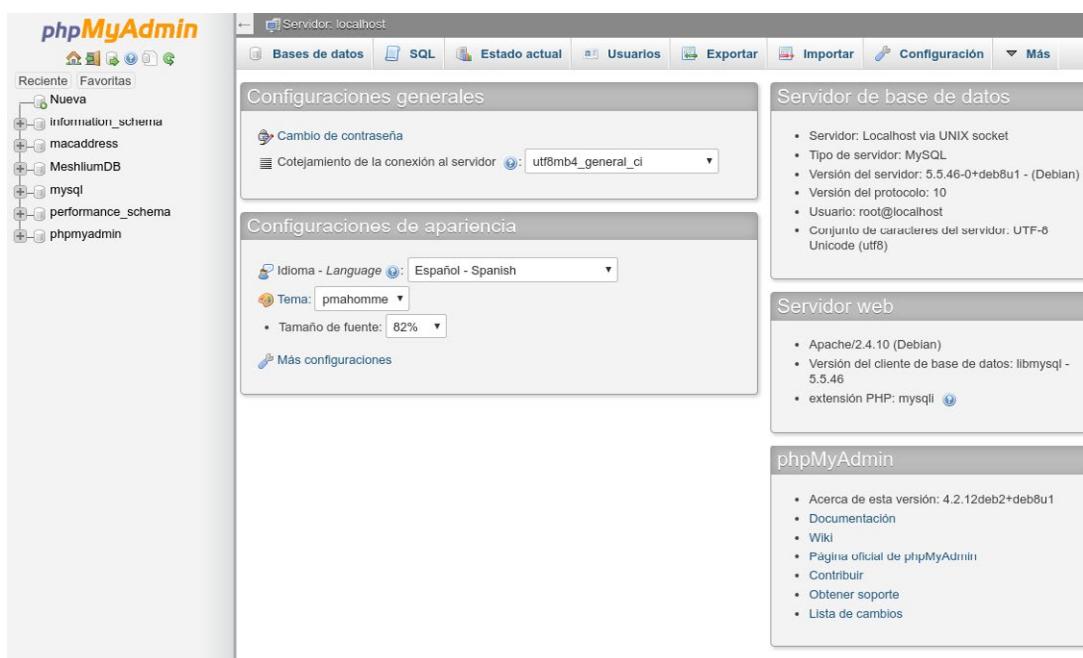


Figure: phpMyAdmin panel

17. System Information

17.1. Hostname

This plugin allow the user to change the hostname of the gateway. By default the name is “meshliumXXXX” where XXXX are the last four digits of Ethernet MAC address.

To change the hostname, enter the desired value and press “Save and Apply” button.

Hostname

Meshlium's hostname **Save And Apply**

Figure: Hostname change form

17.2. Password management

The “Users Manager” section is a plugin that allows to change the password needed to access to the Manager System. The user is always “admin”. To change it press “Change Password” button, introduce and confirm new password and press “Ok”. You can abort operation pressing “Cancel”.

Users Manager

Name
admin **Change Password**

Figure: Password change form

Users Manager

Name
admin
Password Confirm password **Ok** **Cancel**

Figure: Introduce new password

17.3. Disk usage

This plugin offers a graphical board to see the amount of disk being used in each partition.

The most important partition is /dev/sda2 which is mounted in the "/mnt/user" folder. All the data captured (XBee, Scanner, GPS) is stored in this partition. This partition also stores the logs of all the services.

Disk usage

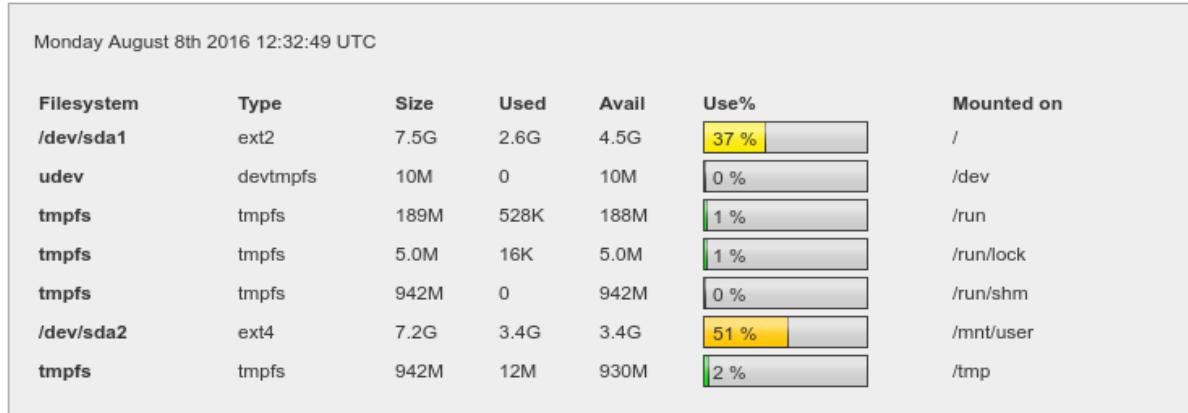


Figure: Disk usage plugin

17.4. Internal temperature sensor

In this plugin the user can see in real time the processor temperature in Celsius degree.

Meshlium Sensors

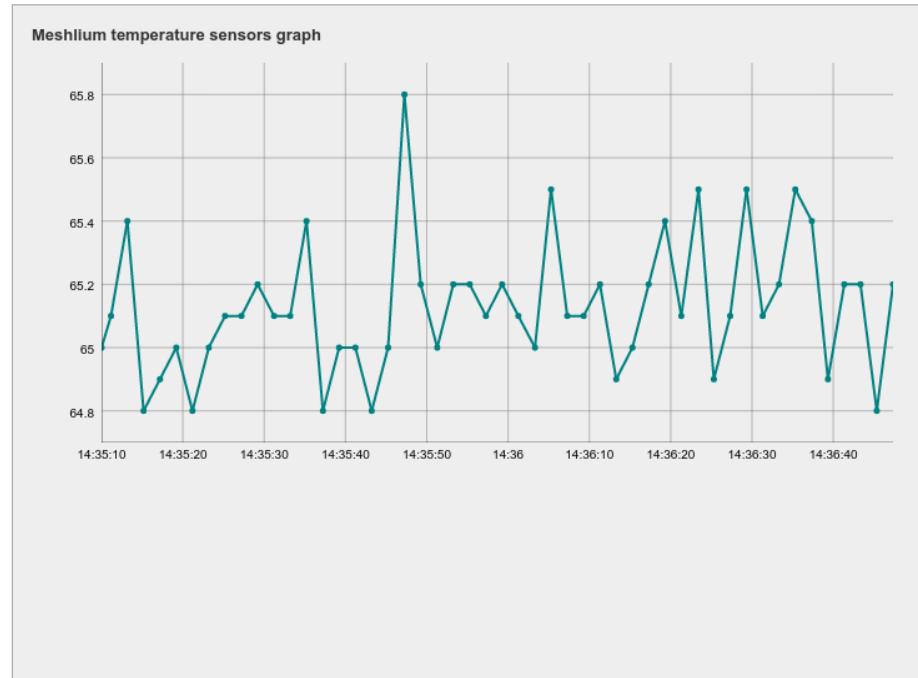


Figure: Temperature Sensors plugin

A temperature above 70 °C is considered high and a temperature above 100 °C could be dangerous for the device.

17.5. Time synchronization

In order to store correctly in the file system and in the local database the data captured from the RF modules and scanner is important to previously set the system time.

Time synchronization

Monday August 8th 2016 12:38:29 UTC

Date and hour for meshlium

Current: 2016 ▾ Current: Augu ▾ 07 11 Current: 38 ▾ Current:GMT ▾ Set

Synchronize with ntp server

pool.ntp.org Sync



Figure: Time Synchronization plugin

The plugin allow the user to set the time, manually selecting the time from the selectors and setting the timezone. Press the "Set" button to apply the time selected.

Date and hour for meshlium

Current: 2016 ▾ Current: Augu ▾ 07 11 Current: 38 ▾ Current:GMT ▾ Set



Figure: Manually selecting time and timezone

In the plugin, the user can use too an NTP server to perform a synchronization. This option runs a one-time synchronization but does not activate any service for continuous synchronization. To perform the synchronization fill the NTP server address (by default "pool.ntp.org") and press "Sync" button.

Synchronize with ntp server

pool.ntp.org Sync

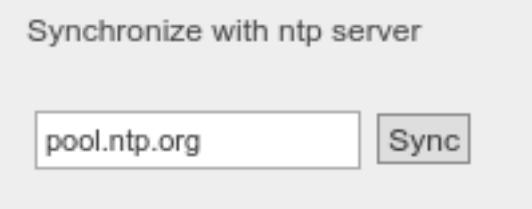


Figure: NTP synchronization

18. Upgrading Meshlium

In the updates plugin, the user can install new Manager System versions. To get to the plugin go to:

Update Manager → Install Updates

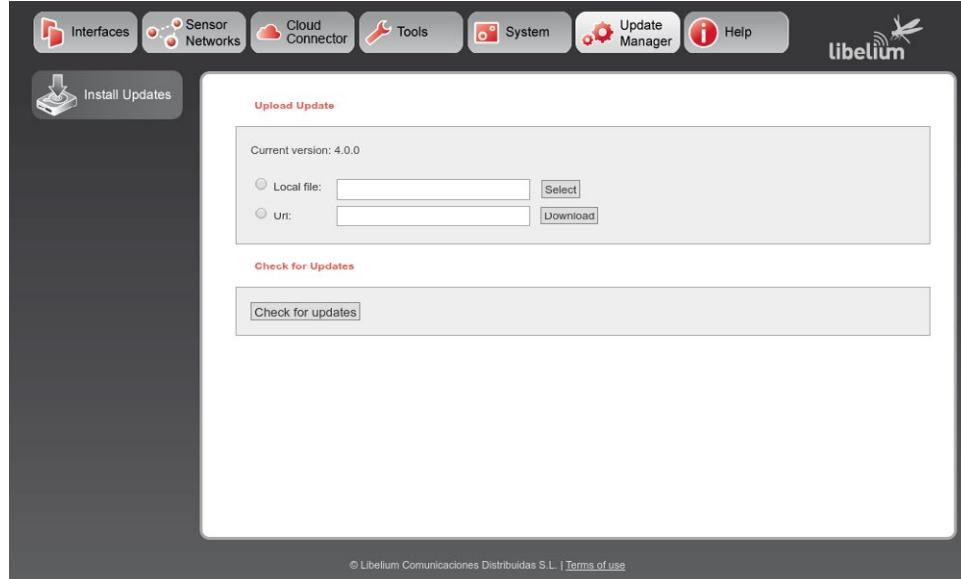


Figure: Install Updates plugin

There are three ways to install updates:

- Check Libelium repository for official updates
- Load the update file from a local computer
- Load the update file from an URL

18.1. Checking for updates

In order to use this feature Meshlium needs to be connected to the Internet and with access to Libelium web page. Given so, press the "Check for updates" button to access the Libelium repository and search for new versions.

If there are new versions, the plugin will display the changelog of every version and will show an "Update" button. This button will download and install ALL the pending updates in one step, always letting Meshlium with the latest version available.

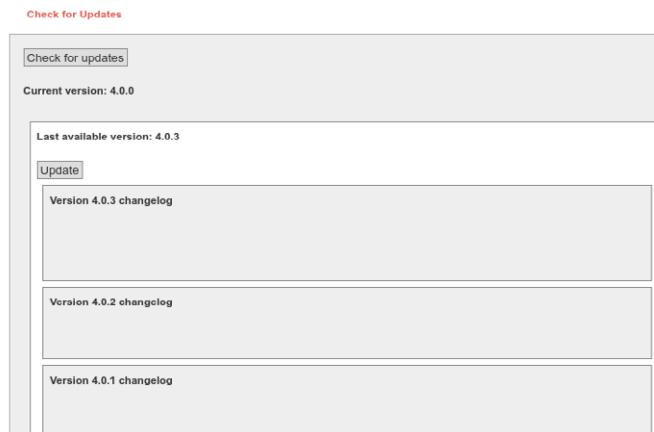


Figure: Updates found

Meshlium will reboot after installing the updates.

18.2. Local file

Meshlium allows to load updates offline, manually uploading the file from a PC. In order to do so, download the update file and upload it to Meshlium selecting the “Local File” checkbox and pressing “Select” button. Browse the file in your PC and upload it pressing “Upload” button.



Figure: Selecting an update file

The system will check the file and if it is a valid update file it will show the file and the button “Install Update”.

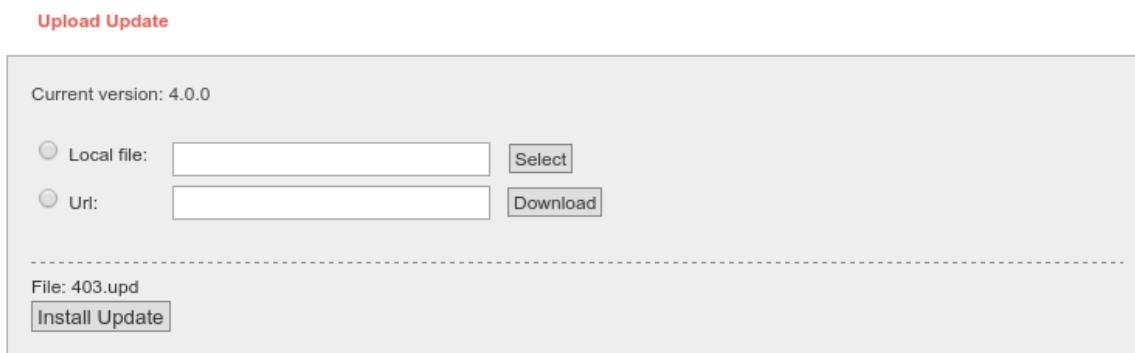


Figure: Install update

Pressing “Install Update” will install the update and reboot Meshlium.

Considerations: You have to finish the installation of a previous package in order to install the next one. If you upload a new package without installing the previous one it will be removed.

Some updates can download big files from the Internet instead of packing them inside the update file. Ask Libelium support for complete update files if this is stated in the update log.

All the updates must be applied in order, and in any case, all the updates must follow the sequence number. For example, do not install 4.0.3 version without installing before 4.0.2.

Warning: *Install only update files provided by Libelium. Any damage on the software caused by any update file not provided by Libelium will not be covered by warranty terms.*

18.3. URL

Update files can be side loaded through an URL. Enter the URL of the update file in the form and press "Download" button. The system will download the file and check if it is a valid update.

The screenshot shows a configuration page for upgrading Meshlium. At the top, it displays the current version as "4.0.0". Below this, there are two options: "Local file:" with a "Select" button and "Url:" with a text input field containing "http://192.168.1.68/403 upd". A "Download" button is located next to the URL input. A dashed line separates this from the bottom section. The bottom section shows the file path "File: 403.upd" and an "Install Update" button.

Figure: Enter the URL of the file

If so, it will show the file and the "Install Update" button. Press "Install Update" button to perform the update. Meshlium will reboot after finishing the update process.

19. Rescue System

The Rescue System allows the user to return Meshlium to factory defaults. After applying the rescue, the device will be formatted and the disk will be left as it was brand new.

The rescue process is recommended when:

- The operating system is corrupt or malfunctioning
- The device has been wrongly setup and it is unreachable
- The device needs to be recovered after an unexpected error

The rescue process is not covered by warranty as described in the section "Important: read me before using". and must be considered an emergency process. This process is intended to help the user to recover the device of software issues without having to send Meshlium to the technical support service.

Important:

Executing the rescue process will delete all the user information stored in Meshlium including sensor information stored in the internal database.

The rescue process can potentially damage the device and leave it unusable.

The rescue process may not work if the file system is severely damaged.

19.1. Rescue steps

You will need a USB pen drive of at least 8 GB.

The first thing to do is download from the website of Libelium the image file "meshliumrescue.iso" needed to restore Meshlium to factory defaults.

Note: You need to contact first our Technical Service Department in order to get the user and password and URL to download the image.

Go to <https://www.libelium.com/contact/#RMA>.

Once the file has downloaded, you must burn it in a USB pen drive. To perform this operation we recommend the use of **unetbootin**.

Unetbootin is a freeware and multiplatform application that allows to create bootable USB pendrives. It can be installed easily in Windows, Linux and MacOS machines.

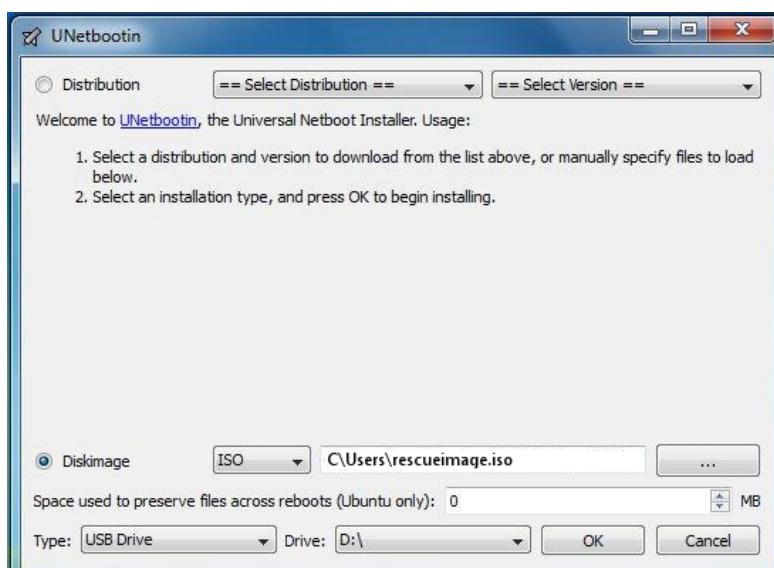


Figure: unetbootin interface

To create the rescue you have to:

- Start **unetbootin** and select the option "Diskimage"
- Select the iso of the rescue image in the file selector
- Select the USB unit where the image will be written
- Click "OK" button to start the process

In some minutes the image will be written and the USB will be ready to use.

To apply the rescue in Meshlium:

- Power off the device
- Plug the USB pendrive in the micro-USB connector through a USB-OTG cable



Figure: USB pendrive connected to Meshlium

- Power on the device
- When the rescue starts, Meshlium will emit a beep. The process can take a few minutes, so be patient.
- When the rescue process finishes, Meshlium will emit several beeps to notify
- Power off Meshlium and unplug the USB pendrive
- Your Meshlium should be now in a default state. It can be powered on now. The user can access Manager System with default credentials and start the setup fresh and use Meshlium normally.

20. Expansion port

Meshlium includes an expansion port with some extra connectivity options. It includes access to a UART, an I²C bus and a USB port.

This port is available for development purposes.

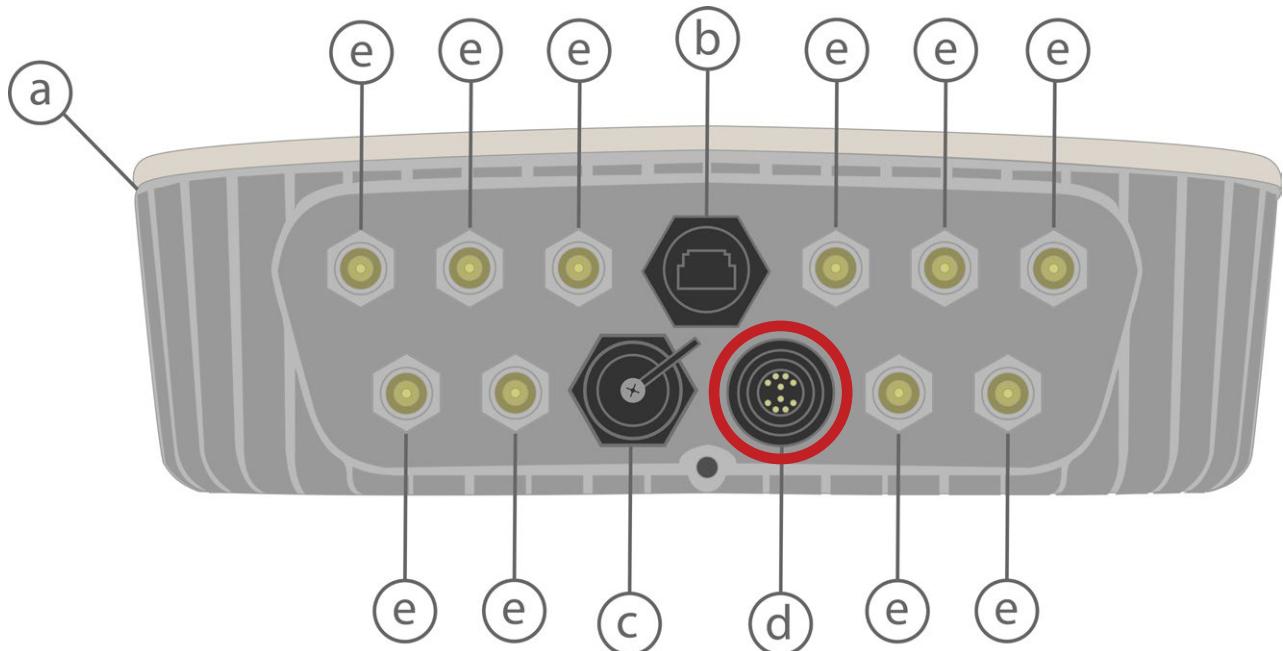


Figure: Meshlium expansion port

21. Manager System changelog

Version 4.0.4

- Added new menu "Devices"
- Added Axis device plugin
- Added new menu "Activity Monitor" for replacing "Disk Usage"
- Added option to change log level in Sensor Parser
- Allowed more characters for parameters in Bluetooth and WiFi Scanner
- Added SSL support in the ThingWorx cloud connector
- Now Azure cloud connector shows logs
- Corrected bug on list of sensors: use wrong sensor list
- Corrected bug on ThingPlus cloud connector: error at start time
- Removed Devicify cloud connector

Version 4.0.3

- Dynamic DNS configuration added with NolP2 agent
- Added new cloud plugins: Ericsson, infiswift, PlasmaComp, Redd System
- Updated cloud connectors: Azure Hub, Bluemix
- Augmented default log level in all the cloud plugins
- Corrected 4G connection bugs
- Corrected WiFiScan bug detection empty

Version 4.0.2

- Added support for new protocol Device to Cloud
- New cloud distribution: premium, advanced, basic
- Added new cloud connectors: Arrow, Haibu, Qmic
- Updated cloud plugins: Amazon, ElementBlue
- Removed deprecated plugin Microsoft Azure Service Bus
- Added a check process on the file system after system reboot
- Show Wifi scan results on visualizations
- Updated sensor list for v15
- Several minor stability and interface updates incorporated

Version 4.0.1

- Added new cloud connectors:
 - Cumulocity
 - Kii
 - Nemachina
 - RedTone
 - SmartPlants
 - TechEdge(SAP)

Version 4.0.0

- Network setup reviewed
- Added “disable/enable” control to main services
- Added compatibility with several radio modules
- Added Auto-purge to sensor, Bluetooth scanner, WiFi scanner and GPS data
- Cellular connection mechanism improved
- Added Azure IoT Hub cloud connector
- Update process improved. No reboot between updates needed.
- Added option to synchronize with NTP server
- Improved speed and stability

22. Documentation changelog

From v7.2 to v7.3

- Added the new chapter “Device connectors”
- Added new device connector for Axis

From v7.1 to v7.2

- Added new cloud connectors: Arrow (Arrow Connect), Ericsson (Ericsson ApploT), Haibu (HaibuSmart), infiswift, PlasmaComp (C2M), Qmic-NexMachina (Labeeb), Redd System (Redd)
- Updated cloud connectors classification
- Added notes for NoIP config in the “Interfaces” menu

From v7.0 to v7.1

- Added new cloud connectors: BaseN, Cumulocity, Ensura, Kii, Orchestra, Microsoft Azure IoT Hub, Nexmachina, RedTone, SensorUP, SmartCityPlatform, SmartPlants, TechEdge SAP HANA, Telit
- Updated cloud connectors: Amazon IoT, Microsoft Azure Event Hubs, MQTT, Sentilo
- Updated antenna position in section “Contents of the box”
- Added Bluetooth radio specifications in section “Specifications”
- Removed SolvView cloud connector

23. Certifications

23.1. General overview

| Products | Europe | US | Canada | Australia | Brazil |
|--------------------------------|--------|--------------------|--------|-----------|--------|
| Meshlium 4G 802.15.4 AP 868 EU | CE | - | - | - | - |
| Meshlium 4G 802.15.4 AP 900 US | - | FCC / PTCRB / AT&T | IC | - | - |
| Meshlium 4G 802.15.4 AP 900 AU | - | - | - | RCM | - |
| Meshlium 4G 802.15.4 AP 900 BR | - | - | - | - | ANATEL |

23.2. CE (Europe)

Compliance with regulations:

- Electromagnetic Compatibility: EN 301 489-1 (1.9.2) / -17 (2.2.1) / -24 (1.5.1), EN 55022 (2010)
- Electrical Security: EN 60950-1 (2006) + A11 (2009) + A1 (2010) + A12 (2011) + Ac (2011) + A2 (2013) (except appendix Zx)

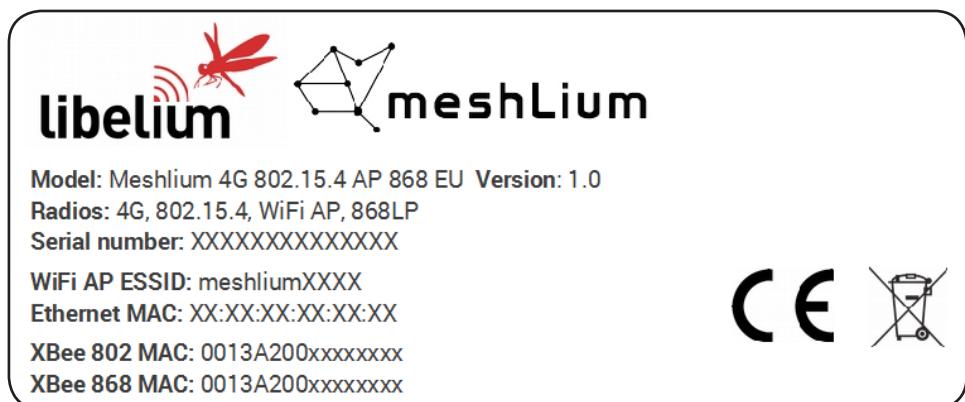


Figure: Back sticker for Meshlium 4G 802.15.4 AP 868 EU

23.3. FCC (USA)

This document applies to the following Meshlium models:

| Model | FCC ID |
|--------------------------------|-----------------|
| Meshlium 4G 802.15.4 AP 900 US | XKM-MESHLIUM-V1 |

Compliance with regulations:

- Electromagnetic Compatibility: FCC Part 15B ed.10.1.13
- Radiofrequency (radiated spurious): FCC Part 15.247 (2013) + CFR 47 Part 15.247 (2013) + FCC Part 22 (2014) + FCC Part 24 (2014) + FCC Part 27 (2014)

PTCRB compliance:

- Radiated Spurious Emissions: 3GPP TS 51.010-1 (s.12.2.x) + 3GPP TS 36.124 (s.8.2)
 - Bands: LTE FDD2, FDD4, FDD5, FDD17, 2G 900/1800
- OTA: CTIA Test Plan for Mobile Station OTA Performance v3.3.2 + AT&T document 13340, version 5.6 - Device Requirements.
 - Bands: LTE FDD2, FDD4, FDD5, FDD17, 2G 900/1800
 - Measures: TRP / TIS / ICS
- SIM electrical ETSI TS 102 230 (s. 5.x)

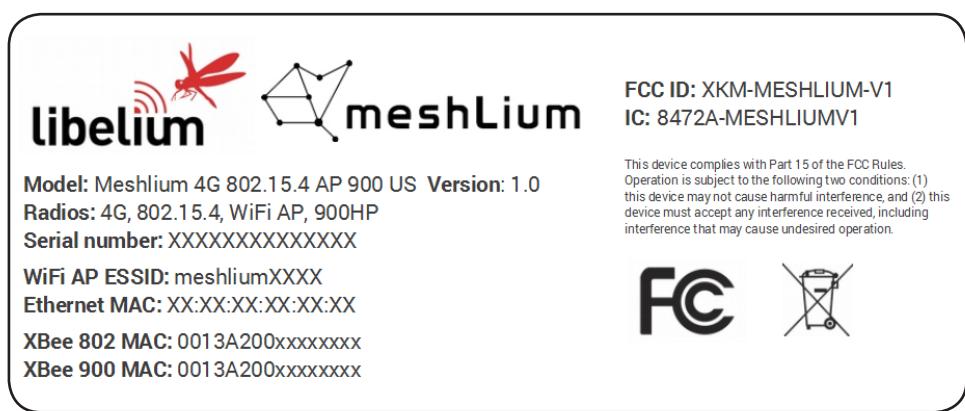


Figure: Back sticker for Meshlium 4G 802.15.4 AP 900 US

23.4. IC (Canada)

This document applies to the following Meshlium models:

| Model | IC ID |
|--------------------------------|------------------|
| Meshlium 4G 802.15.4 AP 900 US | 8472A-MESHLIUMV1 |

IC

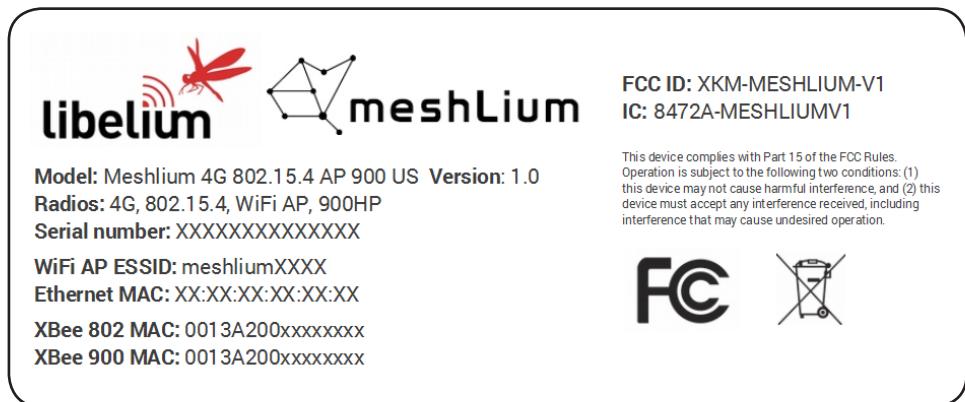


Figure: Back sticker for Meshlium 4G 802.15.4 AP 900 US

23.5. ANATEL (Brazil)

ANATEL

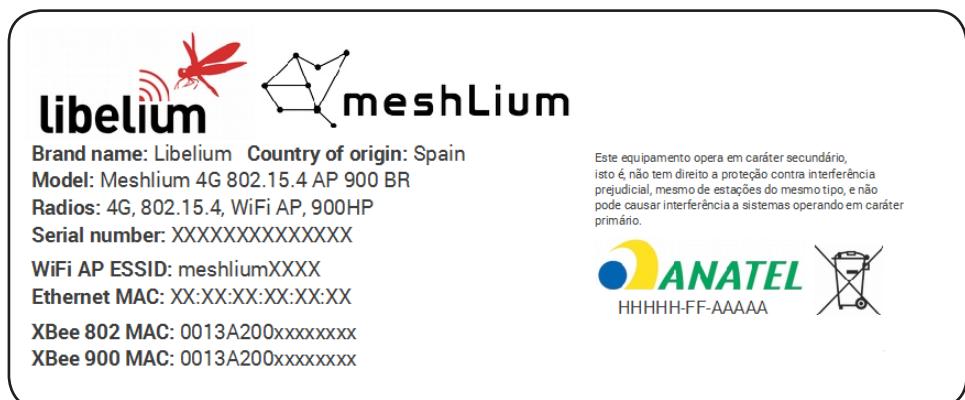


Figure: Back sticker for Meshlium 4G 802.15.4 AP 900 BR

23.6. RCM (Australia)

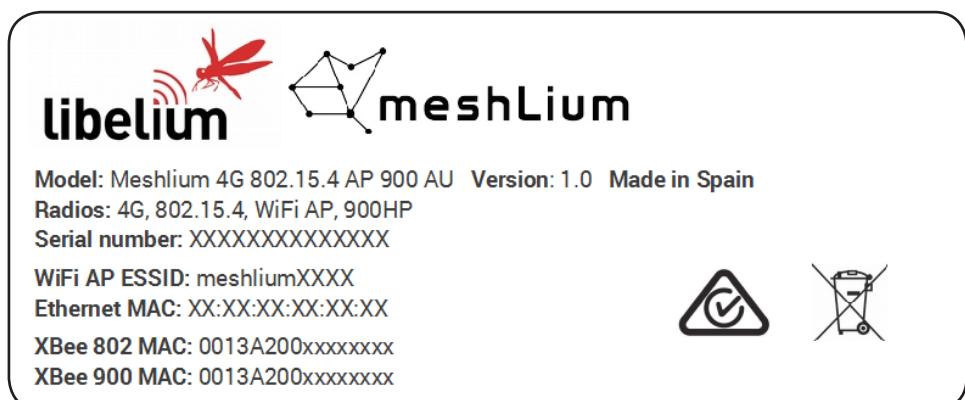


Figure: Back sticker for Meshlium 4G 802.15.4 AP 900 AU

24. Maintenance

- Although Meshlium is a highly resistant product (IP65), please handle with care in order to enjoy a longer life of the product.
- Handle Meshlium with care, do not allow it to drop or move roughly.
- Avoid placing the devices in areas reaching very high temperatures that could damage the electronic components.
- The antennas screw on gently to the connector, do not force them while installing or you could damage the connectors.
- Do not use any type of paint on the device, it could affect the operation of connections and closing mechanisms.
- Power accessories must only be used indoors.
- Do not store Meshlium in places exposed to dirt and dust in order to avoid damage to electronic components.
- Never open the casing, the guarantee will not cover products that have been opened.
- For cleaning, use a damp cloth, do not use aggressive chemical products.

25. Disposal and recycling

When Meshlium reaches the end of its useful life it must be taken to a recycling point for electronic equipment.

- The equipment should be disposed of separately from solid urban waste, please dispose of correctly.
- Your distributor will advise you on the most appropriate and environmentally-friendly way of disposing of the product and its packing.

