3.6. Virtual Sensor Probes

The Virtual sensor probes are devices that can be plugged into the Libelium One main node and emulate the performance of a specific sensor in the Libelium Ecosystem. Virtual sensor probes act just like any other One probe in terms of compatibility with any One main node, other One probes and Libelium Cloud.

The aim of this is to demonstrate how easy the Libelium One platform can send data to the Libelium Cloud without investing money in professional sensors. This is particularly useful for quick demos and PoCs with clients.

Note that this type of probes do not have any real sensors connected so the value given by any virtual sensor probe has nothing to do with the real environment conditions. Despite this, the virtual sensor probe emulation system is unique and capable of matching features such as variance, range and frequency of the emulated sensor values.

Finally, there are three real sensors emulated by the corresponding virtual sensor probe available at this moment, which are the **Teros 12**, the **MaxiMet GMX-240** and the **NTU**.

Virtual Sensor Probes

4. Accessories

The Libelium One main node has some accessories to adapt the node to the most typical installation scenarios.

4.1.   Installation accessory

This accessory allows an easy and quick installation on walls or poles by using a few screws or cable ties. It comes **by default** with every Libelium One node. Refer to the installation section for deeper instructions about how to install it.

Installation accessory

Two metal cable ties are included for pole mount.

Metal cable ties

4.2.   One USB power cable

The USB power cable is used to power the node from a standard USB port. A generic USB wall adapter (not included) could be used for this purpose.

Power cable connected to a generic wall adapter (not included)

However, remember that only the node side of the cable is waterproof. The USB side must be protected if it is installed outdoors.
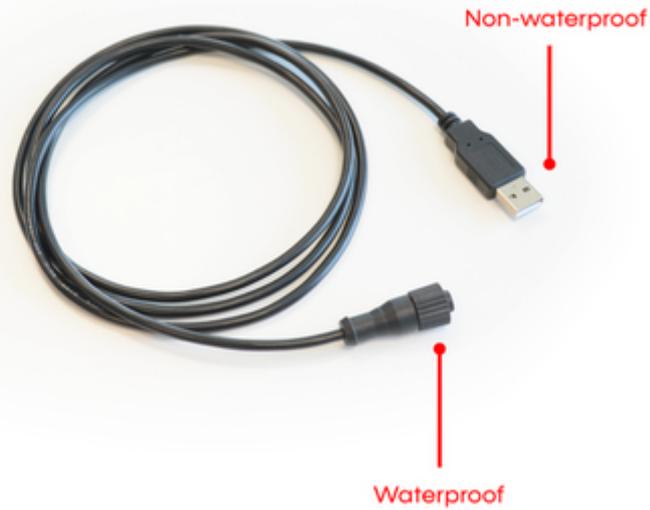
Ends of the power cable

4.3.   Solar panel

The solar panel power accessory is provided together with the necessary cable and also an installation accessory to facilitate the installation in a compact and robust way. It is connected to the One main node power socket. Refer to the installation section to see how it is mounted.
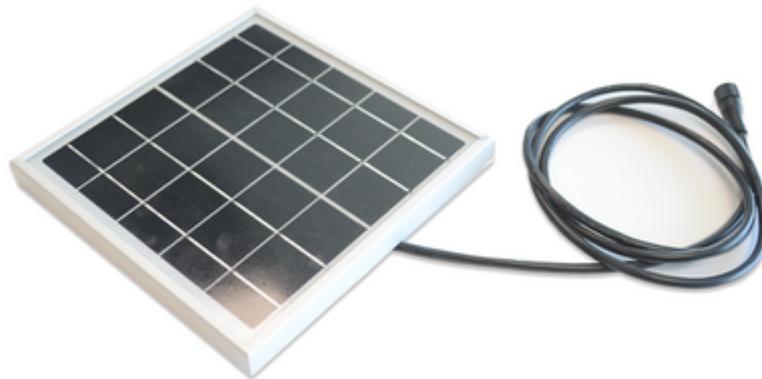
One solar panel with cable

Solar panel installation accessory

Solar panel together with the installation accessory

4.4. Probe extension cords

Some applications may require a larger sensor probe cable. Thanks to the One extension cords, It is possible to enlarge the sensor cable.

One Extension cord (1.5 meters)

The length of the extension cord is 1.5 meters and two or more can be used together by connecting them in series.

Connecting an extension cord in series with the One sensor

Remember to screw the connectors completely in order to maintain the waterproofness of the cable joints.

One node with an extension cord in series with the sensor

4.5. Magnet Keyring

A key ring containing a small magnet is provided for a contactless reset of the Libelium One main node.

Magnetic Keyring

To reset the node, just approach the key ring to the LED zone on the left side and wait for the reset LED pattern, as shown below.

Resetting Libelium One main node

Check the next video to see how to reset a Libelium One node with the magnetic keyring:

- Libelium One - Activation

Note: Remember that nodes come deactivated by default and the user should reset them three times before the first usage.

4.6.   One programmer

This accessory is thought to be used for local configuration, maintenance and debugging purposes. It should not be confused with the USB power cable, which is only a power accessory without maintenance capabilities.

One programmer accessory

It allows connecting the One main node to a PC through the USB port when specific maintenance tasks are needed. Given that it is not intended to be permanently connected to the node, the USB end is not waterproof and therefore it should not be installed outdoors.

Libelium One node connected to a laptop using the One programmer accessory

The One programmer board should be used in combination with a serial monitor (cutecom, hyperterminal, realterm…) or with the "Smart APP", software provided by Libelium with a graphical interface. The next operations could be carried out:

- APN, login, password and SIM PIN settings for cellular connectivity
- Restore factory settings
- Upload a new firmware of the node

5. Connectivity

One of the most striking features of an IoT solution is connectivity, and it is often forgotten till the deployment phase. The Libelium One main node is provided as a complete IoT solution and thanks to that it includes an LTE radio module to provide global connectivity, together with the Libelium Cloud. The network architecture is shown below.

One network architecture

Besides, a global SIM card is already included in the node with the necessary data plan to cover the data consumption needs of the node, so the user doesn't have to worry about looking for a local network operator or other extra costs of the solution.

All the communications between the node and the Libelium Cloud are done with the LTE radio and the global SIM card. That includes sensor readings, configuration or OTAP updates. The LTE Cat 4 radio module delivers maximum data rates of up to 150 Mbps for downlink and 50 Mbps for uplink. It is backward-compatible with existing EDGE and GSM/GPRS networks, ensuring that it can be connected even in remote areas devoid of 4G or 3G coverage.

5.1. Replace the SIM card

A Libelium SIM card is provided by default with every One main node. However, some users may want to use their own SIM cards and data plans with the nodes.

If that is the case, then the node should be opened in order to access the internal SIM card socket. Please contact Libelium technical support for further instructions about how to replace the SIM card and warranty implications.

6. Powering

The node is internally powered by a 3.6V, 10.2Ah Li-Ion rechargeable battery, that can be recharged using the power socket. The voltage range of the power socket is from 5 to 24 VDC and the maximum charging current is 800 mA.

There are two common external power sources for the Libelium One node. The power grid and solar panels. In both cases, the cable is connected to the unique power socket, so the user should make the most suitable choice for the application.

If the power grid is available, then the most preferred power source would be a wall socket adapter and the USB power cable.

However, if the power grid is not available, then the solar panel accessory should be used as a power source for the node.

Note: Remember to check the power LED state to know if the battery is being charged

6.1. Replace battery

If the battery needs to be replaced, then the node should be opened in order to access the internal battery. Please contact Libelium technical support for further instructions about how to obtain a replacement, how to replace it and warranty implications.

7. Configuration

The behavior of the Libelium One main node could be adapted to many kinds of applications.

All the configurable parameters of the Libelium One main node can be easily managed through the Libelium Cloud. The meaning, possible values and implications are described in the following section.

7.1. Node operation

By default, the node operates in an endless loop with three main states: **Sense**, **transmit** and **sleep**. Like every ultra-low power IoT application, the node is most of the time in sleep mode, because it is the state with less power consumption. The sleep time is controlled by the parameter Loop time, explained later in this section.

- ● Sense
- ● Process
- ● Transmit
- ● Sleep
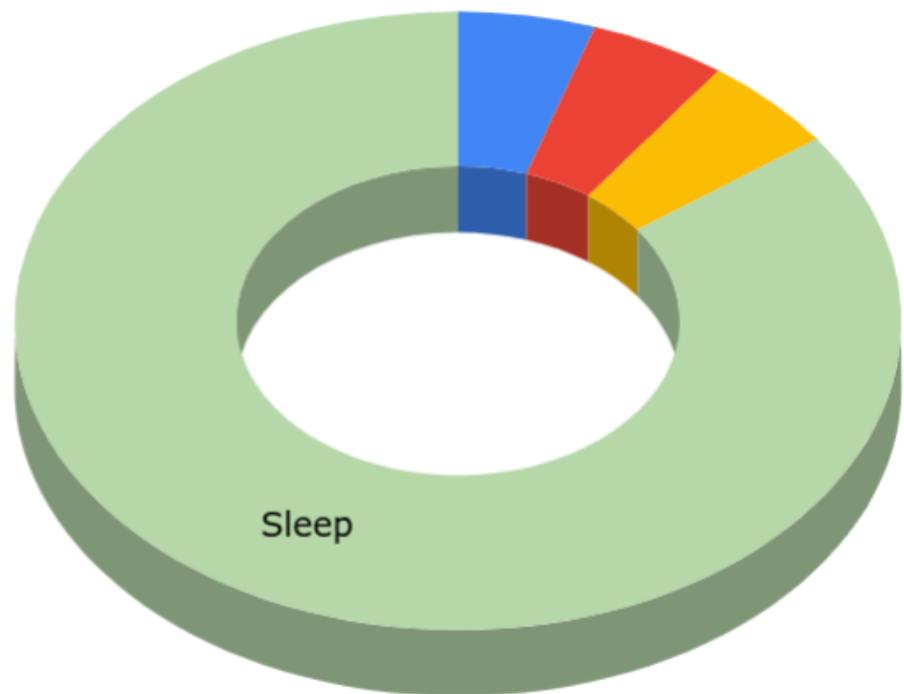
Sleep

Node operation loop

Normally, the node will exit the sleep state once the timer set with the loop time parameter expires, but it can also exit if a sensor is connected or disconnected.

Then, the node starts reading all the sensors connected to the node.

Finally, when all the readings are done and if the number of loops matches the value of the parameter number of loops to send, the node will send the values to the Libelium Cloud and the user will be able to see the data. In addition, the configuration updates made through the Cloud will be downloaded, applied to the node and reported to the cloud again to let the user know the result.

Sensor connection/disconnection

The user should take into account that if a sensor is plugged (or removed), it will be automatically detected and therefore an event will be triggered on the node. If that happens, the node will exit the sleep mode and the current loop will be ended, meaning that the node will wake up to carry out the

necessary actions, like registering a new sensor, updating the node configuration or taking new measures.

Reset

It has to be said also that if the node is reset with a magnetic keyring accessory, the sleep time will be ended too and the loop will start again.

7.2.   Battery modes

If a node is already deployed, it is important to prevent the battery from dropping to zero and losing communication with the node. To achieve that, a few actions are automated depending on the battery level.

The next diagram shows the node behavior regarding battery level.

Battery modes
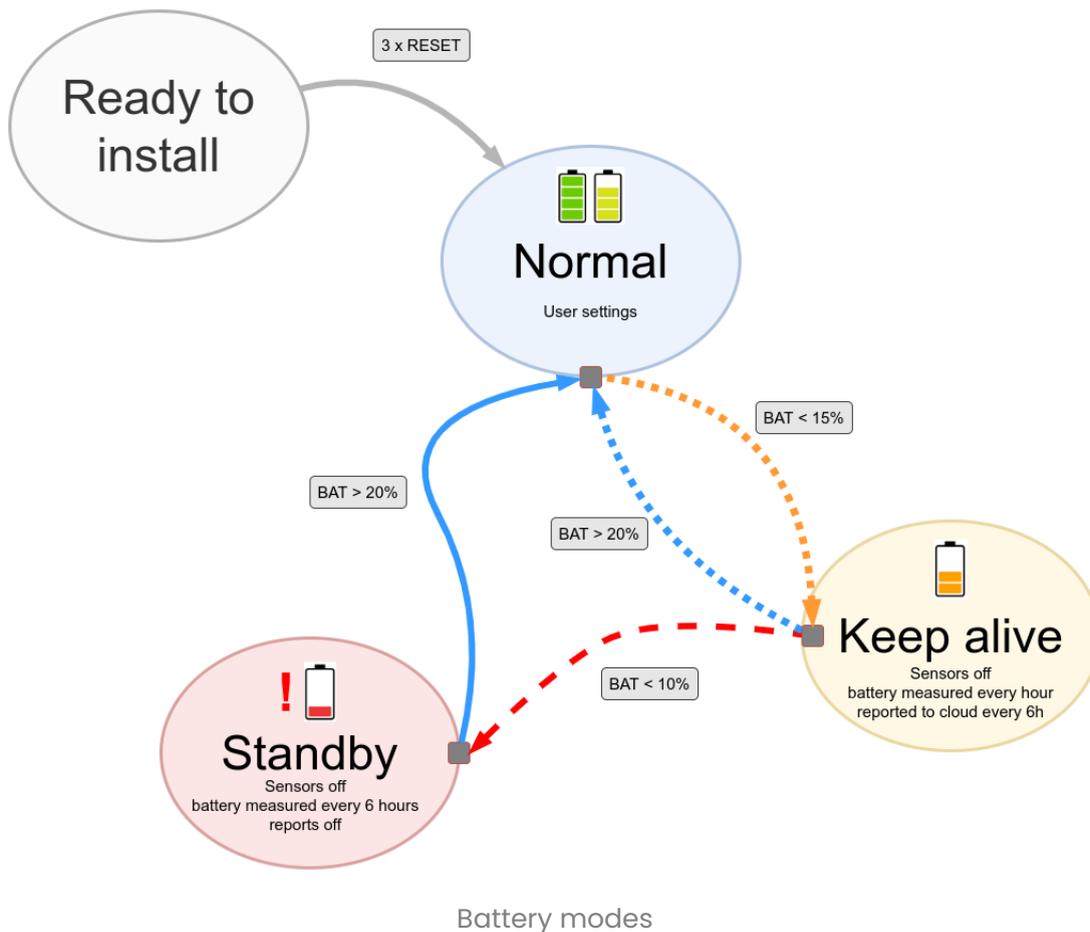
Normal mode

When the battery is above 15%, The node uses the configuration set by the user on Loop time and number of loops to send parameters.

Keep alive mode

When the battery is below 15%, an automatic reconfiguration is forced in order to save as much battery as possible and let the battery recharge:

- The loop time is set to 1 hour
- The number of loops to send is set to 6, so a report will be sent to the cloud every 6 hours.
- Sensors are turned off and therefore not measured and

- New configurations through Libelium Cloud are paused.
- Only the battery level is reported to the cloud every 6 hours until the battery is above 20%.

Standby mode

If the battery level continues dropping below 10%, then the node will enter a special mode where only the battery is measured every 6 hours and no activity will be reported to Libelium Cloud until the battery is above 20%. For the remaining time, the node will be in sleep mode. If a node enters this state, nothing will be reported to the cloud.

Note: A reset process will not change the current battery mode, no matter if it is remote or local reset with a keyring.

"Ready to install" State

The nodes are delivered from Libelium headquarters in a "Ready to install" state where the battery power consumption is reduced to the minimum. Because of that, sensors will not be detected while in this state.

To exit this mode and enter the normal mode the node needs to be reset three times, as shown in the next video.

- Libelium One - Activation

Exit the ready-to-install state with 3 consecutive contactless resets.

Note: It is recommended to charge the node during 24 hours prior to its first usage.

7.3. Configurable parameters

As with other Libelium products, the One node can be configured remotely using the cellular radio and without the need for any wired link.

By default, the configuration of the node is done through the Libelium Cloud platform, going to the devices section, selecting the corresponding device and using the configuration tab.
A deep description of the Libelium Cloud features is provided in a separate document, but a few specific remarks will be described below.
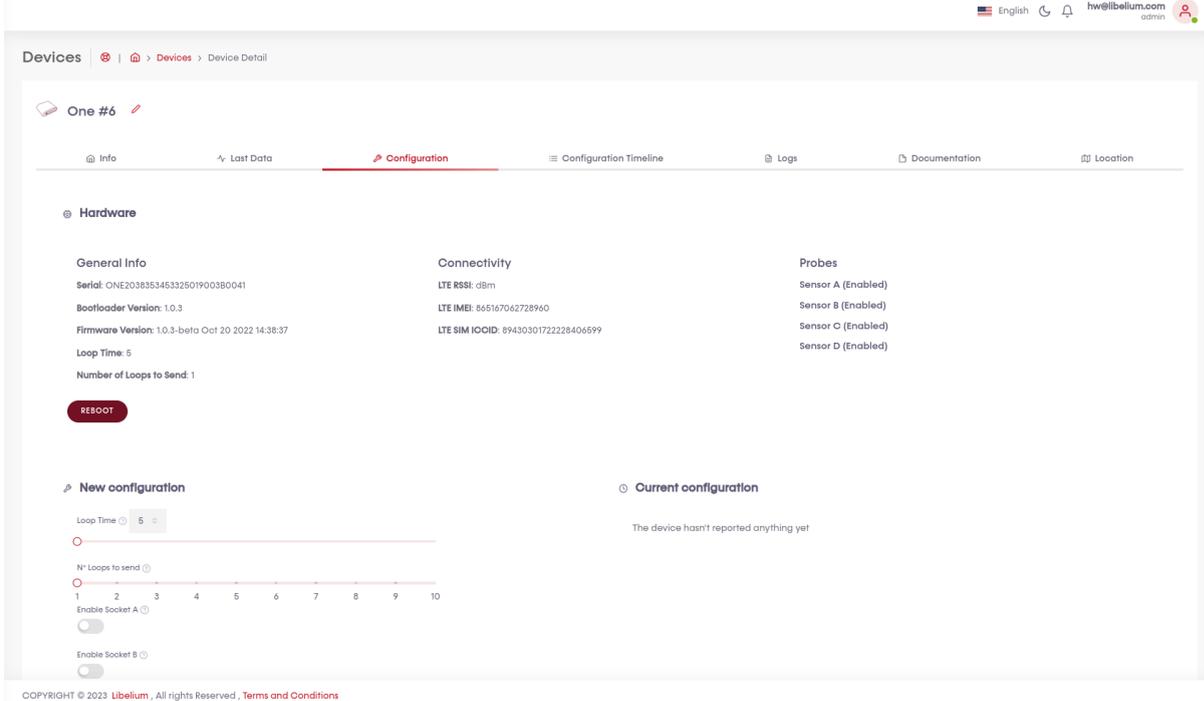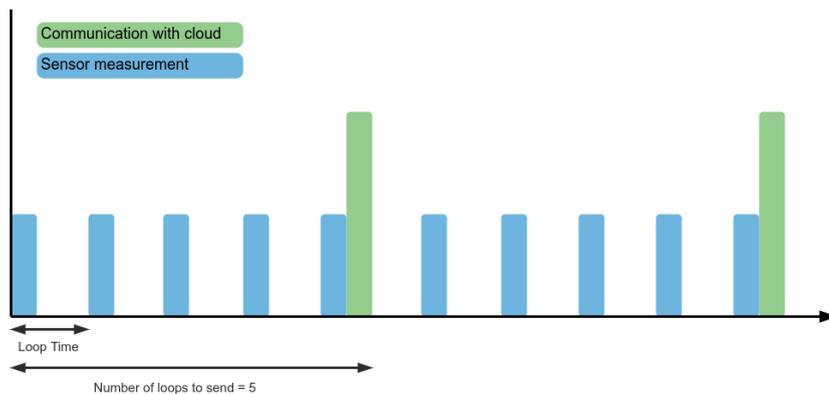
Number of loops to send

As shown in the picture above, the parameters that can be configured on each node are described below.

- **Loop time**: Sets the time between sensor readings. It can be set from a minimum loop time of 5 minutes to a maximum of 24 hours.

- **Number of loops to send**: Sets the number of loops that will be sent together. This is useful for saving power in applications where immediate readings are meaningless, sending a batch of readings at one time instead of single readings. It can be set from 1 to 10.

- **Enable socket X:** If a socket is not going to be used, disable it to save power. If a socket is in disabled mode, it will not detect a sensor connection, so take it into account if you plan to reinstall your sensors.

- **Enable GNSS:** This parameter controls the geolocation feature of the node. If it is not needed, it can be disabled to save battery.

The following graph shows an example with the number of loops to send set = 5. If the loop time is set to 5 minutes, then the values will be uploaded to the cloud every 25 minutes.

Number of loops to send

Once all the device settings have been set on the left side of the page, press the save configuration button to queue the configuration update for this device. It will be applied in the next communication between the node and the Cloud. You will see on the right side of the page the device report configuration values.

As an example, an application requiring short sample periods and almost real-time updates will use low loop time values and a number of loops to send set to 1. But it will also require more power.

On the other hand, a less demanding application where parameters don't have quick variations could have higher loop times and a higher number of loops to send, as data will be only checked once a day for instance. This configuration will require less power.

Besides, if nodes with sensors are already installed in fixed positions, it would be recommendable to disable unused sockets to save power if your application is power sensitive. If this is not the case and you are taking advantage of features of hot plugging the sensors from one node to another, it would be preferable to leave them enabled.

Finally, at the end of the configuration tab, there is a reboot button to schedule a remote software reset on the node. This could be useful if a configuration is not being applied correctly or if a sensor is not working properly, but **a reboot is not necessary to apply a new configuration.**

Configuration example:
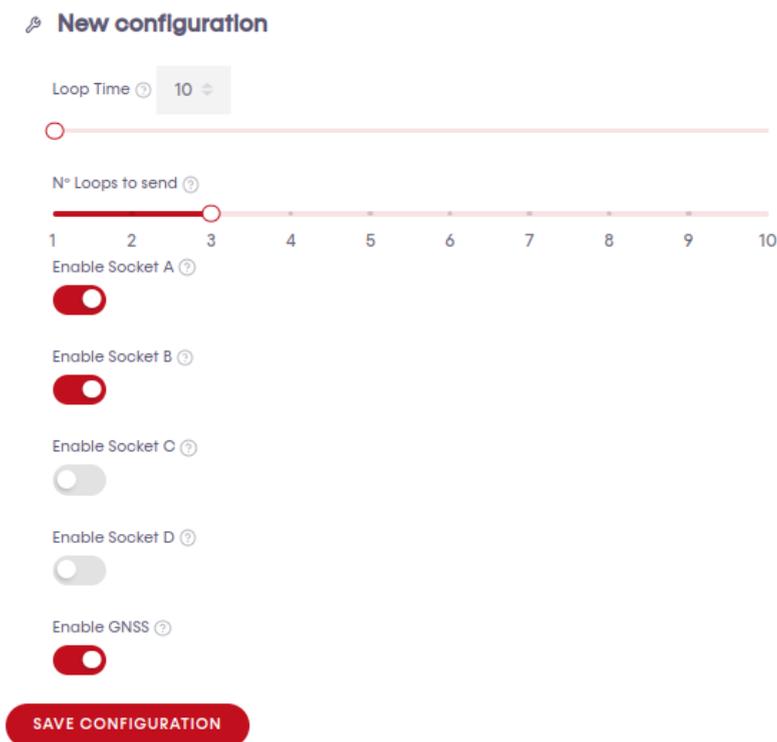
One node device configuration tab on Libelium Cloud

- **Loop time**: 10 minutes
- **Number of loops to send**: 3
- **Enable socket A**: Enabled
- **Enable socket B**: Enabled

- **Enable socket C**: Disabled

- **Enable socket D**: Disabled

- **Enable GNSS**: Enabled

In the previous settings, two sockets are enabled (A and B) and if a sensor is connected to them, then they will be read every ten minutes (loop time = 10). Besides, the readings will be sent in batches of 3 samples, so the user will see an update with new values every 30 minutes on the Libelium Cloud, containing the tree samples measured in the previous 30 minutes, one every 10 minutes. Besides, the GNSS position will be updated too, but only with one measure.

Note: The GNSS and RSSI values are sent only one time per batch of measures.

7.4. Deployment

Now that the node operation and the configuration possibilities have been explained, it is possible to proceed with the in-field deployment.
The Libelium one main node has been designed for easy and quick installation in walls or poles using only a few screws or cable ties. But prior to the physical installation, it is recommended to check all the nodes and their sensors:

- Check the battery level of the nodes and charge them if needed prior to deploying them.
- Test that the sensor readings are in range by connecting the sensors to a node and looking at its values in the Libelium Cloud
- Ensure that there is cellular coverage in each node location.

Now that the devices are ready to install, go to the field and check the data of your devices easily by scanning the QR code at the back of the device or going to the devices tab in the Libelium Cloud platform. It is possible also to go directly to the Libelium Cloud, logging with your user account and look at the specific device. Then go to the real-time tab to see the data or if a dashboard is previously created, check the values on the graphs.

7.5. Remote firmware updates (OTAP)

The concept of wireless programming or commonly known as Over the Air Programming (OTAP) has become a mandatory feature in most Internet of Things deployments, where networks consist of hundreds or thousands of nodes. Libelium provides an OTA through the Libelium Cloud platform, triggering periodic firmware updates on the nodes.

When a new firmware version is available for a node, the user will be prompted to install it in the next loop or schedule it for a certain date.

As with many OTAP processes, it is important to keep the device on during the process, without making any contactless reset or manipulating the sensors connected to it. Remember that connecting or disconnecting any sensor or even the power cable triggers actions that may interfere with the OTAP processes. The device may become unresponsive if the OTAP process is intentionally interrupted.

Finally, when the OTAP process is ended successfully, the node will restart automatically in normal mode. The next video shows a node performing OTAP process.

- Libelium One -OTAP process

7.6.   Wired configuration

In certain situations it may be required a wired configuration directly between a PC and the node. This could be achieved with the One programmer accessory cable and the dedicated software Smart APP.

Please contact our after sales team to obtain the software and more information about its usage.

8. Data visualization

Data visualization with Libelium Cloud

The Libelium One main node sends the sensor measurements directly to the Libelium Cloud, using the cellular radio module embedded by default.
- Store, visualize and analyze the data received from your One devices and their sensors.
- Remotely manage all your devices and sensors.
- Over The Air firmware upgrades.
- Connectors to send the measures to the most relevant clouds in the market: AWS IoT, Azure IoT hub, thingworx, MQTT,...

An account on the Libelium Cloud platform is needed (it includes also the necessary data plan), so the first step is going to The Libelium Cloud.

Moreover, for a deep description of the Libelium Cloud platform please take a deep reading on the dedicated Libelium Cloud documentation.

Remember that the last data tab is useful to check if the sensor is working properly.

One node device tab on Libelium Cloud

Devices tab for device management

If you already have an account, just **scan the QR code** at the back of the node and it will lead you to the device's main tab, which is shown below.
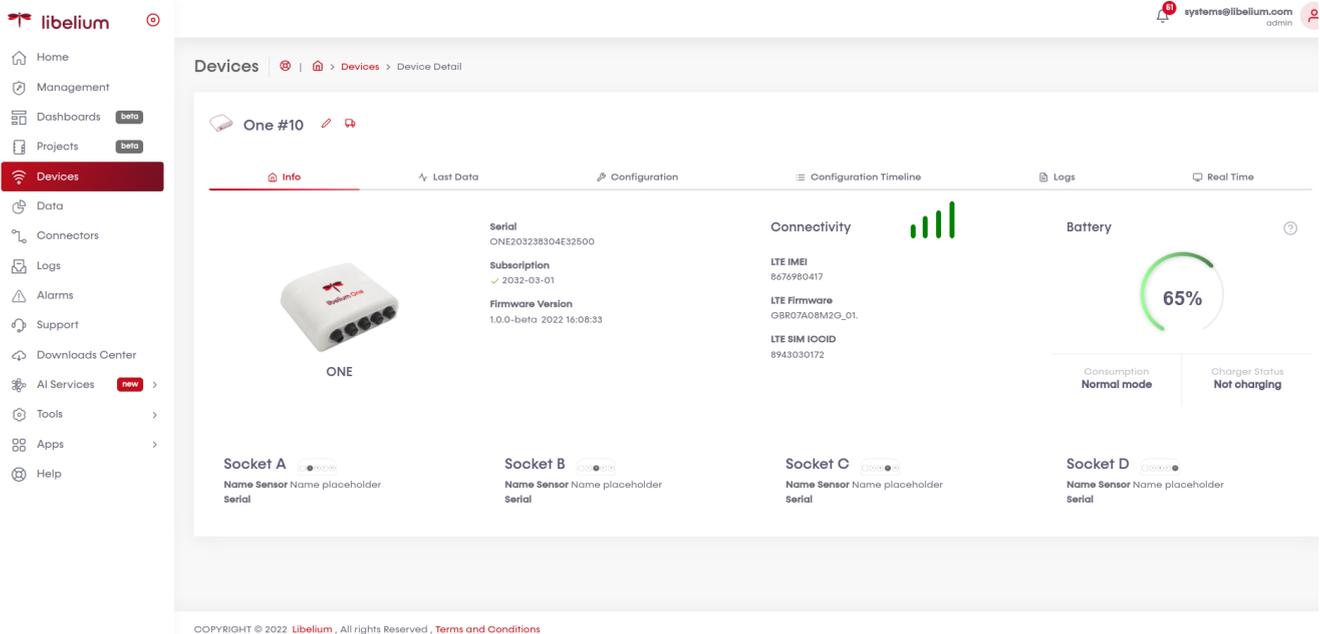
One node device tab on Libelium Cloud

The Devices section allows managing all the Libelium devices you have on your account.

When a specific node is selected, the "Device profile" is shown, and if the selected device is a Libelium One node, you will see information like:

- Serial numbers, firmware versions and sensors attached
- Coverage and battery levels
- Last data received from this node
- Configuration parameters
- Configuration history, timeline and logs
- Real-time data

From this tab, you can check the health of your device (battery & coverage levels) and which sensors are attached to it (and in which socket). You can also check the sensor readings to see if they are correctly installed.

Remember that if the node is already installed and the back QR code is not accessible, go to the devices section and look for the specific device on the devices tab by its serial number.

It is important to remark that you can pick up a sensor from one node and connect it to another one without any configuration. The change will be reported from both nodes to the Libelium Cloud and you will be able to see it almost instantly.

Finally, the real-time tab is a good way to see if a sensor is measuring correctly after an installation. For further reading please go to the Libelium Cloud documentation.

Dashboards for advanced data visualization

The Dashboard tab provides a powerful way to organize your sensor data. It allows the creation of custom views for specific applications with huge flexibility.

For further readings, there is a <u>dedicated section for dashboards</u> on the Libelium Cloud documentation.

A good piece of advice prior to big deployment would be to think about how the data is going to be displayed to take advantage of it. Beyond that, it would be also recommendable to build a dashboard to easily identify changes in sensor behavior and trigger the necessary actions, like maintenance, calibration or replacement.

9. Installation

The Libelium One main node has been designed to keep the whole system as a compact IoT node, maintaining a good appearance that can be easily integrated into Smart city projects, buildings, or applications with small installation space. Custom installation accessories to facilitate the deployment are provided, as described below.

The equipment shall be installed in a proper way to ensure endurance over time. Due to each location having specific conditions, the node enclosure and the installation accessories have been designed for versatility and adaptability. For instance, there are no restrictions on height from the floor, but always ensure there are no loose screws on the enclosure, sensor connectors are firmly screwed, and cable ties are correctly tightened. Finally, try to keep the node and all the accessories away from children.

Wall mount

The Libelium One node comes with a <u>wall mount accessory</u> by default at the back side of the enclosure. If the node is going to be installed on a wall, use the two holes marked below to place the fixing screws.
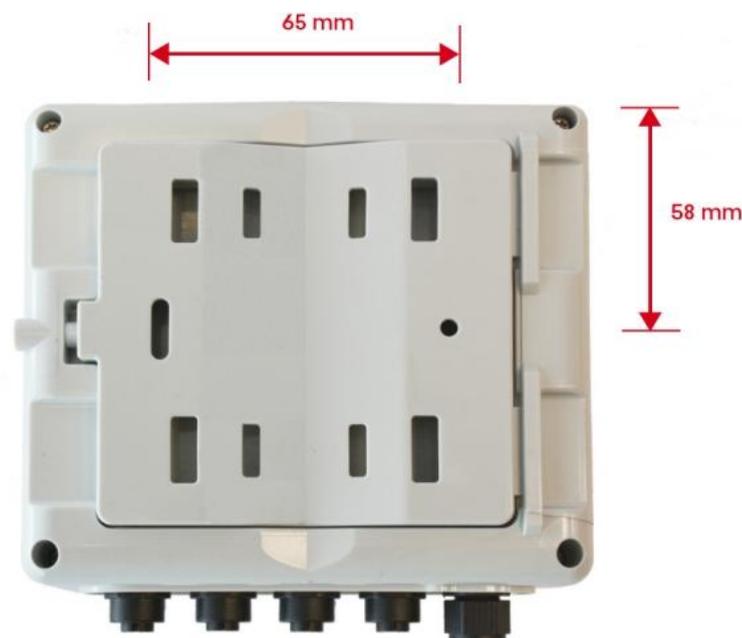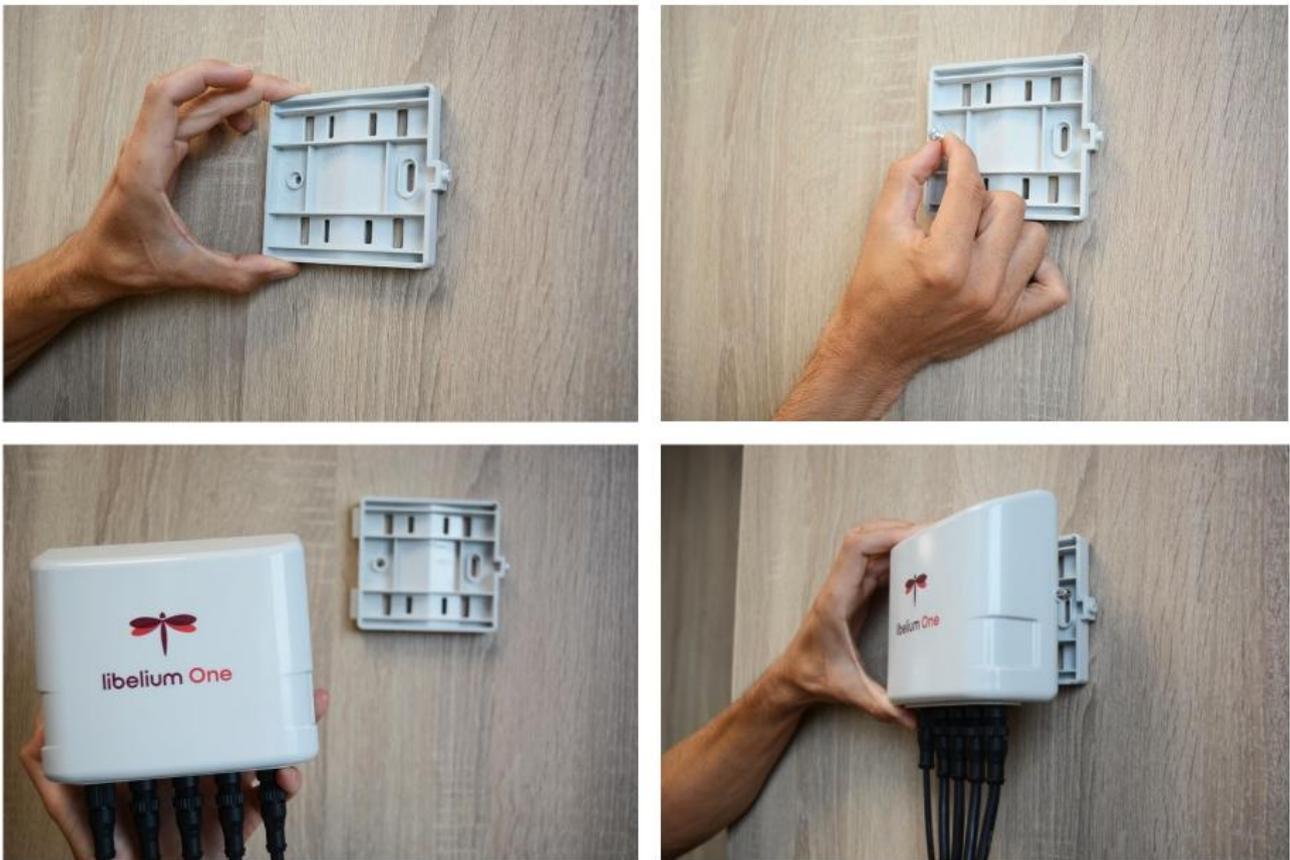
Installation accessory

It fits at the back of the enclosure with two sheets, allowing an easy and quick way to install the node.

Installation accessory mounting

At first, the installation accessory can be mounted on the wall without the node, which can be easily attached later using the screw on the right side. The next figure shows how it could be mounted.
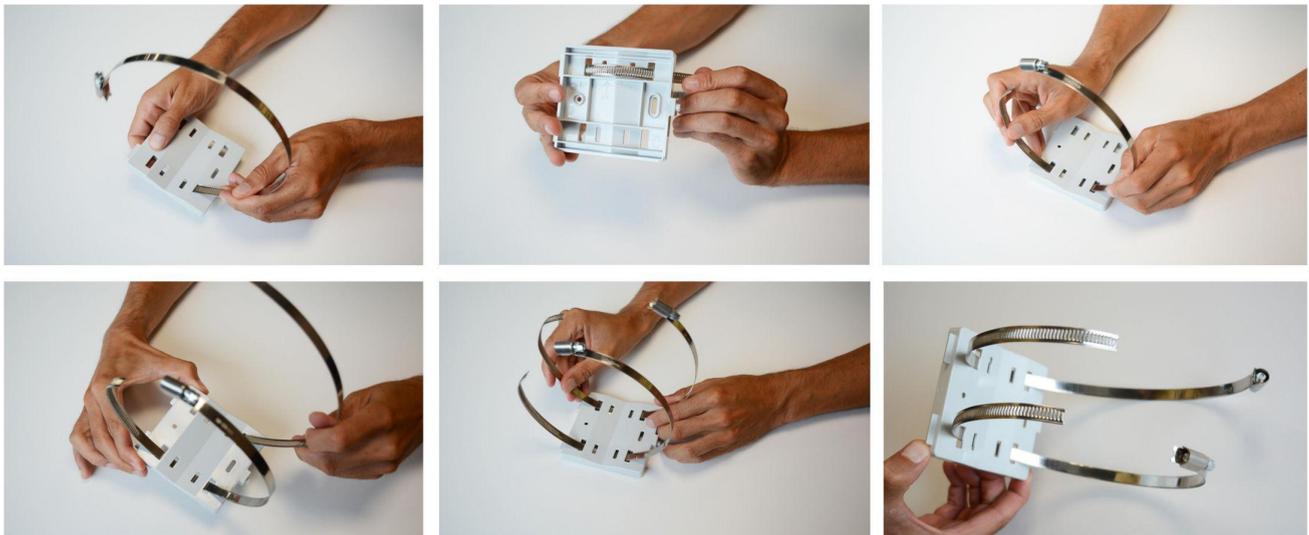

Installation accessory

Remember to screw firmly the accessory screw to avoid a loose installation that may have vibrations from wind or other environmental factors.
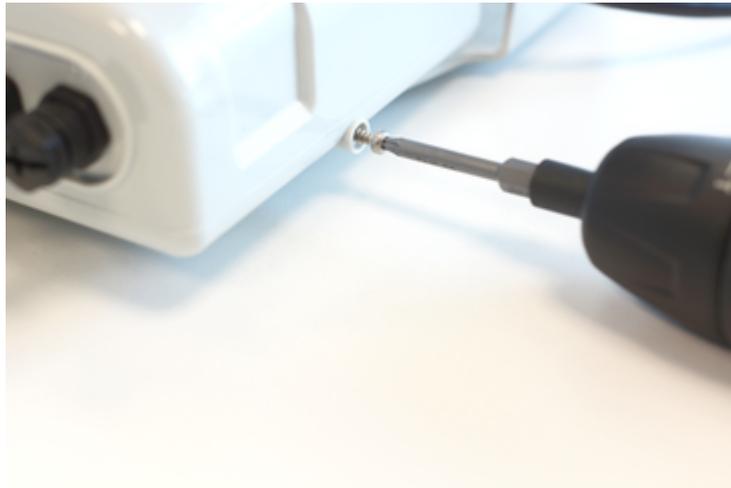
Screw firmly the accessory

Pole Mount

Besides, the same accessory could be used to attach the node to a pole with two metal cable ties. The next pictures show the way to do that.

Cable tie installation for pole mounting

Solar panel installation

If a solar panel is going to be used together with the node, the whole set could use the same holes and cable ties. The assembly of the solar panel mounting accessory with the solar panel and the Libelium one main node is shown below.
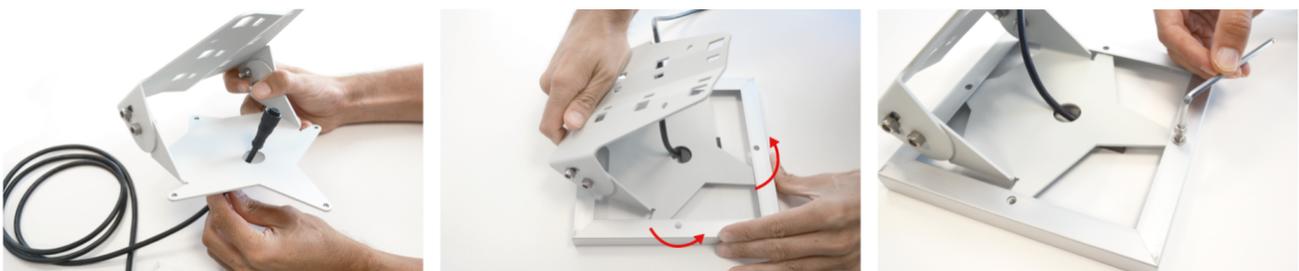

Solar panel with One

The accessory comes mounted with the solar panel, as shown in the next picture, together with the necessary screws.


Solar panel accessory out of the box

If that is not the case, align the mounting accessory with the mounting holes on the frame of the solar panel and use the four screws to fix the solar panel firmly. There is a hole in the solar panel cable, so remember to place the cable through it before mounting the screws.

Mounting the solar panel with the accessory

![libelium](libelium logo)

The next step is to remove the side screw used to fix the position of the accessory during transport and place it in the indicated hole, allowing angle regulation.

1)

①	DIN 912 M5x12 (x1)	
②	DIN 6923 M5 (x1)	
③	DIN 912 M4x10 (x2)	
④	DIN 934 M4 (x2)	

0°

✱ REMOVE (x1)

2)

④

③

15°-75°

① ②
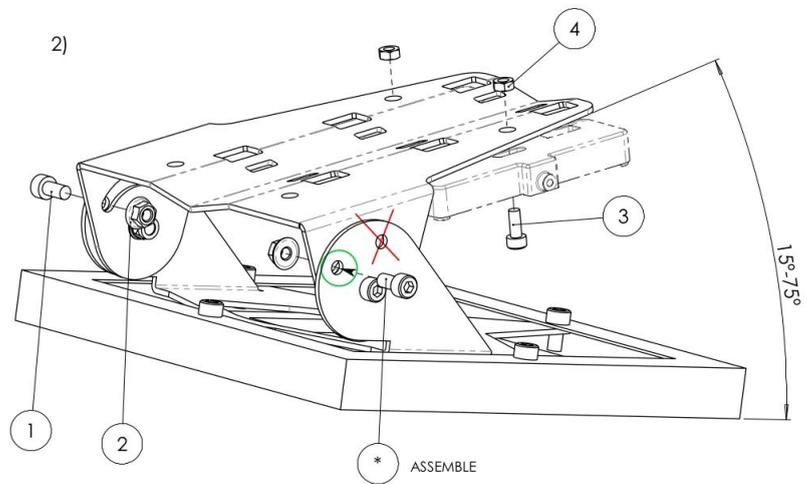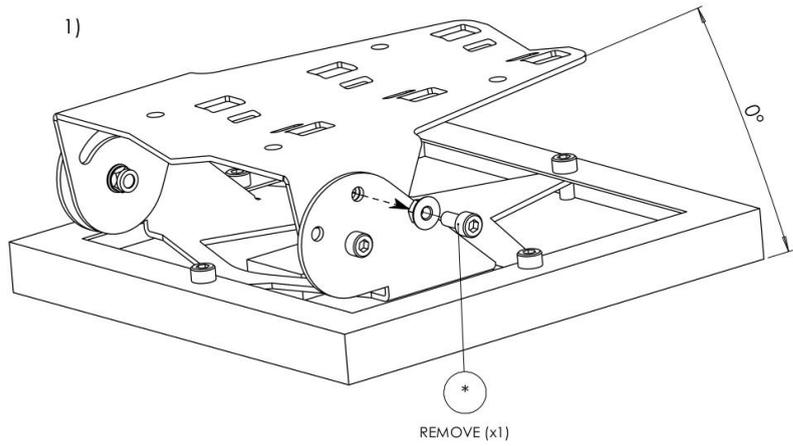
✱ ASSEMBLE

Assembling the screw in the working position

Then, go to the wall or the pole where the device is going to be installed and use the screw holes or the cable ties to fix it. If you use cable ties, you can also fix the installation accessory with the same cable tie. The next figure shows how the node installation accessory fits together with the solar panel.

Mounting the solar panel with the node

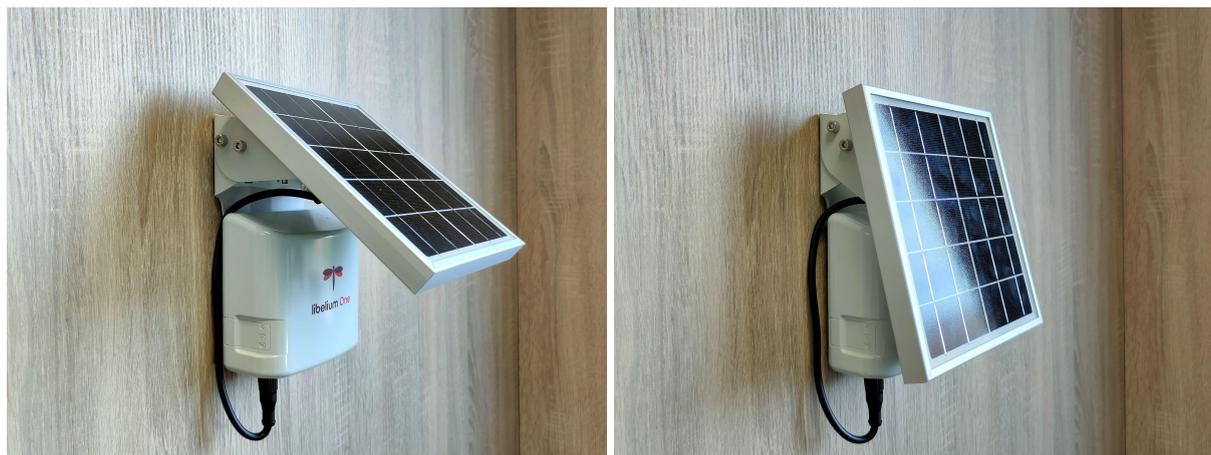Now, the node can be placed on the mounting accessories, fitting the two side sheets and fixing the right side screw.

Assembling the whole set

Fastening the side screw

libelium.com

Finally, the solar panel angle could be adjusted to the latitude of the deployment to maximize its efficiency by the two side screws of the accessory.

Adjusting solar panel angle

10. Certifications

CE (Europe)

The product Libelium One main node is in conformity with the essential requirements and other relevant requirements of the R&TTE Directive (1999/5/EC) and the 2002/95/CE Directive. The product is in conformity with the following standards and/or other normative documents: Health and Safety: RoHS, EN 50581 (2012) Electro-Magnetic Compatibility: EN 301 489-1 v1.9.2 (2011) EN 301 489-17 v2.2.1 (2012) EN 55022 (2010) / A1 (2011) Spectrum: EN 300 328 v1.8.1 (2012-06) Electrical Security:

FCC (USA)

Contains FCC ID: XMR201903EG25G

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

IC(Canada)

Contains IC: 10224A-201903EG25G

UKCA (UK)

IP & IK

IP66 / IP67

Environmental and vibration tests

Note: Certifications in progress

11. Maintenance

- In this section, the term "Libelium One main node" encompasses both the device itself as well as its accessories.
- Although Libelium One main node is a highly resistant product, please handle it with care in order to enjoy a longer useful life.
- Handle Libelium One main node with care, do not allow it to drop or move roughly.
- Avoid placing the devices in areas reaching high temperatures that could damage the electronic components.
- Avoid aggressive environments (corrosive gasses, animals, excessive/condensing humidity or atmospheres with salt suspended in the air).
- Plug sensor probes only in their corresponding connectors.
- Do not use any type of paint on the device, it could affect the operation of connections and closing mechanisms.
- Never open the casing, the warranty will not cover products that have been opened or any mark of tampering. It is recommended to follow the instructions of this guide for the correct use of the product
- For cleaning, use a damp cloth, no aggressive chemical products.

12. Disposal and recycling

- When Libelium one main node 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 it correctly.
- Your distributor will advise you on the most appropriate and environmentally-friendly way of disposing of the product and its packing.
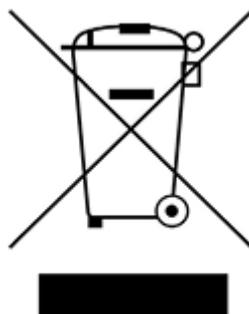
13. Document changelog

v1.0 - First release.

v1.1 - Format changes and other errata

v1.2 - Note about charge the node prior usage

v1.3 - Clarifications about node installation. IP grade updated. Virtual sensors added.

v1.4 - new sensors added: WS-3000, Noise Level Sensor v2 and leaf wetness. Clarifications about loop time.

v1.5 - new sensor added: multilevel soil moisture probe