# SENSOTERRA

## Custom LoRaWAN Integration Guide

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Table of contents

## Scope

This guide describes how to deploy Sensoterra sensors and how to process payloads on a private/custom LoRaWAN network. With private/custom networks, we mean LoRaWAN networks with which we do *not* have a standard integration like we have with for example Senet, TTN and several national or regional providers. If you are not sure if you are using a provider, we have an integration with, please check with our support team via support@sensoterra.com.

Intended audience are customers and/or Value-Added resellers using private LoRaWAN networks and LoRaWAN providers who need to support Sensoterra sensors.

In order to understand how to integrate sensor data to an external system, please consult the *Moisture Data Integration Guide*.

## Introduction

Schematically the data flow is:
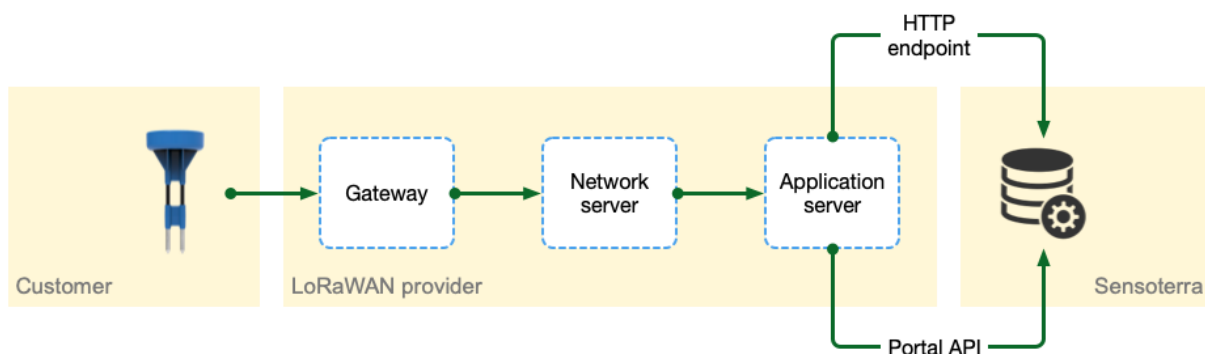


### Network requirements (US915, AU915)

When a Sensoterra probe wants to join a LoRaWAN network it iterates over the 8 sub bands of 8+1 channels. So first a random channel between 0 and 7 is tried, then channel 64, then a random channel between 8 to 15, then channel 65, etc. As soon as a join accept is received, the probe will stick to the last set of 8+1 channels. Also, the spread factor is kept to 10 (DR 0) and transmission power to 20 dBm.

It is good practice for the network server to send a sequence of ADR requests in response to the first uplink message to configure the permitted channels, the data rate, and the transmit power. Please contact the network server supplier for instructions on how to configure ADR commands.

## Probe registration

In order for Sensoterra to process a device uplink payload into a soil measurement, the probe must first be registered by the customer. For this the customer needs to install the Sensoterra app (Android/iOS) and scan the QR code as instructed. This ties the device to the end-user. Alternatively, the Customer API can be used to register a probe automatically. Please consult "Probe Integration Guide".

## Obtain measurement data

Various ways exist to gain access to probe measurement data, namely:

- Excel download, GeoRSS feed
- Download via the Customer API
- Real time server push notifications
- Immediate as return data from the decode call of the Portal API

Download through the Customer API has the disadvantage that you need to regularly poll for new data. That's why server push notifications are often the preferred way to obtain measurements.

Please consult "Sensor Integration Guide" for the details on how to set it up.

## HTTP endpoint versus Portal API

Network integration is possible in two ways:

A. Forward the LoRaWAN uplink payloads to a dedicated HTTP endpoint in the Sensoterra infrastructure. Optionally implementing an API for scheduling downlinks to a device. Workflow:
   - LoRaWAN network server routes uplink payloads from devices to a dedicated Sensoterra endpoint for further processing. Sensoterra provides specific HTTP endpoint to network provider.

- ○ Either Sensoterra or the LoRaWAN provider provisions probes. In case Sensoterra is doing the provision, Sensoterra needs access to the LoRaWAN network portal.
  - ○ LoRaWAN provider offers an API to send downlink configuration messages to a device (optional)
- B. The alternative is that the network provider uses the Portal API to decode uplink payloads. The provider is responsible for the provisioning of the probes. The API authentication is implemented by OAuth.

The next table shows some of the differences:

| | *HTTP Endpoint* | *Portal API* |
|---|---|---|
| Real time decoding | Yes, with a one-minute delay | Yes, each decode call returns the actual soil moisture data |
| Downlink configuration messages | By Sensoterra, depending on the level of integration | By network provider, using the encode call |
| Device creation and provisioning | By Sensoterra, depending on the level of integration | By network provider. |
| Sensoterra support | Yes | Limited as Sensoterra has no access to the network metrics. |
| Setup | Mainly by Sensoterra | By network provider |

## Sensoterra HTTP endpoint

In order for Sensoterra to support a new LoRaWAN network provider, the following needs to be taken into consideration:

1. Agreement on contractual terms, like costs, volume, maximum number of uplinks/downlinks per day, what channel plans will be supported, etc.
2. Procedure to deploy new LoRaWAN probes. And how to remove them. Through an API, Excel upload, mail?
3. Sensoterra must setup endpoint to handle uplink messages.
4. Sensoterra needs access to the portal where devices are managed, if possible.

5. Sensoterra needs specification on how to manage probes (API, Excel upload, etc.).

6. Optional: Sensoterra must implement API to send downlink messages to a device.

7. Optional: customer can configure an endpoint to receive server push notifications for real time probe readings. Please consult "Sensor Integration Guide" for the details on how to set it up.

## Uplink messages

Sensoterra will provide (or configure in the provider portal) an endpoint URL to which device payloads should be sent.

When the LoRaWAN provider gets a payload from a probe, the endpoint must be called preferably as a JSON message, containing:

- DevEUI
- Timestamp with time zone indication
- Uplink counter (FCntUp)
- The payload
- Preferably gateway ID, RSSI and SNR levels

## Downlink messages

To remotely configure a probe, Sensoterra needs to be able to send downlink messages to the probe. The LoRaWAN provider needs to supply an API which facilitates this. The following parameters will be supplied:

- DevEUI
- Payload
- FPort (typically 1)

## Excel upload for device creation

When devices need to be created or removed through Excel uploads, the providers need to specify the format of the import file. Typically, it will contain at least:

- DevEUI
- AppEUI
- AppKey

- Name (to help identify the device)

## Examples

Sensoterra can give guides on how to setup ThingPark (from Actility) or Everynet on request.

## Portal API

In order to support a LoRaWAN provider, the following needs to be taken care of:

1. Agreement on contractual terms, like costs, volume, etc.
2. Procedure to communicate LoRaWAN keys to provider.
3. Provider needs to integrate the decoder API into their infrastructure.

Documentation on the Portal API is available at
https://monitor.sensoterra.com/apiportal/v3/.

## Decoder call

This is essentially a RESTful call where the DevEUI and payload (and optionally the soil type) is POSTed. Response of this call will be the decoded payload as a SenML message. An example of two soil measurements is:

```
[
 {
    "bver": 3, "bn": "urn:dev:mac:0024befffe804ff0_18000125819",
    "bt": 1505747862
 },
 { "u": "%EL", "v": 100 },
 { "u": "%vol", "v": 32.3, "depth": 30, "soil": "CLAY", "ut": 5400 },
 { "u": "%vol", "v": 32.0, "depth": 60, "soil": "CLAY", "ut": 5400, "t": -3600 }
]
```

Notes:

- Part of the Base Name ("bn") is the probe serial label.
- Times (like "bt") are Unix timestamps from 1970-1-1, "t" is a relative time offset with respect to "bt".

- The following units ("u") describe the sensor value ("v"):
  - %EL: battery voltage (0% = empty, 100% = full)
  - %vol: soil moisture content at a certain depth/soil type
- Depth ("depth") in centimeters.

For more details on SenML, please check [https://tools.ietf.org/html/draft-ietf-core-senml-10](https://tools.ietf.org/html/draft-ietf-core-senml-10).

## Encoder call

In the event that a probe needs to be reconfigured, you can use the encoding call.

Parameters are:

| | |
|---|---|
| Measurement interval | The interval between measurements in seconds. Must be a multiple of 3600. Also, note that the Customer API aggregates measurements *per hour.* |
| Upload divisor | Defines how often a probe should upload measurements. A single depth probe uplink typically contains the last 6 measurements. An upload_divisor of 1 will upload the last 6 measurements as soon as a measurement is taken. This is the default. An upload divisor of say 6 will upload the last 6 measurements after these 6 measurements are taken. This means it has no redundancy in uplinks anymore. |

The result will be a payload which should be downloaded to the probe by the network provider.