

Integration into a LoRa Network

PEPPERL+FUCHS



Wireless Ultrasonic Sensor
WILSEN.sonic.level

WS-UCC*-F406-B15-B41-01-02

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Purpose of the Documentation

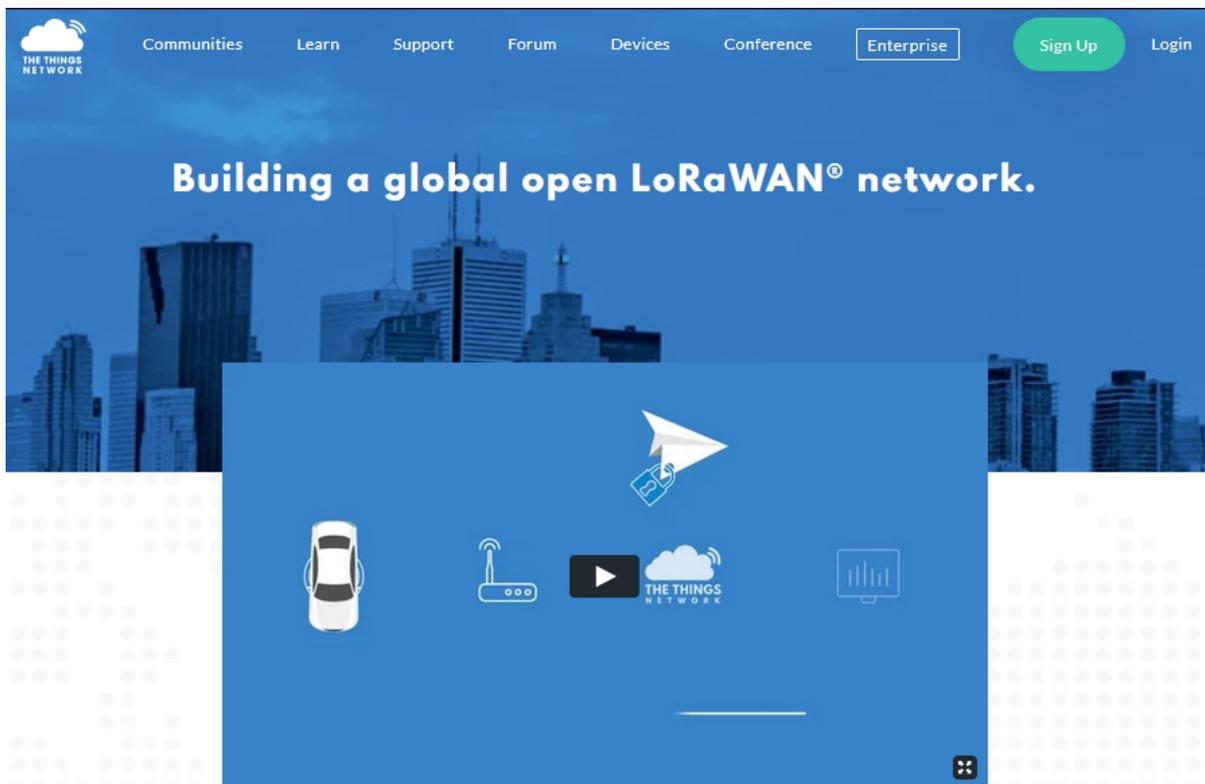
This manual describes the integration of a WILSEN.sonic.level wireless ultrasonic sensor into a LoRa network using the example of the onboarding process to "The Things Network" (TTN) v3.

The example integration consists of the following steps:

1. Creating a customer account with TTN
2. Creating a new application
3. Creating a new device
4. Transmitting sensor data
5. Payload decoder
6. Software applications for processing the sensor data

1. Creating a Customer Account with TTN

1. Type "The Things Network" in the search window of your web browser or follow the link:
<https://www.thethingsnetwork.org/>



2. Click on "Sign Up" to create your own customer account.
3. Follow the further instructions in the dialog menu.

4. After successfully creating a customer account, select the "Console" area.
5. Then select your TTN cluster from the drop-down list on the left side of the screen, e.g. "Europe 1 (eu1)".
 - Here you have the possibility to register a new application (for example a WILSEN sensor) or a new LoRa gateway to the network.

Note

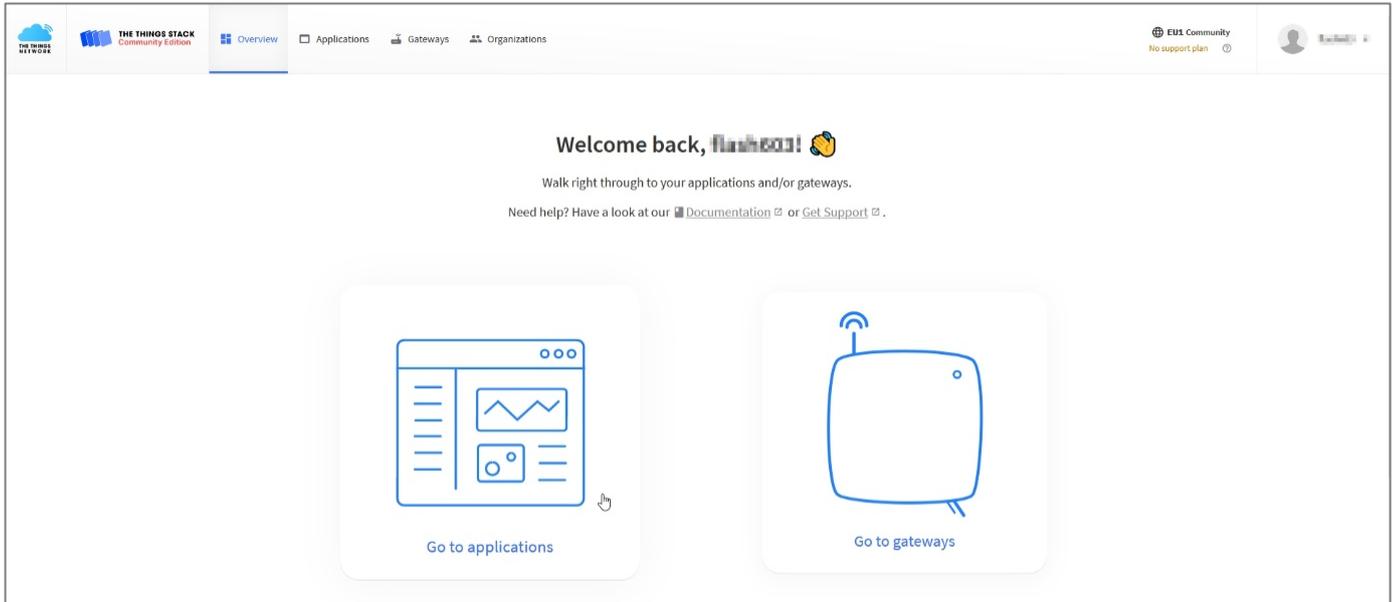
Make sure that the sensor is located in the radio range of at least one LoRa gateway at its later place of use. If you have not yet installed your own gateway, you can use a LoRa network tester to find out whether TTN network coverage is already available at this location. To do this, register a network tester as a new device in your TTN account. You will find instructions on how to proceed in the accompanying documentation of the respective network tester.

If TTN coverage is not yet available, you can install your own LoRa gateway. To do this, follow the instructions in the accompanying documentation from the gateway manufacturer.

If there is already an active TTN network at the sensor's place of use, you can register and operate the WILSEN.sonic.level there.

2. Creating a New Application

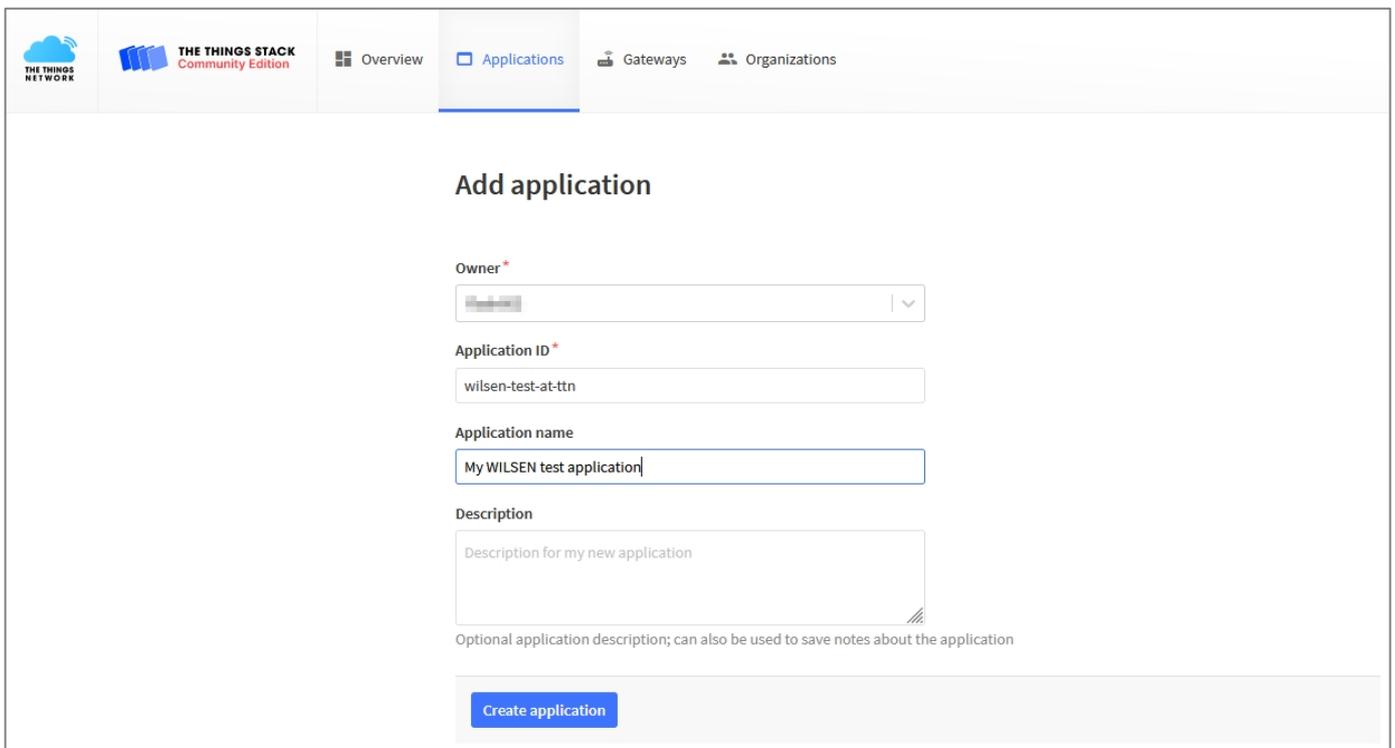
1. In your account, click the *"Go to applications"* link in the *"Overview"* view or select *"Applications"* directly in the header.



2. Select "add application" in the upper right corner of the dialog box.
3. Next, complete the required entries *"Application ID"* and *"Description"*.

Note

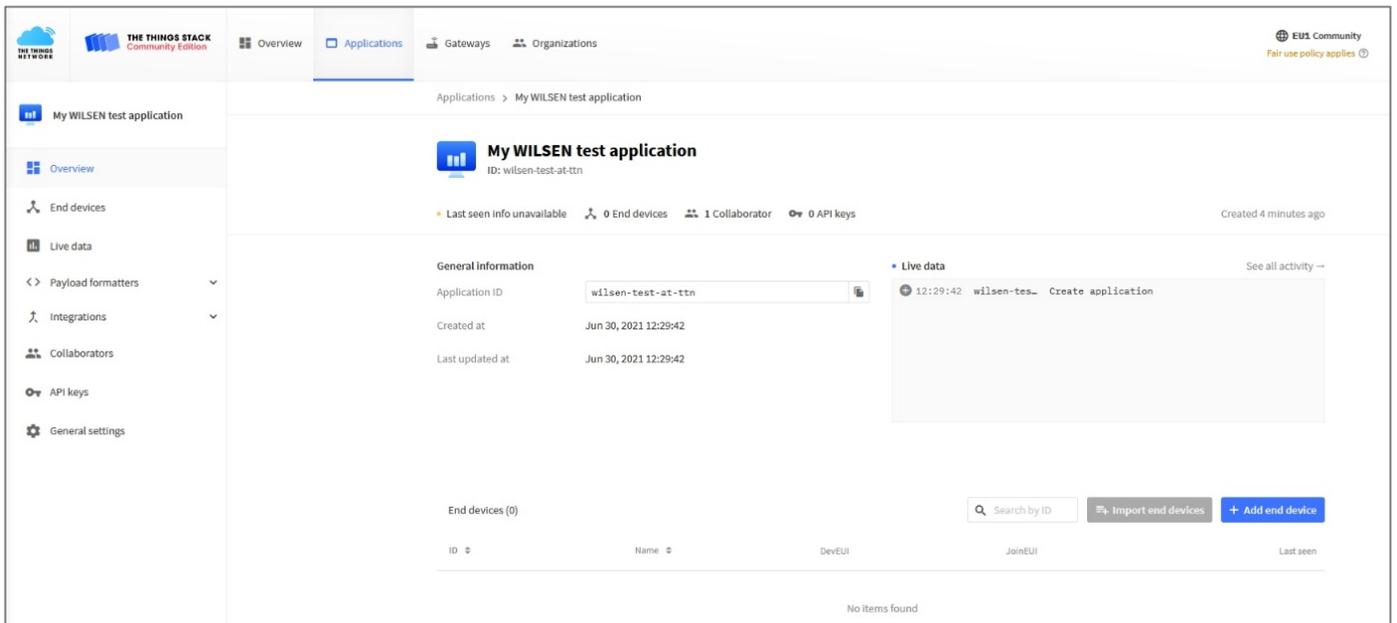
For more detailed information on the entries, see the relevant accompanying documentation in the portal.



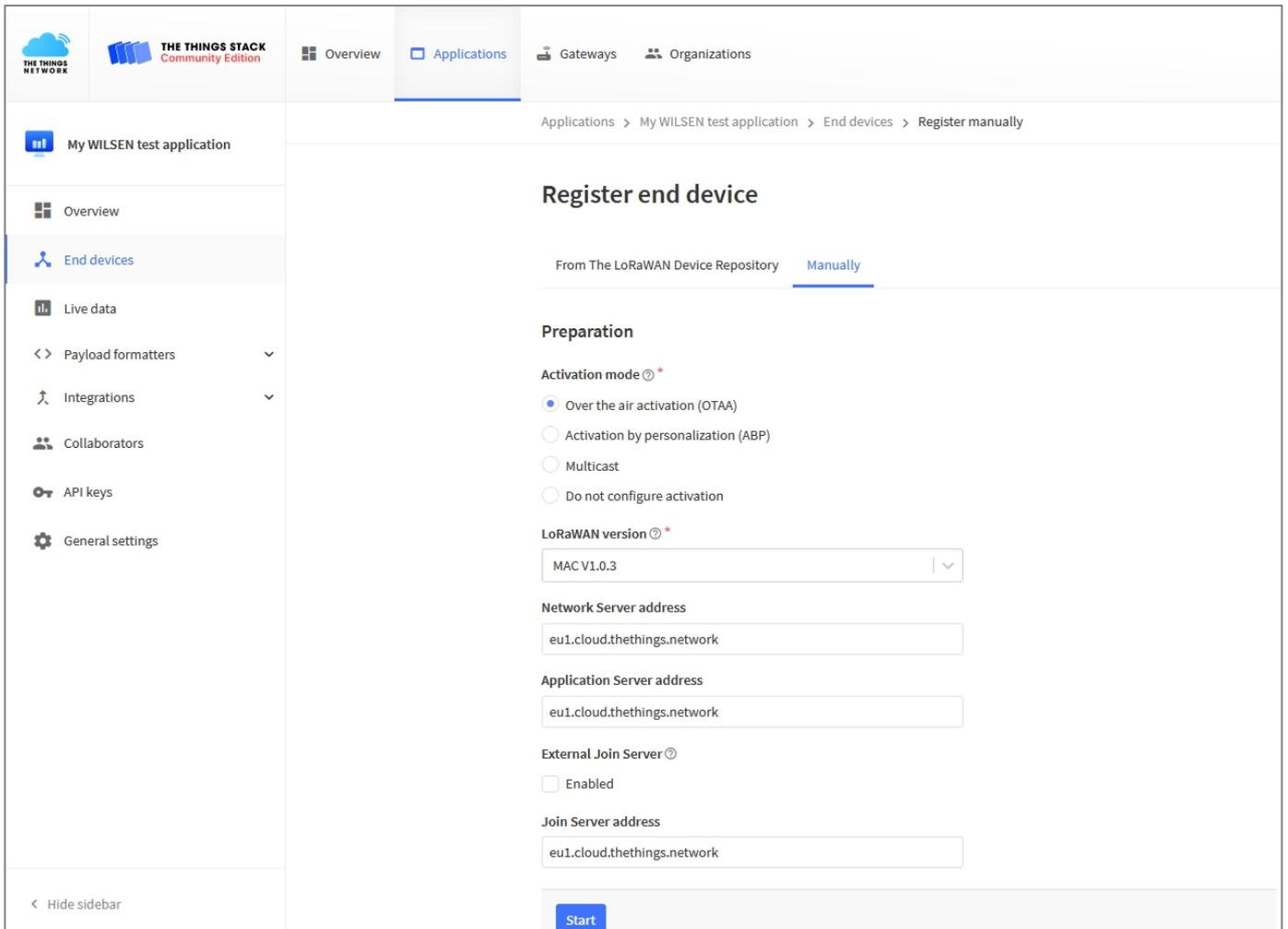
4. Confirm the entries by clicking on the *"Create application"* button.

3. Creating a New Device

1. Select the "Applications" tab and choose the application to which you want to add a device.
2. Then click on the "Add end device" button.



3. In the "Register end device" dialog, first select "Manually". Make sure that "Over the air activation (OTAA)" is selected as "Activation mode". In the following, select "MAC V1.0.3" as "LoRaWAN version".
4. Click on the "Start" button.



5. Follow the dialog for creating a new device and assign an "End Device ID" as device name.
Please note that the form editor only accepts lowercase letters and no spaces!
6. In the "AppEUI" field, enter either the "AppEUI" assigned as factory default by the device manufacturer or assign any 16-digit "AppEUI" in hexadecimal format for your application yourself.

Note

You can find the factory assigned AppEUI by connecting to the device using the WILSEN app. The AppEUI is displayed in the "LoRaWAN configuration" menu of the mobile app.

In case you assign your own AppEUI, the AppEUI must be changed and saved via the mobile app in the sensor settings.

7. Enter the "DevEUI (Device EUI)" next. This is a device-specific, unique identification number that each LoRaWAN device owns.

← LoRaWAN Config.		APPLY
Device EUI	9C:65:F9:FF:FE:45:66:8C	
Application EUI	00:00:00:00:00:00:00:0 1	
Application Key	E0:85:88:AB:24:99:40: 64:B5:16:46:DF:8F:5F: 5A:B0	

For WILSEN devices, the 16-digit number in hexadecimal format can be found by connecting to the device using the WILSEN app. The device-specific **Device EUI** is displayed in the "LoRaWAN configuration" menu of the app.

Alternatively, the Device EUI can also be found on the type plate and the packaging label of the device.

8. The "End device name" and "End device description" labels can be optionally assigned. Click the "Network layer settings" button to access the further settings.

Applications > My WILSEN test application > End devices > Register manually > Basic settings

Register end device

From The LoRaWAN Device Repository **Manually**

- 1 Basic settings**
End device ID's, Name and Description
- 2 Network layer settings**
Frequency plan, regional parameters, end device class and session keys.
- 3 Join settings**
Root keys, NetID and kek labels.

End device ID ⓘ *

AppEUI ⓘ *

00	00	00	00	00	00	00	01	00
----	----	----	----	----	----	----	----	----

DevEUI ⓘ *

9C	65	F9	FF	FE	45	66	8C
----	----	----	----	----	----	----	----

End device name ⓘ

End device description ⓘ

Optional end device description; can also be used to save notes about the end device

[Network layer settings >](#)

9. Select "Europe 863-870 MHz (SF9 for RX2 - recommended)" as "Frequency plan". Then click on the "Join settings" button.

Applications > My WILSEN test application > End devices > Register manually > Network layer settings

Register end device

From The LoRaWAN Device Repository **Manually**

1 **Basic settings**
End device ID's, Name and Description

2 **Network layer settings**
Frequency plan, regional parameters, end device class and session keys.

3 **Join settings**
Root keys, NetID and kek labels.

Frequency plan ⓘ *

Europe 863-870 MHz (SF9 for RX2 - recommended) | v

LoRaWAN version ⓘ *

MAC V1.0.3 | v

Regional Parameters version ⓘ *

PHY V1.0.3 REV A | v

LoRaWAN class capabilities ⓘ

Supports class B

Supports class C

Advanced settings v

< Basic settings

Join settings >

10. Enter the 32-digit AppKey in hexadecimal format required for encrypting the transmission data and click on the "Add end device" button.

Applications > My WILSEN test application > End devices > Register manually > Join settings

Register end device

From The LoRaWAN Device Repository **Manually**

✓ Basic settings
End device ID's, Name and Description

✓ Network layer settings
Frequency plan, regional parameters, end device class and session keys.

3 Join settings
Root keys, NetID and kek labels.

Root keys

AppKey ⓘ *

E0 85 88 AB 24 99 40 64 B5 16 46 DF 8F 5F 5A B0

Advanced settings ▾

< Network layer settings

Add end device

Note

As AppKey, the factory-assigned value from Pepperl+Fuchs can be used. You can find this by connecting to the device using the WILSEN app. The **Application Key** is displayed in the "LoRaWAN configuration" menu of the app.

Alternatively, you can also use a 32-digit hexadecimal value provided by the TTN network server or a 32-digit hexadecimal value that you have created yourself. It is only important that the same AppKey is entered both in the device and at TTN. In case the AppKey stored in the device should be customized, change it using the WILSEN app and save the new LoRaWAN settings in the device by pressing the "Apply" button.

The new device is now added to the selected application and also appears in the application-specific list of "End devices".



my-new-wilsen

ID: my-new-wilsen

Last seen info unavailable ↑ n/a ↓ n/a

Created 34 minutes ago

- Overview
- Live data
- Messaging
- Location
- Payload formatters
- Claiming
- General settings

General information

End device ID: my-new-wilsen

Description: This end device has no description

Created at: Jun 30, 2021 14:01:39

Activation information

AppEUI: 00 00 00 00 00 00 00 01

DevEUI: 9C 65 F9 FF FE 45 66 8C

Root key ID: n/a

AppKey: [redacted]

NwkKey: n/a

Session information

No data available

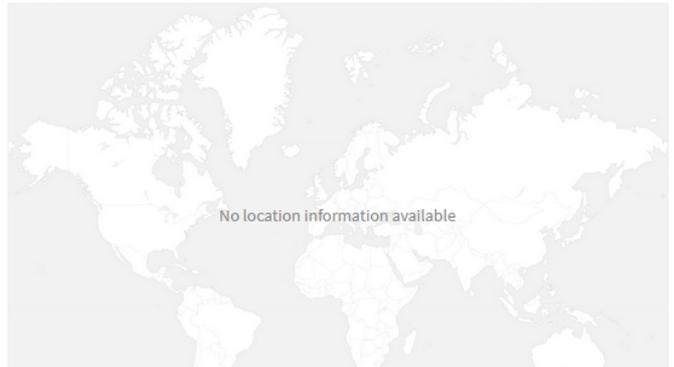
Live data

See all activity →

- 14:01:39 Create end device

Location

Change location settings →



Note

If the sensor is in the detection range of a LoRaWAN gateway registered with TTN, the connection establishment starts after the time set in the WILSEN app in the menu "LoRaWAN configuration" under item "Next transmission" has elapsed. You can recognize a successful connection establishment in the TTN by the fact that the status indicator of your device changes from yellow to blue.

After completing the sensor configuration, disconnect the Bluetooth connection between the WILSEN app and the device by first switching back to the "Device discovery" overview in the WILSEN app and then closing the app.

4. Transmitting Sensor Data

1. Select the "Applications" tab and choose the application you created.
2. Then click on "See all activity" in the "Live data" area on the right side of the screen.

An overview appears showing all incoming and outgoing telemetry data exchanged between LoRa network and the devices.

At the first connection between sensor and network, the device is logged into the network (a join process is performed).

After network login, telemetry data transfer between sensor and network starts. Data uploads from the sensor to the network are marked with a small arrow pointing upwards. Downloads from the network to the sensor are marked with a small arrow pointing down.

5. Payload Decoder

A payload decoder is used to interpret the payload string.

1. Select the "Applications" tab and choose the application you created. Then click "< > Payload formatter" in the left menu section, and then click "Uplink".
2. Select Javascript as the formatter type.
 - In the "Formatter parameter" area, you can now paste the payload decoder as a JavaScript program.

Note

The payload description and the payload decoder for your WILSEN.sonic.level can be downloaded online from the product detail page for the respective WS-UCC*-F406-B15-B41-* wireless ultrasonic sensor at www.pepperl-fuchs.com. See the Documents and Software areas.

```
1 use strict;
2
3 function decodeUplink(input) {
4   var ln;
5   var sID;
6   var obj = {};
7   var hexStr = byte2HexString(input.bytes);
8   var indicatorStr = ['FRESH', 'FIT', 'USABLE', 'REPLACE', 'FALSE DECODING'];
9   obj.payload = hexStr;
10  for (var i = 0; i < hexStr.length; i = i + 2) {
11    ln = parseInt(hexStr.substr(i, 2), 16);
12    sID = hexStr.substr(i + 2, 4);
13    if (sID == "01") { // Ambient Light Sensor
14      if (parseInt(hexStr.substr(i + 4, 2), 16) == 1) {
15        obj.light = parseInt(hexStr.substr(i + 6, 4), 16); // uint16
16      }
17    }
18  }
19  return obj;
20 }
```

3. Copy the program code of the "Payload decoder for TTN V3" from the downloaded text file and replace with it possibly pre-entered code in the field "Formatter parameter".
 - After pasting the source code, you must save it to the application. To do this, click the „Save changes“ button.

The screenshot shows the 'Live data' view for the application 'My WILSEN test application'. The table below summarizes the data transmissions shown in the interface.

Time	Entity ID	Type	Data preview
12:09:07	my-new-wilsen	Forward uplink data message	Payload: { battery_vol: 3.6, fillinglvl: 97, payload: "6488618623838886618682814180999A83518124", proxx: 38, temp: "23.7" } 04 88 01 88 23 83 08 86
12:09:08	my-new-wilsen	Forward uplink data message	Payload: { battery_vol: 3.6, fillinglvl: 97, payload: "6488618623838886618682814180999A83518124", proxx: 38, temp: "23.5" } 04 88 01 88 23 83 08 86
11:09:08	my-new-wilsen	Forward uplink data message	

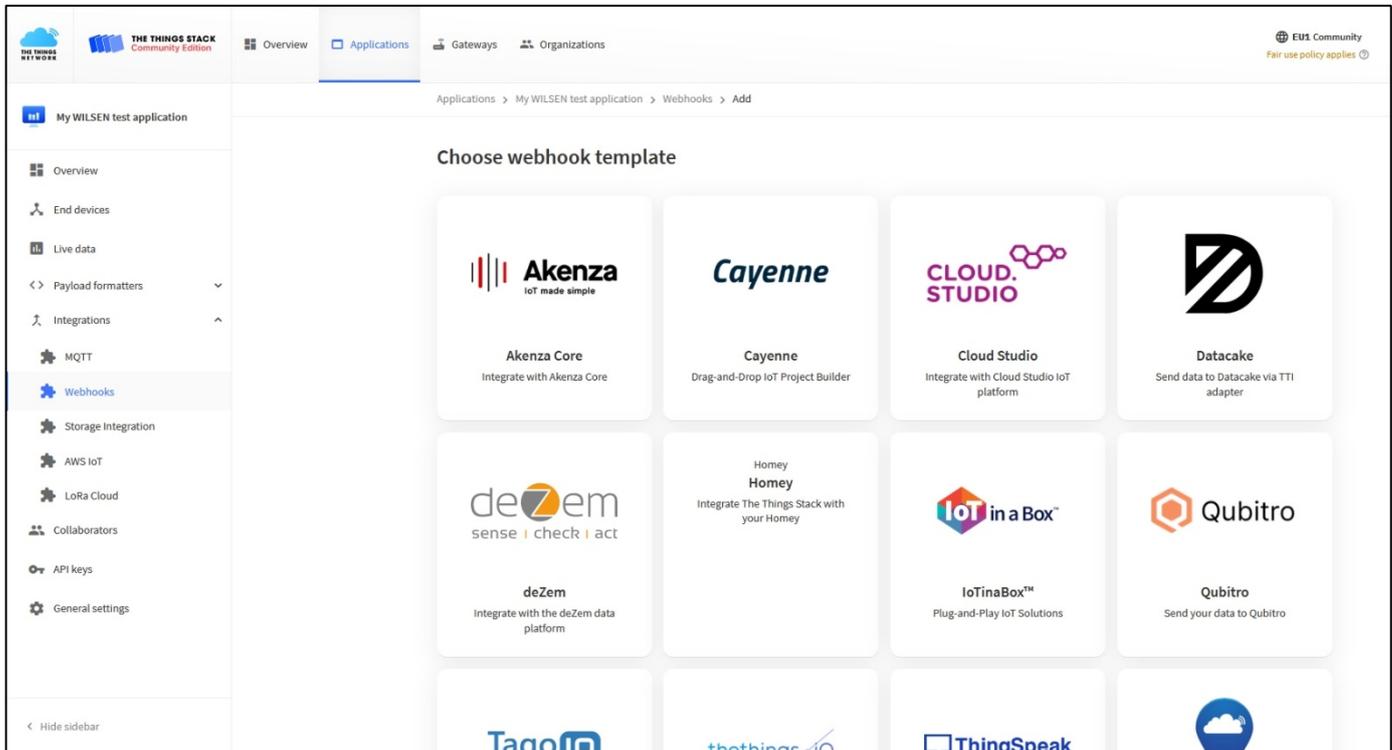
From now on, all newly added telemetry data transmissions under "Live Data" will be decoded and the individual measured values/values and information contained in each payload will be displayed.

6. Software Applications for Processing the Sensor Data

The incoming telemetry data from the LoRa sensors are stored in the TTN only within the active browser window. Thus, the data is lost by closing the browser window.

However, if the sensor data is to be stored for graphical display or later evaluation, it must be transferred from the TTN to a more advanced software application. The TTN already offers some integration possibilities as an example.

Select "Integrations" in the left menu area. In the opening list you can already see some possibilities. If you click on the option "Webhooks" and then on the button "+ Add webhook" in the upper right corner, you will get an overview of different integration options from various providers.



Among the integrations you will find:

- Databases for long-term storage of sensor data,
- IoT platforms for the graphical representation of sensor data,
- Applications for the logical processing of the data, for example, in which certain sensor values can trigger further actions.

To select a suitable integration, read the respective product description. Each integration provides specific documentation on how to integrate the sensor data from the TTN.