# Introduction to UG67 LoRaWAN® Gateway: Features, Configuration, and Applications

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# PLAN

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# Introduction

# Overview of LoRaWAN and IoT

The **Internet of Things (IoT)** refers to the growing network of devices connected to the internet, which communicate and share data. These devices range from simple sensors to complex systems like autonomous vehicles. The importance of IoT lies in its ability to collect real-time data, providing actionable insights across industries.

**LoRaWAN** is a Low Power, Wide Area Network (LPWAN) protocol designed for battery-operated devices in wireless networks. It excels in **long-range, low-power communication**, making it ideal for IoT applications. LoRaWAN allows devices to transmit small amounts of data over long distances, which is why it's widely used in agriculture, utilities, and smart cities.

In a **LoRaWAN network**, gateways act as bridges between the devices (nodes) and the network server (**gateways** act like translators between the devices and the internet).

For example, the **UG67** is a type of gateway that connects thousands of IoT devices to the cloud, where the data is stored and analyzed.

# Introduction to UG67 LoRaWAN Gateway

The UG67 LoRaWAN Gateway is a strong and durable device designed for outdoor use.

- It has 8 channels
- can connect up to 2000 devices at the same time.

This makes it perfect for large-scale projects like smart farming, building management, or industrial monitoring.

It can communicate over long distances:

- up to 15 km in rural areas and 2 km in cities, ensuring IoT devices stay connected.

The UG67 also offers different connection options, including Ethernet, Wi-Fi, and cellular, making it flexible for use in various situations.

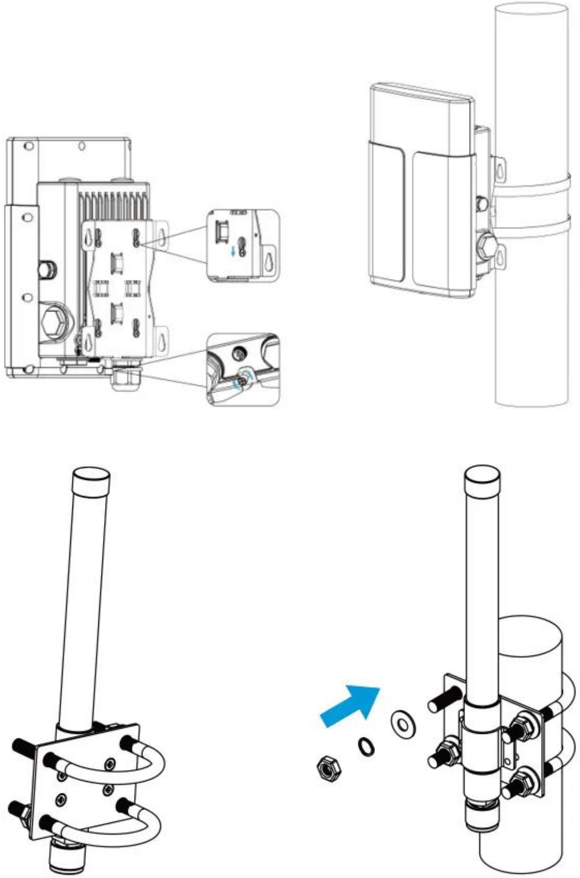
# Hardware and System Overview

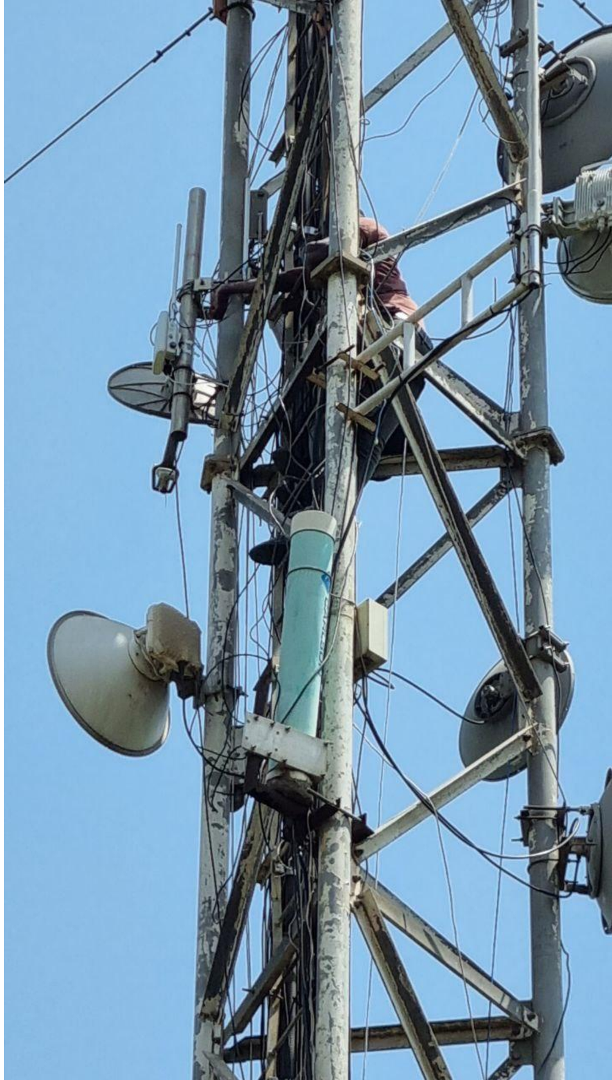
# Hardware Features

The UG67 is built with the **SX1302 LoRa chip** and a **high-performance quad-core processor** (ARM Cortex-A53, 1.5 GHz). This ensures the gateway can handle a large amount of traffic while maintaining low power consumption

**Outdoor Durability**: Designed for harsh environments, the UG67 has an **IP67-rated enclosure**, making it **dustproof and waterproof**. This feature ensures the gateway can operate in extreme temperatures ranging from **-40°C to +70°C**

It supports both **half-duplex and full-duplex** operation, making it versatile for different applications

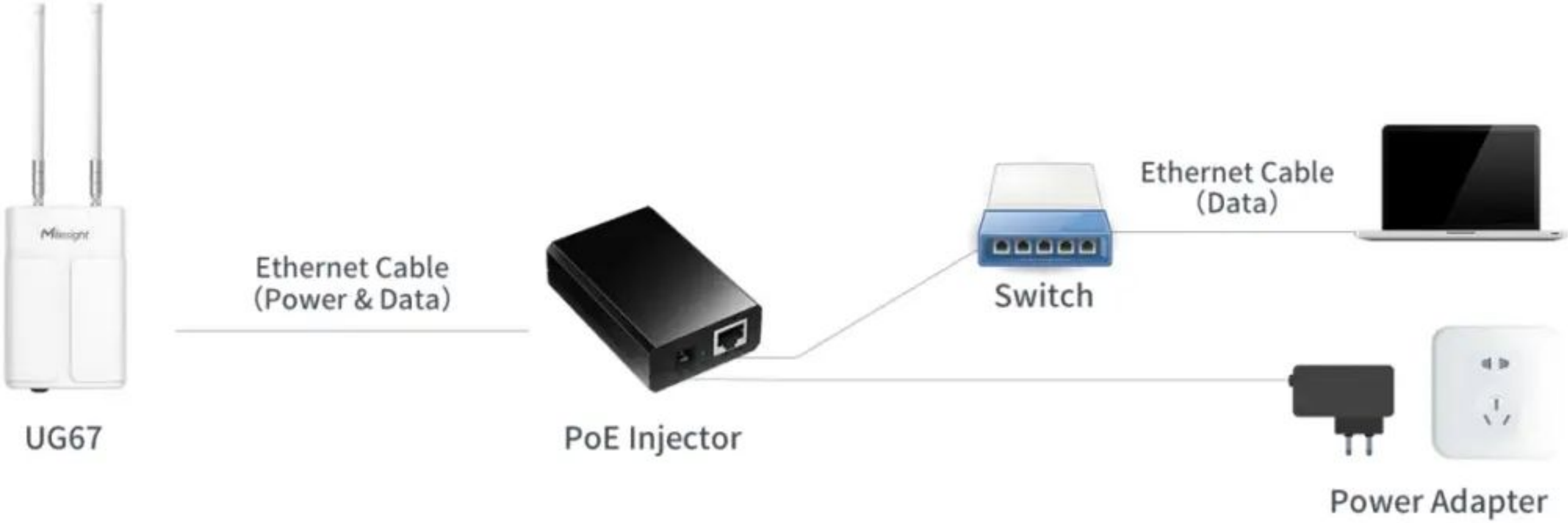




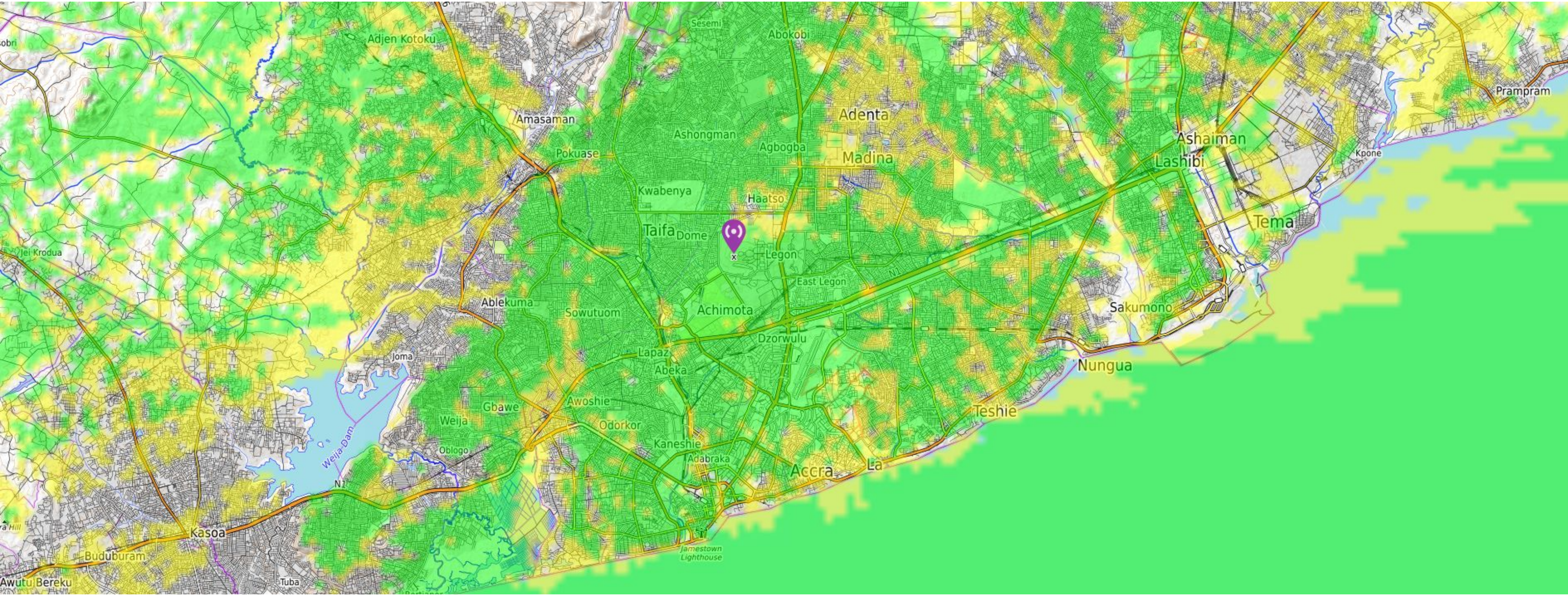
# Connectivity Options

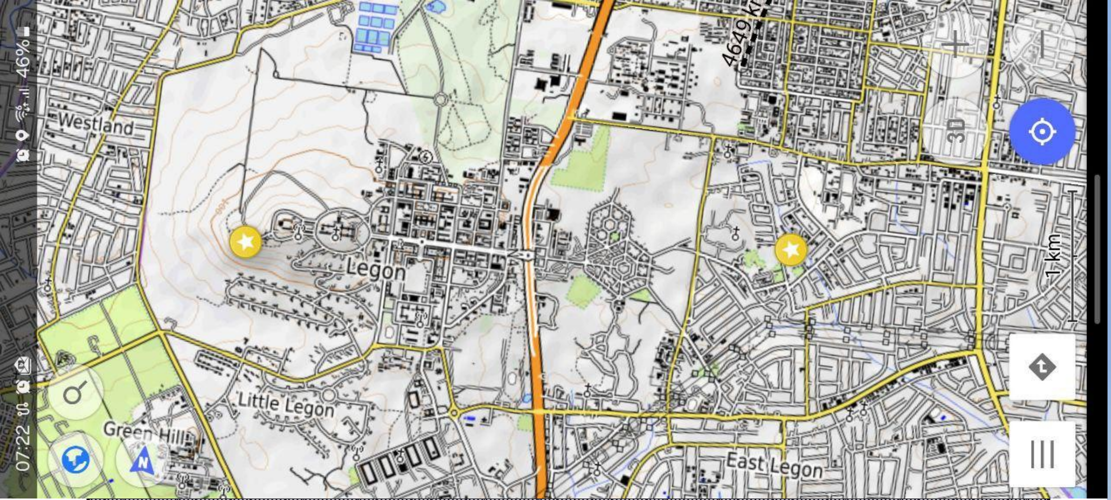
The UG67 offers **multiple backhaul options** for redundancy and reliability. It can connect to the internet through **Ethernet**, **Wi-Fi**, or **cellular** (3G/4G LTE), ensuring continuous operation even if one connection fails

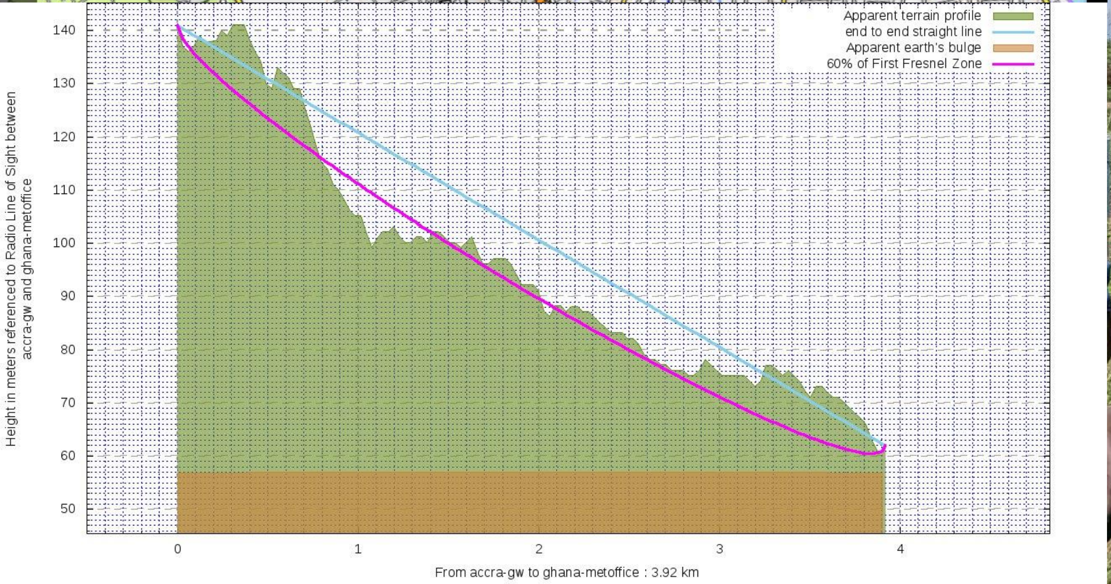
Power supply options include **Power-over-Ethernet (PoE)** or **DC power** through an M12 connector, providing flexibility in installation



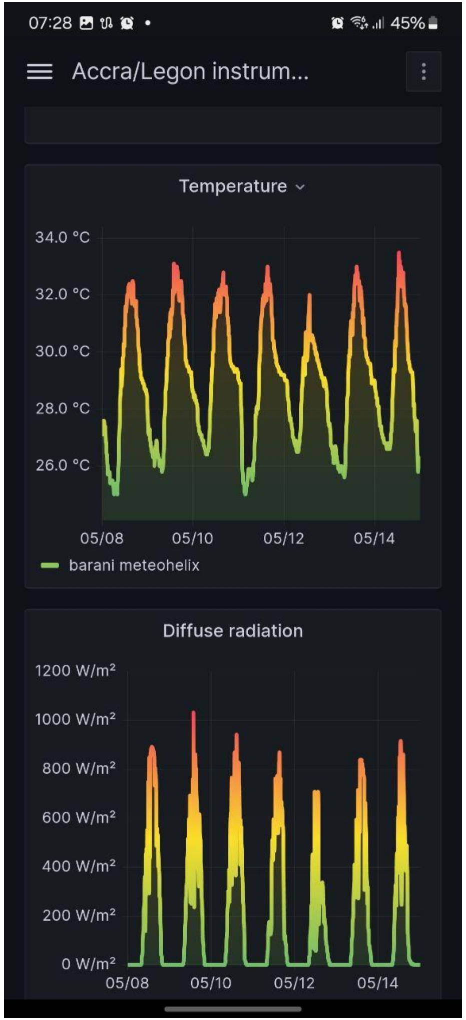
# Approximate coverage map

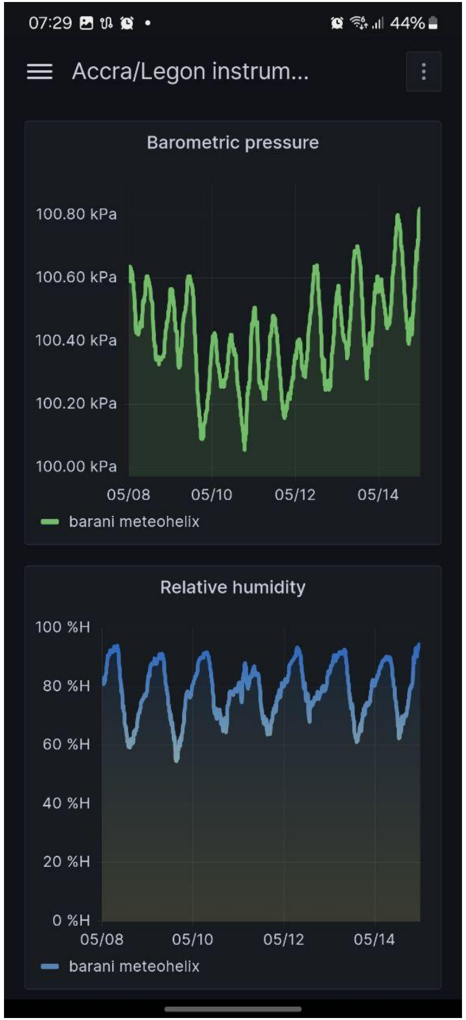


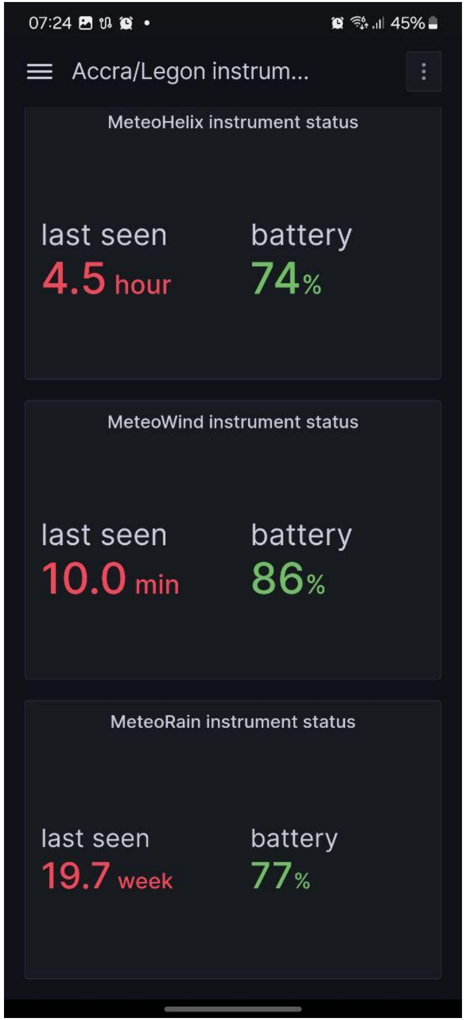

07:22
46%
Westland
Legon
Little Legon
Green Hill
East Legon
4649 km
1 km
3D


Apparent terrain profile
end to end straight line
Apparent earth's bulge
60% of First Fresnel Zone
Height in meters referenced to Radio Line of Sight between accra-gw and ghana-metoffice
140
130
120
110
100
90
80
70
60
50
0
1
2
3
4
From accra-gw to ghana-metoffice : 3.92 km

BARANI







MeteoHelix instrument status

last seen 4.5 hour

battery 74%

MeteoWind instrument status

last seen 10.0 min

battery 86%

MeteoRain instrument status

last seen 19.7 week

battery 77%

# Reliability and Security Features

## Software Reliability Features:

1. the **UG67 LoRaWAN Gateway** includes a **watchdog timer**. This feature helps monitor the system's operation, automatically restarting the gateway if it detects any malfunction or if the system becomes unresponsive. The watchdog enhances the reliability of the device, ensuring continuous operation by preventing software crashes from causing downtime.
2. **Backup Connectivity**: It offers multiple connectivity options (Ethernet, Wi-Fi, cellular) with automatic failover, ensuring that the gateway stays connected even if one network fails.

## Security Features:

1. **Secure Boot**: Ensures that the device starts up with only trusted and verified software, protecting against malware or tampered firmware.
2. **Data Encryption**: The UG67 supports AES-128 encryption for secure communication between devices and the gateway, ensuring that data is protected from unauthorized access.
3. **VPN Support**: It includes Virtual Private Network (VPN) support, such as OpenVPN and IPsec, for secure remote access and data transmission.

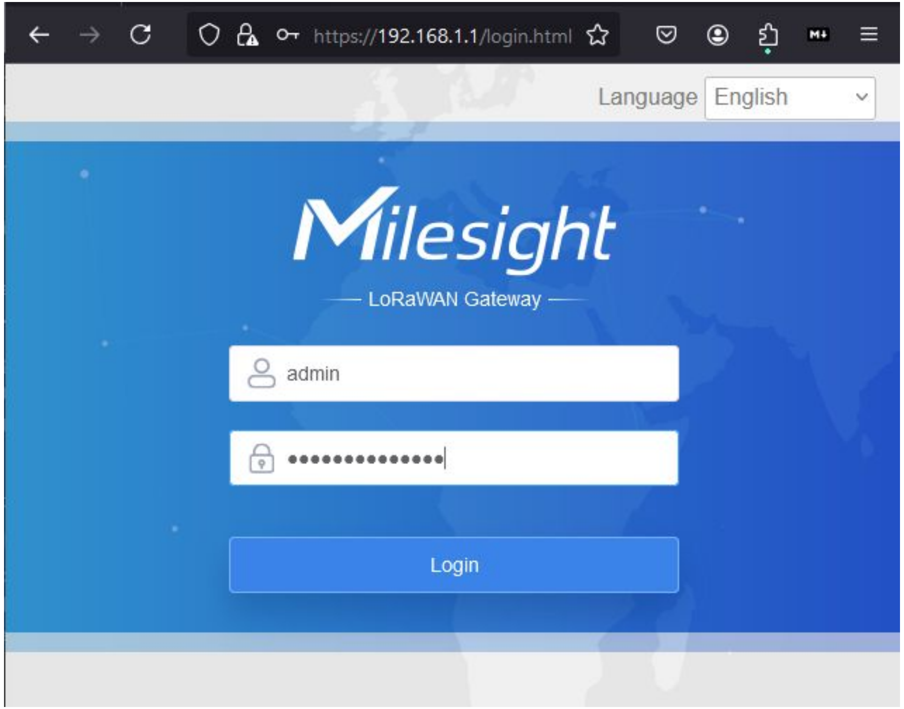
# Configuration and Management

# Web GUI Access and Initial Setup

To configure the UG67 gateway, you can access its **Web GUI** either through a **wired Ethernet connection** or **wirelessly** via Wi-Fi

In **wireless mode**, the gateway acts as an **access point (AP)**, and users can connect to it using default credentials (SSID and password)

After logging into the Web GUI, you can view the system status, set up network configurations, and manage LoRaWAN-related settings. It's recommended to change the default login credentials for security reasons.


https://192.168.1.1/login.html

Language English

admin

••••••••••••••

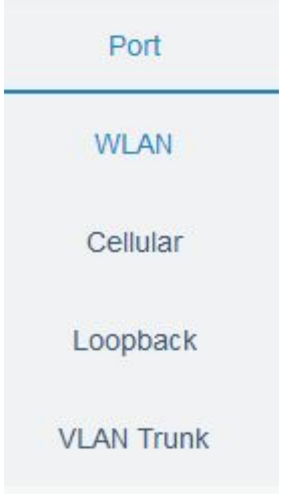
# Basic Network Configuration

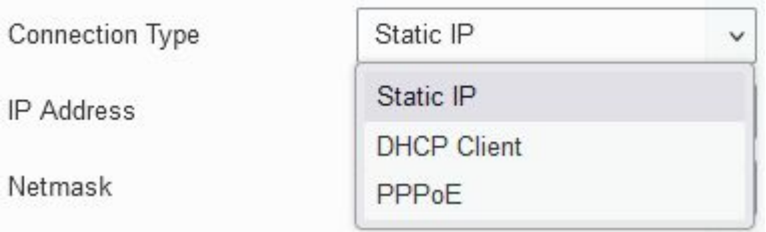
https://192.168.1.1/#network/interfaces/port

**Port (Ethernet Configuration)**: The UG67 supports three IP configuration modes: **Static IP**, **DHCP**, and **PPPoE**. You can manually set the IP address, netmask, and gateway in **Static IP mode**, or allow automatic IP assignment through **DHCP**

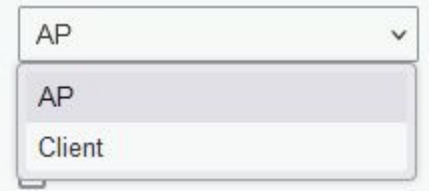
**WLAN (Wi-Fi Configuration)**: In **client mode**, the UG67 connects to an existing Wi-Fi network, while in **AP mode**, it creates its own Wi-Fi network. You can configure various security settings, including WPA2 encryption, to ensure secure wireless communication

**Cellular Configuration**: If the gateway uses a **cellular backhaul**, you can configure the **APN** (Access Point Name), **SIM card settings**, and **roaming options**. The UG67 can also switch automatically between Ethernet, Wi-Fi, and cellular backhauls for maximum uptime

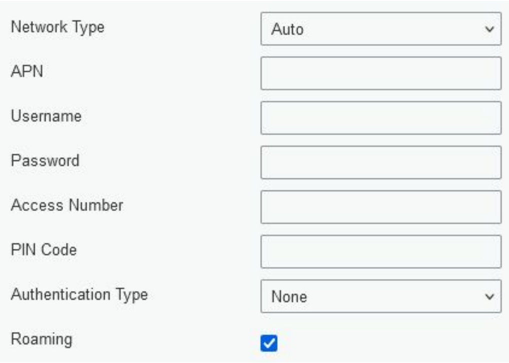




| | |
|---|---|
| Connection Type | Static IP |
| IP Address | |
| Netmask | |



AP



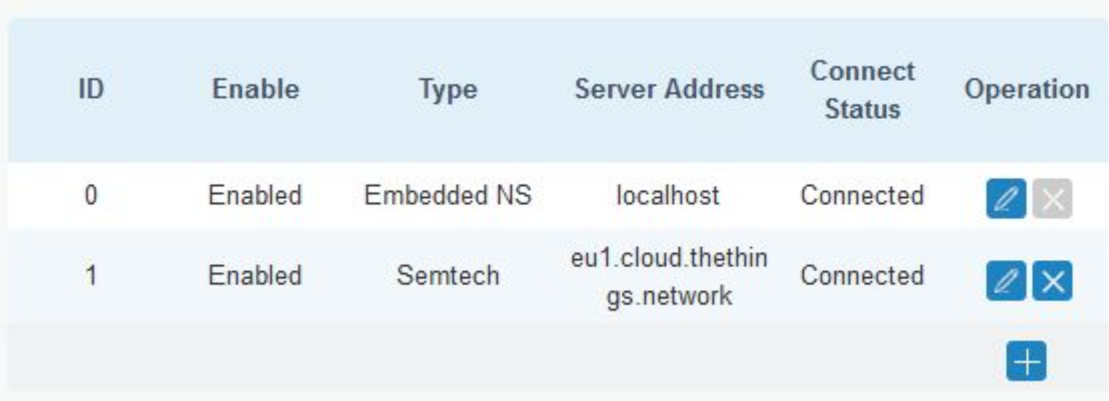
| | |
|---|---|
| Network Type | Auto |
| APN | |
| Username | |
| Password | |
| Access Number | |
| PIN Code | |
| Authentication Type | None |
| Roaming | ☑ |

# LoRaWAN Configuration

The UG67 supports both **packet forwarder** and **built-in network server** modes for LoRaWAN communication

**Packet Forwarder Mode**: This mode forwards data from LoRa nodes to a remote network server like **ChirpStack** or **The Things Network**

**Advanced Radio Settings**: You can customize radio parameters such as **frequency**, **bandwidth**, and **spreading factors** based on your region's regulations. The **noise analyzer** helps monitor interference in the environment to optimize deployment



| ID | Enable | Type | Server Address | Connect Status | Operation |
|---|---|---|---|---|---|
| 0 | Enabled | Embedded NS | localhost | Connected | |
| 1 | Enabled | Semtech | eu1.cloud.thethings.network | Connected | |

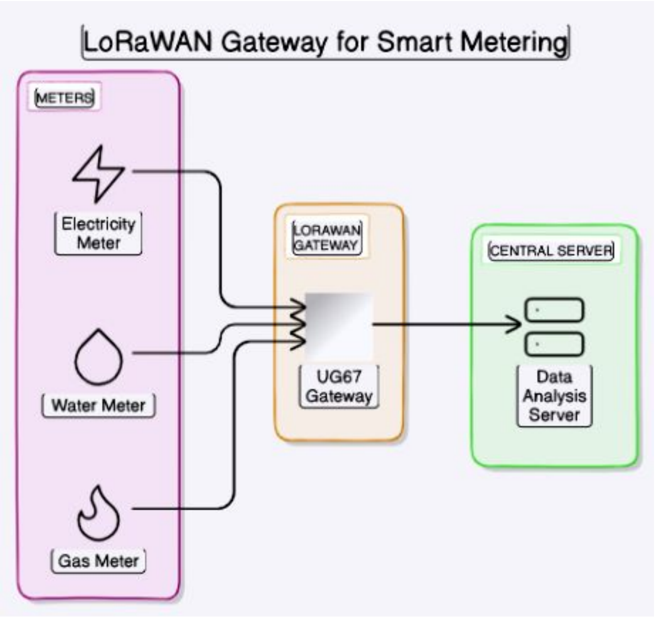
# Use Cases and Applications

# Key Applications

**Smart Metering**: The gateway is perfect for utility companies looking to implement **smart metering** solutions for water, gas, and electricity. Meters can transmit data over long distances to the UG67, which then forwards the data to a central server for analysis

**Smart Agriculture**: Farmers can use the UG67 to monitor soil moisture, temperature, and weather data through LoRaWAN-enabled sensors. The long-range communication and low power consumption of the gateway make it ideal for covering large farmlands

**Building Management Systems (BMS)**: The UG67 supports **BACnet/IP**, enabling integration with building automation systems. This makes it an excellent solution for managing lighting, HVAC systems, and security in smart buildings



# Node-RED and Python SDK

The UG67 LoRaWAN Gateway has two powerful features that make it easier for developers to create custom applications:

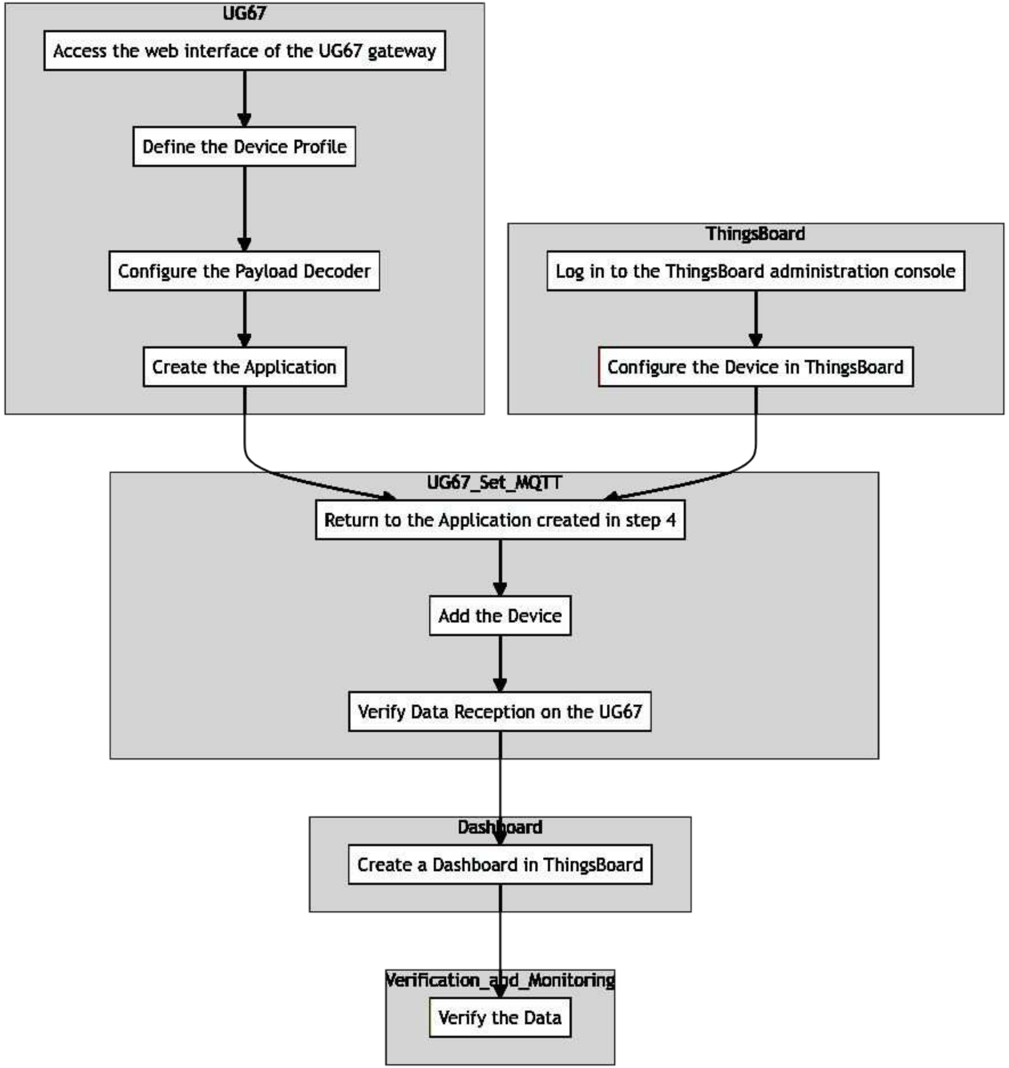
- **Node-RED Integration:** The UG67 comes with built-in support for Node-RED, a visual tool that allows users to connect devices, online services, and APIs through an easy drag-and-drop interface. This makes it simple to create custom workflows without needing to write a lot of code, which is perfect for users who want to quickly set up automation or data processing tasks.
- **Python SDK:** The gateway also includes an embedded Python SDK, allowing developers to write custom scripts directly on the gateway. This is great for creating more advanced applications tailored to specific needs, giving flexibility to developers who need to implement complex functions.

# Summarizing Key Features and Benefits:

- **Robust Connectivity**: It supports thousands of IoT devices with secure, reliable communication.
- **Long-Range Communication**: Provides up to 15 km in rural areas and 2 km in urban settings.
- **Outdoor Durability**: Designed for harsh environments with water and dust resistance (IP67).
- **Versatile Network Options**: Includes multiple backhaul options (Ethernet, Wi-Fi, cellular) and VPN support.
- **Built-in Network Server**: Simplifies IoT deployments by managing devices and data efficiently.

# Next: Clement will tell about ThingsBoard Integration

Configuration sequence to define a Device in UG67 and to collect data to TingsBoard



UG67

Access the web interface of the UG67 gateway

Define the Device Profile

Configure the Payload Decoder

Create the Application

ThingsBoard

Log in to the ThingsBoard administration console

Configure the Device in ThingsBoard

UG67_Set_MQTT

Return to the Application created in step 4

Add the Device

Verify Data Reception on the UG67

Dashboard

Create a Dashboard in ThingsBoard

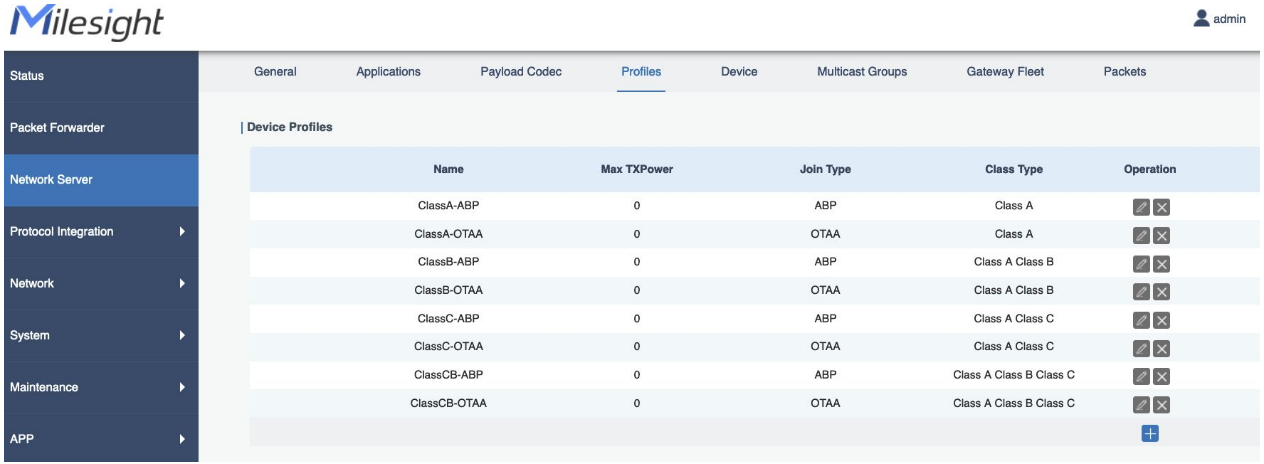
Verification_and_Monitoring

Verify the Data

# Define the End Nodes Profiles

Go to  Network Server > Profiles

Normally will be using only Class A devices, and OTAA (Over The Air Authentication) procedure.



Device Profiles

| Name | Max TXPower | Join Type | Class Type | Operation |
|---|---|---|---|---|
| ClassA-ABP | 0 | ABP | Class A | |
| ClassA-OTAA | 0 | OTAA | Class A | |
| ClassB-ABP | 0 | ABP | Class A Class B | |
| ClassB-OTAA | 0 | OTAA | Class A Class B | |
| ClassC-ABP | 0 | ABP | Class A Class C | |
| ClassC-OTAA | 0 | OTAA | Class A Class C | |
| ClassCB-ABP | 0 | ABP | Class A Class B Class C | |
| ClassCB-OTAA | 0 | OTAA | Class A Class B Class C | |

# LoraWAN: class of devices

Devices are categorized into three classes (A, B, and C) based on how they communicate with the network.

**Class A (Most energy-efficient):** These devices send data to the network whenever they need to, but they only listen for responses for a very short time right after sending their message. This class is great for battery-powered devices like sensors, where saving energy is really important.

**Class B (Scheduled listening times):** These devices not only send data when needed but also have scheduled times to listen for incoming messages from the network. This allows for more frequent communication, but they still manage to save power. Class B is useful for applications where you want to regularly communicate with the device, like in smart meters.

**Class C (Always listening):** These devices are always ready to receive messages, making them perfect for real-time communication. However, this uses much more power.

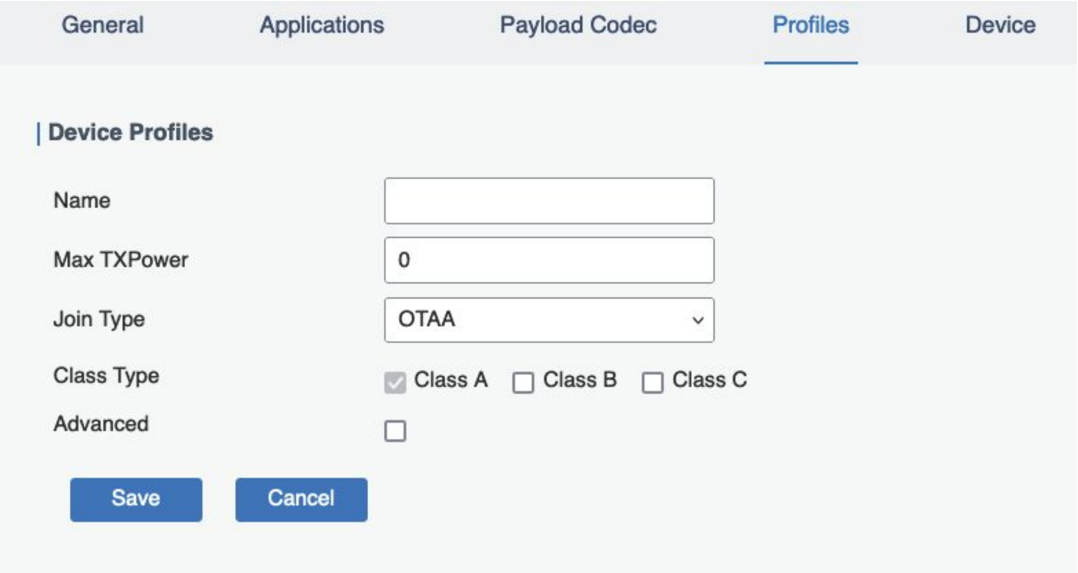
# Add profile

Click on the + sign at the bottom right to add a new End Node

Enter the **name** you chose for the End Node and **0** (zero) for **Max TXPower, OTAA** as Join Type and **Class A.**

Note: **Max TXPower 0** corresponds to 14 dBm of transmission power. Any other value in this field will **reduce** the transmission power. OTAA is the chosen type of authentication. We will only use Class A devices.

Click on Save



Device Profiles

Name

Max TXPower 0

Join Type OTAA

Class Type ☑ Class A □ Class B □ Class C

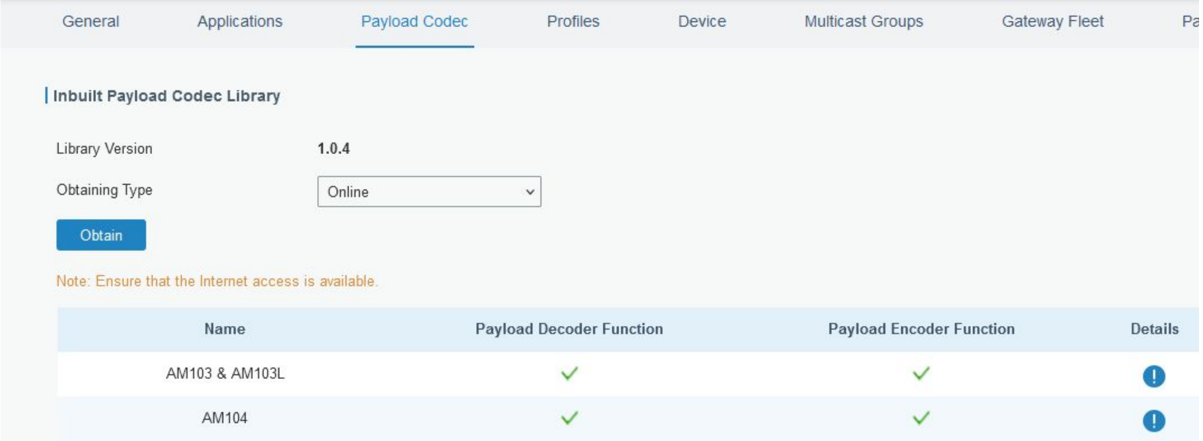
Advanced □

# Entering the Payload Codec for a device

In a LoRaWAN gateway, a payload codec is used to decode or encode the data (payload) that is sent by sensors or devices.

This is important because LoRaWAN messages are often sent in a compressed or binary format to minimize data usage. The payload codec translates this data into a human-readable format (decode) or prepares it for transmission (encode).

In UG67 goto: Network Server > Payload Codec



Inbuilt Payload Codec Library

Library Version 1.0.4

Obtaining Type: Online

Note: Ensure that the Internet access is available.

| Name | Payload Decoder Function | Payload Encoder Function | Details |
|---|---|---|---|
| AM103 & AM103L | ✓ | ✓ | ! |
| AM104 | ✓ | ✓ | ! |

# Payload codec characteristics

### What is the Payload?

- The **payload** is the actual data sent by a device (like a temperature reading or sensor status).
- For example, a sensor might send a value like `0x1F`, which could mean a temperature of 31°C, but it’s not directly readable in this form.

### Why Use a Codec?

- The payload from devices is usually compressed or encoded to make messages smaller, conserving power and bandwidth.
- The **codec** decodes this small, compressed data into something more understandable, like `"temperature": 31°C`.

### Where Does the Codec Run?

- The codec can run either **on the gateway** itself or more commonly **on the platform** (like TTN or ThingsBoard), where you define how to decode and encode the payloads.

### How Does the Codec Work?

- **Decoding**: The sensor sends raw binary data. The codec (written in JavaScript or a similar language) converts this data into a human-readable format.
- **Encoding**: If you're sending data back to the device, the codec converts readable commands into binary form before transmission.

# Create an Applications

In the UG67, applications are set up to manage the data received from LoRaWAN devices and forward it to other servers using protocols such as MQTT, HTTP, or similar methods.

## How it Works:

**Receiving Data from Devices**: LoRaWAN devices, such as temperature or humidity sensors, send their data to the UG67 gateway.

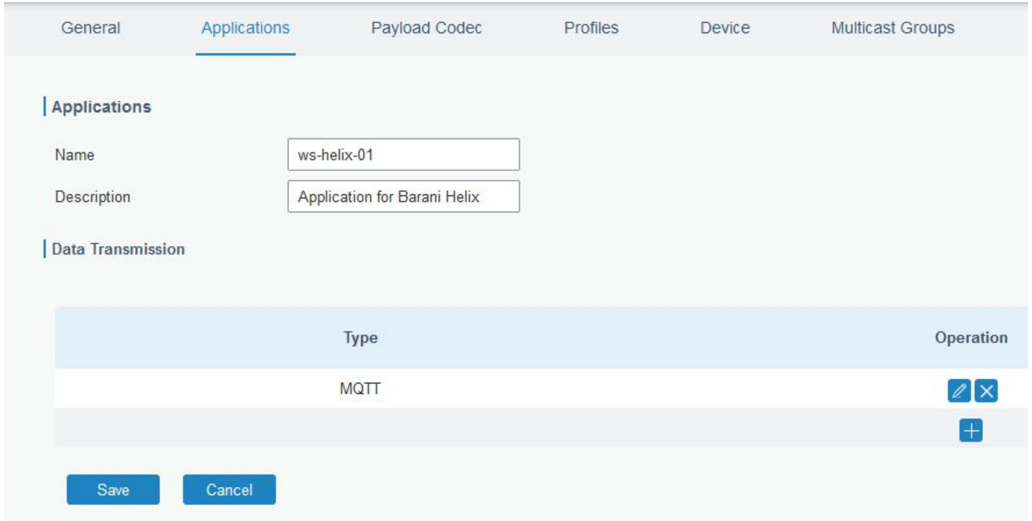
**Application Defined**: In the UG67, you create an application that defines how the collected data will be handled.

- You can configure an **endpoint** (such as an MQTT broker or HTTP server) where the data will be forwarded.

**Sending Data to External Servers**:

- The application takes the data received by the gateway and forwards it to the specified server.
- The chosen protocol (**MQTT**, **HTTP**, **HTTPS**, etc.) depends on your IoT solution's architecture.

# Example of application

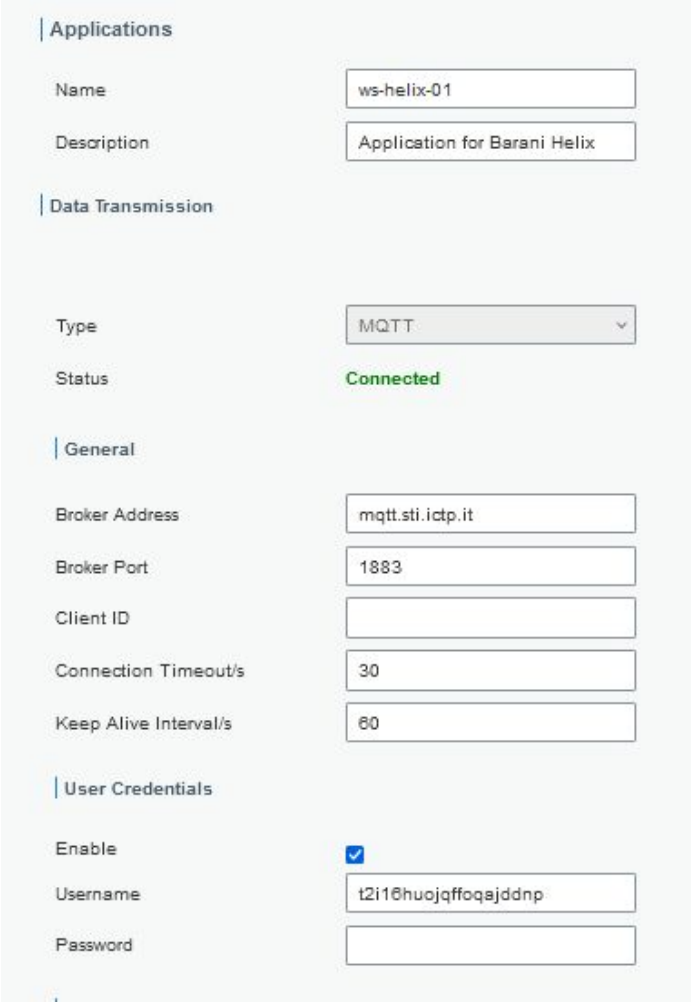


**Applications**

|  |  |
|---|---|
| Name | ws-helix-01 |
| Description | Application for Barani Helix |

**Data Transmission**

| Type | Operation |
|---|---|
| MQTT | ✎ ☒ |
|  | ⊞ |



**Applications**

|  |  |
|---|---|
| Name | ws-helix-01 |
| Description | Application for Barani Helix |

**Data Transmission**

|  |  |
|---|---|
| Type | MQTT |
| Status | Connected |

**General**

|  |  |
|---|---|
| Broker Address | mqtt.sti.ictp.it |
| Broker Port | 1883 |
| Client ID |  |
| Connection Timeout/s | 30 |
| Keep Alive Interval/s | 60 |

**User Credentials**

|  |  |
|---|---|
| Enable | ☑ |
| Username | t2i16huojqffoqajddnp |
| Password |  |

# Devices in UG67

A **device** is typically a sensor or a piece of equipment that measures something in the environment or monitors a certain condition (like temperature, motion, or air quality), connected wirelessly to the **UG67 gateway** using LoRaWAN.

## How Does it Work?

1. **Data Collection**: The device collects data, such as the current temperature, humidity, or the presence of water in an area.
2. **Sending Data**: The device then uses LoRaWAN to send this information wirelessly to the UG67 gateway.
3. **Gateway Receives Data**: The UG67 acts as a **bridge** that receives this data from the device and forwards it to a platform where it can be analyzed or visualized (such as an app or a server).

## How Devices and the UG67 Work Together:

- Devices communicate with the UG67 gateway using **LoRaWAN**.
- The UG67 then processes and forwards this data to a server or platform (using protocols like MQTT or HTTP) where you can view the information and act on it, like turning on a fan if a temperature sensor detects high heat.

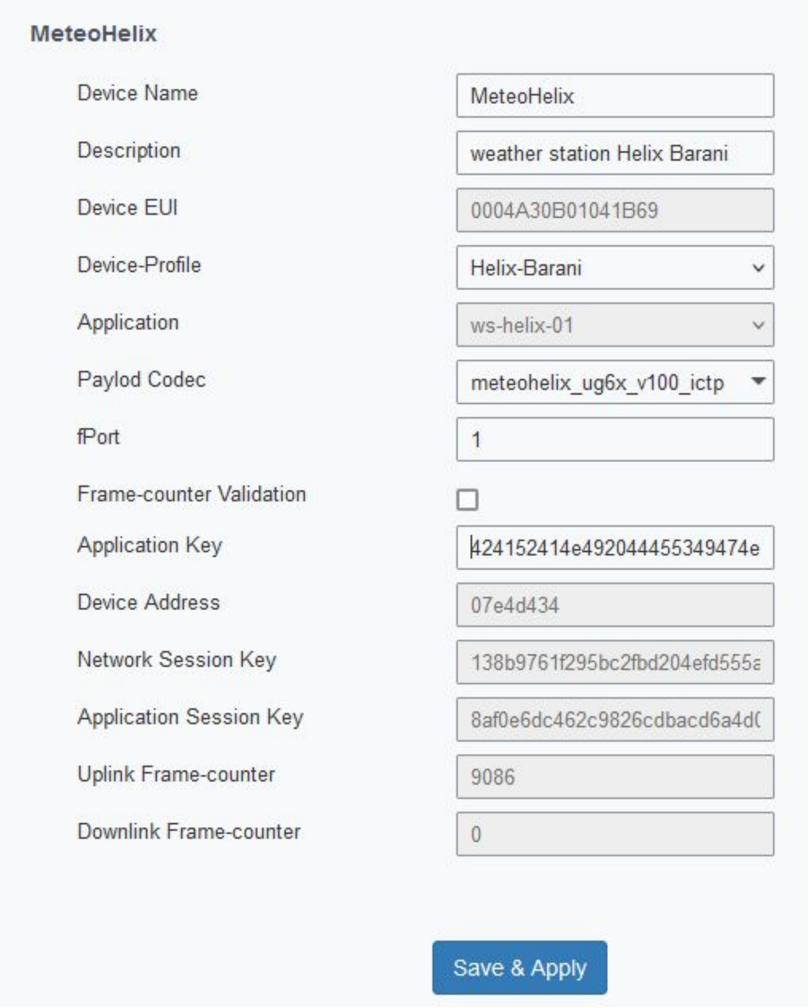
# Create a new device

Go to the Device List page: navigate to `Network Server` > `Device`.
Press `Add Device` button to register new device

Enter these parameters::

- **Device Name**: Arbitrary Name.
- **Device EUI**: Unique identifier of the LoraWAN device.
- **Application**: Select the name of the application previously created.
- **Device Profile**: Select the device profile created
- **Payload Codec**: Select the configured payload codec saved in UG67.
- **Application Key**: Enter the device's Application Key for OTAA connection

Save the settings.



**MeteoHelix**

| | |
|---|---|
| Device Name | MeteoHelix |
| Description | weather station Helix Barani |
| Device EUI | 0004A30B01041B69 |
| Device-Profile | Helix-Barani |
| Application | ws-helix-01 |
| Paylod Codec | meteohelix_ug6x_v100_ictp |
| fPort | 1 |
| Frame-counter Validation | ☐ |
| Application Key | 424152414e492044455349474e |
| Device Address | 07e4d434 |
| Network Session Key | 138b9761f295bc2fbd204efd555 |
| Application Session Key | 8af0e6dc462c9826cdbacd6a4d |
| Uplink Frame-counter | 9086 |
| Downlink Frame-counter | 0 |