LORA: SIMPLIFIED DEPLOYMENT OF SENSORS IN THE FIELD

Autonomous sensors and long-distance communication Using the LoRa module with the Nucleo L476 board

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LoRaWan technology is a radio communication protocol (frequency 868 MHz in France) which allows the exchange of data between connected objects.

The signal is emitted over a wide spectral range, limiting the risk of interference and allowing data to be sent from outdoors or indoors over long distances (1km in urban areas - up to 20km in rural areas).

Message sending is unlimited. However, unlike 4G and 5G networks, LoRaWan data rates are very low, only a few kilobits per second. This type of network is therefore used for the Internet of Things (IoT), i.e., fixed sensors (e.g., temperature, humidity, etc.).

Sensors using LoRa (radio wave modulation) technology connect to the Internet via gateways. These can be antennas (as in France with Orange) or boxes to connect to your personal fiber/ADSL network.

Purpose of the sheet

This datasheet guides you through the creation of a communicating IoT sensor using LoRaWAN technology that allows the visualization of data collected in the field directly on the Vittamap tool. The objective is to develop an autonomous system capable of collecting environmental data (temperature, humidity, pressure) and transmitting it wirelessly over long distances to an online visualization platform.

Operating principle

The assembly is based on a three-layer interconnected architecture. The first layer concerns data acquisition using the NUCLEO-IKS01A3 board, which incorporates several high-precision MEMS sensors to measure environmental parameters in real time. The second layer handles processing and communication: the NUCLEO-L476RG board with its ARM Cortex-M4 microcontroller processes the collected data, while the LoRa E5 Grove module handles long-range radio transmission. Finally, the third layer manages the network and visualization, with the data passing through the public or private LoRaWAN network before being visualized on the Vittamap platform.

The system operates in a continuous, automatic loop. The sensors first acquire environmental parameters, then the microcontroller formats this data before the LoRa module transmits it via radio waves on the 868 MHz frequency. The data is then routed through a LoRaWAN gateway to the Internet to appear in real time on the interactive visualization map.

This solution offers major advantages for field applications. Energy autonomy, thanks to ultra-low consumption, allows battery operation for several years. The communication range can reach 20 km without intermediate infrastructure. Deployment is simple since no complex network configuration is required, and the solution remains easily scalable for hundreds of sensors. This approach is particularly suitable for field applications where traditional networks such as WiFi or 4G are unavailable or unreliable, particularly for environmental monitoring as proposed in SteamCity.

USING THE LORA MODULE WITH THE NUCLEO L476 BOARD

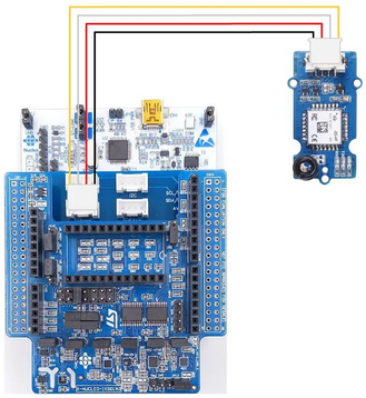
List of necessary equipment

Material	Description	Documentation
NUCLEO-L476RG Cards	Development board designed to facilitate the prototyping of complex electronic projects	https://fr.vittascience.com/shop/289/NUCLEO-L476RG
MiniUSB cable	30cm cable for Arduino Nano board or ST Nucleo-L476RG board	https://fr.vittascience.com/shop/308/Cable-pour-carte-programmable-microUSB
NUCLEO-Shield	Expansion interface allowing easy connection of external modules thanks to its standardized connectors	https://fr.vittascience.com/learn/tutorial.php?id=510
NUCLEUS-IKS01A3	MEMS board including a temperature, pressure, relative humidity sensor, an accelerometer, a gyroscope and a magnetometer	https://fr.vittascience.com/shop/309/NUCLEO-IKS01A3
Module LoRa E5 Grove	Grove LoRa module based on STM32WLE5JC chip	https://fr.vittascience.com/shop/312/Module-LoRa-E5---Grove

Assemblage

To send data over the LoRaWan network, make the following connections:

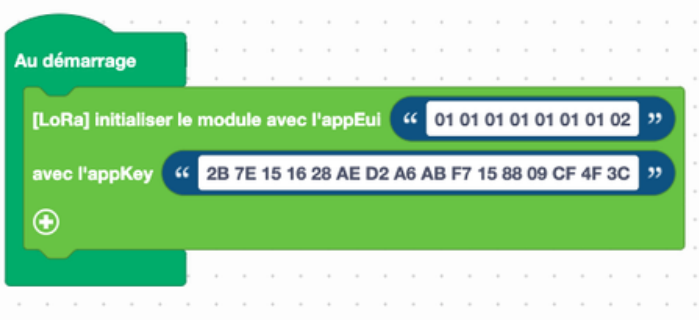
- Connect the NUCLEO shield to the board connectors.
- Connect the LoRa E5 module to the available UART port using the Grove cable.
- Mount the NUCLEO-IKS01A3 module on top.
- Connect the L476RG card to the computer using the mini USB cable.



Programming - Initialization

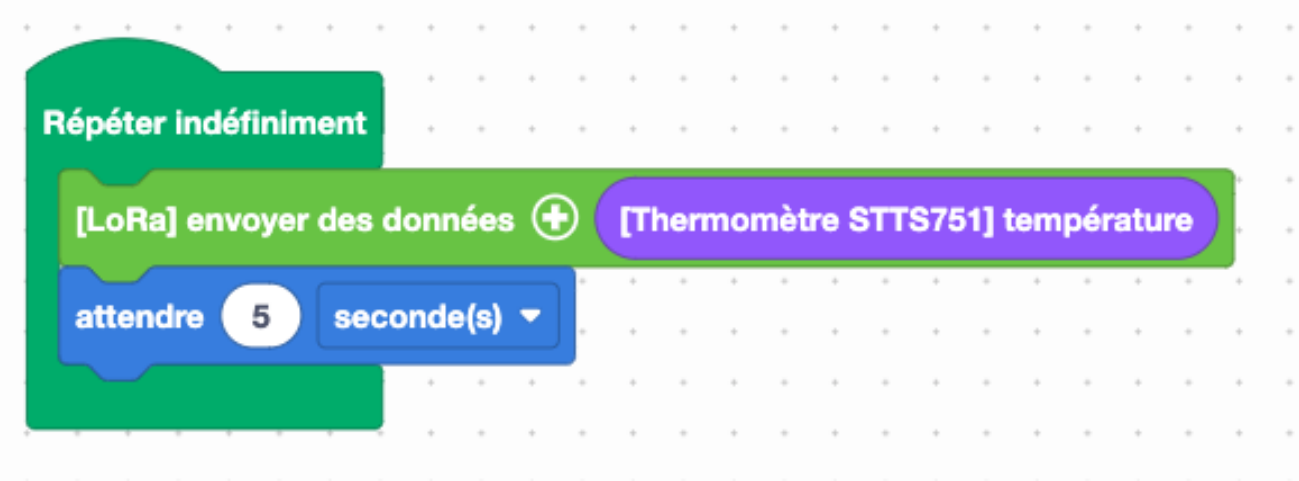
Let's move on to programming! Two blocks are available in the Communication section of the block rack. One block is used to initialize the module upon first use, the other to send sensor data.

The first step is to initialize the LoRa E5 module. This will retrieve its unique identifier and connect it to the network. To do this, place the "[LoRa] initialize module..." block in the On startup block. (Do not touch the values already entered in the block). Then transfer the program to the board and open the console at the bottom of the interface. The devEUI identifier will appear, and you will need to write it down - this is the identifier of your module.



Programming - Sending Data

Now that we have initialized the module, you can send sensor data. Since the LoRa protocol supports the transmission of small amounts of information for stationary objects, we will use the NUCLEO-IKS01A3 board and its temperature, humidity, and pressure sensors. For example, to send temperature information, use the block: "[LoRa] send data (...)" in the Communication section of the blocks folder and the block: "[STTS751 Thermometer] temperature" in the Sensors section. Add a 5-second pause to the program. Then transfer the program to the board.



Visualize the data

Data is now transmitted every 5 seconds over the LoRa network. To view it, you can use the Vittamap map developed by Vittascience, available at: https://fr.vittascience.com/vittamap/

This interactive map brings together all the experiences shared by the Vittascience user community. You'll need to add an experience by clicking the plus sign in the top right corner.