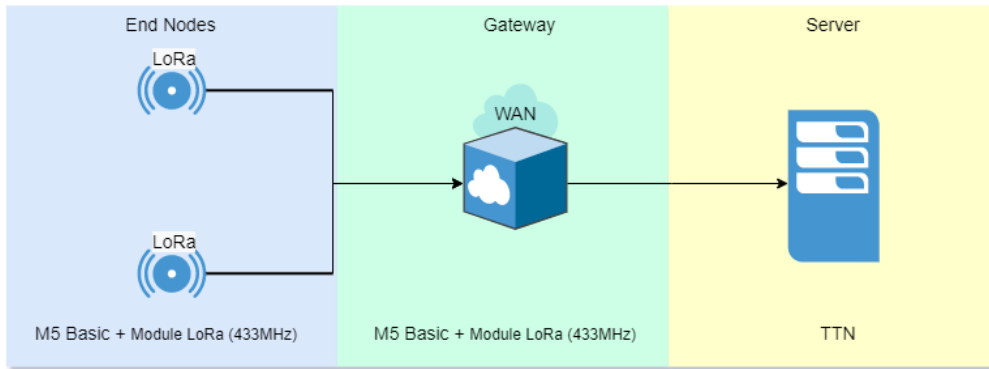


LoRaWAN470 Gateway & Node



Building LoRaWAN470 Gateway and Node based on M5Stack device

This tutorial will introduce how to realize LoRaWAN470 gateway and node through [M5 BASIC](#) host and [Module LoRa \(433MHz\)](#), and communicate with [TTN](#), we put the firmware in [Burner](#), and user can use Burner for parameterization. and communicate with [TTN](#), we put the firmware in [Burner](#), and users can set the parameters through Burner.

1. Step 1: Preparation

1.1 Hardware preparation

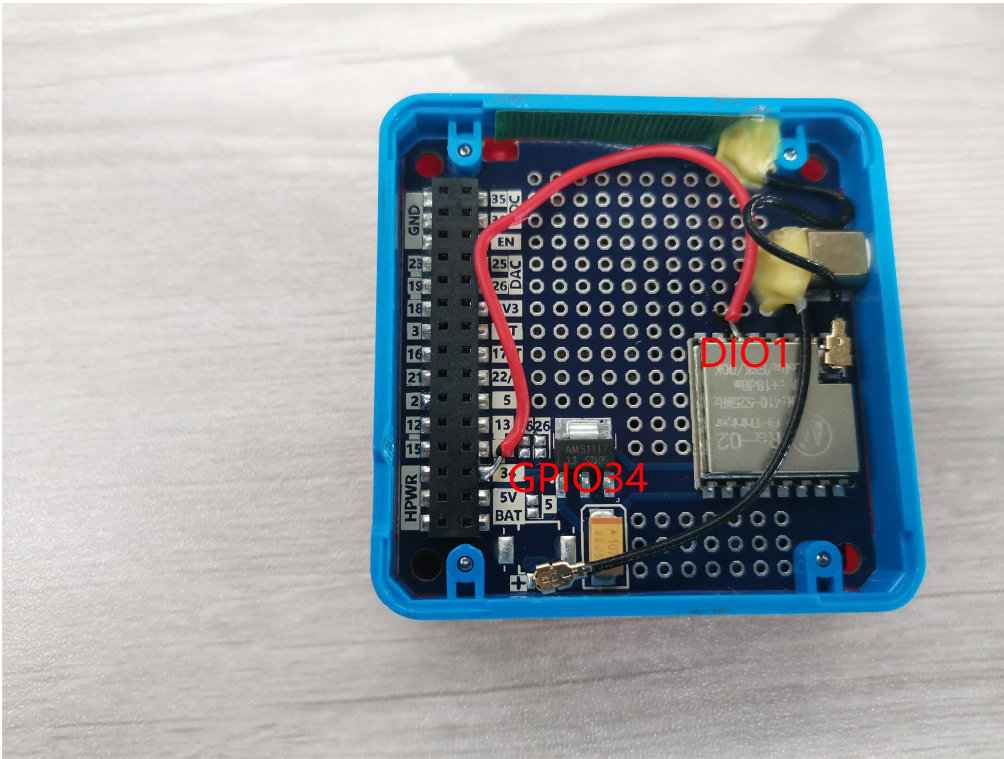


- BASIC Host: 3 (1 gateway 2 nodes)
- Module LoRa (433MHz): 3 (1 gateway 2 nodes)
- ENV-II Unit: 2

Assemble the 433 Module, ENV-II Unit and core mainframe, where two of them are used as LoRaWan terminals and one of them is used as LoRaWan gateway.



Note: Module LoRa (433MHz) module requires DIO1 to GPIO34 connection.

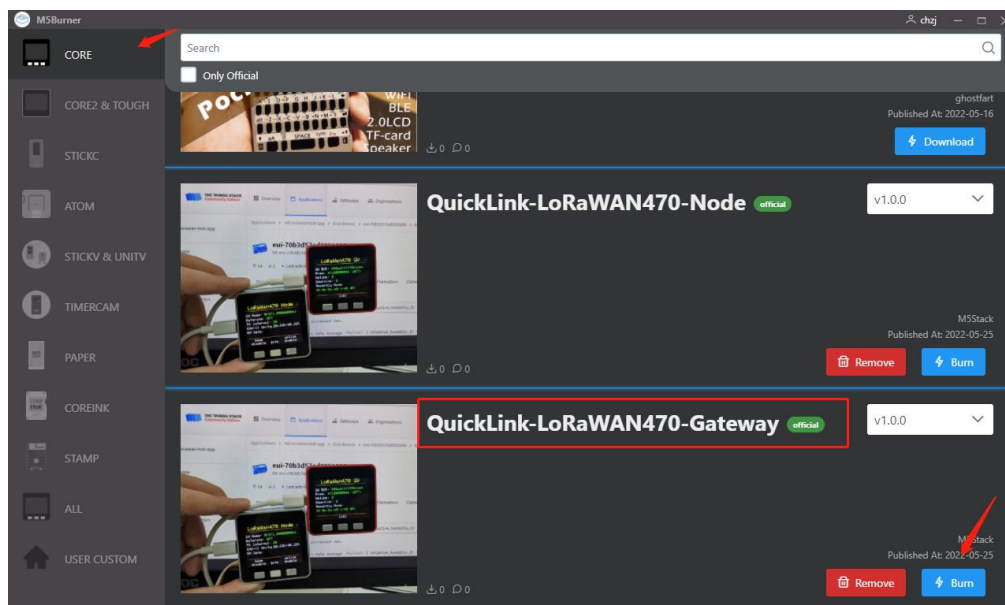


| 2. Step 2: Firmware burning and configuration

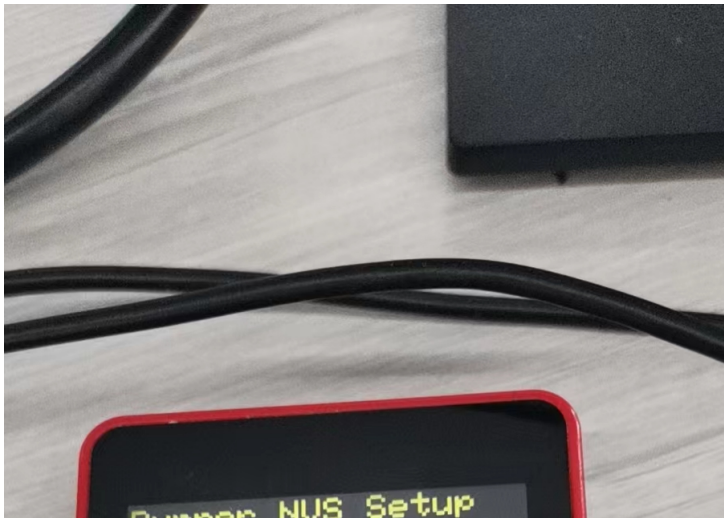
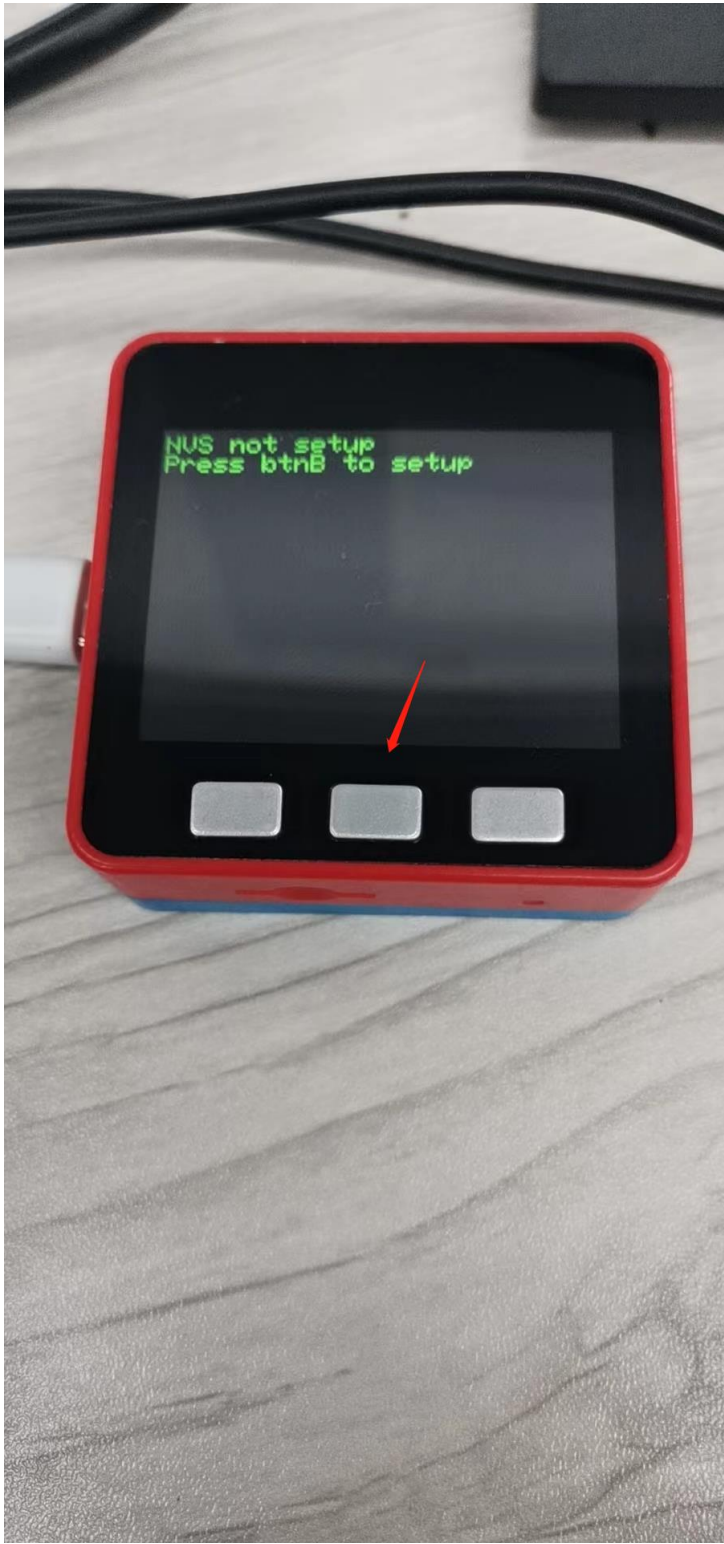
| 2.1 Gateway

| 2.1.1 Gateway firmware burning and configuration

Open the M5burner application to burn the gateway firmware

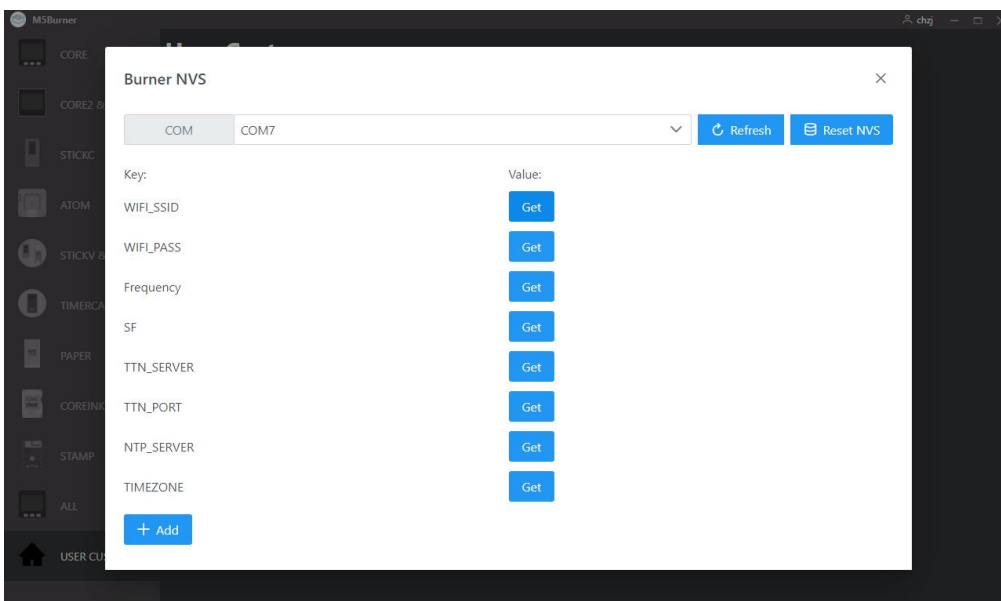
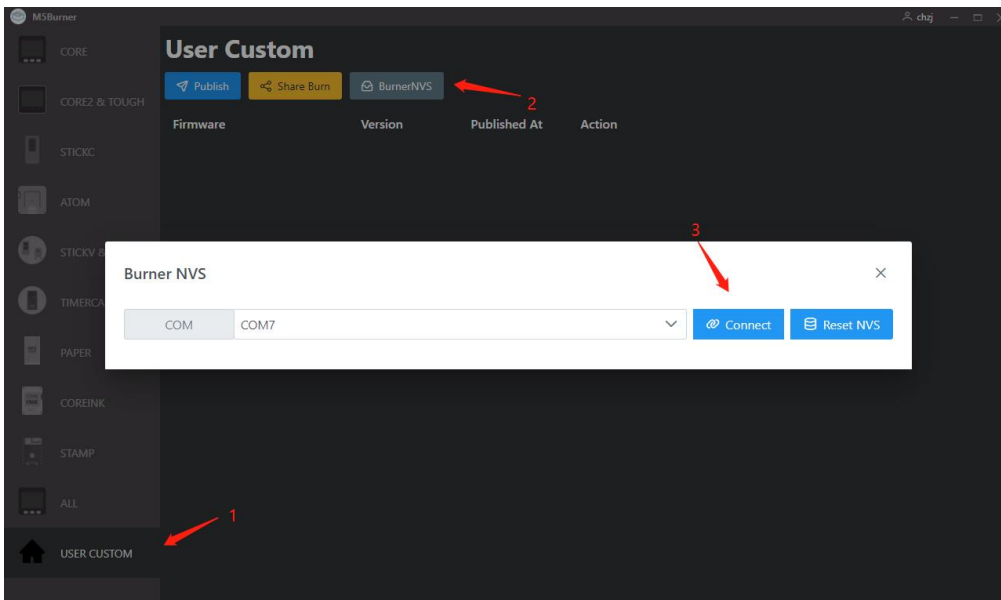


The first time you burn, you will be prompted to enter the M5BurnerNVS setup, at this point we click button B to enter the BurnerNVS setup program.





Open M5Burner and enter the BurnerNVS setup screen to make settings



- parameters that must be set 1. WIFI_SSID: WIFI SSID 2. WIFI_PASS: WIFI password
- Other parameters can be kept as default (**Note:** the default frequency is 471.9MHz/SF7, the default server is nam1.cloud.thethings.network, and the default time zone is +8)
- After completing the setup, we click on the B button of the host computer to reboot the host computer, and then the configuration of the gateway firmware is completed.

2.1.2 Registering a gateway on TTN

- First, open the official website of [TTN](#) and register an account (**Note:** For the graphic, you can check our tutorial [TTN \(The Things Network\)](#))
- The default server of the gateway is nam1.cloud.thethings.network. The default server is nam1.cloud.thethings.network
- Parameters that must be set up



THE THINGS NETWORK



THE THINGS STACK
Community Edition

Overview

Applications

Gateways

Organizations

SNP1 Community

Free use policy applies

q8404

Add gateway

General settings

Gateway ID ⓘ *

core-gateway

Gateway EUI ⓘ

24 BA C4 FF FF 5B 1C E4

Gateway name ⓘ

core-gateway

Gateway description ⓘ

core gateway

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

Gateway Server address

nam1.cloud.things.network

The address of the Gateway Server to connect to

Require authenticated connection ⓘ

☐ Enabled

Controls whether this gateway may only connect if it uses an authenticated Basic Station or MQTT connection

Gateway status ⓘ

☒ Wake status public

The status of this gateway may be visible to other users

Gateway location ⓘ

☒ Wake location public

Gateway location ⓘ

☒ Wake location public

When set to public, the gateway location may be visible to other users of the network

Attributes ⓘ

+ Add attributes

Attributes can be used to set arbitrary information about the entity, to be used by scripts, or simply for your own organization

LoRaWAN options

Frequency plan ⓘ *

China 470-510 MHz, FSB 11 (used by TTN)

Schedule downlink rate ⓘ

☒ Enabled

Enable server-side buffer of downlink messages

Enforce duty cycle ⓘ

☒ Enabled

Recommended for all gateways in order to respect spectrum regulations

Schedule any time delay ⓘ *

500 milliseconds

Configure gateway delay (minimum: 100ms, default: 500ms)

Gateway updates

Automatic updates

☐ Enabled

Gateway can be updated automatically

Channel

Stable

Channel for gateway automatic updates

Create gateway

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EN v3.19.2 Documentation

Get support Status page

1. Gateway ID: human readable string
2. Gateway EUI: The **GW EUI** entry on the host screen, generated based on the MAC address, guarantees global uniqueness.



1. Schedule downlink late: check for downlink function
2. Frequency plan: select China 470-510MHz, FSB11
3. Other parameters can be kept as default, so that the gateway is successfully registered on TTN.

2.2 Node

2.2.1 Creating nodes on TTN

1. Creating Applications

Add application

Application ID *
m5-lorawan-test-app

Application name
My new application

Description
Description for my new application

Optional application description can also be used to save notes about the application

Create application

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EN v3.19.2 Documentation Get support Status page

2. Create two nodes under this application with the entry type of OTAA and get the DEVEUI, APPEUI and APPKEY of each device
(**Note:** for a graphic you can check our tutorial [TTN \(The Things Network\)](#))

Applications > m5-lorawan-test-app

m5-lorawan-test-app
m5-lorawan-test-app

Last activity 20 hours ago

2 End devices 1 Collaborator 0 API keys

General information

Application ID m5-lorawan-test-app

Created at May 23, 2022 15:49:31

Last updated at May 23, 2022 15:50:07

Live data

See all activity

10:18:08 eui-70b345... Forward uplink data message

10:17:49 eui-70b345... Forward uplink data message

10:17:29 eui-70b345... Forward uplink data message

10:17:00 eui-70b345... Forward uplink data message

10:16:40 eui-70b345... Forward uplink data message

10:16:20 eui-70b345... Forward uplink data message

End devices (2)

Search Import end devices Add end device

ID	Name	DevEUI	JoinEUI	Last activity
node1	eui-70b3457e00051095	70 b3 05 7e 00 05 10 95	00 00 00 00 00 00 00	20 hr. ago
node2	eui-70b3457e00051096	70 b3 05 7e 00 05 10 96	00 00 00 00 00 00 00	2 days ago

Hide sidebar

https://main.cloud.thethingsnetwork/console/applications/m5-lorawan-test-app/devices/eui-70b3457e00051095

EN v3.19.2 Documentation Get support Status page

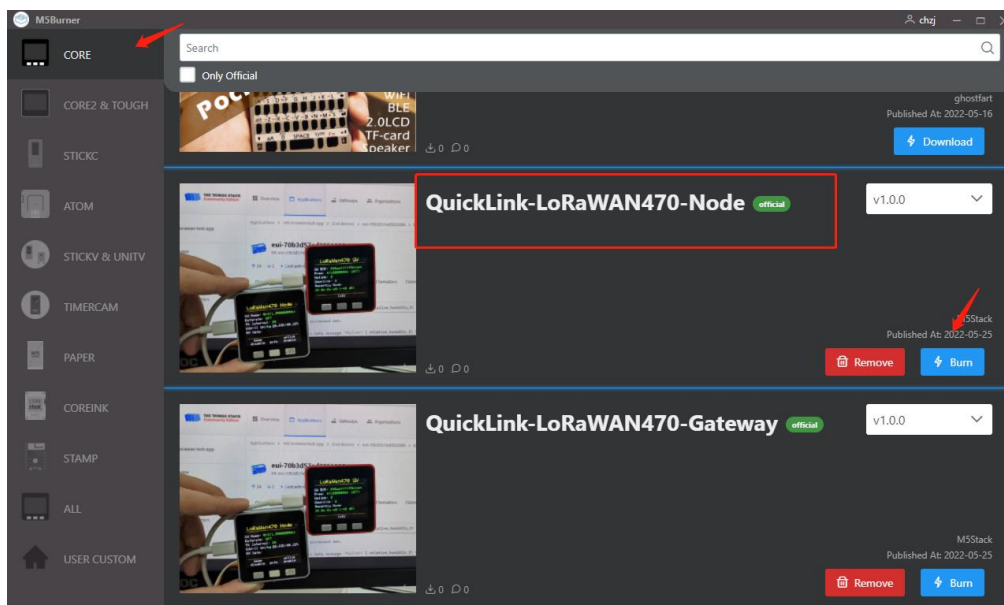
3. Mandatory parameters

1. Frequency plan: Select China 470-510MHz, FSB11
2. LoRaWAN version: LoRaWAN Specifications 1.0.2
3. Regional Parameters version: We choose revision B

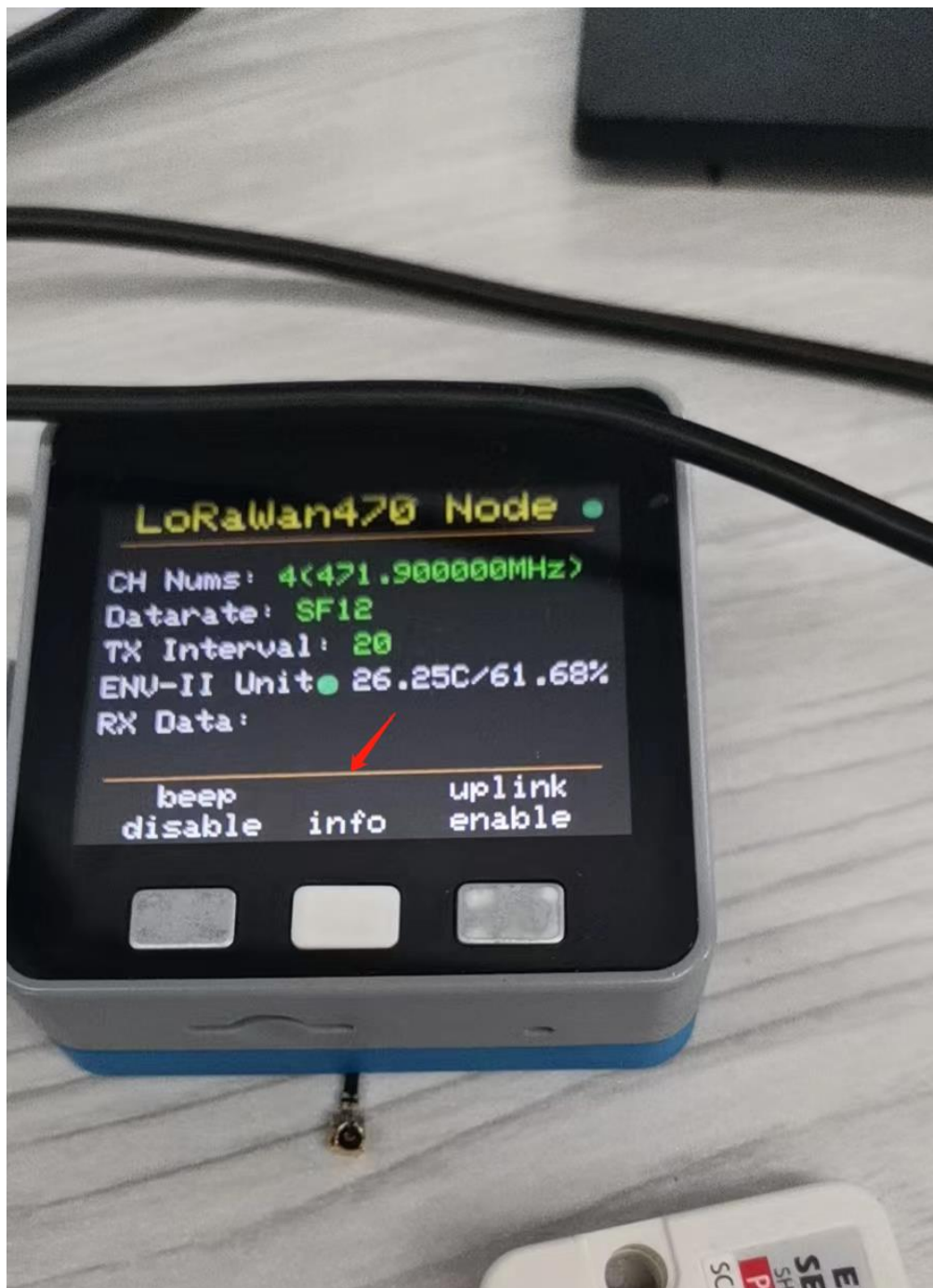
4. The other parameters can be left as default, so the node is successfully created on TTN.

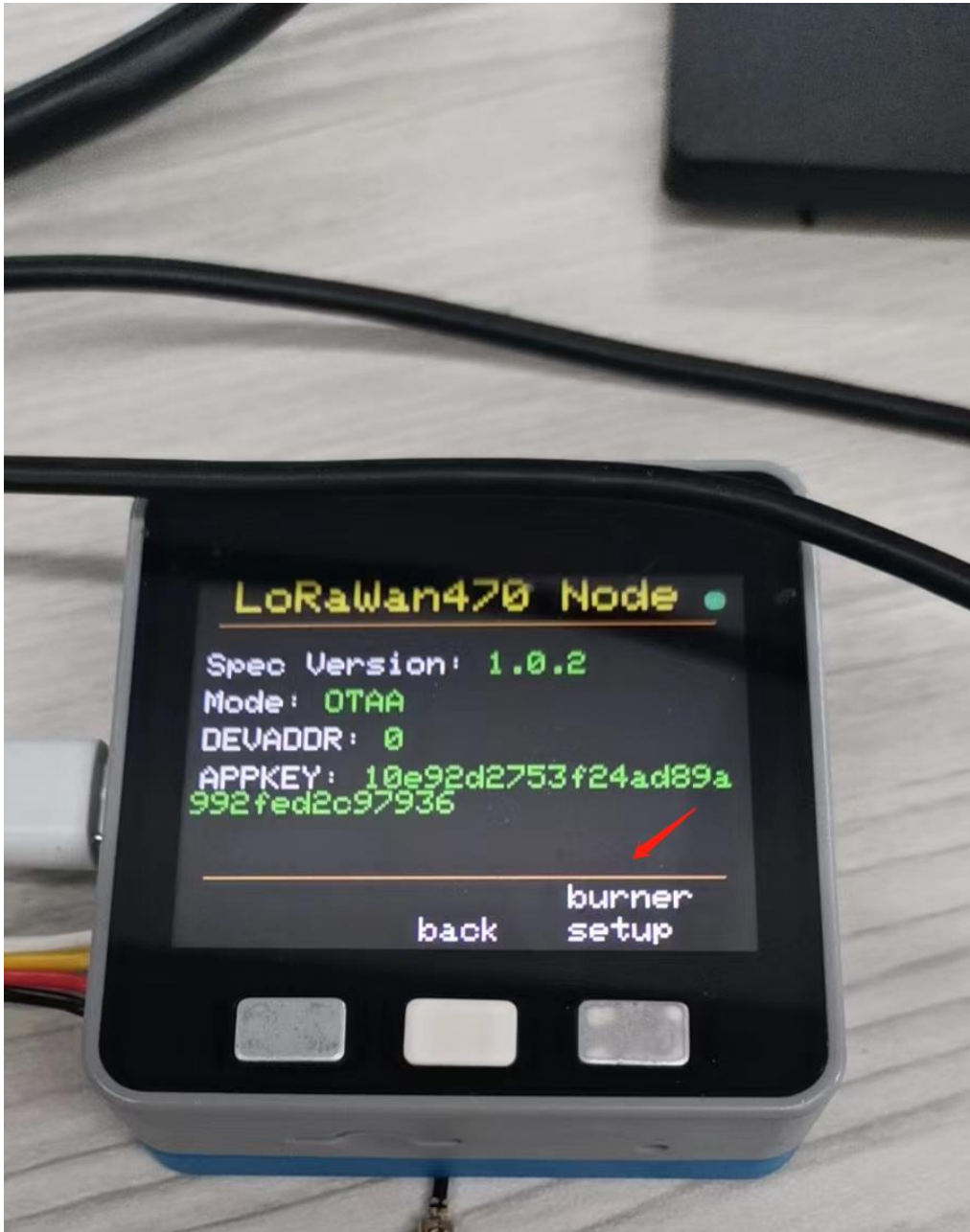
2.2.2 Node firmware burning and configuration

1. Open the M5burner application and burn node firmware



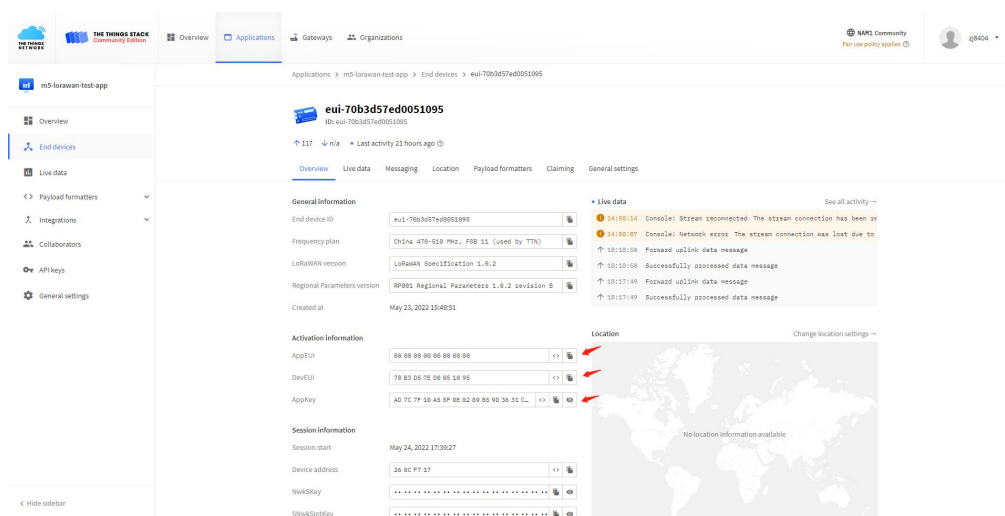
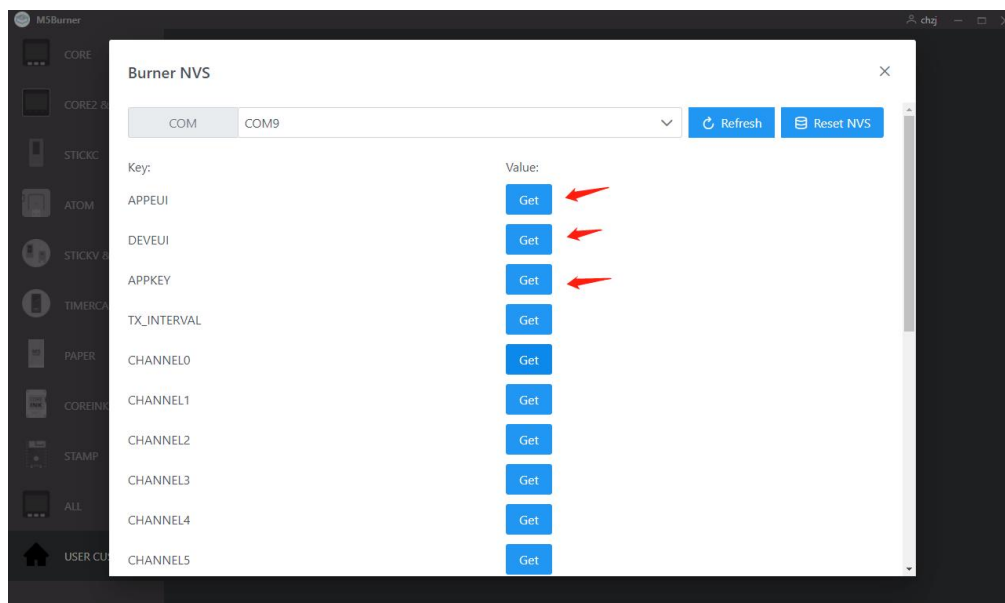
2. Click "info"->"burner setup" to enter the BurnerNVS setup program.







3. Open M5Burner and enter the BurnerNVS setup screen to make settings



1. Parameters that must be set:

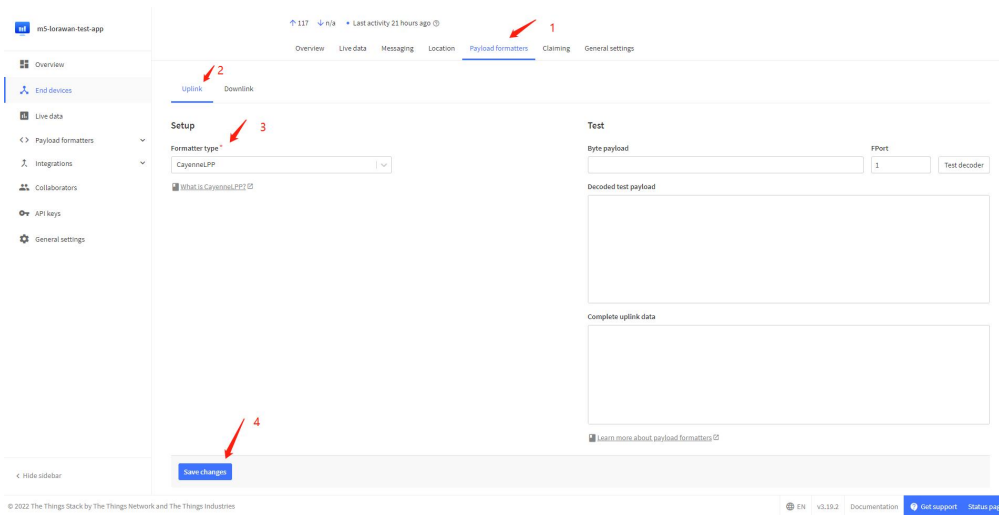
1. APPEUI: Generated by TTN, available on TTN
2. DEVEUI: Generated by TTN, available on TTN
3. APPKEY: Generated by TTN, available on TTN

2. Other parameters can be kept as default (**Note:** the default eight channels are 471.9MHz, the top frequency factor SF7, the entry mode OTAA, the sending interval 20s), so the node firmware configuration is complete!

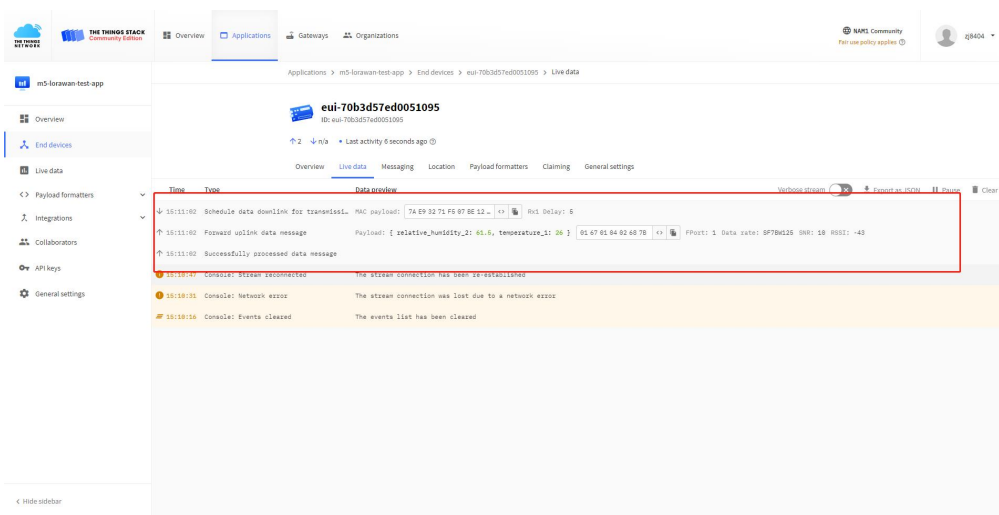
3. Step 3: The node communicates with the TTN

3.1 Uplink

1. We used the CayeneLPP library to encapsulate the information, and you need to change the decoding type to CayeneLPP in TTN to see the data uploaded by the node



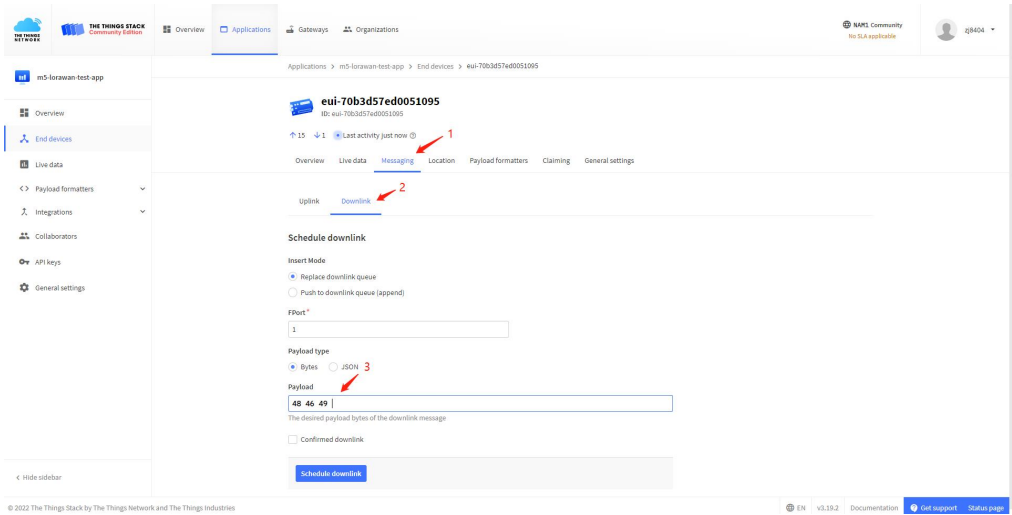
- After the configuration is completed through the above steps, the node will collect environmental information through the ENV-II Unit and upload it to the TTN at 20s intervals, consistent with the temperature and humidity data displayed on the node





3.2 Downlink

We can add the downlink message to the downlink queue on TTN's website, so that the node receives a Downlink message after the next Uplink upload, and the data displayed on the node is the same as the one set up







4. Step 4: Interface and BurnerNVS Parameter Details

4.1 Gateway

4.1.1 gateway

Start Page.



From top to bottom are:

1. Title bar: LoRaWan470 GW
2. Status light: blinking green for normal operation, yellow for initialization.
3. GW EUI: ID unique to each gateway, generated by the MAC address.

4. Freq: Listening frequency and topology factor
5. Uplink: the number of LoRa packets uploaded by the gateway
6. Downlink: The number of LoRa packets downlinked by a gateway
7. Recently Node: address and RSSI of the most recently communicated node
8. Press the key:
 1. info: Allows you to enter the info page.

Key: 1. info: You can enter the info page.

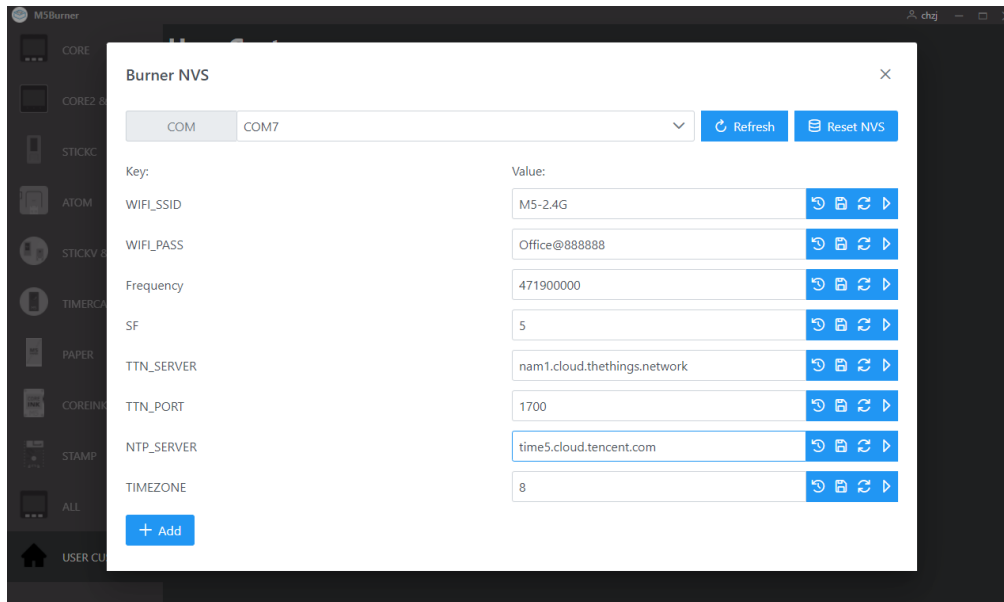


From top to bottom are:

1. Title bar: LoRaWan470 GW
2. Status light: blinking green for normal operation, yellow for initialization state
3. WiFi SSID: WiFi ID
4. LoRaWAN Server: LoRaWAN server address

5. Port: LoRaWAN server port
6. NTP Server: NTP server address
7. Timezone: Time zone
8. keys:
 1. back: Returns to the start page.
 2. burner setup: enter BurnerNVS setup program

4.1.2 Gateway BurnerNVS Parameters



1. WIFI_SSID: WIFI SSID
2. WIFI_PASS: WIFI password
3. Frequency: Listening frequency of the gateway, need to comply with the LoRaWAN protocol, LoRaWAN 470 spectrum range is 470MHz to 510MHz, the specific settings need to check the LoRaWAN protocol, the gateway and the node must be the same frequency.
4. SF: Frequency Expansion Factor, the range is 5-0, corresponding to SF7 to SF12, the gateway and node must have the same frequency expansion factor.
5. TTN_SERVER: Address of the LoRaWAN server. 6.
6. TTN_PORT: Port number of the LoRaWAN server.
7. NTP_SERVER: Address of NTP server
8. TIMEZONE: Time zone

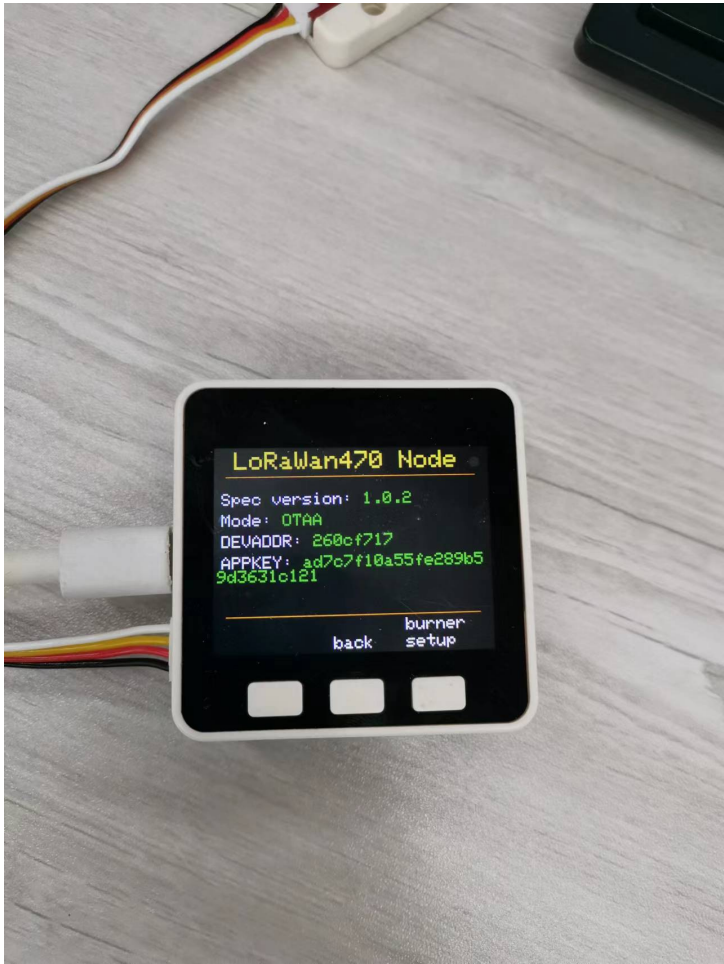
4.2 Node

4.2.1 Node Interface



From top to bottom are:

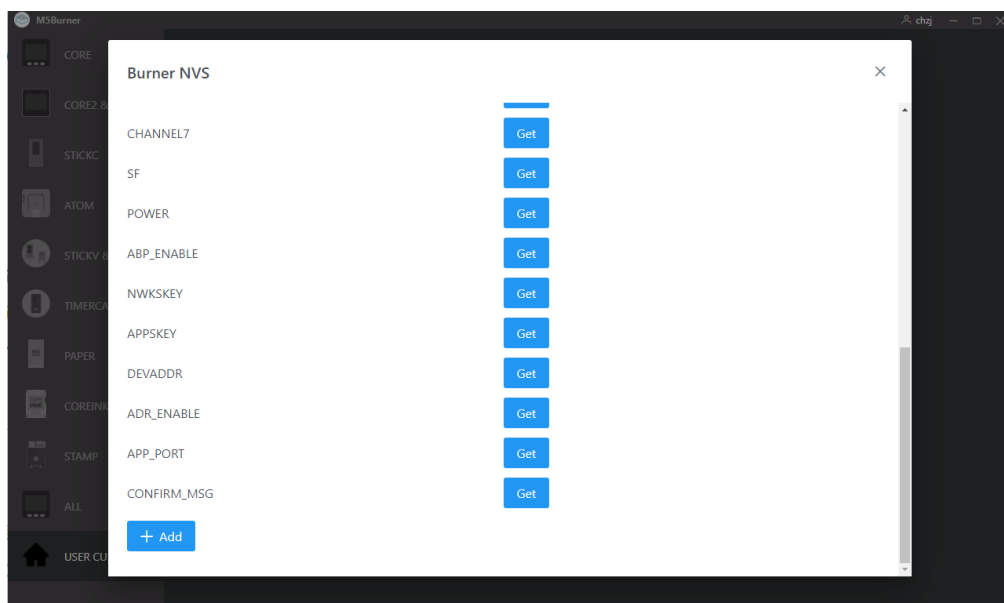
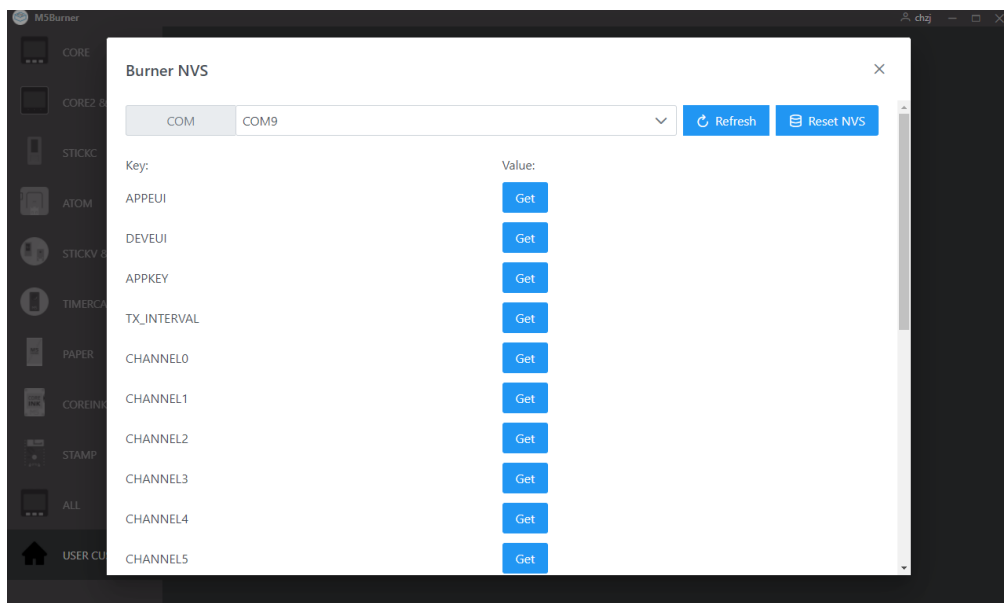
1. Title bar: LoRaWan470 Node
2. Status light: blinking green for normal operation, yellow for initialization.
3. CH Nums: The channel and its corresponding frequency.
4. TX Interval: Uplink's transmit interval.
5. ENV-II Unit: The status of ENV-II Unit, green is the normal working status, otherwise it is red, the right side will also show the temperature and humidity.
6. key:
 1. beep disable means the speaker is off, press this button to switch to beep enable, then if you receive a Downlink message, the speaker will beep once to alert you. 2. info: you can enter the info page, it will show you the time interval of the message.
 2. info: You can enter the info page. 3. uplink enable
 3. uplink enable indicates that Uplink is enabled and the node will upload messages to TTN at 20s interval, press this key to switch to uplink disable.



From top to bottom are:

1. Title bar: LoRaWan470 Node
2. Status Light: Blinking green for normal operation, yellow for initialization.
3. Spec Version: This is the LoRaWAN protocol version. 4.
4. Mode: Mode of entry, now it is OTAA. 5.
5. DEVADDR: Device address
6. keys:
 1. back: Return to the start page.
 2. burner setup: Enter the BurnerNVS setup program.

4.2.2 Node BurnerNVS Parameters

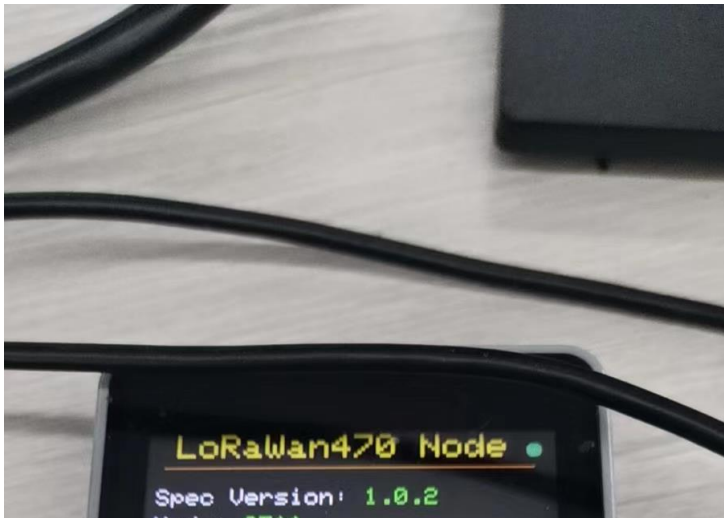


1. APPEUI & DEVEUI & APPKEY: OTAA entry parameters, generated by TTN
2. TX_INTERVAL: time interval of uplink
3. CHANNEL0 ~ CHANNEL8: frequency of each channel, need to comply with the LoRaWAN protocol, LoRaWAN 470 spectrum range is 470MHz to 510MHz, specific settings need to check the LoRaWAN protocol, the frequency of the gateway and the node must be the same.
4. SF: Frequency Expansion Factor, the range is 5-0, corresponding to SF7 to SF12, the gateway and node must have the same frequency expansion factor.
5. POWER: Transmit power, the range is 0-20, the higher the value the higher the power, the default is 20.
6. ABP_ENABLE: ABP Access Mode Enable, 1 is enable, 0 is disable. 1 is on, 0 is off. 0 means OTAA access mode, the setting related to ABP is invalid. If it is 1, it is ABP access mode, and the settings related to OTAA are invalid.
7. NWKSKEY & APPSKEY & DEVADDR: Parameters for ABP access, can be generated by TTN. 8. ADR_ENABLE: The parameters for ABP access.
8. ADR_ENABLE: ADR enable, 1 is on, 0 is off. 9.
9. APP_PORT: Sets the application port, range is 1-255.
10. CONFIRM_MSG: Confirmation message enable, 1 is on, 0 is off. 1 is on, 0 is off. If it is on, you will receive an ACK after each uplink.

| 5. Step 5: Other applications

| 5.1 Enter the BurnerNVS program in Run

Click `info` -> `burner setup`





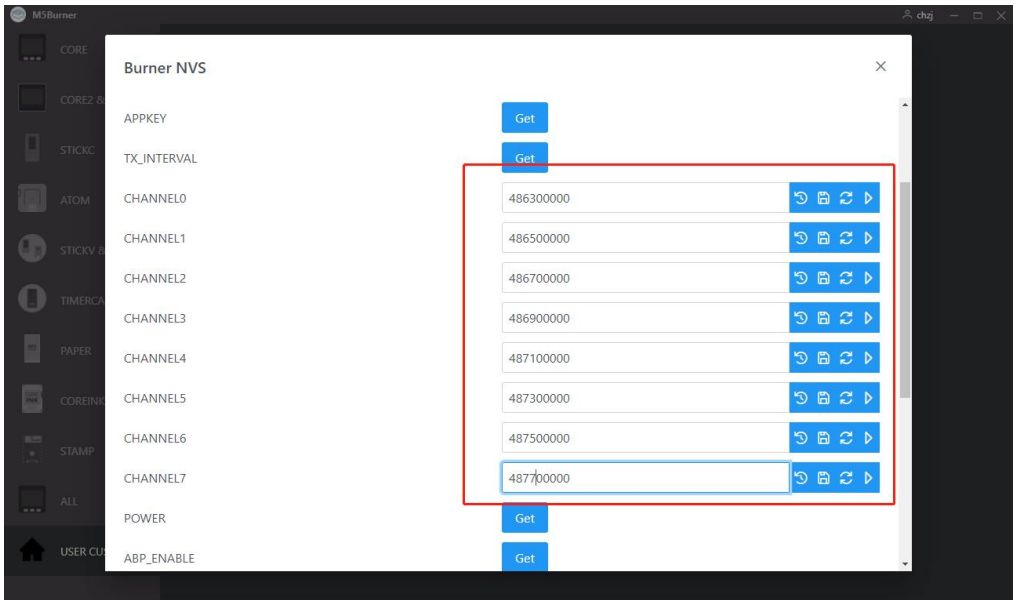
You will then be taken to the following page, indicating that you have entered the Burner NVS setup program



At this point we can open the Burner application to set up BurnerNVS

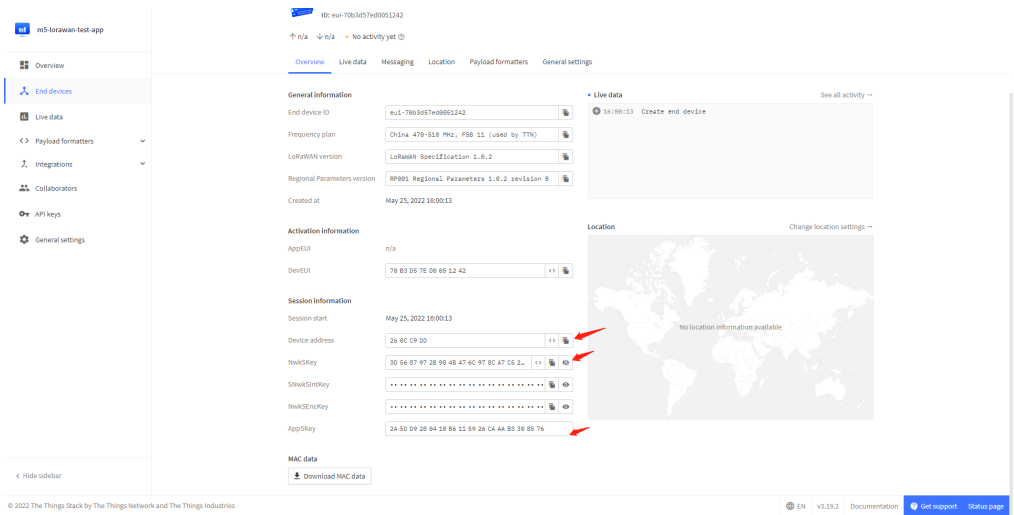
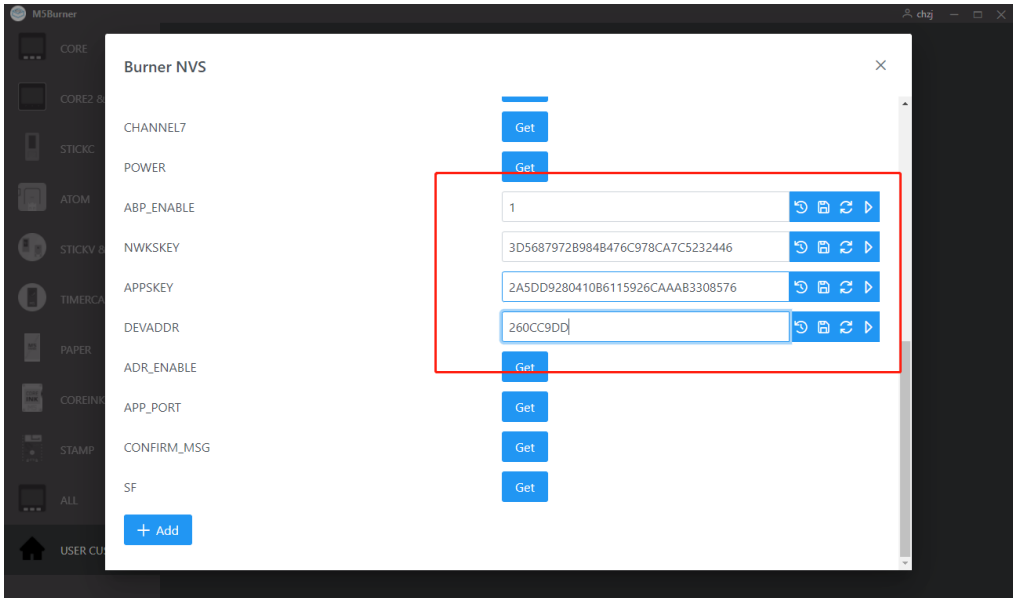
5.2 Nodes connect to other gateways

When we need to connect to other gateways, we only need to modify the frequency of CHANNEL0 - CHANNEL8



5.3 Nodes use ABP mode for network entry

If we need to use ABP mode for network access, we just need to turn on ABP_ENABLE to enable it.



Configuration notes:

You need to change Rx1 delay to 5s and check the **Resets frame counters** option under **General settings** -> **Network layer** -> **Advanced MAC settings** in the TTN ABP node management page.

The screenshot displays the TTN ABP node management interface for a device with EUI-70b3d57ed0051242. The left sidebar shows the navigation menu with 'General settings' selected. The main content area is divided into two sections: 'Basic' and 'Network layer'.

Basic Section:

- End device ID:** eui-70b3d57ed0051242
- DevEUI:** 70 B3 D5 7E D0 85 12 42
- End device name:** My new end device
- End device description:** (empty text area)
- Network Server address:** nam1.cloud.thethings.network
- Application Server address:** nam1.cloud.thethings.network
- Attributes:** (empty list)

Network layer Section:

- Frequency plan:** China 470-510 MHz, FSB 11 (used by TTN)
- LoRaWAN version:** LoRaWAN Specification 1.0.2
- Regional Parameters version:** RP001 Regional Parameters 1.0.2 revision B
- LoRaWAN class capabilities:** Supports class B, Supports class C
- Activation mode:** Over the air activation (OTAA), Activation by personalization (ABP), Define multicast group (ASB & Multicast)
- Device address:** 26 BC C9 DD
- NwkKey:** (empty text area)
- Session and MAC state reset:** (button)
- Advanced MAC settings:** (expanded section)

Advanced MAC settings:

- Frame counter width:** 16 bit, 32 bit
- Rx1 delay:** 5 sec
- Desired Rx1 delay:** 5 sec
- Rx1 data rate offset:** 0
- Desired Rx1 data rate offset:** 0
- Resets frame counters:** (checked)
- Rx2 data rate index:** 0
- Desired Rx2 data rate index:** 0
- Rx2 frequency:** 505.3 MHz
- Desired Rx2 frequency:** 505.3 MHz
- Maximum duty cycle:** 100%
- Desired maximum duty cycle:** 100%
- Factory preset frequencies:** (empty list)
- Status count periodicity:** 200 messages
- Status time periodicity:** 86400 seconds
- Use adaptive data rate (ADR):** (checked)
- ADR margin:** 15 dB

The 'Save changes' button is located at the bottom of the 'Advanced MAC settings' section.