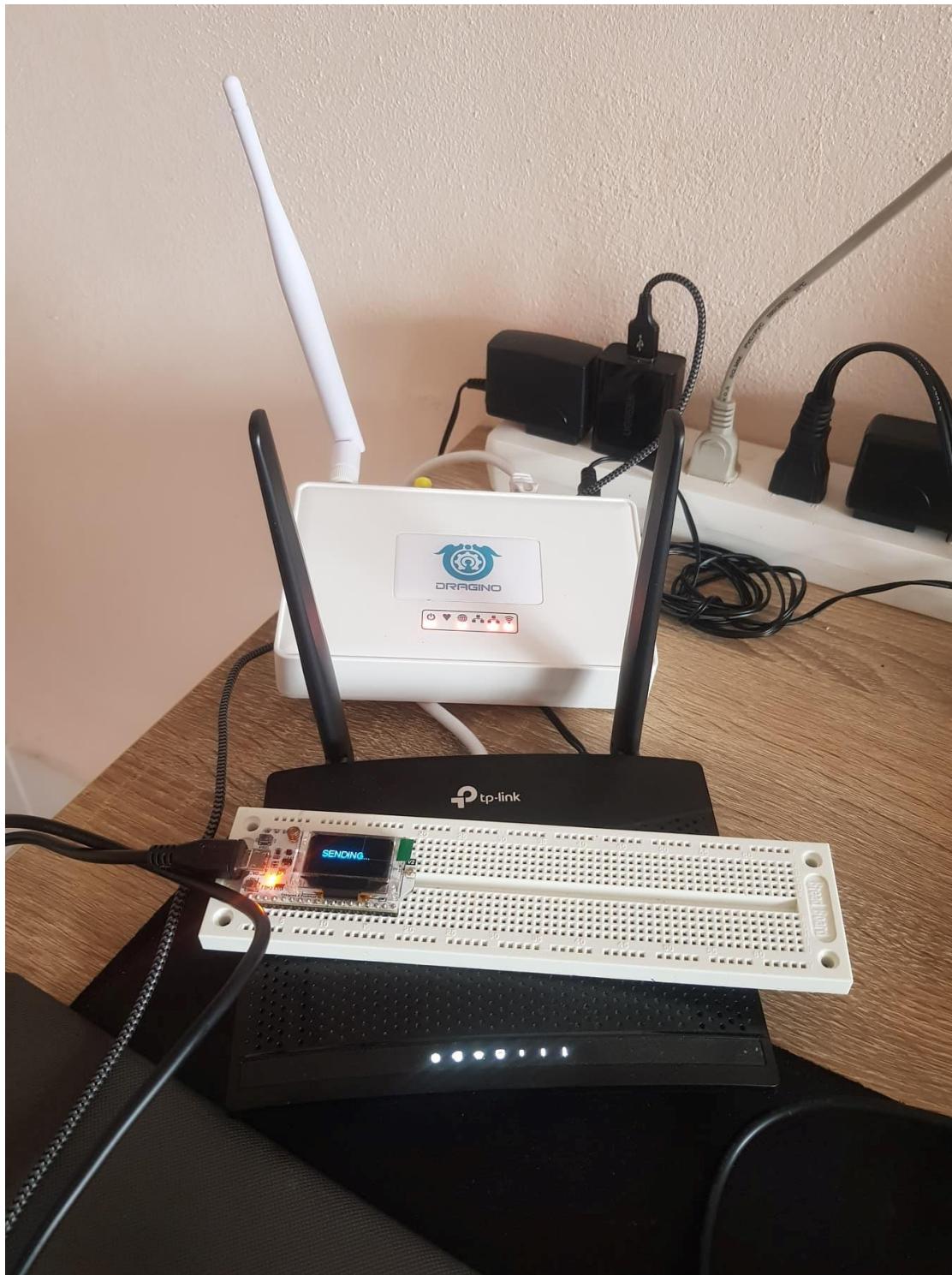


## คู่มือการใช้งาน Chirp Stack Lora WAN® Network Server



## ติดตั้ง Chirp Stack Lora WAN® Network Server บน PI 4B

ก่อนอื่นให้ติดตั้ง Noob หรือ Raspbian ให้เรียบร้อยแล้วใช้คำสั่งดังนี้

```
sudo apt updatesudo apt upgradegit clone
https://github.com/m2mlorawan/ChirpStack\_on\_Raspbiancd
ChirpStack_on_Raspbian/chmod +x install.shsudo
./install.shsudo reboot
```

หลังจาก Pi บูทเสร็จ เรียกใช้งานด้วย Port 8080

<http://<PI IP>:8080>

และใช้ User admin และ Password admin

The screenshot shows the ChirpStack web application interface. The top navigation bar includes a back button, forward button, refresh button, and a search bar with the placeholder 'Search organization, application, gateway or device'. The URL bar shows the address '10.130.1.203:8080/#/network-servers'. The main content area is titled 'Network-servers' and displays a table with one row. The table columns are 'Name' and 'Server'. The single entry is 'ns' with 'localhost:8000' listed under 'Server'. At the bottom right of the table, there is a 'Rows per page:' dropdown set to '10'. On the left side, there is a sidebar with a search bar containing 'chirpstack'. Below the search bar is a list of navigation items: Network-servers, Gateway-profiles, Organizations, All users, API keys, chirpstack (selected), Org. settings, Org. users, Service-profiles, Device-profiles, Gateways, Applications, and Multicast-groups.

Name	Server
ns	localhost:8000

### แก้ค่าใน LoRaWAN® gateway

ให้แก่ที่ Gateway โดยให้ชี้ไปที่ IP ของ LoRaWAN® Network Server ที่เราสร้างขึ้น  
ตัวอย่าง เช่น ถ้าใช้ Dragino LG308-AS923-EC25 ตามรูป



ให้ Connect gateway ด้วย WIFI เลือก Hotspot ที่ขึ้นด้วย Dragino



เข้ามต่อด้วยรหัสผ่าน 12345678 เปิดเวบที่หน้า 10.130.1.1 เข้าด้วย ยูสเซอร์และรหัสผ่าน  
admin/admin

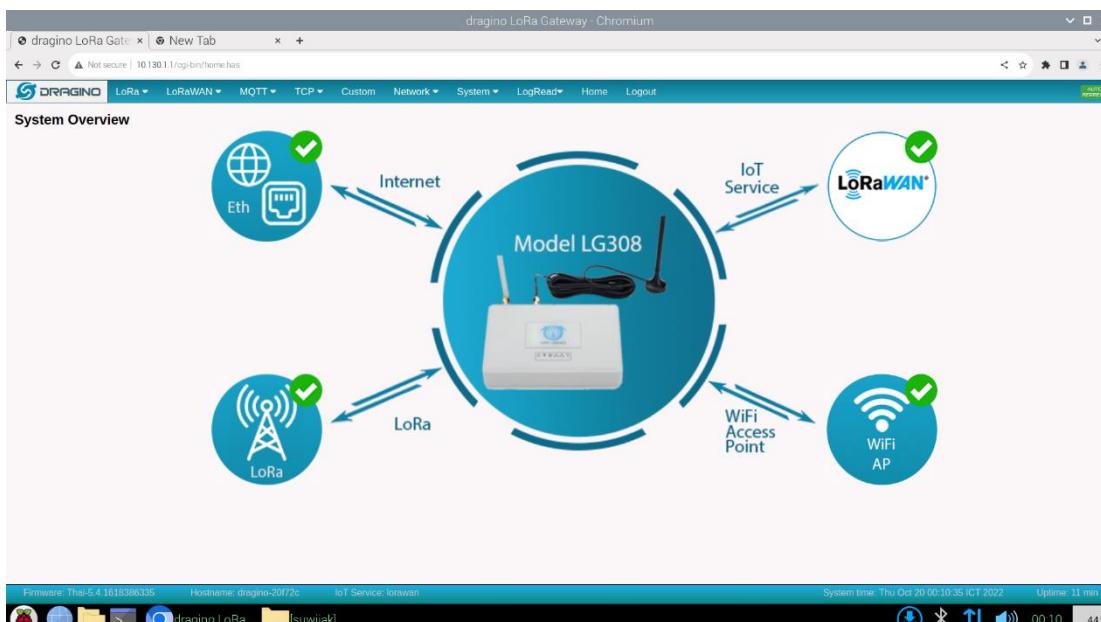
① 10.130.1.1/cgi-bin/home.cgi

ลงชื่อเข้าใช้

http://10.130.1.1  
การเชื่อมต่อค้างไว้ตั้งแต่เมื่อเป็นสถานที่

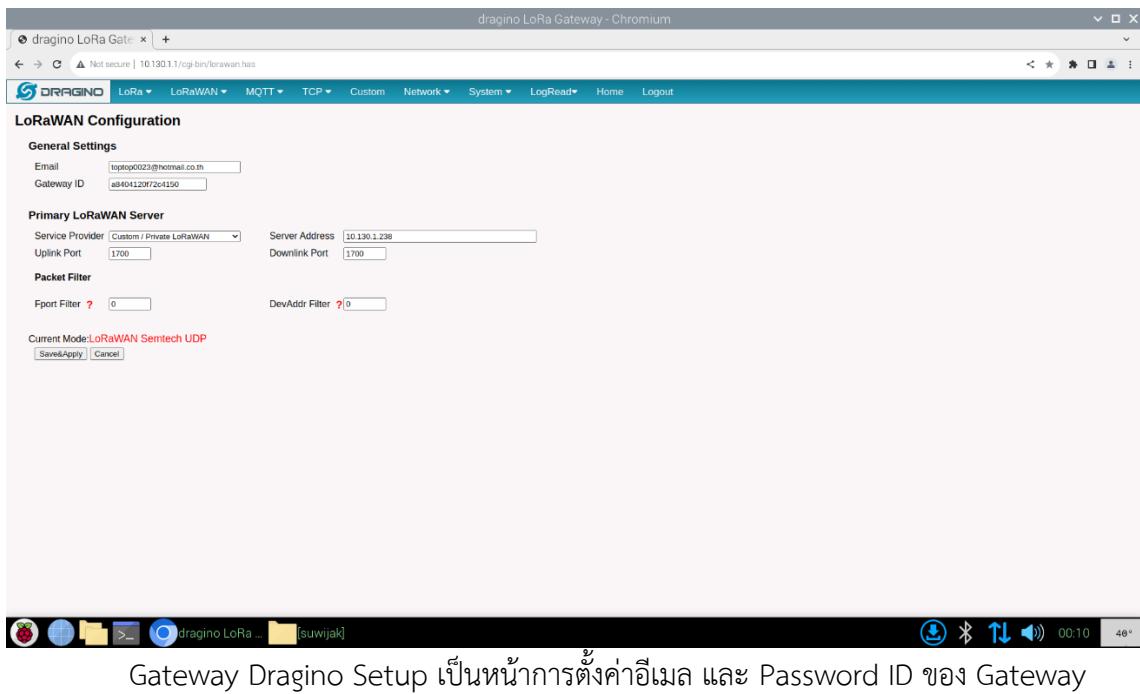
ชื่อผู้ใช้	<input type="text" value="admin"/>
รหัสผ่าน	<input type="password" value="*****"/>

## การทำงาน Gateway



Gateway Dragino Home หน้านี้เป็นหน้าที่บอกรายงานการทำงานของ Gateway ว่าทำงานยังไง และ เชื่อมต่ออะไรบ้าง

## LORAWAN GUIDE BY SUWIJAK



Gateway Dragino Setup เป็นหน้าการตั้งค่าอีเมล และ Password ID ของ Gateway

The screenshot shows the ChirpStack interface under 'Network-servers'. A network-server named 'ns (EU868 @ 3.9.0)' is selected. The 'GENERAL' tab is active, showing 'Network-server name': 'ns' (highlighted with a red arrow) and 'Network-server server': 'localhost:8000' (highlighted with a red arrow). Other tabs include 'GATEWAY DISCOVERY' and 'TLS CERTIFICATES'. A red circle highlights the network-server name 'ns (EU868 @ 3.9.0)'.

ความถี่ของสัญญาณ

Script ที่ติดตั้งวิธีที่ก่อภาระข้องตัน จะติดตั้งค่าความถี่ Default ของ network-server เป็น EU868 โดยสังเกตจาก NS ของเรา Default จะมี (EU868 @ 3.9.0) ต่อท้ายร ซึ่งจะมีปัญหากับเราตอน Downlink ซึ่งหากมี Node แบบ OTAA ติดต่อเข้ามา จังหวะ Downlink ตัว Hardware ของ Lora WAN Gateway จะถูกส่งให้ปรับความถี่กลับไปที่ช่อง 868 ซึ่งตัว Lora WAN Gateway จะไม่ยอมอนุญาตตามที่ chirp stack-network-server ร้องขอ แต่จะรายงาน Error กลับมาที่ Network

Server ทำให้การ Downlink ทั้งหมดทำไม่สำเร็จ ดูว่า Config ที่ใช้อยู่ปัจจุบันของ chirp stack-network-server มีค่าอะไรบ้าง โดยใช้คำสั่ง  
chirp stack-network-server configfile

จะเห็นว่ามีการตั้งค่าเป็น name="EU\_868\_870"

```

10.130.1.203 - pi@raspberrypi: ~ VT
File Edit Setup Control Window Help
# LoRaWAN regional band configuration.
#
# Note that you might want to consult the LoRaWAN Regional Parameters
# specification for valid values that apply to your region.
# See: https://www.lora-alliance.org/lorawan-for-developers
[network_server.band]
# LoRaWAN band to use.
#
# Valid values are:
# * AS923
# * AU915
# * CN470
# * CN779
# * EU433
# * EU868
# * IN865
# * KR920
# * RU864
# * US915
name="EU_863_870"
# Enforce 400ms dwell time.
#

```

แก้ไขความถี่

ก่อนอื่น เข้าสิทธิ System Admin ก่อนโดยใช้คำสั่ง คำสั่งหนึ่งดังนี้

sudo -i หรือ sudo su หรือ sudo -s

เปลี่ยน Dir ใช้งานเป็น /etc/chirp stack-network-server

cd /etc/chirp stack-network-server

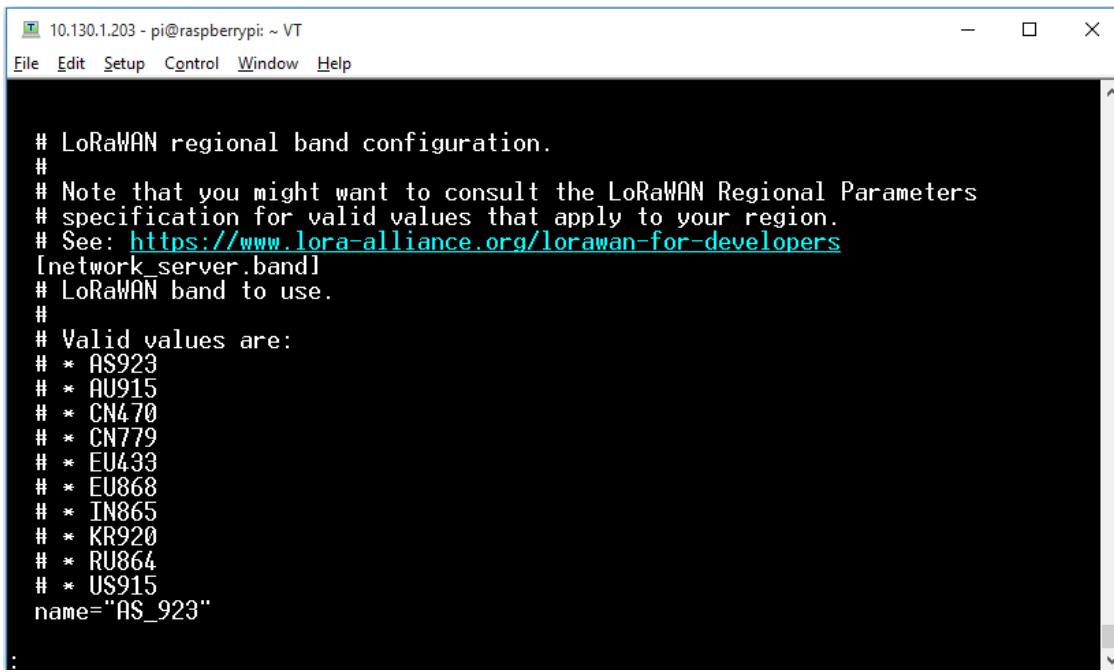
Backup ไฟล์เดิมไว้ก่อน โดยใช้คำสั่ง

cp chirp stack-network-server.toml chirp stack-network-server.toml.BAK

ให้ Copy ไฟล์ AS\_923 ไปแทน

cp chirpstack-network-server.as\_923.toml chirp stack-network-server.toml

ลองเช็คอ่านค่า config อีกครั้งจะเห็นว่า name="AS\_923"



```
# LoRaWAN regional band configuration.
#
# Note that you might want to consult the LoRaWAN Regional Parameters
# specification for valid values that apply to your region.
# See: https://www.lora-alliance.org/lorawan-for-developers
[network_server.band]
# LoRaWAN band to use.
#
# Valid values are:
# * AS923
# * AU915
# * CN470
# * CN779
# * EU433
# * EU868
# * IN865
# * KR920
# * RU864
# * US915
name="AS_923"
```

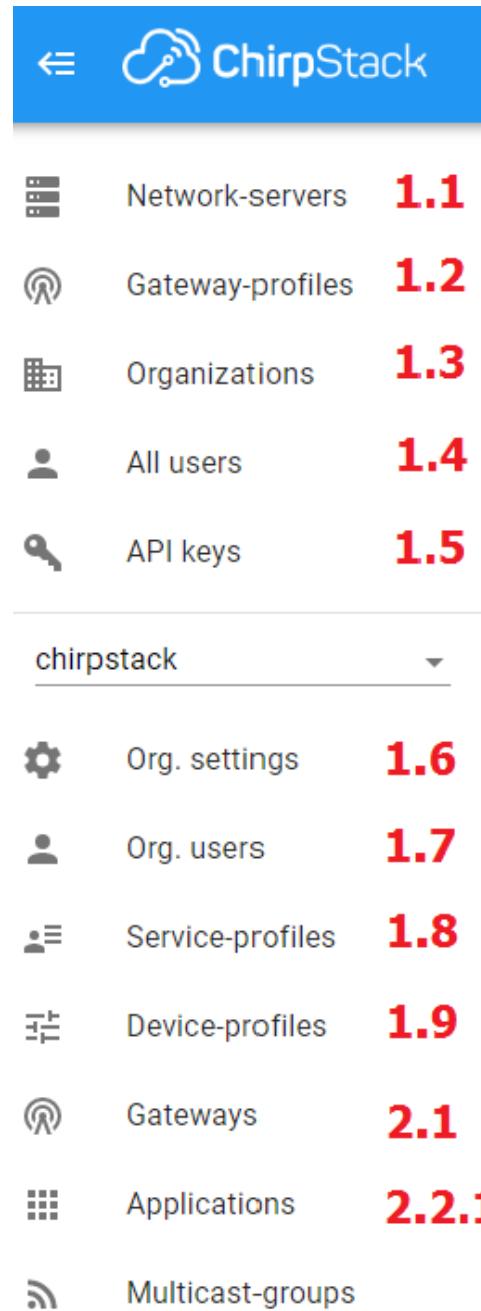
แก้ไขความถี่เป็น AS\_923

Restart chirp stack-network-server ใหม่โดย

sudo systemctl restart chirp stack-network-server

## ใช้งาน Chirp Stack Lora WAN® Network Server บน PI 4B

การใช้งานจะเริ่มต้นจากเมนูข้างซ้ายของจอภาพ จากบนลงล่าง หลังล็อกอินเสร็จจะมีเมนูด้านซ้ายดังนี้ บทความนี้จะแนะนำให้เรียงแต่ละเมนูตามทัวร์ข้อสีแดงในภาพ



เมนูภายใน chirp stack ก็จะมี ปุ่ม Network-servers, Gateway-profiles, Organizations, allusers, API keys, Org. Settings, Org.Users, Service-Profiles ,Device-Profiles, Gateways, Applications, Multicast-groups

The screenshot shows the ChirpStack web interface. On the left, a sidebar menu under the 'chirpstack' section includes 'Network-servers', 'Gateway-profiles', 'Organizations', 'All users', and 'API keys'. The main content area is titled 'Network-servers' and displays a table with one row. The row contains 'ns' in the 'Name' column and 'localhost:8000' in the 'Server' column. Two red arrows point to these two fields. A search bar at the top right says 'Search organization, application, gateway or device'.

เมนู Network-server หน้านี้จะบอก ชื่อของ Network และ ID ของ Server Network

The screenshot shows the ChirpStack web interface. On the left, a sidebar menu under the 'chirpstack' section includes 'Network-servers', 'Gateway-profiles', 'Organizations', 'All users', and 'API keys'. The main content area is titled 'Network-servers / ns (EU868 @ 3.9.0)' and shows a configuration form for the network server 'ns'. The 'GENERAL' tab is selected. It has fields for 'Network-server name' (containing 'ns') and 'Network-server server' (containing 'localhost:8000'). A red arrow points to each of these fields. A 'DELETE' button is visible in the top right corner. At the bottom right is a 'UPDATE NETWORK-SERVER' button.

หน้านี้จะบอกถึงว่ามีการตั้งค่า ns ไว้แล้วเป็น localhost:8000

Name	Network-server
gateway_profile	ns

หน้านี้จะบอกรหัสชื่อของ Gateway-profile และชื่อของ Network server

มีการตั้งค่า gateway profile ไว้แล้ว เชื่อมเข้ากับ Network Server ชื่อ NS

ChirpStack

Search organization, application, gateway or device

Network-servers  
Gateway-profiles  
Organizations  
All users  
API keys

chirpstack

Org. settings  
Org. users

Organizations

Name	Display name	Can have gateways
chirpstack	ChirpStack	<input checked="" type="checkbox"/>

Rows per page: 10 1-1 of 1

หน้าของเมนู Organization จะบอกชื่อของ Organization และชื่อ display ของ Organization ชื่อ chirp Stack

ChirpStack

Search organization, application, gateway or device

Network-servers  
Gateway-profiles  
Organizations  
All users  
API keys

chirpstack

Org. settings  
Org. users  
Service-profiles  
Device-profiles

Organizations / chirpstack

DELETE

Organization name \*  
chirpstack

The name may only contain words, numbers and dashes.

Display name \*  
ChirpStack

Gateways  
 Organization can have gateways

When checked, it means that organization administrators are able to add their own gateways to the network. Note that the usage of the gateways is not limited to this organization.

UPDATE ORGANIZATION

หน้านี้จะเป็นหน้าของเมนู Org. settings ตั้งไว้แล้วตามรูป

ID	Username	Admin
1	admin	<input checked="" type="checkbox"/>

หน้านี้จะเป็นหน้าของเมนู Org. users จะมี Username ชื่อ admin และมี ID คือ 1

Last seen	Name	Gateway ID	Network server	Gateway activity (30d)
a few seconds ago	DRAGINO-TOP	a8404120f72c4150	ns	
Never	rak_gateway	0000000000000000	ns	

หน้านี้จะเป็นหน้าของ Gateway Menu หน้านี้จะบอก ว่า Gateway Menu มีอะไรบ้าง

## LORAWAN GUIDE BY SUWIJAK

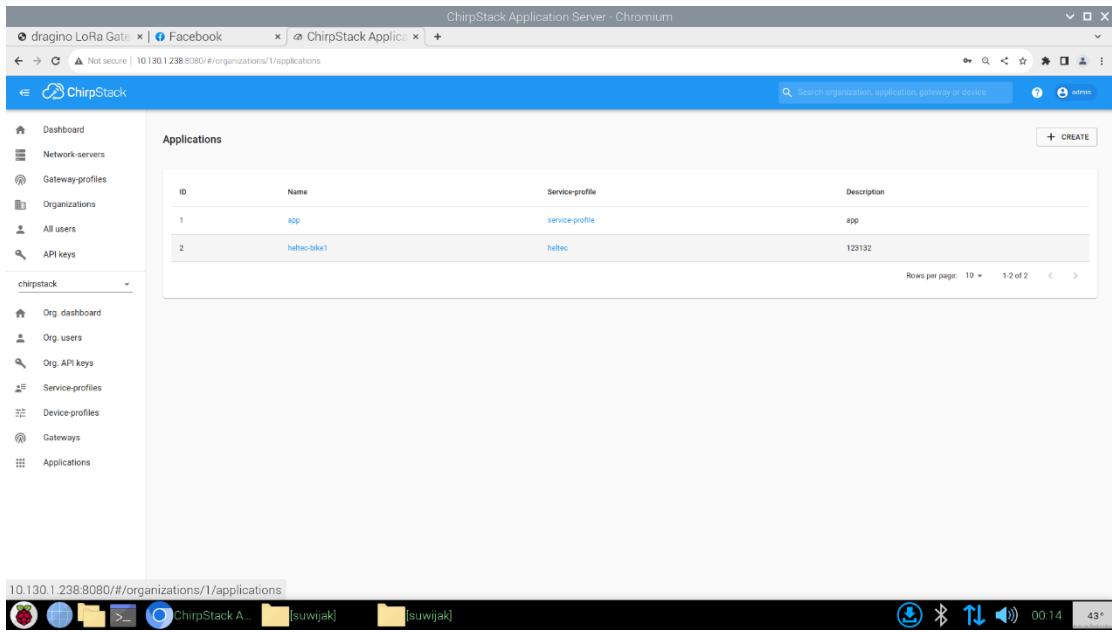
The screenshot shows the ChirpStack Application Server interface. On the left, a sidebar menu includes options like Dashboard, Network-servers, Gateway-profiles, Organizations, All users, API keys, and chirpstack (Org. dashboard, Org. users, Org. API keys, Service-profiles, Device-profiles, Gateways, Applications). The main content area is titled "Gateways / DRAGINO-TOP". It shows "Gateway details" with fields: Gateway ID (a8404120f72c4150), Altitude (10 meters), GPS coordinates (17.1, 104.9), and Last seen at (Oct 20, 2022 12:13 AM). To the right is a map with a blue pin indicating the gateway's location. Below the map are two line graphs: "Received" and "Transmitted", both showing data over time. At the bottom, there are icons for ChirpStack A, [suwijak], and [suwijak]. The status bar at the bottom right shows 00:14 and 46°.

หน้านี้จะบอกรายละเอียดของ Gateway และกราฟ received และ transmitted

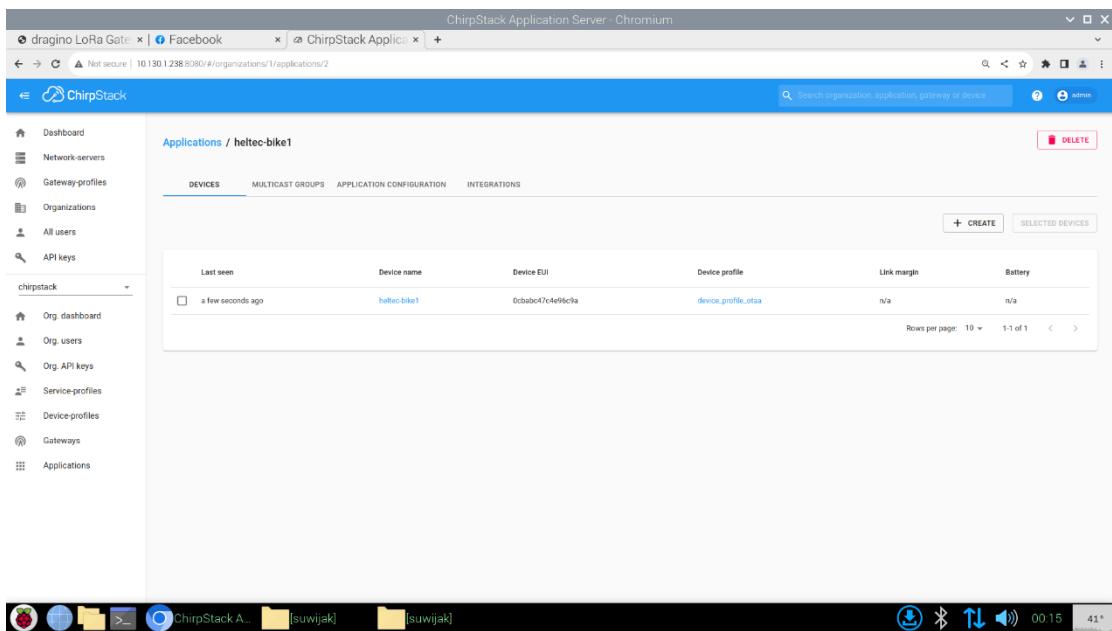
This screenshot shows the same ChirpStack interface as above, but the main content area is now focused on the "LIVE LORAWAN FRAMES" tab. It lists numerous frames with detailed information such as timestamp, frame type, frequency, SF, BW, FPort, and DevAddr. The list includes entries like "Oct 18 1:46:10 AM UnconfirmedDataDown 923.4 MHz SF10 BW125 FPort: 2 DevAddr: 01:0115db GW: a8404120f72c4150" and "Oct 18 1:45:55 AM UnconfirmedDataDown 923.4 MHz SF10 BW125 FPort: 2 DevAddr: 01:0115db GW: a8404120f72c4150". The status bar at the bottom right shows 00:14 and 46°.

หน้านี้จะบอกรถีํข้อมูลที่ส่งผ่าน Gateway

LORAWAN GUIDE BY SUWIJAK



หน้านี้จะเป็นหน้า Application Menu ที่จะบอก name server profile



หน้านี้จะบอกถึงภายใน Application ที่จะแสดง Device

## LORAWAN GUIDE BY SUWIJAK

This screenshot shows the ChirpStack Application Server interface for a device named 'Bike-keep1'. The 'DETAILS' tab is selected, showing the device's name, description ('lora@dev1'), and device profile ('device\_profile\_otaa'). The 'ACTIVATION' tab shows the device was last seen on Oct 31, 2022, at 2:59 PM and is currently enabled. The 'DEVICE DATA' tab is active, displaying two recent uplink frames. The 'LORAWAN FRAMES' tab is also visible. On the left, a sidebar lists ChirpStack organizational structures like Dashboard, Network-servers, and Applications. The bottom of the screen shows system icons and a timestamp of 12:33.

หน้านี้จะแสดงข้อมูล Device Detail

This screenshot shows the ChirpStack Application Server interface for the same device, focusing on the 'DEVICE DATA' tab. It displays two recent uplink frames. Frame 1 was received at 02 Nov 12:33:55 PM on 923.4 MHz with SF10, BW125, FPort:164, and confirmed. Frame 2 was received at 02 Nov 12:33:40 PM on 923.2 MHz with SF10, BW125, FPort:163, and confirmed. Below the frames, a detailed JSON representation of the frame data is shown, including applicationID, applicationName, devEUI, rx2, rx1, rx0, and other parameters. The bottom of the screen shows system icons and a timestamp of 12:34.

หน้านี้จะโชว์ข้อมูลของ Device Data

The screenshot shows the ChirpStack web interface. On the left, a sidebar menu is visible with various options like Network-servers, Gateway-profiles, Organizations, All users, API keys, and others under the 'chirpstack' section. The main content area is titled 'Organizations / chirpstack'. It contains fields for 'Organization name\*' (set to 'chirpstack') and 'Display name\*' (set to 'ChirpStack'). A checkbox labeled 'Organization can have gateways' is checked. Below these fields is a note: 'When checked, it means that organization administrators are able to add their own gateways to the network. Note that the usage of the gateways is not limited to this organization.' At the bottom right of the form is a blue 'UPDATE ORGANIZATION' button.

หน้านี้จะบอกการตั้งค่า Organization ไว้แล้วข้อ chirp stack

The screenshot shows the ChirpStack web interface. The sidebar menu is identical to the previous screenshot. The main content area is titled 'Users'. It displays a table with columns 'Username', 'Active', and 'Admin'. There is one row visible with 'admin' in the 'Username' column, which is highlighted with a red arrow. To the right of the table, there are buttons for 'Rows per page' (set to 10) and a page number '1-1'. The table has three columns:

Username	Active	Admin
admin	✓	✓

หน้านี้จะเป็นหน้าเมนู All users ที่บอกรหัส Username ชื่อ admin

ChirpStack Admin UI - Users / admin

Username \* admin

E-mail address \*

Optional note

Optional note, e.g. a phone number, address, comment...

Permissions

Is active

Is global admin

UPDATE USER

หน้านี้จะบอกว่ามีการตั้งเพิ่มค่าในเมนู All users ไว้แล้วซึ่งเป็น User : admin

ChirpStack Admin UI - Global API keys

ID	Name

Rows per page: 10 0-0 of 0

+ CREATE

ยังไม่ได้มีการตั้งค่าใดๆ เราสามารถสร้าง API KEY โดยคลิก Create มุมขวาบน บทความนี้เรายังไม่ได้ใช้ค่านี้

Organization users / admin

Username: admin

An user without additional permissions will be able to see all resources under this organization and will be able to send and receive device payloads.

User is organization admin ←

An organization admin user is able to add `join request` resources part of the organization.

**UPDATE USER**

หน้านี้จะบอกว่ามีการตั้งค่าไว้แล้วคือ หน้า Organization users ชื่อ admin

Service-profiles

Name
service-profile <span style="color:red">←</span>

Rows per page: 10 1-1 of 1 < >

หน้านี้จะบอกถึงเมนู Service profile ที่มี Username ชื่อ Service profile

## LORAWAN GUIDE BY SUWIJAK

Service-profiles / heltec

Service-profile name \*  
heltec  
A name to identify the service-profile.

Add gateway meta data  
GW metadata (RSSI, SNR, GW geoloc., etc.) are added to the packet sent to the application-server.

Enable network geolocation  
When enabled, the network-server will try to resolve the location of the devices under this service profile. Please note that you need to have gateways supporting the fine-timestamp feature and that the network-server needs to be configured in order to provide geolocation support.

Device-status request frequency  
0  
Frequency to initiate an End-Device status request (request/day). Set to 0 to disable.

Minimum allowed data-rate \*  
10  
Minimum allowed data rate. Used for ADR.

Maximum allowed data-rate \*  
10  
Maximum allowed data rate. Used for ADR.

Private gateways  
Gateways under this service-profile are private. This means that these gateways can only be used by devices under the same service-profile.

**UPDATE SERVICE PROFILE**

Device-profiles

Name	Network Server
device_profile_abp	ns
device_profile_oiaa	ns

Rows per page: 10 ▾ 1-2 of 2 < >

10.130.1.238:8080/#/organizations/1/device-profiles

## LORAWAN GUIDE BY SUWIJAK

ChirpStack Application Server - Chromium

dragino LoRa Gate | Facebook | ChirpStack Application Server

Not secure | 10.130.1.238:8080/#/organizations/1/device-profiles/9e89a1f2-fbf-46fa-840d-73f238053b0d

ChirpStack

Device-profiles / device\_profile\_otaa

GENERAL JOIN (OTAA / ABP) CLASS-B CLASS-C CODEC TAGS

Device profile name \* device\_profile\_otaa

LoRaWAN MAC version \* 1.0.2

LoRaWAN Regional Parameters revision \* A

ADR algorithm \* Default ADR algorithm (LoRa only)

Max EIRP \* 0

Uplink interval (seconds) \* 86400

UPDATE DEVICE-PROFILE

ChirpStack A [suwijak] [suwijak]

00:13 44°

ChirpStack Application Server - Chromium

dragino LoRa Gate | Facebook | ChirpStack Application Server

Not secure | 10.130.1.238:8080/#/organizations/1/device-profiles/9e89a1f2-fbf-46fa-840d-73f238053b0d

ChirpStack

Device-profiles / device\_profile\_otaa

GENERAL JOIN (OTAA / ABP) CLASS-B CLASS-C CODEC TAGS

Device supports Class-B

Class-B confirmed downlink timeout \* 30

Class-B timeout (in seconds) for confirmed downlink transmissions.

Class-B ping slot periodicity \* every 4 seconds

Class-B ping-slot periodicity

Class-B ping-slot data-rate \* 5

Class-B ping-slot frequency (Hz) \* 1

UPDATE DEVICE-PROFILE

ChirpStack A [suwijak] [suwijak]

00:13 46°

## LORAWAN GUIDE BY SUWIJAK

ChirpStack Application Server - Chromium

dragino LoRa Gate | Facebook | ChirpStack Application Server

Device-profiles / device\_profile\_otaas

GENERAL JOIN (OTAA / ABP) CLASS-B CLASS-C CODEC TAGS

Device supports Class-C

Select this option when the device will operate as Class-C device immediately after activation. In case it sends a DeviceModelId mac-command when it changes to Class-C, do not select this option.

Class-C confirmed downlink timeout \*

60

Class-C timeout (in seconds) for confirmed downlink transmissions.

UPDATE DEVICE-PROFILE

DELETE

Dashboard Network-servers Gateway-profiles Organizations All users API keys chirpstack

Org. dashboard Org. users Org. API keys Service-profiles Device-profiles Gateways Applications

ChirpStack Application Server - Chromium

dragino LoRa Gate | Facebook | ChirpStack Application Server

Device-profiles / device\_profile\_otaas

GENERAL JOIN (OTAA / ABP) CLASS-B CLASS-C CODEC TAGS

Payload codec:

Custom JavaScript codec functions

By defining a payload codec, ChirpStack Application Server can encode and decode the binary device payload for you.

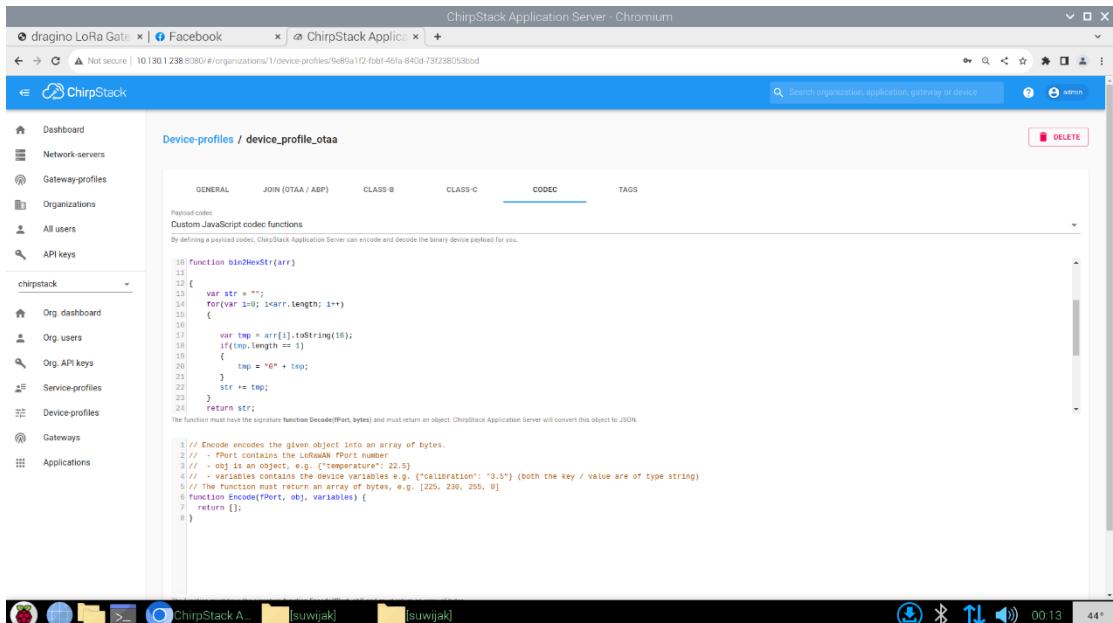
```
23 }
24     return str;
25 }
26
27 function Decode(PPort, bytes)
28 {
29     var myObj = {"DecodeDataToString": "", "DecodeDataHex": ""};
30     var tostring = decodeURIComponent(bytes);
31     var hexstring = bytes.toString('hex');
32     myObj.DecodeDataString = tostring;
33     myObj.DecodeDataHex = toHexString;
34     return myObj;
35 }
36
37
38 The function must have the signature function Decode(PPort, bytes) and must return an object. ChirpStack Application Server will convert this object to JSON.
39
40 // Decode decoder for given object into an array of bytes.
41 // - PPort contains the ChirpStack PPort number
42 // - obj - obj contains the device variables e.g. {"temperature": 22.5}
43 // - variables contains the device variables e.g. {"calibration": "3.5"} (both the key / value are of type string)
44 // - The function must return an array of bytes, e.g. [225, 230, 205, 0]
45 function Encode(PPort, obj, variables) {
46     return [];
47 }
```

DELETE

Dashboard Network-servers Gateway-profiles Organizations All users API keys chirpstack

Org. dashboard Org. users Org. API keys Service-profiles Device-profiles Gateways Applications

LORAWAN GUIDE BY SUWIJAK



## **Downlink guideline.**

The screenshot shows the ChirpStack web interface. The left sidebar contains navigation links: All users, API keys, Org. dashboard, Org. users, Org. API keys, Service-profiles, Device-profiles, Gateways, and Applications. The main content area has a breadcrumb path: Applications / AppB / Devices / Sens3. Below the path is a red-bordered box containing the device name 'Sens3'. A red box highlights the 'DETAILS' tab in the navigation bar. The page displays two sections: 'Details' and 'Status'. The 'Details' section includes fields for Name (Sens3), Description (sensor 3), Device-profile (DEVPROF-AS923), and Multicast groups. The 'Status' section shows the last seen at Sep 21, 2021 3:48 PM and the state as enabled.

DETAILS	CONFIGURATION	KEYS (OTAA)	ACTIVATION	DEVICE DATA	LORAWAN FRAMES
<strong>Details</strong> Name: Sens3 Description: sensor 3 Device-profile: DEVPROF-AS923 Multicast groups:					
<strong>Status</strong> Last seen at: Sep 21, 2021 3:48 PM State: enabled					

Figure 1 shows that you go to Application -> AppB (I created myself) -> Devices -> Sens3 (I created myself) -> DETAILS

Then you scroll down

**Figure 2**

ChirpStack interface showing the 'Enqueue downlink payload' form. The 'Port' field is set to 1, the 'Base64 encoded string' field contains 'U0RJNzA='.

When you scroll down to Enqueue downlink payload, you key in the port number. This port number you will see it when your node sends data over to you application server. Key in the same port number of the node you want to send downlink data to.

Then key in the Base64 value. The base64 value you can obtain by converting it at [asciitohex.com](http://asciitohex.com) (as shown in Figure 3 below) (I guess you know that also. Or you can go to any site that can help you to convert.

Figure 3

FCnt	FPort	Confirmed	Base64 encoded payload
8	1	no	U0RJNzA=

As can be seen in Figure 3, I am, actually, sending SDI70 downlink value to the node. After conversion, I get U0RJNzA=. Key in this value to the BASE64 ENCODED column. Actually, I don't know what to key in to the JSON OBJECT column. Do know what to key in? I just leave it blank.

Then you click on the ENQUEUE PAYLOAD.

Once you have clicked it, if successful, you will see what is shown in Figure 4 below.

Figure 4



Once it is successfully sent over to the node, when you click on the refresh icon (next to the red bin icon) the data will disappear. That's OK.

Figure 5

The screenshot shows a terminal window titled 'Tera Term - [disconnected] VT'. The terminal displays the following text:

```

Payload: 5344493730send data interv 70s
*****
Transmission Success
*****
Sensor Value: 93 Hz
Tx Sensor Data Sent
*** Received DL Data ***
Frame Received at port 1
Frame Length - 6 Ascii value for "SDI70"
Address -
Payload: 5344493730send data interv 70s
*****
Transmission Success
*****
Sensor Value: 95 Hz
Tx Sensor Data Sent
Transmission Success
*****
Sensor Value: 96 Hz
Tx Sensor Data Sent
Transmission Success
*****

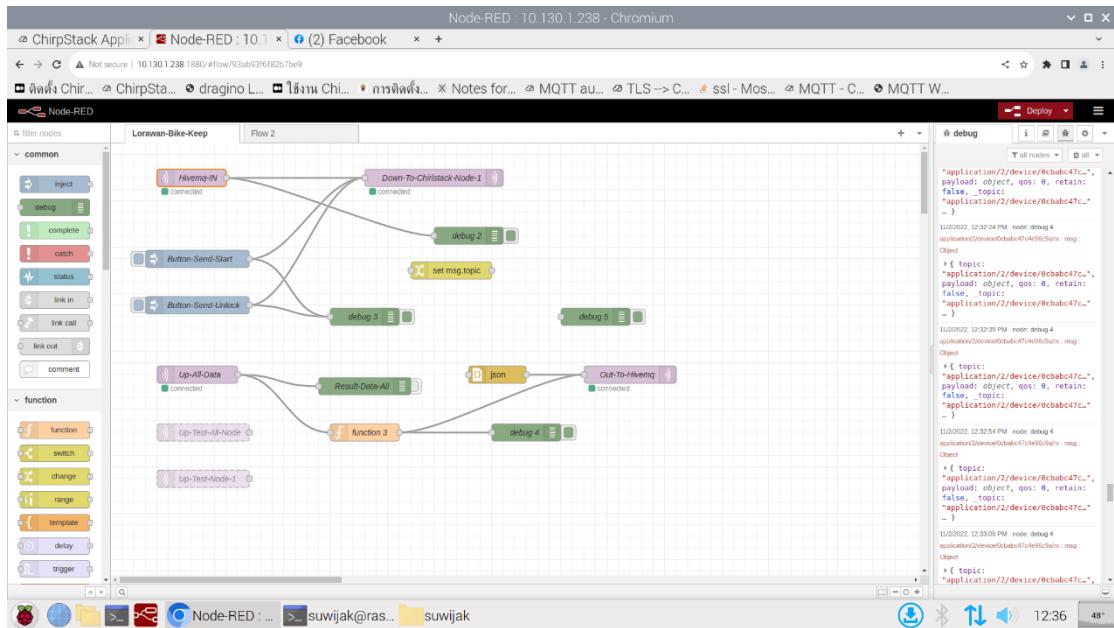
```

A white arrow points from the text 'Ascii value for "SDI70"' to the payload '5344493730' in the second frame. The payload '5344493730' is also highlighted with a red box.

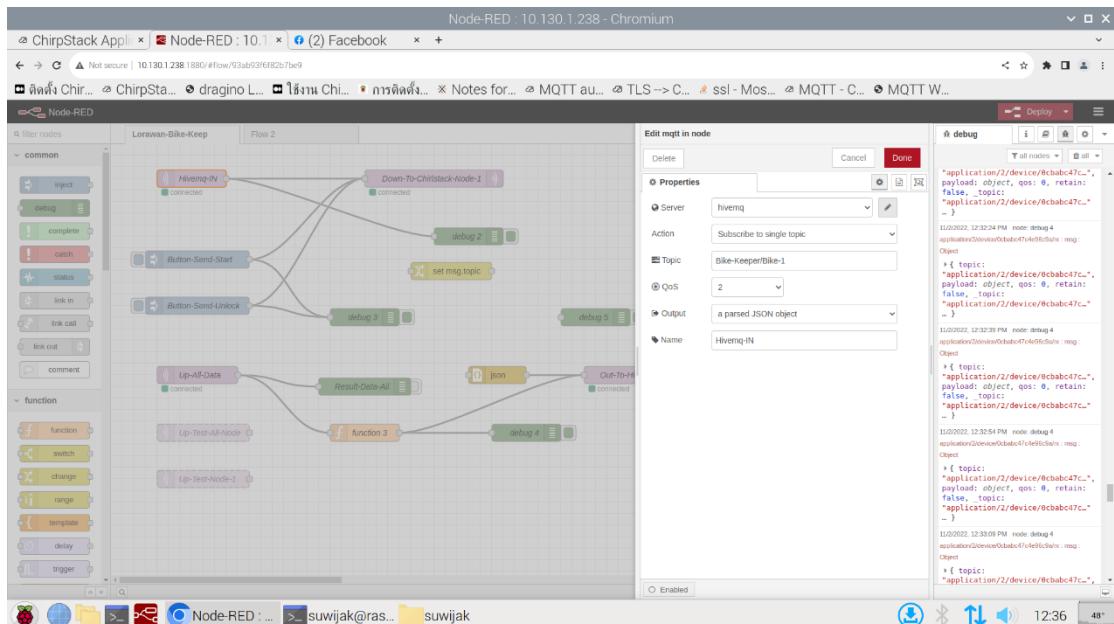
Figure 5 shows the output (I use printf) at my node's part. As you can see, after I have send Sensor Value of 93 Hz over to the application server, I get the downlink data from the application server (5344493730). This string of number (5344493730) is the ASCII value of SDI70 (S - 0x53, D - 0x44, I - 0x49, 7 - 0x37, 0 - 0x30), which is sent by the application server just now.

As you can see, it's quite a lot of job to be done. For a non-programmer, I don't think they want to do that. That's why I am thinking of creating a button for the user to send downlink data over to the node.

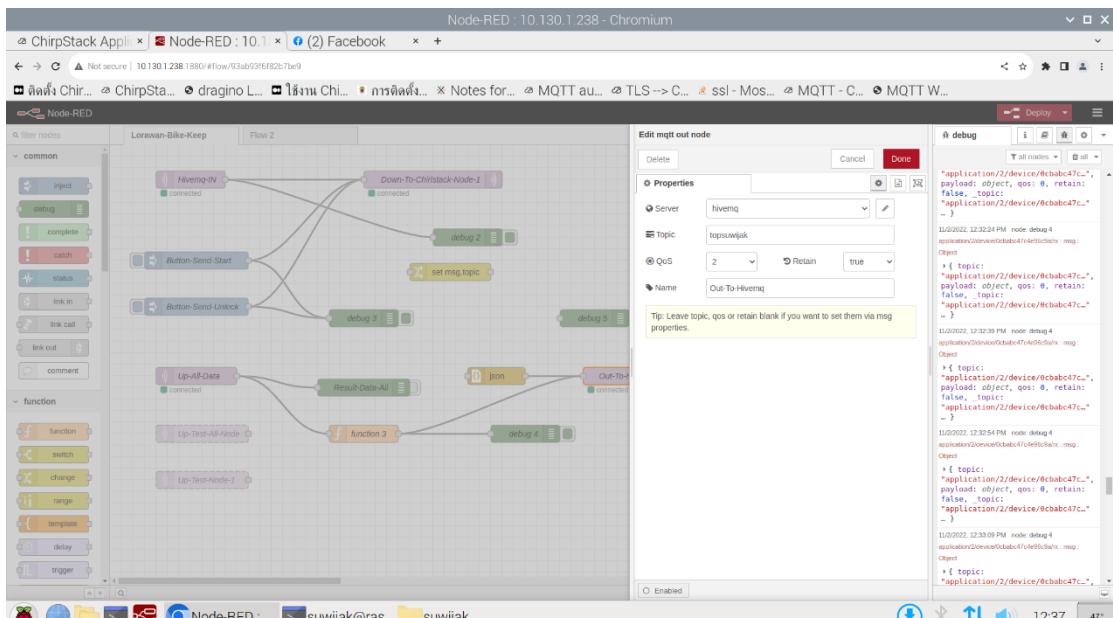
## การทำงานของ Node-red



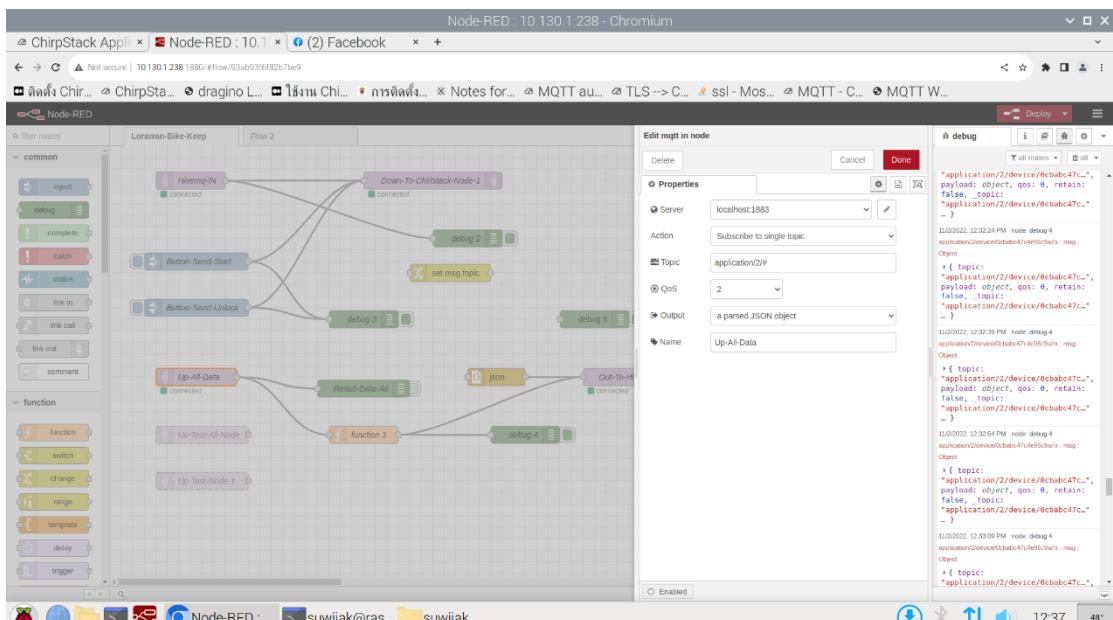
หน้านี้จะเป็นหน้าของ Node-red ที่จะบอกว่า Node-red เชื่อมไปไหนบ้างทำงานยังไงบ้าง



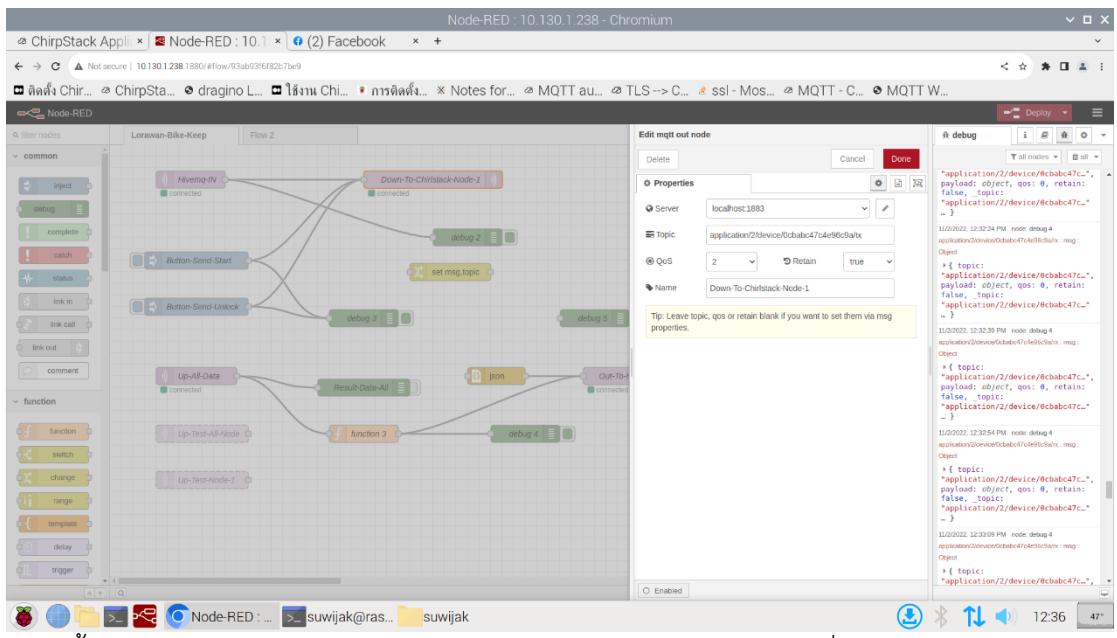
หน้านี้จะบอกว่า Node-red input from Hivemq คือการที่ Node-red เชื่อมต่อหรือ input ไปยัง Hivemq



หน้านี้จะแสดงให้เห็นว่า Node-red Output from Hivemq คือการที่ Node-red ทำการ Output หรือออกจากระบบ Hivemq



หน้านี้จะแสดงหน้า Node-red Get data จาก Chirp stack คือ Node-red รับค่าข้อมูลมาจากการ Data และจาก Chirp stack



หน้านี้จะแสดงให้เห็นว่า Node-red send data ไป Chirp stack คือการที่ Node-red data ส่งข้อ  
มูลไปยัง chirp stack

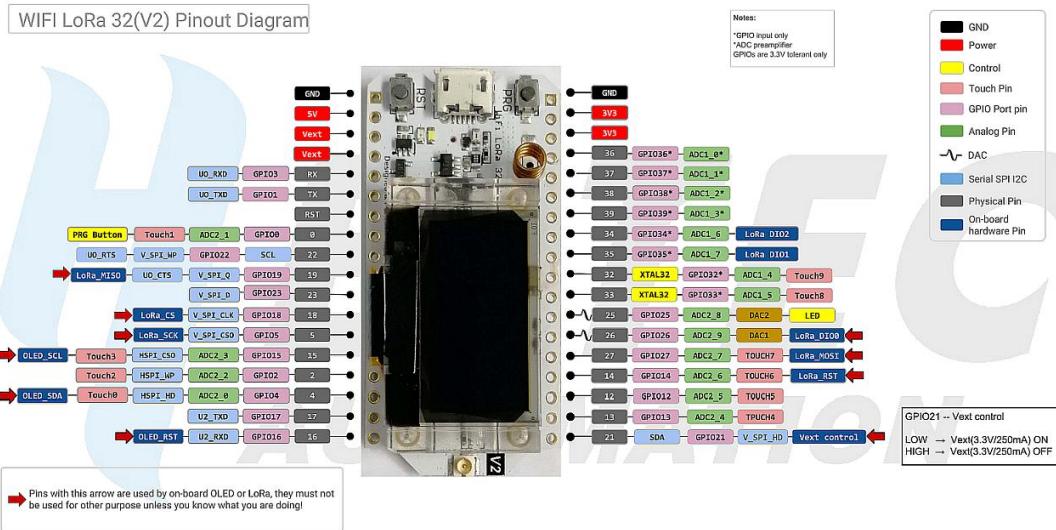
## การทำงานของ MQTT

```
File Edit Tabs Help
sunijk@raspberrypi: ~ $ sudo service mosquitto stop
sunijk@raspberrypi: ~ $ mosquitto -v
1667392683: mosquitto version 2.0.11 starting
1667392683: Using default config.
1667392683: Starting in local only mode. Connections will only be possible from clients running on this machine.
1667392683: Create a configuration file which defines a listener to allow remote access.
1667392683: For more details see https://mosquitto.org/documentation/authentication-methods/
1667392683: Opening ipv4 listen socket on port 1883.
1667392683: Opening ipv6 listen socket on port 1883.
1667392683: New client connection from 127.0.0.1:55930 on port 1883.
1667392684: New client connected from 127.0.0.1:55930 as auto-E3F36EDF-1672-5482-E096-C93EAD934980 (p2, c1, k30).
1667392684: No will message specified.
1667392684: Sending CONNACK to auto-E3F36EDF-1672-5482-E096-C93EAD934980 (0, 0)
1667392684: New connection from ::1:35380 on port 1883.
1667392684: New client connected from ::1:35380 on port 1883.
1667392684: No will message specified.
1667392684: New client connected from ::1:35380 as auto-D37E11A1-DE72-BBD5-2E13-9A601B95D060 (p2, c1, k30).
1667392684: No will message specified.
1667392684: Sending CONNACK to auto-D37E11A1-DE72-BBD5-2E13-9A601B95D060 (0, 0)
1667392684: New client connected from ::1:35394 as auto-10F1A685-7264-1B51-6A66-8A96EEC78002 (p2, c1, k30).
1667392684: No will message specified.
1667392684: Received SUBSCRIBE from auto-D37E11A1-DE72-BBD5-2E13-9A601B95D060
1667392684: Received CONNACK from auto-10F1A685-7264-1B51-6A66-8A96EEC78002 (0, 0)
1667392684: Received SUBSCRIBE from auto-D37E11A1-DE72-BBD5-2E13-9A601B95D060
1667392684: application/+device/+tx (QoS 0)
1667392684: auto-D37E11A1-DE72-BBD5-2E13-9A601B95D066 0 application/+device/+tx
1667392684: Sending SUBACK to auto-D37E11A1-DE72-BBD5-2E13-9A601B95D069
1667392684: Received SUBSCRIBE from auto-10F1A685-7264-1B51-6A66-8A96EEC78002
1667392684: gateway/+event/+ (QoS 0)
1667392684: auto-10F1A685-7264-1B51-6A66-8A96EEC78002 0 gateway/+event/+
1667392684: Sending SUBACK to auto-10F1A685-7264-1B51-6A66-8A96EEC78002
1667392684: Received SUBSCRIBE from auto-E3F36EDF-1672-5482-E096-C93EAD934980
1667392684: gateway/a8a04120f72c4150/command/# (QoS 0)
1667392684: auto-E3F36EDF-1672-5482-E096-C93EAD934980 0 gateway/a8a04120f72c4150/command/# (QoS 0)
1667392684: Sending SUBACK to auto-E3F36EDF-1672-5482-E096-C93EAD934980
1667392687: Received PUBLISH From auto-E3F36EDF-1672-5482-E096-C93EAD934980 (d0, q0, r0, m0, 'gateway/a8a04120f72c4150/state/conn', ... (12 bytes))
1667392687: Received PUBLISH From auto-10F1A685-7264-1B51-6A66-8A96EEC78002 (d0, q0, r0, m0, 'gateway/a8a04120f72c4150/event/up', ... (120 bytes))
1667392687: Sending PUBLISH to auto-10F1A685-7264-1B51-6A66-8A96EEC78002 (d0, q0, r0, m0, 'gateway/a8a04120f72c4150/event/up', ... (120 bytes))
1667392688: Received PUBLISH From auto-D37E11A1-DE72-BBD5-2E13-9A601B95D060 (d0, q0, r0, m0, 'application/2/device/0cababc47c4e96c9a/error', ... (194 bytes))
```

## หน้านี้จะแสดงการใช้งาน MQTT

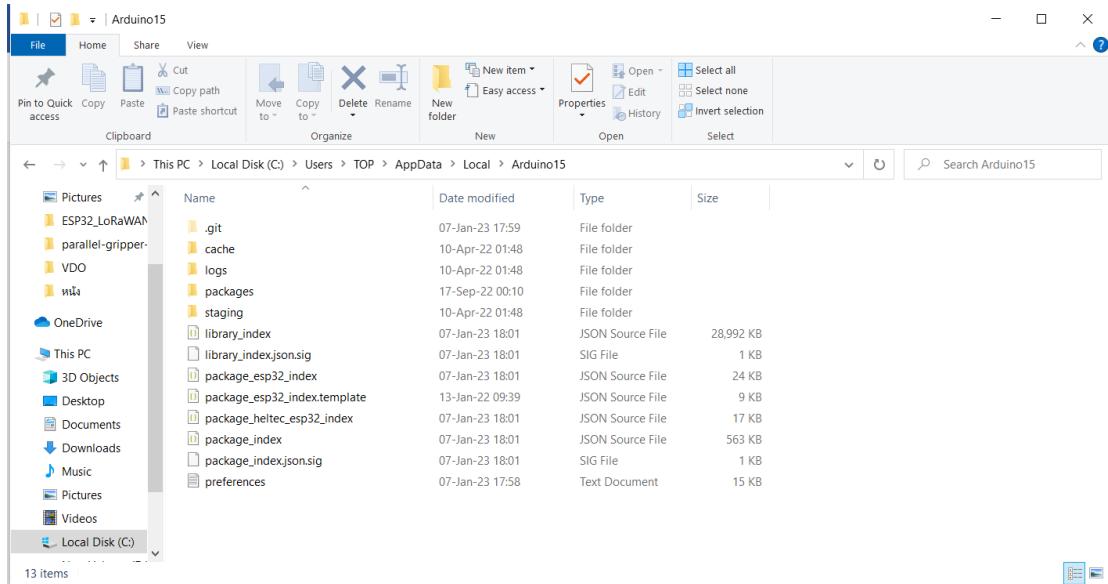
หน้านี้จะแสดงข้อมูล จาก Application ID คือการส่งข้อมูลจาก Application many MQTT

## การทำงานของ Arduino

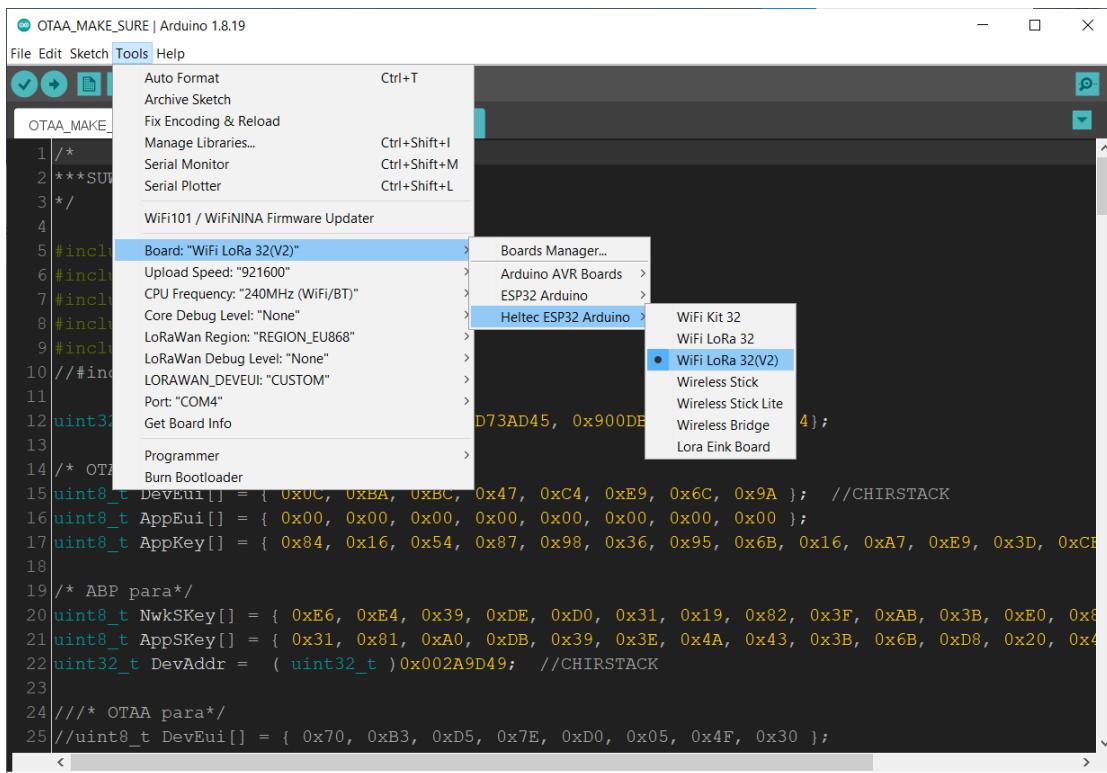


ติดตั้ง ข้อมูลของ Board heltec + libraries ใน โฟลเดอร์ C:\Users\(ชื่อของ user ที่ใช้)\AppData\Local\Arduino15

<https://github.com/suwijak0023/Arduino15>



## LORAWAN GUIDE BY SUWIJAK



The screenshot shows the Serial Monitor window with the port set to 'COM4'. The log output displays the following sequence of events:

```
18:49:52.274 -> DIOU:RX Done
18:49:52.274 -> RX on freq 923200000 Hz at DR 2
18:49:52.274 -> receive data: rssi = -118, snr = 2, datarate = 2
18:49:56.015 -> DIOO:RX Done
18:49:56.015 -> RX on freq 923200000 Hz at DR 2
18:49:56.015 -> receive data: rssi = -116, snr = 3, datarate = 2
18:49:56.015 -> +REV DATA:RXWIN2,RXSIZE 7,PORT 10
18:49:56.015 -> +REV DATA:data:83
18:49:56.015 -> Status : START DEVICE 1
18:49:56.015 ->
18:49:56.015 -> 1:Data InPut : StartD1
18:49:56.015 ->
18:50:05.538 -> confirmed uplink sending ...
18:50:05.584 -> TX on freq 923200000 Hz at DR 2
18:50:06.000 -> DIOO:TX Done
18:50:06.000 -> RX on freq 923200000 Hz at DR 2
18:50:07.019 -> RX on freq 923200000 Hz at DR 2
18:50:07.342 -> DIOO:RX Done
18:50:07.342 -> RX on freq 923200000 Hz at DR 2
18:50:07.342 -> receive data: rssi = -117, snr = 4, datarate = 2
18:50:11.133 -> DIOO:RX Done
18:50:11.133 -> RX on freq 923200000 Hz at DR 2
18:50:11.133 -> receive data: rssi = -119, snr = 1, datarate = 2
18:50:11.133 -> +REV DATA:RXWIN2,RXSIZE 4,PORT 10
18:50:11.133 -> +REV DATA:data:76
18:50:11.133 -> Status : UNLOCK DEVICE 1
18:50:11.133 -> 2:Data InPut : LOCK
18:50:11.133 ->
```

At the bottom of the Serial Monitor window, there are checkboxes for 'Autoscroll' and 'Show timestamp', and dropdown menus for 'Newline', '115200 baud', and 'Clear output'.

หน้านี้จะแสดงการรับข้อมูลจาก MQTT และจะสั่งการทำงานของ Node

LORAWAN GUIDE BY SUWIJAK

```
C:\Users\YOR\Documents\Arduino\Arduino_18.19
File Edit Sketch Tools Help
C:\Users\YOR\Documents\Arduino\Arduino_18.19\deviceunlock.ino
Serial 串行端口 电源 重新编译 退出
1 //DeviceUnlocker
2 #include <Arduino.h>
3 #define LEDPin 20
4 #define LockPin 36
5 void app_start3_5(data)
6 {
7     long_preamble("dataStart\n", data);
8     switch (data)
9     {
10         case 0x01:
11             pinMode(LEDPin, OUTPUT);
12             digitalWrite(LEDPin, HIGH);
13             pinMode(LockPin, OUTPUT);
14             digitalWrite(LockPin, HIGH);
15             Serial.println("Status : START DEVICE ");
16             break;
17         case 0x02:
18             pinMode(LEDPin, OUTPUT);
19             digitalWrite(LEDPin, LOW);
20             pinMode(LockPin, INPUT);
21             digitalWrite(LockPin, HIGH);
22             Serial.println("Status : UNLOCK DEVICE ");
23             break;
24     }
25 }
One Second
```

หน้านี้จะแสดงหน้าของ Down link รับข้อมูลจาก Server และได้ตั้งเงื่อนไขแบบ Switch case



The screenshot shows the Arduino IDE interface with the following details:

- Title Bar:** C:\Users\TOM\Downloads\Arduino 1.8.19
- File Menu:** File > Sketch from Help
- Code Area:** The main code area contains C++ code for LoRaWAN downlink handling. It includes functions for handling downlinks, setting up LoRa parameters, and printing data to the serial port.
- Serial Monitor:** A small window at the bottom left shows the serial output: "Updates available for some of your boards and libraries".
- Bottom Status Bar:** Shows the current sketch name as "LoRaWAN Downlink" and the build status as "Up to date".

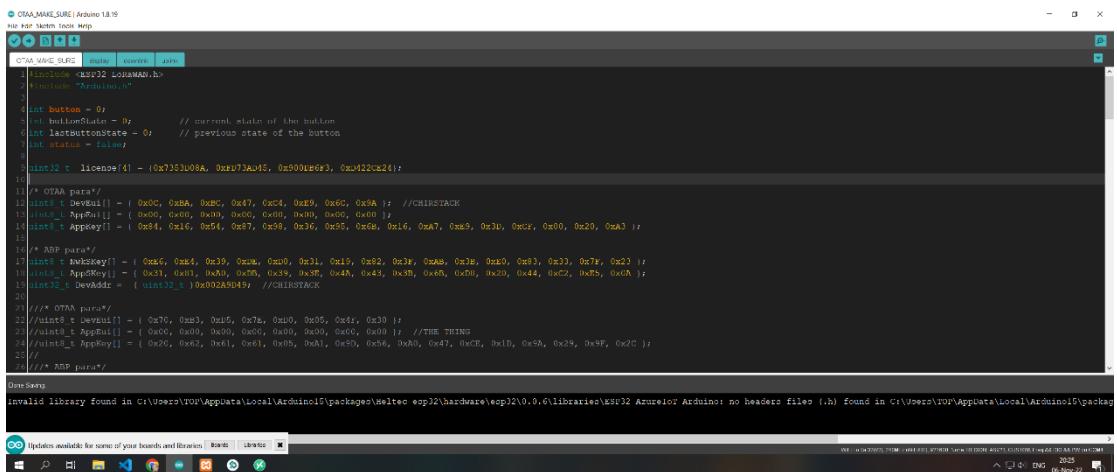
```
String LoRaData;
int16_t num = 0;
bool LoRaDownLink = false;
uint32_t LoRaDownLinkTime;
void downlinkHandle(Mcp32Indication_t *mcp32Indication)
{
    LoRa data = "";
    lora_prinl((char*)DATA,REGISTER_0d,PORT_RX);
    mcp32Indication->RxStat ? "RXWNU" : "RXWNU", mcp32Indication->BufferSix, mcp32Indication->Port);
    lora_prinl("DEV DATA");
    app(mcp32Indication->Buffer[0]);
    for (uint8_t i = 0; i < mcp32Indication->BufferSize; i++)
    {
        // Serial.print((String)i,mcp32Indication->Buffer[i]);
        LoRa_data += (String)(char)mcp32Indication->Buffer[i];
    }
    lora_prinl("\r\n");
    LoRaDownLink = true;
    LoRaDownLinkTime = millis();
    num++;
    // Serial.println();
    Serial.print(num);
    Serial.print((char)0xd);
    Serial.print((char)0xa);
    Serial.print("TxDL");
    Serial.print(" : ");
}

void setup()
{
    Serial.begin(9600);
    // Set pins for LoRa
    // Set pins for MCP3208
}
```

หน้านี้จะแสดงหน้าของ Down link รับข้อมูลจาก Server และทำการแปลงข้อมูลให้เป็น string

หน้านี้จะแสดงหน้าของหน้า Up link ข้อมูลไป Server โดยทำการแปลงข้อมูลให้เป็นรูปแบบ Hex

## LORAWAN GUIDE BY SUWIJAK



```
/* OTAA-MAKE-SURE | Arduino 1.8.9
File File Sketch Tools Help
C:\Users\YOUNG\Documents\Arduino\DevEuiAppKey\DevEuiAppKey.ino
#include <esp32_lorawan.h>
#include "Arduino.h"
...
int button = 0;
int buttonState = 0; // current state of the button
int lastbuttonState = 0; // previous state of the button
int status = false;
...
uint32_t license[4] = {0x7130U08A, 0x2073AU05, 0x9001U063, 0x4220U24};
...
/* OTAA para*/
uint8_t DevEui[] = { 0x0C, 0x0A, 0x0C, 0x07, 0xC4, 0x09, 0x0C, 0xA }; //CHIRPSTACK
uint8_t AppEui[] = { 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 }; //THE THING
uint8_t AppKey[] = { 0x94, 0x16, 0x0f, 0x07, 0x08, 0x36, 0x0e, 0x16, 0x07, 0x09, 0x00, 0x20, 0x03 };
...
/* ABP para*/
uint8_t DevEui[] = { 0x70, 0x31, 0x05, 0x7e, 0x00, 0x05, 0x4f, 0x30 };
uint8_t AppEui[] = { 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 }; //THE THING
uint8_t AppKey[] = { 0x26, 0x62, 0x61, 0x05, 0x01, 0x50, 0x56, 0x00, 0x47, 0xCE, 0x10, 0x5A, 0x24, 0x5F, 0x2C };
...
// Done Setup
invalid library found in C:\Users\YOUNG\AppData\Local\ArduinolD\packages\Heltec esp32\hardware\esp32\0.0.0\libraries\esu32 Aruino| no headers files (.h) found in C:\Users\YOUNG\AppData\Local\ArduinolD\packag
...
Updates available for some of your boards and libraries | Boards | Libraries |
```

หน้านี้จะแสดงหน้าของ DevEui,AppKey ของ OTAA และ Activation ของ ABP



```
/* OTAA-MAKE-SURE | Arduino 1.8.9
File File Sketch Tools Help
C:\Users\YOUNG\Documents\Arduino\DevEuiAppKey\DevEuiAppKey.ino
...
if (!mouStarted == 0)
{
    LoRaWAN.displayMouinit();
}
Serial.begin(115200);
pinMode(button, INPUT_PULLUP);
while (!Serial);
SPI.begin(SCK, MISO, MOSI, SS);
MouInit(SS, INT_LORA, DIO0, DIO1, license);
...
attachInterrupt(37);
analogSetClockDiv(255); // 130ms
...
deviceState = DEVICE_STATE_INIT;
...
void loop() {
...
while (deviceState)
{
    case DEVICE_STATE_INIT:
    ...
    if (LORAWAN_DEVICE_AUTO)
        LoRaWAN.generateDevEuiByChipID();
    ...
    LoRaWAN.init(loraWanLaco, loraWanRegion);
    ...
}
...
}
...
done Setup
invalid library found in C:\Users\YOUNG\AppData\Local\ArduinolD\packages\Heltec esp32\hardware\esp32\0.0.0\libraries\esu32 Aruino| no headers files (.h) found in C:\Users\YOUNG\AppData\Local\ArduinolD\packag
...
Updates available for some of your boards and libraries | Boards | Libraries |
```

หน้านี้จะเป็นการ Setup หรือการตั้งค่าข้อมูล

LORAWAN GUIDE BY SUWIJAK

```
OSA-JANKEURU: Arduino 1.8.19
no file selected from menu

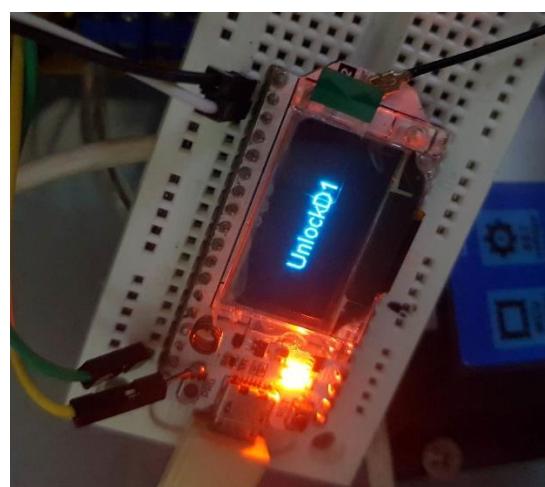
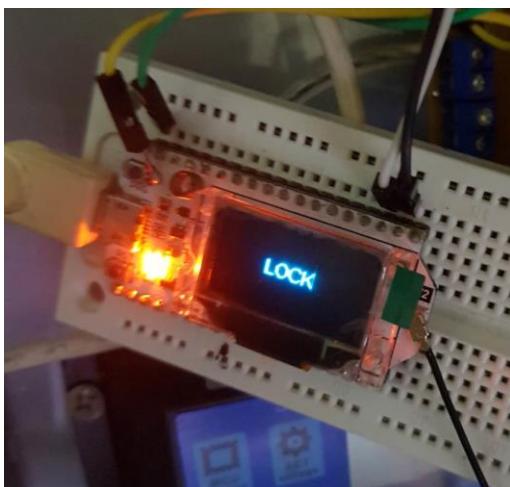
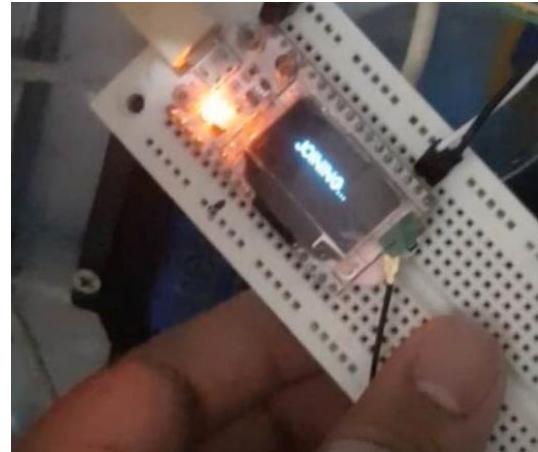
G704_WAVE_SLEUTH: display, assets, ideHelp

147
148     case DEVICE_STATE_JOINING:
149     {
150         WiFiManager.join();
151         WiFiManager.displayJoining();
152         break;
153     }
154     case DEVICE_STATE_SENDING:
155     {
156         WiFiManager.displaySending();
157         //    prepareTxFrame( appPort );
158         //    TXUP Send Button On( appPort );
159         if (digitalRead(button) == LOW)
160         {
161             status = !status;
162             Serial.println(status);
163             //    digitalWrite(red, status);
164         }
165     }
166     while (digitalRead(button) == (LOW));
167     delay(50);
168     if (status == 1)
169     {
170         //    TXUP SetParameterName( appPort );
171         //    TXUP Send Button On( appPort );
172         TXUP_Send_Button_On( appPort );
173         displayInfo();
174         delay(50);
175     }
176 }

AppTerminated

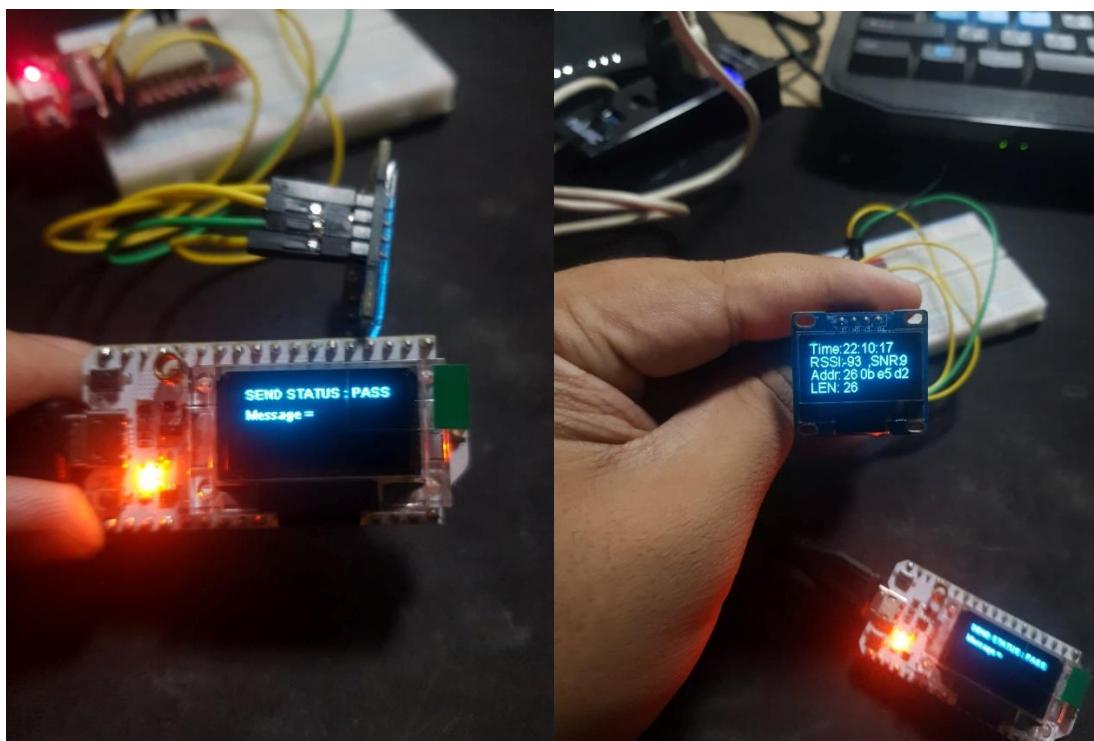
invalid library found in C:\Users\JON\AppData\Local\Arduino15\packages\Heltec\esp32\hardware\esp32\0.0.0\libraries\ESP32_AzureIoT_Arduino: no headers file (.h) found in C:\Users\JON\AppData\Local\Arduino15\packag
```

หน้านี้จะแสดงหน้า loop



หน้านี้แสดงการรับข้อมูลที่ได้ Server mayang Node ปลายทาง

## NODE TO NODE



หน้านี้แสดงถึงการส่งข้อมูลระหว่าง Node หา Node ด้วยกันโดยจะมีฝั่งส่งและรับ

## SC GATEWAY HELTEC

กรณีใช้ Esp32 เป็น Gateway

## ESP Gateway Config

Version: V.5.3.3.H; 180825a

ESP alive since Saturday 13-8-2022 14:55:20, Uptime: 0-00:54:52

Current time Saturday 13-8-2022 15:50:00

[Documentation](#) [Basic Mode](#) [Log Files](#)

### Package Statistics

Counter	C 0	C 1	C 2	Pkgs	Pkgs/hr
Packages Downlink				0	
Packages Uplink Total				8	8
Packages Uplink OK				8	
SF7 rcvd	6	1	1	8	100 %
SF8 rcvd	0	0	0	0	0 %
SF9 rcvd	0	0	0	0	0 %
SF10 rcvd	0	0	0	0	0 %
SF11 rcvd	0	0	0	0	0 %
SF12 rcvd	0	0	0	0	0 %

### Message History

Time	Node	C	Freq	SF	pRSSI
Saturday 13-8-2022 15:45:17	26 0d 26 15	2	923600000	7	-71
Saturday 13-8-2022 15:30:26	26 0d 26 15	0	923200000	7	-73
Saturday 13-8-2022 15:29:59	26 0d 26 15	0	923200000	7	-75
Saturday 13-8-2022 15:28:14	26 0d 26 15	0	923200000	7	-72
Saturday 13-8-2022 15:25:52	26 0d 93 bc	0	923200000	7	-75
Saturday 13-8-2022 15:09:09	26 0d 26 15	0	923200000	7	-73
Saturday 13-8-2022 15:01:31	26 0d 26 15	1	923400000	7	-71
Saturday 13-8-2022 14:57:57	26 0d 26 15	0	923200000	7	-70

### Gateway Settings

Setting	Value	Set
CAD	ON	ON OFF
HOP	ON	ON OFF
SF Setting	AUTO	
Channel	AUTO	
Debug level	1	- +
Debug pattern	SCN CAD RX TX PRE MAI GUI RDIO	
Usb Debug	1	
WWW Refresh	ON	ON OFF
Update Firmware		UPDATE
Format SPIFFS		FORMAT
Statistics	0	RESET
Boots and Resets	17	RESET

### WiFi Config

Parameter	Value
WiFi host	esp32-e282c4
WiFi SSID	SANGTONG 2.4G
IP Address	192.168.1.142
IP Gateway	192.168.1.1
NTP Server	nl.pool.ntp.org
LoRa Router	au1.cloud.thethings.network
LoRa Router IP	13.55.29.193

### System Status

Parameter	Value	Set
Gateway ID	2462abFFFFe282c4	
Free heap	542040	

ជំនួយ

ชื่อ – นามสกุล  
อีเมล  
การศึกษา

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พระเกียรติจังหวัดสกลนคร

Link ข้อมูลและวิธีโอทีเกี่ยวข้อง (อ้างอิง)

Github ของผู้จัดทำ

<https://github.com/suwijak0023/Lorawan-libraries-Code-Esp32>

Board libraries

<https://github.com/suwijak0023/Arduino15>

Chirstack Setup

<https://www.youtube.com/watch?v=FnTP7t47DlI&list=PL9FegcZTeB9LRLnXtN6OMkVSZYgHdlmOr>

MQTT LORA CHIRSTACK

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ESP32 LoRaWan Gateway + LoRa Node

<https://meetjoeblog.com/2018/04/29/esp32-lorawan-gateway/>

LoRaWAN node วัดอุณหภูมิและความชื้น ด้วย Heltec ESP32 Wifi LoRa Oled V.2 ใช้ได้ กับ TheThings หรือ Helium

<https://khunsomsak.medium.com/%E0%B8%97%E0%B8%B3-lorawan-node-%E0%B8%A7%E0%B8%B1%E0%B8%94%E0%B8%AD%E0%B8%B8%E0%B8%93%E0%B8%AB%E0%B8%A0%E0%B8%B9%E0%B8%A1%E0%B8%B4%E0%B9%81%E0%B8%A5%E0%B8%B0%E0%B8%84%E0%B8%A7%E0%B8%B2%E0%B8%A1%E0%B8%8A%E0%B9%89%E0%B8%99-%E0%B8%94%E0%B9%89%E0%B8%A7%E0%B8%A2-heltec-esp32-wifi-lora-oled-v-2-836fabd400b1>

[LoRaWAN] ทดสอบสร้าง Server รับข้อมูลจาก End-node [ต่อ]

<https://iamteam.me/lorawan-%E0%B8%97%E0%B8%94%E0%B8%AA%E0%B8%AD%E0%B8%9A%E0%B8%>

[AA%E0%B8%A3%E0%B9%89%E0%B8%B2%E0%B8%87-server-%E0%B8%A3%E0%B8%B1%E0%B8%9A%E0%B8%82%E0%B9%89%E0%B8%A  
D%E0%B8%A1%E0%B8%B9%E0%B8%A5%E0%B8%88%E0%B8%B2%E0%B8%  
81-end-node-%E0%B8%95%E0%B9%88%E0%B8%AD-75e9484c2df8](#)

End node and gateway connection

<https://www.thethingsnetwork.org/forum/t/end-node-and-gateway-connection/47147/3>

ESP8266 / ESP32 & Mesh Network ตอนที่ 4: Painlessmesh Bridge with LoRa

<https://meetjoeblog.com/2018/04/25/esp8266-esp32-painlessmesh-bridge-with-lora-ep4/>

<https://www.thethingsnetwork.org/forum/t/how-do-i-send-data-from-my-gateway-to-node/17912/3>

<https://how2electronics.com/esp32-lora-thingspeak-gateway-sensor-node/>

<https://www.sparkfun.com/products/18074>

<https://electropeak.com/learn/the-beginners-guide-to-display-text-image-animation-on-oled-display-by-arduino/>

[http://lorawan.lnwshop.com/product/75/heltec-esp32-wifi-lora-oled-v-2-%E0%B9%80%E0%B8%AA%E0%B8%B2%E0%B8%81%E0%B8%A5%E0%B8%A1%E0%B8%9A%E0%B8%B1%E0%B8%94%E0%B8%81%E0%B8%A3%E0%B8%  
B5%E0%B8%82%E0%B8%B2%E0%B9%84%E0%B8%A7%E0%B9%89%E0%B9%81%E0%B8%A5%E0%B9%89%E0%B8%A7](http://lorawan.lnwshop.com/product/75/heltec-esp32-wifi-lora-oled-v-2-%E0%B9%80%E0%B8%AA%E0%B8%B2%E0%B8%81%E0%B8%A5%E0%B8%A1%E0%B8%9A%E0%B8%B1%E0%B8%94%E0%B8%81%E0%B8%A3%E0%B8%<br/>B5%E0%B8%82%E0%B8%B2%E0%B9%84%E0%B8%A7%E0%B9%89%E0%B9%81%E0%B8%A5%E0%B9%89%E0%B8%A7)

[https://wiki.octoate.de/doku.php/thethingsnetwork:esp32\\_mit\\_868\\_mhz\\_lora\\_modul](https://wiki.octoate.de/doku.php/thethingsnetwork:esp32_mit_868_mhz_lora_modul)

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<https://www.youtube.com/watch?v=k5-1o8WifQM>

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