

# Getting Started Guide template for AWS IoT Core for LoRaWAN

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## 1 Document Information

### 1.1 Naming Conventions

The term “downlink device” or “endpoint device” is used in this document to refer to a LoRaWAN device that connects to a LoRaWAN “Gateway”. The “Gateway” in turn, connects to AWS IoT Core for LoRaWAN.

### 1.2 Revision History (Version, Date, Description of change)

Version	Author	Date
1.01	David32.yang	2022/12/23
1.02	Stanley.chou	2023/01/05

## 2 Overview

The WISE-6610 is a high-performance LoRaWAN gateway that offers reliable connectivity for industrial environments. It supports the LoRaWAN protocol for building LoRaWAN private and public networks, as well as various protocols including MQTT. The hardware and software flexibility of the WISE-6610 provides rich features for edge intelligence systems, and its support for VPN tunneling with various protocols ensures safe communications. The WISE-6610 also provides a network server that can phase the LoRaWAN data in our device. The WISE-6610 provides the redundancy-enhanced functions to prevent connection loss

## 3 Hardware Description

### 3.1 DataSheet

WISE-6610:

[https://advdownload.advantech.com/productfile/PIS/WISE-6610-N100/file/WISE-6610\\_DS\(1022221\)20210223090441.pdf](https://advdownload.advantech.com/productfile/PIS/WISE-6610-N100/file/WISE-6610_DS(1022221)20210223090441.pdf)

### 3.2 Standard Kit Contents

Package includes

- 1 x Industrial LoRaWAN gateway
- 1 x DIN-Rail mounting bracket and screws
- 1 x power cable(without adapter)

Can check WISE-6610 UM in below link

[https://advdownload.advantech.com/productfile/Downloadfile2/1-2569SV7/WISE-6610%20Series\\_UM\\_Revision%209\\_100721.pdf](https://advdownload.advantech.com/productfile/Downloadfile2/1-2569SV7/WISE-6610%20Series_UM_Revision%209_100721.pdf)

Product page below for reference.

[https://www.advantech.com/en/products/23ed4776-1633-4901-a776-8532a23ea8b4/wise-6610-n100/mod\\_c0f6fff8-aedf-4d42-b510-9f340ca36810](https://www.advantech.com/en/products/23ed4776-1633-4901-a776-8532a23ea8b4/wise-6610-n100/mod_c0f6fff8-aedf-4d42-b510-9f340ca36810)

### 3.3 User Provided items

Ethernet cable for network connection.

### 3.4 3<sup>rd</sup> Party purchasable items

N/A

### 3.5 Additional Hardware References

[https://www.advantech.com/en/products/23ed4776-1633-4901-a776-8532a23ea8b4/wise-6610-n100/mod\\_c0f6fff8-aedf-4d42-b510-9f340ca36810](https://www.advantech.com/en/products/23ed4776-1633-4901-a776-8532a23ea8b4/wise-6610-n100/mod_c0f6fff8-aedf-4d42-b510-9f340ca36810)

## 4 Setup AWS

If you don't have an AWS account, refer to the instructions in the guide [here](#). The relevant sections are **Sign up for an AWS account** and **Create a user and grant permissions**.

### 4.1 Overview

The high-level steps to get started with AWS IoT Core for LoRaWAN are as follows:

1. Onboard your Gateway (see section [Add the Gateway to AWS IoT](#))
2. Onboard your Device(s) (see section [Add a LoRaWAN Device to AWS IoT](#))
  - a. Verify device and service profiles
  - b. Set up a Destination to which device traffic will be routed and processed by a rule.

These steps are detailed below. For additional details, refer to the AWS [LoRaWAN developer guide](#).

## 4.2 Add the Gateway to AWS IoT

### 4.2.1 Preparation

Refer to the [online guide](#) for steps required prior to onboarding your gateway.

### 4.2.2 Frequency Band selection and Role setup

Refer to the [online guide](#) for information on selecting an appropriate frequency band.

Follow the instructions in the section **Add an IAM role to allow the Configuration and Update Server (CUPS) to manage gateway credentials** in the [online guide](#).

### 4.2.3 Add the LoRaWAN Gateway

To register the Gateway with AWS IoT Core for LoRaWAN, follow the steps in this [online guide](#) under the section **Add a gateway using the console**.

## 4.3 Add a LoRaWAN Device to AWS IoT

### 4.3.1 Preparation

Refer to the instructions in the section **Before onboarding your wireless device** in the [online guide](#).

Then follow the instructions in the section **Add your wireless device to AWS IoT Core for LoRaWAN** [here](#).

### 4.3.2 Verify Profiles

AWS IoT Core for LoRaWAN supports device profiles and service profiles. Device profiles contain the communication and protocol parameter values the device needs to communicate with the network server. Service profiles describe the communication parameters the device needs to communicate with the application server.

Some pre-defined profiles are available for device and service profiles. Before proceeding, verify that these profile settings match the devices you will be setting up to work with AWS IoT Core for LoRaWAN. For more details, refer to the section **Add profiles to AWS IoT Core for LoRaWAN** in the [online guide](#).

Proceed only if you have a device and service profile that will work for you.

### 4.3.3 Set up a Destination for device traffic

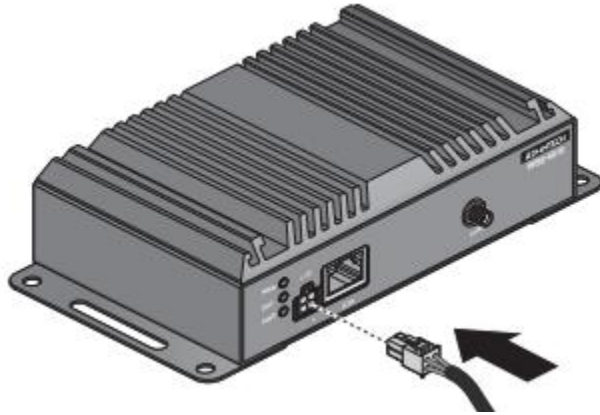
Because most LoRaWAN devices don't send data to AWS IoT Core for LoRaWAN in a format that can be consumed by AWS services, traffic must first be sent to a Destination. A Destination represents the AWS IoT rule that processes a device's data for use by AWS services. This AWS IoT rule contains the SQL statement that selects the device's data and the topic rule actions that send the result of the SQL statement to the services that will use it.

For more information, refer to the [online guide](#) (sections titled **Add a destination using the console** and **Create an IAM role for your destinations**). Also refer to **Create rules to process LoRaWAN device messages** in the [online guide](#).

## 5 Set up the Gateway

### 5.1 Set up Gateway hardware

1. Insert the power cable into the power socket. The cable locks in place if installed correctly.



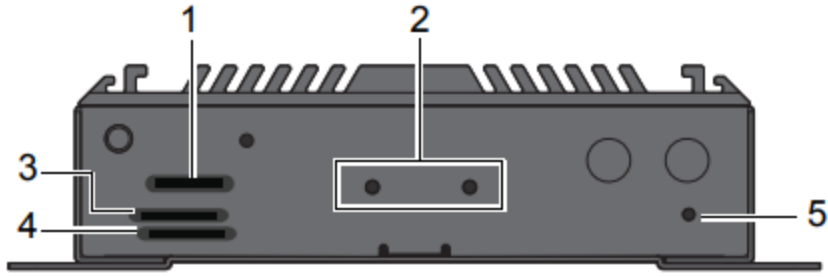
LED Name	LED Color	Description
WAN*	Yellow, blinking	PPP connection established. Signal strength is from -50 dBm to -69 dBm (1x flash per sec.) Signal strength is from -70 dBm to -89 dBm or the difference between neighboring cells is exactly 3 dBm (2x flash per sec.) Signal strength is from -90 dBm to -113 dBm or difference the between neighboring cells is smaller than 3 dBm (3x flash per sec.)
DAT	Red, blinking	Communication in progress on radio channel.
PWR	Green, blinking	Device is ready.
	Green, on	Device is booting.

2. Launch a web browser on a computer.
3. In the browser's address bar type in the default IP address (192.168.1.1). The login screen displays.
4. Enter the default user name and password (root/root) to log into the management interface. You can change the default password after a successfully log in

User manual : <https://www.advantech.com/en/support/details/manual?id=1-1THEK7T>

## 5.2 Set up Gateway Software

- Factory reset : After the green LED starts to blink you may restore the initial device settings by pressing the reset (RST) button on the back panel. If the reset button is pressed, all configuration will revert to factory defaults and the device will reboot (the green LED will be on during the reboot).



No.	Item	Description
1	SD Card	Slot for SIM multimedia card.
2	DIN-Rail holes	Screw holes (2) used in the installation of a DIN rail clip.
3	SIM 2	Slot for SIM 2 smart card.
4	SIM 1	Slot for SIM 1 smart card.
5	RST	Reset button.

- Not supported OTA updates.
- Launch a web browser to access and configure gateway.

### 5.3 Additional Software References

Support from below for reference.

<https://www.advantech.com/en/search/?q=WISE-6610-N100&st=faq>

### 5.4 Configure the Gateway device

1. Go to BasicStation Web

## WISE-6610-N100-A

Status	
General	ADAM Configure 1.0.0 (20210806T012630Z) <input type="button" value="Delete"/>
Network	basicstation 1.0.2 (20221214T063048Z) <input type="button" value="Delete"/>
DHCP	LoRaWAN Gateway 2.3.0 (BETA-20221028T023835Z) <input type="button" value="Delete"/>
IPsec	Node-RED 1.1.3 (2018-05-18) <input type="button" value="Delete"/>
WireGuard	
DynDNS	
System Log	
New Module <input type="text" value="選擇檔案 未選擇任何檔案"/> <input type="button" value="Add or Update"/>	

Configuration	
Ethernet	
VRRP	
PPPoE	
Backup Routes	
Static Routes	
Firewall	
NAT	
OpenVPN	
IPsec	
WireGuard	
GRE	
L2TP	
PPTP	
Services	
Expansion Port 1	
Expansion Port 2	
Scripts	
Automatic Update	

Customization	
User Modules	

2. Set URL and upload trust and certificates which download from AWS

Navigation	
Router	
<a href="#">Settings</a>	
<a href="#">Log</a>	
<a href="#">Return to Router</a>	

LoRaWAN Gateway EUI	
<input type="text" value="74FE48FFFE333333"/>	
<b>Enable</b>	
<input type="text" value="Off"/> <input type="button" value="v"/>	Enable the BasicStation.
<b>Protocol</b>	
<input type="text" value="CUPS"/> <input type="button" value="v"/>	
<b>Log Enable</b>	
<input type="text" value="Off"/> <input type="button" value="v"/>	Enable the Log.
<b>URL</b>	
<input type="text" value="https://A2746GWZJS1NRT.cups.lk"/>	
<input type="button" value="Upload trust file"/>	
<input type="button" value="Upload certificate file"/>	
<input type="button" value="Upload key file"/>	
<input type="button" value="Clear cache"/>	
<input type="button" value="Save"/>	

### 5.5 Connect the Gateway and verify the connection status

Follow the instructions in the [online guide](#) to connect your gateway to AWS IoT Core for LoRaWAN.

To verify the connection status, refer to the instructions in the section **Check gateway connection status using the console**.

## 6 Add End Device(s)

Can check our configuration quick guide in below link.

<https://www.advantech.com/en/support/details/faq?id=1-29KPEKB>

### 6.1 Connect the device and verify the connection status

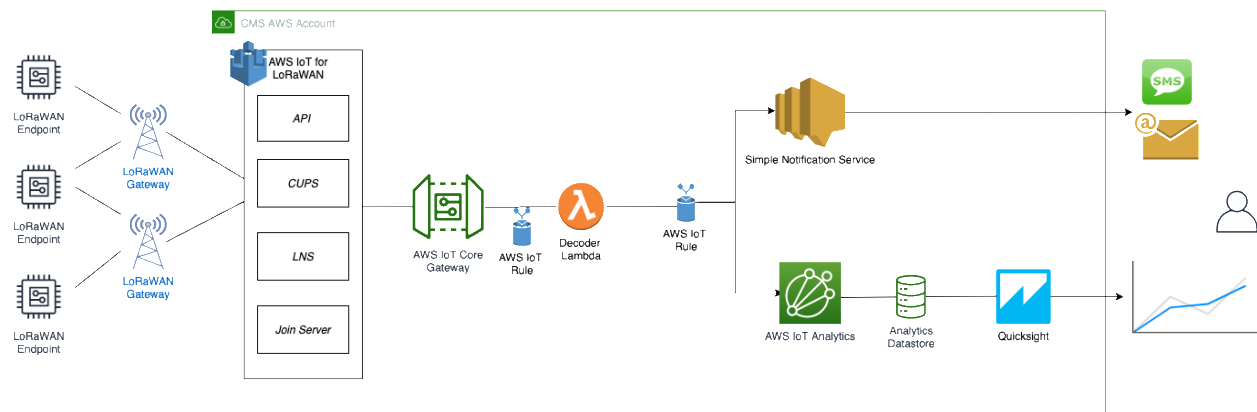
Follow the instructions in the [online guide](#) to connect your device to AWS IoT Core for LoRaWAN.

To verify the connection status, refer to the instructions in the section **Check device connection status using the console**. You can also [View format of uplink messages sent from LoRaWAN devices](#).

## 7 Verifying Operation – a “Hello World” example

Once setup is completed, provisioned OTAA devices can join the network and start to send messages. Messages from devices can then be received by AWS IoT Core for LoRaWAN and forwarded to the IoT Rules Engine.

Instructions for a sample Hello World application are given below, assuming that the device has joined and is capable of sending uplink traffic. The architecture for this sample application is:



### 7.1 Create lambda function for destination rule

Create the lambda function to process device messages processed by the destination rule.

- Go to the AWS Lambda console ([console.aws.amazon.com/lambda](https://console.aws.amazon.com/lambda)).
- Click on **Functions** in the navigation pane
- Click on **Create function**
- Select **Author from scratch**. Under Basic information, enter the function name *"sailboatdecoder"* and choose *Runtime Node.js 12.x* from the drop-down under **Runtime**.
- Click on **Create function**.
- Navigate to `<<provide your github repository URL>>` and copy the code for the lambda function.
- Under **Function code**, paste the copied code into the editor under the **index.js** tab.
- Once the code has been pasted, choose **"Deploy"** to deploy the lambda code.
- Click on the **Permissions** tab of the lambda function
- Change the Lambda Role Policy permission
  - Under **Execution role**, click on the hyperlink under **Role name**
  - On the **Permissions** tab, find the policy name and click on it

- Choose **Edit policy**, and choose the **JSON** tab
- Append the following to the Statement section of the policy to allow publishing to AWS IoT.

```
,
{
  "Effect": "Allow",
  "Action": [
    "iot:Publish"
  ],
  "Resource": [
    "*"
  ]
}
```

- Choose **Review Policy**, then **Save changes**
- Create a test event that will allow you to test the functionality of the lambda function.
  - In the drop-down for *Select a test event*, choose **Configure test events**
  - Enter a name for the test event under **Event name**
  - Paste the following sample payload in the area under Event name:

```
{
  "MessageId": "55d122ab-6355-2233-9874-ff47c5222108",
  "WirelessDeviceId": "65d128ab-90dd-4668-9556-fe47c589610b",
  "PayloadData": "zA0LYgHpAX//f/8=",
  "WirelessMetadata":
  {
    "LoRaWAN":
    {
      "DevEui": "a84041000181bf255",
      "FPort": 2,
      "DataRate": 0,
      "Frequency": 904500000,
      "Gateways": [
        {
          "GatewayEui": "80029cffXXXXXXXX",
          "Snr": 12.25,
          "Rssi": -47
        }
      ],
      "Timestamp": "2020-12-14T08:23:56Z",
    }
  }
}
```

- Choose **Create** to save the event
- Navigate to the AWS IoT console, choose **Test** on the navigation pane, and select **MQTT client**.
- Configure the MQTT client to subscribe to **"#"** (all topics)
- Click on **Test** in the Lambda function page to generate the test event you just created
- Verify the published data in the AWS IoT Core MQTT Test client
  - Open another window. Goto AWS IoT Console, select Test, under Subscription Topic, enter # and select to Subscribe to topic
  - The output should look similar to this:



```
{
  "Ext_sensor": "Temperature Sensor",
  "BatteryV": 3.085,
  "Alert_Temp": "84.45",
  "Humidity": "48.9",
  "Probe_Temp": "327.67",
  "DevEUI": "a84041000181bf255",
  "Timestamp": "2020-12-14T08:23:56Z"
}
```

## 7.2 Create the Destination rule

In this step, you create the IoT rule that forwards the device payload to your application. This rule is associated with the destination created earlier in [Set up a Destination for device traffic](#).

- Navigate to the [AWS IoT console](#).
- In the navigation pane, choose **Act**. Then, choose **Rules**.
- On the Rules page, choose **Create**.
- On the **Create a rule** page, for **Name**, enter *LoRaWANRouting*. For **Description**, enter a description of your choice. Note the name of your rule. The information will be needed when you provision devices to run on AWS IoT Core for LoRaWAN.
- Leave the default Rule query statement: 'SELECT \* FROM 'iot/topic' unchanged. This query has no effect at this time, as traffic is currently forwarded to the rules engine based on the destination.
- Under **Set one or more actions** choose **Add action**.
- On the Select an action page, choose **Republish a message to an AWS IoT topic**. Scroll down and choose **Configure action**.
- On the Configure action page, for **Topic**, enter *project/sensor/decoded*. The AWS IoT Rules Engine will forward messages to this topic.
- Under **Choose or create a role to grant AWS IoT access to perform this action**, choose **Create Role**.
- For **Name**, enter a name of your choice.
- Choose **Create role** to complete the role creation. You will see a "Policy Attached" tag next to the role name, indicating that the Rules Engine has been given permission to execute the action.
- Choose **Add action**.
- Add one more action to invoke the Lambda function. Under **Set one or more actions** choose **Add action**.
- Choose **Send a message to a Lambda function**
- Choose **Configure action**
- Select the *sailboatdecoder* lambda function created earlier and choose **Add action**
- Then, choose **Create rule**.
- A "Success" message will be displayed at the top of the panel, and the destination has a rule bound to it.

You can now check that the decoded data is received and republished by AWS by triggering a condition or event on the device itself.

1. Go to the AWS IoT console. In the navigation pane, select **Test**, and choose **MQTT client**.
2. Subscribe to the wildcard topic '#' to receive messages from all topics
3. You should see traffic similar to that shown below.

```
a84041000ffff255/project/sensor/deco... December 14, 2020, 18:17:04 (UTC-0800) Exp... Hi...  
{  
  "Ext_sensor": "Temperature Sensor",  
  "BatteryV": 3.085,  
  "Alert_Temp": "84.45",  
  "Humidity": "48.9",  
  "Probe_Temp": "327.67",  
  "DevEUI": "a84041000ffff255",  
  "Timestamp": "2020-12-14T08:30:56Z"  
}
```

```
lorawan/uplink/republish December 14, 2020, 18:16:22 (UTC-0800) Export Hide  
{  
  "MessageId": "55d122ab-6355-2233-9874-ff47c5222108",  
  "WirelessDeviceId": "65d128ab-90dd-4668-9556-fe47c589610b",  
  "PayloadData": "zA0LYgHpAX//f/8=",  
  "WirelessMetadata": {  
    "LoRaWAN": {  
      "DevEui": "a84041000ffff255",  
      "FPort": 2,  
      "DataRate": 0,  
      "Frequency": 904500000,  
      "Gateways": [  
        {  
          "GatewayEui": "80029cffffffff",  
          "Snr": 12.25,  
          "Rssi": -47  
        }  
      ],  
      "Timestamp": "2020-12-14T08:30:56Z"  
    }  
  }  
}
```

### 7.3 Configuring Amazon SNS

We will use the Amazon Simple Notification Service to send text messages (SMS) when certain conditions are met.

- Go to the [Amazon SNS console](#).
- Click on the menu in the left corner to open the navigation pane.
- Select **Text Messaging (SMS)** and choose **Publish text message**.
- Under **Message type**, select **Promotional**.
- Enter your phone number (phone number that will receive text alerts)
- Enter "Test message" for the **Message** and choose **Publish message**.
- If the phone number you entered is valid, you will receive a text message and your phone number will be confirmed.

- Create an Amazon SNS Topic as follows:
  - In the navigation pane, choose **Topics**
  - Select **Create topic**
  - Under **Details**, select **Standard**
  - Enter a name of your choice. Here we will use “*text\_topic*”.
  - Choose **Create topic**
- Create a subscription for this topic:
  - In the page for the newly created *text\_topic*, choose the **Subscriptions** tab
  - Choose **Create subscription**
  - Select **Protocol** as *SMS* from the drop-down
  - Under **Endpoint**, enter the previously validated phone number to receive the SMS alerts
  - Choose **Create subscription**. You should see a “*Subscription to text\_topic created successfully*” message.

### 7.3.1 Add a rule for Amazon SNS notification

Now add a new rule to send an Amazon SNS notification when certain conditions are met in a decoded message.

- Navigate to the [AWS IoT console](#).
- In the navigation pane, choose **Act**. Then, choose **Rules**.
- On the Rules page, choose **Create**
- Enter the **Name** as *text\_alert*, and provide an appropriate **Description**
- Under **Rule query statement**, enter the following query:
 

```
SELECT DevEUI as device_id, "Temperature exceeded 80" as message,
Alert_Temp as temp, Humidity as humidity, Timestamp as time FROM
'project/sensor/decoded' where Alert_Temp > 80
```
- Choose **Add action**
- Choose **Send a message as an SNS push notification**
- Choose **Configure action**
- Under **SNS target**, select *text\_topic* from the drop-down
- Select *RAW* under **Message format**
- Under **Choose or create a role to grant AWS IoT access to perform this action**, choose **Create role**.
- Enter a name for the role and choose **Add action**
- Choose **Create rule**. You should see a “*Success*” message, indicating that the rule has been created.

## 7.4 IoT Analytics

We will use IoT Analytics to visually display data via graphs if there is a need in the future to do further analysis.

### 7.4.1 Create an IoT Analytics Rule

First create a rule

- Navigate to the [AWS IoT console](#).
- In the navigation pane, choose **Act**. Then, choose **Rules**.
- On the Rules page, choose **Create**
- Enter the **Name** as *Visualize*, and provide an appropriate **Description**
- Under **Rule query statement**, enter the following query:
 

```
SELECT * FROM 'project/sensor/decoded'
```
- Choose **Add action**
- Select **Send a message to IoT Analytics**
- Choose **Configure Action**
- Choose **Quick Create IoT Analytics Resources**

- Under **Resource Prefix**, enter an appropriate prefix for your resources, such as *LoRa*
- Choose **Quick Create**
- Once the **Quick Create Finished** message is displayed, choose **Add action**.
- Choose **Create rule**. You should see a Success message, indicating that the rule has been created.

### 7.4.2 Configure AWS IoT Analytics

Set up AWS IoT Analytics as follows:

- Go to the [AWS IoT Analytics console](#).
- In the navigation panel, choose **Data sets**
- Select the data set that was generated by the Quick Create in [Create an IoT Analytics Rule](#)
- In the **Details** section, **Edit** the **SQL query**.
- Replace the query with:
 

```
select Alert_Temp as temp, Humidity as humidity, DevEUI as device_id, Timestamp
as time from LoRa_datastore
```
- Under **Schedule**, choose **Add schedule**
- Under **Frequency**, choose **Every 1 minute**, and choose **Save**

### 7.4.3 Configure Amazon QuickSight

Amazon QuickSight lets you easily create and publish interactive BI dashboards that include Machine Learning-powered insights.

- Go to [AWS Management console](#).
- From the management console, enter “QuickSight” in the “*Search for services, features..*” search box.
- Click on **QuickSight** in the search results
- If you haven’t signed up for the service before, go ahead and sign up, as there is a free trial period.
- Select the **Standard** Edition, and choose **Continue**
- Enter a unique name in the field **QuickSight account name**
- Fill in the **Notification email address**
- Review the other checkbox options and change them as necessary. The **AWS IoT Analytics** option must be selected.
- Choose **Finish**. You will see a confirmation message.
- Choose **Go to Amazon QuickSight**
- Select **Datasets**
- Select **New dataset**
- Select **AWS IoT Analytics**
- Under **Select an AWS IoT Analytics data set to import**, choose the data set created in [Create an IoT Analytics Rule](#)
- Choose **Create data source**, and then choose **Visualize**
- Select dataset created, then select **Refresh** or **Schedule Refresh** for periodic refresh of dataset.

## 7.5 Testing your “Hello World” Application

Using your device, create a condition to generate an event such as a high temperature condition. If the temperature is above the configured threshold then you will receive a text alert on your phone. This alert will include key parameters about the alert.

You can also visualize the data set as follows:

- Go to the [AWS IoT Analytics console](#)
- Choose **Data sets**
- Select the dataset created earlier
- Select **Content**, and ensure there are at least few uplink entries available in the data set.
- Go to the [QuickSight console](#)
- Choose **New analysis**
- Choose the dataset created in [Create an IoT Analytics Rule](#)
- Select time on the X-axis, Value as temp (Average) and Color as device\_id to see a chart of your dataset.

## 8 Debugging

Enable BasicStation Log

Navigation	
Router	
Settings	
Log	
Return to Router	

LoRaWAN Gateway EUI		
74FE48FFFE33333		
Enable		
On	Enable the BasicStation.	
Protocol		
LNS		
Log Enable		
On	Enable the Log.	
URL		
wss://A2746GWZJS1NRT.Ins.lora		
Upload trust file	Delete trust file	last upload at Tue Dec 20 01:38:46 2022, size 1606 bytes.
Upload certificate file	Delete certificate file	last upload at Tue Dec 20 01:38:54 2022, size 1220 bytes.
Upload key file	Delete key file	last upload at Tue Dec 20 01:39:01 2022, size 1679 bytes.
Clear cache		
Save		

Check BasicStation Log

Navigation		basicstation Settings	
Router		Log	
Settings			
Log			
Return to Router			
2022-12-14 07:12:46.580 [52E:VERB] RX 922.4MHz DR5 SF9/BU125 snr=7.2 rssi=-103 xtime=0x370000540B6FC - updf mhdr=80 DevAddr=FF4E08A FCtrl=00 FCnt=62171 FQpts=[ ] 018088C1..5156 micr-2122220060 (110 bytes)			
2022-12-14 07:12:52.236 [52E:VERB] RX 922.0MHz DR3 SF9/BU125 snr=11.5 rssi=-94 xtime=0x370000552AFEC - updf mhdr=80 DevAddr=FF22F013 FCtrl=00 FCnt=63485 FQpts=[ ] 01601095..5A81 micr-1594920769 (66 bytes)			
2022-12-14 07:12:52.236 [52E:VERB] Time sync rejected: quality=2843 threshold=2816			
2022-12-14 07:12:53.816 [52E:VERB] RX 922.2MHz DR4 SF8/BU125 snr=8.8 rssi=-97 xtime=0x37000054985F4 - updf mhdr=80 DevAddr=FF5E8196 FCtrl=00 FCnt=16539 FQpts=[ ] 012459F6..802F micr-1396634625 (105 bytes)			
2022-12-14 07:12:54.513 [52E:VERB] RX 922.0MHz DR3 SF9/BU125 snr=10.8 rssi=-100 xtime=0x37000055464A4 - updf mhdr=80 DevAddr=FF22F013 FCtrl=00 FCnt=63486 FQpts=[ ] 015C3924..CF97 micr-670023889 (66 bytes)			
2022-12-14 07:12:56.803 [52E:VERB] RX 922.4MHz DR3 SF9/BU125 snr=13.0 rssi=-97 xtime=0x37000055775F4 - updf mhdr=80 DevAddr=FF22F013 FCtrl=00 FCnt=63487 FQpts=[ ] 0180CDE8..A172 micr-77926145 (204 bytes)			
2022-12-14 07:13:01.698 [52E:INFO] Time sync qualities: min=846 q90=2823 max=2863 (previous q90=2816)			
2022-12-14 07:13:03.861 [52E:VERB] RX 922.0MHz DR4 SF8/BU125 snr=12.0 rssi=-96 xtime=0x370000553090C - updf mhdr=80 DevAddr=FF5E8196 FCtrl=00 FCnt=16540 FQpts=[ ] 01C589A2..3E21 micr-190845446 (105 bytes)			
2022-12-14 07:13:06.958 [52E:VERB] Time sync rejected: quality=2841 threshold=2823			
2022-12-14 07:13:12.043 [52E:VERB] RX 922.2MHz DR3 SF9/BU125 snr=8.8 rssi=-97 xtime=0x370000565F3C4 - updf mhdr=80 DevAddr=FF22F013 FCtrl=00 FCnt=63488 FQpts=[ ] 0118AEE1..9F77 micr-275658768 (66 bytes)			
2022-12-14 07:13:13.913 [52E:VERB] RX 922.0MHz DR4 SF8/BU125 snr=11.5 rssi=-96 xtime=0x370000567C81C - updf mhdr=80 DevAddr=FF5E8196 FCtrl=00 FCnt=16541 FQpts=[ ] 0115C2A4..18CA micr-105996413 (105 bytes)			
2022-12-14 07:13:14.517 [52E:VERB] RX 922.4MHz DR3 SF9/BU125 snr=12.5 rssi=-97 xtime=0x3700005685987 - updf mhdr=80 DevAddr=FF22F013 FCtrl=00 FCnt=63489 FQpts=[ ] 01808BF9..7884 micr-145623612 (66 bytes)			
2022-12-14 07:13:16.372 [52E:ERROR] Repeated excessive clock drifts between MCU/SX130X0 (3 retries): -106.0ppm (threshold 100.0ppm)			
2022-12-14 07:13:16.810 [52E:VERB] RX 922.2MHz DR3 SF9/BU125 snr=9.2 rssi=-101 xtime=0x370000568580A - updf mhdr=80 DevAddr=FF22F013 FCtrl=00 FCnt=63490 FQpts=[ ] 01498EDD..E1F7 micr-901593509 (24 bytes)			
2022-12-14 07:13:17.571 [52E:VERB] RX 922.0MHz DR5 SF7/BU125 snr=9.0 rssi=-107 xtime=0x37000056845E4 - updf mhdr=80 DevAddr=FF4E08A FCtrl=00 FCnt=62172 FQpts=[ ] 0194F127..D7F8 micr-1873493756 (110 bytes)			
2022-12-14 07:13:23.957 [52E:VERB] RX 922.8MHz DR4 SF8/BU125 snr=10.0 rssi=-101 xtime=0x3700005715C12C - updf mhdr=80 DevAddr=FF5E8196 FCtrl=00 FCnt=16542 FQpts=[ ] 014183C1..8019 micr-1308883350 (105 bytes)			
2022-12-14 07:13:24.036 [52E:INFO] MCU/SX130X0 drift stats: min: -2.2ppm q50: +21.9ppm q80: -161.1ppm max: -460.0ppm - threshold q90: -183.9ppm			
2022-12-14 07:13:24.836 [52E:INFO] Mean MCU drift vs SX130X0: -63.4ppm			
2022-12-14 07:13:31.148 [52E:VERB] Time sync rejected: quality=2833 threshold=2823			
2022-12-14 07:13:32.051 [52E:VERB] RX 922.2MHz DR3 SF9/BU125 snr=8.8 rssi=-97 xtime=0x37000057117A4 - updf mhdr=80 DevAddr=FF22F013 FCtrl=00 FCnt=63491 FQpts=[ ] 0128487C..68C3 micr-1563901864 (66 bytes)			
2022-12-14 07:13:34.015 [52E:VERB] RX 922.0MHz DR4 SF8/BU125 snr=11.8 rssi=-95 xtime=0x370000574F165 - updf mhdr=80 DevAddr=FF5E8196 FCtrl=00 FCnt=16543 FQpts=[ ] 01D95654..1091 micr-400021272 (105 bytes)			
2022-12-14 07:13:34.507 [52E:VERB] RX 922.8MHz DR3 SF9/BU125 snr=11.0 rssi=-101 xtime=0x3700005780CC4 - updf mhdr=80 DevAddr=FF22F013 FCtrl=00 FCnt=63492 FQpts=[ ] 01D0706F..D351 micr-939784563 (66 bytes)			
2022-12-14 07:13:36.819 [52E:INFO] Time sync qualities: min=851 q90=2833 max=2986 (previous q90=2823)			
2022-12-14 07:13:41.666 [52E:VERB] Time sync rejected: quality=2908 threshold=2823			
2022-12-14 07:13:44.051 [52E:VERB] RX 922.6MHz DR4 SF8/BU125 snr=12.0 rssi=-97 xtime=0x3700005848679C - updf mhdr=80 DevAddr=FF5E8196 FCtrl=00 FCnt=16544 FQpts=[ ] 01C5E042..D343 micr-1532317005 (105 bytes)			
2022-12-14 07:13:46.573 [52E:VERB] RX 922.8MHz DR5 SF7/BU125 snr=7.0 rssi=-109 xtime=0x37000058D0526C - updf mhdr=80 DevAddr=FF4E08A FCtrl=00 FCnt=62173 FQpts=[ ] 01E9DEAD..7A68 micr-1364154436 (110 bytes)			
2022-12-14 07:13:51.129 [52E:INFO] Time sync qualities: min=851 q90=2833 max=2986 (previous q90=2823)			
2022-12-14 07:13:52.041 [52E:VERB] RX 923.2MHz DR3 SF9/BU125 snr=9.2 rssi=-101 xtime=0x37000058C2488A - updf mhdr=80 DevAddr=FF22F013 FCtrl=00 FCnt=63494 FQpts=[ ] 0151A2E7..0C86 micr-1203980996 (66 bytes)			
2022-12-14 07:13:54.105 [52E:VERB] RX 922.8MHz DR4 SF8/BU125 snr=10.0 rssi=-100 xtime=0x37000058E18CC - updf mhdr=80 DevAddr=FF5E8196 FCtrl=00 FCnt=16545 FQpts=[ ] 01E0D5C6..7A3E micr-4447398076 (105 bytes)			
2022-12-14 07:13:54.510 [52E:VERB] RX 922.0MHz DR3 SF9/BU125 snr=8.2 rssi=-100 xtime=0x37000058E0903C - updf mhdr=80 DevAddr=FF22F013 FCtrl=00 FCnt=63495 FQpts=[ ] 015C94E7..F917 micr-1671774985 (66 bytes)			
2022-12-14 07:13:58.820 [52E:VERB] RX 922.8MHz DR3 SF9/BU125 snr=12.5 rssi=-103 xtime=0x3700005908219C - updf mhdr=80 DevAddr=FF22F013 FCtrl=00 FCnt=63496 FQpts=[ ] 01A8A801..5916 micr-1653703803 (24 bytes)			
2022-12-14 07:14:00.593 [52E:INFO] MCU/SX130X0 drift stats: min: -6.2ppm q50: +109.4ppm q80: -182.1ppm max: +234.1ppm - threshold q90: +210.8ppm			
2022-12-14 07:14:04.152 [52E:INFO] Mean MCU drift vs SX130X0: -33.8ppm			
2022-12-14 07:14:04.152 [52E:VERB] RX 922.4MHz DR4 SF8/BU125 snr=11.2 rssi=-91 xtime=0x3700005978150C - updf mhdr=80 DevAddr=FF5E8196 FCtrl=00 FCnt=16546 FQpts=[ ] 0190A490..47E4 micr-975373689 (105 bytes)			
2022-12-14 07:14:12.057 [52E:VERB] RX 922.4MHz DR3 SF9/BU125 snr=12.2 rssi=-96 xtime=0x37000059937F6A - updf mhdr=80 DevAddr=FF22F013 FCtrl=00 FCnt=63497 FQpts=[ ] 010A43C9..C881 micr-2127996893 (66 bytes)			
2022-12-14 07:14:14.210 [52E:VERB] RX 922.0MHz DR4 SF8/BU125 snr=9.0 rssi=-93 xtime=0x3700005A146EEC - updf mhdr=80 DevAddr=FF5E8196 FCtrl=00 FCnt=16547 FQpts=[ ] 01C6A46E..84CF micr-1461370344 (105 bytes)			
2022-12-14 07:14:14.526 [52E:VERB] RX 923.4MHz DR3 SF9/BU125 snr=10.8 rssi=-101 xtime=0x3700005A19341C - updf mhdr=80 DevAddr=FF22F013 FCtrl=00 FCnt=63498 FQpts=[ ] 018FB8AD..8864 micr-1256806541 (66 bytes)			
2022-12-14 07:14:16.832 [52E:VERB] RX 922.4MHz DR3 SF9/BU125 snr=11.2 rssi=-101 xtime=0x3700005A353574 - updf mhdr=80 DevAddr=FF22F013 FCtrl=00 FCnt=63499 FQpts=[ ] 01E222A2..5431 micr-623846131 (204 bytes)			
2022-12-14 07:14:19.573 [52E:VERB] RX 922.4MHz DR3 SF8/BU125 snr=8.2 rssi=-101 xtime=0x3700005A466044 - updf mhdr=80 DevAddr=FF4E08A FCtrl=00 FCnt=62174 FQpts=[ ] 015A024C..E8C1 micr-438970368 (110 bytes)			
2022-12-14 07:14:24.260 [52E:VERB] RX 923.0MHz DR4 SF8/BU125 snr=7.5 rssi=-97 xtime=0x3700005A4DC084 - updf mhdr=80 DevAddr=FF5E8196 FCtrl=00 FCnt=16548 FQpts=[ ] 0180C11F..C992 micr-1387260235 (105 bytes)			
2022-12-14 07:14:32.056 [52E:VERB] RX 922.2MHz DR3 SF9/BU125 snr=8.8 rssi=-96 xtime=0x3700005B240344 - updf mhdr=80 DevAddr=FF22F013 FCtrl=00 FCnt=63500 FQpts=[ ] 01C48F71..1174 micr-1218945065 (66 bytes)			
2022-12-14 07:14:36.447 [52E:INFO] MCU/SX130X0 drift stats: min: +0.5ppm q50: +87.5ppm q80: -167.3ppm max: +218.0ppm - threshold q90: -216.6ppm			
2022-12-14 07:14:34.247 [52E:INFO] Mean MCU drift vs SX130X0: -11.9ppm			
2022-12-14 07:14:34.248 [52E:VERB] Repeated excessive clock drifts between MCU/SX130X0 (3 retries): -105.5ppm (threshold 100.0ppm)			
2022-12-14 07:14:34.248 [52E:INFO] MCU/SX130X0 drift stats: min: +0.5ppm q50: +87.5ppm q80: -167.3ppm max: +218.0ppm - threshold q90: -216.6ppm			

## 9 Troubleshooting

Follow debugging step to check basicstation log or check system log .

## 10 OTA Updates

Not support