# **RAK4270 Module Quick Start Guide**

This guide covers the following topics:

- The Things Stack (TTN V3) OTAA Guide
- RAK4270 OTAA AT Commands for The Things Stack
- The Things Stack (TTN V3) ABP Guide
- RAK4270 ABP AT Commands for The Things Stack
- Chirpstack OTAA Guide
- RAK4270 OTAA AT Commands for Chirpstack
- Chirpstack ABP Guide
- RAK4270 ABP AT Commands for Chirpstack
- LoRa P2P Guide
- Updating RAK4270 FW Procedure

## **Prerequisites**

## What Do You Need?

Before going through the step in the installation guide of the RAK4270 WisDuo LPWAN Module, make sure to prepare the necessary items listed below:

### **Hardware Tools**

- 1. RAK4270 Module
- 2. USB to TTL Converter
- 3. Windows PC

### **Software Tools**

RAK Serial Port Tool ☐
 RAK Device Firmware Upgrade (DFU) Tool ☐

## **List of Acronyms**

Acronym	Definition
DFU	Device Firmware Upgrade
JTAG	Joint Test Action Group
LoRa	Long Range
ΟΤΑΑ	Over-The-Air-Activation
ABP	Activation-By-Personalization (ABP)
TTN	The Things Network
TTS	The Things Stack

# **Product Configuration**

## **Interfacing with RAK4270**

During the configuration of the module through the AT commands, it is possible to read the console outputs. You can connect to the console of the RAK4270 Module through the UART interface.

## **Connect to the RAK4270**

In this document, a RAK4270 Module is used as an example case. Use a USB to TTL converter to connect to the module.

1. Connect the RAK4270 to a serial port of a general-purpose computer (e.g.: USB port) using a USB to TTL module (3.3v), as shown in **Figure 1**.

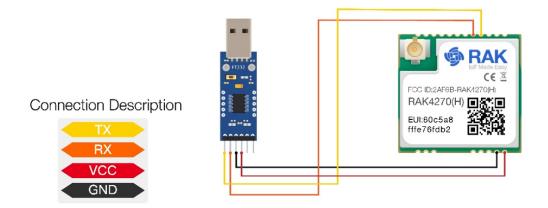


Figure 1: RAK4270 Module Connection

- 2. Any serial communication tool can be used. But, it is recommended to use the RAK Serial Port Tool 🗹 .
- 3. Configure the serial communication tool by selecting the proper port detected by the computer and configure the link as follows:
- Baud Rate: 115200 bauds
- Data Bits: 8 bits

- Stop Bits: 1 stop bit
- Parity: NONE
- 4. The RAK4270 console output can now be read in the RAK serial port tool, as shown in Figure 2.

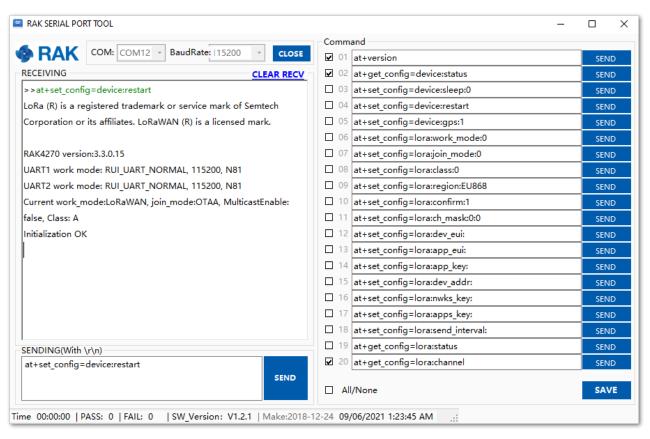


Figure 2: RAK Serial Port Tool Connected to RAK4270 Module

## **Configuring RAK4270**

To connect the RAK4270 Module to a LoRa P2P connection or a LoRaWAN network, the module must be configured and LoRa parameters must be set by sending AT commands. You can send AT commands to the RAK4270 Module through the UART interface.

Connect the RAK4270 Module to the computer as described in the previous section. Use the serial communication tool to send commands to the RAK4270. For example, sending the at+version will return and display the current firmware version, as shown in **Figure 3**. More AT commands can be found in the AT Command Manual.

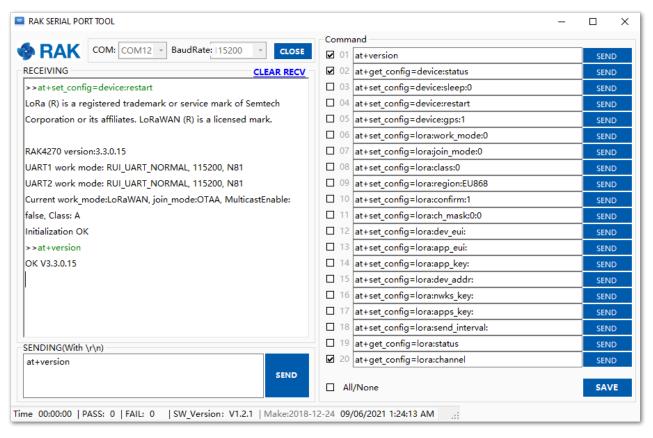


Figure 3: AT Command response

## **Connecting to The Things Stack (TTN V3)**

This section will show how to connect the RAK4270 Module to The Things Stack (TTN V3) platform.

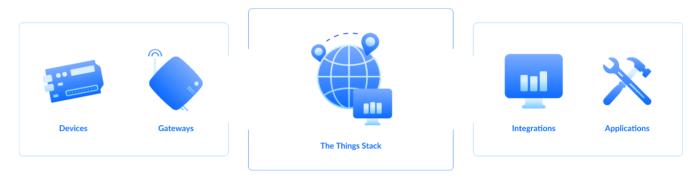


Figure 4: The Things Stack diagram

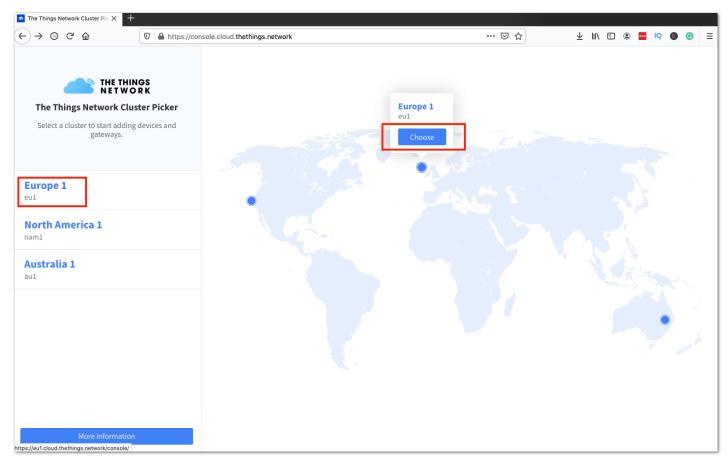
As shown in **Figure 4**, The Things Stack is an open-source LoRaWAN Network Server suitable for global, geodistributed public and private deployments as well as for small, local networks. The architecture follows the LoRaWAN Network Reference Model for standards compliancy and interoperability. This project is actively maintained by The Things Industries 🖸 .

LoRaWAN is a protocol for low-power wide-area networks. It allows for large-scale Internet of Things deployments where low-powered devices efficiently communicate with Internet-connected applications over long-range wireless connections.

The RAK4270 Module can be part of this ecosystem as a device, and the objective of this section is to demonstrate how simple it is to send data to The Things Stack using the LoRaWAN protocol. To achieve this, the RAK4270 Module must be located inside the coverage of a LoRaWAN gateway connected to The Things Stack server.

## **Registration to TTN and Creating LoRaWAN Applications**

The first step is to go to The Things Network platform and select a cluster, as shown in **Figure 5**. The Things Industries adds more clusters from time to time so select the one closes to your location. In this guide, Europe 1 is selected.



#### Figure 5: Selecting Cluster in TTN V3

You can use the same login credentials on the TTN V2 if you have one. If you have no account yet, you need to create one.

1. To register as a new user to TTN, click on Login with The Things ID then select register on the next page, as shown in Figure 6 and Figure 7.

THE THINGS THE THINGS STACK	
The Things Network	
Account <ul> <li>Please login to continue</li> <li>Login with The Things ID</li> <li>Login using credentials</li> </ul>	
Everything you need to build enterprise grade, private LoRaWAN networks – <u>The Things Industries</u>	

Figure 6: Login using TTN account

9	
Login to The Things Stack with <b>ID</b>	The Things
Username or email •	
	1 8
Password •	
Submit	
Cancel	
Register Forgot passwor	?
The Things ID by The Thing Ind	stries

Figure 7: Registration of new account

You should now be on the step of creating your TTN account. Fill in all the necessary details and activate your account.

2. After creating an account, you should log in to the platform using your username/email and password then click **Submit**, as shown in **Figure 8**.

e	9
Login to The Things St ID	stack with <b>The Things</b>
Username or email • demo@rakwireless.com	
Password •	<b>a</b>
Sub	ıbmit
	ancel
<u>Register</u> For	orgot password?
The Things ID by T	The Thing Industries

#### 3. Click Authorize to proceed.

Θ	
Authorization The Things Stack would like to:	
<ul> <li>View your profile information (username, profile picture, name, etc.)</li> <li>View your email address</li> </ul>	
Cancel Authorize	
The Things ID by The Thing Industries	

Figure 9: Authorization to TTN

4. Now that you are logged in to the platform, the next step is to create an application. Click **Create an application**.

THE THINGS THE THINGS STACK	👫 Overview 🗖 Applications 🛁 G	teways 🏔 Organizations	🌐 eu1 Community	rakwireless-app 🔹
	Get started right away by creat	to the Console! ng an application or registering a gate r Documentation II or Get Support		
Create	••••         ••••         ••••         ••         ••         ••         ••         ••         ••         •• </th <th>Regi</th> <th>o ster a gateway</th> <th></th>	Regi	o ster a gateway	

Figure 10: Creating TTN application for your LoRaWAN devices

5. To have an application registered, you need to input first the specific details and necessary information about your application then click **Create application**.

## **AK** Documentation Center

	THE THINGS STACK Community Edition	Applications	🝶 Gateways	2 Organizations	eu1	Community	1	rakwireless-app 🔻
Adda	application							
Owner*	less-app							
	n-devices	Â						
Applicati LoRaWA Descripti	N Devices Application							
	plication involves LoRaWAN devices.	G						
	application description; can also be used to save	notes about the applica	ation					
Crea	te application							

Figure 11: Details of the TTN application

If you have no error on the previous step, you should now be on the application console page. The next step is to add end-devices to your The Things Stack application. LoRaWAN specification enforces that each end device has to be personalized and activated. There are two options on registering devices depending on the activation mode selected. Activation can be done either via Over-The-Air-Activation (OTAA) or Activation-By-Personalization (ABP).

#### **NOTE**:

Once you have the application in The Things Stack (TTN V3), you need to ensure that you are in coverage of a LoRaWAN gateway that is registered to The Things Stack (TTN V3) as well. Without the coverage of that LoRaWAN gateway, you cannot activate any device that you will register in your application.

RAKwireless has LoRaWAN gateways <sup>™</sup> that you can connect to The Things Stack (TTN V3) if no LoRaWAN gateway coverage is available in your location.

### The Things Stack OTAA Device Registration

1. Go to your application console to be able to register a device. To start adding an OTAA end-device, you need to click + Add end device, as shown in Figure 12.

	THE THINOS STACK Community Edition	riew 🗖 Applications 💣	🖁 Gateways 🛛 🏔 Organizatio	ns		🌐 eu1 Community	rakwireless-app 🔹
LoRaWAN Devices Applica	Applications > LoRaWAN Dev						
Overview	LORAWAN De ID: lorawan-devices	evices Application					
🙏 End devices	🙏 0 End devices 🛛 🚢 1 Col	llaborator 🛛 🛛 🗣 0 API keys					Created 34 seconds ago
Live data							
<> Payload formatters v	General information			Live data			See all activity $\rightarrow$
	Application ID	lorawan-devices					
-	Created at	Mar 30, 2021 02:50:03					
🚢 Collaborators	Last updated at	Mar 30, 2021 02:50:03			Waiting for ever	its from lorawan-devices	
Ov API keys							
General settings							
	End devices (0)				<b>Q</b> Search by ID	=+ Import end device	s + Add end device
	ID \$	Name 🗢	DevEUI		JoinEUI		Created 🗢
< Hide sidebar			No item	ns found			

Figure 12: Add end device

 To register the module, you need to click first Manually then configure the activation method by selecting Over the air activation (OTAA) and compatible LoRaWAN version then click Start button, as shown in Figure 13 and Figure 14.

	THE THINGS STACK Community Edition 🖬 Overview 🗅 Applications 🗳 Gateways 🚓 Organizations 🌐 eul Community
LoRaWAN Devices Applica	Applications > LoRaWAN Devices Application > End devices > Register from The LoRaWAN Device Repository
Overview	Register end device
🙏 End devices	From The LoRaWAN Device Repository Manually
🕕 Live data	
<> Payload formatters ~	1. Select the end device
	Brand * Type to search
K Collaborators	Cannot find your exact end device? Get help here and try manual device registration.
🗛 API keys	
🕸 General settings	
	2. Enter registration data
	Please choose an end device first to proceed with entering registration data
	Register end device

Figure 13: Manually register device to The Things Stack

LoRaWAN Devices Applica	From The LoRaWAN Device Repository Manually
Overview	Preparation
🙏 End devices	Activation mode 🗇 *
🖬 Live data	Over the air activation (OTAA)
<> Payload formatters ~	<ul> <li>Activation by personalization (ABP)</li> <li>Multicast</li> </ul>
允 Integrations ∽	O Do not configure activation
🔐 Collaborators	LoRaWAN version ⑦*
Or API keys	The LoRaWAN version (MAC), as provided by the device manufacturer
🗱 General settings	Network Server address
	eu1.cloud.thethings.network
	Application Server address
	eu1.cloud.thethings.network
	External Join Server $\odot$
	Enabled
	Join Server address
	eu1.cloud.thethings.network
< Hide sidebar	Start

Figure 14: Device activation configuration

3. Then input a unique **End device ID** and EUIs (**DevEUI** and **AppEUI**), as shown in **Figure 15**. Check if your module has a DevEUI on sticker or QR that you can scan then use this as the device unique DevEUI.

Optionally, you can add a more descriptive **End device name** and **End device description** about your device.

4. After putting all the details, click **Network layer settings** to proceed to the next step.

#### **NOTE**:

It is advisable to use a meaningful End device ID, End device name, and End device description that will match your device purpose. The End device ID rak-device is for illustration purposes only.

LoRaWAN Devices Applica	Basic settings     2     Network layer settings     3     Join settings       End device ID's, Name and     Frequency plan, regional     Root keys, NetID and kek       Description     parameters, end device     labels.
Overview	class and session keys.
🙏 End devices	End device ID*
🖪 Live data	rak-device
<> Payload formatters ~	10 00 00 00 00 00 09 00
大 Integrations ~	The AppEUI uniquely identifies the owner of the end device. If no AppEUI is provided by the device manufacturer (usually for development), it can be filled with zeros.
Relations	DevEUI 🗇 *
🗣 API keys	11 33 55 77 99 22 44 66 The DevEUI is the unique identifier for this end device
General settings	End device name RAKwireless Device End device description This device is from RAKwireless. Optional end device description; can also be used to save notes about the end device
< Hide sidebar	Network layer settings >

Figure 15: OTAA Device Information

5. Next step is to set up **Frequency plan**, compatible **Regional Parameter version**, and **LoRaWAN class** supported. Then you can click **Join settings** 

LoRaWAN Devices Applica	Basic settings     2     Network layer settings     3     Join settings       End device ID's, Name and     Frequency plan, regional     Root keys, NetID and kek       Description     parameters, end device     labels.
Overview	class and session keys.
🙏 End devices	Frequency plan ③ * Europe 863-870 MHz (SF9 for RX2 - recommended)
Live data	The frequency plan used by the end device
<> Payload formatters ~	LoRaWAN version ⑦*
	MAC V1.0.2 V The LoRaWAN version (MAC), as provided by the device manufacturer
2 Collaborators	Regional Parameters version ⑦*
O∓ API keys	PHY V1.0.2 REV B     V       The LoRaWAN PHY version of the end device
General settings	LoRaWAN class capabilities ✓ Supports class B ✓ Supports class C Advanced settings ✓
< Hide sidebar	< Basic settings > Join settings >

Figure 16: OTAA Configuration

6. The last step in the registration of a new OTAA end device is the configuration of the **AppKey**. To get the AppKey, you must click the **generate button**. Then click **Add end device** to finish your new device registration.

LoRaWAN Devices Applica	Applications > LoRaWAN Devices Application > End devices > Register manually > Join settings					
Overview	Register end device					
🙏 End devices	From The LoRaWAN Device Repository Manually					
Live data						
<> Payload formatters ~	Basic settings Network layer settings 3 Join settings Root keys, NetID and kek					
↑ Integrations	Description parameters, end device labels. class and session keys.					
2 Collaborators	Root keys					
💁 API keys	AppKey ② *					
🔹 General settings	04 FA 4E 62 6E F5 CF 22 7C 96 96 01 17 62 75 C2         The root key to derive session keys to secure communication between the converse and the application					
	Advanced settings v					
< Hide sidebar	< Network layer settings Add end device					

Figure 17: OTAA AppKey generation and device registration

You should now be able to see the device on The Things Stack console after you fully registered your device, as shown in **Figure 18**.

#### **NOTE**:

The **AppEUI**, **DevEUI**, and **AppKey** are the parameters that you will need to activate your LoRaWAN end device via OTAA. The **AppKey** is hidden by default for security reasons, but you can easily show it by clicking the show button. You can also copy the parameters quickly using the copy button.

The three OTAA parameters on The Things Stack device console are MSB by default.

These parameters are always accessible on the device console page, as shown in Figure 18.

	THE THINGS STACK Community Edition	view 🗖 Applications 📸 Gateways 🚢	Organization	IS	🜐 eu1 Community	rakwireless-app 🔹
LoRaWAN Devices Applica		vices Application > End devices > RAKwireless Dev	ice			
Cverview	RAKwireles	s Device				
🙏 End devices	<ul> <li>Last seen info unavailable</li> </ul>	$\uparrow$ n/a $\downarrow$ n/a				Created 36 seconds ago
Live data	Overview Live data	Messaging Location Payload formatters (	Claiming (	General settings		
<> Payload formatters ~	General information			• Live data		See all activity →
た Integrations ~	End device ID	rak-device				
👪 Collaborators	Description	This device is from RAKwireless.				
O∓ API keys	Created at	Mar 30, 2021 04:59:07		Waiting	g for events from rak-device	
General settings	Activation information					
	AppEUI	10 00 00 00 00 00 00 09	$\leftrightarrow$			
	DevEUI	11 33 55 77 99 22 44 66	↔ 🖪	Location		Change location settings $ ightarrow$
	Root key ID	n/a				
	АррКеу	•••••	•			
	NwkKey	n/a				

Figure 18: OTAA device successfully registered to The Things Stack

### **RAK4270 OTAA Configuration for The Things Stack**

The RAK4270 Module supports a series of AT commands to configure its internal parameters and control the functionalities of the module. To set up the RAK4270 Module to join The Things Stack using OTAA, start by connecting the RAK4270 Module to the Computer (see **Figure 1**) and open the RAK Serial Port Tool. Wait for the communication to start. It is recommended to test the serial communication and verify the current configuration by sending either of these two AT commands:

at+set_config=device:restart	
at+version	

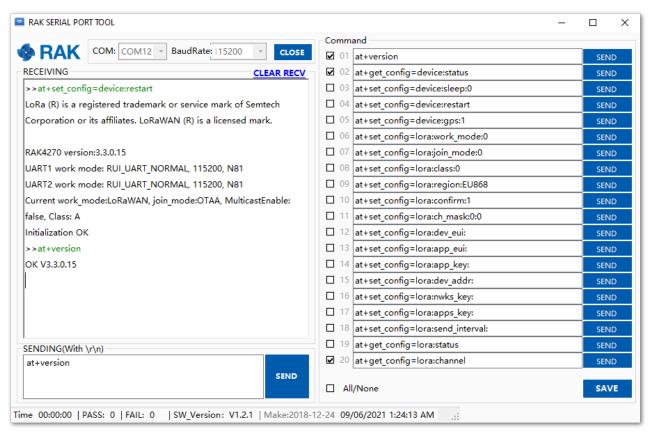


Figure 19: AT Command response

As an example, these are the list of the parameters you need to configure in RAK4270:

- LoRa join mode: OTAA
- LoRa class: Class A
- LoRa region: EU868
- Device EUI: 1133557799224466
- Application EUI: 100000000000009
- Application Key: 04FA4E626EF5CF227C969601176275C2

1. Set the LoRa join mode to OTAA.

at+set\_config=lora:join\_mode:0

2. Set the LoRa class to Class A.

at+set\_config=lora:class:0

- 3. Set the frequency/region to EU868.
- Refer to the RAK4270 Module Datasheet for the list of supported frequencies.

at+set\_config=lora:region:EU868

#### 4. Set the Device EUI.

at+set\_config=lora:dev\_eui:1133557799224466

5. Set the Application EUI.

#### **NOTE**:

at+set\_config=lora:app\_eui:100000000000000

6. Set the Application Key.

at+set\_config=lora:app\_key:04FA4E626EF5CF227C969601176275C2

	Command	
RAK COM: COM7 - BaudRate: 115200 - CLOSE	01 at+version	SEND
RECEIVING CLEAR RECV	02 at+get_config=device:status	SEND
>>at+set_config=lora:join_mode:0	03 at+set_config=device:sleep:0	SEND
ж	04 at+set_config=device:restart	SEND
>>at+set_config=lora:class:0	05 at+set_config=device:gps:1	SEND
ж	06 at+set_config=lora:work_mode:0	SEND
>>at+set_config=lora:region:EU868	07 at+set_config=lora:join_mode:0	SEND
ок	08 at+set_config=lora:class:0	SEND
>>at+set_config=lora:dev_eui:1133557799224466	09 at+set_config=lora:region:EU868	SEND
ок	10 at+set_config=lora:confirm:1	SEND
>>at+set_config=lora:app_eui:1000000000000000	11 at+set_config=lora:ch_mask:0:0	SEND
ок	12 at+set_config=lora:dev_eui:1133557799224466	SEND
>>	13 at+set_config=lora:app_eui:1000000000000000	SEND
at+set_config=lora:app_key:04FA4E626EF5CF227C969601176275C2	14 at+set_config=lora:app_key:04FA4E626EF5CF227C96960	SEND
ок	15 at+set_config=lora:dev_addr:	SEND
	16 at+set_config=lora:nwks_key:	SEND
	□ 17 at+set_config=lora:apps_key:	SEND
	18 at+set_config=lora:send_interval:	SEND
ENDING(With \r\n)	19 at+get_config=lora:status	SEND
at	20 at+get_config=lora:channel	SEND
+set_config=lora:app_key:04FA4E626EF5CF227C96960117 SEND 5275C2	☐ All/None	SAVE

Figure 20: Configuring LoRa Parameters

#### **NOTE**:

After configuring all the parameters, you need to reset your RAK4270 Module to save the parameters.

7. After resetting, join in OTAA mode.



After 5 or 6 seconds, if the request was successfully received by a LoRa gateway, then you should see the messages shown in **Figure 21**.

8. Try to send a message from the RAK4270 Module.

at+send=lora:2:1234567890

RAK COM: COM7 - BaudRate:	15200 · CLOSE	Comm	at+version	SEND
RECEIVING	CLEAR RECV		at+get config=device:status	SEND
>>at+join	CLEAR RECV		at+set config=device:sleep:0	SEND
OK Join Success			at+set_config=device:restart	SEND
>>at+send=lora:2:1234567890			at+set config=device:gps:1	SEND
ок			at+set_config=lora:work_mode:0	SEND
at+recv=0,-55,8,0			at+set_config=lora:join_mode:0	SEND
		08	at+set_config=lora:class:0	SEND
		09	at+set_config=lora:region:EU868	SEND
		10	at+set_config=lora:confirm:1	SEND
		□ 11	at+set_config=lora:ch_mask:0:0	SEND
		12	at+set_config=lora:dev_eui:	SEND
		13	at+set_config=lora:app_eui:	SEND
		14	at+set_config=lora:app_key:	SEND
		15	at+set_config=lora:dev_addr:	SEND
		16	at+set_config=lora:nwks_key:	SEND
		17	at+set_config=lora:apps_key:	SEND
		18	at+set_config=lora:send_interval:	SEND
SENDING(With \r\n)		19	at+get_config=lora:status	SEND
at+send=lora:2:1234567890		<b>⊋</b> 20	at+get_config=lora:channel	SEND
	SEND		l/None	SAVE

Figure 21: OTAA Test Sample Data Sent via RAK Serial Port Tool

You can see the data sent by the RAK4270 Module on The Things Stack platform, as shown in Figure 22.

	THE THINGS STACK Community Edition	rview 🗖 Applications 📾 Gateways .	Crganiza	zations 🕀 eu1 Community rakwireless-app 👻
LoRaWAN Devices Applica		vices Application > End devices > RAKwireless I	Device	
Overview	BAKwireles	s Device		
🙏 End devices	<ul> <li>Last seen 10 seconds ago</li> </ul>	<b>↑</b> 2 <b>↓</b> 1		Created 6 days ago
1. Live data	Overview Live data	Messaging Location Payload formatters	Claiming	g General settings
<> Payload formatters ~	General information			Live data     See all activity →
犬 Integrations ~	End device ID	rak-device		$\psi$ 23:49:22 Successfully scheduled data downlink for transmission on Gate
🚢 Collaborators	Description	This device is from RAKwireless.		↓ 23:49:22 Schedule data downlink for transmission on Gateway Server Dev ↑ 23:49:22 Forward data message to Application Server DevAddr: 26 0B F9
🗛 API keys	Created at	Mar 30, 2021 04:59:07		↑ 23:49:22 Forward uplink data message DevAddr: 26 0B F9 28 MAC paylog
General settings	Activation information			<ul> <li>↑ 23:49:22 Receive uplink data message DevAddr: 26 0B F9 28</li> <li>↑ 23:49:22 Successfully processed data message DevAddr: 26 0B F9 28 F(</li> </ul>
	AppEUI	10 00 00 00 00 00 00 09	↔ 🗈	
	DevEUI	11 33 55 77 99 22 44 66	$\leftrightarrow$	Location Change location settings →
	Root key ID	n/a		
	АррКеу	••••••	•• 🗈 💿	
	NwkKey	n/a		
< Hide sidebar	Session information			No location information available

Figure 22: OTAA Test Sample Data Sent Viewed in The Things Stack

### **The Things Stack ABP Device Registration**

1. To register an ABP device, go to your application console and select the application where you want your device to be added. Then click + Add end device, as shown in Figure 23.

# Section Center

	THE THINOS STACK Community Edition	Applications	🛋 Gateways 🛛 🚢 Organizatio	ons		🜐 eu1 Community	rakwireless-app 🔹
LoRaWAN Devices Applica	Applications > LoRaWAN Devices						
Overview	LoRaWAN Devi ID: lorawan-devices	ces Application					
🙏 End devices	🙏 0 End devices 🛛 🚢 1 Collabo	rator 🛛 🛛 🗛 🛛 API keys					Created 34 seconds ago
Live data							
<> Payload formatters ~	General information			<ul> <li>Live data</li> </ul>			See all activity →
大 Integrations ~		rawan-devices	6				
2 Collaborators		30, 2021 02:50:03			Waiting for ever	nts from lorawan-devices	
O → API keys	Last upuateu at Ma	30, 2021 02:50:03					
🕸 General settings							
	End devices (0)				<b>Q</b> Search by ID	=+ Import end device	+ Add end device
	ID \$	Name 🗢	DevEUI		JoinEUI		Created 🗢
< Hide sidebar			No item	ns found			

Figure 23: Add end device

 To register the module, you need to click first Manually then configure the activation method by selecting Activation by personalization (ABP), compatible LoRaWAN version and click Start button, as shown in Figure 24 and Figure 25.

	THE THINGS STACK Community Edition 🔂 Overview 🗅 Applications 🗟 Gateways 🚓 Organizations 🌐 eu1 Community reading of the community of the c
LoRaWAN Devices Applica	Applications > LoRaWAN Devices Application > End devices > Register from The LoRaWAN Device Repository
	Desister and design
Overview	Register end device
🙏 End devices	From The LoRaWAN Device Repository Manually
Live data	
<> Payload formatters ~	1. Select the end device
↑ Integrations 🗸	Brand* Type to search
🚢 Collaborators	Cannot find your exact end device? Get help here and try manual device registration.
🗣 API keys	
General settings	
	2. Enter registration data
	Please choose an end device first to proceed with entering registration data
	Register end device

Figure 24: Add end device

	THE THINGS STACK Community Edition 🗈 Overview 🗅 Applications 🗳 Gateways 🚢 Organizations 🌐 eul Community Community
LoRaWAN Devices Applica	Applications > LoRaWAN Devices Application > End devices > Register manually
Overview	Register end device
🙏 End devices	From The LoRaWAN Device Repository Manually
Live data	
<> Payload formatters ~	Preparation
尤 Integrations ✓	Activation mode <sup>®</sup> *
👪 Collaborators	Activation by personalization (ABP)
• API keys	Multicast     Do not configure activation
General settings	LoRaWAN version () * MAC V1.0.2 The LoRaWAN version (MAC), as provided by the device manufacturer Network Server address eu1.cloud.thethings.network
< Hide sidebar	Start

Figure 25: Manually register device to The Things Stack

3. At this step, input a unique **End device ID** and **DevEUI**, as shown in **Figure 26**. Check if your module has a DevEUI on sticker or QR that you can scan then use this as the device unique DevEUI.

Optionally, you can add a more descriptive **End device name** and **End device description** about your device.

4. After putting all the details, click **Network layer settings** to proceed to the next step.

#### **NOTE**:

It is advisable to use a meaningful End device ID, End device name, and End device description that will match your device purpose. The End device ID rak-device-abp is for illustration purposes only.

LoRaWAN Devices Applica	Register end device
Overview	
🙏 End devices	From The LoRaWAN Device Repository Manually
🕕 Live data	1 Basic settings       2 Network layer settings       3 Application layer settings
<> Payload formatters ~	End device ID's, Name and         Frequency plan, regional         Application session key to           Description         parameters, end device         encrypt/decrypt LoRaWAN
尤 Integrations ∽	class and session keys. payload.
2 Collaborators	End device ID*
O <b>→</b> API keys	DevEUI ①
🕸 General settings	01 00 00 00 00 00 90
	The DevEUI is the unique identifier for this end device End device name
	RAKwireless ABP Device
	End device description
	This ABP device is from RAKwireless
	G
	Optional end device description; can also be used to save notes about the end device
< Hide sidebar	Network layer settings >

Figure 26: Device Information

 Next step is to set up Frequency plan, compatible Regional Parameter version, and LoRaWAN class supported. In an ABP device, you also need to generate Device Address and NwkSKey (Network Session Keys). Then you can click Application layers settings.

LoRaWAN Devices Applica	class and session keys. payload.
	Frequency plan $\odot$ *
Overview	Europe 863-870 MHz (SF9 for RX2 - recommended)
🙏 End devices	The frequency plan used by the end device LoRaWAN version ⑦*
I Live data	MAC V1.0.2
<> Payload formatters ~	The LoRaWAN version (MAC), as provided by the device manufacturer
↓ Integrations  v	Regional Parameters version ⑦ *
-	PHY V1.0.2 REV B
🚜 Collaborators	The LoRaWAN PHY version of the end device
O → API keys	LoRaWAN class capabilities
General settings	<ul> <li>Supports class B</li> <li>Supports class C</li> </ul>
	Device address *
	NwkSKey ⑦*
	43 3C 7A 92 4F 7F 69 47 77 8F E8 21 52 5F 18 3A 🗘
	Network session key
	Advanced settings 🗸 🗸
< Hide sidebar	< Basic settings > Application layer settings >

Figure 27: ABP Configuration in The Things Stack

6. The last step in the registration of a new ABP end device is the configuration of the **AppSKey**. To get the AppSKey, you must click the **generate button**. Then click **Add end device** to finish your new device registration.

	THE THINGS STACK Community Edition Diverview Applications 🗟 Gateways 🖧 Organizations 🌐 eul Community Community Edition
LoRaWAN Devices Applica	Applications > LoRaWAN Devices Application > End devices > Register manually > Application layer settings
LORAWAN DEVICES Applica	
Overview	Register end device
🙏 End devices	From The LoRaWAN Device Repository Manually
Live data	
<> Payload formatters ~	Basic settings Network layer settings 3 Application layer settings Application session key to
↑ Integrations ~	Description     parameters, end device     encrypt/decrypt LoRaWAN       class and session keys.     payload.
🚓 Collaborators	Skip payload encryption and decryption
O∓ API keys	Enabled Skip decryption of uplink payloads and encryption of downlink payloads
General settings	Skip decryption of uptink payloads and encryption of downlink payloads AppSKey*
	A5 85 65 3A 94 9C 2B 2D 44 B5 5E 99 E9 4C B5 33 $\phi$
	Application session key
	< Network layer settings Add end device
< Hide sidebar	

Figure 28: ABP Configuration in The Things Stack

You should now be able to see the device on The Things Stack console after you fully registered your device, as shown in **Figure 29**.

	THE THINGS STACK Community Edition	rview 🗖 Applications 🕳 Gatew	vays 🏔 Organizatio	ons	eul Community	rakwireless-app 🔹			
LoRaWAN Devices Applica	Applications > LoRaWAN De	Applications > LoRaWAN Devices Application > End devices > RAKwireless ABP Device							
Overview	RAKwireles	s ABP Device							
🙏 End devices	<ul> <li>Last seen info unavailable</li> </ul>	$\uparrow$ n/a $\downarrow$ n/a				Created 14 seconds ago			
1. Live data	Overview Live data	Messaging Location Payload for	natters General setti	ings					
<> Payload formatters ~	General information			Live data		See all activity $\rightarrow$			
た Integrations ~	End device ID	rak-device-abp							
🔐 Collaborators	Description	This ABP device is from RAKwireless							
Ov API keys	Created at	Apr 1, 2021 05:08:13		Wait	ting for events from rak-device-abp				
🕸 General settings	Activation information								
	AppEUI	n/a							
	DevEUI	01 00 00 00 00 00 00 90	$\leftrightarrow$	Location	С	hange location settings $\rightarrow$			
	Session information								
	Device address	26 0B DE 80	$\leftrightarrow$						
	NwkSKey	•••••	••••• 🖥 📀						
< Hide sidebar	SNwkSIntKey	•••••	•••••• 🖺 💿		No location information available	day line			

Figure 29: RAK4270 registered at The Things Stack

## **RAK4270 ABP Configuration for The Things Stack**

To set up the RAK4270 Module to join The Things Stack using ABP, start by connecting the RAK4270 Module to the Computer (see **Figure 1**) and open the RAK Serial Port Tool. It is recommended to test the serial communication by sending either of these two AT commands:

at+set\_config=device:restart

at+version

	Command	
RAK COM: COM12 V BaudRate: 15200 V CLOSE	☑ 01 at+version	SEND
RECEIVING CLEAR RECV	☑ 02 at+get_config=device:status	SEND
>>at+set_config=device:restart	03 at+set_config=device:sleep:0	SEND
LoRa (R) is a registered trademark or service mark of Semtech	04 at+set_config=device:restart	SEND
Corporation or its affiliates. LoRaWAN (R) is a licensed mark.	05 at+set_config=device:gps:1	SEND
	06 at+set_config=lora:work_mode:0	SEND
RAK4270 version:3.3.0.15	07 at+set_config=lora:join_mode:0	SEND
JART1 work mode: RUI_UART_NORMAL, 115200, N81	08 at+set_config=lora:class:0	SEND
JART2 work mode: RUI_UART_NORMAL, 115200, N81	09 at+set_config=lora:region:EU868	SEND
Current work_mode:LoRaWAN, join_mode:OTAA, MulticastEnable:	□ <sup>10</sup> at+set_config=lora:confirm:1	SEND
alse, Class: A	□ 11 at+set_config=lora:ch_mask:0:0	SEND
Initialization OK	□ 12 at+set_config=lora:dev_eui:	SEND
>>at+version	□ <sup>13</sup> at+set_config=lora:app_eui:	SEND
OK V3.3.0.15	□ 14 at+set_config=lora:app_key:	SEND
	□ <sup>15</sup> at+set_config=lora:dev_addr:	SEND
	16 at+set_config=lora:nwks_key:	SEND
	□ 17 at+set_config=lora:apps_key:	SEND
	□ 18 at+set_config=lora:send_interval:	SEND
ENDING(With \r\n)	□ <sup>19</sup> at+get_config=lora:status	SEND
at+version	☑ 20 at+get_config=lora:channel	SEND
SEND	□ All/None	SAVE

Figure 30: AT Command response

As an example, these are the list of the parameters you need to configure in RAK4270:

- LoRa join mode: ABP
- LoRa class: Class A
- LoRa region: EU868
- Device address: 260BDE80
- Network Session Key: 433C7A924F7F6947778FE821525F183A
- Application Session Key: A585653A949C2B2D44B55E99E94CB533
- 1. Set the LoRa join mode to ABP.

at+set\_config=lora:join\_mode:1

2. Set the LoRa class to Class A.

at+set\_config=lora:class:0

- 3. Set the frequency/region to EU868.
- Refer to the RAK4270 Module Datasheet for the list of supported frequencies.

at+set\_config=lora:region:EU868

4. Set the Device Address.

at+set\_config=lora:dev\_addr:260BDE80

#### 5. Set the LoRa Network Session Key.

at+set\_config=lora:nwks\_key:433C7A924F7F6947778FE821525F183A

#### 6. Set the LoRa Application Session Key.

at+set\_config=lora:apps\_key:A585653A949C2B2D44B55E99E94CB533

RAK SERIAL PORT TOOL	-	
	Command	
RAK COM: COM7 - BaudRate: 15200 - CLOSE	☑ 01 at+version	SEND
RECEIVING CLEAR RECV	☑ 02 at+get_config=device:status	SEND
>>at+set_config=lora:join_mode:1	□ 03 at+set_config=device:sleep:0	SEND
ок	04 at+set_config=device:restart	SEND
>>at+set_config=lora:class:0	05 at+set_config=device:gps:1	SEND
ок	□ <sup>06</sup> at+set_config=lora:work_mode:0	SEND
>>at+set_config=lora:region:EU868	07 at+set_config=lora:join_mode:1	SEND
ок	08 at+set_config=lora:class:0	SEND
>>at+set_config=lora:dev_addr:260BDE80	09 at+set_config=lora:region:EU868	SEND
ок	10 at+set_config=lora:confirm:1	SEND
>>	11 at+set_config=lora:ch_mask:0:0	SEND
at+set_config=lora:nwks_key:433C7A924F7F6947778FE821525F183A	12 at+set_config=lora:dev_eui:	SEND
ок	13 at+set_config=lora:app_eui:	SEND
>>	□ 14 at+set_config=lora:app_key:	SEND
at+set_config=lora:apps_key:A585653A949C2B2D44B55E99E94CB533	15 at+set_config=lora:dev_addr:260BDE80	SEND
ок	16 at+set_config=lora:nwks_key:433C7A924F7F6947778FE8	SEND
	17 at+set_config=lora:apps_key:A585653A949C2B2D44B55	SEND
	□ 18 at+set_config=lora:send_interval:	SEND
' SENDING(With \r\n)	19 at+get_config=lora:status	SEND
at	☑ 20 at+get_config=lora:channel	SEND
+set_config=lora:apps_key:A585653A949C2B2D44B55E99 SEND E94CB533	All/None	SAVE

Figure 31: AT Command for ABP LoRa parameters via RAK Serial Port Tool

#### VOTE:

After configuring all the parameters, you need to reset the RAK4270 Module to save the parameters.

#### 7. After resetting, join in ABP mode.

at+join

#### **NOTE:**

By using the ABP mode in LoRaWAN, it doesn't require to join a network before sending a LoRaWAN package. But to keep the consistency of internal states of the firmware of the RAK4270 Module, it is still required to send the at+join command in the ABP mode. This time, the firmware should reply almost immediately with an "OK".

8. Try to send data from the RAK4270 to The Things Network in ABP mode.

RAK SERIAL PORT TOOL		- 🗆 ×
RAK COM: COM7 - BaudRate: 115200 - CLOS		
		SEND
		SEND
>>at+join	03 at+set_config=device:sleep:0	SEND
OK Join Success	04 at+set_config=device:restart	SEND
>>at+send=lora:2:1234567890	05 at+set_config=device:gps:1	SEND
ОК	06 at+set_config=lora:work_mode:0	SEND
at+recv=0,-55,8,0	07 at+set_config=lora;join_mode:0	SEND
	08 at+set_config=lora:class:0	SEND
	09 at+set_config=lora:region:EU868	SEND
	10 at+set_config=lora:confirm:1	SEND
	11 at+set_config=lora:ch_mask:0:0	SEND
	12 at+set_config=lora:dev_eui:	SEND
	13 at+set_config=lora:app_eui:	SEND
	14 at+set_config=lora:app_key:	SEND
	15 at+set_config=lora:dev_addr:	SEND
	at+set_config=lora:nwks_key:	SEND
	at+set_config=lora:apps_key:	SEND
	at+set_config=lora:send_interval:	SEND
SENDING(With \r\n)	19 at+get_config=lora:status	SEND
at+send=lora:2:1234567890	☑ 20 at+get_config=lora:channel	SEND

Figure 32: ABP Test Sample Data Sent via RAK Serial Port Tool

You can see the data sent by the RAK4270 Module on The Things Stack device console *Live data* section and the *Last seen* info should be few seconds ago.

THE THINGS NET WORK	THE THINGS STACK Community Edition	view 🗖 Applications 🝶 Gateways 🛔	Crganizatio	ations 🕀 eul Community rakwireless-app 🔹				
LoRaWAN Devices Applica	Applications > LoRaWAN Dev	Applications > LoRaWAN Devices Application > End devices > RAKwireless ABP Device						
Overview	ID: rak-device-abp	ABP Device						
🙏 End devices	<ul> <li>Last seen 31 seconds ago</li> </ul>	<u>↑</u> 4 <u>↓</u> 3		Created 4 days ago				
Live data	Overview Live data Messaging Location Payload formatters General settings							
<> Payload formatters ~	General information			• Live data See all activity →				
た Integrations 🗸 🗸	End device ID	rak-device-abp		↔ 00:23:36 Rx timing setup request enqueued DevAddr: 26 0B DE 80				
2 Collaborators	Description	This ABP device is from RAKwireless		↔ 00:23:36 New channel request enqueued DevAddr: 26 08 DE 80 ↔ 00:23:36 New channel request enqueued DevAddr: 26 08 DE 80				
O→ API keys	Created at	Apr 1, 2021 05:08:13		↔ 00:23:36 New channel request enqueued DevAddr: 26 0B DE 80				
General settings	Activation information			↔ 00:23:36 New channel request enqueued DevAddr: 26 0B DE 80 ↔ 00:23:36 New channel request enqueued DevAddr: 26 0B DE 80				
	AppEUI	n/a						
	DevEUI	01 00 00 00 00 00 00 90	$\leftrightarrow$	Location Change location settings →				
	Session information							
	Device address	26 0B DE 80	$\leftrightarrow$					
	NwkSKey	43 3C 7A 92 4F 7F 69 47 77 8F E8 21 52 5	> 🖺 🗞					
< Hide sidebar	SNwkSIntKey	43 3C 7A 92 4F 7F 69 47 77 8F E8 21 52 5	> 🖺 🕸	No location information available				

Figure 33: OTAA Test Sample Data Sent Viewed in The Things Stack

## **Connecting with ChirpStack**

In this section, a practical exercise will be performed to show how to connect the RAK4270 Module to the ChirpStack platform.

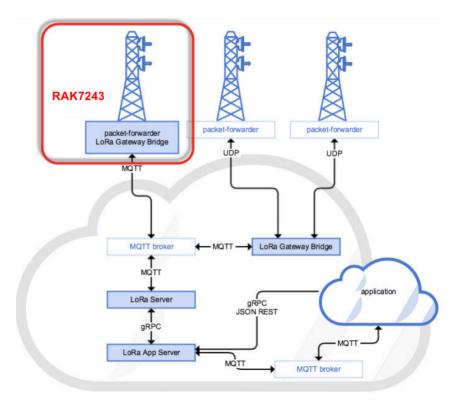


Figure 34: RAK4270 Module in the Context of the ChirpStack Platform

The ChirpStack, previously known as the LoRaServer project, provides open-source components for building LoRaWAN networks. Like the case of TTN, the RAK4270 Module is located in the periphery and transmits the data to the backend servers through a LoRa gateway. Learn more about ChirpStack 🗹 .

#### VOTE:

In this document, it is assumed that you are using RAK Gateway and its built-in ChirpStack or RAK cloud testing ChirpStack. Also, the gateway with the ChirpStack must be configured successfully. For further information, check the RAK documents for more details.

In this section, you need the following requirements:

- 1. Have ChirpStack online gateway, the frequency band of the nodes should be consistent with the frequency band of the gateway in use.
  - Connect the Gateway with Chirpstack
- 2. The RAK Serial Port Tool provided by RAK
- 3. RAK4270 Module

#### **NOTE:**

The frequency band used in the test is EU868, use the high-frequency version of RAK4270.

Before you start, you must choose which mode you are going to use, whether in OTAA or ABP mode, to register the device to the network server.

#### Sign up and login

Login to the ChirpStack server using your account and password.

### **Create a New Application**

1. Go to the Application section, as shown in Figure 35.

€	ChirpStack				Q. Search organization, application, gateway or device	? 😝 admin
<b>.</b>	Network-servers Gateway-profiles	Applications				+ CREATE
•	Organizations All users	ID	Name	Service-profile	Description	
	stack -	1	арр	service-profile	app Rows per page: 10 💌 1-	1 of 1 < >
*	Org. settings					
• •	Org. users Service-profiles					
쁥	Device-profiles Gateways					
	Applications					
2	Multicast-groups					

#### Figure 35: Application Section

 By default, you should create a new Application, although you can reuse the existing ones. For this setup, create a new Application by clicking on the "CREATE" button and filling the required parameters, as shown in Figure 36 and Figure 37.

€	ChirpStack	Q. Search organization, application, gateway or device 🕢 e admin
<b></b>	Network-servers Gateway-profiles	Applications / Create
•	Organizations All users	Application name * The name may only contain words, numbers and dashes.
chirp	Org. settings	Application description *
•	Org. users	Service-profile * Select service-profile The service-profile to which this application will be attached. Note that you can't change this value after the application has been created.
<b>≟</b> ≡	Service-profiles	Payload codec None
ii ®	Device-profiles Gateways	By defining a payload codec, ChipStack Application Berver can encode and decode the binary device payload for you important note: the payload fields have moved to the device-profile. For backward-compatibility and migration, existing codec settings are still visible. Codec settings on the device-profile have priority over the application codec settings.
	Applications	CREATE APPLICATION
2	Multicast-groups	

• For this setup, create an Application named "rak\_node\_test".

ChirpStack LoraServer supports multiple system configurations, with only one by default.

- Service profile: field is to select the system profile.
- Payload codec: is the parsing method for selecting load data. Such as parsing LPP format data.

€	ChirpStack					Q Search organization, application, gateway or	levice	0	e admin
	Network-servers	А	Applications					H	- CREATE
R	Gateway-profiles								
	Organizations		ID	Name	Service-pro	rofile Description			
-	All users		1	арр	service-p	arofile app			
chir	chirpstack -		2	rak_node_test	service-p	orofile test			
¢	Org. settings					Rows per page:	10 💌 1-2	of 2	
*	Org. users								
±≡	Service-profiles								
輩	Device-profiles								
R	Gateways								
	Applications								
2	Multicast-groups								

Figure 37: Filling Parameters of an Application

#### **Register a New Device**

- 3. Choose the **Application** created in the previous step, then select the **DEVICES** tab, as shown in **Figure 38** and **Figure 39**.
- 4. Once done, click "CREATE APPLICATION".

€	ChirpStack					<b>Q</b> Search organization, application, gateway or device	?	8	admin
	Network-servers	А	pplications				+ ci	REATE	
R	Gateway-profiles								
	Organizations		ID	Name	Service-profile	Description			
*	All users		1	арр	service-profile	app			
chirp	chirpstack +		2	rak_node_test	service-profile	test			
۵	Org. settings					Rows per page: 10 💌	1-2 of 2	<	>
<u>*</u>	Org. users								
±≡	Service-profiles								
킢	Device-profiles								
R	Gateways								
	Applications								
2	Multicast-groups								



	Network-servers Gateway-profiles	Applications /	rak_node_test				<b>DELETE</b>
	Organizations	DEVICES	APPLICATION CONFIGURATION INTEGRATIONS	FUOTA			
•	All users						+ CREATE
chir	rpstack 👻						T CREATE
۵	Org. settings	Last seen	Device name	Device EUI	Link margin	Battery	
<u>.</u>	Org. users				1	tows per page: 10 👻 0-0 of 0	< >
≞≡	Service-profiles						
귶놑	Device-profiles						
R	Gateways						
	Applications						
2	Multicast-groups						



€	ChirpStack				Q Search organization, application	n, gateway or device	? 🔒 ad	min
1000	Network-servers	Applications / ra	ak node test				DELE	TE
R	Gateway-profiles	Applications / R						
₽	Organizations	DEVICES	APPLICATION CONFIGURATION INTEGRATIONS	FUOTA				
*	All users							
chir	ostack -						+ CREA	TE
۵	Org. settings	Last seen	Device name	Device EUI	Link margin	Battery		
*	Org. users					Rows per page: 10 - 0-0 of	ro < >	
±≡	Service-profiles							
	Device-profiles							
R	Gateways							
	Applications							
٣	Multicast-groups							

#### Figure 40: Add a New Device

€	ChirpStack	Q Search organization, application, gateway or device	e adr	nin
	Network-servers Gateway-profiles	Applications / rak_node_test / Devices / Create		
•	Organizations All users	GENERAL VARIABLES TAOS		
chirp	ostack +	Device name * The name may only contain words, numbers and dashes.		-
¢	Org. settings	Device description *		
<u>•</u>	Org. users			
₽≡	Service-profiles	Device EUI *	SB C	-
	Device-profiles	Device-profile * Device-profile		-
R	Gateways	Disable frame-counter validation		
	Applications	Disable frame-counter validation will compromise security as it enables people to perform replay-attacks.		
ψ	Multicast-groups	CRE	ATE DEVICE	:

Figure 41: New Device Registration Form

6. Once the node is created, fill in the necessary data. You can generate a Device EUI automatically by clicking the following icon, or you can write a correct Device EUI in the edit box.

Fill in the parameters requested:

- Device name and Device description: These are descriptive texts about your device.
- Device EUI: This interface allows you to generate a Device EUI automatically by clicking the icon highlighted in red in Figure 42. You can also add a specific Device EUI directly in the form.
- Device Profile:
  - If you want to join in OTAA mode, select "DeviceProfile\_OTAA".
  - If you want to join in ABP mode, select "DeviceProfile\_ABP".

⇐	ChirpStack	Q Search organization, application, gateway or device O e admin	
	Network-servers Gateway-profiles	Applications / rak_node_test / Devices / Create	
•	Organizations All users	GENERAL     VARIABLES     TAGS       Device name *     *	
chirp	ostack 👻	rak_node The name may only contain words, numbers and dashes.	
۵	Org. settings	Device description * 1est	
*	Org. users	Device EUI*	
≟≡	Service-profiles	5E 9D 1E 08 57 CF 25 F1 MSB C	
註	Device-profiles	Device-profile_ device_profile_otaa	
R	Gateways	device_profile_abp	
	Applications		
2	Multicast-groups	device_profile_otaa CREATE DEVICE	

Figure 42: Generate a New Device EUI

### **LoRaWAN Join Mode**

In LoRaWAN, there are two (2) ways a node can connect itself to the LoRaWAN network. This is referred to as **Join Mode**. LoRaWAN allows the OTAA mode and the ABP mode. In this section, the configuration process of these two modes, both on the platform side and the node side will be explained.

### **OTAA Mode**

### **Configure the OTAA Mode on the Platform**

1. If you have selected "**DeviceProfile\_OTAA**", as shown in **Figure 43**, then after the device is created, an Application Key must be also created for this device.

€	ChirpStack	Q. Search organization, application, gateway or device e	admin
• ®	Network-servers Gateway-profiles	Applications / rak_node_test / Devices / Create	
•	Organizations All users	GENERAL     VARIABLES     TAGS       Device name*     *	
chir	pstack +	rak_node The name may only contain words, numbers and dashes.	_
\$	Org. settings	Device description * test	
*	Org. users	Device EU *	_
#≣	Service-profiles	5E 9D 1E 08 57 CF 25 F1 MSB	G
井	Device-profiles	Device_profile * device_profile_otaa	
Ŵ	Gateways		_
	Applications	Disable frame-counter validation Note that disabiling the frame-counter validation will compromise security as it enables people to perform replay-attacks.	
2	Multicast-groups	CREATE DE	VICE

Figure 43: Chirpstack OTAA Activation

2. A previously created Application Key can be entered here, or a new one can be generated automatically by clicking the icon highlighted in red in **Figure 44**:

€	ChirpStack	Q Search organization, application, gateway or device	?	e admin
	Network-servers	Applications / rak_node_test / Devices / rak_node		DELETE
R	Gateway-profiles	Applications / Tan_Toue_test / Devices / Tan_Toue		
	Organizations	DETAILS CONFIGURATION KEYS (OTAA) ACTIVATION DEVICE DATA LORAWAN FRAMES FIRMWARE		
<u>.</u>	All users			
chirp	stack -	Application key* F9 21 D5 0C D7 D0 2E E3 C5 E6 14 21 54 F2 74 B2	G	9 69 1
¢	Org. settings	For LoRaWAN 1.0 devices. In case your device supports LoRaWAN 1.1, update the device-profile first.		
<u>.</u>	Org. users	Gen Application key MSB	G	g la
.≞≡	Service-profiles	For LoRaWAN 1.0 devices. This key must only be set when the device implements the remote multicast setup specification / firmware updates over the air (FUOTA). Else leave this field blank.		
	Device-profiles		SET DEV	CE-KEYS
R	Gateways			
	Applications			
2	Multicast-groups			

Figure 44: Chirpstack OTAA Set Device Keys

- 3. Once the Application Key is added to the form, the process can be finalized by clicking on the "SET DEVICE-KEYS" button.
- As shown in **Figure 45**, a new device should be listed in the DEVICES tab. The most important parameters, such as the Device EUI, are shown in the summary.

€	ChirpStack						? 😝 admin			
	Network-servers	Applications / ra	k_node_test				DELETE			
$\bigcirc$	Gateway-profiles									
	Organizations	DEVICES	DEVICES APPLICATION CONFIGURATION INTEGRATIONS FUOTA							
<u>.</u>	All users									
chirp	pstack -						+ CREATE			
\$	Org. settings	Last seen	Device name	Device EUI	Link margin	Battery				
*	Org. users	n/a	rak_node	5e9d1e0857cf25f1	n/a	n/a				
±≡	Service-profiles				Rows per page: 1	. ▼ 1-1 of 1	< >			
	Device-profiles									
$\bigcirc$	Gateways									
	Applications									
٣	Multicast-groups									

Figure 45: Chirpstack OTAA List of Device in the Device Tab

4. To end the process, it is a good practice to review that the Application Key is properly associated with this device. The Application Key can be verified in the **KEYS(OTAA)** tab, as shown in **Figure 46**.

€	ChirpStack	Q Search organization, application, gateway or device	<b>?</b> 0	ədmin
	Network-servers	Applications / rak_node_test / Devices / rak_node		ELETE
R	Gateway-profiles			
	Organizations	DETAILS CONFIGURATION KEYS (OTAA) ACTIVATION DEVICE DATA LORAWAN FRAMES FIRMWARE		
*	All users			
chir	ostack +	Application key * 19 21 d5 0c d7 d0 2e e3 c5 e6 14 21 54 f2 74 b2 MSB C	с П	8
۵	Org. settings	For LGBWAN 1.0 devices. In case your device supports LGBaWAN 1.1, update the device-profile first.  Gen Application key	<u> </u>	
*	Org. users			0
±≡	Service-profiles	For LoRaWAN 1.0 devices. This key must only be set when the device implements the remote multicast setup specification / firmware updates over the air (FUOTA). Else leave this field blank.		
낦	Device-profiles	SI	SET DEVICE	KEYS
R	Gateways			_
	Applications			
۳	Multicast-groups			

Figure 46: Application Key Associated with the New Device

#### **NOTE:**

Standard OTAA mode requires the **Device EUI**, **Application Key**, and the **Application EUI**. But in ChirpStack's implementation, only the Device EUI and the Application Key are mandatory. The Application EUI is not required and is not recorded in the Application tab. Nevertheless, the Application EUI is a mandatory parameter in the RAK4270 module's firmware. To resolve this mismatch, you can reuse the Device EUI as the Application EUI during the configuration on the side of the node.

### Configure the OTAA Mode on the RAK4270

The RAK4270 Module supports a series of AT commands to configure its internal parameters and control the functionalities of the module.

To set up the RAK4270 Module to join ChirpStack using OTAA, start by connecting the RAK4270 Module to the computer (see **Figure 1**), open the RAK Serial Port Tool, and then wait for the communication to start. It is recommended to test the serial communication by sending either of these two AT commands:

ersion		
RAK SERIAL PORT TOOL		
BaudRate: 115200 - CL	Command OSE 01 at+version	CENID
RECEIVING CLEAR R		SEND
>>at+set_config=device:restart	03 at+set config=device:sleep:0	SEND SEND
LoRa (R) is a registered trademark or service mark of Semtech	04 at+set config=device:restart	SEND
Corporation or its affiliates. LoRaWAN (R) is a licensed mark.	05 at+set_config=device:gps:1	SEND
	06 at+set config=lora:work mode:0	SEND
RAK4270 version:3.3.0.15	07 at+set_config=lora:join_mode:0	SEND
UART1 work mode: RUI UART NORMAL, 115200, N81	08 at+set_config=lora:class:0	SEND
UART2 work mode: RUI UART NORMAL, 115200, N81	□ 09 at+set config=lora:region:EU868	SEND
Current work_mode:LoRaWAN, join_mode:OTAA, MulticastEnable	□ 10 at+set_config=lora:confirm:1	SEND
false, Class: A	□ 11 at+set_config=lora:ch_mask:0:0	SEND
Initialization OK	12 at+set_config=lora:dev_eui:	SEND
>>at+version	13 at+set_config=lora:app_eui:	SEND
OK V3.3.0.15	at+set_config=lora:app_key:	SEND
	□ 15 at+set_config=lora:dev_addr:	SEND
·	□ 16 at+set_config=lora:nwks_key:	SEND
	□ 17 at+set_config=lora:apps_key:	SEND
	□ 18 at+set_config=lora:send_interval:	SEND
, SENDING(With \r\n)	□ 19 at+get_config=lora:status	SEND
at+version	☑ 20 at+get_config=lora:channel	SEND
	D	

Figure 47: at+version command response

As an example, these are the list of the parameters you need to configure in RAK4270:

- LoRa join mode: OTAA
- LoRa class: Class A
- LoRa region: EU868
- Device EUI: 5e9d1e0857cf25f1
- Application EUI: 5e9d1e0857cf25f1
- Application Key: f921d50cd7d02ee3c5e6142154f274b2

1. Set the LoRa join mode to OTAA.

at+set\_config=lora:join\_mode:0

2. Set the LoRa class to Class A.

at+set\_config=lora:class:0

- 3. Set the frequency/region to EU868.
- Refer to the RAK4270 Module Datasheet for the list of supported frequencies.

at+set\_config=lora:region:EU868

4. Set the Device EUI.

at+set\_config=lora:dev\_eui:5e9d1e0857cf25f1

5. Set the Application EUI.

at+set\_config=lora:app\_eui:5e9d1e0857cf25f1

#### **NOTE**:

The Application EUI parameter is not required in the ChirpStack platform. Therefore, it is possible to use the same ID as the Device EUI. Otherwise, the firmware will complain.

- 6. Set the Application Key.
- Get the Application Key from the TTN register.

at+set\_config=lora:app\_key:f921d50cd7d02ee3c5e6142154f274b2

RAK SERIAL POR	T TOOL			
<b>SAK</b>	COM: COM6	- BaudRa	ate: 15200	* CLOSE
RECEIVING				CLEAR RECV
>>at+set_config	g=lora:join_mod	e:0		
ок				
>>at+set_config	g=lora:class:0			
ок				
>>at+set_config	g=lora:region:El	J868		
ок				
>>at+set_config	g=lora:dev_eui:5	e9d1e0857d	:f25f1	
ок				
>>at+set_config	g=lora:app_eui:5	5e9d1e0857	cf25f1	
ок				
>>at+set_config	g=lora:app_key:	f921d50cd7	d02ee3c5e61	42154f274b2
ок				
ľ				
SENDING(With \	r\n)			
at				
	ra:app_key:f921	d50cd7d02e	e3c5e614215	54 SEND
f274b2				

Figure 48: Chirpstack OTAA configuration via RAK Serial Port Tool

#### **NOTE:**

After configuring all the parameters, you need to reset your RAK4270 Module to save the parameters.

7. After resetting, start to join.

at+join		
	RAK SERIAL PORT TOOL	
	SaudRate: 1152	200 · CLOSE
	RECEIVING	CLEAR RECV
	>>at+join	
	OK Join Success	
	>>at+send=lora:2:1234567890	
	OK	
	I SENDING(With \r\n)	
	at+send=lora:2:1234567890	SEND

8. You can then see the JoinRequest and JoinAccept on the ChirpStack page.

€	ChirpStack	Q. Search organization, application, gateway or device e admin
80 80 80	Network-servers	Applications / rak_node_test / Devices / rak_node
$\mathbb{R}$	Gateway-profiles	
	Organizations	DETAILS CONFIGURATION KEYS (OTAA) ACTIVATION DEVICE DATA LORAWAN FRAMES FIRMWARE
<u>*</u>	All users	
chirp	ostack -	⑦ HELP II PAUSE
¢	Org. settings	DOWNLINK 5:42:17 PM JoinAccept
•	Org. users	UPLINK 5:42:17 PM JoinRequest 5e9d1e0857cf25f1 ~
±≡	Service-profiles	
	Device-profiles	
R	Gateways	
	Applications	
2	Multicast-groups	

Figure 50: Checking LoRaWAN Joint Request in Chirpstack OTAA Console

9. Now, try to send data from the RAK4270 Module to ChirpStack.

at+send=lora:2:1234567890		
	RAK SERIAL PORT TOOL	
	BaudRate: 115200	CLOSE
	RECEIVING	CLEAR RECV
	>>at+join	
	OK Join Success	
	>>at+send=lora:2:1234567890	
	ОК	
-	SENDING(With \r\n)	
	at+send=lora:2:1234567890	SEND
	L	

Figure 51: Send a LoRaWAN Message via RAK Serial Port Tool

 On the ChirpStack platform, you should also see the messages in the LORAWAN FRAMES tab, as shown in Figure 52. By convention, messages sent from nodes to gateways are considered as Uplinks, while messages sent by gateways to nodes are considered as Downlinks.

€	ChirpStack							Q Search organization, application, gateway or device	? \varTheta admin	
	Network-servers	Applications / ra	k node test / D	evices ( rak node					DELETE	
R	Gateway-profiles	Applications / Ta	plications / rak_node_test / Devices / rak_node							
₽	Organizations	DETAILS	CONFIGURATION	KEYS (OTAA)	ACTIVATION	DEVICE DATA	LORAWAN FRAMES	FIRMWARE		
*	All users									
chirp	ostack -							HELP II PAUSE DOWNLOAD	CLEAR	
۵	Org. settings	UPLINK	5:42:43 PM	UnconfirmedDataUp	018153f7				~	
÷	Org. users	DOWNLINK	5:42:17 PM	JoinAccept					~	
±≡	Service-profiles	UPLINK	5:42:17 PM	JoinRequest	5e9d1e0857cf25f1				~	
幸	Device-profiles									
R	Gateways									
	Applications									
۳	Multicast-groups									

Figure 52: Chirpstack Data Received Preview

This concludes the exercise to send data in the OTAA mode.

# ABP Mode

### Configure the ABP Mode on the Platform

During the registration of a new device, if you select "**DeviceProfile\_ABP**", as shown in **Figure 53**, then the ChirpStack platform will assume that this device will join the LoRaWAN network using the ABP mode.

#### **NOTE:**

Check "**Disable counting frame verification**". During the test, when the module is restarted, the frame counting number will be also be restarted from zero. This would cause a synchronization problem with the ChirpStack server treating it as a replay attack. For the testing purpose, it is safe to disable this feature, but remember to activate it in a production environment.

€	ChirpStack	Q. Search organization, application, gateway or device	0	admin
<b>R</b>	Network-servers Gateway-profiles	Applications / rak_node_test / Devices / Create		
	Organizations	OENERAL VARIABLES TAOS		
-	All users	Device name *		
chirp	ostack +	rak_node		_
٠	Org. settings	Device description * test		
-	Org. users	Device EU *		_
å≡	Service-profiles	5e 9d 1e 08 57 cf 25 f1	MSB	C
	Device-profiles	Device_profile * device_profile_abp		-
R	Gateways			
	Applications	Disable frame-counter validation Note that disabiling the frame-counter validation will compromise security as it enables people to perform replay-attacks.		
2	Multicast-groups		CREATE	DEVICE

Figure 53: ChirpStack Console, Configuring a Device

After selecting the ABP mode, the following parameters appear in the Activation tab:

- Device address
- Network Session Key
- Application Session Key

€	ChirpStack	Q. Search organization, application, gateway or device	?	θ	admin
<b>R</b>	Network-servers Gateway-profiles Organizations	Applications / rak_node_test / Devices / rak_node		T DI	ELETE
	All users				
chirp	pstack -	Device address * 26 01 1a f9	м	SB	C
۵	Org. settings	Network session key (LoRaWAN 1.0) * <pre>c2 80 cb 8d 1d f6 88 bc 18 60 1a 97 02 5c 54 88</pre> MSB	~	6	12
<b>-</b>	Org. users		C		8
±≡	Service-profiles	Application session key (LoftaWAH 1.0) * 4d 42 ec 5c af 97 f0 3d 83 3c da 15 00 3f 69 e1 MSB	С		Ø
幸	Device-profiles	Uplink frame-counter *			
R	Gateways	0			•
	Applications	Downlink frame-counter (network) * O			٠
٣	Multicast-groups	0	RE)ACTIV	ATE DE	VICE

Figure 54: Chirpstack ABP Activation Parameters Needed

• The parameters can be generated as random numbers by the platform or can be set with user values. Once these parameters are filled in properly, the process is completed by clicking on the "ACTIVATE DEVICE" button.

### Configure the ABP mode on the RAK4270

In the following steps, you will configure the RAK4270 Module to work in the ABP mode. To set up the RAK4270 Module to join ChirpStack using ABP, start by connecting the RAK4270 Module to the computer (see **Figure 1**), open the RAK Serial Port Tool, and then wait for the communication to start. It is recommended to test the serial communication by sending either of these two AT commands:

ersion		
RAK SERIAL PORT TOOL		- 0
TAK SENIAL PORT TOOL	Command	
RAK COM: COM12 - BaudRate: 15200 - CLOSE		SEND
RECEIVING CLEAR RECV		SEND
>>at+set_config=device:restart	□ 03 at+set_config=device:sleep:0	SEND
LoRa (R) is a registered trademark or service mark of Semtech	04 at+set config=device:restart	SEND
Corporation or its affiliates. LoRaWAN (R) is a licensed mark.	05 at+set_config=device:gps:1	SEND
	06 at+set_config=lora:work_mode:0	SEND
RAK4270 version:3.3.0.15	07 at+set_config=lora:join_mode:0	SEND
UART1 work mode: RUI_UART_NORMAL, 115200, N81	08 at+set_config=lora:class:0	SEND
UART2 work mode: RUI_UART_NORMAL, 115200, N81	09 at+set_config=lora:region:EU868	SEND
Current work_mode:LoRaWAN, join_mode:OTAA, MulticastEnable:	10 at+set_config=lora:confirm:1	SEND
false, Class: A	□ 11 at+set_config=lora:ch_mask:0:0	SEND
Initialization OK	□ 12 at+set_config=lora:dev_eui:	SEND
>>at+version	□ 13 at+set_config=lora:app_eui:	SEND
OK V3.3.0.15	□ 14 at+set_config=lora:app_key:	SEND
	□ 15 at+set_config=lora:dev_addr:	SEND
	16 at+set_config=lora:nwks_key:	SEND
	17 at+set_config=lora:apps_key:	SEND
	18   at+set_config=lora:send_interval:	SEND
SENDING(With \r\n)	□ 19 at+get_config=lora:status	SEND
	☑ 20 at+get config=lora:channel	SEND

Figure 55: at+version command response

## **AK** Documentation Center

As an example, these are the list of the parameters you need to configure in RAK4270:

- LoRa join mode: ABP
- LoRa class: Class A
- LoRa region: EU868
- Device address: 26011af9
- Network Session Key: c280cb8d1df688bc18601a97025c5488
- Application Session Key: 4d42ec5caf97f03d833cdaf5003f69e1
- 1. Set LoRa join mode to ABP.

at+set\_config=lora:join\_mode:1

2. Set LoRa class to Class A.

at+set\_config=lora:class:0

- 3. Set the frequency/region to EU868.
- Refer to the RAK4270 Module Datasheet for the list of supported frequencies.

at+set\_config=lora:region:EU868

4. Set the Device Address.

at+set\_config=lora:dev\_addr:26011af9

5. Set the Network Session Key.

at+set\_config=lora:nwks\_key:c280cb8d1df688bc18601a97025c5488

6. Set the Application Session Key.

at+set\_config=lora:apps\_key:4d42ec5caf97f03d833cdaf5003f69e1

RAK	COM: COM5	BaudRate:	115200 -	CLOSE
RECEIVING			CLE	AR RECV
>>at+set_conf	ig=lora:join_mo	ode:1		
ОК				
>>at+set_conf	fig=lora:class:0			
ОК				
>>at+set_conf	ig=lora:region:	EU868		
ОК				
>>at+set_conf	fig=lora:dev_ad	dr:26011af9		
ок				
>>				
at+set_config=	lora:nwks_key:	280cb8d1df688k	oc18601a9702	5c5488
ок				
>>at+set_conf	ig=lora:apps_k	ey:4d42ec5caf97f	f03d833cdaf50	03f69e1
ок				
SENDING(With	\r\n)			
at				
+ set config=le	pravanne keville	42ec5caf97f03d8	833cdaf500	SEND

Figure 56: Chirpstack ABP Parameters Configuration via RAK Serial Port Tool

#### **NOTE**:

After configuring all the parameters, you need to reset your RAK4270 Module to save the parameters.

7. After resetting the RAK4270 Module, join in ABP mode.

at+join			

#### VOTE:

By using the ABP mode in the LoRaWAN protocol, it doesn't require to join a network before sending the LoRaWAN package. But to keep the consistency of internal states of the firmware of the RAK4270 Module, it is still required to send the at+join command in the ABP mode. This time, the firmware should reply almost immediately with an "OK".

8. Now, try sending data from the RAK4270 Module to ChirpStack.

at+send=lora:2:1234567890

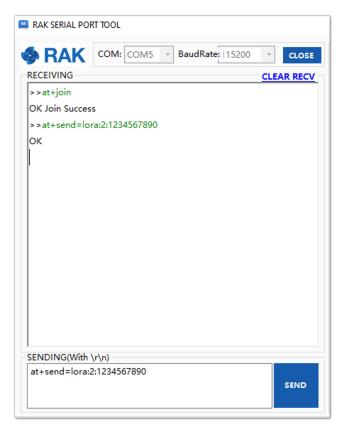


Figure 57: Chirpstack Sample Data Sent via RAK Serial Port Tool

### LoRa P2P Mode

This section will show you how to set up and connect two RAK4270 units to work in the LoRa P2P mode. You will be using EU868 as your frequency, although it is applicable also to other standard bands.

- 1. Two RAK4270 units shall be set to operate on EU868 frequency.
- The setup of the RAK4270 units is done by connecting them with a general-purpose computer through the UART port. The setup of each RAK4270 can be done separately but testing the LoRa P2P mode will require having both units connected simultaneously to their respective UART port. This could be one computer with two (2) USB ports or two (2) computers with one USB port each.
- 3. Set the RAK4270 to work in LoRa P2P mode. Open the RAK Serial Port Tool and send the following command:

at+set\_config=lora:work\_mode:1

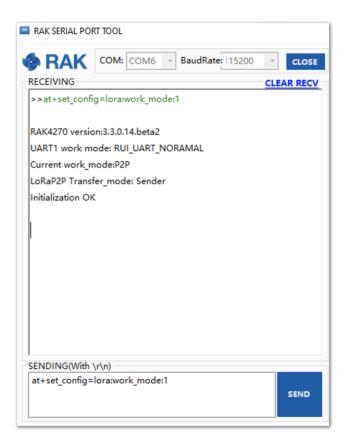


Figure 58: P2P Initialization

4. Then, configure LoRa P2P parameters for both of them.

at+set\_config=lorap2p:XXX:Y:Z:A:B:C

For this example, the LoRa parameters are the following:

- Link frequency: 869525000 Hz
- Spreading factor: 7
- Bandwidth: **125 kHz**
- Coding Rate: 4/5
- Preamble Length: 5
- Power: 5 dBm

#### VOTE:

Refer to the Configuring Using AT Commands section to learn more about the definition of the parameters used.

Hence, it is translated into the following RAK4270 AT command and sent to both units.

at+set\_config=lorap2p:869525000:7:0:1:5:5

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Figure 59: Configuring P2P in both RAK4270 Module

5. Set the transmission mode of the module. Unit 1 is configured as the sender, and Unit 2 is set to the receiver by AT command.

RAK SERIAL PORT TOO	L		RAK SERIAL POF	RT TOOL		
	BaudRate: 115200	CLOSE	<b>•</b> RAK	COM: COM5 ~	BaudRate: 115200	* CLOS
RECEIVING		CLEAR RECV	RECEIVING			CLEAR REC
OK	ap2p:transfer_mode:2		OK	g=lorap2p:transfer_	model	

Figure 60: Setting Modes in both RAK4270 Module

6. Try sending a message from Unit 1 to Unit 2.

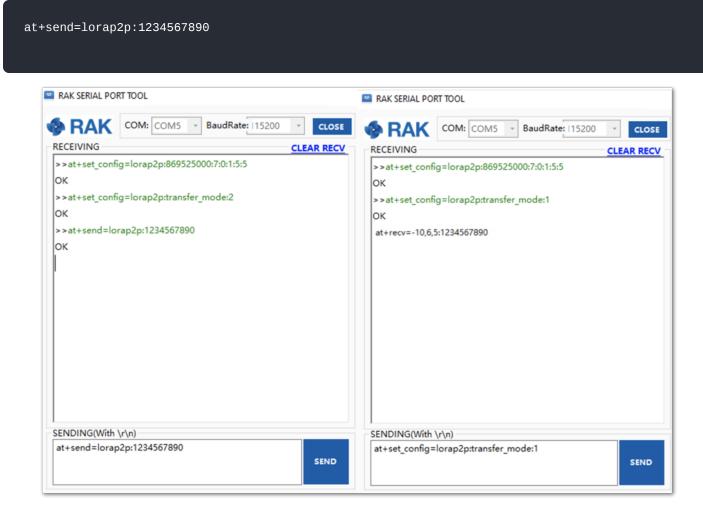


Figure 61: Message sent and received status in the two modules

## Miscellaneous

## **Upgrading the Firmware**

Before you start working with the RAK4270, it is recommended to keep the RAK4270 Module updated to the latest version of the firmware. Download the latest RAK4270 firmware.

#### **NOTE**:

For RAK4270 modules with firmware version V3.0.0.12 and below, you need to use the STM32CubeProgrammer ☐ to upgrade your firmware and upload the **.hex file** (not the .bin file) of the latest RAK4270 firmware ☐ . The lower versions of the firmware have a different bootloader code and will not work on the RAK DFU Tool.

In the following sections, two (2) options for flashing new firmware in a RAK4270 Module are shown: **Upgrade through DAPLink** and **Upgrade through UART1**.

### Firmware Upgrade Through DAPLink

Refer to the RAKDAP1 Flash and Debug Tool guide in the Accessories Category.

## Firmware Upgrade Through UART1 Minimum Hardware and Software Requirements

Refer to the table for the minimum hardware and software required to perform the firmware upgrade using J-Link.

Hardware/Software	Requirement
Computer	A Windows/Ubuntu/Mac computer
Firmware File	Bin firmware file downloaded from the website
Others	A USB to TTL module

### **Firmware Upgrade Procedure**

Execute the following procedure to upgrade the firmware in Device Firmware Upgrade (DFU) mode through the UART1 interface.

- 1. Download the latest application firmware of the RAK4270 that can be found on the datasheet.
  - RAK4270 Module Datasheet
- 2. Download the RAK Device Firmware Upgrade (DFU) tool.
  - RAK Device Firmware Upgrade (DFU) Tool ☑
- 3. Connect the RAK4270 Module with a computer through a USB to TTL. Refer to Figure 1
- 4. Open the Device Firmware Upgrade tool. Select the serial port and baud rate of the module and click the "Select Port" button.

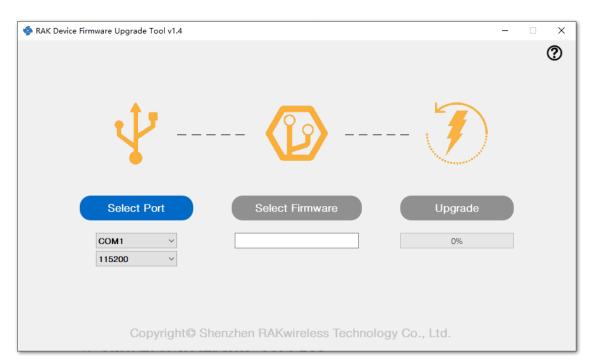


Figure 62: Device Firmware Upgrade Tool

5. Select the application firmware file of the module with the suffix ".bin".

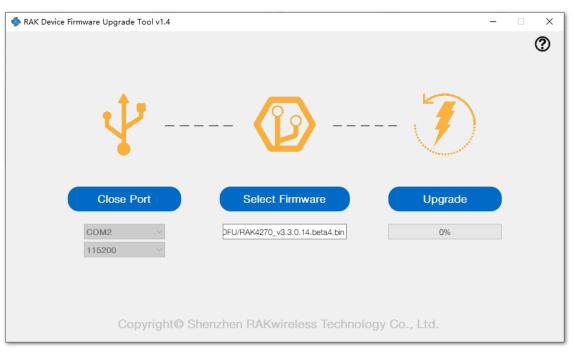


Figure 63: Select Firmware

6. Click the "**Upgrade**" button to upgrade the device. After the upgrade is complete, the RAK4270 Module will be ready to work with the new firmware.

🧇 RAK Device Firmware Upgrade Tool v1.4	- 🗆 X
	٢
Ý Ø Ø	
Close Port Select Firmware Cancel	
COM2 ·	
115200 ~	
Copyright <sup>©</sup> Shenzhen RAKwireless Technology Co., Ltd.	

#### Figure 64: Firmware Upgrading

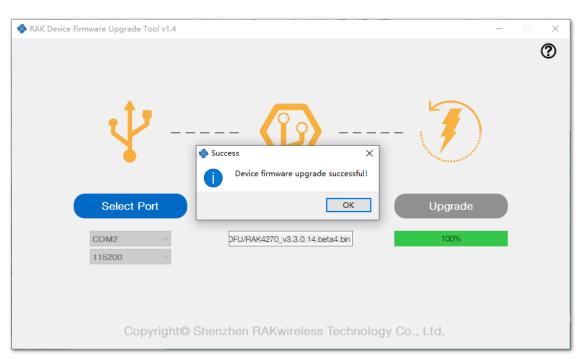


Figure 65: Upgrade Successful

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