# **Quick Start Guide**

# Prerequisites

## What do you need?

Before going through each and every step in the installation and guide of the RAK4270 Breakout Board, make sure to prepare the necessary items listed below:

### Hardware Tools

- 1. RAK4270 Breakout Board
- 2. USB-UART Module (RAKDAP1 Tool)
- 3. Gateway in Range for Testing
- 4. Jumper Wires
- 5. 3.3 V Battery Power Supply
- 6. A Windows/Mac OS/Linux Computer

### **Software Tools**

- 1. RAK Serial Port Tool
- 2. RAK4270 Firmware
- 3. RAK Device Firmware Upgrade (DFU) Tool

### NOTE

The bootloader of the RAK4270 Breakout Board is already pre-installed upon manufacturing so flashing the bootloader is not necessary for you to perform. If you find that the bootloader of your RAK4270 Breakout Board damaged, contact RAK support through **RAKwireless forum** 2. However, if you want to **upgrade the firmware** of the device, refer to the miscellaneous section of this document.

# What's included in the package?

- 1 pc RAK4270 Breakout Board (chipset pre-soldered on the board)
- 1 pc LoRa Antenna

# **Product Configuration**

## Interfacing with RAK4270 Breakout Board

RAK4270 Breakout Board can be configured using AT commands via UART interface. You need a USB to UART TTL adapter to connect the RAK4270 board to PC's USB port and a serial terminal tool.

You can use **RAKDAP1** as the USB to UART interface device. RAKDAP1 is compatible to other RAK modules and can be used as a debugging tool and firmware uploader. It is also highly recommended to use **RAK Serial Port Tool** so you can easily send AT commands and view the replies from its console output.

### 

Before powering the RAK4270 Breakout Board, make sure you have installed the LoRa antenna first. Not doing so might damage the board.

### **USB to UART**

- Connect your RAK4270 Breakout Board to the USB-UART interface as shown in Figures 1 and 2.
- UART1 is used for AT commands input as well as firmware update. Check RAK4270 Breakout Board Pin Definition on the datasheet for complete details.



Figure 1: RAK4270 Breakout Board Connected to RAKDAP1 USB-UART Interface



Figure 2: RAK4270 Breakout Board to USB Uart Module Connection

• Connect your USB - UART Module to your Windows PC and open RAK Serial Port Tool.

	Command	
	PEN 01 stumping	550.0
		SEND
		SEND
	1 03 at+set_config=device:sleep:0	SEND
	□ 04 at+set_config=device:restart	SEND
	□ 05 at+set_config=device:gps:1	SEND
	06 at+set_config=lora:work_mode:0	SEND
	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
	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
si	All/None	SAVE

Figure 3: RAK Serial Port Tool

 In choosing the correct COM Port number for your device, go to your Device Manager by pressing Windows + R and type devmgmt.msc , or search in the Start Menu.

🗄 D	evice Manager	_	$\times$
File	Action View Help		
¢ =			
v J	DESKTOP-M6PAF9B		
>	la Batteries		
>	Bluetooth		
>	Cameras		
>	Computer		
>	Disk drives		
>	lisplay adapters		
>	🛺 Human Interface Devices		
>	TDE ATA/ATAPI controllers		
>	to Intel(R) Dynamic Platform and Thermal Framework		
>	🔤 Keyboards		
>	Mice and other pointing devices		
>	I Monitors		
>	🕎 Network adapters		
>	😰 Other devices		
~	Ports (COM & LPT)		
	💭 Standard Serial over Bluetooth link (COM3)		
	💭 Standard Serial over Bluetooth link (COM4)		
	USB-SERIAL CH340 (COM16)		
>	Print queues		
>	Processors		
>	Software components		
>	Software devices		
>	Sound, video and game controllers		
>	Storage controllers		
>	The System devices		
>	Universal Serial Bus controllers		

Figure 4: Device Manager

• Look for Ports (COM & LPT). Find the name of of your USB UART Module driver and take note of the COM Port Number.

😫 RAK SERIAL PORT TOOL	-	
6	Command	
COM: COM16 • BaudRate: 15200 • OPEN	□ 01 at+version	SEND
RECEIVING CLEAR RECV	02 at+get_config=device:status	SEND
	□ 03 at+set_config=device:sleep:0	SEND
	04 at+set_config=device:restart	SEND
	05 at+set_config=device:gps:1	SEND
	06 at+set_config=lora:work_mode:0	SEND
	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
	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
SEND	All/None	SAVE
	2-24 1/12/2020 10:26:07 PM:	

Figure 5: Correct Port Number and Correct Baud rate

# Connecting to The Things Network (TTN)

In this section, a practical exercise will be performed to show how to connect the RAK4270 Breakout Board to The Things Network (TTN) platform.



Figure 6: RAK4270 Breakout Board in the context of the TTN

As shown in Figure 6, the RAK4270 Breakout Board is one of the devices located on the left side. In the context of an IoT solution, the objective is to deploy devices to sense relevant process variables and transmit the data to the backend servers located in the cloud. The data will be processed and integrated as part of a larger solution that ultimately could generate efficiency, traceability and predictability capacity among others.

The RAK4270 Breakout Board can be part of this ecosystem, and the objective of this section is to demonstrate how simple it is to send data to the TTN using the LoRaWAN protocol. To achieve this, the RAK4270 Breakout Board must be located inside of the coverage of a LoRaWAN gateway.

#### Sign up and login

If you don't have an account yet, head on to the **TTN website** and create one. Once done, login to your account and go to the Console.



Figure 7: The Things Network Home Page

THETHINGS CONSOLE COMMUNITY EDITION			Applications	Gateways	Support	$ ho$ rakwireless2020 $\sim$
	💭 Hi, rakwi	ireless2020!				
	Welcome to The Thir This is where the magic happens. Here you can work with your data. R collaborators	ngs Network Console. tegister applications, devices and gateways, manage your integrations, and settings.				
	APPLICATIONS	GATEWAYS				

Figure 8: TTN Console Page

### **Create a New Application**

1. Choose the "APPLICATIONS".

CONSOLE COMMUNITY EDITION		Applications	Gateways	Support	$ ho$ rakwireless2020 $\sim$
	Applications				
	APPLICATIONS	add application			

Figure 9: Application Section

2. Click the "add application" button.

THE THINGS CONSOLE COMMUNITY EDITION		Applications	Gateways	Support	\Lambda rakwireless2020 🗸
	Applications > Add Application				
	ADD APPLICATION				
	Application ID The unique identifier of your application on the network				
	rak_node_test	0			
	Description A human readable description of your new app				
	rak lora node test	0			
	Application EUI An application EUI will be issued for The Things Network block for convenience, you can add your own in the application settings page.				
	EUI issued by The Things Network				
	Handler registration Select the handler you want to register this application to				
	ttn-handler-eu	0			
	Cancel Add applic	ition			

Figure 10: Adding an Application

- Here are the things that you should take note in adding an application:
  - **Application ID** this will be the unique id of your application in the Network. Note that the characters should be in lower case, no spaces are allowed.
  - Description this is a short and concise human readable description of your application.
  - Application EUI this will be generated automatically by The Things Network for convenience.
  - Handler Registration handler you want to register this application to.
- 3. After you fill in the necessary information, press the "Add application" button at the bottom of this page. If you see similar page as shown in Figure 11, then you have successfully registered your application.

THE THINGS CONSOLE COMMUNITY EDITIO	N					Applicat	ions Gate	vays Suj	pport	A rakwireless2
	Applications > 🥪 rak_node_test									
		Overview	Devices	Payload Formats	Integrations	Data	Settings			
	APPLICATION OVERVIEW									
	Application ID rak_node_test Description rak lora node test Created 34 seconds ago Handler ttn-handler-eu (current handler)					dc	cumentation			
	APPLICATION EUIS					0	manage euis			
	↔ ≒ 70 B3 D5 7E D0 03 24 89 图									
	DEVICES				register device	2 🌣 mar	nage devices			
	ę	0 registered de	vices							

Figure 11: Application Overview

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

1. Scroll down until you see the Devices section. Or, you can click the "Devices" button at the top.



- Figure 12: Register a New Device
- 2. Then, register a new device by clicking on the "register devices".

THE THINGS CONSOLE NETWORK COMMUNITY EDITIO	N					Applicat	ons Gate	eways Su	ipport	$oldsymbol{ ho}$ rakwireless2020 ${\scriptstyle\smile}$
	Applications > 🥹 rak_node_test > Devices									
		Overview	Devices	Payload Formats	Integrations	Data	Settings			
	REGISTER DEVICE					bulk im	port devices			
	Device ID This is the unique identifier for the device in this app. The device ID will be immutat	le.								
	Device EUI The device EUI is the unique identifier for this device on the network. You can chan,	ge the EUI later.								
	*						0 bytes			
	App Key The App Key will be used to secure the communication between you device and the	network.								
	this field will	be generated								
	App EUI									
	70 B3 D5 7E D0 03 24 89						\$			
					Cance		Register			

Figure 13: Add your Device

In this form, the device ID must be unique for the application and must be completed with a lower case, alphanumeric characters. The rest of the parameters in the form are very important for the LoRaWAN protocol:

- Device EUI
- Application Key
- Application EUI

The TTN platform can generate these parameters randomly by leaving those fields empty or you can enter already existing values.

3. Press the "Register" button at the bottom of this page to finish the process.

THE THINGS CONSOLE NETWORK COMMUNITY EDITION	N	Applicat	ions Gat	eways	Support	$oldsymbol{ ho}$ rakwireless2020 $\scriptstyle{\checkmark}$
	Applications > 🥪 rak_node_test > Devices > 🔚 rak_node					
	Overview	Data	Settings			
	DEVICE OVERVIEW					
	Application ID rak_node_test Device ID rak_node					
	Activation Method OTAA					
	Device EUI         ↔         ≒         5E 90 1E 08 57 CF 25 F1         由           Application EUI         ↔         ≒         5E 90 1E 08 57 CF 25 F1         由					
	App Key         <>         #         #         F9 21 D5 0C 07 D0 2E E3 C5 E6 14 21 54 F2 74 B2         #					
	Status • neverseen Frames up 0 reset frame counters					
	Frames down 0					

Figure 14: Device Overview

## LoRaWAN Join Mode

The LoRaWAN specification defines that to join in a LoRaWAN network, each end-device has to be personalized and activated. Activation can be done either via Over-The-Air-Activation (OTAA) or Activation-By-Personalization (ABP). In OTAA, the previously personalized end-device is activated when is deployed or reset. On the other hand, in ABP, the personalization and activation are done as a single step.

Hence, this is referred to as the "Join Mode". LoRaWAN allows the OTAA mode and the ABP mode. In this section, the configuration process of these two modes is explained, both on the platform side and the node side.

### **OTAA Mode**

### Configure the OTAA Mode on the Platform

As shown in Figure 14, the default activation mode in TTN is the OTAA mode. Therefore, no further actions are required in the platform side.

### Configure the OTAA Mode on the RAK4270 Breakout Board

The RAK4270 Breakout Board supports a series of AT commands to configure its internal parameters and control the functionalities of the module. Physically, the module exposes a serial interface through the USB connector.

To set up the RAK4270 Breakout Board to join the TTN using OTAA, start by connecting the RAK4270 Breakout Board 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	
	RAK SERIAL PORT TOOL
	SENDING(With \r\n) at+version SEND

Figure 15: at+version command response

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

- 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 in the RAK4270 Breakout Board 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

6. Set the Application Key.

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



Figure 16: Configuring LoRa Parameters

### NOTE:

After configuring all the parameters, you need to reset your RAK4270 Breakout Board 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 17.

8. Try to send a message from the RAK4270 Breakout Board.

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)	
artsenu-10/8:2:123430/030	SEND

Figure 17: OTAA Test Sample Data Sent via RAK Serial Port Tool

You can see the data sent by the RAK4270 Breakout Board on the TTN platform as shown in Figure 18.

THE THINGS CONSOLE NETWORK COMMUNITY EDITION	N	Applications Gateways Support 🕅 rakwireless2020 ~
	Applications > 🥪 rak_node_test > Devices > 📻 rak_node > Data	
		Overview Data Settings
	APPLICATION DATA	Il pause 🕸 clear
	Filters uplink downlink activation ack error	
	16:39:38         0         33         retry         payload:         5A 00 12 34           +         16:39:07         dev addr:         26 01 29 22         app eul:         5E 9D 1E 08 57 CF 25 F1         dev eul:         5E 9D 1E 0	8 57 CF 25 F1

Figure 18: OTAA Test Sample Data Sent Viewed in TTN

### **ABP Mode**

### Configure the ABP mode on the Platform

If the ABP mode is preferred, then the TTN platform needs to be configured first accordingly. At TTN, once a device is created, you can select the "SETTINGS" section of the "DEVICE" and switch the "Activation Method".

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THETHINGS CONSOLE NETWORK COMMUNITY EDITIO	N			Applications	Gateways	Support	$oldsymbol{ ho}$ rakwireless2020 $\checkmark$
	Applications > 🤤 rak_node_test > Devices >	rak_node > Settings					
			Overview	Data Se	ttings		
	DEVICE SETTINGS	SETTINGS					
	General	Description					
	Location	A human-readable description of the device			0		
		Device EUI The serial number of your radio module, similar to a MAC address					
		⇒ 5E 9D 1E 08 57 CF 25 F1		🔗 8 byb	5		
		Application EUI					
		5E 9D 1E 08 57 CF 25 F1			0		
		Activation Method					

Figure 19: ABP Activation in TTN

- For ABP mode, the TTN parameters needed are the following:
  - Device Address
  - Network Session Key
  - App Session Key

### NOTE:

These fields can be left empty in the form and TTN will complete them with random values, in other cases, you can complete them with specific values.

THE THINGS CONSOLE NETWORK COMMUNITY EDITIO	N		Applications	Gateways	Support	$oldsymbol{ ho}$ rakwireless2020 $\checkmark$
	Applications > 🥪 rak_node_test > Devices > 1	Tak_node > Settings				
	General	Description				
	Location	A human-readable description of the device	0			
		Device EUI         The serial number of your radio module, similar to a MAC address         %       5E 9D 1E 08 57 CF 25 F1	👩 8 bytes			
		Application EUI				
		5E 9D 1E 08 57 CF 25 F1	0			
		Activation Method OTAA ABP				
		Device Address				
		The device address will be assigned by the network server				
		Network Session Key				
		Network Session Key will be generated				
		App Session Key				
		App Session Key will be generated				

Figure 20: ABP Mode Parameters

The same as the OTAA form, you can leave these fields empty to allow TTN to generate random values or input the specific values that you want.

THE THINGS CONSOLE N B T W O R K COMMUNITY EDITION				Application	s Gatewa	ys Support	🗛 rakwireless2020 🗸
Ap	oplications > 🤤 rak_node_test	st > Devices > 📻 rak_node					
			Overview	Data S	iettings		
	DEVICE OVERVIEW						
	Application ID Device ID	rak_node_test rak_node					
	Activation Method	ABP					
	Device EUI	↔ ≒ 5E 9D 1E 08 57 CF 25 F1 割					
	Application EUI	↔ = 5E 9D 1E 08 57 CF 25 F1 (2)					
	Device Address	↔ ≒ 26 01 1A F9 割					
	Network Session Key						
	App Session Key						
]	Status Frames up	never seen     reset frame counters					
	Frames down	0					

Figure 21: ABP Mode Parameters

Configure the ABP mode on the RAK4270 Breakout Board

To set up the RAK4270 Breakout Board to join the TTN using ABP, start by connecting the RAK4270 Breakout Board to the computer via a USB to UART converter (see Figure 2) and open the RAK Serial Port Tool. Wait for the communication to start. It is recommended to test the serial communication by sending either of these two AT commands:

at+set_config=device:restart		
at+version		
	RAK SERIAL PORT TOOL	
	COM: COM6 - BaudRate: 15200	0 - CLOSE
	>>at+version OK V3.3.0.14.beta2	
	SENDING(With \r\n) at+version	SEND

Figure 22: at+version command response

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

- LoRa join mode: ABP
- LoRa class: Class A
- LoRa region: EU868
- Device address: 26011af9
- Network Session Key: c280cb8d1df688bc18601a97025c5488
- Application Session Key: 4d42ec5caf97f03d833cdaf5003f69e1
- 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 in the RAK4270 Breakout Board 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 LoRa Network Session Key.

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

6. Set the LoRa Application Session Key.

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



Figure 23: AT Command for ABP LoRa parameters via RAK Serial Port Tool

#### NOTE:

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

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



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 Breakout Board, it still required to send at+join command in the ABP mode. This time, the firmware should reply almost immediately with an "OK".

8. Try to send a data from the RAK4270 Breakout Board to TTN in ABP mode.

at+send=lora:2:1234567890



Figure 24: ABP Test Sample Data Sent via RAK Serial Port Tool

Then, go to the TTN Console to confirm that the message was properly received.

# Connecting with ChirpStack

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



Figure 25: RAK4270 Breakout Board in the Context of the ChirpStack Platform

#### NOTE:

In this document, it is assumed that you are using RAK Gateway and its built-in ChirpStack or RAK cloud testing ChirpStack. Also, the RAK 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 Breakout Board

#### NOTE:

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

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**

Go to the Application section as shown in the Figure 26.

	ChirpStack					? Ə admin
6 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Network-servers	Applications				+ CREATE
R	Gateway-profiles					
₽	Organizations	ID	Name	Service-profile	Description	
*	All users	1	арр	service-profile	арр	
chirp	ostack -				Rows per page: 10 🔻 1-1	of 1 < >
٠	Org. settings					
<u>*</u>	Org. users					
≛≡	Service-profiles					
	Device-profiles					
R	Gateways					
	Applications					
2	Multicast-groups					



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 fill the required parameters as shown in the Figures 27 and 28.

€	ChirpStack	Q Search organization, application, gateway or device 📀 e admin
	Network-servers Gateway-profiles	Applications / Create
	Organizations	
*	All users	Application name * The name may only contain words, numbers and dashes.
chirp	stack -	
۵	Org. settings	Application description *
<u>.</u>	Org. users	Select service-profile
±≡	Service-profiles	The service-profile to which this application will be attached. Note that you can't change this value after the application has been created. Payload codec
	Device-profiles	None
R	Gateways	by defining pay the determinance experiment the second encoded in cetter in entry verse payoes or you mprove new mean new normal on determinance. For each encode provide the second you are an name. Codes settings on the determinance provide the provide the second payoes or you mprove new mean new normal or determinance. For each encode provide the second you determinate the second payoes new means the payoes new pa
	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: the parsing method for selecting load data such as parsing LPP format data.

€	ChirpStack				c	C Search organization, application, gateway or device	?	e ad	imin
01 00 01	Network-servers	Ар	plications					+ CREA	TE
R	Gateway-profiles								
	Organizations		ID	Name	Service-profile	Description			
*	All users		1	арр	service-profile	app			
chirp	pstack -		2	rak_node_test	service-profile	test			
۵	Org. settings					Rows per page: 10 💌 1-	2 of 2	$\langle \rangle$	
*	Org. users								_
±≡	Service-profiles								
井	Device-profiles								
R	Gateways								
	Applications								
9	Multicast-groups								



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

- 1. Choose the **Application** created in the previous step, then select the **DEVICES** tab as shown in Figures 29 and 30.
- 2. Once done, click "CREATE APPLICATION".

€	ChirpStack			c	<b>Q</b> Search organization, application, gateway or device	? 🔒 admin
	Network-servers	Applications				+ CREATE
R	Gateway-profiles	Applications				
	Organizations	ID	Name	Service-profile	Description	
<u>*</u>	All users	1	aon	service-profile	ann	
chirp	stack -	2	rak node test	service-profile	test	
÷	Org. settings		Tur_Hout_tot	Scree point	tuat	
	Org. users				Rows per page: 10 ¥	1-2 07 2 < >
±=	Service-profiles					
	Device-profiles					
R	Gateways					
	Applications					
2	Multicast-groups					

Figure 29: List of Applications Created

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: ©	Network-servers Gateway-profiles	Applications / ra	oplications / rak_node_test		<b>i</b> D	ELETE			
	Organizations	DEVICES	APPLICATION CONFIGURATION INTEGRATIONS	FUOTA					
•	All users							+ 0	DEATE
chirp	ostack -							- u	REATE
۵	Org. settings	Last seen	Device name	Device EUI	Link margin	B	lattery		
•	Org. users				Rov	vs per page: 10 👻	0-0 of 0	<	>
≛≡	Service-profiles								
井	Device-profiles								
R	Gateways								
	Applications								
2	Multicast-groups								



3. Once inside of the DEVICE tab, create a new device (LoRa node) by clicking on the "+ CREATE" button.

	ChirpStack						? 🔒 admin
83 83 83	Network-servers	Applications / ra	k_node_test				<b>DELETE</b>
R	Gateway-profiles						
	Organizations	DEVICES	APPLICATION CONFIGURATION INTEGRATIONS	FUOTA			
*	All users		-				+ CREATE
chirp	ostack 👻						
۵	Org. settings	Last seen	Device name	Device EUI	Link margin	Battery	
<u>.</u>	Org. users				Ro	owsperpage: 10 👻 0-1	0 of 0 < >
≛≡	Service-profiles						
	Device-profiles						
$\mathbb{R}$	Gateways						
	Applications						
Ψ	Multicast-groups						

Figure 31: Add a New Device

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€	ChirpStack	Q Search organization, application, gateway or device	0	admin
 R	Network-servers Gateway-profiles	Applications / rak_node_test / Devices / Create		
I	Organizations	GENERAL VARIABLES TAGS		
•	All users			
chirp	stack +	Device name * The name may only contain words, numbers and dashes.		
¢	Org. settings	Device description *		
<u>*</u>	Org. users			
≛≡	Service-profiles	Device EUI *	MSB	C
	Device-profiles	Device-profile * Device-profile		
R	Gateways			
	Applications	Disable frame-counter validation  Note that disabling the frame-counter validation will compromise security as it enables people to perform replay-attacks.		
2	Multicast-groups		CREATE	DEVICE
			GALATE	DE TIOL



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 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 33. 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 🕑 e admin
0 0 0	Network-servers	Applications / rak_node_test / Devices / Create
R	Gateway-profiles	
	Organizations	GENERAL VARIABLES TAGS
<u>•</u>	All users	Device name *
chirp	ostack -	rak_node The name may only contain words, numbers and dashes.
٠	Org. settings	Device description *
<u>.</u>	Org. users	Least
≛≡	Service-profiles	5E 9D 1E 08 57 CF 25 F1
	Device-profiles	Device-profile * device_profile.otaa
R	Gateways	device profile abo
	Applications	a a noc_proms_aup
2	Multicast-groups	device_profile_otaa
		CREATE DEVICE

Figure 33: 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 both 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 34, 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	GENERAL VARIABLES TAGS	
*	All users	Device name *	
chirp	stack -	rak_node	
۵	Org. settings	Device description * test	
*	Org. users	Device EUI *	
≛≡	Service-profiles	5E 9D 1E 08 57 CF 25 F1 MSB C	
	Device-profiles	Device_profile *	
R	Gateways		
	Applications	Disable frame-counter validation  Note that disabling the frame-counter validation will compromise security as it enables people to perform replay-attacks.	
ψ	Multicast-groups	CREATE DEVICE	

Figure 34: 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 35.

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€	ChirpStack	Q Search organization, application, gateway or device			e admin
	Network-servers	Applications / rak pode test / Devices / rak pode		<b></b>	DELETE
$\bigcirc$	Gateway-profiles				
	Organizations	DETAILS CONFIGURATION KEYS (OTAA) ACTIVATION DEVICE DATA LORAWAN FRAMES FIRMWARE			
<u>*</u>	All users				
chirp	ostack 👻	Application key * F9 21 D5 0C D7 D0 2E E3 C5 E6 14 21 54 F2 74 B2 MSB	G	6	Ø
\$	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	G	ē	8
≛≡	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.			
ᆂ	Device-profiles		SET	DEVIC	E-KEYS
R	Gateways				
	Applications				
2	Multicast-groups				



- 3. Once the Application Key is added in the form, the process can be finalized by clicking on the "SET DEVICE-KEYS" button.
- As shown in Figure 36, 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					ce	? 😝 admin
61 61 61	Network-servers	Applications / ra	ık_node_test				<b>DELETE</b>
R	Gateway-profiles						
	Organizations	DEVICES	APPLICATION CONFIGURATION INTEGRATIONS	FUOTA			
<u>.</u>	All users						
chirp	ostack -						+ CREATE
\$	Org. settings	Last seen	Device name	Device EUI	Link margin	Battery	
<u>.</u>	Org. users	n/a	rak_node	5e9d1e0857cf25f1	n/a	n/a	
≛≡	Service-profiles				Rows per page: 10	▼ 1-1 of 1	< >
	Device-profiles						
R	Gateways						
	Applications						
9	Multicast-groups						

Figure 36: 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 37.

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€	ChirpStack	Q Search organization, application, gateway or device	?	e admin
81 81 81	Network-servers	Applications / rak node test / Devices / rak node		DELETE
R	Gateway-profiles			
	Organizations	DETAILS CONFIGURATION KEYS (OTAA) ACTIVATION DEVICE DATA LORAWAN FRAMES FIRMWARE		
*	All users			
chirpstack -		Application key * 19 21 d5 0c d7 d0 2e e3 c5 e6 14 21 54 t2 74 b2 MSB	G	i w
۵	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		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.		
뉁	Device-profiles		SET DE	ICE-KEYS
R	Gateways			
	Applications			
2	Multicast-groups			



#### NOTE:

Standard OTAA mode requires the **Device EUI**, **Application Key**, and the **Application EUI**. But in the ChirpStack's implementation, only the Device EUI and the Application Key are mandatory. The Application EUI is neither required nor recorded in the Application tab. Nevertheless, the Application EUI is a mandatory parameter in the RAK4270 Breakout Board firmware. To resolve this mismatch, you can reuse the Device EUI as the Application EUI during the configuration in the side of the node.

### Configure the OTAA mode on the RAK4270 Breakout Board

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

To set up the RAK4270 Breakout to join ChirpStack using OTAA, start by connecting the board to the computer (see Figure 2) and open the RAK Serial Port Tool. Wait for the communication to start. It is recommended to test the serial communication by sending either of these two AT commands:

at+get_config=lora:status			
			J

at+version

COM: COM6 BaudRate: 115200 CLOSE RECEIVING CLEAR RECV >>at+version OK V3.3.0.14.beta2 SENDING(With \r\n) at+version SENDING(With \r\n)	RAK SERIAL POP	IT TOOL	
RECEIVING CLEAR RECV >>at+version OK V3.3.0.14.beta2 SENDING(With \r\n) at+version SENDING(With \r\n)	<b>RAK</b>	COM: COM6 - BaudRate: 1152	200 · CLOSE
>>at+version OK V3.3.0.14.beta2 SENDING(With \r\n) at+version	RECEIVING		CLEAR RECV
OK V3.3.0.14.beta2 SENDING(With \r\n) at+version SEND	>>at+version		
SENDING(With \r\n) at+version	OK V3.3.0.14.be	eta2	
SENDING(With \r\n) at+version			
SENDING(With \r\n) at+version	ľ		
SENDING(With \r\n) at+version			
SENDING(With \r\n) at+version SEND			
, SENDING(With \r\n) at+version SEND			
at+version SEND	, SENDING(With )	(r\n)	
	at+version		SEND

Figure 38: at+version command response

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

- 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 in the RAK4270 Breakout Board 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 App EUI parameter is not needed for the ChirpStack platform; therefore, you will use the same ID as the Device EUI. Otherwise, the firmware will fail connecting to the network server.

6. Set the Application Key.

• Get the Application Key from the TTN register.

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



Figure 39: Chirpstack OTAA configuration via RAK Serial Port Tool

#### NOTE:

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

7. After resetting, start to join.

at+join

KAK SERIAL PORT TOOL	
RAK COM: COM5 V BaudRate: 115200	* CLOSE
ECEIVING	CLEAR RECV
>>at+join	
OK Join Success	
>at+send=lora:2:1234567890	
ж	
ENDING(With \r\n)	
at+send=lora:2:1234567890	SEND

Figure 40: Chirpstack OTAA Join the Network via RAK Serial Port Tool

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

æ	ChirpStack								? Sadmin
41 41	Network-servers	Applications /	( rak node test / D	evices / rak node					DELETE
R	Gateway-profiles	, applications	han_nouo_toot / b						
	Organizations	DETAILS	CONFIGURATION	KEYS (OTAA)	ACTIVATION	DEVICE DATA	LORAWAN FRAMES	FIRMWARE	
<u>*</u>	All users							⑦ HELP II PAUSE	OAD
chirp	stack -								
\$	Org. settings	DOWNLINK	5:42:17 PM	JoinAccept					~
<u>.</u>	Org. users	UPLINK	5:42:17 PM	JoinRequest	5e9d1e0857cf25f1				~
±≡	Service-profiles								
	Device-profiles								
R	Gateways								
	Applications								
2	Multicast-groups								

Figure 41: Checking LoRaWAN Joint Request in Chirpstack OTAA Console

9. Try to send a data from RAK4270 Breakout Board to ChirpStack.



RAK SERIAL POF	IT TOOL	
RAK	COM: COM5 - BaudRate: 11520	00 CLOSE
RECEIVING		CLEAR RECV
>>at+join OK Join Succes: >>at+send=lor OK	s a:2:1234567890	
SENDING(With \	,r\n)	
at+send=lora:2	:1234567890	SEND

Figure 42: 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 43. Note, by convention, messages sent from nodes to gateways are considered as Uplinks while messages sent by gateways to nodes are considered as Downlinks.

								Q Search organization, application, gateway or device	? 😬 admin
Netw	work-servers	Applications / ra	ak_node_test / D	evices / rak_node					DELETE
E Orga	anizations	DETAILS	CONFIGURATION	KEYS (OTAA)	ACTIVATION	DEVICE DATA	LORAWAN FRAMES	FIRMWARE	
All us	users							THELP II PAUSE DOWNLOAD	CLEAR
Org. :	. settings	UPLINK	5:42:43 PM	UnconfirmedDataUp	018153f7				~
🚊 Org. i	users	DOWNLINK	5:42:17 PM	JoinAccept					~
<u>≞</u> ≡ Servi	vice-profiles	UPLINK	5:42:17 PM	JoinRequest	5e9d1e0857cf25f1				~
코는 Devic	ice-profiles								
	eways								
Appli Appli	lications								
ふ Multi	ticast-groups								



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 44, then the ChirpStack platform will assume that this device will join to 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	<b>?</b> 0	admin
	Network-servers Gateway-profiles	Applications / rak_node_test / Devices / Create		
•	Organizations All users	OENERAL     VARIABLES     TAOS       Device name*		
chirp	ostack -	rak_node The name may only contain words, numbers and dashes.		-
¢	Org. settings	Device description * test		
*	Org. users	Device EU *		_
<u>*</u> ≡	Service-profiles	5e 9d 1e 08 57 cf 25 f1	MSB	C
井	Device-profiles	Device_profile * device_profile_abp		
R	Gateways			_
	Applications	Disable frame-counter validation Note that disabling the frame-counter validation will compromise security as it enables people to perform replay-attacks.		
ψ	Multicast-groups		CREATE D	EVICE

Figure 44: 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

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€	ChirpStack	Q. Search organization, application, gateway or device		?	admin
·	Network-servers Gateway-profiles	Applications / rak_node_test / Devices / rak_node		1	DELETE
•	Organizations All users	DETAILS CONFIGURATION KEYS (OTAA) ACTIVATION DEVICE DATA LORAWAN FRAMES FIRMWARE			
chirp	stack -	Device address * 26 01 1a f9		MSB	C
*	Org. settings	Network session key (LoRuWAN 1.0) *           - c2 80 cb 8d 1d 16 88 bc 18 60 1a 97 02 5c 54 88	C	6	8
.=	Service-profiles	Application session key (LsRaWAN 1.5) * 4d 42 ec 5c af 97 f0 3d 83 3c da f5 00 3f 69 e1 MSB	C	6	Q
	Device-profiles	Uplink frame counter *			
$\mathbb{R}$	Gateways	0			•
	Applications	Downlink frame-counter (network) * O			٠
Ψ	Multicast-groups		(RE)AC	TIVATE	DEVICE

Figure 45: 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 properly, the process is completed by clicking on the "ACTIVATE DEVICE" button.

### Configure the ABP mode on the RAK4270 Breakout Board

In the following steps, you will configure the RAK4270 Breakout Board to work in the ABP mode. To set up the RAK4270 Breakout Board to join ChirpStack using ABP, start by connecting the board to the computer (see Figure 2) and open the RAK Serial Port Tool. Wait for the communication to start. It is recommended to test the serial communication by sending either of these two AT commands:



COM: COM6 BaudRate: 15200 CLOSE ECEIVING CLEAR RECV >>at+version DK V3.3.0.14.beta2	RAK SERIAL POI	RT TOOL	
ECEIVING <u>CLEAR RECV</u> > at+version >K V3.3.0.14.beta2	RAK	COM: COM6 - BaudRate: 115200	- CLOSE
->at+version DK V3.3.0.14.beta2	RECEIVING		CLEAR RECV
DK V3.3.0.14.beta2	>>at+version		
	OK V3.3.0.14.b	eta2	
	ľ		
ENDING(With \r\n)	, SENDING(With	\r\n)	
t+version SEND	at+version		SEND

Figure 46: at+version command response

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

- 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 in the RAK4270 Breakout Board 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.

	<u> </u>	
371607	$contine - long \cdot gnnc$	
altsel		Nev. HuHzecJcal J/ 10Ju0JJcual J00J10Jer

۳	RAK	SERIAL	PORT	TOOL	
---	-----	--------	------	------	--



Figure 47: Chirpstack ABP Parameters Configuration via RAK Serial Port Tool

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### NOTE:

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

7. After resetting RAK4270 Breakout Board, join in ABP mode.

#### at+join

#### NOTE:

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

8. Try to send a data from RAK4270 Breakout Board to ChirpStack.

at+send=lora:2:1234567890



Figure 48: 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 Breakout Board 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 Breakout Board units shall be set to operate on EU868 frequency.
- 2. The setup of the RAK4270 board units is done by connecting then with a general-purpose computer through the UART port. The setup of each RAK4270 Breakout Board can be done separately but testing the LoRa P2P mode will require having both units connected simultaneously to its respective UART port. This could be one computer with two USB ports or two computers with one USB port each.
- 3. Set the RAK4270 Breakout Board 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 49: P2P Initialization

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



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

#### NOTE:

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 Breakout Board AT command and send to both units.

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

RAK SERIAL POI	RT TOOL		
<b>Ø</b> RAK	COM: COM5 -	BaudRate: 115200	CLOSE
RECEIVING			CLEAR RECV
>>at+set_confi	g=lorap2p:8695250	000:7:0:1:5:5	
ок			
1			
SENDING(With	\r\n)		
at+set_config=	lorap2p:869525000	:7:0:1:5:5	SEND

Figure 50: Configuring P2P in both RAK4270 Breakout Board

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.

at+set\_config=lorap2p:transfer\_mode:2

at+set\_config=lorap2p:transfer\_mode:1

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Figure 51: Setting Modes in both RAK4270 Breakout Board

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





Figure 52: Message sent and received status in the two modules

# Miscellaneous

# **Upgrading the Firmware**

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

In the following sections, two (2) options for flashing new firmware in the RAK4270 Breakout 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 Accesories 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 Breakout Board.
  - RAK4270 Firmware
- 2. Download the RAK Device Firmware Upgrade (DFU) tool.
  - RAK Device Firmware Upgrade (DFU) Tool □
- 3. Connect the RAK4270 Breakout Board with a computer through a USB to TTL.
- 4. Open the Device Firmware Upgrade tool. Select the serial port and baud rate of the module and click the "Select Port" button.

🚸 RAK Device Firmware Upgrade Tool v1.4	_	
		0
Ý Ø Ø		
Select Port Select Firmware Upgrade		
COM1 ~ 0% 115200 ~		
Copyright© Shenzhen RAKwireless Technology Co., Ltd.		

Figure 53: Device Firmware Upgrade Tool

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



Figure 54: Select Firmware

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



Figure 55: Firmware Upgrading



Figure 56: Upgrade Successful

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