RAK4200 Module Quick Start Guide

Prerequisites

What Do You Need?

Before going through the step in the installation guide of the RAK4200 WisDuo LPWAN Module, make sure to prepare the necessary items listed below:

Hardware Tools

- 1. RAK4200 WisDuo LPWAN Module
- 2. Windows PC
- 3. USB to TTL adapter
- 4. RAKDAP1 Flash and Debug Tool

Software Tools

- RAK Serial Port Tool
- RAK Device Firmware Upgrade (DFU) Tool
- RAK4200 Firmware 🗹
- RAKDAP1 Flash and Debug Tool

Definition of Terms

List of Acronyms

Acronym	Meaning
ABP	Activation By Personalization
BLE	Bluetooth Low Energy
DFU	Device Firmware Upgrade
EUI	Extender Unique Identifier
LoRa	Long Range
ΟΤΑΑ	Over The Air Activation
TTN	The Things Network
P2P	Peer-to-Peer

Product Configuration Connecting to the RAK4200 Console

During the configuration of the module through the AT commands, it is possible to read the console output. You can connect to the console of the RAK4200 module through the UART interface.

Connect to the RAK4200

In this document, a RAK4200 module is used for demonstration. Use a USB to TTL adapter to connect to the module. In case the RAK4200 is mounted on an evaluation board or a customized PCB, then use the appropriate interface to connect to the serial port.

 Connect the RAK4200 to a USB to TTL adapter, as shown in Figure 1. Connect the adapter to a USB port of your Windows PC.



Figure 1: RAK4200 module connection

- 2. Install a serial communication tool. Any serial communication tool will work, but it is recommended to use the RAK Serial Port Tool
- 3. Open the RAK Serial Port Tool.

	Command	
RAK COM: COM12 · BaudRate: 15200 · OPEN	☑ 01 at+version	SEN
CEIVING CLEAR RECV	☑ 02 at+get_config=device:status	SEN
	☑ 03 at+set_config=device:sleep:0	SEN
	☑ 04 at+set_config=device:restart	SEN
	☑ 05 at+set_config=device:gps:1	SEN
	☑ 06 at+set_config=lora:work_mode:0	SEN
	☑ 07 at+set_config=lora:join_mode:0	SEN
	☑ 08 at+set_config=lora:class:0	SEN
	☑ 09 at+set_config=lora:region:EU868	SEN
	☑ 10 at+set_config=lora:confirm:1	SEN
	☑ 11 at+set_config=lora:ch_mask:0:0	SEN
	☑ 12 at+set_config=lora:dev_eui:	SEN
	☑ 13 at+set_config=lora:app_eui:	SEN
	☑ 14 nfig=lora:app_key:	SEN
	☑ 15 at+set_config=lora:dev_addr:	SEN
	☑ 16 =lora:nwks_key:	SEN
	☑ 17 I=lora:apps_key:	SEN
	☑ 18 at+set_config=lora:send_interval:	SEN
IDING(With \r\n)	☑ 19 at+get_config=lora:status	SEN
	☑ 20 at+get_config=lora:channel	SEN
SEND	All/None	SA

Figure 2: RAK Serial Port Tool

4. To find the COM Port number for your device, go to Device Manager by pressing Windows + R and type devmgmt.msc , or search in the Start Menu. Look for Ports (COM & LPT) and find the name USB-SERIAL CH340. Take note of the COM Port number.

🛃 Device Manager \times File Action View Help 🦛 🏟 🗖 🚺 🛒 💭 ✓ LAPTOP-2DEVGJGS > 🐗 Audio inputs and outputs > 🗃 Batteries > 📓 Biometric devices > ଃ Bluetooth Q Cameras
 Computer Disk drives
 Display adaptors > 🞽 Firmware > 🎆 Human Interface Devices > The ATA/ATAPI controllers > 🔤 Keyboards > 📗 Mice and other pointing devices > 📃 Monitors › 💻 Network adapters Portable Devices Y 🛱 Ports (COM & LPT) USB-SERIAL CH340 (COM12) Print queues > 🔲 Processors > 📕 SD host adapters > If Security devices > 📑 Software components > Software devices > 🐗 Sound, video and game controllers > 🍇 Storage controllers > ኪ System devices > 🏺 Universal Serial Bus controllers

Figure 3: Device Manager

NOTE

If you didn't find any port with the name USB-Serial CH340, make sure you have installed the CH340 drivers on your Windows PC.

- 4. Fill in the serial communication parameters: COM Port Number from the Device Manager and Baudrate 115200, then click the "**OPEN**" button.
- 5. The RAK4200 console output can now be read in the RAK Serial Port Tool, as shown in Figure 4.

RAK SERIAL PORT TOOL
RAK COM: COM12 - BaudRate: 115200 - CLOSE
RECEIVING CLEAR RECV
LoRa (R) is a registered trademark or service mark of Semtech
Corporation or its affiliates. LoRaWAN (R) is a licensed mark.
RAK4200 version:3.2.0.14
UART1 work mode: RUI_UART_NORMAL, 115200, N81
UART2 work mode: RUI_UART_NORMAL, 115200, N81
Current work_mode:LoRaWAN, join_mode:OTAA, MulticastEnable:
false, Class: A
Initialization OK
SEND

Figure 4: RAK serial port tool connected to RAK4200

Configure RAK4200

To connect the RAK4200 module to a LoRa P2P network or a LoRaWAN network, the module must be configured and LoRa parameters must be set by sending AT commands through the UART interface.

Connect the RAK4200 module to the Windows PC as described in the previous section. Using the Serial communication tool, it is possible to send commands to the RAK4200. For example: Sending the at+version command will display the current firmware version, as shown in **Figure 5**. For more supported commands, refer to AT Commands for RAK4200.

🔄 RAK SERIAL	PORT TOOL
--------------	-----------

RAK сом: сом12 - В	audRate: 15200	* CLOSE
RECEIVING		CLEAR RECV
LoRa (R) is a registered trademark or	service mark of S	emtech
Corporation or its affiliates. LoRaWAN	I (R) is a licensed	mark.
RAK4200 version:3.2.0.14		
UART1 work mode: RUI_UART_NORM	AL, 115200, N81	
UART2 work mode: RUI_UART_NORM	AL, 115200, N81	
Current work_mode:LoRaWAN, join_m	ode:OTAA, Multic	astEnable:
false, Class: A		
Initialization OK		
>>at+version		
OK V3.2.0.14		
SENDING(With \r\n)		
at+version		
		SEND

Figure 5: at+version command response

Connecting to The Things Network (TTN)

This section shows how to connect the RAK4200 module to The Things Network (TTN) platform. As described in the TTN's website: "The engine of The Things Network is our technology - a robust yet flexible and enterprise-ready LoRaWAN network server stack. Our stack caters to the needs of demanding LoRaWAN deployments, from covering the essentials to advanced security configurations and device life cycle management. Backed by SLAs to meet your availability requirements, facilitated by our team of support engineers"



Figure 6: RAK4200 in the context of the TTN

As shown in **Figure 6**, the RAK4200 module 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 the 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, predictability capacity among others.

The RAK4200 module can be part of this ecosystem, and the objective of this section is to demonstrate how simple is to send data to TTN using LoRaWAN. Users must be aware that to achieve this, the RAK4200 must be located inside of coverage of a LoRaWAN gateway.

In summary, these are the requirements:

- Have an account on the TTN website.
- Have access to a LoRaWAN gateway subscribed to the TTN. The frequency band set for the RAK4200 needs to be consistent with the frequency band of the gateway.
- The "RAK Serial Port Tool" provided by RAKWireless.
- The RAK4200 module is connected to a USB to TTL adapter, as shown in Figure 1.

NOTE

The frequency band used in this example is EU868, which is supported by the high-frequency version of the RAK4200 module.

The steps for sending data to the TTN platform from a RAK4200 module can be summarized as:

- Sign up and log in to the TTN console
- Create a new Application
- Register a new device in the platform
- Configure the Join Mode
 - OTAA mode on the platform
 - OTAA mode on the RAK4200 module
 - ABP mode on the platform
 - ABP mode on the RAK4200 module
 - · Send data from the module and receive it at the platform

In the following sections, each of these steps will be explained in detail. You can choose either to use ABP or OTAA mode to register the device on the network server.

Registering the RAK4200 to TTN

To register the RAK4200 to TTN, execute the following steps:

Login to The Things Network Platform

1. Access and login into the TTN □ , and go to its "**Console**" section by clicking on the Console icon. You should see an interface similar to **Figure 7**.



Figure 7: Console Page

Create a New Application

2. Choose the "APPLICATIONS" option.

THE THINGS CONSOLE COMMUNITY EDITION			Application	s Gateways	Support	$oldsymbol{ ho}$ rakwireless2020 $\scriptstyle{\checkmark}$
	Applications					
	APPLICATIONS		add application			
		Figure 8: Application section				

3. Click on the "add application" link.

THETHINGS CONSOLE NETWORK COMMUNITY EDITION		Applicati	ons Gateways	Support	$oldsymbol{A}$ rakwireless2020 \vee
	Applications > Add Application				
	ADD APPLICATION				
	Application ID The unique identifier of your application on the network				
	Description A human readable description of your new app				
	Eg. My sensor network application	•			
	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 appli	ation			

Figure 9: New Application Form

- 4. Fill in the correct contents in the "Add application form":
 - Application ID: a unique ID on the TTN network that should be in lower case with no spaces
 - Description: This is a short and concise human-readable description of your application
 - Application EUI: automatically generated by TTN
 - Handler Registration: select the handler you want to register this application to

THE THINGS CONSOLE COMMUNITY EDITION		Applications	Gateways Support	$oldsymbol{(a)}$ rakwireless2020 $\scriptstyle{\checkmark}$
	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	application		

Figure 10: Fill the Add Application Form

5. To finish, click on the "Add application" button and a page similar to Figure 11 will appear.

THE THINGS CONSOLE NETWORK COMMUNITY EDITI	л					Applications	Gatewa	ys Support	$oldsymbol{ ho}$ rakwireless2020 ${\scriptstyle\lor}$
	Applications > 🥪 rak_node_test								
		Overview D	Devices	Payload Formats	Integrations	Data Se	ttings		
	APPLICATION OVERVIEW								
	Application ID rak_node_test Description rak lora node test Created 34 seconds ago Handler ttn-handler-eu (current handler)					docum	entation		
	APPLICATION EUIS					🌣 mana	<u>ge euis</u>		
	〈> 二 70 B3 D5 7E D0 03 24 89 首								
	DEVICES				register device	e 🗘 manage	devices		
	₹ "⊒) c	registered device:	s						
Figure 11: Application Overview									

Register a New Device in the Platform

6. In the "Application details" page, find the "DEVICES" section by the middle of this page.

DEVICES		• register device	manage devices
	0 registered devices		
	Figure 12: DEVICES section		

7. Click on the "**register device**" link, then a "**register device form**" will appear.

AK Documentation Center

THETHINGS CONSOLE NETWORK CONMUNITY EDITION					Appli	cations Gateways	Support	9	~
	Applications > 😂 rak4200_node > Devices								
		Overview Devices	Payload Formats	ntegrations Data	Settings				
	REGISTER DEVICE			bulk impo	t devices				
	Device ID This is the unique identifier for the device in this app. The device ID will be immuta	ble.							
	Device EUI The device EUI is the unique identifier for this device on the network. You can char	nge the EUI later.							
	App Key The Ann Key will be used to service the communication between you device and th	e network			yrtes				
	this field will	II be generated							
	App EUI								
	5E 9D 1E 08 57 CF 25 F1				\$				
				Cancel Re	gister				

Figure 13: Register a New Device

In this form, the device ID must be unique for the application and must be completed with 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.

8. Press the "**Register**" button to finish the process. The registration results will appear summarized, as shown in **Figure 14**.

THE THINGS CONSOLE	on	Applications Gateways Support 闪 rakwireless2020 🗸
	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 ・> ニ SE 90 1E 08 57 CF 25 F1 書 Application EUI ・> ニ SE 90 1E 08 57 CF 25 F1 書 App Key ・> ニ SE 90 1E 08 57 CF 25 F1 書 App Key ・> ニ SF 90 1E 08 57 CF 25 F1 書 EUI	
	Status • never seen Frames up 0 r <u>eset frame counters</u> Frames down 0	

Figure 14: New 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 via Activation-By-Personalization (ABP). In OTAA, the end-device previously personalized is activated when deployed or reset. In ABP, personalization and activation are done as a single step.

Join in OTAA Mode

Configure the OTAA Mode on the TTN Platform

As shown in **Figure 15**, the default activation mode in TTN is the OTAA mode. Therefore, no further actions are required on the platform side.

THE THINGS CONSOLE N ET W O R K COMMUNITY EDITIO	N		Applications	Gateways	Support	🔘 rakwireless2020 🗸
	Applications > 🥹 rak_node_test > Devices > 📰 rak_node					
		Overview	Data Se	ttings		
	DEVICE OVERVIEW					
	Application ID rak_node_test Device ID rak_node Activation Method OTAA					
	Device EUI ↔ ≒ 5E 90 1E 08 57 CF 25 F1 面 Application EUI ↔ ≒ 5E 90 1E 08 57 CF 25 F1 面 App Key ↔ ≒ 5F 91 1E 08 57 CF 25 F1 面					
	Status • never seen Frames up 0 reset frame counters Frames down 0					

Figure 15: New Device Parameters

Three parameters from TTN setup are used to configure the RAK4200: "**Device EUI**", "**Application EUI**", and "**App Key**".

Configure the OTAA Mode on the RAK4200 Module

RAK4200 complies with LoRaWAN 1.0.2 specification. By default, the LoRa join mode is **OTAA**, and the LoRa class is **Class A**.

To set up the RAK4200 module to join the TTN using OTAA, start by connecting the RAK4200 module to the computer. Open the RAK Serial Port Tool and wait for the communication to start. It is recommended to test the serial communication by sending an AT command as at+get_config=lora:status or https://att-get_config=lora:status or <a href="https://att-g

RAK SERIAL POI	RT TOOL	
S RAK	COM: COM12 BaudRate: 1152	CLOSE
RECEIVING		CLEAR RECV
LoRa (R) is a re	gistered trademark or service mark	of Semtech
Corporation or	its affiliates. LoRaWAN (R) is a licen	sed mark.
DA164000	- 22014	
KAK4200 versio	n:3.2.0.14	101
UARTI WORK m	ode: RUI_UARI_NORMAL, 115200, N	181
UART2 work m	ode: RUI_UART_NORMAL, 115200, N	481
Current work_n	node:LoRaWAN, join_mode:OTAA, M	IulticastEnable:
false, Class: A		
Initialization Ok	C	
>>at+version		
OK V3.2.0.14		
ľ		
	(
attyersion	(r(n)	
attversion		SEND

Figure 16: RAK Serial Port Tool connected to a RAK4200

As an example, the following parameters will be configured in RAK4200:

- LoRa join mode: OTAA
- LoRa class: Class A
- LoRa region: EU868
- Device EUI: 5e9d1e0857cf25f1 (from TTN registration)
- Application EUI: 5e9d1e0857cf25f1 (from TTN registration)
- Application Key: f921d50cd7d02ee3c5e6142154f274b2 (from TTN registration)
- 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.

For the Europe region, type the command:

at+set_config=lora:region:EU868

• Refer to the RAK4200 Datasheet for the list of supported frequencies.

📝 NOTE

Remember that the device frequency shall be in the same band of the gateway.

4. Set the Device EUI.

Get the Device EUI number from TTN registration.

at+set_config=lora:dev_eui:5e9d1e0857cf25f1

5. Set the Application EUI.

Get the Application EUI number from the TTN registration.

NOTE:

All zero value Application EUI at+set_config=lora:app_eui:000000000000000 is **not supported** and will return error.

6. Set the Application Key.

Get the Application Key from the TTN registration.

at+set_config=lora:app_key:f921d50cd7d02ee3c5e6142154f274b2

7. Save the RAK4200 parameters.

Reset the RAK4200 to save the parameters.

Figure 17 summarizes the set of commands sent over the console to set the OTAA mode on the RAK4200.

RAK SERIAL POP	rt tool	
RAK	COM: COM12 Y BaudRate: 115200 Y	CLOSE
RECEIVING	<u>cu</u>	
>>at+set_confi	g=lora:join_mode:0	
ОК		
>>at+set_confi	g=lora:class:0	
ОК		
>>at+set_confi	g=lora:region:EU868	
ОК		
>>at+set_confi	g=lora:dev_eui:5e9d1e0857cf25f1	
ОК		
>>at+set_confi	g=lora:app_eui:5e9d1e0857cf25f1	
ОК		
>>at+set_confi	g=lora:app_key:f921d50cd7d02ee3c5e61421	54f274b2
ОК		
SENDING(With	\r\n)	
at +set_config=lo f274b2	ra:app_key:f921d50cd7d02ee3c5e6142154	SEND

Figure 17: RAK4200 LoRa parameters configuration over the RAK Serial Port Tool

8. Finally, send the command to join in OTAA mode.



• If the request was successfully received by a LoRa gateway, then the "OK Join Success" message will be shown in the console after a few seconds. See **Figure 18**.

RAK SERIAL PORT TOOL

Cloin Success		CLEAR RECV
NDING(With \r	\n)	

Figure 18: RAK4200 join OTAA mode

9. Send data from RAK4200 to TTN.

To send the string 1234567890 over LoRa port 2, type the command:

at+send=lora:2:123456	7890	
	RAK SERIAL PORT TOOL	CLOSE
	OK Join Success OK at+recv=0,-35,6,0	
	SENDING(With \r\n) at+send=lora:2:1234567890	
Eigure 19: DA	(1200 example of sending data to the TTN, in this case	the string 123456890 over port 2

nple of sending data to the TTN, in this case, the string 123456890 over po

Il cause Il cause Il cause Filters uplink downlink activation ack error time counter port 1 16:29:06 0 devid: 1 16:29:06 0 2 retry 1 16:29:06 0 2 retry devid: 1 16:29:06 0 2 retry devid: 12:34:56:78:90 1 1 16:27:08 devid: devaddr: 26:03:24:C8 appeul: 5E:9D:1E:08:57 CF:25:F1 deved: 5E:9D:1E:08:57 CF:25:F1	APPLICATION DATA III aass to clear Filters uplink downlink activation ack error time counter port v 16:29:06 0 devide: 4 16:29:06 0 2 retry devide: 4 16:27:08 devide: devide: 26 03 24 C8 append: 5E 9D 1E 08 57 CF 25 F1 devide: 5E 9D 1E 08 57 CF	APPLICATION DATA II II III III III III III IIII III								Overview	Devices	Payload Formats	Integrations	Data	Settings
time counter port 16:29:06 0 devid: 16:29:06 0 2 retry devid: payload: 16:29:08 0 2 retry devid: devid: 16:29:08 0 2	Filters uplink downlink activation ack error time counter port 1 16:29:06 0 devid: 1 16:29:06 0 2 retry devid: payload: 12:34:56:78:90 1 16:27:08 devid: devid: 26:03:24:C8 app.eu:: 5E:9D:1E:08:57:CF:25:F1 deveu:: 5E:9D:1E:08:57:CF 1	time counter port 16:29:06 0 dev id: 16:29:06 0 2 retry dev id: payload: 16:29:06 0 2 retry dev id: dev addr: 16:27:08 dev id: dev addr:	APPLIC	ATION	DATA									pau	se 🛍 clear
time counter port 16:29:06 0 devid: 16:29:06 0 2 retry devid: 16:29:06 0 2 retry devid: 12:34:56:78:90 16:27:08 devid: devid: 26:03:24:C8 app eul: 5E:9D:1E:08:57 CF:25:F1 dev eul: 5E:9D:1E:08:57 CF:25:F1	time counter port 16:29:06 0 devid: 16:29:06 0 2 retry 16:29:08 devid: payload: 12 34 56 78 90 16:27:08 devid: devaddr: 26 03 24 C8 app eul: 5E 9D 1E 08 57 CF 25 F1 dev eui: 5E 9D 1E 08 57 CF	time counter port 16:29:06 0 devid: 16:29:06 0 2 retry devid: payload: 12:34:56:78:90 1 16:27:08 devid: devid:: 26:03:24:C8 app eul: 5E:9D 1E:08:57 CF:25 F1 dev eul: 5E:9D 1E:08:57 CF:55 F1 dev eul: 5E:9D 1E:08:57 CF:55 F1 dev eul: 5E:9D 1E:08:57 CF:55 F1	ore	uplink	downlink	activation	ack	error							
16:29:06 0 dev id: 16:29:06 0 2 retry dev id: payload: 12:34:56:78:90 16:27:08 dev id: dev id: dev addr: 26:03:24:C8 app eul: 5E:9D 1E:08:57 CF:25 F1 dev eui: 5E:9D 1E:08:57 CF:25 F1 dev e	▼ 16:29:06 0 dev id: ▲ 16:29:06 0 2 retry dev id: payload: 12 34 56 78 90 ← 16:29:08 dev id: dev addr: 26 03 24 C8 app eul: 5E 9D 1E 08 57 CF 25 F1 dev eul: 5E 9D 1E 08 57 CF	 16:29:06 0 2 retry dev id: payload: 12 34 56 78 90 16:29:06 0 2 retry dev id: payload: 12 34 56 78 90 16:29:06 0 2 retry dev id: 26:03 24 C8 app eul: 5E 9D 1E 08 57 CF 25 F1 deveul: 5E 9D 1E 08 57 CF 25 F1 deveul: 5E 9D 1E 08 57 CF 25 F1 deveul: 5E 9D 1E 08 57 CF 25 F1 deveul: 5E 9D 1E 08 57 CF 25 F1 deveul: 5E 9D 1E 08 57 CF 25 F1 deveul: 5E 9D 1E 08 57 CF 25 F1 deveul: 	Filters	time	counter	port									
16:29:06 0 2 retry dev id: payload: 12 34 56 78 90 + 16:27:08 dev id: dev addi: 26 03 24 C8 app eul: 5E 9D 1E 08 57 CF 25 F1 dev eul: 5E 9D 1E 08 57 CF 25 F1 dev eul: 5E 9D 1E 08 57 CF 25 F1 dev eul: 5E 9D 1E 08 57 CF		16:29:06 0 2 retry devid: payload: 12 34 56 78 90 16:27:08 devid: devid: devid: 26 03 24 C8 appleui: 5E 9D 1E 08 57 CF 25 F1 devieui: 5E 9D 1E 08 57 CF ↓	▼ 16:	5:29:06		0		dev id:							
4 16:27:08 devid: devaddr: 26 03 24 C8 appeul: 5E 9D 1E 08 57 CF 25 F1 deveul: 5E 9D 1E 08 57 CF	+ 16:27:08 devid: 26:03:24:C8 app exil: 5E:9D:1E:08:57:CF:25:F1 devexil: 5E:9D:1E:08:57:CF		▲ 16:	5:29:06	0	2	retry	dev id:	pa	yload: 12 34 56	78 90				
			+ 16:	5:27:08				dev id:	de	waddr: 26 03 24	1C8 app eu	5E 9D 1E 08 57 CF	25 F1 dev eui:	5E 9D 1E	08 57 CF

Figure 20: TTN console showing the data received from RAK4200

Join in ABP Mode

Configure the ABP Mode on the Platform

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

Three parameters from TTN setup are used to configure the RAK4200: "**Device EUI**", "**Application EUI**", and "**App Key**".

For joining TTN in ABP mode, first, you need to change the activation method to ABP. It is done on the TTN console under the "**Device Settings**" page, as shown in **Figure 21**.

THETHINGS CONSOLE		Applications Gat	eways Support 🔘 rakwireless2020 🗸
Applications > 🧼 rak_node_ter	ist > Devices > 📰 rak_node > Settings		
		Overview Data Settings	
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 bytes	
	Application EUI		
	5E 9D 1E 08 57 CF 25 F1	\$	
	Activation Method		

Figure 21: Change the activation mode to ABP

As for the OTAA mode, three TTN parameters will be used to configure the RAK4200 for ABP mode: "**Device Address**", "**Network Session Key**", and "**App Session Key**". These fields can be left empty in the form and TTN will complete them with random values. In other case, you can complete them with specific values.

THE THINGS CONSOLE NETWORK COMMUNITY EDITI	ION		Applications	Gateways	Support	🗛 rakwireless2020 🗸
	Applications > 🤤 rak_node_test > Devices >	Tak_node > Settings				
	General	Description				
	Location	A human-readable description of the device	Ø			
		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	<			
		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 22: ABP Mode Parameters

After completing the mode change, the device parameters will be summarized on: **Applications -> rak_node_test** -> **Devices -> rak_node**. See **Figure 23**.

Figure 23: ABP mode configuration finalized

Configure the ABP Mode on the RAK4200 Module

RAK4200 complies with LoRaWAN 1.0.2 specification. By default, the LoRa join mode is **OTAA**, and the LoRa class is **Class A**.

To set up the RAK4200 module to join the TTN using ABP, start by connecting the RAK4200 module to the Windows PC. Then open the RAK Serial Port Tool and wait for the communication to start. It is recommended to test the serial communication by sending an AT command as at+get_config=lora:status or at+version.

🔄 RAK SERIAL	PORT TOOL
--------------	-----------

RAK COM: COM12 - BaudRate: 15200	CLOSE
RECEIVING	LEAR RECV
LoRa (R) is a registered trademark or service mark of Sem	ntech
Corporation or its affiliates. LoRaWAN (R) is a licensed ma	ırk.
RAK4200 version:3.2.0.14	
UART1 work mode: RUI_UART_NORMAL, 115200, N81	
UART2 work mode: RUI_UART_NORMAL, 115200, N81	
Current work_mode:LoRaWAN, join_mode:OTAA, Multicast	Enable:
false, Class: A	
Initialization OK	
>>at+version	
OK V3.2.0.14	
SENDING(With \r\n)	
at+version	SEND

Figure 24: RAK Serial Port Tool connected to a RAK4200

As an example, the following parameters will be configured in RAK4200:

- LoRa join mode: ABP
- LoRa class: Class A
- LoRa region: EU868
- Device address: 26031171 (from TTN registration)
- Network Session Key: c280cb8d1df688bc18601a97025c5488 (from TTN registration)
- Application Session Key: 4d42ec5caf97f03d833cdaf5003f69e1(from TTN registration)
- 1. Set 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.

For the Europe region, type the command:

at+set_config=lora:region:EU868

• Refer to the RAK4200 Datasheet for the list of supported frequencies.

NOTE

Remember that the device frequency shall be in the same band of the gateway.

4. Set the Device Address.

Get the Device Address from TTN registration.

at+set_config=lora:dev_addr:26031171

5. Set the Network Session Key.

Get the Network Session Key from the TTN registration.

at+set_config=lora:nwks_key:c280cb8d1df688bc18601a97025c5488

6. Set the Application Key.

Get the Application Key from the TTN registration.

```
at+set_config=lora:apps_key: 4d42ec5caf97f03d833cdaf5003f69e1
```

7. Save the RAK4200 parameters.

Reset the RAK4200 to save the parameters. **Figure 25** summarizes the set of commands sent over the console for setting the OTAA mode on the RAK4200.



Figure 25: RAK4200 LoRa parameters configuration over the Serial Port Tool

at+join

NOTE

The ABP mode in LoRaWAN does not require to join a network before sending a LoRaWAN package. But to keep the consistency of the internal states of the firmware of the RAK4200 module, it is still required to send the at+join command in the ABP mode.

Right after sending the command, the "**OK Join Success**" should be replied to in the console the same, as shown in **Figure 25**.

RAK SERIAL PO	RT TOOL	
RAK	COM: COM12 BaudRate: 1152	00 × CLOSE
RECEIVING		CLEAR RECV
OK Join Succes	is	
		^
ENDING(With	\r\n)	
at+join	V V V	
		SEND

Figure 26: RAK Serial port tool join LoRaWAN in ABP mode

9. Send data from RAK4200 to ChirpStack.

To send the string 1234567890 over LoRa port 2, type the command:



RAK SERIAL POI	RT TOOL		
RAK	COM: COM12 - BaudRate: 115200	Ŧ	CLOSE
RECEIVING		CLEA	R RECV
OK Join Succes	s		
ок			
at+recv=0,-35,6	5,0		
SENDING(With	\r\n)		

Figure 27: RAK Serial Port Tool, sending a message in ABP mode

• The data will appear on the TTN console: Applications -> rak_node_test -> Devices -> rak_node -> Data.

									Overview	Data	Settings
APPLI	CATION	DATA								II paus	<u>se</u> ti <u>clear</u>
Filters	uplink	downlink	activation	ack	error						
	time	counter	port								
• 1	9:12:44	0	2	retry	payload: 12	34 56 78 90					

Figure 28: TTN console with received data from RAK4200

Connecting with ChirpStack

This section shows how to connect the RAK4200 module to the ChirpStack platform. As described on ChirpStack's website:

"The ChirpStack open-source LoRaWAN Network Server stack provides open-source components for LoRaWAN networks. Together they form a ready-to-use solution including a user-friendly web interface for device management and APIs for integration.

The modular architecture makes it possible to integrate within existing infrastructures. All components are licensed under the MIT license and can be used for commercial purposes."



Figure 29: RAK4200 module in the context of the ChirpStack platform

The architecture of the ChirpStack platform is shown in **Figure 28**. Similar to the case of TTN, the RAK4200 module is located in the periphery and will transmit the data to the backend servers through a LoRa gateway. For more information about this architecture, refer to Chirpstack website

In this section, it is assumed that you are using a RAK LoRa gateway, such as RAK7243. The gateway must be configured to ChirpStack deployment. More information about that can be found at Connect the Gateway with Chirpstack.

You can also check the other RAK gateways RAK WisGate products.

NOTE

The frequency band used in this example is EU868, which is supported by the high-frequency version of RAK4200.

And these are the steps to send data to the ChirpStack platform from a RAK4200 module:

- Create a new Application
- Register a new device on the platform
- Configure the Join Mode:
 - OTAA mode on the platform
 - OTAA mode on the RAK4200 module
 - ABP mode on the platform
 - ABP mode on the RAK4200 module
 - Send data from the module and receive it at the platform

The following section gives the details of each of these aforementioned steps. As usual, you can either choose to use ABP or OTAA mode to register the device to the network server.

Create a New Application

1. Go to the "Applications" section, as shown in Figure 30.

∉	ChirpStack					Q Search organization, application, gateway or device			3 ac
-	Network-servers	Δ	unnlications					+	CREA
Ð	Gateway-profiles		phonon						
	Organizations								
	All users		U	мате	Service-profile	Description			
	API keys		2	арр	service-profile-build-in	арр			
- hirp	istack 👻					Rows per page: 10 ▼	1-1 of 1	<	>
t	Org. dashboard								
	Org. users								
•	Org. API keys								
	Service-profiles								
	Device-profiles								
Ø	Gateways								
•	Applications								
`	Multicast-groups								



 By default, a new Application should be created, although it is possible to reuse the existing ones. For this setup, create a new Application by clicking on the "+ CREATE" button and filling in the required parameters, as shown in Figure 31 and Figure 32.

	ChirpStack	Q Search organization, application, gateway or device	?
	Network-servers	Applications / Create	
Ø	Gateway-profiles		
]	Organizations		
	All users	Application name *	
	API keys	The name may only contain words, numbers and dashes.	
hirp	stack -	Application description *	
	Org. dashboard	Service-profile * Select service-profile	
	Org. users	The service-profile to which this application will be attached. Note that you can't change this value after the application has been created.	
I	Org. API keys		CREATE APPLICAT
=	Service-profiles		
	Device-profiles		
)	Gateways		
	Applications		
2	Multicast-groups	▼	



- 3. For this setup, create an Application named "**rak_node_test**". Fill in the required parameters, as shown in **Figure 32**.
- 4. To finish, click on the "CREATE APPLICATION" button.

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

- Application Name: rak_node_test
- Application Description: test
- · Service-profile: Select the system profile. Choose service-profile-built-in

The Application Description field is just a descriptive text.

	ChirpStack	Q Search organization, application, gateway or device 🥐 🤮) adm
	Network-servers	Applications / Create	
$\widehat{\mathbb{N}}$	Gateway-profiles	Applications / create	
	Organizations	Appleting errort	
•	All users	rak_node_test	
	API keys	The name may only contain words, numbers and dashes. Application description *	
chirps	stack 👻	test	
h	Org. dashboard	Service-profile * service-profile-build-in	•
	Org. users	The service-profile to which this application will be attached. Note that you can't change this value after the application has been created.	
	Org. API keys	CREATE APPLICA	TION
=	Service-profiles		
F	Device-profiles		
Ø	Gateways		
	Applications		
9	Multicast-groups		



Register a New Device in the Platform

1. Choose the Application created in the previous step, then select the "**DEVICES**" tab, as shown in **Figure 33** and **Figure 34**.

€	ChirpStack					Q Search organization, application, gateway or device	2		a dmin
	Network-servers	Е	Applications					+	CREATE
\bigcirc	Gateway-profiles								
	Organizations		10	News	O and a second	Description			
•	All users		D	Name	Service-prome	Description			
٩	API keys		2	арр	service-profile-build-in	арр			
ohim	octack -		8	rak_node_test	service-profile-build-in	test			
						Rows per page: 10 👻	1-2 of 2	<	>
f	Org. dashboard								
•	Org. users								
٩	Org. API keys								
. ≡	Service-profiles								
	Device-profiles								
\bigcirc	Gateways								
	Applications								
Ψ	Multicast-groups	•							

Figure 33: List of applications created

€	ChirpStack		Q Search organization, application, gateway or device				?	e admi	
**	Network-servers	A	pplications / ral	k node test				Ĩ	DELETE
\bigcirc	Gateway-profiles								
	Organizations		DEVICES	APPLICATION CONFIGURATION	INTEGRATIONS	FUOTA			
•	All users								
٩	API keys							+	CREATE
chirp	stack 👻		Last seen	Device name	Device EUI	Device profile	Link margin	Battery	
f	Org. dashboard						Rows per page: 10 👻	0-0 of 0 <	>
•	Org. users								-
٩	Org. API keys								
. ≡	Service-profiles								
Ξ±	Device-profiles								
\bigcirc	Gateways								
	Applications								
Ψ	Multicast-groups	-							

Figure 34: Device tab of an Application

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

€	ChirpStack					Q Search organizat	ion, application, gateway or device	?	e ad
	Network-servers	Ar	plications / ra	ak node test					🔋 DELE
\bigcirc	Gateway-profiles								
	Organizations		DEVICES	APPLICATION CONFIGURATION	INTEGRATIONS	FUOTA			
•	All users								
٩	API keys								+ CREA
chirp	ostack 👻		Last seen	Device name	Device EUI	Device profile	Link margin	Battery	
ħ	Org. dashboard						Rows per page: 10 👻	0-0 of 0	< >
•	Org. users								
٩	Org. API keys								
. =	Service-profiles								
	Device-profiles								
\bigcirc	Gateways								
	Applications								
٣	Multicast-groups								

Figure 35: Add a new device at the Devices tab

∉	ChirpStack	Q Search organization, application, gateway or device	? 0	admin
-	Network-servers			
\bigcirc	Gateway-profiles	GENERAL VARIABLES TAGS		
	Organizations	Device name *		
•	All users	The name may only contain words, numbers and dashes.		_
٩	API keys	Device description *		
chirp	stack 👻			
♠	Org. dashboard	Device EUI *	MSB	G
•	Org. users	Device-profile * Device-profile		•
٩	Org. API keys	Disable frame-counter validation		
. ≡	Service-profiles	Note that disabling the frame-counter validation will compromise security as it enables people to perform replay-attacks.		
	Device-profiles	Device is disabled		
\bigcirc	Gateways	ChirpStack Network Server will ignore received uplink frames and join-requests from disabled devices.		
	Applications		CREATE DEV	ICE
۳	Multicast-groups			

Figure 36: New device registration form

3. Fill in the parameters requested as appears in Figure 37:

- Device name and Device description: These are just descriptive texts.
- Device EUI: This interface allows you to generate a Device EUI automatically by clicking the icon highlighted in red in Figure 37. You can also add a specific Device EUI directly in the form.
- Device Profile: To join in OTAA mode, select "device_profile_otaa". To join in ABP mode, select "device_profile_abp".
- 4. To finish, click on the "CREATE DEVICE" button.

	NOTE: ChirpStack do	es not support AS923 in ABP mode.	
€	ChirpStack	Q Search organization, application, gateway or device	? e admin
8 - 8 -	Network-servers		
$\widehat{\mathbb{N}}$	Gateway-profiles	GENERAL VARIABLES TAGS	
	Organizations	Device name *	
•	All users	The name may only contain words, numbers and dashes.	
٩	API keys	Device description *	
chirp	stack 👻	Device EUI *	
A	Org. dashboard	5e 9d 1e 08 57 cf 25 f1	MSB C
•	Org. users	Device-profile	
٩	Org. API keys	device_profile_abp	
e ≡	Service-profiles	device_profile_otaa	
	Device-profiles	Device is disabled	
$\widehat{\mathbb{N}}$	Gateways	ChirpStack Network Server will ignore received uplink frames and join-requests from disabled devices.	
	Applications		CREATE DEVICE
9	Multicast-groups		

Figure 37: Generate a new Device EUI in the device registration form

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 via Activation-By-Personalization (ABP). In OTAA, the end-device previously personalized is activated when deployed or reset. In ABP, personalization and activation are done as a single step.

Join in OTAA Mode

Configure the OTAA Mode on the Platform

1. If you have selected "device_profile_otaa", as shown in Figure 38, 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 adm
-	Network-servers			
$\widehat{\mathcal{N}}$	Gateway-profiles	GENERAL VARIABLES TAGS		
	Organizations	Device name * rak_node		
	All users	The name may only contain words, numbers and dashes.		
•	API keys	Device description * test		
chirp	stack 👻	Device EUI *		
ħ	Org. dashboard	5e 9d 1e 08 57 cf 25 f1	MSB	C
•	Org. users	device_profile_otaa		
	Org. API keys	Disable frame-counter validation		
Ē	Service-profiles	Note that disabling the frame-counter validation will compromise security as it enables people to perform replay-attacks.		
ΤI÷	Device-profiles	Device is disabled		
$\widehat{\mathbb{N}}$	Gateways	ChirpStack Network Server will ignore received uplink frames and join-requests from disabled devices.		
	Applications		CREATE	
9	Multicast-groups			

Figure 38: Choosing OTAA mode in the device registration form

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, as shown in **Figure 39**.

€	ChirpStack	Q Search organization, application, gateway or device	?	θ	admin
-	Network-servers	Applications / rak, pode / Devices / rak, pode		DE	LETE
\bigcirc	Gateway-profiles				
	Organizations	DETAILS CONFIGURATION KEYS (OTAA) ACTIVATION DEVICE DATA LORAWAN FRAMES FIRMWARE			
•	All users				
٩	API keys	Application key* f9 21 d5 0c d7 d0 2e e3 c5 e6 14 21 54 f2 74 b2 MSB	G	Ē	0
chirp	ostack 👻	For LoRaWAN 1.0 devices. In case your device supports LoRaWAN 1.1, update the device-profile first.			
A	Org. dashboard	Gen Application key MSB	G	<u> </u>	Ø
•	Org. users	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.			_
٩	Org. API keys		SET DE	VICE-K	EYS
. ≡	Service-profiles				
	Device-profiles				
\bigcirc	Gateways				
	Applications				
٣	Multicast-groups	*			

Figure 39: Application Key for the OTAA mode in the device registration form

- 3. Once the Application Key is added to the form, the process can be finalized by clicking on the "SET DEVICE-KEYS" button.
- 4. As shown in **Figure 40**, a new device should be listed in the "**DEVICES**" tab. The most important parameters, such as the Device EUI, are shown in the summary.

AK Documentation Center

∉	ChirpStack		Q Search organization, application, gateway or device					0	admin
** **	Network-servers		Applications / ra	k node test					DELETE
\bigcirc	Gateway-profiles								
Ξ	Organizations	Ι.	DEVICES	APPLICATION CONFIGUR	RATION INTEGRATIONS	FUOTA			
•	All users								
٩	API keys							+	CREATE
chirp	stack 👻		Last seen	Device name	Device EUI	Device profile	Link margin	Battery	
A	Org. dashboard		n/a	rak_node	5e9d1e0857cf25f1	device_profile_otaa	n/a	n/a	
•	Org. users						Rows per page: 10 ▼	1-1 of 1 <	>
٩	Org. API keys						nono por pago.		
. =	Service-profiles								
违	Device-profiles								
\bigcirc	Gateways								
	Applications								
9	Multicast-groups	*							

Figure 40: New created device listed in the DEVICES tab

5. 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 41**.

€	ChirpStack	Q Search organization, application, gateway or device		
87 87	Network-servers	Applications / rak node test / Devices / rak node		DELETE
\bigcirc	Gateway-profiles			
	Organizations	DETAILS CONFIGURATION KEYS (OTAA) ACTIVATION DEVICE DATA LORAWAN FRAMES FIRMWARE		
•	All users			
٩	API keys	Application key *	_	
chirp	ostack 👻	f9 21 d5 0c d7 d0 2e e3 c5 e6 14 21 54 f2 74 b2 MSB For LoRaWAN 1.0 devices. In case your device supports LoRaWAN 1.1, update the device-profile first. MSB	GI	
♠	Org. dashboard	Gen Application key		Ø
•	Org. users	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.		
٩	Org. API keys		SET DEV	ICE-KEYS
.≡	Service-profiles			
	Device-profiles			
\bigcirc	Gateways			
	Applications			
۳	Multicast-groups			
		*		

Figure 41: Application Key associated with the new device.

📝 NOTE

Standard OTAA mode requires the Device EUI, Application Key, and Application EUI; but in the ChirpStack implementation, only Device EUI and the Application Key are mandatory. The Application EUI is not required nor recorded in the Application tab. Nevertheless, the Application EUI is a mandatory parameter in the RAK4200 module firmware. To resolve this mismatch, reuse the Device EUI as the Application EUI during the configuration on the side of the node.

Configure the OTAA Mode on the RAK4200 Module

RAK4200 complies with LoRaWAN 1.0.2 specification. By default, the LoRa join mode is OTAA, and the LoRa Class is Class A. To set up the RAK4200 module to join ChirpStack using OTAA, start by connecting the RAK4200 module to the computer (see **Figure 1**). Open the RAK Serial Port Tool, and wait for the communication to start. It is recommended to test the serial communication by sending an AT command as at+get_config=lora:status or at+version.

🗐 RAK SERIAL P	ORT TOOL
----------------	----------

	COM: COM12 -	BaudRate: 115200					
		badditate. 115200	CLOSE				
		1 1 0	CLEAR RECV				
LoRa (R) is a re	gistered trademark	c or service mark of S	semtech				
Corporation or its affiliates. LoRaWAN (R) is a licensed mark.							
RAK4200 version:3.2.0.14							
UART1 work m	ode: RUI_UART_NC	RMAL, 115200, N81					
UART2 work m	ode: RUI_UART_NC	RMAL, 115200, N81					
Current work_n	ode:LoRaWAN, joi	n_mode:OTAA, Multic	astEnable:				
false, Class: A							
Initialization Ok	[
>>at+version							
OK V3.2.0.14							
ľ							
service at the service	(1(1))						
at+version			SEND				
L							

Figure 42: RAK Serial Port Tool connected to a RAK4200

As an example, the following parameters will be configured in RAK4200:

- LoRa join mode: OTAA
- LoRa class: Class A
- LoRa region: EU868
- Device EUI: 5e9d1e0857cf25f1 (from ChirpStack registration)
- Application EUI: 5e9d1e0857cf25f1 (from ChirpStack registration)
- Application Key: f921d50cd7d02ee3c5e6142154f274b2 (from ChirpStack registration)
- 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.

For the Europe region, type the command:

at+set_config=lora:region:EU868

- Refer to the RAK4200 Datasheet for the list of supported frequencies.
- 4. Set the Device EUI.

Get the Device EUI number from ChirpStack registration.

at+set_config=lora:dev_eui:5e9d1e0857cf25f1

5. Set the Application EUI.

Get the Application EUI number from the ChirpStack registration.

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 registration.

Type command:

at+set_config=lora:app_key:f921d50cd7d02ee3c5e6142154f274b2

7. Save the RAK4200 parameters.

Reset the RAK4200 to save the parameters.

Figure 42 summarizes the set of commands sent over the console for setting the OTAA mode on the RAK4200.

RAK	COM: COM12 BaudRate: 152	200 -	CLOS
RECEIVING		CLE	
>>at+set_conf	fig=lora:join_mode:0		
ОК			
>>at+set_conf	fig=lora:class:0		
ОК			
>>at+set_conf	fig=lora:region:EU868		
ок			
>>at+set_conf	fig=lora:dev_eui:5e9d1e0857cf25f1		
ОК			
>>at+set_conf	fig=lora:app_eui:5e9d1e0857cf25f1		
ОК			
>>at+set_conf	fig=lora:app_key:f921d50cd7d02ee3	c5e61421	54f274b
ОК			
SENDING(With	\r\n)		
-1			
at			

Figure 43: RAK4200 LoRa parameters configuration over the Serial Port Tool

8. Send command to join in OTAA mode.

at+join			

• If the request is successfully received by a LoRa gateway, then the "**OK Join Success**" message will be shown in the serial console after a few seconds.

RAK SERIAL POI	RT TOOL	
RAK	COM: COM12 BaudRate: 11520	00 × CLOSE
RECEIVING		CLEAR RECV
OK Join Succes	s	
		^
-		
SENDING(With	\r\n)	
at+join		SEND

Figure 44: RAK Serial Port Tool, join the network

The JoinRequest and JoinAccept messages are also displayed on the ChirpStack console, specifically in the "LORAWAN FRAMES" tab, as shown in Figure 45.

∉	ChirpStack	K Q Search organizat	tion, application, gateway or device 🛛 💡 🤮 admin
-	Network-servers	Applications / rak pode / Devices / rak pode	DELETE
\bigcirc	Gateway-profiles		
	Organizations	DETAILS CONFIGURATION KEYS (OTAA) ACTIVATION DEVICE DATA	LORAWAN FRAMES FIRMWARE
•	All users		
٩	API keys	0	HELP II PAUSE 🛓 DOWNLOAD
chirp	stack 👻	DOWNLINK 7:51:40 PM JoinAccept	~
ħ	Org. dashboard	UPLINK 7:51:40 PM JoinRequest 5e9d1e0857cf25f1	~
•	Org. users		
٩	Org. API keys		
E	Service-profiles		
	Device-profiles		
\bigcirc	Gateways		
	Applications		
٣	Multicast-groups	·	
		Figure 45: ChirpStack Console, checking LoRaWAN join re	quest

9. Send data from RAK4200 to ChirpStack.

To send the string 1234567890 over LoRa port 2, type the command:

at+send=lora:2:12345678	90
	RAK SERIAL PORT TOOL COM: COM12 BaudRate: 15200 CLOSE RECEIVING CLEAR RECV OK Join Success OK at+recv=0,-47,7,0
	at+send=lora:2:1234567890 SEND

Figure 46: RAK Serial Port Tool, send a LoRaWAN message.

On the ChirpStack platform, the messages shall appear in the **LORAWAN FRAMES** tab, as shown in **Figure 47**. By convention, messages sent from nodes to gateways are considered as "**UPLINK**", while messages sent by gateways to nodes are considered as "**DOWNLINK**".

€	ChirpStack						Q Search organization, application, gateway or device	? e admin		
ŧ	Dashboard	Δ.	polications / re	ok nodo / Dovice	ns / rak nodo			DELETE		
•	Network-servers		pplications / Ta	IK_HOUE / DEVICE	s / Tak_Houe					
\bigcirc	Gateway-profiles		DETAILS	CONFIGURATION	KEYS (OTAA)	ACTIVATION	DEVICE DATA LORAWAN FRAMES FIRMWARE			
	Organizations									
•	All users						⑦ HELP II PAUSE ▲ DOWNLOAD	CLEAR		
٩	API keys		UPLINK	8:37:20 PM	UnconfirmedDataUp	00aefef8		~		
chirp	stack 👻		DOWNLINK	8:34:36 PM	JoinAccept			~		
ŧ	Org. dashboard		UPLINK	8:34:36 PM	JoinRequest	5e9d1e0857cf25f1		~		
•	Org. users									
٩	Org. API keys									
. ≡	Service-profiles									
	Device-profiles									
\bigcirc	Gateways									
	Applications	•								

Figure 47: ChirpStack Console, checking LoRaWAN messages received.

Join in ABP Mode

Configure the ABP Mode on the Platform

During the registration of a new device, if "**device_profile_abp**" is selected, as shown in **Figure 48**, then the ChirpStack platform will assume that this device will join the LoRaWAN network using the ABP mode.

📝 NOTE

Check **Disable frame-counter validation**. If the server cannot synchronize the node-side counting, the transmission will fail.

€	ChirpStack	Q Search organization, application, gateway or device	? e	admin
R	Network-servers Gateway-profiles	Applications / rak_node_test / Devices / Create		
	Organizations	OENERAL VARIABLES TAOS		
<u>*</u>	All users	Device name *		
chirp	ostack -	rak_node The name may only contain words, numbers and dashes.		
\$	Org. settings	Device description *		
<u>.</u>	Org. users			
≛≡	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 disabling the frame-counter validation will compromise security as it enables people to perform replay-attacks.		
ÿ	Multicast-groups		CREATE D	EVICE

Figure 48: ChirpStack Console, configuring a device in ABP mode

After selecting the ABP mode, the following parameters appear in the Activation tab (See Figure 49):

- Device address
- Network Session Key

Application Session Key

€	ChirpStack	Q Search organization, application, gateway or device	?	e admi	in
	Network-servers Gateway-profiles	Applications / rak_node_test / Devices / rak_node	[]	DELETE	E
•	Organizations All users	DETAILS CONFIGURATION KEYS (OTAA) ACTIVATION DEVICE DATA LORAWAN FRAMES FIRMWARE			
chirp	ora, settinas	Device address * 26.01 1a 19	MS	B C	-
*	Org. users	Network session key (LoRa/WAN 1.0) * MSB c2 80 cb 8d 1d f6 88 bc 18 60 1a 97 02 5c 54 88 MSB	G	ø [-
<u>*</u> ≡ 7±	Service-profiles	Application session key (LoftwiXA) 1 0)* 4d 42 ec 5c af 97 f0 3d 83 3c da f5 00 3f 69 e1 MSB	G	ø ī	-
R	Gateways	Uplink frame-counter* 0		•	8
	Applications	Downlink trame-counter (network) * 0		÷	8
λ	Multicast-groups	(RE)ACTIVA	TE DEVICE	

Figure 49: ChirpStack Console, parameters required for the ABP mode

The parameters can be generated as random numbers by the platform or you can set the values. Once these parameters are filled properly, the process is completed by clicking on the "**(RE)ACTIVATE DEVICE**" button.

Configure the ABP Mode on the RAK4200 Module

RAK4200 complies with LoRaWAN 1.0.2, by default the LoRa join mode is OTAA and the LoRa Class is Class A. To set up the RAK4200 module to join ChirpStack using ABP, start by connecting the RAK4200 module to the computer (see **Figure 1**). Open the RAK Serial Port Tool, and wait for the communication to start. It is recommended to test the serial communication by sending an AT command as at+get_config=lora:status or at+version.

RAK SERIAL PORT TOOL

RAK	COM: COM12 ~	BaudRate: 15200	CLOSE
RECEIVING			CLEAR RECV
LoRa (R) is a re	gistered trademark	or service mark of s	Semtech
Corporation or	its affiliates. LoRaW	/AN (R) is a licensed	mark.
RAK4200 versio	on:3.2.0.14		
UART1 work m	ode: RUI_UART_NO	RMAL, 115200, N81	
UART2 work m	ode: RUI_UART_NO	RMAL, 115200, N81	
Current work_n	node:LoRaWAN, joir	_mode:OTAA, Multic	astEnable:
false, Class: A			
Initialization Of	c		
>>at+version			
OK V3.2.0.14			
SENDING(With	\r\n)		
at+version			
			SEND

Figure 50: RAK Serial Port Tool connected to a RAK4200

As an example, the following parameters will be configured in RAK4200:

- LoRa join mode: ABP
- LoRa class: Class A

- LoRa region: EU868
- Device address: 26011af9 (from ChirpStack registration)
- Network Session Key: c280cb8d1df688bc18601a97025c5488 (from ChirpStack registration)
- Application Session Key: 4d42ec5caf97f03d833cdaf5003f69e1 (from ChirpStack registration)
- 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.

For the Europe region, type the command:

at+set_config=lora:region:EU868

- Refer to the RAK4200 Datasheet for the list of supported frequencies.
- 4. Set the Device Address.

Get the Device Address from ChirpStack registration.

at+set_config=lora:dev_addr:26011af9

5. Set the Network Session Key.

Get the Network Session Key from the ChirpStack registration.

at+set_config=lora:nwks_key:c280cb8d1df688bc18601a97025c5488

6. Set the Application Key.

Get the Network Session Key from the ChirpStack registration.

at+set_config=lora:apps_key:4d42ec5caf97f03d833cdaf5003f69e1

7. Save RAK4200 parameters.

Reset the RAK4200 to save the parameters.

Figure 51 summarizes the set of commands sent over the console to set the ABP mode on RAK4200.

RAK SERIAL PORT TOOL

y i traix		10200	CLOSE
RECEIVING			CLEAR RECV
>>at+set_conf	ig=lora:join_mod	e:1	
OK			
>>at+set_conf	ig=lora:class:0		
OK			
>>at+set_conf	ig=lora:region:EU	868	
OK			
>>at+set_conf	ig=lora:dev_addr	:26011af9	
OK			
>>			
at+set_config=	lora:nwks_key:c28	30cb8d1df688bc18601a	a97025c5488
OK			
>>at+set_conf	ig=lora:apps_key	:4d42ec5caf97f03d8330	:daf5003f69e1
OK			
SENDING(With	\r\n)		
at			
	1 4 1 4 2		00

Figure 51: RAK4200 LoRa parameters configuration over the Serial Port Tool

8. Send command to join in ABP mode.

All the parameters required to join to a LoRaWAN network in OTAA mode have been configured. After the reset, you can send the join command:

at+join			

Right after sending the command, the "**OK Join Success**" should be replied to in the console, as shown in **Figure 52**.

RAK SERIAL PORT TOOL

RECEIVING		
		CLEAR RECV
OK Join Succes	5	,
CENDINGWIth		
SENDING(With	(r\n)	

Figure 52: RAK4200 Serial Port Tool join

VOTE

The ABP mode in LoRaWAN does not require to join a network before sending a LoRaWAN package to the air. Moreover, to keep the consistency of the internal states of the firmware of the RAK4200 module, it is still required to send the at+join command in the ABP mode.

9. Send data from RAK4200 to ChirpStack.

To send the string 1234567890 over LoRa port 2, type the command:

at+send=lora:2:1234567890

RAK SERIAL POI	RT TOOL		
RAK	COM: COM12 - BaudRa	te: 115200 -	CLOSE
RECEIVING		CLE	AR REC
OK Join Succes	s		
ОК			
	,0		

Figure 53: Sending a message in ABP mode

• The console will feedback with an "OK" message (see **Figure 53**). The sent data shall be displayed in the ChirpStack console.

LoRa P2P Mode

This section will show how to set and link two RAK4200 units to work in LoRa P2P mode. The two RAK4200 units shall be set to operate at the same frequency, e.g: EU868.

As shown in the previous sections, the setup of the RAK4200 units is done by connecting them with a generalpurpose computer through the UART port. The setup of each RAK4200 can be done separately, but testing the LoRa P2P mode will require having both units connected simultaneously to a UART port (this could be one computer with 2 ports or 2 computers with one UART port each).

 To set the RAK4200 to work in LoRa P2P mode, open the RAK Serial port tool and send the command, as shown in Figure 54: at+set_config=lora:work_mode:1.

RAK SERIAL PO	RT TOOL		
	COM: COM5 - BaudR	ate: 115200 -	
>>at+set confi	g=lora:work_mode:1	<u></u>	EAR RECV
RAK811 Versio	n:3.0.0.14.H.beta2		
UART1 work m	ode: RUI UART NORAMAL		
LoRa work mo	de: P2P		
Initialization O	(
SENDING(With	\r\n)		
at+set_config=	lora:work_mode:1		
			SEND

Figure 54: RAK4200 setting to LoRa P2P mode

2. Configure the LoRa P2P parameters for both units. The command for setting the parameters has the format. at+set_config=lorap2p:XXX:Y:Z:A:B:C

The parameters are as follows:

- XXX: Frequency in Hz.
- Y: Spreading factor, [6, 7, 8, 9, 10, 11, 12].
- Z: Bandwidth, [0:125 kHz, 1:250 kHz, 2:500 kHz]
- A: Coding Rate, [1:4/5, 2:4/6, 3:4/7, 4:4/8]
- B: Preamble Length, 5~65535.
- C: Power in dBm, 5~20.

For this example, the LoRa parameters are:

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

3. It is translated into the following RAK4200 AT command that is sent to both units, as shown in Figure 55:

RAK SERIAL POP	RT TOOL	
RAK	COM: COM5 BaudRate: 115200	CLOSE
RECEIVING		CLEAR RECV
ок		
SENDING(With 1	\r\n)	

Figure 55: Setting both RAK4200 units with the LoRa P2P parameters

4. Next, set the transmission mode of the module. In this example, Unit 1 is set to sender mode, and unit 2 is set to receiver mode by AT command. See **Figure 56**.

Unit 1(Sender): at+set_config=lorap2p:transfer_mode:2 Unit 2(Receiver):

at+set_config=lorap2p:transfer_mode:1

RAK SERIAL PORT TOOL	RAK SERIAL PORT TOOL
RAK COM: COM5 V BaudRate: 115200 V CLOSE	RECEIVING COM: COM5 BaudRate: 15200 CLOSE
>>at+set_config=lorap2p:869525000:7:0:1:5:5 OK >>at+set_config=lorap2p:transfer_mode:2 OK	>>at+set_config=lorap2p:869525000:7:0:1:5:5 OK >>at+set_config=lorap2p:transfer_mode:1 OK
	±\$3
at+set_config=lorap2p:transfer_mode:2	SENDING(With \r\n) at+set_config=lorap2p:transfer_mode:1 SEND

Figure 56: Set the module in the sender (left) and in the receiver (right) mode

5. To send a message with the string "123456890" from Unit 1 to Unit 2, use the command on Unit 1:

The message will be automatically received by Unit 2. See Figure 57.

RAK SERIAL PORT TOOL	RAK SERIAL PORT TOOL
RECEIVING	RECEIVING COM: COM5 - BaudRate: 115200 - CLOSE
<pre>>>at+set_config=lorap2p:869525000:7:0:1:5:5 OK >>at+set_config=lorap2p:transfer_mode:2 OK >>at+send=lorap2p:1234567890 OK</pre>	>>at+set_config=lorap2p:869525000:7:0:1:5:5 OK >>at+set_config=lorap2p:transfer_mode:1 OK at+recv=-10,6,5:1234567890
SENDING(With \r\n) at+send=lorap2p:1234567890 SEND	SENDING(With \r\n) at+set_config=lorap2p:transfer_mode:1

Figure 57: Sending a message from RAK unit 1(left) to RAK unit 2 (right)

Miscellaneous

Firmware Update

Before to start working with the RAK4200, it is recommended to keep the RAK4200 module updated to the latest version of the firmware.

VOTE:

For RAK4200 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 RAK4200 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 RAK4200 module are shown: "**Firmware Upgrade through DAPLink**" and "**Firmware Upgrade through UART1**".

Firmware Upgrade Through DAPLink

Refer to the RAKDAP1 Flash and Debug Tool Quickstart Guide.

Firmware Upgrade Through UART1 Minimum Hardware and Software Requirements

Computer	A Windows/Linux/Mac computer
Firmware File	Bin firmware downloaded from the website.
Others	A USB to TTL adapter.

Firmware Upgrade Procedure

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

- 1. Download the latest application firmware of the RAK4200 module \square .
- 2. Download the RAK Device Firmware Upgrade (DFU) tool. In this folder are the different DFU tools depending on your machine's OS.
 - RAK Device Firmware Upgrade (DFU) Tool ☑
- 3. Connect the RAK4200 module with a computer through USB to TTL adapter as shown in Figure 58:
- 4. Open the RAK Device Firmware Upgrade (DFU) tool. Select the serial port and baud rate of the module, and then click on the "Select Port" button.



Figure 58: Device Firmware Upgrade Tool

5. Click on the "Select Firmware" button and choose the application firmware file of the module with the suffix ".bin".



Figure 59: Select firmware

6. Click on the "**Upgrade**" button to upgrade the device. After the upgrade is complete, the RAK4200 module is now ready to work with the new firmware.



Figure 60: Firmware upgrading



Figure 61: Upgrade successful