

LoRaWAN Deployment Scenario 1: Using your Gateway as a LoRaWAN Server Hub WisDevice Series RAK7249/RAK7258

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34 PAGES



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1 Overview

The integrated ChirpStack is designed to turn the LoRa Gateway from a device acting as a simple packet forwarder, to a complete solution for monitoring LoRa traffic over applications and devices.

This is a complete solution on its own, you get the packet metadata in its entirety, together with the decrypted payload. However, you can still extend the system by integrating external gateways, creating custom payload encoders/decoders for the purpose for in app visualization.

2 LoRa Network Server Features Set

2.1 General

There is a Built-in LoRa Network Server in the Commercial Gateway line of device. It is perfect for both testing use case scenarios and integration with existing deployments of Nodes and Gateways. We are going to explain its key features and how to configure those. Furthermore this document will address a typical deployment scenario.

🏟 RAK			Lopout
🕑 Status	LoRa Network Server General Configuration		
🖾 Network	General Configuration		
👷 LeRa Galeway			
M LaRa Network Server	Enable		
General 🗸	Report	N860-807 *	
Gulariay	Enable ADR		
Application Clobal Internation	Minimum allowed data-rate	08_0 *	
	Maurour allowed data-rate	Minimum allowed data rata. Used for ADR.	
System		Naxmum allowed data rate, listed for ADR.	
	Network (D	1	
	Downlink Ts Power	14	
	Device-status request interval	0	
		Interval to initiate an End-Covice states request (seconds), Set to 0 to disable.	
			Save & Apply Renet
		Alexandra a Maria da Alexandra d	diese Part and all Distance Research





Enable ADR

If this feature is turned on via the slider, Adaptive Data Rate is enabled. One can set the following parameters:

Minimum allowed data-rate: DR_0 to DR_15

Maximum allowed data-rate: DR_0 to DR_15

By setting the above values, you choose the maximum and minimum allowed rate, meaning it can be anything in between depending the propagation environment. For more details on the possible data rates look up page 16 in the <u>LoRa Regional</u> <u>Parameters</u> document.

Network ID: A number denoting the particular network the gateway is a part of.

Downlink Tx Power: The power in dBm the Gateway will be transmitting with (for example 14 dBm, the limit in the EU)

Device-status request interval: The time in seconds over which the Gateway sends a status request downlink. Enter 0 to disable it.

2.2 Gateway

This is where you can add an external Gateway to forward packets to the Built-in LoRa Server. You can do this for multiple Gateway.

							Logout
Status	LoRa Network	Server Gateway Overview					
13 Network	Gateway						
K LaRa Gateway							
Lel LoRa Network Server	Gateway EUI		Name	Add time	Description	Last Seen	
General Galeway	b827	1900 -	RAKE31 Outdoor	Fil Jun 28 18:49:05 2019	DTY Niki Edition	Never	Edt Delete
Application Global Integration	60c500000000	Nille.	RAK7249	Pin Jun 28 19:00:03 2019		Never	Edt Delete
E Systom		A44					
	Gateway Backe	end Configuration					
	General Setup	NQTT Topic					
			MOTT Broker Address	127.0.0.1			
			MQTT Broker Port	1983			
			Etable User Authentication	D			
			SSLITLS Mode	Disable			
							Sour & Apply Reset







General Setup

MQTT Broker Address:

The address of the MQTT broker where the traffic from the External Gateways is directed.

MQTT Broker Port:

The Port of the MQTT broker

Enable User Authentication:

By turning on this slider, you are presented with options for entering an *Username* and *Password*, as well as an *SSL/TLS Mode* (*Self-signed Server Certificate, CA signed server certificate, Self-signed server & client certificate*). Depending on the chosen certificate option you are prompted to choose a *TLS Version* and import, the certificates in the provided fields (see Figure 3 for an example)

🏟 RAK					Logout
Status	60c5a8fffe71a885	R/W/7249	Fri Jun 28 19:00:03 2019	Never	Edt Delete
83 Network 1/2 LoRe Galerway	Add				
Leff LoRe Network Server	Gateway Backend Configuration				
General Gateway 4	General Setup MQTT Topic				
Application Obtail Integration		MOTT Broker Address	127.0.0.1		
🖬 System		MOTT Brokar Port	1863		
		Enable User Authentication			
		Password			
		SSL/TLS Mode	Sali-signal server & clarit car . ¥		
		TLS Version	TLSv1 +		
		Ch California			
		Client Certificate			
		Clent Key			
		Plant Vice Recordsons			
		Chart Rey Passpirase			
					Save & Apply Reset
				Convrict © RAWireless	Fechnology Co., Ltd. All Rights Reserved.

Figure 3 | Gateway Backend Configuration

MQTT Topic

Templates for the following MQTT Topics are provided, in order to be able to acquire the desired data:

Uplink MQTT Topic

Downlink MQTT Topic

Downlink acknowledgment MQTT Topic



Geteway Statistic MQTT Topic

Note: *eui* stands for the particular Gateway EUI, of the device you want to gather data from.

@ RAK						Logout
Status	LoRa Network Server Gateway Overview					
153 Network 12 ⁴ LoRa Gateway	Gateway					
M LoRa Network Server	Gateway EUI	Name	Add time	Description	Last Seen	
General Gateway	b827ebfffeb45575	RAK831 Outdoor	Pri Jun 28 18:49:05 2019	DDY Niki Edition	Never	Ect Delete
Application Global Integration	60c5a8fffe71a885	RAK7249	Fri Jun 28 19:00:03 2019		Never	Ect Deals
🖾 System	Add					
	Gateway Backend Configuration					
	General Setup HQTT Topic					
		Uplex WQTT Topic	gateway/((eul))/rx			
		Downlink MQTT Topic	gateway/((eu))/fx			
		Downlosk scinowiedge WOTT Topic Galaxway Statistic MOTT Topic	patienzay(((ex)))/stats ((ex)) dense for Loftadalenzay's EUE and result be included in the benylate			
						Sieve & Apply Reset
					Constants in 1999	nation Technology Co., and AT Statis Research

Figure 4 | Adding Gateways

2.3 Application

This is where you add your application. Simply enter a name in the text field and press the "Add" button. You will be directed to a window as shown in Figure 5.

Application Configuration

You can choose to edit the *Application Configuration*, where the *Name* and *Description* fields reside.

<u>Device</u>

In order to register a LoRa node you need to add it as a device, and enter its parameters, so it is recognized. In order to do this you need an appropriate device EUI.

Adding devices can be done in one of the following ways (provided you have their EUIs):

One by one:

Simply enter the EUI in the field and press the "Add" button

Batch:



You need to fill in the following parameters: Start EUI, Step, Count, and Application Key.

The step is a decimal value that represents by how much the value of the EUI will be increased with each consecutive device. This will be done starting from the least significant bit.

The count is the maximum number of devices to be added. Note that if your step is anything different from 1 you will essentially add less devices than the Step value. You will end up with a number of devices that is the Integer Division of the Count by the Step. For example if your Step is 3 and your Count is 10 you will end up with 3 Devices.

The Application Key is an AES-128 value, which is common for all devices under a given application.

Note: When Batch Adding devices they are all configured in Class A, OTAA mode, with Frame counter validation enabled.

🏟 RAK								UNSAVED CH	ANGES: 10 LO	ogout
Status	Application Edit - 1									
🐼 Network	Application RAK720	15								
⁽ A) LoRa Gateway										
네 LoRa Network Server	Devices Application	on Configuration								
General	Last seen	Device name	Device EUI	Class	Activation mode	Device Address	Link margin	Battery Des	cription	
Gateway	1 6 seconds ago	Tracker 1	36383	А	otaa	02000001	-dB	-	G	8 ×
Application Global Integration	2 never		3638 3638 36 31 1 1 1	A	otaa	-	-dB	-	G	8 ×
🗐 System	please input device EUI	Add	Batch Add			Row	vs per page 10 \	V Page 1	In 1 Prev	Next
	Import Export									
	Back to Overview							Sa	ave & Apply	Reset

Figure 5 | Adding Devices

Import:

You can import a whole list of devices at once.

Export:

You can export the current device list.

Once you have a device created you will be redirected to the following screen (or you can enter it any time you want by pressing the *Device EUI* number field in the list of devices).

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🏟 RAK				Logout
Status	Application - Edit Device 00a53f61fe47ebfb			
Network	Device-00a53f61fe47ebfb			
LoRa Gateway				
LoRa Network Server	Configuration Activation Downlink Live Device Data			
Seneral	Device name	RAK811		
Sateway	Class	A		
ikobal Integration	Join mode	OTAA	.w	
Services	Application Key	BIGEBI		
System	Eanble frame-counter Validation			
	Deable Application EUI Validation	Ø		
	Description			
	Back to Overview			Save & Apply Reset



Configuration:

The Device Name, Class (A or C), Join Mode (OTAA, ABP), Application Key, and Description fields are here. Additionally there is a slider for to Enable frame-counter Validation and Disable Application EUI Validation.

Activation:

Once the LoRa Network Server has authenticated the device (provided the EUI and Application Key are valid), you will see those fields updated with the corresponding values as in Figure 6.







Live Device Data:

All the packets are displayed here. They each have a timestamp, a type identifier (Uplink, Downlink, Join), followed by the payload data.

If you expand any of the messages you can see the metadata fields, an example is shown in Figure 7:

🗐 RAK		UNSAVED CHANGES: 10	Logout
Status	Application - Edit Device 3638333567386312		
Network	Device-3638333567386312		
"Å" LoRa Gateway			
네 LoRa Network Server	Configuration Activation Live Device Data		
General Gatoway Application Global Integration	2019/06/30 02:15:54 Uplink 02 67 01 47 05 68 49 06 73 26 13 ("applicationInview" "Ban 700", "applicationInview" "Ban 700", "deput: "3068383673860130",		~
🗐 System	<pre>"deviceMane": "Tracker 1", "timestamp": 10180149, "foot": 5, "dout": 107, "dout": 1 "Amonthervolg2sJBH=", "staff=0": ("gatewory10": "4005#8fff=7442f1", "locatBHM": 0.5, "frequency": 0.66100000, "frequency": 0.66100000, "locatIn": (</pre>		
	"lacitude": 0, "longitude": 0, "altitude": 0,)] 2019/06/30 02:15:47 Uplink 03 71 ff e0 00 00 ff d0		
	2019/06/30 02:15:40 Uplink 07 02 01 78		

Figure 8 | Live Device Data

2.4 **Global Integration**

This is the tab where you can configure your LoRa Network Server to integrate with an external Application Server. This is done by pointing to the corresponding MQTT broker:

General Setup

MQTT Broker Address:

The address of the MQTT broker where the traffic from the External Gateways is directed.

MQTT Broker Port:

The Port of the MQTT broker

Enable User Authentication:

By turning on this slider, you are presented with options for entering an *Username* and *Password*, as well as an *SSL/TLS Mode* (*Self-signed Server Certificate, CA signed server certificate, Self-signed server & client certificate*). Depending on the chosen



certificate option you are prompted to choose a *TLS Version* and import, the certificates in the provided fields (see Figure 3 for an example)

MQTT Topic template Setup

Templates for the following MQTT Topics are provided, in order to be able to acquire the desired data:

Uplink MQTT Topic Downlink MQTT Topic Downlink acknowledgment MQTT Topic Geteway Statistic MQTT Topic

Note: *eui* stands for the particular Gateway EUI, of the device you want to gather data from.

3 A Typical Application Case

We will deploy a typical scenario. We will walk through the configuration process of all devices that are required. Additionally we will explain in detail after we are done configuring, what are the benefits of this particular use-case, the message formats, etc.

Configuration of the devices will be done in order as per the topology in the next subsection.

3.1 Network Topology

- Gateway-A: RAK7249/58 Nexus Gateway (LoRa Server in use)
- Gateway-B: RAK7249/58 External Gateway (MQTT Bridge in use)
- RAK 811 WisNode-LoRa: LoRa node





Figure 9 | Network Topology

This is the minimum of devices required. However you can integrated more nodes and also more External Gateways. As an advanced configuration feature we will forward all the traffic from the Nexus Gateway to a MQTT broker, hosted separately. This is not mandatory, however is good practice and required in some cases.

3.2 Gateway-A

3.2.1 Packet Forwarder Setup

Go to the *LoRa Gateway tab -> LoRa Packet Forwarder -> General Setup*. In the dropdown menu for *Protocol* select: **Built-in LoRa Server** (refer to Figure 10):



@RAK		Logout
🗿 Status	LoRa Packet Forwarder LonaWAN Packet Forwarder Configuration	
🗿 Network	Salaway Configuration	
🕈 LoRa Gateway	Gickey Consideration	
LoRa Packet Forwarder	General Setup Padat Filter GPS Information	
LoRa Gateway MQTT Bridge	Gateway EUI 60C540FF	
LoRa Network Server	Protocol Boll-In LoRa Server	
a Services	Path Treasult (res) 200	
Sector	Statistic Interval (x) 30	
System	Kaspalite Interval (s) 5	
	Automatic data recovery 🔣 Data messages are automatically stored when the connection to the server is lost	
	Auto-restart Teresheld 30	
	Packet forwarder will automatically restart when the keepaine tenseout exceeds this threshold. Set 'U' to disable	
	Import Frequency Plan Template -Select Frequency Plan V Import	
	Standard Friguency Seltup Mode Switch to Advanced Mode	
	Frequency Plan	
	Region EU063-2470 V	
	Multi SF LeRa Channel 667.1MHz 667.3MHz 667.3MHz 667.3MHz 666.3MHz 666.3MHz 666.3MHz	
	Fing (BPc) Add	
	Standard LoRa Channel 868 3MHz SF7 BW250	
	Free (BHz) SF7 V BW250 V Add	
	PALOR I PERMIT COL	

Figure 10 | Gateway Protocol Mode (Built-in LoRa Server)

You can leave the rest of the settings with their default values. Remember to *Save & Apply*.

3.2.2 LoRa Server General Configuration Setup

Go to the LoRa Network Server tab -> General. Make sure the Enable switch is on.

Select your region (LoRa Band), we are going to use EU863-870 in this example (refer to Figure 11):

The rest of the settings you can use with their default values. You can change them is you like, however this is dependent on your particular case. You can look up what each setting is referring to in **Section 1**.

RAK		Logou
③ Status	LoRa Network Server General Configuration	
🐼 Network	General Configuration	
🐮 LoRa Gateway		
LoRa Network Server	Enable	
General	Region	EU863-870 V
Gateway	Enable ADR	
Application	Minimum allowed data-rate	DR_0 V
Global Integration	Han a start a s	Minimum allowed data rate. Used for ADR.
🍰 Services	Maximum allowed data-rate	DR_16 ~
🖩 System	Ha Naturit ID	Haamum allowed data rate. Used for ADR.
	HERRINE	
	Downlink Tx Power	14
	Device-status request interval	
		interval to initiate an Eno Device status request (seconds). Set to 0 to disame.
		Sove & Apply R

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Figure 11 | LoRa Server Enabling and General Configuration

3.2.3 Registering the Gateway with the Built-in LoRa Server

Go to the *LoRa Network Server tab -> Gateway*. Enter the Gateway EUI in the field as in Figure 12.

By pressing the Add button you should end up with a screen as in Figure 13.

There you need to fill the parameters: Name and Description are mandatory.

∲®RAK						NISAVED CHARGES 2	Logout
Status	LoRa Network Server Gateway Overview						
Network	Gateway						
🕷 LoRa Gateway							
네 LoRa Network Server	Gateway EUI	Name	Add time	Description	Last Seen		
General Gateway 4 Application Global Integration	This section contains no values yet GOCSABFFFEXCOCCO(× Add						
💩 Services	Catoway Backand Configuration						
System							
	General Setup MQTT Topic						
		MQTT Broker Address	127.0.0.1				
		MQTT Broker Port	1883				
		Client ID					
		Clean Session					
		Will Retain	0				
		Qos	1 - Atleast Once ~				
		cnable User Authentication					
		aat/1LS Mode	Usion V				
						Save & Apply	Reset

Figure 12 | Adding a Gateway into LoRa Server

Note: The Latitude, Longitude and Altitude parameters are not mandatory. You can leave them for later, or leave them empty if the gateway is not stationary.

2		
🏟 RAK		Instance countered Logout
🕐 status	Gateway Edit - 60C5A8FFFE74D313	
3 Network	Gateway 60C5A8FFFE74D313	
₩ LoRa Gateway		
네 LoRa Network Server	Name RA/72/9-A	
General	Description RAK7249 A Outdoor Nexus	
Gateway •	Lattude	
Global Integration	Althura	
🕹 Services	71000V	
System	Rich is Downleys	Sive & Apply Bund

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Figure 13 | Gateway Description parameters

If everything is set up correctly, you will see an image similar to Figure 14.

Note: In order to see the Last Seen status update you need to refresh the page. There should be a value of a couple of seconds, if so than everything went well. In case there is a message "Never Seen", there is an issue and you best redo the configuration.

🏟 RAK					Logout
🖲 status	LoRa Network Server Gateway Overview				
Network	Gateway				
🕅 LoRa Gateway					
LoRa Network Server	Gateway EUT Name Add time	Descrip	tion	Last Seen	
General Gatoway Application Global Integration	60C5A8 XXXXXX Mon. Jul 15	23:09:52 2019 RAK724	19-A Outdoor Nexus	1 seconds app	Edit Delete
no services	Gateway Backend Configuration				
🖽 System	exempt became compared on				
	General Sebup MQTT Topic				
	MQTT Broker Address	127 0.0.1			
	MQTT Broker Port	1883			
	Client ID				
	Clean Session				
	Will Retain	0			
	Qos	1 - Atleast Once V			
	Enable User Authentication				
	SSL/TLS Mode	LIGHTONE V			
					Save & Apply Resul

Figure 14 | Gateway Description parameters

3.3 Gateway-B

Now we will point Gateway-B to the built-in LoRa Server of Gateway-A

3.3.1 Packet-forwarder Setup

Go to the *LoRa Gateway tab -> LoRa Packet Forwarder -> General Setup.* In the dropdown menu for *Protocol* select: **LoRa Gateway MQTT Bridge** (refer to Figure 15):



I class LGRa Packet Forwarder: Luswwww.Hucket Forwarder: Configuration G class Configuration Concern Soling I class Materia. Soling Packet Flammation I class Matering Solinder Flammation											Logout
Nack Cadeway Configuration Usb Zeb Mered Kase Cadeway Eli Cols Information Service Service Information Service Service Information Service Information Service Information	Packet Forwarder Lorav	VAN Packet Forwarder Configuration									
Luka Cathony Carrier C	way Configuration										
In Parle Forwards But Garwary R12 Solon S	idy configuration										
ala data watar taka data watar sorkas System Percency Plan Frequency Plan Frequency Plan Region Region Statistic Labo Charanti Region Region Statistic Labo Charanti Statistic Horead Visit Statistic Horead Vis	eral Setup Packet Filter	GPS Information									
sda Netronick Karver cervice c		Gateway EUI	60C5A8								
events: stem Pada Tansacat (an) 20 Statistic titerard (a) 3 Statistic titerard (a) 5 Automatic data revery D for amongen are automatically related when the connection to the source is los. Automatic data revery D for amongen are automatically related when the connection to the source is los. Automatic data revery D for amongen are automatically related when the connection to the source is los. Automatic data revery D for a smoother to the source is los. Automatic data revery D for a smoother to the source is los. Standard Fragency State Mote Standard Fragency State Mote State Mote State Mote Standard Fragency State Mote State Mote State Mote State Mote St		Protocol	LoRa Gateway M	QTT Bridge	~						
Sound Statistic Interval (s) S Keepaline Statistic) S Automatic data recover Diala managina are automatically related when the connection is the server is lost Automatic data recover Diala managina are automatically related when the server is lost Automatic data recover Diala managina are automatically related when the server is lost Standard Fragmency Plan Frequency Pla		Push Timeout (ms)	200								
Keepine Isternal (a) S Adversald Threadown (a) S Sandord Frequency Plan Frequency Plan Regin Regin		Statistic Interval (s)	30								
Automatic data second In the manyers are automatically strend when the connection to the server is loss. Automatic data second Image: Thread and the connection to the server is loss. Automatic data second Image: Thread and the connection to the server is loss. Material of Tragenery Streng Material Second Tragenery Streng Material Standard Fragenery Streng Material Second Tragenery Streng Material Frequency Plan Second Tragenery Streng Material Material Standard Tragenery Streng Material Second Tragenery Streng Material Material Standard Tragenery Streng Material Second Tragenery Streng Material Frequency Plan Second Tragenery Streng Material Material Standard Laboratically restantion Second Tragenery Streng Material Standard Tragenery Streng Material Second Tragenery Streng Material Standard Standard Tragenery Streng Material Second Tragenery Streng Material Material Standard Laboratically restantion Second Tragenery Material Material Standard Laboratical Material Second Tr		Keepalive Interval (s)	5								
Addrestat Threadout 3d Public Instructor With Streadout Labout Coll Visitat Advent Bio Exercise Units Threadout Stat Streadout Labout Coll Visitat Advent Bio Exercise Units Threadout Stat Streadout Labout Coll Visitat Advent Bio Exercise Units Threadout Stat Streadout Labout Coll Visitat Advent Bio Exercise Units Threadout Stat Streadout Labout Coll Visitat Advent Bio Exercise Units Threadout Stat Streadout Coll Visitat Advent Bio Exercise Units Threadout Coll Visi		Automatic data recovery	Data missa	ges are automatic	ally stored when	the connect	ion to the server is ke	t.			
Priot Invador III admiticially rotat when the inspute times accessibility developed. Set V to double Import Propercy Plan Tempercy Sander Frequency Plan Frequency Plan Regim EUSION 2-0 ~ Moto SF LoRG Channel ESION 2-0 - 2012 -		Auto-restart Threshold	30								
Import Program / Plan V Import Standard Friguency Plan V Import Frequency Plan Standard 10.04 Standard 20.06 Regin EUROS 870 V Muth-SF LaRa Channel 887 3MHz 887 3MHz 883 3MHz			Packet forwarder will	automatically rest	art when the ke	epaive times	of exceeds this threat	hold. Set '0' to disable			
Standard Friguency Statp Mode Search to: Kuturocal Mode Frequency Plan Regim EU803.5870 V Math SF LaFa Channel 867.584nc 867.584nc 867.584nc 868.584nc 888.584nc		Import Frequency Plan Template	Select Frequence	cy Plan-	~	Import					
Brequency Plan ELISIS 870 V Mode SF LaRia Channel 867.1184c 867.3184c 867.3184c 867.3184c 868.3184c 868.5384c		Standard Frquency Setup Mode	Switch to Advan	ced Mode							
Brogion EL383-370 ~ Mold SF LyRa Channel 867 1384: 867 3384: 867 7384: 867 7384: 868 3384: 868 5											
Regim EUSISS 2/0 v Mote SF LaRia Channel 867.158/c 867.158/c 867.158/c 867.158/c 867.158/c 868.158/c 868.1	iency Plan										
Mole SF LoRa Channel 867.158/L 867.158/L 867.158/L 867.158/L 867.158/L 868.118/L		Region	EU863-870		~						
Proc (Mits) Add Standard LaRa Channel 882.386/rs 597 896259		Multi-SF LoRa Channel	867.1MHz	867.3MHz	867.5	MH2	867,7MHz	868.1MHz	868.3MHz	868,5MHz	868 9MHz
Standard LaRa Channel 168 3MHz SF7 8V/250			Freq (MHz)	Add							
		Standard LoRa Channel	858 3MHz SF7 BV	N250							
Freq.(MHz) SF7 V BW250 V Add			Freq.(MHz)	SF7	✓ BW.	250	 Add 				

Figure 15 | Gateway Protocol Mode (LoRa Gateway MQTT Bridge)

3.3.2 LoRa Gateway MQTT Bridge

Go to the LoRa Gateway tab -> LoRa Gateway MQTT Bridge -> General Setup.

Enable the MQTT Bridge it via the slider and enter the IP address of Gateway-A (the one in Figure 16 is just an example).

The port should be 1883 by default, if it isn't please update the data. Leave the rest of the settings with their default values.

After *Saving* & *Applying*, all LoRa traffic should be redirected via the Bridge of Gateway-B to the MQTT Brocker of Gateway-A.

🏟 RAK		Logout
Status	LoRa Gateway MQTT Bridge	
😢 Network	LoRa Gateway MOTT Bridge Configuration	
⁹ Æ [€] LoRa Gateway		
LoRa Packet Forwarder LoRa Gateway MQTT 4 Bridge	General Schip NQTT Tape: Template Schip Faulde	
Leffa Network Server	MQTT Breker Address 102.160.90.04	
no services	MOTT Blocker Port 1083	
🖽 System	Clert D Class Sension	
	Will Retain	
	Gen 1 - Atliant Orion V	
	Enable User Authentication	
	SSU/ILS Mode Disable v	
	San & Ad Copright & BAXON/reless Technology Co., U.S.	ply Reset

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Figure 16 | LoRa Gateway MQTT Bridge Configuration

3.3.3 Registering Gateway-B in Gateway-A's LoRa Network Server

The procedure is the same as when we registered Gateway-A in its built-in LoRa Network Server. Refer to <u>sub-section 2.2.3</u> on how to repeat the process.

Figure 17 is a representation of what you configuration should look like with the two Gateways added.

🏟 RAK							Logout
③ Status	LoRa Network Server Gateway	Overview					
🐼 Network	Gateway						
😾 LoRa Gateway							
네 LoRa Network Server	Gateway EUI	Name	Add time	Descr	ption	Last Seen	
General Gateway	60C5A8FFFE74D313	RAK7249-A	Mon Jul 15 23:09:52 2	019 RAK7.	49-A Outdoor Nexus	2 seconds ago	Edit Delete
Application Global Integration	60C5A8FFFE74D2F1	RAK7258-B	Tue Jul 16 01:39:57 2	019 RAK73	58-8 Indoor External	9 seconds ago	Edit Delete
🗞 Services		Add					
🗐 System							
	Gateway Backend Configuration	1					
	General Setup MQTT Topic						
		MQT	Broker Address 127.0.0				
		h	IQTT Broker Port 1883				
			Client ID				
			Clean Session				
			Will Retain				
			Qos 1 - Atlea	st Once 🗸 🗸			
		Enable Us	er Authentication				
			SSL/TLS Mode Disable	~			
			_			Copyright @ RAKWi	Save & Acolv Reset reless Technology Co., Ltd. All Rights Reserved.

Figure 17 | LoRa Network Server Gateway List

You can add more Gateway in the same manner as we did for the two we are using. This is a convenient way to monitor if they are up (Last Seen field).

3.4 Setting up the External MQTT Broker

3.4.1 Preparing the Raspberry Pi

We are going to use going to use a Raspberry Pi 3B+ for this tutorial, as the device that is going to be hosting Mosquitto (a popular MQTT broker).

First download the latest Raspbian Buster Lite image from the link.

Next flash the image to an SD card with a tool such as Etcher.

We recommend setting up the <u>Raspberry Pi headless</u>. Once done plug the SD card into the slot and power it.



Use your favorite <u>SSH client</u> to connect to the Raspberry Pi (username: pi, password: raspberry).

Now as we have a platform to work with we can begin.

First execute the following command and note the IP address of the interface you will be using to connect to the network. You will need this, as it will be the address for your MQTT Broker when configuring the Gateway:

ifconfig

🖉 pi@raspberrypi: ~ 🛛 —		×
pi@raspberrypi:~ \$ ifconfig		~
<pre>eth0: flags=4163<uf,broadcast,running,multicast> mtu 1500 inet 192.168.50.181 netmask 255.255.255.0 broadcast 192.168.50 inet6 fe80::30da:3aa2:6390:e070 prefixlen 64 scopeid 0x20<lin ether b8:27:eb:78:81:91 txqueuelen 1000 (Ethernet) RX packets 43918 bytes 2714838 (2.5 MiB) RX errors 0 dropped 0 overruns 0 frame 0 TX packets 2193 bytes 215851 (210.7 KiB) TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0</lin </uf,broadcast,running,multicast></pre>	0.255 k>	
<pre>lo: flags=73<up,loopback,running> mtu 65536 inet 127.0.0.1 netmask 255.0.0.0 inet6 ::1 prefixlen 128 scopeid 0x10<host> loop txqueuelen 1000 (Local Loopback) RX packets 1046 bytes 88088 (86.0 KiB) RX errors 0 dropped 0 overruns 0 frame 0 TX packets 1046 bytes 88088 (86.0 KiB) TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0</host></up,loopback,running></pre>		
<pre>wlan0: flags=4163<up,broadcast,running,multicast> mtu 1500 inet 192.168.50.23 netmask 255.255.255.0 broadcast 192.168.50 inet6 fe80::bd57:5804:e469:290d prefixlen 64 scopeid 0x20<lin ether b8:27:eb:2d:d4:c4 txqueuelen 1000 (Ethernet) RX packets 2932 bytes 217940 (212.8 KiB) RX errors 0 dropped 0 overruns 0 frame 0 TX packets 213 bytes 33679 (32.8 KiB) TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0</lin </up,broadcast,running,multicast></pre>	.255 k>	
pi@raspberrypi:~ \$		~

Figure 18 | Raspberry Pi interfaces

3.4.2 Installing Mosquitto

Now it is time to install the MQTT Broker (Mosquitto), via the command:

sudo apt install mosquitto mosquitto-clients



Get:2 http://archive.raspberrypi.org/debian buster InRelease [25.1 kB] Get:3 http://raspbian.raspberrypi.org/raspbian buster/main armhf Packages [13.0 MB1 Get:4 http://archive.raspberrypi.org/debian buster/main armhf Packages [205 kB] Fetched 13.2 MB in 19s (705 kB/s) Reading package lists... Done pi@raspberrypi:~ 🖇 sudo apt-get upgrade Reading package lists... Done Building dependency tree Reading state information... Done Calculating upgrade... Done 0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded. pi@raspberrypi:~ 💲 sudo apt-get update Hit:1 http://raspbian.raspberrypi.org/raspbian buster InRelease Hit:2 http://archive.raspberrypi.org/debian buster InRelease Reading package lists... Done pi@raspberrypi:~ 💲 sudo apt install mosquitto mosquitto-clients Reading package lists... Done Building dependency tree Reading state information... Done mosquitto is already the newest version (1.5.7-1). mosquitto-clients is already the newest version (1.5.7-1). 0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded. pi@raspberrypi:~ 🖇

Figure 19 | Mosquitto installation

Mosquitto clients help us easily test MQTT through a command line utility. We will use two command windows, one to subscribe to a topic and one to publish a message to it. Those will be explained in detail further in the tutorial.

sudo systemctl enable mosquitto.service

This command is not mandatory, however it is recommended as it creates a *mosquitto service* that will run the broker on startup.

3.4.3 Configuring the Gateway to publish to the MQTT Broker

Now we are going to configure the Gateway to connect to our external MQTT broker.

For the purpose of this example we are going to use the built-in LoRa Server.

First go to the Packet Forwarder Tab and choose Built-in LoRa Server as your Protocol:



Status	LoRa Packet Forwarder LoraWAN Packet Forwarder Configuration
@ Network	Seteway Configuration
(씨) LoRa Gateway	
LoRa Packet Forwarder 📢	General Setup Packet Filter GPS Information
LoRa Gateway MQTT Bridge	Gateway EUI 60C5A0FFFE74D313
네 LoRa Network Server	Protocol Build-in LaRa Server
🗞 Services	Puth Timeout (ms) 220
System	Statistic Interval (s) 30
	Keepalive Interval (s) 5
	Automatic data recovery 🚺 Data messages are automatically stored when the connection to the server is lost
	Auto-restart Threshold 30
	Packet ferwarder will automatically restart when the keepailve timeout exceeds this threshold. Set "V to disable
	Import Frequency Plan TemplateSelect Frequency Plan- V Import
	Standard Freyuncy Setup Mode Switch to Advanced Mode
	Frequency Plan
	Region EU063-870 V
	Multi-SF LoFta Channel 867.1MHz 867.3MHz 867.5MHz 867.5MHz 868.1MHz 868.3MHz 868.5MHz 868.5MHz
	Freq.(Mtd) Add
	Standard LoRa Channel 808 3MHz SF7 8W250
	Freq.(082) SF7 V BW250 V Ad
	Constrict & RAKWireless Technology Co1td All Rights Reserved.

Figure 20 | Protocol selection

Make sure you have the *LoRa Network Server* enabled in the *General* tab:

🏟 RAK		Logout	
🕑 Status	LoRa Network Server General Configuration		
🐼 Network	General Configuration		
🕅 LoRa Gateway			
네 LoRa Network Server	Enable		
General	Region	n EU863-870 V	
Gateway	Enable ADR		
Application Global Integration	Minimum allowed data-rate		
S. Constant	Maximum allowed data-rate	Presentant anomeo usua rate: Opeu na wun- e DR 0 V	
a -		Maximum allowed data rate. Used for ADR.	
🖽 System	Network ID	D 1	
	Downlink Tx Power	и 14	
	Device-status request interval	a 0	
		Interval to initiate an End-Device status request (seconds). Set to 0 to disable.	
		Save & Apply Reset	
		Copyright © RAKWireless Technology Co., Ltd. All Rights Reserved	i.

Figure 21 | Built-in LoRa Server activation

Add Your Gateway in the *Gateway* tab if you haven't done so already (You can add multiples Gateways here):



- ADAK						4707-547
∲ KAK						Logout
Status	LoRa Network Server Gateway Ov	verview				
Network	Gateway					
LoRa Gateway						
LoRa Network Server	Gateway EUI	Name	Add time	Description	Last Seen	
General	60C5A8	RAK7258-1	Sat Jul 20 10:09:33 2019	RAK7258 Indo	or 3 seconds ago	Edit Delete
Gateway Application						
Global Integration		Add				
a Services	Gateway Backend Configuration					
System	Outendy buckend comparation					
	General Setup MQTT Topic					
		MQTT Broker Add	ress 127.0.0.1			
		MQTT Broker	Port 1883			
		Clie	nt ID			
		Clean Sec	sion 💽			
		Will R	atain 🕥			
			Qos 1 - Atleast Once	\sim		
		Enable User Authentic	ation ()			
		SSL/TLS M	lode Disable	\sim		
						Save & Apply Reset

Figure 22 | LoRa Server Gateway configuration

Finally go to the *Global Integration* tab and enter the address where you have your *Mosquitto* instance running in the *MQTT Broker Address* field, leave the *Port* with the default *1883 value*.

🏟 RAK			Logout
🗭 Status	Application Server Integration		
🐼 Network	Application Server Integration		
👷 LoRa Gateway			
네 LoRa Network Server	General Setup MQTT Topic template Setup		
General Gateway Application Global Integration	MQTT Breker Address MQTT Breker Port Client ID	192.168.50.23	
🗞 Services	Clean Session		
📰 System	Will Hetian Qos Enable User Aufhentication SSL/TLS Mode	1-Adeast Once. V Disable v	
			Save & Apply Roset







Now your Gateway parameters are set, except for one last part. You need to register your application in order to be able to send and receive data. We are going to use the RAK811 WisNode as an example in the next sub-section.

3.4.4 Registering the Application

Open your Serial tool, connect to the node and open the corresponding port. Reboot it so you can see the device parameters as in Figure X below:

	Command	
RAK COM: COM14 BaudRate: 15200 CLOSE	☑ 01 at+send=lora:1:10	SEND
RECEIVING CLEAR RECV	☑ 02	SEND
^	☑ 03 at+get_config=dev_eui	SEND
*****	☑ 04 at+set_config=rx2:3,868500000	SEND
RAK811 Version:3.0.0.1.H	☑ 05 at+set_config=app_eui:70B3D57ED001283B&app_key:F:	SEND
******	☑ 06 at+join=otaa	SEND
	☑ 07 at+send=0,2,000000000007F00000000000000000	SEND
	☑ 08 at+send=1,2,000000000007F00000000000000000	SEND
	☑ 09 at+app_interval=120	SEND
Selected LoRaWAN 1.0.2 Region: EU868	☑ 10 at+region=US915	SEND
Initialization OK,Current work_mode:LoRaWAN, Class: A	☑ 11 at+msg_confirm=0	SEND
OTAA:	☑ 12 at+ps=1	SEND
DevEui:00A53F61FE47EBFB	☑ 13 at+run=1	SEND
AppEui:70B3D57ED001F51E	☑ 14 at+apps_key=79F2129C18A055BD5806CA84816DAF47	SEND
AppKey:B06FB684A40D75BC7FAD4003BA8A4E0E	15	SEND
OTAA Join Start	☑ 16	SEND
	☑ 17 at+apps_key=79F2129C18A055BD5806CA84816DAF47	SEND
v .	☑ 18	SEND
SENDING(With \r\n)	☑ 19 at+band	SEND
	20	SEND
SEND	All/None	SAVE

Time 00:00:00 | PASS: 0 | FAIL: 0 | SW_Version: V1.2.1 | Make:2018-12-24 21-Jul-19 04:24:08 AM

Figure 24 | RAK811 parameters

In case your device is already configured to work in OTAA (this example) it will attempt connecting to the gateway and getting authenticated. As it is not yet registered this will not be successful. We need to do some configuring first.

Execute the command to change the working region/band (EU868 in this example):

at+set_config=lora:region:EU868



RAK SERIAL PORT TOOL

	Command	
CLOSE	☑ 01 at+send=lora:1:10	SEND
RECEIVING CLEAR RECV	02	SEND
RAK811 Version:3.0.0.1.H	☑ 03 at+get_config=dev_eui	SEND
*******	☑ 04 at+set_config=rx2:3,868500000	SEND
	☑ 05 at+set_config=app_eui:70B3D57ED001283B&app_key:F3	SEND
	☑ 06 at+join=otaa	SEND
	☑ 07 at+send=0,2,000000000007F00000000000000000	SEND
Selected LoRaWAN 1.0.2 Region: EU868	☑ 08 at+send=1,2,000000000007F00000000000000000	SEND
Initialization OK,Current work_mode:LoRaWAN, Class: A	☑ 09 at+app_interval=120	SEND
OTAA:	☑ 10 at+region=US915	SEND
DevEui:00A53F	☑ 11 at+msg_confirm=0	SEND
AppEui:70B3D5	☑ 12 at+ps=1	SEND
AppKey:B06FB6	☑ 13 at+run=1	SEND
OTAA Join Start	☑ 14 at+apps_key=79F2129C18A055BD5806CA84816DAF47	SEND
[LoRa]:Joined Successed!	☑ 15	SEND
No switch region.Current region:EU868	☑ 16	SEND
ок	☑ 17 at+apps_key=79F2129C18A055BD5806CA84816DAF47	SEND
v	☑ 18	SEND
SENDING(With \r\n)	☑ 19 at+band	SEND
at+set config=lora:region:EU868	20	SEND
SEND		
	All/None	SAVE

Time 00:00:00 | PASS: 0 | FAIL: 0 | SW_Version: V1.2.1 | Make:2018-12-24 21-Jul-19 04:30:09 AM

Figure 25 | Setting the region/band

Set the authentication mode to OTAA:

- 0

×



RAK SERIAL PORT TOOL

	Command	
RAK COM: COM14 - BaudRate: 15200 - CLOS	5E 🔽 01 at+send=lora:1:10	SEND
RECEIVING CLEAR REC	<u>.v</u> → 🔽 02	SEND
	^ ☑ 03 at+get_config=dev_eui	SEND
	☑ 04 at+set_config=rx2:3,868500000	SEND
	☑ 05 at+set_config=app_eui:70B3D57ED001283B&app_key:F: s	SEND
Selected LoRaWAN 1.0.2 Region: EU868	☑ 06 at+join=otaa	SEND
Initialization OK,Current work_mode:LoRaWAN, Class: A	☑ 07 at+send=0,2,000000000007F00000000000000000000000	SEND
OTAA:	☑ 08 at+send=1,2,000000000007F000000000000000000000000	SEND
DevEui:00A53F	☑ 09 at+app_interval=120	SEND
AppEui:70B3D5	☑ 10 at+region=US915	SEND
AppKey:B06FB6	☑ 11 at+msg_confirm=0	SEND
OTAA Join Start	☑ 12 at+ps=1	SEND
[LoRa]:Joined Successed!	☑ 13 at+run=1	SEND
No switch region.Current region:EU868	☑ 14 at+apps_key=79F2129C18A055BD5806CA84816DAF47	SEND
OK	☑ 15	SEND
join_mode:OTAA	☑ 16	SEND
ок		SEND
	V 🗹 18	SEND
, SENDING(With \r\n)	I 19 at+band	SEND
at+set_config=lora:join_mode:0	20	SEND
SEND		
	All/None s	SAVE

Time 00:00:00 | PASS: 0 | FAIL: 0 | SW_Version: V1.2.1 | Make:2018-12-24 21-Jul-19 04:32:35 AM

Figure 26 | OTAA mode

Now that your RAK811 is working in the correct region and mode you need to fill in the application parameters in your Gateway. This will register the specific device and allow you to exchange data.

Go to the Application tab. Enter a name for your application and press the Add button:

X



@RAK						Uncaver charges 2 Logout
③ Status	LoRa Netwo	k Server Application Ov	erview			
I Network	Applications					
忱 LoRa Gateway						
네 LoRa Network Server	ID	Name	Devices	Creation Date	Description	
General Gateway Application Global Integration	This section of Please input ap	plication name	Add			
log Services						Cours & Assolution
E System						Save a Apply Reset

Figure 27 | Application registration

Now go back to your *Serial Tool* and copy the **Application EUI** and **Application Key** (check Figure X below):

RAK COM: COM14 - BaudRate: 15200 - CLOSE	☑ 01 at+send=lora:1:10	SEND
RECEIVING CLEAR RECV	02	SEND
^	☑ 03 at+get_config=dev_eui	SEND
	☑ 04 at+set_config=rx2:3,868500000	SEND
	Ø 05 at+set_config=app_eui:70B3D57ED001283B&app_key:F	SEND
Selected LoRaWAN 1.0.2 Region: EU868	☑ 06 at+join=otaa	SEND
Initialization OK,Current work_mode:LoRaWAN, Class: A	☑ 07 at+send=0,2,00000000007F0000000000000000	SEND
OTAA:	☑ 08 at+send=1,2,000000000007F0000000000000000	SEND
DevEui:00A53F	☑ 09 at+app_interval=120	SEND
AppEui:70B3D5	☑ 10 at+region=US915	SEND
AppKey:B06FB6	☑ 11 at+msg_confirm=0	SEND
OTAA Join Start	☑ 12 at+ps=1	SEND
[LoRa]:Joined Successed!	☑ 13 at+run=1	SEND
No switch region.Current region:EU868	☑ 14 at+apps_key=79F2129C18A055BD5806CA84816DAF47	SEND
ок	☑ 15	SEND
join_mode:OTAA	☑ 16	SEND
ок	☑ 17 at+apps_key=79F2129C18A055BD5806CA84816DAF47	SEND
~	☑ 18	SEND
SENDING(With \r\n)	☑ 19 at+band	SEND
at+set_config=lora:join_mode:0	20	SEND
SEND		
	L All/None	SAVE

Figure 27 | Application EUI and Key



Input those into the corresponding fields in the *Application Configuration* screen in the Gateway:

🏟 RAK		UNSAVED CHANGES & Logout	
Ø Status	Application Edit - 4		
Network	Application RAK811		
⁰ X ⁰ LoRa Gateway			
LoRa Network Server	Application Configuration		
General Gateway Application 4 Global Integration	Name RAK811 Application EUI 708305 Application May B06FB6[
in Services	Auto Ado Loka Denico Uni ensiones, cono Livinze via de azorea automaticany enter appracación tos, emos appracación elegipera- Describition		
III System	Leave and the second		
	Etak to Overview Copyright © PAKVite/cost	Sove & Apply Reset	

Figure 28 | Application parameters

Save & Apply (Make sure the Auto Add Device Slider is in the off position).

🏟 RAK						Logout
Status	LoRa Ne	twork Server Appl	ication Overview			
Network	Applicat	ions				
⁶ X ⁸ LoRa Gateway						
네 LoRa Network Server	ID	Name	Devices	Creation Date	Description	
General Gateway Annirotion	4	RAK811	0	Sun Jul 21 01:36:30 2019		Edt
Global Integration	Please in	put application name	Add			
🗞 Services						Save & Apply Reset
🖽 System						
						Construct © DAVARieslane Technology Co. 11d All Dickte Departed

Now you should have an Application created. Press the *Edit* button:







Now you need to add a Device. Copy the Device EUI from the Serial Tool:

	Command	
COM: COM14 BaudRate: 15200 CLOSE	☑ 01 at+send=lora:1:10	SEND
RECEIVING CLEAR RECV	☑ 02	SEND
^ ·	☑ ⁰³ at+get_config=dev_eui	SEND
	☑ 04 at+set_config=rx2:3,868500000	SEND
	☑ 05 at+set_config=app_eui:70B3D57ED001283B≈	pp_key:F: SEND
Selected LoRaWAN 1.0.2 Region: EU868	☑ 06 at+join=otaa	SEND
Initialization OK,Current work_mode:LoRaWAN, Class: A	☑ 07 at+send=0,2,000000000007F00000000000000000000000	00 SEND
OTAA:	☑ 08 at+send=1,2,000000000007F00000000000000	00 SEND
DevEui:00A53F	☑ 09 at+app_interval=120	SEND
AppEui:70B3D5	☑ 10 at+region=US915	SEND
AppKey:B06FB6	☑ 11 at+msg_confirm=0	SEND
OTAA Join Start	☑ 12 at+ps=1	SEND
[LoRa]:Joined Successed!	☑ 13 at+run=1	SEND
No switch region.Current region:EU868	☑ 14 at+apps_key=79F2129C18A055BD5806CA84816	6DAF47 SEND
ок	☑ 15	SEND
join_mode:OTAA	☑ 16	SEND
ок	☑ 17 at+apps_key=79F2129C18A055BD5806CA8481	6DAF47 SEND
v	☑ 18	SEND
SENDING(With \r\n)	☑ 19 at+band	SEND
at+set_config=lora:join_mode:0	20	SEND
SEND		SAVE

Time 00:00:00 | PASS: 0 | FAIL: 0 | SW_Version: V1.2.1 | Make:2018-12-24 21-Jul-19 04:37:24 AM

Figure 30 | Device EUI

Enter the Device EUI in the corresponding field and press the Add button (Figure 31)

🏟 RAK				Logout
③ Status	Application Edit - 4			
Network	Application RAK811			
🕺 LoRa Gateway				
네 LoRa Network Server	Devices Application Configuration			
General Gateway Application 4 Global Integration	Last seen Device name Device EUI Select All Remove Invince EUI All Bench Add Invince EUI Add Bench Add Invince	Class Activation mode	Device Address Link marg	n Battery Description Rows per page 10 v Page 1 in 0 Prev Next
🗞 Services	Back to Counting			Saus & Annhi Barrat
Ell System				consult & Biologica Technology (n. 114 48 table based





Enter a *Device name*, make sure you are in *Class A*, *OTAA mode*. Leave the rest of the parameters with their default settings. *Save & Apply*.

🏟 RAK	present consultation to prove the consultation of the consultation
③ Status	Application - Edit Device 00a53f61fe47ebfb
톏 Network	Device-00a53f61fe47ebfb
🕅 LoRa Gateway	
네 LoRa Network Server	Configuration Activation Downlink Live Device Data
General	Device name R0X011 ×
Gateway	
Global Integration	Jain mode 017A ~
🗞 Services	Application Key DISF DISLAMID/SDC/7AD-NOCIDAAHCEE
📰 System	Eardele frame-counter Validation
	Disable Application EUI Valdation
	Description
	Back to Overview
	Copyright @ RAKWireless Technology Co., Ltd. All Rights Reserved.

Figure 32 | Device parameters

You should now have your *Device* registered and if you click on the *Device EUI* you will open the corresponding *Device* window. Go to the *Live Device Data* tab. Here you can monitor data that the application is exchanging in real time.

Leave the *Live Device Data* tab open as we want to monitor traffic.

Go the Serial Tool and reboot the RAK811 with the onboard button.



@RAK			i	ogout
🙆 Status	Application Edit Device 00aE2fC1fe47abfb	RAK SERIAL PORT TOOL		– 🗆 X
🕲 Network	Device-00a53f61fe47ebfb	RECEIVING COM: COM: COM: BaudRate: 15200 CLOSE	Command 201 at+send=lora:1:10 202	SEND SEND
'옜'LoRa Gateway 네비 LoRa Network Server	Configuration Activation Downlink Live Device Data	RAK811 Version:3.0.0.1.H	03 at+get_config=dev_eui 04 at+set_config=rx2:3,868500000 05 at+set_config=app_eui?7083D57ED001283B&app_eui?7084D57ED001283B&app_eui?7084D57E001283B&app_eui?7084D57E001283B&app_eui?7084D57E001283B&app_eui?7084D57E001283B&app_eui?7084D57E001283B&app_eui?7084D57E001283B&app_eui?7084D57E001283B&app_eui?7084D57E001283B&app_eui?7084D57E001283B&app_eui?7084D57E001283B&app_eui?7084D57E001283B&app_eui?7084D57E0001283B&app_eui?7084D57E0001283B&app_eui?7084D57E0001283B&app_eui?7084D57E0001283B&app_eui?7084D57E000000000000000000000000000000000000	SEND SEND key:F: SEND
UT DUC REAVAILS Server General Galaway Application Global Integration Caba Integration	2019/07/21.05:34:47 Jon	SENDING/With Virol Time 000000 [PASS: 0 FAIL: 0 SW_Version: V12.1 Mole:2016-	iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii	3,40912 (1330) (340)
	(Convright @ RAKWireless Technology Co., Ltd. All Ric	> hts Reserved

Figure 33 | Successful Joining of the RAK811

Figure 33 represents the output you should get if everything went well. You should see the *Join request* in the *Live Data* tab and the *Join Succeeded!* message in the *Serial Tool*.

3.4.5 Testing and monitoring the traffic

UPLINK

Now your node is authenticated with the built-in LoRa Server. As it is connected to the external MQTT Broker via the Global Integration you can monitor traffic in both the Live Data tab and on the Raspberry Pi where the Mosquitto resides. Let us test this by sending an uplink frame via the RAK811.

First in the command line window of the Raspberry we need to subscribe to the Application/Device we are going to monitor the traffic of. This is done via the following command:

mosquitto_sub -t application/{{application_ID}}/device/{{device_EUI}}/
rx -v



{{application_ID}} – is the application ID from the Application tab in the Gateway



Figure 34 | Application ID

{{device_EUI}} – is the Device EUI of the RAK811

After executing the command you need to send some data via the Serial Tool.

Use the command below to send an uplink frame on *Frame port 1*, with the *Payload 1110*:

at+send=lora:1:1110

www.RAKwireless.com



				Luguu
	Application - Edit Device 00a53f61fe47ebfb			
k	Device-00a53f61fe47ebfb			
iateway				
etwork Server	Configuration Activation Downlink Live Device Data			
	2019/07/21 06:04:56 Uplink 10 10			
in teoration				
~		Command		
	WRAN COMIL COMIL + Baddhater (15200 + CLOSE	01 at+send=lora:1:10	SEND	
	RECEIVING CLEAR RECV		SEND 🖉 pi@raspberrypic ~ 🛛 🗌	×
	OK	M 05 at+get_contig=dev_eu	pi@raspberrypi:- # mosquitto sub -t application/2/device/00a53f6lfe47ebfb/ry	8 - V
	[LORA]: Uncontirm data send UK	distant configerant wir2082057E00012828Rann kmcEi	SEND application/2/device/00a53f6lfe47ebfb/rx {"applicationID":"2", "applicationNa "RAK811"."devEUIT:"00a53f6lfe47ebfb"."deviceName":"dev-00a53f6lfe47ebfb"."ti	ime at
		M 06 atticipantas	amp":1563667080, "fCnt":11, "fPort":1, "adr":false, "data": "EA", "rxInfo":[["ga	atewa
		V 07 atternet=0.2.000000000007500000000000000000000000	<pre>yID*:"60c5a6fffe74d313","10Ra5NR":9.0,"rss1":-47,"frequency":867700000,"10ca ":("latitude":0.000000."longitude":0.000000."altitude":0])]."txInfo":("frequency":867700000,"longitude":0.000000,"altitude":0])]."txInfo":("frequency":867700000,"longitude":0.000000,"altitude":0])]."txInfo":("frequency":867700000,"longitude":0.000000,"altitude":0])]."txInfo":("frequency":867700000,"longitude":0.000000,"altitude":0])]."txInfo":("frequency":867700000,"longitude":0.000000,"altitude":0])]."txInfo":("frequency":867700000,"longitude":0.000000,"altitude":0])]."txInfo":("frequency":867700000,"longitude":0.000000,"altitude":0])]."txInfo":("frequency":867700000,"longitude":0.000000,"altitude":0])]."txInfo":("frequency":867700000,"longitude":0.000000,"altitude":0])]."txInfo":("frequency":867700000,"longitude":0.000000,"altitude":0])]."txInfo":("frequency":867700000,"longitude":0.000000,"altitude":0])]."txInfo":("frequency":867700000,"longitude":0.000000,"altitude":0])]."txInfo":("frequency":867700000,"frequency":8677000000,"altitude":0])]."txInfo":("frequency":867700000,"frequency":867700000,"frequency":867700000,"frequency":867700000,"frequency":867700000,"frequency":867700000,"frequency":867700000,"frequency":867700000,"frequency":867700000,"frequency":867700000,"frequency":867700000,"frequency":867700000,"frequency":867700000,"frequency":867700000,"frequency":86770000,"frequency":867700000,"frequency":86770000,"frequency":86770000,"frequency":86770000,"frequency":86770000,"frequency":86770000,"frequency":86770000,"frequency":86770000,"frequency":86770000,"frequency":86770000,"frequency":8677000,"frequency":8677000,"frequency":8677000,"frequency":867700,"frequency":867</pre>	ation denov
			SIND (1867700000, "dz":5})	
		at+app interval=120	SEND	
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		2 11 at+msg confirm=0	SEND	
		2 12 at+ps=1	SEND	
		2 13 at+run=1	SEND	
		14 at+apps_key=79F2129C18A055BD5806CA84816DAF47	SEND	
		2 15	SEND	
		2 16	SEND	
		2 17 at+apps_key=79F2129C18A055BD5806CA84816DAF47	SEND	
		2 18	SEND	
	CONDITION DO	2 19 at+band	SEND	
	at+send=lora:1:1010	20	SEND	_
	SEND	All/None	SAVE	

Figure 35 | Test uplink (Application)

Now if you look at the three windows in Figure 35 (Serial Tool, Live Device Data and the CLI of the Raspberry you will see that the message arriving is displayed.

Additionally you can monitor the Gateway traffic itself (all packets not just your application). You can do this via the command:

mosquitto_sub -t gateway/{{eui}}/rx -v

{{eui}} – is the Gateway EUI



LoRa	WAN Pac	ket Log	gger										
LoRa	WAN Pac	ket Log	gger										
Туре	AI			¥	DevAddr			Н	Hide CRC_ERR packet				
Total :	: 11 Uplini time	c:7 Di freq.	ownlink rssi	snr	crc	mod.	CR data	arate cni	ıt		Pause	t Clear	± Downlo
	03:00:32	868.1	-44	9.5	CRC_OK	LORA	4/5 SF78V	W125 16	5839 dev addr 260112F9 FPort 1 Payload 0191				
Server	03:00:28	868.3	-100	-11.5	CRC_ERR	LORA	4/8 SF78	W125					
- (03:00:20	868.1	-46	9.3 (CRC_OK	LORA	4/5 SF784	W125 16	5838 dev addr 260112F9 FPort 1 Payload 01 AE	pi@raspberypi ~ pi@raspberypi:- 0 sudo mosquitto .	aub -t gateway/60	c5a8fffe74d3l	- 🗆
- 0	03:00:20 03:00:18	868.1 868.1	-46 -100	9.3 (-11.8 (CRC_OK	LORA LORA	4/5 SF78V	W125 16 W125	5838 devaddr 260112F9 FPort 1 Payload 01 AE	<pre>pi@raxpberypi ~ pi@raxpberypi ~ pi@raxpberypit</pre>	mub -t gateway/60 f0":("mac":"60c5a 1":0,"rfChain":0, 15,"dataRate":("m	cSaSfffe74d31 Sfffe74d313", "crcStatus":1 odulation":"L	v "timestamp" ,"codeRate" .ORA","sprea
• (• (03:00:20 03:00:18 03:00:18	868.1 868.1 867.1	-46 -100 -50	9.3 (-11.8 (9.5 (CRC_OK CRC_ERR CRC_OK	LORA LORA LORA	4/5 SF78V 4/5 SF78V 4/5 SF78V	W125 16 W125 W125 13	5538 dev addr 260112F9 FPort 1 Payload 01.4E 3 dev addr 02000001 FPort 1 Payload 01.3E	PiErspherypi- piErspherypi- paceway/600585ff2r440313/xr (*xIn 1765, *frequency:160710000, *hanne *,ressi*-50, 1068308*9.5, *size*: or:?,*bandwidth*:125), *baard*10,* *or:?,*bandwidth*:125),*baard*10,*	<pre>aub -t gateway/60 fo":("mac":"60c5a) 1":0,"rfChain":0," 15,"dataBate":("m antenna":0),"phyP fo":("mac":"60c5a</pre>	cSa9fffe74d313", Sfffe74d313", "croStatus":1 odulation":"L ayload":"QAEA Sfffe74d313".	<pre></pre>
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	03:00:20 03:00:18 03:00:18 03:00:12 03:00:02 03:00:06 02:59:54 02:59:54	868.1 868.1 867.1 858.5 867.5 868.1 858.1 858.1	-46 -100 -50 -53 -94 -46 -45 -80	9.3 (-11.8 (9.5 (9.8 (-6.8 (10.3 (9.5 (-2.8 (CRC_OK CRC_ERR CRC_OK CRC_OK CRC_CRR CRC_OK CRC_OK CRC_OK	LORA LORA LORA LORA LORA LORA	4/5 SF78V 4/5 SF78V	w125 16 w125 13 w125 12 w125 12 w125 16 w125 16 w125 16	5536 dev addr 260112F9 FPort 1 Payload 01 AE 3 dev addr 02000001 FPort 1 Payload 01 SE 2 dev addr 02000001 FPort 1 Payload 01 SE 5837 dev addr 260112F9 FPort 1 Payload 01 Q2 5836 dev addr 260112F9 FPort 1 Payload 01 A	POLyconyca - policycleropyca - sodia moregania - moliana - policycleropyca - modia moregania - (********************************	<pre>nb -t gateway/60 Co+: { mac +: * * 0058 L + 0, * factaint +: 00 netenne*: 0), * phy? Co*: { mact +: * 00 Co*: { mac +: * 0058 L + 0, * 25 Chaint +: 1, L , * dataBate +: { mact +: 0058 L * * 0, * 25 Chaint +: 0, * phy? Co*: { mact +: 0, * phy</pre>	clasfffe74d313", "cr:Status":1 ayloed":"QARA Sfffe74d313", "cr:Status":1 ayloed":"QARA Sfffe74d313", ayloed":"QPXS Sfffe74d313", ayloed":"QPXS	

Figure 36 | Test uplink (Gateway)

This is very convenient as you have three ways to monitor and you can see the metadata and payload in both the Gateway and via the MQTT Broker.

DOWNLINK

There is a convenient tool in the Built-in LoRa Server for sending a *Downlink* frame. You can find it in the *Device* tab in the *LoRa Network Server* section. You can choose your *Type of frame* (confirmed/unconfirmed), the *Frame port* and the *Hex Data* (Refer to Figure 37).









Once you schedule a message for downlink it will be displayed in the *Live Device Data* window. Upon sending the next uplink via the *Serial Tool* you will also see it there, as it needs an uplink frame in order to send the downlink in the *RX1 window* (refer to Figure 37).

Generation Generation		Logout
🖲 Status	Application - Edit Device 00a53/61fe47ebfb	
3 Network	Design 00x576716x47abib	
A LoRa Gateway	Device-one-sector devices and the sector devices and thevector devices and the sector devic	
Lall LoRa Network Server	Configuration Activation Downlink Live Device Data	
General Gateway Application	2019/07/22 03:54:07 Uplink 11 10 2019/07/22 03:47:15 Downlink 01 10	
Global Integration	RAK SERAL PORT TOOL - CI X	
🗞 Services	Openand Command Image: Command Image: Comman	
	RECEIVING CLEAR RECY 22 SENO	
System	OK Gl 03 at+get_config=dev_eui SEND	
	AT format error. Ind Oil at+set_config=ra2-3.868500000 SERCO	
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	ad 00 at+app_interval=120 SENO	
	10 at+region=US915 SKNO	
	I at+msg.confirm=0 SEND	
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	a 1 to at sapps_key=/src/28C18A0538030805C84816DA47 \$815	
	3 10	
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	IZ 18	
	SENDING(With Vho) of 19 at-band sens	
	at+send=forar1:1110	

Figure 38 | Received Downlink Frame

Alternately if you want to test the Gateway downlink via the external MQTT Broker you need to first create a *json* file which you will be sensing your data in

Below is what the file formatting structure needs to look like:

```
{
"confirmed": true,
"fPort": 10,
"data": "1001"
}
```

"confirmed": true – This is the LoRa frame type. True (confirmed), False (unconfirmed)

"fPort": 10 - the Frame Port Number

"data": "TEST" - example data to be sent

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Note: You need to have a Base64 encoded HEX data for the above to work!

Create the file, for example with the following command and copy the data in discussed above:

sudo nano test.json

After you have your file created, you need to schedule it for downlink. This means you have to publish it via Mosquitto with the command:

sudo mosquito_pub application/{{application_ID{{/device/{{device_EUI}}/
tx -f test.json

The packet will be scheduler for downlink, which you can see in the Gateway Packet logger.

When the next uplink frame that comes for the Application/Device specified by the application_ID and device_EUI is received, the Gateway will send the data in the RX1 window to the node. You should have a response similar to the one in Figure 38.

4 **Contact Information**

Please contact us if you need technical support or want to know more information.

Support center: <u>https://forum.rakwireless.com/</u>

Email us: info@rakwireless.com



5 Revision History

Revision	Description	Date
1.0	Initial Release	2019-04-02

6 **Document Summary**

Prepared by	Checked by	Approved by
Vladislav	Yutao, Penn	



About RAKwireless:

RAKwireless is the pioneer in providing innovative and diverse cellular and LoRa connectivity solutions for IoT edge devices. It's easy and modular design can be used in different IoT applications and accelerate time-to-market. For more information, please visit RAKwireless website at www.rakwireless.com.

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