

User Manual for

# DIY Enterprise LoRa Gateway

WisDevice Series

## RAK7249

Version V1.3 | March 2019



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## 1 Overview

### 1.1 Introduction

The Enterprise Grade DIY outdoor Gateway is an ideal product for IoT commercial deployment. It contains the Main Board, Operator-grade waterproof enclosure, backup battery and mounting accessories. The hardware main board completely integrates the WIFI, 4G, GPS and PoE main supply with an integrated back-up battery. The firmware implements a fully featured LoRaWAN™ compliant network base station. The Gateway has a range of over 15Km line-of-sight and over 2Km in dense urban environments.

The DIY Gateway brings more flexibility for the developer to create an enterprise grade solution: our most important difference is our flexible development support structure, allowing for faster development and time to market. We offer both a ready to go firmware image for openWRT based platforms and an open SDK for integration into hardware to support the needs of each customer.

### 1.2 Main Features

- Enterprise grade network gateway with your own configuration.
- LoRaWAN™ Stack Inside and integrate the Web UI for management.
- Complete Hardware specification including LoRa concentrator, Cellular, GPS and WIFI.
- Supports Power of Ethernet (PoE) IEEE 802.3af/at-Compliant Class 4, 48V.
- Battery Backup sustains operation for 5 hours under typical conditions.
- IP67 waterproof enclosure with cable gland.

## 2 DIY Enterprise Gateway

Create your own Enterprise Gateway using the supplied building Blocks:

- Main Board
- Enclosure
- Backup Battery
- Accessories

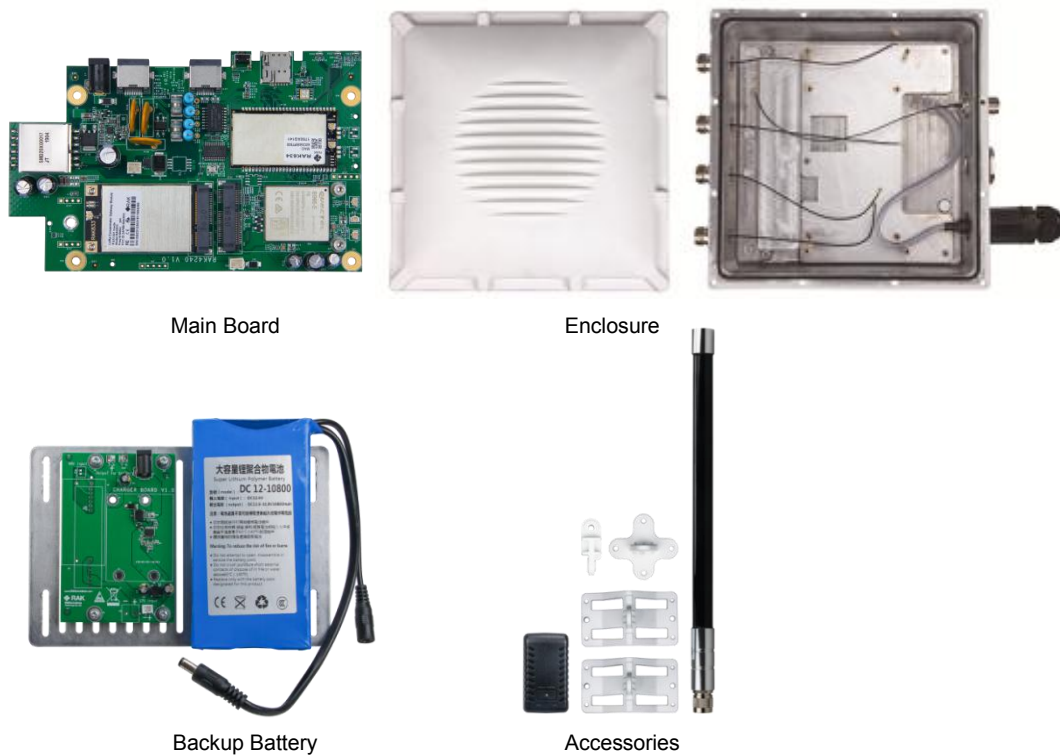


Figure 1 | DIY Enterprise Gateway

*Note: All the pictures are just for reference, if any discrepancy, please adhere to the actual product instead.*

### 2.1 Main Board

- CPU: RAK634 Module (MT7628 inside)
- RAM: 128MB DDR2
- Flash: 16MB
- WIFI: 2x2 MIMO 802.11b/g/n



- LoRa concentrator  
Standard version with 8 channel Gateway and also support Max.16 channel Gateway.  
Tx Power is up to 27dBm and Rx sensitivity is down to -142dBm.
- 4G Cellular  
Quectel EG95 for CAT4 cellular network.
- L70 GPS Module
- Power-over-Ethernet (PoE)  
100M base-T Ethernet with IEEE802.3af/at standard Power-over-Ethernet.

## 2.2 Enclosure

- IP67 waterproof white color.
- Interface: 5 x N-Type connectors for Antenna, 1 PoE port and 1 reserve port.
- Weight (with cable): approximately 70.54oz (2kg).
- Dimensions: 220mm x 220mm x 104mm.
- Wall thickness: 2mm.
- Support up to 70~100 mm diameter pole mount.

## 2.3 Backup Battery

- 12V lithium battery, capacity is 5000mAH for more than 5 hours lifetime under typical operation.
- Battery powered real time clock.
- Battery Within 140 x 70 x 30mm.
- DC 5.5 x 2.1 circular joint with two interfaces, one male and one female.

## 2.4 Accessories

- Mounting Kit
- PoE Injector
- WiFi Antenna
- GPS Antenna
- LoRa Antenna
- LTE Antenna

### 3 DIY Configuration

The bellow table shows the main board configurations of the DIY Enterprise Gateway.

Part Number	8 Channel SX1301	16 channel SX1301	Cat4 Cellular	GPS	WIFI	Battery Backup
RAK7249-0x-14x	√		√	√	√	
RAK7249-1x-14x		√	√	√	√	
RAK7249-2x-14x	√		√	√	√	√
RAK7249-3x-14x		√	√	√	√	√
RAK7249-0x	√			√	√	
RAK7249-1x		√		√	√	
RAK7249-2x	√			√	√	√
RAK7249-3x		√		√	√	√

Table 1 | DIY Configuration

## 4 Hardware Interfaces



Figure 2 | Hardware Interfaces - Front



Figure 3 | Hardware Interfaces - Rear





## 5 Product Specifications

### 5.1 Main Specifications

Feature	Specifications
Computing	<ul style="list-style-type: none"> <li>MT7628, DDR2RAM 128MB</li> </ul>
WIFI Feature	<ul style="list-style-type: none"> <li><b>Frequency:</b> 2.400-2.4835GHz(802.11b/g/n)</li> <li><b>RX Sensitivity:</b> -95dBm (Min), <b>TX Power:</b> 20dBm (Max)</li> <li><b>Operation Channels:</b> 2.4GHz: 1-13</li> </ul>
LoRa Feature	<ul style="list-style-type: none"> <li>SX1301 Mini PCIe card (connects maximum of two), 8Channels (Optional: 16channels)</li> <li><b>RX Sensitivity:</b> -142dBm (Min), <b>TX Power:</b> 27dBm (Max)</li> <li><b>Frequency:</b> EU433, CN470, EU868, US915 AS920, AS923, AU915, KR920, IN865</li> </ul>
Cellular Feature	<ul style="list-style-type: none"> <li><b>With EG95: LTE CAT 4</b></li> <li><b>Cellular Variant for Europe</b></li> <li>LTE FDD: B1/B3/B7/B8/B20/B28A</li> <li>WCDMA: B1/B8</li> <li>GSM: 900/1800MHz</li> <li><b>Cellular Variant for North America</b></li> <li>LTE FDD: B2/B4/B5/B12/B13</li> <li>WCDMA: B2/B4/B5</li> </ul>
Power Supply	<ul style="list-style-type: none"> <li>PoE(IEEE 802.3af/at-Compliant), 42~57VDC</li> </ul>
Power Consumption	<ul style="list-style-type: none"> <li>12W (typical)</li> </ul>
ETH	<ul style="list-style-type: none"> <li>RJ45(10/100M)</li> </ul>
Antenna	<ul style="list-style-type: none"> <li>5 N-Type connectors</li> </ul>
Ingress Protection	<ul style="list-style-type: none"> <li>IP67</li> </ul>
Enclosure Material	<ul style="list-style-type: none"> <li>Aluminum</li> </ul>
Weight	<ul style="list-style-type: none"> <li>Approximately 111.11oz (3.15kg)</li> </ul>
Dimension	<ul style="list-style-type: none"> <li>220mm x 220mm x 104mm</li> </ul>
Operating Temp.	<ul style="list-style-type: none"> <li>-30°C to 65 °C</li> </ul>
Installation method	<ul style="list-style-type: none"> <li>Pole or Wall mounting</li> </ul>

Table 2 | Main Specifications



## 5.2 RF Specifications

### 5.2.1 WiFi Radio Specifications

Feature	Specifications
<b>Wireless Standard</b>	• IEEE 802.11b/g/n
<b>Operating Frequency</b>	• ISM band: 2.412~2.472(GHz)
<b>Operation Channels</b>	• 2.4GHz: 1-13
<b>Transmit Power</b> (The max. power may be different depending on local regulations) -per chain	<ul style="list-style-type: none"> <li>• <b>802.11b</b> 19dBm@ 1Mbps 19dBm@ 11Mbps</li> <li>• <b>802.11g</b> 18dBm@ 6Mbps 16dBm@ 54Mbps</li> <li>• <b>802.11n (2.4G)</b> 18dBm@MCS0 (HT20) 16dBm@MCS7 (HT20) 17dBm@MCS0 (HT40) 15dBm@MCS7 (HT40)</li> </ul>
<b>Receiver Sensitivity</b> (Typical)	<ul style="list-style-type: none"> <li>• <b>802.11b</b> -95dBm@ 1Mbps -88dBm @11Mbps</li> <li>• <b>802.11g</b> -90dBm @6 Mbps -75dBm@54Mbps</li> <li>• <b>802.11n (2.4G)</b> -89dBm@MCS0 (HT20) -72dBm @MCS7(HT20) -86dBm @MCS0(HT40) -68dBm @MCS7(HT40)</li> </ul>

Table 3 | WiFi Radio Specifications

### 5.2.2 LoRa Radio Specifications

Feature	Specifications
<b>Operating Frequency</b>	<ul style="list-style-type: none"> <li>• EU433, CN470, EU868, US915</li> <li>• AS920, AS923, AU915, KR920, IN865</li> </ul>
<b>Transmit Power</b>	• 27dBm (Max)
<b>Receiver Sensitivity</b>	• -142dBm (Min)

Table 4 | LoRa Radio Specifications



## 5.3 Software Specifications

### 5.3.1 LoRa

- Supports class A, B & C
- Supports LoRaWAN protocol
- Supports country code setup
- Supports TX power setup
- Supports data logger
- Supports statistics
- Supports location setup
- Supports server address & port setup

### 5.3.2 Network

- Supports WiFi AP mode
- Supports LTE APN setup
- Supports uplink backup
- Supports 802.1q
- Supports DHCP Server/Client
- Supports router module NAT
- Supports firewall

### 5.3.3 Management

- Supports WEB Management
- Supports SSH2
- Supports firmware update
- Supports NTP

## 5.4 Block Diagram

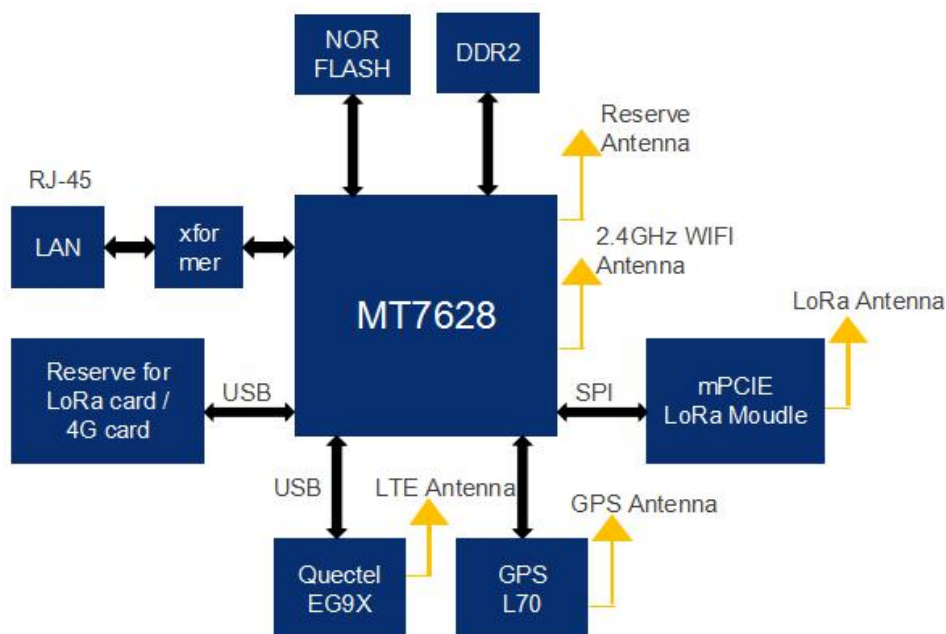


Figure 4 | Block Diagram

## 5.5 Main Board Overview

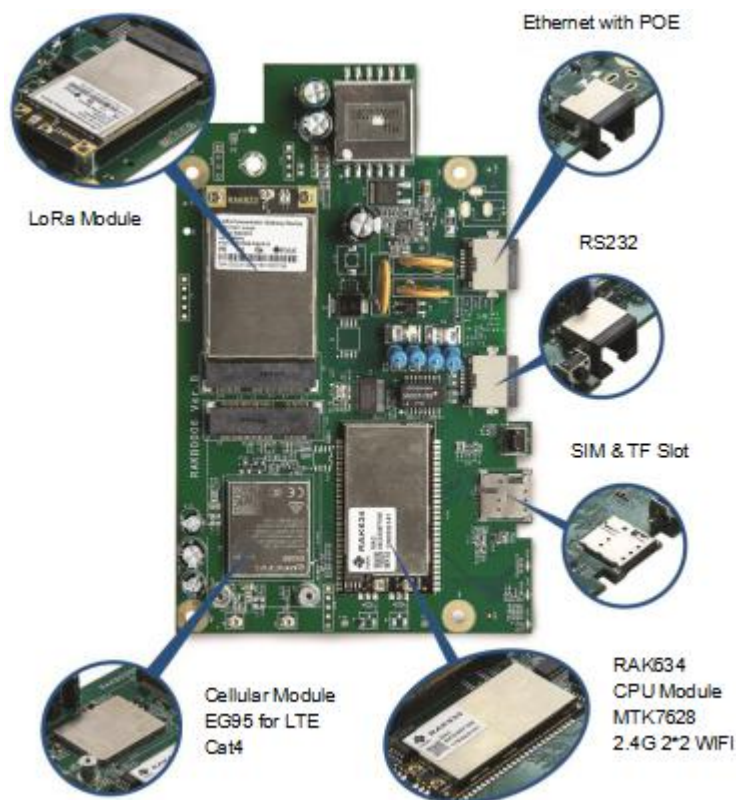


Figure 5 | Circuit Board



The RAK7249 mainboard provide a Reset key and 6\* LEDs for status indication. The function of the Reset key is as follows:

**Short press:** Restart the Gateway;

**Long press (5s and above):** Restore Factory Settings;

The status of the LEDs is described as below. Please refer to the printing of the LEDs on the mainboard.

LEDs	Status Indication Description
LED1(PWR)	<ul style="list-style-type: none"> <li>Power Indicator, Led on when device power on</li> </ul>
LED2(ETH)	<ul style="list-style-type: none"> <li><b>ON</b> - linkup</li> <li><b>OFF</b> - linkdown</li> <li><b>Flash</b> - Data Transmitting and Receiving</li> </ul>
LED3(LoRa1)	<ul style="list-style-type: none"> <li><b>ON</b> - LoRa1 is working</li> <li><b>OFF</b> - LoRa1 is not working</li> <li><b>Flash</b> - Indicate that LoRa1 Packet receiving and sending</li> </ul>
LED4(LTE)	<ul style="list-style-type: none"> <li><b>Slow Flash 1</b> (200ms Bright/1800ms Dark) - unregistered network (in search)</li> <li><b>Slow Flash 2</b> (200ms Dark/1800ms Bright) - idle status(online)</li> <li><b>Flash</b> - Data Transmitting and Receiving</li> <li><b>ON</b> - Voice is working</li> </ul>
LED5(LoRa2 for 16 channel)	<ul style="list-style-type: none"> <li><b>ON</b> - LoRa2 is working</li> <li><b>OFF</b> - LoRa2 is not working</li> <li><b>Flash</b> - Indicate that LoRa2 Packet receiving and sending</li> </ul>
LED6(WLAN)	<ul style="list-style-type: none"> <li><b>AP Mode :</b> <b>ON</b> - WLAN is working; <b>Flash</b> - Data Transmitting and Receiving</li> <li><b>STA Mode :</b> <b>Slow Flash</b> (1Hz) - Connection Disconnected; <b>ON</b> - Connection Successful; <b>Flash</b> - Data Receiving and Sending;</li> </ul>

Table 5 | LEDs Status Description



## 6 WEB Configuration Guide

### 6.1 Connect the Gateway

#### 1. Via WiFi

The WiFi of the gateway works in AP mode by default. The default SSID format is "RAKxxxx\_xxxx" such as "RAK7240\_D3BD", "D3BD" is the last two bytes of the gateway MAC address. Connecting to the SSID using your PC, then can automatically get the IP address. After successful connection, the WEB management platform can be accessed through the IP address 192.168.230.1 of the gateway LAN interface.

#### 2. Via IP Alias of WAN Port

The WAN interface of the gateway has a static IP (Auto IP Alias) generated automatically according to the MAC address. The format of the IP address is 169.254.x.x/255.255.0.0. The 3 and 4 bytes of IP correspond to the decimal representation of the fifth and sixth bytes of the MAC address, respectively. For example, the MAC address is xx: xx: xx: xx: D3: BD, and the Alias IP is 169.254.211.189/255.255.0.0.

Connecting your PC's Ethernet interface to gateway WAN interface, and adding 169.254.x.x/255.255.0.0 IP address to PC's Ethernet interface, then we can access gateway's WEB management platform through Alias IP.

#### 3. Via WAN Port DHCP IP

When DHCP Server is in the network where the gateway WAN interface is located, the WAN interface can automatically get the IP address. After inquiring the IP address of the gateway through DHCP Server, the WEB management platform of the gateway can be accessed through the DHCP IP address of WAN interface.

### 6.2 WEB Management Platform

Open the browser, enter the IP address of the gateway, and open the login page of the WEB Management Platform. Enter the user name and password (user name and password default is **root**) and click login.

#### 6.2.1 Status Overview

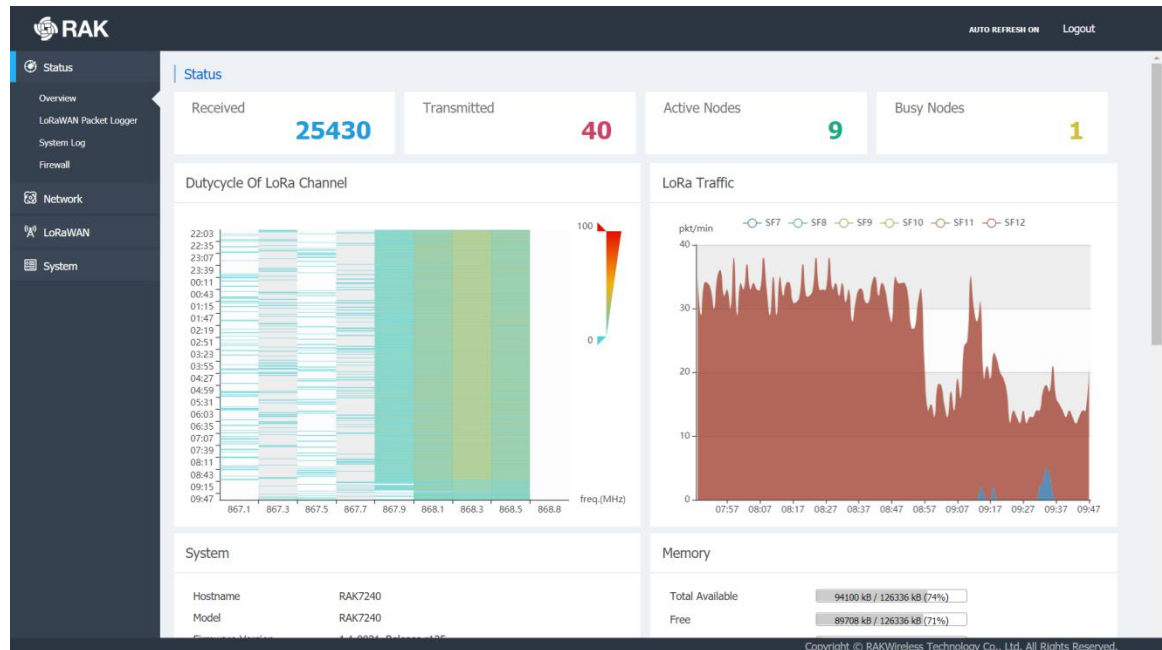


Figure 6 | Status Overview

**Received:** Shows the total number of LoRa messages received by the LoRa gateway;

**Transmitted:** Shows the LoRa message sent by the LoRa gateway;

**Active Nodes:** Shows the number of active LoRa nodes within the LoRa gateway coverage (nodes that sent messages in 10 minutes)

**Busy Nodes:** Shows the number of busy nodes within the LoRa gateway coverage (nodes with an average message spacing of less than 60s)

### Dutycycle Of LoRa Channel:

The chart shows the thermodynamic charts of the "duty cycle" of all channels over time over a period of 12 hours. The longitudinal axis is time and the minimum interval is 60s. The horizontal axis is the channel frequency. Each value represents the average duty cycle of the channel within 60s (range is: 0%-100%), green represents the low duty cycle, and red represents the high duty cycle.

### LoRa Traffic:

The chart shows the LoRa packet rate (packet/min) of each spread factor in two hours. The vertical axis represents the LoRa packet rate, in packet/min, six colors represent six spread factors, and the total height represents the sum of all the rates of LoRa packet.





## 6.2.2 LoRaWAN Packet Logger

The screenshot shows the 'LoRaWAN Packet Logger' interface. On the left is a sidebar with navigation links: Status, Overview, LoRaWAN Packet Logger (selected), System Log, Firewall, Network, LoRaWAN, and System. The main area displays a table of captured packets. At the top, there are filters for 'Type' (set to 'All') and 'DevAddr' (empty), and a checkbox for 'Hide CRC\_ERR packet'. Summary statistics show 'Total: 145', 'Uplink: 93', and 'Downlink: 0'. Action buttons for 'Pause', 'Clear', and 'Download' are present. The table has the following columns: time, freq., rssi, snr, crc, mod., CR, datarate, cnt. The first few rows of data are as follows:

time	freq.	rssi	snr	crc	mod.	CR	datarate	cnt
09:55:45	868.1	-52	10.3	CRC_OK	LORA	4/5	SF12BW125	10866
09:55:43	867.5	-77	7.8	CRC_OK	LORA	4/5	SF12BW125	7790
09:55:41	868.1	-49	10.3	CRC_OK	LORA	4/5	SF12BW125	10865
09:55:35	868.3	-49	9.8	CRC_OK	LORA	4/5	SF12BW125	10864
09:55:31	868.5	-46	8.5	CRC_OK	LORA	4/5	SF12BW125	10863
09:55:25	868.3	-49	9.8	CRC_OK	LORA	4/5	SF12BW125	10862
09:55:20	868.3	-48	9.8	CRC_OK	LORA	4/5	SF12BW125	10861
09:55:16	868.5	-49	8	CRC_OK	LORA	4/5	SF12BW125	10860
09:55:16	868.1	-74	7.5	CRC_OK	LORA	4/5	SF12BW125	7789
09:55:12	868.1	-48	8.8	CRC_OK	LORA	4/5	SF12BW125	10859
09:55:06	868.3	-49	10	CRC_OK	LORA	4/5	SF12BW125	10858
09:55:02	868.1	-49	10	CRC_OK	LORA	4/5	SF12BW125	10857

Figure 7 | LoRaWAN Packet Logger-1

This screenshot shows the same interface as Figure 7, but with a packet selected. The 'cnt' column for the selected packet (09:56:49) is expanded, showing a JSON object with the following structure:

```
{  "freq": 868500000,  "chan": 7,  "time": 2446458468,  "epoch": 1,  "pwr": 1,  "rssi": -48,  "snr": 8.3,  "modu": "LORA",  "data": "SF12BW125",  "code": "4/5",  "lora": 8.3,  "data": "QHspwGkfyOCTyeJzF3lVg=="}
```

The 'cnt' column for the next packet (09:56:45) is also expanded, showing a JSON object with the following structure:

```
{  "freq": 868300000,  "chan": 7,  "time": 2446458468,  "epoch": 1,  "pwr": 1,  "rssi": -49,  "snr": 9.3,  "modu": "LORA",  "data": "SF12BW125",  "code": "4/5",  "lora": 8.3,  "data": "QHspwGkfyOCTyeJzF3lVg=="}
```

Figure 8 | LoRaWAN Packet Logger-2

**LoRaWAN Packet Logger:** Real-time recording and parsing of messages sent and received by LoRa gateway and can be filtered according to message type and node address.



**Type:** Filter by message type. Select ALL as unfiltered and display all messages.

**DevAddr:** Filter messages based on node addresses.

**Hide CRC\_ERR packet:** When it is selected, no CRC check error message will be displayed.

**Pause/Play:** Pause/start message recording.

**Clear:** Clear the current record.

**Download:** Save the current record locally in CSV format.

### 6.2.3 WAN Network Configuration

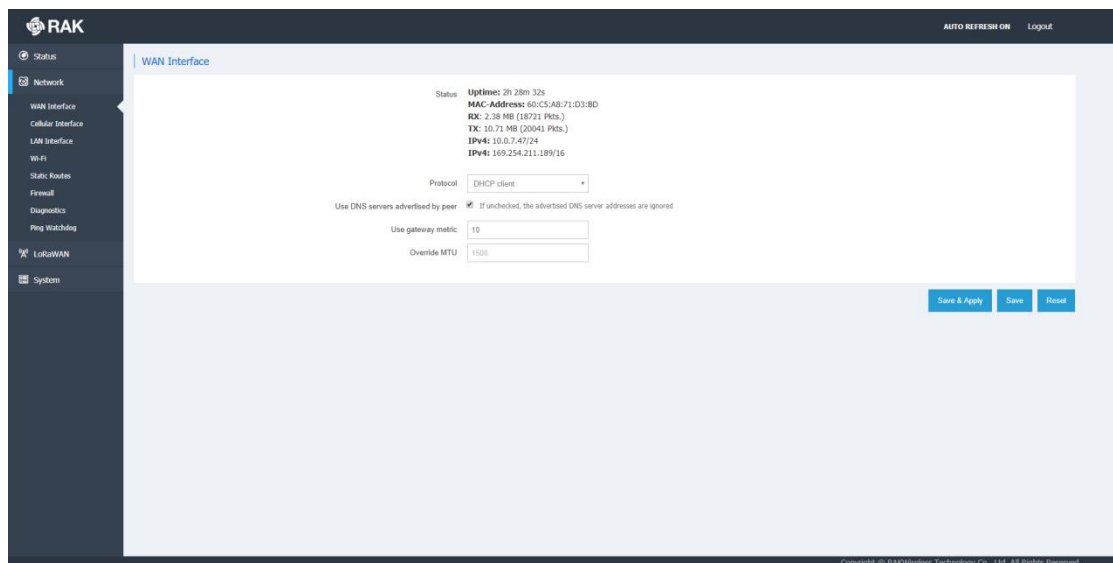


Figure 9 | WAN Network Configuration

This is for Ethernet uplink network (WAN) configuration. It supports the DHCP/PPPoE/static IP three protocols.



## 6.2.4 Cellular Network Configuration

Figure 10 | Cellular Network Configuration

This is for LTE cellular uplink network (WWAN) configuration. Please fill in APN/User/Password correctly according to the information provided by the network operators.

## 6.2.5 Packet Forwarder Configuration

Figure 11 | Packet Forwarder Configuration

**General Setup** : LoRa Network Server Configuration

**Beacon Setup** : Class B / Beacon Configuration

**GPS Information** : GPS Location Setup



LoRa Concentrator 0

radio configuration Tx Gains

Radio 0 Freq: 867500000  
Radio 0 Tx Freq Min: 863000000  
Radio 0 Tx Freq Max: 870000000  
Radio 1 Freq: 868500000

Chan. ID	Multisf 0	Multisf 1	Multisf 2	Multisf 3	Multisf 4	Multisf 5	Multisf 6	Multisf 7	LoRa std	FSK
Enable	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Radio	Radio 1	Radio 1	Radio 1	Radio 0	Radio 0	Radio 0	Radio 0	Radio 0	Radio 1	Radio 1
If	-400000	-200000	0	-400000	-200000	0	200000	400000	-200000	300000
Freq.	868.1MHz	868.3MHz	868.5MHz	867.1MHz	867.3MHz	867.5MHz	867.7MHz	867.9MHz	868.3MHz	868.8MHz
Bandwidth	125 KHz	125 KHz	125 KHz	125 KHz	125 KHz	125 KHz	125 KHz	125 KHz	250 KHz	125 KHz
DataRate	All SF	All SF	All SF	All SF	All SF	All SF	All SF	All SF	SF7	50000

Figure 12 | Radio Configuration

## Radio Configuration : Rx Setup

## Tx Gains : Tx Power Setup

## 6.2.6 Network Ping Watchdog

RAK

Logout

Network

WAN Interface  
Cellular Interface  
LAN Interface  
Wi-Fi  
Static Routes  
Firewall  
Diagnostics  
Ping Watchdog

LoRaWAN  
System

Ping Watchdog Interface Overview

Interfaces

Interface	Enabled	Tracking IP	Tracking reliability	Ping count	Ping timeout	Ping interval	Interface down	Interface up	
wan1	Yes	10.0.7.87	1	1	2s	10s	3	5	Edit Delete
wan0	Yes	10.0.7.87	1	1	2s	10s	3	5	Edit Delete

Add

Save & Apply Save Reset

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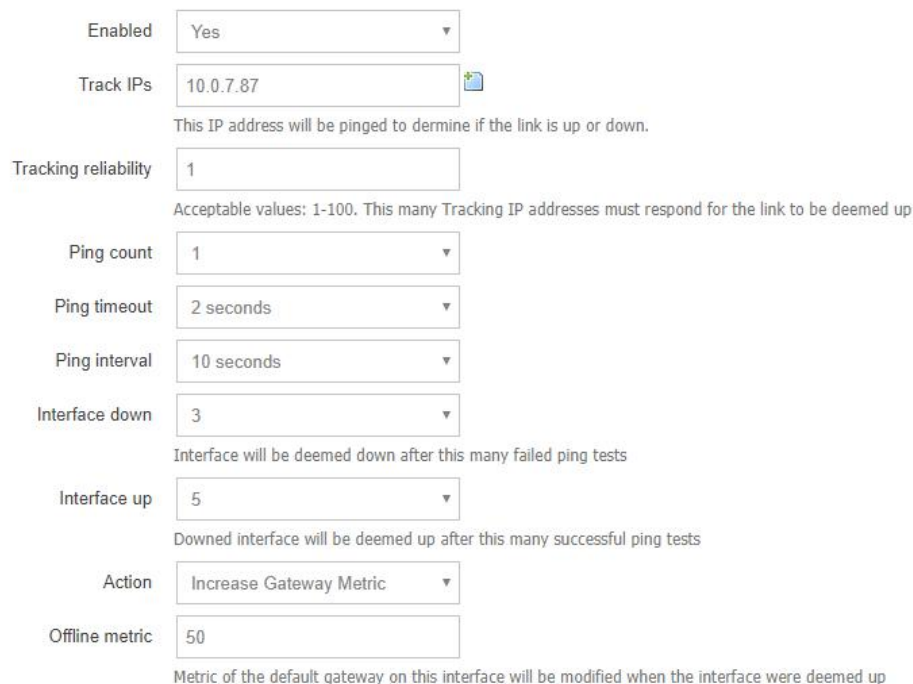
Figure 13 | Ping Watchdog Interface

Ping Watchdog monitors the communication quality of network links by constantly pinging the specified IP address or domain name on the specified uplink network interface. When network link failures are found, scheduled measures are taken automatically, such as <restart interface>/<reduce the priority of this uplink network interface>/<restart the device>.



**Note:** Reducing the priority of an uplink interface only works when the LoRa gateway uses both the Ethernet uplink link and the LTE cellular network uplink link.

WAN interface represents the Ethernet uplink interface and WWAN represents the LTE cellular network uplink interface. If Ping watchdog is opened on both uplink network interfaces at the same time and action is set to Increase Gateway Metric, the two uplink links form backup links and automatically switch to another link when one link fails. The priority of the two links is determined by the default gateway metric of their respective network interfaces. The default gateway metric can be set in Network->WAN Network and Network->Cellular Network. The lower the gateway metric, the higher the priority of the link.



The screenshot shows the 'Ping Watchdog Configuration' settings. The 'Enabled' dropdown is set to 'Yes'. The 'Track IPs' field contains '10.0.7.87' with a help icon. Below it, a note states: 'This IP address will be pinged to determine if the link is up or down.' The 'Tracking reliability' field is set to '1', with a note: 'Acceptable values: 1-100. This many Tracking IP addresses must respond for the link to be deemed up'. The 'Ping count' dropdown is set to '1'. The 'Ping timeout' dropdown is set to '2 seconds'. The 'Ping interval' dropdown is set to '10 seconds'. The 'Interface down' dropdown is set to '3', with a note: 'Interface will be deemed down after this many failed ping tests'. The 'Interface up' dropdown is set to '5', with a note: 'Downed interface will be deemed up after this many successful ping tests'. The 'Action' dropdown is set to 'Increase Gateway Metric'. The 'Offline metric' field is set to '50', with a note: 'Metric of the default gateway on this interface will be modified when the interface were deemed up'.

Figure 14 | Ping Watchdog Configuration

### 6.2.7 Backup or Upgrade

In Backup/Flash Firmware page, you can backup your configuration or restore your gateway, and you can upgrade to a new firmware. As shown in the following figure.

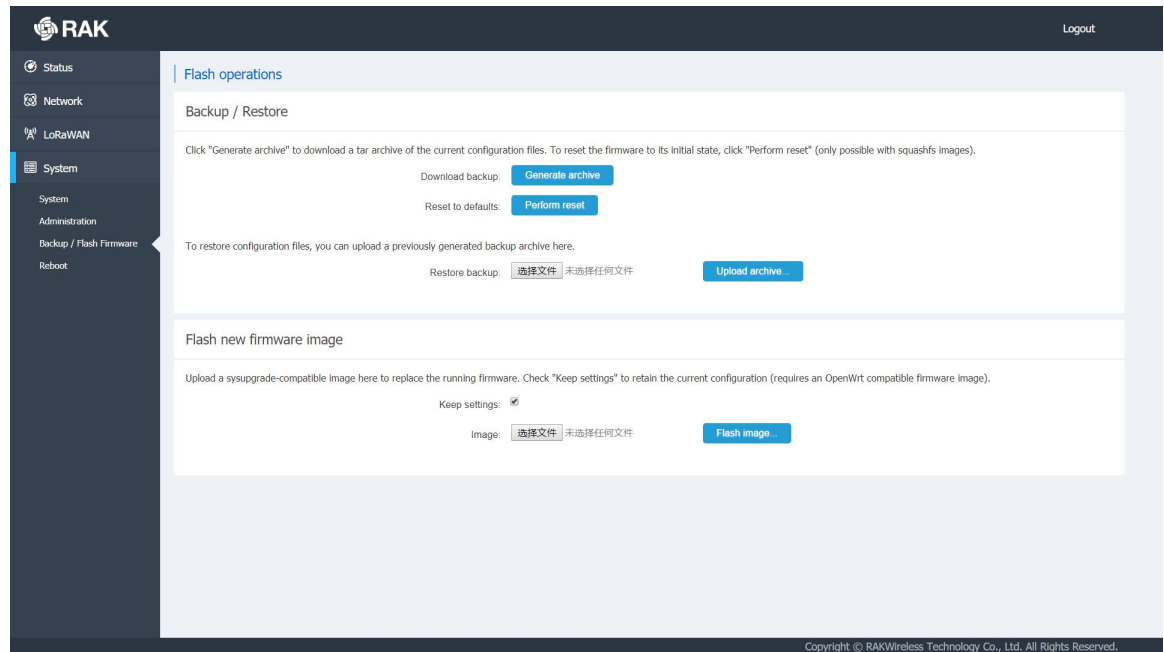


Figure 15 | Backup or Upgrade

## 7 Contact Information

### Shenzhen Business



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### Shenzhen Technical



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## 8 Revision History

Revision	Description	Date
1.0	Initial version	2019-01-15
1.1	Modify pictures and the right context	2019-01-21
1.2	Modify the WEB configuration guide chapter	2019-03-11
1.3	Add the LEDs Status Indication Description	2019-03-13

## 9 Document Summary

**Document Name:** DIY Enterprise Gateway RAK7249 User Manual

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### 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](http://www.rakwireless.com).