

Getting Started Guide for KNOT IoT Gateway

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Table of Contents

1	<i>Document Information</i>	1
2	<i>Overview</i>	2
3	<i>Hardware Description</i>	2
4	<i>Set up your Development Environment</i>	4
5	<i>Set up your hardware</i>	5
6	<i>Setup your AWS account and Permissions</i>	9
7	<i>Create Resources in AWS IoT</i>	9
8	<i>Provision the Device with credentials</i>	9
9	<i>Build the demo</i>	10
10	<i>Run the demo</i>	10
11	<i>Debugging</i>	10
12	<i>Troubleshooting</i>	10

1 Document Information

1.1 Naming Conventions

The term “IoT gateway” is used in this document to refer to the device that is able to connect to AWS IoT portal for data posting. The term “Bluetooth tag” refers to the Bluetooth device that is able to broadcast Bluetooth advertising packets.

1.2 Glossary

Gateway - a device used to connect two different networks, especially a connection to the internet.

Narrowband IoT - is a standards-based low power wide area (LPWA) technology developed to enable a wide range of new IoT devices and services.

CAT-M or LTE-M – is a low power wide area (LPWA) technology designed to support IoT devices with cellular technologies.

IoT Device – is the nonstandard computing device that connects wirelessly to a network and has the ability to transmit data, such as the many devices on the internet of things.

- 1.3 Revision History (Version, Date, Description of change)
- 1.0 14-Jan-2022 Initial Version

2 Overview

KNOT or RB924i-2nD-BT5&BG77.

The newest addition to the MikroTik IoT product family – KNOT – is a truly universal device with exceptional connectivity options and protocol support. It is an IoT Gateway that uses Narrow Band and CAT-M technology. Because of the low cost, low bandwidth cellular connection, it is supported by countless mobile operators around the globe.

KNOT can monitor onboard GPIOs, convert Modbus protocol to TCP, and even forward Bluetooth packets to TCP/IP network via HTTPS and MQTT.

It could be used as a backup connection for the Ethernet or as a management channel for your network. NB/CAT-M monthly plan is much cheaper than LTE.

3 Hardware Description

3.1 DataSheet

KNOT:

<https://mikrotik.com/product/knot#fndtn-specifications>

3.2 Standard Kit Contents

Included parts are shown in the bottom the KNOT's specification page (under "Included parts"):

<https://mikrotik.com/product/knot>

[24V 1.2A power adapter](#)

[K-47 wall mount set](#)

[USB OTG cable](#)

[DIN rail mount set](#)

KNOT manual (hardware setup) can be found at:

<https://help.mikrotik.com/docs/pages/viewpage.action?pageId=41680915>

You will require RJ-45 cables to setup LAN and/or WAN connection. RJ-45 cables are not provided.

The device can be powered with micro-USB(5-5 V), DC-jack (12-57 V) or PoE (active af/at and passive – 12-57 V). Micro-USB and DC jack are provided with the package.

3.3 User Provided items

RJ-45 connection or NB-IoT/Narrow band WAN connection is required for the device to reach global network.

In case it is RJ-45/Ethernet connection to ISP router/any other uplink router – an ethernet cable connection must be provided to the unit (device has x2 100 Mbps Ethernet ports).

In case it is NB-IoT/Narrowband WAN ISP connection, you will need:

- 1) IOT NB/LTE-M SIM card (SIM card that supports IOT NB/LTE-M connection);*
 - 2) External antennas for the Narrow Band modem and GPS. Not provided with the package.*
- <https://help.mikrotik.com/docs/pages/viewpage.action?pageId=41680915#heading-GPS>

Access to the POWER source via a power adapter (adapter is provided).

3.4 3rd Party purchasable items

Not required.

3.5 Additional Hardware References

KNOT can publish MQTT messages to AWS. The message itself can be a KNOT's report – message with the general information about the device, like model name, serial number, RouterOS version, current CPU, used memory, free memory, and up-time.

Or, you can use the KNOT with additional hardware, like Bluetooth tags (that can be positioned around the KNOT's Bluetooth range). Bluetooth tags should be able to broadcast Bluetooth advertising packets over advertising channels 37, 38 or/and 39.

KNOT's Bluetooth interface is able to receive the tag's reports and display them in the device's GUI. Tag's reports are usually broadcasted in the HEX format. The KNOT can be scripted to publish the tag's reports via MQTT to AWS broker/servers.

Once the payload is displayed on the server - the published HEX payload can be deciphered into an understandable format. The HEX's payload (that was reported by the tag) will contain information about the tag, like for example, its temperature at the moment of the report (if the device has a temperature sensor) or its acceleration – movement (if the tag has a built-in acceleration sensor).

You can use any vendor Bluetooth tag, as long as the tag supports advertising over Bluetooth advertising channels 37, 39 and/or 39.

MikroTik's tags can found at:

https://mikrotik.com/product/tg_bt5_in

and

https://mikrotik.com/product/tg_bt5_out

If the GNSS is required to pinpoint the KNOT's location, you can use:
<https://mikrotik.com/product/acgpsa>
GPS antenna.

4 Set up your Development Environment

4.1 Tools Installation (IDEs, Toolchains, SDKs)

MikroTik “first time configuration” guide can be found at:
<https://help.mikrotik.com/docs/display/ROS/First+Time+Configuration>

KNOT manual can be found at:
<https://help.mikrotik.com/docs/pages/viewpage.action?pageId=41680915>

KNOT quick-guide can be found at:
<https://help.mikrotik.com/docs/pages/viewpage.action?pageId=40992896>

MQTT publish to AWS:
<https://help.mikrotik.com/docs/pages/viewpage.action?pageId=63045633>

RouterOS (MikroTik operation system) is based on linux kernel.
RouterOS v6.x. – supports Linux Kernel version 3.3.5.
In RouterOS v7.x – system kernel has been updated to version 5.6.3.

RouterOS can be managed using different options:
<https://help.mikrotik.com/docs/display/ROS/Management+tools>
CLI (telnet), WEBGUI (443/80 port), Winbox (software).
WEBGUI allows you to browse the settings using your browser. Chrome, Mazilla – the popular choices are suggested.
Winbox is a small utility that allows the administration of MikroTik RouterOS using a fast and simple GUI. It is a native Win32 binary but can be run on **Linux** and **macOS (OSX)** using Wine.

RouterOS firmware versions can be found at:
<https://mikrotik.com/download>
KNOT uses MIPSBE architecture.

RouterOS documentation can be found at:
<https://help.mikrotik.com/docs/display/ROS/RouterOS>

4.2 Other software required to develop and debug applications for the device

You can debug the KNOT using its own (software build-in) debug tools, like pings or packet capture.

You can debug NB-IoT/Narrowband connection following the guide:

<https://help.mikrotik.com/docs/display/UM/BG77+modem+AT+commands>

Community presentation on RouterOS debugging:

https://mum.mikrotik.com/presentations/LB16/presentation_3546_1466414640.pdf

and:

https://mum.mikrotik.com/presentations/LK17/presentation_4374_1497252077.pdf

page 35.

4.3 Other pre-requisites

Not required.

4.4 Additional Software References

MikroTik forum:

<https://forum.mikrotik.com/>

5 Set up your hardware

KNOT manual (hardware setup guide) can be found at:

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KNOT quick-guide can be found at:

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MQTT publish to AWS guide:

<https://help.mikrotik.com/docs/pages/viewpage.action?pageId=63045633>

The device pictures are available over at:

<https://mikrotik.com/product/knot#fndtn-gallery>

RouterOS firmware versions can be found at:

<https://mikrotik.com/download>

KNOT uses MIPSBE architecture.

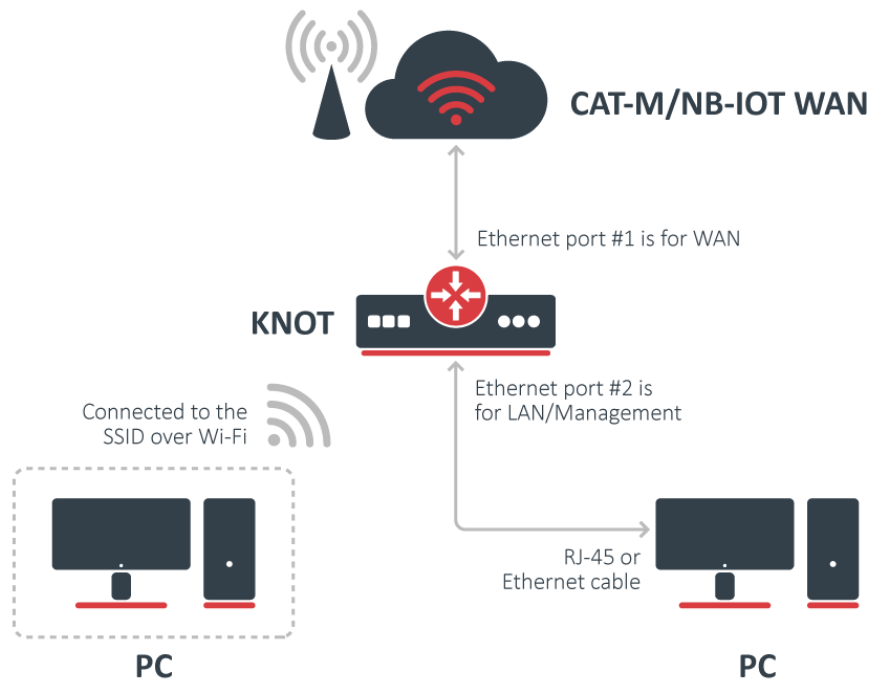
RouterOS upgrade guide can be found at:

<https://help.mikrotik.com/docs/display/ROS/Upgrading+and+installation>

RouterOS documentation can be found at:

<https://help.mikrotik.com/docs/display/ROS/RouterOS>

Connecting:



Make sure your Internet service provider is allowing hardware change and will issue an automatic IP address;

- *Connect your ISP cable to the first Ethernet port (First Ethernet port should be used for WAN connection) or/and insert the CAT-M/NB-IoT SIM Card into the SIM slot;*
- *Connect the device to the power source;*
- *Open network connections on your computer and search for MikroTik wireless network - connect to it or connect your PC to the second Ethernet port with RJ-45 Ethernet cable;*
- *The configuration has to be done using a web browser or mobile app. Alternatively, you can use a WinBox configuration tool <https://mt.lv/winbox>;*
- *Open <https://192.168.88.1> in your web browser to start configuration, user name: admin and there is no password by default;*
- *Click the Check for updates button and update your RouterOS software to the latest version, must have an active Internet connection;*
- *From here, you can use Quick Set for a quick setup for the device.*

Mounting:



1. The device can be mounted using provided DIN rail mount set. Designed to fit standard 35 mm x 7.5 mm DIN rails. Attach it with two provided screws to the device and attach the device to the DIN rail. The DIN rail is not provided in the package.
2. Alternatively, it is possible to attach the device to a wall, using the provided screw holes on the back of the unit. The device should be mounted in a way that the cable openings are pointing downward as shown in the picture.

Warning! This equipment should be installed and operated with a minimum distance of 20 cm between the device and your body. The operation of this equipment in the residential environment could cause radio interference.

Mounting and configuration of this device should be done by a qualified person.

Powering:

- *Direct-input power jack (5.5 mm outside and 2 mm inside, female, pin positive plug) accepts 12-57 V DC.*
- *microUSB port accepts 5 V powering.*
- *Ethernet port accepts 802.3af/at Power over Ethernet 12-57 V DC.*

The power consumption under maximum load with attachments can reach 18 W.

Connecting to a PoE Adapter:

1. *Connect the Ethernet cable from the device to the PoE+DATA port of the PoE adapter.*
2. *Connect an Ethernet cable from your local network (LAN) to the PoE adapter.*
3. *Connect the power cord to the adapter, and then plug the power cord into a power outlet.*

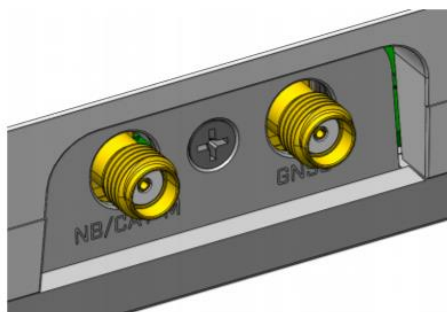
Extension slots and ports:



- 2.4 GHz, 802.11b/g/n, antenna gain 1.5 dBi.
- Built-in GPS module (GPS, GLONASS, BeiDou, Galileo).
- Two 10/100 Ethernet ports, supporting automatic cross/straight cable correction (Auto MDI/X). Either straight or crossover cable can be used for connecting to other network devices. The Ethernet port accepts 12-57 V DC power from an 802.3af/at PoE injector.
- One microUSB 2.0 port.
- One nano SIM slot.
- Bluetooth version 5.2, antenna gain 2 dBi.

GNSS and NB/CAT-M antenna slots:

Attach your antennas to the SMA connectors:



BG77 supports NB and GNSS !cannot be used together!

<https://help.mikrotik.com/docs/display/ROS/IoT>

External antennas must be connected to use the Narrow Band modem and GPS. Not provided with the package.

Buttons and jumpers:

Reset button:

- *Hold this button during boot time until the LED light starts flashing, release the button to reset RouterOS configuration (total 5 seconds). In other words, press the reset button before applying power to the device and power on the unit, while keeping the reset button pressed for 5 seconds (until the last LED [to the right] on the LED panel starts blinking) – then release the button.*
- *Keep holding for 5 more seconds, LED turns solid, release now to turn on CAP mode. The device will now look for a CAPsMAN server (total 10 seconds).*
- *Or keep holding the button for 5 more seconds until LED turns off, then release it to make the RouterBOARD look for Netinstall servers (total 15 seconds).*

Regardless of the above option used, the system will load the backup RouterBOOT loader if the button is pressed before power is applied to the device. Useful for RouterBOOT debugging and recovery.

6 Setup your AWS account and Permissions

Refer to the instructions at [Set up your AWS Account](#). Follow the steps outlined in these sections to create your account and a user and get started:

- Sign up for an AWS account and
- Create a user and grant permissions.
- Open the AWS IoT console

Pay special attention to the Notes.

7 Create Resources in AWS IoT

Refer to the instructions at [Create AWS IoT Resources](#). Follow the steps outlined in these sections to provision resources for your device:

- Create an AWS IoT Policy
- Create a thing object

Pay special attention to the Notes.

8 Provision the Device with credentials

MQTT publish to AWS guide is shown over at:

<https://help.mikrotik.com/docs/pages/viewpage.action?pageId=63045633>

The guide shows how to generate certificates using AWS portal

(<https://help.mikrotik.com/docs/pages/viewpage.action?pageId=63045633#heading-Certificates>) and how to import the certificates into the Router

(<https://help.mikrotik.com/docs/pages/viewpage.action?pageId=63045633#heading-Certificates-2>).

9 Build the demo

10 Run the demo

MQTT publish to AWS:

<https://help.mikrotik.com/docs/pages/viewpage.action?pageId=63045633>

Verification is shown in the last section of the guide:

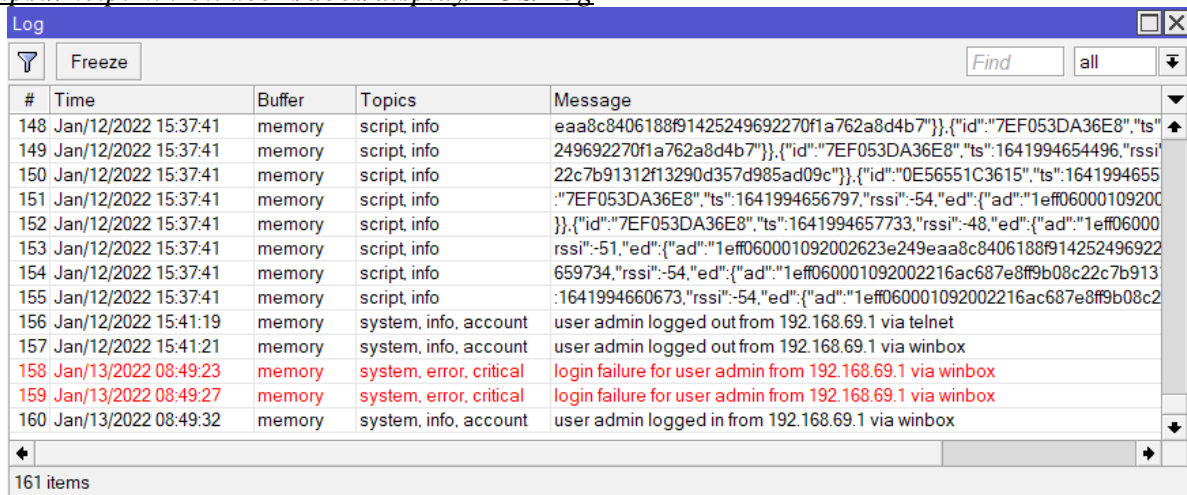
<https://help.mikrotik.com/docs/pages/viewpage.action?pageId=63045633#heading-Verification>

11 Debugging

KNOT does not have a console port for debugging.

But it has logs in GUI. You can find the logs guide over at:

<https://help.mikrotik.com/docs/display/ROS/Log>



The screenshot shows a window titled "Log" with a search bar and a "Freeze" button. Below is a table of log entries with columns for #, Time, Buffer, Topics, and Message. The table contains 161 items, with the last few entries highlighted in red.

#	Time	Buffer	Topics	Message
148	Jan/12/2022 15:37:41	memory	script, info	...{"id":"7EF053DA36E8","ts":...
149	Jan/12/2022 15:37:41	memory	script, info	...{"id":"7EF053DA36E8","ts":...
150	Jan/12/2022 15:37:41	memory	script, info	...{"id":"0E56551C3615","ts":...
151	Jan/12/2022 15:37:41	memory	script, info	...{"id":"7EF053DA36E8","ts":...
152	Jan/12/2022 15:37:41	memory	script, info	...{"id":"7EF053DA36E8","ts":...
153	Jan/12/2022 15:37:41	memory	script, info	...{"id":"7EF053DA36E8","ts":...
154	Jan/12/2022 15:37:41	memory	script, info	...{"id":"7EF053DA36E8","ts":...
155	Jan/12/2022 15:37:41	memory	script, info	...{"id":"7EF053DA36E8","ts":...
156	Jan/12/2022 15:41:19	memory	system, info, account	user admin logged out from 192.168.69.1 via telnet
157	Jan/12/2022 15:41:21	memory	system, info, account	user admin logged out from 192.168.69.1 via winbox
158	Jan/13/2022 08:49:23	memory	system, error, critical	login failure for user admin from 192.168.69.1 via winbox
159	Jan/13/2022 08:49:27	memory	system, error, critical	login failure for user admin from 192.168.69.1 via winbox
160	Jan/13/2022 08:49:32	memory	system, info, account	user admin logged in from 192.168.69.1 via winbox

12 Troubleshooting

RouterOS CLI allows using ping and packet capture tools.

<https://help.mikrotik.com/docs/display/ROS/Ping>

You can use packet capture to capture outgoing/incoming packets and see the packet communication between broker and publisher:

<https://help.mikrotik.com/docs/display/ROS/Packet+Sniffer>

You can also use logs section, to check relevant MQTT log messages reported by the KNOT:

<https://help.mikrotik.com/docs/display/ROS/Log>