

RAK M310/M320 User Manual

Simple configuration guide for developers, private LTE&5G and some other usage

NOTE: This is a beta version document, contact us for more details.

Installation

Attention: Good GPS signal is required to activate and run 4G&5G radios.

- Take out device from package, assemble device with pedestal.



- Put device close to window.



- Connect GPS antenna to the device, and put out the antenna outside the window to get a good GPS signal.



- Connect the PoE power source to the WAN/PoE port on the device to power it up.

Hardware specifications

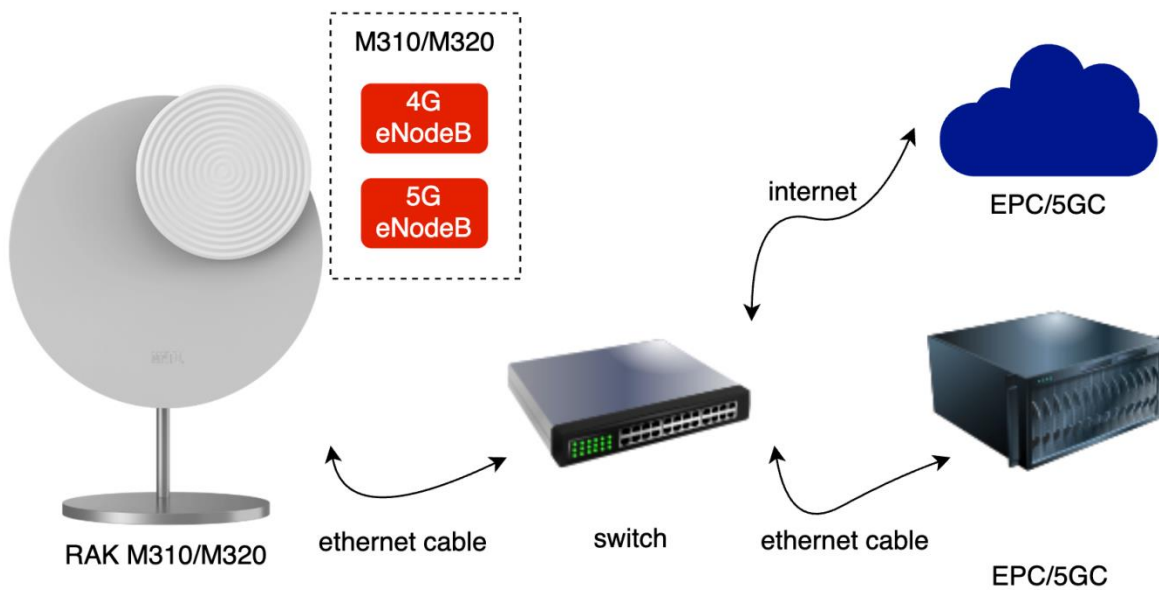
		M310	M320
Network	LTE	✓	✓
	5G NR		✓
	LoRaWAN®	✓	✓
	Wi-Fi 6		
FCC ID		2AF6B-M310	2AF6B-M320
Contain FCC ID		2ABCB-RPICM4	2ABCB-RPICM4
Frequency band		B48 (3550 to 3700 MHz)	B48, n48, n78 (3550 to 3700 MHz)
4G/5G Core		✓	✓
PoE (802.3bt)		✓	✓
Computing		Quad core Cortex-A72 (ARM v8)	Quad core Cortex-A72 (ARM v8)
RAM		4GB	4GB
eMMC		32G	32G
Ethernet		2.5G	2.5G
Tx power		2 x 24 dBm/port	2 x 24 dBm/port
Power consumption		30W (MAX)	55W (MAX)
USB		Type-C USB3.0	
Button		One pairing button	
LED		Tricolor LED (top side)	
Antenna	LTE	Internal antenna	
	5G NR	Internal antenna	

	LoRaWAN®	Internal antenna (supporting switch to external antenna)
	GPS	Internal antenna (supporting switch to external antenna)
Dimension	300 mm x 311.5 mm x 79 mm	
Ingress protection	IP30	
Enclosure material	Plastics	
Weight	4.2 kg	
Operating temperature	-5°C to 45°C	
Storage temperature	-10°C to 50°C	
Humidity	5% to 95% RH	
Atmospheric pressure	70 kPa to 106 kPa	

Configuration

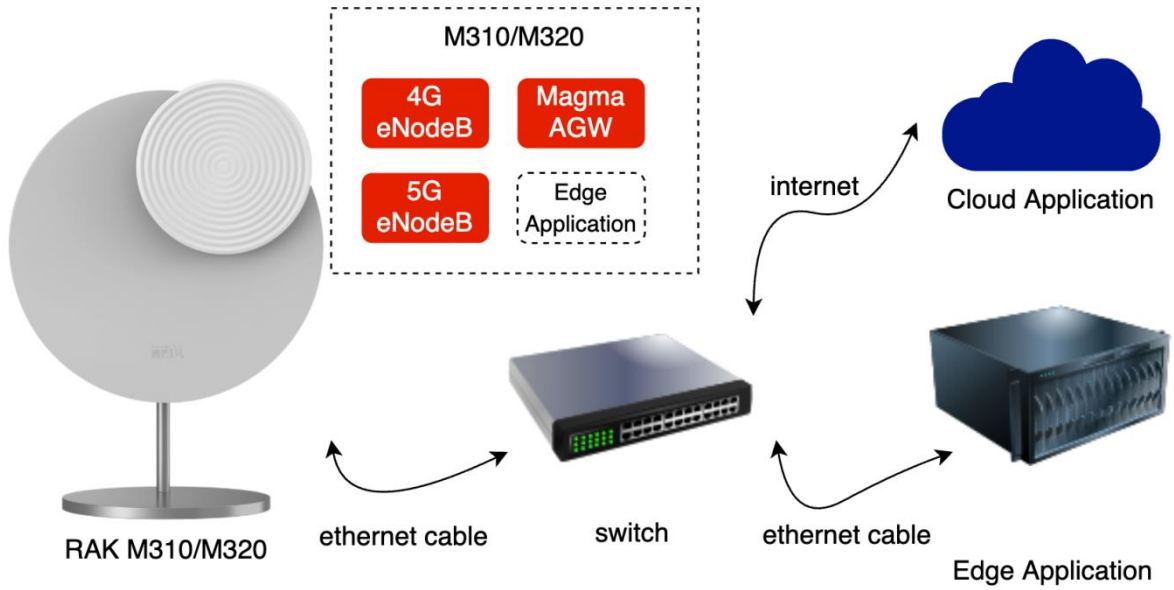
There's 4 major scenario you can use RAK M310/M320 device for, customers are required to configure the device according to their usage.

- Take RAK M310/M320 as a pure 4G and/or 5G radio, connect to external customer's own EPC/5GC. Please refer to chapter **Configuration with External EPC/5GC**



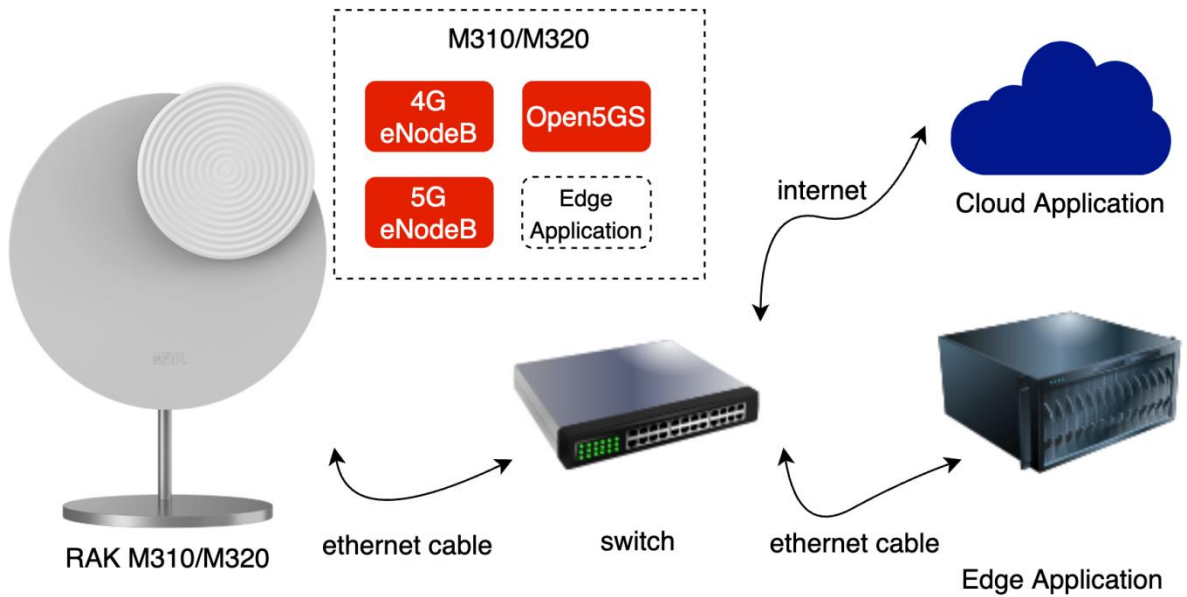
Scenario1. RAK M310/M320 connect to external EPC/5GC

- Take RAK M310/M320 as an All in One device, running with RAK's open source Magma AGW inside. Please refer to chapter **Configuration with Magma inside**



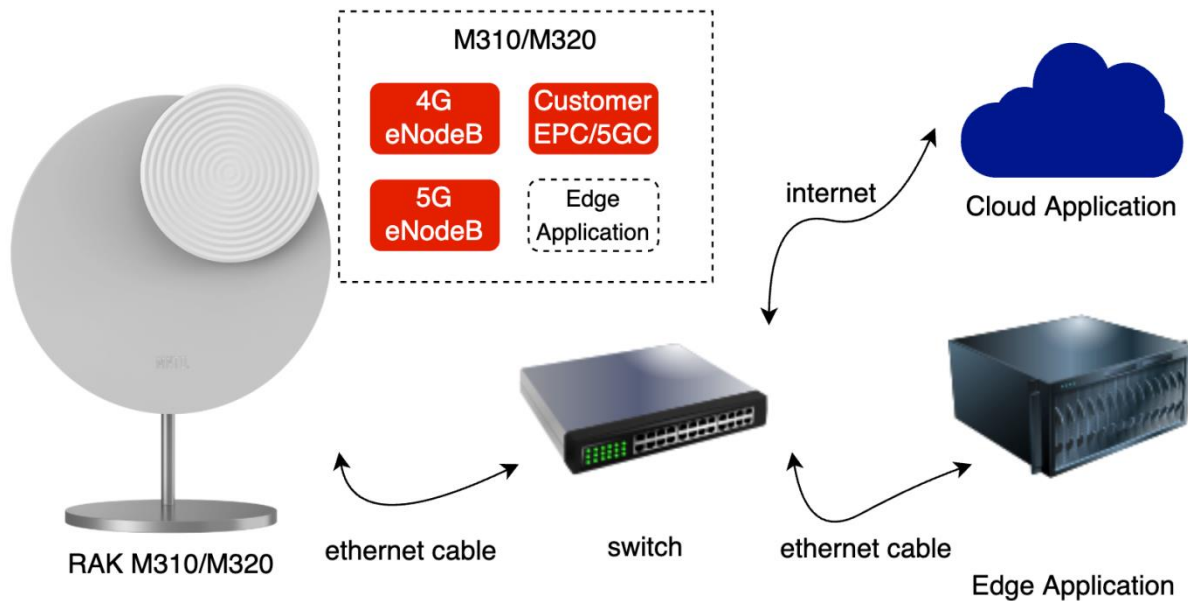
Scenario2. RAK M310/M320 with Magma AGW inside

- Take RAK M310/M320 as an All in One device, running with RAK's open source Open5GS inside. Please refer to chapter **Configuration with Open5GS inside**



Scenario3. RAK M310/M320 with Open5GS inside

- Take RAK M310/M320 as an All in One device, with customers own EPC/5GC on open hardware CM4. Please refer to chapter **Configuration with Customer's EPC/5GC inside**



Scenario4. RAK M310/M320 with Magma AGW inside

Configuration with External EPC/5GC

This chapter will describe basic configuration to connect eNodeB and/or gNodeB to customer's own EPC and/or 5GC, after these configuration, the eNodeB and/or gNodeB start serving. For more configuration details, please refer to **MNTD. 5G LTE Configuration Guide** and **MNTD. 5G NR Configuration Guide**

Here's the basic steps configuring RAK M310/M320 with customer's own EPC/5GC:

- Step 1: Prepare your PC or laptop's network to access to RAK M310/M320's local web
- Step 2: Login to eNodeB and/or gNodeB's local web
- Step 3: Configure eNodeB's S1 and/or gNodeB's N2 interface network according to your requirement
- Step 4: Configure eNodeB and/or gNodeB's PLMN, TAC, Cell ID, MME and/or AMF IP address, etc
- Step 5: Configure NTP server for eNodeB and/or gNodeB.
- Step 6: Reboot eNodeB and/or gNodeB to use new configuration

Please plan parameters below before configuration:

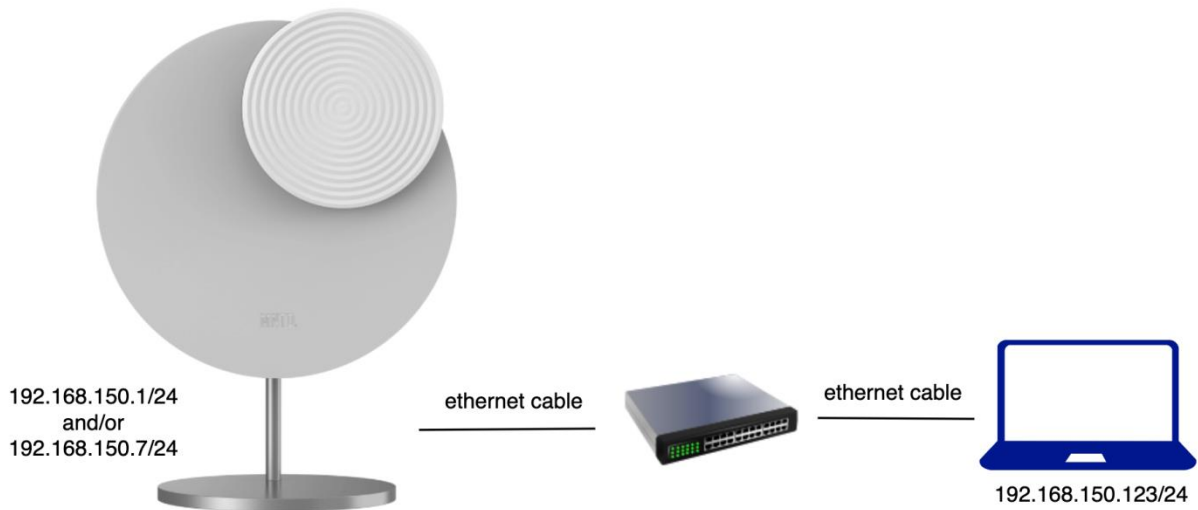
Item	Parameter	Description
IP Address	OAM IP	OAM uses a separate IP address to access to local web, 192.168.150.123/24, etc.
	Core IP	MME IP for 4G eNodeB, AMF IP for 5G gNodeB, planned by the customer.
Cell Parameters	PLMN	Planned by the customer.
	TAC	Planned by the customer.
	Cell ID	Planned by the customer.
NTP Server	NTP Server Address	Planned by the customer. NOTE: NTP is required to activate and run 4G eNodeB and 5G gNodeB.

Step 1 Prepare Network to Access to Local Web

RAK M310&M320's 4G eNodeB configured with a static IP address 192.168.150.1/24 to serve for local web access.

RAK M320's 5G gNodeB configured with a static IP address 192.168.150.7/24 to serve for local web access.

Customers are require to configure their PC or laptop's ethernet port to subnet 192.168.150.0/24 to access eNodeB or gNodeB's local web managment, bridged by a router/switch or connected directly. The network connection may looks like this:

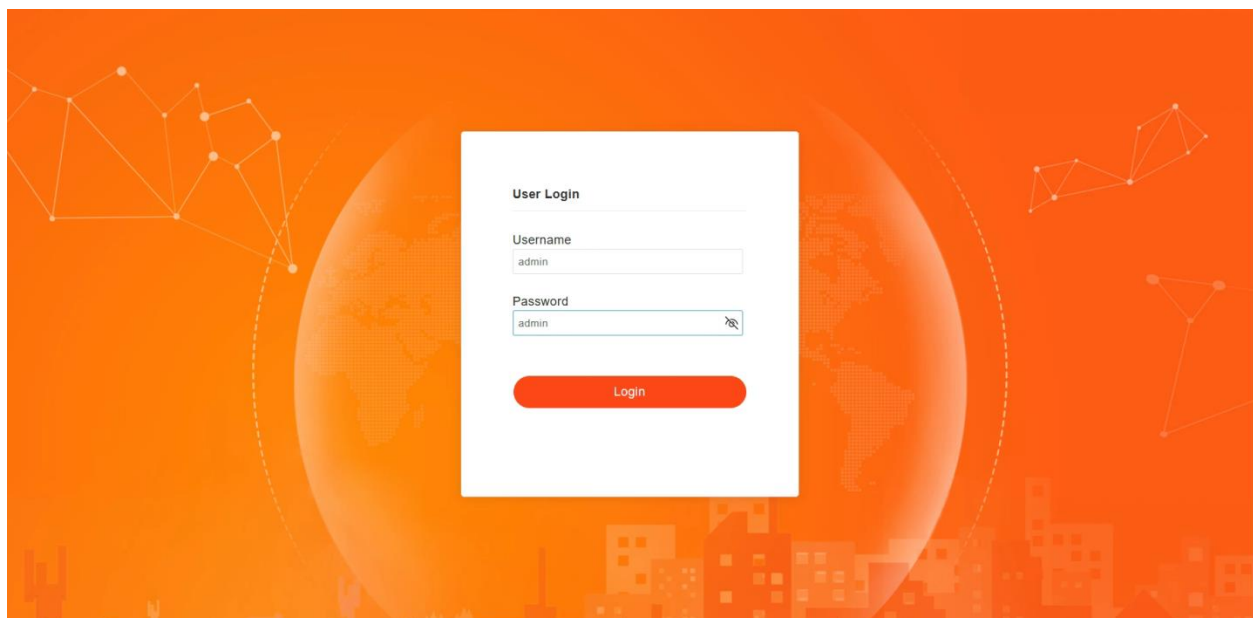


Step 2 Login to Local Web

RAK M310&M320's eNodeB local web serving URL is: `https://192.168.150.1` with default user name admin and default password admin.

RAK M320's gNodeB local web serving URL is `http://192.168.150.7` with default user name new_user and default password gNB@2014

Here we recommend using **Chrome** browser to achieve the best effect.

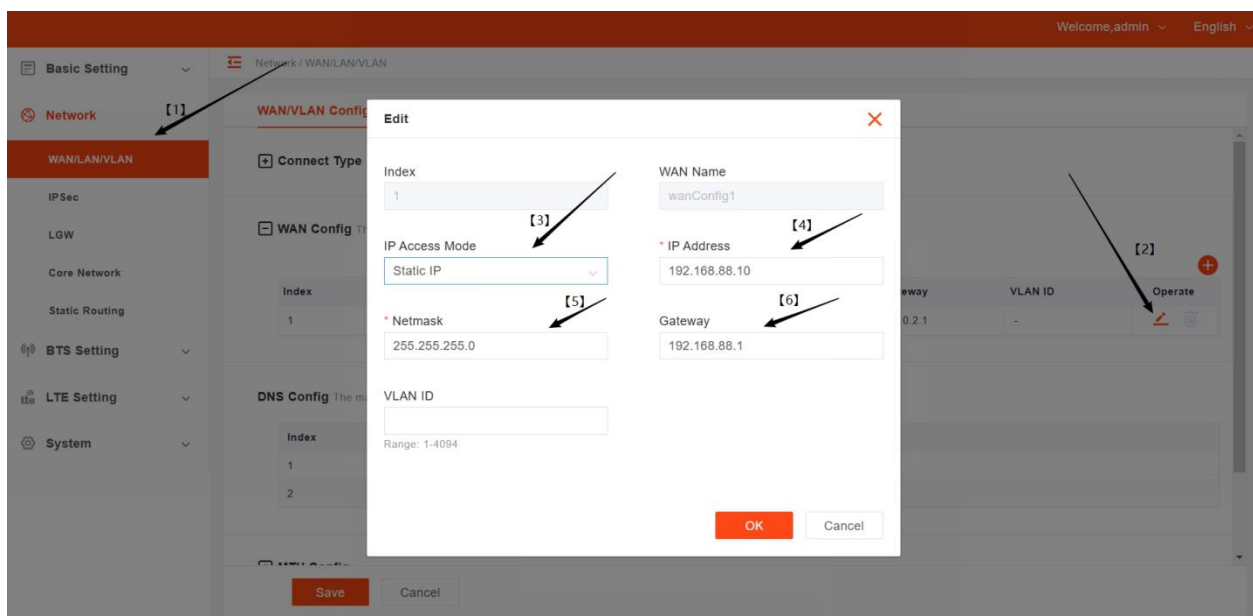


Step 3 Configure eNodeB's S1 and or gNodeB's N2 Interface

Mostly the eNodeB 's S1 and/or gNodeB's N2 interface are required to have a static IP address to connect to customer's EPC and/or 5GC. Dynamic IP address allocated by DHCP is also supported, all depend on customers network requirement.

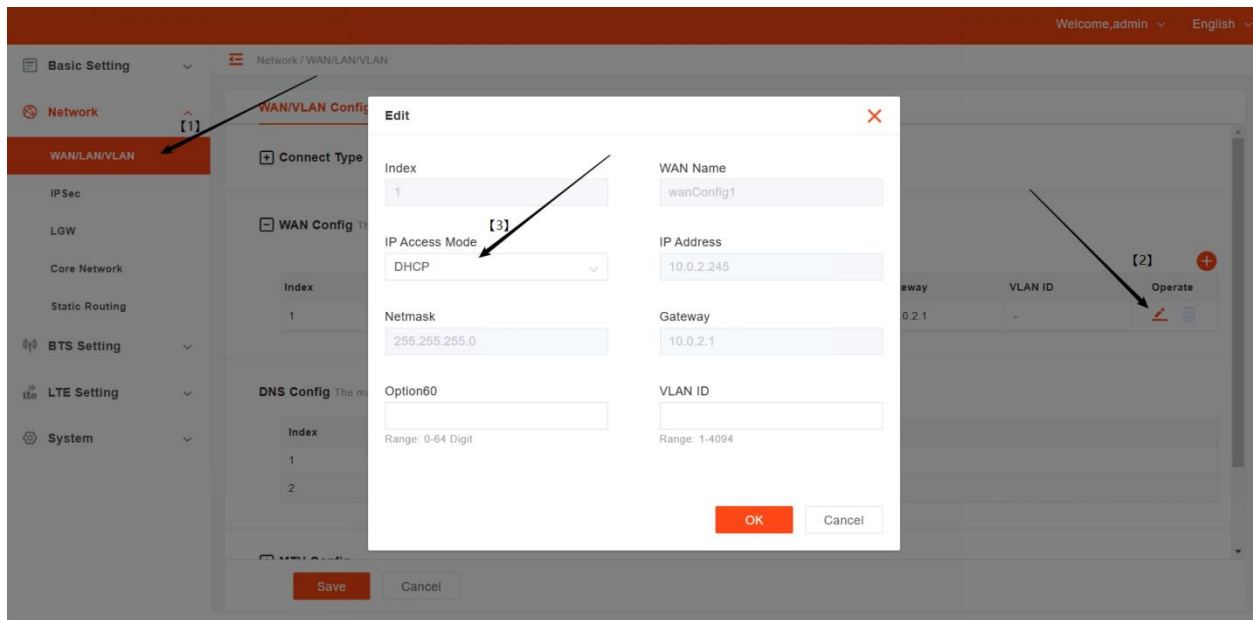
- **Configure eNodeB's S1 Interface with Static IP**

Login to eNodeB's local web via <https://192.168.150.1>, navigate to **Network > WAN/LAN** page, click the **edit** button, and select **Static IP** in **IP Access Mode**, after that edit the static IP address, netmask and gateway for the eNodeB's S1 port. Then click **OK** and **Save** button to save the configuration.



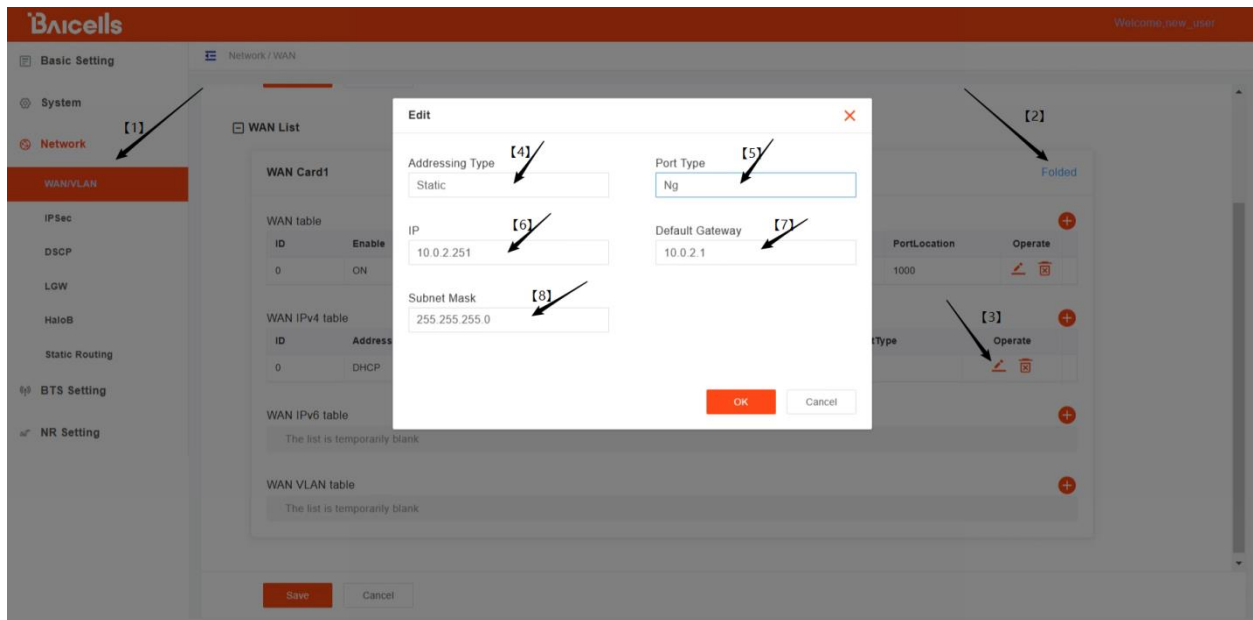
- **Configure eNodeB's S1 Interface with Dynamic IP**

Login to eNodeB's local web via <https://192.168.150.1>, navigate to **Network > WAN/LAN** page, click the **edit** button, and select **DHCP** in **IP Access Mode** to enable DHCP client on the eNodeB's WAN port. Then click **OK** and **Save** button to save the configuration.



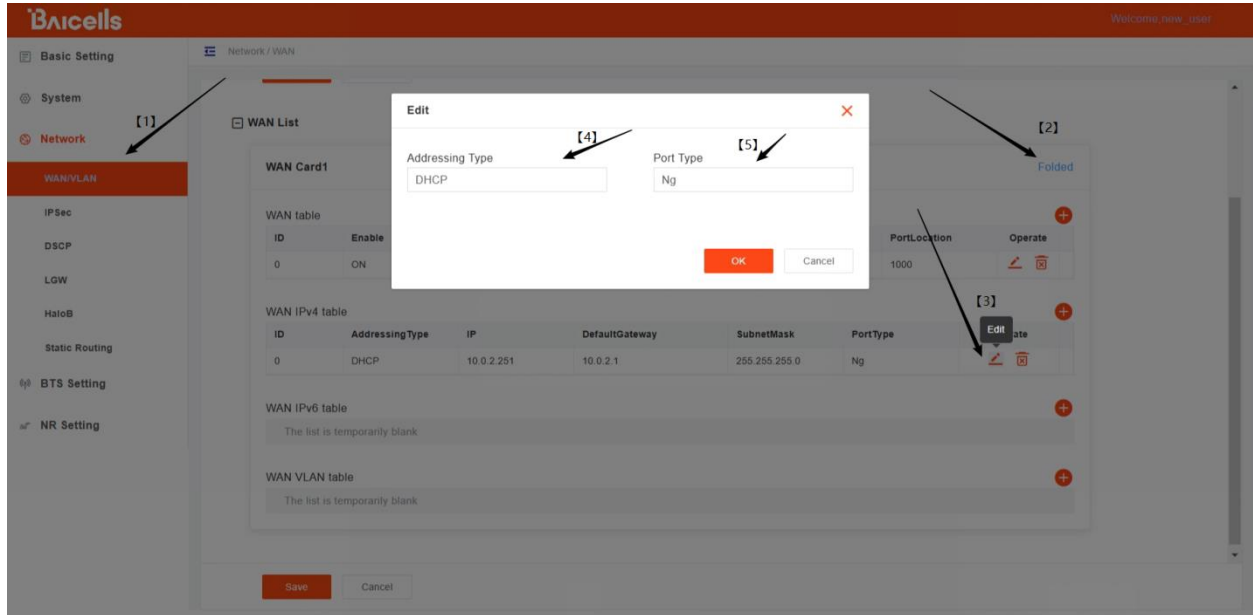
- Configure gNodeB's N2 Interface with Static IP

Login to gNodeB's local web via <http://192.168.150.7>, navigate to **Network** > **WAN/LAN** page, lick **Open** button to expand the configuration table, then click the **edit** button, and select **Static IP** in **Addressing Mode** field, **Ng** in **Port Type** field, after that edit the static IP address, netmask and gateway for the gNodeB's N2 port. Then click **OK** and **Save** button to save the configuration.



- Configure gNodeB's N2 Interface with Dynamic IP

Login to gNodeB's local web via <http://192.168.150.7>, navigate to **Network** > **WAN/LAN** page, click **Open** button to expand the configuration table, then click **Edit** button to pop up edit window, and select **DHCP** in **Addressing Type** field, **Ng** in **Port Type** field, then click **OK** and **Save** button to save configuration.

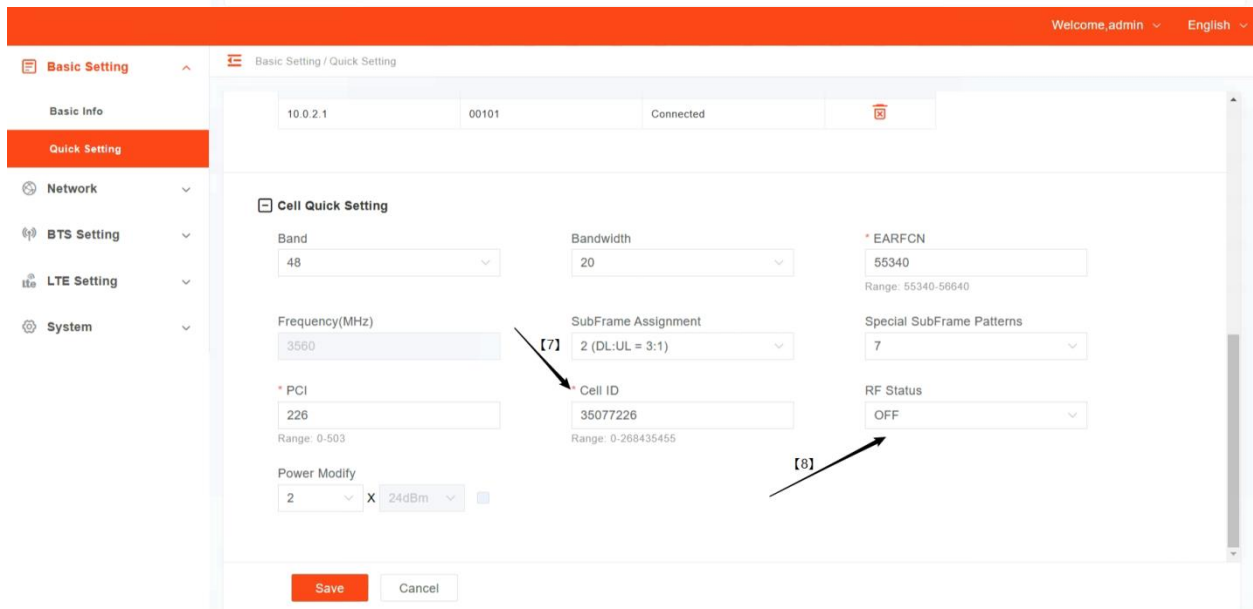
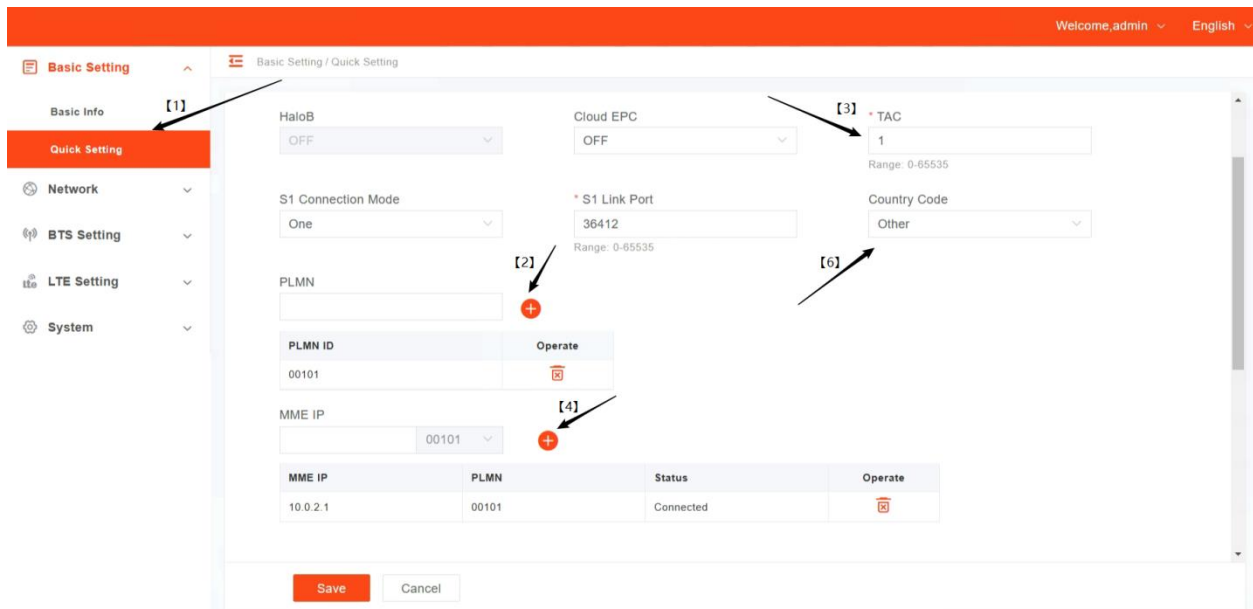


Step 4 Configure PLMN, TAC, Cell ID and Core Address, etc

Customers are required to configure eNodeB and/or gNodeB with planned TAC, PLMN, MME and/or AMF IP address to connect to customers own EPC/5GC. These parameters are depend on customer's network requiremens.

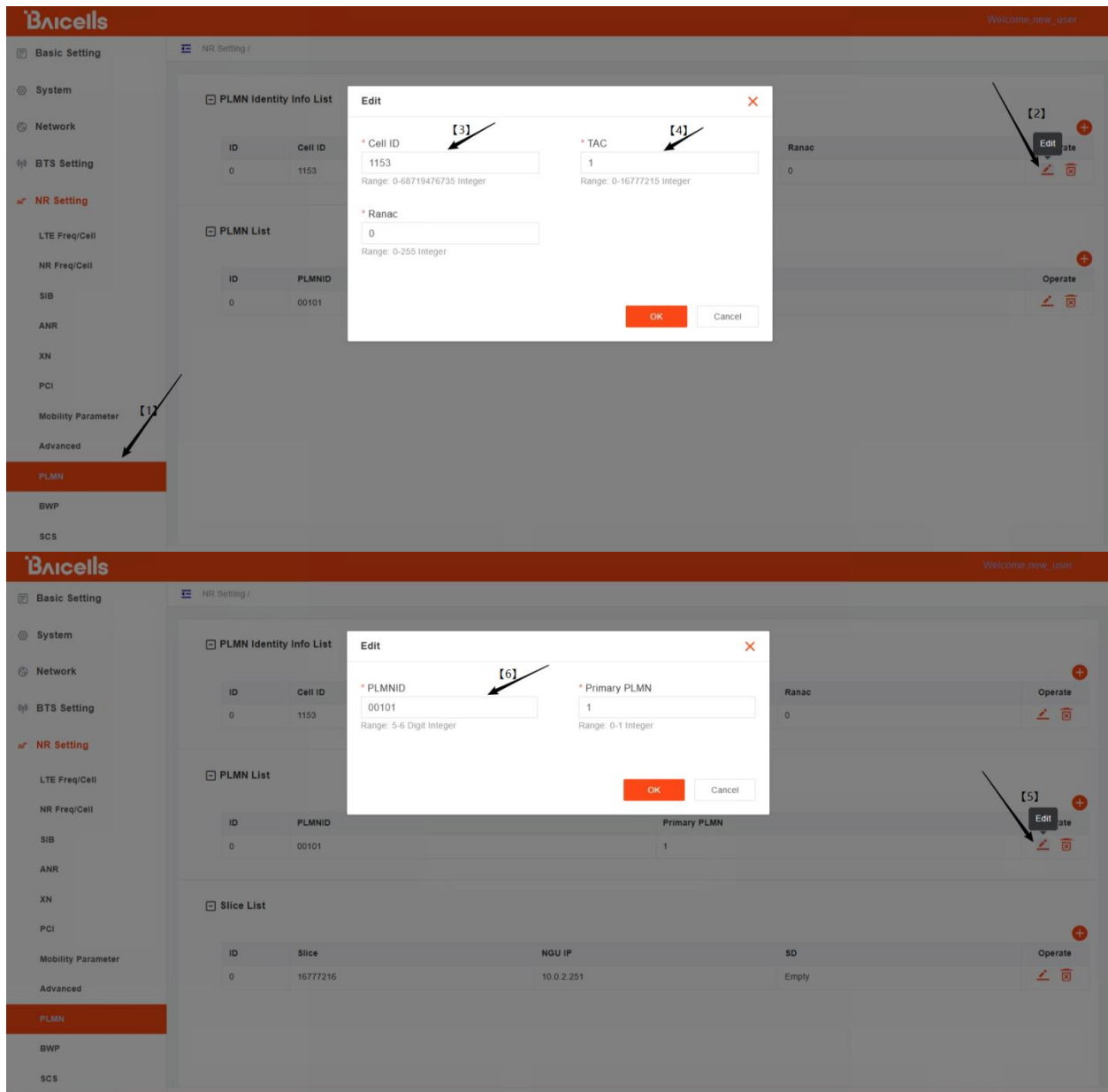
- Configure eNodeB's PLMN, TAC, Cell ID and MME IP, etc.

Login to eNodeB's local web via <https://192.168.150.1>, navigate to **Quick Setting** page, configure the PLMN, TAC, Cell ID, Country code and MME IP, and turn on the RF, and then click **Save** button to save the configuration.



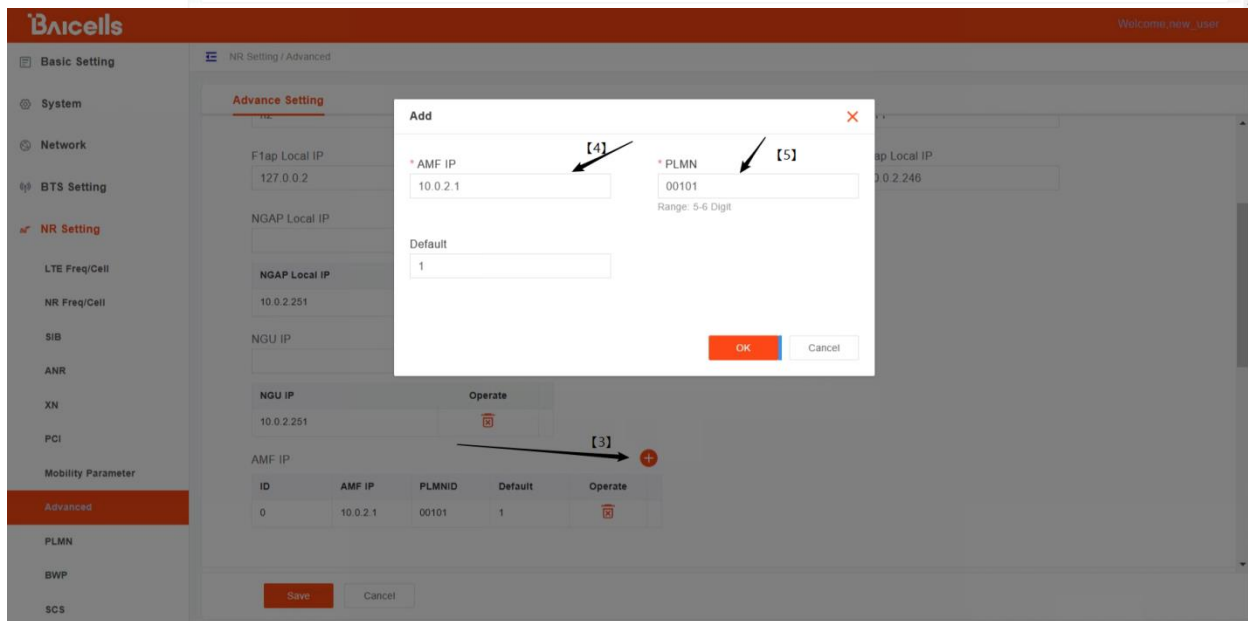
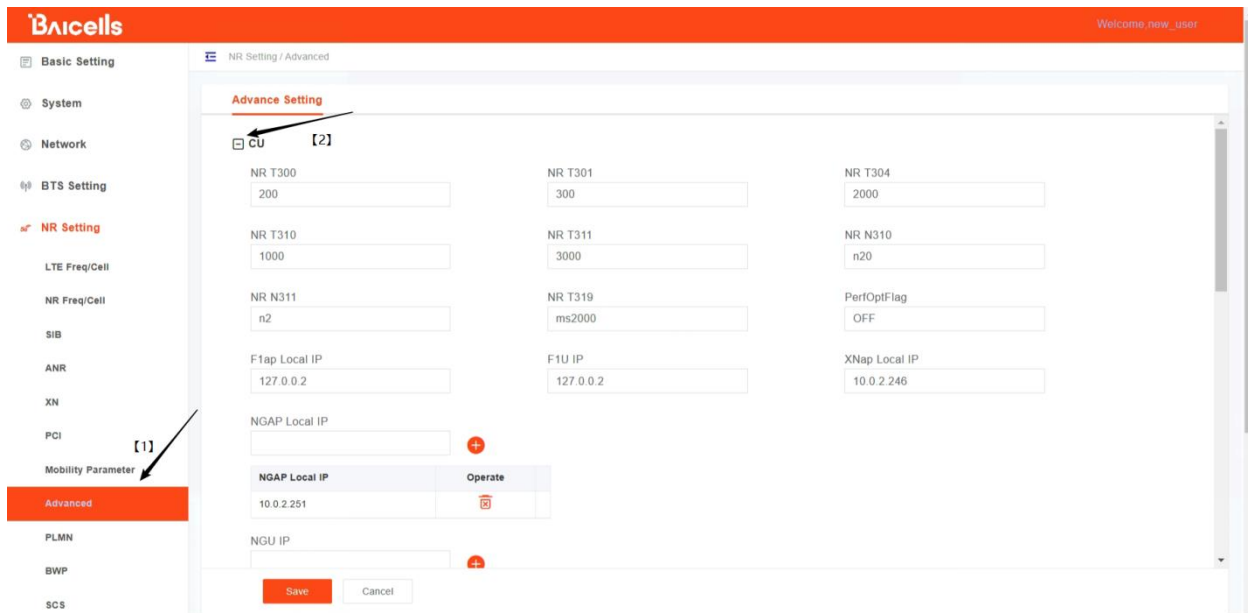
- Configure gNodeB's PLMN, TAC and Cell ID, etc

Login to gNodeB's local web via <http://192.168.150.7>, navigate to **NR Setting** > **PLMN** page, click **Edit** button to edit Cell ID and TAC, and then the PLMN list will show up, click the **PLMN List's Edit** button to edit the PLMN.



- Configure gNodeB's AMF IP Address

Login to gNodeB's local web via <http://192.168.150.7>, navigate to **NR Setting** > **Advanced** page, click + **CU** to expand CU tables, scroll down to the **AMF IP** table, click + button to add AMF IP for PLMN, then click **OK** and **Save** button to save configuration.

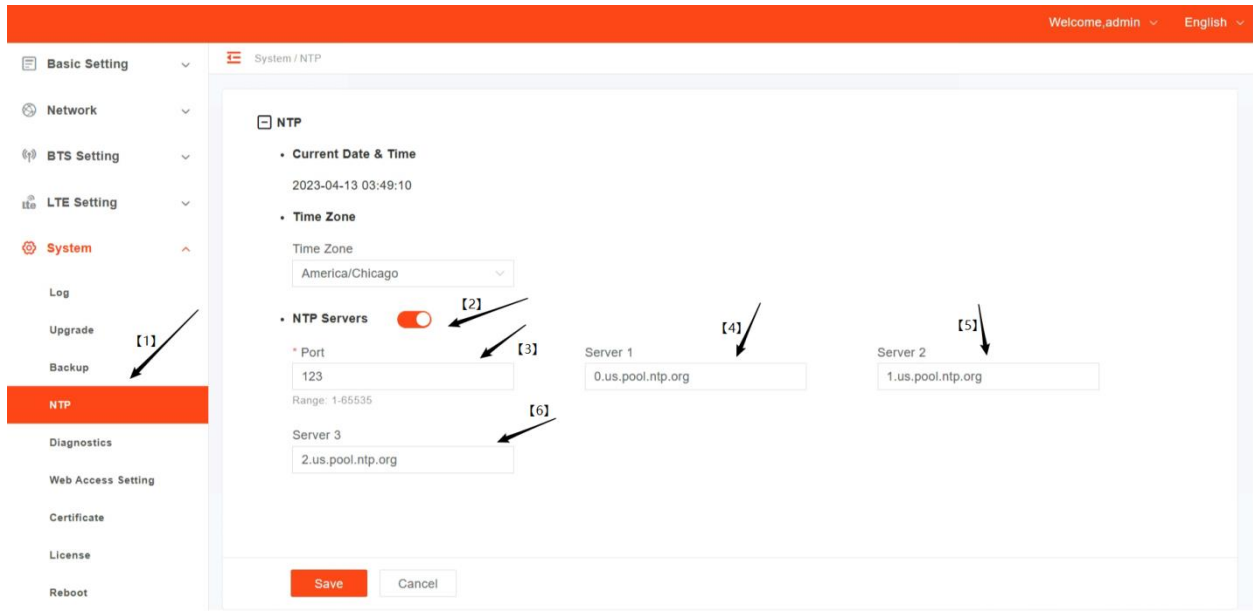


Step 5 Configure NTP Server

NTP is required to activate and run 4G eNodeB and 5G gNodeB. Without any reachable NTP servers. the eNodeB and/or gNodeB cannot activated successful.

- Configure eNodeB's NTP server address

Login to eNodeB's local web via <https://192.168.150.1>, navigate to **System** > **NTP** page, turn on the **NTP Servers** button and edit the NTP servers IP addresses and Port, then click **Save** button to save configuration.



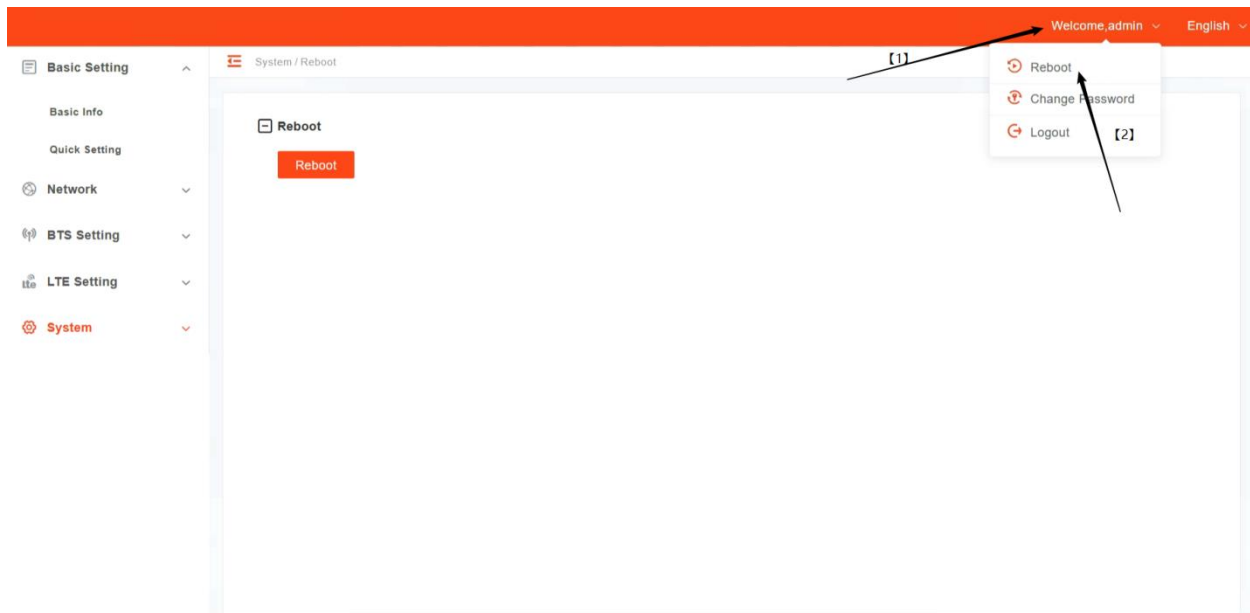
- Configure gNodeB's NTP server address

Login to gNodeB's local web via `http://192.168.150.7`, navigate to **System** > **NTP** page, select **ON** in **Enable** field and edit the NTP servers IP addresses, then click **Save** button to save configuration.

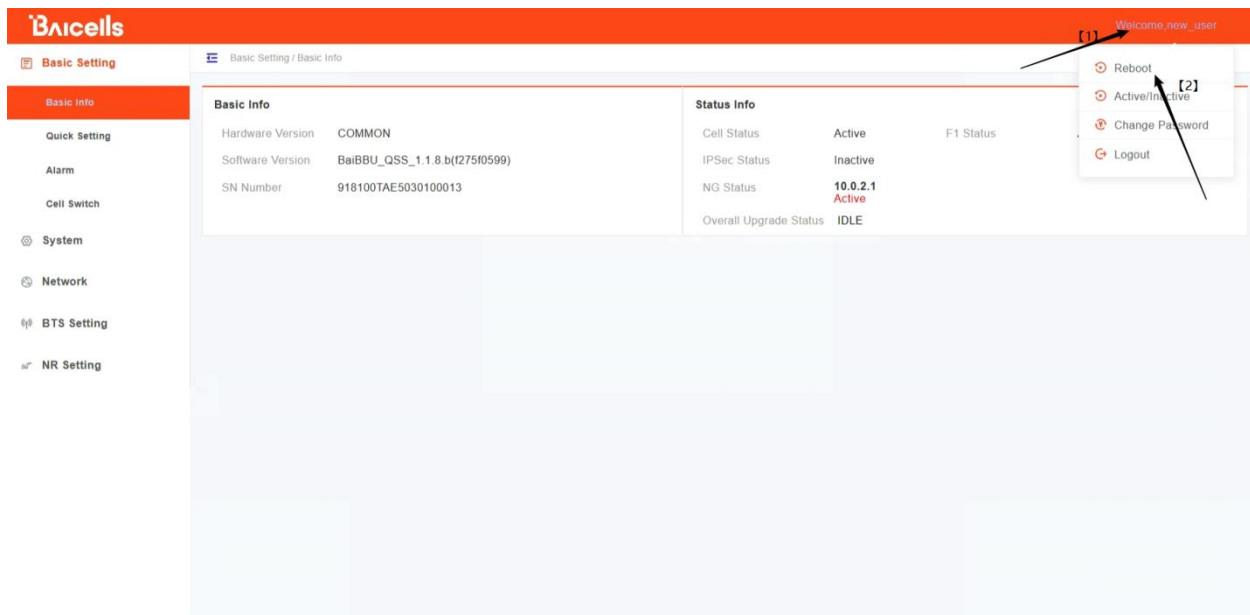


Step 5 Reboot eNodeB and/or gNodeB to use new configuration

- Reboot eNodeB



- Reboot gNodeB



Configuration with Magma inside

RAK M310/M320 has a built-in open source Magma AGW installation package inside, customers can login and install the package manually with following steps:

- Step 1 Prepare network to access to M310/M320 CM4 module
- Step 2 SSH login to M310/M320 CM4 module
- Step 3 Install AGW with built-in package

- Step 4 Reboot to run AGW

Step 1 & Step 2

Please refer to Chapter **Login to CM4 Module** to prepare network and SSH login to CM4

Step 3 Install Built-in Magma AGW Package

Note: The package name would be with prefix "upgrade_agw", the specific package name would be different for different release.

```
magma$ sudo /opt/magma/upgrade_agw_xxx
```

Step 4 Reboot the Device

After Magma AGW installed, the eNodeB and/or gNodeB start serving automatically with default parameters as below:

Parameter	Value
PLMN	00101
TAC	1
Cell ID	1

Note the CM4's static IP address will be changed automatically to 192.168.151.100/24, use this IP address to SSH login to CM4 for more configurations.

For more Magma AGW configuration details, please refer to **MNTD. Magma AGW Configuration Guide**

Configuration with Open5GS inside

RAK M310/M320 has a built-in open source Open5GS installation package inside, customers can login and install the package manually with following steps:

- Step 1 Prepare network to access to M310/M320 CM4 module
- Step 2 SSH login to M310/M320 CM4 module
- Step 3 Install Open5GS with built-in package
- Step 4 Reboot to run AGW

Step 1 & Step 2

Please refer to Chapter **Login to CM4 Module** to prepare network and SSH login to CM4

Step 3 Install Built-in Open5GS Package

Note: The package name would be with prefix "install_open5gs", the specific package name would be different for different release.

```
magma$ sudo /opt/open5gs/install_open5gs_xxx
```

Step 4 Reboot the Device

After Open5GS installed, the eNodeB and/or gNodeB start serving automatically with default parameters as below:

Parameter	Value
PLMN	00101
TAC	1
Cell ID	1

Note the CM4's static IP address will be changed automatically to 192.168.151.100/24, use this IP address to SSH login to CM4 for more configurations.

For more Open5GS configuration details, please refer to **MNTD. Open5GS Configuration Guide**

Configuration with Customer's EPC/5GC inside

For customers who want to install their own EPC or 5GC onto RAK M310/M320's CM4 Module, please confirm that the EPC or 5GC is compatible to Raspberry CM4.

There's also 4 major steps to install customer's EPC or 5GC onto RAK M310/M320's CM4 Module:

- Step 1 Prepare network to access to M310/M320 CM4 module
- Step 2 SSH login to M310/M320 CM4 module
- Step 3 Install with customer's pre-built EPC or 5GC package

- Step 4 Reboot to run AGW

Login to CM4 Module

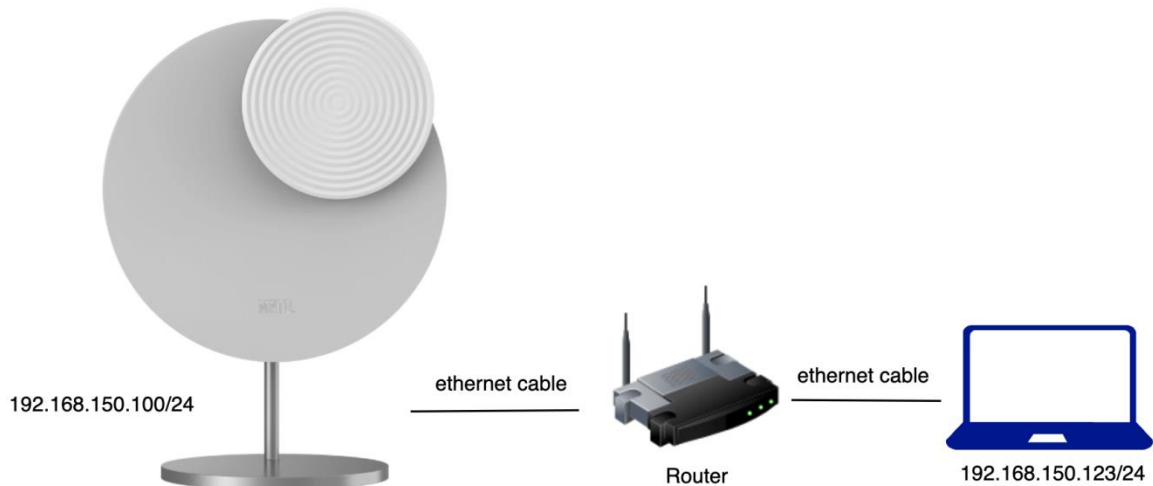
RAK M310&M320 has an Raspberry CM4 that's open to customers, you can login to the CM4 module to install built-in packages or your own application, depends on your requirements. To install packages on CM4, here's some basic steps to operate:

- Step 1 Prepare network to access to M310/M320 CM4 module
- Step 2 SSH login to M310/M320 CM4 module

Step 1 Prepare Network to Access to CM4

RAK M310&M320's CM4 module configured with a static IP address 192.168.150.100/24 to serve local SSH access.

Customers are require to configure their PC or laptop's ethernet port to subnet 192.168.150.0/24 to SSH access to CM4 , bridged by a router/switch or connected directly. The network connection may looks like this:



NOTE: If the device had installed with the built-in Magma AGW or Open5GS, the CM4's static IP address have changed to 192.168.151.100/24, then customers need to configure the PC or laptop's IP to 192.168.151.0/24 to access to CM4.

Step 2 SSH login to CM4

RAK M310&M320's AGW can be SSH to using commands as below with default password rakwireless:

```
customer$ ssh magma@192.168.150.100
```

Disable 4G on M320

RAK M320 integrated with a 4G eNodeB and a 5G gNodeB, for customers who wants 5G gNodeB only, please login to eNodeB's local web via <https://192.168.150.1>, navigate to **Quick Setting** page, configure the **RF** field to **Off**, and then click **Save** button to save the configuration.

The screenshot shows the 'Quick Setting' page in the Magma AGW web interface. The page is titled 'Basic Setting / Quick Setting' and has a navigation menu on the left with options: Basic Info, Quick Setting (selected), Network, BTS Setting, LTE Setting, and System. The main content area displays the 'Cell Quick Setting' configuration. The fields are as follows:

Field	Value
Band	48
Bandwidth	20
* EARFCN	55340
Frequency(MHz)	3560
SubFrame Assignment	2 (DL:UL = 3:1)
* PCI	226
* Cell ID	35077226
Special SubFrame Patterns	7
RF Status	OFF

At the bottom of the form, there are 'Save' and 'Cancel' buttons. An arrow labeled [1] points to the 'RF Status' field.

Mobile Phone Access to Network

For customers using their own EPC or 5GC, you should insert SIM cards managed by yourself to the mobile phones and other end devices, whether configure the phones or devices to access to network depends on your requirements.

For customers using RAK M310/M320's built-in Magma AGW or Open5GS, before mobile phones or other devices access to network, customers are required to insert the SIM cards provided by RAK into mobile phones or other end devices, and add a APN named with **internet**, and select the network **00101** at the first access.

FCC Compliance

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Warning:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.