4G LTE eNodeB

Configuration Guide

BaiBLQ_3.0

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Version 2.04

About This Document

This document describes the mainstream applications used for configuring and administering the Baicells eNodeBs (eNBs). The scope of information includes the standard single carrier eNB Graphical User Interface (GUI), as well as the two-carrier eNB capable of operating in Carrier Aggregation (CA) mode or Dual Carrier (DC)/split mode. The target audience is network administrators who are responsible for configuring, monitoring, troubleshooting, and upgrading Baicells eNBs; configuring network interfaces; adding subscribers and creating service plans. Separate *documents* are available for specific use cases or to focus on particular deployment scenarios:

- HaloB Solution User Guide
- Carrier Aggregation and Dual Carrier/Split Mode Configuration Guide
- SAS Deployment User Guide
- Local OMC+BOSS
- Local Evolved Packet Core (EPC)

This publication of the guide is written to the Baicells eNB software version BaiBLQ_3.0 for Neutrino430/Nova430e/Nova430i/Nova436Q.

Terms used in this document or related to Long-Term Evolution (LTE) are listed in alphabetical order and described in *Acronyms and Abbreviations*, which can be found at Baicells.com > Resources > *Documents*.

New in This Release

This document release includes the following updates:

- The software BaiBS_QRTB migrated to BaiBLQ_3.0 at this release, and all Graphical User Interfaces (GUIs) depicted in this document reflect the BaiBLQ_3.0 software.

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The information in this document is subject to change at any time without notice. For more information, please consult with a Baicells technical engineer or the support team. Refer to the *Contact Us* section.

Revision Record

Date	Version	Description	SMEs/Contributors
08-Aug-2023	V2.04	Updated for BaiBLQ 3.0	Blake Volk
15-Mar-2023	V2.03	Updated to BaiBS_QRTB_2.12	Anna Ch, Blake Volk
20-July-2022	V2.02	Updated to BaiBS_QRTB_2.10.6	Anna Ch, Pengyu Chen, Jason Jiang, Warren Lai, Seng Tang, Blake Volk
4-June-2022	V2.01	• Created a new eNodeB Configuration Guide with focus on eNBs running BaiBS_QRTB software* only. • Documented QRTB 2.9.10 features and new GUI layout. *Refer to the eNodeB Configuration Guide found at Baicells.com > Resources > Documents for content related to eNBs running BaiBS_RTS and BaiBS_RTD software.	Anna Ch, Pengyu Chen, Warren Lai, Seng Tang, Blake Volk

Resources

- **Documentation** - Baicells product datasheets, this document, and other technical manuals can be found at Baicells.com > Resources > *Documents*.
- **Support** - Open a support ticket, process an RMA, and the Support Forum are at Baicells.com > *Support*.

Contact Us

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Introduction

The Baicells products give network operators the ability to offer internet service to subscribers using LTE-based broadband wireless access. In a standard configuration, the key components include Customer Premise Equipment (CPE), eNodeB (eNB) radio access network equipment, and cloud-based core functions and network/subscriber management applications (Figure 1-1). A subscriber connects a laptop, tablet, or other smart device through the CPE – which connects wirelessly to an eNB. The eNB communicates with the LTE backhaul network.

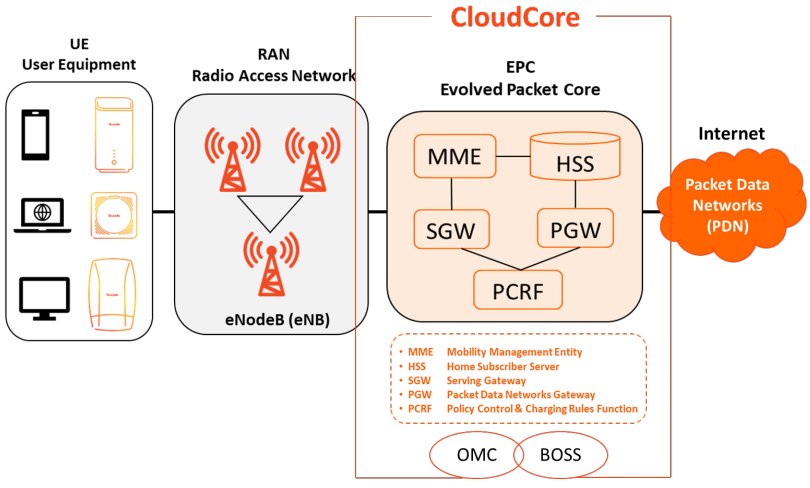
NOTE: The terms UE and CPE have the same meaning and are used interchangeably in this document.

The available Operations, Administration, and Management (OAM) applications include an eNB GUI, a CPE GUI, the Baicells CloudCore Operations Management Console (OMC), and the Baicells CloudCore Business and Operation Support System (BOSS). The eNB GUI for eNBs running software BaiBLQ is documented in this guide, and the other eNB GUIs and apps are documented in:

- 4G LTE eNodeB Configuration Guide - BaiBS_RTS/BaiBS_RTD
- 4G LTE eNodeB Configuration Guide – BaiBU_DNB4 (Nova846)
- Atom CAT4 CPE Configuration Guide
- Atom CAT6/CAT15 CPE Configuration Guide
- CloudCore Configuration and Network Administration Guide

The eNB GUI and the CPE GUI are used to configure and manage individual devices. The CloudCore apps can be used to configure and manage all of the operator's network devices across multiple sites through the OMC and all of the subscribers and services plans through BOSS. Baicells charges a monthly CloudCore usage fee based on the number of active users. CloudCore includes not only management apps but also provides the core LTE network functions that are shown in Figure 1-1. Private network solutions such as Local EPC and Local OMC+BOSS are available.

Figure 1-1: Standard Baicells LTE Network



Many of the equipment and network interface parameters are preconfigured with recommended default settings from the factory. However, every field and operation is explained and illustrated in this guide to allow each operator the flexibility to use the Baicells CloudCore-based solution to meet their unique requirements.

1. eNB GUI

References:

- *Nova430e Outdoor 4x250mW Two-Carrier TDD eNodeB Installation Guide*
- *Nova430i Outdoor 4x250mW Two-Carrier TDD eNodeB Installation Guide*
- *Nova436Q Outdoor 4x1W Two-Carrier TDD eNodeB Installation Guide*
- *Neutrino430 Indoor 4x250mW Two-Carrier TDD eNodeB Installation Guide*

This section describes eNB GUIs for all Baicells eNBs running BaiBLQ_3.0 software, which currently includes Neutrino430, Nova430e, Nova430i, and Nova436Q.

The eNBs running BaiBLQ_3.0 software version can be configured as single-carrier or two-carrier eNBs capable of operating in Carrier Aggregation (CA) mode or Dual Carrier (DC)/split mode. Any major differences for non-standard or two-carrier configurations are noted. Not all menus and fields are applicable to every eNB model or deployment scenario. Specific documents that are available for such exceptions, for specific use cases, or to focus on particular deployment scenarios are cited.

NOTE: The GUIs vary slightly from each other depending on the carrier mode setting. When the eNB is configured for Dual Carrier (DC)/split mode, certain fields that are used to differentiate Cell 1 and Cell 2 may be labeled “Cell1” and “Cell2”. In Carrier Aggregation mode, certain fields that are used to differentiate cells may be labeled Primary Cell (Pcell) and Secondary Cell (Scell). The terms Cell1, Cell2, Pcell, and Scell are used throughout this document.

1.1 Computer Requirements

Refer to Table 2-1 for the minimum requirements of the computer that you use to launch the eNB GUI.

Table 2-1: Computer Requirements

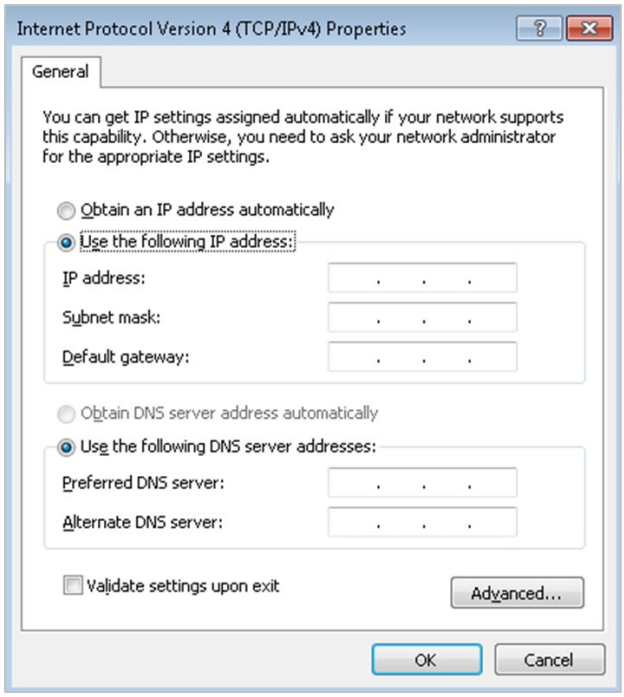
Item	Description
CPU	Higher than Intel Core 1GHz
Memory	Greater than 2G RAM
Hard Disk	No less than 100 MB space available
Ethernet port	10/100/1000 adaptive Ethernet interface
Operating System	Microsoft: Windows XP, Windows Vista, Windows 7, or higher Mac: MacOSX 10.5 or higher
Screen Resolution	Higher than 1024 x 768 pixels
Browser	Google Chrome 9+, Internet Explorer 7.0+, Mozilla Firefox 3.6+

You can launch the eNB GUI through a Web address (discussed in *section 2.2*). If you are on-site you can connect a computer directly to the eNB unit’s Local Maintenance Terminal (LMT), which is the MGMT/LAN port Before launching the GUI, you need to set up the computer’s IP address to connect the client to the server, e.g.:

1. In Windows 7, select *Start > Control Panel*, and in the pop-up dialogue window, select *Network and Internet*.
2. Select *View network status and tasks*, and then select *Local Connectivity*.

3. In the dialogue window labeled *Status of Local Connectivity*, select *Properties*. This opens the *Properties of Local Connectivity* dialogue window.
4. Select Internet Protocol Version (TCP/IPv4), and select Properties (Figure 2-1).

Figure 2-1: Internet Protocol Version 4 (TCP/IPv4)



Select either *Obtain an IP address automatically* and proceed to *step 6*, or *Use the following IP address* and follow *step 5* and *step 6*. If the option for obtaining the IP address automatically fails, you need to set up the IP address manually.

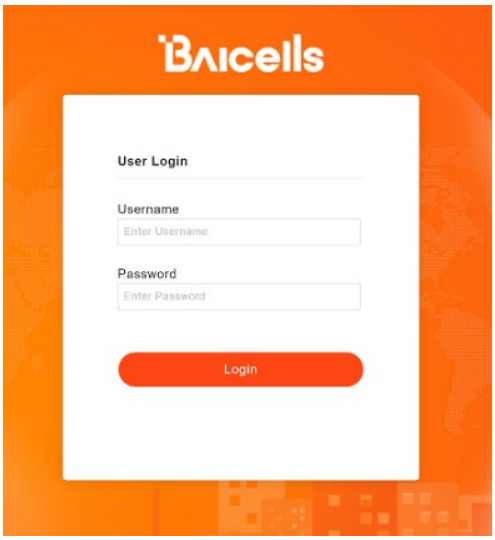
1. Use the following IP address option: Input the IP address, subnet mask, and default gateway, where:
   - IP address is **192.168.150.xxx** (xxx is a number from 100 to 254).
   - Subnet mask is **255.255.255.0**.
   - Default gateway is **192.168.150.1**.
2. Execute ping 192.168.150.1 in the command dialogue window and check whether the connection between the local (client) computer and the server is working.

1.2 Launching the GUI

To launch the GUI, open a Web browser and go to *http://192.168.150.1*. At the *Login* dialogue window (Figure 2-2), enter **admin** for both the default name and password.

NOTE: For security reasons, you should change the password after you first log in rather than leaving the default admin name and password. Refer to *section 2.3.1* of this document.

Figure 2-2: Login



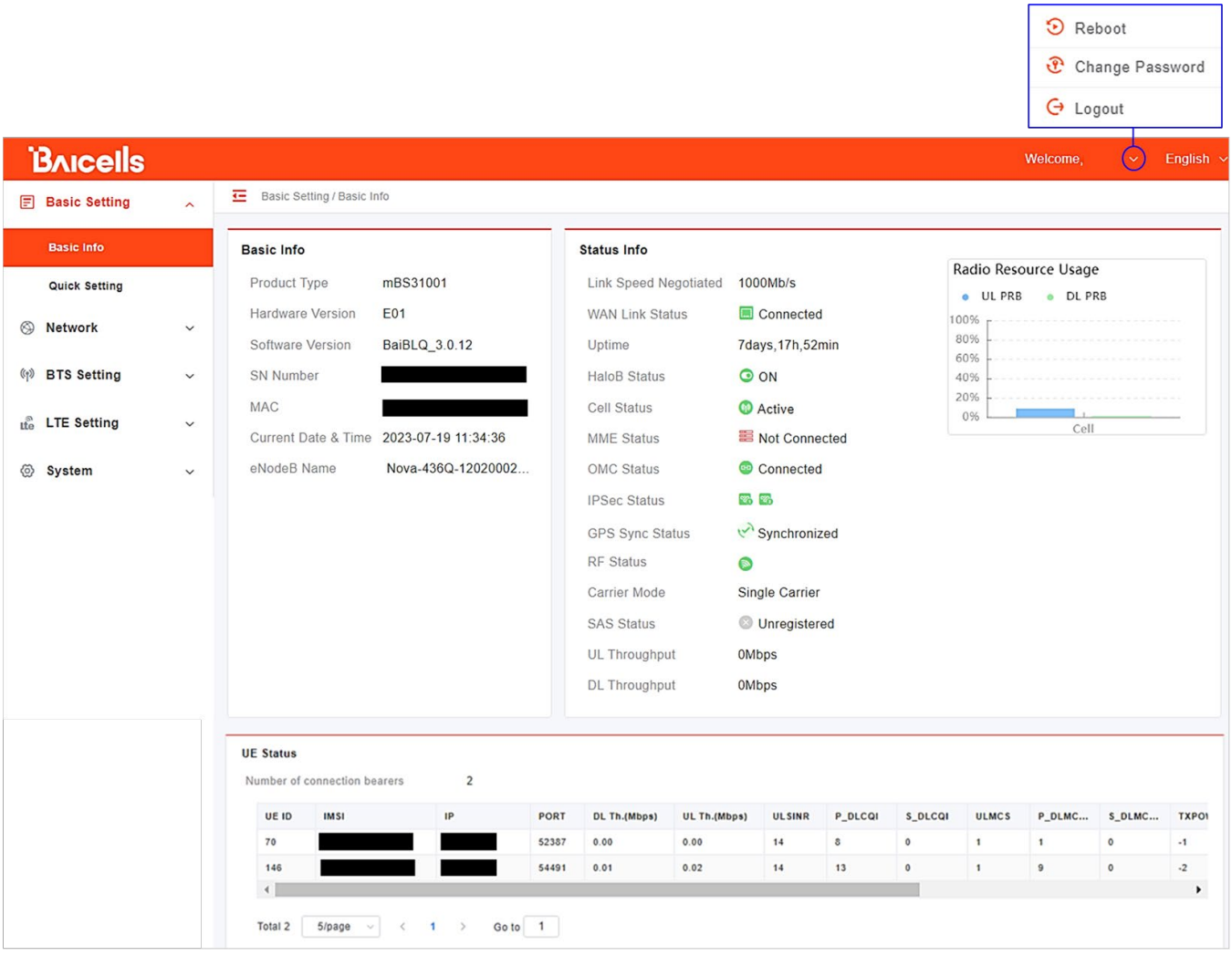
1.3 Home Page Overview

When you log in, the GUI home page displays the *Basic Setting > Basic Info* sub-menu (Figure 2-3). The navigation pane is on the left side and contains main menu items *Basic Setting*, *Network*, *BTS Setting*, *LTE Setting*, and *System*. The main menus and their associated sub-menus may vary by hardware model and eNB operating mode. Vertical scroll bars appear on the right side of the display when their use is necessary to see all of the displayed menu's fields.

NOTE: The GUI displays *Cell1 eNodeB Name* and *Cell2 eNodeB Name* rather than *eNodeB Name* when the eNB is in *Dual Carrier* mode.

Notice that there are three actions you can take from the drop-down menu on the upper right side of the display: *Reboot*, *Change Password*, and *Logout* (Figure 2-3). The *Reboot* action is described in *section 2.9.9*, and the *Change Password* and *Logout* actions are described below.

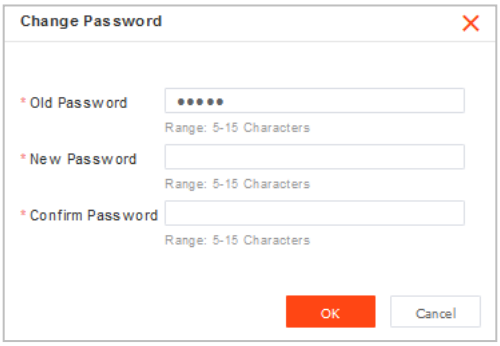
Figure 2-3: Home Page



1.3.1 Change Password

The *Change Password* action (Figure 2-4) is used to change the eNB administrator's GUI password. Enter your old password and then enter a new password. Then, re-enter the new password to confirm it and press *OK*. The passwords must be five to 15 characters each.

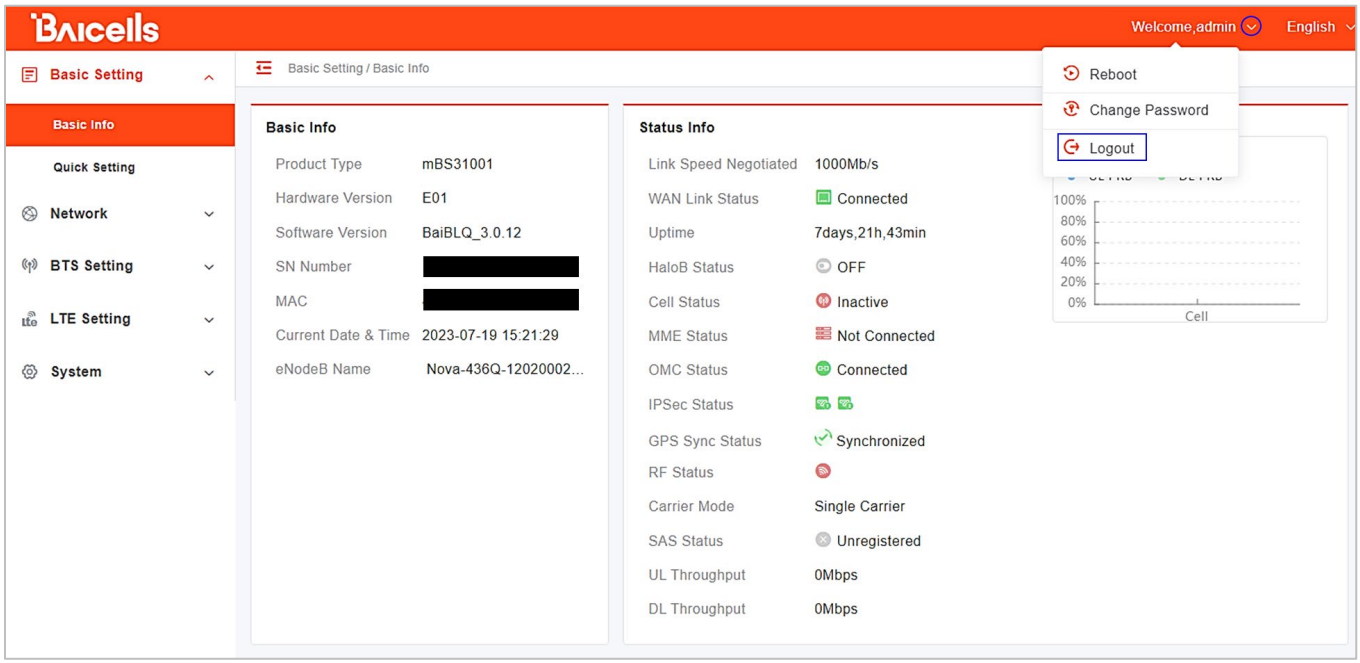
Figure 2-4: Change Password



1.3.2 Logout

To log out of the eNB GUI, go to the top right corner of the display and open the drop-down menu (Figure 2-5). Select *Logout*, and you are automatically logged out of the GUI and presented with the *Login* dialogue window.

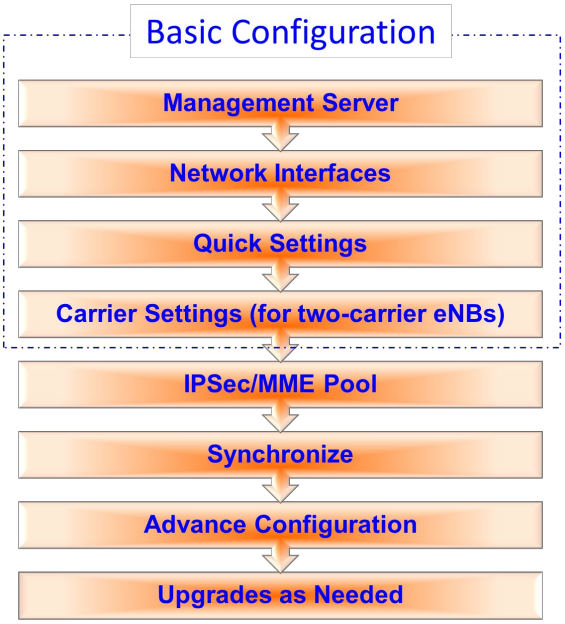
Figure 2-5: Logout



1.4 Configuration Flow

This document is organized around the visual flow of the GUI menus and fields. However, during initial eNB installation and configuration, perform the basic configuration steps in the order shown in (Figure 2-6).

Figure 2-6: Initial eNB Configuration Flow



1.5 Basic Setting

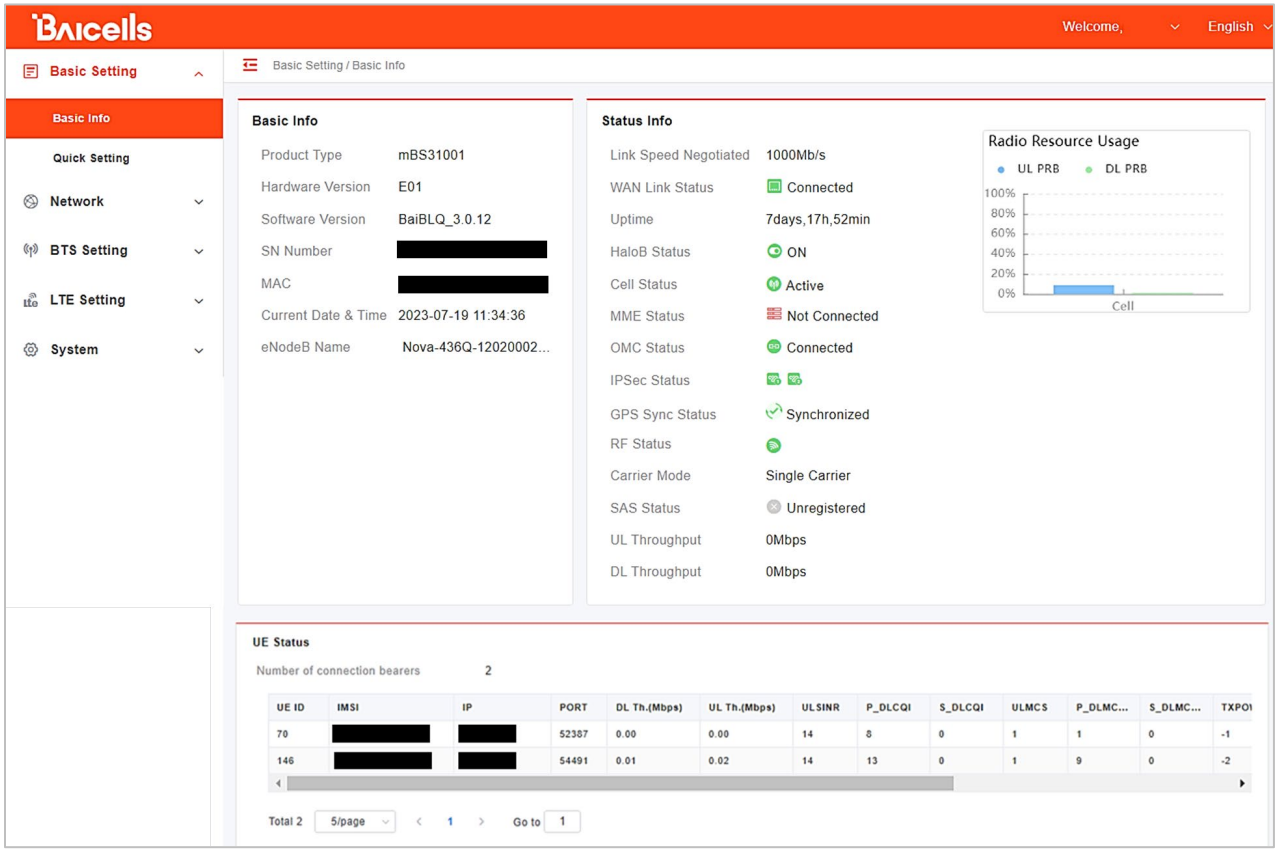
1.5.1 Basic Info

Under the *Basic Setting* > *Basic Info* sub-menu are several fields providing essential eNB operational information. The fields that are displayed depend on the hardware model and eNB operating mode. For example, if you were running the eNB in HaloB mode, the field *HaloB Status ON* displays in the *Status Info* list. If the eNB is a two-carrier system configured for Dual Carrier (DC)/split mode you can view fields that differentiate Cell 1 and Cell 2, e.g., *RF Status(Cell1)* and *RF Status(Cell2)*. If the eNB is configured for Carrier Aggregation mode you can view fields that differentiate Cell 1 and Cell 2, e.g., *RF Status (Pcell)* and *RF Status (Scell)*.

NOTE: Operating modes are covered in detail in the *Network* > *Core Network* sub-menu (*section 2.6.4*). Switching to a different operating mode requires a reboot of the eNB.

The eNB GUI refreshes the basic information every 15 seconds. The *Basic Info* window is shown in Figure 2-7 and the fields are described in Table 2-2.

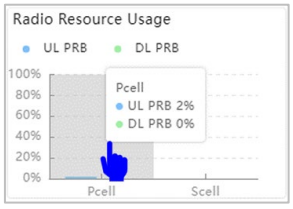
Figure 2-7: Basic Info

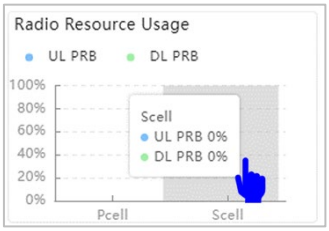


NOTE: The field names annotated by (*) can vary depending on how the carrier mode setting is configured.

Table 2-2: Basic Info Fields

Field Name	Description
Basic Info	
Product Type	The eNB model.
Hardware Version	The version number of the eNB hardware.
Software Version	The version number of the operating software running on the eNB.
SN Number	Serial Number identifier for the eNB.
MAC	Data Link layer Media Access Control address for the eNB.
Current Date & Time	The current date and time.
eNodeB Name	Name you assign to the eNB.
Status Info	
Link Speed Negotiated	Data rate negotiated between the eNB and the WAN interface.
WAN Link Status	Status of link between eNB and WAN (external) interface: Connected/Not Connected.
Uptime	Amount of time the device is functioning or operational.
HaloB Status	Indicates HaloB mode status (*OFF* or *ON*) when the HaloB licensed feature is applied to the eNB.

Field Name	Description
Cell Status*	*Active* or *Inactive*. When the eNB is operating (transmitting and receiving signals), the status is set to active. If not, the status is reported as inactive.
OMC Status	Status of the link between the eNB and the Baicells Operations Management Console is either connected or not connected.
GPS Sync Status	The eNB is either synchronized or not synchronized with other eNBs in the area. Refer to *section 2.7.2* for more information.
RF Status (CELL)*	Indicates if the Radio Frequency (RF) is *ON* (transmitting and receiving) or *OFF*. For two-carrier eNBs, each cell is reported.
Carrier Mode	Indicates what carrier mode the eNB is operating in as specified in the *BTS Setting > Carrier Setting* sub-menu. Options are Single Carrier, Dual Carrier, and Carrier Aggregation. Refer to *section 2.7.4* for more information.
MME Status	Mobility Management Entity status is connected or not connected to the eNB. The LTE MME is responsible for initiating paging and authentication of mobile devices. The operator may have more than one MME in the network. NOTE: This field will not display in HaloB mode.
IPSec Status	The Internet Protocol Security gateway is connected or not connected to the eNB. The operator may have more than one IPSec gateway. The system enables the IPSec by default. In the presence of a security gateway, the security protocols are provided in the network layer to ensure the safety of the message transmission. NOTE: This field will not display in HaloB mode.
SAS Status*	Field that displays whether the device is registered or unregistered with the Citizens Broadband Radio Service (CBRS) and the shared Spectrum Access System (SAS). Refer to *section 2.5.2* and the *SAS Deployment User Guide*.
Radio Resource Usage	
UL PRB Usage*	Shows the percentage of available Physical Resource Blocks being used in the uplink. Hover over the graph to view numerical data for a specific data point.  NOTE 1: A two-carrier eNB operating in Dual Carrier (DC)/split mode displays Cell 1 and Cell 2 data. Refer to the *Carrier Aggregation and Dual Carrier/Split Mode Configuration Guide*. NOTE 2: An eNB in Carrier Aggregation mode displays Pcell and Scell data.

Field Name	Description
DL PRB Usage*	Shows the percentage of available Physical Resource Blocks being used in the downlink. Hover over the graph to view numerical data for a specific data point.  NOTE 1: A two-carrier eNB operating in Dual Carrier (DC)/split mode displays Cell 1 and Cell 2 data. Refer to the *Carrier Aggregation and Dual Carrier/Split Mode Configuration Guide.* NOTE 2: An eNB in Carrier Aggregation mode displays Pcell and Scell data.
UE Status*	
Number of connection bearers	Number of CPEs currently connected to the eNB; if at least one, additional fields display.
UE ID	The CPE identification number assigned by the system.
IMSI	The International Mobile Subscriber Identity (IMSI) number. An IMSI is used to identify the user of a cellular network and is a unique identification associated with all cellular networks.
IP	Internet Protocol address for the eNB.
PORT	Port number assigned to the CPE to allow remote logins. For example, type in the eNB <IP address>:5<last 5 digits of IMSI>.
DL Th. (Mbps)	The data throughput rate, in megabits per second (Mbps), of data transmitted downlink by the eNB to the CPE.
UL Th. (Mbps)	The data throughput rate, in megabits per second (Mbps), of data transmitted uplink by the CPE to the eNB.
ULSINR	Uplink Signal-to-Interference-Plus-Noise Ratio (ULSINR) describes the signal strength of the CPE's signals to the eNB in comparison with other interfering signals or background noise, expressed in dB. Range is 0–30 dB.
P_DLCQI	(Primary Cell) Downlink Channel Quality Indicator indicates how good or bad the communication channel quality is for data being transmitted from the eNB to the CPE. CQI is a combination of SNR, SINR, and SNDR. Value range is 1–15.
S_DLCQI	(Secondary Cell) Downlink Channel Quality Indicator indicates how good or bad the communication channel quality is for data being transmitted from the eNB to the CPE. CQI is a combination of SNR, SINR, and SNDR. Value range is 1–15.

Field Name	Description
ULMCS	Uplink Modulation and Coding Scheme is a numerical index based on Orthogonal Frequency Division Multiplexing (OFDM) that represents the maximum data rate the CPE can achieve when transmitting data over-the-air to the eNB. The MCS index value comprises several variables, including channel width, modulation type, coding rate, and spatial streams.
P_DLMCS	(Primary Cell) Downlink Modulation and Coding Scheme–see description for "ulmcs" above, which in this case pertains to the downlink.
S_DLMCS	(Secondary Cell) Downlink Modulation and Coding Scheme–see description for "ulmcs" above, which in this case pertains to the downlink.
TXPOWER(dBm)	Transmit (Tx) power is the amount of RF power (in Watts) that the CPE produces. Unit of measurement is dBm. Range is -8 to +23 dBm.
ULBLR	Block Error Ratio (BLER) is a measure of how successful a data transmission is over-the-air at the Physical/MAC layer level. Uplink BLER represents a ratio of the number of erroneous data blocks received to the total number of blocks sent from CPE to eNB.
P_TB1_DLBLR	(Primary Cell) Block Error Ratio (BLER) is a measure of how successful a data transmission is over-the-air at the Physical/MAC layer level. Downlink BLER is a ratio of the number of erroneous data blocks received to the total number of blocks sent from the eNB to the CPE.
P_TB2_DLBLR	(Primary Cell) Block Error Ratio (BLER) is a measure of how successful a data transmission is over-the-air at the Physical/MAC layer level. Downlink BLER is a ratio of the number of erroneous data blocks received to the total number of blocks sent from the eNB to the CPE.
S_TB1_DLBLR	(Secondary Cell) Block Error Ratio (BLER) is a measure of how successful a data transmission is over-the-air at the Physical/MAC layer level. Downlink BLER is a ratio of the number of erroneous data blocks received to the total number of blocks sent from the eNB to the CPE.
S_TB2_DLBLR	(Secondary Cell) Block Error Ratio (BLER) is a measure of how successful a data transmission is over-the-air at the Physical/MAC layer level. Downlink BLER is a ratio of the number of erroneous data blocks received to the total number of blocks sent from the eNB to the CPE.
PATHLOSS(dBm)	Reports the reduction in power density (attenuation) as the wireless signal propagates through space. The pathloss value impacts the overall RF link budget. An RF link budget is an accounting of all the gains and losses from the transmitter, through the medium to the receiver.

1.5.2 Quick Setting (Including SAS Parameters)

References:

- *Carrier Aggregation and Dual Carrier/Split Mode Configuration Guide*
- *Nova430e Outdoor 4x250mW Two-Carrier TDD eNodeB Installation Guide*
- *Nova430i Outdoor 4x250mW Two-Carrier TDD eNodeB Installation Guide*
- *Nova436Q Outdoor 4x1W Two-Carrier TDD eNodeB Installation Guide*
- *Neutrino430 Indoor 4x250mW Two-Carrier TDD eNodeB Installation Guide*
- *SAS Deployment User Guide*

The *Basic Setting > Quick Setting* sub-menu is used to configure important RF parameters and connectivity to the Baicells CloudCore Evolved Packet Core (EPC). The eNB also supports Citizens Broadband Radio Service (CBRS) and the shared Spectrum Access System (SAS). The SAS settings are accessed from the *Basic Setting > Quick Setting* sub-menu.

NOTE: The fields that display in the *Basic Setting > Quick Setting* sub-menu GUI depend on how certain key parameters are set. Table 2-3 identifies the conditions in which fields are affected by various eNB settings, but a couple of examples are:

- When the *Cloud EPC* field in the *Quick Setting* pane is set to *ON*, several other fields (*TAC*, *S1 Link Port*, *PLMN*, *MME IP*, and *Cell ID*) are greyed out to indicate they are auto-configured when the eNB is operating in this mode.

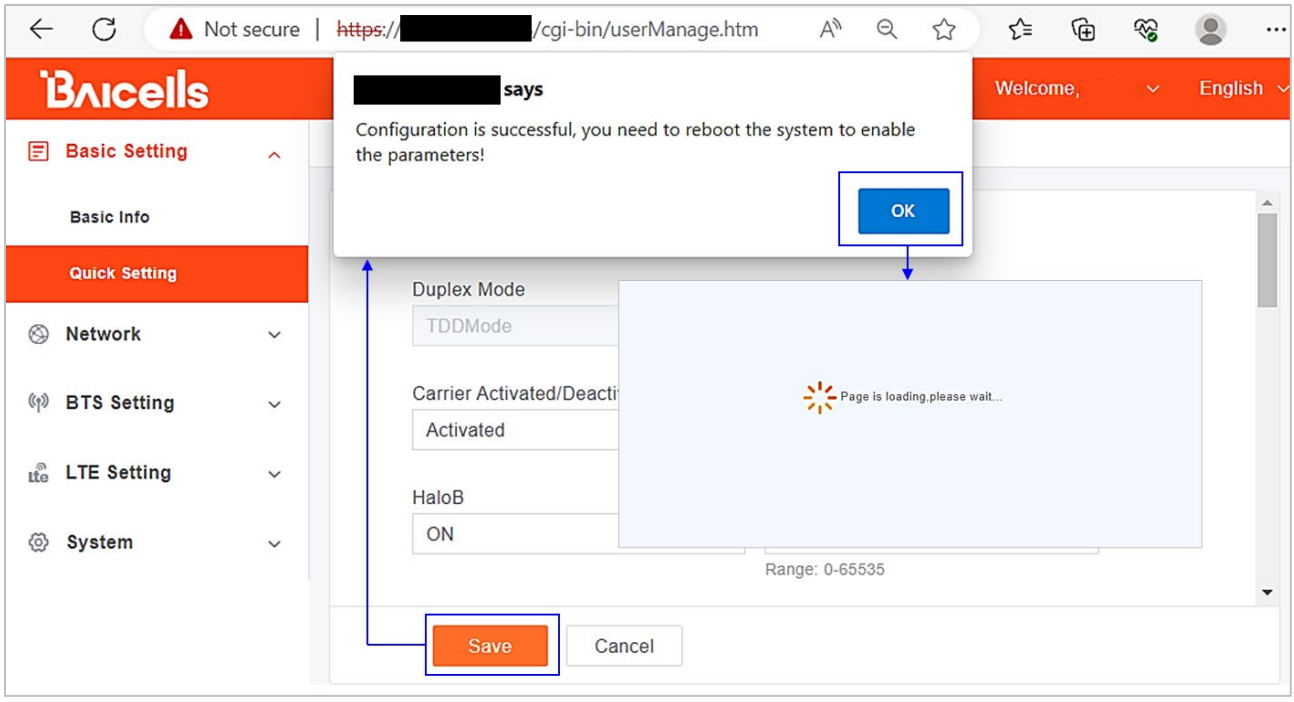
- When the *Carrier Mode* field in the *Quick Setting* pane is set to *Single Carrier*, one cell is configured. When *Dual Carrier* is selected, two cells are configured and display fields for Cell1 and Cell2. When *Carrier Aggregation* is selected, fields display as “Pcell” and “Scell”.

The *Quick Setting* fields must be configured for cell parameters and transmission information. When an eNB is attaching to the core network through the Baicells CloudCore, and the *Cloud EPC* field in the *Quick Setting* pane is set to *OFF*, the *PLMN* field must be set to **314030**. When the eNB connects to CloudCore, the *MME IP* address fields are set to **10.3.0.9** and **10.5.0.9**. Check to make sure the eNB has obtained the two MME addresses.

NOTE 1: The fields *HaloB* and *Cloud EPC*, which are used to set the eNB operating mode, can also be set in the *Network > Core Network* sub-menu (*section 2.6.4*). The *Carrier Mode* field can also be set in the *BTS Setting > Carrier Setting* sub-menu (*section 2.7.4*).

NOTE 2: For most *Basic Setting > Quick Setting* sub-menu parameter changes, after selecting *Save*, the system prompts you to confirm the configuration is successful and that a reboot is required (Figure 2-8). When you get this message, select *OK*, and the page automatically refreshes. You must perform a **reboot** of the eNB for the changes to take effect (*section 2.9.9*).

Figure 2-8: Successful Configuration and Reboot Message



The CBRS SAS is an operating solution available only in the United States. The solution requires a working knowledge of SAS, preparation of personnel and equipment, and coordinated configuration across device GUIs, the OMC, and the selected SAS vendor's portal. For this reason, Baicells created the *SAS Deployment User Guide* to assist operators in planning their deployment of SAS. The *SAS Deployment User Guide* provides detailed information about all SAS requirements and configurations and thoroughly explains how to use *Quick Setting* parameters to support SAS. The following information provides a brief overview only.

The CBRS band covers 3.55–3.65 GHz and was officially launched in January 2020. Operators must sign up with a SAS provider for services to handle the dynamic frequency assignment and release process. Baicells provides FCC Part 96 certified eNBs and CPEs as CBRS Service Devices (CBSDs) that can operate within the FCC rules for CBRS, and certification is an ongoing process as new products are introduced. The SAS vendors currently available to manage spectrum usage are Amdocs, Federated Wireless, and Google.

The Baicells eNBs use Domain Proxy (DP) to connect to the SAS server by leveraging the existing connection with the OMC. All eNBs must connect to the OMC to connect to the SAS.

To begin, you select *USA-FCC (CBRS)* in the *Country Code* drop-down menu in the *Quick Setting* pane of the *Basic Setting* > *Quick Setting* sub-menu to enable SAS on the eNB and gain access to all the SAS configuration parameters (Figure 2-9 and Figure 2-10).

NOTE: In the *Basic Setting* > *Quick Setting* sub-menu, the *SAS Registration Type* selected in the *SAS Preferred Settings* pane determines the fields that display in the *Install Param Config* pane. The *Carrier Mode* selected in the *Quick Setting* pane also determines the fields that display.

Once SAS is enabled, the parameters *Band*, *Bandwidth*, *Frequency*, and *Power Modify* in the *Quick Setting* pane are greyed out. In that case, the eNB uses the settings determined by the SAS vendor. However, you can assign preferences to these settings for the SAS vendor using the parameters in the *SAS Preferred Setting* pane.

Figure 2-9 and Figure 2-10 show the fields that display when the working mode *HaloB* is set to *ON*, carrier mode is *Dual Carrier*, and SAS is enabled with registration type *Single-step* selected.

Table 2-3 describes all the *Basic Setting > Quick Setting* sub-menu fields.

Figure 2-9: Quick Setting (1 of 2)

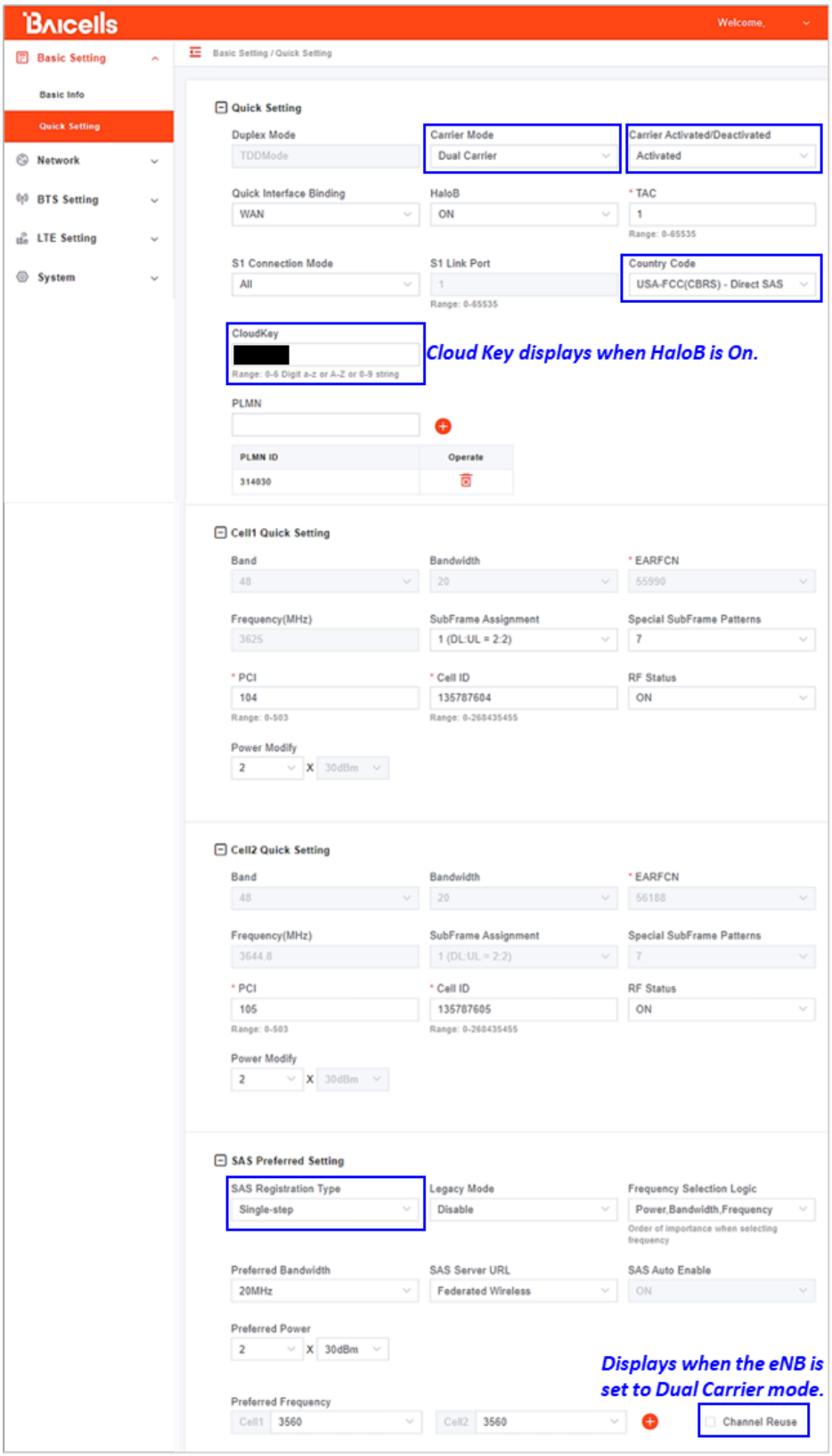


Figure 2-10: Quick Setting (2 of 2)

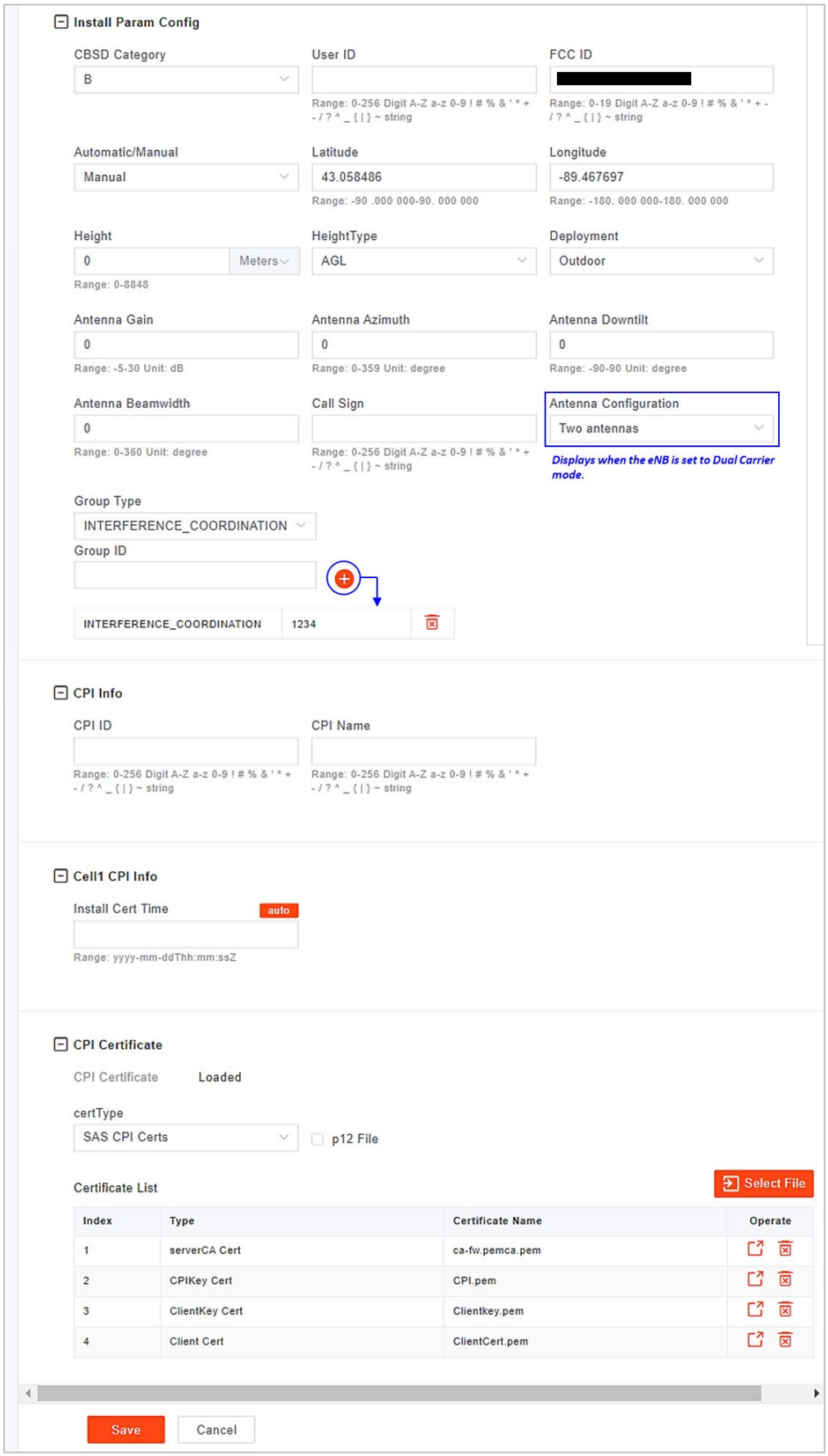


Table 2-3: Quick Setting Fields

Field Name	Description
Quick Setting Pane	
Duplex Mode	Preset field - cannot be configured at this time. Either Time Division Duplexing (TDD) or Frequency Division Duplexing (FDD) depending on model and country.
Carrier Mode	The carrier mode options supported by the eNB: • Single Carrier: The eNB supports only one cell in this mode. • Dual-Carrier: The eNB supports two cells in this mode. Cell1 and Cell2 must both be configured in the *Basic Setting > Quick Setting* sub-menu because the two carriers are independent of each other. • Carrier Aggregation: In this mode, the eNB supports one cell, but the bandwidth and throughput are twice what is possible in Single Carrier mode. The primary carrier is responsible for signaling and services, while the second carrier is responsible for services only.
Carrier Activated / Deactivated	This field is used to enable reasonable CPE battery consumption. If the CPE is configured with one or more Cells, the eNodeB can activate and deactivate the configured Cells. This Activation/Deactivation does not apply to PCell. Activate or deactivate the carrier. • Activated • Deactivated
Quick Interface Binding	Used to assign the interface connected to the MME. The interface should be selected from among the network interfaces previously configured (*section 2.6.1*). Default is the WAN interface, but the VLAN interface can also be used.
HaloB	Shows HaloB status (*ON* or *OFF*) as set in the *Network > Core Network* sub-menu. NOTE: This field will not display if Cloud EPC mode is *ON*.
Cloud EPC	The Baicells CloudCore Evolved Packet Core (EPC) is either *ON* or *OFF*. When you enable it (*ON*), the fields for TAC, S1 Link Port, PLMN, MME IP (*Quick Setting* pane) and CELL ID (*Cell Quick Setting* pane) are automatically assigned and are greyed out. When you disable the Cloud EPC setting (*OFF*), the greyed out fields are unlocked again. Also, when you change the Cloud EPC setting, a **reboot** of the eNB is required. NOTE: This field will not display in HaloB mode.
TAC	Tracking Area Code (TAC) for where the eNB is located. The TAC is used to determine the range of the paging information. Use a number between 1–65535. The default is 1. NOTE: This field is greyed out when the Cloud EPC mode is *ON*.
S1 Connection Mode	The connection mode of the S1 interface between the eNB and the core network. • One: The eNB connects only to the first MME. • All: The eNB connects to all MMEs configured.

Field Name	Description
S1 Link Port	The S1 Link port used. NOTE: This field is greyed out when the HaloB mode or Cloud EPC mode is *ON*.
Country Code	Used to select operating mode: • USA-FCC (CBRS): Used to enable the eNB to operate in CBRS SAS mode. • Other: Used to operate in normal mode.
CloudKey	The Network Management Station (NMS) assigns this unique identifier for each operator. Range is 0–6 characters (using upper-case letters A–Z, lower-case letters a–z, and digits 0–9). NOTE: This field will not display if Cloud EPC mode is *ON*.
PLMN	The numerical identifier for the operator's Public Land Mobile Network (PLMN) for this cell. Must be a 5- or 6-digit number. If you are using the Baicells CloudCore, you must enter **PLMN = 314030**. When you configure the PLMN, it displays in the PLMN ID list. NOTE: This field is greyed out when the Cloud EPC mode is *ON*.
MME IP	The IP address of the associated MME, which is identical to the IP address of the MME at the core network side. If you're using the Baicells CloudCore, you must set the *MME IP* address fields to **10.3.0.9** and **10.5.0.9.** When you configure the MME, it displays in the table below the MME IP field. NOTE: This field will not display in HaloB mode or when IP MME Pool is enabled. This field is greyed out when the Cloud EPC mode is *ON*.
Cell1 and Cell2 Quick Setting Panes	
Band	The eNB's operating frequency band, which is auto-selected based on the hardware model. NOTE: If SAS is enabled, the band is assigned by the SAS vendor and the field is greyed out. Refer to the *SAS Deployment User Guide* for more information.
Bandwidth	For TDD mode, the channel bandwidth the eNB can use: 5, 10, 15, or 20 MHz. Applies to both uplink and downlink. The default is 20 MHz. Example for B43: 44190 (3660 MHz) to 44490 (3690 MHz). NOTE: If SAS is enabled, the bandwidth is assigned by the SAS vendor and the field is greyed out. Refer to the *SAS Deployment User Guide* for more information.
EARFCN	EARFCN stands for Evolved Universal Mobile Telecommunications System (UMTS) Terrestrial Radio Access (E-UTRA) Absolute Radio Frequency Channel Number. Used to set the absolute radio frequency channel number as allocated by the operator. Range is 55340–56640. NOTE: If SAS is enabled, the EARFCN is assigned by the SAS vendor and the field is greyed out. Refer to the *SAS Deployment User Guide* for more information.

Field Name	Description
Frequency(MHz)	The eNB's operating frequency (MHz) as selected by the operator. Range depends on the eNB hardware model, country code, and whether SAS is enabled. Example for B41: 44190 (3660 MHz) to 44490 (3690 MHz). NOTE: If SAS is enabled, the frequency is assigned by the SAS vendor and the field is greyed out. Refer to the *SAS Deployment User Guide* for more information.
SubFrame Assignment	Downlink (DL) and uplink (UL) subframe configuration, where: 1 = DL:UL is 2:2 transmission ratio 2 = DL:UL is 3:1 transmission ratio (default) 6 = DL:UL is 3:5 transmission ratio Refer to the BaiTip on this setting: *https://community.na.baicells.com/t/baitip-of-the-day-december-14th-2016-subframes-and-special-subframes/163*
Special SubFrame Patterns	This is a standard LTE setting that pertains to synchronization of downlink and uplink timing. The guard period between switching from DL to UL or UL to DL determines the maximum supportable cell size. The guard period has to be large enough to cover the propagation delay of DL interferers. Either 5 or 7. The default setting is 7.
PCI	Physical Cell Identifier (PCI) allocated by the operator. Range is 0–503. PCI is an essential Layer 1 cell identity for each cell site in the network. Planning PCIs is crucial for QoS. NOTE: Baicells does not use and does not work with PCI 0.
Cell ID	Unique identification number for the Cell ID. Range from 0 to 268435455. NOTE: This field is greyed out when the Cloud EPC mode is *ON*.
RF Status	Turn *ON* or *OFF* the eNB's RF antenna to allow it to transmit and receive (*ON*) or to keep it from transmitting and receiving (*OFF*). The default is *OFF*.
Power Modify	Output power on each port, typically left with the default values (30 dBm x 2 = 33 dBm). Every 3 dB doubles the power. This field can be used in situations where you need to reduce the output power, such as testing the eNB before installing it on a tower; restricting the eNB output to reduce interference with other eNBs in the same geographical area; or staying within Effective Isotropic Radiated Power (EIRP) rules. NOTE: If SAS is enabled, the power setting is assigned by the SAS vendor. Refer to the *SAS Deployment User Guide* for more information.
SAS Preferred Setting Pane NOTE 1: Refer to the SAS Installation Parameters in the *SAS Deployment User Guide* for more detailed information about the *SAS Preferred Setting* fields. NOTE 2: The *SAS Preferred Setting* pane and all the associated fields won't display unless SAS is enabled.	

Field Name	Description
Install Param Config Pane	NOTE 1: Refer to the SAS Installation Parameters in the *SAS Deployment User Guide* for more detailed information about the *Install Param Config* fields. NOTE 2: The *Install Param Config* pane and all the associated fields won't display unless SAS is enabled.
Cell1 Install Param Config Pane	NOTE 1: Refer to the SAS Installation Parameters in the *SAS Deployment User Guide* for more detailed information about the *Cell1 Install Param Config* fields. NOTE 2: The *Cell1 Install Param Config* pane and all the associated fields won't display unless SAS is enabled.
Cell2 Install Param Config Pane	NOTE 1: Refer to the SAS Installation Parameters in the *SAS Deployment User Guide* for more detailed information about the *Cell2 Install Param Config* fields. NOTE 2: The *Cell2 Install Param Config* pane and all the associated fields won't display unless SAS is enabled.
CPI Info Pane	NOTE 1: Refer to the SAS Installation Parameters in the *SAS Deployment User Guide* for more detailed information about the *CPI Info* fields. NOTE 2: The *CPI Info* pane and all the associated fields won't display unless SAS is enable.
Cell1 CPI Info Pane	NOTE 1: Refer to the SAS Installation Parameters in the *SAS Deployment User Guide* for more detailed information about the *Cell1 CPI Info* fields. NOTE 2: The *Cell1 CPI Info* pane and all the associated fields won't display unless SAS is enabled.
Cell2 CPI Info Pane	NOTE 1: Refer to the SAS Installation Parameters in the *SAS Deployment User Guide* for more detailed information about the *Cell2 CPI Info* fields. NOTE 2: The *Cell2 CPI Info* pane and all the associated fields won't display unless SAS is enabled.
CPI Certificate Pane	NOTE 1: Refer to the SAS Installation Parameters in the *SAS Deployment User Guide* for more detailed information about the *CPI Certificate* fields. NOTE 2: The *CPI Certificate* pane and all the associated fields won't display unless SAS is enabled.

1.6 Network

The *Network* menu settings are where you configure the network interfaces and static routes for the eNB (Figure 2-11). This menu is also used to set the eNB's operating mode.

Figure 2-11: Network Menu

1.6.1 WAN/LAN/VLAN

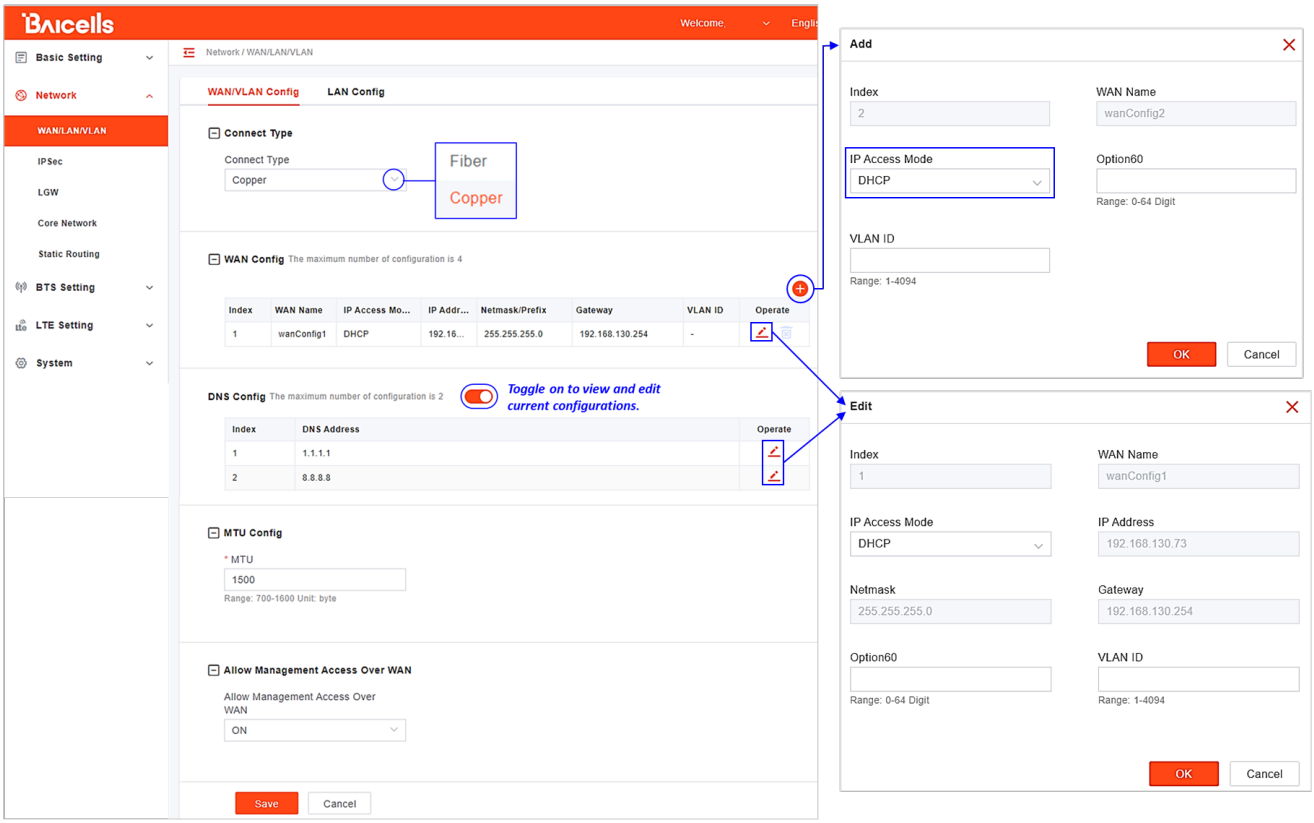
The *Network > WAN/LAN/VLAN* sub-menu contains two tabs: *WAN/VLAN Config* and *LAN Config*. The Wide Area Network (WAN) interface is an external communication portal (Internet connection) between the eNB's NMS and the MME. The eNB's NMS can be the Baicells Operations and Maintenance Console (OMC) or the LTE NMS. The WAN interface supports Virtual Local Area Network (VLAN) configuration as well. The Local Area Network (LAN) interface fields are used to configure the LMT port on the eNB. The port can be used during initial eNB setup and configuration.

The *WAN/VLAN Config* tab (Figure 2-12) is for configuring the default router/Domain Name Services (DNS), the type of physical connection that the eNB uses to the external network, and one or more VLANs (single-carrier eNBs only). The physical *Connect Type* can be copper or fiber, and can connect via DHCP, Static IP, IPv6 DHCP, or IPv6 Static IP.

NOTE 1: If *DHCP* is selected for the interface protocol, only option 60 field needs to be configured.

NOTE 2: If the LAN interface's IP address is modified, the eNB must be rebooted to apply the change.

Figure 2-12: WAN/VLAN Config Tab



The *LAN Config* tab (Figure 2-13) is used the configure the LAN information. You must specify the IP address and subnet mask address for the local network connection. The default LAN IP address is **192.168.150.1** and the default subnet mask address is **255.255.255.0**.

All of the *Network > WAN/VLAN/LAN* sub-menu fields are described in Table 2-4.

Figure 2-13: LAN Config Tab

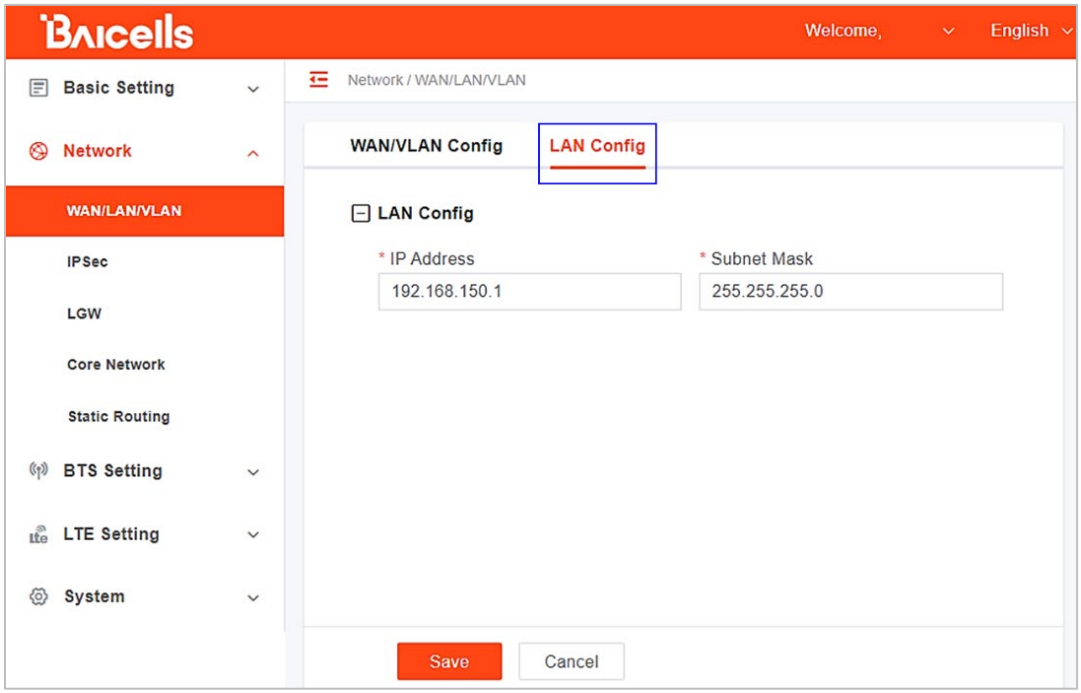


Table 2-4: WAN/VLAN/LAN Fields

Field Name	Description
WAN/VLAN Config Tab	
Connect Type Pane	
Connect Type	Used to select the type of connection for the eNB: • Copper: RJ-45 electrical interface • Fiber: optical fiber interface The connection type is based on the eNB model. If the eNB doesn't support optical ports, the value must be set to *Copper*.
WAN Config Pane	
Index	The WAN index number, which is generated automatically. The eNB supports up to four WAN interfaces.
WAN Name	The WAN Name is automatically. generated
IP Access Mode	Used to select the desired interface protocol to be used by the WAN interface: • DHCP: only the Option60 parameter needs to be configured if DHCP is the interface protocol selected. • Static IP • IPv6 DHCP • IPv6 Static IP
Option60	Used to differentiate between different terminals when *IP Access Mode* is set to *DHCP*. Range is 0–64 digits.
Netmask	The IP address' subnet mask address. This parameter displays when *IP Access Mode* is set to *Static IP*.
Gateway	The default gateway's IP address. This parameter displays when *IP Access Mode* is set to *Static IP*.
Prefix	The IPv6 address' prefix for the WAN interface. This parameter displays when *IP Access Mode* is set to *IPv6 Static IP*. Range is 0–128.
IPv6 Gateway	The IPv6 address' gateway for the WAN interface. This parameter displays when *IP Access Mode* is set to *IPv6 Static IP*.
IP Address	The WAN interface's IP address. This parameter displays when *IP Access Mode* is set to *Static IP* or *IPv6 Static IP*.
VLAN ID	Used to configure more IP addresses for the WAN interface through the VLAN when there is a need to transmit multi-types of data through a separate channel. Range is 1–4094.
DNS Config Pane	
Index	The DNS index number, which is generated automatically.
DNS Address	The IP address assigned to the DNS. The maximum number of configurations is two.
MTU Config Pane	
MTU	Used to specify the size of the largest network layer protocol data unit that can be communicated in a single network transaction. Specifying the correct MTU for the network can help to improve data transmission efficiency. Range is 70–1600 bytes. The default value is 1500 bytes.

Field Name	Description
Allow Management Access Over WAN Pane	
Allow Management Access Over WAN	Used to enable/disable the Local Maintenance Terminal connection through the WAN port (*ON* or *OFF*) for management purposes. If set to *ON*, the administrator can maintain the eNB through the WAN interface.
LAN Config Tab	
LAN Config Pane	
IP Address	The LAN interface IP address. The default value is **192.168.150.1**.
Subnet Mask	Used to define the subnet mask address for the LAN interface. The default value is **255.255.255.0**.

1.6.2 IPSec

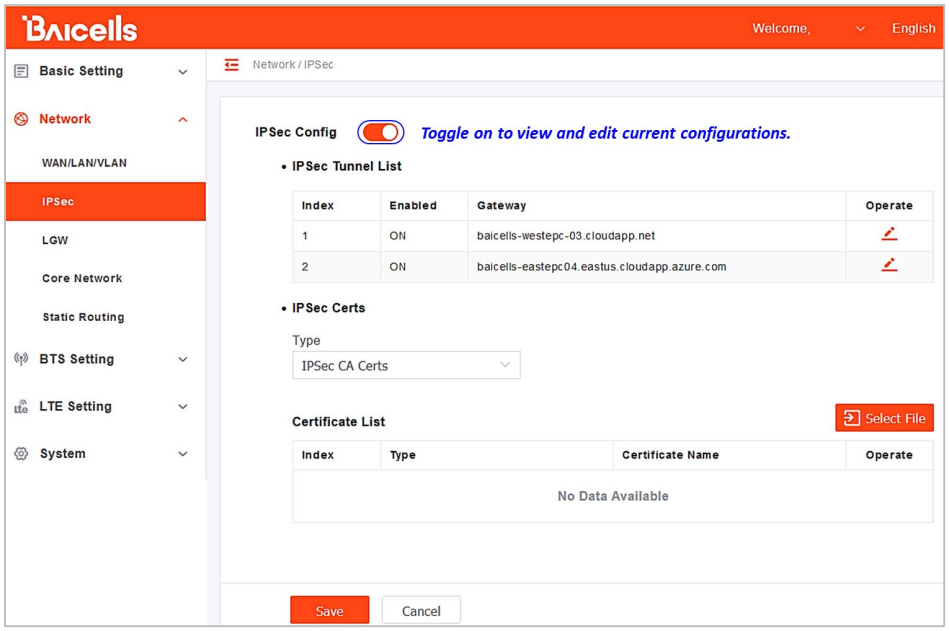
The *Network > IPSec* sub-menu (Figure 2-14) is used to configure the IPSec interface's tunnel list and manage IPSec certificates.

NOTE 1: The *Network > IPSec* sub-menu displays in the *Network* menu when the eNB is operating in HaloB mode. However, IPSec tunnels aren't used when HaloB is on, so the toggle button in the *IPSec Config* pane is disabled.

NOTE 2: The MME IP addresses are **10.3.0.9** and **10.5.0.9** when using PLMN **314030** connecting to the Baicells CloudCore. The MME IP addresses and PLMN are configured in the *Basic Setting > Quick Setting* sub-menu (*section 2.5.2*).

The IP Security (IPSec) interface is used to route the control plane information between the eNB and the EPC. The security gateway can provide security protocol in the network layer to ensure messages are transmitted safely. If the operator has deployed the security gateway, the eNB needs to also enable the IPSec function. By default, in standard mode, the eNB enables the IPSec gateway, where up to two IPSec tunnels are supported.

Figure 2-14: IPSec



1.6.2.1 IPSec Config

In the *IPSec Tunnel List* table, you can define up to two sets of data per IPSec tunnel. Tunnel 1 and Tunnel 2 display information about the tunnel status and gateway. If you click on the *Edit* icon under the *Operate* column of the *IPSec Tunnel List* table, an *Edit* window opens (Figure 2-15), where you can configure the tunnel fields. Notice the two types of settings you can configure: *Basic Setting* and *Advance Setting*.

1.6.2.1.1 IPSec Tunnel List – Basic Setting

The *Basic Setting* fields are shown in Figure 2-15 and described in Table 2-5.

Figure 2-15: IPSec Tunnel List – Basic Setting

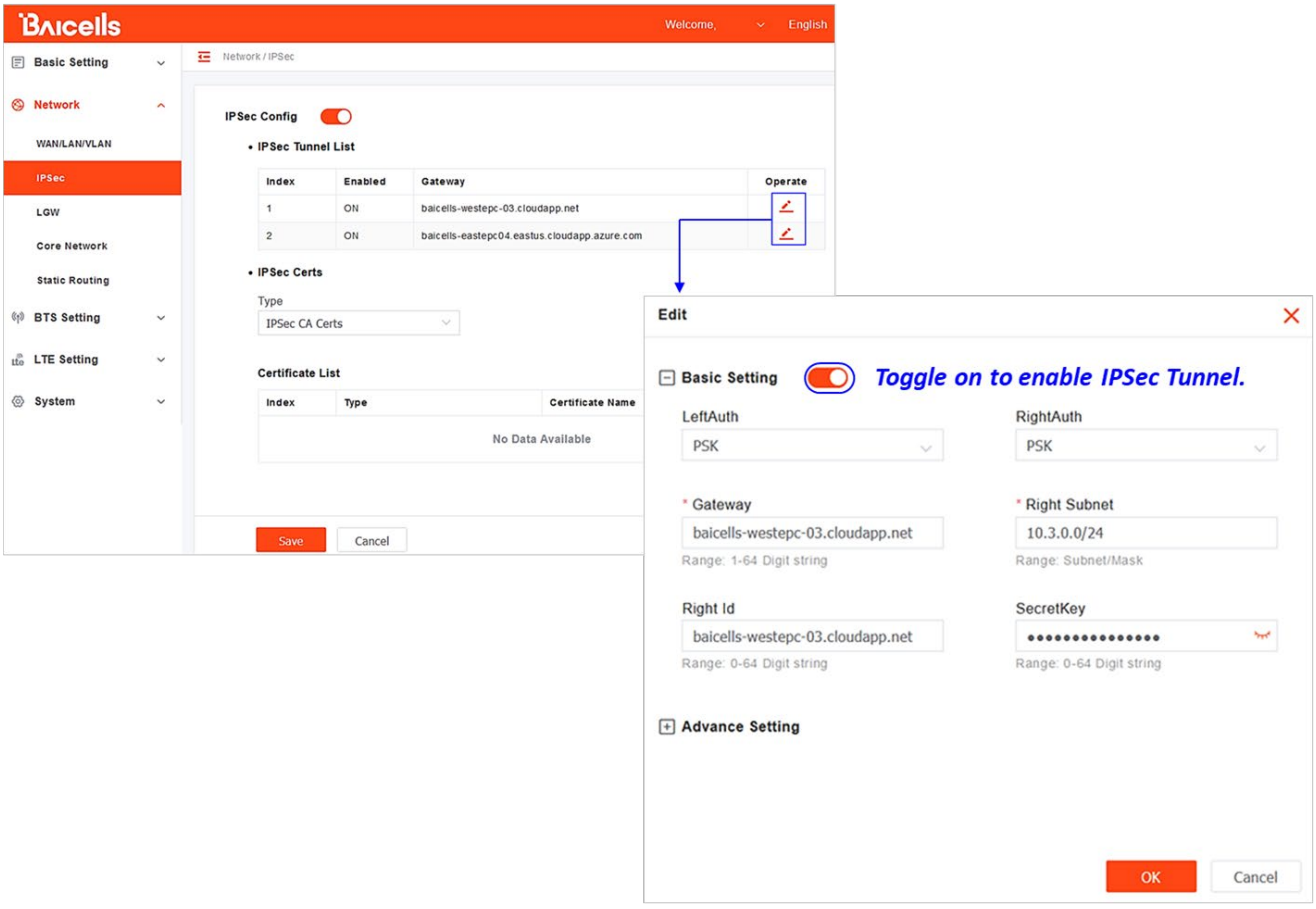


Table 2-5: IPSec Tunnel List – Basic Setting Fields

Field Name	Description
LeftAuth	Caution: Change not recommended! Local authentication method of the IPSec server. Must be consistent with the security gateway side. Options are: • PSK (default) • PUBKEY
RightAuth	Caution: Change not recommended! Peer authentication method of the IPSec server. Ensure input here matches the security gateway side. Options are: • PSK (default) • PUBKEY
Gateway	IP address of the IPSec server (security gateway). Ensure the IP address input here matches the actual IP address on the security gateway side Range is 1–64 digit string.
Right Subnet	IP address of the remote subnet (message within this address range is packed as a tunnel). Ensure input here matches the security gateway side. Range is Subnet/Mask.
Right Id	Peer ID (server). Ensure input here matches the security gateway side. If absent from the security gateway, leave this field empty as well. Range is 0–64 digit string.
SecretKey	File name of private key. When Auth is set to *PSK*, the value is the password of authentication. Range is 0–64 digit string.

1.6.2.1.2 IPSec Tunnel List – Advance Setting

Caution: Using the default values for *Advance Setting* fields is highly recommended. Improper changes may lead to system exceptions.

The *Advance Setting* fields become particularly important to network operations as areas become denser with users. Please refer to Figure 2-16 and Table 2-6.

Figure 2-16: IPSec Tunnel List – Advance Setting

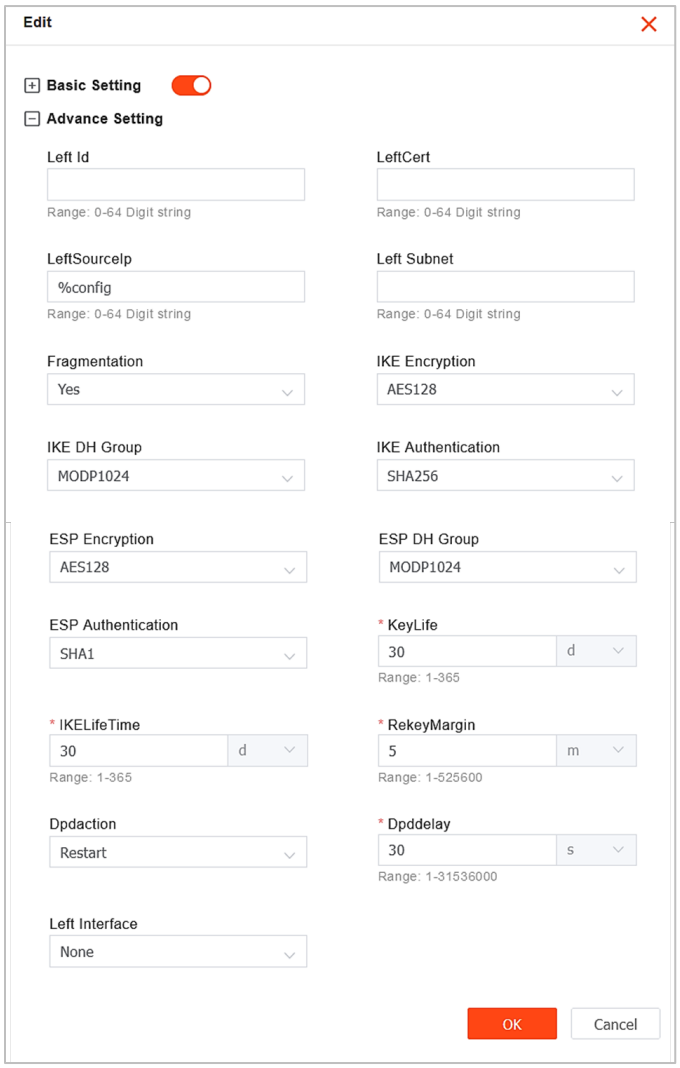


Table 2-6: IPSec Tunnel List – Advance Setting Fields

Field Name	Description
Left Id	Identification of the client end. Ensure input here matches the security gateway side. If absent from the security gateway, leave this field empty as well. Range is 0–64 digit string.
LeftCert	If the *Left Auth* field in the *Basic Setting* parameters is set to *PUBKEY*, this *LeftCert* parameter needs to be set. Certificate name, on this software version, is *client.Cert.derpsk*. Range is 0–64 digit string.
LeftSourceIp	Virtual address allocation assigned by the system. If absent, use the local IP address. Range is 0–64 digit string.
Left Subnet	Local Subnet IP address. Range is 0–64 digit string.
Fragmentation	The fragmentation type. Options are: • YES (default) • ACCEPT • FORCE • NO

Field Name	Description
IKE Encryption	Internet Key Exchange (IKE) encryption method. IKE is a protocol used to ensure security for Virtual Private Network (VPN) negotiation and remote host or network access. Options are: • AES128 (default) • AES256 • 3DES • DES
IKE DH Group	IKE Diffie-Hellman (DF) key computation, or exponential key agreement, to be used between two entities. Options are: • MODP768 • MODP1024 (default) • MODP1536 • MODP2048 • MODP4096
IKE Authentication	IKE authentication algorithm to be used. Options are: • SHA1 (default) • SHA1_160 • SHA256_96 • SHA256 (default)
ESP Encryption	Encapsulating Security Payload (ESP)–a member of the IPsec protocol suite that provides origin authenticity, integrity, and confidentiality protection of packets. Options are: • AES128 (default) • AES256 • 3DES • DES
ESP DH Group	ESP Diffie-Hellman (DF) key computation, or exponential key agreement, to be used between two entities. Options are: • MODP768 • MODP1024 (default) • MODP1536 • MODP2048 • MODP4096
ESP Authentication	ESP authentication algorithm to be used. Options are: • SHA1 (default) • SHA1_160 • SHA256_96 • GSHA256
KeyLife	IPsec security association (SA) renegotiation time. Format: Seconds, Minutes, Hours, or Days. The default setting is 30 days. Ranges are: • 1–31536000 seconds • 1–525600 minutes • 1–8760 hours • 1–365 days

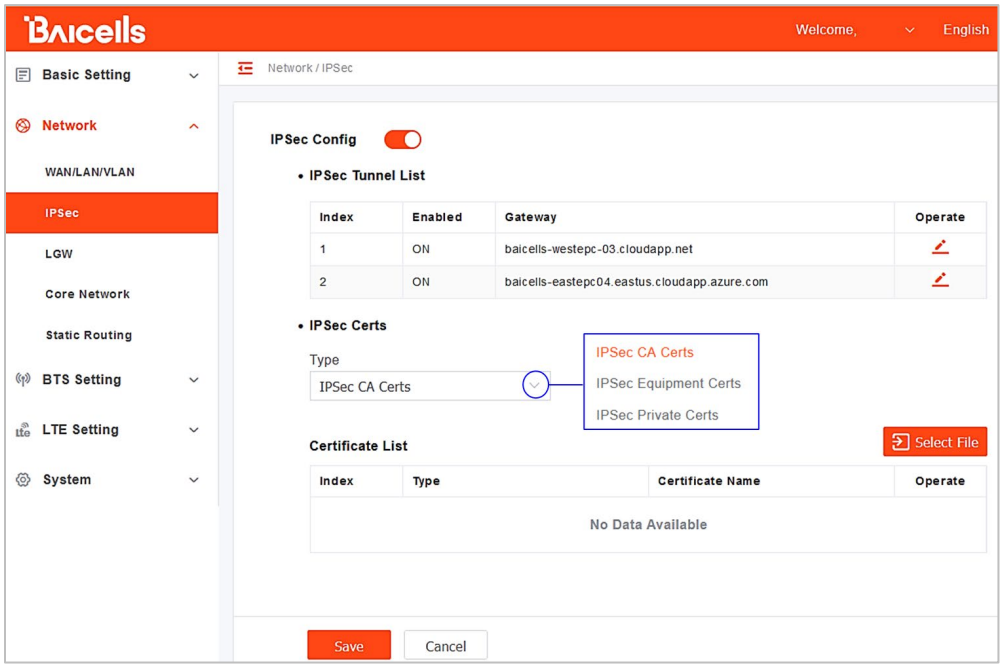
Field Name	Description
IKELifeTime	IKE security association renegotiation time. Format: Seconds, Minutes, Hours, or Days. The default setting is 30 days. Ranges are: • 1–31536000 seconds • 1–525600 minutes • 1–8760 hours • 1–365 days
RekeyMargin	Renegotiation time before the expiry of IKELifeTime (negotiate the IKE security association time before the expiry of IKELifeTime). Format: Seconds, Minutes, Hours, or Days. The default setting is 5 minutes. • 1–31536000 seconds • 1–525600 minutes • 1–8760 hours • 1–365 days
Dpdaction	DPD stands for dead peer detection (DPD) protocol. Determines what action to take when a gateway exception occurs: • None • Clear • Hold • Restart (default)
Dpddelay	Time interval for sending the DPD detection message. Format: Seconds, Minutes, or Days. The default setting is 30 seconds. Ranges are: • 1–31536000 seconds • 1–525600 minutes • 1–8760 hours • 1–365 days
Left Interface	The interface on the eNB side. Options are: • WAN • None (default)

1.6.2.2 IPSec Certs

Use the *Network > IPSec Certs* sub-menu to manage the IPSec certificates (Figure 2-17). There are three types of certificates to choose from:

- IPSec CA Certs (ROOT certificate)
- IPSec Equipment Certs (server and client certificates)
- IPSec Private Certs (server and client private keys)

Figure 2-17: IPSec Certs



1.6.3 LGW

Reference: *Set LGW Mode on eNB*

The Local Gateway (LGW) must be configured when the Baicells CloudCore Evolved Packet Core (EPC) is used. The Baicells eNodeB (eNB) splits the data and control planes, so there are two IP addresses per Customer Premise Equipment (CPE). The data plane is sent out to the LGW, while the control plane is routed through an IPSec tunnel to the Baicells CloudCore EPC.

Most manufacturers do not split the two planes; all traffic is sent through a hardware EPC. You also have that option with Baicells, but anyone who uses the Baicells CloudCore EPC uses LGW.

When LGW is set to *OFF*, the *Get UE IMSI* parameter displays (Figure 2-18). When *Get UE IMSI* is turned on, CPE International Mobile Subscriber Identity (IMSI) information is obtained. After obtaining the CPE IMSI numbers, the information displays in the *UE Status* list on the home page (Figure 2-19).

Figure 2-18: Get UE IMSI

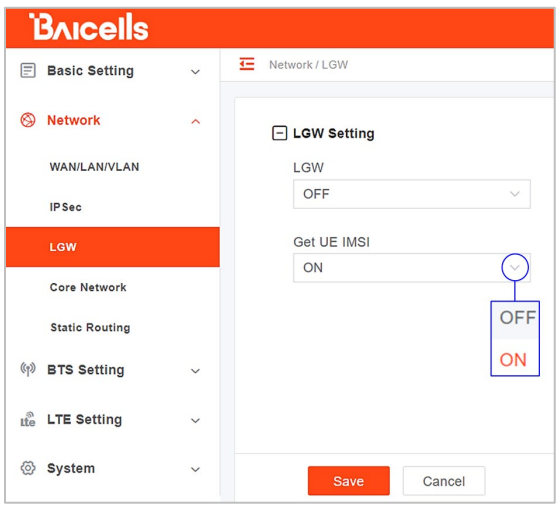
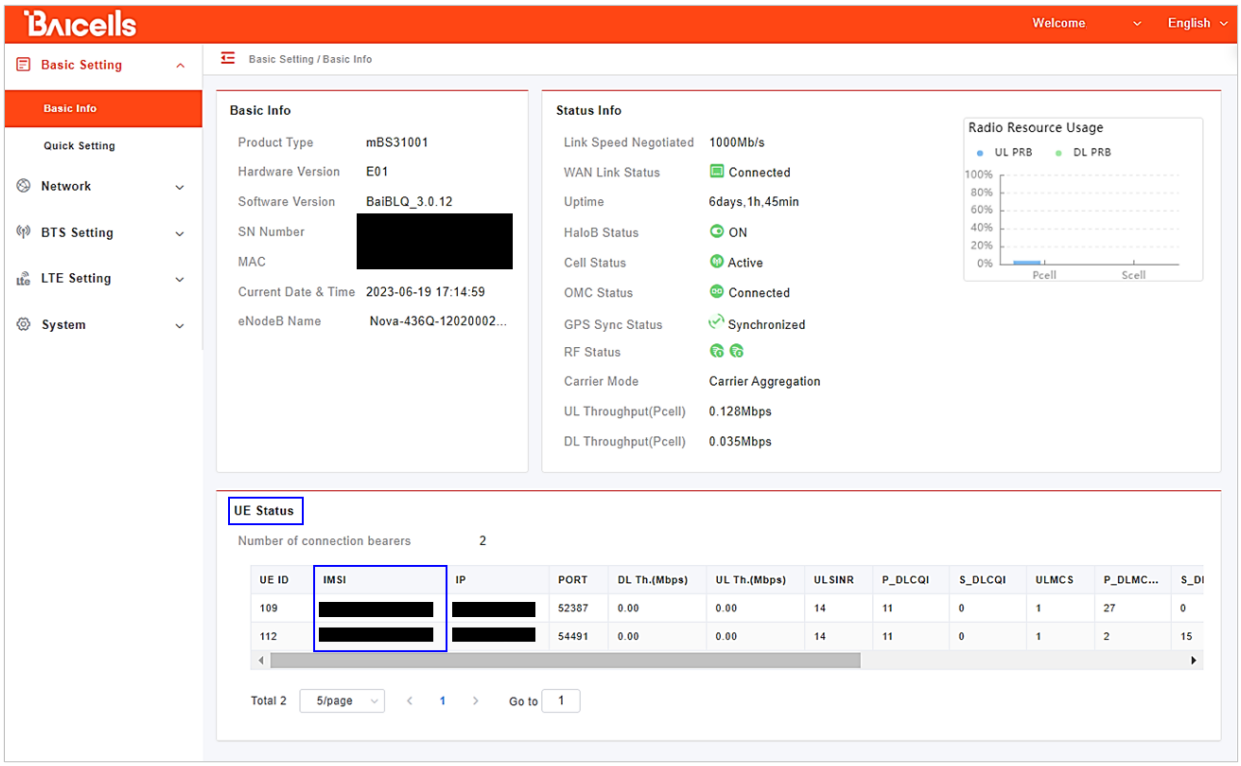


Figure 2-19: UE Status (IMSI)



Using the eNB GUI, follow the steps below to configure LGW, as shown in Figure 2-20, Figure 2-21, and Figure 2-22. The parameters are described in Table 2-7.

1. Go to *Network > LGW*.
2. Verify that LGW is set to *ON*.
3. Select one of three LGW modes: *NAT*, *Router*, or *Bridge*. The modes are explained in the following.

- **NAT** (Network Address Translation) - The IP address is kept local between the eNB and CPE. The eNB modifies the network address in the IP packet headers.
  - To reach user equipment remotely, in your web browser URL bar, enter:

    https://<eNB IP address><5+last 4 digits of CPE IMSI>
  - Leave the CPE Web GUI https port as **433**; do not change the port number.

NOTE: IP binding uses address range **10.10.0.1** to **10.10.0.254**.

- **Router** - The LGW (external router) assigns an IP address when a CPE attaches. Enable static IP addressing and identify the range of addresses.

NOTE: IP binding uses address range **10.10.0.1** to **10.10.0.254**.

- **Bridge** - Layer 2 creates a virtual interface for each CPE that attaches using a DHCP request to create a 1:1 mapping between the CPE IP address (from the EPC) and the LGW IP address.

NOTE: A CPE's MAC address is generated from its International Mobile Subscriber Identity (IMSI): Convert the last 12 digits to hex, and then prefix it with "8A". For example, if the IMSI = 117040000002918, the MAC address would be 8A:95:02:F9:B6:6.

4. Enter the required fields.
   - For the *LGW Interface Binding* field, *WAN* is the only option.
   - In *NAT* and *Router* LGW mode, you can then enter the *LGW IP Pool* address and netmask.

     NOTE: IP binding uses address range **10.10.0.1** to **10.10.0.254**.

   - For *Router* mode, if *Static Address* is *On*, configure the static address range by entering the first IP address and last IP addresses in the empty fields; then, configure the IMSI to IP Binding. Enter an IMSI and IP address in the empty fields and select the *Add* icon .
5. If you change the LGW mode, you must perform a reboot the eNB for the changes to take effect.

Caution: The reboot action temporarily disrupts the eNB service.

Figure 2-20: LGW Setting (NAT Mode)

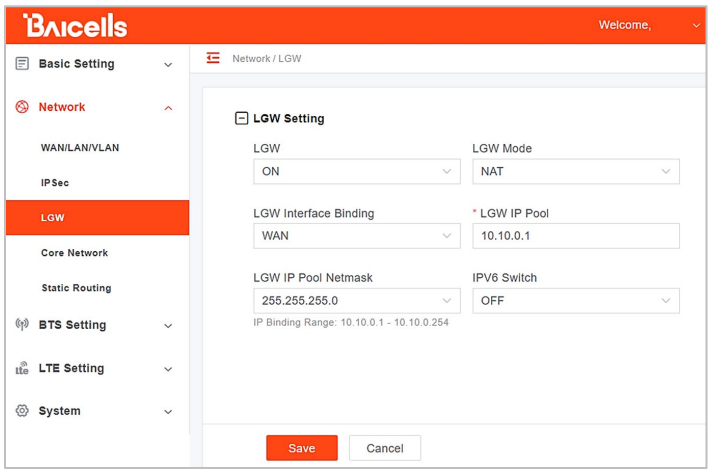


Figure 2-21: LGW Setting (Router Mode)

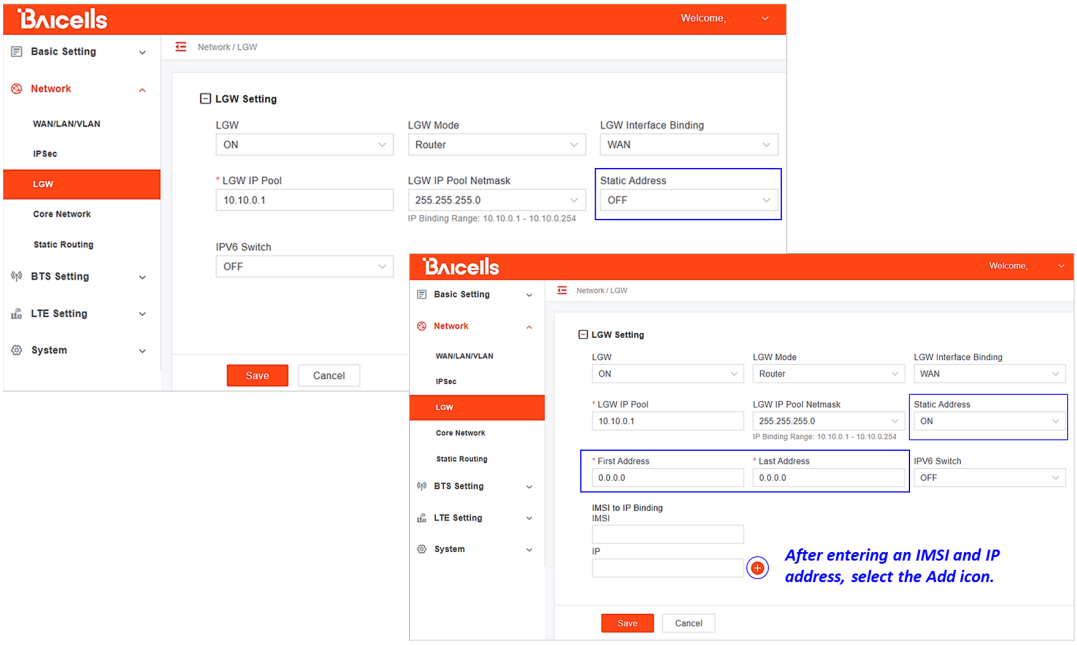


Figure 2-22: LGW Setting (Bridge Mode)

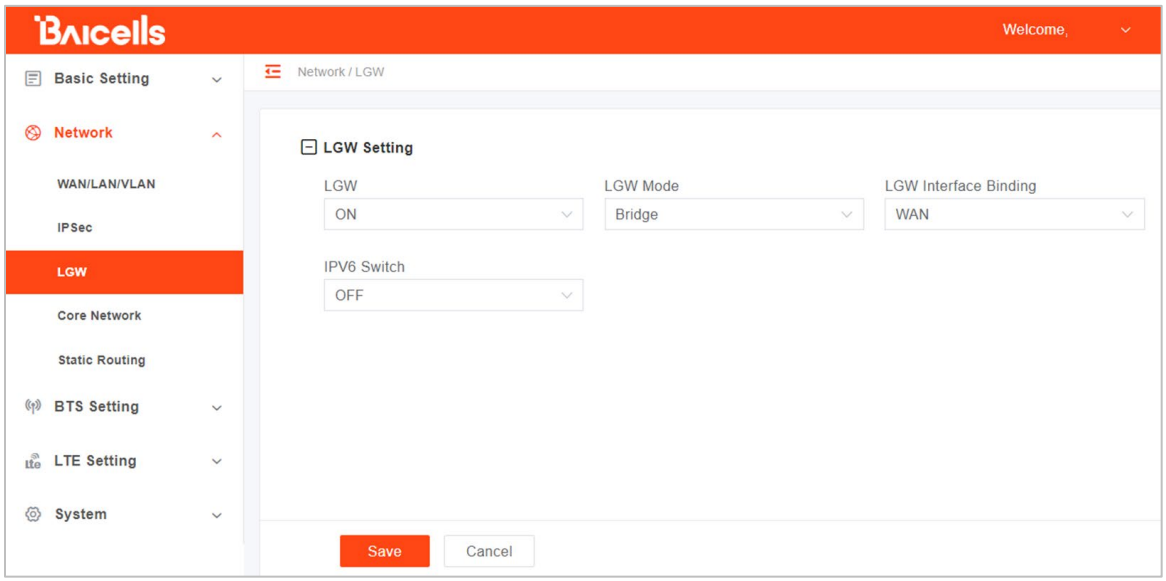


Table 2-7: LGW Fields

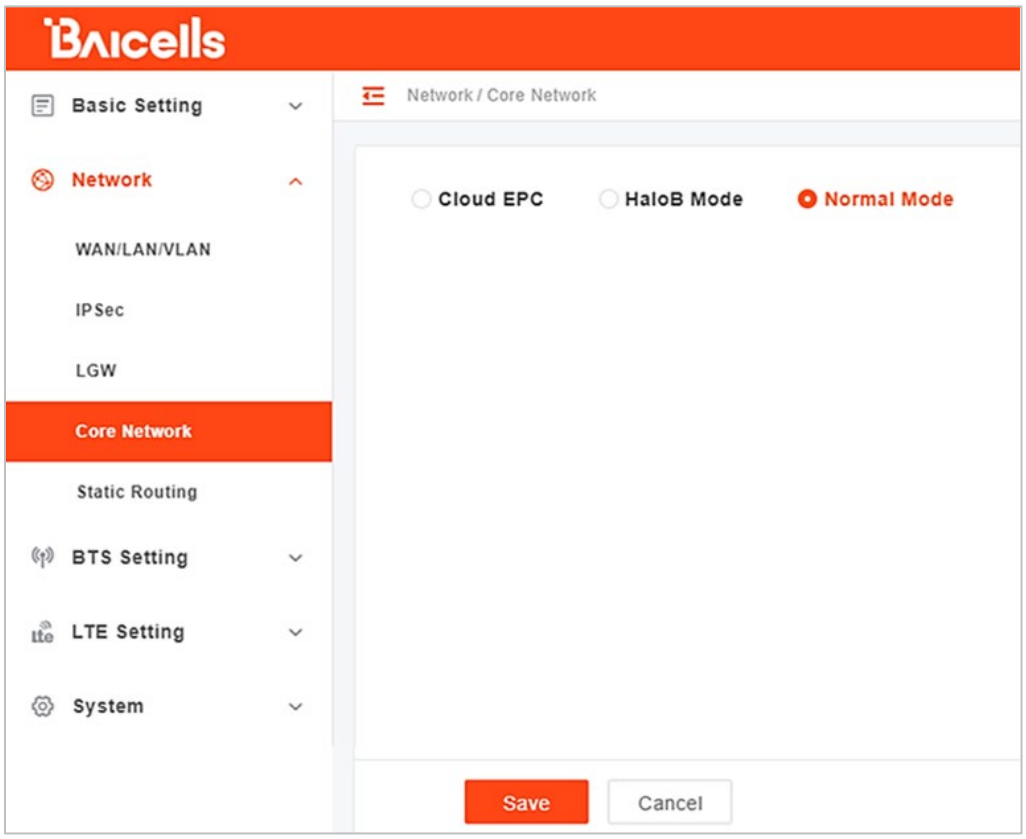
Field Name	Description
LGW	LGW (*ON* or *OFF*). Default is *ON*.
Get UE IMSI	When LGW is set to *OFF*, the parameter displays. Choose whether to obtain UE IMSI numbers by selecting *ON* or *OFF*. • ON: UE IMSI numbers are obtained • OFF: UE IMSI numbers are not obtained After UE IMSI numbers are obtained, they display in the *UE Status* list on the home page.
LGW Mode	LGW mode, which is selected according to the actual situation of the operator's network: • NAT: Packages from the internal network to the external network need Network Address Translation • Router: Select the optimized route from the routing table • Bridge: Transfer in the data link layer
LGW Interface Binding	The IP address LGW used for data unloading. The default value is WAN interface IP address, but the VLAN interface can also be used to separate different links. The WAN interface is described in *section 2.6.1*.
LGW IP Pool	Enter the first IP address of the IP Pool. The LGW assigns a local IP address for the accessed CPE to manage the CPEs.
LGW IP Pool Netmask	For example, if the starting IP address is 10.10.0.1 and the netmask is 255.255.255.0, then the IP address pool includes 254 IP addresses.
IPV6 Switch	The IPV6 network interface is used for in-band connectivity with the switch, as *ON* or *OFF*.
Static Address	When *LGW Mode* is *Router*, this parameter displays. Choose whether to enable the static IP address (*ON* or *OFF*).
First Address	When *Static Address* is *ON*, this parameter displays. Enter the first IP address of the static IP address range.

Field Name	Description
Last Address	When *Static Address* is *ON*, this parameter displays. Enter the last IP address of the static IP address range.
IMSI to IP Binding - IMSI	When *Static Address* in *ON*, this parameter displays. Bind the IMSI and IP address.
IMSI to IP Binding - IP	When *Static Address* in *ON*, this parameter displays. Bind the IMSI and IP address.

1.6.4 Core Network

The *Network > Core Network* sub-menu contains three radio buttons at the top of the GUI, with choices for operating the eNB in *HaloB Mode, Normal Mode*, or in *Cloud EPC* (CloudCore EPC) mode (Figure 2-23).

Figure 2-23: Operating Modes



Notice the eNB operating mode is set to *Normal Mode* when the *Network > Core Network* sub-menu is first accessed unless one of the other two modes is already selected in the *Basic Setting > Quick Setting* sub-menu (*section 2.5.2*).

If you select a different operating mode radio button in the *Network > Core Network* sub-menu and then select *Save*, you are prompted to confirm the configuration is successful and a reboot is needed (Figure 2-24). When you get this message, select *OK*. After the page refreshes, go to the *System > Reboot* sub-menu, choose *Reboot*, and select *OK* when prompted to initate the reboot (Figure 2-25).

Caution: The reboot action temporarily disrupts the eNB service.

Figure 2-24: Successful Configuration Message

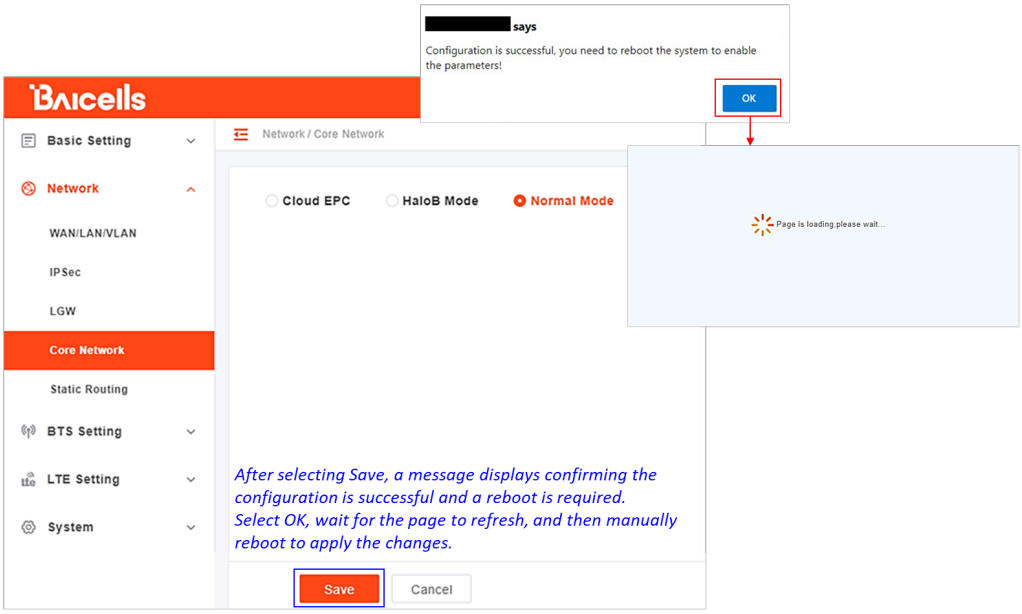
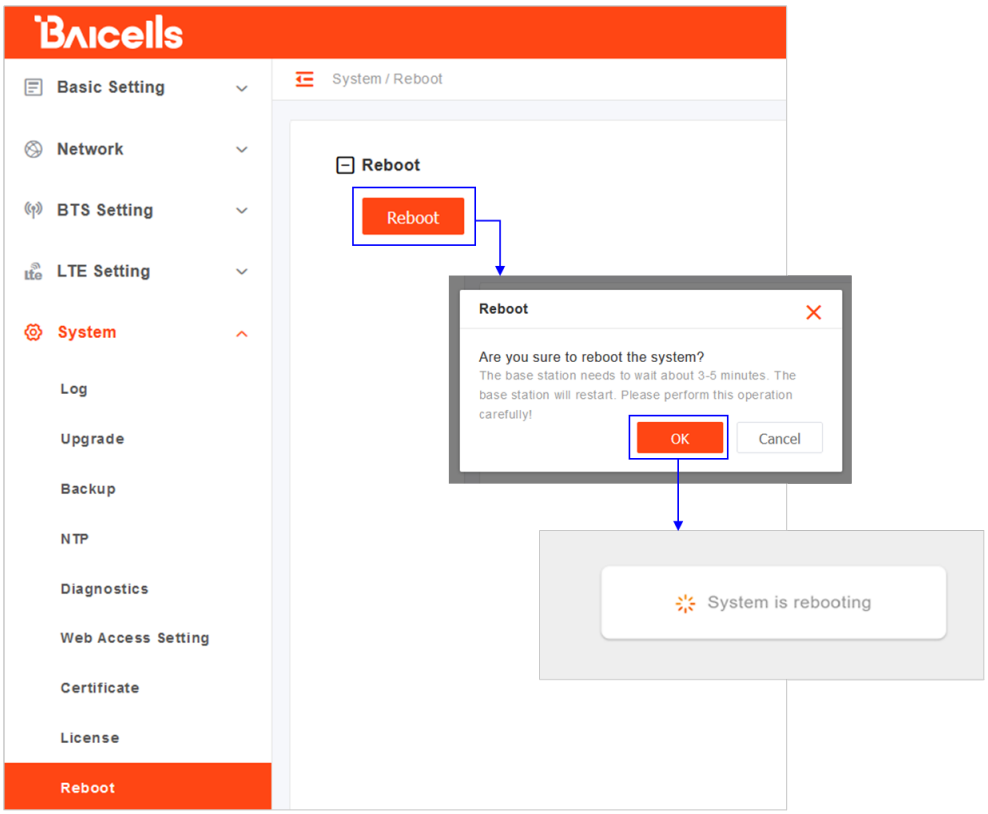


Figure 2-25: Reboot to Apply Changes



Refer to the following documents that are specific to non-standard operating modes:

- *HaloB Solution User Guide*
- *Carrier Aggregation and Dual Carrier/Split Mode Configuration Guide*
- *SAS Deployment User Guide*

The following sections describe each operating mode in detail.

1.6.4.1 HaloB Mode

References:

- *HaloB Solution User Guide*
- *CloudCore Configuration and Network Administration Guide*

The *Network > Core Network* sub-menu setting *HaloB Mode* is used by operators who have a HaloB license for the eNB. An eNB operating in HaloB mode provides “lite" core functions so it can continue serving subscribers even when it has no connection to the LTE EPC.

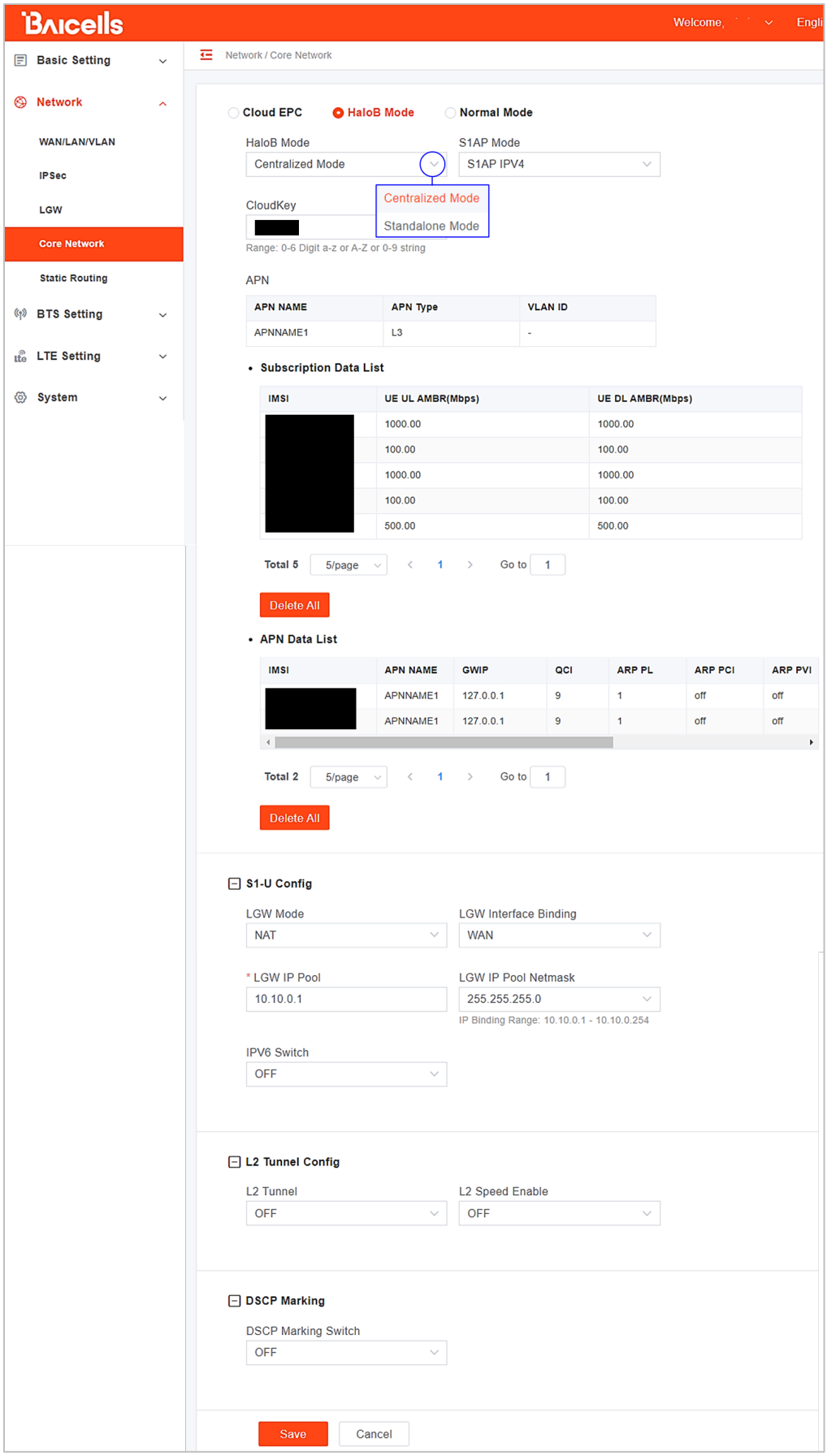
There are two HaloB operating modes: Centralized and Standalone, and in both of these operating modes you can select *S1AP Mode* as *S1AP IPV4* or *S1AP IPV6*. The HaloB license key comes in Centralized Mode by default. To include Standalone Mode, you must send a special request to the Baicells Support team to obtain the associated license. Once you are authorized to use Standalone Mode, you can select it using the *HaloB Mode* field drop-down menu (Figure 2-26).

- Centralized Mode: the eNB needs to connect to the CloudCore BOSS module, which acts as an agent to manage Subscriber Identity Module (SIM) card data.
- Standalone Mode: the client can maintain the SIM card data and Access Point Name (APN) information locally.

NOTE 1: Refer to the *HaloB Solution User Guide* for detailed information regarding the configuration requirements for the HaloB feature.

NOTE 2: The fields in the *S1-U Config* pane can be configured here or can be configured from the *Network > LGW* sub-menu as described in *section 2.6.3*.

Figure 2-26: HaloB Mode Selection



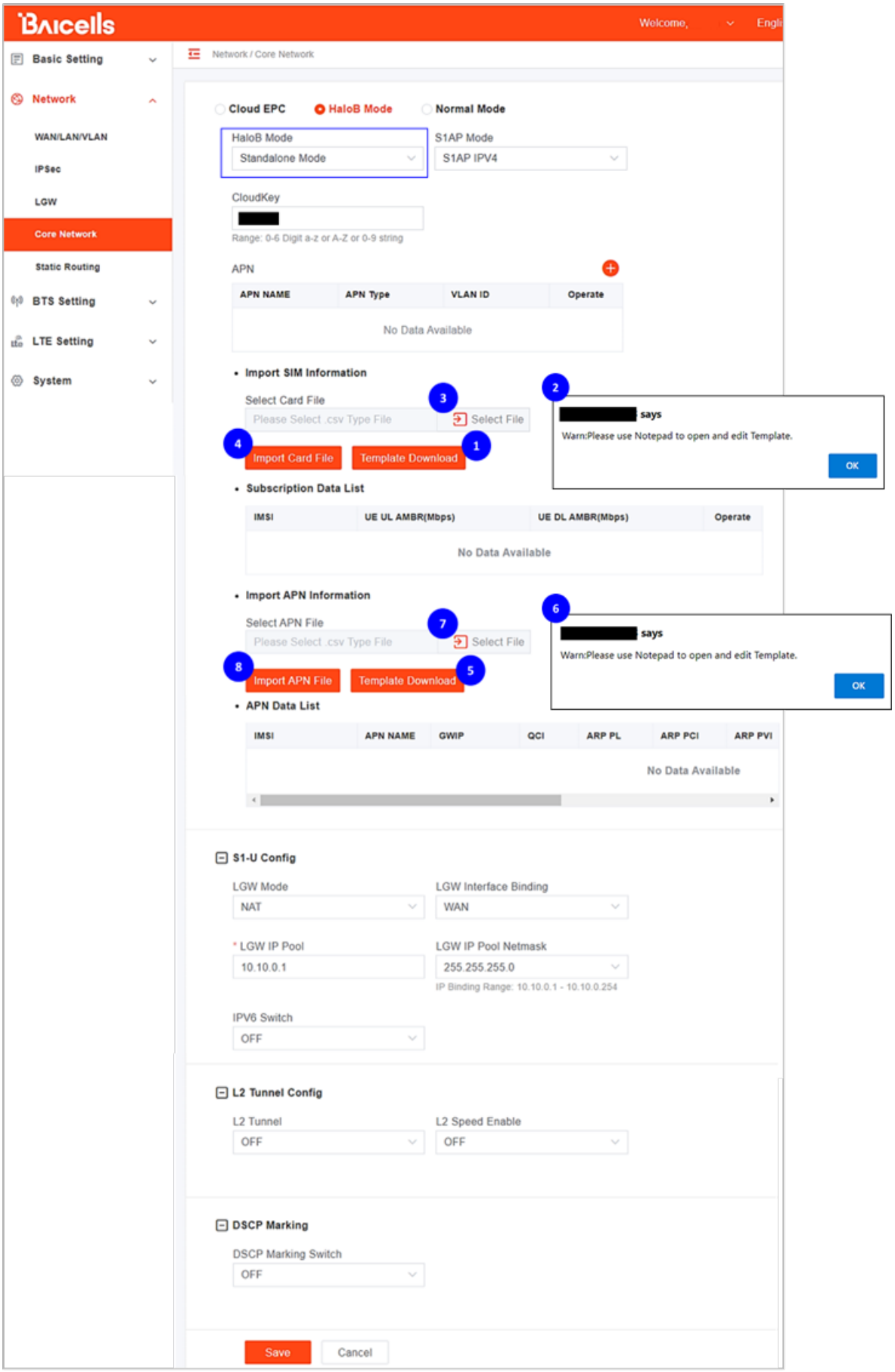
For *Standalone Mode*, the administrator needs to import data files from the LMT to store SIM card data and APN information locally.

To import data files to store SIM card and APN information, follow the steps below (Figure 2-27):

1. In the *Import SIM Information* pane, select *Template Download*.
2. Select *OK* when the prompt to open and edit the template in Notepad displays.
3. Save the template to your computer. Then, open the .csv file in Notepad.
4. Edit the .csv file in Notepad by entering the SIM card data. Then, save the edited file in Notepad.
5. In the *Import SIM Information* pane, choose *Select File,* navigate to the file location, select the .csv file, and then select *Import Card File*.
6. In the *Import APN Information* pane, select *Template Download*.
7. Select *OK* when the prompt to open and edit the template in Notepad displays.
8. Save the template to your computer. Then, open the .csv file in Notepad.
9. Edit the .csv file in Notepad by entering the APN information. Then, save the edited file in Notepad.
10. In the *Import APN Information* pane, choose *Select File*, navigate to the file location, select the .csv file, and then select *Import APN File*.
11. Then select *Save*.

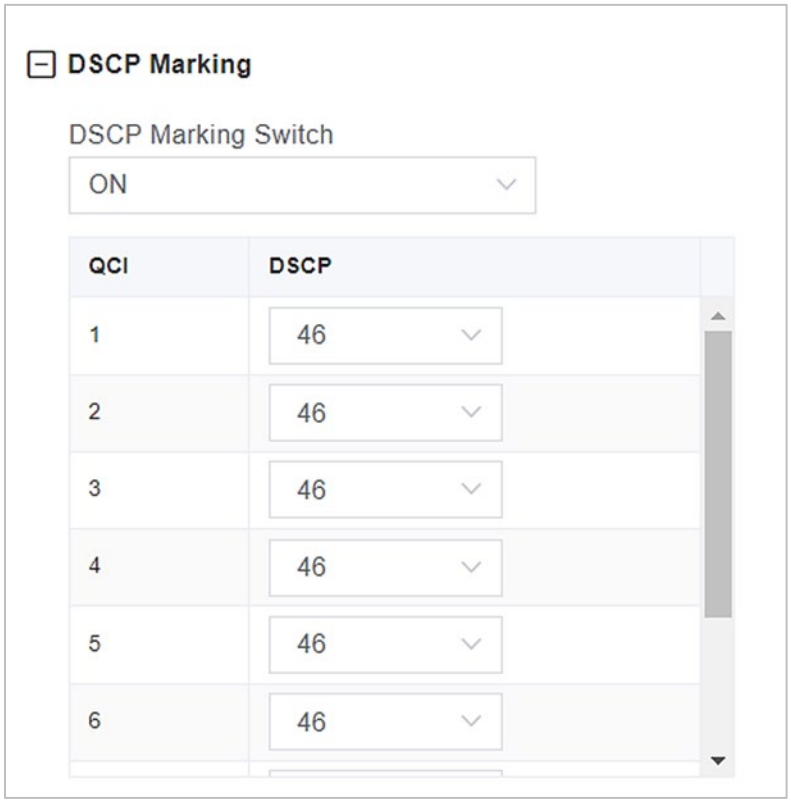
The fields in the *S1-U Config* pane can be configured here or can be configured from the *Network > LGW* sub-menu as described in *section 2.6.3*.

Figure 2-27: HaloB Mode – Standalone Mode



HaloB supports Differentiated Services Code Point (DSCP), which ensures Quality of Service (QoS) in the network. The *DSCP Marking Switch* field in *DSCP Marking* pane defaults to *OFF*. Select *ON* from the drop-down menu to enable DSCP marking, and the mapping table between nine QoS Class Identifiers (QCIs) and DSCPs displays, and can be modified depending on eNB configuration (Figure 2-28). When the DSCP value for data packets is set to a proper value, network devices (such as switches, routers, and firewalls) can schedule packets based on the DSCP value.

Figure 2-28: DSCP Marking Switch Enabled



1.6.4.2 Normal Mode

The *Network > Core Network* sub-menu setting *Normal Mode* is shown in Figure 2-29, Figure 2-30, and Figure 2-31. These fields are used to configure the S1-C control plane (*S1-C Config* pane) and the S1-U user plane (*S1-U Config* pane).

1.6.4.2.1 S1-U User Plane Configuration

In preparing to configure the S1-U user plane, you'll notice the *S1-U Config* pane in Figure 2-29 shows the *LGW Config* radio button activated and *LGW Mode* as *NAT* as the default setting. The *LGW Config* fields can be configured here or can be configured from the *Network > LGW* sub-menu as described in *section 2.6.3*. In addition, you can change the S1-U configuration by clicking on the *SGW Config* radio button in the *S1-U Config* pane (Figure 2-30) and selecting *WAN* as the *SGW Interface Binding*.

Figure 2-29: Normal Mode (S1-U Config = LGW Config)

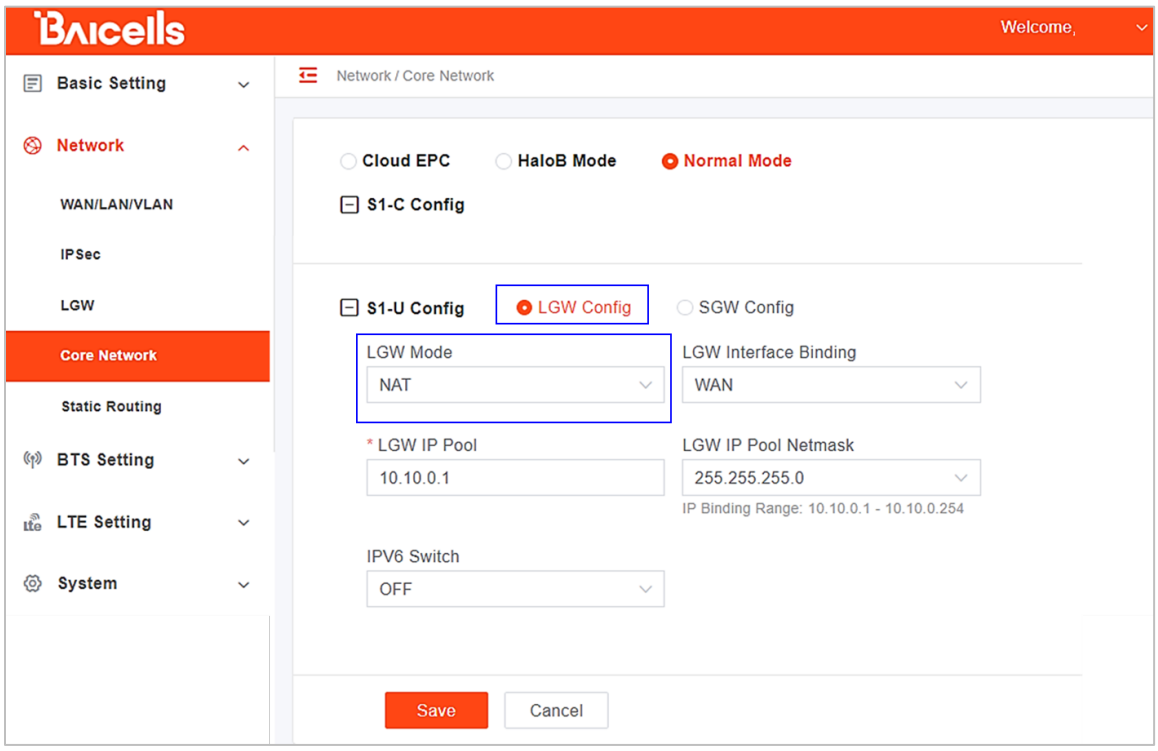
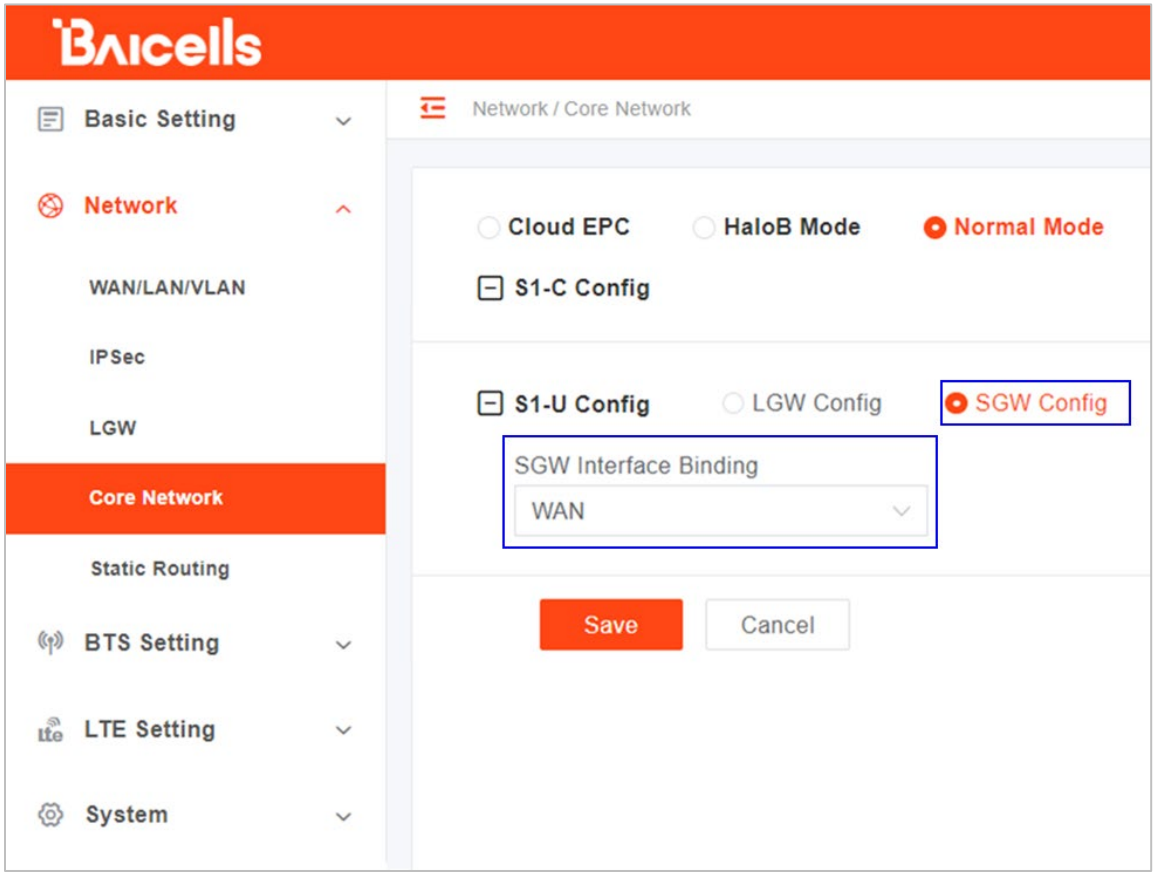


Figure 2-30: Normal Mode (S1-U Config = SGW Config)

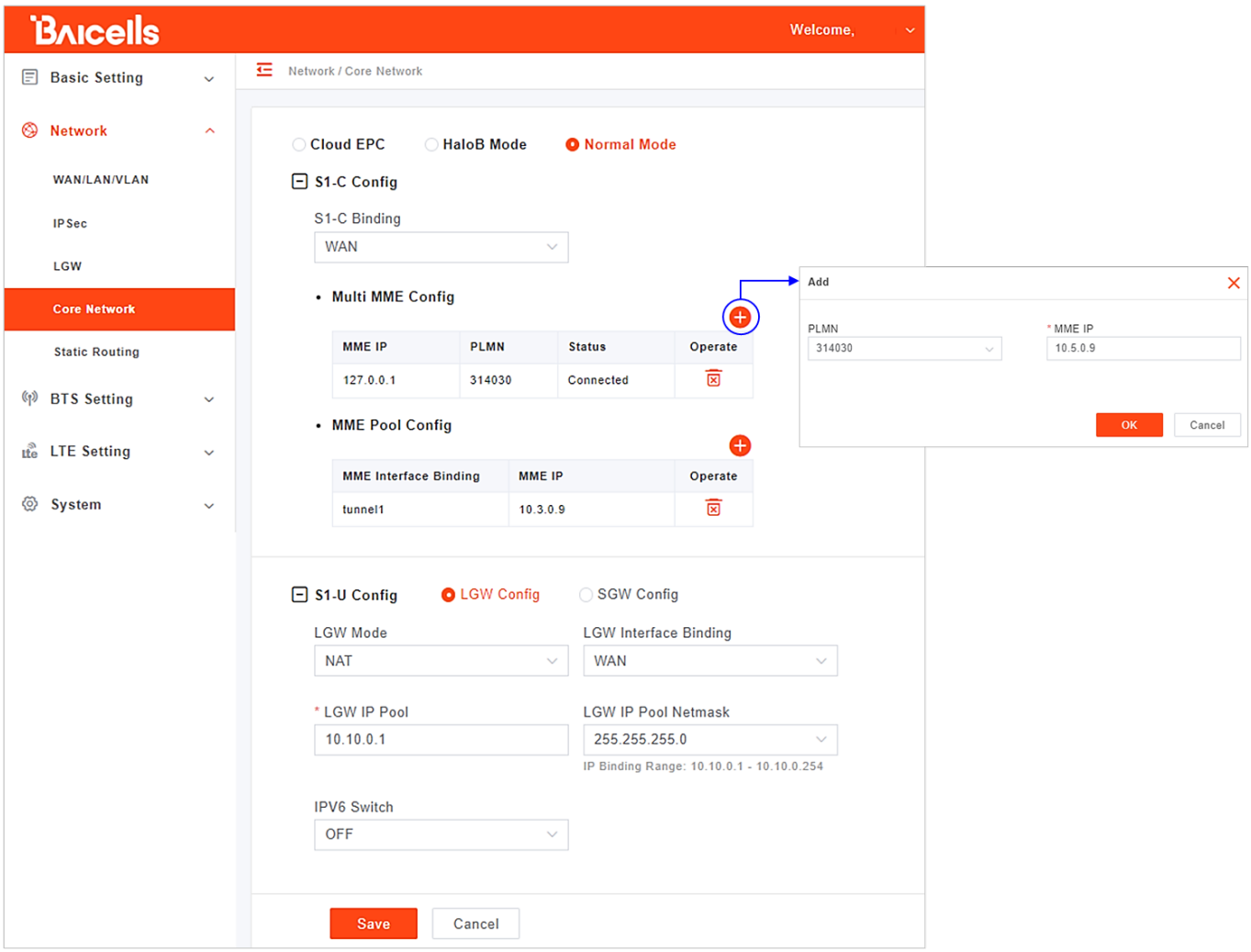


1.6.4.2.2 SU-C Control Plane Configuration

Configure the S1-C control plane using the settings in the *S1-C Config* pane. First, select the *S1-C Binding*, which is the WAN interface that was configured in the *Network > WAN/LAN/VLAN* sub-menu (*section 2.6.1*) as shown in Figure 2-31.

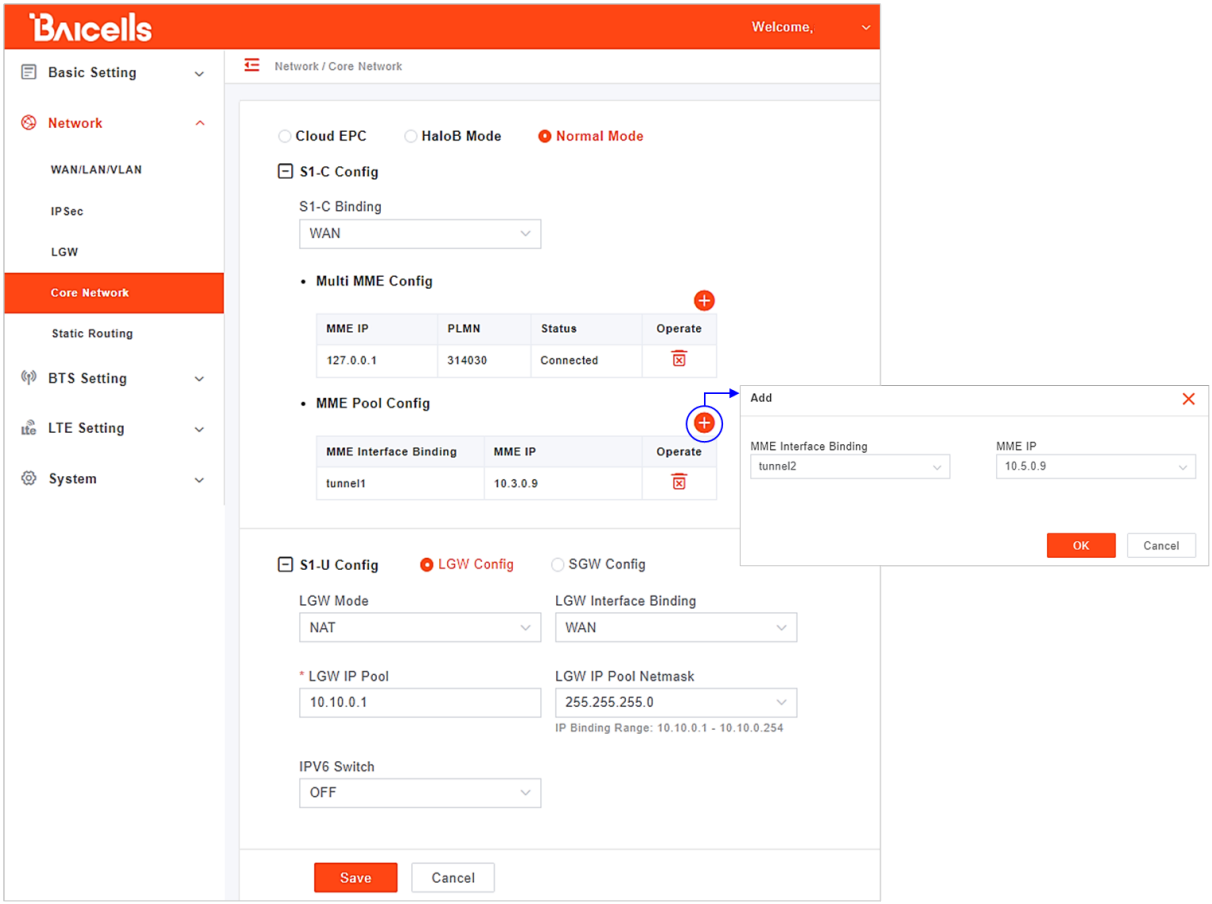
You can add MME IPs to the *Multi MME Config* by selecting the *Add* icon , and enter a second MME IP associated with the PLMN autogenerated in the *PLMN* drop-down menu (Figure 2-31). The MME IP and PLMN are configured in the *Basic Setting > Quick Setting* sub-menu (*section 2.5.2*).

Figure 2-31: S1-C Config and Multi MME Config



You can add the *MME Interface Binding* by selecting the *Add* icon above the *MME Pool Config* table, and configure tunnel 1 and tunnel 2 information (Figure 2-32). You must configure tunnel 1 first, and then tunnel 2. Similarly, you must delete tunnel 2 before you can delete tunnel 1.

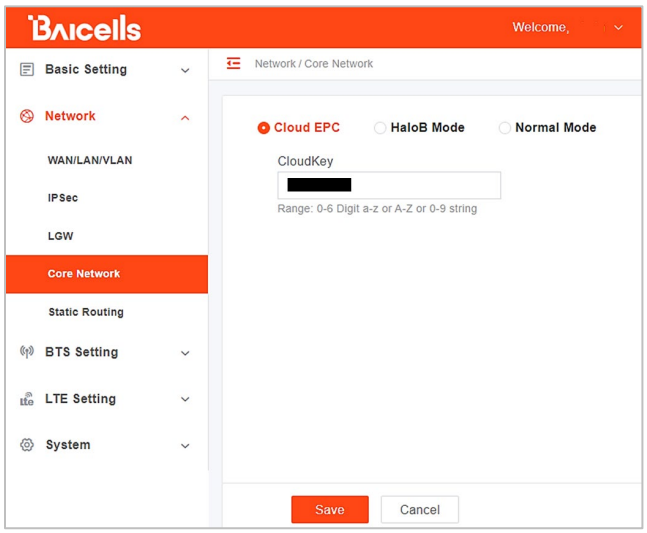
Figure 2-32: MME Pool Config



1.6.4.3 Cloud EPC

The Cloud EPC mode is enabled in the *Network > Core Network* sub-menu by selecting the *Cloud EPC* radio button (Figure 2-33) and inputting your Cloudkey, or it can be turned *ON* in the *Basic Setting > Quick Setting* sub-menu. When the operator enables Cloud EPC, the base settings required to connect the eNB to the CloudCore are configured (e.g. MME, PLMN, and Cell ID). Every time the eNB reboots, the standard configuration is loaded again.

Figure 2-33: Cloud EPC



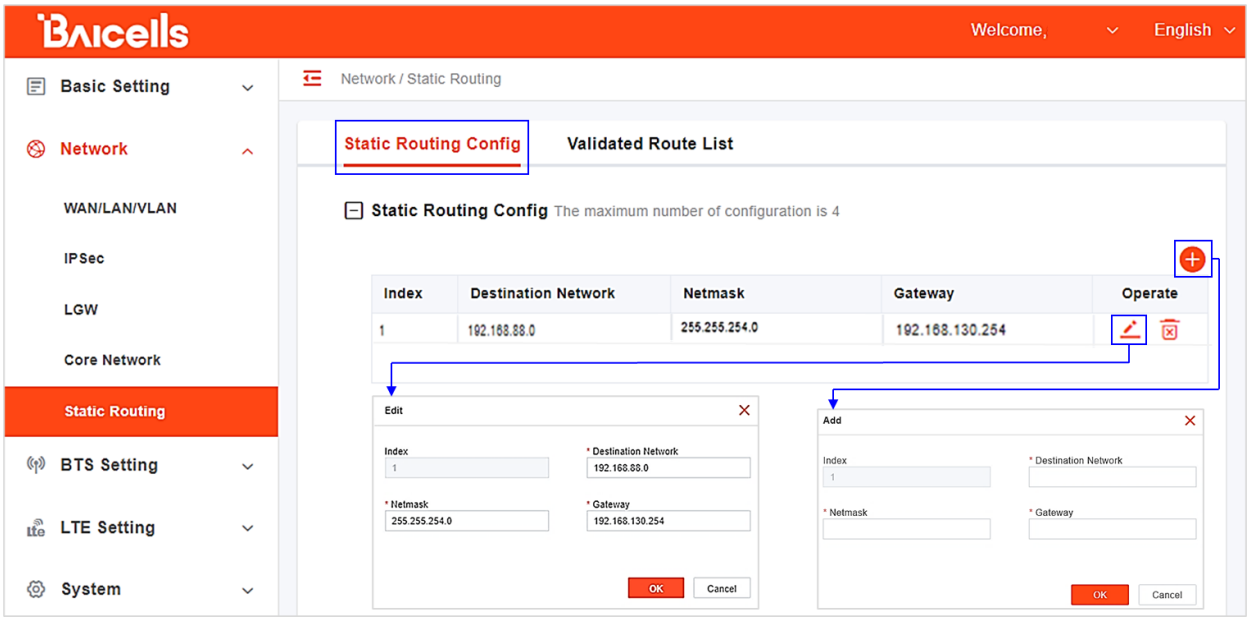
1.6.5 Static Routing

The *Network* > *Static Routing* sub-menu (shown in Figure 2-34 and Figure 2-35, and described in Table 2-8), contains two tabs: *Static Routing Config* and *Validated Route List* tab. Use the *Static Routing Config* tab to add Static IP routing addresses and monitor their status (Figure 2-34).

To add a new static routing address to the list, click on the *Add* icon , enter the information, and select *OK*. Once created, you can enable/disable the address. To edit an existing static routing setting, click on the *Edit* icon , modify the information, and then save. Use the *Delete* icon to remove an existing static route setting (Figure 2-34).

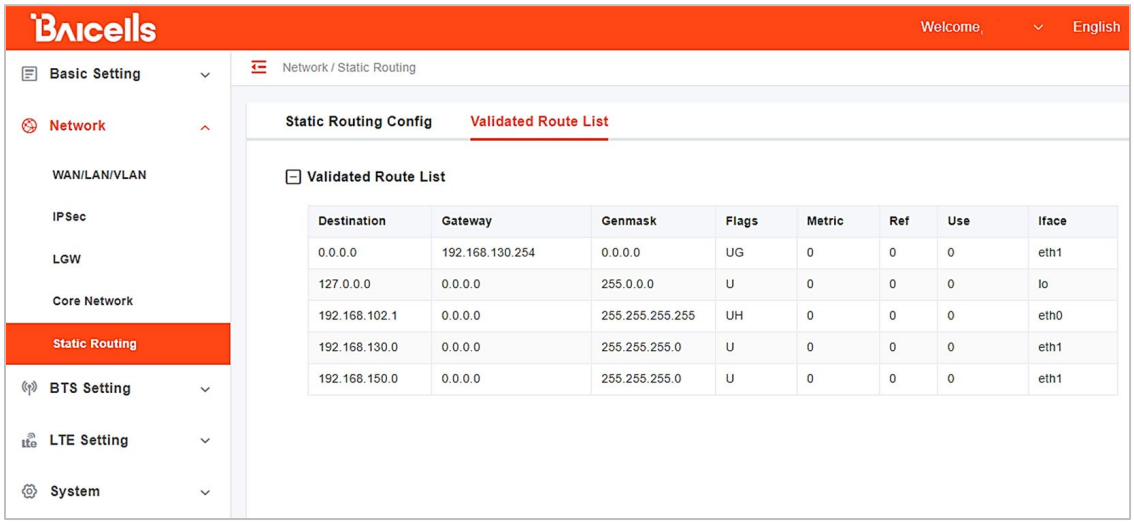
NOTE: The system supports a maximum of four static route configurations.

Figure 2-34: Static Routing Config Tab



Existing routes display in the *Validated Route List* tab (Figure 2-35), showing the destination IP address, netmask or genmask (for general destination netmask), and other data.

Figure 2-35: Validated Route List Tab



Also, when the LGW setting is set to *ON* in the *Network > LGW* sub-menu (*section 2.6.3*) and the *IP Access Mode* is set to *DHCP* in the *Network > WAN/LAN/VLAN* sub-menu (*section 2.6.1*), if there is ever a case when the *IP Access Mode* is changed, then the MAC address and the WAN/LAN/VLAN IP addresses also change. In that event, the static route configuration should also be reconfigured.

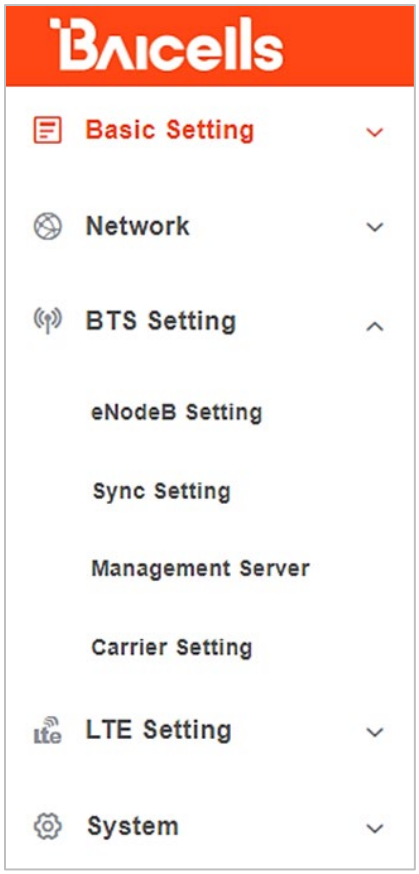
Table 2-8: Static Routing Fields

Field Name	Description
Index	The static route index number, which is assigned automatically.
Enable	Enable/Disable the static route.
Destination Network	The destination IP address. NOTE: The destination IP address must be reachable from the original WAN interface IP address or VLAN source port.
Netmask	The subnet mask of the destination IP address.
Gateway	The target IP address' gateway IP address.

1.7 BTS Setting

The Base Transceiver Station (BTS) settings relate to eNB security, management, and synchronization with other network elements (Figure 2-36).

Figure 2-36: BTS Setting Menu



1.7.1 eNodeB Setting

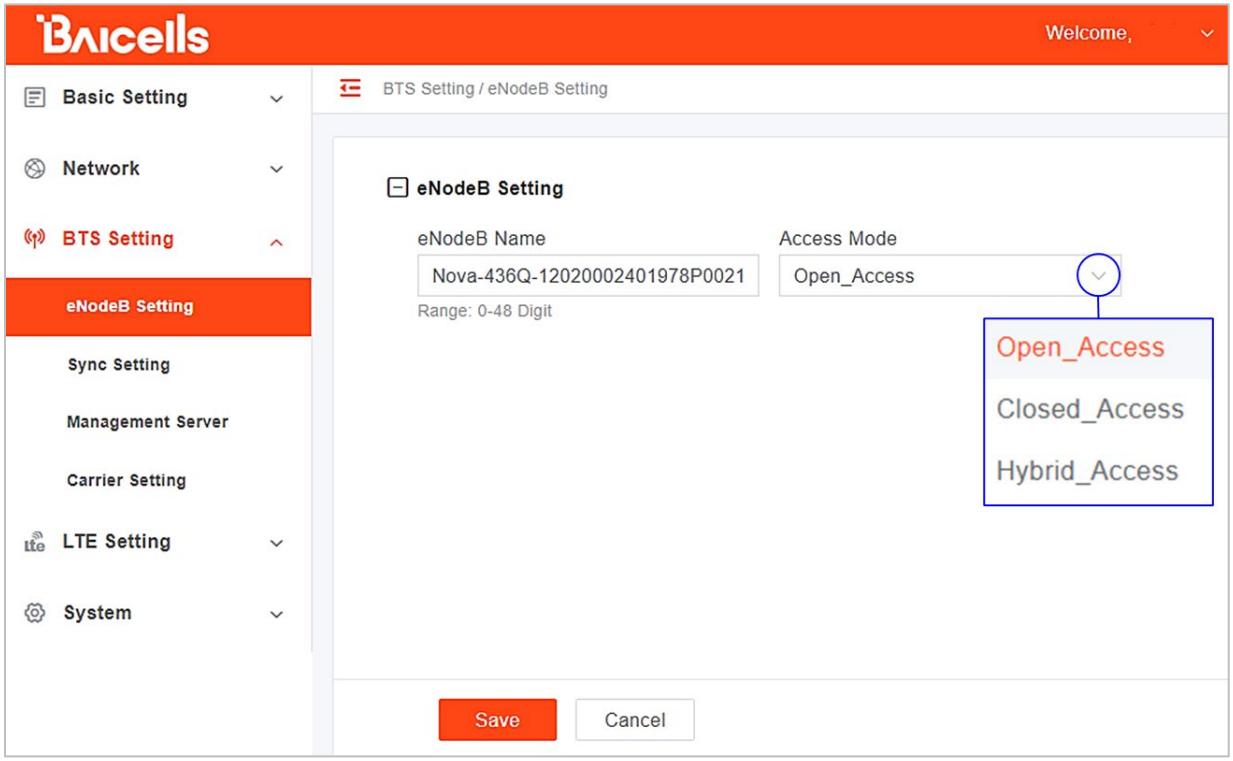
The *BTS Setting > eNodeB Setting* sub-menu is used to enter the eNodeB name (Figure 2-37). The range for eNodeB name is 0–48 characters.

If the eNodeB is set to dual carrier mode in the *BTS Setting > Carrier Setting* sub-menu (*section 2.7.4*), then the Cell1 and Cell2 eNodeB names display.

The *Access Mode* field in the *BTS Setting > eNodeB Setting* sub-menu is used to select the access mode type for the cell (Figure 2-37). The access mode types are:

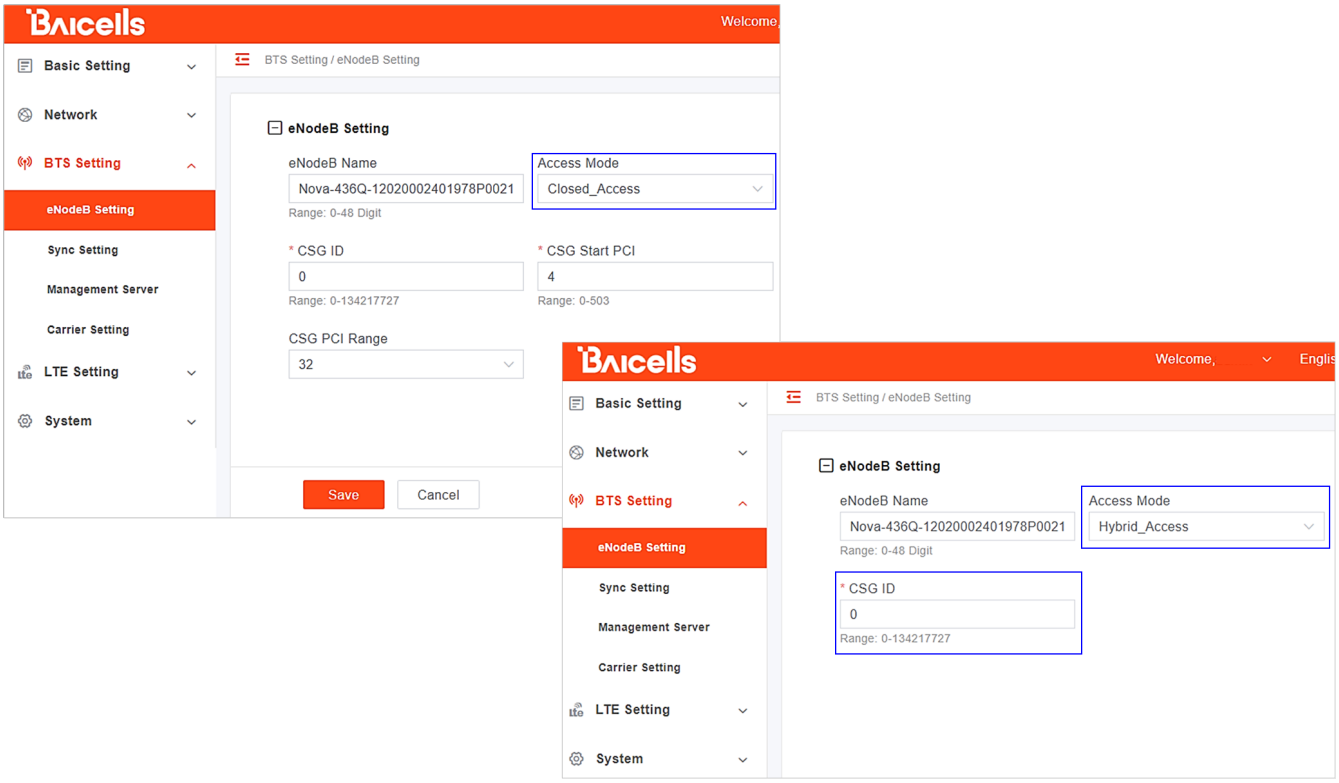
- Open_Access
- Closed_Access
- Hybrid_Access

Figure 2-37: eNodeB Setting



NOTE: If *Closed_Access* or *Hybrid_Access* is selected, the *Closed Subscriber Group* (CSG) parameters display, as described in Table 2-9.

Figure 2-38: eNodeB Setting – Closed_Access and Hybrid_Access Modes



NOTE: You are required to configure the *CSG ID* field if *Hybrid_Access* is the selected access mode.

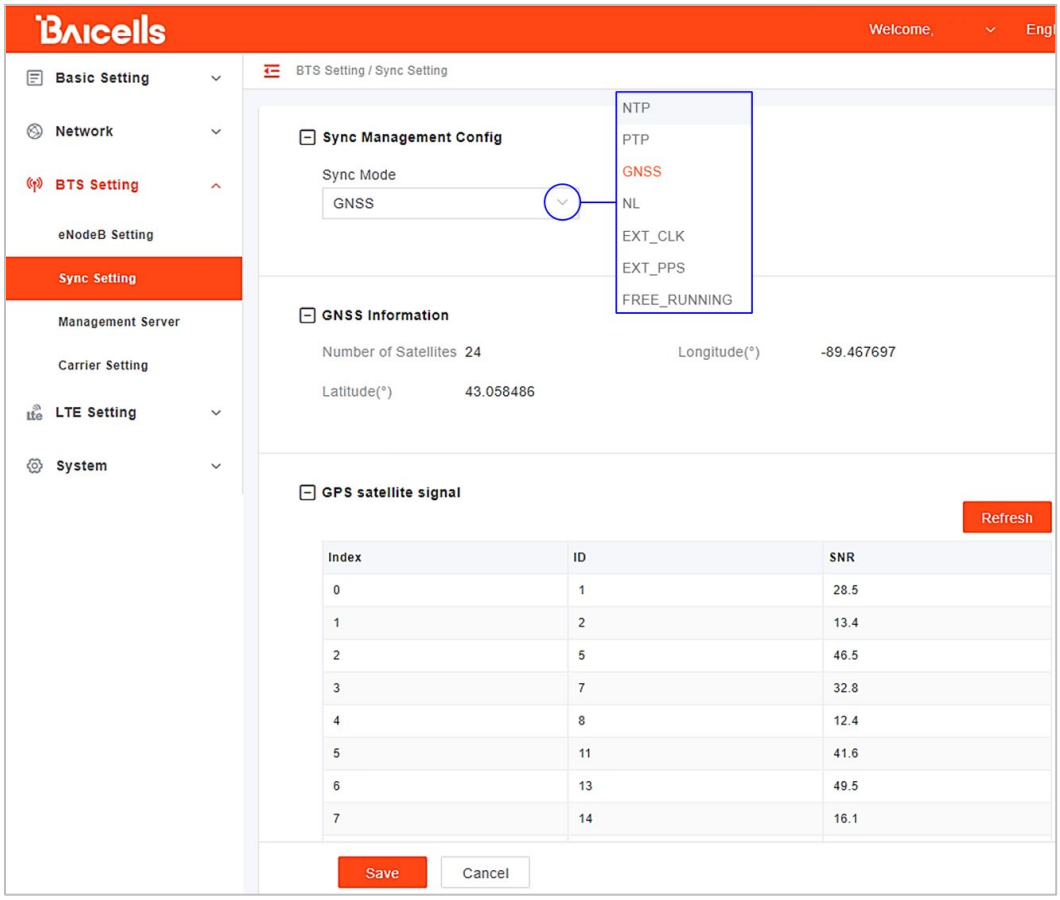
Table 2-9: Access Mode - Closed_Access Mode and Hybrid_Access Fields

Field Name	Description
CSG ID	The CSG ID setting range is: 0 to 134217727.
CSG ID Start PCI	The range for CSG ID Start PCI is 0 to 503.
CSG PCI Range	The CSG PCI range. Options are 4, 8, 16, 24, 32, 48, 64, 84, 96, 128, 168, 252, 504.

1.7.2 Sync Setting

The LTE technology standards specify timing and synchronization requirements between adjacent eNBs. Synchronized transmissions help eNBs avoid interfering with one another, optimize bandwidth usage, and enhance network capacity. Synchronized transmissions can be enabled for sync modes to operate simultaneously or independently. The *BTS Setting > Sync Setting* sub-menu is shown in Figure 2-39.

Figure 2-39: Sync Setting



There are different sync mode options available:

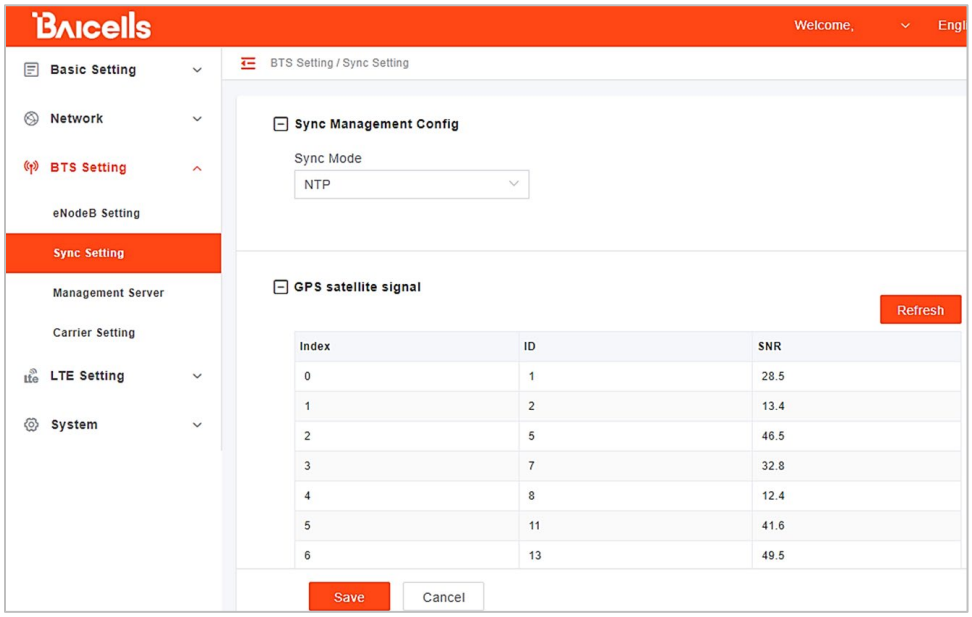
- NTP: Network Time Protocol.
- PTP: Precision Time Protocol.
- GNSS: Global Navigation Satellite System. Only GPS is supported in this synchronization mode.
- NL: Network Listening.
- EXT_CLK: External Clock.
- EXT_PPS: Pulse Per Second.
- FREE_RUNNING: This mode is selected when there is no synchronization resource.

1.7.2.1 NTP Synchronization

Use the *BTS Setting > Sync Setting* sub-menu and set the *Sync Mode* to *NTP* to use the network time protocol sync method (Figure 2-40).

NOTE: The NTP server is described in *section 2.9.4*.

Figure 2-40: Sync Mode - NTP



1.7.2.2 PTP Synchronization

Use the *BTS Setting* > *Sync Setting* sub-menu and set the *Sync Mode* to *PTP* (Figure 2-41) to use the precision time protocol sync method, which is 1588v2 synchronization. Then, configure the data transmission method in the *Trans Port* field of the *PTP Config* pane. You can select either *Ethernet* or *UDP*, which stands for User Datagram Protocol. The other fields in the *PTP Config* pane (*Sync Mode*, *PTP Trigger*, and *Interface*) are autogenerated and greyed out. Provide the unique *Unicast Address* value in the field. The *PTP Config* pane fields are described in Table 2-10.

Figure 2-41: Sync Mode - PTP

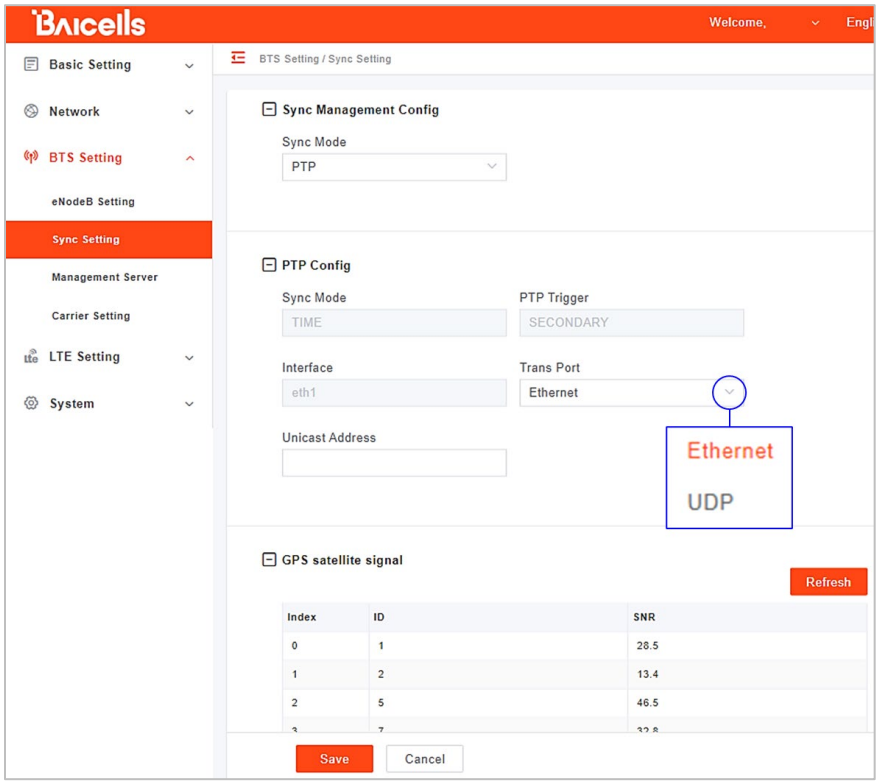


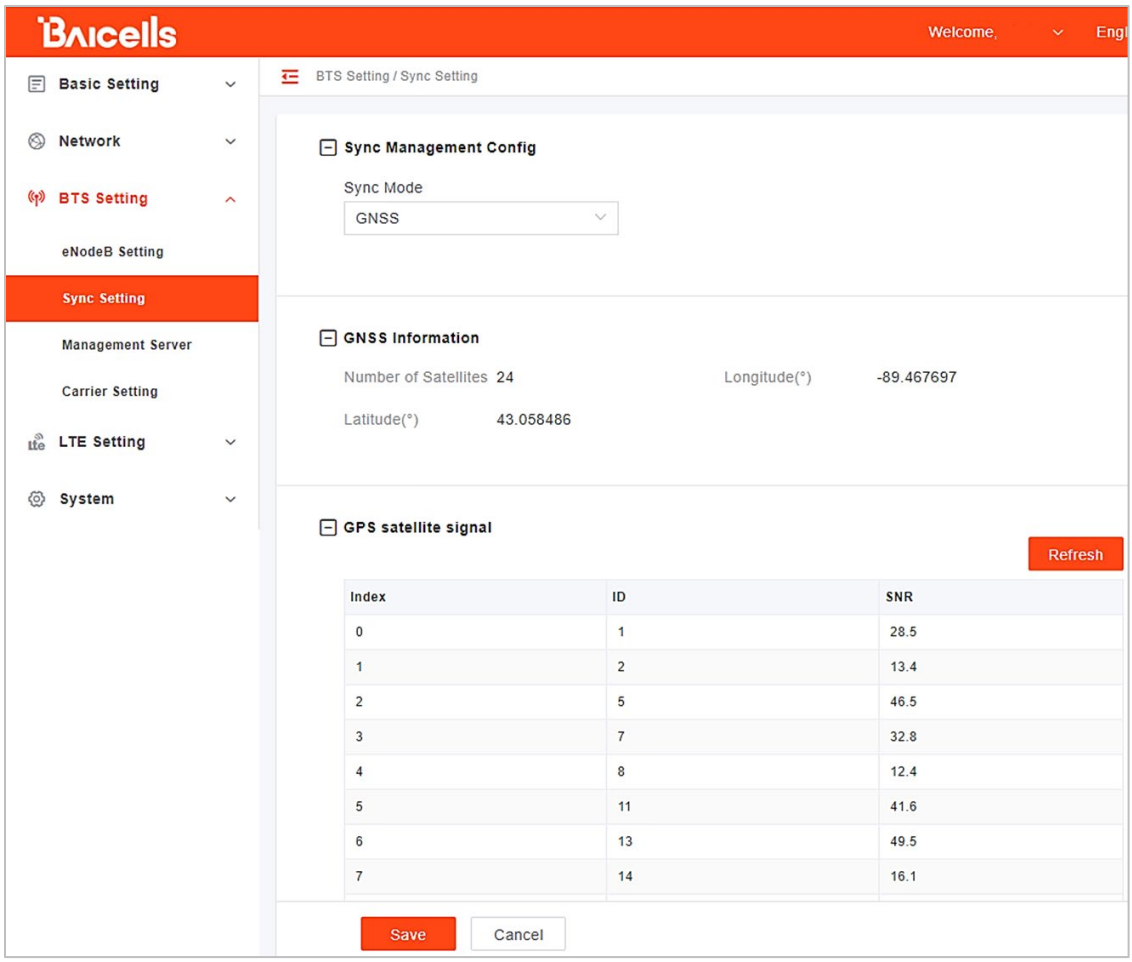
Table 2-10: PTP Config Fields

Field Name	Description
Sync Mode	The current synchronization mode is TIME, which is set by the system.
PTP Trigger	The current synchronization mode is SECONDARY, which is set by the system.
Interface	The current synchronization mode is eth1, which is set by the system
Transport	Transport protocol. • Ethernet • UDP
Unicast Address	The address for unicast.

1.7.2.3 GNSS Synchronization

Use the *BTS Setting Sync Setting* sub-menu and set the *Sync Mode* to *GNSS* (Figure 2-42) to use the global navigation satellite system sync method. The *GNSS Information* pane displays the number of satellites available, and includes longitude and latitude information.

Figure 2-42: Sync Mode - GNSS



1.7.2.4 NL Synchronization

When *Sync Mode* type *NL* is selected, you intend to use two neighboring adjacent eNBs to sync with to establish the tower's GPS location, which ensures your eNB won't cause interference by being out of timing. Once you identify which two neighboring eNBs you want to use for syncing, navigate to the *NL Config* pane and configure key parameters about those two eNBs. If you select *Regular Mode* as the *NL Working Mode*, then click on the *Edit* icon under the *Operate* column of the *NL Sync List* table, and configure the parameters (Figure 2-43). If you select *Full Band Scan* as the *NL Working Mode*, you can configure key parameters that display in the *NL Config* pane (Figure 2-44). In *Full Band Scan* mode, the eNB scans the frequencies within the specified start and end range. All the key parameters in the *NL Config* pane are described in Table 2-11.

Notice in Figure 2-43 that when you select *NL* as the *Sync Mode* type in the *Sync Management Config* pane and select *Regular Mode* as the *NL Working Mode* in the *NL Config pane*, the *NL Sync List* table auto-generates.

Figure 2-43: NL Config (NL Working Mode = Regular Mode)

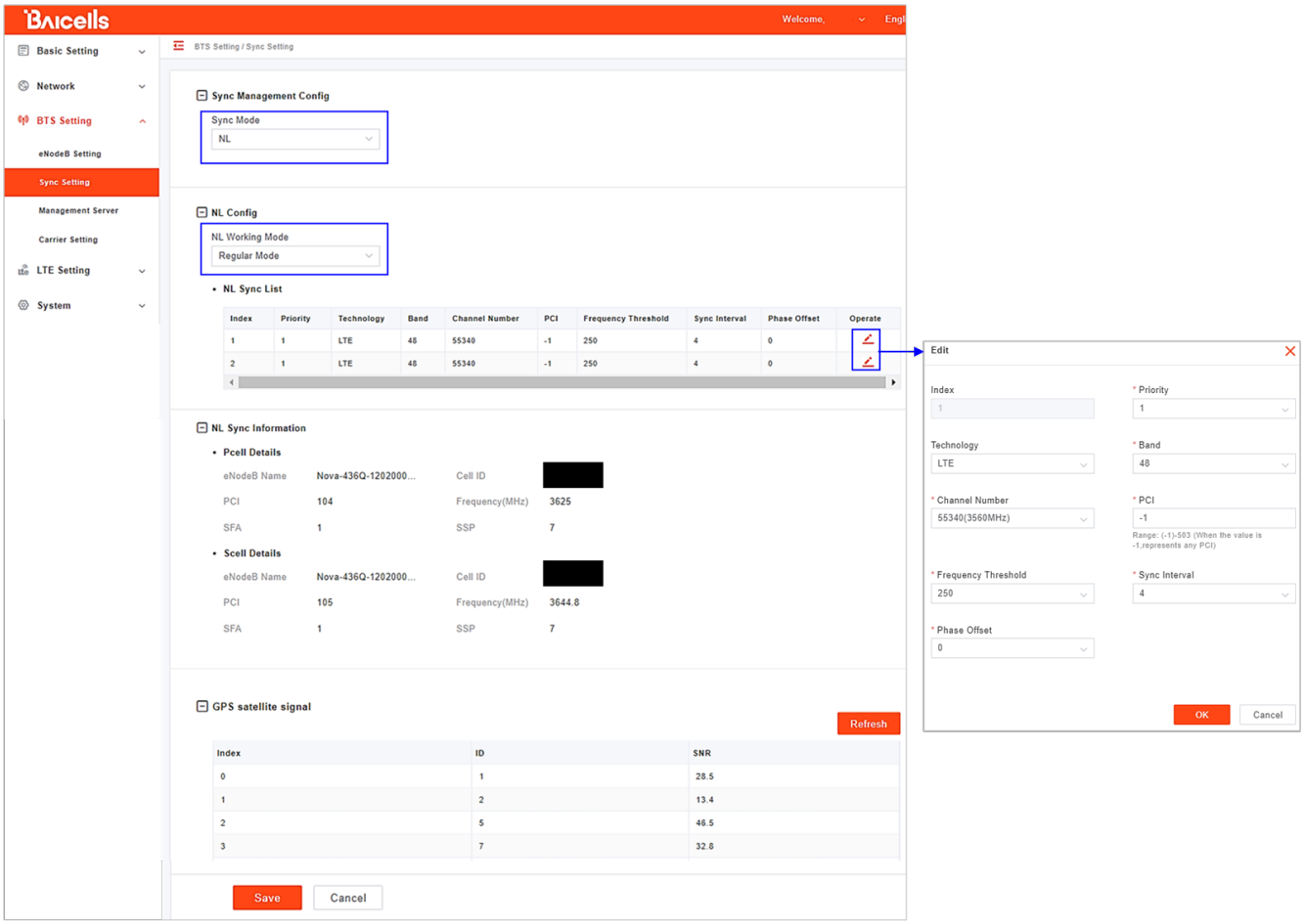


Figure 2-44: NL Config (NL Working Mode = Full Band Scan)

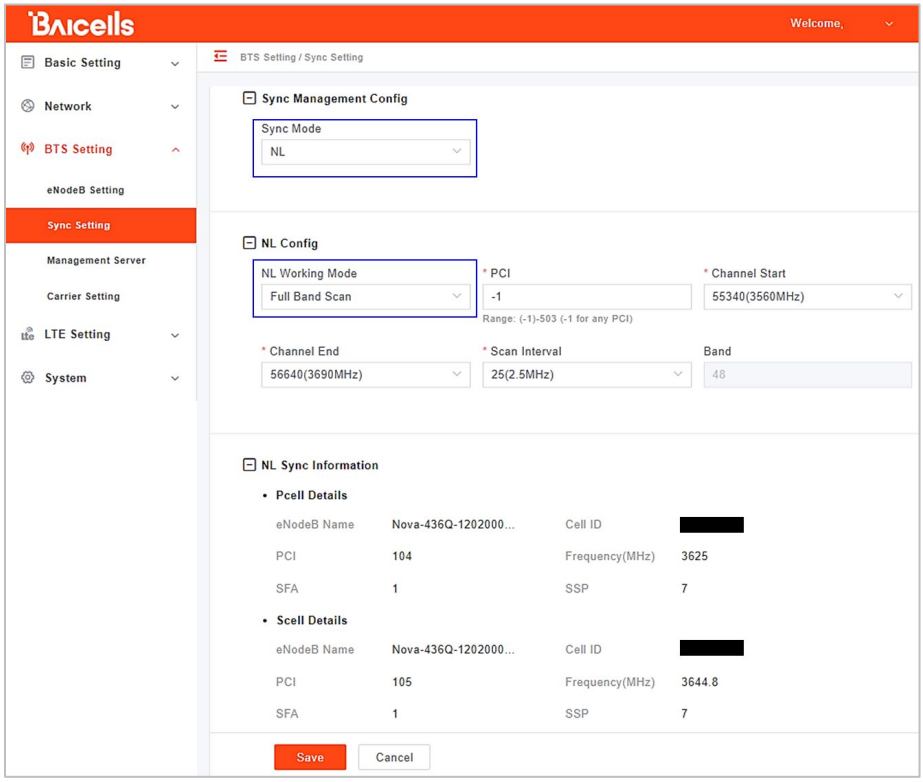


Table 2-11: NL Config and NL Sync Information Fields

Field Name	Description
NL Config - Regular Mode	
Index	The NL sync list index number, which is assigned automatically.
Priority	This syncing source's priority. Range is 0–2. Default is 1.
Technology	Network mode. Only LTE can be selected at this time.
Band	Frequency of the synchronizing band. Range is 42, 43, and 48.
Channel Number	Frequency point of the synchronizing band. Band 42 – Range is 43190 (3560 MHz) to 43565 (3597.5 MHz) Band 43 – Range is 43615 (3602.5 MHz) to 44490 (3690 MHz) Band 48 – Range is 55340 (3560 MHz) to 56640 (3690 MHz)
PCI	PCI of the synchronizing band. Range is -1 to 503. When the value is -1, this represents any PCI.
Frequency Threshold	Frequency threshold of synchronizing band. Only 250 can be selected at this time.
Sync Interval	Interval of syncing measurement. Only 4 can be selected at this time.
Phase Offset	Only 0 can be selected at this time.
NL Config - Full Band Scan	
PCI	PCI of the synchronizing band. Range is -1 to 503. When the value is -1, this represents any PCI.
Channel Start	The channel the band uses to start the scanning process. Range is 55340 (3560 MHz) to 56640 (3690 MHz). Default is 55340 (3560 MHz).
Channel End	The channel the band uses to end the scanning process. Range is 55340 (3560 MHz) to 56640 (3690 MHz). Default is 56640 (3690 MHz).

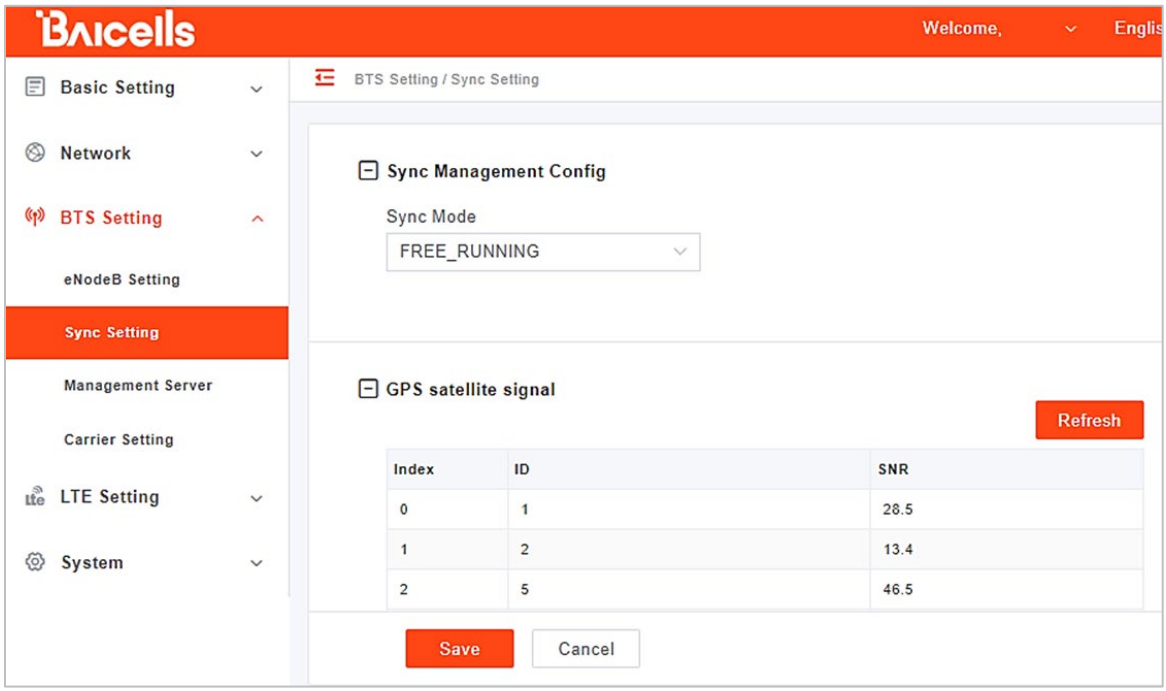
Field Name	Description
Scan Interval	Interval of syncing measurement. Range is 25 (2.5 MHz) to 100 (10 MHz). Default is 25 (2.5 MHz).
Band	This field is greyed out and Band 48 is configured.
NL Sync Information - Cell Details	
eNodeB Name	Name of the eNB.
Cell ID	This is a unique number by which it is identified within a location or GSM network.
PCI	The identifier of a cell in the physical layer of the LTE network.
Frequency(MHz)	Number of waves that passes a fixed place in certain amount of time.
SFA	The cell's SubFrame Assignment (SFA). This field is configured in *Basic Setting > Quick Setting* (*section 2.5.2*).
SSP	The cell's Special SubFrame Pattern (SSP). This field is configured in *Basic Setting > Quick Setting* (*section 2.5.2*).

1.7.2.5 FREE_RUNNING, EXT_CLK, and EXT_PPS Synchronization

The *BTS Setting > Sync Setting* sync mode options *FREE_RUNNING, EXT_CLK,* and *EXT_PPS* are used when no other sync mode is selected. Figure 2-45 shows an example of the *FREE_RUNNING* scan mode.

NOTE: There is no need to connect any clock source when you select the *FREE_RUNNING* sync mode, because the eNB relies on its own synchronous clock. However, if you select *EXT_CLK* or *EXT_PPS* as the sync mode, make sure to connect to an external clock source.

Figure 2-45: Sync Mode - FREE_RUNNING



1.7.3 Management Server

For the NMS, an operator has the option to use the Baicells CloudCore OMC, a Local OMC, or their own management server. Follow the steps below to configure the management server using the *BTS Setting > Management Server* sub-menu. See Figure 2-46 and Table 2-12.

1. Enter the ***http://*** address for your management server. If it is the Baicells CloudCore OMC, proceed to *step 2*. If you are using Local OMC or another EMS/NMS server, enter the URL for that device.
2. If the eNB operating mode is set to *Cloud EPC* in the *Network > Core Network* menu, proceed to *step 3*. Otherwise, go to *step 4*.
3. In the *Management Config* pane of the *BTS Setting > Management Server* sub-menu, set the *Override Cloud OMC URL* field to *ON*.

   NOTE 1: The *Override Cloud OMC URL* field only displays when the eNB operating mode is set to *Cloud EPC* in the *Network > Core Network* sub-menu (*section 2.6.4*).

   NOTE 2: When the *Override Cloud OMC URL* field is set to *OFF* (which is the default setting), the *SSL* and *Management Server* fields are greyed out (as shown in Figure 2-46). You must set the *Override Cloud OMC URL* field to *ON* so you can configure the *Management Server URL* and port number.

4. Enter the URL and port number in the *Management Server* field to ensure port number 8443 is used. You must update the URL from **baiomc.cloudapp.net:48080/smallcell/AcsService** to **baiomc.cloudapp.net:8443/smallcell/AcsService.**
5. Optional: Enable a Secure Socket Layer (SSL) connection for enhanced security by setting the *SSL* field to *ON*.

   NOTE: When the *SSL* field is set to *ON*, the management server URL changes from *http* to *https* Web hypertext transfer protocol.

6. If you are using the Baicells CloudCore OMC for your NMS, enter your unique operator CloudKey ID that you received from Baicells. The CloudKey is used as part of the plug-and-play aspect of the Baicells network elements. When you configure your CloudKey number in the device GUI (eNB and CPE), the first time the device is powered on, it is automatically associated to your OMC account.
7. Notice the *TR069* field is pre-configured, and *WAN* is the default.
8. Click on the *SNMP* toggle button if you want to use SNMP to enable eNBs to report KPI information to the third-party NMS. Configure the parameters in the *SNMP Agent Configuration* and *Trap Agent Configuration* panes.
9. Select *Save*. A message displays confirming the configuration is successful and that you need to reboot the system. Select *OK.*
10. Go to the *System > Reboot* sub-menu and select *Reboot* to reboot the eNB.

Figure 2-46: Management Server and SNMP

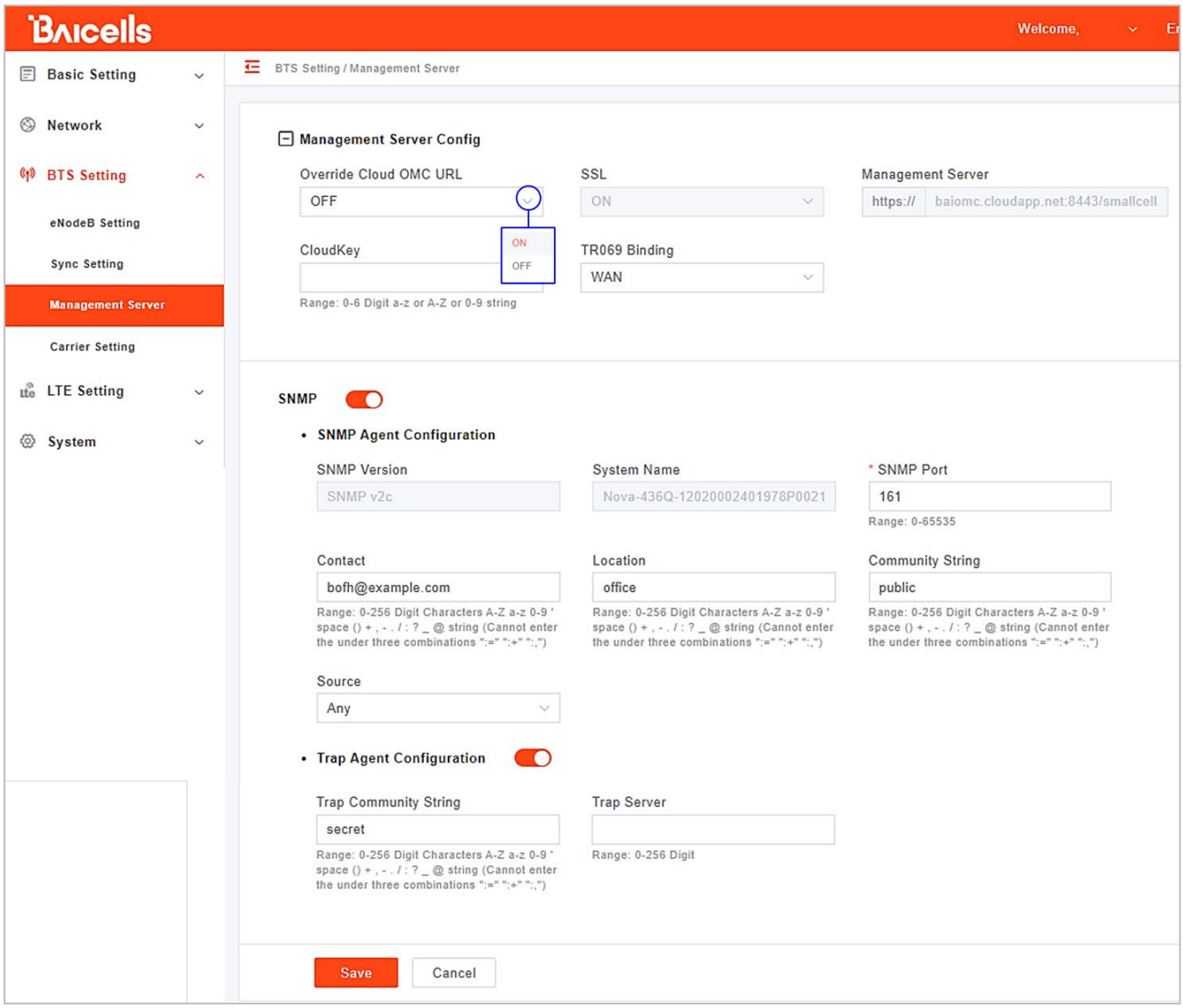


Table 2-12: Management Server and SNMP Fields

Field Name	Description
Management Server Config	
Override Cloud OMC URL	Select *ON* or *OFF*. Selecting *ON* allows you to configure the URL and port number in the *Management Server* field in the *Management Server Config* pane of the *BTS Setting > Management Server* sub-menu. NOTE: This field only displays when the eNB operating mode is set to *Cloud EPC* in the *Network > Core Network* menu (*section 2.6.4*).
SSL	Optional: The SSL connection adds enhanced security when it is turned on.
Management Server	The management server's IP address.
CloudKey	The NMS assigns this unique identifier for each operator. Range is 0–6 characters (using upper-case letters A–Z, lower-case letters a–z, and digits 0–9).
TR069 Binding	The interface binding with TR069 protocol. Default is *WAN*.

Field Name	Description
SNMP Agent Configuration	
SNMP Version	The current supported SNMP version, which is generated automatically and is SNMP v2c.
System Name	The community name, which is generated automatically.
SNMP Port	The SNMP protocol port used. Range is 0–65535.
Contact	The contact email. Range is 0–256 characters (using upper-case letters A–Z, lower-case letters a–z, and digits 0–9). ‘ space ( ) + , - . / : ? _ @ string Cannot enter the following three combinations ":=" ":+" and ":,"
Location	The system’s location. Range is 0–256 characters (using upper-case letters A–Z, lower-case letters a–z, and digits 0–9). ‘ space ( ) + , - . / : ? _ @ string Cannot enter the following three combinations ":=" ":+" and ":,".
Community String	Used to define a community. Default is *public*. Range is 0–256 characters (using upper-case letters A–Z, lower-case letters a–z, and digits 0–9). ‘ space ( ) + , - . / : ? _ @ string Cannot enter the following three combinations ":=" ":+" and ":,".
Source	The source address of acquiring information. Default is *Any*.
Trap Agent Configuration	
Trap Community String	Used to define a community. Default is *secret*. Range is 0–256 characters (using upper-case letters A–Z, lower-case letters a–z, and digits 0–9). ‘ space ( ) + , - . / : ? _ @ string Cannot enter the following three combinations ":=" ":+" and ":,".
Trap Server	The IP address for the host. Range is 0–256 characters.

1.7.4 Carrier Setting

References:

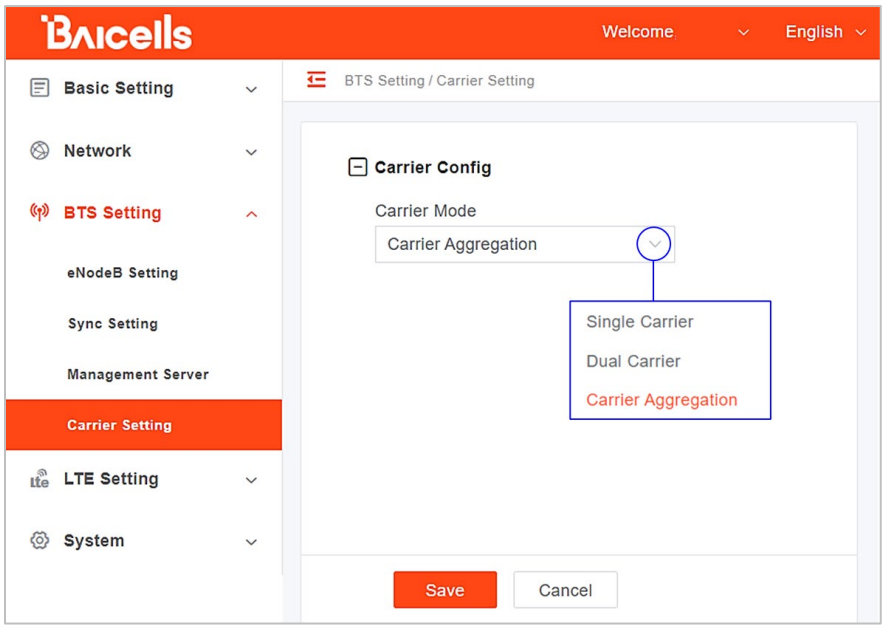
- *Carrier Aggregation and Dual Carrier/Split Mode Configuration Guide*
- *Nova430e Outdoor 4x250mW Two-Carrier TDD eNodeB Installation Guide*
- *Nova430i Outdoor 4x250mW Two-Carrier TDD eNodeB Installation Guide*
- *Nova436Q Outdoor 4x1W Two-Carrier TDD eNodeB Installation Guide*
- *Neutrino430 Indoor 4x250mW Two-Carrier TDD eNodeB Installation Guide*

The *BTS Setting > Carrier Setting* sub-menu is used for two-carrier eNBs (Figure 2-47). You can set the eNB to run as either a single carrier, two combined carriers using Carrier Aggregation (CA), or two separate carriers using Dual Carrier (DC)/split mode.

In single carrier mode, only Cell 1 operates and it uses only two RF ports instead of four. In DC mode, the eNB supports up to two independent carriers and offers twice the capacity as is available in single carrier mode. In CA mode, the bandwidth is extended, which improves data transmission rates. Operators may need to use this mode if they have limited spectrum or are planning to change to CA or DC mode at a later time, for example when more capacity is needed for the coverage area. Whenever you change the carrier setting, you must perform a **reboot** the eNB for the change to take effect.

NOTE: The eNBs in CA mode support contiguous or non-contiguous channels in the North American bands defined by Third-Generation Partnership Project (3GPP).

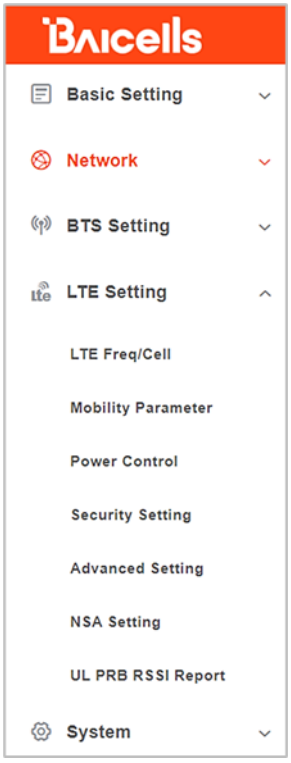
Figure 2-47: Carrier Setting



1.8 LTE Setting

The LTE Setting menu (Figure 2-48) contains sub-menus related to mobility as well as other radio-related settings. Many LTE parameters are important for efficient wireless network operation.

Figure 2-48: LTE Setting Menu



NOTE 1: The *LTE Setting* menu displays the *LTE Freq/Cell* and *Mobility Parameter* sub-menus only when MME pool, LGW, and HaloB functions are disabled.

NOTE 2: The *LTE Setting > NSA Setting* sub-menu displays only when the LGW function is disabled using the *Network > LGW* sub-menu (*section 2.6.3*).

NOTE 3: HaloB-enabled eNBs operate as standalone entities and do not support mobility. Therefore, the *LTE Setting > LTE Freq/Cell* sub-menu does not display when *HaloB Mode* is enabled in the *Network > Core Network* sub-menu
(see *section 2.6.4*).

NOTE 4: The *LTE Setting > SAS Settings* sub-menu was removed with the software update from QRTB 2.6.2 to QRTB 2.9.10 and higher. All SAS settings are accessed from the *Basic Setting > Quick Setting* sub-menu
(see *section 2.5.2*).

NOTE 5: The terms *handoff* and *handover* are used interchangeably in LTE.

When setting up mobility, you must establish the neighboring eNBs operating in the same geographical area as is the eNB that you are configuring. This information is completed for each eNB so that the eNBs collectively work well with one another to handle mobile users and to balance the traffic load.

Use the *LTE Freq/Cell*, *Mobility Parameter*, and *Advanced Setting* sub-menus to configure the neighboring eNBs' frequencies and identify each eNB running on that frequency (*section 2.8.1*); configure the current eNB's mobility parameters (*section 2.8.2*); and examine the current eNB's advanced settings (*section 2.8.5*). Before you begin configuring the eNB, we recommend that you review all of the information in this section first, so you understand how the configuration settings relate.

Important: Make sure the current and neighboring eNBs are synchronized to help the eNBs avoid interfering with one another.

If you change these parameters, perform a **reboot** of the eNB for the new configuration to take effect. A case study for LTE-to-LTE handoffs is provided in *section 2.10*.

Depending on geographic region, there are three types of neighboring eNBs: other LTE eNBs; eNBs running another type of wireless technology called Time Division Synchronous Code Division Multiple Access (TD-SCMDA); and those operating with the Global System for Mobile (GSM) communications technology.

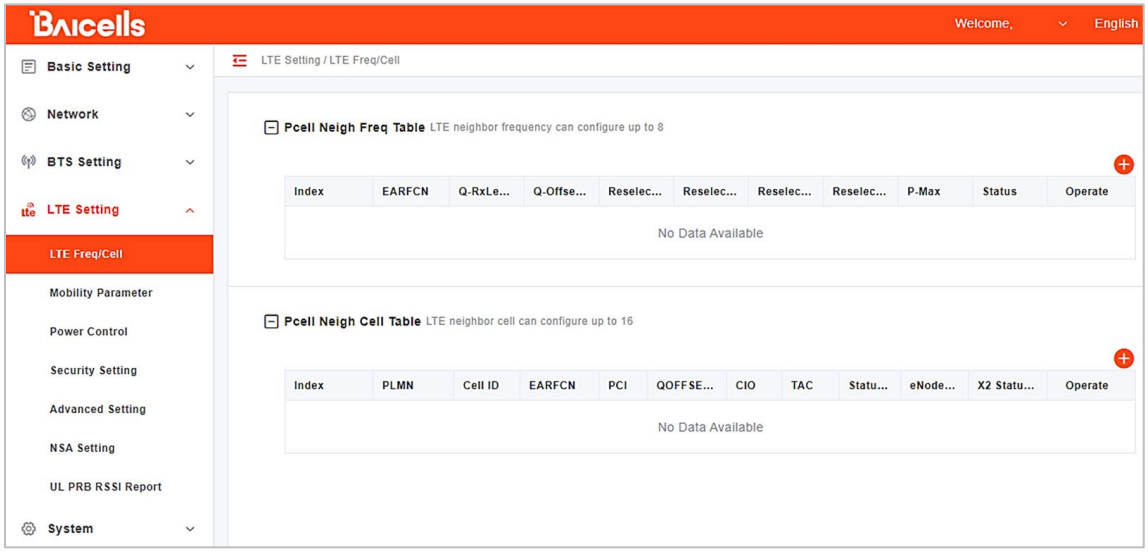
NOTE: TD-SCMDA and GSM settings for handover are not available with BaiBLQ_3.0 software; therefore, *section 2.8.1* and *section 2.8.2* describe only how to configure adjacent eNBs operating with LTE technology.

1.8.1 Configure LTE Neighbor Settings

Using the *LTE Setting > LTE Freq/Cell* sub-menu (Figure 2-49), you can configure parameters related to how adjacent eNBs operating with LTE technology work with the Baicells LTE eNB that you are configuring. You must define for the Baicells eNB how to deal with any neighboring LTE eNBs.

NOTE: When the eNB operates in Dual Carrier mode, the LTE neighbor frequency and cell should be configured for cell1 and cell2 separately.

Figure 2-49: LTE Neighbor Settings (*LTE Setting > LTE Freq/Cell*)



You first add the LTE neighbor frequency settings via the *Cell Neigh Freq Table* (*section 2.8.1.1*). Then, you add the LTE neighbor cell settings associated to the frequencies via the *Cell Neigh Cell Table* (*section 2.8.1.2*).

You can configure the *Cell Neigh Cell Table* for both inter-frequency (between different frequencies) and intra-frequency (within the same frequency) neighboring eNBs. For inter-frequency cells, you must add the neighbor inter-frequency settings in the *Cell Neigh Frequency Table* before you try to add the neighbor inter-frequency cell (eNB) information. Conversely, if you need to delete a neighbor inter-frequency record, you must first delete the neighbor inter-frequency cells (eNBs) associated to it.

For an intra-frequency neighbor cell, meaning a neighbor eNB operates on the same frequency as the eNB you are configuring, you do not need to configure the *Cell Neigh Freq Table* but you do need to configure the *Cell Neigh Cell Table*.

1.8.1.1 Configure LTE Neighbor Frequency Settings

You can configure up to eight LTE cell neighbor frequency tables. In the *Cell Neigh Freq Table* pane of the *LTE Setting > LTE Freq/Cell* sub-menu, click on the *Add* icon . This opens the *Add* window to use for configuration, as shown in Figure 2-50 and described in Table 2-13. The parameters shown in the figure reflect the recommended settings for this operator example.

NOTE: When the eNB is in HaloB mode, the neighbor frequency configuration options don't display.

Figure 2-50: *LTE Setting > LTE Freq/Cell* (Cell Neigh Freq Table)

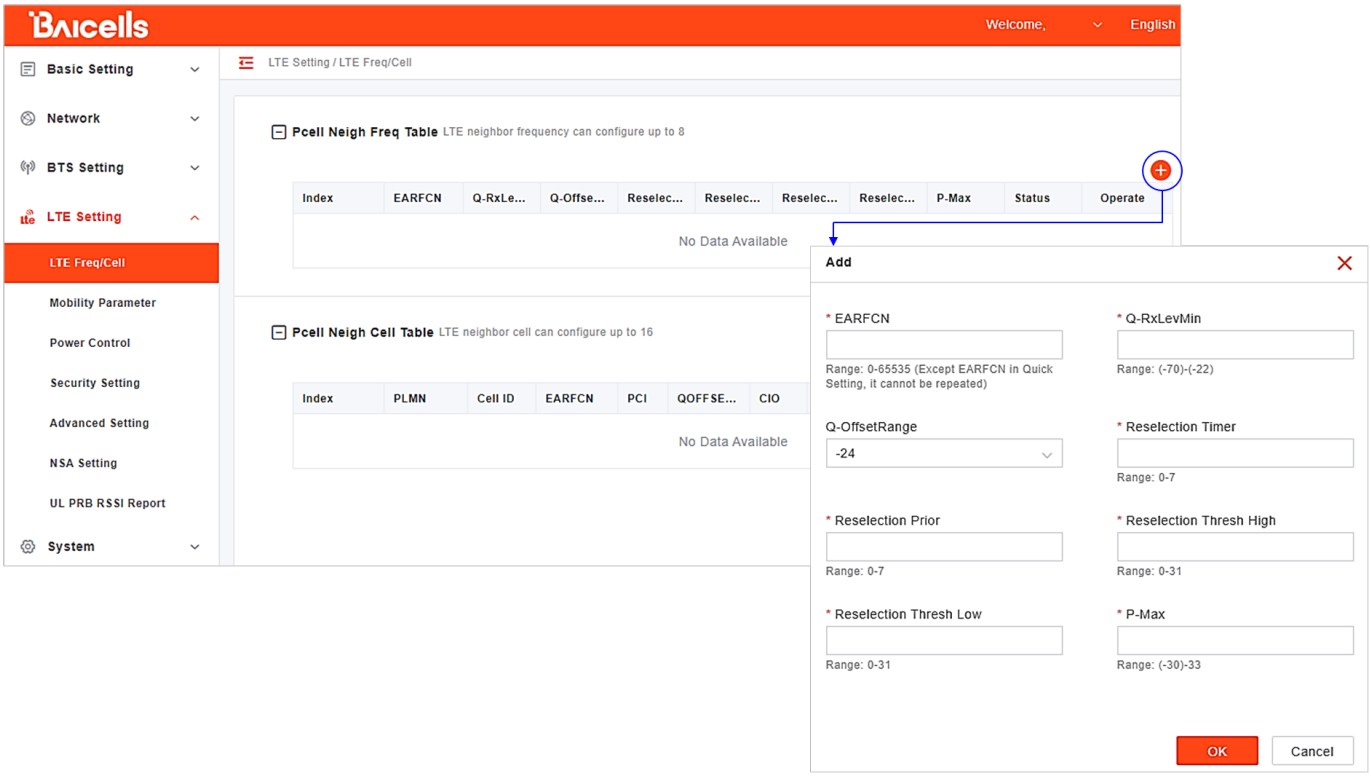


Table 2-13: *LTE Setting > LTE Freq/Cell* (Cell Neigh Freq Table Fields)

Field Name	Description
EARFCN	EARFCN stands for Evolved Universal Mobile Telecommunications System (UMTS) Terrestrial Radio Access (E-UTRA) Absolute Radio Frequency Channel Number. Used to set the absolute radio frequency channel number of the neighboring eNB's frequency. Range is 0–65535, but you cannot repeat the EARFCN you've configured in the *Basic Setting > Quick Setting* sub-menu under the *Cell Quick Setting* pane (*section 2.5.2*).
Q-RxLevMin	The minimum received signal level at which the CPE detects a neighboring eNB's signal. The range is -70 to -22 dBm. A typical value is -62, which equals -124 dBm.
Q-OffsetRange	Indicates the difference in signal level between the serving and neighboring eNBs, as determined by the received signal level at the CPE. If the received signal level is better from a neighboring eNB by at least this amount of difference in dB, the CPE reselects the other cell. The range is +24 to -24 dB. A typical value is 0 dB.
Reselection Timer	Determines when the cell reselection timer expires. Range is 0–7 seconds. A typical value is 0 seconds.
Reselection Prior	Priority of cell reselection to cells at this frequency. Range is 0–7 (integer). A typical value is 4.
Reselection Thresh High	The cell reselection threshold for higher priority inter-band frequency. Represents the access threshold level at which the CPE leaves the serving cell and reselects another cell at the target frequency (assuming the target frequency cell has a higher cell reselection priority than the serving cell). Range is 0–31 dB. A typical value is 18 dB.
Reselection Thresh Low	The cell reselection threshold for lower priority inter-band frequency. Represents the access threshold level at which the CPE leaves the serving cell and reselects another cell at the target frequency (assuming the target frequency cell has an absolute priority lower than the serving cell). Range is 0–31 dB. A typical value is 13 dB.
P-Max	The maximum transmit power that CPEs in this cell are allowed to use in the uplink. The range is -30 to 33 dBm. A typical value is 23 dBm.

1.8.1.2 Configure LTE Neighbor Cell Settings

You can configure up to 16 LTE cell neighbor cell tables. Click on the *Add* icon in the *Cell Neigh Cell Table* pane of the *LTE Setting > LTE Freq/Cell* sub-menu. This opens the *Add* window for configuration, as shown in Figure 2-51 and described in Table 2-14. The parameters shown in the figure reflect the recommended settings for this operator example.

Figure 2-51: LTE Setting > LTE Freq/Cell (Cell Neigh Cell Table)

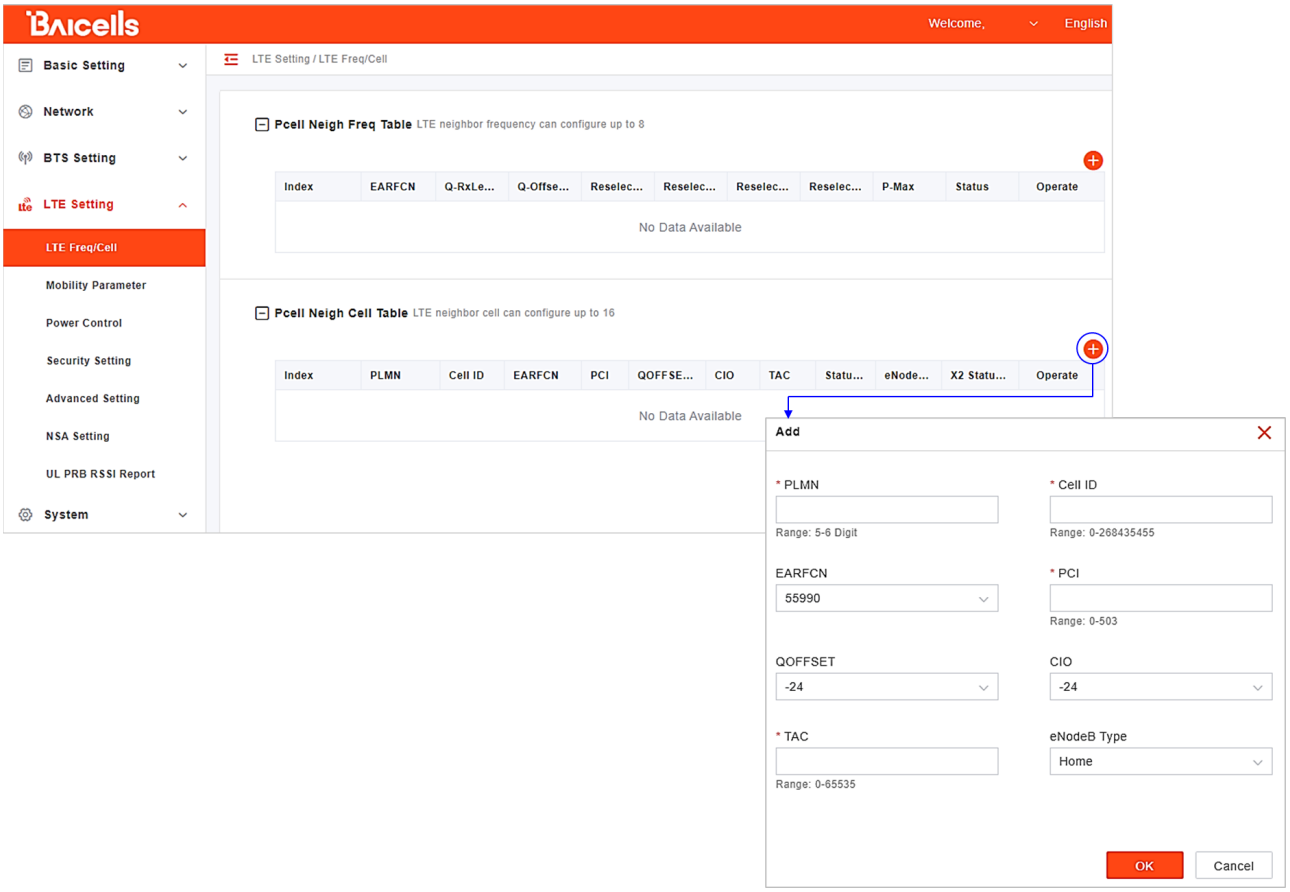


Table 2-14: *LTE Setting > LTE Freq/Cell* (Cell Neigh Cell Table Fields)

Field Name	Description
PLMN	The five- or six-digit Public Land Mobile Network (PLMN) to which the neighbor cell belongs.
Cell ID	The cell ID of the neighbor cell. Range is 0–268,435,455.
EARFCN	EARFCN stands for Evolved Universal Mobile Telecommunications System (UMTS) Terrestrial Radio Access (E-UTRA) Absolute Radio Frequency Channel Number. Used to set the absolute radio frequency channel number of the neighboring eNB's cell. Range is 0–65535, but you cannot repeat the EARFCN you've configured in the *Basic Setting > Quick Setting* sub-menu under the *Cell Quick Setting* pane (*section 2.5.2*).
PCI	Physical Cell Identifier (PCI) of the neighbor cell. Range is 0–503.

Field Name	Description
QOFFSET	Frequency offset of this neighbor cell. Indicates the difference in signal level between the serving and this neighboring eNB, as determined by the received signal level at the CPE. If the received signal level is better from this neighbor eNB by at least this amount of difference in dB, the CPE reselects this cell. Range is 24 to -24 dB. A typical value is 0 dB.
CIO	Cell Individual Offset (CIO) is this neighbor eNB's cell offset, which is one of the variables used to determine which eNB will best serve a given CPE. Range is -24 to 24 dB. A typical value is 0 dB.
TAC	Tracking Area Code (TAC) of this neighbor cell. Range is 0–65535.
eNodeB Type	The eNB type (Macro or Home). • Macro: The eNB covers a large cell area, and the transmission power is on the higher end of the power range. • Home: The eNB's transmission power is much lower than Macro and covers a smaller area.

1.8.2 Mobility Parameter

The *LTE Setting > Mobility Parameter* sub-menu pertains to how roaming CPE sessions are handled between different eNBs in the same service area. When a CPE is actively connected to an eNB, the current eNB is referred to as the serving eNB or cell. The other eNBs in the area are referred to as either neighbor or target eNBs or cells.

The process of a device moving from cell to cell and changing over from its serving eNB to a neighbor (target) eNB is called handoff or handover. The CPE exchanges information with its serving eNB to perform cell selection and reselection based on the parameters you configure for each eNB. Refer to Figure 2-52.

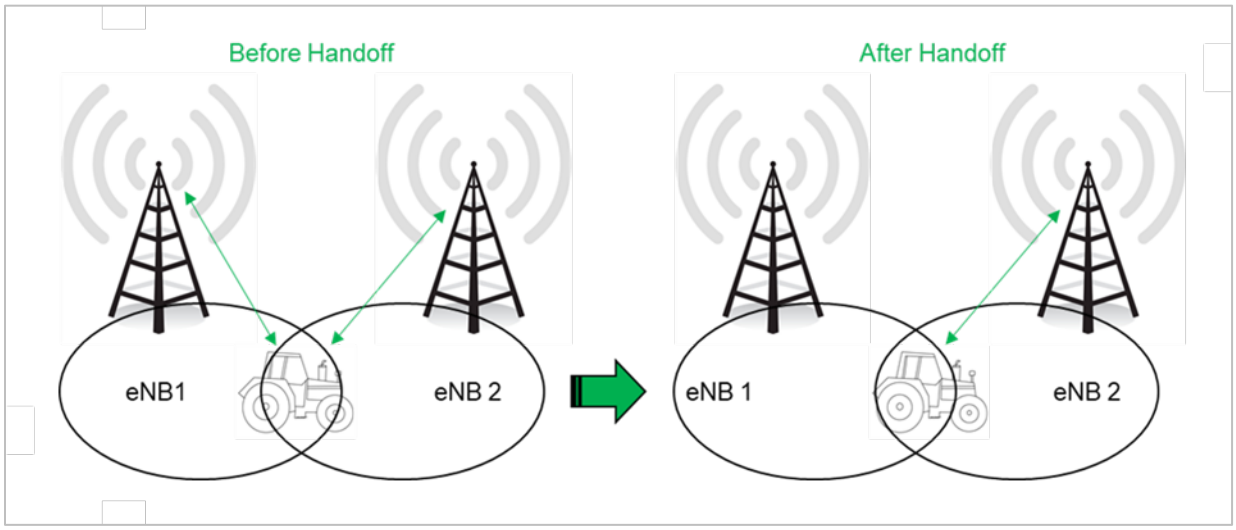
NOTE 1: If the eNB is operating in DC mode, then the mobility parameters must be configured for Cell1 and Cell2 separately.

NOTE 2: Handoff is not supported at this time on an eNB operating in HaloB mode.

NOTE 3: Cloud EPC cannot currently perform handoffs.

NOTE 4: The terms handoff and handover are used interchangeably in LTE.

Figure 2-52: Handoff



What the CPE measures that determines cell selection and reselection is the Reference Signal Received Power (RSRP) of the serving as well as neighboring eNBs. The measurements are sent periodically to the serving eNB, which then determines if the CPE would be better served by an adjacent eNB. Refer to the case study in *section 2.10* for an example of a real-world LTE-to-LTE handoff configuration.

NOTE: The *LTE Setting > Mobility Parameter* sub-menu settings described in this section show configurations that represent standard LTE deployments and are recommended settings. Any modification to these settings should be determined only by experienced wireless professionals.

You will configure the mobility parameters for every adjacent eNB. If the serving eNB determines that more than one adjacent eNB meets the RSRP event thresholds, the settings for *Cell ReSelection Parameter* determine to which adjacent eNB the serving eNB hands off.

To begin the configuration, perform the following steps to configure the event thresholds. Refer to Figure 2-53 and Table 2-15, which describe each of the event threshold fields.

1. Go to the *LTE Setting > Mobility Parameter* sub-menu.
2. Set the *LTE A1 RSRP Threshold* value to *50* in the *A1 Event Threshold* pane.
3. Set the *LTE A2 RSRP Threshold* value to *30* in the *A2 Event Threshold* pane.
4. Set the *Intra-Freq Handover A3 Offset* value to *10* in the *A3 Event Threshold* pane.
5. Set the *Intra-Freq/Inter-Freq Handover A5 RSRP Threshold1* value to *70* and the *Intra-Freq/Inter-Freq Handover A5 RSRP Threshold2* value to *65* in the *A5 Event Threshold* pane.

Figure 2-53: A1, A2, A3, and A5 Event Thresholds

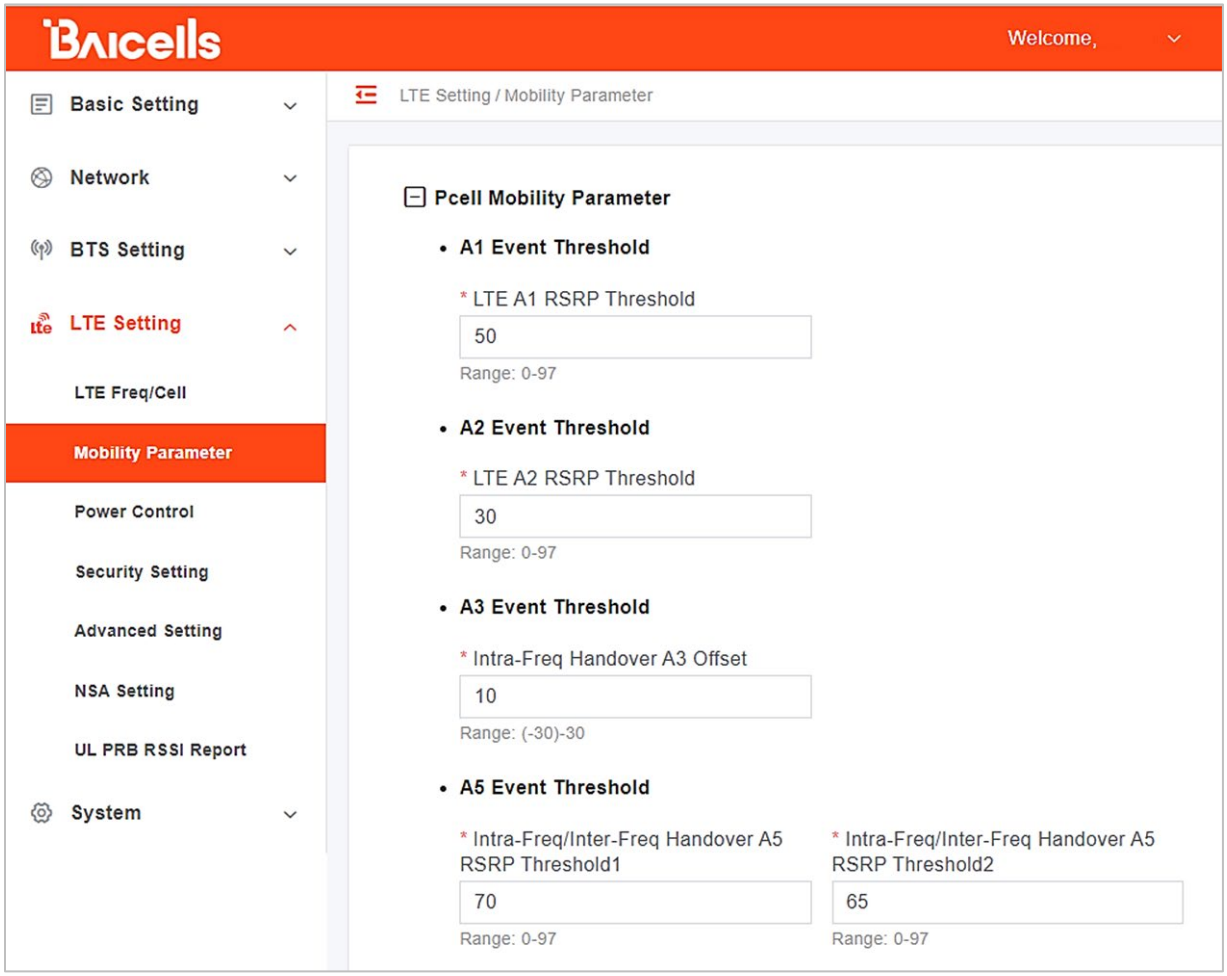


Table 2-15: A1, A2, A3, and A5 Event Threshold Fields

Field Name	Description
A1 Event Threshold: The LTE A1 event is triggered when the serving cell's Reference Signal Received Power (RSRP) is better than the A1 threshold. The A1 event can be used to turn off certain inter-cell measurements.	
LTE A1 RSRP Threshold	The LTE A1 RSRP Threshold range is 0–97 (integer). In this example, the recommended value is 50 (integer), which means -140 dBm + 45 = -90 dBm.
A2 Event Threshold: The LTE A2 event is triggered when the serving cell's Reference Signal Received Power (RSRP) becomes worse than the A2 threshold.	
LTE A2 RSRP Threshold	The LTE A2 RSRP Threshold range is 0–97 dB. In this example, the recommended value is 30 (integer), which means -140 dBm + 30 = -110 dBm. Refer to the Baicells Tip concerning A2 settings: *https://www.facebook.com/groups/baicellsoperatorsupportgroup/permalink/1760449424249426/*
A3 Event Threshold: The LTE A3 event is triggered when a neighbor cell becomes better than the serving cell by as much as the offset value. The offset can be either positive or negative.	
Intra-Freq Handover A3 Offset	The Intra-Freq Handover A3 Offset range is -30 dB to 30 dB. In this example, the recommended value is 10 (integer), which means 10*0.5 = 5 dB.

Field Name	Description
A5 Event Threshold: The LTE A5 event is triggered when the serving cell becomes worse than Threshold1 while a neighbor cell becomes better than Threshold2.	
Intra-Freq/Inter-Freq Handover A5 RSRP Threshold1	The Intra-Freq/Inter-Freq Handover A5 RSRP Threshold1 range is 0-97 (integer). In this example, the recommended value is 70 (integer), which means -140 dBm + 70 = -70 dBm.
Intra-Freq/Inter-Freq Handover A5 RSRP Threshold2	The Intra-Freq/Inter-Freq Handover A5 RSRP Threshold2 range is 0–97 (integer). In this example, the recommended value is 65 (integer), which means -140 dBm + 65 = -75 dBm.

Next, configure measurement control parameters. The configuration in the *Measurement Control Parameters* pane of the *LTE Setting > Mobility Parameter* sub-menu determines how frequently the CPE measures the serving and neighboring eNBs' RSRP values and at what level of hysteresis-based RSRP triggers a handoff (Figure 2-54 and Table 2-16).

The CPE evaluates the RF conditions around it and reports the information to the serving eNB. The eNB's radio resource management function evaluates the measurements and determines whether or not to hand off the session to a neighbor eNB.

To configure the *Measurement Control Parameters*, set the recommended values for this operator example as shown in Figure 2-54. The parameters are described in Table 2-16.

Figure 2-54: Measurement Control Parameters

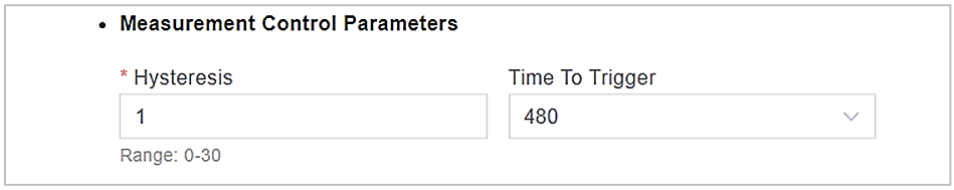


Table 2-16: Measurement Control Parameters Fields

Field Name	Description
Hysteresis	Refers to the hysteresis (historical records) of the handover measurement events. The value is used to avoid the frequent triggering of cell handover evaluation due to the fluctuation in wireless signals. This setting tells the CPE, if you hear another eNB with at least this amount of dB better, initiate a handover. The lower the number the sooner the handover is initiated. If set too low, it may cause the CPE to ping-pong between eNBs. Such events are tracked by the EPC, but not by the eNB. Range is 0–30 dB. In this example, the recommended value is 1 dB.
Time To Trigger	Length of time the target cell RSRP value is better than the serving cell before the CPE initiates a handover request. The range is 0–5120 ms. In this example, the recommended value is 480 ms.

Next, configure cell selection and cell reselection parameters. When the CPE selects a PLMN, it selects an appropriate cell in which to reside based on cell selection parameters you configure. Further, when the CPE is in an idle state, it monitors the signal quality of the neighbor cell and the serving cell to reselect in which cell to reside. Cell reselection includes the intra- and inter-frequency cell reselection.

Go to the *LTE Setting > Mobility Parameter* sub-menu and configure the *Cell Selection Parameter* and *Cell ReSelection Parameter* panes by setting the recommended values for this operator example (Figure 2-55). The parameters are described in Table 2-17.

NOTE: Inter-frequency cell reselection is mainly used to resolve wireless coverage issues, but it can also be used to achieve load balance between different frequency points.

Figure 2-55: Cell Selection and Cell ReSelection Fields

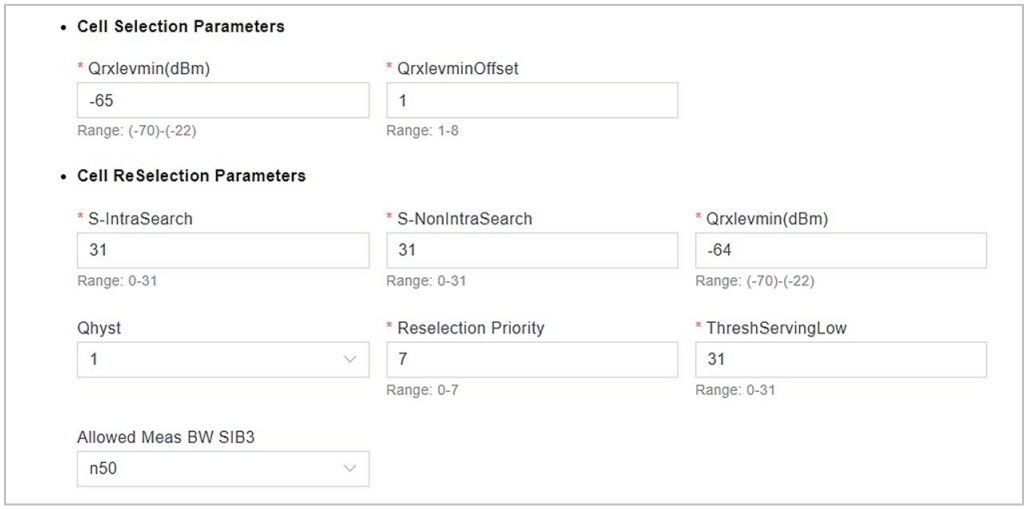


Table 2-17: Cell Selection and Cell ReSelection Parameters Fields

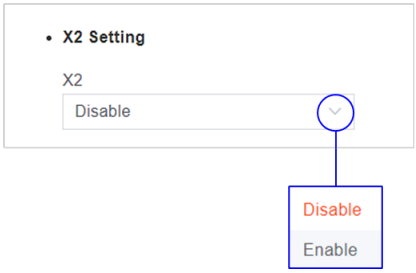
Field Name	Description
Cell Selection Parameter	
Qrxlevmin(dBm)	Minimum acceptable signal level at the CPE before cell selection. Range is -70 dBm to -22 dBm. In this example, the recommended value is -65 dBm, which is multiplied by 2 to reach the minimum acceptable signal level value. In this example, -65*2 = -130 dBm, minus the offset. NOTE 1: The CPE avoids accessing a cell with low receiving signal levels when this parameter is defined. NOTE 2: Factors such as cell size, cell coverage, and background noise need to be factored in a while considering the value to set for this parameter. Reducing the parameter value expands the allowable access range of the cell, but it may result in poor call quality.
QrxdevminOffset	Minimum level offset (difference) in RSRP at the CPE needed for cell selection. The minimum threshold value is offset to prevent ping-pong effect when the CPE residing on a Visited Public Land Mobile Network (VPLMN) periodically searches for a higher-level cell. Range is 1–8 dB. In this example, the recommended value is 1 dB.

Field Name	Description
Cell ReSelection Parameter	
S-IntraSearch	Intra-frequency measurement threshold that must be met before the CPE reselects a neighbor eNB. Range is 0–31 (integer). In this example, the recommended value is 31 (integer), which means 31*2 = 62 dB.
S-NonIntraSearch	Intra-frequency measurement threshold that must be met before the CPE reselects a neighbor eNB. Range is 0–31 (integer). In this example, the recommended value is 31 (integer), which means 31*2 = -62 dB.
Qrxlevmin(dBm)	Minimum level for reselection. Range is -70 to -22 (integer). In this example, the recommended value is -64 (integer), which means -64*2 = -128 dBm.
Qhyst	Delay time for reselection. Range is 0–24 dB. In this example, the recommended value is 2 dB.
Reselection Priority	Priority for reselection. Range is 0–7 (integer). In this example, the recommended value is 7.
ThreshServingLow	Threshold for selection to cells of lower priority. Range is 0–31 dB. In this example, the recommended value is 31 dB.
Allowed Meas BW SIB3	Measurement bandwidth allowed. Choices are n6, n15, n25, n50, n75, or n100. In this example, the recommended value is n50.

Next, configure the X2 setting in the *X2 Setting* pane of the *LTE Setting > Mobility Parameter* sub-menu (Figure 2-56). An X2 interface is a logical interface which may be enabled for intra-LTE eNB handovers when the MME being used for the CPE is the same for both the serving and the target eNB. If enabled, the two eNBs can communicate directly with one another without communicating through a Radio Network Controller (RNC). The X2 starts buffering on the target eNB in advance of a handover.

By default, the *X2 Setting* parameter is set to *Disable*. Use the drop-down menu to select *Enable*, which is the recommended setting.

Figure 2-56: X2 Setting



Next, configure the Automatic Neighbor Relation (ANR) setting in the *ANR Parameters* pane of the *LTE Setting > Mobility Parameter* sub-menu (Figure 2-57). The settings are described in Table 2-18.

Figure 2-57: ANR Parameters

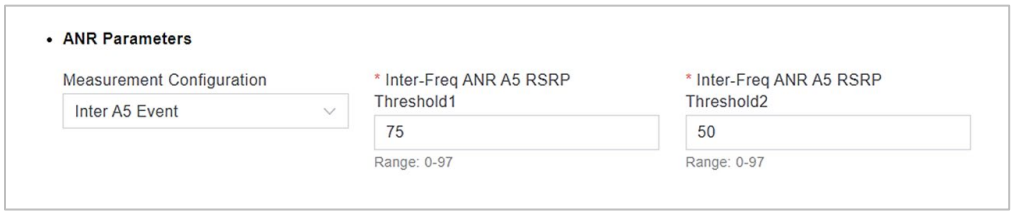


Table 2-18: ANR Parameters Fields

Field Name	Description
Measurement Configuration	There are several management configuration modes: • Measurement Disable • Periodic • Inter A3 Event • Inter A5 Event
Intra-Freq ANR A3 Offset	This parameter displays when the *Measurement Configuration* parameter is set to *Inter A3 Event*. The offset of ANR A3 event for intra-frequency handover. The offset can be either positive or negative. Range is -30 dB to 30 dB. In this example, the recommended value is 5.
Inter-Freq ANR A5 RSRP Threshold1	This parameter displays when the *Measurement Configuration* parameter is set to *Inter A5 Event*. The first threshold of ANR A5 event for inter-frequency handover. Range is 0–97 (integer). In this example, the recommended value is 75.
Inter-Freq ANR A5 RSRP Threshold2	This parameter displays when the *Measurement Configuration* parameter is set to *Inter A5 Event*. The second threshold of ANR A5 event for inter-frequency handover. Range is 0–97 (integer). In this example, the recommended value is 50.

When all the mobility parameter settings have been configured in the *Mobility Parameter* window, select *Save*.

1.8.3 Power Control

The *LTE Setting > Power Control* parameters help to limit CPE transmit power to the eNB being configured, including the power of the transmitted reference signals. The parameters factor into the overall RF link budget. The power control parameters are shown in Figure 2-58 and described in Table 2-19.

Figure 2-58: Power Control

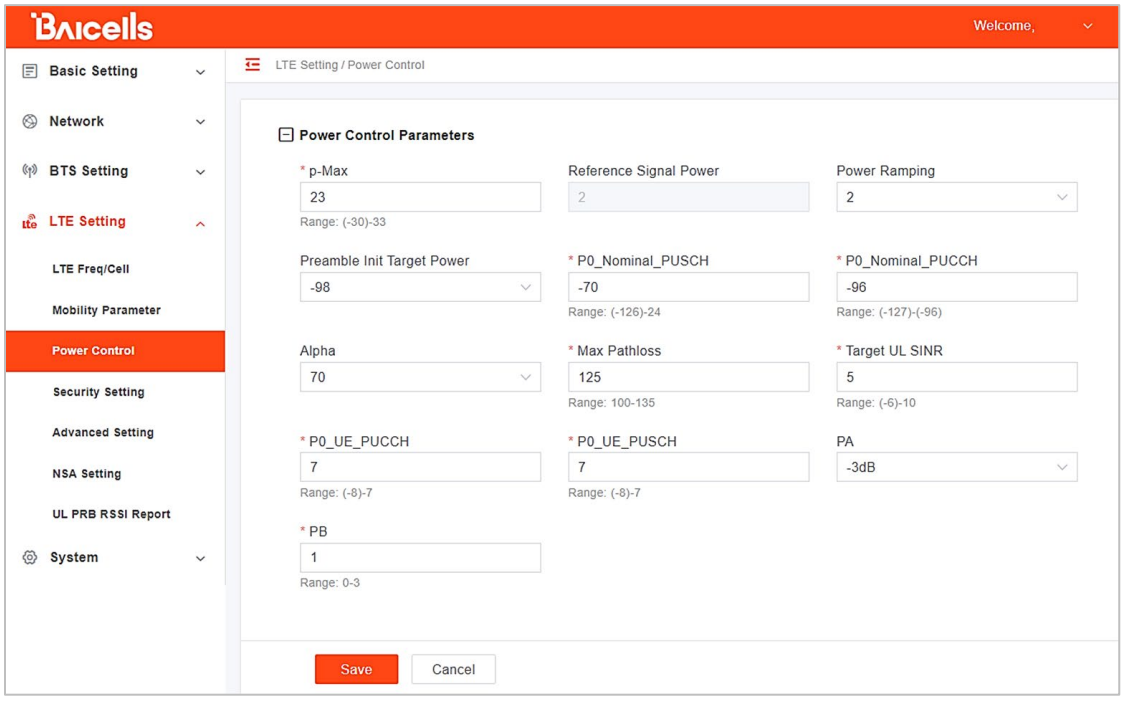


Table 2-19: Power Control Fields

Field Name	Description
p-Max	The maximum power that a CPE can transmit in this cell. Range is -30 dB to 33 dB. In this example, the recommended value is 23 dB.
Reference Signal Power	Transmit power of the reference signals. Value is auto-set.
Power Ramping	Step size of the Physical Random-Access Channel's (PRACH's) power index broadcast to the CPEs via a Layer 1 channel used by CPEs to access the mobile network for call setup and burst data transmission. Options are 0, 2, 4, or 6. In this example, the recommended value is 2.
Preamble Init Target Power	Initial power of the Physical Random-Access Channel (PRACH). Range is -90 to -120. In this example, the recommended value is -98.
P0_Nominal_PUSCH	Physical Uplink Shared Channel (PUSCH) carries user data. It supports Quadrature Phase Shift Keying (QPSK) and 16 Quadrature Amplitude Modulation (QAM), with 64 QAM being optional. Range is -126 to 24 dB. In this example, the recommended value is -70 dB.
P0_Nominal_PUCCH	Physical Uplink Control Channel (PUCCH) is used to carry Uplink Control Information (UCI). LTE CPEs can never transmit both PUCCH and Physical Uplink Shared Channel (PUSCH) during the same subframe. Range is -127 to -96 dB. In this example, the recommended value is -96 dB.
Alpha	Power control loss compensation factor, which controls the CPE power. Range is 0 to 100. In this example, the recommended value is 70.
Max Pathloss	Maximum threshold at which the CPE determines not to transmit to the eNB based on pathloss. Pathloss is the difference between the transmitted reference signal information and the actual received signal power. Range is 100 to 135. In this example, the recommended value is 125.
Target UL SINR	Desired Signal-to-Interference-Plus-Noise Ratio (SINR) level to ensure an acceptable level of communication between the CPE and eNB while also controlling interference that might be caused to neighboring cells. Range is -6 dB to 10 dB. In this example, the recommended value is 5 dB.
P0_UE_PUCCH	Initial CPE transmit power when using PUCCH. Range is -8 dB to 7 dB. In this example, the recommended value is 7 dB.
P0_UE_PUSCH	Initial CPE transmit power when using PUSCH. Range is -8 dB to 7 dB. In this example, the recommended value is 7 dB.
PA	When the Physical Downlink Shared Channel (PDSCH) power control PA adjustment switch and the downlink Inter-Cell Interference Coordination (ICIC) are disabled, the PDSCH uses the PA value for average power distribution. PA = 10lgρA.
PB	Represents the value of the power factor ratio of Energy Per Resource Element (EPRE) on PDSCH, and PB represents the index of PB/PA on the value.

To optimize channel conditions on the eNB, please refer to the BaiTip posted on the Baicells website: *https://community.na.baicells.com/t/recommened-advanced-settings-on-the-enb-to-optimise-channel-conditions/531*

1.8.4 Security Setting

Caution: Do not modify these security settings; keep the default values.

The *LTE Setting > Security Setting* sub-menu parameters pertain to the LTE encryption algorithms that are used (Figure 2-59). The selections depend on the LTE core network setup. In a two-carrier eNB, these settings are configured on the primary cell (Cell1), and apply to both the primary and secondary cell (Cell2). Table 2-20 identifies the security setting fields.

Figure 2-59: Security Setting

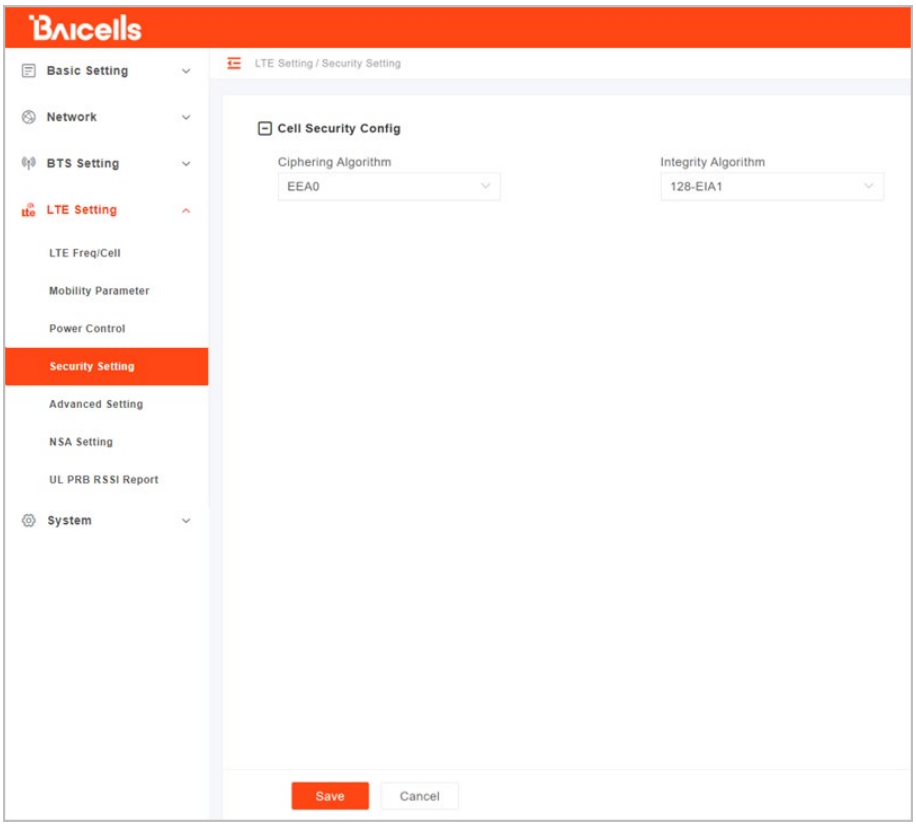


Table 2-20: Security Setting Fields - For Information Only

Field Name	Description
Ciphering Algorithm	Encryption algorithm options: • EEA0 (default) • 128-EEA1: 128-EEA1, EEA0 • 128-EEA2: 128-EEA2, EEA0
Integrity Algorithm	Integrity protection algorithm options: • 128-EIA1: 128-EIA1, EIA0 (default) • 128-EIA2: 128-EIA2, EIA0

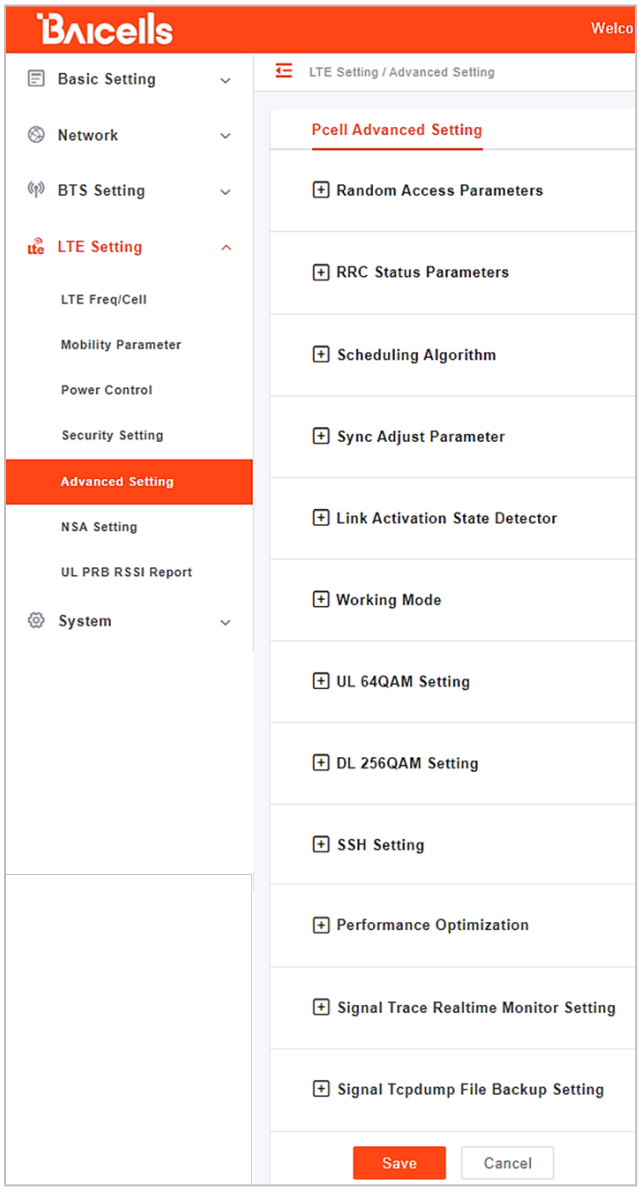
1.8.5 Advanced Setting

Caution: Many, if not all, of the *LTE Setting > Advanced Setting* sub-menu parameters should be left with their default values. Any modifications should be determined only by experienced wireless professionals.

The *LTE Setting > Advanced Setting* sub-menu parameters are primarily used to fine-tune the RF settings and to configure special features. In a two-carrier eNB, these settings are configured on the primary cell (Cell1) and apply to both the primary and secondary cell (Cell2).

Figure 2-60 shows the *LTE Setting > Advanced Setting* sub-menu parameters, which are explained in this section.

Figure 2-60: Advanced Setting



1.8.5.1 Random Access Parameters

The preamble format to be used in a specific cell is messaged from the eNB to the CPE using a Physical Random-Access Channel (PRACH) configuration index. The CPE uses the preamble to access the network when it is first powered on.

The settings in the *Random Access Parameters* pane of the *LTE Setting > Advanced Setting* sub-menu are shown in Figure 2-61 and explained in Table 2-21.

Figure 2-61: Random Access Parameters

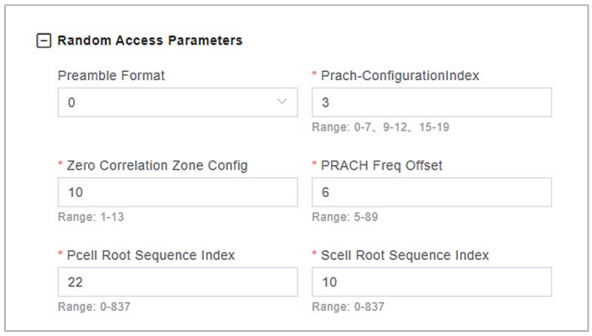


Table 2-21: Random Access Parameters Fields

Field Name	Description
Preamble Format	Packet preamble format (based on the PRACH index) to be used for this cell and communicated to CPEs. Options are 0 or 4. • 0: send PRACH on normal subframe, the farthest covered distance is 8.70 miles (14 km). • 4: send PRACH special subframe, the farthest covered distance is 0.63 miles (1 km).
Prach-Configuration Index	The PRACH configuration index number is broadcast to the CPEs via SIB2. The value range is determined by the *Preamble Format* setting and the *SubFrame Assignment* specified in the *Basic Setting > Quick Setting* sub-menu in the *Cell Quick Setting* pane (*section 2.5.2*). • If *Preamble Format* is set to *0* and *SubFrame Assignment* is set to *1*, the range is 0–7, 9–12, or 15–19. • If *Preamble Format* is set to *0* and *SubFrame Assignment* is set to *2*, the range is 0–4, 6, 9, 10, 12, 15, 16, or 18. • If *Preamble Format* is set to *4*, the range is 48–57.
Zero Correlation Zone Config	Specifies the cyclic shift intervals to generate the preamble sequence. • If *Preamble Format* is set to *0*, the range is 1–13. • If *Preamble Format* is set to *4*, the range is 2–6. The default is 10. Refer to the BaiTip on this setting: *https://community.na.baicells.com/t/baitip-of-the-day-december-14th-2016-subframes-and-special-subframes/163*

Field Name	Description
PRACH Freq Offset	Determines the location of the PRACH preamble in the frequency domain. The value range is determined by the *Bandwidth* setting specified in the *Basic Setting > Quick Setting* sub-menu in the *Cell Quick Setting* pane (*section 2.5.2*). • If *Bandwidth* is set to *10 MHz*, the range is 4–40. • If *Bandwidth* is set to 20 MHz, the range is 5–89.
Pcell Root Sequence Index	Index broadcast by the eNB and used by CPEs to calculate the preamble they should use to attach to the eNB. Range: 0–837.
Scell Root Sequence Index	Index broadcast by the eNB and used by CPEs to calculate the preamble they should use to attach to the eNB. Range: 0–837.

1.8.5.2 RRC Status Parameters

Under the *LTE Setting > Advanced Setting* sub-menu in the *RRC Status Parameters* pane, you configure parameters related to how the Radio Resource Control (RRC) protocol in the air interface control plane establishes, maintains, and releases an RRC connection between CPEs and the eNB. If the CPE *Inactivity Timer* is set to 0, the timer does not take effect. The CPE inactive status duration is equal to the RRC inactivity timer times the maximum expiry count. Refer to Figure 2-62 and Table 2-22.

Figure 2-62: RRC Status Parameters

Table 2-22: RRC Status Parameters Fields

Field Name	Description
Ue Inactivity Timer	Expire time of the CPE inactive status timer(s). Range is 0–4294967 seconds. If set to 0, the timer does not take effect.
Max Expiry Count	Maximum number of times the CPE's inactive status timer expires. The range is 1–65535 times.

1.8.5.3 Scheduling Algorithm

The fields in the *Scheduling Algorithm* pane of the *LTE Setting > Advanced Setting* sub-menu are important for smooth RF operation and can impact key performance indicators such as cell throughput, cell edge users, Voice Over IP (VoIP) capacity, and data Quality of Service (QoS). The three supported scheduling strategies are described below. The most common scheduling strategy is Round Robin (RR), which is the default type for both UL and DL. Refer to Figure 2-63 and Table 2-23.

- RR algorithm: RR scheduling allocates resources to all CPEs equally, and neither QoS nor memory is considered.
- Proportionally Fair Scheduling (PFS): balances between user channel quality and fairness, where both cell throughput and user fairness are considered, and gives higher priority to CPEs with good channel quality and low average data rate.
- QoS: Different QoS is provided for different data bearer categories. Each data bearer category is associated with a QCI.

Figure 2-63: Scheduling Algorithm

Table 2-23: Scheduling Algorithm Fields

Field Name	Description
UL Schd Type	MAC uplink scheduling algorithm. Supports RR, PFS, and QoS scheduling strategies. The default is RR.
DL Schd Type	MAC downlink scheduling algorithm. Support RR and PFS. The default is RR.

1.8.5.4 Sync Adjust Parameter

The settings in the *Sync Adjust Parameter* pane of the *LTE Setting > Advanced Setting* sub-menu (Figure 2-64) are used to help the system compensate for packet delay in the uplink and downlink process. **Do not modify this field.**

Figure 2-64: Sync Adjust Parameter

1.8.5.5 Link Activation State Detector

The fields in the *Link Activation State Detector* pane of the *LTE Setting > Advanced Setting* sub-menu are used to enable or disable a link watchdog, and set an associated timer. When *Link Keep Alive* is *ON*, a watchdog action checks the CPE every "x" minutes to see if it's connected or disconnected from the EPC, LAN, or both. If the CPE is disconnected after "x" minutes, the watchdog performs a reboot of the CPE. When *Link Keep Alive* is *OFF*, the watchdog doesn't reboot the CPE. Refer to Figure 2-65 and Table 2-24.

Figure 2-65: Link Activation State Detector

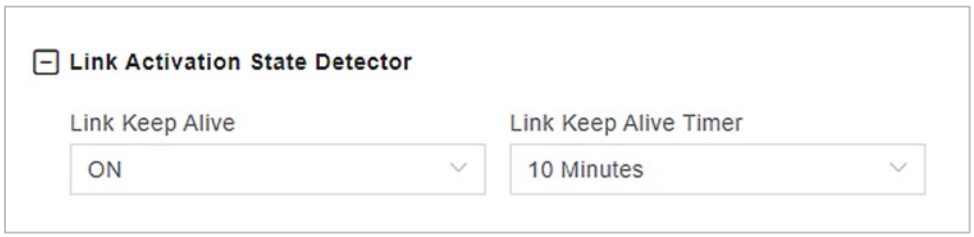


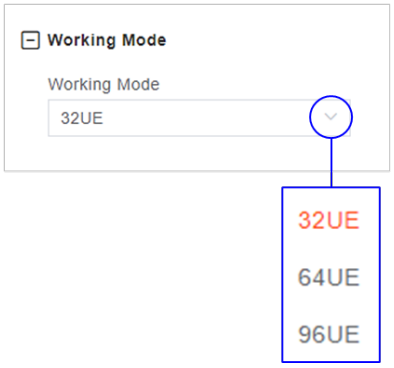
Table 2-24: Link Activation State Detector Fields

Field Name	Description
Link Keep Alive	Select *ON* to enable or *OFF* to disable the link activation state detector between the CPE and the EPC, LAN, or both.
Link Keep Alive Timer	When *Link Keep Alive* is set to *ON*, you must set a timer. Range is 5, 10, or 15 minutes.

1.8.5.6 Working Mode

The *Working Mode* pane of the *LTE Setting > Advanced Setting* sub-menu (Figure 2-66) allows you to configure the maximum number of simultaneous, connected users or limit it to service a maximum of 32 users. When this value is set to *32UE*, fewer users are served and have more capacity than when the value is set to handle the maximum of 96 users. Otherwise, select *96UE* to support the highest possible number of users.

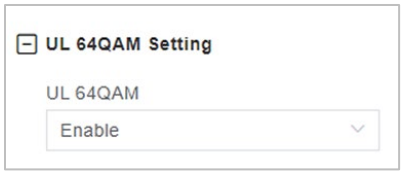
Figure 2-66: Working Mode



1.8.5.7 UL 64QAM Setting

Use the *UL 64QAM Setting* pane in the *LTE Setting > Advanced Setting* sub-menu to disable or enable the UL 64QAM function (Figure 2-67).

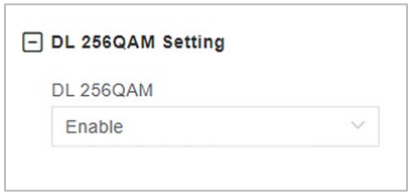
Figure 2-67: UL 64QAM Setting



1.8.5.8 DL 256QAM Setting

Use the *DL 256QAM Setting* pane in the *LTE Setting > Advanced Setting* sub-menu to disable or enable the DL 256QAM function (Figure 2-68).

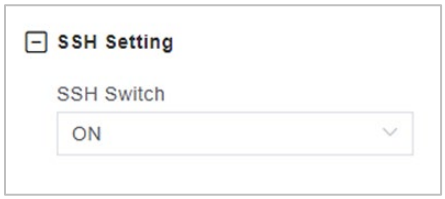
Figure 2-68: DL 256QAM Setting



1.8.5.9 SSH Setting

The Secure Shell (SSH) setting provides a secure, encrypted connection to the eNB from a remote location. Use the *SSH Setting* pane of the *LTE Setting > Advanced Setting* sub-menu to disable (*OFF*) or enable (*ON*) the SSH function (Figure 2-69). If SSH is disabled (*OFF*), you won't be able to SSH into the eNB remotely.

Figure 2-69: SSH Setting



1.8.5.10 Performance Optimization

Use the *Performance Optimization* pane of the *LTE Setting > Advanced Setting* sub-menu to configure performance optimization settings, which are shown in Figure 2-70 and described in Table 2-25.

Figure 2-70: Performance Optimization

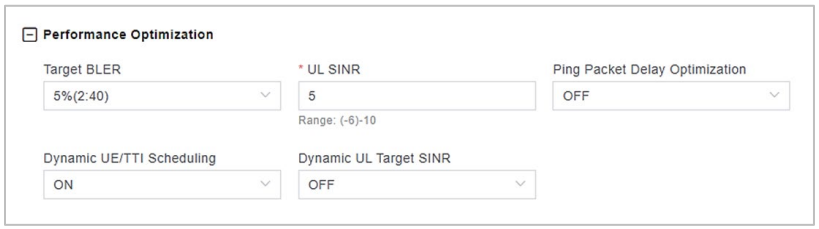


Table 2-25: Performance Optimization Fields

Field Name	Description
Target BLER	Select target block error rate. • 3% (1:33) • 5% (2:40) • 10% (3:30)
UL SINR	Uplink signal-to-interference-plus-noise-ratio. Range is -6 to 10.
Ping Packet Delay Optimization	Enable (*ON*) or disable (*OFF*) the ping packet delay optimization function.
Dynamic UE/TTI Scheduling	Select to enable (*ON*) or disable (*OFF*) the dynamic CPE/TTI scheduling function. TTI stands for Transmission Time Interval.
Dynamic UL Target SINR	Select enable (*ON*) or disable (*OFF).*

1.8.5.11 Signal Trace Realtime Monitor Setting

The *Signal Trace Realtime Monitor Setting* pane of *the LTE Setting > Advanced Setting* sub-menu is used to troubleshoot CPE attachment and handover issues (Figure 2-71). During a signaling trace, RRC protocol and Stream Control Transmission Protocol (SCTP) packets are captured in real time. These packets are then sent to a remote computer running Wireshark or to a Local OMC and are displayed so the data can be analyzed.

The RRC protocol controls the CPE and eNB over-the-air communications, and is especially important in mobility scenarios where a mobile user is handed off from one eNB to another. The SCTP is a transport layer protocol for the S1-MME signaling bearer, and is responsible for the Evolved Packet System (EPS) bearer setup, modification, release, handover procedures, Non-Access Stratum (NAS) signaling transport, and paging procedures.

The fields are described in Table 2-26.

Figure 2-71: Signal Trace Realtime Monitor Setting

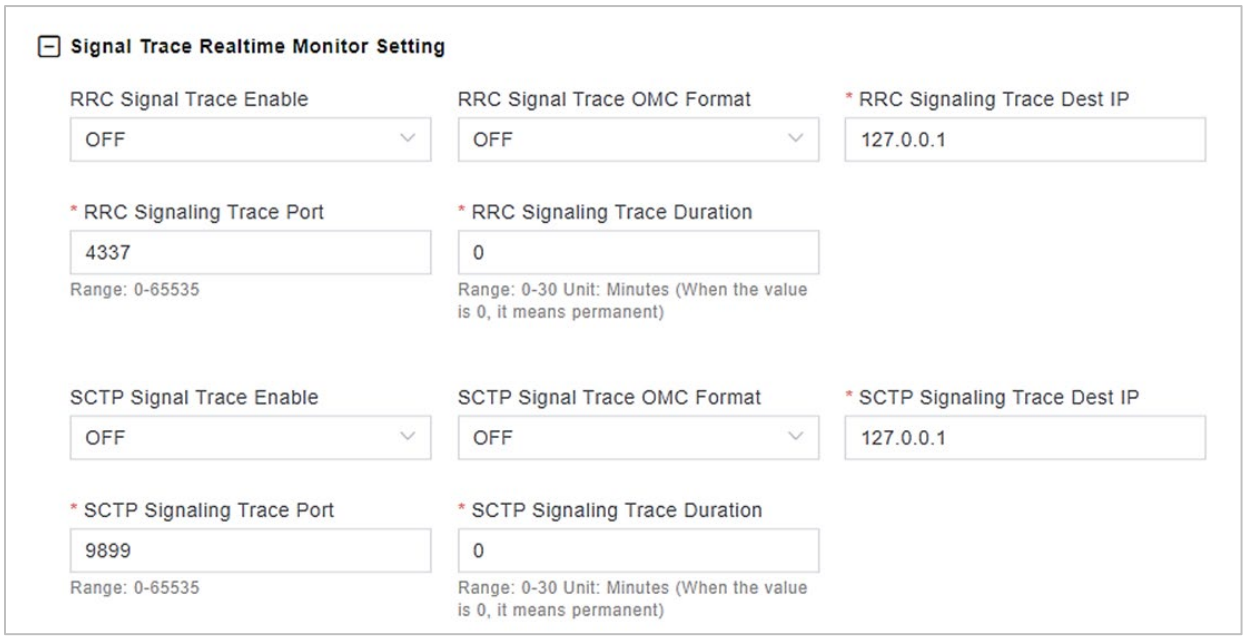


Table 2-26: Signal Trace Realtime Monitor Setting Fields

Field Name	Description
RRC Signal Trace Enable	Enable (*ON*) or disable (*OFF*) the RRC signal trace function.
RRC Signal Trace OMC Format	Enable (*ON*) or disable (*OFF*) sending the RRC signal trace data to the local OMC. If signal trace is exported to the OMC, the parameters need to be configured.
RRC Signaling Trace Dest IP	This is the destination IP address of the computer where RRC signal trace data is sent. The IP address must communicate with the eNB. Default IP is 127.0.0.1 and is configurable.
RRC Signaling Trace Dest Port	This is the port number of the computer where RRC signal trace data is sent. The range is 1 to 65535. The default value is 4337. NOTE: If you are using a MAC computer that holds an existing MAC packet, be sure to use different port number for the RCC packet.
RRC Signaling Trace Duration	The duration of the RRC signal trace. The range is 0 to 30 minutes. If the value is Zero (0), the duration of the RRC signaling trace is continuous.
SCTP Signal Trace Enable	Enable or disable the computer where the SCTP signal trace function is to be performed.
SCTP Signal Trace OMC Format	Enable *(ON)* or disable (*OFF*) sending the SCTP signal trace data to the local OMC. If signal trace is exported to the OMC, the parameters need to be configured.
SCTP Signaling Trace Dest IP	This is the destination IP address of the computer where SCTP signal trace data is sent. The IP address must communicate with the eNB. Default IP is 127.0.0.1 and is configurable.
SCTP Signaling Trace Dest Port	This is the port number of the computer where SCTP signal trace data is sent. The range is 1 to 65535. The default value is 36412.
SCTP Signaling Trace Duration	The duration of the SCTP signal trace range is 0 to 30 minutes. If the value is Zero (0), the duration of the SCTP signaling trace is continuous.

1.8.5.12 Signal Tcpdump File Backup Setting

Use the *Signal Tcpdump File Backup Setting* pane of the *LTE Setting > Advanced Setting* sub-menu to backup the signaling file data (Figure 2-72) The fields are described in Table 2-27.

Figure 2-72: Signal Tcpdump File Backup Setting

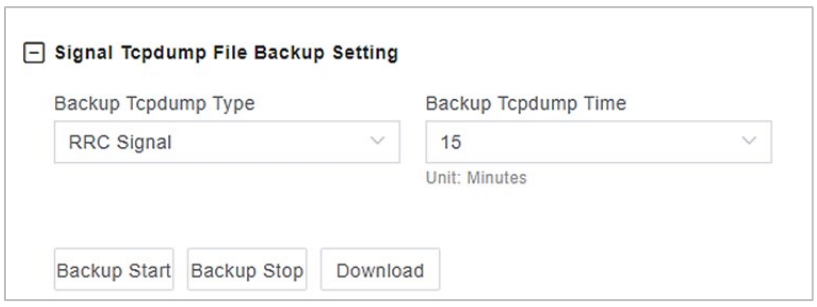


Table 2-27: Signal Tcpdump File Backup Setting Fields

Field Name	Description
Backup Tcpdump Type	Signal Tcpdump type: • RRC • SCTP • RRC and SCTP
Backup Tcpdump Time	Signaling backup time, in minutes. The options are: • 5 • 10 • 15 • 30
Backup Start	Used to start the signal trace backup function.
Backup Stop	Used to stop the signal trace backup function.
Download	Used to download the trace details.

1.8.6 NSA Setting

The Non-Standalone (NSA) setting allows for 4G and 5G interoperability, and can be enabled and configured using the *LTE Setting > NSA Setting* sub-menu. The NSA setting parameters are shown in the *NSA Config* table that displays when the *NSA Config* toggle button is clicked on. To configure the parameters, click on the *Edit* icon under the *Operate* column of the *NSA Config* table (Figure 2-73). The fields are described in Table 2-28.

NOTE: The *LTE Setting > NSA Setting* sub-menu doesn't display if the local gateway function is set to *ON* in the *Network > LGW* sub-menu (*section 2.6.3*).

Figure 2-73: NSA Setting

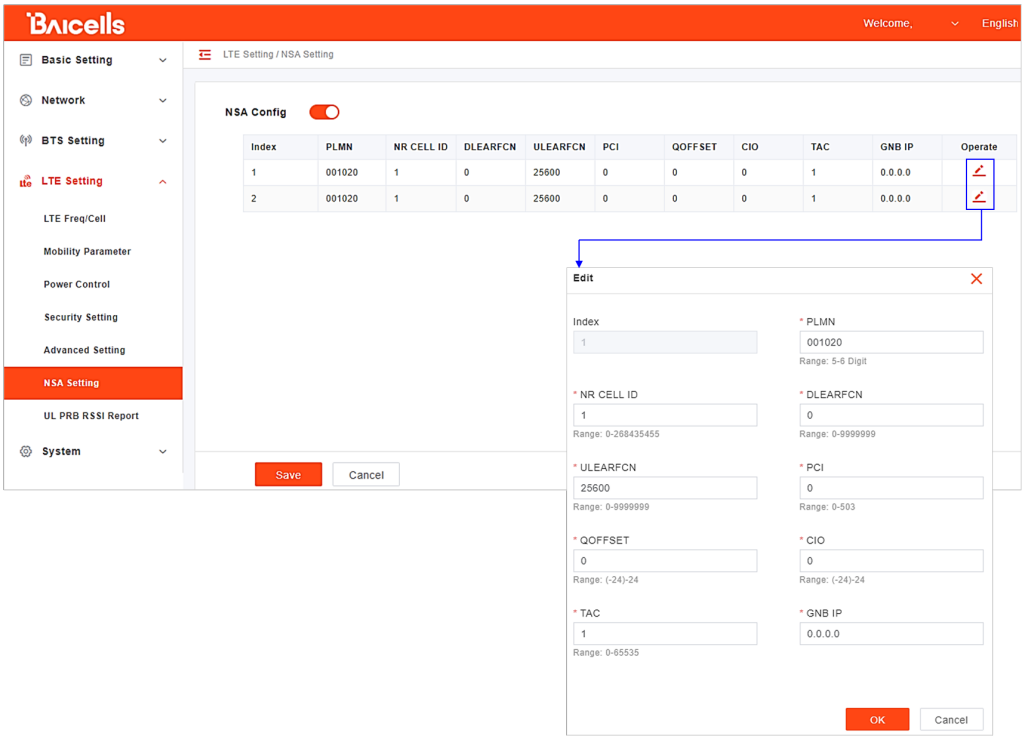


Table 2-28: NSA Setting Fields

Field Name	Description
Index	Configuration index number, which is generated automatically.
PLMN	The five- or six-digit numerical identifier for the operator's PLMN for this cell.
NR CELL ID	The New Radio (NR) eNB cell identification. Range is 0 to 268435455.
DLEARFCN	EARFCN stands for Evolved Universal Mobile Telecommunications System (UMTS) Terrestrial Radio Access (E-UTRA) Absolute Radio Frequency Channel Number. Used to set the absolute radio frequency channel number for the eNB's downlink. Range is 0–9,999,999, but you cannot repeat the EARFCN you've configured in the *Basic Setting > Quick Setting* sub-menu under the *Cell Quick Setting* pane (*section 2.5.2*).
ULEARFCN	Used to set the absolute radio frequency channel number for the eNB's uplink. Range is 0–9,999,999, but you cannot repeat the EARFCN you've configured in the *Basic Setting > Quick Setting* sub-menu under the *Cell Quick Setting* pane (*section 2.5.2*).
PCI	The NR cell's physical cell identifier. Range is 0–503.
QOFFSET	The NR cell's frequency offset. Indicates the difference in signal level between the serving eNB and the NR eNB, as determined by the received signal level at the CPE. If the received signal level is better from a neighboring eNB by at least this amount of difference (in dB), the CPE reselects this cell. Range is -24 to 24 dB. A typical value is 0 dB.
CIO	The NR eNB's cell offset, which is one of the variables used to determine which eNB best serves a given CPE. Range is -24 to 24 dB. A typical value is 0 dB.
TAC	Tracking area code of this neighbor cell. Range is 0–65535.
GNB IP	The IP address for the Next Generation Node B (gNB).

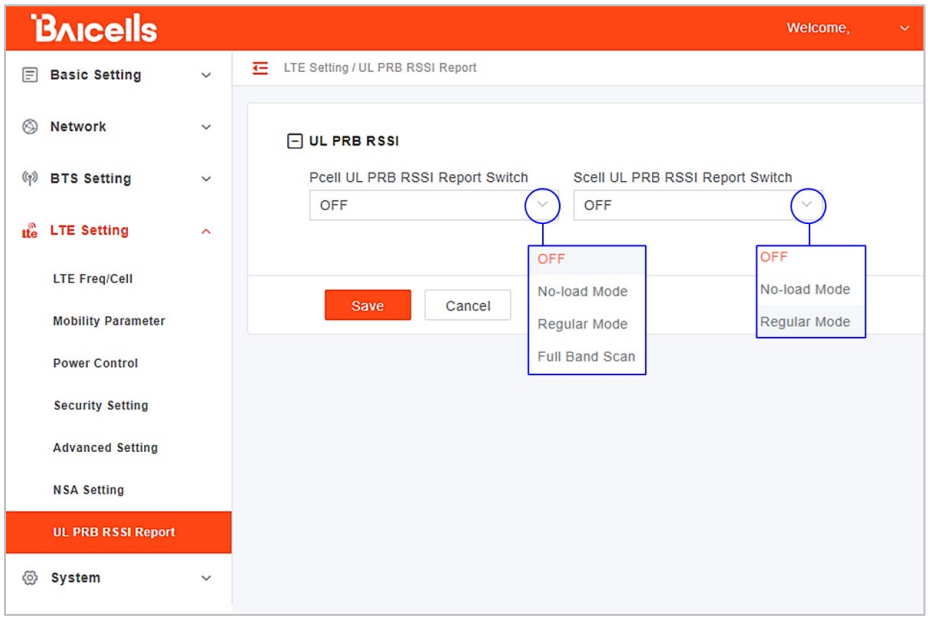
1.8.7 UL PRB RSSI Report

Reference: *Spectrum Analysis User Guide*

The Uplink (UL) Physical Resource Block (PRB) Received Signal Strength Indicator (RSSI) report feature may be used when you think you have an interference issue (Figure 2-74). RSSI measures the total received wideband power, including noise. When you run this report, the eNB looks for CPE subframes not being used (no PRBs assigned and no traffic) and then takes the RSSI measurement.

NOTE: Refer to the *Spectrum Analysis User Guide* for details about how to configure the eNB to enable use of this feature.

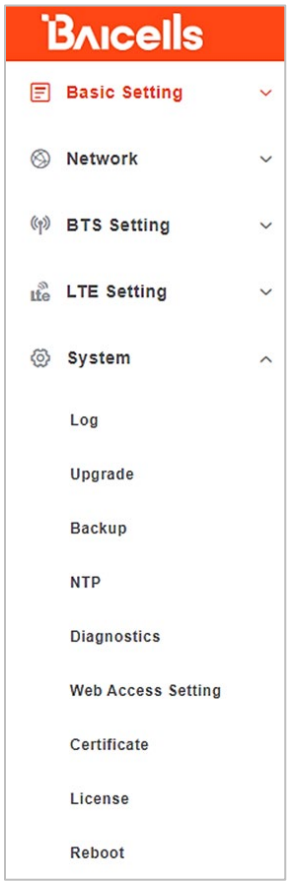
Figure 2-74: UL PRB RSSI Report



1.9 System

The *System* menu (Figure 2-75) is used to access system logs, upgrade firmware, or roll back to the previous version, perform backup activities, configure Network Time Protocol (NTP), set up web access, manage certificates and licenses, and reboot the system. You can also perform diagnostics using this menu.

Figure 2-75: System Menu

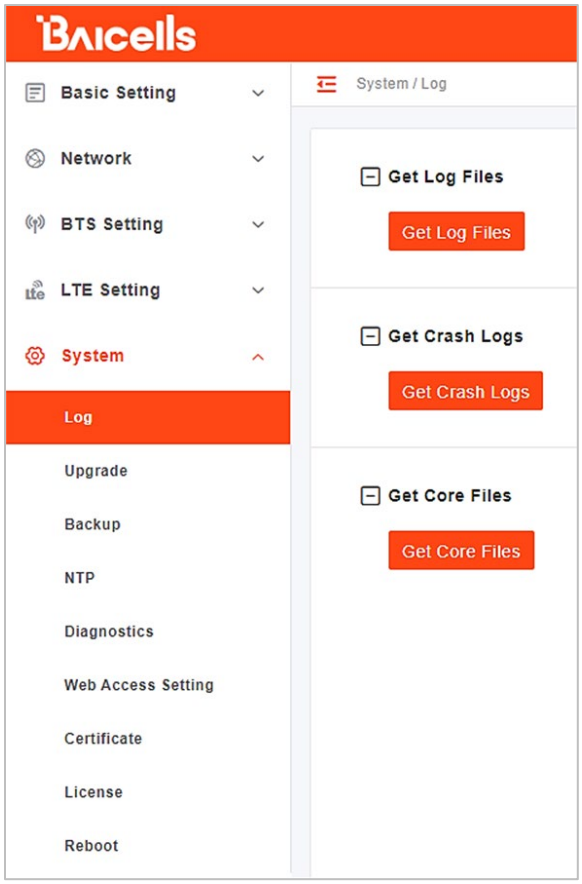


1.9.1 Log

Use the *System > Log* sub-menu (Figure 2-76) to obtain and save backup files to the local computer.

NOTE: The core file may be requested by Baicells support to assist in troubleshooting.

Figure 2-76: Log



1.9.2 Upgrade

Use the *System > Upgrade* sub-menu to upgrade or downgrade (rollback) the eNB software (Figure 2-77).

NOTE 1: Older versions of the eNB GUI may look different. When upgrading from an older version to the latest, the GUI home page and other menus automatically switch over to the new GUI. However, when rolling back from the latest software to a former software version, the home page and other GUI menus won't switch back to the older GUI. In this case you must verify the configuration (e.g., IP address).

NOTE 2: Additional upgrade capabilities, such as upgrading multiple eNBs simultaneously, are available using the OMC. Refer to *CloudCore Configuration and Network Administration Guide*.

Perform the following steps to upgrade firmware:

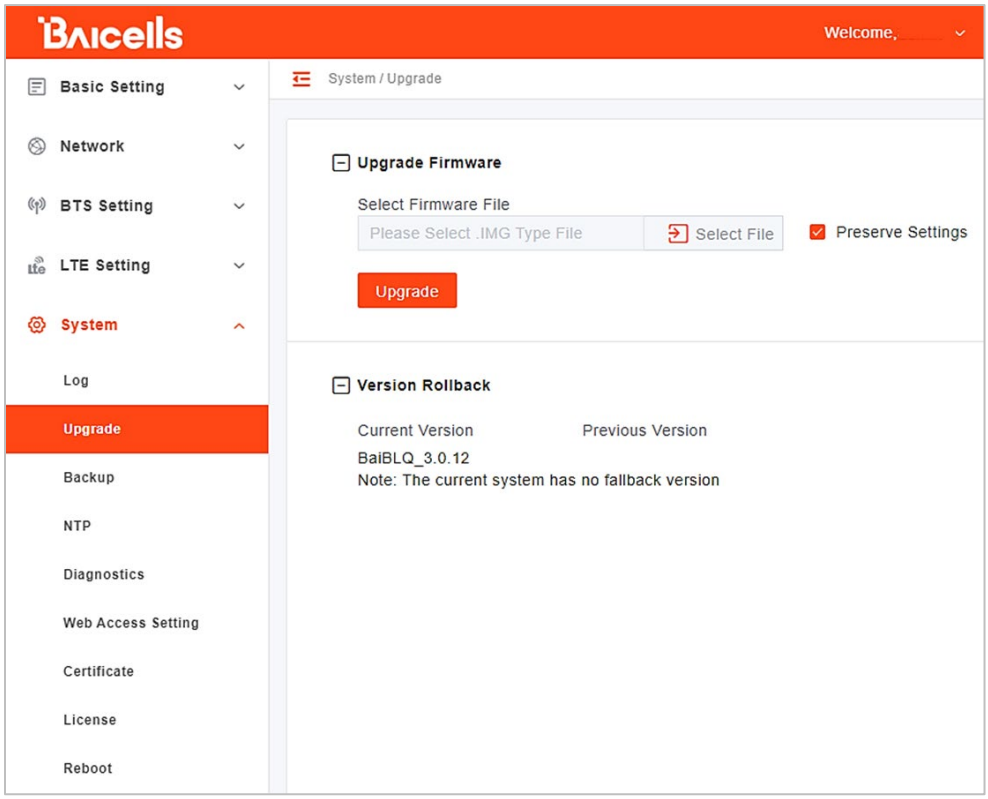
1. Download the most recent firmware file from Baicells.com > Support > *Firmware*, and save on local computer.
2. Go to the *System > Upgrade* sub-menu, and select the checkbox next to *Preserve Settings* if you want to save the current configuration settings.
3. Choose *Select File* in the *Upgrade Firmware* pane, and navigate to the firmware file saved to the local computer.

   NOTE: The file type is *.IMG.

4. Select *Upgrade* in the *Upgrade Firmware* pane.
5. When prompted, select *Proceed*.
6. After the upgrade is completed (about 5 minutes), the eNB performs a reboot.

Caution: The reboot action disrupts the eNB service.

Figure 2-77: Upgrade



Perform the following steps to roll back to the previous software version (Figure 2-78):

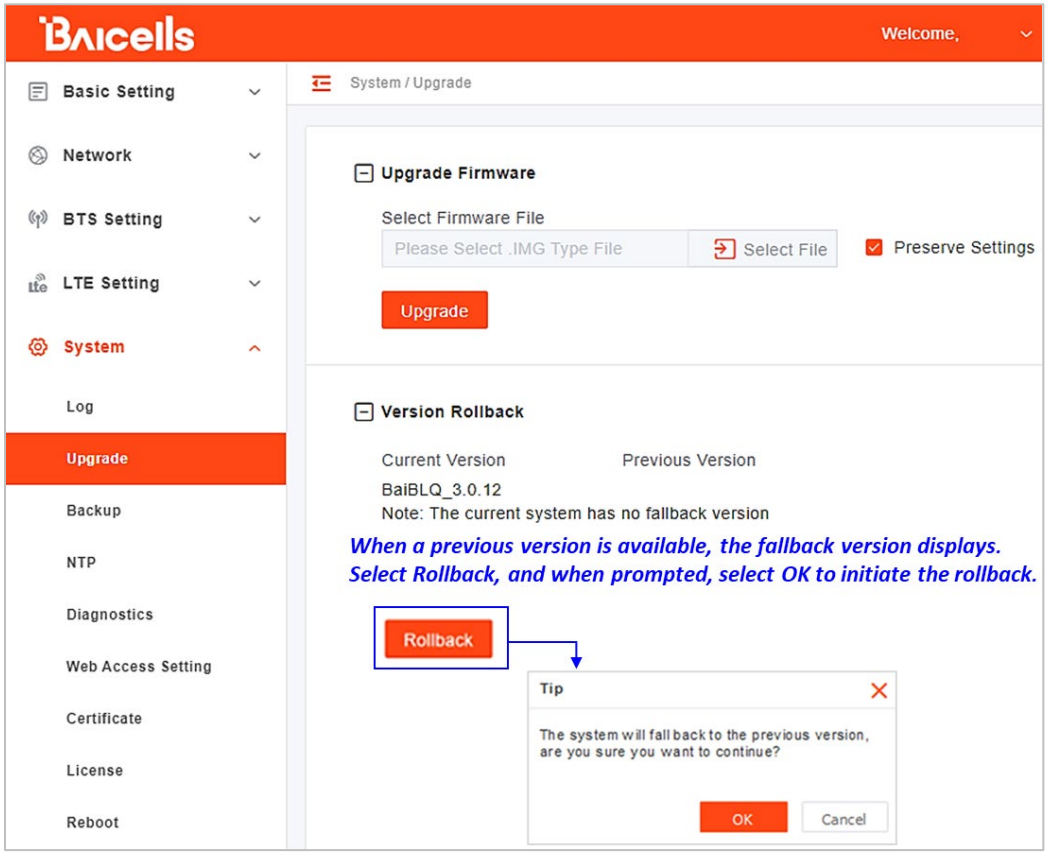
NOTE 1: You can only roll back to the last previous software version.

NOTE 2: Only one roll back operation is permitted for each upgrade.

NOTE 3: After the roll back is completed and the eNB performs a reboot, you can view the change in the software version listed in the *Basic Setting > Basic Info* sub-menu (*section 2.5.1*).

1. Go to the *System > Upgrade* sub-menu.
2. View *Current Version* and *Previous Version* information shown in the *Version Rollback* pane.
3. Select *Rollback* in the *Version Rollback* pane.
4. Select *OK* when prompted if you want to continue with the rollback procedure.
5. After the rollback is completed (about 5 minutes), the eNB performs a reboot.

Figure 2-78: Version Rollback

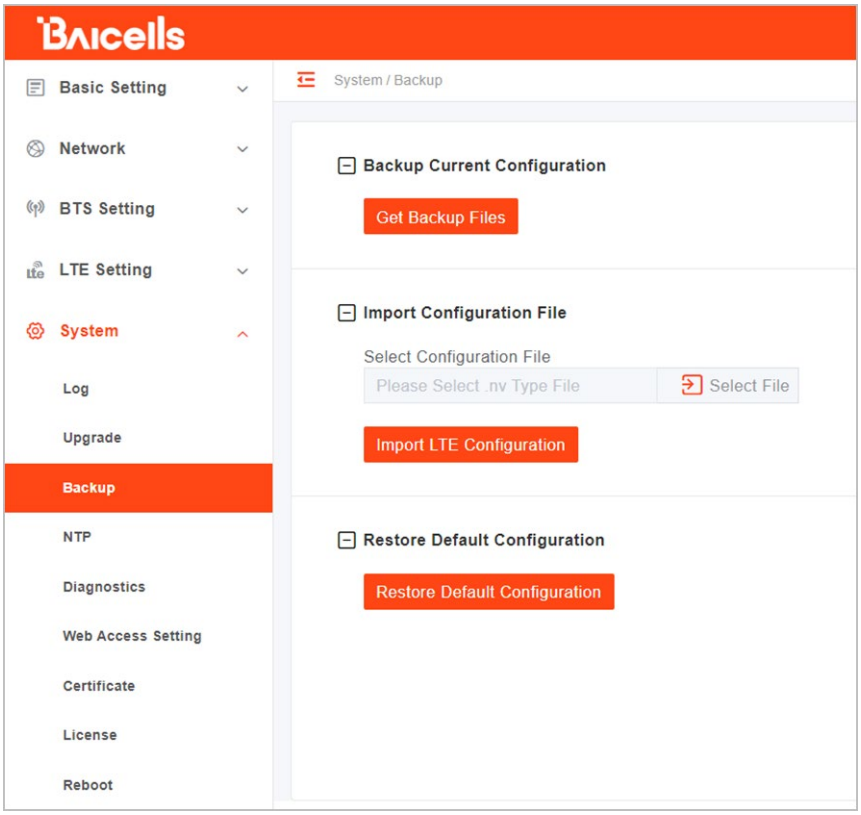


Caution: The reboot action disrupts the eNB service.

1.9.3 Backup

The *System > Backup* sub-menu is used to back up the current configuration, to import configuration files (e.g., to create a new eNB using the configuration from an existing eNB); or to restore all of the default configuration settings for the eNB (Figure 2-79).

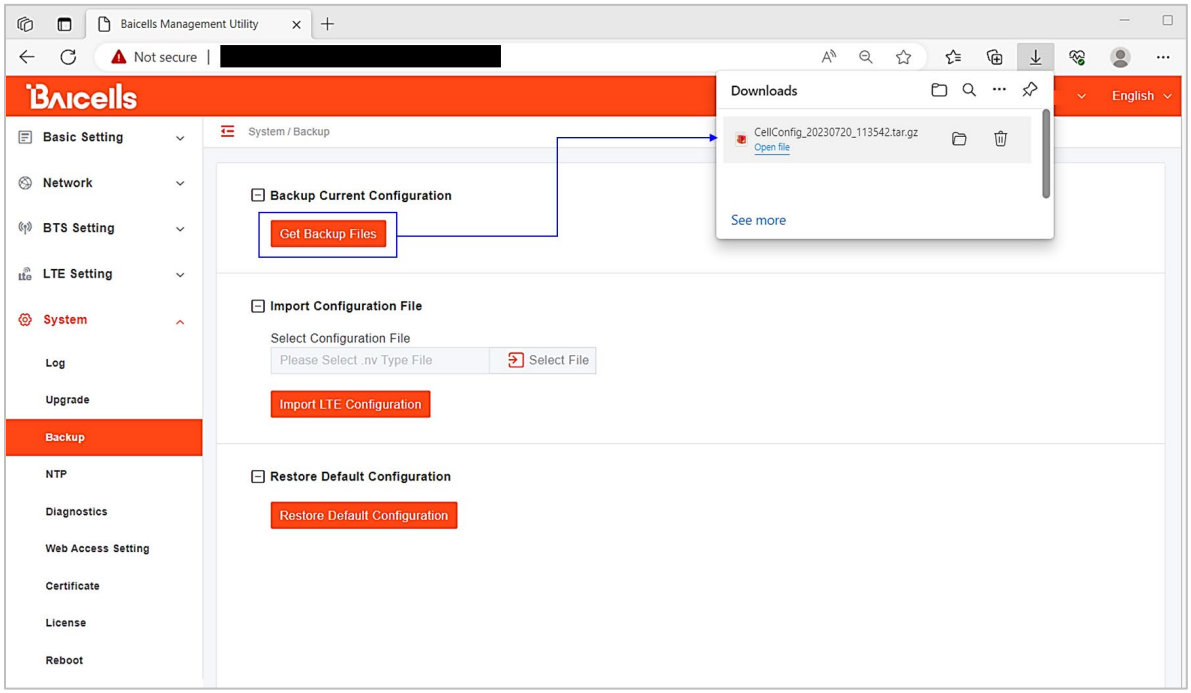
Figure 2-79: Backup, Import, and Restore



Perform the following steps to initiate a backup (Figure 2-80):

1. Go to the *System > Backup* sub-menu.
2. Select *Get Backup Files* from the *Backup Current Configuration* pane.
3. The system automatically downloads the tar.gz file.
4. Open the file and save it to the local computer.

Figure 2-80: Backup Current Configuration



Perform the following steps to import a configuration file:

1. Ensure the configuration file you want to import is saved to your local computer.
2. Go to the *System > Backup* sub-menu.
3. Choose *Select File* in the *Import Configuration File* pane, and navigate to the target file you want to import.
4. Select *Import LTE Configuration* in the *Import Configuration File* pane.

Perform the following steps to restore the default configuration:

1. Go to the *System > Backup* sub-menu.
2. Select *Restore Default Configuration* in the *Restore Default Configuration* pane.
3. The eNB performs a reboot when you restore the default configuration.

Caution: The *Restore Default Configuration* action disrupts the eNB service.

1.9.4 NTP

Using the *System > NTP* sub-menu, the operator can configure more than one NTP server to provide synchronized time-of-day to the eNB (Figure 2-81). If the NTP is used by the eNB as an external clock source, up to three NTP servers are supported, where one server acts as the master and the other two servers provide backup. The parameters are described in Table 2-29.

NOTE: The *Port*, *Server 1*, *Server 2*, and *Server 3* fields display when the *NTP Servers* is toggled on.

Figure 2-81: NTP

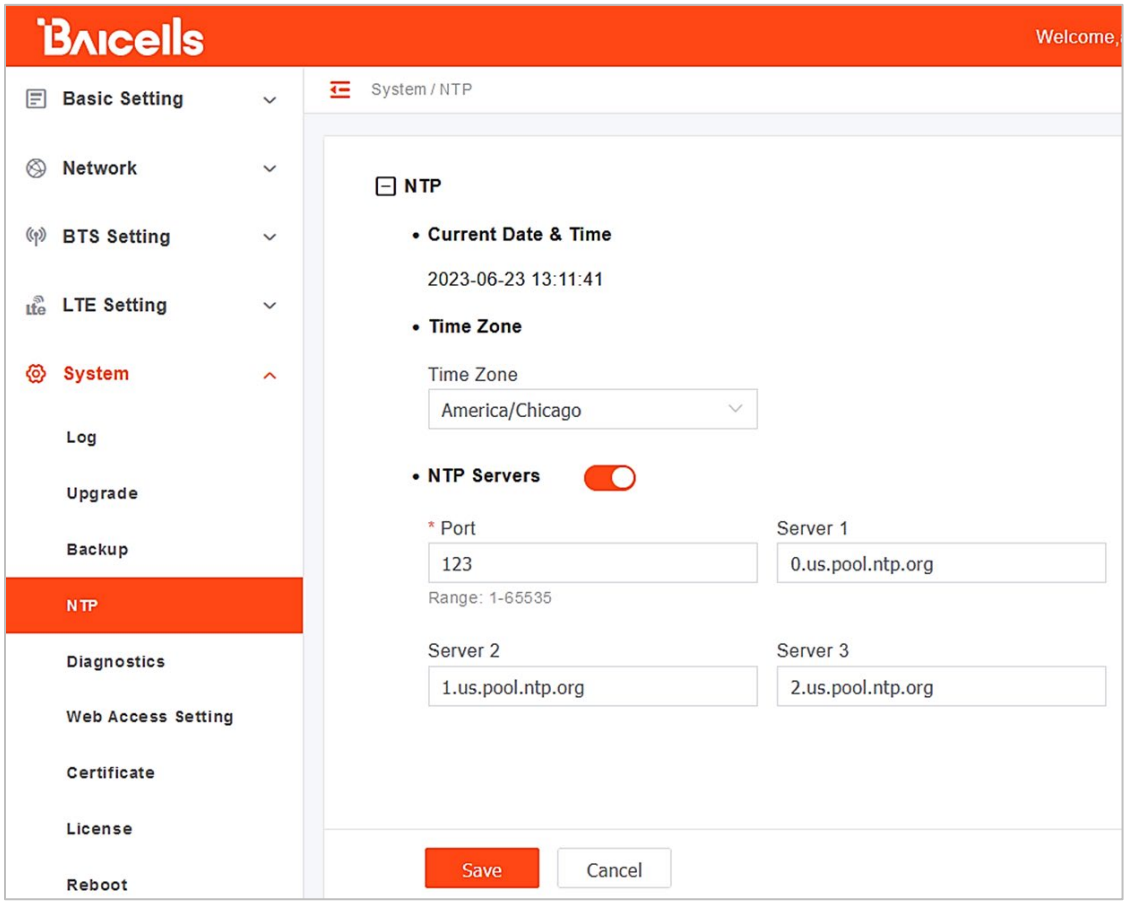


Table 2-29: NTP Fields

Field Name	Description
Current Date & Time	Displays the current date and time that the eNB is using: • Date format is yyyy/mm/dd. • Time format is military time.
Time Zone	The time zone for where the eNB is located. Default is *America/Chicago* servers using Central Standard Time (CST).
Port	Primary NTP server port number.
Server 1	Primary NTP server IP address, which must be configured identically on both ends of the connection.
Server 2	Optional: Slave NTP server IP address, which must be configured identically on both ends of the connection.
Server 3	Optional: Slave NTP server IP address, which must be configured identically on both ends of the connection.

1.9.5 Diagnostics

Use the *System > Diagnostics* sub-menu to perform diagnostic tests from the eNB. There are three test options:

- Ping (Figure 2-82): Ping command is used to check whether the network connection from the eNB to the destination IP address is normal.
- TraceRoute (Figure 2-83): TraceRoute command is used to detect the routing information between the eNB and the destination IP address.
- Iperf3 (Figure 2-84 and Figure 2-85): Iperf3 command is used to check the network performance.

Each field is described in Table 2-30. After entering the settings in the *Diagnostics* pane, select *Implement* to run the test. Details of the test results are reported in the *Result* pane.

Figure 2-82: Diagnostics (Ping)

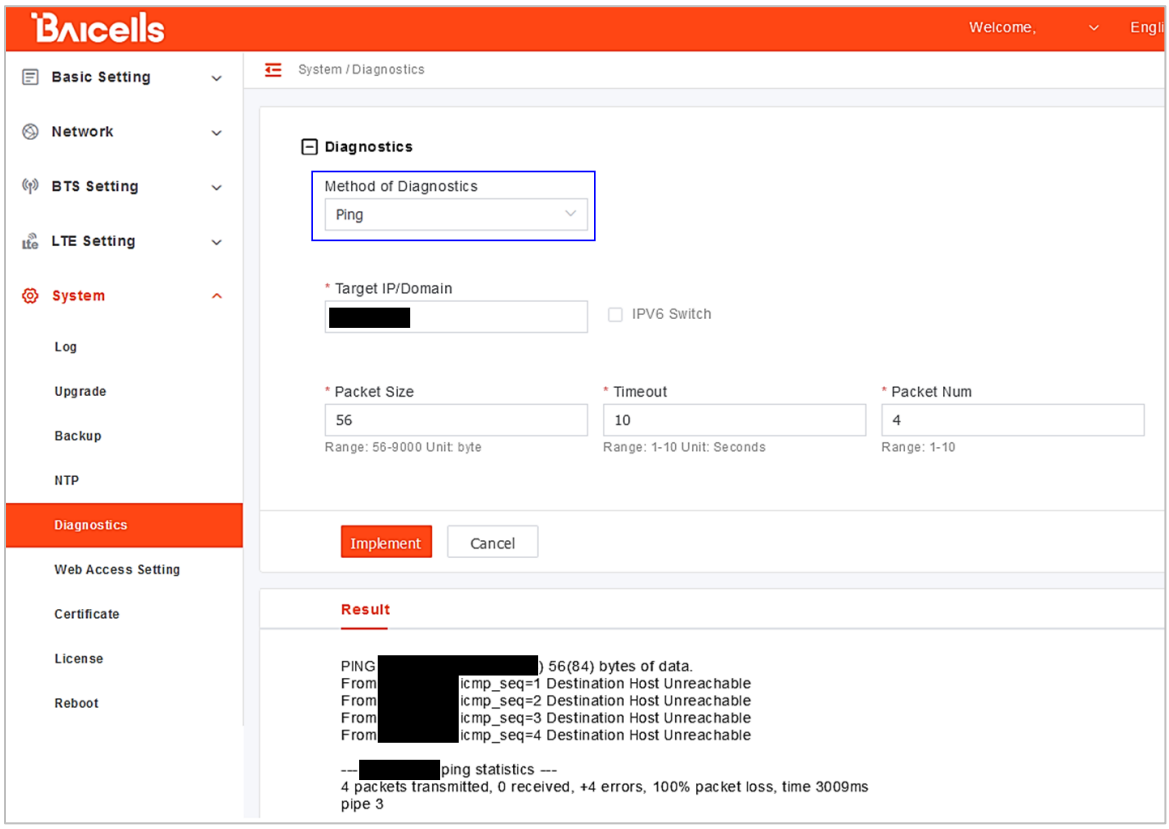


Figure 2-83: Diagnostics (TraceRoute)

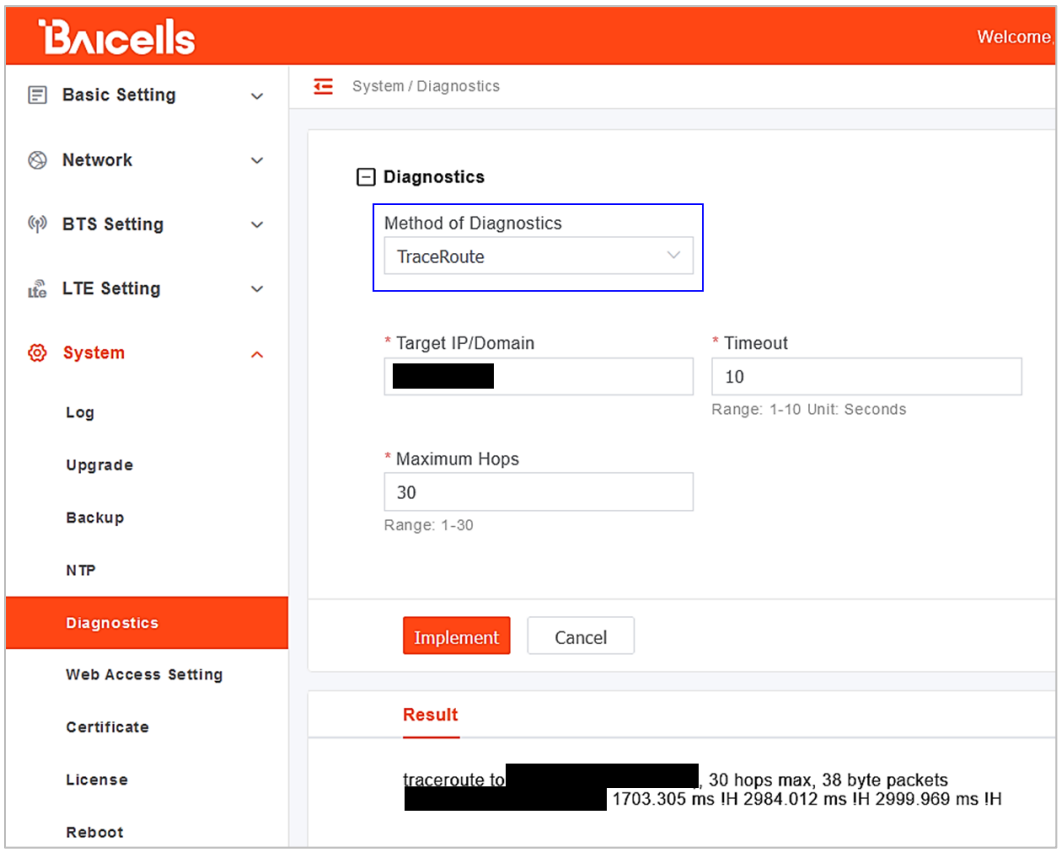


Figure 2-84: Diagnostics (Iperf3, Server Mode)

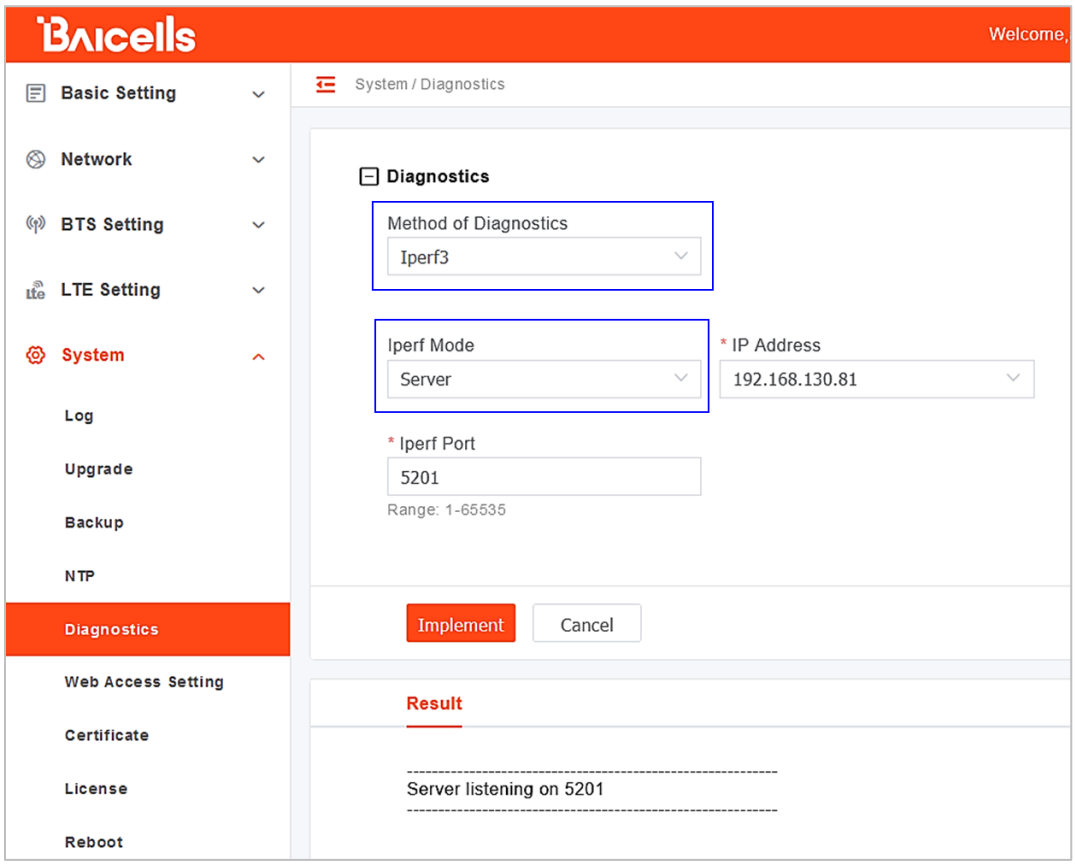


Figure 2-85: Diagnostics (Iperf3, Client Mode)

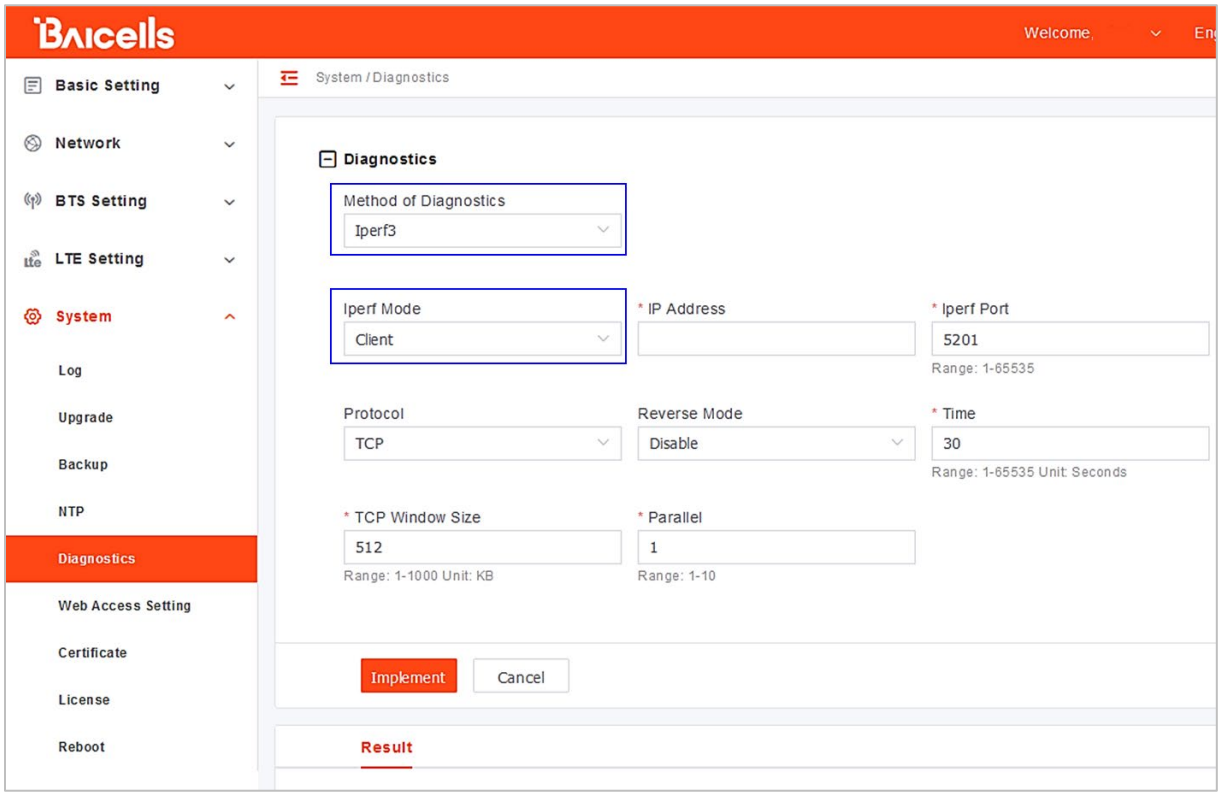


Table 2-30: Diagnostics Fields

Field Name	Description
Method of Diagnostics	Ping, TraceRoute, Iperf3.
Ping	
Target IP/Domain	The IP address or domain name of the destination device.
Packet Size	The size of the data packet to be sent. Range is 56–9000 bytes. Default is 56 bytes.
Timeout	The timeout period when the test ends. Range is 1–10 seconds. Default is 10 seconds.
Packet Num	The number of packets to be sent. Range is 1–10.
TraceRoute	
Target IP/Domain	The IP address or domain name of the destination device.
Timeout	The timeout period when the test ends. Range is 1–10 seconds. Default is 10 seconds.
Maximum Hops	The maximum number of hops (network nodes/routers) the packet will have to pass before arriving at its destination. Range is 1–30. Default is 30.
Iperf3	
Iperf Mode	Iperf Mode: *Server* or *Client.*
Server Mode	
IP Address	IP address of the Iperf being used.
Iperf Port	Port number for the Iperf being used.

Field Name	Description
Client Mode (with Transmission Control Protocol (TCP) selected)	
IP Address	IP address of the Iperf being used.
Iperf Port	Port number for the Iperf being used. Default is 5201.
Protocol*	TCP
Reverse Mode	Disable or Enable. Default is Disable.
Time	Range is 1–65535 seconds. Default is 30 seconds.
TCP Window Size	Range is 1–1000 KB. Default is 512 KB.
Parallel	Range is 1–10. Default is 1.
Client Mode (with User Datagram Protocol (UDP) selected)	
IP Address	IP address of the Iperf being used.
Iperf Port	Port number for the Iperf being used. Default is 5201.
Protocol*	UDP
Reverse Mode	Disable or Enable. Default is Disable.
Time	Range is 1–65535 seconds. Default is 30 seconds.
Socket Buffer Size	Range is 700–1600 KB. Default is 1470 KB.
Bandwidth	Range is 1–1000 MB. Default is 20 MB.

*NOTE: The default protocol for Iperf3 is *TCP*. If you select *UDP* as the protocol to be used, both the client and the server must be in UDP mode to successfully perform the tests.

You can also perform an iperf3 diagnostic test by using Secure Shell Protocol (SSH) to log in to the eNB and execute the command “iperf”. The iperf3 tests that can be performed are:

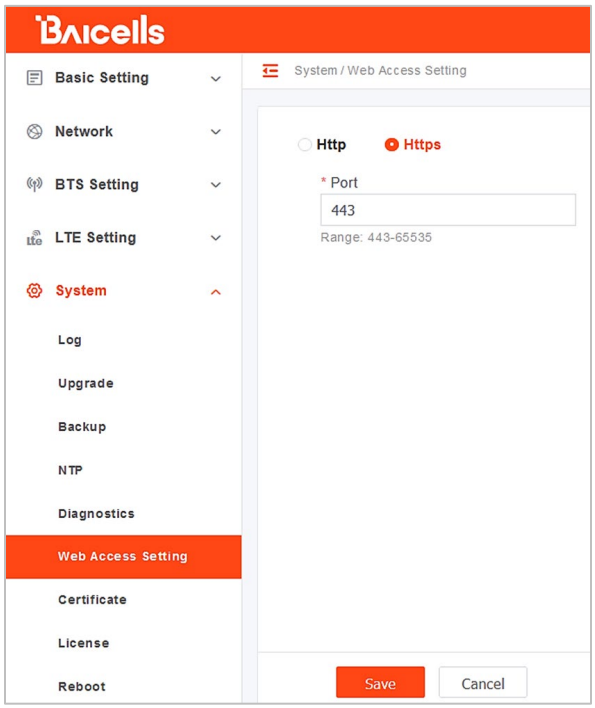
- CPE test (server mode)
- CPE test (client mode using Transmission Control Protocol [TCP])
- CPE test (client mode using User Datagram Protocol [UDP])

NOTE: See *section 2.8.5.9* for more information about how to enable SSH using the SSH Setting parameter.

1.9.6 Web Access Setting

The *System > Web Access Setting* sub-menu is used to change the port number for the eNB (Figure 2-86), which is the port number used for LMT login. The default HTTPS (Web) port for the eNB is port 443, but the port number can be changed if there is any conflict in the network.

Figure 2-86: Web Access Setting



To change port numbers:

1. Go to the *System > Web Access Setting* sub-menu.
2. Click on the *Http* or *Https* radio button to select the Web hypertext transfer protocol you want to use.
3. Enter a new port number in the *Port* field. The range for *Https* is 443–65535.
   The range for *Http* is 80 or 20000–21000. In this example, *Https* and *445* are used.
4. Select *Save*. The eNB performs a reboot, which usually takes about five minutes.
5. To access the GUI using the new port number, open a Web browser and enter the IP address with the new port number, e.g., *https://192.168.100.101:445*.

1.9.7 Certificate

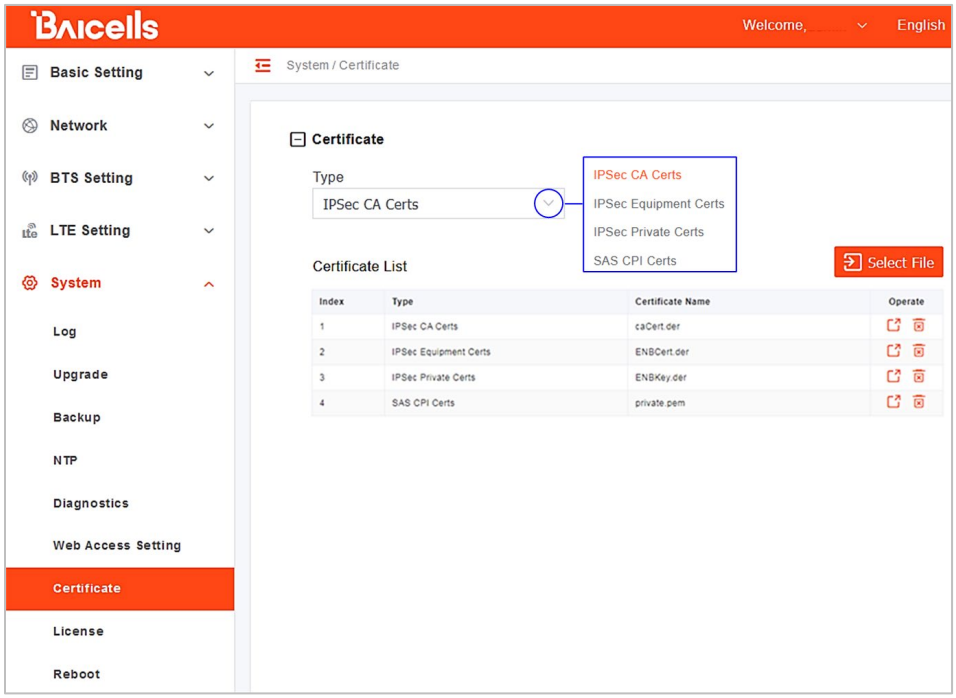
The *System > Certificate* sub-menu provides a way to store important files unique to the eNB, such as regulatory authorization files, HaloB or other licensed feature key files, and the SAS CPI certificate (Figure 2-87).

Use the drop-down menu in the *Certificate* pane to select different types of IPSec Certificates: *IPSec CA Certs*, *IPSec Equipment Certs*, and *IPSec Private Certs*.

NOTE: For eNBs that support CBRS and SAS, you must upload the SAS CPI certificate before you can register the CBSD with the SAS vendor. For more information, including the two types of upload files that are supported, see the *SAS Deployment User Guide*.

To upload any of the files, simply click on the *Select File* button in the *Certificate* pane and navigate to the file to be uploaded. Once you highlight the file, select *Open* and it is added to the *Certificate List* table. Then, click on the *Export* icon in the *Operate* column of the *Certificate List* table to export the certificate file to the local computer.

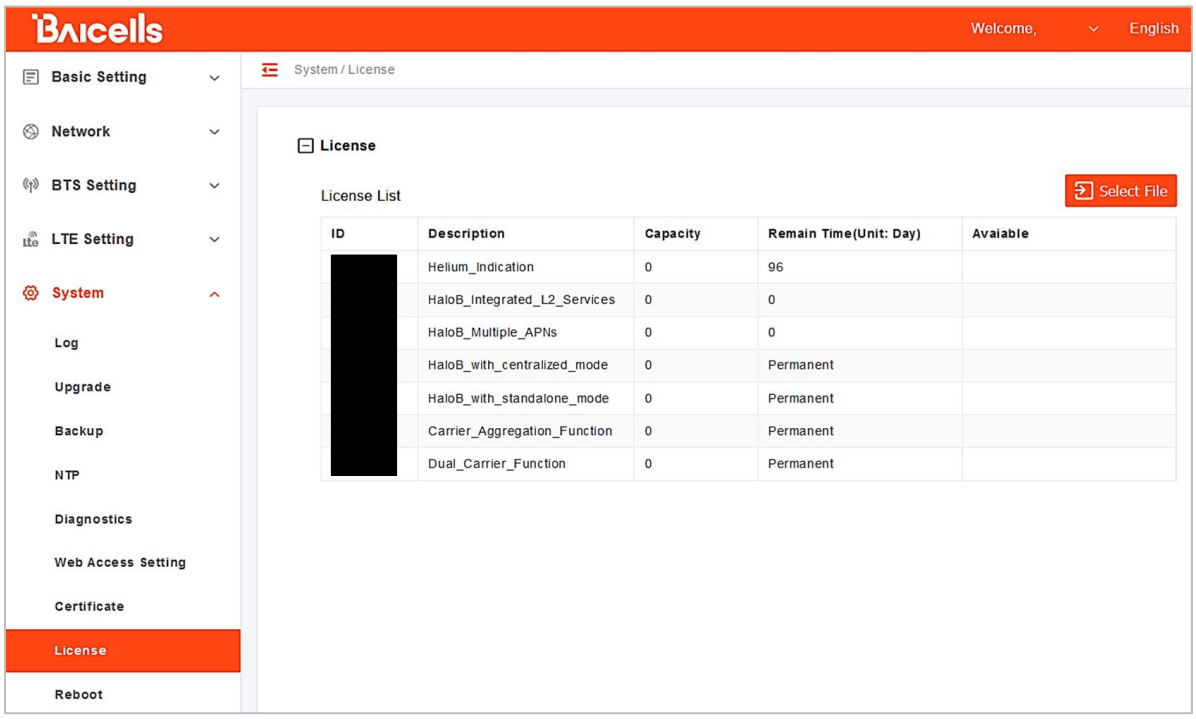
Figure 2-87: Certificate



1.9.8 License

The *System > License* sub-menu can be used to import license files for optional features such as HaloB or regulatory certificates of authorization to operate (Figure 2-88). When imported, the files are stored in the eNB memory and shown in the *License List* area of the *License* pane. The *Remain Time (Unit: Day)* column in the *License List* table shows whether the license is permanent or how many days the license remains active if it is a temporary one.

Figure 2-88: License



1.9.9 Reboot

Caution: The reboot action disrupts the eNB service.

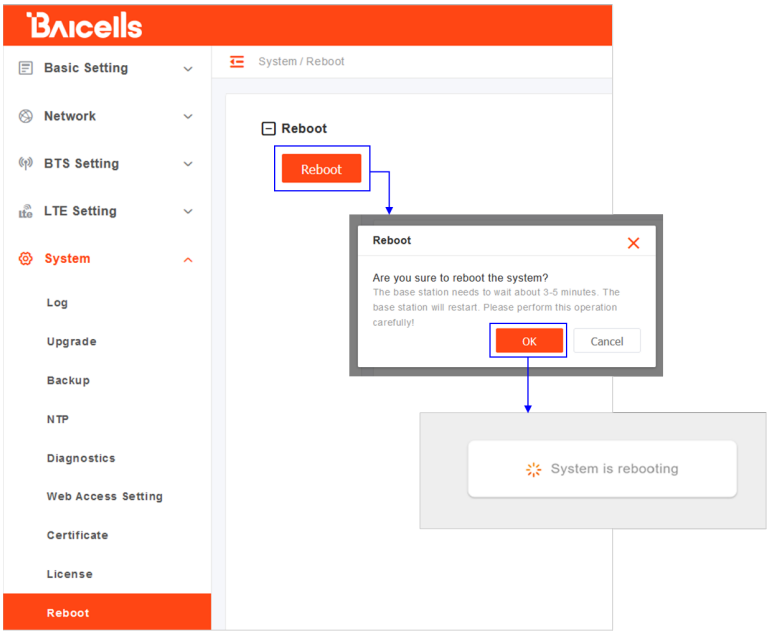
NOTE 1: When you need to reboot the eNB, Baicells recommends that you collect logs on the eNB before you reboot it. That data may be needed for troubleshooting.

NOTE 2: In a lab test environment, you can disable *GPS Sync* to reduce the reboot time.

There are two ways to reboot the eNB:

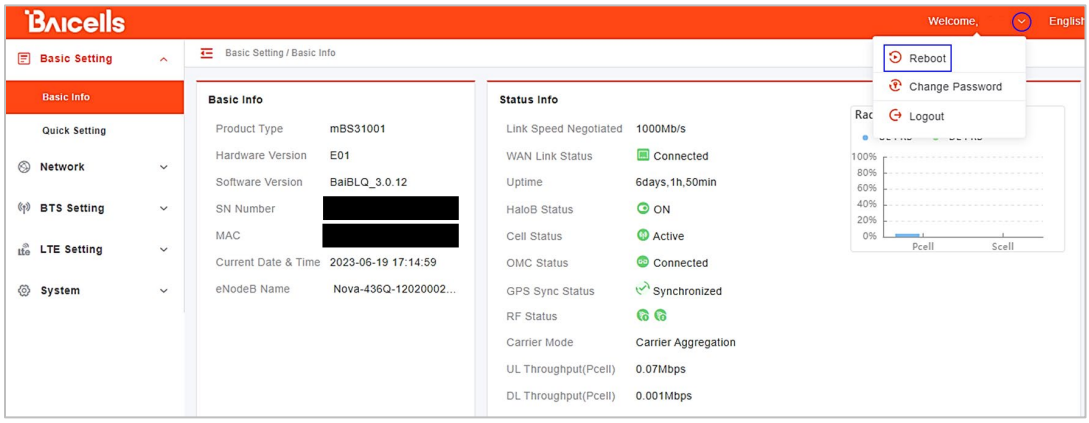
A. Go to the *System > Reboot* sub-menu (Figure 2-89).
   i. Click on the *Reboot* button.
   ii. Select *OK* when prompted to initiate the reboot.

Figure 2-89: Reboot using *System > Reboot* Sub-Menu



B. Go to the top right corner of the dashboard (Figure 2-90).
   i. Open the drop-down menu.
   ii. Select *Reboot* and then select *OK* when prompted to initiate the reboot.

Figure 2-90: Reboot using Dashboard Drop-Down Menu



1.10 Real-World LTE-to-LTE Handoff Configuration Example

Following is an example of the LTE mobility-related parameters, based on eNB software version BaiBLQ_3.0, to illustrate how the system performs based on the configuration settings.

Using the *LTE Setting > LTE Freq/Cell* sub-menu, Figure 2-91 shows how the LTE *Cell Neigh Frequency Table* settings are configured in this example, and Figure 2-92 shows the settings for *Cell Neigh Cell Table*.

Figure 2-91: Example of Cell Neigh Frequency Table Settings

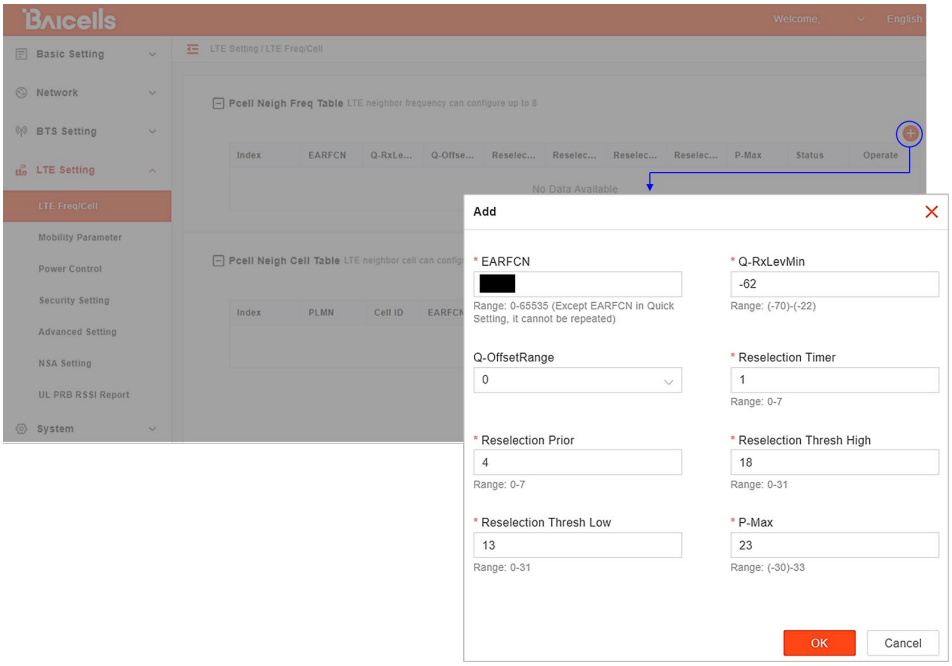
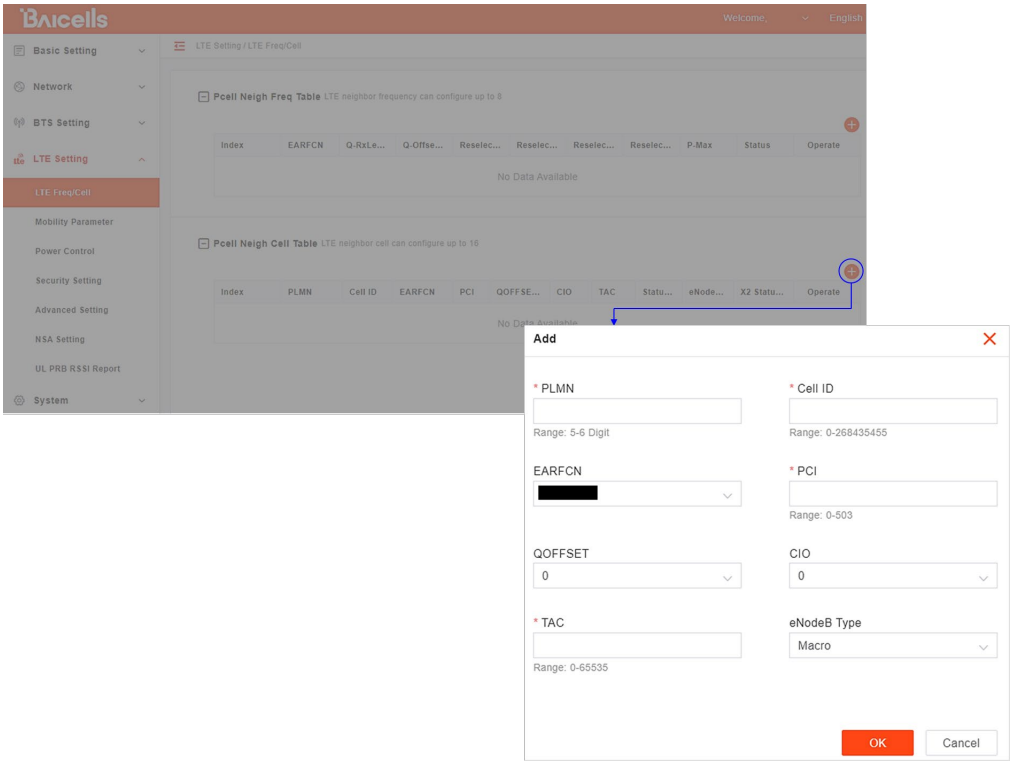


Figure 2-92: Example of Cell Neigh Cell Table Settings



Explanation of the event thresholds: The serving eNB starts the A2 and A3 event threshold measurements. If the A3 event threshold is met by a neighbor intra-frequency cell, the CPE session is handed off to that target eNB. If the A2 event threshold is met, it stops the A2 measurement and triggers the A1 and A5 measurements. Then, if the A1 event threshold is met, it stops the A1/A5 measurements and starts the A2 evaluation again. Assuming the A5 measurement indicates the neighbor inter-frequency cell is better than the serving cell, the serving eNB hands off the session to the neighbor eNB.

Example: In the *A1 Event Threshold* pane of the *LTE Setting > Mobility Parameter* sub-menu, assume the starting measurement for *LTE A1 RSRP Threshold* is set to 45 (Figure 2-93). If the CPE measures RSRP > -95 dBm, the CPE reports the A1 event, and the network stops the A1 and A5 event measurements and starts the A2 event measurement.

Figure 2-93: A1 Event Threshold

In the *A2 Event Threshold* pane of the *LTE Setting > Mobility Parameter* sub-menu, assume the *LTE A2 RSRP Threshold* value is set to 40 (Figure 2-94). If the CPE measures RSRP < -100 dBm, the CPE reports the A2 event, and the network starts the A1 and A5 event measurements.

Figure 2-94: A2 Event Threshold

In the *A3 Event Threshold* pane of the *LTE Setting > Mobility Parameter* sub-menu, assume the *Intra-Freq Handover A3 Offset* value is set to 10 (Figure 2-95). If the CPE reports an A3 event (offset > 10*0.5 = 5 dB) in the *ANR Parameters* pane of the *LTE Setting > Mobility Parameter* sub-menu (Figure 2-96), the eNB may command the CPE to hand off to the target intra-frequency cell.

Figure 2-95: A3 Event Threshold

Figure 2-96: A3 Event Threshold (ANR A3 Offset)

In the *A5 Event Threshold* pane of the *LTE Setting > Mobility Parameter* sub-menu, assume the *Intra-Freq/Inter-Freq Handover A5 RSRP Threshold1* value is set to 40 and *Intra-Freq/Inter-Freq Handover A5 RSRP Threshold2* value is set to 45 (Figure 2-97). If the CPE reports an A5 event (RSRP of the serving cell < -100 dBm, and the RSRP of the neighbor cell is > -95 dBm), the eNB may command the CPE to hand off to the target inter-frequency cell.

Figure 2-97: A5 Event Threshold (Intra-Freq/Inter-Freq Handover A5 RSRP Threshold1 and Threshold2)

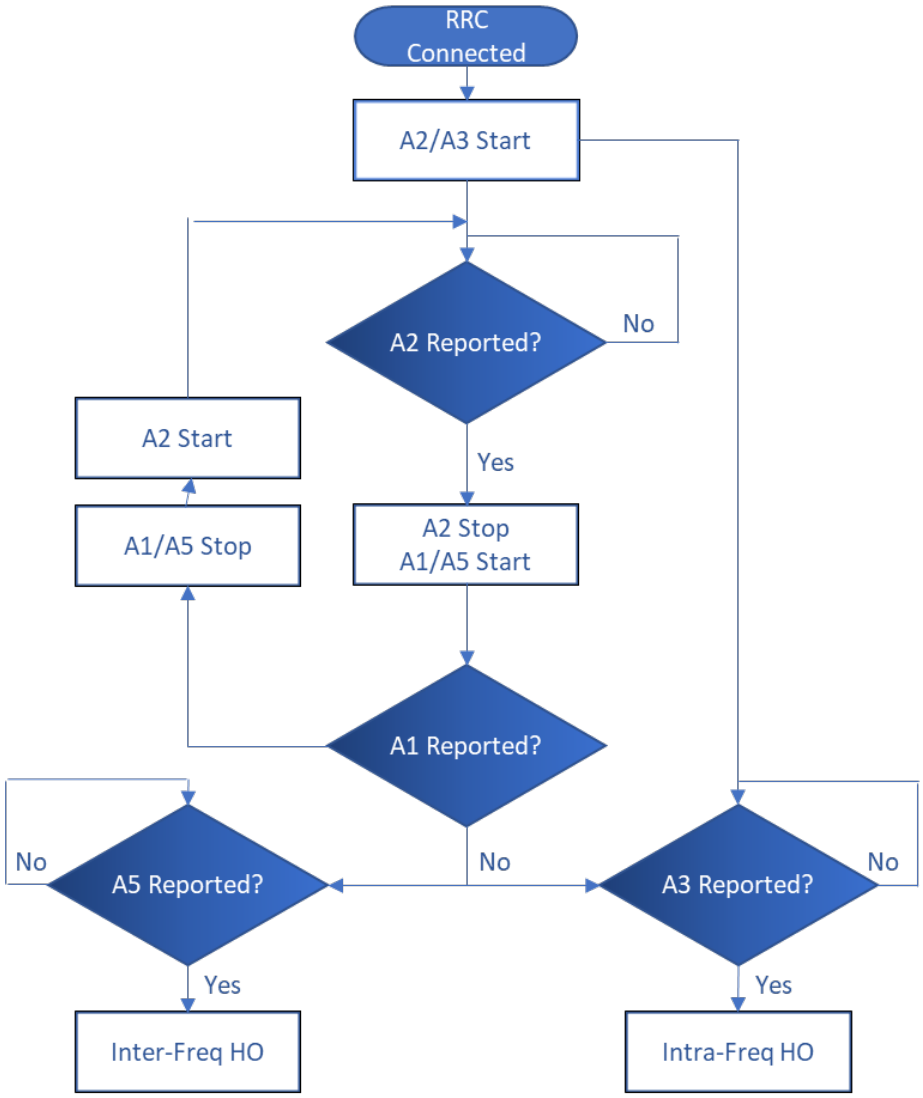
Assume that X2 is enabled in the *X2 Setting* pane of the *LTE Setting > Mobility Parameter* sub-menu (Figure 2-98). To ensure X2 handover is successful, the MME must support eNB configuration transfer and MME configuration transfer S1 message handling.

Figure 2-98: X2 Setting

With any changes to these configuration parameters, perform a reboot the eNB for the new configuration to take effect.

The chart in Figure 2-99 shows the flow of these handoff event thresholds.

Figure 2-99: Flowchart of Handoff Event Thresholds



Event A1: The serving cell becomes better than the absolute threshold.
Event A2: The serving cell becomes worse than the absolute threshold.
Event A3: The neighbor cell becomes "x" amount of offset better than the serving cell.
Event A5: The serving cell becomes worse than the absolute threshold 1 AND the neighbor cell becomes better than another absolute threshold 2.