Dual Carrier Configuration

Quick Guide

May 2018

Version 1.3

About This Document

This document is intended for personnel responsible for configuring dual carrier operation on a Baicells eNodeB (eNB) capable of supporting two carriers. In dual carrier, also referred to as split sector, mode each carrier is treated as an individual cell. The document assumes the eNB is installed and ready to be configured, per the eNB Installation Guide, and that the user is familiar with eNB configuration in general.

This quick guide pertains only to the setting differences specific to dual carrier configuration. This version of the document is based on dual carrier software version BaiBS_RTD_1.0.4, which is built on B110SPC009 and supports 96 users per carrier.

Please refer to the *Baicells Configuration & Network Administration Guide* for the full complement of configuration settings, including those found in the eNB GUI and the OMC application.

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Revision Record

Date	Version	Description	SMEs/Contributors	Author/Editor
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Related Documents

Other Baicells technical documents may be found on the Baicells support website.

UE – Gen 1	Atom 5dBi Indoor CPE User Manual
	Atom 11dBi Outdoor CPE User Manual
	Atom 19.5dBi Outdoor CPE User Manual
UE – Gen 2	Atom ID04/06-6.5 User Manual
	Atom OD04/06-14/19.5 User Manual
eNB – Gen 1	Nova 1W Base Station Installation Guide
	Nova 1W Quick Start Guide
	Nova 10W Base Station Installation Guide
	Nova 10W Quick Start Guide
eNB – Gen 2	Nova-227 Outdoor 2x250mW TDD eNB Installation Guide
	Nova-227 Quick Start Guide
	Nova-233 Outdoor 2x1WG2 FDD-TDD eNB Installation Guide
	Nova-233 Quick Start Guide
	Nova-243 Outdoor 2x10WG2 FDD-TDD eNB Installation Guide
	Nova-243 Quick Start Guide
	Nova-436 Outdoor 4x1W CCA TDD eNB Installation Guide
	Nova-436 Quick Start Guide
	Nova-446 Outdoor 4x10W FDD eNB Installation Guide (forthcoming)
	Nova-446 Quick Start Guide (forthcoming)
	elfcell-220 Indoor 2x50mW FDD eNB Installation Guide (forthcoming)
	elfcell-220 Quick Start Guide (forthcoming)
	NeutralCell Indoor Multi FDD-TDD Small Cell Installation Guide (forthcoming)
	NeutralCell Quick Start Guide (forthcoming)
	Neutrino-224 Indoor 2x125mW FDD-TDD eNB Installation Guide (forthcoming)
	Neutrino-224 Quick Start Guide (forthcoming)
	SolarCell Outdoor Solution Installation Guide (forthcoming)
	SolarCell Quick Start Guide (forthcoming)
	Spectra LTE-U Outdoor 2x500mW FDD eNB Installation Guide (forthcoming)
	Spectra LTE-U Quick Start Guide (forthcoming)
System/CC/OAM	Baicells Configuration & Network Administration Guide
	Baicells Handoff Configuration Guidelines
	Baicells HaloB User Guide
	Baicells BOSS API Manual
	Baicells Dual Carrier Configuration Quick Guide (this document)
	Baicells Operation, Maintenance, & Troubleshooting Guide
	Baicells Enterprise EPC Deployment Guide (forthcoming)
	Baicells Enterprise EPC User Guide (forthcoming)

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1 Introduction

Next-generation Baicells 3GPP LTE Advanced Release 12 eNodeBs (eNBs) such as the Nova-436 provide two carriers which can be configured in dual carrier (DC) or carrier aggregation (CA) mode. This quick guide addresses configuration highlights for operating the eNB in dual carrier (also called split sector) mode.

> NOTE 1: CA mode will be available in a future software release. CA mode provides the ability to aggregate the channels, both contiguous and non-contiguous, for increased capacity.
> NOTE 2: The HaloB feature will be available on the two-carrier eNBs in a future software release.

As a dual carrier eNB each carrier is treated as an individual cell, where each one supports 2x2 MIMO and has its own physical pair of antenna connectors and management interface. The operator may select a single 4-port or two 2-port Radio Frequency (RF) antennas to install with a two-carrier eNB. When the eNB is operating in dual carrier mode, Cell 1 uses ANT2 and ANT3 and Cell 2 uses ANT0 and ANT1.

The current dual carrier software version is BaiBS_RTD_1.0.4, which is based on B110SPC009 and supports 96 users per carrier.

Configuring the eNB to operate in dual carrier mode is only slightly different from single carrier mode:

- Each cell has its own unique serial number.
- Initially, you access the eNB GUI for each individual cell (as if they were two eNBs) to set up a few basic parameters.
- Each cell has its own IP address, and each cell will appear as an individual eNB in the Operations Management Console (OMC).
- You can only configure some parameters for Cell 1 and not for Cell 2: Global Positioning System (GPS) settings, WAN interface, upgrades, and configuration restores. In other words, Cell 2 accepts the same configuration as Cell 1 for these settings.
- Out of box, the two cells share the same RF parameters. You must change the EARFCN and PCI for one cell so that the two cells do not interfere with each other.
- Rebooting one cell will automatically reboot the other cell.

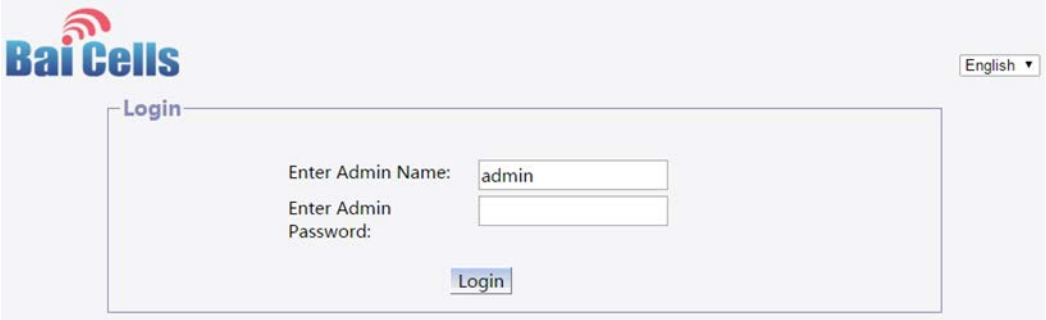
The information assumes the eNB is installed per the Baicells eNB Installation Guide and ready to be configured. Please refer to the *Baicells Configuration & Network Administration Guide* for the full complement of configuration settings.

2 Login

To configure Cell 1 on the dual carrier eNB, open a browser and enter http://192.168.150.1.
To configure Cell 2 on the dual carrier eNB, open a browser and enter http://192.168.150.2.

At the eNB GUI login page, enter the username and password (Figure 2-1). The defaults are admin/admin.

Figure 2-1: Login



Once you log in, you will see the eNB GUI home page, which opens to BTS Info > Basic Info. Refer to examples for Cell 1 and Cell 2 in Figures 2-2 and 2-3 respectively. In particular, notice that each cell has a unique serial number.

Figure 2-2: Cell 1 eNB GUI Home Page

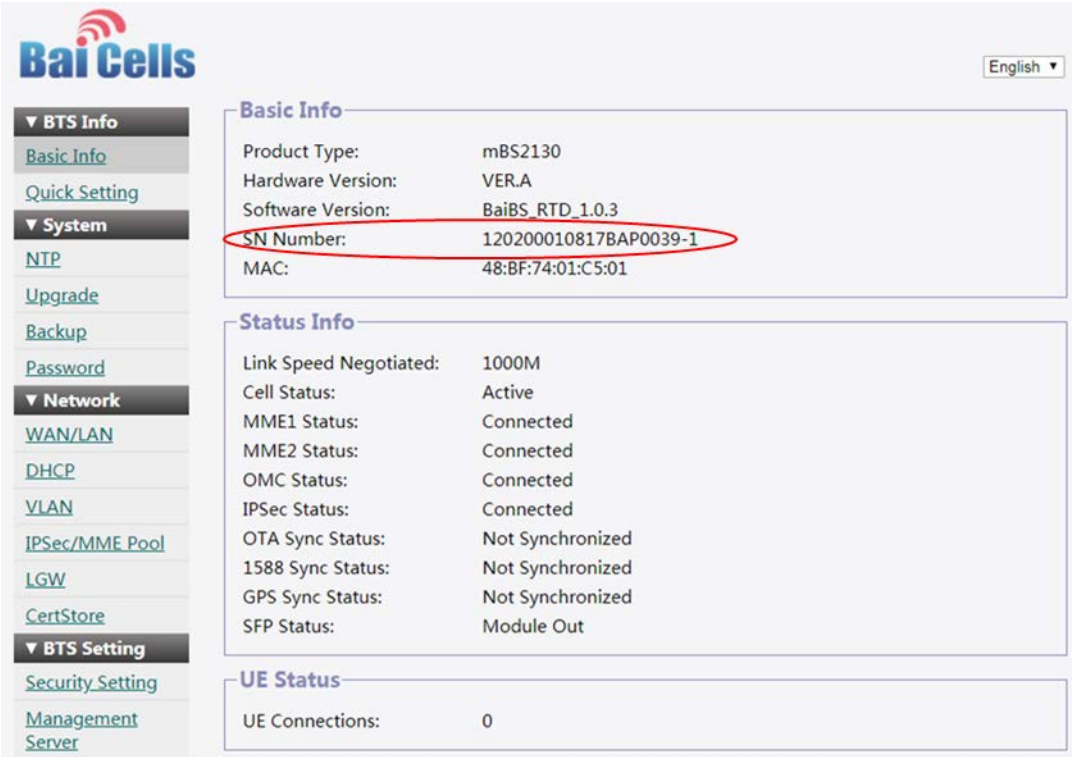
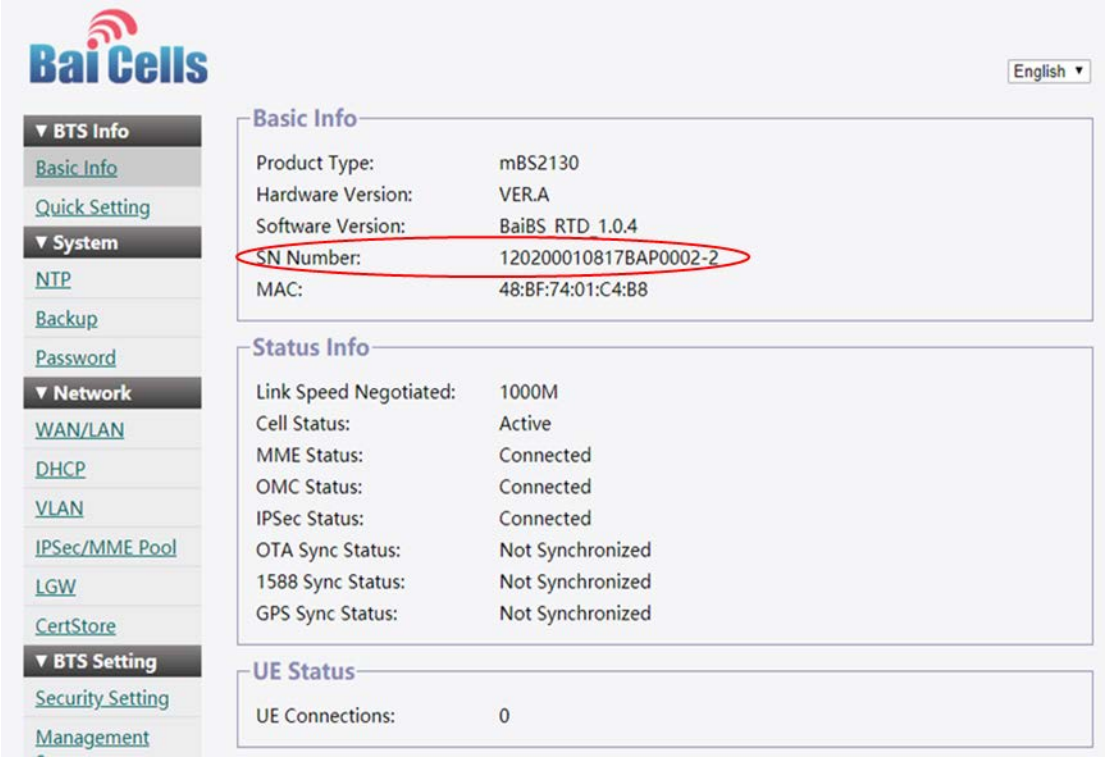


Figure 2-3: Cell 2 eNB GUI Home Page



3 Quick Settings

⚠ **Caution:** Out of the box, the two cells of a dual carrier eNB have the same EARFCN and PCI settings. These two parameters need to be changed on one of the cells, else the two cells will interfere with each other.

Go to BTS Info > Quick Setting for each cell to check the cell parameters and transmission information. Per the caution above, change the EARFCN (frequency) and PCI for one of the cells so that they do not share the same values for these two parameters, and per the operator's network plan.

Also, set the Cloud EPC setting to Enable for each cell. This will allow you to define a separate IPSec tunnel for each cell in dual carrier mode, as covered in section 4.4.1. The other fields may be configured as you normally would for single carrier operation.

Refer to Figure 3-1. Table 3-1 describes the Quick Setting fields. Click on **Save** to save any configuration changes.

Figure 3-1: Quick Setting

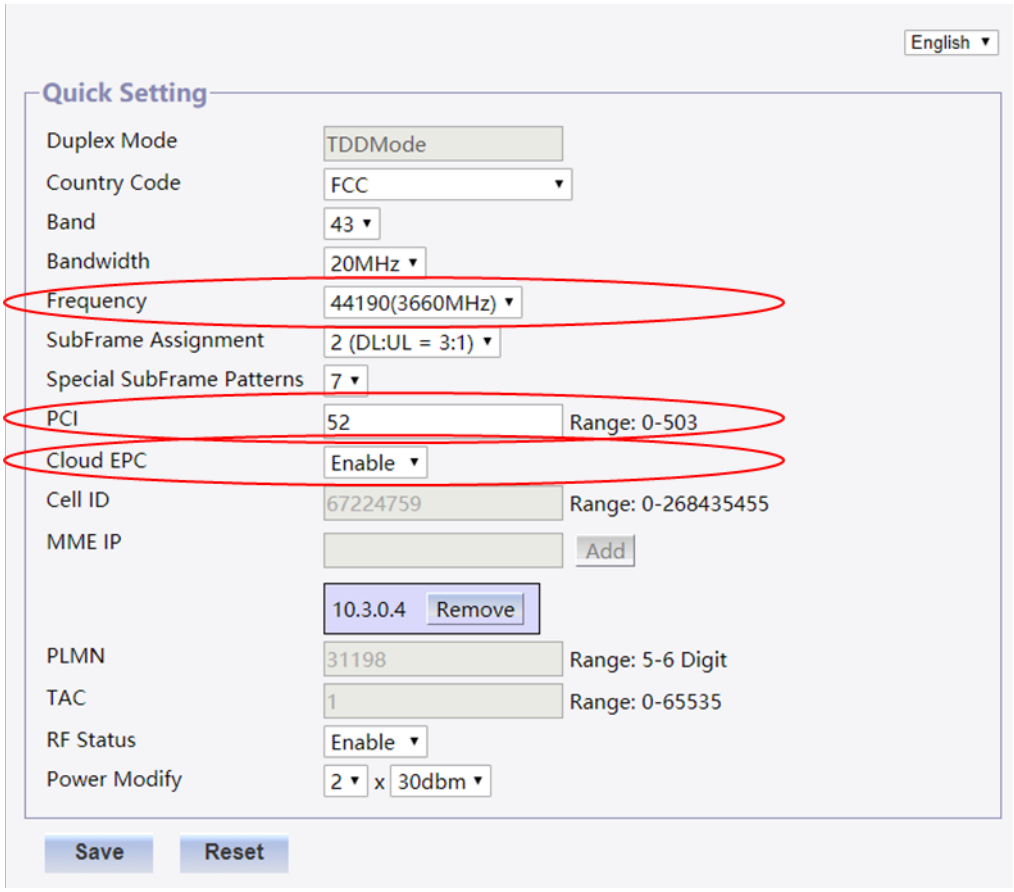


Table 3-1: Quick Setting

Field Name	Description
Duplex Mode	Preset field that cannot be configured at this time. The duplex mode of the Baicells eNB is either Time Division Duplexing (TDD) or Frequency Division Duplexing (FDD) depending on model and country. Currently, TDD is the only option.
Country Code	The country code determines which regulatory restrictions to place on the eNB. Choices are: FCC, for United States Federal Communications Commission, or Canada or Other Area
Band	The eNB's operating frequency band, which is specific to the hardware model.
Bandwidth	Channel bandwidth the eNB may use: either 10 MHz or 20 MHz. Applies to both uplink and downlink. The default is 20 MHz.
Frequency	The eNB's operating frequency, selected by the operator. The range depends on the eNB hardware model and country code.
SubFrame Assignment	Downlink (DL) and uplink (UL) subframe configuration, either 1 or 2, where: 1 = DL:UL is 2:2 transmission ratio 2 = DL:UL is 3:1 transmission ratio (default)

	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	Either 5 or 7. 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. The default setting is 7. 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
PCI	Physical Cell Identification (PCI) allocated by the operator. Range is 0-503. PCI is Layer 1 identity, an essential configuration parameter of a radio cell that uniquely identifies each cell site in the wireless network. PCI planning is crucial for quality of service (QoS).
Cloud EPC	The Cloud Evolved Packet Core (EPC) is either enabled or disabled. For dual carrier operation, enable Cloud EPC for each cell. Each cell will use a separate IPSec tunnel.
Cell ID	The logical cell identification randomly assigned to this eNB. The range is 0-268,435,455.
MME IP	This field appears for standard eNBs (not operating in HaloB mode). Enter the IP address of the Mobility Management Entity (MME). The MME is responsible for initiating paging and authentication of mobile devices. There may be more than one MME in the network.
PLMN	The numerical identifier for the operator's Public Land Mobile Network (PLMN) for this cell. Must be a 5- or 6-digit number.
TAC	Tracking Area Code (TAC) where the eNB is located. The TAC is used to determine the range of the paging information. The operator can use a number between 1 – 65,535. The default is 1.
RF Status	Enable or disable the eNB's RF antenna to allow it to radiate or to keep it from radiating. The default is enabled. When operating in dual carrier mode, Cell 1 uses ANT2 and ANT3, and Cell 2 uses ANT0 and ANT1.
Power Modify	Output power on each port, typically left as the default values. 30 dBm x2 = 33 dBm. Every 3 dB doubles the power. This field may 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.

4 Network Interfaces

Use the eNB GUI (Web client) Network menu to configure the wide area network (WAN) or local area network (LAN), the Dynamic Host Configuration Protocol (DHCP), virtual LANs (VLANs), the IP security (IPSec) gateway and Mobility Management Entity (MME) pools, and the Local Gateway (LGW) mode. Check the interface settings for both Cell 1 and Cell 2.

4.1 WAN/LAN

The WAN interface is an external communication portal (internet connection) between the eNB's Network Management System (NMS) and the MME. The eNB's NMS may be the Baicells Operations Management Console (OMC) or the LTE NMS. A WAN interface supports multiple VLANs.

The LAN interface is used only as a local maintenance port during initial eNB setup and basic configuration. The LAN interface is not used during normal eNB operation.

Figure 4-1 shows an example of the Internet / WAN and Local Network / LAN fields for Cell 1 Figure 4-2 is an example of the Internet / WAN and Local Network / LAN fields for Cell 2. The Internet / WAN fields are described in Table 4-1.

For the Local Network / LAN fields, simply enter the IP address and subnet mask address for the local network connection – that is, **192.168.150.1** for Cell 1 and **192.168.150.2** for Cell 2, subnet mask 255.255.255.0.

Click on **Save** to save the configuration. Use the Reset button if you want to reset the configuration to the original default settings.

Figure 4-1: Cell 1 Internet / WAN Fields

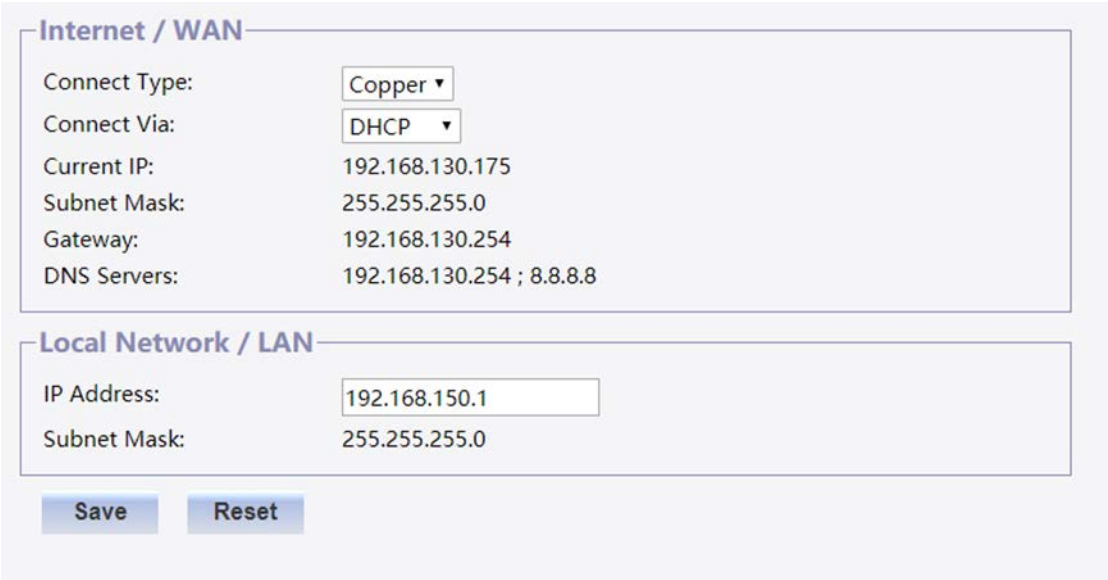


Figure 4-2: Cell 2 Internet / WAN Fields

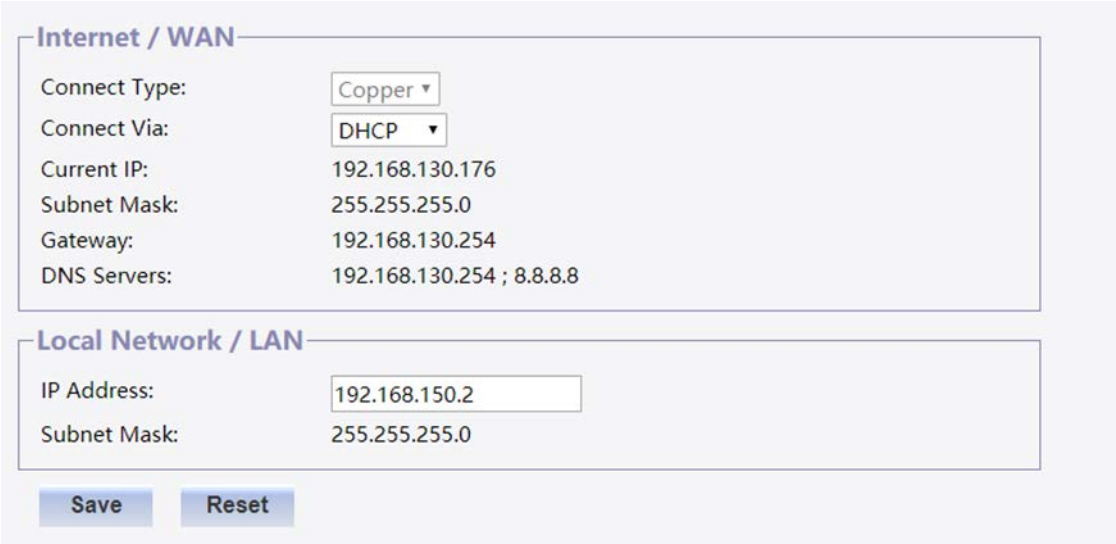


Table 4-1: Internet / WAN Fields

Field Name	Description
Connect Type	Copper or fiber. This parameter may be defined only on Cell 1.
Connect Via	Options for the connection type are: • Dynamic Host Configuration Protocol (DHCP) – the eNB's IP address will be obtained dynamically from the local DHCP server. The current DHCP server IP address will be displayed, along with the link speed. When DHCP is selected as the connection method, there are no further WAN fields to configure in this window. • Point-to-Point Protocol Over Ethernet (PPPoE) – not recommended. If PPPoE is selected, you will be prompted to enter the user name and password. The range of each is 1 to 100 digits. You can also enter an access controller name and service name. • Static IP – IPv4 address, netmask, and gateway or IP address of the Domain Name Server (DNS), where multiple addresses are allowed
Current IP	Current Internet Protocol address for the WAN
Subnet Mask	Current subnet mask address for the WAN
Gateway	WAN gateway IP address
DNS Servers	Domain Name Server (DNS) IP address. More than one server may be added.

4.2 DHCP

If a local DHCP server will be used, in the Network > DHCP menu check the check box next to **LAN DHCP Server Enabled**.

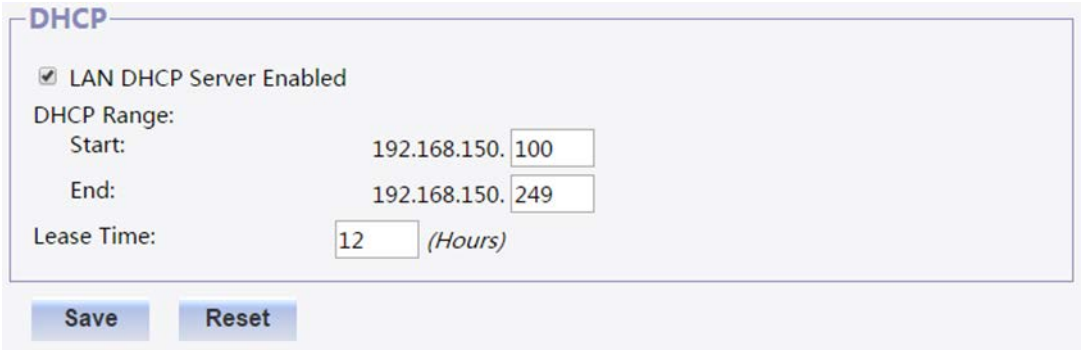
Caution: If the Internet/WAN interface Connect Type was set to copper, the DHCP function cannot be used for either Cell 1 or Cell 2. If the Internet/WAN interface Connect Type was set to fiber, the DHCP function can be used for Cell 1 but not for Cell 2.

Enter the start (lowest) leased IP address and the end (highest) leased IP address in the range.

The lease time field is used to indicate how long a leased IP address remains active before it expires. The range of time may be up to 9,999 hours; the default is 12 hours.

Refer to Figure 4-3. After entering the information, click on **Save** to save the configuration. Use the Reset button if you want to reset the configuration to the original default settings.

Figure 4-3: DHCP

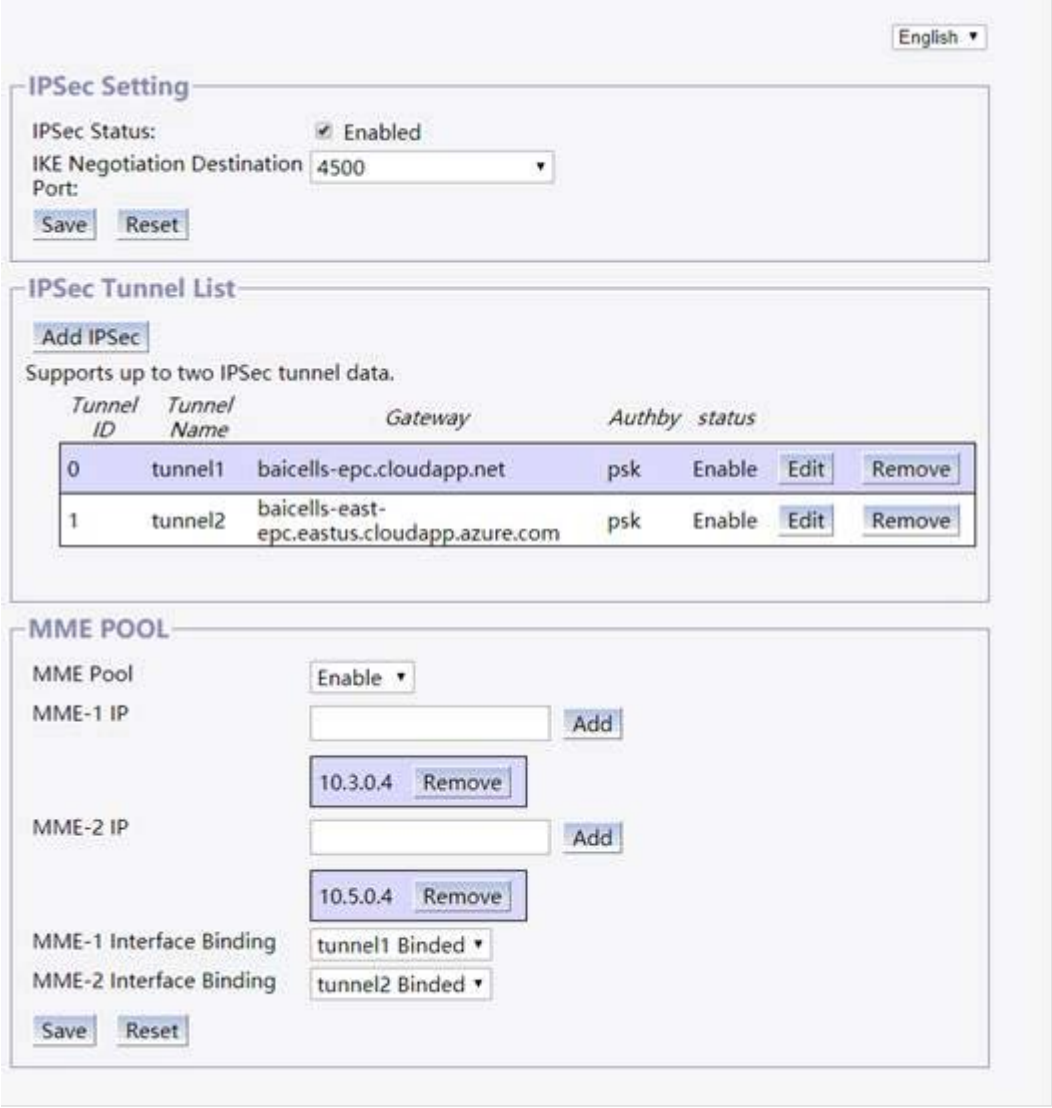


4.3 IPSec/MME Pool

4.3.1 IPSec

The security protocols are provided in the network layer to ensure the safety of message transmission. Out of box, for dual carrier systems the eNB GUI will show the IP Security (IPSec) gateway for only one cell. Under Quick Setting (in section 3 above), when you enabled Cloud EPC and saved the setting this automatically established two IPSec tunnels and enabled the MME Pool. Refer to Figure 4-4.

Figure 4-4: IPSec



⚠ **Caution:** It is highly recommended that you use the default advance settings for IPSec. Improper changes may lead to system exception.

4.4 LGW

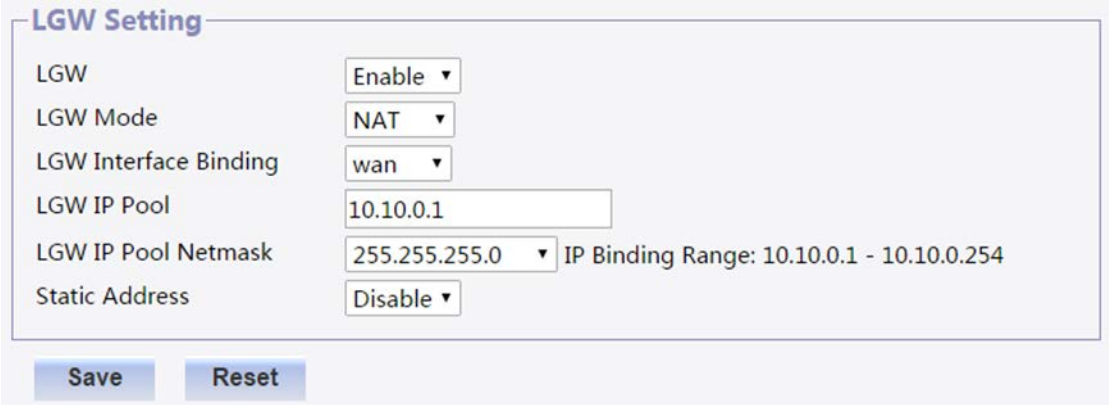
The local gateway (LGW) fields shown in Figure 4-8 allow you to enable or disable the gateway connection to the backhaul network; to select an LGW Mode of Network Address Translation (NAT), router, or bridge; and to select an LGW Interface Binding of WAN – Wide Area Network - or PPPoE – Point-to-Point Protocol over Ethernet. Most operators use bridge mode, though NAT is the default mode. You can then enter the LGW IP Pool address and network. The IP binding range is 10.10.0.1 to 10.10.0.254.

For dual carrier operation, when the connected EPC is the cloud EPC (reference section 3) you must configure the LGW and reboot the eNB once the LGW configuration is completed.

Caution: Rebooting the eNB will disrupt service. Rebooting the eNB from either Cell 1 or Cell 2 when operating in dual carrier mode will automatically reboot both Cell 1 and Cell 2.

Click on **Save** to save the configuration. Table 4-2 describes the LGW fields.

Figure 4-8: LGW Setting



For additional guidance on setting the LGW to router mode, please refer to the BaiTip on the Baicells website: https://community.na.baicells.com/t/enb-basestation-lgw-router-mode-configuration-example/89

Table 4-2: LGW Setting

Parameter Name	Descriptions
LGW	Enable or disable the LGW function. The default is enable.
LGW Mode	LGW mode: • NAT (default) • Router • Bridge (most commonly used)
LGW Interface Binding	The network interface connected to the LGW. The default value is WAN.
LGW IP Pool	The dynamic IP address assigned to user equipment out of the IP pool. Enter the first IP address of the IP pool.
LGW IP Pool Netmask	For example, if the first IP address is 10.10.10.1, and the netmask is 255.255.255.0, the IP address pool includes 255 IP addresses
Static Address	Enable or disable a static IP address. The default is disable.
Configure Static Range	This field is visible if the “Static Address” is set to Enable. Enter the start IP address and the end IP address of the static IP address range.
IMSI to IP Binding	This field is visible if the “Static Address” is set to Enable. Bind the IP address with the International Mobile Subscriber Identity (IMSI) number.

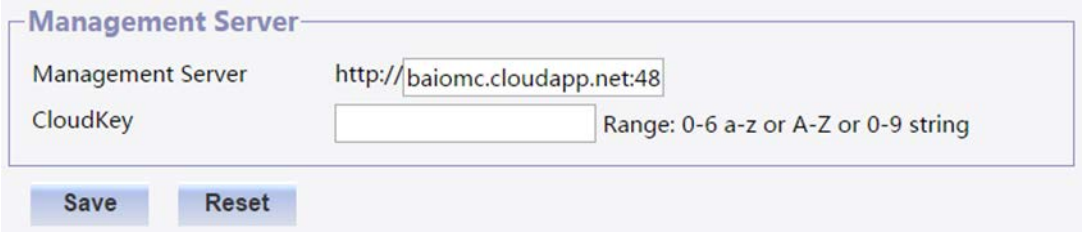
5 BTS Setting

5.1 Management Server

For dual carrier operation, Cell 1 and Cell 2 must be added separately in the OMC using their individual serial numbers. Add your operator CloudKey for both cells so that both cells associate to your cloud account. Each cell will appear as a separate eNB in the OMC.

To enter the management server address and your CloudKey, go to BTS Setting > Management Server as shown in Figure 5-1. Click on **Save** to save the configuration.

Figure 5-1: Management Server



Alternatively, you can enter each eNB (Cell 1 and Cell 2) manually using their serial numbers in the OMC under Device Management. You will make two different entries, one for each cell based on its individual serial number.

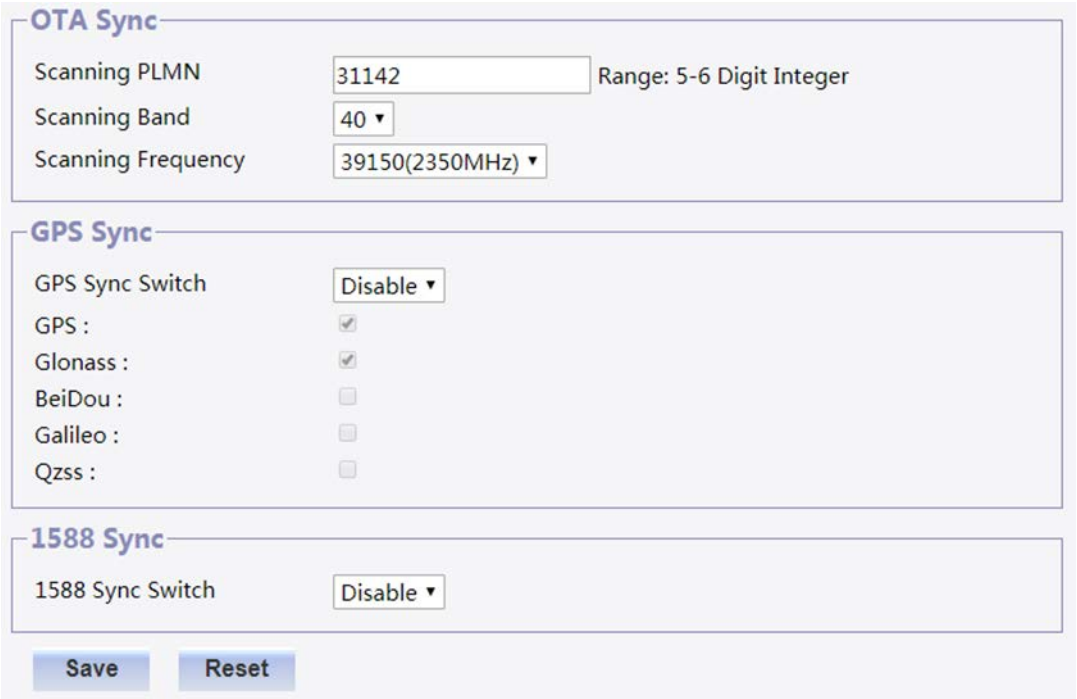
5.2 Sync Setting

The LTE technology standards specify timing and synchronization requirements between adjacent eNBs. Synchronized transmission helps to avoid eNBs interfering with one another, optimize bandwidth usage, and enhance network capacity.

Baicells supports multiple eNB synchronization methods. Operators may choose the synchronization method to meet their network requirements. The default priority among the different Baicells methods is as follows: Over-the-air interface (OTA), Global Positioning System (GPS), and 1588V2 synchronization. Whichever mode you select, you will enter the parameters for that mode and disable the other synchronization modes in the BTS Setting > Sync Setting window (Figure 5-2).

> NOTE: The two cells in CCA-capable eNBs share a single GPS antenna. If GPS sync is selected, it is controlled by Cell 1 and therefore configured in the Cell 1 GUI. Cell 2 will sync with the same antenna as used by Cell 1.

Figure 5-2: Sync Setting



For OTA Sync, enter the scanning Public Land Mobile Network (PLMN) number (5- or 6-digit integer), the scanning band (38, 39, or 40, depending on your eNB model), and the scanning frequency [ranges from 38700 (2305 MHz) to 39600 (2395 MHz)].

To enable GPS synchronization, the GPS antenna must be installed on the eNB. When enabled you can then choose which time reference type(s) to use for the GPS clock:

- GPS – choose this option if you installed a GPS antenna with the eNB; it will reference the atomic clock at the monitor stations and satellites, accurate within 25 ns.
- Glonass – generated by the GLONASS Central Synchronizer, whose time scale implements leap seconds like Coordinated Universal Time (UTC).
- BeiDou – a continuous time scale which is synchronized with UTC within 100 ns.
- Galileo - a continuous time scale maintained by Galileo Central Segment, with an offset of below 50 ns.
- Qzss – Quasi-Zenith Satellite System (QZSS) is a highly precise three or four orbiting satellite timing system that is in development for Japan. Expected availability was by the end of 2017.

Most operators select either GPS or Glonass clocks. The Glonass and the BeiDou options cannot be selected concurrently.

By default the 1588V2 synchronization mode is disabled. To use 1588V2 mode, set the Switch field to Enable.

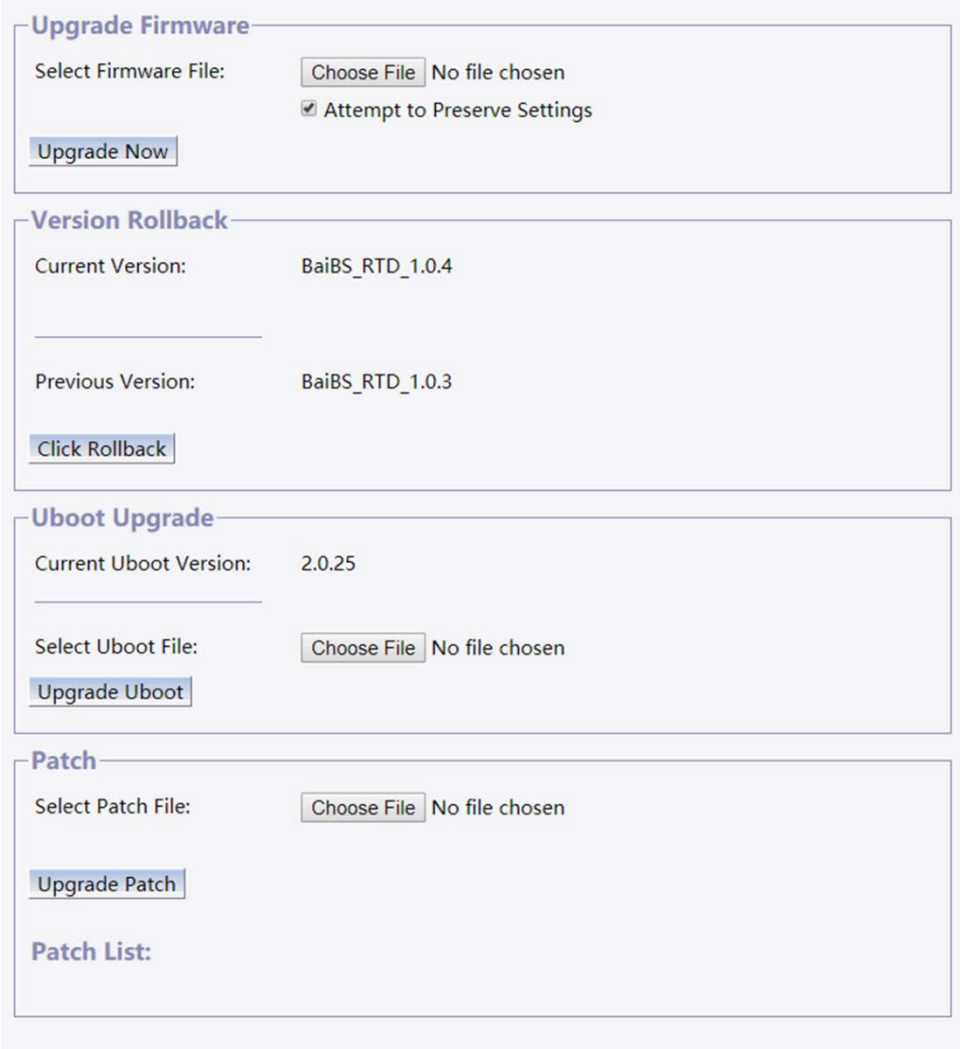
Click on **Save** to save the configuration data. Use the Reset button to restore the configuration settings to their original default values.

6 System

6.1 Upgrade

For eNBs operating in dual carrier mode, you will upgrade or downgrade only Cell 1. Any changes to the Cell 1 software version will automatically affect Cell 2. Refer to the example in Figure 6-1.

Figure 6-1: Upgrade Cell 1



6.2 Restore

For dual carrier operation the Restore function is available only on Cell 1. The Restore function will reboot the eNB immediately. Refer to Figure 6-2.

⚠ **Caution:** Rebooting the eNB will disrupt service. Rebooting the eNB from either Cell 1 or Cell 2 when operating in dual carrier mode will automatically reboot both Cell 1 and Cell 2.

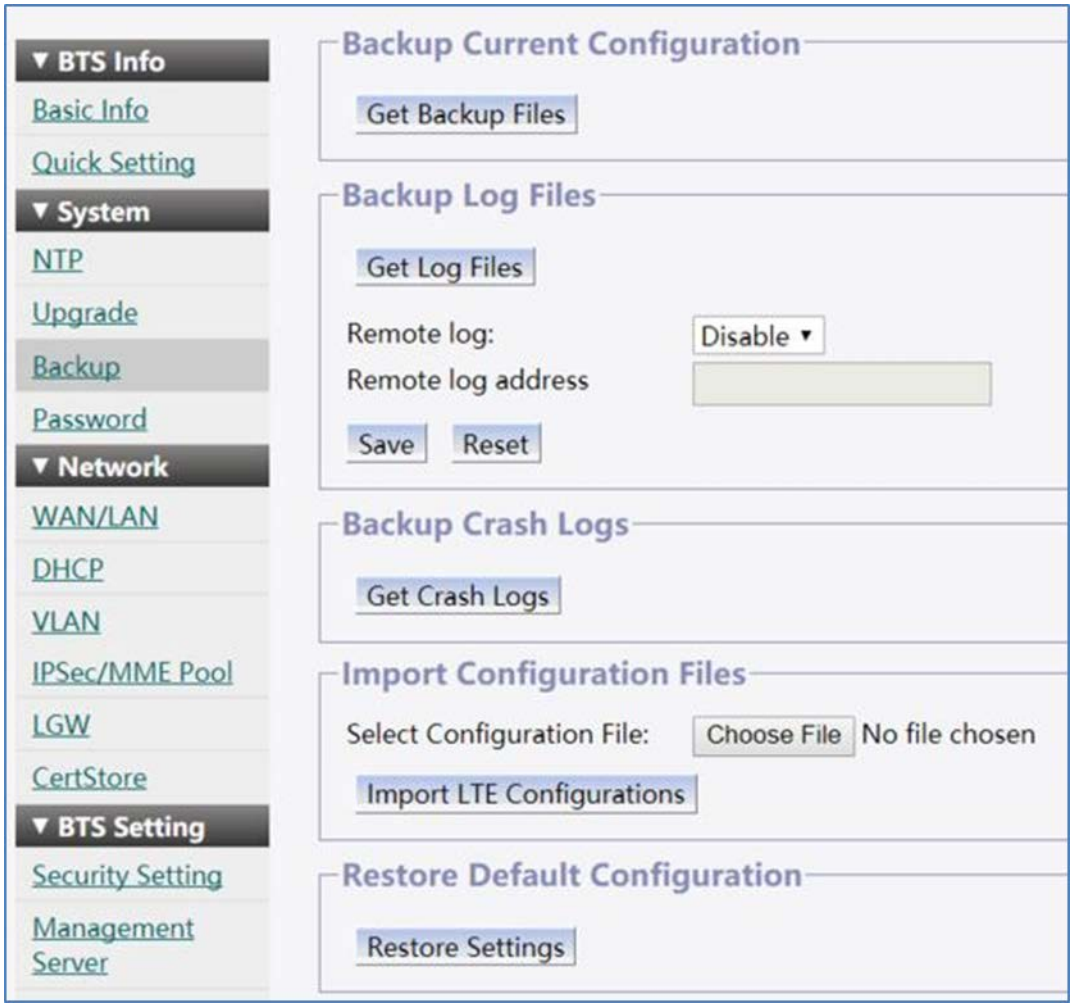



Figure 6-2: Restore