SAS Deployment Guide

CloudCore OMC – Version 7.1.6
BaiBS_RTS_3.6.6
BaiBS_QRTB_2.6.2
BaiCE_BG_1.6.5.3
BaiCE_AP_2.4.7_NA

September 2021

Version 1.20

About This Document

This document is intended for operators who are utilizing the Citizens Broadband Radio Service (CBRS) spectrum and the shared Spectrum Access System (SAS). The information is targeted to the CBRS network operator and/or the Certified Professional Installer (CPI) and covers how to plan and deploy the SAS setup in the Baicells CBRS Service Devices (CBSDs). This document does not cover the background on CBRS commercialization, how to become a SAS vendor, or how to become a CPI, for which there are many industry websites, such as:

- Wireless Innovation Forum (WINNF): *https://www.wirelessinnovation.org/information-documents*
- CBRS Alliance (LTE-based OnGo): *https://www.cbrsalliance.org/*

Users of this document should already be familiar with and have some experience in deploying and using the Baicells equipment and software applications.

The information in this document is based on the following Baicells software versions:

- eNB: BaiBS_RTS_3.6.6 (Nova227 and Nova233)
- eNB: BaiBS_QRTB_2.6.2 (Neutrino430, Nova430, Nova430i, and Nova436Q)
- CPE: BaiCE_BG_1.6.5.3 (Atom-OD06H, -OD06L, -ID06B, -OD15)
- CPE: BaiCE_AP_2.4.7_NA (Atom-OD04H, -OD04L)
- OMC: Version 7.1.6

Terms used in this document or related to LTE are listed in alphabetical order and described in Acronyms & Abbreviations, which can be found at Baicells > Resources > *Documents*.

New in This Release

The following updates have been provided in this release:

- Added SAS-capable eNBs Nova430 and Nova430i.
- Updated SAS main log example (Figure 4-30) to show new *Log Names* column, which is used to display the SAS message procedure.
- Added procedures in *section 4.4.1* for viewing device logs (step 13) and exporting device logs (step 14).
- Added information about General Authorized Access (GAA) and Priority Access License (PAL) channels (*section 4.2.1.3* and Figure 4-31).

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Revision Record

Date	Version	Description	SMEs/Contributors	Author/Editor
11-Sep-2021	V1.20	Updated for OMC 7.1.6	Yunfeng Jiang, Warren Lai, Blake Volk	Kathy Clark
16-Jun-2021	V1.19	Updated for QRTB 2.6.2 and OMC 7.0.4. Also updated to include Neutrino430 and Atom OD15.	Yunfeng Jiang, Warren Lai, Jesse Raasch	Kathy Clark
16-Mar-2021	V1.18	Updated for QRTB 2.5.4, BG_1.6.5.3 (CAT6/7), AP_2.4.7_NA (CAT4), and OMC 6.3.4. Removed Appendix and added reference to Acronyms & Abbreviations document.	Yunfeng Jiang, Jesse Raasch, Nitisha Potti	Kathy Clark
3-Nov-2020	V1.17	Added SAS vendor recommendations for requesting grants	Nitisha Potti	Kathy Clark
19-Oct-2020	V1.16	Updated for CAT6/7 BaiCE_BG_1.6.4.	Nitisha Potti	Jocelyn Watson
14-Oct-2020	V1.15	Updated Table 4-1 SAS Settings. Removed *Optional* from userid description	Nitisha Potti	Jocelyn Watson
12-Oct-2020	V1.14	Updated for QRTB 2.4.2, AP 2.4.5 NA (CAT4), BG 1.6.2 (CAT6/7), OMC 6.2.6	TangHoucheng, WangYong, Nitisha Potti, Jesse Raasch	Kathy Clark
8-Sep-2020	V1.13	Updated for RTS 3.6.6, QRTB 2.3.6, AP 2.4.2, OMC 6.0.5.1, BOSS 6.1.3	Yunfeng Jiang	Jocelyn Watson
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18-May-2020 4-May-2020	V1.11 V1.10	Software updates RTS 3.6.3, QRTB 2.2.4, OMC/BOSS 6.0	Yunfeng Jiang, Nitisha Potti, Jesse Raasch	Sharon Redfoot
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19-Dec-2019 17-Dec-2019 12-Dec-2019 10-Dec-2019 9-Dec-2019	V1.8 V1.7 V1.6 V1.5 V1.4	OMC 5.2.7, RTS 3.4.8, QRTB 2.05 updates Enhancements SME comments Updates from beta trials Added CPI sig gen tool	Ronald Mao, Pengyu Chen, Jason Yunfeng, Katie Heyl, Jesse Raasch	Sharon Redfoot
22-Nov-2019 20-Nov-2019 15-Oct-2019	V1.3 V1.2 V1.1	Updated FCC #s Draft-2 (RTS 3.4.5, QRTB 2.0.4) Draft-1 trial/ICD	Ronald Mao, Jesse Raasch, Katie Heyl, Rick Harnish, Nitisha Potti	Sharon Redfoot

Support Resources

- **Documentation** - Baicells product data sheets and technical manuals may be found at Baicells > Resources > *Documents*.
- **Support** - Open a support ticket, process an RMA, and the Support Forum are at Baicells > *Support*.

Contact Us

Baicells Technologies Co., Ltd. China	Baicells Technologies North America, Inc. North America
Address: 3F, Bldg. A, No. 1 Kai Tuo Rd, Haidian Dist, Beijing, China	Address: 5700 Tennyson Pkwy, #300, Plano, TX 75024, USA
Phone: +86-10-62607100	Phone: +1-888-502-5585
E-mail: *contact@Baicells.com*	Email: *sales_na@Baicells.com* or *support_na@Baicells.com*
Website: *www.Baicells.com*	Website: *https://na.Baicells.com*

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1. Overview

The Citizens Broadband Radio Service (CBRS) covers the once regulated 3.55-3.7 GHz band. The FCC freed up the previous military-only CBRS band for commercial use. CBRS officially launched in January 2020. The ability for operators to use CBRS provides an economical way for existing operators to increase coverage and capacity, and it provides a low-cost solution for start-up operators to enter the market. Not only does CBRS add available spectrum, it rivals current Wi-Fi networks due to its (a) propagation characteristics, and (b) planned design and support for next-generation mobility and 5G networks.

In terms of implementation, what makes CBRS especially different is the way the 3.55-3.7 GHz band may be accessed. CBRS commercialization is based on the concept of "shared" spectrum, where spectrum is dynamically assigned and released on an as-needed basis. Shared spectrum assignment is handled by Spectrum Access System (SAS) vendors. Currently Amdocs, CommScope, Federated Wireless, and Google are FCC Part 96 certified SAS vendors. To use the CBRS spectrum, the CBRS Service Devices (CBSD) such as the Baicells eNodeB (eNB) and user equipment also must go through certification. Certification will be an ongoing process as new products are introduced. All CBSDs must be installed by a Certified Professional Installer (CPI) in order to lawfully operate within the designated spectrum of CBRS.

The CBSD equipment must be configured to connect to a SAS vendor for band assignment. A CBSD transmits RF in the CBRS band and is subject to FCC rules. The SAS enforces the FCC rules. When the assigned band is no longer needed, SAS can free it up so that other users can operate in that band. A CBSD is served by a SAS either directly or through a Domain Proxy (DP). A DP is an aggregation point that interfaces with the SAS on behalf of all the devices behind it. The Baicells CBRS/SAS solution includes a DP. The Baicells eNodeB (eNB) uses DP to connect to the SAS by leveraging the existing connection with the Baicells Operations Management Console (OMC). All eNBs will need to connect to the OMC in order to connect to the SAS.

As a champion of CBRS commercialization for years, Baicells is ready to work with operators. Once you have your SAS vendor account and are approved to be a Baicells trial user, follow this guide to configure the eNB and user equipment, and associate your OMC account to your SAS account.

2. Reference Information

For certification, the CBSD equipment is categorized as shown in Table 2-1.

Table 2-1: CBSD Categories

Device	Power	Max EIRP (dBm/10 MHz)	Max PSD (dBm/MHz)
End User Device (EUD)	23 dBm or 200mV	23	N/A
CAT A CBSD	30 dBm or 1W	30	20
CAT B CBSD	47 dBm or 50W	47	37

The 'dBm/10 Mhz' means EIRP power density per 10 MHz in dBm.
EIRP: Effective Isotropic Radiated Power
PSD: Power Spectral Density

3. Preparation

3.1 SAS Account

You will need to create a SAS account directly with an approved SAS vendor for services to authorize transmission within the CBRS spectrum. Currently, the supported SAS administrators are Amdocs, CommScope, Federated Wireless, and Google.

3.2 Certified Professional Installer

You will need at least one CPI's credentials that will be entered in the configuration on the CBSD, DP, or SAS portal. Each SAS vendor provides their own GUI to assist you in using their SAS portal.

3.3 Equipment & Software

The following are the current Baicells eNB/CPE models and OMC software versions that support SAS.

- Nova227/233 BaiBS_RTS_3.6.6
- Neutrino430, Nova430, Nova430i, and Nova436Q BaiBS_QRTB_2.6.2
- Atom-OD06/ID06/OD15 BaiCE_BG_1.6.5.3
- Atom-OD04 BaiCE_AP_2.4.7_NA
- OMC BaiOMC 7.1.6

NOTE 1:The first generation (Gen 1) Baicells CPEs do not support SAS.
NOTE 2: Gen 1 CAT4 CPEs are now End Of Life (EOL).
NOTE 3: BaiOMC can be cloud-based (cloudcore.baicells.com) or local (private network).

4. Configuration

Reference: *CloudCore Configuration & Network Administration Guide*, *eNodeB Configuration Guide*, and *CPE Configuration Guide*. These three documents cover all Baicells GUIs/configuration menus.

Caution: Once you have an account with an approved SAS vendor and you enable SAS on the CBSD and in the OMC (DP), current users attached to the CBSD will be disconnected until the CBSD reaches transmission state with the SAS. Once the SAS authorizes the CBSD and it reaches transmission state, users will automatically reconnect.

NOTE 1: Throughout this document, the term CBSD can mean any of the following devices: eNB, CPE, Virtual eNB, and/or Virtual CPE. If a procedure is specific to one device type, it will be identified as such. The term Virtual eNB or Virtual CPE CBSD is used to describe any device you pre-configure for SAS operation that has not been registered with the OMC yet. When a virtual CBSD connects to the OMC for the first time, the device is moved from the virtual device tab into its respective 'regular' device tab listing. Device tabs are described in more detail in *section 4.4*.
NOTE 2: Each SAS vendor provides their own GUI to assist you in using their SAS portal.
NOTE 3: When SAS is enabled on the eNB, the standard BTS Info > Quick Setting for *Band, Bandwidth, Frequency,* and *Power modify* will become greyed out; the eNB will use the configuration based on the SAS settings response. However, you can configure your preferences for these settings by selecting a *Frequency Selection Logic*, which is described in detail in *section 4.2.1*.
NOTE 4: The GUI SAS fields vary slightly between RTS 3.6.6 and QRTB 2.6.2 software versions.

4.1 SAS Registration Options

The operator has three options for registering CBSDs with the SAS provider. The first two options use a Single-Step registration method, where all CBSD configuration is performed in the Baicells device GUIs or by using the OMC. Option three uses a Multi-Step registration method, where only the CBSD's basic information is configured using the OMC and then all other installation parameters are entered in the SAS portal. The following information provides more details:

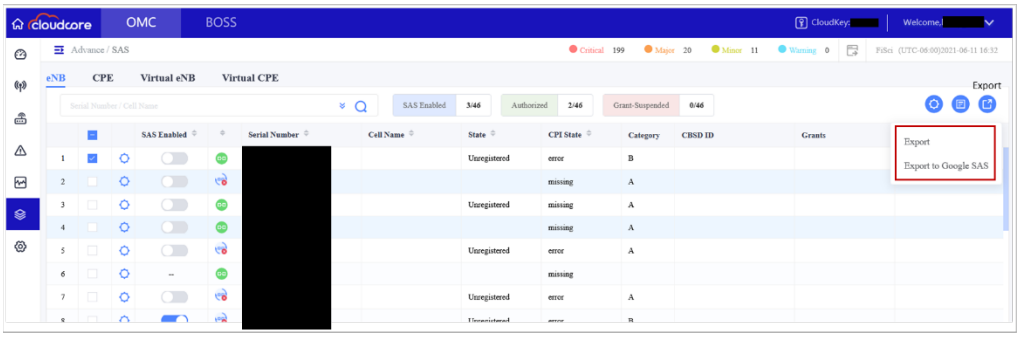
NOTE 1: Regardless of which registration option you use, you must configure the CBSD's basic information for successful registration with SAS.
NOTE 2: For Option 3, when using the Multi-Step registration method, Baicells recommends that you upload all CBSD information in the SAS portal prior to enabling SAS on the CBSD.
NOTE 3: The CPI must upload the certificate directly through the SAS portal.

- **Option 1: Configure installation parameters directly in the CBSD GUI**
  The CPI certificate is uploaded directly to the CBSD, which effectively signs and encodes all installation parameters. The encoded CPI data is sent to the OMC (DP), which is then passed to the SAS during the registration request. It is not necessary to add the CBSD in the SAS portal when using this method. SAS settings are configured as follows:
    - CBSD GUI: Set *SAS Registration Type* to *Single-Step*.
    - OMC (DP): Select *Single-Step* and upload CPI certificate.
- **Option 2: Configure installation parameters using the OMC (DP)**
  The installation parameters are entered using the OMC (DP) and signed by the CPI. It is not necessary to add the CBSD in the SAS portal when using this method. SAS settings are configured as follows:
    - CBSD GUI: Set *SAS Registration Type* to *Single-Step*.
    - OMC (DP): Select *Single-Step* and upload CPI certificate.
- **Option 3: Configure installation parameters in the SAS portal**
  The installation parameters are entered directly in the SAS portal and signed by the CPI. Only the basic CBSD info (such as Category, User ID, and FCC ID) is entered on the CBSD. SAS settings are configured as follows:
    - CBSD GUI: Set *SAS Registration Type* to *Multi-Step*.
    - OMC (DP): Select *Multi-Step*.

For operators who have chosen Google as their SAS provider, there is a new OMC feature that allows you to export CBSD data directly onto the Google SAS portal when you are using the Multi-Step registration method. The export function is shown in Figure 4-1.

NOTE 1: Choose the Export to Google function only if Google is your SAS vendor.
NOTE 2: Baicells is committed to working with all certified SAS vendors to support this type of functionality as it becomes available in order to assist you with SAS deployment activities.

Figure 4-1: Export to Google SAS Portal



4.2 CBSD Configuration

4.2.1 eNB Configuration

Follow the steps below to complete the eNB/CBSD configuration.

Prerequisites: Verify the management server URL is correct on the eNB GUI. Since the eNB uses a domain proxy (DP) method to connect to the SAS, an OMC connection is required.

1. Go to BTS Setting > Management Server:
   a. For the CloudCore OMC, enter **baiomc.cloudapp.net:48080/smallcell/AcsService**.
   b. For a Local OMC, enter the Local OMC server URL, e.g., **xx.xx.xx.xx:8080/smallcell/AcsService**.
2. If using the CloudCore OMC, enter your unique CloudKey shown at the top of your CloudCore account window. (The CloudKey is not required for Local OMC).
3. If you choose to use the Single-Step registration type, have your CPI info and all antenna requirements ready to input before you start the configuration procedures.

4.2.1.1 Configure the CBSD SAS settings on eNB GUI

NOTE: With OMC 7.1.6 software, you can now configure and modify all the CBSD settings directly in the OMC if desired. Refer to *CloudCore Configuration & Network Administration Guide* for more information.

1. Go to LTE > SAS Settings (RTS 3.6.6 software) or LTE Setting > SAS Settings (QRTB 2.6.2 software).
2. *SAS*: Set to *Enable* (RTS 3.6.6 software) or *ON* (QRTB 2.6.2 software).
3. *SAS Registration Type*: For the field in this menu, simply select either *Single-Step* or *Multi-Step* from the drop-down list. The fields that display beneath the registration type will depend on which option you select. For RTS 3.6.6, refer to Figure 4-2 and Figure 4-3. For QRTB 2.6.2, refer to Figure 4-4, Figure 4-5, and Figure 4-6.

NOTE 1: More about each registration option (Single-Step or Mult-Step) is covered in *section 4.1* and *section 4.3*.
NOTE 2: With the software update from QRTB 2.5.4 to QRTB 2.6.2, the "Channel Reuse" check box moved from the SAS Settings GUI to the Quick Setting GUI. See *section 4.2.1.3* for more information.
NOTE 3: HaloB-enabled eNBs operate as standalone entities and do not support mobility, so the *LTE* menu options change depending on the HaloB function setting. Therefore, as you are selecting the *SAS Settings* sub-menu from the *LTE* menu, you may notice differences between your eNB GUI and how the *LTE* menu is depicted in Figure 4-2, Figure 4-3, Figure 4-4, Figure 4-5, and Figure 4-6.

4. *Install Param Config*: Refer to Table 4-1 for each parameter's description to complete the SAS configuration in this menu.
5. *CPI info*: If you selected Single-Step method for registration type, enter the CPI ID, name, and installation information.

6. *CPI certstore*: If you selected Single-Step method for registration type, this section displays the CPI certification if it is already uploaded, and it provides an add/change function to upload or change the certificate here.

Figure 4-2: SAS Settings (RTS 3.6.6, Single-Step Registration)

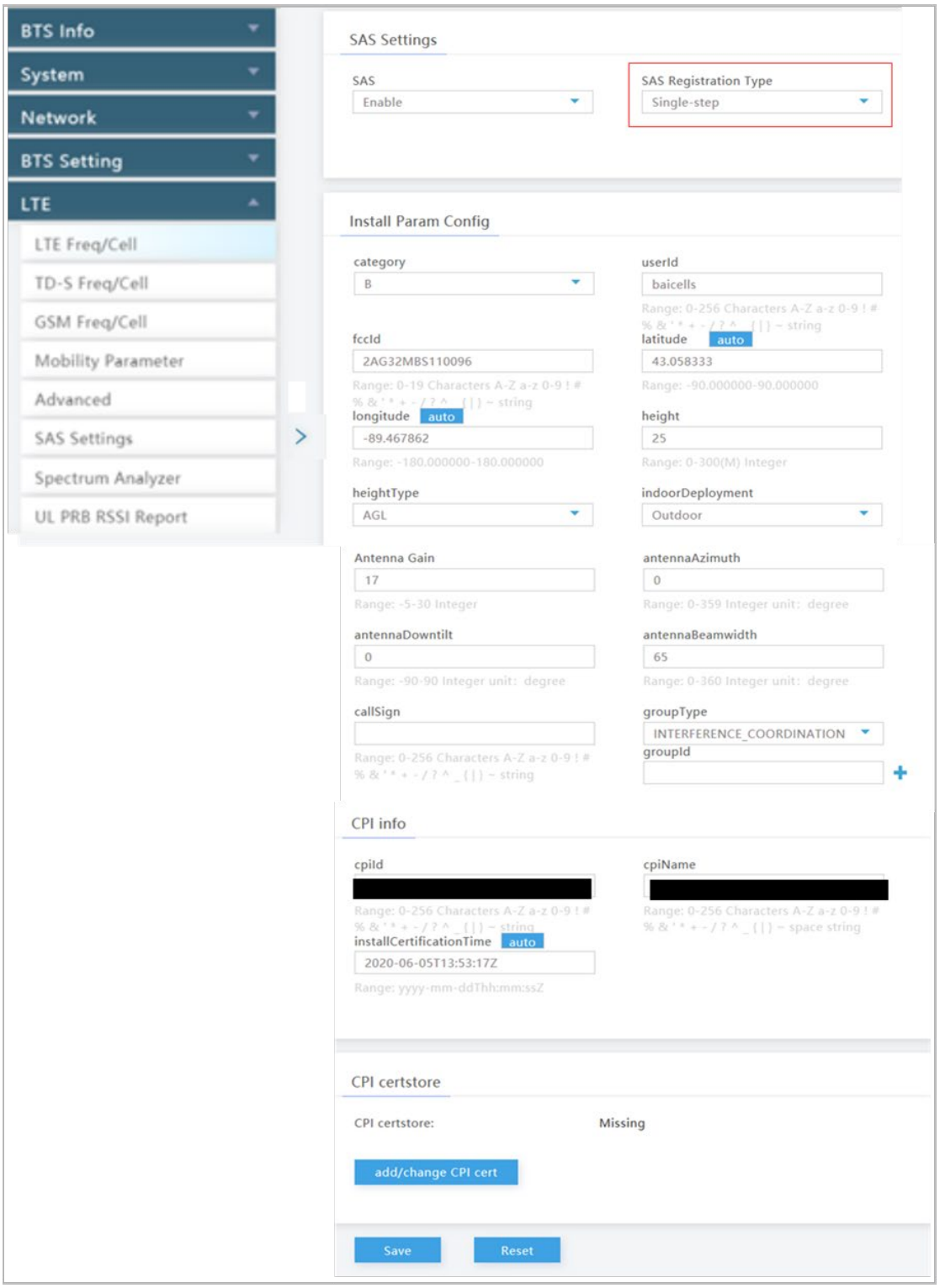


Figure 4-3: SAS Settings (RTS 3.6.6, Multi-Step Registration)

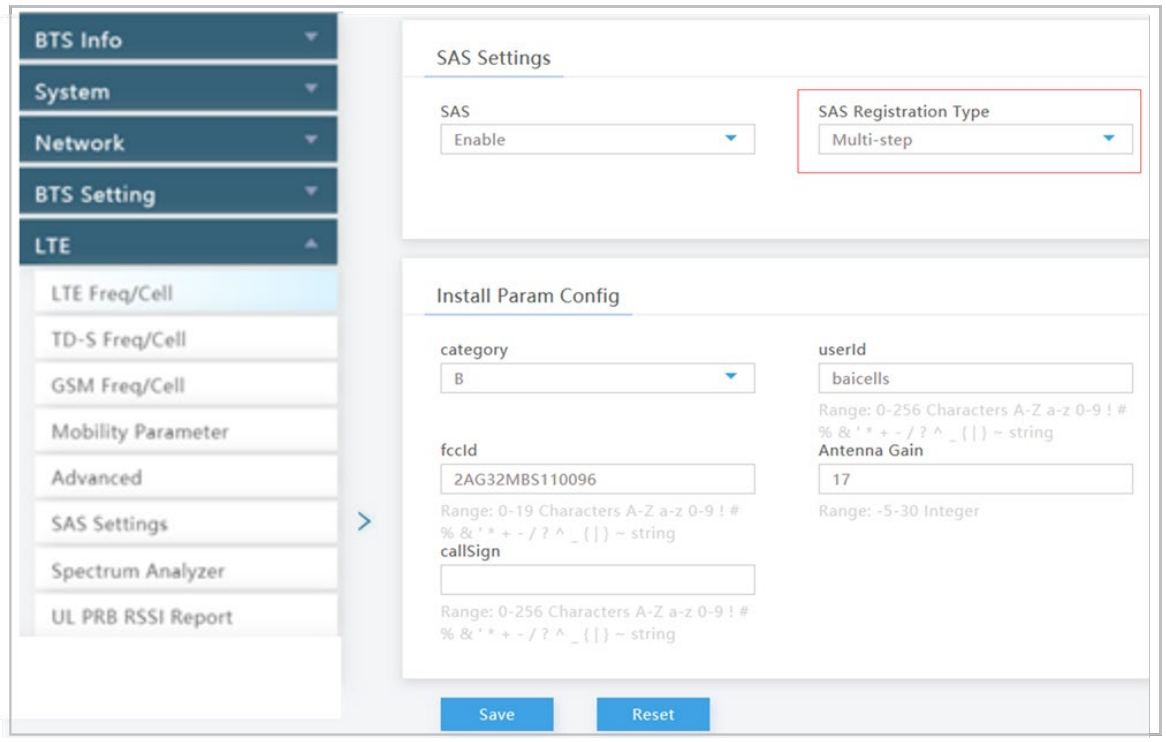


Figure 4-4: SAS Settings (QRTB 2.6.2, Single-Step Registration in DC Mode) (1 of 2)

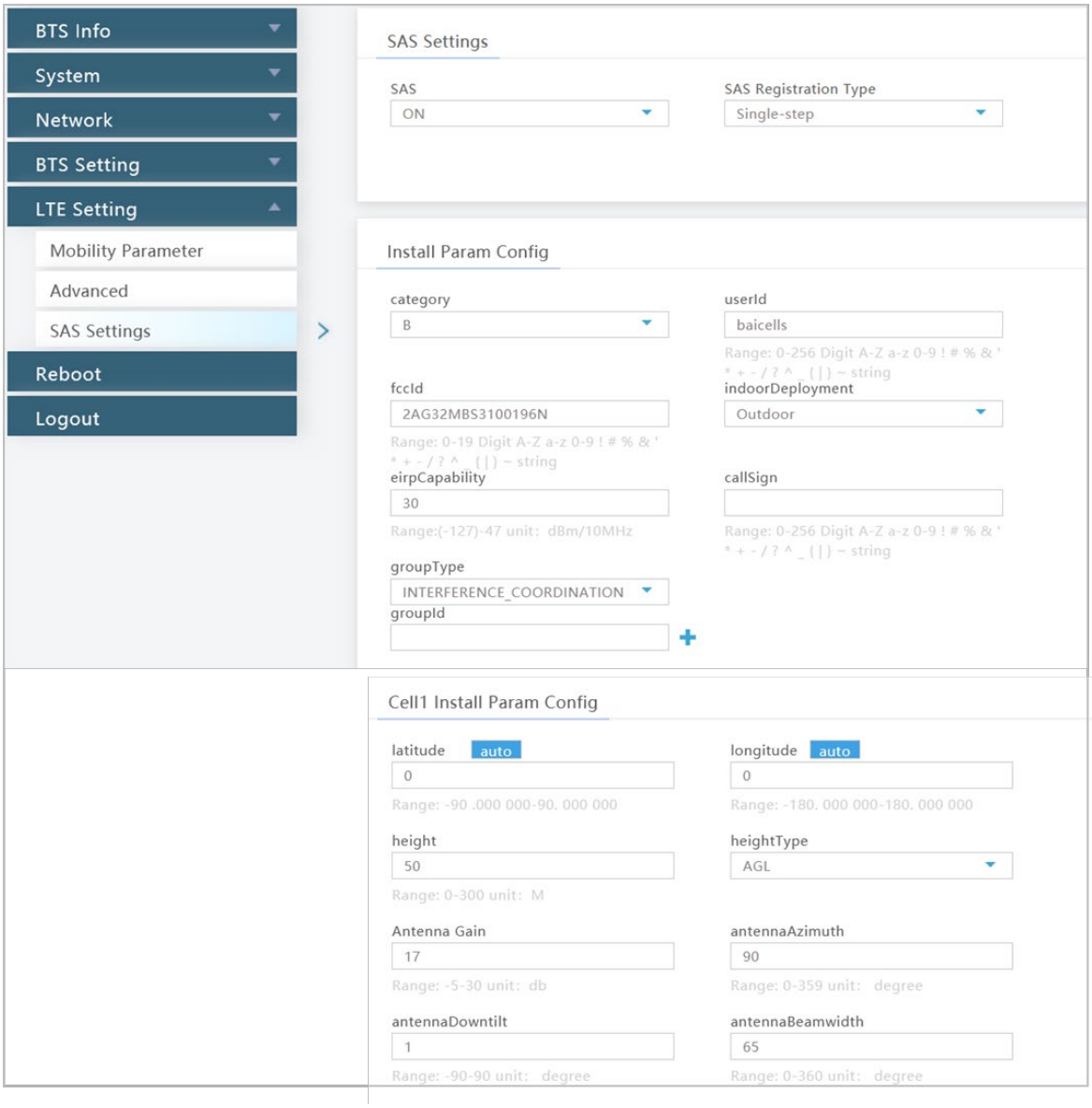


Figure 4-5: SAS Settings (QRTB 2.6.2, Single-Step Registration in DC Mode) (2 of 2)

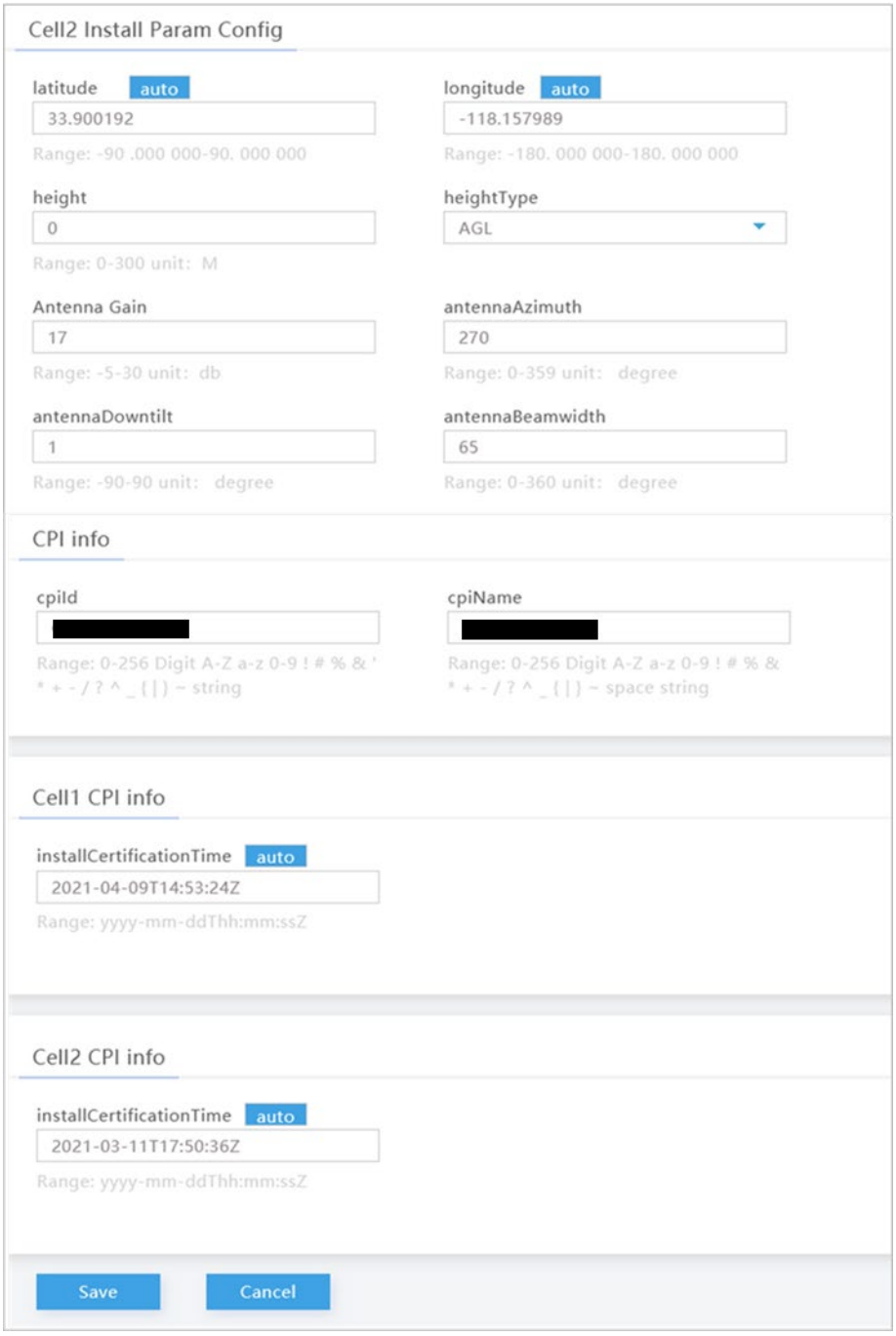
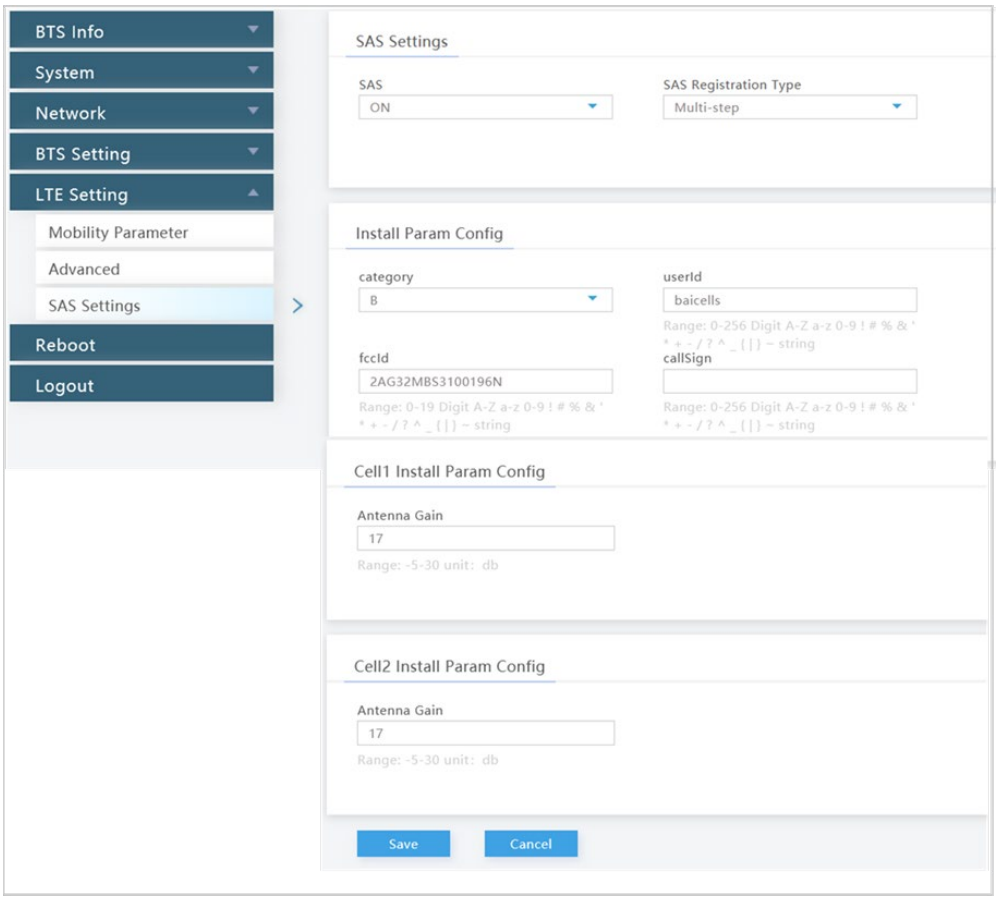


Figure 4-6: SAS Settings (QRTB 2.6.2, Multi-Step Registration in DC Mode)



4.2.1.2 Upload the CPI certificate on eNB GUI

The steps below are required to upload the CPI certificate before you can perform steps in *section 4.4*, which is where you register the CBSD with the SAS vendor. For RTS 3.6.6, see Figure 4-7. For QRTB 2.6.2, see Figure 4-8.

1. Go to System > CertStore.
2. *SAS CPI certstore*: If you will be using a p12 file format, select the check box, and enter a password. Choose *Select File*, and navigate to the certificate file. Select *Upload*. The file name appears in the *Certificate List* window.

*NOTE: Certificate file types supported are p12 and pem. One of the pem formats is pkcs8.

- If you select file type p12, you have to input a password.
- If you select file type pkcs8, you do not need a password.

Figure 4-7: Certificate Upload (RTS 3.6.6)

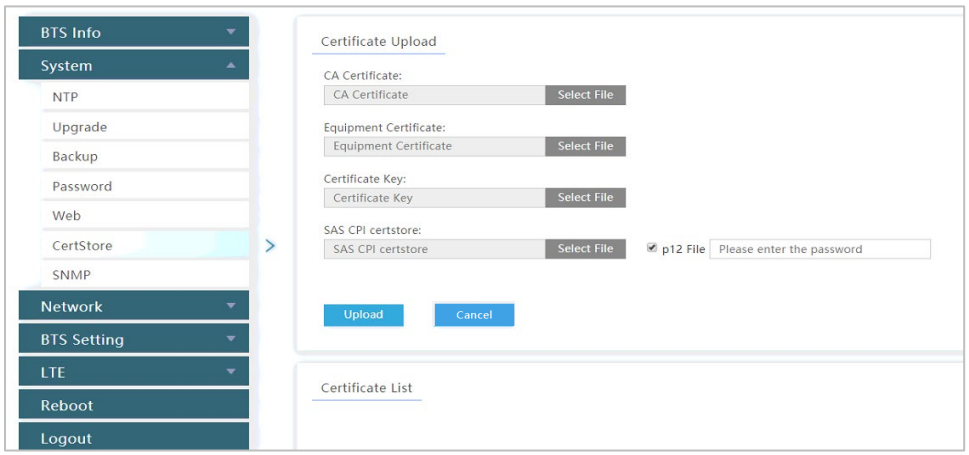
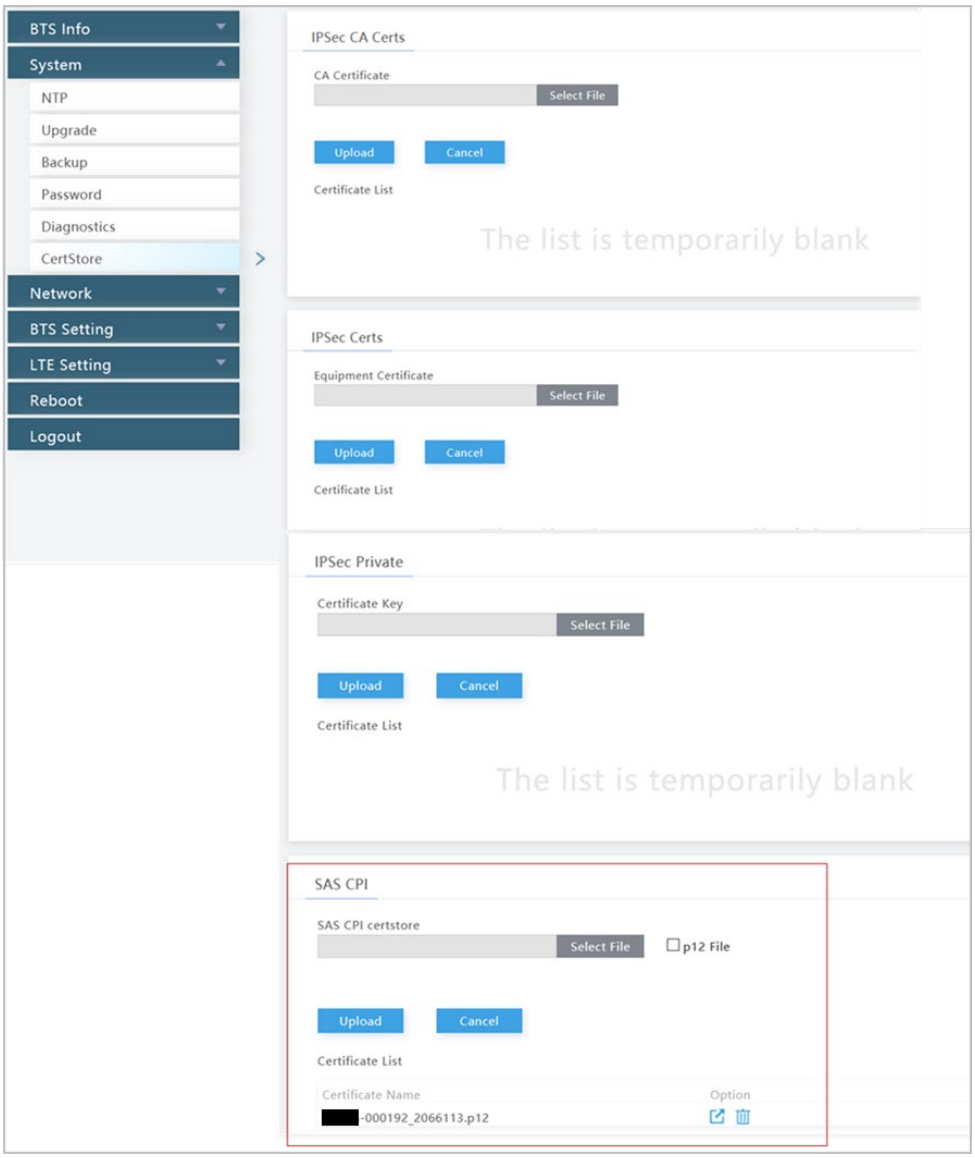


Figure 4-8: Certificate Upload (QRTB 2.6.2)



4.2.1.3 Configure Quick Setting parameters on eNB GUI

The steps below are required to configure the eNB Quick Setting parameters. For RTS 3.6.6, see Figure 4-9. For QRTB 2.6.2, see Figure 4-10.

1. Go to BTS Info > Quick Setting.
2. *Legacy Mode*: If you have CPEs that only support Bands 42 or 43, set the Legacy mode to "Enable" (RTS software) or "True" (QRTB software) . The default value is "Disable" (RTS software) or "False" (QRTB software).
3. *Frequency Selection Logic*: By default, after sending a request for spectrum from the SAS, the DP selects the first channel available from the SAS's response. But operators can configure their preferred frequencies, channel bandwidth, and power by selecting a *Frequency Selection Logic* and entering the *Preferred Bandwidth, Preferred Power*, and *Preferred Frequency.*

   For example, if you choose Power, Frequency, Bandwidth for this setting, the DP uses power as the most important value to calculate CBRS channel selection.

   Select one of the following to indicate the order of importance for the frequency selection logic:

   - Frequency, Bandwidth, Power
   - Frequency, Power, Bandwidth
   - Bandwidth, Frequency, Power
   - Bandwidth, Power, Frequency
   - Power, Bandwidth, Frequency (default)
   - Power, Frequency, Bandwidth
4. *Preferred Bandwidth*: Enter the preferred bandwidth for this eNB.
5. *Preferred Power*: Enter the preferred power for this eNB. Preferred power is the total TX power (in dBm) being transmitted per carrier. For example, if it is desired for the eNB to emit 2W of power (2x1W) per carrier, then preferred power would be 33 (dBm).
6. *Preferred Frequency*: Enter the preferred frequency for this eNB. You can add more than one preferred frequency and set the priority of each. To add more preferred frequencies, click on the **+** (Add) icon, enter the value(s), and set the priority. If the eNB is a two-carrier eNB, enter the preferred frequency or frequencies for the Primary Cell (Pcell) and Secondary Cell (Scell).

NOTE 1: When applying any changes to these preferred parameters, the DP will automatically relinquish the eNB's existing grant and restart the spectrum inquiry and grant procedure.
NOTE 2: If you have purchased a Priority Access License (PAL), then when you are using the frequency selection logic, the DP chooses that channel type instead of a General Authorized Access (GAA) channel. You can view SAS logs to verify the authorized channels in use. See *section 4.4.1* and Figure 4-31 for more information.
NOTE 3: With the software update from QRTB 2.5.4 to QRTB 2.6.2, the "Channel Reuse" check box moved from the SAS Settings GUI to the Quick Setting GUI.
NOTE 4: For eNBs running QRTB 2.6.2 software, the "ChannelReuse" check box in the Preferred Frequency parameter displays when the eNB is set to Dual Carrier mode and the "Carrier Aggregation Enabled" check box is not checked in BTS Setting > Carrier Setting.
NOTE 5: For eNBs running QRTB 2.6.2 software, the Quick Setting GUI labels vary slightly depending on carrier setting (when set to Dual Carrier Mode) and if the "Carrier Aggregation

Enabled" check box is checked in BTS Setting > Carrier Setting. Labels are either "Cell1" and "Cell2" or "Pcell" and "Scell".

NOTE 5: SAS vendors recommend requesting grants before 12:00 AM or after 3:00 AM PST.

Figure 4-9: Quick Setting (RTS 3.6.6)

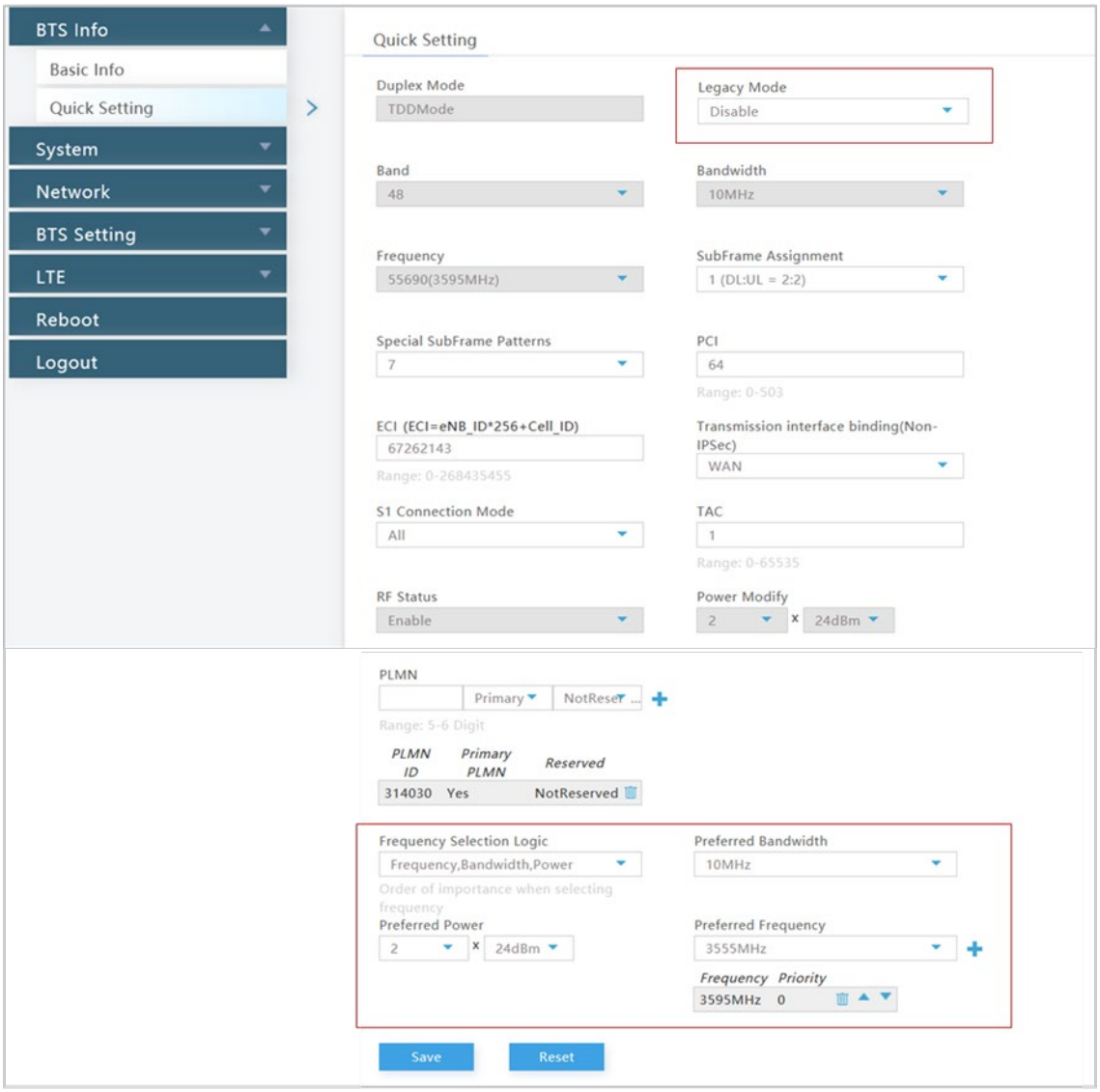
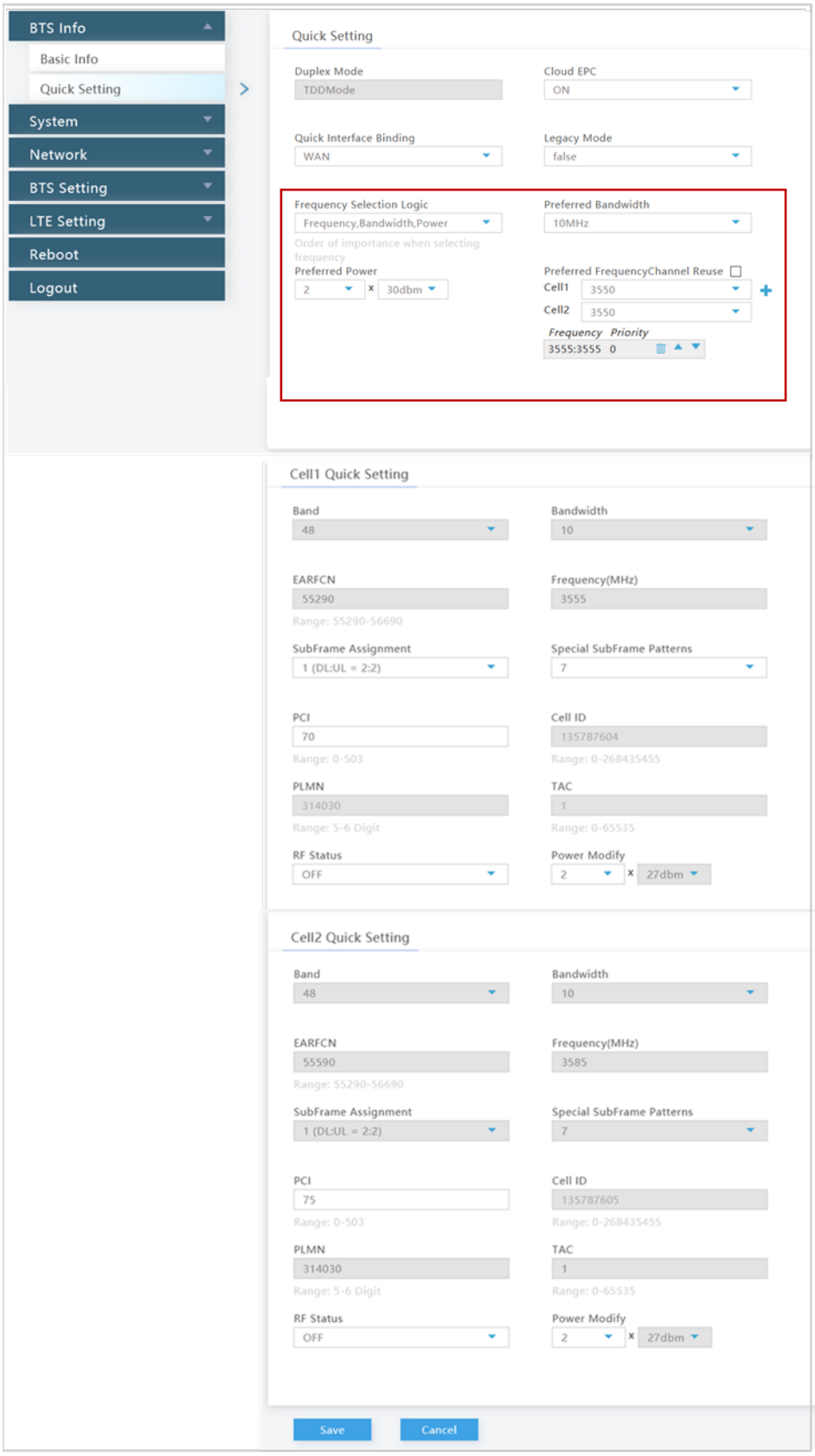


Figure 4-10: Quick Setting (QRTB 2.6.2)



4.2.2 CPE Configuration

Follow the steps below in the order shown to complete the CPE/CBSD and OMC (DP) setup.

Prerequisites: Verify the management server URL is correct on CPE GUI. Since the CPE uses a domain proxy (DP) method to connect to the SAS, an OMC connection is required.

1. Go to System > TR-069, and ensure the *ACS Address* field has been entered correctly.

   NOTE: The OMC functions as an Auto Configuration Server (ACS).

   a. For the CloudCore OMC, enter

   http://baiomc.cloudapp.net:48080/smallcell/AcsService.

   b. For a Local OMC, enter the Local OMC server URL, e.g., **http://xx.xx.xx.xx:8080/smallcell/AcsService.**

2. If using the CloudCore OMC, enter your unique CloudKey shown at the top of your CloudCore account window. (The CloudKey is not required for Local OMC).

Perform the following steps to enable SAS operation on a certified CPE device (Figure 4-11):

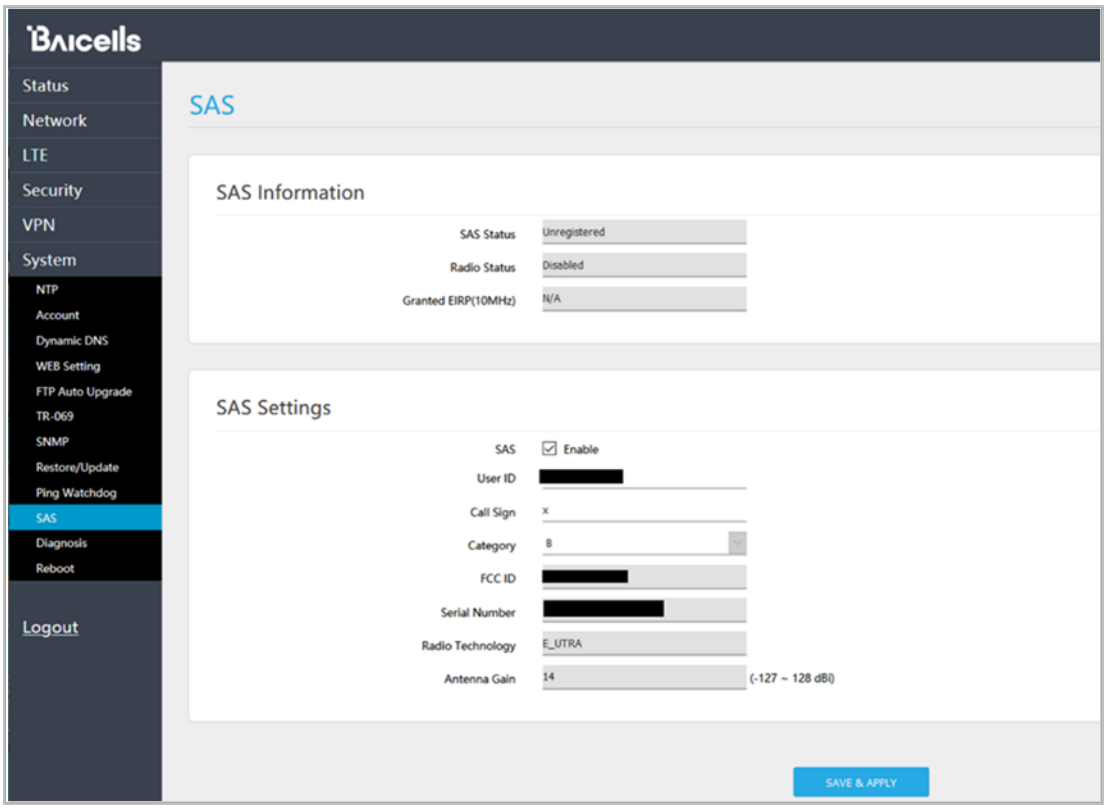
NOTE 1: Before enabling SAS on the CPE, make sure you import your CBSD information on your SAS portal for the CPE.
NOTE 2: With OMC 7.1.6 software, you can now configure and modify all the CBSD settings directly in the OMC if desired. Refer to *CloudCore Configuration & Network Administration Guide* for more information.

1. Go to System > SAS.
2. Enter the User ID provided by your SAS vendor.
3. Enter the operator's Call Sign in the *Call Sign* field. The range is 0 to 256 digits.

   NOTE: The Call Sign is a unique company identifier that is issued by the FCC. The *Call Sign* field is not a mandatory requirement and can be left blank.

4. If this is an indoor CPE leave the default setting of A. If this is an outdoor CPE leave the default setting of B.
5. All the other fields will either be auto-filled based on the model of CPE you have or are the CPE SAS status indications.
6. Click on the *Enable* check box to enable SAS.
7. Click on *SAVE & APPLY*.

Figure 4-11: CPE SAS Settings



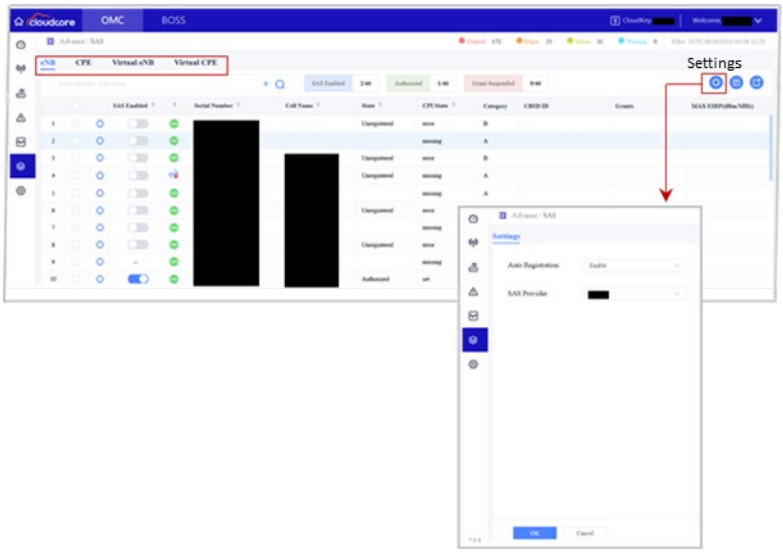
4.3 Domain Proxy (OMC) Configuration

Enable the SAS domain proxy (OMC)

1. Go to Advance > SAS and click on the *Settings* icon (Figure 4-12).
2. In the Settings pane that displays, enable “Auto Registration”, and select the SAS provider you are using; then, click OK. The Settings pane closes.
3. In Advance > SAS, all devices that have been or will be authorized to operate in SAS mode will be listed in device tabs labeled *eNB*, *CPE*, *Virtual eNB* and *Virtual CPE*. Select the desired device tab to view device details and register CBSDs.

NOTE: The OMC display defaults to the eNB device tab.

Figure 4-12 : OMC - Enable SAS

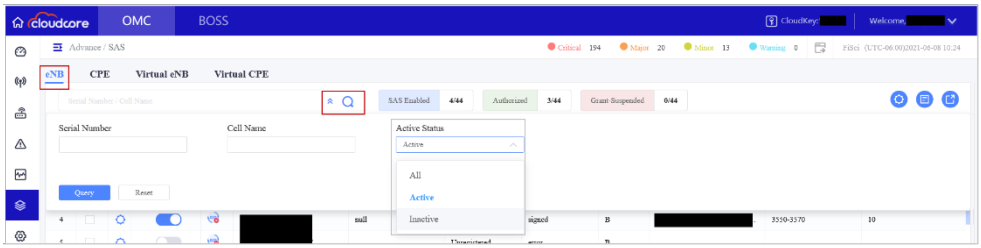


The CBSD-SAS connection setup progresses in the order shown below.

You can use the OMC query or advanced query functions (Figure 4-13) to search for a specific eNB device or to check active status.

NOTE: Refer to *CloudCore Configuration & Network Administration Guide* for more information about non-SAS-related searches you can perform.

Figure 4-13: Check eNB Active Status



There are two options from which you can choose to register the eNB and CPE CBSDs with SAS using the domain proxy (OMC) as described here.

- Choice 1 (Single-Step): Use the OMC to configure all the required parameters.
- Choice 2 (Multi-Step): Configure only the CBSD's basic information using the OMC, and then use the SAS portal to configure the antenna installation parameters.

NOTE 1: Regardless of registration type you choose, you must configure the CBSD's basic for successful registration with SAS.
NOTE 2: You must upload a CPI certificate (signature) to use Single-Step registration.
NOTE 3: The OMC also supports virtual eNB and CPE CBSD registration. See *section 4.4.2* for more information.
NOTE 4: See *section 4.2.1.3* for information on configuring eNB preferred frequency settings.

4.4 Register CBSDs with SAS

4.4.1 Register eNBs and CPEs with SAS

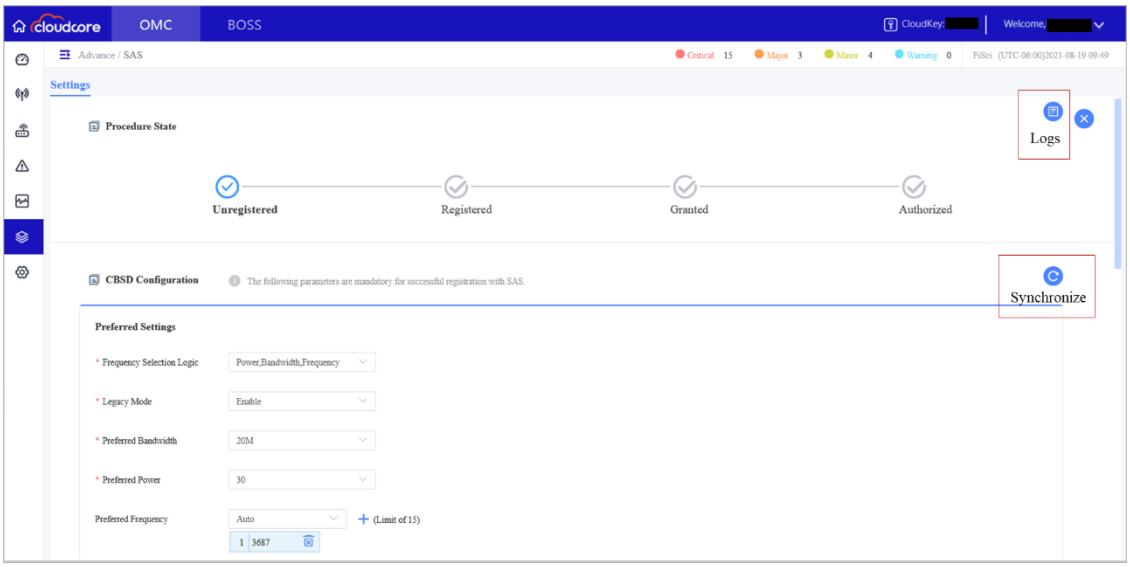
The following procedure describes how to register eNB or CPE device types using the OMC to configure all the required parameters (Single-Step registration):

1. Identify all antenna requirements before starting procedure.
2. On the OMC, go to Advance > SAS.

   NOTE 1: The OMC display defaults to the eNB device tab list and you can click on CPE device tab when needed.
   NOTE 2: Each CBSD device row includes a Settings icon to left of row.
   NOTE 3: All figures in this section show eNB GUIs because most of the SAS Setting parameters for eNB and CPE device types are the same.

3. Click the Settings icon on the left of the desired device to display its Settings window (Figure 4-14, Figure 4-15, and Figure 4-16).

Figure 4-14: Register CBSD with SAS (Page 1 of 3)



NOTE 1: The Synchronize icon can be used to immediately synchronize the eNB SAS settings with the OMC. One practical example for using this function is to upload a new CPI certificate from here by synchronizing with an eNB that has the certificate already loaded.
NOTE 2: Device logs can be viewed by clicking on the Logs icon. See step 12 and Figure 4-21 for more information.

Figure 4-15: Register CBSD with SAS (Page 2 of 3)

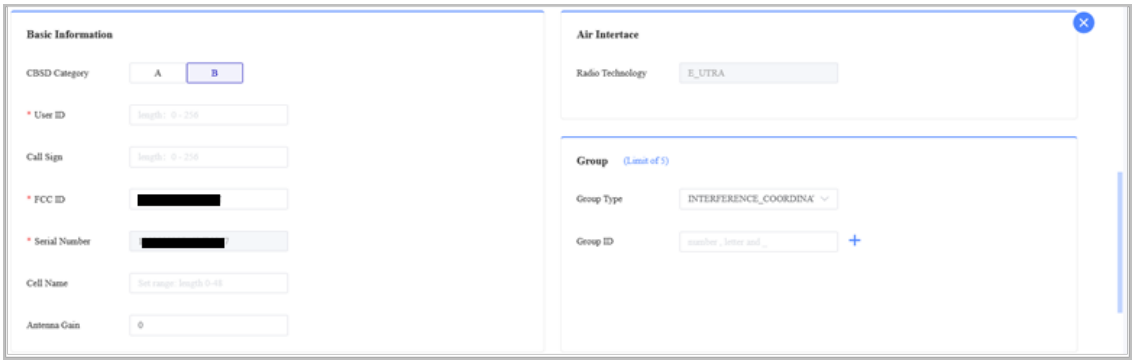
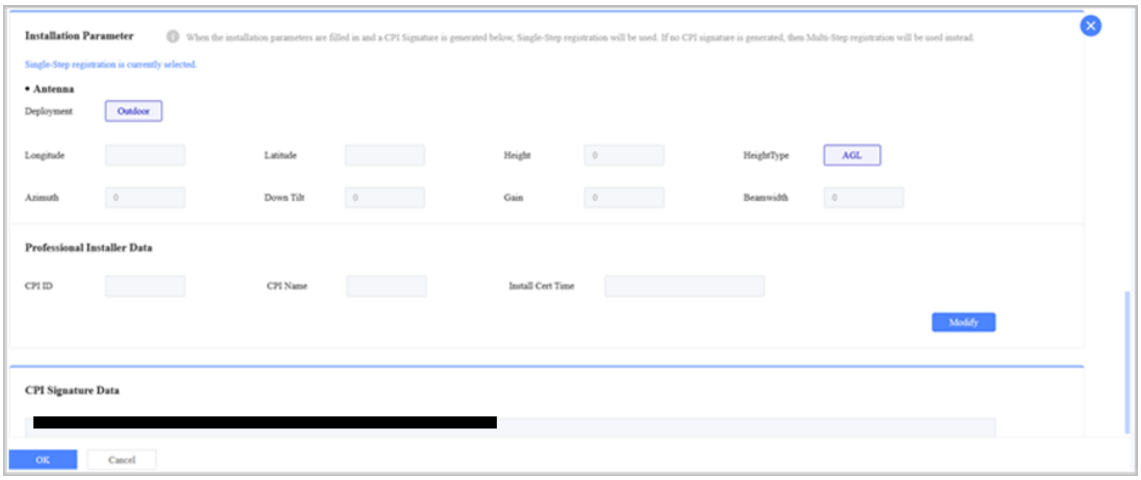


Figure 4-16: Register CBSD with SAS (Page 3 of 3)



4. Configure the required preferred settings parameters, which may vary depending on CBSD device type.

   NOTE: Set Legacy Mode to “Enable” if there are legacy CPEs that only support Bands 42 or 43.

5. Configure the required basic information parameters, which may vary depending on CBSD device type.

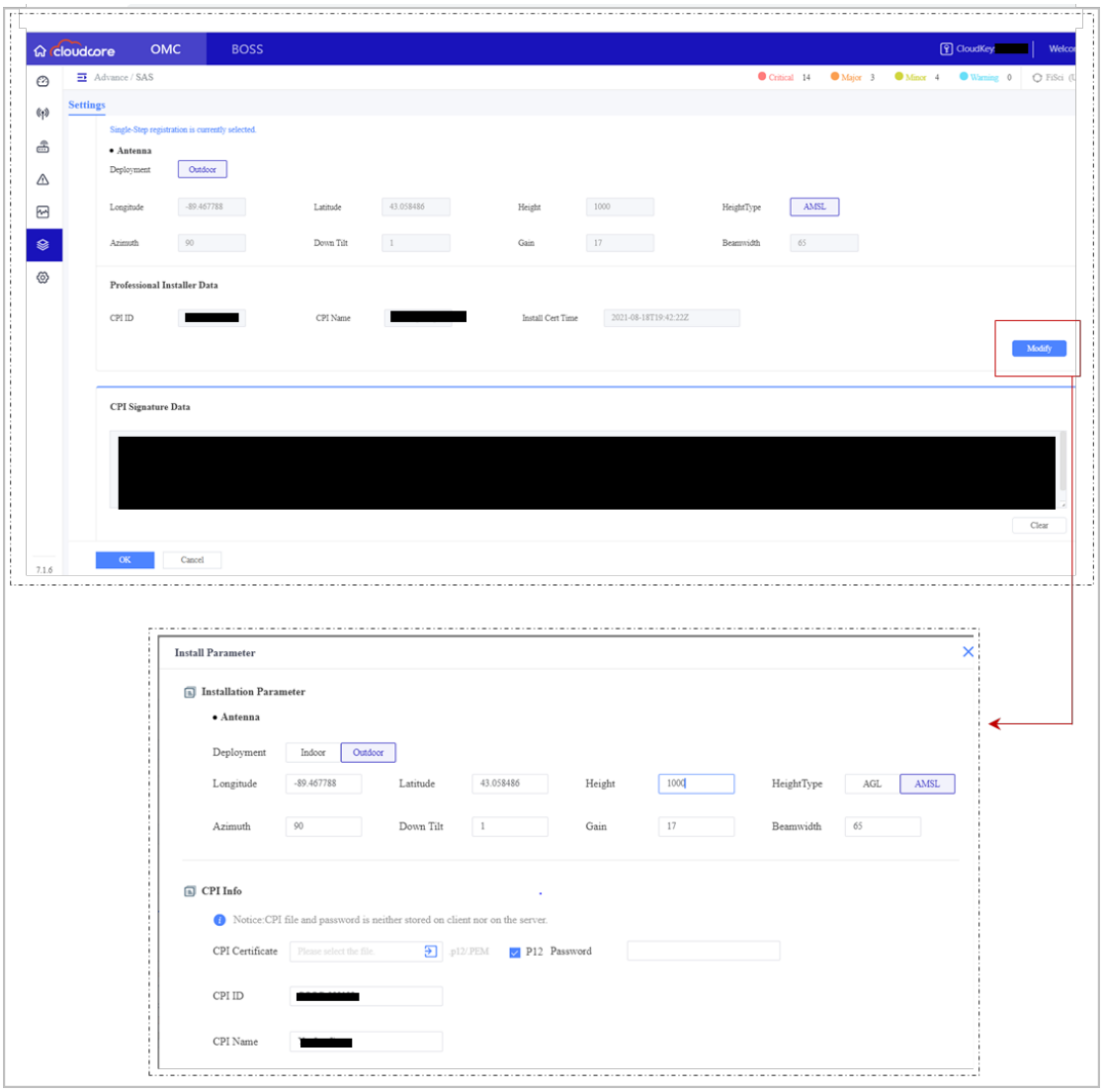
   NOTE: The User ID is provided by your SAS vendor. The Call Sign is a unique company identifier issued by the FCC. You can configure the Call Sign, but it’s not a mandatory requirement.

6. Configure the required air interface parameters (Radio Technology and Group). At this time, for Radio Technology you will see only E_UTRA and the field is greyed out. This identifies that

the eNB CBSD is using LTE technology. Currently, only INTERFERENCE_COORDINATION is used in the Group pane. SAS vendors will likely use CBSD groups in the future when General Authorized Access (GAA) coexistence is introduced.

7. Configure or modify antenna parameters by clicking the “Modify” button and uploading your CPI certificate information (Figure 4-17).

Figure 4-17: Modify CBSD Antenna Parameters

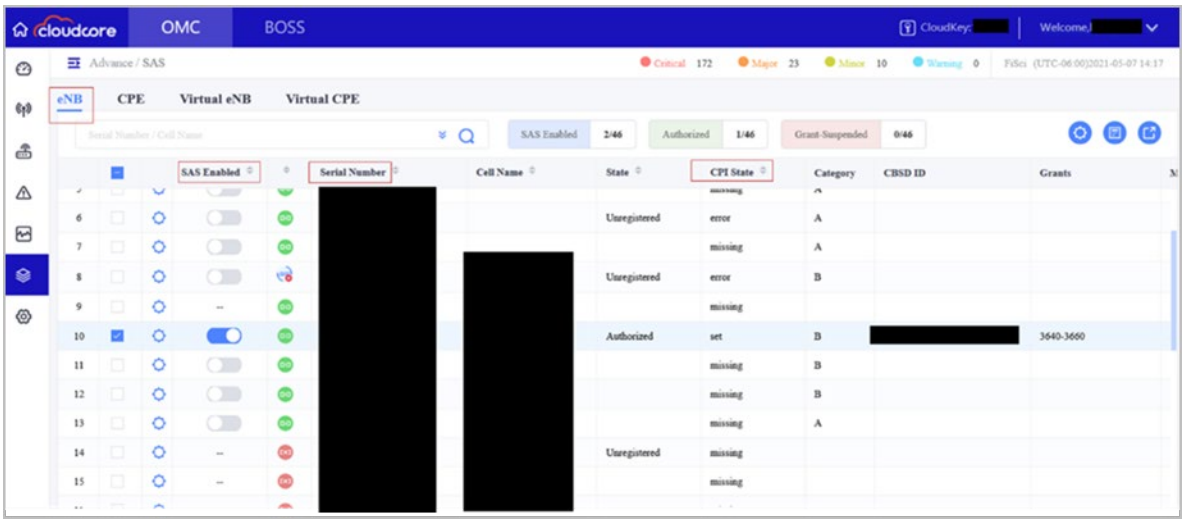


8. Configure antenna installation parameters (Deployment, Longitude, Latitude, Height, HeightType, Azimuth, Down Tilt, Gain, and Beamwidth).

9. Click OK; then, click the X icon in upper right-hand side of screen to close Settings pane.

10. Check CBSD SAS connectivity (Figure 4-18): Go to Advance > SAS, click on the CBSD device tab in the upper left-hand side of screen, and confirm the CBSD is listed and connected by checking the following columns: *SAS Enabled, Serial Number*, and *State*.

Figure 4-18: Confirm CBSD SAS Connectivity



11. Check the CBSD's connection state by clicking on the Settings icon for the device you want to check and the Settings pane displays. You'll see a Procedure State diagram at the top of the Settings pane. If you hover over one of the Procedure State icon labels, you will get a drop-down menu to take action on *that* step of the connection setup process. In Figure 4-19, for example, the device is not registered yet and is shown as *Unregistered*. Another scenario would be if you've enabled SAS and want to manually request device registration using the Procedure State diagram rather than using the auto-registration option. When you hover over the *Unregistered* Procedure State icon label, the drop-down menu displays the action you perform at this point: *Register req*. Select this action to start the request. In Figure 4-20, for example, the device Procedure State shows *Authorized* and the drop-down menu displays two actions you can perform at this point: *Heartbeat req* and *Relinquishment req*.

Figure 4-19: Check CBSD Connection Details (Example 1, Unregistered)

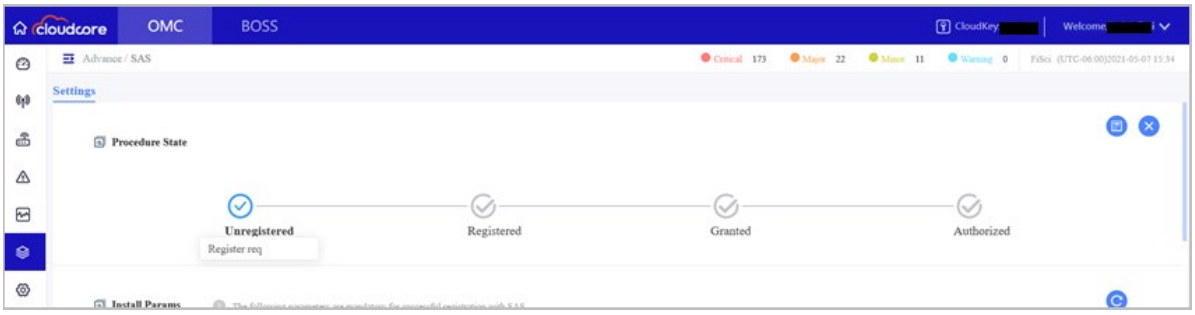
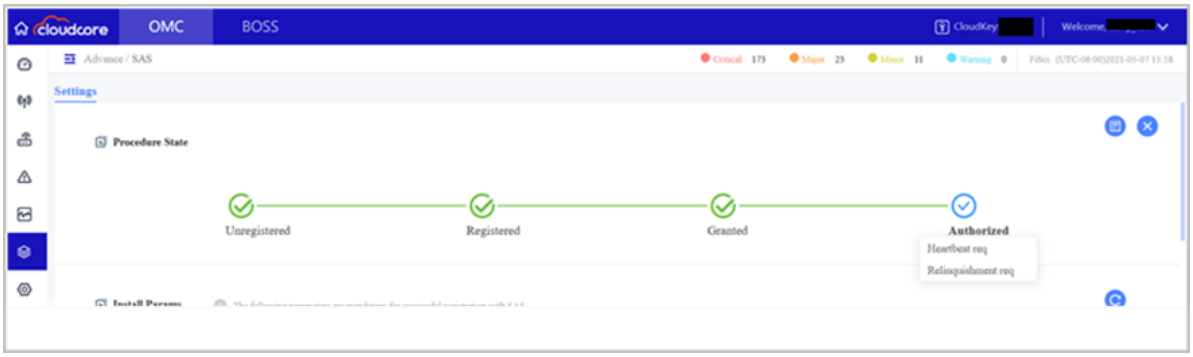


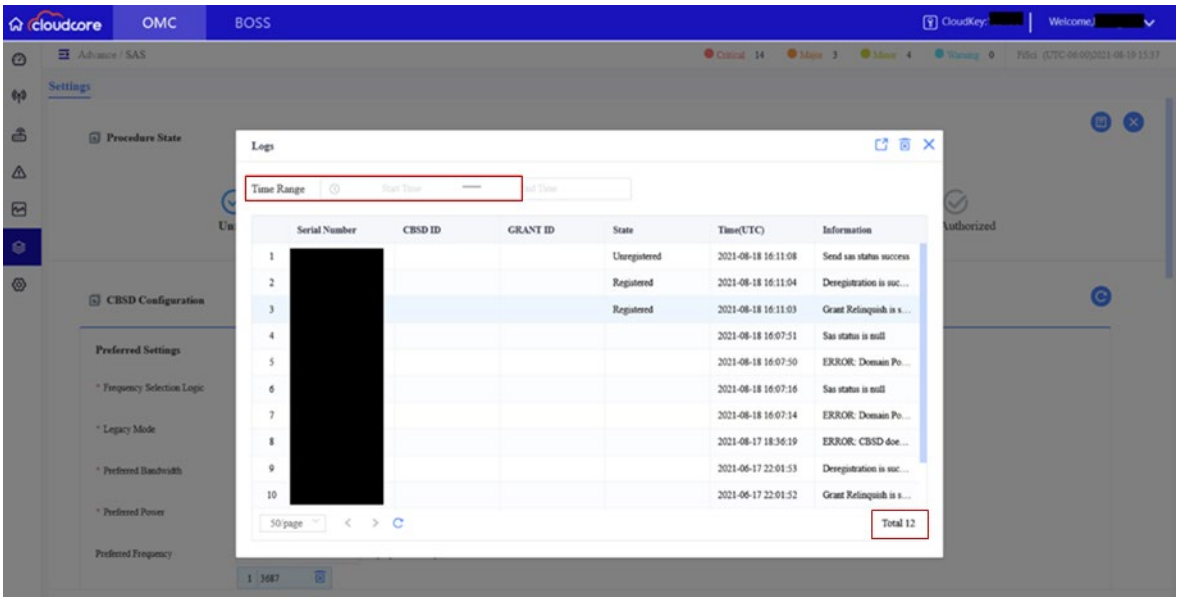
Figure 4-20: Check CBSD Connection Details (Example 2, Authorized)



12. Access device logs by first selecting the eNB or CPE device tab on the upper left-hand side of screen to display the complete device list. Then, click the Settings icon on left of the desired device to display its Settings window. In the Settings window, click the Logs icon to display a log of all the key events that have occurred for the device since it was registered with SAS. Figure 4-21 shows an example of a device log with 12 total key events that have occurred for the selected device.

    Notice the default setting for an initial device logs query doesn't include a specific date and time range. If you want to apply filters to view a sub-set of device logs online, see step 13. If you want to apply filters to export a sub-set of device logs to another file, see step 14.

Figure 4-21: Access Device Logs (All Key Events)

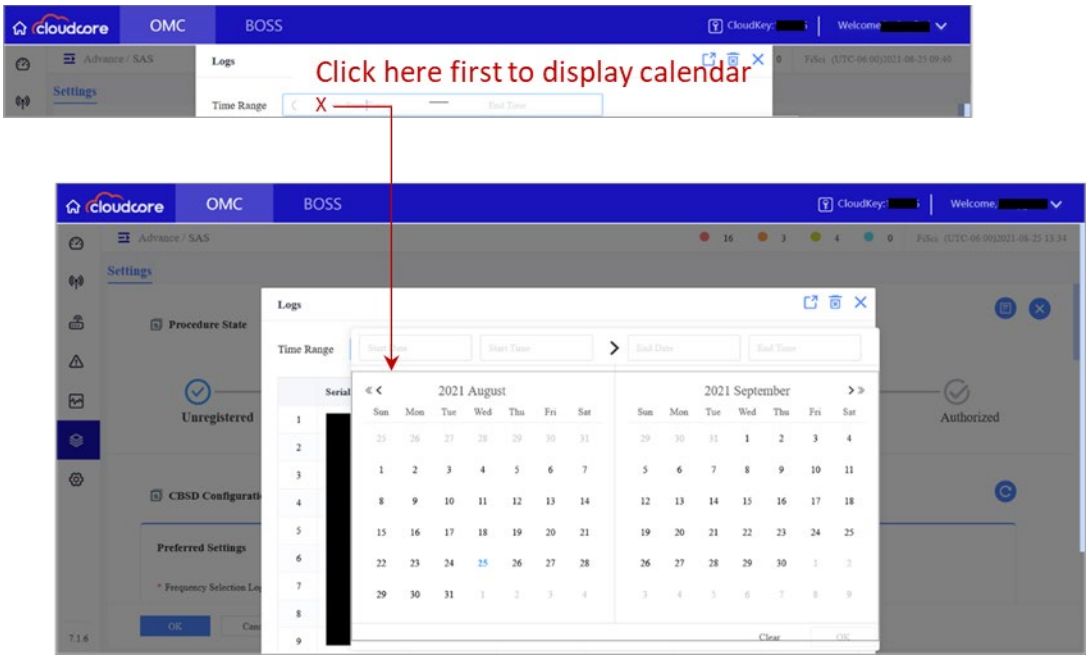


13. After accessing device logs (step 12), you can filter and view a sub-set of them online according to a preferred date and time range by performing the following steps:

NOTE 1: If you plan to export the device logs file instead of viewing online, we recommend applying the filters while using the Export function and not at this step. See step 14.
NOTE 2: The time range you specify cannot exceed 7 calendar days (to the exact hour, minute, and second) or you will receive an error message.
NOTE 3: To configure a time range filter, you must first select a start and end date (step 13a through step 13c) before you can select an exact time interval (step 13d through step 13g).

a. Click in the Time Range field to display a calendar (Figure 4-22).

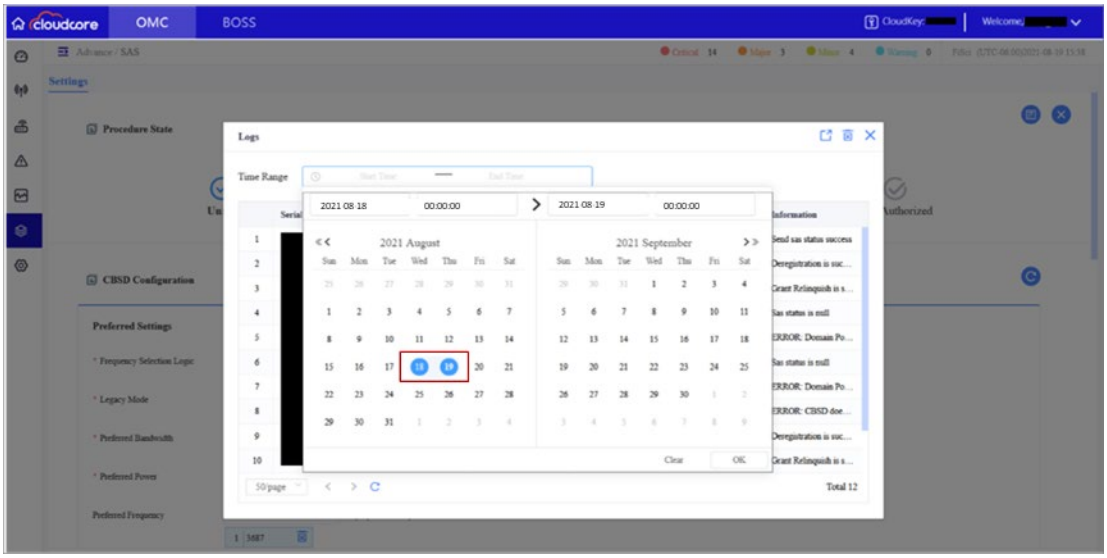
Figure 4-22: View Device Logs (Filter - Calendar Tool)



b. Without clicking anywhere else, click on a calendar day to select your preferred time range start date. Then, click on a second calendar day to select your preferred time range end date (Figure 4-23).

Notice the date range fields at the top of the calendar update to display the days you selected.

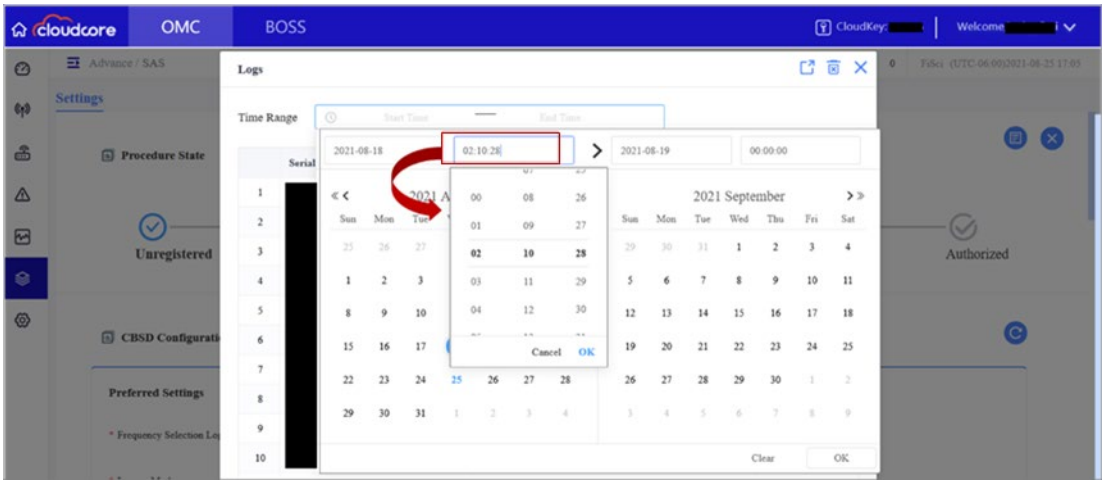
Figure 4-23: View Device Logs (Filter - Set Date Range)



c. If you want to set specific time intervals for the filter, see step 13d through step 13g. Otherwise, go to step 13h.

d. Click on the start date time interval field to display the time set box (Figure 4-24), which contains three columns for setting hours, minutes, and seconds.

Figure 4-24: View Device Logs (Filter - Set Time Interval)



e. Click in the first column, scroll to the hour you want and select it. Then, repeat the process to select minutes from the middle column and seconds from the third column, in that order.

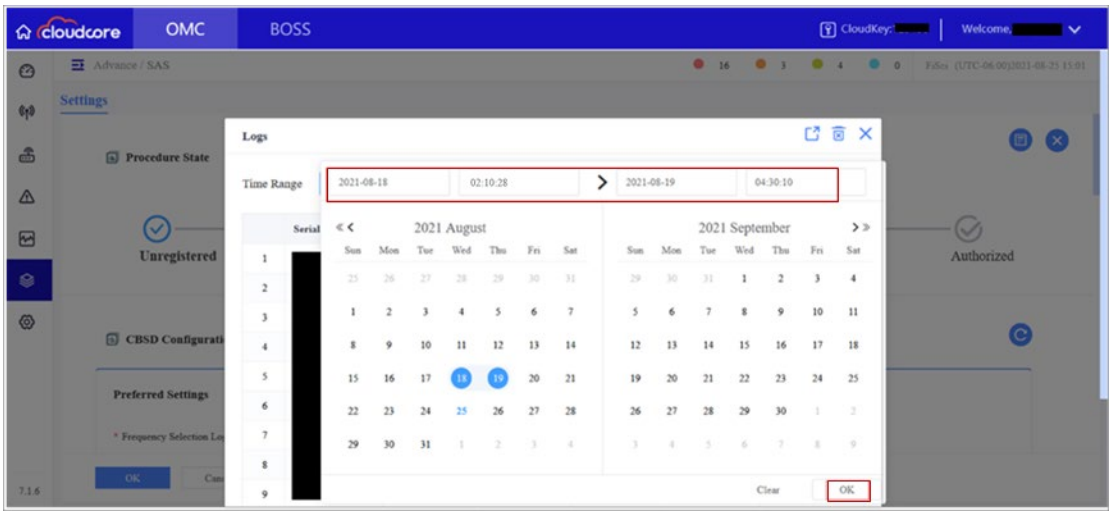
NOTE: The time intervals can also be entered in the time interval fields instead of using the time set boxes, if you prefer. Make sure you enter the times using the format “hh:mm:ss” with colons separating each increment.

f. Click OK in the time set box.

g. Click on the end date time interval field to display its associated time set box. Repeat step 13e and step 13f to specify the end date time interval. Then proceed to step 13h.

h. Click OK in the main Logs window to apply the filters (Figure 4-25) or click CLEAR to make new selections.

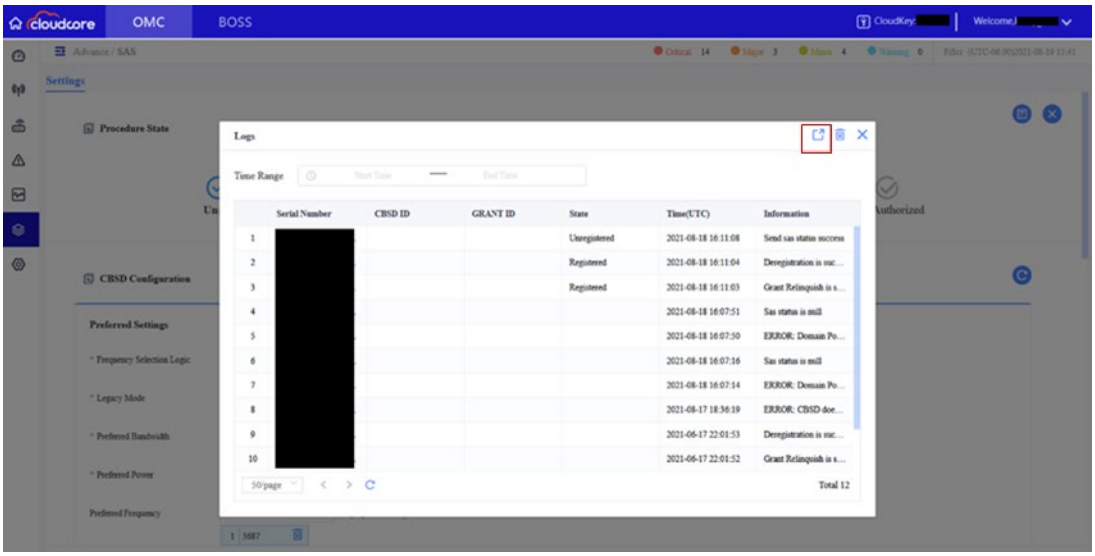
Figure 4-25: View Device Logs (Filter - Apply Preferences)



14. After accessing device logs (step 12), you can filter and export a sub-set of them according to a preferred date and time range by performing the following steps:

    a. Click on the Export icon in the Logs window (Figure 4-26).

Figure 4-26: Display Export Window



Once the Export window displays, there are several different ways you can filter the device log file before exporting it. Use the export default date and time ranges (see step 14b), or export the log files according to your preferred date and time ranges (see step 14c), or export the log files for the current date and time only (see step 14d).

b. In the Export window that displays after you perform step 14a, notice the default (autofilled) Start Time and End Time fields that are displayed (Figure 4-27). The default ranges use the current calendar day and time to specify the End Time range. Likewise,

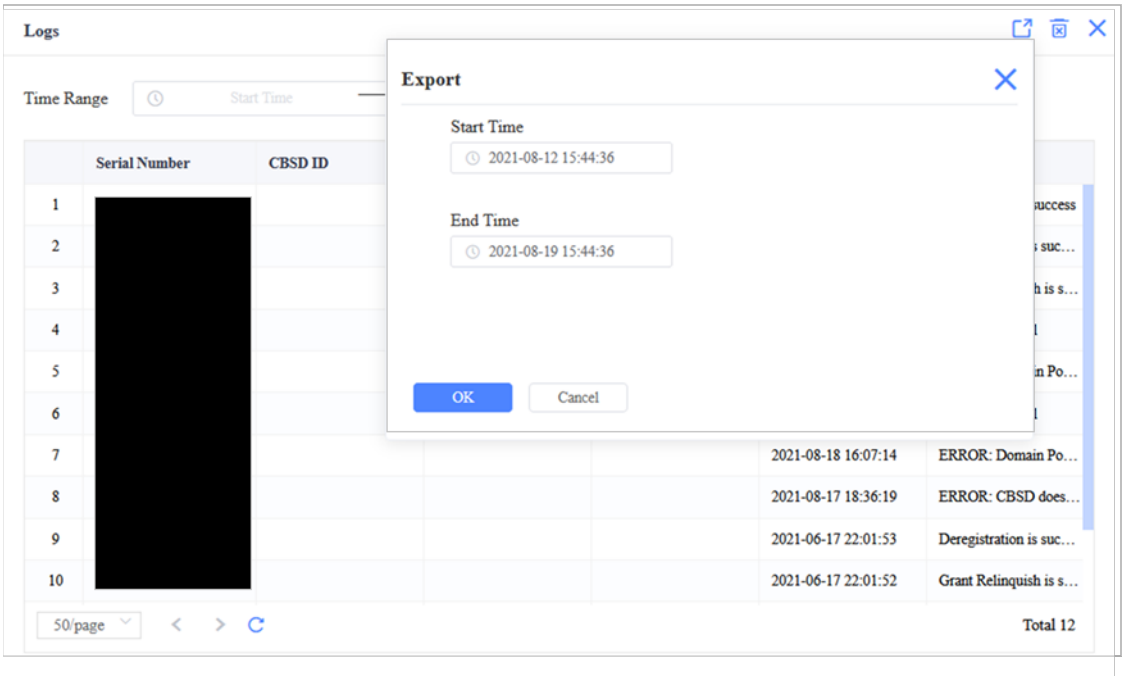
according to the maximum day range rule, the Start Time range is specified as 7 days prior to the End Time range, to the exact hour, minute, and second.

(1) Click OK in the Export window to accept the default date and time range specified. Then, follow the prompts to complete the file export action.

(2) If you want to change the dates to a preferred range, go to step 14c and follow the directions.

(3) Click Cancel if you do not want to accept the deafault date and time range specified. This action will take you back to the device Log window.

Figure 4-27: Export Device Logs (Filter - Default Time Ranges)

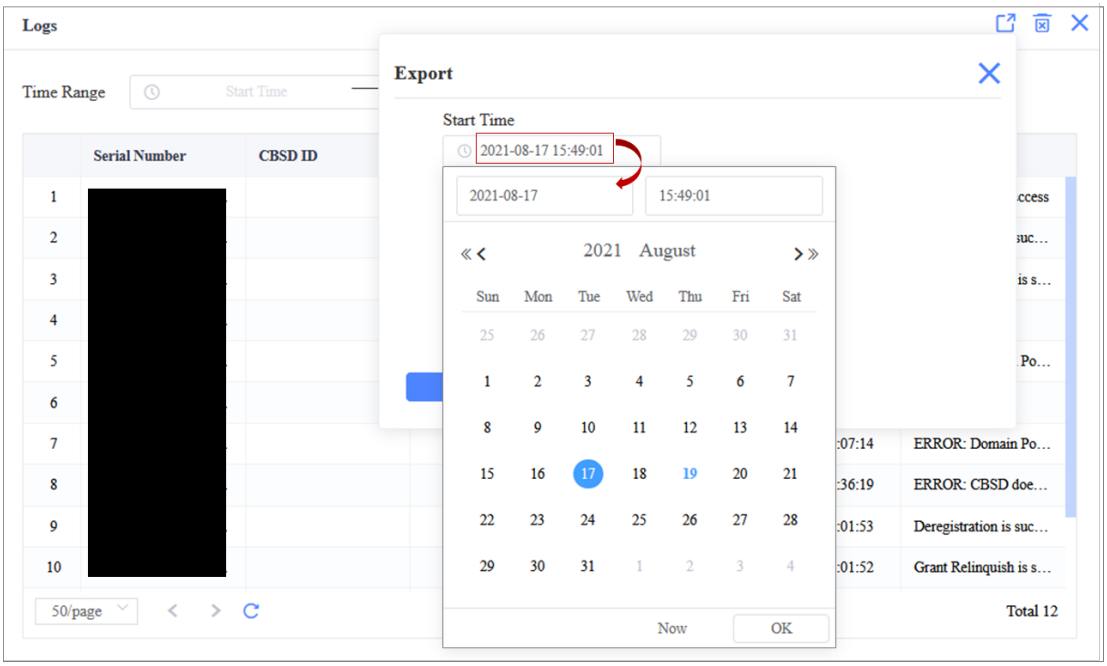


c. In the Export window that displays after you perform step 14a, configure your preferred date and time range for exporting device logs by performing the following steps:

NOTE: The time range you specify cannot exceed 7 calendar days (to the exact hour, minute, and second) or you will receive an error message.

(1) Click in the Start Time field to display a calendar (Figure 4-28). Notice the calendar has two fields: one is used to set the date and one is used to set the time.

Figure 4-28: Export Device Logs (Filter - Custom Time Ranges)



(2) Without clicking anywhere else, click on a calendar day to select your preferred time range start date. Notice the date range field at the top of the calendar updates to display the day you selected.

(3) If you want to set a new time increment other than the time that displays on the calendar, click in the time interval field to display the time set box, which contains three columns for setting hours, minutes, and seconds.

(4) Click in the first column, scroll to the hour you want and select it. Then, repeat the process to select minutes from the middle column and seconds from the third column, in that order.

NOTE: The time interval can also be entered in the time interval field instead of using the time set box, if you prefer. Make sure you enter the time using the format “hh:mm:ss” with colons separating each increment.

(5) Click OK in the time set box.

(6) If you want to select a preferred end date, click in the End Time field to display a calendar and use the same method to change it that you used to configure the start time in the previous step 14c(2) through step 14c(5) . Then, proceed to step 14c(7).

(7) Confirm the date and time ranges displaying in the Export window are set to your preferences and click OK in the Export window. Then, follow the prompts to complete the file export action.

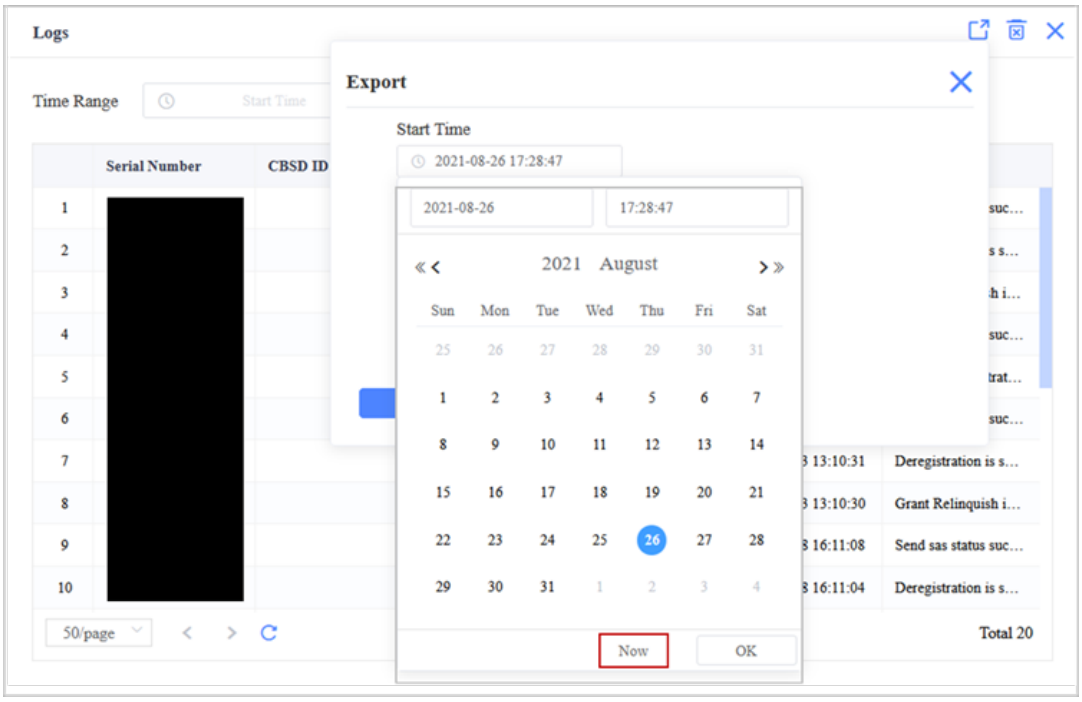
d. In the Export window that displays after you perform step 14a, you can export the files for the current date and time by performing the following steps:

(1) Click in the Start Time field to display a calendar. Notice the calendar shows, highlighted in a blue circle, the day identified in the original Start Time field.

(2) Click on the current date in the calendar and notice the blue circle moves to highlight the day you selected.

(3) Click NOW. The calendar closes and both the Start Time and End Time fields in the Export window update to display the current time and date (Figure 4-29).

Figure 4-29: Export Device Logs (Filter - Current Date and Time)

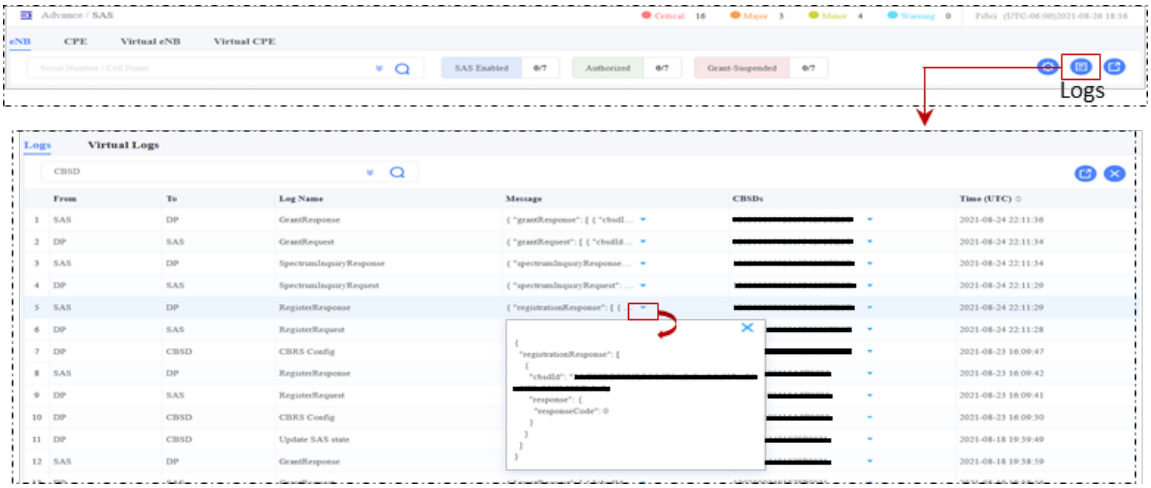


(4) Click OK in the Export window. Then, follow the prompts to complete the file export action.

15. View SAS logs by clicking on the Logs icon in the upper right-hand side of the main Advance > SAS window. The *Logs* and *Virtual Logs* tabs list all CBSD to SAS messages (Figure 4-30). The logs show information pertaining to CBSD <-> OMC (DP) <-> SAS communications, i.e., messages sent to and from SAS. The columns show the direction (to/from), the object (SAS, CBSD), the message sent or received, the CBSD involved, and the date and time* of the event. Under the Message column, use the drop-down arrow to view the actual code of a message. See *section 4.4.2* for information regarding the *Virtual Logs* tab.

*NOTE: The time reported is in Coordinated Universal Time (UTC) format.

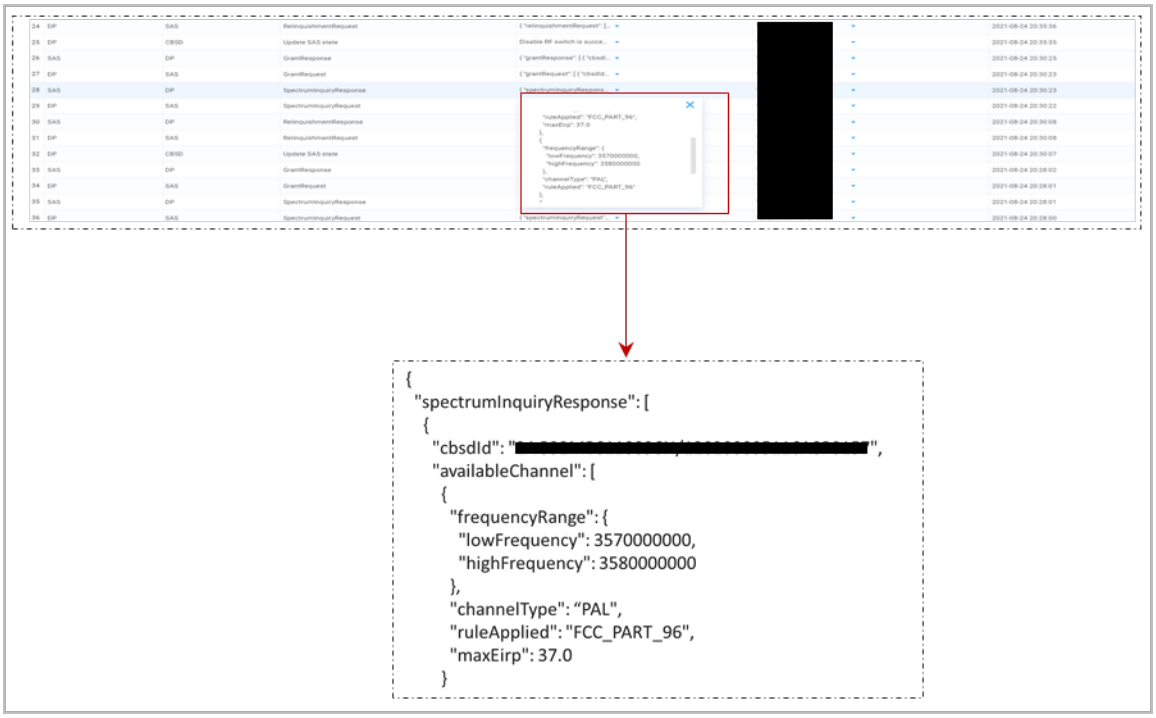
Figure 4-30: SAS Logs



16. Check “spectrumInquiryResponse” messages in the SAS logs (Figure 4-31) to verify the types of channels (GAA and/or PAL) being requested for use according to the frequency selection logic settings you selected in section 4.2.1.3.

NOTE: Currently, adjacent 20MHz PAL channels are not supported, but will be in a future software release.

Figure 4-31: Verify Authorized Channels in Use



4.4.2 Register Virtual eNBs and Virtual CPEs with SAS

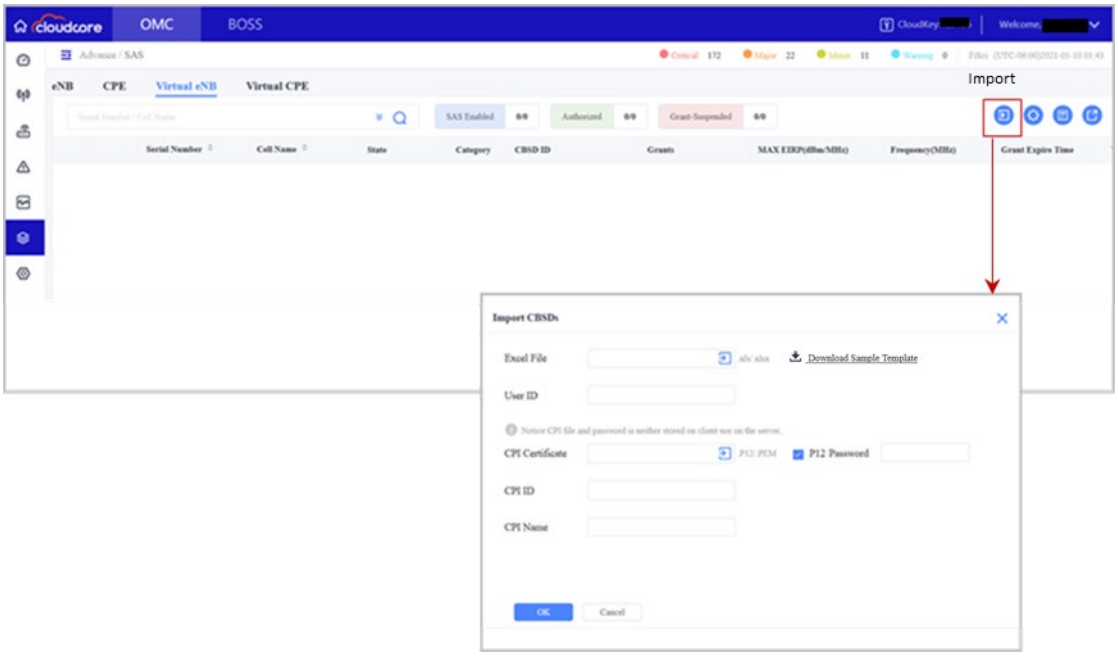
The OMC also supports virtual CBSD registration with a mass data file importing function, which allows you to register the devices in your inventory with SAS in advance of putting the devices online and connecting to the OMC. Then, once the devices are online on the OMC (DP), they will immediately be authorized by SAS. The function works for both types of virtual CBSDs (virtual eNBs and virtual CPEs).

> NOTE 1: Before beginning this procedure, we recommend creating your CBSD data file so it is ready to import to the OMC when you are prompted. Instructions are provided below to assist if you need help creating a CBSD data file.
> NOTE 2: The procedures described below are common for both types of virtual CBSDs. In the figures, the Virtual eNBs are used as examples that apply to both types.

1. On the OMC, go to Advance > SAS.
2. Click on *Virtual eNB* tab or *Virtual CPE* tab, and click on the import icon to access the Import CBSDs pane (Figure 4-32).

> NOTE: All the fields in this pane, as well as the associated files and certificates, are required for successful CBSD data file import.

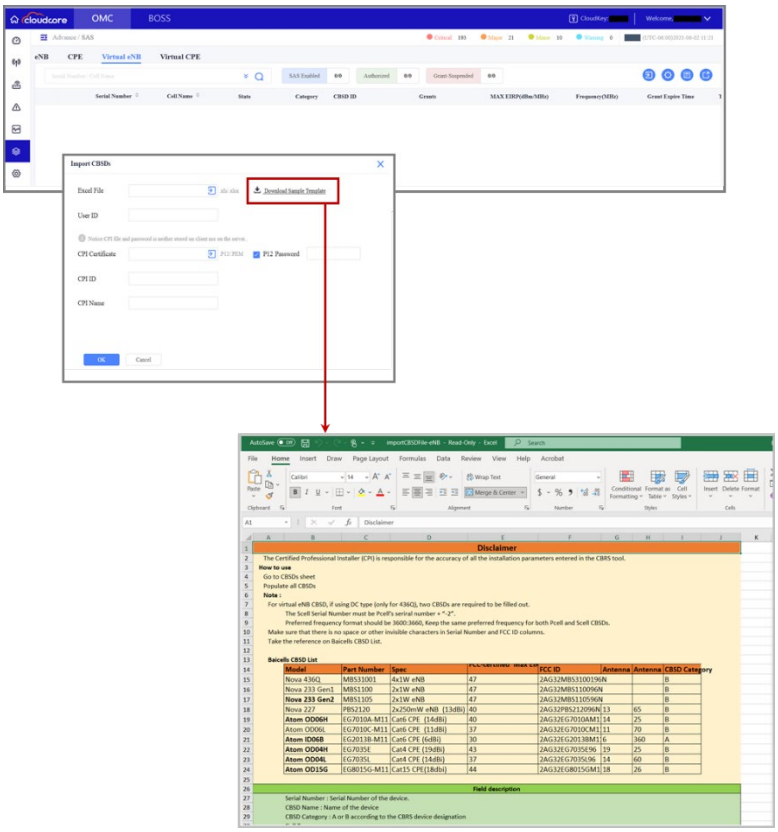
Figure 4-32: Import Virtual CBSD Data File



3. Click on the blue arrow icon to upload the Excel file containing your CBSD data. If you need help creating a CBSD data file, proceed to step 4. If not, skip to step 5.
4. Click on the "Download Sample Template" link and open or save the .xlsx file; then, once the file opens, follow the instructions provided (Figure 4-33).

> NOTE: Do not remove the template instruction page from the template file.

Figure 4-33: Download Sample Template

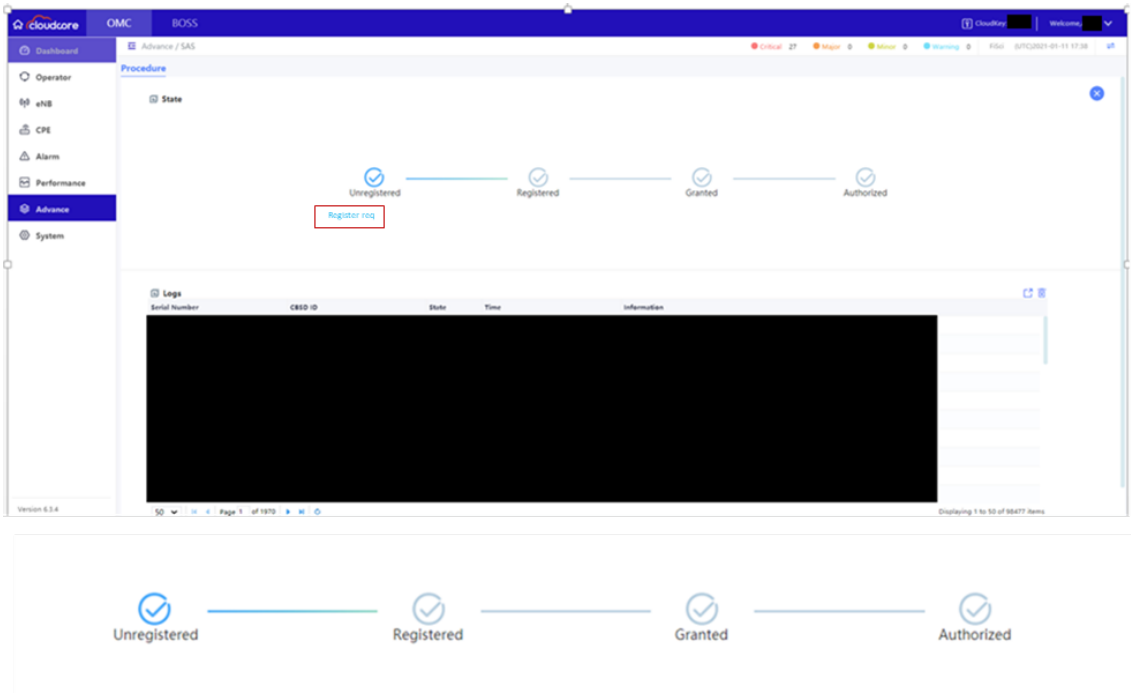


5. Input your User ID.
6. Click on the blue arrow icon to upload your CPI certificate.

   NOTE: If your CPI certificate is p12 format, then your p12 password is required.

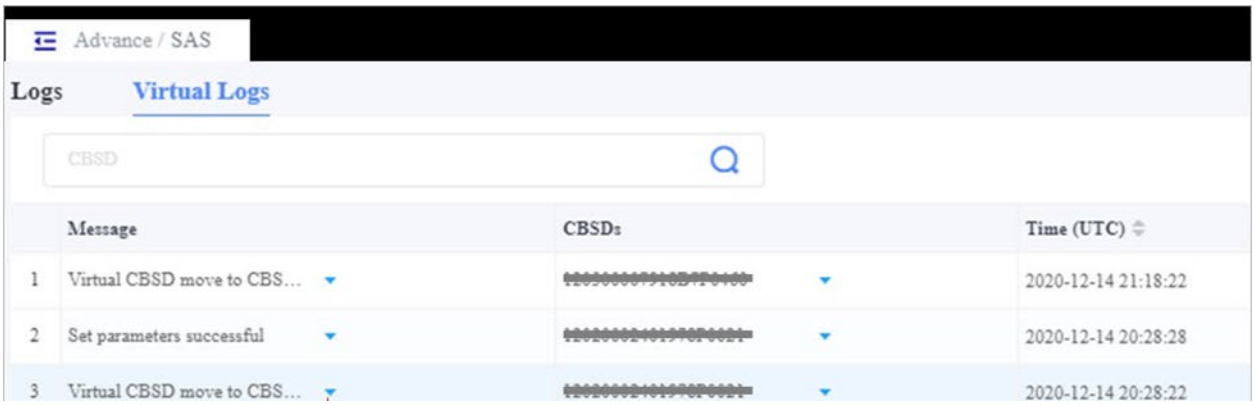
7. Input your CPI ID and CPI Name.
8. Click OK; then, click the X icon in upper right-hand side of screen to close the Import CBSDs pane.
9. Check Virtual CBSD SAS connectivity. Go to Advance > SAS, click on *Virtual eNB* tab or *Virtual CPE* tab, and confirm the Virtual CBSD is listed and connected by checking the following columns: *SAS Enabled, Serial Number*, and *State.*
10. Check the virtual CBSD's connection states. Go to Advance > SAS and click on *Virtual eNB* tab or *Virtual CPE* tab. Then, select the Settings icon on the left of the row for the virtual device you want to check and the Settings pane displays (Figure 4-34). You'll see a Procedure State diagram at the top of the Settings pane. If you hover over one of the Procedure State icon labels, you will get a drop-down menu to take action on *that* step of the connection setup process. In Figure 4-34, for example, the virtual device is not registered yet and is shown as *Unregistered*. Another scenario would be if you've enabled SAS and want to manually request device registration using the Procedure State diagram rather than using the auto-registration option. When you hover over the *Unregistered* Procedure State icon label, the drop-down menu displays the action you perform at this point: *Register req*. Select this action to start the request.

Figure 4-34: Check Virtual CBSD Connection Details



11. View SAS logs by clicking on the Logs icon in the upper right-hand side of the main Advance > SAS window. Two tabs are presented (*Logs* and *Virtual Logs*).
12. Click on *Virtual Logs* tab (Figure 4-35). The list of logs includes all request and response messages between the DP and SAS service, and instructions the DP assigns to the virtual CBSD.

Figure 4-35: Virtual Logs



13. Put the virtual devices online on the OMC (DP) to connect them to the network , and they are immediately authorized by SAS. The connected devices and associated data will then be moved from the *Virtual eNB* or *Virtual CPE* device tab into the "regular" *eNB* or *CPE* device tab.

4.5 Perform Actions on Multiple Devices Simultaneously

There are three actions you can perform on multiple eNBs and/or CPEs simultaneously:

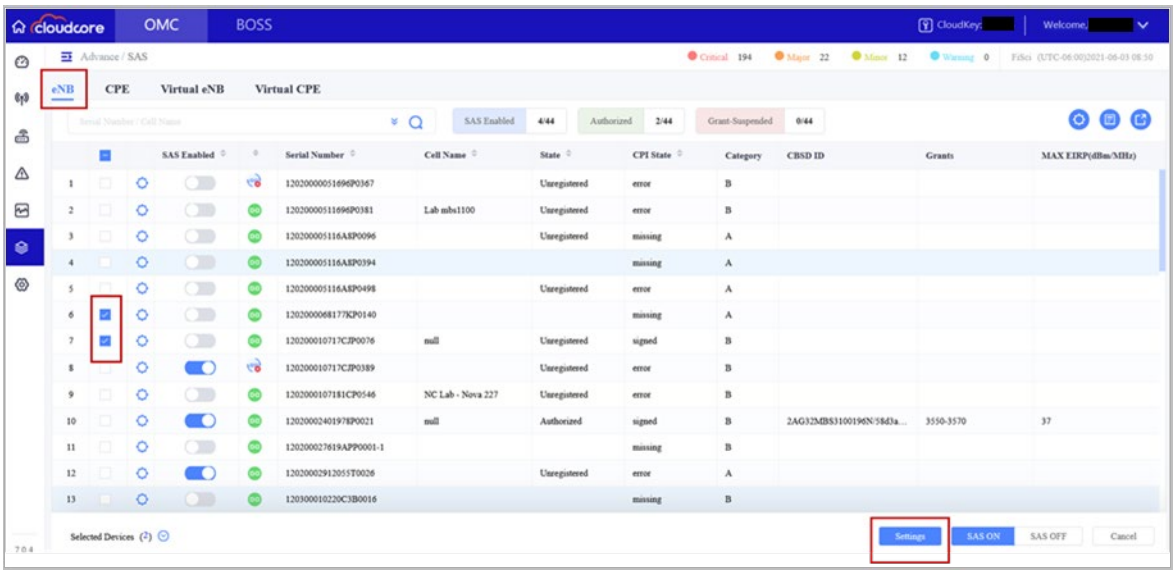
- You can assign a User ID
- You can enable SAS
- You can disable SAS

NOTE: The actions described in this section can only be performed on same device types (eNBs or CPEs) and are not applicable to virtual devices.

Perform the following steps to assign a User ID (Figure 4-36):

1. Go to Advance > SAS.
2. Select the *eNB* or *CPE* device tab on upper left-hand side of the screen to display the eNB or CPE device list.
3. Click on the check box next to target device(s) or click the check box at column header to select all the devices in the list.
4. Click the “Settings” button that displays at the bottom of the page to open the Settings pane.
5. Input your User ID (required) and Call Sign (Optional).
6. Click OK.

Figure 4-36: Assign User ID to Multiple Devices Simultaneously

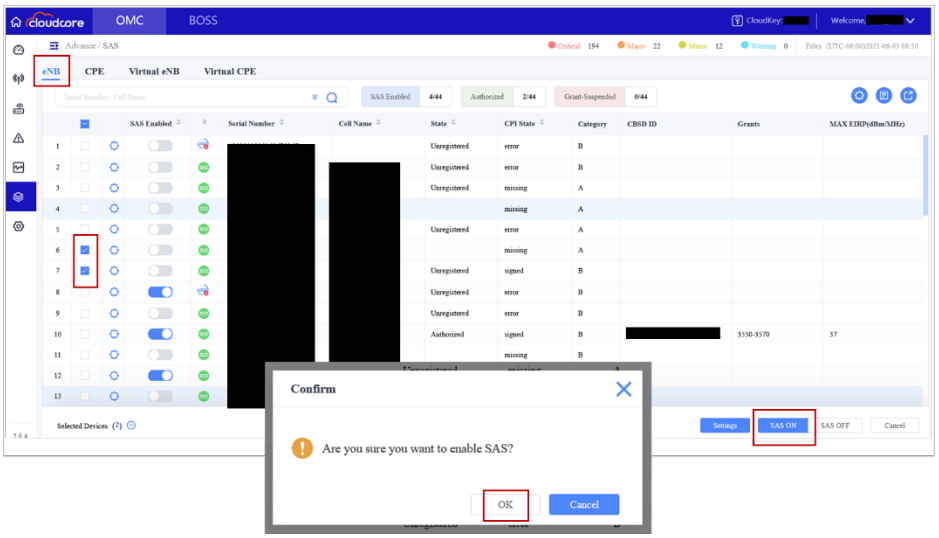


Perform the following steps to enable SAS (Figure 4-37):

NOTE: You should configure all the devices' installation parameters and upload to the SAS portal prior to enabling SAS on multiple devices.

1. Go to Advance > SAS.
2. Select the *eNB* or *CPE* device tab on upper left-hand side of the screen to display the eNB or CPE device list.
3. Click on the check box next to target device(s) or click the check box at column header to select all the devices in the list.
4. Click the "SAS ON" button that displays at the bottom of the page to open the Confirm pane.
5. Click OK when prompted to enable SAS in the Confirm pane.

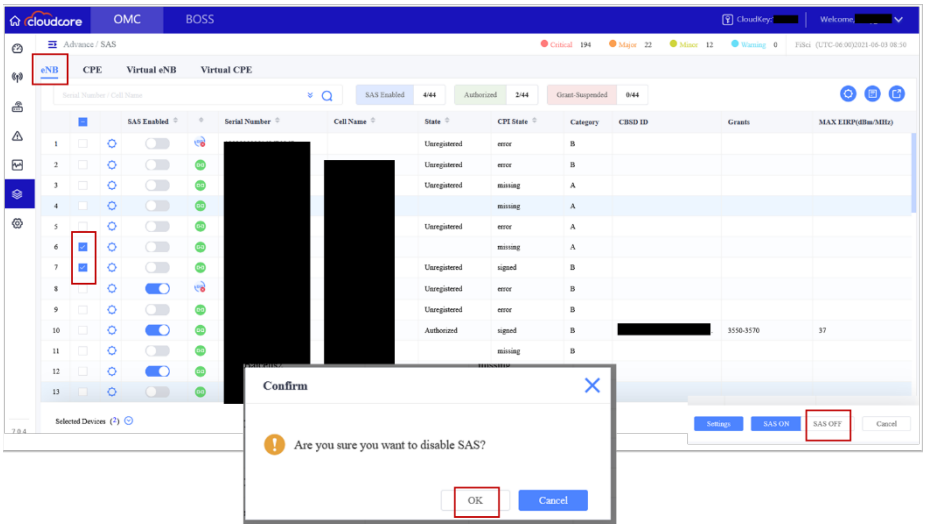
Figure 4-37: Enable SAS on MultipleDevices Simultaneously



Perform the following steps to disable SAS (Figure 4-38):

1. Go to Advance > SAS.
2. Select the *eNB* or *CPE* device tab on upper left-hand side of the screen to display the eNB or CPE device list.
3. Click on the check box next to target device(s) or click the check box at column header to select all the devices in the list.
4. Click the "SAS OFF" button that displays at the bottom of the page to open the Confirm pane.
5. Click OK when prompted to disable SAS in the Confirm pane.

Figure 4-38: Disable SAS on MultipleDevices Simultaneously



4.6 SAS Installation Parameters

Table 4-1: eNB SAS Settings

NOTE: For eNBs running QRTB 2.6.2 in Dual Carrier Mode, the following parameters will be configured for both Cell1 and Cell2: latitude, longitude, height, heightType, antennaGain, antennaAzimuth, antennaDowntilt, antennaBeamwidth, and installCertificationTime.

Parameter	Description
SAS Settings	
SAS	Enable (ON)/Disable (OFF) the SAS function.
SAS Registration Type	Select Single-Step or Multi-Step method to register the eNB with the SAS vendor.
Install Param Config	
category	Either A or B according to the eNB's designation. See Table 4-3 for more information.
userid	Enter a user ID, which is provided by your SAS vendor and is associated with this SAS-enabled eNB. Range is 0 to 256 characters (using upper-case letters A-Z, lower-case letters a-z, and digits 0-9).
fccid	The eNB's FCC certification number.
latitude	Latitude of the eNB's location. Select auto to autofill the latitude based on GPS data; otherwise, enter the latitude.
longitude	Longitude of the eNB's location. Select auto to autofill the longitude based on GPS data; otherwise, enter the longitude.
height	Enter the antenna height, in meters. Range: 0-300 meters.
heightType	Only Above Ground Level (AGL) may be selected
indoorDeployment	Indicate whether the eNB is an Indoor or Outdoor (default) unit
eirpCapability (eNBs running QRTB software)	Maximum Effective Isotropic Radiated Power that may be radiated from the antenna. Range: -127 to 47 dB/10 MHz
Antenna Gain	Set the eNB's antenna gain. Range: -5 to 30 dBi.
antennaAzimuth	Enter the antenna azimuth, in degrees. Default is 180°. Range: 0 - 359°
antennaDowntilt	Enter the degrees of antenna downtilt. Default is 5°. Range: -90° to 90°.
antennaBeamwidth	Enter the degrees of antenna beamwidth. Default is 65°. Range: 0 - 360°.
callSign	Optional: Parameter that is useful to identify the PAL license under which the operator is deploying a CBSD. The parameter is not necessary to configure for the GAA spectrum (3550 – 3700 MHz). Range is 0 to 256 characters (using upper-case letters A-Z, lower-case letters a-z, and digits 0-9).
groupType	Optional: Only INTERFERENCE_COORDINATION may be selected at this time. Adding a Group is also optional at this time. CBSD grouping is currently not being used by SAS vendors, but will be used in the future when General Authorized Access (GAA) coexistence is introduced.

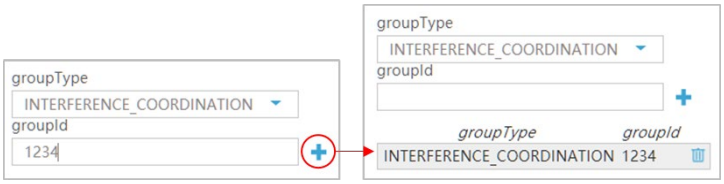
Parameter	Description
groupID	Optional: You must enter a group ID if using a group type. You cannot leave the groupID field blank when using a group type. Specify the group ID using letters, numbers, or special characters. When you add the ID, it will be displayed beneath this field. 
CPI info	
cpiId	Enter the Certified Professional Installer's identification number.
cpiName	Enter the Certified Professional Installer's name. Use an underscore to separate first name and last name; you cannot use a space in this field.
installCertificationTime	Select “Auto” to automatically enter the date and time of installation: yyyy-mm-ddThh:mm:ssZ
CPI certstore	
CPI certstore	Displays the CPI's certificate if it has been uploaded
Missing	Indicates if the CPI certificate is missing
add/change CPI cert	Select to upload or change the CPI certificate. You can also use the System > CertStore menu to upload the certificate.

Table 4-2: CPE SAS Settings

Parameter	Description
SAS Settings	
SAS	Enable/Disable the SAS function.
User ID	Enter a user ID, which is provided by your SAS vendor, associated with this SAS-enabled CPE. Range is 0 to 256 characters (using upper-case letters A-Z, lower-case letters a-z, and digits 0-9).
Call Sign	Optional: Parameter that is useful to identify the PAL license under which the operator is deploying a CPE. The parameter is not necessary to configure for the GAA spectrum (3550 – 3700 MHz). Range is 0 to 256 characters (using upper-case letters A-Z, lower-case letters a-z, and digits 0-9).
Category	Either A or B according to the CPE’s designation. See Table 4-3 for more information.
FCC ID	The CPE’s FCC certification number, which is auto-filled based on CPE model.
Serial Number	The CPE’s unique serial number.
Radio Technology	Auto-filled as “E_UTRA” and the field is greyed out. E_UTRA identifies that the CPE is using LTE technology.
Antenna Gain	Auto-filled based on CPE model and the field is greyed out.

Table 4-3: Baicells CBSD Product Information

Model	Part Number	Antenna Gain	Antenna Beamwidth	CBSD Category	FCC-Certified Maximum EIRP (10Mhz)	FCC Identification
eNB CBSDs						
Neutrino430	PBS31010	3	360	A	30	2AG32PBS31010
Nova227*	PBS2120	13	65	B	40	2AG32PBS212096N
Nova233 Gen1	MBS1100			B	47	2AG32MBS110096N
Nova233 Gen2	MBS1105			B	47	2AG32MBS110596N
Nova430	PBS3101SE			B	44	2AG32PBS3101SE
Nova430i	PBS3101S	13	65	B	40	2AG32PBS3101S
Nova436Q	MBS31001			B	47	2AG32MBS3100196N
CPE CBSDs						
Atom-OD04H	EG7035E	19	25	B	43	2AG32EG7035E96
Atom-OD04L	EG7035L	14	60	B	37	2AG32EG7035L96
Atom-ID06B	EG2013B-M11	6	360	A	30	2AG32EG2013BM11
Atom-OD06H	EG7010A-M11	14	25	B	40	2AG32EG7010AM11N
Atom-OD06L	EG7010C-M11	11	70	B	37	2AG32EG7010CM11N
Atom-OD15	EG8015G-M11	18	26	B	44	2AG32EG8015GM11

*NOTE: The Nova227 (PBS2120) has a 10-degree electrical down tilt.