

# CBRS Configuration and Testing

## Introduction

This guide only applies to Citizens Broadband Radio Service (CBRS) models, which operate in the 3550-3700 MHz CBRS frequency band. See our [RM-3625-2J-X](#) datasheet for more information on CBRS.

## General CBRS Information

CBRS devices are broadly grouped into CBSDs (Citizens Broadband Service Device) and EUDs (End User Device). CBSDs must maintain a connection to a Spectrum Access System (SAS) over the internet, and must provide their GPS coordinates along with other important information to the SAS. Our radios are tested with Google SAS. More information is available [here](#).

CBSDs are categorized as Class A or Class B. Class A CBSDs are designed for shorter-range deployments with limitations on the maximum EIRP and antenna height, while Class B CBSDs technically support much greater range through higher EIRP and height limits, but must be installed by a Certified Professional Installer (CPI). CPI certification can be obtained through [Google](#). A full set of CBRS regulations is detailed [here](#).

Note that **Class A devices which are not installed by a CPI must include an internal GPS** to send the CBSD's location to the SAS.

## Supported Networking Modes

Doodle Labs CBRS Mesh Rider Radios support simple star networks with a CBSD acting as an Access Point (AP), and many EUDs acting as clients (Fig. 1). In addition, we support a mesh mode where several CBSDs can be chained together over a mesh backbone, each serving multiple EUDs.

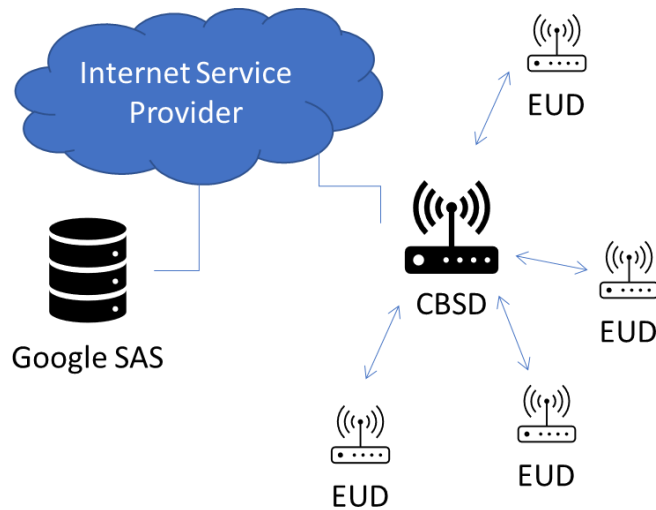


Fig. 1 CBRS Simple Star Network

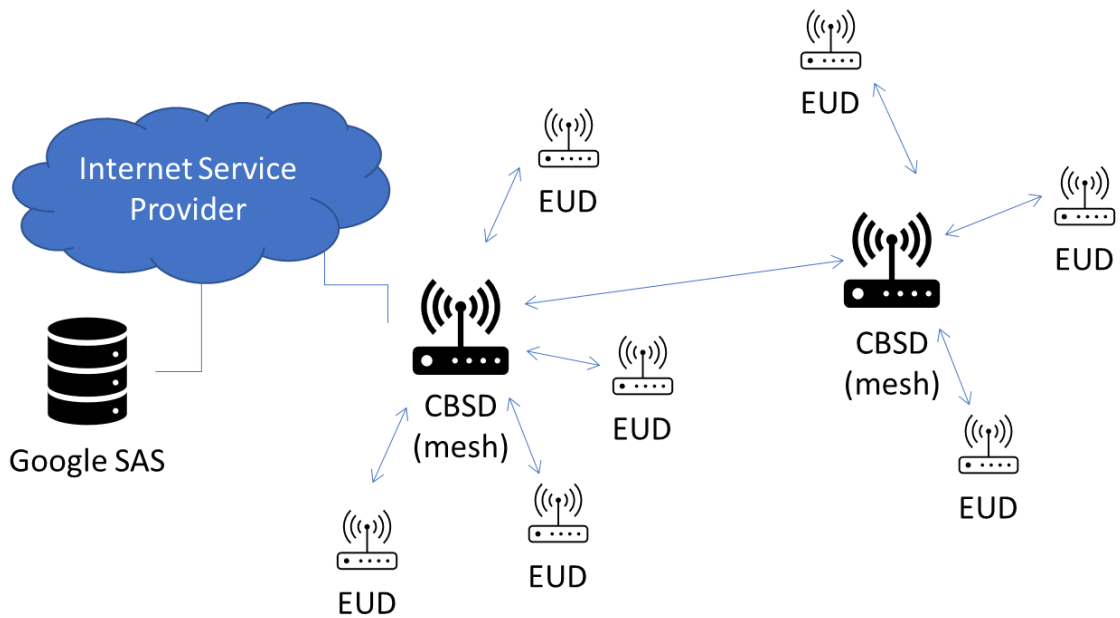
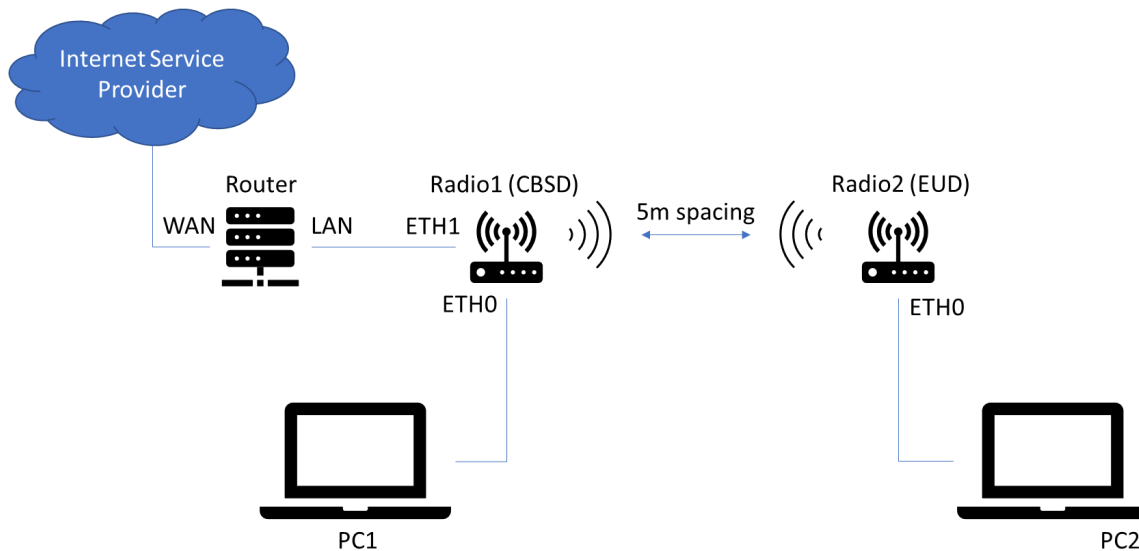


Fig. 2 CBRS Mesh Network

## Hardware Setup

Set up your hardware as in Fig. 3. See our [Embedded](#) and [External](#) Design-in-Docs pages for information on how to power and hook-up the radios.



**Fig. 3 CBRS Hardware Setup**

- The CBSD needs a connection to the internet. This comes from your router connected to your ISP. For a first-time setup, this could be an office router/modem for example.
- The Mesh Rider Radio's Ethernet port (ETH0 and ETH1) are bridged to the wireless interface. Their IP addresses are in the 10.223.0.0/16 subnet as discussed [here](#).
- PC1 and PC2 should have their IP addresses configured in the 10.223.0.0/16 subnet for initial configuration. Ultimately, they will use DHCP to connect to the gateway (your router).
- Keep the radios at least 5m apart during the initial setup to prevent the receivers from saturating.

## Firmware Upgrade

This guide is based on the October 2022 CBRS release. The latest firmware is available in the design-in-docs pages discussed [above](#).

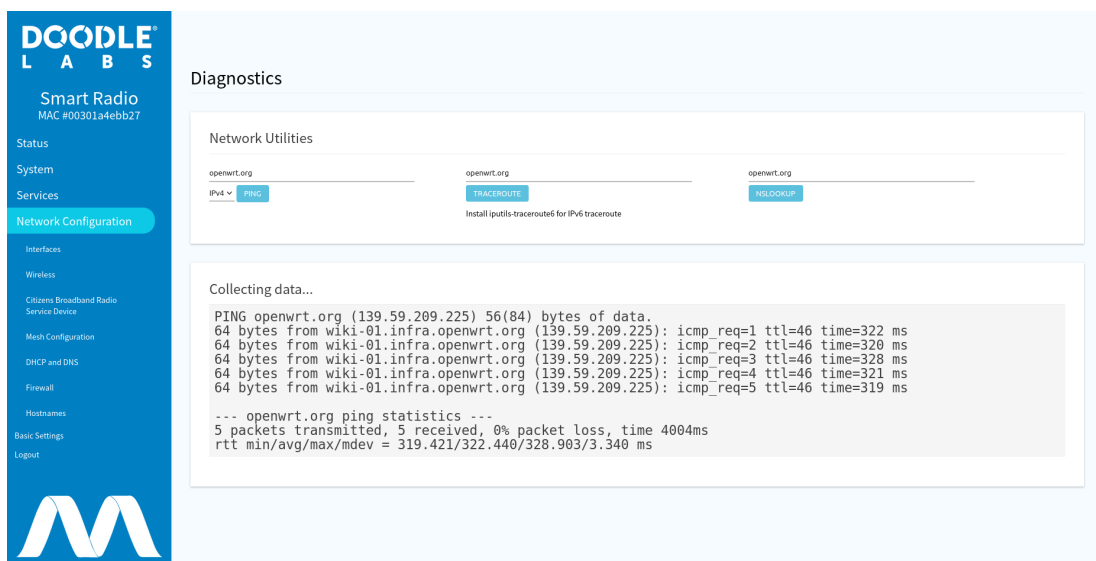
## Software Configuration

### CBSD-A Connected to Google Test SAS

In this guide, we will connect to the Google Test SAS (see [CBRS Connection to the Production Google SAS](#) for information on how to connect to the Production Google SAS). The Google Test SAS cannot be used in a real deployment, and the SAS is not available at the following times:

7:00 AM - 8:30 AM UTC  
 3:00 PM - 4:30 PM UTC  
 11:00 PM - 12:30 AM UTC

1. Start by setting up an appropriate static IP address on PC1 in the 10.223.0.0/16 subnet.
2. Make sure you can ping Radio1. If not, see our [troubleshooting guide](#).
3. Open up a web browser and put the IP address of Radio1 into the address bar.
4. The user name is `root` and the default password is `CwE=10X+Nss/`.
5. Click `Advanced Settings` at the lower left-hand corner to see a full list of configuration options.
6. If you have set up the hardware correctly, Radio1 should have received an IP address from your router (in addition to its default IP address). Check that you can ping a site on the internet using the diagnostics tools in the `Network Configuration -> Diagnostics` page.



**Fig. 4 Internet connectivity check**

7. If the device has GPS, you can make sure it has a valid GPS location at the bottom of the `Status -> Overview` page. If it does not, you will need to be a CPI to manually enter GPS coordinates.
8. Navigate to `Network-Configuration -> Citizens Broadband Service Device` to configure the CBRS device.
9. An example CBSD-A configuration is shown in Fig. 5. Note that in order to be able to configure the CBSD, you will need either an account with Google SAS for a real-world deployment or you will need to obtain test certificates from your SAS provider for lab testing (e.g. [Google test SAS](#)).



## Citizens Broadband Radio Service Device

### General

CBSD client disabled

SAS Server https://test.sas.goog/443/v1/2/  
ⓘ e.g. https://sas.server.com/443/

CA file location Browse... google\_rootCA.cert  
ⓘ Optional.

SSL certificate location Browse... doodlelabs01.cert

SSL private key location Browse... doodlelabs01.key  
ⓘ Pass phrase protected private key is not supported.

### Owner Information

User identifier SAS-doodle-labs  
ⓘ Mandatory parameter when operating mode is set to CBSD.

Call sign \_\_\_\_\_  
ⓘ e.g. First Name, Last Name.

Name \_\_\_\_\_

Contact Phone \_\_\_\_\_

Contact Email root

### Transmission parameters

Maximum ERP 15  
ⓘ Ignored in EUD mode. Minimum of -137 (dBm/MHz), maximum of 20 (dBm/MHz) for cat A CBSD or maximum of 37 (dBm/MHz) for cat B CBSD.

Low frequency 3550 Mhz  
ⓘ Low frequency of operation. Ignored when operating mode is set to EUD, used when set to CBSD mode.

High frequency 3560 Mhz  
ⓘ High frequency of operation. Ignored when operating mode is set to EUD, used when set to CBSD mode.

### Operating Mode

Current setting CBSD-A  
ⓘ Wireless throughput can be improved by adjusting the distance setting. It can be changed [here](#).

### Certified professional installer

SAS has installation parameters   
ⓘ If a CPI already registered this CBSD on SAS, the installation parameters will not be sent during the registration request.

CPI private key location Browse... No file selected.

JWT algorithm \_\_\_\_\_

CPI id \_\_\_\_\_

CPI name \_\_\_\_\_

Contact Phone \_\_\_\_\_

Contact Email \_\_\_\_\_

CBSD install certification date (eg. 2020-01-31) \_\_\_\_\_  
ⓘ in UTC.

CBSD install certification time (eg. 16:59:00) \_\_\_\_\_  
ⓘ in UTC.

CBSD serial number 00301a4ebb27

CBS FCC ID 2AG87RM-3625

### Device Location Information

Latitude 0

Longitude 0  
ⓘ These coordinates will be used instead of the ones provided by the GPS receiver, during a locally certified professional installation. Please remove both values to use the ones provided by the GPS, when available.

Indoor deployment Yes

### Antenna Information

Peak gain 10  
ⓘ Must be set between -127 and 128 (dBi). Mandatory parameter for all operating modes.

Height 1  
ⓘ Minimum of -10000 (m) and maximum of 10000 (m). It will be used instead of the one provided by the GPS receiver, during a locally certified professional installation.

Height type AMSL  
ⓘ Above Ground Level or Above Mean Sea Level. It will be used instead of the ones provided by the GPS receiver, during a locally certified professional installation.

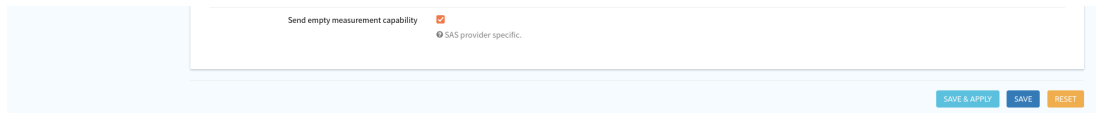
Azimuth \_\_\_\_\_  
ⓘ Boresight direction of the horizontal plane of the antenna in degrees with respect to true north. Must be set between 0 and 350 degrees.

Downtilt \_\_\_\_\_  
ⓘ Antenna down tilt in degrees. Must be set between -90 and 90 degrees. A negative value means the antenna is tilted up (above horizontal).

Beamwidth \_\_\_\_\_  
ⓘ Antenna beamwidth is the angle measured between -3 dB points of main lobe. Must be set between 0 and 360 degrees. A value of 360 means that the antenna has an omnidirectional radiation pattern in the horizontal plane.

Sum of RF loss 3  
ⓘ The sum of cable, insertion and other RF losses. Must be set between 0 and 200 (dB). Mandatory parameter for all operating modes.

### Measurement Capabilities



**Fig. 5 CBSD-A configuration**

- a. Uncheck the **CBSD Client Disabled** box
  - b. SAS Server: **https://test.sas.goog:443/v1.2/** (normally provided by SAS provider)
  - c. CA file location: e.g. **google\_rootCA.cert** (normally can be left blank)
  - d. SSL certificate location: e.g. **doodlelabs01.cert** (request test certificate from Google SAS. Pre-installed certificate is for final deployment)
  - e. SSL private key location: e.g. **doodlelabs01.key** (request test key from Google SAS. Pre-installed key is for final deployment)
  - f. User identifier: e.g. **SAS-doodle-labs** (normally provided by SAS provider)
  - g. Low frequency: 3550
  - h. High frequency: 3560 (can leave as default 3700)
  - i. Operating Mode: CBSD-A
  - j. The section **General** can be left as is on screen.
  - k. The section **Owner information** can be left as is on screen.
  - l. Maximum EIRP: 15
  - m. Indoor deployment: yes
  - n. Peak gain: 10
  - o. Antenna height: 1
  - p. Sum of RF loss: 3
  - q. **Height**, **Height type**, **Azimuth**, **Downtilt** and **Beamwidth** can have any valid value as they are not used.
10. The settings above are just an example. If you are a CBRS CPI, then you can upload your CPI certificates and include your CPI information here too.
  11. Click **Save & Apply** at the bottom of the page.
  12. You can verify that the CBSD is ready by navigating to the bottom of the **Status -> Overview** page.

The screenshot shows the Doodle Labs Smart Radio web interface. The left sidebar contains navigation options: Overview, Firewall, Routes, System Log, Kernel Log, Processes, Realtime Graphs, System, Services, Network Configuration, Basic Settings, and Logout. The main content area is titled 'Wireless' and includes an 'AUTO REFRESH ON' button. It displays the following information:

- Wireless:** Mesh Rider (radio0) with SSID: wireless-hotspot, Mode: CBSD, Channel: 2 (3.369 GHz), Bitrate: 14Mbps, BSSID: 00:30:1A:4E:BB:27, and Encryption: WPA2 PSK (CCMP).
- Associated End User Devices:** A table with columns for Network, MAC-Address, Host, Signal / Noise, and RX Rate / TX Rate. It shows 'No information available'.
- GPS data:** Latitude: 41.570738, Longitude: -90.602715.
- Citizens Broadband Radio Service Device:** Latest log entries showing system messages such as 'Problem in HTTPS Request', 'Retrying HTTPS Request', 'REGISTERED', 'GRANTED', 'AUTHORIZED', and 'Enable transmitter'.

Fig. 6 CBSD Ready

13. The AP starts with an SSID `wireless-hotspot` and password `DoodleSmartRadio`. You can change these in the `Network-Configuration -> wireless` menu.

## EUD

1. If you are using an CBRS EUD Mesh Rider Radio, then it will connect automatically to the SAS unless you have modified the wireless SSID and password. Otherwise navigate to the `Network-Configuration -> wireless` menu and change the `ESSID` and `password` appropriately.
2. If you intend to use a CBSD-enabled device as an EUD, simply change the `Operating Mode` in the `Network-Configuration -> Citizens Broadband Service Device` menu to EUD.
3. Once the EUD is connected, you should see an association in the `Network-Configuration -> wireless` menu.

The screenshot shows the Doodle Labs Smart Radio web interface for a Smart Radio model RM-3625-ZJ-EDA-M. The left sidebar includes: Status, Network Configuration, Wireless, Interfaces, Traffic Prioritization, Firewall, Services, Admin, Advanced Settings, and Logout. The main content area is titled 'Wireless Overview' and includes a 'SCAN' and 'ADD' button. It displays the following information:

- Wireless Overview:** Generic MAC80211 802.11an (radio0) with Channel: 2 (3.355000000 GHz) and Bitrate: 130 Mbit/s. It shows a 91% signal strength and includes buttons for SCAN, ADD, EDIT, and REMOVE. The SSID is wireless-hotspot, Mode is EUD, BSSID is 00:30:1A:4E:BB:29, and Encryption is WPA2 PSK (CCMP).
- Associated End User Devices:** A table with columns for SSID, MAC-Address, Host, Signal / Noise, and RX Rate / TX Rate. It shows an association for wlan0 with SSID: wireless-hotspot, MAC-Address: 00:30:1A:4E:BB:27, Host: ?, Signal / Noise: -46 / -95 dBm, and RX Rate / TX Rate: 46.8 Mbit/s, 10MHz, MCS 14, 52.0 Mbit/s, 10MHz, MCS 15.

Fig. 7 EUD associated to CBSD

## PC2

Ultimately PC2 needs a connection to the internet. If your router runs a DHCP server, then you should now change PC2's IP addressing mode to DHCP client. Radio1 and Radio2 each operate in DHCP client mode in addition to have a static IP address. Therefore, you can login to your router to see the dynamic IP addresses which were assigned to Radio1 and Radio2.

## Troubleshooting

If you are experiencing problems with your configuration, you can either look at our [troubleshooting pages](#) or contact us for [Technical Support](#).