8.13 FCC 15.713(e)(6) Unsuccessful registration due to HAAT > 250 m

8.13.1 Definitions and limits

A fixed device with an antenna height above ground that exceeds 30 meters or an antenna height above average terrain (HAAT) that exceeds 250 meters shall not be provided a list of available channels.

8.13.2 Test summary

Test date	June 28, 2019

8.13.3 Observations, settings and special notes

EUT was configured with information that included a location with HAAT of more than 250 m (at latitude 37.9° N and longitude 114.6° W). It was verified, that after database rejection, the EUT didn't start the transmission.
To test this feature the device was configured with invalid information and requested to transmit on the channel. Once the database responded with an empty channel list as a result of the antenna height above ground, or excessive HAAT, the EUT didn't start to transmit. Subscriber unit was waiting for the information from Base station and didn't start transmission as well.

8.13.4 Test data

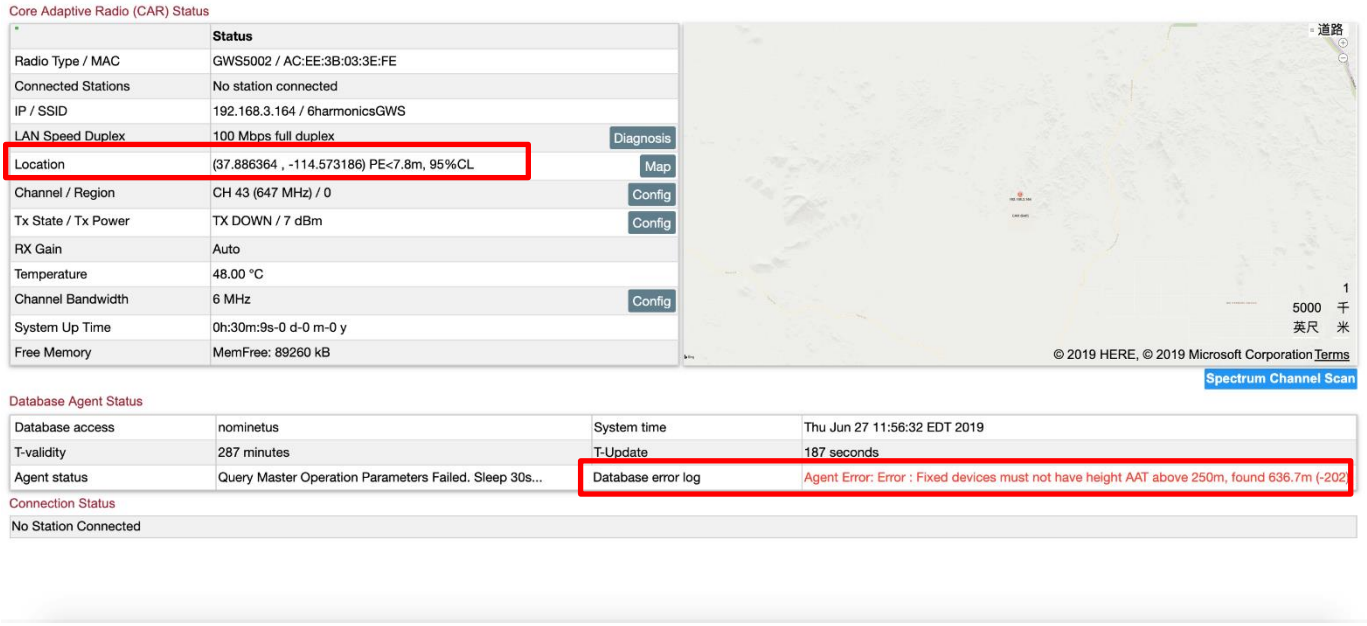

Figure 8.13-1: *Unsuccessful registration with restricted HAAT location*

8.14 FCC 15.713(e)(6) Unsuccessful registration due to antenna height that exceeds 30 m

8.14.1 Definitions and limits

A fixed device with an antenna height above ground that exceeds 30 meters or an antenna height above average terrain (HAAT) that exceeds 250 meters shall not be provided a list of available channels.

8.14.2 Test summary

Test date	October 17, 2018

8.14.3 Observations, settings and special notes

EUT was configured with information that included an antenna height that exceeded 30 m limit in congested areas and 100 m in less congested areas (the limit is set by the database). It was verified, that after database rejection, the EUT stopped the transmission.
To test this feature the device was initially configured with valid information and allowed to transmit on the channel. The registration information was then modified to render it invalid and a registration request was re-initiated. Once the database responded with an empty channel list as a result of the antenna height above ground, the EUT stopped to transmit. For the Base station device, during the initial power up and registration, if the database returns an empty channel list, it will not turn on the transmitter. For the Subscriber device, the EUT will perform a passive scan and will attempt to connect to a Base station device on a channel where it detects a beacon. If the database responds with an empty channel list, or the device is unable to connect to the database, it will cease to transmit on the channel.

8.14.4 Test data

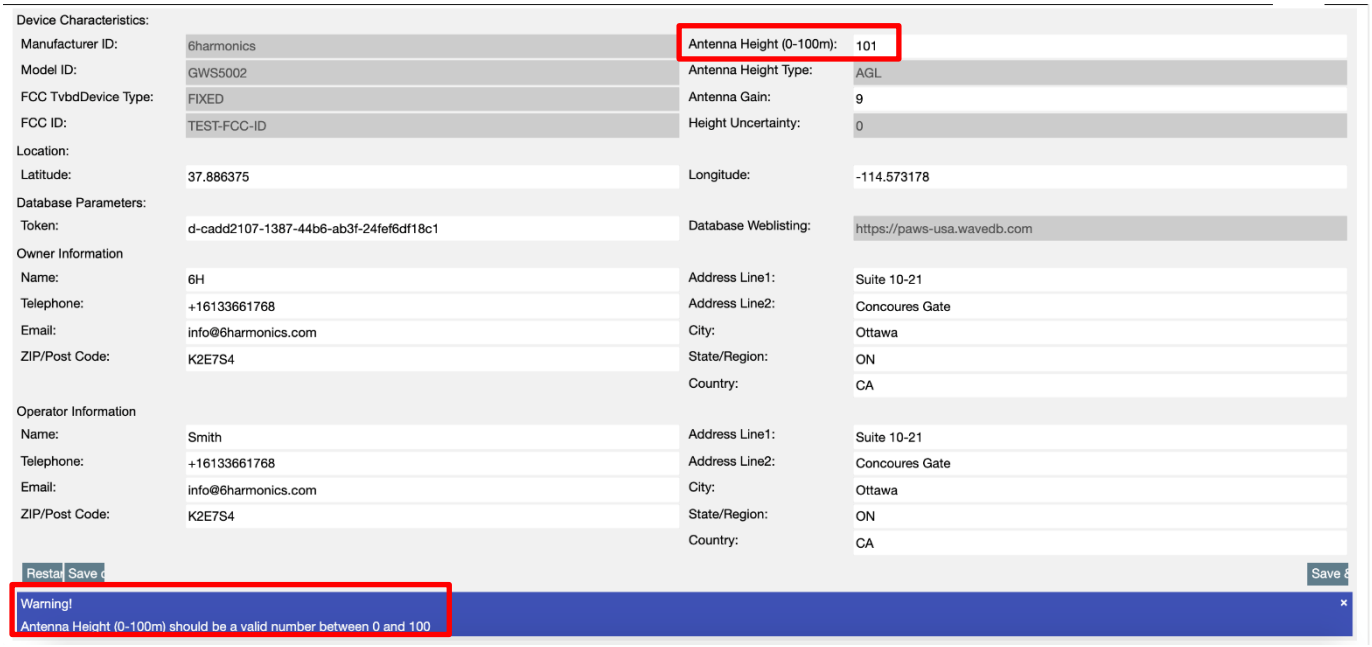

Figure 8.14-1: *Unsuccessful registration with restricted antenna height in the less congested area*

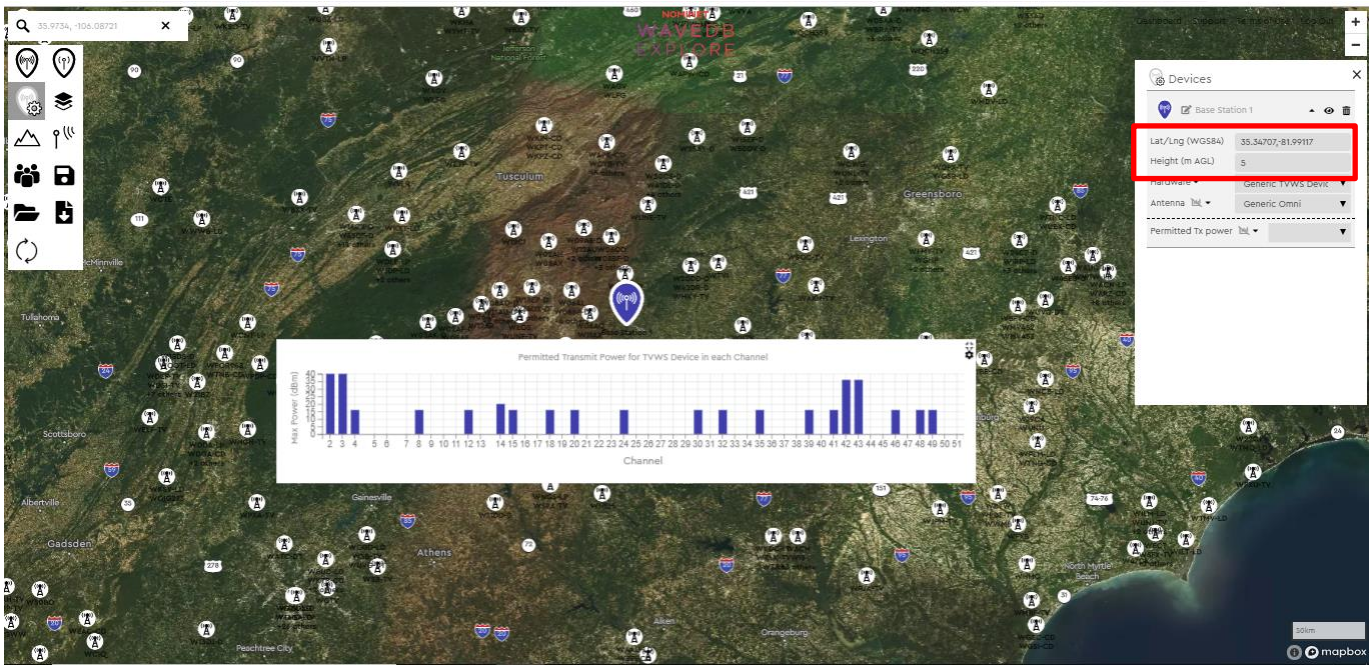

Figure 8.14-2: *Example of congested area location with available channels for antenna height of 5 m*

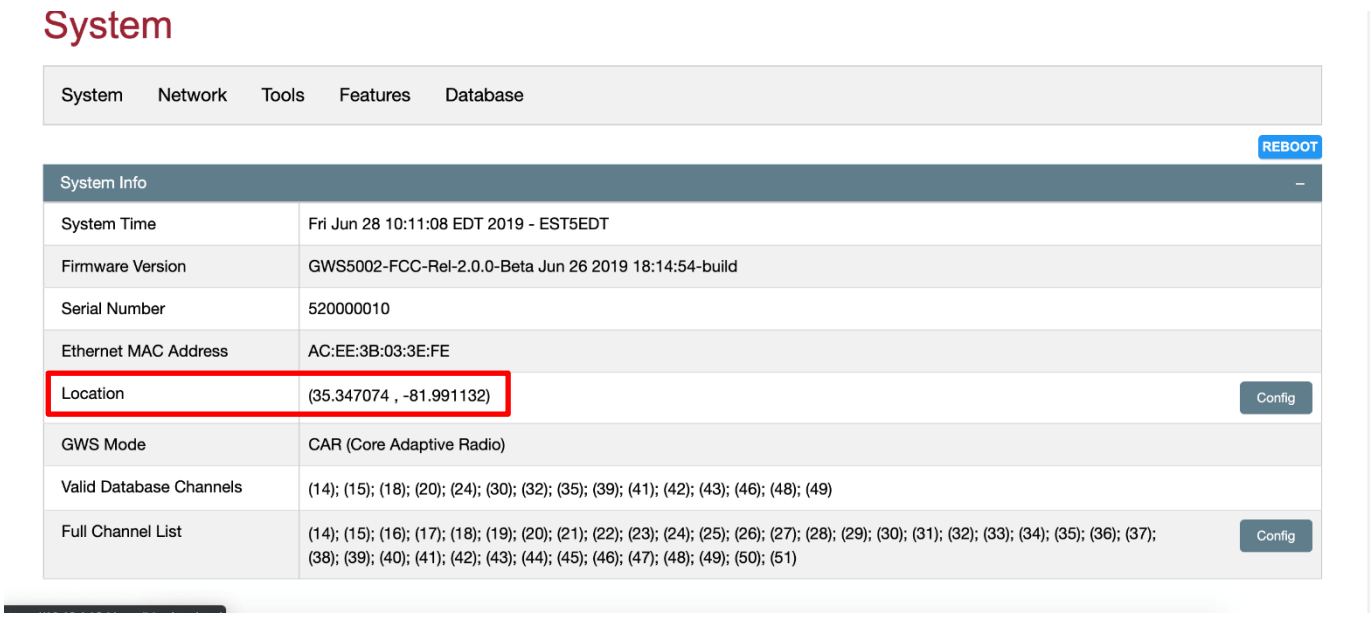

Figure 8.14-3: *System location settings*

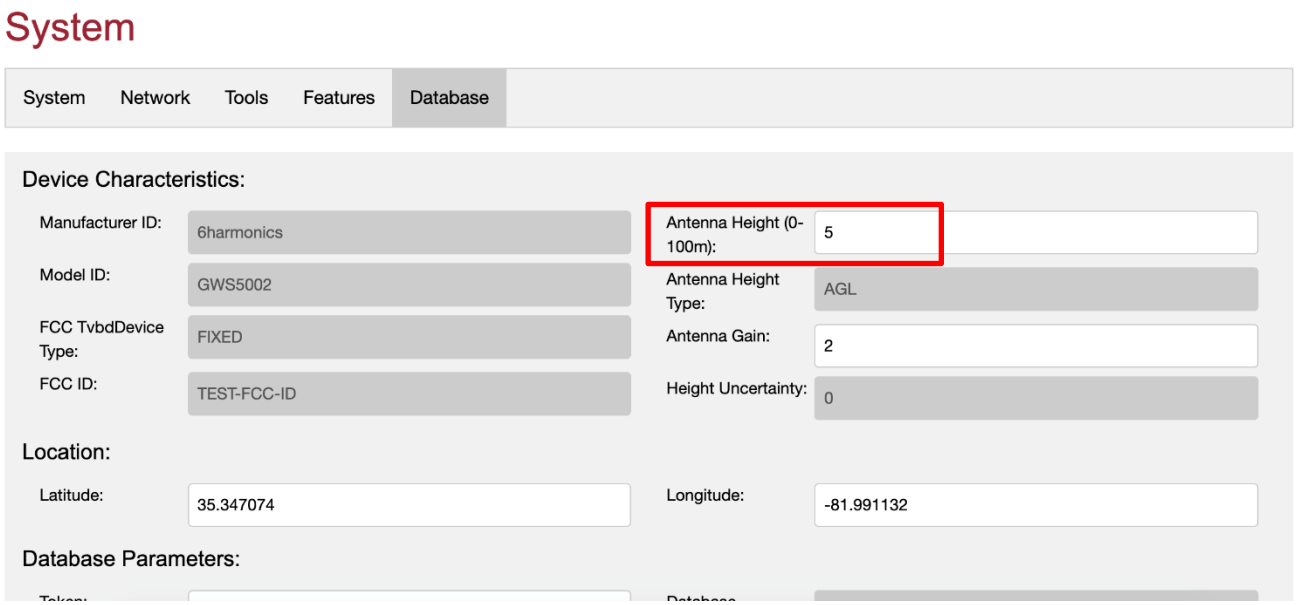

Figure 8.14-4: *Antenna height adjusted to the specific height.*

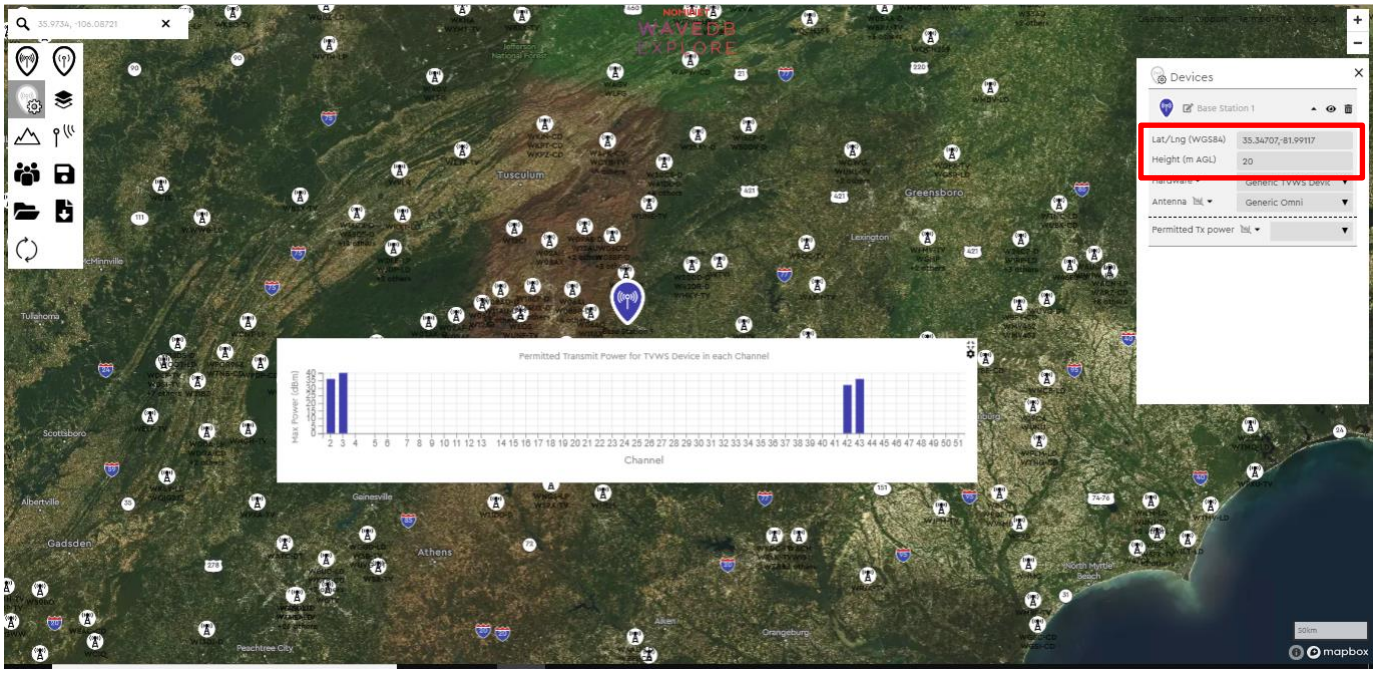

Figure 8.14-5: *Example of congested area location with available channels for antenna height of 20 m*

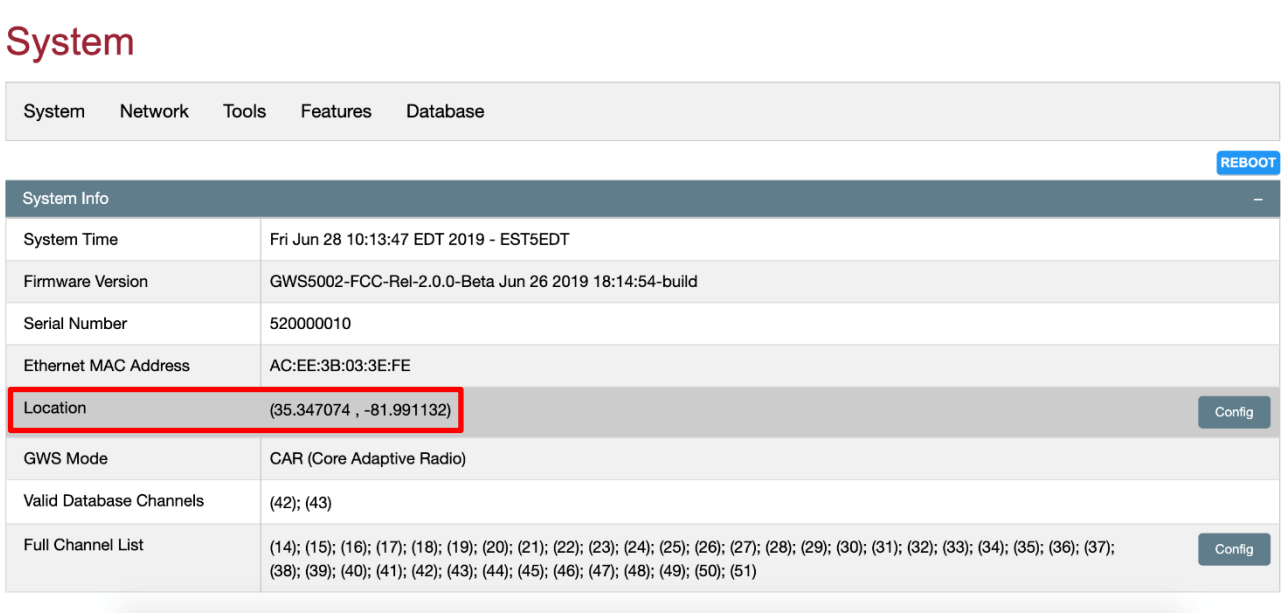

Figure 8.14-6: *System location settings*

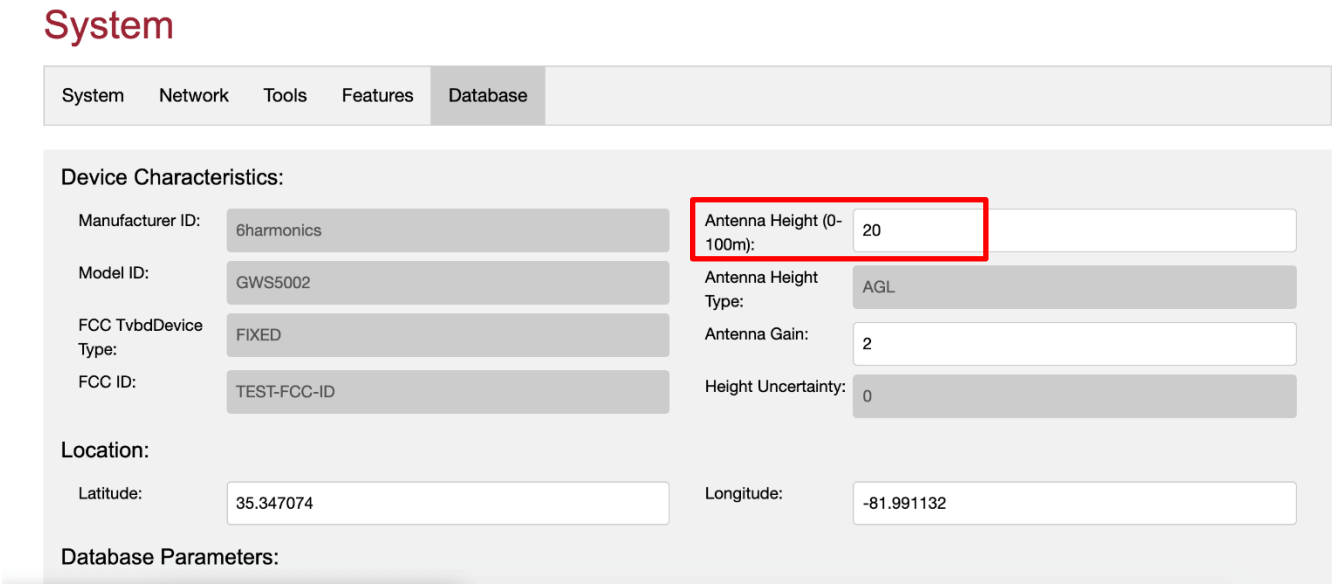

Figure 8.14-7: *Antenna height adjusted to the specific height.*

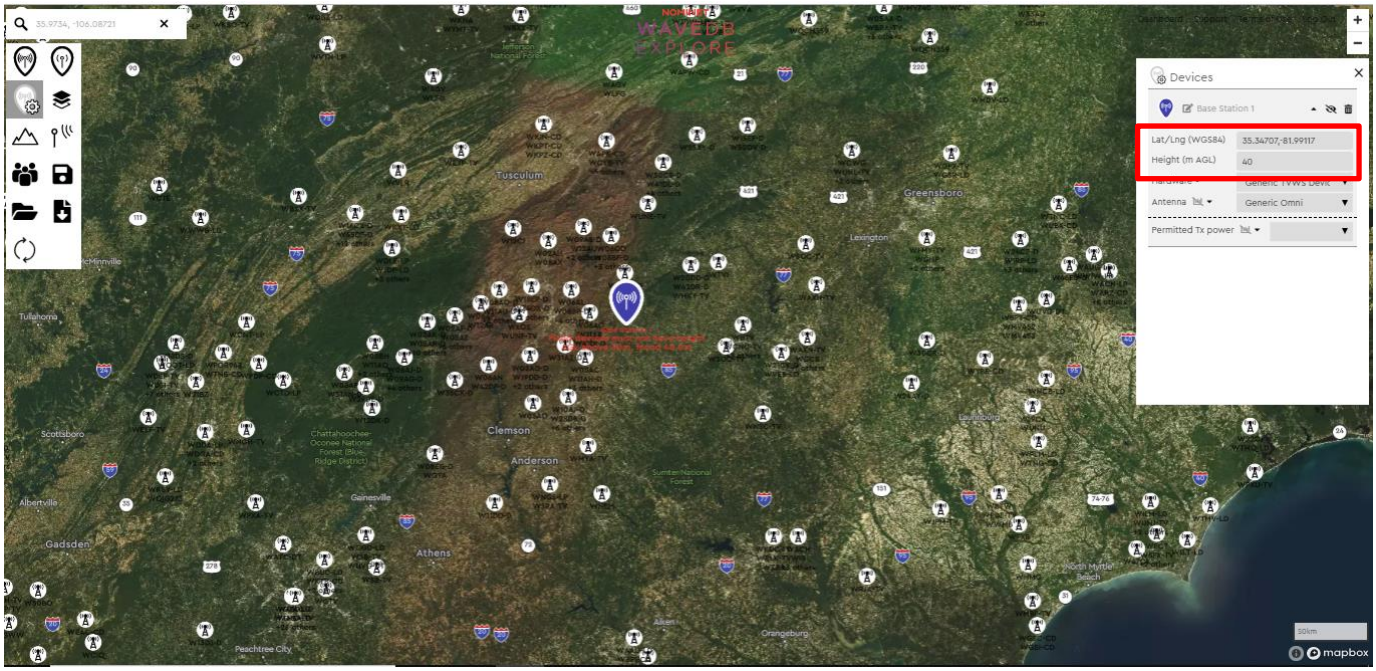

Figure 8.14-8: *Example of congested area location with no available channels for antenna height of 40 m*

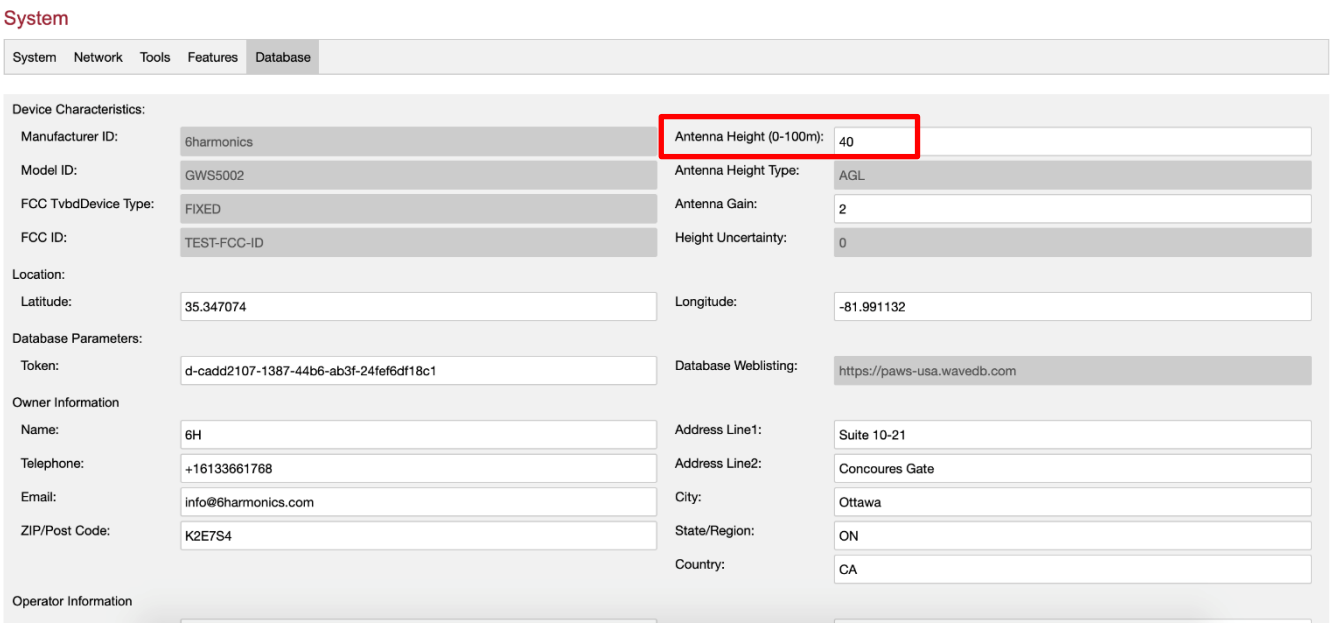

Figure 8.14-9: *Antenna height adjusted to the specific height.*

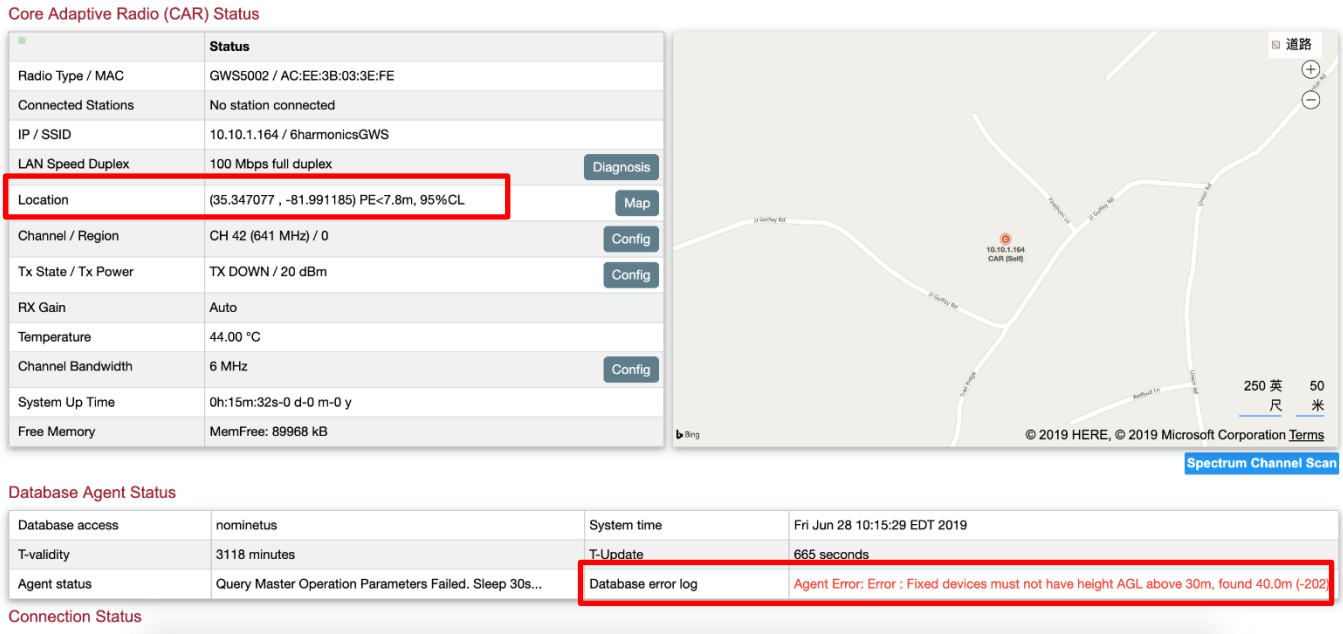

Figure 8.14-10: *System location settings and Database error due to antenna height, that exceeded the limit*

8.15 FCC 15.713(g)(3)(i) and (ii) Unsuccessful registration due to incomplete information – FCC ID and Serial number

8.15.1 Definitions and limits

(3) The white space device registration database shall contain the following information for fixed white space devices:
(i) FCC identifier (FCC ID) of the device;
(ii) Manufacturer's serial number of the device

8.15.2 Test summary

Test date	June 27, 2019

8.15.3 Observations, settings and special notes

The registration interface does not contain a mechanism by which the serial number or the FCC ID of the radio can be changed. The FCC ID and serial number are flash-programmed during the manufacturing process and could not be changed without being returned to the manufacturer.

8.16 FCC 15.713(a)(3) Relocation of fixed TVBD

8.16.1 Definitions and limits

The white space database serves the following function:
(3) To register the identification information and location of fixed white space devices and unlicensed wireless microphone users.
The Data base will not provide a channel list for a fixed TVBD at a location other than that registered.

8.16.2 Test summary

Test date	June 27, 2019

8.16.3 Observations, settings and special notes

The implementation of the location input prevents the radio from requesting channels from another location other than the last successful registration. It is not possible for the user to input location information into the radio that would result in a channel request from a different location other than the current registration location. In the event of a change in the input location information, a new registration and channel request are sent using the same entered registration location information.

8.17 FCC 15.711(c)(2)(i), FCC 15.711(h) Fixed & Mode II TVDB database update

8.17.1 Definitions and limits

Each fixed white space device must access a white space database over the Internet to determine the available channels and the corresponding maximum permitted power for each available channel that is available at its geographic coordinates, taking into consideration the fixed device's antenna height above ground level and geo-location uncertainty, prior to its initial service transmission at a given location. Testing in accordance with KDB 416721 D01, III (2)(e)

8.17.2 Test summary

Test date	June 27, 2019

8.17.3 Observations, settings and special notes

EUT was configured with proper registration information and the successful registration was verified. Database URL was modified from *paws-**usa**.wavedb.com* to *paws-**ca**.wavedb.com*. After the time of channel allocation has passed it was verified that without the proper database access the EUT received empty channel list and stopped the transmission. Then the URL was changed back to and it was verified that with the proper database access the EUT received a channel list and started the transmission. Testing was repeated with Base station disconnected from the internet and it was verified, that after refresh time both EUTs ceased transmission.

8.17.4 Test data

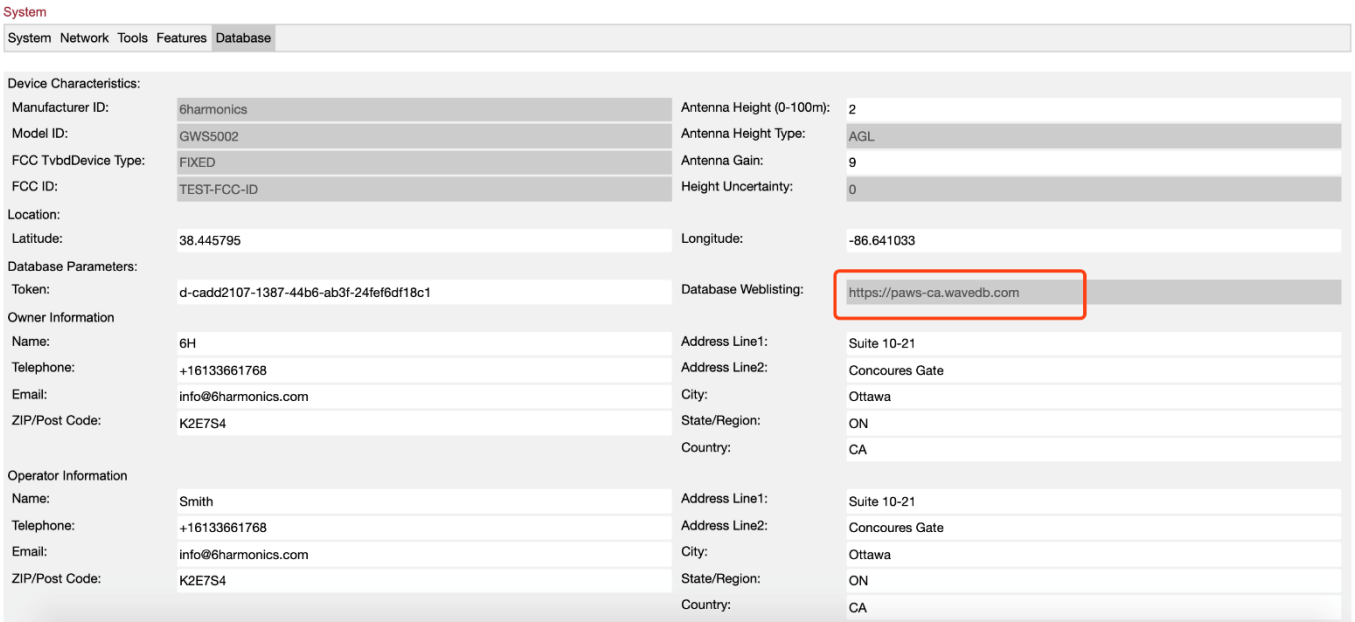

Figure 8.17-1: *Wrong database URL setting*

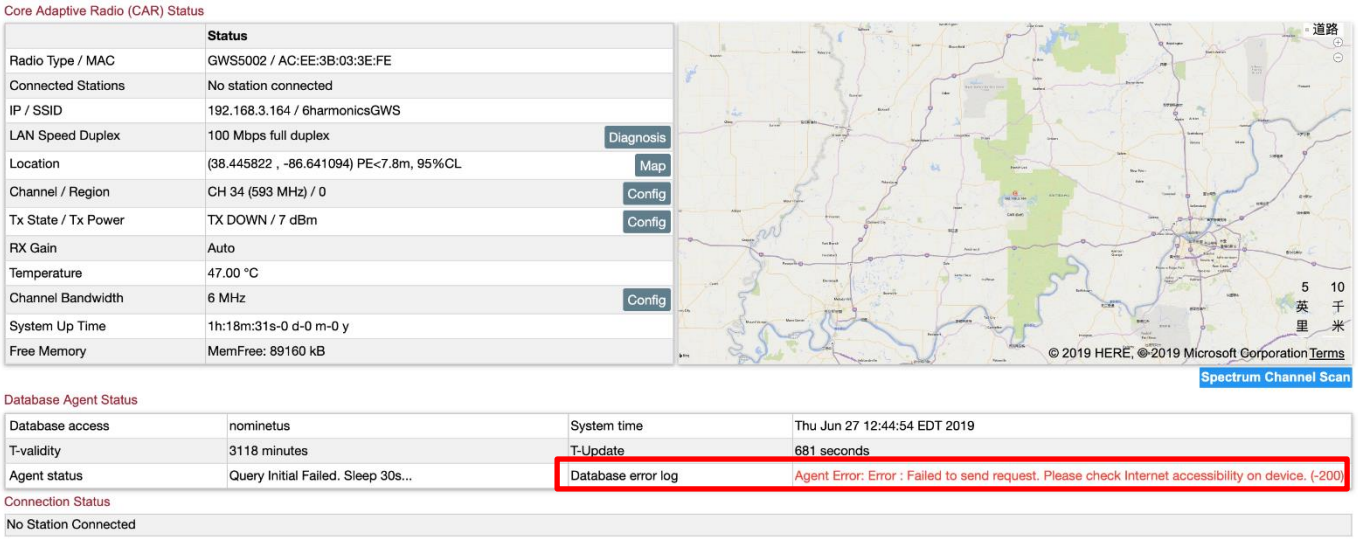

Figure 8.17-2: *Unsuccessful registration due to wrong database URL*

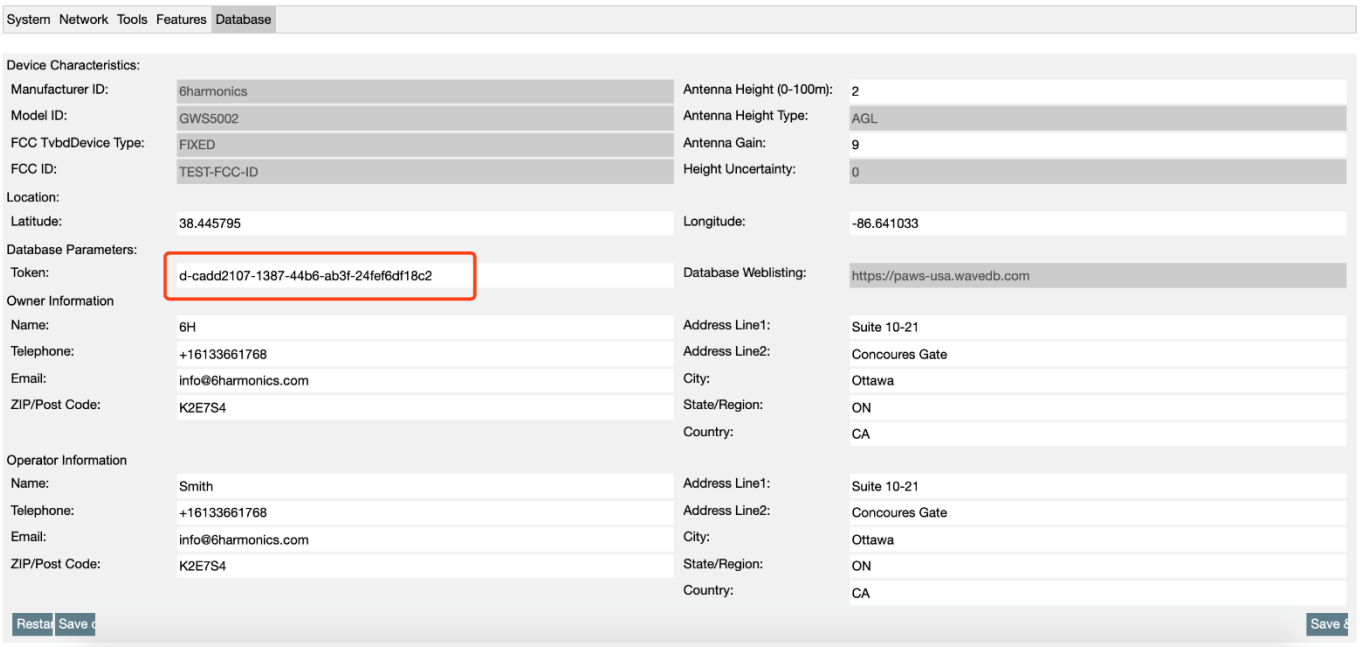

Figure 8.17-3: *Database parameter: token was removed*

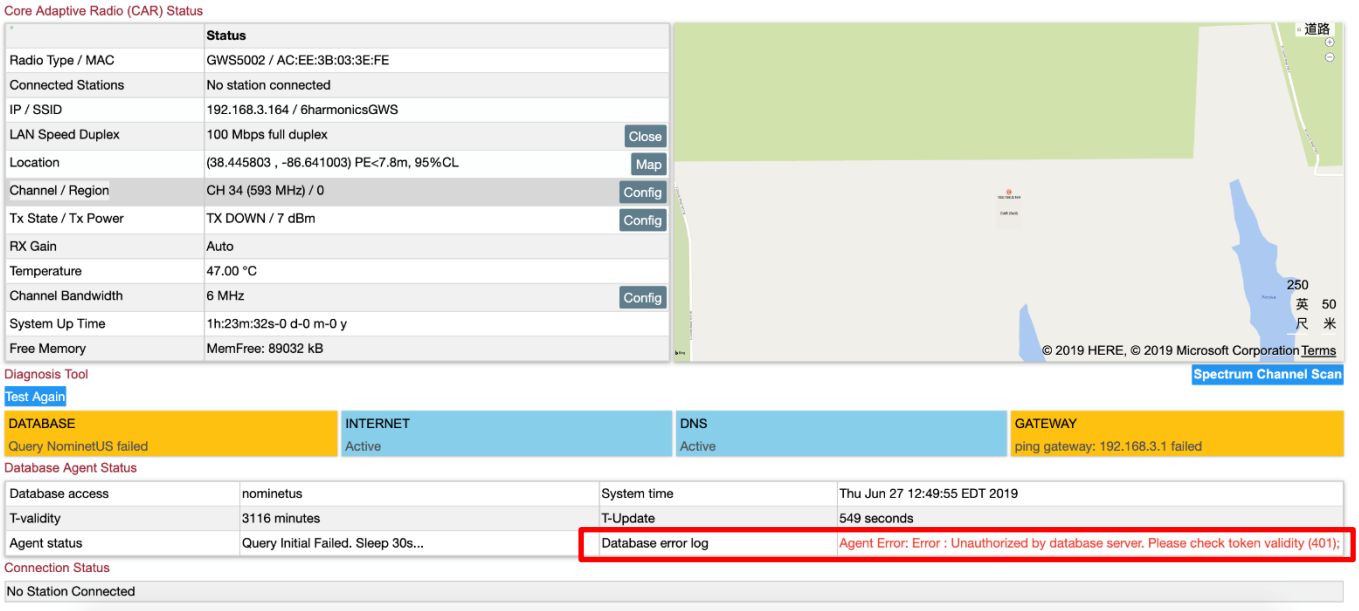

Figure 8.17-4: *Unsuccessful registration due to a missing token.*

8.18 FCC 15.711(c)(2)(iii) Low-power auxiliary device protection

8.18.1 Definitions and limits

Each fixed white space devices shall access the database at least once a day to verify that the operating channels continue to remain available. Each fixed white space device must adjust its use of channels in accordance with channel availability schedule information provided by its database for the 48-hour period beginning at the time the device last accessed the database for a list of available channels.

Use of database protected entity interface to register protection for a low-power auxiliary device in the same location and channel which EUT has selected and operating. The registered protection for the low-power auxiliary device should be scheduled within the next 48-hour period. Testing in accordance with KDB 416721 D01, III (2)(I).

8.18.2 Test summary

Test date	June 27, 2019

8.18.3 Observations, settings and special notes

EUT was configured with proper registration information and the successful registration was verified. The channel expiration time for testing purposes was reduced to 5 minutes. Meantime it was scheduled with WSDB that channel 30 would be registered for low-power device. After the time of channel allocation of the EUT has passed it was verified that the EUT stopped the transmission on the temporary restricted and removed from the channel list. Since EUT is not waiting 48 hours for the push notification but rather following refresh rate of 20 minues.

8.18.4 Test data

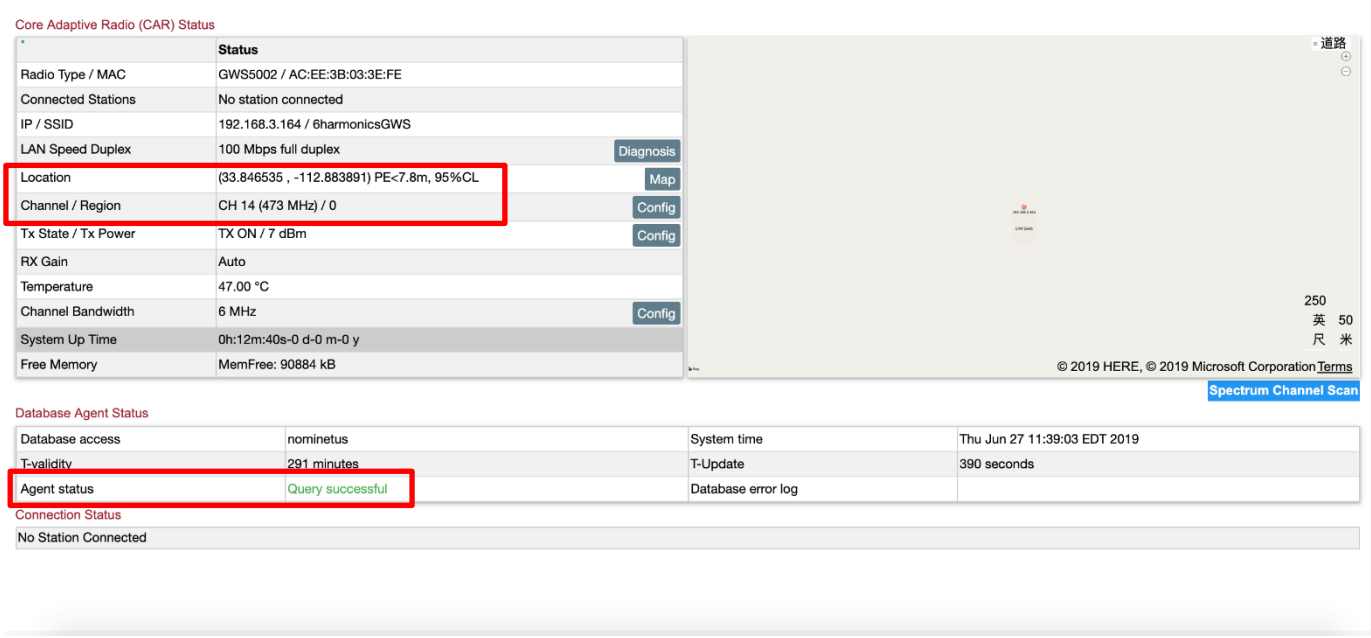

Figure 8.18-1: *Successful registration before the registration of LP device on the channel 14*

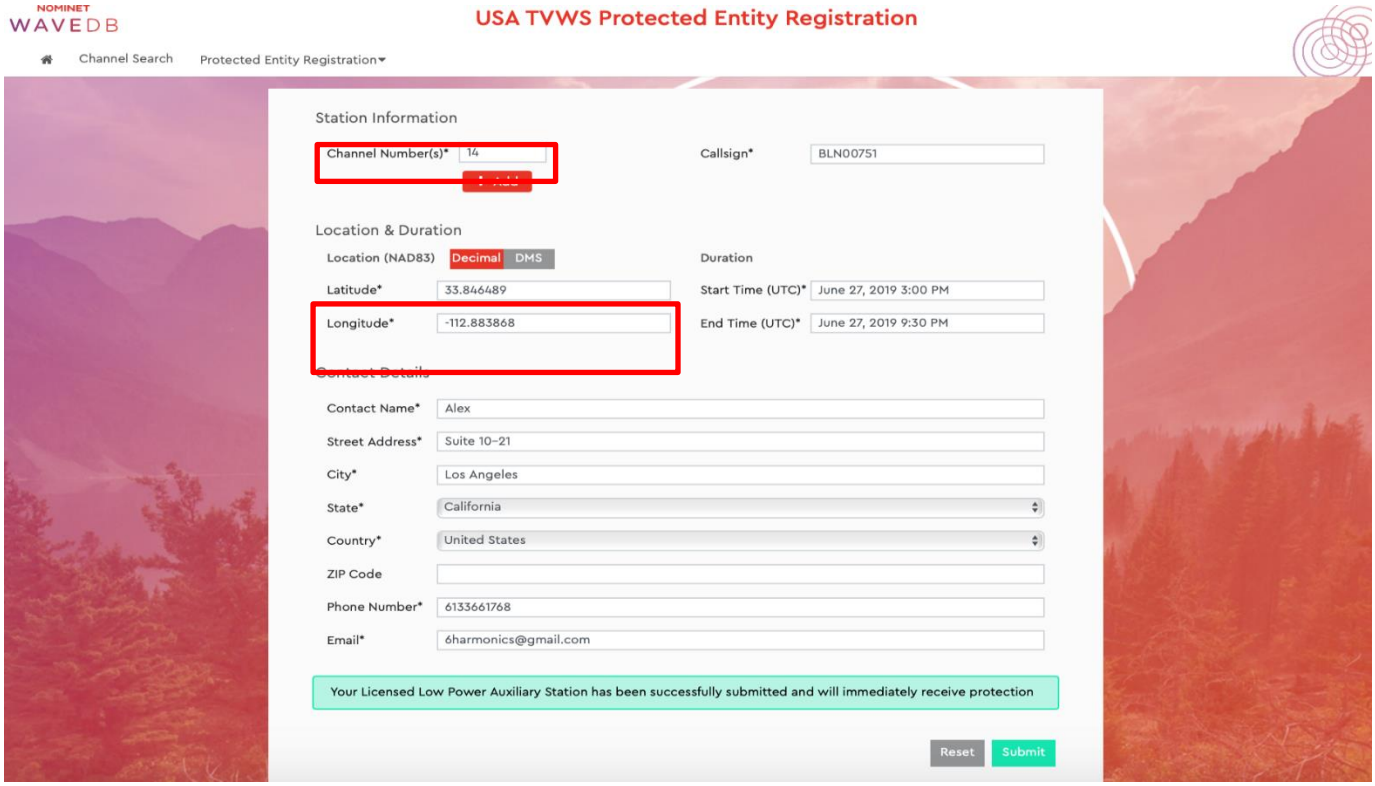

Figure 8.18-2: *Registration of LP device on the channel 14 at the same location*

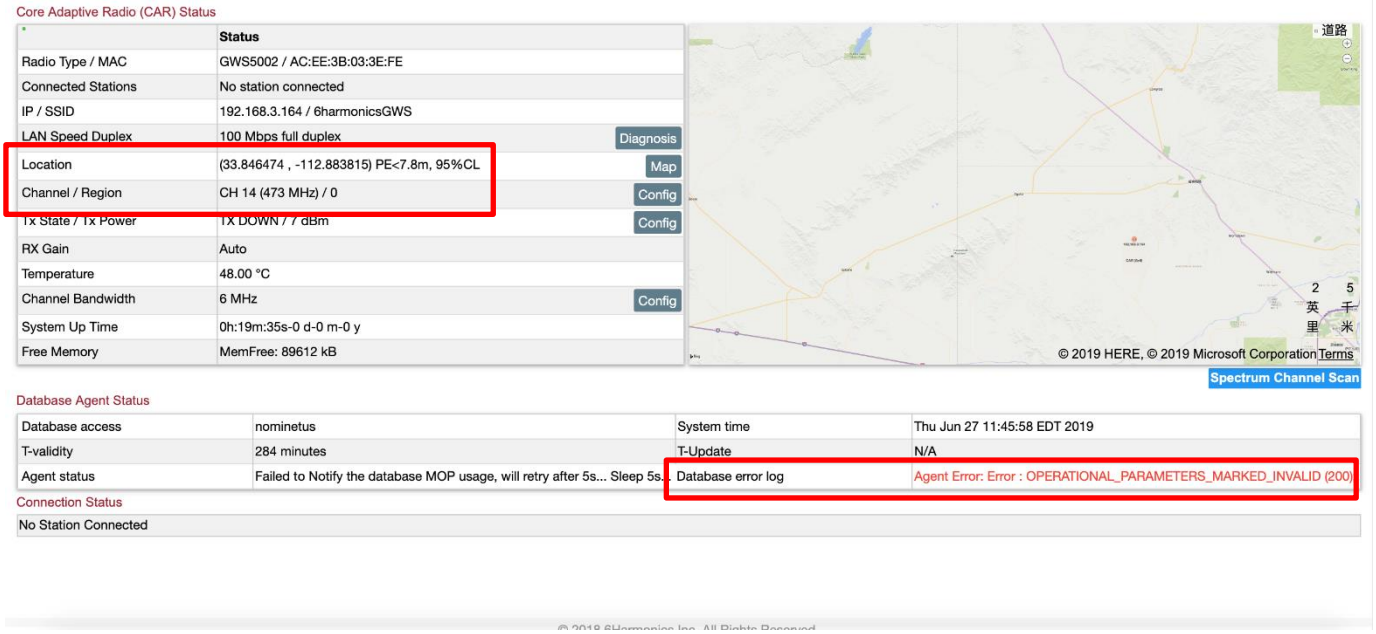

Figure 8.18-3: *Unsuccessful registration after the registration of LP device on the channel 14.*

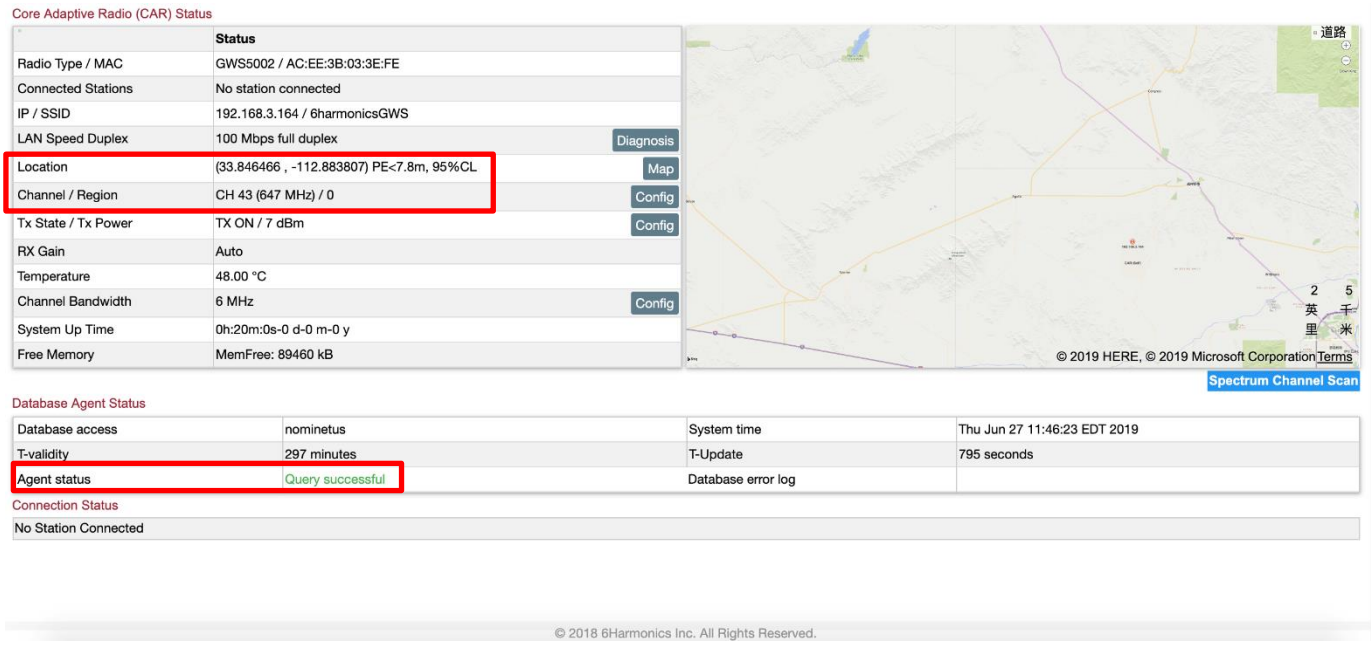

Figure 8.18-4: *Successful registration on channel 43 after the registration of LP device on the channel 14.*

8.19 FCC 15.712 Interference protection requirements (Fixed and personal/portable)

8.19.1 Definitions and limits

Using system management software or database, provide different location (coordinates) so that compliance with operating channel and power level is shown under each of the scenarios outlined in §15.712. Include a sample scan showing the total channel power and adjacent channel emission settings for test coordinates.

8.19.2 Test summary

Test date	June 27, 2019

8.19.3 Observations, settings and special notes

EUT was configured with proper registration information and the successful registration was verified. The coordinates then were changed in accordance with FCC 15.712 test scenarios. Updated channel list with unavailable channels was verified. Once the device gets updated channel list, the device flagged the error in the GUI when trying to set the restricted channel.
Test scenarios were as follows:
(a) Digital television stations, and digital and analog Class A TV, low power TV, TV translator and TV booster stations.
(b) TV translator, Low Power TV (including Class A) and Multi-Channel Video Programming Distributor (MVPD) receive sites.
(c) Fixed Broadcast Auxiliary Service (BAS) links.
(d) PLMRS/CMRS operations.
(e) Offshore Radiotelephone Service.
(f) Low power auxiliary services, including wireless microphones - Duplicate of earlier tests
(g) Border areas near Canada and Mexico.
(h) Radio astronomy services.
(i) 600 MHz service band.
(j) Wireless Medical Telemetry Service. - No existing examples
(k) 488-494 MHz band in Hawaii.

8.19.4 Test data

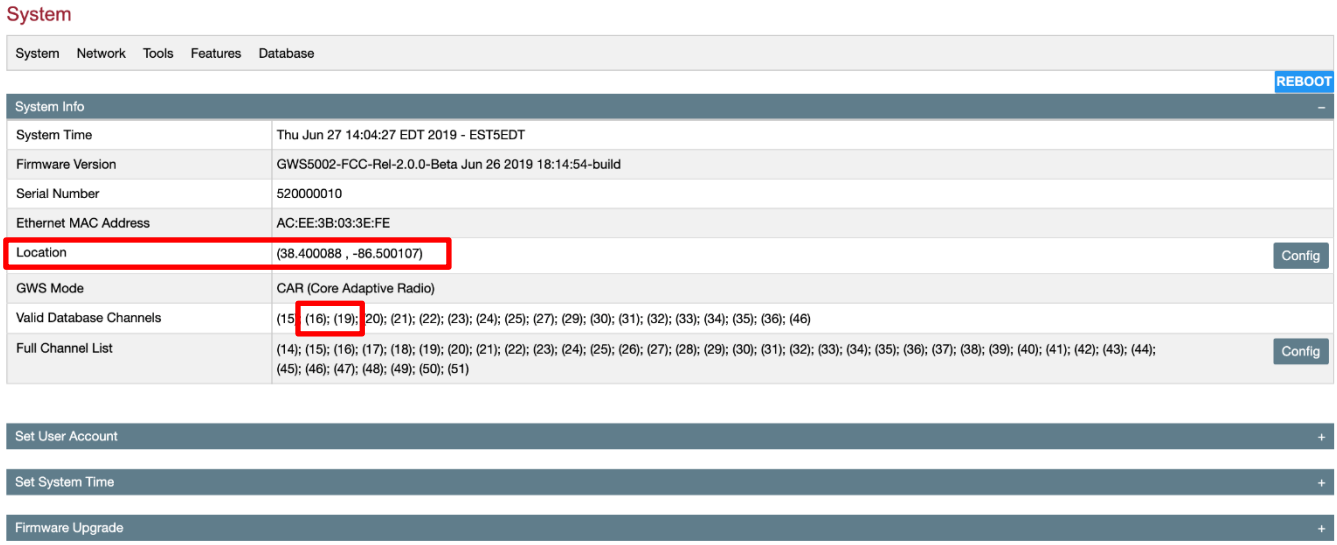

Figure 8.19-1: *Received channel list for coordinates set in scenarios (a) and (b). DCA channel 18 at location coordinates 38.4N, 86.5W*

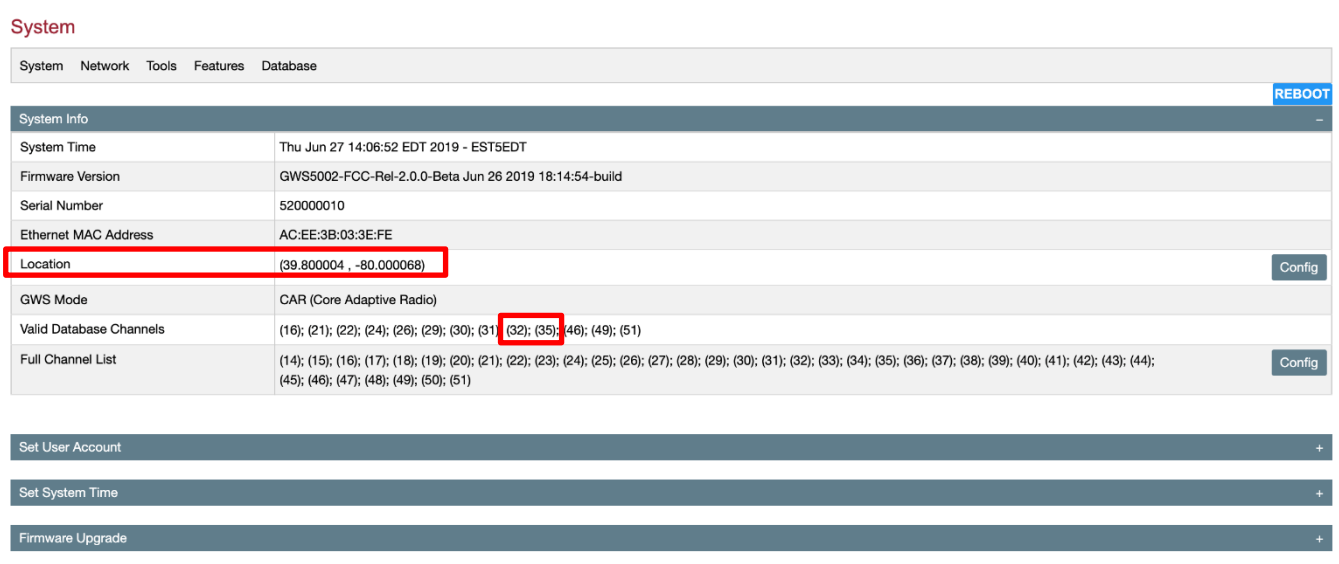

Figure 8.19-2: *Received channel list for coordinates set in scenarios (a) and (b). DRT channel 33 at location coordinates 39.8N, 80.0W*

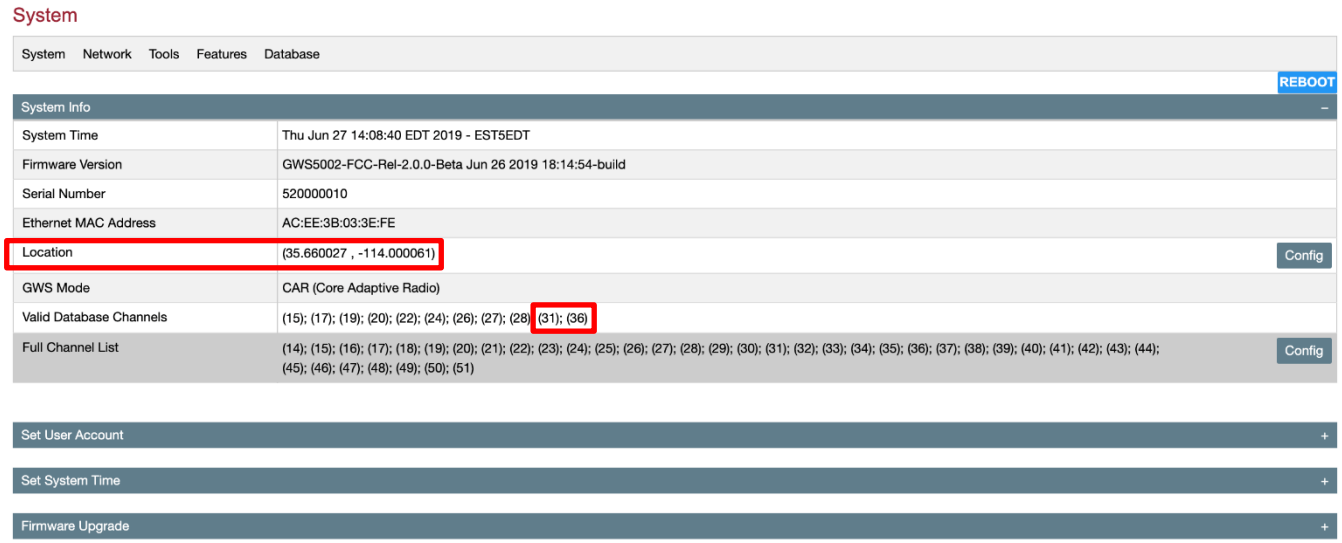

Figure 8.19-3: *Received channel list for coordinates set in scenarios (a) and (b). DTS channel 32 at location coordinates 35.66N, 114.0W*

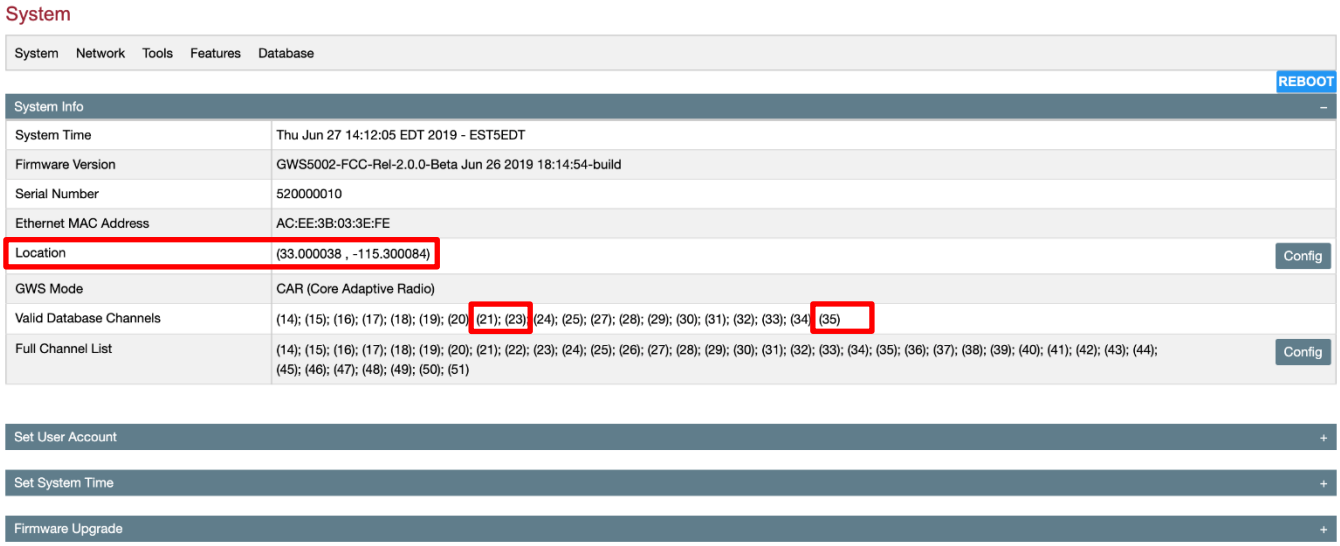

Figure 8.19-4: *Received channel list for coordinates set in scenarios (a) and (b). DTV channels 22 and 36 at location coordinate 33.0N, 115.3W*

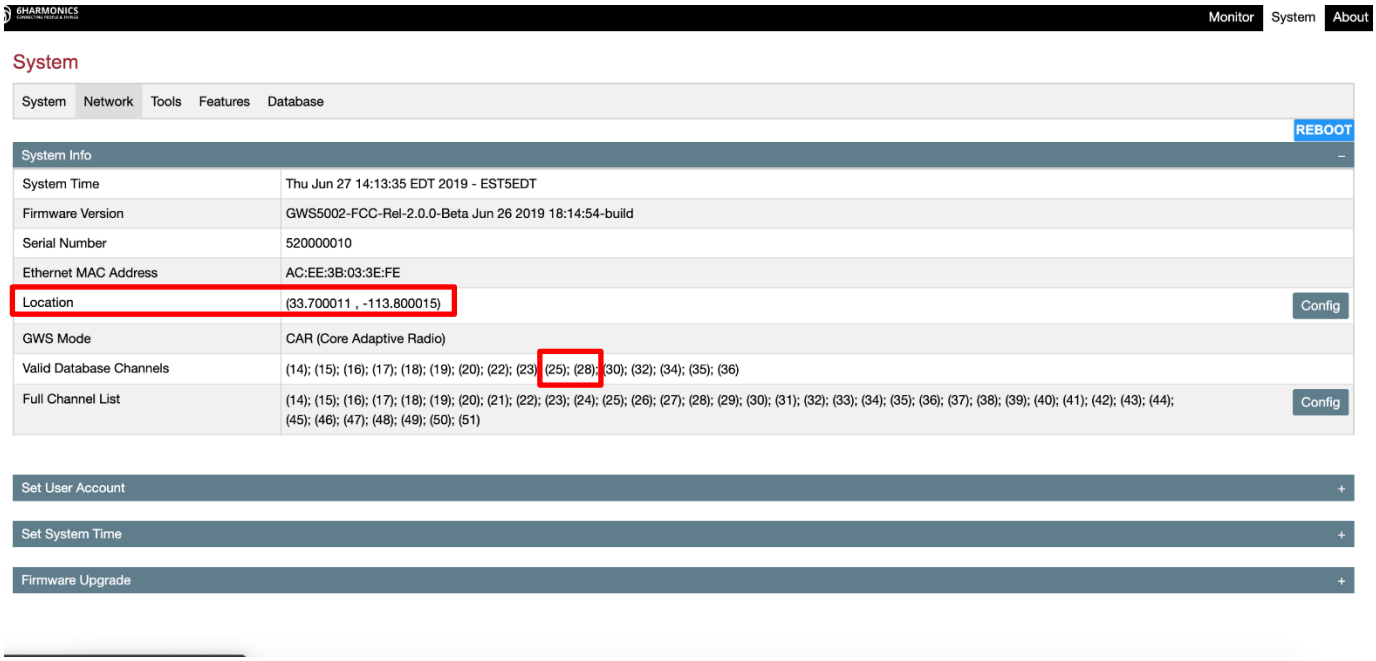

Figure 8.19-5: *Received channel list for coordinates set in scenario (a) and (b). LPA channel 27 at location coordinates 33.7N, 113.8W*

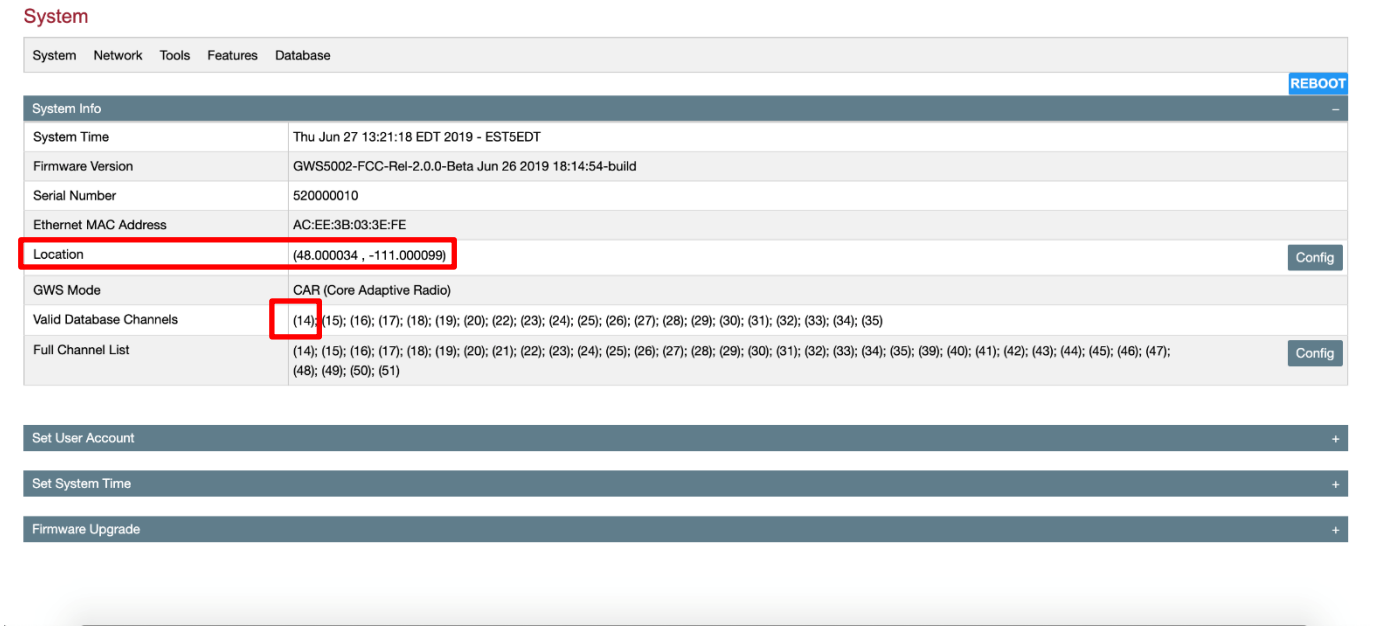

Figure 8.19-6: *Received channel list for coordinates set in scenario (a) and (b). LPD channel 11 at location coordinates 48.0N, 111.0W*

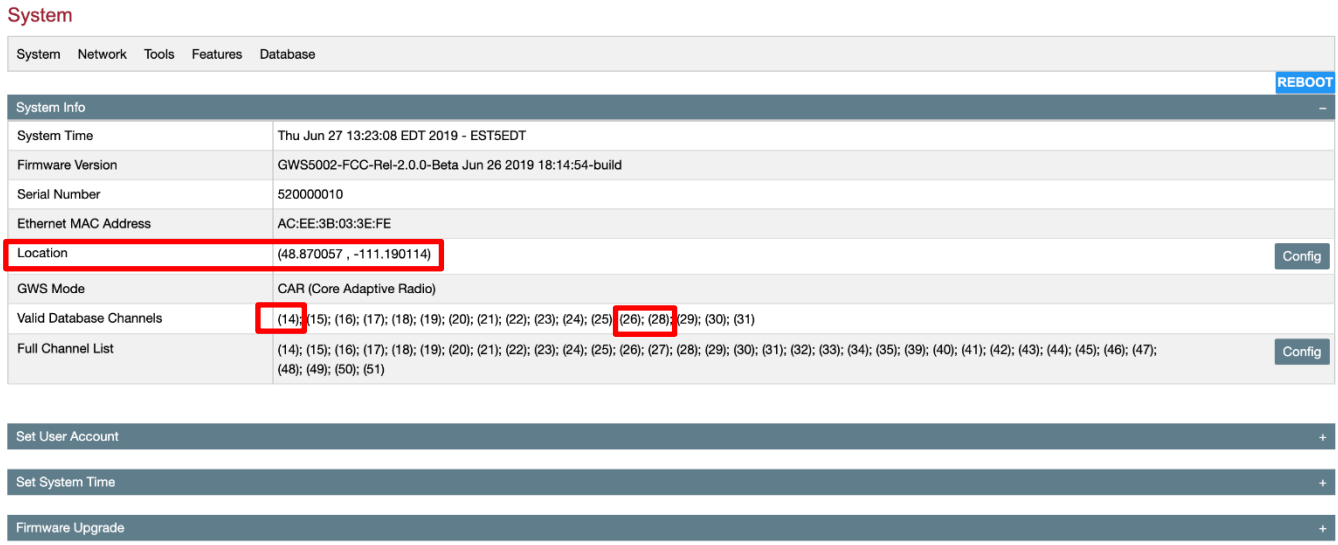

Figure 8.19-7: *Received channel list for coordinates set in scenario (a) and (b). LPT channel 27 and TV receive site channel 11 at location coordinates 48.87N, 111.19W*

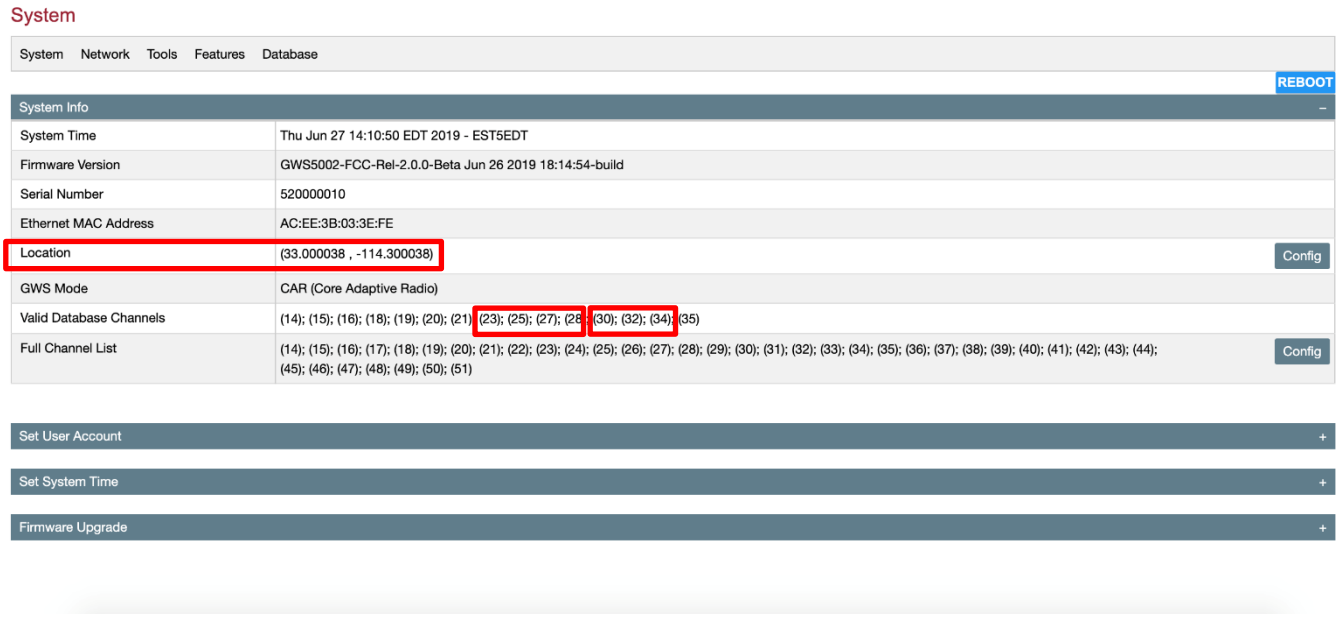

Figure 8.19-8: *Received channel list for coordinates set in scenario (a) and (b). LPX channels 24, 26, 29, 31 and 33 at location coordinates 33N, 114.3W*

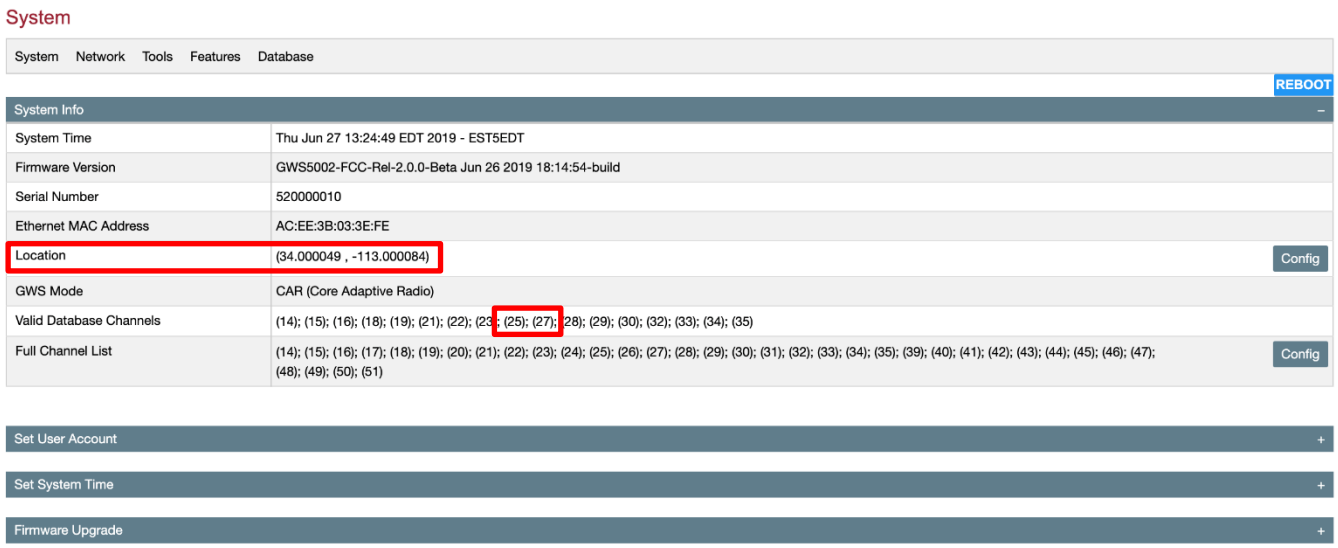

Figure 8.19-9: *Received channel list for coordinates set in scenario (a) and (b). MVPD channel 26 at location coordinates 34.0N, 113.0W*

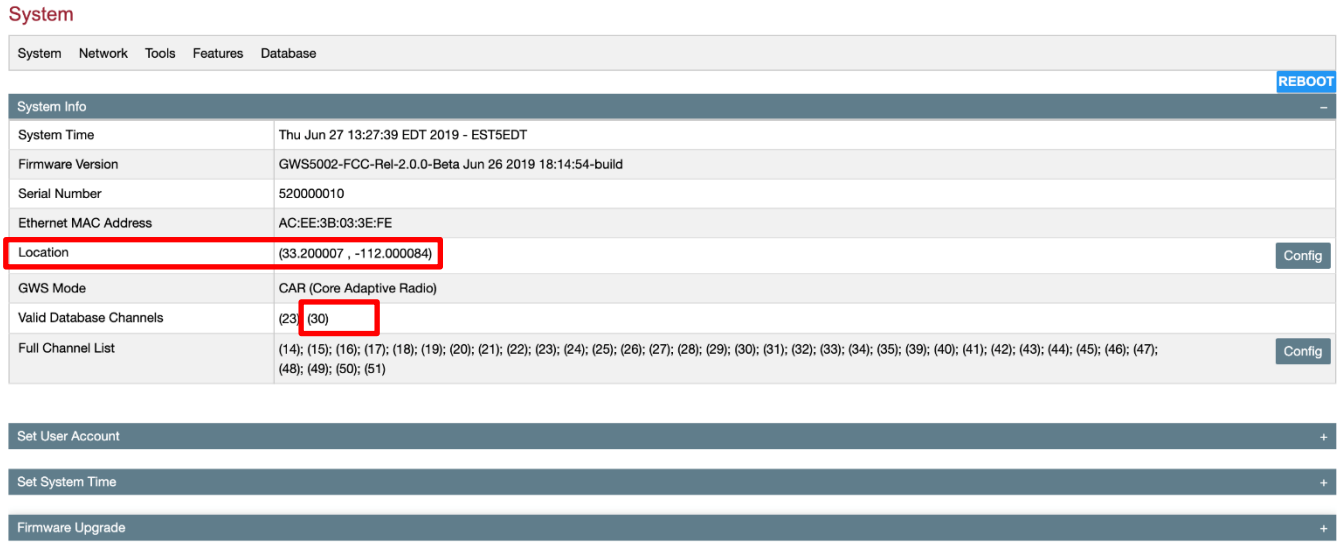

Figure 8.19-10: *Received channel list for coordinates set in scenario (c). Fixed BAS link channel 36 at location coordinates 33.2N, 112.0W*

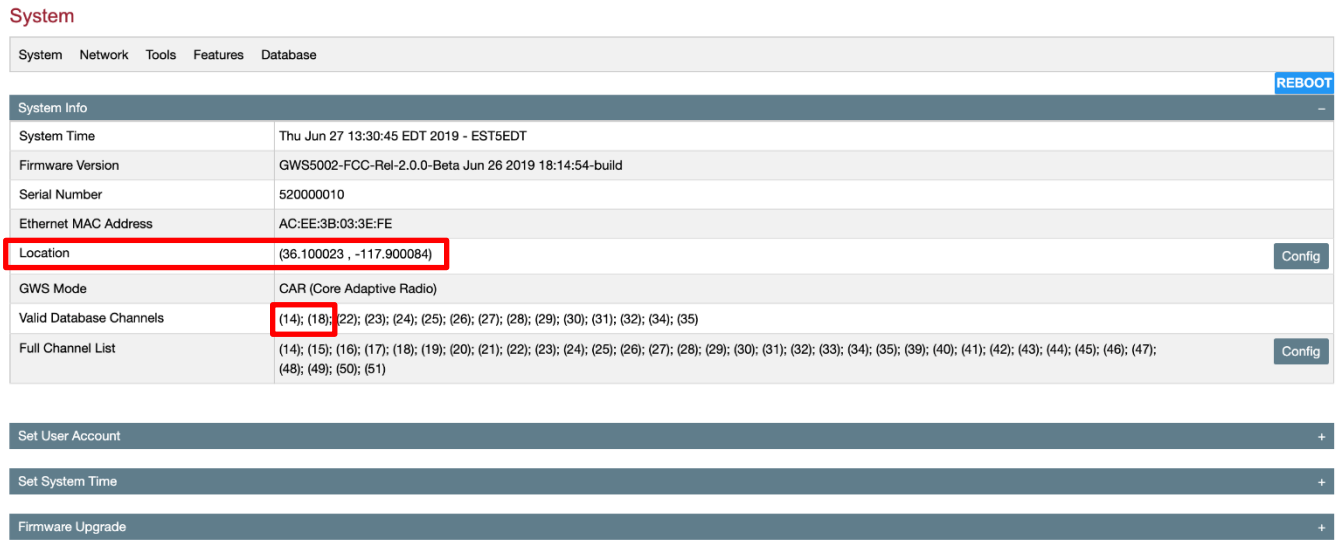

Figure 8.19-11: *Received channel list for coordinates set in scenario (d). PLMRS/CMRS operations channel 16 at location coordinates 36.1N, 117.9W*

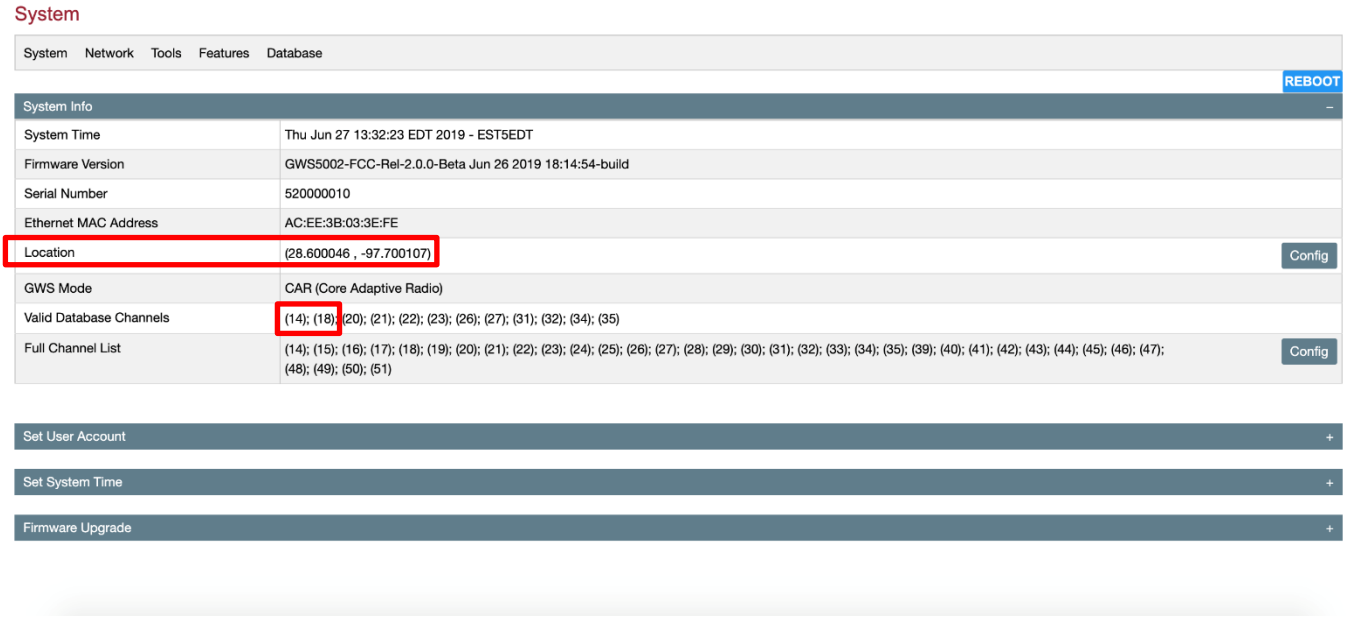

Figure 8.19-12: *Received channel list for coordinates set in scenario (e). Offshore radiotelephone on channel 15 at location coordinates 28.6 N, 97.1W*

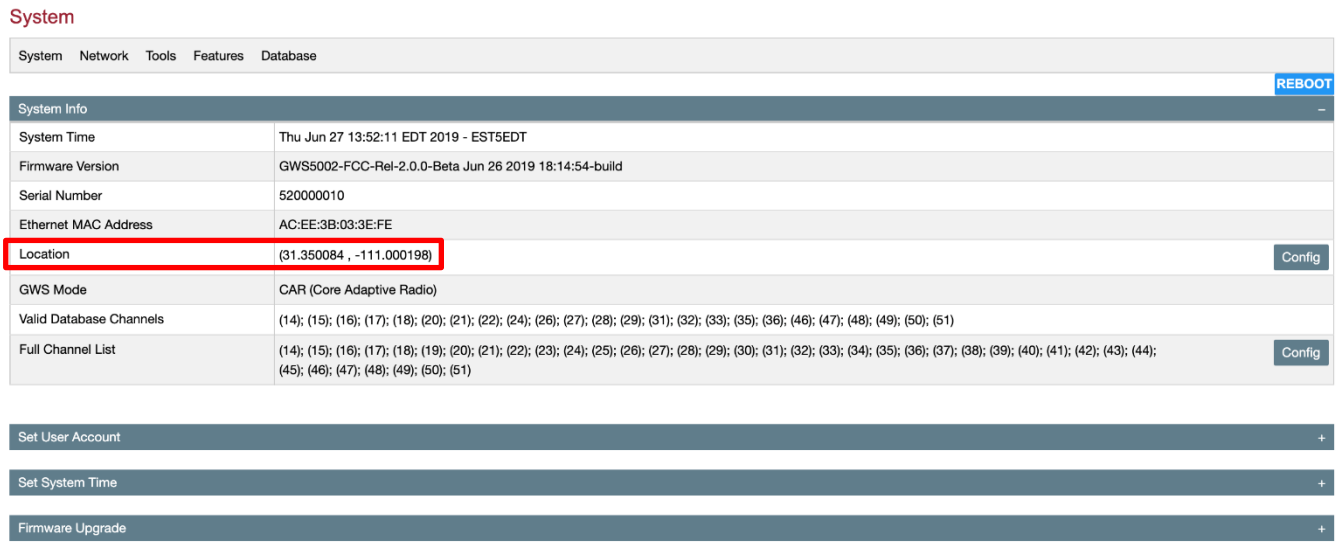

Figure 8.19-13: *Received channel list for coordinates set in scenario (g). Mexico border at location coordinates 31.35N, 111.0W*

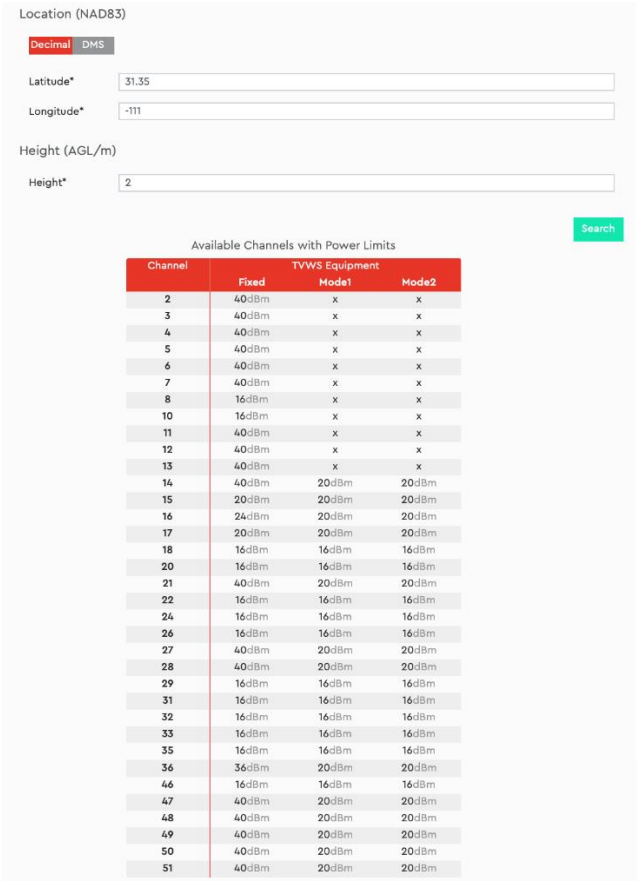

Figure 8.19-14: *Channel availability for coordinates set in scenario (g). Mexico border at 31.35N, 111.0W*

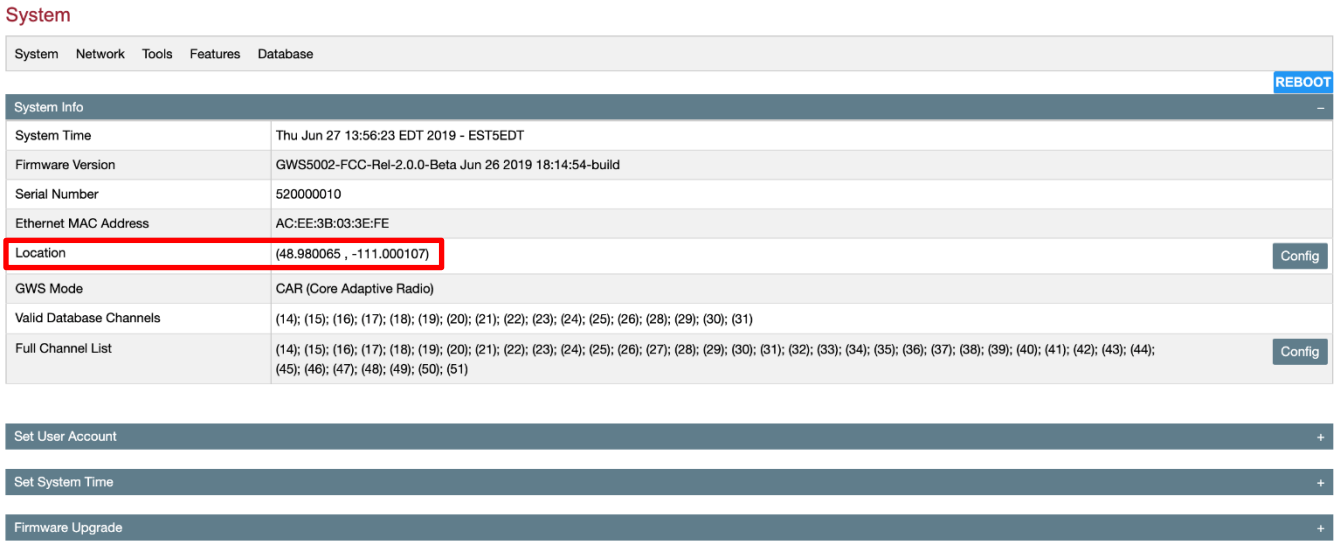

Figure 8.19-15: *Received channel list for coordinates set in scenario (g). Canada border at location coordinates 48.98N, 111.0W*

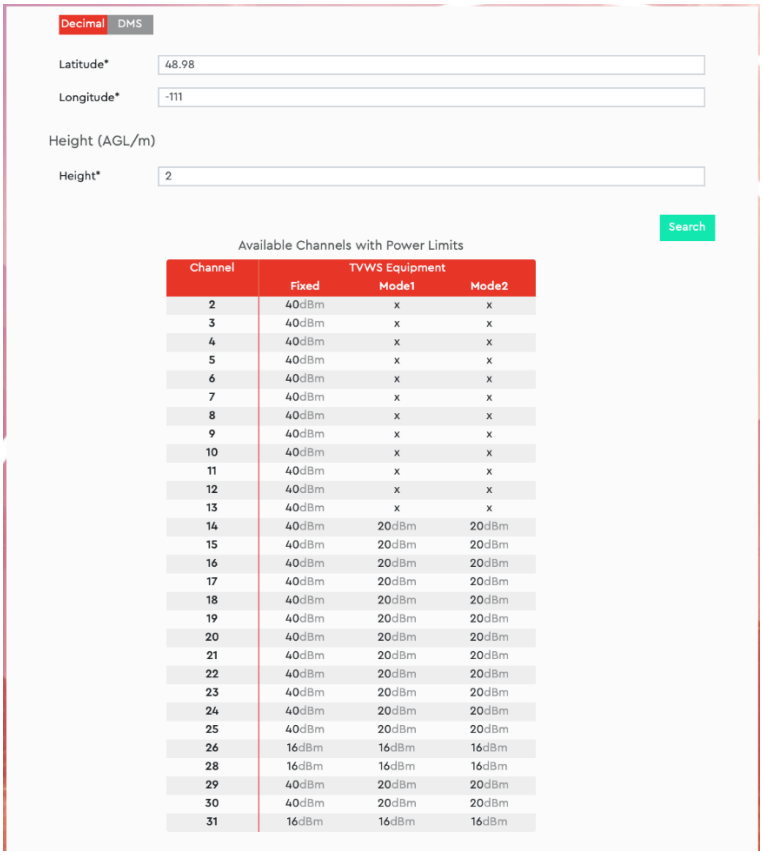

Figure 8.19-16: *Channel availability for coordinates set in scenario (g). Canada border at 48.98N, 111.0W*

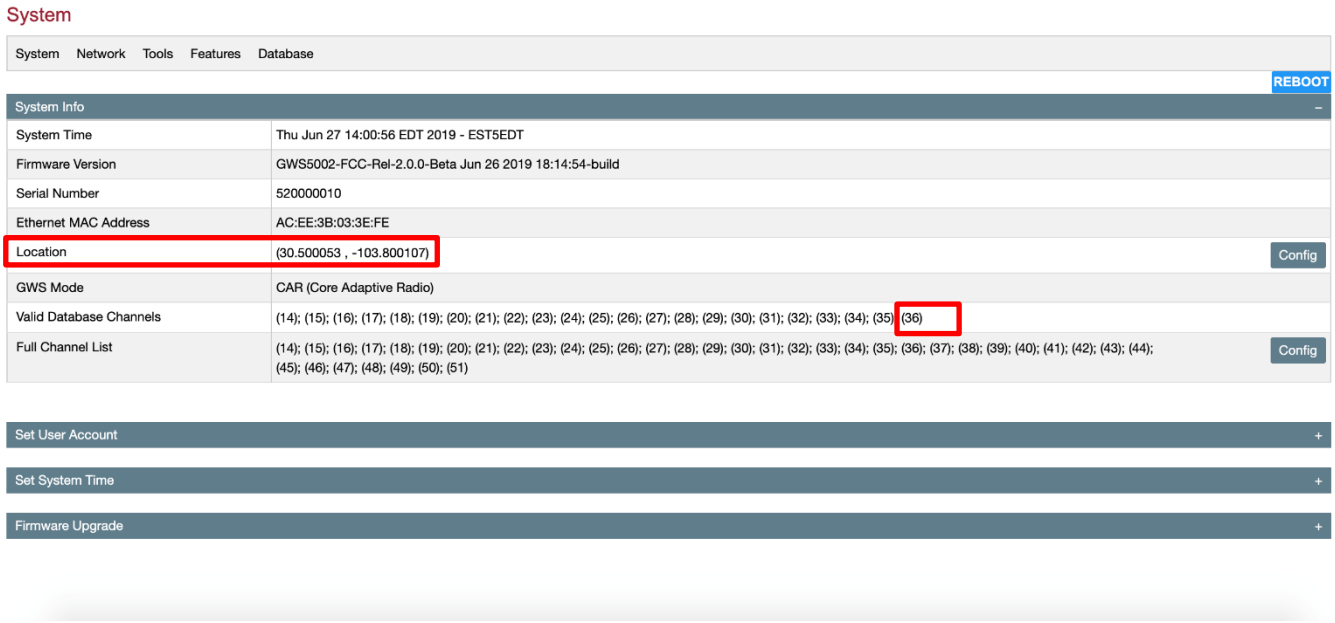

Figure 8.19-17: *Received channel list for coordinates set in scenario (h). Radio astronomy services on channel 37 at location coordinates 30.5N, 103.8W*

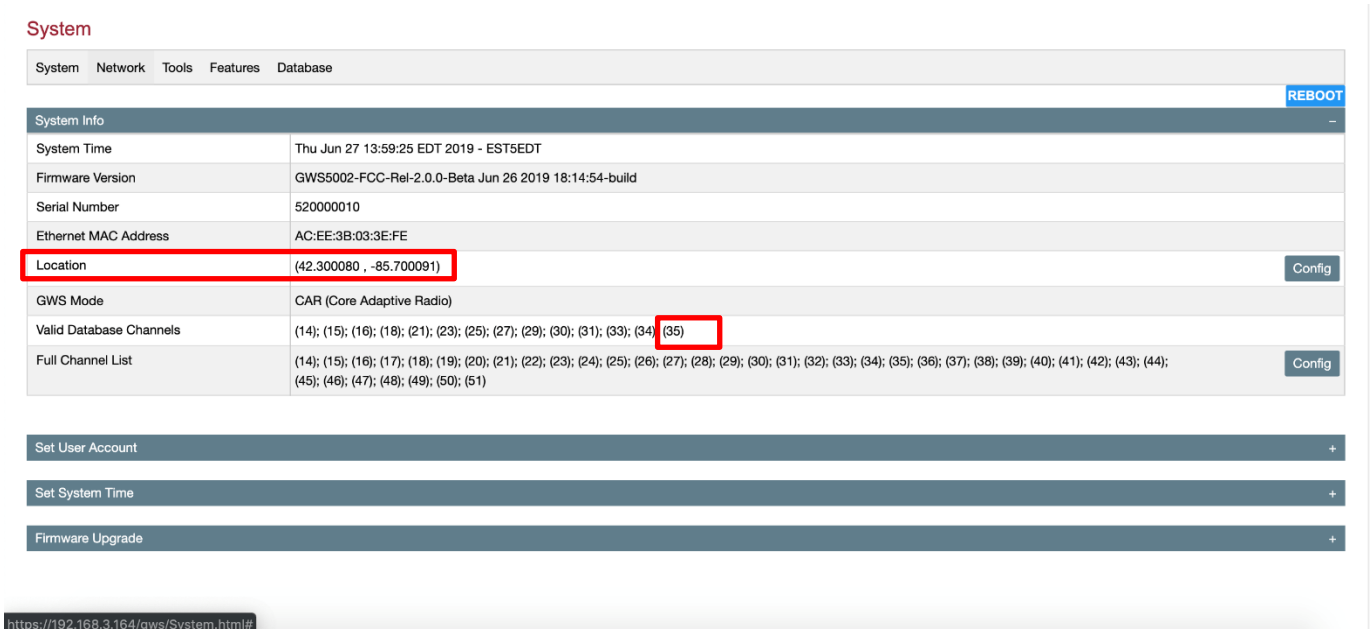

Figure 8.19-18: *Received channel list for coordinates set in scenario (i). 600 MHz service band on channels 39–42, 47–50 at location coordinates 42.3N, 85.7W*

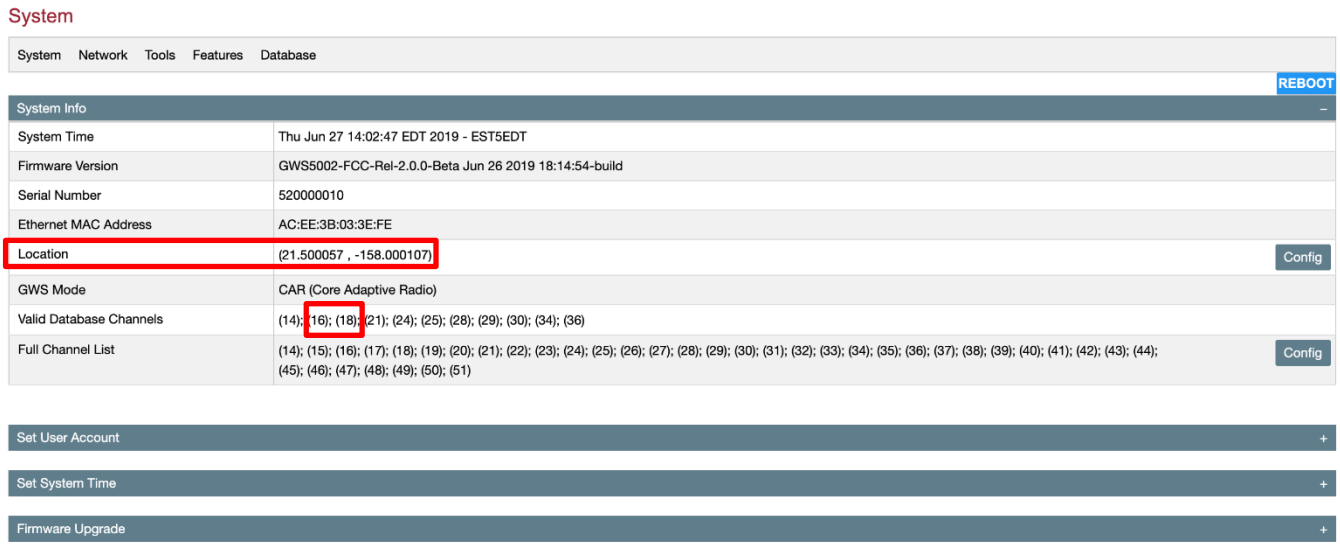

Figure 8.19-19: *Received channel list for coordinates set in scenario (k). 488–494 MHz band in Hawaii channel 17 at location coordinates 21.5N, 158.0W*

8.20 FCC 15.711(c)(2)(ii), (d)(3), 15.715(e) Fixed and Mode II Power level reduction

8.20.1 Definitions and limits

Using system management software, make a channel availability request to the database. Using the spectrum analyzer, confirm that the WSD operates at no more than the maximum power level indicated by the database and that the power level cannot be set to a higher level than indicated by the database at that specific location. If the device cannot reduce power, it must cease operation. Testing in accordance with KDB 416721 D01, III (2)(o).

8.20.2 Test summary

Test date	June 27, 2019

8.20.3 Observations, settings and special notes

EUT was configured with proper registration information and the successful registration was verified. After receiving channel EIRP limit, EUT Tx power and Antenna gain were modified to exceed the limit. It was verified that the output power was automatically reduced to comply with EIRP restriction for the operation channel used.

8.20.4 Test data

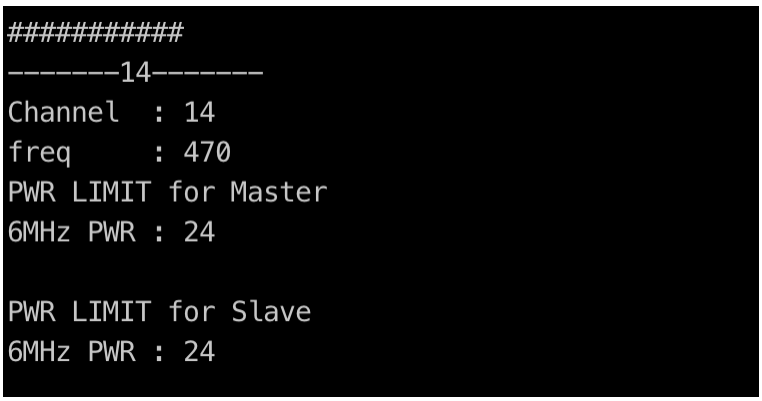

Figure 8.20-1: *Attempt 1 (antenna gain 4 dBi) Database provided an EIRP limitation of 24 dBm for channel 14*

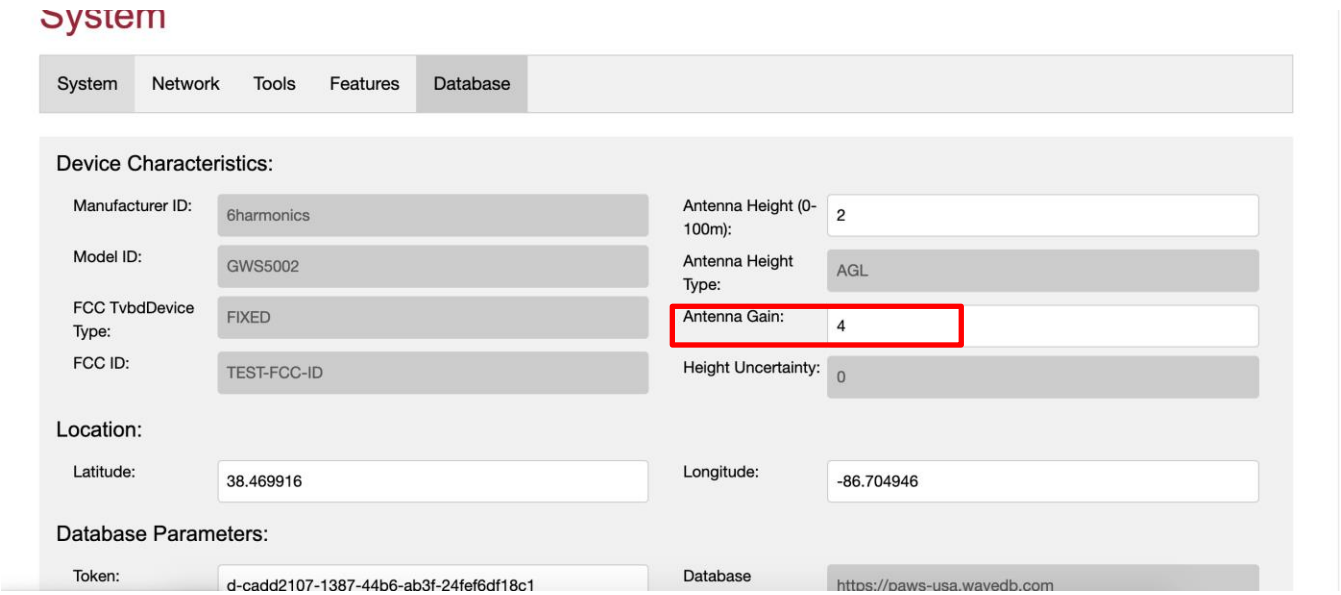

Figure 8.20-2: *Attempt 1 (antenna gain 4 dBi) Antenna gain settings*

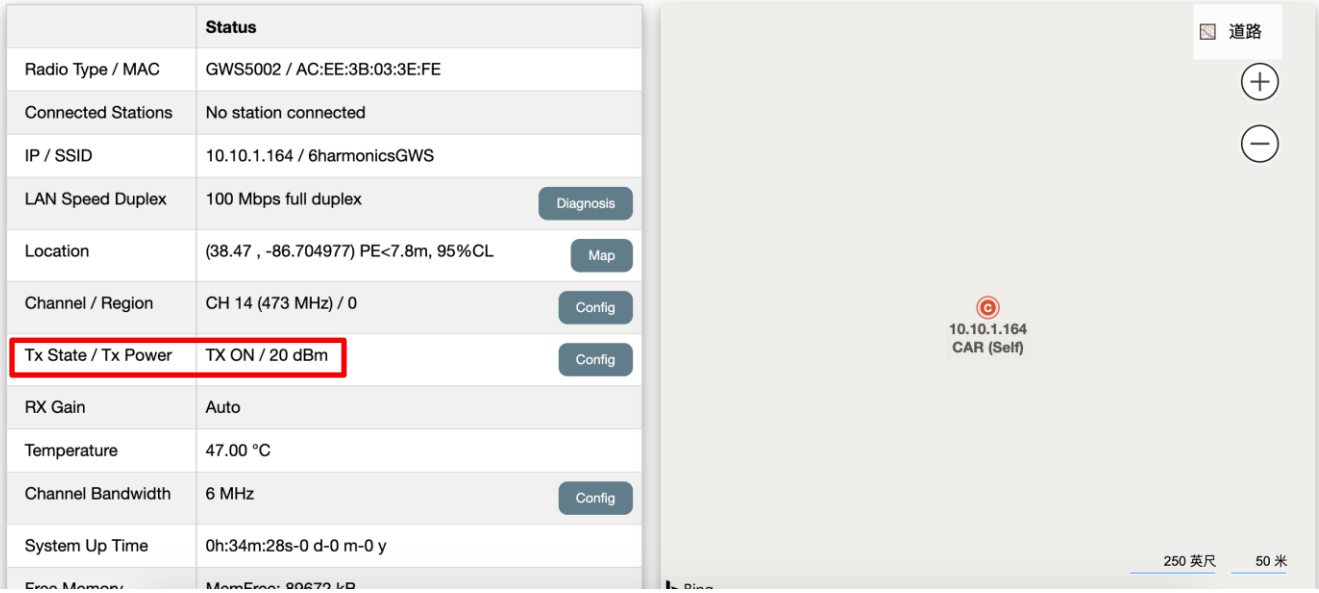

Figure 8.20-3: *Attempt 1 (antenna gain 4 dBi) Transmit max power settings for compliance with the EIRP requirement: 24 dBm (EIRP limit) – 4 dBi (Antenna gain) = 20 dBm (Tx power)*

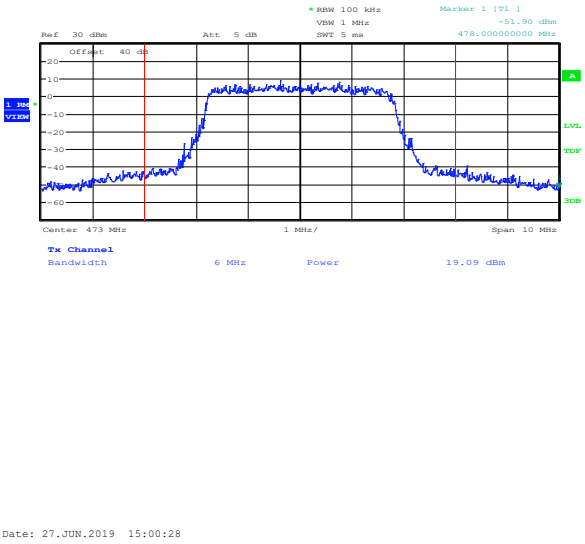

Figure 8.20-4: *Attempt 1 (antenna gain 4 dBi) Output power measurement on the channel 14 after registration and reception max EIRP limit.*

```
j
###########
-------14-------
Channel  : 14
freq     : 470
PWR LIMIT for Master
6MHz PWR : 24

PWR LIMIT for Slave
6MHz PWR : 24
```

Figure 8.20-5: *Attempt 2 (antenna gain 8 dBi) Database provided an EIRP limitation of 24 dBm for channel 14*

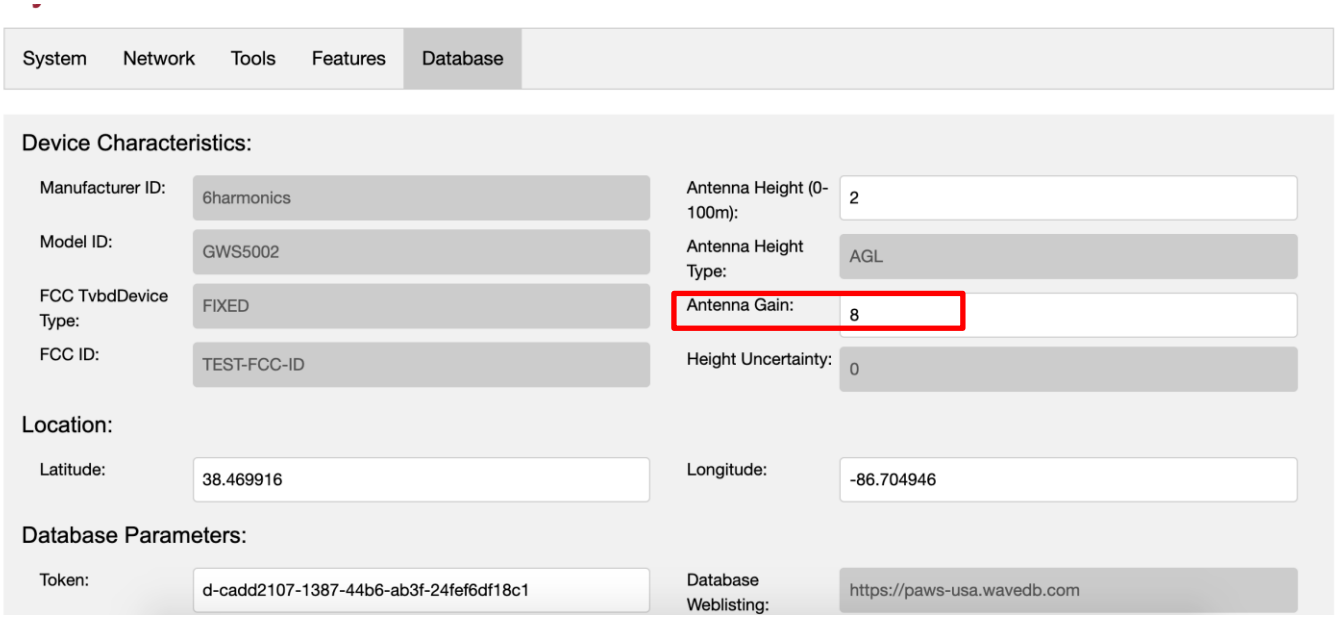

Figure 8.20-6: *Attempt 2 (antenna gain 8 dBi) Antenna gain settings*

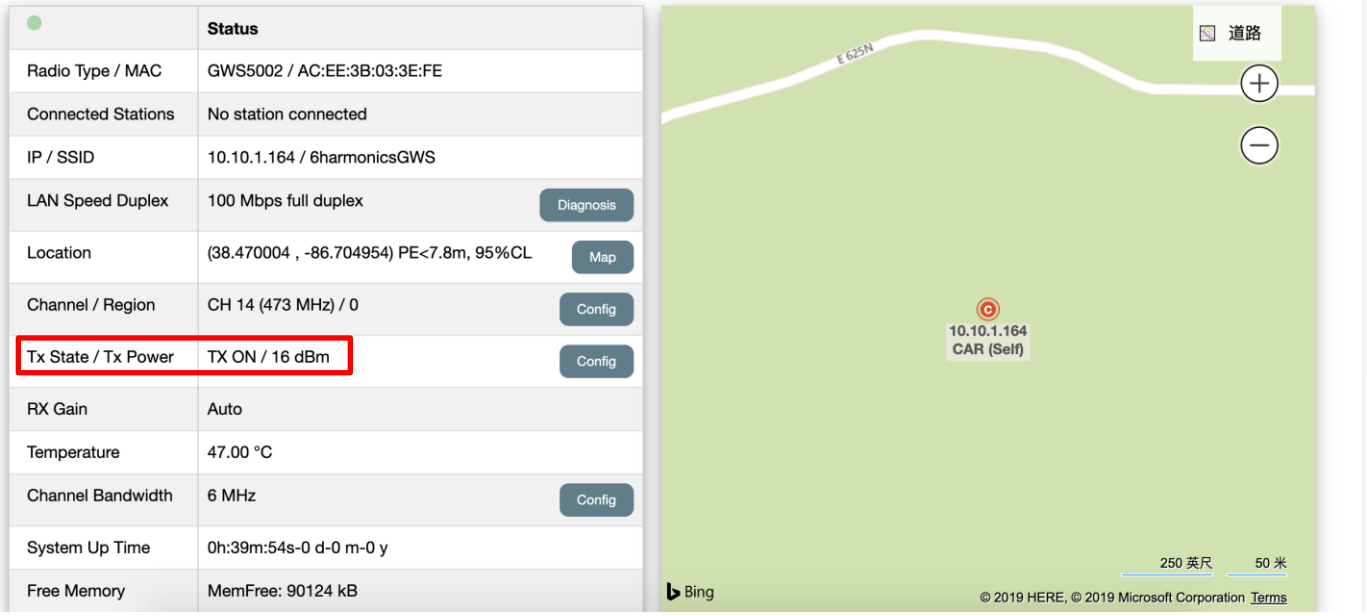

Figure 8.20-7: *Attempt 2 (antenna gain 8 dBi) Transmit max power settings for compliance with the EIRP requirement: 24 dBm (EIRP limit) – 8 dBi (Antenna gain) = 16 dBm (Tx power)*

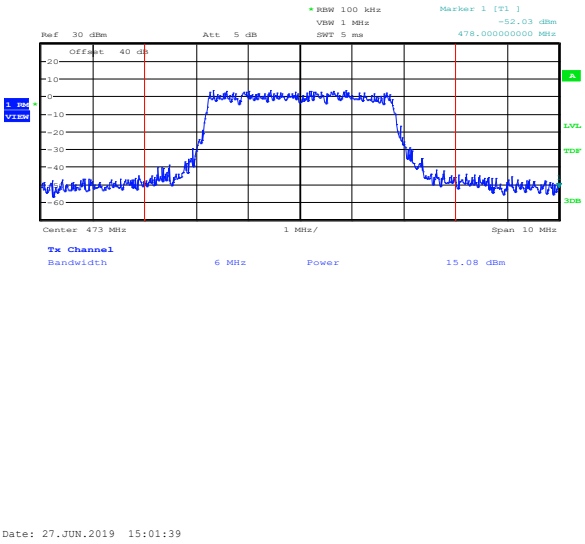

Figure 8.20-8: *Attempt 2 (antenna gain 8 dBi) Output power measurement on the channel 14 after registration.*

8.21 FCC 15.711(j) Security

8.21.1 Definitions and limits

White space devices shall incorporate adequate security measures to ensure that they are capable of communicating for purposes of obtaining lists of available channels only with databases operated by administrators authorized by the Commission, and to ensure that communications between white space devices and databases are secure to prevent corruption or unauthorized interception of data. This requirement applies to communications of channel availability and other spectrum access information between the databases and fixed and Mode II devices (it is not necessary for white space devices to apply security coding to channel availability and channel access information where they are not the originating or terminating device and that they simply pass through).

8.21.2 Test summary

Test date	June 27, 2019

8.21.3 Observations, settings and special notes

Information provided by the manufacturer

8.21.4 Test data

i. What communication protocol is used between the database and the WSD?

The Fixed WSD (WSD) connects to the Nominet database using HTTPS over SSL/TLS. The Nominet database is certified by FCC which includes the protocol of how WSD interact with the database.

ii. How are communications initiated?

When the WSD boots up the WSD first ensures a connection to the internet with a valid DNS and gateway. Then the radio accesses the URL of the database and undergoes a TLS v1.2 handshake before exchanging data. This ensures a secure exchange. The WSD initiates communication with the Nominet database by initially sending an INIT_REQ message which includes the WSD Descriptor.

The WSD Descriptor contains;

- the device serial number
- manufacturer ID
- model ID
- FCC ID

iii. How does the WSD validate messages from the database?

The identity of the Nominet database is validated through verification of the Nominet SSL/TLS certificate through standard third-party certificate authority mechanisms, ensuring communications are secure and authenticated between the WSD and the database.

iv. How does the device handle failure to communicate or authenticate the database?

If the WSD does not successfully communicate with an authenticated database (as above), it will not allow operations to begin. If the device fails to communicate with the database, it will re-try every 30 seconds.

v. How does the database validate messages from a WSD?

A unique database token installed in the radio during manufacture is required to validate the exchange. Only devices that have a valid database token can receive communications from the database. The database validates the token against the provided serial number, manufacturer name, model ID and FCC ID.

The list of valid serial numbers is generated by the device manufacturer. Using the Nominet database web interface authorized users can generate tokens for specific devices with specific serial numbers. Users are authorized by Nominet via an account name and password, which is only available to persons authorized by the device manufacturer.

vi. What encryption method is used?

SSL/TLS1.2 encryption is used to encrypt packets sent between the WSD and the database.

vii. How does the database ensure secure registration of protected devices?

Protected devices are entities authorized by the rules for protection from WSD transmissions. Nominet provides a public interface to register protected devices in the database web tool using a valid account, valid username and valid password.

Section 9. Block diagrams of test set-ups

9.1 Test setup diagram