RF TEST REPORT

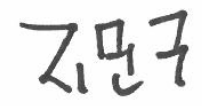
Report number		RAPA24-O-016R
Applicant	Name	NZIA Connect Inc.
	Logo	N/A
	Address	#1302, 286, Beotkkot-ro, Geumcheon-gu, Seoul, Republic of Korea
Manufacturer	Name	NZIA Connect Inc.
	Address	#1302, 286, Beotkkot-ro, Geumcheon-gu, Seoul, Republic of Korea
Type of equipment		TVWS Wireless Networking Radio System
Basic model name		NZC-WS20
Multi model name		N/A
Serial number		N/A
FCC ID		2AUON-NZC-WS20
Test duration		Nov 16, 2023 to July 11, 2024
Date of issue		July 11, 2024
Total page		37 Pages (including this page)

SUMMARY

The equipment complies with the regulation; FCC Part 15 Subpart H

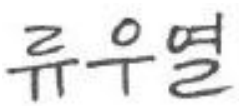
This test report only contains the result of a single test of the sample supplied for the examination.
It is not a general valid assessment of the features of the respective products of the mass-production.

July 11, 2024



Tested by MinGu Ji
Tester

July 11, 2024



Reviewed by Wooyeol- Ryu
Executive Manager

Test Report Version History

Version	Date	Reason for revision
1.0	Feb 8, 2024	Original Document
2.0	July 11, 2024	p.26 Interference protection requirements TEST Modified

CONTENTS

1. Description of EUT

1.1 Applicant

• Company name : NZIA Connect Inc.
• Address : #1302, 286, Beotkkot-ro, Geumcheon-gu, Seoul, Republic of Korea
• Contact person : Lee Nam Ku / Senior Researcher / kevin@nzia.kr
• Phone/Fax : +82-70-4282-4700 / +82-2-851-3873

1.2 Manufacturer

• Company name : NZIA Connect Inc.
• Address : #1302, 286, Beotkkot-ro, Geumcheon-gu, Seoul, Republic of Korea
• Phone/Fax : +82-70-4282-4700 / +82-2-851-3873

1.3 Basic description

• Product name : TVWS Wireless Networking Radio System
• Basic model name : NZC-WS20
• Alternative model name : N/A

1.4 General description

• EQUIPMENT CLASS : WGF – White Space Device with Geo-location - Fixed

• Frequency Range : 470 MHz ~ 698 MHz
• Output Power : 16.03 dBm
• Modulation Type : QPSK
• Antenna Type : Patch Antenna
• Antenna Gain : 8.28 dBi
• Power Supply : AC 110.0 ~ 230.0 V

Start of Frequency range, MHz	End of Frequency range, MHz	Frequency range Bandwidth, MHz	Channel size, MHz	Low channel	Mid channel	High channel
470	698	228	6	473	587	695

1.5 Alternative type(s)/model(s)

There is no alternative type(s) and/or model(s).

2. General information of test

2.1 Test standards and results

Applied Standards : FCC Part 15 Subpart H		
Section	**Description of Test**	**Result**
§ 15.713(g)(3)	Fixed white space device registration	Pass
§ 15.713(g)(3)(iii)	Unsuccessful registration – restricted coordinates	Pass
§ 15.713(g)(3)(v)	Unsuccessful registration due to incomplete information	Pass
§ 15.713(e)(6)	Unsuccessful registration due to HAAT > 250 m	Pass
§ 15.713(e)(6)	Unsuccessful registration due to antenna height that exceeds 30 m	Pass
§ 15.713(g)(3)(i) and (ii)	Unsuccessful registration due to incomplete information – FCC ID and Serial number	Pass
§ 15.713(a)(1)	48-hour channel scheduling	Pass
§ 15.713(a)(3)	Relocation of fixed TVBD	Pass
§ 15.711(c)(2)(i)	Fixed & Mode II TVDB database update	Pass
§ 15.711(c)(2)(iii)	Low-power auxiliary device protection	Pass
§ 15.712	Interference protection requirements (Fixed and personal/portable)	Pass
§ 15.711(c)(2)(ii)	Fixed and Mode II Power level reduction	Pass
§ 15.711(j)	Security	Pass

2.2 Description of EUT during the test

During the test, keep the EUT in continuously transmitting mode.
There was no mechanical or circuitry modification to improve RF and spurious characteristic, and any RF and spurious suppression device(s) was not added against the device tested.
The EUT was moved throughout the X, Y, and Z axis and worst case data was recorded in this report.

2.3 Test configuration

• Type of peripheral equipment used

Model	Manufacturer	Description	Connected to
650G1	HP	Notebook	EUT
PA-1900-32HT	LITE-ON TECHNOLOGY(CHANGZHOU_Co., Ltd.	Power Adapter	Notebook

2.4 Test Facility

• FCC Registration No: 927453
• IC Company address code: 9355B
• RRA Designation Number: KR0027

• Place of Test
Anyang Test Site(RF Test Room)
#101 & B104 Anyang Megavalley, 268, Hagui-ro, Dongan-gu, Anyang-si, Gyeonggi-do, 14056, Korea

2.5 PRELIMINARY TEST

• Product description and theory of operation

- The TVWS base station is a outdoor unit that transmits independent carriers. Each carrier provides up to 32 Mbps by TVWS channels. The base station is deployed with an external SISO antenna. It is connected to the network through a SFP with AC input. The base station includes an GPS an external antenna. The base station main features include up to 32 Mbps throughput, up to 256 QAM modulation rates in 6 MHz channel bandwidths. The TVWS subscriber unit delivers up to 32 Mbps and includes a directional integrated flat panel antenna for quick and easy installation. TVWS is highly robust, a mandatory requirement for maintaining low operational costs in remote rural networks. The TVWS incorporates an embedded GPS, enabling dynamic spectrum allocation according to the regulation.

2.5.1 AC Power line Conducted Emissions Tests

Operation Mode	The Worse operating condition (Please check one only)
Transmitting mode.	X

2.5.2 General Radiated Emissions Tests

During Preliminary Tests, the following operating modes were investigated

Operation Mode	The Worse operating condition (Please check one only)
Transmitting mode.	X

3. Measurement data

3.1 Fixed white space device registration

3.1.1 Requirement

• FCC Part15 subpart H, §15.713(g)(3)

3.1.2 Test Procedure

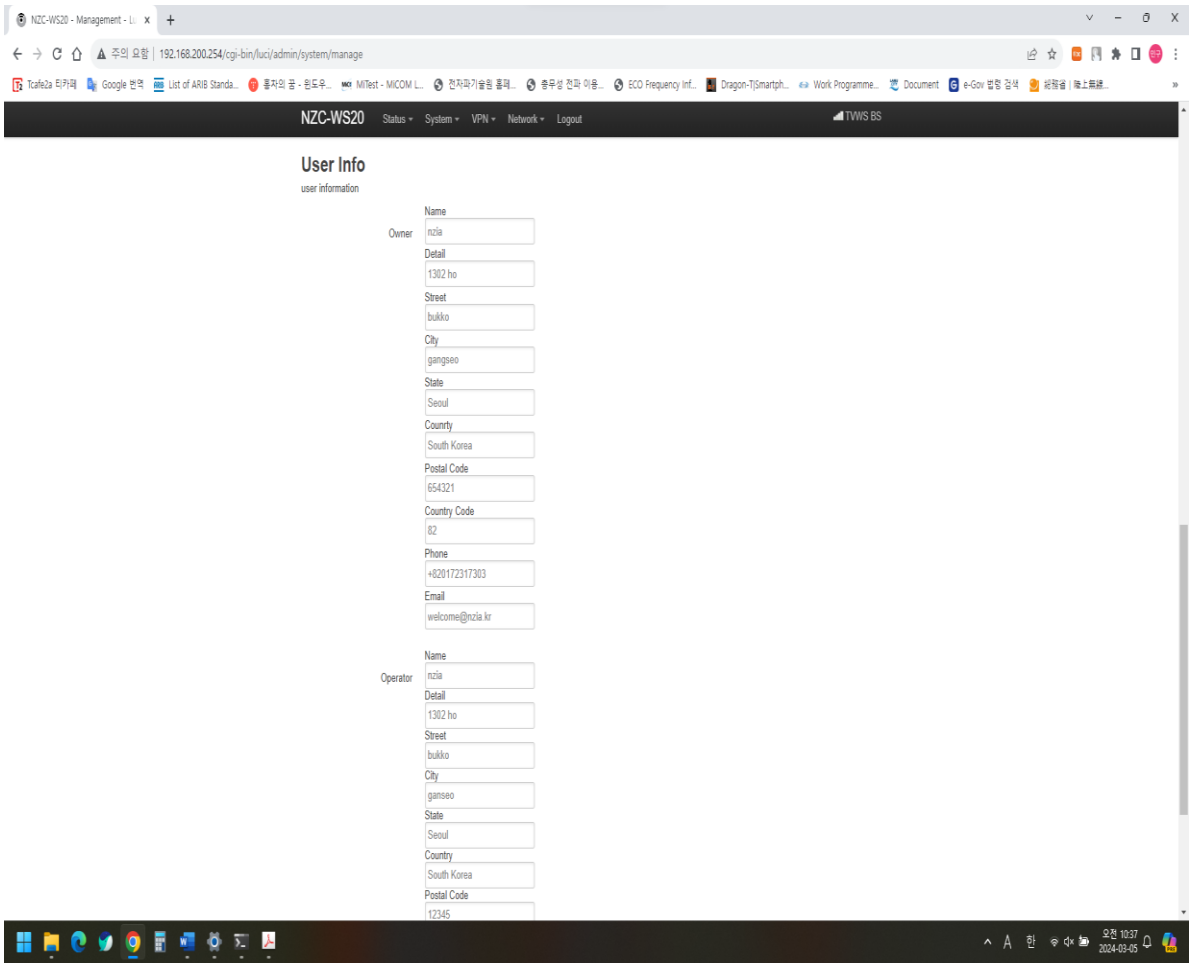
Prior to operating for the first time or after changing location, a fixed white space device must register with the white space database by providing the

information listed in paragraph (g)(3) of §15.713. Testing in accordance with KDB 416721 D01, III (2)(a)

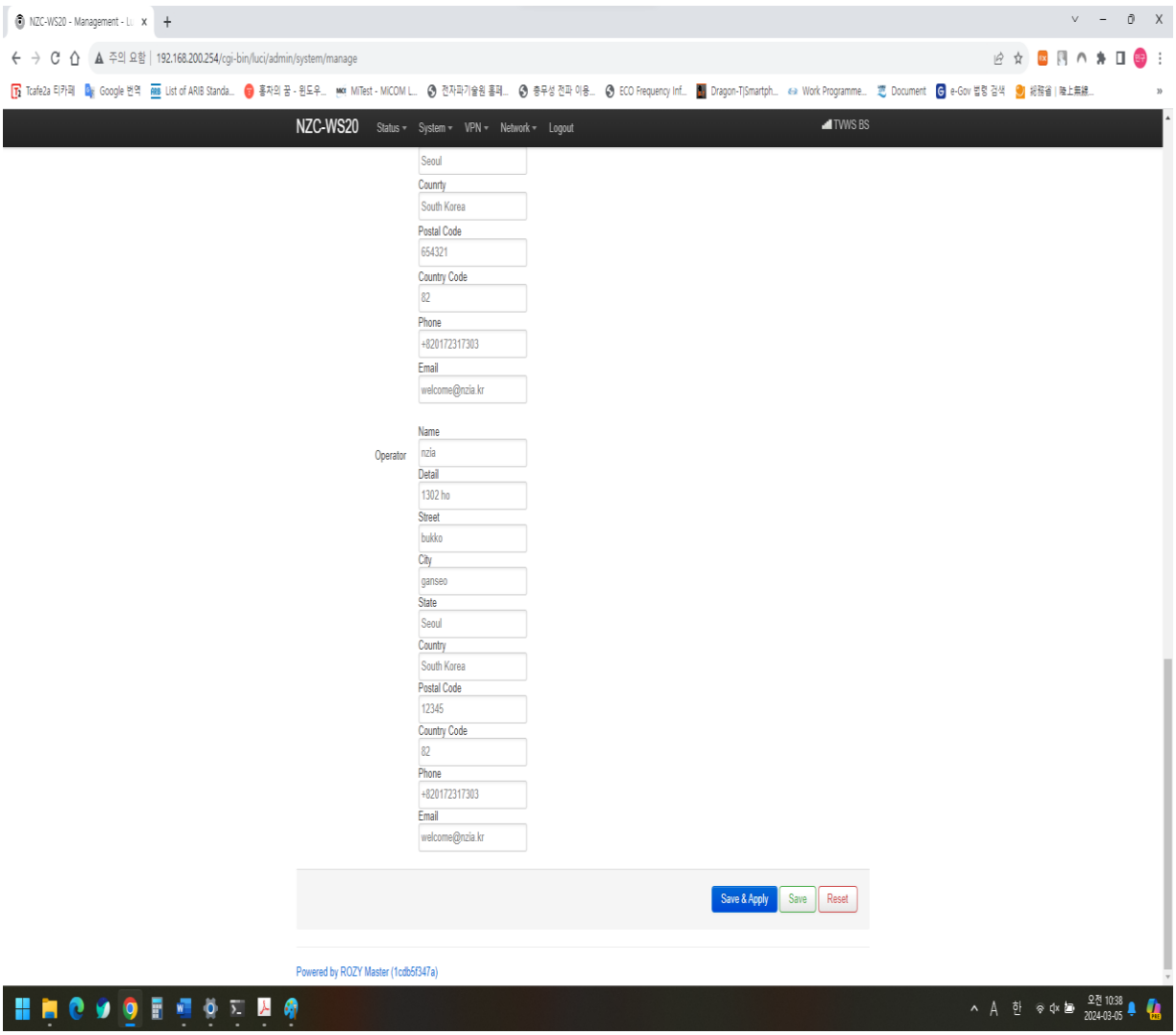
3.1.3 Test environment

• 22 °C, 43 % R.H.

3.1.5 Test Plots



UI


NZC-WS20 - Management
192.168.200.254/cgi-bin/luci/admin/system/manage
NZC-WS20
Status
System
VPN
Network
Logout
TVWS BS
Seoul
Country
South Korea
Postal Code
654321
Country Code
82
Phone
+820172317303
Email
welcome@nzia.kr
Operator
Name
nzia
Detail
1302 ho
Street
bukko
City
ganseo
State
Seoul
Country
South Korea
Postal Code
12345
Country Code
82
Phone
+820172317303
Email
welcome@nzia.kr
Save & Apply
Save
Reset
Powered by ROZY Master (1cdb5f347a)

UI

3.2 48-hour channel scheduling

3.2.1 Requirement

- FCC Part15 subpart H Section 15.713(a)(1), 15.711(c)(2)(iii)

3.2.2 Test Procedure

After receiving an available channel list, register a low-power auxiliary device on the WSD operating channel to operate on an available channel and in an upcoming time period when the device will be tested. Repeat the available channel request after the update interval and in the time period when the lowpower auxiliary device is scheduled to operate and confirm that the low-power device is accounted for in the schedule. Using the system management software, confirm that the device changes channels at the scheduled time. Testing in accordance with KDB 416721 D01, III (2)(h)

3.2.3 Test environment

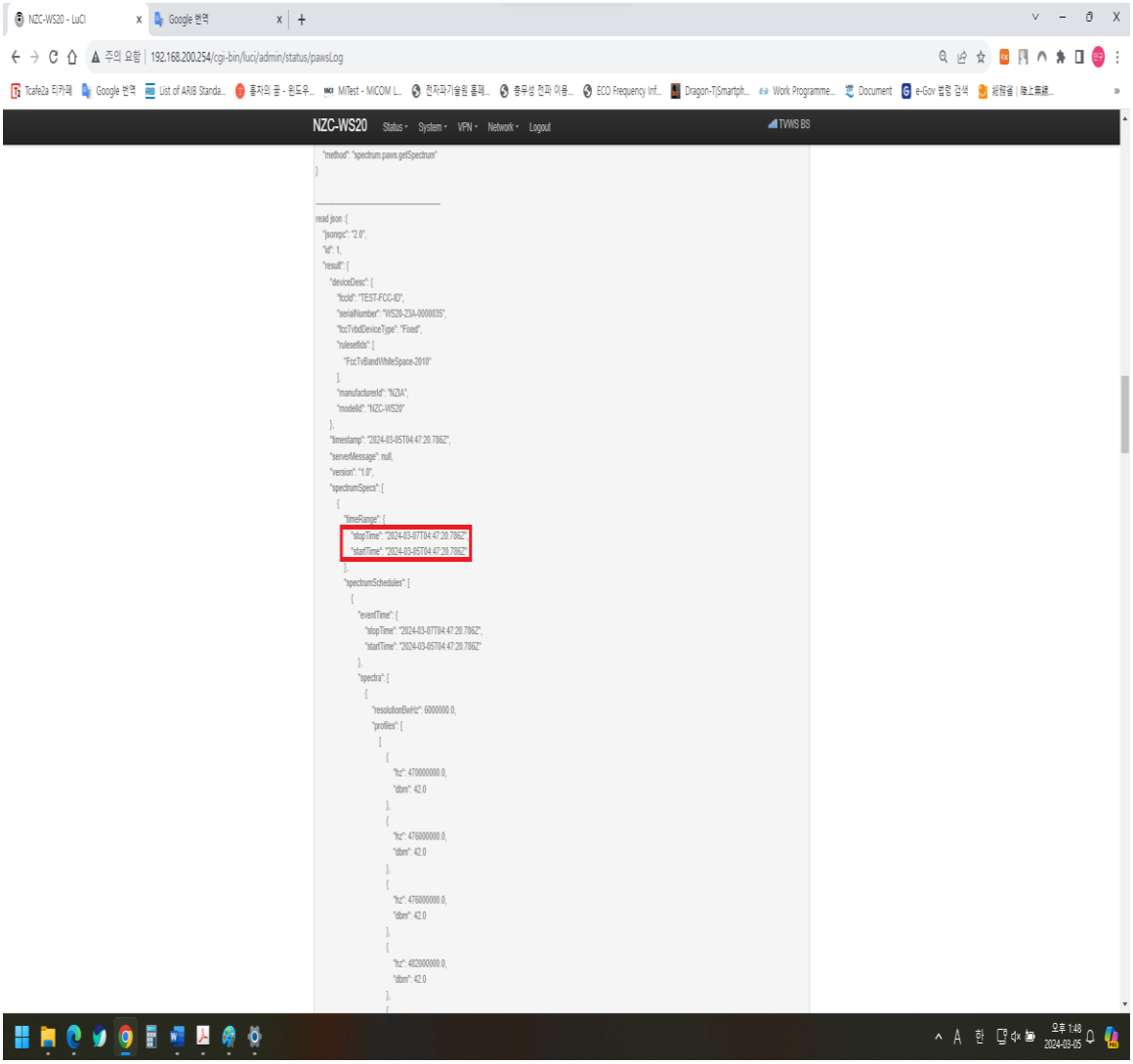
• 22 °C, 43 % R.H.

3.2.4 Test Observations, settings

EUT implements a refresh time of 24 hours instead of 48-hour push notification wait.

3.2.4 Test results

3.1.5 Test Plots



3.3 Unsuccessful registration – restricted coordinates

3.3.1 Requirement

- FCC Part15 subpart H Section 15.713(g)(3)(iii)

3.3.2 Test Procedure

(3) The white space device registration database shall contain the following information for fixed white space devices:

(iii) Device's geographic coordinates (latitude and longitude (NAD 83));

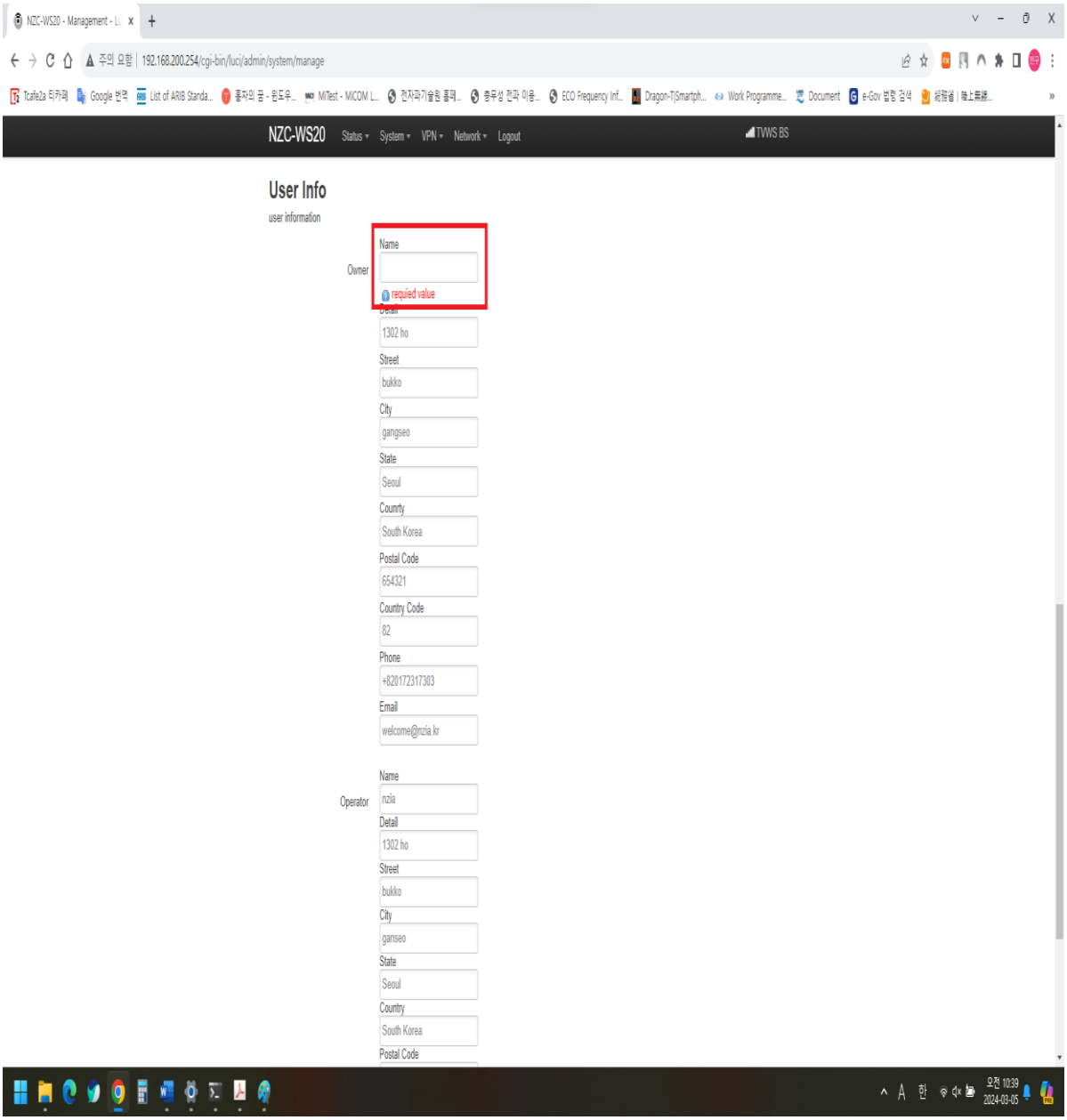
3.3.3 Test environment

- 22 °C, 43 % R.H.

3.3.4 Test Observations, settings

EUT configured with incomplete information. The Contact TEL field has been intentionally left blank. After detecting the missing contact information, the EUT was identified as Fields missing when checking against the database.

3.3.4 Test Plots



Name

3.4 Unsuccessful registration due to incomplete information - FCC ID and Serial number

3.4.1 Requirement

- FCC Part15 subpart H Section 15.713(g)(3)(iii)

3.4.2 Test Procedure

- Configure the base EUT with missing contact information, e.g. email.
- The device software cannot proceed with registration and prompts user to enter the missing information.

3.4.3 Test environment

- 22 °C, 43 % R.H.

3.2.4 Test Observations, settings

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.

3.5 Unsuccessful registration due to HAAT > 250 m

3.5.1 Requirement

- FCC Part15 subpart H Section 15.713(e)(6)

3.5.2 Test Procedure

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.

3.5.3 Test environment

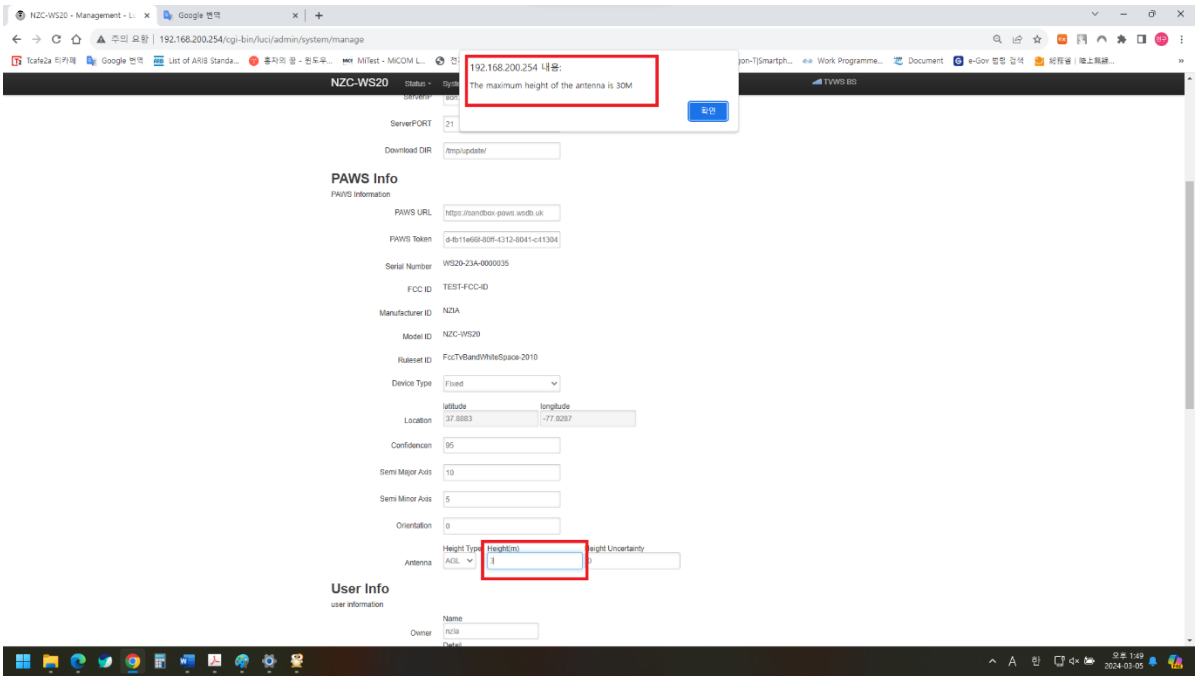
• 22 °C, 43 % R.H.

3.5.4 Test Observations, settings

EUT was configured with information that included a location with HAAT of more than 250 m. 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.

3.5.4 Test Plots



Set height 35

3.6 Unsuccessful registration due to antenna height that exceeds 30 m

3.6.1 Requirement

- FCC Part15 subpart H Section 15.713(e)(6)

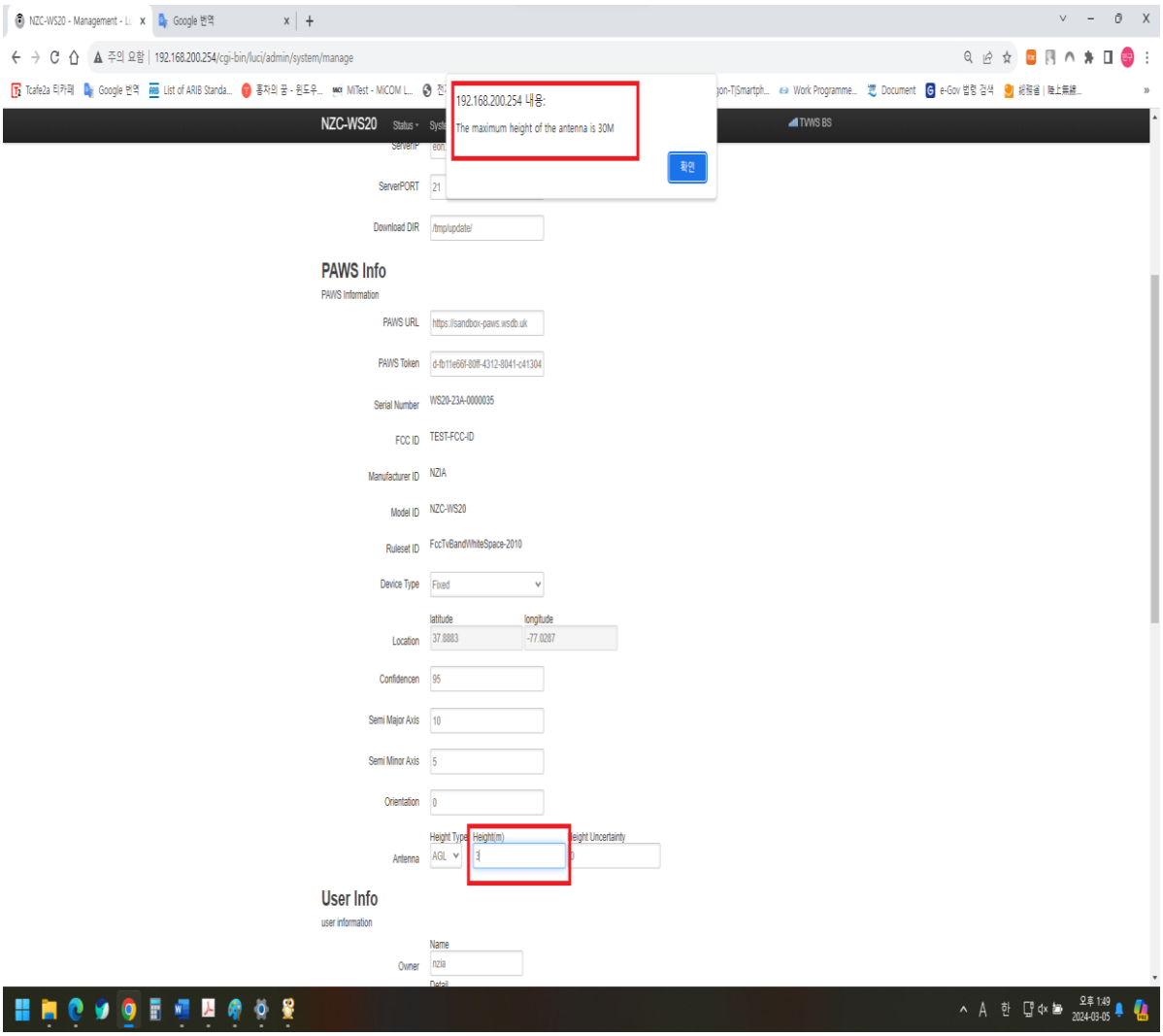
3.6.2 Test Procedure

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.

3.6.3 Test environment

• 22 °C, 43 % R.H.

3.5.4 Test Plots



set height 35

3.7 Relocation of fixed TVBD

3.7.1 Requirement

- FCC Part15 subpart H Section 15.713(a)(3)

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.

3.7.2 Result

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.

3.8 Fixed & Mode II TVDB database update

3.8.1 Requirement

- FCC Part15 subpart H Section 15.711(c)(2)(i), 15.711(h)

3.8.2 Test Procedure

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)

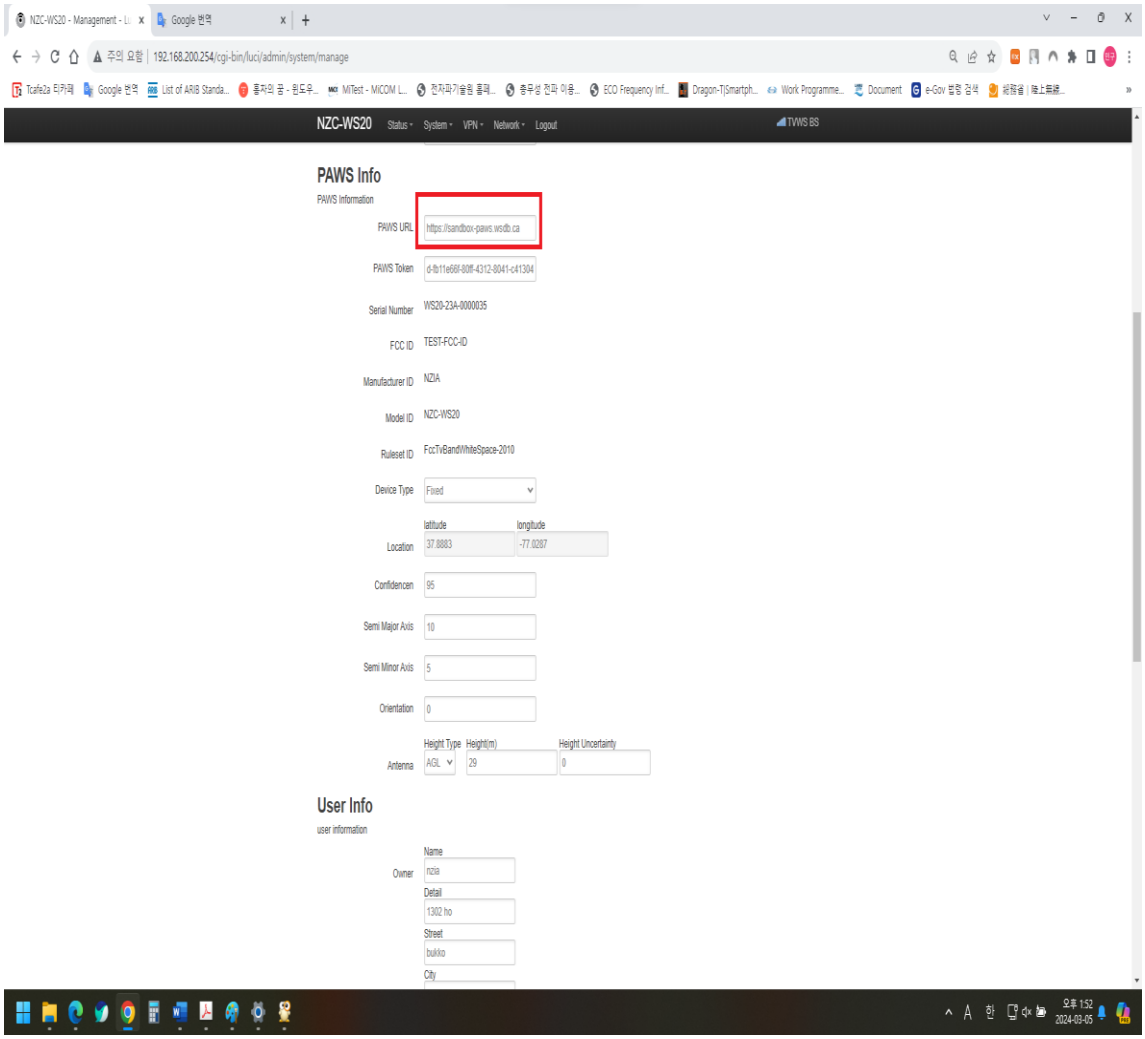
3.8.3 Test environment

• 22 °C, 43 % R.H.

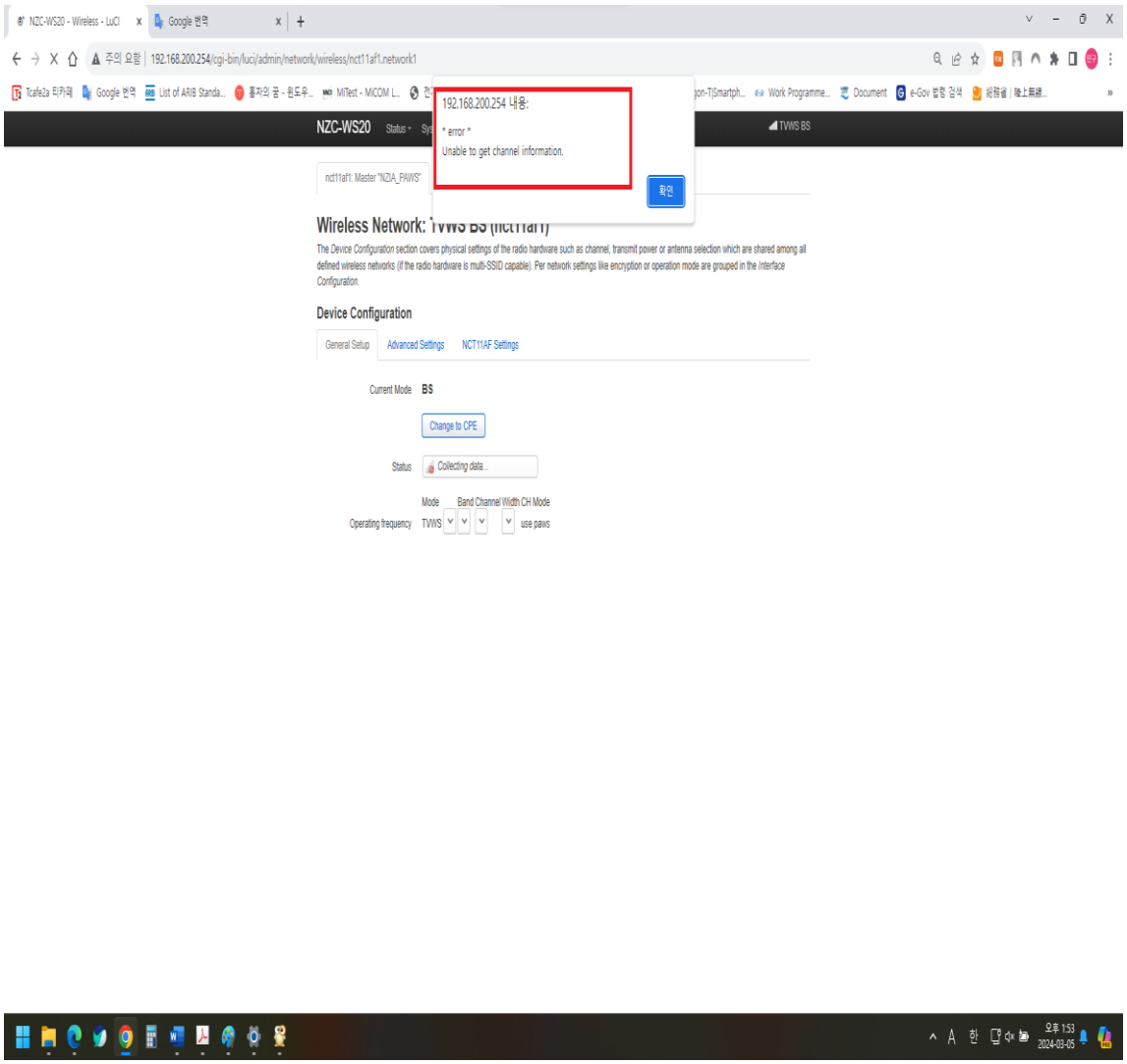
3.8.4 Test Observations, settings

EUT was configured with proper registration information and the successful registration was verified. Database URL was modified from sandbox-paws.wavedb.uk to paws-usa.wavedb.ca. 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.

3.8.4 Test Plots



after domain change



after domain change Channel List Fail

3.9 Low-power auxiliary device protection

3.9.1 Requirement

- FCC Part15 subpart H Section 15.711(c)(2)(i), 15.711(h)

3.9.2 Test Procedure

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)(l). (2)(e)

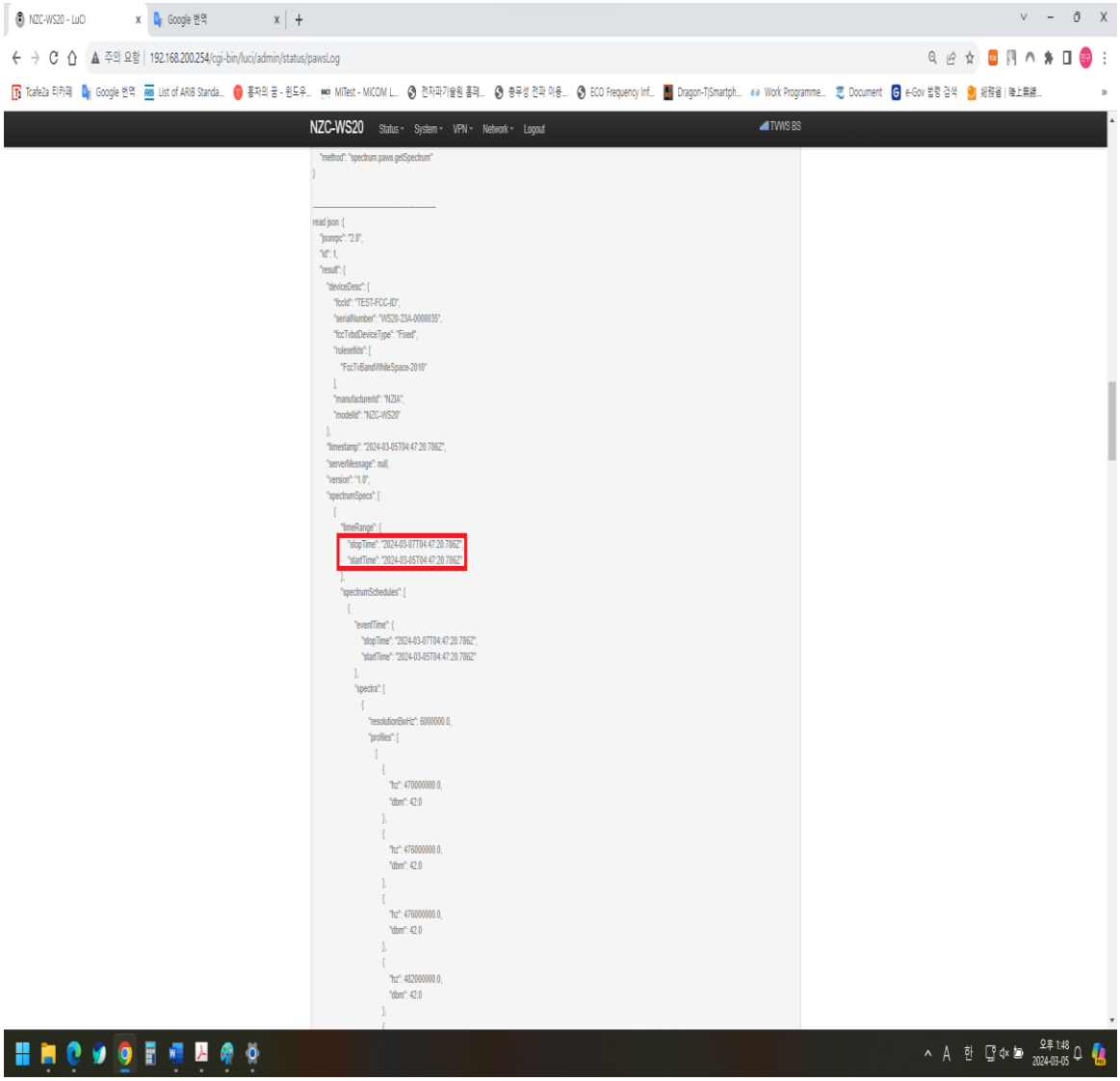
3.9.3 Test environment

• 22 °C, 43 % R.H.

3.9.4 Result

EUT was configured with proper registration information and the successful registration was verified. 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.

3.9.5 Test Plots



3.10 Interference protection requirements (Fixed and personal/portable)

3.10.1 Requirement

- FCC Part15 subpart H Section 15.712

3.10.2 Test Procedure

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.

3.10.3 Test environment

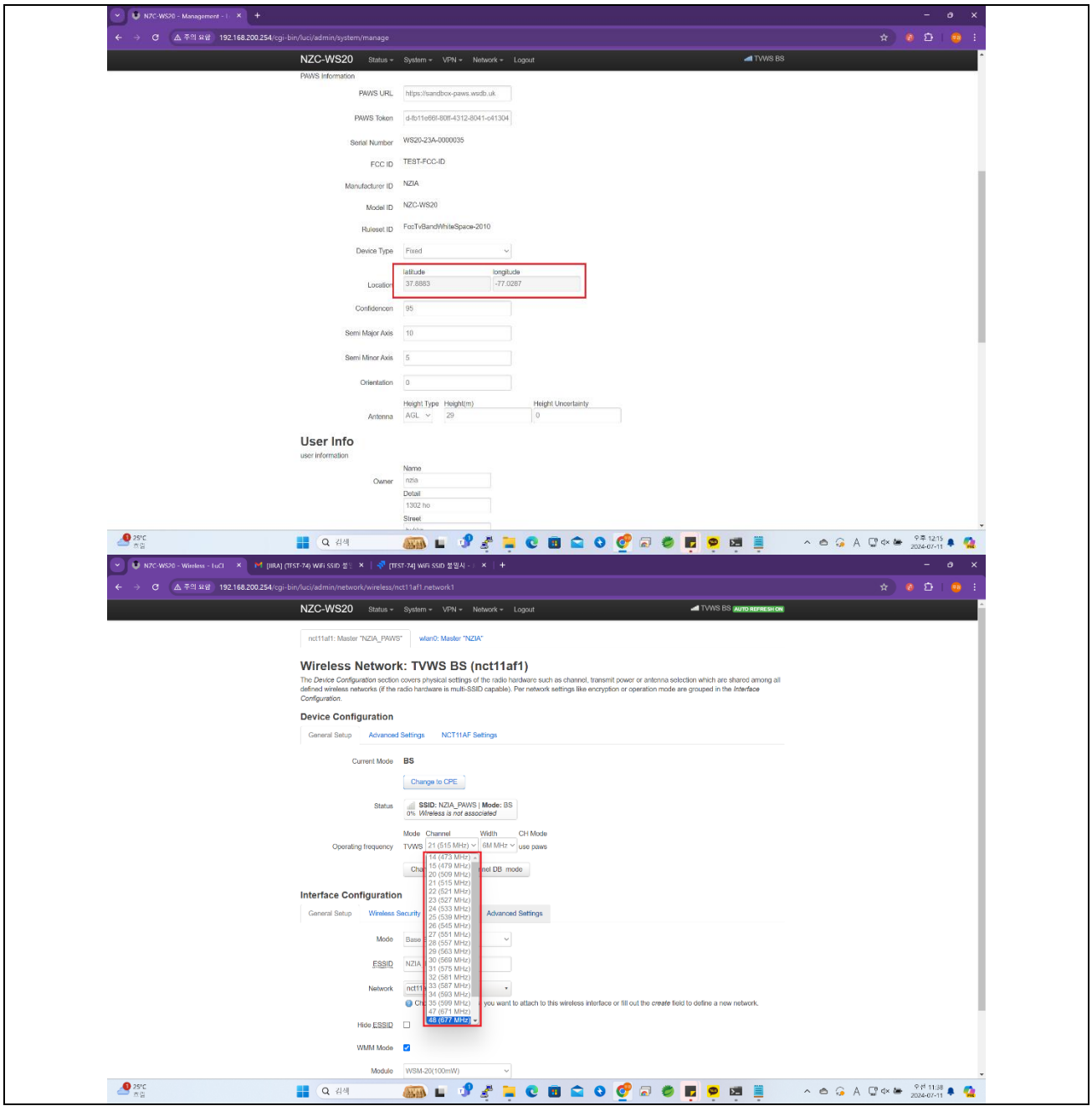
• 22 °C, 43 % R.H.

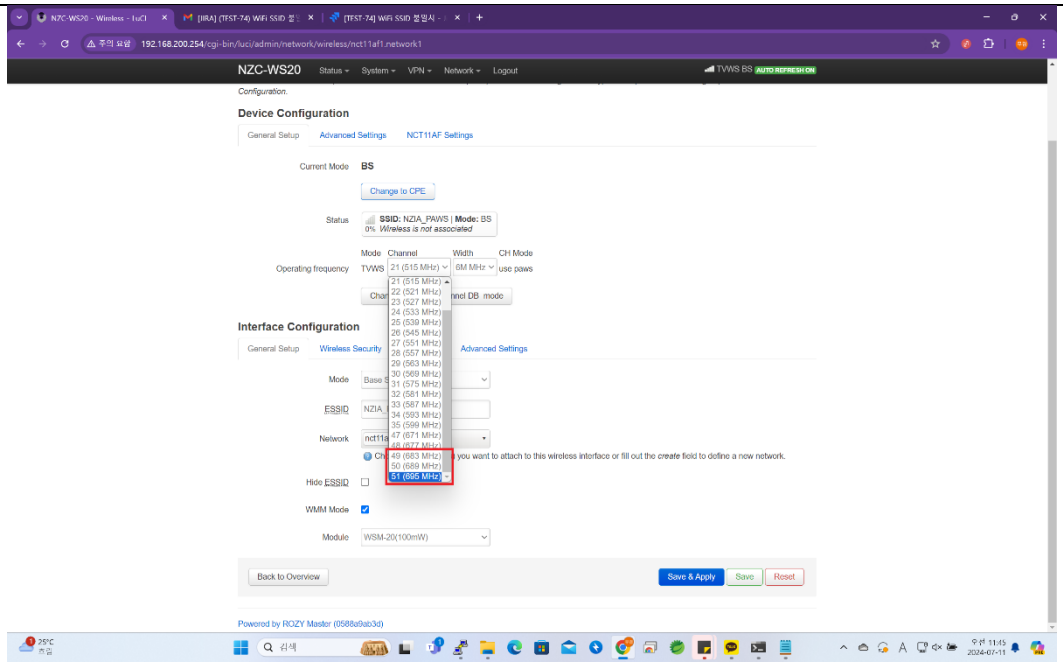
3.10.4 Result

EUT was configured with proper registration information and the successful registration was verified. By changing the coordinates, the channels and limiting channels were checked.

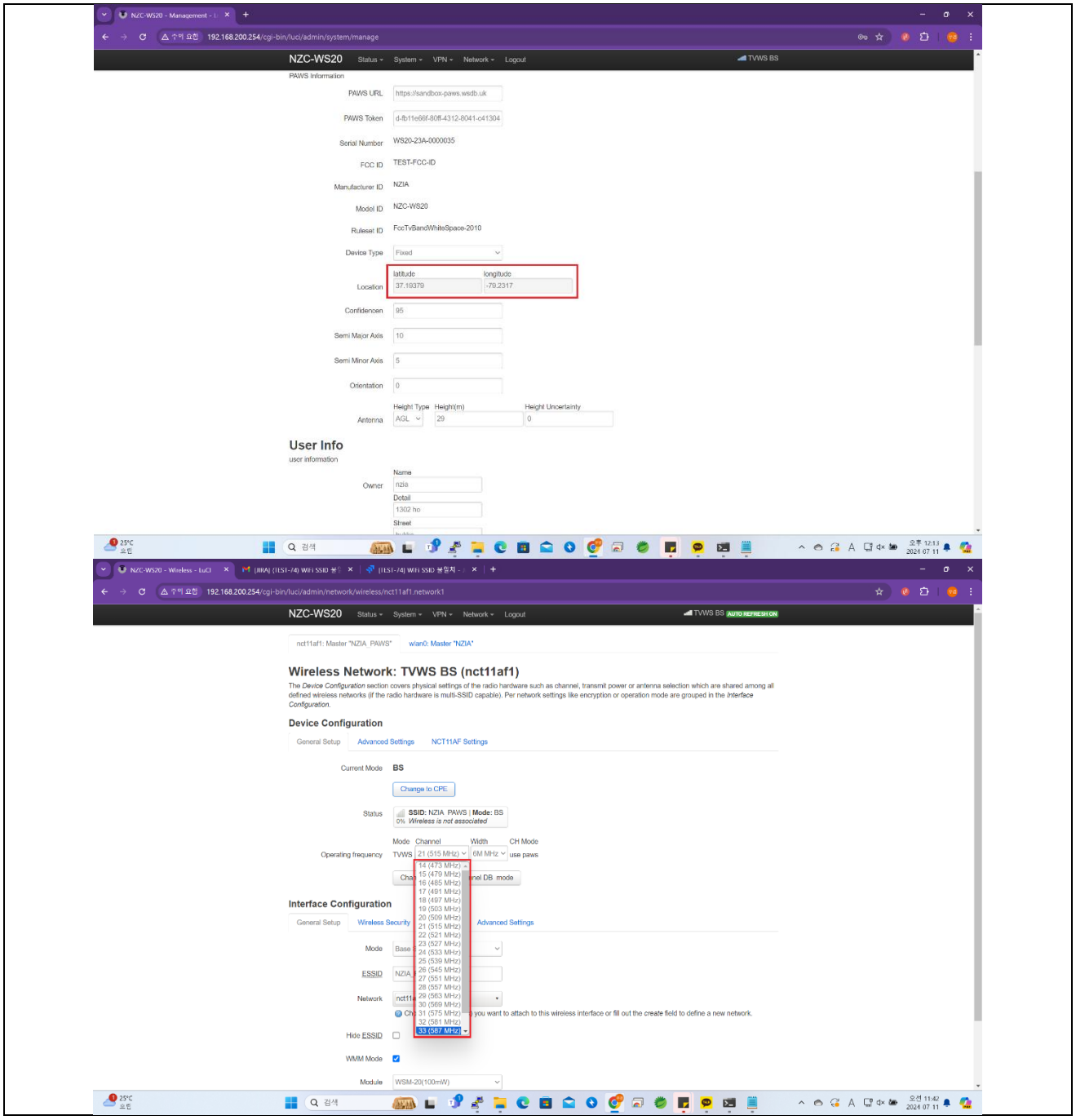
When a device updates its channel list, the device disappears from the channel selection on the GUI when trying to set up a restricted channel.

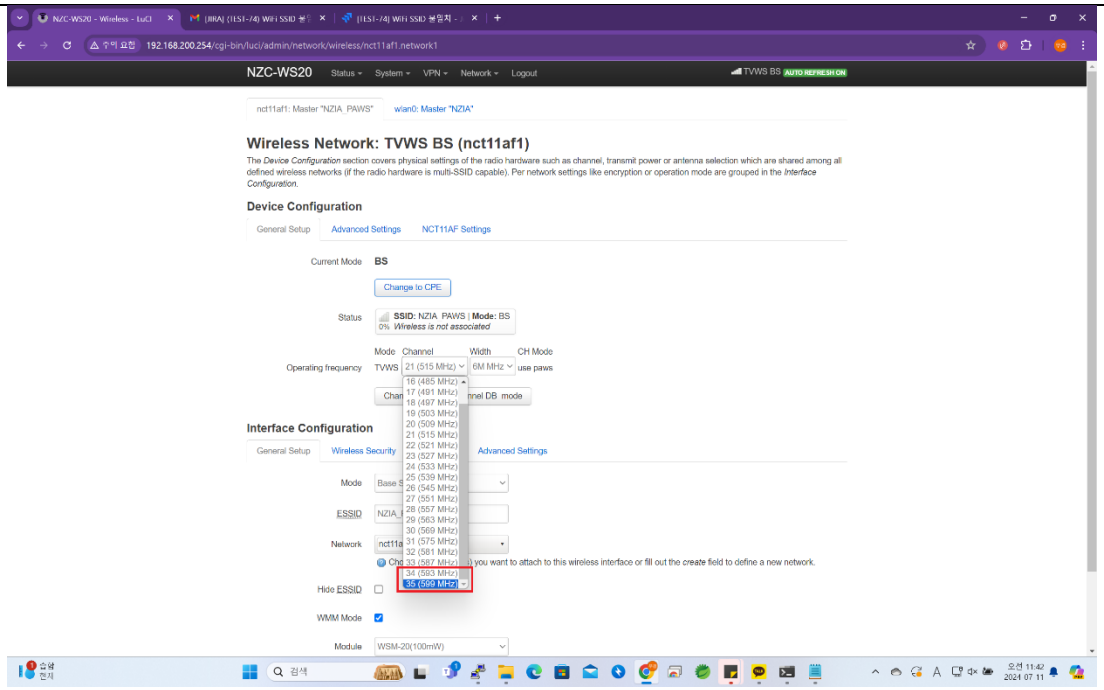
3.10.5 Test Plots





Before coordinate change Channel List : 23


NZC-WS20
PAWS Information
PAWS URL
PAWS Token
Serial Number
FCC ID
Manufacturer ID
Model ID
Ruleset ID
Device Type
Location
Confidenoen
Semi Major Axis
Semi Minor Axis
Orientation
Antonna
User Info
user information
Owner
Detail
Street
NZC-WS20
Wireless Network: TVWS BS (nct11af1)
Device Configuration
Current Mode
Change to CPE
Status
Operating frequency
Interface Configuration
Mode
ESSID
Network
Hide ESSID
WMM Mode
Module



After coordinate change Channel List : 23

3.11 Fixed and Mode II Power level reduction

3.11.1 Requirement

• FCC Part15 subpart H Section 15.711(c)(2)(ii), 15.715(e)

3.11.2 Test Procedure

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).

3.11.3 Test environment

• 22 °C, 43 % R.H.

3.11.4 Result

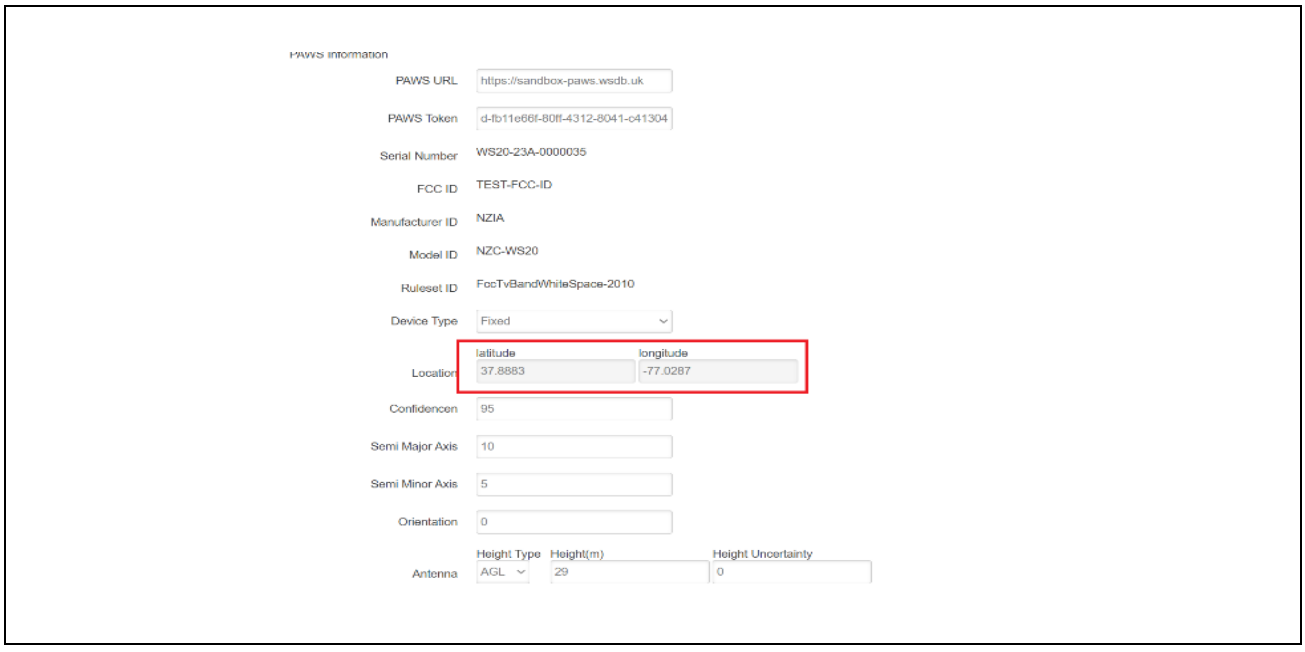
You receive a list of available channels from the channel server and store it in a structure. As the code processes this list, it generates a list of usable channels. However, if the channel is 36, 37, 38, 45, or 46, it will be ignored and not included in the list.

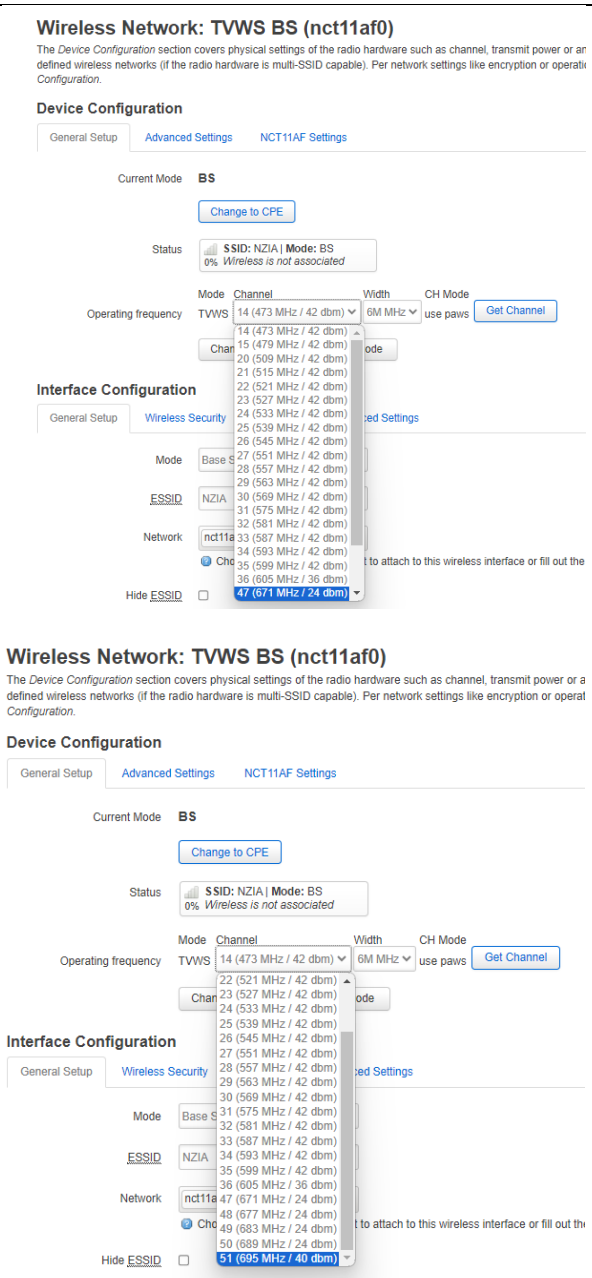
• Brief description of the two plots before and after (comparison).

In Plot 1, the information about the available channels from the server is displayed. Plot 2 shows the channels that are actually usable on the equipment among the available channels received from the server.

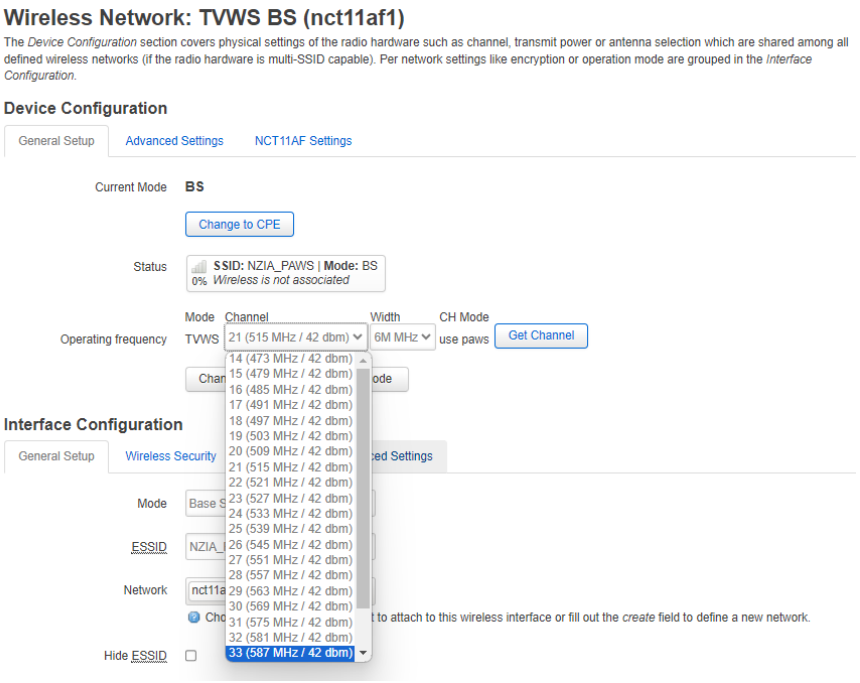
In Plot 1, channel 36, which is unavailable, is included, as well as channels 47, 48, 49, and 50, which are subject to output limitations lower than the equipment's output. These channels are removed from the available list provided to the user, as shown in Plot 2. Similarly, channel 36 is also removed from the list because it is unavailable, ensuring that it is not provided to the user, just like in Plot 2.

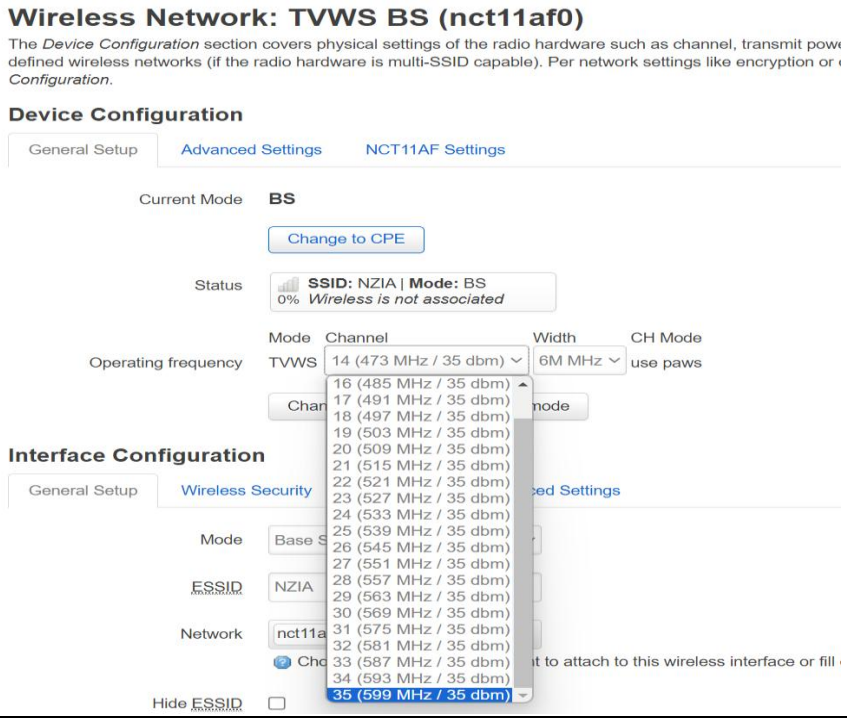
3.11.5 Test Plots





List of channels supported by all DB servers (Plot1)





List of channels excluded from use (Plot2)

3.12 Security

3.12.1 Requirement

- FCC Part15 subpart H Section 15.711(j)

3.12.2 Test Procedure

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).

3.12.3 Test environment

• 22 °C, 43 % R.H.

3.12.4 Result

Information provided by the manufacturer.

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

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

ii. How are communications initiated?

When the WSD is booted, the WSD accesses the URL set through the DNS and gateway and performs a handshake through SSL authentication to create a session of security communication. WSD begins communication with the database by sending INIT_REQ messages containing non-modifiable WSD technicians given by the manufacturer.

The WSD Descriptor contains;

• the device serial number

• manufacturer ID

• model ID

• FCC ID

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

SSL certificate verification through a standard third-party certification authority mechanism identifies the database and ensures that communication between WSD and the database is secure and authenticated.

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

If the WSD fails to communicate with the database, the device immediately stops communicating with the TVWS. The device then retries communication with the database every 10 seconds

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

The database needs a specific API key given by the manufacturer to check the message of the WSD. Only a device with an API key registered in the database may receive communication from the database. The database verifies the validity of the WSD by matching the provided serial number, model ID, FCC ID and API key.

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?

The database provides a public interface for registering a device. To access this interface, you must use authorized accounts, user names, and passwords to access the database web interface.

3.13 Location accuracy

3.13.1 Requirement

- FCC Part15 subpart H Section §15.711(b)

3.13.2 Test Procedure

For Fixed and Mode II devices, provide details regarding the technologies used by the device to determine its location and how, in case of other than GPS technology, the location uncertainty is calculated with a 95% confidence level

3.13.3 Results

EUT uses GPS technology for determining location.

The GPS manufacturer was confirmed to confirm that the corresponding details were supported.

4. Test equipment list

Use	Model Number	Manufacturer	Description	Serial Number	Cal. Date.(Interval)
☒	AMP 20-1000	INFINITECH	BROADBAND PRE-AMP	2013 05 00003	Dec 21, 2023(1Y)
☒	DS 2000S	Innco GmbH	Turn Table	N/A	N/A
☒	MA4000-EP-HS	Innco GmbH	Antenna Mast	N/A	N/A
☒	MA4640-XP-ET	Innco GmbH	Tilt Antenna Mast	N/A	N/A
☒	CO3000	Innco GmbH	Controller	N/A	N/A
☒	CO3000	Innco GmbH	Controller	N/A	N/A
☒	N9020A	Agilent	Spectrum Analyzer	MY50200260	Dec 21, 2023(1Y)
☒	FSV3007	R&S	Spectrum Analyzer	101334	Jun 18, 2024(1Y)
☒	6502	EMCO	Loop Antenna	9609-3087	Oct 23, 2023(2Y)
☒	VULB 9168	SCHWARZBECK	Bi-Log Antenna	180	Nov 16, 2022(2Y)
☒	8449B	Agilent	Preamplifier	3008A02013	Dec 21, 2023(1Y)
☒	3115	EMCO	Horn Antenna	9402-4229	Oct 23, 2023(2Y)
☒	ESCI7	Rohde & Schwarz	EMI Test Receiver	100938	Dec 21, 2023(1Y)
☒	ESH-Z2	Rohde & Schwarz	Pulse Limter	101631	Jun 17, 2024(1Y)
☒	ENV216	Rohde & Schwarz	LISN	101264	Jun 17, 2024(1Y)
☒	PE7019-20	PASTERNACK	Attenuator	TEMP_1	Jun 18, 2024(1Y)
☒	ES-SCAN	Rohde & Schwarz	EMI Software	N/A	N/A
☒	EMC32	Rohde & Schwarz	EMI Software	N/A	N/A
☐	SAS-574	A.H.Systems	Horn Antenna	595	Jun 21, 2024(2Y)
☐	PAM-840A	Com-power	Preamplifier	461334	Dec 21, 2023(1Y)