Wireless Innovation Forum Contribution

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Committee: Spectrum Sharing Committee, Steering Committee
Title: Examples from CBRS Architecture Test and Certification Technical Report
Short Title: Conformance test cases examples for review and comment by FCC
Source: Working Group 4

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Document Summary: This Document provides the detail of two test cases, extracted from the current working version of the WG4 Technical Report (WINNF-15-P-0061), for presentation to FCC Staff for their review and comment.

Notes of Importance: Used for FCC Presentation

Action Desired: Request for Comments

Action Required for Closure: Present for consideration by FCC staff and invite staff to participate in WINNF as an observer and contributor to the development process.

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Test Examples from CBRS Architecture Test and Certification Technical Report

Document WINNF-16-RFI-0030

31 March 2016

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Examples from CBRS Architecture Test and Certification Technical Report

1 Introduction

The present document contains the two test cases extracted from CBRS Architecture Test and Certification Technical Report. The Technical Report contains Protocol Implementation Conformance Statement (PICS), test cases to ensure conformance of the components of a three-tiered Spectrum Sharing Architecture to the specifications and Requirements defined by Federal Communications Commission (FCC) and Winn Forum.

2 References

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[1] FCC Report and Order 15-47A1: "Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band", FCC, April 17 2015, https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-47A1.pdf

[2] FCC Further Notice of Proposed Rulemaking (FNPRM), FCC 14-19 GN Docket No. 12-354, "In the Matter of Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band ", FCC, April 23 2014, https://apps.fcc.gov/edocs_public/attachmatch/FCC-14-49A1.pdf

[3] SSC-Winn Forum, WG1&3 Task Group: "SAS Functional Architecture ", Working Document WINNF-15-P-0047 Version V0.3.6, 12 June 2015,

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[4] "NTIA Letter to FCC on Commercial Operations in the 3550-3650 MHz Band," GN Docket No. 12-354, April 14, 2015. Available online: http://www.ntia.doc.gov/fcc-filing/2015/ntia-letter-fcc-commercial-operations-3550-3650-MHz-band

[5] E. Drocella, et. al., "3.5 GHz Exclusion Zone Analyses and Methodology," NTIA Technical Report TR-15-517, June 2015. Available at http://www.its.bldrdoc.gov/publications/2805.aspx

[6] Python Package Index, https://pypi.python.org/pypi

[7] WG4 GitHub Repository, https://github.com/Wireless-Innovation-Forum/Spectrum-Access-System

[8] http://robotframework.org/

[9] SAS to CBSD Protocol Technical Report-A, WINNF-15-P-0023 V0.3.6

[10] SAS to CBSD Protocol Technical Report-B, WINNF-15-P-0062 V0.3.6

[11] Shapely Documentation: http://toblerity.org/shapely/manual.html Last accessed March 16, 2016

[12] GeoPy Documentation: http://geopy.readthedocs.org/en/latest/# Last accessed March 16, 2016

[13] NOAA Maritime Boundaries, Available online: http://www.nauticalcharts.noaa.gov/csdl/mbound.htm Last accessed March 16, 2016

[10] https://www.census.gov/geo/maps-data/data/kml/kml_nation.html

3 SAS Conformance Test Specifications

This Section includes all test cases required for the ensuring SAS functionalities conforms by the specifications defined Winn Forum and directed by the requirements established by FCC and DOD.

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3.1 SAS Exclusion Test Cases

3.1.1 Ground Based Exclusion Zone Enforcement Test

3.1.1.1 Definition and applicability and Scope of Test Case

This section proposes tests to verify correct implementation of the Exclusion Zones required by 96.15 prior to approval of one or more ESCs used by at least one SAS in accordance by 96.67.

3.1.1.2 Test Characteristics

Table 3.1-1: Test Case FCC.FT.0.001 definition

1	**Test ID**	FCC.FT.0.001
2	**Title**	Exclusion Zone Enforcement Test
3	**Working Group / Entity**	FCC 96.15 (requirement) NTIA [2] (exclusion zone specifics)
4	**Test Type**	Functionality
5	**Test Class**	Certification
6	**Component / Interface**	SAS

3.1.1.2.1 Minimum Requirement

This test targets FCC CBRS requirements (96.15 as further specified by the NTIA [2]).

3.1.1.2.2 Test Purpose

The purpose of the test is to verify correct SAS implementation of Exclusion Zones. The SAS should return all correct channel availability messages to the simulated CBSD channel availability messages as compiled by the test harness.

3.1.1.2.3 Test Tools Required

The proposed test leverages the Test Infrastructure described in Section 5 of WINNF-15-P-0061. Specifically, to verify SAS implementation of the Exclusion Zones[1], a scripted sequence of simulated CBSD registrations and channel requests from carefully crafted locations are sent to the SAS under test via the SAS's CBSD / user interface from the Test Harness. The SAS's replies to

[1] See http://www.ntia.doc.gov/fcc-filing/2015/ntia-letter-fcc-commercial-operations-3550-3650-mhz-band

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the requests (also over the SAS to CBSD interface) are compared against known correct results and tabulated by the test harness to assess accuracy.

3.1.1.3 Method of test

3.1.1.3.1 Overview

Exclusion Zones are areas wherein CBSD operation is prohibited prior to ESC authorization and include the following classes of exclusion zones:

- Ground Based Radar Sites
- Coastal Areas
- Radiolocation sites

Testing of SAS enforcement of the Exclusion Zones are performed by presenting the SAS with a series of carefully crafted simulated CBSD registrations and spectrum requests via the SAS-CBSD protocol with locations chosen to elicit both positive and negative responses from the SAS. A SAS is deemed to have passed these tests if it returns the correct responses to all of these simulated registrations and spectrum requests. The tests support both manually specified locations (to allow the tester to evaluate particular points of interest) and randomly generated locations (to minimize the possibility of "building to the test" and to limit human bias in test location selection). Both points inside and outside of each exclusion zone are generated with extra emphasis placed on locations near boundaries of the exclusion zone as these are where implementation errors are more likely to arise.

The Python library shapely [11] provides convenient tools for evaluating if a point lies inside of an arbitrary polygon, including irregularly shaped polygons such as the White Sands Exclusion Zone and is used extensively in the associated test code.

3.1.1.3.2 Test Triggers

Test should be performed as part of the SAS certification test suite or as needed/

3.1.1.3.3 Test Pre-Requisites

The SAS under test must have already passed the following tests:

- SAS-to-SAS protocol test suite
- SAS-to-CBSD protocol test suite

3.1.1.3.4 Initial Conditions / Test Pre-conditions

Tester should verify that the test harness has access to the associated test message suite and that parameters of the suite are as desired. Default parameters are defined

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3.1.1.4 Test Procedure

1. Verify that the SAS is connected to the test harness and the SAS has passed test pre-requisites

2. Ensure test message suite conforms to desired parameters. If not, follow the ground based radar test message generation procedure.

3. Instruct the test harness to conduct the ground based radar exclusion zone test with the desired test message suite.

4. Upon test completion, verify that the test harness reports 100% correct replies to test messages.

5. Retain test log for records.

3.1.1.4.1 Test Requirement

The expected outcome is one of two options:

- the test harness reports that the SAS has successfully returned correct channel availability messages to the test message suite (PASS)
- the test harness reports that the SAS has failed to return correct channel availability messages for at least some portion of the test message suite (FAIL)

3.1.1.5 Methods for Generating Test Locations

This section describes the methods used to generate test locations as part of the Exclusion Zone tests.

The test supports both manually specified locations (to allow the tester to evaluate particular points of interest) and randomly generated locations (to minimize the possibility of "building to the test" and to limit human bias in test location selection). Both points inside and outside of each exclusion zone are generated with extra emphasis placed on locations close to the boundaries of the exclusion zone as these are where implementation errors are more likely to arise.

3.1.1.5.1 Methods for Automated Generation of Test Locations for Exclusion Zones

To limit human bias and to handle varying types of areas that require testing, the following two methods are adopted:

- Edge distribution for generating test locations close to the perimeter of an exclusion zone
- 2-D Gaussian for generating random test locations around the area encompassed by the exclusion zone

The following describes these methods for generating test locations in more detail.

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3.1.1.5.1.1 Edge Distribution

As conceptually shown in Figure 3.1-1, the edge distribution method generates a number of test locations randomly distributed along the perimeter of the linear ring (uniform distribution) and offset from each location by a randomly generated distance (2-D Gaussian). This method is especially appropriate for exclusion zones with irregular boundaries with relatively small interior areas and is illustrated for a short segment of the boundary exclusion zone

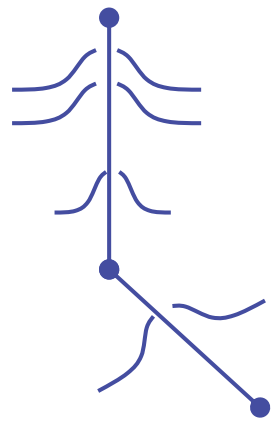

Figure 3.1-1: The edge distribution method generates test points randomly distributed along the edge of the Exclusion Zone, which are then offset by a small amount to lie inside or outside of the Exclusion Zone. Here, two segments of the exclusion zone are shown with four test points distribute along the segments where the test points are offset from the edges by a Gaussian distribution.

To generate a test location according a uniform distribution along the perimeter, perform the following steps:

- Determine the total distance, d around the perimeter of the linear ring
- Generate a random number, d_r, from the uniform distribution [0, d].
- Find the point following on the perimeter d_r starting from the first coordinate in the linear ring.

A two-dimensional Gaussian location offset from an initial location, L_i can be generated by the following steps.

- Create random variables d_x and d_y according to a Gaussian random variable with zero mean and specifiable standard deviation, σ.[2,3]
- Determine the coordinates at $L_i + (d_x, d_y)$ using an appropriate projection method. [4]

---

[2] More precisely, assuming that $\sigma = \sigma_X = \sigma_Y$ and no desired correlation between offsets d_x and d_y, the joint distribution is defined as $f\left(d_x, d_y\right) = \frac{1}{2\pi\sigma_X\sigma_Y}\exp\left(-\frac{dx^2}{2\sigma_X^2} - \frac{dy^2}{2\sigma_Y^2}\right)$.

[3] Larger values can be used to cover more of the interior of the exclusion zone, when appropriate. It may also be appropriate for elliptical or oblong areas to choose different values for σ_X and σ_Y.

[4] The provided code uses WGS-84.

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The following parameters must be specified to generate test locations for an exclusion zone to use this method:

- Applicable linear ring (some exclusion zones have multiple rings)
- Number of points
- One-dimensional standard deviation

3.1.1.5.1.2 Two-Dimensional Gaussian Distribution

Illustrated in Figure 3.1-2, the two-dimensional Gaussian distribution method generates a number of test locations randomly distributed across an area offset from some central location. This method is especially appropriate for generating points inside of an exclusion zone or for small exclusion zones with regular boundaries (e.g., Knoxville).

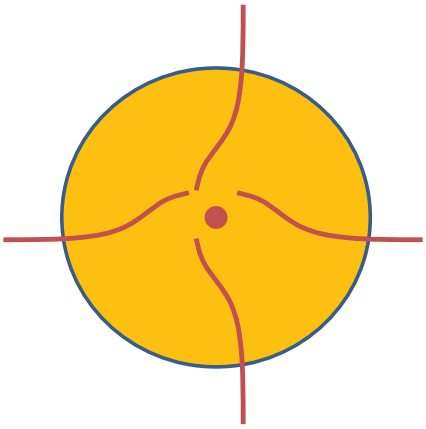

Figure 3.1-2: For a circular exclusion zone (orange disc), the 2D Gaussian method generates test points according to a two dimensional Gaussian distribution (no correlation) that determines the offset from a specified initial point (the mean of the distribution), which defaults to the centroid of the exclusion zone.

To generate a test location according to this distribution, the process described for 2-D Gaussian distribution described in the previous section is adopted, except that multiple test locations are generated from a single initial location.

The following parameters must be specified to generate test locations for an exclusion zone to use this method:

- Applicable linear ring (some exclusion zones have multiple rings)
- Number of points
- One-dimensional standard deviation
- Center point (if unspecified, the centroid of the polygon is used)

3.1.1.5.1.3 Excision of test points within 50 meters of boundaries

NTIA defined exclusion zones are specified as a linear ring of points; the edges connecting these points, however, are currently undefined. These edges could be defined as straight lines consistent

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with projection onto a plane or onto the Earth leading to different interpretations of the allowability of boundary cases.

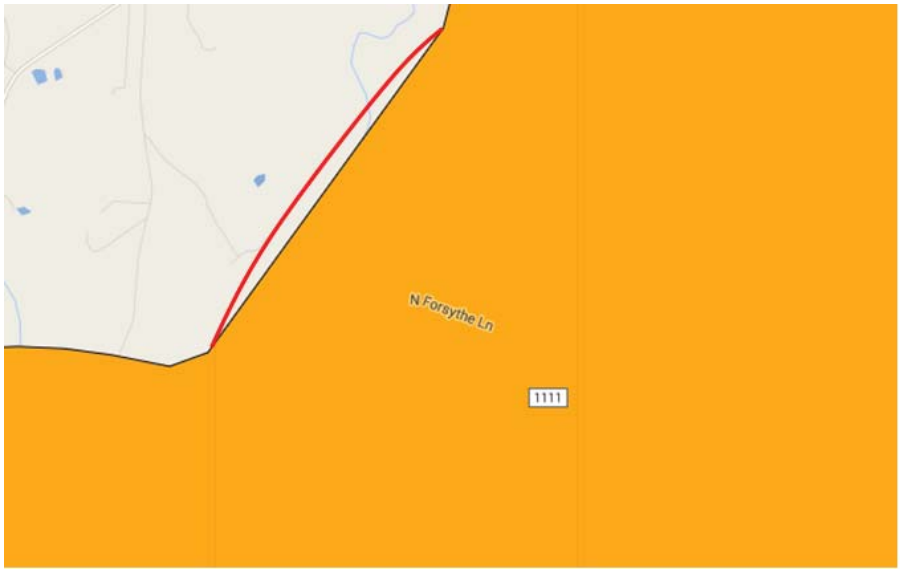

Figure 3.1-3: An Exaggerated Illustration of the Projection Ambiguity for an Edge of the Fort Bragg Exclusion Zone

To mitigate this problem, the test code will remove all test locations within the error radius of CBSD registration, namely 50 meters from the exclusion zone boundary as measured using the default Shapely projection.

3.1.1.5.1.4 Excising Extra-Territorial Test Points

With automated test point generation, particularly for shoreline exclusion zones, it is possible to that test points would violate international treaties with Canada and Mexico on radio operation and thus should be disallowed. Pending FCC further guidance on international treaties enforcement, test locations outside of the US are excised from tests by evaluating if the points lie inside of the kml polygon defined by the US Census. [14] Again, points within 50 meters of this boundary are also excluded.

3.1.1.5.2 Comments on Ground Based Radar Exclusion Zones

Ground-based radar exclusion zones are irregularly shaped areas where CBSD operation is not allowed prior to an approved ESC is operational (Phase I). The exclusion zones were generally created by the NTIA by defining a stand-off distance from a critical military installation or radar test site where protected radars are continuing operation in the CBRS band. As illustrated in Figure 3.1-4 and Figure 3.1-5, these zones may overlap and may even have interior regions where CBSD operation is allowed.

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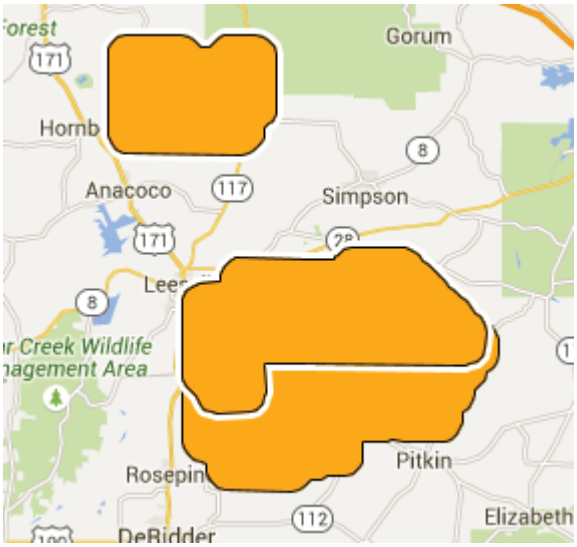

Figure 3.1-4: Fort Polk Exclusion Zones have multiple overlapping areas.

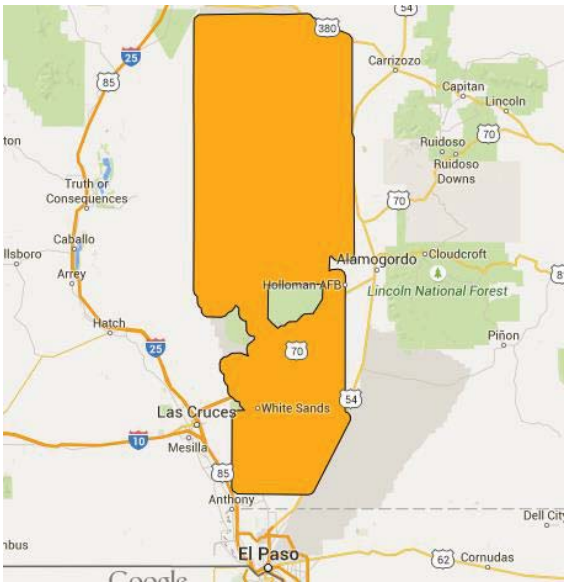

Figure 3.1-5: The White Sands Exclusion Zone has an interior region where CBSD operation is allowed.

Because of the large variation in size, shape, and relative positioning of the exclusion zones, the following principles are adopted for this test:

- A location is only allowable if it lies outside the boundaries of all exclusion zones. Thus determining if a location is allowable cannot be performed by taking each zone in isolation as points outside of one exclusion zone may lie in another zone. Further, the other exclusion zones should be considered in determining if CBRS spectrum is allowed for use at a location.
- When using statistical techniques to generating test locations, the appropriateness of different methods varies by the specific exclusion zone. Exclusion zones with narrow, irregular shapes benefit from creating most test points close to the borders. Exclusion zones with relatively large interiors could be better handled by randomly generating locations that cover the interior and exterior of the zone.
- Some zones have both irregular boundaries and large interiors, which implies that multiple methods are sometimes needed.

3.1.1.5.3 Comments on Shoreline Exclusion Zones

As shown in Figure 3.1-6, the NTIA defined two shoreline exclusion zones, within which CBRS operation is not permitted prior to ESC approval.

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Figure 3.1-6: The CBRS Shoreline Exclusion Zones

However, these exclusion zones do not define closed boundaries, as illustrated in Figure 3.1-7, which poses a problem in applying the preceding test methodologies.

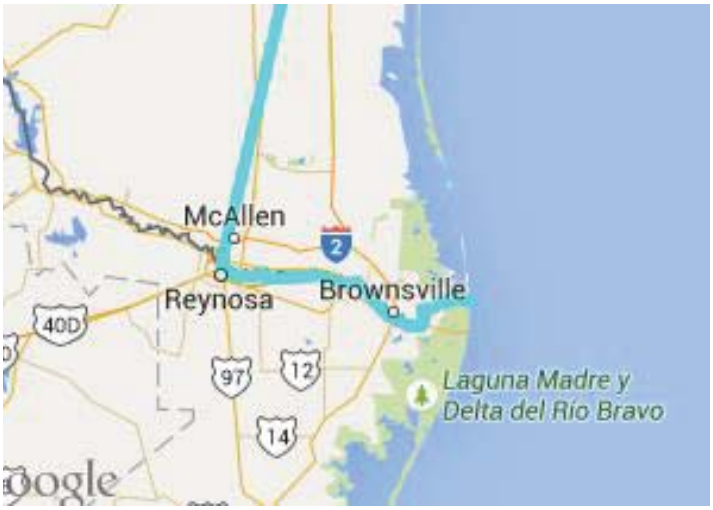

Figure 3.1-7: NTIA-Defined Shoreline Exclusion Boundary near Brownsville, TX.

To address this issue, WG4 defined shoreline polygons by combining the NTIA exclusion zones with NOAA maintained maritime sea boundaries [13] as illustrated in Figure 3.1-8 and Figure 3.1-9. This then allows the original methods to be implemented.

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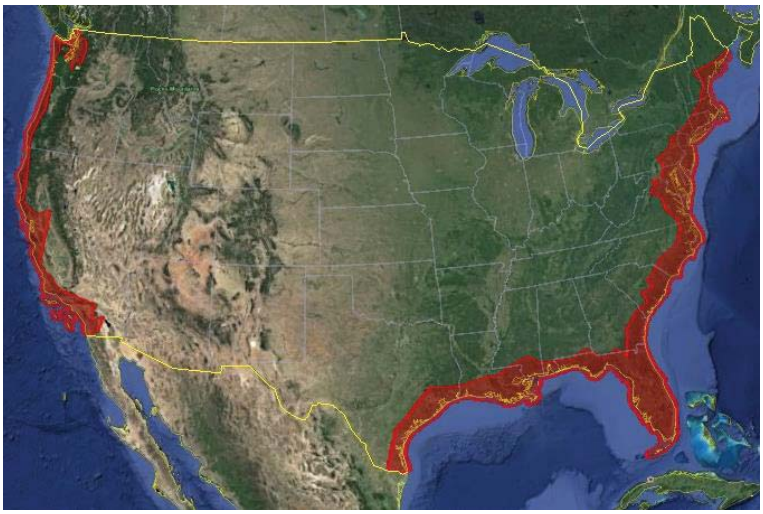

Figure 3.1-8: NTIA-Defined Shoreline Exclusion Boundary near Brownsville, TX.

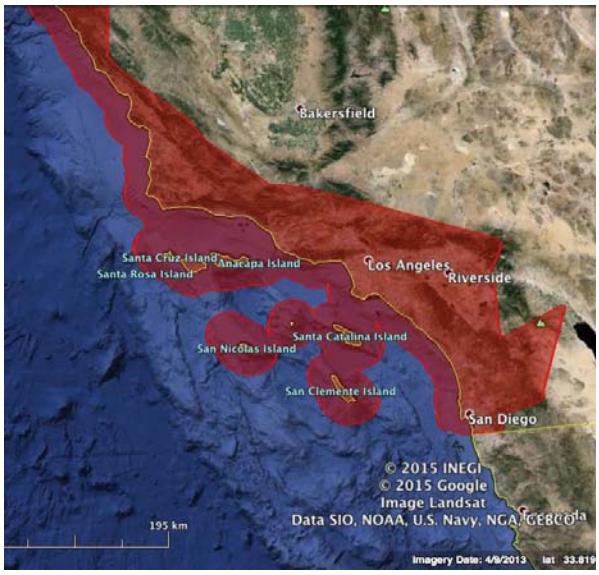

Figure 3.1-9: WG4-Defined Shoreline Exclusion Polygon near San Diego.

However, automated edge-based test-point generation is constrained to only follow the original NTIA-defined boundary on-land so as to minimize test locations at sea beyond the maritime boundary.

3.1.1.5.4 Comments on Radio Location Sites

Rather than specifying polygons, the following three radiolocation sites are protected by restricting CBSDs within 80 km of the sites.

- St. Inigoes, MD—38° 10' N., 76°, 23' W
- Pensacola, FL—30° 21' 28" N., 87°, 16' 26" W
- Pascagoula, MS---30 22' N, 88 29' W

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Implicitly, this protection criterion defines a circular exclusion zone around each of these sites and automated test-point generation can use the same approaches as used for circular polygon-defined exclusion areas, e.g., Knoxville. As such, WG4 has generated polygons around each of these sites using a WGS-84 projection and tests for these sites will follow the same procedures as for preceding exclusion zones.

4 SAS-User Interface Conformance Test Specifications

This Section includes all test cases required for the ensuring the SAS-User interface conforms by the specifications defined Winn Forum and directed by the requirements established by FCC and DOD.

4.1 CBSD Spectrum Grant Process – SAS Operation

4.1.1 Definition and applicability and Scope of Test Case

This section explains test steps/condition/procedure for SAS Grant Response to a CBSD Grant Request.

A Grant Request is issued by a CBSD to request permission to operate in a particular frequency range at a particular peak power. A Grant Request Message issued by a CBSD consists of the following fields. (Section 7.5 in [10])

Parameter Name	Data Type	Required/ Optional	Description
cbsdId	string	Required	This is a globally unique identifier for each CBSD registered to SAS.
operationParam	object: OperationParam	Required	This data object includes operation parameters of the requested grant.

The OperationParam object has following elements:

Parameter Name	Data Type	Required/ Optional	Description
palCredential	array of string	Optional	PAL credential(s) shall be provided here if the grant requires

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			PAL protection. This field is not included if the CBSD does not demand PAL protection for the grant.
peakPower	Number	Required	Peak transmission power to be used in the grant. The peak power is in the unit of dBm/MHz.
operationFrequencyRange	FrequencyRange	Required	This parameter is frequency range of a contiguous segment.

The FrequencyRange object has following elements.

FrequencyRange data object:

Parameter Name	Data Type	Required/ Optional	Description
lowFrequency	Number	Required	The lowest frequency of the frequency range in Hz.
highFrequency	Number	Required	The highest frequency of the frequency range in Hz.

In the Grant Response, the SAS should echo back the cbsdId to the CBSD. If the grant request was successful, it will also contain grantId, grantExpireTime, heartbeatDuration and error object with errorcode set to 0. Optionally a successful grant response may contain measReportConfig. If grant request fails, then error object carries information about the cause of failure. A Grant Response Message issued by a SAS in response to this message consists of the following fields. (Section 7.6 in [10]).

Parameter Name	Data Type	Required/ Optional	Description
cbsdId	string	Required	This is a globally unique identifier for each CBSD registered to SAS.
grantId	string	Optional	An ID provided by SAS for each approved grant. If the request is rejected, this field must not be included.

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grantExpireTime	string	Optional	If the request is approved, SAS shall include this field to indicate the UTC time when the grant expires. It is expressed using the format, YYYY-MM-DDThh:mm:ssZ, as defined by "Date and Time on the Internet: Timestamps" [RFC3339].
heartbeatDuration	number	Optional	If the request is approved, SAS shall include this field to indicate the time interval in seconds between two consecutive heartbeat requests.
measReportConfig	object: MeasReportConfig	Optional	Configuration for CBSD to perform various measurements (interference, incumbent, etc) and report to SAS.
operationParam	object: OperationParam	Optional	If grant request is disapproved, SAS can optionally provide a new set of operation parameters for the CBSD.
error	object: Error	Required	This parameter includes information on whether the corresponding CBSD request is approved or disapproved for a reason.

The philosophy adopted in this test set is to present a variety of Grant Requests to SAS such that the SAS responds with Grant Responses with all possible errorcodes including the errorcode 0.

Error Codes for SAS responses to CBSD messages are defined in Section 8.13 of [10] and include the following classes of responses:

- 0: success
- 100 – 199: general errors regarding CBSD and protocol
- 200 – 299: error events related to CBSD registration
- 300 – 399: error events related to spectrum inquiry
- 400 – 499: error events related to grant
- 500 – 599: error events related to heartbeat

The following table lists proposes error codes for the possible conditions associated a Grant Request and the expected Grant Response from a SAS and the Section that defines the test.

Condition	Description	errorCode	Name	Section

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cbsdId = valid, operationParam=valid, Requestor = valid, Protocol = valid	Accepted GrantRequest	0	SUCCESS	4.1.4.1
cbsdId = valid, operationParam=valid, Requestor = valid, Protocol = invalid	SAS does not support the protocol used to send the message	100	Version not supported	Do we want to test this for each message ? (TBD)
(cbsdId || operationParam) = missing, Requestor = valid, Protocol = valid	Required Parameter missing	102	Missing Parameter	4.1.4.2
(cbsdId || opertaionParam) = invalid, Requestor = valid, Protocol = valid	Invalid parameter value	103	Invalid Value	4.1.4.3
Cbsdid = valid, palCredential in operationParam= mismatch, Requestor = valid, Protocol = valid	PAL credential does not match with other CBSD attributes (e.g., location/frequency range)	104	PAL_CREDENTIAL_MISMATCH	4.1.4.4
cbsdId = valid, frequencyRange (opertaionParam) = outside the part 96 range, Requestor = valid, Protocol = valid	Unsupported spectrum	300	UNSUPPORTED_SPECTRUM	4.1.4.5
cbsdId = valid, operationParam = valid, Requestor = valid, Protocol = valid Condition: some operationParameter value is such that it	Too much interference	400	INTERFERENCE	4.1.4.6

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will cause too much interference.				
cbsdId = valid operationParam=valid, Requestor = valid, Protocol = valid, Condition: send a grant request which conflicts with an existing grant (of same CBSD)	Conflict with an existing grant	401	GRANT_CONFLICT	4.1.4.7
cbsdId = valid, operationParam=valid, Requestor = valid, Protocol = valid, Condition: send more number of grants than "maximumGrants" specified during registration	Grant Request exceeds the maximum number of grants of a CBSD	402	TOO_MANY_GRANTS	0
cbsdId = valid, opertaionParam = valid, Requestor = valid Protocol = valid Condition: peakpower higher than allowed in Part 96	Unsupported peak power	4xx	TBD	4.1.4.9

4.1.2 Test Characteristics

1	**Test ID**	WG3.FT.0.003
2	**Title**	SAS Grant Response
3	**Working Group / Entity**	WG3
4	**Test Type**	Functionality
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS

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4.1.2.1 Minimum Requirement

This test case targets Section 10.13 of WINNF-15-P-0061 to verify the SAS Grant Response to a CBSD Grant Request.

4.1.2.2 Test Purpose

The purpose of this test is to verify that SAS responds correctly to a CBSD Grant Request.

4.1.2.3 Test Tools Required

This test case should be carried out in a test lab, with the following nodes available for testing:

1- SAS
   a. Appropriate configuration/logging tool to collect SAS messages for this testing.
   a. Ability to emulate presence of tier-1 user (incumbent) in a frequency range of a census tract.

2- SAS Test Harness, in particular the CBSD Test Interface of the SAS Test Harness should be available

4.1.3 Method of test

4.1.3.1 Test Triggers

Here is the list of causes that mandate performing the test:

– New SAS that must go through certification process
– Changes in SW interfaces of SAS that may impact grant process

4.1.3.2 Test Pre-Requisites

The following messages and responses should be verified (to facilitate scripting for this test):

- Registration Response
- Spectrum Inquiry Response

4.1.3.3 Initial Conditions / Test Pre-conditions

The typical pre-conditions of the test case are the following:

- CBSD has obtained its CBSD ID (C) after successfully registering with the SAS.

4.1.4 Test Procedure

4.1.4.1 Successful Grant Request (errorCode 0)

4.1.4.1.1 As GAA user

4.1.4.1.1.1 No incumbent or PAL user present in the frequency range requested by the GAA user

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The following steps describe the test execution steps.

#	Test Execution Steps	Results	
1	Make sure CBSD ID (C) exists in SAS.	OK	NOK
2	• Send a valid Spectrum Inquiry Request such that its response is successful and it carries a list of frequency ranges that are available. • Make sure that SAS does not get any other grant request for the frequencyRange that will be used in this Grant Request after this Spectrum Inquiry Response is received. • Make sure that no incumbent present in the free frequency range which will be used in this Grant Request. • Make sure that no PAL user present in the free frequency range which will be used in this Grant Request.	OK	NOK
3	CBSD Harness sends Grant Request to SAS including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., set it to one of the values received in the Spectrum Inquiry Response message).	OK	NOK
4	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G) assigned by the SAS. • Valid grantExpireTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK

4.1.4.1.1.2 Incumbent is present, but no PAL user present in the frequency range requested by the GAA user who is outside the protection zone identified by ESC.

The following steps describe the test execution steps.

#	Test Execution Steps	Results	
1	Make sure CBSD ID (C) exists in SAS.	OK	NOK
2	• Send a valid Spectrum Inquiry Request such that its response is successful and it carries a list of frequency ranges that are available. • Make sure that SAS does not get any other grant request for the frequencyRange that will be used in this Grant Request after this Spectrum Inquiry Response is received. • Make sure that incumbent is present in the free frequency range which will be used in this Grant Request. • Make sure that no PAL user present in the free frequency range which will be used in this Grant Request. • CBSD is outside the protection zone identified by ESC	OK	NOK
3	CBSD Harness sends Grant Request to SAS including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., set it to one of the values received in the Spectrum Inquiry Response message).	OK	NOK

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4	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G) assigned by the SAS. • Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK

4.1.4.1.1.3 Incumbent is present, but no PAL user present in the frequency range requested by the GAA user who is inside the protection zone identified by ESC.

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure CBSD ID (C) exists in SAS.	OK	NOK
2	• Send a valid Spectrum Inquiry Request such that its response is successful and it carries a list of frequency ranges that are available. • Make sure that SAS does not get any other grant request for the frequencyRange that will be used in this Grant Request after this Spectrum Inquiry Response is received. • Make sure that incumbent is present in the free frequency range which will be used in this Grant Request. • Make sure that no PAL user present in the free frequency range which will be used in this Grant Request. • CBSD is inside the protection zone identified by ESC	OK	NOK
3	CBSD Harness sends Grant Request to SAS including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., set it to one of the values received in the Spectrum Inquiry Response message).	OK	NOK
4	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G) assigned by the SAS (when errorCode = 0). • Valid grantExpiteTime and heartbeatDuration (when errorCode = 0). • Error Code (Response) = 0 or Error Code = 400 • Note that, if errorCode = 0, the SAS will delay the transition of CBSD to *transmission* state during exchange of Heartbeat messages.	OK	NOK

4.1.4.1.2 As PAL user

4.1.4.1.2.1 No incumbent or GAA user present in the frequency range requested by the PAL user

The following steps describe the test execution steps.

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#	Test Execution Steps	Results	
1	Make sure CBSD ID (C) exists in SAS.	OK	NOK
2	• Send a valid Spectrum Inquiry Request such that its response is successful and it carries list of frequency ranges that are available. • Make sure that SAS does not get any other grant request for the frequencyRange that will be used in this Grant Request after this Spectrum Inquiry Response is received. • Make sure that no incumbent is present in the free frequency range that will be used in this Grant Request. • Make sure that no GAA user is present in the same census tract (as CBSD) in the free frequency range that will be used in this Grant Request.	OK	NOK
3	CBSD Harness sends Grant Request to SAS including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., set it to one of the values received in the Spectrum Inquiry Response message). Include valid and correct PAL credential in the request.	OK	NOK
4	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G) assigned by the SAS. • Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK

4.1.4.1.2.2 No incumbent present, but GAA user present in the frequency range requested by the PAL user

The following steps describe the test execution steps.

#	Test Execution Steps	Results	
1	Make sure CBSD ID (C) exists in SAS.	OK	NOK
2	• Send a valid Spectrum Inquiry Request such that its response is successful and it carries list of frequency ranges that are available. • Make sure that SAS does not get any other grant request for the frequencyRange that will be used in this Grant Request after this Spectrum Inquiry Response is received. • Make sure that no incumbent is present in the free frequency range that will be used in this Grant Request. • Make sure that one or more GAA user is present in the same census tract (as CBSD) in the free frequency range that will be used in this Grant Request.	OK	NOK
3	CBSD Harness sends Grant Request to SAS including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., set it to the value received in the Spectrum Inquiry Response message such	OK	NOK

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	that the frequency range is same/overlapping as being granted to GAA user). Include valid and correct PAL credential in the request.		
4	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G) assigned by the SAS. • Valid grantExpireTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK

4.1.4.1.2.3 Incumbent present, but no GAA user present in the frequency range requested by the PAL user who is outside of protection zone identified by ESC

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure CBSD ID (C) exists in SAS.	OK	NOK
2	• Send a valid Spectrum Inquiry Request such that its response is successful and it carries list of frequency ranges that are available. • Make sure that SAS does not get any other grant request for the frequencyRange that will be used in this Grant Request after this Spectrum Inquiry Response is received. • Make sure that incumbent is present in the free frequency range that will be used in this Grant Request. • Make sure that no GAA user is present in the same census tract (as CBSD) in the free frequency range that will be used in this Grant Request. • CBSD is outside the protection zone identified by ESC	OK	NOK
3	CBSD Harness sends Grant Request to SAS including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., set it to one of the values received in the Spectrum Inquiry Response message). Include valid and correct PAL credential in the request.	OK	NOK
4	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G) assigned by the SAS. • Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK

4.1.4.1.2.4 Incumbent present, but no GAA user present in the frequency range requested by the PAL user who is inside of protection zone identified by ESC

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure CBSD ID (C) exists in SAS.	OK	NOK

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2	• Send a valid Spectrum Inquiry Request such that its response is successful and it carries list of frequency ranges that are available. • Make sure that SAS does not get any other grant request for the frequencyRange that will be used in this Grant Request after this Spectrum Inquiry Response is received. • Make sure that incumbent is present in the free frequency range that will be used in this Grant Request. • Make sure that no GAA user is present in the same census tract (as CBSD) in the free frequency range that will be used in this Grant Request. • CBSD is inside the protection zone identified by ESC	OK	NOK
3	CBSD Harness sends Grant Request to SAS including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., set it to the values received in the Spectrum Inquiry Response message). Include valid and correct PAL credential in the request.	OK	NOK
4	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G) assigned by the SAS (when errorCode = 0). • Valid grantExpiteTime and heartbeatDuration (when errorCode = 0). • Error Code (Response) = 0 or Error Code = 400 • Note that, if errorCode = 0, the SAS will delay the transition of CBSD to *transmission* state during exchange of Heartbeat messages.	OK	NOK

4.1.4.1.2.5 Incumbent present, one or more GAA user present in the frequency range requested by the PAL user who is outside of protection zone identified by ESC

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure CBSD ID (C) exists in SAS.	OK	NOK
2	• Send a valid Spectrum Inquiry Request such that its response is successful and it carries list of frequency ranges that are available. • Make sure that SAS does not get any other grant request for the frequencyRange that will be used in this Grant Request after this Spectrum Inquiry Response is received. • Make sure that incumbent is present in the free frequency range that will be used in this Grant Request. • Make sure that one or more GAA user is present in the same census tract (as CBSD) in the free frequency range that will be used in this Grant Request.	OK	NOK

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	• CBSD is outside the protection zone identified by ESC		
3	CBSD Harness sends Grant Request to SAS including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., set it to one of the values received in the Spectrum Inquiry Response message such that it is same/overlaps with frequency range granted to a GAA user). Include valid and correct PAL credential in the request.	OK	NOK
4	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G) assigned by the SAS. • Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK

4.1.4.1.2.6 Incumbent present, one or more GAA user present in the frequency range requested by the PAL user who is inside of protection zone identified by ESC

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure CBSD ID (C) exists in SAS.	OK	NOK
2	• Send a valid Spectrum Inquiry Request such that its response is successful and it carries list of frequency ranges that are available. • Make sure that SAS does not get any other grant request for the frequencyRange that will be used in this Grant Request after this Spectrum Inquiry Response is received. • Make sure that incumbent is present in the free frequency range that will be used in this Grant Request. • Make sure that one or more GAA user is present in the same census tract (as CBSD) in the free frequency range that will be used in this Grant Request. • CBSD is inside the protection zone identified by ESC	OK	NOK
3	CBSD Harness sends Grant Request to SAS including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., set it to one of the values received in the Spectrum Inquiry Response message such that it is same/overlaps with frequency range granted to a GAA user)). Include valid and correct PAL credential in the request.	OK	NOK
4	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G) assigned by the SAS (when errorCode = 0). • Valid grantExpiteTime and heartbeatDuration (when errorCode = 0). • Error Code (Response) = 0 or Error Code = 400	OK	NOK

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	• Note that, if errorCode = 0, the SAS will delay the transition of CBSD to *transmission* state during exchange of Heartbeat messages.		

4.1.4.1.3 Multiple Grants

4.1.4.1.3.1 Multiple Grants, first as GAA user and then as PAL user, non-overlapping frequency ranges.

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	• Make sure CBSD ID (C) exists in SAS. • Make sure that the CBSD was registered with *maximumGrant* > 1	OK	NOK
2	• Send a valid Spectrum Inquiry Request as GAA user such that its response is successful and it carries list of frequency ranges that are available. Let this list be L_{GAA}. • Send a valid Spectrum Inquiry Request as PAL user such that its response is successful and it carries list of frequency ranges that are available. Let this list be L_{PAL} • Make sure that SAS does not get any other grant request for the frequencyRanges that will be used in the following two Grant Requests after this Spectrum Inquiry Response is received. • Make sure that no incumbent is present in the free frequency range that will be used in the two Grant Requests. • Make sure that no other condition for rejecting the grants holds (e.g., conditions related to exclusion/protection zone).	OK	NOK
3	CBSD Harness sends Grant Request to SAS as GAA user including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., choose from L_{GAA})	OK	NOK
4	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G1) assigned by the SAS. • Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK
5	CBSD Harness sends Grant Request to SAS as PAL users including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., choose from L_{PAL}). Make sure that this frequency range is non-overlapping with the frequency range sent in the previous Grant Request. Include valid and correct PAL credential in the request.	OK	NOK
6	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A different Grant ID (G2) assigned by the SAS.	OK	NOK

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	• Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0		

4.1.4.1.3.2 Multiple Grants, first as PAL user and then as GAA user, non-overlapping frequency ranges.

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	• Make sure CBSD ID (C) exists in SAS. • Make sure that the CBSD was registered with *maximumGrant* > 1	OK	NOK
2	• Send a valid Spectrum Inquiry Request as GAA user such that its response is successful and it carries list of frequency ranges that are available. Let this list be L_{GAA}. • Send a valid Spectrum Inquiry Request as PAL user such that its response is successful and it carries list of frequency ranges that are available. Let this list be L_{PAL} • Make sure that SAS does not get any other grant request for the frequencyRanges that will be used in the following two Grant Requests after this Spectrum Inquiry Response is received. • Make sure that no incumbent is present in the free frequency range that will be used in the two Grant Requests. • Make sure that no other condition for rejecting the grants holds (e.g., conditions related to exclusion/protection zone).	OK	NOK
3	CBSD Harness sends Grant Request to SAS as PAL users including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., choose from L_{PAL}). Make sure that this frequency range is non-overlapping with the frequency range sent in the previous Grant Request. Include valid and correct PAL credential in the request.	OK	NOK
4	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G1) assigned by the SAS. • Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK
5	CBSD Harness sends Grant Request to SAS as GAA user including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., choose from L_{GAA}).	OK	NOK
6	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A different Grant ID (G2) assigned by the SAS. • Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK

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4.1.4.1.3.3 Multiple Grants, both as GAA user, non-overlapping frequency ranges.

The following steps describe the test execution steps.

#	Test Execution Steps	Results	
1	• Make sure CBSD ID (C) exists in SAS. • Make sure that the CBSD was registered with *maximumGrant* > 1	OK	NOK
2	• Send a valid Spectrum Inquiry Request as GAA user such that its response is successful and it carries list of frequency ranges that are available. Let this list be L_{GAA}. • Make sure that SAS does not get any other grant request for the frequencyRanges that will be used in the following two Grant Requests after this Spectrum Inquiry Response is received. • Make sure that no incumbent is present in the free frequency range that will be used in the two Grant Requests. • Make sure that no other condition for rejecting the grants holds (e.g., conditions related to exclusion/protection zone).	OK	NOK
3	CBSD Harness sends Grant Request to SAS as GAA user including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., choose from L_{GAA}).	OK	NOK
4	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G1) assigned by the SAS. • Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK
5	CBSD Harness sends Grant Request to SAS as GAA user including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., choose from L_{GAA}). Make sure that this frequency range is non-overlapping with the frequency range sent in the previous Grant Request.	OK	NOK
6	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A different Grant ID (G2) assigned by the SAS. • Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK

4.1.4.1.3.4 Multiple Grants, both as PAL user, non-overlapping frequency ranges.

The following steps describe the test execution steps.

#	Test Execution Steps	Results	
1	• Make sure CBSD ID (C) exists in SAS. • Make sure that the CBSD was registered with *maximumGrant* > 1	OK	NOK

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2	• Send a valid Spectrum Inquiry Request as PAL user such that its response is successful and it carries list of frequency ranges that are available. Let this list be L_{PAL} • Make sure that SAS does not get any other grant request for the frequencyRanges that will be used in the following two Grant Requests after this Spectrum Inquiry Response is received. • Make sure that no incumbent is present in the free frequency range that will be used in the two Grant Requests. • Make sure that no other condition for rejecting the grants holds (e.g., conditions related to exclusion/protection zone).	OK	NOK
3	CBSD Harness sends Grant Request to SAS as PAL user including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., choose from L_{PAL}). Include valid and correct PAL credential in the request.	OK	NOK
4	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G1) assigned by the SAS. • Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK
5	CBSD Harness sends Grant Request to SAS as PAL user including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., choose from L_{PAL}). Make sure that this frequency range is non-overlapping with the frequency range sent in the previous Grant Request. Include valid and correct PAL credential in the request.	OK	NOK
6	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A different Grant ID (G2) assigned by the SAS. • Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK

4.1.4.1.4 First request granted as GAA, send next request as PAL for an overlapping frequency range

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	• Make sure CBSD ID (C) exists in SAS. • Make sure that the CBSD was registered with *maximumGrant* > 1	OK	NOK
2	• Send a valid Spectrum Inquiry Request as GAA user such that its response is successful and it carries list of frequency ranges that are available. Let this list be L_{GAA}.	OK	NOK

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	• Send a valid Spectrum Inquiry Request as PAL user such that its response is successful and it carries list of frequency ranges that are available. Let this list be L_{PAL} • Make sure that SAS does not get any other grant request for the frequencyRanges that will be used in the following two Grant Requests after this Spectrum Inquiry Response is received. • Make sure that no incumbent is present in the free frequency range that will be used in the two Grant Requests. • Make sure that no other condition for rejecting the grants holds (e.g., conditions related to exclusion/protection zone).		
3	CBSD Harness sends Grant Request to SAS as GAA user including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., choose from L_{GAA}). Let the frequency range in this grant request be FR1.	OK	NOK
4	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G1) assigned by the SAS. • Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK
5	CBSD Harness sends Grant Request to SAS as PAL users including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., choose from L_{PAL}). Make sure that this frequency range is overlapping with FR1. Include valid and correct PAL credential in the request.	OK	NOK
6	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A different Grant ID (G2) assigned by the SAS. • Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK

4.1.4.1.5 First request granted as GAA, send next request as GAA for an overlapping frequency range

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	• Make sure CBSD ID (C) exists in SAS. • Make sure that the CBSD was registered with *maximumGrant* > 1	OK	NOK
2	• Send a valid Spectrum Inquiry Request as GAA user such that its response is successful and it carries list of frequency ranges that are available. Let this list be L_{GAA}.	OK	NOK

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	• Make sure that SAS does not get any other grant request for the frequencyRanges that will be used in the following two Grant Requests after this Spectrum Inquiry Response is received. • Make sure that no incumbent is present in the free frequency range that will be used in the two Grant Requests. • Make sure that no other condition for rejecting the grants holds (e.g., conditions related to exclusion/protection zone).		
3	CBSD Harness sends Grant Request to SAS as GAA user including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., choose from L_{GAA}). Let the frequency range in this grant request be FR1.	OK	NOK
4	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G1) assigned by the SAS. • Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK
5	CBSD Harness sends Grant Request to SAS as GAA user including CBSD ID. Set peakPower, lowFrequency and highFrequency appropriately (e.g., choose from L_{GAA}). Make sure that this frequency range is overlapping with FR1.	OK	NOK
6	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A different Grant ID (G2) assigned by the SAS. • Valid grantExpiteTime and heartbeatDuration. • Error Code (Response) = 0	OK	NOK

4.1.4.1.6 Exclusion Zone related

4.1.4.1.6.1 ESC not present, category-A CBSD is outside of the Exclusion zone

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS • CBSD registered as category A • There is no ESC deployed • CBSD location is outside of the Exclusion zone	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • All parameters of operationParams have valid value.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • A Grant ID (G) assigned by the SAS.	OK	NOK

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	• Valid grantExpiteTime and heartbeatDuration • Error Code (Response) = 0		

4.1.4.2 Missing Parameter (Error Code 102)

4.1.4.2.1 Missing CBSD ID (TBD)

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS, but does not include CBSD ID, whereas it includes all other mandatory fields.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID assigned to the CBSD during registration = (TBD) • No Grant ID in the Response message. • Error Code (Response) = 102	OK	NOK

4.1.4.2.2 Missing operationParam object

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is NOT present in the Grant Request	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = C • No Grant ID in the Response message. • Error Code (Response) = 102	OK	NOK

4.1.4.2.3 Missing peakPower in operationParam object

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK

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2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request, but its peakPower element is missing. Both lowFrequency and highFrequency elements are present with valid values.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = C • No Grant ID in the Response message. • Error Code (Response) = 102	OK	NOK

4.1.4.2.4 Missing lowFrequency in operationParam object

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request, but its lowFrequency element is missing. peakPower and highFrequency elements are present with valid values.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = C • No Grant ID in the Response message. • Error Code (Response) = 102	OK	NOK

4.1.4.2.5 Missing highFrequency in operationParam object

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request, but its highFrequency element is missing. peakPower and lowFrequency elements are present with valid values.	OK	NOK
3	Verify the following in the Grant Response Message from SAS	OK	NOK

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	• CBSD ID (Response) = C • No Grant ID in the Response message. • Error Code (Response) = 102		

4.1.4.3 Invalid Parameter in Grant Request (errorCode 103)

4.1.4.3.1 CBSD ID Does Not Exist in SAS

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: • CBSD ID (C) does not exist in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS including CBSD ID (C) and other required parameters.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 103	OK	NOK

4.1.4.3.2 CBSD ID value invalid

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS in which CBSD ID is not a string, but an arbitrary number. It includes other required parameters.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = C • No Grant ID in the Response message. • Error Code (Response) = 103	OK	NOK

4.1.4.3.3 peakPower in operationPower invalid

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request, but its peakPower value is set an invalid value, e.g., a character.	OK	NOK

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	lowFrequency and highFrequency elements should have valid values.		
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 103	OK	NOK

4.1.4.3.4 lowFrequency value in operationPower invalid

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request, but its lowFrequency value is set to an invalid value, e.g., a character. peakPower and highFrequency elements should have valid values.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 103	OK	NOK

4.1.4.3.5 highFrequency value in operationPower invalid

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request, but its highFrequency value is set to an invalid value, e.g., a character. peakPower and lowFrequency elements should have valid values.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 103	OK	NOK

4.1.4.3.6 lowFrequency and highFrequency value in operationPower mutually invalid

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The following steps describe the test execution steps.

#	Test Execution Steps	Results	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request, but its lowFrequency value is set to a value higher than highFrequency value. peakPower should be a valid value.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 103	OK	NOK

4.1.4.3.7 palCredential in operationPower invalid

The following steps describe the test execution steps.

#	Test Execution Steps	Results	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request, but its palCredential parameter is invalid, e.g., a number. • All other parameters of operationParams should have valid values.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 103	OK	NOK

4.1.4.4 PAL credential mismatch (errorCode 104)

4.1.4.4.1 PAL credential provided in the Grant Request does not match

The following steps describe the test execution steps.

#	Test Execution Steps	Results	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request	OK	NOK

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	• operationParams object is present in the Grant Request. palCredential is present in the request, but it does not match with the information SAS has for the PAL user at the current location. All other parameters in operationParams have valid values.		
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 104	OK	NOK

4.1.4.5 Unsupported Spectrum (errorCode 300)

4.1.4.5.1 Frequency range specified in the grant is completely outside of the range 3550 MHz to 3700 MHz

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request, but its lowFrequency and highFrequency values are such that the frequency range is completely non-overlapping with the range 3550MHz to 3700 MHz. peakPower should be a valid value.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 300	OK	NOK

4.1.4.5.2 Frequency range specified in the grant is partially outside of the range 3550 MHz to 3700 MHz

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request, but its lowFrequency and highFrequency values are such that the	OK	NOK

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	frequency range is partially non-overlapping with the range 3550MHz to 3700 MHz. peakPower should be a valid value.		
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 300	OK	NOK

4.1.4.5.3 Frequency range specified by PAL user in the grant is partially or completely outside of the range 3550 MHz to 3650 MHz

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request, but its lowFrequency and highFrequency values are such that the frequency range is partially or completely outside of the range 3550MHz to 36500 MHz. peakPower should be a valid value. Include valid and correct PAL credential in the request.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 300	OK	NOK

4.1.4.6 Requested operation parameter causes too much interference (errorCode 400)

4.1.4.6.1 PAL user present in the frequency range requested by GAA user

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS • PAL user is previously granted a frequency range (PAL_FR) which overlaps with the frequency range (G_FR) requested in the grant request	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request. palCredential is not present, peakPower is set to valid value. The frequency range in the request (G_FR) overlaps with PAL_FR.	OK	NOK

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3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 400	OK	NOK

4.1.4.6.2 ESC related test cases

4.1.4.6.2.1.1 ESC not present, category-A CBSD is inside the Exclusion zone

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS • CBSD registered as category A • There is no ESC deployed • CBSD location is inside the Exclusion zone	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • All parameters of operationParams have valid value.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 400	OK	NOK

4.1.4.6.2.2 ESC not present, category B CBSD is inside or outside of the Exclusion zone

The following steps describe the test execution steps.

#	Test Execution Steps	**Results**	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS • CBSD registered as category B • There is no ESC deployed • CBSD location could be inside or outside of the Exclusion zone	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • All parameters of operationParams have valid value.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 400	OK	NOK

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4.1.4.7 Grant conflicts with an existing grant of the same CBSD (errorCode 401)

4.1.4.7.1 First request granted as PAL, send next request as PAL for the same frequency range

The following steps describe the test execution steps.

#	Test Execution Steps	Results	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS • The CBSD has an existing grant as a PAL user with frequency range = FR1	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request. The request carries correct palCredential in the operationParams, i.e., CBSD is requesting this grant as a PAL uses. peakPower is set to a valid value. The frequency range is set to the same frequency range, i.e., FR1.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 401	OK	NOK

4.1.4.7.2 First request granted as PAL, send next request as GAA for an overlapping frequency range

The following steps describe the test execution steps.

#	Test Execution Steps	Results	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS • The CBSD has an existing grant as a PAL user with frequency range = FR1	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request. There is no palCredential in the operationParams, i.e., CBSD is requesting this grant as a GAA user. peakPower is set to a valid value. The frequency range is set to a value such that it overlaps with FR1.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message.	OK	NOK

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	• Error Code (Response) = 401		

4.1.4.8 Too many grants (errorCode 402)

4.1.4.8.1 Send one request more than indicated in "maximumGrants" during registration

The following steps describe the test execution steps.

#	Test Execution Steps	Results	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS • CBSD has registered with SAS with maximumGrants = n (easy to test by setting n=1) • The CBSD has 'n' existing grants with frequency range = FR_1, FR_2, …, FR_n	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request. peakPower is set to a valid value. The frequency range is set to a value that is completely non-overlapping with FR_1, FR_2, … FR_n.	OK	NOK
3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 402	OK	NOK

4.1.4.9 Unsupported peak power (errorCode 4xx) (TBD)

4.1.4.9.1 Peak power specified in the grant is not supported

The following steps describe the test execution steps.

#	Test Execution Steps	Results	
1	Make sure the following conditions hold: • CBSD ID (C) exists in SAS	OK	NOK
2	CBSD Harness sends Grant Request to SAS such that • CBSD ID (C) is present in the Grant Request • operationParams object is present in the Grant Request, but its peakPower value is more than specified in R&O, e.g., for category A CBSD, set it to a value more than 30 dBm/10MHz EIRP. Set lowFrequency and highFrequency to valid values.	OK	NOK

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3	Verify the following in the Grant Response Message from SAS • CBSD ID (Response) = CBSD ID (Request) = C • No Grant ID in the Response message. • Error Code (Response) = 4xx	OK	NOK

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