Test and Certification for Citizens Broadband Radio Service (CBRS); Conformance and Performance Test Technical Specification; SAS as Unit Under Test (UUT)

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Test and Certification for CBRS; Conformance and Performance Test Technical Specification; SAS as UUT

1 Introduction

The present document contains the 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 Wireless Innovation Forum (WInnForum).

2 Scope

The present document specifies test procedures to demonstrate conformance of the requirements defined in [n.8 to n.17] for the components of the CBRS Architecture, detailed in Section 5. These procedures comprise transmit characteristics, receive characteristics, and performance requirements defined by the WInnForum, Spectrum Sharing Committee. The conformance tests include protocol and functional tests necessary to ensure the components comply with Part 96 of the FCC's rules [n.15] and the WInnForum CBRS Requirements as specified in [n.12].

Not all components and interfaces in [n.3] are covered by the certification and test cases defined in this document. Development of some of the interfaces and components are out of the scope of WInnForum, and therefore no test and certification process are provided for them. The scope of WInnForum test and certification specification includes:

- Conformance of the Spectrum Access System (SAS) for protecting federal incumbents from harmful interference.
- Conformance of SAS and potentially other components and interfaces, whose functionalities are standardized by WInnForum in [n.9], [n.11], and [n.12].
- Conformance of the SAS for protecting non-federal Incumbents and Priority access licensees from harmful interference.

The functionalities of Radio Access Network (RAN) or radio device operations and functions are outside the scope of this document.

More generally, tests are only applicable to those components that are intended to support the appropriate functionality. To indicate the circumstances in which tests apply, this is noted in the "*definition and applicability*" part of the test.

This document only covers the test cases required for certification of the SAS components of the CBRS, and does not include the proprietary tests performed by equipment vendors.

Moreover, this document only covers the test specifications and test cases for the CBRS Architecture components, and does not include the test software. The test software is described in a repository maintained by WInnForum Working Group 4 [i.1].

Certain elements of this published WINNF specifications are subject to change and update in this release. The test elements are identified in the traceability Matrix [i.5].

3 References

3.1 Normative references

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

[n.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

[n.2] FCC Report and Order 16-55A1: "Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band", FCC, May 2 2016, https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-55A1.pdf

[n.3] SSC- Wireless Innovation Forum, WG1&3 Task Group: "SAS Functional Architecture ", Working Document WINNF-15-P-0047 Version V1.0.0

[n.4] 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

[n.5] "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

[n.6] NOAA Maritime Boundaries, Available online: http://www.nauticalcharts.noaa.gov/csdl/mbound.htm Last accessed March 16, 2016

[n.7] https://www.census.gov/geo/maps-data/data/kml/kml_nation.html

[n.8] SSC-Wireless Innovation Forum, "CBRS Communications Security Technical Specification", WINNF-TS-0065 V1.1.0

[n.9] SSC-Wireless Innovation Forum, "Signaling Protocols and Procedures for Citizens Broadband Radio Service (CBRS): Spectrum Access System (SAS) - Citizens Broadband Radio Service Device (CBSD) Interface Technical Specification", WINNF-TS-0016 V1.2.2

[n.10]   FCC List of protected FSS Sites in 3650-3700 MHz Band
https://transition.fcc.gov/ib/sd/3650/grandftr.pdf

[n.11]   SSC-Wireless Innovation Forum, "Signaling Protocols and Procedures for
Citizens Broadband Radio Service (CBRS); Spectrum Access System (SAS) -
SAS Interface Technical Specification", WINNF-TS-0096 V1.3.0

[n.12]   SSC-Wireless Innovation Forum, "Requirements for Commercial Operation in
the U.S. 3550-3700 MHz Citizens Broadband Radio Service Band", WINNF-
15-S-0112 V1.6.0

[n.13]   "FSS Sites in 3650-3700 MHz",
https://transition.fcc.gov/ib/sd/3650/grandftr.pdf, FCC.

[n.14]   SSC-Wireless Innovation Forum, "Test and Certification for Citizens
Broadband Radio Service (CBRS); Conformance and Performance Test
Technical Specification; CBSD as Unit Under Test (UUT) – DRAFT, Request
for Comment", WINNF-TS-0122 V1.1.1

[n.15]   Electronic Code of Federal Regulations, Title 47, Chapter I, Subchapter D, Part
96, http://www.ecfr.gov/cgi-
bin/retrieveECFR?gp=&SID=0076fe7586178336d9db4c5146da8797&mc=true
&n=pt47.5.96&r=PART&ty=HTML.

[n.16]   SSC-Wireless Innovation Forum, "Signaling Protocols and Procedures for
Citizens Broadband Radio Service (CBRS): WInnForum Recognized CBRS
Air Interfaces and Measurements", WINNF-SSC-0002

[n.17]   RFC-2119, "Key words for use in RFCs to Indicate Requirement Levels",
March 1997. Available at: https://tools.ietf.org/html/rfc2119

[n.18]   www.fcc.gov/cbrs-protected-fss-sites

[n.19]   Wireless.fcc.gov/ULS

[n.20]   Coordinated Periodic Activities Policy, WINNF-SSC-0008

[n.21]   Margin Policy, WINNF-SSC-0007

[n.22]   FSS Earth Station Antenna Registration System

[n.23]   Arrangement R, https://transition.fcc.gov/ib/sand/agree/files/can-
          nb/Arrangement_R.pdf

3.2   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.

[i.1]   WG4 GitHub Repository, https://github.com/Wireless-Innovation-
         Forum/Spectrum-Access-System

[i.2]   http://robotframework.org/

[i.3]   Deprecated

[i.4]   Deprecated

[i.5]   SSC-Wireless Innovation Forum, "CBRS Requirements Traceability Matrix",
         WINNF-SSC-0003

4   Definitions and Abbreviations

4.1   Abbreviations

CBRS: Citizens Broadband Radio Service

CBSD: Citizens Broadband Radio Service Device

CPAS: Coordinated Periodic Activities among SASs

CPI: Certified Professional Installer

DOD: Department of Defense

DPA: Dynamic Protection Area

EIRP: Effective Isotropic Radiated Power

ESC: Environmental Sensing Capability

FCC: Federal Communications Commission

FSS: Fixed Satellite Service

GAA: General Authorized Access

GWBL: Grandfathered Wireless Broadband Licensee

GWPZ: Grandfathered Wireless Protection Zone

HAAT: Height Above Average Terrain

IAP: Iterative Allocation Process

IOT: Inter-Operability Test

NOAA: National Oceanic and Atmospheric Administration

NTIA: National Telecommunications and Information Administration

PAL: Priority Access License

PPA: PAL Protection Area

RAN: Radio Access Network

SAS: Spectrum Access System

TLS: Transport Layer Security

UUT: Unit Under Test

4.2   Definitions

Main Test Harness: is a collection of routines that can be configured by the test operator to interact with the SAS UUT in order to execute the test cases described in this document. It includes the reference models, Admin Test Harness, SAS Test Harnesses, DP Test Harnesses, CBSD Test Harnesses, and all other test harnesses defined in this document. The Main Test Harness software is stored in a public location specified in [i.1].

SAS Under Test: A Spectrum Access System (SAS) to which the sequence of steps listed in the test specifications in this document is applied via the SAS, CBSD, and ESC Test Harnesses, the SAS Under Test exchanges sequences of simulated messages with simulated Spectrum Access Systems, simulated CBSDs, and simulated ESCs according to the test specifications in this document. In this document, it is referred to as SAS UUT (Unit Under Test).

SAS Test Harness: A collection of routines that can be configured by the test operator to interact with the SAS UUT via interfaces specified in [n.11], and automates critical test sequences and procedures in this document and [n.14]. Via these interfaces and following the specified test procedures, the SAS Test Harness emulates the SAS-SAS Messages specified in [n.11] that would be generated by one SAS. The software without SAS certificate is stored in a public location specified in [i.1].

CBSD Test Harness: A collection of routines that can be configured by the test operator to interact with the SAS UUT via interfaces specified in [n.9] and automates critical test sequences and

procedures in this document and [n.14]. Via these interfaces and following the specified test procedures, the CBSD Test Harness emulates the SAS-CBSD Request Messages specified in [n.9] that would be generated by one CBSD, using a TLS connection with CBSD certificate to the SAS UUT. If multiple CBSD Test Harnesses are directly connected to the SAS UUT, each has its own TLS connection to the SAS UUT. The software without CBSD certificate is stored in a public location specified in [i.1].

DP Test Harness: A collection of routines that can be configured by the test operator to interact with the SAS UUT via interfaces specified in [n.9] and automates critical test sequences and procedures in this document and [n.14]. Via these interfaces and following the specified test procedures, the DP Test Harness emulates the SAS-CBSD Request Messages specified in [n.9] that would be generated by one or more CBSDs, using a TLS connection with DP certificate to the SAS UUT. If multiple DP Test Harnesses are connected to the SAS UUT, each has its own TLS connection to the SAS UUT. The DP function within the DP Test Harness merely aggregates the Request Messages of multiple single CBSDs and disaggregates the respective Response Messages of the SAS UUT and does nothing else (i.e., does not have any other unique functionality of a real Domain Proxy). The software without DP certificate is stored in a public location specified in [i.1].

ESC Test Harness: is a collection of routines that can be configured by the test operator to interact with the SAS UUT in order to execute the ESC functionalities of the test cases described in this document. Via these interfaces and following the specified test procedures, the ESC Test Harness emulates the messages that would be sent from an ESC system to a SAS. The ESC Test Harness software is stored in a public location specified in [i.1].

Admin Test Harness: A collection of routines that can be configured by the test operator to inject data that is required for the purpose of the test cases, into the SAS UUT. The Admin Test Harness also has the ability to recognize the completion of CPAS executed by the SAS UUT. The Admin Test Harness software is stored in a public location specified in [i.1].

Baseline State: Baseline State refers to the state of SAS UUT after it is triggered to reset by the test operator or Admin Test Harness.

Coordinated Periodic Activities among SASs (CPAS): Periodic coordination among SASs, which in Release 1 operation is comprised of scheduled external database synchronization, Full Activity Dump Exchange, IAP, and DPA move list calculation. In Release 1, these coordination activities happen daily among SASs. Note: "trigger CPAS" as used in this document differs from normal operation in the following three ways; in particular: (1) all activities will be completed as fast as possible; (2) FAD generation by the SAS UUT is omitted; (3) the SAS UUT will only pull from the external databases specified by the Admin Test Harness.

PPA Information: PPA information includes PAL Database Record and PPA (as defined in [n.11]), which includes the cluster list, list of PAL IDs, and the polygon describing the zone. When Admin Test Harness injects PPA information into SAS UUT, Admin Test Harness shall inject PAL Database Record first and then PPA Zone Definition Message.

Reference Model: Reference Model refers to a calculation implemented in the Main Test Harness. The Reference Model includes the calculation of the Propagation Models, Iterative Allocation Process (IAP), PPA creation, Antenna Gain Model (including antenna pattern), aggregate interference, and DPA Move List as specified in [n.12].

The following terms are used within this document and should be interpreted as described in [n.17]:
- ***SHALL*** is a mandatory requirement (negative is ***SHALL NOT***)
- ***SHOULD*** is recommended requirement /best practice (negative is ***SHOULD NOT***)
- ***MAY*** is an optional requirement, i.e. something that is allowed (negative is ***NEED NOT***)

5 General Principles of Certification Test Cases

The requirements, protocols, specifications, and interfaces are defined by SSC-Wireless Innovation Forum Work Groups 1, 2, and 3. The specifications are derived from FCC, NTIA, and DOD requirements. According to requirements and specifications defined by other work groups, Work Group 4 develops the test cases. The certification test cases can be classified in three classes as follows:

- **Functional Test (FT):** Test to validate the conformance of the Protocols and functionalities implemented in the SAS UUT to the requirements developed by WInnForum and supporting FCC/DoD requirements.

- **Interoperability Test (IOT):** Test to validate the interoperability between the components developed by different vendors, compliant to WInnForum Requirements.

- **Field/Performance Test (PT):** Test to check the capability of the SAS UUT to support various traffic models and actual operations in the field.

The Protocol and Functional test cases are converted to test scripts, which have to be validated through a process defined by WInnForum and FCC. The lab and performance testing require traffic/capacity modeling and measurement equipment.

Vendor testing could be either considered as a pre-requisite for certification process, or, by discretion of the certification management entity, they could be partially or fully considered as part of certification plan.

Certification is governed either directly by, or through a certification body designated by, the FCC, DOD, and WInnForum.

5.1 Test ID Definition

Each test case specified in this document has an associated test ID. A test ID shall be defined in the following format.

{*TestRequirement*}.{*TestCategory*}.{*UnitUnderTest*}.{*TestFunction*}.{*SubTestNumber*}

Test Requirement indicates the test is to verify if the Unit Under Test meets the Technical Specifications provided by WInnForum, which in turn are designed to be compliant with the FCC rules. The category of a test, which can be functional, interoperability, or performance, is shown in *TestCategory*. *UnitUnderTest* represents the entity under test, which can be SAS, CBSD, Domain Proxy, ESC or a combination of those entities. *TestFunction* indicates a particular function or requirement a test intends to verify. *SubTestNumber* is an integer larger than 0 to number different test cases in a group of tests performing similar test functions.

In the above Test ID format, the strings in the curly braces are replaced by values in the following tables depending on the characteristics of each test.

Table 5.1-1 The values of TestRequirement in Test ID

Value	Description
WINNF	This test is to verify a Technical Specifications provided by Wireless Innovation Forum

Table 5.1-2 The values of TestCategory in Test ID

Value	Description
FT	This test is a functional test
IT	This test is an interoperability test
PT	This test is a performance test

Table 5.1-3 The values of UnitUnderTest in Test ID

Value	Unit under test
S	SAS
C	CBSD/DP
E	ESC
SC	SAS and CBSD
SS	SAS and SAS

Table 5.1-4 The values of TestFunction in Test ID

Value	Description
EXZ	Exclusion Zone enforcement test
REG	CBSD Registration procedure
SIQ	CBSD Spectrum inquiry procedure
GRA	CBSD Grant procedure
HBT	CBSD Heartbeat procedure
MES	CBSD Measurement report
RLQ	CBSD Grant Relinquishment procedure
DRG	CBSD Deregistration procedure
SCS	SAS-CBSD Security validation
EPR	ESC Protection
IPR	Federal Incumbent Protection
FPR	FSS Protection
GPR	GWPZ Protection
PPR	PPA Protection
MCP	Multi-Constraint Protection
BPR	Border Protection
PCR	PPA Creation
FDB	Federal Government Database
WDB	WINNF Database
PAT	Propagation Model and Antenna gain
SSS	SAS-SAS Security, Authentication and Encryption Protocols
FAD	Full Activity Dump Message

5.2 Test Triggers

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

- A SAS Implementation that has not gone through the certification tests, is being launched.

- Changes in a Certified SAS Implementation that may impact functionality, interoperability, or performance

- One or more changes in a Certified SAS Implementation, where the changes could impact the Protocol and Functional Test Cases specified in this document.

5.3 Test Tools Required

The following modules and functionality shall be used for the conformance tests in this document:
- SAS UUT
  - The SAS UUT shall support the following triggers:
    - Reset to baseline state
    - Generate a full activity dump ("FAD generation")
    - Execute CPAS, excluding FAD generation (per [n.20])
    - Execute CPAS as scheduled (including FAD generation) (per [n.20])
    - Always request measurement reports in Registration Response
    - Always request measurement reports in Heartbeat Response
    - Reload all DPAs which may be monitored by an ESC
    - Activate DPA/channel pair
    - Deactivate DPA/channel pair
    - Enable NTIA 15-517 exclusion zones
    - Disconnect ESC
  - The SAS UUT shall support injection of the following data:
    - FCC ID
    - User ID
    - Blacklisted FCC ID
    - Conditional Registration information
    - CPI user information
    - PAL database record
    - Peer SAS (SAS Test Harness) into peer group
    - External database URL
    - Protected entities
      - PPA
      - GWPZ and GWBL
      - FSS
      - Exclusion zone
      - ESC sensor
  - The SAS UUT shall support the following additional APIs:

- Create PPA
- Propagation model query

Exactly the same information exchanged by FAD generation and exchange during CPAS shall be used by all SASs to execute the steps of CPAS

- SAS Test Harness
  - Appropriate logging tool to collect SAS-SAS messages from SAS Test Harness to SAS UUT and messages from SAS UUT to SAS Test Harness
  - Ability to perform FAD Exchange and to be configured with FAD files
  - Ability to configure the SAS Test Harness to contain CBSDs and Grants (by provding SAS Test Harness with the corresponding FAD files)

- CBSD Test Harness
  - Appropriate logging tool to collect messages from the CBSD Test Harness to the SAS UUT and from the SAS UUT to the CBSD Test Harness.
  - Appropriate configuration tool to send SAS-CBSD Request Messages to the SAS UUT

- Main Test Harness
  - Ability to use different Test Harness(es)
  - Appropriate logging tool for the messages received from the SAS UUT.
  - Ability to check the PASS/FAIL criteria in each test case

- Admin Test Harness
  - Ability to inject information into the SAS UUT such as FCC ID whitelist, User ID whitelist, Blacklist Data, REG-Conditional Registration data, zone data (PPA, GWPZ, DPA, Exclusion Zone, Quiet Zone), FSS station data, ESC Sensor data, PAL database record.
  - Ability to include CBSDs in the PPA cluster list
  - Ability to trigger SAS UUT specific function such as to reset SAS UUT to Baseline State, to request measurement report, to send SAS-SAS Push messages, to perform CPAS and to confirm its completion by SAS UUT, to generate the Full Activity Dump"

- DP Test Harness
  - Appropriate logging tool to collect SAS-DP messages from the DP Test Harness to the SAS UUT and from the SAS UUT to the DP Test Harness
  - Appropriate configuration tool to send SAS-DP Request Message to the SAS UUT

- ESC Test Harness:
  - Appropriate configuration tool to send messages to the SAS UUT
  - Appropriate logging tool to collect the messages from the SAS UUT; a message log to collect messages sent between the ESC Test Harness and the SAS UUT.
  - At least provide the following parameters to SAS UUT:

- ▪ DPA Index Number (s)
- ▪ DPA Activation/Deactivation flag (s)
- ▪ Channel Number (s) / frequency Range (s)

5.4 Baseline State of the SAS UUT

Unless explicitly stated otherwise as part of the test procedure, the SAS UUT will be reset to the Baseline State at the beginning of every test case. The Reset functionality causes the SAS UUT to delete at least the following data:

- Information about peer SASs (i.e. the number of peer SASs in the Baseline State is zero)
- FCC ID whitelist
- User ID whitelist
- Blacklist data
- CBSD data Record, (including Registration and Grant data)
- Pre-loaded REG-Conditional Registration data
- FSS data
- GWPZ data
- PAL database records
- PPAs
- CPI information
- All data obtained from other SASs (including SAS Test Harnesses)
- Exclusion zones which cannot be monitored by an ESC
- CBSD ID

The following are unloaded by the SAS UUT during Reset:

- DPAs which may be monitored by ESCs

The following are NOT affected by Reset:

- International border data
- Census tract data
- United States Coast-line (Mean low Water line)
- Terrain Data and Land Cover
- Quiet Zones

In addition, the SAS UUT shall be configured in the following ways prior to testing:

- All scheduled behavior (external database synchronization, SAS-SAS exchange) is disabled.
- Grant duration (difference between *grantExpireTime and the current time*) is set to a small value.

6   SAS-CBSD Interface Conformance Test Specifications

This Section includes all test cases required to ensure the SAS-CBSD interface conforms to the specifications defined by WInnForum and as directed by the requirements established by the FCC.

6.1   CBSD Registration Procedure

6.1.1   Definition, Applicability, and Scope of the Test Case

This section provides test steps, conditions, and procedures to test the conformance of SAS implementation of CBSD Registration Procedure.

In this Section "Multi-Step Registration" refers to the Registration procedure in which the "REG-Conditional" parameters are preloaded into the SAS UUT prior to initiating the CBSD Registration Procedure and excluded from the CBSD Registration Request Message. That is, when REG-Conditional data objects including *cpiSignatureData* is blank. Single-Step Registration refers to the Registration procedure where the REG-Conditional parameters are included in the "*RegistrationRequest* Object". That is, when REG-Conditional data objects are all included, regardless of whether a CPI provided the data or not.

The main approach is for each test to create necessary conditions to generate a SAS Registration response to a request with all the *responseCode*s parameters defined in section 10.13 of [n.9], that pertain to the CBSD Registration Procedure in the same reference. This includes successful Registration as well, which is signified by *responseCode* 0 (please see the table below)

Table 6.1-1 Response Codes for CBSD Registration Procedure Test Cases (Informative)

response Code	Name	Condition	Test Scenario	Test ID
0	SUCCESS	The SAS UUT completes the Registration process with no error.	• Array Multi-Step Registration • Array Single-Step Registration • Array re-Registration of the multi-step registered CBSDs • Array re-Registration of the single-step registered CBSDs	WINNF.FT.S.REG.1 WINNF.FT.S.REG.2 WINNF.FT.S.REG.3 WINNF.FT.S.REG.4 WINNF.FT.S.REG.7 WINNF.FT.S.REG.8

100	VERSION	The version number of the SAS-CBSD protocol used by the CBSD Test Harness is not supported by the SAS UUT.	• The CBSD Test Harness sends the request message using the URL of the SAS UUT including the newer protocol version than the most recent SAS-CBSD Protocol version supported by the SAS UUT.	WINNF.FT.S.REG.10 WINNF.FT.S.REG.13
101	BLACKLISTED	The CBSD has been included in a blacklist of CBRS operation (SAS or FCC enforcement action) or the CBSD operating privileges have been revoked.	• Registered CBSD is manually blacklisted before re-Registration.	WINNF.FT.S.REG.9
102	MISSING_PARAM	One or more "Required" parameters are missing.	• Array Multi-Step Registration missing "Required" parameter.	WINNF.FT.S.REG.5
103	INVALID_VALUE	Value of one or more parameters are invalid	• One or more "Required"/ "Optional" parameters with invalid value are provided to the SAS UUT. • One or more "REG-Conditional" parameters with invalid value are provided to the SAS UUT.	WINNF.FT.S.REG.7 WINNF.FT.S.REG.8
200	REG_PENDING	One or more "REG-Conditional" parameters have not yet been supplied to the SAS UUT.	• One or more "REG-Conditional" parameters or CPI-related parameters are missing	WINNF.FT.S.REG.6

6.1.2 Test Characteristics

Table 6.1-2: CBSD Registration Procedure Test Characteristics

1	**Test ID**	WINNF.FT.S.REG
2	**Title**	CBSD Registration Procedure
3	**Working Group / Entity**	WG3
4	**Test Type**	Functional
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification**	[n.9]

6.1.3   Method of test

6.1.3.1   Initial Conditions / Test Pre-conditions

1. All the message exchanges between the SAS UUT and the CBSD/DP Test Harness shall be done by using HTTPS.
2. Unless otherwise specified, CBSDs registered in the course of a test case are assumed to have their FCC IDs and user IDs already whitelisted by the SAS UUT.
3. The SAS UUT must be reset at the beginning of each test case to a baseline state.

6.1.4   Test Procedure

6.1.4.1   [WINNF.FT.S.REG.1] Array Multi-Step Registration for CBSDs (Cat A and B)

Step	Instructions
1	Ensure no *cbsdId* exists in the SAS for the CBSDs being tested. All REG-Conditional parameters for the three CBSDs (a combination of both Cat A and Cat B) shall already be pre-loaded into the SAS.
2	Ensure that the DP Test Harness (containing both Cat A and Cat B CBSDs) sends correct Registration Request in the form of one 3-element Array to the SAS: valid *userId*, *fccId*, and *cbsdSerialNumber*.
CHECK	SAS UUT approves the request by sending a CBSD Registration Response in the form of one 3-element Array to the DP Test Harness as follows: • SAS response includes a valid *cbsdId* for each CBSD. • The *responseCode* parameter contained in the *response* parameter is 0 for each CBSD concluding an approved Registration *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.1.4.2   [WINNF.FT.S.REG.2] Array re-Registration of multiple CBSDs

Step	Instructions
1	Ensure four CBSDs have already registered with the SAS. Make sure that their *cbsdId* parameters exists in the SAS. Record the *cbsdId* parameters (C1, C2, C3, and C4). Make sure no *cbsdId* parameter exists in the SAS for the fifth

	CBSD. All REG-Conditional parameters for these CBSDs shall already be pre-loaded into the SAS.
2	CBSDs C3 and C4 successfully request Grants (G3 and G4), and exchange Heartbeat to enter and stay in the *Authorized* state.
3	DP Test Harness sends a correct Registration Request in the form of one 5-element Array to the SAS with valid *userId*, *fccId*, and *cbsdSerialNumber*. Ensure that *userId*, *fccId*, and *cbsdSerialNumber* of the elements match those in Step 1.
CHECK	SAS UUT approves the request by sending a CBSD Registration Response in the form of one 5-element Array to the DP Test Harness as follows: • SAS UUT response includes a valid *cbsdId* for each CBSD (C1', C2', C3', C4', C5'). • The *responseCode* parameter contained in the *response* parameter is 0 for each CBSD concluding an approved Registration. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
4	DP Test Harness sends a Heartbeat Request Message in an Array form with (C3, G3) and (C4, G4) before the *grantExpireTime* in Step 2.
CHECK	SAS UUT responds with a Heartbeat Response as follows: • The *responseCode* parameter contained in the response parameter set to 103, concluding a failed operation due to invalid parameters. The alternative *responseCode* of 500 is also a SUCCESS criterion. • *transmitExpireTime* shall be no later than the current time. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.1.4.3 [WINNF.FT.S.REG.3] Array Single-Step Registration for CBSDs (Cat A and B)

Step	Instructions
1	Ensure no *cbsdId* exists in the SAS for the CBSDs being tested. Ensure that information about a CPI is loaded into the SAS. Use the same CPI information for Step 2.
2	Ensure the DP Test Harness (containing two Cat A and one Cat B CBSDs) sends correct Registration Request in the form of one 3-element Array to the SAS: valid *userId*, *fccId*, and *cbsdSerialNumber*, plus all REG-Conditional parameters for Cat A CBSDs. Additionally, for Cat B CBSD, ensure that: • All REG-Conditional parameters are included except *installationParam* outside *cpiSignatureData*.
CHECK	SAS UUT approves the request by sending a CBSD Registration Response in the form of one 3-element Array to the DP Test Harness as follows: • SAS response includes a valid *cbsdId* for each CBSD. • The *responseCode* parameter contained in the *response* parameter is 0 for each CBSD concluding an approved Registration

If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.1.4.4 [WINNF.FT.S.REG.4] Array re-Registration of Single-step-registered CBSD (*cbsdId* exists)

Step	Instructions
1	Ensure that two CBSDs have already registered with SAS with correct Registration Requests with valid *userId*, *fccId*, and *cbsdSerialNumber* (one Cat A and one Cat B). Make sure that their *cbsdId* parameters exists in the SAS. Record the two *cbsdId parameter*s (C1 and C2). Make sure no *cbsdId* exists in the SAS for the third CBSD. Ensure that information about a CPI is loaded into the SAS. Use the same CPI information for Step 3.
2	CBSDs C1 and C2 successfully request Grants (G1 and G2), and exchange Heartbeat to enter and stay in the *Authorized* state.
3	Ensure that the DP Test Harness sends correct Registration Request in the form of one 3-element Array without Deregistration to the SAS including valid *userId*, *fccId*, and *cbsdSerialNumber*. All REG-Conditional parameters for the CBSD shall be included regardless of any changes. For the CatB CBSD, ensure that: • *cpiSignatureData* has all the Required parameters, including: • *encodedCpiSignedData*, shall contain all the parameters in the *InstallationParam* object that is being certified by the CPI
CHECK	SAS UUT approves the request by sending a CBSD Registration Response in the form of one 3-element Array to the DP Test Harness as follows: • SAS UUT response includes a valid *cbsdId* for each CBSD (C1', C2', C3'). • The *responseCode* parameter contained in the *response* parameter is 0 for each CBSD concluding an approved Registration *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
4	DP Test Harness sends a Heartbeat Request Message in an Array form with (C1, G1) and (C2, G2) after the *transmitExpireTime* but before the *grantExpireTime* in Step 2.
CHECK	SAS UUT responds with a Heartbeat Response as follows: • The *responseCode* parameter contained in the response parameter set to 103, concluding a failed operation due to invalid parameters. The alternative *responseCode* of 500 is also a SUCCESS criterion. • *transmitExpireTime* shall be no later than the current time. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.1.4.5 [WINNF.FT.S.REG.5] Missing Required parameters in Array Registration Request (*responseCode* 102)

Step	Instructions
1	Ensure no *cbsdId* exists in the SAS for the CBSDs being tested. All REG-Conditional parameters for six CBSDs shall already be pre-loaded into the SAS.
2	Ensure that the DP Test Harness sends a Multi-Step Registration Request in the form of one 6-element Array to the SAS with the following conditions: • valid *userId*, *fccId*, and *cbsdSerialNumber* for the first CBSD • valid *userId*, *fccId*, and missing *cbsdSerialNumber* for the second CBSD • valid *userId*, *cbsdSerialNumber*, and missing *fccId* for the third CBSD • valid *fccId*, *cbsdSerialNumber*, and missing *userId* for the fourth CBSD • valid *userId*, *fccId*, and *cbsdSerialNumber* plus all REG-Conditional parameters for Cat B CBSD shall be included for the fifth CBSD (Cat B). *cpiSignatureData* has all the Required parameters except *digitalSignature*. *cpiSignatureData* has all the Required parameters, including *encodedCpiSignedData*, shall contain all the parameters in the *InstallationParam* object that is being certified by the CPI. • valid *userId*, *fccId*, and *cbsdSerialNumber* plus all REG-Conditional parameters for Cat B CBSD shall be included for the sixth CBSD (Cat B). The *cpiId* in the *professionalInstallerData* object shall not exist. Otherwise, *cpiSignatureData* shall contain all the required parameters. *cpiSignatureData* has all the Required parameters, including *encodedCpiSignedData*, shall contain all the parameters in the *InstallationParam* object that is being certified by the CPI.
CHECK	SAS UUT sends a CBSD Registration Response in the form of one 6-element Array to the DP Test Harness as follows: • SAS response includes a valid *cbsdId* for the first CBSD. • The *responseCode* parameter contained in the *response* parameter is 0 for the first CBSD concluding an approved Registration • The *responseCode* parameter contained in the *response* parameter is 102 for the second, third, fourth, fifth, and sixth CBSDs, concluding failed Registrations. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.1.4.6 [WINNF.FT.S.REG.6] Pending Registration in Array Registration Request (*responseCode* 200)

Step	Instructions
1	Ensure no *cbsdId* exists in the SAS for three CBSDs being tested. Also make sure no REG-Conditional parameters for the CBSDs are pre-loaded into SAS except for the third CBSD, which shall have all REG-Conditional parameters pre-loaded into the SAS except for one missing REG-Conditional parameter for

	Cat B CBSD. Ensure that information about a CPI is loaded into the SAS. Use the same CPI information for Step 2.
2	Ensure that the DP Test Harness sends a Registration Request in the form of one 3-element Array to the SAS as follows: • valid *userId*, *fccId*, and *cbsdSerialNumber* plus all REG-Conditional parameters for Cat A CBSD shall be included for the first and second CBSDs (Cat A), except that for the second CBSD at least one REG-Conditional parameter for a Cat A CBSD missing. • valid *userId*, *fccId*, and *cbsdSerialNumber* shall be included for the third CBSD (Cat B). The *encodedCpiSignedData* parameter in the *cpiSignatureData* parameter shall be set to the value generated by using the *CpiSignedData* object that contains *installationParam* parameter with all the required parameters being certified by the CPI, except for one REG-Conditional parameter.
CHECK	SAS UUT sends a CBSD Registration Response in the form of one 3-element Array to the DP test Harness as follows: • SAS response includes a valid *cbsdId* for the first CBSD. • The *responseCode* parameter contained in the *response* parameter is 0 for the first CBSD concluding an approved Registration • The *responseCode* parameter contained in the *response* parameter is 200 for the second, and third CBSDs, concluding a failed Registration. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.1.4.7 [WINNF.FT.S.REG.7] Invalid parameters in Array Registration Request (*responseCode* 103)[1]

Step	Instructions

1	Ensure no *cbsdId* exists in the SAS for sixteen CBSDs being tested.
	• For CBSDs 1 through 11 and 15 through 16, no REG-Conditional parameters are pre-loaded.
	• For CBSDs 12 through 14, the following REG-Conditional parameters are pre-loaded:
	  • For CBSD 12:
	    ▪ *installationParam* shall be 100% correct and complete
	  • For CBSD 13:
	    ▪ *installationParam* shall be 100% correct and complete
	  • For CBSD 14:
	    ▪ *installationParam* shall be 100% correct and complete
	• Ensure that information about a CPI is loaded into the SAS. Use the same CPI information for Step 2.

2	Ensure that the DP Test Harness sends a Registration Request in the form of one 16-element Array to the SAS with the following conditions:

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[1] An FCC-certified SAS is expected to conform to the behavior described for CBSDs #15 and #16, utilizing a fully-automated mechanism for SASs to retrieve and ingest the relevant FCC-owned information.

- valid *userId*, *fccId*, and *cbsdSerialNumber* plus all REG-Conditional parameters for Cat A CBSD for the first CBSD
- valid *userId* and *fccId*, invalid *cbsdSerialNumber*, plus all REG-Conditional parameters for Cat A CBSD for the second CBSD
- valid *userId*, and *cbsdSerialNumber* invalid *fccId*, plus all REG-Conditional parameters for Cat A CBSD for the third CBSD
- valid *fccId*, and *cbsdSerialNumber*, invalid *userId*, plus all REG-Conditional parameters for Cat A CBSD for the fourth CBSD
- valid *userId*, *fccId*, and *cbsdSerialNumber* plus all REG-Conditional parameters for Cat A CBSD for the fifth CBSD, except an out-of-range value for latitude.
- valid *userId*, *fccId*, and *cbsdSerialNumber* plus all REG-Conditional parameters for Cat A CBSD for the sixth CBSD, except an invalid value for *measCapability*.
- For the seventh CBSD ensure:
  - *cbsdCategory* = "B"
  - *installationParam* parameter inside of *cpiSignatureData*: *eirpCapability* > 47 dBm/10MHz with valid CPI certification
- For the eighth CBSD ensure:
  - *cbsdCategory* = "A"
  - No *cpiSignatureData* is included.
  - Contents of the *installationParam* parameter:
    - *latitude* equals to 38° 52' 55.783" N
    - *longitude* equals to 77° 6' 49.518" W
    - *height* =4m
    - *heightType* = AGL
    - *indoorDeployment* = FALSE
  - All other REG-Conditional parameters valid and included
    (Note: *FCC web page-https://www.fcc.gov/media/radio/haat-calculator-calculates HAAT at the street level to be 20m for this location. Installed on a 2nd floor of a building at an AGL of ~4m, HAAT for this CBSD will be 24 meters*.)
- For the ninth CBSD ensure:
  - *cbsdCategory* = "A"
  - No *cpiSignatureData* is included.
  - Contents of the *installationParam* parameter:
    - *eirpCapability* > 30 dBm/10MHz
  - All other REG-Conditional parameters valid and included
- For the tenth CBSD ensure:
  - *cbsdCategory* = "B"
  - Contents of the *installationParam* parameter inside of *cpiSignatureData*:
    - *indoorDeployment* = TRUE
    - *eirpCapability* > 30 dBm/10MHz
  - All other REG-Conditional parameters valid and included by a CPI (pre-loaded into SAS)

- o No *installationParam* outside of *cpiSignatureData* is included.
- For the eleventh CBSD ensure:
  - o *cbsdCategory* = "B"
  - o Contains
    - *installationParam* parameter outside *encodedCpiSignedData*
  - o All other REG-Conditional parameters valid and included
- For the twelfth CBSD ensure:
  - o *cbsdCategory* = "B"
  - o *cpiSignatureData* object contains at least one invalid identification-related parameter for the CPI
  - o No *installationParam* outside of *cpiSignatureData* is included.
- For the thirteenth CBSD ensure:
  - o *cbsdCategory* = "B"
  - o *cpiSignatureData* has all the required parameters but has a mismatch on at least one parameter under *encodedCpiSignedData* compared to the preloaded REG-Conditional parameters
  - o The *installationParam* parameter used for *encodedCpiSignedData* parameter shall contain all the required parameters being certified by the CPI.
  - o No *installationParam* outside of *cpiSignatureData* is included.
- For the fourteenth CBSD ensure:
  - o *cbsdCategory* = "B"
  - o all REG-Conditional parameters are included outside *cpiSignedData*.
  - o No *cpiSignatureData* is included.
- For the fifteenth CBSD ensure:
  - o *cbsdCategory* = "A"
  - o *eirpCapability* set to a value greater than the FCC-approved EIRP
  - o No *cpiSignatureData* is included.
- For the sixteenth CBSD ensure:
  - o *cbsdCategory* = "B"
  - o Contents of the *installationParam* parameter inside of *cpiSignatureData*:
    - *eirpCapability* set to a value greater than the FCC-approved EIRP
  - o No *installationParam* outside of *cpiSignatureData* is included.

CHECK	SAS UUT sends a CBSD Registration Response in the form of one 16-element Array to the DP Test Harness as follows: • SAS response includes a valid *cbsdId* for the first CBSD. • The *responseCode* in the *RegistrationResponse* Object is 0 for the first and the thirteenth CBSD concluding an approved Registration • The *responseCode* parameter contained in the *response* parameter is 103 for the rest of the CBSDs, concluding a failed Registration. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.1.4.8 [WINNF.FT.S.REG.8] Invalid REG-Conditional parameters in Array Registration Request (*responseCode* 103)

Step	Instructions
1	Ensure no *cbsdId* exists in the SAS for the CBSDs being tested. No REG-Conditional parameters for CBSDs are pre-loaded into the SAS. Ensure that information about a CPI is loaded into the SAS. Use the same CPI information for Step 2.
2	Ensure that the DP Test Harness sends a Single-Step Registration Request for 3 CBSDs in the form of one 3-element Array to the SAS including valid *userId*, *fccId*, and *cbsdSerialNumber*, as well as REG-Conditional parameters with the following conditions: • All valid REG-Conditional parameters for Cat A CBSD for the first CBSD • All valid REG-Conditional parameters for Cat A CBSD for the second CBSD except an out-of-range for azimuth. • All valid REG-Conditional parameters for Cat A CBSD for the third CBSD except an out-of-range for latitude.
CHECK	SAS sends a CBSD Registration Response in the form of one 3-element Array to the DP Test Harness as follows: • SAS response includes a valid *cbsdId* for the first CBSD. • The *responseCode* parameter contained in the *response* parameter is 0 for the first CBSD concluding an approved Registration • The *responseCode* parameter contained in the *response* parameter is 103 for the second, and third CBSDs, concluding a failed Registration. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.1.4.9 [WINNF.FT.S.REG.9] Blacklisted CBSD in Array Registration Request (*responseCode* 101)

Step	Instructions
1	Ensure no *cbsdId* exists in the SAS for three CBSDs being tested.
2	Manually Blacklist the third CBSD.
3	Ensure that the DP Test Harness containing the three CBSDs in Step 1 sends correct Single-step Registration Requests in the form of one 3-element Array to the SAS including valid *userId*, *fccId*, and *cbsdSerialNumber*. All REG-Conditional parameters for the CBSD shall be included.
CHECK	SAS sends a CBSD Registration Response in the form of one 3-element Array to the DP Test Harness as follows: • SAS response includes a valid *cbsdId* for the first two CBSDs. • The *responseCode* parameter contained in the *response* parameter is 0 for the first two CBSDs concluding an approved Registration

	• The *responseCode* parameter contained in the *response* parameter is 101 for the third CBSD, concluding a failed Registration. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.1.4.10 [WINNF.FT.S.REG.10] Unsupported SAS protocol version in Array Registration Request (*responseCode* 100)

Step	Instructions
1	Ensure no *cbsdId* exists in the SAS for the CBSDs being tested. Also make sure no REG-Conditional parameters for three CBSDs are pre-loaded into the SAS.
2	Ensure that the DP Test Harness sends a Single-Step Registration Request Message in the form of one 3-element Array to the SAS including valid *userId*, *fccId*, and *cbsdSerialNumber* plus all REG-Conditional parameters for Cat A CBSDs. However, make sure the request uses a protocol version newer than the most recent SAS-CBSD protocol version supported by SAS.
CHECK	SAS sends a CBSD Registration Response Message in the form of one 3-element Array to the DP Test Harness as follows: • SAS response does not include *cbsdId parameters* • The *responseCode* parameter contained in the *response* parameter is 100 for all three CBSDs concluding a failed Registration. Alternatively, the SAS can return HTTP status code 404 as a success criterion. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.1.4.11 [WINNF.FT.S.REG.11] [Configurable] One-time Registration

This configurable test covers tests for both single-step and multi-step Registration
(and pending Registrations) for CBSDs (Cat A and/or Cat B) with no existing *cbsdId*,
and with varying combinations of valid, missing, and invalid required parameters,
and Reg Conditional parameters, as specified in input configuration files. The test will check the
number of and value of the SAS UUT *responseCode*(s) to verify if they match the expected
respondCode(s) as specified in the respective input configuration file.

Step	Instructions
1	Configure the SAS UUT to whitelist N1 >= 0 FCC IDs and N2 >= 0 user IDs.
2	Pre-load the SAS UUT with conditional Registration data for N3 >= 0 CBSDs.
3	Using a DP Test Harness, send a Registration Request Message for N4 > 0 CBSDs to the SAS UUT. The Registration Request Message shall be syntactically correct according to the SAS-CBSD specification but need not meet all application-level requirements (e.g. required fields may be missing).
CHECK	The SAS response to the Registration Request Message must satisfy all of the following conditions:

	• The response shall contain N4 *RegistrationResponse* objects.
	• For each *RegistrationResponse* object:
	    o The *responseCode* parameter contained in the *response* parameter shall match the corresponding expected response code listed in the configuration file.
	    o If *responseCode* == SUCCESS, verify that the response contains a valid *cbsdId*.
	        ▪ Otherwise, verify that the response does *not* contain a *cbsdId*.
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.1.4.12 [WINNF.FT.S.REG.12] [Configurable] re-Registration (including intervening blacklist)

This configurable test covers single-step and multi-step re-Registration of CBSDs (Cat A and/or Cat B). The test may blacklist selected CBSDs during re-Registration. The test can use different sets of CBSDs for Registration, blacklisting, and re-Registration. The test will check the number of and value of the SAS UUT *responseCode*(s) to see if they match the expected *responseCode*(s) as specified in the respective input configuration file. This includes *responseCode* 101 (Blacklisted) where appropriate.

Step	Instructions
1	Configure the SAS UUT to whitelist N1 >= 0 FCC IDs and N2 >= 0 user IDs.
2	Admin Test Harness pre-loads the SAS UUT with conditional Registration data for N3 >= 0 CBSDs.
3	Using a DP Test Harness, send a valid Registration Request Message for N4 > 0 CBSDs to the SAS UUT. Ensure that the Registration Request messages are configured in such a way that the *responseCode* for all N4 CBSDs is SUCCESS.
4	Configure the SAS UUT to blacklist N5 >= 0 CBSDs.
5	Using a DP Test Harness, send a Registration Request for N6 >= 0 CBSDs to the SAS UUT.

CHECK	The SAS response to the Registration Request Message must satisfy all of the following conditions:
	• The response shall contain N6 *RegistrationResponse* objects.
	• For each *RegistrationResponse* object:
	    o The *responseCode* shall match the corresponding expected response code listed in the configuration file.
	    o If *responseCode* == SUCCESS, verify that the response contains a valid *cbsdId*.
	        ▪ Otherwise, verify that the response does *not* contain a *cbsdId*.
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.1.4.13 [WINNF.FT.S.REG.13] [Configurable] Unsupported SAS protocol version

This configurable test covers single-step Registration of CBSD(s) (Cat A and/or Cat B) where the CBSD Registration Request includes a SAS protocol version higher than the highest SAS-CBSD protocol version supported by the SAS UUT. The test will check the number of and value of the SAS UUT *responseCode*(s) to see if they match the expected *responseCode*(s) as specified in the respective input configuration file.

Step	Instructions
1	Configure the SAS UUT to whitelist N1 > 0 FCC IDs and N1 *userIds*.
2	Using a DP Test Harness, send a valid Registration Request Message for N1 CBSDs to the SAS UUT. This request shall use the URL specified in the test's configuration file
CHECK	The SAS response to the Registration Request Message must satisfy all of the following conditions: • EITHER the SAS shall respond with HTTP 404 o OR the response shall contain N1 *RegistrationResponse* objects, each with *responseCode* == 100 (VERSION). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.2 CBSD Spectrum Inquiry Procedure

6.2.1 *Definition, Applicability, and Scope of the Test Case*

This section explains test steps, conditions, and procedures for SAS Spectrum Inquiry Response to a CBSD Spectrum Inquiry Request. It assumes as a precondition that CBSD has successfully registered with the SAS and has obtained a *cbsdId*.

The test cases specified in this section attempt to cover the response codes as described in Table 6.2-1.

Table 6.2-1 Response Codes for CBSD Spectrum Inquiry Procedure Test Cases (Informative)

response Code	Name	Condition	Test Scenario	Test ID
0	SUCCESS	The SAS UUT completes the channel availability assessment with no error.	• Response with a mix of PAL and GAA channels • Response with no available channel • CBSD inside DPA Neighborhood Area	WINNF.FT.S.SIQ.1 WINNF.FT.S.SIQ.2 WINNF.FT.S.SIQ.3 WINNF.FT.S.SIQ.4 WINNF.FT.S.SIQ.5 WINNF.FT.S.SIQ.9 WINNF.FT.S.SIQ.10

101	BLACKLISTED	The CBSD has been included in a blacklist of CBRS operation (SAS or FCC enforcement action) or the CBSD operating privileges have been revoked.	• Registered CBSD is manually blacklisted before re-Registration.	WINNF.FT.S.SIQ.13
102	MISSING_PARAM	One or more "Required" parameters are missing.	• One of the frequency parameters is missing.	WINNF.FT.S.SIQ.10 WINNF.FT.S.SIQ.11
103	INVALID_VALUE	One or more parameters with invalid value are provided to the SAS UUT.	• The *cbsdId* is different from assigned *cbsdId*. • Parameters in the *inquiredSpectrum* parameter are mutually invalid.	WINNF.FT.S.SIQ.6 WINNF.FT.S.SIQ.7 WINNF.FT.S.SIQ.8 WINNF.FT.S.SIQ.10
300	UNSUPPORTED_SPECTRUM	The frequency range in the request is set to a value partially overlapping or completely outside the frequency range of the CBRS Band (3550-3700 MHz)	• The frequency range in the *inquiredSpectrum* parameter is partially overlapping with the CBRS Band. • The frequency range in the *inquiredSpectrum* parameter is completely outside the CBRS Band.	WINNF.FT.S.SIQ.1 WINNF.FT.S.SIQ.11

6.2.2   Test Characteristics

Table 6.2-2: CBSD Spectrum Inquiry Procedure Test Characteristics

1	**Test ID**	WINNF.FT.S.SIQ
2	**Title**	CBSD Spectrum Inquiry Procedure
3	**Working Group / Entity**	WG3
4	**Test Type**	Functional
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.9]

6.2.3   Method of test

6.2.3.1   Initial Conditions / Test Pre-conditions

1. No Channel is declared unavailable due to Federal Incumbent Protection purposes (DPA active or inactive) for OPSEC reasons, for any DPA monitored by the SAS's associated ESC (s).
2. If CBSD is within 150 km of FSS station and a GWBL station is also within 150 km of FSS using any portion of the channel, SAS shall declare the FSS associated channel as unavailable
3. If CBSD is inside a PPA (CBSD is not part of PPA cluster list) or GWBL zone, the associated channel is declared unavailable.
4. For the purpose of this document, the Spectrum Inquiry response for other reasons (such as IAP) is per SAS discretion.
5. The SAS UUT must be reset at the beginning of each test case to a baseline state

6.2.4   Test Procedure

6.2.4.1   [WINNF.FT.S.SIQ.1] Deprecated; the Test ID is Reserved

6.2.4.2   [WINNF.FT.S.SIQ.2] Response has no available channel.

Step	Instructions
1	• Ensure that DP Test Harness has registered with the SAS and has obtained a *cbsdId* = C which is located inside GWPZ. • Configure the SAS UUT such that there is no available channel in the frequency range (FR) sent in the *inquiredSpectrum* parameter. ○ Inject a Grandfathered Wireless Protection Zone (GWPZ) to simulate database synchronization of GWPZ • Trigger CPAS to simulate coordination and synchronization tasks. (this will make the GWPZ active and protected.)

2	• DP Test Harness sends a spectrumInquiryRequest message to SAS UU with
	    ○ Frequency range in the *inquiredSpectrum* parameter is set to FR.
	    ○ *cbsdId* parameter set to C.

CHECK	SAS UUT approves the request by sending a Spectrum Inquiry Response as follows: • SAS response includes *cbsdId* = C. • *availableChannel* has zero elements. • *responseCode* = 0, indicating a successful inquiry of the spectrum *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.2.4.3   [WINNF.FT.S.SIQ.3] Multiple CBSDs inside and outside the Exclusion Zone

Step	Instructions
1	Admin Test Harness injects an FSS station into SAS UUT such that FSS operating channel starts from 3670MHz. The end frequency for the FSS station is 4200MHz.

2	Admin Test Harness injects an GWBL station within 150 km of the FSS station, with an operating frequency range of 3650-3700MHz. Also, Admin Test Harness injects the associated GWPZ in the SAS UUT.
3	DP Test Harness registers five CBSDs with SAS UUT with the following characteristics: • CBSD with *cbsdId* C1 is outside 150 km range of the FSS station, and it is part of the PPA cluster list • CBSD with *cbsdId* C2 is outside 150 km range of the FSS station, is not part of the PPA cluster list, and is outside PPA boundary • CBSD with *cbsdId* C3 is within 150 km of the FSS station, and is part of the PPA cluster list • CBSD with *cbsdId* C4 is within 150 km of the FSS station, is not part of the PPA cluster list, and is outside PPA boundary • CBSD with *cbsdId* C5 is within 150 km of the FSS station, is not part of the PPA cluster list, and is outside PPA boundary. All CBSDs are outside GWPZ.
4	Admin Test Harness injects PPA Information into SAS UUT with an operating channel F within 3600-3650MHz frequency range.
5	Admin Test Harness triggers CPAS in the SAS UUT, and waits until completion of CPAS.
6	DP Test Harness sends an *spectrumInquiryRequest* in the form of a 5-element array for C1, C2, C3, C4, and C5, • The requested frequency range for the CBSDs C1, C2, C3, and C4 is 3550-3700MHz • The requested frequency range for the CBSD C5 is 3670-3700MHz

CHECK	SAS UUT sends correct *spectrumInquiryResponse* in the form of a 5-element array as follows:
	
	For C1:
	• *responseCode*=0
	• the *availableChannel* includes <u>at least</u> the following frequency ranges with *channelType* set as GAA and *ruleApplied* as "FCC_PART_96"
	    o 3550 MHz to the lower edge of F
	    o upper edge of F to 3700 MHz,
	• *availableChannel* includes F, with *channelType* set as PAL and *ruleApplied* as ""FCC_PART_96"
	For C2:
	• *responseCode*=0
	• the *availableChannel* includes <u>at least</u> the following frequency ranges with *channelType* set as GAA and *ruleApplied* as "FCC_PART_96"
	    o 3550 MHz to the lower edge of F
	    o upper edge of F to 3650 MHz,
	• *availableChannel* <u>does not</u> include any channel with *channelType* set as PAL
	For C3:

- *responseCode*=0
- the *availableChannel* includes <u>at least</u> the following frequency ranges with *channelType* set as GAA and *ruleApplied* as "FCC_PART_96"
  - 3550 MHz to the lower edge of F
  - upper edge of F to 3650 MHz,
- *availableChannel* includes F, with *channelType* set as PAL and *ruleApplied* as "FCC_PART_96"
- *availableChannel* **does not** include any frequency range from 3650-3700 MHz.

For C4:
- *responseCode*=0
- the *availableChannel* includes **at least** the following frequency ranges with *channelType* set as GAA and *ruleApplied* as "FCC_PART_96"
  - 3550 MHz to the lower edge of F
  - upper edge of F to 3650 MHz,
- *availableChannel* <u>does not</u> include any channel with *channelType* set as PAL
- *availableChannel* <u>does not</u> include any frequency range from 3650-3700 MHz.

For C5:
- *responseCode* = 0
- *availableChannel* is NULL

If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.2.4.4 [WINNF.FT.S.SIQ.4] DPA activated for some channels, CBSD inside DPA Neighborhood

Step	Instructions
1	• ESC Test Harness communicates with the SAS UUT that all its fully monitored DPAs are inactive.
2	• ESC Test Harness communicates with the SAS UUT that DPA/Channel pair (D_i, C_k) is active.
3	Pause 300 seconds
4	• Ensure that CBSD is located inside the DPA Neighborhood. • The location of the CBSD shall be away from the Neighborhood of the ESC sensor. • No other incumbent is present (FSS, PAL, GWBL…) • Ensure that CBSD Test Harness has registered with the SAS and has obtained a *cbsdId* = C
5	The CBSD Test Harness sends Spectrum Inquiry Request in which the frequency range is specified as FR. *cbsdId* parameter shall be set to C.
CHECK	SAS UUT approves the request by sending a Spectrum Inquiry Response as follows: • SAS response includes *cbsdId* = C. • *availableChannel* parameter includes all channels within frequency range FR.

> - *responseCode* = 0, indicating a successful inquiry of the spectrum.
>
> *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.2.4.5 [WINNF.FT.S.SIQ.5] Tests related to PAL Protection Area (PPA)

Step	Instructions
1	- Inject PPA Information with frequency range FR1 - Trigger CPAS - Ensure that DP Test Harness successfully registers a CBSD with *cbsdId* (C) that is located inside the PPA, but it is not part of the PPA's cluster list. - Select a frequency range (FR) such that it partially or fully overlaps with frequency range FR1. - A DP Test Harness sends Spectrum Inquiry Request in which the frequency range is specified as FR. *cbsdId* parameter shall be set to C.
CHECK	SAS UUT approves the request by sending a Spectrum Inquiry Response as follows: - SAS response includes *cbsdId* = C. - *availableChannel* parameter does not include the frequency range FR1. - *responseCode* = 0, indicating a successful inquiry of the spectrum. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.2.4.6 [WINNF.FT.S.SIQ.6] *cbsdId* sent in the Spectrum Inquiry Response is different from its assigned *cbsdId*, but the *cbsdId* does not exist in the SAS

Step	Instructions
1	- DP Test Harness registers a CBSD with the SAS UUT, obtaining a *cbsdId* = C1. - *cbsdId* (C) does not exist in the SAS.
2	A DP Test Harness sends a Spectrum Inquiry Request with *cbsdId* = C. frequencyRange shall be a valid value.
CHECK	SAS UUT rejects the request by sending a Spectrum Inquiry Response as follows: - SAS response does not include *cbsdId*. - *responseCode* =103, indicating invalid parameter (*cbsdId*, in this case) *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.2.4.7 [WINNF.FT.S.SIQ.7] *cbsdId* different from its assigned *cbsdId* and the *cbsdId* exists in the SAS.

Informative note: One recommended approach to detect the wrong *cbsdId* is to use the association between the *cbsdId* and CBSD certificate

Step	Instructions

1	Register two CBSDs with SAS UUT (*cbsdId* C1 and C2).
2	Ensure the CBSD Test Harness 1 (*cbsdId* =C1) sends a Spectrum Inquiry Request Message with *cbsdId* = C2. *frequencyRange* shall be a valid value.
CHECK	SAS UUT rejects the request by sending a Spectrum Inquiry Response as follows: • SAS response does not include *cbsdId*. • *responseCode* =103, indicating invalid parameter (*cbsdId*, in this case) *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.2.4.8 [WINNF.FT.S.SIQ.8] Parameters in *inquiredSpectrum* mutually invalid

Step	Instructions
1	Register a CBSD with SAS UUT.
2	Send a Spectrum Inquiry Request with its correct *cbsdId*, but the *lowFrequency* of *inquiredSpectrum* parameter is set to a value higher than the *highFrequency*. Make sure that both the *lowfrequency* and the *highFrequency* are within 3550 MHz to 3700 MHz.
CHECK	SAS UUT rejects the request by sending a Spectrum Inquiry Response as follows: • SAS response includes its correct *cbsdId*. • *responseCode* = 103, indicating invalid parameter. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.2.4.9 [WINNF.FT.S.SIQ.9] Multiple Requests as claimed PPAs or as GAAs

Step	Instructions
1	• DP Test Harness registers four CBSDs with the SAS UUT and obtains *cbsdId* parameters C1 with userId U1, C2 with userId U2, C3, and C4. • Admin Test Harness injects two PPA Information into SAS UUT, where for the first one userId is U1 and primaryAssignment parameter is set to the frequency range (FR1) within 3550 – 3650 MHz. For the second one, userId is U2 and primaryAssignment parameter is set to the frequency range (FR2) within 3550 – 3650 MHz. 　　o *cbsdId* = C1 is part of PPA1 over *frequencyRange* FR1 within 3550 – 3650 MHz 　　o *cbsdId* = C2 is part of PPA2 over *frequencyRange* FR2 within 3600 – 3650 MHz 　　o *cbsdId* = C3 and C4 are not part of any claimed PPA. • No other protected entities is present
2	DP Test Harness sends Spectrum Inquiry Request in which there are four *SpectrumInquiryRequest* objects each corresponding to *cbsdId* parameters C1, C2, C3, and C4 respectively. In addition: • *frequencyRange*=3550 – 3700 MHz for C1, C3, and C4

	• *frequencyRange*=3600 – 3700 MHz for C2

CHECK	SAS UUT approves the request by sending a Spectrum Inquiry Response as follows:
	• The *spectrumInquiryResponse* has four objects
	• For the first object
	    ○ *cbsdId* = C1.
	    ○ The *availableChannel* parameter contains at least one element with *frequencyRange* (FR1) and *channelType* 'PAL', and the rest may be *channelType* GAA but *frequencyRange* shall be out of FR1
	    ○ The *ruleApplied* shall be "FCC_PART_96"
	    ○ The *responseCode* shall be 0, indicating a successful inquiry of the spectrum
	• For the second object
	    ○ *cbsdId* = C2.
	    ○ The *availableChannel* parameter contains at least one element with *frequencyRange* (FR2) and *channelType* 'PAL', and the rest may be *channelType* GAA but *frequencyRange* shall be out of FR2
	    ○ The *ruleApplied* shall be "FCC_PART_96"
	    ○ The *responseCode* shall be 0, indicating a successful inquiry of the spectrum
	• For the third object
	    ○ *cbsdId* = C3.
	    ○ If *availableChannel* parameter has any element, then *channelType* of all the available channels shall be "GAA"
	    ○ The *ruleApplied* shall be "FCC_PART_96"
	    ○ The *responseCode* shall be 0, indicating a successful inquiry of the spectrum
	• For the fourth object
	    ○ *cbsdId* = C4.
	    ○ If *availableChannel* parameter has any element, then *channelType* of all the available channels shall be "GAA"
	    ○ The *ruleApplied* shall be "FCC_PART_96"
	    ○ The *responseCode* shall be 0, indicating a successful inquiry of the spectrum
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.2.4.10 [WINNF.FT.S.SIQ.10] Array request with successful and unsuccessful responses

Step	Instructions
1	Ensure that the DP Test Harness have registered six CBSDs with the SAS UUT and their *cbsdId*s are C1, C2, C3, C4, C5 and C6.
2	Using a DP Test Harness, send a Spectrum Inquiry Request with six request objects: • The first one has *cbsdId* = C1 and has all other parameters valid.

	• The second object has *cbsdId* = C2 and one parameter invalid (pick one case from the single request case), but all other parameters are valid. • The third object has *cbsdId* = C3. The *FrequencyRange* object representing the *inquiredSpectrum* parameter is present, but the *highFrequency* parameter is missing from this object. • The fourth object has *cbsdId* = C4. The *FrequencyRange* object representing the *inquiredSpectrum* parameter is present, but the *lowFrequency* parameter is missing from this object. • The fifth object has *cbsdId* = C5, but the *FrequencyRange* object representing the *inquiredSpectrum* parameter is completely missing. • The sixth object has *cbsdId* missing.

CHECK	SAS UUT sends a Spectrum Inquiry Response as follows:
	The *spectrumInquiryResponse* has six objects
	• For the first object
	    ○ *cbsdId* = C1.
	    ○ An array of *availableChannel* parameters (this may have zero element)
	    ○ The *ruleApplied* shall be "FCC_PART_96"
	    ○ The *responseCode* shall be 0, indicating a successful inquiry of the spectrum
	• For the second object
	    ○ *cbsdId* = C2.
	    ○ no *availableChannel* parameter
	    ○ The *responseCode* shall be 103, indicating an invalid parameter
	• For the third object
	    ○ *cbsdId* = C3.
	    ○ no *availableChannel* parameter
	    ○ The *responseCode* shall be 102, indicating a missing parameter
	• For the fourth object
	    ○ *cbsdId* = C4.
	    ○ no *availableChannel* parameter
	    ○ The *responseCode* shall be 102, indicating a missing parameter
	• For the fifth object
	    ○ *cbsdId* = C5.
	    ○ no *availableChannel* parameter
	    ○ The *responseCode* shall be 102, indicating a missing parameter
	• For the sixth object
	    ○ *No cbsdId*
	    ○ no *availableChannel* parameter
	    ○ The *responseCode* shall be 102, indicating a missing parameter
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.2.4.11 [WINNF.FT.S.SIQ.11] Unsupported Spectrum (*responseCode* 300)

Step	Instructions
1	Ensure that the DP Test Harness registers 3 CBSDs have registered with the SAS UUT, *cbsdId*s (C1, C2, and C3).
2	DP Test Harness, sends a Spectrum Inquiry Request with three request objects. • The first one has *cbsdId* = C1 and has all other parameters valid. • The second one has *cbsdId* = C2, but both the *lowFrequency* and the *highFrequency* are set so that the *inquiredSpectrum* falls fully outside the range of 3550 MHz to 3700 MHz. • The second object has *cbsdId*=C3, but both the *lowFrequency* and the *highFrequency* are set so that the *inquiredSpectrum* falls partially outside the range of 3550 MHz to 3700 MHz (e.g. 3600-3800 MHz)

CHECK	SAS UUT sends a Spectrum Inquiry Response as follows:
	• The *spectrumInquiryResponse* has three objects
	• For the first object
	    ○ *cbsdId* = C1.
	    ○ An array of *availableChannel* parameters (this may have zero element)
	    ○ If *availableChannel* parameter is not NULL, the *ruleApplied* shall be "FCC_PART_96"
	    ○ The *responseCode* shall be 0, indicating a successful inquiry of the spectrum
	• For the second and third objects:
	    ○ *cbsdId* = C2, and C3 respectively
	    ○ no *availableChannel* parameter
	    ○ The *responseCode* shall be 300, indicating unsupported spectrum.
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.2.4.12 [WINNF.FT.S.SIQ.12] [Configurable] Spectrum inquiry in the presence of protected entities

This configurable array test covers spectrum inquiry request(s), optionally in the presence of protected entities. The first step is to inject Grandfathered Wireless Broadband Licensee Protected Zones into the SAS. The next step is to successfully register CBSD(s). The next step is to inject PPAs into the SAS, and to run CPAS to start protection of protected entities. Then, submit a spectrum inquiry request from previously registered CBSD(s) with varying combinations of valid, missing, and invalid required parameters. The test will check the number of and value of the spectrum inquiry SAS UUT *responseCode*(s) to see if they match the expected *responseCode*(s) as specified in the respective input configuration file. The SAS UUT response shall also include a list of available channels.

Step	Instructions

1	Load information about N1 >= 0 Grandfathered Wireless Broadband Licensee Protected Zones (GWPZs) into the SAS UUT.
2	Configure the SAS UUT to whitelist the FCC IDs and user IDs corresponding to the *RegistrationRequest* which will be sent in Step 3.
3	Using a DP Test Harness, send a valid Registration Request Message with the *registrationRequest* parameter containing N2 > 0 CBSDs. Verify that the *responseCode* for each is SUCCESS.
4	Load N3 >= 0 PPA Information into the SAS UUT, each with a cluster list as defined in the configuration file. The cluster list may be empty for any or all of PPAs.
5	If N1>0 or N3>0, instruct the SAS UUT to execute its CPAS and wait until completion.
6	Send a spectrum inquiry request with N2 elements (one per registered CBSD).

CHECK	The SAS UUT response to the spectrum inquiry request must satisfy all of the following conditions:
	• The response shall contain N2 *SpectrumInquiryResponse* objects.
	• For each *SpectrumInquiryResponse* object:
	    o If the corresponding request contained a valid *cbsdId*, the response shall contain the same *cbsdId*.
	    o The *responseCode* shall match the corresponding expected response code listed in the configuration file.
	    o If the *responseCode* is SUCCESS, the *availableChannel* parameter shall be included in the object, otherwise, the *availableChannel* parameter shall not exist.
	    o For each element of the *availableChannel* parameter, the *ruleApplied* shall be "FCC_PART_96".
	    o None of the *frequencyRange* parameters in the *availableChannel* parameters marked as available for GAA use overlap with the frequency range(s) specified in $FR1_{cbsd,n2}$, where $FR1_{cbsd,n2}$ is a list of the frequency ranges specified in the configuration file for n_2-th CBSD ($1 \le n_2 \le N_2$), and is consistent with the information of protected entities.
	    o The *frequencyRange* parameters in the *availableChannel* parameters marked as available for PAL use is included in the frequency range(s) specified in $FR2_{cbsd,n2}$, where $FR2_{cbsd,n2}$ is a list of the frequency ranges specifed in the configuration file for each n_2-th CBSD ($1 \le n_2 \le N_2$), and is consistent with the information of protected entities, consistent with R2-SPU-01. The *availableChannel* parameters marked as available for PAL use does not include any frequency range from *3650-3700MHz*.
	    o All of the available channels are within the range requested by each CBSD.
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.2.4.13 [WINNF.FT.S.SIQ.13] Blacklisted CBSD in Array request (*responseCode* 101)

Step	Instructions
1	Ensure that three CBSDs register with SAS UUT; *cbsdId* (C1, C2, C3)
2	Manually Blacklist the third CBSD, *cbsdId* (C3)
3	DP Test Harness sends a Spectrum Inquiry Request Message with 3 request objects: • All three objects have valid *cbsdId*, as well as all other parameters.
CHECK	SAS responds with a Spectrum Inquiry Response Message in the form of one 3-element Array as follows: • The *cbsdId*s for the first and second CBSD match C1 and C2 respectively. • The *responseCode* is 0 for the first two CBSDs concluding a successful operation. • The *responseCode* is 101 for the third CBSD *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.3 CBSD Spectrum Grant Procedure

6.3.1 Definition, Applicability, and Scope of the Test Case

This section explains test steps, conditions, and procedures to test the conformance of CBSD Grant Procedure.

The *responseCode* parameters in tables 40 and 41 of [n.9] outlines the possible conditions associated with a Grant Request and the expected Grant Response from a SAS UUT. (please see the table below)

Table 6.3-1 Response Codes for CBSD Grant Procedure Test Cases (Informative)

response Code	Name	Condition	Test Scenario	Test ID
0	SUCCESS	Either of following: • The SAS UUT completes the spectrum accessibility process with no error. • Grant pending	• Grant Request for PAL or GAA channel when no incumbent present • Grant pending when DPA is activated.	WINNF.FT.S.GRA.1 WINNF.FT.S.GRA.5 WINNF.FT.S.GRA.10 WINNF.FT.S.GRA.11 WINNF.FT.S.GRA.12 WINNF.FT.S.GRA.13
101	BLACKLISTED	The CBSD has been included in a blacklist of CBRS operation (SAS or FCC enforcement action) or the CBSD operating privileges have been revoked.	• Registered CBSD is manually blacklisted.	WINNF.FT.S.GRA.12

102	MISSING_PARAM	One or more parameters to be included in the request are missing.	• One or more parameters are missing.	WINNF.FT.S.GRA.2 WINNF.FT.S.GRA.15
103	INVALID_VALUE	One or more parameters with invalid value are provided to the SAS UUT.	• *cbsdId* is different from the assigned *cbsdId*. • Parameters in the *operationFrequencyRange* parameter are mutually invalid. • Requested operational parameter includes the frequency range with both PAL and GAA channels • Maximum EIRP specified in the Grant request is higher than the certified maximum EIRP for the CBSD or its claimed *eirpCapability* during the Registration.	WINNF.FT.S.GRA.3 WINNF.FT.S.GRA.4 WINNF.FT.S.GRA.7 WINNF.FT.S.GRA.8 WINNF.FT.S.GRA.11 WINNF.FT.S.GRA.15
300	UNSUPPORTED_SPECTRUM	The frequency range in the request is set to a value partially overlapping or completely outside the frequency range of the CBRS Band (3550-3700 MHz)	• The frequency range in the *operationFrequencyRange* parameter is partially overlapping with the CBRS Band. • The frequency range in the *operationFrequencyRange* parameter is completely outside the CBRS Band.	WINNF.FT.S.GRA.7
400	INTERFERENCE	The requested Grant is likely to result in too much interference.	• Frequency range requested by a CBSD overlaps with PAL channel but the CBSD is not a member of claimed PPA.	WINNF.FT.S.GRA.1 WINNF.FT.S.GRA.9

| 401 | GRANT_CONFLICT | The requested operation parameters conflict with an existing Grant of the same CBSD. | • The requested operation parameters are partially or fully overlapped the frequency range of the existing Grant of the same CBSD.
• One Grant Request Message includes two Grant Requests but the frequency ranges are overlapping with each other. | WINNF.FT.S.GRA.5
WINNF.FT.S.GRA.10
WINNF.FT.S.GRA.16 |

6.3.2   Test Characteristics

Table 6.3-2 CBSD Spectrum Grant Procedure Test Characteristics

1	**Test ID**	WINNF.FT.S.GRA
2	**Title**	CBSD Spectrum Grant Procedure
3	**Working Group / Entity**	WG3
4	**Test Type**	Functional
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.9]

6.3.3   Method of test

6.3.3.1   Initial Conditions / Test Pre-conditions

The typical pre-conditions of the test case are the following:
• The SAS UUT must be reset at the beginning of each test case to a baseline state.

6.3.4   Test Procedure

6.3.4.1   [WINNF.FT.S.GRA.1] Federal Incumbent present in the PAL frequency range requested by the CBSD who is inside the DPA Neighborhood

Step	Instructions
1	Ensure that CBSD registers with SAS UUT, with *cbsdId* (C), and is inside the Neighborhood of the DPA in Step 2.
2	• Inject PPA Information into the SAS UUT such that *cbsdId* = C is part of the PPA.

	• Configure the SAS UUT such that a frequency range FR is available to this CBSD as a PAL channel. • Ensure that a DPA is inactive on frequency range FR. • No other Incumbent or PPA present.
3	• Activate the DPA on the frequency range FR.
4	Wait for 240 seconds.
5	DP Test Harness sends Grant Request to SAS. In which *cbsdId* = C, *operationFrequencyRange* = FR. Set *maxEirp* appropriately.
CHECK	Verify the following in the Grant Response Message from SAS • Verify that this *grantResponse* is valid. • *cbsdId* (Response) = *cbsdId* (Request) = C • *responseCode* = 0 or *responseCode* = 400 • A *grantId* (G) assigned by the SAS (when *responseCode* = 0). • *channelType* is "PAL" (when *responseCode* = 0). Note that, if *responseCode* = 0, the SAS will delay the transition of CBSD to *Authorized* state during exchange of Heartbeat messages. *If any of the above conditions is not met, the SAS FAILS this test. If responseCode = 400, the SAS PASSES this test (do not perform any more steps). Otherwise, proceed.*
6	DP Test Harness sends a HB Request with • *cbsdId* = C • *grantId* = G • *operationState* = GRANTED
CHECK	Verify the following in the HB Response message from the SAS • *cbsdId* = C • *grantId* = G • *transmitExpireTime* is no later than the current time. • *responseCode* = SUSPENDED_GRANT *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.3.4.2 [WINNF.FT.S.GRA.2] Grant Array with Missing parameters

Step	Instructions
1	Ensure that CBSDs have registered with the SAS and their *cbsdId* parameters are C1, C2, C3, C4 and C5.
2	DP Test Harness sends Grant Request in an array format to SAS such that: • The first CBSD is missing its *cbsdId* (C1) but all other parameters are valid. • The second one has *cbsdId* = C2 and has all other parameters valid, but *operationParam* parameter is NOT present. • The third one has *cbsdId* = C3 and has all other parameters valid. *operationParam* parameter is present in the Grant Request, but its *maxEirp* parameter is missing. Both *lowFrequency* and *highFrequency* elements are present with valid values.

- The fourth one has *cbsdId* = C4 and has all other parameters valid. *operationParam* parameter is present in the Grant Request, with valid *maxEirp* parameter and *lowFrequency*, but *highFrequency* element is missing.
- The fifth one has *cbsdId* = C5 and has all other parameters valid. *operationParam* parameter is present in the Grant Request, with valid *maxEirp* parameter and *highFrequency*, but *lowFrequency* element is missing.

CHECK	SAS sends a Grant Response Message in an array format as follows:
	• For the first element of the *grantResponse* parameter:
	    ○ No *cbsdId* in Response message.
	    ○ No *grantId* in the Response message
	    ○ *responseCode* = 102
	• For the second, third, fourth, and fifth elements of the *grantResponse* parameter:
	    ○ *cbsdId* = C2 to C5 respectively.
	    ○ No *grantId*
	    ○ The *responseCode* shall be 102, indicating am missing parameter
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.3.4.3   [WINNF.FT.S.GRA.3] *cbsdId* does not exist in SAS

Step	Instructions
1	Ensure the following conditions hold: • *cbsdId* (C) does not exist in SAS
2	DP Test Harness sends Grant Request Message to SAS including *cbsdId* (C) and other required parameters.
CHECK	Verify the following in the Grant Response Message from SAS: • No *cbsdId* • No *grantId* • *responseCode* = 103 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.3.4.4   [WINNF.FT.S.GRA.4] *cbsdId* sent by the CBSD is not its *cbsdId*, but of some other CBSD which is currently registered with the SAS

Informative note: One recommended approach to detect the wrong *cbsdId* is to use the association between the *cbsdId* and CBSD certificate

Step	Instructions
1	Two CBSD Test Harnesses register with SAS UUT; *cbsdId* (C1 and C2)
2	CBSD Test Harness (C1) sends a Grant Request Message in which *cbsdId* is set to C2, with all other required parameters valid.
CHECK	Verify the following in the Grant Response Message from SAS • No *cbsdId*

- No *grantId*
- *responseCode* = 103

If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.3.4.5 [WINNF.FT.S.GRA.5] SAS rejects GrantRequest if the CBSD already has a Grant from another SAS

Step	Instructions
1	Configure the SAS Test Harness such that it contains a single record for CBSD C1 with Grant G1 and nothing else.
2	Admin Test Harness triggers CPAS and waits until completion of CPAS.
3	Register the same CBSD C1 (as mentioned in Step1), and another CBSD C2 to the SAS UUT. Both Registrations shall be successful.
4	Send a valid Grant Request on behalf of C1 and C2 to the SAS UUT.
CHECK	SAS UUT sends correct Grant Response Messages as follows: • The *responseCode* in Response Object is 401 for the first CBSD concluding a failed Grant Request (grant conflict). • The *responseCode* in Response Object is 0 for the second CBSD concluding a successful Grant Request. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.3.4.6 [WINNF.FT.S.GRA.6] SAS terminates Grant upon learning that the CBSD has a Grant from another SAS

Step	Instructions
1	DP Test Harness successfully registers (*cbsdId*=C1) and gets a Grant G1 from SAS UUT.
2	Configure the SAS Test Harness such that it contains a single record for the same CBSD C1 (as mentioned in Step 1), with Grant G2 and nothing else.
3	Admin Test Harness triggers CPAS and waits until completion of CPAS.
4	DP Test Harness sends a valid Heartbeat Request Message to the SAS UUT.
CHECK	SAS UUT sends a HeartBeat Response Message to the DP Test Harness as follows: • The *responseCode* is 500 for the CBSD concluding a terminated spectrum Grant. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.3.4.7 [WINNF.FT.S.GRA.7] Invalid *operationFrequencyRange*

Step	Instructions

1	Ensure the following conditions hold: • Three CBSDs register with SAS UUT; *cbsdId* (C1, C2, C3)
2	DP Test Harness sends Grant Request in an Array form to SAS such that: • For *cbsdId* (C1), *operationParam* parameter is present in the Grant Request, but its *lowFrequency* value is set to a value higher than *highFrequency* value. *maxEirp* shall be a valid value • For *cbsdId* (C2), *operationParam* parameter is present in the Grant Request, but the values of the *lowFrequency* and *highFrequency* parameters are set to values such that the frequency range is completely outside the CBRS band • For *cbsdId* (C3), *operationParam* parameter is present in the Grant Request, but the values of the *lowFrequency* and *highFrequency* parameters are set to values such that the frequency range is partially overlapping with CBRS band
CHECK	Verify the following in the Grant Response Message in an Array form from SAS: • *cbsdId* (Response) = *cbsdId* (Request) = C1, C2, and C3 respectively • No *grantId*s • For *cbsdId* (C1) the *responseCode* = 103 • For *cbsdId* (C2 and C3) the *responseCode* = 300 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.3.4.8 [WINNF.FT.S.GRA.8] CBSD requests a frequency range which is a mix of PAL and GAA channel.

Step	Instructions
1	Admin Test Harness injects PPA Information into SAS UUT, with frequency range FR1
2	Ensure the following conditions hold: • CBSD registers with SAS UUT; *cbsdId* (C) • *cbsdId* = C is part of the PPA in Step 1
3	Ensure that frequency range FR2 is adjacent to FR1 and available for GAA use
4	DP Test Harness sends Grant Request to SAS such that • *cbsdId* = C • *operationFrequencyRange* = FR = FR1+FR2 (FR contains both PAL and GAA channel) • *maxEirp* is set appropriately
CHECK	Verify the following in the Grant Response Message from SAS • *cbsdId* = C • No *grantId* • *responseCode* = 103 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.3.4.9 [WINNF.FT.S.GRA.9] Frequency range requested by a CBSD overlaps with PAL channel and the CBSD is inside the PPA boundary claimed by other CBSD User.

Step	Instructions
1	Ensure the following conditions hold: • Register *cbsdId* (C1) with SAS • Admin Test Harness injects PPA Information into SAS UUT for CBSD C1 over frequency range PAL_FR (PPA1) • Register CBSD 'C2' (located inside PPA1, but not part of it) with the SAS
2	Trigger CPAS
3	DP Test Harness sends Grant Request Message to SAS such that • *cbsdId* =C2 • *operationFrequencyRange* is set to G_FR, maxEirp is set appropriately. o Frequency range G_FR overlaps with PAL_FR.
CHECK	Verify the following in the Grant Response Message from SAS • *cbsdId* = C2 • No *grantId* • *responseCode* = 400 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.3.4.10 [WINNF.FT.S.GRA.10] First request granted as PAL or GAA channel, send next request for PAL or GAA channel for a partially or fully overlapped frequency range

Step	Instructions
1	DP Test Harness shall initiate the CBSD Registration Procedure for two CBSDs and obtains two *cbsdId* parameters (C1 and C2) from the SAS UUT for those CBSDs.
2	Inject the following into the SAS UUT: • PAL Database Record (PAL1), where the frequency range of primary channel assignment is 3,550 – 3,560 MHz (FR1) • Zone data of PPA boundary associated with PAL1, where the PPA boundary is set so that the location of C1 is within. • PPA Cluster List containing C1
3	The DP Test Harness shall initiate the CBSD Grant Procedure by sending a Grant Request Message to the SAS UUT, where the Grant Request Message shall meet the following conditions: • The Grant Request Message includes the *grantRequest* parameter which contains two *GrantRequest* objects • For the first *GrantRequest* object: o The *cbsdId* parameter set to C1. o The *operationParam* parameter which includes: o The *maxEirp* parameter set to valid value o The *operationFrequencyRange* parameter set to FR1 • For the second *GrantRequest* object: o The *cbsdId* parameter set to C2.

	o The *operationParam* parameter which includes:
	o The *maxEirp* parameter set to valid value
	o The *operationFrequencyRange* parameter set to 3,560 – 3,570 MHz (FR2)

CHECK	The DP Test Harness checks a Grant Response Message received from the SAS UUT. If the any of the following conditions is not met, the SAS UUT fails this test case. Otherwise, proceed to Step 4
	• The Grant Response Message includes the *grantResponse* parameter which contains two *GrantResponse* objects
	• For the first *GrantResponse* object:
	   o The *cbsdId* parameter (C1)
	   o The *grantId* parameter set to valid value (G1)
	   o The *grantExpireTime* parameter set to valid value with correct format.
	   o The *heartbeatInterval* parameter set to valid value with correct format.
	   o No *operationParam* parameter
	   o The *channelType* parameter set to "PAL"
	   o The *responseCode* parameter in *Response* object is set to 0 (SUCCESS)
	• For the second *GrantResponse* object:
	   o The *cbsdId* parameter set to C2
	   o The *grantId* parameter set to valid value (G2)
	   o The *grantExpireTime* parameter set to valid value with correct format.
	   o The *heartbeatInterval* parameter set to valid value with correct format.
	   o No *operationParam* parameter
	   o The *channelType* parameter set to "GAA"
	   o The *responseCode* parameter in *Response* object is set to 0 (SUCCESS)
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.

4	The DP Test Harness shall initiate the CBSD Grant Procedure by sending a Grant Request Message to the SAS UUT, where the Grant Request Message shall be same as sent in Step 3.

CHECK	The DP Test Harness checks a Grant Response Message received from the SAS UUT. If the any of the following conditions is not met, the SAS UUT fails this test case.
	• The Grant Response Message includes the *grantResponse* parameter which contains two *GrantResponse* objects
	• For the first *GrantResponse* object:
	   o The *cbsdId* parameter (C1)
	   o No *grantId* parameter
	   o No *grantExpireTime* parameter
	   o No *heartbeatInterval* parameter
	   o No *operationParam* parameter
	   o No *channelType* parameter
	   o The *responseCode* parameter in *Response* object set to 401 (GRANT_CONFLICT)
	• For the second *GrantResponse* object:
	   o The *cbsdId* parameter set to C2
	   o No *grantId* parameter

	o No *grantExpireTime* parameter o No *heartbeatInterval* parameter o No *operationParam* parameter o No *channelType* parameter o The *responseCode* parameter in *Response* object set to 401 (GRANT_CONFLICT) *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.3.4.11 [WINNF.FT.S.GRA.11] Un-Supported CBSD maximum EIRP

This test case tests SAS operation in response to a requested *maxEirp* specified in the *grantRequest* that is not supported for the CBSD claimed category, or compared with CBSDs certified (allowed) maximum EIRP in FCC-ID Whitelist (noted as FCC_EIRPCi for CBSD Ci below

Step	Instructions

1	Configure the SAS UUT to whitelist five FCC IDs with certified maximum EIRP as follows:
	• For the first CBSD (C1):
	  o $FCC\_EIRP_{C1} = 30$ (dBm/10MHz)
	• For the second CBSD (C2):
	  o $FCC\_EIRP_{C2} = 20$ (dBm/10MHz)
	• For the third CBSD (C3):
	  o $FCC\_EIRP_{C3} = 40$ (dBm/10MHz)
	• For the fourth CBSD (C4):
	  o $FCC\_EIRP_{C4} = 47$ (dBm/10MHz)
	• For the fifth CBSD (C5):
	  o $FCC\_EIRP_{C5} = 30$ (dBm/10MHz)

2	DP Test Harness shall initiate the Registration Procedure for five CBSDs and obtains *cbsdId* parameters (C1, C2, C3, C4, C5) as follows:
	• For the first CBSD (C1):
	  o The *cbsdCategory* parameter set to "A"
	  o The *eirpCapability* parameter set to 20 (dBm/10MHz)
	• For the second CBSD (C2):
	  o The *cbsdCategory* parameter set to "A"
	  o No *eirpCapability* parameter included
	• For the third CBSD (C3):
	  o The *cbsdCategory* parameter set to "B"
	  o No *eirpCapability* parameter included
	• For the fourth CBSD (C4):
	  o The *cbsdCategory* parameter set to "B"
	  o The *eirpCapability* parameter set to 40 (dBm/10MHz)
	• For the fifth CBSD (C5):
	  o The *cbsdCategory* parameter set to "B"

	o No *eirpCapability* parameter included

3	The DP Test Harness shall send a Grant Request Message with the *grantRequest* array containing five *GrantRequest* objects as follows:
	 • For the first *GrantRequest* object:
	  o The *cbsdId* parameter set to C1.
	  o The *operationParam* parameter which includes:
	   ▪ The *maxEirp* parameter set to 11 (dBm/MHz)
	   ▪ The *operationFrequencyRange* parameter is set to valid range.
	 • For the second *GrantRequest* object:
	  o The *cbsdId* parameter set to C2.
	  o The *operationParam* parameter which includes:
	   ▪ The *maxEirp* parameter set to 11 (dBm/MHz)
	   ▪ The *operationFrequencyRange* parameter is set to valid range.
	 • For the third *GrantRequest* object:
	  o The *cbsdId* parameter set to C3.
	  o The *operationParam* parameter which includes:
	   ▪ The *maxEirp* parameter set to 31 (dBm/MHz)
	   ▪ The *operationFrequencyRange* parameter is set to valid range.
	 • For the fourth *GrantRequest* object:
	  o The *cbsdId* parameter set to C4.
	  o The *operationParam* parameter which includes:
	   ▪ The *maxEirp* parameter set to 31 (dBm/MHz)
	   ▪ The *operationFrequencyRange* parameter is set to valid range.
	 • For the fifth *GrantRequest* object:
	  o The *cbsdId* parameter set to C5.
	  o The *operationParam* parameter which includes:
	   ▪ The *maxEirp* parameter set to 21 (dBm/MHz)
	   ▪ The *operationFrequencyRange* parameter is set to valid range.

CHECK[2]	SAS UUT responsed with a Grant Response Message containing five *GrantResponse* objects such that: • *cbsdId* (Response) = *cbsdId* (Request) = C1, C2, C3, C4, C5 respectively • No *grantIds* in the Response message • *responseCode* = 103 for all CBSDs *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*

4	The DP Test Harness shall send a Grant Request with the *grantRequest* array containing five *GrantRequest* objects as follows:
	 • For the first *GrantRequest* object:
	  o The *cbsdId* parameter set to C1.
	  o The *operationParam* parameter which includes:
	   ▪ The *maxEirp* parameter set to 10 (dBm/MHz)
	   ▪ The *operationFrequencyRange* parameter is set to valid range.
	 • For the second *GrantRequest* object:

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[2] An FCC-certified SAS is expected to conform to the behavior described in this CHECK process, utilizing a fully-automated mechanism for SASs to retrieve and ingest the relevant FCC-owned information

	o The *cbsdId* parameter set to C2.
	o The *operationParam* parameter which includes:
	    ▪ The *maxEirp* parameter set to 10 (dBm/MHz)
	    ▪ The *operationFrequencyRange* parameter is set to valid range.
	• For the third *GrantRequest* object:
	o The *cbsdId* parameter set to C3.
	o The *operationParam* parameter which includes:
	    ▪ The *maxEirp* parameter set to 20 (dBm/MHz)
	    ▪ The *operationFrequencyRange* parameter is set to valid range.
	• For the fourth *GrantRequest* object:
	o The *cbsdId* parameter set to C4.
	o The *operationParam* parameter which includes:
	    ▪ The *maxEirp* parameter set to 30 (dBm/MHz)
	    ▪ The *operationFrequencyRange* parameter is set to valid range.
	• For the fifth *GrantRequest* object:
	o The *cbsdId* parameter set to C5.
	o The *operationParam* parameter which includes:
	    ▪ The *maxEirp* parameter set to 20 (dBm/MHz)
	    ▪ The *operationFrequencyRange* parameter is set to valid range.

CHECK	SAS UUT responds with a Grant Response Message containing five *GrantResponse* objects such that: • *cbsdId* (Response) = *cbsdId* (Request) = C1, C2, C3, C4, C5 respectively • A *grantId* (G) assigned by the SAS UUT for every *GrantResponse* object • *responseCode* = 0 for all CBSDs *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.3.4.12 [WINNF.FT.S.GRA.12] Blacklisted CBSD in Array request (*responseCode* 101)

Step	Instructions
1	Ensure that three CBSDs register with SAS UUT; *cbsdId* (C1, C2, C3)
2	• Configure the SAS UUT such that frequency ranges (FRs) are frequency ranges available as "GAA". • Ensure that no incumbent is present in those frequency ranges.
3	Manually Blacklist the third CBSD, *cbsdId* (C3)
4	DP Test Harness sends Grant Request Message to SAS which has the *grantRequest* parameter containing 3 elements.
CHECK	SAS responds with a Grant Response in the form of one 3-element Array as follows: • The *cbsdId*s for the first and second CBSD match C1 and C2 respectively. • The *responseCode* is 0 for the first two CBSDs concluding a successful operation. *channelType* shall be set to GAA • The *responseCode* is 101 for the third CBSD *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.3.4.13 [WINNF.FT.S.GRA.13] Requests for multiple PAL channels and for multiple GAA channels; no incumbent present in the PAL and GAA frequency ranges used in the requests.

Step	Instructions
1	The Admin Test Harness injects two PAL Database Records into the SAS UUT, with corresponding *primaryAssignment* parameter indicated as FR1 and FR2. FR1 and FR2 do not overlap.
2	• The DP Test Harness initiates the CBSD Registration procedure for three CBSDs and obtains three *cbsdId* parameters (C1, C2 and C3) • C1 and C2 are each associated with one of the PPAs injected in the Step 3, the location of CBSDs are within the associated PPAs, and the userId parameters are same as the corresponding value in PAL Database Records injected in the Step 1 • C3 is not associated with any of the PPAs • Make sure no other protected entity is present.
3	The Admin Test Harness injects the PPA Zone Definition Message for each of the two PPAs mentioned in Step 2

4	The DP Test Harness shall send a Grant Request Message with the *grantRequest* array containing three *GrantRequest* objects as follows:
	• For the first *GrantRequest* object:
	    o The *cbsdId* parameter set to C1.
	    o The *operationFrequencyRange* parameter is set to FR1
	• For the second *GrantRequest* object:
	    o The *cbsdId* parameter set to C2.
	    o The *operationFrequencyRange* parameter is set to FR2
	• For the third *GrantRequest* object:
	    o The *cbsdId* parameter set to C3.
	    o The *operationFrequencyRange* parameter is set to a frequency range FR3
	        ▪ FR3 do not overlap with FR1 or FR2

CHECK	Verify the following in the Grant Response Message from SAS:
	• The *grantResponse* parameter contains three elements:
	• The first element shall have
	    o *cbsdId* = C1
	    o *grantId* (G1)
	    o Verify that *grantExpireTime* parameter set to the value that does not extend beyond the corresponding PAL *licenseExpiration* in Step 1
	    o *channelType* is set to PAL
	    o *responseCode* = 0
	• The second element shall have
	    o *cbsdId* = C2
	    o *grantId* (G2)
	    o Verify that *grantExpireTime* parameter set to the value that does not extend beyond the corresponding PAL *licenseExpiration* in Step 1

<table>
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o *channelType* is set to PAL
o *responseCode* = 0
• The third element shall have
o *cbsdId* = C3
o *grantId* (G3)
o *channelType* is set to GAA
o *responseCode* = 0

If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

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6.3.4.14 [WINNF.FT.S.GRA.14] Deprecated; the Test ID is Reserved

6.3.4.15 [WINNF.FT.S.GRA.15] Both the requests result in unsuccessful Grant Response

Step	Instructions
1	Ensure that DP Test Harness registers two CBSDs with SAS UUT; *cbsdId* (C1, C2)
2	Configure the SAS UUT such that FR1 is a frequency range available as "GAA".
3	DP Test Harness sends Grant Request Message to SAS which has a *grantRequest* parameter containing two elements in it: • The first element has *cbsdId* = C1, *operationFrequencyRange* set to FR1, but its maxEirp is missing. • The second element has *cbsdId* = C2, but its highFrequency is set to a value lower than its lowFrequency value. Set maxEirp to a valid value.
CHECK	Verify the following in the Grant Response Message from SAS • The *grantResponse* parameter contains two elements: • The first element shall have o *cbsdId* = C1 o No *grantId.* o *responseCode* = 102 (MISSING_PARAM) • The second element shall have (for the example given in Step 3) o *cbsdId* = C2 o No *grantId.* o *responseCode* = 103 (invalid value) *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.3.4.16 [WINNF.FT.S.GRA.16] The two requests carry overlapping frequency range in the Grant Request from the same CBSD.

Step	Instructions
1	DP Test Harness registers a CBSD with SAS UUT; *cbsdId* (C)

2	Ensure that the frequency ranges FR1 and FR2 that are overlapping and available as GAA.
3	• DP Test Harness sends Grant Request message to SAS which has two GrantRequest objects in it. • The first GrantRequest object has *cbsdId* = C, frequencyRange = FR1. Set maxEirp appropriately. • The second GrantRequest object has *cbsdId* = C, frequencyRange = FR2. Set maxEirp appropriately
CHECK	Verify the following in the Grant Response Message from SAS The *grantRequest* parameter containing two elements: • Both elements shall have *cbsdId* = C • At least one element shall have *responseCode* = 401 (GRANT_CONFLICT) • The *grantExpireTime* with a correct format and range is included for the element with *responseCode* = 0 o The *heartbeatInterval* with a correct format and range is included *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.3.4.17 [WINNF.FT.S.GRA.17] [Configurable] Array Grant Request

This configurable test covers Grant tests where there is no incumbent present (Grant tests where an incumbent is present are covered in the functional tests), and can cover situations where the CBSD (Cat A and/or Cat B) Grant Request: includes frequency ranges covering GAA frequencies and/or PAL frequencies and/or combinations of GAA and PAL frequencies and/or frequencies ranges that are completely and/or partly outside the CBRS band; has a missing *cbsdId* and/or a *cbsdId* that does not exist in the SAS; has missing and/or invalid and/or valid operational parameters. The test can also include CBSD Grant Requests that fall within PPAs. The test will check the number and value of the Grant SAS UUT *responseCode*s (including the appropriate number of *responseCode*s) to see if they match the expected *responseCode*s as specified in the respective input configuration file, which will include codes of 0 (success), 102 (missing parameter), 103 (invalid value), 300 (unsupported spectrum), 400 (Interference), 401 (grant conflict).

Step	Instructions
1	Configure the SAS UUT to whitelist the FCC IDs and user IDs corresponding to the *registrationRequest* which will be sent in Step 2.
2	Send a valid Registration Request with the *registrationRequest* parameter containing N1 > 0 CBSDs. Verify that the *responseCode* for each is SUCCESS.
3	Load information about N2 >= 0 PPAs into the SAS UUT, each with a cluster list as defined in the configuration file. The cluster list may be empty for any and all PPAs.
4	If N2>0, instruct the SAS UUT to execute its CPAS and wait until completion.
5	Send a Grant Request Message with the *grantRequest* parameter containing N1 elements (one per registered CBSD).

CHECK	The Grant Response Message from the SAS UUT must satisfy all of the following conditions:

	The *grantResponse* parameter shall contain N1 elements:
	• For each element:
	    ○ The *responseCode* shall match the corresponding expected *responseCode* listed in the configuration file.
	    ○ If the corresponding request contained a valid *cbsdId*, the response shall contain the same *cbsdId*.
	    ○ If *responseCode* = SUCCESS, verify that the response contains a valid *grantId*.
	        ▪ Otherwise, verify that the response does *not* contain a *grantId*.
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.4 CBSD Heartbeat Procedure

6.4.1 Definition, Applicability, and Scope of the Test Case

This section explains test steps, conditions, and procedures for SAS Heartbeat Response Message to a CBSD Heartbeat Request Message.

The approach is for each test to create necessary conditions to generate a SAS Heartbeat Response Message to a CBSD Heartbeat Request Message with all the defined *responseCode* parameters pertaining to the CBSD Heartbeat Procedure in [n.9]. This includes successful Heartbeat Request as well, which is signified by *responseCode* 0. (please see the table below)

Table 6.4-1 Response Codes for CBSD Heartbeat Procedure Test Cases (Informative)

response Code	Name	Condition	Test Scenario	Test ID
0	SUCCESS	The SAS UUT completes the Heartbeat Processing with no error.	• Heartbeat Request with no incumbent or any other activity to affect the Grant • Grant renewal Request	WINNF.FT.S.HBT.1 WINNF.FT.S.HBT.2 WINNF.FT.S.HBT.4 WINNF.FT.S.HBT.7 WINNF.FT.S.HBT.8 WINNF.FT.S.HBT.9

100	VERSION	The version number of the SAS-CBSD protocol used by the CBSD Test Harness is not supported by the SAS UUT, or the version number used by CBSD is invalid.	• The CBSD Test Harness sends the request message using the URL of the SAS UUT including the newer protocol version than the most recent SAS-CBSD Protocol version supported by the SAS UUT.	WINNF.FT.S.HBT.3
101	BLACKLISTED	The CBSD has been included in a blacklist of CBRS operation (SAS or FCC enforcement action) or the CBSD operating privileges have been revoked.	Registered CBSD is manually blacklisted.	WINNF.FT.S.HBT.8
102	MISSING_PARAM	One or more parameters required to be included in the request are missing.	• "Required" parameter is missing from the request.	WINNF.FT.S.HBT.4
103	INVALID_VALUE	One or more parameters with invalid value are provided to the SAS UUT	• "Required" parameter is set to an invalid value. • Heartbeat Procedure after Grant is relinquished. • Heartbeat Procedure after Grant is expired.	WINNF.FT.S.HBT.5 WINNF.FT.S.HBT.6 WINNF.FT.S.HBT.7 WINNF.FT.S.HBT.11
500	TERMINATED_GRANT	Grant is terminated due to permanent change in incumbent status, or CBSD located in an exclusion zone, or CBSD causing excessive interference to the incumbent as a result of IAP process, or CBSD being in a DPA Move List upon DPA activation.	• Activities of FSS Earth Station and GWBL are changed.	WINNF.FT.S.HBT.5 WINNF.FT.S.HBT.6 WINNF.FT.S.HBT.9 WINNF.FT.S.HBT.12
501	SUSPENDED GRANT	Pending Grant cannot be enabled due to incumbent status	• Heartbeat Response after Grant Procedure concluding Grant pending (*responseCode* 0)	WINNF.FT.S.HBT.12

| 502 | UNSYNC_OP_ PARAM | Grant state is out-of-synchronization between the SAS UUT and the CBSD (emulated by the CBSD Test Harness). | • Grant state "AUTHORIZED" is indicated to the SAS UUT while the current Grant state in SAS UUT is "GRANTED". | WINNF.FT.S.HBT.11 |

6.4.2 Test Characteristics

Table 6.4-2 CBSD Heartbeat Procedure Test Characteristics

1	**Test ID**	WINNF.FT.S.HBT
2	**Title**	CBSD Heartbeat Procedure
3	**Working Group / Entity**	WG3
4	**Test Type**	Functional
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD $\leftarrow$ $\rightarrow$ SAS
7	**Target Specification / Feature**	[n.9]

6.4.3 Method of test

6.4.3.1 Initial Conditions / Test Pre-conditions

The typical pre-conditions of the test case are the following:
- The SAS UUT must be reset at the beginning of each test case to a baseline state.

6.4.4 Test Procedure

6.4.4.1 [WINNF.FT.S.HBT.1] Array request: Successful Heartbeat Request

This test case tests the scenario when the CBSDs move immediately into *Granted* State or following a Heartbeat Response.

Step	Instructions
1	Ensure the following conditions hold: • DP Test Harness registers three CBSDs with SAS UUT; *cbsdId* (C1, C2, C3) • DP Test Harness successfully requests Grants for a PAL or GAA channel for the CBSDs • DP Test Harness successfully exchanges Heartbeat with SAS UUT for the CBSDs and keeps them in the *Authorized* state
2	DP Test Harness sends a Heartbeat Request Message with the *heartbeatRequest* parameter containing 3 elements before the *grantExpireTime*. Each element contains *cbsdId*, *grantId*. Ensure no incumbent or any other activity to affect the Grant.

CHECK	SAS UUT responds with a Heartbeat Response Message with the *heartbeatResponse* parameter containing 3 elements as follows:
	• Each element includes the *cbsdId*, and *grantId* that matches the request from each CBSD in the array.
	• *transmitExpireTime* set to a valid UTC time in the future for each CBSD. It shall be not later than 240 seconds in the future and not later than the *grantExpireTime*.
	• The *responseCode* shall be 0 for all CBSDs concluding a successful operation.
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.4.4.2 [WINNF.FT.S.HBT.2] Array request: Successful Heartbeat Request from CBSD for Grant renewal

Step	Instructions
1	Ensure the following conditions hold:
	• DP Test Harness registers 3 CBSDs with SAS UUT; *cbsdId* (C1, C2, C3)
	• DP Test Harness successfully requests Grant for a PAL or GAA channel for the CBSDs
2	DP Test Harness sends a Heartbeat Request Message with the *heartbeatRequest* parameter containing 3 elements before the expiration of the *grantExpireTime*. Ensure no incumbent or any other activity to affect the Grant. For each CBSD, this request shall include:
	• *cbsdId*
	• *grantId*
	• *grantRenew* set to True.
CHECK	SAS UUT responds with a Heartbeat Response Message with the *heartbeatResponse* parameter containing 3 elements as follows:
	• Each element includes the *cbsdId*, and *grantId* that matches the Heartbeat Request Message .
	• *transmitExpireTime* set to a valid UTC time in the future. It shall be not later than 240 seconds in the future and not later than the *grantExpireTime*.
	• *grantExpireTime* is set to a valid UTC time greater than or equal to the original *grantExpireTime*
	• The *responseCode* shall be 0 for the all CBSDs concluding a successful operation.
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.4.4.3 [WINNF.FT.S.HBT.3] Array request: Unsuccessful VERSION (*responseCode* 100)

Initial Heartbeat Request (immediately after CBSD moves into *Granted* State) is from a CBSD with an unsupported protocol version by SAS.

Step	Instructions
1	Ensure the following conditions hold: • DP Test Harness registers 3 CBSDs with SAS UUT; *cbsdId* (C1, C2, C3) • DP Test Harness successfully requests Grant for a PAL or GAA channel for the CBSDs
2	DP Test Harness sends a Heartbeat Request Message with the *heartbeatRequest* parameter containing 3 elements (each element includes *cbsdId*, *grantId*) before the expiration of the *transmitExpireTime*, but with a protocol version newer than the most recent SAS-CBSD protocol version supported by SAS.
CHECK	SAS UUT responds with a Heartbeat Response with the *heartbeatResponse* parameter containing 3 elements as follows: • Each element includes the *cbsdId*, and *grantId* that match the request from each CBSD in the array • The *responseCode* for all CBSDs set to 100, concluding a failed operation due to protocol error. • *transmitExpireTime* set to a value equal or less than the *transmitExpireTime* in the previous successful Heartbeat response. If this is the first Heartbeat response, *transmitExpireTime* shall be no later than the current time. Alternatively, the SAS UUT can return HTTP status code 404. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.4.4.4 [WINNF.FT.S.HBT.4] Array request: Successful or Unsuccessful Heartbeat Request from CBSD in *Granted* or *Authorized* state due to missing required parameters.

This test case tests the scenario when the CBSDs move immediately into *Granted* State or following a Heartbeat Response has required parameters missing.

Step	Instructions
1	Ensure the following conditions hold: • DP Test Harness registers 4 CBSDs with SAS UUT; *cbsdId* (C1, C2, C3, C4) • DP Test Harness successfully requests Grant for a PAL or GAA channel for the CBSDs • No Protected Entity are present
2	DP Test Harness sends a Heartbeat Request Message with their *cbsdId*, *grantId* before the expiration of the *transmitExpireTime* in the form of one 4-element Array. In particular, the listed CBSDs have the following conditions: • CBSD 1 has all required parameters included • CBSD 2 has *cbsdId* missing • CBSD 3 has *grantId* missing • CBSD 4 has *operationState* (AUTHORIZED or GRANTED) missing
CHECK	SAS UUT responds with a Heartbeat Response Message in the form of one 4-element Array as follows: • CBSD 1 has included all required parameters.

- SAS response includes the *cbsdId*, and *grantId* that match the request from CBSD 1, and 4 in the array.
- The *responseCode* shall be 0 for the first CBSD concluding a successful operation.
- *transmitExpireTime* is set to a valid UTC time in the future for the first CBSD. It shall be not later than 240 seconds in the future and not later than the *grantExpireTime*.
- The *responseCode* for CBSDs 2 to 4 set to 102, concluding a failed operation due to missing parameters.
- *transmitExpireTime* set to a time no later than the current time, for CBSDs 2 to 4.

If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.4.4.5 [WINNF.FT.S.HBT.5] Unsuccessful Heartbeat Request from CBSD in Registered state

This test case tests the scenario when the CBSD sends Heartbeat Request immediately after CBSD's Grant is terminated.

Step	Instructions
1	DP Test Harness shall successfully registers, successfully gets a Grant and exchange Heartbeat, and then relinquish the Grant. No Protected Entity are present.
2	DP Test Harness sends a Heartbeat Request Message with its *cbsdId*, and its old (terminated) *grantId* after the *transmitExpireTime* but before the *grantExpireTime*. Ensure incumbent or any other activity stays the same as in Step 1.

CHECK	SAS UUT responds with a Heartbeat Response Message as follows:
	 • It includes the *cbsdId*.
	 • The *responseCode* set to
	     o 103: concluding a failed operation due to invalid parameters.
	     o 500: indicating a terminated Grant
	 • *transmitExpireTime* shall be no later than the current time.
	
	 If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.4.4.6 [WINNF.FT.S.HBT.6] Unsuccessful Heartbeat Request from CBSD in Registered state (immediately after CBSD's Grant is expired)

Step	Instructions
1	DP Test Harness shall successfully register, successfully get a Grant and exchange Heartbeat to enter and stay in the *Authorized* state. No Protected Entity are present.
2	DP Test Harness sends a Heartbeat Request Message after the *grantExpireTime*, with its old (expired) *grantId*.
CHECK	SAS UUT responds with a Heartbeat Response Message as follows: • It includes the *cbsdId*. • The *responseCode* set to:

	o 103: concluding a failed operation due to invalid parameters.
	o 500: indicating a terminated Grant due to incumbent status
	• *transmitExpireTime* shall be no later than the current time.
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.4.4.7 [WINNF.FT.S.HBT.7] Array request: Unsuccessful INVALID_VALUE (*responseCode* 103)

Heartbeat Request from CBSD in *Granted* or *Authorized* state (immediately after CBSD moves into *Granted* State or following a Heartbeat Response) has invalid required parameters.

Step	Instructions
1	Ensure the following conditions hold: • DP Test Harness registers 3 CBSDs with SAS UUT; *cbsdId* (C1, C2, C3) • DP Test Harness successfully requests Grant for a PAL or GAA channel for the CBSDs
2	DP Test Harness sends a Heartbeat Request Message with their *cbsdId*, *grantId* before the expiration of the *transmitExpireTime* in the form of one 3-element Array. The third CBSD has at least one of the following contain an invalid value: • *cbsdId* • *grantId*
CHECK	SAS UUT responds with a Heartbeat Response Message with the *heartbeatResponse* parameter containing 3 elements as follows: • The first and second elements include the *cbsdId*, and *grantId* that match the request from the first two CBSDs in the array. • SAS response includes the valid parameters for the third CBSD in Step 2 • The *responseCode* shall be 0 for the first two CBSDs concluding a successful operation. • *transmitExpireTime* is set to a valid UTC time in the future for the first two CBSDs. It shall be not later than 240 seconds in the future and not later than the *grantExpireTime*. • The *responseCode* for the third CBSD set to 103, concluding a failed operation due to invalid parameters. • *transmitExpireTime* shall be no later than the current time, for the third CBSD *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.4.4.8 [WINNF.FT.S.HBT.8] Array request: Unsuccessful BLACKLISTED (*responseCode* 101)

Step	Instructions

1	Ensure the DP Test Harness has 3 CBSDs in *Granted* or *Authorized* state. No Protected Entity are present.
2	The Admin Test Harness notifies the SAS UUT that the third CBSD is Blacklisted
3	DP Test Harness sends a Heartbeat Request Message with their *cbsdId*, *grantId* before the expiration of the *transmitExpireTime* in the form of one 3-element Array.
CHECK	SAS UUT responds with a Heartbeat Response Message with the *heartbeatResponse* parameter containing 3 elements as follows: • The first and second elements include the *cbsdId*, and *grantId* that match the request from CBSDs 1 and 2 in the array. • The *responseCode* shall be 0 for the first two CBSDs concluding a successful operation. • *transmitExpireTime* is set to a valid UTC time in the future for the first two CBSDs. It shall be not later than 240 seconds in the future and not later than the *grantExpireTime*. • The *responseCode* for the third CBSD set to 101 • *transmitExpireTime* shall be no later than the current time, for the third CBSD *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*
4	DP Test Harness sends a Heartbeat Request for the third CBSD to SAS UUT
CHECK	SAS UUT sends a Heartbeat Response as follows: • The *responseCode* is 101, or 103 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.4.4.9 [WINNF.FT.S.HBT.9] Array request: Heartbeat Request for the Grants in *Authorized* state results TERMINATED_GRANT

The CBSD Heartbeat Procedure for the Grants in *Authorized* state results in 500 (TERMINATED_GRANT) when incumbent status has changed permanently

Step	Instructions
1	DP Test Harness shall successfully register, successfully get Grants for 3 CBSDs and exchange Heartbeats to keep them in the *Authorized* state. The third CBSD shall be a GAA with its Grant in 3650-3700MHz range.
2	• An Exclusion Zone is created by injecting an FSS Station and injecting a GWBL station within the 150km of the FSS Station, such that only the third CBSD is inside of it. • The frequency of operation and location of the other 2 CBSDs shall be chosen to ensure that they do not both overlap with that of the FSS station.
3	Trigger CPAS
4	After a previous Heartbeat Response, the DP Test Harness sends a Heartbeat Request Message with the *heartbeatRequest* parameter containing 3 elements before the expiration of the *transmitExpireTime*. Each element includes *cbsdId*, *grantId*.
CHECK	SAS UUT responds with a Heartbeat Response Message with the *heartbeatResponse* parameter containing 3 elements as follows:

- Each element includes the *cbsdId*, and *grantId* that match the request from each CBSD in the array.
- The *responseCode* shall be 0 for the first two CBSDs concluding a successful operation.
- *transmitExpireTime* is set to a valid UTC time in the future for the first two CBSDs. It shall be not later than 240 seconds in the future and not later than the *grantExpireTime*.
- The *responseCode* for the third CBSD set to 500, concluding a failed operation due to termination of the Grant.
- *transmitExpireTime* shall be set to no later than the current time, for the third CBSD

If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.4.4.10 [WINNF.FT.S.HBT.10] [Configurable] Heartbeat with optional intervening Grant termination or blacklist

This configurable array test covers Heartbeat Request Messages for CBSDs with existing Grants where Heartbeat Request Messages come immediately after a CBSD moves into *Granted* State or following a Heartbeat Response Message; for Grant Renewal; Heartbeat Request Messages with and without missing, valid, and invalid required parameters; and Heartbeat Request Messages requiring Deregistration. The test will check the number of and value of the Heartbeat SAS UUT *responseCode*(s) to see if they match the expected *responseCode*(s) as specified in the respective input configuration file.

Step	Instructions
1	Configure the SAS UUT to whitelist the FCC ID and user ID parameters corresponding to the Registration Request Message which will be sent in Step 2. No Protected Entity are present.
2	Send a valid Registration Request Message with the *registrationRequest* parameter containing N1 > 0 CBSDs. Verify that the *responseCode* for each is SUCCESS.
3	Send a valid Grant Request Message with the *grantRequest* parameter containing N1 elements (one per registered CBSD). Verify that the *responseCode* for each is SUCCESS.
4	Instruct the SAS UUT to blacklist N2 >= 0 CBSDs. Set of N2 CBSDs may include CBSDs from N1 CBSDs in Step 2
5	Send a Heartbeat Request Message with the *heartbeatResponse* parameter containing N1 elements (one per CBSD/Grant).
CHECK	The Heartbeat Response Message must satisfy all of the following conditions: • The *heartbeatResponse* parameter shall contain N1 elements • For each element: o The *responseCode* shall match the corresponding expected *responseCode* listed in the configuration file.

o If the corresponding request contained a valid *cbsdId*, the response shall contain the same *cbsdId*.
o If the corresponding request contained a valid *cbsdId* and *grantId*, the response shall contain the same *grantId*.
o If *responseCode* == SUCCESS,
  ▪ Verify that *transmitExpireTime* exists and satisfies the following criteria:
    • Is a valid UTC time
    • Is in the future
    • Is no later than 240 seconds in the future
    • Is no later than the corresponding *grantExpireTime*
  ▪ If *grantRenew*=TRUE in the corresponding Grant Request, verify that *grantExpireTime* exists and is set to a valid UTC time in the future.
o If *responseCode* != SUCCESS
  ▪ verify that *transmitExpireTime* exists and shall be no later than the current time.

If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.4.4.11 [WINNF.FT.S.HBT.11] Out of sync Grant state between the CBSD and the SAS

#	Test Execution Steps
1	The DP Test Harness registers one CBSD (C1) with the SAS UUT.
2	The DP Test Harness sends a Grant Request Message with the *grantRequest* parameter containing one *GrantRequest* object to the SAS UUT and obtains a Grant (G1) from the SAS UUT.
3	The DP Test Harness sends a Heartbeat Request Message with the *heartbeatRequest* parameter containing one *HeartbeatRequest* object just after the Step #2, and receives the Heartbeat Response Message from the SAS UUT. The *HeartbeatRequest* object shall include the following parameters: *cbsdId*: C1 *grantId*: G1 *operationState*: *AUTHORIZED*
CHECK	The DP Test Harness receives the following Heartbeat Response Message: - The *heartbeatResponse* parameter containing one *HeartbeatResponse* object is included. - The *HeartbeatResponse* object includes: - Valid *cbsdId* (C1) - Valid *grantId* (G1) - The *responseCode* parameter set to 502 (UNSYNC_OP_PARAM). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.4.4.12 [WINNF.FT.S.HBT.12] The Grant is Suspended or Terminated in the Heartbeat Response

#	Test Execution Steps
1	Ensure all DPAs are inactive.
2	Using a DP Test Harness, register CBSD C1 to the SAS UUT in the neighborhood of DPA D. Ensure that the parameters for C1 and its Grant G1 (obtained in Step 3) are such that it is guaranteed to be on the move list for DPA D.
3	Using a DP Test Harness, CBSD C1 sends a successful Grant Request, getting *grantId* G1.
4	Using a DP Test Harness, CBSD successfully exchanges Heartbeat with SAS UUT for G1.
5	ESC Test Harness notifies the SAS UUT that DPA D has been activated.
6	Wait for 240 seconds
7	Using a DP Test Harness, CBSD send a Heartbeat for G1.
CHECK	The SAS UUT response to the Heartbeat Request satisfies all of the following conditions: • The response shall contain 1 *heartbeatResponse* object. • For each *heartbeatResponse* object: o The *responseCode* = 500 (TERMINATED_GRANT) or 501 (SUSPENDED_GRANT) o *cbsdId* (Response) == *cbsdId* (Request) o *grantId* (Response) == *grantId* (Request) *If any of the above conditions is not met, the SAS FAILS this test. If responseCode = 500, the SAS PASSES this test (do not perform any more steps). Otherwise, proceed.*
8	Wait 300 seconds, before the expiration of the Grant.
9	Using a DP Test Harness, CBSD send a Heartbeat for G1, with *operationState* = *GRANTED*.
CHECK	The SAS UUT response to the Heartbeat Request satisfies all of the following conditions: • The response shall contain 1 *heartbeatResponse* object. • For each *heartbeatResponse* object: o The *responseCode* = 500 (TERMINATED_GRANT) or 501 (SUSPENDED_GRANT) o *cbsdId* (Response) == *cbsdId* (Request) o *grantId* (Response) == *grantId* (Request) *If the any of the above conditions is not met, the SAS FAILS this test. Otherwise, it PASSES.*

6.5 CBSD Measurement Report

6.5.1 *Definition, Applicability, and Scope of the Test Case*

This section specifies test cases to validate SAS configuring CBSD measurement report based on CBSD measurement capability, based on CBSD measurement capability in the Registration Response Message. (please see the table below)

Table 6.5-1 Response Codes for CBSD Measurement Report Test Cases (Informative)

response Code	Name	Condition	Test Scenario	Test ID
0	SUCCESS	Either of following: • The CBSD Registration Procedure is completed with no error when the measurement capability is provided to the SAS UUT in the Registration Request. • The CBSD Heartbeat Procedure is completed with no error when the SAS UUT is triggered to notice the measurement configuration to the CBSD. • The other SAS-CBSD Procedure in which the request message includes the CBSD measurement report is completed with no error.	• Registration Request includes the measurement capability of the CBSD. • CBSD measurement report is provided through the Spectrum Inquiry Request. • CBSD measurement report is provided through the Grant Request. • CBSD measurement report is provided through the Heartbeat Request.	WINNF.FT.S.MES.1 WINNF.FT.S.MES.2
102	MISSING_PARAM	One or more "Required" parameters for measurement report are missing.	• "Required" parameter is missing from the measurement report in the Spectrum Inquiry Request. • "Required" parameter is missing from the measurement report in the Grant Request. • "Required" parameter is missing from the measurement report in the Heartbeat Request.	WINNF.FT.S.MES.1 WINNF.FT.S.MES.2

103	INVALID_ VALUE	One or more parameters with invalid value is provided to the SAS UUT as part of measurement reporting.	• Parameter of the measurement report in the Spectrum Inquiry Request is invalid. • Parameter of the measurement report in the Grant Request is invalid. • Parameter of the measurement report in the Heartbeat Request is invalid.	WINNF.FT.S.MES.1 WINNF.FT.S.MES.2

6.5.2   Test Characteristics

Table 6.5-2 CBSD Measurement Report Test Characteristics

1	**Test ID**	WINNF.FT.S.MES
2	**Title**	CBSD Measurement Report
3	**Working Group / Entity**	WG3
4	**Test Type**	Functional
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.9, 17]

6.5.3   Method of test

6.5.3.1   Initial Conditions / Test Pre-conditions

The typical pre-conditions of the test case are the following:
- The SAS UUT must be reset at the beginning of each test case to a baseline state.
- *cbsdId* is known (C)
- SAS has registered CBSD and for some of the test cases, issued approved a Grant Request with *grantId* G1.

6.5.4   Test Procedure

To exercise the possible types of successful measurement report mechanisms the following aspects are tested:
- CBSD measurement capability exchange
- CBSD measurement configuration through Registration Response
- CBSD measurement configuration through Grant Response
- CBSD measurement configuration through Heartbeat Response

6.5.4.1 [WINNF.FT.S.MES.1] Registration response with measurement report configuration

Step	Instructions
1	The DP Test Harness configures the SAS UUT to request measurement reporting based on the CBSD measurement capability. Make sure no *cbsdId* exists in SAS for the CBSD being tested. Ensure that the DP Test Harness sends a Registration Request Message with the *registrationRequest* parameter containing six elements, to the SAS UUT. All Required and REG-Conditional parameters are included. measCapability is set to "RECEIVED_POWER_WITHOUT_GRANT" for all CBSDs.
CHECK	SAS approves the requests by sending a CBSD Registration Response Message with *registrationResponse* parameter containing six elements: • Each element includes *cbsdId*. • Each element includes *measReportConfig* and sets it to "RECEIVED_POWER_WITHOUT_GRANT". • The *responseCode* is 0, concluding an approved Registration *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
2	The DP Test Harness issues a Spectrum Inquiry Request Message with the *spectrumInquiryRequest* parameter containing six elements. Each element includes valid *cbsdId* and *inquiredSpectrum*. The following measurement report parameters are configured for each CBSD, as defined in [n.16]: • CBSD 1: include *measReport*, which has an array of 15 elements of *rcvdPowerMeasReports*, each covering a measurement report for a 10 MHz channel in the band. All required parameters in the *rcvdPowerMeasReports* object are included with valid values. • CBSD 2: include *measReport*, which has an array of 15 elements of *rcvdPowerMeasReports*, each covering a measurement report for a 10 MHz channel in the band. *measFrequency* and *measBandwidth* in the *rcvdPowerMeasReports* object are included with valid values. *measRcvdPower* is not included in *rcvdPowerMeasReports*. • CBSD 3: include *measReport*, which has an array of 10 elements of *rcvdPowerMeasReports*, each covering a measurement report for a 10 MHz channel in the band. All required parameters in the *rcvdPowerMeasReports* object are included with valid values. • CBSD 4: *measReport* is included, but *rcvdPowerMeasReports* is not included in *measReport* • CBSD 5: *measReport* is not included • CBSD 6: include *measReport*, which has an array of 15 elements of *rcvdPowerMeasReports*, each covering a measurement report for a 10 MHz channel in the band. All required parameters in the *rcvdPowerMeasReports* object are included. *measBandwidth* is set to 15000000.
CHECK	The SAS UUT should send a Spectrum Inquiry Response Message with the following *responseCode* for each CBSD: • CBSD 1: *responseCode*=0 • CBSD 2: *responseCode*=102

	• CBSD 3: *responseCode*=102
	• CBSD 4: *responseCode*=102
	• CBSD 5: *responseCode*=102
	• CBSD 6: *responseCode*=103
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.
3	The DP Test Harness issues a Grant Request Message with the *grantRequest* parameter containing six elements. Each element includes valid *cbsdId* and *operationParam*. The following measurement report parameters are configured for each CBSD, as defined in [n.16]: • CBSD 1: include *measReport*, which has an array of 15 elements of *rcvdPowerMeasReports*, each covering a measurement report for a 10 MHz channel in the band. All required parameters in the *rcvdPowerMeasReports* object are included with valid values. • CBSD 2: include *measReport*, which has an array of 15 elements of *rcvdPowerMeasReports*, each covering a measurement report for a 10 MHz channel in the band. *measFrequency* and *measBandwidth* in the *rcvdPowerMeasReports* object are included with valid values. *measRcvdPower* is not included in *rcvdPowerMeasReports*. • CBSD 3: include *measReport*, which has an array of 10 elements of *rcvdPowerMeasReports*, each covering a measurement report for a 10 MHz channel in the band. All required parameters in the *rcvdPowerMeasReports* object are included with valid values. • CBSD 4: *measReport* is included, but *rcvdPowerMeasReports* is not included in measReport • CBSD 5: *measReport* is not included • CBSD 6: include *measReport*, which has an array of 15 elements of *rcvdPowerMeasReports*, each covering a measurement report for a 10 MHz channel in the band. All required parameters in the *rcvdPowerMeasReports* object are included. *measBandwidth* is set to 15000000.
CHECK	The SAS UUT should send a Grant Response Message with the following *responseCode* for each CBSD: • CBSD 1: *responseCode*=0 • CBSD 2: *responseCode*=102 • CBSD 3: *responseCode*=102 • CBSD 4: *responseCode*=102 • CBSD 5: *responseCode*=102 • CBSD 6: *responseCode*=103 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.5.4.2 [WINNF.FT.S.MES.2] Heartbeat response with measurement report configuration

Step	Instructions
1	The DP Test Harness configures the SAS UUT to request measurement reporting based on the CBSD measurement capability.
2	DP Test Harness sends a Registration Request for five CBSDs to the SAS UUT. *measCapability* shall be set to "RECEIVED_POWER_WITH_GRANT" for the first four CBSDs and set to "RECEIVED_POWER_WITHOUT_GRANT" for the fifth CBSD.

CHECK	The SAS response to the Registration Request Message must satisfy all of the following conditions:
	• The response shall contain five *RegistrationResponse* objects.
	• For each *registrationResponse* object:
	  o *responseCode* is 0 (success)
	  o *measReportConfig* does not contain "RECEIVED_POWER_WITH_GRANT"
	
	If all of the above conditions are met, the SAS PASSES this test. Otherwise, PROCEED

3	DP Test Harness sends a Grant Request for five CBSDs to the SAS UUT. Verify that the *responseCode* for each is SUCCESS.
4	The DP Test Harness sends a Heartbeat Request Message for the five CBSDs in the form of a five-element array of *HeartbeatRequest*, each element with *cbsdId* and *grantId* of the previously approved Grant.
CHECK	SAS UUT approves the request by sending a CBSD Heartbeat Response with the *heartbeatResponse* parameter containing 5 elements as follows: • SAS response includes the same *cbsdId* and *grantId*. • *transmitExpireTime* is set to a valid UTC time in the future. • For the first four elements, SAS includes *measReportConfig* and set it to "RECEIVED_POWER_WITH_GRANT". RECEIVED_POWER_WITHOUT_GRANT" should not be included in *measReportConfig* • *measReportConfig* is not set for the fifth element. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
5	Before *transmitExpireTime* in the previous Stage, the DP Test Harness issues a Heartbeat Request Message with the *heartbeatRequest* parameter containing five elements, each including all required parameters. The following measurement report parameters are configured for each CBSD, as defined in [n.16]: • CBSD 1: include *measReport*, which has one element of *rcvdPowerMeasReports*. All required parameters in the *rcvdPowerMeasReports* object are included with valid values. • CBSD 2: include *measReport*, which has one element of *rcvdPowerMeasReports*. *measBandwidth* and *measRcvdPower* are included in the *rcvdPowerMeasReports*. *measFrequency* is not included in *rcvdPowerMeasReports*.

	• CBSD 3: include *measReport*, which has one element of *rcvdPowerMeasReports*. All required parameters in the *rcvdPowerMeasReports* object are included. *measFrequency* is set to 3540000000. • CBSD 4: include *measReport*, but does not include *rcvdPowerMeasReports* in *measReport*. • CBSD 5: does not include *measReport*.
CHECK	The SAS UUT should send a Heartbeat Response Message with the following *responseCode* for each CBSD: • CBSD 1: *responseCode*=0 • CBSD 2: *responseCode*=102 • CBSD 3: *responseCode*=103 • CBSD 4: *responseCode*=102 • CBSD 5: *responseCode*=0 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.6 CBSD Spectrum Relinquish Procedure

6.6.1 Definition, Applicability, and Scope of the Test Case

This section specifies test steps, conditions, and procedures to test the conformance of CBSD Relinquishment Procedure.

A Relinquishment Request is issued by a CBSD to inform a SAS that one or more Grants are no longer being used by the CBSD.

The approach is for each test to create necessary conditions to trigger a Relinquish Response from SAS to a Relinquish request from a CBSD with all the defined *responseCode* parameters in [n.9], both successful Relinquishments (*responseCode* 0) and unsuccessful Relinquishments (other *responseCode*s). (please see the table below)

Table 6.6-1 Response Codes for CBSD Grant Relinquishment Procedure Test Cases (Informative)

response Code	Name	Condition	Test Scenario	Test ID
0	SUCCESS	The SAS UUT completes the Grant Relinquishment Process with no error.	• Multiple Iterative Grant Relinquishments • Array Grant Relinquishment Request	WINNF.FT.S.RLQ.1 WINNF.FT.S.RLQ.2

100	VERSION	The version number of the SAS-CBSD protocol used by the CBSD Test Harness is not supported by the SAS UUT.	• The CBSD Test Harness sends the request message using the URL of the SAS UUT including the newer protocol version than the most recent SAS-CBSD Protocol version supported by the SAS UUT.	WINNF.FT.S.RLQ.4
102	MISSING_ PARAM	One or more "Required" parameters are missing.	• "Required" parameter is missing from the request.	WINNF.FT.S.RLQ.5
103	INVALID_ VALUE	One or more parameters with invalid value are provided to the SAS UUT	• Invalid *cbsdId* is provided to the SAS UUT • Invalid Grant ID is provided to the SAS UUT • Relinquished Grant ID is provided to the SAS UUT.	WINNF.FT.S.RLQ.3

6.6.2   Test Characteristics

Table 6.6-2 CBSD Spectrum Relinquish Procedure Test Characteristics

1	**Test ID**	WINNF.FT.S.RLQ
2	**Title**	CBSD Spectrum Relinquish Procedure
3	**Working Group / Entity**	WG3
4	**Test Type**	Functional
5	**Test Class**	Certification
6	**Component / Interface**	SAS/CBSD ⬅ ➡ SAS
7	**Target Specification / Feature**	[n.9]

6.6.3   Method of test

6.6.3.1   Initial Conditions / Test Pre-conditions

The typical pre-conditions of the test case are the following:
• The SAS UUT must be reset at the beginning of each test case to a baseline state.

6.6.4   Test Procedure

To exercise the possible types of successful Relinquishment Requests the following three types of Grant Relinquishment Requests are tested:

- Grant and Relinquishment of a single Grant
- Three Grants, iteratively relinquished
- Three Grants, simultaneously relinquished as an array of three Relinquishment Requests

For invalid Relinquishment Requests, the following types of Grant Relinquishment Requests are tested:

- Grant and Relinquishment of a single Grant with an error
- Three Grants, requested for release in an array, with an error in one element of the array

6.6.4.1   [WINNF.FT.S.RLQ.1] Multiple Iterative Grant Relinquishments:

Step	Instructions
1	Ensure the following conditions hold: • A CBSD registers with SAS UUT; *cbsdId* (C)
2	DP Test Harness successfully requests two Grants for two non-overlapping channels (G1, G2)
3	DP Test Harness sends Relinquishment Request Message to SAS including *cbsdId* (C) and *grantId* G1 in correct format
CHECK	Ensure the following in the Relinquishment Response Message from SAS • *cbsdId* = C • *grantId* = G1 • *responseCode* (Response) = 0 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
4	DP Test Harness sends Relinquishment Request Message to SAS including *cbsdId* and *grantId* G2 in correct format
CHECK	Verify the following in the Relinquishment Response Message from SAS • *cbsdId* = C • *grantId* = G2 • *responseCode* (Response) = 0 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
5	DP Test Harness sends a Heartbeat Request Message with the *heartbeatRequest* parameter containing two elements, before the *grantExpireTime* in Step 2. The elements include (C, G1) and (C, G2) respectively.
CHECK	SAS responds with a Heartbeat Response Message with *heartbeatResponse* parameter containing two elements as follows: • Each element includes the valid *cbsdId* C • The *responseCode* set to 103, concluding a failed operation due to invalid parameters.

- *transmitExpireTime* set to a value equal or less than the *transmitExpireTime* in the previous successful Heartbeat response. If this is the first Heartbeat response, any value for *transmitExpireTime* is acceptable.

If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.6.4.2 [WINNF.FT.S.RLQ.2] Multiple Grant Relinquishments: Successful Simultaneous Relinquishment Request of Multiple Grants (*responseCode* 0)

Step	Instructions
1	Ensure the following conditions hold: • A CBSD registers with SAS UUT; *cbsdId* (C)
2	DP Test Harness successfully requests three Grants for three non-overlapping channels (G1, G2, G3)
3	DP Test Harness sends Relinquishment Request Message to SAS including *cbsdId* and *grantId* Parameters G1-G3 in correct format.
CHECK	Verify the following for all Relinquishment objects in the Relinquishment Response Message from SAS: For the first element: • *cbsdId* = C • *grantId* = G1 • *responseCode* (Response) = 0 For the second element: • *cbsdId* = C • *grantId* = G2 • *responseCode* (Response) = 0 For the third element: • *cbsdId* = C • *grantId* = G3 • *responseCode* (Response) = 0 I *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
4	DP Test Harness sends a Heartbeat Request Message with the *heartbeatRequest* parameter containing 3 elements before the *grantExpireTime* in Step 2. The elements contain (C, G1) and (C, G2), and (C, G3) respectively.
CHECK	SAS sends a Heartbeat Response Message with the *heartbeatResponse* parameter containing three elements as follows: • Each element includes the valid *cbsdId* • The *responseCode* set to 103, concluding a failed operation due to invalid parameters. • *transmitExpireTime* set to a value equal or less than the *transmitExpireTime* in the previous successful Heartbeat response. If this is the first Heartbeat response, any value for *transmitExpireTime* is acceptable.

If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.6.4.3 [WINNF.FT.S.RLQ.3] Invalid Parameter in Relinquishment Request-Array Request

Step	Instructions
1	Ensure: • *cbsdId* (C1) does not exist in SAS • *grantId* (G1) does not exist in SAS
2	Ensure the following conditions hold: • DP Test Harness registers 2 CBSDs with SAS UUT; *cbsdId* (C2, C4)
3	DP Test Harness successfully requests two Grants for two non-overlapping channels (G2, G3) for CBSD C2, and one Grant for CBSD C4 (G4)
4	DP Test Harness sends Relinquishment Request Message to SAS including *cbsdId* (C2) and *grantId* (G3) in correct format, and receives a successful response from SAS with *responseCode* (Response) = 0.
5	DP Test Harness sends Relinquishment Request Message with the *relinquishmentRequest* parameter containing 5 elements. The elements contain *cbsdId* and *grantId* parameters in correct format with the following pairings: • C1, G2 • C2, G1 • C1, G1 • C2, G4 • C2, G3
CHECK	Verify the following for all Relinquishment objects in the Relinquishment Response Message with the *relinquishmentResponse* parameter containing 5 elements as follows: For the first element: • No *cbsdId* • No *grantId* • *responseCode* (Response) = 103 For the second element: • *cbsdId* = C2 • No *grantId* • *responseCode* = 103 For the third element: • No *cbsdId* • No *grantId* • *responseCode* = 103 For the fourth element: • *cbsdId* = C2 • No *grantId* • *responseCode* = 103 For the fifth element: • *cbsdId* = C2

- No *grantId*
- *responseCode* = 103

If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.6.4.4 [WINNF.FT.S.RLQ.4] Protocol Not Supported by SAS-Array Request

Step	Instructions
1	Ensure the following conditions hold: • A CBSD registers with SAS UUT; *cbsdId* (C) • The CBSD successfully requests three Grants for three non-overlapping channels (G1, G2, G3) • The most recent SAS-CBSD protocol version is known
2	Configure DP Test Harness to use a protocol version newer than the most recent SAS-CBSD protocol version supported by SAS
3	DP Test Harness sends Relinquishment Request Message with the *relinquishmentRequest* parameter containing 3 elements. The elements contain *cbsdId* and *grantId* parameters G1-G3 in correct format with the following pairings: • C, G1 • C, G2 • C, G3
CHECK	Verify the following for all Relinquishment objects in the Relinquishment Response Message with the *relinquishmentResponse* parameter containing 3 elements as follows: For the first element: • *cbsdId* = C • *grantId* = G1 • *responseCode* = 100 For the second element: • *cbsdId* = C • *grantId* = G2 • *responseCode* = 100 For the third element: • *cbsdId* = C • *grantId* = G3 • *responseCode* = 100 Alternatively, the SAS can return HTTP status code 404. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.6.4.5 [WINNF.FT.S.RLQ.5] Missing Parameter -Array Request

Step	Instructions
1	Ensure the following conditions hold: • A CBSD registers with SAS UUT; *cbsdId* (C)
2	The CBSD successfully requests three Grants for three non-overlapping channels (G1, G2, G3)
3	DP Test Harness sends Relinquishment Request Message with the *relinquishmentRequest* parameter containing 3 elements. The elements contain *cbsdId* and *grantId* parameters G1-G3 in correct format with the following pairings: • C, (Missing G1) • (Missing C, G2) • (Missing C), G3
CHECK	Verify the following for all Relinquishment objects in the Relinquishment Response Message with the *relinquishmentResponse* parameter containing 3 elements as follows: For the first element: • *cbsdId* = C • No *grantId* • *responseCode* (Response) = 102 For the second element: • No *cbsdId* • No *grantId* • *responseCode* = 102 For the third element: • No *cbsdId* • No *grantId* • *responseCode* = 102 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.6.4.6 [WINNF.FT.S.RLQ.6] [Configurable] Multiple Relinquishments

This configurable array test covers Relinquishment Request(s) for CBSDs with existing Grants, including Relinquishment Requests for multiple iterative Grants, simultaneous Relinquishment of multiple Grants and array relinquishment requests; and Relinquishment Requests with missing parameters. The test will check the number of and value of the Relinquishment SAS UUT *responseCode*(s) to see if they match the expected *responseCode*(s) as specified in the respective input configuration file.

Step	Instructions
1	Configure the SAS UUT to whitelist the FCC IDs and user IDs corresponding to the RegistrationRequest which will be sent in Step 2.

2	DP Test Harness sends a valid Registration Request Message with the *registrationRequest* parameter containing N1 >= 0 CBSDs. Verify that the *responseCode* for each is SUCCESS.
3	DP Test Harness sends a valid Grant Request with the *grantRequest* parameter containing N2 >= 0 elements. Verify that the *responseCode* for each is SUCCESS.
4	DP Test Harness sends a Relinquishment Request Message with the *relinqushmentRequest* parameter containing N3 >= 0 elements.

CHECK	The SAS response to the Relinquishment Request must satisfy all of the following conditions:
	
	• The *relinquishmentResponse* parameter contains N3 elements.
	• For each element:
	    o The *responseCode* shall match the corresponding expected *responseCode* listed in the configuration file.
	    o If the corresponding request contained a valid *cbsdId* and *grantId*, the response shall contain the same *grantId*.
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.

5	DP Test Harness sends a Relinquishment Request Message with the *relinqushmentRequest* parameter containing N4 >= 0 elements.

CHECK	The SAS response to the Relinquishment Request Message must satisfy all of the following conditions:
	
	• The *relinquishmentResponse* parameter contains N4 elements.
	• For each element:
	    o The *responseCode* shall match the corresponding expected *responseCode* listed in the configuration file.
	    o If the corresponding request contained a valid *cbsdId* and *grantId*, the response shall contain the same *grantId*.
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.7 CBSD Deregistration Procedure

6.7.1 Definition, Applicability, and Scope of the Test Case

This section explains test steps, conditions, and procedures for SAS Deregistration Response to a CBSD Deregistration Request. (please see the table below for the *responseCode*s)

Table 6.7-1 Response Codes for CBSD Deregistration Procedure Test Cases (Informative)

response Code	Name	Condition	Test Scenario	Test ID
0	SUCCESS	The SAS UUT completes the Deregistration process with no error.	• Array Deregistration Request	WINNF.FT.S.DRG.1 WINNF.FT.S.DRG.2 WINNF.FT.S.DRG.3 WINNF.FT.S.DRG.4
102	MISSING_ PARAM	One or more "Required" parameters are missing.	• *cbsdId* is missing.	WINNF.FT.S.DRG.2
103	INVALID_ VALUE	One or more parameters with invalid value is provided to the SAS UUT.	• Invalid *cbsdId* is provided to the SAS UUT. • *cbsdId* that has been deregistered is provided to the SAS UUT. • Heartbeat Procedure after the CBSD Deregistration Procedure for the CBSD that has a Grant.	WINNF.FT.S.DRG.3 WINNF.FT.S.DRG.4 WINNF.FT.S.DRG.5

6.7.2   Test Characteristics

Table 6.7-2 CBSD Deregistration Procedure Test Characteristics

1	**Test ID**	WINNF.FT.S.DRG
2	**Title**	CBSD Deregistration Procedure
3	**Working Group / Entity**	WG3
4	**Test Type**	Functional
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.9]

6.7.3   Method of test

6.7.3.1   Initial Conditions / Test Pre-conditions

The typical pre-conditions of the test case are the following:
• The SAS UUT must be reset at the beginning of each test case to a baseline state.

6.7.4   Test Procedure

6.7.4.1   [WINNF.FT.S.DRG.1] Valid and correct *cbsdId*: two *DeregistrationRequest* objects

Step	Instructions
1	DP Test Harness registers *cbsdId* (C1) and (C2) with SAS UUT.
2	DP Test Harness sends Deregistration Request Message with the *deregistrationRequest* parameter containing two elements to the SAS UUT. The two elements shall have *cbsdId* parameters C1 and C2 in that order.
CHECK	Verify the following in the Deregistration Response Message from SAS UUT: • The *deregistrationResponse* parameter contains two elements • The first element: ○ *cbsdId* = C1. ○ *responseCode* = 0 • The second element: ○ *cbsdId* = C2. ○ *responseCode* = 0 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
4	The CBSDs C1 and C2 send a Grant Request Message with their *cbsdId parameters* to SAS UUT
CHECK	SAS responds with a Grant Response as follows: • The *responseCode* is 103 for both CBSDs *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.7.4.2 [WINNF.FT.S.DRG.2] Missing *cbsdId*: two elements in the *DeregistrationRequest* parameter

Step	Instructions
1	DP Test Harness registers *cbsdId* (C1) and (C2) with SAS UUT.
2	DP Test Harness sends Deregistration Request to the SAS UUT with the *deregistrationRequest* parameter containing two elements such that the first element has C1 as the *cbsdId*, but the second element does not have *cbsdId*
CHECK	Verify the following in the Deregistration Response Message from SAS UUT: • The *deregistrationResponse* parameter contains two elements • *cbsdId* in the first element = C1 • *responseCode* in the first element = 0 • No *cbsdId* in the element object • *responseCode* in the second element = 102 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.7.4.3 [WINNF.FT.S.DRG.3] *cbsdId* initially exists, CBSD deregisters first by sending Deregistration request. Then sends another Deregistration request to check that SAS has indeed erased the CBSD information from its database.

Step	Instructions
Step	Instructions

1	DP Test Harness registers *cbsdId* (C) with SAS UUT.
2	DP Test Harness sends Deregistration Request Message with the *deregistrationRequest* parameter containing one element which has *cbsdId* = C.
CHECK	Verify the following in the Deregistration Response Message from SAS UUT: • The *deregistrationResponse* parameter contains one element • *cbsdId* = C • *responseCode* =0 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	DP Test Harness sends another Deregistration Request Message with the *deregistrationResponse* parameter containing one element which has *cbsdId* = C, which was deregistered in the previous request.
CHECK	Verify the following in the Deregistration Response Message from SAS UUT: • The *deregistrationResponse* parameter contains one element • No *cbsdId* • *responseCode* = 103 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.7.4.4 [WINNF.FT.S.DRG.4] *cbsdId* value invalid: two request objects

Step	Instructions
1	Ensure the following conditions hold: • DP Test Harness registers *cbsdId* (C1) with SAS • *cbsdId* (C2) does not exist in SAS
2	DP Test Harness sends Deregistration Request Message to the SAS UUT with the *deregistrationResponse* parameter containing two elements such that the first element has C1 as the *cbsdId*, and the second element has C2 as *cbsdId*.
CHECK	Verify the following in the Deregistration Response Message from SAS UUT: • The *deregistrationResponse* parameter contains two elements • *cbsdId* in the first element = C1 • *responseCode* in the first element = 0 • No *cbsdId* in the second element • *responseCode* in the second element = 103 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.7.4.5 [WINNF.FT.S.DRG.5] *cbsdId* initially exists with a Grant, CBSD deregisters, then re-registers and attempts to use the old *grantId* (verifying that SAS deletes Grants on Deregistration).

Step	Instructions
Step	Instructions

1	DP Test Harness registers *cbsdId* (C) with SAS UUT. No Protected Entity are present.
2	The DP Test Harness successfully requests Grant for a PAL or GAA channel. Ensure the CBSD successfully exchanges Heartbeat with SAS UUT and is in the *Authorized* state
3	DP Test Harness sends a successful Deregistration Request Message to the SAS UUT with the *deregistrationResponse* parameter containing one element which has *cbsdId* = C.
4	DP Test Harness sends a successful Registration Request Message with the *registrationRequest* parameter containing one element with the same Registration parameters as was sent to get *cbsdId* = C in Step 1.
5	DP Test Harness sends a Heartbeat Request Message that is otherwise valid, except that it sets its *grantId* = G, which the SAS shall have deleted.
CHECK	SAS UUT shall respond with the *responseCode* set to 103, concluding a failed operation due to invalid parameters. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.7.4.6 [WINNF.FT.S.DRG.6] [Configurable] Array Deregistration

This configurable array test covers Deregistration Request(s) for existing CBSDs, and can include Deregistration Requests with valid and invalid *cbsdId*s, missing *cbsdId*s, iterative Deregistrations, and where a CBSD reregisters, and sends a *HeartbeatRequest* with an old *grantId*. The test will check the number of and value of the Deregistration SAS UUT *responseCode*(s) to see if they match the expected *responseCode*(s) as specified in the respective input configuration file.

Step	Instructions
1	Configure the SAS UUT to whitelist the FCC IDs and user IDs corresponding to the RegistrationRequest which will be sent in Step 2.
2	DP Test Harness sends a valid Registration Request Message the *registrationRequest* parameter containing N1 > 0 elements. Verify that the *responseCode* for each is SUCCESS.
3	DP Test Harness sends a valid Grant Request Message with the *grantRequest* parameter containing N1 elements (one per registered CBSD). Verify that the *responseCode* for each is SUCCESS.
4	DP Test Harness sends a valid Heartbeat Request Message with the *heartbeatRequest* parameter containing N1 elements. Verify that the *responseCode* for each is SUCCESS.
5	DP Test Harness sends a Deregistration Request Message with the *deregistrationRequest* parameter containing N1 elements.
CHECK	The SAS UUT response to the Deregistration Request Message must satisfy all of the following conditions: • The *deregistrationResponse* parameter contains N1 elements. • For each element: o The *responseCode* shall match the corresponding expected response code listed in the configuration file.

	o If the corresponding request contained a valid *cbsdId*, the response shall contain the same *cbsdId*. Otherwise, verify that the response does not contain a *cbsdId* *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
6	Send the Deregistration Request Message from Step 5.

CHECK	The SAS UUT response to the Deregistration Request Message must satisfy all of the following conditions:
	• The *deregistrationResponse* parameter shall contain N1 elements.
	• For each element:
	  o If the corresponding *responseCode* in the previous Deregistration Response Message was 102 (MISSING_PARAM), the *responseCode* shall be 102.
	  o Otherwise, the *responseCode* shall be INVALID_VALUE or DEREGISTER.
	  o In all cases, the response shall not contain a *cbsdId*.
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.

7	DP Test Harness sends the Registration Request Message from Step 2. Verify that the *responseCode* for each is SUCCESS.
8	DP Test Harness sends the Heartbeat Request Message from Step 4.
CHECK	The SAS UUT response to the Heartbeat Request Message must satisfy all of the following conditions: • The *heartbeatResponse* parameter shall contain N1 elements. • For each element: o The *responseCode* shall be either INVALID_VALUE or TERMINATED_GRANT. *If the any of the above conditions is not met, the SAS FAILS this test. Otherwise, it PASSES.*

6.8   CBSD Device Security Validation

6.8.1   Definition, Applicability, and Scope of the Test Case

This section explains test steps, conditions, and procedures for SAS validation of CBSD security credentials.

6.8.2   Test Characteristics

Table 6.8-1 CBSD Device Security Validation Test Characteristics

1	**Test ID**	WINNF.FT.S.SCS
2	**Title**	CBSD Device Security Validation
3	**Working Group / Entity**	WG2/WG3
4	**Test Type**	Functional

5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.9]

6.8.3   Method of test

6.8.3.1   Initial Conditions / Test Pre-conditions

– The SAS may be placed in a test configuration so that test certificates can be used for testing.
– Valid certificates must be created according to the guidelines given in [n.8]. Sample code for creating test certificates is provided in [i.1]. If such test code is used, the SAS must be configured to use the test certificate root of trust.
– The certificates required to perform the test cases may be created by the sample code provided in [i.1] or provided by a valid CBRS root of trust CA
– The SAS UUT must be reset at the beginning of each test case to a baseline state.

6.8.4   Test Procedure

6.8.4.1   [WINNF.FT.S.SCS.1] New Registration with TLS_RSA_WITH_AES_128_GCM_SHA256 ciphersuite (No existing *cbsdId*)

Step	Instructions
1	Replace the CBSD Test Harness certificate with a valid certificate
2	CBSD Test Harness attempts to establish a TLS session with the SAS UUT using a TLS_RSA_WITH_AES_128_GCM_SHA256 ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • The SAS UUT agrees to use the TLS_RSA_WITH_AES_128_GCM_SHA256 ciphersuite • The SAS UUT agrees to use TLS Protocol Version 1.2 (server_version = 3.3) • Valid Finished message is returned by the SAS UUT immediately following the ChangeCipherSpec message *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	CBSD Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object is 0, concluding an approved Registration • Verify that the response contains a valid *cbsdId*. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.8.4.2 [WINNF.FT.S.SCS.2] New Registration with TLS_RSA_WITH_AES_256_GCM_SHA384 ciphersuite (No existing *cbsdId*)

Step	Instructions
1	Replace the CBSD Test Harness certificate with a valid certificate
2	CBSD Test Harness attempts to establish a TLS session with the SAS UUT using a TLS_RSA_WITH_AES_256_GCM_SHA384 ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • The SAS UUT agrees to use the TLS_RSA_WITH_AES_256_GCM_SHA384 ciphersuite • The SAS UUT agrees to use TLS Protocol Version 1.2 (server_version = 3.3) • Valid Finished message is returned by the SAS UUT immediately following the ChangeCipherSpec message *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	CBSD Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object is 0, concluding an approved Registration • Verify that the response contains a valid *cbsdId*. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.8.4.3 [WINNF.FT.S.SCS.3] New Registration with TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 (No existing *cbsdId*)

Step	Instructions
1	Replace the CBSD Test Harness certificate with a valid certificate
2	CBSD Test Harness attempts to establish a TLS session with the SAS UUT using a TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • The SAS UUT agrees to use the TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 ciphersuite • The SAS UUT agrees to use TLS Protocol Version 1.2 (server_version = 3.3) • Valid Finished message is returned by the SAS UUT immediately following the ChangeCipherSpec message *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	CBSD Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object is 0, concluding an approved Registration

- Verify that the response contains a valid *cbsdId*.

If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.8.4.4 [WINNF.FT.S.SCS.4] New Registration with TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384 (No existing *cbsdId*)

Step	Instructions
1	Replace the CBSD Test Harness certificate with a valid certificate
2	CBSD Test Harness attempts to establish a TLS session with the SAS UUT using a TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384 ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • The SAS UUT agrees to use the TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384 ciphersuite • The SAS UUT agrees to use TLS Protocol Version 1.2 (server_version = 3.3) • Valid Finished message is returned by the SAS UUT immediately following the ChangeCipherSpec message *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	CBSD Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object is 0, concluding an approved Registration • Verify that the response contains a valid *cbsdId*. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.8.4.5 [WINNF.FT.S.SCS.5] New Registration with TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 (No existing *cbsdId*)

Step	Instructions
1	Replace the CBSD Test Harness certificate with a valid certificate
2	CBSD Test Harness attempts to establish a TLS session with the SAS UUT using a TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • The SAS UUT agrees to use the TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 ciphersuite • The SAS UUT agrees to use TLS Protocol Version 1.2 (server_version = 3.3) • Valid Finished message is returned by the SAS UUT immediately following the ChangeCipherSpec message *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*

3	CBSD Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object is 0, concluding an approved Registration • Verify that the response contains a valid *cbsdId*. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.8.4.6 [WINNF.FT.S.SCS.6] Unrecognized root of trust certificate presented during Registration.

Step	Instructions
1	Replace the CBSD Test Harness certificate with an invalid certificate. This certificate shall be valid except for being signed by a root of trust not recognized by the SAS.
2	CBSD Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite

CHECK	The SAS UUT response must satisfy the following condition:
	 • Either the HTTP status code is 403 (Forbidden)
	 • Or
	     o The SAS UUT sends a fatal alert message with the following parameters:
	        ▪ AlertLevel = 2 (fatal)
	     o The SAS UUT immediately terminates the TLS session
	
	 If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.8.4.7 [WINNF.FT.S.SCS.7] Corrupted certificate presented during Registration.

Step	Instructions
1	Replace the CBSD Test Harness certificate with an invalid certificate. This certificate shall be valid except for being corrupted.
2	CBSD Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite

CHECK	The SAS UUT response must satisfy the following condition:
	 • Either the HTTP status code is 403 (Forbidden)
	 • Or
	     o The SAS UUT sends a fatal alert message with the following parameters:
	        ▪ AlertLevel = 2 (fatal)
	     o The SAS UUT immediately terminates the TLS session
	
	 If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.8.4.8 [WINNF.FT.S.SCS.8] Self-signed certificate presented during Registration.

Step	Instructions
1	Replace the CBSD Test Harness certificate with an invalid certificate. This certificate shall be valid except for being self-signed.
2	CBSD Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy the following condition: • Either the HTTP status code is 403 (Forbidden) • Or ○ The SAS UUT sends a fatal alert message with the following parameters: ▪ AlertLevel = 2 (fatal) ○ The SAS UUT immediately terminates the TLS session *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.8.4.9 [WINNF.FT.S.SCS.9] Non-CBRS trust root signed certificate presented during Registration.

Step	Instructions
1	Replace the CBSD Test Harness certificate with an invalid certificate. This certificate shall be valid except for being signed by a non-CBRS trust root.
2	CBSD Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy the following condition: • Either the HTTP status code is 403 (Forbidden) • Or ○ The SAS UUT sends a fatal alert message with the following parameters: ▪ AlertLevel = 2 (fatal) ○ The SAS UUT immediately terminates the TLS session *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.8.4.10 [WINNF.FT.S.SCS.10] Certificate of wrong type presented during Registration.

Step	Instructions
1	Replace the CBSD Test Harness certificate with an invalid certificate. This certificate shall be valid except for being a certificate of the wrong type but having correct signatures descending from the CBRS trust root (e.g. a SAS certificate, not a CBSD certificate)

2	CBSD Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite

CHECK	The SAS UUT response satisfies all of the following conditions:
	   • The SAS UUT sends a fatal alert message with the following parameters:
	      ○ AlertLevel = 2 (fatal)
	   • The SAS UUT immediately terminates the TLS session
	
	If all of the above conditions are met, the SAS UUT PASSES this test. If a TLS session is established, proceed.

3	CBSD Test Harness sends a valid Registration Request to the SAS UUT

CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions:
	   • The *responseCode* in Response Data Object is 104, concluding a failed Registration.
	   • The SAS UUT immediately terminates the TLS session
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.8.4.11 [WINNF.FT.S.SCS.11] Blacklisted certificate presented during Registration.

Step	Instructions
1	Replace the CBSD Test Harness certificate with an invalid certificate. This certificate shall be a valid certificate which the SAS has been configured to blacklist (from a test input of the form an enforcement action would take).
2	CBSD Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite

CHECK	The SAS UUT response must satisfy the following condition:
	   • Either the HTTP status code is 403 (Forbidden)
	   • Or
	      ○ The SAS UUT sends a fatal alert message with the following parameters:
	         ▪ AlertLevel = 2 (fatal)
	      ○ The SAS UUT immediately terminates the TLS session
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.8.4.12 [WINNF.FT.S.SCS.12] Expired certificate presented during Registration.

Step	Instructions
1	Replace the CBSD Test Harness certificate with an invalid certificate. This certificate shall be a valid but expired certificate.
2	CBSD Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy the following condition:

- Either the HTTP status code is 403 (Forbidden)
- Or
    - The SAS UUT sends a fatal alert message with the following parameters:
        - AlertLevel = 2 (fatal)
    - The SAS UUT immediately terminates the TLS session

If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.8.4.13 [WINNF.FT.S.SCS.13] Disallowed TLS method attempted during Registration.

Step	Instructions
1	Replace the CBSD Test Harness certificate with a valid certificate
2	CBSD Test Harness attempts to establish a TLS handshake using a disallowed method (e.g. TLS v1.1 per [n.8]) with the SAS UUT
CHECK	The SAS UUT response must satisfy the following condition: • Either the HTTP status code is 403 (Forbidden) • Or ○ The SAS UUT sends a fatal alert message with the following parameters: ▪ AlertLevel = 2 (fatal) ○ The SAS UUT immediately terminates the TLS session *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.8.4.14 [WINNF.FT.S.SCS.14] Invalid ciphersuite presented during Registration.

Step	Instructions
1	Replace the CBSD Test Harness certificate with a valid certificate
2	CBSD Test Harness attempts to establish a TLS handshake with the SAS UUT using a ciphersuite specifically not allowed by [n.8].
CHECK	The SAS UUT response must satisfy the following condition: • Either the HTTP status code is 403 (Forbidden) • Or ○ The SAS UUT sends a fatal alert message with the following parameters: ▪ AlertLevel = 2 (fatal) ○ The SAS UUT immediately terminates the TLS session *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.8.4.15 [WINNF.FT.S.SCS.15] Certificate with inapplicable fields presented during Registration.

Step	Instructions
1	Replace the CBSD Test Harness certificate with an invalid certificate. This certificate shall be valid except for being configured to contain at least one inapplicable field for ROLE:CBSD (FRN, CPIRID, ZONE, or FREQUENCY)
2	CBSD Test Harness attempts to establish a TLS handshake with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • A valid TLS session is established *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	CBSD Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object is 104, concluding a failed Registration. • The SAS UUT immediately terminates the TLS session *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.8.4.16 [WINNF.FT.S.SCS.16] Certificate signed by a revoked sub-CA presented during Registration.

Step	Instructions
1	Replace the CBSD Test Harness certificate with an invalid certificate. This certificate shall be a valid certificate signed by a previously valid certificate that has since been revoked
2	CBSD Test Harness attempts to establish a TLS handshake with the SAS UUT using a valid ciphersuite

CHECK	The SAS UUT response must satisfy the following condition:
	• Either the HTTP status code is 403 (Forbidden)
	• Or
	  o The SAS UUT sends a fatal alert message with the following parameters:
	    ▪ AlertLevel = 2 (fatal)
	  o The SAS UUT immediately terminates the TLS session
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.8.4.17 [WINNF.FT.S.SCS.17] Invalid certificate following an approved Registration Request

Step	Instructions
1	Replace the CBSD Test Harness certificate with a valid certificate, Cr1
2	CBSD Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • A valid TLS session is established *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	CBSD Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object shall be 0, concluding an approved Registration • Verify that the response contains a valid *cbsdId*, C1 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
4	Make certificate, Cr1, invalid. This may be accomplished by waiting until a time after the validity period for the certificate or by adding the certificate to the CRL server.
5	CBSD Test Harness attempts to re-establish the TLS session established in Step 2
CHECK	The SAS UUT response must satisfy the following condition: • Either the HTTP status code is 403 (Forbidden) • Or ○ The SAS UUT sends a fatal alert message with the following parameters: ▪ AlertLevel = 2 (fatal) ○ The SAS UUT immediately terminates the TLS session *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.8.4.18 [WINNF.FT.S.SCS.18] Invalid certificate following an approved Grant Request

Step	Instructions
1	Replace the CBSD Test Harness certificate with a valid certificate, Cr1
2	CBSD Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • A valid TLS session is established *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	CBSD Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object shall be 0, concluding an approved Registration • Verify that the response contains a valid *cbsdId*, C1

	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.
4	CBSD Test Harness sends a valid Grant Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object shall be 0, concluding an approved Registration • Verify that the response contains a valid *grantId*, G1 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
5	Make certificate, Cr1, invalid. This may be accomplished by waiting until a time after the validity period for the certificate or by adding the certificate to the CRL server.
6	CBSD Test Harness attempts to re-establish the TLS session established in Steps 2 and 4

CHECK	The SAS UUT response must satisfy the following condition:
	• Either the HTTP status code is 403 (Forbidden)
	• Or
	    o The SAS UUT sends a fatal alert message with the following parameters:
	        ▪ AlertLevel = 2 (fatal)
	    o The SAS UUT immediately terminates the TLS session
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.8.4.19 [WINNF.FT.S.SCS.19] Invalid certificate following an approved Heartbeat Request

Step	Instructions
1	Replace the CBSD Test Harness certificate with a valid certificate, Cr1
2	CBSD Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • A valid TLS session is established *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	CBSD Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object shall be 0, concluding an approved Registration • Verify that the response contains a valid *cbsdId*, C1 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
4	CBSD Test Harness sends a valid Grant Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions:

	• The *responseCode* in Response Data Object shall be 0, concluding an approved Registration • Verify that the response contains a valid *grantId*, G1 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
5	CBSD Test Harness sends a valid Heartbeat Request to the SAS UUT
CHECK	The SAS UUT response to the Heartbeat Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object shall be 0, concluding an approved Heartbeat *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
6	Make certificate, Cr1, invalid. This may be accomplished by waiting until a time after the validity period for the certificate or by adding the certificate to the CRL server.
7	CBSD Test Harness attempts to re-establish the TLS session established in Steps 2, 4, and 5

CHECK	The SAS UUT response must satisfy the following condition:
	• Either the HTTP status code is 403 (Forbidden)
	• Or
	   ○ The SAS UUT sends a fatal alert message with the following parameters:
	      ▪ AlertLevel = 2 (fatal)
	   ○ The SAS UUT immediately terminates the TLS session
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.8.4.20 [WINNF.FT.S.SCS.20] Deprecated; the Test ID is Reserved

6.9 Domain Proxy Security Validation

6.9.1 *Definition, Applicability, and Scope of the Test Case*

This section explains test steps, conditions, and procedures for SAS validation of DP security credentials.

6.9.2 *Test Characteristics*

Table 6.9-1 Domain Proxy Security Validation Test Characteristics

1	**Test ID**	WINNF.FT.S.SDS
2	**Title**	Domain Proxy Security Validation
3	**Working Group / Entity**	WG2/WG3
4	**Test Type**	Functional

5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.9]

6.9.3   Method of test

6.9.3.1   Initial Conditions / Test Pre-conditions

− The SAS may be placed in a test configuration so that test certificates can be used for testing.
− Valid certificates must be created according to the guidelines given in [n.8]. Sample code for creating test certificates is provided in [i.1]. If such test code is used, the SAS must be configured to use the test certificate root of trust.
− The certificates required to perform the test cases may be created by the sample code provided in [i.1] or provided by a valid CBRS root of trust CA
− The SAS UUT must be reset at the beginning of each test case to a baseline state.

6.9.4   Test Procedure

6.9.4.1   [WINNF.FT.S.SDS.1] New Registration with TLS_RSA_WITH_AES_128_GCM_SHA256 ciphersuite (No existing *cbsdId*)

Step	Instructions
1	Replace the DP Test Harness certificate with a valid certificate
2	DP Test Harness attempts to establish a TLS session with the SAS UUT using a TLS_RSA_WITH_AES_128_GCM_SHA256 ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • The SAS UUT agrees to use the TLS_RSA_WITH_AES_128_GCM_SHA256 ciphersuite • The SAS UUT agrees to use TLS Protocol Version 1.2 (server_version = 3.3) • Valid Finished message is returned by the SAS UUT immediately following the ChangeCipherSpec message *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	DP Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object is 0, concluding an approved Registration • Verify that the response contains a valid *cbsdId*. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.9.4.2 [WINNF.FT.S.SDS.2] New Registration with
TLS_RSA_WITH_AES_256_GCM_SHA384 ciphersuite (No existing *cbsdId*)

Step	Instructions
1	Replace the DP Test Harness certificate with a valid certificate
2	DP Test Harness attempts to establish a TLS session with the SAS UUT using a TLS_RSA_WITH_AES_256_GCM_SHA384 ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • The SAS UUT agrees to use the TLS_RSA_WITH_AES_256_GCM_SHA384 ciphersuite • The SAS UUT agrees to use TLS Protocol Version 1.2 (server_version = 3.3) • Valid Finished message is returned by the SAS UUT immediately following the ChangeCipherSpec message *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	DP Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object is 0, concluding an approved Registration • Verify that the response contains a valid *cbsdId*. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.9.4.3 [WINNF.FT.S.SDS.3] New Registration with
TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 (No existing *cbsdId*)

Step	Instructions
1	Replace the DP Test Harness certificate with a valid certificate
2	DP Test Harness attempts to establish a TLS session with the SAS UUT using a TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • The SAS UUT agrees to use the TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 ciphersuite • The SAS UUT agrees to use TLS Protocol Version 1.2 (server_version = 3.3) • Valid Finished message is returned by the SAS UUT immediately following the ChangeCipherSpec message *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	DP Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object is 0, concluding an approved Registration

- Verify that the response contains a valid *cbsdId*.

If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.9.4.4 [WINNF.FT.S.SDS.4] New Registration with TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384 (No existing *cbsdId*)

Step	Instructions
1	Replace the DP Test Harness certificate with a valid certificate
2	DP Test Harness attempts to establish a TLS session with the SAS UUT using a TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384 ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • The SAS UUT agrees to use the TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384 ciphersuite • The SAS UUT agrees to use TLS Protocol Version 1.2 (server_version = 3.3) • Valid Finished message is returned by the SAS UUT immediately following the ChangeCipherSpec message *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	DP Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object is 0, concluding an approved Registration • Verify that the response contains a valid *cbsdId*. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.9.4.5 [WINNF.FT.S.SDS.5] New Registration with TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 (No existing *cbsdId*)

Step	Instructions
1	Replace the DP Test Harness certificate with a valid certificate
2	DP Test Harness attempts to establish a TLS session with the SAS UUT using a TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • The SAS UUT agrees to use the TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 ciphersuite • The SAS UUT agrees to use TLS Protocol Version 1.2 (server_version = 3.3) • Valid Finished message is returned by the SAS UUT immediately following the ChangeCipherSpec message *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*

3	DP Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object is 0, concluding an approved Registration • Verify that the response contains a valid *cbsdId*. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.9.4.6 [WINNF.FT.S.SDS.6] Unrecognized root of trust certificate presented during Registration.

Step	Instructions
1	Replace the DP Test Harness certificate with an invalid certificate. This certificate shall be valid except for being signed by a root of trust not recognized by the SAS.
2	DP Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite

CHECK	The SAS UUT response must satisfy the following condition:
	 • Either the HTTP status code is 403 (Forbidden)
	 • Or
	     o The SAS UUT sends a fatal alert message with the following parameters:
	        ▪ AlertLevel = 2 (fatal)
	     o The SAS UUT immediately terminates the TLS session
	
	 If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.9.4.7 [WINNF.FT.S.SDS.7] Corrupted certificate presented during Registration.

Step	Instructions
1	Replace the DP Test Harness certificate with an invalid certificate. This certificate shall be valid except for being corrupted.
2	DP Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite

CHECK	The SAS UUT response must satisfy the following condition:
	 • Either the HTTP status code is 403 (Forbidden)
	 • Or
	     o The SAS UUT sends a fatal alert message with the following parameters:
	        ▪ AlertLevel = 2 (fatal)
	     o The SAS UUT immediately terminates the TLS session
	
	 If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.9.4.8 [WINNF.FT.S.SDS.8] Self-signed certificate presented during Registration.

Step	Instructions
1	Replace the DP Test Harness certificate with an invalid certificate. This certificate shall be valid except for being self-signed.
2	DP Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy the following condition: • Either the HTTP status code is 403 (Forbidden) • Or ○ The SAS UUT sends a fatal alert message with the following parameters: ▪ AlertLevel = 2 (fatal) ○ The SAS UUT immediately terminates the TLS session *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.9.4.9 [WINNF.FT.S.SDS.9] Non-CBRS trust root signed certificate presented during Registration.

Step	Instructions
1	Replace the DP Test Harness certificate with an invalid certificate. This certificate shall be valid except for being signed by a non-CBRS trust root.
2	DP Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy the following condition: • Either the HTTP status code is 403 (Forbidden) • Or ○ The SAS UUT sends a fatal alert message with the following parameters: ▪ AlertLevel = 2 (fatal) ○ The SAS UUT immediately terminates the TLS session *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.9.4.10 [WINNF.FT.S.SDS.10] Certificate of wrong type presented during Registration.

Step	Instructions
1	Replace the DP Test Harness certificate with an invalid certificate. This certificate shall be valid except for being a certificate of the wrong type but having correct signatures descending from the CBRS trust root (e.g. a SAS certificate, not a CBSD certificate)

2	DP Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response satisfies all of the following conditions: • The SAS UUT sends a fatal alert message with the following parameters: ○ AlertLevel = 2 (fatal) • The SAS UUT immediately terminates the TLS session *If all of the above conditions are met, the SAS UUT PASSES this test. If a TLS session is established, proceed.*
3	DP Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object is 104, concluding a failed Registration. • The SAS UUT immediately terminates the TLS session *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.9.4.11 [WINNF.FT.S.SDS.11] Blacklisted certificate presented during Registration.

Step	Instructions
1	Replace the DP Test Harness certificate with an invalid certificate. This certificate shall be a valid certificate which the SAS has been configured to blacklist (from a test input of the form an enforcement action would take).
2	DP Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy the following condition: • Either the HTTP status code is 403 (Forbidden) • Or ○ The SAS UUT sends a fatal alert message with the following parameters: ▪ AlertLevel = 2 (fatal) ○ The SAS UUT immediately terminates the TLS session *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.9.4.12 [WINNF.FT.S.SDS.12] Expired certificate presented during Registration.

Step	Instructions
1	Replace the DP Test Harness certificate with an invalid certificate. This certificate shall be a valid but expired certificate.
2	DP Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy the following condition: • Either the HTTP status code is 403 (Forbidden)

	• Or
	    o The SAS UUT sends a fatal alert message with the following parameters:
	        ▪ AlertLevel = 2 (fatal)
	    o The SAS UUT immediately terminates the TLS session
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.9.4.13 [WINNF.FT.S.SDS.13] Disallowed TLS method attempted during Registration.

Step	Instructions
1	Replace the DP Test Harness certificate with a valid certificate
2	DP Test Harness attempts to establish a TLS handshake using a disallowed method (e.g. TLS v1.1 per [n.8]) with the SAS UUT

CHECK	The SAS UUT response must satisfy the following condition:
	• Either the HTTP status code is 403 (Forbidden)
	• Or
	    o The SAS UUT sends a fatal alert message with the following parameters:
	        ▪ AlertLevel = 2 (fatal)
	    o The SAS UUT immediately terminates the TLS session
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.9.4.14 [WINNF.FT.S.SDS.14] Invalid ciphersuite presented during Registration.

Step	Instructions
1	Replace the DP Test Harness certificate with a valid certificate
2	DP Test Harness attempts to establish a TLS handshake with the SAS UUT using a ciphersuite specifically not allowed by [n.8].

CHECK	The SAS UUT response must satisfy the following condition:
	• Either the HTTP status code is 403 (Forbidden)
	• Or
	    o The SAS UUT sends a fatal alert message with the following parameters:
	        ▪ AlertLevel = 2 (fatal)
	    o The SAS UUT immediately terminates the TLS session
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.9.4.15 [WINNF.FT.S.SDS.15] Certificate with inapplicable fields presented during Registration.

Step	Instructions
1	Replace the DP Test Harness certificate with an invalid certificate. This certificate shall be valid except for being configured to contain at least one inapplicable field for ROLE:OPERATOR (FCCID, SERIAL, CPIRID, ZONE, or FREQUENCY)
2	DP Test Harness attempts to establish a TLS handshake with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • A valid TLS session is established *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	DP Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object is 104, concluding a failed Registration. • The SAS UUT immediately terminates the TLS session *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.9.4.16 [WINNF.FT.S.SDS.16] Certificate signed by a revoked sub-CA presented during Registration.

Step	Instructions
1	Replace the DP Test Harness certificate with an invalid certificate. This certificate shall be a valid certificate signed by a previously valid certificate that has since been revoked
2	DP Test Harness attempts to establish a TLS handshake with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy the following condition: • Either the HTTP status code is 403 (Forbidden) • Or o The SAS UUT sends a fatal alert message with the following parameters: ▪ AlertLevel = 2 (fatal) o The SAS UUT immediately terminates the TLS session *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

6.9.4.17 [WINNF.FT.S.SDS.17] Invalid certificate following an approved Registration Request

Step	Instructions
1	Replace the DP Test Harness certificate with a valid certificate, Cr1
2	DP Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite

CHECK	The SAS UUT response must satisfy all of the following conditions: • A valid TLS session is established *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	DP Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object shall be 0, concluding an approved Registration • Verify that the response contains a valid *cbsdId*, C1 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
4	Make certificate, Cr1, invalid. This may be accomplished by waiting until a time after the validity period for the certificate or by adding the certificate to the CRL server.
5	DP Test Harness attempts to re-establish the TLS session established in Step 2

CHECK	The SAS UUT response must satisfy the following condition:
	• Either the HTTP status code is 403 (Forbidden)
	• Or
	    o The SAS UUT sends a fatal alert message with the following parameters:
	        ▪ AlertLevel = 2 (fatal)
	    o The SAS UUT immediately terminates the TLS session
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.9.4.18 [WINNF.FT.S.SDS.18] Invalid certificate following an approved Grant Request

Step	Instructions
1	Replace the DP Test Harness certificate with a valid certificate, Cr1
2	DP Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • A valid TLS session is established *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	DP Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object shall be 0, concluding an approved Registration • Verify that the response contains a valid *cbsdId*, C1 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
4	DP Test Harness sends a valid Grant Request to the SAS UUT

CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object shall be 0, concluding an approved Registration • Verify that the response contains a valid *grantId*, G1 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
5	Make certificate, Cr1, invalid. This may be accomplished by waiting until a time after the validity period for the certificate or by adding the certificate to the CRL server.
6	DP Test Harness attempts to re-establish the TLS session established in Steps 2 and 4

CHECK	The SAS UUT response must satisfy the following condition:
	 • Either the HTTP status code is 403 (Forbidden)
	 • Or
	      ○ The SAS UUT sends a fatal alert message with the following parameters:
	          ▪ AlertLevel = 2 (fatal)
	      ○ The SAS UUT immediately terminates the TLS session
	
	 If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

6.9.4.19 [WINNF.FT.S.SDS.19] Invalid certificate following an approved Heartbeat Request

Step	Instructions
1	Replace the DP Test Harness certificate with a valid certificate, Cr1
2	DP Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • A valid TLS session is established *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	DP Test Harness sends a valid Registration Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object shall be 0, concluding an approved Registration • Verify that the response contains a valid *cbsdId*, C1 *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
4	DP Test Harness sends a valid Grant Request to the SAS UUT
CHECK	The SAS UUT response to the Registration Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object shall be 0, concluding an approved Registration • Verify that the response contains a valid *grantId*, G1

	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.
5	DP Test Harness sends a valid Heartbeat Request to the SAS UUT
CHECK	The SAS UUT response to the Heartbeat Request must satisfy all of the following conditions: • The *responseCode* in Response Data Object shall be 0, concluding an approved Heartbeat *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
6	Make certificate, Cr1, invalid. This may be accomplished by waiting until a time after the validity period for the certificate or by adding the certificate to the CRL server.
7	DP Test Harness attempts to re-establish the TLS session established in Steps 2, 4, and 5

CHECK	The SAS UUT response must satisfy the following condition:
	 • Either the HTTP status code is 403 (Forbidden)
	 • Or
	     ○ The SAS UUT sends a fatal alert message with the following parameters:
	         ▪ AlertLevel = 2 (fatal)
	     ○ The SAS UUT immediately terminates the TLS session
	
	 If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

7 SAS-SAS Interface Conformance Test Specifications

This section specifies test cases required for SAS to verify the conformance with the technical specifications on procedures and protocols for SAS-SAS interface [n.11] and the requirements established by FCC and DOD.

7.1 SAS-SAS Security, Authentication, and Encryption Protocols

7.1.1 Definition, Applicability, and Scope of the Test Case

This section explains test steps, conditions, and procedures for SAS validation of SAS security credentials. The precondition is that the SAS UUT has been granted a valid certificate according to the processes described in [n.8].

7.1.2 Test Characteristics

Table 7.1-1 SAS Security Validation Test Characteristics

1	**Test ID**	WINNF.FT.S.SSS
2	**Title**	SAS-SAS Security, Authentication, and Encryption Protocols
3	**Working Group / Entity**	WG2/WG3
4	**Test Type**	Functional

5	**Test Class**	Certification
6	**Component / Interface**	SAS ← → SAS
7	**Target Specification / Feature**	[n.11]

7.1.3 Method of test

7.1.3.1 Initial Conditions / Test Pre-conditions

− The SAS may be placed in a test configuration so that test certificates can be used for testing.
− Valid certificates must be created according to the guidelines given in [n.8]. Sample code for creating test certificates is provided in [i.1]. If such test code is used, the SAS must be configured to use the test certificate root of trust.
− The certificates required to perform the test cases may be created by the sample code provided in [i.1] or provided by a valid CBRS root of trust CA
− The SAS UUT must be reset at the beginning of each test case to a baseline state.
− Unless otherwise specified, SAS Test Harnesses used in the course of a test case are assumed to be whitelisted with the SAS UUT.

7.1.4 Test Procedure

7.1.4.1 [WINNF.FT.S.SSS.1] New Registration with TLS_RSA_WITH_AES_128_GCM_SHA256 ciphersuite

Step	Instructions
1	Replace the SAS Test Harness certificate with a valid certificate
2	SAS Test Harness attempts to establish a TLS session with the SAS UUT using a TLS_RSA_WITH_AES_128_GCM_SHA256 ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • The SAS UUT agrees to use the TLS_RSA_WITH_AES_128_GCM_SHA256 ciphersuite • The SAS UUT agrees to use TLS Protocol Version 1.2 (server_version = 3.3) • Valid Finished message is returned by the SAS UUT immediately following the ChangeCipherSpec message *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	SAS Test Harness sends a valid Full Activity Dump Request to the SAS UUT
CHECK	SAS UUT approves the request and responds with a Full Activity Dump message that satisfies all the following conditions: • The message includes all required fields, and all fields are syntactically correct. • Confirm that HTTP status code shall be 200 (SUCCESS). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

7.1.4.2 [WINNF.FT.S.SSS.2] New Registration with TLS_RSA_WITH_AES_256_GCM_SHA384 ciphersuite

Step	Instructions
1	Replace the SAS Test Harness certificate with a valid certificate
2	SAS Test Harness attempts to establish a TLS session with the SAS UUT using a TLS_RSA_WITH_AES_256_GCM_SHA384 ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • The SAS UUT agrees to use the TLS_RSA_WITH_AES_256_GCM_SHA384 ciphersuite • The SAS UUT agrees to use TLS Protocol Version 1.2 (server_version = 3.3) • Valid Finished message is returned by the SAS UUT immediately following the ChangeCipherSpec message *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	SAS Test Harness sends a valid Full Activity Dump Request to the SAS UUT
CHECK	SAS UUT approves the request and responds with a Full Activity Dump message that satisfies all the following conditions: • The message includes all required fields, and all fields are syntactically correct. • Confirm that HTTP status code shall be 200 (SUCCESS). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

7.1.4.3 [WINNF.FT.S.SSS.3] New Registration with TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 ciphersuite

Step	Instructions
1	Replace the SAS Test Harness certificate with a valid certificate
2	SAS Test Harness attempts to establish a TLS session with the SAS UUT using a TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • The SAS UUT agrees to use the TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 ciphersuite • The SAS UUT agrees to use TLS Protocol Version 1.2 (server_version = 3.3) • Valid Finished message is returned by the SAS UUT immediately following the ChangeCipherSpec message *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	SAS Test Harness sends a valid Full Activity Dump Request to the SAS UUT
CHECK	SAS UUT approves the request and responds with a Full Activity Dump message that satisfies all the following conditions: • The message includes all required fields, and all fields are syntactically correct.

- Confirm that HTTP status code shall be 200 (SUCCESS).

If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

7.1.4.4 [WINNF.FT.S.SSS.4] New Registration with TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384 ciphersuite

Step	Instructions
1	Replace the SAS Test Harness certificate with a valid certificate
2	SAS Test Harness attempts to establish a TLS session with the SAS UUT using a TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384 ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • The SAS UUT agrees to use the TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384 ciphersuite • The SAS UUT agrees to use TLS Protocol Version 1.2 (server_version = 3.3) • Valid Finished message is returned by the SAS UUT immediately following the ChangeCipherSpec message *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	SAS Test Harness sends a valid Full Activity Dump Request to the SAS UUT
CHECK	SAS UUT approves the request and responds with a Full Activity Dump message that satisfies all the following conditions: • The message includes all required fields, and all fields are syntactically correct. • Confirm that HTTP status code shall be 200 (SUCCESS). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

7.1.4.5 [WINNF.FT.S.SSS.5] New Registration with TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 ciphersuite

Step	Instructions
1	Replace the SAS Test Harness certificate with a valid certificate
2	SAS Test Harness attempts to establish a TLS session with the SAS UUT using a TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • The SAS UUT agrees to use the TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 ciphersuite • The SAS UUT agrees to use TLS Protocol Version 1.2 (server_version = 3.3) • Valid Finished message is returned by the SAS UUT immediately following the ChangeCipherSpec message *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*

3	SAS Test Harness sends a valid Full Activity Dump Request to the SAS UUT
CHECK	SAS UUT approves the request and responds with a Full Activity Dump message that satisfies all the following conditions: • The message includes all required fields, and all fields are syntactically correct. • Confirm that HTTP status code shall be 200 (SUCCESS). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

7.1.4.6 [WINNF.FT.S.SSS.6] Unrecognized root of trust certificate presented by SAS Test Harness

Step	Instructions
1	Replace the SAS Test Harness certificate with an invalid certificate. This certificate shall be valid except for being signed by a root of trust not recognized by the SAS.
2	SAS Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite

CHECK	The SAS UUT response must satisfy the following condition:
	• Either the HTTP status code is 403 (Forbidden)
	• Or
	    o The SAS UUT sends a fatal alert message with the following parameters:
	        ▪ AlertLevel = 2 (fatal)
	    o The SAS UUT immediately terminates the TLS session
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

7.1.4.7 [WINNF.FT.S.SSS.7] Corrupted certificate presented by SAS Test Harness

Step	Instructions
1	Replace the SAS Test Harness certificate with an invalid certificate. This certificate shall be valid except for being corrupted.
2	SAS Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite

CHECK	The SAS UUT response must satisfy the following condition:
	• Either the HTTP status code is 403 (Forbidden)
	• Or
	    o The SAS UUT sends a fatal alert message with the following parameters:
	        ▪ AlertLevel = 2 (fatal)
	    o The SAS UUT immediately terminates the TLS session
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

7.1.4.8 [WINNF.FT.S.SSS.8] Self-signed certificate presented by SAS Test Harness

Step	Instructions
1	Replace the SAS Test Harness certificate with an invalid certificate. This certificate shall be valid except for being self-signed.
2	SAS Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy the following condition: • Either the HTTP status code is 403 (Forbidden) • Or o The SAS UUT sends a fatal alert message with the following parameters: ▪ AlertLevel = 2 (fatal) o The SAS UUT immediately terminates the TLS session *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

7.1.4.9 [WINNF.FT.S.SSS.9] Non-CBRS trust root signed certificate presented by SAS Test Harness

Step	Instructions
1	Replace the SAS Test Harness certificate with an invalid certificate. This certificate shall be valid except for being signed by a non-CBRS trust root.
2	SAS Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy the following condition: • Either the HTTP status code is 403 (Forbidden) • Or o The SAS UUT sends a fatal alert message with the following parameters: ▪ AlertLevel = 2 (fatal) o The SAS UUT immediately terminates the TLS session *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

7.1.4.10 [WINNF.FT.S.SSS.10] Certificate of wrong type presented during Full Activity Dump .

Step	Instructions
1	Replace the SAS Test Harness certificate with an invalid certificate. This certificate shall be valid except for being a certificate of the wrong type but having correct signatures descending from the CBRS trust root (e.g. a CBSD certificate, not a SAS certificate)

2	SAS Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite

CHECK	The SAS UUT response satisfies all of the following conditions:
	    • The SAS UUT sends a fatal alert message with the following parameters:
	        o AlertLevel = 2 (fatal)
	    • The SAS UUT immediately terminates the TLS session
	
	If all of the above conditions are met, the SAS UUT PASSES this test. If a TLS session is established, proceed.

3	SAS Test Harness sends a valid Full Activity Dump Request to the SAS UUT

CHECK	The SAS UUT response to the Full Activity Dump Request must satisfy all of the following conditions:
	    • HTTP status code is 403 (Forbidden)
	    • The SAS UUT immediately terminates the TLS session
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

7.1.4.11 [WINNF.FT.S.SSS.11] Blacklisted certificate presented by SAS Test Harness

Step	Instructions
1	Replace the SAS Test Harness certificate with an invalid certificate. This certificate shall be a valid certificate which the SAS has been configured to blacklist (from a test input of the form an enforcement action would take).
2	SAS Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite

CHECK	The SAS UUT response must satisfy the following condition:
	    • Either the HTTP status code is 403 (Forbidden)
	    • Or
	        o The SAS UUT sends a fatal alert message with the following parameters:
	            ▪ AlertLevel = 2 (fatal)
	        o The SAS UUT immediately terminates the TLS session
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

7.1.4.12 [WINNF.FT.S.SSS.12] Expired certificate presented by SAS Test Harness

Step	Instructions
1	Replace the SAS Test Harness certificate with an invalid certificate. This certificate shall be a valid but expired certificate.
2	SAS Test Harness attempts to establish a TLS session with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy the following condition: • Either the HTTP status code is 403 (Forbidden)

- Or
    - The SAS UUT sends a fatal alert message with the following parameters:
        - AlertLevel = 2 (fatal)
    - The SAS UUT immediately terminates the TLS session

If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

7.1.4.13 [WINNF.FT.S.SSS.13] Disallowed TLS method attempted by SAS Test Harness

Step	Instructions
1	Replace the SAS Test Harness certificate with a valid certificate
2	SAS Test Harness attempts to establish a TLS handshake using a disallowed method (e.g. TLS v1.1 per [n.8]) with the SAS UUT

CHECK	The SAS UUT response must satisfy the following condition:
	• Either the HTTP status code is 403 (Forbidden)
	• Or
	    ○ The SAS UUT sends a fatal alert message with the following parameters:
	        ▪ AlertLevel = 2 (fatal)
	    ○ The SAS UUT immediately terminates the TLS session
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

7.1.4.14 [WINNF.FT.S.SSS.14] Invalid ciphersuite presented by SAS Test Harness

Step	Instructions
1	Replace the SAS Test Harness certificate with a valid certificate
2	SAS Test Harness attempts to establish a TLS handshake with the SAS UUT using a ciphersuite specifically not allowed by [n.8].

CHECK	The SAS UUT response must satisfy the following condition:
	• Either the HTTP status code is 403 (Forbidden)
	• Or
	    ○ The SAS UUT sends a fatal alert message with the following parameters:
	        ▪ AlertLevel = 2 (fatal)
	    ○ The SAS UUT immediately terminates the TLS session
	
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

7.1.4.15 [WINNF.FT.S.SSS.15] Certificate with inapplicable fields presented during Full Activity Dump.

Step	Instructions
1	Replace the SAS Test Harness certificate with an invalid certificate. This certificate shall be valid except for being configured to contain at least one inapplicable field for ROLE:SAS (CPIRID, ZONE, or FREQUENCY)
2	SAS Test Harness attempts to establish a TLS handshake with the SAS UUT using a valid ciphersuite
CHECK	The SAS UUT response must satisfy all of the following conditions: • A valid TLS session is established *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
3	SAS Test Harness sends a valid Full Activity Dump Request to the SAS UUT
CHECK	The SAS UUT response to the Full Activity Dump Request must satisfy all of the following conditions: • HTTP status code is 403 (Forbidden) • The SAS UUT immediately terminates the TLS session *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

7.1.4.16 [WINNF.FT.S.SSS.16] Certificate signed by a revoked sub-CA presented by SAS Test Harness

Step	Instructions
1	Replace the SAS Test Harness certificate with an invalid certificate. This certificate shall be a valid certificate signed by a previously valid certificate that has since been revoked
2	SAS Test Harness attempts to establish a TLS handshake with the SAS UUT using a valid ciphersuite

CHECK	The SAS UUT response must satisfy the following condition:
	 • Either the HTTP status code is 403 (Forbidden)
	 • Or
	     o The SAS UUT sends a fatal alert message with the following parameters:
	        ▪ AlertLevel = 2 (fatal)
	     o The SAS UUT immediately terminates the TLS session
	
	 If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

7.1.4.17 [WINNF.FT.S.SSS.17] Unknown SAS attempts to establish a TLS session

Step	Instructions
1	Replace the SAS Test Harness certificate with a valid certificate not known to the SAS UUT
2	SAS Test Harness attempts to establish a TLS handshake with the SAS UUT using a valid ciphersuite

CHECK	The SAS UUT response must satisfy the following condition: • HTTP status code is 403 (Forbidden) *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

7.1.4.18 [WINNF.FT.S.SSS.18] Security requirement for Full Activity Dump message Request

This test verifies that a SAS UUT can successfully validate the appropriateness of the security credentials included in a Full Activity Dump Message request from the SAS Test Harness. If the FAD request security credentials are appropriate, the SAS UUT approves the FAD request and responds with the Full Activity Dump Message. If any of the certificates turns out to be invalid, the SAS UUT rejects the request. This test case shall be re-run for all possible iterations of an "invalid certificate"

#	Test Execution Steps
1	Ensure that the DP Test Harness registers with the SAS UUT with *cbsdId* (C)
2	DP Test Harness successfully requests Grant for a PAL or GAA channel
3	The SAS Test Harness sends a Full Activity Dump Request to the SAS UUT with an invalid certificate.
CHECK	SAS UUT approves the request and responds with a Full Activity Dump message. • The message includes all required fields, and all fields are syntactically correct. • Confirm that HTTP status code shall be 200 (SUCCESS). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
4	Using one of the URLs, the SAS Test Harness attempts to retrieve the activity dump file with an invalid certificate.
CHECK	SAS UUT rejects the activity dump file retrieval request by the SAS Test Harness either by refusing the TLS handshake or by denying it with *HTTP code* 401 (UNAUTHORIZED) *If the any of the above conditions is not met, the SAS FAILS this test. Otherwise, it PASSES.*

7.2 SAS-SAS Full Activity Dump Message

7.2.1 *Definition, Applicability, and Scope of the Test Case*

This section provides test steps, conditions, and procedures of test cases for SAS validation of the Full Activity Dump exchange procedure. SAS UUT shall have valid certificates and information to send message to SAS Test Harness, and vice versa.

7.2.2 Test Characteristics

Table 7.2-1: SAS-SAS Full Activity Dump Test Characteristics

1	**Test ID**	WINNF.FT.S.FAD
2	**Title**	SAS-SAS Full Activity Dump Message
3	**Working Group / Entity**	WG3
4	**Test Type**	Functional
5	**Test Class**	Certification
6	**Component / Interface**	SAS / SAS ← → SAS
7	**Target Specification / Feature**	[n.11]

7.2.3 Method of test

7.2.3.1 Initial Conditions / Test Pre-conditions

- SAS UUT can establish a TLS session with SAS Test Harness, as well as the other way around.

- The SAS UUT must be reset at the beginning of each test case to a Baseline State.

- Unless otherwise specified, SAS Test Harnesses used in the course of a test case are assumed to be whitelisted with the SAS UUT.

- All SAS Administrators shall adhere to information sharing requirements as described in [n.12, R2-ISC-07]

7.2.4 Test Procedure

7.2.4.1 [WINNF.FT.S.FAD.1] [Configurable] SAS UUT Response to a Full Activity Dump Pull Request

This test verifies that a SAS UUT can successfully respond to a Full Activity Dump Request from a SAS Test Harness, and that responses to all SAS Test Harnesses are consistent.

Step	Instructions
1	Use Admin Test Harness to configure the SAS UUT to whitelist N1 > 0 FCC IDs and N1 user IDs.
2	Send a valid Registration Request Message for N1 CBSDs to the SAS UUT. Verify that the SAS UUT *responseCode* for each *registrationRequest* is SUCCESS.
3	Admin Test Harness injects information about N2 > 0 PPAs into the SAS UUT.
4	Send a valid Grant Request Message with N1 elements (one per registered CBSD). Verify that the *responseCode* for each is SUCCESS.

5	Admin Test Harness injects information about N3 > 0 ESC sensors into the SAS UUT.
6	Notify the SAS UUT about N4 > 0 SAS Test Harnesses
7	Trigger the SAS UUT to generate a Full Activity Dump.
8	Send a Full Activity Dump Request to the SAS UUT.
CHECK	The SAS UUT response to the request must satisfy all of the following conditions: • HTTP status code shall be 200 (success). • The message includes all required fields and the fields are syntactically correct. *If the any of the above conditions is not met, the SAS FAILS this test. Otherwise, PROCEED.*
9	The first SAS Test Harness retrieves all of the data in the Full Activity Dump.
CHECK	The SAS UUT response to each data retrieval request shall be HTTP 200 (success). The SAS responses must collectively satisfy all of the following conditions: • Exactly N1 CBSDs are included, each with parameters corresponding to the Registrations and Grants in Steps 2-3. • Exactly N2 PPAs are included, each with parameters corresponding to the information loaded in Step 4. • Exactly N3 ESC sensors are included, each with parameters corresponding to the information loaded in Step 5. • All required field exists, and no banned content [n.12, R2-ISC-06, R2-ISC-07] is included. *If the any of the above conditions is not met, the SAS FAILS this test. Otherwise, PROCEED.*
10	If N4 > 1, the remaining SAS Test Harnesses retrieve all of the data in the Full Activity Dump from the SAS UUT.
CHECK	The data retrieved by each SAS Test Harness is consistent with the data retrieved in Step 9. *If the any of the above conditions is not met, the SAS FAILS this test. Otherwise, it PASSES.*

7.2.4.2 [WINNF.FT.S.FAD.2] [Configurable] Full Activity Dump Pull Command by SAS UUT

This test verifies that a SAS UUT can successfully request a Full Activity Dump and utilize the retrieved data.

Step	Instructions
1	Configure the SAS UUT to whitelist the FCC IDs and user IDs that will be used in Steps 4 and 8 and the FCC IDs that will be used in Steps 3 and 7.
2	Configure the SAS Test Harness with information about 1 ESC sensor.

3	Configure the SAS Test Harness with information about 1 CBSD (C1) with 1 Grant (G1). Ensure that the CBSD is in the neighborhood area of the ESC sensor and that the *maxEIRP* for G1 is sufficiently high to support Step 5.
4	Send a valid Registration Request for 1 CBSD (C2) to the SAS UUT. Ensure that the CBSD is in the neighborhood area of the ESC sensor. Verify that the *responseCode* is SUCCESS.
5	Send a valid Grant Request Message for CBSD C2 to the SAS UUT. Set *maxEirp* such that that the Grant (G2) is initially accepted but, after exchanging data with the SAS Test Harness and executing IAP, the EIRP will need to be reduced. Verify that the *responseCode* is SUCCESS.
6	Configure the SAS Test Harness with information about 1 PPA.
7	Configure the SAS Test Harness with information about 1 CBSD (C3) with 1 Grant (G3). Ensure that the CBSD is in the neighborhood area of the PPA and that its EIRP is sufficiently high to support Step 9.
8	Send a valid Registration Request Message for 1 CBSD (C4) to the SAS UUT. Ensure that the CBSD is in the neighborhood area of the PPA. Ensure that the Registration Request message is configured in such a way that the *responseCode* is SUCCESS.
9	Send a valid Grant Request Message for CBSD C4 to the SAS UUT. Set *maxEirp* such that that the Grant (G4) is initially accepted but, after exchanging data with the SAS Test Harness and executing IAP, the EIRP will need to be reduced. Ensure that the Grant Request message is configured in such a way that the *responseCode* is SUCCESS.
10	Send a valid Heartbeat Request Message for Grants G2 and G4.
11	Notify the SAS UUT about the SAS Test Harness.
12	Trigger CPAS in the SAS UUT. Verify that the CPAS have completed.
13	Send a valid Heartbeat Request Message for Grants G2 and G4.
CHECK	The SAS response must satisfy all of the following conditions: • The response shall contain 2 *HeartbeatResponse* objects. • For each *HeartbeatResponse* object: ○ The *responseCode* shall be either GRANT_TERMINATED or INVALID_VALUE, indicating a terminated Grant. *If the any of the above conditions is not met, the SAS FAILS this test. Otherwise, it PASSES.*

8 SAS Functional Test Specifications

This section specifies the test cases required to ensure the functionalities implemented in the SAS UUT conform to the specifications, as defined by WInnForum and directed by the requirements established by FCC and DOD.

8.1 Exclusion Zone Enforcement

8.1.1 Definition, Applicability, and Scope of the Test Case

This section provides steps, conditions and procedures to test the conformance of SAS implementation of the Exclusion Zone Enforcement required by [n.1] and [n.2] prior to approval of one or more ESCs used by at least one SAS in accordance to [n.1].

The following classes of Exclusion zones are within the scope of these tests:
- Ground Based Radar Exclusion Zone
- Shoreline Exclusion Zone
- Radiolocation sites

8.1.2 Test Characteristics

Table 8.1-1 Exclusion Zone Enforcement Test Characteristics

1	**Test ID**	WINNF.FT.S.EXZ
2	**Title**	Exclusion Zone Enforcement Test
3	**Working Group / Entity**	FCC/NTIA
4	**Test Type**	Functionality
5	**Test Class**	Certification
6	**Component / Interface**	SAS

8.1.3 Method of test

8.1.3.1 Initial Conditions / Test Pre-conditions

8.1.3.2 Test Tools Required
- Admin Test Harness, DP Test Harness
- SAS UUT supports an API trigger to enforce the Exclusion Zone Boundaries defined by NTIA in [n.4]

8.1.3.3 General Test Methodology

For the first test case, Exclusion Zones are prepared. Multiple zones can be tested at once. These zones are injected by the Admin Test Harness and some number of CBSDs are configured inside or outside the Exclusion Zones.

For the second test case, the Exclusion Zones defined in NTIA TR 15-517 [n.4] are used. The SAS UUT is triggered by the Admin Test Harness to enforce the zones.

The test results are verified by checking if the SAS UUT correctly responds to the Grant Requests from the DP Test Harness according to the distance between the CBSD and the boundary of each Exclusion Zone.

The Grant response shall be as follows according to the location of each CBSD:
- When a CBSD is inside the Exclusion Zone, the Grant shall be denied.
- When a CBSD is outside the Exclusion Zone but the distance from the boundary is less than or equal to 50 m, the Grant shall be denied.
- Otherwise, the Grant shall be accepted.

8.1.4 Test Procedure

8.1.4.1 [WINNF.FT.S.EXZ.1] Injected Exclusion Zones

Step	Instructions
1	Admin Test Harness injects information about N1 > 0 Exclusion Zones into the SAS UUT.
2	DP Test Harness sends a valid Registration Request for N2 ≥ 0 CBSDs each located outside 50 meters of all N1 Exclusion Zones. Ensure that the Registration Request messages are configured in such a way that the *responseCode* for all CBSDs is SUCCESS.
3	DP Test Harness sends a valid Registration Request for N3 ≥ 0 CBSDs each located within at least one Exclusion Zone. Ensure that the Registration Request messages are configured in such a way that the *responseCode* for all CBSDs is SUCCESS.
4	DP Test Harness sends a valid Registration Request for N4 ≥ 0 CBSDs each located within 50 meters of at least one Exclusion Zone. Ensure that the Registration Request messages are configured in such a way that the *responseCode* for all CBSDs is SUCCESS.
5	Admin Test Harness triggers the SAS UUT to execute CPAS and wait until completion.
6	DP Test Harness sends a Grant Request with N2 + N3 + N4 elements (one per registered CBSD) with the *operationFrequencyRange* parameter of each *GrantRequest* object set to at least partially overlap with at least one of the frequency ranges of the nearest exclusion zone.

CHECK	The SAS response to the Grant Request satisfies all of the following conditions:
	• The response shall contain N2 + N3 + N4 *grantResponse* objects.
	• For each N3 *grantResponse* object:
	o The *responseCode* = 400
	o *cbsdId* (Response) == *cbsdId* (Request)
	o The response does not contain a *grantId*.
	• For each N4 *grantResponse* object:
	o The *responseCode* = 400
	o *cbsdId* (Response) == *cbsdId* (Request)
	o The response does not contain a *grantId*.
	If the any of the above conditions is not met, the SAS FAILS this test. Otherwise, it PASSES.

8.1.4.2 [WINNF.FT.S.EXZ.2] Exclusion Zones defined in NTIA TR 15-517

Note: FCC is in process of evaluating the waiver of this test case for SAS Administrators supporting DPA functionality.

Step	Instructions
1	Admin Test Harness triggers the SAS UUT to enforce the NTIA Exclusion Zones defined by [n.4].
2	DP Test Harness sends a valid Registration Request for N1 ≥ 0 CBSDs each located outside 50 meters of all Exclusion Zones. Ensure that the Registration Request messages are configured in such a way that the *responseCode* for all CBSDs is SUCCESS.
3	DP Test Harness sends a valid Registration Request for N2 ≥ 0 CBSDs each located within at least one Exclusion Zone. Ensure that the Registration Request messages are configured in such a way that the *responseCode* for all CBSDs is SUCCESS.
4	DP Test Harness sends a valid Registration Request for N3 ≥ 0 CBSDs each located within 50 meters of at least one Exclusion Zone. Ensure that the Registration Request messages are configured in such a way that the *responseCode* for all CBSDs is SUCCESS.
5	DP Test Harness sends a Grant Request with N1 + N2 + N3 elements (one per registered CBSD) with the *operationFrequencyRange* parameter of each *GrantRequest* object set to at least partially overlap with the frequency range of the nearest exclusion zone.
CHECK	The SAS response to the Grant Request must satisfy all of the following conditions:
	• The response shall contain N1 + N2 + N3 *grantResponse* objects.
	• For each N2 *grantResponse* object:
	o The *responseCode* = 400

> > > o *cbsdId* (Response) == *cbsdId* (Request)
> > > o The response does not contain a *grantId*.
> > - For each N3 *grantResponse* object:
> > > o The *responseCode* = 400
> > > o *cbsdId* (Response) == *cbsdId* (Request)
> > > o The response does not contain a *grantId*.
>
> *If the any of the above conditions is not met, the SAS FAILS this test. Otherwise, it PASSES.*

8.2   Propagation Model and Antenna Gain Calculation Testing

8.2.1   Definition, Applicability, and Scope of the Test Case

This section explains test steps, conditions, and procedures to verify that SAS correctly calculates:

1. path loss based on propagation models as defined in [n.12], and

2. the antenna gains of CBSDs and FSS based on locations and antenna patterns of the transmitter and the receiver as defined in [n.12].

8.2.2   Test Characteristics

Table 8.2-1 Propagation model and Antenna Gain Calculation Test Characteristics

1	**Test ID**	WINNF.FT.S.PAT
2	**Title**	Propagation model and antenna gain test
3	**Working Group / Entity**	WG1
4	**Test Type**	Functionality
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.12]

8.2.3   Method of test

A special Propagation Model API is used for this test so that the SAS UUT can perform path loss and antenna gain calculation without exercising the rest of the SAS functions. The Propagation Model API shall be used to execute the test case outlined in this section to validate SAS UUT implementation of propagation model and antenna gain only. To execute this test, the Admin Test Harness shall send configurations of a CBSD as the transmitter, an FSS as the receiver, and a propagation model type to the SAS UUT through the Propagation Model API. After receiving the test configurations from the Admin Test Harness, the SAS UUT shall compute the CBSD antenna gain, the FSS antenna gain, and the path loss accordingly, and send the results back to Admin Test Harness through the Propagation Model API. The Main Test Harness calculates the CBSD antenna

gain, the FSS antenna gain, and the path loss with the same configurations using the reference implementation. A SAS UUT passes this test if the calculated antenna gains and path loss are within certain ranges of the results calculated by the reference implementation.

This test can be configured differently to test different scenarios.

8.2.3.1   Initial Conditions / Test Pre-conditions

8.2.3.2   *Test Tools Required*

The Propagation Model API used for this test includes two parts. The first part is test configurations sent by Admin Test Harness to SAS UUT. The second part is test results sent by SAS UUT to Admin Test Harness. The content of the Propagation Model API is listed in the following.

From Admin Test Harness to SAS UUT:

1. Propagation model:

   Reliability level: -1, 0.05, and 0.95. A value of "-1" indicates the mean value shall be calculated. This parameter only applies to the ITM model. The mean path loss is always returned by the SAS UUT if the Hybrid model is used. The mean path loss is defined as $\frac{1}{<1/L>}$, where L is the path loss of the ITM and hybrid propagation Reference Models, and $<\cdot>$ denotes the statistical mean. Confidence interval is always set at 0.5 for ITM model.

2. CBSD (Tx) configuration:

   a) Latitude, longitude

   b) Height of the CBSD, and Height Type (AGL/AMSL)

   c) Antenna azimuth, peak gain, beamwidth of the CBSD

   d) Indoor or outdoor of the CBSD location

3. Receiver configuration:

   1. FSS; for ITM model only (Use default values for weights w1 and w2)

      a) Latitude, longitude, height of the FSS (Lat/long could present a point within an offshore DPA. In that case, antenna height = 50m)

      b) Antenna peak gain, azimuth and elevation of the FSS

      c) Rx Antenna Gain Required; A flag to determine whether the Rx antenna gain is required

- If the flag is set to True, SAS UUT shall send the Rx antenna gain to Admin Test Harness.

- If the flag is set to False, SAS UUT doesn't need to send the Rx antenna gain to Admin Test Harness.

2. PPA; for Hybrid model only

   a) PPA boundary containing exactly one protection point

      1. The boundary shall also be small enough that it includes exactly one 1-arcsecond point so that the NLCD value at the location of the protection point is used by the propagation model.

From SAS UUT to Admin Test Harness

1. Path loss in dB

2. Tx antenna gain in dBi toward the direction of the receiver

3. Rx antenna gain in dBi toward the direction of the transmitter

8.2.4 Test Procedure

8.2.4.1 [WINNF.FT.S.PAT.1] Propagation model and antenna gain calculation testing

For clarity, this test is written with a single CBSD and protected entity. The test code shall allow for execution of multiple non-interacting tests as part of a single test run in order to reduce total test execution time. It is recommended to test with a large number of points at one time.

Step	Instructions
1	The Admin Test Harness sends the configurations of a CBSD, an FSS or PPA, and the reliability factors to the SAS UUT through the Propagation Model API and receives the results
2	The Main Test Harness calculates the CBSD antenna gain, the FSS antenna gain, and the path loss using the reference implementation with the same configuration in Step 1.
CHECK	• SAS UUT sends the CBSD antenna gain in dBi, the FSS antenna gain in dBi (If Rx Antenna Gain Required flag is TRUE and the receiver is FSS) and the path loss in dB. • The path loss calculated by the SAS UUT shall be no more than 1dB higher than the path loss calculated by the reference implementation. • The CBSD antenna gain calculated by the SAS UUT shall be no less than the CBSD antenna gain calculated by the reference implementation minus 0.2 dB.

- The FSS antenna gain calculated by the SAS UUT shall be no less than the FSS antenna gain calculated by the reference implementation minus 0.2 dB.

If any of the above conditions do not hold for at least 99.9% of trials, the SAS UUT FAILS this test. Otherwise, it PASSES.

8.3 PPA Creation Test

8.3.1 Definition, Applicability, and Scope of the Test Case

This section explains test steps, conditions, and procedures for successful execution and completion of the PPA Creation test.

8.3.2 Test Characteristics

Table 8.3-1 PPA Creation Test Characteristics

1	**Test ID**	WINNF.FT.S.PCR
2	**Title**	PPA Creation Test
3	**Working Group / Entity**	WG1
4	**Test Type**	Functionality
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.12]

8.3.3 Method of test

8.3.3.1 Initial Conditions / Test Pre-conditions

According to [n.12, R2-PAL-05], the area of the non-overlapping difference between the maximum PPA boundary created by SAS UUT shall be no more than 10% of the area of the maximum PPA boundary created by the Reference Model.
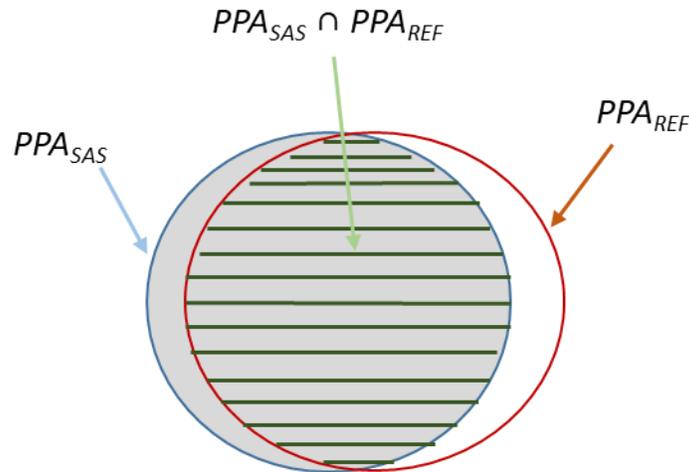
Figure 8.3-1 Overlap of maximum PPA Boundaries created by SAS UUT and the Reference Model

In Figure 8.3-1, the zone denoted by PPA_{REF} is the maximum boundary generated by the Reference Model, the zone denoted by PPA_{SAS} is the maximum boundary generated by the SAS UUT, and the zone denoted by $PPA_{REF} \cap PPA_{SAS}$ is the overlap between the two areas PPA_{REF} and PPA_{SAS}. Moreover, the area of a zone Z is denoted by $a(Z)$. To test the capability of SAS UUT to fulfil [n.12, R2-PAL-05], the following criterion is checked:

$$a(PPA_{REF} \cup PPA_{SAS}) - a(PPA_{REF} \cap PPA_{SAS}) \; < \; 0.1 \times a(PPA_{REF})$$

Equation 8.3-1

Figure 8.3-2 depicts the maximum PPA boundary generated by the Reference Model (PPA_{REF}), the maximum PPA boundary generated by the SAS UUT (PPA_{SAS}), and different choices for the PPA boundary claimed by the PAL holder (denoted as *A, B, C, D, E, F, G,* and *H*).
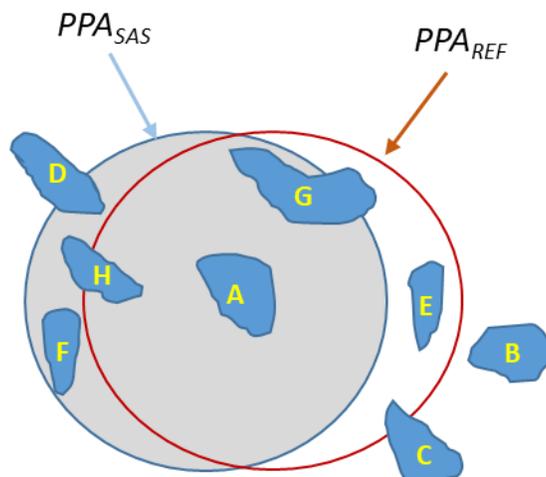
Figure 8.3-2 maximum PPA Boundaries created by SAS UUT, the Reference Model, and proposed by the PAL holder

According to [n.12, R1-SPU-01], the managing SAS shall approve the claimed boundary if it is fully contained within the maximum PPA boundary generated by the SAS UUT. Therefore, the claimed boundaries B, C, and D shall be rejected by the SAS UUT. Moreover, assuming all CBSDs within cluster list are owned by the PAL holder with valid *userId*, the PPA boundary A shall be approved by the SAS UUT. To address other boundaries (E, F, G, and H), the Main Test Harness shall be able to take as input the PAL holder claimed boundary, and provide it as an input to SAS UUT. The PAL claimed area shall be compared with the maximum PPA boundary generated by the SAS UUT (PPA_{SAS}). In the test cases PCR.3 and PCR.6 below, the input to the test case must be generated by first running the prerequisite test case (PCR.1), manually creating the PAL holder claimed boundary, and then combining that with the input to the prerequisite test case (i.e. using the same CBSD deployment, PAL records, etc).

In this Section, a PAL service area might contain one or more census tracts that use are licensed with the same frequency assignments.

8.3.3.2   Test Tools Required

- PPA Creation Reference Model for the creation of a PPA. This Reference Model takes in a list of CBSD-IDs and an optional area description and returns a PPA-ID upon success and an error upon failure.
- A test API supported by the SAS UUT, so that the Admin Test Harness can trigger the creation of a PPA by SAS UUT.
- The test API method has two variants exercised by the test: first, creation of a PPA depending only on a specific set of CBSDs, and second, the creation of a PPA given a specific set of CBSDs and a claimed PPA boundary by the PAL holder enclosing those CBSDs.
- The inputs to the PPA creation method are as follows:
  - List of CBSD IDs
  - List of PAL IDs
  - (optional) Provided contour The SAS UUT must implement the API to return a valid PPA-ID when the PPA creation succeeds, and an error when it fails.
- A mechanism of injecting the PAL Database records into the SAS UUT.

8.3.4   Test Procedure

8.3.4.1   [WINNF.FT.S.PCR.1] Successful Maximum PPA Creation

The tests in this section verify that a SAS can correctly create a maximum PPA boundary given a set of CBSDs.

Step	Instructions
1	Inject into the SAS UUT one or more PAL records, with frequency range F in service area C, referencing one or more adjacent Census Tracts.
2	DP Test Harness registers N CBSDs with the SAS UUT successfully: • The CBSDs are geographically located inside the Service Area.

	• The *userId* of CBSDs are associated to the *userId* of the PAL holder configured in the PAL records for this service area. • The CBSD locations, antenna gains, and EIRP limits are chosen in a way that only one PPA zone is created by those CBDSs using PPA Creation Reference Model.
3	Admin Test Harness triggers SAS UUT to create a PPA boundary using the PAL ID(s) from Step 1 and the CBSD IDs obtained in Step 2.
CHECK	SAS UUT creates one and only one PPA successfully. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
4	Admin Test Harness triggers the SAS UUT to generate the Full Activity Dump
5	SAS Test Harness uses the SAS-SAS protocol to retrieve the PPA zone using the Full Activity Dump and the PPA-ID returned by the SAS UUT.
6	Main Test Harness uses the PPA Creation Reference Model to calculate the maximum PPA boundary given the CBSD cluster list provided to SAS UUT at Step 2.
CHECK	• The PPA generated by the SAS UUT shall be fully contained within the service area in Step 1 • Check if Equation 8.3-1 is satisfied. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.3.4.2 [WINNF.FT.S.PCR.2] Successful Maximum PPA Boundary Creation Clipped by Service Area Boundary

This test verifies that a SAS can create the maximum PPA boundary, being clipped by the Service Area composed of one or more adjacent Census Tracts. The CBSD locations shall be configured in a way that at least one of the CBSDs is close to the boundary of the Service Area, so that its −96 dBm/10 MHz protection contour extends beyond the service area boundary

Step	Instructions
1	Inject into the SAS UUT one or more PAL records, with frequency range F in service area C, referencing one or more adjacent Census Tracts.
2	DP Test Harness registers *N* CBSDs with the SAS UUT. • The *userId* of CBSDs are associated to the userId of the PAL holder configured in the PAL records for this service area. • The CBSD locations are configured in a way that at least one of the CBSDs is close to the boundary of the Service Area, so that its −96 dBm/10 MHz protection contour extends beyond the service area boundary. • The CBSD locations, antenna gains, and EIRP limits are chosen in a way that only one PPA zone is created by those CBDSs using PPA Creation Reference Model.
3	Admin Test Harness triggers SAS UUT to create a PPA using the PAL ID(s) from Step 1 and the CBSD IDs obtained in Step 2.

CHECK	SAS UUT creates the one and only one PPA successfully. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
4	Admin Test Harness triggers the SAS UUT to generate the Full Activity Dump
5	SAS Test Harness uses the SAS-SAS protocol to retrieve the PPA zone using the Full Dump Activity and the PPA-ID returned by the SAS UUT.
6	Main Test Harness uses the PPA Creation Reference Model to calculate the maximum PPA boundary given the CBSDs registered provided to SAS UUT at Step 2.
CHECK	- The PPA generated by the SAS UUT shall be fully contained within the service area in Step 1. - Check if Equation 8.3-1 is satisfied. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.3.4.3   [WINNF.FT.S.PCR.3] Successful PPA Confirmation with Claimed Boundary by PAL Holder

This test verifies that a SAS UUT shall confirm a valid PPA boundary claimed by the PAL holder, composed of one or more adjacent Census Tracts, and the claimed area is fully contained within the maximum boundary created by the SAS UUT.

To create the configuration for this test case, first execute PCR.1 and note the maximum PPA boundary generated by the SAS UUT. Use that boundary to create the PAL holder claimed contour provided in this test case. All other inputs must be identical to those used in the corresponding configuration of PCR.1.

Step	Instructions
1	Inject into the SAS UUT one or more PAL records, with frequency range F in service area C, referencing one or more adjacent Census Tracts.
2	DP Test Harness registers *N* CBSDs with the SAS UUT: - The CBSDs are geographically located inside the service area. - The *userId* of CBSDs are associated to the *userId* of the PAL holder configured in the PAL records for this service area. - The CBSD locations, antenna gains, and EIRP limits are chosen in a way that only one PPA zone is created by those CBDSs using PPA Creation Reference Model.
3	Admin Test Harness triggers SAS UUT to create a PPA using the PAL ID from Step 1 and the CBSD IDs obtained in Step 2, including a claimed PPA boundary.
4	Admin Test Harness triggers the SAS UUT to create a Full Activity Dump
5	SAS Test Harness uses the SAS-SAS protocol to retrieve the PPA zone using the Full Dump Activity and the PPA-ID returned by the SAS UUT.

CHECK	Main Test Harness compares the PPA contour provided in Step 3 with the contour provided by the SAS UUT is Step 5. The two are geometrically identical.
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

8.3.4.4 [WINNF.FT.S.PCR.4] Unsuccessful PPA Creation with one or more CBSDs Outside Service Area

This test verifies that a SAS UUT rejects creation of a PPA boundary if at least one of the CBSDs included in the CBSD cluster list is located outside PAL holder service area, which is composed of one or more adjacent Census Tracts.

Step	Instructions
1	Inject into the SAS UUT one or more PAL records, with frequency range F in service area C, referencing one or more adjacent Census Tracts.
2	DP Test Harness registers *N* CBSDs with the SAS UUT: • At least one of the CBSDs is located outside the service area C. • The *userId* of CBSDs are associated to the *userId* of the PAL holder configured in the PAL records for this service area. • The CBSD locations, antenna gains, and EIRP limits are chosen in a way that only one PPA zone is created by those CBDSs using PPA Creation Reference Model.
3	Admin Test Harness triggers SAS UUT to create a PPA using the PAL ID from Step 1 and the *cbsdId*s obtained in Step 2.
CHECK	SAS does not create a PPA and generates an error. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.3.4.5 [WINNF.FT.S.PCR.5] Unsuccessful PPA Creation with one or more CBSDs not belonging to the PAL Holder

This test verifies that a SAS UUT rejects creation of a PPA boundary if at least one of the CBSDs included in the CBSD cluster list does not belong to the PAL holder.

Step	Instructions
1	Inject into the SAS UUT one or more PAL records, with frequency range F in service area C, referencing one or more adjacent Census Tracts.
2	DP Test Harness registers *N* CBSDs with the SAS UUT: • The CBSDs are located inside the service area C. • The *userId* of at least one of the CBSDs is not associated to the *userId* of the PAL Holder configured in the PAL record for this service area.
3	Admin Test Harness triggers SAS UUT to create a PPA using the PAL ID from Step 1 and the *cbsdId*s obtained in Step 2.

CHECK	SAS does not create a PPA and generates an error.
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

8.3.4.6 [WINNF.FT.S.PCR.6] Unsuccessful PPA boundary Claimed by PAL Holder Not contained within Maximum PPA Boundary

This test verifies that a SAS UUT shall reject a PPA boundary claimed by the PAL holder, that is not fully contained within the maximum PPA boundary created by SAS UUT.

To create the configuration for this test case, first execute PCR.1 and note the maximum PPA boundary generated by the SAS UUT. Use that boundary to create the boundary for the PPA which is injected in this test case. All other inputs must be identical to those used in the corresponding configuration of PCR.1.

Step	Instructions
1	Inject into the SAS UUT one or more PAL records, with frequency range F in service area C, referencing one or more adjacent Census Tracts.
2	DP Test Harness registers *N* CBSDs with the SAS UUT: • The CBSDs are geographically located inside the service area. • The *userId* of CBSDs are associated to the *userId* of the PAL holder configured in the PAL records for this service area. • The CBSD locations, antenna gains, and EIRP limits are chosen in a way that only one PPA zone is created by those CBDSs using PPA Creation Reference Model.
3	Admin Test Harness triggers SAS UUT to create a PPA using the PAL ID from Step 1 and the *cbsdId*s obtained in Step 2, including the PAL holder contour, which is not completely contained within the PPA boundary created by SAS UUT.
CHECK	SAS does not create a PPA and generates an error. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.3.4.7 [WINNF.FT.S.PCR.7] Overlapping PPA Boundaries

This test verifies that the SAS UUT does not create or confirm PPAs with overlapping zones for the same frequency range.

To create the configuration for this test case, first execute PCR.1 and note the maximum PPA boundary generated by the SAS UUT. Use that boundary to create the PAL holder claimed contour provided in this test case. All other inputs must be identical to those used in the corresponding configuration of PCR.1.

Step	Instructions

1	Inject into the SAS UUT one or more PAL records, with frequency range F in service area C, referencing one or more adjacent Census Tracts.
2	Admin Test Harness inject a PPA Zone Definition for a PPA using the PAL record from Step 1, which has some geographical overlap with the maximum PAL boundary created by SAS UUT.
3	DP Test Harness registers *N* CBSDs with the SAS UUT: - The CBSDs are geographically located inside the service area. - The *userId* of CBSDs are associated to the *userId* of the PAL holder configured in the PAL records for this service area. - The CBSD locations, antenna gains, and EIRP limits are chosen in a way that only one PPA zone is created by those CBDSs using PPA Creation Reference Model.
4	Admin Test Harness triggers SAS UUT to create a PPA using the PAL ID from Step 1 and the *cbsdId*s obtained in Step 3.
CHECK	SAS does not create a PPA and generates an error. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.4 Aggregate Interference Protection – Single Protected Entity

8.4.1 Definition, Applicability, and Scope of the Test

This section outlines a template for test steps, conditions, and procedures for SAS to authorize CBSDs to transmit only when they do not interfere with a protected entity X. The scope of this test is to verify that the SAS continuously maintains aggregate interference below the protected entity's protection threshold, whether it is calculated at the location of the protected entity, or on grid points within a pre-defined protection area. This section only provides the template for test cases that will be referenced in subsequent sections per the protected entity type.

8.4.2 Test Characteristics

Table 8.4-1 Aggregate Interference Protection

1	**Test ID**	WINNF.FT.S.xPR
2	**Title**	Aggregate Interference Protection
3	**Working Group / Entity**	WG1
4	**Test Type**	Functionality
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.12]

8.4.3 Method of test

8.4.3.1 Initial Conditions / Test Pre-conditions

- No more than one protected entity type is present at a time.

8.4.3.2 Test Tools Required

- Main Test Harness
- Ability to compute pathloss propagation using the ITM and hybrid propagation Reference Models and the CBSD antenna pattern Reference Model, and to compute aggregate interference at the location of the protected entity or each grid point inside the protection area of the protected entity or each grid point inside the protection area of the protected entity, using the WG4 Aggregate Interference Reference Model, as specified for protected entity X in [n.12].
    - Ability to simulate IAP with a set of active Grants using IAP Reference Model.
- SAS Test Harness(es) hosts a configurable group of Grants with CBSD locations inside and outside the neighborhood of protected entity requiring protection. The protected entity is injected by the Admin Test Harness with configurable operating parameters.
    - The necessary data in order to protect the protected entity, are exchanged with SAS UUT through a Full Activity Dump exchange. This exchange is necessary to inform SAS UUT about *Authorized* or *Granted* CBSD Grants belonging to SAS Test Harness(es).

8.4.3.3 Protected entity types and their Parameters

The following Table lists the protected entities for which IAP is applied along with their associated parameters.

For this table, please note the following:

1- In this table, the reference bandwidth (*RBW*), and protection threshold per the reference bandwidth for each protection entity (*Th*), as identified by Part 96 [n.1, 2] and in [n.12] for ESC sensors, are included. Moreover, the channel bandwidth over which SASs execute the IAP process is denoted as *IAPBW*. The protection threshold per *IAPBW* (Q) is then calculated by scaling *Th* for *IAPBW*, using the equation

$$Q = Th + 10 * \log\left\{\frac{IAPBW}{RBW}\right\}$$

Equation 8.4-1

2- In this section, F_i denotes the operating frequency of a CBSD's Grant, while F_p denotes the protected channel range of the protected entity.

3- In this section, the actual protection threshold used for IAP is calculated by applying a pre-defined Pre-IAP Headroom (*Mg*) [n.21] at each protection threshold. The actual IAP

protection level for the protected entity = $Q - Mg$. A unique value of Mg is applied consistently among all SASs for each type of protected entities. Assuming the number of SASs in a peer group is N_{SAS}, the allowed headroom for SAS UUT is:

$$I = 10 * log \left\{ \frac{10^{\frac{Q}{10}} - 10^{\frac{Q-Mg}{10}}}{N_{SAS}} \right\}$$

Equation 8.4-2

Table 8.4-2 Protected entity reference for IAP Protection

IAP protected entity	Neighborhood size (km)	Protected Channel Range (MHz)	Protection reference BW (MHz)	Part 96 Protection Threshold (dBm/RBW)	Bandwidth for IAP Process BW (MHz)	In-Band Insertion Loss (dB)	Protection Threshold per IAPBW (dBm/IAPBW)
X	Y	F_p	RBW	Th	IAPBW	IL	Q
ESC sensor	40 for Cat A 80 for Cat B	3550-3680	1	-109	5	0.5	-102 at the ESC Rx Filter Output (post Filter Protection, SAS would apply 10dB per 10MHz roll off)
FSS Co-Channel	150	Registered Pass-band within 3600-3700	1	-129	5	0.5	-122
FSS Blocking	40	Protection range 3550-3700	150 (range 3550-3700)	-60	150 (range 3550 -3700 MHz))	Filter response	-60dBm for the entire band (3600-3700)
FSS OOBE (TT&C)	40	Pass band within 3700-4200 if registered upper Frequency is larger than 3700 (lower frequency range = 3700 MHz)	1	-129	5	0.5	-122

FSS Blocking (TT&C)	40	Protection range 3550-3700	150 (range 3550-3700)	-60	150 (range 3550 -3700 MHz)	Filter response	-60 for the entire band
PPA	40	PPA BW (Contiguous 10 MHz within the 3550-3650 MHz range)	10	-80	5	0	-83
GWPZ 25	40	3650-3675 or 3675-3700	10	-80	5	0	-83
GWPZ 50	40	3650-3700	10	-80	5	0	-83

8.4.4 Test Procedure

8.4.4.1 [WINNF.FT.S.xPR.1] Grants from Multiple CBSDs Inside and Outside the Neighborhood (Y) of a Protected Entity (X).

Execute Steps 3 through [End] of MCP.1 with the following values:
- No DPAs activated or deactivated
- $K = 1$
- $N_S = 0$
- $\mathcal{P}_{IAP,k}$ contains a single protected entity (one PPA, GWPZ, FSS, or ESC sensor)

8.4.4.2 [WINNF.FT.S.xPR.2] Multiple CBSDs from Multiple SASs Inside and Outside the Neighborhood of the Protected Entity

Multiple CBSDs, registered with multiple SASs, located inside and outside the neighborhood (Y) of the protected entity X, request Grants for independent frequency F_i that overlaps with F_p

Execute Steps 3 through [End] of MCP.1 with the following values:
- $K = 1$
- $N_S \geq 1$
- $\mathcal{P}_{IAP,k}$ contains a single protected entity (one PPA, GWPZ, FSS, or ESC sensor)

8.5 ESC Protection

8.5.1 Definition, Applicability, and Scope of the Test Case

This section explains test steps, conditions, and procedures for SAS to grant CBSDs only when they do not interfere with its hosted ESC sensors. The scope of this test is to verify that the SAS continuously maintains aggregate interference below the ESC sensors' protection threshold. In addition, a test case is included to verify ESC sensor protection when multiple SASs are present. ESC sensors in all cases are active.

8.5.2   Test Characteristics

Table 8.5-1 ESC Protection

1	**Test ID**	WINNF.FT.S.EPR
2	**Title**	ESC Protection
3	**Working Group / Entity**	WG1
4	**Test Type**	Functionality
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.12]

8.5.3   Method of test

8.5.3.1   Initial Conditions / Test Pre-conditions

- SAS Test Harness hosts a configurable group of active or suspended Grants with CBSD locations within and outside the 40km and 80km radius of the Sensor location. Admin Test Harness provides Sensor locations, frequency, ESC antenna pattern, and all the required operating parameters to the SAS UUT.
    - The protection threshold of -109dBm per MHz as referenced in [n.12] is used. This reference also pre-defines a 10dB/10MHz roll-off margin for Out-Of-Band CBSDs (3650-3660 MHz for Cat A, and 3650-3680MHz for Cat B.
    - ESC IAP Protection test cases are performed both for In-Band (3550-3650 MHz) CBSDs, as well as Out-of-Band CAT A CBSDs in 3650-3660 MHz and CAT B CBSDs in 3650-3680 MHz.

8.5.3.2   Test Tools Required

- Main Test Harness
    - Ability of Aggregate Interference Reference Model and IAP Reference Model to calculate the received in-band and out-of-band interference energy based on the ESC reference receiver filter and the ESC antenna pattern.

8.5.4   Test Procedure

8.5.4.1   [WINNF.FT.S.EPR.1] Single SAS ESC Sensor Protection

Perform WINFF.FT.S.xPR.1 for X= ESC sensor, Table 8.4-2 with configurable F_i

8.5.4.2 [WINNF.FT.S.EPR.2] Multiple SAS ESC Sensor Protection

Perform WINNF.FT.S.xPR.2 for X= ESC sensor, Table 8.4-2 with configurable F_i

8.6 PPA Protection

8.6.1 *Definition, Applicability, and Scope of the Test Case*

The purpose of this test case is to test the SAS UUT can protect one or more pre-defined PPA zones (according to R2-SGN-12 & R2-PAL-01 in [n.12]), in a protection level of -80dBm/10MHz on at least 95% of the points.

The aggregate interference comparisons are performed for all grid points inside and on the PPA boundary, and the SAS UUT passes these test cases if the comparisons are successful for at least 95% of the points inside and on the PPA boundary.

The test case is considering CBSDs operating co-channel with the PPA to be protected.

8.6.2 *Test Characteristics*

Table 8.6-1 PPA Protection

1	**Test ID**	WINNF.FT.S.PPR
2	**Title**	PPA Protection
3	**Working Group / Entity**	WG1
4	**Test Type**	Functionality
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.12]

8.6.3 *Method of test*

8.6.3.1 Initial Conditions / Test Pre-conditions

The parameter has the following constraints: A 10 MHz PPA is used; the PPA can be associated with one or multiple PAL licenses whose assigned physical channels are on the following range: 3550-3650 MHz.

The location of the protected entity in the PPA Protection test case is equivalent to every grid point within the PPA contour. Therefore, the Aggregate Interference should be below the protection threshold *Th-Mg* for at least 95% of grid points inside the PPA boundary. For a grid point to be considered protected, the aggregate interference must be below the protection threshold for all frequencies at that point.

8.6.3.2 Test Tools Required

- Admin Test Harness
  - Ability to inject PPA Information through Admin Test Harness
- Main Test Harness
  - Ability to compute pathloss propagation using the ITM and hybrid propagation Reference Models and the CBSD antenna pattern Reference Model, and to compute aggregate resulting interference level on every protection point within the neighborhood of a protected entity using the WG4 Aggregate Interference Reference Model.

8.6.4   Test Procedure

8.6.4.1   [WINNF.FT.S.PPR.1] Single SAS PPA Protection

Perform WINNF.FT.S.xPR.1 for X= PPA, Table 8.4-2 with configurable F_i

8.6.4.2   [WINNF.FT.S.PPR.2] Multiple SAS PPA Protection

Perform WINNF.FT.S.xPR.2 for X= PPA, Table 8.4-2 with configurable F_i

8.6.4.3   [WINNF.FT.S.PPR.3] Protection of PPA managed by peer SAS

Step	Instructions
1	Activate one SAS Test Harness and notify the SAS UUT. The SAS Test Harness must contain exactly one PPA, and also contains N1>0 CBSDs, at least one of which is on the PPA's cluster list.
2	Inject into the SAS UUT one or more PAL records corresponding to the PPAs in steps 1 and 4.
3	DP Test Harness sends a registration request for N2 CBSDs to the SAS UUT.
4	Admin Test Harness injects a PPA into the SAS UUT, with a (potentially empty) subset of CBSDs from step 3 on the PPA's cluster list.

Note: if any of the CBSDs on the specified cluster list failed to register, the Admin Test Harness shall omit them from the cluster list injected into the SAS UUT. |
| 5 | DP Test Harness sends a grant request for each of the N2 CBSDs to the SAS UUT.

Note: the grant requests need not be for the same channel as the PPAs in Steps 1 and 4. |
6	Admin Test Harness triggers FAD generation and waits until completion of FAD generation.
7	The SAS Test Harness pulls the FAD data from the SAS UUT.
8	Admin Test Harness triggers CPAS and waits until completion of CPAS.

9	Main Test Harness executes the IAP Reference Model using the FAD information from Steps 1 and 7.
10	DP Test Harness sends Heartbeat Requests for each SAS UUT Grant.
11	DP Test Harness relinquishes the non-terminated Grants that received suggested *operationParam* in the Heartbeat Responses in Step 10.
12	DP Test Harness sends Grant Requests for all CBSDs whose Grants were relinquished in Step 11 or terminated in Step 10. Each Grant Request uses the suggested *operationParam* provided by the SAS UUT.
13	DP Test Harness sends Heartbeat Requests for each Grant managed by SAS UUT.
14	For each protection point p of the IAP-protected entities, the Main Test Harness calculates: • A_p^{IAP}, the mean aggregate interference at protection point p of all Grants authorized by SAS UUT in Step 13 that are in the neighborhood of p using *maxEirp* from the corresponding Grant Requests. • $A_p^{IAP,ref}$, the sum of the SAS's Pre-IAP Headroom and leftover allocation (see Equation B- 3 in Appendix B) plus the mean aggregate interference at protection point p of Grants in the neighborhood of p that are managed by SAS UUT at the *maxEirp* levels calculated by the IAP Reference Model in Step 9. Note 1: "IAP-protected entities" refers to the PPAs in steps 1 and 4. Note 2: The Main Test Harness shall calculate A_p^{IAP} and $A_p^{IAP,ref}$ in the reference bandwidth (RBW) of the corresponding protected entity as given in Table 8.4-2.
CHECK	$A_p^{IAP} \leq A_p^{IAP,ref} + \Delta^{IAP}$ for at least 95% of the protection points of each PPA. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.7 GWPZ Protection

8.7.1 *Definition, Applicability, and Scope of the Test Case*

The purpose of this test case is to verify the SAS UUT can protect one or more pre-defined GWPZ (GWBL Protection areas, according to R2-SGN-12, R0-IPM-02) with a protection threshold of -80dBm/10MHz with at least 95% coverage of the GWPZ.

The aggregate interference comparisons are performed for all grid points inside and on the GWPZ boundary, and the SAS UUT passes these test cases if the comparisons are successful for at least 95% of the points inside and on the GWPZ boundary.

8.7.2   Test Characteristics

Table 8.7-1 GWPZ Protection

1	**Test ID**	WINNF.FT.S.GPR
2	**Title**	GWPZ Protection
3	**Working Group / Entity**	WG1
4	**Test Type**	Functionality
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.12]

8.7.3   Method of test

8.7.3.1   Initial Conditions / Test Pre-conditions

The parameter has the following constraints: A 25-50MHz GWPZ is used; the GWPZ can be associated with one or multiple GWBLs whose assigned physical channels are on the following range: [3650-3675 MHz], [3675-3700MHz], or [3650-3700MHz].

The location of the protected entity in the GWPZ Protection test case is equivalent to every grid point within the GWPZ contour. Therefore, the Aggregate Interference should be below the protection threshold *Th-Mg* for at least 95% of grid points inside the GWPZ boundary. For a grid point to be considered protected, the aggregate interference must be below the protection threshold for all frequencies at that point.

8.7.3.2   Test Tools Required

- Admin Test Harness
  - Ability to inject GWPZ through Admin Test Harness
- Main Test Harness
  - Ability to compute pathloss propagation using the ITM and hybrid propagation Reference Models and the CBSD antenna pattern Reference Model, and to compute aggregate resulting interference level on every protection point within the neighborhood of a protected entity using Aggregate Interference Reference Model.

8.7.4   Test Procedure

8.7.4.1   [WINNF.FT.S.GPR.1] Single SAS GWPZ Protection

Perform WINNF.FT.S.xPR.1 for X= GWPZ 25 or GWPZ 50, Table 8.4-2 with configurable *Fi*

8.7.4.2   [WINNF.FT.S.GPR.2] Multiple SAS GWPZ Protection

Perform WINNF.FT.S.xPR.2 for X= GWPZ 25 or GWPZ 50, Table 8.4-2 with configurable *Fi*

8.7.4.3   [WINNF.FT.S.GPR.3] GWPZ Exclusion Zone

One or more CBSDs, located inside a GWPZ, request Grants and are rejected

Step	Instructions
1	Admin Test Harness injects a GWPZ into the SAS UUT. Denote its frequency range as F.
2	Admin Test Harness triggers CPAS and waits until completion of CPAS.
3	The DP Test Harness registers N > 0 CBSDs which are located inside the GWPZ boundary in Step 1.
4	The DP Test Harness requests one Grant per registered CBSD. The requested frequency ranges are each partially or fully overlapping with F.
CHECK	SAS UUT rejects all Grant Requests with *responseCode* 400. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.8   FSS Protection

8.8.1   *Definition, Applicability, and Scope of the Test Case*

This section explains test steps, conditions, and procedures for SAS to grant CBSDs to protect FSS earth station. The scope of this section is to verify that SAS would not authorize CBSD Grants when they interfere with FSS. In addition, test cases are included to verify FSS protection when multiple SASs are present. It is assumed that all the necessary information regarding FSS sites are available and can be injected to the SAS UUT through Admin Test Harness.

8.8.2   *Test Characteristics*

Table 8.8-1 FSS Protection

1	**Test ID**	WINNF.FT.S.FPR
2	**Title**	FSS Protection
3	**Working Group / Entity**	WG1
4	**Test Type**	Functionality
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.12]

8.8.3   *Method of test*

8.8.3.1   Initial Conditions / Test Pre-conditions

- The Pre-IAP Headroom Margin for FSS TT&C and in-band is denoted as $Mg_{Blocking}$ (dB).
- The Pre-IAP Headroom Margin for in-band FSS is denoted as $Mg_{CoChannel}$ (dB).

• The Headroom Margin for FSS out of band emission is denoted as Mg_{OOBE} (dB).

8.8.3.2 Test Tools Required

Main Test Harness configures and uses the following test tools in the test cases specified in this section.
- Propagation model Reference Model
- Aggregate Interference Reference Model
    - Antenna Gain Reference Model to simulate FSS receive antenna characteristics, and CBSD antenna including antenna gain toward the side lobes of the FSS
- FSS earth station receive antenna Reference Model (R2-SGN-21)
- IAP Reference Model
- FSS Purge List Reference Model
- Admin Test Harness
- SAS Test Harness
- DP Test Harness
- Ability of Aggregate Interference Reference Model and IAP Reference Model and Purge List Reference Model to calculate the received in-band and out-of-band emission and blocking interference energy based on the FSS reference receiver filter.

SAS Test Harness hosts a configurable group of active or suspended Grants with CBSD locations inside or outside the Protection area of the FSS

8.8.3.3 FSS filter for Blocking Protection

Figure 8.8-1, Figure 8.8-2, and Figure 8.8-3 depict the FSS receive filter mask for three different scenarios of FSS registered passbands.

Figure 8.8-1, referred to as "FSS Scenario 1", depicts a common FSS passband that starts below 3700 MHz (e.g. 3625 MHz), and extends to 4200 MHz. In this case, the portion of FSS passband the lies below 3700 MHz shall be protected from all co-channel CBRS CBSDs (in this figure, CBSD5, CBSD6, and a portion of CBSD4 Grant that is above f_{p1}). Moreover, the FSS station shall be protected from blocking effects of all CBSDs with Grants outside FSS passband (in this figure, CBSD1, CBSD2, CBSD3, and a portion of CBSD4 Grant that is below f_{p1}). Moreover, if and only if the TT&C flag is set for this FSS station, the portion of FSS passband starting from 3700 MHz extending to 4200 MHz is protected against Out Of Band Emissions (OOBE) effects of all CBRS CBSDs. For TT&C Flag refer to [n.22]. The protection methodology in this scenario applies also if the registered upper frequency is greater than 3700 MHz and no more than 4200 MHz.

Figure 8.8-2, referred to as "FSS Scenario 2", depicts an FSS passband that starts from 3700 MHz and extends to 4200 MHz. In this case, if the TT&C flag is set to ON, the FSS passband is protected against both blocking effect and OOBE from all CBRS CBSDs.

For identifying the aggregate blocking effect, the CBSD Grants that are overlapping with FSS passband are not used. The protection methodology in this scenario applies also if the registered upper frequency is greater than 3700 MHz and no more than 4200 MHz.

Figure 8.8-3, referred to as "FSS Scenario 3", depicts a common FSS passband that starts below 3700 MHz (e.g. 3625 MHz), and extends to 3700 MHz. The protection methodology in this scenario is similar to "FSS Scenario 1", with one difference. In this case, the FSS OOBE protection is not applied regardless of the value of TT&C Flag. The protection methodology in this scenario applies also if the registered upper frequency is below 3700 MHz.

$$I_{aggr} = 10 \log_{10} \left\{ E \left[\left(\sum_{\substack{i=1 \\ \textit{The portion of grants not overlapping with} \\ \textit{FSS passband}}}^{N_{Grant}} \frac{1}{PL_i} \times 10^{\left(G_{FSS_i}/10\right)} \right) \right. \right.$$

$$\left. \left. \times \sum_{f=f_{i1}}^{f_{i2}} 10^{\left(EIRP_i(f)/10\right)} \times 10^{\left(mask(f)/10\right)} \times \Delta f \right] \right\} (dBm)$$

Equation 8.8-1

where:
- I_{aggr} is the aggregate blocking effect from all CBSDs (dBm)
- N_{Grant} is the number of CBSD Grants in the band that are within the neighborhood protection of FSS station for blocking protection.
- $EIRP_i(f)$ is the power spectral density of ith CBSD (*dBm/MHz*) toward FSS earth station at frequency *f (MHz)*
- $mask(f)$ is the FSS receiver filter characteristics as the function of frequency *f* (MHz)
- PL_i is the mean linear path loss from the ith CBSD to the location of FSS station
- G_{FSS_i} is the FSS Rx antenna gain toward the ith CBSD *(dB),* and
- $E[\cdot]$ stands for the mean calculation
- Δf is the frequency step size in Equation 8.8-1, and is set to 1 MHz in this specification.
- Use Linear Model for EIRP
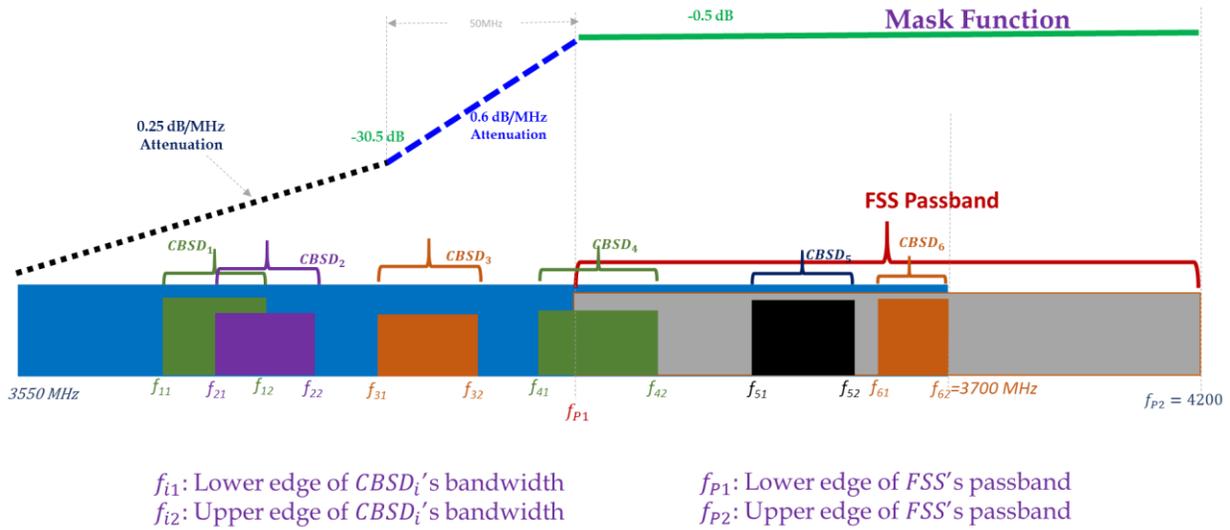
Figure 8.8-1 Mask Function for FSS Blocking – FSS Scenario 1: Passband starting below 3700 extending to 4200 MHz
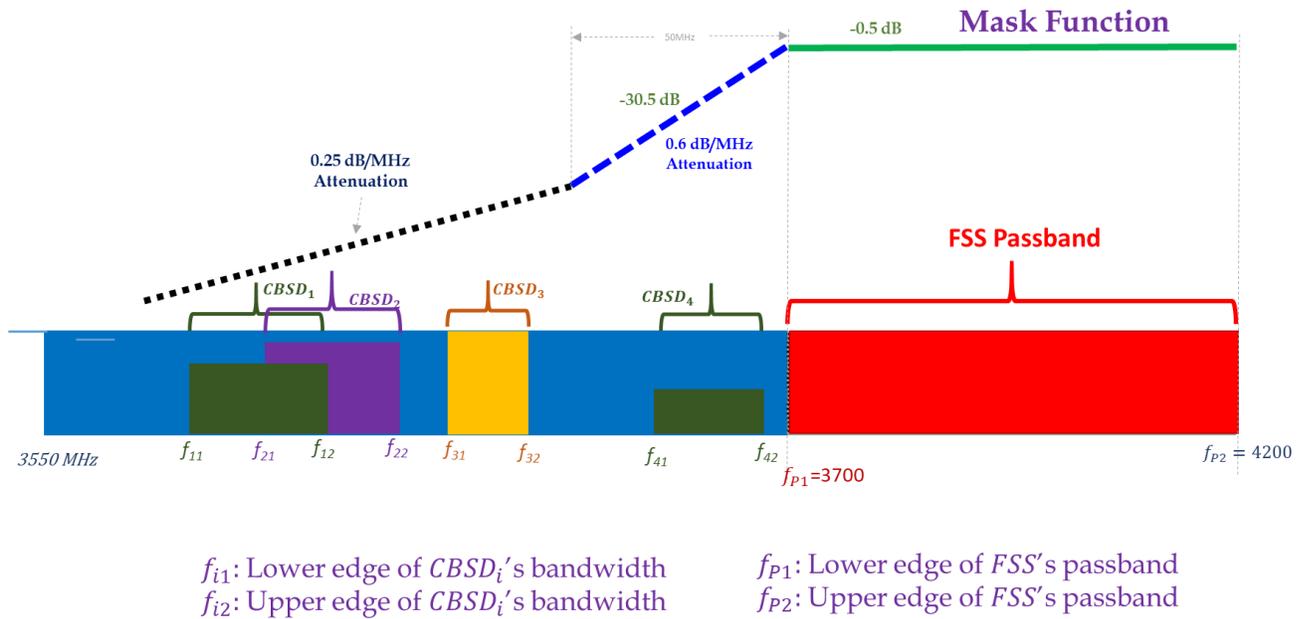
Figure 8.8-2 Mask Function for FSS Blocking – FSS Scenario 2: Passband from 3700-4200 MHz
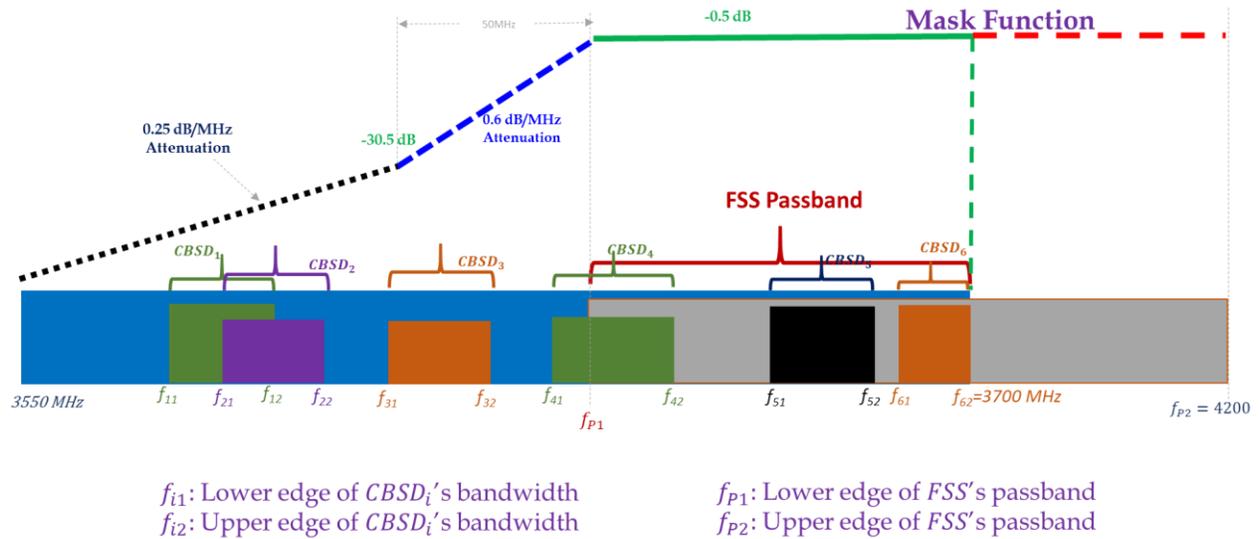
Figure 8.8-3 Mask Function for FSS Blocking – FSS Scenario 3: Passband starting Below 3700 and extending to 3700 MHz

In this section, the actual protection threshold used for IAP and FSS Purge Calculations is calculated by applying a pre-defined Pre-IAP or pre-Purge List Headroom (*Mg*) [n.21] at each FSS protection threshold. The actual IAP protection level or Purge list threshold for the FSS station is Q-Mg. A unique value of Mg is applied consistently among all SASs for co-channel, blocking, or OOBE protection. Equation 8.4-2 is used to calculate the allowed headroom for SAS UUT.

8.8.3.4   FSS Protection Criteria

The full passband of FSS station is denoted as F_{FSS}, while the portion (if any) below 3700MHz is denoted as $F_{CoChannel}$, and the portion above 3700MHz is denoted as F_{TTC}. In normal operation, F_{FSS} is derived from the lower frequency and upper frequency information obtained from FSS database.

To protect an FSS entity, and depending on FSS scenario depicted in Figure 8.8-1 and Figure 8.8-2, and the status of TT&C Flag, a combination of the following three criteria shall be satisfied:

- Blocking Protection
- Co-Channel Protection
- Out of Band Emission

8.8.3.4.1   Blocking protection

To test the SAS UUT ability to protect FSS stations from blocking interference, the following steps shall be performed:

1. Calculate *B*, the mean aggregate blocking interference to the FSS station. To calculate the aggregate blocking interference, the Main Test Harness uses

2. Equation 8.8-1 applied to the following Grants with any frequency assignment in 3550-3700 MHz:
   a. All authorized Grants managed by the SAS UUT for CBSDs that are within 40 km from the FSS station, and,
   b. Exclude the portion of Grants that overlaps with $F_{CoChannel}$, and
   c. No out of band emissions of CBSDs are considered in this calculation.

3. Calculate *Bref*, the mean aggregate blocking interference obtained from the IAP Reference Model. To calculate *Bref*, the Main Test Harness uses

4. Equation 8.8-1 applied to the following Grants with any frequency assignment in 3550-3700 MHz:
   a. All authorized Grants managed by SAS UUT for CBSDs that are within 40 km from the FSS station, and
   b. Exclude the portion of Grants that overlaps with $F_{CoChannel}$, and
   c. No out of band emissions of a CBSD are considered in this calculation.
   d. Use $Mg_{Blocking}$ for calculating Headroom

The Blocking Protection criterion is satisfied if and only if $B \leq Bref + \Delta_{Blocking}$.

Note: *B* and *Bref* in this section correspond to A_p^{IAP} and $A_p^{IAP,ref}$ in Section 8.10, respectively, when the protected entity is FSS Blocking.

8.8.3.4.2 Co-channel protection

To test the SAS UUT ability to protect FSS stations from co-channel interference, the following steps shall be performed. Note that the FSS station passband insertion loss is 0.5 dB, which increases the co-channel threshold in Table 8.4-2 by this value.

1. Calculate *A*, the mean aggregate co-channel interference to the FSS station. To calculate the aggregate co-channel interference, the Main Test Harness uses the following Grants with any frequency assignment in 3550-3700 MHz:
   a. All authorized Grants managed by the SAS UUT for CBSDs that are within 150 km from the FSS station, and
   b. Use the portion of Grants that overlaps with $F_{CoChannel}$, and
   c. No out of band emissions of CBSDs are considered in this calculation, and
   d. Divide $F_{CoChannel}$, into *M* channel bandwidths, each with the size of *IAPBW*; denote each as *BWj (j = 1, …, M)*.
   e. For each BW_j, calculate the mean aggregate interference A_j, which is the *jth* element of *A*:
      - If no Grants overlap with BW_j, skip to *j = j + 1*.
      - Otherwise, use the Aggregate Interference Reference Model to calculate the aggregate interference of all Grants which partially or fully overlap with BW_j.

2   Calculate *Aref*, the mean aggregate co-channel interference threshold obtained from the IAP Reference Model. To calculate *Aref*, the Main Test Harness uses the following Grants with any frequency assignment in 3550-3700 MHz:

    a. All authorized Grants managed by the SAS UUT for CBSDs that are within 150 km from the FSS station, and

    b. Use the portion of Grants that overlaps with $F_{CoChannel}$, and

    c. No out of band emissions of CBSDs are considered in this calculation, and

    d. For each BW_j, calculate the mean aggregate interference $Aref_j$ which is the *j*th element of *Aref*:

        ▪ If no Grants overlap with BW_j, skip to j = j + 1.

        ▪ Otherwise, use the Aggregate Interference Reference Model to calculate the aggregate interference of all Grants which partially or fully overlap with BW_j.

    e. Use $Mg_{CoChannel}$ for calculating Headroom.

The co-channel protection criterion is satisfied if and only if $A_j \leq A_{ref,j} + \Delta_{CoChannel}$ for all *j*.

Note: A_j and $A_{ref,j}$ in this section correspond to A_p^{IAP} and $A_p^{IAP,ref}$ in section 8.10, respectively, when the protected entity is FSS co-channel.

8.8.3.4.3   Out of Band Emission (OOBE) Protection

To test the SAS UUT ability to protect FSS stations from OOBE interference, the following steps shall be performed. Note that the FSS station passband insertion loss is 0.5 dB, which increases the OOBE threshold in Table 8.4-2 by this value.

1   Calculate A_{OOBE}, the mean aggregate OOBE interference to the FSS station. To calculate the aggregate OOBE interference, the Main Test Harness applies [n.12, R2-SGN-29] to the following Grants with any frequency assignment in 3550-3700 MHz:

    a. All authorized Grants managed by the SAS UUT for CBSDs that are within 40 km from the FSS station, and

    b. For CBSDs having multiple Grants, the Grant closest to 3700 MHz is taken into account.

    c. The OOBE aggregate OOBE interference is applied to the frequency segment BW_1 starting from 3700 MHz and channel bandwidth of *IAPBW*.

2   Calculate $Aref_{OOBE}$, the mean aggregate OOBE interference threshold obtained from the Purge List Reference Model. To calculate $Aref_{OOBE}$, the Main Test Harness applies [n.12, R2-SGN-29] to the following Grants with any frequency assignment in 3550-3700 MHz:

    a. All authorized Grants managed by the SAS UUT for CBSDs that are within 40 km from the FSS station, and

    b. For CBSDs having multiple Grants, the Grant closest to 3700 MHz is taken into account.

      c. The OOBE aggregate OOBE interference is applied to the frequency segment BW_1 starting from 3700 MHz and channel bandwidth of *IAPBW*.

      d. Use Mg_{OOBE} for calculating Headroom.

The OOBE protection criterion is satisfied if and only if $A_{OOBE} \leq Aref_{OOBE} + \Delta_{OOBE}$

Note: A_{OOBE} and $Aref_{OOBE}$ in this section correspond to A_p^{IAP} and $A_p^{IAP,ref}$, respectively, in section 8.10, when the protected entity is FSS out of band emission.

8.8.3.5   FSS Protection Steps

If "FSS Scenario 1" (Figure 8.8-1) with TT&C Flag = OFF, or "FSS Scenario 3" (Figure 8.8-3), regardless of the value of TT&C Flag, apply Co-Channel Protection (passband below 3700 MHz), and Blocking Protection (at 3550-3700 MHz).

If "FSS Scenario 1" (Figure 8.8-1) and TT&C Flag = ON, apply Co-Channel Protection (passband below 3700 MHz), Blocking Protection (3550-3700 MHz), and OOBE Protection to F_{TTC}. OOBE Protection shall be applied prior to Co-channel Protection and Blocking Protection.

If "FSS Scenario 2" (Figure 8.8-2) and TT&C Flag = OFF, no protection is applied.

If "FSS Scenario 2" (Figure 8.8-2) and TT&C Flag = ON, apply Blocking Protection (at 3550-3700 MHz) and OOBE Protection to F_{TTC}. OOBE Protection shall be applied prior to Blocking Protection.

8.8.4   Test Procedure

8.8.4.1   [WINNF.FT.S.FPR.1] Multiple CBSDs from Multiple SASs Inside and Outside the Neighborhood of an FSS Station for "FSS Scenario 1" with TT&C Flag = OFF, or "FSS Scenario 3" with configurable value for TT&C Flag.

The lower edge of FSS passband is below 3700MHz, and the upper edge of FSS passband is set at 4200MHz.

Perform xPR.2 using "FSS Scenario 1" with TT&C Flag = OFF, or "FSS Scenario 3", regardless of the value of TT&C Flag (refer to Section 8.8.3.5).

8.8.4.2   [WINNF.FT.S.FPR.2] Multiple CBSDs from Multiple SASs Inside and Outside the Neighborhood of an FSS Station for FSS Scenario 1 with TT&C Flag = ON

The lower edge of FSS passband is below 3700MHz, and the upper edge of FSS passband is set at 4200MHz.

Perform xPR.2 using "FSS Scenario 1" with TT&C Flag = ON (refer to Section 8.8.3.5).

8.8.4.3 [WINNF.FT.S.FPR.3] Multiple CBSDs from Multiple SASs Inside and Outside the Neighborhood of an FSS Station for "FSS Scenario 2" with TT&C Flag = OFF

The lower edge of FSS passband is 3700MHz, and the upper edge of FSS passband is set at 4200MHz.

Perform xPR.2 using "FSS Scenario 2" with TT&C Flag = OFF (refer to Section 8.8.3.5).

8.8.4.4 [WINNF.FT.S.FPR.4] Multiple CBSDs from Multiple SASs Inside and Outside the Neighborhood of an FSS Station for "FSS Scenario 2" with TT&C Flag = ON

The lower edge of FSS passband is 3700MHz, and the upper edge of FSS passband is set at 4200MHz.

Perform xPR.2 using "FSS Scenario 2" with TT&C Flag = ON (refer to Section 8.8.3.5).

8.8.4.5 [WINNF.FT.S.FPR.5] Grant Requests from one or more CBSDs Inside an FSS-GWBL Exclusion Zone

One or more CBSDs, located inside the 150km of the FSS site with presence of a GWBL in that area, request a Grant but are rejected. In this test case, it is assumed that there is no coordination among FSS user, GWBL user, and CBSD user to allow operation of CBSD within FSS-GWBL Exclusion zone. Such coordination agreement reported to SAS manually offline, may overrule this test case.

Step	Instructions
1	Inject information for an FSS site operating in 3600-3700 MHz band into the SAS UUT.
2	Inject information for a GWBL into the SAS UUT, such that the GWBL is located within 150km of the FSS station site in Step 1 and operating in a frequency range that overlaps with the FSS pass-band.
3	Admin Test Harness triggers CPAS and waits until completion of CPAS.
4	The DP Test Harness registers N > 0 CBSDs located inside 150km area of the FSS.
5	The DP Test Harness requests one Grant per registered CBSD within 3650 to 3700 MHz. The requested frequency ranges are each partially or fully overlapping with FSS passband.
CHECK	SAS UUT responds to all Grant Requests with *responseCode* 400. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.9 Federal Incumbent Protection

8.9.1 Definition, Applicability, and Scope of the Test Case

This test verifies that the SAS as the unit under test (UUT) meets established criteria for the protection of federal incumbent dynamic protection areas (DPAs). It tests the response of the SAS UUT to new Grant Requests, as well as the ability of the SAS UUT to manage the aggregate interference of existing authorized CBSD Grants when DPAs are activated. It also tests the response of the SAS UUT to loss of connectivity with the ESC.

8.9.2 Test Characteristics

Table 8.9-1 Federal Incumbent Protection

1	**Test ID**	WINNF.FT.S.IPR
2	**Title**	Federal Incumbent Protection
3	**Working Group / Entity**	WG1
4	**Test Type**	Functionality
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.12]

8.9.3 Method of test

8.9.3.1 Initial Conditions / Test Pre-conditions

- The SAS UUT is active and able to receive messages from the CBSD, SAS, and ESC Test Harnesses.
  - The ESC Test Harness is associated with all DPAs. The ESC Test Harness provides the ability to arbitrarily activate/deactivate DPAs.

8.9.3.2 Test Tools Required

- ESC Test Harness
  - Representing a single ESC system
  - Capable of communicating the activation of one or more DPAs and the affected channels of each activated DPA
  - With support as needed by the SAS UUT to detect loss of connectivity with the ESC Test Harness
- DPA Reference Move List Model
  - To pre-calculate the reference move list for a DPA on a frequency range, the Main Test Harness shall follow the procedure in [n.12, R2-SGN-24]. This calculation shall assume that a CBSD with an approved Grant (i.e., in the *Granted* or *Authorized* state) emits with the maximum EIRP permitted by the Grant

(*maxEirp* parameter in the Grant Request). The reference move list shall account for the uncertainty in the output of the reference move list model.

- Aggregate Interference Model
- SAS Test Harness
  - To create Grant configurations in the SAS Test Harness that achieve desired aggregate interference conditions, these Grants can be run through the Aggregate Interference Reference Model prior to the test to ensure they meet those conditions.
- DP Test Harness

8.9.4   Test Procedure

8.9.4.1   [WINNF.FT.S.IPR.1] In the absence of an ESC, SAS protects all ESC-monitored DPAs.[3]

This test does not use the ESC Test Harness. In the absence of an ESC, SAS UUT is expected to protect all ESC-monitored DPAs. In the PASS/FAIL criteria of this and following tests, Δ^{DPA} is an aggregate interference uncertainty margin (dB) whose value shall be configured to be commensurate with the 95% confidence interval of the aggregate interference calculation. To reduce execution time, it is recommended to use a small number of CBSDs which are in the neighborhood of a small number of DPAs.

Step	Instructions
1	Admin Test Harness instructs the SAS UUT to load all ESC-monitored DPA contours and protection criteria.
2	Activate $N_S \geq 0$ SAS Test Harnesses and notify the SAS UUT.
3	SAS Test Harnesses are configured with FAD Records containing N_1 registered and granted CBSDs.
4	DP Test Harness registers with the SAS UUT N_2 CBSDs and requests Grants such that the aggregate interference from the $N_1 + N_2$ Grants would not exceed the protection criteria of any DPA.
5	Admin Test Harness triggers CPAS and waits until completion of CPAS.
6	DP Test Harness registers with the SAS UUT N_3 CBSDs and requests Grants such that the aggregate interference from the $N_1 + N_2 + N_3$ Grants would exceed the protection criteria of one or more DPAs in a channel C_k in 3500 MHz to 3650 MHz. Each of the N_3 CBSDs must be inside the neighborhood of at least one DPA and their Grant requests include frequencies in 3550 MHz to 3650 MHz.
7	DP Test Harness sends a Heartbeat Request for each Grant managed by SAS UUT.
CHECK	None of the Grants requested in Step 6 are in the *Authorized* state. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*

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[3] "ESC-monitored DPAs" include offshore (or coastal) DPAs as well as ground-based radar and in-port inland DPAs which are ESC-monitored in 3550-3650 MHz and always active in 3500-3550 MHz

8	Admin Test Harness triggers FAD generation and waits until completion of FAD generation.
9	One of the SAS Test Harnesses pulls the FAD data from the SAS UUT if $N_S > 0$.
10	Admin Test Harness triggers CPAS and waits until completion of CPAS.
11	If $N_S > 0$, the Main Test Harness executes the DPA Move List Reference Model using the FAD information from Step 3 and Step 9 and obtains the reference move lists of all ESC-monitored DPAs for channel C_k.
12	DP Test Harness sends a Heartbeat Request for each SAS UUT Grant.

13	For each protection point p of ESC-monitored DPAs and in channel C_k, the Main Test Harness calculates:
	 • $A_{p,a}^{DPA}$, the 95th percentile of the aggregate interference at protection point p and incumbent antenna azimuth a of:
	     ○ all SAS UUT Grants authorized in Step 12, and
	     ○ all SAS Test Harness Grants that are not in the union of the reference move lists of the active DPA/channel pairs; and
	 • $A_{p,a}^{DPA,ref}$, the 95th percentile of the aggregate interference at protection point p and incumbent antenna azimuth a of:
	     ○ all SAS UUT Grants included in the FAD information from Step 9 that are not in the union of the reference move lists of the active DPA/channel pairs, and
	     ○ all SAS Test Harness Grants that are not in the union of the reference move lists of the active DPA/channel pairs.
	
	 Note 1: If $N_S = 0$, the Main Test Harness calculates $A_{p,a}^{DPA}$ of SAS UUT Grants authorized in Step 12, and $A_{p,a}^{DPA,ref}$ is equal to the protection level of the DPA.
	
	 Note 2: Since ESC-monitored inland DPAs are always activated below 3550 MHz, if Ck is below 3550 MHz, the aggregate interference is computed over the frequency range "3540-3550 MHz".

CHECK	$A_{p,a}^{DPA} \leq A_{p,a}^{DPA,ref} + \Delta^{DPA}$ for each azimuth a of each protection point p of each ESC-monitored DPA in channel C_k *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.9.4.2 [WINNF.FT.S.IPR.2] Activation of Multiple Offshore DPAs

In this test case, SAS UUT is expected to manage the Grants of CBSDs after DPAs are activated to meet their protection criteria. In the following, (D_i, C_j) is a DPA/channel pair, where D_i is a DPA ID, and C_j is a CBRS channel in 3550 MHz to 3650 MHz that must be protected in DPA D_i. Let DPA D_{i+1} be adjacent to DPA D_i, and let DPA D_k be non-adjacent to DPAs D_i and D_{i+1}. Let C_l be a second CBRS channel in 3550 MHz to 3650 MHz different from C_j. In Steps 13, 16, and

19 below, T_{pause} is a configurable duration (seconds) to pause between DPA activations, but shall not exceed *grantExpireTime* provided by SAS UUT.

Step	Instructions
1	Admin Test Harness instructs the SAS UUT to load all ESC-monitored DPA contours and protection criteria.
2	ESC Test Harness communicates that all its fully monitored DPAs are inactive (except those which are always active, e.g., inland sites with a permanent frequency assignment).
3	Activate $N_S \geq 0$ SAS Test Harnesses and notify the SAS UUT.
4	SAS Test Harnesses are configured with FAD Records containing N_1 registered and granted CBSDs.
5	$N_D > 0$ DP Test Harnesses register with the SAS UUT N_2 CBSDs and request Grants such that the aggregate interference from the $N_1 + N_2$ Grants would exceed the protection criteria of DPA/channel pairs (D_i, C_j), (D_i, C_l), (D_{i+1}, C_j), and (D_k, C_l).
6	Admin Test Harness triggers FAD generation and waits until completion of FAD generation.
7	One of the SAS Test Harnesses pulls the FAD data from the SAS UUT if $N_S > 0$.
8	Admin Test Harness triggers CPAS and waits until completion of CPAS.
9	If $N_S > 0$, the Main Test Harness executes the DPA move list reference model using the FAD information from Step 4 and Step 7 and obtains the reference move lists of DPA/channel pairs (D_i, C_j), (D_i, C_l), (D_{i+1}, C_j), and (D_k, C_l)
10	ESC Test Harness communicates that the DPA/channel pair (D_i, C_j) is active.
11	After 240 seconds, DP Test Harnesses send a Heartbeat Request for each Grant managed by SAS UUT.
12	For each protection point p of active DPA/channel pairs, the Main Test Harness calculates: • $A_{p,a}^{DPA}$, the 95th percentile of the aggregate interference at protection point p and incumbent antenna azimuth a of: ○ all SAS UUT Grants authorized in the previous Step, and ○ all SAS Test Harness Grants that are not in the union of the reference move lists of the active DPA/channel pairs; and • $A_{p,a}^{DPA,ref}$, the 95th percentile of the aggregate interference at protection point p and incumbent antenna azimuth a of: ○ all SAS UUT Grants included in the FAD information from Step 7 that are not in the union of the reference move lists of the active DPA/channel pairs, and ○ all SAS Test Harness Grants that are not in the union of the reference move lists of the active DPA/channel pairs.

	Note: If $N_S = 0$, the Main Test Harness calculates $A_{p,a}^{DPA}$ of SAS UUT Grants authorized in the previous Step, and $A_{p,a}^{DPA,ref}$ is equal to the protection level of the DPA.
CHECK	$A_{p,a}^{DPA} \leq A_{p,a}^{DPA,ref} + \Delta^{DPA}$ for each azimuth a of each protection point p of DPA/channel pair (D_i, C_j) *If any of the above conditions are not met, the SAS UUT FAILS this test. In either case, proceed.*
13	Pause T_{pause} seconds. ESC Test Harness communicates that the DPA/channel pair (D_i, C_l) is active.
14	After 240 seconds, DP Test Harnesses send a Heartbeat Request for each Grant managed by SAS UUT.
15	Repeat Step 12
CHECK	$A_{p,a}^{DPA} \leq A_{p,a}^{DPA,ref} + \Delta^{DPA}$ for each azimuth a of each protection point p of DPA/channel pairs (D_i, C_j) and (D_i, C_l) *If any of the above conditions are not met, the SAS UUT FAILS this test. In either case, proceed.*
16	Pause T_{pause} seconds. ESC Test Harness communicates that the DPA/channel pair (D_{i+1}, C_j) is active.
17	After 240 seconds, DP Test Harnesses send a Heartbeat Request for each Grant managed by SAS UUT.
18	Repeat Step 12
CHECK	$A_{p,a}^{DPA} \leq A_{p,a}^{DPA,ref} + \Delta^{DPA}$ for each azimuth a of each protection point p of DPA/channel pairs (D_i, C_j), (D_i, C_l), and (D_{i+1}, C_j) *If any of the above conditions are not met, the SAS UUT FAILS this test. In either case, proceed.*
19	Pause T_{pause} seconds. ESC Test Harness communicates that the DPA/channel pair (D_k, C_l) is active.
20	After 240 seconds, DP Test Harnesses send a Heartbeat Request for each Grant managed by SAS UUT.
21	Repeat Step 12
CHECK	$A_{p,a}^{DPA} \leq A_{p,a}^{DPA,ref} + \Delta^{DPA}$ for each azimuth a of each protection point p of DPA/channel pairs (D_i, C_j), (D_i, C_l), (D_{i+1}, C_j), and (D_k, C_l) *If any of the above conditions are not met, or any of the preceding conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.9.4.3 [WINNF.FT.S.IPR.3] CBSD Grant Request in the Neighborhood of an Activated Offshore DPA.

In this test case, SAS UUT is expected not to authorize Grant Requests from CBSDs in the neighborhood of a protection constraint of an active offshore co-channel DPA made prior to the

next move-list computation (i.e. CPAS). In the following, D_i is the ID of an offshore DPA, and C_j is a CBRS channel in 3550 MHz to 3650 MHz.

Step	Instructions
1	Admin Test Harness instructs the SAS UUT to load all ESC-monitored DPA contours and protection criteria.
2	ESC Test Harness communicates that all its fully monitored DPAs are inactive (except those which are always active, e.g., inland sites with a permanent frequency assignment).
3	ESC Test Harness communicates that DPA D_i is active on channel C_j.
4	Pause 240 seconds.
5	DP Test Harness registers and requests a Grant for a CBSD in the neighborhood of a protection constraint of DPA D_i in channel C_j.
6	DP Test Harness transmits a Heartbeat Request for the CBSD Grant requested in Step 5, if it was approved.
CHECK	The Grant Requested in Step 5 is not in the *Authorized* state. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.9.4.4 [WINNF.FT.S.IPR.4] CBSD Grant Request in the Neighborhood of an Activated Inland DPA.

In this test case, SAS UUT is expected to not authorize Grant Requests from CBSDs in the neighborhood of a protection constraint of an active inland DPA made prior to the next move-list computation (i.e. CPAS). In the following, D_i is the ID of an inland DPA, and C_j is a channel in 3500 MHz to 3650 MHz.

Step	Instructions
1	Admin Test Harness instructs the SAS UUT to load all ESC-monitored DPA contours and protection criteria.
2	ESC Test Harness communicates that all its fully monitored DPAs are inactive in 3550 MHz to 3650 MHz (except those which are always active, e.g., inland sites with a permanent frequency assignment).
3	If C_j is in 3550 MHz to 3650 MHz, ESC Test Harness communicates that DPA D_i is active on channel C_j.
4	Pause 240 seconds.
5	DP Test Harness registers and requests a Grant for a CBSD in the neighborhood of a protection constraint of DPA D_i. If C_j is in 3550 MHz to 3650 MHz, some portion of the Grant must overlap with C_j.
6	DP Test Harness transmits a Heartbeat Request for the CBSD Grant Requested in Step 5, if it was approved.
CHECK	The Grant Requested in Step 5 is not in the *Authorized* state.

	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

8.9.4.5 [WINNF.FT.S.IPR.5] CBSD Grant Requests in the Neighborhood of Inactive DPAs followed by DPA Activation

In this test case, CBSDs in the neighborhood of a protection constraint of an inactive DPA request Grants after the most recent move-list computation by the SAS. After the DPA is activated, the SAS suspends or terminates the Grants, if approved. In the following, D_i is the ID of a DPA, and C_j is a CBRS channel in 3550 MHz to 3650 MHz.

Step	Instructions
1	Admin Test Harness instructs the SAS UUT to load all ESC-monitored DPA contours and protection criteria.
2	ESC Test Harness communicates that all its fully monitored DPAs are inactive (except those which are always active, e.g., inland sites with a permanent frequency assignment).
3	Admin Test Harness triggers CPAS and waits until completion of CPAS.
4	$N_D > 0$ DP Test Harnesses register N_1 CBSDs with the SAS UUT and request Grants in the neighborhood of a protection constraint of DPA D_i in channel C_j.
5	DP Test Harnesses send Heartbeat Requests for the CBSD Grants requested in Step 4 (if they were approved).
6	ESC Test Harness communicates that DPA D_i is active on channel C_j and records the time of this communication as t_{ESC}.
7	Repeat Step 5 X times at an interval of T seconds.
CHECK	None of the Heartbeat responses from the SAS UUT have *transmitExpireTime* set to a value greater than $t_{ESC} + 240$ seconds. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.9.4.6 [WINNF.FT.S.IPR.6] Broken Connectivity between the SAS UUT and ESC Monitoring DPAs on all channels

In this test case, SAS UUT is expected to manage the Grants of CBSDs after losing connectivity with the ESC to meet the protection criteria of all ESC-monitored DPAs on all channels. To reduce execution time, it is recommended to use a small number of CBSDs which are in the neighborhood of a small number of DPAs.

Step	Instructions
1	Admin Test Harness instructs the SAS UUT to load all ESC-monitored DPA contours and protection criteria.
2	ESC Test Harness communicates that all its fully monitored DPAs are inactive (except those which are always active, e.g., inland sites with a permanent frequency assignment).

3	Activate $N_S \geq 0$ SAS Test Harnesses and notify the SAS UUT.
4	SAS Test Harnesses are configured with FAD Records containing N_1 registered and granted CBSDs.
5	$N_D > 0$ DP Test Harnesses register with the SAS UUT N_2 CBSDs and request Grants such that the aggregate interference from the $N_1 + N_2$ Grants would exceed the protection criteria of one or more ESC-monitored DPAs in one or more CBRS channels in 3550 MHz to 3650 MHz if the DPA/channel pairs were activated.
6	Admin Test Harness triggers FAD generation and waits until completion of FAD generation.
7	One of the SAS Test Harnesses pulls the FAD data from the SAS UUT if $N_S > 0$.
8	Admin Test Harness triggers CPAS and waits until completion of CPAS.
9	If $N_S > 0$, the Main Test Harness executes the DPA move list reference model using the FAD information from Step 4 and Step 7 and obtains the reference move lists of all ESC-monitored DPAs for all channels in 3550 MHz to 3650 MHz.
10	Connectivity between the ESC Test Harness and the SAS UUT is intentionally broken.
11	After 240 seconds, DP Test Harnesses send a Heartbeat Request for each Grant managed by SAS UUT.
12	For each protection point p of active DPA/channel pairs, the Main Test Harness calculates: • $A_{p,a}^{DPA}$, the 95th percentile of the aggregate interference at protection point p and incumbent antenna azimuth a of: ○ all SAS UUT Grants authorized in Step 11, and ○ all SAS Test Harness Grants that are not in the union of the reference move lists of the active DPA/channel pairs; and • $A_{p,a}^{DPA,ref}$, the 95th percentile of the aggregate interference at protection point p and incumbent antenna azimuth a of: ○ all SAS UUT Grants included in the FAD information from Step 7 that are not in the union of the reference move lists of the active DPA/channel pairs, and ○ all SAS Test Harness Grants that are not in the union of the reference move lists of the active DPA/channel pairs. Note: If $N_S = 0$, the Main Test Harness calculates $A_{p,a}^{DPA}$ of SAS UUT Grants authorized in Step 11, and $A_{p,a}^{DPA,ref}$ is equal to the protection level of the DPA.
CHECK	$A_{p,a}^{DPA} \leq A_{p,a}^{DPA,ref} + \Delta^{DPA}$ for each azimuth a of each protection point p of each ESC-monitored DPA/channel pair *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.9.4.7   [WINNF.FT.S.IPR.7] Activation of a Single DPA

In this test case, SAS UUT is expected to manage the Grants of CBSDs after a DPA is activated to meet its protection criteria. In the following, (D_i, C_j) is a DPA/channel pair, where D_i is the DPA ID of an ESC-monitored DPA or a portal-controlled DPA, and C_j is a channel in 3500 MHz to 3650 MHz that must be protected in DPA D_i.

Step	Instructions
1	If testing with ESC-monitored DPA(s), Admin Test Harness instructs SAS UUT to load all ESC-monitored DPA contours and protection criteria. If testing with portal-controlled DPA(s), create a DPA database which contains the DPA to be tested.
2	If testing ESC-monitored DPA(s), ESC Test Harness communicates that all its fully monitored DPAs are inactive in 3550 MHz to 3650 MHz (except those which are always active, e.g., inland sites with a permanent frequency assignment).
3	If Testing portal-controlled DPA(s), and the CPAS Flag in the configuration file is TRUE, Admin Test Harness triggers CPAS and waits until completion of CPAS.
4	Activate $N_S \geq 0$ SAS Test Harnesses and notify the SAS UUT.
5	SAS Test Harnesses are configured with FAD Records containing N_1 registered and granted CBSDs.
6	$N_D > 0$ DP Test Harnesses register with the SAS UUT N_2 CBSDs and request Grants such that the aggregate interference from the $N_1 + N_2$ Grants would exceed the protection criteria of DPA/channel pair (D_i, C_j).
7	Admin Test Harness triggers FAD generation and waits until completion of FAD generation.
8	One of the SAS Test Harnesses pulls the FAD data from the SAS UUT if $N_S > 0$.
9	Admin Test Harness triggers CPAS and waits until completion of CPAS.
10	If $N_S > 0$, Main Test Harness executes the DPA move list reference model using the FAD information from Step 4 and Step 7 and obtains the reference move list of DPA/channel pair (D_i, C_j).
11	If D_i is an ESC-monitored DPA and C_j is in 3550 MHz to 3650 MHz, ESC Test Harness communicates that DPA/channel pair (D_i, C_j) is active.
12	After 240 seconds, DP Test Harnesses send a Heartbeat Request for each Grant managed by SAS UUT.
13	For each protection point p of the active DPA/channel pair, the Main Test Harness calculates: • $A_{p,a}^{DPA}$, the 95th percentile of the aggregate interference at protection point p and incumbent antenna azimuth a of: ○ all SAS UUT Grants authorized in the previous Step, and ○ all SAS Test Harness Grants that are not on the reference move list of the active DPA/channel pair; and • $A_{p,a}^{DPA,ref}$, the 95th percentile of the aggregate interference at protection point p and incumbent antenna azimuth a of:

	o all SAS UUT Grants included in the FAD information from Step 7 that are not on the reference move list of the active DPA/channel pair, and o all SAS Test Harness Grants that are not on the reference move list of the active DPA/channel pair. Note 1: If $N_S = 0$, the Main Test Harness calculates $A_{p,a}^{DPA}$ of SAS UUT Grants authorized in the previous step, and $A_{p,a}^{DPA,ref}$ is equal to the protection level of the DPA. Note 2: Since ESC-monitored inland DPAs are always activated below 3550 MHz, if Cj is below 3550 MHz and the DPA is an ESC-monitored DPA, the aggregate interference is computed over the frequency range "3540-3550 MHz".
CHECK	$A_{p,a}^{DPA} \leq A_{p,a}^{DPA,ref} + \Delta^{DPA}$ for each azimuth a of each protection point p of DPA/channel pair (D_i, C_j) *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.10 Incumbent Protection – Multi Constraint Protection (MCP)

8.10.1 Definition, Applicability, and Scope of the Test Case

This test verifies that the SAS as the unit under test (UUT) meets established criteria for interference protection with multiple constraints, including FSS, GWPZ, PPA, ESC sensor, and DPA. It tests the response of the SAS UUT to Grant Requests subject to one or more of these constraints.

8.10.2 Test Characteristics

Table 8.10-1 Multiple Constraint Protection Test Characteristics

1	**Test ID**	WINNF.FT.S.MCP
2	**Title**	Multiple Constraints Protection
3	**Working Group / Entity**	WG1
4	**Test Type**	Functional
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.12]

8.10.3 Method of test

8.10.3.1 Initial Conditions / Test Pre-conditions

- The SAS UUT is active and able to receive messages from the CBSD, SAS, and ESC Test Harnesses.

o The ESC Test Harness is associated with all DPAs. The ESC Test Harness provides the ability to arbitrarily activate/deactivate DPAs.

8.10.3.2 Test Tools Required

- ESC Test Harness
  - Representing a single ESC system
  - Capable of communicating the activation of one or more DPAs and the affected channels of each activated DPA
  - Appropriate configuration/logging tool for this test
- DPA Reference Move List Model
  - To pre-calculate the reference move list for a DPA on a frequency range, the Main Test Harness shall follow the procedure in [n.12, R2-SGN-24]. This calculation shall assume that a CBSD with an approved Grant (i.e., in the *Granted* or *Authorized* state) emits with the maximum EIRP permitted by the Grant (*maxEirp* parameter in the Grant Request). The reference move list shall account for the uncertainty in the output of the reference move list model.
- Aggregate Interference Model
- IAP Reference Model
- SAS Test Harness
  - To ensure the validity of CBSD and Grant configurations in the SAS Test Harness for a given set of protection constraints, these Grants can be run through the IAP Reference Model prior to the test to ensure they can be satisfied at their requested power levels.
- DP Test Harness

8.10.4 Test Procedure

8.10.4.1 [WINNF.FT.S.MCP.1] SAS manages a mix of GAA and PAL Grants in 3550 MHz to 3700 MHz to protect configurable IAP-protected entities and DPAs.

Figure below depicts the test execution steps at a high level.
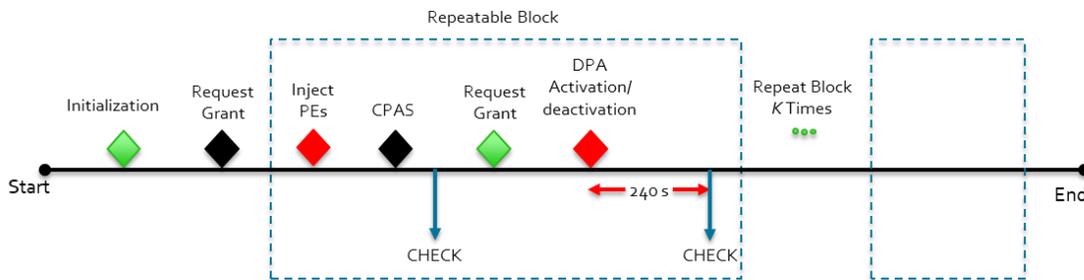
Figure 8.10-1 Overview of test execution steps

In the following, Δ^{IAP} and Δ^{DPA} shall be configured to be commensurate with the 95% confidence intervals of the respective aggregate interference calculations.

Delta IAP, Δ^{IAP}, is the maximum allowable margin by which a SAS UUT aggregated interference, A_p^{IAP}, must be bounded from the aggregate interference, $A_p^{IAP,ref}$, computed by the reference Implementation, to pass any IAP related test. Commensurate with PAT.1 test case, Delta IAP, Δ^{IAP}, will be 1dB.

Step	Instructions
1	Admin Test Harness instructs the SAS UUT to load all ESC-monitored DPA contours and protection criteria.
2	ESC Test Harness informs the SAS UUT that all its fully monitored DPAs are inactive (except those DPAs which are always active, e.g., inland sites with a permanent frequency assignment).
3	Activate $N_S \geq 0$ SAS Test Harnesses and notify the SAS UUT. The SAS Test Harnesses do not contain any CBSDs or Grants. Note: N_{SAS} as used in Equation B- 2 is equal to $N_S + 1$.
4	DP Test Harnesses register N_2 CBSDs with the SAS UUT and request a Grant for each.
5	Repeat Steps 6 through [end] K times. In the kth iteration, $1 \leq k \leq K$, the following values are defined: • $N_{1,k}$ is the number of CBSDs configured in the SAS Test Harnesses (each will use a disjoint subset), • $N_{2,k}$ is the number of CBSDs registered with the SAS UUT (note: the sets of CBSDs between different iterations are disjoint), • $\mathcal{P}_{IAP,k}$ is a set of IAP-protected entities (which may be empty), • $\mathcal{D}_{activated,k}$ is a set of DPA/channel pairs to be activated (which may be empty), and • $\mathcal{D}_{deactivated,k}$ is a set of DPA/channel pairs to be deactivated (which may be empty).
6	Admin Test Harness injects IAP-protected entities $\mathcal{P}_{IAP,k}$ into the SAS UUT.
7	Admin Test Harness triggers FAD generation and waits until completion of FAD generation if $N_S > 0$.
8	One of the SAS Test Harnesses pulls the FAD data from the SAS UUT if $N_S > 0$.
9	Configure the SAS Test Harnesses with FAD records containing $N_{1,k}$ registered and granted CBSDs.
10	Admin Test Harness triggers CPAS and waits until completion of CPAS.
11	If $N_S > 0$, Main Test Harness executes the IAP Reference Model using the FAD information from Steps 8 and 9. Note: the IAP Reference Model includes pre-IAP filtering (which includes e.g. FSS Purge List calculation). CBSDs removed during pre-IAP filtering are not used in the IAP Reference Model and are not used in the DPA Move List Reference Model.
12	If $N_S > 0$, Main Test Harness executes the DPA Move List Reference Model using the FAD information from Steps 8 and 9 for all DPA/channel pairs which are either currently active or will become activated in Step 21 of this iteration.
13	DP Test Harnesses send Heartbeat Requests for each SAS UUT Grant.

14	DP Test Harnesses relinquish the non-terminated Grants that received suggested *operationParam* in the Heartbeat Responses in Step 13.
15	DP Test Harnesses send Grant Requests for all CBSDs whose Grants were relinquished in Step 14 or terminated in Step 13. Each Grant Request uses the suggested *operationParam* provided by the SAS UUT.
16	DP Test Harnesses send Heartbeat Requests for each Grant managed by SAS UUT.
17	For each protection point p of the IAP-protected entities, the Main Test Harness calculates: • A_p^{IAP}, the mean aggregate interference at protection point p of all Grants authorized by SAS UUT in Step 16 that are in the neighborhood of p using *maxEirp* from the corresponding Grant Requests. • $A_p^{IAP,ref}$, the sum of the SAS's Pre-IAP Headroom and leftover allocation (see Equation B- 3 in Appendix B) plus the mean aggregate interference at protection point p of Grants in the neighborhood of p that are managed by SAS UUT at the *maxEirp* levels calculated by the IAP Reference Model in Step 11. Note 1: if $N_S = 0$ (i.e. there are no peer SASs), $A_p^{IAP,ref}$ is equal to the protection threshold and the IAP Reference Model need not be used. Note 2: for an FSS protected entity, these calculations shall be performed for the criteria in Section 8.8.3.5 ("FSS Protection Steps") according to the FSS scenario and status of the TT&C Flag. Note 3: For an FSS protected entity that requires OOBE Protection (see Section 8.8.3.5), pre-Purge List Headroom is used. CBSDs included in the Purge List are not used in applying the IAP Reference Model. Note 4: The Main Test Harness shall calculate A_p^{IAP} and $A_p^{IAP,ref}$ in the reference bandwidth (RBW) of the corresponding protected entity as given in Table 8.4-2.

18	For each protection point p of all active DPA/channel pairs, using all Grants whose operationFrequency overlaps with the active DPA channels, the Main Test Harness calculates:
	• $A_{p,a}^{DPA}$, the 95th percentile of the aggregate interference at protection point p and incumbent antenna azimuth a of:
	  o all SAS UUT Grants authorized in Step 16, and
	  o all SAS Test Harness Grants that are not in the union of the reference move lists of the active DPA/channel pairs; and
	• $A_{p,a}^{DPA,ref}$, the 95th percentile of the aggregate interference at protection point p and incumbent antenna azimuth a of:
	  o all SAS UUT Grants included in the FAD information from Step 8 that are not in the union of the reference move lists of the active DPA/channel pairs, and all SAS Test Harness Grants that are not in the union of the reference move lists of the active DPA/channel pairs.

	Note 1: if $N_S = 0$ (i.e. there are no peer SASs), $A_{p,a}^{DPA,ref}$ is equal to the protection threshold and the DPA Move List Reference Model need not be used.
CHECK	1. $A_{p,a}^{DPA} \leq A_{p,a}^{DPA,ref} + \Delta^{DPA}$ for each azimuth a of each protection point p of each active DPA/channel pair. 2. $A_p^{IAP} \leq A_p^{IAP,ref} + \Delta^{IAP}$ for each FSS and ESC sensor protection point, and for at least 95% of the protection points of each PPA and GWPZ. *If any of the above conditions are not met, the SAS UUT FAILS this test. If condition 2 is not met, stop the test. Otherwise, proceed.*
19	DP Test Harnesses register $N_{2,k}$ CBSDs with the SAS UUT and request a Grant for each.
20	DP Test Harnesses send Heartbeat Requests for each Grant managed by SAS UUT.
21	ESC Test Harness communicates that the DPA/channel pairs in $\mathcal{D}_{deactivated,k}$ are deactivated and that the DPA/channel pairs in $\mathcal{D}_{activated,k}$ are activated.
22	If any DPA/channel pair was activated in Step 21, wait 240 seconds. Otherwise wait 15 seconds.
23	DP Test Harnesses send Heartbeat Requests for each SAS UUT Grant.
24	For each protection point p of active IAP-protected entities, the Main Test Harness recalculates A_p^{IAP} using the Heartbeat information from Step 23. $A_p^{IAP,ref}$ from Step 17 is used below.
25	For each protection point p of all active DPA/channel pairs, the Main Test Harness recalculates $A_{p,a}^{DPA}$ using the Heartbeat information from step 23. $A_{p,a}^{DPA,ref}$ from Step 18 is used below.
CHECK	1. $A_{p,a}^{DPA} \leq A_{p,a}^{DPA,ref} + \Delta^{DPA}$ for each azimuth a of each protection point p of each active DPA/channel pair. 2. $A_p^{IAP} \leq A_p^{IAP,ref} + \Delta^{IAP}$ for each FSS and ESC sensor protection point, and for at least 95% of the protection points of each PPA and GWPZ. *If any of the above conditions are not met, the SAS UUT FAILS this test. If condition 2 is not met, stop the test. Otherwise, if this is the Kth iteration and all of the preceding conditions are met, it PASSES. Otherwise, go back to Step 6 with k = k +1.*

8.11 SAS Federal Government Database Update

8.11.1 Definition, Applicability, and Scope of the Test Case

This section explains test steps, conditions, and procedures for successful execution and completion of the SAS operation to access external database managed by Federal Government, pull the data, and to update its database accordingly.

8.11.2 *Test Characteristics*

Table 8.11-1 Federal Government Database Update Test Characteristics

1	**Test ID**	WINNF.FT.S.FDB
2	**Title**	SAS Federal Government Database Update
3	**Working Group / Entity**	WG5
4	**Test Type**	Functionality
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.12]

8.11.3 *Method of test*

8.11.3.1 Initial Conditions / Test Pre-conditions

8.11.3.1.1 The preconditions for Exclusion Zone Database Update:

- Exclusion Zone Database is available on the designated database (such as GitHub) and the SAS is able to retrieve the data from the designated Database.
- The SAS Administrator must provide adequate time to update/synchronize the SAS UUT with exclusion zone database.
    - a) Updating and implementing database on the SAS database may take some time.
    - b) Updating database may impact IAP calculation. Test Engineer should work with the SAS administrator and inquire about the time necessary for the database verification to complete.
    - c) This time can be an input to test case execution pause/wait time.
    - d) SAS Administrator will provide a means to identify when the database update/synchronization is completed
    - e) All the preconditions of Exclusion Zone test case when Exclusion Zone test case is executed, see Section 8.1

8.11.3.1.2 The preconditions for DPA Database Update:

- The DPA Database should be available in the designated database and the SAS is able to retrieve the data from the designated database.
- SAS Administrator will provide a means to identify when the database update/synchronization is completed.
    - a) Updating and implementing database on the SAS Database may take some time.
    - b) Updating database may impact the DPA move list update. The Test Engineer should work with the SAS administrator and inquire about the time to wait until Database verification should be executed.
    - c) This time can be an input to test case.
    - d) All the preconditions of the Federal Incumbent Protection test case when the Federal Incumbent Protection test is executed, is applicable here. See Section 8.9.

The Field/Format will be added when FCC releases the DPA database.

8.11.3.1.3 Pre-conditions for FSS Database Update

- FSS Database should be available in the designated database (such as GitHub) and the SAS is able to retrieve the data from the designated database.
- The SAS Administrator should provide the time it takes to update/synchronize its database with the FSS Data.
    a) Updating and implementing database on the SAS Database may take some time.
    b) Updating database may impact IAP calculation. Test Engineer should work with the SAS administrator and inquire about the time to wait until Database verification should be executed.
    c) This time can be an input to test case.
    d) All the pre-conditions of FSS IAP test case when FSS test case is executed, see Section 8.8.

The information that the SAS needs in order to be able to adequately protect FSS sites from CBDSs is available from FCC FSS database [n.18].

8.11.3.1.4 The preconditions for GWBL Database Update:

- GWBL Database should be available on the designated database (such as GitHub) and the SAS be able to retrieve the data from the designated database.
- The SAS Administrator should provide the time it takes to update/synchronize its database with the GWBL Data.
    a) Updating and implementing database on the SAS Database may take some time.
    b) Updating database may impact IAP calculation. Test Engineer should work with the SAS administrator and inquire about the time to wait until Database verification should be executed.
    c) This time can be an input to test case.
    d) All the preconditions of GWPZ IAP test case when GWPZ test case is executed, see Section 8.7.

The information that the SAS needs in order to be able to adequately protect GWPZ from CBDSs is available from FCC GWBL and GWPZ database [n.19-20].

8.11.3.1.5 The preconditions for FCC ID Database Update:

- The SAS does not need to access any dummy database for CBSD FCC ID. The SAS can access FCC CBSD database and access an existing FCC ID.
    a) FCC will provide part 96 FCC test ID which will be posted on FCC database.
    b) These are test IDs generated for the purpose of testing
    c) The SAS will be instructed to remove the existing FCC ID at the beginning of the testing.
- The SAS Administrator should provide the time it takes to update/synchronize its database with FCC CBSD ID Data.

a) Updating and implementing database on the SAS Database may take some time.
b) This time should be an input to test case.

CBSD FCC ID verification is part of CBSD Registration Test case. For all the preconditions of CBSD Registration test case, see Section 6

8.11.4 Test Procedure

8.11.4.1 [WINNF.FT.S.FDB.1] Exclusion Zone Database Update

For clarity, this test is written with a single CBSD and protected entity. The test code shall allow for parallel execution of non-interacting tests in order to reduce total test execution time.

Step	Instructions
1	DP Test Harness successfully registers CBSD C at location X and successfully requests a Grant G for a frequency range which partially or fully overlaps F1 (defined in Step 2).
2	Create an exclusion zone database which includes a zone that contains location X or is within 50 meters of location X. Denote the protected frequency range as F1.
3	Admin Test Harness triggers CPAS and waits until completion of CPAS.
4	DP Test Harness sends a Heartbeat Request for (C, G) to the SAS UUT.
CHECK	The *responseCode* of the Heartbeat Response is either 500 (TERMINATED_GRANT) or 501 (SUSPENDED_GRANT). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
5	DP Test Harness sends a Relinquishment Request for the Grant if the *responseCode* was 501 in Step 4.
6	DP Test Harness sends a Grant Request for CBSD C with another frequency range which partially or fully overlaps with F1.
CHECK	The Grant Request is rejected with response code 400 (INTERFERENCE). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
7	Make a modification to the exclusion zone from Step 2 in the exclusion zone database. Denote the protected frequency range as F2 (which is not necessarily equal to F1).
8	Admin Test Harness triggers CPAS and waits until completion of CPAS.
9	DP Test Harness sends a Grant Request for CBSD C with a frequency range which partially or fully overlaps with F2.
CHECK	The Grant Request is rejected with response code 400 (INTERFERENCE). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.11.4.2 [WINNF.FT.S.FDB.2] DPA Database Update for DPAs which cannot be monitored by an ESC

For clarity, this test is written with a single CBSD and protected entity. The test code shall allow for parallel execution of non-interacting tests in order to reduce total test execution time.

Step	Instructions
1	DP Test Harness successfully registers CBSD C and successfully requests a Grant G1 for frequency range F, which is approved and authorized. F partially or fully overlaps the frequency range F1 in Step 2.
2	Create a DPA database which includes at least one inland DPA. Denote a portion of its protected frequency as F1. The parameters of at least one of the DPAs are such that the Grant in Step 1 would not have been approved and authorized had the DPA already existed and activated (i.e. CBSD is in DPA move list).
3	Admin Test Harness triggers CPAS and waits until completion of CPAS.
4	DP Test Harness sends a Heartbeat Request for (C, G) to the SAS UUT.
CHECK	The *responseCode* of the Heartbeat Response is either 500 (TERMINATED_GRANT) or 501 (SUSPENDED_GRANT). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
5	DP Test Harness sends a Relinquishment Request for the Grant if the *responseCode* was 501 in Step 4.
6	DP Test Harness sends a Grant Request G2 for CBSD C with another frequency range which partially or fully overlaps with F1. If the Grant Request is approved, DP Test Harness sends a Heartbeat Request for (C, G2).
CHECK	Either: • The Grant Request is rejected with *responseCode* 400 (INTERFERENCE) Or: • The Grant Request is approved with *responseCode* 0 (SUCCESS), and • The Heartbeat Request contains *responseCode* 501 (SUSPENDED_GRANT). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
7	If a Grant was obtained in Step 6, DP Test Harness sends a Relinquishment Request for (C, G2).
8	Make a modification to the DPA from Step 2 in the DPA database. Denote a portion of the protected frequency range as F2 (which is not necessarily equal to F1).
9	Admin Test Harness triggers CPAS and waits until completion of CPAS.
10	DP Test Harness sends a Grant Request G3 for CBSD C with a frequency range which partially or fully overlaps with F2. If the Grant Request is approved, DP Test Harness sends a Heartbeat Request for (C, G3).
CHECK	Either: • The Grant Request is rejected with *responseCode* 400 (INTERFERENCE) Or: • The Grant Request is approved with *responseCode* 0 (SUCCESS), and

	• The Heartbeat Request contains *responseCode* 501 (SUSPENDED_GRANT).
	If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.

8.11.4.3 [WINNF.FT.S.FDB.3] FSS Database Update: Adding an FSS Site

For clarity, this test is written with a single CBSD and protected entity. The test code shall allow for parallel execution of non-interacting tests in order to reduce total test execution time.

Step	Instructions
1	DP Test Harness registers CBSD C at location X and successfully requests a Grant G for frequency range F. Ensure that the Registration and Grant Request messages are configured in such a way that the *responseCode* in the Registration response is SUCCESS, and the Grant is approved and authorized.
2	Create an FSS database which includes at least one FSS site near location X. The parameters of at least one of the FSS sites are such that the Grant in Step 1 would not have been approved and authorized had the FSS site already existed (e.g. the interference from CBSD to FSS is above the FSS Co-channel protection threshold, -129 dBm/MHz).
3	Admin Test Harness triggers CPAS and waits until completion of CPAS.
4	DP Test Harness sends a Heartbeat Request for (C, G) to the SAS UUT.
CHECK	The *responseCode* of the Heartbeat Response is 500 (TERMINATED_GRANT). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.11.4.4 [WINNF.FT.S.FDB.4] FSS Database Update: FSS Site Modification

For clarity, this test is written with a single CBSD and protected entity. The test code shall allow for parallel execution of non-interacting tests in order to reduce total test execution time.

Step	Instructions
1	DP Test Harness registers CBSD C at location X. Ensure that the Registration request message is configured in such a way that the *responseCode* is SUCCESS.
2	Create an FSS database which includes at least one FSS site S near location X.
3	Admin Test Harness triggers CPAS and waits until completion of CPAS.
4	DP Test Harness sends a Grant Request G1 from the configuration file for C to the SAS UUT. Ensure the Grant is approved (*responseCode* SUCCESS in Grant Response).
5	DP Test Harness sends a Heartbeat Request for (C, G1) to the SAS UUT.
CHECK	The *responseCode* of the Heartbeat Response for (C, G1) matches the *responseCode* in the configuration file (SUCCESS or SUSPENDED_GRANT). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
5	DP Test Harness sends a Relinquishment Request for (C, G1)

6	Modify the FSS database to include a modified version of the FSS site S.
7	Admin Test Harness triggers CPAS and waits until completion of CPAS.
8	DP Test Harness sends a second Grant Request G2 from the configuration file for C to the SAS UUT.
9	DP Test Harness sends a Heartbeat Request for (C, G2) to the SAS UUT.
CHECK	The *responseCode* of the Heartbeat Response for (C, G2) matches the *responseCode* in the configuration file (SUCCESS or SUSPENDED_GRANT). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.11.4.5 [WINNF.FT.S.FDB.5] GWBL Database Update: Adding a GWBL

For clarity, this test is written with a single CBSD, FSS, and GWBL. The test code shall allow for parallel execution of non-interacting tests in order to reduce total test execution time.

Step	Instructions
1	DP Test Harness registers CBSD C at location X and successfully requests a Grant G for frequency range F. Ensure that the Registration and Grant Request messages are configured in such a way that the *responseCode* in the Registration response is SUCCESS, and the Grant is approved and authorized.
2	Create an FSS database which includes at least one FSS site near location X.
3	Create a GWBL database which includes at least one GWBL near location X. The parameters of at least one of the GWBLs, in conjunction with the FSS parameters, are such that the Grant in Step 1 would not have been approved and authorized had the protected entities already existed (i.e. the CBSD and GWBL are both within 150 km of the FSS site).
4	Admin Test Harness triggers CPAS and waits until completion of CPAS.
5	DP Test Harness sends a Heartbeat Request for (C, G) to the SAS UUT.
CHECK	The *responseCode* of the Heartbeat Response is 500 (TERMINATED_GRANT). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.11.4.6 [WINNF.FT.S.FDB.6] GWBL Database Update: GWBL Modification

For clarity, this test is written with a single CBSD, FSS, and GWBL. The test code shall allow for parallel execution of non-interacting tests in order to reduce total test execution time.

Step	Instructions
1	DP Test Harness registers CBSD C at location X. Ensure that the Registration request message is configured in such a way that the *responseCode* is SUCCESS.
2	Create an FSS database which includes at least one FSS site within 150 km of location X.
3	Create a GWBL database which includes at least one GWBL W near location X (not necessarily within 150 km of the FSS site).

4	Admin Test Harness triggers CPAS and waits until completion of CPAS.
5	DP Test Harness sends a Grant Request G1 from the configuration file for C to the SAS UUT.
CHECK	The *responseCode* of the Grant Response for (C, G1) matches the *responseCode* in the configuration file (SUCCESS or INTERFERENCE). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
6	If the responseCode in the previous Step was SUCCESS, DP Test Harness sends a Relinquishment Request for (C, G1)
7	Modify the GWBL database to include a modified version of the GWBL W (for example, W may be moved to be further than 150 km from the FSS site).
8	Admin Test Harness triggers CPAS and waits until completion of CPAS.
9	DP Test Harness sends a second Grant Request G2 from the configuration file for C to the SAS UUT.
CHECK	The *responseCode* of the Grant Response for (C, G2) matches the *responseCode* in the configuration file (SUCCESS or INTERFERENCE). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.11.4.7 [WINNF.FT.S.FDB.7] FCC ID Database Update[4]

For clarity, this test is written with a single CBSD and protected entity. The test code shall allow for parallel execution of non-interacting tests in order to reduce total test execution time.

Step	Instructions
1	DP Test Harness sends a Registration request for CBSD C with FCC ID F_ID to the SAS UUT, such that the Registration request parameters match the FCC ID fields from Step 2.
CHECK	The Registration request is rejected with *responseCode* 103 (INVALID_VALUE). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
2	Create an FCC ID database which includes at least one FCC ID F_ID.
3	Admin Test Harness triggers CPAS and waits until completion of CPAS.
4	DP Test Harness sends the Registration request for CBSD C with FCC ID F_ID with the same Registration parameters from Step 1.
CHECK	The Registration request is approved with *responseCode* 0 (SUCCESS). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
6	Modify the FCC ID database by modifying or removing the fields for FCC ID F_ID.
7	Admin Test Harness triggers CPAS and waits until completion of CPAS.
8	DP Test Harness sends the Registration request for CBSD C with FCC ID F_ID with the same Registration parameters from Step 1.

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[4] This test case is only applicable if the FCC provides a fully-automated mechanism for SASs to access the relevant FCC-owned information

CHECK	The *responseCode* of the Registration response matches the *responseCode* in the configuration file (SUCCESS or INVALID_VALUE). (For example, if F_ID was removed, the *responseCode* is INVALID_VALUE.) *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.11.4.8 [WINNF.FT.S.FDB.8] Scheduled Database Update

For clarity, this test is written with a single CBSD and protected entity. The test code shall allow for parallel execution of non-interacting tests in order to reduce total test execution time.

Step	Instructions
1	Admin Test Harness instructs the SAS UUT to perform CPAS according to its operational schedule.
2	DP Test Harness registers CBSD C at location X and successfully requests a Grant G for frequency range F. Ensure that the Registration and Grant Request messages are configured in such a way that the *responseCode* in the Registration response is SUCCESS, and the Grant is approved and authorized.
3	Create an FSS database which includes at least one FSS site near location X. The parameters of at least one of the FSS sites are such that the Grant in Step 1 would not have been approved and authorized had the FSS site already existed (e.g. the interference from CBSD to FSS is above the FSS Co-channel protection threshold, -129 dBm/MHz).
4	Admin Test Harness injects the location of the FSS database into the SAS UUT.
5	Wait until after the completion of scheduled CPAS, specified in [n.20].
6	DP Test Harness sends a Heartbeat Request for (C, G) to the SAS UUT.
CHECK	The *responseCode* of the Heartbeat Response is 500 (TERMINATED_GRANT). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.12 SAS WINNF Database Update

8.12.1 Definition, Applicability, and Scope of the Test Case

This section explains test steps, conditions, and procedures for successful execution and completion of the SAS operation to verify that SAS UUT can retrieve and update its database with shared PAL and CPI Databases.

8.12.2 Test Characteristics

Table 8.12-1 WINNF Database Test Characteristics

1	**Test ID**	WINNF.FT.S.WDB
2	**Title**	WINNF Database Update

3	**Working Group / Entity**	WG5
4	**Test Type**	Functionality
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS
7	**Target Specification / Feature**	[n.12]

8.12.3 Method of test

8.12.3.1 Initial Conditions / Test Pre-conditions

- The preconditions for Shared PAL Database test case are defined below:
  - The WInnForum Shared PAL Database is available on the WInnForum database and SAS UUT is able to retrieve the data from this Database.
  - The SAS Administrator must provide the time it takes to pull/synch its database with the Shared PAL Data.
    - a. Updating and implementing database on the SAS database may take some time.
    - b. This time can be an input to test case execution pause/wait time.
  - All the pre-conditions of PPA Creation Test Case in Section 8.3 are met.

- The preconditions for CPI Database test case are defined below:
  - The WInnForum CPI Database is available on the WInnForum database and SAS UUT is able to retrieve the data from this Database.
  - The SAS Administrator must provide the time it takes to pull/synch its database with the CPI Data.
    - a. Updating and implementing database on the SAS database may take some time.
    - b. This time can be an input to test case execution pause/wait time.
  - A CPI provides its credential to SAS.
    - a. All the CPI credentials are available for this testing. The credentials can be dummy ones as along as it meets CPI credential requirements.
    - b. CPI credentials can be provided through Single-Step Registration.
  - Successful Registration testing will be carried out for Single-Step Registration.
    - a. All the applicable preconditions of Successful Single-Step Registration Test case (REG.3) is met.

8.12.4 Test Procedure

8.12.4.1 [WINNF.FT.S.WDB.1] PAL Database Update

For clarity, this test is written with a single CBSD and protected entity. The test code shall allow for parallel execution of non-interacting tests in order to reduce total test execution time.

Step	Instructions

1	DP Test Harness sends a Registration request for CBSD C with user ID U to the SAS UUT.
2	Use the testing API to request creation of a PPA with PAL ID P which is owned by user U, which has CBSD C as part of its cluster list.
CHECK	The PPA creation request is rejected. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
2	Create a PAL database which includes at least one PAL entry with PAL ID P, which is owned by user U.
3	Admin Test Harness triggers CPAS and waits until completion of CPAS.
4	Repeat Step 2.
CHECK	The PPA creation request is approved. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.12.4.2 [WINNF.FT.S.WDB.2] CPI database update

For clarity, this test is written with a single CBSD and protected entity. The test code shall allow for parallel execution of non-interacting tests in order to reduce total test execution time.

Step	Instructions
1	DP Test Harness sends a Registration request for Category B CBSD C. The *cpiSignatureData* object in the request is correctly signed by CPI X.
CHECK	The Registration request is rejected with *responseCode* 103 (INVALID_VALUE). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, proceed.*
2	Create a CPI database which includes CPI X with credentials matching those used to create the request in Step 1.
3	Admin Test Harness triggers CPAS and waits until completion of CPAS.
4	Repeat Step 1.
CHECK	The Registration request is approved with *responseCode* 0 (SUCCESS). *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.13 International Border Protection

8.13.1 Definition, Applicability, and Scope of the Test Case

This section explains test steps, conditions, and procedures to verify that SAS properly handles Grants for CBSDs located near the International Borders of the US. While Part96 has not clearly outlined the requirements of the International border protection, WInnForum has defined the criteria for SAS to approve the operation of CBSDs near the border.

8.13.2 Test Characteristics

Table 8.13-1 International Border Protection Test Characteristics

1	**Test ID**	WINNF.FT.S.BPR
2	**Title**	International Border Protection
3	**Working Group / Entity**	WG4
4	**Test Type**	Functional
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS

8.13.3 Method of test

8.13.3.1 Initial Conditions / Test Pre-conditions

The preconditions for this test case are defined below:
- Assume no Incumbent is present near the border that impacts the Registration of the CBSD.
- Ensuring compliance with Arrangement R [n.23] along the US-Canada border, applied to 3650-3700MHz.

8.13.3.2 International Border Protection Requirement

Consistent with Arrangement R (Ref.15) and (Ref.4), WinnForum defines a "Sharing Zone" adjacent to United States border is defined as 8 km from United States border for any CBSD utilizing an antenna of which the entire main beam looks within the 160-degree sector oriented away from the closest point on the border, or 56 km from United States border for any CBSD utilizing an antenna of which any part of the main beam looks within the 200-degree sector toward the closest point on the border.

Figure 8.13-1clarifies the concept of Sharing Zone as described above. As depicted in this figure, all omni-directional antenna CBSDs are considered inside the Sharing Zone if they are within 56 km of the closet point on the border
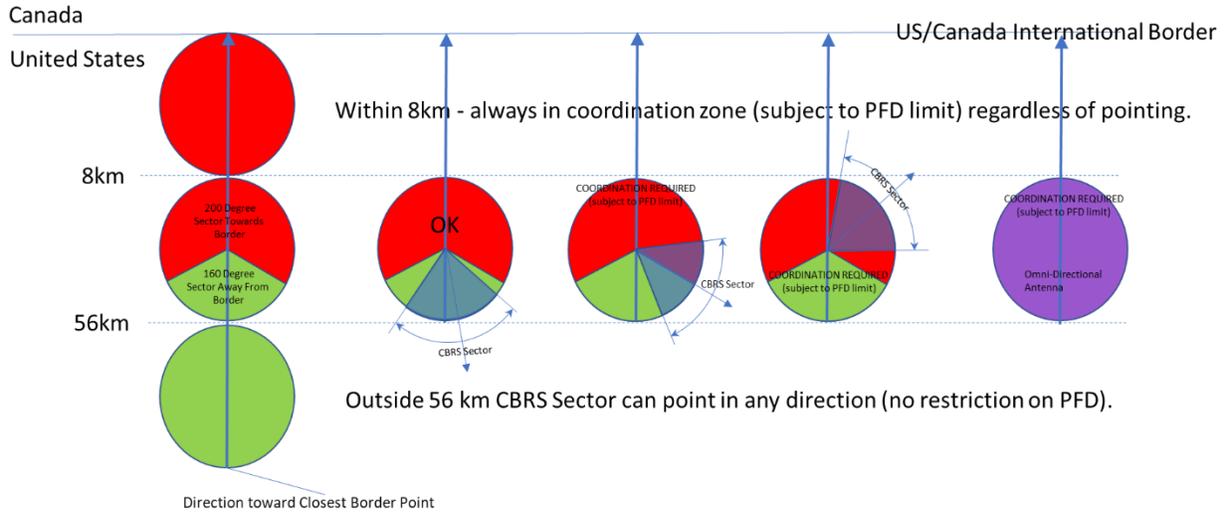
Figure 8.13-1 Clarification of Sharing Zone along International Borders

The SAS shall allow spectrum grants to all CBSDs within the sharing zone adjacent to Canadian border over 3650-3700 MHz frequency range, only if the Power Flux Density (PFD) of CBSD transmission at any point along the border is less than *-110 dBW/m²/MHz* (or *-80 dBm/m²/MHz)* at a height *1.5m* above the ground.

Assuming the CBSD is located a distance d from its closest point at the international border (point *M*), its requested maximum EIRP for the grant (*maxEirp*) is *P (dBm/MHz)*, *maxAntGain* is the maximum antenna gain of the CBSD, *antGain* is the antenna gain of the CBSD towards point M, and the mean ITM path loss (in linear domain) from the location of CBSD to point *M* at a certain height is *PL*, then the Power Flux Density (PFD) at point *M* is, calculated at frequency 3.6 GHz by:

$$PFD\left(\frac{\frac{dBm}{m^2}}{MHz}\right) = 10 * log\left(\frac{1}{PL}\right) + P + 10 * log\left(\frac{4\pi}{\lambda^2}\right)$$

$$= P - maxAntGain + antGain - 10 * log(PL) + 32.6$$

Equation 8.13-1

8.13.4 Test Procedure

8.13.4.1 [WINNF.FT.S.BPR.1] Deprecated; the Test ID is Reserved

8.13.4.2 [WINNF.FT.S.BPR.2] Grant Request from CBSDs within the Shared Zone adjacent the Canadian border

Step	Instructions
1	The DP Test Harness attempts to register the following CBSDs with SAS UUT: • CBSD #1: Category A CBSD within 56 km of the Canadian border with omni-directional antenna. • CBSD #2: Category B CBSD located within 56 km of the Canadian border with omni-directional antenna. • CBSD #3: Category A CBSD located within 8 km of the Canadian border with directive antenna • CBSD #4: Category B CBSD located within 8 km of the Canadian border with directive antenna • CBSD #5: Category A CBSD located between 8 km and 56 km of the Canadian border with directive antenna of which any part of the main beam looks within the 200-degree sector toward the closest point on the Canadian border. • CBSD #6: Category B CBSD located between 8 km and 56 km of the Canadian border with directive antenna of which any part of the main beam looks within the 200-degree sector toward the closest point on the Canadian border.
2	For the CBSDs that are successfully registered in Step 1, the DP Test Harness requests one Grant per CBSD with *maxEIRP P_i, (i=1, ..., 6)*, such that all or part of the requested *operationFrequencyRange* is within *3650-3700 MHz*.
CHECK	The Grant Response from SAS UUT to all CBSDs, if successfully registered in Step 1, satisfy the following condition: • If PFD at point M calculated by Equation 8.13-1 exceeds -80 dBm/m^2/MHz, the *responseCode* is 400. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.13.4.3 [WINNF.FT.S.BPR.3] Deprecated; the Test ID is Reserved

8.14 Quiet Zone Protection

8.14.1 Definition, Applicability, and Scope of the Test Case

This section explains test steps, conditions, and procedures to verify that SAS protects designated Quiet Zones [47 CFR 1.924,]. The CBSD shall not be authorized to transmit in the Quiet Zones, without appropriate coordination.

The following Quiet Zones are considered in this test case:

1- **National Radio Astronomy Observatory (NRAO) and the Naval Radio Research Observatory (NRRO)**.
2- **The Table Mountain Radio Receiving Zone, Boulder County, Co.**

3- **FCC Protected Field Offices**. FCC has identified a number of FCC field offices that requires protection. Here is the list of the FCC protected offices:

   a. Allegan, Michigan: *42°36'20.1" N. Latitude, 85°57'20.1" W. Longitude*
   b. Belfast, Maine: *44°26'42.3" N. Latitude, 69°04'56.1" W. Longitude*
   c. Canandaigua, New York: *42°54'48.2" N. Latitude, 77°15'57.9" W. Longitude*
   d. Douglas, Arizona: *31°30'02.3" N. Latitude, 109°39'14.3" W. Longitude*
   e. Ferndale, Washington: *48°57'20.4" N. Latitude, 122°33'17.6" W. Longitude*
   f. Grand Island, Nebraska: *40°55'21.0" N. Latitude, 98°25'43.2" W. Longitude*
   g. Kenai, Alaska: *60°43'26.0" N. Latitude, 151°20'15.0" W. Longitude*
   h. Kingsville, Texas: *27°26'30.1" N. Latitude, 97°53'01.0" W. Longitude*
   i. Laurel, Maryland: *39°09'54.4" N. Latitude, 76°49'15.9" W. Longitude*
   j. Livermore, California: *37°43'29.7" N. Latitude, 121°45'15.8" W. Longitude*
   k. Powder Springs, Georgia: *33°51'44.4" N. Latitude, 84°43'25.8" W. Longitude*
   l. Santa Isabel, Puerto Rico: *18°00'18.9" N. Latitude, 66°22'30.6" W. Longitude*
   m. Vero Beach, Florida: *27°36'22.1" N. Latitude, 80°38'05.2" W. Longitude*
   n. Waipahu, Hawaii: *21°22'33.6" N. Latitude, 157°59'44.1" W. Longitude*

8.14.2 Test Characteristics

Table 8.14-1 Quiet Zone Protection Test Characteristics

1	**Test ID**	WINNF.FT.S.QPR
2	**Title**	Quiet Zone Protection
3	**Working Group / Entity**	WG4
4	**Test Type**	Functional
5	**Test Class**	Certification
6	**Component / Interface**	SAS / CBSD ← → SAS

8.14.3 Method of test

8.14.3.1 Initial Conditions / Test Pre-conditions

This test case is written with the assumption that no coordination event is submitted to SAS UUT at the time of the CBSD Registration. In the event of coordination, approved by written consent from the appropriate government agency for the facility, SAS may approve registration request or grant request according to the terms of coordination, and return SUCCESS *responseCode*.

SAS UUT will reject CBSD Registration that violates the distance and the power requirement below:

1- National Radio Astronomy Observatory (NRAO) and the Naval Radio Research Observatory (NRRO): The zone is approximately 34,000 km^2 rectangular shape area

2- The Table Mountain Radio Receiving Zone, Boulder County, CO: FCC requires advanced coordination for CBSDs around Table Mountain. The coordination is required to protect Table Mountain Radio Receiving Zone at a reference point with coordinates

      i. 40.130660 degrees N,
     ii. -105.244596 degrees W

According to CFR 1.924(b)(1), the transmissions above *890 MHz* shall not result in Power Flux Density more than *-85.8 dBW/m^2 (or -55.8 dBm/m^2)* received on this 1800 acre site. According to Equation 8.13-1, this is equivalent to *-88.4 dBm* received power. Table 8.14-2 shows the Coordination Area around Table Mountain QZ, inside which, either the users of the CBSD requires coordination with NTIA/ITS, as the designated Radio Frequency Manager for the Table Mountain Radio Receiving Zone, or SAS rejects the grant request from CBSD if the total interference from all of that CBSD's grants, using ITM median path loss, to Table Mountain QZ reference point is above -88.4 dBm. Each channel corresponds to one 10 MHz frequency range. Partial frequency range is also considered as one channel:

Table 8.14-2 Coordination Area around Table Mountain Quiet Zone Reference Point

CBSD Category	Number of Channels	Coordination Distance (Km)
A	N/A	3.8
B	1	38
B	2	54
B	3	64
B	4 or more	80

3- Distance and power requirements for FCC Field Offices:
- Stations located within 2.4 kilometers (1.5 miles) of the protected field office
- Stations located within 4.8 kilometers (3 miles) with 50 watts or more average effective radiated power (ERP) in the primary plane of polarization in the azimuthal direction of the protected field offices
- Stations located within 16 kilometers (10 miles) with 1 kw or more average ERP in the primary plane of polarization in the azimuthal direction of the protected field office

The preconditions for this test case are defined below:
− The Main Test Harness has the coordinates of all the Quiet Zones.
− The Main Test Harness can choose a location within the Quiet Zone.
− Assume no non-Federal incumbent is present near the zone that impacts the Registration of the CBSD.
− The users of CBSDs have not provided any evidence of coordination to the SAS. In case of any advanced coordination provided to SAS offline, the test cases in this section will be waived.

8.14.4 Test Procedure

8.14.4.1 [WINNF.FT.S.QPR.1] Deprecated; the Test ID is Reserved

8.14.4.2 [WINNF.FT.S.QPR.2] Rejecting Registration of CBSD inside the NRAO/NRRO Quiet Zone

Step	Instructions
1	The DP Test Harness attempts to register the following CBSDs with SAS UUT: CBSD #1: Category A CBSD located within the boundary of the NRAO/NRRO Quiet Zone CBSD #2: Category B CBSD located within the boundary of the NRAO/NRRO Quiet Zone.
CHECK	SAS UUT rejects the Registration of all CBSDs. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.14.4.3 [WINNF.FT.S.QPR.3] Deprecated; the Test ID is Reserved

8.14.4.4 [WINNF.FT.S.QPR.4] Deprecated; the Test ID is Reserved

8.14.4.5 [WINNF.FT.S.QPR.5] Unsuccessful Grant Request from CBSDs within Coordination Area around Table Mountain Quiet Zone (QZ) with Multiple Grants

Step	Instructions
1	The DP Test Harness attempts to register the following CBSDs with SAS UUT. - CBSD #1: Category A CBSD within 3.8 km of the Table Mountain QZ reference point - CBSD #2: Category B CBSD located within 38 km of the Table Mountain QZ reference point - CBSD #3: Category B CBSD located within 54 km of the Table Mountain QZ reference point - CBSD #4: Category B CBSD located within 64 km of the Table Mountain QZ reference point - CBSD #5: Category B CBSD located within 80 km of the Table Mountain QZ reference point

2	If the Registration Requests for CBSD #i (i=1 ... 5), in Step 1 are successful, the DP Test Harness requests one Grant per CBSD with *maxEIRP* equal to P_{i1} *(dBm/MHz)*, and the size of *operationFrequencyRange* equal to BW_{i1} *(MHz)*.
3	If the Registration Requests for CBSD #i (i=1 ... 5), in Step 1 are successful, the DP Test Harness requests another Grant per CBSD with *maxEIRP* denoted as P_{i2} *(dBm/MHz),* and the bandwidth of *operationFrequencyRange* denoted as BW_{i2} *(MHz),* such that for CBSD #i (i=1 ... 5), • CBSD #1: *no limitation on* BW_{1j} • CBSD #2: $\sum_{all\ approved\ Grants\ j} BW_{2j} \leq 10MHz$ • CBSD #3: $\sum_{all\ approved\ Grants\ j} BW_{3j} \leq 20MHz$ • CBSD #4: $\sum_{all\ approved\ Grants\ j} BW_{4j} \leq 30MHz$ • CBSD #5: $\sum_{all\ approved\ Grants\ j} BW_{5j} > 30MHz$
4	For CBSD #i (i=1, ..., 5), SAS Test Harness calculates the aggregate interference from all of approved grants from CBSD #i to Table Mountain QZ reference point, using the following equation: $$I_i = antGainDbi(i) - maxAntGainDbi(i)$$ $$+ 10 * \log_{10}\left(\sum_{all\ approved\ grants\ j} \left(10^{\frac{P_{ij}}{10}} * BW_{ij} \right) \right) - 10 * \log_{10}(PL_i)$$ Where, $- I_i$ is the total interference from CBSD #i to Table Mountain QZ reference point in *dBm*, $- maxAntGainDbi\ (i)$ is the maximum antenna gain of CBSD #i in *dBi*, $- antGainDbi\ (i)$ is the antenna gain of CBSD #i towards Table Mountain QZ reference point in *dBi,* and $- PL_i$ is the median linear ITM path loss from CBSD #i to Table Mountain QZ reference point.
CHECK	The total Interference from CBSD #i (i=1, ..., 5) to the Table Mountain QZ reference point, as calculated in Step 4 is less than or equal to *-88.4 dBm.* *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.14.4.6 [WINNF.FT.S.QPR.6] Rejecting Registration of CBSD inside the FCC Protected Field Offices Quiet Zone

Step	Instructions
1	The DP Test Harness attempts to register the following CBSDs with SAS UUT:

	• CBSD #1: Category A within 2.4 km of any of the FCC Fields Offices (See Section 8.14.1) • CBSD #2: Category B within 2.4 km of any of the FCC Fields Offices (See Section 8.14.1)
CHECK	SAS UUT rejects the Registration of all CBSDs. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.14.4.7 [WINNF.FT.S.QPR.7] Unsuccessful Grant Request from CBSDs within 4.8 km of the FCC Field Offices

Step	Instructions
1	The DP Test Harness attempts to register the following CBSD with SAS UUT: • Category B CBSD located more than 2.4 km away but within 4.8 km of any of the FCC Field Offices (See Section 8.14.1)
2	If the Registration Request in Step 1 is successful, the DP Test Harness requests one Grant per CBSD with *maxEIRP* equal to *P*, and the size of *operationFrequencyRange* equal to *BW*
3	SAS Test Harness calculates the EIRP of the CBSD toward the FCC Field Office using the following equation $$EIRP\ (dBm) = P - maxAntGain + antGain + 10*LOG10(BW)$$ Where *maxAntGain* is the maximum antenna gain of the CBSD, and *antGain* is the antenna gain of the CBSD towards the FCC Field Office (both in *dBi*).
CHECK	The Grant Response from SAS UUT to the Grant Requests satisfies the following condition: • If *EIRP > 49.15 dBm*, the *responseCode* is 400 (INTERFERENCE) *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

8.14.4.8 [WINNF.FT.S.QPR.8] Unsuccessful Grant Request from CBSDs within 4.8 km of the FCC Field Offices with Multiple Grants

Step	Instructions
1	The DP Test Harness attempts to register the following CBSD with SAS UUT: • Category B CBSD located more than 2.4 km away but within 4.8 km of any of the FCC Field Offices (See Section 8.14.1)
2	The DP Test Harness requests one grant from SAS UUT with *operationFrequencyRange* whose bandwidth is denoted as *BW1*, and *maxEIRP* of *P1* dBm/MHz.
3	The DP Test Harness requests one Grant with *maxEIRP* denoted as *P2* dBm/MHz, and the bandwidth of *operationFrequencyRange* denoted as *BW2.*

	SAS Test Harness calculates the total EIRP of the CBSD toward the nearest FCC Field Office using the following equation: $$Total\ EIRP\ (dBm) = ntGainDbi - maxAntGainDbi$$ $$+ 10 * log10\left(\sum_{all\ approved\ grants\ i} \left(10^{\frac{Pi}{10}} * BWi\right)\right)$$ Where *maxAntGainDbi* is the maximum antenna gain of the CBSD, and *antGainDbi* is the antenna gain of the CBSD towards the nearest FCC Field Office (both in *dBi*).
CHECK	The total EIRP of all approved Grants for registered CBSDs is less than or equal to 49.15 dBm. *If any of the above conditions are not met, the SAS UUT FAILS this test. Otherwise, it PASSES.*

Appendix A

(Normative) Clarifications of JSON Number-type Parameters

The table below shows the clarifications of JSON Number-type parameters used in SAS-CBSD Protocol.

Table 8.14-3 Clarifications of JSON Number-type parameters

Integer	Value with decimal points
horizontalAccuracy	*latitude*
verticalAccuracy	*longitude*
antennaAzimuth	*height*
antennaDowntilt	*maxEirp*
antennaGain	
eirpCapability	
antennaBeamwidth	
responseCode	
lowFrequency	
highFrequency	
heartbeatInterval	

Appendix B

B.1 Margin usage for improved operation and efficiency

Per R2-SGN-16, SASs may collaborate to modify the IAP to provide for a modest remainder of interference margin to enable ease of operations during CBSD deployment. This is identified as pre-IAP headroom that all SAS administrators **shall** take into account before running IAP. The pre-IAP headroom is predefined for each protection entity type and the value of pre-IAP headroom will be captured in [n.21]. This headroom is divided equally among peer SASs. The channel unit over which the margins are calculated is noted as *IAPBW* in *MHz*. To calculate pre-IAP headroom and other margins specified in this section (such as post-IAP margin), only Grants overlapping *IAPBW* are used. All the aggregate interference values in this Appendix are mean values. The term Q_p in this Section is equivalent to term Q in Equation 8.4-2, and Table 8.4-2 for protected entity p.

If the interference threshold of a protected entity p, is Q_p, *in dBm/IAPBW,* and pre-IAP Headroom is Mg_p *(dB),* then each SAS shall adjust the threshold of that protection entity to Q_p-Mg_p *(dBm/IAPBW)* for IAP calculation. For a protected entity p, the following equation shows the allocation of the headroom per reference bandwidth, *IAPBW*

$$HM_p = \left\{ \frac{10^{\frac{Q_p}{10}} - 10^{\frac{Q_p - Mg_p}{10}}}{N_{SAS}} \right\} \quad (mW/IAPBW)$$

B- 1

where N_{SAS} is the number of SASs in the peer group.

This margin HM_p, may be used for new requested Grants after CPAS (which includes IAP) or to adjust the EIRP level of Grants determined by IAP.

SAS may also some post-IAP use margin for new requested Grants or to adjust the EIRP level of Grants that remain after completion of IAP. This margin is inherently included in IAP and has two components: CBSD attributed unused component, and common leftover component. The common leftover component is apportioned equally among peer SASs and the CBSD attributed unused component is specific to a SAS. The post-IAP margin for a specific protected entity, p, for a specific SAS can be expressed as following:

$$PIAP_p^S = \left\{ \frac{10^{\frac{Q_p - Mg_p}{10}} - 10^{\frac{A_p}{10}}}{N_{SAS}} \right\} \quad + \quad \left\{ 10^{\frac{ASAS_p^S}{10}} - 10^{\frac{Aaggr_p^S}{10}} \right\} \left(\frac{mW}{IAPBW} \right)$$

Common leftover component   CBSD attributed unused component

B- 2

where,

A_p in (*dBm/ IAPBW*) is the aggregate interference calculated by managing SAS using the EIRP obtained by all CBSDs (including the CBSDs managed by other SASs) through application of IAP for protected entity *p*.

$ASAS_p^s$ in (*dBm/ IAPBW*) is the aggregate interference calculated by managing SAS using the EIRP obtained by all CBSDs managed by the managing SAS through application of IAP for protected entity p.

$Aaggr_p^s$ in (*dBm/ IAPBW*) is the aggregate interference calculated by managing SAS using the minimum of EIRPs from IAP applied over all protected entities that a CBSD impacts (only CBSDs managed by the managing SAS.

The margin in excess of IAP for CBSDs managed by the SAS at the protected entity *p* is limited to $HM_p^s + PIAP_p^s$ in *(mW/ IAPBW)*.

Therefore, using the calculation methods in Section B.2, the aggregate interference from all the CBSDs managed by the SAS at protected entity *p* shall not exceed:

$$A_p^{IAP,ref} = HM_p + PIAP_p + 10^{\frac{Aaggr_p^s}{10}} = \frac{10^{\frac{Q_p}{10}} - 10^{\frac{A_p}{10}}}{N_{SAS}} + 10^{\frac{ASAS_p^s}{10}} \quad \left(\frac{mW}{IAPBW}\right)$$

B- 3

B.2 Aggregate Interference Among All SASs (Informative)

The sum of interference from all SAS for protection point p

$$I \le \sum_{s=1}^{NSAS} \left[HM_p + PIAP_p + 10^{\frac{Aaggr_p^s}{10}} \right]$$

$$\le \sum_{s=1}^{NSAS} \left[\left\{ \frac{10^{\frac{Q_p}{10}} - 10^{\frac{Q_p - Mg_p}{10}}}{N_{SAS}} \right\} + \left\{ \frac{10^{\frac{Q_p - Mg_p}{10}} - 10^{\frac{A_p}{10}}}{N_{SAS}} \right\} + \left\{ 10^{\frac{ASAS_p^s}{10}} - 10^{\frac{Aaggr_p^s}{10}} \right\} + 10^{\frac{Aaggr_p^s}{10}} \right]$$

$$\le \sum_{s=1}^{NSAS} \left[\frac{10^{\frac{Q_p}{10}}}{N_{SAS}} \right] - \sum_{s=1}^{NSAS} \left\{ \frac{10^{\frac{A_p}{10}}}{N_{SAS}} \right\} + \sum_{S=1}^{NSAS} 10^{\frac{ASAS_p^s}{10}}$$

$$\le 10^{\frac{Q_p}{10}} - 10^{\frac{A_p}{10}} + 10^{\frac{A_p}{10}}$$

$$\le 10^{\frac{Q_p}{10}}$$