Test and Certification for Citizens Broadband Radio Service (CBRS); CBRS Release 2 Regulatory Impacting (RI) Test Specification for SAS as UUT

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Test and Certification for CBRS; Conformance and Performance Test Technical Specification for Release 2 RI; SAS as Unit Under Test (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) [n.1] and Wireless Innovation Forum (WInnForum).

2   Scope

The scope of this present document is to specify test procedures to demonstrate conformance of the CBRS Release 2 requirements and protocols concerning Regulatory Impacting (RI) features defined in [n.9] and the included conformance tests address only those features.

NOTE: For information on RI features and their definitions please refer to [n.9]

Not all components and interfaces in [n.3] are covered by the Release 2 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 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 RI test cases required for Release 2 certification of the SAS to attest conformance to WInnForum-defined Release 2 features marked as RI and does not include any conformance tests for Non-Regulatory Impacting (NRI) and 3rd Party Proprietary Features.

Moreover, this document only covers the test specifications and test cases for the CBRS Architecture components and does not include the test software.

Certain elements of this published WINNF specifications are subject to change and update in this release.

3 References

3.1 Normative references

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

[n.1]   FCC Title 47, Part 96, "https://www.ecfr.gov/current/title-47/chapter-I/subchapter-D/part-9"

[n.2]   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.3]   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.4]   RFC-2119, "Key words for use in RFCs to Indicate Requirement Levels", March 1997. Available at: https://tools.ietf.org/html/rfc2119

[n.5]   SSC-Wireless Innovation Forum, "Extensions to SAS-CBSD Interface Technical Specification (Release 2)", WINNF-TS-3002 V1.0.0

[n.6]   SSC-Wireless Innovation Forum, "Extensions to Spectrum Access System (SAS) - SAS Interface Technical Specification (Release 2)", WINNF-TS-3003 V1.0.0

[n.7]   SSC-Wireless Innovation Forum, "Technical Specification; SAS as Unit Under Test (UUT)", WINNF-TS-0061 V1.5.1

[n.8]   SSC-Wireless Innovation Forum, "Signaling Protocols and Procedures for Citizens Broadband Radio Service (CBRS): WInnForum Recognized CBRS Grouping Information", WINNF-SSC-0010

[n.9]   SSC-Wireless Innovation Forum, "CBRS Operational and Functional Requirements (Release 2)", WINNF-TS-1001 V1.4.1

[n.10]   SSC-Wireless Innovation Forum, "Test and Certification for Citizens Broadband Radio Service (CBRS); CBRS Release 2 Non-Regulatory Impacting (NRI) Test Specification for CBSD as UUT", WINNF-TS-4004

[n.11]   SSC-Wireless Innovation Forum, "Test and Certification for Citizens Broadband Radio Service (CBRS); CBRS Release 2 Non-Regulatory Impacting (NRI) Test Specification for SAS as UUT", WINNF-TS-4003

[n.12]   FCC Public Notice for SAS Approval, DA 20-110, "https://docs.fcc.gov/public/attachments/DA-20-110A1.pdf", August 2020

[n.13]   SSC-Wireless Innovation Forum, "CBSD Antenna Pattern Database Technical 6 Specification", WINNF-TS-5006

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]   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

[i.3]   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

[i.4]   FCC Report and Order 18-149: "Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band", FCC, October 24 2018, https://docs.fcc.gov/public/attachments/FCC-18-149A1_Rcd.pdf

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

EAP: Enhanced Antenna Pattern

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

MSIRI: Multi-SAS Inter Release IAP

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 RI Test Harness: A collection of routines that can be configured by the RI test operator to interact with the SAS RI UUT in order to execute the test cases described in this document. It includes Admin RI Test Harness, SAS RI Test Harnesses, DP RI Test Harnesses, CBSD RI Test Harnesses, and all other test harnesses defined in this document.

SAS Under RI 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 and CBSD RI Test Harnesses, the SAS Under RI 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 RI UUT (Regulatory Impacting Unit Under Test). Unless otherwise specified, SAS RI UUT, or UUT in this document refers to SAS RI UUT.

SAS RI Test Harness: A collection of routines that can be configured by the RI test operator to interact with the SAS RI UUT via interfaces specified in [n.3, n.6], and automates critical test sequences and procedures in this document and [n.7, n.11]. Via these interfaces and following the specified test procedures, the SAS RI Test Harness emulates the SAS-SAS Messages specified in [n.3, n.6] that would be generated by one SAS. The software without SAS PKI certificate for testing RI features is vendor-specific.

CBSD RI Test Harness: A collection of routines that can be configured by the RI test operator to interact with the SAS RI UUT via interfaces specified in [n.2, n.5] and automates critical test sequences and procedures in this document and [n.7, n.11]. Via these interfaces and following the specified test procedures, the CBSD RI Test Harness emulates the Release 2 SAS-CBSD Request Messages specified in [n.2, n.5] that would be generated by one CBSD, using a TLS connection with CBSD PKI certificate to the SAS RI UUT. If multiple CBSD RI Test Harnesses are directly connected to the SAS RI UUT, each has its own TLS connection to the SAS RI UUT. The software without CBSD PKI certificate for testing RI features is vendor-specific.

DP RI Test Harness: A collection of routines that can be configured by the RI test operator to interact with the SAS RI UUT via interfaces specified in [n.2, n.5] and automates critical test sequences and procedures in this document and [n.7, n.11]. Via these interfaces and following the specified test procedures, the DP RI Test Harness emulates the Release 2 SAS-CBSD Request Messages specified in [n.2. n.5] that would be generated by one or more CBSDs, using a TLS connection with DP PKI certificate to the SAS RI UUT. If multiple DP RI Test Harnesses are connected to the SAS RI UUT, each has its own TLS connection to the SAS RI UUT. The DP function within the DP RI Test Harness merely aggregates the Request Messages of multiple single CBSDs and disaggregates the respective Response Messages of the SAS RI UUT and does nothing else (i.e., does not have any other unique functionality of a real Domain Proxy). The software without DP PKI certificate for testing RI features is vendor-specific.

Admin RI Test Harness: A collection of routines that can be configured by the RI test operator to inject data that is required for the purpose of the test cases, including SAS operationally supported FIDs, into the SAS RI UUT. The Admin RI Test Harness also has the ability to recognize the

completion of CPAS executed by the SAS RI UUT. The Admin RI Test Harness software for testing RI features is vendor-specific.

Non-Regulatory Impacting (NRI): The features defined by WInnForum used for operation not impacting Part 96 regulatory compliance [n.9]

Regulatory Impacting (RI): The features defined by WInnForum used for operation impacting Part 96 regulatory compliance [n.9]

Allow List: A list of the allowed FCC IDs and the combination of the FCC ID and the device serial number.

The following terms are used within this document and should be interpreted as described in [n.4]:
- ***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 for RI features are defined by CBRS WG1 to meet FCC, NTIA, and DOD requirements; interfaces and protocols are then defined by CBRS WG3; finally technical specifications for operation are defined by CBRS WG5. 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 RI UUT to the requirements developed by WInnForum and Part 96 regulatory compliance.

- **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 RI 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. According to the FCC Public Notice [n.12],

> "*If a SAS operator plans to make substantive changes to its system, for example, to comply with new releases of industry standards, the SAS operator must supplement or amend its filings in GN Docket No. 15-319 to reflect these changes. Before WTB/OET approves the use of new or modified SAS features, the SAS operator must demonstrate that the modified SAS will continue to comply with the Commission's rules, and it may be required to submit its systems for additional testing.*"

> "*Upon request, the SAS operator must provide external testing interfaces to enable WTB/OET, in collaboration with NTIA and DoD, to verify that the proposed modifications comply with the relevant rules as specified by the Commission.*"

Such additional testing and external testing interfaces are outside the scope of this technical specification.

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*}.REL{*X*}.RI.{*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. REL *X* indicates the test as designated is for SAS Release *X* certification testing. *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.

Note: RI signifies Regulatory Impact

Table 5-1 The values of TestRequirement in Test ID

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

Table 5-2 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 5-3 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 5-4 The values of TestFunction in Test ID

Value	Description
EXZ	Exclusion Zone enforcement test (Note 1)
REG	CBSD Registration procedure (Note 1)
SIQ	CBSD Spectrum inquiry procedure (Note 1)
GRA	CBSD Grant procedure (Note 1)
HBT	CBSD Heartbeat procedure (Note 1)
MES	CBSD Measurement report (Note 1)
RLQ	CBSD Grant Relinquishment procedure (Note 1)
DRG	CBSD Deregistration procedure (Note 1)
SCS	SAS-CBSD Security validation (Note 1)
EPR	ESC Protection (Note 1)
IPR	Federal Incumbent Protection (Note 1)
FPR	FSS Protection (Note 1)
GPR	GWPZ Protection (Note 1)
PPR	PPA Protection (Note 1)
MCP	Multi-Constraint Protection (Note 1)

BPR	Border Protection (Note 1)
PCR	PPA Creation (Note 1)
FDB	Federal Government Database (Note 1)
WDB	WINNF Database (Note 1)
PAT	Propagation Model and Antenna gain (Note 1)
SSS	SAS-SAS Security, Authentication and Encryption Protocols (Note 1)
FAD	Full Activity Dump Message (Note 1)
FCE	Feature Capability Exchange (Note 1)
EGH	Enhanced CBSD Group Handling
EAP	Enhanced Antenna Pattern
CPE	CPE-CBSD Indicator (Note 1)
PDG	Passive DAS Group (Note 1)
PSSFG	Principal-Subordinate Single Frequency Group (Note 1)
GRU	Grant Update
MSIRI	Multi-SAS Inter Release IAP
Note 1: These values are used for testing either Release 1 or NRI features, and therefore are not used in this document	

Table 5-5 The values of X in Test ID

Value	REL
2	Release 2

5.2   Test Triggers

Different from Release 1 testing as specified in WINNF-TS-0061 [n.7], an SAS Administrator shall perform Release 2 RI testing on per-feature basis. The sub-section "*Definition, Applicability, and Scope of the Test Case*" of section 6 defines test triggers for each feature.

If the SAS Administrator plans to make substantive changes to its SAS for support of an RI feature, the SAS shall pass all the test cases for compliance with that RI feature specified in this technical specification.

For the purpose of this technical specification, the SAS RI UUT is assumed to meet the followings:

- It has already passed all the tests defined in [n.7] and has been certified by FCC for Release 1 CBRS operation.
- It has already passed all the tests of Feature Capability Exchange defined in [n.11], which is at minimum necessary for compliance with WInnForum Release 2.

5.3   Test Tools Required

In addition to test tools defined in [n.7], the following modules and functionality shall be used for the conformance tests specified in this document:

- Admin RI Test Harness
    - Ability to configure a SAS RI UUT's operationally supported features that require re-registration (see section 6.2)
    - Ability to configure a SAS RI UUT's operationally supported features that does not require re-registration (see section 6.2)
    - Ability to inject supported and non-supported Group types/IDs.
    - Ability to inject records of CBSD Antenna Pattern Database [n.13]

5.4   Baseline State of the SAS RI UUT

Unless explicitly stated otherwise as part of the test procedure, the SAS RI UUT shall be reset to the Baseline State at the beginning of every test case. Baseline State of Release 1 SAS UUT defined in [n.7] applies to the Baseline State of SAS RI UUT. In addition to the data defined in [n.7], the following data shall be deleted by the Reset functionality:
- SAS's operationally supported features configured by Admin RI Test Harness
- Other SAS's Feature Capability Records
- All CBSD feature capabilities.
- List of supported and non-supported Group types/IDs injected by Admin RI Test Harness
- Records of CBSD Antenna Database

5.5 Mapping between Test Cases and Release 2 Features

This section includes all the test cases required for ensuring the Protocol and Functional conformance of SAS RI UUT to the specifications defined by WInnForum and directed by the requirements established by the FCC. The tables in this section identify and categorize the test cases for conformance testing.

All the test cases appearing in this document are Regulatory Impacting (RI).

Table 5.6 indicates the legend for test case classification in Table 5.7.

Table 5.6: Test Case Classification (for Table 5.7)

REL2.M	Mandatory for WInnForum Release 2 Compliance Note: The category applies only to testing of "Feature Capability Exchange" feature, as defined in [n.9]
REL2.O	Optional. Not required for WInnForum Release 2 Compliance
REL2.C	Conditional. Required to execute the test case if SAS RI UUT supports relevant functionality. See Table 5.7 for definition of conditional notation.
REL2.D	Deprecated. Test no longer required.

Table 5.7 lists all test cases in this document and their applicability to SAS with indication of test case classification (REL2.M/O/C, as defined in Table 5.6). This table identifies all test cases required or optional to certify the conformance of a Release 2 SAS to a particular Release 2 feature.

Table 5.7 Test Cases Required or Optional for Release 2 Features

Rel 2 Features	References	Test Case Classification	Conditions (if any)	Test Case Information
Grant Update	WINNF-TS-1001 [n.9]: Annex 8 WINNF-TS-3002 [n.5]: Section 6.6, Section 8.11.1, Section 8.16	Rel2.C	1- Support of Grant Update Feature	**Test Case ID**: WINNF.FT.S.REL2.RI.GRU.1 **Test Case Title**: CBSD Requesting an EIRP update **Section**: 6.1.4.1
Enhanced Antenna Pattern (EAP)	WINNF-TS-1001 [n.9]: Annex 5.3 WINNF-TS-3002 [n.5]: Section 6.4, Section 8.2.3 WINNF-TS-5006 [n.13]: Section 6	Rel2.C	1- Support of EAP Feature	**Test Case ID**: WINNF.FT.S.REL2.RI.EAP.1 **Test Case Title**: Testing of antenna gain calculation using EAP methods **Section**: 6.2.4.1
	WINNF-TS-1001 [n.9]: Annex 5.3 WINNF-TS-3002 [n.5]: Section 6.4, Section 8.2.3 WINNF-TS-5006 [n.13]: Section 6	Rel2.C	1- Support of EAP Feature	**Test Case ID**: WINNF.FT.S.REL2.RI.EAP.2 **Test Case Title**: Enhanced Antenna Pattern for Single SAS IAP-Based PPA Protection **Section**: 6.2.4.2
	WINNF-TS-1001 [n.9]: Annex 5.3 WINNF-TS-3002 [n.5]: Section 6.4, Section 8.2.3 WINNF-TS-5006 [n.13]: Section 6	Rel2.C	1- Support of EAP Feature	**Test Case ID**: WINNF.FT.S.REL2.RI.EAP.3 **Test Case Title**: Enhanced Antenna Pattern for DPA Protection **Section**: 6.2.4.3
	WINNF-TS-1001 [n.9]: Annex 5.3 WINNF-TS-3002 [n.5]: Section 6.4, Section 8.2.3	Rel2.C	1- Support of EAP Feature	**Test Case ID**: WINNF.FT.S.REL2.RI.EAP.4 **Test Case Title**: Enhanced Antenna Pattern for

	WINNF-TS-5006 [n.13]: Section 6			Release 2 Multi-SAS IAP for ESC Sensor Protection **Section**: 6.2.4.4
	WINNF-TS-1001 [n.9]: Annex 5.3 WINNF-TS-3002 [n.5]: Section 6.4, Section 8.2.3 WINNF-TS-5006 [n.13]: Section 6	Rel2.C	1- Support of EAP Feature 2- Not Supporting MSIRI	**Test Case ID**: WINNF.FT.S.REL2.RI.EAP.5 **Test Case Title**: Enhanced Antenna Pattern for Release 2 Multi-SAS IAP for ESC Sensor Protection, when MSIRI is not supported **Section**: 6.2.4.5
Multi-SAS Inter Release IAP	WINNF-TS-1001 [n.9]: REL2-R3-SGN-08 (Section 6.2.1)	Rel2.C	1-Support of MSIRI	**Test Case ID**: WINNF.FT.S.REL2.RI.MSIRI.1 **Test Case Title**: Multi-SAS Inter Release IAP for PPA Protection **Section**: 6.3.4.1
		Rel2.C	1-Support of MSIRI	**Test Case ID**: WINNF.FT.S.REL2.RI.MSIRI.2 **Test Case Title**: Multi-SAS Inter Release IAP for ESC Protection **Section**: 6.3.4.1

6   Release 2 RI Feature Conformance Test Specifications

This section specifies test cases for each RI feature to ensure the compliance of SAS RI UUT to the relevant WInnForum Release 2 specifications and the Part 96 regulatory compliance.

6.1   Grant Update Feature Tests

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

This section provides test steps, conditions, and procedures to test the conformance of a Release 2 SAS that operationally supports the Grant Update Feature.

The Grant Update feature includes the modification of *channelType*. However, since no action is required from CBSD upon receiving such update, and the fact that SAS has already been tested for generation and protection of PPAs in Release 1 test plan, no test case is being added to this section for the change of *channelType*. The SAS RI UUT that has successfully passed all the test cases specified in Section 6.1 is allowed to enable the modification of *channelType* during its operation using Grant Update feature.

6.1.2   Test Characteristics

Table 6.1-1: CBSD Grant Update Procedure Test Characteristics

1	**Test ID**	WINNF.FT.S.REL2.RI.GRU
2	**Title**	Grant Update
3	**Working Group / Entity**	WG1/WG3
4	**Test Type**	Protocol
5	**Test Class**	Certification
6	**Component / Interface**	CBSD ← → SAS
7	**Target Specification**	WINNF-TS-1001 CBRS Operational and Functional Requirements (Release 2) WINNF-TS-3002 SAS-CBSD CBRS Interface (Release 2)

6.1.3   Method of test

6.1.3.1   Initial Conditions / Test Pre-conditions

1. All the message exchanges between the SAS RI UUT and the CBSD/DP RI 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 included in the Allow List by the SAS RI UUT.
3. The SAS RI UUT shall 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.REL2.RI.GRU.1]: CBSD Requesting a EIRP update

The objective of this test is to ensure that the SAS approves a new Grant whose requested frequency range is exactly the same as the existing Grant owned by the requesting CBSD without relinquishing the existing Grant.

Step	Instructions
1	• Ensure no *cbsdIds* exists in the SAS for the CBSD being tested. • REG-Conditional parameters for the CBSD shall be pre-loaded into the SAS RI UUT.
2	The CBSD/DP RI Test Harness sends a Registration Request for the CBSD to the SAS RI UUT • The Registration Request is in proper format and parameters are within acceptable ranges. • *cbsdFeatureCapabilityList* is included with FID: WF_GRANT_UPDATE • The CBSD is outside any exclusion zones, PPAs, GWPZs, and DPA Neighborhood, so that any grant request would be accepted
CHECK	SAS RI UUT approves the request and sends a Registration Response as follows: • CBSD 1 ○ Includes valid **cbsdId** for the CBSD. ○ The *responseCode* parameter is 0 (SUCCESS) indicating an approved Registration, ○ If the *responseCode* is 106 (NOT_PROCESSED), go to Step 2 ○ *sasFeatureCapabilityList* shall be included with FID list containing at least FID: WF_GRANT_UPDATE *If any of the above conditions are not met, the SAS RI UUT FAILS this test. Otherwise, it PASSES*
3	The CBSD/DP RI Test Harness sends a Grant Request (frequency **f1** and *maxEirp* set **eirp1**) for the CBSD registered in step 2 such that the Grant is approved (*responseCode* 0) by the SAS RI UUT with *grantId* set to **GrantId1**.
4	The CBSD/DP RI Test Harness sends a Heartbeat Request for Grant **GrantId1** which is either Authorized (*responseCode* set to 0) or Suspended (*responseCode* set to 501)
5	The CBSD/DP RI Test Harness sends Grant Requests for the CBSD registered in Step 2 in proper format with frequency **f1** and the *maxEirp* set to **any EIRP value eirp2** that is different from **eirp1.**
CHECK	SAS RI UUT sends a Grant Response as follows: • Includes the *cbsdId* for the CBSD. • If the responseCode is 106 (NOT_PROCESSED), go to Step 5 • Otherwise, the *responseCode* parameter is either 0 (SUCCESS) or any value other than 401 (GRANT _CONFLICT) • A valid Grant Id (**GrantId2**) shall be included when the responseCode is 0 (SUCCESS) *If any of the above conditions are not met, the SAS RI UUT FAILS this test.*

6	The CBSD/DP RI Test Harness sends a Heartbeat Request for Grant **GrantId1**.
CHECK	The SAS RI UUT sends a Heartbeat Response • Includes the cbsdId • Includes the Grant Id (**GrantId1**) • The *responseCode* set to 103 (INVALID_VALUE) or 500 (TERMINATED_GRANT) *If any of the above conditions are not met, the SAS RI UUT FAILS this test.*
7	The CBSD/DP RI Test Harness sends a Heartbeat Request for Grant **GrantId2**.
CHECK	The SAS RI UUT sends a Heartbeat Response • Includes the **cbsdId** • Includes the Grant ID (**GrantId2**) • The *responseCode* set to 0 (SUCCESS) or 501 (SUSPENDED) *If any of the above conditions are not met, the SAS RI UUT FAILS this test.*

6.2 Enhanced Antenna Pattern Feature (RI) Tests

6.2.1 Definition, Applicability, and Scope of the Test Case

This section explains test steps, conditions, and procedures to verify that the SAS RI UUT correctly implements the enhanced antenna pattern feature (EAP) for protection of Protected Entities in accordance with [n.9], [n.5], and [n.13].

6.2.2 Test Characteristics

Table 6.2-1: Enhanced Antenna Pattern Test Characteristics

1	Test ID	WINNF.FT.S.REL2.RI.EAP
2	Title	Enhanced Antenna Pattern Test for Protection
3	Working Group / Entity	WG1, WG3, WG5
4	Test Type	Functionality
5	Test Class	Certification
6	Component / Interface	SAS / CBSD ← → SAS
7	Target Specification / Feature	[n.9], [n.5], and [n.13]

6.2.3 Method of test

In the beginning, the SAS RI UUT shall be tested for its ability to calculate CBSD antenna gain towards a protection point using the EAP feature. To execute these tests, the Admin RI Test Harness shall first register a group of CBSDs supporting the Enhanced Antenna Pattern feature with the SAS RI UUT using the SAS-CBSD interface. The group of CBSDs, all in the protection neighborhood of the Protected Entities, shall be configured with a mixture of the following configurations for the EAP parameters:

Table 6.2-2: EAP Parameter Configurations of Category A CBSDs

Config	EAP Method	EAP Parameters in *RegistrationRequest* object						
		antennaModel	*antennaGain*	*antennaAzimuth*	*antennaDowntilt*	*antennaBeamwidth*	*antennaVerticalBeamwidth*	*frontToBackRatio*
A-1	B1	Included and corresponds to both horizontal and vertical patterns	Included and valid	Included and valid	Included, and equal to or less than 15 degrees	Not included	Not included	Not included
A-2	C	Not included	Included and valid	Included and valid	Included, and equal to or less than 15 degrees	Included and valid	Included and valid	Included and valid
A-3	C	Included but does not correspond to any patterns	Included and valid	Included and valid	Included, and equal to or less than 15 degrees	Included and valid	Included and valid	Included and valid
A-4	D	Included and corresponds to a horizontal pattern	Included and valid	Included and valid	Included, and equal to or less than 15 degrees	Included and valid	Included and valid	Included and valid
A-5	E	Included and corresponds to a horizontal pattern	Included and valid	Included and valid	Not included	Included and valid	Not included	Included and valid
A-6	E	Included and corresponds to a horizontal pattern	Included and valid	Included and valid	Included, and greater than 15 degrees	Included and valid	Included and valid	Included and valid
A-7	E	Included and corresponds to a horizontal pattern	Included and valid	Included and valid	Included, and equal to or less than 15 degrees	Included and valid	Included but invalid	Included and valid
A-8	F	Included but does not correspond to any patterns	Included and valid	Included and valid	Not included	Included and valid	Not included	Included and valid
A-9	F	Included and corresponds to a horizontal pattern	Included and valid	Not included	Not included	Not included	Not included	Included and valid
A-10	F	Included but does not correspond to any patterns	Included and valid	Included but invalid	Included, and greater than 15 degrees	Included but invalid	Included but invalid	Included and valid
A-11	F	Not included	Included and valid	Not included	Included, and equal to or less than 15 degrees	Included and valid	Included and valid	Included but invalid
A-12	F	Not included	Included and valid	Not included	Included, and equal to or less than 15 degrees	Included and valid	Included and valid	Not included

NOTE: For Category A CBSDs, *antennaGain* is the only antenna parameter which is mandatory for Release 1-based CBSD Registration. Therefore, all configurations in this table assume *antennaGain* is included and valid for testing purpose.

Table 6.2-3: EAP Parameter Configurations of Category B CBSDs

Config	EAP Method	EAP Parameters in *RegistrationRequest* object						
		antennaModel	*antennaGain*	*antennaAzimuth*	*antennaDowntilt*	*antennaBeamwidth*	*antennaVerticalBeamwidth*	*frontToBackRatio*
B-1	B1	Included and corresponds to both horizontal and vertical patterns	Included and valid	Included and valid	Included, and equal to or less than 15 degrees	Included and valid	Not included	Not included
B-2	C	Not included	Included and valid	Included and valid	Included, and equal to or less than 15 degrees	Included and valid	Included and valid	Included and valid
B-3	C	Included but does not correspond to any patterns	Included and valid	Included and valid	Included, and equal to or less than 15 degrees	Included and valid	Included and valid	Included and valid
B-4	D	Included and corresponds to a horizontal pattern	Included and valid	Included and valid	Included, and equal to or less than 15 degrees	Included and valid	Included and valid	Included and valid
B-5	E	Included and corresponds to a horizontal pattern	Included and valid	Included and valid	Included, and equal to or less than 15 degrees	Included and valid	Not included	Included and valid
B-6	E	Included and corresponds to a horizontal pattern	Included and valid	Included and valid	Included, and equal to or less than 15 degrees	Included and valid	Included but invalid	Included and valid
B-7	E	Included and corresponds to a horizontal pattern	Included and valid	Included and valid	Included, and greater than 15 degrees	Included and valid	Not included	Included and valid
B-8	F	Included but does not correspond to any patterns	Included and valid	Included and valid	Included, and equal to or less than 15 degrees	Included and valid	Not included	Included and valid
B-9	F	Included but does not correspond to any patterns	Included and valid	Included and valid	Included, and equal to or less than 15 degrees	Included and valid	Included but invalid	Included and valid
B-10	F	Not included	Included and valid	Included and valid	Included, and equal to or less than 15 degrees	Included and valid	Included but invalid	Included and valid
B-11	F	Not included	Included and valid	Not included	Included, and equal to or less than 15 degrees	Included and valid	Included and valid	Included but invalid
B-12	F	Not included	Included and valid	Not included	Included, and equal to or less than 15 degrees	Included and valid	Included and valid	Not included

NOTE: For Category B CBSDs, *antennaGain*, *antennaAzimuth*, *antennaDowntilt* and *antennaBeamwidth* are the antenna parameters which are mandatory for Release 1-based CBSD Registration. Therefore, all configurations in this table assume these parameters are included and valid for testing purpose.

The above CBSDs registered by the DP RI Test Harness shall support the EAP feature (i.e., *cbsdFeatureCapabilityList* includes the FID: "WF_ENH_ANTENNA_PATTERN") and the mandatory Release 1 antenna parameters shall be complete for the testing purpose.

Note: Since the scenario where the antenna model in the antenna database corresponds to full 3-D antenna pattern is not widely used in the industry, this scenario will not be included in the presented test cases in this Section for this Release.

Thereafter, the SAS RI UUT shall be tested for its ability to protect Protected Entities when using the EAP feature. The test methodology follows WINNF.FT.S.PPR.1 and WINNF.FT.S.IPR.1 in [n.7] to verify protection of PPAs and DPAs.

6.2.3.1   Initial Conditions / Test Pre-conditions

In addition to the conditions described in WINNF.FT.S.PPR.1 and WINNF.FT.S.IPR.1 in [n.7], the CBSD Antenna Pattern Database is required for the SAS RI UUT to access necessary antenna pattern information in the tests. The CBSD Antenna Pattern Database shall be configured to support different CBSD antenna configurations described in the method of test.

6.2.3.2   Test Tools Required

A special EAP Testing API is used for this test so that the SAS RI UUT can perform the antenna gain calculation towards a protection point using the EAP feature without exercising the rest of the SAS functions[1]. The EAP Testing API shall be used to execute the test case outlined in WINNF.FT.S.REL2.RI.EAP.1 to validate SAS RI UUT implementation of antenna gain calculation only. To execute this test, the Admin RI Test Harness shall send CBSD IDs of the registered CBSDs and geographic coordinates and height of a protection point to the SAS RI UUT through the EAP Testing API. After receiving the CBSD IDs from the Admin RI Test Harness, the SAS RI UUT shall compute the CBSD antenna gain of the corresponding CBSDs and send the results back to Admin RI Test Harness through the EAP Testing API. The SAS RI UUT shall provide the following information:

- CBSD ID,

- The EAP method applied to the CBSD,

- The CBSD antenna gain towards the protection point, calculated by SAS RI UUT

The Main RI Test Harness calculates the CBSD antenna gain towards the protection point with the same configurations using the reference implementation. A SAS RI UUT passes this test if the calculated antenna gain is within certain ranges of the results calculated by the reference implementation.

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[1] The address of EAP Testing API: https://github.com/Wireless-Innovation-Forum/Spectrum-Access-System

In addition to test tools required for WINNF.FT.S.PPR.1 and WINNF.FT.S.IPR.1 in [n.7], the reference model for CBSD antenna gain calculation shall support the enhanced antenna pattern feature and be incorporated in the reference models of IAP and DPA move list calculation.

6.2.4 Test Procedure

6.2.4.1 [WINNF.FT.S.REL2.RI.EAP.1] Testing of antenna gain calculation using EAP methods.

Step	Instructions
1	Ensure no *cbsdId* exists in the SAS RI UUT for the CBSDs being tested.
2	The Admin RI Test Harness injects records of CBSD Antenna Pattern Database into the SAS RI UUT.
3	The DP RI Test Harness sends the Registration Request Message for Twelve (12) Category A CBSDs each of which are configured as per each row of Table 6.2-2 and Twelve (12) Category B CBSDs each of which are configured as per each row of Table 6.2-3.
CHECK	The SAS RI UUT approves the request by sending a Registration Response Message to the DP RI 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 RI UUT FAILS this test. Otherwise, proceed.*
4	Admin RI Test Harness sends the CBSD IDs and geographic coordinates and height of a protection point to the SAS RI UUT through the EAP Testing API. The SAS RI UUT calculates the CBSD antenna gain towards the protection point using the EAP methods and sends the results back to the Admin RI Test Harness.
5	The Main RI Test Harness calculates the CBSD antenna gain towards the protection point using the reference implementation with the same configuration in Step 3.
CHECK	The information provided by the SAS RI UUT through the EAP Testing API shall meet the following conditions: • The CBSD IDs provided are the same as those given in step 4, • For each CBSD ID: o The EAP method applied is the same as the configuration of the CBSD as defined in corresponding Tables (Tables 6.2-2 and 6.2-3) o The CBSD antenna gain in dBi towards the protection point calculated by the SAS RI UUT is no less than the CBSD antenna gain calculated by the reference implementation minus 0.2 dB. *If the above conditions are not met, the SAS RI UUT FAILS this test. Otherwise, it PASSES.*

6.2.4.2 [WINNF.FT.S.REL2.RI.EAP.2] Use of Enhanced Antenna Pattern Feature for IAP-Based Protected Entities (No Peer SAS exists)

The purpose of this test case is to check if the SAS RI UUT appropriately uses EAP feature in IAP-based protection. For this purpose, PPA is used as the Protected Entity. This test follows the same test procedure and pass/fail criteria as WINNF.FT.S.PPR.1 in [n.7]. All CBSDs registered by the CBSD/DP RI Test Harness with the SAS RI UUT shall be within the protection neighborhood of a single PPA. The test assumes protection is applied by only the SAS RI UUT.

In the following, Δ^{IAP} 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 RI 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 WINNF.FT.S.PAT.1 in [n.7] test case, Δ^{IAP}, will be 1dB.

The test follows Steps 3 through the end of WINNF.FT.S.MCP.1 in [n.7] with the following values:

- No DPAs activated or deactivated,
- $K = 1$, where K is the number of iterations
- $N_S = 0$, where N_S is the number of peer SASs used by SAS RI Test Harness
- $\mathcal{P}_{IAP,k}$ contains a single PPA protected entity, where $\mathcal{P}_{IAP,k}$ is the set of impacted Protected Entities.

Step	Instructions
1	DP RI Test Harness registers N_1 CBSDs with the SAS RI UUT and requests a Grant for each. Among N_1 CBSDs, DP RI Test Harness shall register at least one CBSD using each one of the Enhanced Antenna Pattern methods described in Section 6.2.3
2	Admin RI Test Harness injects a PPA into the SAS RI UUT, with a (potentially empty) subset of CBSDs in the PPA's Cluster List. Note: if any of the CBSDs on the specified Cluster List failed to register, the Admin RI Test Harness shall omit them from the Cluster List injected into the SAS RI UUT. All CBSDs shall be located in the neighborhood of the PPA injected in Step 2.
3	Admin RI Test Harness triggers CPAS and waits until completion of CPAS.
4	DP RI Test Harness sends Heartbeat Requests for each SAS RI UUT Grant. It is expected that SAS RI UUT responds successfully to each Heartbeat Request.
5	DP RI Test Harness relinquishes the non-terminated Grants that received suggested *operationParam* in the Heartbeat Responses in Step 4.

6	DP RI Test Harness sends Grant Requests for all CBSDs whose Grants were relinquished in Step 5 or terminated in Step 4. Each Grant Request uses the suggested *operationParam* provided by the SAS RI UUT.
7	DP RI Test Harness sends Heartbeat Requests for each Grant managed by SAS RI UUT.
8	For each protection point p within the PPA, the Main RI Test Harness calculates: • A_p^{IAP}, the mean aggregate interference at protection point p of all Grants authorized by SAS RI UUT in Step 7 that are in the neighborhood of p using *maxEirp* from the corresponding Grant Requests. The Main RI Test Harness calculates A_p^{IAP} using the antenna models registered by N_1 CBSDs in Step 1. • $A_p^{IAP,ref}$, the sum of the SAS's Pre-IAP Headroom and leftover allocation (see Equation B-3 in Appendix B in [n.7]) plus the mean aggregate interference at protection point p of Grants in the neighborhood of p that are managed by SAS RI UUT at the *maxEirp* levels. Since there are no peer SASs, $A_p^{IAP,ref}$ is equal to the PPA protection threshold and the IAP Reference Model need not be used. Note: The Main RI Test Harness shall calculate A_p^{IAP} and $A_p^{IAP,ref}$ in each 5 MHz of the PAL channel associated with the injected PPAs in Step 2.
CHECK	$A_p^{IAP} \leq A_p^{IAP,ref} + \Delta^{IAP}$ for at least 95% of the protection points of the injected PPA in Step 2 *If the above condition is not met, the SAS UUT FAILS this test. Otherwise, proceed.*
9	DP RI Test Harness registers N_2 CBSDs with the SAS RI UUT and request a Grant for each. Among N_2 CBSDs, DP RI Test Harness shall register at least one CBSD using each one of the Enhanced Antenna Pattern modes described in Section 6.2.3 All CBSDs shall be located in the neighborhood of the PPA injected in Step 2.
10	DP RI Test Harness sends Heartbeat Requests for each Grant managed by SAS RI UUT.
11	For each protection point p of the injected PPA in Step 6, the Main RI Test Harness recalculates A_p^{IAP} using the Heartbeat information from Step 10. $A_p^{IAP,ref}$ is equal to the PPA protection threshold.
CHECK	$A_p^{IAP} \leq A_p^{IAP,ref} + \Delta^{IAP}$ for at least 95% of the protection points of the injected PPA in Step 2 *If the above condition is not met, the SAS RI UUT FAILS this test. Otherwise, it PASSES*

6.2.4.3 [WINNF.FT.S.REL2.RI.EAP.3] Use of Enhanced Antenna Pattern Feature for DPA Protection

The purpose of this test case is to check if the SAS RI UUT appropriately uses EAP feature in DPA protection. This test follows the same test procedure and pass/fail criteria as WINNF.FT.S.IPR.1 in [n.7]. All CBSDs registered by the CBSD/DP RI Test Harness with the SAS RI UUT shall be within the protection neighborhood of a single DPA.

This test does not use the ESC Test Harness. In the absence of an ESC, SAS RI UUT considers all ESC-monitored DPAs always activated. 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 RI Test Harness instructs the SAS RI UUT to load all ESC-monitored DPA contours and protection criteria.
2	Activate $N_S \geq 0$ SAS Test Harnesses (Release 1) and notify the SAS RI UUT.
3	SAS Test Harnesses are configured with FAD Records containing N_1 registered and granted CBSDs.
4	DP RI Test Harness registers with the SAS RI 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. Among N_2 CBSDs, DP RI Test Harness shall register at least one CBSD using each one of the Enhanced Antenna Pattern modes described in Section 6.2.3.
5	Admin RI Test Harness triggers CPAS and waits until completion of CPAS.
6	DP RI Test Harness registers with the SAS RI 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. Among N3 CBSDs, DP RI Test Harness shall register at least one CBSD using each one of the Enhanced Antenna Pattern modes described in Section 6.2.3
7	DP RI Test Harness sends a Heartbeat Request for each Grant managed by SAS RI 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 RI UUT FAILS this test. Otherwise, proceed.*
8	Admin RI 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 RI UUT if $N_S > 0$.

10	Admin RI Test Harness triggers CPAS and waits until completion of CPAS.
11	If $N_S > 0$, the Main RI 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 RI Test Harness sends a Heartbeat Request for each SAS RI UUT Grant. It is expected that SAS RI UUT responses successfully to each Heartbeat Request.
13	For each protection point p of ESC-monitored DPAs and in channel C_k, the Main RI 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 RI UUT Grants authorized in Step 12, 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 RI 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 o 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 RI Test Harness calculates $A_{p,a}^{DPA}$ of SAS RI 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 C_k 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 RI UUT FAILS this test. Otherwise, it PASSES.*

6.2.4.4 [WINNF.FT.S.REL2.RI.EAP.4] Use of Enhanced Antenna Pattern Feature for IAP-Based Protection (Peer-SAS supporting EAP Feature exists)

The purpose of this test case is to check if the SAS RI UUT appropriately uses EAP feature in IAP-based protection. For this purpose, ESC sensor is used as the Protected Entity. This test follows the same test procedure and pass/fail criteria as WINNF.FT.S.EPR.2 in [n.7]. At least a subset of CBSDs registered with the SAS RI UUT shall be within the Protection Neighborhood of an ESC sensor, using the Release 2 Enhanced Antenna Pattern Feature. At least a subset of CBSDs registered with the SAS RI Test Harness, which is also using the Release 2 Enhanced Antenna Pattern Feature shall have at least one approved Grant and be within the Protection

Neighborhood of the same ESC sensor. The test expects the SAS RI UUT to use Release 2 EAP parameters to perform IAP process.

In the following, Δ^{IAP} 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 RI 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, Δ^{IAP}, will be 1dB.

The test follows WINNF.FT.S.MCP.1 in [n.7] with the following values:

- No DPAs activated or deactivated,
- *K = 1*
- $N_S \geq 1$
- $\mathcal{P}_{IAP,k}$ contains a single ESC sensor.

Step	Instructions
1	Admin RI Test Harness instructs the SAS RI UUT to load all ESC-monitored DPA contours and protection criteria.
2	ESC Test Harness informs the SAS RI 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 $N_S > 0$ SAS RI Test Harnesses and notify the SAS RI UUT. The SAS RI Test Harnesses do not contain any CBSDs or Grants. Note: N_{SAS} as used in Equation B-2 in [n.7] is equal to $N_S + 1$.
4	DP RI Test Harness register N_2 CBSDs with the SAS RI UUT and request a Grant for each. Among N_2 CBSDs, DP RI Test Harness shall register at least one CBSD using each one of the Enhanced Antenna Pattern modes described in Section 6.2.3 All CBSDs shall be located in the neighborhood of the ESC sensor injected in Step 5.
5	Admin RI Test Harness injects ESC information into the SAS RI UUT.
6	Admin RI Test Harness triggers FAD generation and waits until completion of FAD generation. The FADs from SAS RI Test Harnesses indicate that the SAS RI Test Harnesses support Release 2 Enhanced Antenna Pattern feature as described in Section 6.2.3.
7	One of the SAS RI Test Harnesses pulls the FAD data from the SAS RI UUT
8	Configure the SAS RI Test Harnesses with FAD records containing N_1 registered and granted CBSDs. DP RI Test Harnesses shall register all N_1 CBSDs using Release 2 Enhanced Pattern parameters as described in Section 6.2.3.
9	Admin RI Test Harness triggers CPAS and waits until completion of CPAS.
10	Main RI Test Harness executes the IAP Reference Model using the FAD information from Steps 8 and 9.

	Note 1: the IAP Reference Model includes pre-IAP filtering. CBSDs removed during pre-IAP filtering are not used in the IAP Reference Model. Note 2: the IAP Reference Model uses Release 2 Antenna Parameters for all CBSDs, registered at SAS RI Test Harnesses and SAS RI UUT.
11	DP RI Test Harness send Heartbeat Requests for each SAS RI UUT Grant. It is expected that SAS RI UUT responds successfully to each Heartbeat Request.
12	DP RI Test Harness relinquish the non-terminated Grants that received suggested *operationParam* in the Heartbeat Responses in Step 11.
13	DP RI Test Harness sends Grant Requests for all CBSDs whose Grants were relinquished in Step 12 or terminated in Step 11. Each Grant Request uses the suggested *operationParam* provided by the SAS RI UUT.
14	DP RI Test Harness sends Heartbeat Requests for each Grant managed by SAS RI UUT.
15	For the ESC sensor injected in Step 5, the Main RI Test Harness calculates: • A_p^{IAP}, the mean aggregate interference at the ESC sensor of all Grants authorized by SAS RI UUT in Step 14 that are in the neighborhood of the ESC using *maxEirp* from the corresponding Grant Requests. The Main RI Test Harness calculates A_p^{IAP} using Release 2 Enhanced Antenna Parameters registered by N_1 CBSDs at the SAS RI UUT in Step 8. • $A_p^{IAP,ref}$, the sum of the SAS's Pre-IAP Headroom and leftover allocation (see Equation B-3 in Appendix B of [n.7]) plus the mean aggregate interference at the ESC sensor of Grants in the neighborhood of ESC that are managed by SAS RI UUT at the *maxEirp* levels calculated by the IAP Reference Model in Step 10. The Main RI Test Harness calculates $A_p^{IAP,ref}$ using the Release 2 Enhanced Antenna Pattern antenna parameters for all $N_2 + N_1$ CBSDs registered in Steps 4 and 8. Note: The Main RI Test Harness shall calculate A_p^{IAP} and $A_p^{IAP,ref}$ in the reference bandwidth (RBW) of the ESC sensor as given in Table 8.4.2 in [n.7].
CHECK	$A_p^{IAP} \leq A_p^{IAP,ref} + \Delta^{IAP}$ for the ESC sensor. *If the above conditions are not met, the SAS RI UUT FAILS this test. Otherwise, Proceed.*
16	DP RI Test Harness registers N_3 CBSDs with the SAS RI UUT and request a Grant for each. Among N_3 CBSDs, DP RI Test Harness shall register at least one CBSD using each one of the Enhanced Antenna Pattern modes described in Section 6.2.3 All CBSDs shall be located in the neighborhood of the ESC sensor injected in Step 5.
17	DP RI Test Harness send Heartbeat Requests for each Grant managed by SAS RI UUT.
18	For the ESC sensor, the Main RI Test Harness recalculates A_p^{IAP} using the Heartbeat information from Step 17, using Release 2 Enhanced Antenna Pattern parameters for

	N$_2$ + N$_3$ CBSDs registered at SAS RI UUT in Steps 4 and 16, and $A_p^{IAP,ref}$ from Step 15 is used below.
CHECK	$A_p^{IAP} \leq A_p^{IAP,ref} + \Delta^{IAP}$ for the ESC sensor. *If the above conditions are not met, the SAS RI UUT FAILS this test. Otherwise, it PASSES.*

6.2.4.5 [WINNF.FT.S.REL2.RI.EAP.5] Use of Enhanced Antenna Pattern Feature for IAP-Based Protection (For SAS RI UUT not supporting MSIRI)

The purpose of this test case is to check if the SAS RI UUT not supporting MSIRI can appropriately disable EAP feature in IAP-based protection in multi-SAS environment. For this purpose, ESC sensor is used as the Protected Entity. This test follows the same test procedure and pass/fail criteria as WINNF.FT.S.EPR.2 in [n.7]. At least a subset of CBSDs registered with the SAS RI UUT shall be within the Protection Neighborhood of an ESC sensor, using Release 2 Enhanced Antenna Pattern. At least a subset of CBSDs registered with the SAS Test Harness, using Release 1 antenna parameters shall have at least one approved Grant and be within the Protection Neighborhood of the same ESC sensor. The test case is required for SAS RI UUT that does not support MSIRI. The Test expects the SAS RI UUT to use Release 1 antenna parameters to perform IAP process.

In the following, Δ^{IAP} 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 RI 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, Δ^{IAP}, will be 1dB.

The test follows WINNF.FT.S.MCP.1 in [n.7] with the following values:

- No DPAs activated or deactivated,
- *K = 1*
- $N_S \geq 1$
- $\mathcal{P}_{IAP,k}$ contains a single ESC sensor.

Step	Instructions
1	Admin RI Test Harness instructs the SAS RI UUT to load all ESC-monitored DPA contours and protection criteria.
2	ESC RI Test Harness informs the SAS RI 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 $N_S > 0$ SAS Test Harnesses (Release 1) and notify the SAS RI UUT. The SAS Test Harnesses do not contain any CBSDs or Grants. Note: N_{SAS} as used in Equation B-2 in [n.7] is equal to $N_S + 1$.
4	DP RI Test Harness register N_2 CBSDs with the SAS RI UUT and request a Grant for each. Among N_2 CBSDs, DP RI Test Harness shall register at least one CBSD using each one of the Enhanced Antenna Pattern modes described in Section 6.2.3

	All CBSDs shall be located in the neighborhood of the ESC sensor injected in Step 5.
5	Admin RI Test Harness injects ESC information into the SAS RI UUT.
6	Admin RI Test Harness triggers FAD generation and waits until completion of FAD generation. The FADs from SAS Test Harnesses indicate that the SAS Test Harnesses do not support Release 2 Enhanced Antenna Pattern feature.
7	One of the SAS Test Harnesses pulls the FAD data from the SAS RI UUT
8	Configure the SAS Test Harnesses with FAD records containing N_1 registered and granted CBSDs. DP Test Harnesses shall register all N_1 CBSDs using Release 1 antenna parameters (Method F as described in Section 6.2.3)
9	Admin RI Test Harness triggers CPAS and waits until completion of CPAS.
10	Main RI Test Harness executes the IAP Reference Model using the FAD information from Steps 8 and 9. Note 1: the IAP Reference Model includes pre-IAP filtering. CBSDs removed during pre-IAP filtering are not used in the IAP Reference Model. Note 2: the IAP Reference Model uses Release 1 Antenna Parameters for $N_1 + N_2$ CBSDs, registered at SAS Test Harnesses and SAS RI UUT, respectively.
11	DP RI Test Harness send Heartbeat Requests for each SAS RI UUT Grant. It is expected that SAS RI UUT responds successfully to each Heartbeat Request.
12	DP RI Test Harness relinquish the non-terminated Grants that received suggested *operationParam* in the Heartbeat Responses in Step 11.
13	DP RI Test Harness sends Grant Requests for all CBSDs whose Grants were relinquished in Step 12 or terminated in Step 11. Each Grant Request uses the suggested *operationParam* provided by the SAS RI UUT.
14	DP RI Test Harness sends Heartbeat Requests for each Grant managed by SAS RI UUT.
15	For the ESC sensor injected in Step 5, the Main RI Test Harness calculates: • A_p^{IAP}, the mean aggregate interference at the ESC sensor of all Grants authorized by SAS RI UUT in Step 14 that are in the neighborhood of the ESC using *maxEirp* from the corresponding Grant Requests. The Main RI Test Harness calculates A_p^{IAP} using Release 1 antenna parameters for N_1 CBSDs registered at the SAS RI UUT in Step 8. • $A_p^{IAP,ref}$, the sum of the SAS's Pre-IAP Headroom and leftover allocation (see Equation B-3 in Appendix B of [n.7]) plus the mean aggregate interference at the ESC sensor of Grants in the neighborhood of ESC that are managed by SAS RI UUT at the *maxEirp* levels calculated by the IAP Reference Model in Step 9. The Main RI Test Harness calculates $A_p^{IAP,ref}$ using the Release 1 antenna parameters for all $N_2 + N_1$ CBSDs registered in Steps 4 and 8.

	Note: The Main RI Test Harness shall calculate A_p^{IAP} and $A_p^{IAP,ref}$ in the reference bandwidth (RBW) of the ESC sensor as given in Table 8.4-2 in [n.7].
CHECK	$A_p^{IAP} \leq A_p^{IAP,ref} + \Delta^{IAP}$ for and the ESC sensor. *If the above conditions are not met, the SAS RI UUT FAILS this test. Otherwise, Proceed.*
16	DP RI Test Harness register N_3 CBSDs with the SAS RI UUT and request a Grant for each. Among N_3 CBSDs, DP RI Test Harness shall register at least one CBSD using each one of the Enhanced Antenna Pattern modes described in Section 6.2.3 All CBSDs shall be located in the neighborhood of the ESC sensor injected in Step 5.
17	DP RI Test Harness send Heartbeat Requests for each Grant managed by SAS RI UUT.
18	For the ESC sensor, the Main RI Test Harness recalculates A_p^{IAP} using the Heartbeat information from Step 17, using Release 1 antenna parameters for $N_2 + N_3$ CBSDs registered at SAS RI UUT in Steps 4 and 16, and $A_p^{IAP,ref}$ from Step 15 is used below.
CHECK	$A_p^{IAP} \leq A_p^{IAP,ref} + \Delta^{IAP}$ for the ESC sensor. *If the above conditions are not met, the SAS RI UUT FAILS this test. Otherwise, it PASSES.*

WIRELESS INNOVATION FORUM

CBRS Committee Work Group 4 (Test and Certification)
CBRS Release 2 Regulatory Impacting (RI) Test Specification for SAS as UUT
WINNF-TS-4006-V1.0.0

6.3 Testing the Multi-SAS Inter Release IAP for Protection of Protected Entities

6.3.1 Definition, Applicability, and Scope of the Test Case

This section explains test steps, conditions, and procedures to verify that the SAS RI UUT supports the Multi-SAS Inter Release IAP (MSIRI) feature following Requirement REL2-R3-SGN-08 in [n.9] for protection of Protected Entities.

6.3.2 Test Characteristics

Table 6.3-1: Multi-SAS Inter Release IAP Test Characteristics

1	Test ID	WINNF.FT.S.REL2.RI.MSIRI
2	Title	Multi-SAS Inter Release IAP Test for protection of Protected Entities
3	Working Group / Entity	WG1, WG3
4	Test Type	Functionality
5	Test Class	Certification
6	Component / Interface	SAS / CBSD ← → SAS
7	Target Specification / Feature	[n.9]

6.3.3 Method of test

The test methodology follows WINNF.FT.S.PPR.3 and WINNF.FT.S.EPR.2 in [n.7] to verify protection of PPAs and ESC Sensors, while CBSDs are registered at SASs with multiple releases located within the Neighborhood of those Protected Entities. To execute these tests, the DP RI Test Harness shall first register a group of CBSDs supporting Release 1 Antenna parameters with the SAS Test Harness, where at least a subset of those CBSDs are in the Neighborhood of those Protected Entities. Moreover, the DP RI Test Harness shall register a different group of CBSDs supporting Release 2 Enhanced Antenna Pattern feature, according to REL2-R3-SGN-52100.b, REL2-R3-SGN-52100.c, or REL2-R3-SGN-52100.d [n.9], with the SAS RI UUT , where at least a subset of those CBSDs are in the Neighborhood of those Protected Entities. All registrations happen using the SAS-CBSD interface.

Note: Since the scenario where the antenna model in the antenna database corresponds to full 3-D antenna pattern is not widely used in the industry, this scenario will not be included in the presented test cases in this Section for this Release.

MSIRI is applicable to all RI features impacting IAP. For the purpose of testing, the test plan specified in this section uses EAP as the RI feature. However, if a new RI feature impacting IAP is implemented by the SAS, the test cases specified in Section 6.3.4 of this document shall be repeated by the SAS RI UUT using MSIRI and that RI feature, in addition to the test cases specific to the RI feature itself.

6.3.3.1   Initial Conditions / Test Pre-conditions

In addition to the conditions described in WINNF.FT.S.PPR.3 and WINNF.FT.S.EPR.2 in [n.7] (repeated below), the CBSD Antenna Pattern Database is required for the SAS RI UUT to access necessary antenna pattern information in the tests. The CBSD Antenna Pattern Database shall be configured to support different CBSD antenna configurations described in the method of test.

The conditions described in Release 1 test WINNF.FT.S.PPR.3 [n.7] are considered for testing of MSIRI feature:

- The PPA Information 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.

The conditions described in Release 1 test WINNF.FT.S.EPR.2 [n.7] are considered for testing of MSIRI feature:

- 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.

6.3.3.2   Test Tools Required

In addition to test tools required for WINNF.FT.S.PPR.3 and WINNF.FT.S.EPR.2 in [n.7], the reference model for CBSD antenna gain calculation shall support the enhanced antenna pattern feature and be incorporated in the reference models of IAP.

6.3.4   Test Procedure

6.3.4.1   [WINNF.FT.S.REL2.RI.MSIRI.1] Multi-SAS Inter Release IAP for PPA Protection

This test follows the same test procedure and pass/fail criteria as WINNF.FT.S.PPR.3 in [n.7]. At least a subset of CBSDs registered with the SAS RI UUT shall be within the Protection Neighborhood of a single PPA, using Release 2 Enhanced Antenna Pattern. At least a subset of CBSDs registered with the SAS Test Harness, using Release 1 antenna pattern shall have at least one approved Grant, and be within the Protection Neighborhood of the same PPA. The SAS RI UUT uses the Release 2 RI feature to calculate the aggregate interference for its own managed CBSDs according to MSIRI feature defined in [n.9].

This test case is applicable to SAS RI UUT implementing Release 2 EAP feature.

Step	Instructions
1	Activate one SAS Test Harness (Release 1) and notify the SAS RI 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. SAS Test Harness shall include at least one CBSD using Release 1 antenna model that is not included in the PPA Cluster List and is within the PPA neighborhood in the FAD exchanged in Step 6
2	Inject into the SAS RI UUT one or more PAL records corresponding to the PPAs in steps 1 and 4. Among N2 CBSDs, DP RI Test Harness shall register at least one CBSD using each one of the Enhanced Antenna Pattern modes described in Section 6.2.3
3	DP RI Test Harness sends a Registration Request for N_2 CBSDs to the SAS RI UUT.
4	Admin RI Test Harness injects a PPA into the SAS RI 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 PPA Cluster List failed to register, the Admin RI Test Harness shall omit them from the PPA Cluster List injected into the SAS RI UUT.
5	DP RI Test Harness sends a Grant Request for each of the N2 CBSDs to the SAS RI UUT. Note: the Grant Requests need not be for the same channel as the PPAs in Steps 1 and 4.
6	Admin RI Test Harness triggers FAD generation and waits until completion of FAD generation.
7	The SAS Test Harness pulls the FAD data from the SAS RI UUT.
8	Admin RI Test Harness triggers CPAS and waits until completion of CPAS.
9	Main RI Test Harness executes the IAP Reference Model using the FAD information from Steps 1 and 7.
10	DP RI Test Harness sends Heartbeat Requests for each SAS RI UUT Grant.

11	DP RI Test Harness relinquishes the non-terminated Grants that received suggested *operationParam* in the Heartbeat Responses in Step 10.
12	DP RI 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 RI UUT.
13	DP RI Test Harness sends Heartbeat Requests for each Grant managed by SAS RI UUT. Note that the SAS RI UUT uses the Release 2 RI feature to calculate the aggregate interference for its own managed CBSDs according to MSIRI feature defined in [n.9].
14	For each protection point p of the IAP-protected entities, the Main RI Test Harness calculates: • A_p^{IAP}, the mean aggregate interference at protection points p of all Grants authorized by SAS RI 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 of [n.7]) plus the mean aggregate interference at protection point p of Grants in the neighborhood of p that are managed by SAS RI 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 RI 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 on [n.7]. Note 3: A_p^{IAP} shall be calculated using Release 2 EAP as defined by MSIRI feature in [n.9]), but $A_p^{IAP,ref}$ shall be calculated using Release 1 antenna patterns.
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 RI UUT FAILS this test. Otherwise, it PASSES.*

6.3.4.2 [WINNF.FT.S.REL2.RI.MSIRI.2] Multi-SAS Inter Release IAP for ESC Sensor Protection

This test follows the same test procedure and pass/fail criteria as WINNF.FT.S.EPR.2 in [n.7]. All CBSDs registered with the SAS RI UUT shall be within the Protection Neighborhood of an ESC sensor, using Release 2 Enhanced Antenna Pattern. At least a subset of CBSDs registered

with the SAS Test Harness(es), using Release 1 antenna pattern shall have at least one approved Grant, and be within the Protection Neighborhood of the same ESC sensor.

In the following, Δ^{IAP} 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 RI 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, Δ^{IAP}, will be 1 dB.

The test follows WINNF.FT.S.MCP.1 in [n.7] with the following values:

- No DPAs activated or deactivated,
- $K = 1$
- $N_S \geq 1$
- $\mathcal{P}_{IAP,k}$ contains a single ESC sensor.

This test case is applicable to SAS RI UUT implementing Release 2 EAP feature.

Step	Instructions
1	Admin RI Test Harness instructs the SAS RI UUT to load all ESC-monitored DPA contours and protection criteria.
2	ESC Test Harness informs the SAS RI 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 $N_S > 0$ SAS Test Harnesses (Release 1) and notify the SAS RI UUT. The SAS Test Harnesses do not contain any CBSDs or Grants. Note: N_{SAS} as used in Equation B-2 in [n.7] is equal to $N_S + 1$.
4	DP RI Test Harness register N_2 CBSDs with the SAS RI UUT and request a Grant for each. Among N_2 CBSDs, DP RI Test Harness shall register at least one CBSD using each one of the Enhanced Antenna Pattern modes described in Section 6.2.3 All CBSDs shall be located in the neighborhood of the ESC sensor injected in Step 5.
5	Admin RI Test Harness injects ESC information into the SAS RI UUT.
6	Admin RI Test Harness triggers FAD generation and waits until completion of FAD generation. The FADs from SAS Test Harnesses indicate that the SAS Test Harnesses do not support Release 2 Enhanced Antenna Pattern feature.
7	One of the SAS Test Harnesses pulls the FAD data from the SAS RI UUT
8	Configure the SAS Test Harnesses with FAD records containing N_1 registered and granted CBSDs. DP Test Harnesses shall register all N_1 CBSDs using Release 1 antenna parameters (Method F as described in Section 6.2.3)

	At least a subset of these N_1 CBSDs shall be inside the Neighborhood of ESC.
9	Admin RI Test Harness triggers CPAS and waits until completion of CPAS.
10	Main RI Test Harness executes the IAP Reference Model using the FAD information from Steps 8 and 9. Note 1: the IAP Reference Model includes pre-IAP filtering. CBSDs removed during pre-IAP filtering are not used in the IAP Reference Model. Note 2: the IAP Reference Model uses Release 1 Antenna Parameters for $N_1 + N_2$ CBSDs, registered at SAS Test Harnesses and SAS RI UUT, respectively.
11	DP RI Test Harness send Heartbeat Requests for each SAS RI UUT Grant.
12	DP RI Test Harness relinquish the non-terminated Grants that received suggested *operationParam* in the Heartbeat Responses in Step 11.
13	DP RI Test Harness sends Grant Requests for all CBSDs whose Grants were relinquished in Step 12 or terminated in Step 11. Each Grant Request uses the suggested *operationParam* provided by the SAS RI UUT.
14	DP RI Test Harness sends Heartbeat Requests for each Grant managed by SAS RI UUT . Note that the SAS RI UUT uses the Release 2 RI feature to calculate the aggregate interference for its own managed CBSDs according to MSIRI feature defined in [n.9].
15	For the ESC sensor injected in Step 5, the Main RI Test Harness calculates: • A_p^{IAP}, the mean aggregate interference at the ESC sensor of all Grants authorized by SAS RI UUT in Step 14 using *maxEirp* from the corresponding Grant Requests. The Main RI Test Harness calculates A_p^{IAP} using Release 2 Enhanced Antenna Parameters (as defined by MSIRI feature in [n.9]) registered by N_2 CBSDs at the SAS RI UUT in Step 4. • $A_p^{IAP,ref}$, the sum of the SAS's Pre-IAP Headroom and leftover allocation (see Equation B-3 in Appendix B of [n.7]) plus the mean aggregate interference at the ESC sensor of Grants in the neighborhood of ESC that are managed by SAS RI UUT at the *maxEirp* levels calculated by the IAP Reference Model in Step 10. The Main RI Test Harness calculates $A_p^{IAP,ref}$ using the Release 1 antenna parameters for all $N_2 + N_1$ CBSDs registered in Steps 4 and 8. Note: The Main RI Test Harness shall calculate A_p^{IAP} and $A_p^{IAP,ref}$ in the reference bandwidth (RBW) of the ESC sensor as given in Table 8.4-2 in [n.7].
CHECK	$A_p^{IAP} \leq A_p^{IAP,ref} + \Delta^{IAP}$ for and the ESC sensor. *If the above conditions are not met, the SAS RI UUT FAILS this test. Otherwise, Proceed.*
16	DP RI Test Harness register N_3 CBSDs with the SAS RI UUT and request a Grant for each. Among N_3 CBSDs, DP RI Test Harness shall register at least one CBSD using each one of the Enhanced Antenna Pattern modes described in Section 6.2.3

	All CBSDs shall be located in the neighborhood of the ESC sensor injected in Step 5.
17	DP RI Test Harness send Heartbeat Requests for each Grant managed by SAS RI UUT.
18	For the ESC sensor, the Main RI Test Harness recalculates A_p^{IAP} using the Heartbeat information from Step 17, using Release 2 Enhanced Antenna Pattern parameters for $N_2 + N_3$ CBSDs registered at SAS RI UUT in Steps 4 and 16, and $A_p^{IAP,ref}$ from Step 15, recalculated using $N1 + N_2 + N_3$ CBSDs, is used below.
CHECK	$A_p^{IAP} \leq A_p^{IAP,ref} + \Delta^{IAP}$ for the ESC sensor. *If any of the above conditions are not met, the SAS RI UUT FAILS this test. Otherwise, it PASSES.*

Appendix A (Informative) Document History

Table 9-1: Document History

Document history		
V1.0.0	14 March 2024	Initial release