WInnForum Extension to AFC System (SUT) and AFC Device (DUT) Compliance Test Plans

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WInnForum Extension to AFC System (SUT) and AFC Device (DUT) Compliance Test Plans

1 Scope

The scope of this document is to specify extensions to test procedures specified in the Wi-Fi Alliance AFC System (SUT) Compliance Test Plan [n.1] (hereinafter "WFA SUT document") and the Wi-Fi Alliance AFC Device (DUT) Compliance Test Plan [n.10] (hereinafter "WFA DUT document"), including the test plan that covers non-Wi-Fi specific features. The extension to the WFA SUT document specified in this document can be used by an AFC System Operator to demonstrate conformance of its AFC System with the requirements defined in WINNF-TS-1014 [n.2] during thorough testing in a controlled environment (e.g. lab testing) as part of the FCC certification test. The extension to the WFA DUT document specified in this document can be used by a device manufacturer to demonstrate conformance of its Standard Power Devices (SPDs) and/or a pair of a Proxy and a particular model of SPD with the requirements defined in WINNF-TS-1014 [n.2] during the equipment certification process.

The extension test procedures specified in this document includes protocol and functional tests necessary to ensure the AFC System and the SPD comply with the technology-neutral and technology-specific requirements, optional features specified in WINNF-TS-1014 [n.2] and WINNF-TS-3007 [n.3].

Proprietary tests to be performed by prospective AFC System Operators and device manufacturers are out of the scope of this specification.

NOTE 1: Compliance with the test procedures specified in this document does not imply an AFC System is compliant with the FCC Part 15 Subpart E rules [n.4], since not all FCC rules are captured as requirements in WINNF-TS-1014 and test cases for some FCC rules are not specified in this document. WINNF-6GHZ-0002 [i.1] provides the traceability matrix that creates mapping between requirements and Test Vectors and shows whether a requirement is required to be tested, asserted or has no test requirement.

NOTE 2: When referring the WFA DUT document together with this technical specification, "AFC Device" refers to "Standard Power Device".

The key words "required", "shall", "shall not", "should", "should not", "recommended", "may", and "optional" in this document are to be interpreted as described in RFC-2119 [n.5]. In addition, the key word "conditional" shall be interpreted to mean that the definition is an absolute requirement of this specification only if the stated condition is met.

2 References

2.1 Normative References

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

[n.1] Wi-Fi Alliance AFC System (SUT) Compliance Test Plan V1.3, available at: https://www.wi-fi.org/downloads-registered-guest/AFC_Specfications_and_Test_Plans_01232023.zip/38132

[n.2] WINNF-TS-1014, "Functional Requirements for the U.S. 6 GHz Band under the Control of an AFC System", Wireless Innovation Forum

[n.3] WINNF-TS-3007, "Signaling Protocols and Procedures for 6 GHz Band; AFC System - Standard Power Device Interface Technical Specification (Baseline)", Wireless Innovation Forum

[n.4] Title 47, Code of Federal Regulations, Part 15 Subpart E - Unlicensed National Information Infrastructure Devices, available at: https://ecfr.federalregister.gov/current/title-47/chapter-I/subchapter-A/part-15/subpart-E

[n.5] RFC-2119, "Key words for use in RFCs to Indicate Requirement Levels", March 1997. Available at: https://tools.ietf.org/html/rfc2119

[n.6] Wi-Fi Alliance AFC System to AFC Device Interface Specification, available at: https://www.wi-fi.org/file/afc-system-to-afc-device-interface-specification

[n.7] Wi-Fi Alliance AFC System (SUT) Compliance Test Vector Requests V1.0, available at: https://www.wi-fi.org/downloads-registered-guest/AFC_Specfications_and_Test_Plans_01232023.zip/38132

[n.8] Reserved

[n.9] WINNF-6GHZ-0004, "WInnForum Extension to AFC System (SUT) and AFC Device (DUT) Compliance Test Vectors", Wireless Innovation Forum

[n.10] Wi-Fi Alliance AFC Device (AFC DUT) Compliance Test Plan, available at: https://www.wi-fi.org/downloads-registered-guest/AFC_Specfications_and_Test_Plans_01232023.zip/38132

2.2 Informative References

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

[i.1] WINNF-6GHZ-0002, "6 GHz Traceability Matrix", Wireless Innovation Forum

[i.2] WINNF-RC-4009, "Endorsement of Wi-Fi Alliance AFC System (SUT) Compliance Test Plan and Test Vectors", Wireless Innovation Forum

[i.3] https://github.com/Wi-FiTestSuite/6GHz-AFC

3 Definitions, Abbreviations and Symbols

3.1 Definitions

For the purposes of the present document, the definitions given in WINNF-TS-1014 [n.2] and WINNF-TS-3007 [n.3] and the following apply.

AFC System Unit Under Test: An AFC System to which the sequence of steps listed in the test procedures is applied.

SPD Unit Under Test: A Standard Power Device to which the sequence of steps listed in the test procedures is applied.

SPD/Proxy Unit Under Test: A pair of a Standard Power Device and a Proxy to which the sequence of steps listed in the test procedures is applied.

Test Harness: A collection of routines that can be configured by the test operator to interact with the AFC System UUT or the SPD UUT and emulates messages that would be generated by one Standard Power Device, a Proxy representing one or more Standard Power Devices, or an AFC System for the purpose of the test procedures.

Test Vector: A set of a pair of request message and an expected response message.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in WINNF-TS-1014 [n.2] and WINNF-TS-3007 [n.3] and the following apply.

TV Test Vector

UUT Unit Under Test

4 General Principles of Certification Test Cases

4.1 Test Case Classification

The test cases specified in this document are classified in two classes as follows:

- **Protocol Test (PT):** Test to validate the conformance of the protocol implementation in the AFC System UUT to the technical specifications developed by the WInnForum
- **Functional Test (FT):** Test to validate the conformance of the functionalities implemented in the AFC System UUT to the requirements developed by the WInnForum

4.2 Test Triggers

4.2.1 Test Triggers for AFC System

The test cases specified in this document are applicable to the following AFC Systems.

a. An AFC System that implements both WINNF-TS-1014 [n.2] and the Wi-Fi Alliance AFC System to AFC Device Interface Technical Specification (hereinafter “WFA SDI document”) [n.6]

b. An AFC System described in the item a. above that follows mandatory protocol requirements specified in WINNF-TS-3007 [n.3].

c. An AFC System described in the item b. above that implements Channel-Based Query for NRU1 feature as specified in WINNF-TS-3007 [n.3].

Above AFC Systems shall run the necessary test cases specified in this document in the following scenarios:

- An AFC System that has not gone through the certification tests, is being launched.
- Changes in a Certified AFC System implementation that may impact functionality, interoperability, or performance
- One or more changes in a Certified AFC System implementation, where the changes could impact the Protocol and Functional Test Cases specified in this document.

4.2.2 Test Triggers for Standard Power Device

The test cases specified in this document are applicable to the following SPDs.

a. An SPD or a pair of an SPD and a Proxy that implements both WINNF-TS-1014 [n.2] and the WFA SDI document" [n.6]

b. An SPD or a pair of an SPD and a Proxy described in the item a. above that follows mandatory protocol requirements specified in WINNF-TS-3007 [n.3].

c. An SPD or a pair of an SPD and a Proxy described in the item b. above that implements Channel-Based Query for NRU1 feature as specified in WINNF-TS-3007 [n.3].

Above SPDs shall run the necessary test cases specified in this document in the following scenarios:

- An SPD or a pair of an SPD and a Proxy that has not gone through the certification tests.
- Changes in a certified implementation of an SPD or a pair of an SPD and a Proxy that may impact functionality, interoperability, or performance
- One or more changes in a certified implementation of an SPD or a pair of an SPD and a Proxy, where the changes could impact the Protocol and Functional Test Cases specified in this document.

4.3 Test Tools Required

The following modules and functionality shall be used for the conformance tests specified or referenced by this document:

Table 4.3-1: Test Tools Required

Modules	Functionality
AFC System UUT	Functionality to inject the following data:

	▪ Certified FCC ID List [n.3] ▪ Disallowed Device List [n.3] ▪ List of designated geographic areas where Standard Power Device operations must be discontinued. ▪ Snapshot of the FCC ULS database	
SPD UUT and SPD/Proxy UUT	No additional functionality is required.	
Test Harness	For AFC System UUT	Functionality to send one or more Test Vector request messages to the AFC System UUT
		Functionality to receive and log response messages from the AFC System UUT.
		Functionality to validate the received response messages by using Test Vector response messages corresponding to the Test Vector request messages sent to the AFC System UUT.
	For SPD UUT and SPD/Proxy UUT	Functionality to receive and validate request messages from the SPD UUT and SPD/Proxy UUT
		Functionality to return the response message to the SPD UUT and SPD/Proxy UUT
NOTE: Test Harness provided by the Wi-Fi Alliance [i.3] employs required functionalities described in this table.		

4.4 Prerequisites

4.4.1 Prerequisites for AFC System UUT

If the AFC System UUT supports only Frequency-Based Query or both Frequency-Based Query and Channel-Based Query for IEEE 802.11-based air interface, the AFC System UUT shall run the test cases specified in the WFA SUT document [n.1] using the Test Vectors [n.7] as described in Table 4.4-1.

Table 4.4-1: Minimum Mandatory Test Cases and Test Vector IDs for AFC System UUT

WFA SUT Test Case	WFA Test Vector ID range
AFCS.SRS	1
AFCS.URS	1-7
AFCS.FSP	1-100
AFCS.IBP	1-8
AFCS.SIP	1-16

For an AFC System UUT not supporting Frequency-Based Query or Channel-Based Query for IEEE 802.11 based interface and supporting NRU1 feature the AFC System UUT shall run the tests specified in section 5.2

4.4.2 Prerequisites for SPD UUT and SPD/Proxy UUT

If the SPD UUT or SPD/Proxy UUT supports only Frequency-Based Query or both Frequency-Based Query and Channel-Based Query for IEEE 802.11-based air interface, the UUT shall run the test cases specified in the WFA DUT document [n.10] using the Test Vectors [n.7] as described in Table 4.4-2.

Table 4.4-2: Minimum Mandatory Test Cases and Test Vector IDs for SPD UUT and SPD/Proxy UUT

WFA DUT Test Case	WFA Test Vector ID range
AFCD.RSA	TBD
AFCD.USA	TBD
AFCD.SAU	TBD
AFCD.UAU	TBD

For an SPD UUT or SPD/Proxy UUT not supporting Frequency-Based Query or Channel-Based Query for IEEE 802.11 based interface and supporting NRU1 feature, the SPD UUT or SPD/Proxy UUT shall run the tests specified in section 5.2

4.5 Assumptions in Test Vectors

Some requirements specified in WINNF-TS-1014 could lead to different implementations among different AFC System Operators. For the purpose of developing Test Vectors accompanied with this technical specification, the following implementations are considered:

Table 4.5-1: Implementation Assumptions for Test Vector Development (for AFC System UUT)

Requirement ID	Requirement Description	Assumptions in Test Vectors
R2-AIP-02	Fixed service receiver noise level	▪ Technique a is used
R2-AIP-07	Fixed service receiver and diversity receiver antenna RPE	▪ Default RPE is used.
R2-AIP-10	Feeder loss	▪ 3 dB feeder loss is used for “Unknown Radio”.
R2-AIP-24	Use of National Land Cover Database (NLCD)	▪ Versions of NLCD data as suggested by the footnote are used
R2-AIP-26	Building entry loss	▪ 20.5 dB Building Entry Loss is applied to Standard Power Devices located indoors.

R2-AIP-27	ITM parameters	▪ No site-specific modification to the ITM reliability and confidence factors is applied
R2-AIP-34	WINNER II	▪ No site-specific information is used ▪ No modification is applied
R2-AIP-35	Confidence factor for P.2108-0	▪ No site-specific modification to the P.2108-0 confidence factor is applied

5 Extensions to Test Cases and Test Vectors

This section specifies extension test cases and associated vectors required for compliance with WINNF-TS-1014 [n.2] which are not defined in the Wi-Fi Alliance specifications [n.1][n.7] or are required for optional features specified by the WInnForum are captured in this section.

5.1 Extensions to Definition of Test Case and Test Vector ID

Each test vector referenced by this document has an associated test case ID. A test case ID shall be defined in the following format:

Test Case ID: {*TestedEntity*}.{*TestFunction*}_{*FeatureName*}

Test Vector ID: {*TestedEntity*}.{*TestFunction*}_{*FeatureName*}.{*SubTestNumber*}

{*TestedEntity*} indicates whether the tested entity is AFC System (“AFCS") or SPD or SPD/Proxy ("AFCD”).

Definition of *TestFunction* follows the WFA SUT document or WFA DUT document as per {*TestedEntity*}.

FeatureName indicates an ID specific to an optional feature defined by the WInnForum. In this version of this technical specification, the IDs listed in Table 5.1-1 are defined.

Table 5.1-1: *FeatureName* IDs

Features	*FeatureName* IDs
NRU1 feature	NRU1

SubTestNumber indicates an ID of sub-test for a particular scenario in the test case.

5.2 Test Cases and Test Vectors for NRU1 Feature (Conditional)

This section specifies test cases for compliance with NRU1 feature. The AFC System Operator (or device manufacturer) that wants its AFC System UUT (or SPD UUT or SPD/Proxy UUT) to employ Channel-Based Query using NRU1 feature as specified in WINNF-TS-1014 [n.2] and WINNF-TS-3007 shall run the test cases specified in this section.

For the purpose of testing of NRU1 feature, the necessary test cases and Test Vectors are designed on top of the WFA SUT document and they are defined as shown in Table 5.2-1.

Table 5.2-1: Test Cases and Test Vectors for AFC System UUT employing NRU1 Feature

Test Case IDs	Range of *SubTestNumber*	Descriptions
AFCS.SRS_NRU1	1001	Testing for Successful Registration using NRU1 feature
AFCS.URS_NRU1	1001-1007	Testing for Unsuccessful Registration using NRU1 feature
AFCS.FSP_NRU1	1001-1100	Testing for Fixed Service Protection using NRU1 feature
AFCS.IBP_NRU1	1001-1008	Testing for International Border Protection using NRU1 feature
AFCS.SIP_NRU1	1001-1016	Testing for Special Incumbent Protection using NRU1 feature

Table 5.2-2: Test Cases and Test Vectors for SPD UUT and SPD/Proxy UUT employing NRU1 Feature

Test Case IDs	Range of *SubTestNumber*	Descriptions
AFCD.RSA_NRU1	1002	Testing for successful registration and spectrum access request using NRU1 feature
AFCD.USA_NRU1	1002	Testing for unsuccessful spectrum access request using NRU1 feature
AFCD.SAU_NRU1	1002	Testing for successful spectrum access update using NRU1 feature
AFCD.UAU_NRU1	1002	Testing for unsuccessful spectrum access update using NRU1 feature
AFCD.USV_NRU1	1001-1008	Testing for unsuccessful server validation using NRU1 feature

Annex A (Informative): Document History

Document History		
V1.0.0	23 March 2023	Initial Version
V1.1.0	22 June 2023	Implemented: ▪ WINNF-23-I-00030-r1 Proposed Changes to WINNF-TS-4007 for Incorporating 3GPP DUT ▪ revising Table 4.4-1 and Table 5.2-1 to include more FSP test cases in consistent with the WFA AFC SUT Test Vectors. ▪ Editorial changes