



SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

SZEMC-TRF-01 Rev. A/0 Aug01,2022

Report No.: SZCR221200413105

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TEST REPORT

Application No.: SZCR2212004131AT
Applicant: Shenzhen RAKwireless Technology Co.,Ltd.
Address of Applicant: Room 506, Building B, New Compark, Pingshan First Road, Taoyuan Street, Nanshan District, Shenzhen, China
Manufacturer: Shenzhen RAKwireless Technology Co.,Ltd.
Address of Manufacturer: Room 506, Building B, New Compark, Pingshan First Road, Taoyuan Street, Nanshan District, Shenzhen, China
Equipment Under Test (EUT):
EUT Name: All-in-One. 5G
Model No.: M320
Trade Mark: RAK, MNTD
FCC ID: 2AF6B-M320
Standard(s) : CBRSA-TS-9001-V1.0.0
WINNF-TS-0122-V1.0.2
FCC 47 CFR Part 96
KDB 940660 D01 V03
Date of Receipt: 2023-03-23
Date of Test: 2023-03-23 to 2023-04-04
Date of Issue: 2023-05-10

Test Result:	Pass*
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* In the configuration tested, the EUT complied with the standards specified above.

Keny Xu

Keny Xu
EMC Laboratory Manager



SGS-CSTC Standards Technical Services Co., Ltd.
Shenzhen Branch EMC Laboratory

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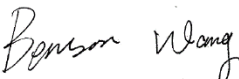
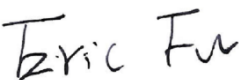
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Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2023-05-10		Original

Authorized for issue by:				
				
		Benson Wang/Project Engineer		
				
		Eric Fu/Reviewer		



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2 Test Summary

Item	Standard	Test Case ID	Result
Domain Proxy Multi-Step registration	WINNF-TS-0122-V1.0.2	WINNF.FT.D.REG.2	Pass
Domain Proxy Single-Step registration for Cat A CBSD	WINNF-TS-0122-V1.0.2	WINNF.FT.D.REG.4	Pass
Registration due to change of an installation parameter	WINNF-TS-0122-V1.0.2	WINNF.FT.C.REG.7	Pass
Domain Proxy Missing Required parameters (responseCode 102)	WINNF-TS-0122-V1.0.2	WINNF.FT.D.REG.9	Pass
Domain Proxy Pending registration (responseCode 200)	WINNF-TS-0122-V1.0.2	WINNF.FT.D.REG.11	Pass
Domain Proxy Invalid parameters (responseCode 103)	WINNF-TS-0122-V1.0.2	WINNF.FT.D.REG.13	Pass
Domain Proxy Blacklisted CBSD (responseCode 101)	WINNF-TS-0122-V1.0.2	WINNF.FT.D.REG.15	Pass
Domain Proxy Unsupported SAS protocol version responseCode 100)	WINNF-TS-0122-V1.0.2	WINNF.FT.D.REG.17	Pass
Domain Proxy Group Error (responseCode 201)	WINNF-TS-0122-V1.0.2	WINNF.FT.D.REG.19	Pass
Category A CBSD location update	WINNF-TS-0122-V1.0.2	WINNF.FT.C.REG.20	Pass
Unsuccessful Grant responseCode=400 (INTERFERENCE)	WINNF-TS-0122-V1.0.2	WINNF.FT.C.GRA.1	Pass
Unsuccessful Grant responseCode=401 (GRANT_CONFLICT)	WINNF-TS-0122-V1.0.2	WINNF.FT.C.GRA.2	Pass
Domain Proxy Heartbeat Success Case (first Heartbeat Response)	WINNF-TS-0122-V1.0.2	WINNF.FT.D.HBT.2	Pass
Heartbeat responseCode=105 (DEREGISTER)	WINNF-TS-0122-V1.0.2	WINNF.FT.C.HBT.3	Pass
Heartbeat responseCode=501 (SUSPENDED_GRANT) in First Heartbeat Response	WINNF-TS-0122-V1.0.2	WINNF.FT.C.HBT.5	Pass
Heartbeat responseCode=501 (SUSPENDED_GRANT) in Subsequent Heartbeat Response	WINNF-TS-0122-V1.0.2	WINNF.FT.C.HBT.6	Pass
Heartbeat responseCode=502 (UNSYNC_OP_PARAM)	WINNF-TS-0122-V1.0.2	WINNF.FT.C.HBT.7	Pass
Domain Proxy Heartbeat responseCode=500 (TEMINATED_GRANT)	WINNF-TS-0122-V1.0.2	WINNF.FT.D.HBT.8	Pass



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Item	Standard	Test Case ID	Result
Heartbeat Response Absent (First Heartbeat)	WINNF-TS-0122-V1.0.2	WINNF.FT.C.HBT.9	Pass
Heartbeat Response Absent (Subsequent Heartbeat)	WINNF-TS-0122-V1.0.2	WINNF.FT.C.HBT.10	Pass
Domain Proxy Successful Relinquishment	WINNF-TS-0122-V1.0.2	WINNF.FT.D.RLQ.2	Pass
Domain Proxy Successful Deregistration	WINNF-TS-0122-V1.0.2	WINNF.FT.D.DRG.2	Pass
Successful TLS connection between UUT and SAS Test Harness	WINNF-TS-0122-V1.0.2	WINNF.FT.C.SCS.1	Pass
TLS failure due to revoked certificate	WINNF-TS-0122-V1.0.2	WINNF.FT.C.SCS.2	Pass
TLS failure due to expired server certificate	WINNF-TS-0122-V1.0.2	WINNF.FT.C.SCS.3	Pass
TLS failure when SAS Test Harness certificate is issue by unknown CA	WINNF-TS-0122-V1.0.2	WINNF.FT.C.SCS.4	Pass
TLS failure when certificate at the SAS Test Harness is corrupted	WINNF-TS-0122-V1.0.2	WINNF.FT.C.SCS.5	Pass
UUT RF Transmit Power Measurement	WINNF-TS-0122-V1.0.2	WINNF.PT.C.HBT.1	Pass
SAS Version: 1.0.0.3			

The UUT is a CBSD with Domain Proxy. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

Test standards:

CBRSA-TS-9001-V1.0.0

CBRS Alliance Certification Test Plan

WINNF-TS-0122-V1.0.2

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

KDB 940660 D01 Part 96 CBRS Eqpt v03



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4 General Information

4.1 Details of E.U.T.

Product Information:	This base station consists ofC BU and RU
Power supply:	Powered by POE adapter: Adapter model: RP026-5601080YE Input: AC 100-240V 50/60Hz Output: DC 56.0V 1.08A
Sample Type:	Fixed device
CBSD Class:	A
Transmitter Frequency Band:	LTE Band 48; 5G NR n48
Transmitter Frequency Range:	3550~3700MHz
Hardware Version:	RAKBS_M320_1.0.0
Software Version:	BaiBBU_QSS_1.1.8.a
Test sample:	SN1: 918100TAE4030100008 SN2: 918100TAE4030100009
Antenna Gain:	5.5dBi
MIMO supported	2*2 UL
Antenna Type:	Integral Antenna

Note: This is a BTS-CBSD communication with Domain Proxy. Domain Proxy information show as below:

Name of Domain Proxy: RAK CloudNMS

Software Version of Domain Proxy: V1.8.0



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4.2 Description of CBSD/DP Support Features

Condition	Feature Description	Supported
C1	Mandatory for UUT which supports multi-step registration message.	Y
C2	Mandatory for UUT which supports single-step registration with no CPI-signed data in the registration message. By definition, this is a subset of Category A devices which determine all registration information, including location, without CPI intervention.	Y
C3	Mandatory for UUT which supports single-step registration containing CPI-signed data in the registration message.	N
C4	Mandatory for UUT which supports RECEIVED_POWER_WITHOUT_GRANT measurement report type.	N
C5	Mandatory for UUT which supports RECEIVED_POWER_WITH_GRANT measurement report type.	N
C6	Mandatory for UUT which supports parameter change being made at the UUT and prior to sending a deregistration.	Y

Y: Supported

N: Not supported



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4.3 Summary of Test Results

WINNF-TS-0122			
Classes	Test Case Items	Pass Items	Pass Rate (%)
FT (CBSD, DP/CBSD)	27	27	100
PT (CBSD, DP/CBSD)	1	1	100
Total	28	28	100

Note:

1. Functional Test (FT): Test to validate the conformance of the Protocols and functionalities implemented in the CBSD/DP UUT to the requirements developed by WinnForum and supporting FCC/DoD requirements.
2. Field/Performance Test (PT): Test to check the capability of the CBSD/DP UUT to support various traffic models and actual operations in the field.

4.4 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	$\pm 7.25 \times 10^{-8}$
2	RF conducted power	$\pm 0.75\text{dB}$
3	Temperature test	$\pm 1^{\circ}\text{C}$
4	Humidity test	$\pm 3\%$
5	Supply voltages	$\pm 1.5\%$
6	Time	$\pm 3\%$

4.5 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
CPE	SMAWAVE	USB Dongle	/
Mobile	OSOM	OV1	/
Router	TP-LINK	TL-R860+	1175379002425



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4.6 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen Branch

No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, Guangdong, China.
518057.

Tel: +86 755 2601 2053 Fax: +86 755 2671 0594

No tests were sub-contracted.



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5 Equipment List

Test Equipment	Manufacturer	Model No.	Inventory No.	Cal Date	Cal Due Date
Laptop (With SAS Test harness)	Samsung	930XCJ	REF. No.SEA1900	/	/
Spectrum Analyzer	Keysight	N9020B	SEM004-28	2022-09-20	2023-09-19
Shield Room	SAEMC	MSR433	SEM001-11	2021-03-13	2024-03-12
Coaxial Cable	SGS	N/A	SEM031-01	2022-07-11	2023-07-10
Attenuator	Weinschel Associates	WA41	SEM021-09	N/A	N/A
Splitter	MACOM	2090-6214-00	N/A	N/A	N/A
Humidity/ Temperature Indicator	Shanghai Meteorological Industry Factory	ZJ1-2B	SEM002-03	2022-09-27	2023-09-26



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6 Test Method and Environment

6.1 CBSD/DP Conformance and Performance

Test Requirement: CBRS CBSD Test Specification WINNF-TS-0122-V1.0.2

Test Method: CBRS CBSD Test Specification WINNF-TS-0122-V1.0.2
WINNF-IN-0156_WinnForum_SAS_Test_Harness_CBSD_UUT_Tutorial_
v1_0_0_1

6.2 CBSD Test Procedure

- Connect the UUT to SAS Test Harness system and RF Test instruments via the DP interface and RF components. The highest level is set to test configuration.
- UUT shall be UTC time synchronized
- The frequency band is granted and set as UUT supported Modulation and Channels, transmitted power of the UUT according to it granted parameters from the SAS TestHarness.
- Each test case results were recorded and validated by SAS Test Harness system and RF instruments test cases was recorded test results from SAS Test Harness system.



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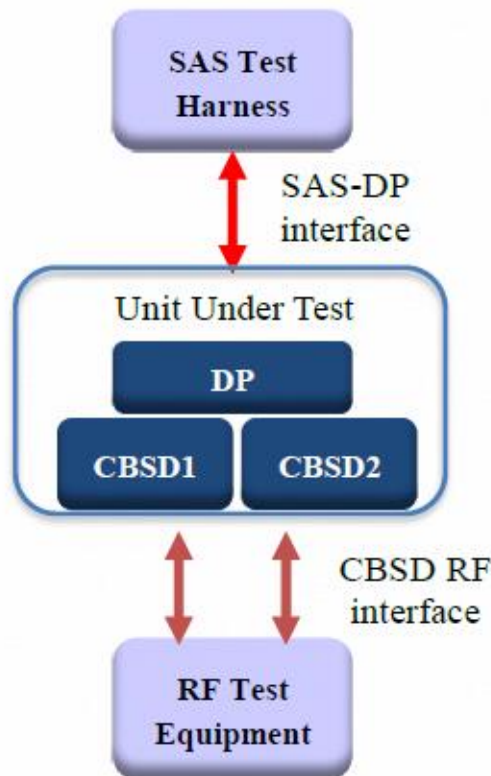
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6.3 Test Environment

Test Harness Version:	V1.0.0.3
Operating System:	Microsoft Windows 10
TLS Version:	1.2
Python Version:	2.7.13
Environmental Conditions:	25deg. C, 65%RH
Input Power:	120Vac, 60Hz

6.4 Test Setup

- 1) DP is deployed on the network management, and the registration of DP to SAS is to register with SAS according to the granularity of CBSD ID;
- 2) The DP and the network element communicate messages according to the cell granularity, and each CBSDID corresponds to a cell of an RRU which belongs to a base station.



DP/CBSD as UUT, BTS-CBSD communication with Domain Proxy



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7 Test Data

7.1 CBSD Registration Process

7.1.1 WINNF.FT.D.REG.2

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has successfully completed SAS Discovery and Authentication with the SAS Test Harness ● UUT is in the Unregistered state	--	--
2	DP with two CBSD sends correct Registration request information, as specified in [n.5], in the form of one 2-element Array or as individual messages to the SAS Test Harness: ● The required userId, fcId and cbsdSerialNumber registration parameters shall be sent for each CBSD and conform to proper format and acceptable ranges. ● Any REG-conditional or optional registration parameters that may be included in the message shall be verified that they conform to proper format and are within acceptable ranges. Note: It is outside the scope of this document to test the Registration information that is supplied via another means.	■ Pass	□ Fail
3	● SAS Test Harness sends a CBSD Registration Response in the form of one 2-element Array or individual messages as follows: - cbsdId = Ci - measReportConfig shall not be included - responseCode = 0 for each CBSD	--	--
4	After completion of step 3, SAS Test Harness will not provide any positive response (responseCode=0) to further request messages from the UUT.	--	--
5	Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: ● UUT shall not transmit RF	■ Pass	□ Fail

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7.1.2 WINNF.FT.D.REG.4

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has successfully completed SAS Discovery and Authentication with the SAS Test Harness ● UUT is in the Unregistered state	--	--
2	The DP with two CBSDs sends Registration requests in the form of one 2-element Array or as individual messages to SAS Test Harness. ● The required userId, fcId and cbsdSerialNumber and REG-Conditional cbsdCategory, airInterface, installationParam, and measCapability registration parameters shall be sent from the CBSD and conform to proper format and acceptable ranges. ● Any optional registration parameters that may be included in the message shall be verified that they conform to proper format and are within acceptable ranges.	☒ Pass	☐ Fail
3	● SAS Test Harness sends a CBSD Registration Response in the form of one 2-element Array or individual messages as follows: - cbsdId = Ci - measReportConfig for each CBSD shall not be included - responseCode = 0 for each CBSD	--	--
4	After completion of step 3, SAS Test Harness will not provide any positive response (responseCode=0) to further request messages from the UUT.	--	--
5	Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: ● UUT shall not transmit RF	☒ Pass	☐ Fail



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7.1.3 WINNF.FT.C.REG.7

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness	--	--
2	UUT has successfully registered with SAS Test Harness	--	--
3	Change an installation parameters at the UUT (time T) - Tester needs to record the current time at which the parameter change is executed.	--	--
4	Monitor the SAS-CBSD interface. UUT sends a deregistrationRequest to the SAS Test Harness The deregistration request shall be sent within (T + 60 seconds) from step 3.	■ Pass	□ Fail



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7.1.4 WINNF.FT.D.REG.9

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness ● UUT is in the Unregistered state	--	--
2	The DP with two CBSDs sends a Registration request in the form of one 2-element Array or as individual messages to SAS Test Harness.	--	--
3	SAS Test Harness sends a CBSD Registration Response in the form of one 2-element Array or as individual messages as follows: - SAS response does not include a cbsdId. - responseCode = 102 for CBSD1 and CBSD2	--	--
4	After completion of step 3, SAS Test Harness will not provide any positive response (responseCode=0) to further request messages from the UUT.	--	--
5	Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: ● UUT shall not transmit RF	☒ Pass	☐ Fail

7.1.5 WINNF.FT.D.REG.11

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness ● UUT is in the Unregistered state	--	--
2	The DP with two CBSDs sends a Registration request in the form of one 2-element Array or as individual messages to SAS Test Harness.	--	--
3	SAS Test Harness sends a CBSD Registration Response in the form of one 2-element Array or as individual messages as follows: - SAS response does not include a cbsdId. - responseCode = 200 for CBSD1 and CBSD2	--	--
4	After completion of step 3, SAS Test Harness will not provide any positive response (responseCode=0) to further request messages from the UUT.	--	--
5	Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: ● UUT shall not transmit RF	☒ Pass	☐ Fail



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7.1.6 WINNF.FT.D.REG.13

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness ● UUT is in the Unregistered state	--	--
2	The DP with two CBSDs sends a Registration request in the form of one 2-element Array or as individual messages to SAS Test Harness.	--	--
3	SAS Test Harness sends a CBSD Registration Response in the form of one 2-element Array or as individual messages as follows: - SAS response does not include a cbsdId. - responseCode = 0 for CBSD1 - responseCode = 103 for CBSD2	--	--
4	After completion of step 3, SAS Test Harness will not provide any positive response (responseCode=0) to further request messages from the UUT.	--	--
5	Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: ● UUT shall not transmit RF	☒ Pass	☐ Fail

7.1.7 WINNF.FT.D.REG.15

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness ● UUT is in the Unregistered state	--	--
2	The DP with two CBSDs sends a Registration request in the form of one 2-element Array or as individual messages to SAS Test Harness.	--	--
3	SAS Test Harness sends a CBSD Registration Response in the form of one 2-element Array or as individual messages as follows: - SAS response does not include a cbsdId. - responseCode = 0 for CBSD1 - responseCode = 101 for CBSD2	--	--
4	After completion of step 3, SAS Test Harness will not provide any positive response (responseCode=0) to further request messages from the UUT.	--	--
5	Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: ● UUT shall not transmit RF	☒ Pass	☐ Fail



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7.1.8 WINNF.FT.D.REG.17

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness ● UUT is in the Unregistered state	--	--
2	The DP with two CBSDs sends a Registration request in the form of one 2-element Array or as individual messages to SAS Test Harness.	--	--
3	SAS Test Harness sends a CBSD Registration Response in the form of one 2-element Array or as individual messages as follows: - SAS response does not include a cbsdId. - responseCode = 100 for CBSD1 and CBSD2	--	--
4	After completion of step 3, SAS Test Harness will not provide any positive response (responseCode=0) to further request messages from the UUT.	--	--
5	Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: ● UUT shall not transmit RF	■ Pass	□ Fail

7.1.9 WINNF.FT.D.REG.19

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness ● UUT is in the Unregistered state	--	--
2	The DP with two CBSDs sends a Registration request in the form of one 2-element Array or as individual messages to SAS Test Harness.	--	--
3	SAS Test Harness sends a CBSD Registration Response in the form of one 2-element Array or as individual messages as follows: - SAS response does not include a cbsdId. - responseCode = 0 for CBSD1 - responseCode = 201 for CBSD2	--	--
4	After completion of step 3, SAS Test Harness will not provide any positive response (responseCode=0) to further request messages from the UUT.	--	--
5	Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: ● UUT shall not transmit RF	■ Pass	□ Fail



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7.2 CBSD Spectrum Grant Process

7.2.1 WINNF.FT.C.GRA.1

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has registered successfully with SAS Test Harness, with cbsdId = C	--	--
2	UUT sends valid Grant Request.	--	--
3	SAS Test Harness sends a Grant Response message, including - cbsdId=C - responseCode = 400	--	--
4	After completion of step 3, SAS Test Harness will not provide any positive response (responseCode=0) to further request messages from the UUT.	--	--
5	Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: ● UUT shall not transmit RF	☒ Pass	☐ Fail

7.2.2 WINNF.FT.C.GRA.2

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has registered successfully with SAS Test Harness, with cbsdId = C	--	--
2	UUT sends valid Grant Request.	--	--
3	SAS Test Harness sends a Grant Response message, including - cbsdId=C - responseCode = 400	--	--
4	After completion of step 3, SAS Test Harness will not provide any positive response (responseCode=0) to further request messages from the UUT.	--	--
5	Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: ● UUT shall not transmit RF	☒ Pass	☐ Fail



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7.3 CBSD HeartBeat Process

7.3.1 WINNF.FT.D.HBT.2

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● DP has two CBSD registered successfully with SAS Test Harness, with cbsdId = Ci, i={1,2}	--	--
2	DP sends a message: ● If message is type Spectrum Inquiry Request, go to step 3, or ● If message is type Grant Request, go to step 5	--	--
3	DP sends a Spectrum Inquiry Request message for each CBSD. This may occur in a separate message per CBSD, or together in a single message with array of 2. Verify Spectrum Inquiry Request message is formatted correctly for each CBSD, including for CBSDi, i={1,2}: ● cbsdId = Ci ● List of frequencyRange objects sent by DP are within the CBRS frequency range	■ Pass	□ Fail
4	If a separate Spectrum Inquiry Request message was sent for each CBSD, the SAS Test Harness shall respond to each Spectrum Inquiry Request message with a separate Spectrum Inquiry Response message. If a single Spectrum Inquiry Request message was sent containing a 2-object array (one per CBSD), the SAS Test Harness shall respond with a single Spectrum Inquiry Response message containing a 2-object array. Verify parameters for each CBSD within the Spectrum Inquiry Response message are as follows, for CBSDi, i={1,2}: ● cbsdId = Ci ● availableChannel is an array of availableChannel objects ● responseCode = 0	--	--
5	DP sends a Grant Request message for each CBSD. This may occur in a separate message per CBSD, or together in a single message with array of 2. Verify Grant Request message is formatted correctly for each CBSD, including for CBSDi, i={1,2}: ● cbsdId = C ● maxEIRP is at or below the limit appropriate for CBSD category as defined by Part 96 ● operationFrequencyRange, Fi, sent by UUT is a valid range within the CBRS band	■ Pass	□ Fail
6	If a separate Grant Request message was sent for each CBSD, the SAS Test Harness shall respond to each Grant Request message with a separate Grant Response message. If a single Grant Request message was sent containing a 2-object array (one per CBSD), the SAS Test Harness shall respond with a single Grant Response message containing a 2-object array. Verify parameters for each CBSD within the Grant Response message are as follows, for CBSDi, i={1,2}:	--	--



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	● cbsdId = Ci ● grantId = Gi = a valid grant ID ● grantExpireTime = UTC time greater than duration of the test ● responseCode = 0		
7	Ensure DP sends first Heartbeat Request message for each CBSD. This may occur in a separate message per CBSD, or together in a single message with array of 2. Verify Heartbeat Request message is formatted correctly for each CBSD, including, for CBSDi i={1,2}: ● cbsdId = Ci, i={1,2} ● grantId = Gi, i={1,2} ● operationState = "GRANTED"	☒ Pass	☐ Fail
8	If a separate Heartbeat Request message was sent for each CBSD by the DP, the SAS Test Harness shall respond to each Heartbeat Request message with a separate Heartbeat Response message. If a single Heartbeat Request message was sent by the DP containing a 2-object array (one per CBSD), the SAS Test Harness shall respond with a single Heartbeat Response message containing a 2-object array. Verify parameters for each CBSD within the Heartbeat Response message are as follows, for CBSDi: ● cbsdId = Ci ● grantId = Gi ● transmitExpireTime = current UTC time + 200 seconds ● responseCode = 0	--	--
9	For further Heartbeat Request messages sent from DP after completion of step 8, validate message is sent within latest specified heartbeatInterval for CBSDi: ● cbsdId = Ci ● grantId = Gi ● operationState = "AUTHORIZED" and SAS Test Harness responds with a Heartbeat Response message including the following parameters, for CBSDi ● cbsdId = Ci ● grantId = Gi ● transmitExpireTime = current UTC time + 200 seconds ● responseCode = 0	☒ Pass	☐ Fail
10	Monitor the RF output of the UUT from start of test until UUT transmission commences. Monitor the RF output of the UUT from start of test until RF transmission commences. Verify: ● UUT does not transmit at any time prior to completion of the first heartbeat response ● UUT transmits after step 8 is complete, and its transmission is limited to within the bandwidth range Fi.	☒ Pass	☐ Fail



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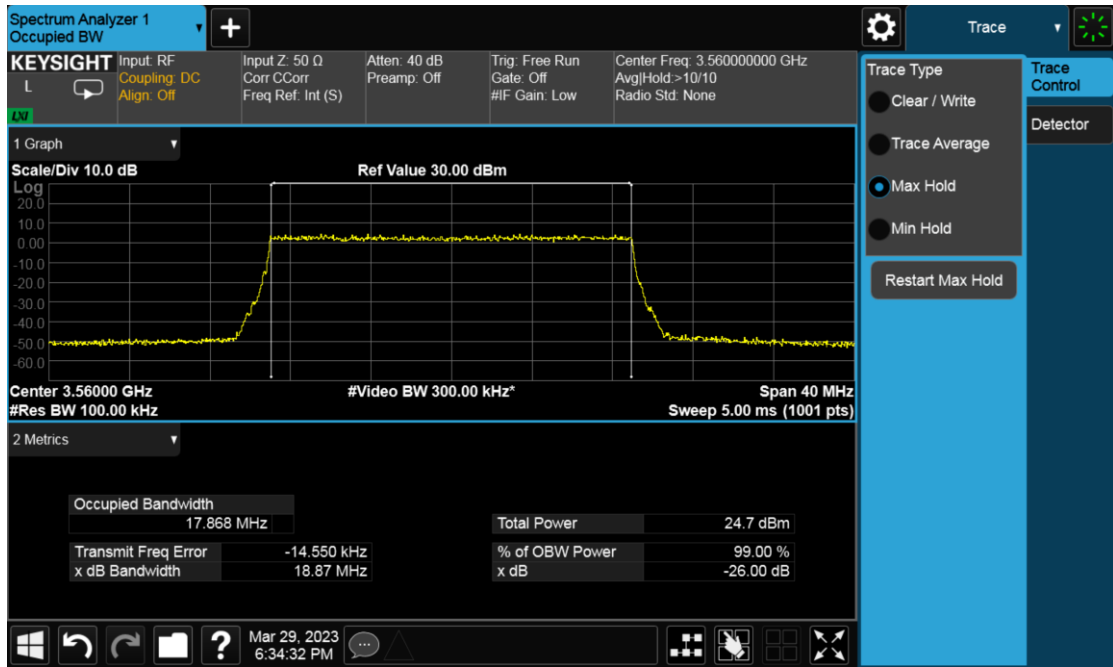
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7.3.2 WINNF.FT.C.HBT.3

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has registered successfully with SAS Test Harness ● UUT has a valid single grant as follows: ○ valid cbsdId = C ○ valid grantId = G ○ grant is for frequency range F, power P ○ grantExpireTime = UTC time greater than duration of the test ● UUT is in AUTHORIZED state and is transmitting within the grant bandwidth F on RF interface	--	--
2	UUT sends a Heartbeat Request message. Ensure Heartbeat Request message is sent within Heartbeat Interval specified in the latest Heartbeat Response, and formatted correctly, including: ● cbsdId = C ● grantId = G ● operationState = "AUTHORIZED"	☒ Pass	☐ Fail
3	SAS Test Harness sends a Heartbeat Response message, including the following parameters: ● cbsdId = C ● grantId = G ● transmitExpireTime = T = Current UTC time ● responseCode = 105 (DEREGISTER)	--	--
4	After completion of step 3, SAS Test Harness shall not allow any further grants to the UUT.	--	--
5	Monitor the RF output of the UUT. Verify: ● UUT shall stop transmission within (T + 60 seconds) of completion of step 3	☒ Pass	☐ Fail



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7.3.3 WINNF.FT.C.HBT.5

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has registered successfully with SAS Test Harness ● UUT has a valid single grant as follows: ○ valid cbsdId = C ○ valid grantId = G ○ grant is for frequency range F, power P ○ grantExpireTime = UTC time greater than duration of the test ● UUT is in GRANTED, but not AUTHORIZED state (i.e. has not performed its first Heartbeat Request)	--	--
2	UUT sends a Heartbeat Request message. Verify Heartbeat Request message is formatted correctly, including: ● cbsdId = C ● grantId = G ● operationState = "GRANTED"	☒ Pass	☐ Fail
3	SAS Test Harness sends a Heartbeat Response message, including the following parameters: ● cbsdId = C ● grantId = G ● transmitExpireTime = T = current UTC time ● responseCode = 501 (SUSPENDED_GRANT)	--	--
4	After completion of step 3, SAS Test Harness shall not allow any further grants to the UUT.	--	--
5	Monitor the SAS-CBSD interface. Verify either A OR B occurs: A. UUT sends a Heartbeat Request message. Ensure message is sent within latest specified heartbeatInterval, and is correctly formatted with parameters: ● cbsdId = C ● grantId = G ● operationState = "GRANTED" B. UUT sends a Relinquishment request message. Ensure message is correctly formatted with parameters: ● cbsdId = C ● grantId = G Monitor the RF output of the UUT. Verify: ● UUT does not transmit at any time	☒ Pass	☐ Fail

7.3.4 WINNF.FT.C.HBT.6

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has registered successfully with SAS Test Harness ● UUT has a valid single grant as follows: ○ valid cbsdId = C ○ valid grantId = G ○ grant is for frequency range F, power P ○ grantExpireTime = UTC time greater than duration of the test ● UUT is in AUTHORIZED state and is transmitting within the grant bandwidth F on RF interface	--	--
2	UUT sends a Heartbeat Request message. Ensure Heartbeat Request message is sent within latest specified heartbeatInterval, and is formatted correctly, including: ● cbsdId = C ● grantId = G ● operationState = "AUTHORIZED"	☒ Pass	☐ Fail
3	SAS Test Harness sends a Heartbeat Response message, including the following parameters: ● cbsdId = C ● grantId = G ● transmitExpireTime = T = current UTC time ● responseCode = 501 (SUSPENDED_GRANT)	--	--
4	After completion of step 3, SAS Test Harness shall not allow any further grants to the UUT.	--	--
5	Monitor the SAS-CBSD interface. Verify either A OR B occurs: A. UUT sends a Heartbeat Request message. Ensure message is sent within latest specified heartbeatInterval, and is correctly formatted with parameters: ● cbsdId = C ● grantId = G ● operationState = "GRANTED" B. UUT sends a Relinquishment request message. Ensure message is correctly formatted with parameters: ● cbsdId = C ● grantId = G Monitor the RF output of the UUT. Verify: ● UUT shall stop transmission within (T+60) seconds of completion of step 3	☒ Pass	☐ Fail

7.3.5 WINNF.FT.C.HBT.7

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has registered successfully with SAS Test Harness ● UUT has a valid single grant as follows: ○ valid cbsdId = C ○ valid grantId = G ○ grant is for frequency range F, power P ○ grantExpireTime = UTC time greater than duration of the test ● UUT is in AUTHORIZED state and is transmitting within the grant bandwidth F on RF interface	--	--
2	UUT sends a Heartbeat Request message. Ensure Heartbeat Request message is sent within latest specified heartbeatInterval, and is formatted correctly, including: ● cbsdId = C ● grantId = G ● operationState = "AUTHORIZED"	■ Pass	□ Fail
3	SAS Test Harness sends a Heartbeat Response message, including the following parameters: ● cbsdId = C ● grantId = G ● transmitExpireTime = T = current UTC time ● responseCode = 502 (UNSYNC_OP_PARAM)	--	--
4	After completion of step 3, SAS Test Harness shall not allow any further grants to the UUT.	--	--
5	Monitor the SAS-CBSD interface. Verify: ● UUT sends a Grant Relinquishment Request message. Verify message is correctly formatted with parameters: ○ cbsdId = C ○ grantId = G Monitor the RF output of the UUT. Verify: ● UUT shall stop transmission within (T+60) seconds of completion of step 3	■ Pass	□ Fail

7.3.6 WINNF.FT.D.HBT.8

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● DP has two CBSD registered successfully with SAS Test Harness ● Each CBSD {1,2} has a valid single grant as follows ○ valid cbsdId = Ci, i={1,2} ○ valid grantId = Gi, i={1,2} ○ grant is for frequency range Fi, power Pi ○ grantExpireTime = UTC time greater than duration of the test ● Both CBSD are in AUTHORIZED state and transmitting within their granted bandwidth on RF interface	--	--
2	DP sends a Heartbeat Request message for each CBSD. This may occur in a separate message per CBSD, or together in a single message with array of size 2. Verify Heartbeat Request message is sent within latest specified heartbeatInterval, and is formatted correctly for each CBSD, including, for CBSDi i={1,2}: ● cbsdId = Ci, i = {1,2} ● grantId = Gi, i = {1,2} ● operationState = "AUTHORIZED"	■ Pass	□ Fail
3	If separate Heartbeat Request message was sent for each CBSD by the DP, the SAS Test Harness shall respond to each Heartbeat Request message with a separate Heartbeat Response message. If a single Heartbeat Request message was sent by the DP containing a 2-object array (one per CBSD), the SAS Test Harness shall respond with a single Heartbeat Response message containing a 2-object array. Parameters for each CBSD within the Heartbeat Response message should be as follows, for CBSDi: ● cbsdId = Ci ● grantId = Gi ● For CBSD1: ○ transmitExpireTime = current UTC time + 200 seconds ○ responseCode = 0 ● For CBSD2: ○ transmitExpireTime = T = current UTC time ○ responseCode = 500 (TERMINATED_GRANT)	--	--
4	After completion of step 3, SAS Test Harness shall not allow any further grants to the UUT. If CBSD sends further Heartbeat Request messages for CBSD1, SAS Test Harness shall respond with a Heartbeat Response message with parameters: ● cbsdId = C1 ● grantId = G1 ● transmitExpireTime = current UTC time + 200 seconds ● responseCode = 0 ● Heartbeat Request message is within heartbeatInterval of previous Heartbeat Request message	--	--

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5	Monitor the RF output of CBSD2. Verify: ● CBSD2 shall stop transmission within bandwidth F2 within (T + 60 seconds) of completion of step 3	☒ Pass	☐ Fail
---	--	--	-------------------------------



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7.3.7 WINNF.FT.C.HBT.9

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has registered successfully with SAS Test Harness ● UUT has a valid single grant as follows: ○ valid cbsdId = C ○ valid grantId = G ○ grant is for frequency range F, power P ○ grantExpireTime = UTC time greater than duration of the test ● UUT is in GRANTED, but not AUTHORIZED state(i.e. has not performed its first Heartbeat Request)	--	--
2	UUT sends a Heartbeat Request message. Ensure Heartbeat Request message is sent within latest specified heartbeatInterval, and is formatted correctly, including: ● cbsdId = C ● grantId = G ● operationState = "GRANTED"	☒ Pass	☐ Fail
3	After completion of step 2, SAS Test Harness does not respond to any further ● messages from UUT to simulate loss of network connection	--	--
4	Monitor the RF output of the UUT from start of test to 60 seconds after step 3. Verify: ● At any time during the test, UUT shall not transmit on RF interface	☒ Pass	☐ Fail



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7.3.8 WINNF.FT.C.HBT.10

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● UUT has registered successfully with SAS Test Harness ● UUT has a valid single grant as follows: ○ valid cbsdId = C ○ valid grantId = G ○ grant is for frequency range F, power P ○ grantExpireTime = UTC time greater than duration of the test ● UUT is in AUTHORIZED state and is transmitting within the grant bandwidth F on RF interface	--	--
2	UUT sends a Heartbeat Request message. Verify Heartbeat Request message is sent within latest specified heartbeatInterval, and is formatted correctly, including: ● cbsdId = C ● grantId = G ● operationState = "AUTHORIZED"	■ Pass	□ Fail
3	SAS Test Harness sends a Heartbeat Response message, including the following parameters: ● cbsdId = C ● grantId = G ● transmitExpireTime = T = current UTC time + 200 seconds ● responseCode = 0	--	--
4	After completion of step 3, SAS Test Harness shall not allow any further grants to the UUT.	--	--
5	Monitor the RF output of the UUT. Verify: ● UUT shall stop all transmission on RF interface within (transmitExpireTime + 60 seconds), using the transmitExpireTime sent in Step 3.	■ Pass	□ Fail



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7.4 CBSD Relinquishment Process

7.4.1 WINNF.FT.D.RLQ.2

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● DP has successfully completed SAS Discovery and Authentication with SAS Test Harness ● DP has successfully registered 2 CBSD with SAS Test Harness, each with cbsdId=Ci, i={1,2} ● DP has received a valid grant with grantId = Gi, i={1,2} for each CBSD ● Both CBSD are in Grant State AUTHORIZED and actively transmitting within the bounds of their grants. Invoke trigger to relinquish UUT Grant from the SAS Test Harness	--	--
2	Verify DP sends a Relinquishment Request message for each CBSD. This may occur in a separate message per CBSD, or together in a single message with array of 2. Verify Relinquishment Request message contains all required parameters properly formatted for each CBSD, specifically, for CBSDi: ● cbsdId = Ci ● grantId = Gi	☒ Pass	☐ Fail
3	If a separate Relinquishment Request message was sent for each CBSD by the DP, the SAS Test Harness shall respond to each request message with a separate response message. If a single Relinquishment Request message was sent by the DP containing a 2-object array (one per CBSD), the SAS Test Harness shall respond with a single Response message containing a 2-object array. Parameters for each CBSD within the Relinquishment Response shall be as follows: ● cbsdId = Ci ● grantId = Gi ● responseCode = 0	--	--
4	After completion of step 3, SAS Test Harness will not provide any additional positive response (responseCode=0) to further request messages from the UUT.	--	--
5	Monitor the RF output of each UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: ● UUT shall stop RF transmission at any time between triggering the relinquishments and UUT sending the relinquishment requests for each CBSD.	☒ Pass	☐ Fail



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7.5 CBSD Deregistration Process

7.5.1 WINNF.FT.D.DRG.2

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: ● Each UUT has successfully registered with SAS Test Harness ● Each UUT is in the authorized state ● DP has successfully completed SAS Discovery and Authentication with SAS Test Harness ● DP has successfully registered 2 CBSD with SAS Test Harness, each with cbsdId=Ci, i={1,2} ● DP has received a valid grant with grantId = Gi, i={1,2} for each CBSD ● Both CBSD are in Grant State AUTHORIZED and actively transmitting within the bounds of their grants. Invoke trigger to relinquish UUT Grant from the SAS Test Harness	--	--
2	UUT sends a Relinquishment request and receives Relinquishment response with responseCode=0	--	--
3	Verify DP sends a Deregistration Request message for each CBSD. This may occur in a separate message per CBSD, or together in a single message with array of 2. Verify Deregistration Request message contains all required parameters properly formatted for each CBSD, specifically, for CBSDi: ● cbsdId = Ci	■ Pass	□ Fail
4	If a separate Deregistration Request message was sent for each CBSD by the DP, the SAS Test Harness shall respond to each request message with a separate response message. If a single Deregistration Request message was sent by the DP containing a 2-object array (one per CBSD), the SAS Test Harness shall respond with a single Response message containing a 2-object array. Parameters for each CBSD within the Deregistration Response shall be as follows: ● cbsdId = Ci ● responseCode = 0	--	--
5	After completion of step 4, SAS Test Harness will not provide any positive response (responseCode=0) to further request messages from the UUT.	--	--
6	Monitor the RF output of each UUT from start of test until 60 seconds after Step 4 is complete. This is the end of the test. Verify: ● UUT stopped RF transmission at any time between triggering the deregistration and either A OR B occurs: A. UUT sending a Registration Request message, as this is not mandatory B. UUT sending a Deregistration Request message	■ Pass	□ Fail

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7.6 CBSD Security Validation

7.6.1 WINNF.FT.C.SCS.1

#	Test Execution Steps	Results	
1	- UUT shall start CBSD-SAS communication with the security procedure - The UUT shall establish a TLS handshake with the SAS Test Harness using configured certificate. - Configure the SAS Test Harness to accept the security procedure and establish the connection	☒ Pass	☐ Fail
2	- Make sure that Mutual authentication happens between UUT and the SAS Test Harness. - Make sure that UUT uses TLS v1.2 - Make sure that cipher suites from one of the following is selected, - TLS_RSA_WITH_AES_128_GCM_SHA256 - TLS_RSA_WITH_AES_256_GCM_SHA384 - TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 - TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384 - TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256	☒ Pass	☐ Fail
3	A successful registration is accomplished using one of the test cases described in section 6.1.4.1, depending on CBSD capability. UUT sends a registration request to the SAS Test Harness and the SAS Test Harness sends a Registration Response with responseCode = 0 and cbsId.	☒ Pass	☐ Fail
4	Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: UUT shall not transmit RF	☒ Pass	☐ Fail

7.6.2 WINNF.FT.C.SCS.2

#	Test Execution Steps	Results	
1	UUT shall start CBSD-SAS communication with the security procedures	☒ Pass	☐ Fail
2	- Make sure that UUT uses TLS v1.2 for security establishment. - Make sure UUT selects the correct cipher suite. - UUT shall use CRL or OCSP to verify the validity of the server certificate. - Make sure that Mutual authentication does not happen between UUT and the SAS Test Harness.	☒ Pass	☐ Fail
3	UUT may retry for the security procedure which shall fail.	☒ Pass	☐ Fail
4	SAS Test-Harness shall not receive any Registration request or any application data.	--	--
5	Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: UUT shall not transmit RF	☒ Pass	☐ Fail



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7.6.3 WINNF.FT.C.SCS.3

#	Test Execution Steps	Results	
1	UUT shall start CBSD-SAS communication with the security procedures	☒ Pass	☐ Fail
2	- Make sure that UUT uses TLS v1.2 for security establishment. - Make sure UUT selects the correct cipher suite. - UUT shall use CRL or OCSP to verify the validity of the server certificate. - Make sure that Mutual authentication does not happen between UUT and the SAS Test Harness.	☒ Pass	☐ Fail
3	UUT may retry for the security procedure which shall fail.	☒ Pass	☐ Fail
4	SAS Test-Harness shall not receive any Registration request or any application data.	--	--
5	Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: UUT shall not transmit RF	☒ Pass	☐ Fail

7.6.4 WINNF.FT.C.SCS.4

#	Test Execution Steps	Results	
1	UUT shall start CBSD-SAS communication with the security procedures	☒ Pass	☐ Fail
2	- Make sure that UUT uses TLS v1.2 for security establishment. - Make sure UUT selects the correct cipher suite. - UUT shall use CRL or OCSP to verify the validity of the server certificate - Make sure that Mutual authentication does not happen between UUT and the SAS Test Harness.	☒ Pass	☐ Fail
3	UUT may retry for the security procedure which shall fail.	☒ Pass	☐ Fail
4	SAS Test-Harness shall not receive any Registration request or any application data.	--	--
5	Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: UUT shall not transmit RF	☒ Pass	☐ Fail



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7.6.5 WINNF.FT.C.SCS.5

#	Test Execution Steps	Results	
1	UUT shall start CBSD-SAS communication with the security procedures	☒ Pass	☐ Fail
2	- Make sure that UUT uses TLS v1.2 for security establishment. - Make sure UUT selects the correct cipher suite. - UUT shall use CRL or OCSP to verify the validity of the server certificate - Make sure that Mutual authentication does not happen between UUT and the SAS Test Harness.	☒ Pass	☐ Fail
3	UUT may retry for the security procedure which shall fail.	☒ Pass	☐ Fail
4	SAS Test-Harness shall not receive any Registration request or any application data.	--	--
5	Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify: UUT shall not transmit RF	☒ Pass	☐ Fail



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7.7 CBSD RF Power Measurement

7.7.1 WINNF.PT.C.HBT.1

#	Test Execution Steps	Results	
1	Ensure the following conditions are met for test entry: - UUT has successfully completed SAS Discovery and Authentication with the SAS Test Harness - UUT has registered with the SAS, with CBSD ID = C - UUT has a single valid grant G with parameters {lowFrequency = FL, highFrequency = FH, maxEirp = Pi}, with grant in AUTHORIZED state, and grantExpireTime set to a value far past the duration of this test case - Note: in order for the UUT to request a grant with the parameters {lowFrequency, highFrequency, maxEirp}, the SAS Test Harness may need to provide appropriate guidance in the availableChannel object of the spectrumInquiry response message, and the operationParam object of the grant response message. Alternately, the UUT vendor may provide the ability to set those parameters on the UUT so that the UUT will request a grant with those parameters	--	--
2	UUT and SAS Test Harness perform a series of Heartbeat Request/Response cycles, which continues until the other test steps are complete. Messaging for each cycle is as follows: - UUT sends Heartbeat Request, including: - cbsdId = C - grantId = G - SAS Test Harness responds with Heartbeat Response, including: - cbsdId = C - grantId = G - transmitExpireTime = current UTC time + 200 seconds - responseCode = 0	--	--
3	Tester performs power measurement on RF interface(s) of UUT, and verifies it complies with the maxEirp setting, Pi. The RF measurement method is out of scope of this document, but may include additional configuration of the UUT, as required, to fulfill the requirements of the power measurement method. Note: it may be required for the vendor to provide a method or configuration to bring the UUT to a mode which is required by the measurement methodology. Any such mode is vendor-specific and depends upon UUT behavior and the measurement methodology.	☒ Pass	☐ Fail

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RF measurement plot for Test Case:

- Tester performs power measurement on RF interface(s) of UUT, and verifies it complies with the maxEirp setting, Pi. The RF measurement method is out of scope of this document, but may include additional configuration of the UUT, as required, to fulfill the requirements of the power measurement method.

LTE							
Freq. (MHz)	Conducted PSD (dBm/MHz)	Path Loss (dB)	Antenna Gain (dBi)	Array Gain (dB)	EIRP PSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
3560	3.841	5	5.5	3.01	17.351	20	Pass
3560	-5.899	5	5.5	3.01	7.611	10	Pass
Note:							
1. Array Gain=10log(n), n is the antenna number, for this test the n=2							
2. EIRP PSD= Conducted PSD+ Path Loss+ Antenna Gain+ Array Gain							

5G NR							
Freq. (MHz)	Conducted PSD (dBm/MHz)	Path Loss (dB)	Antenna Gain (dBi)	Array Gain (dB)	EIRP PSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
3560	3.209	5	5.5	3.01	16.719	20	Pass
3560	-5.671	5	5.5	3.01	7.839	10	Pass
Note:							
3. Array Gain=10log(n), n is the antenna number, for this test the n=2							
4. EIRP PSD= Conducted PSD+ Path Loss+ Antenna Gain+ Array Gain							



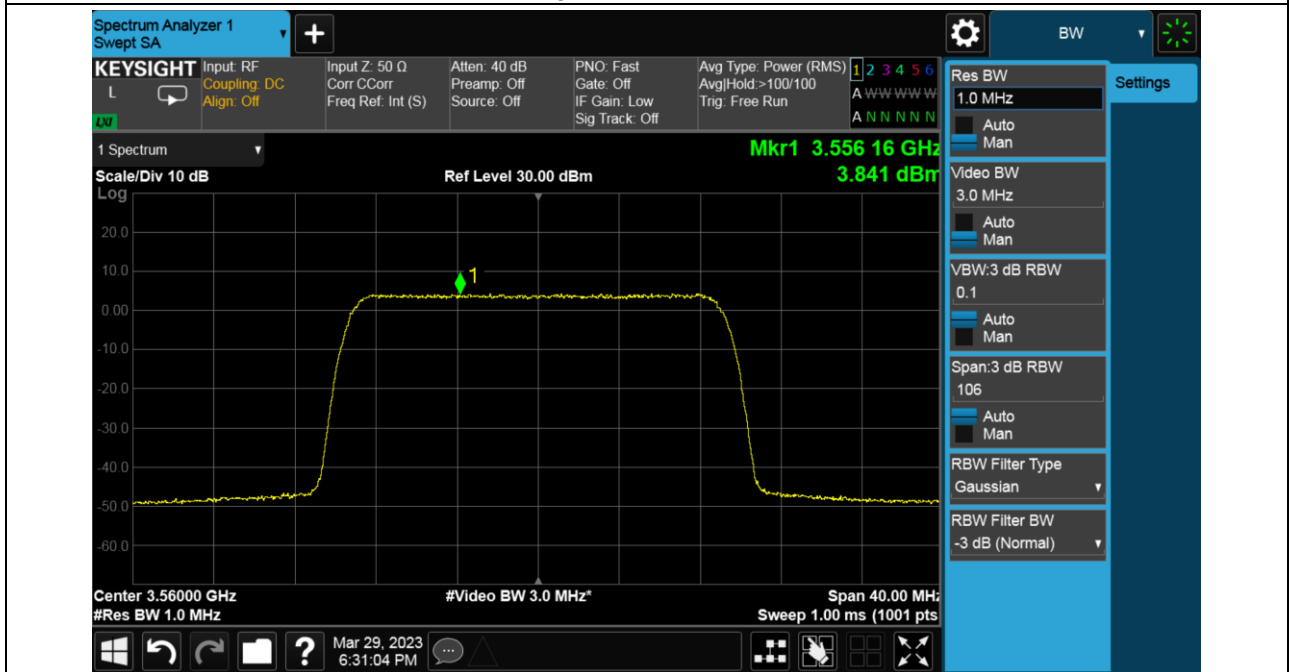
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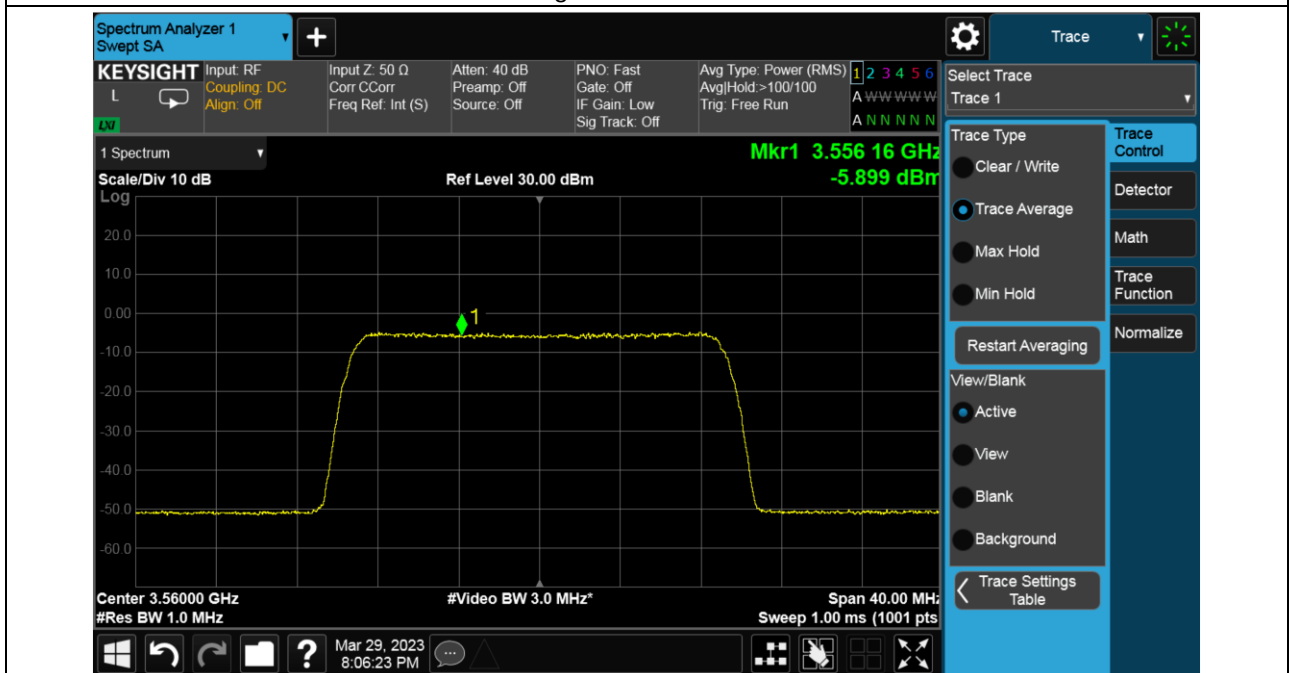
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LTE Target Power: 20dBm/MHz



LTE Target Power: 10dBm/MHz



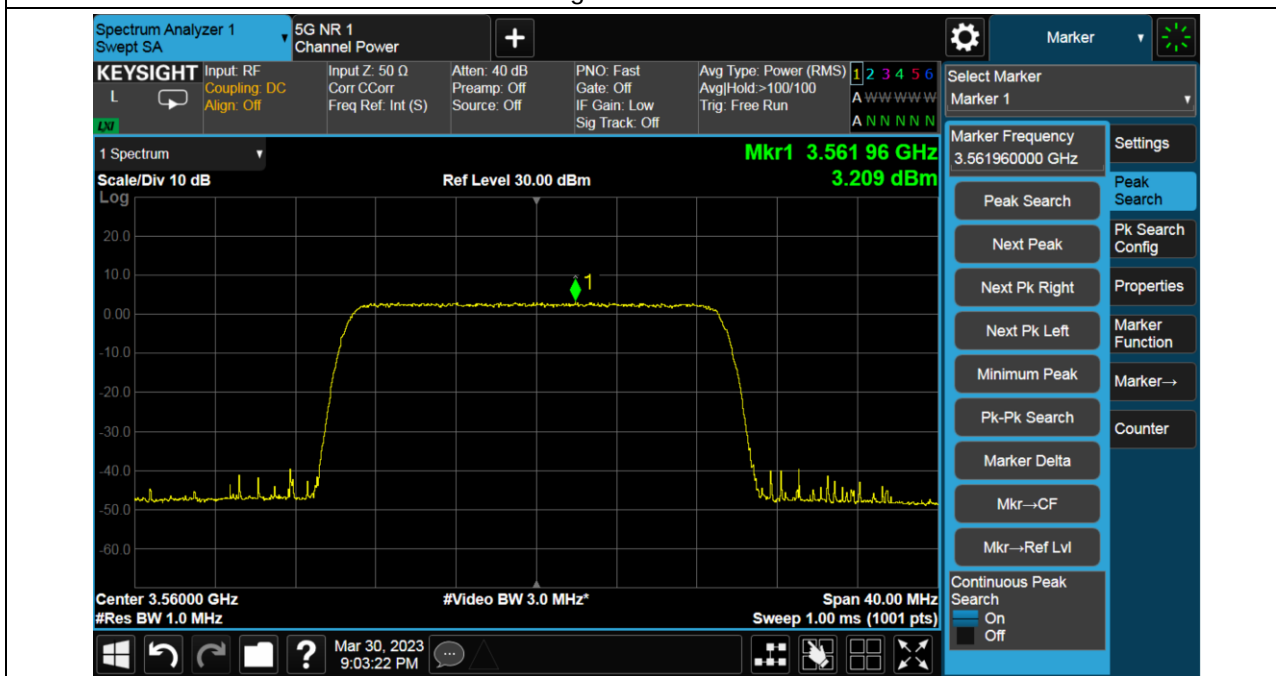
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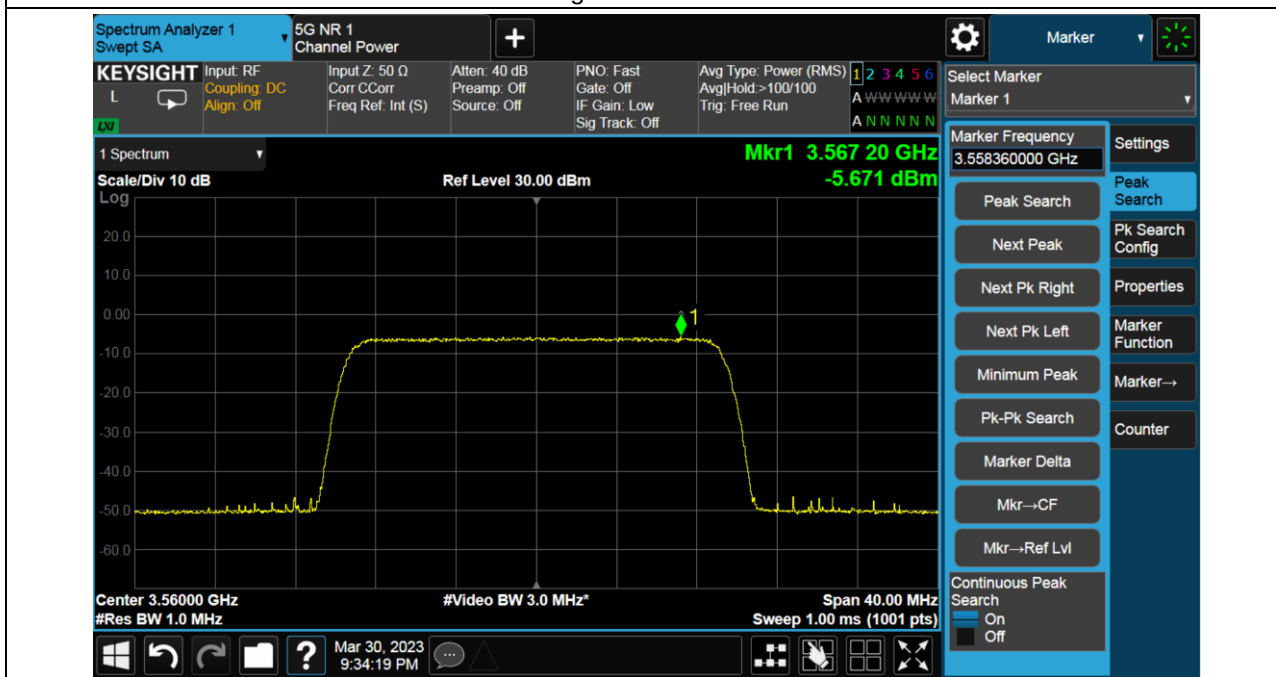
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5G NR Target Power: 20dBm/MHz



5G NR Target Power: 10dBm/MHz



8 Test Data Log

Test data log refer to log files (Log files appendix) except for securitytest cases which shows below.

8.1 WINNF.FT.C.SCS.1

No.	Time	Source	Destination	Protocol	Length	Info
44	28.584687	16.163.69.34	172.31.26.201	TLSv1	583	Client Hello
45	28.584703	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
47	28.584798	172.31.26.201	16.163.69.34	TLSv1	1514	Certificate
48	28.584791	172.31.26.201	16.163.69.34	TLSv1	78	Certificate Request, Server Hello Done
50	28.587198	16.163.69.34	172.31.26.201	TLSv1	3365	Certificate, Client Key Exchange, Certificate Verify, Change Cipher Spec, Encrypted Handshake Message
52	28.511443	172.31.26.201	16.163.69.34	TLSv1	117	Change Cipher Spec, Encrypted Handshake Message
54	28.512576	16.163.69.34	172.31.26.201	TLSv1	315	Application Data
55	28.512590	16.163.69.34	172.31.26.201	TLSv1	465	Application Data
59	28.526577	172.31.26.201	16.163.69.34	TLSv1	112	Application Data
61	28.527383	172.31.26.201	16.163.69.34	TLSv1	568	Application Data, Application Data, Application Data, Application Data, Application Data, Application Data
83	38.519816	16.163.69.34	172.31.26.201	TLSv1	583	Client Hello
85	38.519969	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
86	38.519971	172.31.26.201	16.163.69.34	TLSv1	1514	Certificate
87	38.519972	172.31.26.201	16.163.69.34	TLSv1	78	Certificate Request, Server Hello Done
89	38.522145	16.163.69.34	172.31.26.201	TLSv1	3365	Certificate, Client Key Exchange, Certificate Verify, Change Cipher Spec, Encrypted Handshake Message

Frame 46: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0
 Ethernet II, Src: 06:3f:d6:46:fc:c8 (06:3f:d6:46:fc:c8), Dst: 06:1c:55:6d:4b:70 (06:1c:55:6d:4b:70)
 Internet Protocol Version 4, Src: 172.31.26.201, Dst: 16.163.69.34
 Transmission Control Protocol, Src Port: 5000, Dst Port: 54474, Seq: 1, Ack: 518, Len: 1448
 Transport Layer Security
 TLSv1.2 Record Layer: Handshake Protocol: Server Hello
 Content Type: Handshake (22)
 Version: TLS 1.2 (0x0303)
 Length: 85
 Handshake Protocol: Server Hello
 Handshake Type: Server Hello (2)
 Length: 81
 Version: TLS 1.2 (0x0303)
 Random: fba429718c2a4853a5289cdf5b5bc617eaeef0c3c5ad192da24239d44d4821104
 GMT Unix Time: Oct 15, 2103 05:15:29.000000000 CST
 Random Bytes: 8c2a4853a5289cdf5b5bc617eaeef0c3c5ad192da24239d44d4821104
 Session ID Length: 32
 Session ID: 76a106732542044d91ee0b544e8db93d260ef635f4409d3c0e87040a555ab750
 Cipher Suite: TLS_RSA_WITH_AES_256_GCM_SHA384 (0x009d)
 Compression Method: null (0)
 Extensions Length: 9
 Extension: renegotiation_info (len=1)
 Type: renegotiation_info (65281)
 Length: 1
 Renegotiation Info extension
 Renegotiation info extension length: 0
 Handshake protocol message (tls.handshake), 85 bytes



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8.2 WINNF.FT.C.SCS.2

No.	Time	Source	Destination	Protocol	Length	Info
348	0.947579486	16.163.69.34	172.31.26.201	HTTP	243	GET /criserver.crl HTTP/1.1
352	0.948427125	172.31.26.201	16.163.69.34	PKIX~	1130	Certificate Revocation List
628	10.970841349	16.163.69.34	172.31.26.201	HTTP	243	GET /criserver.crl HTTP/1.1
624	10.974813431	172.31.26.201	16.163.69.34	PKIX~	1130	Certificate Revocation List
749	30.889553124	16.163.69.34	172.31.26.201	HTTP	243	GET /criserver.crl HTTP/1.1
753	30.81805980	172.31.26.201	16.163.69.34	PKIX~	1130	Certificate Revocation List
803	40.842836854	16.163.69.34	172.31.26.201	HTTP	243	GET /criserver.crl HTTP/1.1
803	40.842836813	172.31.26.201	16.163.69.34	PKIX~	1130	Certificate Revocation List
1989	50.869254215	16.163.69.34	172.31.26.201	HTTP	243	GET /criserver.crl HTTP/1.1
1913	50.878345732	172.31.26.201	16.163.69.34	PKIX~	1130	Certificate Revocation List
4329	60.897976892	16.163.69.34	172.31.26.201	HTTP	243	GET /criserver.crl HTTP/1.1
4333	60.898041555	172.31.26.201	16.163.69.34	PKIX~	1130	Certificate Revocation List
6235	70.133443756	16.163.69.34	172.31.26.201	HTTP	243	GET /criserver.crl HTTP/1.1
6239	70.132152525	172.31.26.201	16.163.69.34	PKIX~	1130	Certificate Revocation List
7825	80.163185366	16.163.69.34	172.31.26.201	HTTP	243	GET /criserver.crl HTTP/1.1
7829	80.1631881349	172.31.26.201	16.163.69.34	PKIX~	1130	Certificate Revocation List

```
Frame 348: 243 bytes on wire (1944 bits), 243 bytes captured (1944 bits) on interface ems5, id 0
Ethernet II, Src: 08:00:15:55:6d:4b:70 (08:00:15:55:6d:4b:70), Dst: 08:00:15:55:6d:4b:70 (08:00:15:55:6d:4b:70)
Internet Protocol Version 4, Src: 16.163.69.34, Dst: 172.31.26.201
Transmission Control Protocol, Src Port: 26641, Dst Port: 80, Seq: 1, Ack: 1, Len: 177
Hypertext Transfer Protocol
GET /criserver.crl HTTP/1.1\r\n
Host: ec2-18-163-59-180.ap-east-1.compute.amazonaws.com\r\n
User-Agent: Mget/1.21.2\r\n
Accept: */*\r\n
Accept-Encoding: identity\r\n
Connection: Keep-Alive\r\n
\r\n
[Full request URI: http://ec2-18-163-59-180.ap-east-1.compute.amazonaws.com/criserver.crl]
[HTTP request 1/1]
[Response in frame: 352]
```

HyperText Transfer Protocol

No.	Time	Source	Destination	Protocol	Length	Info
360	0.962723718	16.163.69.34	172.31.26.201	TLSv1	417	Client Hello
362	0.962989806	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
364	0.962989585	172.31.26.201	16.163.69.34	TLSv1	484	Certificate, Certificate Request, Server Hello Done
366	0.964949124	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Certificate Revoked)
632	15.992272539	16.163.69.34	172.31.26.201	TLSv1	417	Client Hello
634	15.991447436	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
636	15.991458235	172.31.26.201	16.163.69.34	TLSv1	484	Certificate, Certificate Request, Server Hello Done
638	15.993847373	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Certificate Revoked)
761	30.828495987	16.163.69.34	172.31.26.201	TLSv1	417	Client Hello
763	30.828672446	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
765	30.828679842	172.31.26.201	16.163.69.34	TLSv1	484	Certificate, Certificate Request, Server Hello Done
767	30.838083864	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Certificate Revoked)
891	40.854954078	16.163.69.34	172.31.26.201	TLSv1	417	Client Hello
893	40.855154813	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
895	40.855158318	172.31.26.201	16.163.69.34	TLSv1	484	Certificate, Certificate Request, Server Hello Done
897	40.854956238	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Certificate Revoked)
1921	50.869405888	16.163.69.34	172.31.26.201	TLSv1	417	Client Hello
1923	50.865263292	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
1925	50.865267863	172.31.26.201	16.163.69.34	TLSv1	484	Certificate, Certificate Request, Server Hello Done
1927	50.867618171	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Certificate Revoked)
4341	60.114905613	16.163.69.34	172.31.26.201	TLSv1	417	Client Hello
4343	60.115083553	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
4345	60.115086757	172.31.26.201	16.163.69.34	TLSv1	484	Certificate, Certificate Request, Server Hello Done
4348	60.117906882	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Certificate Revoked)
6247	70.149494295	16.163.69.34	172.31.26.201	TLSv1	417	Client Hello

```
Frame 362: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface ems5, id 0
Ethernet II, Src: 08:00:15:55:6d:4b:70 (08:00:15:55:6d:4b:70), Dst: 08:00:15:55:6d:4b:70 (08:00:15:55:6d:4b:70)
Internet Protocol Version 4, Src: 172.31.26.201, Dst: 16.163.69.34
Transmission Control Protocol, Src Port: 8085, Dst Port: 443, Seq: 1, Ack: 352, Len: 1448
Transport Layer Security
TLSv1.2 Record Layer: Handshake Protocol: Server Hello
Content Type: Handshake (22)
Version: TLS 1.2 (0x0303)
Length: 57
Handshake Protocol: Server Hello
Handshake Type: Server Hello (2)
Version: TLS 1.2 (0x0303)
Random: 6073a02767b30105c0da2279f443b0508dc0d6d104127131e0462ee0ed7d
Session ID Length: 0
Cipher Suite: TLS_RSA_WITH_AES_256_GCM_SHA384 (0x009d)
Compression Method: null (0)
Extensions Length: 13
Extension: renegotiation_info (len=1)
Type: renegotiation_info (05281)
Length: 1
Renegotiation Info extension
Extension: session_ticket (len=0)
Type: session_ticket (135)
Length: 0
Data (0 bytes)
```

8.3 WINNF.FT.C.SCS.3

No.	Time	Source	Destination	Protocol	Length	Info
4	0.004761	16.163.69.34	172.31.26.201	TLSv1	583	Client Hello
6	0.004947	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
7	0.004950	172.31.26.201	16.163.69.34	TLSv1	1514	Certificate
8	0.004951	172.31.26.201	16.163.69.34	TLSv1	78	Certificate Request, Server Hello Done
10	0.008496	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Certificate Expired)
15	9.986451	16.163.69.34	172.31.26.201	TLSv1	583	Client Hello
17	9.986625	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
18	9.986628	172.31.26.201	16.163.69.34	TLSv1	1514	Certificate
19	9.986629	172.31.26.201	16.163.69.34	TLSv1	78	Certificate Request, Server Hello Done
21	9.987646	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Certificate Expired)
28	19.971614	16.163.69.34	172.31.26.201	TLSv1	583	Client Hello
30	19.971786	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
31	19.971789	172.31.26.201	16.163.69.34	TLSv1	1514	Certificate
32	19.971790	172.31.26.201	16.163.69.34	TLSv1	78	Certificate Request, Server Hello Done
34	19.972784	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Certificate Expired)

Frame 6: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0
 Ethernet II, Src: 06:3f:d6:46:fc:c8 (06:3f:d6:46:fc:c8), Dst: 06:1c:55:6d:4b:70 (06:1c:55:6d:4b:70)
 Internet Protocol Version 4, Src: 172.31.26.201, Dst: 16.163.69.34
 Transmission Control Protocol, Src Port: 5000, Dst Port: 8070, Seq: 1, Ack: 518, Len: 1448
 Transport Layer Security
 TLSv1.2 Record Layer: Handshake Protocol: Server Hello
 Content Type: Handshake (22)
 Version: TLS 1.2 (0x0303)
 Length: 85
 Handshake Protocol: Server Hello
 Handshake Type: Server Hello (2)
 Length: 81
 Version: TLS 1.2 (0x0303)
 Random: a156d8195b3fd4a650cfae5974c5750c9aeaeac0648f34fa2ab5e755815fa8c
 GMT Unix Time: Oct 11, 2055 07:19:53.000000000 CST
 Random Bytes: 5b3fd4a650cfae5974c5750c9aeaeac0648f34fa2ab5e755815fa8c
 Session ID Length: 32
 Session ID: e558baad02b69cb69dc7bc76e8349b31a07d99e33a8bb9af42796fb01f6db2ec
 Cipher Suite: TLS_RSA_WITH_AES_256_GCM_SHA384 (0x009d)
 Compression Method: null (0)
 Extensions Length: 9
 Extension: renegotiation_info (len=1)
 Type: renegotiation_info (65281)
 Length: 1
 Renegotiation Info extension
 Extension: extended master secret (len=0)

8.4 WINNF.FT.C.SCS.4

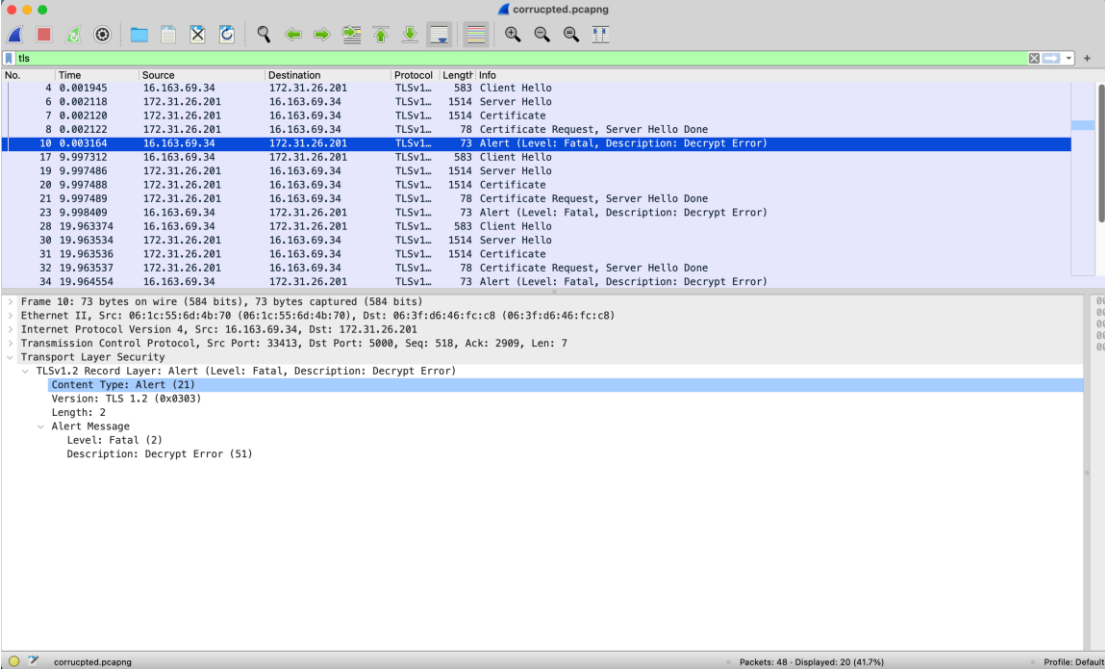
No.	Time	Source	Destination	Protocol	Length	Info
14	280.002520	16.163.69.34	172.31.26.201	TLSv1	583	Client Hello
16	280.002695	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
17	280.002697	172.31.26.201	16.163.69.34	TLSv1	1514	Certificate
18	280.002699	172.31.26.201	16.163.69.34	TLSv1	78	Certificate Request, Server Hello Done
20	280.003412	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Unknown CA)
25	289.986664	16.163.69.34	172.31.26.201	TLSv1	583	Client Hello
27	289.986845	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
28	289.986848	172.31.26.201	16.163.69.34	TLSv1	1514	Certificate
29	289.986849	172.31.26.201	16.163.69.34	TLSv1	78	Certificate Request, Server Hello Done
31	289.987574	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Unknown CA)
36	300.001673	16.163.69.34	172.31.26.201	TLSv1	583	Client Hello
38	300.001823	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
39	300.001825	172.31.26.201	16.163.69.34	TLSv1	1514	Certificate
40	300.001826	172.31.26.201	16.163.69.34	TLSv1	78	Certificate Request, Server Hello Done
43	300.002568	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Unknown CA)

Frame 16: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0
 Ethernet II, Src: 06:3f:d6:46:fc:c8 (06:3f:d6:46:fc:c8), Dst: 06:1c:55:6d:4b:70 (06:1c:55:6d:4b:70)
 Internet Protocol Version 4, Src: 172.31.26.201, Dst: 16.163.69.34
 Transmission Control Protocol, Src Port: 5000, Dst Port: 65361, Seq: 1, Ack: 518, Len: 1448
 Transport Layer Security
 TLSv1.2 Record Layer: Handshake Protocol: Server Hello
 Content Type: Handshake (22)
 Version: TLS 1.2 (0x0303)
 Length: 85
 Handshake Protocol: Server Hello (2)
 Length: 81
 Version: TLS 1.2 (0x0303)
 Random: b64ac668bb22b82a3ba8f57570cbe8228be1409c3a32a19e65a9a52dde1db40
 GMT Unix Time: Nov 30, 2066 22:42:48.000000000 CST
 Random Bytes: 8bb22b82a3ba8f57570cbe8228be1409c3a32a19e65a9a52dde1db40
 Session ID Length: 32
 Session ID: 974324bcb0e222b80b52331b8f3c84bcabda87afdf06819af330a18a1d94ec7a
 Cipher Suite: TLS_RSA_WITH_AES_256_GCM_SHA384 (0x009d)
 Compression Method: null (0)
 Extensions Length: 9
 Extension: renegotiation_info (len=1)
 Type: renegotiation_info (65281)
 Length: 1
 Renegotiation Info extension
 Extension: extended_master_secret (len=0)

No.	Time	Source	Destination	Protocol	Length	Info
14	280.002520	16.163.69.34	172.31.26.201	TLSv1	583	Client Hello
16	280.002695	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
17	280.002697	172.31.26.201	16.163.69.34	TLSv1	1514	Certificate
18	280.002699	172.31.26.201	16.163.69.34	TLSv1	78	Certificate Request, Server Hello Done
20	280.003412	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Unknown CA)
25	289.986664	16.163.69.34	172.31.26.201	TLSv1	583	Client Hello
27	289.986845	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
28	289.986848	172.31.26.201	16.163.69.34	TLSv1	1514	Certificate
29	289.986849	172.31.26.201	16.163.69.34	TLSv1	78	Certificate Request, Server Hello Done
31	289.987574	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Unknown CA)
36	300.001673	16.163.69.34	172.31.26.201	TLSv1	583	Client Hello
38	300.001823	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
39	300.001825	172.31.26.201	16.163.69.34	TLSv1	1514	Certificate
40	300.001826	172.31.26.201	16.163.69.34	TLSv1	78	Certificate Request, Server Hello Done
43	300.002568	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Unknown CA)

Frame 20: 73 bytes on wire (584 bits), 73 bytes captured (584 bits) on interface 0
 Ethernet II, Src: 06:1c:55:6d:4b:70 (06:1c:55:6d:4b:70), Dst: 06:3f:d6:46:fc:c8 (06:3f:d6:46:fc:c8)
 Internet Protocol Version 4, Src: 16.163.69.34, Dst: 172.31.26.201
 Transmission Control Protocol, Src Port: 65361, Dst Port: 5000, Seq: 518, Ack: 2909, Len: 7
 Transport Layer Security
 TLSv1.2 Record Layer: Alert (Level: Fatal, Description: Unknown CA)
 Content Type: Alert (21)
 Version: TLS 1.2 (0x0303)
 Length: 2
 Alert Message
 Level: Fatal (2)
 Description: Unknown CA (48)

8.5 WINNF.FT.C.SCS.5



No.	Time	Source	Destination	Protocol	Length	Info
4	0.001945	16.163.69.34	172.31.26.201	TLSv1	583	Client Hello
6	0.002118	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
7	0.002120	172.31.26.201	16.163.69.34	TLSv1	1514	Certificate
8	0.002122	172.31.26.201	16.163.69.34	TLSv1	78	Certificate Request, Server Hello Done
10	0.003164	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Decrypt Error)
17	9.997312	16.163.69.34	172.31.26.201	TLSv1	583	Client Hello
19	9.997486	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
20	9.997488	172.31.26.201	16.163.69.34	TLSv1	1514	Certificate
21	9.997489	172.31.26.201	16.163.69.34	TLSv1	78	Certificate Request, Server Hello Done
23	9.998409	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Decrypt Error)
28	19.963374	16.163.69.34	172.31.26.201	TLSv1	583	Client Hello
30	19.963534	172.31.26.201	16.163.69.34	TLSv1	1514	Server Hello
31	19.963536	172.31.26.201	16.163.69.34	TLSv1	1514	Certificate
32	19.963537	172.31.26.201	16.163.69.34	TLSv1	78	Certificate Request, Server Hello Done
34	19.964554	16.163.69.34	172.31.26.201	TLSv1	73	Alert (Level: Fatal, Description: Decrypt Error)

Frame 10: 73 bytes on wire (584 bits), 73 bytes captured (584 bits) on interface 0
 Ethernet II, Src: 08:00:1c:55:6d:4b (08:00:1c:55:6d:4b:70), Dst: 08:00:1c:55:6d:4b:70 (08:00:1c:55:6d:4b:70)
 Internet Protocol Version 4, Src: 16.163.69.34, Dst: 172.31.26.201
 Transmission Control Protocol, Src Port: 33413, Dst Port: 5000, Seq: 518, Ack: 2909, Len: 7
 Transport Layer Security
 TLSv1.2 Record Layer: Alert (Level: Fatal, Description: Decrypt Error)
 Content Type: Alert (21)
 Version: TLS 1.2 (0x0303)
 Length: 2
 Alert Message
 Level: Fatal (2)
 Description: Decrypt Error (51)

9 Photographs

9.1 EUT Constructional Details (EUT Photos)

Please Refer to external and internal photos for details.

- End of the Report -

