VVDN Technologies Private Limited
GLOBAL INNOVATION PARK (GIP)
Pot No.: CP-07, Sector-8,
IMT Manesar,
Gurugram, Haryana – 122050

GSTIN: 06AABCE7582R1ZX
CIN: U72200HR2007PTC125241

Confidential and Proprietary

TEST RESULTS: Federated Wireless SAS - DOMAIN Proxy Interoperability Testing

NOTE - All Fields in BLUE are to be filled in by vendor. Do not change text in BLACK.

Name of Vendor: AmpliTech Group

Date of Test Submittal: 2/15/2025

This test report summarizes the results of Interoperability Tests (IOT) to validate the BSD/DP-SAS interface compatibility between Amplitech Domain proxy and a specific instance of Federated wireless SAS designed to execute this test plan for AmpliTech Group. The relevant document describing the test requirements is located here:

The results of these test are 'Confidential Information' under the terms of the Federated Wireless SAS Integration Testing Agreement between Amplitech and Federated wireless SAS for customers (AmpliTech Group). Therefore, in addition to the other obligations contained in that agreement, you will not disclose or make public this report or the results hereof outside of the scope of that agreement.

CBSD Model Number: VLRU-Gen3-3537-AE-AI

CBSD Serial Number(s): 2404348600008

Device Category (A or B): A

User ID(s): 1VM1QI

CBSD FCC ID(s): 2BNMP-AMPU-LPRU

Verified for Federated Wireless: **Quoc Huy Pham (qpham@federatedwireless.com)**

fw federated wireless

2121 Crystal Drive
7th Floor
Arlington, VA 22202

MICOM Lab,

Federated Wireless confirms that AmpliTech validated the CBRS functionality of its LPRU B48 equipment between February 26, 2025 and March 6, 2025 using Federated Wireless' testbed. Test results are summarized in the report with file name: "FW SAS CBRS-Radio-Lab-Tests_result.pdf", provided in a separate attachment.

Sincerely,

Quoc Huy Pham
Interoperability Engineer
qpham@federatedwireless.com

federatedwireless.com

Connecting you
to the future

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1. Report Scope

This report addresses the EMC verification testing and test results of the **Amplitech o-RAN Low power Radio B48 (3550-3700 MHz)** herein referred to as EUT (Equipment Under Test). The EUT was tested for compliance against the following standards:

FCC Part 96 SAS requirements (Domain Proxy Test Plan)

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

2. Summary

The results contained in this report relate only to the item(s) tested.

Equipment Under Test (EUT)	**Amplitech LPRU B48**
EUT passed all tests performed	yes
Tests conducted by	VVDN/Federated Wireless

3. Test Results Summary

Section as per Working Document WINNF-TS-0122

Section	CBSD	D P	Test Case ID	Test Case Title	RF Measurement Requirement	Pass / Fail
6.1.4.1.1	X	--	WINNF.FT.C.R EG.1	Multi-Step registration	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A

6.1.4.1.2	--	X	WINNF.FT.D.R EG.2	Domain Proxy Multi-Step registration	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A
6.1.4.1.3	X	--	WINNF.FT.C.R EG.3	Single-Step registration for Category A CBSD	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A
6.1.4.1.4	--	X	WINNF.FT.D.R EG.4	Domain Proxy Single-Step registration for Cat A CBSD (Note: Mandatory for without CPI, if EUT will always have signed CPI – asked for email waiver)	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	P
6.1.4.1.5	X	--	WINNF.FT.C.R EG.5	Single-Step registration for CBSD with CPI signed data	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A
6.1.4.1.6	--	X	WINNF.FT.D.R EG.6	Domain Proxy Single-Step registration for CBSD with CPI signed data	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A
6.1.4.1.7	X	X	WINNF.FT.C.R EG.7	Registration due to change of an installation parameter	Test waits until transmission starts, then trigger an installationParam change. • Record time at which transmission stops. Time must be within 60 seconds of	N/A

					the installationParam change taking effect.	
6.1.4.2.1	X	--	WINNF.FT.C.R EG.8	Missing Required parameters (responseCode 102)	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A
6.1.4.2.2	--	X	WINNF.FT.D.R EG.9	Domain Proxy Missing Required parameters (responseCode 102)	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	P
6.1.4.2.3	X	--	WINNF.FT.C.R EG.10	Pending registration (responseCode 200)	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A
6.1.4.2.4	--	X	WINNF.FT.D.R EG.11	Domain Proxy Pending registration (responseCode 200)	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A
6.1.4.2.5	X	--	WINNF.FT.C.R EG.12	Invalid parameter (responseCode 103)	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A
6.1.4.2.6	--	X	WINNF.FT.D.R EG.13	Domain Proxy Invalid parameters (responseCode 103)	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	P
6.1.4.2.7	X	--	WINNF.FT.C.R EG.14	Blacklisted CBSD (responseCode 101)	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A

6.1.4.2.8	--	X	WINNF.FT.D.R EG.15	Domain Proxy Blacklisted CBSD (responseCode 101)	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A
6.1.4.2.9	X	--	WINNF.FT.C.R EG.16	Unsupported SAS protocol version (responseCode 100)	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A
6.1.4.2.10	--	X	WINNF.FT.D.R EG.17	Domain Proxy Unsupported SAS protocol version responseCode 100)	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A
6.1.4.2.11	X	--	WINNF.FT.C.R EG.18	Group Error (responseCode 201)	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A
6.1.4.2.12	--	X	WINNF.FT.D.R EG.19	Domain Proxy Group Error (responseCode 201)	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A
6.1.4.3.1	X	X	WINNF.FT.C.R EG.20	Category A CBSD location update		N/A
6.3.4.2.1	X	X	WINNF.FT.C.G RA.1 (TYPO FIXED D TO C)	Unsuccessful Grant responseCode=400 (INTERFERENCE)	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	N/A
6.3.4.2.2	X	X	WINNF.FT.C.G RA.2	Unsuccessful Grant responseCode=401 (GRANT_CONFLI C T)	Monitor for 60 seconds after the REG message was sent. No transmission during the test.	P

6.4.4.1.1	X	--	WINNF.FT.C.H BT.1	Heartbeat Success Case (first Heartbeat Response)	Monitor RF from start of test. Ensure that: • Transmission does not start until time of first heartbeat response or after. • After transmission starts, measure that transmission is within the granted channel (frequencyLow, frequencyHigh)	N/A
6.4.4.1.2	--	X	WINNF.FT.D.H BT.2	Domain Proxy Heartbeat Success Case (first Heartbeat Response)	Monitor RF from start of test. Ensure that: • Transmission does not start until time of first heartbeat response or after. • After transmission starts, measure that transmission is within the granted channel (frequencyLow, frequencyHigh) (this is not a	P

					pass/fail criteria, but check) • CBSD2: must stop transmission within 60 seconds of being sent heartbeatResponse with responseCode = 500	
6.4.4.2.1	X	X	WINNF.FT.C.H BT.3	Heartbeat responseCode=105 (DEREGISTER)	Monitor RF transmission. Ensur e that: CBSD stops transmission within 60 seconds of the heartbeatRe sponse which contains responseCod e=105	N/A
6.4.4.2.2	X	--	WINNF.FT.C.HBT.4	Heartbeat responseCode=500 (TERMINATED_GRANT)	Monitor RF transmission. CBSDs will have different behavior: • CBSD1: will continue to transmit to end of test (this is not a pass/fail criteria, but check) • CBSD2: must stop transmission within 60 seconds of being sent heartbeatResponse with responseCode = 500	N/A

6.4.4.2.3	X	X	WINNF.FT.C.H BT.5	Heartbeat responseCode=501 (SUSPENDED_GRANT) in First Heartbeat Response	Monitor RF transmission from the start of the test. Ensure there is no transmission during the test	P
6.4.4.2.4	X	X	WINNF.FT.C.H BT.6	Heartbeat responseCode=501 (SUSPENDED_GRANT) in Subsequent Heartbeat Response	Monitor RF transmission. Ensur e: CBSD stops transmission within 60 seconds of heartbeatResponse which contains responseCod e=501	P
6.4.4.2.5	X	X	WINNF.FT.C.H BT.7	Heartbeat responseCode=502 (UNSYNC_OP_PARAM)	Monitor RF transmission. Ensur e: CBSD stops transmission within 60 seconds of heartbeatResponse which contains responseCod e=502	P
6.4.4.2.6	--	X	WINNF.FT.D.H BT.8	Domain Proxy Heartbeat responseCode=500 (TEMINATED_GRANT)	Monitor RF transmission. CBSD S will have different behavior: CBSD1 : will continue to transmit to end of test (this is not a pass/fail criteria, but check) CBSD2: must stop transmission within 60 seconds of being sent heartbeatResponse with responseCod e = 500	P
6.4.4.3.1	X	X	WINNF.FT.C.H BT.9	Heartbeat Response Absent (First Heartbeat)	Monitor RF from start of test to 60 seconds after last heartbeatResponse message was sent. CBSD should not transmit at any time during test	P

6.4.4.3.2	X	X	WINNF.FT.C.H BT.10	Heartbeat Response Absent (Subsequent Heartbeat)	Monitor RF transmission. Verify: • CBSD must stop transmission within transmitExpireTime+60 seconds, where transmitExpireTime is from last successful heartbeatResponse message	P
6.5.4.2.1	X	--	WINNF.FT.C.M ES.1	Registration Response contains measReportConfig	No RF monitoring	N/A
6.5.4.2.2	--	X	WINNF.FT.D.M ES.2	Domain Proxy Registration Response contains measReportConfig	No RF monitoring	N/A
6.5.4.2.3	X	X	WINNF.FT.C.M ES.3	Grant Response contains measReportConfig	No RF monitoring	N/A
6.5.4.2.4	X	--	WINNF.FT.C.M ES.4	Heartbeat Response contains measReportConfig	No RF monitoring	N/A
6.5.4.2.5	--	X	WINNF.FT.D.M ES.5	Domain Proxy Heartbeat Response contains measReportConfig	No RF monitoring	N/A

6.6.4.1.1	X	--	WINNF.FT .C.R LQ.1	Successful Relinquishment	Monitor RF transmission. Ensur e: • CBSD stops transmission at any time prior to sending the relinquishme ntRequest message.	N/A
6.6.4.1.2	--	X	WINNF.FT. D.R LQ.2	Domain Proxy Successful Relinquishment	Monitor RF transmission. Ensure : • CBSD stops transmission at any time prior to sending the relinquishmentReque st message.	P
6.7.4.1.1	X	--	WINNF.FT. C.D RG.1	Successful Deregistration	Monitor RF transmission. Ensur e: • CBSD stops transmission at any time prior to sending the relinquishme ntRequest message or deregistrat ionRequest message (whichever is sent first)	N/A
6.7.4.1.2	--	X	WINNF.FT. D.D RG.2	Domain Proxy Successful Deregistration	Monitor RF transmission. Ensure : • CBSD stops transmission at any time prior to sending the relinquishmentReque st message or deregistrationReques t message (whichever is sent first)	P

6.8.4.1.1	X	X	WINNF.FT.C.SC S.1	Successful TLS connection between UUT and SAS Test Harness	No RF transmission during test Check the tcpdump for the TLS information	P
6.8.4.2.1	X	X	WINNF.FT.C.SC S.2	TLS failure due to revoked certificate	No RF transmission during test Check the tcpdump for the TLS information	N/A
6.8.4.2.2	X	X	WINNF.FT.C.SC S.3	TLS failure due to expired server certificate	No RF transmission during test Check the tcpdump for the TLS information	N/A
6.8.4.2.3	X	X	WINNF.FT.C.SC S.4	TLS failure when SAS Test Harness certificate is issued by unknown CA	No RF transmission during test Check the tcpdump for the TLS information	N/A
6.8.4.2.4	X	X	WINNF.FT.C.SC S.5	TLS failure when certificate at the SAS Test Harness is corrupted	No RF transmission during test Check the tcpdump for the TLS information	N/A
7.1.4.1.1	X	X	WINNF.PT.C.H BT	UUT RF Transmit Power Measurement	Power Spectral Density test case. Assume we use 1 carrier bandwidth(say, 5 or 10 MHz), one frequency (say middle channel in band) for test. Measure at max transmit power, and reduce in steps of 3 dB to minimum declared transmit power.	P

If the product as tested complies with the specification, the EUT is deemed to comply with the standard and is deemed a 'PASS' or ‘P’ grade. If not 'FAIL' grade is issued. Where ‘N/A’ is stated this means the test case is not applicable, and see

Notes, Justifications or Deviations Section for details.

4. Definitions and Acronyms

The following definitions and acronyms are applicable in this report.

AE – Auxiliary Equipment. A digital accessory that feeds data into or receives data from another device (host) that in turn, controls its operation.

AM – Amplitude Modulation

Class A device – A device that is marketed for use in a commercial, industrial or business environment. A 'Class A' device should not be marketed for use by the general public and the instructions for use accompanying the product shall contain the following text:

> **Caution:** This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

Class B device – A device that is marketed for use in a residential environment and may also be used in a commercial, business or industrial environment.

EMC – Electro-Magnetic Compatibility. The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

EMI – Electro-Magnetic Immunity. The ability to maintain a specified performance when the equipment is subjected to disturbance (unwanted) signals of specified levels.

Enclosure Port – Physical boundary of equipment through which electromagnetic fields may radiate or impinge.

EUT – Equipment Under Test. A device or system being evaluated for compliance that is representative of a product to be marketed.

LISN – Line Impedance Stabilization Network

NCR – No Calibration Required

NSA – Normalized Site Attenuation

RF – Radio Frequency

EMC Test Plan – An EMC test plan established prior to testing. See 'Appendix A – EUT & Client Provided Details'.

5. Testing Facility

Testing for EMC on the EUT was carried out at customer location as described in Appendix A.

Testing Environmental Conditions and Dates

Following environmental conditions were recorded in the facility during time of testing

Date	Test	Initials	Temperature (°C)	Humidity (%)	Pressure (kPa)
Feb 27 – 28, 2025	All	SD	0 to 55	10 to 95	96
Feb 28, 2025	PSD retesting	SD	0 to 55	10 to 95	96

6. Test Setup

Block Diagram

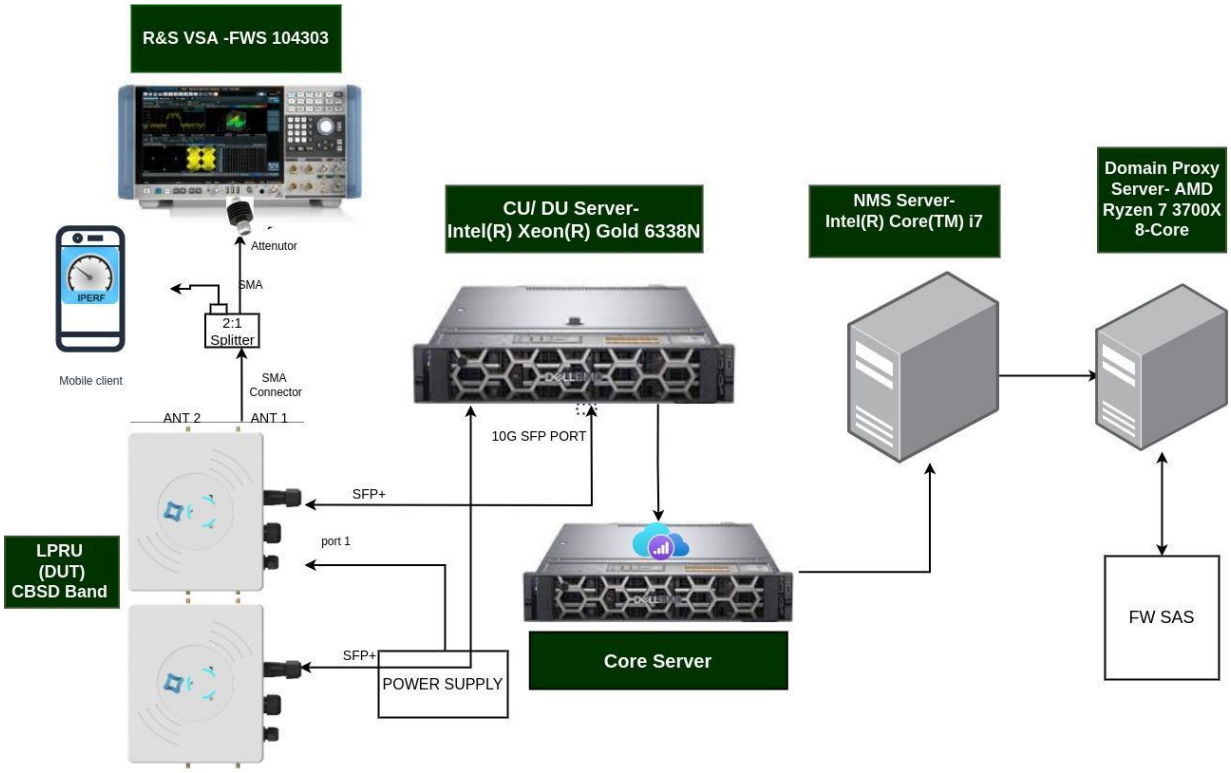


Figure. 01 - End to end Block diagram

Block Descriptions

R&S VSA- FWS 104303

Type: Vector Signal Analyzer (VSA)

Function: Measures and analyzes complex RF signals

Key Features: Frequency range support, demodulation capabilities, real-time signal analysis

Connectivity:An attenuator to control signal power.Input: From 2:1 splitter

CU/DU Server - Intel Xeon Gold 6338N

CPU: Intel Xeon Gold 6338N (32 cores, 2.2 GHz base clock)

Network: 10G SFP+ ports for fronthaul connection

Function: Executes Layer 1 and Layer 2 processing for 5G RAN

NMS Server - Intel Core i7

CPU: Intel Core i7 (8 cores, up to 5.0 GHz with Turbo Boost)

Function: Manages and monitors network elements through the NMS (Network Management System)

DP Server: AMD Ryzen 7 3700X

CPU: AMD Ryzen 7 3700X (8 cores, 3.6 GHz base clock)

Function: Runs Domain Proxy software to interface with FW SAS for spectrum allocation

LPRU (DUT)

Frequency Band: CBRS (3550–3700 MHz)

Antenna Ports: 4 (ANT 1 to ANT 4)

Antenna Configuration: ANT 1 & ANT 2 connected to a 2:1 splitter

RF Output Power: 4x250mW

Connectivity: SFP+ (10G) to CU/DU server

2:1 Splitter

Function: An RF power splitter that divides the signal from the LPRU antenna ports into two outputs, with a 2:1 power ratio.

Connectivity: SMA connector from DUT Antenna 1.

FW SAS

Type: Cloud-based Spectrum Access System (SAS)

Function: Allocates and manages CBRS spectrum dynamically

Connectivity: Integrated via Domain Proxy

Core Server

Functionality: This server acts as the 5G core network handling session management, mobility management, and user traffic routing. It’s connected to the CU/DU server and NMS server.

Connectivity: CU/DU Server, NMS Server

UE

Device Type: Smartphone.

Software: iPerf for network throughput and latency testing

Functionality:Measures data rate and latency over the CBRS link, Communicates with LPRU via wireless connection.

7. Detailed Test Results Section

Authorization is transmitted after it receives authorization from a SAS.

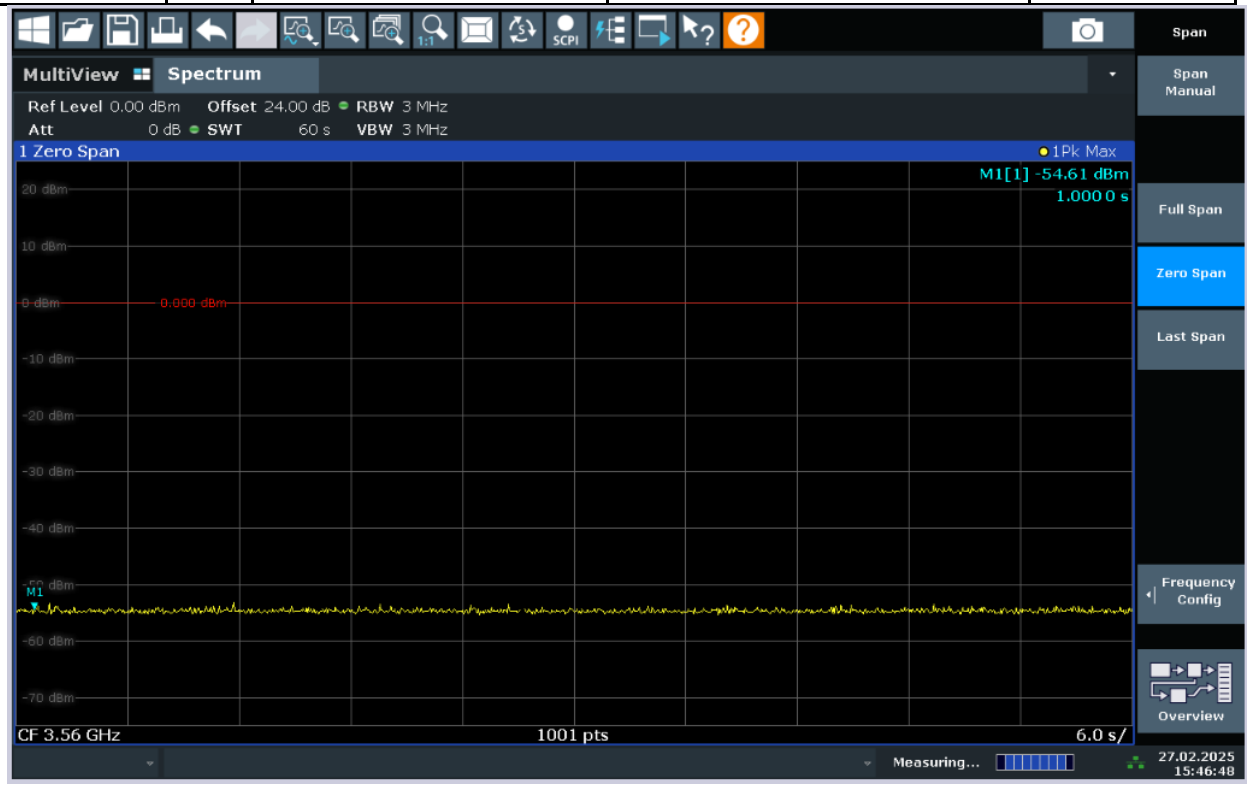
Section	DP	Test Case ID	Test Case Title	Pass / Fail
6.1.4.1.3	X	WINNF.FT.C.REG.3	Single-Step registration for Category A CBSD	P

6.1.4.1.6	X	WINNF.FT.D.REG.6	Domain Proxy Single-Step registration for CBSD with CPI signed data	N/A

6.1.4.1.7	X	WINNF.FT.C.REG.7	Registration due to change of an installation Parameter	N/A

This test only applies to CBSD devices that allow a registration parameter change to be made prior to sending a deregistration, here we are sending deregistration messages first.

6.1.4.2.2	X	WINNF.FT.D.REG.9	Domain Proxy Missing Required parameters (responseCode 102)	P



6.1.4.2.4	X	WINNF.FT.D.REG.11	Domain Proxy Pending registration (responseCode 200)	N/A

6.1.4.2.6	X	WINNF.FT.D.REG.13	Domain Proxy Invalid parameters (responseCode 103)	P

6.1.4.2.8	X	WINNF.FT.D.REG.15	Domain Proxy Blacklisted CBSD (responseCode 101)	N/A

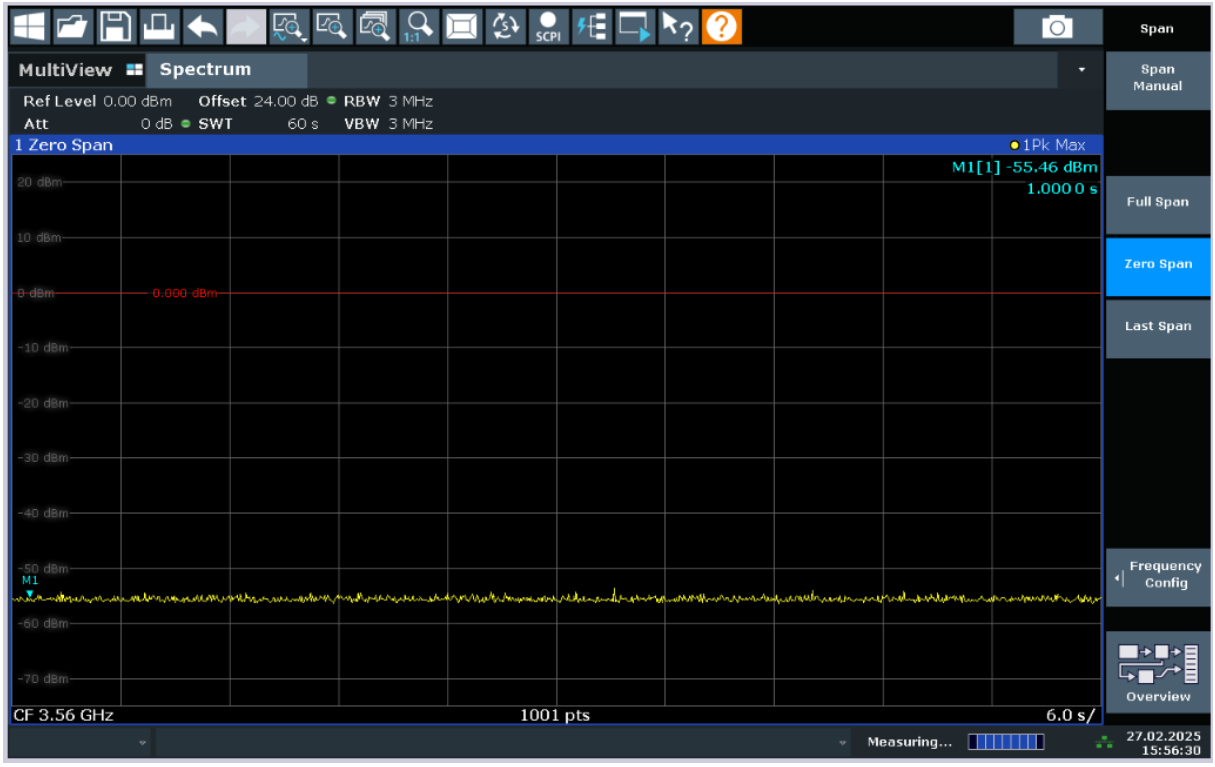
6.1.4.2.10	X	WINNF.FT.D.REG.17	Domain Proxy Unsupported SAS protocol version responseCode 100)	N/A

6.1.4.2.12	X	WINNF.FT.D.REG.19	Domain Proxy Group Error (responseCode 201)	N/A

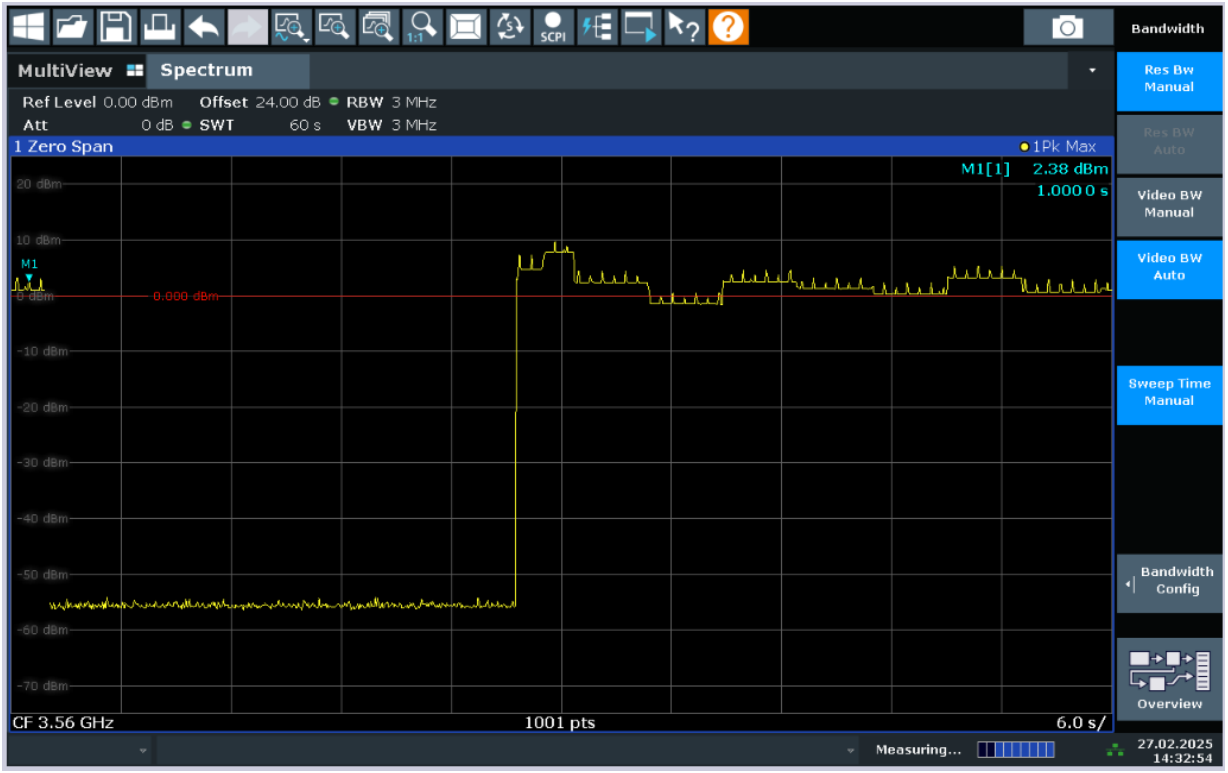
Check the device registration and authorization with the SAS, confirm that the device changes its operating power and/or channel in response to a command from the SAS and confirm that the device correctly configures based on the different license classes.

6.3.4.2.1	WINNF.FT.C.GRA.1	Unsuccessful Grant responseCode=400 (INTERFERENCE)	Monitor for 60 seconds after REG message sent. No transmission during the test.	N/A

6.3.4.2.2	WINNF.FT.C.GRA.2	Unsuccessful Grant responseCode=401 (GRANT_CONFLICT)	Monitor for 60 seconds after the REG message is sent. No transmission during the test.	P



6.4.4.1.2	WINNF.FT.D.HBT.2	Domain Proxy Heartbeat Success Case (first Heartbeat Response)	Monitor RF from start of test. Ensure that: • Transmission does not start until time of first heartbeat response or after. • After transmission starts, measure that transmission is within the granted channel (frequencyLow, frequencyHigh)	P



Test Harness logs and timing on graph was verified, the EUT passed the requirement.

6.4.4.2.1	WINNF.FT.C.HBT.3	Heartbeat responseCode=105 (DEREGISTER)	Monitor RF transmission. Ensure that: • CBSD stops transmission within 60 seconds of the heartbeatResponse which contains responseCode = 105	N/A

6.4.4.2.2	WINNF.FT.C.H BT.4	Heartbeat responseCode=500 (TERMINATED_0 RANT)	Monitor the RF output of the UUT. Verify: UUT shall stop transmission within (T + 60 seconds) of completion of responseCode = 500 (TERMINATED_GRANT)	N/A

6.4.4.2.3	WINNF.FT.C.HBT.5	Heartbeat responseCode=501 (SUSPENDED_GRANT) in First Heartbeat Response	Monitor RF transmission from the start of the test. Ensure there is no transmission during the test	p

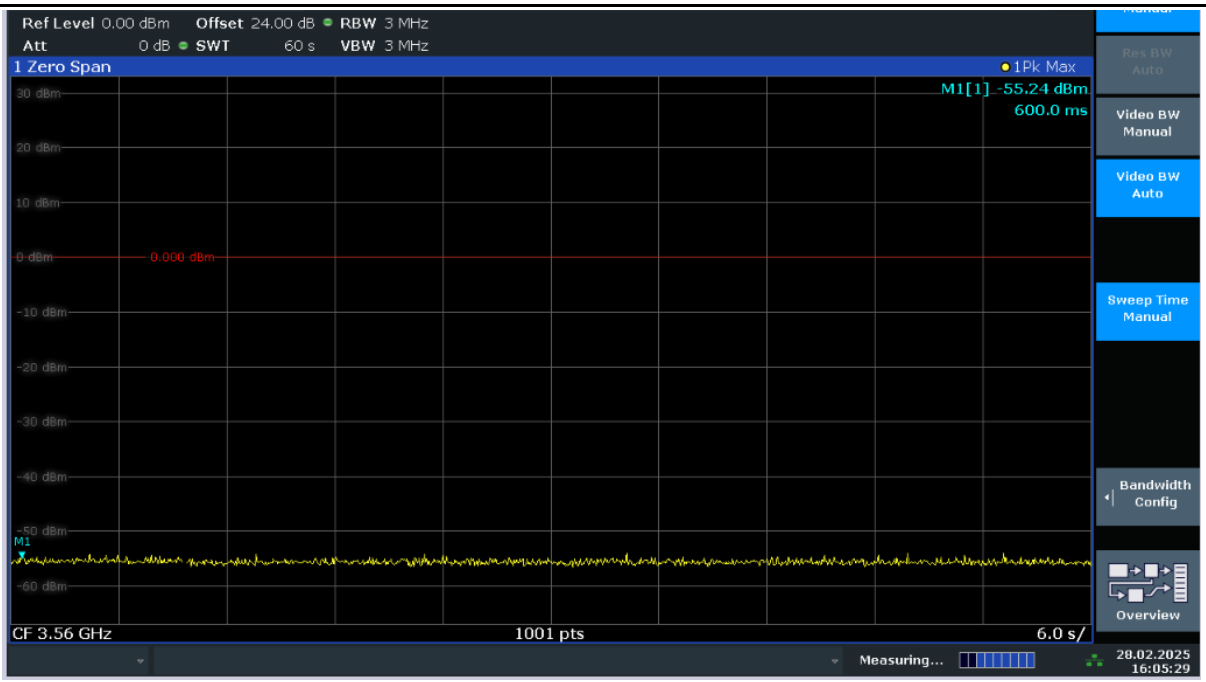
6.4.4.2.4	WINNF.FT.C.HBT.6	Heartbeat responseCode=501 (SUSPENDED_GRANT) in Subsequent Heartbeat Response	Monitor RF transmission. Ensure: • CBSD stops transmission within 60 seconds of heartbeatResponse which contains responseCode=501	p

Test Harness logs and timing on graph was verified, the EUT passed the requirement.

6.4.4.2.5	WINNF.FT.C.HBT.7	Heartbeat responseCode=502 (UNSYNC_OP_PARAM)	Monitor RF transmission. Ensure: • CBSD stops transmission within 60 seconds of heartbeatResponse which contains responseCode=502	p

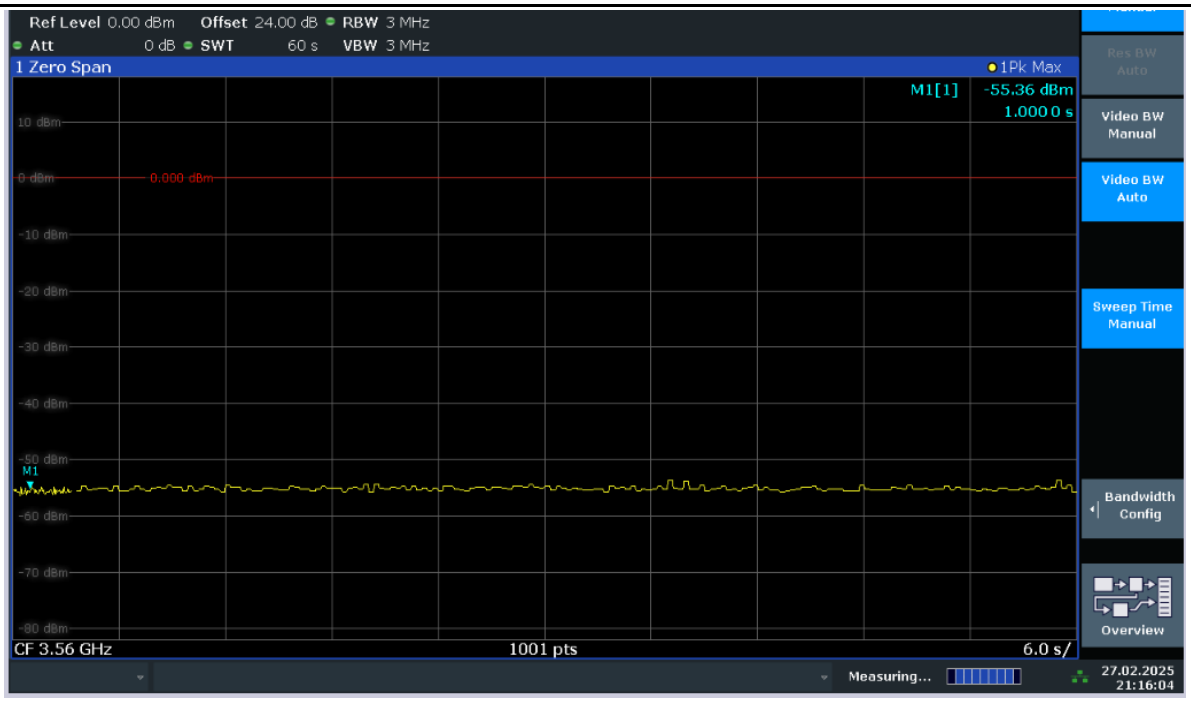
Test Harness logs and timing on graph was verified, the EUT passed the requirement.

6.4.4.2.6	--	X	WINNF.FT.D.H BT.8	Domain Proxy Heartbeat responseCode=500 (TEMINATED_GR ANT)	Monitor RF transmission. CBSDs will have different behavior: • CBSD1: will continue to transmit to end of test (this is not a pass/fail criteria, but check) • CBSD2: must stop transmission within 60 seconds of being sent heartbeatResponse with responseCode = 500	P

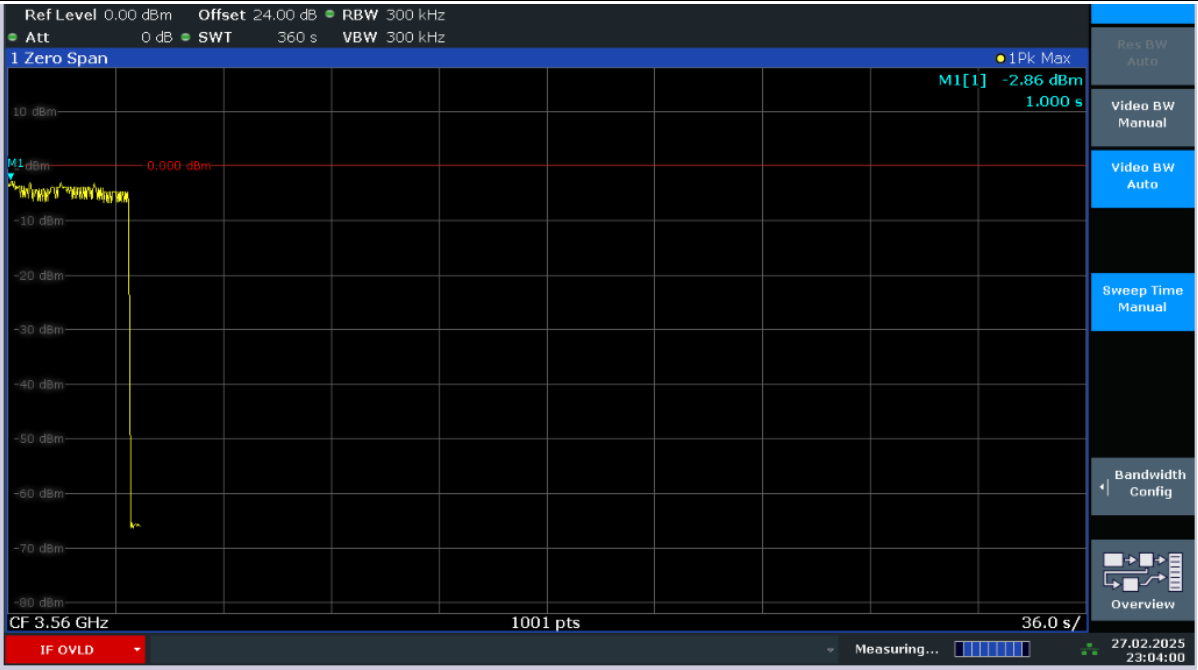


Test Harness logs and timing on graph was verified, the EUT passed the requirement.

6.4.4.3.1	WINNF.FT.C.HBT.9	Heartbeat Response Absent (First Heartbeat)	Monitor RF from start of test to 60 seconds after last A heartbeatResponse message was sent. CBSD should not transmit at any time during test	P



6.4.4.3.2	WINNF.FT.C.HBT.10	Heartbeat Response Absent (Subsequent Heartbeat)	Monitor RF transmission. Verify: • CBSD must stop transmission within transmitExpireTime+60 seconds, where transmitExpireTime is from last successful heartbeatResponse message	P



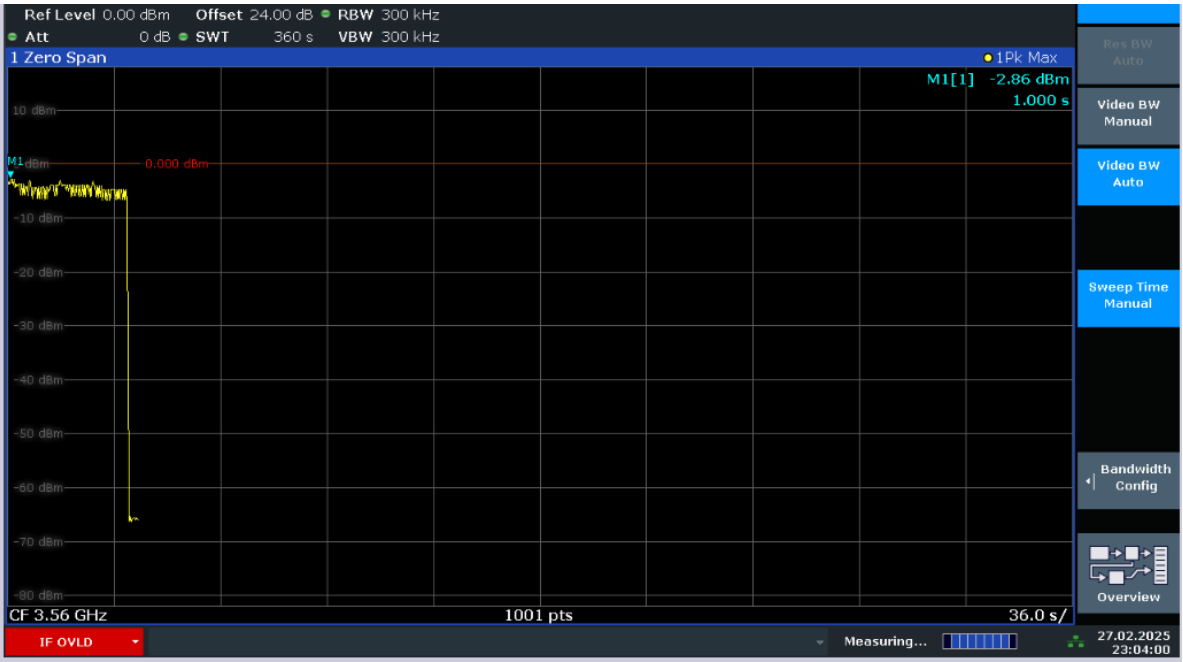
Test Harness logs and timing on graph was verified, the EUT passed the requirement.

6.5.4.2.2	WINNF.FT.D.MES.2	Domain Proxy Registration Response contains measReportConfig	No RF monitoring	NA

6.5.4.2.3	WINNF.FT.C.MES.3	Grant Response contains measReportConfig	No RF monitoring	NA

6.5.4.2.5	WINNF.FT.D.MES.5	Domain Proxy Heartbeat Response contains measReportConfig	No RF monitoring	NA

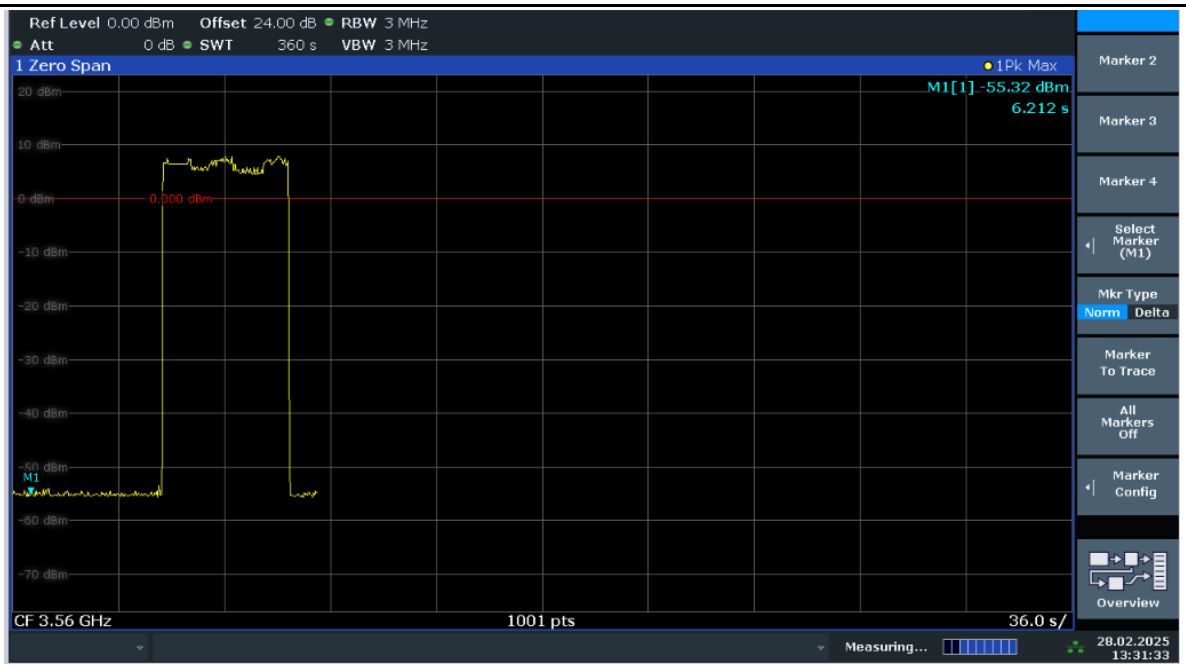
6.6.4.1.2	WINNF.FT.D.RLQ.2	Domain Proxy Successful Relinquishment	Monitor RF transmission. Ensure: • CBSD stops transmission at any time prior to sending the relinquishmentRequest message.	P



Test Harness logs and timing on graph was verified, the EUT passed the requirement.

Shutdown time taken from Domain Proxy logs, and shutdown confirmed by RF monitoring.

6.7.4.1.2	WINNF.FT.D.DRG.2	Domain Proxy Successful Deregistration	Monitor RF transmission. Ensure: • CBSD stops transmission at any time prior to sending the relinquishmentRequest message or deregistrationRequest message (whichever is sent first)	P



Test Harness logs and timing on graph was verified, the EUT passed the requirement.

Shutdown time taken from Domain Proxy logs, and shutdown confirmed by RF monitoring.

Note: There are two RU's attached as per the requirement.

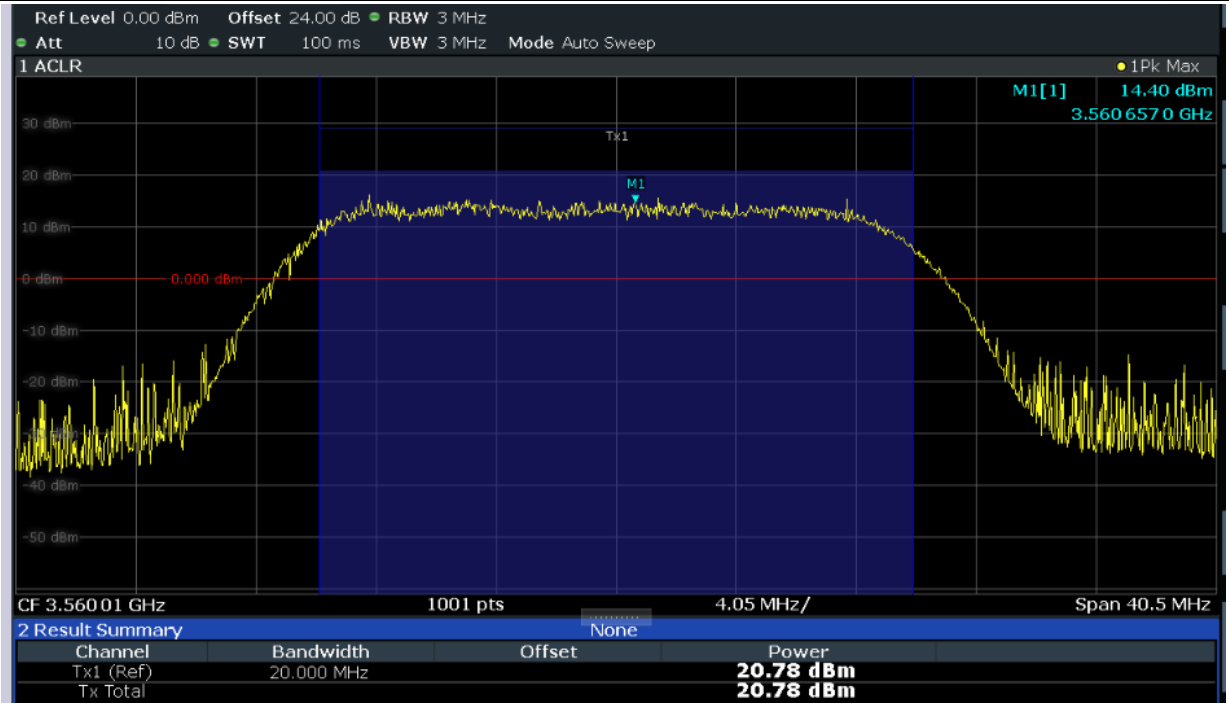
Confirm that the device transmits at a power level less than or equal to the maximum power level approved by the SAS.

7.1.4.1.1	X	X	WINNF.PT.C.H BT	UUT RF Transmit Power Measurement	Power Spectral Density test case. Assume we use 1 carrier bandwidth (say, 5 or 10 MHz), one frequency (say middle channel in band) for test. Measure at max transmit power, and reduce in steps of 3 dB to minimum declared transmit power.	P

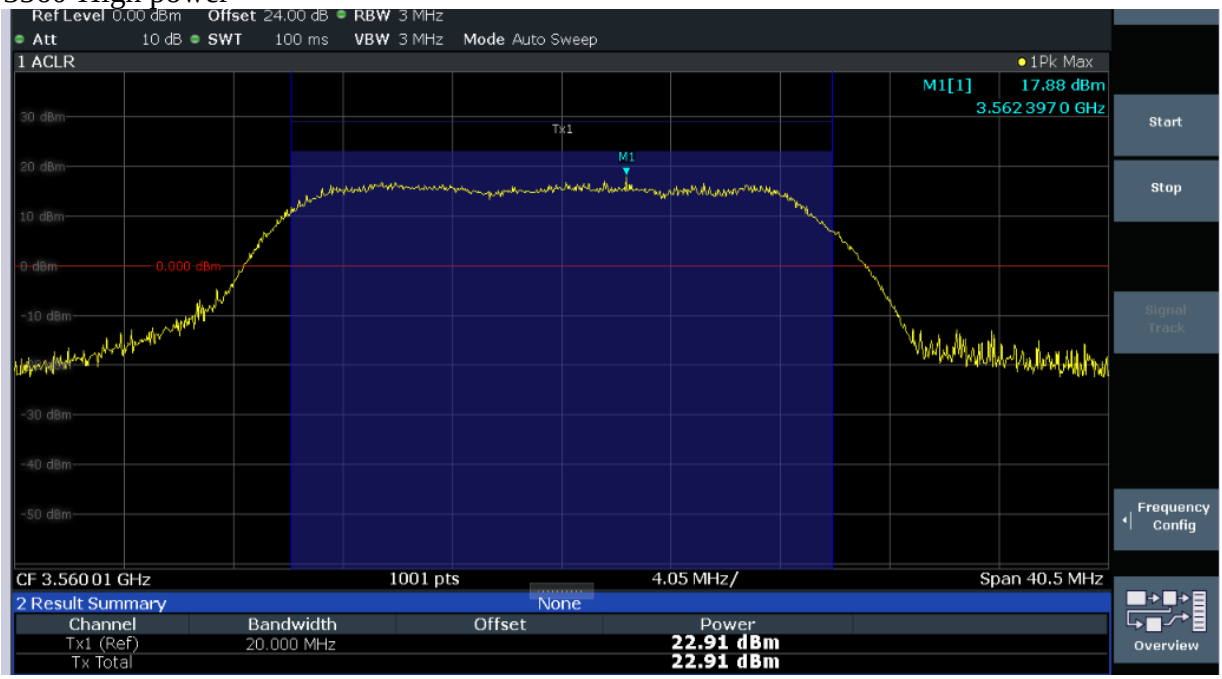
Test Table

Freq	1MHz EIRP limit (target) dBm	Raw 10 MHz	Raw 1MHz	External Losses (dB)	Conducted Raw dBm/MHz	antenna gain dBi	ports	port gain (dB)	EIRP 1MHz dBm/MHz	EIRP 10 MHz dBm	margin dB
3555-Low	11	20.78	14.4	24.6	-10.2	7	4	0	11.2	12	-0.2
3555-High	8	22.91	17.88	24.6	-6.72	7	4	0	18.16	16	-10.16
3630-low	11	20.52	13	24.6	-11.6	7	4	0	8.4	7	2.6
3630-high	8	23	17.53	24.6	-7.07	7	4	0	17.46	13	-9.46
3690-low	11	21.67	12.5	24.6	-12.1	7	4	0	7.4	-78	3.6
3690-high	8	24.32	17.4	24.6	-7.2	7	4	0	17.2	-48	-9.2

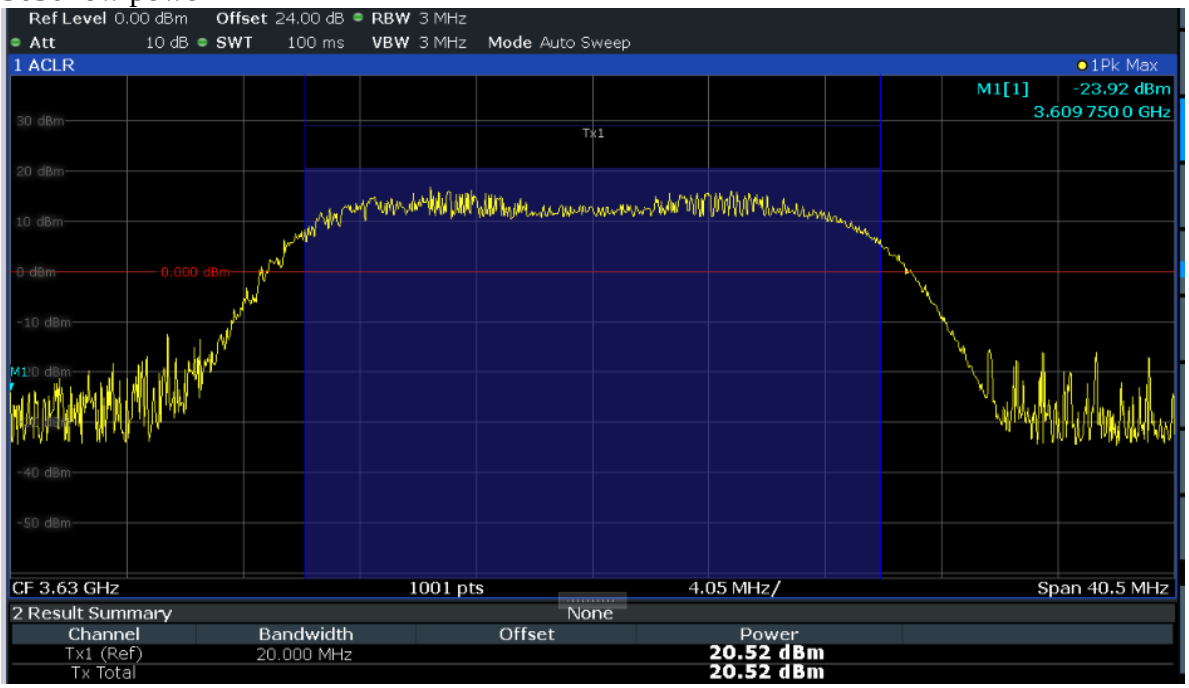
3560 low power



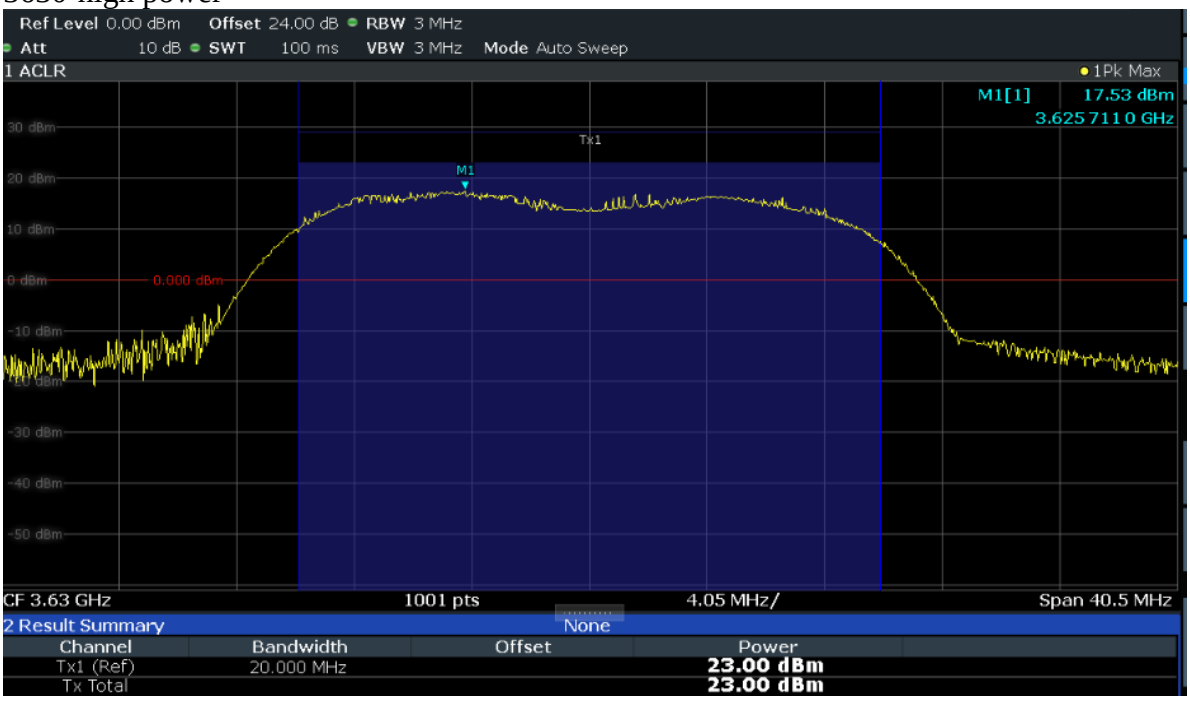
3560-High power



3630 low power

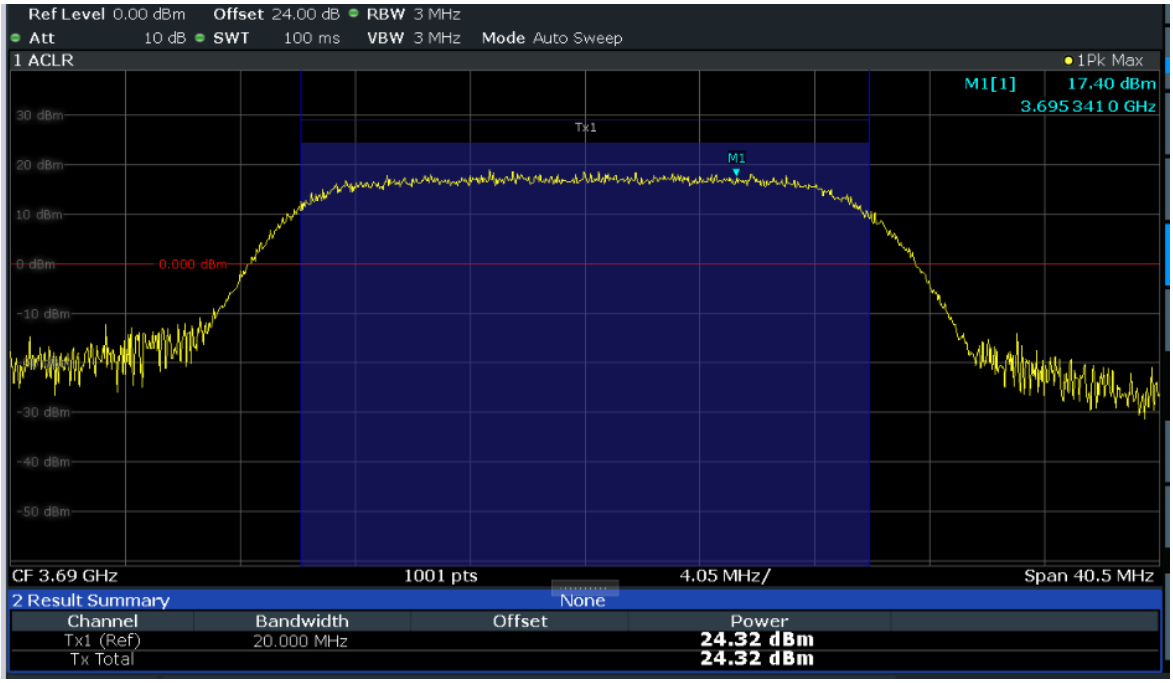


3630-high power



3690 low power

3690-high power

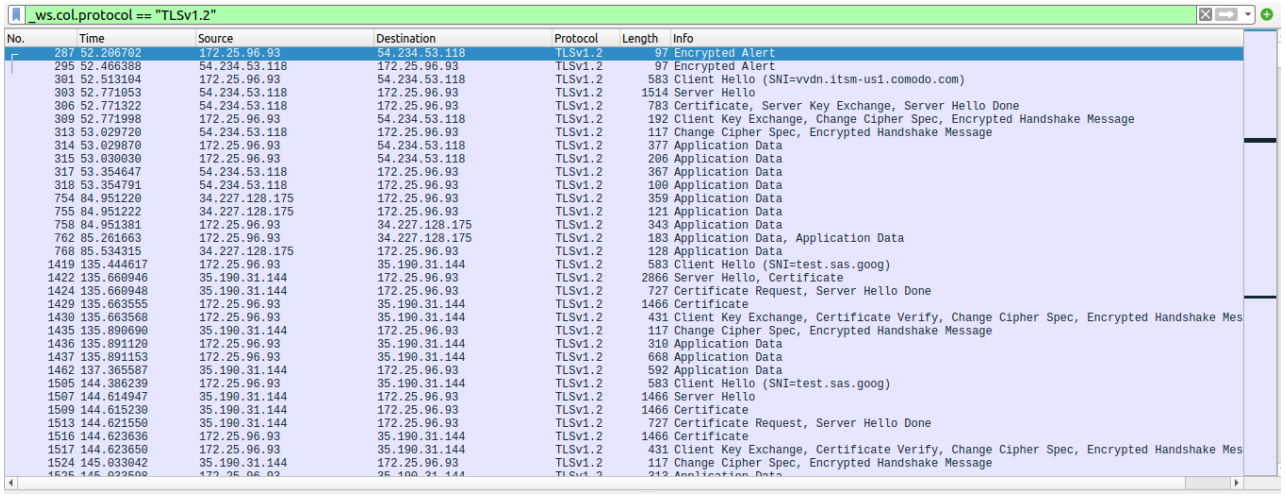


8. DOT CBRS Radio: WINNF / Security Test Case Analysis

WINNF Security Test Case Analysis

WINNF.FT.C.SCS.1

Packet Capture Sequence



_ws.col.protocol == "TLSv1.2"

No.	Time	Source	Destination	Protocol	Length	Info
287	52.206702	172.25.96.93	54.234.53.118	TLSv1.2	97	Encrypted Alert
295	52.466388	54.234.53.118	172.25.96.93	TLSv1.2	97	Encrypted Alert
301	52.513104	172.25.96.93	54.234.53.118	TLSv1.2	583	Client Hello (SNI=vvdn.itsm-us1.comodo.com)
303	52.771053	54.234.53.118	172.25.96.93	TLSv1.2	1514	Server Hello
306	52.771322	54.234.53.118	172.25.96.93	TLSv1.2	783	Certificate, Server Key Exchange, Server Hello Done
309	52.771998	172.25.96.93	54.234.53.118	TLSv1.2	192	Client Key Exchange, Change Cipher Spec, Encrypted Handshake Message
313	53.029720	54.234.53.118	172.25.96.93	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
314	53.029870	172.25.96.93	54.234.53.118	TLSv1.2	377	Application Data
315	53.030030	172.25.96.93	54.234.53.118	TLSv1.2	206	Application Data
317	53.354647	54.234.53.118	172.25.96.93	TLSv1.2	367	Application Data
318	53.354791	54.234.53.118	172.25.96.93	TLSv1.2	100	Application Data
754	84.951220	34.227.128.175	172.25.96.93	TLSv1.2	359	Application Data
755	84.951222	34.227.128.175	172.25.96.93	TLSv1.2	121	Application Data
758	84.951381	172.25.96.93	34.227.128.175	TLSv1.2	343	Application Data
762	85.261663	172.25.96.93	34.227.128.175	TLSv1.2	183	Application Data, Application Data
768	85.534315	34.227.128.175	172.25.96.93	TLSv1.2	128	Application Data
1419	135.444617	172.25.96.93	35.190.31.144	TLSv1.2	583	Client Hello (SNI=test.sas.goog)
1422	135.660946	35.190.31.144	172.25.96.93	TLSv1.2	2866	Server Hello, Certificate
1424	135.660948	35.190.31.144	172.25.96.93	TLSv1.2	727	Certificate Request, Server Hello Done
1429	135.663555	172.25.96.93	35.190.31.144	TLSv1.2	1466	Certificate
1430	135.663568	172.25.96.93	35.190.31.144	TLSv1.2	431	Client Key Exchange, Certificate Verify, Change Cipher Spec, Encrypted Handshake Mes
1435	135.890690	35.190.31.144	172.25.96.93	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
1436	135.891120	172.25.96.93	35.190.31.144	TLSv1.2	310	Application Data
1437	135.891153	172.25.96.93	35.190.31.144	TLSv1.2	668	Application Data
1462	137.365587	35.190.31.144	172.25.96.93	TLSv1.2	592	Application Data
1505	144.386239	172.25.96.93	35.190.31.144	TLSv1.2	583	Client Hello (SNI=test.sas.goog)
1507	144.614947	35.190.31.144	172.25.96.93	TLSv1.2	1466	Server Hello
1509	144.615230	35.190.31.144	172.25.96.93	TLSv1.2	1466	Certificate
1513	144.621550	35.190.31.144	172.25.96.93	TLSv1.2	727	Certificate Request, Server Hello Done
1516	144.623636	172.25.96.93	35.190.31.144	TLSv1.2	1466	Certificate
1517	144.623650	172.25.96.93	35.190.31.144	TLSv1.2	431	Client Key Exchange, Certificate Verify, Change Cipher Spec, Encrypted Handshake Mes
1524	145.033042	35.190.31.144	172.25.96.93	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message

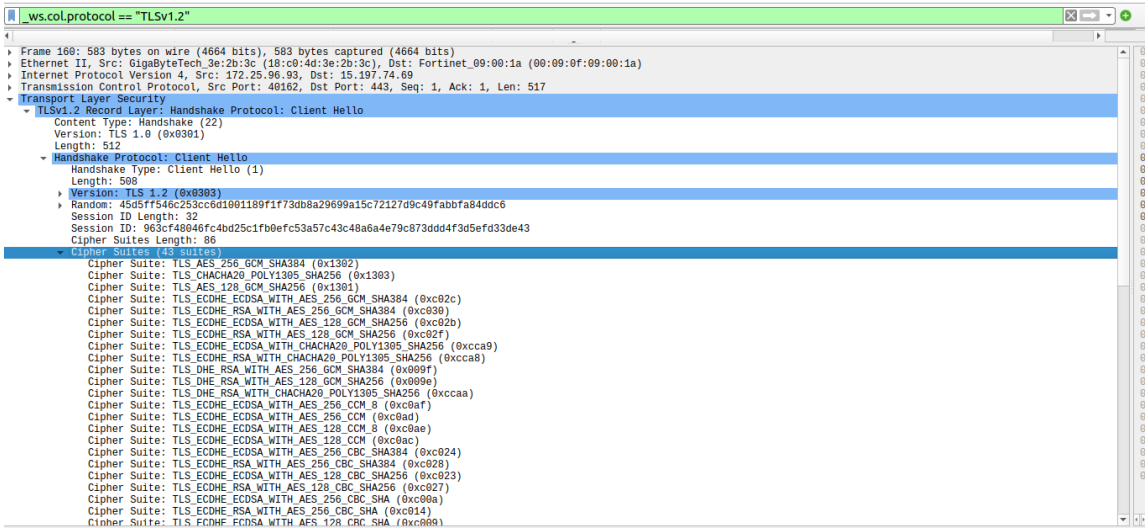
WINNF test requirements:

WINNF test requirements from WINNF-TS-0122-V1.0.1 CBRS CBSD Test Specification:

- 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

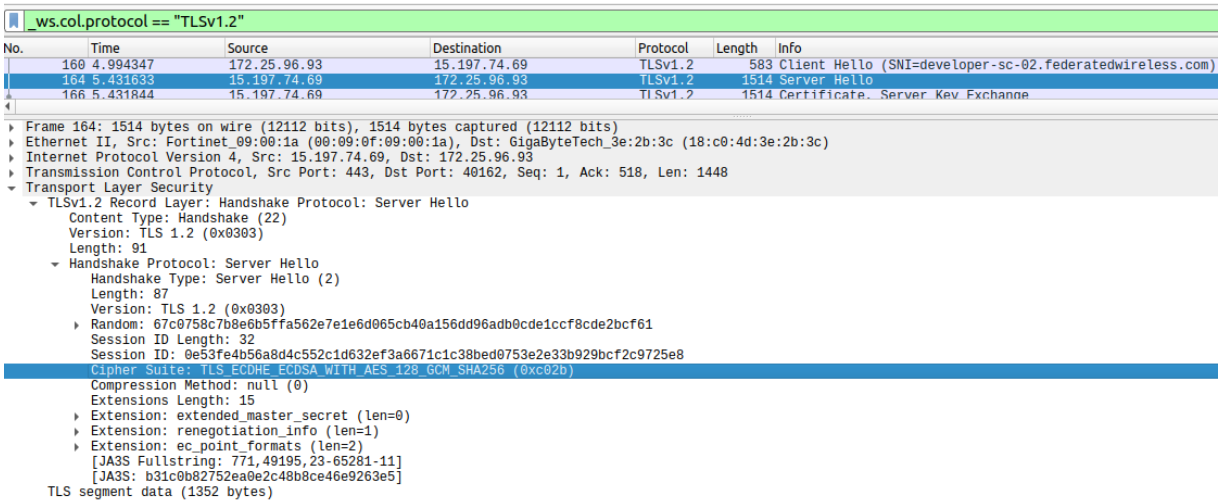
Analysis of WINNF Test Requirements

1. From Client Hello: TLS version = TLS 1.2



2. Cipher suite list from Client Hello is from WINNF approved list:
   TLS_RSA_WITH_AES_128_GCM_SHA25
   TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
   TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256

3. Cipher suite chosen (from Server Hello): TLS_RSA_WITH_AES_128_GCM_SHA256



4. The Registration request message arrived at the Test Harness, so authentication was completed.

Appendix A – EUT & Client Provided Details

General EUT Description

Manufacturer	VVDN Technologies
Address	AmpliTech 155 Plant Avenue Hauppauge, New York 11788.
Product Name	LPRU (Low Power Radio Unit)
Model Number	VLRU-Gen3-3537-AE-AI Gen3: Hardware Generation 3537: RU Band (e.g., 3550-3700MHz) AE/AI: Antenna External/Internal A/I: RU Revision and Environmental Condition (A for revision, I for IP65 Compliance).
Serial Number(s)	2404348600008
Software Version	03-v3.0.9
Hardware Version	A1-20240120

Domain Proxy Software Version: = 1.0.0

Test Specification/Issue/Date FCC CFR 47 Part 96: 2025

Note: For the testing performed in Feb 2025, the following EUT details were additionally recorded:

Technical Description

The Low Power Radio Unit (LPRU) is a single-board Optical to Radio interface solution for 5G low-power RU application, The RU has a digital and RF section realized in a single board, and the system can be used for improving 5G network coverage and can be cascaded into multiple stages. The LPRU can be operated using POE++ 802.3bt/60W POE adaptor or via a 12V/5A DC adaptor.

The Equipment Under Test (EUT) is shown in the photograph below. A full technical description can be found in the Manufacturer's documentation.