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: 3/19/2025

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 tests 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: VMRU-Gen1-3537-AE-AI

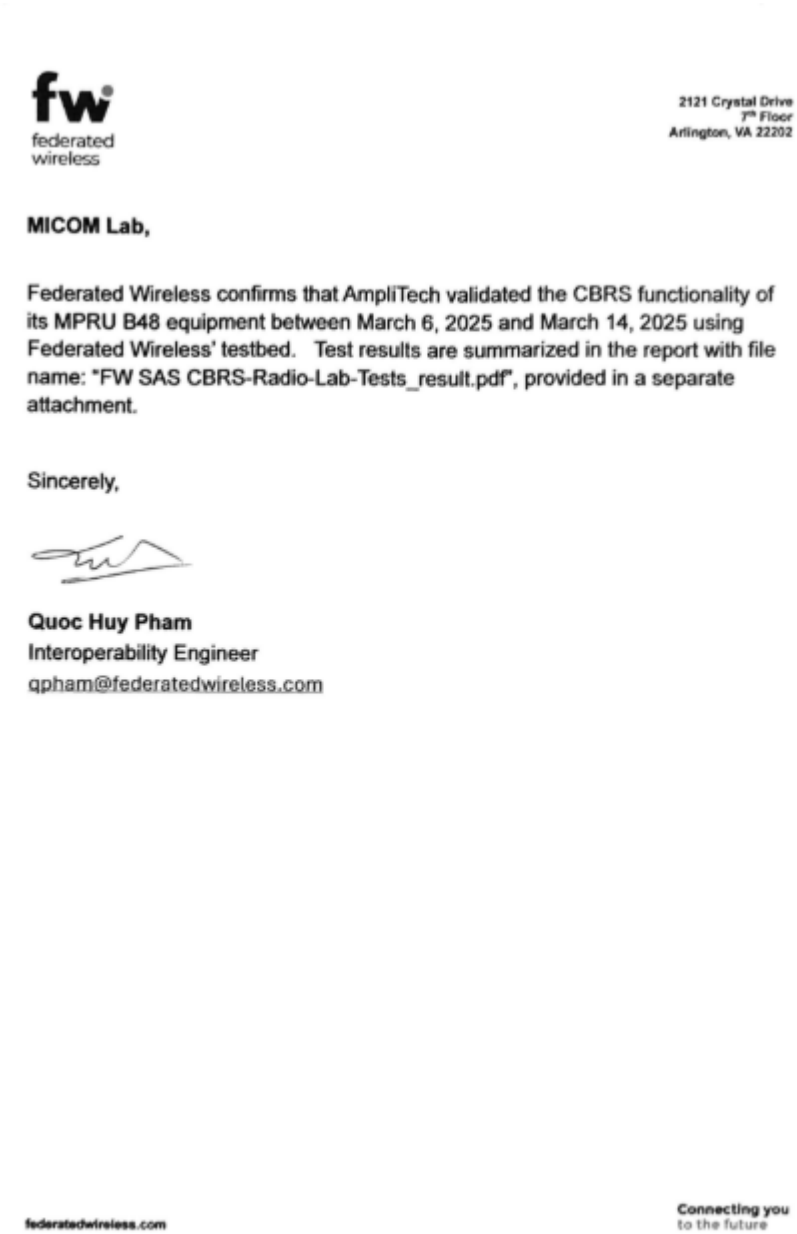
CBSD Serial Number(s): 2404199000025

Device Category (A or B): B

User ID(s): 1VM1QI

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

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 MPRU B48 equipment between March 6, 2025 and March 14, 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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TEST RESULTS: Federated Wireless SAS - DOMAIN Proxy Interoperability Testing

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1. Report Scope

This report addresses the EMC verification testing and test results of the **Amplitech o-RAN Medium 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 (CBRS 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 MPRU 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.	N/A
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.	P
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

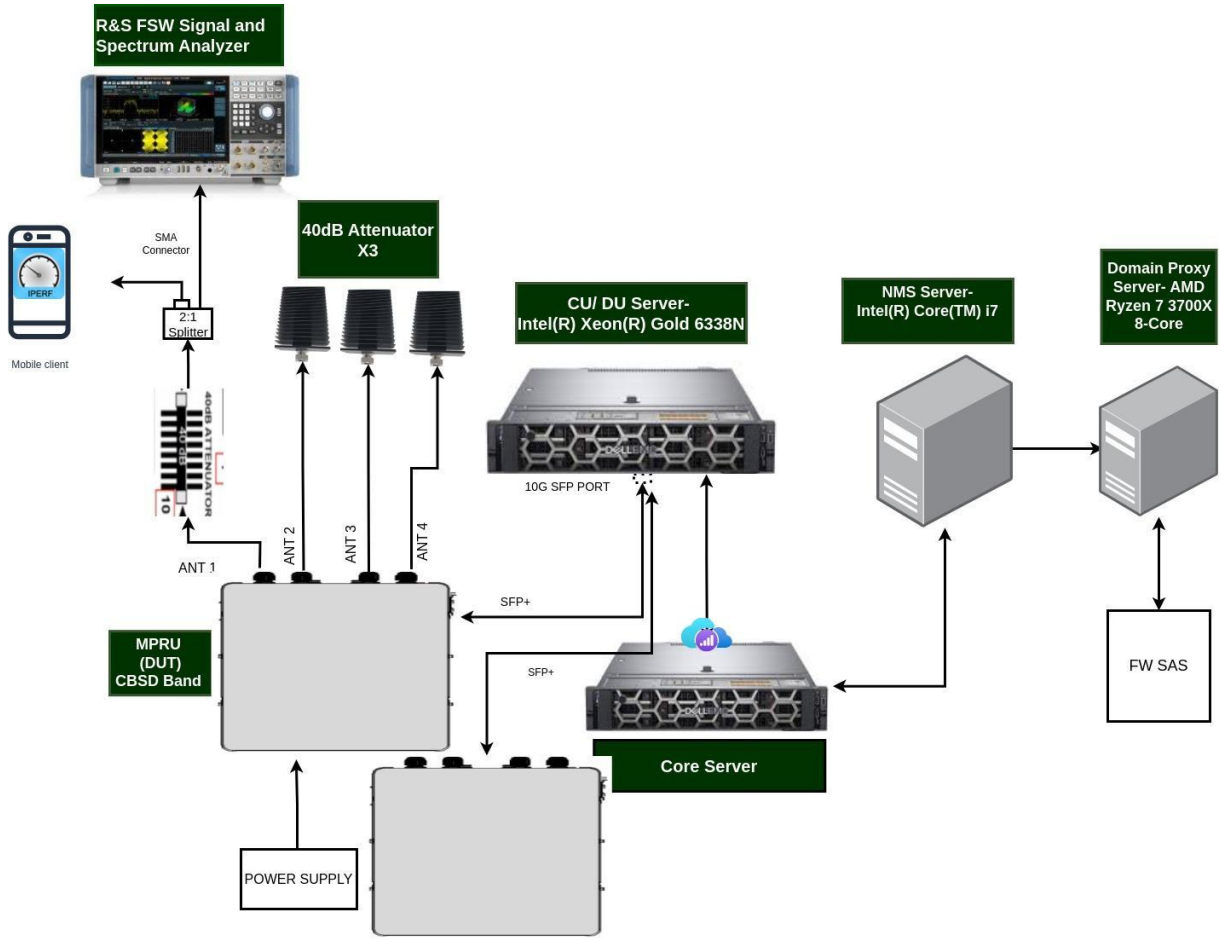


Figure. 01 - End to end Block diagram

Block Descriptions

R&S VSA- FWS26

Type: R&S FSW Signal and Spectrum Analyzer (2Hz - 26.5GHz)
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 SAS for spectrum allocation

MPRU (DUT)

Frequency Band: Medium Power Radio Unit 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: 4x5W
Connectivity: SFP+ (10G) to CU/DU server

40dB Attenuator

Connectivity: The 40 dB Attenuator is connected to an RF signal path.
Function: Lowers the power of an RF signal to prevent overloading sensitive receivers or test equipment.

2:1 Splitter
Function: An RF power splitter that divides the signal from the MPRU antenna ports into two outputs, with a 2:1 power ratio.
Connectivity: SMA connector from DUT Antenna 1 and to VSA.

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 MPRU

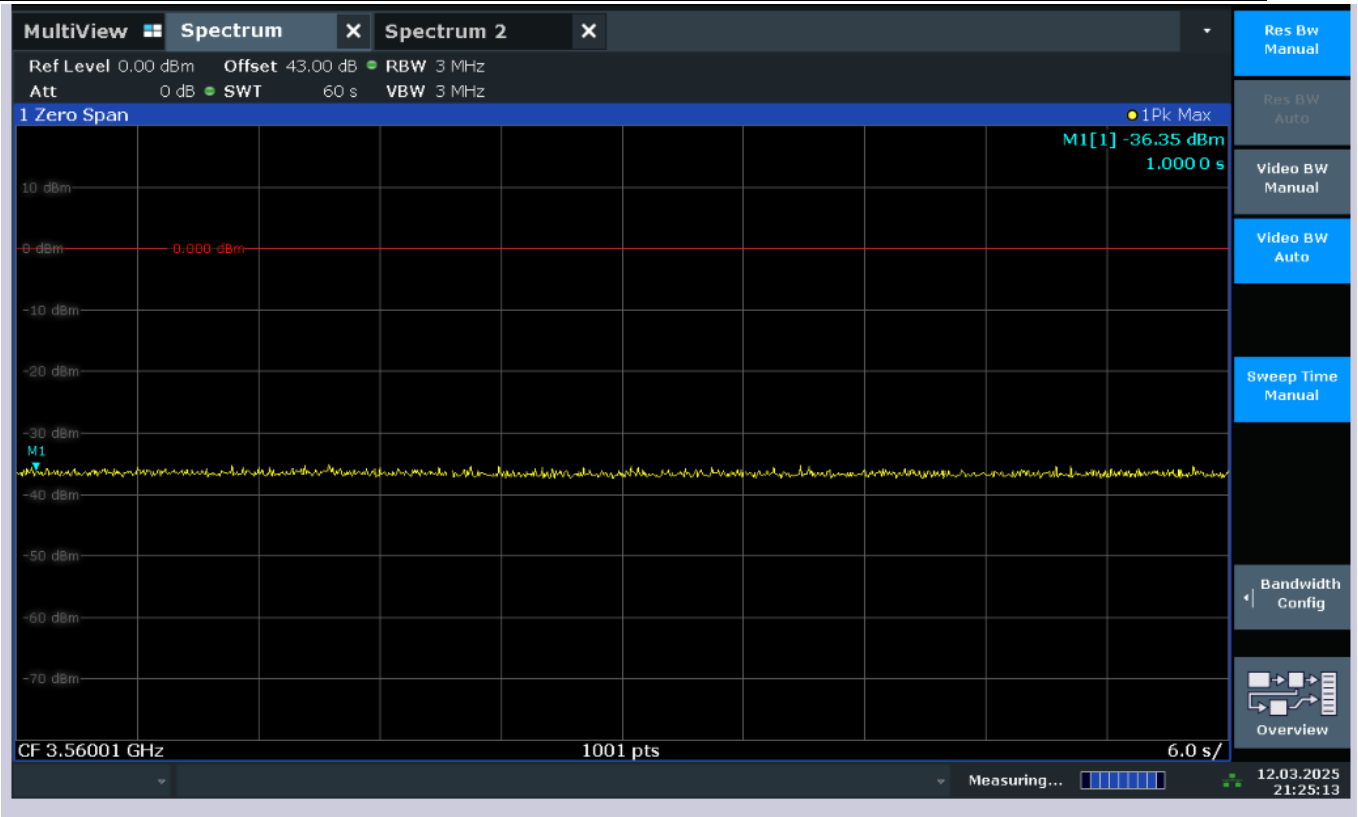
via wireless connection.

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	N/A

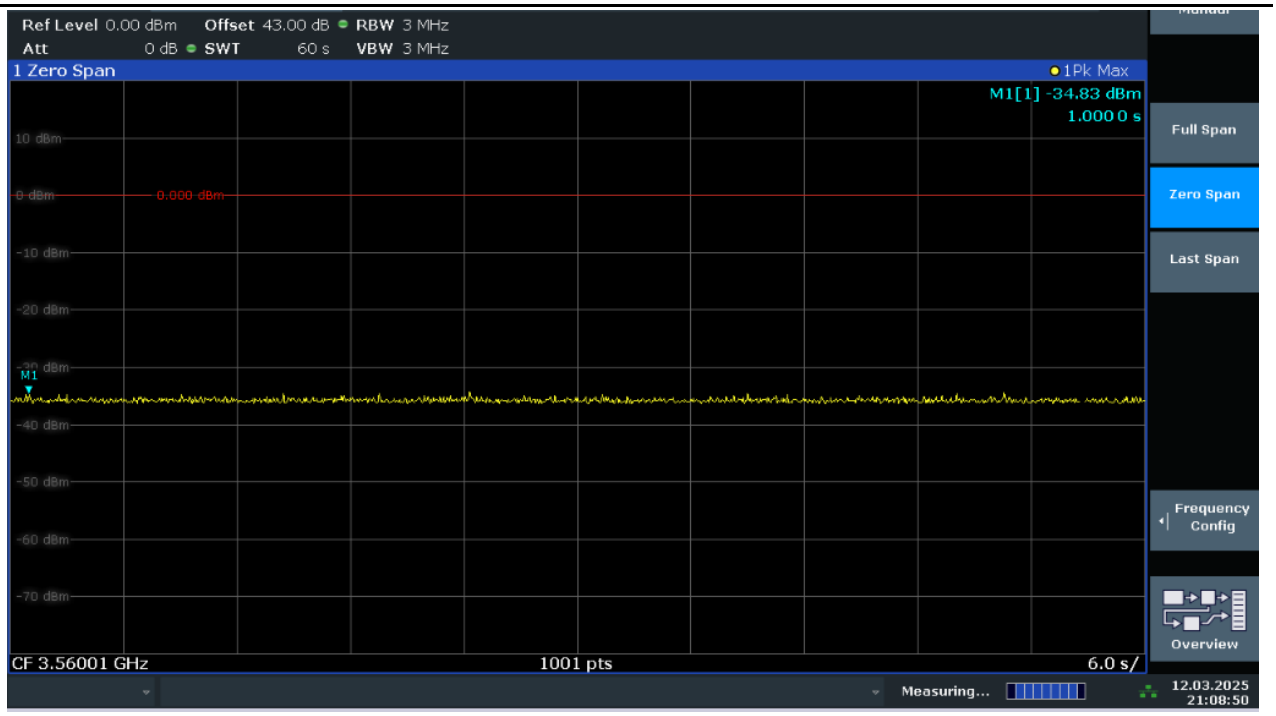
6.1.4.1.6	X	WINNF.FT.D.REG.6	Domain Proxy Single-Step registration for CBSD with CPI signed data	P



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

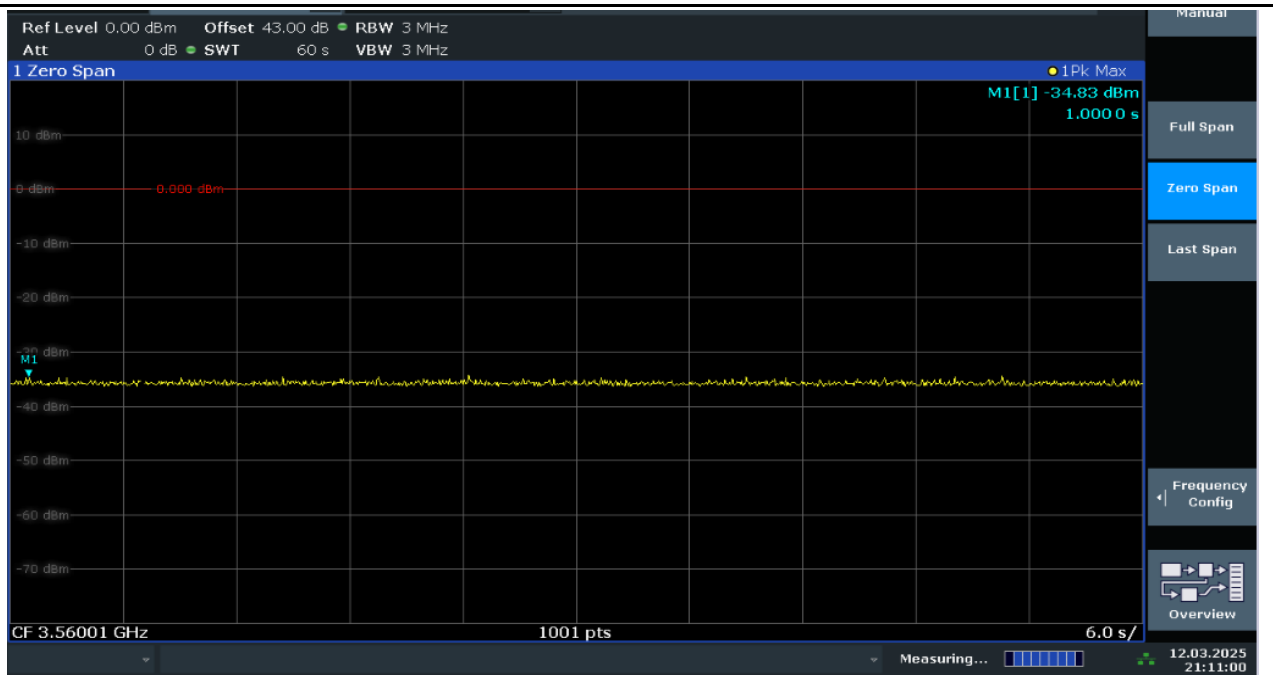
This test only applies to CBSD devices that allow a registration parameter change to be made prior to sending a deregistration, here we are sending deregistration messages first.

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

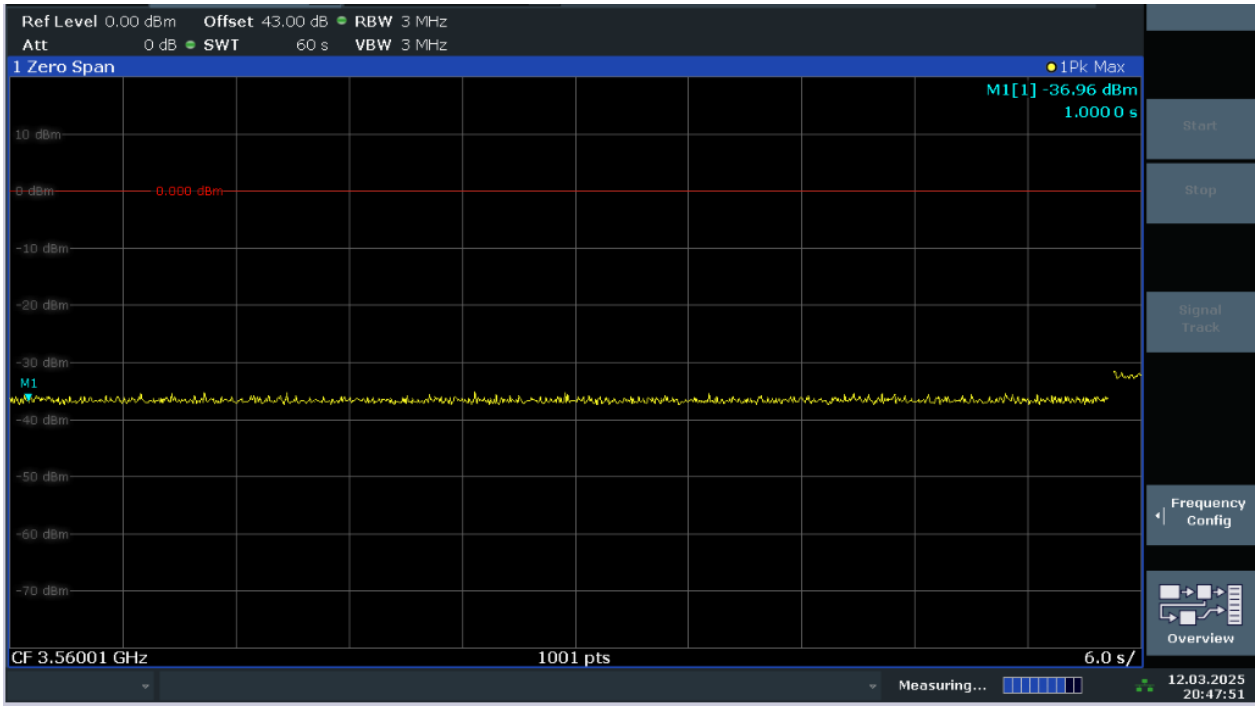
6.1.4.2.10	X	WINNF.FT.D.REG.17	Domain Proxy Unsupported SAS protocol version responseCode 100)	N/A

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

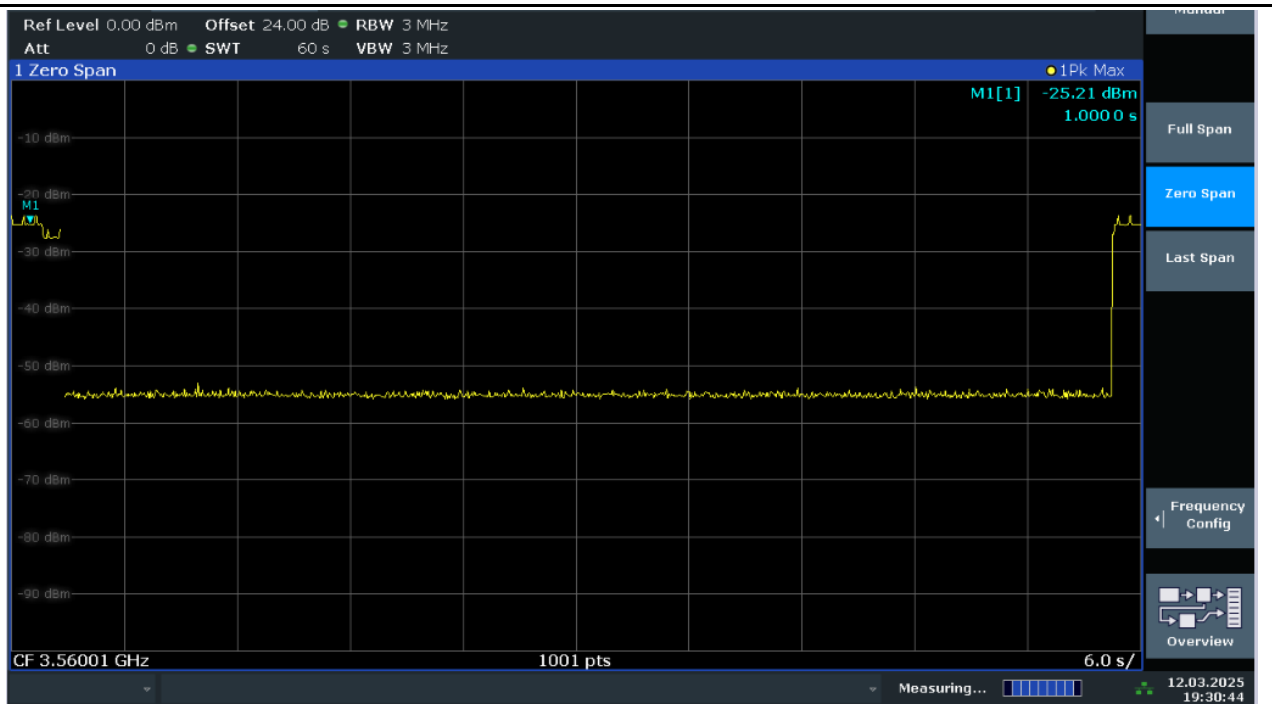
Check the device registration and authorization with the SAS, confirm that the device changes its operating power and/or channel in response to a command from the SAS and confirm that the device correctly configures based on the different license classes.

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

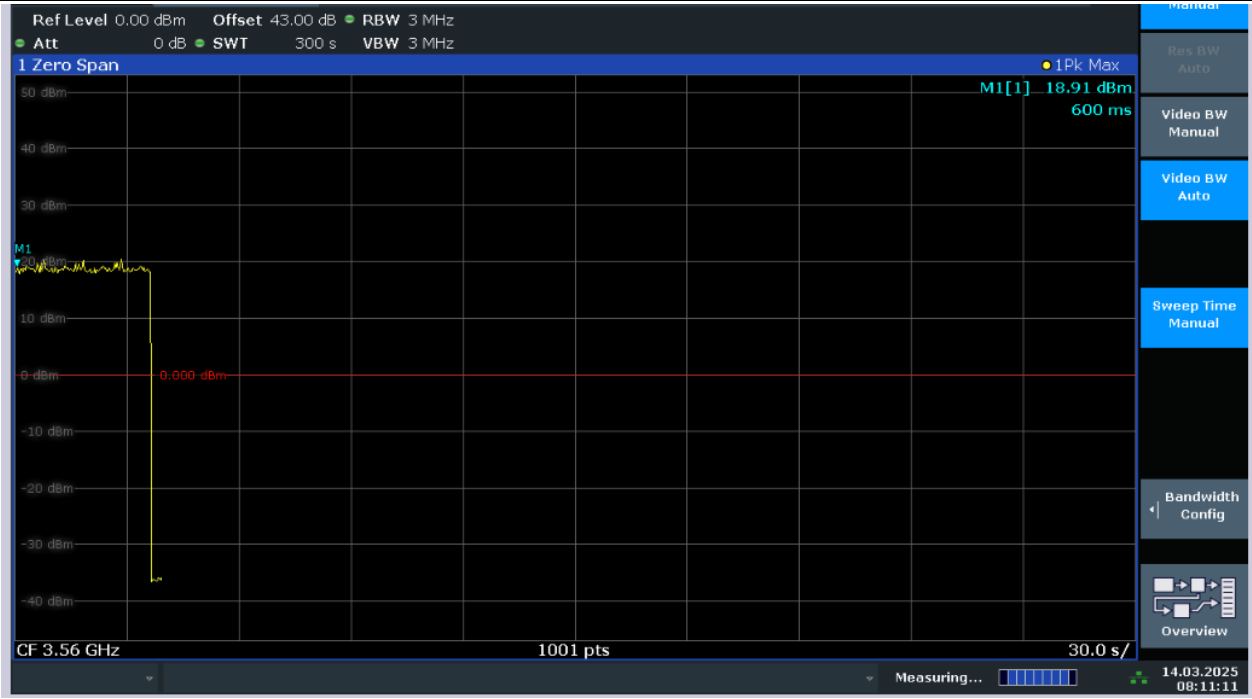
6.4.4.2.2	WINNF.FT.C.H BT.4	Heartbeat responseCode=500 (TERMINATED_0 RANT)	Monitor the RF output of the UUT. Verify: UUT shall stop transmission within (T + 60 seconds) of completion of responseCode = 500 (TERMINATED_GRANT)	N/A

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

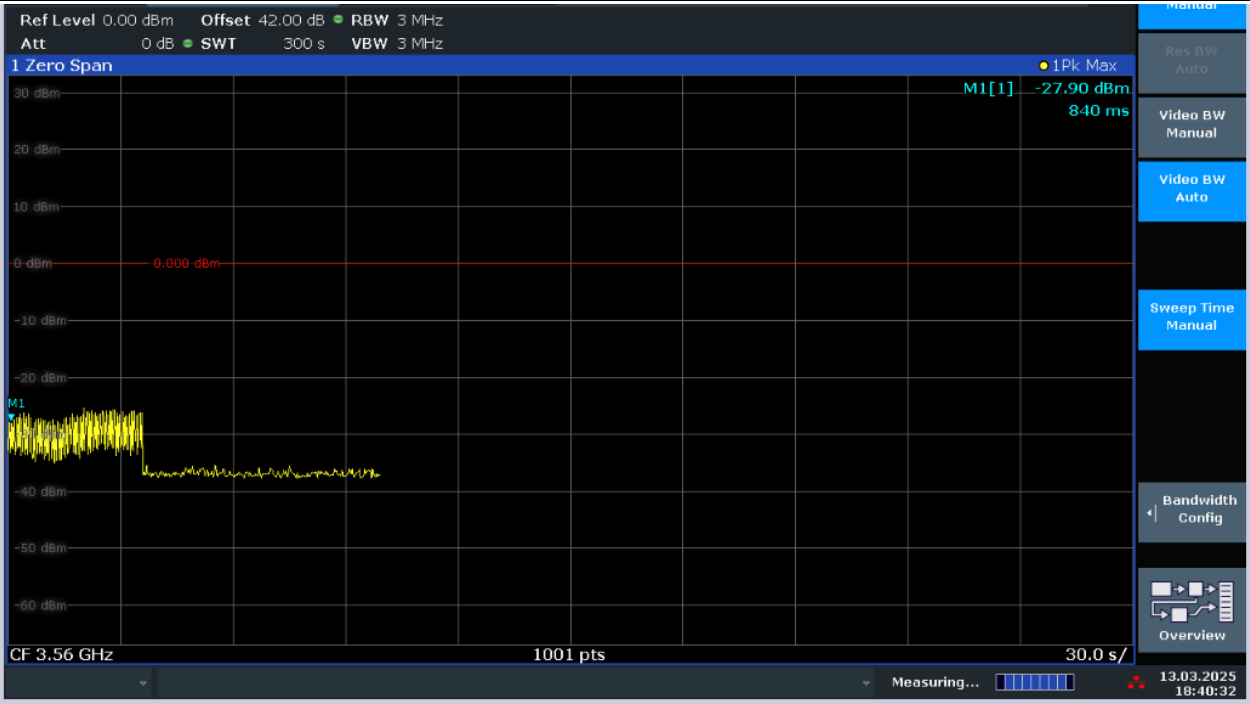
Test Harness logs and timing on graph was verified, the EUT passed the requirement.

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



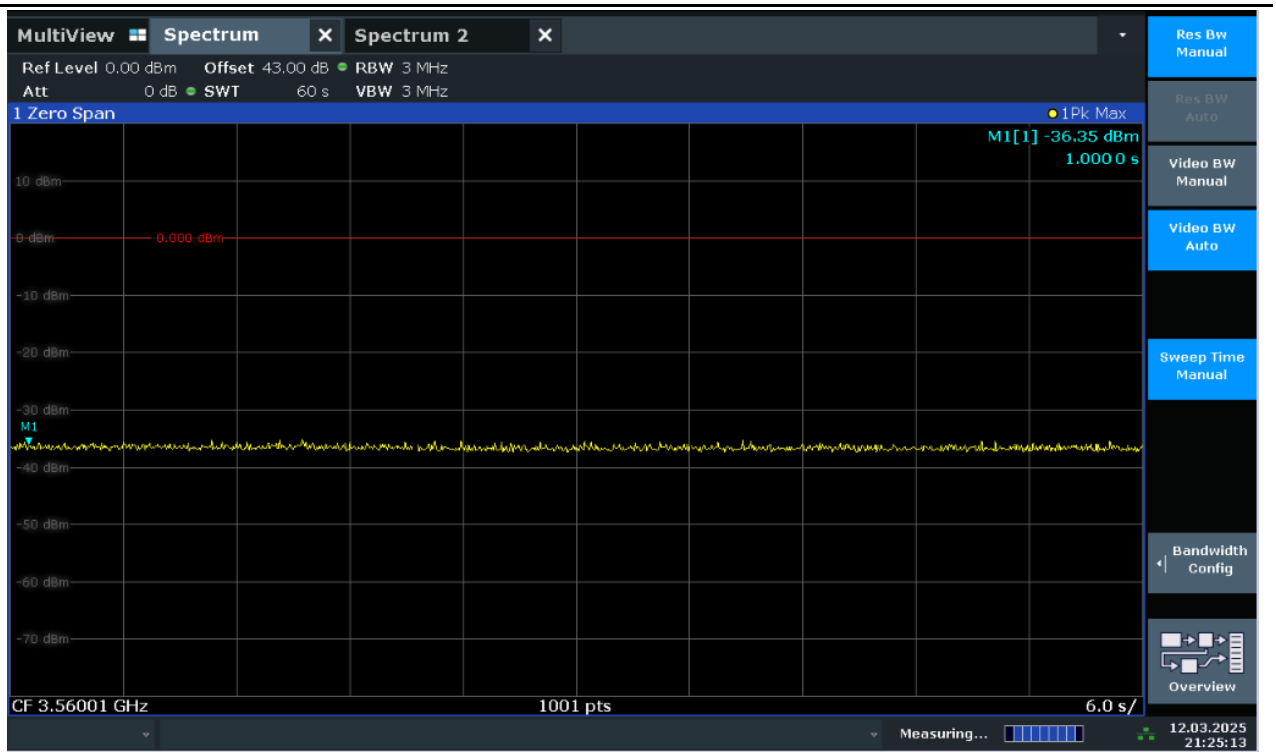
Test Harness logs and timing on graph was verified, the EUT passed the requirement.

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

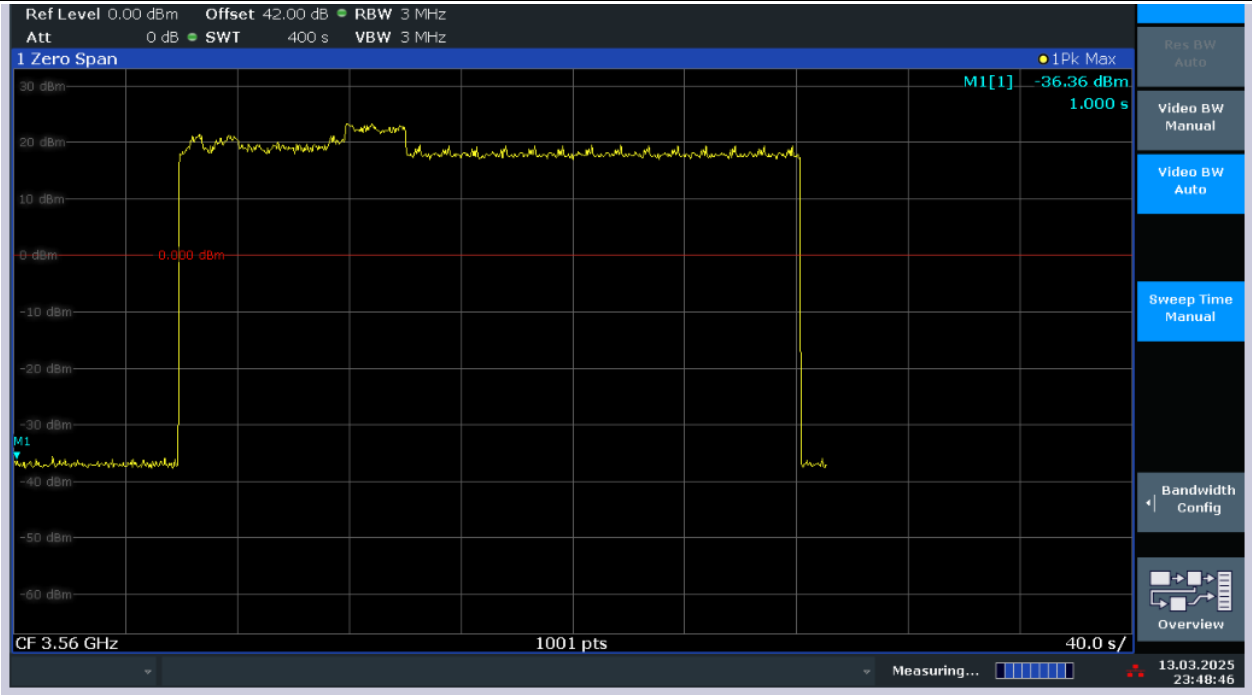


Test Harness logs and timing on graph was verified, the EUT passed the requirement.

6.4.4.3.1	WINNF.FT.C.HBT.9	Heartbeat Response Absent (First Heartbeat)	Monitor RF from the start of the 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



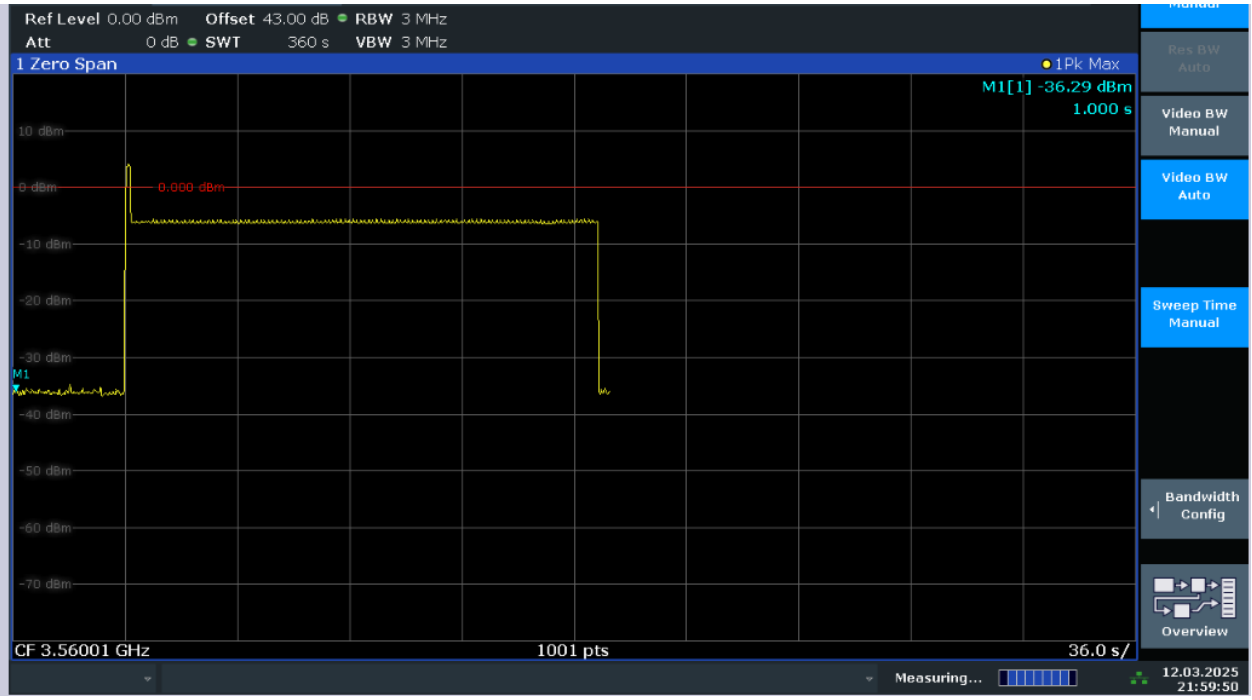
Test Harness logs and timing on graph was verified, the EUT passed the requirement.

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

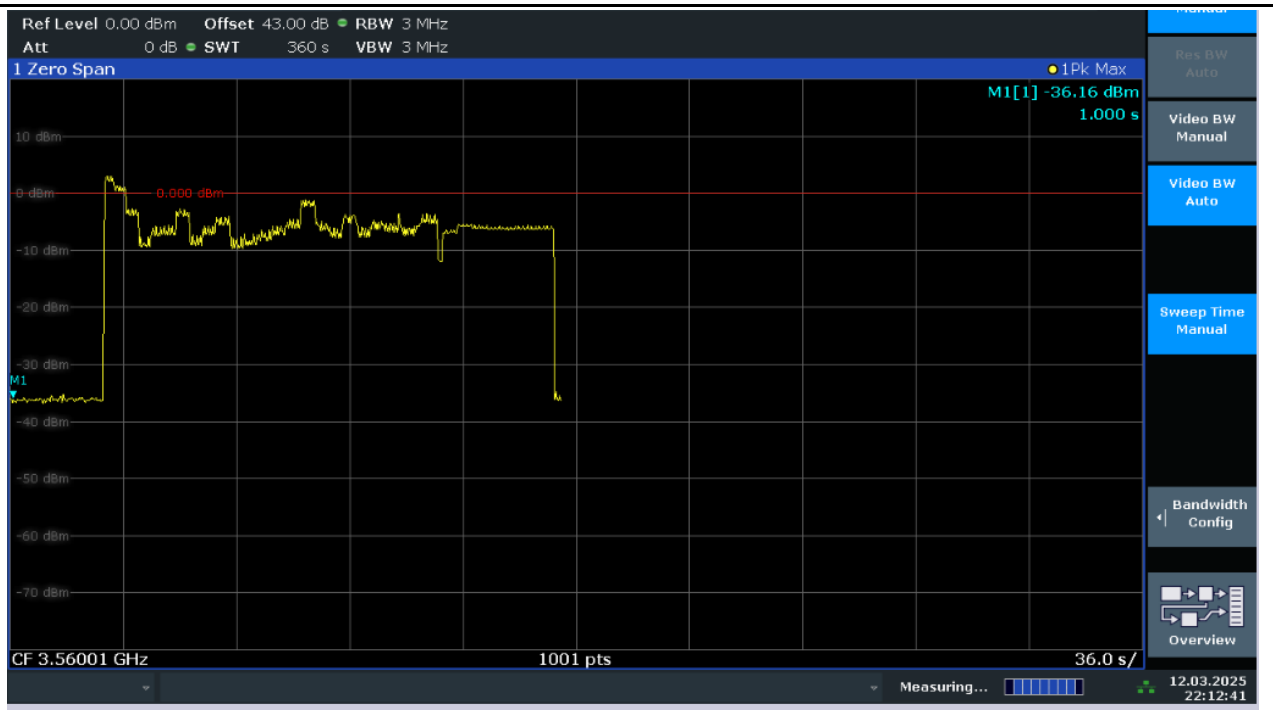
6.6.4.1.2	WINNF.FT.D.RLQ.2	Domain Proxy Successful Relinquishment	Monitor RF transmission. Ensure: • CBSD stops transmission at any time prior to sending the relinquishmentRequest message.	P



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.

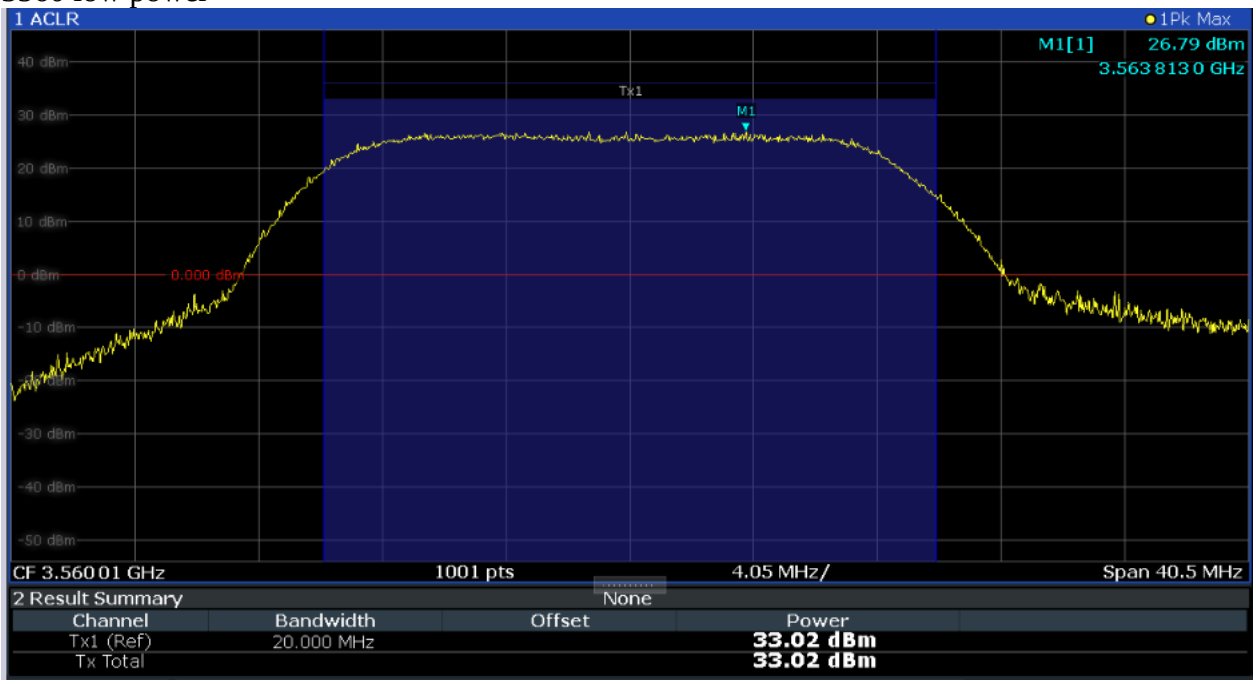
Confirm that the device transmits at a power level less than or equal to the maximum power level approved by the SAS.

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

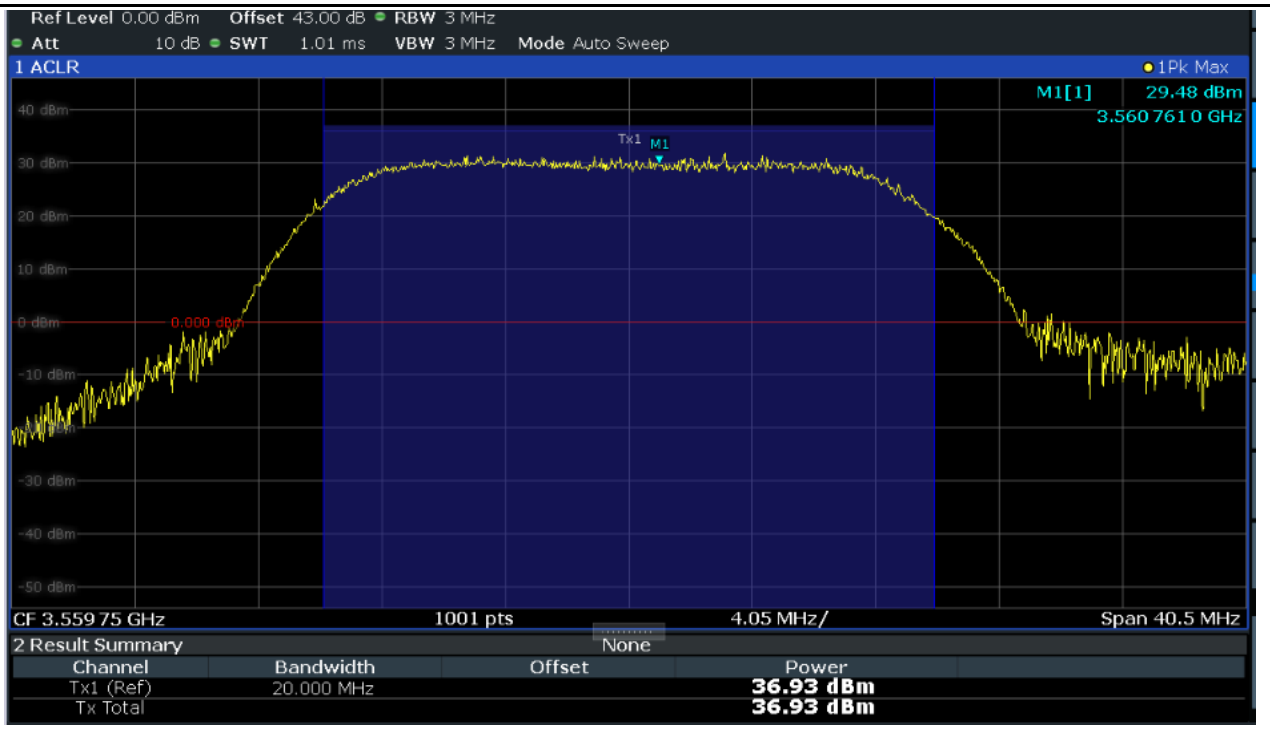
Test Table

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	34	33.02	26.79	43	-16.21	13	4	0	13.58	23.58	20.42
3555-High	37	36.93	29.48	43	-13.52	13	4	0	18.96	28.96	18.04
				43		13					
3630-low	34	33.44	27.36	43	-15.64	13	4	0	14.72	24.72	19.28
3630-high	37	36.97	29.36	43	-13.64	13	4	0	18.72	28.72	18.28
				43		13					
3690-low	34	33.26	27.43	43	-15.57	13	4	0	14.86	24.86	19.14
3690-high	37	36.21	30.66	43	-12.34	13	4	0	21.32	31.32	15.68

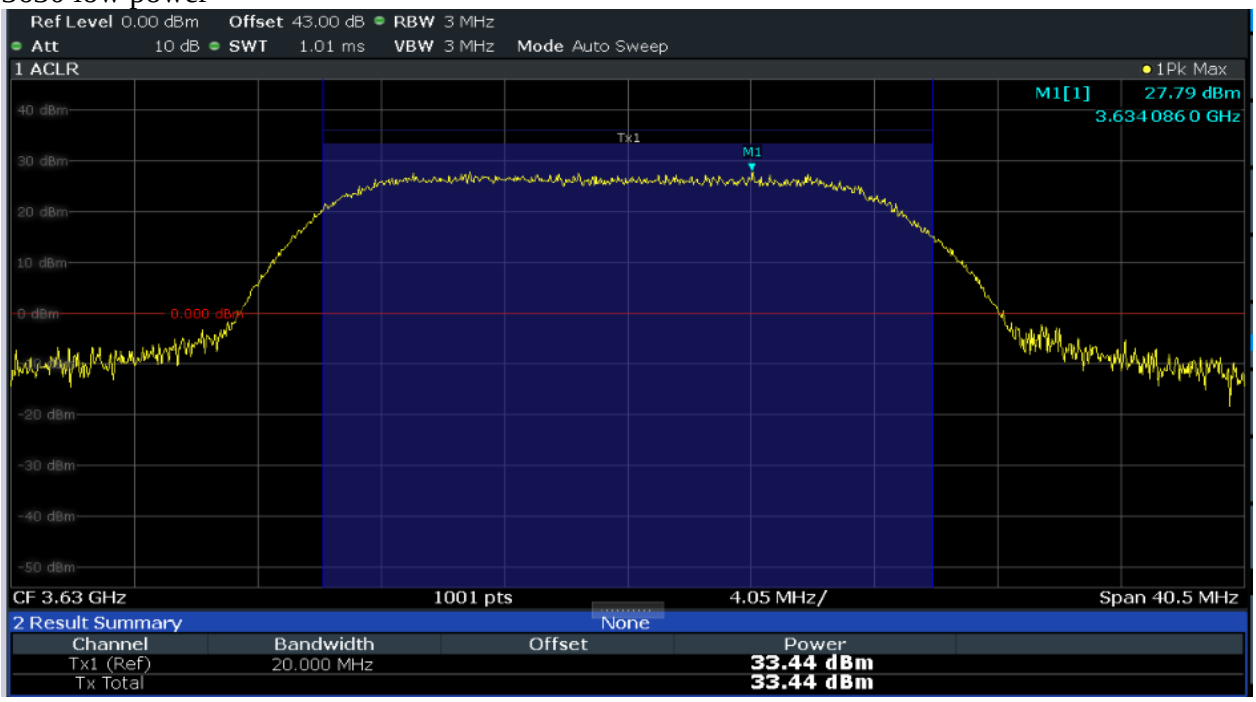
3560 low power



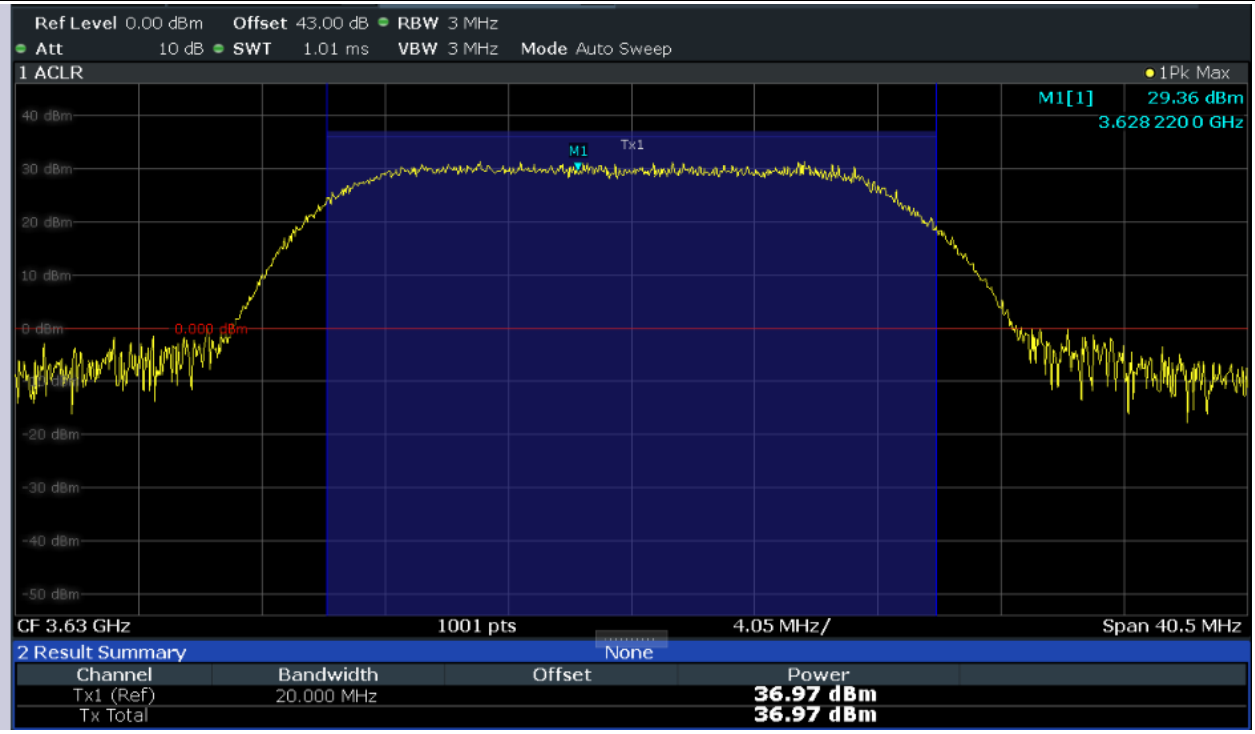
3560-High power



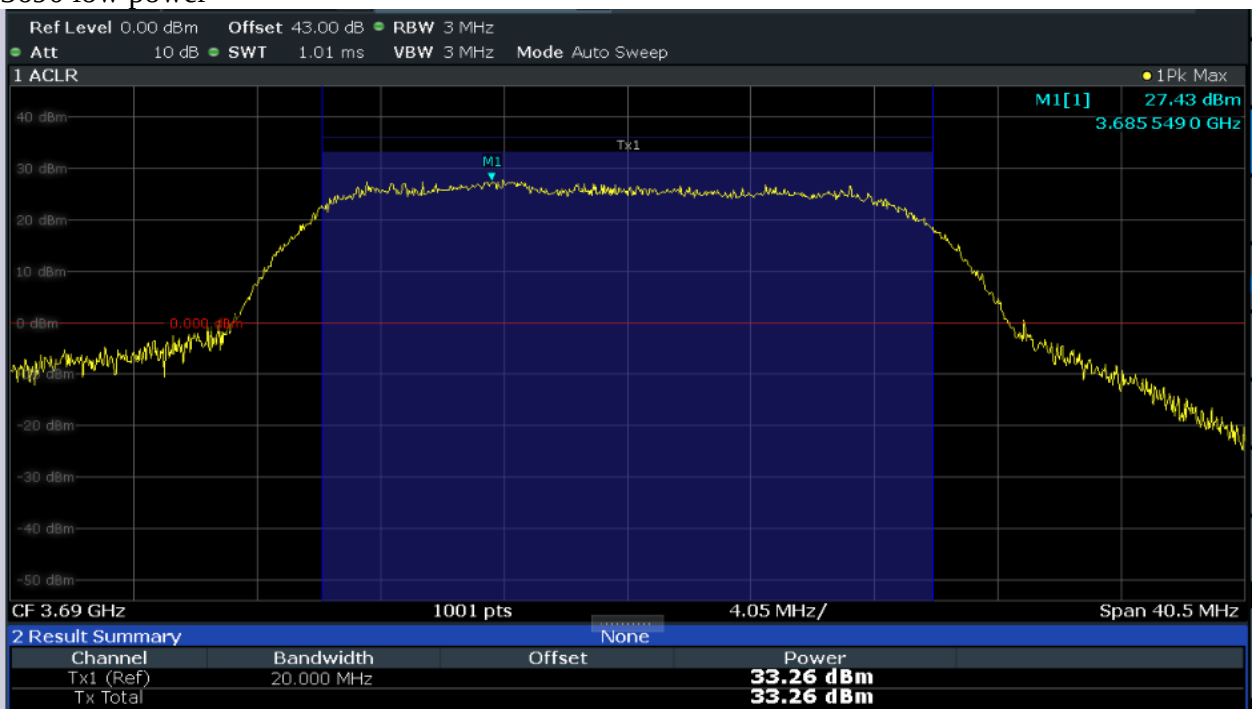
3630 low power



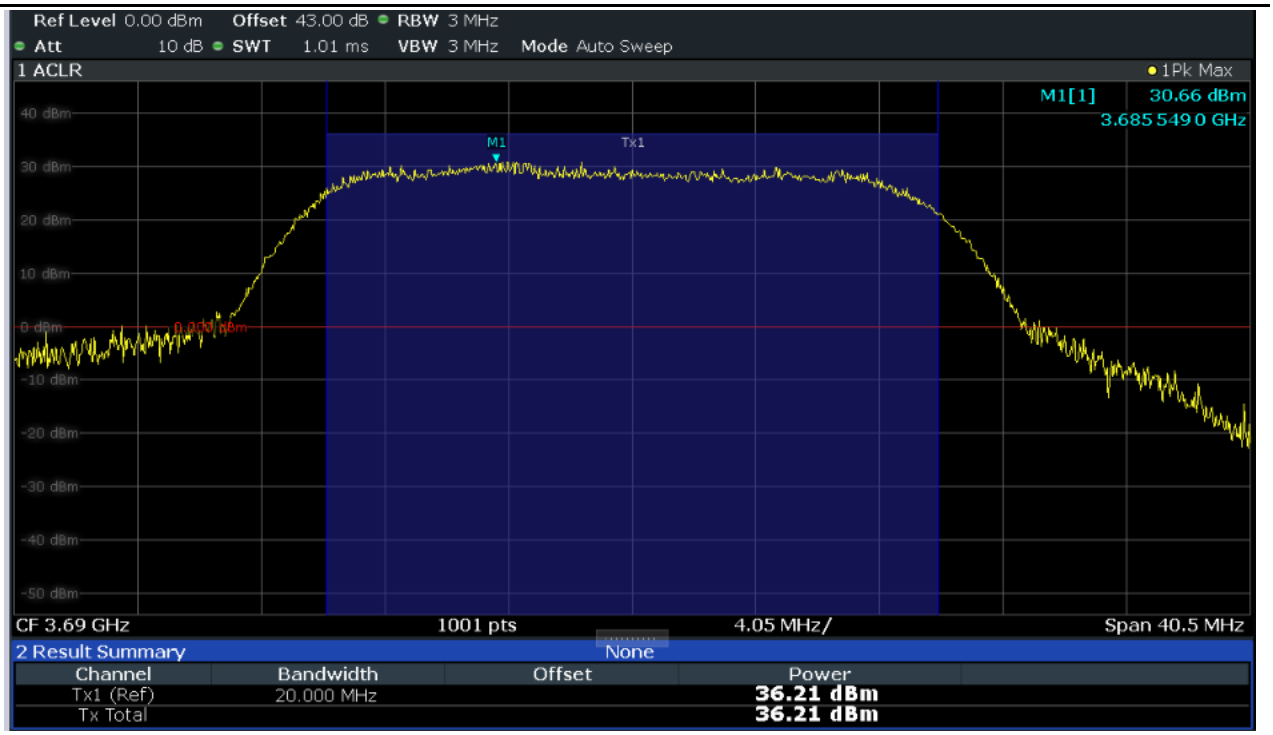
3630-high power



3690 low power



3690-high power

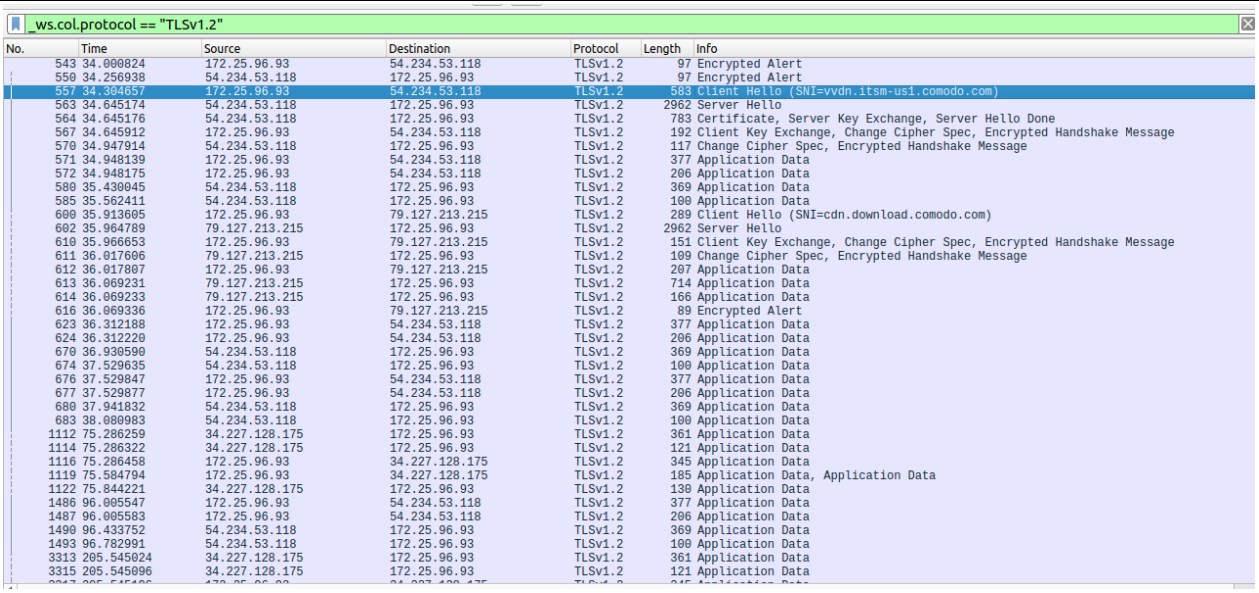


DOT CBRS Radio: WINNF / Security Test Case Analysis

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
543	34.000824	172.25.96.93	54.234.53.118	TLSv1.2	97	Encrypted Alert
550	34.256938	54.234.53.118	172.25.96.93	TLSv1.2	97	Encrypted Alert
557	34.304657	172.25.96.93	54.234.53.118	TLSv1.2	583	Client Hello (SNI=vvdn.itsm-us1.comodo.com)
563	34.645174	54.234.53.118	172.25.96.93	TLSv1.2	2962	Server Hello
564	34.645176	54.234.53.118	172.25.96.93	TLSv1.2	783	Certificate, Server Key Exchange, Server Hello Done
567	34.645912	172.25.96.93	54.234.53.118	TLSv1.2	192	Client Key Exchange, Change Cipher Spec, Encrypted Handshake Message
570	34.947914	54.234.53.118	172.25.96.93	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
571	34.948139	172.25.96.93	54.234.53.118	TLSv1.2	377	Application Data
572	34.948175	172.25.96.93	54.234.53.118	TLSv1.2	206	Application Data
580	35.430045	54.234.53.118	172.25.96.93	TLSv1.2	369	Application Data
585	35.562411	54.234.53.118	172.25.96.93	TLSv1.2	100	Application Data
600	35.913605	172.25.96.93	79.127.213.215	TLSv1.2	289	Client Hello (SNI=cdn.download.comodo.com)
602	35.964789	79.127.213.215	172.25.96.93	TLSv1.2	2962	Server Hello
610	35.966653	172.25.96.93	79.127.213.215	TLSv1.2	151	Client Key Exchange, Change Cipher Spec, Encrypted Handshake Message
611	36.017606	79.127.213.215	172.25.96.93	TLSv1.2	109	Change Cipher Spec, Encrypted Handshake Message
612	36.017807	172.25.96.93	79.127.213.215	TLSv1.2	207	Application Data
613	36.069231	79.127.213.215	172.25.96.93	TLSv1.2	714	Application Data
614	36.069233	79.127.213.215	172.25.96.93	TLSv1.2	166	Application Data
616	36.069336	172.25.96.93	79.127.213.215	TLSv1.2	89	Encrypted Alert
623	36.312188	172.25.96.93	54.234.53.118	TLSv1.2	377	Application Data
624	36.312220	172.25.96.93	54.234.53.118	TLSv1.2	206	Application Data
670	36.930590	54.234.53.118	172.25.96.93	TLSv1.2	369	Application Data
674	37.529635	54.234.53.118	172.25.96.93	TLSv1.2	100	Application Data
676	37.529847	172.25.96.93	54.234.53.118	TLSv1.2	377	Application Data
677	37.529877	172.25.96.93	54.234.53.118	TLSv1.2	206	Application Data
680	37.941832	54.234.53.118	172.25.96.93	TLSv1.2	369	Application Data
683	38.080983	54.234.53.118	172.25.96.93	TLSv1.2	100	Application Data
1112	75.286259	34.227.128.175	172.25.96.93	TLSv1.2	361	Application Data
1114	75.286322	34.227.128.175	172.25.96.93	TLSv1.2	121	Application Data
1116	75.286458	172.25.96.93	34.227.128.175	TLSv1.2	345	Application Data
1119	75.584794	172.25.96.93	34.227.128.175	TLSv1.2	185	Application Data, Application Data
1122	75.844221	34.227.128.175	172.25.96.93	TLSv1.2	130	Application Data
1486	96.005547	172.25.96.93	54.234.53.118	TLSv1.2	377	Application Data
1487	96.005583	172.25.96.93	54.234.53.118	TLSv1.2	206	Application Data
1490	96.433752	54.234.53.118	172.25.96.93	TLSv1.2	369	Application Data
1493	96.782991	54.234.53.118	172.25.96.93	TLSv1.2	100	Application Data
3313	205.545024	34.227.128.175	172.25.96.93	TLSv1.2	361	Application Data
3315	205.545096	34.227.128.175	172.25.96.93	TLSv1.2	121	Application Data

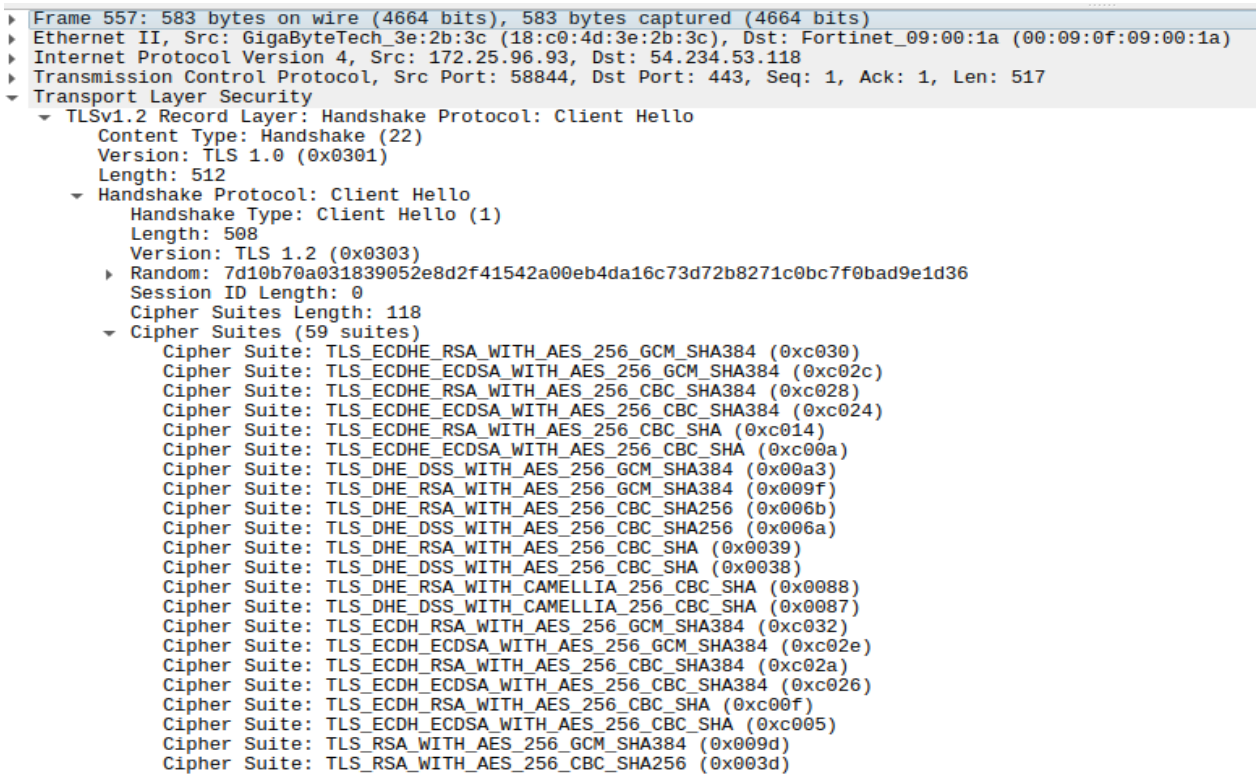
WINNF test requirements:

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

```
▸ Frame 563: 2962 bytes on wire (23696 bits), 2962 bytes captured (23696 bits)
▸ Ethernet II, Src: Fortinet_09:00:1a (00:09:0f:09:00:1a), Dst: GigaByteTech_3e:2b:3c (18:c0:4d:3e:2b:3c)
▸ Internet Protocol Version 4, Src: 54.234.53.118, Dst: 172.25.96.93
▸ Transmission Control Protocol, Src Port: 443, Dst Port: 58844, Seq: 1, Ack: 518, Len: 2896
▾ Transport Layer Security
  ▾ TLSv1.2 Record Layer: Handshake Protocol: Server Hello
      Content Type: Handshake (22)
      Version: TLS 1.2 (0x0303)
      Length: 70
    ▾ Handshake Protocol: Server Hello
        Handshake Type: Server Hello (2)
        Length: 66
        Version: TLS 1.2 (0x0303)
      ▸ Random: aaf5adca6739b8f0744e8b7504d1daf56acadf11ee430487444f574e47524401
        Session ID Length: 0
        Cipher Suite: TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 (0xc02b)
        Compression Method: null (0)
        Extensions Length: 26
      ▸ Extension: renegotiation_info (len=1)
      ▸ Extension: application_layer_protocol_negotiation (len=11)
      ▸ Extension: ec_point_formats (len=2)
        [JA3S Fullstring: 771,49195,65281-16-11]
        [JA3S: 554786d4c84f8a7953b7e453c6371067]
  TLS segment data (2821 bytes)
```

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	MPRU (Medium Power Radio Unit)
Model Number	VMRU-Gen1-3537-AE-AI Gen1: 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)	2404199000025
Software Version	01-v1.0.6
Hardware Version	A1-20250129
Test Specification/Issue/Date	FCC CFR 47 Part 96: 2025

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

Technical Description

The Medium Power Radio Unit (MPRU) is a single-board Optical to Radio interface solution for 5G Medium-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 MPRU can be operated using a DC 48V power connector.

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

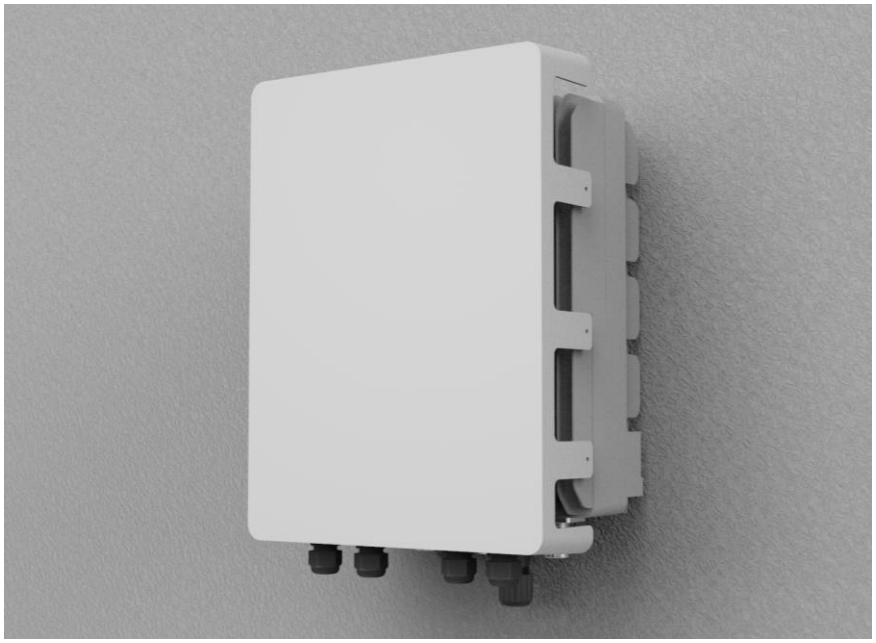


Figure. 02 - Equipment Under Test (EUT)

EUT Configuration
Please see Appendix B for close up pictures of the unit as configured during testing

- Cables and earthing when applicable were connected as per manufacturer's specification.

Domain Proxy Software Version: = 1.0.0

Appendix B – EUT, Peripherals, and Test Setup Photos

Block Diagram

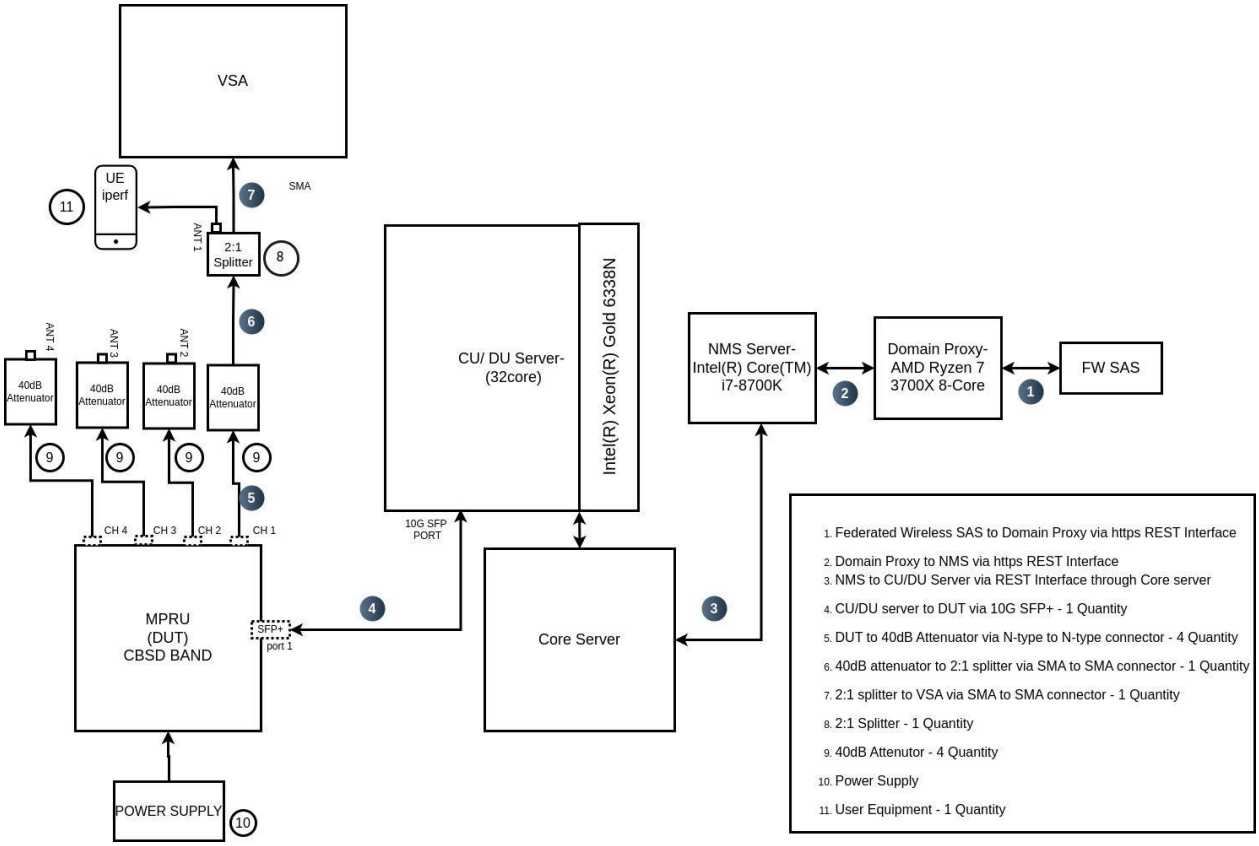


Figure. 03 - Block Diagram

1. Federated Wireless SAS to Domain Proxy

- This is an HTTPS REST interface connection.
- The Federated Wireless SAS (FW SAS) communicates with the Domain Proxy to authorize spectrum access.

2. Domain Proxy to NMS (Network Management Server)

- The Domain Proxy communicates with the NMS Server via HTTPS REST Interface.
- This is needed for managing CBRS devices and configurations.

3. NMS server to CU/DU Server via Core Server

- The NMS Server connects to the CU/DU Server using a REST interface through the core server.
- Purpose: The NMS Server communicates with the CU/DU Server via the Core Server to manage network functions.

4. CU/DU Server to MPRU (DUT)

- The CU/DU Server is connected to the MPRU (DUT - Device Under Test) via 10G SFP+connector in PORT 1.
- This allows data exchange between the CU/DU and the radio unit (MPRU).

5. MPRU to RF Components (Attenuators and Splitters)

- The MPRU outputs RF signals, which are then passed through 40 dB Attenuators to reduce signal strength before further processing.
- There are four 40dB attenuators used in the setup.

6. RF Signal Path to VSA (Vector Signal Analyzer)

- The attenuated signal is then fed into a 2:1 splitter.
- The splitter has SMA connectors and splits the signal between the VSA and another test device.

7. VSA Connection

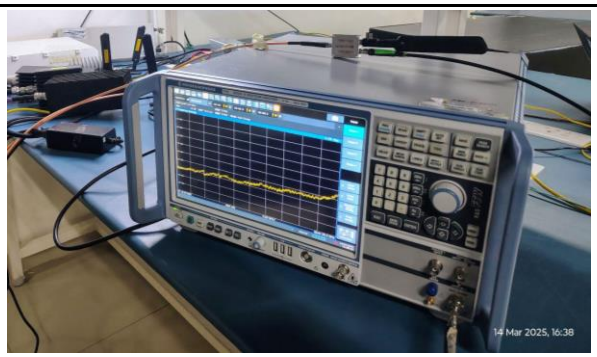
- The Vector Signal Analyzer (VSA) is connected via SMA connector through the splitter.
- This allows monitoring and analyzing RF performance.

8. Power Supply to MPRU

- The MPRU (DUT) is powered by a dedicated power supply.

9. User Equipment (iperf - Performance testing)

- iPerf for network throughput and latency testing
- Measures data rate and latency over the CBRS link, Communicates with MPRU via wireless connection.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