Conformance Test User Meeting 2024

RF, RRM, PCT
CONFORMANCE TEST SOLUTIONS

ROHDE&SCHWARZ

Make ideas real

MWC 2024 NTN NB-IOT AND CMX OBT FOR RF CONFORMANCE
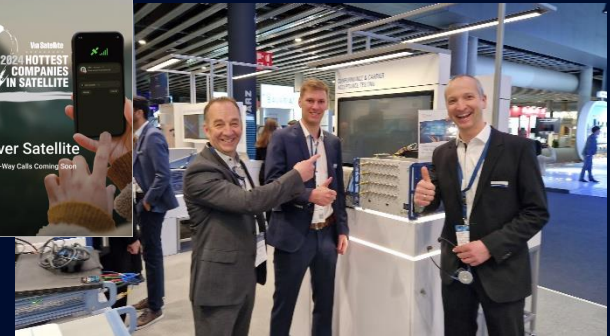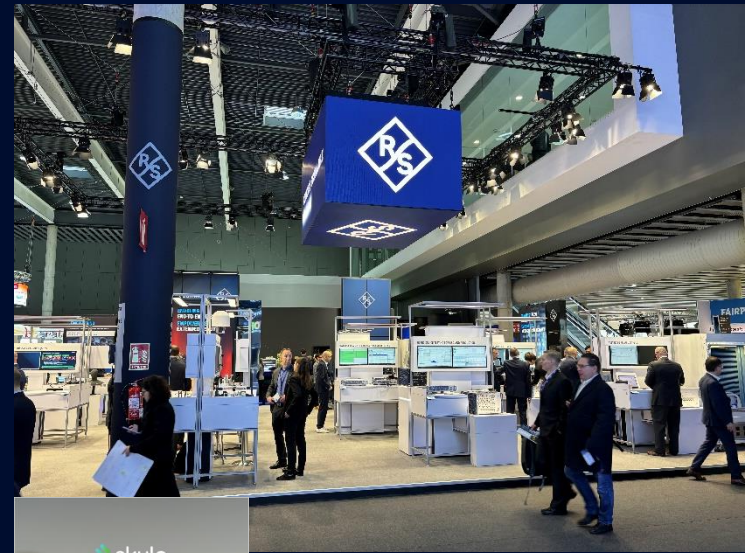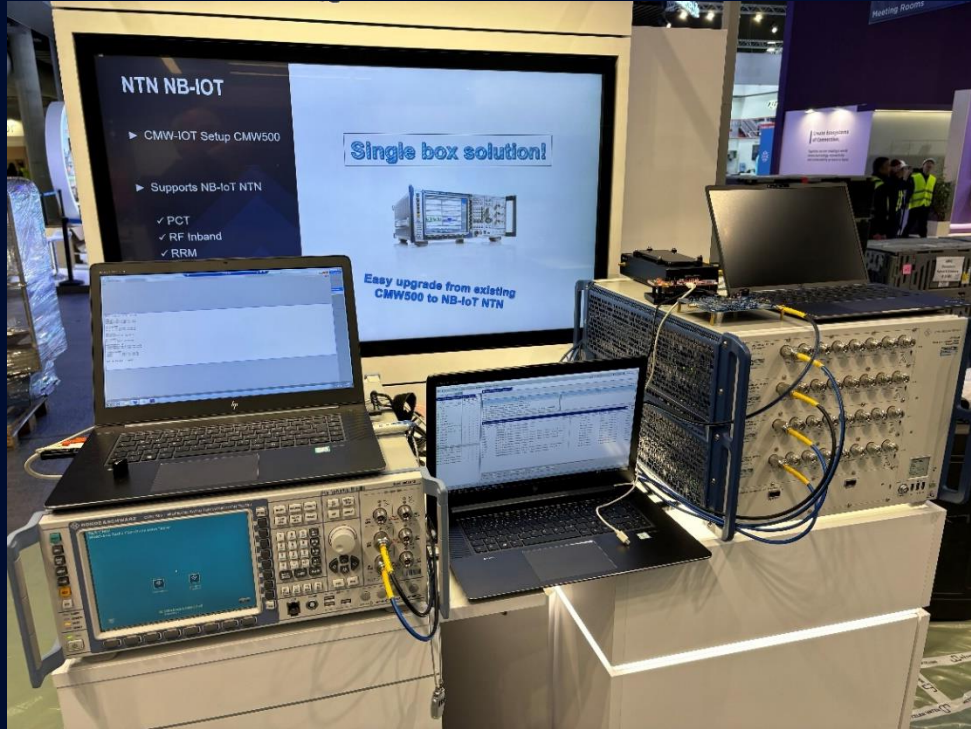
AGENDA

► Certification Updates

► Update on NTN

► Update on RedCap

► Update on FR1 RF / RRM

► Update on FR2 RF / RRM

► Update on FR1 / FR2 PCT

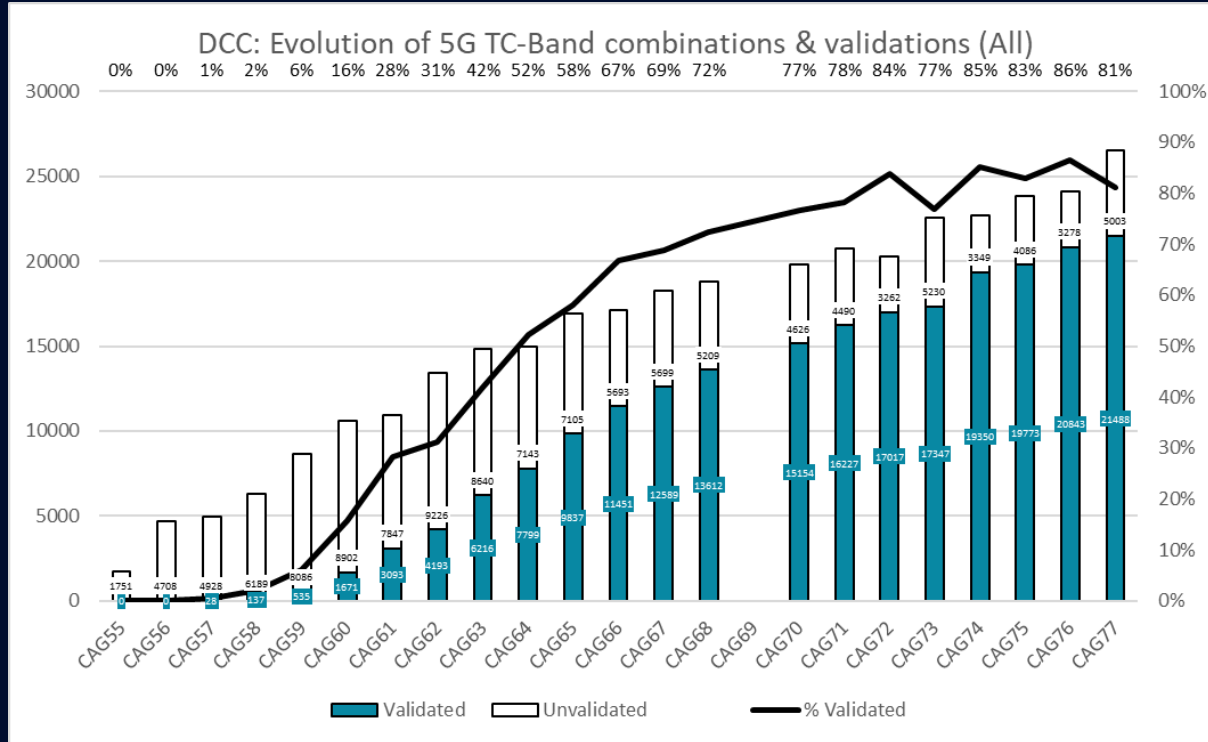# CERTIFICATION UPDATES

VALIDATION PROGRESS: 5G TOTAL

DCC: Evolution of 5G TC-Band combinations & validations (All)

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ACTIVATED 5G WORK ITEMS

Work Item	Work Item Description	Work Item Group	Type Of Test	R&S TP
WI-506-8 (EN-DC)	5G Positioning Test EN-DC with GNSS A-GPS, A-GLONASS and A-BEIDOU only	5G WIG independent Work Items	Minimum Performance	
WI-506-10 (EN-DC)	5G Positioning Test EN-DC with GNSS A-GPS, A-BEIDOU and A-GALILEO only	5G WIG independent Work Items	Minimum Performance	
WI-510-2CC_CA_UL_n41C	NR 2CC Carrier Aggregation CA_UL_n41C	5G WIG independent Work Items	RF	
WI-512-5CC_EN-DC_1A_n258I	WI-512-5CC_EN-DC	5G WIG independent Work Items	RF TX-RX	298
WI-512-5CC_EN-DC_3A_n258I	WI-512-5CC_EN-DC	5G WIG independent Work Items	RF TX-RX	298
WI-513-n2-FDD13	Interworking between NR with 5GC and E-UTRA with EPC	5G WIG independent Work Items	Protocol	292
WI-513-n2-FDD13	Interworking between NR with 5GC and E-UTRA with EPC	5G WIG independent Work Items	RRM	296
WI-513-n2-FDD66	Interworking between NR with 5GC and E-UTRA with EPC	5G WIG independent Work Items	Protocol	292
WI-513-n2-FDD66	Interworking between NR with 5GC and E-UTRA with EPC	5G WIG independent Work Items	RRM	296
WI-516_HO-n78-EN-DC_28A_n78A	Inter-RAT handover / From NR to EN-DC / Success (n78 to EN_DC 28A_n78A)	5G WIG independent Work Items	Protocol	
WI-517_A-n78	Rel-16 NR SON and MDT	5G WIG independent Work Items	Protocol	292
WI-522_CHO-NR_n2	Rel-16 NR Conformance Test Aspects for mobility enhancement feature CHO (Conditional Handover)	5G WIG independent Work Items	Protocol	292
WI-522_CHO-NR_n2	Rel-16 NR Conformance Test Aspects for mobility enhancement feature CHO (Conditional Handover)	5G WIG independent Work Items	RRM	296
WI-530-n78-FDD1_RedCap	New 530 Redcap subWI for Band combination with NR band n78 and FDD band1	5G WIG independent Work Items	RRM	
WI-530-n78-FDD3_RedCap	New 530 Redcap subWI for Band combination with NR band n78 and FDD band3	5G WIG independent Work Items	RRM	
WI-541-n1_RedCap	Protocol conformance test for Release 17 eDRX	5G NR	Protocol	
WI-541-n8_RedCap	Protocol conformance test for Release 17 eDRX	5G NR	Protocol	
WI-541-n78_RedCap	Protocol conformance test for Release 17 eDRX	5G NR	Protocol	
WI-543-NR_n41	Transparent Tx Diversity (TxD) for NR with default PC2	5G WIG independent Work Items	RF TX-RX	298

ACTIVATED LTE WORK ITEMS

Work Item	Work Item Description	Work Item Group	Type Of T	R&S TR
WI-162-CA_1A-26A+1A-26A	E-UTRA Carrier Aggregation CA_1A-26A+1A-26A	4G	RF	98
WI-162-CA_1A-26A+1A-26A	E-UTRA Carrier Aggregation CA_1A-26A+1A-26A	4G	RRM	
WI-162-CA_1A-28A+1A-28A	E-UTRA Carrier Aggregation CA_1A-28A+1A-28A with 2UL	4G	Protocol	
WI-162-CA_1A-28A+1A-28A	E-UTRA Carrier Aggregation CA_1A-28A+1A-28A with 2UL	4G	RF	98
WI-162-CA_1A-28A+1A-28A	E-UTRA Carrier Aggregation CA_1A-28A+1A-28A with 2UL	4G	RRM	
WI-231-CA_1A-3A-42A	Further Rel-12 Configurations for LTE Advanced Carrier Aggregation with 3DL CA_1A-3A-42A	4G	RF	98
WI-231-CA_1A-3A-42A	Further Rel-12 Configurations for LTE Advanced Carrier Aggregation with 3DL CA_1A-3A-42A	4G	RRM	96
WI-231-CA_1A-42C	E-UTRA Carrier Aggregation CA_1A-42C	4G	RF	98
WI-231-CA_3A-41A-42A	Further Rel-12 Configurations for LTE Advanced Carrier Aggregation with 3DL CA_3A-41A-42A	4G	RF	98
WI-231-CA_3A-41A-42A	Further Rel-12 Configurations for LTE Advanced Carrier Aggregation with 3DL CA_3A-41A-42A	4G	RRM	96
WI-231-CA_3A-41C	Further Rel-12 Configurations for LTE Advanced Carrier Aggregation with 3DL CA_3A-41C	4G	RF	98
WI-231-CA_3A-41C	Further Rel-12 Configurations for LTE Advanced Carrier Aggregation with 3DL CA_3A-41C	4G	RRM	96
WI-231-CA_3A-42C	E-UTRA Carrier Aggregation CA_3A-42C	4G	RF	98
WI-231-CA_19A-42C	E-UTRA Carrier Aggregation CA_19A-42C	4G	RF	98
WI-240-CA_1A-3A-19A-42A	E-UTRA Carrier Aggregation configurations for 4DL (CA_1A-3A-19A-42A)	4G	RF	98
WI-240-CA_1A-19A-21A-42A	E-UTRA Carrier Aggregation configurations for 4DL (CA_1A-19A-21A-42A)	4G	RF	98
WI-240-CA_1A-41A-42C	Further Rel-13 Configurations for LTE Advanced Carrier Aggregation with 4DL CA_1A-41A-42C	4G	RF	
WI-240-CA_1A-41A-42C	Further Rel-13 Configurations for LTE Advanced Carrier Aggregation with 4DL CA_1A-41A-42C	4G	RRM	
WI-240-CA_19A-21A-42C	E-UTRA Carrier Aggregation configurations for 4DL (CA_19A-21A-42C)	4G	RF	98
WI-240-CA_41C-42C	Further Rel-13 Configurations for LTE Advanced Carrier Aggregation with 4DL CA_41C-42C	4G	RF	98
WI-302-CA_1A-41C-42C	E-UTRA Carrier Aggregation configurations for 5DL band CA_1A-41C-42C	4G	RF	
WI-333_NB-IoT_255	Protocol conformance test for Release 17 NB-IoT support for Non-Terrestrial Networks (NTN) including EPS aspects for FDD 2	4G	Protocol	92
WI-333_NB-IoT_256	Protocol conformance test for Release 17 NB-IoT support for Non-Terrestrial Networks (NTN) including EPS aspects for FDD 2	4G	Protocol	92

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NEW LTE REL-17 NB-IOT WORK ITEMS

WI	Name	Bands		P1	TPAC	P2 gate	P2
WI-336	New **Umbrella** WI: **WI-336_NB-IoT NTN** devices	xxx	RF	10	50%	50%	20
			RF perf	2			2
			RRM	4			23
WI-336	New sub WI: **WI-336_NB-IoT_255**	FDD255	RF	10	50%	50%	20
			RF perf	2			1
			RRM	4			22
WI-336	New sub WI: **WI-336_NB-IoT_255_NGSO**	FDD255_NGSO	RF	10	50%	50%	20
			RF perf	2			2
			RRM	3			19
WI-336	New sub WI: **WI-336_NB-IoT_256**	FDD256	RF	10	50%	50%	20
			RF perf	2			1
			RRM	4			22
WI-336	New sub WI: **WI-336_NB-IoT_256_NGSO**	FDD256_NGSO	RF	10	50%	50%	20
			RF perf	2			2
			RRM	3			19

NEW 5G WORK ITEMS

WI	Name / Scope	Bands	Notes
WI-500	New **RedCap** sub Work Items for WI-500 **SUL** of RedCap	n78-n81, n78-n84	
WI-500, WI-502	New **RF** sub-WIs for **EN-DC**_1A_n41A and EN-DC_41A_n77A	1A_n41A, 41A_n77A	
WI-504	New Sub WI-504-NR_n257 (**NAS** Protocol Test)	n257	**FR2**
WI-504	New Sub WI-504-NR_n21 (**NAS** Protocol Test)	n21	
WI-510	New Sub WI-510-**2CC_CA_DL**_n1A-n28A; n28A-n77A, n3A-n77A	n1A-n28A; n28A-n77A, n3A-n77A	
WI-510	New Sub WI-510-**2CC_CA_UL**_n1A-n3A	n1A-n3A; n3A-n78A; n28A-n78A	
WI-510	New Sub WI-510-**3CC_CA_DL**_n1A-n3A-n28A	n1A-n3A-n28A	
WI-510	New Sub-WI 510-**4CC**_CA_DL_n1A-n3A-n28A-n78A	n1A-n3A-n28A-n78A	
WI-512	New sub-WI for WI-512-**5CC**_EN-DC_18A_n257I	18A_n257I	**FR2**
WI-513	New **RedCap prot.** sub Work Items for WI-513	n1_FDDx, n8_FDDx, n78_FDD_x: n1_FDD5; n5_FDD3; n5_FDD1; n5_FDD3; n78_FDD5	351 prot tc
WI-513	New **RedCap IRAT** subWIs of WI-513 between NR and LTE bands	n28_FDD3/8, n28_TDD39/40/41; n41_FDD3/8, n41_TDD39/40/41; n79_FDD3/8, n79_TDD39/40/41	
WI-530	New **RedCap** sub Work Items for WI-530 **IRAT**	n1_FDD1/3/8, n8_FDD1/3/8: n1-FDD5; n5-FDD3; n5-FDD1; n78-FDD5	
WI-530	New **RedCap IRAT** WI-530 subWIs between **NR and LTE** bands	n28_FDD3/8, n28_TDD39/40/41; n41_FDD3/8, n41_TDD39/40/41 n79_FDD3/8, n79_TDD39/40/41	
WI-534	New Sub WI-534-n21 **Rel-17 5G CP SoR for UE in Connected mode**	n21	
WI-545	New Umbrella and subWIs: WI-545 **Rel-17 DL 1024-QAM for NR FR1**	n1, n28, n78	5 RF Perf.; supported by CMCC, Telefonica, Telecom Italia, Vodafone

Conformance Test User Meeting 2024

NON-TERRESTRIAL NETWORKS (NTN)

NON-TERRESTRIAL NETWORKS

NB-IoT for NTN

Expand to global reach for IoT use cases across land, sea, and air

Diverse set of use cases across all verticals e.g.

- Higher resolution of data points in asset tracking and logistics
- Ubiquitous drone connectivity
- Boat position information
- Wearables connectivity
- Operates for both GEO and LEO altitudes, but predominantly GEO
- 8% of IoT market is addressable by NTN-IoT
- Mainly S/L bands

5G NR for NTN

Extended coverage that complements terrestrial networks

Direct link to smartphones for mission critical and low data services e.g.

- Disaster recovery
- Emergency services
- Financial services – payments
- Predominantly operates at LEO altitude
- 3G like speeds for smartphones <6GHz
- Fixed broadband services on VSATs >10GHz

Today   5G Advanced/6G

NB-IOT FOR NTN ON CMW500

NB-IoT for NTN

Expand to global reach for IoT use cases
across land, sea, and air

Diverse set of use cases across all verticals e.g.

- Higher resolution of data points in asset tracking and logistics
- Ubiquitous drone connectivity
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- Operates for both GEO and LEO altitudes, but predominantly GEO
- 8% of IoT market is addressable by NTN-IoT
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Protocol Conformance

- Test cases available since July 2023
- R&S is leading for first active GCF WI-333 (TPAC reached)
- Target for CAG #78
  - → completion of WI-333
  - → first validations for WI-257

RF / RRM

- RF/RRM test cases verified with all major chipsets
- Activation planned for WI-336 in CAG #78 by Rohde & Schwarz

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NB-IOT FOR NTN

#1

Rohde & Schwarz Drives Roll-Out of NTN NB-IoT Technology with New GCF-Certified Conformance Test Cases

Mountain View, CA/Munich / 21-Feb-2024
Skylo achieves successful phase 1 validation of NTN test plan with Rohde & Schwarz
Rohde & Schwarz has reached a major milestone: its NTN Netop test solutions have been accepted as part of Skylo's NTN Certification Program.

► CMW-IOT Setup CMW500 (SW upgrade)
  ✓ PCT
  ✓ RF Inband
  ✓ RRM
  ✓ Skylo test plan
    – NPT
    – PQA

► TS8980FTA-3 (SW upgrade)
  ✓ RF IB + OOB
  ✓ RRM

Easy SW upgrade from existing CMW500 or TS8980 to NB-IoT NTN

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NB-NTN CONFORMANCE AND NPT

All conformance and NetOp testplans run on the same setup!

5G NR NTN

5G NR NTN

Extended coverage that complements terrestrial networks

RF/RRM/PCT Conformance Test

- 3GPP RAN5 progress carefully observed
- Development on-going

First 5G NTN-NR test cases by end of '24

Direct link to smartphones for mission critical and low data services e.g.

- Disaster recovery
- Emergency services
- Financial services – payments
- Predominantly operates at LEO altitude
- 3G like speeds for smartphones <6GHz
- Fixed broadband services on VSATs >10GHz

Today

5G Advanced/6G

Source: GSMA Intelligence

Conformance Test User Meeting 2024
REDUCED CAPABILITY UE (REDCAP)

REDCAP

#1

▶ CMX500 FR1 Specialist

  – Supports RF-Inband

  – Supports RRM

  – Supports PCT

▶ TS8980FTA-3A

  – Supports RF-Inband and OOB

  – Supports RRM

▶ Smooth Upgrade from existing 5G setups

Munich / 28-Feb-2024

Rohde & Schwarz receives GTI Award 2024 for its 5G RedCap test solution

Rohde & Schwarz received the Innovative Breakthrough in Mobile Technology Award at GTI Awards 2024 for its R&S CMX500 radio communication tester's support of RedCap testing from early R&D to certification and conformance. The GTI Awards takes place during Mobile World Congress and recognizes industry achievements and successes in 5G development across a wide range of market segments.

Munich / 01-Jun-2023

Rohde & Schwarz takes lead in number of GCF-validated 5G RedCap conformance test cases

Rohde & Schwarz has successfully validated 5G RedCap (reduced capability) test cases for its R&S CMX500 one-box signaling tester and R&S TS8980 conformance test system for the recent Conformance Agreement Group (CAG) #74 meeting, allowing the Global Certification

Conformance Test User Meeting 2024

FR1 RF/RRM

3GPP CONFORMANCE
5G FR1 RF / RRM

Most compact full conformance test solution on the market!

S-4A Coverage vs. FTA-3A
- TX/RX ~70-80%
- PX 100%
- RRM 100%

TS8980S-4A (TP298)

TS-RRM-NR (TP296)

TS8980FTA-3A (TP298/TP296)

GCF
Global Certification Forum

TS8980S-4A

- ► One-Box-Test solution, cost-optimized (CAPEX & OPEX)

- ► RF Inband (Tx & Rx)
  3GPP 38.521-1 & 3

- ► RF Demod
  (Px: performance)
  3GPP 38.521-4

- ► RRM 3GPP 38.533

- ► Netop

- ► All 3gpp bands & CA/MIMO band combinations supported

CMX500 OBT FR1 SPECIALIST

Rohde & Schwarz

TS8980FTA-3A
5G FR1 RF / RRM

Smooth upgrade path from LTE

GCF / PTCRB TP 96 / 98 **for 2G / 3G / 4G**

+ TP 296 / 298 for 5G

ⓘ **SMW 6/20 GHz**
(with 500 MHZ BW)

☑ **FSW26 GHz**

☑ **SSCU3**

☑ **CMWC**

☑ **Rubidium refer.**

☑ **CMW500**

ⓘ **New cooling concept**

ⓘ **New CMX**

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Conformance Test User Meeting 2024
FR2 RF/RRM

3GPP CONFORMANCE + NETOP + CTIA 5G FR2 RF / RRM

TS8980FTA-M1 / PRE-M1

RF in-band **RRM** 1AOA	**RF** in-band + out-of-band **RRM** 1AOA	**RF** in-band + out-of-band **RRM** 1AOA + 2AOA

ATS1800**C**

ATS1800**C**
(with automatic feed switcher)

ATS1800**M**
(with automatic feed switcher)

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3GPP CONFORMANCE VALIDATION ROADMAP
5G FR2 RF / RRM

RF

- WI500
    - **100%** of what is validatable
- WI502 (Demod / Reporting)
    - 100% (July) of validatable
- WI512 (UL CA)
    - **100%** (in July) of validatable

RRM 100% ✓

NetOp:

- **ATT   100%** ✓
- **TMO 100%** ✓
- **VzW   100%** ✓

CTIA: 100% ✓

RED: IB and OOB ✓

FEATURE OVERVIEW

Compact, high dynamic, scalable, IB, OOB, ETC, mAoA RRM

- **Test plans: 3GPP, CTIA, ATT, VzW, TMO, RED**

- **All 3GPP TX, RX, Demod TC**

- **8CC in DL / 4CC in UL**

- **UL MIMO Rel.15 and 16**

- **CBW 50MHz, 100MHz, 200MHz**

- **Power Class 1, 2, 3, 4, 5, 6**

- **All types of Grids** (Step-Step, Charged Particle; Weighting: Clenshow-Curtis)

- **All UE alignments** supported

- **Resume functionality**

- **Stability, recovering mechanism, ETC, …**

TRP PCL1 UE

TRP PCL3 UE
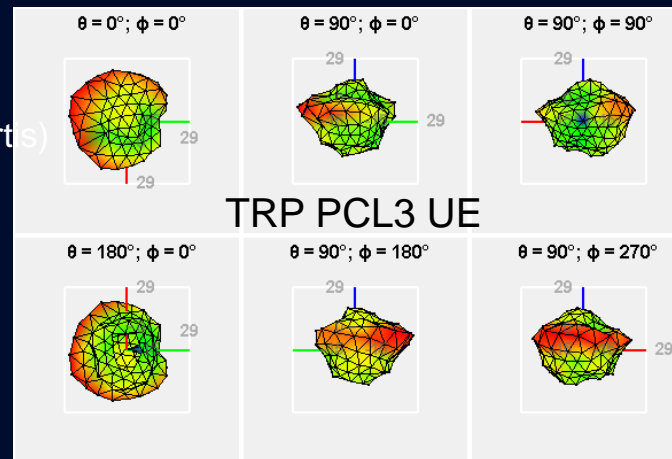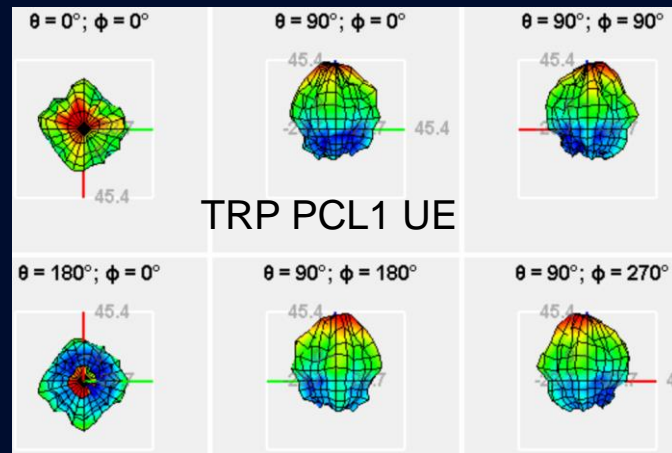
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PROTOCOL CONFORMANCE

5GS TTCN-3 ROADMAP + DRAFT ATS DELIVERY SCHEDULE

Date	ATS	Comments
22/03/24	24wk12	Rel-13/14 NB-IoT TCs applicable for NTN 5G Control Plane SoR Redcap IRAT TCs
14/06/24	24wk24	NR-NTN SON/MDT enhancements Power Saving enhancements
13/09/24	24wk37	NR 2Step RACH Small Data Transmission
13/12/24	24wk49	MUSIM Rel-18 Baseline updates

R&S CMX500 (TP 292) VALIDATION STATUS

TP 292

► **GCF (CAG#77) and PTCRB (PVG#104)**

- Total **581 individual EN-DC and NR PCT** test cases validated

- Currently **898** TC validated at PTCRB

- **> 12100** band combinations in GCF,

- **>9000** band combinations in PTCRB

- **R&S PCT is leading in GCF individual TC validation**

- **R&S PCT is leading in Rel16 GCF validation**

- **R&S is leading in GCF RedCap validation with**
  5 Rel 17 and 208 Rel 15 redcap variant TCs

UPGRADE PATH FROM NR FR1 TO FR2

FR1 configuration **+ IF boards + Remote Radio Head + chamber**

Thank you
very much

ROHDE & SCHWARZ

Make ideas real