Conformance Test User Meeting 2025

# TS8991
# OTA Performance test system

Stone Lin

# TS8991

**Turnkey OTA Performance Test System**

Chamber
+
Positioner
+
Rack w/ instruments
+
Contest software

- Full solution supporting 3GPP, CTIA SISO, CWG and A-GNSS for legacy and 5G
- Fast and easy to handle single antenna test system
- One-stop-shopping
- Worldwide installed base „Made in Germany“

# FOR INSTALLED BASE:
# 5G FR1 UPGRADE WITH CMX OBT

## Hardware upgrade

- CMX500 OBT lite or OBT
- 2x NRQ6
- OSP320
- accessories: cable set, amplifier, rack

## Software upgrade

- Contest software (supports all RATs)

# TS8991 BENEFITS

- One-stop-shopping: Chamber, positioner and T&M hard- and software
- Excellent build quality “Made in Germany” – “Made at Rohde & Schwarz”
- Planning, integration and system training by experienced OTA engineers
- Various system service level agreements available for worldwide services
- Worldwide installed base with many reference customers

Conformance Test User Meeting 2025

# Navigating the Latest Updates in Regulatory Testing for Wireless Devices

Stone Lin

# Validation Tests secure market access of wireless products

## Diverse compliance or certification are required

***Wireless Products***

**Network Operator Acceptance Test**

Demonstrate interoperability for specific features in network

- AT&T
- T-mobile
- …
- VzW
- CMCC

**Telecom Industry Certification Test**

Enable the high quality, reliable, and secure wireless communication according to technology standards

- GCF/Cellular
- FiRa/UWB
- …
- SIG/Bluetooth
- WiFi Aliance/WiFi

**Regulatory Compliance Test**

Grant market access under legal aspect in regions

- CE RED
- FCC
- …

***Market Access***

# Wireless products need CE marking/FCC ID
## No regulatory compliance means NO market access!


Testing according to regulatory standards is a mandatory step in the demonstration of compliance.

**Test results are part of 'technical documentation':**

- be prepared before placing product on the market
- be made available to surveillance authorities
- be kept for 10years from placed on the market

Link

**Testing is performed by an FCC-recognized accredited testing laboratory.**

Link

# 4 essential requirements under CE RED

## Tons of EN standards for wireless devices

### Art3.1a Health & Safety Art

Directive 2014/35/EU (LVD)
CENELEC - EN 50360
**Specific Absorption Rate**

### Art 3.1b EMC

EN 301 489-1 Common
EN 301 489-17 WLAN
EN 301 489-19 GNSS
EN 301 489-33 UWB
EN 301 489-50 Cellular BS
EN 301 489-52 Cellular UE
EN 301 489-?? …

### Art 3.2 Radio Spectrum

EN 300 328 WLAN2.4GHz
EN 301 893 WLAN5GHz
EN 303 687 WLAN6GHz
EN 301 908-1 Cellular Common
EN 301 908-2 WCDMA UE
EN 301 908-3 WCDMA BS
EN 301 908-13 LTE UE
EN 301 908-14 LTE BS
EN 301 908-24 5G NR BS
EN301 908-25 5G NR UE

### Art 3.3 Specific topics

Guideline 2019/320 (E112)
Emergency service

Standard list is examples, not holistic!

# FCC compliance requirements are outlined in 47CFR ANSI C63 standards and FCC KDBs give guidance for testing

| Cellular in licensed bands | Satellite/NTN In licensed bands | WiFi&Co In unlicensed | Ultra Wideband |
|---|---|---|---|
| 47CFR §2/22/24/27/… | 47CFR §25 SATELLITE COMMUNICATIONS | 47CFR§15C/E<br>**2.4GHz** ISM band - §15.247& KDB558074<br>**5GHz** UNII(1-4)bands - §15.407/247&KDB789033/905462(DFS)<br>**6GHz** UNII(5-8)bands - §15.407& KDB987594 | 47CFR §15F<br>Ultra-Wideband Operation |

ANSI C63.26 American National Standard for Compliance Testing of Transmitters Used in the Licensed Radio Service

ANSI C63.10 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

- IEEE Std 1528™-2013 IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
- C63.19 American National Standard Methods of Measurement of Compatibility Between Wireless Communications Devices and Hearing Aids


Rohde & Schwarz

CMsequencer

EMC& Regulatory Test

TS8996

TS8997

FSW43

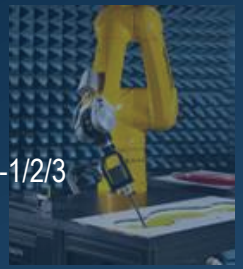
FSV3044

# 3.1a Health&Safety - SAR test
## 5G NR, HAC, TA-SAR

Art3.1a
Health & Safety

**Specific Absorption Rate (SAR)**

EN 50360
EN 50566
EN 50663
EN 50665
EN 62209-1/2/3



SAR
47CFR§2.1093/IEEE1528™

HAC
47CRF§68.4/
C63.19 Hearing Aid Compatibility

**Test requirement and Solution trend**

- EN62209-3 & Vector Probe Measurement method in EU
- Revision of FCC HAC requirements
- Upgrading SAR system (Scanning or Vector Probe Measurement) with 5G NR, NTN, RedCap, etc
- Time-Average SAR

**Impactful progress by R&S**

- Improved CMX500 OBT stability& receiver dynamic range enhance stabile radio link
- In-box Data Application Unit for VoNR/VoLTE/VoWi-Fi features simplify the audio support for HAC test needs
- Enhance collaboration with SAR system vendors
- Support chipset vendors for TA-SAR testing

CMW500

CMX500

VNA and VSG help the calibration of SAR test system.

# 3.1b EMC
## New technology for legacy EMC test systems

| Art 3.1b EMC | |
|---|---|
| **EMC** | |
| EN 301 489-1 V2.2.3 | Common |
| EN 301 489-3 V2.3.2 | SRD |
| EN 301 489-17 V3.2.5 [DRAFT] | WLAN |
| EN 301 489-19 V2.2.1 [DRAFT] | GNSS |
| EN 301 489-20 V2.2.1 | MES/NTN |
| EN 301 489-33 V2.2.1 | UWB |
| EN 301 489-52 V1.2.1 | Cellular |
| EN 55032:2015 + A11:2020 | Multimedia (Emission/Immunity) |
| EN 55035:2017+A11:2020 | |

### Test requirement and Solution trend

- More EMC test chambers are ready for new tech, like 5G NR/RedCap, NTN, WiFi6E/7 etc
- More EMC test chambers are combined with RSE test.
- More upgrade of ABT test

### Impactful progress by R&S

- ELEKTRA SW continuedly support 5G NR and further tech evolution.
- CMX OBT as communication link got WLAN signaling beside LTE&5G NR/RedCap.
- CMW as legacy communication link support NB-IoT-NTN

TS9982 EMS&TS9975 EMI systems

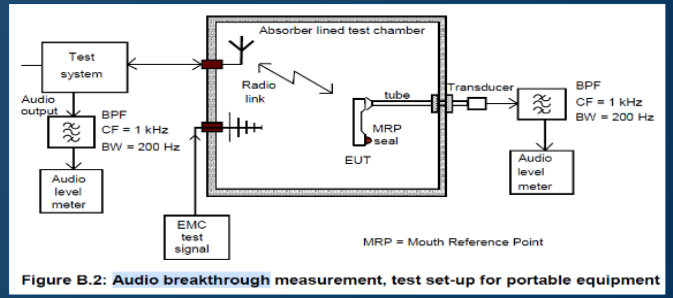



Figure B.2: Audio breakthrough measurement, test set-up for portable equipment

Application Note about ABT(link)

# 3.2 Radio Spectrum
## ETSI Technical Committee working groups and standards

**MSG**
**Mobile Standards Group**
Responsible for the IMT mobile telecommunications family, to take account of the new specifications in 3GPP Releases.

| | |
|---|---|
| EN 301 908-1 | Cellular Common |
| EN 301 908-2 | WCDMA UE |
| EN 301 908-3 | WCDMA BS |
| EN 301 908-13 | LTE UE |
| EN 301 908-14 | LTE BS |
| EN 301 908-24 | 5G NR BS |
| EN 301 908-25 | 5G NR UE (draft) |

…

**BRAN**
**Broadband Radio Access Networks Group**
Responsible for RLAN &Co in 5GHz/6GHz and other bands

| | |
|---|---|
| EN 301 893 | RLAN 5GHz |
| EN 303 687 | RLAN 6GHz |
| EN 300 328 | 2.4GHz (by ERM-TG11 group) |
| EN 302 502 | BFWA 5.8GHz |
| EN 301 598 | WSD TVB |
| EN 302 567 | RLAN 60GHz |

…

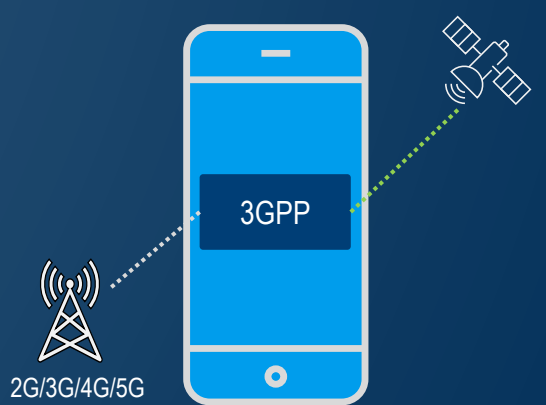
**SES**
**Satellite Earth Stations and Systems Group**
Responsible for all aspects related to satellite earth stations and systems.

EN 301 441
EN 301 442
EN 301 444
EN 301 681
EN 302 574
EN 303 981
…

**Question:** **How about smartphones with NTN technology?**

# 3.2 Radio Spectrum

## NTN capable deice technology and market view

| | Proprietary Satellite Link | 3GPP NTN | Direct to Cell |
|---|---|---|---|
| Technology |  | • NTN-IoT R17<br>• NTN-NR R18<br>  |  |
| Market | • Commercialized<br>• Global presents | • Commercialized with NTN-IoT<br>• Chipsets Released with NTN-NR<br>• Global presents | • Temporary commercialized in US<br>• Global presents? |

# 3.2 Radio Spectrum
## Status with standards under EU RED & FCC

| CE RED Art3.2 | Earth-to-space in MHz | Space-to-earth in MHz | Note |
|---|---|---|---|
| EN 301 441 | 1610-1626.5 | 1613.8-1626.4<br>2483.5-2500 | S-PCN (Satellite-Personal Communications Network) |
| EN 301 442 | 1980-2010 | 2170-2200 | NGSO (Non-geostationary satellite systems); S-PCN |
| EN 301 444 | 1626.5-1660.5<br>1668-1675 | 1525-1559<br>1518-1525 | LMES(Land Mobile Earth Stations);<br>MMES(Maritime Mobile Earth Stations) |
| EN 301 681 | 1626.5-1660.5<br>1668-1675 | 1525-1559<br>1518-1525 | GSO(Geostationary satellite systems);S-PCN;<br><15dBW(45dBm) |
| EN 302 574 | 1980-2010 | 2170-2200 | GSO |
| EN 303 981 | 14000-14500 | 10700-12750 | NEST (Non-geostationary satellite systems)<br>WBES (Wide Band Earth Station) |

iridium Globalstar inmarsat OneWeb STARLINK

- A group of existing EN standards from SES group can be used for devices with NTN.
- FCC CFR47§25 for Mobile Satellite Service is the regulations for US market access.
- CE RED/ETSI and FCC are working on regulation adaptation for future mobile satellite communication services. Stay tuned!


Check this ETSI magazine!

# NTN test requirements and solutions

| EN 301 681 Test Cases |
|---|
| Unwanted emissions outside the band |
| Unwanted emissions within the band |
| Unwanted emissions in carrier-off state |
| Protection of the radio astronomy service operation (1660 to 1660,5)MHz & (1668 to 1670)MHz |
| Receiver Adjacent Channel Selectivity |
| Receiver Blocking Characteristics |
| MES Control and Monitoring Function (CMF)<br>Processor monitoring |
| Equipment identity |

| CFR47 §25 MSS/MES Test Items | |
|---|---|
| RF Output power | §25.204(a) |
| Occupied bandwidth | 2.1049 |
| Emission mask within 25% of authorized BW | 25.202(f 1&2) |
| Out of band emissions | 25.202(f 3) |
| Additional unwanted emission (1559-1610MHz) | 25.216(c&g) |
| Carrier-off State Emissions (1559-1610MHz) | 25.216(i) |
| Frequency Stability | 25.202(d) |

## Required Instruments

**Spectrum analyzer** (30MHz-12.75GHz)

**R&S®FSV(A)3000**

10 Hz to 4 / 7.5 / 13.6 / 30 / 44 / 50 / 54 GHz

**Signal Generator** (CW& unwanted signal)

**R&S®SMBV100B**

**Network emulation for 3GPP NTN**

**R&S®CMX500**

**R&S®CMW500**

# 3.2 Radio Spectrum – Cellular Technology

## Overview of test system solutions

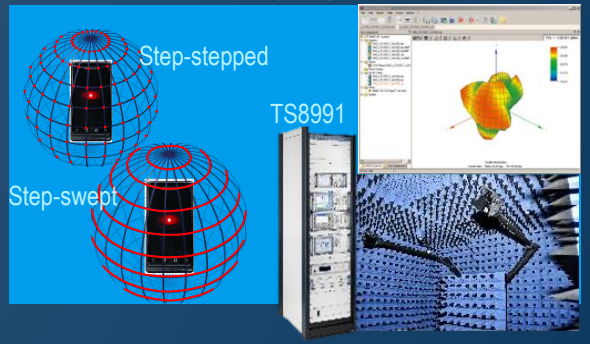
**"3GPP" test cases**

- Transmitter maximum output power
- Transmitter minimum output power
- Transmitter spectrum emission mask
- Transmitter Adjacent Channel Leakage Power Ratio
- Transmitter spurious emissions
- Receiver Reference Sensitivity Level
- Receiver adjacent channel selectivity (ACS)
- Receiver blocking characteristics
- Receiver spurious response
- Receiver intermodulation characteristics
- Receiver spurious emissions
- Transmit OFF power


- Almost the same RF conformance test cases in 3GPP
- 5G NR specification needs support of FR1/FR2/FR1+FR2
- FR1 test setup stays conducted; FR2 test setup become radiated

**"CTIA-OTA" test cases**

- Receiver Total Radiated Sensitivity (TRS)
- Total Radiated Power (TRP)

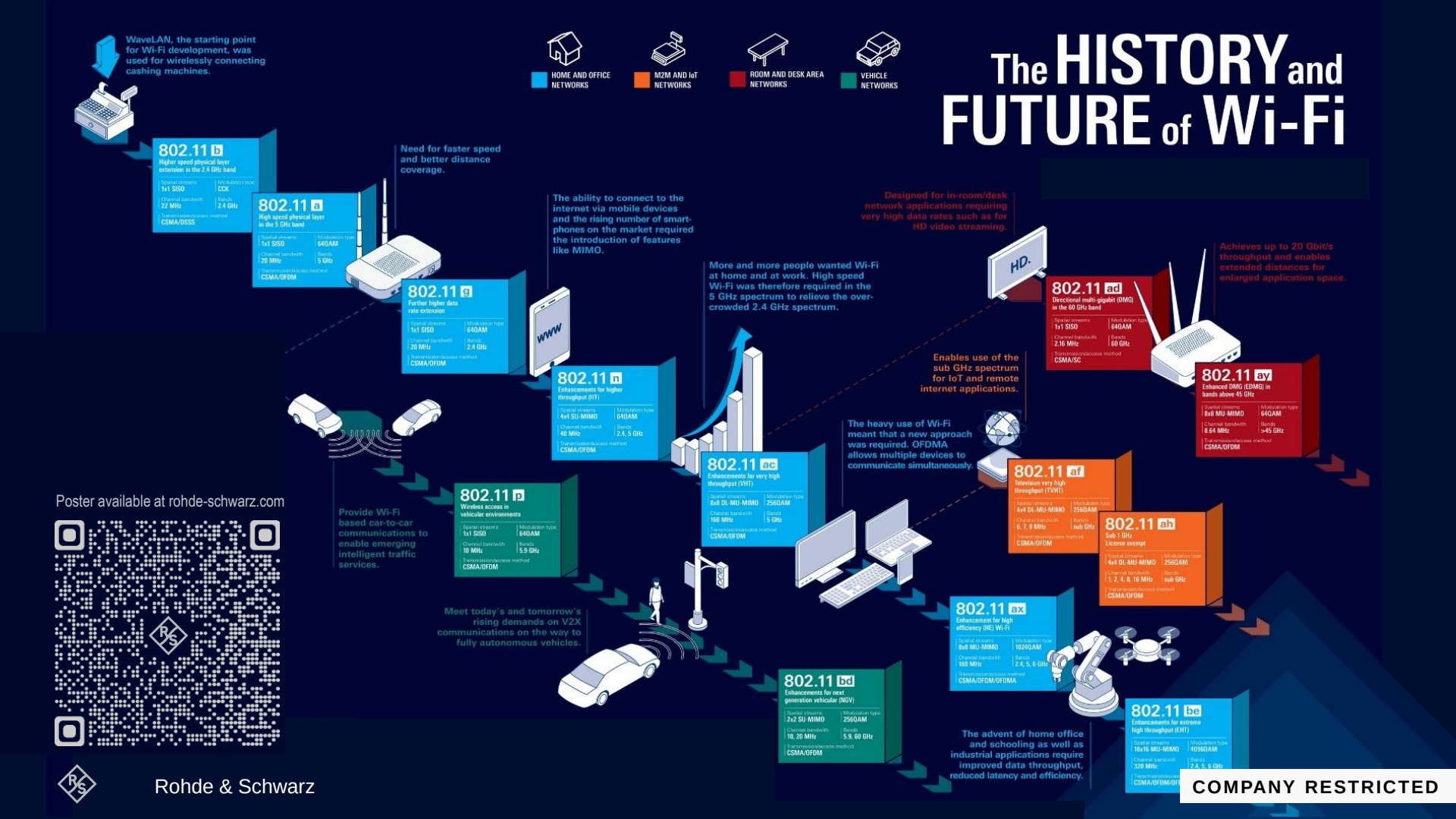



**"RSE" test case**

- Radiated Spurious Emissions

- Measurement up to 200 GHz(FCC) for 5G FR2 with high sensitivity of -40 dBm/MHz
- Special signaling Conditioning for carrier
- All standards support

# The HISTORY and FUTURE of Wi-Fi

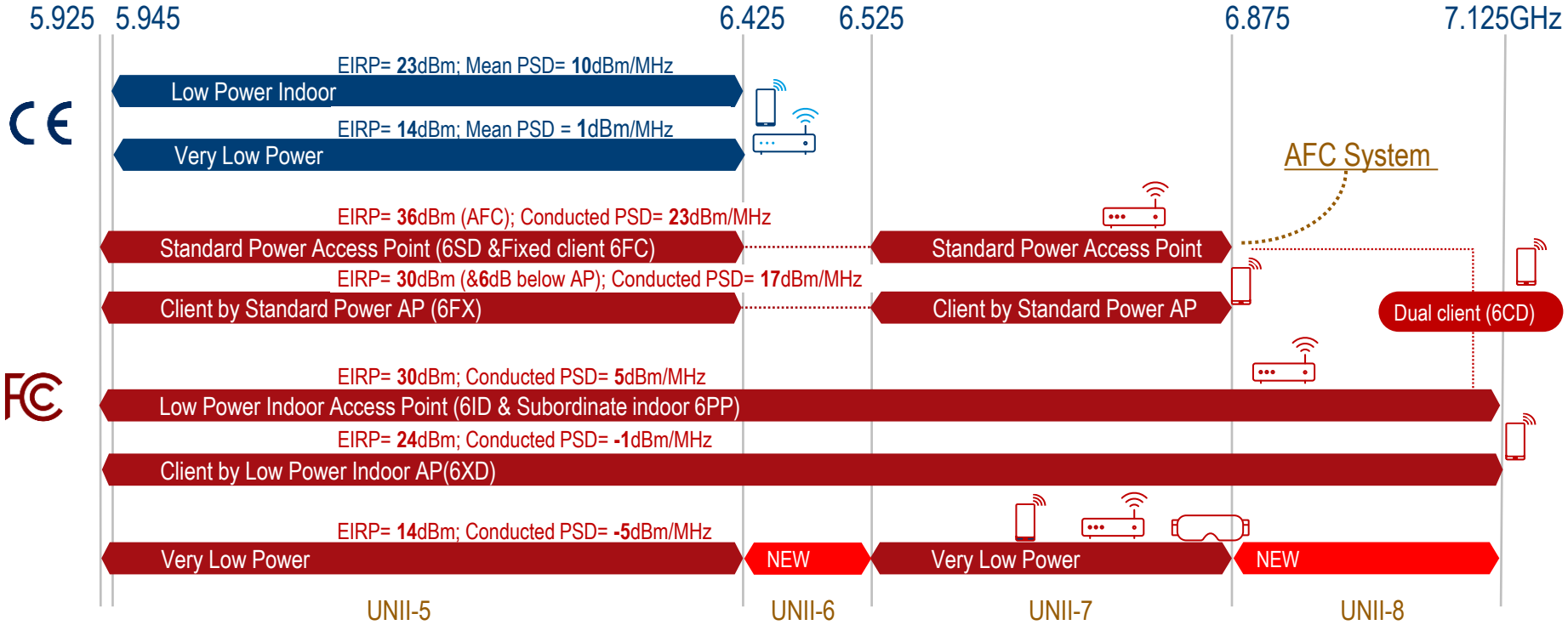



Poster available at rohde-schwarz.com

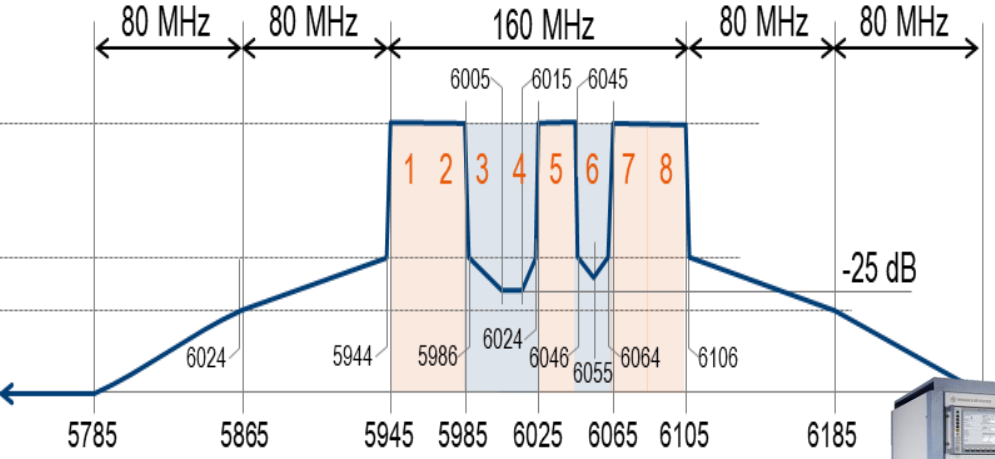
Rohde & Schwarz

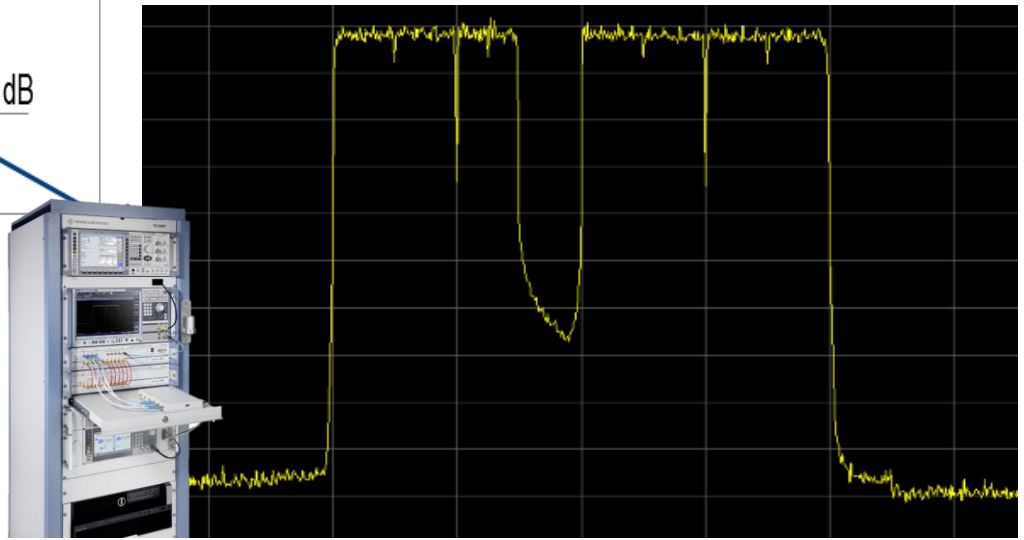
EN 300 328
EN 301 893
EN 303 687
47CFR 15.407

# RED vs. FCC Requirements at unlicensed bands
## Similar Wording, Differences in Details



# Wi-Fi 7 introducing New Test Case Requirements
## Unwanted emissions

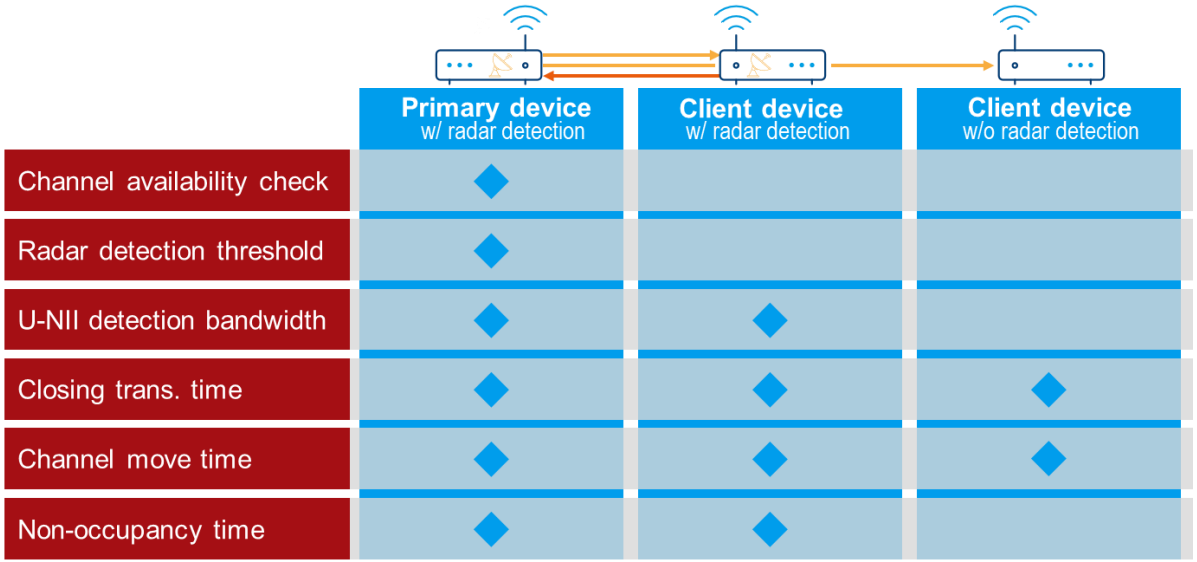


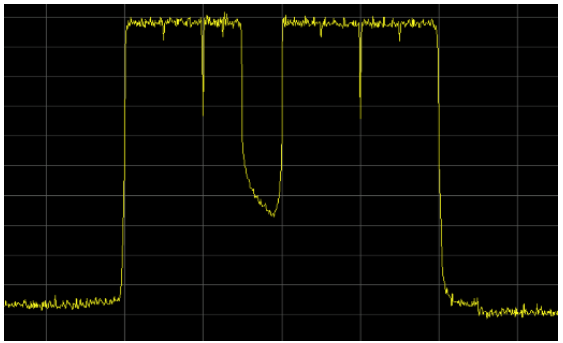
WiFi7 Multi-channel operation/ preamble puncturing feature introduced complex unwanted emission mask.

# Wi-Fi 7 introducing New Test Case Requirements

## 5GHz DFS test is required by preamble puncturing technique




Challenge: When WiFi7 AP and client take preamble puncturing technique for DFS case in 5GHz band, CE RED and FCC DFS test requirements are needed.

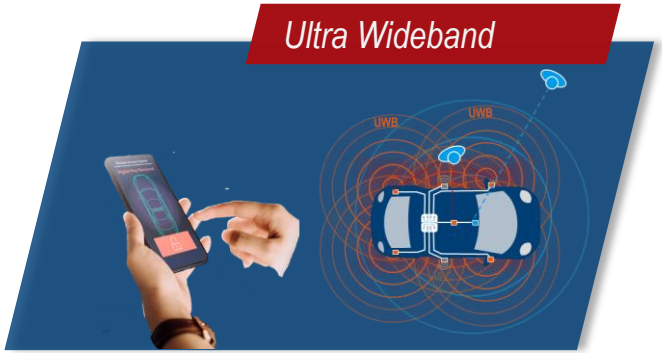


We are working on test solutions with CMX500 WLAN signaling functionality to support some of these cases. Verification test **PARTNER IS WANTED!**

R&S®CMX500

# Regulations for UWB are earlier than present applications

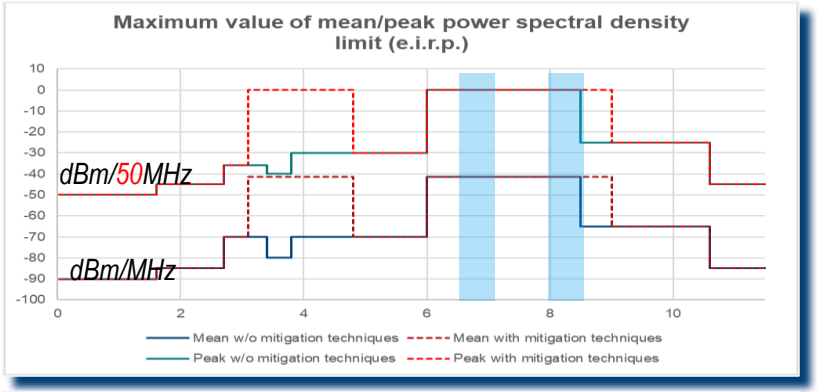
## The minimum bandwidth and highest power are key parameters

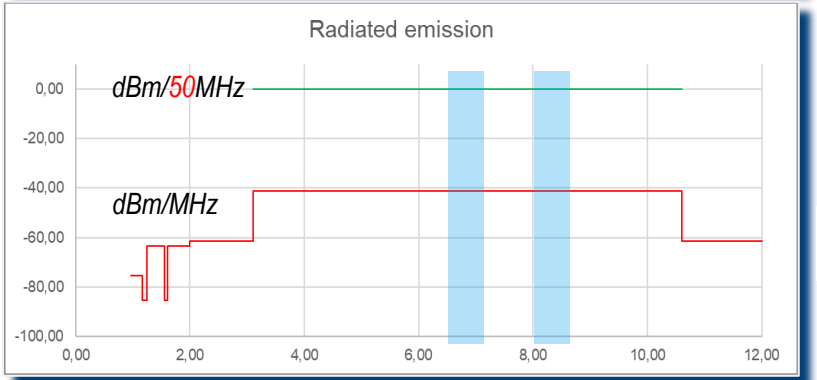



- UWB car-key and allocation trackers are popular products.
- Most chipsets support Channels 5 (6.5 GHz) and 9 (8 GHz) and 500MHz bandwidth.
- Regulators in many countries have concern of the interference by UWB devices.

R&S®SMW200A
[12.75 GHz; 2 GHz BW]

R&S® FSW43
[FSW-B8 50MHz RBW]




**EN 302 065-1/2/...**
**EN 303 883-1/2**
**EN 301 489-33**

**CFR47**
**/§15/Subpart F**

**Challenge:**
an issue for traditional measurement method*:
"When using resolution bandwidths below 50MHz, this method **overestimates** the **peak power** result for most UWB signals due to the **worst-case** correction factor

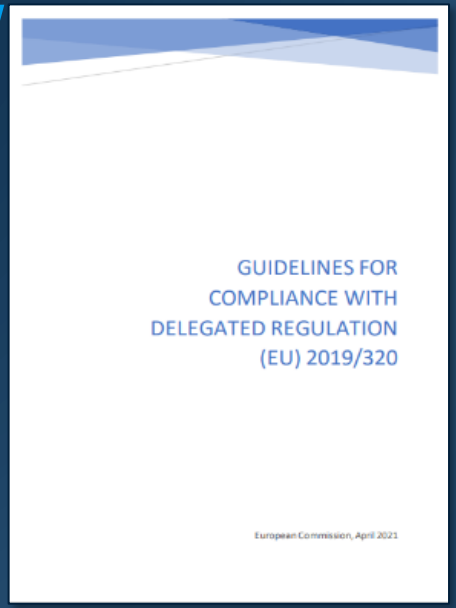
$$Corr_{dB} = 20 \times \log_{10}\left(\frac{50\ MHz}{RBW_{used}\ [MHz]}\right)$$

50MHz RBW helps!

# 3.3g Special smart phone RED requirement
## A regulatory compliance requirement without ETSI standard

Art 3.3g
Specific topics

**E112**
**Guideline 2019/320**
**Emergency service**




All smartphones sold in the European Union have to be compliant as of March 17, 2022, with the Delegated Regulation (EU) 2019/320. It defines that 112 emergency calls provide caller location information to emergency services in a fast and accurate way, to make sure first responders can arrive at the site of an accident quickly.

Notified body has to be involved, when there is no EN standard available. R&S TS-LBS location-based services test system is the first test solution available to perform the necessary LBS compliance tests.

# Designing mobile phones and tablets to be sustainable
## new Energy Efficient Index from EU Eco-Design Directive

- **COMMISSION DELEGATED REGULATION (EU) 2023/1669** of 16 June 2023 supplementing Regulation (EU) 2017/1369 of the European Parliament and of the Council with regard to the **energy labelling of smartphones and slate tablets**
- …It shall **apply from 20 June 2025**.
- ANNEX II Energy efficiency classes & ANNEX IV: **Measurement and calculation methods**
- ANNEX Iva EEI **test specifications**: https://ec.europa.eu/docsroom/documents/50214
- ETSI TECHNICAL COMMITTEE (TC) ENVIRONMENTAL ENGINEERING (EE) got mandate to develop harmonized standard.



GSMA MWC Barcelona

Press release about joint CMX demo in MWC2024

# MY BUZZWORDS IN WIRELESS TECHNOLOGY

Wi-Fi 7

NTN

RedCap

UWB

FR3

O-RAN

AI/ML

Energy awareness