5G Devices Over the Air Performance

by NGMN Alliance

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Abstract

The purpose of this document is to provide a survey and analysis of 5G Devices OTA test methodologies and performance requirements defined by the most relevant Standard Development Organizations in the mobile industry.
Furthermore, this White Paper is aimed at providing NGMN recommendations on best practices and best ways forward for getting consensus, among mobile industry players, on the definition of 5G Devices OTA performance requirements not yet finalized.

Contents

1 INTRODUCTION

This document presents the up-to-date progress of 3GPP, GSMA, PTCRB/CTIA, CCSA and ETSI MSG Standard Development Organizations about definition of standard test methodologies and requirements for performance of 5G Devices.
Furthermore, this White Paper is aimed at providing NGMN recommendations on best practices and best ways forward for getting consensus, among mobile industry players, on the definition of 5G Devices OTA performance requirements not yet finalized.

2 3GPP RAN4 WORK PLAN AND RESULTS FOR NR OTA

3GPP RAN4 has been working on NR OTA test methodologies and performance requirements for NR devices on FR1 and FR2, both NSA and SA at least since 2019. The up-to-date status is as follows:

NR MIMO OTA test methodologies and performance requirements related SI/WIs:

The Rel-16 SI: Study on radiated metrics and test methodology for the verification of multi-antenna reception performance of NR UEs was focused on developing test methodologies of NR MIMO OTA, for FR1 and FR2, in both cases of SA and NSA mode. The SI was closed in RAN#88e meeting with 100% completion level. The outcome of this SI is captured in the published 3GPP TR 38.827 V16.0.0.
This SI has defined the radiated metrics and end-to-end test methodology for the verification of multi-antenna reception performance of NR UEs in FR1 and FR2 and the associated preliminary measurement uncertainty budgets.
There are two radiated metrics that have been defined the MIMO OTA throughout and the average of different throughput curves relative to the DUT positions.
Based on the outcome of this SI, a new Rel-17 WI has been started to finalize the performance requirement of NR UEs.

The new Rel-17 WI: WI on Multiple Input Multiple Output (MIMO) Over-the-Air (OTA) performance requirements for NR UEs was approved in RAN RAN#88e meeting. This WI is focused on specifying the minimum performance requirements for NR MIMO OTA, both FR1 and FR2. The outcome of NR MIMO OTA WI will be captured in the 3GPP TS 38.151.

NR SISO OTA test methodologies and performance requirements related SI/WIs is separated into two parts:

All the FR2 UE RF, RRM and Demodulation requirements are verified by OTA approach. Considering the Maximum Output Power (MOP) and Reference Sensitivity (REFSENS) tested under OTA condition were always taken as SISO OTA performance, so the status of FR2 MOP and REFSENS (subset of the 3GPP FR2 UE RF test cases) is as follows:

The Rel-15 SI: Study on test methods for New Radio was focused on defining the over the air (OTA) testing methodology for UE RF, UE RRM, and UE demodulation requirements; This SI was closed in RAN#82 meeting with 100% completion level. The outcome of this SI is captured in the published 3GPP TR 38.810 V16.5.0.
The related FR2 MOP and REFSENS requirements are specified in 3GPP TS 38.101-2 and 3GPP TS 38.101-3.
A Rel-17 SI: Study on enhanced test methods for FR2 was approved to enhance the FR2 UE RF test methodology. The outcome of this SI will be captured in 3GPP TR 38.884.

With respect to potential distinction between different frequency bands belonging to same Frequency Range, it is to be considered that RAN4 will only specify FR1 4x4 MIMO OTA requirement for 4Rx antenna bands (e.g., Band n41, n77, n78 and n79).
From test methodology perspective, the potential MU assessment of FR1 MPAC MIMO OTA system for FR1 low frequency (410MHz<f≤3GHz) and FR1 high frequency (3GHz <f≤7.125GHz) could be different.
The FR2 MOP and REFSENS requirements defined in 3GPP TS 38.101-2 and 3GPP TS 38.101-3 for n257, n258 and n261, is different from band n260 and n259.
A Multiband relaxation framework was agreed to introduce a per-band relaxation for FR2 MOP and REFSENS, due to UE supporting for multi-band operation.

At 3GPP TSG-RAN Meeting #91-e, the new Work Item "Introduction of UE TRP (Total Radiated Power) and TRS (Total Radiated Sensitivity) requirements and test methodologies for FR1 (NR SA and EN-DC)" was approved, with following justifications and objectives:
Until now, the UE FR1 transmit power and receiver sensitivity are tested by conducted methodology at the temporary antenna ports and it remains unknown what the actual performance of the UE would be in realistic network conditions with the UE antenna included. Radiated performance based on OTA testing is one of the most important characteristics to verify the entire UE performance under conditions more closely resembling the end user's interaction with the device.
To ensure good overall system performance, the requirements for NR UE TRP and TRS is important for consistent devices performance in the real NR networks which operate in the OTA manner. Unified requirements in 3GPP will provide authoritative guidance and will greatly promote the development of 5G industries.

The objective of this Work Item is to extend SISO OTA methodology defined in TR37.902 to NR FR1 (NR SA and EN-DC) and to specify FR1 TRP and TRS performance requirements for both SA and EN-DC UEs.
For Core part of WI, 3GPP intentions are to investigate and specify the following aspects:

- General aspects
    - Considering the following Device types:
        - Smartphone (Considering UEs with antenna configurations of 1Tx, 2Tx, 2 Rx and 4 Rx)
        - Tablet
        - Laptop embedded equipment (LEE)
        - Laptop mounted equipment (LME)
    - Test scenarios:
        - For Smartphone, head/hand phantoms testing configuration is the first priority
        - For other device types,
        - Free space (FS) testing configuration is the first priority (OTA performance requirements with head/hand/Laptop ground plane phantoms are second priority)
    - Environmental conditions:
        - Normal temperature and voltage test conditions

- SISO OTA Test methodology enhancement
    - Specify necessary enhancements of the SISO OTA test methodology for NR FR1 TRP and TRS, e.g.
        - Using the test methodology defined in TR37.902 as well as the associated aspects related to measurement uncertainty in TR25.914 and section 4.2 of TS 37.144 as the basis for NR FR1
        - Support UE operating frequency in the range of 410 MHz – 7125 MHz (i.e., test methods will cover all the NR FR1 bands)
        - Support up to 100 MHz CBW
        - Define the configured power settings for EN-DC (1 CC LTE with 1 CC NR)
        - Develop the Measurement Uncertainty (MU) assessment [RAN5] (Measurement Uncertainty (MU) aspects will be handled by RAN5 and the conclusions can be captured in a separate section of TR)
    - Consider UE with multi-antenna under SISO OTA Test Methodology, e.g.

        - Study whether a test procedure for UL Transmit Diversity of SA, if this feature is supported by UE, is needed (This task shall not start until RAN4 concludes on all of the corresponding requirements related to UL Transmit Diversity of SA)
        - Consider how to treat the UE with Tx switching and ensure predictable verification of TRP results
        - Consider how to treat the UE with multiple antenna receivers and ensure predictable verification of TRS results
    - Consider whether exceptional requirements to be tested for EN-DC TRS is needed, this will be treated as second priority
        - Example: NSA TRS requirements for potential UE self-interference due to IMD3 in EN-DC
    - Consider the testing time reduction for TRP and TRS among the bands and EN-DC band combinations that UE support
        - Example: Alternative Single Point Offset TRP/TIS Test is not precluded

During the course of this work item, ongoing communication with 3GPP RAN WG5, CTIA OTA Working Group, CCSA TC9 WG1, GCF, ETSI MSG TFES and PTCRB will be maintained to ensure industry coordination on this topic.

- Performance part framework
    - Define a framework on how to handle requirements task for SA and EN-DC TRP and TRS before collecting trustable UE measurement results, the requirements task will follow the framework strictly
    - Main actions in the framework in sequence:
        - Requirements task should be a step-by-step approach, bands selected as first priority in the WID will be defined for the first step
        - Decide the minimum number of devices (e.g., at least 20) for defining requirements
        - Start lab alignment activity among volunteered certified labs before collecting measurement results
        - Select sufficient devices those are commercially available in the market, and the measurement results of these devices from the aligned labs should be submitted for data processing
        - Specify the requirements based on the measurement results with a per-band approach

- Start with one type of device requirement which is most efficient to collect enough results
- Only specify 4Rx requirement for n41, n78, n79
- Specifying requirements of SA with 1 CC is the first priority
- Define clear process of submitting and processing the measurement results (e.g., example decide which entity collects and manages the data)

- Specify final requirements
  - Specify the NR FR1 SISO SA TRP and TRS requirements and tolerance:
    - Band n41, n28, n78, and n79 for PC3 and PC2 UEs are the first priority
    - Define the detailed requirements of the selected bands based on the conclusion of above requirement definition framework

  - Specify the FR1 EN-DC TRP and TRS requirements and tolerance:
    - For EN-DC, only NR requirements will be specified, and no additional LTE requirements will be introduced.
    - Only consider EN-DC combinations of 1 CC LTE with 1 CC NR
    - Band n41, n28, n78, and n79 related EN-DC band combinations for PC3 UEs are the first priority
    - Further limiting the number of EN-DC band combinations
    - Define the detailed requirements of the selected bands based on the conclusion of above requirement definition framework

3 GSMA TSG WORK PLAN FOR NR OTA

5G NR Sub-6G OTA Work Plan (Starting from 1H 2020)

Step1: To discuss the test method and configuration, 3GPP TS 38.521
Step2: To discuss the NR Bands to be tested for SA and the NR-LTE bands combination to be tested for NSA
Step3: To discuss the test configuration
Step4: To launch a GSMA test campaign
Step5: To discuss the test results and align the operator accepted values
Step6: To update the TS.24 with 5G NR sub-6GHz OTA values

4 PTCRB AND CTIA WORK PLAN AND RESULTS FOR NR OTA

In terms of 5G NR FR1, in 2018 CTIA Certification extended its existing TRP/C-TIS methodology to 5G NR FR1 in Stand Alone (SA) mode. Combined TIS (C-TIS) is utilized to measure the OTA performance of the UE with all receivers active. C-TIS is similar to the 3GPP TRS quantity as TRS is also measured with all receivers active. This TRP/C-TIS testing, which includes the use of phantoms, was incorporated as an informative appendix to Version 3.9 of the CTIA Certification Test Plan for Wireless Device Over-the-Air Performance, published in November 2019.

Subsequently, the OTA Working Group CA Task Force completed a novel TRP/C-TIS methodology for 5G NR FR1 EN-DC which, together with CTIA Certification's 5G NR FR1 SA methodology, will become normative in Version 4.0 of the CTIA Certification OTA test plan, which is scheduled for release in early 2021. The OTA Working Group CA Task Force developed TRP and C-TIS test methodologies for 5G NR FR1 EN-DC combinations with 1 CC LTE and 1 CC NR. The 5G NR FR1 EN-DC OTA test methodologies for TRP and C-TIS are based on the 3GPP UE RF test cases for maximum output power and reference sensitivity, respectively, with the following differences:

- TRP is measured for each RAT. The RAT under measurement operates at maximum output power while the output power of the other RAT is minimized.
- C-TIS is measured for each RAT using a 50% uplink output power split between LTE and NR in case the UE supports simultaneous LTE and NR uplink operation. In case the UE only supports single uplink operation, uplink power is set to maximum, and no uplink traffic is scheduled on the RAT not being tested (e.g., when measuring NR, no uplink traffic shall be scheduled on LTE).

In terms of 5G NR FR2, CTIA Certification formed a dedicated 5G millimetre-Wave OTA Sub-Working Group in 2018 to progress with an OTA performance test methodology. The group finalized Version 1.0.1 of the CTIA Certification Test Plan for millimetre-Wave Wireless Device Over-the-Air Performance, which was published in April 2020.

The 5G millimetre-wave test plan is based on a small subset of the 3GPP UE RF test cases, i.e.,

- Maximum Output Power (MOP)
    - Peak EIRP
    - TRP

    - Spherical Coverage
- Reference Sensitivity (REFSENS)
    - Peak EIS
    - Spherical Coverage

This set of test cases was identified to reliably assess the radiated RF power and receiver performance of 5G millimetre-wave capable wireless devices while operating in the EN-DC mode for FR2 bands n260 and n261.

CTIA Certification's test methodology differs from 3GPP in some respects. For example, CTIA Certification focused on the use of a single Quiet Zone (QZ) size of 30 cm (in diameter) due to the upcoming introduction of phantoms that cannot fit into a QZ of less than 30 cm. In comparison, 3GPP decided to select 20 cm and 30 cm QZ sizes. Additionally, CTIA Certification defined a single TRP quadrature and PDF scaling approach for constant-step size grids based on the Clenshaw-Curtis weights. 3GPP decided to select both the Clenshaw-Curtis and sin(theta) based weights. Most importantly, CTIA Certification augmented the amplitude quality of Quiet Zone validation with a phase validation to evaluate the phase variation inside the quiet zone. Finally, CTIA Certification introduced two Quiet Zone phase quality procedures, i.e., the rotary scan and the field probing approach. In 3GPP, only the amplitude quality of the Quiet Zone approach was adopted.

The Near Field Phantom OTA Sub-Working Group is progressing with the definition of suitable millimetre-wave phantoms, i.e., head phantoms, one-handed and two-handed grip hand phantoms. The inclusion of phantoms is intended for inclusion in a 2021 / 2022 revision of the 5G millimetre-wave test plan.

CTIA Certification has not currently defined pass/fail requirements for any of the FR1 and FR2 OTA test cases.

5 CCSA WORK PLAN AND RESULTS FOR NR OTA

5.1 CCSA Completed standards for NR

Recently, China Communications Standard “Measurement method for radiated RF power and receiver performance of wireless device Part 9：5G NR wireless device (Sub-6GHz)” has been completed.

After many rounds of discussion, test procedures and performance requirements (SA n41 SISO) for radiated RF power and receiver performance are defined in this Standard.

- TRP test methods for SA SISO in this standard
  The NR base station simulator is configured according to the parameters defined in 3GPP TS 38.521-1, 6.2 on the measurement of maximum output power, and a loop back test mode is established between the EUT and the base station simulator. During the measurement process, the base station simulator sends power control instructions to the EUT according to the definition in 3GPP TS 38.521-1, 6.2.1 to ensure that the EUT is transmitted at maximum power throughout the measurement process, without considering the influence of MPR and A-MPR configuration. The current version of the standard only covers test methods for 1TX EUT.
- TRP test methods for EN-DC in this standard
  The NR base station simulator and the LTE base station simulator are configured according to the parameters defined in the section on maximum output power measurement of 3GPP TS 38.521-1 6.2.1 and 3GPP TS 36.521-1 6.2.2, respectively. A loopback test mode with NR FR1 and LTE double connection was established between the EUT and the base station simulator. In NSA mode, the EUT needs to complete the LTE TIRP and NR TIRP tests. With the EUT in the same state, NR TIRP and LTE TIRP can be tested simultaneously or successively. In the measurement process, the base station simulator sends power control instructions to the EUT, configures PLTE = 20dBm, PNR and PEMAX, and EN-DC are not configured. LTE and NR are simultaneously uplinked to test NR TIRP and LTE TIRP without considering the influence of the configuration of MPR and A-MPR.
- TIRS test methods for SA SISO in this standard
  The NR base station simulator was configured according to the parameters defined in 3GPP TS 38.521-1 7.3 on reference sensitivity measurement, and a loopback test mode was established between the EUT and the base station simulator. The EUT adopts closed-loop power control mode to transmit at maximum power without

considering the influence of MPR and A-MPR configuration. Note that the downlink power initial value is required to ensure that the BLER is zero for the initial test and that there is equal power on each RB.

- TIRS test methods for EN-DC in this standard
  According to the parameters defined in Section 7.3 of 3GPP TS 38.521-1 and Section 7.3 of 3GPP TS 36.521-1 on reference sensitivity measurement, the NR FR1 and LTE base station simulators were configured respectively, and a loopback test mode with dual connection of NR FR1 and LTE was established between the EUT and the base station simulators. For all NSA EUT, NR TIRS and LTE TIRS performance were tested separately in NSA mode. For, PLTE = 20dBm is configured, PNR and PEMAX, EN-DC are not configured, and LTE and NR are simultaneously uplinked to test TIRS performance in NSA mode.
- Performance requirements for SA n41
  Performance requirements are shown as the tables below:

Power Class	Band n41 TIRP / dBm					
	Free space		Head and hand models		Hand models only	
	Average	Minimum	Average	Minimum	Average	Minimum
Maximum transmitting power (PC2)	17	16	FFS	FFS	FFS	FFS

Power Class	Band n41 TIRS / dBm					
	Free space		Head and hand models		Hand models only	
	Average	Maximum	Average	Maximum	Average	Maximum
Maximum transmitting power (PC2)	-81	-80	FFS	FFS	FFS	FFS

Performance requirements for other bands (SA) are still undecided.

- Performance requirements for EN-DC

Power Class	EN-DC Band DC_1_n78/DC_3_n41/DC_3_n78/DC_3_n79/DC_5_n78/DC_8_n78/DC_39_n41/DC_39_n79 NR TIRP / dBm		
	Free space	Head and hand models	Hand models only

	Average	Maximum	Average	Maximum	Average	Maximum
Maximum transmitting power	FFS	FFS	FFS	FFS	FFS	FFS
Power Class	EN-DC Band DC_1_n78/DC_3_n41/DC_3_n78/DC_3_n79/DC_5_n78/DC_8_n78/DC_39_n41/DC_39_n79 LTE TIRP / dBm					
	Free space		Head and hand models		Hand models only	
	Average	Maximum	Average	Maximum	Average	Maximum
Maximum transmitting power	FFS	FFS	FFS	FFS	FFS	FFS

Power Class	EN-DC Band DC_1_n78/DC_3_n41/DC_3_n78/DC_3_n79/DC_5_n78/DC_8_n78/DC_39_n41/DC_39_n79 NR TIRS / dBm					
	Free space		Head and hand models		Hand models only	
	Average	Maximum	Average	Maximum	Average	Maximum
Maximum transmitting power	FFS	FFS	FFS	FFS	FFS	FFS
Power Class	EN-DC Band DC_1_n78/DC_3_n41/DC_3_n78/DC_3_n79/DC_5_n78/DC_8_n78/DC_39_n41/DC_39_n79 LTE TIRS / dBm					
	Free space		Head and hand models		Hand models only	
	Average	Maximum	Average	Maximum	Average	Maximum
Maximum transmitting power	FFS	FFS	FFS	FFS	FFS	FFS

- Plan for subsequent updates
  SISO OTA test requirements for SA n28, n78 and n79 are under discussion now

Power Class	Band n28 TIRP / dBm					
	Free space		Head and hand models		Hand models only	
	Average	Minimum	Average	Minimum	Average	Minimum
Maximum transmitting power (PC3)	[11-14]	FFS	FFS	FFS	FFS	FFS

Power Class	Band n78 TIRP / dBm					
	Free space		Head and hand models		Hand models only	
	Average	Minimum	Average	Minimum	Average	Minimum
Maximum transmitting power (PC2)	FFS	FFS	FFS	FFS	FFS	FFS
Power Class	Band n79 TIRP / dBm					
	Free space		Head and hand models		Hand models only	
	Average	Minimum	Average	Minimum	Average	Minimum
Maximum transmitting power (PC2)	FFS	FFS	FFS	FFS	FFS	FFS

5.2 CCSA Ongoing Study Item and Work Item

- Test methods for SA SISO 2Tx UE

  The test methods for SA SISO 2Tx UE are under discussion now in Study Item of CCSA, and the conclusions are expected to be completed by 2021Q4.

  The SI analyse the current industrial status of SA 2Tx UE, progress of international standardization, the challenges brought by the antenna form of 2Tx UE to OTA testing, the ability of existing test instruments. The SI also analyse the corresponding test methods for different UE types, and finally propose the corresponding solutions.

  For now, a number of potential SA 2TX test methods have been proposed, including:

  1. Two antennas simultaneously transmit the same code stream to test TRP
  2. Two antennas respectively transmit to test the TRPs and sum the TRPs up
  3. Two antennas simultaneously transmit to test the TRP by using UL MIMO test method.

  However, there are still no clear conclusions on how to evaluate the influence of relative phase shift on test results, and how to balance coherent and non-coherent UE capabilities, which need to be further studied and validated with practical tests.

- Performance requirement and test methods for MIMO OTA

  "Performance requirement and measurement method for 5G MIMO antenna terminal Part 1: Sub-6GHz bands" are under discussion and are expected to be completed by

2022Q4.
"Performance requirement and measurement method for 5G MIMO antenna terminal Part 1: Sub-6GHz bands" and "Performance requirement and measurement method for 5G MIMO antenna terminal Part 3: 5G NR wireless device (mmWave)" are under discussion and are expected to be completed by 2021Q4.

For reference, the standard status can be found on the website below:
http://www.ccsa.org.cn/webadmin/#/td-standardproject/projectplan/approvalforplan

6 ETSI MSG TFES APPROACH

In relation to Devices OTA performance requirements standard initiatives triggered and managed by ETSI MSG TFES, we would like to highlight how ETSI was recently able to handle the 4G case.

6.1 LTE UE OTA requirements in 3GPP

3GPP RAN WG 4 started to define LTE UE OTA requirement in 2012. More than 1 000 measured UE OTA values were submitted over 20 bands from companies participating in 3GPP RAN WG 4. However, in 2017, 3GPP RAN decided to terminate the work item due to lack of agreement in RAN WG 4. Under the request of the European Commission, MSG TFES has been tasked to provide UE OTA TRP TRS requirements. To meet RED requirements in ETSI EN 301 908-13, MSG TFES established an ad hoc WG to define LTE UE OTA requirement in MSG TFES ad hoc #1 in October 2017.

6.2 Working Approach in TFES ad hoc UE OTA WG

The TFES ad hoc OTA WG agreed to take a different approach from those used in 3GPP RAN WG 4 by deriving OTA requirements from commercial devices measurement. Based on the distribution of OTA measurement from a selected pool of devices, measured LTE UE OTA values are used to agree on OTA requirements for the following European LTE bands, B1, B3, B7, B8, B20, B28, B32, B38 and B40.

6.3 Measurement of Commercial Devices to Establish a Baseline

6.3.1 Device selection for measurement

It was agreed to select the devices based on the following criteria. The consensus was that the 21 selected device models provide a good representation of devices available on European market:

a) When the devices came to European market (i.e. 2017, 2018)
b) Brand variety
c) Price range (to capture different price segment)
d) Popularity
e) Number of bands supported
f) Device width

Five ISO/IEC 17025 certified test laboratories volunteered to participate in the measurement activity, which was managed by ETSI secretariat to ensure device and laboratory anonymity. The OEM questionnaire also identifies if a device is TAS (Transmit Antenna Selection) capable or not with explanations on how to test such devices.
At the first stage, two devices were selected at random out of 21 by ETSI secretariat for a round robin test among the test laboratories. Then four devices were chosen for each laboratory except five devices were allocated to a randomly and anonymously selected laboratory to evenly distribute the 21 devices.
The measurement took several months to complete due to the nature of UE OTA tests and time needed to transport the devices across various continents and the results became available at the beginning of 2020.

6.3.2 Measurement Result Analysis

The round robin test revealed a large discrepancy in the test results from one laboratory with a deviation of 4 dB across the TRP of device 1 and 2, which this WG has decided to remove from test campaign. As a result, four devices tested by this laboratory were re-tested by the remaining four laboratories.
The group decided to analyse the TRP and TRS results separately.
The measurement results were analysed and results in the form of TRP and TRS distributions and passing rates were given.

7 NGMN RECOMMENDATIONS FOR NR OTA STANDARDIZATION FINALIZATION

For NR OTA Standardization finalization, NGMN strongly recommends adopting, in any relevant SDO organizations (such as 3GPP), the very same approach defined and leveraged by ETSI MSG TFES, mainly in terms of:

- deriving OTA requirements from commercial devices measurements
- identifying and selecting a set of commercial devices providing a significant representation of current mobile industry
- involve proper test laboratories

Abbreviations

A-MPR	-	Additional Maximum Power Reduction
DUT	-	Device under Test
EUT	-	Equipment under Test
FR	-	Full Rate
FS	-	Free Space
LEE	-	Laptop Embedded Equipment
LME	-	Laptop Mounted Equipment
MIMO	-	Multiple Input Multiple Output
MOP	-	Maximum Output Power
MPAC	-	Multi-Probe Anechoic Chamber
MPR	-	Maximum Power Reduction
MU	-	Measurement Uncertainty
NR	-	New Radio
NR-DC	-	New Radio Dual Connectivity
NSA	-	Non-Standalone
OTA	-	Over the Air
PEMAX	-	Maximum TX power level a UE may use when transmitting on the uplink in the cell (dBm)
PNR	-	Push-Notification-Request
QZ	-	Quiet Zone
REFSENS	-	Reference Sensitivity
RRM	-	Radio Resource Management
SA	-	Standalone
SI	-	3GPP Study Item
SISO	-	Single Input Single Output
TAS	-	Transmit Antenna Selection
TIRS	-	Total Isotropic Radiated Sensitivity
TRP	-	Total Radiated Power
TRS	-	Total Radiated Sensitivity
UE	-	User Equipment
WI	-	3GPP Work Item