CTIA Certification Program Working Group
Liaison Statement

To	GCF SG, GCF-ITAOTA Task Force
CC	3GPP RAN4, 3GPP RAN5
Source	CTIA OTA Working Group
Subject	Reply LS from CTIA CCLLC OTA WG to the GCF SG Concerning Antenna Performance Assessments
Date	12 May, 2020

Introduction

The CTIA OTA Working Group would like to provide an update to the Reply LS from CTIA CCLLC OTA WG to the GCF SG sent on 19 March, 2020 concerning antenna performance assessments related to the LS dated 4 October, 2019 (Device Under Test Configuration for OTA Antenna Performance Assessments). In this LS, the GCF SG highlights several UE-specific features and/or functions which have the potential to affect the accuracy and/or the repeatability of certain OTA measurements.

The purpose of this updated Reply LS is to provide the GC SGF with additional information and clarifications related to the solutions CTIA has developed to address most of these concerns. This information is intended to help foster the development of an OTA test environment (and its associated controls) which could become an industry standard.

The updates to the recommendations are identified below by [OTA WG 04 May 2020]. Additionally, the updated reply LS has been copied to 3GPP RAN4 and 3GPP RAN5 for information.

Background

According to the "Background" portion of GCF LS document S-19-149, today's carriers are being presented with OTA test results from devices which employ various antenna and/or transmitter control mechanisms, all of which potentially compromise the accuracy/repeatability of certain OTA performance measurements.

Three of the four mechanisms described in S-19-149 have been addressed by the CTIA OTA Test Plan (V 3.8.2) [1] and are summarized in this LS as the basis for a potential way-forward for GCF OTA measurements utilizing the 3GPP OTA test methodology.

Recommendations

Each of GCF's concerns in S-19-149 are paraphrased below, followed by CTIA's recommended solution:

1) Transmit Antenna Switching (TAS):

Problem Description: There are several potential measurement uncertainty aspects associated with TAS, but the most significant is that, depending upon the

mechanical configuration under test, the antenna autonomously selected by the UE (based on its proprietary selection algorithm/sensors) may not be optimized relative to the DUTs behavior under the same conditions in the real-world. This can result in reported TRP values which can be either above or below what would be expected during actual use.

Potential Solution(s): CTIA OTA has identified TAS as a potentially significant source of TRP measurement uncertainty. The solution described in [1], Clause 5, Section 5.14.1 addresses TAS measurement uncertainty by requiring the DUT (or a set of DUTs) to meet the following criteria:

a. *Provide special software with which to enable/disable TAS in the DUT or*

b. *Provide individual DUT samples, with each sample pre-configured to represent one of all the possible antenna switch states that the DUT can support in the field.*

The device manufacturer shall indicate which frequency bands and air interfaces support TX antenna switching.

2) Dynamic configuration of the RFFE:

Problem Description: Many of today's UEs include some form of RFFE optimization, and the process used to determine when optimization is required and how optimization shall be performed is typically proprietary. In order to obtain reliable measurements of TRP/TRS, some form of control over the DUT's RFFE optimization should be available.

Potential Solution(s): [1] does not specifically address RFFE optimization. While OTA test results can be affected by changes/adjustments made to the DUT's RFFE, the control mechanisms necessary to change RFFE settings may not always available to test labs, nor is there any guarantee that every test lab would use these control mechanisms in the same way if they were available.

To help ensure that RFFE settings remain in a consistent default state during OTA testing, all measurements should be made while using a standard 3GPP 001/01 test UICC, and no special attempts to control the DUT's RFFE should be attempted.

[OTA WG 04 May 2020] Because certain CA combinations utilized in certain ITU regions and/or MNO networks can be especially challenging for the UE, dynamic configurations may be employed by the UE's RFFE. The CTIA OTA Working Group has considered the inclusion of utilizing a software control mechanism to measure the DUT's PCC radiated performance for certain especially challenging 2 CC and 3 CC combinations, as recommended by the industry. While this approach is not currently included in [1], it could be considered in a future release based on the industry's needs.

Options also exist to develop MNO-specific test UICCs such that the RFFE optimization algorithms could be exercised during OTA testing. These options have been considered. To date, the CTIA OTA Working Group has not pursued these options due to the additional certification testing cost impacts.

3) TX Power Reduction:

Problem Description: Many devices support TX power reduction, which can be invoked for any number of reasons by any number of mechanisms. These power reduction mechanisms can significantly affect the DUT's TRP if not properly accounted for during the OTA measurement process.

Potential Solution(s): [1] addresses power reduction in Appendix O.5, Note 2, which specifies that:

a) For devices which employ TX power reduction based on sensors detecting the UE being in close proximity to the user [OTA WG 04 May 2020], an initial set of TRP measurements shall be made using a sample DUT in which the TX power reduction sensors have been disabled and the DUT operates at full power.

b) Once the measurements in (a) have been executed, a subsequent set of radiated or conducted measurements [OTA WG 04 May 2020] shall be made using a DUT in which:

(1) The power reduction sensors have been enabled and

(2) The DUT operates at the maximum power reduction which can be invoked based on input from all its power-reduction sensors.

From the measurements in (a) and (b) above, the test lab shall provide a table describing:

1. The DUT's maximum TRP per band (in dBm)

2. The DUT's maximum power reduction per band (in dB).

These are also devices where the choice of which TX antenna is active is a function of the proximity to the user's hand, head or body, or nearby object and is usually determined by sensors contained within the device. Such a device will switch from one TX antenna to another based on the inputs it receives from its own self-contained sensors. For such a device, it is required that the choice of TX antenna of the device remains the same during the TRP test. The solution described in [1], Clause 5, Section 5.14.2 addresses TAS measurement uncertainty of such devices by requiring the manufacturer to meet the following:

a. *Provide declaration that the device will operate with the expected TX antenna for the entire test when configured with the associated phantom(s) or*

b. *Provide a "truth table" that clearly identifies which TX antenna will be used for the configuration under test. The manufacturer would provide the mechanism for the lab to select the appropriate TX antenna or would provide individual DUT samples, with each sample pre-configured to represent one of all the possible antenna switch states that the DUT would utilize across all usage cases.*

4) Variable TX Power:

This mechanism appears to be a variation of power back-off as noted in (3) above and is not specifically addressed in [1]. Like power reduction, Variable TX Power can be assessed by the test lab if the triggers which affect the DUT's Variable TX Power control mechanisms are documented and/or special software to manually alter the DUT's power to its minimum value through this mechanism can be provided. [OTA WG 04 May 2020] Some DUTs, especially those designed to operate at low duty-cycles, may display some variance in transmit power due to heating. Compensation for this potential variable is currently addressed in [1]. Specifically, labs have been instructed to:

1) Allow the DUT's output power to stabilize by operating the transmitter for 5 minutes prior to beginning the measurement of TRP ([1], Section 5, Overview)
2) Test DUTs which are incapable of transmitting at full power for the duration of a TRP measurement by transmitting at an output power that's approximately 10 dB below the DUT's declared power class. Data for the DUT's measurement points will be obtained at this reduced power and the results can be normalized to what would have been measured had the DUT supported its full power per the methodology described in [1], Clause 5.11.4.
3) Concurrently measure TRP and TIS of DUTs designed to operate at low TX duty-cycles, which will help reduce RF output power variations due to thermal effects ([1], Clause 6.15.5).

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Date of Next CTIA OTA Working Group Meetings

- 2020 Meeting #6 02 June, 2020 Teleconference Meeting

References

[1] CTIA Certification, LLC, *CTIA Test Plan for Wireless Device Over the Air Performance Ver. 3.8.2;* http://testplansprod.wpengine.com/wp-content/uploads/2019/10/CTIA-Test-Plan-for-Wireless-Device-Over-the-Air-Performance-V3-8-2.pdf