

CTIA Certification Program Working Group Liaison Statement

To	GSMA TSG
CC	GCF SG, GCF PAG, GCF CAG, PTCRB, RAN4, RAN5
Source	CTIA MIMO OTA Subgroup (MOSG)
Subject	LS Response to GSMA TSG30_007 (LS Regarding MIMO OTA)
Date	16 November, 2017

1. Introduction

The CTIA MIMO OTA Subgroup (MOSG) recently received the LS TSG30_007 regarding MIMO OTA testing [1]. The CTIA MIMO OTA Subgroup (MOSG) would like to thank GSMA for providing this LS, and especially Vodafone and Orange for providing the data and analysis included in the LS. The CTIA MIMO OTA Subgroup (MOSG) would like take this opportunity to provide additional input concerning this topic.

2. Discussion

In the GSMA LS [1], GSMA raised concerns about the CTIA MIMO OTA testing approach defined in the CTIA Test Plan for 2x2 Downlink MIMO and Transmit Diversity Over-the-Air Performance [2] (also referred to as the CTIA MIMO OTA Test Plan). Specifically, GSMA raised concerns that the results using the CTIA MIMO OTA Test Plan do not show sufficient variation across devices, especially when compared to the 3GPP MIMO test approach defined in 3GPP TR 37.977 [3] and 3GPP TS 37.144 [4].

The CTIA MIMO OTA Test Plan scope is to evaluate the UE antenna system and its impact on MIMO demodulation performance. The CTIA test approach is focused on antenna performance with an emphasis on antenna correlation. As MIMO is utilized in areas of a network which are not constrained by the UE noise floor, CTIA believes that an SIR-based test is more appropriate as antenna efficiency will not play a significant role in MIMO performance when operating in real deployment scenarios.

In addition to focusing on antenna correlation, the CTIA MIMO OTA test approach also defines a very high transmit side correlation to stress the UE. If the UE manufacturer has done a sufficiently good job on designing the antenna system design to allow for proper MIMO demodulation performance in the presence of high transmit side correlation, the CTIA MIMO OTA test results will approach the modem performance. However, when the antenna system design is not as good, the UE will struggle to meet certain throughput thresholds at different device orientations in the channel. These gaps in performance are the ways that performance deltas are shown in the CTIA MIMO OTA Test Plan.

Conversely, the 3GPP MIMO OTA test approach also includes antenna efficiency since the UE is tested in a noise-limited environment. As a result, the CTIA MOSG believes two additional pieces of information are critical in providing a complete comparison of the test results between the CTIA and 3GPP test approaches:

- TRS data for the UE's tested to determine if the 3GPP MIMO OTA test ranks the devices differently compared to TRS.

- Perform the 3GPP MIMO OTA test using TM2 (as opposed to TM3) to determine if the 3GPP MIMO OTA test approach results are being dominated by antenna efficiency or antenna MIMO performance.

Also, it was noted by CTIA MOSG members that the UEs included in the GSMA reported results are not consistent from test to test. It appears one lab tested one set of devices with two metrics, and the other lab tested a different set of devices with two further metrics which makes it difficult to draw conclusions. The CTIA MOSG would kindly ask that GSMA include the results for all UEs for each test so that full comparisons can be made.

To demonstrate an example where the CTIA OTA Test Plan identifies UE's with MIMO performance deficiencies, a CTIA Authorized Test Laboratory (CATL) tested two commercially available devices in LTE Band 5. A sample of results are shown below.

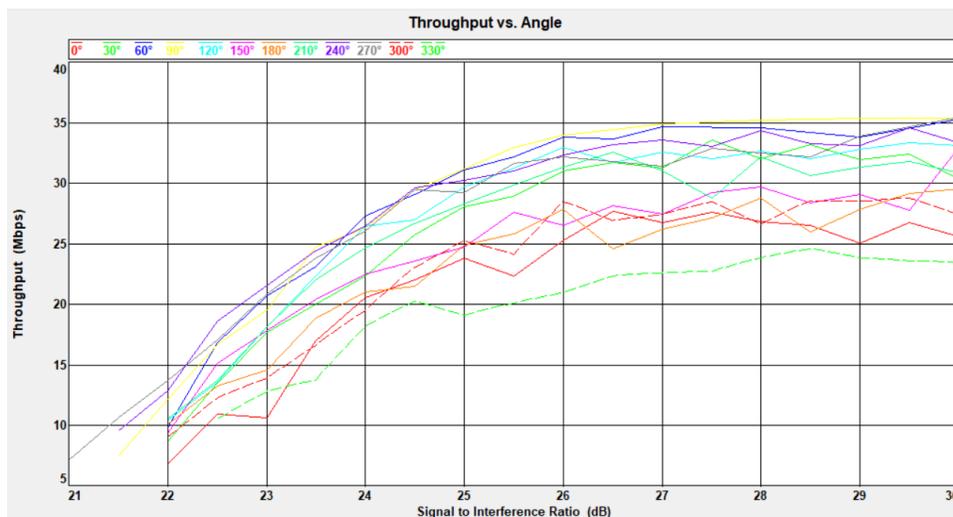


Figure 1. UE #1 Band 5 DMP

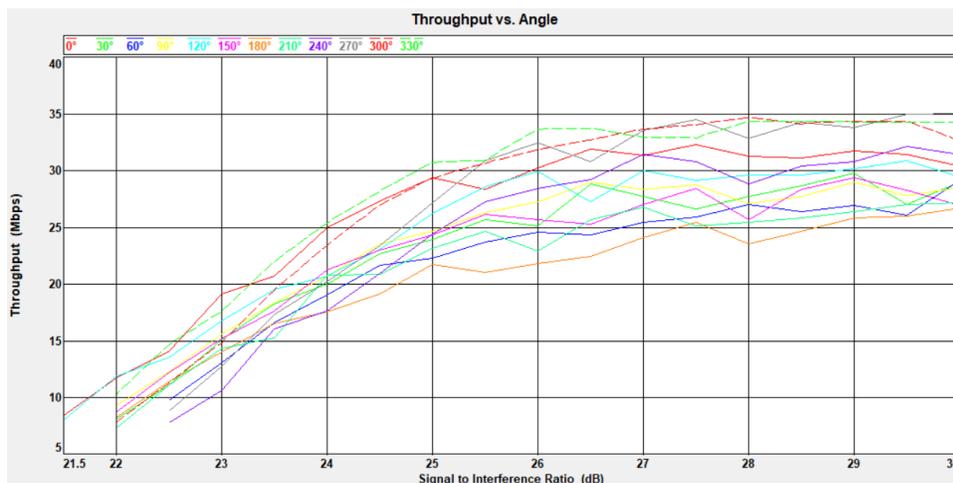


Figure 2. UE #2 Band 5 DMP

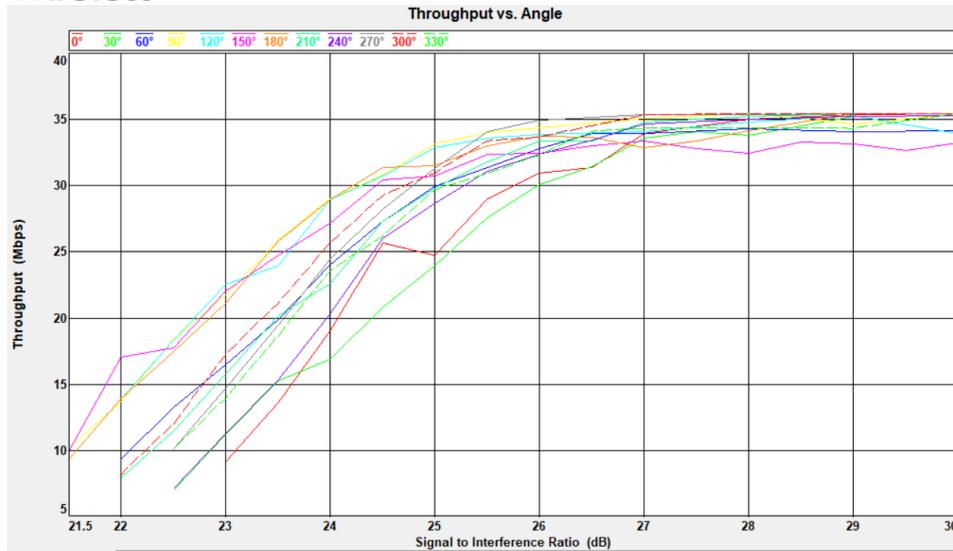


Figure 3. UE #2 Band 5 DML – Left Tilt

In the first two figures, one can see that both UEs struggle to meet the 95% throughput threshold in the DMP position at most azimuthal orientations in the channel. UE #1 fails to meet the 70% throughput threshold in DMP when positioned at 330 degrees within the channel.

However, UE #2 when positioned in the DML – Left Tilt configuration meets the 95% throughput threshold. This demonstrates that the device orientation in the channel can produce significant performance differences when utilizing the CTIA MIMO OTA Test Plan due to the deltas in the receive side antenna correlation of the UE when positioned differently in a spatial channel.

It is interesting to note that the UEs above showed almost no performance differences when utilizing the 3GPP MIMO OTA test methodology with TM3 as shown in Table 1 below.

Table 1. 3GPP TM3 TRMS and Smode Results

		UE #1	LTE Band 5			
			DMP	DML - Left Tilt	DMSU	TRMS
3GPP - TM3	Throughput	95%	-88.41	-87.91	-87.86	-88.07
		70%	-90.52	-90.06	-89.47	-90.04
			LTE Band 5			
			UE #2	DMP	DML - Left Tilt	DMSU
Throughput	33.6528 (95%)	-88.46	-88.32	-88.47	-88.42	
	24.7968 (70%)	-90.74	-90.50	-90.44	-90.56	

Also, the performance utilizing the 3GPP methodology with TM2 showed that the performance of the two UEs was similar as shown in Table 2. This not only provides evidence that the antenna efficiencies are similar but it is also evidence that there is

no difference in the ability of the test method to discern any appreciable difference in the Rx side correlation of the UEs.

Table 2. 3GPP TM2 TRMS and Smode Results

3GPP - TM2	UE #1		LTE Band 5			
	Throughput		DMP	DML - Left Tilt	DMSU	TRMS
		95%	-96.76	-96.88	-96.34	-96.66
	70%	-98.74	-98.89	-98.35	-98.67	
	UE #2		LTE Band 5			
	Throughput		DMP	DML - Left Tilt	DMSU	TRMS
95%		-97.61	-97.55	-98.52	-97.92	
70%	-99.64	-99.52	-99.65	-99.60		

For v1.2 of the CTIA MIMO OTA Test Plan, the CTIA MOSG is planning to make the following additions to allow for an even more thorough assessment of UE MIMO performance:

- Two additional mechanical use cases for low (< 1 GHz) bands: data mode landscape (DML) left tilt and data mode screen up (DMSU).
- An additional throughput test that uses a variable reference measurement channel (based on 3GPP TR 37.901 [5]). This will be added as informative in v1.2 with the goal of making this test normative in v1.3.

3. Actions

None

Contact Info

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Date of Next CTIA MIMO OTA Sub-Group Meetings:

4 December 2017, Teleconference

References:

[1] TSG30_007, *LS on MIMO OTA*, GSMA TSG.

[2] *CTIA Test Plan for 2x2 Downlink MIMO and Transmit Diversity Over-the-Air Performance*, Version 1.1, August 2016.

[3] 3GPP TR 37.977, *Verification of radiated multi-antenna reception performance of User Equipment (UE)*.

[4] 3GPP TS 37.144, *User Equipment (UE) and Mobile Station (MS) GSM, UTRA and E-UTRA over the air performance requirements*.

[5] 3GPP TR 37.901, *User Equipment (UE) application layer data throughput performance*.