

# **MIMO OTA Test Campaign 2017**

**Vodafone & Orange**

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# Background

- 3GPP and CTIA have defined MIMO OTA test methods which cannot produce comparable results each other.
- Orange and Vodafone have conducted a program of testing in order to determine:
  - Which MIMO OTA test method (3GPP or CTIA) can show differences between device performances
  - The impact on channel model (UMi or UMa) on performances
  - To help certification industry choosing the right method for device certification
- 10 commercial smartphones (2016) have been selected and 2 smartphones from 2013 year models.
- 10 Labs(GCF–RTOs and CTIA CATLs) have contributed on test program
- Tests have been performed in Free Space and in middle channel of FDD band 7 and FDD band 20

# Test Samples and Labs

10 Smart phone models have been tested in Anechoic Chamber ( AC)

## Devices commercial versions :

all devices are released for year: 2016

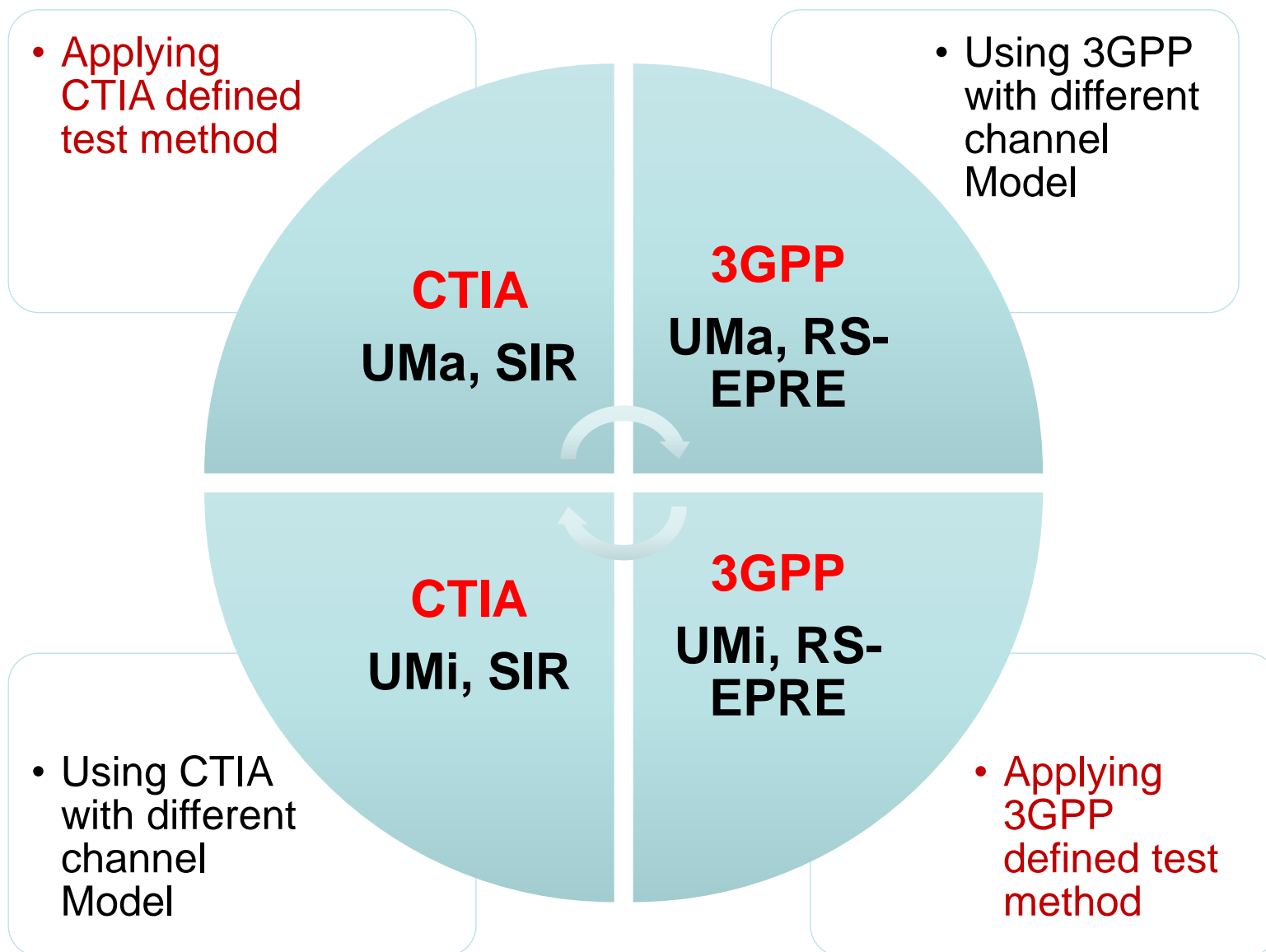
- Huawei Mate 9
- LG G5
- HTC Desire 530
- Sony xperia X
- Microsoft Lumia 650
- Samsung G935F
- Blackberry SQW 100
- Sumsung Note 3 (2013)
- Sony Xperia Z1
- Iphone 7+ (test not completed)

## Test Labs:

- SGS
- TA/EMITE (test in RC)
- CTTL
- SPORTON\*
- BV
- VERKOTAN
- TTA
- INTEL (no results yet)

\*Special thanks to Sporton for providing additional measurements

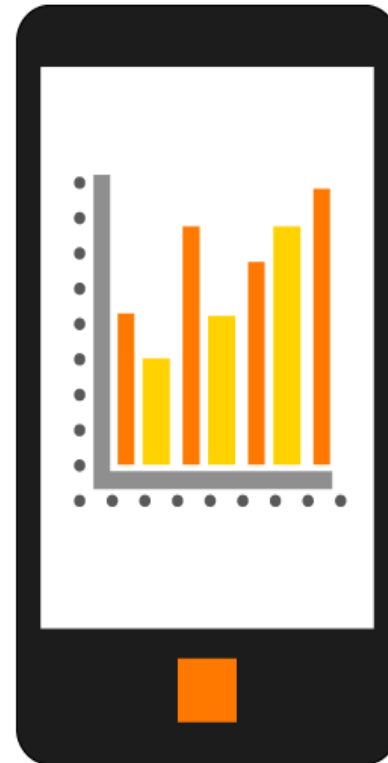
# Used Methods



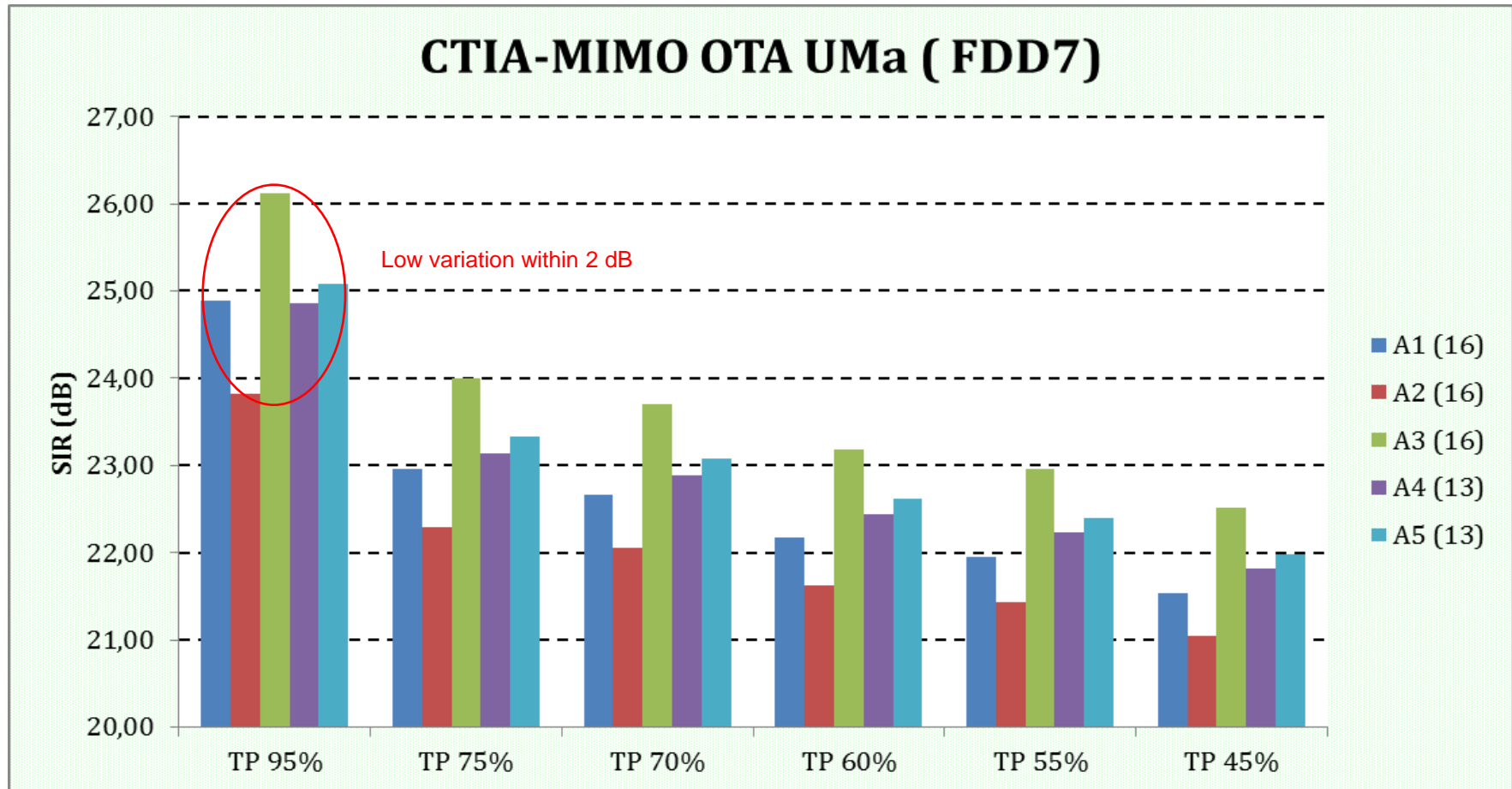
# Which test method shows difference on device performances?

Performing test on devices using strictly methods defined in specifications CTIA MIMO V1.0 and 3GPP TS.37.977

**Goal**: determine test method which helps to see the performance differences between devices

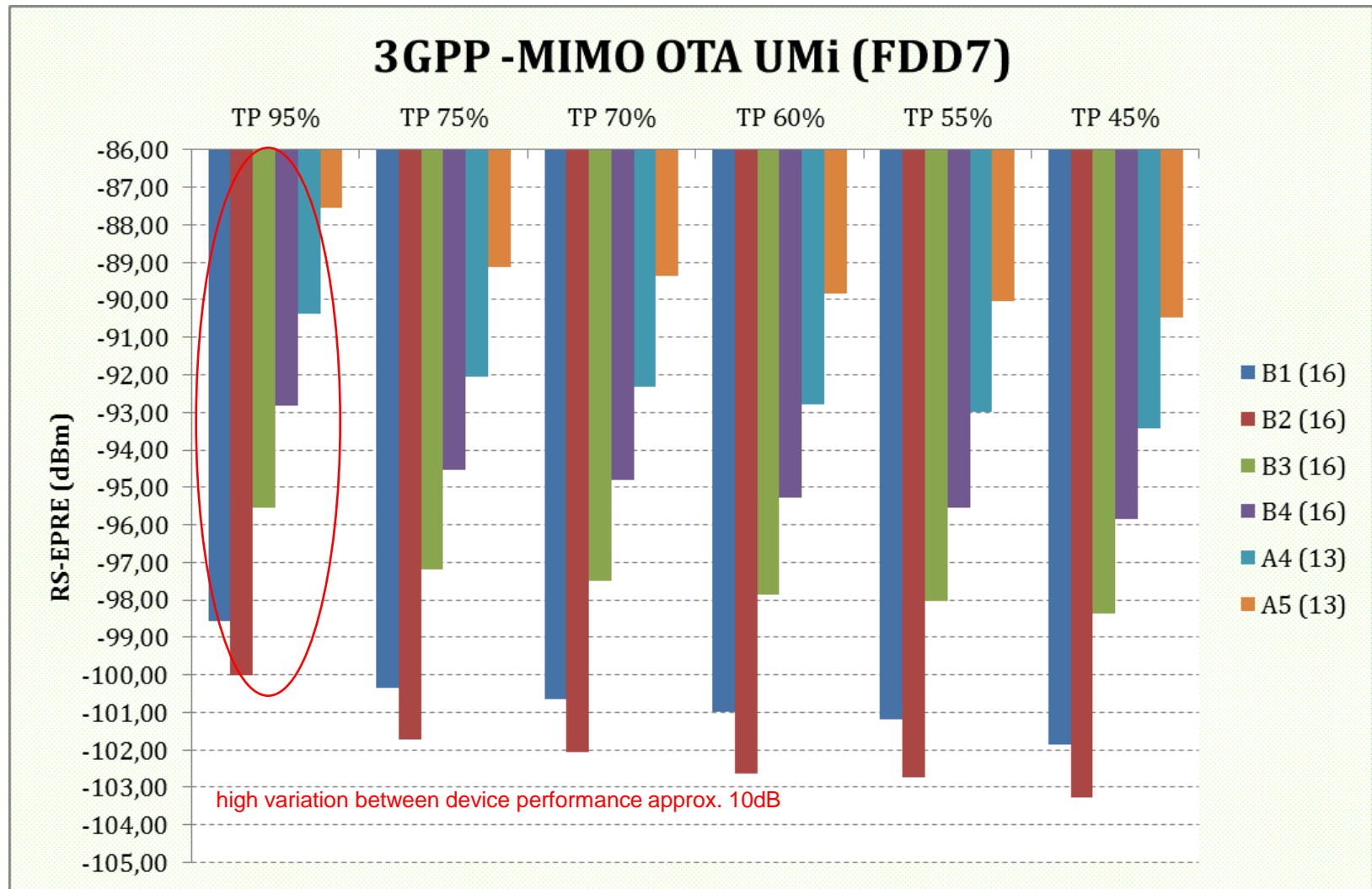


# MIMO-OTA by CTIA test method



- For all outage points the variation between device performances is within 2 dB
- It's noticed that performance ranking between devices is the same for all outage points

# MIMO OTA by 3GPP test method





# Conclusion with standardized channel models

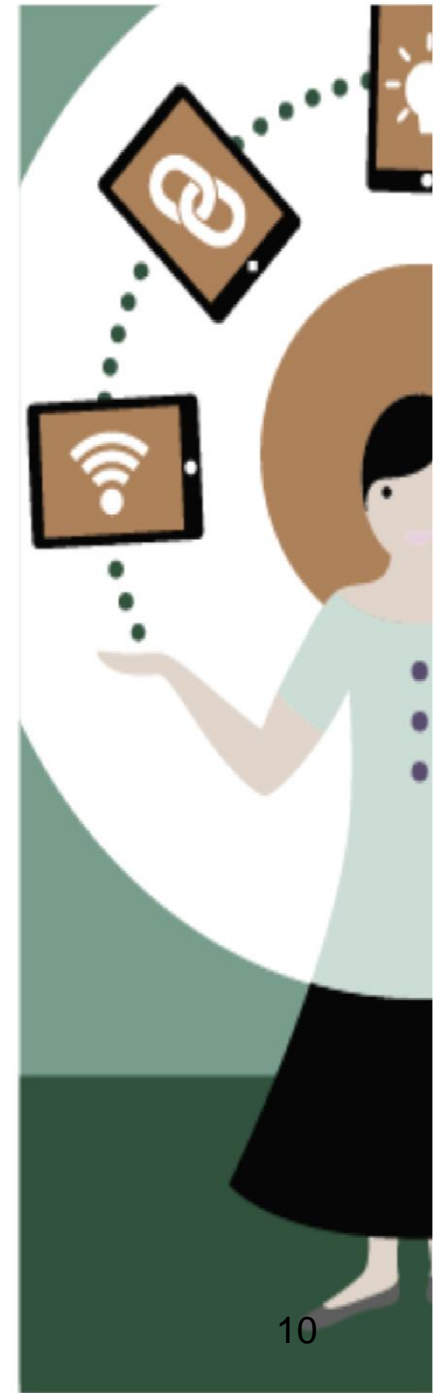
- With CTIA test method we do not observe much variation between device performances; max difference cannot exceed 1,5 dB.
- CTIA cannot shows difference higher than measurement uncertainties
- Furthermore, CTIA method bypasses the antenna performances (Antenna efficiency is not taken into account)
- Whilst 3GPP method shows a significant difference between devices approximatively 5~6 dB and even at outage point TP 95% (Good radio conditions).
- In addition 3GPP method highlights the progress made by UE vendors when we compare devices from 2013 (Note 3) and devices from 2016

# Verifying channel model's impact on performance

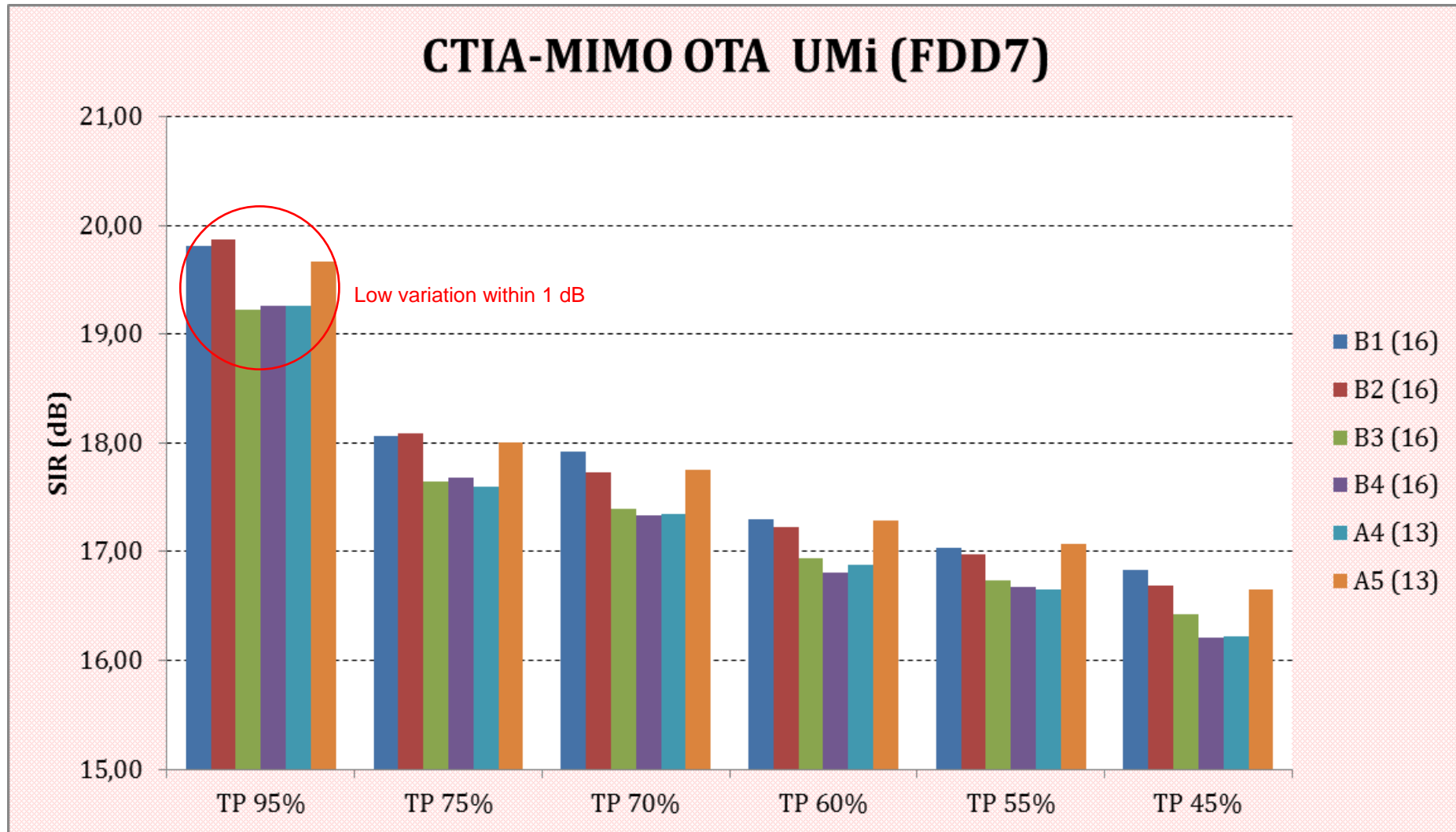
Inverting channel models :

- Test CTIA method with UMi channel model
- Testing 3GPP with UMa channel model

**Goal:** check if Channel model can have impact on performances given that the two specifications have different channel models.

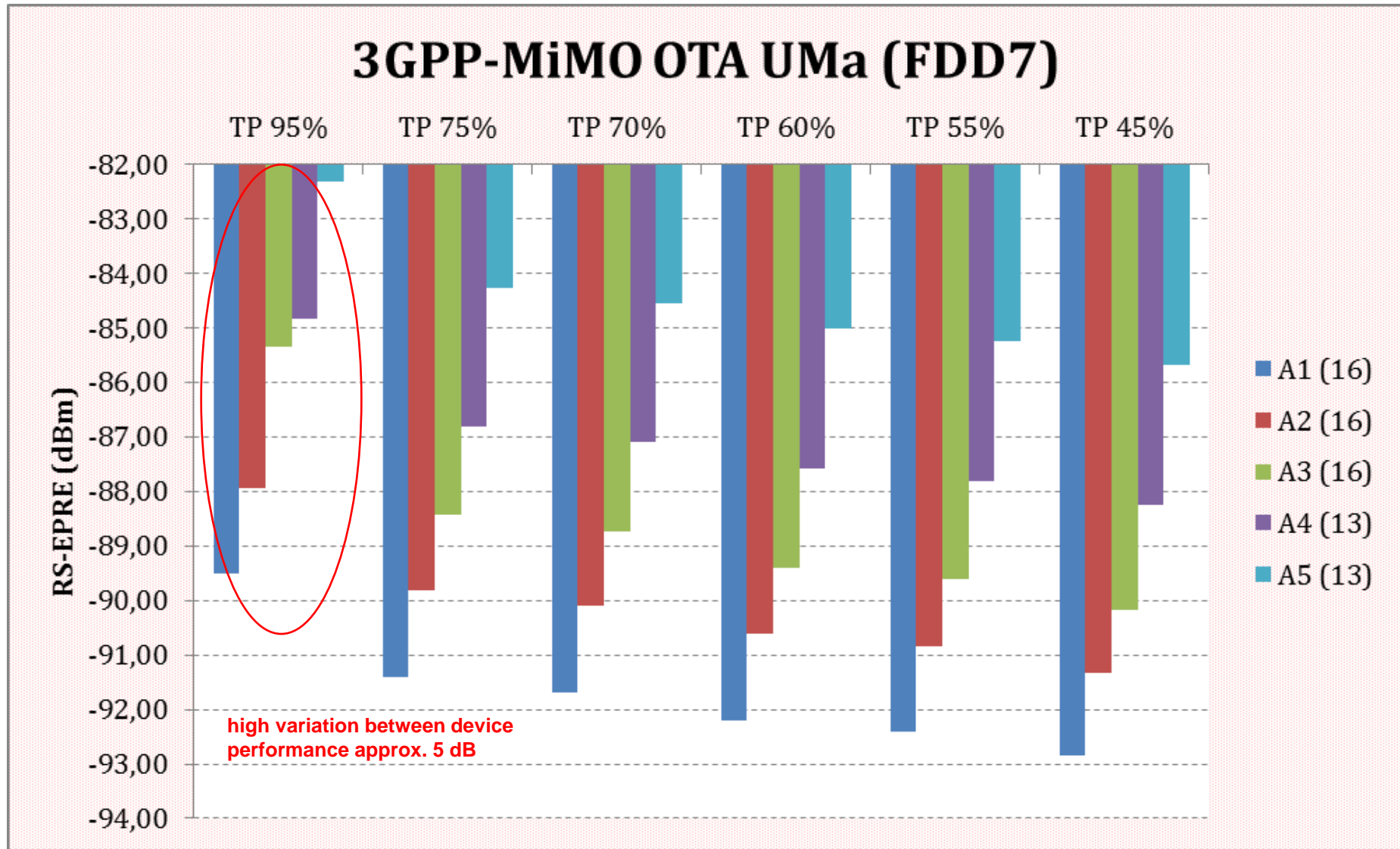


# Combining CTIA method with UMi channel model



For all outage point the variation between device performances is less than 1 dB

# Combining 3GPP method with UMa channel model



# Conclusion with Inverted channel models

- For CTIA, inverting channel model doesn't impact the comparison of device performances but add an offset equal to approximatively 5 dB
- For 3GPP, inverting channel model adds an offset on performance which is approximatively 7 dB but also reduces the range of difference between devices i.e. from 10 to 5 dB
- In Addition with 3GPP we are still able to see the performance difference between UEs from 2013 and UEs from 2016

In all cases, better comparison is observed with 3GPP test method instead of using CTIA test method

# Comparison of frequency bands FDD 7 vs FDD 20

Comparing performances  
of CTIA & 3GPP method  
on bands FDD7 and  
FDD20

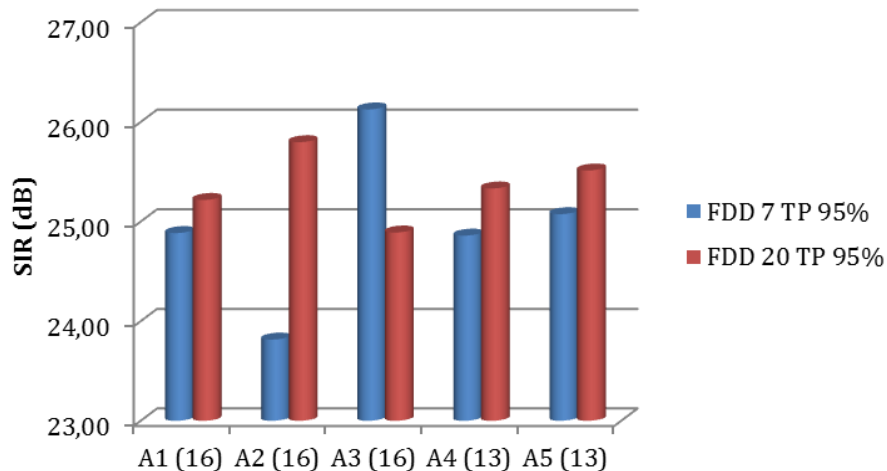
**Goal:** check if both methods  
can show differences between  
device performances in lower  
and higher frequencies.



# Impact of the frequency bands on CTIA method

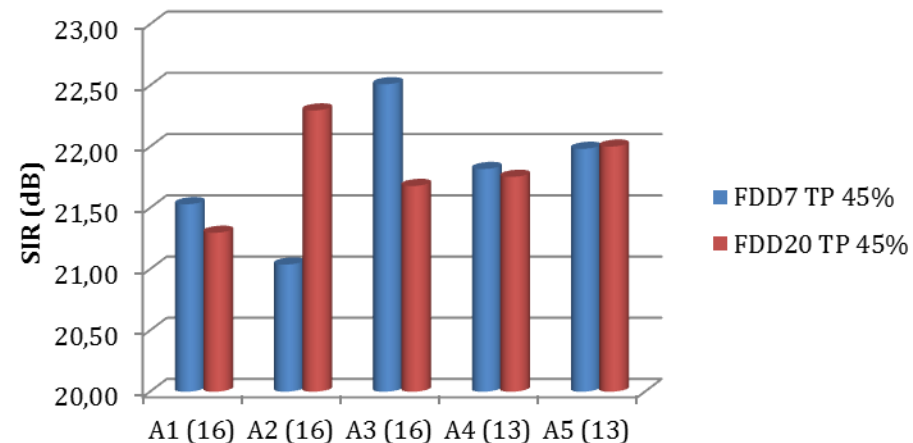
## Close to Enode B

CTIA TP 95% FDD7 vs FDD20



## Towards Cell Edge

CTIA TP 45% FDD7 vs FDD20

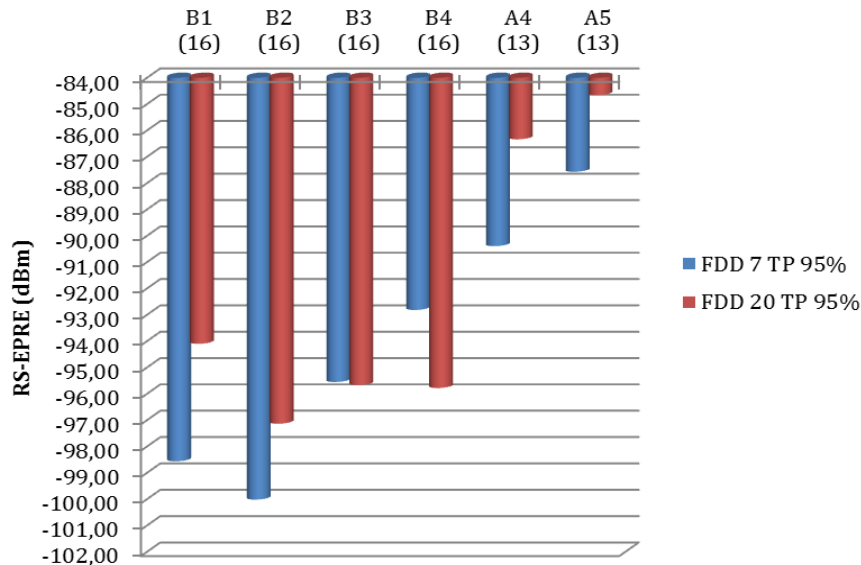


- Performance difference between high and low bands is not significant (in average 1dB)
- This confirms that CTIA method bypasses the antenna efficiency

# Impact of the frequency bands on 3GPP method

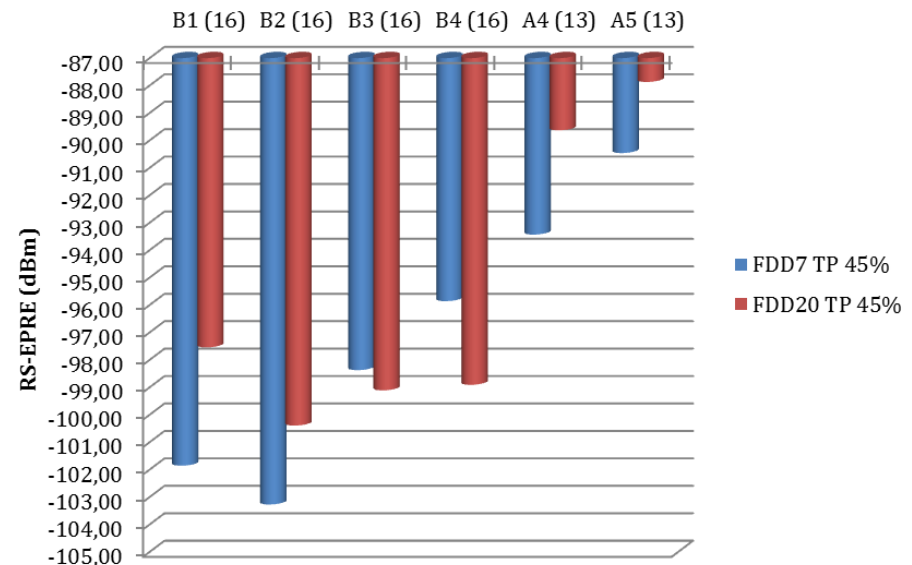
## Close to Enode B

3GPP TP 95% FDD7 vs FDD20



## Towards Cell Edge

3GPP TP 45% FDD7 vs FDD20



Significant difference between high and low bands observed ( up to 5dB)



# Summary of findings

## SIR variation (CTIA)

- Low variance between devices (UMa, UMi), like we have seen in GSMA test campaign
- Difference between UMa and UMi about 5 dB (offset)
- Low difference between band 7 and 20

## RS-EPRE variation ( 3GPP)

- Much higher variance between devices (UMa, UMi),
- Difference between UMa and UMi about 7 dB (offset)
- UMi shows more difference between devices
- More difference between band 7 and 20
- With 3GPP method we can see improvement of device performances 2013 versus 2016

# Conclusion

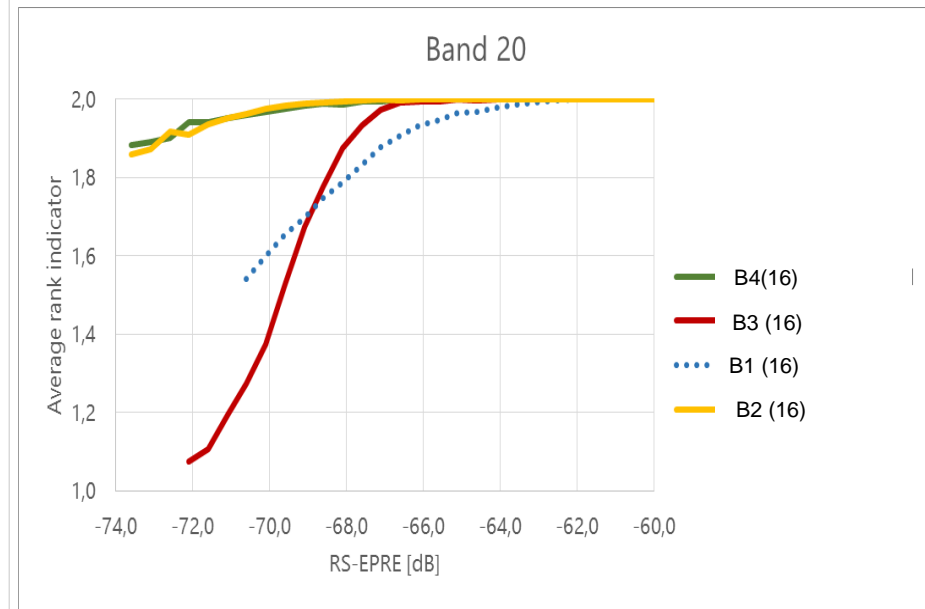
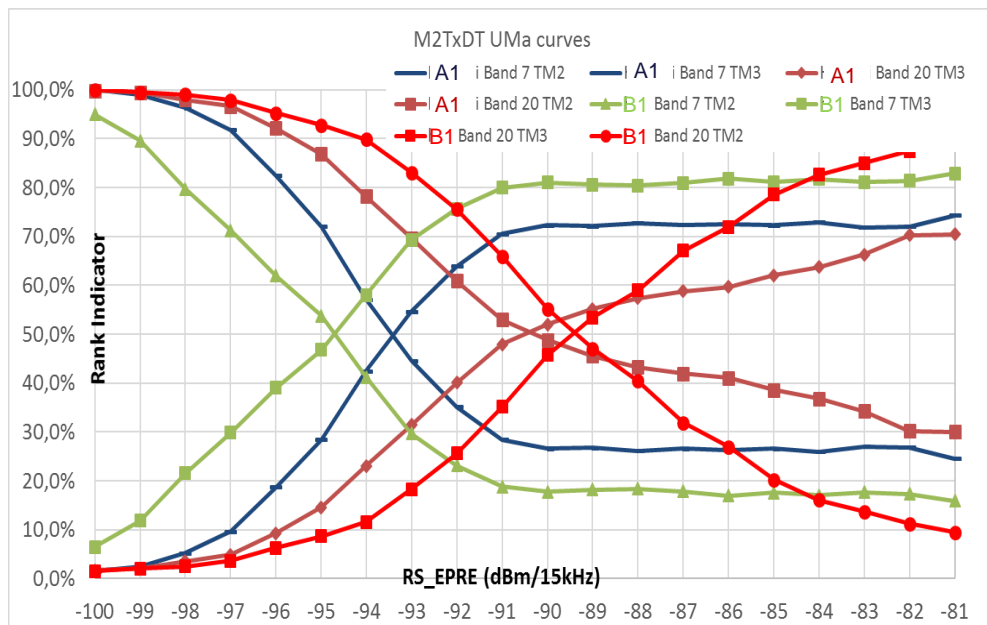


# Conclusions

- The test campaign shows that for the time being, 3GPP **is the preferred method** to be used in order to compare device performances and also for Operators to define requirements.
- Although CTIA approach can show the performance of demodulator( chipset) of the device, we cannot compare results between devices because values of the results are close to each other.
- 3GPP method allows to see the performance of the demodulator but also the antenna efficiency and the self-interference.
- NB: self Interference will never be seen with current CTIA method

# Next Step

1. **CTIA method:** It might be interesting to add fading profile such as ePA3 or eVA 120 with CTIA method to see if higher difference between devices will be observed.
2. **3GPP method:** It will be also interesting to see if there is a high correlation between the MIMO performances and antenna TIS measurements in order to ensure that the MIMO performance is not reflecting only the TIS but rather the TIS + algorithm and Chipset performance +antenna implementation
3. It has been observed during the study that another approach of comparing the device performance could be to consider the Rank Indicator values such as figures shown below



# Thank you

Should you have any questions please feel free to contact:

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