TSG-RAN Working Group 4 (Radio) meeting #99-ER4- 2108649

Electronic Meeting, 19th – 27th May 2021

**Title: LS on Test methods for over-the-air TRP field measurements of unwanted emissions from IMT radio equipment utilizing active antennas**

**Response to: LS RP-210021 on test methods for over-the-air TRP field measurements of unwanted emissions from IMT radio equipment utilizing active antennas from ITU-R WP1C**

**Release: -**

**Work Item: -**

**Source: TSG RAN WG4**

**To:** **TSG RAN**

**Cc: -**

**Contact person: Torbjörn Elfström**



**Send any reply LS to: 3GPP Liaisons Coordinator,** **mailto:3GPPLiaison@etsi.org**

**Attachments:** -

# 1 Overall description

An LS was received from ITU-R WP1C on Test methods for over-the-air TRP (Total Radiated Power) field measurements of unwanted emissions from IMT radio equipment utilizing active antennas ([RP-210021](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Docs/RP-210021.zip)) and RAN4 was tasked by TSG RAN to study the request from ITU-R WP1C and provide an answer to RAN#92e.

RAN WG4 has analysed the incoming LS from ITU-R WP1C and presents the information below to be used for a response to ITU-R WP1C. The analysis is presented in two parts, where the first gives feedback on the test signal proposed by ITU-R WP1C, while the second part proposes some alternatives to using a test signal.

# 2 In-field unwanted emission and test signal aspects

In previous LS exchange between 3GPP and ITU-R ([1C/4](https://www.itu.int/md/R19-WP1C-C-0004/en)), characteristics of BS with active antenna systems in the OOB and spurious domain was discussed and it was noted that test modes or test signals are presently not specified by 3GPP. In the subsequent response ([RP-210021](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Docs/RP-210021.zip)), ITU-R WP1C notes that assessment of unwanted emissions is only possible when the base station transmits full power and bandwidth. Consequently, it is proposed to 3GPP to consider defining a test signal that could be transmitted in intervals together with normal traffic.

TSG RAN WG4 was tasked to analyse the technical aspects of the request and has noted the following that requires further consideration.

As expressed in previous LS ([1C/4](https://www.itu.int/md/R19-WP1C-C-0004/en)), the characteristics for an AAS base station are created as a super-positioning of signals, both wanted and unwanted, from many antenna elements, the radiating characteristics for a specific frequency varies as function of the signal correlation applied to the array antenna and the frequency characteristics related to the radiating element. For unwanted emissions, the correlation is undetermined and varies as function of the emissions relationship to the wanted signal, but will vary and depend strongly on antenna configuration and implementation. Consequently, a test signal in itself does not guarantee accurate measurement of unwanted emissions in the field.

Based on the request from ITU-R WP 1C the following issues to further study have been identified:

1. Whether a test signal duration of one symbol is sufficient for measuring unwanted emission TRP levels.
2. The periodicity of the test signal needs to be defined. Study is needed of required periodicity from an emission test perspective giving acceptable measurement accuracy.
3. The test signal should mimic normal traffic as much as possible. Hence, the spatial behaviour of the test signal needs further considerations. It would be reasonable to use beam directions within the intended coverage range.
4. Consider the contents of the test signal. To mimic normal traffic the test signal Resource Element (RE) used could potentially carry random data. TSG RAN can study aspects related to power statistics due to test signal RE allocation.
5. Consider the implications for base stations supporting multiple carriers and bands using common electronics, the test signal needs to be enabled on all transceivers branches simultaneously. TSG RAN can study the implications to support the test signal for different types of CA configurations and implementations.

In addition, a new test signal requires a thorough study of physical layer implementation and impact on system interfaces and protocols, and to conclude on possible impact on performance. The following questions for possible further discussion internally in TSG RAN were identified:

1. How will the test signal affect interference e.g. different base stations, between MIMO layers, etc., considering the resulting pulsed interference in the network?
2. Is the intention to enable test signal synchronously in the network, which would require coordination between base stations?
3. How will the test signal affect power saving modes and the lean carrier wave form? Energy efficiency is defined as a key capability for IMT-2020 by ITU-R in [ITU-R Recommendation M.2083](https://www.itu.int/rec/R-REC-M/recommendation.asp?lang=en&parent=R-REC-M.2083) with the corresponding minimum requirement defined in [ITU R Report M.2410](https://www.itu.int/pub/R-REP-M/publications.aspx?lang=en&parent=R-REP-M.2410).
4. How will the test signal beam pattern affect network performance, considering the max power used?
5. How would a test signal that overrides the regular transmission impact the network scheduler?
6. What interfaces will be required to enable/disable the test signal?

# 3 Other aspects of in-field emission measurements

There are other alternative solutions that can be used to guarantee a loaded carrier during in-field measurements, without the need for a new test signal and related impact on physical layer specifications:

1. Normal operation: The network traffic varies during the day. With this approach unwanted emission measurements need to be conducted at peak traffic hours. When data is scheduled, instances where the carrier will be fully loaded with maximum configured power will occurs. This approach has the benefit that no changes to the standard are required. Initially when networks are deployed the traffic load is low and will gradually increase when more UEs supporting the band are commercially available. Averaging measurement over longer time could also more properly capture the time-varying emissions due to varying beam direction
2. Proprietary test configuration: The operator can enable vendor proprietary test signal schemes to generate random data to be transmitted on un-used resources to mimic a loaded carrier. This is a test signal that is controlled by the network operator. Proprietary test configuration may also need changes in the physical layer. Coordination between unwanted emission tester and operator can be established to allow for a specific test scheme. Using this approach currently available NR physical signal (CSI-RS, etc.) can be used and scheduled properly. This approach could also include the test signal principle described above.
3. Provoking traffic: In a situation with no or low network traffic, traffic can be generated by a test UE or a few test UEs. The test UE downloads a large amount of data to force the base station to schedule all resources. If the test UE is capable of receiving at the full base station carrier bandwidth and it is equipped with operator specific SIM, a fully loaded carrier can be guaranteed. Additionally, if the UE signal is attenuated the UE will report CQI for QPSK which removes any uncertainty related to possible power back off for higher order modulations.

Fundamentally, when TRP unwanted emission is measured in-field, there are two interesting approaches to consider:

1. Use a measurement receiver at a fixed location, while a UE or multiple UEs moves around the test object to provoke traffic. The UEs will stimulate the base station to generate beams in different directions, while the measurement receiver measures the averaged unwanted emission over the complete measurement duration time.
2. Use a UE provoking traffic at a fixed location, while the measurement receiver is moved around to captured spatial samples required to measure TRP. With this approach the measurement receiver is moved around and TRP is calculated using traditional integration methods.

# 2 Actions

**To TSG RAN**

**ACTION:** RAN WG4 asks TSG RAN to take the information provided concerning OTA in-field test aspects related to measuring TRP unwanted emissions into account when replying to **ITU-R WP1C**.
In order to facilitate discussions and enable progress of the issue, the LS reply should also be copied to
**CEPT/ECC SE21**.

# 3 Dates of next TSG RAN WG 4 meetings

TSG RAN4 Meeting #100-E 16 – 27 August 2021 Online

TSG RAN4 Meeting #101-E 1 – 12 November 2021 Online