**3GPP TSG-RAN WG4 Meeting #116bis R4-25xxxxx**

**Prague, Czech Republic, 13th – 17th October, 2025**

**Agenda item:** 8.4

**Source:** Feature lead (Qualcomm)

**Title:** AH minutes for [116bis][102] 6G general RF and UE RF

**Document for:** Approval

# Topic #5: Tx requirements

### Sub-topic 5-1 Unwanted emissions

For unwanted emissions the general view was to keep the framework aligned with 5G NR. It was also raised the OOB boundary defined in 3GPP is stricter than what ITU-R recommendations set. Therefore, as a starting point it is proposed to start from the 5G framework and especially check the out-of-band boundary.

**Issue 5-1-1: Unwanted emission framework**

* Proposals
  + Proposal 1: The specifications should be aligned with applicable ITU-R recommendations e.g. ITU-R Rec. SM-1539 and ITU-R for emissions in the OoB domain.
  + Proposal 2: 6GR studies should be based on maintaining the concept of a general SEM for compliance with regulatory emissions requirements and the ACLR specified for intra-system coexistence.
  + Proposal 3: to enable global circulation of terminals, the 6GR studies are based on maintaining the general NR spurious emissions limits for FR1 and FR2-1 based on ERC Rec. 74-01.
  + Proposal 4: Consider SM.1541 when discussing OOB boundary in 6GR.
* Recommended WF
  + As a starting point for 6GR studies
    - Spurious emission requirements are based on ERC 74-01
    - SEM is defined ~~to meet regulatory requirements~~
    - ACLR is defined for intra-system co-existence
    - Further study OOB boundary

Nokia: Very sensible starting point

Huawei: Consider 5G requirements as starting point, also spurious and ACLR can be regulatory in some countries

Skyworks: ACLR may be different on different frequency range. SEM definition within first MHz of SEM needs attention.

Oppo: What is ERC 74-01? Also other than SEM needed for regulatory purposes. Is ACLR only for intra-system or 5G-6G

ZTE: Support proposal 1 and proposal 4

CATT: For spurious we need to consider also ITU. A-MPR is defined for local requirements.

Xiaomi: Clarification is needed if this is for all frequency ranges, existing requirements may not apply for new frequencies

Vivo: We need to consider UE emission profile together with the emission limits

Sony: We need survey on regulatory requirements

Viasat: Are these for both NTN and TN

Ericsson: Support this as starting point

Status after AH (not agreed)

* + As a starting point for 6GR studies
    - Spurious emission requirements are based on [ERC 74-01]
    - SEM is defined
    - ACLR is defined for 3GPP system co-existence
    - Further study OOB boundary
    - FFS on details dependent on e.g. different frequency ranges

### Sub-topic 5-2 MPR study assumptions

**Issue 5-2-1: PA modelling and general aspects**

For MPR study many companies see the need to update the PA modelling. A lot of improvements of possible updates to the PA model were provided. It should be discussed which of these can be considered to be relevant for defining minimum requirements.

At the same time, there were mentions that RAN4 should be able to provide MPR and A-MPR for all bands in the first version of the 6G specifications. Therefore process improvements were desired.

Having more complicated and detailed PA models is somewhat in conflict with quickly providing results for a large number of additional emission requirements. It will be important to ensure that the PA modelling aspects are stable when 6G WI begins, and from feature leads perspective this should be taken into account when considering the level of ambition in modelling details.

From feature lead perspective, both PA modelling and process improvements should be studied and in the future they can be discussed as individual items, considering also that the same PA modelling can be applicable for multiple areas of the SI.

UPDATE: PA modelling is to be discussed in system parameters and already captured in thread [101] draft AH minutes for Wed evening

* Proposals
  + Proposal 1: Study improved PA modelling. Further discuss considering
    - PA dimensioning (MPR-0)
    - Pre-distortion
    - Memory effects
    - APT PA model
    - Doherty PA
    - PA model being based on each company’s own choice.
    - Different PA models e.g. for IoT or FWA
    - Better alignment of simulations and measurements

Huawei (sys params FL): There is urgency to send PA model to RAN1, and it may be simplified. Further work may be needed for modelling.

* + Proposal 2: Study on the MPR/A-MPR requirements simplification aiming to reduce workload and improve process efficiency of requirements development over 5G.
    - Study how to deliver all the A-MPR for all the bands with additional requirements for all the power classes from 6GR day 1
    - Study feasibility to have same MPR requirements for the same power class with different number of Tx chains.
    - Study feasibility to specify MPR/A-MPR requirements which is power class independent or having one set of MPR/A-MPR requirements covering more than 3dB power range

Apple: What does all the bands mean in first sub-bullet

Nokia: Simplified approach should not mean excessive MPR/AMPR, RAN4 should deliver more UE output power

Oppo: Delivering all A-MPR is work item issue.

Qualcomm: Delivering all A-MPRs is a good goal in isolation. We should organize the work in a manner that A-MPRs for all bands can be done during WI. Do we want to do PA models close to implementation or keep fixed bias model? Implementation is quite similar between different companies.

Vivo: We should try to avoid defining single set of requirement for A-MPR which are too large

LG: We need decision on device types to make decision

Skyworks: MPR and A-MPR should be separately considered. MPR should come first. Simplification should consider also Tx impairments.

Mediatek: MPR can be band agnostic but A-MPR is related to additional emission requirements. Prioritize MPR

Huawei: We should also consider re-farming. Initially focus on MPR. IN reality there are different power classes

Sony: This is a direction that should be investigated

Murata: Agree with Skyworks

Apple: We should not assume that all bands will be re-farmed

ZTE&Nokia&Charter: Higher output power should be the goal

Xiaomi: MPR framework could be different if the UE output power has high flexibility

**Status after AH (not agreed)**

Study on the MPR/A-MPR requirements simplification aiming to reduce workload and improve process efficiency of requirements development over 5G. Consider that MPR is needed before A-MPR and both MPR and A-MPR should values should not be inflated unnecessarily and there is strong desire to deliver more UE output power.

# Topic #8: Spectrum aggregation

### Sub-topic 8-1 Spectrum aggregation study scope

**Agreements in RAN1#122**

Agreement

Study and identify the lessons learned from NR spectrum utilization and aggregation framework.

* DC is subject to RANP decision in June 2026.
* Note: MRSS aspects are separate discussion.

Agreement

Study and identify the lessons learned from NR BWP framework.

**Agreements in RAN#109**

* No agreement on dual connectivity

**Issue 8-1-1: Spectrum aggregation study scope and timeline**

Feature lead’s understanding is that RAN1 will start work on potential new spectrum aggregation concepts only in Q1/2026. In general, it would be preferable to discuss RF aspects which are not dependent on RAN1, e.g. aspects related to RF performance, and initially put lower priority on new concepts which are not in the agenda even in RAN1 yet.

The motivation for this approach is to use the hours efficiently on topics which need to be studied independent of final specified spectrum aggregation approach and reduce risk on wasting hours on topics which will not proceed in RAN1.

* Proposals
  + Proposal 1: Begin spectrum aggregation studies from Carrier Aggregation, and look into other schemes upon confirmation of support from RAN/RAN1
    - Study all applicable duplexing modes, according to the outcomes of upcoming studies in RAN1
    - Study RF performance aspects which can be relevant for various spectrum aggregation methods
  + Proposal 2: Study also RF impact of other novel spectrum aggregation methods
    - Further discuss timeline when to start the study
      * Alt 1) consider progress in RAN1 and/or trigger from RAN1 (e.g. LS) from RAN1 to start work on
        + UL-DL decoupling
        + Multiple carriers in a single cell
        + Bandwidth adaptation
      * Alt 2) consider these topics in RAN4 study from the beginning

Skyworks: In 5G only DL were done in first release. Is this both intra-band and inter-band.

Xiaomi: We already have discussed on many topics whether to wait for other WGs. RAN4 can start parallel discussion for topics with low-dependency to other WG. RAN4 can focus and RF and RRM feasibility.

Samsung: Generally agree to start from RAN4 centric topics. We have high interest on multicarrier single cell. We set checkpoint e.g. in April.

Huawei: Can focus on CA first, but we are also interested in other schemes. Checkpoint is good idea.

Vivo: Some RAN1 colleagues have interest in RAN4 impact of new schemes.

CATT: Some schemes were discussed already in 5G

Qualcomm: Support the proposal, generally good to wait have RAN1 progress first

Mediatek: Support the proposal. UL decoupling could be discussed

ZTE: Generally P1 is ok. Cell definition is highly dependent on RAN1/2 design

Ericsson: Early RAN4 involvement in new schemes is important, support Vivo

Apple: What do we need to study further for CA. We are open to study other schemes

Nokia: Samsung approach for checkpoint is good. RAN1 can always send an LS. WE can prioritize inter-band CA.

Apple: We should try to understand the impact to UE RF architecture

Oppo: We need to understand RAN1 timeline

Xiaomi: For spectrum aggregation objective both RAN1 and RAN4 are involved

# Topic #9: Joint UE and BS RF

### Sub-topic 9-1 Low power receiver

**Issue 8-1-1: Low-power receiver study scope and timeline**

* Proposals
  + Proposal 1: Study including lower power receiver to 6GR based on RAN1 signal design
  + Proposal 2: Coexistence study should be in 6G for wake up receiver to decide selectivity to avoid the coverage hold in presence of jammer

**Status after AH (not agreed)**

Feature lead recommended companies to contribute to next meeting if there are concrete study points for low power receiver. Coexistence study including need for coex study will be discussed in agenda for BS RF and co-existence.

### Sub-topic 9-2 UE coverage enhancements

Proposals on UE coverage enhancements covered topics for UE requirement relaxations and waveform improvements. EVM relaxation discussion is separated from the other coverage enhancement proposals as EVM relaxation is also in studied for 5G despite being discussed in 6G agenda. The discussion is structured as follows

Issue 9-2-1: High level scope of non-EVM related proposals

Issue 9-2-2: Common aspects to study between non-EVM related proposals

Issue 9-2-3: Tx EVM relaxation

**Issue 9-2-1: Study scope for UE coverage enhancements**

* Proposals
  + Proposal 1: Study feasibility and methods for UE coverage enhancements both for high order and low order modulations
    - UE requirement relaxation considering
      * Identifying scenarios where the RF requirements can be relaxed
      * Tx ACLR/SEM/IBE relaxation
    - PAPR reduction schemes
      * Transparent and waveform related mechanisms
        + Consider RAN1 progress on waveforms like frequency domain truncated pi/2 BPSK and frequency domain spectrum shaping with or without spectrum extension
  + Proposal 2: For all methods, identify how to quantify system gain e.g.
    - Net gain (Tx power gain – link loss)
    - BS demodulation performance impact

Huawei: IF this is going to be recommended WF the PAPR reduction is not a complete objective. RAN4 can work only on transparent schemes

ZTE: sysparams also have discussion on PAPR reduction. This is also important for around/above 7 GHz. Also UL coherent MIMO can be considered

CATT: RAN4 needs to consider UE modulation performance

Skyworks: WE should start with what is the default power class and MPR. WE need to set priorities

Vivo: Agree with ZTE on overlap with system parameters. UL-MIMO is postponed

Oppo: 6G Day 1 baseline is most important.

Nokia: baseline UE power capability is more important. This is 2nd priority

Sony: Agree to define baseline first

Samsung: Agree with Nokia. There is a common target to deliver more power, should also consider the Tx EVM relaxation as priority.

MTK: Enhanced UL coverage is a priority. Default power class output power can be increased

Apple: Heavily tied to power class framework

Xiaomi: Echo comments from Apple. We need to clarify which schemes target low order modulations.

Ericsson: Relaxing ACLR is popular, but it is defined for co-existence purpose. For relaxing EVM we see relationship to Tx assumptions, so it is not a obvious starting point. We should start from Tx assumptions and Tx modeling.

Huawei: 5G assumption can be used in 5G study

**Status after AH (not agreed)**

* Baseline needs to be understood to understand from where relaxation is taken

**Issue 9-2-3: EVM relaxation study organization**

* Proposals
  + Proposal 1: Discuss the common parts of AI and non-AI based approaches in UE RF session. Further check which session/thread to handle demod and AI-related aspects.
    - Common parts include at least non-linearity and impairment model(s) of transmission signals used in the study
    - Simulation framework except for gNB AI processing
    - Need for network control
* Proposal 2 from feature lead: When discussing EVM relaxation, further identify which aspects are common with non-AI and and AI-based approaches.
* Proposal 3 from feature lead: Identify if there are aspects which need to be complete in UE RF before starting work in demod or AI-details, e.g. UE Tx modelling

Samsung: Suggest to agree proposal 1. Common part at least include to PA model and demod-centric feasibility study. Also demod-part can be discussed in UE RF session. Otherwise this is spread in too many places

ZTE: Our understanding is that RAN tasked us to build common assumptions first until Q3/26, then we can start on demod and simulations

Skyworks: What is the difference for Ai and non-AI from UE and PA perspective?

Sony: Our understanding is that UE RF behavior is not changed. We need to only identify how much UE Tx EVM can be relaxed.

Qualcomm: We agree with Ericsson that good Tx impairment and non-linearity model is needed. When we look at the WI, primary factor is EVM relaxation. CO-existence needs to be considered.

Vivo: From UE side there is not much to do. Performance gain relies on base station. If BS cannot compensate there will no gain. We support Samsung, we need to study demod.

Huawei: Support Samsung to centralize the work

Samsung: Respond to ZTE: Feasibility study on BS demod is needed on how much BS can compensate. After BS demod is understood, this can be an input for UE RF to study how much power gain is achieved. Net gain needs to be achieved.