3GPP TSG-RAN WG4 Meeting #116bis R4-2514618

Prague, Czech Republic, Oct 13 – 17, 2025

**Agenda item:** 8.1

**Source:** Feature lead (Huawei, HiSilicon)

**Title:** AGREEMENT for 6GR system parameter

**Document for:** Approval

# Topic #1: Waveform

## Framework study for waveform

* Agreement:
  + The primary purpose of RAN4 study on waveform is to evaluate candidate waveforms and potential PAPR reduction techniques based on agreements and inputs from RAN1
  + To establish the foundational evaluation framework in RAN4 firstly, and RAN4 waveform study should focus on the following aspects
    - Tx assumption including PA model
    - Related RF requirements which should be taken into consideration
    - Both UL and DL are considered
    - Take the candidate waveforms identified/discussed in RAN1 as the baseline
    - Identify the evaluation metric, e.g. net gain
    - Implementation constraints
  + Model and evaluate the RF performance of different waveform candidates and PAPR reduction techniques pending on RAN1 inputs
    - Evaluation cases could be selected step-by-step, based on RAN1 progress
    - Whether to investigate RF impacts of DL DFT-s-OFDM pending on RAN1 agreement

## PA model

* Agreement
  + Consider PA modelling at least for the following aspects for RAN4 discussion
    - Memory effects for UE supporting larger CBW
    - Different PA models for different sub-frequency ranges, e.g. around 7GHz (high priority, PC3/PC2) and lower frequency bands (PC3)
    - Calibration conditions
    - RF impairments used for MPR evaluation, e.g. carrier leakage, I/Q imbalance, etc.
    - PA models for different device types, handheld UE is prioritized
    - Applicable requirements
      * 5G-A requirements as starting point
    - PA models for RAN1 waveform evaluation and RAN4 requirements discussion can be decoupled

# Topic #2: Modulation

* Agreement
  + RAN4 evaluation work focus on the feasibility study and RF requirements impact
  + To establish the foundational evaluation framework in RAN4 firstly when no solid progress and inputs from RAN1
    - Identify the main affected requirements for modulation evaluations
      * The existing 5G NR requirements will serve as the baseline, which are subject to future updates based on RAN4’s 6G UE RF discussions.
    - Align on the evaluation assumptions
    - Study on how to align on the transmitter chain model, including PA model, for consistent evaluations on the modulation
    - RF evaluation could be done firstly for 5G supported modulations with new assumptions for 6G study, such as assumed new spectrum, CBW, new PA models, etc. Co-ordination with 6G UE RF study is needed.
    - Both link-level and system-level simulations should be performed as usual for high-order modulations study done by RAN4 in prior releases, pending on the progress of RAN1.
  + Model and evaluate the performance and the implementation complexity of higher-order modulations, e.g. 1024QAM on the UL and/or new constellations
    - For high order QAM with uniform constellation, e.g. 1024QAM on the UL, RAN4 can work concurrently with RAN1 studies
    - For new non-uniform constellation, the evaluation in RAN4 should depend on RAN1 progress and request.

# Topic #3: Channel bandwidth

### Sub-topic 3-1: Max Channel Bandwidth

* AGREEMENT

In the absence of RAN1 agreements, RAN4 could conduct preliminary assessments of the RF feasibility for the candidate maximum channel bandwidths.

* + RF performance evaluation with proposed max CBW
    - Identify the prioritized max CBW scenarios (e.g., TDD/FDD, frequency ranges) for evaluation
    - From transmitter perspective, evaluate the feasibility of meeting out-of-band emission requirements
    - From receiver perspective, study the impact on reference sensitivity, blocking, and ACS when receiving these wide carriers
    - 5G NR requirements could be considered as baseline for the evaluation on existing frequency bands, FFS for the new spectrum
    - ~~[Study the need and impact of specifying large CBW, e.g. from operator spectrum perspective]~~
    - The large CBW study can take into consideration on the potential spectrum availability for re-farming spectrum as well as the regulatory and WRC discussion of new 6G spectrum.
    - Assess the implementation feasibility and complexity and power consumption
    - Compare implementation options, e.g., for cases like 200MHz/400 MHz, evaluate the RF performance and implementation trade-offs of the different proposed UE architectures (e.g., single 16K FFT vs. multi-FFT vs. CA). The evaluation cases also depend on the discussion in RAN1.
  + Study the feasibility to support different NW and UE max CBW.
  + Collaborate with RAN1 on feasibility findings
    - Provide early feedback to RAN1 with RAN4's initial findings on the RF feasibility and trade-offs of the most prominent max CBW/SCS/FFT combinations.

### Sub-topic 3-2: Min Channel Bandwidth

* AGREEMENT
  + Compare options of defining min CBW, considering pros and cons
  + Study the following aspects from RAN4 perspective, meanwhile tracking RAN1/RAN progress
    - Whether 5MHz could be considered as a general baseline while 3MHz is allowed for particular bands
    - SCS-dependent framework
    - Other aspects are not precluded
  + Provide early feedback to RAN1 with RAN4's initial findings on min CBW from implementation and spectrum perspective.

### Sub-topic 3-3: FFT size

* AGREEMENT
  + Consider FFT size, maximum Channel Bandwidth and numerology as a framework to have feasibility and complexity study from implementation perspective, especially for 8K or 16K FFT size considering the associated SCS and also the frequency ranges
  + Provide RAN1 with early RAN4 feedback on the feasibility and trade-offs of the proposed FFT/CBW/SCS combinations to help guide their decisions.

### Sub-topic 3-4: Numerology

* AGREEMENT
  + Evaluate the following proposals regarding numerology from RAN4 perspective
    - "Single numerology" proposal
    - Frequency sub-range/Band specific SCS values proposal
      * Compare perf gain and implementation complexity for different SCS with same frequency range or specific band
      * Study numerology for SSB of initial cell search from RAN4 perspective
    - Other proposals not presented in this meeting are not precluded
  + Provide RAN1 with early RAN4 feedback on the feasibility and trade-offs of the proposed FFT/CBW/SCS combinations to help guide their decisions.

### Sub-topic 3-5: Spectrum utilization

* AGREEMENT
  + Agree on a set of common simulation assumptions for SU evaluation, including PA models, RF impairments (e.g., carrier leakage, I/Q imbalance, phase noise, etc.), and baseline RF requirements (e.g., SEM, ACLR, EVM).
    - 5G NR channel bandwidth, requirements can be considered as starting point for the SU evaluation with new assumptions for 6G
  + Evaluate the RF performance impact (complying with the affected requirements) of advanced spectral confinement techniques (e.g., better filtering, windowing) to understand how many RBs can be enabled
    - Considering trade-offs between SU, RF performance, and UE/BS complexity
    - Channel bandwidth and SCS with smaller SU should be prioritized
    - SU for larger channel bandwidth shall be evaluated based on progress on CBW
    - Closely coordinate with RAN1 on different waveform candidates and SCS configurations.

### Sub-topic 3-6: Asymmetric channel bandwidths

* AGREEMENT
  + Study the need and feasibility to enable asymmetric CBW

# Topic #4: Channel arrangement

### Sub-topic 4-1: Channel raster

* AGREEMENT
  + Study 5G-6GR co-existence impact on channel raster with legacy NR refarmed bands
    - Note that NR bands could have 100kHz channel raster, 10kHz enhanced channel raster or SCS based channel raster
  + Investigate the interaction between the channel raster and the synchronization raster
  + Investigate the necessity of channel raster or alternative ways for the channel configuration
    - If channel raster needs to be specified, further investigate granularity including SCS based raster, and enhanced channel raster
    - Investigate the possibility of migrating to SCS based raster if legacy rasters are still to be supported
  + Study the listed main proposals especially for the migration and co-existence approaches
    - Other options not presented in this meeting are not precluded
  + Provide early feedback to RAN1 with RAN4's analysis on the RF coexistence performance and potential implementation complexity associated with the various proposed channel raster options (5 kHz, 10 kHz, SCS-based).

### Sub-topic 4-2: Sync raster

* AGREEMENT
  + Evaluation on sync raster from RAN4 perspective:
    - Investigate the interaction between the channel raster and the synchronization raster and other aspects identified in RAN4
    - Study enhancement and/or simplification considering, e.g. fast UE cell search and power saving
  + Collaboration and planning:
    - Proactively collaborate with RAN1 to ensure that the evolving SSB design considers the practical RF and implementation constraints related to the sync raster from the outset.
    - Develop a flexible evaluation framework in RAN4 that can quickly assess different sync raster proposals once key parameters (like final SSB bandwidth and min CBW) are stabilized by RAN1.

### Sub-topic 4-3: Channel spacing

* AGREEMENT
  + Further study in RAN4 regarding channel spacing

# Topic #5: Irregular channel bandwidth

* AGREEMENT
  + 5G concepts from TR 38.844 can be considered as starting point to study a more generic solution for 6G
    - The listed main proposals and identified issues should be taken into account for the following study of irregular/flexible/scalable channel bandwidths
    - Other options not presented in this meeting are not precluded

# Topic #6: Number of Tx and Rx

* AGREEMENT
  + Study the framework of spec impact with different number of Tx/Rx
  + Evaluate number of Tx/Rx from both a performance and implementation complexity perspective.
    - E.g. device size (e.g. foldable smartphone)/form factors constraints, antenna design
  + Co-ordinate with RAN and RAN1 for number of Tx/Rx

# Topic #7: Device types

* AGREEMENT
  + The following aspects could be further studied
    - Investigate detailed RF/BB implementation feasibility and constraints related to different devices assumption, for example, size/form factors and use cases (e.g., IoT, Wearable, Smartphone, FWA devices). These should include concrete assumptions, e.g. number of antennas, CBW, power class, and supported modulation per frequency range.
      * Study on the NW impact should also be considered
    - Study how to better support variety devices from RAN4 perspective
      * E.g. differentiate devices, use cases, features
    - Other aspects are not precluded
  + Collaborate on the framework with other WGs:
    - Provide necessary inputs to RAN/other WGs with RAN4's study outcome for the above-mentioned issues