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
		- 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

RAN4 will 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 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 enabling different number of Tx/Rx and the possible sepc impact
	+ 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 of 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