**3GPP TSG-RAN WG4 Meeting #116bis R4-2514607**

**Prague, Czech Republic, Oct 13th ‒ 17th, 2025**

**Title:** Way Forward for [116bis][111] 6G operation efficiency

**Agenda Item:** 8.1

**Source: CATT**

**Document for:** Approval

# 0 Background

This special thread is to make sure that we will deliver 6G RAN4 specs with improved quality, but with an easier life in 6G days hopefully. Specifically, we may have such goals from FL’s perspective:

(1) Identify lessons on RAN4 practice in 5G standardization in a general view or the way of how to proceed, such as CR-related procedures, etc.

(2) Identify lessons or issues on RAN4 specifications, including UE RF specs, BS specs, RRM specs, demodulation specs.

(3) Based on (1), RAN4 leadership to consider and make adjustments aiming at an improved RAN4 group efficiency

(4) Based on (2), RAN4 specs for 6G to be orchestrated and improved compared with those in 5G aiming at

a) conciseness, free of redundancy

b) correctness,

c) readability, and

d) consistency

e) maintainability

The first meeting for RAN4 operations efficiency aims to gather a wide range of unconstrained opinions, which will then be used to shape discussion tracks and directions.

This way forward is the outcome of online exchanges and one Ad Hoc session, which captures the agreements reached during this meeting regarding 6G operational efficiency, and also outlines the identified potential key directions and categorizes discussion points for further consideration at the next meeting. In addition, other issues summarized in [1] but not addressed in this meeting may also be discussed further in the upcoming meeting, which are included in Section 3 in this way forward.

Note: Some of issues are further categorized into several corresponding discussion points after discussion in this meeting, and part of these discussion points are treated with conclusions or recommendations.

# 1 Guidelines for the November meeting

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| **Agreement**:   * By taking the identified issues in the feature lead’s summary into consideration, in RAN4#117, a dedicated singe sub-agenda item will be introduced for the spec improvement. Interested companies are encouraged to structure their contributions such that the spec specific proposals and the general proposals for all RAN4 spec can be separately presented. * Interested companies are encouraged to continue populating the list of identified issues to be addressed in 6G as necessary. * A dedicated sub-agenda will be introduced on CR handling improvement from RAN4#117 |

# 2 General aspects on RAN4 6G standardization

## 2.1 General principles

**Issue 2-2-1: General principles for RAN4 6GR specifications**

* Proposals
  + Proposal 1: Adapt an overall principle for 3GPP RAN4 specifications – creating lean and streamlined standards for 6G, e.g., by dimensioning an appropriate set of functionalities, minimizing the adoption of multiple options for the same functionality, avoiding excessive configurations, etc. Any exception to the above shall be well justified.
  + Proposal 2: Scalable specs consideration
    - Proposal 2a: Study how to manage growing number of CBWs, e.g., requirements scalable to CBW, etc.
    - Proposal 2b: Study in Rel-20 on how to define a more scalable and maintainable structure for 6G RRM specifications before formalization in Release 21.
  + Proposal 3: Specs restructuring
    - Proposal 3a: Revisit the orchestrations of RAN4 specifications for 6G, with the goal of reducing redundancy, improving clarity and easing long-term maintenance
    - Proposal 3b: For AI/ML-enabled features, how to capture the standardized AI/ML model and dataset in the 3GPP specification, considering AI/ML model and dataset naming rules, and unified AI/ML model and dataset format for sharing.
    - Proposal 3c: Consider common coexisting framework for all features.
    - Proposal 3d: Use RAN2 release independent from Rel-N with early implementation concept for “release independent” feature instead of the 3x.307.
    - Proposal 3e: Remove release-independent spec and capture all of the information in a separate file in the latest-release core spec package.

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| **Way forward**:  Companies are encouraged to provide views on the following discussion points for this issue.   * Discussion point #1: overall principle   + Proposal 1: Adapt an overall principle for 3GPP RAN4 specifications – creating lean and streamlined standards for 6G, e.g., , minimizing the adoption of multiple options for the same functionality, avoiding excessive configurations, etc. Any exception to the above shall be well justified. * Discussion point #2: Scalable considerations   + Proposal 2: Scalable specs consideration     - Proposal 2a: Study how to manage growing number of CBWs, e.g., requirements scalable to CBW, etc.     - Proposal 2b: Study in Rel-20 on how to define a more scalable and maintainable structure for 6G RRM specifications before formalization in Release 21. * Discussion point #3: restructuring   + Proposal 3: Specs restructuring     - Proposal 3a: Revisit the working procedure for 6G, with the goal of reducing redundancy, improving clarity and easing long-term maintenance     - Proposal 3b: For AI/ML-enabled features, how to capture the standardized AI/ML model and dataset in the 3GPP specification, considering AI/ML model and dataset naming rules, and unified AI/ML model and dataset format for sharing.     - .     - Proposal 3d: Use RAN2 release independent from Rel-N with early implementation concept for “release independent” feature instead of the 3x.307.     - Proposal 3e: Remove release-independent spec and capture all of the information in a separate file in the latest-release core spec package. |

## 2.2 Modernization and new tools

**Issue 2-2-2: Modernization and new tools**

* Proposals
  + Proposal 1: Follow conclusions in 6GSM SID (SP-250802).
    - Modernization of drafting tool: markdown, version control (TR 21.802).
    - Study RAN4 impacts on new formats such as Markdown or LaTeX.
    - RAN4 needs to keep an eye on the progress of alternative tools to replace current Word-based specification, and prepare for the potential impacts.
  + Proposal 2: The general specification modernization works (6GSM SID) can be discussed and decided in RANP to identify the needs and feasibility first, before starting any trial/study in RAN WGs level.
  + Proposal 3: Adopt equivalent multi-formatted specifications with each format tailored to a specific purpose, e.g., facilitating script-based tools for CR drafting and consolidation: one format as the root specification under version control, and other formats can automatically be generated from the root format for different purposes.
  + Proposal 4: New tools to avoid cover sheet issues.

**Way forward**:

* Discussion point #1: On the conclusions of 6GSM SID (Planned till March 2026)
  + Proposal 1: follow the conclusions
  + Proposal 2: discussed and decided in RANP once feasibility/needs identified, and start study and trial in RAN4

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| Conclusions:   * + Postponed until March 2026   + Companies encouraged to be actively involved into SID discussion. |

* Discussion point #2: multi-formatted specs
  + Proposal 3: multi-formatted specs introduced, with each format tailored to a specific purpose
    - “root format”: convenient for version control
    - E.g., “format 1”: convenient for script-based tools for CR drafting and consolidation
    - E.g., “format 2”: e.g., PDF, easy to open
    - “Non-root format” can be automatically generated via some tool from “root format”

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| Conclusions:   * + Continue discussion in the next meeting and check its use for RAN4 contributions to facilitate the possible assistance of AI tools. |

* Discussion point #3: other general auxiliary tools
  + Proposal 4: new tools to avoid cover sheet issues
  + Any other

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| Conclusions:   * + Further collect information on how CR check is done before each meeting in RAN5, in which coversheet issues and content conflicts are checked.   + Companies are encouraged to further consider demand for tools to resolve coversheet issues for CRs revised or allocated during the meeting. |

**Issue 3-1-2: Band-Combination Handling and Tool Support**

* Proposals
  + Proposal 1:
    - Proposal 1a: Utilize the band-combination database from the beginning of 6GR.
    - Proposal 1b: Band combos stored in database instead of in specs.
    - Proposal 1c: Exploit the rules and principles made on the band/band combinations in 5G-NR via data-based approach and spec. modernization as much as possible.
    - Proposal 1d: RAN4 to make some trial of using this band-combination database and study how to incorporate this database into RAN4 specification and meeting handling like CR process, etc.
    - Proposal 1e: Consider the CA MSD requirements or relevant notation notes in the CA database.
  + Proposal 2: Automated tools for generating supported band combinations and their related specific requirements, e.g. delta values and MSD in 6GR.
  + Proposal 3: Develop an automatic checking tool for fallback band combinations in RAN4.
  + Proposal 4: With the introduction of assistant new tools for band/band combinations, RAN4 6G specifications should still remain tangible, self-contained and not dependent on any new tool.
  + Proposal 5: Consider the progress in band-combo simplification.
  + Proposal 6: Simplify band and band-combination requirements (Emissions, REFSENS, MSD, blocking) with a default set of requirements per band groups and band group combinations (See also in Issue 3-1-3).
  + Proposal 5 (from Issue 2-2-2): For band combos, continue to use JSON schema with CA config tables as first priority.

**Way forward**:

* Discussion point #1: Relationship between band combination database and RAN4 Specifications (In- or Out-of-Spec Consideration)
  + Option 1: band combination database is part of specs
    - Proposal 1b: band combos stored in database instead of in specs
    - Proposal 5 (from Issue 2-2-2): For band combos, continue to use JSON schema with CA config tables as first priority
  + Option 2: band combination database itself is NOT part of specs, but an assistant tool since specs should be self-contained.
    - Proposal 4: With the introduction of assistant new tools for band/band combinations, RAN4 6G specifications should still remain tangible, self-contained and not dependent on any new tool.
    - Proposal 5: Consider the progress in band-combo simplification.
  + Option 3 (Proposal 1d) RAN4 to make some trial of using this band-combination database and study how to incorporate this database into RAN4 specification and meeting handling like CR process, etc.

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| Conclusions:   * + Companies are encouraged to     - Learn how to generate a JSON file, and participate in trial practice of using the band combination database     - Study how to incorporate this database into RAN4 specification and meeting handling like CR process, etc |

* Discussion point #2: utilization of band combo database
  + Proposal 1a: Utilize the band-combination database from the beginning of 6GR.
  + Proposal 1e: Consider the CA MSD requirements or relevant notation notes in the CA database
  + Proposal 1c: Exploit the rules and principles made on the band/band combinations in 5G-NR via data-based approach and spec. modernization as much as possible.
  + Proposal 6: Simplify band and band-combination requirements (Emissions, REFSENS, MSD, blocking) with a default set of requirements per band groups and band group combinations (See also in Issue 3-1-3).

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| Conclusions:   * + Companies are encouraged to provide further views on utilization of band combo database. |

* Discussion point #3: automation tools related to band combination database
  + Proposal 2: Automated tools for generating supported band combinations and their related specific requirements, e.g. delta values and MSD in 6GR.
  + Proposal 3: Develop an automatic checking tool for fallback band combinations in RAN4.

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| Conclusions:   * + Companies are encouraged to provide further views on automation tools related to band combination database |

## 2.3 Drafting rules

**Issue 2-2-5: Drafting rules and principles for specification quality assurance**

* Proposals
  + Proposal 1: Study the root causes of specification quality challenges in RAN4.
  + Proposal 2: Uniform drafting guidance/rules for requirements definition when introduction of a new feature in the specification.
  + Proposal 3: For 6G, the specification needs to be explicitly stated so that it is always clear which requirements apply to a given BS.
  + Proposal 4: Consistency and editorial improvements:
    - To ensure consistency in terminology and structure within the same topic, a partial initial draft template can be provided before the overall drafting.
    - Consistent and identical terminologies shall be used.
    - Avoid the following issues:
      * Terminology/style inconsistency, incorrect notation/symbols/abbreviation, undefined abbreviations, redundant information/notes.
      * “TBD”, “FFS”, empty test cases.
  + Proposal 5: Reduce redundancy
    - Proposal 5a: Add paragraph numbering to some paragraphs, and using these numbers to refer to identical paragraphs without any text changes.
    - Proposal 5b: Block-based method, i.e., capture similar requirements just in one place and refer this part if needed.
    - Proposal 5c: Introduce an applicability description in relevant sections and define different parameter values for each relevant parameter for the different scenarios, use cases etc.
  + Proposal 6: Reduce the usage of RAN2 language in RAN4 specification as much as possible.

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| **Way forward**:  Companies are encouraged to provide views on the following discussion points for this issue.   * Discussion point #1: Consistency and editorial improvements   + Proposal 4:     - To ensure consistency in terminology and structure within the same topic, a partial initial draft template can be provided before the overall drafting.     - Consistent and identical terminologies shall be used.     - Avoid the following issues:       * Terminology/style inconsistency, incorrect notation/symbols/abbreviation, undefined abbreviations, redundant information/notes.       * “TBD”, “FFS”, empty test cases. * Discussion point #2: Reduce redundancy   + Proposal 5:     - Proposal 5a: Add paragraph numbering to some paragraphs, and using these numbers to refer to identical paragraphs without any text changes.     - Proposal 5b: Block-based method, i.e., capture similar requirements just in one place and refer this part if needed.     - Proposal 5c: Introduce an applicability description in relevant sections and define different parameter values for each relevant parameter for the different scenarios, use cases etc. * Discussion point #3: General drafting rules   + Proposal 1: Study the root causes of specification quality challenges in RAN4.   + Proposal 2: Uniform drafting guidance/rules for requirements definition when introduction of a new feature in the specification.   + Proposal 3: For 6G, the specification needs to be explicitly stated so that it is always clear which requirements apply to a given BS.   + Proposal 6: Reduce the usage of RAN2 language in RAN4 specification as much as possible. |

# 3 Potential improvement directions

The following issues were observed during previous 5G RAN4 standardization activities and may offer valuable insights for ongoing discussions. As such, they could be considered and further explored in subsequent meetings.

## 3.1 General potential improvement directions

**Issue 1-1-1: General and common Issues for all RAN4 specifications**

* Observed issues
  + Issue 1: Requirements for one feature
    - One single feature may have requirements at multiple clauses and across multiple specs.
    - For the same feature, either new clause for one requirement or re-use legacy clause for another requirement.
    - Different approaches are adopted for different features in the structure.
  + Issue 2: Redundancy
    - Many duplications and repetition of requirements for different scenarios and use cases.
    - Duplicated requirements scattered throughout different sections.
  + Issue 3: Consistency
    - Terminologies are not aligned or consistent
  + Issue 4: Structuring
    - Combine core and performance requirements into the same spec.
    - Some of the 3GPP specs are too large and become very difficult even to open.

**Issue 1-1-2: Issues for UE RF specifications**

* Observed issues
  + Issue 1: framework
    - Inefficiency caused by RF requirements framework (time-consuming for MSD, too many segmentations for BCS, unuseful complex requirements such as Power class, inter-band UL combo, duty cycle for SAR mitigation, complex Pcmax section).
    - The NR UE RF spec is split based on frequency range (FR1/FR2).
    - The latest release requirements are the superset of all previous releases.
    - NR spec mixes mandatory and optional feature requirements in one spec
  + Issue 2: band combinations
    - Huge band combination tables in MS Word format.
    - Tens of thousands of band combinations have been specified in UE specifications.
  + Issue 3: Suffix approach
    - For TS 38.101-1, suffix-ed requirements for different features make specs complex.
    - Rules on applicability of suffix requirements and general requirements are not clear or not strictly followed.
    - Different approaches are adopted for different features in the structure; too many undefined (sub-)clause suffixes.
    - Too many (sub-)clause suffixes not defined for RF requirements.
  + Issue 4: Readability
    - Poor readability caused by recursively 3rd-level heading in UE RF specs.
    - Some RF requirements are quite complicated and difficult to understand.
    - Readability not good enough for engineers who only want to implement mandatory features and making maintenance difficult.

**Issue 1-1-3: Issues on RRM Specifications**

* Observed issues
  + Issue 1: Redundancy
    - The duplicated requirement in TS 38.133 leads to confusion and unnecessary extra effort for spec maintenance.
    - Many instances of redundancy in TS 38.133 for NR, with repeated definitions and tables appearing throughout the specification.
    - Duplicated clauses exist in TS 38.133.
    - Duplicated requirements scattered throughout different sections.
    - Many configuration parameters in test cases are repeated in RRM specs
  + Issue 2: Cases and scenarios
    - When defining RRM requirements there are multiple cases and scenarios involved even when they are rarely deployed.
  + Issue 3: Readability
    - Measurement requirements categorized by intra/inter-frequency are not efficient in TS 38.133.
    - Readability and friendliness issues in TS 38.133.
    - Unclear or non-straightforward relation between requirements and test cases in RRM specs.
  + Issue 4: Test cases
    - Test cases exist in the top-level heading in RRM specs

**Issue 1-1-4: Issues on BS specification**

* Observed issues
  + Issue 1: Observed mismatch between requirements and conformance specs in TS 38.104.
  + Issue 2: In the 5G BS demodulation performance specifications, the applicability of certain requirements is not explicitly linked to the support of the corresponding features, leading to unintentional omission of requirements and inconsistent network performance.

**Issue 1-1-5: Issues on Performance or Demodulation Specifications**

* Observed issues
  + Issue 1: In the 5G BS demodulation performance specifications, applicability of certain requirements is not explicitly linked to the support of the corresponding features.
  + Issue 2: The current structure of applicability rules in TS 38.101-4 is fragmented and inconsistent across device types

**Issue 1-2-1: Discussion arrangement and WI management**

* Issues observed
  + Issue 1: Discussion arrangement
    - Number of parallel sessions: Main/RRM/BDaT + 1/2 ad hoc sessions: scheduling conflicts.
    - Current offline discussion usually is handled in an informal and sometimes non-transparent way.
  + Issue 2: WI management
    - Mismatch between TU budget and actual meeting time spent in some WI/SIs.
    - Open issues still left to maintenance when declaring 100% completion.
    - Not every tdoc has a WI code.

**Issue 1-2-3: Release independent handling**

* Issues observed
  + Issue 1: The current release independent handling is inherited from LTE which was mainly for band and band combinations, but extended to other features.
  + Issue 2: Different from the way in RAN2 which is early implementation without interoperability issue
  + Issue 3: TS 38.307 is messy and difficult to maintain.

**Issue 1-2-4: Coexistence studies**

* Issues observed
  + Issue 1: Coexistence studies carried out in 5G are captured in several TRs and
  + Issue 2: No common generic guideline is followed.

**Issue 2-2-3: Meeting arrangement and WI management**

* Proposals
  + Proposal 1: Limit parallel sessions to Main/RRM/BdaT + 1 Ad Hoc session.
  + Proposal 2: Enhanced transparency
    - * Proposal 2a: Dedicated email thread for the Ad Hoc session.
      * Proposal 2b: Put the meeting schedule to a common calendar.
      * Proposal 2c: Formal offline discussions need to be triggered on the reflector to let companies aware of such discussion
  + Proposal 3: RAN4 to study procedures how to relieve the workload on Friday, e.g. making decision early during the meeting, etc.
  + Proposal 4: WI management
    - * Proposal 4a: Actual meeting time spent should reflect TU budget.
      * Proposal 4b: Restrict work/open issues left to maintenance stage.
      * Proposal 4c: Mandate WI code for each tdoc to facilitate searching.

## 3.2 Potential improvements for RAN4 specifications

### 3.2.1 UE RF specs improvement

**Issue 3-1-1: General and Structural Improvements**

* Proposals
  + Proposal 1: Further study on UE RF specs improvements by taking into account identified issues.
  + Proposal 2: Study UE RF spec structure by the requirements with different features.
  + Proposal 3: Restructuring: requirements without suffixes + requirements per features + release-independent information.
  + Proposal 4: Only maintain one release RF spec.
  + Proposal 5: Only maintain the latest-release 307 spec.
  + Proposal 6: Clause numbering alignment should be kept.
  + Proposal 7: RAN4 specification should consider features to be self-contained in a clause and introduce UE types to avoid ambiguity for the implementation.
    - No separate file for one feature.
    - In its simplest implementation, all single band requirements should be in one place in the specification, then followed by intra-band and inter-band combinations
    - Requirement could then be across UE types and applications
  + Proposal 8: TN and NTN application should not be separated, as it can be identified by different bands and UE types.

**Issue 3-1-2: Band-Combination Handling and Tool Support**

* Proposals
  + Proposal 1:
    - Proposal 1a: Utilize the band-combination database from the beginning of 6GR.
    - Proposal 1b: Band combos stored in database instead of in specs.
    - Proposal 1c: Exploit the rules and principles made on the band/band combinations in 5G-NR via data-based approach and spec. modernization as much as possible.
    - Proposal 1d: RAN4 to make some trial of using this band-combination database and study how to incorporate this database into RAN4 specification and meeting handling like CR process, etc.
    - Proposal 1e: Consider the CA MSD requirements or relevant notation notes in the CA database.
  + Proposal 2: Automated tools for generating supported band combinations and their related specific requirements, e.g. delta values and MSD in 6GR.
  + Proposal 3: Develop an automatic checking tool for fallback band combinations in RAN4.
  + Proposal 4: With the introduction of assistant new tools for band/band combinations, RAN4 6G specifications should still remain tangible, self-contained and not dependent on any new tool.
  + Proposal 5: Consider the progress in band-combo simplification.
  + Proposal 6: Simplify band and band-combination requirements (Emissions, REFSENS, MSD, blocking) with a default set of requirements per band groups and band group combinations (See also in Issue 3-1-3).

**Issue 3-1-3: Requirement Definition and Feature Separation**

* Proposals
  + Proposal 1: Define UE RF requirements for single carrier as baseline for minimum requirements and specifies the 2Tx / CA / DC / DL-UL decoupling / 1Tx RF requirements with Suffix.
  + Proposal 2: Separate specs for vertical device requirements (i.e. Vehicle Device, RedCap, NTN, ATG, UAV, …).
  + Proposal 3: Decouple the mandatory feature and optional feature into different spec.
  + Proposal 4: Simplify spectrum requirements by creating band-group level requirements (at least as a default)
  + Proposal 5: Rather than using frequency ranges, requirements should be separated between individual antennas/connectors/conducted measurements versus antenna arrays/beamforming/OTA measurements
    - In that case, the associated frequency ranges could overlap within the 7-20GHz region: For 0.4 to 52GHz, two overlapping frequency ranges may prove sufficient.
    - Simplify band and band-combination requirements (Emissions, REFSENS, MSD, blocking) with a default set of requirements per band groups and band group combinations.
    - Favor equation-based requirements and parameters.

**Issue 3-1-4: Frequency-Range and New-Spectrum Handling**

* Proposals
  + Proposal 1: RAN4 to discuss how to capture the UE RF requirement for new spectrum (e.g. FR3):
    - * Option 1: Allocate a dedicated spec for the new 6G spectrum.
      * Option 2: Two specs are created for conductive requirement and radiated requirement respectively, and capture the RF requirement of FR3 based on the decision of requirement applicability.
  + Proposal 2: Discuss which specification is used to specify the 7 GHz, 8 GHz and 15 GHz bands.

**Issue 3-1-5: Improved CBW and BWP support**

* Proposals
  + Proposal 1: Support of 2x 5G maximum CBW in the same band thanks to 8K FFT and single SCS per band/band-group.
  + Proposal 2: Enable variable BW support by design such that any CBW (1MHz granularity?) can be supported but only a limited set is measured.

### 3.2.2 RRM specs improvement

**Issue 3-2-1: General principles and targets**

* Proposals
  + Proposal 1:
    - Proposal 1a: Follow agreements in R4-2420107 for better readability.
    - Proposal 1b: The agreements in R4-2420107 should be treated as a starting point for 6G RRM spec.
  + Proposal 2: Consider 6GR specification drafting rules (e.g. overall spec structure, hierarchy of indent, suffix rule, etc.).
  + Proposal 3: Enforcement of drafting rules: only CRs following drafting rules can be agreed.
  + Proposal 4: Differentiate whether the difference between two requirements is due to editorial issue or technical issue.
  + Proposal 5: For spec and CR drafting rules, follow agreed principles as in 5G RAN4 Meeting Efficiency Improvements (R4-2114691), i.e., big CR approach.
  + Proposal 6: Study further drafting rules to improve readability.
  + Proposal 7:
    - Proposal 7a: Avoid corner cases and focus on most typical and practical use cases.
    - Proposal 7b: Focus on enhancing the testing of RRM procedures to ensure that functionality and performance is tested under conditions that reflect field-relevant scenarios.
    - Proposal 7c: Study how to ensure that real UE implementations are tested as much as possible.
    - Proposal 7d: Discuss whether to define two threads requirements, one focus on the baseline and another focus on the strict performance with real field request.
    - Proposal 7e: Study how to define RRM requirements that allow UE implementation based on minimum requirements but also allow UEs that can outperform the minimum requirements the benefits from such better performance

* + Proposal 8: Consider a template for requirements.
  + Proposal 9: Use the following aspects as start point:
    - Reuse the Big CR procedure and RAN4 Chair and MCC’s rules of Big CR: no [], TBD, FFS clean up in the Big CR and specs.
    - Reuse the rules of “Forward section” to ensure consistent usage of frequently used terms, notation, abbreviations, CA configuration vocabulary, etc.
    - For new features, determine the common rule of whether to add a new sub-clause. If new sub-clauses are introduced:
    - Clearly declare the numbering corresponding to a feature in an appendix or designated location.
    - For situations where similar text needs to be repeated across multiple sections (or specifications), the general text should first be agreed upon as a reference and then used across different sections/CRs/specifications to improve consistency.
  + Proposal 10: Study at least following aspects or RRM spec improvement in 6GR
    - Better classification of L3 RRM measurement requirements
    - Consistent principles to address different collisions
  + Proposal 11:
    - Introduce a more intuitive and simpler way to define RRM requirements, and new forms of representation if necessary.
    - Adopt a more unified form to manage similar parameters and simplify as much as possible, avoiding the introduction of too many parameters with similar meanings and functions.
  + Proposal 12: Target for next generation technique innovation on RRM should be more efficiency and less energy consumption, higher throughput and less interruption.
  + Proposal 13: clear scope and goal / direction to be discussed /derived during 6G SI phase.
  + Proposal 14: Comprehensively consider the RRM design in 6G with some high-level principles:
    - Measurement bandwidth/Rx number vs implementation complexity
    - Power saving vs always-on RF chain
    - Gap-less design vs the number of searcher/idle RF chain
    - Measurement period vs measurement accuracy
    - TN&NTN integration vs implementation complexity
  + Proposal 15: Even without AI/ML-based operation, the 6G RRM specifications must provide improvements over NR
  + Proposal 16: Strive to establish quantifiable requirements to avoid the vague specification.

**Issue 3-2-2: Structural Options and Specification Organization**

* Proposals
  + Proposal 1: High-level structure for new 6G RRM specs
    - Proposal 1a: RAN4 to discuss the following for new 6G RRM specs:
      * a. High level structure (highest level sections: Idle, Inactive etc.)
      * b. UE requirements for a scalable 6G design
      * c. Any gain in further splitting the specification
      * d. Test case mapping (e.g. TC reference in core part)
    - Proposal 1b: Consider the following framework (preferred):
      * RRC\_IDLE/INACTIVE state mobility
      * RRC\_CONNECTED state mobility
      * Timing
      * Measurement procedure for RRC\_CONNECTED state
      * RLM/BFD/CBD
      * PSCell/SCell management (if applicable by PHY/high layer design in 6GR)
      * Other UE-specific characteristic switching (if applicable by PHY design in 6GR)
      * Measurement performance
    - Proposal 1c:
      * For the 6G RRM spec, top level of sections 4, 5, 6, 7, 9, 10 in TS 38.133 can be reused.
      * Section 8 is used to capture procedure delay related requirements.
      * Scheduling restriction related requirements and interruption requirements are captured in one high-level section.
      * L1 measurement requirements (incl. RLM and link recovery) and L3 measurement requirements are captured in one high-level section.
      * Some distinct features (e.g. sidelink requirements) can be captured in a separate section.
    - Proposal 1d: The following skeleton as a starting point:
      * Requirements for RRC\_Idle/Inactive
      * Requirements for RRC\_Connected
      * Requirements for timing signal
      * Requirements for the measurement procedure
      * Reconsider if there should be RRC\_INACTIVE.
      * Second-level heading to be discussed further:
        + More UE states
        + Intra/inter-frequency requirements separation
        + RRM unified requirement framework.
    - Proposal 1e: Specification structure for 6G test cases is similar to the requirements structure in the main part of the specification (at least top level, maybe second level).
    - Proposal 1f: the overall spec structure in 5GNR can be inherited such as: RRC\_IDLE/INACTIVE/ CONNECTED state mobility, Timing, Signaling, Measurement. etc.
      * Decide the high-level principle to decide whether a new feature is introduced, new sub-clauses can be allowed or not. Preferable to category the clauses from procedures and different assumptions rather than UE types.
      * Even the named of procedures are the same as in 5GNR, it doesn’t mean the exactly same RRM requirements in 5GNR will be reused.
      * Achieve the common assumption of each component for different UE capabilities, including assumption of RF and BB processing, like: RF retuning time, AGC time, time for change bandwidth, time for BB processing, T/F tracking, number of searchers, etc
  + Proposal 2: The following alternatives can be considered in 6G to improve spec readability:
    - Option 1: a single spec for all UE features
    - Option 2: different sub-specs for common features and other vertical UE features (e.g. sidelink, NTN)
    - Option 3: different sub-specs for core, performance, TC separately.
  + Proposal 3: The basic functionalities and prioritize 6G day-1 typical cases’ requirements.
  + Proposal 4: Avoid duplication and repetition of UE requirements for different scenarios and use cases.
  + Proposal 5:
    - Proposal 5a: RAN4 to study how new features introduced in 6G are captured in RRM requirements specification.
    - Proposal 5b: New features introduced in later releases are captured either by incorporating in existing sections or by creating new sub-sections. Same suffix should be used for the same feature in different sub-sections.
  + Proposal 6:
    - Proposal 6a: Consider split RRM spec into two files for core part and performance part, respectively.
    - Proposal 6b: Avoid defining too huge spec like 38.133; consider splitting the 6G RRM spec into several specs covering core requirements, performance requirements, and test cases respectively.

**Issue 3-2-3: Drafting approach**

* Proposals
  + Proposal 1: Adopt RAN2 pseudo-code approach in all sections.
  + Proposal 2: Uses block-based approach to define core requirements and test cases.
  + Proposal 3: A new tool, if possible, is used to capture tabulated test setup in test cases.

**Issue 3-2-4: Readability and simplification**

* Proposals
  + Proposal 1: simplification on core requirements and tests by considering real demands, typical scenarios and realistic UE implementation
    - Proposal 1a: Study how to reduce the amount of RRM procedure and requirements are defined only for key RRM procedures.
    - Proposal 1b: Re-evaluate existing RRM core and performance requirements whether they still reflect state-of-the art UE implementations.
    - Proposal 1c: Study in the 6G study item whether the amount of RRM procedures can be reduced. Requirements should only be defined for key RRM procedures.
    - Proposal 1d: Investigate how the network can be enabled to follow true UE performance in its RRM procedures instead of assuming that all UEs just support minimal requirements.
    - Proposal 1e: Define necessary RRM requirements for key features and procedures. It is not mandatory to define RRM requirements for all features and procedures. To consider by two criteria:
      * Must to have actual impacts and guidance on implementation design.
      * Must to be tested and testable in conformance testing.
    - Proposal 1f: the feature with market demand are supported from 6G day-one.
    - Proposal 1g: Defining standardized and meaningful measurement metrics for 6G from day one, ensuring that these metrics are clearly specified and consistently implemented across vendors.
    - Proposal 1h: Define 6G feature requirements based on realistic UE architecture assumptions, rather than relying solely on basic UE profiles that may not support the intended feature.
  + Proposal 2:
    - Proposal 2a: Include references or mapping tables in the core part requirements that point to the relevant test cases in 6G.
    - Proposal 2b: Include a reference to the corresponding test cases in the corresponding requirement clause (e.g., in the text or as a new sub-clause).
    - Proposal 2c: Test cases for specific applications or use cases can be in a separate section, but without breaking the main structure and mapping between core requirements and test cases:
      * Option 1: use cases added as separate sections after the main test case hierarchy.
      * Option 2: use cases grouped at a second level of the test case hierarchy.
    - Proposal 2d: If common configurations can be identified for different test cases, they can be collected in a common section (e.g. under A.3 RRM test configurations or similar).
  + Proposal 3: Reduce redundancy by referencing common descriptions instead of repeating descriptions in multiple places.
  + Proposal 4: Editorial modifications in NR can be used as the baseline for future optimization toward 6G.
  + Proposal 5: Study any changes to the synchronization signal design and other related reference signals and the impact on cell detection and measurement requirements.

### 3.2.3 BS specs improvement

**Issue 3-3: BS specs improvements**

* Proposals
  + Proposal 1: Study a methodology to align specifications created in parallel
  + Proposal 2: Leverage the Rel-19 RAN task for the simplification for co-existence and co-location requirements for 6GR BS specification
  + Proposal 3: Discuss how to capture the same requirements (e.g. TRP measurement, EVM measurement, test mode/configuration, OTA test chamber) or test procedures across different network nodes specifications if there are many similarities just with some items/notation difference."

### 3.2.4 Performance/demodulation specs improvement

**Issue 3-4: Perf/Demod specs improvements**

* Proposals
  + Proposal 1: Replacing broad applicability statements with clear, centralized mappings of test coverage. This would enhance consistency and reduce ambiguity across device types and configurations.
  + Proposal 2: A capability-aware test applicability framework should be intended, e.g., For devices lacking legacy TN support, test applicability should be designed to avoid dependency on TN-related procedures and corresponding test cases."
  + Proposal 3: FRC table improvements considering
    - necessary configuration and avoid derived information
    - methodology to generate FRC table efficiently

# Reference

[1] R4-2514518, “Topic summary for [116bis][111] 6G operation efficiency”, Moderator(CATT)