3GPP TSG-RAN WG4 Meeting #116bis R4-2514512

Prague, Czech Republic, October 13 – 17, 2025

**Agenda item:** 8.1

**Source:** Feature lead (Apple)

**Title:** FL summary for [116bis][105]6G RRM

**Document for:** Information

# Introduction

This FL summary includes 6G RRM (8.7) and the prioritized topic for discussion is summarized as follows.

*List of candidate target of discussions for this topic.*

* Mainly discuss on
  + Presenting the summary of 6G RRM proposals in issue 1
  + Issue 4-2, Issue 4-1: Measurement gap(MG) and interruption
  + Issue 5: RRM framework: Measurement capability/delay/overhead/accuracy
  + Issue 8: Spectrum aggregation and CA related RRM
  + Issue 7: RRM related energy efficiency
  + Issue 6: Mobility related RRM
  + Issue 1: Summary of the support status for the main features
* If time allows, then discuss on:
  + Issue 9, Issue 10, Issue 11, Issue 12, Issue 3
* Issue 2 and issue 13 is moved to [116bis][111] 6G operation efficiency

# Topic #1: 6G RRM (8.7)

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2513034**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513034.zip) | Apple | **Measurement gap(MG)**  Proposal 1: MG design is discussed in Rel-20 6G SI from RAN4 RRM perspective.  Proposal 2: for MG design scope, following aspects can be studied:   * To study reducing MG patterns from 5G(e.g., only focus on most typical MG use cases) * To study unified MG concept in 6G   + Unified MG for NR MG and NR scheduling restriction   + Unified MG sharing among intra-frequency, inter-frequency, and inter-RAT measurement (including L3 and L1 measurement)   + Unified MG for different feature related measurements, e.g., RRM measurement, MUSIM related measurement, positioning measurement, and etc * To study UE-request-based MG configuration and applicability   + UE request of MG for multiple measurement purposes   + MG activation/deactivation due to measurement demands * To study multiple CC measurement in single MG occasion   **Mobility related RRM**  Proposal 3: virtual RRM UE group is discussed in Rel-20 6G SI from RAN4 RRM perspective.  Proposal 4: for virtual RRM UE group, following aspects can be studied:   * To study the feasibility of Virtual RRM group concept   + Only RRM functionality (e.g., L3 RSRP/RSRQ measurement) is considered   + No Tx/Rx timing sharing, no data sharing, no coherent transmission/reception is considered   + Prioritize the case without side-link * To study the feasibility and schemes of Measurement load balance among devices in virtual RRM group   **Mobility related RRM**  Proposal 5: for study on RRM enhancement for mobility, following two directions can be studied:   * Facilitate preparation phase: to reduce latency between the time when channel condition can meet event triggered threshold and the time when UE realizes the condition is met. * Reduce interruption during HO execution without significantly increase complexity at both UE and network sides.   **RRM related energy efficiency**  Proposal 6: study UE state based RRM, e.g.   * Investigate measurement reduction for stationary UE, including both L3 and L1 measurement * Investigate reporting reduction for stationary UE, including both RRM and CSI reporting * Investigate threshold for neighbor cell measurement triggering when UE is in stationary mode   **Multi-TRP RRM**  Proposal 7: study RRM impact from mTRP on different carriers, if supported. |
| [**R4-2513039**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513039.zip) | MediaTek inc. | **Measurement gap(MG)**  Conventional measurement gaps:  Proposal 1: Investigate methods to reduce the use of measurement gaps in 6G systems.  Proposal 2: Identify and address the reasons behind measurement gaps in previous generations of mobile systems and how to handle these issues in 6G systems.  Gapless solutions  Proposal 3: The gapless capability to be specified in the 6G Day-1 spec, including both signalling and RRM requirements.  Issue 1: Available RF chain:  Proposal 4: Further investigate how to limit the measurement gap impact to a single carrier or specific number of carriers.  Proposal 5: When defining measurement gap/interruption requirements and reporting signalling, different UE behaviours should be specified based on the availability of an idle RF chain.  Issue 2: RF retuning time:  Proposal 6: RAN4 (RRM/RF) to further investigate the possibility of reducing the RF retuning time for measurement gaps/gapless.  Issue 3: Non-colliding multiple GAPs:  Proposal 7: Investigate the introduction of non-colliding multiple concurrent measurement gaps in 6G systems from the initial release.  **Fast RF retuning/interruption-free**  Proposal 8: RAN4 (RRM/RF) to further study the possibility of reducing the interruption time including the RF retuning time for different UE procedures.  **Mobility related RRM**  Proposal 9: In 6G SI, RAN4 to start from mobility solutions with less RAN1/2-dependency.  Proposal 10: A solution that can mitigate the problem of longer SSB periodicity needs to be considered in 6G study.  Proposal 11: 6G Day-1 HO solution should be applicable to all the scenarios and work well without conditions.  Proposal 12: For 6G mobility, decouple the KPIs of HO delay and HO interruption with the priority on reducing interruption.  Proposal 13: HO interruption can be reduced by postponing Tprocessing to the last, e.g., just before RACH occasion for RACH-based HO.  Proposal 14: To further reduce HO interruption, source cell should keep scheduling until UE breaks the link with source cell.  Proposal 15: Support UE initiated early RRC decoding and early T/F tracking in 6G.  **UE Tx timing**  Proposal 16: Study PRACH (if introduced) specific timing accuracy requirement.  Proposal 17: Study the feasibility of replacing gradual timing adjustment with UE pre-compensation, while retaining the Timing Advance command.  **Spectrum aggregation related RRM**  Cell with multiple carrier  Proposal 18: RAN4 RF should study the conditions and requirements for aggregating multiple carriers to a single cell for 6G. For example, RF switch-time requirements, acceptable transmit timing alignment error (TAE), base-station (BS) frequency error, and total received power difference limits at the UE. And RAN4 RRM should study the corresponding interruption and delay requirements.  Carrier switch enhancements for UL and DL  Proposal 19: RAN4 should study support of carrier switching and simplify configurations with forward compatibility; specifically, RAN4 RF should study applicable scenarios and RF switch-time requirements, and RAN4 RRM should study the corresponding interruption and delay requirements.  SCell activation, increase of spectrum aggregation  Proposal 20: RAN4 should study critical, high likely SCell activation scenarios and ensure timely CSI acquisition; RAN4 RF should study RF switch-time requirements, and RAN4 RRM should study SCell activation interruption and overall delay.  **Measurement capability and delay reduction**  Proposal 21: Study the appropriate measurement capability for number of cells in 6G. The number of detected cells in FR1 is <=4 with 90% probability and <=5 with 97% probability.  **Other PHY signal/channel/procedure related RRM**  Proposal 22: Synchronized Inter-RAT to be the baseline assumption for 6G to enable inter-RAT measurement and mobility. |
| [**R4-2513040**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513040.zip) | Qualcomm Technologies Ireland | **Views for the 6G Study Item for RRM (RRM requirement design principle)**  Proposal 1: RAN4 should focus on enhancing the testing of RRM procedures to ensure that functionality and performance is tested under conditions that reflect field-relevant scenarios.  Proposal 2: RAN4 should study how to ensure that real UE implementations are tested as much as possible.  Proposal 3: RAN4 should re-evaluate existing RRM core and performance requirements whether they still reflect state-of-the art UE implementations.  Proposal 4: RAN4 should 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 5: RAN4 should 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 6: We propose to discuss between RAN4 and RAN5 whether in 6GR RAN4 could focus on the scope and framework for defining RRM performance tests and RAN5 could specify the detailed parameter configurations of the RRM performance tests.  **Mobility related RRM**  Proposal 7: If a unified measurement and mobility framework for 6G is defined based on the 5G LTM feature, RAN4 should re-evaluate the benefits of the feature, thoroughly analyze the implementation challenges arising from its complexity and associated RRM requirements, and investigate how to address the identified issues to the extent that the feature can be implemented with reasonable complexity.  Proposal 8: 6G mobility requirements should be constrained to scenarios where the resulting handover latencies or interruption durations are technically meaningful and operationally relevant. Requirements that lead to excessively large values should be avoided.  Proposal 9: RAN4 to study the practically achievable end-to-end handover latency target, taking into account user-plane data forwarding latency, to better align handover requirements with practical effectiveness.  **Spectrum aggregation and CA related RRM:**  Activation/Deactivation of Cells  Proposal 10: For 6G carrier aggregation features, RAN4 should investigate which SCell activation features have been commercially deployed or are planned for deployment and prioritize those based on proven deployment evidence to avoid unnecessary complexity and ensure practical impact.  Proposal 11: In 6G, interruption requirements during deactivated SCell measurement and SCell activation should be defined to align with state-of-the-art UE implementations. For example, the interruption duration for intra-band CA in 5G is excessively long and may not reflect practical deployment needs.  Proposal 12: For 6G carrier aggregation, RAN4 should re-evaluate the assumptions made in the 5G SCell activation requirement definition, based on state-of-the-art UE implementations, and investigate whether and to what extent SCell activation latency modeling can be simplified to better align requirements with practical UE behavior and implementation realities.  **Measurement gap(MG) and interruption**  Measurement and Gaps  Proposal 13: RAN4 should study the overall measurement gap framework in 6GR and identify all inefficiencies—technical and operational—that hinder optimal gap usage.  Proposal 15: RAN4 should study how to enable UEs to indicate preferred MG configurations, allowing for more adaptive and efficient measurement scheduling.  Proposal 17: RAN4 should study for the case of 15 kHz subcarrier spacing whether the unused half slot (0.5 ms) in the duration of a measurement gap can be used efficiently, e.g., for data transmission.  Enhancements of Interruptions  Proposal 14: RAN4 should identify and evaluate mechanisms that enable interruption-free measurements, with a focus on deployability from the beginning of 6GR.  Proposal 16: RAN4 should study all existing interruption scenarios in 5G NR whether they are still applicable to 6GR, whether the existing requirements should be refined and whether interruptions are needed in certain scenarios not yet covered in 5G NR.  **Measurement capability and delay reduction**  Proposal 19: RAN4 should study if and how to reduce RX beam sweeping factor in FR2 evaluation period related requirements in 6G.  Proposal 20: RAN4 should evaluate measurement period related requirements of FR1 and FR2, and study if and how to reduce them in 6G.  **Other PHY signal/channel/procedure related RRM**  RRM-specific Categories  Proposal 18: For 6G, RAN4 should study how to provide a more intuitive framework to guide implementation and deployment decisions by labeling UE RRM performance, based on all capabilities supported by the UE, in a standardized format. The framework could include a mapping that links each RRM aspect to its corresponding set of optional UE capabilities, enabling a more intuitive and comprehensive understanding of overall UE performance.  Testability  Proposal 21: RAN4 should study whether to use TDL, instead of AWGN, in more performance tests of 6G RRM.  TCI switching  Proposal 22: RAN4 should study the mechanisms to reduce TCI state switch timeline in 6G. |
| [**R4-2513047**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513047.zip) | Samsung | **RRM for Frequency Ranges (general RRM scope)**  Proposal 1: In 6GR, RAN4 RRM should support all frequency ranges which may be extended by current FR or new frequency ranges. For extended/new frequency ranges, RAN4 can take FR1-like or FR2-like methodology as baseline to specify such RRM requirements.  **RRM for different UE device types (general RRM scope)**  Proposal 2: In 6GR, RAN4 RRM should support diverse UE device types. From RRM perspective, RRM for different procedures and different requirements/performance are highly relied on below aspects, it should be discussed from below aspects:   * Number of Rx * Bandwidth * Multiple Rx chains including simultaneous Rx reception * Multiple panels for uplink transmission with/without simultaneous transmission * Power consumption * Mobility status   Proposal 3: RAN4 to discuss how to manage the RRM requirements for different UE device types in spec. This can be also discussed together with RRM spec improvement.  **RRM for harmonized 6G Radio design for TN and NTN**  Proposal 4: RAN4 to discuss for harmonized 6G Radio design for TN and NTN, can start from these aspects:   * Re-consider which procedures can be common for TN and NTN. * Integrated TN-NTN mobility support. * Re-consider the framework and mechanisms for the different NTN UE types.   **Mobility related RRM**  Proposal 5: In 6GR, RAN4 RRM should support key RRM requirements for mobility for all RRC states no matter whether 5GNR RRC states are reused or new RRC states are introduced. RAN4 to use 5GNR RRM as baseline for further detailed discussion.  **RRM for initial access**  Proposal 6: In 6GR, for initial access, RAN4 RRM to discussion on following aspects:   * Whether to specify the RRM requirements for initial cell search. To consider on following aspects:   + Whether can find the start point to define such RRM requirement like “power on”   + Necessity to specify such RRM requirements if “UE is powered on” happened infrequently.   + Part of UE performance in initial cell search can be ensured by other procedures like cell identification; sync raster   + RRM requirements are needed for cell selection * Whether to specify the RACH RRM requirements as functionality as correct UE behavior and tests in RRM.   **RRM for spectrum aggregation**  Proposal 7: In 6GR, for spectrum aggregation, RAN4 RRM to discussion on following aspects:   * CA and/or DC. In 6GR, we prefer to simpler framework as only keep CA and 6GR-6GR DC. No other DC solution to support between 5GNR and 6GR. * SCS for spectrum. We prefer to only single SCS per band to avoid unnecessary and unrealistic RRM request. * DL and UL decoupling. RAN4 to track other working groups to consider whether/how to impact RRM. * MRSS: RAN4 RRM should discuss how to support the RRM for mobility between 5GNR and 6GGR   **MIMO and Multi-TRP related RRM**  Proposal 8: In 6GR, for MIMO operation and multi-TRP, RAN4 RRM to discussion on following aspects:   * Multiple Tx and Multiple Rx with/without simultaneously in transmission/reception * TCI states: RRM only support unified TCI states framework * Further harmonized “TR point” and “cell” for mobility and measurement   **RRM for energy efficiency**  Proposal 9: In 6GR, according to the progress in RAN1, RAN4 to discuss whether/how to define a simple/unified RRM requirements for energy efficiency. The RAN4 discussion can be deferred until further RAN1 progress.  **RRM for duplexing**  Proposal 10: In 6GR, RAN4 RRM shall collaborate with RAN1 to discuss on how to support multiple types of duplexing including SBFD.  **RRM for SSB evaluation**  Proposal 11: In 6GR, RAN4 cannot wait for finial decision for SSB in RAN1 but need to be early involved with the discussion to evaluate the SSB design including:   * Extend the SSB periodicity * Change SSB sequence * Multiple-types of SSBs   RAN4 can start and agree the Link level simulation in RAN4 firstly, RAN4 can reuse some conditions in 5GNR, the proposed table are as below.  **Unified measurements(L3, L1)**  Proposal 12: In 6GR, although L3 measurement cannot be dropped at all due to the reason above, L1 and L3 are both based on raw measurement based on the quality of reference signals to be measured in physical layer. RAN4 can find some cases to integrate L1 and L3 measurement from UE measurement perspective. RAN4 to discuss whether/how to integrate L1 and L3 measurement from above aspects in Observation 9.  **Measurement Gap**  Proposal 13: In 6GR, RAN4 to re-consider and discuss on the scenarios and definition of Intra-frequency and Inter-frequency measurement in order to a commonality of purpose: intra-frequency without MG and inter-frequency with MG. take an example as one solution – relationship between serving cells/neighbor cells and BWP.  Proposal 14: In 6GR, RAN4 to discuss on Measurement gap for following aspects:   * re-evaluate whether are necessity measurement gap patterns and measurement gap types which need to be discussed together with SSB design and numerology in different frequency ranges. * Extend more scenarios to use measurement without MG including consider together with UE RF capabilities such as CA; new RF assumptions; CSSF etc. * Some Gap types like NCSG, whether it can be further enhanced/used in harmonized 6G Radio design for TN and NTN   **RRM simplification and spec simplification**  **(RRM requirement design principle)**  Proposal 15: For 6G Day-1 RRM requirements, we propose to align with high-level principles for:   * RAN4 to 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. As mentioned above, many of the RRM requirements haven’t never actually been utilized in real-world deployments. Take an example, several MGs have never been utilized in practice.   + Must to be tested and testable in conformance testing: we can use existing GCF (Global Certification Forum) test scope as start point and further consider the mandatory from 2.2~2.12. If RRM requirements cannot be tested with testability issue, there is really no need to waste time discussing corner cases and cases in paper work. * Even the named of procedures are the same as in 5GNR, it doesn’t mean RAN4 will reuse the exactly same RRM requirements in 5GNR. Take an example, RRM with timeline procedures can be changed in 6GR. * RAN4 to discuss and 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. It can be shared and utilized in different RRM requirements to avoid different and excursive assumption for timeline RRM requirements.   Proposal 16: For 6GR RRM spec structure and drafting rules, the overall spec structure in 5GNR can be inherited such as: RRC\_IDLE/INACTIVE/ CONNECTED state mobility, Timing, Signaling, Measurement. etc.  RAN4 to discuss and decide the high-level principle to decide whether a new feature is introduced, new sub-clauses can be allowed or not. We prefer to category the clauses from procedures and different assumptions rather than UE types.  **RAN4 operation efficiency**  Proposal 17: RAN4 can 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:   - It is recommended to 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. |
| **[R4-2513113](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513113.zip)** | OPPO | What is 6G RRM  **(RRM requirement design principle)**  Proposal 1: From RRM requirements’ perspective, more efficiency and less energy consumption, higher throughput and less interruption, should be considered as target for next generation technique innovation.  **(general RRM scope)**  Proposal 2: RAN4 to take Table 1 as starting point for 6G study of RRM, and both basic R15 features and some enhanced features in later releases of NR can be considered in 6G Day 1.  Proposal 3: Study the RRM impact of new spectrum of 6G and possible new UE RF/baseband architecture(s).  Proposal 9: Reuse NR basic assumption and procedure for 6G, e.g.,   Idle/connected mode measurement procedure   Intra and inter-frequency definition   Scenarios of gap-based or gap-less   Sharing factor, e.g., CSSF, P, Kp   Known/unknown cell definition  **Measurement gap(MG) and interruption**  Proposal 4: Measurement and gap related topics can be firstly considered as RAN4 driven for 6G.  GAP framework  Proposal 12: Strive for a simple and clear classification of MO (e.g., with gap, with NCSG, without gap, without gap without interruption, without gap with interruption) in the first release of 6G.  Proposal 13: Consider a simple and unified UE capability report to cover the existing NR reports, including needForGap, needForGapNCSG, needForInterruption.  GAP pattern  Proposal 14: The gap patterns in 6G should match with target measurement purposes, including both 5G NR measurement and 6G measurement.  Proposal 15: Select a subset of NR gap patterns for inter-RAT NR measurement in 6G   * Option 1: prioritize NR mandatory gap patterns * Option 2: study FR-agnostic gap patterns assuming 0.5ms RF switch time for all FRs   Proposal 16: Study 6G-specific gap patterns, at least considering new design of reference signals or MTC.  Proposal 17: Simplify UE capabilities on the support of gap patterns in 6G.  Proposal 18: Consider per-UE gap as baseline, and open to discuss per-FR, per-CC (group) gap.  Unified GAP  Proposal 19: Study the following aspects for unified GAP design:   * Unified GAP configuration, e.g., enabling Pre-MG, con-MG, NCSG * Simplified GAP (de)activation, e.g., per UE/FR/carrier level (de)activation * Efficient GAP change or gap adaptation * Semi static and dynamic GAP skipping or cancelling * Unified solution for GAP collision   GAP sharing  Proposal 20: For GAP sharing scheme, consider more measurement types.  **Unified measurements(L3, L1)**  Proposal 5: RAN4 to investigate a harmonized design for 6G RRM, at least considering both L1 and L3 measurement, always-on and on-demand signals, and other comprehensive assumptions for RRM measurement.  Proposal 6: RAN4 to study the following RRM topics with high priority in 6G study phase:   * Unified L1 and L3 measurement and report * Unified GAP design * RRM impact due to new spectrum aggregation operation, e.g., SCMC, enhanced CA * RRM impact due to UE and network energy savings, e.g., OD-SSB based measurement, low-power wake-up receiver, or low-capability device types.   Proposal 10: RAN4 to study a unified solution to support both L1 and L3 measurement, at least including:   * Identify the need of unified configuration for same function, e.g., RS, MO, MTC, GAP * Evaluate RRM impact of unified cell switch/handover, e.g., triggers/conditions/reports * Assess the difference of measurement requirements and measurement restriction   Proposal 11: RAN4 to focus on cross-layer L1 and L3 unified measurements firstly in 2025 Q4. Further evaluate RRM impact of cross-function L1 measurement like MIMO and LTM based on initial assumption or conclusion from other WGs.  **Measurement capability and delay reduction**  Proposal 7: UE measurement capabilities for 6G are assumed to be able to cover those for 5G, at least including frequency layers, cells, searchers, RSs, measurement gaps.  Proposal 8: RAN4 to consider the minimum UE requirements and avoid too many UE capabilities and corner cases in 6G RRM discussion, leaving more flexibility for implementation. |
| [**R4-2513124**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513124.zip) | Sony | **Other PHY signal/channel/procedure related RRM**  Proposal 1: RAN4 should study the RRM relaxation and simplification for 6G massive IoT, comparing it with legacy IoT devices, to reduce device complexity and improve network/device energy efficiency.  **RRM related energy efficiency**  Proposal 2: RAN4 shall study the power-saving mechanism from the RRM perspective, including legacy power-saving techniques, and can further investigate whether more RRM measurements can be offloaded to LR.  **Measurement gap(MG) and interruption**  Proposal 3: RAN4 can also study methods to reduce the number of measurement gap patterns and eliminate possible redundant measurement results if identified. |
| [**R4-2513127**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513127.zip) | CMCC | **General RRM scope**  Proposal 1: in general, it is proposed to consider following table as starting point for 6G study on RRM requirements and procedure aspects.  Intra-frequency/inter-frequency definition  Proposal 8: it is proposed to discuss whether to have the definition on intra-frequency/ inter-frequency measurement in 6GR. Suggest to discuss whether following consideration is feasible   * Option 1: no definition on intra-frequency/ inter-frequency measurement. RRM requirements are categorized as measurement with gap and measurement without gap   **RRM requirement design principle**  Proposal 2: it is proposed that the feature with market demand are supported from 6G day-one.  **Measurement gap(MG) and interruption**  Proposal 3: it is proposed that measurement without gaps, e.g. NCSG or NeedForGap are supported as mandatory from 6G day-one.  Proposal 4: for 6GR, it is proposed to assume no interruption for measurement without gap including NCSG and NeedForGap.  Proposal 5: it is proposed to support concurrent measurement gaps from 6G day-1.  Proposal 6: it is proposed to support parallel measurement for the colliding measurement gaps.  Proposal 7: it is proposed to consider MG skipping/cancelling from 6G day-1, and MG skipping/cancelling is a generic approach, not limit to XR.  UE capability  Proposal 13: Towards 6G, the baseline UE measurement capability shall be reconsidered, at least the UE capability of parallelSMTC-r17, parallelMeasurementGap-r17, parallelMeasurementWithoutRestriction-r17 need to be inherited as mandatory to 6G.  **Unified measurements(L3, L1)**  Proposal 9: for L3 measurement and L1 measurement for mobility, it is proposed to consider unified measurement framework and define unified measurement requirements.  Proposal 10: it is proposed to consider unified measurement framework and define unified requirements for RLM, BFD, CBD.  **RRM related energy efficiency**  Proposal 11: For UE energy efficiency, RAN4 need to wait the RAN1/RAN2 progress and then refine measurement design strategy, our initial thinking is as below:   1. Whether to continue the DRX cycle bounded measurement requirement in 6G 2. Whether to integrate the link quality and mobility state with measurement requirement in 6G Day1 3. Merge repeated measurement behaviors. Unified L1/L3 measurement as we discussed in Clause 2.4 can be the starting point.   Proposal 12: For BS energy efficiency, RAN4 need to wait the RAN1/RAN2 progress and then identify the feasible corresponding BS energy efficiency strategy which can be done within RAN4 scope  **NTN related RRM**  Proposal 14: Within the harmonized 6G Radio design for TN and NTN, if both TN measurement and NTN measurement are configured to UE, the measurement priority shall be under network control, the measurement on TN carrier shall have higher priority as the default assumption. |
| [**R4-2513203**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513203.zip) | CATT | **general RRM scope**  Proposal 1: RAN4 to define RRM requirements for frequency ranges up to 52.6GHz, which includes the following:  • FR1 (up to 7.125GHz)  • the range between FR1 and FR2-1 (including around ~7GHz)  • FR2-1 (24.25 GHz – 52.6GHz)  **RAN4 operation efficiency**  Proposal 2: It is necessary for RAN4 to introduce a more intuitive and simpler way to define RRM requirements, and new forms of representation can be introduced if necessary to make spec more concise, such as: multi-dimensional condition configuration tables, diagrams of timeline, etc.  Proposal 3: RAN4 to 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.  **Sensor based RRM**  Proposal 4: RAN4 to consider enriching RRM measurement content and introducing sensing information based mobility management.  • In addition to link quality measurement such as RSRP/RSRQ/SINR, the measurement content can also include speed, distance, angle, positioning, imaging, or activity detection, etc.  **Space-Air-Ground Integrated Network (SAGIN) related RRM**  Proposal 5: RAN4 to consider RRM impact for multi-functional RAN, where communication and sensing functionalities are jointly supported.  Proposal 6: For Space-Air-Ground Integrated Network, RAN4 to study the optimization of RLM and access performance with frequent and significant changes in propagation delay, which may involve multi-dimensional optimization at least including frequency layer and spatial layer.  **user-centric based RRM**  Proposal 7: RAN4 to study the RRM impact for user-centric operation.  **RRM related energy efficiency**  Proposal 8: RAN4 to study enhanced energy saving solutions and processes for 6G.  Proposal 9: In order to further save energy, RAN4 to consider energy sensing based RRM strategy for 6G. |
| [**R4-2513259**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513259.zip) | LG Electronics Inc. | **RRM requirement design principle**  Proposal 1: RAN4 to first discuss clear scope and goal / direction to be discussed /derived during 6G SI phase.  **General RRM scope**  Proposal 5: 6GR RAN4 RRM discussion should consider the impact on the RRM by 6G tech features (full duplex, energy saving, MIMO, NTN, MRSS, MCSC, etc.) depending on the progress of other WGs’ discussion  **Measurement gap(MG) and interruption**  Proposal 2: RAN4 to study dynamic and/or integrated measurement gaps for 6G.  **Unified measurements(L3 and/or L1)**  Proposal 3: RAN4 to study efficient/unified measurement procedure and requirements for 6GR RRM aspects.  **Mobility related RRM**  Proposal 4: RAN4 to study efficient UE mobility for delay/interruption reduction and UE-assisted mechanism of handover/cell switching |
| [**R4-2513278**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513278.zip) | Xiaomi | **Measurement gap(MG) and interruption/ Unified measurements(L3 and/or L1)**  **/UE capability**  Proposal 1: RAN4 is invited to initiate a Study Item on Unified RRM Requirements Framework for 6GR. The work would be organized around the following study aspects:  1. Unified Measurement Architecture — Study a common coordination framework for cross-layer and cross-feature measurement tasks, to clarify resource sharing, eliminate redundancies, and improve overall UE/Network efficiency.  2. Unified Measurement Gap Design – Study a unified measurement-gap mechanism with emphasis on efficiency and reduced overhead  3. Unified modular based UE RRM Capability Definitions – Study common, reusable capability blocks for fundamental UE abilities (e.g., beam-sweeping factor, message-processing footprint) to improve consistency and scalability across RRM procedures.  **Unified measurements(L3 and/or L1)**  Proposal 2-1: It is proposed that RAN4 initiate a Study on Unified Measurement Framework with the following possible directions:  - Unified L1 and L3 measurement for mobility  - Unified L1 measurement for MIMO and LTM  - Unified L1 measurement for MIMO and L3 measurement for mobility  - Unified L1 Link-Level Measurement  **Measurement gap(MG) and interruption**  Proposal 3-1: In 6GRR, the measurement requirements can be categorized by gap-based and gapless.  Proposal 3-2: RAN4 shall focus on the mandatory measurement gap pattern(s) in 6GRR to minimize the gap pattern number.  Proposal 3-3: the other applicability beside per-UE and per-FR can be studied upon RAN4 RF study on the CA simplified operation.  Proposal 3-4 : RAN4 can consider to unify the measurement gap configuration and activation mechanism in 6GRR.  Proposal 3-5: RAN4 can leverage NCSG design in NR as one candidate solutions to improve the measurement gap efficiency in 6GRR.  Proposal 3-6: RAN4 can firstly study the capability and the conditions of measurement without gap to avoid the ambiguous UE behavior when the necessary physical layer design are stable in RAN1.  Proposal 3-7: Before the more concreted discussions on measurement gap and interruption requirements, RAN4 shall align on the baseline UE architecture. |
| [**R4-2513285**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513285.zip) | ZTE Corporation, Sanechips | **General RRM scope**  Proposal 1: Compared with the existing 5G framework in TS38.133, it is proposed to reconstruct the 6G RRM specification with more clear structure from the RRM procedure perspective. The following framework is proposed by us:  - 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 framework design in 6GR)  - Other UE-specific characteristic switching(if applicable by PHY design in 6GR)  - Measurement performance  **RRM requirement design principle**  Proposal 2: 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  **Measurement gap(MG) and interruption**  Measurement gap  Proposal 3: To learn from the fruitful experience in 5G, the design and utilization of measurement gap allow less interruption, adaptive ON/OFF mechanism and accommodation of diverse measurement requirements from 6G day 1.  Proposal 4: Seek more chance for gap-less measurement based on the feasibility analysis in 6G day 1.  Proposal 5: Discuss the assumption on searcher  based on the basic synchronization signal structure design and the parallel signal detection capability of baseband in 6G.  Proposal 6: Finer granularity of measurement gap and better knowledge on which measurement occasion would utilize the measurement gap, both of them benefit the system performance.  Proposal 7: The self-adaptive ON/OFF of measurement gap facilitates the semi-static and dynamic update on carrier/cell/bandwidth.  Proposal 8: The following key points should be taken into account for the design of measurement gap in 6G:  - How to distinguish gap-less and gap-based measurement  - The granularity/type of measurement gap  - The unified design of measurement gap to ensure the forward compatability  - The self-adaptive ON/OFF mechanism of measurement gap  Interruption  Proposal 9: Finer granularity of interruption such as symbol level is foreseen in 6G to benefit the throughput via avoid the vital symbols within a slot used for DCI or UCI. Awareness of the location of interruption by NW could lesson the impact on throughput.  **Mobility related RRM**  Proposal 10: In 6G, Study the integration design of measurement/mobility management from the following dimensions:  - Whether and how to design the L1/L3 measurement based PCell/[PSCell]/SCell/beam management procedures  - Whether and how to design both the NW controlled and UE initiated L1/L3 measurement report to facilitate mobility  - Whether and how to speed up the PCell/[PSCell]/SCell/beam management procedure  - How to simplify the UE capability design for all above  Proposal 11: Efficient beam sweeping via advanced antenna technique is to be considered into the L3/L1 measurement for 6G.  Proposal 12: Study the virtual UE group based RRM measurement in 6G. |
| [**R4-2513291**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513291.zip) | NTT DOCOMO, INC. | **RRM requirement design principle**  Proposal 1: Even without AI/ML-based operation, the 6G RRM specifications must provide improvements over NR.  Proposal 3: RAN4 should initiate discussions on defining standardized and meaningful measurement metrics for 6G from day one, ensuring that these metrics are clearly specified and consistently implemented across vendors.  **Measurement gap(MG) and interruption**  Proposal 2: To avoid similar issues in 6G, MG-less needs to be introduced from day one to minimize service interruptions during measurements. |
| [**R4-2513308**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513308.zip) | Huawei, HiSilicon | **Mobility related RRM**  Proposal 1: RAN4 to study how to reduce delay and interruption during HO, and strive for a unified solution for the first release of 6GR.  **Measurement gap(MG) and interruption**  Proposal 2: RAN4 to study solutions to support measurement without gap, and strive for a unified solution the first release of 6GR.  **Measurement capability and delay reduction**  Proposal 3: RAN4 to study RRM measurement delay reduction for the first release of 6GR by considering enhanced simultaneous measurements.  **RAN4 operation efficiency**  Proposal 4: RAN4 to study at least following aspects or RRM spec improvement in 6GR  - Better classification of L3 RRM measurement requirements  - Consistent principles to address different collisions |
| [**R4-2513313**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513313.zip) | vivo | **RRM related energy efficiency**  SSB periodicity extension  Proposal 1: The impact of the SSB extension on the 6G RRM requirement should be studied by RAN4.  Proposal 2: On the methodology/principles/structure for 6G RRM requirements, I-DRX based requirement structure defined in 5G for idle (inactive) state could be considered as the starting point. For 6G connected state cell identification requirements, the requirement structure using max function to handle impacts from different factors such as SSB/SMTC period, DRX (if necessary) and MGRP (if necessary) defined in 5G, could be considered as the starting point.  OD-SSB  Proposal 3: For on-demand SSB, RAN4 may need study on-demand SSB related requirement in 6G time frame. Particularly, RAN4 may need investigate requirements when OD-SSB is used for other measurement purpose at connected state or any impact when OD-SSB is implemented in NES cell.  OD-SIB1  Proposal 4: RAN4 may study on-demand SIB1 related requirements in 6G time frame.   1. Upton detail procedure for on-demand SIB1 by RAN1/2, for on-demand SIB1, no matter for the single cell on-demand SIB1 scenario or cell A assisted on-demand SIB1 scenario, the SIB1 acquisition time may need further studied by RAN4. For the scenario when both SSB/SIB1 of the NES cell are on-demand, besides the SIB1 acquisition time, the period to obtain the timing reference may need study.   DL WUR/WUS  Proposal 5: For the impact of the DL WUS/WUR for the energy efficiency, if WUS is expanded for coverage purpose, requirements related to WUS signal may need further studied including accuracy requirements, measurement delay etc.  Proposal 6: For the impact of the DL WUS/WUR for the energy efficiency, if more measurements are be based on the DL WUS signal, corresponding measurement requirements, such as intra/inter-frequency measurement based on WUS signal, should be further studied once the corresponding solution is stable.  **Initial access related RRM**  Proposal 7: The cell detection should be studied based on 6G SSB design. In addition, RAN4 may discuss whether necessary to introduce cell selection delay requirement whereas the same principle as that of 4G/5G, i.e., no corresponding cell selection delay requirement, can be used as the base.  **Spectrum aggregation and CA related RRM**  Proposal 8: RAN4 should consider to define new requirements for solutions to improve SCell activation delay, if there is any.  Proposal 9: For the Single Cell Multi-Carriers solution, the transition/switch related requirements and corresponding interruption requirement may need be studied by RAN4, once the SCMC based solution is adopted and stable.  **MIMO and multi-TRP related RRM**  Proposal 10: Proposal X: MIMO/mTRP related RRM requirements (e.g., measurement for beam management, TCI state switching) need be studied based on concrete RAN1 assumptions and progress, and early RAN4 evolvement is needed w.r.t UE implementation constraint (e.g., UE multi-panel, Rx/Tx timing difference).  **Measurement gap(MG) and interruption**  Proposal 11: RAN4 should evaluate the existing gap based techniques defined in 5G based on 6G scenario at 6G day 1 and determine which gap techniques could be supported from 6G day 1.  Proposal 12: For measurement gap related techniques, the per-UE gap, per-FR gap and measurement without gap related techniques including NCSG could be considered to be supported from 6G Day 1. Other gap related techniques should be studied once more detail RAN1/2 6G design is available.  Proposal 13: Gap sharing between 5G and 6G needs be studied by RAN4. Whether to maintenance the same number of gap patterns in 6G should be studied by RAN4.  Proposal 14: For the number of measurement gap patterns, depending on 6G design, less measurement gap patterns and more mandatory gap patterns compared with 5G may be studied by RAN4.  **Other PHY signal/channel/procedure related RRM**  BWP switch  Proposal 15: For BWP switch, reduction on BWP switch time may need study once BWP design (if there is any) in 6G is clear. Particularly, the reduction on the duration for UE parsing time may be studied if the BWP framework is further simplified. At the same time, RAN4 could study whether the RF retuning time can be further improved or not.  **General RRM scope**  Intra-frequency/inter-frequency definition  Proposal 16: Study the definition of the intra-frequency and inter-frequency measurement for both L3 and L1 measurement and the following aspects could be discussed as the starting point:  • The relationship between intra-frequency measurement and gap-less measurement  • The relationship between intra-frequency measurement and serving cell measurement  • The relationship between intra-frequency measurement band intra-frequency mobility (handover/cell switch)  • The reference for intra-frequency measurement, e.g., center frequency of reference signal, active BWP etc.  • Necessity of intra-frequency measurement definition.  Proposal 20: In 6G, RAN4 could identify key components, e.g., RF retuning time, baseband processing time for typical scenarios, which will be used in various requirement and generalize/categorize these key components in RAN4 specs and optimize their corresponding value.  **Mobility related RRM**  Proposal 17: In 6G, RAN4 to study necessary enhancement for L1 measurement for serving cell compared to 5G.  Proposal 18: In 6G, RAN4 to study potential requirements enhancement compared to 5G for L3 measurement on CSSF, number of searchers etc.  Proposal 19: In 6G, RAN4 to study possible sharing between L3 measurement and L1 measurements. |
| [**R4-2513331**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513331.zip) | Ericsson | **RRM requirement design principle**  Proposal 1: When RAN4 defines the RRM requirement,  • RAN4 should consider both the baseline requirement and the strict performance requirement based on real field conditions without UE capability.  • RAN4 should define reasonable baseline requirements based on the typical scenarios other than focus on minimum requirement for corner cases.  • RAN4 should strive to establish quantifiable requirements to avoid the vague specification.  Proposal 2: RAN4 to discuss UE reference architectures in early stage of 6G. The RRM requirements should be compatible with the UE reference architecture.  Proposal 3: RAN4 should 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.  **Other PHY signal/channel/procedure related RRM**  UE MRTD  Proposal 4: When feasible, in timing requirement, use a total budget that allows flexible allocation among subcomponents instead of specifying sub-requirements on part of the system.  Proposal 5: When feasible, specify MRTD (RRM) as a total budget and avoid stating TAE (BS RF) between ARP.  TDD Cell Phase Synchronization  Proposal 6: Keep TDD Cell Phase Synchronization requirement the same as in NR NR.  CGI reading  Proposal 7: RAN4 should define the CGI reading requirement in 6G first release.  **Measurement gap(MG) and interruption**  Interruption  Proposal 8: RAN4 shall strive for reducing the amount of interruptions in UEs.  Proposal 9: The interruptions can be specified at a symbol level.  Proposal 10: The existing interruption requirements may need to be revisited for 6G, if the 6G UEs can achieve a better performance.  MG  Proposal 21: RAN4 to study how to simplify the MGP design to avoid unnecessary MGPs.  Proposal 22: RAN4 to study a unified measurement gap design to consider the following dimensions:  • Measurement without spare RF chain, Measurement with spare RF chain and gapless measurement  • Both UE controlled and NW controlled measurement gap  • Both static and dynamic gap activation/deactivation/cancellation mechanism  Proposal 23: For gap design, RAN4 should firstly study how to design the UAI to avoid unnecessary information exchange with NW.  **Mobility related RRM**  Proposal 11: RAN4 shall study possible solutions and requirements to improve UE camping behavior and reduce redundant mobility activities.  Proposal 12: As a baseline to 6G connected mode mobility  • RAN4 should target <=10 ms handover interruption as a baseline system design for 6G and study the necessary assistance information required.  • RAN4 should aim for low signalling overhead mechanisms to maintain DL and UL synchronization.  **Measurement capability and delay reduction**  Proposal 13: For 6G, RAN4 shall define requirements assuming multiple (e.g., more than three) searchers as a baseline.  Proposal 14: RAN4 shall revisit the default RX beam sweeping factor design for FR2.  Proposal 15: RAN4 should study the measurement requirements based on NW aided measurement priority on top of the baseline requirement.  Proposal 16: RAN4 to study the flexible and adaptive measurement behaviour for L1 measurement.  Proposal 20: RAN4 to discuss, agree on, and specify minimum requirements on 6G UE capability in terms of:  • the number of parallel measurements, and  • the number of simultaneously measured entities (e.g., carriers, cells, beams, etc.).  **General RRM scope**  Proposal 17: RAN4 should study the measurements delay and accuracy requirements based on the new SSB design.  Proposal 18: RAN4 to discuss the UE reference architecture for new frequency range of 7 to 15 GHz before discussing the related RRM requirements.  Proposal 19: RAN4 to discuss and identify measurement quantities to introduce in 6G from Day 1. The measurements shall include at least SINR and RTD measurements.  **Spectrum aggregation and CA related RRM**  Proposal 24: RAN4 to study and support fast carrier set up in 6G Day-1.  Proposal 25: RAN4 to study the feasibility to define a unified UL-DL carrier activation requirement based on spectrum aggregation scheme and flexible DL UL carrier pairing.  Proposal 26: RAN4 to study the potential relaxation of the requirement on timing alignment between carriers to increase deployment flexibility, for example inter-site aggregation.  **RRM related energy efficiency**  NES  Proposal 27: RAN4 shall evaluate the new SSB and relevant designs and assess their impact on concerning RRM requirements.  Proposal 28: RAN4 to investigate different scenarios and requirements for sparse SSB and/or OD-SSB for IDLE/INACTIVE mode mobility, Connection establishment, CONNECTED mode operation and CONNECTED mode mobility.  Proposal 29: The SSB-less based carrier activation should be considered as a mandatory feature in 6G.  UE power saving  Proposal 30: RAN4 shall study and define a scalable set of measurement requirements in 6G to ensure compatibility across different UE types and configurations and conditions.  Proposal 31: RAN4 to define a simple unified RRM relaxation solution for UE power saving.  Proposal 32: RAN4 to study and evaluate an OFDM-based LP-WUS/WUR mobility performance together with NES in both IDLE and CONNECTED mode in 6G.  Proposal 33: RAN4 should introduce eDRX based requirement in IDLE/INACTIVE mode as a baseline for 6G IoT.  **NTN related RRM**  Proposal 34: RAN4 shall ensure that NTN RRM requirements remain aligned with the TN RRM framework in 6G, while incorporating updates to address NTN-specific aspects (which have already been introduced in earlier releases or may be introduced in 6G).  Proposal 35: RAN4 shall study valid and effective NTN RRM requirements remain under both GNSS-resilient and GNSS-less operation. |
| [**R4-2513340**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513340.zip) | Nokia, Nokia Shanghai Bell | **RRM requirement design principle**  Proposal 1: 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 2: RAN4 to study any changes to the synchronization signal design and other related reference signals and the impact on cell detection and measurement requirements.  **NTN related RRM**  Proposal 3: NTN should be considered as a day-1 feature in NR and not be relegated to separate subclauses. This includes the measurement framework.  Proposal 7: RAN4 to study how to simplify the measurement requirements for NTN. RAN4 to inform RAN1/2 about the conclusions of the study.  **Other PHY signal/channel/procedure related RRM**  UE timing  Proposal 4: In 6G, the UE transmit timing requirements would have to address practical aspects from deployments and define UE requirements for these.  Purpose-based measurement requirements  Proposal 5: For Connected mode, Idle mode, and Inactive mode, RAN4 to study defining measurement requirements depending on purpose of the configured measurement: mobility or data (CA).  TCI switching  Proposal 12: RAN4 to study the steps involved in TCI switching and identify potential reductions in TCI switching delay for 6G.  **General RRM scope**  Proposal 6: To enable robust 6G beam management measurements and reporting, RAN4 to identify any issues related to NR beam management at early stages of 6G study item and inform RAN1 about such issues.  **Unified measurements(L3 and/or L1)**  Proposal 8: Study unified UE measurement requirements, including cell detection status and measurements, across state transitions and cell changes.  **Measurement gap(MG) and interruption**  MG  Proposal 9: Investigate in which scenarios the UE can perform measurements without gaps in 6G.  Proposal 10: RAN4 to study how to simplify the measurement gap framework in 6G including NTN use-cases and inter-satellite measurements.  Interruption  Proposal 20: RAN4 to aim at removing all UE autonomous interruptions in 6G.  **Mobility related RRM**  Proposal 11: RAN4 to study at least the following aspects of handover delay/interruption:  a. HO interruption reduction directly through RAN4-defined components  b. HO requirements based on target cell status (known, unknown, or other status)  c. Feasibility of any RAN1/2 created HO features (e.g. early DL or UL sync)  **MIMO and mTRP related RRM**  Proposal 13: RAN4 to study how to enable robust multi TRP operation considering both beam pairs and deployments  **RRM related energy efficiency**  Proposal 14: RAN4 to define the 6G UE requirements from Day-1 to enable support of energy saving features with joint network and UE optimization.  NES  Proposal 15: RAN4 shall discuss the impact from flexible SSB transmission periodicity on RRM procedures and related UE requirements keeping a balance between maximizing the NES gain and minimizing the negative impacts on UE.  Proposal 16: RAN4 to discuss conditions where UE would need additional synchronization signal assistance prior to e.g. data reception and under which conditions this would not be necessary.  UE PS  Proposal 17: Study how to harmonise various UE power saving measurement relaxations under a single, clear framework providing real world power saving gains. Consider power saving features at least from R15 to R19, RedCap and LP-WUS/WUR and consider idle-/inactive mode and connected mode.  Proposal 18: Study how to define generic scalable idle-mode requirements supporting a wide range of devices including from low-power UEs to high-end UEs.  **Spectrum aggregation and CA related RRM**  Proposal 19: For cell activation in 6G, RAN4 to discuss what are the necessary delay components to be counted when specifying the SCell activation relay requirements. At least the following conditions needs to be taken into account to minimize the SCell activation delay:  - To consider the measurements and reporting across different RRC states  - To leverage the measurements from other relevant cells based on network deployments |

## Open issues summary

*Before f2f meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

The RAN4 RRM related features in RP-252912 (Revised SID: Study on 6G Radio, RANP #109)

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| --- |
| **(1) Single technology framework**  j) Aim at a harmonized 6G Radio design for TN and NTN, including their integration  **(2) Physical Layer structure for 6GR**  h) Initial access [RAN1, RAN2, RAN4]  i) 6GR spectrum utilization and aggregation.  [RAN1, RAN2, RAN4]  **(4) Mobility for 6GR (for all RRC states), including related RRM [RAN2, RAN1, RAN4, RAN3]**  **(7) Migration from 5G NR to 6GR as well as interworking and mobility between 5G NR and 6GR:**   1. 5G-6G Multi-RAT Spectrum Sharing for migration [RAN1, RAN2, RAN4, RAN3] 2. Study if any additional migration option(s) is needed (other than standalone, MRSS, and inter-RAT mobility between NR-6G). [RAN] [RAN2, RAN1, RAN3, RAN4] RAN plenary starts this study in March 2026 and will make a decision by September 2026 whether to expand WG SI scope to cover additional migration option(s). 3. Mobility between 5G NR and 6GR [RAN2, RAN3, RAN4]   **(8) AI/ML for 6GR and Radio Access Network, leveraging 5G AI/ML framework, as appropriate [See TR38.843] [RAN1, RAN2, RAN3, RAN4]**  **(5) 6G RRM core and performance requirements**  d) RRM aspects for 6GR [RAN4, RAN1, RAN2]   * RRM requirement and procedure aspects aiming at improvements and/or simplification compared to 5G NR * Study how to improve 6G requirement specification, including structure and drafting principles |

In RAN4 #116 meeting, RAN4 chairman has also shared the 6G work plan (R4-2511652) for RAN4, and following RRM scopes are highlighted:

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### Issue 1: Summary of the support status for the main features

In RAN4#116bis meeting, 16 companies submitted tdocs to this 6G RRM scope discussion.

Note: Principle for above categorization: follow the work plan guidance from chairman (R4-2511652). If there are majority supporting from companies (more than 3 companies), new category can be added, e.g., MG, RRM framework and NTN related RRM.

|  |  |  |
| --- | --- | --- |
| **Topics (mainly from R4-2511652)** | **Companies who have proposals related with this topic** | **Supporting companies’ number** |
| Measurement gap(MG) and interruption | Apple (P1, P2(MG))  MTK (P1~P7(MG), P8(interruption))  QC(P13~P15(MG), P16~P17(interruption) )  Samsung (P13~P14)  OPPO (P4, P12~P20)  Sony (P3)  CMCC (P3~P7, P13)  LGE (P2)  Xiaomi (P1, P3-1~P3-7)  ZTE (P3~P8(MG), P9(interruption))  NTT DCM (P2)  Huawei(P2)  Vivo (P11~P14)  Ericsson (P8~P10(interruption), P21~P23)  Nokia (P9/P10, P20(interruption)) | 15 |
| RRM framework: Measurement capability/delay/overhead/accuracy | **Measurement capability/delay/overhead**  MTK(P21),  QC(P19/P20)  Apple (P3/P4(virtual UE group for RRM))  OPPO(P7~P8),  Huawei(P3(searcher)),  Samsung (P15(searcher), P11(SSB evaluation)),  ZTE(P2, P5(searcher), P12(virtual UE group for RRM)),  Vivo (P18)  Ericsson (P13~P15, P20)  Nokia (P5, P8)  **Unified measurements(L3 and/or L1)**  Samsung (P12)  OPPO (P5/P6/P10/P11)  CMCC (P9~P10)  LGE (P3)  Xiaomi (P1, P2-1)  Ericsson (P16): measurement model for L3 and L1 | 12 |
| Mobility related RRM | Apple (P5, P3/P4(virtual UE group for RRM))  MTK (P9~P15)  QC (P7~P9)  Samsung(P5)  LGE (P4)  ZTE (P10~P11, P12(virtual UE group for RRM))  HW (P1)  Vivo(P17~P19)  Ericsson (P11/P12)  Nokia (P5, P8, P11) | 10 |
| RRM related energy efficiency | Apple (P6)  Samsung (P9)  Sony (P2)  CMCC (P11~P12)  CATT (P8/P9)  Vivo (P1~P6)  Ericsson (P27~P29(NES), P30~P33(UE PS))  Nokia (P14~P18) | 8 |
| Spectrum aggregation and CA related RRM | MTK (P18~P20)  QC (P10~P12)  Samsung (P7)  Vivo (P8/P9)  Ericsson (P24~26)  Nokia (P5, P8, P19) | 6 |
| MIMO and mTRP related RRM | Apple (P7)  Samsung (P8)  Vivo (P10)  Nokia (P13) | 4 |
| NTN related RRM | Samsung: RRM for harmonized 6G Radio design for TN and NTN (P4)  CMCC: Prioritization between TN measurement and NTN measurement (P14)  Ericsson: P35/P35  Nokia (P3, P7) | 4 |
| Initial access related RRM | Samsung (P6)  Vivo (P7) | 2 |
| Other PHY signal/channel/procedure related RRM | UE Tx timing: MTK(P16/P17), Nokia(P4)  Inter-RAT sync : MTK (P22)  Testability: QC(P21)  RRM-specific Categories: QC(P18)  TCI switching reduction: QC(P22), Nokia(P12)  Duplexing: Samsung(P10)  RRM relaxation and simplification for 6G massive IoT: Sony(P1)  Sensor based RRM: CATT(P4~P5)  Space-Air-Ground Integrated Network (SAGIN) related RRM: CATT(P5~P6)  user-centric based RRM: CATT(P7)  Unified UE capability: Xiaomi(P1)  BWP switch: vivo(P15)  MRTD: Ericsson(P4/P5)  TDD Cell Phase Synchronization: Ericsson(P6)  CGI reading: Ericsson(P7) |  |

**Issue 1: RRM features prioritization for 6G SI**

* Recommended WF: discuss the following FL proposal:
* FL Proposal based on the summary:
  + Prioritize the following RAN4 driven RRM topics for 6G SI scope (top 5)
    - Measurement gap(MG) and interruption (15 companies)
    - RRM framework: Measurement capability/delay/overhead/accuracy (12 companies)
    - Mobility related RRM (10 companies)
    - RRM related energy efficiency (8 companies)
    - Spectrum aggregation and CA related RRM (6 companies)
  + Further discuss if the list can be further prioritized based on the following criteria, and further discuss the detailed scopes for the selected topics
    - Topics that can be initiated directly in RAN4
    - Topics with clear commercial demand for RRM
    - Topics for fundamental feature in RRM (not incremental enhancement from 5G)
    - Topics with the strongest support from companies
    - Topics whose study can address the most critical pain points in 5G RRM

### Issue 2: RRM requirement design principle

**Issue 2: RRM requirement design principle**

* Proposal 1 (QC):
  + RAN4 should focus on enhancing the testing of RRM procedures to ensure that functionality and performance is tested under conditions that reflect field-relevant scenarios.
  + RAN4 should study how to ensure that real UE implementations are tested as much as possible.
  + RAN4 should re-evaluate existing RRM core and performance requirements whether they still reflect state-of-the art UE implementations.
  + RAN4 should study in the 6G study item whether the amount of RRM procedures can be reduced. Requirements should only be defined for key RRM procedures.
  + RAN4 should 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.
  + We propose to discuss between RAN4 and RAN5 whether in 6GR RAN4 could focus on the scope and framework for defining RRM performance tests and RAN5 could specify the detailed parameter configurations of the RRM performance tests.
* Proposal 2 (Samsung):
  + For 6G Day-1 RRM requirements, we propose to align with high-level principles for:
    - RAN4 to 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. As mentioned above, many of the RRM requirements haven’t never actually been utilized in real-world deployments. Take an example, several MGs have never been utilized in practice.
      * Must to be tested and testable in conformance testing: we can use existing GCF (Global Certification Forum) test scope as start point and further consider the mandatory from 2.2~2.12. If RRM requirements cannot be tested with testability issue, there is really no need to waste time discussing corner cases and cases in paper work.
    - Even the named of procedures are the same as in 5GNR, it doesn’t mean RAN4 will reuse the exactly same RRM requirements in 5GNR. Take an example, RRM with timeline procedures can be changed in 6GR.
    - RAN4 to discuss and 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. It can be shared and utilized in different RRM requirements to avoid different and excursive assumption for timeline RRM requirements.
* Proposal 3 (OPPO):
  + From RRM requirements’ perspective, more efficiency and less energy consumption, higher throughput and less interruption, should be considered as target for next generation technique innovation.
* Proposal 4 (CMCC):
  + it is proposed that the feature with market demand are supported from 6G day-one.
* Proposal 5 (LGE):
  + RAN4 to first discuss clear scope and goal / direction to be discussed /derived during 6G SI phase.
* Proposal 6 (ZTE):
  + 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 6 (NTT DCM):
  + Even without AI/ML-based operation, the 6G RRM specifications must provide improvements over NR.
  + RAN4 should initiate discussions on defining standardized and meaningful measurement metrics for 6G from day one, ensuring that these metrics are clearly specified and consistently implemented across vendors.
* Proposal 7 (Ericsson):
  + When RAN4 defines the RRM requirement,
    - RAN4 should consider both the baseline requirement and the strict performance requirement based on real field conditions without UE capability.
    - RAN4 should define reasonable baseline requirements based on the typical scenarios other than focus on minimum requirement for corner cases.
    - RAN4 should strive to establish quantifiable requirements to avoid the vague specification.
  + RAN4 should 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 8 (Nokia):
  + 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.
  + RAN4 to study any changes to the synchronization signal design and other related reference signals and the impact on cell detection and measurement requirements.
* FL note: This issue 2 has been moved to [116bis][111] 6G operation efficiency.

### Issue 3: General RRM scope

**Issue 3: General RRM scope**

FL note: this general RRM scope is not for a specific feature or functionality, but it’s the basic/common part for RRM requirement design.

* Proposal 1 (Samsung):
  + In 6GR, RAN4 RRM should support all frequency ranges which may be extended by current FR or new frequency ranges. For extended/new frequency ranges, RAN4 can take FR1-like or FR2-like methodology as baseline to specify such RRM requirements.
  + In 6GR, RAN4 RRM should support diverse UE device types. From RRM perspective, RRM for different procedures and different requirements/performance are highly relied on below aspects, it should be discussed from below aspects:
    - Number of Rx
    - Bandwidth
    - Multiple Rx chains including simultaneous Rx reception
    - Multiple panels for uplink transmission with/without simultaneous transmission
    - Power consumption
    - Mobility status
  + RAN4 to discuss how to manage the RRM requirements for different UE device types in spec. This can be also discussed together with RRM spec improvement.
* Proposal 2 (OPPO):
  + RAN4 to take Table 1 as starting point for 6G study of RRM, and both basic R15 features and some enhanced features in later releases of NR can be considered in 6G Day 1.
  + Study the RRM impact of new spectrum of 6G and possible new UE RF/baseband architecture(s).
  + Reuse NR basic assumption and procedure for 6G, e.g.,
    - Idle/connected mode measurement procedure
    - Intra and inter-frequency definition
    - Scenarios of gap-based or gap-less
    - Sharing factor, e.g., CSSF, P, Kp
    - Known/unknown cell definition
* Proposal 3 (CMCC):
  + in general, it is proposed to consider following table as starting point for 6G study on RRM requirements and procedure aspects.

|  |  |
| --- | --- |
|  | Detail on RRM requirements and procedure aspects |
| RRC\_IDLE state mobility | Cell re-selection, Idle Mode CA/DC Measurements, Measurement report for fast CA/DC setup, etc |
| RRC\_INACTIVE state mobility | Cell re-selection, Inactive Mode CA/DC Measurements, Measurement report for fast CA/DC setup, etc |
| RRC\_CONNECTED state mobility | Handover, Conditional Handover, RRC Re-establishment, Random access, L1/L2-Triggered Mobility, etc |
| Timing | UE transmit timing, UE timer accuracy, Timing advance, Cell phase synchronization accuracy, Maximum Transmission Timing Difference, Maximum Receive Timing Difference, etc |
| Signalling characteristics | Radio Link Monitoring, Interruption, SCell Activation and Deactivation Delay, Link Recovery Procedures, etc |
| Measurement Procedure | Measurement gap including gap pattern and gap type, UE Measurement capability, L3/L1 intra-frequency measurements, L3/L1 inter-frequency measurements, Inter-RAT measurements, etc |
| Measurement Performance requirements | RSRP/RSRQ/SINR accuracy requirements, etc |

* + it is proposed to discuss whether to have the definition on intra-frequency/ inter-frequency measurement in 6GR. Suggest to discuss whether following consideration is feasible
    - Option 1: no definition on intra-frequency/ inter-frequency measurement. RRM requirements are categorized as measurement with gap and measurement without gap
* Proposal 4 (CATT):
  + RAN4 to define RRM requirements for frequency ranges up to 52.6GHz, which includes the following:
    - FR1 (up to 7.125GHz)
    - the range between FR1 and FR2-1 (including around ~7GHz)
    - FR2-1 (24.25 GHz – 52.6GHz)
* Proposal 5 (LGE):
  + 6GR RAN4 RRM discussion should consider the impact on the RRM by 6G tech features (full duplex, energy saving, MIMO, NTN, MRSS, MCSC, etc.) depending on the progress of other WGs’ discussion
* Proposal 6 (ZTE):
  + Compared with the existing 5G framework in TS38.133, it is proposed to reconstruct the 6G RRM specification with more clear structure from the RRM procedure perspective. The following framework is proposed by us:
    - 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 framework design in 6GR)
    - Other UE-specific characteristic switching(if applicable by PHY design in 6GR)
    - Measurement performance
* Proposal 7 (vivo):
  + Study the definition of the intra-frequency and inter-frequency measurement for both L3 and L1 measurement and the following aspects could be discussed as the starting point:
    - The relationship between intra-frequency measurement and gap-less measurement
    - The relationship between intra-frequency measurement and serving cell measurement
    - The relationship between intra-frequency measurement and intra-frequency mobility (handover/cell switch)
    - The reference for intra-frequency measurement, e.g., center frequency of reference signal, active BWP etc.
    - Necessity of intra-frequency measurement definition.
  + In 6G, RAN4 could identify key components, e.g., RF retuning time, baseband processing time for typical scenarios, which will be used in various requirement and generalize/categorize these key components in RAN4 specs and optimize their corresponding value.
* Proposal 8 (Ericsson):
  + RAN4 to discuss UE reference architectures in early stage of 6G. The RRM requirements should be compatible with the UE reference architecture.
  + RAN4 should study the measurements delay and accuracy requirements based on the new SSB design.
  + RAN4 to discuss the UE reference architecture for new frequency range of 7 to 15 GHz before discussing the related RRM requirements.
  + RAN4 to discuss and identify measurement quantities to introduce in 6G from Day 1. The measurements shall include at least SINR and RTD measurements.
* Proposal 9 (Nokia):
  + To enable robust 6G beam management measurements and reporting, RAN4 to identify any issues related to NR beam management at early stages of 6G study item and inform RAN1 about such issues.
* Recommended WF
  + FL observation: some companies followed the TS38.133 structure to discuss which section/requirement shall be specified or enhanced for 6G.
  + To discuss the following points:
    - Whether discuss such general RRM scope in 6G SI?
    - If yes, which part shall be prioritized? E.g., select/delete/add based on followings:
      * Intra and inter-frequency definition
      * RF retuning time, baseband processing time for typical use cases
      * UE reference architecture for 6G spectrums
      * Baseline assumptions of RRM requirements for different UE device types

### Issue 4: Measurement gap(MG) and interruption

**Issue 4-1:** **MG related scope**

* Proposal 1(Apple): for MG design scope, following aspects can be studied:
  + To study reducing MG patterns from 5G(e.g., only focus on most typical MG use cases)
  + To study unified MG concept in 6G
    - Unified MG for NR MG and NR scheduling restriction
    - Unified MG sharing among intra-frequency, inter-frequency, and inter-RAT measurement (including L3 and L1 measurement)
    - Unified MG for different feature related measurements, e.g., RRM measurement, MUSIM related measurement, positioning measurement, and etc
  + To study UE-request-based MG configuration and applicability
    - UE request of MG for multiple measurement purposes
    - MG activation/deactivation due to measurement demands
  + To study multiple CC measurement in single MG occasion
* Proposal 2(MTK):
  + Conventional measurement gaps:
    - Investigate methods to reduce the use of measurement gaps in 6G systems.
    - Identify and address the reasons behind measurement gaps in previous generations of mobile systems and how to handle these issues in 6G systems.
  + Gapless solutions
    - The gapless capability to be specified in the 6G Day-1 spec, including both signalling and RRM requirements.
  + Issue 1: Available RF chain:
    - Further investigate how to limit the measurement gap impact to a single carrier or specific number of carriers.
    - When defining measurement gap/interruption requirements and reporting signalling, different UE behaviours should be specified based on the availability of an idle RF chain.
  + Issue 2: RF retuning time:
    - RAN4 (RRM/RF) to further investigate the possibility of reducing the RF retuning time for measurement gaps/gapless.
  + Issue 3: Non-colliding multiple GAPs:
    - Investigate the introduction of non-colliding multiple concurrent measurement gaps in 6G systems from the initial release.
* Proposal 3(QC):
  + RAN4 should study the overall measurement gap framework in 6GR and identify all inefficiencies—technical and operational—that hinder optimal gap usage.
  + RAN4 should identify and evaluate mechanisms that enable interruption-free measurements, with a focus on deployability from the beginning of 6GR
  + RAN4 should study how to enable UEs to indicate preferred MG configurations, allowing for more adaptive and efficient measurement scheduling.
  + RAN4 should study for the case of 15 kHz subcarrier spacing whether the unused half slot (0.5 ms) in the duration of a measurement gap can be used efficiently, e.g., for data transmission.
* Proposal 4(Samsung):
  + In 6GR, RAN4 to re-consider and discuss on the scenarios and definition of Intra-frequency and Inter-frequency measurement in order to a commonality of purpose: intra-frequency without MG and inter-frequency with MG. take an example as one solution – relationship between serving cells/neighbor cells and BWP.
  + In 6GR, RAN4 to discuss on Measurement gap for following aspects:
    - re-evaluate whether are necessity measurement gap patterns and measurement gap types which need to be discussed together with SSB design and numerology in different frequency ranges.
    - Extend more scenarios to use measurement without MG including consider together with UE RF capabilities such as CA; new RF assumptions; CSSF etc.
    - Some Gap types like NCSG, whether it can be further enhanced/used in harmonized 6G Radio design for TN and NTN
* Proposal 5(OPPO):
  + Measurement and gap related topics can be firstly considered as RAN4 driven for 6G.
  + GAP framework
    - Strive for a simple and clear classification of MO (e.g., with gap, with NCSG, without gap, without gap without interruption, without gap with interruption) in the first release of 6G.
    - Consider a simple and unified UE capability report to cover the existing NR reports, including needForGap, needForGapNCSG, needForInterruption.
  + GAP pattern
    - The gap patterns in 6G should match with target measurement purposes, including both 5G NR measurement and 6G measurement.
    - Select a subset of NR gap patterns for inter-RAT NR measurement in 6G
      * Option 1: prioritize NR mandatory gap patterns
      * Option 2: study FR-agnostic gap patterns assuming 0.5ms RF switch time for all FRs
    - Study 6G-specific gap patterns, at least considering new design of reference signals or MTC.
    - Simplify UE capabilities on the support of gap patterns in 6G.
    - Consider per-UE gap as baseline, and open to discuss per-FR, per-CC (group) gap.
  + Unified GAP
    - Study the following aspects for unified GAP design:
      * Unified GAP configuration, e.g., enabling Pre-MG, con-MG, NCSG
      * Simplified GAP (de)activation, e.g., per UE/FR/carrier level (de)activation
      * Efficient GAP change or gap adaptation
      * Semi static and dynamic GAP skipping or cancelling
      * Unified solution for GAP collision
  + GAP sharing
    - For GAP sharing scheme, consider more measurement types.
* Proposal 6(Sony):
  + RAN4 can also study methods to reduce the number of measurement gap patterns and eliminate possible redundant measurement results if identified.
* Proposal 7(CMCC):
  + it is proposed that measurement without gaps, e.g. NCSG or NeedForGap are supported as mandatory from 6G day-one.
  + for 6GR, it is proposed to assume no interruption for measurement without gap including NCSG and NeedForGap.
  + it is proposed to support concurrent measurement gaps from 6G day-1.
  + it is proposed to support parallel measurement for the colliding measurement gaps.
  + it is proposed to consider MG skipping/cancelling from 6G day-1, and MG skipping/cancelling is a generic approach, not limit to XR.
* Proposal 8(LGE):
  + RAN4 to study dynamic and/or integrated measurement gaps for 6G.
* Proposal 9(Xiaomi):
  + In 6GRR, the measurement requirements can be categorized by gap-based and gapless.
  + RAN4 shall focus on the mandatory measurement gap pattern(s) in 6GRR to minimize the gap pattern number.
  + the other applicability beside per-UE and per-FR can be studied upon RAN4 RF study on the CA simplified operation.
  + RAN4 can consider to unify the measurement gap configuration and activation mechanism in 6GRR.
  + RAN4 can leverage NCSG design in NR as one candidate solutions to improve the measurement gap efficiency in 6GRR.
  + RAN4 can firstly study the capability and the conditions of measurement without gap to avoid the ambiguous UE behavior when the necessary physical layer design are stable in RAN1.
  + Before the more concreted discussions on measurement gap and interruption requirements, RAN4 shall align on the baseline UE architecture.
* Proposal 10(ZTE):
  + To learn from the fruitful experience in 5G, the design and utilization of measurement gap allow less interruption, adaptive ON/OFF mechanism and accommodation of diverse measurement requirements from 6G day 1.
  + Seek more chance for gap-less measurement based on the feasibility analysis in 6G day 1.
  + Discuss the assumption on searcher
    - based on the basic synchronization signal structure design and the parallel signal detection capability of baseband in 6G.
  + Finer granularity of measurement gap and better knowledge on which measurement occasion would utilize the measurement gap, both of them benefit the system performance.
  + The self-adaptive ON/OFF of measurement gap facilitates the semi-static and dynamic update on carrier/cell/bandwidth.
  + The following key points should be taken into account for the design of measurement gap in 6G:
    - How to distinguish gap-less and gap-based measurement
    - The granularity/type of measurement gap
    - The unified design of measurement gap to ensure the forward compatability
    - The self-adaptive ON/OFF mechanism of measurement gap.
* Proposal 11(NTT DCM):
  + To avoid similar issues in 6G, MG-less needs to be introduced from day one to minimize service interruptions during measurements..
* Proposal 12(HW):
  + RAN4 to study solutions to support measurement without gap, and strive for a unified solution the first release of 6GR.
* Proposal 13(vivo):
  + RAN4 should evaluate the existing gap based techniques defined in 5G based on 6G scenario at 6G day 1 and determine which gap techniques could be supported from 6G day 1.
  + For measurement gap related techniques, the per-UE gap, per-FR gap and measurement without gap related techniques including NCSG could be considered to be supported from 6G Day 1. Other gap related techniques should be studied once more detail RAN1/2 6G design is available.
  + Gap sharing between 5G and 6G needs be studied by RAN4. Whether to maintenance the same number of gap patterns in 6G should be studied by RAN4.
  + For the number of measurement gap patterns, depending on 6G design, less measurement gap patterns and more mandatory gap patterns compared with 5G may be studied by RAN4.
* Proposal 14(Ericsson):
  + RAN4 to study how to simplify the MGP design to avoid unnecessary MGPs.
  + RAN4 to study a unified measurement gap design to consider the following dimensions:
    - Measurement without spare RF chain, Measurement with spare RF chain and gapless measurement
    - Both UE controlled and NW controlled measurement gap
    - Both static and dynamic gap activation/deactivation/cancellation mechanism
  + For gap design, RAN4 should firstly study how to design the UAI to avoid unnecessary information exchange with NW.
* Proposal 15(Nokia):
  + Investigate in which scenarios the UE can perform measurements without gaps in 6G.
  + RAN4 to study how to simplify the measurement gap framework in 6G including NTN use-cases and inter-satellite measurements.
* **Recommended WF**
  + Discuss the following FL proposal:
    - FL proposal:
    - based on the majority views from companies, RAN4 RRM to discuss which MG related sub-topics can be prioritized from the following candidate list, and then discuss the solutions for the selected topics in 6G SI:
      * MG pattern reduction from 5G (10 companies: Apple, MTK, QC, OPPO, Sony, Xiaomi, vivo, Ericsson, Samsung, Nokia)
      * Gap-less measurement and its side conditions (10 companies: MTK, Samsung, CMCC, ZTE, NTT DCM, HW, Ericsson, Nokia, QC, Xiaomi)
        + In scenarios with and without an available RF chain.
      * Unified MG (7 companies: Apple, OPPO, LGE, Xiaomi, ZTE, Ericsson, QC), e.g.,
        + Unified MG configuration
        + Unified MG and scheduling restriction
        + Unified MG for different feature related measurements
      * Adapative MG operation, e.g., activation/deactivation/cancellation/skipping (7 companies: Apple, OPPO, CMCC, Xiaomi, ZTE, Ericsson, LGE)
      * Using which 5G MG enhancement features to 6G day 1 (OPPO, CMCC, Xiaomi, vivo)
        + E.g., needforGap, NCSG, concurrent MG, preconfigured MG and etc.
      * MG sharing(Apple, OPPO, vivo), e.g.,
        + among intra-frequency, inter-frequency, and inter-RAT measurement (including L3 and L1 measurement)
      * UE assisted MG configuration (Apple, QC)
        + e.g., MG requesting by UE (Apple, QC)
      * Multi-CC measurements in MG (Apple, CMCC, ZTE(searcher related))
      * Optimization on MGL and RF tuning/retuning (Apple, MTK, QC)
      * MG applicability for per-UE, per-FR, per-CC, or per-CC group (OPPO, Xiaomi, ZTE(granularity))

**Issue 4-2: interruption related scope**

* Proposal 1(QC):
  + RAN4 should identify and evaluate mechanisms that enable interruption-free measurements, with a focus on deployability from the beginning of 6GR.
  + RAN4 should study all existing interruption scenarios in 5G NR whether they are still applicable to 6GR, whether the existing requirements should be refined and whether interruptions are needed in certain scenarios not yet covered in 5G NR.
  + RAN4 should study for the case of 15 kHz subcarrier spacing whether the unused half slot (0.5 ms) in the duration of a measurement gap can be used efficiently, e.g., for data transmission.
* Proposal 2(ZTE):
  + Finer granularity of interruption such as symbol level is foreseen in 6G to benefit the throughput via avoid the vital symbols within a slot used for DCI or UCI. Awareness of the location of interruption by NW could lesson the impact on throughput.
* Proposal 3(Ericsson):
  + RAN4 shall strive for reducing the amount of interruptions in UEs.
  + The interruptions can be specified at a symbol level.
  + The existing interruption requirements may need to be revisited for 6G, if the 6G UEs can achieve a better performance.
* Proposal 4(Nokia):
  + RAN4 to aim at removing all UE autonomous interruptions in 6G.
* Proposal 5(MTK):
  + RAN4 (RRM/RF) to further study the possibility of reducing the interruption time including the RF retuning time for different UE procedures.
* **Recommended WF**
  + FL observation: two main sub-topics are identified based on companies’ views
    - Sub-topic 1: interruption-free RRM and its side conditions
    - Sub-topic 2: Finer granularity of interruption, e.g., symbol level
  + Discuss the following options based on the views from companies:
    - Option 1: merge the sub-topic of interruption-free to sub-topic of gap-less in issue 4-1, and other interruption related discussion can be left to WI stage.
    - Option 2: interruption related discussion can be left to WI stage.

### Issue 5: RRM framework:

**Issue 5: RRM framework: Measurement capability/delay/overhead/accuracy**

**Measurement capability/delay/overhead**

* Proposal 1(MTK):
  + Study the appropriate measurement capability for number of cells in 6G. The number of detected cells in FR1 is <=4 with 90% probability and <=5 with 97% probability.
* Proposal 2(QC):
  + RAN4 should study if and how to reduce RX beam sweeping factor in FR2 evaluation period related requirements in 6G.
  + RAN4 should evaluate measurement period related requirements of FR1 and FR2, and study if and how to reduce them in 6G.
* Proposal 3(OPPO):
  + UE measurement capabilities for 6G are assumed to be able to cover those for 5G, at least including frequency layers, cells, searchers, RSs, measurement gaps.
  + RAN4 to consider the minimum UE requirements and avoid too many UE capabilities and corner cases in 6G RRM discussion, leaving more flexibility for implementation.
* Proposal 4(HW):
  + Proposal 3: RAN4 to study RRM measurement delay reduction for the first release of 6GR by considering enhanced simultaneous measurements.
* Proposal 5(Samsung):
  + RAN4 to discuss and 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. It can be shared and utilized in different RRM requirements to avoid different and excursive assumption for timeline RRM requirements.
  + In 6GR, RAN4 cannot wait for finial decision for SSB in RAN1 but need to be early involved with the discussion to evaluate the SSB design including:

• Extend the SSB periodicity

• Change SSB sequence

• Multiple-types of SSBs

* + RAN4 can start and agree the Link level simulation in RAN4 firstly, RAN4 can reuse some conditions in 5GNR, the proposed table are as below.
* Proposal 6(ZTE):
  + Discuss the assumption on searcher
    - based on the basic synchronization signal structure design and the parallel signal detection capability of baseband in 6G.
  + Study the virtual UE group based RRM measurement in 6G.
* Proposal 7(vivo):
  + In 6G, RAN4 to study potential requirements enhancement compared to 5G for L3 measurement on CSSF, number of searchers etc.
* Proposal 8(Ericsson):
  + For 6G, RAN4 shall define requirements assuming multiple (e.g., more than three) searchers as a baseline.
  + RAN4 shall revisit the default RX beam sweeping factor design for FR2.
  + RAN4 should study the measurement requirements based on NW aided measurement priority on top of the baseline requirement.
  + RAN4 to study the flexible and adaptive measurement behaviour for L1 measurement.
  + RAN4 to discuss, agree on, and specify minimum requirements on 6G UE capability in terms of:
    - the number of parallel measurements, and
    - the number of simultaneously measured entities (e.g., carriers, cells, beams, etc.).
* Proposal 9 (Apple):
  + virtual RRM UE group is discussed in Rel-20 6G SI from RAN4 RRM perspective.
  + for virtual RRM UE group, following aspects can be studied:
    - To study the feasibility of Virtual RRM group concept
      * Only RRM functionality (e.g., L3 RSRP/RSRQ measurement) is considered
      * No Tx/Rx timing sharing, no data sharing, no coherent transmission/reception is considered
      * Prioritize the case without side-link
    - To study the feasibility and schemes of Measurement load balance among devices in virtual RRM group
  + for study on RRM enhancement for mobility, following two directions can be studied:
    - Facilitate preparation phase: to reduce latency between the time when channel condition can meet event triggered threshold and the time when UE realizes the condition is met.
    - Reduce interruption during HO execution without significantly increase complexity at both UE and network sides.
* Proposal 10 (Nokia):
  + For Connected mode, Idle mode, and Inactive mode, RAN4 to study defining measurement requirements depending on purpose of the configured measurement: mobility or data (CA).
  + Study unified UE measurement requirements, including cell detection status and measurements, across state transitions and cell changes.

**Unified measurements(L3 and/or L1)**

* Proposal 1(Samsung):
  + In 6GR, although L3 measurement cannot be dropped at all due to the reason above, L1 and L3 are both based on raw measurement based on the quality of reference signals to be measured in physical layer. RAN4 can find some cases to integrate L1 and L3 measurement from UE measurement perspective. RAN4 to discuss whether/how to integrate L1 and L3 measurement from above aspects in Observation 9.
* Proposal 2(OPPO):
  + RAN4 to investigate a harmonized design for 6G RRM, at least considering both L1 and L3 measurement, always-on and on-demand signals, and other comprehensive assumptions for RRM measurement.
  + RAN4 to study the following RRM topics with high priority in 6G study phase:
    - Unified L1 and L3 measurement and report
    - Unified GAP design
    - RRM impact due to new spectrum aggregation operation, e.g., SCMC, enhanced CA
    - RRM impact due to UE and network energy savings, e.g., OD-SSB based measurement, low-power wake-up receiver, or low-capability device types.
  + RAN4 to study a unified solution to support both L1 and L3 measurement, at least including:
    - Identify the need of unified configuration for same function, e.g., RS, MO, MTC, GAP
    - Evaluate RRM impact of unified cell switch/handover, e.g., triggers/conditions/reports
    - Assess the difference of measurement requirements and measurement restriction
  + RAN4 to focus on cross-layer L1 and L3 unified measurements firstly in 2025 Q4. Further evaluate RRM impact of cross-function L1 measurement like MIMO and LTM based on initial assumption or conclusion from other WGs.
* Proposal 3(CMCC):
  + for L3 measurement and L1 measurement for mobility, it is proposed to consider unified measurement framework and define unified measurement requirements.
  + it is proposed to consider unified measurement framework and define unified requirements for RLM, BFD, CBD.
* Proposal 4(LGE):
  + RAN4 to study efficient/unified measurement procedure and requirements for 6GR RRM aspects..
* Proposal 5(Xiaomi):
  + It is proposed that RAN4 initiate a Study on Unified Measurement Framework with the following possible directions:
    - Unified L1 and L3 measurement for mobility
    - Unified L1 measurement for MIMO and LTM
    - Unified L1 measurement for MIMO and L3 measurement for mobility
    - Unified L1 Link-Level Measurement
* Proposal 7 (Ericsson):
  + RAN4 to study the flexible and adaptive measurement behaviour for L1 measurement. Unification in terms of reusing L3 measurements for L1 before certain point (e.g., before TCI state activation)
* **Recommended WF**
  + Discuss the following FL proposal based on the majority views from companies:
  + FL proposal:
    - RAN4 to identify which of the following topics can be starts directly in RAN4:
      * Measurement capability
        + measurement capability for number of cells, beams and frequency layers (MTK, OPPO, Ericsson)
        + Virtual RRM UE group (Apple, ZTE)
        + Measurement requirements depending on purpose of the configured measurement: mobility or data (CA) (Nokia)
      * Measurement delay/overhead
        + Searcher number for enhanced simultaneous measurements (OPPO, HW, Samsung, ZTE, vivo, Ericsson)
        + Rx beam sweeping factor reduction (QC, Ericsson)
        + Identification/measurement/tracking/reporting delay reduction (QC)
        + RRM with NW aided measurement priority (Ericsson)
        + Virtual RRM UE group (Apple, ZTE)
        + Measurement requirements depending on purpose of the configured measurement: mobility or data (CA) (Nokia)
        + Unified UE measurement requirements, including cell detection status and measurements, across state transitions and cell changes. (Nokia)
        + SSB evaluation (Samsung)
      * Unified measurements
        + United/integrated cross-layers measurement and/or report between L1 and L3 (Samsung, OPPO, CMCC, LGE, Xiaomi)
        + United/integrated cross-functions measurement and/or report for L1 (e.g., integration of MIMO and LTM, or integration of RLM/BFD/CBD)(OPPO, CMCC, Xiaomi)
        + RAN4 to study the flexible and adaptive measurement behaviour for L1 measurement. Unification in terms of reusing L3 measurements for L1 before certain point (e.g., before TCI state activation) (Ericsson)
    - To be discussed:
      * Option 1: RAN4 to set check points to check whether or not starting discussion on other RRM framework related RRM topics if there are sufficient conclusions from other WGs
        + FFS: Check point timeline

Option 2: RAN4 to check whether or not starting discussion on other RRM framework related RRM topics once there are sufficient conclusions from other WGs.

### Issue 6: Mobility related RRM

**Issue 6: Mobility related RRM**

* Proposal 1(Apple):
  + virtual RRM UE group is discussed in Rel-20 6G SI from RAN4 RRM perspective.
  + for virtual RRM UE group, following aspects can be studied:
    - To study the feasibility of Virtual RRM group concept
      * Only RRM functionality (e.g., L3 RSRP/RSRQ measurement) is considered
      * No Tx/Rx timing sharing, no data sharing, no coherent transmission/reception is considered
      * Prioritize the case without side-link
    - To study the feasibility and schemes of Measurement load balance among devices in virtual RRM group
  + for study on RRM enhancement for mobility, following two directions can be studied:
    - Facilitate preparation phase: to reduce latency between the time when channel condition can meet event triggered threshold and the time when UE realizes the condition is met.
    - Reduce interruption during HO execution without significantly increase complexity at both UE and network sides.
* Proposal 2(MTK):
  + In 6G SI, RAN4 to start from mobility solutions with less RAN1/2-dependency.
  + A solution that can mitigate the problem of longer SSB periodicity needs to be considered in 6G study.
  + 6G Day-1 HO solution should be applicable to all the scenarios and work well without conditions.
  + For 6G mobility, decouple the KPIs of HO delay and HO interruption with the priority on reducing interruption.
  + HO interruption can be reduced by postponing Tprocessing to the last, e.g., just before RACH occasion for RACH-based HO.
  + To further reduce HO interruption, source cell should keep scheduling until UE breaks the link with source cell.
  + Support UE initiated early RRC decoding and early T/F tracking in 6G.
* Proposal 3(QC):
  + If a unified measurement and mobility framework for 6G is defined based on the 5G LTM feature, RAN4 should re-evaluate the benefits of the feature, thoroughly analyze the implementation challenges arising from its complexity and associated RRM requirements, and investigate how to address the identified issues to the extent that the feature can be implemented with reasonable complexity.
  + 6G mobility requirements should be constrained to scenarios where the resulting handover latencies or interruption durations are technically meaningful and operationally relevant. Requirements that lead to excessively large values should be avoided.
  + RAN4 to study the practically achievable end-to-end handover latency target, taking into account user-plane data forwarding latency, to better align handover requirements with practical effectiveness.
* Proposal 4(Samsung):
  + In 6GR, RAN4 RRM should support key RRM requirements for mobility for all RRC states no matter whether 5GNR RRC states are reused or new RRC states are introduced. RAN4 to use 5GNR RRM as baseline for further detailed discussion.
* Proposal 5(LGE):
  + RAN4 to study efficient UE mobility for delay/interruption reduction and UE-assisted mechanism of handover/cell switching
* Proposal 6(ZTE):
  + In 6G, Study the integration design of measurement/mobility management from the following dimensions:
    - Whether and how to design the L1/L3 measurement based PCell/[PSCell]/SCell/beam management procedures
    - Whether and how to design both the NW controlled and UE initiated L1/L3 measurement report to facilitate mobility
    - Whether and how to speed up the PCell/[PSCell]/SCell/beam management procedure
    - How to simplify the UE capability design for all above
  + Efficient beam sweeping via advanced antenna technique is to be considered into the L3/L1 measurement for 6G.
  + Study the virtual UE group based RRM measurement in 6G.
* Proposal 7(HW):
  + RAN4 to study how to reduce delay and interruption during HO, and strive for a unified solution for the first release of 6GR.
* Proposal 8(vivo):
  + In 6G, RAN4 to study necessary enhancement for L1 measurement for serving cell compared to 5G.
  + In 6G, RAN4 to study potential requirements enhancement compared to 5G for L3 measurement on CSSF, number of searchers etc.
  + In 6G, RAN4 to study possible sharing between L3 measurement and L1 measurements.
* Proposal 9(Ericsson):
  + RAN4 shall study possible solutions and requirements to improve UE camping behavior and reduce redundant mobility activities.
  + As a baseline to 6G connected mode mobility
    - RAN4 should target <=10 ms handover interruption as a baseline system design for 6G and study the necessary assistance information required.
    - RAN4 should aim for low signalling overhead mechanisms to maintain DL and UL synchronization.
* Proposal 10(Nokia):
  + RAN4 to study at least the following aspects of handover delay/interruption:
    - HO interruption reduction directly through RAN4-defined components
    - HO requirements based on target cell status (known, unknown, or other status)
    - Feasibility of any RAN1/2 created HO features (e.g. early DL or UL sync)
  + RAN4 to study defining measurement requirements depending on purpose of the configured measurement: mobility or data (CA).
  + Study unified UE measurement requirements, including cell detection status and measurements, across state transitions and cell changes.
* **Recommended WF**
  + Discuss the following FL proposal based on the majority views from companies:
  + FL proposal:
    - RAN4 to start from mobility related RRM solutions with less RAN1/2-dependency.
    - RAN4 to identify which of the following topics can be starts directly in RAN4:
      * Latency and/or interruption reduction for mobility through RAN4-defined components (Apple, MTK(interruption only), QC, LGE, ZTE, HW, vivo, Ericsson, Nokia)
        + discuss RRM part reduction during mobility, e.g., L1/L3 measurement, beam sweeping and etc.
        + discuss the scenarios/conditions for such reduction (known, unknown, or other status)
        + discuss NW controlled and UE initiated L1/L3 measurement report
      * Solutions for longer SSB periodicity in mobility (MTK, Samsung)
      * Early RRC decoding, and/or, DL/UL sync, and/or, early T/F tracking for mobility (MTK, Nokia)
      * Virtual RRM UE group (Apple, ZTE)
      * Unified measurement and mobility framework (QC)
        + E.g., based on 5G LTM
      * End-to-end handover latency target (QC)
        + RAN4 to study the practically achievable end-to-end handover latency target, taking into account user-plane data forwarding latency, to better align handover requirements with practical effectiveness.
      * Unified UE measurement requirements across cell changes (Nokia)
    - To be discussed:
      * Option 1: RAN4 to set check points to check whether or not starting discussion on other mobility related RRM topics if there are sufficient conclusions from other WGs
        + FFS: Check point timeline
      * Option 2: RAN4 to check whether or not starting discussion on other mobility related RRM topics once there are sufficient conclusions from other WGs.

### Issue 7: RRM related energy efficiency

**Issue 7: RRM related energy efficiency**

* Proposal 1(Apple):
  + study UE state based RRM, e.g.
    - Investigate measurement reduction for stationary UE, including both L3 and L1 measurement
    - Investigate reporting reduction for stationary UE, including both RRM and CSI reporting
    - Investigate threshold for neighbor cell measurement triggering when UE is in stationary mode
* Proposal 2(Samsung):
  + In 6GR, according to the progress in RAN1, RAN4 to discuss whether/how to define a simple/unified RRM requirements for energy efficiency. The RAN4 discussion can be deferred until further RAN1 progress.
* Proposal 3(Sony):
  + RAN4 shall study the power-saving mechanism from the RRM perspective, including legacy power-saving techniques, and can further investigate whether more RRM measurements can be offloaded to LR.
* Proposal 4(CMCC):
  + For UE energy efficiency, RAN4 need to wait the RAN1/RAN2 progress and then refine measurement design strategy, our initial thinking is as below:
    - Whether to continue the DRX cycle bounded measurement requirement in 6G
    - Whether to integrate the link quality and mobility state with measurement requirement in 6G Day1
    - Merge repeated measurement behaviors. Unified L1/L3 measurement as we discussed in Clause 2.4 can be the starting point.
  + For BS energy efficiency, RAN4 need to wait the RAN1/RAN2 progress and then identify the feasible corresponding BS energy efficiency strategy which can be done within RAN4 scope
* Proposal 5(CATT):
  + RAN4 to study enhanced energy saving solutions and processes for 6G.
  + In order to further save energy, RAN4 to consider energy sensing based RRM strategy for 6G.
* Proposal 6(vivo):
  + SSB periodicity extension
    - The impact of the SSB extension on the 6G RRM requirement should be studied by RAN4.
    - On the methodology/principles/structure for 6G RRM requirements, I-DRX based requirement structure defined in 5G for idle (inactive) state could be considered as the starting point. For 6G connected state cell identification requirements, the requirement structure using max function to handle impacts from different factors such as SSB/SMTC period, DRX (if necessary) and MGRP (if necessary) defined in 5G, could be considered as the starting point.
  + OD-SSB
    - For on-demand SSB, RAN4 may need study on-demand SSB related requirement in 6G time frame. Particularly, RAN4 may need investigate requirements when OD-SSB is used for other measurement purpose at connected state or any impact when OD-SSB is implemented in NES cell.
  + OD-SIB1
    - RAN4 may study on-demand SIB1 related requirements in 6G time frame.
      * Upton detail procedure for on-demand SIB1 by RAN1/2, for on-demand SIB1, no matter for the single cell on-demand SIB1 scenario or cell A assisted on-demand SIB1 scenario, the SIB1 acquisition time may need further studied by RAN4. For the scenario when both SSB/SIB1 of the NES cell are on-demand, besides the SIB1 acquisition time, the period to obtain the timing reference may need study.
  + DL WUR/WUS
    - For the impact of the DL WUS/WUR for the energy efficiency, if WUS is expanded for coverage purpose, requirements related to WUS signal may need further studied including accuracy requirements, measurement delay etc.
    - For the impact of the DL WUS/WUR for the energy efficiency, if more measurements are be based on the DL WUS signal, corresponding measurement requirements, such as intra/inter-frequency measurement based on WUS signal, should be further studied once the corresponding solution is stable.
* Proposal 7(Ericsson):
  + NES
    - RAN4 shall evaluate the new SSB and relevant designs and assess their impact on concerning RRM requirements.
    - RAN4 to investigate different scenarios and requirements for sparse SSB and/or OD-SSB for IDLE/INACTIVE mode mobility, Connection establishment, CONNECTED mode operation and CONNECTED mode mobility.
    - The SSB-less based carrier activation should be considered as a mandatory feature in 6G.
  + UE power saving
    - RAN4 shall study and define a scalable set of measurement requirements in 6G to ensure compatibility across different UE types and configurations and conditions.
    - RAN4 to define a simple unified RRM relaxation solution for UE power saving.
    - RAN4 to study and evaluate an OFDM-based LP-WUS/WUR mobility performance together with NES in both IDLE and CONNECTED mode in 6G.
    - RAN4 should introduce eDRX based requirement in IDLE/INACTIVE mode as a baseline for 6G IoT.
* Proposal 8(Nokia):
  + RAN4 to define the 6G UE requirements from Day-1 to enable support of energy saving features with joint network and UE optimization.
  + NES
    - RAN4 shall discuss the impact from flexible SSB transmission periodicity on RRM procedures and related UE requirements keeping a balance between maximizing the NES gain and minimizing the negative impacts on UE.
    - RAN4 to discuss conditions where UE would need additional synchronization signal assistance prior to e.g. data reception and under which conditions this would not be necessary.
  + UE PS
    - Study how to harmonise various UE power saving measurement relaxations under a single, clear framework providing real world power saving gains. Consider power saving features at least from R15 to R19, RedCap and LP-WUS/WUR and consider idle-/inactive mode and connected mode.
    - Study how to define generic scalable idle-mode requirements supporting a wide range of devices including from low-power UEs to high-end UEs
* **Recommended WF**
  + Discuss the following FL proposal based on the majority views from companies:
  + FL proposal:
    - RAN4 to identify candidate topics can be studied in RAN4 directly:
      * Network energy saving:
        + RRM for new SSB design(e.g., SSB periodicity extension, OD-SSB/OD-SIB1) (vivo, Ericsson, Nokia)
        + SSB-less based RRM (Ericsson, Nokia)
      * UE power saving:
        + UE type/state based RRM relaxation (Apple, CMCC, Ericsson(scalable set of measurement requirement), Nokia)
        + LR based solutions for UE power saving (Sony, vivo, Ericsson)
        + DRX/eDRX based measurement (CMCC, Ericsson)
        + Energy sensing based RRM strategy (CATT)
    - To be discussed:
      * Option 1: RAN4 to set check points to check whether or not starting discussion on other energy efficiency related RRM topics if there are sufficient conclusions from other WGs
        + FFS: Check point timeline
      * Option 2: RAN4 to check whether or not starting discussion on other energy efficiency related RRM topics once there are sufficient conclusions from other WGs.

### Issue 8: Spectrum aggregation and CA related RRM

**Issue 8: Spectrum aggregation and CA related RRM**

* Proposal 1(MTK):
  + Cell with multiple carrier
    - RAN4 RF should study the conditions and requirements for aggregating multiple carriers to a single cell for 6G. For example, RF switch-time requirements, acceptable transmit timing alignment error (TAE), base-station (BS) frequency error, and total received power difference limits at the UE. And RAN4 RRM should study the corresponding interruption and delay requirements.
  + Carrier switch enhancements for UL and DL
    - RAN4 should study support of carrier switching and simplify configurations with forward compatibility; specifically, RAN4 RF should study applicable scenarios and RF switch-time requirements, and RAN4 RRM should study the corresponding interruption and delay requirements.
  + SCell activation, increase of spectrum aggregation
    - RAN4 should study critical, high likely SCell activation scenarios and ensure timely CSI acquisition; RAN4 RF should study RF switch-time requirements, and RAN4 RRM should study SCell activation interruption and overall delay.
* Proposal 2(QC):
  + Activation/Deactivation of Cells
    - For 6G carrier aggregation features, RAN4 should investigate which SCell activation features have been commercially deployed or are planned for deployment and prioritize those based on proven deployment evidence to avoid unnecessary complexity and ensure practical impact.
    - In 6G, interruption requirements during deactivated SCell measurement and SCell activation should be defined to align with state-of-the-art UE implementations. For example, the interruption duration for intra-band CA in 5G is excessively long and may not reflect practical deployment needs.
    - For 6G carrier aggregation, RAN4 should re-evaluate the assumptions made in the 5G SCell activation requirement definition, based on state-of-the-art UE implementations, and investigate whether and to what extent SCell activation latency modeling can be simplified to better align requirements with practical UE behavior and implementation realities.
* Proposal 3(Samsung):
  + In 6GR, for spectrum aggregation, RAN4 RRM to discussion on following aspects:
    - CA and/or DC. In 6GR, we prefer to simpler framework as only keep CA and 6GR-6GR DC. No other DC solution to support between 5GNR and 6GR.
    - SCS for spectrum. We prefer to only single SCS per band to avoid unnecessary and unrealistic RRM request.
    - DL and UL decoupling. RAN4 to track other working groups to consider whether/how to impact RRM.
    - MRSS: RAN4 RRM should discuss how to support the RRM for mobility between 5GNR and 6GGR
* Proposal 4(vivo):
  + RAN4 should consider to define new requirements for solutions to improve SCell activation delay, if there is any.
  + For the Single Cell Multi-Carriers solution, the transition/switch related requirements and corresponding interruption requirement may need be studied by RAN4, once the SCMC based solution is adopted and stable.
* Proposal 5(Ericsson):
  + RAN4 to study and support fast carrier set up in 6G Day-1.
  + RAN4 to study the feasibility to define a unified UL-DL carrier activation requirement based on spectrum aggregation scheme and flexible DL UL carrier pairing.
  + RAN4 to study the potential relaxation of the requirement on timing alignment between carriers to increase deployment flexibility, for example inter-site aggregation.
* Proposal 6(Nokia):
  + For cell activation in 6G, RAN4 to discuss what are the necessary delay components to be counted when specifying the SCell activation relay requirements. At least the following conditions needs to be taken into account to minimize the SCell activation delay:
    - To consider the measurements and reporting across different RRC states
    - To leverage the measurements from other relevant cells based on network deployments
* **Recommended WF**
  + Discuss the following FL proposal based on the majority views from companies:
  + FL proposal:
    - RAN4 to identify which of the following topics can be starts directly in RAN4 RRM with less RAN1/2 and RAN4 RF session dependency:
      * SCell activation/deactivation, deactivated SCell measurement based on 6G UE implementations (MTK(SCell activation), QC, vivo(activation), Ericsson, Nokia)
      * RRM conditions and requirements for Single Cell Multi-Carriers (MTK, vivo)
      * RRM impacts of DL and UL decoupling (Samsung, Ericsson)
      * Carrier switch enhancements for UL and DL (MTK)
      * RRM impacts of realistic SCS for spectrum (Samsung)
      * relaxation of the requirement on timing alignment between carriers (Ericsson)
      * RRM for MRSS (Samsung)
    - To be discussed:
      * Option 1: RAN4 to set check points to check whether or not starting discussion on other spectrum aggregation and CA related RRM topics if there are sufficient conclusions from other WGs and RAN4 RF session
        + FFS: Check point timeline
      * Option 2: RAN4 to check whether or not starting discussion on other spectrum aggregation and CA related RRM topics once there are sufficient conclusions from other WGs and RAN4 RF session

### Issue 9: MIMO and mTRP operation related RRM

**Issue 9: MIMO and mTRP operation related RRM**

* Proposal 1(Apple):
  + study RRM impact from mTRP on different carriers, if supported.
* Proposal 2(Samsung):
  + In 6GR, for MIMO operation and multi-TRP, RAN4 RRM to discussion on following aspects:
    - Multiple Tx and Multiple Rx with/without simultaneously in transmission/reception
    - TCI states: RRM only support unified TCI states framework
    - Further harmonized “TR point” and “cell” for mobility and measurement
* Proposal 3(vivo):
  + MIMO/mTRP related RRM requirements (e.g., measurement for beam management, TCI state switching) need be studied based on concrete RAN1 assumptions and progress, and early RAN4 evolvement is needed w.r.t UE implementation constraint (e.g., UE multi-panel, Rx/Tx timing difference).
* Proposal 4(Nokia):
  + RAN4 to study how to enable robust multi TRP operation considering both beam pairs and deployments
* **Recommended WF**
  + Discuss the following FL proposal based on the views from companies:
  + FL observation: MIMO and mTRP operation related RRM relies on the MIMO/mTRP discussion in other WGs
  + FL proposal:
    - To be discussed: RAN4 to set a check point to check whether or not starting study of the MIMO and mTRP operation related RRM in 6G SI, e.g., check if conclusions from other WGs are sufficient to support RAN4 study
      * FFS: check point timeline.
      * RAN4 will discuss and decide which topics can be studied if decided to start this study after check point.

### Issue 10: NTN related RRM

**Issue 10: NTN related RRM**

* Proposal 1(Samsung):
  + RAN4 to discuss for harmonized 6G Radio design for TN and NTN, can start from these aspects:
    - Re-consider which procedures can be common for TN and NTN.
    - Integrated TN-NTN mobility support.
    - Re-consider the framework and mechanisms for the different NTN UE types.
* Proposal 2(CMCC):
  + Within the harmonized 6G Radio design for TN and NTN, if both TN measurement and NTN measurement are configured to UE, the measurement priority shall be under network control, the measurement on TN carrier shall have higher priority as the default assumption.
  + Towards 6G, the baseline UE measurement capability shall be reconsidered, at least the UE capability of parallelSMTC-r17, parallelMeasurementGap-r17, parallelMeasurementWithoutRestriction-r17 need to be inherited as mandatory to 6G.
* Proposal 3(Ericsson):
  + RAN4 shall ensure that NTN RRM requirements remain aligned with the TN RRM framework in 6G, while incorporating updates to address NTN-specific aspects (which have already been introduced in earlier releases or may be introduced in 6G).
  + RAN4 shall study valid and effective NTN RRM requirements remain under both GNSS-resilient and GNSS-less operation.
* Proposal 4(Nokia):
  + NTN should be considered as a day-1 feature in NR and not be relegated to separate subclauses. This includes the measurement framework.
  + RAN4 to study how to simplify the measurement requirements for NTN. RAN4 to inform RAN1/2 about the conclusions of the study.
* Proposal 5(CATT):
  + For Space-Air-Ground Integrated Network, RAN4 to study the optimization of RLM and access performance with frequent and significant changes in propagation delay, which may involve multi-dimensional optimization at least including frequency layer and spatial layer.
* **Recommended WF**
  + Discuss the following FL proposal:
  + FL observation: NTN related RRM relies on the NTN discussion in other WGs
  + FL proposal:
    - To be discussed: RAN4 to set a check point to check whether or not starting study of the NTN related RRM in 6G SI, e.g., check if conclusions from other WGs are sufficient to support RAN4 study
      * FFS: check point timeline.
      * RAN4 will discuss and decide which topics can be studied if decided to start this study after check point.

### Issue 11: Initial access related RRM

**Issue 11: Initial access related RRM**

* Proposal 1(Samsung):
  + In 6GR, for initial access, RAN4 RRM to discussion on following aspects:
    - Whether to specify the RRM requirements for initial cell search. To consider on following aspects:
      * Whether can find the start point to define such RRM requirement like “power on”
      * Necessity to specify such RRM requirements if “UE is powered on” happened infrequently.
      * Part of UE performance in initial cell search can be ensured by other procedures like cell identification; sync raster
      * RRM requirements are needed for cell selection
    - Whether to specify the RACH RRM requirements as functionality as correct UE behavior and tests in RRM.
* Proposal 2(vivo):
  + The cell detection should be studied based on 6G SSB design. In addition, RAN4 may discuss whether necessary to introduce cell selection delay requirement whereas the same principle as that of 4G/5G, i.e., no corresponding cell selection delay requirement, can be used as the base.
* **Recommended WF**
  + Discuss the following FL proposal:
  + FL observation: Initial access related RRM relies on the initial access discussion in other WGs
  + FL proposal:
    - To be discussed: RAN4 to set a check point to check whether or not starting study of the initial access related RRM in 6G SI, e.g., check if conclusions from other WGs are sufficient to support RAN4 study
      * FFS: check point timeline.
      * RAN4 will discuss and decide which topics can be studied if decided to start this study after check point.

### Issue 12: Other PHY signal/channel/procedure related RRM

**Issue 12: Other PHY signal/channel/procedure related RRM**

* UE Tx timing:
  + Proposal 1(MTK):
    - Study PRACH (if introduced) specific timing accuracy requirement.
    - Study the feasibility of replacing gradual timing adjustment with UE pre-compensation, while retaining the Timing Advance command.
  + Proposal 2(Nokia):
    - In 6G, the UE transmit timing requirements would have to address practical aspects from deployments and define UE requirements for these.
* Inter-RAT sync:
  + Proposal 1(MTK):
    - Synchronized Inter-RAT to be the baseline assumption for 6G to enable inter-RAT measurement and mobility.
* Testability:
  + Proposal 1(QC):
    - RAN4 should study whether to use TDL, instead of AWGN, in more performance tests of 6G RRM.
* RRM-specific Categories:
  + Proposal 1(QC):
    - For 6G, RAN4 should study how to provide a more intuitive framework to guide implementation and deployment decisions by labeling UE RRM performance, based on all capabilities supported by the UE, in a standardized format. The framework could include a mapping that links each RRM aspect to its corresponding set of optional UE capabilities, enabling a more intuitive and comprehensive understanding of overall UE performance.
* TCI switching reduction:
  + Proposal 1(QC):
    - RAN4 should study the mechanisms to reduce TCI state switch timeline in 6G.
  + Proposal 2(Nokia):
    - RAN4 to study the steps involved in TCI switching and identify potential reductions in TCI switching delay for 6G.
* Duplexing:
  + Proposal 1(Samsung):
    - In 6GR, RAN4 RRM shall collaborate with RAN1 to discuss on how to support multiple types of duplexing including SBFD.
* RRM relaxation and simplification for 6G massive IoT:
  + Proposal 1(Sony):
    - RAN4 should study the RRM relaxation and simplification for 6G massive IoT, comparing it with legacy IoT devices, to reduce device complexity and improve network/device energy efficiency.
* Sensor based RRM:
  + Proposal 1(CATT):
    - RAN4 to consider enriching RRM measurement content and introducing sensing information based mobility management.
      * In addition to link quality measurement such as RSRP/RSRQ/SINR, the measurement content can also include speed, distance, angle, positioning, imaging, or activity detection, etc.
    - RAN4 to consider RRM impact for multi-functional RAN, where communication and sensing functionalities are jointly supported.
* user-centric based RRM:
  + Proposal 1(CATT):
    - RAN4 to study the RRM impact for user-centric operation.
* Unified UE capability:
  + Proposal 1(Xiaomi):
    - Unified modular based UE RRM Capability Definitions – Study common, reusable capability blocks for fundamental UE abilities (e.g., beam-sweeping factor, message-processing footprint) to improve consistency and scalability across RRM procedures.
* BWP switch:
  + Proposal 1(vivo):
    - For BWP switch, reduction on BWP switch time may need study once BWP design (if there is any) in 6G is clear. Particularly, the reduction on the duration for UE parsing time may be studied if the BWP framework is further simplified. At the same time, RAN4 could study whether the RF retuning time can be further improved or not.
* MRTD:
  + Proposal 1(Ericsson):
    - When feasible, in timing requirement, use a total budget that allows flexible allocation among subcomponents instead of specifying sub-requirements on part of the system.
    - When feasible, specify MRTD (RRM) as a total budget and avoid stating TAE (BS RF) between ARP.
* TDD Cell Phase Synchronization:
  + Proposal 1(Ericsson):
    - Keep TDD Cell Phase Synchronization requirement the same as in NR NR.
* CGI reading:
  + Proposal 1(Ericsson):
    - RAN4 should define the CGI reading requirement in 6G first release.
* Purpose-based measurement requirements:
  + Proposal 1(Nokia):
    - For Connected mode, Idle mode, and Inactive mode, RAN4 to study defining measurement requirements depending on purpose of the configured measurement: mobility or data (CA).
* **Recommended WF**
  + Discuss the following FL proposal:
  + FL proposal:
    - Due to the limited TU of the 6G SI for RRM, the topics in “Issue 13: Other PHY signal/channel/procedure related RRM” will not be studied in 6G SI timeline, unless it can be well justified with following criteria in next RAN4#117 meeting:
      * Topics that can be initiated directly in RAN4
      * Topics with clear commercial demand for RRM
      * Topics for fundamental feature in RRM (not incremental enhancement from 5G)
      * Topics with the strongest support from companies
      * Topics whose study can address the most critical pain points in 5G RRM

### Issue 13: RAN4 RRM spec simplification/improvement

**Issue 13: RAN4 RRM spec simplification/improvement**

* Proposal 1 (Samsung):
  + For 6GR RRM spec structure and drafting rules, the overall spec structure in 5GNR can be inherited such as: RRC\_IDLE/INACTIVE/ CONNECTED state mobility, Timing, Signaling, Measurement. etc.
    - RAN4 to discuss and decide the high-level principle to decide whether a new feature is introduced, new sub-clauses can be allowed or not. We prefer to category the clauses from procedures and different assumptions rather than UE types.
  + RAN4 can 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:
      * It is recommended to 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 2 (HW):
  + RAN4 to 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 3 (CATT):
  + It is necessary for RAN4 to introduce a more intuitive and simpler way to define RRM requirements, and new forms of representation can be introduced if necessary to make spec more concise, such as: multi-dimensional condition configuration tables, diagrams of timeline, etc.
  + RAN4 to 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.
* FL note: This issue 13 has been moved to [116bis][111] 6G operation efficiency.