3GPP TSG-RAN WG4 Meeting #112 R4-2411799

Maastricht, Netherlands, 19th – 23rd August, 2024

**Agenda item:** 8.15.4

**Source:** Moderator (Apple)

**Title:** Topic summary for [112][218] NR\_RRM\_Ph5\_Part1

**Document for:** Information

# Introduction

This topic summary includes General aspects (8.15.1 ), FR2-1 L3 measurement delay by optimizing Rx beam sweeping factor (8.15.2.1), and FR2-1 L3 measurement delay by optimizing CSSF outside gap in CA/DC (8.15.2.2).

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

* Mainly discuss on
  + Issue 1-1, issue1-2, issue 1-3, issue 2-1, issue 2-2, issue 2-3, issue 2-4, issue 2-5.
  + Then other issues.

# Topic #1: FR2-1 L3 measurement delay by optimizing Rx beam sweeping factor (8.15.2.1)

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **[R4-2411357](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411357.zip)** | CATT | Proposal 1: For enhanced Rx BSF to reduce L3 measurement delay, it is proposed to reuse the condition and definition in Rel-18 Multi-Rx as much as possible. But some Rel-19 specific enhancements are still allowed.  Proposal 2: It is proposed not to limit the applied power class for enhancement of Rx BSF.  Proposal 3: The enhanced Rx BSF applies to the UE supporting Multi-Rx operation for L3 measurements which means UE supports simultaneous reception of multiple SSBs from different directions of the same target frequency layer inside a SMTC window.  Proposal 4: No need to add additional processing time due to multiple SSBs within one SMTC.  Proposal 5: The condition of Multi-Rx operation in Rel-18 can be reused, i.e.,   * the UE is in multi-Rx operation if following condition is met:   + UE is configured with group-based beam reporting (GBBR) report.   Proposal 6: UE can indicate the preference of Multi-Rx operation for L3 measurement and further discuss whether to reuse the existing signaling.  Proposal 7: The existing searcher assumption (i.e., 2 searchers) is applied to the requirements of enhanced BSF.  Proposal 8: The requirements of enhanced BSF can also be applied to HST if UE supports both of the capabilities.  Proposal 9: For enhanced BSF to reduce L3 measurement delay, on top of the UE capability of supporting Multi-Rx, no additional conditions of prior knowledge for target cell is needed so far.  Proposal 10: Do not consider simultaneous Multi-Rx operation for both L1 and L3 measurement in this WI.  Proposal 11: Taking intra-/inter-frequency measurement and handover requirements as baseline to discuss the L3 measurement delay reduction by optimizing Rx BSF.  Proposal 12: For UE supporting Multi-Rx operation for L3 measurement, the Rx BSF can be reduced to 2, 4 or 6 according to the UE capability.  Proposal 13: The reduced Rx BSF in proposal 11 can be applied to:   * TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra for SSB based intra-frequency measurement; * TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter for SSB based inter-frequency measurement; * Tsearch for FR1-FR2 HO and FR2-FR2 HO.   Proposal 14: The reduced Rx BSF in proposal 11 can be applied to the associated SSB in CSI-RS based measurement, CHO and DAPS HO with no specification impact. |
| **[R4-2411407](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411407.zip)** | Apple | Proposal 1: It is proposed to focus on PC3 UE as first priority.  Proposal 2: It is proposed to allow additional processing time for UE supporting multiple-Rx simultaneous reception for L3 delay enhancement if there is only one searcher available for the processing.  Proposal 3: For power saving purpose, there is a need to have a mechanism to activate/de-activate L3 fast beam sweeping. The R18 mechanism (i.e., multi-RX operation definition and UAI indication of preference) can be considered as a baseline, while other conditions are not precluded.  Proposal 4: Prioritize following scenarios as starting points to use L3 measurement delay reduction by optimizing Rx BSF:   * SSB based Intra-frequency measurement without MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra * SSB based Intra-frequency measurement with MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra * SSB based Inter-frequency measurement without MG, including TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter * SSB based Inter-frequency measurement with MG, including TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter   Proposal 5: After RAN4 has conclusion(s) on the solution(s) of L3 measurement delay reduction for the above baseline scenarios, the solutions(s) can be extended to other scenarios, e.g., handover, PSCell addition, RRC Re-establishment/RRC Connection Release with Redirection, SCell activation, SCG activation, CGI reading, and the associated SSB synchronization in CSI-RS L3 measurement.  Proposal 6: For UE supporting multiple-Rx simultaneous reception, it is proposed to reduce L3 measurement delay by reducing Rx BSF, and Rel-18 Rx BSF reduction in L1 measurement can be used as baseline.  Proposal 7: RAN4 is to introduce a new individual capability for L3 BSF reduction due to multi-Rx operation in R19. The detailed definition can be postponed to the end of the core part discussion. |
| **[R4-2411483](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411483.zip)** | OPPO | Proposal 1: RAN4 to consider UE supporting FR2-1 power class 3 as first priority.  Proposal 2: Multi-Rx simultaneous reception of UE is in active mode, which is expected to follow the one specified in Rel-18 for multi-Rx simultaneous reception feature.  Proposal 3: Focus on low mobility case in this WI.  Proposal 4: Open to support the enhanced searcher assumption that two searchers are occupied by this single carrier for L3 RRM measurement with two UE’s panels activated.  Proposal 5: RAN4 firstly to define requirements of SSB based intra-frequency and inter-frequency L3 measurements with fast beam sweeping, and then decide whether to apply them for other L3 procedures.  Proposal 6: For deactivated SCell and PSCell in FR2-1, the enhancement of TPSS/SSS\_sync and TSSB\_measurement\_period can also apply. |
| **[R4-2411622](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411622.zip)** | Xiaomi | Proposal 1: The following L3 measurement delay requirements in TS38.133 [3] can be taken as our baseline to be optimized.   |  |  | | --- | --- | | Current requirements in TS38.133 | UE operating multiple-Rx mode | | 9.2.5 Intra-frequency measurements without measurement gaps | Needs to be enhanced | | 9.2.6 Intra-frequency measurements with measurement gaps | Needs to be enhanced | | 9.3.4 Inter-frequency measurement with measurement gaps | Needs to be enhanced | | 9.3.9 Inter frequency measurements without measurement gaps | Needs to be enhanced | | 6.1.1.4 NR FR2- NR FR2 Handover | Needs to be enhanced by leveraging the conclusion from the requirements for L3 measurement defined in 9.2 and 9.3. |   Proposal 2: The SSB based L3 measurement delay reduction with DRX shall be deprioritized.  Proposal 4: In order to shorten the overall L3 measurements delay, the smaller RX beam sweeping factor for SSB index acquiring and SSB measurement can be used in comparison with that for PSS/SSS detection. |
| **[R4-2411681](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411681.zip)** | NTT DOCOMO, INC. | Proposal 1: RAN4 to consider UE supporting FR2-1 power class 3 as first priority. Whether other power classes could apply the outcome of the WI discussion can be FFS after concluding on PC3. These extra FFS parts will NOT delay the WI completion.  Proposal 2: Beam sweeping factor reduction for L3 measurement delay reduction should be independent to R18 multi-Rx simultaneous reception feature includes conditions and requirement.  Proposal 3: HST scenario should be precluded. |
| **[R4-2411688](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411688.zip)** | LG Electronics Inc. | - Proposal 1: For the applicable scenario based on agreement of the last meeting,  Baseline: L3 delay enhancements in Rel-19 by optimizing Rx BSF for UE supporting multi-rx simultaneous reception are applicable provided that:   the target carrier(s) to be measured: only one carrier in the single FR2-1 band is configured for L3 SSB measurement and   UE serving carrier(s): UE is configured with single carrier on FR2-1 band, i.e. FR2-1 PCell without CA/DC.  Note: Target and serving carrier frequency can be the same or different.  Note: The ‘other UE CA/DC modes (e.g., 1 or 2 FR2-1 bands CA, or FR1+FR2 CA/DC, or EN-DC)’ and/or the ‘other number of target to-be-measured carrier(s) on FR2-1 band’ can be FFS after concluding the baseline above. These extra FFS parts will NOT delay the WI completion.  - Proposal 2: RAN4 to focus on SSB based intra- / inter-frequency L3 measurement to reduce measurement delay by optiminzing Rx BSF as first priority.  - Proposal 3: The supporting power class for L3 measurement delay enhancement with multi-Rx simultaneous reception is PC3 as first priority, but RAN4 should consider if other power classes could apply the outcome of the WI discussion.  - Proposal 4: Rel-19 UE behaviour for multi-Rx reception does not have to depend on the condition for active mode of multi-Rx reception in Rel-18, and detailed condition could be further discuss based on agreed target scenario to use L3 measurement dealy reduction by Rx BSF.  - Proposal 5: Do not consider mobility condition for L3 measurement delay reduction by optimizing Rx BSF, and power class 3 can be first priority (i.e., power class 6 as HST can be further discussed later)  - Proposal 6: For power consumption of multi-Rx operation, Rel-18 UAI ‘multiRx-PreferenceFR2’ for power saving can be considered as starting point.  - Proposal 7: Scenario 1 to 4 as SSB based intra- / inter-frequency measurement should be considred as first priority.  - Proposal 8: If UE supports multi-Rx reception simultaneously for L3 measurement and signal quality for serving cell is low, L3 measurement delay reduction by optimizing Rx BSF could be applied to scenario 1 to 4.  - Proposal 8-1: RAN4 to discuss how to reduce M values for SSB based intra- / inter-frequency measurements for UE supporting multi-Rx simultaneous reception  - Proposal 9: RAN4 not to consider SSB based L3 measurement delay enhancement with other features and previous release features. |
| **[R4-2411975](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411975.zip)** | CMCC | Proposal 1: the conditions for UE to apply L3 measurement delay reduction by optimizing Rx BSF is that multi-Rx simultaneous reception of UE is in active mode. And it is not necessary to assume that the condition of in active mode is same as that for Rel-18 multi-Rx simultaneous reception.  Proposal 2: L3 measurement delay reduction by optimizing Rx BSF is applied to HST.  Proposal 3: at least following scenarios need to be considered to apply L3 measurement delay reduction by optimizing Rx BSF:   * SSB based Intra-frequency measurement without MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra * SSB based Intra-frequency measurement with MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra * SSB based Inter-frequency measurement without MG, including TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter * SSB based Inter-frequency measurement with MG, including TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter   Proposal 4: L3 measurement delay reduction by optimizing Rx BSF is applied to handover, in detail, Tsearch can be reduced.  Proposal 5: L3 measurement delay reduction by optimizing Rx BSF is applied to RRC Re-establishment, in detail, Tidentify\_intra\_NR and Tidentify\_inter\_NR can be reduced.  Proposal 6: L3 measurement delay reduction by optimizing Rx BSF is applied to RRC Connection Release with Redirection, in detail, Tidentify-NR can be reduced.  Proposal 7: L3 measurement delay reduction by optimizing Rx BSF is applied to CSI-RS based intra-/inter-frequency measurements, in detail, at least PSS/SSS detection time of associatedSSB for CSI-RS based L3 intra-/inter-frequency measurement can be reduced. |
| **[R4-2412117](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412117.zip)** | China Telecom | Proposal 1: It’s proposed to consider UE supporting FR2-1 power class 3 as first priority.  Proposal 2: “For UE supporting multiple Rx simultaneous reception for L3 delay enhancement” means UE supporting “simultaneous reception of multiple SSBs from different directions of the same target frequency layer inside a SMTC window. But it does not mean “UE can process multiple SSBs from different directions of the target frequency in parallel”.  Proposal 3: For conditions to apply L3 measurement delay reduction by optimizing Rx BSF, UE shall support Rel-18 multi-Rx capability and multi-Rx simultaneous reception of UE is in active mode, but the conditions are not needed to be same as Rel-18 multi-Rx work item.  Proposal 4: The discussion on L3 measurement delay reduction by optimizing Rx BSF can be focused on low mobility status, and HST is precluded.  Proposal 5: It’s proposed to consider the condition whether UE has prior knowledge on the cell to be measured or not, which may have different impacts on BSF reduction.  Proposal 6: Rel-19 L3 measurement with multi-Rx DL reception is irrelevant to multi-TRP operation deployment.  Proposal 7: For scenarios to use L3 measurement delay reduction by optimizing Rx BSF, the L3 measurement process of SSB based Intra-frequency/Inter-frequency measurement without/with MG can be considered, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra, TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter.  Proposal 8: For scenarios to use L3 measurement delay reduction by optimizing Rx BSF, unknown target FR2 cell delay requirements in Handover scenario can be considered.  Proposal 9: Fast beam sweeping method introduced for FR2 L1 measurement delay reduction in Rel-18 multi-Rx WI can be considered as baseline for FR2-1 SSB based L3 measurement delay reduction by optimizing Rx BSF. |
| **[R4-2412202](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412202.zip)** | Huawei, HiSilicon | Proposal 1: RAN4 shall firstly identify the promising scenario(s) for L3 measurement delay reduction enabled by multi-Rx with clear/significant benefits, which could help to converge the discussion.  Proposal 2: One possible scenario to be considered is when there is strong demand of mobility performance (e.g. UE at cell edge or the link is about to break).  Proposal 3: It shall not be assumed that UE supporting this feature shall activate multiple panels all the time for all L3 measurement. RAN4 shall discuss the entering and/or exiting conditions for enhanced L3 measurement enabled by multi-Rx taking the targeting scenario into account. |
| **[R4-2412236](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412236.zip)**  **R4-2412237(Proposal 11)** | Ericsson | Proposal 1: To gain the most significant measurement delay reduction, we agree to prioritize power class 3.  Proposal 2: As a feature, measurement enhancement by FBS doesn’t follow multi-Rx simultaneous reception for L1 measurement enhancement in Rel-18. Also, measurement enhancements by FBS can’t reuse the applicable conditions (e.g., multi-TRP, GBBR) specified in multi-Rx in Rel-18.  Proposal 3: For sake of simplification while considering the target scenarios, when Rel-19 L3 measurement enhancement is enabled, it is assumed that L1 measurement enhancement in Rel-18 doesn’t work simultaneously. Subsequently, the sharing factor between L3 and L1 is defined with respect to the assumption of L3 measurement applying FBS and L1 measurement not applying multi-Rx in Rel-18, so legacy ﻿Psharing factor is applied.  Proposal 4: For sake of simplification, we don’t expect simultaneous operation between L3 measurement and data reception, if its interpretation is that L3 measurement on one panel and data reception on another panel on same resources at same time.  Proposal 5: RAN4 to study the requirements relevant to switching between different operations, including:   * Transition time period when enabling and disabling FBS in Rel-19. * Transition time period when switching between FBS in Rel-19 and multi-Rx in Rel-18.   Proposal 6: RAN4 to prioritize FBS for legacy normal (non-HST) requirements. FBS in HST is feasible from technical perspective but it might not be the WI's main concern.  Proposal 7: Support Option1/1a. One searcher is able to handle the single carrier received from multiple panels, targeting the scenario: ‘UE is configured with single carrier on FR2-1 band. Only one carrier in the single FR2-1 band is configured for L3 SSB measurement.’  Proposal 8: Extra SSB post-processing time in several ms, as side effect of BSF enhancement, may be acceptable, but it depends on how much we can gain with BSF enhancement.  Proposal 9: NW indicates UE enabling/disabling FBS through L3 or lower layers signaling.  Proposal 10: A UE may only measure less spatial directions with one panel or multiple panels upon acquiring prior knowledge on the cell to be measured, e.g., The UE has done measurements before in a time period.  Proposal 11: As a particular example of the last proposal, apply reduced Rx beam sweeping in the subsequent operation(s) compared to the full (legacy) Rx beam sweeping in the prior operation(s), e.g., in SSB based Intra/inter-frequency measurement, apply reduced Rx beam sweeping factor consequently in Tpss/sss\_sync, TSSB\_time\_index\_inter and Tssb\_measurement\_period.  Proposal 12: FBS may cover DRX cases, no need to deprioritize DRX case.  Proposal 13: To support FBS, RAN4 to check if those capabilities for multi-Rx in Rel-18, e.g., faster RX beam sweeping, enhanced scheduling and measurement restrictions and multi-Rx preference indication, can be used directly. If the NW indicates FBS and multi-RX in Rel-18 not parallelly, we can observe the possibility of reusing at least part of such capabilities.  Proposal 14: As a result of FBS, RX beam sweep factor can be defined as [4].  Proposal 15: Prioritize the following requirements since they are most important to improve mobility latency.   * SSB based Intra-frequency measurement without MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra * SSB based Intra-frequency measurement with MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra * SSB based Inter-frequency measurement without MG, including TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter * SSB based Inter-frequency measurement with MG, including TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter * Handover   Apart from the aformentioned cases, we also are open to other cases if noticeable value is observed.  From R4-2412237  Proposal 11: Regarding FBS, only Rel-18 multi-Rx scenario should be assumed, and we should not assume that the UE is also supporting other features. But it is noted that it doesn’t mean L1 measurement enhancement by multi-Rx in Rel-18 is mandatory for FBS. |
| **[R4-2412256](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412256.zip)** | vivo | Proposal 1: RAN4 to consider introduce multi-Rx UE capability of reduced Rx beam sweeping factor for FR2 L3 measurement delay reduction.  Proposal 2: RAN4 to consider UE supporting FR2-1 power class 3 as first priority and whether other power classes could apply the outcome of the WI discussion can be FFS after concluding on PC3.  Proposal 3: For the issue of clarification on “for UE supporting multiple-Rx simultaneous reception for L3 delay enhancement”, there is no need to consider whether UE can process multiple SSBs from different directions of the target frequency in parallel and the FFS can be removed.  Proposal 4: RAN4 to discuss the following conditions for UE to apply L3 measurement delay reduction by optimizing Rx BSF.   * + Multi-Rx simultaneous reception of UE is in active mode, which is expected to follow the one specified in Rel-18 for multi-Rx simultaneous reception features   + Low mobility status   + RRM measurement with two panels activated, two searchers are occupied by this single carrier   + Time for buffering and processing multiple beams received in a SMTC is long enough and no need to considered the condition.   + Power consumption issue is important and BSF reduction of L3 measurement will not trigger UE to activate multi-Rx   + UE has prior knowledge on the cell to be measured   + Rel-19 L3 measurement with multi-Rx DL reception is irrelevant to multi-TRP operation deployment   + Consider cell-edge UE for L3 FBS   + The issue of simultaneous operation between L3 and L1 measurements is out of scope and no need to discussion   Proposal 5: RAN4 to considered the SSB based inter/intra frequency with/without MG as the scenarios to use L3 measurement delay reduction by optimizing Rx BSF and find solutions to reduce the M value.  Proposal 6: Following aspects are out of scope:   * Handover * PSCell addition * RRC Re-establishment/RRC Connection Release with Redirection * SCell activation * SCG activation * CGI identification * CSI-RS based intra-/inter-frequency measurements, the CSI-RS is configured associatedSSB   + The discussion on CSI-RS configured with associatedSSB could be revisited if SSB based L3 measurement delay reduction is concluded. |
| **[R4-2412417](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412417.zip)** | Intel Corporation | Proposal 1: The precondition for the multi-Rx simultaneous reception to be in active mode is based on those specified in Rel-18 for multi-Rx simultaneous reception features.  Proposal 2: The UE is considered activated in multi-Rx simultaneous reception mode and activated for L3 reporting when the GBBR is configured and configured not long prior to the expected L3 reporting.  Proposal 3: Consider UE baseband processing capabilities when specifying the L3 delay reduction for simultaneous receptions on multiple FR2 SSB-s.  Proposal 4: Different (or whether or not) delay reduction applies when the ratio of number of SSB within a burst and time duration of the measurement periodicity varies.  Proposal 5: Mobility status should not be considered as a limitation for UE delay reduction since the purpose of the reduction is to have greater mobility in general, so we are not supposed to compromise on mobility status.  Proposal 6: Power consumption is not an issue in the scope since the total power consumption for a handover stays roughly the same even delay is reduced.  Proposal 7: Whether UE has prior knowledge or cell centre/edge conditions do not affect reduction in BSF but they are addressed in legacy side conditions. |
| **[R4-2412495](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412495.zip)** | Nokia | Proposal 1: RAN4 to consider L3 measurement delay reduction targeting cell edge scenarios as the first priority.  Proposal 2: Do not reuse Rel-18 multi-Rx BSF reduction activation conditions for Rel 19 multi Rx BSF reduction.  Proposal 3: Discuss BSF reduction triggering conditions among the following options:  a. Option 1: Network configuration of BSF reduction  b. Option 2: Mobility Event triggering BSF reduction  c. Option 3: Conditional Handover configuration  d. Option 4: BSF reduction is always enabled, but used for reduced measurement delay in cell edge and used for reduced scheduling restrictions in cell center (e.g. by extending T\_SMTC).  Proposal 4: If additional time for SSB processing is needed when UE is measuring multiple beams in one SMTC, RAN4 to consider measurement delay with SSB processing as  a. Tidentify\_intra\_without\_index = (TPSS/SSS\_sync\_intra + T SSB\_measurement\_period\_intra+TSSB\_processing) ms  b. Tidentify\_inter\_without\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter+TSSB\_processing) ms  c. where TSSB\_processing = 2 ms  Observation 4: L1 and L3 measurements are not performed in the same SSB occasions.  Proposal 5: Rel-18 L1 BSF reduction operates independently of Rel-19 L3 BSF reduction.  Proposal 6: RAN4 to introduce a new individual capability for L3 beam sweeping factor reduction due to multi-Rx operation.  Proposal 7: Rel-19 BSF reduction applies for  a. Scenario 1: SSB based Intra-frequency measurement without MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra  b. Scenario 2: SSB based Intra-frequency measurement with MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra  c. Scenario 3: SSB based Inter-frequency measurement without MG, including TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter  d. Scenario 4: SSB based Inter-frequency measurement with MG, including TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter  Proposal 8: After RAN4 has conclusion(s) on the solution(s) of L3 measurement delay reduction for the above baseline scenarios 1/2/3/4, the solutions(s) can be extended to these scenarios:  a. Scenario 5: Handover  b. Scenario 6: PSCell addition  c. Scenario 8: SCell activation  d. Scenario 9: SCG activation  Proposal 9: Not to consider the following scenarios for FBS:  a. Scenario 10: CGI identification  b. Scenario 11: CSI-RS based intra-/inter-frequency measurements  Proposal 10: L3 measurement enhancements are not restricted by power class.  Proposal 11: Prior knowledge of target cells to be measured is not to be used as a condition for L3 BSF reduction. |
| **[R4-2412852](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412852.zip)** | Samsung | Proposal 1: RAN4 to consider UE supporting FR2-1 power class 3 as first priority   * Suggest to preclude HST at current stage * Suggest to discuss the applicability of the outcome of the WI discussion to other power classes after concluding on PC3   Proposal 2: Rel-19 L3 measurement with multi-Rx DL reception is irrelevant to multi-TRP operation deployment  Proposal 3: Do not reuse the same applicable conditions specified in Rel-18 L1 multi-Rx (i.e., GBBR is configured ) in Rel-19 L3 multi-Rx measurement WI  Proposal 4: Prefer to define a new UE capability of supporting L3 multi-Rx FBS, and which is optional  Proposal 5: RAN4 to discuss the feasibility of defining scheduling availability requirement of UE performing SSB based L3 measurement under multi-Rx simultaneous reception in FR2-1.  Proposal 6: Suggest to take the following scenarios as the highest priority:   * Scenario 1: SSB based Intra-frequency measurement without MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra * Scenario 2: SSB based Intra-frequency measurement with MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra * Scenario 3: SSB based Inter-frequency measurement without MG, including TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter * Scenario 4: SSB based Inter-frequency measurement with MG, including TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter   Proposal 7: To define the delay requirements for intra-frequency and inter-frequency measurement w/o MG for L3 multi-Rx measurement, suggest to take N=4, M=20 as the baseline   * Whether to/How to define the other values can be based on SLS results (if necessary)   Proposal 8: It is pessimistic to reduce handover delay to unknown target cell by optimizing Rx BSF  Proposal 9: The impact on the L3 measurement requirement of CSI-RS based cell identification when associatedSSB is configured could be revisited when SSB based L3 measurement delay reduction is concluded. |
| **[R4-2413077](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413077.zip)** | ZTE Corporation, Sanechips | Proposal 1: Firstly concentrate on the technical issues, then restart the discussion on applicable scenarios besides the single carrier single FR2-1 band case until concrete progress achieved.  Proposal 2: The prerequisite of fast beam sweeping in L3 measurement is the multi-panel Rx simultaneously. In other words, each panel scans a subset of beams, multiple panels perform the subset beam sweeping simultaneously.  Proposal 3: At least the following applicability conditions are supported:   * Multi-Rx simultaneous reception of UE is in CONNECTED mode * RRM measurement with two panels activated * Preclude the HST scenario since reduced Rx beam sweeping has been introduced for HST   Proposal 4: Either single-TRP or multi-TRP or both of them are targeted deployment for this R19 WID, it should be clarified.  Proposal 5: Due to L3 measurement is long-term operation, power consumption issue could be considered, which may lead to some interaction signalling. But which would not be the applicability condition of applying fast beam sweeping.  Proposal 6: The multi-Rx L3 measurement can be applied for:   * SSB based Intra-frequency measurement without MG * SSB based Intra-frequency measurement with MG * SSB based Inter-frequency measurement without MG * SSB based Inter-frequency measurement with MG * Handover * PSCell addition * RRC Re-establishment/RRC Connection Release with Redirection * SCG activation * CGI identification   Proposal 7: The basic solution is UE applies multiple panels to perform L3 beam sweeping simultaneously. Each panel used to sweep individual subset of beams. Besides, simultaneous L3 beam sweeping and data reception/L1 beam sweeping are allowed. |
| **[R4-2413167](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413167.zip)** | Qualcomm Incorporated | Proposal 1: RAN4 to define an overall framework for the fast beam sweeping factor based L3-measurement and mobility latency enhancement for a single serving cell. Whether/how to extend the solution and framework to CA/DC scenarios (e.g., FR2 PSCell addition, FR2 SCell activation, FR2 SCG activation) is FFS.  Proposal 2: The fast beam sweeping factor, if in use, applies to both SSB detection (PSS/SSS detection, PBCH-DMRS reading, MIB decoding) and SSB based L3 measurement period requirements.  Proposal 3: RAN4 to adopt the following framework for the fast UE Rx beam sweeping based L3 measurement and mobility requirements:   * NW provides the following criteria for fast beam sweeping application, and the signaling details are FFS   + Cell edge condition: Threshold value of absolute L3 SSB-RSRP of SpCell   + High speed condition: Threshold value of L3 SSB-RSRP variation on SpCell over a time period T   + When the condition of not cell-edge (and not high-speed, if configured) is met, the UE is allowed to fallback Rx beam sweeping factor to the existing N value   + Note: the existing criteria defined for the relaxed idle/inactive mode measurement and/or RLM/BFD evaluation can be reused or served as a baseline * Report configuration for the status of fast beam sweeping factor application, and the signaling details are FFS   + A TTT-like time window or N310-like timer, which starts running or counting upon the first satisfaction of the condition “not cell-edge (and not high-speed)” is observed by the UE, can be configured to avoid frequent status transitions and reports   + Note: the existing report defined for RLM/BFD relaxation status can be reused or served as a baseline * Besides, other explicit signaling (e.g. FR2 CHO, FR HO, GBBR, etc.) may disallow the fallback of UE Rx beam sweeping factor to the existing N value until the signaled configuration is no longer in effect or the relevant task has been completed. * FFS on the application delay of UE Rx beam sweeping factor switch |
| **[R4-2413326](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413326.zip)** | MediaTek inc. | Proposal 1: Do not reuse the same applicable conditions specified in Rel-18 multi-Rx for Rel-19 L3 measurement delay reduction with UE supporting multi-Rx.  Proposal 2: Activating multi-Rx for L3 measurements (intra/inter-frequency) may or may not be always necessary, depending on UE current conditions:   * UE location (cell centre or cell edge) * UE mobility (stationary or moving) * Both above   Proposal 3: On UE mobility status, RAN4 should consider low/medium speed mobility of the UEs as one of the conditions to activate multi-Rx for L3 measurement delay reduction.  Proposal 4: RAN4 to discuss UE indication capability to the NW whenever UE requires to deactivate multi-Rx for FR2-1 SSB based L3 measurement delay reduction (e.g., indication due to overheating resulting from activating multiple panels for long time).  Proposal 5: L3 measurement delay reduction by optimizing Rx beam sweeping factor are applied to the following scenarios only when the conditions (under discussion) for activating multi-Rx in R19 are met:   * Intra-frequency measurements with/without gap * Inter-frequency measurements with/without gap   Proposal 6: L3 measurement delay reduction by optimizing Rx beam sweeping factor are applied to the following scenarios only when the conditions (under discussion) for activating multi-Rx in R19 are met:  • Handover event, DAPS Handover event, handover with PSCell event  • SCell activation event, SCG activation event  • PSCell addition event  Proposal 7: RAN4 to consider UE supporting FR2-1 power class 3 as first priority. |

*The moderator can suggest a limited number of papers which could be presented.*

## 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 WID RP-240830 agreed in the RANP#103 meeting is:

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| * FR2-1 SSB based L3 measurement delay reduction for connected mode   + For UE supporting multiple-Rx simultaneous reception on single carrier:     - Study suitable scenarios and conditions and, if feasible, introduce methods to reduce FR2-1 L3 measurement delay by optimizing:       * Rx beam sweeping factor   + For UE not in multiple-Rx simultaneous reception mode:     - Study suitable scenarios and conditions and, if feasible, introduce methods to reduce FR2-1 L3 measurement delay by optimizing:       * CSSF outside gap in CA/DC scenarios         + Baseline assumption on number of searchers is 2 |

**Abbreviation:**

* + BSF: beam sweeping factor
  + FBS: fast beam sweeping

### Issue 1-1: Applicability requirement of L3 measurement delay reduction by optimizing Rx BSF

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| Agreement in last meeting:  Baseline: L3 delay enhancements in Rel-19 by optimizing Rx BSF for UE supporting multi-rx simultaneous reception are applicable provided that:   * the target carrier(s) to be measured: only one carrier in the single FR2-1 band is configured for L3 SSB measurement and * UE serving carrier(s): UE is configured with single carrier on FR2-1 band, i.e. FR2-1 PCell without CA/DC.   Note: The ‘other UE CA/DC modes (e.g., 1 or 2 FR2-1 bands CA, or FR1+FR2 CA/DC, or EN-DC)’ and/or the ‘other number of target to-be-measured carrier(s) on FR2-1 band’ can be FFS after concluding the baseline above. These extra FFS parts will NOT delay the WI completion. |

**Applicability requirement:**

* Proposal 1 (LGE): add one note to the last agreement.
  + Note: Target and serving carrier frequency can be the same or different.
* Proposal 2 (CTC, ZTE):
  + Firstly concentrate on the technical issues, then restart the discussion on applicable scenarios besides the single carrier single FR2-1 band case until concrete progress achieved.
* Proposal 3 (QC):
  + RAN4 to define an overall framework for the fast beam sweeping factor based L3-measurement and mobility latency enhancement for a single serving cell. Whether/how to extend the solution and framework to CA/DC scenarios (e.g., FR2 PSCell addition, FR2 SCell activation, FR2 SCG activation) is FFS.

**UE Power class:**

* Option 1 (Apple, OPPO, NTT DCM, LGE, CTC, Ericsson, vivo, Samsung, MTK):
  + focus on PC3 UE as first priority.
  + Option 1a (NTT DCM, LGE, vivo, Samsung): Whether other power classes could apply the outcome of the WI discussion can be FFS after concluding on PC3. These extra FFS parts will NOT delay the WI completion.
* Option 2 (CATT, Nokia):
  + not to limit the applied power class for enhancement of Rx BSF.

**Other clarification on WID:**

* Option 1 (CATT):
  + The enhanced Rx BSF applies to the UE supporting Multi-Rx operation for L3 measurements which means UE supports simultaneous reception of multiple SSBs from different directions of the same target frequency layer inside a SMTC window.
* Option 2 (CTC):
  + “For UE supporting multiple Rx simultaneous reception for L3 delay enhancement” means UE supporting “simultaneous reception of multiple SSBs from different directions of the same target frequency layer inside a SMTC window. But it does not mean “UE can process multiple SSBs from different directions of the target frequency in parallel”.
* Option 3 (vivo): no need to consider this issue, and FFS in last agreement can be removed.
* Recommended WF
  + Moderator note: try to accommodate all the options, suggest to discuss if following can be agreed:

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| **Applicability requirement:**  Moderator: P1 is captured as in following yellow-highlighted sentence. P2 and P3 has already reflected in the last agreement.  Baseline: L3 delay enhancements in Rel-19 by optimizing Rx BSF for UE supporting multi-rx simultaneous reception are applicable provided that:   * the target carrier(s) to be measured: only one carrier in the single FR2-1 band is configured for L3 SSB measurement and * UE serving carrier(s): UE is configured with single carrier on FR2-1 band, i.e. FR2-1 PCell without CA/DC.   Note: Target and serving carrier frequency can be the same or different.  Note: The ‘other UE CA/DC modes (e.g., 1 or 2 FR2-1 bands CA, or FR1+FR2 CA/DC, or EN-DC)’ and/or the ‘other number of target to-be-measured carrier(s) on FR2-1 band’ can be FFS after concluding the baseline above. These extra FFS parts will NOT delay the WI completion.  **UE Power class:**  Baseline: RAN4 to consider UE supporting FR2-1 power class 3 as first priority.  Note: whether other power classes could apply the outcome of the WI discussion can be FFS after concluding on PC3. These extra FFS parts will NOT delay the WI completion.  **Other clarification on WID:**  Moderator: this issue can directly be discussed in issue of SSB processing time.  Remove {FFS: “For UE supporting multiple-Rx simultaneous reception for L3 delay enhancement” means UE supporting “simultaneous reception of multiple SSBs from different directions of the same target frequency layer inside a SMTC window. But it does not mean “UE can process multiple SSBs from different directions of the target frequency in parallel.”}. |

### Issue 1-2: Conditions to apply L3 measurement delay reduction by optimizing Rx BSF

[Moderator note]: The condition here means in which case/condition/use-case/mode UE can apply the L3 measurement delay reduction by optimizing Rx BSF.

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| WF R4-2410260  FFS：Conditions for UE to apply L3 measurement delay reduction by optimizing Rx BSF   * + FFS: multi-Rx simultaneous reception of UE is in active mode, which is expected to follow the one specified in Rel-18 for multi-Rx simultaneous reception features   + FFS: UE’s mobility status, e.g., whether HST is precluded or not   + FFS: RRM measurement with two panels activated, two searchers are occupied by this single carrier   + FFS: SSB processing delay/time for processing multiple beams received in a SMTC   + FFS: Power consumption issue   + FFS: UE has prior knowledge on the cell to be measured   + FFS: Rel-19 L3 measurement with multi-Rx DL reception is irrelevant to multi-TRP operation deployment   + FFS: Other conditions: cell-centre UE or cell-edge UE   + FFS: DRX is configured or not   + FFS: Simultaneous operation between L3 and L1 measurements   + FFS: UE is in RRC CONNECTED mode     - Agreement: Only support multi-Rx L3 measurement for CONNECTED UE |

**Conditions for UE to apply L3 measurement delay reduction by optimizing Rx BSF:**

**Issue 1-2-1: FFS: multi-Rx simultaneous reception of UE is in active mode, which is expected to follow the one specified in Rel-18 for multi-Rx simultaneous reception feature**

* + - Option 1 (CATT, OPPO, vivo, Intel): multi-Rx simultaneous reception of UE is in active mode, which is expected to follow the one specified in Rel-18 for multi-Rx simultaneous reception feature.
      * Option 1a (CATT):
  + But some Rel-19 specific enhancements are still allowed. The condition of Multi-Rx operation in Rel-18 can be reused, i.e., the UE is in multi-Rx operation if following condition is met:
    - UE is configured with group-based beam reporting (GBBR) report.
  + UE can indicate the preference of Multi-Rx operation for L3 measurement and further discuss whether to reuse the existing signaling.
    - * Option 1b (Intel): The UE is considered activated in multi-Rx simultaneous reception mode and activated for L3 reporting when the GBBR is configured and configured not long prior to the expected L3 reporting.
    - Option 2 (NTT DCM, CMCC, LGE, Ericsson, Nokia, Samsung, MTK): the conditions for UE to apply L3 measurement delay reduction by optimizing Rx BSF is that multi-Rx simultaneous reception of UE is in active mode. And it does not assume that the condition of in active mode is same as that for Rel-18 multi-Rx simultaneous reception
      * Option 2a (Ericsson): For sake of simplification while considering the target scenarios, when Rel-19 L3 measurement enhancement is enabled, it is assumed that L1 measurement enhancement in Rel-18 doesn’t work simultaneously. Subsequently, the sharing factor between L3 and L1 is defined with respect to the assumption of L3 measurement applying FBS and L1 measurement not applying multi-Rx in Rel-18, so legacy ﻿Psharing factor is applied.
      * Option 2b (Nokia): Rel-18 L1 BSF reduction operates independently of Rel-19 L3 BSF reduction.
    - Option 3 (CTC): For conditions to apply L3 measurement delay reduction by optimizing Rx BSF, UE shall support Rel-18 multi-Rx capability and multi-Rx simultaneous reception of UE is in active mode, but the conditions are not needed to be same as Rel-18 multi-Rx work item.
    - Option 4 (ZTE):
  + At least the following applicability conditions are supported:
    - Multi-Rx simultaneous reception of UE is in CONNECTED mode
    - RRM measurement with two panels activated
    - ~~Preclude the HST scenario since reduced Rx beam sweeping has been introduced for HST~~(this point is captured by Issue 1-2-2, so I removed)
      * Option 4a (ZTE): The prerequisite of fast beam sweeping in L3 measurement is the multi-panel Rx simultaneously. In other words, each panel scans a subset of beams, multiple panels perform the subset beam sweeping simultaneously.

[Moderator]: discussion can be mainly focus on option 1 and 2, and then add details from other options if needed.

**Issue 1-2-2: FFS: UE’s mobility status, e.g., whether HST is precluded or not**

* + - Option 1 (CATT, CMCC): requirements of enhanced BSF can also be applied for HST
    - Option 2 (OPPO, NTT DCM, CTC, Ericsson, vivo, Samsung, ZTE): do not consider HST case
    - Option 3 (LGE): Do not consider mobility condition for L3 measurement delay reduction by optimizing Rx BSF, and power class 3 can be first priority (i.e., power class 6 as HST can be further discussed later)
    - Option 3 (Intel): Mobility status should not be considered as a limitation for UE delay reduction since the purpose of the reduction is to have greater mobility in general, so we are not supposed to compromise on mobility status.
    - [Moderator option]: Option 4:
      * RAN4 to consider UE in non-HST case as first priority.
      * Note: whether or how HST case could use the outcome of the WI discussion can be FFS after concluding on non-HST case. These extra FFS parts will NOT delay the WI completion.

**Issue 1-2-3: FFS: RRM measurement with two panels activated, two searchers are occupied by this single carrier**

* + - Option 1 (CATT, OPPO, vivo): The existing searcher assumption (i.e., 2 searchers) is applied to the requirements of enhanced BSF for single carrier.
    - Option 2 (Ericsson): One searcher is able to handle the single carrier received from multiple panels, targeting the scenario: ‘UE is configured with single carrier on FR2-1 band. Only one carrier in the single FR2-1 band is configured for L3 SSB measurement.’

[Moderator]: check if option 1 is agreeable.

**Issue 1-2-4: FFS: SSB processing delay/time for processing multiple beams received in a SMTC**

* + - Option 1 (CATT, vivo): No need to add additional processing time due to multiple SSBs within one SMTC.
    - Option 2 (Apple): allow additional processing time for UE supporting multiple-Rx simultaneous reception for L3 delay enhancement if there is only one searcher available for the processing
    - Option 3 (Ericsson): Extra SSB post-processing time in several ms, as side effect of BSF enhancement, may be acceptable, but it depends on how much we can gain with BSF enhancement
    - Option 4 (Intel):
* Consider UE baseband processing capabilities when specifying the L3 delay reduction for simultaneous receptions on multiple FR2 SSB-s.
* Different (or whether or not) delay reduction applies when the ratio of number of SSB within a burst and time duration of the measurement periodicity varies.
  + - Option 5 (Nokia):
* If additional time for SSB processing is needed when UE is measuring multiple beams in one SMTC, RAN4 to consider measurement delay with SSB processing as
  + a. Tidentify\_intra\_without\_index = (TPSS/SSS\_sync\_intra + T SSB\_measurement\_period\_intra+TSSB\_processing) ms
  + b. Tidentify\_inter\_without\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter+TSSB\_processing) ms
  + c. where TSSB\_processing = 2 ms

[Moderator]: if searcher number assumption is agreed as 2 for single carrier in last FFS, check if option 1 can be agreed.

**Issue 1-2-5: FFS: Power consumption issue (including conditions to trigger UE using FBS for L3 measurement)**

* + - Option 1 (Apple, LGE): For power saving purpose, there is a need to have a mechanism to activate/de-activate L3 fast beam sweeping. The R18 mechanism (i.e., multi-RX operation definition and UAI indication of preference) can be considered as a baseline, while other conditions are not precluded.
    - Option 2 (HW):
* RAN4 shall firstly identify the promising scenario(s) for L3 measurement delay reduction enabled by multi-Rx with clear/significant benefits, which could help to converge the discussion.
* One possible scenario to be considered is when there is strong demand of mobility performance (e.g. UE at cell edge or the link is about to break).
* It shall not be assumed that UE supporting this feature shall activate multiple panels all the time for all L3 measurement. RAN4 shall discuss the entering and/or exiting conditions for enhanced L3 measurement enabled by multi-Rx taking the targeting scenario into account.
  + - Option 3 (Ericsson/Nokia): NW indicates UE enabling/disabling FBS through L3 or lower layers signaling.
    - Option 4 (vivo): Power consumption issue is important and BSF reduction of L3 measurement will not trigger UE to activate multi-Rx
    - Option 5 (Intel): Power consumption is not an issue in the scope since the total power consumption for a handover stays roughly the same even delay is reduced. Whether UE has prior knowledge or cell centre/edge conditions do not affect reduction in BSF but they are addressed in legacy side conditions.
* Option 6a (Nokia): Mobility Event triggering BSF reduction
* Option 6b (Nokia): FBS is triggered by conditional Handover configuration
* Option 6c (Nokia): BSF reduction is always enabled, but used for reduced measurement delay in cell edge and used for reduced scheduling restrictions in cell center (e.g. by extending T\_SMTC).
  + - Option 7 (QC):

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| RAN4 to adopt the following framework for the fast UE Rx beam sweeping based L3 measurement and mobility requirements:   * NW provides the following criteria for fast beam sweeping application, and the signaling details are FFS   + Cell edge condition: Threshold value of absolute L3 SSB-RSRP of SpCell   + High speed condition: Threshold value of L3 SSB-RSRP variation on SpCell over a time period T   + When the condition of not cell-edge (and not high-speed, if configured) is met, the UE is allowed to fallback Rx beam sweeping factor to the existing N value   + Note: the existing criteria defined for the relaxed idle/inactive mode measurement and/or RLM/BFD evaluation can be reused or served as a baseline * Report configuration for the status of fast beam sweeping factor application, and the signaling details are FFS   + A TTT-like time window or N310-like timer, which starts running or counting upon the first satisfaction of the condition “not cell-edge (and not high-speed)” is observed by the UE, can be configured to avoid frequent status transitions and reports   + Note: the existing report defined for RLM/BFD relaxation status can be reused or served as a baseline * Besides, other explicit signaling (e.g. FR2 CHO, FR HO, GBBR, etc.) may disallow the fallback of UE Rx beam sweeping factor to the existing N value until the signaled configuration is no longer in effect or the relevant task has been completed. * FFS on the application delay of UE Rx beam sweeping factor switch |

* + - Option 8 (MTK): Activating multi-Rx for L3 measurements (intra/inter-frequency) may or may not be always necessary, depending on UE current conditions:
      * UE location (cell centre or cell edge)
      * UE mobility (stationary or moving)
      * Both above
      * Option 8a (MTK):
  + On UE mobility status, RAN4 should consider low/medium speed mobility of the UEs as one of the conditions to activate multi-Rx for L3 measurement delay reduction.
  + RAN4 to discuss UE indication capability to the NW whenever UE requires to deactivate multi-Rx for FR2-1 SSB based L3 measurement delay reduction (e.g., indication due to overheating resulting from activating multiple panels for long time).
    - Option 9 (ZTE): Due to L3 measurement is long-term operation, power consumption issue could be considered, which may lead to some interaction signalling. But which would not be the applicability condition of applying fast beam sweeping.

[Moderator]: discussion can be mainly focus on 3 directions: (1)“additional triggering for this R19 L3 measurement with FBS” (use option 8 for discussion) or (2)“L3 measurement with FBS can be activated/deactivation following on R18 mechanism” (use option 1 for discussion) or (3)“up to network indication” (use option 3 for discussion).

Discuss option 1/3/8 together, and then add details from other options if needed.

**Issue 1-2-6: FFS: UE has prior knowledge on the cell to be measured**

* + - Option 1 (CATT, Intel, Nokia): on top of the UE capability of supporting Multi-Rx, no additional conditions of prior knowledge for target cell is needed
    - Option 2(CTC, Ericsson, vivo): to support FBS for L3 measurement, UE needs prior knowledge on the cell to be measured
      * Option 2a (CTC): consider the condition whether UE has prior knowledge on the cell to be measured or not, which may have different impacts on BSF reduction.
      * Option 2b (Ericsson):
        + A UE may only measure less spatial directions with one panel or multiple panels upon acquiring prior knowledge on the cell to be measured, e.g., The UE has done measurements before in a time period.
        + As a particular example of the last proposal, apply reduced Rx beam sweeping in the subsequent operation(s) compared to the full (legacy) Rx beam sweeping in the prior operation(s), e.g., in SSB based Intra/inter-frequency measurement, apply reduced Rx beam sweeping factor consequently in Tpss/sss\_sync, TSSB\_time\_index\_inter and Tssb\_measurement\_period.

[Moderator]: discussion can be mainly focus on option 1 and 2, and then add details from other options if needed.

**Issue 1-2-7: FFS: Rel-19 L3 measurement with multi-Rx DL reception is irrelevant to multi-TRP operation deployment**

* + - Option 1 (CTC, vivo, Samsung): Rel-19 L3 measurement with multi-Rx DL reception is irrelevant to multi-TRP operation deployment
    - Option 2 (ZTE): Either single-TRP or multi-TRP or both of them are targeted deployment for this R19 WID, it should be clarified.

[Moderator]: check if option 1 is agreeable.

**Issue 1-2-8: FFS: cell-centre UE or cell-edge UE**

* + - Option 1 (Nokia, vivo): RAN4 to consider L3 FBS targeting cell edge scenarios

[Moderator]: this issue can be discussed in issue 1-2-5. No more duplicated discussion in issue 1-2-8.

**Issue 1-2-9: FFS: DRX is configured or not**

* + - Option 1 (Xiaomi): SSB based L3 measurement delay reduction with DRX shall be deprioritized
    - Option 2 (Ericsson): FBS may cover DRX cases, no need to deprioritize DRX case.

[Moderator]: discuss option 1 and 2.

**Issue 1-2-10: FFS: Simultaneous operation between L3 and L1 measurements**

* + - Option 1 (CATT, vivo): Do not consider simultaneous Multi-Rx operation for both L1 and L3 measurement in this WI.
    - Option 2 (ZTE): The basic solution is UE applies multiple panels to perform L3 beam sweeping simultaneously. Each panel used to sweep individual subset of beams. Besides, simultaneous L3 beam sweeping and data reception/L1 beam sweeping are allowed.

[Moderator]: According to the WID, option 2 is out of scope, check if option 1 is agreeable.

### Issue 1-3: Scenarios to use L3 measurement delay reduction by optimizing Rx BSF

[Moderator note]: The scenarios here means which UE behavior/activity/procedure(s) would be improved with this feature or which corresponding requirements in the existing RRM spec will be enhanced to accommodate this feature.

**Which scenarios are considered to use L3 measurement delay reduction by optimizing Rx BSF:**

* + Scenario 1: SSB based Intra-frequency measurement without MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra
    - Option 1(CATT, Apple, OPPO, Xiaomi, LGE, CMCC, CTC, Ericsson, vivo, Nokia, Samsung, ZTE, QC, MTK): Yes
    - Option 1a (OPPO): For deactivated SCell and PSCell in FR2-1, the enhancement of TPSS/SSS\_sync and TSSB\_measurement\_period can also apply.
    - Option 2: No

[Moderator]:

Tentative agreement: Option 1.

Option 1a is not needed due to the agreement in last meeting that “only consider FR2-1 PCell without CA/DC at this stage”.

* + Scenario 2: SSB based Intra-frequency measurement with MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra
    - Option 1(CATT, Apple, OPPO, Xiaomi, LGE, CMCC, CTC, Ericsson, vivo, Nokia, Samsung, ZTE, QC, MTK): Yes
    - Option 2: No

[Moderator]: Tentative agreement: Option 1.

* + Scenario 3: SSB based Inter-frequency measurement without MG, including TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter
    - Option 1(CATT, Apple, OPPO, Xiaomi, LGE, CMCC, CTC, Ericsson, vivo, Nokia, Samsung, ZTE, QC, MTK): Yes
    - Option 2: No

[Moderator]: Tentative agreement: Option 1.

* + Scenario 4: SSB based Inter-frequency measurement with MG, including TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter
    - Option 1(CATT, Apple, OPPO, Xiaomi, LGE, CMCC, CTC, Ericsson, vivo, Nokia, Samsung, ZTE, QC, MTK): Yes
    - Option 2: No

[Moderator]: Tentative agreement: Option 1.

* + Scenario 5: Handover
    - Option 1(CATT, Xiaomi, CMCC, CTC, Ericsson, ZTE, MTK): Yes
      * Option 1a (CATT):
        + reduced Rx BSF in scenario 1/2/3/4 can be applied to Tsearch for FR1-FR2 HO and FR2-FR2 HO.
        + reduced Rx BSF in scenario 1/2/3/4 can be applied to CHO and DAPS HO with no specification impact.
      * Option 1b (CTC): For scenarios to use L3 measurement delay reduction by optimizing Rx BSF, unknown target FR2 cell delay requirements in Handover scenario can be considered.
      * Option 1c (MTK): Handover event, DAPS Handover event, handover with PSCell event
    - Option 2(vivo, Samsung): No
    - Option 3 (Apple, Nokia): After RAN4 has conclusion(s) on the solution(s) of L3 measurement delay reduction for the above baseline scenarios 1/2/3/4, the solutions(s) can be extended to this scenario

[Moderator]: discuss option 1/2/3.

* + Scenario 6: PSCell addition
    - Option 1(ZTE, MTK): Yes
    - Option 2(vivo): No
    - Option 3 (Apple, Nokia): After RAN4 has conclusion(s) on the solution(s) of L3 measurement delay reduction for the above baseline scenarios 1/2/3/4, the solutions(s) can be extended to this scenario

[Moderator]: discuss option 1/2/3.

* + Scenario 7: RRC Re-establishment/RRC Connection Release with Redirection
    - Option 1(CMCC, ZTE): Yes
    - Option 2(vivo): No
    - Option 3 (Apple): After RAN4 has conclusion(s) on the solution(s) of L3 measurement delay reduction for the above baseline scenarios 1/2/3/4, the solutions(s) can be extended to this scenario

[Moderator]: discuss option 1/2/3.

* + Scenario 8: SCell activation
    - Option 1(MTK): Yes
    - Option 2(vivo): No
    - Option 3 (Apple, Nokia): After RAN4 has conclusion(s) on the solution(s) of L3 measurement delay reduction for the above baseline scenarios 1/2/3/4, the solutions(s) can be extended to this scenario

[Moderator]: discuss option 1/2/3.

* + Scenario 9: SCG activation
    - Option 1(ZTE, MTK): Yes
    - Option 2(vivo): No
    - Option 3 (Apple, Nokia): After RAN4 has conclusion(s) on the solution(s) of L3 measurement delay reduction for the above baseline scenarios 1/2/3/4, the solutions(s) can be extended to this scenario

[Moderator]: check if option 3 is agreeable.

* + Scenario 10: CGI identification
    - Option 1 (ZTE): Yes
    - Option 2(vivo, Nokia): No
    - Option 3 (Apple): After RAN4 has conclusion(s) on the solution(s) of L3 measurement delay reduction for the above baseline scenarios 1/2/3/4, the solutions(s) can be extended to this scenario.

[Moderator]: check if option 3 is agreeable.

* + Scenario 11: CSI-RS based intra-/inter-frequency measurements, the CSI-RS is configured *associatedSSB*. The discussion on CSI-RS configured with associatedSSB could be revisited if SSB based L3 measurement delay reduction is concluded.
    - Option 1(CMCC): Yes
      * in detail, at least PSS/SSS detection time of associatedSSB for CSI-RS based L3 intra-/inter-frequency measurement can be reduced, which refer to SSB based L3 measurement delay defined in 9.2.5, 9.3.4 of TS38.133
    - Option 2(vivo, Nokia): No
    - Option 3 (Apple, Samsung): After RAN4 has conclusion(s) on the solution(s) of L3 measurement delay reduction for the above baseline scenarios 1/2/3/4, the solutions(s) can be extended to this scenario
      * Option 3a(CATT, Samsung): The reduced Rx BSF in scenario 1/2/3/4 can be applied to the associated SSB in CSI-RS based measurement

[Moderator]: check if option 3 is agreeable.

* Recommended WF
  + Moderator note: to discuss the above scenarios.
  + Scenario 1: SSB based Intra-frequency measurement without MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra
  + Scenario 2: SSB based Intra-frequency measurement with MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra
  + Scenario 3: SSB based Inter-frequency measurement without MG, including TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter
  + Scenario 4: SSB based Inter-frequency measurement with MG, including TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter
  + Scenario 5: Handover
  + Scenario 6: PSCell addition
  + Scenario 7: RRC Re-establishment/RRC Connection Release with Redirection
  + Scenario 8: SCell activation
  + Scenario 9: SCG activation
  + Scenario 10: CGI identification
  + Scenario 11: CSI-RS based intra-/inter-frequency measurements, the CSI-RS is configured *associatedSSB*. The discussion on CSI-RS configured with associatedSSB could be revisited if SSB based L3 measurement delay reduction is concluded.

[Moderator proposal]:

Which scenarios are considered to use L3 measurement delay reduction by optimizing Rx BSF:

* + Scenario 1/2/3/4 can be considered as first priority. After RAN4 has conclusion(s) on the solution(s) of L3 measurement delay reduction for the baseline scenarios 1/2/3/4, RAN4 can discuss whether and how the solutions(s) can be extended to the scenario 5~11. The discussion on scenario 5~11 will NOT delay the WI completion.

### Issue 1-4: Solutions to apply/specify L3 measurement delay reduction by optimizing Rx BSF

* Proposal 1 (CATT):
  + For UE supporting Multi-Rx operation for L3 measurement, the Rx BSF can be reduced to 2, 4 or 6 according to the UE capability.
* Proposal 2 (Apple, CTC):
  + For UE supporting multiple-Rx simultaneous reception, it is proposed to reduce L3 measurement delay by reducing Rx BSF, and Rel-18 Rx BSF reduction in L1 measurement can be used as baseline.
* Proposal 3 (Xiaomi):
  + In order to shorten the overall L3 measurements delay, the smaller RX beam sweeping factor for SSB index acquiring and SSB measurement can be used in comparison with that for PSS/SSS detection.
* Proposal 4 (LGE):
  + If UE supports multi-Rx reception simultaneously for L3 measurement and signal quality for serving cell is low, L3 measurement delay reduction by optimizing Rx BSF could be applied to scenario 1 to 4.
    - RAN4 to discuss how to reduce M values for SSB based intra- / inter-frequency measurements for UE supporting multi-Rx simultaneous reception
* Proposal 5 (Ericsson):
  + As a result of FBS, RX beam sweep factor can be defined as [4].
* Proposal 6 (Ericsson):
  + RAN4 to study the requirements relevant to switching between different operations, including:
    - Transition time period when enabling and disabling FBS in Rel-19.
    - Transition time period when switching between FBS in Rel-19 and multi-Rx in Rel-18.
* Proposal 7 (Samsung):
  + To define the delay requirements for intra-frequency and inter-frequency measurement w/o MG for L3 multi-Rx measurement, suggest to take N=4, M=20 as the baseline
    - Whether to/How to define the other values can be based on SLS results (if necessary)
* Recommended WF
  + TBA

### Issue 1-5: feature capability of L3 measurement delay reduction by optimizing Rx BSF

* Option 1(Apple, vivo, Nokia, Samsung):
  + RAN4 to introduce a new individual optional capability for L3 BSF reduction due to multi-Rx operation in R19.
  + Option 1a(Apple): The detailed definition can be postponed to the end of the core part discussion.
* Option 2(Eircsson):
  + To support FBS, RAN4 to check if those capabilities for multi-Rx in Rel-18, e.g., faster RX beam sweeping, enhanced scheduling and measurement restrictions and multi-Rx preference indication, can be used directly. If the NW indicates FBS and multi-RX in Rel-18 is not enabled parallelly, we can observe the possibility of reusing at least part of such capabilities.
* Recommended WF
  + [Moderator]: tentative agreement: option 1.

### Issue 1-6: scheduling/measurement restriction relaxation

* Option 1 (Ericsson):
  + For sake of simplification, we don’t expect simultaneous operation between L3 measurement and data reception, if its interpretation is that L3 measurement on one panel and data reception on another panel on same resources at same time.
* Option 2 (Samsung):
  + RAN4 to discuss the feasibility of defining scheduling availability requirement of UE performing SSB based L3 measurement under multi-Rx simultaneous reception in FR2-1.
* Option 3 (ZTE):
  + The basic solution is UE applies multiple panels to perform L3 beam sweeping simultaneously. Each panel used to sweep individual subset of beams. Besides, simultaneous L3 beam sweeping and data reception/L1 beam sweeping are allowed.
* Recommended WF
  + [Moderator]: According to the WID, option 2/3 is out of scope, check if option 1 is agreeable.

### Issue 1-7: whether and/or which previous release feature shall also be considered in “ FR2-1 L3 measurement delay by optimizing Rx beam sweeping factor”

* Option 1 (LGE):
  + RAN4 not to consider SSB based L3 measurement delay enhancement with other features and previous release features.
* Option 2 (Ericsson):
  + Regarding FBS, only Rel-18 multi-Rx scenario should be assumed, and we should not assume that the UE is also supporting other features. But it is noted that it doesn’t mean L1 measurement enhancement by multi-Rx in Rel-18 is mandatory for FBS.
* Recommended WF
  + [Moderator]: discuss option 1 and 2.

# Topic #2: FR2-1 L3 measurement delay by optimizing CSSF outside gap in CA/DC (8.15.2.2)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **[R4-2411358](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411358.zip)** | CATT | Proposal 1: Clarify on the CSSF optimization with one of the following options:   * Option 1: The discussion of CSSF optimization starts from the case when UE is not capable of Multi-Rx or UE is capable of Multi-Rx but not in Multi-Rx operation. * Option 2: Discuss CSSF optimization independently with the UE support of multi-Rx capabilities.   Proposal 2: For L3 measurement delay reduction by optimizing CSSF outside gap, all the EN-DC, NE-DC, SA and NR-DC scenarios can be considered.  Proposal 3: Not to preclude the solutions based on 3 searchers assumption in current stage.  Proposal 4: The CSSF outside gap optimization applies to:   * TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra for SSB based intra-frequency measurement without gap; * TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter for SSB based inter-frequency measurement without gap; * Inter-RAT measurement without gap   Proposal 5: The applied SSB based intra-frequency and inter-frequency measurements include the cases when:   * UE indicates ‘nogap-noncsg’ via *NeedForGapNCSG-InfoNR* or, * UE indicates ‘no-gap’ via *NeedForGapsInfoNR*   Proposal 6: Multiple solutions can be considered for CSSF optimization, and option #4 and option #2 are preferred.   * Solution #4: Three searchers assumption for UE supporting per-FR gap * Solution #2: Using PCC/PSCC searcher to speed up SCC measurement   Proposal 7: Discuss the feature capability after the solutions are decided. |
| **[R4-2411454](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411454.zip)** | Apple | Proposal 1: agree on either one of following options:   * Option 1: Rel-19 CSSF optimization applies for CA/DC scenario when (1)UE is not capable of Rel-18 multi-Rx simultaneous reception or (2)UE is capable of Rel-18 multi-Rx simultaneous reception but work in single-Rx currently. * Option 4a: Rel-19 discussion on the scenarios for CSSF optimization will be considered in CA/DC scenarios with at least two FR2 serving cells, independently of the UE support of multi-Rx capabilities.   Proposal 2: the following scenarios to use L3 measurement delay reduction by optimizing CSSF shall be prioritized:   * SSB based Intra-frequency measurement without MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra * SSB based Inter-frequency measurement without MG, including TPSS/SSS\_sync\_inter, TSSB\_measurement\_period\_inter and TSSB\_time\_index\_inter   Proposal 3: RAN4 to consider EN-DC, NE-DC, SA and NR-DC for L3 measurement delay reduction by optimizing CSSFoutside\_gap,i, and the specific scope can be as following:   * EN-DC   + EN-DC with FR2 only intra band CA   + EN-DC with FR2 only inter band CA   + EN-DC with FR1 +FR2 CA (FR1 PSCell)   + EN-DC with FR1 +FR2 CA (FR2 PSCell) * NE-DC   + NE-DC with FR2 only intra band CA   + NE-DC with FR2 only inter band CA   + NE-DC with FR1 +FR2 CA (FR1 PCell) * SA   + FR1+FR2 CA (FR1 PCell)   + FR1+FR2 CA (FR2 PCell)   + FR2 only intra-band CA   + FR2 only inter-band CA * NR-DC   + FR1 + FR2 NR-DC (FR1 PCell and FR2 PScell)   Proposal 4: RAN4 only consider the enhancement based on 2 searchers, i.e., same as previous release, for L3 measurement delay reduction by optimizing CSSF.   * If companies cannot achieve consensus, RAN4 work can start with the baseline assumption in WID, i.e., 2 searchers.   Proposal 5: Solutions to apply/specify L3 measurement delay reduction by optimizing CSSF outside gap in CA/DC:   * Option 1/1a: UE only needs to measure one serving carrier per band if multiple serving carriers are in the same band,   + If PCC in the band, measure PCC   + Otherwise if PSCC in the band, measure PSCC   + Otherwise if SCC is in the band, measure the SCC with neighbor cell MO   + Otherwise up to UE implementation * Option 2: UE can reduce the searcher occupancy ratio of PCC or PSCC measurement to speed up SCC measurement for certain conditions   + The conditions can be FFS. * Option 5: To consider the CSSF optimization by minimizing the impact from CSI-RS based measurements on SSB-based measurements.   Proposal 6: RAN4 to introduce a new individual capability for CSSF reduction in R19. But also fine to delay the capability discussion to the end of the core part.  Proposal 7: RAN4 not to consider SSB based L3 measurement delay enhancement with previous release features, only except R16 inter-frequency measurement without MG and R18 inter-RAT measurement without MG for CSSF enhancement. |
| **[R4-2411484](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411484.zip)** | OPPO | Proposal 1: L3 delay enhancements in Rel-19 by optimizing Rx BSF for UE supporting multi-rx About the clarification on “UE not in multiple-Rx simultaneous reception mode”, consider both Case 1 that UE is not capable of R18 multi-Rx simultaneous reception, and Case 2 that UE is capable of multi-Rx but not configured with GBBR report.  Proposal 2: Consider both intra-frequency and inter-frequency measurement without MG for L3 measurement delay reduction by optimizing CSSF.  Proposal 3: RAN4 to discuss the optimization of counting the number of configured SCell(s) or MOs without MG for CSSFoutside\_gap in FR2 L3 measurements. |
| **[R4-2411623](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411623.zip)** | Xiaomi | Proposal 1: Rel-19 CSSF optimization can be applicable for the both cases:   * UE is not capable of Rel-18 multi-Rx simultaneous reception * UE is capable of Rel-18 multi-Rx simultaneous reception but work in single-Rx currently.   Proposal 2: Rel-19 CSSF optimization can be prioritized for the following cases:   |  |  | | --- | --- | | Current requirements in TS38.133 | Priority | | 9.1.5.1.1 EN-DC mode: carrier-specific scaling factor for SSB-based, CSI-RS based L3 measurements and RSSI and channel occupancy measurements performed outside gaps | Low | | 9.1.5.1.2 SA mode: carrier-specific scaling factor for SSB-based, CSI-RS based L3 measurements and RSSI and channel occupancy measurements performed outside gaps | high | | 9.1.5.1.3 NR-DC mode: carrier-specific scaling factor for SSB-based and CSI-RS based L3 measurements performed outside gaps | Low | | 9.1.5.1.4 NE-DC mode: carrier-specific scaling factor for SSB-based and CSI-RS based measurements performed outside gaps | Low | | 9.1.5.2.1 EN-DC mode: carrier-specific scaling factor for SSB, CSI-RS-based L3 measurements and RSSI and channel occupancy measurements performed within gaps | Low | | 9.1.5.2.2 SA mode: carrier-specific scaling factor for SSB, CSI-RS-based L3 measurements and RSSI and channel occupancy measurements performed within gaps | high | | 9.1.5.2.3 NE-DC: carrier-specific scaling factor for SSB-based and CSI-RS based L3 measurements performed within gaps | Low | | 9.1.5.2.4 NR-DC: carrier-specific scaling factor for SSB-based and CSI-RS-based L3 measurements performed within gaps | Low | | 9.1.5.2.5 SA mode: carrier-specific scaling factor for PRS-based measurements performed within gaps | high | | 9.1.5.2.6 NE-DC: carrier-specific scaling factor for PRS-based measurements performed within gaps | Low | | 9.1.5.2.7 NR-DC: carrier-specific scaling factor for PRS-based measurements performed within gaps | Low | | 9.1.5.3 Monitoring of multiple layers within NCSG | Low | |
| **[R4-2411976](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411976.zip)** | CMCC | Proposal 1: it is proposed to follow the RAN Plenary common understanding (as captured in RP-240817, RAN#103) that Rel-19 CSSF optimization applies for the two cases: (1)UE is not capable of multiple-Rx simultaneous reception, (2)UE is capable of multiple-Rx simultaneous reception but the UE is not in multi-Rx operation.  Proposal 2: for L3 measurement delay reduction by optimizing CSSF, it is proposed to consider following scenarios:   * Intra-frequency measurement without MG in clause 9.2.5 of TS38.133, which means that all the cases that refer to clause 9.2.5 of TS38.133 are considered * Inter-frequency measurement without MG in clause 9.3.9 of TS38.133, which means that all the cases that refer to clause 9.3.9 of TS38.133 are considered   Proposal 3: For CSSF optimization, it is proposed that SA, NR-DC, NE-DC, EN-DC are considered, since legacy CSSFoutside\_gap are specified for all these scenarios.  Proposal 4: it is proposed to consider both the CSSF optimization based on 2 searchers and the CSSF optimization based on 3 searchers.  Proposal 5: it is proposed to follow the RAN Plenary common understanding (as captured in RP-240817, RAN#103) that FR2-1 L3 measurement delay reduction by optimizing CSSF is considered for 1st phase, and the technical solutions can be extended to FR1 when applicable. |
| **[R4-2412118](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412118.zip)** | China Telecom | Proposal 1: It’s preferred to decouple Rel-19 FR2-1 L3 measurement enhancement and Rel-18 multi-Rx work item, if there is no consensus on the description that “UE is capable of Rel-18 multi-Rx simultaneous reception but work in single Rx currently”, it’s proposed Rel-19 discussion on CSSF optimization can be focused on the case that UE is not capable of Rel-18 multi-Rx simultaneous reception.  Proposal 2: For scenarios to use L3 measurement delay reduction by optimizing CSSF, the L3 measurement process of SSB based Intra-frequency/Inter-frequency measurement without MG can be considered, including TPSS/SSS\_sync\_intra, TSSB\_time\_index\_intra and TSSB\_measurement\_period\_intra, TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter.  Proposal 3: If the workload is not very heavy, the modes of EN-DC, SA, NR-DC, NE-DC can be considered.  Proposal 4: For searcher assumption to apply L3 measurement delay reduction by optimizing CSSF, it’s proposed to consider the enhancement based on 2 searchers.  Proposal 5: UE can measure one serving CC per band if multiple serving CCs are in the same band.  Proposal 6: The solution of changing CSSF allocation (statically or dynamically) among PCC/PSCC/SCC can be considered.  Proposal 7: The solution of enhanced CSSF can be applied in FR1 if applicable, after the work for FR2-1 L3 measurement delay reduction is done. |
| **[R4-2412220](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412220.zip)** | Huawei, HiSilicon | Proposal 1: L3 measurement delay reduction by optimizing CSSFoutsidegap can be applied in:   * CSSFintra for intra-frequency measurement without gap which is defined since Rel-15; * CSSFinter for inter-frequency measurement without gap (either legacy gap or NCSG). Multiple cases are included herein:   + R16 Inter-frequency measurement without gap where SSB is completely contained in active BWP;   + R17 NCSG measurement with ‘nogap-noncsg’;   + R18 NeedForGaps measurement with ‘no-gap-no-interruption’ or with “no-gap-with-interruption”, * CSSFinterRAT for inter-RAT measurement without gap if the UE indicates ‘nogap-noncsg’ via NeedForGapNCSG-InfoEUTRA for the inter-RAT measurement.   Proposal 2: L3 measurement delay reduction by optimizing CSSFoutsidegap can be applied in   * SA: FR2+FR2 CA, FR1+FR2 CA * NRDC: FR1+FR2 DC   Proposal 3: The candidate solutions of optimizing CSSF (Reducing the number of frequency layers involved in competing searchers) are network implementation.  Observation 1: In order to meet the legacy requirements for measurement within gap in FR2 and outside gap in FR1, a UE is supposed to be equipped with 3 searchers.  Proposal 4: For UE supporting per FR gap, when all MOs are to be measured outside gap, the searcher used for within gap can be leveraged for outside gap. CSSFoutsidegap can be optimized, as these MOs can share totally three searchers.  Proposal 5: We are open to further discuss the applicable condition of the three searcher solution and whether a new capability is needed.  Proposal 6: More details need to be revealed of the solution of optimizing the searcher occupancy ratio of candidate frequency layer. |
| **[R4-2412237](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412237.zip)** | Ericsson | Proposal 1: RAN4 to deprioritize ‘the case UE is capable of Rel-18 multi-Rx simultaneous reception but work in single-Rx currently’.  Proposal 2: RAN4 to study the following scenarios applying L3 measurement delay reduction by optimizing CSSF:   * SSB based Intra-frequency measurement without MG * SSB based Inter-frequency measurement without MG   Proposal 3: RAN4 further to take below scenarios into account:   * + FFS on NeedForGaps measurement without MG, including both with and without interruption   + FFS on NCSG measurement without MG without interruption   + FFS on Inter-RAT measurement without MG   Proposal 4: CSSF optimization considers the configuration below: FR2 only intra band CA, FR2 only inter band CA, FR1+FR2 CA, FR1+FR2 NR-DC, and also EN-DC or NE-DC cases.  Proposal 5: RAN4 to check contiguous and/or non-contiguous FR2 CC configuration in CSSF optimization.  Proposal 6: RAN4 to study the mechanism of CSSF optimization, indicated by NW configuration/indication, enabling/disabling measurement on particular CC(s).  Proposal 7: If UE only measures one CC (e.g., determined by either UE or NW) out of multiple CCs, regarding measurement (including reporting) configurations to the CC and other CC(s), some promising approaches to indicate the CC(s) to be measured (or not to be measured) are listed as follows:   * Option 1: NW measurement configuration only covers the CC to be measured, i.e., doesn’t cover the CC(s) not to be measured. * Option 2: NW measurement configuration covers all CC, by further (e.g. dynamical) indication,   + Option 2.1. No measurement report or measurement configuration is configured for the CC(s) which are not to be measured.   + Option 2.2: If measurement configuration is configured for the CC(s) which not to be measured, the report on the CC(s) reuses the measured result of the CC to be measured.   Proposal 8: RAN4 to clarify the scope of CSSF enhancement, e.g., the scope covers the below:   * Includes CSSF for SCCs where neighbor cell measurement isn’t required. * Doesn’t include CSSF on SCCs where neighbor cell measurement is required. * Doesn’t include CSSF on SCCs for inter-frequency without gap.   Proposal 9: CSSF enhancement also includes: prioritizing the CSSF for one or more than one CC out of multiple CCs to be measured, i.e., different CSSF inequivalently applies on different CCs.  Proposal 10: RAN4 to study the minimal CC number to apply CSSF enhancement.  Proposal 12: Regarding CSSF enhancement, below features shall be checked:   * Rel-16 NeedForGaps * Rel-17 NCSG * Rel-18 NeedForInterruption * Rel-18 Inter-RAT measurement wo MG |
| **[R4-2412257](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412257.zip)** | vivo | Propose 1: Following two cases applies:   * Case 1: UE is not capable of multiple-Rx simultaneous reception * Case 2: UE is capable of multiple-Rx simultaneous reception but the UE is not in multi-Rx operation.   Observation 1: It is a very challenged job to change the number of searchers and 3 searcher-implementation may impacts a lot of aspects of UE architecture.  Proposal 2: RAN4 to consider the SSB based intra and inter frequency measurement without MG as the scenarios to use L3 measurement delay reduction by optimizing CSSF.  Proposal 3: RAN4 to consider EN-DC, SA, NR-DC, NE-DC modes to define requirements of L3 measurement delay reduction by optimizing CSSF. |
| **[R4-2412418](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412418.zip)** | Intel Corporation | Proposal 1: RAN4 enhances the scaling factor of CSSF outside gap so that the UE is required to only measure one of the FR2 carriers and share the results among all for each band when carrying out SSB based FR2 L3 measurements.  Proposal 2: Regarding NR-DC, requirements follow CA cases.  Proposal 3: Deprioritize EN-DC scope in this work item. |
| **[R4-2412851](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412851.zip)** | Samsung | Proposal 1: Rel-19 CSSF optimization and multi-Rx simultaneous reception enhancement to L3 measurement are independent features  Proposal 2: The RRM measurement requirements of CSSF optimization shall be derived based on the assumption that UE could sweep one beam direction at any single time instance  Proposal 3: The following RRM requirements shall be studied on whether SSB based L3 measurement delay can be reduced by optimizing CSSF outside gap in CA/DC scenarios   * SSB based Intra-frequency measurement without MG. Including: TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra * SSB based Inter-frequency measurement without MG. Including: TPSS/SSS\_sync\_inter , TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter   Proposal 4: The considered BC should align to the RF BC configuration specified in 38.101-1/2/3  Proposal 5: RAN4 to consider following CA/DC mode for L3 measurement delay reduction by optimizing CSSFoutside\_gap,i:   * EN-DC: EN-DC with FR2 only intra band CA; EN-DC with FR2 only inter band CA; EN-DC with FR1 +FR2 CA (FR1 PSCell); EN-DC with FR1 +FR2 CA (FR2 PSCell) * SA: FR2 only intra band CA; FR2 only inter band CA; FR1 +FR2 CA (FR1 PCell); FR1 +FR2 CA (FR2 PCell) * NR-DC: FR1 + FR2 NR-DC (FR1 PCell and FR2 PScell) * NE-DC: NE-DC with FR2 only intra band CA; NE-DC with FR2 only inter band CA; NE-DC with FR1 +FR2 CA (FR1 PCell)   Proposal 6: If RAN4 agree to take: Optimize the CSSF by changing the searcher sharing ratio among all serving carriers as the solution to specify L3 measurement delay reduction   * RAN4 should to discuss the corresponding applicable condition and the scenario   Proposal 7: RAN4 to discuss the feasibility of reducing NSCC\_SSB to optimize the CSSF for FR2 intra-band CA |
| **[R4-2413076](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413076.zip)** | ZTE Corporation, Sanechips | Proposal 1: For the CSSF enhancement, CA, EN-DC, NE-DC and NR-DC are applicable scenarios.  Proposal 2: It should be clarified that“For UE not in multiple-Rx simultaneous reception mode” includes two cases: 1) The UE is not capable of R18 multi-Rx; 2) The UE is capable of R18 multi-Rx but work in normal mode currently.(highlight the refining part)  Proposal 3: Type 1 and Type 2 can be deemed as the starting point. |
| **[R4-2413190](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413190.zip)** | Qualcomm Incorporated | Target scenarios for FR2 CSSF enhancement  Proposal 1: RAN4 to not consider following scenarios for CSSF enhancement to reduce L3-measurement delay on FR2 neighbour cells:   * FR2 PCC-only * FR2 single SCC-only * FR2 NCC where no serving cell is configured   CSSF for outside MG in SA mode  Proposal 2: RAN4 to consider introducing a new UE optional capability regarding the number of cell search/L3-measurement engines for CSSF enhancement, with the details to be finalized (FFS). |

## Open issues summary

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

### Issue 2-1: Clarification on the bullets in WID for this CSSF optimization

|  |
| --- |
| In WID:  For UE not in multiple-Rx simultaneous reception mode:   * + - Study suitable scenarios and conditions and, if feasible, introduce methods to reduce FR2-1 L3 measurement delay by optimizing:       * CSSF outside gap in CA/DC scenarios         + Baseline assumption on number of searchers is 2   Agreement in WF R4-2406392:  Rel-19 discussion on CSSF optimization starts for the case UE is not capable of Rel-18 multi-Rx simulaeous reception, further discuss whether/how it can be applied to the case UE is capable of Rel-18 multi-Rx simulaeous reception but work in single-Rx currently. |

* Option 1 (CATT, Apple, OPPO, Xiaomi, CMCC, vivo): Rel-19 CSSF optimization applies for the both cases: (1)UE is not capable of Rel-18 multi-Rx simultaneous reception, (2)UE is capable of Rel-18 multi-Rx simultaneous reception but not work in multiple-Rx reception mode currently.
  + Option 1a (OPPO): Rel-19 CSSF optimization applies for the both cases: (1)UE is not capable of Rel-18 multi-Rx simultaneous reception, (2)UE is capable of multi-Rx but not configured with GBBR report.
  + Option 1b (ZTE): Rel-19 CSSF optimization applies for the both cases: 1) The UE is not capable of R18 multi-Rx; 2) The UE is capable of R18 multi-Rx but work in normal mode currently.(highlight the refining part)
* Option 2 (CATT): Discuss CSSF optimization independently with the UE support of multi-Rx capabilities.
* Option 3 (Apple, Nokia): Rel-19 discussion on the scenarios for CSSF optimization will be considered in CA/DC scenarios [with at least two FR2 serving cells], independently of the UE support of multi-Rx capabilities.
* Option 4 (CTC): It’s preferred to decouple Rel-19 FR2-1 L3 measurement enhancement and Rel-18 multi-Rx work item, if there is no consensus on the description that “UE is capable of Rel-18 multi-Rx simultaneous reception but work in single Rx currently”,
  + (CTC, Ericsson) it’s proposed Rel-19 discussion on CSSF optimization can be focused on the case that UE is not capable of Rel-18 multi-Rx simultaneous reception.
* Option 5(Samsung):
  + Rel-19 CSSF optimization and multi-Rx simultaneous reception enhancement to L3 measurement are independent features
  + The RRM measurement requirements of CSSF optimization shall be derived based on the assumption that UE could sweep one beam direction at any single time instance
* Recommended WF
  + Summarized all options into 3 options (a/b/c) as following for discussion. If companies cannot achieve consensus on option a/b/c, RAN4 can start work firstly with UE is not capable of Rel-18 multi-Rx simultaneous reception (option b).
  + Option a:
    - Rel-19 CSSF optimization applies for the both cases: (1)UE is not capable of Rel-18 multi-Rx simultaneous reception, (2)UE is capable of Rel-18 multi-Rx simultaneous reception but not work in multiple-Rx reception mode currently.
    - Note: if option a is agreeable, then work on wording polishing based on option 1a/1b.
  + Option b:
    - Rel-19 CSSF optimization applies for case that UE is not capable of Rel-18 multi-Rx simultaneous reception.
  + Option c:
    - Rel-19 CSSF optimization applies for CA/DC scenarios with at least two FR2 serving cells, independently of the UE support of multi-Rx capabilities.

### Issue 2-2: UE measurement procedure to use L3 measurement delay reduction by optimizing CSSF

**Proposals:** the following aspects in CA/DC to use L3 measurement delay reduction by optimizing CSSF shall be prioritized:

* + Aspect 1 (CATT, Apple, OPPO, CMCC, CTC, HW, Ericsson, vivo, Samsung, Nokia): SSB based Intra-frequency measurement without MG
    - Option 1 (CATT, Apple, Samsung, Nokia): including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra
    - Option 2 (CTC): including TPSS/SSS\_sync\_intra, TSSB\_time\_index\_intra and TSSB\_measurement\_period\_intra
    - Option 3 (HW): CSSFintra for intra-frequency measurement without gap which is defined since Rel-15
  + Aspect 2 (CATT, Apple, OPPO, CMCC, CTC, HW, Ericsson, vivo, Samsung, Nokia): SSB based Inter-frequency measurement without MG
    - Option 1 (CATT, Apple, CTC, Samsung, Nokia): including TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter
    - Option 2 (HW): CSSFinter for inter-frequency measurement without gap (either legacy gap or NCSG).
  + Aspect 3 (CATT, HW): Inter-RAT SSB measurement without MG
    - Option 1(HW): CSSFinterRAT for inter-RAT measurement without gap if the UE indicates ‘nogap-noncsg’ via NeedForGapNCSG-InfoEUTRA for the inter-RAT measurement.
    - Option 2(Ericsson): FFS on Inter-RAT measurement without MG
  + MG related features to be considered in aspect 1/2/3
    - Option 1 (CATT): The applied SSB based intra-frequency and inter-frequency measurements include the cases when:
      * UE indicates ‘nogap-noncsg’ via NeedForGapNCSG-InfoNR or,
      * UE indicates ‘no-gap’ via NeedForGapsInfoNR
    - Option 2 (CMCC): all the cases that refer to clause 9.2.5 and 9.3.9 of TS38.133 are considered
    - Option 3 (HW): Multiple cases are included herein:
      * R16 Inter-frequency measurement without gap where SSB is completely contained in active BWP;
      * R17 NCSG measurement with ‘nogap-noncsg’;
      * R18 NeedForGaps measurement with ‘no-gap-no-interruption’ or with “no-gap-with-interruption”,
    - Option 4 (Ericsson):RAN4 further to take below scenarios into account:
      * FFS on NeedForGaps measurement without MG, including both with and without interruption
      * FFS on NCSG measurement without MG without interruption
      * FFS on Inter-RAT measurement without MG
* Recommended WF
  + Moderator note: to check if following summary from Moderator can be accepted.
  + The following aspects in CA/DC to use L3 measurement delay reduction by optimizing CSSF shall be prioritized:
    - Aspect 1: SSB based Intra-frequency measurement without MG, including:
      * TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra
      * CSSFintra for intra-frequency measurement without gap which is defined since Rel-15
    - Aspect 2: SSB based Inter-frequency measurement without MG, including:
      * TPSS/SSS\_sync\_inter, TSSB\_time\_index\_inter and TSSB\_measurement\_period\_inter
      * CSSFinter for inter-frequency measurement without gap.
    - Aspect 3: Inter-RAT SSB measurement without MG, including:
      * CSSFinterRAT for inter-RAT measurement without gap if the UE indicates ‘nogap-noncsg’ via NeedForGapNCSG-InfoEUTRA for the inter-RAT measurement.
    - MG related features to be considered in aspect 1/2/3 including:
      * R16 Inter-frequency measurement without gap where SSB is completely contained in active BWP
      * R17 NCSG measurement with ‘nogap-noncsg’
      * R18 NeedForGaps measurement with ‘no-gap-no-interruption’ or with “no-gap-with-interruption”

### Issue 2-3: Applicability requirement of L3 measurement delay reduction by optimizing CSSF

* Proposal: RAN4 to consider following CA/DC mode for L3 measurement delay reduction by optimizing CSSFoutside\_gap,i
  + EN-DC (CATT, CMCC, CTC, Ericsson, vivo, ZTE, Nokia):
    - EN-DC with FR2 only intra band CA (Apple, Samsung)
    - EN-DC with FR2 only inter band CA (Apple, Samsung)
    - EN-DC with FR1 +FR2 CA (FR1 PSCell) (Apple, Samsung)
    - EN-DC with FR1 +FR2 CA (FR2 PSCell) (Apple, Samsung)
    - Intel: Deprioritize EN-DC scope in this work item
  + NE-DC (CATT, CMCC, CTC, Ericsson, vivo, ZTE):
    - NE-DC with FR2 only intra band CA (Apple, Samsung)
    - NE-DC with FR2 only inter band CA (Apple, Samsung)
    - NE-DC with FR1 +FR2 CA (FR1 PCell) (Apple, Samsung)
  + SA (CATT, Xiaomi, CMCC, CTC, vivo, Intel, ZTE, Nokia):
    - FR1+FR2 CA (FR1 PCell) (Apple, HW, Ericsson, Samsung)
    - FR1+FR2 CA (FR2 PCell) (Apple, HW, Ericsson, Samsung)
    - FR2 only intra-band CA (Apple, HW, Ericsson, Samsung)
    - FR2 only inter-band CA (Apple, HW, Ericsson, Samsung)
  + NR-DC (CATT, CMCC, CTC, vivo, Intel, ZTE)
    - FR1 + FR2 NR-DC (FR1 PCell and FR2 PScell) (Apple, HW, Ericsson, Samsung)
  + Other proposals:
    - (Samsung): The considered BC should align to the RF BC configuration specified in 38.101-1/2/3
    - (QC): RAN4 to not consider following scenarios for CSSF enhancement to reduce L3-measurement delay on FR2 neighbour cells:
      * FR2 PCC-only
      * FR2 single SCC-only
      * FR2 NCC where no serving cell is configured
    - (Ericsson): RAN4 to clarify the scope of CSSF enhancement, e.g., the scope covers the below:
      * Includes CSSF for SCCs where neighbor cell measurement isn’t required.
      * Doesn’t include CSSF on SCCs where neighbor cell measurement is required.
      * Doesn’t include CSSF on SCCs for inter-frequency without gap.
* Recommended WF
  + Moderator note: based on the tables of CSSFoutside\_gap in clause 9.1.5.1.1/2/3/4, check if following summary is agreeable or not?
    - RAN4 to consider following CA/DC mode for L3 measurement delay reduction by optimizing CSSFoutside\_gap,i
      * EN-DC
        + EN-DC with FR2 only intra band CA
        + EN-DC with FR2 only inter band CA
        + EN-DC with FR1 +FR2 CA (FR1 PSCell)
        + EN-DC with FR1 +FR2 CA (FR2 PSCell)
      * NE-DC
        + NE-DC with FR2 only intra band CA
        + NE-DC with FR2 only inter band CA
        + NE-DC with FR1 +FR2 CA (FR1 PCell)
      * SA
        + FR1+FR2 CA (FR1 PCell)
        + FR1+FR2 CA (FR2 PCell)
        + FR2 only intra-band CA
        + FR2 only inter-band CA
      * NR-DC
        + FR1 + FR2 NR-DC (FR1 PCell and FR2 PScell)

### Issue 2-4: Searcher assumption to apply L3 measurement delay reduction by optimizing CSSF

|  |
| --- |
| In WID:  For UE not in multiple-Rx simultaneous reception mode:   * + - Study suitable scenarios and conditions and, if feasible, introduce methods to reduce FR2-1 L3 measurement delay by optimizing:       * CSSF outside gap in CA/DC scenarios         + Baseline assumption on number of searchers is 2 |

* Option 1 (CATT): Not to preclude the solutions based on 3 searchers assumption in current stage.
  + Option 1a (CMCC, HW): it is proposed to consider both the CSSF optimization based on 2 searchers and the CSSF optimization based on 3 searchers.
  + Option 1b (QC): RAN4 to consider introducing a new UE optional capability regarding the number of cell search/L3-measurement engines for CSSF enhancement, with the details to be finalized (FFS).
* Option 2 (Apple, CTC, Nokia, Ericsson): RAN4 only consider the enhancement based on 2 searchers, i.e., same as previous release, for L3 measurement delay reduction by optimizing CSSF.
  + Option 2a (Apple): If companies cannot achieve consensus, RAN4 work can start with the baseline assumption in WID, i.e., 2 searchers.
  + Option 2b (Nokia) RAN4 to confirm if one of the searchers is assumed for PCC/PSCC measurement and the other is assumed for the measurements on all SCCs.
* Recommended WF
  + Moderator note: check if following can be agreeable:
    - RAN4 work can start with the baseline assumption in WID, i.e., 2 searchers.
    - The 3 searcher based solution can be FFS after concluding the baseline above. The 3 searcher related discussion will NOT delay the WI completion.

### Issue 2-5: Solutions to apply/specify L3 measurement delay reduction by optimizing CSSF outside gap in CA/DC

* Option 1 (Apple, CTC. Ericsson, Intel, Samsung, ZTE): UE only needs to measure one serving CC per band if multiple serving CCs are in the same band
  + Option 1a (Apple): details of option 1 is:
    - If PCC in the band, measure PCC
    - Otherwise if PSCC in the band, measure PSCC
    - Otherwise if SCC is in the band, measure the SCC with neighbor cell MO
    - Otherwise up to UE implementation
  + Option 1b (Ericsson):
    - Option 1b-1: NW measurement configuration only covers the CC to be measured, i.e., doesn’t cover the CC(s) not to be measured.
    - Option 1b-2: NW measurement configuration covers all CC, by further (e.g. dynamical) indication,
      * Option 1b-2.1. No measurement report or measurement configuration is configured for the CC(s) which are not to be measured.
      * Option 1b-2.2: If measurement configuration is configured for the CC(s) which not to be measured, the report on the CC(s) reuses the measured result of the CC to be measured.
  + Option 1c (Samsung): RAN4 to discuss the feasibility of reducing NSCC\_SSB to optimize the CSSF for FR2 intra-band CA
  + Option 1d (opponent proposal from HW, Nokia): The candidate solutions of optimizing CSSF (Reducing the number of frequency layers involved in competing searchers) are network implementation.
    - (Nokia) The CSSF values shall be derived based on network configuration instead of UE implementation.
* Option 2 (CATT, Apple, CTC, ZTE): UE can change the searcher occupancy ratio of PCC or PSCC measurement to speed up SCC measurement for some conditions
  + RAN4 should to discuss the corresponding applicable condition and the scenario. (Samsung, Apple)
  + More details need to be revealed of the solution of optimizing the searcher occupancy ratio of candidate frequency layer. (HW)
* Option 3 (Apple, Nokia):
  + To consider the CSSF optimization by minimizing the impact from CSI-RS based measurements on SSB-based measurements.
* Option 4 (CATT, HW):
  + For UE supporting per FR gap, when all MOs are to be measured outside gap, the searcher used for within gap can be leveraged for outside gap. CSSFoutsidegap can be optimized, as these MOs can share totally three searchers. (HW, CATT)
  + We are open to further discuss the applicable condition of the three searcher solution and whether a new capability is needed. (HW)
* Option 5 (Ericsson):
  + RAN4 to check contiguous and/or non-contiguous FR2 CC configuration in CSSF optimization
  + RAN4 to study the mechanism of CSSF optimization, indicated by NW configuration/indication, enabling/disabling measurement on particular CC(s).
  + CSSF enhancement also includes: prioritizing the CSSF for one or more than one CC out of multiple CCs to be measured, i.e., different CSSF inequivalently applies on different CCs.
  + RAN4 to study the minimal CC number to apply CSSF enhancement.
* Option 6 (Nokia): RAN4 to define optimized CSSF assuming the UE is able to sample SSBs simultaneously from multiple CCs and process these SSB samples offline.
  + UE is able to receive SSBs (i.e. get SSB samplings) from multiple configured CCs at the same time e.g. within one SMTC window.
* Recommended WF
  + Moderator note:
    - Discussion focuses on option 1/2/4 with the most supporting companies.
    - If issue 2-4 concluded on 3 searchers, then 3 searchers based solution can also be discussed.

### Issue 2-6: feature capability of L3 measurement delay reduction by optimizing CSSF

* Option 1 (Apple, Nokia): RAN4 to introduce a new individual capability for CSSF reduction in R19.
  + Option 1a(Nokia):The reduced CSSF shall be applied to the UE supporting the capability and starting from R19
* Option 2 (CATT, Apple): delay the capability discussion to the end of the core part.
* Recommended WF
  + Moderator note:
    - Tentative agreement: delay the capability discussion to the end of the core part (after solution(s) are concluded).

### Issue 2-7: Other WID scope discussion

* Proposal 1(CMCC, CTC): after FR2-1 L3 measurement delay reduction by optimizing CSSF is concluded, the technical solutions can be extended to FR1 if applicable.
* Recommended WF
  + [Moderator note]: Please companies to check if proposal 1 is out of current WID scope and need RAN plenary discussion for WID revision?

### Issue 2-8: whether and/or which previous release feature shall also be considered in “ FR2-1 L3 measurement delay by optimizing CSSF outside gap in CA/DC”

* Option 1 (Apple):
  + RAN4 not to consider SSB based L3 measurement delay enhancement with previous release features, only except R16 inter-frequency measurement without MG and R18 inter-RAT measurement without MG for CSSF enhancement.
* Option 2 (Ericsson): Regarding CSSF enhancement, below features shall be checked:
  + Rel-16 NeedForGaps
  + Rel-17 NCSG
  + Rel-18 NeedForInterruption
  + Rel-18 Inter-RAT measurement wo MG
* Recommended WF
  + Moderator: Discuss this issue together with issue 2-2

# Annex (agreements from previous meetings)

## RAN4#110bis, April 2024

R4-2404841 Topic summary for [110bis][230]

R4-2406392 WF for [110bis][230]

**Issue 1-1: Work plan for NR\_RRM\_Ph5 WI**

* Work plan for whole WI in R4-2404368.

Agreement: The content of the work plan is agreeable.

**Issue 2-2-1: Clarification on the bullets in WID for this CSSF optimization**

Agreement:

Rel-19 discussion on CSSF optimization starts for the case UE is not capable of Rel-18 multi-Rx simulaeous reception, further discuss whether/how it can be applied to the case UE is capable of Rel-18 multi-Rx simulaeous reception but work in single-Rx currently.

**Issue 2-2-2: UE measurement procedure to use L3 measurement delay reduction by optimizing CSSF**

Agreement:

* + Only consider CSSF outside MG case.

Proposal for further discussion:

* + Scenarios to use L3 measurement delay reduction by optimizing CSSF:
    - SSB based Intra-frequency measurement without MG, including TPSS/SSS\_sync\_intra and TSSB\_measurement\_period\_intra
    - SSB based Inter-frequency measurement without MG, including TPSS/SSS\_sync\_inter and TSSB\_measurement\_period\_inter

## RAN4#111, May 2024

R4-2408025 Topic summary for [111][228]

R4-2410260 Way Forward for [111][228] NR\_RRM\_Ph5

**Issue 2-1-1: Applicability requirement of L3 measurement delay reduction by optimizing Rx BSF**

**Applicability requirement:**

Agreement:

Baseline: L3 delay enhancements in Rel-19 by optimizing Rx BSF for UE supporting multi-rx simultaneous reception are applicable provided that:

* the target carrier(s) to be measured: only one carrier in the single FR2-1 band is configured for L3 SSB measurement and
* UE serving carrier(s): UE is configured with single carrier on FR2-1 band, i.e. FR2-1 PCell without CA/DC.

Note: The ‘other UE CA/DC modes (e.g., 1 or 2 FR2-1 bands CA, or FR1+FR2 CA/DC, or EN-DC)’ and/or the ‘other number of target to-be-measured carrier(s) on FR2-1 band’ can be FFS after concluding the baseline above. These extra FFS parts will NOT delay the WI completion.

**Issue 2-1-2: Conditions to apply L3 measurement delay reduction by optimizing Rx BSF**

* + **FFS: UE is in RRC CONNECTED**
* Agreement: Only support multi-Rx L3 measurement for CONNECTED UE

**Issue 2-1-5: measurement performance requirement when apply L3 measurement delay reduction by optimizing Rx BSF**

* Agreement:
  + RAN4 is not to change existing measurement performance requirement when consider optimization of Rx BSF in L3 measurement delay reduction.

**Issue 2-2-6: measurement performance requirement when apply L3 measurement delay reduction by optimizing CSSF**

* Agreement:
  + RAN4 is not to change existing measurement performance requirement when consider optimization of CSSF in L3 measurement delay reduction.