3GPP TSG-RAN WG4 Meeting #112 R4-24xxxxx

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

**Agenda item:** 8.15.4

**Source:** Moderator (Apple)

**Title:** AdHoc minutes for [112][218][219]

**Document for:** Approval

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

**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**

Agreement in online session:

* + - 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.

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

Agreement in online session:

* + - * 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**

[Discussion]:

* + - Option A/1a: Two searchers are occupied by this single carrier to the requirements of enhanced BSF for single carrier. Discuss CA case later. (E/// - with condition, HW, Apple, CATT, Xiaomi, OPPO, LGE)
    - Option B: Consider one searcher for single carrier. (E///, QC, Apple, vivo, Nokia, MTK, ZTE, OPPO)

**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):

|  |
| --- |
| 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.

[Discussion]:

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.

[Discussion]:

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.

[Discussion]:

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

[Discussion]:

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.

[Discussion]: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.

[Discussion]:

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**

**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.

**[Discussion]**

* + 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.

[Discussion]:

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.

[Discussion]:

* + 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.
* [Discussion]
  + 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.
* [Discussion]
  + discuss option 1 and 2.

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

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

* 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
* [Discussion]
  + Option a (ZTE, CMCC, Intel, CATT, MTK):
    - 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 (HW, MTK, Samsung, E///):
    - Rel-19 CSSF optimization applies for case that UE is not capable of Rel-18 multi-Rx simultaneous reception.
  + Option c (Apple, Nokia, QC):
    - 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.
  + Option d (newly added):
    - Rel-19 CSSF optimization applies for the both cases: (1)UE is not capable of Rel-18 and Rel-19 multi-Rx simultaneous reception, (2)UE is capable of Rel-18 or Rel-19 multi-Rx simultaneous reception but not work in multiple-Rx reception mode currently.

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

Agreement in online session:

* + The following aspects in CA/DC to use L3 measurement delay reduction by optimizing CSSF shall be discussed, and further prioritization among the 3 aspects can be discussed in future meeting:
    - 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.
* Discussion
  + 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.

Discussion

* + 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.

Discussion:

* + - 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.
* 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 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
* 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)

### 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.

Discussion

* + 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.

Discussion

* + [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

Discussion

* + Moderator: Discuss this issue together with issue 2-2

# Topic #3: Fast SCell activation for UE supporting Rel-18 EMR (8.15.3)

**Issue 1-1-1: Clarification on Rel-18 eEMR**

Agreement in online session:

* + - Do not change the Rel-18 eEMR definition in this fast SCell activation discussion

**Issue 1-1-2: Applicability of fast SCell activation delay requirements**

Agreement in online session:

* + - The fast SCell activation delay requirements are defined for the case when
      * the UE supports Rel-18 eEMR:
        + Including both EMR and cell reselection measurement,
        + Including the case when *measIdleValidityDuration-r18* and / or *measReselectionValidityDuration-r18* are configured
        + FFS Including the case when *measIdleValidityDuration-r18* and / or *measReselectionValidityDuration-r18* are not configured
      * and the UE has reported valid results on the SCell to be activated before SCell activation command.

**Issue 1-1-3: Scope of fast SCell activation for UE supporting Rel-18 eEMR**

* Proposals
  + Option 1: (CATT)
    - RAN4 to discuss the fast SCell activation delay with valid EMR reporting using Rel-15 SCell activation as baseline.
  + Option 2: (Samsung)
    - The scope of fast SCell activation for UE supporting Rel-18 EMR can contain normal SCell activation and direct SCell activation, the impact on the following RRM requirements can be studied as the highest priority:
      * 8.3.2 SCell Activation Delay Requirement for Deactivated SCell
      * 8.3.4 Direct SCell Activation at SCell addition
  + Option 3: (MTK)
    - Fast SCell activation using Rel-18 EMR is applicable to normal SCell activation (triggered by MAC CE command) and direct SCell activation (triggered by RRC command).
  + Option 4: (Ericsson)
    - Both Rel-17 fast Scell activation and Rel-18 Scell activation delay reduction shall be considered as the baseline scenario for this Rel-19 RRM enhancement.

Discussion

* + The scope of fast SCell activation for UE supporting Rel-18 EMR includes:
    - Single MAC CE based DL SCell and PUCCH SCell Activation
    - Direct SCell Activation at SCell addition
  + FFS other SCell activation procedures

**Issue 1-2-1: How to define the fast SCell activation delay requirements with valid eEMR reporting**

* Proposals
  + Option 1: (CATT, CMCC)
    - if UE send valid EMR report during a period before the reception of the SCell activation command, the SCell to be activated can be considered as known, and the activation delay requirements for known SCell can be applied.
    - RAN4 to update the known condition for SCell activation to include the case when UE has valid EMR reporting before SCell activation command.
  + Option 2: (Apple)
    - the current side condition and delay requirement for FR1 known SCell activation shall be updated to cover the fast SCell activation with EMR.
    - the current side condition and delay requirement for FR2 known SCell activation can cover the fast SCell activation with EMR. Potential clarification can only focus on the issue in proposal 1(issue 1-2-2).
  + Option 3: (MTK)
    - If the introduced conditions in RAN4 for fast SCell activation using R18 EMR are met, then the unknow SCell can be activated by applying the activation delay used for the known SCell scenario.
  + Option 4: (Huawei)
    - For the fast SCell activation for UE supporting Rel-18 EMR, the baseline solution to be defined is to extend the known condition for SCell activation considering the valid L3-RSRP measurement report via EMR report.

Discussion

* + if UE send valid EMR report during a period before the reception of the SCell activation command, the SCell to be activated can be considered as known, and the activation delay requirements for known SCell can be applied.
  + RAN4 to update the known condition for SCell activation to include the case when UE has valid EMR reporting before SCell activation command.
    - FFS how to update the known condition (issue 1-2-1a).

**Issue 1-2-1a: How to update the known condition with consideration of valid eEMR reporting**

* Proposals
  + Option 1: (Apple)
    - the current side condition and delay requirement for FR1 known SCell activation shall be updated to cover the fast SCell activation with EMR, as following:
      * The side condition that “the SSB measured during the period equal to max(5\*measCycleSCell, 5\*DRX cycles) also remains detectable during the SCell activation delay” shall be changed to “the SSB measured during the period equal to measurement period in IDLE/Inactive mode for EMR report also remains detectable during the SCell activation delay”, and the “measurement period in IDLE/Inactive mode” refers to:
        + measurement period in section 4.4.2.2, if a UE supporting measValidationReportEMR-r18 and configured with measIdleCarrierListNR-r16 by higher layers.
        + measurement period in section 4.2.2.4, if UE supporting measValidationReportReselectionMeasurements-r18 and idleInactiveNR-MeasReport-r16.
      * The update of FR1 known SCell activation delay requirement shall be based on the solution for issue in proposal 2 (issue 1-2-3).
  + Option 2: (CMCC)
    - If the common understanding is that existing definition of known SCell cannot cover the case of valid EMR report, it is necessary to update the definition of known SCell to cover it. And the known cell definition can be updated as following:
      * **For FR1:**
        + - the UE has sent a valid measurement report/ valid EMR report for the SCell being activated and …
      * **For FR2:**
        + - the UE has sent a valid L3-RSRP measurement report with SSB index / valid EMR report with SSB index, and …
  + Option 3: (vivo)
    - RAN4 to discuss how to define known condition with consideration of valid EMR reporting, the following Options can be considered:
      * Option 3a: The SCell to-be-activated can be regarded as known cell when the UE has sent a valid measurement report of the SCell being activated during IDLE/INACTIVE state for fast CA/DC setup
      * Option 3b: The SCell to-be-activated can be regarded as known cell when valid measurement report is sent within [Z] seconds before SCell activation command reception
  + Option 4: (Huawei)
    - Based existing known conditions, the condition that “UE has sent a valid L3-RSRP measurement report” shall include the report from EMR. RAN4 to define the conditions/definition of “valid L3-RSRP measurement report via EMR”.
    - RAN4 to discuss whether and how to define conditions for valid L3-RSRP EMR report for known SCell activation consider following options:
      * Option 4a: UE support Rel-19 EMR based known SCell activation, it means all EMR report shall also guarantee known SCell activation.
      * Option 4b: RAN4 to define a condition/limit that measurement performed X seconds before SCell activation is considered as valid for known SCell activation conditions.
      * Option 4c: Introduce new dedicated EMR based SCell activation indication
  + Option 5: (MTK)
    - The applicability of Rel-18 EMR reporting for SCell activation delay reduction can be based on the following conditions:
      * Rel-18 EMR of the SCell-to-be-activated is sent within [Y] time window before the reception of the SCell activation command.
      * The SSB measured of the SCell-to-be-activated remains detectable during [Y]
      * FFS [Y]
* Recommended WF
  + Discuss the option 1 and 4; and after we have baseline conclusions we can add more details based on other options.