**3GPP TSG-RAN WG4 Meeting # 101bis-e R4-2202726**

**Electronic Meeting, 17 – 25 Jan, 2022**

**Agenda item:** 6.11.1 and 6.11.2.2

**Source:** Moderator (MediaTek inc.)

**Title:** Email discussion summary for [101bis-e][209] NR\_MG\_enh\_1

**Document for:** Information

# Introduction

This document is the email discussion summary for [101bis-e][209] NR\_MG\_enh\_1 with the following topics covered

* Topic 1: General (AI 6.11.1)
* Topic 2: Multiple concurrent and independent MG patterns (AI 6.11.2.2)
  + **UE feature list will be discussed in Sub-topic 2-2.**

List of candidate target of email discussion for 1st round and 2nd round

* 1st round: Collect views from companies. Make early decision on issues with clear consensus. Decide on the scope, priority, options and tentative agreement to be discussed in the 2nd round.
* 2nd round:
  + Conclude the issues identified in the 1st round.
  + Revise and endorse draft CRs

# Topic #1: General (AI 6.11.1)

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2200486 | MediaTek Inc | **Proposal 1: Introduce separate UE capabilities of network-controlled and UE autonomous mechanism for preconfigured measurement gap activation and deactivation.**  **Proposal 2: Introduce a UE baseline capability of concurrent gap and conclude the following issues with potential UE capability impact: max number of gaps for per-FR capable UE, E-UTRAN only measurement, overhead cap and gap sharing ratios.**  **Proposal 3: Introduce a UE baseline capability of NCSG and the UE capability to indicate the supported NCSG patterns.**  Moderator: According to session chair’s guidance, the proposals will be handled by individual Email threads. Proposal 2 will be discussed under **Issue2 -2-3** for UE capability |
| R4-2200599 | ZTE | Moderator: This document is for pre-MG and will be handled in thread [101bis-e][210] NR\_MG\_enh\_2 |

## Open issues summary

### Sub-topic 1-1: General isues

Moderator: all issues are moved to other Email threads or other section.

## Companies views’ collection for 1st round

### Open issues

Moderator: Companies’ views are collected in previous section together with the list of issues

### CRs/TPs comments collection

No CR/TP submitted in this agenda

## Summary for 1st round

### Open issues

### CRs/TPs

No CR/TP submitted in this agenda

## Discussion on 2nd round (if applicable)

No 2nd round discussion in this section

# Topic #2: Multiple concurrent and independent MG patterns (AI 6.11.2.2)

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc #** | **Company** | **Proposals / Observations** |
| R4-2200113 | CATT | Proposal 1: Concurrent gaps are allowed in the case when only non-NR RAT measurement objectives are configured.  Proposal 2: When UE supports per-FR gap, allow simultaneous configuring per-UE gap and per-FR gap.  Proposal 3: The max number of supported concurrent gaps across all FRs for per-FR gap capable UE is 4.  Proposal 4: The following combinations of gap configuration for per-FR gap capable UE should be supported:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Index | # of simultaneous MG | | | RAN4 conclusion | | Per-FR1 | Per-FR2 | Per-UE | | 3 | 1 | 0 | 1 | Supported | | 4 | 0 | 1 | 1 | Supported | | 5 | 1 | 1 | 1 | Supported | | 6 | 2 | 2 | 0 | Supported |   Proposal 5: For colliding (overlapping) condition#2 for concurrent gap, X=1ms for both FR1 and FR2.  Proposal 6: For UE behavior during colliding gap occasion, support option 5 (i.e. introduce gap sharing rule and only sharing factor 0% and 100% are considered in R17).  Proposal 7: The data can be scheduled on the non-overlapped part in the dropped gap occasion.  Proposal 8: Support to introduce FO, FPO, PFO, PPO scenarios.  Proposal 9: Not to define overhead cap for concurrent gap.  Proposal 10: For the measurement without gap, the following principles apply:   * Case 1: All SMTC occasions are non-overlapped with any of the 2 MGs,   + The current measurement requirements without gap with CSSFoutside\_gap,i apply. * Case 2: All SMTC occasions are fully-overlapped with one of the 2 MGs (including both MGs),   + For non-overlapping case of concurrent gap, the current measurement requirements without gap with CSSFwithin\_gap,i apply, the CSSFwithin\_gap,i is based on the gap that fully-overlapped with SMTC.   + For overlapping case of concurrent gap, the current measurement requirements without gap with CSSFoutside\_gap,i apply if SMTC is fully overlapped with the dropped gap, and the current measurement requirements without gap with CSSFwithin\_gap,i apply if it is overlapped with the prioritized gap in which the CSSFwithin\_gap,i is based on the prioritized gap. * Case 3: Some SMTC occasions are non-overlapped with MGs and some are not   + The measurement requirements are based on the number of SMTC occasions that non-overlapped with MG and the number of SMTC occasions that overlapped with MG.   Proposal 11: For the measurement within gap, the current measurement requirements within gap apply in which the CSSFwithin\_gap,i is based on the associated MG. |
| R4-2200114 | CATT | Proposal 1: Confirm to RAN2 that the understanding in the LS is correct.  Proposal 2: Rel-17 concurrent gaps cannot be configured together with legacy gap.  Proposal 3: If UE doesn’t support per-FR gap, at most 2 per-UE gaps can be configured. If UE support per-FR gap, at most 2 gaps can be configured in each FR.  Proposal 4: Concurrent gaps can be configured with different types and at most 4 gaps can be configured across all FRs.  Proposal 5: The legacy gap sharing configuration is still applicable for each gap of the concurrent gaps.  Proposal 6: From RAN4 perspective, the measurement requirements on NR and EUTRAN will be prioritized. Whether to support gap association to 2G/3G from signalling perspective is up to RAN2. |
| R4-2200115 | CATT | Draft CR on measurement delay requirements for concurrent MG patterns |
| R4-2200242 | Apple | Proposal 1: not allow concurrent gap in the case when only non-NR RAT measurement objectives are configured. This can be handled by simply adding clarification in CSSF session in RAN4 spec.  Proposal 2: Simultaneous configuring per-UE gap and per-FR gap is only allowed when the per-UE gap is associated to PRS measurement.  Proposal 3: Max number of concurrent gap across all FRs for per-FR gap capable Ues (without considering MU-SIM and NTN):   * Option 1: 3 * Option 2: Up to UE capability   Proposal 4: gap in proximity condition for overlapping is 4ms for both FR1 and FR2.  Proposal 5: Introduce gap sharing rule:   * Request RAN2 to reserve some RRC signaling for different sharing factors.   + The signalling design may consider the possibility of resuming data scheduling on dropped gaps * Rel-17 requirements will only consider sharing ratios 0% and 100%.   Proposal 6: it is necessary to introduce an overhead cap for concurrent gaps. RAN4 can introduce a UE capability indicating the supported maximum overhead.  Proposal 7: to define overhead cap, the following option 1 is preferred and option 3 is also acceptable:   * Option 1: The max overhead that UE can support in Rel-15/16. * Option 2:   + N : number of multiple MG patterns   + MGLr : MGL of referenced MG   + MGRPr : MGRP * Option 3: When concurrent MGs are configured, the MGRP for each MG cannot be smaller than 40ms   Proposal 8: for the open issue Issue 2-7-2: UE measurement behavior after transition in the last meeting, option 1 is not supported.   * Option 1:   + The UE will continue and complete the ongoing measurement on MO1 using MGP1 and meet the corresponding measurement requirement based on MGP1 during this measurement period even if the MO1 is reconfigured to be measured using MGP2.   + UE will perform the measurement on MO2 using MGP2 immediately after the concurrent gaps reconfiguration, if MO2 can’t be measured by MGP1 due to gap offset or if gap length is not enough.   + After one of concurrent gaps deconfiguration, data scheduling is expected on this disabled MG’s time occasions. * Option 2:   + FFS whether/how to define UE measurement behaviour after transition.   Proposal 9: RAN4 response to RAN2 LS:   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | (Moderator: Skip some text from RAN2 LS)  [RAN4]: RAN4 confirms all above understanding is correct. Note that RAN4 may not define RRM requirements for yellow (since R16), even though it can be supported from RRC configuration point of view.  Yellow: It is possible to have Multiple MOs including CSI-RS resources with same center frequency  [RAN4 answer to Q1]: Yes. However, from RAN4 perspective, it is important for NW and UE to have same understanding on which MG pattern to use for each MO. Therefore, for the MOs for which NW doesn’t provide the association, UE shall conduct measurement using the legacy MG.  [RAN4 answer to Q2]:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Index | # of simultaneous MG | | | RAN4 conclusion | | Per-FR1 | Per-FR2 | Per-UE | | 0 | 2 | 1 | 0 | Supported | | 1 | 1 | 2 | 0 | Supported | | 2 | 0 | 0 | 2 | Supported | | 3 | 1 | 0 | 1 | FFS | | 4 | 0 | 1 | 1 | FFS | | 5 | 1 | 1 | 1 | FFS | | 6 | 2 | 2 | 0 | FFS | | 7 | 0 | 0 | 1 | Supported | | 8 | 1 | 1 | 0 | Supported | | 9 | 1 | 0 | 0 | Supported | | 10 | 0 | 1 | 0 | Supported | | 11 | 2 | 0 | 0 | Supported | | 12 | 0 | 2 | 0 | Supported |   [RAN4 answer to Q3]: same as above.  [RAN4 answer to Q4]: from flexibility perspective, it is beneficial to allow separate *MeasGapSharingConfig* for each MG pattern. This is feasible from RAN4 point of view, since both NW and UE know the category and which MG pattern to use for each MO.  [RAN4 answer to Q5]: RAN4 agreed to leave it up to RAN2:   * Agreement in RAN4:   + RAN4 to focus on NR and EUTRAN measurement requirements with concurrent gaps before considering 2G/3G.     - It is up to RAN2 to decide whether to support gap association to 2G/3G from signalling perspective     - Note: The understanding of “2G/3G is not supported with concurrent gap” is that UE expects network to configure only one MG if any 2G/3G measurements are configured, regardless whether NR or EUTRAN measurements are configured. | |
| R4-2200243 | Apple | CR on CSSF for concurrent gaps |
| R4-2200388 | vivo | Proposal 1: Whether concurrent gaps are allowed in the case when only E-UTRAN measurement objectives are configured depends on UE capability, i.e., option 4.  Proposal 2: Use option 2a for whether allow simultaneous configuring per-UE gap and per-FR gap for per-FR gap capable UEs issue. If option 2a is not agreeable we prefer option 1.  Proposal 3: For the scenario where only per-FR is configured, the max number of gaps across all FRs could be 4.  Proposal 4: Consider both option 1 and option 5 for UE behavior during colliding gap occasion.  Proposal 5: For the FO case, support option 1, i.e., defining requirements, at least for the right hand side scenario in the figure. FPO, PFO, PPO should be introduced.  Proposal 6: Suggest to define the overhead cap, i.e., option 1. Ok with option 3. For the method on how to define the overhead cap, in principle Rel-15/16 max overhead can be used, i.e., option 1.  Proposal 7: for the delay requirement outside gap, principle for L1 measurement could be reused.  Proposal 8: Suggest to define multiple CSSFinter,i, i.e., from CSSFinter,1 to CSSFinter, N where *N* is the total number of concurrent gaps allocated per UE or per FR.  Proposal 9: The measurement delay requirements of a particular MO could be based on the new introduced CSSFinter,i and the legacy framework where MGRP, SMTC period, DRX cycle are jointly considered. Whether the MGRP here is impacted by the overlapping issue could be FFS.  Proposal 10: Investigate how to define a suitable MGRP when multiple measurement gaps are configured for related measurement performance requirements such as RLM.  Proposal 11: suggest to consider the following answers for the LS from RAN2:  Answers for Q1: RAN4 does not identify the necessity where concurrent gaps are configured together with a legacy gap.  Answers for Q2: For the max number of concurrent gap across all FRs for per-FR gap capable UEs, the total number of concurrent gaps are [4].  Answers for Q3: The only case identified by RAN4 where concurrent gaps are configured with different gap types is when simultaneous configuring per-UE gap and per-FR gap is only allowed when the per-UE gap is associated to PRS measurement.  Answers for Q4: The legacy gap sharing configuration (configured in *MeasGapSharingConfig*) is applicable to each individual gap among Rel-17 concurrent gaps. For each individual gap among concurrent gaps, the principles on how gap sharing configuration works should follow the legacy principles defined in Rel-15/16.  Answers for Q5: RAN4 clarifies that UTRAN-FDD measurement (configured in *MeasObjectUTRA-FDD*) is not applicable in concurrent gap operation. |
| R4-2200404 | vivo | Draft CR on inter-RAT measurement requirements with concurrent gaps |
| R4-2200489 | MediaTek inc. | Proposal 1: No limitation to concurrent gap in the case when only E-UTRAN measurement objectives are configured.  Proposal 2: For per-FR gap capable UE, simultaneous configuring per-UE gap and per-FR gap is only allowed when the per-UE gap is associated to PRS measurement.  Proposal 3: Without considering other WIs, the max # of gap to be supported across all FRs for per-FR gap capable UEs is up to UE’s capability. The value is either 3 or 4.  Proposal 4: Two measurement gap occasions are defined as colliding, if the minimal distance between the two gap instances is equal or less to X, where X = 4ms in FR1 and 1ms in FR2.  Proposal 5: On UE behavior during colliding gap occasion, adopt Option 5 to move forward. FFS whether to introduce a UE capability to indicate whether UE supports only 0% and 100% gap sharing ratios or UE supports arbitrary configured sharing ratios.  Proposal 6: For per-UE gap case, one gap sharing ratio can be defined between the 2 per-UE gaps. For per-FR gap case, 2 gap sharing ratios can be configured for FR1 and FR2, respectively.  Proposal 7: Resume data scheduling on the dropped gap occasions. FFS the impact to the delay requirements of intra-frequency measurements and L1 measurements.  Proposal 8: Send an LS to RAN2 with the suggested gap sharing ratios 0%, 25%, 50%, 75% and 100%.  Proposal 9: The baseline UE supports the overhead cap no larger than the max overhead that it can support in Rel-15/16. An advanced UE capability can be added for the UE which does not need this overhead cap.  Proposal 10: The definitions for the applicable measurement types specified in Section 9.1.5.1 for CSSF outside gap can be re-used as a starting point with the modification to consider more than 1 measurement gaps.  Proposal 11: The Kp value for the frequency layers to be measured outside gap is defined as Kp = Noriginal / Nremaining, where   * Noriginal is the number of original SMTC occasions without considering gap within a [160ms] window. * Nremaining is the number of remaining SMTC occasions not collided with measurement gap within a [160ms] window * The [160ms] window starts from the beginning of a SMTC occasion of the target frequency   Proposal 12: The definitions for the applicable measurement types specified in Section 9.1.5.2 for CSSF within gap can be re-used as a starting point with the modification to indicate which measurement gap to be considered when calculating the CSSF value of a particular frequency layer.  Proposal 13: In the delay requirements of measurements within gap, indicate which MGRP to be selected between 2 configured measurement gaps.  Proposal 14: Introduce the Kp value to address the issue of dropped gap occasions due to gap collision. The Kp value for the frequency layers to be measured within gap is defined as Kp = Noriginal / Nremaining, where   * Noriginal is the number of original associated gap occasions covering the target SMTC without considering the other measurement gaps within a [160ms] window * Nremaining is the number of remaining associated gap occasions covering the target SMTC by removing the dropped gap occasions within a [160ms] window * The [160ms] window starts from the beginning of an associated gap occasion covering the SMTC occasion of the target frequency   Proposal 15: When there are still some L1 RS occasions not overlapped by measurement gaps and intra-frequency SMTC in FR2, the P factor for L1 measurements equals Noriginal / Nremaining, where   * Noriginal is the number of original RS occasions without considering measurement gaps nor intra-frequency SMTC occasions within a [160ms] window. * Nremaining is the number of remaining RS occasions not fully nor partially collided with measurement gap or intra-frequency SMTC occasions within a [160ms] window * The [160ms] window starts from the beginning of a slot with the target RS occasion   Proposal 16: In FR1 or when there are no L1 RS occasions not overlapped by measurement gaps and intra-frequency SMTC in FR2, the P factor for L1 measurements equals Psharing factor x Noriginal / Nremaining, where   * Noriginal is the number of original RS occasions without considering measurement gaps nor intra-frequency SMTC occasions within a [160ms] window. * Nremaining is the number of remaining RS occasions not fully nor partially collided with measurement gap within a [160ms] window * The [160ms] window starts from the beginning of a slot with the target RS occasion   Proposal 17: Reply to RAN2 that RAN2’s agreement about the concurrent gap operation and the clarification on frequency layer (and its limitations) aligns with RAN4 understanding  Proposal 18: Reply to RAN2 with the answer to Q1 that it is up to RAN2 decision if associations are provided to all gaps.  Proposal 19: Reply to RAN2 with the answer to Q2 that Up to 2 gaps can be configured to UE which does not support per-FR gap. Regarding per-FR gap capable UE, RAN4 can reply to RAN2 once the consensus is reached.  Proposal 20: Reply to RAN2 with the answer to Q3 that it is still under discussion in RAN4. RAN4 can reply to RAN2 once the consensus is reached  Proposal 21: Reply to RAN2 with the answer to Q4 that t MeasGapSharingConfig is applicable to Rel-17 concurrent gaps. Same configuration can be shared by all concurrent gaps.  Proposal 22: Reply to RAN2 with the answer to Q5 that it is already addressed in RAN4’s previous LS R4-2120304. |
| R4-2200490 | MediaTek inc. | Draft CR on 38.133 for L1 measurement impact of concurrent gaps |
| R4-2200538 | Intel Corporation | Proposal 1: Simultaneous configuration of per-UE gap and per-FR gap to FR gap capable UEs shall be allowed if UE support the concurrent gaps.  Proposal 2: The maximum number of supported concurrent gaps across all FRs can be 3.  Proposal 3: No need to define the gap overhead cap.  Proposal 4: The minimal distance between two gap instances is equal or less to 4ms for both FR1 and FR2.  Proposal 5: Introduce gap sharing rule to handle the overlapping issues in case of concurrent gaps.  Proposal 6: RAN4 can define the requirements for PPO only with the different gap sharing factor  Proposal 7: No need to define the new UE measurement behavior after transition when UE’s new MG instance configured.  Proposal 8: The measurement delay requirement in case of multiple gaps shall be revisited. The non-overlapping scenarios can be studied as a start point. |
| R4-2200560 | LG Electronics | Proposal 1: Do not define simultaneous configurations of per-UE gap and per-FR gap for UE supporting per-FR gap in Rel-17.  Proposal 2: For minimum distance between two GPs of proximity condition #2, X = 1 or 4ms for both FR1 and FR2.  Proposal 3: Decide one option between the updated 2 options.   * Option 1   + UE will only do the measurement w.r.t. the gap with higher priority on all colliding occasions   + The priority can be configurable or fixed   + Data scheduling is resumed during dropped gap occasions * Option 5: Compromised proposal   + Introduce gap sharing rule.     - Request RAN2 to reserve some RRC signaling for different sharing factors.       * The signaling design may consider the possibility of resuming data scheduling on dropped gaps     - Rel-17 requirements will only consider sharing ratios 0% and 100%.       * The sharing ratios can be configurable or fixed.     - The requirements for other sharing factors are FFS in later releases.     - Data scheduling is assumed on those dropped gaps     - FFS the impact to other intra-frequency measurements   Proposal 4: Define overhead cap.  Proposal 4-1 : Consider overhead cap with when configuring multiple MG patterns.   * + N : number of multiple MG patterns   + MGLr : MGL of referenced MG   + MGRPr : MGRP of referenced MG   + K is FFS |
| R4-2200587 | ZTE Corporation | Proposal 1: Since the demand of PRS measurement, UE should support simultaneous configuring per-UE gap and per-FR gap for the UE being capable of per-FR gap and concurrent gaps.  Proposal 2: Once the simultaneous configuring supported, no need to introduce additional limitation, NW can decide whether executing such simultaneous configuring depend on the RRM measurement demand. Proposal 3: Based on the starting point of max 2 MGs in an FR, we support 4 MGs for the two FRs.  Proposal 4: If without specific technical consideration for X=2, we suggest using unified candidate values for both FR1 and FR2.  Proposal 5: Option 3, 4 and 5 can be removed firstly, Option 1 and 2 can be kept.  Proposal 6: Between Option 1 and Option 2, we believe Option 2 is more flexible and preferred by us.  Proposal 7: It is no need to define an overhead cap for concurrent gaps. NW can fully control the concurrent gaps overhead when configuring.  Proposal 8: Some further clarification should be added into the limitation of “Measurements for different frequency layers but with the same reference signal can be associated to different concurrent MGs” for the case of CSI-RS frequency layer. The meaning of “same reference signal” is ambiguous.  Proposal 9: In order to identify the Kp and CSSF according to the exact overlapping case, we suggest NW should configure the associated gap between concurrent gaps even for a MO/frequency layer without gap.  Proposal 10: For the measurement delay within gap case, not need any new solution. Just re-using the mechanism of CSSFwithin\_gap,i in legacy Rel-16 for each gap is enough. All MOs/frequency layers with gap associated with a same gap would participate in the sharing of this gap. |
| R4-2200631 | CMCC | Proposal 1: it is proposed to consider partially and fully-overlapped concurrent gaps (FO, FPO, PFO, PPO scenarios).  Proposal 2: whether to have different X for FR1 and FR2 depends on the reason why we consider it as overlapped cases even if two gaps are not physically overlapping in time domain.   * If only measurement scheduling is considered, it is better to have same value of X for FR1 and FR2. * If UE processing is considered, it is suggested to have different X for FR1 and FR2.   Proposal 3: if the reason to consider it as overlapped cases even if two gaps are not physically overlapping in time domain is mainly about UE processing, it is proposed to introduce UE capability, which means for some UEs with high capability, X is not needed or the value of X is zero.  Proposal 4: for UE behavior during colliding gap occasion, it is proposed to take option 5.  Proposal 5: for the dropped gaps during the overlapping scenarios, the scheduling can be resumed.  Proposal 6: concurrent gaps are allowed in the case when only E-UTRAN measurement objectives are configured.  Proposal 7: For the per-FR gap capable UE, it is proposed to allow the simultaneous configuring per-UE gap and per-FR gap at least for PRS measurement.  Proposal 8: the max number of concurrent gaps across all FRs for per-FR gap capable UEs is proposed to be 4.  Proposal 9: it is not necessary to define an overhead cap for concurrent gaps, which can be left to network implementation. |
| R4-2200677 | Xiaomi | Proposal 1: It is allowed to be configured with concurrent MG to perform only non-NR RAT measurements provided that the UE is capable to support inter-RAT E-UTRAN measurement with concurrent gaps.  Proposal 2: For an UE supporting per-FR gap, the use case of simultaneous configuring per-UE gap and per-FR gap is only allowed when per-UE gap is associated to PRS measurement.  Proposal 3: For per-FR capable UE, the maximum number of the concurrent measurement gap across all FRs is 3.  Proposal 4: The minimum distance between two gap instances is equal or less than 4ms for both FR1 and FR2.  Proposal 5: Either the priority rule or gap sharing rule is adopted for the colliding gap occasions.  Proposal 6: RAN4 is deprioritized to define requirements for fully-overlapped (FO) and fully-partial overlapped (FPO) concurrent gaps in Rel-17.  Proposal 7: RAN4 is to define the RRM requirements for partial fully-overlapped (PFO) or partial partial-overlapped (PPO) concurrent gaps in Rel-17.  Proposal 8: For measurement delay without gap, when SMTC occasion is partially overlapping with both concurrent gaps, the scaling factor Kp = , where MGRP1 and MGRP2 is the MGRP of concurrent gaps.  Proposal 9: For the measurement within the concurrent gap with priority or 100% gap sharing, the existing measurement delay requirement within gap is applied.  Proposal 10: For the measurement within the concurrent gap with low priority or 0% gap sharing, the measurement delay would be extended by a scaling factor of , where MGRP1 is the MGRP of prioritized concurrent gap or the MGRP of concurrent gap with 100% gap sharing, and the MGRP2 is the MGRP of deprioritized concurrent gap or the MGRP of concurrent gap with 0% gap sharing. |
| R4-2200678 | Xiaomi | DraftCR on inter-frequency measurement delay requirements with concurrent gaps |
| R4-2200694 | Intel Corporation | DraftCR on positioning measurement requirements due to concurrent gap in NR |
| R4-2200762 | Qualcomm Incorporated | Proposal 1: For UEs capable of per-FR gaps and multiple concurrent gaps, support simultaneous configuration of per-UE gap and per-FR gap when the per-UE gap is used for positioning measurements.  Proposal 2: Support a maximum of 3 concurrent MG across FRs. Specifically, support concurrent MG combinations in rows 0-4 in the table below.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Index | # of simultaneous MG | | | RAN4 conclusion | | Per-FR1 | Per-FR2 | Per-UE | | 0 | 2 | 1 | 0 | Supported | | 1 | 1 | 2 | 0 | Supported | | 2 | 0 | 0 | 2 | Supported | | 3 | 1 | 0 | 1 | FFS | | 4 | 0 | 1 | 1 | FFS | | 5 | 1 | 1 | 1 | FFS | | 6 | 2 | 2 | 0 | FFS | | 7 | 0 | 0 | 1 | Supported | | 8 | 1 | 1 | 0 | Supported | | 9 | 1 | 0 | 0 | Supported | | 10 | 0 | 1 | 0 | Supported | | 11 | 2 | 0 | 0 | Supported | | 12 | 0 | 2 | 0 | Supported |   Proposal 3: The UE should be able to signal which concurrent MG configurations it supports from the table above as part of the UE capability.  Proposal 4a: Two measurement gap occasions are declared to be “colliding occasions” if the minimum distance between them, from the end of the first occasion to the start of the second occasion, is equal or less than 4 ms, regardless of which FR is measured on each occasion.  Proposal 4b: Support of colliding MG would be subject to additional UE capability.  Proposal 5: The definition of colliding measurement gap occasions applies only between   1. two per-FR1 gaps, or 2. two per-FR2 gaps, or 3. one per-UE gap and one per-FR (FR1 or FR2) gap.   Proposal 6: Support priority rule (option 1) to resolve collisions between concurrent MG instances. Each concurrent MG should be assigned a unique priority so that collisions can be resolved without ambiguity and data transfers can be scheduled during the dropped gap instances.  Proposal 7: Do not introduce support FO or FPO concurrent MG in Rel 17.  Proposal 8: Do not introduce a hard limit on MG overhead. It would be up to the network to control MG overhead by choosing efficient MG configurations.  Proposal 9: Modify the definition of Ri for CSSFwithin\_gap,i as follows: Ri is the maximal ratio of the number of measurement gap where measurement object *i* is a candidate to be measured over the number of measurement gap where measurement object *i* is a candidate and not used for a long-periodicity measurement defined above and not dropped due to measurement gap collisions.  Proposal 10: Modify the definition of Kp for NR intra-frequency measurements without gaps as follows: Kp is the reciprocal of the fraction of SMTC occasions that do not overlap with measurement gaps.  Proposal 11: Modify the definition of the P scaling factor for L1-RSRP measurements: P is the reciprocal of the fraction of SSB (or CSI-RS) occasions that do not overlap with measurement gaps.  Proposal 12: No need to specify transient UE behavior when concurrent MGs are re-configured.  [RAN4 response to Q1]:  It may be possible to configure a legacy gap together with a Rel-17 concurrent gap, however RAN4 does not anticipate any benefit of configuring a legacy gap vs. an equivalent Rel-17 concurrent gap.  From a configuration perspective, the main differences RAN4 can identify between the two types of gaps are   1. that measurement objects cannot be explicitly associated with a legacy MG, and 2. there is no explicit priority assigned to a legacy MG to resolve collisions.   RAN4 would need to define rules to determine implicit association and priority for legacy MG. Once those rules are in place, the UE behavior would be well defined and there would be no difference in UE behavior w.r.t. to the case where the UE is configured with an equivalent Rel-17 concurrent MG.  [RAN4 response to Q2]:  RAN4 has sent additional information regarding this question in a follow-up LS to RAN2. RAN4 kindly requests that RAN2 refer to LS R4-2120304.  [RAN4 response to Q3]:  RAN4 has sent additional information regarding this question in a follow-up LS to RAN2. RAN4 kindly requests that RAN2 refer to LS R4-2120304.  [RAN4 response to Q4]:  RAN4 understands that the network would benefit from having the flexibility to specify and select a gap sharing scheme for Rel-17 concurrent gaps, as with legacy gaps. Ideally, the network would have the flexibility to configure different gap sharing schemes for each MG. To enable configuring separate gap sharing schemes for each concurrent gap, RAN4 kindly requests RAN2 to consider upgrading the signalling structure.  Regarding the question of how it would work, RAN4 has agreed that CSSF will be calculated separately for each concurrent MG, counting only the measurement objects assigned/associated with each gap. The gap sharing scheme signalled for each gap would be applied to the corresponding CSSF calculation. Additionally, if there are collisions any between gaps, they should be accounted for when calculating CSSF. This issue is still under discussion in RAN4.  [RAN4 response to Q5]:  RAN4 has sent additional information regarding this question in a follow-up LS to RAN2. RAN4 kindly requests that RAN2 refer to LS R4-2120304 |
| R4-2201139 | OPPO | Proposal 1: E-UTRAN measurement is applicable in concurrent gap operation under the condition that only one per-UE MG is configured for UE.  Proposal 2: For Per-FR gap capable UE, it is allowed to be configured with only per-FR or per-UE concurrent gaps, but not allowed for per-UE gap and per-FR gap to be configured simultaneously.  Proposal 3: Define max number of concurrent gaps across all FRs for per-FR gap capable UEs as 4.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Index | # of simultaneous MG | | | RAN4 conclusion | | Per-FR1 | Per-FR2 | Per-UE | | 3 | 1 | 0 | 1 | Not Supported | | 4 | 0 | 1 | 1 | Not Supported | | 5 | 1 | 1 | 1 | Not Supported | | 6 | 2 | 2 | 0 | Supported |   Proposal 4: Either priority rule or gap sharing rule with sharing ratios 0% and 100% for colliding occasions is feasible.  Proposal 5: if RAN4 agreed to adopt gap sharing rule for overlapping between gaps, new signaling design should be considered to cover all the cases of sharing factors in concurrent gap.  Proposal 6: Open to discuss overhead issues after conclusion of overlapping issues.  Proposal 7: UTRAN-FDD measurement (configured in MeasObjectUTRA-FDD) is also applicable in concurrent gap operation if only one per-UE MG is configured for UE. |
| R4-2201140 | OPPO | Draft CR to 38133 on CSI-RS based L3 measurement requirements with concurrent gap |
| R4-2201213 | Ericsson | Proposal 1: It’s up to NW to decide whether to configure only E-UTRAN RAT measurement objectives.  Proposal 2: UE can be configured with per-UE gap and per-FR gap when UE is capable of per-FR gap and concurrent gaps.  Proposal 3: When UE supports both per-FR gap and concurrent gaps, except the legacy gap combination, the combination of the per-UE gap and/or per-FR gap to be configured can be as follow.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Index | # of simultaneous MG | | | RAN4 conclusion | | Per-FR1 | Per-FR2 | Per-UE | | 0 | 2 | 1 | 0 | Supported | | 1 | 1 | 2 | 0 | Supported | | 2 | 0 | 0 | 2 | Supported | | 3 | 1 | 0 | 1 | Supported | | 4 | 0 | 1 | 1 | Supported | | 5 | 1 | 1 | 1 | Supported | | 6 | 2 | 2 | 0 | Supported | | 7 | 0 | 0 | 1 | Supported | | 8 | 1 | 1 | 0 | Supported | | 9 | 1 | 0 | 0 | Supported | | 10 | 0 | 1 | 0 | Supported |   Proposal 4: The max number of supported concurrent gap can be 4 when UE supports both per-FR gap and concurrent gaps without considering MUSIM and NTN gaps.  Proposal 5: The proximity condition X = 4ms for FR1 and 1ms for FR2 once data scheduling is assumed during dropped gap occasions.  Proposal 6: Data scheduling is assumed on the dropping gap occasions.  Proposal 7: As a compromised solution, RAN4 to only define requirement for UE to perform measurement in the gap with higher priority on all colliding occasions in Rel-17.  Proposal 8: The concurrent gaps can support new type of gaps by indicating the gaps based on the usage, such as MU-SIM gaps.  Proposal 9: NW needs to configure each measurement gap together with the priority indication.  Proposal 10: RAN4 not to define an overhead cap for concurrent gaps.  Proposal 11: The following UE behaviours after transition should be defined.   * UE will continue the measurement by MGP2 and meet the corresponding measurement requirement based on MGP2 during this measurement period once the MO1 is reconfigured to be measured using MGP2. * UE will perform the measurement on MO2 using MGP2 immediately after the concurrent gaps’ reconfiguration, if MO2 can’t be measured by MGP1 due to gap offset or if gap length is not enough. * After one of concurrent gaps deconfiguration, data scheduling is expected on this disabled MG’s time occasions.   Proposal 12: Additional scaling factor Kgap shall be introduced on top of CSSF within gap, where:   * When none of the MG occasions of the MGP with lower priority are overlapped by other MGP(s), Kgap = 1. * When all of the MG occasions of the MGP with lower priority are overlapped by other MGP(s), the MGP with lower priority will be disabled. * Otherwise, Kgap will be applied to the MG with lower priority and equals.   Proposal 13: The scaling factor for measurement outside gap shall be updated as follow.   * + When all the MG occasions of the MGP with lower priority are overlapped by other MGP(s), the MGP with lower priority will be disabled.   + When none of the MG occasions of the MGP with lower priority are overlapped by other MGP(s), .   + Otherwise,     - When both MGs are overlapping with the SMTC,     - When MG with lower priority is overlapping with the SMTC, but MG with higher priority isn’t overlapping with the SMTC,     - When MG with lower priority isn’t overlapping with the SMTC, but MG with higher priority is overlapping with the SMTC,   Proposal 14: Reply RAN2’s LS as follow.  Q1 – Can Rel-17 concurrent gaps be configured together with legacy gap?  In Rel-17, concurrent gaps can be believed as multiple legacy gaps. NW can configure one legacy gap firstly. After that how to configure additional gaps for concurrent gaps is up to RAN2’s design. NW can also configure multiple gaps simultaneously, where at least one of the gaps shall be legacy gap.  Q2 – How many concurrent gaps could be configured simultaneously?  When UE only supports per-UE gap and concurrent gaps, up to 2 gaps can be configured to UE. When UE supports per-FR gap and concurrent gaps, up to 2 gaps in each FR can be configured to UE.  Q3 – Could concurrent gaps be configured with different gap types?  RAN4 agrees to support per-UE gap and per-FR gap configuration in Rel-17.  Q4 – Is the legacy gap sharing configuration (configured in MeasGapSharingConfig) applicable to Rel-17 concurrent gaps?  RAN4 confirms that the legacy gap sharing configuration for intra-frequency and inter-frequency is applicable in each measurement gap. The network can configure MeasGapSharingConfig for each legacy gap within concurrent gaps separately.  Q5 – Could RAN4 help to clarify whether UTRAN-FDD measurement (configured in MeasObjectUTRA-FDD) is also applicable in concurrent gap operation?  It has already captured in previous RAN4 LS. |
| R4-2201214 | Ericsson | draftCR on concurrent gaps (9.1.2B) |
| R4-2201623 | Huawei, Hisilicon | Proposal 1: RAN4 not to define E-UTRA measurement requirements with concurrent MGs.   * When UE is configured with only E-UTRA MOs, it is not expected to be configured with concurrent MGs; * When UE is configured with both E-UTRA and NR MOs, UE can be configured with concurrent MGs, but all E-UTRA MOs are expected to be associated with one single MG.   Proposal 2: RAN4 to ask RAN2 to decide whether concurrent MGs is supported in MR-DC scenario.  Proposal 3: Simultaneous configuration of per-UE MG and per-FR MG is only allowed when the per-UE MG is associated to PRS measurement.  Proposal 4: Max number of concurrent MGs across all FRs for per-FR MG capable UE is 3.  Proposal 5: Define X value in proximity condition as 4ms for both FR1 and FR2.  Proposal 6: Adopt priority rule for collision handling for concurrent MGs:   * + UE will only do the measurement w.r.t. the MG with higher priority   + The MG priority is configured by NW   + Data scheduling is expected during dropped MG occasions   Proposal 7: Define overhead for concurrent MGs: when concurrent MGs are configured, the MGRP for each MG cannot be smaller than 40ms.  Proposal 8: For measurement with MG, existing measurement period requirements can be re-used, where the MGRP and CSSF are based on the MG to which the measurement is associated. Impact of the MG colliding can be discussed after collision handling is settled.  Proposal 9: For measurement outside MG,   * + If the SMTC windows or CSI-RS resources are fully non-overlapped with any of the concurrent MGs, the existing measurement period requirements can be re-used.   + If the SMTC windows or CSI-RS resources are partially overlapped with one or both of the concurrent MGs, the measurement will be performed outside MG.     - Kp = Ntotal / Navailable, where Ntotal is the total number of SMTC windows or CSI-RS resource occasions during T, and Navailable is the number of SMTC windows or CSI-RS resource occasions that are not overlapped with any MG occasion during T, and T = max(TSMTC, MGRP1, MGPR2).   + If the SMTC windows are fully overlapped with one or both of the concurrent MGs, the measurement will be performed with MG.   Proposal 10: Re-use the existing requirements for L1 measurement with the updated calculation for P factor as follows:   * + For L1 measurement in FR1, P = Ntotal / Navailable   + For L1 measurement in FR2,     - P = Psharing \* Ntotal / Noutside\_MG, if Navailable = 0     - P = Ntotal / Navailable, if Navailable > 0   + where, Ntotal is the total number of L1 resource occasions during T, Noutside\_MG is the number of L1 resource occasions not overlapped with any MG occasion during T, Navailable is the number of L1 resource occasions not overlapped with any MG occasion or any SMTC window during T, and T = max(TL1, MGRP1, MGPR2).   Proposal 11: RAN4 not to define UE measurement behaviour after transition.  Proposal 12: In the reply LS to R2-2111472, inform RAN2 that different MOs with CSI-RS resources are considered as different frequency layers, no matter if the CSI-RS resources are with same or different centre frequencies.  Proposal 13: In the reply LS to R2-2111472, inform RAN2 the following   * + Concurrent MGs cannot be configured with legacy MG   + The UE capabilities in number of concurrent MGs based on RAN4 agreements   + The applicability of legacy MG sharing configuration and new signaling for collision handling of concurrent MGs   [RAN4 response to Q1] No. RAN4 has agreed that “Concurrent gaps are multiple measurement gaps configured by RRC message(s)”, so when more than one gaps are configured, UE is considered to be configured with concurrent gaps, and there is no such scenario where concurrent gaps are configured together with legacy gaps.  [RAN4 response to Q2] For UE not capable of per-FR MG, at maximum 2 per-UE MGs can be configured.  For UE capable of per-FR MG, the following configurations are supported:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Index | # of simultaneous MG | | | RAN4 conclusion | | Per-FR1 | Per-FR2 | Per-UE | | 0 | 2 | 1 | 0 | Supported | | 1 | 1 | 2 | 0 | Supported | | 2 | 0 | 0 | 2 | Supported | | 3 | 1 | 0 | 1 | Supported Note 1 | | 4 | 0 | 1 | 1 | Supported Note 1 | | 5 | 1 | 1 | 1 | FFS | | 6 | 2 | 2 | 0 | FFS | | 7 | 0 | 0 | 1 | Supported | | 8 | 1 | 1 | 0 | Supported | | 9 | 1 | 0 | 0 | Supported | | 10 | 0 | 1 | 0 | Supported | | 11 | 2 | 0 | 0 | Supported | | 12 | 0 | 2 | 0 | Supported | | Note 1: Supported only when the per-UE gap is associated to PRS measurement. | | | | |   [RAN4 response to Q3] Please refer to the answer to Q2.  [RAN4 response to Q4] Yes. RAN4 would like to clarify that the legacy gap sharing configuration (configured in MeasGapSharingConfig) is applicable for different measurements (e.g. intra- and inter-frequency) that are associated to the same gap, while for handling of collision between different gaps, new signalling is needed as mentioned below.  [RAN4 response to Q5] RAN4 has agreed that it is up to RAN2 to decide whether to support gap association to 2G/3G from signalling perspective. |
| R4-2201624 | Huawei, Hisilicon | CR on collision handling and MG related requirements for concurrent MGs |
| R4-2201694 | Nokia, Nokia Shanghai Bell | Proposal 1: Allow concurrent gap when only non-NR RAT measurement objectives are configured.  Proposal 2: UE can be configured with one legacy gap pattern and additional concurrent measurement gaps patterns reaching the maximum gap configuration limitation  Proposal 3: UE can be configured with one or more concurrent measurement gap patterns reaching the maximum gap configuration limitation  Proposal 4: Capture LTE layers in a similar manner as RAN4 has captured it for NR SSB, CSI-RS and PRS layers  Proposal 5: RAN4 to discuss and agree the scenario where, for concurrent measurement gaps, UE is configured with more than one MO including CSI-RS resources with the same center frequency.  Proposal 6: Support simultaneous configuring of per-UE gap and per-FR gap (for per-FR gap capable UE).  Proposal 7: Simultaneous MG combinations Index 3 – 5 are supported.  Proposal 8: Support Index 6, 2 MGs per FR when UE support per-FR and concurrent MGs and in total of 4 MGPs.  Proposal 9: X = 1 for FR1  Proposal 10: X = 1 for FR2  Proposal 11: It is not necessary to split X between FR1/FR2.  Proposal 12: Support Option 5 regarding UE behavior during colliding gap occasion  Proposal 13: UE will resume normal operation during the dropped gaps  Proposal 14: Define requirements for fully overlapped (FO)  Proposal 15: Define requirements for fully partial overlapped (FPO)  Proposal 16: Option 2. There is no need for RAN4 to define a measurement gap overhead.  Proposal 17: Any measurement gap overhead limitations need to be justified.  Proposal 18: For measurement delay outside gaps the existing sharing rule applies as general principle.  Proposal 19: When the C-MG collide with and have to share the gap opportunities with legacy gaps RAN4 can apply same principles as for legacy for each GP  Proposal 20: The MGRP to be applied in the requirements would need to capture both or either of legacy and C-MG MRGP.  Proposal 21: RAN4 follow legacy principle: UE measure an MO according to the MGP while MO/MGP is configured. |
| R4-2201695 | Nokia, Nokia Shanghai Bell | Regarding:   * RAN2 confirms the following understanding for concurrent gap operation:   1. Concurrent gaps are multiple measurement gaps and each gap pattern could be associated with one or multiple frequency layers.  2. Each frequency layer can be associated with only one of the concurrent gaps.  3. Without considering pre-configured MG, concurrent gaps are always activated if it is setup by the network.  4. No new gap pattern is introduced for concurrent gap, the existing R15/R16 gap pattern could be configured for the concurrent gaps.  Proposal 1: Reply and confirm to RAN2 according to above discussion TP. Additionally, clarify to RAN2 on the Issues not yet explicitly agreed in RAN4 yet.  Concerning:   * RAN2 to clarify “frequency layer” and limitations as below:   PRS measurement can be associated with one gap pattern, no matter how many frequencies are measured for PRS.  Each measured SSB or LTE frequency is considered as one frequency layer.  Measured CSI-RS resources with the same center frequency is considered as one frequency layer. It is possible to have Multiple MOs including CSI-RS resources with same center frequency.  SSB and CSI-RS measurement in one MO are considered as different frequency layers.  Proposal 2: Reply to RAN2 according to above discussion TP. Additionally, clarify to RAN2 on the Issues not yet explicitly agreed in RAN4 yet. |

## Open issues summary

### Sub-topic 2-1 Applicability and configurations

Moderator’s note:

* OPPO has a proposal (P7) regarding UTRAN-FDD. According to the agreement in the WF in last meeting, RAN4 to focus on NR and EUTRAN measurement requirements with concurrent gaps before considering 2G/3G. Therefore, this proposal is skipped here.
* Nokia has a proposal (P4) to capture LTE layers in a similar manner as RAN4 has captured it for NR SSB, CSI-RS and PRS layers. However, it should already be address in previous RAN4 agreements, e.g., in R4-2115343 as below. Please Nokiacomment if Moderator mis-understood your proposal.

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| * The measurement gap can be associated to one or multiple use cases in the following, while the detail on how to implement the association is left to RAN2   + One or more MO(s) for same or different RATs   + SSB and/or CSI-RS in each associated NR MO   + PRS |

* Ericsson has a proposal (P8) to support concurrent gaps for MU-SIM gaps. As RAN4 will not work on the corresponding requirements for MU-SIM in Rel-17, the proposal probably only makes sense from RAN2 perspective. To moderator’s understanding, RAN2 already has some planned discussions regarding this issue. Therefore, the proposal is skipped here.

#### **Issue 2-1-1: Whether concurrent gaps are allowed in the case when only E-UTRAN measurement objectives are configured**

* Proposals
  + Option 1: CATT, MTK, CMCC, Intel, Ericsson, Nokia
    - Yes
  + Option 1a: vivo, Xiaomi,
    - Yes, provided that UE supports LTE measurement with concurrent MGs, which is up to UE capability
  + Option 1b: OPPO
    - Yes, under the condition that only one per-UE MG is configured for UE
  + Option 2: Apple, Huawei
    - No
* Recommended WF
  + Collect view from companies in 1st round

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| **Company** | **Comments** |
| Ericsson | Option 1.  This issue is similar as whether to limit the NW’s configuration on the type of measurement objectives. In legacy Rel-15, there is no such limitation on whether UE can perform inter-RAT measurements within the MG based on the UE’s capability. Thus, it’s natural to deduce the same conclusion for concurrent gaps. It’s up to NW to configure one gap or two gaps for E-UTRAN measurements once UE supports concurrent gaps. |
| MTK | Support Option 1.  We understand that there is no issue to cover PSS/SSS of multiple EUTRAN frequency layers by only one single gap, but this does not imply that network cannot configure 2 concurrent gaps for EUTRAN only measurement. We prefer to leave this up to network to decide. |
| CMCC | Option 1. We do not see the reason why concurrent gaps cannot be used in the case when only E-UTRAN measurement objectives are configured. Another consideration is that MG configuration and MO configuration are up to network implementation, it is not preferred to have restriction on network configuration. |
| Apple | Support option 2.  Proponents of option 1 mainly focus on network flexibility. However, such flexibility doesn’t come for free. From UE complexity point of view, multiple concurrent gap patterns are not supported in LTE. Allowing such feature will increase the complexity of LTE module.  On the other hand, such flexibility doesn’t really provide much gain. In LTE there is PSS, SSS and CRS every 5ms. Therefore, a MGP with 6ms MGL can cover any LTE cell. |
| vivo | Ok with option 1a as a compromise between option 1 and 2 |
| Huawei | Option 2.  Technically all LTE layers can be measured with a single MG, so in our view having different LTE layers measured in different MGs is an optimization and so far there is no clear benefit identified. On the other hand, it would require UE to enhance the implementation for LTE measurement, and this is why we suggest to not pursue this optimization in Rel-17.  If clear benefits can be identified, we are open to consider support of LTE measurement with concurrent MGs, but this should be defined as a separate UE capability as in option 1a. |
| OPPO | Option 1a or 1b is fine. The UE behaviour falls back to the legacy if only one per-UE MG is configured for UE. OK with UE capability of supporting LTE measurement with concurrent MGs. |
| Xiaomi | Fine with option1 and option 1a, option 1a can be considered as a compromise. In my understanding, there is no reason to exclude the concurrent gaps for E-UTRAN only measurement. |
| Intel | Option 1.If UE can support concurrent gap, it is up to NW to configure more than one MG to UE. |
| CATT | Support option 1.  There is no need to have this limitation and can leave it to NW implementation. This doesn’t mean that NW will definitely configure two gaps for LTE measurement, but it is not reasonable to forbid the NW to do so. |
| Nokia | Option 1.  As discussed, our preference is to have a simple approach to the concurrent MG feature without complicated limitations in the use and configuration.  Hence, we prefer to discuss the technical reason why it would not be technically feasible to allow concurrent gap in the case when only non-NR RAT measurement objectives are configured?  To Apple: there may be different understanding on the Issue? Our understanding of the issue here is whether network can configure the UE with concurrent gaps including only LTE carriers. It is not clear if this is common understanding or whether the Issue should be clarified |

#### **Issue 2-1-2: Additional limitation when UE is configured with both E-UTRA and NR MOs**

* Proposals
  + Option 1: Huawei
    - When UE is configured with both E-UTRA and NR MOs, UE can be configured with concurrent MGs, but all E-UTRA MOs are expected to be associated with one single MG.
* Recommended WF
  + Collect views from companies in 1st round

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| **Company** | **Comments** |
| Ericsson | Not support option1.  We think this issue 2-1-2 is similar as issue 2-1-1. There is no big technical obstacle for the UE to handle the E-UTRA MOs within two MGs once the association is clearly indicated.  When the association is configured by the ‘usage’, it’s clearly that the inter-RAT MOs will be associated with one single MG. However, once the association is configured by frequency layers, we understand this scenario may exsist. |
| MTK | Do not support Option 1.  In Rel-15/16, one single gap can already be used for both NR and EUTRAN measurements. Further extension to concurrent gaps is very straightforward to us. Option 1 could be one possible network configuration, but we do not see the need to add this as a limitation to network. |
| CMCC | Not OK with option 1. As commented by MTK, legacy MG can cover both NR and LTE measurements, we do not see the reason why we need to have this limitation for multiple gaps. |
| Apple | Support option 1. Similar comment as issue 2-1-1. |
| Huawei | Pending on Issue 2-1-1, support option 1.  To MTK/CMCC, our concern is not about measuring NR and LTE with one MG, but about measuring LTE with multiple MGs, which is discussed in Issue 2-1-1. |
| OPPO | Option 1 is fine, if UE not capable of measuring LTE with multiple MGs. |
| Xiaomi | Do not support option 1, the same view as MTK, we do not see the benefit to add this limitation for concurrent gaps. |
| Intel | Pending on issue2-1-1 |
| CATT | Do not support option 1. This issue is same as issue 2-1-1. |
| Nokia | Do not support option 1.  The reason is the same as for former issue 2-1-1. |
| Qualcomm | It can be left up to the network. To clarify, this scenario is different from issue 2-1-1. |

#### **Issue 2-1-3: Supporting concurrent gap in MR-DC scenario**

* Proposals
  + Option 1: Huawei
    - RAN4 to ask RAN2 to decide whether concurrent MGs is supported in MR-DC scenario
* Recommended WF
  + Collect view from companies in 1st round

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| **Company** | **Comments** |
| Ericsson | Option 1.  Depends on RAN2. |
| ZTE | Option 1. Up to RAN2. |
| MTK | Support Option 1.  Although from RAN4’s viewpoint we see no problem to support concurrent gaps for MR-DC, but we still need to consider all the RRC implementation limitation or complexity. Therefore, we agree to send an LS to inform RAN2 that it up to them to decide. |
| vivo | Ok with option 1 |
| Huawei | Option 1. |
| OPPO | No strong view. |
| Xiaomi | Fine with option 1 |
| Intel | Option 1. |
| CATT | Fine with option 1. |
| Nokia | Option 1 is agreeable. |
| Qualcomm | We’re OK with option 1. |

### Sub-topic 2-2: UE capability related issues

#### **Issue 2-2-1: Whether to allow simultaneous configuration of per-UE gap and per-FR gap to FR gap capable Ues**

* Proposals
  + Option 1: LGE, OPPO
    - No
  + Option 2: CATT, [CMCC], Ericsson, Nokia, ZTE
    - Yes
  + Option 2a: Apple, QC, MTK, vivo, Xiaomi, Huawei
    - Yes, but only when the per-UE gap is associated to PRS measurements
* Recommended WF
  + Collect views from companies. Expected to be concluded in this meeting for not delaying RAN2 work.

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| **Company** | **Comments** |
| Ericsson | Option 2.  Some companies think that only considering the per-UE gap for positioning because no other use case for per-UE gap and per-FR gap. However, in Rel-17, MUSIM gaps are also introduced in RAN2 which are only per-UE gap. From our understanding, MUSIM gap can be seen as one type of gaps within the concurrent gaps framework.  To consider forward compatibility, UE can be configured with per-UE gap and per-FR gap simultaneously when UE is capable of per-FR gap and concurrent gaps. |
| ZTE | Option 2.  PRS measurement is widely regarded as a use case of simultaneous configuring per-UE gap and per-FR gap until now. If such simultaneous configuring supported for the UE being capable of per-FR gap and concurrent gaps, then we can not see clear reason to give any limitation for the simultaneous configuring. In other words, NW can configure simultaneous per-UE gap and per-FR gap depending on the measurement demand, not only limit to the PRS measurement. |
| MTK | Support Option 2a.  We still see PRS as the only use case to configure simultaneous per-UE gap and per-FR gap. We are not sure whether RAN4 or RAN2 already has the consensus that MUSIM gaps are also per-UE. It is highly appreciated of company can share some further information to the group.  Nevertheless, per Plenary’s guidance, RAN4 will not work only any requirements for MUSIM. Therefore, we do not think that we need to consider MUSIM in this WI in Rel-17. |
| CMCC | We support option 2, but we are also fine with option 2a to move forward. |
| Apple | Option 2a.  From system throughput perspective, we don’t see any benefit for NW to configure per-UE gap for the UE which supports per-FR gap. Because for every FR1 MGP there is a corresponding FR2 MGP with shorter MGL. One exception is for PRS measurement. According R16 PRS measurement design, PRS measurement is always with measurement gap. In our understanding the measurement gap for PRS measurement shall apply for all serving cells across FR1 and FR2. It is equivalent to per-UE gap.  Another point is we don’t think RAN4 is ready to consider MUSIM with concurruent gaps from requirement perspective. |
| LG Electronics | We can compromise with Option2a. |
| vivo | Ok with option 2a. To MTK, we can confirm Rel-17 MUSIM gaps are per UE gaps. |
| Huawei | Option 2a.  In our view, there is no clear benefit in simultaneously using per-UE MG and per-FR MG once per-FR MG is supported by the NW. PRS measurement is a special case with explicit restriction on the applicability so it can be handled separately. We agree with MTK that in Rel-17 we do not need to consider MUSIM gaps in the concurrent MG framework. |
| OPPO | Option 1 is preferred because for PRS measurement case 2 per-UE MGs can be configured as concurrent gaps for MG enhancement.  Regarding “from system throughput perspective, we don’t see any benefit for NW to configure per-UE gap for the UE which supports per-FR gap.”, the comment makes sense to us as well. We can accept PRS measurement as an exception and compromise to option 2a if all other companies agreed. |
| Xiaomi | Option 2a. PRS measurement is the only case that NW can configure per-UE gap for per-FR capable UE. And there is no benefit to configure per-UE gap for per-FR capable UE. |
| Intel | We can support Option 2a |
| CATT | Option 2.  To cover the PRS measurement within concurrent gaps, per-UE and per-FR gap should anyway be allowed. If it is allowed for PRS measurement, then there is no need to have further limitation to avoid the simultaneous configuration. |
| Nokia | We initially support option 2.  However, if there are UE complexity issues supporting option 2 (Support simultaneous configuring of per-UE gap and per-FR gap (for per-FR gap capable UE)) we can compromise to option 2a and can discuss further option 2 in later releases.  Option 2a.  We agree with Apple that RAN4 do not need to consider MUSIM gaps as concurrent gap in Rel-17. |
| Qualcomm | Option 2a. NR positioning is the main motivation for supporting concurrent per-UE and per-FR gaps. Currently, NR positioning measurements are only supported with per-UE MG. Even though a new capability for PRS measurements with per-FR gaps may be introduced in R17 (not yet agreed), not all UEs that support NR positioning may support it. |

#### **Issue 2-2-2: Max number of concurrent gap across all FRs for per-FR gap capable UEs (without considering other WIs)**

* Proposals
  + Option 1: Apple, QC, Xiaomi, Intel, Huawei
    - 3
  + Option 2: CATT, CMCC, vivo, OPPO, Ericsson, Nokia, ZTE
    - 4
  + Option 3: Apple, MTK
    - Up to UE capability
* Recommended WF
  + Collect views from companies. Expected to be concluded in this meeting for not delaying RAN2 work.

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| **Company** | **Comments** |
| Ericsson | Option 2.  Without considering MU-SIM and NTN gaps, the maximum number of supported concurrent gaps can be 4.  To option 3, we strongly oppose to further introduce the unnecessary capability to an optional feature. |
| ZTE | Option 2.  We should note that it was agreed to assume max 2 MGs in an FR as a starting point during 99 meeting. From our view, each FR shall be treated equally for the per-FR gap capable UE. Based on this understanding, the max number of concurrent gaps across all FRs should be 4. |
| MTK | Support Option 3.  Actually, we have no strong view between Option 1 and Option 2. However, as this issue has been discussed for almost a year and companies still stay in the same camp with no change, Option 3 is the middle ground between the 2 camps. BTW, whether this capability is necessary or unnecessary is very subjective. It could be different from company to company. |
| CMCC | Option 2. In previous meetings, it was agreed to assume max 2 MGs in an FR as a starting point. And in our view, each FR shall be treated equally for the per-FR gap capable UEs. Based on this understanding, the max number of concurrent gaps across all FRs is 4 |
| Apple | Support option 1 and 3. 2 FR1 gaps + 2 FR2 gaps comes at the price of UE extra complexity without attractive gain. We propose option 1 and can compromise to option 3. |
| LG Electronics | Preference is Option 1. However, if burden is not high in implementation, we’re fine with Option 2. |
| vivo | Our consideration is 2 gaps per FR have already been supported and the corresponding complexity is already there. Further limitation on number of gaps for FR1+FR2 limit the benefit which can be achieved. |
| Huawei | Option 1.  We believe 3 is a reasonable value considering usage of the feature in the real NW. |
| OPPO | OK with Option 2 with 2 FR1 gaps + 2 FR2 gaps, and we can compromise to option 3. |
| Xiaomi | Fine with option 1 and 3. |
| Intel | Option 1.  For Option 3, we have same concern as Ericsson there are too many UE capability to support a single feature. |
| CATT | Option 2.  It has been agreed that max 2 gaps are supported in each FR. Since the configuration in each FR is independent, there is no reason to have further limitation. |
| Nokia | We do not support defining yet another UE capability to address this.  We would still prefer option 2 |
| Qualcomm | We support option 1. We also proposed in our paper (see issue 2-2-4) that the UE should be able to signal which concurrent MG combinations it supports as part of the UE capability. Our proposal aligns with option 3 and is more granular/flexible. |

#### **Issue 2-2-3: UE feature list**

* Moderator: Let’s focus on the wording of baseline concurrent gap feature. For other features related to ongoing discussions, we can wait for the technical discussions to conclude first.
* Proposals
  + Some entries with the same proposals are skipped in below table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Feature group** | **Components** | **Consequence if the feature is not supported by the UE** | **Note** | **Mandatory/Optional** |
| Option 1  Apple  0286 | Multiple independent and concurrent gaps | Support of multiple independent and concurrent gaps | UE cannot support multiple independent and concurrent gaps | The capability is to indicate UE support multiple independent and concurrent gaps. | Optional with capability signalling |
| Option 2  MTK  0485 | Concurrent measurement gaps | Capability of configuration of more than 1 per-UE measurement gap configurations or more than 1 per-FR gap measurement gap configurations in an FR | UE cannot be configured with concurrent gaps |  | Optional with capability signalling |
| Option 3  Intel  0544 | Concurrent measurement gaps | 1) Support of configuration of more than 1 per-UE/per-FR measurement gap configurations | UE cannot be configured with concurrent gaps | The maximum supported number of concurrent gaps is FFS and pending RAN4 discussion | Optional with capability signalling |

* Recommended WF
  + Moderator: 3 proposals have no technical difference. Please check if the below **merged version** is agreeable.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Feature group** | **Components** | **Consequence if the feature is not supported by the UE** | **Note** | **Mandatory/Optional** |
| **Merged version** | Multiple independent and concurrent gaps | Support of more than 1 per-UE measurement gap configurations or more than 1 per-FR gap measurement gap configurations in an FR | UE cannot be configured with multiple independent and concurrent gaps | This is the baseline capability is to indicate UE support multiple independent and concurrent gaps. | Optional with capability signalling |

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Can we simplify the terminology ‘Multiple independent and concurrent gaps’ -> ‘Concurrent measurement gaps’ since RAN4 only achieve the agreements on ‘concurrent gaps’ in RAN4 #99 meeting?   |  | | --- | | * Refinement of concurrent gap definition   + Concurrent gaps are multiple measurement gaps configured by RRC message(s)     - Either by same or separate RRC messages     - Whether and how to introduce new IE(s) or duplicate the existing IE is left to RAN2.     - Note: if existing IE is to be used, the configuration mechanism shall allow NW to use the same IE to either configure additional concurrent MGP or update the configured MGP. | |
| ZTE | For the description of Components, since it is still suspending for Issue 2-2-1, we concern “more than 1 per-UE measurement gap configurations or more than 1 per-FR gap measurement gap configurations” can not cover the possible case of 1 per-FR gap+ 1 per-UE gap.  If the Option 2 or 2a approved for Issue 2-2-1, we suggest to revise the Components as: Support of more than 1 per-UE measurement gap configurations or more than 1 per-FR gap measurement gap configurations or simultaneous 1 per-UE measurement gap configuration plus 1 per-FR measurement gap configuration in an FR. |
| MTK | We agree with ZTE on the point that the ‘component’ is pending on our conclusion in Issue 2-2-1. |
| Apple | In general, it is ok. We are also fine to revisit it after issue 2-2-1 is concluded. |
| LG Electronics | We’fine with ZTE’s comment. |
| Vivo | Ok with the recommended wording |
| Huawei | It should be clarified in the **Components** column that more than 1 per-FR MG (or 1 per-UE MG plus one per-FR MG) in an FR is supported only when UE supports per-FR MG. Current wording looks like UE supporting concurrent MGs will also support per-FR MG, which is not the case. |
| OPPO | Fine with the recommended WF. |
| Xiaomi | Fine with ZTE and HW comments on the “component description” |
| Intel | Fine with the recommended WF and updates from ZTE. |
| CATT | Basically fine with the capability and Fine with Huawei’s suggestion. |
| Nokia | Feature group: We think it is sufficient to state ‘Concurrent measurement gaps’  Component: This wording would need to reflect the agreement of the ongoing discussion (as pointed out by ZTE). TP looks like a good starting baseline. Details can also be captured in Notes.  Consequence: original option 2/3 is fine. For the TP we suggest remove ‘multiple independent and’  Note: TP is unclear  Optional feature |
| Qualcomm | **Feature group:** Concurrent measurement gaps  **Components:** Support configuring more than one per-UE measurement gap or more than one per-FR gap measurement gap in an FR  **Consequence:** The UE cannot be configured with concurrent measurement gaps |

#### **Issue 2-2-4: UE indication of supported gap combination index**

* Proposals
  + Option 1: QC
    - The UE should be able to signal which concurrent MG configurations it supports from the table below as part of the UE capability

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Index** | **# of simultaneous MG** | | | **RAN4 conclusion** |
| **Per-FR1** | **Per-FR2** | **Per-UE** |
| **0** | **2** | **1** | **0** | Supported |
| **1** | **1** | **2** | **0** | Supported |
| **2** | **0** | **0** | **2** | Supported |
| **3** | **1** | **0** | **1** | FFS |
| **4** | **0** | **1** | **1** | FFS |
| **5** | **1** | **1** | **1** | FFS |
| **6** | **2** | **2** | **0** | FFS |
| **7** | **0** | **0** | **1** | Supported |
| **8** | **1** | **1** | **0** | Supported |
| **9** | **1** | **0** | **0** | Supported |
| **10** | **0** | **1** | **0** | Supported |
| **11** | **2** | **0** | **0** | Supported |
| **12** | **0** | **2** | **0** | Supported |

* Recommended WF
  + Collect views from companies.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Not support this proposal.  From our understanding, UE should support all the combinations in the table. Otherwise, UE can report NOT supporting the concurrent gaps.  To the proponent company,  Could you further explain the technical reason on which and why cannot be supported? |
| ZTE | Similar view as Ericssio.  UE only needs to report whether it has the capability of Concurrent gaps and per-FR gap is enough. If the UE is capable of both Concurrent gaps and per-FR gap, NW can decide which index of simultaneous MG would configure depend on the RRM measurement demand. |
| MTK | Do not support Option 1.  At this the indices marked as ‘supported’ should be supported by UE without additional capability. For those with ‘FFS’, they are up to the technical discussions. |
| CMCC | Not OK with option 1. If UE is capable of concurrent gaps, all the combinations in the table are supported, no need to have additional capability. |
| Apple | Don’t see the need of such signaling once issue 2-2-1 and 2-2-2 are concluded. If consensus cannot be reached for the previous two issues, then RAN4 can further work on the signalling. |
| LG Electronics | Same view with MTK. Additional capability is not necessary. |
| vivo | Solve issue 2-2-1 and 2-2-2 firstly. |
| Huawei | Similar view as MTK/CMCC. |
| OPPO | Depend on issue 2-2-1 and 2-2-2. |
| Xiaomi | Similar view as MTK and Apple, the additional signaling is not needed to report the supported concurrent gaps. The the concurrent gaps with FFS, they depend on the conclusion on issue 2-2-1 and 2-2-2. |
| Intel | If the basic capability to support the concurrent gap and per-FR are known by gNB, the possible pattern which can be supported as given in the table above can be clear.  On the other hand, is it necessary to differentiate the same similar combinations (e.g. config #0, and #1) |
| CATT | Similar view as MTK and CMCC. |
| Nokia | We do not support this proposal. If the proposal only refer to the highlight FFS options RAN4 would need to wait discussion on Issues 2-2-1 and 2-2-2.  However, our view is that if the UE indicates support of concurrent measurement gaps it shall support the combinations in the table. Hence, no need to discuss mandatory/optional for each of the table entries. |
| Qualcomm | Clarification on option 1. Rows 7-10 can be omitted since they are not new MG configurations that require the UE capability for concurrent measurement gaps.  Rows 11 and 12 could be omitted too since they are fallbacks of rows 0 and 1. |

### Sub-topic 2-3: Overlapping

#### **Issue 2-3-1: X value in proximity condition for overlapping in FR1.**

* Proposals
  + Option 1: CATT, Nokia, ZTE
    - 1 ms
  + ~~Option 2: ZTE~~
    - ~~2 ms~~
  + Option 3: Apple, QC, MTK, Xiaomi, Intel, Ericsson, Huawei, ZTE
    - 4 ms
  + Option 4: CMCC
    - Up to UE capability
* Recommended WF
  + Collect views from companies.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Option 3.  From our understanding, proximity condition can be used for two reasons. On the one hand, the proximity condition shall guarantee UE to perform the consecutive measurements within two gaps which are close to each other. On the other hand, the proximity condition can avoid UE not to receive the DL or/and transmit the UL during a long period.  4ms for FR1 is fine once data scheduling is resumed for the disabled gap occasions. |
| ZTE | Our original suggestion is that If without specific technical consideration for X=2, we suggest using unified candidate values for both FR1 and FR2.  X = 1 or 4ms for FR1 has been agreed during 101-e meeting, so we believe Option 2 can be removed. |
| MTK | Support Option 3, but we are also open to see other technical considerations |
| CMCC | For option 4, our consideration is that, for two gaps which are not physically overlapped in time domain, if the main reason to consider this case as overlapped is due to UE processing, we are wonder whether all UEs need X. For the UE which have better capability, the value of X could be zero, which means this kind of UE can handle the case that there is no physically overlapped.  Based on above consideration, we propose option 4. For UE with better capability, X is zero. For other UE, X is non-zero, and we are open for the detailed value. |
| Apple | Support option 3. In our view this should be independent of frequency range. We propose 4ms for both FR1 and FR2. |
| LG Electronics | Support Option 3 based on agreement in RAN4#101-e. |
| Huawei | Option 3. |
| OPPO | Option 3 is fine. |
| Xiaomi | Support option 3, the same view as Apple, the margin is independent of frequency range, and use 4ms for both FR1 and FR2. |
| Intel | Option 3 |
| CATT | Support option 1, but we can compromise to option 4. |
| Nokia | Although we originally supported other option, we can compromise to option 3 to progress the work. |
| Qualcomm | Option 3. We favor the same value for both FRs. Note that this value should take into account the time the UE needs to prepare for the next gap. This issue is not just about allowing sufficient scheduling time between adjacent gap instances. |

#### **Issue 2-3-2: X value in proximity condition for overlapping in FR2**

* Proposals
  + Option 1: CATT, Nokia, MTK, Ericsson
    - 1 ms
  + ~~Option 2:~~ ZTE
    - ~~2 ms~~
  + Option 3: Apple, QC, Xiaomi, Intel, Huawei
    - 4 ms
  + Option 4: CMCC
    - Up to UE capability
* Recommended WF
  + Collect views from companies.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Option 1.  Generally, UE processing in FR2 can be faster than FR1. 4ms means 16 slots in FR2 which seems too long in FR2. Especially, when we further consider 71GHz with SCS=960KHz in the future, 4ms is too exaggerated for UE. |
| ZTE | Our original suggestion is that If without specific technical consideration for X=2, we suggest using unified candidate values for both FR1 and FR2. So we believe Option 2 can be removed.  To align with the agreed value for FR1, we support Option 1 and Option 3. |
| MTK | Support Option 1, but we are also open to see other technical considerations |
| CMCC | Similar comments as for Issue 2-3-1. |
| Apple | Support option 3. In our view this should be independent of frequency range. We propose 4ms for both FR1 and FR2. |
| LG Electronics | Support Option 3. |
| Huawei | Option 3  From UE side this values is related to the time for measurement scheduling, so FR2 delay is not necessarily smaller than FR1. Also, having one single value can be simpler for both UE and NW implementation, e.g. it can be difficult to use different X values for FR1 and FR2 for a UE configured with per-UE MG and FR1-FR2 CA. |
| OPPO | Option 3 is fine. |
| Xiaomi | Support option 3, the same view as Apple, the margin is independent of frequency range, and use 4ms for both FR1 and FR2. |
| Intel | Option 3 |
| CATT | Same as issue 2-3-1. We suggest to use the same value for FR1 and FR2. |
| Nokia | Support option 1. |
| Qualcomm | Option 3. We favor the same value for both FRs. Note that this value should take into account the time the UE needs to prepare for the next gap. This issue is not just about allowing sufficient scheduling time between adjacent gap instances.  To the proponents of option 1, is your proposal valid only between two per-FR2 gap instances?  For FR2, currently the minimum time between adjacent gap instances is ~14 ms. Reducing it to 1ms (option 1) would be a big change. |

#### **Issue 2-3-3: UE behavior during colliding gap occasion**

* Background: Status after last meeting
  + Option 1: Priority rule
    - UE will only do the measurement w.r.t. the gap with higher priority on all colliding occasions
    - The priority can be configurable or fixed
    - FFS whether to resume data scheduling during dropped gap occasions
  + Option 5: Compromised proposal from moderator
    - Introduce gap sharing rule.
      * Request RAN2 to reserve some RRC signaling for different sharing factors.
        + The signalling design may consider the possibility of resuming data scheduling on dropped gaps
      * Rel-17 requirements will only consider sharing ratios 0% and 100%.
      * The requirements for other sharing factors are FFS in later releases.
      * FFS whether the resume scheduling on those dropped gaps as well as the impact to other intra-frequency measurements
* Moderator:
  + As RAN4 already spent a great effort to converge to the 2 options above, I suggest not to go back to re-open other options.
  + Whether to resume data scheduling will be discussed in a separate issue.
* Proposals
  + Option 1: QC, vivo, Xiaomi, LGE, OPPO, Huawei, Ericsson
    - Option 1 in last meeting. Each concurrent MG should be configured with a unique priority
  + Option 5: CATT, Apple, MTK, CMCC, vivo, Xiaomi, LGE, OPPO, Nokia
    - Option 5 in last meeting.
* Recommended WF
  + Collect views from companies.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Option 1  The most important issue for gap overlapping is that both NW and UE should have the clear understanding of each gap where collision happens. On the one hand, UE can easily schedule the measurements based on the NW’s gap indication. On the other hand, NW can schedule the data on the unused gap occasion when collision happens.  It’s better to find a good compromise solution to consider the possible forward compatibility to introduce enhanced mechanism for gap overlapping, especially, when RAN4 considers a greater number of gaps will be supported in the future release, such as MU-SIM gaps and NTN gaps.  Furthermore, if RAN4 further consider network indicated gap in next release, indicating sharing percentage is redundant. On the contrary, the priority indication can be easily extended in the next release to support the network indicated patterns for each gap occasion and easy to extend to support multiple gap types. For example, NW can configure one gap for legacy L3 mobility with priority as ‘1’, one gap for positioning with priority as ‘0’ and two gaps for MUSIM with priority as ‘2’. (‘0’ – the highest priority, ‘2’ – the lowest priority). UE can easily handle the overlapping when receiving the indication from network. |
| ZTE | Compromise to Option 5.  Actually we believe the results of Option 1 and Option 5 is similar since the sharing factor was limited within only 0% and 100%. But considering for the expandability in future, we prefer Option 5. |
| MTK | Ericsson’s points are exactly our argument in the last meeting, but unfortunately still failed to convince all the companies. Therefore, we brought Option 5 as a compromise. We understand that with Option 5, the whole design may not be fully optimized, but this is exactly the spirit of ‘compromise’: we are trying to reach the middle ground between both sides with neither side gets the exact solution they want. |
| CMCC | Option 5. The higher priority of one MG is the same as sharing ratios of 100% for the target MG. From this point of view, option 1 can be considered as a special case of option 5. Secondly, option 5 is more flexible. In Rel-17, we are OK to only consider sharing ratios 0% and 100% taking the limited timeline. But the signaling design can be reserved for different sharing factors for future enhancement. Taking above consideration into account, it is proposed to take option 5 to move forward. |
| Apple | Prefer option 5. Option 1 can be achieved by simply configuring 0% and 100%. If RAN4 needs to consider all the gaps related enhancement in future (e.g. MUSIM, NTN, Positioning and etc), priority rule can be considered in future release. |
| LG Electronics | Preference is Option 1. As Ericsson mentioned, RAN4 need to considerr forward compatibility including MUSIM gap and NTN gap. Option 1 is better in aspect of forward compatibility. |
| vivo | Prefer option 1. |
| Huawei | Option 1.  One benefit of option 1 is that it enables data scheduling on the dropped occasion, which cannot be easily done with sharing factor. Another benefit is the better scalability as it can work when more than 2 MGs are considered.  On option 5, we do not prefer the approach to design signalling based on speculations on what may be defined in the future. For example, as Ericsson commented, if in the future we introduce priority pattern on MG occasion level, the configuration of sharing factor can be redundant or confusing. |
| OPPO | Either option is fine. |
| Xiaomi | Option 1 or option 5, we also think either option can work for more than 2 concurrent gaps including MUSIM gap and NTN gap. |
| Intel | We are also prefer Option 5 |
| CATT | Support option 5, but can also compromise to option 1.  With only considering sharing ration 100% and 0%, the two options are the same at least for this release. |
| Nokia | We are wondering if there is large difference between the option 1 and option 5?  Both options define a sharing/priority rule:  Option 1: priority can be configured or fixed  Option 5: sharing can be fixed in Rel-17 (0% or 100%) or configured (in future)  UE will measure according to sharing/priority:  Option 1: UE measure according to gap with highest priority  Option 5: UE measure according to sharing rules (0% and 100%) in Rel17  Hence, if we consider that in Option 1 the highest priority equals 100% in option 5, we do se the proposals rather similar. However, option 5 then allows further sharing refinement in the future.  Originally, supported a simple approach where the concurrent gap would always be the gap with highest priority and hence always the gap used in case of overlap. We see this approach can be reached with both option 1 an option 5.  Option 5 is preferred. |
| Qualcomm | Our preference is option 1 because of simplicity and because there is no advantage from option 5 if only sharing ratios of 0% and 100% are supported. With option 1 it is straightforward to enable data transfers during the dropped MG instances, which is key to avoid further MG overhead with no added benefit. The priority should be configurable by the network.  Both options may be supported under separate capability if no consensus can be reached. |

#### **Issue 2-3-4: Whether to resume data scheduling on the dropped gap ocassions**

* Proposals
  + Option 1: CATT, QC, MTK, CMCC, LGE, Ericsson, Nokia, Huawei
    - Yes
* Recommended WF
  + Agree on Option 1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Option 1.  When RAN4 defines the requirement based on the overlapping rule, some gap occasions will be disabled. The scheduling issue will be severe when overlapping happens frequently once data scheduling is forbidden for the disabled gaps. More importantly, we can anticipate more and more gaps will be defined in the future release which will have a big impact to the system performance. Both UE and network’s performance will be degraded too much once data scheduling is not permitted when multiple gaps will be introduced. |
| ZTE | Of course support Option 1.  One of the motivation to introduce the collision handling is to decrease the throughput performance degradation due to dense gap occasions, so resume data scheduling on the dropped gap occasions is of course necessary. |
| MTK | Option 1 |
| CMCC | Option 1 |
| Apple | Option 1. |
| LG Electronics | Support Option 1. |
| Vivo | Option 1 |
| Huawei | Option 1 |
| OPPO | Option 1 |
| Xioami | Option 1 |
| Intel | Option 1 |
| CATT | Option 1. |
| Nokia | Support recommended WF |
| Qualcomm | Support the recommended WF. |

#### **Issue 2-3-5: Whether to introduce a UE capability to indicate whether UE supports only 0% and 100% gap sharing ratios or UE supports arbitrary configured sharing ratios. (If Option 5 in Issue 2-3-3 is agreed)**

* Proposals
  + Option 1: MTK
    - Yes
* Recommended WF
  + Collect views from companies

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Not support.  Same comments as issue 2-3-3. |
| ZTE | Not support Option 1.  Even though other sharing ratios except for 0% and 100% are supported, which value of sharing ratios should be configured, it is up to NW implementation, not need any additional UE capability. |
| MTK | The intention of bringing this up is to consider the later confusion in testing. If there is a clear UE capability to reflect the existing RAN4 requirement, we can avoid the confusion in the market. But we are open to listen to companies’ views. |
| CMCC | Not OK with option 1. Currently, for existing MG, we already have gap sharing mechanism with no UE capability. The similar approach can be reused for multiple gaps. No need to introduce UE capabilities. |
| Apple | we are open to this. UE with this capability doesn’t need to implement other sharing factor. |
| LG Electronics | At first, Issue 2-3-5 needs to be concluded. Additional capability is not needed even for Option 5. |
| Vivo | FFS |
| Huawei | Pending on issue 2-3-3. |
| OPPO | Pending on issue 2-3-3. |
| Xiaomi | No need to introduce such UE capability. |
| Intel | Pending on issue 2-3-3. |
| CATT | No need to introduce the UE capability. |
| Nokia | Do not support option 1.  In Rel-17 only 0% and 100% is supported (part of compromise option 5 in issue 2-3-3.  No need to discuss in Rel-17 assuming a Rel-17 UE only support 0 or 100%. If further sharing options are introduced in the future – including UE requirements - RAN4 can discuss which numbers and how to indicate such support at that point in time. |
| Qualcomm | Depends on the outcome of issue 2-3-3. |

#### **Issue 2-3-6: Detail gap sharing ratios (If Option 5 in Issue 2-3-5 is agreed)**

* Proposals
  + Option 1: MTK
    - Send an LS to RAN2 with the suggested gap sharing ratios 0%, 25%, 50%, 75% and 100%.
    - For per-UE gap case, one gap sharing ratio can be defined between the 2 per-UE gaps.
    - For per-FR gap case, 2 gap sharing ratios can be configured for FR1 and FR2, respectively.
* Recommended WF
  + Collect views from companies

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Not support.  Same comments as issue 2-3-3. |
| ZTE | Support Option 1. |
| MTK | Support Option 1, if Option 5 in Issue 2-3-5 is agreed.  This is the part missing right now and needs to be implemented by RAN2, if Option 5 in Issue 2-3-5 is agreed. |
| Apple | Support option 1. |
| LG Electronics | At first, Issue 2-3-5 needs to be concluded. |
| Vivo | Can discuss it after issue 2-3-5 is solved |
| Huawei | Pending on issue 2-3-3. |
| Xiaomi | Fine with option 1, and propose to add one more bullet if option 2a is agreed in issue 2-2-1.   * For per-FR capable UE, one gap sharing ratio can be defined between one per-UE gap and one per-FR gap. |
| Intel | Pending on issue 2-3-3. |
| CATT | Pending on issue 2-3-3. |
| Nokia | We do not support option 1.  RAN4 shall only indicate support of 0% and 100% in Rel-17. Introduction of other sharing factors can be discussed further – including the sharing factors. RAN4 can indicate that 0% and 100% is supported in Rel-17 and other may be supported in the future. How then to design the related signaling can be left to RAN2. |
| Qualcomm | Depends on the outcome of issue 2-3-3. |

#### **Issue 2-3-7: Whether to introduce FO, FPO, PFO, PPO scenarios.**

* Proposals
  + Option 1: CATT, CMCC, vivo, [Nokia]
    - Introduce all scenarios
  + Option 2: QC, Xiaomi, [Intel]
    - Only introduce PFO, PPO scenarios
  + Option 3: Nokia
    - Only introduce FO, FPO scenarios
* Recommended WF
  + Collect views from companies

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Option 1.  Once proximity condition and overlapping rule is defined, both UE and NW will have a clear understanding on gap usage when overlapping happens. RAN4 doesn’t need to further spend time to consider which scenarios will be NOT defined. |
| MTK | We share similar view as Ericsson that the general colliding rule can help to cover all scenarios.  Sametime, we also understand that in the end some of the scenario, like FO, FPO, will be kind of redundant in fact. We are fine to either keep them or remove them, but we do not think this is a very important issue at this moment. |
| CMCC | Option 1.  To MTK, we would like to know why FO, FPO, will be kind of redundant in fact. |
| Apple | Support option 1, if sharing factor in previous issues is agreed. We mentioned similar observation with MTK and Ericsson in prevous meeting. |
| LG Electronics | Option 1 can be supported. |
| Vivo | Support option 1 |
| Huawei | Option 1.  The collision handling rule is generic so it can work for all scenarios. We do not see RAN4 needs to spend further efforts in excluding scenarios which can be already supported by the spec. It can be left to NW implementation. |
| OPPO | Option 1 is fine. |
| Xiaomi | Prefer option 2, can compromise to option 1 if the general colliding rules are defined. And similar view as MTK, we do not think it is beneficial to configure concurrent gaps for FO and FPO cases. |
| Intel | Option 2.  The general scenarios can be enough. And we need not to introduce too many scenarios which could result in heavier standardization works loading. |
| CATT | Option 1.  All the scenarios are similar, there is no need to have further limitation. |
| Nokia | Option 3  We see that this would depend on the outcome of the issue 2-3-3 discussion.  Our understanding is that if agreement is that RAN4 support option 5 with 0% and 100% there seems to us only to be either overlap or no overlap. Overlap can then be in every gap instance (FO) or only some instances (FPO).  if a gap is PFO and one gap has 100% - only 1 gap will be measured and hence it is similar to FPO. |
| Qualcomm | Option 2. With the proposed rules for handling collisions in issue 2-3-3 (with 0% and 100% sharing ratios on option 5), FO and FPO gaps reduce to a single gap pattern. |

#### **Issue 2-3-8: Whether to introduce UE capability for different overlapping scenarios (FO, FPO, PFO, PPO).**

* Proposals
  + Option 1: QC
    - Support of colliding MG would be subject to additional UE capability
* Recommended WF
  + Collect views from companies

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Not support.  Once proximity condition and overlapping rule is defined, both UE and NW will have a clear understanding on gap usage when overlapping happens. RAN4 doesn’t need to further spend time to consider which scenarios will be NOT defined. |
| MTK | Do not support Option 1.  The comment is similar to Issue 2-3-7. |
| Apple | We are open to this. Similar with issue 2-3-5 |
| LG Electronics | Not support Option 1. |
| vivo | Do not support option 1. Do not see benefit to introduce UE capabilities on this dimension |
| Huawei | We do not support option 1.  In our view, UE supporting concurrent MGs should also support the collision handling, and this is the very reason RAN4 spent efforts in defining the collision handling rule. |
| OPPO | Do not support additional UE capability. |
| Xiaomi | Do not support option 1. |
| Intel | Do not support additional UE capability. |
| CATT | Not support option 1. |
| Nokia | We see it better for RAN4 to reach agreement. Our current view is that RAN4 agreed on collision rule in last meeting (now discussing the X value). We believe that if RAN4 can agree on simple sharing/priority rule (as discussed in 2-3-3) this should result in fully overlap or not and only additionally whether it occurs at every gap occasion or not.  This should simplify the complexity and no capability should be necessary besides UE support concurrent gap or not. |
| Qualcomm | Option 1. Since there is no strong consensus on which colliding patterns should be supported or regarding the rules for handling such collisions, adding support via a separate capability could be way to move forward. |

### Sub-topic 2-4: Overhead

#### **Issue 2-4-1: Whether to define the overhead cap**

* Proposals
  + Option 1: Apple, vivo, LGE, Huawei
    - Yes
  + Option 2: CATT, QC, CMCC, Intel, Ericsson, Nokia, ZTE
    - No
  + Option 3: Apple, MTK, vivo
    - Up to UE capability
* Recommended WF
  + Collect views from companies

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| **Company** | **Comments** |
| Ericsson | Option 2.  Whether to define an overhead cap is related to restrict the configuration from network side. On the one hand, network can manage this cap and tradeoff between the throughput loss and measurement gaps’ configuration. On the other hand, there is no significant throughput loss for UE compared with the legacy MG once data scheduling is assumed on the dropping gap occasions. |
| ZTE | Option 2.  The overhead can fully controlled by NW. Further more, with the help of collision handling, which can alleviate the throughput deterioration caused by too heavy overhead of gaps. Therefore, throughput loss caused by concurrent gaps is more controllable, so we think define an overhead cap is unnecessary. |
| MTK | We are fine with either one.  Option 1 brings us the benefit to remove some of the useless configurations. This can help to speed up the development of product and time spent for verification.  Option 2 also has its point. We believe that both network and UE cares about the throughput drop due to measurement gap overhead. So we are fine to leave this to network to decide.  However, as this issue has been discussed for a very long time, we cannot help but bring this capability based solution as a middle ground between 2 camps. |
| CMCC | Option 2. Our consideration is not necessary to have this cap, which can be left to network implementation |
| Apple | Support option 1 and 3. Disagree with option 2.  UE complexity is not considered in arguments from proponents of option 2. We understand that companies are asking for NW flexibility. However, such flexibility comes at the price of UE complexity without attractive gain. |
| LG Electronics | Option 1.  When gaps are not overlapped based on proximity rule, overhead cap is eneficial to reduce throughput loss. |
| Vivo | Support option 1 and 3. |
| Huawei | Option 1.  It is the UE who will suffer the throughput loss due to large overhead of concurrent MGs, while NW can use the time resource to schedule other UEs, i.e. there may be not much cost from NW perspective even the MG overhead is large at individual UEs. |
| Xiaomi | Fine with option 1 and 3 |
| Intel | Option 2 |
| CATT | Option 2.  We think this should be left to NW implementation. And also with the proximity condition of collision, the gap interval has been guaranteed, and we think there is no need to further define the overhead. |
| Nokia | Option 2.  But it may depend on the agreements related to the former issues e.g. like 2-3-3. We are open to discuss the UE complexity and how gap overlap depends taking into account aspects discussed in other issues. |
| Qualcomm | Option 2. Even though we agree that MG overhead should be limited to reasonable levels, we don’t see a strong need to specify a cap. |

#### **Issue 2-4-2: Definition of overhead cap (if agreed in Issue 2-4-1)**

* Proposals
  + Option 1: Apple, vivo, MTK
    - The max overhead that UE can support in Rel-15/16
  + Option 2: LGE
    - Consider overhead cap with when configuring multiple MG patterns.
      * + N : number of multiple MG patterns
        + MGLr : MGL of referenced MG
        + MGRPr : MGRP of referenced MG
        + K is FFS
  + Option 3: Apple, Huawei
    - When concurrent MGs are configured, the MGRP for each MG cannot be smaller than 40ms
* Recommended WF
  + Collect views from companies

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| **Company** | **Comments** |
| Ericsson | Postpone the discussion after agreeing 2-4-1. |
| ZTE | Wait for the outcome of Issue 2-4-1. |
| MTK | We are fine with Option 1 and 3. |
| Apple | Fine with either option 1 or 3. |
| LG Electronics | If yes in Issue2-4-1, preference is Option 2. |
| vivo | Option 1 is more straightforward if the overhead is defined |
| Huawei | Option 3, if option 1 or 3 is agreed for Issue 2-4-1.  On option 1, we think it is valid but maybe a bit restrictive. E.g. if a UE does not support 20ms MGRP, then max overhead for this UE in Rel-15/16 would be based on GP#0. NW could then not configure the UE with one MG with GP#0 for RRM measurement and another MG with 160ms MGRP (e.g. GP#25) for PRS measurement, which is a basic use case for concurrent MGs. |
| Xiaomi | Option1 or 3 is fine to us. |
| Intel | Pending on issue 2-4-1 |
| Nokia | Wait for further progress on other issues like 2-3-3 and 2-4-1 |
| Qualcomm | Note that MG overhead should take into account gap collisions/overlap (and whether data transfers are enabled in dropped gaps instances) and that MG configurations may be different for each FR (with per-FR MG). |

### Sub-topic 2-5: Measurement requirements

Moderator: There are many different proposals on how to specify the requirement. It is difficult to put all proposals within the same issues for discussion. Therefore, Moderator will separate the discussions in to 2 parts: measurement outside gap and within gap. In each part, we further discuss how the CSSF, Kp should be revised and other issues.

#### **Issue 2-5-1: [Outside gap] CSSF**

* Proposals
  + Option 1: MTK
    - The definitions for the applicable measurement types specified in Section 9.1.5.1 for CSSF outside gap can be re-used as a starting point with the modification to consider more than 1 measurement gaps
* Recommended WF
  + Collect views from companies

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| **Company** | **Comments** |
| Ericsson | Fine with Option 1 |
| ZTE | We believe some further solutions were proposed by multiple companies including us. First, only all MOs without gap should be considered in this issue, we called them the target MOs. Then we try to summarize into two cases:  Case 1: If the association between the target MOs and concurrent gaps is not given by NW  Re-using the definition of CSSF outside gap in Section 9.1.5.1. Further more, modify the definition of Kp for NR intra-frequency measurements without gaps as follows: Kp is the reciprocal of the fraction of SMTC occasions that do not overlap with measurement gaps.  Case 2: If the association between the target MOs and concurrent gaps is given by NW  Re-using the definition of CSSF outside gap in Section 9.1.5.1. For the determination of Kp, Kp = 1/(1- (SMTC period /MGRP\_associated)). |
| MTK | Option 1 is very straightforward to us.  To ZTE, we are not sure why we still need association between MO and gap, if the MO is to be measured outside gap. |
| CMCC | OK with option 1. |
| Apple | Option 1 is fine.  To ZTE, case 1/2 needs further discussion. if target MO cannot be covered by any gaps. It is straightforward for NW NOT to provide the association and UE can only measure it outside gaps. But if target MO can be covered by some MGP while somehow NW doesn’t provide association, we encourage companies also discuss this case, as also raised by RAN2 in their LS. |
| Huawei | We can support option 1.  In our view, whether an MO should be measured with or without MG is not changed due to concurrent MGs, expect that overlapping with MG should now consider both MGs. This is the case no matter association between MG and MO (or use case or freq layer) is provided or not. |
| Xiaomi | Fine with option 1 |
| Intel | Option 1 is fine for us. |
| CATT | Support option 1.  Share the same view as Huawei. Whether an MO should be measured with or without MG is not changed due to concurrent MGs. What need to consider due to concurrent gap is the overlapping condition. |
| Nokia | Maybe MTK can clarify: CSSF outside gaps in section 9.1.5.1. Our understanding is that this section captures CSSF for measurements performed without gaps?  However, this WI is about concurrent measurement gaps. We may not fully understand has gap assisted measurement performed using concurrent impact CSSF outside gaps – perhaps this issue description can be clarified?  We somehow also see that this would depend on the sharing/priority rule. But in general we are fine using existing requirements as baseline starting point. |
| Qualcomm | OK with option 1. |

#### **Issue 2-5-2: [Outside gap] Kp**

* Proposals
  + Option 1: QC
    - Kp is the reciprocal of the fraction of SMTC occasions that do not overlap with measurement gaps
  + Option 2: MTK
    - The Kp value for the frequency layers to be measured outside gap is defined as Kp = Noriginal / Nremaining, where
      * Noriginal is the number of original SMTC occasions without considering gap within a [160ms] window.
      * Nremaining is the number of remaining SMTC occasions not collided with measurement gap within a [160ms] window
      * The [160ms] window starts from the beginning of a SMTC occasion of the target frequency
  + Option 3: vivo
    - Principle for L1 measurement could be reused
  + Option 4: Xiaomi
    - When SMTC occasion is partially overlapping with both concurrent gaps, the scaling factor Kp = , where MGRP1 and MGRP2 is the MGRP of concurrent gaps.
  + Option 5: Ericsson
    - When all the MG occasions of the MGP with lower priority are overlapped by other MGP(s), the MGP with lower priority will be disabled.
    - When none of the MG occasions of the MGP with lower priority are overlapped by other MGP(s), .
    - Otherwise,
      * When both MGs are overlapping with the SMTC,
      * When MG with lower priority is overlapping with the SMTC, but MG with higher priority isn’t overlapping with the SMTC,
      * When MG with lower priority isn’t overlapping with the SMTC, but MG with higher priority is overlapping with the SMTC,
  + Option 6: Nokia
    - The existing sharing rule applies as general principle.
  + Option 7: Huawei
    - If the SMTC windows or CSI-RS resources are fully non-overlapped with any of the concurrent MGs, the existing measurement period requirements can be re-used.
    - If the SMTC windows or CSI-RS resources are partially overlapped with one or both of the concurrent MGs, the measurement will be performed outside MG.
    - Kp = Ntotal / Navailable, where Ntotal is the total number of SMTC windows or CSI-RS resource occasions during T, and Navailable is the number of SMTC windows or CSI-RS resource occasions that are not overlapped with any MG occasion during T, and T = max(TSMTC, MGRP1, MGPR2).
    - If the SMTC windows are fully overlapped with one or both of the concurrent MGs, the measurement will be performed with MG.
* Recommended WF
  + Moderator: It seems that companies’ proposals follow a similar principle but have different level of detail and different way to present the solution. To speed up the discussion, moderator tried to provide a harmonized proposal, as below. Companies are encouraged to directly comment to the harmonized proposal:
    - The Kp value for the frequency layers to be measured outside gap is defined as Kp = Ntotal / Navailable
      * Ntotal is the total number of SMTC occasions or CSI-RS resource occasions without considering MG overlapping during a window T
      * Navailable is the number of SMTC occasions or CSI-RS resource occasions that are not overlapped with any MG occasion during a window T.
      * The window T has the duration max(TSMTC, MGRP1, MGPR2) and starts from the beginning of a SMTC occasion of the target frequency

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| **Company** | **Comments** |
| Ericsson | The recommended WF seems too general and very vague on the CSSF calculation which will result in the overall delay requirement is unclear. In other words, we prefer to have a clear definition if RAN4 can find the clear equation. |
| ZTE | Same as the analysis in Issue 2-5-1 |
| MTK | We support the recommended WF which tries to make the requirement general to be extended for other WI (NTN, MUSIM) or even later releases.  To Ericsson, defining a very clear equation could get more and more complicated if we consider other WIs, like MUSIM. E.g., if we consider 3 more gaps introduced by MUSIM, we may have the occasions collided by 2, 3, 4, and 5 gaps. There are too many combinations to be investigated and we are even not sure if RAN4 has the time to finish the work. |
| Apple | Since only up to two MG patterns (within each FR) are to be covered by RAN4 requirements in this release, it is still possible to specify clear equation. However, we do understand the concern from moderator. In future more and more concurrent patterns are to be supported. RAN4 may eventually end with such high level description. Therefore, we are also fine with doing this from now on. |
| vivo | Ok with the principle and framework of the recommended WF. Detailed information needs more time to check |
| Huawei | Support the recommended WF.  To Ericsson, we understand the recommended WF gives a clear definition to Kp, i.e. we can always derive a numerical value for Kp for a given SMTC/MG configuration, so we are not sure why it leads to unclear requirement. |
| OPPO | Generally, the logic in the recommended WF is fine. We can further discuss how to capture them in the spec in a cleared way. |
| Xiaomi | Fine with the general principle and description on the Kp calculation, but for 2 concurrent gap case, it is preferred to use the specific equation. |
| Intel | Support the recommended WF |
| CATT | Fine with the recommended WF. |
| Nokia | Initially we ask the question: this is Kp for measurements outside gaps while WI is discussing concurrent measurement gaps. Hence, how does that impact requirement for measurement outside gaps?  Following is then conditioned the answer to the question.  Depending on the outcome of the sharing/priority discussion in 2-3-3 this may be a matter of having a simple relative ‘collision’ scaling.  For example, if we have FPO in every second occasion and we have 100% sharing/priority for Concurrent gaps, we assume it should be enough to scale the non-concurrent measurements with a factor 2. This may be the same as option 1 and the recommended WF?  However, as it depends on the former discussions, we would need to have agreement on those aspects before this can be concluded. The WF also need a bit more clarification on the parameters. |
| Qualcomm | We suggest converging on the definition for SSB first and then modifying it accordingly for CSI-RS.  For SSB, we suggest the following modifications to the recommended WF:   * The Kp value for a SSB frequency layer to be measured outside gap is defined as Kp = Ntotal / Navailable * For a window W of duration max(TSMTC, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the SSB frequency layer, and starting at the beginning of any SMTC occasion:   + Ntotal is the total number of SMTC occasions within the window, ignoring any overlap with MG occasions within the window, and   + Navailable is the number of SMTC occasions that are not overlapped with any MG occasion within the window W, after accounting for MG collisions by applying the selected gap collision rule. |

#### **Issue 2-5-3: [Within gap] CSSF**

* Proposals
  + Option 1: Apple, Huawei, CATT, vivo
    - The CSSF is calculated separately for each gap pattern, [provided that the association between measurement objects and gap pattern is configured by network. Only the measurement objects associated to the same measurement gap pattern are counted when deriving CSSFwithin\_gap,i for a target measurement object with index *i*.]
  + Option 2: QC
    - Modify the definition of Ri for CSSFwithin\_gap,i as follows: Ri is the maximal ratio of the number of measurement gap where measurement object i is a candidate to be measured over the number of measurement gap where measurement object i is a candidate and not used for a long-periodicity measurement defined above and not dropped due to measurement gap collisions.
* Recommended WF
  + Collect views from companies

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| **Company** | **Comments** |
| Ericsson | Option 1 which align with the agreements in last meeting. |
| ZTE | Support Option 1. |
| MTK | We support Option 1.  We can also support Option 2 with some modifications. In our view, Option 2 is trying to say that if a gap occasion j is dropped for a MO i, then we do not need to consider the gap occasion j when calculating the CSSF of MO i. This makes sense to us, but they way to determine the dropped gap can be FFS. |
| CMCC | Support option 1. |
| Apple | Support option 1. |
| vivo | OK with option 1. |
| Huawei | Support option 1.  On option 2 we suggest FFS, as in our view for deriving Ri, both the number of total MG occasions and the number available MG occasions should only count the occasions not dropped. |
| Xiaomi | Fine with option 1 |
| Intel | Option 1 |
| CATT | Support option 1. |
| Nokia | We can conditionally support Option 1 (without text in []). However, we would like to discuss the text in [] as it may need some clarification.  E.g. for classical gaps (legacy non-concurrent) is not configured with a measurement gap association. And we should not change this or related assumptions. |
| Qualcomm | Options 1 and 2 address different aspects. Option 1 is consistent with an existing RAN4 agreement. Option 2 clarifies how to handle MG collisions in the calculation of CSSF. Both options can be supported. |

#### **Issue 2-5-4: [Within gap] MGRP**

* Proposals
  + Option 1: MTK
    - In the delay requirements of measurements within gap, indicate which MGRP to be selected between 2 configured measurement gaps.
* Recommended WF
  + Collect views from companies

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| **Company** | **Comments** |
| Ericsson | Fine with option 1. |
| ZTE | Support Option 1. |
| MTK | Support Option 1 |
| Apple | Support option 1. |
| Vivo | Ok with option 1 |
| Huawei | Support Option 1 |
| Intel | Option 1 |
| CATT | Fine with option 1. |
| Nokia | Option 1 seems agreeable |
| Qualcomm | When the network provides explicit association of the MO with a concurrent MG, use the corresponding MGRP.  When no association is provided by the network, if the MO can only be a measured within one of the concurrent MGs, use the MGRP of the applicable MG. However, when no association is provided by the network, there may be cases in which a MO could be measured within gap instances from two overlapping concurrent MGs with different MGRPs. Those cases are FFS. |

#### **Issue 2-5-5: [Within gap] Kp**

* Proposals
  + Option 1: MTK
    - Introduce the Kp value to address the issue of dropped gap occasions due to gap collision. The Kp value for the frequency layers to be measured within gap is defined as Kp = Noriginal / Nremaining, where
      * Noriginal is the number of original associated gap occasions covering the target SMTC without considering the other measurement gaps within a [160ms] window
      * Nremaining is the number of remaining associated gap occasions covering the target SMTC by removing the dropped gap occasions within a [160ms] window
      * The [160ms] window starts from the beginning of an associated gap occasion covering the SMTC occasion of the target frequency
  + Option 2: Xiaomi
    - For the measurement within the concurrent gap with priority or 100% gap sharing, the existing measurement delay requirement within gap is applied.
    - For the measurement within the concurrent gap with low priority or 0% gap sharing, the measurement delay would be extended by a scaling factor of 1/(1-MGRP1/MGRP2), where MGRP1 is the MGRP of prioritized concurrent gap or the MGRP of concurrent gap with 100% gap sharing, and the MGRP2 is the MGRP of deprioritized concurrent gap or the MGRP of concurrent gap with 0% gap sharing.
  + Option 3: Ericsson
    - When none of the MG occasions of the MGP with lower priority are overlapped by other MGP(s), Kgap = 1.
    - When all of the MG occasions of the MGP with lower priority are overlapped by other MGP(s), the MGP with lower priority will be disabled.
    - Otherwise, Kgap will be applied to the MG with lower priority and equals.
  + Option 4: Nokia
    - When the C-MG collide with and have to share the gap opportunities with legacy gaps RAN4 can apply same principles as for legacy for each GP
  + Option 5: ZTE
    - Not need any new solution. Just re-using the mechanism of CSSFwithin\_gap,i in legacy Rel-16 for each gap is enough. All MOs/frequency layers with gap associated with a same gap would participate in the sharing of this gap.
  + Option 6: Huawei
    - Impact of the MG colliding can be discussed after collision handling is settled.
* Recommended WF
  + Moderator: The situation is similar to Issue 2-5-2. To speed up the discussion, moderator tried to provide a harmonized proposal, as below. Companies are encouraged to directly comment to the harmonized proposal:
    - Introduce a Kgap value to address the issue of dropped gap occasions due to gap collision. For the frequency layers to be measured outside gap is defined as Kgap = Ntotal / Navailable
      * Ntotal is the total number of gap occasions covering target SMTC occasions or CSI-RS resource occasions without considering MG overlapping during a window T
      * Navailable is the number of gap occasions covering target SMTC occasions or CSI-RS resource occasions, and these occasions are not overlapped with any MG occasion during a window T.
        + When Navailable =0, the MGP is disabled.
      * The window T has the duration max(TSMTC, MGRP1, MGPR2) and starts from the beginning of a gap occasions covering target SMTC of the target frequency

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| **Company** | **Comments** |
| Ericsson | The recommended WF seems too general and very vague on the CSSF calculation which will result in the overall delay requirement is unclear. In other words, we prefer to have a clear definition if RAN4 can find the clear equation. |
| ZTE | Fine with the recommended WF. |
| MTK | We support the recommended WF.  The comments are the same as we provided in Issue 2-5-3. |
| Apple | Support the recommended WF. Same comments with issue 2-5-2. |
| vivo | Ok with the WF. |
| Huawei | We support the Recommended WF in general but details are pending on issue 2-3-3.  If priority based approach is agreed in 2-3-3 (which is our proposal), then only the occasions of the low priority MG will be dropped when colliding with high priority MG, i.e. for high priority MG, Kgap = 1. |
| Xiaomi | Fine with the general principle and description on the Kp calculation, but for 2 concurrent gap case, it is preferred to use the specific equation. |
| Intel | Support the recommended WF. |
| CATT | Fine with the recommended WF. |
| Nokia | If this is following the principle of sharing/prioritizing the gaps according to the sharing/priority rule and scale accordingly, it is likely fine as baseline.  However, as also mentioned by Ericsson we would like more details on the parameters etc. Additionally, it also depends on other issues under discussion. |
| Qualcomm | This issue is the complement of issue 2-5-2. Once there’s an agreement for that issue the same logic can be extended to this one. |

### Sub-topic 2-6: Impact to other L1 measurements

#### **Issue 2-6-1: P factor of L1 measurement**

* Proposals
  + Option 1: QC
    - Modify the definition of the P scaling factor for L1-RSRP measurements: P is the reciprocal of the fraction of SSB (or CSI-RS) occasions that do not overlap with measurement gaps.
  + Option 2: MTK
    - When there are still some L1 RS occasions not overlapped by measurement gaps and intra-frequency SMTC in FR2, the P factor for L1 measurements equals Noriginal / Nremaining, where
      * Noriginal is the number of original RS occasions without considering measurement gaps nor intra-frequency SMTC occasions within a [160ms] window.
      * Nremaining is the number of remaining RS occasions not fully nor partially collided with measurement gap or intra-frequency SMTC occasions within a [160ms] window
      * The [160ms] window starts from the beginning of a slot with the target RS occasion
    - In FR1 or when there are no L1 RS occasions not overlapped by measurement gaps and intra-frequency SMTC in FR2, the P factor for L1 measurements equals Psharing factor x Noriginal / Nremaining, where
      * Noriginal is the number of original RS occasions without considering measurement gaps nor intra-frequency SMTC occasions within a [160ms] window.
      * Nremaining is the number of remaining RS occasions not fully nor partially collided with measurement gap within a [160ms] window
      * The [160ms] window starts from the beginning of a slot with the target RS occasion
  + Option 3: Huawei
    - Re-use the existing requirements for L1 measurement with the updated calculation for P factor as follows:
      * For L1 measurement in FR1, P = Ntotal / Navailable
      * For L1 measurement in FR2,
        + P = Psharing \* Ntotal / Noutside\_MG, if Navailable = 0
        + P = Ntotal / Navailable, if Navailable > 0
      * where, Ntotal is the total number of L1 resource occasions during T, Noutside\_MG is the number of L1 resource occasions not overlapped with any MG occasion during T, Navailable is the number of L1 resource occasions not overlapped with any MG occasion or any SMTC window during T, and T = max(TL1, MGRP1, MGPR2)
* Recommended WF
  + The situation is similar to Issue 2-5-2. To speed up the discussion, moderator tried to provide a harmonized proposal, as below. Companies are encouraged to directly comment to the harmonized proposal:
    - The P factor for L1 measurements equals
      * Ntotal / Navailable in FR1
      * Psharing \* Ntotal / Noutside\_MG in FR2 with Navailable = 0
      * Ntotal / Navailable in FR2 with Navailable > 0
      * Where
        + Ntotal is the total number of L1 resource occasions without considering measurement gaps nor intra-frequency SMTC occasions during a window T
        + Noutside\_MG is the number of L1 resource occasions not overlapped with any MG occasions during a window T,
        + Navailable is the number of L1 resource occasions not overlapped with any MG occasions nor any SMTC occasions during T,
        + The window T has the duration max(TL1, MGRP1, MGPR2) and starts from the beginning of a L1 resource occasion

TL1 is periodicity of the target L1 RS.

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| **Company** | **Comments** |
| Ericsson | Postpone the discussing after RAN4 has a clear equation on L3 measurement requirement. |
| ZTE | Fine with the recommended WF. |
| MTK | We support the recommended WF.  If companies understand the principle for Kp in Issue 2-5-2 and Issue 2-5-5, it requires only a very small step extension to L1 requirement. We are open to check companies’ views to make the WF better. |
| Apple | Fine with the recommended WF. Same comments with 2-5-2. |
| Huawei | We support the recommended WF. |
| OPPO | Fine with the recommended WF. |
| Xiaomi | Fine with the recommended WF. |
| Intel | Support the recommended WF |
| Nokia | This can wait until L3 is more clear. |
| Qualcomm | Similar to issue 2-5-2. Once there’s an agreement for that issue the same logic can be extended to this one. |

### Sub-topic 2-7: Others

#### **Issue 2-7-1: Whether to to specify transient UE behavior when concurrent MGs are re-configured**

* Proposals
  + Option 1: Apple, QC, Intel, Huawei
    - No
  + Option 2: Ericsson
    - UE will continue the measurement by MGP2 and meet the corresponding measurement requirement based on MGP2 during this measurement period once the MO1 is reconfigured to be measured using MGP2.
    - UE will perform the measurement on MO2 using MGP2 immediately after the concurrent gaps’ reconfiguration, if MO2 can’t be measured by MGP1 due to gap offset or if gap length is not enough.
    - After one of concurrent gaps deconfiguration, data scheduling is expected on this disabled MG’s time occasions.
* Recommended WF
  + Collect views from companies

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| **Company** | **Comments** |
| Ericsson | From our understanding, the transient requirement should be clearly defined similar as single MG. Network should clearly understand UE’s behaviour during the transient period. |
| MTK | Support Option 1.  We do not see the need to specify the behavior. UE should follow the new requirement after RRC processing time. |
| Apple | Support option 1. we don’t think we shall mandate any UE behavior in this RRC procedure. |
| vivo | Support option 1 |
| Huawei | Option 1.  For the configuration and de-configuration of concurrent MGs, there is no difference compared to those of a single MG in Rel-15 (or in LTE). Since there has been no requirement defined for the transition, we do not see a clear need to define UE measurement behaviour after transition between concurrent MGs and single MG or between concurrent MGs and no MG. |
| Xiaomi | Option 1 |
| Intel | Option 1 |
| CATT | Support option 1. |
| Nokia | Option 1. We do not see a need for this. Once a GP is de-configured the UE stop the related gap assisted measurements. This is the current approach when using classical MGs and can also be applied to concurrent MGs |
| Qualcomm | Option 1. This issue is not specific to concurrent MG. There are no such requirements for transient behavior when legacy MG is reconfigured. |

### Sub-topic 2-8: RAN4 reply to RAN2 LS R2-2111472

#### **Issue 2-8-1: Confirmation to RAN2’s understanding**

* Background

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| … RAN2 has discussed the operation and limitation for concurrent gap and reached the following agreements.   * RAN2 confirms the following understanding for concurrent gap operation:   1. Concurrent gaps are multiple measurement gaps and each gap pattern could be associated with one or multiple frequency layers.  2. Each frequency layer can be associated with only one of the concurrent gaps.  3. Without considering pre-configured MG, concurrent gaps are always activated if it is setup by the network.  4. No new gap pattern is introduced for concurrent gap, the existing R15/R16 gap pattern could be configured for the concurrent gaps.   * RAN2 to clarify “frequency layer” and limitations as below:   PRS measurement can be associated with one gap pattern, no matter how many frequencies are measured for PRS.  Each measured SSB or LTE frequency is considered as one frequency layer.  Measured CSI-RS resources with the same center frequency is considered as one frequency layer. It is possible to have Multiple MOs including CSI-RS resources with same center frequency.  SSB and CSI-RS measurement in one MO are considered as different frequency layers.  Firstly, RAN2 would like to confirm with RAN4 that the above understanding is correct. |

* Proposals
  + Option 1: CATT, MTK
    - Confirm to RAN2 that the understanding in the LS is correct
  + Option 2: Apple, Huawei
    - RAN4 confirms all above understanding is correct, but different MOs with CSI-RS resources are considered as different frequency layers, no matter if the CSI-RS resources are with same or different centre frequencies.
  + Option 3: Nokia
    - Reply and confirm to RAN2 according to above discussion TP. Additionally, clarify to RAN2 on the Issues not yet explicitly agreed in RAN4 yet.
    - For concurrent measurement gaps, UE is configured with more than one MO including CSI-RS resources with the same center frequency.
* Recommended WF
  + Collect views from companies

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| **Company** | **Comments** |
| Ericsson | Option 1 and 2 |
| ZTE | Support Option 1 and Option 2. |
| MTK | We are fine with Option 2 |
| Apple | Support option 2. |
| vivo | Option 1 and option 2 |
| Huawei | Option 2. |
| OPPO | Option 1 or 2.   * Measured CSI-RS resources with the same center frequency and same/different BWs is considered as one frequency layer. * Different MOs with CSI-RS resources are considered as different frequency layers |
| Xiaomi | Option 2 |
| Intel | Option 2 |
| CATT | Support option 1.  Option 2 seems not consistent with the following sentence:  “It is possible to have Multiple MOs including CSI-RS resources with same center frequency.” |
| Nokia | We cannot fully agree without some further details as also raised during the discussion:  Each measured SSB or LTE frequency is considered as one frequency layer.  Partly yes.  RAN4 has agreed that SSB, CSI-RS and PRS are treated as different frequency layers.  However, there is no explicit agreement that a measured LTE frequency is considered as one frequency layer.  RAN4 need to indicate that layer includes also LTE carrier.  Measured CSI-RS resources with the same center frequency is considered as one frequency layer. It is possible to have Multiple MOs including CSI-RS resources with same center frequency.  RAN4 has no explicit agreement related to whether measured CSI-RS resources with the same center frequency is considered as one frequency layer. RAN4 has agreed that SSB, CSI-RS and PRS are treated as different frequency layers.  RAN4 has not excluded that it is possible to have multiple MOs including CSI-RS resources with same center frequency.  Hence, RAN4 need to agree on this (one proposal is in Option 2) |
| Qualcomm | Option 1. Could the proponents of option 2 clarify the motivation? |

#### **Issue 2-8-2: RAN4 response to Q1**

* Background

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| **Q1 –** Can Rel-17 concurrent gaps be configured together with legacy gap? If ‘yes’, what would be the UE behavior? |

* Proposals
  + Option 1: CATT, Huawei
    - Rel-17 concurrent gaps cannot be configured together with legacy gap
  + Option 2: Apple
    - Yes. For the MOs without the association, UE shall conduct measurement using the legacy MG.
  + Option 2a: Nokia
    - UE can be configured with one legacy gap pattern and additional concurrent measurement gaps patterns reaching the maximum gap configuration limitation
    - UE can be configured with one or more concurrent measurement gap patterns reaching the maximum gap configuration limitation
  + Option 3: QC, vivo
    - Possible, but no benefit. Gap priority and association may be missing for legacy gap. Extra RAN4 work is needed to define new UE behaviours.
  + Option 4: MTK
    - Up to RAN2, as long as the associations are provided to all gaps
  + Option 5: Ericsson
    - Up to RAN2, as long as the associations are clear to concurrent gaps
* Recommended WF
  + Moderator: the controversial point seems on the lack of association to legacy gap. In moderator’s understanding, it is also possible to associate a MO to a legacy gap, if RAN2 wants to do so. Therefore, Moderator suggest proceeding with the following WF:
    - If RAN2 decides to introduce gap association and [sharing ratio or priority] to legacy gap, Rel-17 concurrent gaps can be configured together with legacy gap. Otherwise, they cannot.

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| **Company** | **Comments** |
| Ericsson | Option 5.  RAN2 only need to introduce the association to the new concurrent gap and doesn’t need to further introduce the association to legacy gap. It can be believed the remaining MOs will be handled by legacy gap once legacy gap and concurrent gap are configured together. |
| ZTE | We believe this question can help us to clarify the relationship between legacy gap and concurrent gaps. Before we discuss whether association can be configured for the legacy gap, we suggest the clarification for the two possible cases in Option 2a is needed. If the first possible case in Option 2a is supported, can we conclude that the legacy gap should be configured as one of independent gap instance when NW configured the multiple concurrent gaps to the capable UE. |
| MTK | Support Option 4 or 5.  We share similar view as Ericsson that as long as the gap association is clear, it does not matter how RAN2 wants to implement the RRC signalling. It can be done by either   * 1 legacy + 1 new gap, or * 2 new gaps   From RAN4 requirement point of view, there is no different between above 2 options, as long as the gap associations are clear. We can leave it to RAN2 to optimize their signaling design. |
| Apple | Our target is to make sure both NW and UE knows which layers shall be measured within each measurement gap patterns.  There could be multiple alternatives to achieve this purpose. One is to mandate NW to provide the association (preferred). Alternatively, NW can provide association for some of the MO. For the rest MO w/o association, UE shall measure them by using a ‘default gap’. From RAN2 point of view, this ‘default gap’ may be effectively same as legacy gap (in their LS they mentioned “legacy MG do not provide this association”).  We are also fine with the recommended WF. |
| vivo | From feasibility and signaling point of view, it is ok however we do not see any benefit or target use case where a legacy gap is configured when a UE is configured with multiple gaps.  Ok with option 3 and option 1 |
| Huawei | Option 1.  On all the other options, it seems there are two types of MGs, one is legacy MG and the other is concurrent MG (or new MG). RAN4 has agreed that “Concurrent gaps are multiple measurement gaps configured by RRC message(s)”. Without considering joint work with pre-MG or NCSG, we think multiple MGs in the definition are all legacy MGs, so there is no new MG type called concurrent MG.  How to configure the association between MGs and use cases or freq layers can be left to RAN2 signaling design, but when concurrent MGs are configured or in other words when multiple measurement gaps are configured by RRC message(s), the association between MGs and use cases or freq layers should be made clear to UE. |
| OPPO | Option 4. Share the similar view as MTK. |
| Xiaomi | It is feasible if the association is clear from both UE and NW side, and it is assumed that concurrent gap is used to measure the associated MOs, and legacy gap is used to measure the non-associated MOs. |
| Intel | Yes: The legacy gap can be configured as one of independent gap instance when NW configured the multiple concurrent gaps to the capable UE.  But we are also fine with the recommended WF. This is up to RAN2 on how to associated them. |
| CATT | Option 1.  Same view as Huawei. Concurrent gap means multiple legacy gaps and it is not a new gap type. With association information provided in the legacy gap, it will be one of the concurrent gaps. |
| Nokia | Recommended WF is not agreeable.  There shall be no changes to how legacy gaps are configured and operated.  Our view is partly the same as Ericsson that it is only necessary to have an association between concurrent gap and measured object/layer.  We agree with Apple that what is important is that it is clear what the UE measures within each MGP.  We also agree with Ericsson/MTK that legacy gaps and concurrent gaps can be configured simultaneously.  We do not agree on UE filtering based on Object being present on legacy and concurrent MG. |
| Qualcomm | Option 3. What would be the motivation or benefit?  It’s not only the association of MO with a MG, Another issue is how to handle MG collisions. |

#### **Issue 2-8-3: RAN4 response to Q2 and Q3**

* Background

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| **Q2** – How many concurrent gaps could be configured simultaneously?  **Q3** – Could concurrent gaps be configured with different gap types (i.e., some gaps are per-UE while some gaps are per-FR)? If so, what is the maximum number of gaps that could be configured simultaneously for each gap type (per-UE /per-FR1/per-FR2)? |

* Recommended WF
  + - Moderator: This is already an ongoing discussion in Issue 2-2-2 and Issue 2-2-1. No need to duplicate the discussion here. RAN4 can reply to RAN2 after reaching conclusions.

#### **Issue 2-8-4: RAN4 response to Q4**

* Background

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| **Q4** – Is the legacy gap sharing configuration (configured in MeasGapSharingConfig) applicable to Rel-17 concurrent gaps? If ‘yes’, could RAN4 clarify how this would work? |

* Proposals
  + Option 1: CATT, vivo, Huawei
    - Yes.
  + Option 2: Apple, QC, Ericsson
    - Yes, with separate MeasGapSharingConfig for each MG pattern.
  + Option 3: MTK
    - Yes, with same MeasGapSharingConfig for each MG pattern
* Recommended WF
  + - Collect views from companies

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| **Company** | **Comments** |
| Ericsson | Option 2  It’s better to introduce the separate MeasGapSharingConfig for each MG pattern. Whether introducing the separate IEs depends on RAN2’s decision. |
| ZTE | Support Option 2.  The gap sharing configured by MeasGapSharingConfig is used to determine the sharing between intra-frequency Mos and other non intra-frequency Mos, similar as the gap sharing in legacy gap. It should be noted that all these Mos should be the Mos associated with this concurrent gap. |
| MTK | We are fine to Both Option 2 and 3.  Just to mention that the intention of Option 3 is to reduce the extra work in RAN2. |
| CMCC | OK with option 2. |
| Apple | Option 2. |
| Vivo | Option 2 |
| Huawei | We can support option 2. |
| OPPO | Option 2. |
| Xiaomi | Option 2 |
| Intel | Option 2 |
| CATT | Fine with option 2. |
| Nokia | Option 2. Same principle as legacy Sharing can be applied (hence, only parameter name is changed) |
| Qualcomm | Option 2. It is more flexible. |

#### **Issue 2-8-5: RAN4 response to Q5**

* Background

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| **Q5** – Could RAN4 help to clarify whether UTRAN-FDD measurement (configured in MeasObjectUTRA-FDD) is also applicable in concurrent gap operation? |

* Recommended WF
  + - Moderator: This issue has been included in the previous LS R4-2120304 to RAN2. Moderator does not see a need to reopen the discussion here.

## Companies views’ collection for 1st round

### Open issues

Moderator: Companies’ views are collected in previous section together with the list of issues

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| R4-2201214  Ericsson  General | ZTE:  This CR is fine for us. |
| MTK: We provided our comments in <https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_101-bis-e/Inbox/Drafts/%5B101-bis-e%5D%5B209%5D%20NR_MG_enh_1/Round%201/CR%20revisions/rev_R4-2201214%20draftCR%20on%20concurrent%20gaps_v01_mtk.docx>  A quick summary:   * Minor wording changes. * A MO can be configured with both SSB and CSI-RS based measurement. So we change SSB based MO to MO with SSB based measurement. Same for CSI-RS case * RSSI/CO seems missing in the agreement. Need some RAN4 agreement to add them into consideration. * One paragraph seems duplicated, please check * The intention to add some paragraphs are not clear to us. Need the reasonale. |
| Huawei: We provided our comments and updates in  [rev\_R4-2201214 draftCR on concurrent gaps\_v02\_mtk\_HW.docx](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_101-bis-e/Inbox/Drafts/%5B101-bis-e%5D%5B209%5D%20NR_MG_enh_1/Round%201/CR%20revisions/rev_R4-2201214%20draftCR%20on%20concurrent%20gaps_v02_mtk_HW.docx) |
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| R4-2201624  Huawei  Collision rule | 1. Ericsson: the minimal distance needs to be further explained, such as ‘***the time difference between ending point of one gap occasion for one of the concurrent gaps and the starting point of one gap occasion for the other gap of the concurrent gaps*** ’ |
| ZTE:  Similar view as Ericsson. |
| MTK: We added our comments in “https://www.3gpp.org/ftp/tsg\_ran/WG4\_Radio/TSGR4\_101-bis-e/Inbox/Drafts/%5B101-bis-e%5D%5B209%5D%20NR\_MG\_enh\_1/Round%201/CR%20revisions/rev\_R4-2201624\_v01\_mtk.docx”  A quick summary:   * The intention of introducing “When UE is configured with both per-UE measurement gap and per-FR measurement gap for FR1 or FR2, the per-UE measurement gap is considered as one per-FR measurement gap for FR1 and one per-FR measurement gap for FR2.” Is not clear to us. It may lead to the misunderstanding that one per-UE gap can be treated as 2 per-FR gaps. * Other wording suggestions |
| Huawei:  To Ericsson/ZTE, we will add the definition of the min distance in the revision.  To MTK, the intention is to define the colliding between per-UE MG and per-FR MG when they are simultaneously configured, but we can update the wording in the revision by separate description for this case. |
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| R4-2200243  Apple  CSSF | Ericsson:  It’s too early to capture this CR.   1. It’s better to split to a separate section for CSSF for concurrent gaps, such as  9.1.5.3 Monitoring of multiple layers by concurrent measurement gaps  1. It’s better to define the variable to split the CSSF for different gaps, such as CSSFwithin\_gap,i,j is the scaling factor for the measured NR carrier *i* and measurement gap *j* 2. Wait the discussion on CSSF and measurement period 3. Whether concurrent gaps NOT support EN-DC? |
| ZTE:  Wait for the outcome of Sub-topic 2-5. |
| MTK: Just need to wait for the conclusion of Issue 2-5-3. Others are fine to us. |
| Huawei:  To Ericsson, we support the approach in this CR instead of split a separate section for CSSF for concurrent MGs. Also, as one carrier i can be only associated to one MG, there will be only one CSSFwithin\_gap,i for carrier i, do we need to split the CSSF for different gaps? |
| Apple: thanks all companies for the comments. To Ericsson: 1) so far we still prefer to modify existing section since the additional part is quite limited. If a new section is created, most content need to be duplicated. 2) we don’t see the need to split CSSF. Same understanding as HW. 3) agree that conclusion on CSSF discussion need to be captured. 4) feasibility in DC has not yet been confirmed. Corresponding requirements can be added if there is agreement. |
| R4-2200115  CATT  Intra-freq | Ericsson:  It’s too early to capture this CR.   1. Wait the discussion on CSSF and measurement period 2. Don’t need to split the scenarios 3. Not apply to NR-U |
| ZTE  Wait for the outcome of Sub-topic 2-5 |
| MTK:   * The update for Kp calculation is missing. * Not sure if we need to define different requirement for different overlapping scenario. Or we can simply add a generic requirement. |
| Huawei:  Same comment as MTK. In addition,  The following two sentences need to be based on sub-topic 2-5.  *when intra-frequency SMTC is fully overlapping with one of the concurrent gaps, CSSFwithin\_gap,i is calculated based on the concurrent gap which is overlapped with intra-frequency SMTC,*  *when intra-frequency SMTC is fully overlapping with both of the concurrent gaps, CSSFwithin\_gap,i is the summation of the two CSSFwithin\_gap,i calculated for each of concurrent gap.* |
| CATT: we are fine to define generic requirements for all scenarios. Our initial consideration on overlapping cases is the disabled gap which is not the problem in FNO case. |
| R4-2200678  Xiaomi  Inter-freq | 1. Ericsson: Looks fine, need to align the variables with other sections |
| ZTE:  This CR is fine for us. |
| MTK   * We need an indication of which MGRP to follow for a particular frequency layer. * The calculation of Kconcurrent\_gap only handles the case when 2 gaps overlap, but we still have the non-overlapped case. Also, the equation is only valid when MGRP2>MGRP1. * As most of the content in the section are duplicated from existing requirement, we prefer to merge the changes into existing requirements instead of creating a new section. |
| Huawei:  The calculation of Kconcurrent\_gap need to be updated based on outcome of issue 2-3-3. Also agree with MTK that no separate section is needed. |
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| R4-2200404  Vivo  Inter-RAT | 1. Ericsson:   It’s better to define the variable to split the CSSF for different gaps, such as  CSSFinterRAT will be   * CSSFwithin\_gap,i is the scaling factor for the measured inter-RAT E-UTRA carrier *i* which is calculated as specified in clause 9.1.5.2 when UE does not support concurrent measurement gaps capability. * CSSFwithin\_gap,i,j is the scaling factor for the measured inter-RAT E-UTRA carrier *i* and measurement gap *j* which is calculated as specified in clause 9.1.5.3 when UE supports concurrent measurement gaps capability. |
| MTK: For non-DRX case, we also need to address the case if some gaps are dropped due to gap collision, e.g., introducing a Kp factor (and ceiling function if needed) |
| Huawei: Whether to define LTE measurement requirements with concurrent MGs is pending on Issue 2-1-1 and 2-1-2. |
| Apple: same comments as HW. |
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| R4-2200694  Intel  Positioning | 1. Ericsson: Looks fine, need to align the variables with other sections |
| ZTE:  This CR is fine for us. |
| MTK: The requirements seems to assume that positioning measurement is always prioritized. Therefore the gap associated to positioning is never to be dropped? |
| Huawei: Need to be aligned with R4-2200678, i.e. Kconcurrent\_gap is needed, also we do not have clauses like 9.9.2a. |
| Apple: the following sentence may need to be updated:  “UE is configured with more than one measurement gaps which can be used for PRS measurement and other measurement simulatanously”  Which may imply more than one measurement gaps can both be used for PRS. It is better to reflect the following agreement in the last meeting:   * + PRS measurement for positioning including all positioning frequency layers is associated with only one of the concurrent gaps |
| Qualcomm: Clarify that in the case of concurrent MG, the measurement gap used for positioning must be of type per-UE. (This may need to be revised later if a new capability for PRS measurements with per-FR MG is added.) |
| R4-2201140  OPPO  L3 CSI-RS | ZTE:  Wait for the outcome of Sub-topic 2-5 |
| MTK: Fine with the CR. But would still suggest to revise it to capture any potential agreements in the open issues. |
| OPPO: Expected to be revised if any new agreements in the open issues. |
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| R4-2200490  MTK  L1 impact | 1. Ericsson: It’s better NOT change the requirement for legacy single gap. The requirement section can be separated. |
| Huawei: support the approach in the CR, but the detailed wording is pending on issue 2-6-1. |
| Apple: in general the apporach is OK for us. However, we may need to find a way to merge it with NCSG (R4-2200492 also from MTK). Otherwise the two CRs cannot be implemented. According to comments received so far, seems the NCSG CR can be agreed in this meeting. One way is to endorse NCSG CR, then reflect the change in CR for concurrent gaps. |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | **Status summary** |
| **Issue 2-1-1** | **Whether concurrent gaps are allowed in the case when only E-UTRAN measurement objectives are configured** *Status:* No clear consensus is observed. Option 1 gets more support than Option 2, while some companies mentioned that Option 1a could be a middle ground for ocmpromise.  *Tentative agreements:* No  *Recommendations for 2nd round:* Capture this issue in the WF to continue discussion in 2nd round. |
| **Issue 2-1-2** | **Additional limitation when UE is configured with both E-UTRA and NR MOs**  *Status:* No clear consensus is observed. The majority disagree with Option 1, while some companies pointed out this issue is realted to Issue 2-1-1.  *Tentative agreements:* No  *Recommendations for 2nd round:* Capture this issue in the WF to continue discussion in 2nd round. |
| **Issue 2-1-3** | **Supporting concurrent gap in MR-DC scenario**  *Status:*All companies are fine with Option 1  *Tentative agreements:* RAN4 to ask RAN2 to decide whether concurrent MGs is supported in MR-DC scenario  *Recommendations for 2nd round:* Include the tentative agreement in the WF and the LS to RAN2 |
| **Issue 2-2-1** | **Whether to allow simultaneous configuration of per-UE gap and per-FR gap to FR gap capable UEs**  *Status:* No clear consensus is observed. Option 2a is supported by 10 companies. Option 2 is supported by 5. CMCC, Nokia are fine to both (thanks for the compromise BTW!)  *Tentative agreements:* No  *Recommendations for 2nd round:* This issue will be treated in the GTW. Conclusion, if any, will be captured in the WF and LS reply to RAN2. |
| **Issue 2-2-2** | **Max number of concurrent gaps across all FRs for per-FR gap capable UEs (without considering other WIs)**  *Status:* No clear consensus is observed.  *Tentative agreements:* No  *Recommendations for 2nd round:* This issue will be treated in the GTW. Conclusion, if any, will be captured in the WF and LS reply to RAN2. |
| **Issue 2-2-3** | **UE feature list**  *Status:* No company has concern to introduce the baseline capability for concurrent gap. Companies provided valuable suggestions for wording improvement.  *Tentative agreements:* No  *Recommendations for 2nd round:* Moderator to consider suggestions from companies and provide a revised proposal in the WF for further comments. The draft version is like below:   * **Feature group:** Concurrent measurement gaps * **Components:**    + Support of more than 1 per-UE measurement gap configurations for UE not capable of Rel-15 per-FR gap (*independentGapConfig*)   + Support of more than 1 per-FR gap measurement gap configurations [or simultaneous 1 per-UE measurement gap plus 1 per-FR measurement gap configurations] in an FR for UE capable of Rel-15 per-FR gap (*independentGapConfig*) * **Consequence if the feature is not supported by the UE:** UE cannot be configured with multiple independent and concurrent gaps * **Note:** This is the baseline capability is to indicate UE support multiple independent and concurrent gaps. * **Mandatory/Optional**: Optional with capability signalling |
| **Issue 2-2-4** | **UE indication of supported gap combination index**  *Status:*11 companies do not support Option 1. 2 companies suggest to resolve Issue 2-2-1 and 2-2-2 first. The proponent clarified that only index 0 to 6 needs to be considered.  *Tentative agreements:* No  *Recommendations for 2nd round:* Capture this issue in the WF (with index 7 to 12 removed) to continue discussion in 2nd round. |
| **Issue 2-3-1** | **X value in proximity condition for overlapping in FR1.**  *Status:* 11 companies are fine with Option 3. 2 companies suggest to also consider X=0 as an option to be allowed in UE’s capability.  *Tentative agreements:* No  *Recommendations for 2nd round:* Moderator suggests taking the majority view as the starting point. Capture below in the WF to be discussed in the 2nd round:   * Consider as least X=4 in proximity condition for overlapping in FR1 * FFS to introduce X=0 as an optional UE capability |
| **Issue 2-3-2** | **X value in proximity condition for overlapping in FR2**  *Status:* 8 companies support Option 3 (4ms), while 4 companies support Option 1 (1ms). 2 companies suggest to also consider X=0 as an option to be allowed in UE’s capability.  *Tentative agreements:* No  *Recommendations for 2nd round:* Moderator suggests taking the majority view as the starting point. Capture below in the WF to be discussed in the 2nd round:   * Consider as least X=4 in proximity condition for overlapping in FR2 * FFS to introduce X=0 as an optional UE capability |
| **Issue 2-3-3** | **UE behavior during colliding gap occasion**  *Status:* No clear consensus is observed. It seems that in Rel-17 Option 1 and Option 5 have no fundamental difference in terms of UE behavior or RAN4 requirement. The controversial part is about their potential of future extesion. Option 1 brings better forward compatability when considering MUSIM or NTN gaps in the later release, while Option 5 provide better potential extension for other sharing ratios.  *Tentative agreements:* No  *Recommendations for 2nd round:* Moderator suggest companies to proceed on the CR based on the priority rule, while adding an editor’s note to address the current condition of Issue 2-3-3. This issue will be discussed in GTW, if time allows. The GTW conclusion will be captured in the WF and LS if needed. |
| **Issue 2-3-4** | **Whether to resume data scheduling on the dropped gap occasions**  *Status:* All companies are fine with Option 1  *Tentative agreements:* Data scheduling is resumed on the dropped gap occasions  *Recommendations for 2nd round:* Include the tentative agreement in the WF. |
| **Issue 2-3-5** | **Whether to introduce a UE capability to indicate whether UE supports only 0% and 100% gap sharing ratios or UE supports arbitrary configured sharing ratios. (If Option 5 in Issue 2-3-3 is agreed)**  *Status:* The majority view is to wait for the conclusion of Issue 2-3-3.  *Tentative agreements:* No  *Recommendations for 2nd round:* Capture this issue in the WF to continue discussion in 2nd round. |
| **Issue 2-3-6** | **Detail gap sharing ratios (If Option 5 in Issue 2-3-5 is agreed)**  *Status:* The majority view is to wait for the conclusion of Issue 2-3-3.  *Tentative agreements:* No  *Recommendations for 2nd round:* Capture this issue in the WF to continue discussion in 2nd round. |
| **Issue 2-3-7** | **Whether to introduce FO, FPO, PFO, PPO scenarios.**  *Status:* 9 companies support Option 1. 3 companies support Option 2 and one supports Option 3.  *Tentative agreements:* No  *Recommendations for 2nd round:* As mentioned by some companies that this issue is highly depending on how RAN4 will resolve the gap colliding issue, it is fair to wait for the conclusion first. Capture this issue in the WF to continue discussion in 2nd round. |
| **Issue 2-3-8** | **Whether to introduce UE capability for different overlapping scenarios (FO, FPO, PFO, PPO).**  *Status:*The mojority (11 companies) does not support Option 1.  *Tentative agreements:* No  *Recommendations for 2nd round:* Moderator suggest taking the majority view as the starting point for the 2nd round discussion, i.e., Do not introduce UE capability for different overlapping scenarios (FO, FPO, PFO, PPO) |
| **Issue 2-4-1** | **Whether to define the overhead cap**  *Status:* No clear consensus is observed.  *Tentative agreements:* No  *Recommendations for 2nd round:* Capture this issue in the WF to continue discussion in 2nd round. This issue will be discussed in GTW, if time allows. The WF can be updated later based on the GTW conclusion. |
| **Issue 2-4-2** | **Definition of overhead cap (if agreed in Issue 2-4-1)**  *Status:* No clear consensus is observed. It is up to the decision in Issue 2-4-1.  *Tentative agreements:* No  *Recommendations for 2nd round:* Capture this issue in the WF to continue discussion in 2nd round. |
| **Issue 2-5-1** | **[Outside gap] CSSF**  *Status:*9 companies support Option 1. ZTE provided a 2nd level detail including the calculation of Kp. Nokia wants to clarify the impact of concurrent gap to CSSF outside gap  *Tentative agreements:* No.  *Recommendations for 2nd round:* Moderator suggest taking Option 1 which is supported by majority as the starting point for further discussion in the 2nd round.   * To Nokia’s question: The understanding is that a frequency layer considered as CSSF outside gap in Rel-15 may become within gap after introducing concurrent gap. One example is a layer with SMTC periodicity 20ms and offset 0ms and a gap with MGRP 40ms and offset 0ms in Rel-15. If we later add a new gap with MGRP 40ms and offset 20ms, then the SMTC occasions will be fully overlapped by 2 gaps. This means we need to remove this frequency layer from outside gap to within gap. This is the reason that the definition of CSSF outside gap needs to be revised. |
| **Issue 2-5-2** | **[Outside gap] Kp**  *Status:*9 companies are fine with the recommended WF with some further wording adjustment expected. 2 companies prefer to keep legacy fashion with exact equation specified, but it seems like no technical concern was mentioned. Nokia raised a similar clarification as in Issue 2-5-1. (please check Moderator’s reply in that issue.)  *Tentative agreements:* No  *Recommendations for 2nd round:* Moderator suggests taking the majority view as a starting point to be further discussed in 2nd round, e.g., based on Qualcomm’s revision.   * The Kp value for a SSB frequency layer to be measured outside gap is defined as Kp = Ntotal / Navailable * For a window W of duration max(TSMTC, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the SSB frequency layer, and starting at the beginning of any SMTC occasion:   + Ntotal is the total number of SMTC occasions within the window, ignoring any overlap with MG occasions within the window, and   + Navailable is the number of SMTC occasions that are not overlapped with any MG occasion within the window W, after accounting for MG collisions by applying the selected gap collision rule. * FFS: extension to CSI-RS based L3 measurements |
| **Issue 2-5-3** | **[Within gap] CSSF**  *Status:* 11 companies are fine with Option 1. Nokia wanted to discuss a bit more the text in []. 3 companies provided views on Option 2.  *Tentative agreements:* No  *Recommendations for 2nd round:* Since Option 1 gets the majority support, Moderator suggests taking Option 1 as a starting point for further discussion. At the same time, there is no technical objection to Option 2, although some further revision may be needed. Capture the following merged version in the WF for 2nd round discussion.   * The CSSF is calculated separately for each gap pattern. [provided that the association between measurement objects and gap pattern is configured by network.]   + [Only the measurement objects associated to the same measurement gap pattern are counted when deriving CSSFwithin\_gap,i for a target measurement object with index *i*.]   + The dropped gap occasions will not be used in deriving CSSFwithin\_gap,i   As for the discussion point raised by Nokia, Moderator’s understanding is that RAN4 already has an agreement that the association is mandatory when concurrent gap is configured (R4-2115342). And RAN4 can revisit this agreement if RAN2 reports us any issue in the RRC implementation. Moderator believes that this point is related to Q1 of the reply LS to RAN2. Therefore, Moderator suggests to put the text in [ ] at this moment before RAN2 concludes their final implementation. |
| **Issue 2-5-4** | **[Within gap] MGRP**  *Status:* All companies are fine with Option 1. QC raised the issue about the case if the association between the gap and dedicated use case is not provided.  *Tentative agreements:* No  *Recommendations for 2nd round:* Take Majority view as the starting point in the WF for 2nd round discussion. Regarding the point raised by QC, Moderator believe that it is related to Q1 of the reply LS to RAN2, too. Therefore, we can add an point to allow RAN4 to revisit the agreement after RAN2 concludes their implementation. |
| **Issue 2-5-5** | **[Within gap] Kp**  *Status:* 9 companies are fine with the recommended WF with some further wording adjustment expected. 2 companies prefer to keep legacy fashion with exact equation specified, but it seems like no technical concern was mentioned.  *Tentative agreements:* No  *Recommendations for 2nd round:* Moderator suggests taking the majority view as a starting point to be further discussed in 2nd round, e.g., based on Qualcomm’s revision in Issue 2-5-2 with the required modifications underlined.   * The Kp value for a SSB frequency layer to be measured within gap is defined as Kp = Ntotal / Navailable * For a window W of duration max(TSMTC, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the SSB frequency layer, and starting at the beginning of any gap occasions covering the SMTC occasion:   + Ntotal is the total number of gap occasions covering SMTC occasions within the window, ignoring any overlap with other MG occasions within the window, and   + Navailable is the number of gap occasions covering SMTC occasions that are not overlapped with any other MG occasion within the window W, after accounting for MG collisions by applying the selected gap collision rule.     - When Navailable =0, the MGP is regarded as disabled   + FFS: extension to CSI-RS based L3 measurements   To Huawei’s comment, for high priority MG, we will automatically get Kp=1 because Ntotal = Navailable. |
| **Issue 2-6-1** | **P factor of L1 measurement**  *Status:* Same situation as Kp discussion.  *Tentative agreements:* No  *Recommendations for 2nd round:* Moderator suggests taking the majority view as a starting point to be further discussed in 2nd round, e.g., based on Qualcomm’s revision in Issue 2-5-2 with the required modifications underlined.   * The P value for a L1 resource to be measured is defined as   + Ntotal / Navailable in FR1   + Psharing \* Ntotal / Noutside\_MG in FR2 with Navailable = 0   + Ntotal / Navailable in FR2 with Navailable > 0 * For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as serving cell, and starting at the beginning of any gap occasions covering the L1 resource occasion:   + Ntotal is the total number of L1 resource occasions within the window, ignoring any overlap with MG occasions or SMTC occasions within the window, and   + Noutside\_MG is the number of L1 resource occasions that are not overlapped with any MG occasion within the window W, after accounting for MG collisions by applying the selected gap collision rule.   + Navailable is the number of L1 resource occasions that are not overlapped with any MG occasion nor any SMTC occasion within the window W, after accounting for MG collisions by applying the selected gap collision rule.   + TL1 is periodicity of the target L1 RS. |
| **Issue 2-7-1** | **Whether to specify transient UE behavior when concurrent MGs are re-configured**  *Status:*9 companies support Option 1, while 1 company supports Option 2  *Tentative agreements:* No.  *Recommendations for 2nd round:* Moderator suggest taking majority view as the starting point in the WF for 2nd round discussion, i.e.,   * Do not specify transient UE behavior when concurrent MGs are re-configured |
| **Issue 2-8-1** | **Confirmation to RAN2’s understanding**  *Status:* The majority is fine with either Option 1 or 2. QC asked for the clarification on the motivation of Option 2. Nokia raised the concern regarding how to treat LTE layers and CSI-RS layers.  *Tentative agreements:* No  *Recommendations for 2nd round:*   * Regarding LTE layer: In moderator’s understanding, LTE measurement is configured by individual MOs. And RAN4 has WF R4-2108346 in which the gap can be associated to one or more MOs. In this sense, one LTE layer is treated as one frequency layer implicitly. Nevertheless, it seems OK to have some further clarification.  |  | | --- | | * Inform RAN2 that the measurement gap can be associated to one or multiple use cases in the following, while the detail on how to implement the association is left to RAN2   + One or more MO(s) for same or different RATs   + SSB and/or CSI-RS in each associated NR MO   + PRS |  * Regarding CSI-RS layer: RAN4 had the agreement in R4-2012168 as the following. Therefore, it should be clear at least from RAN4’s understanding that Option 2 is fine.  |  | | --- | | * Only one MO corresponding to one frequency layer is considered in R16 for requirements definition. |   With above understandings, Moderator thinks it is fine to reply RAN2 based on Option 2. |
| **Issue 2-8-2** | **RAN4 response to Q1**  *Status:*The views are very diverged. It seems like the companies are having different expectation on how RAN2 will implement the signallings. Therefore, the discussions are not on the same page. Maybe one obvious consensus is that the association needs to be clear to both UE and network.  *Tentative agreements:* No  *Recommendations for 2nd round:* This issue will be treated in GTW session. WF and LS are expected to be updated to capture GTW conclusions. |
| **Issue 2-8-3** | **RAN4 response to Q2 and Q3**  *Status:* No additional discusions are ndded for this issue  *Tentative agreements:* No  *Recommendations for 2nd round:* The reply LS to RAN2 is expected to be capture the conclusion in Issue 2-2-2 and Issue 2-2-1. |
| **Issue 2-8-4** | **RAN4 response to Q4**  *Status:*All comapnies are fine with Option 2  *Tentative agreements:* Yes, with separate MeasGapSharingConfig for each MG pattern.  *Recommendations for 2nd round:* Include the tentative agreement in the reply LS to RAN2 |
| **Issue 2-8-5** | **RAN4 response to Q5**  No additional discusions are ndded for this issue  *Tentative agreements:* No  *Recommendations for 2nd round:* Telling RAN2 that the response had been sent in the previous LS R4-2120304 to RAN2 |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| R4-2201214  Ericsson  General | To be revised.  Try to address the comments from MTK and Huawei.  Capture agreements in 2nd round if any. |
| R4-2201624  Huawei  Collision rule | To be revised.  Try to address the comments from Ericsson, ZTE and MTK.  Capture agreements in 2nd round if any. |
| R4-2200243  Apple  CSSF | To be revised.  Try to address the comments from Ericsson and Huawei  Capture agreements in 2nd round if any.  Suggest adding an editor’s note for EN-DC, which is pending on RAN2 decision |
| R4-2200115  CATT  Intra-freq | To be revised.  Try to address the comments from Ericsson, MTK and Huawei  Capture agreements in 2nd round if any.  If open issues are not resolved, please add a corresponding eidtor’s note. |
| R4-2200678  Xiaomi  Inter-freq | To be revised.  Try to address the comments from Ericsson, MTK and Huawei  Capture agreements in 2nd round if any.  If open issues are not resolved, please add a corresponding eidtor’s note. |
| R4-2200404  Vivo  Inter-RAT | To be revised.  Try to address the comments from Ericsson, MTK, Huawei and Apple  Capture agreements in 2nd round if any.  If open issues are not resolved, please add a corresponding eidtor’s note. |
| R4-2200694  Intel  Positioning | To be revised.  Try to address the comments from MTK, Huawei, Apple and QC.  Capture agreements in 2nd round if any.  If open issues are not resolved, please add a corresponding eidtor’s note. |
| R4-2201140  OPPO  L3 CSI-RS | To be revised.  Capture agreements in 2nd round if any.  If open issues are not resolved, please add a corresponding eidtor’s note. |
| R4-2200490  MTK  L1 impact | To be revised.  Try to address the comments from Ericsson, Huawei and Apple.  Capture agreements in 2nd round if any.  If open issues are not resolved, please add a corresponding eidtor’s note. |

## Discussion on 2nd round (if applicable)

Moderator: The comments to the WF are provided below

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| **Applicability and configurations** **Issue 2-1-1: Whether concurrent gaps are allowed in the case when only E-UTRAN measurement objectives are configured**  * Open issue   + Option 1: Yes   + Option 1a: Yes, provided that UE supports LTE measurement with concurrent MGs, which is up to UE capability   + Option 1b: Yes, under the condition that only one per-UE MG is configured for UE   + Option 2: No   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | Option 1. Preference is less restrictions which complicates the use of the feature in the field. Otherwise, as we read this Issue the network has to configure NR in addition to LTE even if not really needed – which does not benefit either UE or network.  Just for our clarification does the issue address:   * The UE is configured with concurrent gaps only containing LTE objects?   It is not fully clear and having it clarified will avoid confusion. | | Huawei | Option 2. All LTE MOs can be measured with one MG, and having different LTE MOs measured in multiple MGs seems to us an optimization without clear benefit but with clear impact on UE implementation.  To Nokia, we understand the issue is:   * Is multiple MGs allowed to be configured when only LTE MOs are configured?   We use the term “multiple” but not “concurrent” because it seems the definition of “concurrent” is ambiguous based on the discussion on Q1 in RAN2 LS, but it is a separate issue.  Our answer to the question would be ‘yes’ provided that all the LTE MOs are associated to one MG. Of course this means the other MG is not necessary, but we do not need to limit NW implementation in the spec. | | Intel | Option 1. Even we thought when NW configure the gap to UE under such case, most likely not to configure the concurrent gap to UE, but it is completely up to NW to whether or what types MG to be granted. | | vivo | Option 1a. | | OPPO | Option 1b. Concurrent gaps could include only one MG for LTE MOs, regarding the comments from Huawei. We think it is at least valid with such association/condition. | | Apple | Option 2. We have been raising concern many times without being addressed. Proponents of option 1 mainly focus on network flexibility. However, such flexibility doesn’t come for free. From UE complexity point of view, multiple concurrent gap patterns are not supported in LTE. Allowing such feature will increase the complexity of LTE module, depending on UE implementation.  On the other hand, such flexibility doesn’t really provide attractive gain. One legacy gap can already cover all LTE MO. | | CATT | Prefer option 1. | | CMCC | Support option 1, can compromise to option 1a. | | Ericsson | Option 1.  From our understanding, the main aspects of UE design difficulty are as follow.   * software scheduling algorithm * hardware and RF design * based band algorithm complexity   Firstly, the multiple gaps’ scheduling is agnostic on the measurement type. It only focuses on when to switch the RF chain to the target frequency for measurement and stop the data reception channel.  After that, UE will receive the RS signals based on the designed RF BW (Obviously, the received BW for LTE is the same and agnostic about the number of gaps). There is no any new band and frequency will be introduced due to support LTE measurements by multiple gaps.  In the end, the RF data will be transformed to based band to perform RSRP algorithm, However, if UE finished the LTE RSRP algorithm design, then it still no much difference to perform once or twice.  In other words, we can believe two measurement gaps for LTE measurement as one ‘effective’ short MGRP measurement gap provided UE supports the multiple gap scheduling algorithm. For example, NW can configure one gap with MGRP=40ms and also can configure two gaps with MGRP=80ms and the offset =0ms and 40ms. We think UE should have the same behaviour for LTE measurement.  Therefore, we don’t see any technical obstacle on UE’s design.  To proponent of option 2, we want to further understand the issue in UE’s design. If the issue is really there, we’re fine to support option 2. | | Moderator | No clear consensus is observed. Keep the same options FFS. |  **Issue 2-1-2: Additional limitation when UE is configured with both E-UTRA and NR Mos**  * Open issue   + FFS: When UE is configured with both E-UTRA and NR MOs, UE can be configured with concurrent MGs, but all E-UTRA Mos are expected to be associated with one single MG   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | The reasoning for this restriction is not clear. This restriction could have side effects such that network would have to reconfigure existing measurement configuration. Hence, we do not support this proposal, but it needs further justification. | | Qualcomm | We can support no restriction. Leave it up to the network. | | Huawei | Support the proposal.  All LTE Mos can be measured with one MG, and having different LTE Mos measured in multiple MGs seems to us an optimization without clear benefit but with clear impact on UE implementation. | | Vivo | Support. This will make concurrent gaps more easily to work. | | OPPO | Fine with the proposal. | | Apple | Support the proposal. One legacy gap can already cover all the LTE Mos. | | CATT | We think this is the issue as 2-1-1. | | CMCC | No need to have such restriction | | Ericsson | Same comments as 2-1-1 | | Moderator | Keep the same options FFS. |  **Issue 2-1-3: Supporting concurrent gap in MR-DC scenario**  * Agreement   + RAN4 to ask RAN2 to decide whether concurrent MGs is supported in MR-DC scenario   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | ok | | Qualcomm | OK | | Huawei | ok | | Intel | OK | | OPPO | OK | | Apple | ok | | CATT | OK | | ZTE | OK | | Ericsson | OK  BTW, RAN2 had already achieved the agreements:   * For all the 3 objectives in MG enh. WI, RAN2 prioritize the design in NR SA. | | Moderator | No further changes are needed |  **UE capability related issues** **Issue 2-2-1: Whether to allow simultaneous configuration of per-UE gap and per-FR gap to FR gap capable UEs**  * Agreement   + UE can be configured with per-UE gap and per-FR gap simultaneously when     - 1) UE is capable of per-FR gap and concurrent gaps, and     - 2) per-UE gap is associated with PRS measurements       * Note: Additional use cases incl. Rel-17 MUSIM and Rel-17 NR NTN Wis are not precluded to be included in future releases.   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | This is agreed. Any comments expected? | | Moderator | No further changes are needed | |  |  | |  |  | |  |  |  **Issue 2-2-2: Max number of concurrent gap across all FRs for per-FR gap capable Ues (without considering other Wis)**  * Agreement   + The maximum number of concurrent gaps across all FRs for per-FR gap capable Ues is     - 3 for SA case     - FFS for MR-DC case if it is supported   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | As commented during GTW we can compromise to go with 3 for SA in Rel-17. | | Moderator | No further changes are needed | |  |  | |  |  | |  |  |  **Issue 2-2-3: UE feature list**  * Agreement   + **Feature group**: Concurrent measurement gaps   + **Components**:     - Support of more than 1 per-UE measurement gap configurations     - Support of more than 1 per-FR gap measurement gap configurations in an FR, or simultaneous 1 per-UE measurement gap plus 1 per-FR measurement gap configurations in an FR, or more than 1 per-UE measurement gap configurations for UE capable of Rel-15 per-FR gap (independentGapConfig)     - Note: The above 2 bullets are not 2 separate indications but a single indication with different interpretations, depending on the support of independentGapConfig.   + **Consequence if the feature is not supported by the UE**: UE cannot be configured with concurrent gaps   + **Note**: This is the baseline capability is to indicate UE support multiple concurrent gaps.   + **Mandatory/Optional**: Optional with capability signalling   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | A UE supporting independentGapConfig should also support concurrent Per-UE measurement gaps. This was agreed in RAN4#99 ‘Allow network to fall back to use per-UE gap’. Current description seems not to include this.  Could this be captured by following:  Support of more than 1 per-UE measurement gap configurations ~~for UE not capable of Rel-15 per-FR gap (independentGapConfig)~~ | | Qualcomm | We do not agree with Nokia’s comment. Support of concurrent per-UE MG is not implied by independentGapConfig; it is a new feature.  Clarification about the two components in the new capability: support for each component would be indicated independently as part of the new capability or does it rely on signaling of independentGapConfig? | | Huawei | Support Nokia’s comment, so second bullet of component can be updated:   * + - Support of more than 1 per-FR gap measurement gap configurations in an FR, or simultaneous 1 per-UE measurement gap plus 1 per-FR measurement gap configurations in an FR, or more than 1 per-UE measurement gap configurations for UE capable of Rel-15 per-FR gap (independentGapConfig)   To QC, we think it should be single capability and the applicable component rely on signaling of independentGapConfig, but we are open to further discussion. | | Intel | Also have similar question as QC: these two components are independent? In the 1st round discussion, it seems not consensus on whether they can be coupled. | | Vivo | We are ok with the two components. Whether the two components can be interpret as independent or not needs clarification | | OPPO | Share the similar view as QC and Intel. For the 1st bullet, 2 per-UE gaps can be configured regardless of supporting independentGapConfig. | | Apple | It is better to clarify if the proposed components need two independent indications, or one indication to indicate support of both.  Technical part, we agree with Nokia that UE supporting concurrent gap shall support 2 per-UE gaps regardless independentGapConfig. | | CATT | The current components didn’t include the configuration {per UE + per FR1 + pre FR2} which is the index 5 in issue 2-2-4. | | ZTE | Agree with QC and Intel, the two capabilities should be independent. We believe the original components given by moderator is OK. | | Ericsson | We have the same view as HW. It should be single capability and the applicable component rely on signaling of independentGapConfig | | Moderator | Regarding the 1st part, it is true that network is allowed to fallback. Therefore the condition “for UE not capable of Rel-15 per-FR gap (independentGapConfig)” is redundant.  Regarding the 2nd part, take Huawei’s suggestion to move forward. I don’t think we need to list all combinations here, RAN4 has table for all configuration combinations in the spec.  To QC/intel/vivo/ZTE: Let me add a note to clarify that the above 2 bullets are not 2 separate indications but a single indication with different interpretation depending on the support of independentGapConfig |  **Issue 2-2-4: UE indication of supported gap combination index**  * Agreement   + Do not introduce UE capability indication of supported gap combination index 0 to 5.  |  |  |  |  | | --- | --- | --- | --- | | **Index** | **# of simultaneous MG** | | | | **Per-FR1** | **Per-FR2** | **Per-UE** | | **0** | **2** | **1** | **0** | | **1** | **1** | **2** | **0** | | **2** | **0** | **0** | **2** | | **3** | **1** | **0** | **1** | | **4** | **0** | **1** | **1** | | **5** | **1** | **1** | **1** | |  |  |  |  |   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | It is not clear to us if:  1) one capability indication per Index  2) one capability indication for all Indexes  This would need to be clarified. In general, we are not in favour of additional capabilities. The feature is already an optional feature. | | Qualcomm | Many companies had concerns about signaling each row in the previous table. The table above has the essential rows concerning this new feature. We don’t think an indication per row is needed but perhaps indication for groups of rows may be considered. E.g. support of row 2 would be indicated by signaling the new capability in issue 2-2-3 without signaling independentGapConfig (or explicitly as part of the new capability? This is related to our question in issue 2-2-3). Support of rows 0 and 1 would be indicated by signaling the new capability in issue 2-2-3 together with independentGapConfig. Rows 3 and 4 can be supported according to the agreement in issue 2-2-1. A dedicated signaling bit could be considered for those two rows (together).  We understand that rows 5 and 6 are not yet agreed as valid configurations. If they are agreed, separate capability bits could be considered for each. FFS. | | Huawei | We think 5 and 6 are not supported based on 2-2-2, and all the other indexes are supported by UE supporting per-FR MG and concurrent MG. We do not see clear need for additional capability, but open to discuss. | | Intel | Agree that only part of them need the other signaling | | OPPO | We can first agree on whether to use full bit-maps indication for all possible cases. | | Apple | We still don’t see the need of this additional capability. NW knows whether UE supports independentGapConfig. Together with issue 2-2-3, NW can know the supported combinations. | | CATT | It is not clear whether index 5 is supported since it also meets the maximum number is 3.  And we don’t think a new capability is needed because we already have the capability to indicate the support of concurrent MG. If UE support concurrent MG, all there configurations should be supported. | | ZTE | Similar view as CATT. | | CMCC | No need to have additional UE capability to indicate which combination is supported. | | Ericsson | From our understanding, row 5 should be supported only when the per-UE gap is associated with positioning measurement. Row 6 is out of scope in R-17.  Same view as CATT, no further capability is needed, only concurrent gaps indication is enough. | | Moderator | * Delete Index 6 * To QC, this table was first used when we discuss per-FR capable UEs. Therefore, I would assume independentGapConfig a prerequisite before we discuss the table. * It seems to me no company actually asking for new capability now, but just some further clarifications. So let me change the open issue to agreement with no introduction of the corresponding capability. |  **Overlapping** **Issue 2-3-1: X value in proximity condition for overlapping in FR1.**   * Agreement   + Consider as least X=4 in proximity condition for overlapping in FR1     - FFS to introduce X=0 as an optional UE capability   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | We can compromise to X=4ms in general to avoid additional capability | | Qualcomm | OK with the tentative agreement. | | LG Electronics | Fine with the tentative agreement | | Huawei | OK with the tentative agreement. | | Intel | Fine with the tentative agreement | | vivo | ok | | OPPO | Fine with the tentative agreement | | Apple | Fine with tentative agreement. | | CATT | Fine with the tentative agreement | | ZTE | Fine with the tentative agreement | | CMCC | OK with the tentative agreement | | Ericsson | Fine with the tentative agreement, but avoid additional capability | | Moderator | To E///: anyway this new capability is FFS.  Let’s keep the agreement unchanged |  **Issue 2-3-2: X value in proximity condition for overlapping in FR2**  * Open issue   + FFS to consider as least X=4 in proximity condition for overlapping in FR2     - FFS to introduce X=0 as an optional UE capability   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | We still consider 4ms quite much for FR2. Hence, we prefer to discuss furhter | | Qualcomm | OK with the tentative agreement. | | LG Electronics | Fine with the tentative agreement | | Huawei | OK with the tentative agreement. | | Intel | Fine with the tentative agreement | | OPPO | Fine with the tentative agreement | | Apple | Fine with tentative agreement. | | CATT | Fine with the agreement. | | ZTE | Fine with the tentative agreement | | CMCC | OK with the tentative agreement | | Ericsson | Further discussion | | Moderator | I still see 2 companies have concern.  Let’s make it an open issue for FFS. |  **Issue 2-3-3: UE behavior during colliding gap occasion**  * Open issue   + Option 1: Priority rule     - UE will only do the measurement w.r.t. the gap with higher priority on all colliding occasions     - The priority can be configurable or fixed   + Option 5: Compromised proposal from moderator     - Introduce gap sharing rule.       * Request RAN2 to reserve some RRC signaling for different sharing factors.         + The signalling design may consider the possibility of resuming data scheduling on dropped gaps       * Rel-17 requirements will only consider sharing ratios 0% and 100%.       * The requirements for other sharing factors are FFS in later releases. * Agreement: CRs can be drafted based on Option 1 with the editor’s note: “The detail UE behavior can be revised based on the later RAN4 agreement on UE behavior during colliding gap occasion.”   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | ok to proceed in CR | | Qualcomm | OK with the proposal from moderator for the draft CR. | | LG Electronics | Fine with moderator’s proposal for draft CR. | | Huawei | OK with the proposal from moderator for the draft CR. | | Intel | Fine with moderator’s proposal for draft CR.. | | vivo | OK with the proposal from moderator | | Ericsson | Fine with moderator’s proposal for draft CR. | | Moderator | Thanks everyone. Let me make the Note to an agreement. |  **Issue 2-3-4: Whether to resume data scheduling on the dropped gap occasions**  * Agreement   + Data scheduling is resumed on the dropped gap occasions   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | ok | | Qualcomm | OK | | LG Electronics | Fine | | Huawei | OK | | Intel | OK | | vivo | OK | | Apple | OK | | ZTE | OK | | CMCC | OK | | Ericsson | OK | | Moderator | Keep this as an agreement |  **Issue 2-3-5: Whether to introduce a UE capability to indicate whether UE supports only 0% and 100% gap sharing ratios or UE supports arbitrary configured sharing ratios. (If Option 5 in Issue 2-3-3 is agreed)**  * Postpone to next meeting   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | ok to postpone | | Qualcomm | OK | | LG Electronics | Fine to postpone | | Huawei | ok to postpone | | Intl | postpone | | vivo | ok | | Apple | OK | | ZTE | ok to postpone | | Moderator | Postpone to next meeting |  **Issue 2-3-6: Detail gap sharing ratios (If Option 5 in Issue 2-3-5 is agreed)**  * Postpone to next meeting   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | ok to postpone | | Qualcomm | OK | | LG Electronics | Fine to postpone | | Huawei | ok to postpone | | Intl | postpone | | vivo | ok | | Apple | ok | | ZTE | OK | | Moderator | Postpone to next meeting |  **Issue 2-3-7: Whether to introduce FO, FPO, PFO, PPO scenarios.**  * Open issue   + Option 1: Introduce all scenarios   + Option 2: Only introduce PFO, PPO scenarios   + Option 3: Only introduce FO, FPO scenarios   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | As mentioned in the summary this depend on how collision is handled. Hence, we can postpone this issue but in general our only concern is the complexity and timeline | | Qualcomm | Option 2 is our preference. | | LG Electronics | Preference is Option 1. We think these scenarios depend on NW configuration. Do we need to define the scenarios in spec? | | Huawei | Option 1, but ok to postpone also.  In our view we will not define any specific handling for specific cases, so the only question is the applicability of the requirements for different scenarios. | | Intl | Option 2. | | Vivo | Option 1 | | Apple | According to our observation on the CR, which are being discussed in this meeting, seems option 1 requires the least standard effort. Current rules for collision handling are quite general and can cover all the scenario. | | CATT | Prefer option 1. There is no big difference on all the cases. | | Ericcson | Option 1 | | Moderator | No clear consensus is observed.  Keep it as an open issue |  **Issue 2-3-8: Whether to introduce UE capability for different overlapping scenarios (FO, FPO, PFO, PPO).**  * Agreement   + Do not introduce UE capability for different overlapping scenarios (FO, FPO, PFO, PPO)   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | ok | | Qualcomm | We could support the tentative agreement as long as the UE can indicate the type rule it supports to resolve collisions (option 1 or option 5 in issue 2-3-3). | | LG Electonics | Fine | | Huawei | ok | | Intl | OK | | vivo | ok | | OPPO | OK | | Apple | ok | | CMCC | OK | | Ericsson | OK | | Moderator | To QC, we even do not have the agreement to introduce both Option 1 and Option 5 in Issue 2-3-3.  Let me keep it as an agreement and please QC let me know if you have a strong concern. |  **Overhead** **Issue 2-4-1: Whether to define the overhead cap**  * Open issue   + Option 1: Yes   + Option 2: No   + Option 3: Up to UE capability   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | Option 2. No capability | | Qualcomm | Prefer option 2. | | LG Electonics | Option 1. | | Huawei | Option 1 | | Intel | Option 2 | | vivo | Option 1 or 3 | | Apple | Support option 1 or 3. | | CATT | Option 2 and we don’t think capability is reasonable. | | ZTE | Option 2 | | CMCC | Option 2 | | Ericsson | Option 2. | | Moderator | Now clear consensus. Keep it as an open issue |  **Issue 2-4-2: Definition of overhead cap (if agreed in Issue 2-4-1)**  * Open issue   + Option 1: The max overhead that UE can support in Rel-15/16   + Option 2: Consider overhead cap with when configuring multiple MG patterns.     - * N : number of multiple MG patterns       * MGLr : MGL of referenced MG       * MGRPr : MGRP of referenced MG       * K is FFS   + Option 3: When concurrent MGs are configured, the MGRP for each MG cannot be smaller than 40ms   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | Depends on outcome of 2-4-1. | | Qualcomm | Same comment as in 1st round. | | LG Electonics | Preference is Option 2, if overhead cap is defined. | | Huawei | Option 3 | | vivo | Depends on outcome of 2-4-1. | | Apple | Support option 1 and 3. | | Moderator | Now clear consensus. Keep it as an open issue |  **Measurement requirements** **Issue 2-5-1: [Outside gap] CSSF**   * Agreement   + The definitions for the applicable measurement types specified in Section 9.1.5.1 for CSSF outside gap can be re-used as a starting point with the modification to consider more than 1 measurement gaps   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | From summary:  To Nokia’s question: The understanding is that a frequency layer considered as CSSF outside gap in Rel-15 may become within gap after introducing concurrent gap. One example is a layer with SMTC periodicity 20ms and offset 0ms and a gap with MGRP 40ms and offset 0ms in Rel-15. If we later add a new gap with MGRP 40ms and offset 20ms, then the SMTC occasions will be fully overlapped by 2 gaps. This means we need to remove this frequency layer from outside gap to within gap. This is the reason that the definition of CSSF outside gap needs to be revised  Thank you for the explanation and clarification. This was also according to our understanding of what could happen.  We are fine with the agreement but the detailed sharing then need more discussion as we see it may also depend on collision rule. | | Qualcomm | We are fine with the agreement to use the requirements mentioned above as starting point. | | Huawei | Ok, we share same understanding as MTK in response to Nokia above. | | Intel | We are fine with the agreement | | OPPO | OK | | Apple | Ok | | ZTE | We are fine with the agreement.  Further more, as we suggested in 1st round and Apple’s further clarification, if the target MO can be covered by some MG while somehow NW doesn’t provide association, how to address the CSSF issue should be further studied. | | Ericsson | OK | | Moderator | In my understanding this issue raised by Apple and ZTE has been address in the LS to RAN2.  Let me keep it as an agreement. @ ZTE, please let me know if you have strong concern. |  **Issue 2-5-2: [Outside gap] Kp**  * Agreement   + The following is taken a starting point to proceed and is subject to further checking in the next meeting.   + The Kp value for a SSB frequency layer to be measured outside gap is defined as Kp = Ntotal / Navailable   + For a window W of duration max(TSMTC, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the SSB frequency layer, and starting at the beginning of any SMTC occasion:     - Ntotal is the total number of SMTC occasions within the window, ignoring any overlap with MG occasions within the window, and     - Navailable is the number of SMTC occasions that are not overlapped with any MG occasion within the window W, after accounting for MG collisions by applying the selected gap collision rule.     - FFS: extension to CSI-RS based L3 measurements   + Kp = 1 when Navailable = 0.     - In this case, the SMTC occasions are fully overlapped by MGs and the measurement should be conducted within gap.   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | we can proceed with the baseline proposal as it has good support mong companies. We would prefer to have time to check until next meeting. Hence, unless we identify something is broken by the above we can agree in next meeting (basically having the text in []). | | Qualcomm | OK with the tentative agreement and to keep it in [] for further checking. | | Huawei | OK with the tentative agreement and to keep it in [] for further checking. | | Intel | We are fine with the tentative agreement | | vivo | ok | | OPPO | For CR implementation, CSI-RS based L3 measurements can be assumed to use the similar rules for kp. It can apply to CSI-RS based L3 as follows:   * The Kp value for a CSI-RS frequency layer to be measured outside gap is defined as Kp = Ntotal / Navailable * For a window W of duration max(CSI-RS period, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the CSI-RS frequency layer, and starting at the beginning of any CSI-RS resources:   + Ntotal is the total number of CSI-RS resources within the window, ignoring any overlap with MG occasions within the window, and   + Navailable is the number of CSI-RS resources that are not overlapped with any MG occasion within the window W, after accounting for MG collisions by applying the selected gap collision rule.   Also fine to keep it in [] for further checking. | | MTK | A modification is added for the case when SMTC is fully overlapped by MG | | Apple | In general we are ok with tentative agreement. | | CATT | Fine with the tentative agreement. | | Ericsson | We need time to further check. | | Moderator | It seems all companies are fine with the agreement, but want to have some further checking.  Let me add a note to say that this is taken as a starting point, subject to further checking in the next meeting. |  **Issue 2-5-3: [Within gap] CSSF**   * Agreement   + The CSSF is calculated separately for each gap pattern. [provided that the association between measurement objects and gap pattern is configured by network.]     - [Only the measurement objects associated to the same measurement gap pattern are counted when deriving CSSFwithin\_gap,i for a target measurement object with index i.]     - FFS: how the dropped gap occasions will not be used in deriving CSSFwithin\_gap,i   + RAN4 can revisit this agreement when the association implemented by RAN2 is clear.   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | This text still causes some question:  ‘provided that the association between measurement objects and gap pattern is configured by network’  In legacy gaps there is not such association. RAN4 would need to have soe common understanding how the measurement objects measured using the classical (legacy) gaps are understood when we discuss ‘associated’. Straight forward is to define objects configured with classical gaps be associated with those gaps – just one option. But it needs to be well defined how the objects and gaps are associated.  Hence, we prefer to have this clear before agreeing. | | Qualcomm | Regarding the last bullet point in the tentative, we propose that it may be clarified as follows:   * The calculation of CSSFwithin\_gap,i needs to account for gap occasions that are dropped due to collisions * FFS how to modify the calculation of CSSFwithin\_gap,i to account for gap collisions   + Option1:     - Modify the definition of Ri for CSSFwithin\_gap,i as follows: Ri is the maximal ratio of the number of measurement gap where measurement object i is a candidate to be measured over the number of measurement gap where measurement object i is a candidate and not used for a long-periodicity measurement defined above and not dropped due to measurement gap collisions. | | Huawei | Support main bullet and first sub-bullet.  To Nokia, we understand RAN4 requirements are to be defined assuming association between measurements and MGs are made clear to UE, and how this can be achieved (how the association information is provided) is a RAN2 issue.  Support the updated version from QC for the last sub-bullet, better to add that ‘other option not precluded’. | | Apple | The main bullet and first sub-bullet are clear to us. For the second sub-bullet, we are open for further discussion to make it clearer. QC’s proposal looks good to us. | | ZTE | Support main bullet and first sub-bullet. | | Ericsson | We need time to further check. | | Moderator | Since the main concern is still on the 2nd sub-bullet, let me make it FFS.  It seems some companies are not clear about how the final association will be implemented by RAN2. Let me add a note saying that “RAN4 can revisit this agreement when the association implemented by RAN2 is clear.” |  **Issue 2-5-4: [Within gap] MGRP**  * Agreement   + In the delay requirements of measurements within gap, indicate which MGRP to be selected between 2 configured measurement gaps     - RAN4 can revisit this agreement when the association implemented by RAN2 is clear.   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | We are wondering if this is also related to our input in 2-5-3 and how to associate Objects and classical gaps?  We see that it is important to get this ‘association’ clarified such that all has a common understanding which can be captured in the specification. | | Qualcomm | Copying our response from the 1st round. We think the tentative agreement should be revised. The agreement can address the case where explicit association provided by the network. FFS when no explicit association is provided.  When the network provides explicit association of the MO with a concurrent MG, use the corresponding MGRP.  When no association is provided by the network, if the MO can only be a measured within one of the concurrent MGs, use the MGRP of the applicable MG. However, when no association is provided by the network, there may be cases in which a MO could be measured within gap instances from two overlapping concurrent MGs with different MGRPs. Those cases are FFS. | | Huawei | Support the agreement.  As commented for above issue, we understand RAN4 requirements are to be defined assuming association between measurements and MGs are made clear to UE, and how this can be achieved (how the association information is provided) is a RAN2 issue. | | OPPO | Support the agreement. Associated MGRP should be also clarified in measurement requirements. | | Apple | Support the agreement. For the case wherein association is not provided, we propose the following options:   1. No RRM requirements apply. 2. Define rules to let both UE and NW know which MO to measure in every gap occasion. 3. Define requirement based on the ‘worst case’. i.e. count every MO (which can be covered by the MGP) when defining requirement for each MGP. Some MO may be counted twice.   The simplest way is 1), i.e. assuming NW will always provide the association. | | CATT | Support the agreement. We think we have agreed the association is mandatorily provided and has been confirmed by RAN2 it is feasible. So we don’t need to consider the case when no association is provided. | | ZTE | Support the agreement. | | Ericsson | We need to further check RAN2’s progress whether the association is mandatory or clear between NW and UE. | | Moderator | It seems some companies are not clear about how the final association will be implemented by RAN2. Let me add a note saying that “RAN4 can revisit this agreement when the association implemented by RAN2 is clear.” |  **Issue 2-5-5: [Within gap] Kp**  * Agreement   + The following is taken a starting point to proceed and is subject to further checking in the next meeting.   + The Kp value for a SSB frequency layer to be measured within gap is defined as Kp = Ntotal / Navailable   + For a window W of duration max(TSMTC, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the SSB frequency layer, and starting at the beginning of any associated gap occasions covering the SMTC occasion:     - Ntotal is the total number of associated gap occasions covering SMTC occasions within the window, ignoring any overlap with other MG occasions within the window, and     - Navailable is the number of associated gap occasions covering SMTC occasions that are not overlapped with any other MG occasion within the window W, after accounting for MG collisions by applying the selected gap collision rule.       * Requirements do not apply if Navailable =0     - FFS: extension to CSI-RS based L3 measurements   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | We can use this as baseline, but we prefer to have time until next meeting to analyse the proposal fully. Same as in 2-5-2. | | Qualcomm | We’re OK to leave it as FFS until next meeting. | | Huawei | OK with the tentative agreement and to keep it in [] for further checking. | | OPPO | Similar comments as issue 2-5-2. | | MTK | We add a modification that the gap occasions that covers the target SMTC should belong to the associated gap | | Apple | In general, it looks good. We provided comment on the last sub-bullet on some CRs:   * + - * When Navailable =0, the MGP is regarded as disabled   Navailable = 0 is an error configuration in our view. However, it doesn’t always mean the MGP is disabled. For instance, MGRP1=SMTC=40ms, MGRP2=20ms. The MO is associated with MGP2 but MGP1 is with higher priority. Thus Navailable = 0 for this MO. But MGP2 is still there and can be used for measuring other carriers.  We can simply say requirements do not apply if Navailable =0. | | CATT | Fine with the tentative agreement and to keep it in [].  To Apple’s comments, in our understanding, when we say the MGP is regarded as disabled, it is for the SSB layer to be measured not for other carriers. But we can also accept the updated wording by Apple. | | ZTE | Fine with the tentative agreement and to keep it in []. | | Ericsson | We need time to further check. | | Moderator | Same as Issue 2-5-2, let me add “The following is taken a starting point to proceed and is subject to further checking in the next meeting.”  Also take Apple’s comment to revise a sub-bullet. |  **Impact to other L1 measurements** **Issue 2-6-1: P factor of L1 measurement**   * Agreement   + The following is taken a starting point to proceed and is subject to further checking in the next meeting.   + The P value for a L1 resource to be measured is defined as     - Ntotal / Navailable in FR1     - Psharing \* Ntotal / Noutside\_MG in FR2 with Navailable = 0     - Ntotal / Navailable in FR2 with Navailable > 0   + For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as serving cell, and starting at the beginning of any gap occasions covering the L1 resource occasion:     - Ntotal is the total number of L1 resource occasions within the window, ignoring any overlap with MG occasions or SMTC occasions within the window, and     - Noutside\_MG is the number of L1 resource occasions that are not overlapped with any MG occasion within the window W, after accounting for MG collisions by applying the selected gap collision rule.     - Navailable is the number of L1 resource occasions that are not overlapped with any MG occasion nor any SMTC occasion within the window W, after accounting for MG collisions by applying the selected gap collision rule.     - TL1 is periodicity of the target L1 RS.   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | Keep this open and once L3 is clear the same principle can likely be used. | | Qualcomm | We suggest to keep it open until next meeting to give more time for companies to check. | | Huawei | OK with the tentative agreement and to keep it in [] for further checking. | | Apple | Ok with the tentative agreement | | Ericsson | We need time to further check. | | Moderator | Same as Issue 2-5-2, let me add “The following is taken a starting point to proceed and is subject to further checking in the next meeting.” |  **Others****Issue 2-7-1: Whether to specify transient UE behavior when concurrent MGs are re-configured**  * Agreement   + Do not specify transient UE behavior when concurrent MGs are re-configured   Addition comments (to be moved to moderator’s summary and removed in the formal Tdoc)   |  |  | | --- | --- | | Company | comments | | Nokia | ok | | Qualcomm | OK | | Huawei | OK | | Intel | OK | | vivo | ok | | Apple | ok | | Ericsson | We can compromise. | | Moderator | Keep this as an agreement. Thanks for the compromise. |  **Issue 2-7-2: CR handling in RAN4#101bis-e meeting**  * Agreement   + All endorsed CRs are just a start point to move forward and are subject to further checking and revising in the next meeting. |

The discussion for the LS are captured as follows

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| **1. Overall Description**  RAN4 would like to thank RAN2 for the LS on R17 NR MG enhancements – Concurrent MG [1]. RAN4 has discussed the LS and would like to provide RAN2 the following feedback and additional information.  Regarding the following understanding, clarification and limitation from RAN2,   |  | | --- | | * RAN2 confirms the following understanding for concurrent gap operation:   1. Concurrent gaps are multiple measurement gaps and each gap pattern could be associated with one or multiple frequency layers.  2. Each frequency layer can be associated with only one of the concurrent gaps.  3. Without considering pre-configured MG, concurrent gaps are always activated if it is setup by the network.  4. No new gap pattern is introduced for concurrent gap, the existing R15/R16 gap pattern could be configured for the concurrent gaps.   * RAN2 to clarify “frequency layer” and limitations as below:   PRS measurement can be associated with one gap pattern, no matter how many frequencies are measured for PRS.  Each measured SSB or LTE frequency is considered as one frequency layer.  Measured CSI-RS resources with the same center frequency is considered as one frequency layer. It is possible to have Multiple MOs including CSI-RS resources with same center frequency.  SSB and CSI-RS measurement in one MO are considered as different frequency layers. |  * RAN4 response: RAN4 confirms all above understanding is correct, but different MOs with CSI-RS resources are considered as different frequency layers from RAN4 requirement’s viewpoint, no matter if the CSI-RS resources are with same or different centre frequencies.   **Q1 –** Can Rel-17 concurrent gaps be configured together with legacy gap? If ‘yes’, what would be the UE behavior?   * RAN4 response: From RAN4 requirement perspective, RAN4 would like to ensure that the association of frequency layers or dedicated use cases to measurement gaps shall be clearly understood by both UE and Network for all configured measurements. How the association can be made clear to UE is up to RAN2.   **Q2 –** How many concurrent gaps could be configured simultaneously?   * RAN4 response:   + Up to 2 gaps can be configured to UE which does not support per-FR gap.   + Up to 3 gaps cross all FRs can be configured to UE which supports per-FR gap in SA case. FFS for MR-DC case if it is supported.   **Q3 –** Could concurrent gaps be configured with different gap types (i.e., some gaps are per-UE while some gaps are per-FR)? If so, what is the maximum number of gaps that could be configured simultaneously for each gap type (per-UE /per-FR1/per-FR2)?   * RAN4 response:   + In Rel-17, UE can be configured with per-UE gap and per-FR gap simultaneously when     - 1) UE is capable of per-FR gap and concurrent gaps, and     - 2) per-UE gap is associated with PRS measurements       * Note: Additional use cases incl. Rel-17 MUSIM and Rel-17 NR NTN WIs are not precluded to be included in future releases.   A list of all supported combinations can be found in below table for reference.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Combinations of different gap types for per-FR gap capable UE | | | | | | Index | # of simultaneous MG | | | RAN4 conclusion | | Per-FR1 | Per-FR2 | Per-UE | | 0 | 2 | 1 | 0 | Supported | | 1 | 1 | 2 | 0 | Supported | | 2 | 0 | 0 | 2 | Supported | | 3 | 1 | 0 | 1 | Supported when per-UE gap is associated to PRS measurement | | 4 | 0 | 1 | 1 | | 5 | 1 | 1 | 1 | | 6 | 0 | 0 | 1 | Supported | | 7 | 1 | 1 | 0 | Supported | | 8 | 1 | 0 | 0 | Supported | | 9 | 0 | 1 | 0 | Supported | | 10 | 2 | 0 | 0 | Supported | | 11 | 0 | 2 | 0 | Supported |   **Q4 –** Is the legacy gap sharing configuration (configured in *MeasGapSharingConfig*) applicable to Rel-17 concurrent gaps? If ‘yes’, could RAN4 clarify how this would work?   * RAN4 response: Yes. Each gap is configured with separate *MeasGapSharingConfig* which has the same configurable range of parameters.   **Q5 –** Could RAN4 help to clarify whether UTRAN-FDD measurement (configured in *MeasObjectUTRA-FDD*) is also applicable in concurrent gap operation?   * RAN4 response: RAN4 already provided our response in the previous LS R4-2120304.   In addiiton, RAN4 also would like to inform RAN2 that   * It is up to RAN2 to decide whether concurrent MGs is supported in MR-DC scenario. * It would be necessary for the UE and the network to have a common understanding about how to resolve collisions between gaps. RAN4 has not yet agreed how to address that scenario and will inform RAN2 once the conclusions are reached.   **2. Actions:**  ACTION: RAN4 respectfully asks RAN2 to take above information into consideration in the future works. |

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on R17 NR MG enhancements – multiple concurrent MGs | MediaTek inc. |  |
| Further reply LS on R17 NR MG enhancements – Concurrent MG | MediaTek inc. | To: RAN\_2; Cc: RAN\_1 |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
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| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2200115 | Draft CR on measurement delay requirements for concurrent MG patterns | CATT | Revised |  |
| R4-2200243 | CR on CSSF for concurrent gaps | Apple | Revised |  |
| R4-2200404 | Draft CR on inter-RAT measurement requirements with concurrent gaps | vivo | Revised |  |
| R4-2200490 | Draft CR on 38.133 for L1 measurement impact of concurrent gaps | MediaTek inc. | Revised |  |
| R4-2200678 | DraftCR on inter-frequency measurement delay requirements with concurrent gaps | Xiaomi | Revised |  |
| R4-2200694 | DraftCR on positioning measurement requirements due to concurrent gap in NR | Intel Corporation | Revised |  |
| R4-2201140 | Draft CR to 38133 on CSI-RS based L3 measurement requirements with concurrent gap | OPPO | Revised |  |
| R4-2201214 | draftCR on concurrent gaps (9.1.2B) | Ericsson | Revised |  |
| R4-2201624 | CR on collision handling and MG related requirements for concurrent MGs | Huawei, Hisilicon | Revised |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2202603 | WF on R17 NR MG enhancements – multiple concurrent MGs | MediaTek inc. | Agreeable |  |
| R4-2202604 | Further reply LS on R17 NR MG enhancements – Concurrent MG | MediaTek inc. | Agreeable | To: RAN\_2; Cc: RAN\_1 |
| R4-2202613 | Draft CR on measurement delay requirements for concurrent MG patterns | CATT | Endorsed |  |
| R4-2202605 | CR on CSSF for concurrent gaps | Apple | Endorsed |  |
| R4-2202606 | Draft CR on inter-RAT measurement requirements with concurrent gaps | vivo | Endorsed |  |
| R4-2202607 | Draft CR on 38.133 for L1 measurement impact of concurrent gaps | MediaTek inc. | Endorsed |  |
| R4-2202608 | DraftCR on inter-frequency measurement delay requirements with concurrent gaps | Xiaomi | Endorsed |  |
| R4-2202609 | DraftCR on positioning measurement requirements due to concurrent gap in NR | Intel Corporation | Endorsed |  |
| R4-2202610 | Draft CR to 38133 on CSI-RS based L3 measurement requirements with concurrent gap | OPPO | Endorsed |  |
| R4-2202611 | draftCR on concurrent gaps (9.1.2B) | Ericsson | Return to |  |
| R4-2202612 | CR on collision handling and MG related requirements for concurrent MGs | Huawei, Hisilicon | Endorsed |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
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Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)