**3GPP TSG-RAN WG4 Meeting # 98-e-Bis R4-2103714**

**Electronic Meeting, Jan 25– Feb 5, 2021**

**Agenda item:** 11.5.1 and 11.5.2.2

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

**Title:** Email discussion summary for [98e][233] NR\_MG\_enh\_1

**Document for:** Information

# Introduction

This document is the email discussion summary for [98e][233] NR\_MG\_enh\_1 with the following topics covered

* Topic 1: General (AI 11.5.1)
* Topic 2: Multiple concurrent and independent MG patterns (AI 11.5.2.2)

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

* 1st round: Decide on the scope, priority, options and tentative agreement to be discussed in the 2nd round. Conclude issues with strict consensus, if any.
* 2nd round: Conclude the issues identified in the 1st round.

# Topic #1: General (AI 11.5.1)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2101061 | MediaTek inc | **Proposal 1**: RAN4 to agree on the latest RRM work plan for “R17 NR and MR-DC measurement gap enhancements WI” as presented in this contribution. |
| R4-2102535 | Ericsson | **Proposal 2:** In the first phase of the WI, RAN4 focus on the functionality and principles needed to support parallel MG patterns, while considering existing MG patterns first. |

## Open issues summary

### Sub-topic 1-1: Work plan

**Issue 1-1: Workplan proposals**

* Proposals
  + Option 1: R4-2101061 (extend core part by 2 quarters according to RAN#90e decision in RP-202868)
* Recommended WF
  + Agree on the updated workplan in R4-2101061

**Issue 1-2: Focus in the 1st phase of WI**

* Proposals
  + Option 1: (Ericsson)
    - In the first phase of the WI, RAN4 focus on the functionality and principles needed to support parallel MG patterns, while considering existing MG patterns first.
* Recommended WF
  + Companies to comment if Option 1 is agreeable

## Companies views’ collection for 1st round

### Open issues

**Issue 1-1: Workplan proposals**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | Support |
| Apple | Support |
| E/// | Support the work plan |
| Intel | Recommended WF can be agreed. |
| Huawei | We understand the change of the WI completion date should be firstly reflected in the WID and TU allocation, which are to be decided in RAN. We can revise the work plan accordingly based on RAN outcome. |
| Xiaomi | Fine with the update |
| Nokia | Support the work plan proposal |

**Issue 1-2: Focus in the 1st phase of WI**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | We’re fine to focus on the principles with existing MG patterns in the 1st phase.  We suggest the 1st phase can be from #98e meeting to #100e meeting, the 2nd phase from #110b-e meeting to #102e meeting |
| Apple | Fine to focus on existing MG first. |
| LG | We’re fine with 2 phase approach and to focus on existing MG patterns in 1st phase. |
| CMCC | OK with option 1. |
| OPPO | Agree to focus on existing MG. |
| E/// | We also prefer to focus on the existing MG patterns in the 1st phase. It is difficult to say when exactly 1st phase ends. But we also agree to review the situation in Q4-2021 and see if the 2nd phase can start then. |
| Qualcomm | We agree with option 1. |
| Intel | Support this proposal. RAN4 prefers to not introduce any new gap patterns as the individual gap instances of the multiple concurrent (parallel) MG pattern. |
| Huawei | We do not quite understand option 1. In our understanding, the scope of the WI does not include introduction of new MG patterns, so all the discussions should be based on existing MG patterns. Option 1, however, seems to implicate there will be second phase of the WI where we may work on extending concurrent MGs to new MG patterns. This has not been discussed in RAN4 or RAN, and we cannot agree to option 1 with the current wording. |
| Xiaomi | Fine with option 1 with 2 phase approach. |
| CATT | Fine with option 1 to focus on the existing MG. |
| Nokia | Agree on the principle of considering existing measurement gaps. However, it is not clear if it is within the WI scope to introduce new measurement gap patterns? Our understanding is that this is not the case. |

### CRs/TPs comments collection

Moderator: No CRs/TPs in this AI

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Issue 1-1** | **Workplan proposals**  *Status:*   * 5 companies support the revised WP * 1 companies suggest to revise WP after WID and TU are updated in Plenary   *Tentative agreements:* No  *Recommendations for 2nd round:* **Guidance from chair** is needed on whether RAN4 should wait for Plenary update. |
| **Issue 1-2** | **Focus in the 1st phase of WI**  *Status:*   * 10 companies agreed to focus on existing gap pattern in the 1st phase. * 1 company raised concern that this seems to imply new gap pattern(s) will be introduced in the 2nd phase. * Moderator: Since there is already a clear consensus in **Issue 2-18** that we will not introduce new gap pattern in this work. Moderator believes that intention to have 1st and 2nd phase is to set a clear time line on whether to consider the other 2 objectives in the same WI into concurrent gap.   *Tentative agreements:* No  *Recommendations for 2nd round:* Companies please check if the following revised WF is agreeable:   * Before RAN4#100b (Q4’20), RAN4 focuses on the functionality and principles needed to support parallel MG patterns without considering pre-configured gap and NCSG. |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| R4-2101061  (WP, MTK) | Revised to capture the potential agreement on 2 phases  Whether to approve the WP is pending on chair’s guidance in **Issue 1-1** |

## Discussion on 2nd round (if applicable)

Moderator: According to session chair’s guidance, the workplan is noted and is expected to be revised after the timeline update in next RAN Plenary meeting.

## Summary on 2nd round (if applicable)

Moderator: No issue

# Topic #2: Multiple concurrent and independent MG patterns (AI 11.5.2.2)

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc #** | **Company** | **Proposals / Observations** |
| [R4-2100113](file:///D:\docs\R4-2100113.zip) | ZTE Corporation | **Proposal 1**: RAN4 will specify corresponding requirement after agreeing on the definition of concurrent MGs.  **Proposal 2**: Define concurrent MGs as follows: two MGs are considered concurrent if they overlap with each other partly or completely.  **Proposal 3**: No RF tuning time shall be considered when defining concurrent MGs since the current specification already allows 0.5 ms for RF tuning at the beginning and the end of MGs. |
| [R4-2100222](file:///D:\docs\R4-2100222.zip) | Apple | Observation 1: sometimes MG overhead can be lowered by configuring two concurrent and independent MG patterns.  Observation 2: too many concurrent MG patterns would result in high MG overhead, which is not desirable considering data throughput degradation and mobility performance loss for carriers which are measured outside MG.  **Proposal 1**: MG overhead should be taken into account when discussing the maximum number of multiple concurrent and independent MG patterns.  **Proposal 2**: when configuring multiple MG patterns, NW should make sure that the MG overhead shall not exceed the maximum MG overhead of the pattern supported by the UE according to R15/16 capabilities supportedGapPattern and supportedGapPattern-NRonly.  Observation 3: to guarantee basic mobility performance, R17 network still has to make sure all carriers can be measured by R15/R16 UEs with one single measurement gap pattern.  **Proposal 3**: no more than 2 multiple concurrent and independent MG patterns is expected in R17.  **Proposal 4**: RAN4 needs to discuss the measurement requirement for scenario wherein there is MG occasion overlapping between multiple concurrent MG patterns. |
| [R4-2100455](file:///D:\docs\R4-2100455.zip) | CATT | **Proposal 1**: The multiple concurrent gap patterns can be applied for all the measurements that need gaps. It is network implementation which measurement can be performed in a certain gap pattern.  **Proposal 2**: The multiple concurrent gap patterns can be applied for different SMTC configuration.  **Proposal 3**: The following issues need to be considered for the mechanisms of multiple concurrent and independent gap patterns:   * The maximum number of multiple gap patterns * The proximity of different gap patterns   UE behaviors and RRM requirements when different gap patterns fully or partially overlapped  **Proposal 4**: When gap pattern #0 to pattern #23 defined in table 9.1.2-1 in TS 38.133 are used, at most three concurrent gap patterns can be configured. When gap #24 or #25 is used, at most 2 concurrent gap patterns can be configured.  **Proposal 5**: When used for covering different SMTC configuration, at most 2 concurrent gap patterns can be configured.  **Proposal 6**: When different SMTC and different measurement are both used, at most 3 concurrent gap patterns can be configured. |
| [R4-2100641](file:///D:\docs\R4-2100641.zip) | LG Electronics | **Proposal 1**: Consider multiple same MG pattern IDs with different MG offset and different MG pattern IDs with different MG offset for multiple MG patterns.  **Proposal 2**: Consider single MG pattern ID with multiple MG offsets as multiple MG patterns.  **Proposal 3**: For UE capable of per-UE MG, consider MG pattern ID #0~#11 for multiple MG patterns.  **Proposal 4**: For UE capable of per-FR MG, consider MG pattern ID #0~#11 for FR1 NR measurements and MG pattern ID #12~#23 for FR2 NR measurements for multiple MG patterns.  **Proposal 5**: In Proposal 3 and 4, consider the existing applicable MG pattern IDs in Table 2.2 and Table 2.3.  **Proposal 6**: Consider MG pattern IDs having same MGL for multiple MG patterns, if SMTCs are configured with same SMTC window duration.  **Proposal 7**: Consider Primary MG pattern ID(s) and Secondary MG pattern ID(s) for multiple MG patterns.  **Proposal 8**: In Proposal 7, consider that Secondary MG pattern ID(s) can be activated or deactivated to reduce performance degradation due to multiple MG patterns.  **Proposal 9**: Consider MG pattern ID with largest MGRP of 160ms as one of multiple MG pattern IDs to reduce performance degradation due to multiple MG patterns.  **Proposal 10**: Keep the existing UE measurement capability of monitoring of multiple layers for multiple MG patterns. |
| [R4-2100713](file:///D:\docs\R4-2100713.zip) | Xiaomi | **Proposal 1**: It is proposed to configure 2 independent measurement gap pattern during one measurement period.  **Proposal 2**: The CSSF with gap should be defined based on the carriers to be measured with the same measurement gap pattern.  **Proposal 3**: The MG offset difference between independent MGs should be larger than the MG duration. |
| [R4-2100870](file:///D:\docs\R4-2100870.zip) | CMCC | Observation 1: since requirements and UE behavior will be impacted by the scenarios, it is necessary to have discussion on the scenarios to which the multiple concurrent MG patterns are applied.  **Proposal 1**: following two scenarios are suggested to be considered for the multiple concurrent and independent MG patterns:   * Scenario 1: multiple concurrent MG patterns are applied for the same measurement purpose, e.g. multiple concurrent MG patterns are used for RRM measurement, different MG are used for the measurement of different frequency layers. * Scenario 2: multiple concurrent MG patterns are applied for different measurement purpose, e.g. two MG patterns are configured, one is used for the RRM measurement, and the other one is used for the PRS measurement   Observation 2：multiple concurrent and independent MG patterns will result in more throughput loss.  **Proposal 2**: It is necessary to determine the maximum number of concurrent and independent MG patterns, and the impact on the throughput need to be considered. |
| [R4-2101063](file:///D:\docs\R4-2101063.zip) | MediaTek inc. | Observation 1: The usage of the new gap can be SSB-periodicity specific, Inter-RAT specific, CSI-RS specific, PRS specific, NR-U RSSI specific, Intra-frequency specific, NCSG specific, etc..  Observation 2: When UE supports concurrent gaps, the legacy gap applicability can be extended.  Observation 3: The application of NR-only mandatory gaps in Rel-16 can be extended when UE supports concurrent gaps.  **Proposal 1**: The overall data dropping rate won’t exceed the legacy NR system when multiple concurrent gap is introduced in R17.  **Proposal 2**: The maximum number of concurrent MGs won’t be larger than 2 per UE or per FR, according to UE’s capability.  **Proposal 3**: When UE supports both per-UE gap and concurrent gap, both MGs shall be per-UE gap.  **Proposal 4**: When UE supports both per-FR gap and concurrent gaps, RAN4 can start the discussion the scenario when 1 FR1 gap, 1 FR2 gap and 1 additional FR1 new gap.  **Proposal 5**: RAN4 to define the framework of usage for new gap dedicated to specific purpose(s), such as different RS(s), different RATs or different gap types.  **Proposal 6**: RAN4 to ensure both UE and NW have the same understanding on the usage of the new gap.  **Proposal 7**: In EN-DC, when UE supports per-UE gap or FR1 gap, the concurrent gaps will be configured by MN; when UE supports FR2 gap, the concurrent gaps will be configured by SN.  **Proposal 8**: In NR SA, NE-DC, NR-DC, the concurrent gaps will be configured by MN.  **Proposal 9**: Do not introduce the concurrent gap in LTE SA mode.  **Proposal 10**: When concurrent gaps are partially or fully overlapping in a gap duration, they are treated as fully overlapping for these two gaps in that gap duration.  **Proposal 11**: RAN4 can prioritize fully non-overlapping scenario. FFS whether to specify requirements for other partially and fully overlapped scenarios. |
| [R4-2101081](file:///D:\docs\R4-2101081.zip) | NEC | **Proposal 1**: When designing multiple MG patterns in a measurement period, RAN4 to agree that maximum of only one MG is allowed for every 20ms.  **Proposal 2**: RAN4 to agree the principle for deciding the number of MG patterns per measurement period is “total cumulative MGL across MG patterns in a measurement period shall be less than current maximum MGL of 20ms and there cannot be more than one MG for each 20ms period”. |
| [R4-2101270](file:///D:\docs\R4-2101270.zip) | Intel Corporation | Observation 1. Whether and how many concurrent gap patterns supported by UE shall be completely up to UE implementation.  **Proposal 1**: The number of supported concurrent gap patterns can be defined as UE capability.  Observation 2: How to define the limitation of the total concurrent gap patterns activated can be FFS, e.g.   * The static number or * The adaptive limitation based on the gap instances within the concurrent gap pattern   Observation 4: It is feasible to allow the overlapping among the multiple gaps for the concurrent independent gap pattern.  Observation 5: The serving gNB can configure the concurrent gaps for SSB and CSI-RS measurements without overlapping.  Observation 6: When non-overlapping concurrent measurement gap patterns, the measurement requirements for SSB/CSI-RS/PRS in Rel15/Rel16 without the gap sharing can be applicable for them independently.  Observation 7: The gap sharing factor shall be applicable to the delay requirements when overlapping case.  Observation 8: How to define the gap sharing factor when the multiple concurrent gap patterns configured can be FFS.  **Proposal 2**: The measurement delay requirement in case of multiple gaps shall be revisited. As a starting point, the two basic scenarios can be studied.   * Non-overlapping * Overlapping   **Proposal 3**: The gap patterns defined in Rel16 [3] can be reused for the gap instances being included in the multiple concurrent gap pattern.  **Proposal 4**: The concurrent multiple MG pattern capability is per-UE.  Observation 9: The gap instances configured by a same concurrent MG pattern can only be used by the specific measurement type(s) occurred in a same frequency layers indicated by serving gNB  Observation 10: UE processing capability shall be taken count into the proximity of two adjacent gap instances in a concurrent measurement gap configuration. |
| [R4-2101538](file:///D:\docs\R4-2101538.zip) | OPPO | Observation 1: Current MG patterns can be reused for all concurrent and independent MG patterns.  Observation 2: At most 5 pre-configured MG patterns are commonly considered for UE.  **Proposal 1**: The maximum number of concurrent and independent MG patterns active at any time subjects to UE capabilities of DL CA and maximum number of measurement engines.  **Proposal 2**: Define 3 as the maximum number of concurrent and independent MG patterns active at any time.  **Proposal 3**: Additional MG are usually assumed to be supplement for those of per UE or per FR gap. |
| [R4-2102269](file:///D:\docs\R4-2102269.zip) | Nokia, Nokia Shanghai Bell | 1. For a Per UE gap capable UE, multiple concurrent and independent MGPs applies per UE. 2. For a Per FR gap capable UE, multiple concurrent and independent MGPs applies per FR. 3. A per FR GP capable UE shall support multiple concurrent and independent MGPs on at least one FR. 4. RAN4 need to agree on what is understood as independent MGPs 5. RAN4 should not define new requirements (multiple concurrent and independent MGPs) for which RAN4 already has defined requirements. 6. MGPs are not independent MGPs if they are fully or partially fully overlapping in time. 7. Partially but not fully overlapping or fully non-overlapping MGPs would be considered as independent MGPs. 8. RAN4 need to define which aspect are limiting factors on the UE side in terms of the maximum number of concurrent independent MGPs a UE would be able to support. |
| [R4-2102297](file:///D:\docs\R4-2102297.zip) | Qualcomm Incorporated | **Proposal 1**: RAN4 should enable configuration of independent MG patterns dedicated to RRM and NR positioning, respectively, during a positioning session.  **Proposal 2**: RAN4 to discuss whether to consider NTN NR deployments during the specification of requirements for multiple concurrent and independent MG patterns.  **Proposal 3**: RAN4 to specify UE capability to support up to a maximum of [2] per-UE or [3] per-FR concurrent and independent MG patterns.  **Proposal 4**: Concurrent MG patterns that would have overlapping instances in time should not be allowed (except in the case of per-FR gaps in different FRs).  **Proposal 5**: RAN4 should discuss requirements for minimum guard period between measurement gap instances when multiple concurrent MG patterns are configured.  **Proposal 6**: RAN4 to discuss whether to specify a cap on aggregate fractional interruption time as applicability condition for configuring multiple concurrent and independent MG patterns.  **Proposal 7**: RAN4 to discuss how to configure a dedicated MG pattern(s) for NR positioning measurements for the duration of a positioning session.  Observation 1: The definition of CSSF within gap would need to be updated to account for multiple concurrent and independent MG patterns. |
| [R4-2102535](file:///D:\docs\R4-2102535.zip) | Ericsson | **Proposal 1**: In Rel-17, RAN4 introduces new MG patterns with MGL>20 ms and/or MGRP>160 ms.  **Proposal 2**: In the first phase of the WI, RAN4 focus on the functionality and principles needed to support parallel MG patterns, while considering existing MG patterns first.  **Proposal 3**: At least two MG gap patterns can be configured and used in parallel.   * The maximum number of parallel MG patterns depends also on the exact definition of parallel MG patterns.   **Proposal 4**: The parallel MG patterns can be any of:   * all per-UE, * all per-FR (for the same FR), or * a combination of per-UE and per-FR MG patterns, with at least one per-UE and at least one per-FR (for the FR in question).   **Proposal 5**: FFS: simultaneous use of parallel MG patterns in different FRs (e.g., at least one per-FR MG pattern used in FR1 in parallel with another MG pattern (per-FR in FR1 or per-UE) and at least one per-FR MG pattern used in FR2 in parallel with another MG pattern (per-FR in FR2 or per-UE)).  **Proposal 6**: Consider at least the following aspects while defining rules for parallel MG patterns:   * measurement type * RAT * Periodicity of signals to be measured in MGs * Relation between the parameters of the parallel patterns. |
| [R4-2102811](file:///D:\docs\R4-2102811.zip) | Huawei, HiSilicon | **Proposal 1**: Support multiple concurrent MGs for measurements of different frequency layers, with same or different RS (SSB/CSI-RS/PRS).  **Proposal 2**: All concurrent MGs are of the same type (per UE MG or per FR MG). At most 2 concurrent MGs are supported   * for a UE, if UE is configured with per UE MG * for an FR, if UE is configured with per FR MG   **Proposal 3**: All MG related requirements defined for single MG, including UE behaviour during MG, MG patterns and their applicability, MG timing, effective MGRP, MG interruption and UE UL behaviour after MG, apply for each of the multiple concurrent MGs.  **Proposal 4**: Each frequency layer that requires MG is measured in a single MG.  **Proposal 5**: CSSF is calculated independently for each of the multiple concurrent MGs.  **Proposal 6**: UE is assumed to measure only in MGL of one MG in occasions where two MGs are overlapped. RAN4 to define sharing rules for cases where multiple MGs are partially/fully overlapped. |

## Open issues summary

### Sub-topic 2-1 Definition

**Issue 2-1: Definition of concurrent gaps**

* Proposals
  + Option 1: (ZTE)
    - Two MGs are considered concurrent if they overlap with each other partly or completely
  + Option 2: (LGE)
    - Multiple same MG pattern IDs with different MG offset
    - Different MG pattern IDs with different MG offset
    - Single MG pattern ID with multiple MG offsets
  + Option 3: (Intel, Huawei)
    - The gap patterns defined in Rel16 can be reused for the gap instances being included in the multiple concurrent gap pattern.
* Recommended WF
  + The gap patterns and offset defined in Rel-16 can be reused for the gap instances being included in the multiple concurrent gap pattern. FFS the limitation on overlapping.

**Issue 2-2: Definition of independent gaps**

* Proposals
  + Option 1: (Nokia)
    - MGPs are not independent MGPs if they are fully or partially fully overlapping in time.
    - Partially but not fully overlapping or fully non-overlapping MGPs would be considered as independent MGPs.

### Sub-topic 2-2 Applicability

**Issue 2-3: Applicability (measurement purposes) of concurrent gaps**

* Proposals
  + Option 1: Different SMTC configurations, e.g., different MOs (CATT, CMCC, Ericsson, HW)
  + Option 2: Different RSs, e.g., SSB, CSI-RS, PRS, RSSI (CATT, CMCC, MTK, QC, Ericsson, HW, Intel)
  + Option 3: Different RATs (CATT, CMCC, MTK, Ericsson, HW)
  + Option 4: Different gap types, e.g., NCSG or pre-configured MG (MTK, LGE)
  + Option 5: NTN measurement
* Recommended WF
  + Can we agree on at least Options 1, 2 and 3 and FFS Options 4 and 5 in next meetings?

**Issue 2-4: Principle of concurrent gap usage**

* Proposals
  + Option 1: (MTK)
    - RAN4 to ensure both UE and NW have the same understanding on the usage of the new gap.
  + Option 2 (Huawei)
    - Each frequency layer that requires MG is measured in a single MG
* Recommended WF
  + Companies to check if Option 1 is agreeable.

**Issue 2-5: Whether to introduce a new gap for dedicated purpose(s)**

* Proposals
  + Option 1: (LGE)
    - Consider Primary MG pattern ID(s) and Secondary MG pattern ID(s), where that Secondary MG pattern ID(s) can be activated or deactivated to reduce performance degradation due to multiple MG patterns
  + Option 2: (MTK)
    - RAN4 to define the framework of usage for new gap dedicated to specific purpose(s)
* Recommended WF:
  + Need more discussions

### Sub-topic 2-3 UE capability related issues

**Issue 2-6: Max number of concurrent gaps**

* Proposals
  + Option 1: (Apple, CATT, Xiaomi)
    - 2
  + Option 2: (Ericsson)
    - At least 2
  + Option 3: (HW)
    - 2 per UE or 2 per FR, according to UE’s per-FR gap capability
  + Option 4: (QC, MTK)
    - 2 per UE gaps and 3 per FR gaps
  + Option 5: (OPPO)
    - 3
  + Option 6: (Intel)
    - Up to UE’s capability
  + Option 7: (CATT)
    - When gap pattern #0 to pattern #23 defined in table 9.1.2-1 in TS 38.133 are used, at most three concurrent gap patterns can be configured. When gap #24 or #25 is used, at most 2 concurrent gap patterns can be configured.
    - When used for covering different SMTC configuration, at most 2 concurrent gap patterns can be configured.
    - When different SMTC and different measurement are both used, at most 3 concurrent gap patterns can be configured.
  + Option 8: (Nokia)
* Recommended WF
  + Companies may need to revise the proposals after considering the capability of per-UE gap and per-FR gap.
  + Moderator thinks it will be easier and clearer if we discuss the number for per-UE gap and per-FR gap separately. Therefore, please provide proposals again the max number of concurrent gaps for UE supporting only per-UE gap and supporting per-FR gap.

**Issue 2-7: Relation to per-UE gap and per-FR gap**

* Proposals
  + Option 1: (HW, MTK, LGE)
    - All concurrent MGs are of the same type (per UE MG or per FR MG)
  + Option 2: (Ericsson) The parallel MG patterns can be any of
    - all per-UE,
    - all per-FR (for the same FR), or
    - a combination of per-UE and per-FR MG patterns, with at least one per-UE and at least one per-FR
  + Option 2a(Intel) The gap patterns/instance configured by a same concurrent MG can be agnostic with per-UE or per-FR.
  + Option 3 (Nokia):
    - For a Per UE gap capable UE, multiple concurrent and independent MGPs applies per UE.
    - For a Per FR gap capable UE, multiple concurrent and independent MGPs applies per FR
* Recommended WF
  + Need more discussions

**Issue 2-8: Other aspects on UE capability**

* Proposals
  + Option 1: (Nokia)
    - A per FR GP capable UE shall support multiple concurrent and independent MGPs on at least one FR
* Recommended WF
  + Need more discussions

### Sub-topic 2-4 Overlaping issues

**Issue 2-9: Whether to allow overlapping between concurrent gaps**

* Proposals
  + Option 1: (QC, Xiaomi)
    - Concurrent MG patterns that would have overlapping instances in time should not be allowed
    - RAN4 should discuss requirements for minimum guard period between measurement gap instances when multiple concurrent MG patterns are configured
  + Option 2: (MTK, Intel)
    - RAN4 can prioritize fully non-overlapping scenario. FFS whether to specify requirements for other partially and fully overlapped scenarios
  + Option 3: (Apple, CATT, Intel, Nokia, Ericsson, Huawei)
    - RAN4 to define sharing rules for cases where multiple MGs are partially/fully overlapped
* Recommended WF
  + Need more discussions

**Issue 2-10 Overlapping in gap duration, if overlapping is allowed**

* Proposals
  + Option 1: (MTK)
    - When concurrent gaps are partially or fully overlapping in a gap duration, they are treated as fully overlapping for these two gaps in that gap duration
* Recommended WF
  + Need more discussions

**Issue 2-11: UE behavior in overlapped gap occasion, if overlapping is allowed**

* Proposals
  + Option 1: (E///, Huawei)
    - UE is assumed to measure only in MGL of one MG in occasions where two MGs are overlapped
  + Option 2: (Nokia)
    - RAN4 need to define which aspect are limiting factors on the UE side in terms of the maximum number of concurrent independent MGPs a UE would be able to support.
* Recommended WF
  + Need more discussions

### Sub-topic 2-5 Overhead

**Issue 2-12: Overall MG overhead**

* Proposals
  + Option 1a: (Apple, MTK)
    - NW should make sure that the MG overhead shall not exceed the maximum MG overhead of the pattern supported by the UE according to R15/16 capabilities
  + Option 1b: (NEC)
    - Total cumulative MGL across MG patterns in a measurement period shall be less than current maximum MGL of 20ms and there cannot be more than one MG for each 20ms period and actual max number of concurrent gaps is FFS
  + Option 2: (LGE)
    - Consider MG pattern ID with largest MGRP of 160ms as one of multiple MG pattern IDs to reduce performance degradation due to multiple MG patterns
  + Option 3: (QC)
    - RAN4 to discuss whether to specify a cap on aggregate fractional interruption time as applicability condition for configuring multiple concurrent and independent MG patterns
* Recommended WF
  + Need more discussions

### Sub-topic 2-6 Measurement requirements

**Issue 2-13: CSSF**

* Proposals
  + Option 1: (Xiaomi)
    - The CSSF with gap should be defined based on the carriers to be measured with the same measurement gap pattern.
  + Option 2: (Huawei)
    - CSSF is calculated independently for each of the multiple concurrent MGs.
* Recommended WF
  + The framework on how each gap is associated to different MOs, RSs, RATs, are not concluded yet. Moderator thinks maybe it is too early to directly agree on CSSF details. Moderator’s suggestion is to postpone this issue to next meeting.
  + Please provide your view to above 2 options as well as to Moderator’s suggestion

**Issue 2-14: Measurement capability**

* Proposals
  + Option 1: (LGE)
    - Keep the existing UE measurement capability of monitoring of multiple layers for multiple MG patterns.
* Recommended WF
  + From Moderator’s point of view, it is not very clear whether the measurement capability is about # of layers, # of cells and # of beams, or the # of layers UE can measure in one gap occasion. Please LGE clarify a little bit.
  + Need more discussion.

**Issue 2-15: Measurement delay requirements**

* Proposals
  + Option 1: (Intel)
    - Two basic scenarios can be studied.
      * Non-overlapping
      * Overlapping
* Recommended WF

**Issue 2-16: Other aspects in measurement requirements**

* Proposals
  + Option 1: (Huawei)
    - All MG related requirements defined for single MG, including UE behaviour during MG, MG patterns and their applicability, MG timing, effective MGRP, MG interruption and UE UL behaviour after MG, apply for each of the multiple concurrent MGs.
  + Option 2 (Nokia):
    - RAN4 should not define new requirements (multiple concurrent and independent MGPs) for which RAN4 already has defined requirements
* Recommended WF
  + Some of the items mentioned in Option 1 were already discussed in previous issues, e.g., UE behaviour during MG, MG patterns and applicability. Moderator suggests to focus on following items and see if some early agreement can be reached.
    - MG timing
    - Effective MGRP
    - MG interruption
    - UE UL behaviour after MG

### Sub-topic 2-7 Others

**Issue 2-17: RF re-tuning time**

* Proposals
  + Option 1: (ZTE)
    - No RF tuning time shall be considered when defining concurrent MGs since the current specification already allows 0.5 ms for RF tuning at the beginning and the end of MGs
* Recommended WF
  + Need more discussions

**Issue 2-18: New MG patterns**

* Proposals
  + Option 1: (E///)
    - RAN4 introduces new MG patterns with MGL>20 ms and/or MGRP>160 ms
* Recommended WF
  + Moderator thinks this proposal is not within the scope of this WI. Comments are welcomed

**Issue 2-19: Network configuration under DC**

* Proposals
  + Option 1: (MTK)
    - In EN-DC, when UE supports per-UE gap or FR1 gap, the concurrent gaps will be configured by MN; when UE supports FR2 gap, the concurrent gaps will be configured by SN.
    - In NR SA, NE-DC, NR-DC, the concurrent gaps will be configured by MN
* Recommended WF
  + Need more discussions.

**Issue 2-20: Support of concurrent gap in LTE SA**

* Proposals
  + Option 1: (MTK)
    - Do not introduce the concurrent gap in LTE SA mode
* Recommended WF
  + Need more discussions.

## Companies views’ collection for 1st round

### Open issues

**Issue 2-1: Definition of concurrent gaps**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | Support the recommended WF. |
| Apple | Recommended WF looks good. |
| LG | Generally, we’re fine with the recommended WF. However, we think further discussion whether or not MG pattern ID#24 and #25 can be reused as the gap instances of multiple concurrent MGs. |
| OPPO | Agree with the recommended WF. |
| NEC | We can agree to recommend WF without offset. Which means, the gap patterns ~~and offset~~ defined in Rel-16 can be reused for the gap instances being included in the multiple concurrent gap pattern. FFS the limitation on overlapping.  This is mainly due to the fact that since limitation on overlapping is FFS, agreeing to offset contradicts FFS part. |
| E/// | Support the recommended WF. |
| Qualcomm | The WF, although reasonable, is a little confusing in the context of the title of this issue. The title of the issue suggests the question of what is meant by concurrent gaps.  Our understanding is that “concurrent MG patterns” refers to multiple MG patterns that are active during a common period of time. |
| Intel | Agree the recommended WF. It is also better to clarify that the concurrent gaps are actually composed by >1 individual gaps (which can be denoted as one gap instance within this concurrent gap pattern). |
| Huawei | We are fine with the Recommended WF. |
| CATT | Fine with the recommended WF. |
| Nokia | As such concurrent is one aspect and overlapping is another aspect. And we see that the overlapping aspect more related to the discussion on independent GPs.  We support option 3 in the sense that RAN4 should work with the existing MPGs which can be operating concurrently.  Recommended WF: baseline is ok but FFS part is a discussion related to independent GPs so should it be under the next Issue 2-2?. Why ‘offset’? |

**Issue 2-2: Definition of independent gaps**

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| --- | --- |
| **Company** | **Comments** |
| MTK | Whether the gaps are independent gaps depends on NW’s configuration.  If NW configures two gaps, then we can say they’re concurrent and independent gaps. What Nokia mentioned here is how to handle the overlapping scenarios:   * Fully non-overlapping * Fully overlapping(MGRPlegacy≤ MGRPnew)   I guess this scenario is what mentioned in Nokia’s proposal(fully or partially fully overlapping)   * Partially overlapping(MGRPlegacy> MGRPnew) * Firstly, RAN4 can start the discussion based on non-overlapping scenario. * Secondly, RAN4 can further discuss the overlapping after RAN4 has a clear consensus on the usage, applicability etc. There are several options to handle the MG overlapping cases: * RAN4 defines explicitly rule, such as legacy/new gap will be always prioritized * NW indicates how to handle the collision, such as NW can configures the gap’s priority together with MG configuration * Up to UE implementation |
| Apple | There are three aspects for MG configuration:   * MGL * MGRP * Time offset   If NW configures multiple MG patterns with at least one different aspect, we consider that as multiple concurrent and independent MG patterns. The above three dimensions can be extended to cover NCSG if necessary.  Even for fully or partially fully overlapping case, sometimes we can still have benefit. For instance:  Graphical user interface  Description automatically generated  MG2 is shorter than MG1 with larger periodicity. Using MG2 to measure CSI-RS on f2 can help to reduce MG overhead in time domain. What RAN4 shall do is to study how to handle overlapping MG occasion. |
| LG | From Apple’s Figure above, for partially fully overlapping case, MG1 and MG2 can be independent MGs. As Apple mentioned, need discussion how to handle the overlapped MG. For example, legacy gap can be always prioritized to new gap added for multiple concurrent gaps to guarantee the legacy measurements. Legacy MG can be considered as Primary MG and new MG can be considered as Secondary MG. |
| OPPO | Agree that it is related to gap configuration, including not only the parameters but also signaling design. In our view, for Apple’s example, MG2 can be taken as per RS gap as a new type of gap.  So we suggest RAN4 to check with RAN2 to keep understanding on the same page. |
| NEC | If the MG are used for different application, we could refer to them as independent MG. Different application can be Mobility measurements, Positioning measurements, etc.  Another way of definition could be based on the RS used for measurement. For example, as shown in Apple’s figure, SSB, CSI-RS, or PRS can be independent MG. |
| E/// | In our view concurrent MGPs (e.g. 2 concurrent MGPs) will be realized by configuring the UE with existing MGPs (e.g. 2 independent MGPs). We suggest to use one term: concurrent MG patterns which can be configured via existing independent MGPs.  Two MG patterns can be considered concurrent if they are configured and can be used by the UE over the same time period. The time period can be FFS. The definition of concurrent gaps shall not preclude overlapping gaps, but RAN4 will define rules on how to configure the gaps, and these rules may also address the overlap issue if seen necessary. The rules are FFS at this stage. |
| Qualcomm | By “independent” we understand that each MG pattern has its own *measGapConfig*, i.e. the network is able to configure and/or modify the properties of each MG pattern without altering the properties of the others. However, whether the configurations are truly independent is to be decided during the core part of the WI. i.e. RAN4 will discuss applicability conditions that may limit the allowable combinations of MG patterns that can be configured concurrently. |
| Intel | In our understanding, these independent gaps within a same concurrent gap pattern can be denoted as one of gap instance as we described in WID. But it is better to algin the terminology hereby. |
| Huawei | The MG configuration from 38.331 is copied below. We share similar view as Apple that as long as there is a difference in MGL, MGRP and offset in the configurations for the two MGs. Then they will be considered as independent concurrent MGs. MGTA can be FFS.  Of course, as discussed in Issue 2-1, we can further discuss limitation on overlapping in next meeting.  GapConfig ::= SEQUENCE {  gapOffset INTEGER (0..159),  mgl ENUMERATED {ms1dot5, ms3, ms3dot5, ms4, ms5dot5, ms6},  mgrp ENUMERATED {ms20, ms40, ms80, ms160},  mgta ENUMERATED {ms0, ms0dot25, ms0dot5},  ...,  [[  refServCellIndicator ENUMERATED {pCell, pSCell, mcg-FR2} OPTIONAL -- Cond NEDCorNRDC  ]],  [[  refFR2ServCellAsyncCA-r16 ServCellIndex OPTIONAL, -- Cond AsyncCA  mgl-r16 ENUMERATED {ms10, ms20} OPTIONAL -- Cond PRS  ]]  } |
| Xiaomi | Independent gaps means it can be configure differently from the other configured gap patterns in point of mgl, mgrp, mgta and mgoffset aspects. |
| CATT | Share the same view as Apple that the MG can be considered as concurrent and independent gap pattern when NW configures multiple MG patterns with at least one different aspect. But for the overlapping case, further discussion is needed for the NW and UE handling mechanism. But actually it needs to be discussed whether the gaps in overlapping case can be called independent. For example, if the gap patterns used for different measurement are overlapped, that means UE need to perform 2 type of measurements in the same time. |
| Nokia | We need to distinguish independent MGPs and not independent MGPs. If GPs are fully overlapping, they are as such dependent on each other and if the UE is limited in the measurement processing there will likely need for a discussion on ‘sharing’ like current CSSF.  Example, 2 MGPs which are exactly the same (GP, offset etc.) are not independent but instead this would likely be a discussion on how to share the gaps among the measurements to be performed.  Example: 2 fully non-overlapping MGPs are considered independent as measurement occasions are clearly not shared. |

**Issue 2-3: Applicability (measurement purposes) of concurrent gaps**

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| **Company** | **Comments** |
| MTK | Support the recommended WF.  Option 4 and 5 can be discussed in phase 2. |
| Apple | Agree recommended WF. Option 4 is also feasible in our view. |
| LG | Support Option 1, 2 and 3 as use cases of concurrent gaps. Option 4 is also feasible. Option 5 can be covered with Option 1, because NTN needs different SMTC configurations due to significant propagation delay. However, firstly, measurement requirements with single MG pattern should be specified for NTN, after that, we can discuss multiple MG patterns for NTN. |
| CMCC | We support option 1, 2 and 3. For option 4 and 5, both are ongoing parallel Rel-17 topics, it may complex the discussion if we mix multiple ongoing topics together at this early stage. |
| OPPO | Agree with the recommended WF. |
| NEC | Support option 2 to start with. Option 3 can be covered with option 2? |
| E/// | We support options 1, 2 and 3. It is unrealistic to discuss options 4 and 5 in the next meeting. Option 4 can be discussed in 2nd phase. But option 5 may not even be realistic to discuss in 2nd phase since RAN4 has not even identified gaps for NTN. But any way we are OK to discuss options 4 and 5 in the 2nd phase. |
| Qualcomm | Agree with the WF. Options 4 and 5 can be discussed further. |
| Intel | We can support both Option 1 and 2. For the usage in case of inter-RAT, how to coordinate these measurement resource among them shall be more careful. For an example, the measurement gap configured by NR shall be aligned with the LTE PSS/SSS/CRS |
| Huawei | We are fine with the Recommended WF. |
| Xiaomi | Agree with the recommended WF. |
| CATT | Fine with the recommended WF. |
| Nokia | Our view is that multiple concurrent MGPs should be defined in a generic way (if possible) without restricting the actual reason for or purpose of the measurements performed.  Hence, it can be either of the options 1-4 listed while option 5 is open as they are not defined yet. |

**Issue 2-4: Principle of concurrent gap usage**

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| **Company** | **Comments** |
| MTK | Support both option 1 and 2. |
| Apple | Support option 1. Option 2 may need more study. |
| LG | Support Option 1. We need discussion how to differentiate legacy gap and new gap in multiple concurrent gaps.  For Option 2, need clarification. Our understanding is that single frequency layer can be measured in a single MG. If it is correct, we can support Option2. |
| CMCC | OK with option 1 from the scheduling point of view. For option 2, we agree that UE behavior in the scenario that same MO can be measured in multiple MG need to be discussed. And how to solve this issue, we are open to have further discussion. |
| OPPO | Option is fine. For option 2 , we can further discuss. |
| NEC | Agree with option 1 |
| E/// | Support option 1. We do not support option 2, which may be contradictory to option 2 in issue 2-3. For example the UE may be configured to measure PRS and SSB measurements on the same layer but using different gap pattern.  Option 1 means to us defining clear rules, which we are fine with. |
| Qualcomm | We agree with option 1. |
| Intel | For Option1, it is true that for every MG within the concurrent gap pattern UE and NW shall algin the individual gap usage. Further question is what is “new gap” ? Is it the gap instance ?If so, we don’t think it is “New” as we commented for Iusse 2-1.  For Option 2, beyond Rel16, whether the measurement gap is needed can be dependent with the other things beside the frequency layer. On the other hand, if there are multiple reference signals in a same frequency layer (e.g. SSB and CSI-RS), the single MG for all of them is desired. |
| Huawei | We have some concern on the term “new gap” in option 1, as we have not agreed that there will be a differentiation between legacy and new gap. We suggest to update the wording as   * RAN4 to ensure both UE and NW have the same understanding on the usage of each measurement gap   On option 2, the intention is that one frequency layer is only measured with one MG, and of course which gap is used for a particular layer also need to be aligned between NW and UE. We are fine to keep it FFS in this meeting.  To Ericsson, we understand PRS and SSB measurements are always considered as separate frequency layers, so they can be measured with different MGs even they have some overlapping in freq domain. |
| Xiaomi | Agree with option 1 |
| CATT | Fine with option 1. |
| Nokia | Support in principle option 1. We see it very important that both UE and network at all times are synchronised (have same understanding) on the current MGPs in use.  Can it be clarified what ‘the new gap’ refer to? |

**Issue 2-5: Whether to introduce a new gap for dedicated purpose(s)**

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| --- | --- |
| **Company** | **Comments** |
| MTK | As mentioned in issue 2-2, 2-3, it’s possible to have lots of different usages from NW in different scenarios. Both UE and NW shall have clear understanding on the usage of the gap.  Thus, it’s better to configure the new gap with specific usage at a time. NW can reconfigure the usage of the gap by RRC reconfiguration. Otherwise, it will be no much difference between the new gap and the legacy gap and no much benefits to introduce this concurrent gaps capability. |
| Apple | In our view option 1 is a solution to handle overlapping MG occasion if multiple MG patterns are configured. There could be some other ways, as mentioned in our contribution such as prioritize certain type of measurement object and so on. We are open to further study. |
| LG | Option 1 is our proposal. Introducing new gap on top of legacy gap as multiple pattern gaps can increase performance degradation of serving cells. Option 1 can reduce the performance degradation. |
| OPPO | Agree with option 2 in principle. It is related to the definition of independent gap, and further discussion may be needed. |
| NEC | Our view is option 1 can be starting point and RAN4 can further study |
| E/// | The issue title is a bit misleading – it’s about new gaps, and we think we should focus first on making this possible to work with existing MG patterns. However, proposal 1 is more about how to use them in parallel, which may not necessarily require new gaps. Proposal 2 uses “new gap” but means a parallel gap, so the terminology is a bit misleading.  Hence, we need to first align on the terminology. And in the 1st phase we should focus on simple scenarios where concurrent gap patterns are configured by the network with specific usages (e.g. based on RAT types, SMTC period, measurement types etc) and the UE will follow. If there is any problem then network can always deconfigure one or more gap patterns. |
| Qualcomm | In our view RAN4 should first discuss a framework that would allow the network and UE to prioritize certain types of measurements on at least some of the configured MG patterns. We view this objective as consistent with option 1 under issue 2-4, which received wide support.  Option 1 seems to be about one potential benefit of enabling multiple MG patterns. It’s not clear whether a distinction between primary and secondary MG patterns would be beneficial. FFS. |
| Intel | Is the option 1 want to prioritize the MG. How to prioritize these measurements can’t be decide by RAN4.  The new gap in Option 2 may not proper if we are talk about the concurrent gap pattern. Such concurrent gap pattern is indeed one of new way to configure/combine the individual gaps (defined in Rel16[#0~24]) instead of the gap instance themselves.  We think for these gap instance within a concurrent gap pattern, it is unnecessary to support all existing or possible measurements (e.g. CSI-RS, RSSI or others) but part of specific one. |
| Huawei | On option 1, as we commented for Issue 2-4, at current stage we are not sure if there is a need to differ primary and secondary MGs, so this needs further study. The (de)activation.of MG should be also FFS.  On option 2, if different MGs can only be used for different purposes, would this be contradict with option 1 in Issue 2-3? For example, can we use different MGs to measure two SSB layers? |
| Xiaomi | If multiple MG patterns are configured, for overlapping cases, option 1 is a alternative solution, and we think there may be other solution, e.g. gap sharing between the overlapping MGs. We need to firstly figure out the framework and principle for the dedicated measurement purpose. |
| CATT | Need more clarification. Is this about to configure dedicate usage for a certain purpose from existing gap pattern or to introduce new gap pattern beyond the existing pattern. |
| Nokia | For option 1 we believe this should be discussed under pre-configured MGPs topic.  For option 2 it would be good to have some common understanding on what is understood with words like ‘legacy’ and ‘new’. From the MTK paper it seems that ‘legacy’ refer to an already configured GP and ‘new’ refer to the concurrent GP. Can MTK clarify? |

**Issue 2-6: Max number of concurrent gaps**

# of concurrent gap for per-UE gap:

# of concurrent gap for per-FR gap in FR1:

# of concurrent gap for per-FR gap in FR2:

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| --- | --- |
| **Company** | **Comments** |
| MTK | # of concurrent gap for per-UE gap: 2  # of concurrent gap for per-FR gap in FR1: 2  # of concurrent gap for per-FR gap in FR2: 1 |
| Apple | # of concurrent gap for per-UE gap: 2  # of concurrent gap for per-FR gap in FR1: 2  # of concurrent gap for per-FR gap in FR2: 1 or 2 |
| LG | # of concurrent gap for per-UE gap: 2  # of concurrent gap for per-FR gap in FR1: 2  # of concurrent gap for per-FR gap in FR2: 2 |
| CMCC | # of concurrent gap for per-UE gap: 2  # of concurrent gap for per-FR gap in FR1: 2  # of concurrent gap for per-FR gap in FR2: 2 |
| OPPO | # of concurrent gap for per-UE gap:2  # of concurrent gap for per-FR gap in FR1: 2  # of concurrent gap for per-FR gap in FR2: 1or 2.To be clarified, is any new type of gap allowed except perUE/perFR gap for multiple concurrent and independent MG patterns in Rel-17? It may depend on the definition in sub-topic 2-1. |
| NEC | # of concurrent gap for per-UE gap: FFS  # of concurrent gap for per-FR gap in FR1: FFS  # of concurrent gap for per-FR gap in FR2: FFS  Can we initially agree on principle for deciding the max number of concurrent gaps? |
| E/// | We think that a per-FR gap and per-UE gap can also be configured in parallel but within the same FR there will still be two gap patterns in parallel.  We agree to count MGs in FR, but these would be any gaps the UE can use for measurements in this FR, e.g., the cases when a UE configured with 1 per-FR gap pattern for measurements in FR1 and 1 per-UE gap pattern would be viewed as two parallel gap patterns in FR1 (bot not in FR2, since measurements in FR2 are based only on the per-UE gap pattern in this example).  Please see additional (4th scenario below):  # of concurrent gap patterns for per-UE gap: 2  # of concurrent gap patterns for per-FR gap in FR1: 2  # of concurrent gap patterns for per-FR gap in FR2: 2  # of concurrent gap patterns for per UE gap and per-FR gap: 3 gap patterns in total i.e.  1 per UE gap pattern,  1 per FR gap pattern in FR1 and  1 per FR gap pattern in FR2 |
| Qualcomm | # of concurrent gap for per-UE gap: 2  # of concurrent gap for per-FR gap in FR1: 2  # of concurrent gap for per-FR gap in FR2: 2  # of concurrent gap for per-FR gap in FR1+FR2: 3 |
| Intel | Firstly in our understanding, this is completely up to UE itself.  Also we prefer not to differentiate per UE and per FR gap instance because it is possible to config 1 per-UE gap and 1 per-FR gap. |
| Huawei | We share view as QC. Alternatively, this can be up to UE capability as in option 6. |
| Xiaomi | # of concurrent gap for per-UE gap: 2  # of concurrent gap for per-FR gap in FR1: 2  # of concurrent gap for per-FR gap in FR2: 2 |
| CATT | Need further check based on the definition of concurrent and independent gap pattern. |
| Nokia | We do not see an urgent need to decide on a number in the first discussion meeting. It would be best to first get a common understanding in RAN4 what ‘concurrent’ and ‘independent’ means. Additionally, it would also be best to have some visibility to companies views on other topics such as per-UE and Per-FR and possible UE limitations.  We can discuss the actual Max number further and for now we support option 2. This means that for a per-UE GP capable UE it supports at least 2 concurrent independent MPGs. A Per-FR capable UE will support at least 2 concurrent and independent GPs on at least on FR. |

**Issue 2-7: Relation to per-UE gap and per-FR gap**

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| --- | --- |
| **Company** | **Comments** |
| MTK | Option 1.  In legacy Rel-15/16 NR system, per-FR gap’s capability had already introduced.  The per-FR capability totally depends on UE’s RF architecture. The RF components will be shared between FR1 and FR2 once UE reports per-UE gap. Thus, UE had to follow the same RF architecture to support concurrent gap. Thus, when UE supports per-UE gap and concurrent gap, it implies the concurrent gap should still be a per-UE gap. |
| Apple | Fine with both option 1 and option 3.  Whether per-FR gap can be supported depends on UE architecture. Don’t understand in option 2 why per-UE gap and per-FR gap can be configured together. |
| LG | Support Option 1. Legacy UE’s RF architecture should not be impacted by addressing multiple concurrent gaps. Therefore, all possible concurrent MGs can be of per-UE or per-FR depending on UE capability. In addition, the existing applicability of MG pattern IDs needs to be considered for concurrent MGs in same type.  For Option 3, our understanding is it is same as Option 1. What is difference between Option 1 and Option 3? |
| OPPO | It has impact on the max number of concurrent gaps. Based on R15/16 assumption per UE gap cannot be configured together with per FR gap, e.g, Per UE, per FR1+ per FR2.  As commented in issue 2-6, is it possible to define any new type of gap except perUE/perFR gap for multiple concurrent and independent MG patterns in Rel-17? |
| NEC | We support option 3 |
| E/// | Support option 2, no need to restrict to the same type.  We think that a per-FR gap and per-UE gap can also be configured in parallel. See our comments on issue 2-6.  We agree to count MGs in FR, but these would be any gaps the UE can use for measurements in this FR, e.g., the cases when a UE configured with 1 per-FR gap pattern for measurements in FR1 and 1 per-UE gap pattern would be viewed as two parallel gap patterns in FR1 (bot not in FR2, since measurements in FR2 are based only on the per-UE gap pattern in this example). |
| Qualcomm | We support option 3 and option 1. |
| Intel | We can support Option 2 and 3. These gap instances can be either per-UE or per-FR. |
| Huawei | We support option 1 for the reasons mentioned by MTK/Apple.  Option 3 seems to be similar as option 1, but the definition of concurrent and independent MGs may need to be clarified first (in sub-topic 2-1). |
| Xiaomi | We support option 1 and option 3 |
| CATT | Option 1 can be a starting point. |
| Nokia | RAN4 would need to account both per-UE and Per-FR GP capable UEs when discussing multiple concurrent and independent MGPs. And hence, as we propose for a per-UE MG capable UE such UE can be configured with multiple concurrent and independent MGPs on a per-UE basis (i.e. according to the Per-UE MGP capability). A per-FR capable UE we propose that such UE can be configured with multiple concurrent and independent MGPs either on each of the FRs or on one of the FRs – but at least on one of the FRs.  We anyway see options 2 and 3 being rather similar |
|  |  |

**Issue 2-8: Other aspects on UE capability**

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| **Company** | **Comments** |
| MTK | Support the proposal.  When UE supports per-FR gap and concurrent gaps, there are 3 following options:   * Scenario 1: 1 FR1 gap, 1 FR2 gap, 1 FR1 concurrent gap * Scenario 2: 1 FR1 gap, 1 FR2 gap, 1 FR2 concurrent gap * Scenario 3: 1 FR1 gap, 1 FR2 gap, 1 FR1 concurrent gap and 1 FR2 concurrent gap   The total number of supported concurrent gaps depends on the discussion in issue 2-5. |
| Apple | In principle option 1 is OK. The prerequisite is UE support multiple concurrent and independent MG patterns. |
| LG | Support the proposal. |
| OPPO | OK with option 1 in principle. |
| NEC | Our understanding is a per FR GP capable UE shall support multiple concurrent and independent MGPs per-FR |
| E/// | Per FR gap capable UE should also support concurrent gap patterns with the constrain that within the same FR, two gap patterns can be used. Please see our scenarios in issue 2.6.  Comment about terminology: concurrent and independent MG patterns are used interchangeably causing confusion. It is better to use one term concurrent MG patterns. |
| Qualcomm | This would be subject to UE capability of supporting multiple concurrent MG patterns. |
| Intel | This is up to UE capability to support the concurrent MG patterns. That is if UE support concurrent MG, it must support per-FR gap. But it is insufficient to conclude UE can support concurrent gap if per-FR is support. |
| Huawei | Support option 1. |
| Xiaomi | Agree with option 1 |
| CATT | Share the same view with Apple. This proposal is for the UE which support multiple and independent gap pattern. |
| Nokia | Agree with the comments that this will in the end be a discussion on the UE capability.  Hence, we think that RAN4 need to consider if the per-FR capable UE being able to support multiple concurrent and independent MGPs on each FR or at least on one of the FRs.  Additionally, it is likely good also to open the discussion on whether concurrent and independent MGPs can be configured in FR1, in FR2 or in both FR1 and FR2 (with the applicable MGPs). |

**Issue 2-9: Whether to allow overlapping between concurrent gaps**

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| **Company** | **Comments** |
| MTK | Option 2.  RAN4 can start the discussion based on non-overlapping scenario. RAN4 can further discuss the overlapping after RAN4 has a clear consensus on the usage, applicability etc. For example, if RAN4 agrees to use the new gap for positioning measurement, obviously, the collision between the legacy gap and positioning gap may happen. |
| Apple | Support option 3. As mentioned above, network and UE can benefit from overlapping scenario. |
| LG | Support option 3. |
| CMCC | Option 3. As companies commented in previous issues that for overlapped MG, there is benefit for some scenario. And in our view, the overlapped MG could reduce data loss introduced by multiple MG. Based on above consideration, we support to consider the overlapping cases. |
| OPPO | Prefer option 2. We can focus on non-overlapping scenario firstly.  For partially/fully overlapped scenarios, if no new type of gap was introduced, we think option 1 (No) could be more feasible, which can be ensured by network configuration. |
| NEC | Our preference is option 1. Can agree to option 2 also |
| E/// | In the 1st phase we are fine to consider only non-overlapping gaps to simplify the work. |
| Qualcomm | Prefer option 1. Could support option 2. |
| Intel | Technically if the concurrent gap pattern can be used for CSI-RS , RSSI or other cases, the serving gNB can’t guarantee there is no overlapping among the gaps for these measurement. But we thought the non-overlapping case shall be prioritized.  For the overlapping case, Option 3 shall be considered. |
| Huawei | We support option 3, as it can enable more use cases. We are open to discuss the prioritization of scenarios (option 2) in next meeting. |
| Xiaomi | Support option 1 and option 2 |
| CATT | Option 3. |
| Nokia | We support option 3 |

**Issue 2-10: Overlapping in gap duration, if overlapping is allowed**

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| **Company** | **Comments** |
| MTK | Option 1.  Without MGTA, the granularity for gap offset configuration is 1ms. Theoretically, 2 concurrent gap may partially overlapped in their duration. But we prefer not to open up such a discussion on how UE should do further RF re-tuning to meet the requirements of the 2 MGs. The discussion could be very lengthy with a complicated (but not useful) outcome. To simplify the spec, when two gaps are partially or fully overlapping in MGL, it can be always believed as fully overlapping for these two gaps in the MGL occasions. |
| Apple | Agree option 1. We assume UE can measure only one of carriers with one of the partially overlapped MG occasions. RAN4 also needs to discuss how to handle partially overlapping case. Same approach may apply to both full overlapping and partially overlapping. |
| LG | Multiple MGs can be configured with partially or fully overlapping in a gap duration. Need further discussion how to handle this case as Apple mentioned. |
| OPPO | Depending on issue 2-9. |
| E/// | It depends on outcome of the definition discussion and also issue 2-9. If only non-overlapping gaps are considered then requirements will not be defined for partially or fully overlapping gaps. |
| Qualcomm | This can be postponed pending the conclusion of issue 2-9. |
| Intel | We can support no differentiate the fully and partly overlapping cases due to the too complicated configurations. |
| Huawei | We support option 1, and we understand it is same issue as 2-11. |
| Xiaomi | OK with option 1, as UE can measure one carrier during MG occasion#i, if MGs are fully or partially overlapped, it is assumed that UE have no chance to measure the other carrier during MG occasion#i. |
| CATT | Depending on the conclusion of issue 2-9. |
| Nokia | We see this question related to the discussion whether there are limitations on how close gaps can be situated in time domain – as also discussed under other Issues. |

**Issue 2-11: UE behaviour in overlapped gap occasion, if overlapping is allowed**

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| **Company** | **Comments** |
| MTK | Support option 1.  When gap collision happens, each frequency layer shall be only measured in one gap. RAN4 shall define the clear rule for gap overlapping.  The to-be-measured frequency layers shall be clearly indicated by NW for measuring in new gap.  Other frequency layers shall still be measured in legacy gap. |
| Apple | Support option 1 as baseline. Further enhancement can be considered later depending on progress. |
| LG | Support Option 1. If new gap is configured to be overlapped with legacy gap, which frequency layers can be measured with either new gap or legacy gap needs to be discussed. Our preference is to sustain legacy measurements with legacy MG during the overlapped MG. |
| E/// | It depends on outcome of the definition discussion and also issue 2-9. We support option 1 if overlap gaps are allowed, but the issue can be revisited if overlapping gap patterns are allowed. |
| Qualcomm | This can be postponed pending the conclusion of issue 2-9. |
| Intel | This is same as Option 3 in Issue 2-9? |
| Huawei | We support option 1, and we understand it is same issue as 2-10. |
| Xiaomi | Agree with option 1 in principle |
| CATT | Depending on the conclusion of issue 2-9 and need further study. |
| Nokia | We believe this is also dependent on the discussion under other Issues above. But we see that we would at least need to discuss if overlapping is allowed and if allowed:  limitation in overlapping  limitations in ‘how close’ in time domain concurrent gaps can be. |

**Issue 2-12: Overall MG overhead**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | Support option 1a.  Due to the 1st meeting, RAN4 shall get a consensus on the overhead for concurrent gaps.  ‘NW should make sure that the MG overhead shall not exceed the maximum MG overhead of the pattern supported by the UE according to R15/16 capabilities.’  RAN4 can further discuss the solutions on how to guarantee the overall overhead doesn’t exceed the upper limitation. |
| Apple | Support option 1a. |
| LG | Multiple MG IDs need to be configured in a way not to increase performance degradation due to multiple MGs. There can be different candidates. At first, discuss the allowed maximum performance degradation. After that, do narrow-down candidates. |
| CMCC | Support option 1a. Multiple MG will further reduce the throughput. It is necessary to take the impact on the throughput into consideration. And option 1a is a good way to evaluate the impact on throughput from multiple MGs. |
| OPPO | OK with Option 1 in principle. |
| NEC | Support option 1b, can agree to option 1a also. We also agree with comments from LG. |
| E/// | We agree that since 1st will reuse existing MGPs so the effective MGRP and aggregated gaps in current MGPs should not exceed the current values e.g.  Shortest separation between the MGLs of the concurrent MGPs should be 20 ms i.e. equal to the shortest existing MGRP. For example concurrent gaps created by two MGPs each with MGRP = 40 ms can be offset by 20 ms to maintain 20 ms separation between their respective MGLs.  Total aggregated gaps per 160 ms should not exceed 20 ms i.e. max existing MGL. |
| Qualcomm | Option 3. Agree a cap should be discussed and actual cap value is FFS. |
| Intel | In principle, we need some cap on the total overhead of MG utilization because they lead to interruption to the serving cells’s data. But how to define and evaluate the whole interruption (e.g. how to define the evaluation period if the different periodicity of these gap instances are different) |
| Huawei | We support option 3.  We agree that the overhead needs to be considered, but on the other hand, we prefer to not impose too much restrictions on NW side in using the multiple MGs.  One clarification question on option 1a: does it mean NW needs to determine the configurable MG patterns for concurrent MGs for individual UE, by considering the supported MG patterns supportedGapPattern indicated by each UE? |
| CATT | Fine with option 1a. |
| Nokia | This is of course relevant to discuss. However, we should identify any UE limitation related to possible configuration of multiple concurrent and independent MGPs. This should account possible limitations in e.g.:  measurement processing capacity  searchers  time domain restrictions  to mention some. Once such limitations have been identified this will set the rules for how the network can configure the UEs regarding multiple concurrent MGPs.  It would then be network responsibility to weight the overhead and loss in scheduling as long as the network accounts the UE measurement restrictions |

**Issue 2-13: CSSF**

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| **Company** | **Comments** |
| MTK | Support moderator’s recommended WF.  It’s too early to discuss the CSSF. RAN4 shall have a consensus on the framework about how each gap is associated to different MOs, RSs, RATs or usages. After that, RAN4 can start the discussion on how to calculate the CSSF. |
| Apple | Agree with recommended WF. Option 1 and 2 doesn’t seem to completely conflict with each other. |
| LG | Support moderator’ recommended WF. |
| OPPO | FFS. |
| NEC | Support recommended WF |
| E/// | Option 2 as a baseline, unless any issue is identified. Is there any difference between option 1 and option 2?  This also depends on the outcome of the discussion on the definition and 2-9. |
| Qualcomm | Agree with moderator’s notes. FFS. |
| Intel | This is up to some basic conclusion on the using scenario. Can be FFS. |
| Huawei | We understand option 1 and option 2 are similar, and should be used as the baseline, but we are also fine with the Recommended WF since it is the first meeting. |
| Xiaomi | OK with the recommended WF, option 1 and option2 is similar in principle. |
| CATT | Fine with the recommended WF. Further discuss when other issues concluded. |
| Nokia | Agree with moderator |

**Issue 2-14: Measurement capability**

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| --- | --- |
| **Company** | **Comments** |
| MTK | From our understanding, LG’s proposal is to guarantee each frequency layer which needs gap shall be measured in only one gap. It seems the same as issue 2-11.  Please LG help to further confirm this. |
| Apple | Our understanding on option 1 is that the capability requirement w.r.t. number of layers to be measured should be kept unchanged even we introduce multiple concurrent MG patterns. If our understanding is correct, we support option 1. |
| LG | Apple’s understanding is correct. Support Option 1. |
| OPPO | Based on the clarification, support option 1. |
| E/// | The proposal is unclear. We do not see any link between monitoring of multiple layers and concurrent MGPs. |
| Qualcomm | Same comment as Apple. Further clarification is welcome. |
| Intel | For the individual gaps, such capability restriction is still be valid. |
| Huawei | We support option 1 based on Apple’s clarification. |
| Xiaomi | Agree with option 1 with further clarification. |
| CATT | Fine with option 1 with clarification above. |
| Nokia | Agree with moderator. The Issue is unclear. |

**Issue 2-15: Measurement delay requirements**

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| **Company** | **Comments** |
| MTK | This issue is the same as issue 2-13.  It’s too early to discuss the delay requirements. RAN4 shall have a consensus on the framework about how each gap is associated to different MOs, RSs, RATs or usages. After that, RAN4 can start the discussion on how to define the delay requirements by CSSF. |
| Apple | As issue as previous one regarding whether overlapping should be considered. |
| LG | Support Option 1. For overlapping, we can start discussion in next meeting as Issue2-13 recommended WF. |
| OPPO | Depending on sub-topic 2-4. |
| NEC | Agree with MTK comments |
| E/// | First RAN4 needs to agree whether concurrent MGPs will be non-overlapping or not before discussing the requirements. |
| Qualcomm | This can be postponed pending the conclusion of issues 2-9 and 2-13. |
| Intel | Can be FFS. The requirements under these two scenarios will be significantly different. |
| Huawei | We understand this is same issue as 2-9. |
| Xiaomi | Propose to postpone this issue. |
| Nokia | Unclear Issue description |

**Issue 2-16: Other aspects in measurement requirements**

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| --- | --- |
| **Company** | **Comments** |
| MTK | Support option 1.  The concurrent gaps shall follow the same rule for single MG.   * MG timing * Effective MGRP * MG interruption   UE UL behaviour after MG |
| Apple | Option 1 is OK. On top of option 1, RAN4 needs to study some more side condition for the requirements, such MG overhead and so on. |
| LG | Support Option 1. Need to consider both fully non-overlapped case, and partially or fully over-lapped case. |
| OPPO | OK with the recommended WF. |
| E/// | Agree with the WF |
| Qualcomm | Applicability of existing MG could be revisited later on, once the feature is better defined.  Some aspects may need to be revised if multiple MG patterns with overlapping instances are allowed, e.g. UE behavior during MG and MG interruption. |
| Intel | If there is no any new gap patterns (e.g. MGL, MGRP) for the individual gap instance, these requirements shall follow these of Rel16. |
| Huawei | Support option 1.  We can have further clarifications regarding the overlapping case if needed. |
| CATT | Fine with option 1. |
| Nokia | Probably there is no need for agreeing any details in this meeting related to this Issue. We agree that the aspects raised in Option 1 needs to be part of the overall discussion (and somehow also addressed a bit in the discussion on the earlier Issues).  As for Option 2, the discussion is more addressing the issue that RAN4 should not define new requirements for something we have already defined. Example, if UE is configured with MGPs for SSB measurements and CSI-RS measurements – if these MGPs are fully overlapping this would be seen as covered by the current CSSF |

**Issue 2-17: RF re-tuning time**

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| --- | --- |
| **Company** | **Comments** |
| MTK | Not support.  The concurrent gaps are two independent gaps.  Each frequency layer shall be only measured in one gap and the RF retuning time is always needed to measure the frequency from UE side. |
| Apple | Option 1 is not clear to us. Does ZTE refer to the case wherein two MG occasions from two MG patterns collides with each other? In our view in this case UE only needs to measure one carrier using one of the MG occasion. |
| LG | Not support. RF retuning time should be considered with 0.5ms in FR1 and 0.25m in FR2 for each MG in concurrent MGs. |
| ZTE | What we suggested is not to have extra RF tuning time when defining concurrent MGs. We agree that concurrent gaps are two independent gaps thus the RF tuning time for the two gaps are already defined. No extra RF tuning time shall be defined.  After reading the comments we think that actually we’re on the same page. |
| OPPO | We agree that RF retuning time has been considered in current MGs. |
| E/// | The proposal is unclear. Each gap pattern has its retuning time within its MGL. Current RF tuning time values for FR1 and FR2 will be reused. |
| Qualcomm | It seems that ZTEs proposal is made in the context of overlapping MG instances. If so the question can be postponed pending conclusion of issue 2-9. Further clarification would be welcome. |
| Intel | Option 1 can be agreed because we prefer to no new gap for the concurrent gap patterns |
| Huawei | We understand ZTE proposal is for the case shown by MTK figure in Issue 1-10, but please ZTE help to clarify. |
| Xiaomi | Agree with Ericsson, each gap pattern has its retuning time within its MGL. Current RF tuning time values for FR1 and FR2 will be reused. |
| CATT | No extra RF tuning time is needed. |
| Nokia | We could start re-using the existing re-tuning assumptions |

**Issue 2-18: New MG patterns**

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| **Company** | **Comments** |
| MTK | Not support the proposal.  It seems the new MG pattern discussion is out of WI scope.  RAN4 shall discuss the concurrent gaps based on the legacy MG patterns. |
| Apple | Disagree with option 1. It is not in the scope. |
| LG | Not support the proposal. At first, new MG patterns need to be agreed before discussing in scope of multiple MGs. It seems out of scope. |
| E/// | We are fine with moderator proposal. |
| Qualcomm | Out of scope. |
| Intel | Support the recommentd WF. In the last RAN meeting, this was excluded in the WI scope. |
| Huawei | We understand it is out of the WI scope. |
| Xiaomi | The same view as other companies, it is not in the scope. |
| CATT | Agree with the recommended WF. It is out of scope. |
| Nokia | We agree with the moderator comment |

**Issue 2-19: Network configuration under DC**

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| --- | --- |
| **Company** | **Comments** |
| MTK | Support the proposal.  We think how to configure the new gap shall follow the same rule as legacy gap. |
| Apple | Agree the principle that new gap shall follow the same rule as legacy. However, whether extension to LTE is necessary needs more study. Concern is on potential impact on LTE side. |
| LG | Support the proposal. |
| OPPO | Depending on the definition of concurrent gap. Option 1 is fine if the concurrent gaps are agreed to defined based on legacy per UE or per FR gap. |
| E/// | We need some feedback from RAN2 since configuration is fundamentally RAN2 issue. |
| Qualcomm | FFS |
| Intel | Can be FFS. |
| Huawei | We support the proposal in principle, but we also prefer to further study e.g. the impact to LTE as Apple mentioned. |
| Xiaomi | Need some further discussion. |
| CATT | Need more discussion on the configuration mechanism of concurrent gap pattern in DC mode. E.g. whether the patterns can be configured simultaneously from MN and SN. |
| Nokia | We can discuss this but this is more network architecture and for RAN2 and RAN3 to discuss. However, this should already be clear from Rel-16 and we do not right now see why it would need to be changed. Hence, we can follow existing assumption from Rel-16 |

**Issue 2-20: Support of Concurrent gap in LTE SA**

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| **Company** | **Comments** |
| MTK | Support the proposal.  Concurrent gap in LTE SA is out of WI scope. |
| Apple | Support the proposal.  We also need to be careful for EN-DC and NE-DC scenario. If multiple MG patterns are configured, there is potential impact on LTE side as well. |
| LG | Support the proposal |
| OPPO | Support the proposal |
| E/// | Support proposal. In our understanding LTE SA is not within the scope of the WI. |
| Qualcomm | Agree with option 1. It is out of scope. |
| Intel | Agree with Option 1 |
| Huawei | Support option 1. |
| Xiaomi | Support option 1. |
| CATT | Fine with option 1. |
| Nokia | Support option 1 |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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** | **Definition of concurrent gaps**  *Status:*   * 6 companies is fine with the recommended WF * 5 companies suggest revisions and clarifications on the following issues   + MG pattern ID#24 and #25   + MGoffset   + # of MG patterns (e.g., >1) during a common period of time   + Relation to independent gap     - Moderator suggest companies to check whether the definitions of concurrent gap and independent gap can be merged   *Tentative agreements:* No  *Recommendations for 2nd round:* Companies are encouraged to check if the following revised definition is agreeable   * Concurrent gaps are multiple MG patterns that are configured during a common period of time,   + Gap patterns are selected from at least Rel-16 gap patterns #0 to #23.   + Note: The definition can be further revised in the future based on consensus |
| **Issue 2-2** | **Definition of independent gaps**  *Status:*   * The majority view is to consider independent gap from the perspective of how network configures and leave the overlapping issue to another discussion * 1 companies suggest to merge the definition of concurrent gap and independent gap * 1 companies think the definition also needs to consider the corresponding UE behavior   *Tentative agreements:* No  *Recommendations for 2nd round:* Companies are encouraged to check if the following revised definition is agreeable   * Gaps are considered as independent if at least one of the configurations in MGL, MGRP, time offset is different.   + UE behaviors on partially or fully overlapped cases is irrelevant to the definition and will be discussed separately.   + FFS whether to merge the definition of independent gap and concurrent gap in WF drafting phase |
| **Issue 2-3** | **Applicability (measurement purposes) of concurrent gaps**  *Status:*   * 12 companies agreed to include Options 1, 2, 3 in the measurement purpose in the 1st phase * 1 company raised concern on LTE measurements   + Moderator believes that how NR configures MG to cover PSS/SSS/CRS is not a new Rel-17 issue in 3GPP. Same issues happened in NE-DC already.   *Tentative agreements:* No  *Recommendations for 2nd round:* Companies are encouraged to check if the following revised definition is agreeable   * The applicability of concurrent gaps includes the following measurement purposes: * Different SMTC configurations * Different RSs, e.g., SSB, CSI-RS, PRS, RSSI * Different RATs * FFS on whether to extend the applicability to different gap types, e.g., NCSG or pre-configured MG, in the 2nd phase of the WI |
| **Issue 2-4** | **Principle of concurrent gap usage**  *Status:*   * Option 1: 10 companies support. 3 companies suggest clarification on ‘new gap’   + Moderator: Huawei’s suggestion should resolve the concerns * Option 2: 6 companies prefer further discussions.   *Tentative agreements: No*  *Recommendations for 2nd round:* Companies are encouraged to check if the following revised definition is agreeable   * RAN4 to ensure both UE and NW have the same understanding on the usage of each measurement gap |
| **Issue 2-5** | **Whether to introduce a new gap for dedicated purpose(s)**  *Status:*   * Option 1: Many companies suggest to FFS * Option 2: the term ‘new gap needs to be clarified’   + Moderator suggest to use the term suggested by Huawei in Issue 2-4   *Tentative agreements:* No  *Recommendations for 2nd round:* Continue discussion. |
| **Issue 2-6** | **Max number of concurrent gaps**  *Status:*   * 12 companies provided their view on the max number of concurrent gap for per-UE gap FR1-gap and FR2-gap. * 3 companies suggest to first work on the principle and definitions * 1 company prefer no differentiation to per-UE or per-FR gap * 1 company wondered whether new gap type will be introduced in Rel-17   + Moderator suggests to work on the gap type we have for now.   *Tentative agreements:* No  *Recommendations for 2nd round:* Continue discussion. Moderator encourage companies to also consider the definition and principle discussed in previous issues. |
| **Issue 2-7** | **Relation to per-UE gap and per-FR gap**  *Status:*   * Option 1 is supported by 7 companies * Option 3 is supported by 7 companies * Option 2 is supported by 3 companies   *Tentative agreements:* No  *Recommendations for 2nd round:* Continue discussion   * Question from Moderator to Option 3: For per-FR gap capable UE, network should still be able to configure per-UE gap (current Rel-15 mechanism). Does Option 3 still allows this? |
| **Issue 2-8** | **Other aspects on UE capability**  *Status:*   * 7 companies support Option 1 * 5 companies suggest clarification on UE capabilities of per-RF gap and concurrent gap * 1 company suggested to key terminology simple (mention only concurrent gap)   *Tentative agreements:* No  *Recommendations for 2nd round:* Companies are encouraged to check if the following revised definition is agreeable   * A per FR gap and concurrent gap capable UE shall support multiple concurrent gaps on at least one FR |
| **Issue 2-9** | **Whether to allow overlapping between concurrent gaps**  *Status:*   * Option 2 is supported by 7 companies * Option 3 is supported by 6 companies * Option 1 is supported by 3 companies   *Tentative agreements:* No  *Recommendations for 2nd round:* Moderator thinks there is no objection to work on non-overlapping cases. The controversial parts are on whether to work on partially and fully-overlapped cases. Companies are encouraged to check if the following revised definition is agreeable   * RAN4 to work on at least non-overlapping concurrent gap. FFS whether to work on partially and fully-overlapped cases. |
| **Issue 2-10** | **Overlapping in gap duration, if overlapping is allowed**  *Status:*   * 6 companies suggested to wait for the conclusion of Issue 2-9 * 4 companies support Option 1   *Tentative agreements:* No  *Recommendations for 2nd round:* Postpone to next meeting |
| **Issue 2-11** | **UE behaviour in overlapped gap occasion, if overlapping is allowed**  *Status:*   * 6 companies support Option 1 * 5 companies suggested to wait for the conclusion of Issue 2-9   *Tentative agreements:* No  *Recommendations for 2nd round:* Postpone to next meeting |
| **Issue 2-12** | **Overall MG overhead**  *Status:*   * 6 companies support Option 1a * 4 companies support Option 3 * 2 companies support Option 1b   Moderator thinks there is a clear consensus to define a certain cap on overall MG interruption for concurrent gap, although companies still need time on the detail rule.  *Recommendations for 2nd round:* Companies are encouraged to check if the following revised definition is agreeable   * RAN4 to specify a cap on aggregate fractional interruption time as applicability condition for configuring multiple concurrent MG patterns |
| **Issue 2-13** | **CSSF**  *Status:* All companies are fine to postpone the discussion to next meeting  *Tentative agreements:* Postpone the discussion of CSSF to next meeting  *Recommendations for 2nd round:* No |
| **Issue 2-14** | **Measurement capability**  *Status:*   * LGE has clarified that the measurement capability is about # of layers that should be monitored by UE. After clarification, Option 1 is supported by 9 companies. * 1 companies do not see the link between this capability and concurrent measurement gap   *Recommendations for 2nd round:* Companies are encouraged to check if the following revised definition is agreeable   * Keep Rel-16 UE measurement capability of number of layers to be monitored by gap for UE configured with concurrent gaps |
| **Issue 2-15** | **Measurement delay requirements**  *Status:* Companies think this issue is already covered by Issue 2-9  *Tentative agreements:* No  *Recommendations for 2nd round:* Merge this issue in to Issue 2-9 |
| **Issue 2-16** | **Other aspects in measurement requirements**  *Status:*   * Option 1 is supported by 7 companies.   + 3 companies mentioned that there may be other aspects to be considered, e.g., overlapping   + 1 companies suggested to ensure no new MG patterns   + 1 company suggest to postpone the agreement. * Option 2 is supported by 1 companies   + Moderator believe Option 1 and Option 2 are trying to address the same thing. Option 1 is more detail, while Option 2 in high level   *Tentative agreements:* No  *Recommendations for 2nd round:* Companies are encouraged to check if the following revised definition is agreeable (some items discussed in previous discussions are removed to avoid duplicated agreements)   * RAN4 to reuse the following existing MG related requirements for concurrent gaps: MG reference timing, effective MGRP, MG interruption and UE UL behaviour after MG   + Other requirements can be further discussed in future meetings |
| **Issue 2-17** | **RF re-tuning time**  *Status:*   * Companies think Option 1 is not clear for discussion and may be overlapped by previous issues   *Tentative agreements:* No  *Recommendations for 2nd round:* Moderator suggests ZTE to revise the proposal, if needed. |
| **Issue 2-18** | **New MG patterns**  *Status:* All companies agree that this issue is not in the scope of this WI.  *Tentative agreements:* No new gap pattern will be introduced in the scope concurrent gaps objective in this WI  *Recommendations for 2nd round:* Issue closed |
| **Issue 2-19** | **Network configuration under DC**  *Status:*   * 6 companies suggest FFS * 5 companies supports Option 1 * One companies suggest to get some feedback from RAN2   *Tentative agreements:* No  *Recommendations for 2nd round:* Continue discussion. Companies are encouraged to provide view on whether to trigger LS to get RAN2 feedback |
| **Issue 2-20** | **Support of Concurrent gap in LTE SA**  *Status:* All companies support Option 1  *Tentative agreements:* Do not introduce the concurrent gap in LTE SA mode  *Recommendations for 2nd round:* No |

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on R17 NR measurement gap enhancements (Part 1) | MediaTek inc. |

### 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** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

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| --- | --- |
| **Issue 2-1** | **Definition of concurrent gaps**  *Recommendations for 2nd round:* Companies are encouraged to check if the following revised definition is agreeable   * Concurrent gaps are multiple MG patterns that are configured during a common period of time,   + Gap patterns are selected from at least Rel-16 gap patterns #0 to #23.   + Note: The definition can be further revised in the future based on consensus |
| Moderator | Please direct comment to the revised definition. Suggested to be discussed in **GTW** |
| **Xiaomi** | **The recommended definition is fine for us.** |
| Intel | **The common period shall be clarified indeed. For example, if UE needs the concurrent gaps to measure SSB and PRS. Definitely the measurement period of PRS can be different with SSB. That is the concurrent gap pattern can’t be applied in this scenario. But according to previous discussion in RAN plenary, such using case shall be considered in this WI.**  **We need also to clarify whether the components of concurrent gaps (e.g. the individual gap instance ) shall be configured by NW together (e.g. with a single IE)** |
| **LG Electronics** | **Generally, we’re fine with the recommended definition.** |
| Qualcomm | Our understanding is that “concurrent MG patterns” refers to multiple MG patterns (specifically measGapConfig defined in 38.331. i.e. it includes gapOffset) that are active during a common period of time. Regarding the definition of “active,” we refer to the agreement from today’s GTW in the context of pre-configured gaps. In our view, the condition of multiple MG being simultaneously active is essential when discussing “concurrent MG patterns.” If we limit the scope to only one gap pattern being active at time then the situation would be substantially the same as in Rel-16 and most of the sub-topics being discussed under this objective would be irrelevant (e.g. time overlap). |

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| **Issue 2-2** | **Definition of independent gaps**  *Recommendations for 2nd round:* Companies are encouraged to check if the following revised definition is agreeable   * Gaps are considered as independent if at least one of the configurations in MGL, MGRP, time offset is different.   + UE behaviors on partially or fully overlapped cases is irrelevant to the definition and will be discussed separately.   + FFS whether to merge the definition of independent gap and concurrent gap in WF drafting phase |
| Moderator | Please direct comment to the revised definition. Suggested to be discussed in **GTW** |
| **Xiaomi** | **The recommended definition is fine for us. According to our understanding, the concurrent gap is a kind of independent gap, which is overlapping with other gap during a common period of time. So, we support to merge the definition of independent gap and concurrent gap.** |
| Intel | **We don’t think we need such definition of “independent” . The concurrent gaps can be composed by individual gap instances which can be independent each other no matter whether their MGRP or MGL are different because they are targeted to use for different measurement objects or layers. E.g. in the figure below, UE can be configured with >1 MGs if the capability of “multiple concurrent gap” supported.** |
| LG Electronics | We’re fine with the recommended definition. However, it can be merged with concurrent gaps. So, we would like to suggest to use multiple MGs instead of concurrent and independent MGs.   * Definition of multiple MG patterns   + Multiple MG patterns are configured during a common period of time   + Multiple MG patterns are selected from at least Rel-16 gap patterns #0 to #23   + At least one of the configurations in MGL, MGRP, time offset is different for multiple MG patterns.   + UE behaviors on partially or fully overlapped cases is irrelevant to the definition and will be discussed separately   + Note: The definition can be further revised in the future based on consensus |
| Qualcomm | We understand that “independent gap patterns” refers to gap patterns that have separate, individual configurations (measGapConfig in 38.133) and that the network has freedom to choose the configuration parameters of each gap pattern independently. E.g. imagine the network configures a first MG pattern from a set *A* and later on it decides to add a second MG pattern. If the patterns are truly independent, the network should be able to choose any pattern from the same set *A* as the second MG pattern.  During the core part of this WI, RAN4 may decide to impose some restrictions/constraints on the combinations of MG patterns that may be configured concurrently (i.e. at the same time). Thus, ultimately, the concurrent MG patterns specified by RAN4 may not be completely independent. |

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| **Issue 2-3** | **Applicability (measurement purposes) of concurrent gaps**  *Recommendations for 2nd round:* Companies are encouraged to check if the following revised applicability is agreeable   * The applicability of concurrent gaps includes the following measurement purposes: * Different SMTC configurations * Different RSs, e.g., SSB, CSI-RS, PRS, RSSI * Different RATs * FFS on whether to extend the applicability to different gap types, e.g., NCSG or pre-configured MG, in the 2nd phase of the WI |
| Moderator | Please direct comment to the revised applicability |
| **Xiaomi** | **The recommended applicability is fine** |
| Intel | **This recommend WF is fine us. But it may be need to consider the priority of them if the maximum number of concurrent gaps is very small (e..g 2)** |
| **LG Electronics** | **We’re fine with the recommended WF.** |
| Qualcomm | Applicability should be discussed further in future meetings. To simplify the discussion we suggest splitting the discussion into two separate issues: a) applicability regarding the type of measurement, b) applicability of different types of MG (e.g. NCSG or pre-configured). |

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| **Issue 2-4** | **Principle of concurrent gap usage**  *Recommendations for 2nd round:* Companies are encouraged to check if the following revised WF is agreeable   * RAN4 to ensure both UE and NW have the same understanding on the usage of each measurement gap |
| Moderator | Please direct comment to the revised WF |
| **Xiaomi** | **OK with the revised WF** |
| Intel | **This WF is fine for us. But it means the overlapping cases of concurrent gaps can’t satisfy such principle.** |
| **LG Electronics** | **We’re fine with the recommended WF. For overlapping cases, we think a legacy MG is higher priority than a MG added for multiple MGs.** |
| Qualcomm | We can support the proposed WF. In our view, this is reasonable as a general guideline and does not preclude leaving some aspects up to implementation, as long as the scope of such implementation aspects is well defined and understood. |

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| **Issue 2-5** | **Whether to introduce a new gap for dedicated purpose(s)**  *Candidate Options:*   * Option 1: Consider Primary MG pattern ID(s) and Secondary MG pattern ID(s), where that Secondary MG pattern ID(s) can be activated or deactivated to reduce performance degradation due to multiple MG patterns * Option 2: RAN4 to define the framework of usage for ~~new~~ gaps dedicated to specific purpose(s)   *Recommendations for 2nd round:* Continue discussion. |
| **Xiaomi** | **We support option 1 in principle, in order to guarantee the throughput performance, it is preferred to introduced the activated/deactivated mechanism for a dedicated measurement purpose with a dedicated MG pattern.** |
| Intel | **We prefer Option 1. The current gap patterns shall be enough cover all possible measurements in Rel16.** |
| **LG Electronics** | **Support Option 1.** |
| Qualcomm | Same comments as in the 1st round. We support option 2. |

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| **Issue 2-6** | **Max number of concurrent gaps**  *Candidate Options:*   * Option 1: (Apple, CATT, Xiaomi)   + 2 * Option 2: (Ericsson)   + At least 2 * Option 3: (HW)   + 2 per UE or 2 per FR, according to UE’s per-FR gap capability * Option 4: (QC, MTK)   + 2 per UE gaps and 3 per FR gaps * Option 5: (OPPO)   + 3 * Option 6: (Intel)   + Up to UE’s capability * Option 7: (CATT)   + When gap pattern #0 to pattern #23 defined in table 9.1.2-1 in TS 38.133 are used, at most three concurrent gap patterns can be configured. When gap #24 or #25 is used, at most 2 concurrent gap patterns can be configured.   + When used for covering different SMTC configuration, at most 2 concurrent gap patterns can be configured.   + When different SMTC and different measurement are both used, at most 3 concurrent gap patterns can be configured.   *Recommendations for 2nd round:* Continue discussion. Moderator encourage companies to also consider the definition and principle discussed in previous issues. |
| **Xiaomi** | **Support option 1 or option 3, we prefer to introduce 1 additional MG pattern based on the legacy MG configuration defined in Rel-15.** |
| intel | **Can be FFS** |
| **LG Electronics** | **Support Option 3.** |
| Qualcomm | To be discussed further.  Options 1, 2 and 3 should be further clarified in terms of per-UE and per-FR.  Does option 6 suggest that RAN4 should not specify a maximum number of concurrent MGs that may be configured by the network? We agree that there should be a UE capability but we also think that RAN4 should specify a maximum number.  Given the diversity of views, we think that this discussion would be more productive if we focus on use cases of interest and use those to further motivate the choice of max number of concurrent MGs. |

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| **Issue 2-7** | **Relation to per-UE gap and per-FR gap**  *Candidate Options:*   * Option 1: (HW, MTK, LGE)   + All concurrent MGs are of the same type (per UE MG or per FR MG) * Option 2: (Ericsson) The parallel MG patterns can be any of   + all per-UE,   + all per-FR (for the same FR), or   + a combination of per-UE and per-FR MG patterns, with at least one per-UE and at least one per-FR * Option 2a(Intel) The gap patterns/instance configured by a same concurrent MG can be agnostic with per-UE or per-FR. * Option 3 (Nokia):   + For a Per UE gap capable UE, multiple concurrent and independent MGPs applies per UE.   + For a Per FR gap capable UE, multiple concurrent and independent MGPs applies per FR   *Tentative agreements:* No  *Recommendations for 2nd round:* Continue discussion |
| Moderator | Suggested to be discussed in **GTW**  Question to Option 3: For per-FR gap capable UE, network should still be able to configure per-UE gap (current Rel-15 mechanism). Does Option 3 still allows this? |
| **Xiaomi** | **Option 1** |
| Intel | **We support Option 2 and 2a. But this is also related to issue 2-7.** |
| **LG Electronics** | **Support Option 1.** |
| Qualcomm | Support of per-FR gaps is a UE capability. A UE that is not capable of per-FR gaps can only be configured with per-UE gaps. A UE that is capable of per-FR gaps can be configured with either per-UE or per-FR gaps. We think the same reasoning should be applied in the context of multiple concurrent MG patterns.  In addition, we think it may be reasonable to extend the current requirement that only MG of the same type, either per-UE or per-FR, may be configured at any given time (option 1). E.g. the same effect of a per-UE gap could be achieved by configuring concurrent per-FR gaps. Therefore, it is not clear if there is a case for allowing concurrent per-UE and per-FR gaps to be configured. This particular point can be FFS. |

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| **Issue 2-8** | **Other aspects on UE capability**  *Recommendations for 2nd round:* Companies are encouraged to check if the following revised WF is agreeable   * A per FR gap and concurrent gap capable UE shall support multiple concurrent gaps on at least one FR |
| Moderator | Please direct comment to the revised WF |
| **Xiaomi** | **Fine with the revised WF** |
| Intel | **Can be FFS. We could not differentiate the capability of concurrent gap supporting by per-FR or per-UE as we commented in issue 2-7.** |
| **LG Electronics** | **We’re fine with the revised WF.** |
| Qualcomm | We think this would be subject to UE capability. A per-FR capable UE also supports per-UE gaps. Such a UE could support multiple concurrent MG only of per-UE type. FFS. |

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| **Issue 2-9** | **Whether to allow overlapping between concurrent gaps**  *Recommendations for 2nd round:* Moderator thinks there is no objection to work on non-overlapping cases. The controversial parts are on whether to work on partially and fully-overlapped cases. Companies are encouraged to check if the following revised definition is agreeable   * RAN4 to work on at least non-overlapping concurrent gap. FFS whether to work on partially and fully-overlapped cases. |
| Moderator | Please direct comment to the revised WF. Suggested to be discussed in **GTW** |
| **Xiaomi** | **Support the revised WF. For fully-overlapping or partial overlapping case, UE performs the measurement on one of the concurrent gap and will miss the measurement on the other concurrent gap.** |
| Intel | **Technically the overlapping case is possible. But we are fine to keep the scope for non-overlapping case.** |
| **LG Electronics** | **We’re fine with the revised WF. Need to clarify FFS work on partially and fully-overlapped cases. Does FFS mean is not to define in Rel-17?** |
| Qualcomm | We support the suggested WF. If overlapping cases are to be considered, we think RAN4 should evaluate the benefits, if any, versus the additional complexity of specifying and testing UE behavior when such MG patterns are configured. |

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| **Issue 2-10** | **Overlapping in gap duration, if overlapping is allowed**  *Recommendations for 2nd round:* Postpone to next meeting |
| Moderator | Not expected to be discussed in 2nd round |

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| **Issue 2-11** | **UE behaviour in overlapped gap occasion, if overlapping is allowed**  *Recommendations for 2nd round:* Postpone to next meeting |
| Moderator | Not expected to be discussed in 2nd round |

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| **Issue 2-12** | **Overall MG overhead**  *Recommendations for 2nd round:* Companies are encouraged to check if the following revised definition is agreeable   * RAN4 to specify a cap on aggregate fractional interruption time as applicability condition for configuring multiple concurrent MG patterns |
| Moderator | Please direct comment to the revised WF |
| **Xiaomi** | **Fine with the revised WF** |
| Intel | **From system efficiency perspective, we can support this WF.** |
| **LG Electronics** | **Generally, we’re fine with the revised WF.** |
| Qualcomm | We support the proposed WF. |

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| **Issue 2-13** | **CSSF**  *Recommendations for 2nd round:* Postpone the discussion of CSSF to next meeting |
| Moderator | Not expected to be discussed in 2nd round |

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| **Issue 2-14** | **Measurement capability**  *Recommendations for 2nd round:* Companies are encouraged to check if the following revised WF is agreeable   * Keep Rel-16 UE measurement capability of number of layers to be monitored by gap for UE configured with concurrent gaps |
| Moderator | Please direct comment to the revised WF |
| **Xiaomi** | **Support the revised WF** |
| Company B | **Can be FFS. The layers definition shall be clarified also.** |
| **LG Electronics** | **Support this WF. It is related to the requirement 9.1.3.2 in TS38.133.** |
| Qualcomm | We support the proposed WF. |

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| **Issue 2-15** | **Measurement delay requirements**  *Recommendations for 2nd round:* Merge this issue in to Issue 2-9 |
| Moderator | Not expected to be discussed in 2nd round |

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| **Issue 2-16** | **Other aspects in measurement requirements**  *Recommendations for 2nd round:* Companies are encouraged to check if the following revised definition is agreeable (some items discussed in previous discussions are removed to avoid duplicated agreements)   * RAN4 to reuse the following existing MG related requirements for concurrent gaps: MG reference timing, effective MGRP, MG interruption and UE UL behaviour after MG   + Other requirements can be further discussed in future meetings |
| Moderator | Please direct comment to the revised WF |
| **Xiaomi** | **Fine with the revised WF** |
| Intel | **One clarification is needed for “effective MGRP”. Is it defined for NR positioning? We have not requirements on these “effective MGRP” which is only the intermediate parameters.** |
| **LG Electronics** | **We’re fine with the revised WF.** |
| Qualcomm | Same comment as in round 1. FFS. |

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| **Issue 2-17** | **RF re-tuning time**  *Recommendations for 2nd round:* Moderator suggests ZTE to revise the proposal, if needed. |
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| **Issue 2-18** | **New MG patterns**  *Recommendations for 2nd round:* No new gap pattern will be introduced in the scope concurrent gaps objective in this WI |
| Moderator | All companies agreed with the proposal in the 1st round, but it was not yet captured as an agreement in chairman’s note. Moderator expects no further discussion is needed and the proposal will be added in the WF |

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| **Issue 2-19** | **Network configuration under DC**  *Status:*   * Option 1: (MTK)   + In EN-DC, when UE supports per-UE gap or FR1 gap, the concurrent gaps will be configured by MN; when UE supports FR2 gap, the concurrent gaps will be configured by SN.   + In NR SA, NE-DC, NR-DC, the concurrent gaps will be configured by MN   *Recommendations for 2nd round:* Continue discussion. Companies are encouraged to provide view on whether to trigger LS to get RAN2 feedback |
| Moderator | Do not expect any LS in this meeting |
| Qualcomm | FFS |
| Company B |  |
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| **Issue 2-20** | **Support of Concurrent gap in LTE SA**  *Recommendations for 2nd round:* Do not introduce the concurrent gap in LTE SA mode |
| Moderator | All companies agreed with the proposal in the 1st round, but it was not yet captured as an agreement in chairman’s note. Moderator expects no further discussion is needed and the proposal will be added in the WF |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| R4-2103676 | Title: WF on R17 NR MG enhancements - Multiple concurrent and independent MG patterns  Recommendation: TBD |