**3GPP TSG-RAN WG4 Meeting # 98-bis-e R4-2105688**

**Electronic Meeting, 12th – 20th April, 2021**

**Agenda item:** 8.5.1, 8.5.2.2

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

**Title:** Email discussion summary for [98-bis-e][218] NR\_MG\_enh\_1

**Document for:** Information

# Introduction

This document is the email discussion summary for [98-bis-e][218] NR\_MG\_enh\_1 with the following topics covered

* Topic 1: General (AI 8.5.1)
* Topic 2: Multiple concurrent and independent MG patterns (AI 8.5.2.2)

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 8.5.1)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2104581 | 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. |

## Open issues summary

### Sub-topic 1-1 Work plan

**Issue 1-1: Workplan proposals**

* Proposals
	+ Option 1: R4-2104581 (extend core part by 2 quarters according to RAN#90e decision in PR-210679)
* Recommended WF
	+ Agree on the updated workplan in R4-2104581

## Companies views’ collection for 1st round

### Open issues

**Issue 1-1: Workplan proposals**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| CMCC | In general, we are OK with the WP. One small comment, according to the WP, the updated WP is discussed in #98e, but it should be in #98b-e. |
| MTK | All comments on the WP are highly appreciated. |
| Ericsson | Fine |
|  |  |

### 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**  |
| **Sub-topic #1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **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)

# Topic #2: Multiple concurrent and independent MG patterns (AI 8.5.2.2)

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2104583 | MediaTek inc. | ***Observation 1: Without clear indication, NW and UE may have different understanding on the usage of the new gap.******Proposal 1: Independent gaps are independent configurations by NW. In the same FR at least one of the configurations in MGL, MGRP, time offset is different.******Proposal 2: UE’s behavior for gaps’ non-overlapping, partially or fully overlapping cases in time domain is irrelevant to the definition of independent gaps.******Proposal 3: The definitions of concurrent gaps and independent gaps should be merged. RAN4 does not need to specify 2 separate definitions.******Proposal 4: The common period of time is the duration in which UE can see at least two activated measurement gaps in one FR during this time period.******Proposal 5: The concurrent (and independent) gaps shall be multiple activated measurement gaps in at least one FR that are independent configured for measurements during a common period of time.******Proposal 6: NW shall clearly indicate at least single specific usage (MO, RS or RAT) and a type (legacy, pre-configured or NCSG) for the new gap together with measurement gap’s configuration. The max number of usages for one new gap is FFS.******Proposal 7: For any gap occasion that the concurrent gaps are partially or fully overlapping in their durations, they are treated as fully overlapped duration in that occasion.******Proposal 8: UE will not perform the measurements on more than one frequency layers during a fully overlapped duration for concurrent gaps.******Proposal 9: RAN4 starts from the requirements with scenario where 2 gaps are fully non-overlapping.******Proposal 10: The new gap with a specific usage should be prioritized over legacy gap when they collide in time.******Proposal 11: RAN4 can define a general rule for UE behaviour w.r.t. gap collision between Rel-17 new gap and legacy gap.**** ***In the gap occasions where 2 gap collides, UE performs measurement toward the objects associated to new gap.***
* ***The legacy gap occasions, except the occasions occupied by the Rel-17 new gap, will be reserved for the remaining measurement objects which aren’t indicated to be measured in the specific gap but still need gaps.***
* ***The measurement objects which don’t need the gap will be measured in other SMTC occasions which don’t overlap with any new or legacy gap occasions.***

***Proposal 12: When UE supports concurrent gaps, at most one additional new gap will be supported.******Proposal 13: When UE doesn’t support per-FR gap, all concurrent gaps are per-UE.******Proposal 14: When UE supports per-FR gap and concurrent gaps, UE shall support more than one gap in at least one FR. RAN4 can start the discussion for the scenario: 1 FR1 gap, 1 FR2 gap and 1 additional FR1 new gap.******Proposal 15: When UE supports concurrent gaps, explicitly captured the overhead limitation in the spec.**** ***Option 1: The overall data dropping rate won't be larger than 30%.***
* ***Option 2: The MGRP of concurrent gaps can’t be less than 40ms.***

***Proposal 16: Reuse the following existing MG related requirements: MG reference timing (including MGTA), effective MGRP, MG interruption and UE UL behaviour after MG.******Proposal 17: RAN4 to send the LS to ask RAN2 for how to configure the concurrent gaps once RAN4 agreed the maximum number of concurrent gaps and the relation with per-UE and per-FR gap.***  |
| R4-2104636 | vivo | **Proposal 1: The definition of concurrent and multiple MGs should be sufficient enough to differentiate individual gaps among a common period. Whether a configuration satisfying concurrent and multiple MG definition will be used or not in practice should be separated with concurrent MG definition** **Proposal 2: The concurrent and multiple MG is defined when either one of the following two rules is satisfied:** **1. different gap pattern with same/different MG offset 2. same gap pattern with different MG offset****Proposal 3: the MG overhead of a concurrent and multiple MG configuration shall not exceed a threshold defined based on UE capabilities.****Proposal 4: When MGs are fully nonoverlapping, not matter the offsets between individual gap patterns among a concurrent MG configuration, the overhead ratio can be calculated as: (total MGL length within X)/X, where X is the least common multiple among all MGRPs within a concurrent and multiple MG configuration.** **Proposal 5: When MGs are overlapping, not matter the offsets between individual gap patterns among a concurrent MG configuration, the overhead ratio can be calculated as: [(total MGL length – total overlapping period) within X]/X, where X is the least common multiple among all MGRPs within a concurrent and multiple MG configuration.****Proposal 6: At least 2 concurrent gaps are considered for the concurrent and multiple MG design.** **Proposal 7: For a per UE capable UE, the concurrent and multiple gaps apply at per UE level whereas for the per FR capable UE, the concurrent and multiple gaps could apply at per FR level.****Proposal 8: When all objects cannot share one particular gap among a concurrent and multiple gap configuration, the CSSFwithin\_gap,i for these objects are not within that gap needs recalculation. The new value of CSSFwithin\_gap,i should be known by the network side as well.** |
| R4-2104688 | Xiaomi | **Proposal 1: The MGs are considered as independent gaps if at least one of the configurations in MGL, MGRP or gapOffset is different per FR for per-FR gap capable UE or per UE for per-UE gap capable UE.****Proposal 2: it is proposed to merge the definition of independent MG and concurrent MG.****Proposal 3a: For per-UE capable UE, the independent gap shall be applied per-UE.****Proposal 3b: For per-FR capable UE, the independent gap shall be applied per-FR.****Proposal 4: The maximum number of the independent measurement gap pattern are proposed as follows:*** **For per-UE capable UE, the max number of independent MG pattern is 2;**
* **For per-FR capable UE,**
	+ **the max number of independent MG pattern in FR1 is 2;**
	+ **the max number of independent MG pattern in FR2 is 2;**
	+ **the max number of independent MG pattern in FR1+ FR2 is 3;**

**Observation 1: UE should be implemented parallel RF chains per-UE for per-UE gap capable UE or per-FR for per-FR gap capable UE to support the simultaneous measurements with independent gaps on the MOs which are fully overlapped or partial overlapped.****Proposal 5: RAN4 is prioritized to work on non-overlapping independent gap in 1st phase.****Proposal 6: The CSSF with gap should be defined based on the carriers to be measured with the same measurement gap pattern.** |
| R4-2104751 | CATT | **Proposal 1: The common period is the time when multiple gap patterns are existing in the system simultaneously i.e. from the time that the second gap pattern is configured to the start time when only one gap pattern is existing.** **Proposal 2: There is no need to define concurrent and independent separately. Concurrent means independent.** **Proposal 3: All concurrent MGs are of the same type (per UE MG or per FR MG).** **Proposal 4: When all the concurrent MGs are selected from gap pattern #0 to pattern #23 defined in table 9.1.2-1 in TS 38.133, at most three concurrent gap patterns can be configured. When one of gap #24 and #25 is used, at most 2 concurrent gap patterns can be configured.** **Proposal 5: RAN to work on at least non-overlapping case. For overlapping case, only the cases when the concurrent gaps have different periodicity are considered. The gap offset can be same or different.** **Proposal 6: The overhead for configuring multiple concurrent MG patterns depends on the NW configuration (Option 2).** **Proposal 7: The requirements are defined based on the following assumption:** * **Only one frequency layer can be measured in a single gap instance.**
* **Only one type of RSs can be performed in a single gap instance.**
* **One RS configuration can only be measured in one MG pattern.**

**Proposal 8: The CSSF for concurrent gaps in non-overlapping case can reuse the definition in R16. And only the measurement object that will be measured using this gap pattern will be considered.** **Proposal 9: There is no need to trigger LS to RAN2 in this stage. RAN4 should focus on the concurrent gaps design and trigger LS to RAN2 after having conclusions.** **Proposal 10: Multiple concurrent gap patterns can also be used for the case when the SMTC from different cells cannot be covered by one gap occasion due to the asynchronization.**  |
| R4-2104855 | Apple | **Proposal 1: gaps are considered as independent gaps if at least one of the configurations in MGL, MGRP, time offset is different.****Proposal 2: RAN4 shall merge the definition of independent gap and concurrent gap.****Proposal 3: All concurrent MGs are of the same type (per UE MG or per FR MG).** **Proposal 4: RAN4 to work on non-overlapping concurrent gaps and partially overlapped gaps.****Proposal 5: RAN4 to specify a cap on aggregate fractional interruption time as applicability condition for multiple concurrent MG patterns. One possible option is to define it as the maximum MG overhead according to the supported single MG pattern.****Proposal 6: if each MO can only be covered by certain MG pattern (cannot be covered by other MG pattern), then CSSFwithin\_gap for each MO can be calculated independently. For other scenarios, further discussion is needed.** |
| R4-2104933 | CMCC | Definition of concurrent MG***Observation 1: it is not necessary to restrict that“concurrent gaps are operating at the same time”. It can be considered that “concurrent gaps are operating during the single MGRP duration”******Proposal 1: common period of time is a certain value, and the exact value could be selected from MGRP, which is {20, 40, 80, 160} ms.*** Definition of independent MG***Observation 2: network do not have the information of whether multiple gaps are operated simultaneously by UE, since which MG instance is in use and which MG instance is not used is up to UE implementation.******Proposal 2: it is preferred to define the independent MG from configuration perspective. And at least the difference in MGL, MGRP and time offset need to be considered.******Proposal 3: for the definition of independent MG, it is proposed to discuss that except MGL, MGRP, time offset, whether MGTA is considered or not?*** * ***For two gaps with same MGL, MGRP, time offset, and only MGTA is different, whether these two gaps are considered as independent MG or not?***

Relation to per-UE gap and per-FR gap***Observation 3: according to TS 38.331 on MeasGapConfig, per FR gap cannot be configured together with per UE gap.******Proposal 4:*** * ***For the per-UE gap capable UE, multiple concurrent and independent MGs applies per UE.***
* ***For the per-FR gap capable UE, there are two cases.***
* ***Case 1: multiple concurrent and independent MGs can be configured as per-UE gaps and applies per UE.***
* ***Case 2: multiple concurrent and independent MGs can be configured as per-FR gaps and applies per FR.***

Partially and fully-overlapped cases***Proposal 5: it is proposed to consider partially and fully-overlapped concurrent gaps, which could reduce the impact on the data loss.***Network configuration under DC mode***Proposal 6: for multiple concurrent and independent MG patterns, existing configuration mechanism under DC mode can be reused:**** ***In EN-DC, per-UE gap and FR1 gap are configured by MN, FR2 gap is configured by SN.***
* ***In NE-DC and NR-DC, per-UE gap, FR1 gap and FR2 gap are configured by MN.***
 |
| R4-2104982 | NEC | **Proposal 1: RAN4 to agree that measurement gaps are considered as independent if UE can measure on these gaps simultaneously without impacting the measurement performance requirements of each MG.****Proposal 2: RAN4 to agree that concurrent MGs are multiple MGs that are configured for measurements during a common period of time*** + **Where common period of time is measurement period of UE**
	+ **Any two measurement gaps configured as concurrent MG can have different MGL, MGRP, offset different values.**
	+ **Note 1: UE behaviour for non-overlapping, partially or fully overlapped cases is irrelevant to the definition and will be discussed separately.**
	+ **Note 2: current definition does not address pre-configured MG patterns and NCSG. FFS how to address pre-configured MG patterns and NCSG**

**Proposal 3: RAN4 to further study and request other WG to define new capability to indicate which of the following capability is supported by UE.** * **Concurrent but not independent**
* **Concurrent and independent**
* **Independent but not concurrent**

**Proposal 4: When designing multiple MG patterns in a measurement period, RAN4 to agree that maximum of only one MG is allowed for every 20ms.****Proposal 5: 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”.** |
| R4-2106303 | LG Electronics Polska | **Proposal 1: A common period of time for multiple MGs can be considered as the commonly activated duration of the multiple MGs.** **Proposal 2: MGs are considered as independent gaps if at least one of the configurations in MGL, MGRP, time offset is different** **Proposal 3: For a Per UE gap capable UE, multiple concurrent and independent MG Patterns apply per UE.****For a Per FR gap capable UE, multiple concurrent and independent MG Patterns apply per FR****Proposal 4: Define the number of activated multiple MGs simultaneously as follows.*** **2 for per-UE gap**
* **2 for per-FR gap in FR1**
* **2 for per-FR gain in FR2**
 |
| R4-2106344 | Qualcomm Incorporated | **Proposal 1: RAN4 should discuss whether each of the multiple MG will have its own separate configuration (preferred) or whether some parameters will be shared among them.****Proposal 2: RAN4 will discuss applicability conditions that may limit the allowable combinations of MG that can be configured concurrently.****Proposal 3: Concurrent MG can be any combination of per-UE and per-FR gaps (on one or more FRs), subject to UE capabilities to support of multiple MG and support of per-FR gaps.****Proposal 4: RAN4 to discuss whether to specify a cap on aggregate overhead of multiple concurrent MGs. RAN4 should first discuss which measurement objectives warrant configuring multiple concurrent MG.****Proposal 5: Multiple concurrent MGs are not applicable when the UE is configured to perform only non-NR RAT measurements.****Proposal 6: When multiple concurrent per-FR MGs are configured, MG overhead should be calculated per FR and limits on MG overhead, if any, should be applied per FR.****Proposal 7:**1. **Add signaling from the UE to the network, potentially via *LocationMeasurementIndication*, indicating whether the requested MG would be dedicated to NR positioning measurements.**
2. **Add signaling from the UE to the network, potentially via *LocationMeasurementIndication*, indicating whether the requested MG for NR positioning is per-UE or per-FR.**
3. **The decision to request a dedicated MG of per-UE or per-FR type would be based on the requested/expected measurement latency and on the processing capabilities of the UE.**
4. **If the number of configured MG patterns at the time when serving gNB receives the MG request is less than the maximum number of concurrent MG patterns supported by the UE, then the serving gNB would configure one additional MG pattern for NR positioning as requested by the UE.**
5. **On the other hand, if the number of configured MG patterns already equals the maximum number of concurrent MG patterns supported by the UE, then the serving gNB would release one of the active MG patterns and replace it with a MG pattern for NR positioning as requested by the UE.**
6. **When the UE has completed performing the NR positioning measurements it would signal to the network to release the MG pattern.**
7. **The specification of CSSF within gap would be updated to enable and account for MG dedicated to NR positioning measurements.**

**Proposal 8: RAN4 to discuss whether a dedicated MG requested for NR positioning would be prioritized over another MG pattern that is already configured if any instances of the two MG overlap in time. e.g. the network would release the conflicting MG.** |
| R4-2106392 | Nokia, Nokia Shanghai Bell | **Concurrent MG Definition:**1. Once an MGP is configured it is active and gap assisted measurements are performed.

When UE is configured with more than one MGP, the UE is configured with multiple MGPs.1. The time when UE is configured with more than one MGP is defined as the common period of time
2. The UE shall apply the configured MGP no later than after the RRC processing delay.

**Definition of independent MG:**It is important that the UE requirements are well defined when UE is configured with more than MGP.1. For concurrent MGPs, each RRC configuration configures independent MGPs.
2. RAN4 shall define the UE measurement requirements when UE is configured with concurrent MGPs.

**Merging the definition of independent gap and concurrent gap:**1. There is no strong need to merge the definition of independent gaps and concurrent gaps if the definition of each is clear and captured.

**Measurement gaps applicability:**Discussion of new gap patterns and the current measurement gap applicability is not part of this WI.The WI does not include objectives related to defining gaps dedicated to specific purpose(s).**Per-UE gap and Per-FR gap:**1. A UE support Per-UE gap can be configured with concurrent MGPs Per-UE.
2. A UE supporting Per-FR MG can be configured with concurrent MGPs Per-UE and Per-FR.
3. UEs supporting this feature would at least need to support 2 concurrent MGPs being configured.
4. A UEs supporting this feature and capable of per-FR MGPs should support at least 2 concurrent MGPs per FR.

**Overhead:**1. RAN4 need to identify any UE constraints related to network configuration of concurrent MGPs. and use such when defining the applicability of concurrent MGPs.
2. UE restriction related to configuration of concurrent MGPs should be reflected in the applicability of the UE requirements defined for when UE is configured with concurrent MGPs.

**Concurrent measurement gaps and CSSF:**1. Both partially and fully-overlapped MGPs can be configured as concurrent MGPs.
2. Define that the CSSF applies also when concurrent MGPs are configured.
 |
| R4-2106447 | Intel Corporation | **Observation 1: The common period in the definition of concurrent MG [2] can be max(MGRPi). MGRPi is the measurement periodicity of** $i$**th induvial MG configured within these concurrent MGs.** ***Proposal 1: Concurrent MGs are multiple individual MGs that can be co-existent for UE’s measurements during [160ms].*****Observation 2 *:* The induvial MGs within these concurrent MGs can be independent each other.*****Proposal 2: The definition of independent MG is unnecessary***. ***Proposal 3: The concurrent MGs 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***

**Observation 3**: **Whether and how many concurrent gaps supported by UE shall be completely up to UE themselves.*****Proposal 4: The number of maximum support individual gaps within a concurrent MG pattern can be also defined as one of UE capabilities***. **Observation 4: In case of per-FR MGs being configured to UE as concurrent MGs, there are more than 2 gaps beside the per-FR MGs configured at least.****Observation 5: How to define the limitation of the total concurrent gap patterns activated can be FFS, e.g.*** **The static number (e.g. a cap as the applicability condition)**
* **The adaptive limitation based on the gap instances within the concurrent gap pattern**

***Proposal 5: The adaptive way depending on NW configuration to limit the overhead of concurrent MGs is preferred.******Proposal 6: Concurrent MGs can be configured based on the legacy MeasConfig [4, TS38.331].*****Observation 6: The gap instances configured by a same concurrent MG pattern can be used by the specific measurement type(s) occurred in a same frequency layers indicated by serving gNB .** ***Proposal 6a: the concurrent gap pattern can be configured based on the legacy MeasConfig [4,TS38.331] with the indication of the specific measurement reservation.*** **Observation 7: The serving gNB can configure the concurrent MGs without overlapping (e.g. the gaps for SSB and CSI-RS measurements).****Observation 8: 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 9: The gap sharing factor shall be applicable to the delay requirements when overlapping case.** **Observation 10: How to define the gap sharing factor when the multiple concurrent gap patterns configured can be FFS.** ***Proposal 7: The measurement delay requirement in case of multiple gaps shall be revisited. As the start point, the non-overlapping scenarios can be studied as a start point.*****Observation 11: UE processing capability shall be taken count into the proximity of two adjacent gap instances in a concurrent measurement gap configuration.** |
| R4-2106536 | OPPO | **Proposal 1: Gaps are considered as independent gaps if at least one of the configurations in MGL, MGRP, time offset is different.****Proposal 2: Concurrent MGs are multiple independent MGs that are configured for measurements during a common period of time.****Proposal 3: From configuration perspective, RAN4 study the feasibility of per UE and per FR gaps configured or pre-configured in parallel as concurrent gaps.** **Observation 1: If per UE and per FR gaps are not allowed to be configured in parallel, UE capable of per FR gap and concurrent gap supports multiple concurrent gaps on at least one FR.** **Observation 2: Assuming per UE and per FR gaps are independent gap, they are allowed to be configured in parallel.****Observation 3: Assuming per UE and per FR gaps are not independent gap, they are not allowed to be configured in parallel.****Proposal 4: UE supports at most 3 concurrent MG patterns activated at any time.** |
| R4-2106880 | Ericsson | ***Proposal 1:*** *Starting point for common period of time is defined by the start of the first MG in the added concurrent MGP. Ending point for common period of time is defined by completion of processing of RRC message that releases the concurrent MGP(s).****Proposal 2:*** *UE shall support combinations of concurrent gaps comprising any of the by UE supported MGPs.****Proposal 3:*** *Focus on the definition of concurrent gaps that cover all necessary aspects, and do not further define independent MGs.****Proposal 4:*** *Define a framework for configuring gaps dedicated to specific purpose(s). Consider at least the following aspects while defining rules for usage of the parallel MGPs:** *measurement type*
* *RAT*
* *Periodicity of signals to be measured in MGs*
* *Relation between the parameters of the parallel patterns.*

***Proposal 5:*** *The parallel MGPs can be any of: all per-UE, all per-FR (for same FR), or a combination of per-UE and per-FR MGPs with at least one per-UE and one per-FR.* |
| R4-2106923 | ZTE Corporation | **Proposal 1: Gaps are considered as independent gaps if at least one of the configurations in MGL, MGRP, time offset is different.** |
| R4-2107028 | Huawei, HiSilicon | **Proposal 1: UE is configured with concurrent MG when it is configured with more than one independent MGs. Gaps are considered as independent gaps if at least one of the configurations in MGL, MGRP, time offset is different.****Proposal 2: When UE is configured with concurrent MG, NW configures which MG is to be used for each MO.****Proposal 3: UE not capable of per FR MG but capable of concurrent MG can be configured with up to 2 per UE MGs.****Proposal 4: UE capable of per FR MG and capable of concurrent MG can be configured with** * **Up to 2 per UE MGs, or**
* **Up to 3 per FR MGs**

**Proposal 5: 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.****Proposal 6: No need to specify a cap on aggregate fractional interruption time as applicability condition.****Proposal 7: CSSF is calculated independently for each of the multiple concurrent MGs.****Proposal 8: All MG related requirements defined for single MG, including MG reference timing, effective MGRP, MG interruption and UE UL behaviour after MG, apply for each of the multiple concurrent MGs.** |

## Open issues summary

### Sub-topic 2-1 Definition

**Issue 2-1: Definition of independent gap**

* Proposals
	+ Option 1a: (MTK, Xiaomi, Apple, LGE, QC, Nokia, OPPO, ZTE, Huawei)
		- Multiple MGs with their own separate configurations, i.e., MGL, MGRP, time offset.
	+ Option 1b: (CMCC)
		- Multiple MGs with their own separate configurations, i.e., MGL, MGRP, time offset, MGTA.
	+ Option 2: (NEC)
		- Measurement gaps are considered as independent if UE can measure on these gaps simultaneously without impacting the measurement performance requirements of each MG .
	+ Option 3: (Intel, E///, vivo, CATT)
		- The definition of independent MG is unnecessary
* Recommended WF
	+ More discussion are needed.

**Issue 2-2: Common period of time for concurrent gap**

* Proposals
	+ Option 1a: (MTK, CATT, LGE, E///, Nokia)
		- Common period of time is the duration in which multiple gap patterns are configured in the system simultaneously
	+ Option 1b: (Intel)
		- The common period in the definition of concurrent MG [2] can be max(MGRPi). MGRPi is the measurement periodicity of $i$th induvial MG configured within these concurrent MGs**.** .
	+ Option 1c: (CMCC)
		- Common period of time is a certain value, and the exact value could be selected from MGRP, which is {20, 40, 80, 160} ms.
	+ Option 2: (NEC)
		- Common period of time is the measurement period of UE.
* Recommended WF
	+ More discussion are needed.
	+ Note that in the discussion of this phase, we do not consider pre-configured gap. Therefore a gap is already activated (or ON) once configured.

**Issue 2-3: Whether to merge the definitions of concurrent and independent gaps**

* Note: this discussion is pending on the conclusion in Issue 2-1.
* Proposals
	+ Option 1: (MTK, Xiaomi, CATT, Apple)
		- Yes, e.g., concurrent = independent
	+ Option 1a: (Huawei)
		- Yes, UE is configured with concurrent MG when it is configured with more than one independent MGs.
	+ Option 2a: (Nokia)
		- No, if the definition of each is clear and captured. For concurrent MGPs, each RRC configuration configures independent MGPs.
	+ Option 2b: (NEC)
		- RAN4 to further study and request other WG to define new capability to indicate which of the following capability is supported by UE.
			* Concurrent but not independent
			* Concurrent and independent
			* Independent but not concurrent
* Recommended WF
	+ More discussion are needed.

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

**Issue 2-4: Use case**

* Proposals
	+ Option 1: (CATT)
		- Multiple concurrent gap patterns can also be used for the case when the SMTC from different cells cannot be covered by one gap occasion due to the asynchronization
	+ Option 2: (QC)
		- Multiple concurrent MGs are not applicable when the UE is configured to perform only non-NR RAT measurements.
	+ Option 3: (E///)
		- Define a framework for configuring gaps dedicated to specific purpose(s). Consider at least the following aspects while defining rules for usage of the parallel MGPs:
			* measurement type
			* RAT
			* Periodicity of signals to be measured in MGs
			* Relation between the parameters of the parallel patterns.
	+ Option 4: (Nokia)
		- Discussion of new gap patterns and the current measurement gap applicability is not part of this WI. The WI does not include objectives related to defining gaps dedicated to specific purpose(s).
* Recommended WF
	+ More discussion are needed.

**Issue 2-5: Associate Gap to use case(s)**

* Proposals
	+ Option 1: (MTK)
		- NW shall clearly indicate at least single specific usage (MO, RS or RAT) and a type (legacy, pre-configured or NCSG) for the new gap together with measurement gap’s configuration. The max number of usages for one new gap is FFS
	+ Option 2: (QC)
		- A dedicated MG requested for NR positioning.
	+ Option 3: (Intel)
		- The concurrent gap pattern can be configured based on the legacy MeasConfig in TS38.331 with the indication of the specific measurement reservation.
	+ Option 4: (Huawei)
		- NW configures which MG is to be used for each MO.
	+ Option 5: (Nokia)
		- The WI does not include objectives related to defining gaps dedicated to specific purpose(s).
* Recommended WF
	+ More discussion are needed.

**Issue 2-6: Inheriting legacy configuration in DC**

* Proposals
	+ Option 1: (CMCC)
		- Existing configuration mechanism under DC mode can be reused:
			* In EN-DC, per-UE gap and FR1 gap are configured by MN, FR2 gap is configured by SN.
			* In NE-DC and NR-DC, per-UE gap, FR1 gap and FR2 gap are configured by MN.
* Recommended WF
	+ More discussion are needed.

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

**Issue 2-7: Relation to per-UE gap capability (UE not capable for per-FR gap)**

* Proposals
	+ Option 1: (MTK, vivo, Xiaomi, CATT, Apple, CMCC, LGE, QC, Nokia, Huawei)
		- When UE doesn’t support per-FR gap, all concurrent gaps are per-UE
* Recommended WF
	+ Agree on Option 1.

**Issue 2-8: Relation to per-FR gap capability**

* Proposals
	+ Option 1: (MTK, vivo, Xiaomi, CATT, Apple, LGE)
		- When UE supports per-FR gap, all concurrent gaps are per-FR
	+ Option 1a: (Huawei)
		- When UE supports per-FR gap, concurrent gaps are either all per-FR or all per-UE, but no simultaneous configuration of per-UE and per-FR gaps
	+ Option 2: (, QC, Nokia, Intel, E///)
		- Any combination of per-UE and per-FR gaps
	+ Option 3: (CMCC)
		- For the per-FR gap capable UE, following two cases can be supported:
			* Case 1: multiple concurrent and independent MGs can be configured as per-UE gaps and applies per UE.
			* Case 2: multiple concurrent and independent MGs can be configured as per-FR gaps and applies per FR.
* Recommended WF
	+ More discussion are needed.

**Issue 2-9: Max number of supported concurrent gap**

* Proposals
	+ Option 1: (MTK)
		- At most one additional new gap will be supported
	+ Option 2: (vivo)
		- At least 2 concurrent gaps
	+ Option 3: (OPPO)
		- At most 3 concurrent gaps
	+ Option 4: (Xiaomi)
		- For per-UE capable UE, the max number = is 2;
		- For per-FR capable UE,
			* the max number in FR1 = 2;
			* the max number in FR2 = 2;
			* the max number ern in FR1+ FR2 = 3;
	+ Option 5: (CATT)
		- When all the concurrent MGs are selected from gap pattern #0 to pattern #23, at most 3 concurrent gap patterns can be configured.
		- When one of gap #24 and #25 is used, at most 2 concurrent gap patterns can be configured
	+ Option 6: (LGE, Nokia)
		- 2 for per-UE gap
		- 2 for per-FR gap in FR1
		- 2 for per-FR gap in FR2
	+ Option 7: (Huawei)
		- UE not capable of per FR MG can be configured with up to 2 per UE MGs
		- UE capable of per FR MG can be configured with
			* Up to 2 per UE MGs, or
			* Up to 3 per FR MGs
	+ Option 8: (Intel)
		- Up to UE capability
* Recommended WF:
	+ More discussion are needed. Perhaps we need to conclude Issue 2-7 and 2-8 first?

**Issue 2-10: Applicability and UE capability for gap patterns**

* Proposals
	+ Option 1: (E///)
		- UE shall support combinations of concurrent gaps comprising any of the by UE supported MGPs.
	+ Option 2: (QC)
		- RAN4 will discuss applicability conditions that may limit the allowable combinations of MG that can be configured concurrently
* Recommended WF
	+ More discussion are needed.

### Sub-topic 2-4 Overlapping issues

**Issue 2-11: Overlapping scenarios to be studied in RAN4**

* Proposals
	+ Option 1: (MTK, Xiaomi, Intel)
		- RAN4 to start from on non-overlapping independent gap.
	+ Option 2 (CATT)
		- RAN to work on at least non-overlapping case. For overlapping case, only the cases when the concurrent gaps have different periodicity are considered. The gap offset can be same or different.
	+ Option 3 (Apple)
		- RAN4 to work on non-overlapping concurrent gaps and partially overlapped gaps.
	+ Option 4 (CMCC)
		- Except the non-overlapping gaps, it is proposed to consider partially and fully-overlapped concurrent gaps, which could reduce the impact on the data loss.
	+ Option 5 (Nokia)
		- Both non-overlapping, partially overlapping and fully-overlapped MGPs can be configured as concurrent MGPs.
* Recommended WF
	+ More discussion are needed.

**Issue 2-12: UE behaviour in collided gap durations**

* Note: this discussion is pending on the conclusion in Issue 2-9.
* Proposals
	+ Option 1: (MTK)
		- For any gap occasion that the concurrent gaps are partially or fully overlapping in their durations, they are treated as fully overlapped duration in that occasion.
		- UE will not perform the measurements on more than one frequency layers during a fully overlapped duration for concurrent gaps.
		- The new gap with a specific usage should be prioritized over legacy gap when they collide in time.
	+ Option 2: (Huawei)
		- 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.
	+ Option 3 (QC)
		- RAN4 to discuss whether a dedicated MG requested for NR positioning would be prioritized over another MG pattern that is already configured if any instances of the two MG overlap in time. e.g. the network would release the conflicting MG
	+ Option 4 (Nokia)
		- Define that the CSSF applies when concurrent MGPs are configured.
* Recommended WF
	+ More discussion are needed.

### Sub-topic 2-5 Overhead

**Issue 2-13: Whether and how to define an overhead cap**

* Proposals
	+ Option 1: (MTK)
		- The overall data dropping rate won't be larger than 30%.
	+ Option 2: (MTK)
		- The MGRPs of concurrent gaps can’t be less than 40ms
	+ Option 3: (vivo)
		- When MGs are fully nonoverlapping, not matter the offsets between individual gap patterns among a concurrent MG configuration, the overhead ratio can be calculated as: (total MGL length within X)/X, where X is the least common multiple among all MGRPs within a concurrent and multiple MG configuration.
		- When MGs are overlapping, not matter the offsets between individual gap patterns among a concurrent MG configuration, the overhead ratio can be calculated as: [(total MGL length – total overlapping period) within X]/X, where X is the least common multiple among all MGRPs within a concurrent and multiple MG configuration.
	+ Option 4: (Apple)
		- RAN4 to specify a cap on aggregate fractional interruption time as applicability condition for multiple concurrent MG patterns. One possible option is to define it as the maximum MG overhead according to the supported single MG pattern
	+ Option 5: (NEC)
		- 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”
	+ Option 6: (QC)
		- RAN4 to discuss whether to specify a cap on aggregate overhead of multiple concurrent MGs. RAN4 should first discuss which measurement objectives warrant configuring multiple concurrent MG.
		- When multiple concurrent per-FR MGs are configured, MG overhead should be calculated per FR and limits on MG overhead, if any, should be applied per FR
	+ Option 7: (Nokia)
		- RAN4 need to identify any UE constraints related to network configuration of concurrent MGPs. and use such when defining the applicability of concurrent MGPs.
		- UE restriction related to configuration of concurrent MGPs should be reflected in the applicability of the UE requirements defined for when UE is configured with concurrent MGPs.
	+ Option 8: (CATT, Intel, Huawei)
		- No. Up to network configuration
* Recommended WF
	+ More discussion are needed.

### Sub-topic 2-6 Measurement requirements

**Issue 2-14: Re-using legacy requirements**

* Proposals
	+ Option 1: (MTK, HW)
		- Reuse the following existing MG related requirements: MG reference timing (including MGTA), effective MGRP, MG interruption and UE UL behaviour after MG.
	+ Option 2 (Nokia)
		- No changes would be needed related to the existing UE requirements.
* Recommended WF
	+ Agree on Option 1.

**Issue 2-15: Assumptions for requirements of concurrent gap**

* Proposals
	+ Option 1: (CATT)
		- The requirements are defined based on the following assumption:
			* Only one frequency layer can be measured in a single gap instance.
			* Only one type of RSs can be performed in a single gap instance.
			* One RS configuration can only be measured in one MG pattern
* Recommended WF
	+ More discussion are needed.

**Issue 2-16: CSSF**

* Proposals
	+ Option 1: (vivo)
		- When all objects cannot share one particular gap among a concurrent and multiple gap configuration, the CSSFwithin\_gap,i for these objects are not within that gap needs recalculation. The new value of CSSFwithin\_gap,i should be known by the network side as well.
	+ Option 2: (Xiaomi)
		- The CSSF with gap should be defined based on the carriers to be measured with the same measurement gap pattern.
	+ Option 3: (CATT)
		- The CSSF for concurrent gaps in non-overlapping case can reuse the definition in R16. And only the measurement object that will be measured using this gap pattern will be considered.
	+ Option 4: (Apple)
		- If each MO can only be covered by certain MG pattern (cannot be covered by other MG pattern), then CSSFwithin\_gap for each MO can be calculated independently. For other scenarios, further discussion is needed.
	+ Option 5: (Nokia)
		- Define that the CSSF applies also when concurrent MGPs are configured
	+ Option 6: (Huawei)
		- CSSF is calculated independently for each of the multiple concurrent MGs
* Recommended WF
	+ More discussion are needed.

### Sub-topic 2-7 Others

**Issue 2-17: Gap validation delay**

* Proposals
	+ Option 1: (Nokia)
		- The UE shall apply the configured MGP no later than after the RRC processing delay
* Recommended WF
	+ More discussion are needed.

## Companies views’ collection for 1st round

### Open issues

**Issue 2-1: Definition of independent gap**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| CMCC | The difference between option 1a and 1b is whether to consider MGTA. We would like to know companies’ view on the scenario that two gaps with same MGL, MGRP, time offset, and only MGTA is different, whether these two gaps are considered as independent MG or not? For option 3, we have one question for clarification, if the 2 gaps are for the same purpose, e.g. both are for SSB based measurement, whether need to consider the definition of independent MG? |
| Apple | Support option 1.To CMCC, the example (that two gaps with same MGL, MGRP, time offset, and only MGTA is different) refers to ‘almost’ fully overlapped scenario. We are just wondering in what scenario network would configure two MG patterns in such way. In our view this is more or less the same with one single MG pattern with longer MGL (we assume UE only needs to measure one target cell in such overlapped MG occasion).Regarding option 3, actually we are negative on separate definition for concurrent MG and independent MG. in this meeting, we propose to merge these two definitions. |
| MTK | Support Option 1a and 1b.We have no strong view on MGTA. If there is a use case, we are fine to include it. We think one purpose of this whole discussion is to provide a guidance to RAN2 on how the signaling of the new gap can be designed. If RAN4 can agree that the RRC configurations for the 2 (or more) concurrent gaps are independent and separate, it should be some good information to RAN2 to avoid unnecessary discussions. In this case, although the independent gap definition may not really have an impact on RAN4 requirement, it is still preferred to make the definition clear. |
| LG Electronics | Support option 1a. For CMCC’s question on MGTA, we think that it is not possible configuration with same MGL, MGRP, time offset, and only different MGTA. Because, the configuration of MGTA is defined per FR. |
| CATT | Support option 3. No need to have the definition of independent MG. Since each MG is configured individually, they can be considered independently as long as it is configured. All we need to consider is whether the concurrent MGs are overlapped or not. After the overlapping cases are considered and decided, the gap configuration will be clear. For example, if the fully overlapping case is not included in the requirement, then all the concurrent gaps will be independent and no need separate definition.  |
| vivo | Our intention is in the end the BS and UE can identify one particular gap pattern among concurrent gap patterns without any ambiguity, actually this is align with option 1. Following above discussion if there are two fully overlapping gap patterns, it is still possible to configure these two gap patterns as the concurrent gap pattern unless this case is clearly precluded. Under this scenario, “individual/component gap pattern” is a better wording compared with “independent”  |
| Ericsson | Option 3.We suggest to merge the discussion on issue 2-1 and 2-3.The definition of ‘Concurrent and independent gaps’ can be ‘UE configured with concurrent MGs when it is configured with more than one independent MGs’. |
| OPPO | Support option 1a. We think independent gap should be also defined from configuration’s perspective. For MGTA, the feasibility needs to be further discussed.  |
| Intel | Support Option 3. Actually all the configured MGs support the concurrent measurements can be defined with the different MG parameters (e.g. MGL, MGRP) separately. They are obviously “independent”. The extra definition of “independent MG” is redundant and misleading. Also for the clarifications on Option 1a,1b,2, does they support to introduce the” independent gap” ? |
| Nokia | To progress the work, we suggest following:When considering concurrent MGPs, each separate RRC configuration which configures a MGP, each such MGP will be regarded as independent MGPs.Hence, the understanding of ‘independent’ more a combination of options 1a, 1b and 3 and any newly configured MGP would be regarded as independent – irrespective of the parameters (e.g. MGL, MGRP etc.). With such agreement RAN4 would not need any definition of ‘independent’ while assuming that any concurrent active MGPs is independent. |

**Issue 2-2: Common period of time for concurrent gap**

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| --- | --- |
| **Company** | **Comments** |
| CMCC | We agree with option 1a, but we think option 1a is not enough, and more clarification is needed to be differentiated from legacy R15/16 MG mechanism. In our understanding, the common period is the time over which UE can see at least 2 gaps per-UE or per-FR. We agree that the total time that UE can see at least two gaps per-UE or per-FR is the duration in which multiple gap patterns are configured. From this point of view, we agree with option 1. But we think option 1 is not enough, and more clarification is needed to be differentiated from legacy R15/16 MG mechanism. As shown in figure 1, 2 gaps are configured, but in each MGRP, there is only one gap instance. In our understanding, this case is same as the legacy MG mechanism considering that MG can be changed by reconfiguration as shown in figure 2. We would like to firstly check companies’ views whether it is the right understanding to consider the case shown in Figure 1 as legacy MG mechanism (as shown in Figure 2). If so, it is better to preclude the case in the definition of current gaps. As for how to reflect this in the definition, we propose option 1c, but we are open to have further discussion. |
| Apple | We are not sure if we need to explicitly define “common period” in our spec. however, for better understanding it would be good that companies have common understanding on that. In our view the two MG patterns can be configured either together in one RRC or separately in two different RRC commands. Thus it would be more precise to focus on MG status rather than MG configuration, such as “Concurrent MGs refers to the operation wherein there are multiple **active** MG patterns for a UE” Regarding CMCC’s question, we are not sure if we are on the same page of MGRP in this objective. In our understanding MGRP#1 represents the repetition period of Gap1, which shall be equal to MGRP1+MGRP2 shown in the figure. In figure 2 why Gap1 and Gap2 are configured twice? Maybe we didn’t correctly get the point here. |
| MTK | Support Option 1. Regarding ‘configured’ or ‘activated’, we believe that they are essentially the same if we do not consider pre-configured gap in the 1st phase.Regarding CMCC’s question, this seems belong to legacy Rel-15 mechanism, e.g., using RRC reconfiguration to change MGL and MGRP. It should be precluded in this Rel-17 discussion. |
| LG Electronics | Support Option 1a.For CMCC’s understanding, we have different view. 2 concurrent gaps can be configured and activated independently each other. Therefore, in CMCC’s figures, same MGRP (MGRP1 + MGRP2) can be configured instead of MGRP1 and MGRP2 for MG1 and MG2. |
| CATT | Support option 1a. For CMCC’s question, we think the figure 1 belongs to concurrent gap discussed in R17 which is non-overlapping case. And we share the same view as Apple that the repetition period of MGL1 should be (MGRP1 + MGRP2) in the figure. And if only Gap1 and Gap2 in the figure are configured, based on option 1a, the common period is from the time that the Gap2 is configured to the time that Gap1 or Gap2 is released. In order to address the possible joint discussion with pre-configured gap, we can accept to modify the wording in option 1a from ‘configured’ to ‘activated’.  |
| vivo | Ok with option 1a |
| Ericsson | Option 1a.It’s very directly to define the common period of time as ‘when UE is configured with more than one MGP’.The same view as Apple on CMCC’s question.In Fig 1., if two MGPs are configured together, then it shall be activated at the same time, so MGRP1 and MGRP2 shall be overlapped in time(MGRP2 is shorter than MGRP1). This scenario belongs to the new concurrent gap configuration.In Fig. 2, if two MGPs are configured sequentially, and switched ‘disable/enable/disable/enable…’ Then we don’t think more than one MGPs are simultaneously configured during a common period of time.  |
| OPPO | Support option 1 in principle. And share the similar understanding that “common period” may not be explicitly defined in the spec.Regarding CMCC’s question, this seems belong to legacy Rel-15/16 mechanism, e.g., using RRC reconfiguration to change MGL and MGRP in fig. 2. However, for fig 1, MGRPs need more clarification. |
| Intel | We support Option 1b.We can’t agree Option1a because the being configurated simultaneously doesn’t make sense. Does mean these MGs are configured by same entity? Does mean with same RRCRecnfiguation IE? For an example, the gap configuration for PRS can be quite different with other MGs which is triggered by LMF. And if these MGs shall be configured “simultaneously” , how can they be independent because of there are too strict constriction on their configuration time. Thus we prefer to justify whether there are the multiple valid (activated) MGs be a “time window” instead of a fixed time (“simultaneously”). |
| Nokia | We support Option 1a. Whether there is a strong need to explicitly define ‘common period of time’ can be discussed. However, there need to clear understanding about what concurrently configured MGPs means and in our view, this means that the network can configure the UE with more than 1 MGP simultaneously – and being active in parallel (during a period of time both gap are active). As pointed out by the moderator, assuming only RRC configuration for concurrent MGPs, any configured MGPs is active when configured. This to us mean that if the network has already configured the UE with one MGP and then later configured the UE with one additional MGP, the UE is configured with concurrent MGPs. While both are configured, they are configured during a common period of time.Regarding CMCC figure we are not sure we have the same understanding. Although it is good to raise this aspect our view is that if the UE is configured with MGP1 and MGP2 concurrently (hence configured to be active simultaneously and in parallel). Current Measurement gap configuration are according to the defined GP’s in 38.133. This objective is about configuring more than 1 MGP in parallel (which is not possible currently) but the GPs are among those already defined. |

**Issue 2-3: Whether to merge the definitions of concurrent and independent gaps**

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| --- | --- |
| **Company** | **Comments** |
| ZTE | Prefer Option 2a which is to have clear definitions for the two concepts separately. |
| Apple | Support merging concurrent and independent. We have no idea what are “Concurrent but not independent” and “Independent but not concurrent”. |
| MTK | Support Option 1 or 1a.Option 2a, although it says No, basically it aligns with Option 1 and 1a that the concept of concurrent and independent should always come together.We want to avoid option 2b which creates different variations of the configuration.  |
| LG Electronics | Support Option 1 and 1a. |
| CATT | Support option 1.  |
| vivo | Better to discuss it after the conclusion of issue 2-1 |
| Ericsson | Option 1a, Merge the definition. |
| OPPO | Yes. |
| Intel | Support Option 1. If we are agree Option 1 here, why did we need the definition of “independent gap” in issue 2-1? |
| Nokia | Based on out previous input to this discussion it may not be necessary.If RAN4 can reach agreements on the former issues we may be able to agree that what we also propose in option 2a is in the end the same as is proposed in option 1a and option 1b.However, there need to a clear understanding on what is considered concurrent and independent. |

**Issue 2-4: Use case**

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| --- | --- |
| **Company** | **Comments** |
| Apple | Option 1 and 2 are agreeable to us. |
| MTK | On top of what we agreed in last meeting, more discussions are needed on any new use case.For Option 1, SMTC offset configuration is carrier specific. Therefore, we failed to understand the scenario. Perhaps some more elaboration can help.For Option 2, we believe this is up to network configuration and how RAN4 will associate the gaps to different measurement purposes (or use cases). More discussion on the intention is appreciated.For Option 3, we need more time to understand the 4th usage. Some more elaboration can helpFor Option 4, we do not think dedicating the measurement gap to specific purpose(s) is precluded in the WID. Instead, this is a required discussion to make the feature work. Otherwise, UE and network may have different understanding on how gaps should be used. Same time, RAN4 needs this to define the expected measurement delay requirement.  |
| LG Electronics | Support Option 1.For Option 2, need more clarification for the case. Why the network does not configure multiple concurrent MGs when performing only non-NR RAT measurements? Isn’t it possible that one MG is configured for NR measurement and the other MG for non-NR RAT measurement? |
| CATT | Support option 1. The scenario in option 1 is that for asynchronous cells even if the SMTC configurations(e.g. periodicity and offset) in different cell are the same, they cannot covered by one gap occasion due to big timing offset between cells. In this case, multiple gap patterns can work to solve this issue. For option 2, we think it is NW implementation whether to configure multiple gap patterns for non-RAT measurement. There is no need to have this limitation. For option 3, more clarification is needed. Since in our understanding, we can give the possible scenarios applied for multiple gap patterns and the requirement when multiple gap patterns are configured. But whether and when to configure the multiple gap patterns should be based on NW implementation and UE request. For option 4, we think the applicability discussion should be included.  |
| vivo | In principle we are ok with option 3 however we are not sure the exactly meaning of the 4th bullet of option 3. |
| Ericsson | Option 1,2,3.There are lots of possible usages for the concurrent gaps. RAN4 shall discuss and agree which scenario(s) shall be prioritized in this release. After that, RAN4 can start the discuss on how to associate the gap to these use cases.For bullet 4 in option 3, it means RAN4 should consider the use cases to group MOs in different MGs efficiently. For example, MG1 for short SMTCs, MG2 for long SMTCs. |
| OPPO | Support option 1 and 2. For option 4, we are ok with gaps dedicated to specific purpose(s), e.g., positioning. |
| Intel | We support Option 3. But in order to avoid the back forward compatibility issue, Option 2 shall be considered  |
| Nokia | As for the use case we would consider e.g. configuring a concurrent MGP for enabling PRS measurements would be one useful case from network point of view. In this case the MGP is of course clear and the purpose (PRS) is clear assuming network configures the MGP designed only for PRS measurements. For other cases the UE will measure RS according to MGP and RS. E.g. if a certain carrier SMTC falls within a configured measurement gap, the carrier will be one candidate to be measured in that gap.Which carriers that would be candidates for being measured within a gap would be decided (as now) based on the gap configuration, SMTC configurations of the carriers and the CSSF (within gaps).If the UE is configured with concurrent MGPs the UE would in essence have more gaps to perform the measurements on the configured carriers.This means we support option 4 (based in above arguments).  |

**Issue 2-5: Associate Gap to use case(s)**

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| --- | --- |
| **Company** | **Comments** |
| Apple | Option 4 looks good. NW and UE can have common understanding on the usage of each MG pattern. |
| MTK | Option 1 is preferred.On Option 2, it is included in Option 1.Option 3 is in principle fine to us, but we would like to leave the issue of where to configure this association to RAN2Option 4 may have problem for CSI-RS based measurement which share the same MO as SSB based measurement and for PRS which is not configured in MO.On Option 5 (from Nokia), please check our comment to Option 4 in Issue 2-4. |
| LG Electronics | Option 3 is fine.  |
| CATT | Fine with option 1.  |
| vivo | Ok with option 4. |
| Ericsson | Option 1 and 4(HW’s option).We think either option is possible, but the detail signalling can be defined in RAN2.To Mediatek, we want to check how to handle the cases when different MOs have different periodicities for SMTCs?To HW, we want to further check when one MO has both CSI-RS and SSB, could CSI-RS and SSB be assigned to different MG? How to consider the backward compatibility with legacy MG and MO’s configuration? Or we just associate the MG to the MOs which will be assigned in new gap? |
| OPPO | Fine with Option 1 in principle. The dedicated usage (e.g., MO, RS, RAT or gap type) can be associated with MG configuration by network. |
| Intel | Option 1, 3 and 4 are same in principle. We are fine for all these three.  |
| Nokia | As argued in previous Issues we see one use case of concurrent MGP is for configuring MGP for PRS measurements (as suggested by QC in option 2).Currently the UE is required to perform gap assisted measurement on carriers which needs gap assistance for performing measurements.Configuration of concurrent MGPs does not seem to include discussing changing the usage compared to existing – at least it is not stated in the WID? |

**Issue 2-6: Inheriting legacy configuration in DC**

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| **Company** | **Comments** |
| Apple | Option 1 can be used as a starting point. We would like to further study if it is beneficial/feasible for other configuration. |
| MTK | Option 1 is agreeable to us. |
| LG Electronics | Option 1 is fine as starting point. |
| CATT | Fine with option 1.  |
| Ericsson | Option 1 can be used as a start point. |
| OPPO | Fine with option 1. |
| Intel | Some clarifications needed @CMCC. Does mean the multiple concurrent MGs can be applied for the E-UTRAN measurement under EN/NE DC ?  |
| Nokia | Option 1. We do not see a need for change. But this is maybe not for RAN4 to evaluate and decide. We would expect to leave the signaling and configuration related aspects to RAN2 |

**Issue 2-7: Relation to per-UE gap capability (UE not capable for per-FR gap)**

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| --- | --- |
| **Company** | **Comments** |
| Apple | Agree on option 1. |
| MTK | Agree with Option 1. |
| LG Electronics | Agree on Option 1. |
| CATT | Support option 1.  |
| Vivo | Ok with option 1 |
| Ericsson | Option 1. |
| OPPO | Agree on option 1. |
| Intel | The recommended WF can be agreeable.  |
| Nokia | Support the recommended WF |

**Issue 2-8: Relation to per-FR gap capability**

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| --- | --- |
| **Company** | **Comments** |
| CMCC | We checked the TS38.331, for *MeasGapConfig*, it is stated that per FR gap cannot be configured together with per UE gap. Based on this existing restriction, we propose option 3. But we are open to the combination of per-UE gap and per-FR gap, and we would like to know more about the use case of this combination and how UE to perform measurement based on this combination. |
| Apple | We would like to understand why NW would configure per-UE gap plus per-FR gap for the UE if it can support per-FR gap. Even though from RRC signaling point of view it may be possible, we are wondering what is the benefit of such configuration. |
| MTK | Our original proposal is Option 1, but we are fine to further discuss how to deal with gap dedicated for positioning. In our understanding UE does not have to receive or transmit data during positioning gap. This makes positioning gap somehow a per-UE gap. |
| LG Electronics | Support Option 1. For Option 2, same view with Apple. |
| CATT | Support option 1. First, from the current RAN2 spec, per-UE gap and per-FR gap cannot be configured simultaneously. Second, share the same view with Apple that NW is no need to configure per-UE gap when per-FR is supported.  |
| vivo | Ok with option 1 |
| Ericsson | Option 2.To Apple,A useful scenario is when UE supports per-FR gap, and FR1 and FR2 SMTC are configured as partially overlapping or fully overlapping in time domain, NW may only configure per-UE gap to measure these MOs. After that, when there are some new inter-RAT MOs need to be measured, NW may only need a per-FR1 gap to measure these MOs instead of a per-UE gap.Positioning gap is another use case, especially the gap #24, 25 which had to be a per-UE gap. Once NW want to configure another gap, a per-FR gap is possible. |
| OPPO | Whether per-UE and per-FR gap are allowed to be configured simultaneously, needs to be decided. From our side, option 1a is fine. R15/R16 principle can be followed that no simultaneous configuration of per-UE and per-FR gaps to avoid incompatibility of UE and network. |
| Intel | We support Option 2. E.g. it is possible to config 1 per-UE gap and 1 per-FR gap. |
| Nokia | Option 2. We should follow the baseline. A UE supporting Per-FR UE also support Per-UE MG configurations and it is up to network configuration strategy which approach to use. |

**Issue 2-9: Max number of supported concurrent gap**

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| --- | --- |
| **Company** | **Comments** |
| Apple | Support option 4. Open to further discussion. |
| MTK | If the conclude in Issue 2-7 for per-UE gap case is Option 1, then we think the max number 2 can be agreeable to the group.For per-FR gap case, we need to conclude Issue 2-8 first. |
| LG Electronics | Support Option 6. For Option 4, we have one question for clarification of the max number in FR1+FR2 = 3. Does it mean either FR1 or FR2 is configured with multiple gaps?  |
| CATT | As multiple measurement types and reference signals to be measured in NR, we suggest 3 gap patterns are considered.  |
| Ericsson | We think the discussion on the max supported number for concurrent gaps will result in some misunderstanding on each company’s view and not reflect the supported combinations from each company. We suggest to discuss the potential combinations other than the overall number.

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| --- | --- | --- | --- | --- |
|  | Index | Per-FR1 | Per-FR2 | Per-UE |
| Legacy Gap | 0 | 1 | 1 | 0 |
|  | 1 | 0 | 0 | 1 |
| Concurrent Gaps | 2 | 2 | 1 | 0 |
|  | 3 | 1 | 2 | 0 |
|  | 4 | 0 | 0 | 2 |
|  | 5 | 1 | 0 | 1 |
|  | 6 | 0 | 1 | 1 |
|  | 7 | 1 | 1 | 1 |
|  | 8 | 2 | 2 | 0 |

From Ericsson’s perspective, we support all these 9 combinations.  |
| OPPO | Support option 1,3 and 7. We support at most 3 concurrent MGs regardless of the applicability. In detail, we proposed two cases as below.Case 1: Assuming per UE and per FR gaps are independent, and are allowed to be configured in parallel, the following cases could be allowed:* 1 per UE gap + 2 per FR gap (i.e., per FR1 and/or per FR2 gap)
* 2 per UE gap, only 1 per FR1 or per FR2 gap

Case 2: Assuming per UE and per FR gaps are not independent, and are not allowed to be configured in parallel, the following cases could be allowed:* 2 Per FR1 gap + 1 per FR2 gap
* 1 Per FR1 gap + 2 per FR2 gap
* 2 Per UE gap
 |
| Intel | In our understanding, the bottle neck of multiple MGs is in the NW. That is the too many configured concurrent MGs will increase the overhead of NW (NW can’t schedule data within the gap). So such requirements on UE is unnecessary. But we are also fine to FFS on this number.  |
| Nokia | We prefer Option 6.  |

**Issue 2-10: Applicability and UE capability for gap patterns**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Support Option 1, or else some combinations will be introduced and will complicate things. |
| Apple | Option 1 is not that straightforward for us. For instance, if UE can support GP#4 (MGL=6ms, MGRP=20ms), it doesn’t mean UE has to support two GP#4 with different time offset (MG overhead would become 60%). |
| MTK | Support Option 1.To Apple’s comment, we can separate the overhead discussion from Issue 2-10, e.g., further limitation can be considered if an overhead cap is agreed. |
| LG Electronics | Support Option 1 including MG offset in addition to the UE supported MGPs. |
| CATT | Fine with 1.  |
| Vivo | Ok with option 1 |
| Ericsson | Option 1.All the combinations are possible from the NW’s view.  |
| OPPO | FFS. How to limit offset configuration to avoid MG overhead should be considered. |
| Intel | Support Option1 |
| Nokia | Option 1 is preferred. However, we would like to understand if there would be any UE restrictions. |

**Issue 2-11: Overlapping scenarios to be studied in RAN4**

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| --- | --- |
| **Company** | **Comments** |
| CMCC | Multiple concurrent MG patterns, especially non-overlapping case will further degrade the throughput. While the overlapped MG could reduce the impact on data loss introduced by multiple MG. Based on above consideration, we support to consider the partially and fully-overlapped cases. |
| ZTE | Support Option 4 to consider all cases based on similar thinking as CMCC. |
| Apple | Maybe we need a definition (at least used for discussion) for “partially overlapped” and “fully-overlapped” to move forward. In our current understanding, “fully-overlapped” mean one of the multiple active MG patterns can be fully covered by another one. If this is the common understanding, we don’t know why network has to configure the fully-overlapped MG pattern.one thing we would like to highlight is that the impact on system throughput is determined by actual MG overhead, rather than whether the patterns are overlapped or not. Non-overlapping case doesn’t always result in higher data loss. For instance, two non-overlapping GP#11 with different time offset actually have smaller data loss compared with two partially overlapped GP#0. |
| MTK | Option 1 is our first preference, but we also open to consider partially overlapping case. For fully overlapping case, we have similar question as Apple on the benefit and intention of such a configuration. |
| LG Electronics | Support Option 1 and Option 2. However, overlapping case is open to us. For overlapping case, we need to consider the expected issues and work load to complete in Rel-17.For Option 2, partially overlapping case can occur when the concurrent gaps have same periodicity and different gap offset.  |
| CATT | Support option 2. Agree that we should have a common understanding on the partially and fully overlapped cases. Since from our contribution, it will have two cases for partially overlapped case. One is that when two gap patterns have the same periodicity and different offset, then all the gap occasions will be partially overlapped. And the other case is that when two gap patterns have different periodicity and the same offset, then part of gap occasion will be fully overlapped.  |
| Ericsson | Option 1.We also agree with Apple to clarify the definition on ‘fully non-overlapping’, ‘partially overlapping’ and ‘fully overlapping’. |
| OPPO | Option 1 is fine. MG overhead should be also considered. |
| Intel | Prefer to prioritize the non-overlapping cases.  |
| Nokia | Initially it would be best for RAN4 to have common understanding on what fully, partially and partially partial overlapping cases cover. Non-overlapping (fully) should be clear. Once this is clarified RAN4 base is better for the continued discussion.Our initial thinking was based on the Rel-15 measurement gap discussion. But some companies pointed out that for concurrent gaps we have a new scenario (as we have concurrent gap which is different than Rel-15 discussion). In the new scenario (colliding gaps in Issue 2-12) the concurrent gap could in theory overlap in time domain leading to partial overlap of the MGs.Option 5. |

 **Issue 2-12: UE behaviour in collided gap durations**

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| **Company** | **Comments** |
| Apple | Support option 2. |
| MTK | We are also fine with Option 2. For clarification, the sharing rule is not necessary a sharing factor. We kind of prefer to define simple rule, such as priority.  |
| LG Electronics | Support Option 2 |
| CATT | Option 2 can be a starting point, but we have one question for the first bullet, when UE performs measurement in MGL of one gap occasion whether the RF tuning time of the other overlapped gap should be considered.  |
| Ericsson | We support the following wording in option 1 and 2.* For any gap occasion that the concurrent gaps are partially or fully overlapping in their durations, they are treated as fully overlapped duration in that occasion.
* UE will not perform the measurements on more than one frequency layers during a fully overlapped duration for concurrent gaps.

UE is assumed to measure only in MGL of one MG in occasions where two MGs are overlapped.  |
| CATT | Option 2 can be a starting point, but we have one question for the first bullet, when UE performs measurement in MGL of one gap occasion whether the RF tuning time of the other overlapped gap should be considered.  |
| Intel | When there are collision among the MGs, RAN4 can’t define any prioritization rules but the gap sharing requirements. So we prefer the Option 2. For Option 1 and 3, how are the measurement objects prioritized is out of RAN4 scope.  |
| Nokia | Initially, RAN4 would need to understand what ‘colliding gap’ is. Does it mean that two gaps collide fully? Collide partially? Collide in other ways?We agree to define applicability for the case when MGs may collide once RAN4 has clear view on colliding gaps.If e.g. RAN4 define that if Mgs collide UE only measure according to one of the GPs. And in this case we see that current CSSF can be applied for gap sharing rules and there would not be a need for further rules. This is also related to next Issue 2-13. |

**Issue 2-13: Whether and how to define an overhead cap**

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| --- | --- |
| **Company** | **Comments** |
| Apple | Support option 4. |
| MTK | Given that this overhead can always be controlled by network, we believe that Option 8 is what we have as the starting point for now. The additional discussion that we should have is on the additional benefit or any UE implementation limitation to introduce an overhead cap. At least in our view, it helps to reduce the gap pattern combinations that UE needs to implement for concurrent gap. If there is any combination of gap patterns that we can identify as no benefit, it is highly suggested to preclude it in the spec. If the need to introduce the cap is justified, RAN4 can further discuss the values. |
| LG Electronics | There are many options. At first focus the allowed overall data dropping rate as option 1. After that, discuss other options. |
| CATT | Support option 8.  |
| vivo | Support to define overhead cap and ok with option 3 |
| Ericsson | Option 8.We don’t think it’s necessary to define an overhead in spec. NW can control the overhead by itself. |
| OPPO | Agree with option 6 in principle.  |
| Intel | Support Option 8 because the measurement gap was fully under NW’s control.  |
| Nokia | We are fine to support Option 8. However, we also believe Option 7 is important. Which would mean that it is up to network configuration assuming network account any identified UE configuration constraints. |

**Issue 2-14: Re-using legacy requirements**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Option 1 is OK. |
| MTK | Support Option 1, which is more specific than Option 2. On Option 2, we think the changes may be possible on measurement period requirement if partial overlapped case is agreed. |
| LG Electronics | Support Option 1. |
| CATT | Option 1 is generally OK, but whether the following clarification should be added?* Reuse the following existing MG related requirements for each gap pattern: MG reference timing (including MGTA), effective MGRP, MG interruption and UE UL behaviour after MG.
 |
| Ericsson | Option 1 |
| OPPO | Option 1 can be as baseline. |
| Intel | Support Option 1 |
| Nokia | We believe we agree on the principle of re-using requirements when feasible. But as this is early in the WI we may not have to agree on re-using all legacy requirements. Anyway, we agree that we can re-use existing MG patterns and gap pattern configurations in 9.1.2-1. We can likely also agree on re-using the applicability rules in 9.1.2-2. We prefer to more specific regarding when we agree agreeing on re-using existing requirements. Hence, Option 1 should be more specific. |

**Issue 2-15: Assumptions for requirements of concurrent gap**

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| --- | --- |
| **Company** | **Comments** |
| MTK | We are fine with Option 1.This should help to provide the guidance in the following discussion for measurement delay requirements and CSSF. |
| LG Electronics | Support Option 1. |
| CATT | Support option 1.  |
| vivo | Ok with option 1 |
| Ericsson | It’s too early to have such conclusions. We think it should be FFS in current stage.Especially for ‘One RS configuration can only be measured in one MG pattern’, it seems we should agree to preclude the use case for SMTCs with different periodicities in different MGs. |
| Intel | Support Option 1 and recommended WF |
| Nokia | We assume no changes to the existing assumptions. Hence, UE is only assumed to measure one carriers (Object) within each MG. It is not clear why bullet 2 is needed? E.g. if measuring LTE UE can receive both CRS and sync signal with 5ms. |

**Issue 2-16: CSSF**

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| --- | --- |
| **Company** | **Comments** |
| Apple | Support option 4. |
| MTK | We need to set up a clear rule on how each MO (or usage) is associated to different measurement gap and perhaps how we resolve priority for the overlapping case. We are only ready to start the CSSF discussion after concluding these pre-requisite discussions. |
| CATT | Support option 3.  |
| vivo | Agree with MTK that the issue can be discussed after the linkage between MO and gap patterns are more clear.  |
| Ericsson | RAN4 shall start with non-overlapping case firstly.We can discuss CSSF later after we have clear understanding on the scenarios. |
| Intel | How to define CSSF shall consider the other issue above (e.g. 2-9, 2-11) . It can be FFS. |
| Nokia | Seems views are different. We still support our proposal and we can return once we have further agreement on some of the higher level aspects. E.g. if concurrent GMPs are just regarded as any GP the final GP can be used to determine the gap sharing among the measured carriers according to CSSF. |

**Issue 2-17: Gap validation delay**

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| --- | --- |
| **Company** | **Comments** |
| Apple | Option 1 is OK if we don’t consider this together with pre-configured MG. |
| MTK | Option 1 is fine to us. Same view as Apple. |
| CATT | More clarification is needed.  |
| Ericsson | Option 1. |
| Intel | For legacy MG configuration, the gap shall be valid after UE successfully received RRCReconfig. So Option 1 is true. But what’s the motivation of such discussion here?  |
| Nokia | To Apple and MTK – our understanding is that this discussion is only about RRC based configuration. We can discuss further when we start discussing pre-configured MGPs. To CATT: what we propose is that when the network configures the concurrent MGP the GP should be applied by the UE according to the time the takes for processing the RRC command. |

### 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.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Notes:

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

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

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