**3GPP TSG-RAN WG4 Meeting #113 R4-2420212**

**Orlando, US, 18th – 22nd November, 2024**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
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|  | **38.133** | **CR** | **4998** | **rev** | **2** | **Current version:** | **18.7.0** |  |
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| *For* ***[HE](http://www.3gpp.org/3G_Specs/CRs.htm%22%20%5Cl%20%22_blank)******[LP](http://www.3gpp.org/3G_Specs/CRs.htm%22%20%5Cl%20%22_blank)*** *on using this form: comprehensive instructions can be found at <http://www.3gpp.org/Change-Requests>.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network |  |

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| ***Title:***  | (NR\_MG\_enh2-Core) CR on core requirements of Rel-18 gap enhancements |
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| ***Source to WG:*** | CATT, CMCC, Nokia, Ericsson |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_MG\_enh2-Core |  | ***Date:*** | 2024-11-06 |
|  |  |  |  |  |
| ***Category:*** | F |  | ***Release:*** | Rel-18 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
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| ***Reason for change:*** | 1. In Rel-18 positioning, CPP measurements are introduced and they should be also included in the applicability of measurement gaps.
2. Concurrent gap with NCSG requirements can also be used for intra-frequency measurement which is missing in the specification.
3. CSI-RS based measurement can only be associated with MG.
4. Whether the UE supports *concurrentMeasGapsPreMG-r18* only decide whether the configured gap can be Pre-MG but not relevant to NCSG. So the note 2 in Table 9.1.12-1 should not limit the configuration of NCSG. The same issue exists in Table 9.1.13-1.
5. In RAN4 #111 meeting, UE behaviors for performing deactivated SCell measurement within NSCG are agreed as following.
* For UE configured with one NCSG and one Type 1/2 MG: All deactivated SCells are measured within NCSG, regardless of the reported UE capabilities [and gap association]
* For UE configured with 2 NCSG, deactivated SCells are measured with NCSG
	+ If the association is provided, deactivated SCells are measured with NCSG according to gap association.
	+ If the association is not provided, UE is not expected to cause interruption outside the VIL due to measurement on any of the deactivated SCells, and the existing measurement delay requirement does not apply to this case.
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| ***Summary of change:*** | 1. Add CPP measurements into the applicability of measurement gaps.
2. Add intra-frequency measurement into concurrent MG with NCSG requirements.
3. Correct the gap association for CSI-RS based measurement.
4. Correct the note 2 in Table 9.1.12-1 and Table 9.1.13-1.
5. Clarify the UE behaviors for performing deactivated SCell measurement within NSCG.
6. Some other typo corrections.
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| ***Consequences if not approved:*** | The requirements for measurement gap enhancements are incomplete.  |
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| ***Clauses affected:*** | 9.1.12, 9.1.13 |
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|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

# <Start of Change 1>

### 9.1.12 Concurrent measurement gaps with Pre-MG

#### 9.1.12.1 Introduction

When UE supports *concurrentMeasGapsPreMG-r18* capability, network can provide multiple measurement gap patterns with at least one of the measurement gaps is pre-configured measurement gap (Pre-MG) pattern configured by RRC message(s) as specified in TS 38.331 [2]. Requirements in this clause apply when the UE is in SA operation mode.

#### 9.1.12.2 Requirements

If the UE requires measurement gaps and/or Pre-MGs to identify and measure intra-frequency cells and/or inter-frequency cells and/or inter-RAT E-UTRAN cells, and the UE supports *concurrentMeasGapsPreMG-r18* but does not support independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements in the following clauses to apply, the network can provide the UE with not more than two per-UE measurement gap patterns for monitoring all the frequency layers.

If the UE supports both *concurrentMeasGapsPreMG-r18* and independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements defined for concurrent measurement gaps with Pre-MG to apply, the network can provide the measurement gap pattern combinations specified in Table 9.1.12.1 for monitoring of all frequency layers.

Table 9.1.12-1: The number of Gap Combination Configurations by UE supporting both *concurrentMeasGapsPreMG-r18* and independent measurement gap patterns

|  |  |
| --- | --- |
| Gap CombinationConfiguration Id  | The number of simultaneous configured measurement gap patterns |
| Per-FR1 measurement gap | Per-FR2 measurement gap | Per-UE measurement gap |
| 0 | 2 | 1 | 0 |
| 1 | 1 | 2 | 0 |
| 2 | 0 | 0 | 2 |
| 3Note 1 | 1 | 0 | 1 |
| 4Note 1 | 0 | 1 | 1 |
| 5Note 1 | 1 | 1 | 1 |
| 6 | 2 | 0 | 0 |
| 7 | 0 | 2 | 0 |
| Note 1: Gap Combination Configuration Id #3, #4, #5 are only applicable when the per-UE measurement gap is associated to measure PRS for any RSTD, PRS-RSRP, RSCP, RSCPD, UE Rx-Tx time difference measurement and PRS-RSRPP measurement defined in TS 38.215 [4].Note 2: For UE capable of *concurrentMeasGapsPreMG-r18*, up to 2 measurement gap patterns can be configured as Pre-MG in one FR, regardless of whether they are per-UE or per-FR configuration. Otherwise, the gaps can only be configured as Gap(s) configured via *GapConfig* without suffix or Gap(s) configured via *GapConfig-r17* without *preConfigInd-r17*.Note 3: In Gap Combination Configuration Id #0, #1, #6, #7, one per-FR measurement gap in an FR can be associated to measure PRS for any RSTD, PRS-RSRP, PRS-RSRPP, RSCP, RSCPD and UE Rx-Tx time difference measurement defined in TS 38.215 [4] provided that UE supports *independentGapConfigPRS-r17*. |

When the UE supports *concurrentMeasGapsPreMG-r18*, the gap association for a frequency layer is configured by the network via *associatedMeasGapSSB-r17* or *associatedMeasGapCSIRS-r17* in the corresponding MO(s) or via *gapAssociationPRS-r17* in *GapConfig-r17*. In this case the gap association rules in clause 9.1.8.2 shall also apply to either measurement gap or Pre-MG.

When autonomous mechanism [2] is used for activation/deactivation of Pre-MG pattern, the UE shall autonomously determine the Pre-MG status only based on the measurement objects associated with the concerned Pre-MG. The related Pre-MG autonomous activation/deactivation mechanism is specified in clause 9.1.7.3.1.

When network-controlled mechanism [2] is used for activation/deactivation, the requirements specified in clause 9.1.7.3.2 apply.

When UE supports *concurrentMeasGapsPreMG-r18*, where at least one of the concurrent gaps is Pre-MG, applicable measurement gap patterns are listed in Table 9.1.2-1, and their applicability based on measurement and serving cell configurations is specified in Table 9.1.2-3.

The requirements in clause 9.1.2 are applicable for the UE, capable of *concurrentMeasGapsPreMG-r18* and configured with multiple concurrent measurement gap patterns, within each activated Pre-MG occasion.

#### 9.1.12.3 Collisions involving Pre-MG(s)

A collision between occasions of two measurement gaps where the higher priority gap is a Pre-MG and the lower priority gap may or may not be a Pre-MG is called as dynamic collision.

For a UE that supports *dynamicCollision-r18*:

- Collisions between a Pre-MG and a measurement gap may occur only when the Pre-MG is activated.

- Collisions between two Pre-MGs may occur only when both Pre-MGs are activated.

When the collision between a Pre-MG and a measurement gap or two Pre-MGs satisfy the collision rule defined in clause 9.1.8.3, the UE shall perform measurements in the occasion of the non-dropped gap except the scenario specified in clause 9.1.12.5.

For a UE that does not support *dynamicCollision-r18*:

- Collisions between a Pre-MG and a measurement gap or two Pre-MGs may occur when the collision rule defined in clause 9.1.8.3 is satisfied, regardless of the Pre-MG activation status. .

When the collision between a Pre-MG and a measurement gap or two Pre-MGs satisfy the collision rule defined in clause 9.1.8.3, the UE shall perform measurements in the occasion of the non-dropped gap regardless of whether it collides with the Pre-MG activation or deactivation procedure.

The requirements for *concurrentMeasGapsPreMG-r18* apply provided that the two measurement gaps colliding with each other are configured with different priorities.

No collisions can occur between a per-FR Pre-MG and a per-FR measurement gap when they are configured in different FRs.

No collisions can occur between per-FR Pre-MGs when they are configured in different FRs.

#### 9.1.12.4 Collision between Pre-MG activation/deactivation and measurement gap

The requirements in this clause apply for UE that supports *dynamicCollision-r18*.

A measurement gap occasion and a Pre-MG activation/deactivation procedure collide when the ending point of the Pre-MG activation/deactivation procedure occurs anywhere within a time period starting 4ms before the starting point of the gap occasion and ending 4ms after the ending point of the gap occasion. The ending point of the Pre-MG activation/deactivation procedure in this collision case is defined in clause 8.19.2, 8.19.3 and 8.19.4.

- When a collision occurs between a measurement gap occasion and a Pre-MG activation procedure, and the Pre-MG is configured with higher priority, the UE shall perform measurements during the measurement gap occasion and the activation of the Pre-MG is delayed until 5ms after the ending point of the measurement gap occasion.

- When a collision occurs between a measurement gap occasion and a Pre-MG deactivation procedure, and the Pre-MG is configured with higher priority, the measurement gap occasion shall be dropped.

#### 9.1.12.5 Pre-MG related requirements

A slot is interrupted by a Pre-MG if it overlaps with any occasion of the configured Pre-MG, if the Pre-MG is activated and the Pre-MG occasion is not dropped.

### 9.1.13 Concurrent measurement gaps with NCSG

#### 9.1.13.1 Introduction

When UE supports *concurrentMeasGapsNCSG-r18* capability, network can provide multiple measurement gaps with at least one of the measurement gaps is NCSG configured by RRC message(s) as specified in TS 38.331 [2].

Requirements in this section apply when the UE is in SA operation mode.

#### 9.1.13.2 Requirements

If the UE requires concurrent measurement gaps and/or NCSG to identify and measure intra-frequency cells and/or inter-frequency cells and/or inter-RAT E-UTRAN cells, and the UE supports *concurrentMeasGapsNCSG-r18* but does not support *independentGapConfig* or *ncsg-MeasGapPerFR-r17* as specified in [14], in order for the requirements in the following clauses to apply, the network can provide one per-UE concurrent measurement gap and one per-UE NCSG or at most two per-UE NCSGs for monitoring of all frequency layers.

If the UE requires concurrent measurement gaps and/or NCSG to identify and measure intra-frequency cells and/or inter-frequency cells and/or inter-RAT E-UTRAN cells, and the UE supports *concurrentMeasGapsNCSG-r18,* *independentGapConfig* and *ncsg-MeasGapPerFR-r17* as specified in [14], in order for the requirements defined for concurrent measurement gaps with NCSG to apply, the network can provide the concurrent measurement gap with NCSG combinations configurations specified in Table 9.1.13-1 for monitoring of all frequency layers.

Table 9.1.13-1: The number of Gap Combination Configurations by UE supporting concurrent measurement gap with NCSG patterns, per-FR NCSG patterns and independent measurement gap patterns

|  |  |
| --- | --- |
| Gap CombinationConfiguration Id  | The number of simultaneous configured measurement gap patterns |
| Per-FR1 measurement gap/NCSG | Per-FR2 measurement gap/NCSG | Per-UE measurement gap/NCSG |
| 0 | 2 | 1 | 0 |
| 1 | 1 | 2 | 0 |
| 2 | 0 | 0 | 2 |
| 3Note 1 | 1 | 0 | 1 |
| 4Note 1 | 0 | 1 | 1 |
| 5Note 1 | 1 | 1 | 1 |
| 6 | 2 | 0 | 0 |
| 7 | 0 | 2 | 0 |
| Note 1: Gap Combination Configuration Id #3, #4, #5 will be only applied when the per-UE measurement gap (and cannot be NCSG) is associated to measure PRS for any RSTD, PRS-RSRP, RSCP, RSCPD, UE Rx-Tx time difference and PRS-RSRPP measurement defined in TS 38.215 [4], and when the per-FR measurement gap in an FR is NCSG.Note 2: In Gap Combination Configuration Id #0, #1, #6, #7, one per-FR measurement gap in an FR (and cannot be NCSG) can be associated to measure PRS for any RSTD, PRS-RSRP, RSCP, RSCPD, UE Rx-Tx time difference and PRS-RSRPP measurement defined in TS 38.215 [4] provided that UE supports *independentGapConfigPRS-r17*.Note 3: In Gap Combination Configuration Id #0, #1, #2, #6, #7, one FR can be configured with up to 2 NCSGs, regardless they are per-UE or per-FR configured. Otherwise, the gaps can only be configured as Gap(s) configured via *GapConfig* without suffix or Gap(s) configured via *GapConfig-r17* without *ncsgInd-r17*. |

For UE configured in the SA operation mode, when monitoring of multiple inter-RAT E-UTRAN carrier frequency layers, intra-frequency NR carrier frequency layers and/or inter-frequency NR carrier frequency layers as configured by PCell using gaps, each monitored carrier frequency layer, including following measurement types:

- a measurement object with SSB based measurement,

- E-UTRA inter-RAT measurement object,

can be associated to either one concurrent measurement gap pattern or one NCSG pattern, while the following measurement types:

- a measurement object with CSI-RS based measurement,

- E-UTRAN inter-RAT RSTD measurement,

- NR PRS-based positioning measurement,

can be only associated to one measurement gap pattern. Requirements for UE capable of *concurrentMeasGapsNCSG-r18* apply provided that each frequency layer is only associated with one concurrent measurement gap or one NCSG, and at least one of the gaps is NCSG. There can be one or more frequency layers associated with each concurrent measurement gap or each NCSG. Furthermore, if the UE is not capable of *concurrentMeasGapEUTRA-r17*[2], all E-UTRAN measurement objects shall be associated with a single concurrent measurement gap or NCSG for the requirement to apply.

When UE supports *concurrentMeasGapsNCSG-r18*, where at least one of the concurrent gaps is NCSG, supported concurrent measurement gap patterns are listed in Table 9.1.2-1 based on the applicability specified in Table 9.1.2-3, while supported NCSG patterns are listed in Table 9.1.9.3-1 based on the applicability specified in Table 9.1.9.3-2.

The requirements in clause 9.1.2 are also applicable for the UE capable of *concurrentMeasGapsNCSG-r18* and configured with multiple measurement gap or NCSG patterns within each concurrent measurement gap pattern. The requirements in clause 9.1.9 are also applicable for the UE capable of *concurrentMeasGapsNCSG-r18* and configured with multiple measurement gap or NCSG patterns within each NCSG pattern.

#### 9.1.13.3 Collision involving NCSGs

Collisions between occasions of concurrent measurement gap and NCSG or of two NCSGs may occur as specified in this clause if the two occasions are

- two per-UE NCSGs, or

- two per-FR NCSGs in the same FR, or

- one per-UE NCSG and one per-UE measurement gap, or

- one per-FR NCSG and one per-UE measurement gap, or

- one per-UE NCSG and one per-FR measurement gap, or

- one per-FR NCSG and one per-FR measurement gap in the same FR.

and if the gap collision condition specified in clause 9.1.8.3 is met then the gap collision rule applies.

When the first occasion is NCSG, the ending point of the first occasion is the end of VIL2 and/or when the second occasion is NCSG, the starting point of the second occasion is the start of VIL1.The requirements with *concurrentMeasGapsNCSG-r18* apply provided that two gaps (at least one of the gaps is NCSG) colliding with each other are configured with different priorities.

# <End of Change 1>