**3GPP TSG- Meeting #109R4-2319244**

[Chicago](https://www.3gpp.org/Specification-Groups/), U.S.A., Nov. 13-17, 2023

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** |  | **Current version:** | **18.3.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **×** | Radio Access Network |  | Core Network |  |

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|  |
| ***Title:***  | draft CR on genearl aspects for MUSIM gaps and collision handling |
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| ***Source to WG:*** | vivo |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_MG\_enh2-Core |  | ***Date:*** | 2023-10-27 |
|  |  |  |  |  |
| ***Category:*** | B |  | ***Release:*** |  |
|  | *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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
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| ***Reason for change:*** | Add the general aspects of MUSIM and MUSIM collisions handling.  |
|  |  |
| ***Summary of change:*** | Requirements applicability The conditions when MUSIM requirements applyMUSIM gap priority preference indicationIntroductionPriority preference indicated by UEpriority preference orderCollision handling within MUSIM gapsIntroductionPriority based collision handling rules within MUSIM gaps“Keep” solution based collision handling within MUSIM gapsCollision handling between MUSIM gaps and legacy gapsIntroductionCollision between MUSIM gaps and gap configured via GapConfig-r17 without preConfigInd-r17 or ncsgInd-r17 (Type-2) gapsCollision between MUSIM gaps and gap configured via GapConfig (Type-1) gaps |
|  |  |
| ***Consequences if not approved:*** | The requirements of MUSIM will not be completed.  |
|  |  |
| ***Clauses affected:*** | 9.1.5; 9.1.10 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  |  |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS38.533 |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

**--- Start of change 1 ---**

#### 9.1.5.1 Monitoring of multiple layers outside gaps

For a UE supporting concurrent gaps and when concurrent gaps are configured the carrier-specific scaling factor CSSFoutside\_gap,i for measurement object *i* derived in this chapter is applied to following measurement types :

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when none of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap or the union of concurrent measurement gaps.

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when part of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap or the union of concurrent measurement gaps.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when none of CSI-RS resources for L3 measurement of this intra-frequency measurement object are overlapped by the measurement gap or the union of concurrent measurement gaps.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when all CSI-RS resources for L3 measurement of this intra-frequency measurement object are partially overlapped by the measurement gap or the union of concurrent measurement gaps.

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when none of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or the union of concurrent measurement gaps, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or the union of concurrent measurement gaps, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

For a UE supporting concurrent gaps or MUSIM gaps or both concurrent measurement gaps and MUSIM gaps, and when concurrent gaps or periodic MUSIM gaps or both concurrent and periodic MUSIM gaps are configured the carrier-specific scaling factor CSSFoutside\_gap,i for measurement object *i* derived in this chapter is applied to following measurement types :

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when none of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap or the union of concurrent measurement gaps or MUSIM gaps or the union of concurrent measurement gaps and MUSIM gaps.

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when part of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap or the union of concurrent measurement gaps or MUSIM gaps or the union of concurrent measurement gaps and MUSIM gaps.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when none of CSI-RS resources for L3 measurement of this intra-frequency measurement object are overlapped by the measurement gap or the union of concurrent measurement gaps or MUSIM gaps or the union of concurrent measurement gaps and MUSIM gaps.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when all CSI-RS resources for L3 measurement of this intra-frequency measurement object are partially overlapped by the measurement gap or the union of concurrent measurement gaps or MUSIM gaps or the union of concurrent measurement gaps and MUSIM gaps.

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when none of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or the union of concurrent measurement gaps or MUSIM gaps or the union of concurrent measurement gaps and MUSIM gaps, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or the union of concurrent measurement gaps or MUSIM gaps or the union of concurrent measurement gaps and MUSIM gaps, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

Otherwise, the carrier-specific scaling factor CSSFoutside\_gap,i for measurement object *i* derived in this chapter is applied to following measurement types:

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when none of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap.

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when part of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when none of CSI-RS resources for L3 measurement of this intra-frequency measurement object are overlapped by the measurement gap.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when all CSI-RS resources for L3 measurement of this intra-frequency measurement object are partially overlapped by the measurement gap.

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when none of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap.

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap.

- For a UE in E-UTRA-NR dual connectivity operation, NR SSB-based inter-RAT measurement object configured by the E-UTRAN PCell on an NR serving carrier

- the SSB is completely contained in the active BWP of the UE, and

- none or part of the SMTC occasions of this inter-RAT measurement object are overlapped by the measurement gap;

- Intra-frequency RSSI and channel occupancy measurement with no measurement gap on a carrier subject to CCA when SMTC and RMTC are overlapping and RMTCs are not fully overlapped with measurement gap(s).

The UE is expected to conduct the measurement of this measurement object *i* only outside the measurement gaps.

For a UE in E-UTRA-NR dual connectivity operation, if a measurement object configured by PSCell and an NR inter-RAT measurment object configured by E-UTRAN PCell are on the same serving carrier, they shall be counted as one intra-frequency measurement object, provided that they meet the measurement object merging conditions [in clause 9.1.3.2].

The number of frequency layers for SSB measurements shall include the total number of MOs with

- *ssb-ConfigMobility* configured, or

- *ssb-ConfigMobility* not configured but *csi-rs-ResourceConfigMobility* configured with *associatedSSB*.

If *ssbfrequency, smtc1, smtc2* and *ssbSubcarrierSpacing* are same in multiple MOs, the multiple MOs are counted as one SSB frequency layer.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and *smtc1* is fully overlapping with measurement gaps and *smtc2* is partially overlapping with measurement gaps, CSSFoutside\_gap,i and requirements derived from CSSFoutside\_gap,i are not specified.

The UE cell identification and measurement periods derived based on CSSFoutside\_gap,i in clauses 9.2.5.1, 9.2.5.2 and 9.10.2 may be extended for measurement objects of which the cell identification and measurement periods are overlapped with Tmeasure\_SFTD1 specified in clause 9.3.8 when no measurement gaps are provided.

The requirements in this clause apply provided that

- The SMTC on all CCs and inter-frequency layers without measurement gap in FR2 have the same offset, and one of following conditions is met

- If *smtc2* is configured on any FR2 CC,

- All CCs have the same configuration for *smtc1*, and

- All CCs configured with *smtc2* have the same configuration for *smtc2*

- If *smtc2* is not configured on any FR2 CC,

- The total number of different SMTC periodicities on all serving CCs and inter-frequency layers without measurement gap does not exceed 4

- The starting point of the first 5ms window for CSI-RS measurement as defined in clause 9.10.1 on all CCs in FR2 is same and one of following conditions is met

- If any CSI-RS resource is configured in the second 5ms window for CSI-RS measurement as defined in clause 9.10.1 on any FR2 CC,

- All CCs with CSI-RS resources only in the first 5ms window have the same CSI-RS resource periodcity, and

- All CCs with CSI-RS resources both in the first and the second 5ms window have the same CSI-RS resource periodcity

- If no CSI-RS resource is configured in the second 5ms window for CSI-RS measurement as defined in clause 9.10.1 on any FR2 CC,

- The total number of different CSI-RS resources periodicities on all serving CCs does not exceed 3Note: Longer delays for cell identification and measurement periods derived based on CSSFoutside\_gap,i in clauses 9.2.5.1, 9.2.5.2, can be expected, if the UE is configured with more than 4 different SMTC periodicities on FR2 serving carriers. The longer delay applies for the FR2 intra-frequency measurement objects with the longest SMTC periodicity/periodicities.

**--- End of change 1 ---**

**--- Start of change 2 ---**

### 9.1.10 MUSIM gaps

If the UE requires gap patterns for MUSIM purpose, such as cell identification and measurement, paging monitoring, SIB acquisition, and/or on-demand SI request of the target cell in the target network, then the network may provide one or more per-UE MUSIM gap pattern(s) for concurrent monitoring of all frequency layers for MUSIM via *MUSIM-GapConfig* [2]. The UE can be configured with no more than three periodic MUSIM gap patterns and/or one aperiodic MUSIM gap pattern for MUSIM via *MUSIM-GapConfig* [2]. The MUSIM gap patterns specified in Table 9.1.10-1 are applicable only for MUSIM operation.

The UE is not required to perform cell identification and measurement, paging monitoring, SIB acquisition, and/or on-demand SI request of the target cell in the target network that is outside the MUSIM gaps.

UE supporting MUSIM capability shall support the MUSIM gap patterns listed in Table 9.1.10-1 based on UE’s capability specified in TS38.306[14] and the applicability specified in Table 9.1.10-2.

UE determines MUSIM gap timing based on gap offset configuration from serving cell provided by higher layer signalling as specified in TS 38.331 [2].

Table 9.1.10-1: MUSIM Gap Pattern Configurations

|  |  |  |
| --- | --- | --- |
| **MUSIM Gap Pattern Id** | **MUSIM Gap Length (MGL, ms)** | MUSIM Gap Repetition Period (MGRP, ms) |
| 0 | 6 | 40 |
| 1 | 6 | 80 |
| 2 | 3 | 40 |
| 3 | 3 | 80 |
| 4 | 6 | 20 |
| 5 | 6 | 160 |
| 6 | 4 | 20 |
| 7 | 4 | 40 |
| 8 | 4 | 80 |
| 9 | 4 | 160 |
| 10 | 3 | 20 |
| 11 | 3 | 160 |
| 12 | 10 | 80 |
| 13 | 20 | 160 |
| 14 | 6 | 320 |
| 15 | 6 | 640 |
| 16 | 6 | 1280 |
| 17 | 6 | 2560 |
| 18 | 10 | 320 |
| 19 | 10 | 640 |
| 20 | 10 | 1280 |
| 21 | 10 | 2560 |
| 22 | 20 | 320 |
| 23 | 20 | 640 |
| 24 | 20 | 1280 |
| 25 | 20 | 2560 |
| 26 | 20 | 5120 |
| 27 | 10 | NA |
| 28 | 20 | NA |
| Note 1: Measurement gap pattern #27, #28 are the aperiodic gap pattern without MGRP. |

Table 9.1.10-2: Applicability for MUSIM Gap Pattern Configurations supported by the UE with NR standalone operation (with single carrier, NR CA configuration)

|  |  |  |  |
| --- | --- | --- | --- |
| MUSIM gap pattern configuration | Serving cell  | Gap Purpose | Applicable MUSIM Gap Pattern Id |
| Per-UE  | FR1, FR2, or | MUSIM Note1  | 0-13, 14-26, 27, 28 |
| MUSIM gap | FR1 + FR2 |
|  |  |
| NOTE 1: Inclusion of MUSIM procedures for per-UE MUSIM gaps only in NR single carrier, NR CA mode: MUSIM purpose which includes cell identification and measurement, paging monitoring, SIB acquisition, and/or on-demand SI request of the target cell in the target network. |

#### 9.1.10.1 Introduction

This clause contains the requirements on the UE supporting MUSIM capability, requirements in this section are applicable for UE in NR SA (including CA) operation mode.

#### 9.1.10.2 Priorities for MUSIM gaps

Prioriy levels are introduced for each periodic MUSIM gap. A UE shall request its preferred priority for all periodic MUSIM gaps when it requests MUSIM gaps via MUSIM-GapConfig-r17 [2]. The UE shall not request the same priority level for multiple periodic MUSIM gaps.The network may assign priority values to periodic MUSIM gaps that are different from the values requested by the UE. However, if the network does not retain the same relative priorities among MUSIM gaps as requested by the UE, the UE behaviour is not specified.

If the network assigns the same priority level to multiple periodic MUSIM gaps, the requirements in clause 9.1.10 do not apply. If the network assigns the same priority level to a periodic MUSIM gap and to any measurement gap(s) configured via GapConfig-r17 without preConfigInd-r17 or ncsgInd-r17, the requirements in clause 9.1.10 do not apply.

#### An aperiodic MUSIM gap, when configured, is always kept (not dropped) from UE perspective in case of collisions with other gaps, i.e. all gaps including MUSIM gaps and measurement gaps. The gap priority level of an aperiodic MUSIM gap is not configured by the the network.9.1.10.3 Collisions between different MUSIM gaps

MUSIM gap occasions are considered colliding if at least one of the following conditions is met:

- the MUSIM occasions are fully or partially overlapping in time domain, or

- the distance between the two MUSIM occasions is equal to or smaller than 4ms.

The distance between two MUSIM gap occasions is defined as the time difference between the ending point of the first occasion and the starting point of the second occasion, where the first MUSIM gap occasion occurs earlier in time than the second MUSIM gap occasion.

UE can request to use “keep solution” for collision handling among different MUSIM gaps via [corresponding RAN2 signalling]. If the usage of “keep solution” is granted, the UE keeps all colliding periodic and aperiodic MUSIM gaps irrespective of the priority of the periodic MUSIM gaps and when no measurement gap is involved in the collision.

When “keep solution” is not requested by the UE or [when “keep solution” is not granted], collisions between MUSIM gap occasions are resolved based on their assigned priorities. Collisions are resolved sequentially in order of decreasing priority, starting with the gap that has the highest priority. For each collision, the occasion of the MUSIM gap with highest priority between the colliding occasions shall be kept and the one with lower priority shall be dropped.

[The UE shall be able to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI in the corresponding NR serving cells in the slots that are not interrupted according to requirements in clause 9.1.10.5.]

#### 9.1.10.4 Collisions between MUSIM gaps and measurement gaps

MUSIM gap and measurement gap occasions are considered colliding if at least one of the following conditions is met:

- the MUSIM gap and measurement gap occasions are fully or partially overlapping in time domain, or

- the distance between any two occasions is equal to or smaller than 4ms.

The distance between two gap occasions is defined as the time difference between the ending point of the first occasion and the starting point of the second occasion, where the first gap occasion occurs earlier in time than the second gap occasion. The gap occasion can be either a MUSIM gap occasion or a measurement gap occasion.

Collisions between MUSIM gaps and measurement gaps configured via GapConfig-r17 without preConfigInd-r17 or ncsgInd-r17 with assigned priority are handled based on their assigned priorities. Collisions are resolved sequentially in order of decreasing priority, starting with the gap that has the highest priority. For each collision, the occasion of the MUSIM gap or measurement gap with highest priority between the colliding occasions shall be kept and the one with lower priority shall be dropped. Any collisions between MUSIM gaps shall be addressed as specified in clause 9.1.10.3.

Collisions between MUSIM gaps and measurement gaps gap(s) configured via GapConfig or configured via GapConfig-r17 without assigned priority are handled based on MGRP of the colliding gaps. Collisions are resolved sequentially in order of decreasing MGRP, starting with the gap that has the longest MGRP. For each collision, the occasion of the MUSIM gap or measurement gap with longer MGRP among the colliding occasions shall be kept and the rest shall be dropped. If the colliding MUSIM gap and measurement gap have the same MGRP, the requirements in clause 9 shall not apply. Any collisions between MUSIM gaps shall be addressed as specified in clause 9.1.10.3.

The UE shall be able to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI in the corresponding NR serving cells in the slots that are not interrupted according to requirements in clause 9.1.10.5

**--- End of change 2 ---**