**3GPP TSG-RAN4 Meeting #98-bis-e *R4-210xxxx***

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

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **36.133** | **CR** | **draft** | **rev** | **1** | **Current version:** | **16.9.0** |  |
|  | | | | | | | | |
| *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 | **x** | Radio Access Network |  | Core Network |  |

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| ***Title:*** | CR to remove measurement gap pattern #25 for LTE measurement in 36.133 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei, HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_pos-Core | | | | |  | ***Date:*** | | | 2021-03-23 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-16 |
|  | *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 can be 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-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | MG pattern #25 is defined as an applicable pattern for LTE RRM measurement, but it should not be applicable for LTE measurement, same as the other patterns #5,9,11 with 160ms MGRP. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Remove measurement gap pattern #25 for LTE measurement | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | No requiements for LTE measurement with pattern #25 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 8.1.2.1 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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 ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

<Start of Change 1>

#### 8.1.2.1 UE measurement capability

If the UE requires measurement gaps to identify and measure inter-frequency and/or inter-RAT cells and the UE does not support perServingCellMeasurementGap-r14 or is not configured with per serving cell measurement gaps, in order for the requirements in the following subsections to apply the E-UTRAN must provide a single measurement gap pattern with constant gap duration for concurrent monitoring of all frequency layers and RATs. If the UE requires measurement gaps to identify and measure inter-frequency and/or inter-RAT cells and the UE supports perServingCellMeasurementGap-r14 and is configured with per serving cell measurement gaps, in order for the requirements in the following subsections to apply the E-UTRAN must provide gap pattern(s) on at least each serving component carrier (per-CC) where the UE has indicated in the *perCC-ListGapIndication* IE that gaps are required. No gap pattern is required to be provided on the serving component carrier where UE has indicated in the the *perCC-ListGapIndication* IE that gaps are not required. The requirements apply if the gap on each serving cell is at least that which the UE has indicated with gapIndication in the *perCC-ListGapIndication* IE, and if the gapOffset, MGRP and MGL are the same for each serving component carrier. During the measurement gaps the UE:

During the measurement gaps the UE:

- shall not transmit any data

- is not expected to tune its receiver on any of the E-UTRAN carrier frequencies of PCell and any SCell.

- is not expected to tune its receiver on any of the E-UTRAN carrier frequencies of PCell, PSCell, and SCell.

If the UE supporting dual connectivity is configured with PSCell, during the total interruption time as shown in Figure 8.1.2.1-1, the UE shall not transmit and receive any data in SCG.

In addition, for UE supporting E-UTRA-NR dual connectivity, if MG timing advance of 0.5ms is applied, the UE:

- shall not transmit any data

- is not expected to tune its receiver on any of the E-UTRAN carrier frequencies of PCell and any SCell.

- is not expected to tune its receiver on any of the E-UTRAN carrier frequencies of PCell, PSCell, and SCell.

in subframes fully or partially overlapping with the measurement gaps on E-UTRAN serving cells. The total interruption time on E-UTRAN serving cells is (MGL+1) subframes.

When MG timing advance of 0.5 ms is not applied, in the uplink subframe occurring immediately after the measurement gap,

- if the following conditions are met then it is up to UE implementation whether or not the UE can transmit data:

- all the serving cells belong to E-UTRAN TDD;

- the measurement objects do not include any NR carrier frequency;

- if the subframe occurring immediately before the measurement gap is an uplink subframe.

- Otherwise the UE shall not transmit any data.

When MG timing advance of 0.5 ms is applied, in the uplink subframe occurring immediately after the subframe partially overlapped with measurement gap,

- it is up to UE implementation whether or not the UE can transmit data

In determining the above UE behaviour in the uplink subframe occurring immediately after the measurement gap or after the subframe partially overlapped with measurement gap,the UE shall treat a special subframe as an uplink subframe if the special subframe occurs immediately before the measurement gap.

Inter-frequency and inter-RAT measurement requirements within this clause rely on the UE being configured with one measurement gap pattern unless the UE has signaled that it is capable according to the capability interFreqNeedForGaps or interRATNeedForGaps of conducting such measurements without gaps and without interruption. UEs shall only support those measurement gap patterns listed in Table 8.1.2.1-1 and table 8.1.2.1.-2 that are relevant to its measurement capabilities. UEs supporting network controlled small gap and which have signaled that they are capable of measurements without gap but requiring NCSG, can be configured with a network controlled small gap pattern in table 8.1.2.1.3-1 on all component carrier(s) to perform inter-frequency and inter-RAT measurement.

ProSe capable UE is allowed to perform ProSe transmissions during the measurement gaps that are not used for measurements if the requirements specified in section 8 for inter-frequency and inter-RAT measurements are fulfilled.

In E-UTRA-NR dual connectivity mode, NR - E-UTRAdual connectivity mode and E-UTRA standalone mode, all gap patterns #0~11 in Table 8.1.2.1-1 can be configured for measurements of NR carriers only, and gap pattern#0, 1, 2, 3, 4, 6, 7, 8, 10 can be configured for measurements of E-UTRA carriers with the applicability as specified in Table 8.1.2.1-1.

Table 8.1.2.1-1: Gap Pattern Configurations supported by the UE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Gap Pattern Id | MeasurementGap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) | Minimum available time for inter-frequency and inter-RAT measurements during 480ms period  (Tinter1, ms) | Measurement Purpose |
| 0 | 6 | 40 | 60 | Inter-Frequency E-UTRAN FDD and TDD, UTRAN FDD, GERAN, LCR TDD, HRPD, CDMA2000 1x, inter-RAT NR |
| 1 | 6 | 80 | 30 | Inter-Frequency E-UTRAN FDD and TDD, UTRAN FDD, GERAN, LCR TDD, HRPD, CDMA2000 1x, inter-RAT NR |
| 2 | 3 | 40 | 24NOTE 1,2 | Inter-Frequency E-UTRAN FDD and TDD for cells with time difference as specified below.  inter-RAT NR |
| 3 | 3 | 80 | 12NOTE 1,2 | Inter-Frequency E-UTRAN FDD and TDD for cells with time difference according as specified below.  inter-RAT NR |
| 4 | 6 | 20 | 120 Note 1 | inter-RAT NR, Inter-Frequency E-UTRAN FDD and TDD Note 6 |
| 5 | 6 | 160 | Note 3 | inter-RAT NR |
| 6 | 4 | 20 | 72 Note 1, 5, 7 | inter-RAT NR, Inter-Frequency E-UTRAN FDD and TDD Note 6 |
| 7 | 4 | 40 | 36 Note 1, 5, 8 | inter-RAT NR, Inter-Frequency E-UTRAN FDD and TDD Note 6 |
| 8 | 4 | 80 | 18Note 1, 5, 9 | inter-RAT NR, Inter-Frequency E-UTRAN FDD and TDD Note 6 |
| 9 | 4 | 160 | Note 3 | inter-RAT NR |
| 10 | 3 | 20 | 48 Note 1, 5 | inter-RAT NR, Inter-Frequency E-UTRAN FDD and TDD Note 6 |
| 11 | 3 | 160 | Note 3 | inter-RAT NR |
| 24 | 10 | 80 | 54Note 1 | Inter-Frequency E-UTRAN FDD and TDD Note 11 |
| 25 | 20 | 160 | Note 3 | Note 11 |
| NOTE 1: When determing UE requirements using Tinter1 for GP2, 3, 4, 6, 7, 8, 10, Tinter1 = 60 for GP2, GP4, GP6, GP7, GP10 and Tinter1 = 30 for GP3, GP8 and GP24 shall be used.  NOTE 2: Void.  NOTE 3: This gap pattern can be used only for measurement of NR carriers, and Tinter is not applicable.  NOTE 4: Void  NOTE 5: Void.  NOTE 6: This gap pattern is supported by UEs which are configured to perform both E-UTRA inter-frequency measurement and inter-RAT NR measurement or supported by UEs configured to perform inter-RAT NR measurement only.  NOTE 7: When this gap pattern is used, the Tinter for E-UTRA interfrequency measurements is 48ms corresponding to the first 3ms of the 4ms gap  NOTE 8: When this gap pattern is used, the Tinter for E-UTRA interfrequency measurements is 24ms corresponding to the first 3ms of the 4ms gap  NOTE 9: When this gap pattern is used, the Tinter for E-UTRA interfrequency measurements is 12ms corresponding to the first 3ms of the 4ms gap  NOTE 10: For UE only supporting *measGapPatterns-NRonly-r16* for the corresponding gap patterns among GP2-11, the corresponding gap patterns are only applicable to measurement of inter-RAT NR.  NOTE 11: Measurement gap patterns #24 and #25 can be requested by NR PCell [38] only when the UE is configured at least with any of RSTD, UE Rx-Tx, or PRS-RSRP measurements requiring such gaps and can only be used during the corresponding positioning measurement period | | | | |

Table 8.1.2.1-2: Gap Pattern Configurations for UE supporting low density burst gap pattens

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Gap Pattern Id | MeasurementGap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) | Number of gaps per burst | Burst repetition period Tburst | Measurement Purpose |
| nonUniform1 | 6 | 40 | 13 | 1.28s | Inter-Frequency E-UTRAN FDD and TDD |
| nonUniform2 | 6 | 40 | 13 | 2.56s | Inter-Frequency E-UTRAN FDD and TDD |
| nonUniform3 | 6 | 40 | 13 | 5.12s | Inter-Frequency E-UTRAN FDD and TDD |
| nonUniform4 | 6 | 40 | 13 | 10.24s | Inter-Frequency E-UTRAN FDD and TDD |
| NOTE 1: When determing UE requirements nonUniform1, nonUniform2, nonUniform3 or nonUniform4, 60ms shall be assumed as the minimum available time for inter-frequency and inter-RAT measurements during each burst..  NOTE 2: The Gap patterns nonUniform1, nonUniform2, nonUniform3 and nonUniform4 cannot be be combined with IncMon reduced performance group | | | | | |

NOTE 1: When inter-frequency RSTD measurements are configured and the UE requires measurement gaps for performing such measurements, only Gap Pattern 0 can be used. For defining the inter-frequency and inter-RAT requirements Tinter1=30ms shall be assumed.

NOTE 2: A measurement gap starts at the end of the latest subframe occurring immediately before the measurement gap among MCG serving cells subframes. If the measurement objects include at least one NR carrier frequency, the measurement gap starts at time TMG ms if configured advanced to the end of the latest DL E-UTRA subframe occurring immediately before the configured measurement gap among MCG serving cells.

NOTE 2a: In EN-DC mode, the measurement gap starts at time TMG ms if configured advanced to the end of the latest E-UTRA DL subframe occurring immediately before the configured measurement gap among MCG serving cells subframes.

NOTE 2b: In NE-DC mode,

- if per-UE measurement gap is configured with MG timing advance of TMG ms, the measurement gap starts at time TMG ms advanced to the end of the latest NR DL subframe occurring immediately before the configured measurement gap among MCG serving cells subframes.

- if per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms and UE has NR serving cell in FR1, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest NR DL subframe occurring immediately before the configured measurement gap among MCG serving cells subframes in FR1.

- if per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms and UE doesn’t have NR serving cell in FR1, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest DL E-UTRA subframe occurring immediately before the configured measurement gap among SCG serving cells subframes.

TMG is the MG timing advance value provided in mgta according to TS 36.331 [2].

NOTE 3: MGL is the time from start of tuning to end of retuning, which is aligned between MCG and SCG.

NOTE 4: For GP0 and GP1 The total interruption time on SCG is 6 subframes for synchronous dual connectivity, and the total interruption time on SCG is 7 subframes for asyncrhonous dual connectivity. As shown in Figure 8.1.2.1-1, MCG subframes from *i+*1 to *i+*6 are included in total interruption time together with SCG subframes from *j+*1 to *j+*6 for synchronous dual connectivity and *j+*1 to *j+*7for asyncrhonous dual connectivity.

NOTE 5: For GP0 and GP1 and asynchronous dual connectivity as shown in Figure 8.1.2.1-1 (b), subframe *j* is regarded as the subframe occurring immediately before the measurement gap for SCG, similarly, subframe *j*+8 is regarded as the subframe occurring immediately after the measurement gap for SCG.

NOTE 6: For GP2 and GP3 the total interruption time on SCG is 3 subframes for synchronous dual connectivity, and the total interruption time on SCG is 4 subframes for asyncrhonous dual connectivity. The total interrupt is applied in same spirit as shown in Figure 8.1.2.1-1. I.e. For MCG subframes from *i+*1 to *i+*3 are included in total interruption time together with SCG subframes from *j+*1 to *j+*3 for synchronous dual connectivity and *j+*1 to *j+*4for asyncrhonous dual connectivity.

NOTE 7: For GP2 and GP3 and asynchronous dual connectivity as shown in Figure 8.1.2.1-1 (b) with measurement gap length 3, subframe *j* is regarded as the subframe occurring immediately before the measurement gap for SCG, similarly, subframe *j*+5 is regarded as the subframe occurring immediately after the measurement gap for SCG.

NOTE 8: nonUniform1 – nonUniform4 gap patterns are shown in figure 8.1.2.1-2. A burst repetition period Tburst is consisted of T1 and T2. During T1, UE performs measurement during the gap. During T2, UE suspends measurement gap. Both UE and eNB can assume there is no gap during T2. T1 equals to number of gaps per burst in Table 8.1.2.1-2. Tburst is configured by the higher layers.For nonUniform1 – nonUniform4 the total interruption time on SCG is same as for GP0 and GP1 for both synchronous and asynchronous dual connectivity as shown in Figure 8.1.2.1-1. For asynchronous dual connectivity as shown in Figure 8.1.2.1-1 (b), subframe *j* is regarded as the subframe occurring immediately before the measurement gap for SCG, similarly, subframe *j*+8 is regarded as the subframe occurring immediately after the measurement gap for SCG.

NOTE 9: When UE is in NE-DC, the total interruption time on SCG is MGL subframes for synchronous NE-DC, and the total interruption time on SCG is (MGL+1) subframes for asyncrhonous NE-DC. Subframe occurring immediately before the measurement gap for SCG is the latest subframe in SCG which is before and fully non-overlapped with the measurement gap, similarly, subframe occurring immediately after the measurement gap for SCG is the earliest subframe in SCG which is after and fully non-overlapped with the measurement gap.



Figure 8.1.2.1-1: Measurement GAP and total interruption time on MCG and SCG



Figure 8.1.2.1-2: Non-uniform gap pattern

A UE that is capable of identifying and measuring inter-frequency and/or inter-RAT cells without gaps shall follow requirements as if Gap Pattern Id #0 had been used and the minimum available time Tinter1 of 60 ms shall be assumed for the corresponding requirements.

A UE configured with gap pattern Id 2, 3 or 10, shall be able to detect a target cell if the sub frame #0 or #5 of the target cell begins no earlier than 500uS from the start of the measurement gap and if the sub frame #0 or #5 of the target cell ends no later than 500uS before the end of the measurement gap in case of FDD, and no later than [750]us before the end of measurement gap in case of TDD.

A UE configured with gap pattern Id 6, 7 or 8 shall be able to detect a target cell if the sub frame #0 or #5 of the target cell begins no earlier than 500uS from the start of the measurement gap and if the sub frame #0 or #5 of the target cell ends no later than 1500uS before the end of the measurement gap in case of FDD, and no later than 1750us before the end of measurement gap in case of TDD.

If the UE supporting E-UTRA carrier aggregation when configured with up to six SCCs is performing measurements on cells on PCC, inter-frequency measurements, or inter-RAT measurements, and interruption occurs on PCell or any activated SCell or both due to measurements performed on cells on an SCC with a deactivated SCell according to section 8.3, then the UE shall meet the requirements specified for each measurement in Section 8 and Section 9.

If the UE supporting E-UTRA dual connectivity when configured with a PSCell is performing measurements on cells on PCC, inter-frequency measurements, or inter-RAT measurements, then the UE shall meet the requirements specified for each measurement in Section 8 and Section 9.

A UE which indicate support for Increased UE carrier monitoring E-UTRA according to the capabilities in [2, 31] and which is capable of identifying and measuring inter-frequency and/or inter-RAT cells without gaps, shall be able to monitor maximum number of layers as defined in 8.1.2.1.1.1a, and apply the *MeasScaleFactor* [2] defining the relaxation to the requirements for the configured carriers according to section 8.1.2.1.1a.

A UE configured via LPP [24] to perform RSTD measurements requiring measurement gaps and provided with the OTDOA assistance data, which is comprising at least one PRS configuration with >6 consecutive downlink positioning subframes defined in TS 36.211 [16] in at least one cell, can be configured for performing the RSTD measurements with the following measurement gap patterns and shall not be used outside the corresponding RSTD measurement period:

- measurement gap pattern with Id 0 specified in Table 8.1.2.1-1, or

- an applicable measurement gap pattern specified in Table 8.1.2.1-3, provided the following conditions are met:

- the UE is Cat M1 or Cat M2 UE, and

- the applicability conditions are met for the UE.

Table 8.1.2.1-3: Additional Measurement Gap Pattern Configurations supported by the UE

|  |  |  |  |
| --- | --- | --- | --- |
| Gap Pattern Id | Measurement Gap Length  (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) | Applicability |
| rstd0 | 10 | 80 | NOTE 1, 2 |
| rstd1 | 10 | 160 |
| rstd2 | 10 | 320 |
| rstd3 | 10 | 640 |
| rstd4 | 10 | 1280 |
| rstd5 | 14 | 160 | NOTE 1, 2 |
| rstd6 | 14 | 320 |
| rstd7 | 14 | 640 |
| rstd8 | 14 | 1280 |
| rstd9 | 24 | 320 | NOTE 1, 2 |
| rstd10 | 24 | 640 |
| rstd11 | 24 | 1280 |
| rstd12 | 32 | 320 | NOTE 1, 2 |
| rstd13 | 32 | 640 |
| rstd14 | 32 | 1280 |
| rstd15 | 54 | 640 | NOTE 2 |
| rstd16 | 54 | 1280 |
| rstd17 | 64 | 640 | NOTE 2 |
| rstd18 | 64 | 1280 |
| rstd19 | 80 | 640 | NOTE 3 |
| rstd20 | 80 | 1280 |
| NOTE 1: For FDD, (MGL-2) shall not be larger than the required minimum number of available measurement subframes specified in Section 9 in the corresponding RSTD measurement accuracy requirements.  NOTE 2: For TDD, the number of DL subframes within the available measurement time of the measurement gap shall not be larger than the required minimum number of available measurement subframes specified in Section 9 in the corresponding RSTD measurement accuracy requirements.  NOTE 3: At least one cell in the OTDOA assistance data is configured with multiple PRS configurations | | | |

If the UE is configured with any of the measurement gap patterns specified in Table 8.1.2.1-3 for performing RSTD measurements, using of any other measurement gap pattern configured to the UE is suspended during the RSTD measurement period.

#### 8.1.2.1 UE measurement capability

If the UE requires measurement gaps to identify and measure inter-frequency and/or inter-RAT cells and the UE does not support perServingCellMeasurementGap-r14 or is not configured with per serving cell measurement gaps, in order for the requirements in the following subsections to apply the E-UTRAN must provide a single measurement gap pattern with constant gap duration for concurrent monitoring of all frequency layers and RATs. If the UE requires measurement gaps to identify and measure inter-frequency and/or inter-RAT cells and the UE supports perServingCellMeasurementGap-r14 and is configured with per serving cell measurement gaps, in order for the requirements in the following subsections to apply the E-UTRAN must provide gap pattern(s) on at least each serving component carrier (per-CC) where the UE has indicated in the *perCC-ListGapIndication* IE that gaps are required. No gap pattern is required to be provided on the serving component carrier where UE has indicated in the the *perCC-ListGapIndication* IE that gaps are not required. The requirements apply if the gap on each serving cell is at least that which the UE has indicated with gapIndication in the *perCC-ListGapIndication* IE, and if the gapOffset, MGRP and MGL are the same for each serving component carrier. During the measurement gaps the UE:

During the measurement gaps the UE:

- shall not transmit any data

- is not expected to tune its receiver on any of the E-UTRAN carrier frequencies of PCell and any SCell.

- is not expected to tune its receiver on any of the E-UTRAN carrier frequencies of PCell, PSCell, and SCell.

If the UE supporting dual connectivity is configured with PSCell, during the total interruption time as shown in Figure 8.1.2.1-1, the UE shall not transmit and receive any data in SCG.

In addition, for UE supporting E-UTRA-NR dual connectivity, if MG timing advance of 0.5ms is applied, the UE:

- shall not transmit any data

- is not expected to tune its receiver on any of the E-UTRAN carrier frequencies of PCell and any SCell.

- is not expected to tune its receiver on any of the E-UTRAN carrier frequencies of PCell, PSCell, and SCell.

in subframes fully or partially overlapping with the measurement gaps on E-UTRAN serving cells. The total interruption time on E-UTRAN serving cells is (MGL+1) subframes.

When MG timing advance of 0.5 ms is not applied, in the uplink subframe occurring immediately after the measurement gap,

- if the following conditions are met then it is up to UE implementation whether or not the UE can transmit data:

- all the serving cells belong to E-UTRAN TDD;

- the measurement objects do not include any NR carrier frequency;

- if the subframe occurring immediately before the measurement gap is an uplink subframe.

- Otherwise the UE shall not transmit any data.

When MG timing advance of 0.5 ms is applied, in the uplink subframe occurring immediately after the subframe partially overlapped with measurement gap,

- it is up to UE implementation whether or not the UE can transmit data

In determining the above UE behaviour in the uplink subframe occurring immediately after the measurement gap or after the subframe partially overlapped with measurement gap,the UE shall treat a special subframe as an uplink subframe if the special subframe occurs immediately before the measurement gap.

Inter-frequency and inter-RAT measurement requirements within this clause rely on the UE being configured with one measurement gap pattern unless the UE has signaled that it is capable according to the capability interFreqNeedForGaps or interRATNeedForGaps of conducting such measurements without gaps and without interruption. UEs shall only support those measurement gap patterns listed in Table 8.1.2.1-1 and table 8.1.2.1.-2 that are relevant to its measurement capabilities. UEs supporting network controlled small gap and which have signaled that they are capable of measurements without gap but requiring NCSG, can be configured with a network controlled small gap pattern in table 8.1.2.1.3-1 on all component carrier(s) to perform inter-frequency and inter-RAT measurement.

ProSe capable UE is allowed to perform ProSe transmissions during the measurement gaps that are not used for measurements if the requirements specified in section 8 for inter-frequency and inter-RAT measurements are fulfilled.

In E-UTRA-NR dual connectivity mode, NR - E-UTRAdual connectivity mode and E-UTRA standalone mode, all gap patterns #0~11 in Table 8.1.2.1-1 can be configured for measurements of NR carriers only, and gap pattern#0, 1, 2, 3, 4, 6, 7, 8, 10 can be configured for measurements of E-UTRA carriers with the applicability as specified in Table 8.1.2.1-1.

Table 8.1.2.1-1: Gap Pattern Configurations supported by the UE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Gap Pattern Id | MeasurementGap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) | Minimum available time for inter-frequency and inter-RAT measurements during 480ms period  (Tinter1, ms) | Measurement Purpose |
| 0 | 6 | 40 | 60 | Inter-Frequency E-UTRAN FDD and TDD, UTRAN FDD, GERAN, LCR TDD, HRPD, CDMA2000 1x, inter-RAT NR |
| 1 | 6 | 80 | 30 | Inter-Frequency E-UTRAN FDD and TDD, UTRAN FDD, GERAN, LCR TDD, HRPD, CDMA2000 1x, inter-RAT NR |
| 2 | 3 | 40 | 24NOTE 1,2 | Inter-Frequency E-UTRAN FDD and TDD for cells with time difference as specified below.  inter-RAT NR |
| 3 | 3 | 80 | 12NOTE 1,2 | Inter-Frequency E-UTRAN FDD and TDD for cells with time difference according as specified below.  inter-RAT NR |
| 4 | 6 | 20 | 120 Note 1 | inter-RAT NR, Inter-Frequency E-UTRAN FDD and TDD Note 6 |
| 5 | 6 | 160 | Note 3 | inter-RAT NR |
| 6 | 4 | 20 | 72 Note 1, 5, 7 | inter-RAT NR, Inter-Frequency E-UTRAN FDD and TDD Note 6 |
| 7 | 4 | 40 | 36 Note 1, 5, 8 | inter-RAT NR, Inter-Frequency E-UTRAN FDD and TDD Note 6 |
| 8 | 4 | 80 | 18Note 1, 5, 9 | inter-RAT NR, Inter-Frequency E-UTRAN FDD and TDD Note 6 |
| 9 | 4 | 160 | Note 3 | inter-RAT NR |
| 10 | 3 | 20 | 48 Note 1, 5 | inter-RAT NR, Inter-Frequency E-UTRAN FDD and TDD Note 6 |
| 11 | 3 | 160 | Note 3 | inter-RAT NR |
| 24 | 10 | 80 | 54Note 1,11 | Note 12 |
| 25 | 20 | 160 | Note 3 | Note 12 |
| NOTE 1: When determing UE requirements using Tinter1 for GP2, 3, 4, 6, 7, 8, 10, Tinter1 = 60 for GP2, GP4, GP6, GP7, GP10 and Tinter1 = 30 for GP3, GP8 and GP24shall be used.  NOTE 2: Void.  NOTE 3: This gap pattern can be used only for measurement of NR carriers, and Tinter is not applicable.  NOTE 4: Void  NOTE 5: Void.  NOTE 6: This gap pattern is supported by UEs which are configured to perform both E-UTRA inter-frequency measurement and inter-RAT NR measurement or supported by UEs configured to perform inter-RAT NR measurement only.  NOTE 7: When this gap pattern is used, the Tinter for E-UTRA interfrequency measurements is 48ms corresponding to the first 3ms of the 4ms gap  NOTE 8: When this gap pattern is used, the Tinter for E-UTRA interfrequency measurements is 24ms corresponding to the first 3ms of the 4ms gap  NOTE 9: When this gap pattern is used, the Tinter for E-UTRA interfrequency measurements is 12ms corresponding to the first 3ms of the 4ms gap  NOTE 10: For UE only supporting *measGapPatterns-NRonly-r16* for the corresponding gap patterns among GP2-11, the corresponding gap patterns are only applicable to measurement of inter-RAT NR.  NOTE 11: When this gap pattern is used, the Tinter for E-UTRA inter-RAT measurements as configured by NR PCell is 30ms corresponding to the first 6ms of the 10ms gap.  NOTE 12: This gap pattern is only configured by NR PCell, and the applicability is defined in Table 9.1.2-2 and Table 9.1.2-3 of TS 38.133 [50]. | | | | |

Table 8.1.2.1-2: Gap Pattern Configurations for UE supporting low density burst gap pattens

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Gap Pattern Id | MeasurementGap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) | Number of gaps per burst | Burst repetition period Tburst | Measurement Purpose |
| nonUniform1 | 6 | 40 | 13 | 1.28s | Inter-Frequency E-UTRAN FDD and TDD |
| nonUniform2 | 6 | 40 | 13 | 2.56s | Inter-Frequency E-UTRAN FDD and TDD |
| nonUniform3 | 6 | 40 | 13 | 5.12s | Inter-Frequency E-UTRAN FDD and TDD |
| nonUniform4 | 6 | 40 | 13 | 10.24s | Inter-Frequency E-UTRAN FDD and TDD |
| NOTE 1: When determing UE requirements nonUniform1, nonUniform2, nonUniform3 or nonUniform4, 60ms shall be assumed as the minimum available time for inter-frequency and inter-RAT measurements during each burst..  NOTE 2: The Gap patterns nonUniform1, nonUniform2, nonUniform3 and nonUniform4 cannot be be combined with IncMon reduced performance group | | | | | |

NOTE 1: When inter-frequency RSTD measurements are configured and the UE requires measurement gaps for performing such measurements, only Gap Pattern 0 can be used. For defining the inter-frequency and inter-RAT requirements Tinter1=30ms shall be assumed.

NOTE 2: A measurement gap starts at the end of the latest subframe occurring immediately before the measurement gap among MCG serving cells subframes. If the measurement objects include at least one NR carrier frequency, the measurement gap starts at time TMG ms if configured advanced to the end of the latest DL E-UTRA subframe occurring immediately before the configured measurement gap among MCG serving cells.

NOTE 2a: In EN-DC mode, the measurement gap starts at time TMG ms if configured advanced to the end of the latest E-UTRA DL subframe occurring immediately before the configured measurement gap among MCG serving cells subframes.

NOTE 2b: In NE-DC mode,

- if per-UE measurement gap is configured with MG timing advance of TMG ms, the measurement gap starts at time TMG ms advanced to the end of the latest NR DL subframe occurring immediately before the configured measurement gap among MCG serving cells subframes.

- if per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms and UE has NR serving cell in FR1, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest NR DL subframe occurring immediately before the configured measurement gap among MCG serving cells subframes in FR1.

- if per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms and UE doesn’t have NR serving cell in FR1, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest DL E-UTRA subframe occurring immediately before the configured measurement gap among SCG serving cells subframes.

TMG is the MG timing advance value provided in mgta according to TS 36.331 [2].

NOTE 3: MGL is the time from start of tuning to end of retuning, which is aligned between MCG and SCG.

NOTE 4: For GP0 and GP1 The total interruption time on SCG is 6 subframes for synchronous dual connectivity, and the total interruption time on SCG is 7 subframes for asyncrhonous dual connectivity. As shown in Figure 8.1.2.1-1, MCG subframes from *i+*1 to *i+*6 are included in total interruption time together with SCG subframes from *j+*1 to *j+*6 for synchronous dual connectivity and *j+*1 to *j+*7for asyncrhonous dual connectivity.

NOTE 5: For GP0 and GP1 and asynchronous dual connectivity as shown in Figure 8.1.2.1-1 (b), subframe *j* is regarded as the subframe occurring immediately before the measurement gap for SCG, similarly, subframe *j*+8 is regarded as the subframe occurring immediately after the measurement gap for SCG.

NOTE 6: For GP2 and GP3 the total interruption time on SCG is 3 subframes for synchronous dual connectivity, and the total interruption time on SCG is 4 subframes for asyncrhonous dual connectivity. The total interrupt is applied in same spirit as shown in Figure 8.1.2.1-1. I.e. For MCG subframes from *i+*1 to *i+*3 are included in total interruption time together with SCG subframes from *j+*1 to *j+*3 for synchronous dual connectivity and *j+*1 to *j+*4for asyncrhonous dual connectivity.

NOTE 7: For GP2 and GP3 and asynchronous dual connectivity as shown in Figure 8.1.2.1-1 (b) with measurement gap length 3, subframe *j* is regarded as the subframe occurring immediately before the measurement gap for SCG, similarly, subframe *j*+5 is regarded as the subframe occurring immediately after the measurement gap for SCG.

NOTE 8: nonUniform1 – nonUniform4 gap patterns are shown in figure 8.1.2.1-2. A burst repetition period Tburst is consisted of T1 and T2. During T1, UE performs measurement during the gap. During T2, UE suspends measurement gap. Both UE and eNB can assume there is no gap during T2. T1 equals to number of gaps per burst in Table 8.1.2.1-2. Tburst is configured by the higher layers.For nonUniform1 – nonUniform4 the total interruption time on SCG is same as for GP0 and GP1 for both synchronous and asynchronous dual connectivity as shown in Figure 8.1.2.1-1. For asynchronous dual connectivity as shown in Figure 8.1.2.1-1 (b), subframe *j* is regarded as the subframe occurring immediately before the measurement gap for SCG, similarly, subframe *j*+8 is regarded as the subframe occurring immediately after the measurement gap for SCG.

NOTE 9: When UE is in NE-DC, the total interruption time on SCG is MGL subframes for synchronous NE-DC, and the total interruption time on SCG is (MGL+1) subframes for asyncrhonous NE-DC. Subframe occurring immediately before the measurement gap for SCG is the latest subframe in SCG which is before and fully non-overlapped with the measurement gap, similarly, subframe occurring immediately after the measurement gap for SCG is the earliest subframe in SCG which is after and fully non-overlapped with the measurement gap.



Figure 8.1.2.1-1: Measurement GAP and total interruption time on MCG and SCG



Figure 8.1.2.1-2: Non-uniform gap pattern

A UE that is capable of identifying and measuring inter-frequency and/or inter-RAT cells without gaps shall follow requirements as if Gap Pattern Id #0 had been used and the minimum available time Tinter1 of 60 ms shall be assumed for the corresponding requirements.

A UE configured with gap pattern Id 2, 3 or 10, shall be able to detect a target cell if the sub frame #0 or #5 of the target cell begins no earlier than 500uS from the start of the measurement gap and if the sub frame #0 or #5 of the target cell ends no later than 500uS before the end of the measurement gap in case of FDD, and no later than [750]us before the end of measurement gap in case of TDD.

A UE configured with gap pattern Id 6, 7 or 8 shall be able to detect a target cell if the sub frame #0 or #5 of the target cell begins no earlier than 500uS from the start of the measurement gap and if the sub frame #0 or #5 of the target cell ends no later than 1500uS before the end of the measurement gap in case of FDD, and no later than 1750us before the end of measurement gap in case of TDD.

If the UE supporting E-UTRA carrier aggregation when configured with up to six SCCs is performing measurements on cells on PCC, inter-frequency measurements, or inter-RAT measurements, and interruption occurs on PCell or any activated SCell or both due to measurements performed on cells on an SCC with a deactivated SCell according to section 8.3, then the UE shall meet the requirements specified for each measurement in Section 8 and Section 9.

If the UE supporting E-UTRA dual connectivity when configured with a PSCell is performing measurements on cells on PCC, inter-frequency measurements, or inter-RAT measurements, then the UE shall meet the requirements specified for each measurement in Section 8 and Section 9.

A UE which indicate support for Increased UE carrier monitoring E-UTRA according to the capabilities in [2, 31] and which is capable of identifying and measuring inter-frequency and/or inter-RAT cells without gaps, shall be able to monitor maximum number of layers as defined in 8.1.2.1.1.1a, and apply the *MeasScaleFactor* [2] defining the relaxation to the requirements for the configured carriers according to section 8.1.2.1.1a.

A UE configured via LPP [24] to perform RSTD measurements requiring measurement gaps and provided with the OTDOA assistance data, which is comprising at least one PRS configuration with >6 consecutive downlink positioning subframes defined in TS 36.211 [16] in at least one cell, can be configured for performing the RSTD measurements with the following measurement gap patterns and shall not be used outside the corresponding RSTD measurement period:

- measurement gap pattern with Id 0 specified in Table 8.1.2.1-1, or

- an applicable measurement gap pattern specified in Table 8.1.2.1-3, provided the following conditions are met:

- the UE is Cat M1 or Cat M2 UE, and

- the applicability conditions are met for the UE.

Table 8.1.2.1-3: Additional Measurement Gap Pattern Configurations supported by the UE

|  |  |  |  |
| --- | --- | --- | --- |
| Gap Pattern Id | Measurement Gap Length  (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) | Applicability |
| rstd0 | 10 | 80 | NOTE 1, 2 |
| rstd1 | 10 | 160 |
| rstd2 | 10 | 320 |
| rstd3 | 10 | 640 |
| rstd4 | 10 | 1280 |
| rstd5 | 14 | 160 | NOTE 1, 2 |
| rstd6 | 14 | 320 |
| rstd7 | 14 | 640 |
| rstd8 | 14 | 1280 |
| rstd9 | 24 | 320 | NOTE 1, 2 |
| rstd10 | 24 | 640 |
| rstd11 | 24 | 1280 |
| rstd12 | 32 | 320 | NOTE 1, 2 |
| rstd13 | 32 | 640 |
| rstd14 | 32 | 1280 |
| rstd15 | 54 | 640 | NOTE 2 |
| rstd16 | 54 | 1280 |
| rstd17 | 64 | 640 | NOTE 2 |
| rstd18 | 64 | 1280 |
| rstd19 | 80 | 640 | NOTE 3 |
| rstd20 | 80 | 1280 |
| NOTE 1: For FDD, (MGL-2) shall not be larger than the required minimum number of available measurement subframes specified in Section 9 in the corresponding RSTD measurement accuracy requirements.  NOTE 2: For TDD, the number of DL subframes within the available measurement time of the measurement gap shall not be larger than the required minimum number of available measurement subframes specified in Section 9 in the corresponding RSTD measurement accuracy requirements.  NOTE 3: At least one cell in the OTDOA assistance data is configured with multiple PRS configurations | | | |

If the UE is configured with any of the measurement gap patterns specified in Table 8.1.2.1-3 for performing RSTD measurements, using of any other measurement gap pattern configured to the UE is suspended during the RSTD measurement period.

<End of Change 1>